

TECHNICAL MANUAL

AVUM AND AVIM MAINTENANCE MANUAL

AH-1S (MOD)

This copy is a reprint which includes current
pages from Changes 1 through 75.

HEADQUARTERS, DEPARTMENT OF THE ARMY
30 SEPTEMBER 1976

CHANGE

NO. 77

HEADQUARTERS
DEPARTMENT OF THE ARMY,
WASHINGTON, D.C., 31 August 1994

Aviation Unit and Aviation Intermediate
Maintenance Manual

HELICOPTER, ATTACK AH-1S (MOD)

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Remove pages

Insert pages

1-13 and 1-14
5-31 and 5-32

1-13 and 1-14
5-31 and 5-32

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By Order of the Secretary of the Army.

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**TM 55 1520-234-23-1
C76**

CHANGE

NO. 76

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WASHINGTON, D.C., 29 July 1994

AVUM AND AVIM Maintenance Manual

HELICOPTER, ATTACK AH-1S (MOD)

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TM 55-1520-234-23-1

C 75

CHANGE }
NO. 75 }

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AVIATION UNIT AND AVIATION INTERMEDIATE Maintenance Manual

HELICOPTER, ATTACK AH-IS (MOD)

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1-48A/ 1-48B
5-30G and 5-30H

Insert pages

1-48A/ 1-48B
5-30G and 5-30H

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TM 55-1520-234-23-1
C 74

CHANGE }
NO. 74 }

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DEPARTMENT OF THE ARMY
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AVIATION UNIT AND AVIATION INTERMEDIATE Maintenance Manual

HELICOPTER, ATTACK AH-IS (MOD)

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Remove pages

Insert pages

5-5 and 5-6

5-4A/5-4B

5-5 and 5-6

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TM 55-1520-234-23-1
C 73

CHANGE }
NO. 73 }

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 29 May 1992

AVIATION UNIT AND AVIATION INTERMEDIATE
Maintenance Manual

HELICOPTER, ATTACK AH-1S (MOD)

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Remove pages	Insert pages
v through viii	v through viii
----	viii A/viii B
ix through xii	ix through xii
1-11 and 1-12	1-11 and 1-12
1-22A/1-22B	1-22A/1-22B
6-71 and 6-72	6-71 and 6-72
6-72A/6-72B	6-72A/6-72B
6-73 and 6-74	6-73 and 6-74
6-79 and 6-80	6-79 and 6-80
6-80A and 6-80B	6-80A and 6-80B
6-80E and 6-80F	6-80E and 6-80F
6-81 and 6-82	6-81 and 6-82
6-90E and 6-90F	6-90E and 6-90F
6-91 and 6-92	6-91 and 6-92
6-92A and 6-92B	6-92A and 6-92B
6-101 and 6-102	6-101 and 6-102
----	6-104A through 6-104C/6-104D

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TM 55-1520-234-23-1

C 72

CHANGE }
NO. 72 }

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AVIATION UNIT AND AVIATION INTERMEDIATE Maintenance Manual

HELICOPTER, ATTACK AH-1S (MOD)

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Remove pages

5-54A/5-54B
5-55 and 5-56

Insert pages

5-54A/5-54B
5-55 and 5-56

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CHANGE }
NO. 71 }

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DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 31 May 1991

AVIATION UNIT AND AVIATION INTERMEDIATE
Maintenance Manual

HELICOPTER, ATTACK AH-1S (MOD)

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Remove pages

iii and iv
xiii and xiv
1-2A and 1-2B
1-15 and 1-16
1-32A/1-32B
1-33 and 1-34
1-47 and 1-48
1-53 through 1-56
1-66A and 1-66B
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1-70C and 1-70D
1-71 and 1-72
1-72A/ 1-72B
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4-13 and 4-14
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5-1 and 5-2
- - - -
5-3 and 5-4
5-9 and 5-10
5-10A and 5-10B
5-11 and 5-12
5- 1 2A/5- 1 2B
5-13 and 5-14
5-14A/5-14B
5-15 and 5-16
5-16A/5-16B
5-29 and 5-30
5-30AA and 5-30AB
- - - -
5-30BB and 5-30BC
5-30CF and 5-30CG

Insert pages

iii and iv
xiii and xiv
1-2A and 1-2B
1-15 and 1-16
1-32A and 1-32B
1-33 and 1-34
1-47 and 1-43
1-53 through 1-56
1-66A and 1-66B
1-67 and 1-68
1-70C and 1-70D
1-71 and 1-72
1-72A/ 1-72B
3-1 and 3-2
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4-5 and 4-6
4-13 and 4-14
4-43 and 4-44
5-1 and 5-2
5-2C and 5-2D
5-3 and 5-4
5-9 and 5-10
5-10A through 5-10D
5-11 and 5-12
5- 1 2A/ 5- 1 2B
5-13 and 5-14
5-14A and 5-14B
5-15 and 5-16
5-16A and 5-16B
5-29 and 5-30
5-30AA and 5-30AB
5-30AB.1 and 5-30AB.2
5-30BB and 5-30BC
5-30CF and 5-30CG

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Remove pages

5-31 and 5-32
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5-47 and 5-48
5-63 and 5-64
5-66A/ 5-66B
5-83 and 5-84
5-93 and 5-94
5-94A and 5-94B
5-95 and 5-96
5-96A/5-96B
5-132A/5-132B
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6-10C and 6-10D
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- - - -
6-39 and 6-40
6-42A and 6-42B
6-51 through 6-54
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6-64A through 6-64C/6-64D
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6-80C and 6-80D
6-90C and 6-90D
6-94A and 6-94B
6-103 and 6-104
6-112A and 6-112B

7-21 and 7-22
7-50A through 7-50C/7-50D
8-12A/8-12B
9-39 and 9-40
9-44A and 9-44B
9-67 and 9-68

Insert pages

5-31 and 5-32
5-39 and 5-40
5-43 and 5-44
5-44A through 5-44C/
5-44D
5-47 and 5-48
5-63 and 5-64
5-66A/ 5-66B
5-83 and 5-84
5-93 and 5-94
5-94A through 5-94D
5-95 and 5-96
5-96A/5-96B
5-132A/5-132B
6-3 and 6-4
6-10C and 6-10D
6-17 and 6-18
6-29 and 6-30
6-38A/6-38B
6-39 and 6-40
6-42A and 6-42B
6-51 through 6-54
6-63 and 6-64
6-64A through 6-64C/6-64D
6-77 and 6-78
6-80C and 6-80D
6-90C and 6-90D
6-94A and 6-94B
6-103 and 6-104
6-112A through 6-112C/
6-112D
7-21 and 7-22
7-50A through 7-50K
8-12A/8-12B
9-39 and 9-40
9-44A and 9-44B
9-67 and 9-68

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TM 55-1520-234-23-1

C 70

CHANGE }
NO. 70 }

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 14 May 1991

AVIATION UNIT AND AVIATION INTERMEDIATE
Maintenance Manual

HELICOPTER, ATTACK AH-1S (MOD)

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5-54A/5-54B

5-55 and 5-56

5-55 and 5-56

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TM 55-1520-234-23-1
C 69

CHANGE }
NO. 69 }

HEADQUARTERS
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AVIATION UNIT AND AVIATION INTERMEDIATE Maintenance Manual

HELICOPTER, ATTACK AH-1S (MOD)

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1-72A/1-72B

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TM 55-1520-234-23-1
C 68

CHANGE }
NO. 68 }

HEADQUARTERS
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AVIATION UNIT AND AVIATION INTERMEDIATE Maintenance Manual

HELICOPTER, ATTACK AH-1S (MOD)

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5-55 and 5-56

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5-55 and 5-56

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TM 55-1520-234-23-1
C 67

CHANGE }
NO. 67 }

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5-30AA through 5-30AD
5-30AG and 5-30AH
5-30AJ
5-30AK and 5-30AL
5-30AR and 5-30AS
5-30AZ through 5-30BC

Insert pages

5-30AA through 5-30AD
5-30AG and 5-30AH
5-30AJ
5-30AK and 5-30AL
5-30AR and 5-30AS
5-30AZ through 5-30BC

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TM 55-1520-234-23-1

C 66

CHANGE }
NO. 66 }

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AVIATION UNIT AND AVIATION INTERMEDIATE Maintenance Manual

HELICOPTER, ATTACK AH-1S (MOD)

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Remove pages

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6-11 and 6-12

Insert pages

6-10A through 6-10D
6-11 and 6-12

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CHANGE }
NO. 65 }

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Maintenance Manual

HELICOPTER, ATTACK AH-1S (MOD)

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Remove pages

1-17 and 1-18
1-19 and 1-20
- - - -
1-23 and 1-24
1-66A and 1-66B
1-67 and 1-68
1-70A through 1-70E/1-70F
2-100A/2-100B
2-104A and 2-104B
2-104E through 2-104H
2-109 and 2-110
2-126E through 2-126H
- - - -
2-132A and 2-132B
2-133 and 2-134
2-142A and 2-142B
3-3 and 3-4
- - - -
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4-4C and 4-4D
4-5 through 4-10
4-15 and 4-16
4-42 through 4-44
5-12A/5- 12B
5-13 and 5-14
5- 20A/ 5-20B
5-21 and 5-22
5-29 and 5-30
5-30C through 5-30M
- - - -
5-30Q through 5-30T
5-30Y and 5-30Z
- - - -
5-30AK and 5-30AL
5-30AX through 5-30BC
5-30BM through 5-30BY
5-30CD through 5-30CG
5-41 and 5-42

Insert pages

1-17 and 1-13
1-19 and 1-20
1-22A/1-22B
1-23 and 1-24
1-66A and 1-66B
1-67 and 1-6S
1-70A through 1-70E/1-70F
2-100A/2-100B
2-104A and 2-104B
2-104E through 2-104H
2-109 and 2-110
2-126E through 2-126H
2-126J through 2-126M
2-132A and 2-132B
2-133 and 2-134
2-142A and 2-142B
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3-4A/3-4B
3-5 and 3-6
4-4C and 4-4D
4-5 through 4-10
4-15 and 4-16
4-42 through 4-44
5-1 2A/5-1 2B
5-13 and 5-14
5-20A/ 5- 20B
5-21 and 5-?2
5-29 and 5-30
5-30A/5-30B through 5-30M
5-30P.1 and 5-30P.2
5-30Q through 5-30T
5-30Y and 5-30Z
5-30Z.1 through 5-30Z.3/5-30Z.4
5-30AK and 5-30AL
5-30AX through 5-30BC
5-30BM through 5-30BY
5-30CD through 5-30CG
5-41 and 5-42

Remove pages

5-50A/5-50B
5-51 and 5-52
5-66A/5-66B
5-69 and 5-70
5-73 and 5-74

5-78A and 5-78B
5-79 and 5-80

5-96A/5-96B
5-101 and 5-102
5-111 and 5-112
5-115 and 5-116
5-116A/5-116B
5-123 and 5-124
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5-131 and 5-132
5-132A/5-132B
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6-20A through 6-20D
6-39 through 6-42

6-43 and 6-44
6-63 and 6-64
6-65 and 6-66
6-71 and 6-72
6-73 and 6-74!
6-80C through 6-80F
6-90C through 6-90F
6-93 and 6-94
6-107 and 6-108
6-111 and 6-112

7-34A and 7-34B
7-43 and 7-44
7-44A and 7-44B
8-18A/8-18B
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8-37 and 8-38
9-1 and 9-2
9-15 and 9-16
9-16A/9-16B
9-23 and 9-24
9-24A and 9-24B
9-72A and 9-72B

Insert pages

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5-50A/5-50B
5-51 and 5-52
5-66A/5-66B
5-69 and 5-70
5-73 and 5-74
5-74A/5-74B
5-78A through 5-78C/5-78D
5-79 and 5-80
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5-115 and 5-116
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5-127 and 5-128
5-131 and 5-132
5-132A/5-132B
5-135 and 5-136
5-136A/5-136B
6-20A through 6-20D
6-39 through 6-42
6-42A through 6-42E/6-42F
6-43 and 6-44
6-63 and 6-64
6-65 and 6-66
6-71 and 6-72
6-73 and 6-74
6-80C through 6-80G/6-80H
6-90C through 6-90F
6-93 and 6-94
6-107 and 6-108
6-111 and 6-112
6-112A and. 6-112B
7-34A and 7-34B
7-43 and 7-44
7-44A and 7-44B
8-18A/8-18B
8-31 and 8-32
8-37 and Y,-38
9-1 and 9-2
9-15 and 9-16
9-16A/9-16B
9-23 and 9-24
9-24A and 9-24B
9-72A and 9-72B

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TM 55-1520-234-23-1
C 64

CHANGE }
NO. 64 }

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Maintenance Manual

HELICOPTER, ATTACK AH-1S (MOD)

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1-55 and 1-56
2-101
5-79 and 5-80

Insert pages

1-55 and 1-56
2-101
5-79 and 5-80

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C 63**

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NO. 63 }

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HELICOPTER, ATTACK AH-IS (MOD)

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Remove pages

1-69 and 1-70
1-71 and 1-72
1-72A/1-72B
6-79 and 6-80
6-80A and 6-80B

Insert pages

1-69 and 1-70
1-17 and 1-72
1-72A/1-72B
6-79 and 6-80
6-80A and 6-80B

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Remove pages

iii and iv
xiii and xiv
1-35 through 1-38

Insert pages

iii and iv
xiii and xiv
1-35 through 1-38
1-38A/1-38B
1-40A/1-40B

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Insert pages

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9-44A and 9-44B

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C 60

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NO. 60 }

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Remove pages

1-67 and 1-68
1-71 and 1-72
6-33 and 6-34

Insert pages

1-67 and 1-68
1-71 and 1-72
6-33 and 6-34

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C 59**

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NO. 59 }

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Remove pages

5-41 and 5-42
7-44A/7-44B
7-45 and 7-46

Insert pages

5-41 and 5-42
7-44A and 7-44B
7-45 and 7-46

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C 58**

CHANGE }
NO. 58 }

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Remove pages

a and b
1-66A and 1-66B
1-71 and 1-72
1-72A/1-72B
5-30G and 5-30H
9-75 and 9-76
9-97 and 9-98

Insert pages

a and b
1-66A and 1-66B
1-71 and 1-72
1-72A/1-72B
5-30G and 5-30H
9-75 and 9-76
9-97 and 9-98

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Remove pages

ix through xiv
1-11 and 1-12
1-15 through 1-18
9-36A through 9-36C/9-36D
9-37 through 9-42
- - -
9-43 and 9-44
- - -

Insert pages

ix through xiv
1-11 and 1-12
1-15 through 1-18
9-36A through 9-36D
9-37 through 9-42
9-42A through 9-42Z
9-43 and 9-44
9-44A and 9-44B

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Remove pages

c/d
1-29 and 1-30

1-31 and 1-32
1-41 and 1-42

1-55 and 1-56
1-67 through 1-70
1-71 and 1-72
1-72A/1-72B
2-96A and 2-96B
2-110E and 2-110F
3-1 and 3-2
4-7 through 4-10
4-15 and 4-16
4-53 and 4-54
5-14A/5-14B
5-30Y and 5-30Z
5-43 and 5-44
5-57 and 5-58

5-79 and 5-80
5-87 and 5-88
5-94A and 5-94B
5-113 and 5-114
6-27 and 6-28
6-31 and 6-32

6-33 and 6-34
6-34A/6-34B
6-77 and 6-78
6-92A and 6-92B
6-93 and 6-94

Insert pages

c and d
1-29 and 1-30
1-30A/1-30B
1-31 and 1-32
1-41 and 1-42
1-42A/1-42B
1-55 and 1-56
1-67 through 1-70
1-71 and 1-72
1-72A/1-72B
2-96A and 2-96B
2-110E and 2-110F
3-1 and 3-2
4-7 and 4-10
4-15 and 4-16
4-53 and 4-54
5-14A/5-14B
5-30Y and 5-30Z
5-43 and 5-44
5-57 and 5-58
5-58A/5-58B
5-79 and 5-80
5-87 and 5-88
5-94A and 5-94B
5-113 and 5-114
6-27 and 6-28
6-31 and 6-32
6-32A/6-32B
6-33 and 6-34
6-34A/6-34B
6-77 and 6-78
6-92A and 6-92B
6-93 and 6-94

Remove pages

7-25 and 7-26
7-37 through 7-38
7-39 and 7-42
7-42A/7-42B
7-51 and 7-52
8-15 and 8-16
8-18A/8-18B
9-43 through 9-48

Insert pages

7-25 and 7-26
7-37 through 7-38
7-39 and 7-42
7-42A/7-42B
7-51 and 7-52
8-15 and 8-16
8-18A/8-18B
9-43 through 9-48

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Remove pages

iii thru xii
1-7 and 1-8
1-11 thru 1-18
1-18A/1-18B
1-19 and 1-20
1-23 and 1-24
1-37 and 1-38
1-48A/1-48B
1-50C/1-50D
1-59 and 1-60
1-67 and 1-68
1-70C and 1-70D
1-71 and 1-72
1-72A/1-72B
2-1 and 2-2
2-7 and 2-8
2-73 and 2-74
2-100A/2-100B
2-143 and 2-144
4-5 and 4-6
4-15 and 4-16
5-5 and 5-6
5-37 and 5-38
5-65 and 5-66
5-78A and 5-78B
5-79 and 5-80
5-97 and 5-98
5-101 and 5-102
5-121 thru 5-124
5-135 and 5-136
6-24C and 6-24D
6-33 and 6-34
6-63 and 6-64
6-65 thru 6-70

Insert pages

iii thru xiv
1-7 and 1-8
1-11 thru 1-18
1-18A/1-18B
1-19 and 1-20
1-23 and 1-24
1-37 and 1-38
1-48A/1-48B
1-50C/1-50D
1-59 and 1-60
1-67 and 1-68
1-70C and 1-70D
1-71 and 1-72
1-72A/1-72B
2-1 and 2-2
2-7 and 2-8
2-73 and 2-74
2-100A/2-100B
2-143 and 2-144
4-5 and 4-6
4-15 and 4-16
5-5 and 5-6
5-37 and 5-38
5-65 and 5-66
5-78A and 5-78B
5-79 and 5-80
5-97 and 5-98
5-101 and 5-102
5-121 thru 5-124
5-135 and 5-136
6-24C and 6-24D
6-33 and 6-34
6-63 and 6-64
6-65 thru 6-70

Remove pages

6-71 and 6-72
6-73 and 6-74
6-77 and 6-73
6-90C thru 6-90F
6-93 and 6-94
6-94A and 6-94B
6-103 and 6-104
9-1 and 9-2
9-23 and 9-24

Insert pages

6-71 and 6-72
6-73 and 6-74
6-77 and 6-78
6-90C thru 6-90F
6-93 and 6-94
6-94A and 6-94B
6-103 and 6-104
9-1 and 9-2
9-23 and 9-24

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Insert pages

1-29 and 1-30

1-29 and 1-30

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NO. 52 }

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Insert pages

1-29 and 1-30

1-29 and 1-30

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NO. 51 }

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6-13

6-13 and 6-14

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C 50

CHANGE
NO. 50

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Remove pages

1-29 and 1-30

1-55 and 1-56

5-29 and 5-30

5-30A and 5-30B

5-30CF/5-30CG

5-67 and 5-68

Insert pages

1-29 and 1-30

1-55 and 1-56

1-56A/1-56B

5-29 and 5-30

5-30CF and 5-30CG

5-67 and 5-68

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C 49**

CHANGE
NO. 49

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Remove pages

5-29 and 5-30
5-30C through 5-30Z
5-30AA through 5-30AZ
5-30BA through 5-30BN
- - -
- - -
5-103 and 5-104

Insert pages

5-29 and 5-30
5-30C through 5-30Z
5-30AA through 5-30AZ
5-30BA through 5-30BN
5-30BP through 5-30BZ
5-30CA through 5-30CF/5-30CG
5-103 and 5-104

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Remove pages

a and b
1-11 through 1-16
1-31 and 1-32
1-32A/1-32B
1-53 and 1-54
1-67 and 1-68
1-71 and 1-72
1-72A/1-72B
2-49 and 2-50
2-57 and 2-58
- - -
2-95 and 2-96
2-96A and 2-96B
2-133 and 2-134
2-139 and 2-140
4-49 through 4-52
5-2A and 5-2B
5-10A and 5-10B
5-14A/5-14B
5-15 and 5-16
5-25 and 5-26
5-28A and 5-28B
5-30BH.1 and 5-30BH.2
5-30BN and 5-30BP
5-37 through 5-40
5-53 and 5-54
- - -
5-81 through 5-84
5-89 and 5-90
5-115 and 5-116
6-9 and 6-10
6-13 and 6-14
6-16C and 6-16D
6-17 and 6-18
6-20A through 6-20D

Insert pages

a and b
1-11 through 1-16
1-31 and 1-32
1-32A/1-32B
1-53 and 1-54
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6-16C and 6-16D
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9-85 and 9-86

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8-7 and 8-8
8-16A and 8-16B
8-19 and 8-20
9-24A and 9-24B
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9-57 and 9-58
9-58A through 9-58D
9-59 and 9-60
9-60A through 9-60C/9-60D
9-85 and 9-86

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NO. 47

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Maintenance Manual

HELICOPTER, ATTACK AH-1S (MOD)

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1-66A and 1-66B
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1-72A/(1-72B)

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1-66A and 1-66B
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1-72A/(1-72B)

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Remove pages

iii and iv
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2-88A/2-88B
2-96A through 2-96D
2-97 and 2-98
2-101 through 2-104
- - -
2-105 and 2-106

Insert pages

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2-97 and 2-98
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2-104A through 2-104H
2-105 and 2-106

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5-30AL and 5-30AM
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5-103 and 5-104
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1-41 and 1-42
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6-80A and 6-80B
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5-23 and 5-24

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1-51 and 1-52

5-23 and 5-24

5-24A/5-24B

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Remove pages

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1-43 and 1-44
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Remove pages

a through c/d
v through viii
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1-9 and 1-10
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1-10A and 1-10B
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8-35 and 8-36
9-11 and 9-12
9-24A and 9-24B

Insert pages

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5-30AS and 5-30AT
5-30AT.1/5-30AT.2
5-30AW and 5-30AX
5-30AX.1/5-30AX.2
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9-11 and 9-12
9-24A and 9-24B

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WARNING

Personnel performing instructions involving operations, procedures, and practices which are included, or implied in this technical manual, shall observe the following instructions.
Disregard of these warnings and precautionary information can cause serious injury,

DEATH

or an aborted mission.

Starting and Operation
of the helicopter will be performed only by
authorized personnel in accordance with AR95-1.

HIGH VOLTAGE

Turn off all power switches before making electrical connections or disconnections.
Serious burns and electrical shock can result from contact
with exposed electrical wires or connectors.

RADIATION HAZARD

Self-luminous dials contain radio active materials.
If such an instrument is broken or becomes unsealed, avoid personal contact.
Use forceps or gloves made of rubber or polyethylene to pick up contaminated material.
Place material and gloves in a plastic bag.
Seal bag and dispose of it as radio active waste
in accordance with AR755-15 and TM 3-261 (Refer to TB 55-1500-314-24).
Repair procedures shall conform to requirements in AR700-52.

DANGEROUS CHEMICALS

Exposure to high concentration of fire extinguishing agents
can cause severe irritation of eyes or nose.
Corrosive Battery Electrolyte (Potassium Hydroxide).
Wear rubber gloves, apron, and face shield when handling leaking batteries.

If potassium hydroxide is spilled on clothing, or other material
wash immediately with clean water.
If spilled on personnel, immediately start flushing
the affected area with clean water.
Continue washing until medical assistance arrives.
Use solvent in a well ventilated area.
Do not inhaled vapors, or allow to come in contact with skin or eyes.
Observe proper fire prevention rules.

ARMAMENT

When working on, or near an armed helicopter, take all possible
precautions to avoid accidental firing or armament.
Personnel shall not occupy possible firing pattern in front of or up to
20 feet behind rocket pods.
Munitions shall be handled by authorized personnel only.
All weapons shall be dry-fired. Only dummy ammunition with
smooth cases like live ammunition shall be used.

HYDRAULIC FLUID, FUEL AND OIL

Lubricating oil used in engine, transmission and gear boxes may cause a skin rash if prolonged contact is allowed.
When handling fuel, observe precautions and procedures in TM 10-1101.
Prolonged contact with hydraulic fluid will cause burns.
When handling hydraulic fluid (MIL-H-83282), table 1-3, item 73A, observe the following:
Prolonged contact with liquid or mist can irritate eyes and skin.
After any prolonged contact with skin, immediately wash contacted area with soap and water.
If liquid contacts eyes, flush them immediately with clear water.
If liquid is swallowed, do not induce vomiting; get immediate medical attention.
Wear rubber gloves when handling liquid.
If prolonged contact with mist is likely, wear an appropriate respirator.
When fluid is decomposed by heating, toxic gases are released.

JETTISON

All ground safety pints must be removed before night.
Failure to do so will prevent emergency jettison of stores.

JETTISON

Jettison circuit may be activated with battery switch OFF and pilot's wing stores jettison circuit breaker pulled. For positive deactivation of jettison circuit, open both the pilots wing stores jettison circuit breaker and the jettison circuit breaker located in the aft electrical compartment. Serious injury can result from accidental ground jettison.

SANDING DUST

Sanding on glass cloth reinforced laminated produces fine dust that may cause skin irritations.
Observe necessary protective measures.

TRANSMISSION LEVELING

Do not attempt to level transmission with "Jacks Only"
Hoist must be used in conjunction with jacks while lifting transmission.

EXTERNAL STORES

Prior to any aircraft maintenance functions that require external stores be removed, ejector cartridge shall be removed.

Remove jettison cartridges from pylon stores ejection device prior to placing aircraft in a hangar, to prevent injury to personnel and damage to equipment.
Exception: Removal is not necessary when aircraft is to be placed in hangar for short-term, providing both circuit breakers are open, ground safety pins installed, jettison switches are OFF, and warning signs indicate that aircraft has an armed jettison system.

CANOPY REMOVAL SYSTEM

Ground safety pins must be installed in pilot's and gunner's arming/firing handles of canopy removal system whenever the helicopter is on the ground. Pins should be installed by crew.

EPOXY BASED ADHESIVE

Epoxy based adhesive, P/N EA934, contains an asbestos filler which could be inhaled or ingested during grinding, cutting, or sanding operations on cured epoxy material.

TOOLS

Use only chrome plated steel or unplated steel tools for disassembly or reassembly procedures described in this manual. Use of cadmium or zinc plated tools is not permitted.

GROUNDING

All aircraft parked outside will be grounded and bonded, in accordance with FM 1-500, to the aerospace ground equipment while servicing, i.e., fueling or defueling, arming (ammunition or explosives), oxygen, hydraulic fluids or any flammable liquids. Grounding is not necessary for aircraft parked outside unless one of the above is being accomplished.

INSPECTION OF REMOVED COMPONENT

When components are being removed from an aircraft, all inspections required by the next phase maintenance inspection must be accomplished prior to either immediate re-use or storage. Upon installation, the component will be inspected in accordance with the current phase (either that phase the receiving aircraft is in or if in between phase, the last phase performed). This will ensure that a re-used component will not overfly any PM inspections, and that it will be properly interfaced with the receiving aircraft phase sequence.

**CLEANING HYDRAULIC
COMPONENTS**

The use of any alcohol in cleaning components which contact hydraulic fluids is prohibited. Formation of a polymeric residue can result, which could impair mechanical operation of the component.

TECHNICAL MANUAL

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C. 30 September 1976

OPERATORS MANUAL

HELICOPTER. ATTACK AH-1S

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PREFACE

P-1. General

a. This manual is the official document for Aviation Unit and Intermediate Maintenance of Army Model AH-IS Helicopters.

b. The purpose of this manual is to familiarize you with the maintenance functions to be performed at the Aviation Unit and Intermediate maintenance levels. The Table of Contents for this manual is provided to assist in determining the chapter in the manual in which individual functions are covered. This manual provides all essential information for personnel to accomplish Aviation Unit and Intermediate maintenance on the complete airframe, its components, and systems, excluding armament and avionics subsystem as indicated for Aviation Unit and Intermediate maintenance activities in the Maintenance Allocation chart (MAC). (Refer to Appendix B).

P-2. Quality Assurance/Quality Control(QA/QC).

Information not available.

P-3. Description.

The AH-IS helicopter is a two-place assault type helicopter with a narrow fuselage, single main and tail rotors, short wings, and provisions for a variety of armament. The forward fuselage is built up on two main longitudinal beams with lateral bulkheads, floors, shear panels, and decks of honeycomb panel construction, forming a box beam. Crew compartments are arranged in tandem, with the pilot seated behind and above the gunner, and are covered by a transparent canopy with two doors. Both doors are sections of the canopy, hinged at top, with the gunner's door opening at left and the pilot's door opening at right side. Both seats are protected by armor on backs, seats, and sides of supports. The compartment area is ventilated by forced air from a transmission-driven blower. The short wings provide support for armament mounting pylons and also aid maneuverability by providing lift at higher air speeds.

a. *Tail Boom Section.* The tail boom section, attached to the forward fuselage by four bolts, is a tapered semimonocoque structure with a vertical fin slanting up and aft at the rear end to support the tail rotor. Tail rotor drive shafts and gear

boxes are mounted under covers along the top of the tail boom and front of the vertical fin. A controllable elevator is also mounted on the tail boom.

b. *Propulsion System.* The propulsion system consists of a gas turbine engine, main drive shaft, transmission and mast, main rotor, and the tail rotor with its drive shafts and gear boxes. The transmission and engine are mounted on the forward fuselage aft of the crew compartment, and covered by cowlings and fairing. The engine drives the transmission through the short main drive shaft, rotating the mast and main rotor. Power is also taken off from the transmission to drive the tail rotor, which compensates for main rotor torque to control the helicopter heading. Fuel tanks consist of two interconnected cells, located in the forward fuselage.

c. *Flight Controls.* Flight controls are direct mechanical linkages from sticks and pedals at pilot's and gunner's stations, assisted by hydraulic cylinders powered by transmission-driven hydraulic pumps. A stabilization and control augmentation system is also incorporated in the control linkage to steady the helicopter during use of armament.

d. *Armament Provisions.* Armament provisions include mounting, wiring and hydraulic lines for an armament turret under the forward end of the fuselage, an ammunition compartment immediately aft of the turret location, sights and control panels at crew stations, and mounting pylons for external armament pods on each wing.

e. *Landing Gear.* Landing gear is skid type, with arched cross tubes attached to the fuselage. Exposed portions of cross tubes are covered by streamlined fairings to reduce drag. A tail skid is provided to protect the aft end of the tail boom during a tail-low landing.

P-4. Reporting of Errors.

Every effort is made to keep this publication current and error free. Review conferences with using personnel, and a constant review of accident and flight test reports assure inclusion of the latest data in this publication. However, we cannot correct an error unless we know of its existence. In this regard it is essential that you do your part. Reports of errors, omissions, and recommendations

for improving this publication by you are encouraged. Your letter or DA Form 2028, Recommended Changes to Publications and Blank Forms should be mailed to Commander, U.S. Army Aviation Systems Command, ATTN: AMSAV-MPSD, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798.

P-5. Destruction of Army Material To Prevent Enemy Use.

For destructions of Army materiel to prevent enemy use, refer to TM750-244-1-5.

P-6. Maintenance of Forms and Records.

Maintenance of forms, records, and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed I by DA Pam 738-751.

P-7. Authority For Substitution.

Substitution or interchange of items of materiel for maintenance of Department of the Army aircraft shall not be authorized, nor shall orders be issued for shipment. Substitution or interchangeability shall only be authorized by US Army Aviation Systems Command.

P-8. Special Tools and Equipment.

Aviation Unit and Intermediate maintenance special tools and equipment will be found in TM55-1520-234-23P (RPSTL) manual. Use of special tools and equipment for complex tasks is described in this manual.

P-9. Calibration.

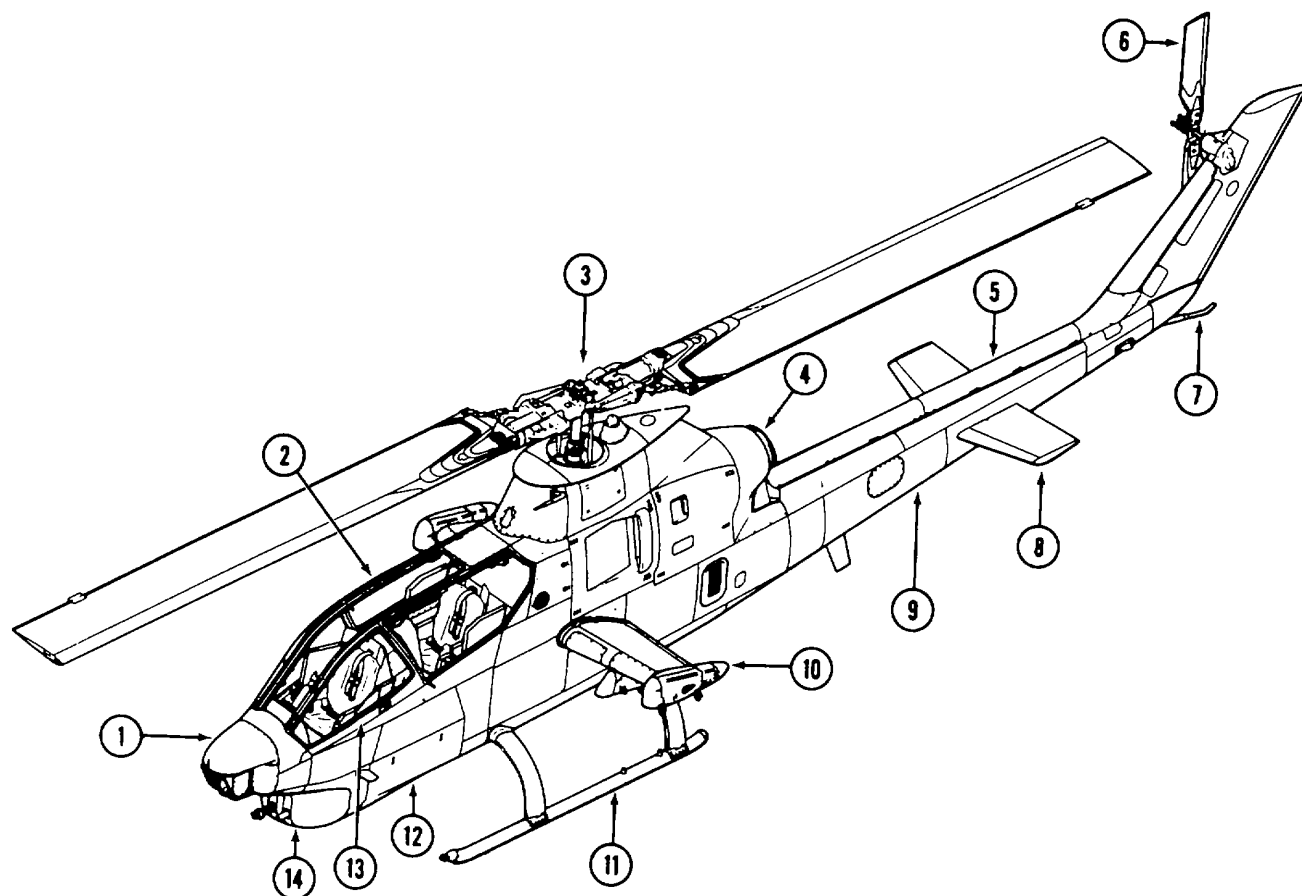
Equipment requiring calibration shall be indicated and reference made to a publication(s) containing the applicable procedures.

a. Aircraft components, accessories, and instruments requiring calibration shall be specified in Chapter 1.

b. Special tools and test equipment shall be calibrated as specified in TB 750-25, Army Metrology and Calibration System.

P-10. Storage.

Refer to TM740-90-1 and Appendix E for Storage of Aircraft.



1. Forward Fuselage	8. Controllable Elevator
2. Pilot Door	9. Tailboom
3. Main Rotor	10. Wings
4. Engine	11. Landing Gear
5. Tail Rotor Drive Shaft Covers	12. Ammunition Compartment
6. Tail Rotor	13. Gunner Door
7. Tail Skid	14. Armament Turret

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Figure P-1. AH-1S Helicopter

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CHAPTER 1 AIRCRAFT GENERAL

Section I. SERVICING

1-1. Servicing - General.

Servicing information and procedures are presented by systems or components in the following paragraphs. Points used in frequent servicing and replenishment of fuels, oils, hydraulic fluid and other materials are shown on a diagram. (See figure 1-1.)

1-2. Fuel System Servicing.

The fuel supply tank consists of two cells, located in the fuselage forward and aft of the wings, interconnected by a crossover and vented through a common outlet line. Each cell has a sump and a fuel pump with drains (1 and 2, figure 1-1) accessible through doors in the fuselage lower skin. The fuel tank filler cap (12) and static ground receptacle (11) serve both tanks. **TOTAL TANK CAPACITY FOR FUEL SYSTEM IS 262 U.S. GALLONS AND NORMAL SERVICE CAPACITY IS 260 U.S. GALLONS.**

WARNING

Servicing personnel shall comply with all safety precautions and procedures specified in FM 10-68 Aircraft Refueling field manual.

NOTE

The fuel system can be serviced by either closed circuit or gravity system.

a. Closed Circuit Refueling (Power Off).

- (1) Refer to Figure 1-1 for fuel filler location.
- (2) Assure fire guard is in position with fire extinguisher.
- (3) Ground servicing unit to ground stake.
- (4) Ground servicing unit to helicopter.
- (5) Ground fuel nozzle to ground receptacle, located adjacent to fuel receptacle on helicopter.
- (6) Remove fuel filler cap, and assure refueling module is in locked position. Refer to figure 1-1A.
- (7) Remove nozzle cap, insert nozzle into fuel receptacle, and lock into position.

(8) Activate flow control handle to ON or FLOW position. Fuel flow will automatically shutoff when fuel cell is full. Just prior to normal shutoff, fuel flow may cycle several times, as maximum fuel level is reached.

(9) Assure flow control handle is in OFF or NO FLOW position and remove nozzle.

(10) Replace fuel nozzle cap.

(11) Replace fuel filler cap.

(12) Disconnect fuel nozzle ground.

(13) Disconnect ground from helicopter to servicing unit.

(14) Disconnect servicing unit ground from ground stake.

(15) Return fire extinguisher to designated location.

b. Gravity or Open-Port Refueling (Power Off).

(1) Refer to figure 1-1 for fuel filler location.

(2) Assure that fire guard is in position with fire extinguisher.

(3) Ground servicing unit to ground stake.

(4) Ground servicing unit to helicopter.

(5) Ground fuel nozzle to ground receptacle located adjacent to fuel receptacle on helicopter.

(6) Remove fuel filler cap.

(7) Using latch tool, attached to filler cap cable open refueling module if equipped with closed circuit receptacle. Refer to figure 1-1A.

(8) Remove nozzle cap and insert nozzle into fuel receptacle.

(9) Activate flow control handle to ON or FLOW position.

(10) Assure flow control handle is in OFF or NO FLOW position and remove nozzle.

(11) Replace fuel nozzle cap.

(12) Close refueling module by pulling cable until latch is in locked position, if equipped with closed circuit receptacle. Refer to figure 1-1A.

(13) Replace fuel filler cap.

(14) Disconnect fuel nozzle ground.

(15) Disconnect ground from helicopter to servicing unit.

(16) Disconnect servicing unit ground from ground stake.

(17) Return fire extinguisher to designated location.

b-A. RAPID (HOT) Refueling (Closed Circuit).

(1) Before RAPID Refueling.

(a) IDLE.

(b) FORCE TRIM Switch - FORCE TRIM.

WARNING

In case of helicopter fire, observe fire emergency procedures in Chapter 9 of TM55-1520-234-10.

(2) During RAPID Refueling. A crewmember shall observe the refueling operation (performed by authorized refueling personnel) and stand fireguard as required. One crewmember shall remain in the helicopter to monitor controls. Only emergency radio transmission should be made during rapid refueling.

(3) Refer to figure 1-1 for fuel filler location.

(4) Assure fireguard is in position with fire extinguisher.

(5) Ground servicing unit to ground stake.

(6) Ground servicing unit to helicopter.

(7) Ground fuel nozzle to ground receptacle located adjacent to fuel receptacle on helicopter.

(8) Remove fuel filler cap, and assure refueling module is in closed position. Refer to figure 1-1A.

(9) Remove nozzle cap and insert nozzle into fuel receptacle and lock into position.

(10) Activate flow control handle to ON or FLOW position. Fuel flow will automatically shutoff when fuel cell is full. Just prior to normal shutoff, fuel flow may cycle several times, as maximum fuel level is reached.

(11) Assure flow control handle is in OFF or NO FLOW position and remove nozzle.

(12) Replace fuel nozzle cap.

(13) Replace fuel filler cap.

(14) Disconnect fuel nozzle ground.

(15) Disconnect ground from helicopter to servicing unit. AFTER RAPID FUELING. The pilot shall be advised, by the refueling crew, that fuel cap is secure and grounding cables have been removed.

(16) Disconnect servicing unit ground from ground stake.

(17) Return fire extinguisher to designated location.

b-B. RAPID (HOT) GRAVITY Refueling.

(1) Before RAPID Refueling.

(a) Throttle - IDLE.

(b) FORCE TRIM Switch - FORCE TRIM.

WARNING

In case of helicopter fire, observe fire emergency procedures in Chapter 9 of TM55-1520-234-10.

(2) During RAPID Refueling. A crewmember, shall observe refueling operation (performed by authorized refueling personnel) and stand fireguard as required. One crewmember shall remain in the helicopter to monitor controls. Only emergency radio transmission should be made during rapid refueling.

(3) Refer to figure 1-1 for fuel filler location.

(4) Assure fireguard is in position with fire extinguisher.

(5) Ground servicing unit to ground stake.

(6) Ground servicing unit to helicopter.

(7) Ground fuel nozzle to ground receptacle located adjacent to fuel receptacle on helicopter.

(8) Remove fuel filler cap.

(9) Using latch tool attached to filler cap cable, open refueling module if equipped with closed circuit rapid refueling receptacle. Refer to figure 1-1A.

WARNING

During RAPID GRAVITY Refueling, exercise extreme caution to prevent fuel splashing from fuel cell or fuel nozzle. Any fuel leakage could be extremely hazardous if ingested into engine air intake.

(10) Remove nozzle cap and insert nozzle into fuel receptacle.

(11) Activate flow control handle to ON or FLOW position. Fuel flow will automatically shutoff when cell is full.

(12) Assure flow control handle is in OFF or NO FLOW position and remove nozzle. Close refueling module by pulling cable until latch is in locked position, if equipped with closed circuit receptacle. Refer to figure 1-1A.

- (13) Replace fuel nozzle cap.
- (14) Replace fuel filler cap.
- (15) Disconnect fuel nozzle ground.
- (16) Disconnect ground from helicopter to servicing unit. AFTER RAPID FUELING. The pilot shall be advised, by the refueling crew, that fuel cap is secure and grounding cables have been removed.
- (17) Disconnect servicing unit ground from ground stake.
- (18) Return fire extinguisher to designated location.

c. *Defueling.*

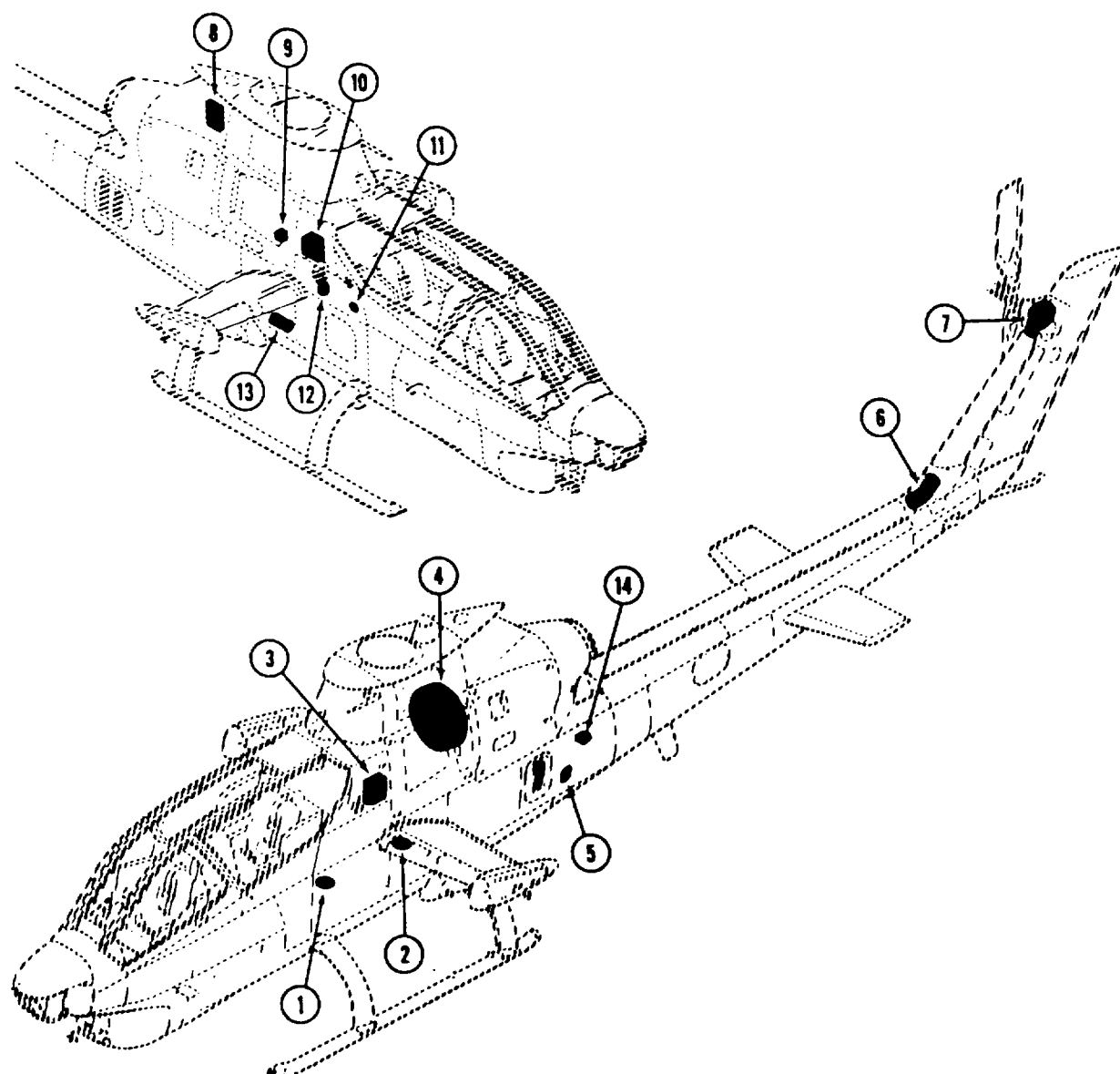
- (1) Remove drain valve from aft fuel cell.

NOTE

Aft fuel drain valve assembly is a two piece valve which will automatically close valve opening when lower valve is removed. Refer to FM 10-68 for defueling procedures.

- (2) Install MS24392D12 fitting, with flexible hose installed, in valve assembly in bottom of cell. Valve will open as fitting is being installed.

- (3) After defueling, remove MS24392D12 fitting. Install lower section of valve and lockwire.



- 1. Fuel Tank Drain, Forward
- 2. Fuel Tank Drain, Aft
- 3. Hydraulic Reservoir, Left Side
- 4. Particle Separator
- 5. External Power Receptacle
- 6. 42 Degree Gearbox
- 7. 90 Degree Gearbox

- 8. Engine Oil Tank
- 9. Transmission Oil Sump
- 10. Hydraulic Reservoir, Right Side
- 11. Static Ground Receptacle
- 12. Fuel Tank Filler Cap
- 13. Emergency Collective Accumulator
- 14. Battery

209900-453

Figure 1-1. Servicing points diagram

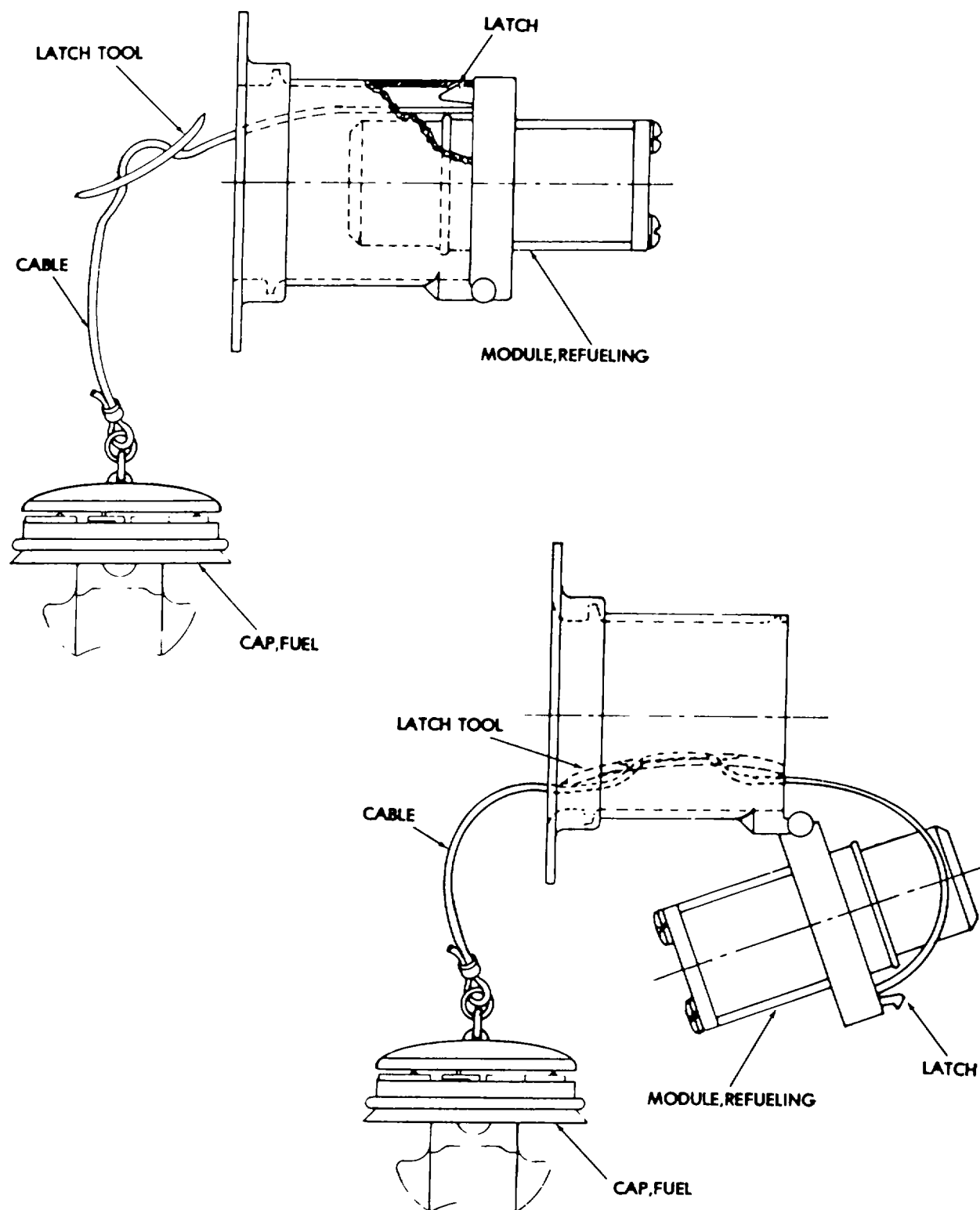


Figure 1-1A. Closed Circuit Refueling System

d. *Fuel Requirements.* Fuel requirements for the engine are listed in Table 1-1. A general listing of acceptable fuels is provided in Table 1-2. The fuels listed in Table 1-2 for each type have nearly identical characteristics. All of the fuels are compatible and may be mixed in aircraft fuel tanks. The use of fuels shall be in accordance with TB 55-9150-200-25.

WARNING

Turbine engine fuels, as well as gasoline, form explosive mixtures readily. To ensure safety of personnel, aircraft handling and filling operations shall conform to TM 10-1101.

e. *Fuel Types.* Fuels are classified as Army Standard, Alternate, or Emergency.

- (1) *Army Standard Fuels:* These are the Army designated primary fuels adopted for

worldwide use, and will be the only fuels readily available in the Army support system.

(2) *Alternate Fuels:* These are fuels which can be used continuously when Army Standard fuel is not available, without reduction of power output. Power setting adjustments may be required when an alternate fuel is used.

(3) *Emergency Fuels:* These are fuels which can be used if Army Standard and approved Alternate fuels are not available. Their use is subject to a specific time limit. (Refer to TM 55- 1520-234-10.)

f. *Use of Fuels.* There is no special limitation on the use of Army Standard fuel, but certain limitations are imposed when Emergency fuels are used. For the purpose of record, fuel mixtures shall be identified as to the major component of the mixture (except when the mixture contains leaded gasoline) and recorded on DA Form 2408-13 (Aircraft Inspection and Maintenance Record). A fuel mixture which contains over 10 percent leaded gasoline shall be recorded as all leaded gasoline.

Table 1-1. Engine Fuel Specifications

ARMY STANDARD FUEL	ALTERNATE FUEL	EMERGENCY FUEL
MIL-T-5624	MIL-T-5624	MIL-G-5572
Grade JP-4	Grade JP-5	Aviation Gasoline
(NATO Code No. F-40)	(NATO Code No. F44)	Refer to TB 55-9150-200-25
NOTE: An entry shall be made on DA Forms 2408-13 if EMERGENCY fuel is used.		

(1) The use of kerosene fuels (JP-5 type) in turbine engines dictates the need for observance of special precautions. Both ground starts and air restarts at low temperature may be more difficult due to low vapor pressure. Kerosene fuels having a freezing of -40°F (-40°C) limit the maximum altitude of a mission to 28,000 feet under standard day conditions. Those having a freezing point of -55°F (-48°C) limit the maximum altitude of a mission to 33,000 feet under standard day condition.

(2) The use of straight unleaded gasoline may shorten the operating life of combustor parts; therefore, its use between scheduled internal (hot end) inspections is limited. When the time limit has been reached, the use of

unleaded gasoline must be discontinued pending result of internal inspection.

NOTE

Two parts of unleaded gasoline mixed with one part of kerosene fuel (JP-5 type) produce a fuel which is preferred above straight unleaded gasoline. In the fueling record, this mixture should be identified as unleaded gasoline.

NOTE

Unleaded gasoline leaves combustor parts clean; therefore, no special cleaning is required between scheduled internal (hot end) inspections.

Table 1-2. Approved Fuels

Source	Primary or Standard Fuel	Alternate Fuel	
US Military Fuel	JP-4 (MIL-T-5624)	JP-5 (MIL-T-5624)	
<u>Commercial Fuel</u> <u>(ASTM-D-1655)</u>	<u>JET B</u>	<u>JET A</u>	<u>JET A-1</u> <u>NATO F-34</u>
America Oil Co.	American JP-4	American Type A	Aerojet A-1
Atlantic Richfield	Aerojet B	Aerojet A	Richfield A-1
Richfield Div		Richfield A	B.P.A.T.K.
B. P. Trading	B.P.A.T.G	CITGO A	Caltex Jet A-1
Caltex Petroleum Corp	Caltex Jet B	Conoco Jet-50	
Cities Service Co.		Gulf Jet A	Conoco Jet-60
Continental Oil Co	Conoco JP-4	EXXON A	Gulf Jet A-1
. Gulf Oil	Gulf Jet B	Mobil Jet A	EXXON-A-1
EXXON Co, USA	EXXON Turbo Fuel B	Philjet A-50	MOBIL JET A
Mobil Oil	Mobil Jet B	Aeroshell 640	Aeroshell 650
Phillips Petroleum	Philjet JP-4		Superjet A-1
Shell Oil	EXXON A-1	Jet A Kerosine	Jet A-1 Kerosine
Sinclair	Aeroshell JP-4	Chevron A-50	Chevron A-1
Standard Oil Co	Mobil Jet A-1	Avjet A	Avjet A-1
Chevron		76 Turbine Fuel	
Texaco			
Union Oil	Chevron B	Superjet A	
	Texaco Avjet B		
	Union JP-4		
<u>Foreign Fuel</u>			<u>NATO F-44</u> (High flash type)
Belgium	<u>NATO F-40</u>		
Canada	(Wide cut type)		
Denmark	BA-PF-2B	3-6P-24c	
France	3GP-22F		
Germany (West)	JP-4 MIL-T-5624		
Greece	Air 3407A	UTL-9130-007/UTL 9130-010	
Italy	VTL-9130-006		
Netherlands	JP-4 MIL-T-5624	AMC-143	
Norway	AA-M-C-1421	D. Eng RD 2493	
Portugal	JP-4 MIL-T-5624		
Turkey	JP-4 MIL-T-5624		
United Kingdom	JP-4 MIL-T-5624		
(Britain)	JP-4 MIL-T-5624		
	D. Eng RD 2498		

NOTE:

Anti-icing and Biocidal Additive for Commercial Turbine Engine Fuel - The fuel system icing inhibitor shall conform to MIL-I-27686. The additive provides anti-icing protection and also functions as a biocide to kill microbial growths in aircraft fuel systems. Icing inhibitor conforming to MIL-I-27686 shall be added to commercial fuel, not containing an icing inhibitor, during refueling operations, regardless of ambient temperatures. Refueling operations shall be accomplished in accordance with accepted commercial procedures. Commercial product "PRIST" conforms to MIL-I-27686.

(3) Leaded gasoline, either straight or mixed with other fuels in any proportion, will deposit a layer of lead oxide on combustor parts. The lead oxide attacks the underlying metal and also acts as an insulator which reduces combustion efficiency and causes the formation and deposition of carbon. Therefore, the operating time between scheduled internal (hot end) inspections is limited. If the permissible accumulated operating time is exceeded, a special cleaning and inspection is mandatory. See TM 55-2840-229-23.

NOTE

Special cleaning and inspection may be delayed for 10 operating hours provided that only Army Standard fuel is used during the delay.

1-3. Engine Oil System Servicing.

The engine oil tank (8, figure 1-1) is located above the engine in the aft fairing. Oil level sight gage and filler cap are on front of tank, accessible through doors on pylon center fairing. Tank drain valve is accessible through the engine compartment, and has an overboard drain line.

a. Fill engine oil tank to spill-over for normal servicing. Sight gage is positioned to show low oil level. When oil level is below spillover level, the tank should be filled. Useful capacity of tank is 2.25 US gallons, with expansion space of 1.15 gallons.

b. Before adding oil, determine whether system contains oil (C93) or oil (C94). Maximum oil consumption for T53-L-703 engine is 0.3 gal./hr. (2.4 US pints). The oil level sight gage is provided for the purpose of determining a low oil condition. When oil level is at sight gage level, oil supply is $2.75 \pm .25$ quarts low. When servicing oil tank, fill completely to a spill over condition. The system warning light will come ON and the bypass valve will open when the oil is down 3.8 quarts low from spill over.

c. *Usage of Oils.* It is not advisable to mix oil (C94) and oil (C93) except when an emergency exists and conditions warrant. If mixing becomes necessary, the engine oil system shall be drained within 6 hours of operations, and refilled with the appropriate oil. (See subparagraphs (1) and (2) below for oil usage.) If engine oil system is to be replenished with oil (C94) proceed in accordance with paragraph 1-3, step d. When refilling engine oil system with oil (C93) proceed in accordance with paragraph 1-3, step d (2), steps (a) thru (e).

Transmission and gear boxes shall be drained and refilled in accordance with paragraph 1-6.

(1) Oil (C94) used in engine, main transmission, and gearboxes, oil systems is authorized and directed for ambient temperatures above minus 32°C (minus 25°F).

(2) Oil (C93) used in engine, main transmission, and gearboxes, oil systems is specified for operation in ambient temperatures below minus 32°C (minus 25°F). This oil may also be used when oil (C94) is not available.

CAUTION

Under no circumstances shall oil (C94) be used at temperatures below minus 32°C (minus 25°F).

d. Procedure for Changing Engine Oils.

(1) When changing over from oil (C93) to oil (C94) in engine oil system, accomplish steps below.

(a) Drain oil (C93) from system.

(b) Inspect, clean and reinstall all engine oil filters and strainers.

(c) Fill engine oil tank to lip of filler neck with oil (C94). Motor engine to pump oil into cooler and lines. Check tank level and refill. Repeat until level does not change, indicating the cooler and lines are refilled.

(d) Operate engine for 30 minutes to 1 hour. Shut down engine.

(e) Inspect, clean, and reinstall all engine oil filters and strainers.

1. If oil filter was heavily contaminated, accomplish all steps below.

2. If oil filter was not heavily contaminated, omit steps (f) and (g) and accomplish steps (h) through (i) below.

(f) Drain all oil from engine oil system, and discard oil.

(g) Fill engine oil system with new oil (C94) and release helicopter for use.

(h) After 5 hours operation, inspect and clean all engine oil filters and strainers.

(i) 15 hours after oil change, inspect and clean all engine oil filters and strainers.

(j) Revert to normal schedule of inspections of engine oil filter and strainers.

(2) When changing over from oil (C94) to oil (C93) in engine oil system, accomplish the following.

(a) Drain oil (C94) from system.

(b) Inspect, clean, and reinstall all engine oil strainers and filters.

(c) Fill engine oil tank with oil (C93) motor engine to pump oil into cooler and lines. Check tank level and add oil. Repeat until tank level does not change, indicating that cooler and lines are filled.

(d) Operate engine until oil reaches operating temperature. Shut down engine.

(e) Inspect, clean, and reinstall all engine oil strainers and filter. Release helicopter for service use.

(f) After 5 hours of operation, inspect and clean all engine oil strainers and filter.

(g) After 15 hours of operation, since last oil change, inspect and clean engine oil strainers and filter.

(h) Revert to normal interval of inspection for engine oil strainers and filter.

1-4. Transmission Oil System Servicing.

The transmission oil supply is contained in the sump case (9, figure 1-1.) A double sight gage on the sump can be viewed through a small transparent plastic window in the right-hand pylon cowling door, using a light controlled by a push-button below the door. Before servicing oil, determine whether system contained oil (C93) or oil (C94). If unable to determine type of oil used, refer to paragraph 1-3, step c. When filling is required, open the cowling door for access to the filler cap on the transmission support case. The sump drain valve is accessible by removing an access panel on fuselage below either wing.

a. Before servicing transmission sump to upper sight gage level, determine whether system contains oil (C93) or oil (C94). If unable to determine type of oil used, refer to paragraph 1-3, step c. Systems capacity is 2.25 US gallons.

1-5. 42° and 90° Gearbox Servicing.

The 42° gear box (6, figure 1-1) is under a removable cover, located between drive shaft covers of tail boom and vertical fin. An oil level sight glass, a chip detector and drain plug, are on the right side of the gear box, a vented filler cap is on the top side of the gear box. The 90° gear box (7) is covered by two removable fairings near upper end of the vertical fin. An oil level sight glass is provided on lower left side, a chip detector and drain plug at bottom, and a vented filler cap on the aft side of the gear box.

a. Before servicing both gear boxes to indicated sight glass level with turbine engine lubricating oil, determine whether system contains oil (C93) or oil (C94). If unable to determine type of oil used, refer to paragraph 1-3, step c.

1-6. Procedures For Changing Transmission And Gear Box Oils.

When changing over from oil (C93) to oil (C94) or from oil (C94) to oil (C93) accomplish the following steps:

a. Drain oil.

b. Change filter elements (transmission only).

c. Perform normal periodic inspection.

d. Refill with appropriate oil (see paragraph 1-3, step c.)

1-7. Hydraulic System Servicing.

Reservoirs (3 and 10, figure 1-1) for hydraulic systems No. 1 and No. 2 are located in a compartment just aft of the canopy. Access doors are provided at both sides of the fuselage. Fluid level sight glasses on both reservoirs are visible through left side door. Each reservoir has a filler cap accessible from nearest door. The emergency collective accumulator (13) is accessible by removing a panel located on the fuselage below the right wing and has a pressure gage and filler valve for nitrogen charging. A valve and stowed hose connection, with instructions on a decal, are

provided in the same area for releasing hydraulic pressure from the accumulator.

a. Bleed hydraulic pressure from emergency collective accumulator. Check accumulator gas pressure gage, and charge as required with compressed nitrogen (C89). (Refer to Chapter 7.)

WARNING

When handling hydraulic fluid (MIL-H-83282), observe the following: Prolonged contact with liquid or mist can irritate eyes and skin. After any prolonged contact with skin, immediately wash contacted area with soap and water. If liquid contacts eyes, flush them immediately with clear water. If liquid is swallowed, do not induce vomiting; get immediate medical attention. Wear rubber gloves when handling liquid. If prolonged contact with mist is likely, wear an appropriate respirator. When fluid is decomposed by heating, toxic gases are released.

CAUTION

Hydraulic pressure must be released from emergency collective accumulator before adding fluid to avoid overfilling hydraulic system.

CAUTION

Do not mix hydraulic fluid (C73) with fire retardant fluid (C73A). Refer to TB 55-1500-334-25.

b. Service both reservoirs with hydraulic fluid (C73 or C73A) through filler caps. Each reservoir holds 3.2 US pints. Total capacity of System No. 1 is 6.0 pints; capacity of System No. 2 is 6.6 pints.

WARNING

To avoid contamination, a sealed can of fluid must be opened and used. Do not use previously opened cans of hydraulic fluid.

1-8. Particle Separator (Self Purging) Servicing.

The particle separator (4, figure 1-1) is an inertial-type consisting of an upper and lower assembly half. Lower assembly half mounts air cleaner which collects particles removed from engine air and ejects them overboard. A foreign object damage screen consists of two halves which fit around particle separator.

a. Cleaning.

- (1) Open and secure transmission cowling.
- (2) Unlock the two latches on foreign object screen.
- (3) Disengage hook portions and lift top half of screen free of particle separator.
- (4) Release two latches on rear faces and two latches on front face of separator halves by simultaneously pressing safety latch up and lifting up on release latch. Release latch on top of separator upper half and remove upper half.

(5) Remove gaskets.

(6) Remove any foreign material from inside of separator.

(7) Remove foreign material from filter on front face of lower portion of separator.

(8) Position gaskets over positioning pins on lower separator.

(9) Position upper separator on lower assembly. Tilt top slightly forward to position assembly on four positioning pins.

(10) Secure upper assembly to flange with latch at top of separator.

(11) Engage latch assemblies on front face of separator and lock.

NOTE

Secure front latch assemblies before securing rear latches.

(12) Engage latches on rear face of separator and lock.

CAUTION

Ensure that safety catch on latches is engaged by exerting a slight pull on release catch. Catch should not open.

(13) Check for proper seating by appearance of seals. Approximately **0.125** inch of rubber on gasket assemblies between halves will be uniformly exposed. Seal at aft edge of separator will be approximately half compressed.

(14) Position top half of screen to engage aft screen molding slot over separator split flange. Position screen cut-out over latch on separator. Refer to Chapter 4, Section III.

(15) Secure top half of screen to bottom half by engaging and locking both latches.

(16) Minimize gaps which may exist between top and bottom screen halves or between screens and separator by repositioning or slightly reforming screens. Gaps greater than **0.15** inch are cause for screen replacement.

- (17) Close and secure transmission cowling.

1-9. Battery Servicing.

The nickel-cadmium battery (14, figure 1-1) is mounted in BATTERY compartment. It is connected to the helicopter electrical system through a relay which is controlled by the battery switch on the pilot's console. Two overflow, or vent, tubes extend from the battery to the underside of the fuselage. Access to the battery is gained through a door in the helicopter battery compartment. The battery is a lightweight, 24 volt 22 ampere-hour nickel-cadmium battery unit. A 34 ampere-hour nickel-cadmium battery may be used as an alternate.

CAUTION

Battery failure and explosions may be caused by an excess of electrolyte in the cells. The specific gravity of a nickel-cadmium battery remains constant when the battery is in either a charged or discharged condition, consequently the state of charge cannot be determined by a test of the electrolyte. Neither can the state of charge be determined by a voltage test, due to the fact that the voltage remains constant over 90 percent of the discharge time. Since the state of charge cannot be determined by a check of either voltage or the electrolyte, the charging input to a completely discharged battery must be monitored in both current and time until the ampere hour capacity of the battery has been reached.

1-10. Ground Handling Wheels (Truck) Servicing.

- a. Lubricate assemblies with grease (C67) through fittings on wheels, actuating arms, and cradles as frequently as operating conditions warrant.
- b. Repair tires and tubes in accordance with TM 55-2620-200-24. Inflate with compressed air to 75 psi.
- c. Check and fill hydraulic pump as required.

(1) Hold handling gear assembly so that pump is vertical with filler hole at upper end. Remove screw from filler hole.

- (2) Fill pump to filler hole level with hydraulic fluid (C73). Reinstall screw in filler hole.

1-11. Cleaning Helicopter.

CAUTION

To preclude damage to honeycomb panels, solvents and water are to be applied at the minimum pressure required to maintain a constant flow suitable for washing and rinsing. Steam is not to be utilized.

- a. *General.* The helicopter must be grounded prior to any cleaning, maintenance, disassembly or preservation.

NOTE

Additional cleaning procedures are covered in this manual under individual components.

WARNING

Use trichlorotrifluoroethane cleaning compound in a well ventilated area and avoid prolonged breathing of vapors. Do not use in an area with open flame or high temperature as the products of decomposition are toxic and very irritating. Avoid contact with the skin. Wear rubber gloves.

- b. *Interior.* Clean the interior of the helicopter to prevent debris from falling into the operating mechanism. If the seats and cushions need cleaning, use mild soap (C125) and water. To remove grease or oil spots use solvent (C143). Wipe dry with a clean cloth. Finally, thoroughly clean the helicopter with a vacuum cleaner.

- c. *Exterior.* Clean the exterior structure by applying a mixture of one part cleaning compound (C41) and three to seven parts water. Use the stronger mixtures for exhaust outlet areas and other very dirty surfaces. Wash a small area at a time making sure to rinse thoroughly with water under pressure. If allowed to dry or if not completely rinsed off, streaking will occur.

NOTE

Do not spray or rinse main rotor hub with water under *pressure*.

d. *Canopy.***CAUTION**

Do not use compounds other than those specified. Avoid excessive scrubbing of plastic panels during washing operation.

(1) Clean all transparent plastic with large quantities of cleaning compound (C41) and water. Cleaning compound (C39) may be used as an alternate to clean transparent plastic.

(2) Gently free all caked mud or dirt with the pads on the fingers. Do not use sponges or coarse cloths. Rinse the area continuously while removing the mud.

CAUTION

Do not use aliphatic naphtha (Type 1).

(3) Remove grease or oil with aliphatic naphtha, Type 2 (C88).

(4) Allow surfaces to drip dry.

(5) Minor scratches may be reduced or removed. Refer to TB 55-1560-276-24/1.

(6) Apply repellant and conditioner (C125). Refer to TM 55-1500-204-25/1.

e. *Rotor Blades.***NOTE**

Do not spray or rinse main rotor hub with water under *pressure*.

Wash rotor blades with one part cleaning compound (C41) and nine parts water.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

f. *Treatment of Aluminum and Magnesium Alloy Corrosion.* Aluminum and magnesium alloy corrosion will be treated in accordance with TM 43-0105. Apply the protective paint finish to the affected area immediately after drying of chemical treatment in accordance with TB 746-93-2.

1-11A. Removal of Snow and Ice.**CAUTION**

Extreme care shall be exercised at all times to prevent any damage to the aircraft surfaces. Sharp instruments such as picks, knives, or screw drivers will not be used to loosen the ice formation.

a. Check entire helicopter for snow, frost, and ice accumulation. Snow can be removed from airframe and rotor blades by using a bristle brush or equivalent. Ensure that helicopter skids are not frozen to ground.

WARNING

Extreme care must be exercised when melting ice and frost with applied heat. Water accumulation may flow into critical areas in proximity to heat application. If heat gun is used, exercise caution to prevent excessive heat from damaging rotor blades, bonded panels, metal surfaces, and paint.

b. *Frost or moderate ice.* Apply heat to ice accumulations and dry with rags as melting occurs.

c. *Severe ice accumulation.* Helicopter should be moved into a warm hangar, when possible, for natural de-icing.

WARNING

Extreme caution must be exercised in the use of Ethylene Glycol-water solutions (including Ethylene Glycol, technical or specification MIL-A-8243 Anti-Icing/Deicing/Defrosting Fluid) in and around aircraft having silver or silver-coated electrical/electronic circuitry. Rapid oxidation and fire can occur when Glycol-water solutions come in contact with and short across bare or defectively insulated silver or silver-coated electrical circuits such as wiring, switches, circuit breakers, etc., which are carrying positive direct current (DC).

De-icing fluids are toxic irritants; protective precautionary measures apply.

CAUTION

Because of adverse effects of heated de-icing fluid, precaution must be taken to protect bearings, plastic windows, covers and boots.

d. Apply de-icing/defrosting fluid (C58A) to remove ice or heaving accumulations and to retard recurrence. Fluid may be applied with a low pressure spray or a brush, and will provide retarding protection for approximately 10 hours.

e. Upon completion of de-icing procedures, check all controls for ice and freedom of movement.

1-11B. De-Ice K747 Blade.

a. Use MIL-A-8243C or MIL-A-8243B ethylene propylene glycol.

b. Do not break ice with sharp, blunt, or similar instrument.

c. Apply to ice by spray:

(1) Pressure low/medium.

(2) Hand pump spray (atomizer).

d. Wipe off de-ice fluid from all surfaces. Fluid should not be dripping off of blade.

e. Allow ice to melt off.

f. Very light scraping can be done using either a wood, plastic, or teflon scraper.

g. Do not scrape leading edge boot.

1-12. Subassembly Painting (AVIM)

Helicopter and components will be painted in accordance with procedures covered in TB 746-93-2. Special painting procedures will be covered in this manual under individual components. General painting procedures will be in accordance with the following paragraphs.

a. *Paint Refinish - Exterior.*

(1) Mask around area to be repainted. Apply masking tape (C133) at a skin edge, or break point, that will allow the new paint to blend with the existing paint.

(2) Remove paint from area to be refinished with thinner, (C140), or approved paint remover, using caution to prevent solutions from contacting acrylic plastics.

NOTE

It is neither advisable nor necessary to remove epoxy primer when refinishing.

(3) Wash all surfaces with cleaning compound (C39) after removal of paint and rinse to ensure removal from crevices, pockets, etc.

WARNING

Alodine is extremely dangerous. It contains an oxidizing ingredient which may cause an explosion if it comes in contact with combustible materials such as paints, solvents, etc. Chromic acid is extremely dangerous. Avoid breathing fumes or contact with clothing or body. Contact with combustible materials may cause fire.

(4) Apply chemical film treatment to bare metal while the surface is still wet from washing rinse. Treat aluminum with Alodine (C37). Treat magnesium with chromate pickle solution (C38). Treat cadmium plated steel with a ten percent solution of chromic acid (C3). Before the solution dries, wipe with a clean dampened cloth or rinse thoroughly with clean, fresh water to remove all chemical film treatment solution.

(5) Allow treated surface to dry, and apply primer as follows: Prime magnesium, aluminum, fiberglass and cadmium-plated steel with primer (C102) in accordance with TB746-93-2.

(6) Apply finish coats of acrylic lacquer, gloss or camouflage of color to match adjoining area.

(a) Apply one light first coat and allow 30 minutes to one hour to air dry.

(b) Apply second full covering coat, and allow one hour minimum drying time.

(c) Apply the final lacquer coat of the proper color number, thinned approximately one part basic lacquer to one and one-half parts thinner (C140).

(7) Apply final finish to various special areas as follows:

(a) Paint the external exhaust blast area, consisting of the engine exhaust pipe fairing, drive shaft forward access cover and the two top forward skin sections of the tailboom with two coats of high heat resistant acrylic enamel (C60). Apply the first coat as a thin tacky coat; follow with one full wet coat while the first coat is still tacky.

(b) Finish the ADF sense antenna surface with anti-static epoxy (C61).

(c) Finish surfaces within 12 inches of the battery, and other surfaces subject to electrolyte spillage or spray, with one coat of primer (C100). Follow with two coats of lacquer (C75). Allow 30 minutes to one hour air drying time between coats.

(8) Allow finish coats a minimum of six hours air drying time at normal temperature (700 to 900F), and humidity (30 to 75 percent) conditions prior to masking for application of markings.

(9) Apply walkway coating (C148) to wing and skid gear.

a1. *Paint Refinish - Exterior - Low Reflective Acrylic Lacquer.*

(1) Remove any markings in area to be painted by sanding with 320 grit sandpaper (C112).

NOTE

Polyurethane coated surfaces must be scuff sanded all over to remove glaze. Use 320 grit or finer sandpaper (C112).

(2) Where finish has been damaged or does not adhere to base material, remove finish down to base material. Use 320 grit or finer sandpaper (C112).

(3) Use 320 grit or finer sandpaper (C112) to remove all rough, high, or corroded areas. Feather rough areas. Fair edges where finish was removed in step (2) or where finish did not adhere to primer.

WARNING

Use solvent (C124) in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

(4) Remove all grease, oil, grime, etc., by washing area to be painted with solvent (C124). Dry thoroughly.

(5) After solvent is completely dry, use masking tape (C134) to mask area to be painted.

WARNING

Toluene is highly flammable. Ground container to dispense. Avoid skin contact. Avoid breathing vapors.

NOTE

Apply lacquer (C75A) within four hours after step (6).

(6) After masking, activate surface to be painted by washing with toluene (C144). Allow to dry thoroughly.

NOTE

Ensure that toluene did not loosen masking tape. Re-mask as necessary.

(7) Areas which were sanded must be primed with epoxy polyamide primer (C100) prior to coating with lacquer. Areas which did not require sanding do not require priming.

NOTE

Apply lacquer (C75A) within one to eight hours after application of primer (C100).

(8) Prepare Low Reflective Acrylic Lacquer for Application.

(a) The lacquer base (C75A) in its original container shall have all settling and/or caking redispersed by hand stirring using a clean metal or wood stirrer. After hand stirring, invert and agitate, on a paint shaker, in original container, for an additional 30 minutes prior to thinning.

(b) Immediately after shaking, pour lacquer base (C75A) into a clean container and add thinner (C140) one to one and one-half parts by volume to one part lacquer base.

(c) Thinned mixture shall be agitated in the pressure pot for thirty minutes prior to use. Agitation shall then be continuous throughout application.

(d) Acrylic retarder (C62A) may be added up to thirty percent by volume when high temperatures or humidity cause blushing.

CAUTION

Halts over two minutes duration during application will require flushing of paint lines and spray gun to remove dried particles prior to restarting application.

NOTE

A slight increase in fluid and air pressure, approximately 5 psi over that used for application of standard acrylic lacquers, is required. Respraying of partially dried areas will cause excessive surface roughness.

(9) Apply finish coats of low reflective acrylic lacquer. When spraying, hold gun 10 to 12 inches from the surface to prevent dry spraying. This material shall be sprayed wet.

NOTE

The low reflective acrylic lacquer will dry to touch in one hour. Full cure is attained in 12 hours. Allow 30 minutes minimum to 12 hours maximum dry time between coats.

b. Paint Refinishing - Cockpit Interior.

(1) Mask all acrylic surfaces and items of different color.

(2) Use primer (C102) where old primer has been removed.

(3) Refinish the following with lusterless black lacquer (C80).

(a) Cyclic and collective control sticks.

(b) Edge lit plastic panels and metal backing panels.

(c) Instrument glare shield and lighting fixtures.

(d) Instrument panel shrouds, stand by compass card holder bracket.

(4) Use dark gull gray camouflage lacquer (C81), on all cockpit surfaces except the cockpit floor and items listed in step (3).

c. Paint Refinishing - Cockpit Floor.

(1) Remove seats and clean cabin floor area. Refer to Chapter 2 for removal and installation.

(2) Mask all areas and items adjacent to floor.

(3) Remove all grease, oil, dust, etc., from floor with aliphatic naphtha (C88), and clean cloths. Sand the cleaned area with No. 400 or 600 grit paper (C112) and wipe with clean cloth.

(4) Apply primer (C102) as necessary.

(5) Apply two coats of lacquer (C81), to floor area.

NOTE

Allow 2 hours drying time for paint.

(6) Apply markings in accordance with TB746-93-2.

(7) Apply walkway coating (C148).

(8) Install pilots and gunners seats. Refer to Chapter 2.

d. Dissimilar Metals. Faying surfaces of dissimilar metals must be treated before assembling, to prevent contact of bare metals and resulting corrosion damage.

e. Procedures for Dissimilar Metals.

(1) Mating surfaces of dissimilar metals shall receive a minimum of two coats of zinc chromate primer (C102) before assembly.

(2) Where magnesium is one of dissimilar metals, install tape (C131) between mating surfaces. Tape shall extend not less than 0.26 inch beyond edges of joint to prevent moisture bridging between dissimilar metals.

1-13. List of Consumable Maintenance Supplies and Materials.

Consumable maintenance supplies and materials are listed in table 1-3 in alphabetical order. Each consumable also has an item number assigned for ease of location and reference. When an item number is unknown you may locate any consumables used within this manual through its alphabetical arrangement.

When an item number is referenced in the manual, you may locate the item through its C designator and item number. C designators are used only with consumable maintenance supplies and materials. Consumable maintenance supplies and materials tables are found only in this chapter therefore, the table number will not be referenced in the text. NSN's in the consumable table list only the smallest quantity of the material. If larger quantities are required, see TM 55-1520-234-23P.

Table1-3. Consumable Maintenance Supplies and Materials

The supplies and material listed in this table are required for maintenance support of this equipment and am authorized to be requisitioned by CTA 50-970 (Common Table of Allowances).

Item No.	Description	Ref. No. and FSCM	NSN
01	Abrasive Pads, Nylon Wed, Scotch-Brite, Type A, Very Fine, L-P-50, Type 1, Class 1, Size 1	81348	7920-00-0659-9175
1	Acetone, Technical	0-A-51	6810-00-184-4796
2	Acid, Boric, Technical Grade	-C-265	6810-00-264-6535
3	Acid, Chromic	0-C-303, Type II	6810-00-264-6517
4	Acid, Hydrochloric (Muriatic)	O-H-765	6810-00-222-9641
5	Acid Nitric	O-N-350	6810-00-237-2918
6	Use C12A		
7	Adhesive, A-6 with Activator A	A6 (98911)	8040-00-691-1322
7A	Adhesive, EA9330 (HYSOL)	(04347)	8040-01-089-9073
7B	Adhesive, EA9309	299-947-125, Type I (33564)	8040-01-012-8749
8	Adhesive, EC-678	MIL-A-9117	8040-00-262-9060
9	Adhesive, EC-776	MMM-A- 122	8040-00-664-0439
10	Adhesive, EC1300L	EC1300L(04633)	8040-00-514-1880
11	Adhesive, EC2216, Scotchweld	Scotchweld 2216BA (94960)	8040-00-145-0019
11A	Adhesive (RP-1257)	(48909)	
12	Adhesive, Epoxy, EA9340, Metalset A4	MMM-A-1754	8040-00-944-7292
12A	Adhesive, PS-18	MIL-A-8576 (77902)	8040-00-526-1910
13	Adhesive, Q2-0046	RTV 730 (71984)	8040-00-251-2312
13A	Adhesive Mixture		
	Epon 826	(86961)	8030-00-144-9658
	Versamid 125	(11884)	8030-00-893-4224
	Diethylenetramine (DTA)	(79741)	8040-01-194-3933

Table 1-3. Consumable Maintenance Supplies and Materials (Cont)

Item No.	Description	Ref. No. and FSCM	NSN
14	Adhesive, Rubber Base	MMM-A-1617	8040-00-262-9031
14A	Adhesive, Ethyl-2-Cyanoacrylate	MIL-A-46050 Type 2, Class 3	8040-01-140-0954
15	Adhesive, Silicone Rubber	MIL-A-46146	8040-00-224-4655
16	Adhesive, Silicone Rubber	MILA-46146	8040-01-130-3210
16A	Adhesive, Silicone	MIL-1-46146A	8040-01-009-1562
17	Adhesive, Two-Part EA934NA	MMM-A-132, Type 1 Class 3, (33564)	8040-01-102-2098
18	Adhesive, Two-Part Liquid Silicone	SR 529 and SRC18 (01139)	8040-00-097-6524
19	Adhesive, Type --Class 2	MMM-A-132	8040-00-664-2912
20	Adhesive, Uralane (Part A and B) 5738-A/BX	EC3549AB(04963)	8040-01-016-4726
21	Adhesive, Uralane 8089, Type 1	(90039)	8040-00-828-4936
21A	Adhesive, Rubber Base EC-2126	MMM-A-1617	8040-00-281-1617
22	Alcohol, Methyl	OM232F	6810-00-275-6010
23	Alcohol, Isopropyl	TT-I-735	6810-00-855-6160
24	Aluminum Wool	MIL-A-4864, Type 2	5350-00-286-4851
25	Ammonium Nitrate Solution (For removing Cadmium Plate)	MIL-A-175B	6810-01-091-8676
25A	Anodic, Black	MIL-A-8625, Type H	
26	Antiseize Compound	MIL-A-907	8030-00-597-5367
26A	Deleted		
27	Bag, Plastic	PPP-B-26	8105-00-054-0939
28	Barrier Material, Grease-Proofed	MIL-B-121, Grade A	8135-00-224-8885
29	Barrier Material, Flexible, Type 1	MIL-B-131	
30	Barrier Material, Waterproof, Vaporproof	MIL-B-131, Class 1	8135-00-282-0565

Table 1-3. Consumable Maintenance Supplies and Materials (Cont)

Item No.	Description	Ref. No. and FSCM	NSN
30A	Bottle, Screw Cap, 16 oz.	S-8275G (64484)	6640-00-404-0660
30B	Bottle, Screw, Cap, 32 oz	S-8275H (64484)	6640-00-404-0661
31	Bungee Cord	MIL-C-5651, Type 3	8305-00-267-3119
32	Deleted		
33	Cellophane	L-C-110	8135-00-392-8971
34	UseC12A		
35	Cement (EC1357)	MMM-A-121 (76381)	8040-00-165-8614
36	Cheesecloth	CCC-C-440 (81348)	8305-00-267-3015
37	Chemical Film, Alodine No. 1200	MIL-C-81706 Class 1A, Form III	8030-00-613-3131
38	Chromic Pickle Brush-On Solution, Type 1	MIL-M-3171	
39	Cleaning and Polishing Compound, Biodegradable	PP-560	7930-00-634-5340
40	Cleaning Compound	MIL-C-372	6850-00-224-6658
41	Cleaning Compound, Aircraft Surface, Alkaline, Waterbase	MIL-C-25769	6850-00-935-0995
42	Cleaning Compound, Aluminum Non-Flame Sustaining	MIL-C-5410	6850-00-282-6770
43	Cleaning Compound, Oil Cooler Solvent	MIL-C-6864	6850-00-551-3694
44	Cloth, Abrasive	P-C-451	5350-00-192-5050
44A	Cloth, Cotton Flannel	CCC-C-458	
44B	Cloth, Screen, Abrasive	3-738-7011-0 (27712)	
45	Cloth, Crocus	P-C-458	5350-00-221-0872
46	Cloth, Fiberglass, Type C (0.010 inch thick)	MIL-C-9084	8505-00-530-0109
47	Cloth, Fiberglass Type 181	MIL-C-9084	
48	Cord, Nylon, Type III	MIL-C-5040	4020-00-841-6583
49	Corrosion Preventive, Aircraft Engine	MIL-C-6529, Type III	6850-00-281-2031

Table 1-3. Consumable Maintenance Supplies and Materials (Cont)

Item No.	Description	Ref. No. and FSCM	NSN
50	Corrosion Preventive Compound (Clear protective coating) 204-011-449	(97499)	
51	Corrosion Preventive Compound, Cold Application, Solvent Cutback	MIL-C-16173, Grade 1	8030-00-231-2345
52	Corrosion Preventive Compound, Cold Application, Solvent Cutback	MIL-C-16173, Grade 11	8030-00-244-1297
53	Corrosion Preventive Compound, Hot Application	MIL-C-11796, Class 3	8030-00-231-2353
55	Corrosion Preventive Fingerprint Remover	MIL-C-15074	8030-00-664-4017
56	Cushioning Material, Bound Fiber	PPP-C-1120 (Type VI, Class A)	8135-00-292-9800
57	Deleted		
58	Cushioning Material, Packaging, Water Resistant, Type II	PPP-C-843	8135-00-664-0366
58A	De-Icing/De-frosting Fluid Type II	MIL-A-8243C	6850-01-039-3842
59	Desiccants, Packaging Use and Static Dehumidification, Bagged, Activated	MIL-D-3464	6850-00-264-6573
59A	Detergent	Joy (76188)	7930-00-764-5066
59B	Detergent, General Purpose	MIL-D-16791	7930-00-985-6911
60	Enamel, Acrylic, Heat Resistant, X130	(06613)	
61	Epoxy, Anti-Static XA147	(06613)	
62	Etchant, Tetra-etch	(17217)	6850-00-431-8662
62A	Ethylene Glycol, Monoethyl, Ether Acetate	MILE-7125	6810-00-265-0563
63	Fabric, Synthetic, 5066	(89616)	
64	Fairing Compound (RP-1257-3)	(48909)	8030-00-891-3113

Table 1-3. Consumable Maintenance Supplies and Materials (Cont)

Item No.	Description	Ref. No. and FSCM	NSN
64A	Filler Urethane Compound K747 Blade	R.P. 3265 (02684) (DC 182-72)	8030-01-229-2659
64B	Film, Teflon, Unperforated No. E3760-P2	Richmond Corp Highland, CA	
65	Flannel Outing	CCC-F-466	8305-00-641-5606
66	Fuel, Turbine, Grades JP-4 and JP-5	MIL-T-5624	
66A	Gasket, AsbestosJM89-3-64	(08835)	
66B	Gloves, Cotton	MIL-G-3866	8415-00-268-8353
67	Grease, Aircraft, Oscillating Bearing	MIL-G-25537	9150-00-478-0055
68	Grease, Extreme Pressure (Tube Pack) (97499)	ASN-Tech 3913-G1 or 204-040-755-5	9150-00-506-8497
69	Grease (Lubriplate)	(73219)	9150-00-068-6268
70	Grease, Aircraft Multipurpose	MIL-G-81322	9150-00-944-8953
70.1	Grease, Aircraft Multipurpose	MIL-G-81322 14 oz. Cartridge	9150-01-622-3358
71	Grease, Silicone, Dow Corning II, or Equivalent	8490010 (96717)	9150-00-616-9212
72	Grease Silicone (#33 Medium)	(71984) DC33 Fluid	9150-00-823-8048
73	Hydraulic Fluid, Petroleum Base	MIL-H-5606	9150-00-180-6181
73A	Hydraulic Fluid, Fire Retardant	MIL-H-83282	9150-00-149-7431
74	Hydraulic Fluid, Preservative, Petroleum Base, Type 1	MIL-H-6083	9150-00-935-9807
74A	Ink, Indelible		
74B	Insulating Compound	MIL-I-46058, Type UR	
75	Lacquer, Acrylic, Gull Gray, 36231	1T-L-20	9150-00-515-1568
75A	Lacquer, Acrylic, Low Reflective, Olive Drab	MIL-L-46159	8010-00-083-6588
76	Lacquer, Acrylic, Olive Drab, Camouflage, X34087	MIL-L-81352	8010-01-033-8917
77	Lacquer, Acrylic, Orange-Yellow, 33538	MIL-L-81352	9150-00-166-3158
78	Lacquer, Acrylic Resin, Black	MIL-L.46159	8010-01-211-1106
79	Use C75		
80	Lacquer, Non-Acrylic, Black, Lusterless, 37038	MIL-L-46159	
81	Use C75		

Table 1-3. Consumable Maintenance Supplies end Materials (Cont)

Item No.	Description	Ref. No. and FSCM	NSN
81A	Lacquer Light Full Gray	MIL-L-81352 (81349)	8010-00-935-7060
82	Lead Wool		
83	Lexcote	G-3397 (51747)	8030-00-118-1022
84	Lubricant	ASU-M100 (78511)	9150-00-823-8048
85	Lubricant, Solid Film. Type 2	MIL-L-8937A (59595)	9150-00-834-5608
86	Material, Nylon Sandwich Buna. N5200 5187	(89616)	
87	Methyl-ethyl-ketone	TT-M-261	6810-00-281-2785
88	Naphtha, Aliphatic	TT-N-95, Type 2	6810-00-238-8119
89	Nitrogen	AFPIDN06830-1	
90	Oil, Corrosion Preventive, Grade B	MIL-C-8188	6850-00-273-2395
91	Oil, Lubricating, Jet Engine (Grade 1010)	MIL-L-6081	9150-00-273-2388
92	Oil, Lubricating, Low Temperature, General Purpose	MIL-L-7870	9150-00-263-3490
93	Oil, Lubricating. Synthetic Base	MIL-L-7808	9150-00-782-2627
94	Oil, Lubricating, Synthetic Base	MIL-L-23699	(8oz) 9150-00-180-6266 (1qt) 9150-00-985-7099
95	Oil, Penetrating	VV-P-216	9150-00-261-7899
95A	Paint Aircraft Green, Polyurethane	MIL-C-46168	8010-01-141-2420
96	Petrolatum, Lubrication Vacuum Bagging	VV-P-236	9150-00-250-0926
97	Plastilube, Moly No. 3	(02307)	9150-00-141-4481
98	Polyurethane. Color Black 37038	MIL-C-83286	8010-00-482-5671
98A	Potassium Dichromate		
98B	Potting Resin Uralite No. 3148 A B	(01490)	
99	Primer, A934B	(76500)	8040-00-943-2502
100	Primer. Epoxy	MIL-P-23377	8010-00-082-2450
101	Primer, Silicone Adhesive, 1200	SS4004 (0 1139)	8010-00-701-9616

Table 1-3. Consumable Maintenance Supplies and Materials (Cont)

Item No.	Description	Ref. No. and FSCM	NSN
102	Primer, Zinc Chromate	1T-P-1757, MIL-P-8585	8010-00-297-0593
103	Prussion Blue Paste, Bearing Surface (Thinned with oil)	MIL-P-30501	8010-00-281-4105
104	Putty, Zinc Chromate	MIL-P-8116	8030-00-664-4968
105	Remover, Paint	qTT-R-248B	8010-00-515-2258
106	Remover, Paint, Epoxy System	MIL-R-81294	8010-00-926-1488
106A	Repair Kit, Infrared Suppression System	(97499) 2057067831	1560-00-103-3459
107	Resin Epoxy, Liquid EPON 828 and Catalyst Diethylenetriamine (DTA)	MIL-R-9300 O-D-1271	8040-00-822-6430 6810-00-995-4804
108	Rubber, Silicone, RTV	(71984)	8030-00-903-6566
109	Rubber, Silicone, Type I	(71983)	
110	Rubber Strip, Type II, Grade A, Soft	MIL-R-6130	9320-00-814-4583
111	Rust Stripper, (For cleaning metal prior to application of brush cadmium plate)	(13429)	
112	Sandpaper	P-101	5350-00-224-7215
113	Scotchbrite (81348)	L-P-0050	7920-00-659-9175
114	Use C115		
115	Sealing Compound, Low Adhesion (Proseal 706)	MIL-S-8784 PROSEAL 706B2 (83527)	8030-00-616-9191
115A	Sealant (Pro Seal 700)	MIL-S-38249	8030-00-723-5345
116	Sealant (Proseal 890)	MILS-8802, Class B-2	8030-00-723-2746
117	Sealer Polysulfide	MILS7124	
117A	Sealant No. EC 801	MIL-S-8802D Class B	8030-00-275-8117
118	Sealing Compound, Locking and Retaining, Single Component	MILS-22473	
118A	Sealing Compound Grade H	MIL-S-22473	8030-00-081-2330
119	Use C115		
119A	Sealing Compound Brushable CLA-1/2	MIL-S-8784	8030-00-291-8380

Table 1-3. Consumable Maintenance Supplies and Materials (Cont)

Item No.	Description	Ref. No. and FSCM	NSN
119B	Sealing Compound Brushable CLA-2	MIL-S-8784	8030-00-152-0062
119C	Sealing Compound Extrudable CLB- 1/2	MIL-S-8784	8030-00-152-0022
119D	Sealing Compound Extrudable CLB-2	MIL-S-8784	8030-00-680-2041
119E	Sealing Compound PR-1422 B-2	(83574)	8030-01-154-9254
120	Shellac, Type I, Grade B, Body 1	TT-S-300	8010-00-577-4816
121	Silicone Compound	MIS-8660	6850-00-880-7616
122	Deleted		
123	Smoother, Aerodynamic, EA 960, Type I. RP-1257-3	EA960A-B (38564)	8010-00-006-7089
124	Solvent, Dry Cleaner	P-D-680, Type I	6850-00-264-9038
124A	Solvent, Safety	MIL-S-18718	
125	Soap, Liquid	P-S-624	8520-00-228-0598
126	Soap, Toilet, Cake	P-20	8520-00-531-6484
127	Steel Wool	FF-W-1825	5350-00-240-2920
128	Stone, Sharpening (India) (Novaculite)	SS-8-736, Type II Clam B, Style 1 (81348)	5345-00-144-6894
129	Synthane Sheet (0.0175 inch thick)	MILP- 15037	5970-00-115-8838
129A	Tack Rag	(57687)	4940-01-198-9333
130	Tape, Antichafe Teflon	5490 (76381)	7510-00-923-0591
131	Tape, Dissimilar Metal Separation	MIIT-23142	7510-00-472-4021
132	Tape, Electrical, Black	MIL-I-24391	5970-00-419-4290
132A	Tape. Fastener Hook, Velcro	MIL-L-21840 (81349)	8315-00-926-4931
133	Tape, Insulation Spiral Wrap (0.006 x 1.0 inch)	MIII-18746	5970-00-935-0098
134	Tape, Masking	PPP-T-42	7510-00-290-2026
134A	Tape, Polyurethane, Pressure Sensitive	Y9265A (76381)	751000-145-0171
134B	Tape, Tuck	Whittaker Corp. Normco Material Division 600 Victoria Street Costa Mesa, CA, 92627	

Table 1-3. Consumable Maintenance Supplies and Materials (Cont)

Item No.	Description	Ref. No. and FSCM	NSN
135	Tape, Multi-Purpose, Double-Faced, Cloth	P50 (99742)	7510-00-584-2848
135A	Tape, Nylon, Wright Lon No. 7400PS	International Plastics Products, Carson, CA	
136	Tape, Pressure Sensitive, Waterproof	PPP-T-60, Type II	7510-00-663-0199
137	Tape, Teflon, Self-Adhesive	MIL-I-23594	5970-00-812-7387
138	Tape, Vinyl, No. 473 (0.003 inch thick)	(76381)	8030-00-514-0981
139	Tedlar, Bondable Film	(31708)	
140	Thinner, Acrylic Lacquer	MIL-T-19544	8010-00-527-2897
140A	Thinner, Polyurethane	MIL T-81772/AS	
141	Thread Compound	MIL-T-23361	8030-00-292-1102
142	Use C143A		
142A	Toluene-Methyl Isobutyl Ketone Mixture	MIL-T-19588	6810-00-286-0458
142B	Toluene	TT-T-548	6810-00-281-2002

Table 1-3. Consumable Maintenance Supplies and Materials (Cont)

Item No.	Description	Ref. No. and FSCM	NSN
143	Trichlorotrifluoroethane Cleaning Compound	MIL-C-81302	6850-00-033-8851
143A	Trichlorethylene, Technical	O-T-634	6810-00-184-4800
143B	Trichloroethane	O-T-620	6810-00-930-6311
144	Use C142B		
145	Varnish, Alkali-Resistant	MS35637-1	8010-00-697-7856
146	Versilube F50	MIL-S-81087	9150-00-082-5616
147	Walkway Coating, Type 1 Color 37038	MIL-W-5044	5610-00-641-0429
148	Walkway Coating, Type 2, Color 37038	MIL-W-5044	5610-00-641-0427
149	Deleted		
150	Wire, Steel (Lockwire)	MS20995C20	9525-00-221-2650
151	Wire, Steel (Lockwire)	MS20995C32	9505-00-293-4208
152	Wire, Steel (Lockwire)	MS20995C41	9505-00-603-4120
153	Xylene	TT-X-916	6810-00-598-6600
154	Use C134A		
155	Use C143B		
156	Versilock 204	1270-4300	8040-01-184-1704
157	Accelerator No. 5		8040-01-174-4684

1-14. Special Tools And Equipment.

Special tools and test equipment are listed in table 1-4 in alphanumeric order. Each tool or piece of test equipment has an item number assigned for ease of location and reference. When an item number is unknown, you may locate special tools and test equipment through alphanumeric arrangement within the table. When an item is referenced in the manual,

you may locate the item through its T designator and item number. T designators are used only with special tools and test equipment. The special tools and test equipment table is found only within this chapter; therefore the table number will not be referenced within the text. A complete listing of all special tools and test equipment authorized for use to perform maintenance on AH-1S aircraft/accessories are contained in the aircraft parts manuals.

Table 1-4. Special Tools and Test Equipment

Item No.	Part No.	Nomenclature	Usability Code Calibration	Figure Reference
1	AN8514-2	Spanner Wrench	R/IN	
2	AN8516-1	Spanner Wrench	R/IN	
3	ED0899	Test Fixture	T	7-24

Table 1-4. Special Tools and Test Equipment (Cont)

Item No.	Part No.	Nomenclature	Usability Code Calibration	Figure Reference
4	ED0933	Control Box	T	7 23
5	BH112JB53	Tester, Exhaust Gas Temperature	T	
6	BH16492	Temperature Indicator Adapter	T	
6A	BH16491	Temperature Trim Adapter	T	5-8
7	LTCT 773	Engine Sling	R/IN	
7A	M1A1	Gunner Control Quadrant	T	
8	PD1201	Power Wrench	R/IN/D/A	
9	PD1404	Power Wrench Multiplier	D/A	
10	PD1468	Adapter	D/A	5-8
11	PD1469	Socket	D/A	
11A	PD1470	Socket Collective	D/A	
11B	PD1471	Extension Socket WRN.	D/A	
12	PD2658	Adapter	D/A	
13	PD2659	Socket	R/IN/D/A	5-8
14	PD2660	Reaction Torque Adapter	R/IN	
15	S22	Bushing Tool	IN	1-4
16	S135	Packing Seating Tool	IN	
17	SWE13852-40	Adapter, Transmission	R/IN	
18	SW4738-2	Tie Down, Main Rotor		6-6
19	T100921	Jackscrow	R	
20	T100929	Jackscrow	R	
21	T101220	Rotor Hoisting Sling	R/IN	6-52
22	T101306	Splined Wench	D/A	
23	T101307	Wrench	D/A	6-52
24	T101308	Jackscrow	R/D	
25	T101338	Jackscrow	R	

Table 1-4. Special Tools and Test Equipment (Cont)

Item No.		Part No.	Nomenclature	Usability Code Calibration	Figure Reference
26	T101356	Build-up Bench		R/IN/D/A/AD	5-17
27	T101369	Support Plate		D/A	
28	T101382	Ram Adapter		D/A	
29	T101392	Wrench		D/A	
30	T101401	Alignment Scope		AD	
31	T101414	Socket Wrench		R/IN	
32	T101419	Alignment Tool Set		T	6-8
33	T101420	Holding Fixture		D/A	6-5
34	T101421	Adapter Plate		R/IN/D/A/AD	5-17
35	T101424	Holding Bar		R/IN	
36	T101440	Jack Set		AD	6-7
37	T101447	Holding Fixture		D/A	
38	T101449	Wrench		D/A	6-53
39	T101564	Plate		D/A	6-52
39A	T101560	Plate		D/A	652
40	T101456	Wrench		R/IN	
41	T101467	Alignment Scope Supp		AD	
42	T101468	Flap Stop		AD	5-35
43	T101475	Bearing Remover		RP	5-32
44	T101485	Tab Bending Gage		AD	
45	T101487	Arbor		RP	5-33
46	T101488	Wrench		D/A	
47	T101491	Bearing Puller		RP	5-31
48	T101493	Wrench		R/IN	
49	T101520	Hoist		R/IN	1-9

Table 1-4. Special Tools and Test Equipment (Cont)

Item No.	Part No.	Nomenclature	Usability Code Calibration	Figure Reference
50	T101524	Cyclic Stick Fixture	AD	
51	T101525	Tab Bender	AD	
52	T101549	Fixture	D/A	
53	T101550	Disassembly Tool	D	
54	T101551	Puller	D	
55	T101553	Holding Fixture	A	
56	T101559	Grip Spacing Gage	AD	5-35
57	T101577	Staking Tool	RP	5-67
57A	T102095	Staking Tool Set	RP	11-1E, Detail B
57B	T101873	Staking Tool Set	RP	11-1E, Detail B
58	T101600	Wrench	D/A	6-53
59	T101864	Grip Lock	R/IN/D/A/AD	5-7
59A	114-99194	TSU Boresight Device		
60	5120-EG-007	Pylon Damper Assembly Tool	A	6-22
61	204-011-178-1	Clevis Assy		
62	204-050-200-11	Ground Handling Gear		1-4
63	50-T	Sealing Iron (19838)	RP	
64	Deleted			
66	209-030-195-1	Jack Fitting, Aft	I/T	
66	209-030-245-1	Jack Fitting, Fwd	I/T	
67	209-030-405-1	Jack Fitting, Wing	I/T	
68	AN/USM-223	Multimeter	T	
69	AN/USM-303A	Multimeter	T	
70	209-070-532-1	Shield, Air Inlet		1-7
71	209-071-239-1	Wrench, Rack Release	R/IN	16-6
72	209-071-244-1	Pin, Ground Safety	R/IN	16-6
72A	209-071-275	Ejector Rack Alignment Fixture		

Table 1-4. Special Tools and Test Equipment (Cont)

Item No.	Part No.	Nomenclature	Usability Code Calibration	Figure Reference
73	2516	Arbor (Part of 7HEL153)	AD	5-55
74	2529	Pilot Bushing (Part of 7HEL153)	AD	5-55
75	2532	Fixture (Part of 7HEL153)	AD	5-55
76	2539	Post Assembly (Part of 7HEL153)	AD	5-55
76A	387991-003	Calibration Unit, Field	T	8-5
77	3091	Positioning Yoke (Squaring Plate) (Part of 7HEL153)	AD	5-55
78	42M76	Transmission Stand	R/IN	
79	7A050	Rotor Balance Kit	AD	5-38
80	7HEL054	Balancing Kit	AD	5-38
81	7HEL066	Adapter Kit, Balancing	AD	5-38
82	7HEL074	Squaring Plate	AD	5-55
83	7HEL153	Small Part Balance Kit	AD	5-55
84	76008-157	Release Wrench	R/IN	
85	76008-159	Ground Safety Pin	R/IN	
86	94251	Seal Installation Tool	IN	13-7
87	5120-AH1-001	Swashplate Alignment Tool	I	D-384
88	K747-404-1	Blade Repair Fixture	RP	5-17L
89	K747406-1	Cable Assembly	RP	5-17L
90	K747-409-1	Router Assembly	I	5-17M
91	K747-401-1	Blade Repair Tool Set	RP	
92	1733	Puller, Circuit Board	R	
93	TY9CL2STA	Gap Setting Gage		6-54B

Table 1-4. Special Tools and Test Equipment (Cont)

Item No.	Part No.	Nomenclature	Usability Code Calibration	Figure Reference
94	LT40	Bushing and Bearing Tool Kit	A/D/R	
* 95	LT40-]	Nest		
* 96	LT40-2	Ram Adapter		
* 97	LT40-3	Bushing Tool		
* 98	LT40-4	Bushing Tool		
* 99	LT40-5	Bearing Tool		
* 100	LT40-6	Staking Tool		
* 101	LT40-7	Staking Tool		
102	LT40-8	Piercing Tool	DR	
103	LT40-9	Piercing Tool	DR	
104	MIL-B-43714	Balance Trip		
105	1031-102A-351X	Vacuum Pump	RP	
106	P508	End Mill	RP	5-17M
107	K747-407-11	End Mill	RP	5-17M

USABILITY CODES

R - Removal
 D - Disassembly
 I - Inspection
 RP - Repair/Replace
 T - Testing
 A - Assembly
 IN - Installation
 AD - Adjustment
 S/P - Storage/Preservation

1-15. Torque Procedures and Requirements.

Refer to TM 55-1500-204-25/1.

1-16. Deleted.

*Part of LT40 Bushing and Bearing Tool Kit (Item No. 94).

Table 1-5. Adhesive Mix Ratio, Pot Life, and Cure Cycles

Consumable Maintenance Supplies and Materials Number	Adhesive	Activator Hardener, or Catalyst	Mix Ratio by Weight	Pot Life (Minutes)	Cure Cycle			Alternate Cure Cycle		
					Time Minimum	Pressure psi	Temperature	Time Minimum (Minutes)	Pressure psi	Temperature
C14	EC 2216 Two part See Note 1	Part "A" See Note 2	100 parts "B" 140 parts "A"	110 to 130	24 hrs. See Note 3	Firm Contact	70 to 95 Degrees F (21 to 35 Degrees C)	120	Firm Contact to 10	145 to 155 Degrees F (63 to 68 Degrees C)
C12	Metalset A-4 Two part See Note 1	Part "B"	Equal Parts "A" and "B"	30 to 40	24 hrs.	Firm Contact	70 to 95 Degrees F (21 to 35 Degrees C)	30	Firm Contact	145 to 180 Degrees F (63 to 82 Degrees C)
C13A	EPON 826 Three part Adhesive System	--	100 parts EPON 826 10 parts Vesamid 125 6 parts DTA	--	24 hrs.	Firm Contact	75 Degrees F (23.8 Degrees C)	16 hrs. *F O L L O W E D 2 hrs.	Firm Contact	75 Degrees F (23.8 Degrees C) B Y* 120 - 140 Degrees F (52.4-56.4 Degrees C)
								4 hrs.	Firm Contact	120 - 140 Degrees F (52.4-56.4 Degrees C)
C17	EA 934NA Two part Type II Class 2 See Note 1 See Note 4	Part "B"	100 parts "A" 33 parts "B"	30 to 30	24 hrs. See Note 3	Firm Contact to 10	70 to 95 Degrees F (21 to 35 Degrees C)	60	Firm Contact to 10	175 to 190 Degrees F (79 to 88 Degrees C)
C64A	Filler RP3265 2 part See Note 1	Part "B"	100 parts "A" and 100 parts "B"	3	15 - 20 Minutes	Firm Contact	70 to 75 Degrees F (21 to Degrees C)	--	--	--
C98B	URALITE #3148	--	100 parts "A" and 40 parts "B"	60 to 120	12 hrs.	Firm Contact	75 Degrees F (23.8 Degrees C)	--	--	--
C107	Adhesive EPON 828 2 part	Part "B"	100 parts "A" and 10 parts "B"	15	4 hrs.	Firm Contact	75 Degrees F (22.2 Degrees C)	--	--	--
C117A	EC 801	Part "B"	10 parts "A" and 100 parts "B"	30	24 hrs.	--	70 Degrees F (21 Degrees C)	60	--	140 - 180 Degrees F (56.4 to 82 Degrees C)

Notes:

1. Comply with manufacturer's expiration date stamped on container.
2. For EC 2216, part "A" (grey) is the catalyst or hardener, part "B" (white) is the base resin.
3. Maximum strength is obtained in 6 to 7 days.
4. Part "A" of EA934NA has a three months shelf life when stored at 80 degrees F. The shelf life decreases to two months when adhesive is stored at 100 degrees F.

All data on pages 1-25 through 1-27 is deleted

1-17. Dimensions and Tolerances.

a. Dimensions in this manual are normally in inches and decimal fractions thereof unless otherwise specified. Common fractions are used to refer to rivets, cables, raw stock, and other items supplied in fractional sizes, and sometimes for an estimated or nominal dimension which cannot or need not be more precise. Angles are stated in degrees and common fractions.

b. Tolerances on dimensions in decimal fractions of an inch can be determined by the number of decimal places, unless otherwise specified, as shown below. Tolerances on angles are in a common fraction of a degree.

TOLERANCES ON DECIMALS	TOLERANCES ON ANGLES
.XXX $\pm$ 0.010	$\pm$ 1/2°
.XX $\pm$ 0.03	
.X $\pm$ 0.1	

Section II. LUBRICATION**1-18. Lubrication.**

The lubrication chart consists of a main drawing which is a perspective diagram of the helicopter, with enlarged or detail views where required to show items clearly. (See figure 1-2). The chart shows all parts requiring periodic lubrications, except the engine and transmission and tail rotor gearboxes, which are lubricated by oil in accordance with servicing instructions and Preventive Maintenance Inspection Checklists.

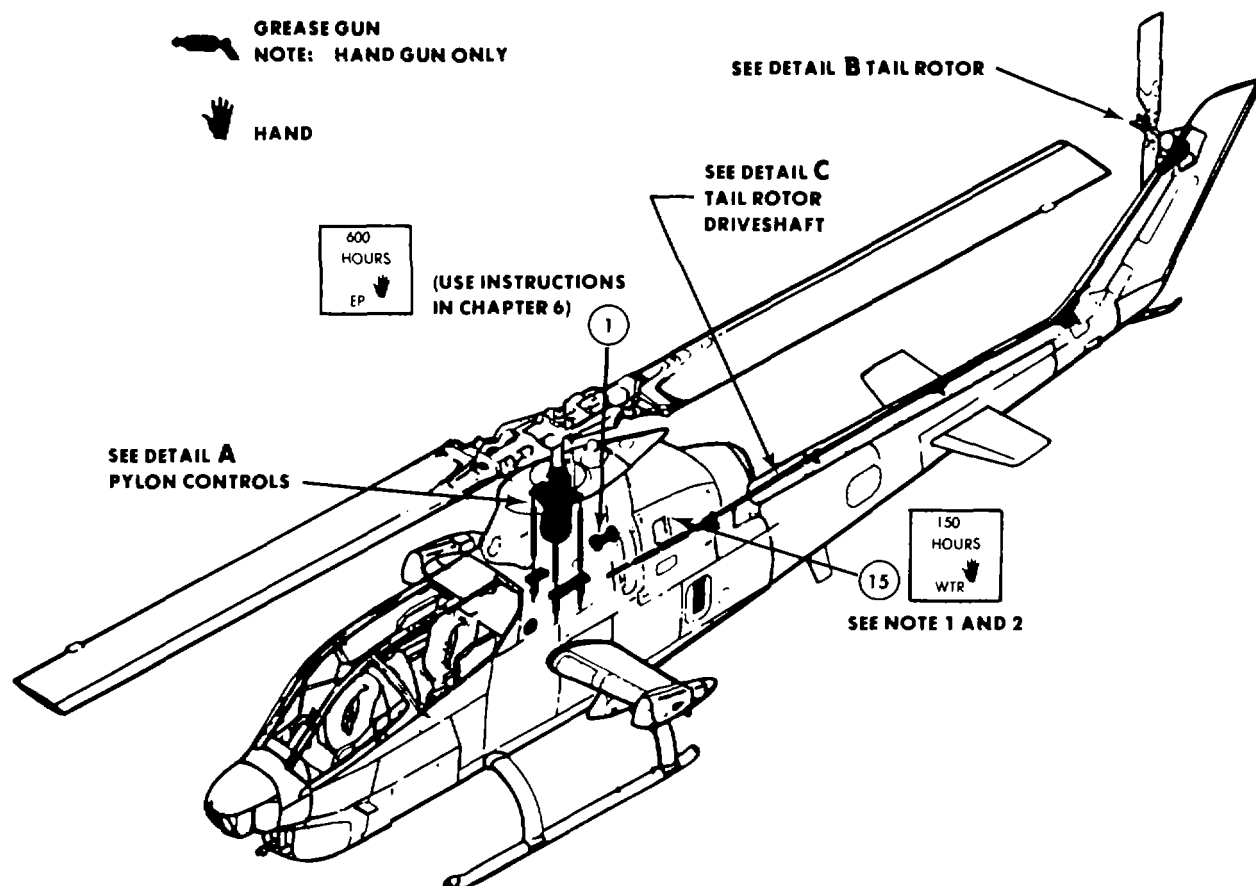
NOTE

When a change of lubricant is made, it is important that all lubricants previously used be purged from the item before the replacement lubricant is applied.

1-19. Symbols.

The lubrication chart uses symbols and abbreviations to indicate the required lubricant, method of application, and time interval for lubrication of each part listed. A key on the chart defines the meanings of symbols and abbreviations.

TABLE OF LUBRICANTS		
IDENTIFICATION LETTER	SPECIFICATION	TYPE OF LUBRICANT
WTR	MIL-G-81322	GREASE AIRCRAFT WIDE TEMP RANGE
EP	204-040-755-5 ASN TECH-3913-G1	GREASE, EXTREME PRESSURE



PARTS NOMENCLATURE KEY

1. Main Driveshaft Couplings (Note 6)	9. Hydraulic Cylinder Bearings
2. Collective Sleeve Hub	10. Tail Rotor Control Crosshead
3. Scissors	11. Transmission Quill Coupling (Note 6)
4. Collective Lever Link	12. Hanger Flexible Couplings (Note 6)
5. Collective Sleeve and Mast Splines	13. 42° Gearbox Quill Couplings (Note 6)
6. Pitch Link Assembly Pin 209-010-460 Only	14. 90° Gearbox Quill Couplings (Note 6)
7. Swashplate Bearings	15. Droop Cam Slider
8. Collective Lever Trunnions	

Figure 1-2. Lubrication Chart (Sheet 1 of 4)

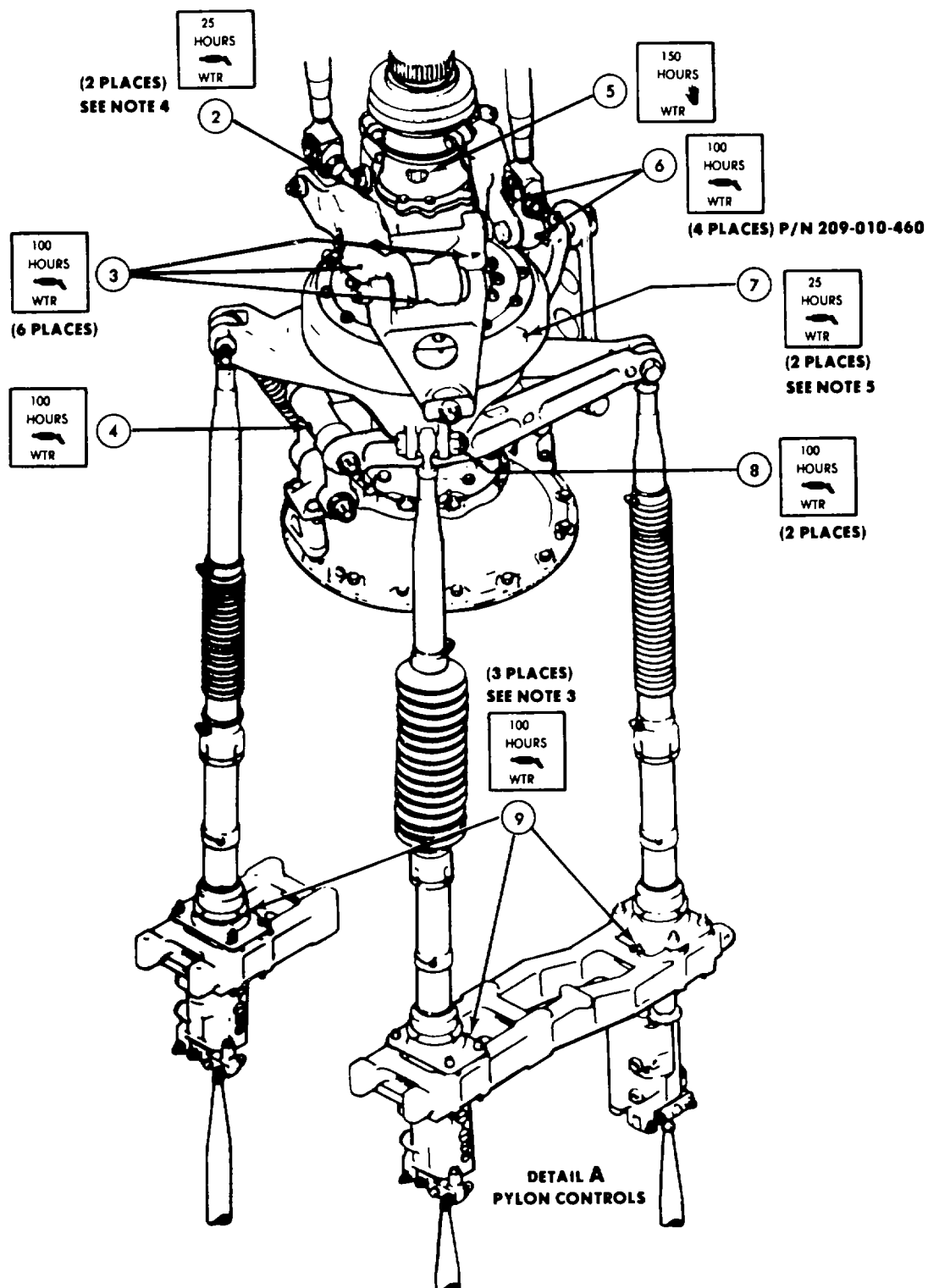
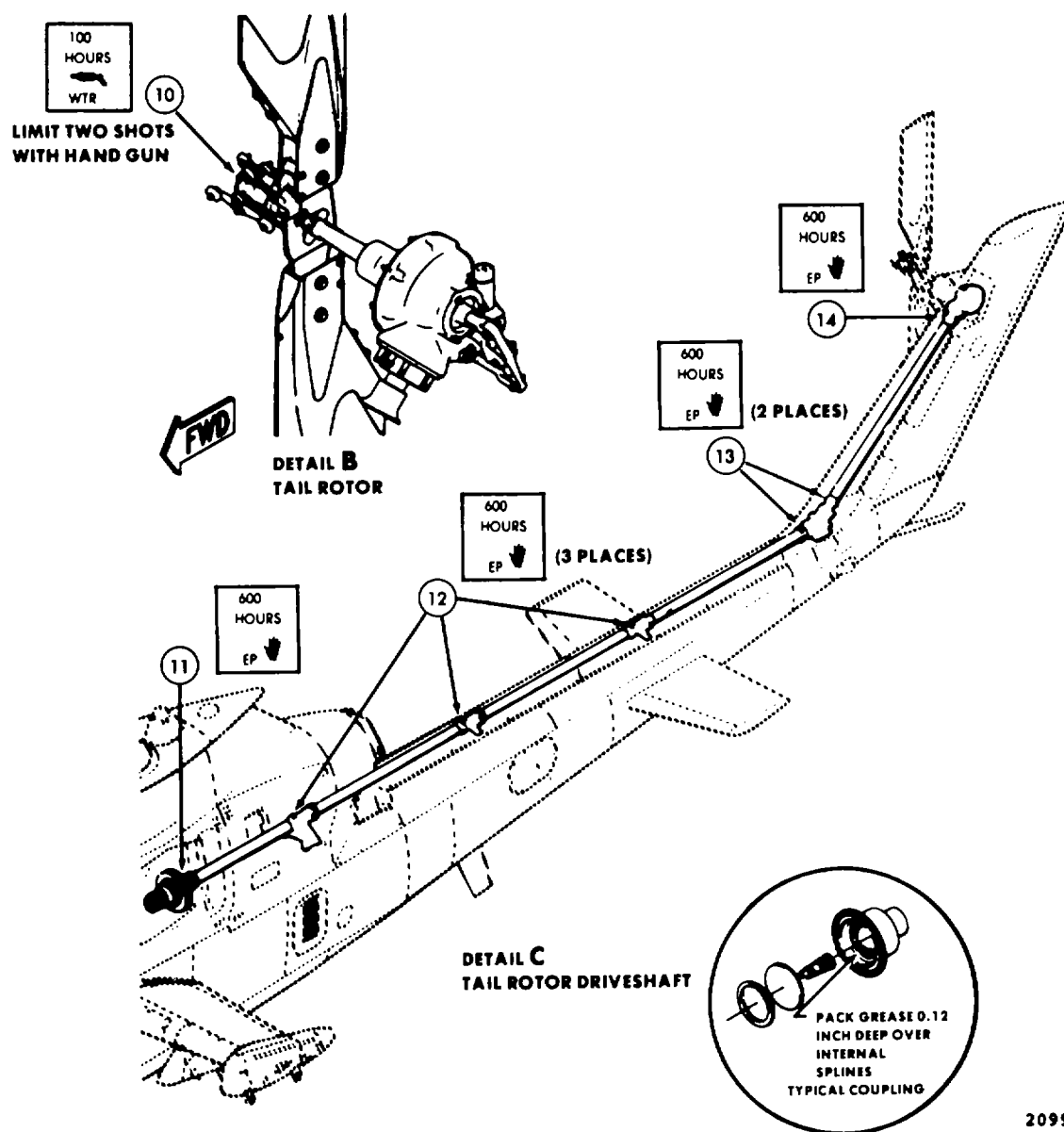


Figure 1-2. Lubrication Chart (Sheet 2 of 4)



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Figure 1-2. Lubrication Chart (Sheet 3 of 4)

Change 56 1-30A/(1-30B Blank)

NOTES:

WARNING

Failure of swashplate to accept grease requires investigation and correction prior to releasing aircraft for flight. Perform swashplate alignment check in accordance with the procedures contained in the Special Inspection section.

CAUTION

Take care not to strike side of pylon structure when oscillating cylinder.

Do not lubricate bearings PN KSP6099-1.

Nuts must be completely removed from drive link attaching pin before rotating main rotor blade. This will avoid damage to anti-drive link horn on non-rotating part of swashplate.

1. Lubricate droop cam slider (15) lightly. Wipe excess off and out of slots. Slide contacts should have minimum lubrication required to prevent dry contact without contributing to grit build-up. More frequent lubrication may be necessary depending on environment and usage factors.
2. If MIL-G-25537 grease (C67) was used previously, purge with MIL-G-81322 grease (C70).
3. Disconnect rod end from pitch control lever or swashplate horn and oscillate cylinder assembly while greasing.
4. Rotate main rotor by hand and grease at approximately 30° intervals until assembly has been rotated one full turn to ensure thorough purging of bearings. After lubrication, clean debris from boot, cut safety wire, raise boot and inspect to ensure no grease has fallen on uniball. Clean grease from uniball, if necessary. Reinstall boot and safety.
5. Disconnect drive links. Rotate swashplate, grease at 30° intervals through 360°. Continue to grease until old grease is purged. See Special Inspection section.
6. The lubrication interval for flexible couplings on seven tail rotor driveshaft couplings and two main driveshaft couplings is as follows:
  - a. Inspect and lubricate flexible couplings in main and tail rotor drive systems at time of installation of couplings on helicopter.

NOTE

This inspection and lubrication requirement will be accomplished on all couplings NEW and USED.

- b. Maximum interval from last lubrication is 600 hours (aircraft flying hours) or 12 months (from last lubrication date).
  - c. Make entry on DA Form 2408-18 to indicate date and aircraft flying hour of next inspection and lubrication due.

Figure 1-2. Lubrication chart (Sheet 4 of 4)

Section III. HANDLING, JACKING, MOORING, HOISTING AND SLING LOADING

1-20. Ground Handling.

WARNING

Before any work in cockpit area of a helicopter with explosive canopy removal system, ensure that ground safety pins are installed in pilot's and gunner's arming/firing mechanisms.

CAUTION

The structural panels shown in figure 2-2 must be installed prior to helicopter ground run, flight, or ground handling.

Ground handling includes hoisting, jacking, mooring, parking, towing, and application of external electrical power.

Pre-maintenance requirements for ground handling.

Condition	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	(T61) (T65) (T66) (T67) (T49)
Test Equipment	None
Support Equipment	Tow Bar, Maintenance Hoist
Minimum Personnel Required	Two
Consumable Materials	None
Special Environmental Conditions	None

1-21. Towing.

CAUTION

Do not move helicopter for 25 minutes after power has been removed from MD 1 displacement

gyros and CN 998/ASN-43 directional gyros. If helicopter must be moved after shutdown and before 25 minutes have elapsed, power should be reapplied to these gyros. After power has been applied for five minutes, helicopter may be safely moved.

The helicopter can be equipped for towing by attachment of two ground handling gear assemblies (6, figure 1-3) on landing skids. Each assembly consists of two wheels on offset axles, mounted to a supporting cradle, with a hand operated hydraulic pump and two rams for actuating the axle to extended position. The cradle has a fixed pin at rear end, and a spring-loaded pin at forward end, for mounting to eyebolt fittings on landing gear.

a. *Work Aid for Ground Handling Gear.* A work aid, for moving ground handling gear assemblies to and from parked helicopters can be locally fabricated. (See figure 1-4.) The device is a small tow bar, with lugs to fit on mounting pins of ground handling gear which can then be pulled or pushed on its own wheels.

b. *Installation - Ground Handling Gear.*

WARNING

Keep clear of area above handling gear as much as possible when weight of helicopter is on wheels, to avoid injury if mounting pins are not securely engaged.

(1) Position handling gear assembly, with a spring loaded pin forward, over landing gear skid between eyebolts.

(2) Release enough hydraulic pressure by turning T-handle of pump valve to allow alignment of cradle mounting pins with eyebolts. Insert fixed pin in aft eyebolt, then engage spring-loaded pin securely in forward eyebolt. (Spring-loaded pin can be moved by means of flat-headed release pin.)

(3) Install handling gear on opposite skid.

(4) Station personnel at tail skid to steady helicopter and to force tail boom down as handling wheel pumps are actuated.

(5) On both sets of handling gear, close pump valve and operate handle to extend wheels until skids are raised.

c. Towing Procedure.

(1) Check that both ground handling gear assemblies are installed and extended. (Refer to paragraph 1-21b.)

CAUTION

Towing the helicopter on ground handling gear over prepared surfaces at a gross weight in excess of 9500 pounds will cause permanent set in the aft cross tube. Towing on unprepared surfaces must not exceed 7500 pounds. Caution should be exercised when towing on unprepared surfaces at any gross weight.

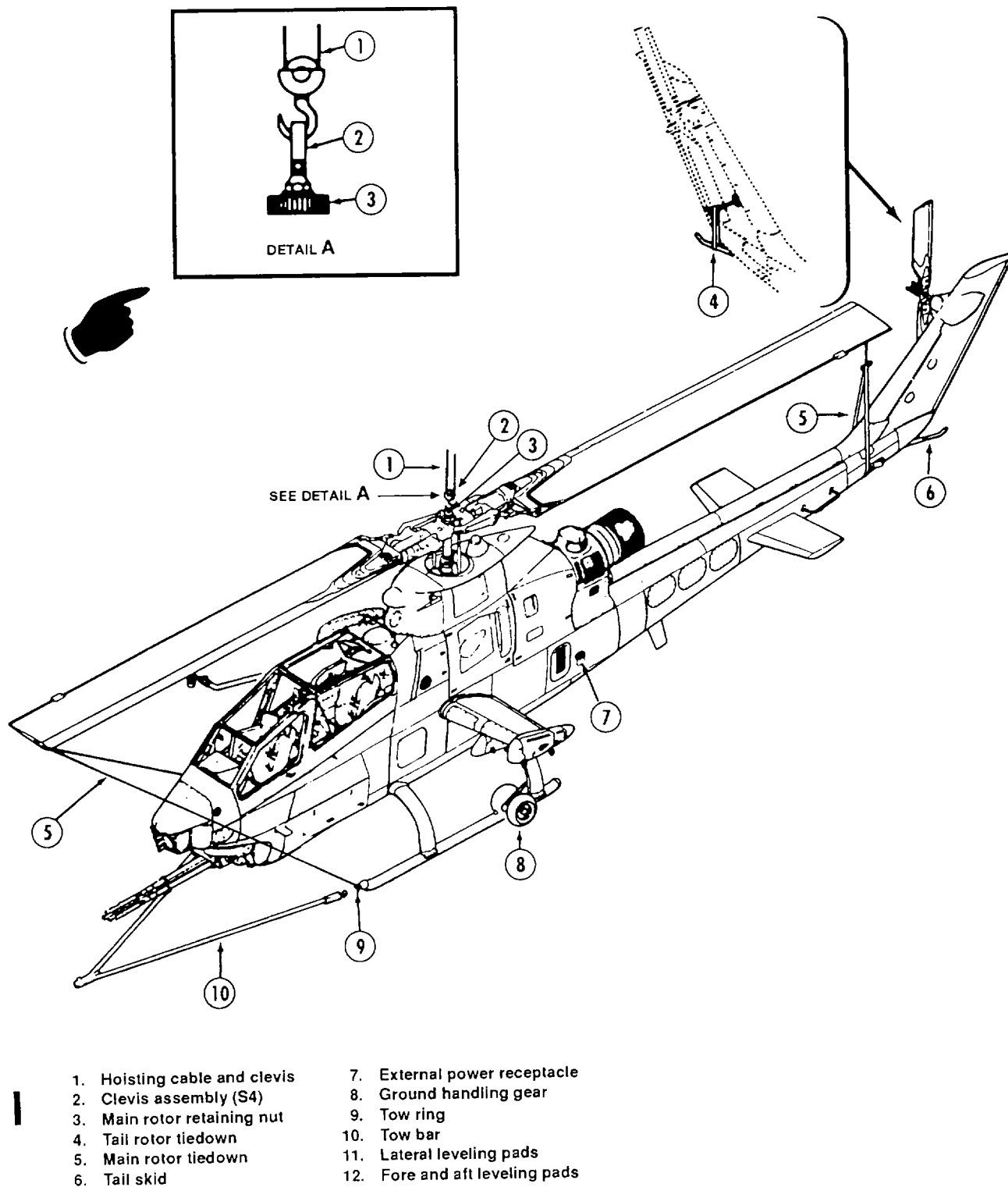
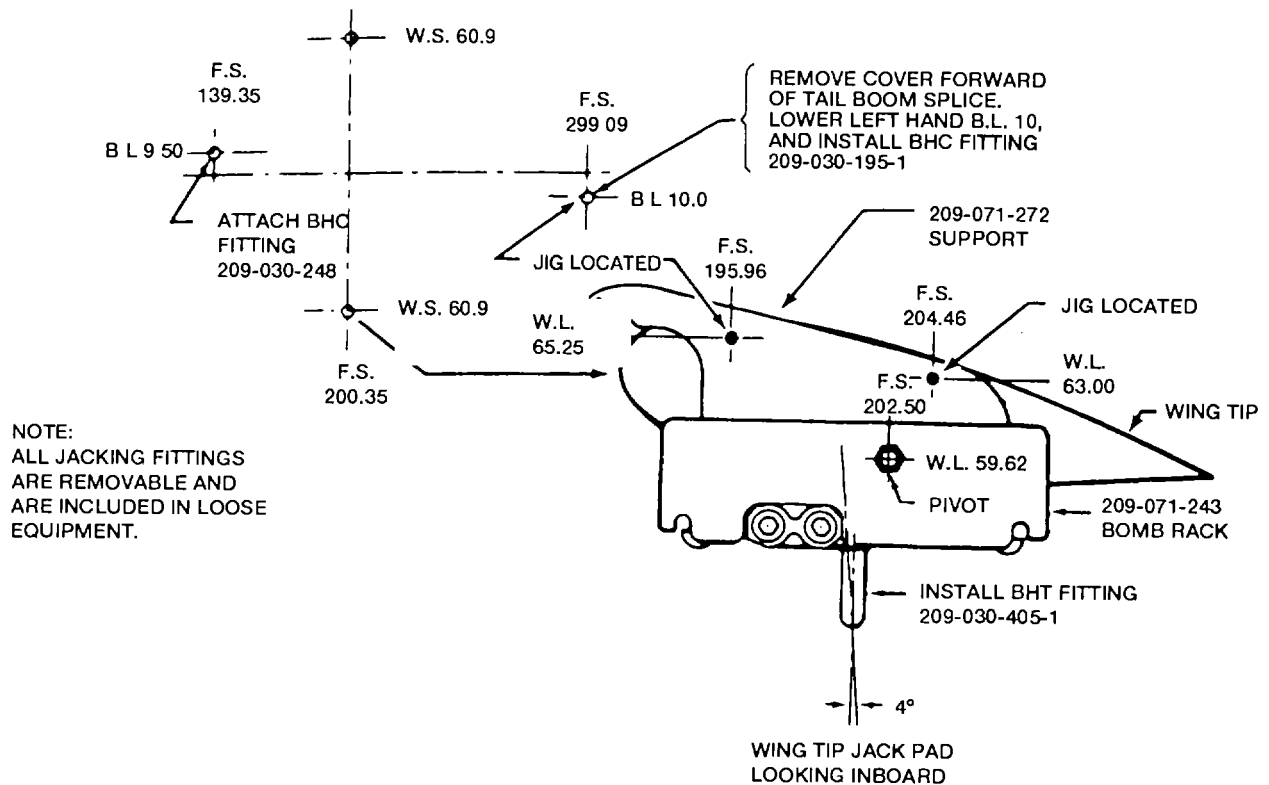


Figure 1-3. Ground Handling Diagram (Sheet 1 of 2)

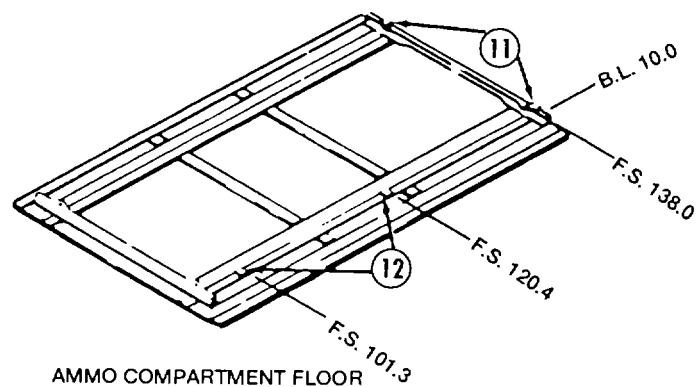
JACK PAD LOCATION DATA



NOTE:

USE SCALES UNDER ONLY THREE OF THE JACK PADS. ONE UNDER EACH OF THE WING JACK PADS AND ONE UNDER EITHER THE FORWARD OR AFT JACK POINT DEPENDING UPON THE C.G. LOCATION (e.g. IF THE C.G. IS AFT OF F.S. 200.35, USE THE AFT PAD). ALWAYS PLACE A JACK UNDER THE REMAINING JACK PAD AS A PRECAUTION AGAINST TIPPING. THIS FOURTH JACK MUST BE ADJUSTED TO CARRY NO LOAD. WHEN JACKING HELICOPTER, THE BOMB RACK SHOULD BE IN THE 4° NOSE UP ATTITUDE.

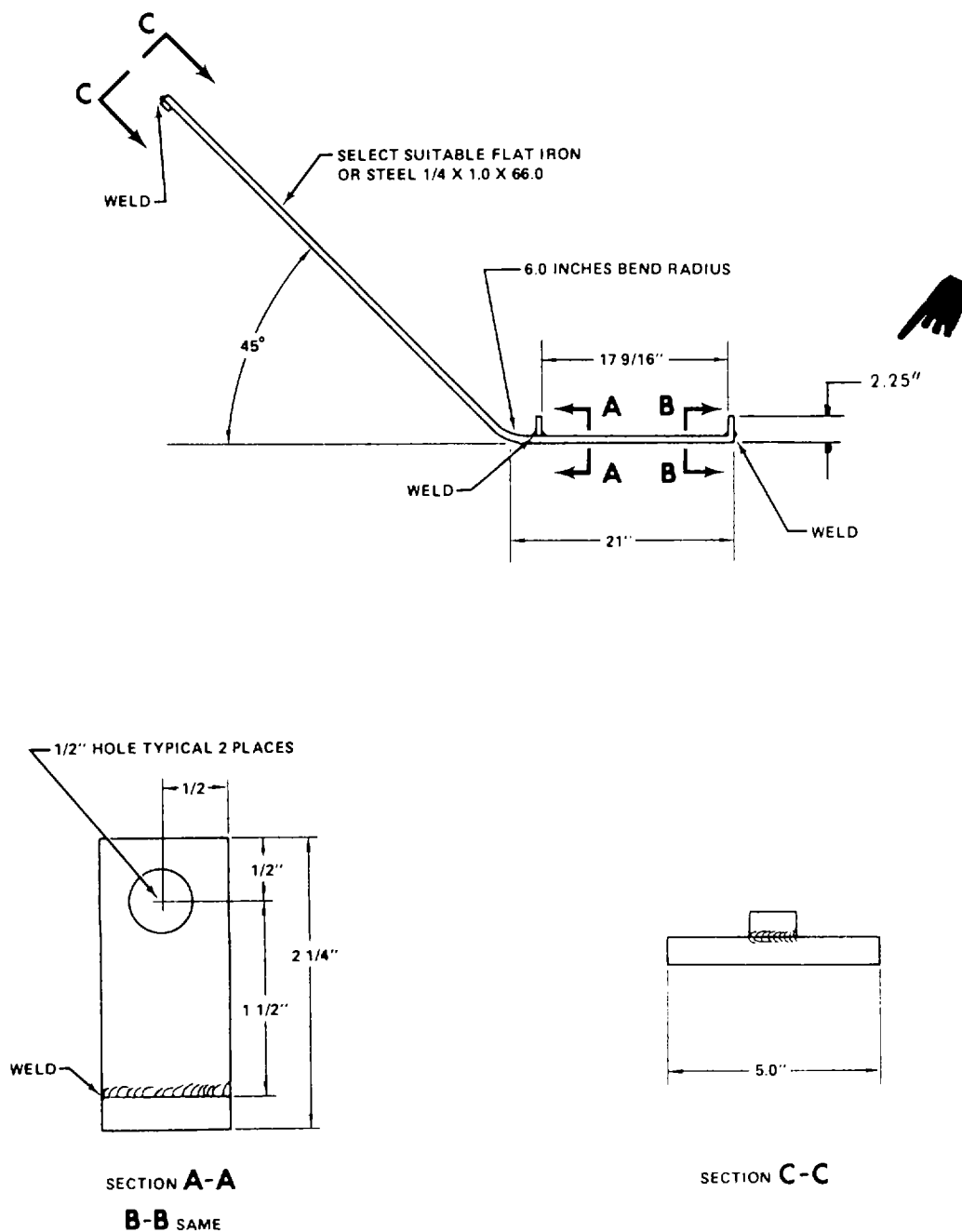
HELICOPTER LEVELING PROVISIONS



- (1) PADS FOR HORIZONTAL LEVELING LOCATED IN DEPRESSION NEAR LEFT SIDE OF FLOOR, PALLET MUST BE REMOVED.
- (2) PADS FOR LATERAL LEVELING LOCATED ON TOP OF AFT AND FORWARD AMMO PALLET TRACK

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Figure 1-3. Ground Handling Diagram (Sheet 2 of 2)



204900-187

Figure 1-4. Work air for towing ground handling gear

(2) Attach tow bar (8, figure 1-3) to rings (9) on forward ends of landing skids.

(3) Station a man at aft end of tail boom to balance helicopter on handling gear and to assist in control while towing.

d. Removal - Ground Handling Gear

(1) Station a man at tail boom to assist by steadying helicopter.

(2) Release hydraulic pressure, by turning T-handle of pump valve on each set of handling gear, allowing wheels to retract and landing skids to rest on ground. Close valve.

(3) Push release pin on front of cradle to disengage spring-loaded mounting pin from eyebolt. Pull rear pin free of eyebolt and remove handling gear assembly. Remove opposite assembly.

(4) Remove tow-bar.

1-22. Jacking.

Four jack fittings with mooring shackles attached are provided as loose equipment for use at two jack points on the fuselage and on two outboard wing pylons. (See figure 1-5). The forward jack fitting is attached by bolts under the structure of the right main beam and the ammunition compartment rear bulkhead. The aft jack fitting is screwed into a socket on the left main beam ahead of the tail boom attach splice. Wing pylon jack fittings are substituted for ejector tube assemblies in outboard armament racks.

WARNING

Do not jack aircraft in open area during windy or gusty conditions.

CAUTION

Outboard articulated pylons must be in the stowed position (four degrees up) when the helicopter is to be jacked for any purpose. Jacking fitting, (T67), must be installed.

CAUTION

All structural panels must be installed prior to jacking and leveling. Do not lower jacks until panels have been reinstalled to prevent possible permanent set to helicopter structure.

a. Remove three screws and washers from forward jack point, under ammunition compartment rear bulkhead (Station 138.7) approximately 10 inches right of center. Install jack fitting (T66), using three bolts and washers provided with fitting.

b. Select jack fitting (T65) with threaded end approximately 1.0 inch long, from shoulder to end. Install fitting in aft jack point socket, on bottom of left main beam just forward of tail boom.

c. Remove outboard armament pods. (Refer to Chapter 16.) Check that two remaining jack fittings (T67), for wing jack points, are similar to fitting used in step (2) except for shorter threaded ends approximately 0.49 inch long.

WARNING

Ejector cartridges must be removed before installing jack fittings in outboard wing pylons.

d. At each outboard rack, remove lockwire and remove complete ejector tube assembly and install jack fitting.

e. Place jacks under four jack point fittings. If removing landing gear, align all jacks with inboard legs parallel at approximately 27 degrees to axis of fuselage.

CAUTION

High center of gravity makes it imperative that all jacks must be raised evenly.

f. Raise helicopter slowly and evenly.

g. Observe the following precautions while helicopter is on jacks.

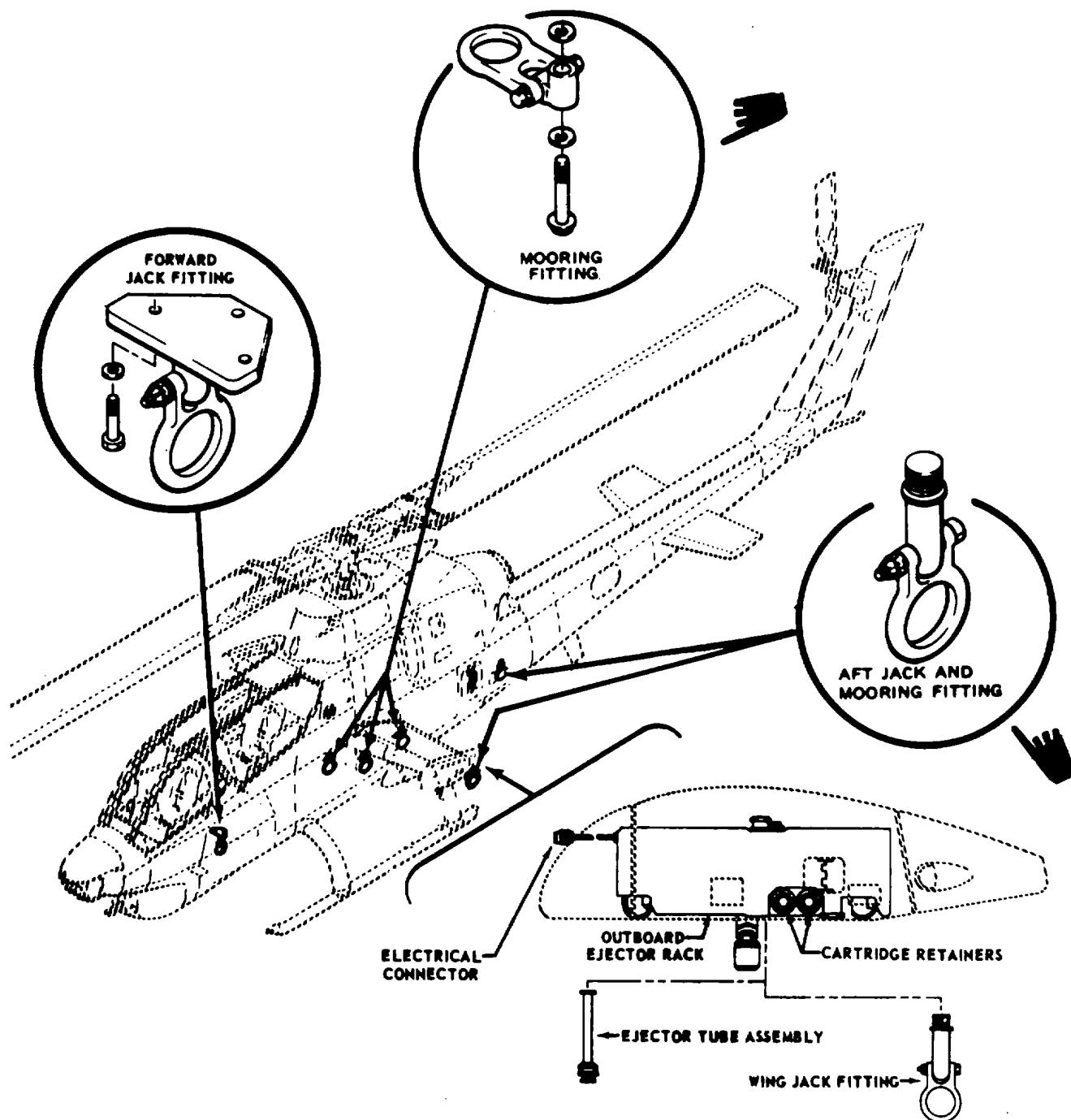


Figure 1-5. Jacking and mooring fittings

(1) All personnel in immediate area shall exercise extreme caution not to bump or otherwise disturb helicopter while raised or supported on jacks.

(2) Personnel shall not climb into or onto helicopter while raised or supported on jacks.

(3) Rope off area around helicopter and prominently display warning signs stating CAUTION: THIS HELICOPTER IS ON JACKS.

(4) After necessary work, lower helicopter slowly and evenly. Remove jacks.

(5) Remove jack fittings from outboard pylon ejector racks. Reinstall ejector tubes. Torque to a range of 290 TO 310 INCH-POUNDS. Reinstall lockwire. Reinstall cartridges. (Refer to chapter 16.)

(6) Remove forward jack fitting with bolts and washers. Reinstall screws with washers in jack point bolt holes.

(7) Remove aft jack fitting. Return all fittings to loose equipment.

h. Install outboard armament pods. (Refer to Chapter 16.)

1-23. Parking.

Parking as used in this manual, is defined as condition in which helicopter will be secured while on the ground. Direction of heading and location of helicopter is normally determined by ease of maintenance and servicing; to allow removal of any one helicopter from parking area, and to permit ready access or mobile fire fighting equipment within area. Although parking arrangements may vary according to local facilities, the following general procedure should be observed.

a. Double-row lateral parking, with front and rear helicopter of each double row placed tail to tail, should be used where possible.

b. Helicopter should be parked not less than 750 feet from ends of center line of nearest runway, and not less than 250 feet from edge of connecting taxi strips.

c. Width of fire lanes between each double row should be slightly greater than rotor span of parked helicopters. This spacing will facilitate removal of any helicopter from parking area, as well as permitting

greater ease of movement of mobile fire fighting equipment within area.

d. Fire lanes having a minimum width of 50 feet should be provided to cross main fire lanes and isolate blocks of 10 helicopters or less.

e. Helicopters parked on concrete ramps or aprons should be placed to utilize mooring rings when available.

f. Parked helicopter will be provided with a static ground.

g. Under normal conditions park the helicopter as follows:

(1) Park helicopter on a level surface, whenever possible, so that load will be evenly distributed on landing gear.

(2) Retract or remove ground handling wheels to allow helicopter to rest on landing skids.

NOTE

If helicopter is to remain parked more than 14 days, use suitable blocks or shoring to raise skids slightly off supporting surface.

CAUTION

Do not use a rope to pull rotor blades in- to alignment for tiedown. Damage to leading edge may result. Manually position rotor blades.

(3) Align main rotor blades fore and aft and horizontal, and tail rotor blades parallel to vertical fin.

NOTE

If the collective stick is positioned in other than full down, turn blades in the direction of rotation and fully lower collective prior to main rotor tiedown.

NOTE

Use 1/2 inch polyester rope, NSN 4020-00-630-4873, for blade tie-down. Reference TM 1-1520-250-23-1 for additional information.

(4) Engage hook of main rotor tie-down (3, figure 1-3) in hole of fitting on each end of rotor blade and position blade above tail boom. Pull on tiedown to remove the spanwise slack from the rotor system and secure rotor by wrapping tiedown rope firmly around tailboom (see figure 1-3). Tie forward tiedown rope to tow rings on landing gear skid.

(5) Attach tail rotor tiedown rope (4) to tail rotor and secure to loop provided on side of vertical fin. Additional security of the main rotor tiedown can be accomplished by inserting an AN416-2 safety pin through a 0.060 inch hole drilled through the hook of the main rotor tiedown. The hole is drilled perpendicular to the plane of the handle 1/4 inch from the insertion end of the hook. Secure the safety pin to the hook handle with a six inch piece of NAS1455B30-6 chain and safety wire. Insert the pin through the hook after inserting the hook through the rotor blade fitting.

WARNING

Before entry into cockpit area, ensure that canopy removal system ground safety pins are installed in pilots and gunners arming/firing mechanisms.

(6) Check that all switches are OFF and external power disconnected, and close all doors and access plates. Lock ignition and canopy doors. Remove keys.

(7) Install pitot tube cover (2, figure 1-6), engine air inlet shield (4), and exhaust cover (3).

NOTE

If required and available, install canopy covers (1).

h. Under turbulent weather conditions park the helicopter as follows:

CAUTION

Structural damage can occur from turbulent weather conditions. Anchoring and mooring should be accomplished when wind is expected to exceed 45 knots per hour. When possible, helicopter should be evacuated to a safe weather area if a tornado, hurricane, or wind condition above 75 knots is expected.

(1) Park helicopter.

(2) Moor helicopter in accordance with paragraph 1-24.

(3) Fill fuel cell to capacity if time permits.

(4) Disconnect battery. Secure all loose equipment. Moor all ground support equipment at safe distance from helicopter.

(5) After high winds have passed, inspect helicopter for damage from flying objects.

1-24. Mooring.

1-24A. Mooring Hardware (Table 1-6).

1-24B. Mooring Procedure On Unpaved Surface.

Mooring is a process of securing parked helicopter to avoid damage by high winds or turbulent weather. Mooring fittings are provided on the four jack pad fittings. Where properly spaced rings are not available, mooring can be accomplished with a standard mooring kit.

a. Park helicopter on unpaved parking area, headed in direction of highest winds forecast.

b. Screw anchor rod (1, figure 1-7) into arrow (3).

c. Slip driving rod (2) over anchor rod and into socket of arrow.

d. Turn cam of driving rod so that prongs of arrow are not spread by driving.

e. If necessary, loosen surface of ground.

f. Position driving rods as shown in figure 1-7.

g. Drive each arrow into ground until driving rod handle is approximately three inches above surface.

h. Rotate driving rod handle approximately 90 degrees and give it a sharp blow to spread arrow prongs.

i. Return driving rod to driving position and remove it from anchor rod.

j. Align squared socket of eye (4) with squared end of anchor rod. Fit in place and tighten knurled nut.

k. Set arrow prongs by pulling up on eye assembly.

CAUTION

Do not overtighten tie-down cable or rope. Overtightening may cause the mooring fitting bolt to bend.

l. Secure helicopter with quarter inch cables or one-inch manila rope.

NOTE

When anchor rods are no longer needed, they may be removed by turning eye assemblies counterclockwise, leaving arrows in ground.

1-24C. Mooring Procedure on Paved Surface.

a. Position the aircraft on the mooring pad with the longitudinal centerline of the aircraft directly above and parallel to the longitudinal axis of the pad as shown in figure 1-7A. The aft mooring ring is to be located directly opposite the center pair of mooring points on the pad as illustrated.

NOTE

It will be necessary to remove the fairing which covers the forward jack-point, by removing the flush head bolts which secure the fairing to the aircraft. With the fairing removed, install the stainless steel jack-point in the uncovered recess, as described in this TM. With the jack-point installed, install the mooring clevis to the jack-point as described in this TM. A mechanics tool kit will be required.

b. Place the hook-ends of the two forward chains into the mooring clevis. Adjust the chains with the chain adjusters provided on each chain. Chains should be adjusted to the point where the slack has been removed.

c. Remove the fairing covering the aft jack-point. Four flush head bolts must be removed. With the fairing removed install the jack-point in the uncovered recess and install the aft mooring clevis on the jack-point as described in this TM. A Frearson head screw driver will be required.

d. Place the hook-ends of the two aft mooring chains into the aft mooring ring. Place the hook-end of the two center mooring chains into the most aft of the three D- rings provided under the aircraft wings. Adjust the chains with the chain adjusters provided with each chain. Chains should be adjusted to the point where the slack has been removed.

NOTE

It is highly recommended that AH-1 helicopters be flown with the mooring hardware installed at all times to permit a rapid response to weather emergencies, unless it is the commander's decision that to fly without the fairings would significantly impact the mission.

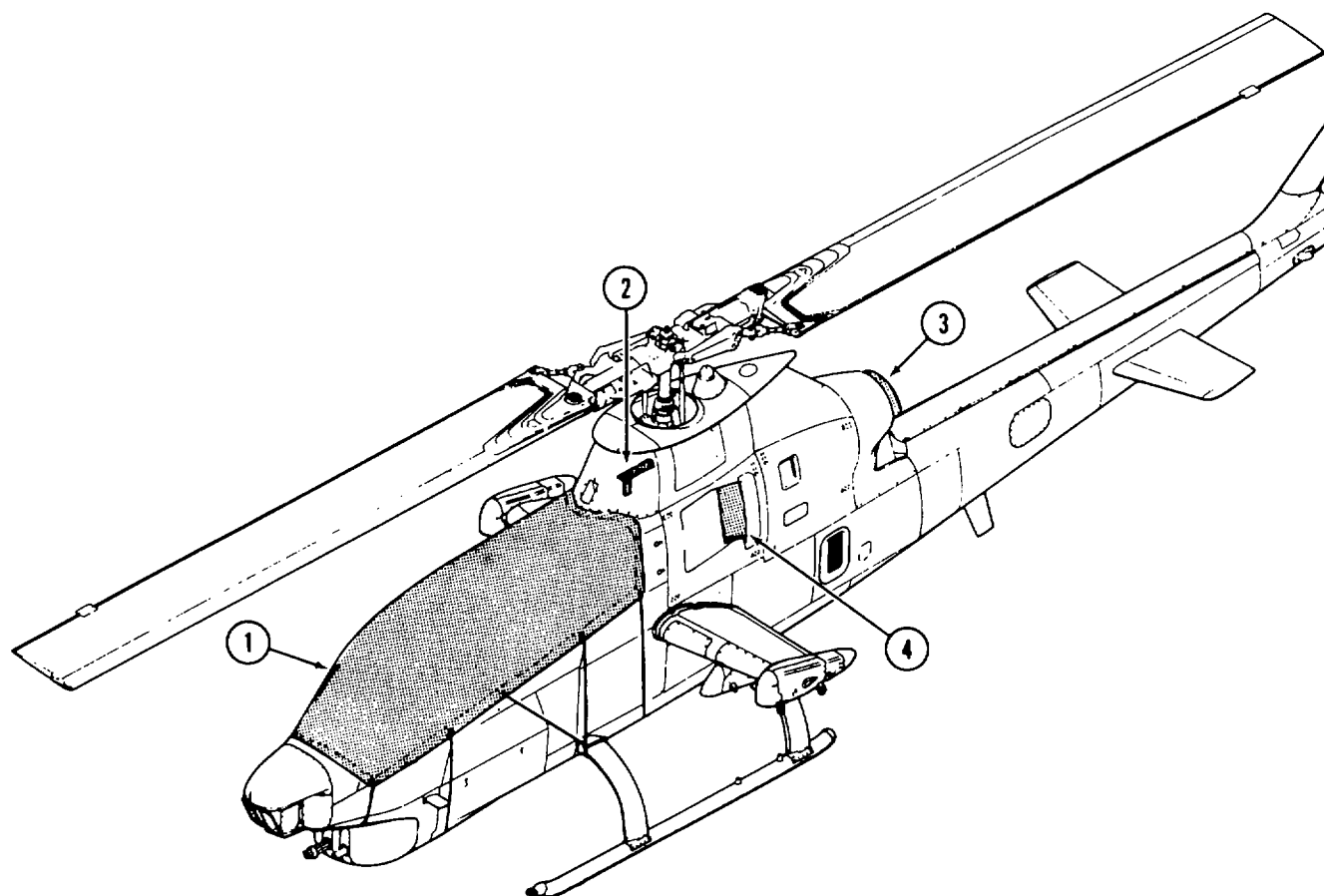
NOTE

The mooring hardware is not considered flyaway equipment. All active mooring points shall be equipped with this hardware.

MOORING HARDWARE

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>P/N</u>	<u>NSN</u>	<u>QUANTITY</u>
1	CHAIN ADJUSTER	MB-I	1670-00-212-1149	6
2	CHAIN WITH HOOK	FOR MB-1	4010-00-516-8405	12

TABLE 1-6. MOORING HARDWARE CHART



1. Canopy Cover	3. Exhaust Cover
2. Pitot Tube Cover	4. Engine Air Inlet Shield (2)

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Figure 1-6. Covers diagram

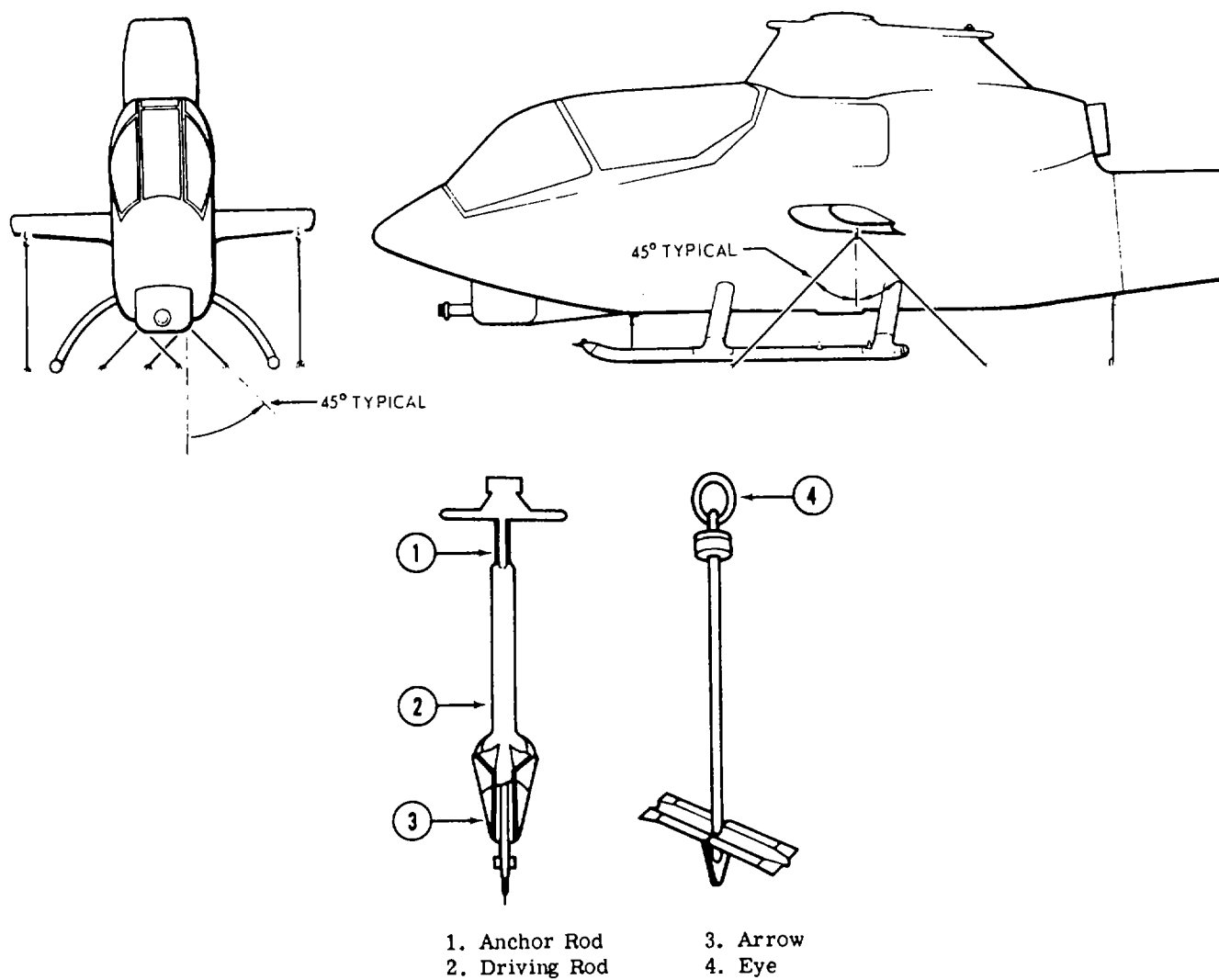


Figure 1-7. Mooring diagram

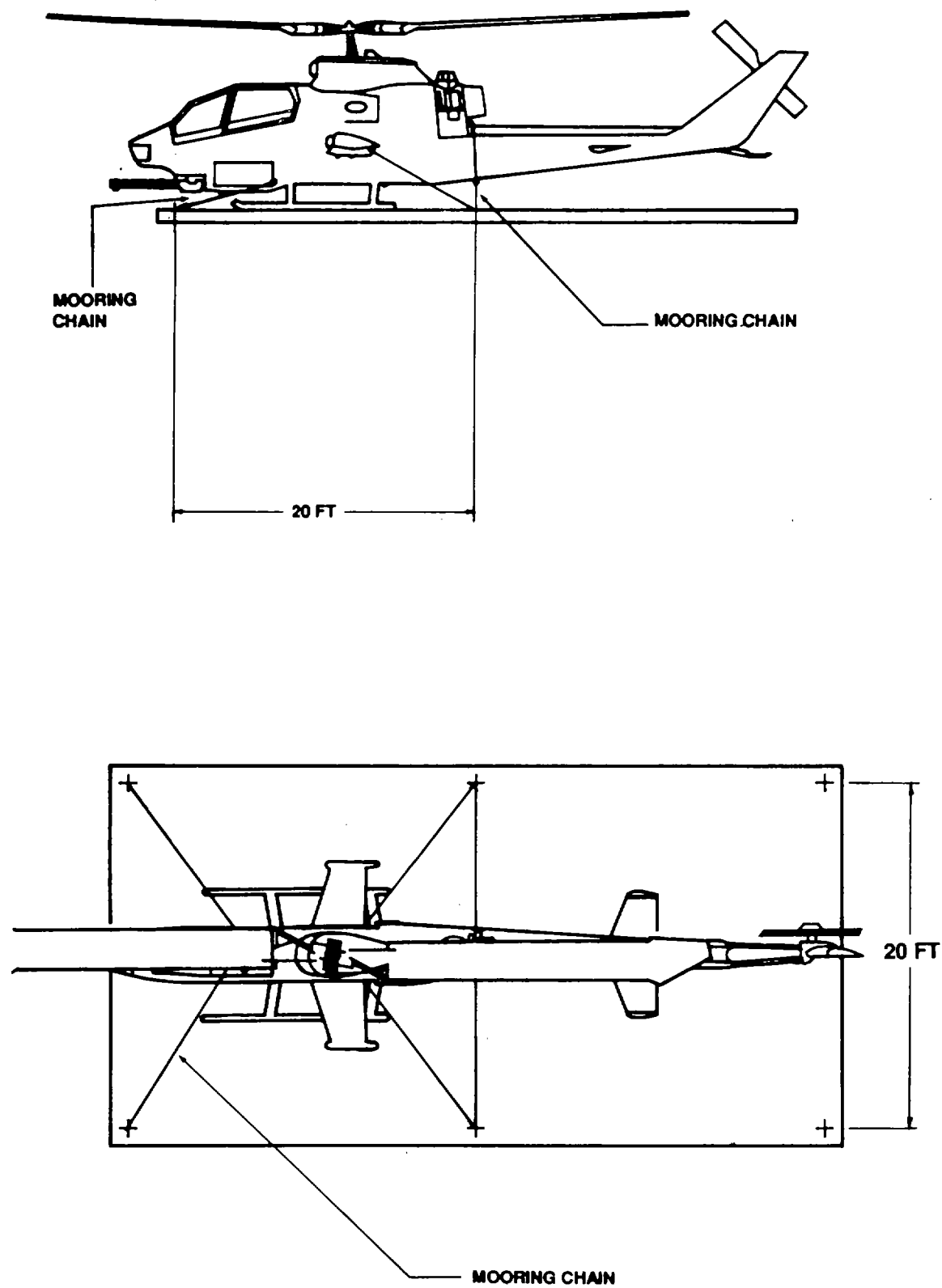


Figure 1-7A. AH-1 Paved Surface Mooring Configuration

Change 62 1-40A/(1-40B blank)

1-25. Hoisting

The entire helicopter can be lifted by a suitable hoist attached to an eye provided on the main rotor retaining nut at top of the mast. This hoisting point can also be used to lift out the mast assembly (with or without the main rotor and rotating controls assemblies), or the complete mast and transmission assembly.

a. Hoisting Helicopter.

(1) Attach a hoisting cable and clevis or clevis assembly (T61) to lifting eye of main rotor retaining nut (figure 1-3). Connect a suitable hoist and take up slack.

(2) Station a man at tail skid to steady helicopter against swinging or turning when hoisted. If lifting beyond reach, attach a suitable rope for this purpose.

(3) Hoist slowly, maintaining a steady lifting force.

b. Maintenance Hoist. (Figure 1-8). A maintenance hoist (T49), designed to mount on left side of the fuselage, is provided for use in removing and installing main rotor, mast, transmission, or engine assemblies. The hoist consists of a tube assembly, a hub assembly, and attaching parts. The tube assembly has a hand-operated winch, with cable, pulleys and weighted hook. The hub is a socket made from larger diameter tubing, with attachment fittings, sleeve bearings, and a platform to aid the operator. The tube assembly rests on a steel ball in the hub, and can be rotated by means of the crossbar handle to move the hook into position.

(1) Installation. (Figure 1-8).

(a) At left side of fuselage, remove two screws and washers from bolt holes of upper hoist supports, located just ahead of engine forward firewall. Remove six screws and washers from lower support bolt holes, located in vertical rows of three ahead of and behind landing gear aft crosstube.

NOTE

Prior to installation of maintenance hoist inspect upper hoist support visually for cracks and other damage which may affect function of the support. Replace upper hoist support if damaged.

(b) Install bracket (10) above landing gear cross- tube, using six bolts and washers instead of screws removed in preceding step.

(c) Insert lower end of tube assembly (1) into hub assembly (8). Align lower fitting of hub in support bracket and install pin (9).

(d) Raise hoist assembly. Attach upper fitting of hub to upper supports, using two bolts and washers instead of screws previously removed.

WARNING

Handle hoist with care to avoid personal injury or damage to aircraft.

(2) Removal.

(a) Detach hub fitting from upper supports by removing two bolts and washers.

(b) Carefully swing top of hoist assembly outward and down until resting on ground. Remove tube assembly (1) from hub assembly (8).

(c) Detach lower fitting of hub from bracket (10) by pulling out pin (9). Remove hub assembly.

(d) Remove bracket with attaching bolts and washers from fuselage. Bracket can be attached with pin to hub for convenience.

(e) Reinstall screws and washers in bolt holes of upper and lower support points.

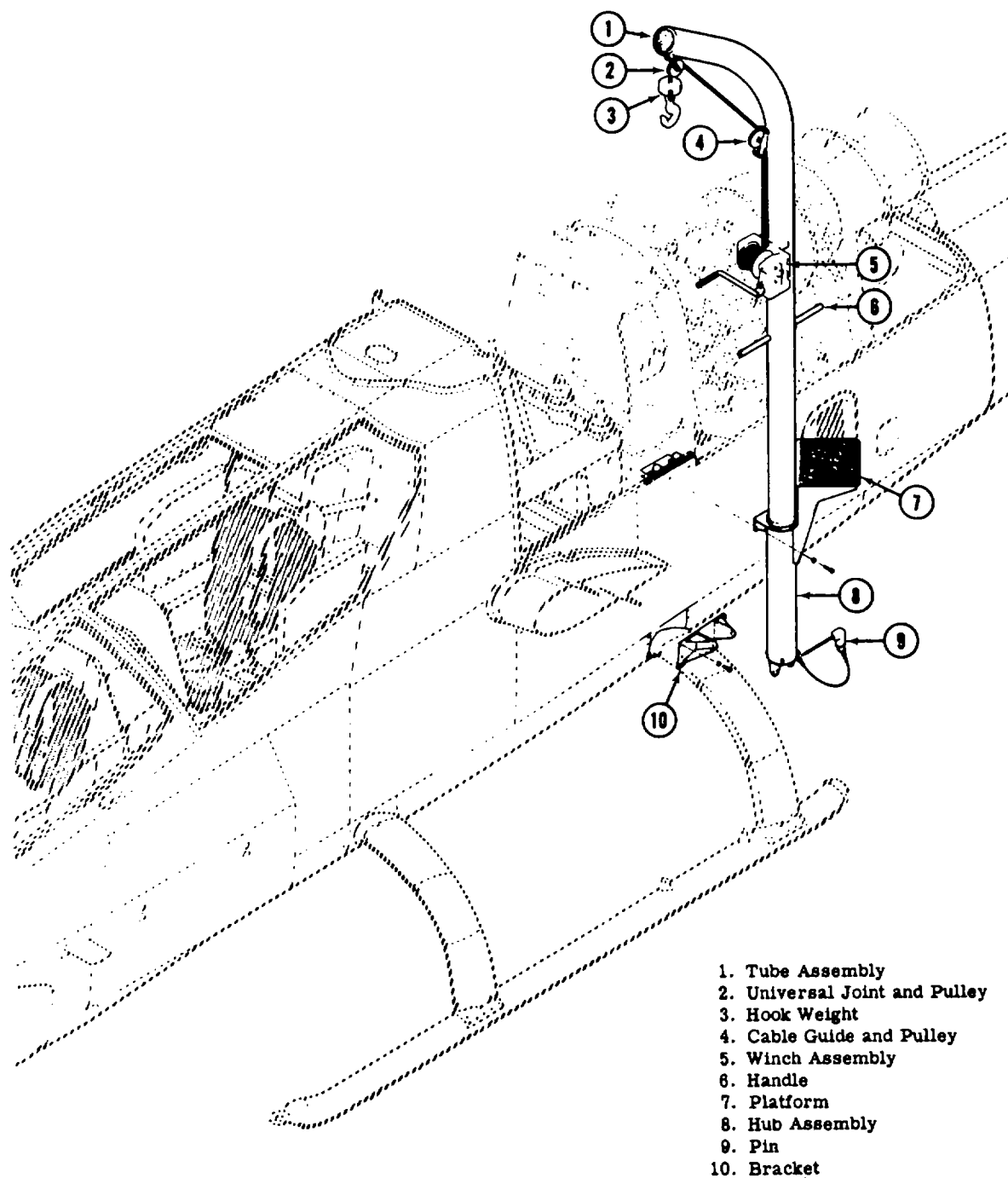
1-26. Leveling.

Leveling lugs located in the ammunition compartment floor are used with a bubble protractor when it is necessary to level the helicopter. Pallet must be removed for access. For fore-and-aft leveling, use two lugs (10, figure 1-3), located in depression near left side of floor. For lateral leveling, use two lugs (9), located on top of aft ammunition pallet track. Apply jacking procedures to correct helicopter position.

1-26A. Leveling Pads Replacement.

CAUTION

Do not attempt to replace leveling pads if structure in pylon area of helicopter is damaged. Send helicopter having damaged pylon structure to depot.



209900-28

Figure 1-8. Maintenance hoist T101620

NOTE

Any or all leveling pads may be replaced as necessary.

- a. Open transmission cowl assembly (17, figure 2-3).
- b. Check structure in pylon area including lift beam (12, figure 2-69), pylon support (10) and fifth mount support (14).
- c. Place bubble protractor in fore-and-aft direction on lift beam (12).

NOTE

Fore-and-aft member of pylon support (10) may be used instead of lift beam (12).

- d. Jack up helicopter. Refer to paragraph 1-22.
- e. Adjust jacks to level helicopter in fore-and-aft direction. Use bubble protractor to check level.
- f. Place bubble protractor in lateral direction on lift beam (12) or fore-and-aft member of pylon support (10).
- g. Adjust jacks to level helicopter in lateral direction. Use bubble protractor to check level.
- h. Repeat steps c and e through g to make sure helicopter is level.
- i. Open ammunition compartment doors (8, figure 2-3).
- j. If either or both fore-and-aft leveling pads are damaged or missing, replace as follows:

- (1) Remove any remaining portion of leveling shim assembly.

- (2) Use scotch-brite (CI13) to clean area.

- (3) Use adhesive (C12) to bond new leveling shim assembly in place. Allow adhesive to dry.

- (4) Place bubble protractor on leveling pads. Check fore-and-aft level of leveling pads.

- (5) As necessary, peel lamination from shim until leveling in fore-and-aft direction is accomplished.

- k. If any or all lateral leveling pads are damaged or missing, replace as follows:

- (1) Remove five screws and remove ammunition floor track having damaged or missing leveling pads.

- (2) Place new ammunition floor track in position and attach with five screws.

- (3) Place bubble protractor on leveling pads of new ammunition floor track. Check lateral level of leveling pads.

- (4) Place shim under ammunition floor track as necessary and repeat steps (3) and (4) until leveling in lateral direction is accomplished.

- l. Check leveling in both directions to insure that it is satisfactory.

- m. Remove bubble protractor and other tools. Lower helicopter slowly and evenly.

- n. Remove jacks (paragraph 1-22).

- o. Close access doors.

1-27. Retrieval of Disabled Helicopter

(Refer to FM 55-413).

1-28. Application of External Power.

An external power receptacle (5, figure 1-3) for application of external 28V DC power is located in left side of the fuselage at station 274, covered by a spring-loaded access door. When the door is open, a switch causes the EXTERNAL POWER caution panel segment to be lighted. Battery switch should be at OFF position. Use a 28V DC power source capable of delivering 650 to 800 amperes. When cable connector from power

source is connected to the receptacle, the external power relay in the helicopter DC circuit will be energized and power will be supplied to the main bus for distribution.

NOTE

If battery charge is less than 24 volts, external power may be required to avert hot starts.

Section IV. INSPECTION REQUIREMENTS**1-29. General Information.**

This section contains complete requirements for special inspections, overhaul and retirement schedule, and standards of serviceability applicable to the aircraft. Daily inspections are contained in TM 55-1500-220-PMD, Preventive Maintenance Daily. Phased maintenance inspections are contained in TM 55.1500-220-PM, Phased Maintenance Checklists. The inspections prescribed in this chapter shall be accomplished at specific periods by aviation unit maintenance activities with the assistance of intermediate maintenance activities when required.

a. Special inspection frequencies that are based on flight hours may be accomplished within a plus or minus ten percent tolerance from the nominal time when such inspections would ordinarily be due.

b. Special inspections based on calendar times will have a tolerance of plus or minus ten percent not to exceed thirty days.

airframe inspection intervals. Refer to DA PAM 738-751 for applicable forms, records, and worksheets required for these inspection intervals. Typical of this type inspection items are:

a. An inspection which is contingent upon specific conditions or incidents that arise, and only because of these conditions or incidents, immediate inspection is required to ensure safe flight. Typical of these conditions are hard landings, overspeed, and sudden stoppage.

b. Inspection of components or in frame on a calendar basis: first aid kits, weight and balance check, aircraft inventory, etc.

c. Refer to DA PAM 738-751 for applicable forms, records, and worksheets.

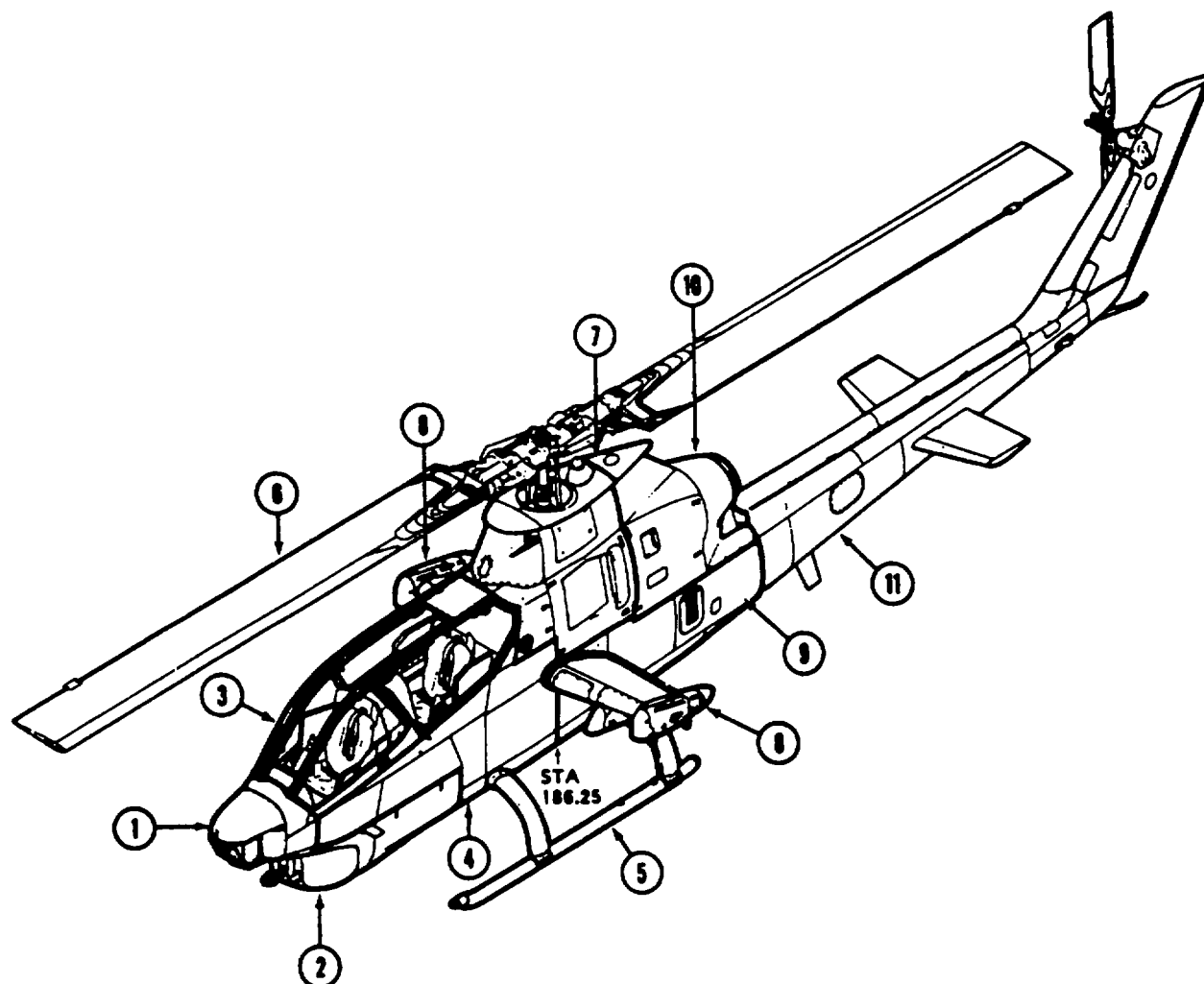
CAUTION**1-30. Standard of Serviceability.**

Standards of Serviceability to be utilized in the day-to-day inspection and maintenance of the aircraft can be found as fits, tolerances, wear limits, and specifications in the aircraft maintenance manuals. Standards of serviceability for transfer to aircraft are contained in TM 55-1500-326-25.

1-31. Special Inspection.

This section supplements the scheduled inspections as contained in TM 55-1500-220-PM Phased Maintenance requirements. This section also includes inspection of items which are required to be inspected at intervals not compatible with airframe operating time or

When components are being removed from an aircraft, all inspections required by the next phase maintenance inspection must be accomplished prior to either immediate re-use or storage. Upon installation, the component will be inspected in accordance with the current phase (either that phase the receiving aircraft is in or if in between phase, the last phase performed). This will ensure that a re-used component will not overfly any PM inspections, and that it will be properly interfaced with the receiving aircraft phase sequence.



AREA NO. 1:	Nose Area	All surfaces, components and equipment in nose compartment and on exterior ahead of forward edge of gunners door.
AREA NO. 2:	Turret Area	All surfaces, components and equipment inside and outside of armament turret and ammunition compartment.
AREA NO. 3:	Gunner and Pilot Area.	All surfaces, components and equipment inside and outside the gunner-pilot compartment. Includes items stowed in cabin aft of pilot's seat.
AREA NO. 4:	Lower Forward Fuselage Area	All surfaces, components and equipment contained in, and on exterior of, lower forward portion of fuselage between ammunition compartment and aft cabin bulkhead (Sta 186.25) except forward fuel cell.
AREA NO. 5:	Landing Gear Area	All surfaces, components and equipment which constitute the landing gear and attachments.

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Figure 1-9. Inspection area diagram (Sheet 1 of 2)

AREA NO. 6:	Main Rotor Area	All components of the main rotor hub and blade. Does not include the mast.
AREA NO. 7:	Pylon Area	All surfaces, components and equipment contained in, and on the exterior of, the hydraulic and transmission compartments to the bottom of the transmission. Includes transmission cowling, mast, mounts, rotating controls, and main (input) drive shaft.
AREA NO. 8:	Wing Area	All surfaces, components and equipment in and on the wings. Includes all external fittings and attachments.
AREA NO. 9:	Center Fuselage Area	All surfaces, components and equipment in and on the fuselage below the engine deck (WL 65.00) and between the cabin area (Sta 186.25) and tail boom attachment bulkhead (Sta 299.57). Includes forward and aft fuel cells, compartment below transmission, oil cooler and compartments accessible through side doors and panels on fuselage.
AREA NO. 10:	Engine Area	All surfaces, components and equipment associated with engine installation located above engine deck (WL 65.00) and within engine cowling, tailpipe fairing, and aft fairing.
AREA NO. 11:	Tail Boom Area	All surfaces, components and equipment located in and on the tail boom and vertical fin. Includes tail rotor, synchronized elevator, control linkages, drive shafts, gearboxes, electronic gear and cooling fan.

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Figure 1-9. Inspection area diagram (Sheet 2 of 2)

AIRCRAFT INSPECTION CHECKSHEET		TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 1	NO. OF PAGES 24
AIRCRAFT AND SERIAL NO.		INSPECTION NO.	DATE OF INSPECTION	
AREA NO.	REQUIRE- MENT EVERY	ITEM	STA- TUS	RECORDED ON WORKSHEET
All Areas		<u>AFTER A HARD LANDING</u> Definition: Hard landing is defined as any accident or incident in which ground impact of the helicopter causes severe pitching of main rotor, allowing hard contact of hub with mast, or results in cracking or yielding of the mounting lugs of the transmission support case or noticeable yielding or cracking of fuselage pylon support structure or landing gear. This definition is confined only to those accidents not involving sudden stoppage of main rotor or tail rotor. Inspections: When a probable hard landing incident has occurred, proceed as follows: - Inspect main and tail rotor blades for evidence of strike damage. If such evidence is found on either rotor, perform AFTER SUDDEN STOPPAGE Special Inspection. - Visually inspect underside of fuselage and tail boom for evidence of ground contact. - Inspect landing gear for yielding of cross tubes to cause skid tube tread width to exceed allowable dimensions. If not obvious, determine condition by measurements according to instructions in Chapter 3. - If cross tubes have yielded, remove landing gear and inspect supports and structure to which they are attached for signs of yielding or other damage. - If supports and attaching structure are undamaged, replace landing gear. - Penetrant inspect tubes for cracks in area from saddle fittings to fuselage mount. - Inspect mast for evidence of hard rotor hub contact, sufficient to move any mast material. - Inspect supports of dampers under pylon aft mounts for loose rivets or other damage. - If no damage other than yielded landing gear cross tubes has been found at this point, it can reasonably be decided that a true hard landing did not occur. Complete a careful Daily Inspection and return helicopter to operation if no further evidence of damage is found.		

AIRCRAFT INSPECTION CHECKSHEET		TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 2	NO. OF PAGES 24
AIRCRAFT AND SERIAL NO.		INSPECTION NO.	DATE OF INSPECTION	
AREA NO.	REQUIRE- MENT EVERY	ITEM	STA- TUS	RECORDED ON WORKSHEET
		<i>g.</i> If damage other than yielded landing gear cross tubes was found in preceding steps, a hard landing has occurred, and the following steps must be performed. <i>h.</i> Remove main (input) drive shaft. Tag shaft with reason for removal, and send to overhaul facility for evaluation. <i>i.</i> Remove transmission. Tag assembly with reason for removal, and send to overhaul facility for evaluation. <i>j.</i> Remove and inspect mast. (1) If there is yielding or deformation in area which might be contacted by main rotor hub, or if there is other obvious damage, the mast should be considered unserviceable and non-reparable. (2) If such damage is not found, tag mast assembly with reason for removal and send to overhaul facility for evaluation. <i>k.</i> Perform thorough visual inspection of the following components, which may be kept in service if no discrepancy or damage is found. (1) Main Rotor Blades (2) Main Rotor Hub (3) Tail Rotor Blades (4) Tail Rotor Hub (5) 42° Gearbox (6) 90° Gearbox (7) Tail Rotor Driveshafts (8) Tail Rotor Driveshaft Hanger Assemblies (9) Swashplate and Support Assembly (10) Scissors and Sleeve Assembly <i>l.</i> Remove cowling. Inspect all cowl attachment fittings.		

AIRCRAFT INSPECTION CHECKSHEET		SPECIAL INSPECTION	PAGE NO. 3	NO. OF PAGES 24
AIRCRAFT AND SERIAL NO.		INSPECTION NO.	DATE OF INSPECTION	
AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET
	<i>m.</i> Make complete inspection of pylon support structure (including damper supports) for loose rivets, cracked forgings, and buckled or cracked support angles and webs. <i>n.</i> Check each pylon mount damper for yielding, by measuring clearances according to instructions in Chapter 6. Replace dampers if yielded. <i>o.</i> Make complete inspection of lift link, attachment fitting, and lift beam for cracks, buckling, or other evidence of damage. <i>p.</i> Make complete inspection of area where tailboom is attached to forward fuselage section. This includes both sets of attachment fittings, and the longerons, beam caps, skins, webs, bulkhead flanges, and other structural members. Check torque on attachment bolts to determine if yielding has occurred. (Refer to Chapter 2.) <i>q.</i> Conduct a complete inspection of engine mount for yielding or other damage of tubes, rod ends, and attaching parts. Inspect trunnions and airframe attachment fittings by magnetic-particle method. If damage exceeding that defined in step g. is incurred, remove engine and send to higher level of maintenance for inspection. <i>r.</i> If no significant damage has been found, no further inspection is necessary. <i>s.</i> If significant damage has been found in any area of the airframe, inspection should be expanded in those areas until it extends beyond the zone of damage. <i>t.</i> Inspect pitch change tube upper bearing for marks on lower surface face and outer race, indicating metal to metal contact. (1) If such contact is evident, remove the tube assembly and inspect bearing and tube. Test tube for straightness by procedures in Chapter 5 and for cracks by procedures in TM 43-0103, Chapter 6, or TM 55-1500-204-25/1, Chapter 7. (2) Inspect bearing for damage, axial and radial play by limits in figure 5-52 and 5-52A. The deformed areas should be marked with Prussian Blue or an equivalent substitute to preclude further inspection of an already inspected damage. (3) If pitch change tube passes inspection, the assembly may be retained in service.			

AIRCRAFT INSPECTION CHECKSHEET		SPECIAL INSPECTION		PAGE NO. 3A	NO. OF PAGES
AIRCRAFT AND SERIAL NO.		INSPECTION NO.		DATE OF INSPECTION	
AREA NO.	REQUIRE- MENT EVERY	ITEM	STA- TUS	RECORDED ON WORKSHEET	
2	u.	Inspect lower wire strike cutter for bends, cracks, and alignment. Replace cutter if damage is found.			
6		K747 MAIN ROTOR BLADE SUBJECTED TO HIGH WINDS Blades unrestrained and/or have torn loose from their mooring when subjected to winds of 60 MPH and higher are to be tap tested in main spar areas between stations 70 to 90.			
6, 7, 10& 11		SUDDEN STOPPAGE Sudden Stoppage is defined as an instantaneous shock load applied to the drive train and rotor systems either POWER ON or POWER OFF. Shock loads result from: a. Main rotor blade(s) striking a movable or immovable object. b. Tail rotor blade(s) striking a movable or immovable object. c. Seizures which occur as a result of an internal failure of a drive train/rotor system component. d. Engine compressor stall. After a Sudden Stoppage event has occurred, one of the following special inspections shall be conducted depending on the origin of the shock load. All components removed for overhaul as a result of these inspections must be tagged to call attention to the nature of the incident.			

AIRCRAFT INSPECTION CHECKSHEET		TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL		PAGE NO. 4	NO. OF PAGES 24
AIRCRAFT AND SERIAL NO.		INSPECTION NO.		DATE OF INSPECTION	
AREA NO.	REQUIRE- MENT EVERY	ITEM	STA- TUS	RECORDED ON WORKSHEET	
	a.	<i>Main Rotor Blade Strike.</i> (1) No visible damage to either blade. (a) Wipe upper and lower surfaces of main rotor blades with a clean, soft cloth and inspect both surfaces for cracks, distortion or bond separation. (b) Visually inspect hub assembly and mast for damage. (c) If no damage is found, inspection is complete. If damage is found in either of the above inspections proceed to paragraph 2 below: (2) Minor Damage to Either Blade. NOTE This category includes both field repairable damage and skin tears whether repairable or not. (a) Inspect and replace the following items if damage is found: <u>1.</u> Main rotor hub trunnion cap attach bolts and drag brace jamnuts and attach bolts for security. <u>2.</u> Flight control system, from the rotor to servo cylinder, for bent or damaged tubes. <u>3.</u> Scissors levers drive links for damage. <u>4.</u> Swashplate gimbal mounting for damage. <u>5.</u> Collective friction collet assembly for free travel. <u>6.</u> Structure at transmission mounting points (use ten-power magnifying glass) for cracks. <u>7.</u> Lift link and structure for damage, security and distortion. <u>8.</u> Main driveshaft. <u>9.</u> Mast.			

AIRCRAFT INSPECTION CHECKSHEET		TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL		PAGE NO. 5	NO. OF PAGES 24
AIRCRAFT AND SERIAL NO.		INSPECTION NO.		DATE OF INSPECTION	
AREA NO.	REQUIRE- MENT EVERY	ITEM		STA- TUS	RECORDED ON WORKSHEET
		<u>10.</u> Transmission sump oil filter, external oil filter and chip detector for metal particles. <u>a.</u> Positive indications are cause for replacing transmission. <u>b.</u> If no metal particles are found continue operation for 5 hours, then repeat inspection. If no positive indications are found, resume normal operation. <u>11.</u> 42 degree and 90 degree gearboxes for metal particles. <u>12.</u> Tail rotor driveshafts and hanger assemblies for obvious damage. <u>13.</u> Tail rotor hub and blade assemblies. (b) Repair/replace blades as required. (c) Inspection complete. (3) Major damage to either blade. NOTE This category is restricted to non-repairable damage other than skin tears. For skin damage, see Minor Damage Inspection. (a) Replace the following: (Disposition as noted) <u>1.</u> Main rotor hub assembly (overhaul). <u>2.</u> Main rotor blades scrap). <u>3.</u> Mast (overhaul). <u>4.</u> Swashplate (overhaul). <u>5.</u> Scissors and sleeve assembly (scrap). <u>6.</u> Control rods (rotor to scissors levers) (scrap). <u>7.</u> Transmission (overhaul).			

AIRCRAFT INSPECTION CHECKSHEET		TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL		PAGE NO. 6	NO. OF PAGES 24
AIRCRAFT AND SERIAL NO.		INSPECTION NO.		DATE OF INSPECTION	
AREA NO.	REQUIRE- MENT EVERY	ITEM	STA- TUS	RECORDED ON WORKSHEET	
		<u>8.</u> Engine. Refer to TM 556-2840-229-23 for required inspection. (b) Inspect and repair/replace the following as required: <u>1.</u> Tail rotor blades. <u>2.</u> Intermediate and tail rotor drive gearboxes (inspect for damage to gears and input/output couplings). (c) Inspection complete. b. Tail Rotor Blade Strike. (1) No visible damage to either blade. (a) Inspect doublers for bonding separation, attachment area for distortion. (b) Inspect and replace the following items if damage is found. <u>1</u> Tail rotor hub assembly. <u>2</u> Tail rotor rotating controls. <u>3</u> 42 degree and 90 degree gearboxes (inspect for metal particles). <u>4</u> Tail rotor driveshafts and hangers. (c) If no damage is found, inspection complete. If damage is found proceed to following paragraph (2).			

AIRCRAFT INSPECTION CHECKSHEET		TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL		PAGE NO. 6A	NO. OF PAGES 24
AIRCRAFT AND SERIAL NO.		INSPECTION NO.		DATE OF INSPECTION	
AREA NO.	REQUIRE- MENT EVERY	TEST	STA- TUS	RECORDED ON WORKSHEET	
		(2) Visible damage to either blade. (a) Scrap both blades. (b) Replace 42 degree and 90 degree gearboxes and return for overhaul. (c) Inspect and replace the following items if damage is found. <u>1</u> Deleted <u>2</u> Tail rotor hub assembly. <u>3</u> Tail rotor rotating controls. <u>4</u> Tail rotor driveshafts. <u>5</u> Tail rotor hanger assemblies (inspect for internal spline and curvic coupling damage). <u>6</u> Transmission sump oil filter, external oil filter and chip detector for metal particles. a. Positive indications are cause for replacing transmission. b. If no metal particles are found, continue operation for 5 hours, then repeat inspection. If no positive indications are found, resume normal operation. <u>7</u> Main driveshaft. <u>8</u> Tailboom attachment points. <u>9</u> Mast assembly. <u>10</u> Main rotor rotating controls. <u>11</u> Main rotor blades. <u>12</u> Main rotor hub trunnion cap attach bolts and drag brace jamnuts for security. <u>13</u> Transmission tail rotor output quill. (3) Inspection complete.			

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AIRCRAFT AND SERIAL NO.		INSPECTION NO.		DATE OF INSPECTION		
AREA NO.	REQUIRE- MENT EVERY	TEST			STA- TUS	RECORDED ON WORKSHEET
		c. Internal Failure of Drive Train/Rotor System Component. (1) Replace the following (disposition as noted): (a) Transmission (overhaul). (b) Mast assembly (overhaul). (c) 42 degree gearbox (overhaul). (d) 90 degree gearbox (overhaul). (e) Tail rotor driveshafts and hanger assemblies (overhaul). (f) Engine (refer to TM 55-2840-229-23). (g) Main rotor hub assembly (overhaul). (2) Inspect and repair/replace the following as required: (a) Main rotor blades. (b) Main rotor rotating controls. (c) Tail rotor blades. (d) Tail rotor hub assembly. (e) Main driveshaft (inspect for internal and curvic coupling damage). (f) Deleted (g) Deleted (h) Helicopter structure. d. Compressor Stall. Engine compressor stall surge is characterized by a sharp rumble or a series of loud, sharp reports, severe engine vibration and a rapid rise in exhaust gas temperature (egt) depending on the severity of the surge. (1) Perform engine compressor stall inspection in accordance with TM 55-2840-229-23.				

AIRCRAFT INSPECTION CHECKSHEET		TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL		PAGE NO. 6C	NO. OF PAGES 24	
AIRCRAFT AND SERIAL NO.		INSPECTION NO.		DATE OF INSPECTION		
AREA NO.	REQUIRE- MENT EVERY	TEST			STA- TUS	RECORDED ON WORKSHEET
		(2) Inspect 90 degree gearbox for damage to gears, unusual wear pattern on either coast or drive side of gears and damage to input/out coupling internal and curvic coupling splines. (a) No damage to 90 degree gearbox. Visually inspect remaining tail rotor drive shaft components. If no damage is found, inspection complete. (b) Damage to 90 degree gearbox or other drivetrain component: Perform inspection requirements of subparagraph (3). (3) Inspect and replace the following items if damage is found: (a) 42 degree gearbox (inspect for damage to gears, unusual wear pattern on either coast or drive side of gears and damage to input/output coupling internal and curvic coupling splines) (b) Tail rotor hanger assemblies (inspect for internal spline and curvic coupling damage. (c) Tail rotor drive shafts (loose rivets, bent). (d) Main rotor driveshaft (bent or twisted). (e) Transmission sump oil filter, external oil filter and chip detector for metal particles. <u>1</u> Positive indications are cause for replacing transmission. <u>2</u> If no metal particles are found, continue operation for five hours and then repeat inspection. If no positive indications are found, resume normal operation. (f) Mast assembly. (g) Helicopter structure including tailboom attachment area and vertical fin.				

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AREA NO.	REQUIRE- MENT EVERY	TEST		STA- TUS	RECORDED ON WORKSHEET
6&11		(h) Replace main rotor hub trunnion attach bolts. (i) Tail rotor blades. (j) Tail rotor hub assembly. (4) Inspection complete. <u>AFTER MAIN ROTOR OVERSPEED</u> Inspection and/or replacements are required after any report that main rotor has exceeded 339 rpm limit. When 356rpm has been exceeded, additional requirements apply. Main Rotor Overspeed Less Than 356RPM: Inspect the following: a. Main rotor blades for damage, bond separation and distortion. b. Tail rotor blades for damage, bond separation and distortion. Main Rotor Overspeed Exceeding 356RPM: a. Inspect main rotor blades as follows: (1) Visually inspect blade skins. Any wrinkle or deformation is cause for blade replacement. (2) Remove tip cap and inspect balance weights. Deformation of weights and/or studs is cause for blade replacement. Loose weights is not a cause for blade replacement. Inspect stud retention nuts for looseness by applying 30 inch pound torque. Torque loose stud retention nuts to 130 to 145 inch pounds. (3) Blades which pass these inspections are acceptable for further service. Return faulty blades to depot activity with details of overspeed incident. b. Replace main rotor hub assembly. Send removed hub to overhaul facility, with information on overspeed incident. Bolts should remain with hub. c. Visually inspect blade retention bolts and drag brace bolts for shear offset.			

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AREA NO.	REQUIRE- MENT EVERY	TEST	STA- TUS	RECORDED ON WORKSHEET	
		d. Inspect tail rotor blades: (1) Bond separation anywhere on the blade is cause for replacing blades. Send removed blades to next higher maintenance level for evaluation and possible repair. (2) If any movement of the tip or root end balance weights has occurred, scrap the blade. (3) Check the retention bushings for evidence of looseness. If any bushing is loose scrap the blade. (4) If blade passes the above inspection requirements and no other discrepancies exist, then the blade is serviceable. e. Perform a thorough visual inspection of tail rotor hub. If no discrepancies are found, the hub may be retained in service. f. Visually inspect the following components, which may be considered satisfactory for continued use if no visible damage is found: (1) Transmission Assembly (2) 42 Degree Gearbox (3) 90 Degree Gearbox (4) Tail Rotor Driveshafts and Hangers (5) Main Rotor Driveshaft (6) Mast (7) Swashplate Assembly (8) Scissors and Sleeve Assembly (9) Tail Rotor Hub			

AIRCRAFT INSPECTION CHECKSHEET		TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL		PAGE NO. 9	NO. OF PAGES 24
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AREA NO.	REQUIRE- MENT EVERY	TEST	STA- TUS	RECORDED ON WORKSHEET	
6		MAIN ROTOR HUB INSPECTION The following inspection shall be performed whenever external indications of hub problems exist, i.e., unusual noises, excessive heat, vibrations, etc. a. Remove hub assembly from aircraft and disassemble to the extent required in order to determine the serviceability of the following components. (1) Feathering axis bearings. (2) Extension sleeves. (3) Radius rings. (4) Inboard bearing housing seals. (5) Outboard dust seals. (6) Flapping axis bearings, trunnion sleeves, and dust seals. b. Replace items as required, reassemble hub assembly, and reinstall on aircraft.			
6	EVERY 20-25 HOURS	a. Deleted. <u>WARNING</u> Do not flap rotor hard against mast. b. Inspect teflon trunnion bearings (non-elastomeric only) for squeaking, binding, and/or ratcheting while flapping hub to each limit of travel. c. Reconnect pitch links IAW para 5-4b (13)(c). ULTRASONIC INSPECTION OF MAIN ROTOR BLADES. Perform ultrasonic shear wave and thru transmission inspection on main rotor blades (P/N 540-011-001-5 and 540-011-250;1) at 550, 650, 750, 850, 950 and 1,050 total blade hours since new.			

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AREA NO.	REQUIRE- MENT EVERY	TEST	STA- TUS	RECORDED ON WORKSHEET	
	EVERY 25 HOURS				
6	a.	K747 Rotor Blade-Visually inspect the erosion guard edge seams from station 75 to 260 (213 to 215 if appropriate). Inspect chordwise, spanwise, top and bottom surfaces for separation or delamination.			
7	b.	Remove transmission sump oil filter (wafer disk screen), and electrical chip detector, check for contamination, then clean and reinstall.			
7	c.	Intermediate (42') gearbox filler cap for clogged vent.			
7	d.	Hydraulic fluid is to receive spectrometric analysis per TB 43-0106 every 25 hours.			
11	e.	Tail rotor (90') gearbox filler cap for clogged vent.			
11	f.	Tail rotor and elevator control tubes for wear at bulkhead grommets.			
7		IMMEDIATELY PRECEDING 25 HOUR LUBRICATION AND AT INSTALLATION			
	a.	Swashplate and Support.			
	(1)	Visually inspect for evidence of contact between outer ring or drive link and stationary swashplate. Measure vertical clearance from the bottom of both drive links, PIN 209-010-408-7 to all three horns of stationary swashplate. The minimum clearance must be not less than .035 inch. Replace swashplate if any contact is evident or if clearance is below minimum.			
	(2)	Disconnect main rotor drive links from swashplate and secure to prevent damage. Rotate swashplate ring, checking for roughness, binding, or unusual noise from swashplate bearing. Check for up and down play in bearing between inner and outer swashplate. Replace swashplate if any roughness, binding, noise or play is evident where rotation of the main rotor blades is not possible. This procedure can be accomplished as follows: disconnect the pitch change links at the upper universal and remove the 6(each) bolts securing the collet extension and the collet spline plate. This will allow you to rotate the swashplate as required.			
	(3)	Using a soft, clean, lint free cloth dampened with cleaning solvent (C124), clean the inner ring assembly and outer ring assembly at the dust cover. Insure all surface grit, sand and other surface materials are removed.			

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AREA NO.	REQUIRE- MENT EVERY	TEST	STA- TUS	RECORDED ON WORKSHEET	
		(4) Using a grease gun with a flexible hose, purge lubricate the swashplate per figure 1-2. If the swashplate fails to accept grease, perform a swashplate bearing sleeve alignment check. Also, replace grease fittings if clogged. (5) Remove old grease purged from swashplate using a wooden tongue depressor (NSN 6515-00-324-5500). Place sample of old grease in plastic bottle (NSN 8125-01-082-9697) ensuring that the bottle is more than half filled. The bottle label should be filled out as completely as possible to avoid confusion with other grease samples. Label to show operating activity, swashplate serial number, aircraft serial number and date of sample. (6) Prepare DD Form 2026, Transit Aircraft Oil Analysis Record, and submit along with grease sample to the AOAP Laboratory designated in TB 43-0106. Make appropriate entries on DA Form 2408-20 in accordance with DA PAM 738-751. (7) Reconnect drive links and perform maintenance operational check of at least 15 minutes duration. <i>b.</i> Scissors and Sleeve Assembly. (1) Visually inspect visible part of scissors hub assembly and boat for signs of heat. Any heat discoloration or distortion of components is cause for replacement. (2) Using a soft, clean, lint-free cloth dampened with cleaning solvent (C124), remove all surface grit, sand, and other surface materials. (3) Using a grease gun with a flexible hose, purge/lubricate the scissors bearing in accordance with figure 1-2, at approximately 30-degree intervals until the assembly has been lubricated through one full turn (360').			

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AREA NO.	REQUIRE- MENT EVERY	TEST		STA- TUS	RECORDED ON WORKSHEET
	(4)	Remove old grease purged using a wooden tongue depressor (NSN 6515-00-324-5500). Place sample of old grease in plastic bottle (NSN 8125-01-082-9697), ensuring that the bottle is more than half filled. The bottle label should be filled out as completely as possible to avoid confusion with other grease samples. Label to show operating activity, scissors and sleeve assembly serial number, aircraft serial number, and date of sample.			
	(5)	Prepare DD Form 2026, Transit Aircraft Oil Analysis Record, and submit along with grease sample to the AOAP Laboratory designated in TB 43-0106. Make appropriate entries on DA Form 2408-20 in accordance with DA Pam 738-751.			

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AREA NO.	REQUIRE- MENT EVERY	TEST			STA- TUS	RECORDED ON WORKSHEET
		<u>AFTER ENGINE OVERTEMPERATURE</u> An engine hot-end inspection, in accordance with TM 55-2840-229-23 (T53 Engine Inspection Guide), is required when exhaust gas temperature limits have been exceeded. During transient for starting and acceleration when turbine gas temperature (TGT) exceeds 950 degrees C at any time or when TGT exceeds 880 degrees C for more than 5 seconds, a hot-end inspection must be performed. Refer to TM 55-2840-229-23. NOTE If engine cannot be operated without exceeding TGT limits (of 950 degrees C TGT at any time) as specified in TM 55-2840-229-23, Engine Operating Limits Table, this is indication of engine malfunction or instrument error. Refer to Troubleshooting Tables, to determine cause and correct action as overtemperature inspection is not required. <u>WHEN ENGINE OIL TEMPERATURE LIMITS ARE EXCEEDED</u> Refer to TM 55-2840-229-23.				

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AREA NO.	REQUIRE- MENT EVERY	TEST		STA- TUS	RECORDED ON WORKSHEET
10		<u>AFTER ENGINE OVERSPEED</u> An engine overspeed exists under the following conditions: a. When N1 speed exceeds 106 percent. b. When steady-state output shaft speed exceeds: (1) 6900 rpm as a maximum 10 second limit. (2) 6700 rpm when operating above 750° C TGT. NOTE At TGT of 750°C or less, a steady output shaft speed of 6900 rpm is permissible. If overspeed limits are exceeded, perform engine overspeed inspection in accordance with TM 55-2840-229-23.			

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AREA NO.	REQUIRE- MENT EVERY	TEST		STA- TUS	RECORDED ON WORKSHEET
10		<u>AFTER HELICOPT'ER IS FLOWN IN A LOOSE GRASS ENVIRONMENT.</u> Any time the helicopter is flown in a loose grass environment, the engine shall be inspected for grass blockage in accordance with TM 55-2840-229-23.			
10		<u>ENGINE POST-INSTALLATION INSPECTION</u> a. Check installation of power control linkage in accordance with Chapter 4, Section VII.			

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AREA NO.	REQUIRE- MENT EVERY	TEST			STA- TUS	RECORDED ON WORKSHEET
		<i>b.</i> Perform turbine gas temperature (TGT) System test. (Refer to TM 55-2840-229-23 and TM 55-4920-244-14.) <i>c.</i> Perform a Daily Inspection. (Refer to TM 551500-220PMD.) NOTE The following step d. need not necessarily be performed if the engine has merely been removed and reinstalled for reasons other than engine maintenance. However, the engine should be inspected for leaks and security of mounting provisions, hoses and accessories prior to flight. <i>d.</i> Perform inspection before and after initial check run. (Refer to TM 55-2840-229-23.) <i>e.</i> Perform a limited test flight. (Refer to TM 55-1520-234 MTF.) <i>f.</i> Perform an engine vibration test. (Refer to TM 55-2840-229-23.)				

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AIRCRAFT AND SERIAL NO.		INSPECTION NO.		DATE OF INSPECTION																	
AREA NO.	REQUIRE- MENT EVERY	TEST		STA- TUS	RECORDED ON WORKSHEET																
10		<u>ENGINES DROPPED DURING HANDLING</u> a. If an engine is dropped during handling, perform inspection. (Refer to TM 55-2840-229-23). <u>AFTER EXCESSIVE ENGINE TORQUE</u> Overtorque is defined as any incident in which torsional loads are introduced into the helicopter dynamic system in excess of 56 psi as determined on the engine torquemeter (calibrated). NOTE Use calibrated torque for overtorque limits. The following table shall be used to convert indicated torque to calibrated torque. <table border="0" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: right;">Calibration Factor</td> <td style="text-align: left;">Multiply Indicated Torque By</td> </tr> <tr> <td style="text-align: right;">64</td> <td style="text-align: left;">0.96</td> </tr> <tr> <td style="text-align: right;">63</td> <td style="text-align: left;">0.97</td> </tr> <tr> <td style="text-align: right;">62</td> <td style="text-align: left;">0.99</td> </tr> <tr> <td style="text-align: right;">61</td> <td style="text-align: left;">1.00</td> </tr> <tr> <td style="text-align: right;">60</td> <td style="text-align: left;">1.02</td> </tr> <tr> <td style="text-align: right;">59</td> <td style="text-align: left;">1.04</td> </tr> <tr> <td style="text-align: right;">58</td> <td style="text-align: left;">1.06</td> </tr> </table> Example: For an indicated torque of 55 psi with a calibration factor of 58, the calibrated torque is 58.3 psi (55 x 1.06 = 58.3). <u>OVERTORQUE IN EXCESS OF 56 PSI BUT NOT EXCEEDING 58 PSI</u> Perform thorough visual inspection of components. If inspection reveals no discrepancies, or damage to the following components, they may be retained in service. (1) Main Rotor Blades (2) Main Rotor Hub (3) Tail Rotor Blades		Calibration Factor	Multiply Indicated Torque By	64	0.96	63	0.97	62	0.99	61	1.00	60	1.02	59	1.04	58	1.06		
Calibration Factor	Multiply Indicated Torque By																				
64	0.96																				
63	0.97																				
62	0.99																				
61	1.00																				
60	1.02																				
59	1.04																				
58	1.06																				

AIRCRAFT INSPECTION CHECKSHEET		TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL		PAGE NO.	NO. OF PAGES
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AREA NO.	REQUIRE- MENT EVERY	TEST		STA- TUS	RECORDED ON WORKSHEET
		(4) Tail Rotor Hub (5) 42° Gearbox (6) 90° Gearbox (7) Tail Rotor Driveshafts (8) Swashplate (9) Scissors and sleeve assembly (10) Input driveshaft (11) Mast (12) Transmissions (all part numbers) (13) Driveshaft Hanger assemblies <u>AFTER ENGINE TORQUE IN EXCESS OF 58 PSI</u> <u>BUT NOT EXCEEDING 62 PSI</u> Inspect and/or replace components as follows. Records of replaced components shall show over-torque condition as reason for removal. a. Replace main rotor trunnion bearing bolts. b. Inspect main transmission sump filter and chip detector. (1) If metal particles are found indicating internal failure, replace transmission, and send it to overhaul for evaluation. (2) If there are no positive indications of failure continue operation for 5 hours, then repeat inspection. If no indications of failure are then found, resume normal operation. c. Perform thorough visual inspection of the following components, each may be kept in service if no discrepancy or obvious damage is found. Replace any damaged component. (1) Main Rotor Blades (2) Main Rotor Hub			

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AREA NO.	REQUIRE- MENT EVERY	TEST	STA- TUS	RECORDED ON WORKSHEET	
		(3) Tail Rotor Blades (4) Tail Rotor Hub (5) 42° Gearbox (6) 90° Gearbox (7) Tail Rotor Driveshafts (8) Tail Rotor Driveshaft Hangers (9) Swashplate Assembly (10) Scissors and Sleeve Assembly (11) Input Driveshaft (12) Mast <u>AFTER ENGINE TORQUE IN EXCESS OF 62 PSI</u> a. Replace the following components, and send to overhaul for evaluation, with records showing over-torque as reason for removal. (1) Transmission (2) Main (input) Driveshaft (3) Mast (4) Main Rotor Blades (5) Main Rotor Hub (6) Tail Rotor Blades b. Perform thorough inspection of the following components, each may be kept in service if no discrepancy or obvious damage is found. (1) Deleted (2) Tail Rotor Hub (3) 42° Gearbox			

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AREA NO.	REQUIRE- MENT EVERY	TEST		STA- TUS	RECORDED ON WORKSHEET						
7		(4) 90° Gearbox (5) Tail Rotor Driveshafts (6) Driveshaft Hangers (7) Swashplate Assembly (8) Scissors and Sleeve Assembly <u>ENGINE OVERTORQUE INSPECTION REQUIREMENTS:</u> When the engine has exceeded overtorque limits, perform engine overtorque inspection in accordance with TM 55-2840-229-23. CAUTION The following limits are engine torque limits only. Pilot monitoring is necessary to prevent the engine from exceeding dynamic components (airframe) limits. a. Output shaft torque emits: <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">(1) Military (30 minutes)</td> <td style="width: 50%;">64 psi</td> </tr> <tr> <td>(2) Normal (continuous)</td> <td>60 psi</td> </tr> <tr> <td>(3) Transient operation (2 seconds or less)</td> <td>86 psi</td> </tr> </table> <u>AFTER TAIL ROTOR DRIVE SYSTEM OVER-TORQUE.</u> After any report of suspected over-torquing of the tail rotor drive system during operation, perform the following inspection as soon as possible after the incident.		(1) Military (30 minutes)	64 psi	(2) Normal (continuous)	60 psi	(3) Transient operation (2 seconds or less)	86 psi		
(1) Military (30 minutes)	64 psi										
(2) Normal (continuous)	60 psi										
(3) Transient operation (2 seconds or less)	86 psi										

AIRCRAFT INSPECTION CHECKSHEET		TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL		PAGE NO.	NO. OF PAGES
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AREA NO.	REQUIRE- MENT EVERY	TEST	STA- TUS	RECORDED ON WORKSHEET	
		a. Remove output quill assembly from 42° gearbox, and inspect output gear teeth for damage as described in Chapter 6. If no scoring or scuffing is found, and if there are no other indications of damage, reassemble gearbox in accordance with maintenance manual, and retain in service. If gear teeth are scored or scuffed, or if there are other indications of damage, replace gearbox and perform inspection in step b. b. Remove output quill assembly from 900 gearbox, and inspect condition of gears as in step a. If no scoring or scuffing is found, and if there are no other indications of damage, reassemble gearbox in accordance with maintenance manual, and retain in service. If gear teeth are scored or scuffed, or if there are other indications of damage, replace gearbox and perform inspection in step c. c. Remove transmission tail rotor drive quill and inspect condition of gear teeth. Evidence of scoring or scuffing is cause for replacement of main transmission assembly. If it is necessary to replace the transmission assembly, then the tail rotor hanger bearing assemblies and tail rotor driveshafts must also be replaced. d. Tag any removed components with reason for removal before turning in through normal supply channels for overhaul. <u>AFTER KNOWN OR PROBABLE WIRE STRIKE</u>			
1		a. Inspect wire strike deflector on TSU windows for bends, cracks, and alignment. Replace if damage is found.			
		b. Inspect nose wire strike cutter for bends, cracks, and alignment. Replace if damage is found.			
3		c. Inspect channels, inserts, and nose deflectors for bends, cracks, and alignment. Replace if damage is found.			
		d. Inspect upper wire strike cutter for bends, cracks, and alignment. Inspect panel for cracks and pulled inserts. Replace damaged parts.			
2		e. Inspect lower wire strike cutter for bends, cracks, and alignment. Replace if damage is found.			

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AREA NO.	REQUIRE- MENT EVERY	TEST			STA- TUS	RECORDED ON WORKSHEET
7		<u>MAST BUMPING</u> a. Visually inspect the mast area where the hub stop would contact the mast. If no surface deformation of the mast has occurred, the inspection is complete. b. If there is visual evidence of surface deformation of the mast due to hub stop contact: (1) Evaluate the condition of the mast per the damage limits in Chapter 6. (2) Inspect and replace the following items if damage is found: (a) Main rotor hub trunnion cap attach bolts and drag brace jamnuts and attach bolts for security.				

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AREA NO.	REQUIRE- MENT EVERY	TEST	STA- TUS	RECORDED ON WORKSHEET	
		(b) Flight control system, from rotor to servo cylinder, for bent or damaged tubes and rod end bearings. (c) Structure at transmission mounting points. (d) Lift link and structure for damage, security and distortion. (e) Transmission sump oil filter, external oil filter, and chip detector for metal particles. (f) Main Drive shaft. (g) Tail rotor driveshafts and hanger assemblies for obvious damage. (h) Tail rotor drive quill. (i) Canopy of aircraft. (j) Tail rotor driveshaft cover.			
7		AFTER TRANSMISSION OIL OVER TEMP a. Troubleshoot transmission oil system to determine cause. (Refer to Chapter 6.) b. Replace transmission, mast, oil cooler and external oil filter if cause is due to transmission internal failure. If cause is due to oil system external to transmission and oil temperature did not exceed 130°C for 15 minutes, correct cause of overheating and drain and refill transmission oil system. c. If temperature exceeded above limits, replace transmission and mast. If abnormal contamination is present, also replace oil cooler and external oil filter.			
7		AFTER COMPLETE LOSS OF TRANSMISSION OIL a. Troubleshoot transmission oil system to determine cause. b. Replace transmission and mast, if engine power was applied after complete loss of oil. Also replace oil cooler and external oil filter if abnormal contamination is present.			

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AREA NO.	REQUIRE- MENT EVERY	TEST	STA- TUS	RECORDED ON WORKSHEET	
8		<u>AFTER FIRTING EJECTOR CARTRIDGES.</u> Refer to Chapter 16.			
		<u>AFTER KNOWN OR PROBABLE WIRE STRIKE</u>			
1	a.	Inspect wire strike deflector on TSU windows for bends, cracks, and alignment. Replace if damage is found.			
2	b.	Inspect nose wire strike cutter for bends, cracks, and alignment. Replace if damage is found.			
2	c.	Inspect lower wire strike cutter for bends, cracks, and alignment.			
9		<u>AFTER OVERFLOW OF BATTERY</u>			
	a.	Refer to TM 55-1500-204-25/1 for treatment of affected areas.			
	b.	Sheet metal surfaces and overlaps, both internal and external, for damage.			
	c.	Rivets, bolts, screws, and other hardware for damage.			
	d.	Troubleshoot battery system to determine cause.			
9		EVERY 30 DAYS OR 25 FLIGHT HOURS, WHICHEVER OCCURS FIRST			
		Perform preventive maintenance checks and services on nickel-cadmium battery. (Refer to TM 11-6140-203-14-2).			
9		EVERY 100 HOURS OR 120 CALENDAR DAYS, WHICHEVER OCCURS FIRST			
	a.	Perform preventive maintenance checks and services on nickel-cadmium battery. (Refer to TM 11-6140-203-14-2.)			
	b.	Check voltage regulator setting; adjust for temperature as required. TM 55-1500-204-25/1.			

AIRCRAFT INSPECTION CHECKSHEET		TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL		PAGE NO. 21B	NO. OF PAGES 24	
AIRCRAFT AND SERIAL NO.		INSPECTION NO.		DATE OF INSPECTION		
AREA NO.	REQUIRE- MENT EVERY				STA- TUS	RECORDED ON WORKSHEET
3	EVERY 24 MONTHS a. Pilot Static System-Perform a functional check of system: refer to paragraph 8-20A. NOTE Compute calendar time from date stamped on instrument case of altimeter and airspeed indicator. b. Encoding Altimeter - After the 24 month test or replacement of the altimeter, check mode C (altitude) test using the appropriate transponder test procedure in TM 11-6625-667-12 or TM 11-4920-296-14&P.					

AIRCRAFT INSPECTION CHECKSHEET		TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL		PAGE NO. 22	NO. OF PAGES 24
AIRCRAFT AND SERIAL NO.		INSPECTION NO.		DATE OF INSPECTION	
AREA NO.	REQUIRE- MENT EVERY			STA- TUS	RECORDED ON WORKSHEET
3	<u>EVERY 12 MONTHS OR NEAREST SCHEDULED PHASE INSPECTION</u>				
	Inspect and test OAT/FAT gage in accordance with TM 55-1500-204-25/1.				
3	<u>EVERY 12 MONTHS</u>				
	a. Magnetic compass for discoloration of liquid and proper calibration; recompensate if necessary.				
	b. Gyromagnetic compass system for proper calibration; recompensate if necessary. (Refer to TM 55-1500-204-25/1.)				
	c. Replace ejector rack cartridges (refer to Chapter 16).				
	d. Deleted.				
6	<u>DAILY WHEN OPERATING IN HIGH HUMIDITY OR SALT-LADEN AIR</u>				
	Wash main and tail rotor blades with mild soap (C125), rinse with clear water, and dry.				
6	<u>30 DAYS OR 50 HOURS OF OPERATION (WHICHEVER IS FIRST)</u>				
	Wash main and tail rotor blades with mild soap (C125), rinse with clear water, and dry.				
All Areas	<u>AFTER THE HELICOPTER HAS BEEN SUBJECTED TO SALT WATER OR SALT WATER SPRAY</u>				
	a. Wash entire helicopter with fresh water, particularly inside of engine compartment doors; wash all compartments which were exposed to salt water; make a detail check of all surfaces for corrosion. Apply corrosion preventive compound to exposed non-painted, anodized, or cadmium plated assemblies. Water-wash engine internally.				
	b. lean water wash engine daily when operated within 10 miles of salt water or within 200 miles of volcanic activity. (IAW TM 55-2840-229-23)				
3	<u>AFTER WASHING HELICOPTER</u>				
	Check pitot-static system for moisture.				

AIRCRAFT INSPECTION CHECKSHEET		TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL		PAGE NO. 23	NO. OF PAGES 24
AIRCRAFT AND SERIAL NO.		INSPECTION NO.		DATE OF INSPECTION	
AREA NO.	REQUIRE- MENT EVERY			STA- TUS	RECORDED ON WORKSHEET
3	<u>EVERY 6 MONTHS</u>				
	a. Weight check CF3BR fire extinguisher. Refer to TM 55-1500-204-25/1 b. Inspect and test connector receptacle (ground). Refer to TM 55-1500-323-25.				
All	<u>AFTER PROBABLE EXPOSURE TO RADIOACTIVITY</u> Accomplish the following: a. Survey helicopter for level of radioactivity. b. Decontaminate helicopter as required. (Refer to TM 3-220.)				
All	<u>WHEN HELICOPTER IS TRANSFERRED, RECEIVED, PLACED IN STORAGE, OR REMOVED FROM STORAGE</u> Inventory helicopter for availability of inventoriable property. (Refer to DA PAM 738-751.)				
All	<u>AFTER INSTALLATION, REMOVAL OR RELOCATION OF EQUIPMENT OR MAJOR MODIFICATION WHICH RESULTS IN UNKNOWN CHANGE IN BASIC WEIGHT AND BALANCE; AFTER REPORT OF UNSATISFACTORY FLIGHT CHARACTERISTICS</u> Weigh helicopter and accomplish necessary entries in Weight and Balance Data, DD Forms 365. (Refer to AR95-3 and TM 55-1500-342-23.)				
9	<u>AFTER INDICATION OF UNUSUAL OVER OR UNDER FUEL CAPACITY OR UNUSUAL OVER OR UNDER FUEL CONSUMPTION</u> Perform inspection of fuel cells with special attention to possible self sealing material and/or inner liner separation.				
All	<u>UPON TRANSFER AND UPON RECEIPT OF A HELICOPTER; UPON EXPIRATION OF 12 MONTHS ELAPSED TIME SINCE LAST INVENTORY, UPON PLACING A HELICOPTER IN STORAGE AND UPON REMOVAL FROM STORAGE (HELICOPTER NEED NOT BE INVENTORIED - WHILE IN STORAGE)</u> Perform an inventory check. (Refer to DA Form 2408-17 and Appendix C.)				

AIRCRAFT INSPECTION CHECKSHEET		TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL		PAGE NO. 24	NO. OF PAGES 24
AIRCRAFT AND SERIAL NO.		INSPECTION NO.		DATE OF INSPECTION	
AREA NO.	REQUIRE- MENT EVERY			STA- TUS	RECORDED ON WORKSHEET
All		<u>WHEN OVERHAULS, MAJOR MODIFICATIONS OR MAJOR AIRFRAME REPAIRS ARE ACCOMPLISHED, ANY SPECIAL EQUIPMENT HAS BEEN ADDED TO OR REMOVED FROM THE BASIC AIRFRAME OR WHEN WEIGHT AND BALANCE DATA ARE SUSPECTED TO BE IN ERROR.</u> For general weight and balance information, refer to TM 55-1500-342-23, Army Aviation Maintenance Engineering Manual, Weight and Balance. Appendix B, Maintenance Allocation Chart should be consulted for responsibility of weighing and balancing of the aircraft.			
11		<u>AFTER M65 TOW MISSILE HAS BEEN FIRED</u> Inspect tailboom skins for nicks, dents, scratches, creases and cracks.			
11		<u>AFTER FIRING 2.75 INCH ROCKETS</u> Visually inspect tailboom skins, synchronized elevators, and tail rotor blades for damage.			
7 & 11		<u>EVERY 12 MONTHS OR 600 HOURS (WHICHEVER IS FIRST)</u> Accomplish the following: a. Lubricate tail rotor drive train flexible couplings. b. Visually check splines for wear and nicks. c. Visually check flexible coupling seal for proper installation, cuts, and tears. d. Inspect hanger bearings for evidence of grease leakage, corrosion, overheating (brown discoloration of green zinc chromate paint on hanger), and notchiness. e. Remove, disassemble, clean, inspect, lubricate, assemble, and reinstall main drive shaft assembly. f. Inspect main driveshaft for internal corrosion.			
7		<u>EVERY 18 MONTHS</u> Transmission external oil filter replaced.			
All		<u>AFTER 7 DAYS</u> After the aircraft has remained inactive for 7 consecutive days, process the aircraft into the appropriate storage category. (See Appendix E.)			

AIRCRAFT INSPECTION CHECKSHEET		TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL		PAGE NO. 24A	NO. OF PAGES 24	
AIRCRAFT AND SERIAL NO.		INSPECTION NO.		DATE OF INSPECTION		
AREA NO.	REQUIRE- MENT EVERY				STA- TUS	RECORDED ON WORKSHEET
All	<u>AFTER LIGHTNING STRIKE</u> <i>a. General Requirements:</i> Whenever the aircraft is struck by lightning: (1) Inspect the fuselage interior and exterior, the landing gear, the rotor systems and static ground wire for burn marks, cracks, pitting or other signs of high temperature stress, to determine the lightning entry and exit points. (2) Trace the path of the lightning strike to the extent possible using a magnetometer. (3) Check the magnetic compass for accuracy (the degree of inaccuracy may serve as an indicator of the severity of the strike). (4) Inspect wiring in tunnel areas and exposed areas for burns. (5) Inspect antennas for burns and pitting. (6) Inspect all electrically operated components and lightning systems for damage. (7) Inspect communications and navigation equipment for damage. (8) If the preceding steps reveal major damage has occurred, proceed as follows: (a) Bench test all avionics and electrical systems and components. WARNING If damage to fuel probes is suspected, probes shall be removed from helicopter and continuity check performed on bench. Fuel quantity Indicator wiring shall be checked with fuel probes removed, or with wiring disconnected from probes. (b) Perform a Megger check and continuity check on all wiring and cables.					

AIRCRAFT INSPECTION CHECKSHEET		TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL		PAGE NO. 24B	NO. OF PAGES 24	
AIRCRAFT AND SERIAL NO.		INSPECTION NO.		DATE OF INSPECTION		
AREA NO.	REQUIRE- MENT EVERY			STA- TUS	RECORDED ON WORKSHEET	
	WARNING Do not use VSWR on fuel probes installed in helicopter. (c) Perform a Voltage Standing Wave Ratio (VSWR) check on all antennas, antenna cables, and connectors. (9) Perform specific inspections/replacements as required. (10) Perform a ground run operational check on the helicopter. Functionally check the flight control system, and all avionics, electrical, lighting, communication, and navigation systems. (11) Repair any damage and replace damaged components as required, using standard maintenance practices. <i>b. Specific Requirements:</i> (1) Whenever lightning strike is evident on main rotor system: NOTE If there is any evidence of lightning strike on blades or any other parts, scrap parts locally. In case of doubt, proceed as outlined below. (a) Inspect blades for damage such as burns, pitting, skin separation, etc. If any damage is evident, locally scrap damaged blade(s). (6) Remove hub assembly and return for overhaul. (c) Replace all bearings (or next higher assembly if required) in the fixed and rotating control system located above the servo cylinders. (d) Remove transmission assembly, and return for overhaul, if required. (e) Check main rotor driveshaft for residual magnetism. If magnetized, remove, and visually inspect short shaft for damage and remove engine and return for overhaul. (f) Inspect swashplate assembly and mast assembly. Return for overhaul if required.					

AIRCRAFT INSPECTION CHECKSHEET		TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL		PAGE NO. 24C	NO. OF PAGES 24
AIRCRAFT AND SERIAL NO.		INSPECTION NO.		DATE OF INSPECTION	
AREA NO.	REQUIRE- MENT EVERY			STA- TUS	RECORDED ON WORKSHEET
	(2) Whenever lightning strike is evident on tail rotor system: NOTE If there is any evidence of lightning strike on blades or any other parts, scrap parts locally. In case of doubt, proceed as outlined below. (a) Inspect blades for damage such as burns, pitting, skin separation, etc. If damage is evident, locally scrap damaged blade(s). (b) Tail rotor hub: Scrap locally. (c) Remove and condemn pitch change links, crosshead bearing and control quill bearings. (d) Inspect crosshead, control quill components, and control rod for any indications of arcing. Replace as necessary. (e) Remove main transmission and both the 42 degree and 90 degree gearboxes and return them for overhaul. (f) Remove hanger assemblies and return for overhaul. (g) Inspect tail rotor driveshafts for evidence of arcing, burns, or other related damage. If damage is evident, locally scrap damaged shafts. (h) Remove, disassemble, and inspect main rotor driveshaft for damage. If damage is evident or if residual magnetism is found in couplings or shaft, remove engine and return for overhaul.				

AIRCRAFT INSPECTION CHECKSHEET		TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL		PAGE NO. 24D	NO. OF PAGES 24	
AIRCRAFT AND SERIAL NO.		INSPECTION NO.		DATE OF INSPECTION		
AREA NO.	REQUIRE- MENT EVERY				STA- TUS	RECORDED ON WORKSHEET
5	<u>EVERY 50 HOURS</u> c. Nonstandard locally manufactured heavy duty skid shoes exceeding 20 pounds each in weight, Inspect as follows: (1) Perform inspection using liquid fluorescent dye penetrant method. This inspection is to be conducted by AVUM with assistance from AVIM as required to gain access to inspection area. (a) Jack airframe and remove landing gear assembly in accordance with specified procedures. (b) Conduct visual inspection for nicks, scratches, or gouges over entire cross tube surface. Refer to Chapter 3 for allowable damage criteria. (c) Remove blind rivets securing cross tube/fuselage attachment fittings to cross tubes and remove fittings. Save fittings for reuse. (d) Fluorescent dye penetrant inspection is required on cross tube surface of an area completely around cross tube at support fitting locations and adjacent area one inch out from each end of support fittings. A one inch band around cross tubes at chem-milled step area adjacent to skid tube saddle fitting will also be dye penetrant inspected. (e) Prepare the surface and conduct a liquid fluorescent dye penetrant inspection in accordance with TM 43-0103, utilizing penetrant kit NSN 6850-00-782-2740. (f) Wash and remove all excess penetrant and developer from cross tube surfaces. (g) Recoat surface of cross tube to be covered by the attachment fittings with sealant (C116). (h) Reinstall attachment fittings to cross tubes. Diameter and length of rivets to be determined at time of installation. (2) Cross tubes with crack indications will be scrapped. All cross tubes with no crack indications are to be returned to service.					

AIRCRAFT INSPECTION CHECKSHEET		TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL		PAGE NO. 24E	NO. OF PAGES 24	
AIRCRAFT AND SERIAL NO.		INSPECTION NO.		DATE OF INSPECTION		
AREA NO.	REQUIRE- MENT EVERY				STA- TUS	RECORDED ON WORKSHEET
5	<u>EVERY 150 HOURS</u> Nonstandard locally manufactured heavy duty skid shoes weighing 20 pounds or less each, inspect same as 50 Hours inspection on same item of more weight.					
7	<u>EVERY 300 HOURS</u> Remove, disassemble, clean and inspect main rotor hub assembly. (See Chapter 5.) NOTE When main rotor hub assembly is removed from one aircraft and installed on another, assure that the component's next inspection due time is transferred to the receiving aircraft's DA Form 2408-18.					
10	<u>EVERY 900 HOURS OR EACH TIME ENGINE IS REMOVED AND REPLACED</u> a. Engine oil system, including oil cooler, drained and refilled. If engine is replaced due to internal failure, flush all airframe-mounted oil lines and engine oil tank and replace engine oil cooler. NOTE Only to aircraft engine serviced with MIL-L-23699. If MIL-L-7808 is used, oil change is required every 300 hours. b. If engine is changed check gyromagnetic compass for proper calibration; recompensate if necessary (TM 55-1500-204-25/1).					

AIRCRAFT INSPECTION CHECKSHEET		TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL		PAGE NO. 24F	NO. OF PAGES 24
AIRCRAFT AND SERIAL NO.		INSPECTION NO.		DATE OF INSPECTION	
AREA NO.	REQUIRE- MENT EVERY			STA- TUS	RECORDED ON WORKSHEET
7	<u>EVERY 900 HOURS OR EACH TIME TRANSMISSION IS REMOVED AND REPLACED</u> Transmission and transmission oil cooler drained and oil pump screen inspected for metallic particles and other contaminants. Clean screen, replace and refill transmission oil system to proper level. If transmission is replaced due to internal failure, flush all airframe-mounted transmission oil lines and replace transmission oil cooler.				
	NOTE Only to aircraft transmission serviced with MIL-L-23699. If MIL-L-7808 is used, oil change is required every 300 hours.				
9	<u>EVERY 1100 HOURS OR AT OVERHAUL (WHICHEVER COMES FIRST)</u> Inspect diagonal brace fitting P/N 209-030-183-1 for cracks using fluorescent penetrant method.				
7	<u>SWASHPLATE BEARING SLEEVE ALIGNMENT CHECK</u> Perform the following whenever the swashplate fails to accept grease or upon any indication of linear misalignment (overheating; difficulty in lubing). a. Using pliers, remove lubrication fitting (NAS516) from one side of swashplate. b. <i>Insert alignment tool (T65) into lubrication port. Any stoppage before tool is fully seated is cause for rejecting the swashplate.</i> c. Lightly tap a new fitting (NAS516) into place. d. <i>Lubricate swashplate and support in accordance with figure 1-2.</i>				
3	<u>FIRST AID KIT INSPECTION</u> Inspect per TM 55-1500-204-25/1.				

Section V. OVERHAUL AND RETIREMENT SCHEDULE

1-32. Overhaul and Retirement Schedule.

WARNING

TM 55-1500-328-25 should be referred to concerning mutilation destruction of items when they have reached the established life expectancy (finite life) before the items are forwarded for property disposal.

This section lists units of operating equipment that are to be overhauled or retired at the period specified. Removal of equipment for overhaul may be accomplished at the inspection nearest the time when overhaul is due unless otherwise specified in TM 55-1500-328-25.

AREA FIGURE 1-9	PART NUMBER AND ITEM	OVERHAUL INTERVAL	RETIREMENT SCHEDULE	
	T53-L-703	Engine	2400	
	Canopy			
3	209-030-711-11	Interconnect Line (Detonating Cord)	72 Months****	
3	209-030-711-13	Interconnect Line (Detonating Cord)	72 Months****	
3	209-030-711-37	Arming/Firing Mechanism	72 Months***	
3	6106319 (821798-1) Crew Compartment	Arming/Firing Mechanism	72 Months****	
3	54H1956	Seat Belt		
3	62B4407	Seat Belt		
3	57D677	Shoulder Harness	Refer to TM 55-1500-204-25/1	
3	0101949-1	Shoulder Harness		
	Main Rotor			
6	209-010-518-101	Pitch Link Assembly	5700	
6	209-010-520-101	Pitch Link Assembly	5500	
6	540-015-001-1	Main Rotor Blade Assembly	1100	
6	540-011-101-5	Main Rotor Hub Assembly	1200	
6	540-011-101-17	Main Rotor Hub Assembly	1200	
6	540-011-101-25	Main Rotor Hub Assembly	1200	
6	540-011-101-131	Main Rotor Hub Assembly	1200	
6	540-011-153-13	Main Rotor Hub Extension Assembly	2200	
6	540-011-153-15	Main Rotor Hub Extension Assembly	2200	
6	540-011-153-17	Main Rotor Hub Extension Assembly	2200	
6	540-011-102-5	Main Rotor Hub Yoke Assembly	4800	
6	204-012-112-7	Main Rotor Hub Retention Straps	1200	
6	204-012-122-3	Retention Straps	1200	
6	204-012-122-7	Retention Straps	1200	
6	540-011-101-129	Main Rotor Hub	1200	
6	540-011-101-131	Main Rotor Hub	1200	
6	540-011-112-1	Pin, Inboard	2400	
6	540-011-112-5	Pin, Inboard	2400	
6	540-011-112-3	Pin, Outboard	2400	
6	540-011-112-7	Pin, Outboard	2400	
6	K747-003-205	Main Rotor Blade	10,000	
6	K747-003-205	Deviation Main Rotor Blade	10,000	
6	K747-003-209	Main Rotor Blade	10,000	
6	K747-003-303	Main Rotor Blade	10,000	
6	K747-003-303	Field Modified Main Rotor Blade	10,000	
6	K747-003-309	Main Rotor Blade	10,000	
6	K747-003-401	Main Rotor Blade	10,000	
6	K747-003-403	Main Rotor Blade	10,000	
6	K747-072-1	Fitting Assembly, Drag Strut	1400	
6	K747-061-5	Fitting Assembly, Root	1000	

AREA FIGURE 1-9	PART NUMBER AND ITEM		OVERHAUL INTERVAL	RETIREMENT SCHEDULE
6	K747-082-1	Drag Strut		4000
6	K747-083-1	Root Fitting		4000
6	NAS6618D112	Bolt		4000
6	NAS6210-38D	Bolt		4000
6	NAS464P8-36	Fitting Bolt, Drag Strut		450
6	NAS6206-76D	Bolt		4000
6	NAS6209-103D	Bolt		4000
6	540-011-113-1	Fitting, Strap		2400
6	540-011-177-1	Nut, Strap Fitting		2400
6	540-011-154-5	Grip Assembly, Main		5500
6	209-010-109-5, -109	Pitch Horn Assy.		6600
6	204-310-101-103	Retention Strap		1200
	Mast Controls			
7	209-010-460-3	Pitch Control Tube		600
7	209-010-400-1	Swashplate & Support Assembly	1200	
7	209-010-403-1	Outer Ring		3300
7	209-010-402-1	Inner Ring		3300
7	204-076-317-1,-5, -7	Bearing Housing		3300
7	100328	Cylinder Barrel		3300
7	209-010-401-11, -5	Scissors & Sleeve Assembly	1200	
7	209-010-405-7	Scissors Lever		3600
7	204-076-428-1, -3, -5	Rod End Bearing		600
7	41000434	Housing Assembly, Servo		3300
7	209-076-124-1, -3, -5	Extension Tube		3300
7	209-001-358-13, -17, -21	Extension Tube	Extension Tube	3300
7	209-010-408-7	Drive Link, Swashplate		11000
7	209-010-407-1	Hub Assy.		11000
7	209-010-450-5	Shaft, Mast Assy.		3300
7	540-011-456-1	Sleeve, Collective		11000
	Transmission			
7	209-011-208-101	Plate		5700
7	209-011-212-101	Support Set		5700
7	209-011-219-101	Strap Assembly		5700
7	209-310-100-105	Spring		5700
7	205-040-263-105	Quill Assembly	1500	
7	209-961-410-1	Hydraulic Pump Quill	1200	
7	209-961-400-3	Transmission Assembly	1200	
7	212-040-001-39	Transmission Assembly	1200	
7	205-040-263-3, -111	Main Input Quill	1500	
7	212-040-365-33	Hydraulic Pump Quill	1200	
7	212-040-365-25	Tail Rotor Output Quill	1200	
7	209-040-366-3	Mast Assembly	1200	
7	204-040-136-7	Mast Bearing		1500
7	204-040-136-9	Mast Bearing		1500
7	212-040-136-1	Mast Bearing		1500
7	212-030-104-5	Lift Link		5700
7	SKCP 2381-1	KFLEX, SHAFT		1500
	Ejector Racks			
8	ARD863-1	Cartridges		15 months**
	P7911-2			
8	CCU-44/B	Cartridges		36 months*
	5184850			
	Oil Cooler Turbine			
9	J33C32	Bearing, Oil Cooler		450
9	H33C32	Bearing, Oil Cooler		450
9	P9103NPPFS50160	Bearing, Oil Cooler		450
9	P9101NPPFS50160	Bearing, Oil Cooler		450
	Tail Rotor and Drive System			
11	204-040-623-5	Tail Rotor Driveshaft Hanger Bearing		600*****
11	212-010-744-5	Yoke Assembly		2400
11	212-010-704-5	Yoke Assembly		2400
11	212-010-750-11	Blade Assembly		2400
11	212-040-003-13-23	42 Degree Gearbox	1200	
11	212-040-004-9	90 Degree Gearbox	1200	

- * Not to exceed 8.5 years from date of manufacture (shelf life), or 36 months from the date of opening the sealed cartridge container (installed life) or 10 installations and or removals from cartridge housing. Explosive life is not additive and therefore cartridge removal is required whenever any of these conditions are reached.
- ** Not to exceed 10 years from date of manufacture (shelf life) or 15 months from date of opening the sealed cartridge container (installed life) or ten installations and or removals from cartridge housing. Explosive life is not additive and therefore cartridge removal is required whenever any of these conditions are reached.
- *** Denotes life is not to exceed 9 years from date of manufacture (shelf life) or 72 months from the date of installation, whichever comes first.
- **** Denotes life is not to exceed 8 years from the date of manufacture (shelf life) or 72 months from the date of installation, whichever occurs first.
- ***** Denotes life is not to exceed 9 years from the date of manufacture (shelf life) or 72 months from the date of installation, whichever occurs first.
- ***** Denotes bearing has a shelf life of 5 years, effective 31 December 1990.

NOTE

All unserviceable explosive items (NSN 1377 Class) shall be tagged with NSN, installation date, removal date, reason for removal, lot number helicopter type model and serial number, aviation unit destination and returned to supporting ammunition supply activity in the container used to transport the replacement cartridge.

NOTE

All Retirement Life Items will have a Demil Code of "L" and will be mutilated in accordance with DOD 4160.25-M-1, DEFENSE DEMILITARIZATION MANUAL.

CHAPTER 2

AIRFRAME

2-1. Airframe.

a. This chapter contains instructions for AVUM (Aviation Unit Maintenance) and AVIM (Aviation Intermediate Maintenance) on the helicopter airframe. The airframe consists of the fuselage, tailboom, and wings. See figure 2-1.

CAUTION

The structural panels shown on figure 2-2 must be installed prior to helicopter ground run, flight, or ground handling.

NOTE

The nonstructural access panels and doors shown on figure 2-3 may be removed during helicopter ground run. All fasteners shall be installed in

structural panels. Nonstructural panels may have every third fastener missing, however, no panel shall have more than thirty-three percent of the total number of fasteners missing.

b. The damage limits provided in chapter 2 on bonded panels are not intended to red X the aircraft. The limits are to provide guidance for scheduling repair or replacement at a schedule maintenance interval. When damage limits, particularly bond voids in bonded panels, are exceeded, the responsible unit maintenance authority will establish a reoccurring special inspection on the damaged area until the damage to the structure is corrected. If the damage is in the area that requires engineering authority for repair, engineering should be contacted in writing with a description of damage. If depot assistance will be required, unit should contact AVSCOM, AMSAV-MDP with your requirement.

Section I. FUSELAGE**2-2. Fuselage.**

The fuselage constitutes the primary structural assembly of the helicopter. It encloses and/or supports such major provisions and systems as the tandem crew compartment, the engine, the fuel and oil systems, the armament system, the transmission and main rotor pylon, the alighting gear, the wings and the tailboom. See figure 2-1.

the seal and burn the sample. Silicone seals burn readily and leave a gray ash residue. Rubber-type seals are more fire resistant and leave a black ash residue.

*d. Installation.***WARNING**

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

CAUTION

Do not permit methyl-ethyl-ketone to contact acrylic windows of canopy or canopy doors.

NOTE

It is necessary to thoroughly clean surfaces prior to sanding to avoid working foreign matter into pores of material.

2-3. Seals on Doors, Cowlings and Fairings.

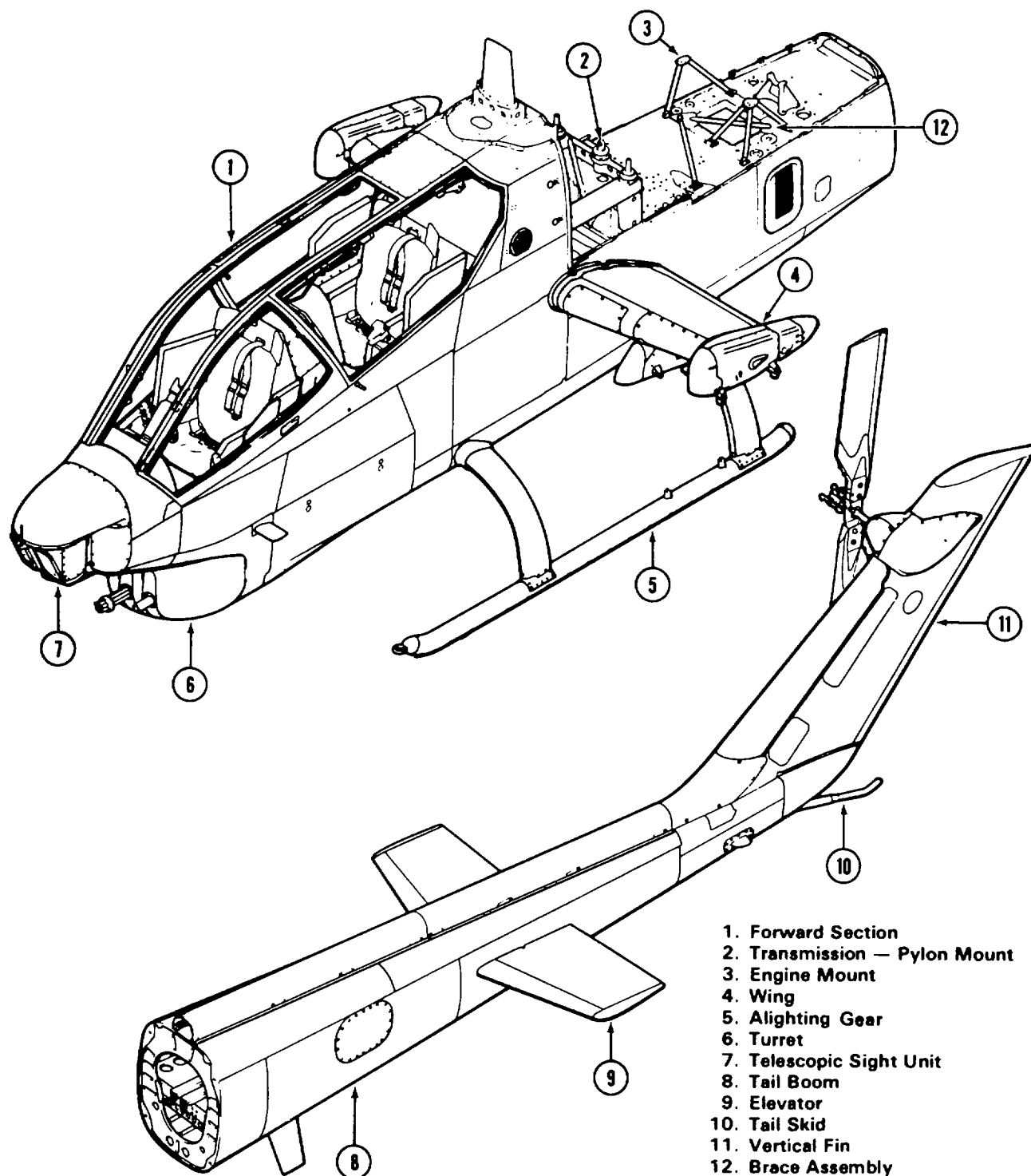
Many of the doors, cowlings and fairings have replaceable seals. The seals may be either of rubber or silicone composition. Seals that are subjected to fuel and/or oil contamination are of the polysulfide or neoprene rubber type.

a. Inspect seals for failed bonding, tears, breaks and deterioration that would affect function.

b. *Removal.* Remove damaged or worn seal. Use paint remover (C105) to remove old adhesive, paint and primer from area where new seal will be installed.

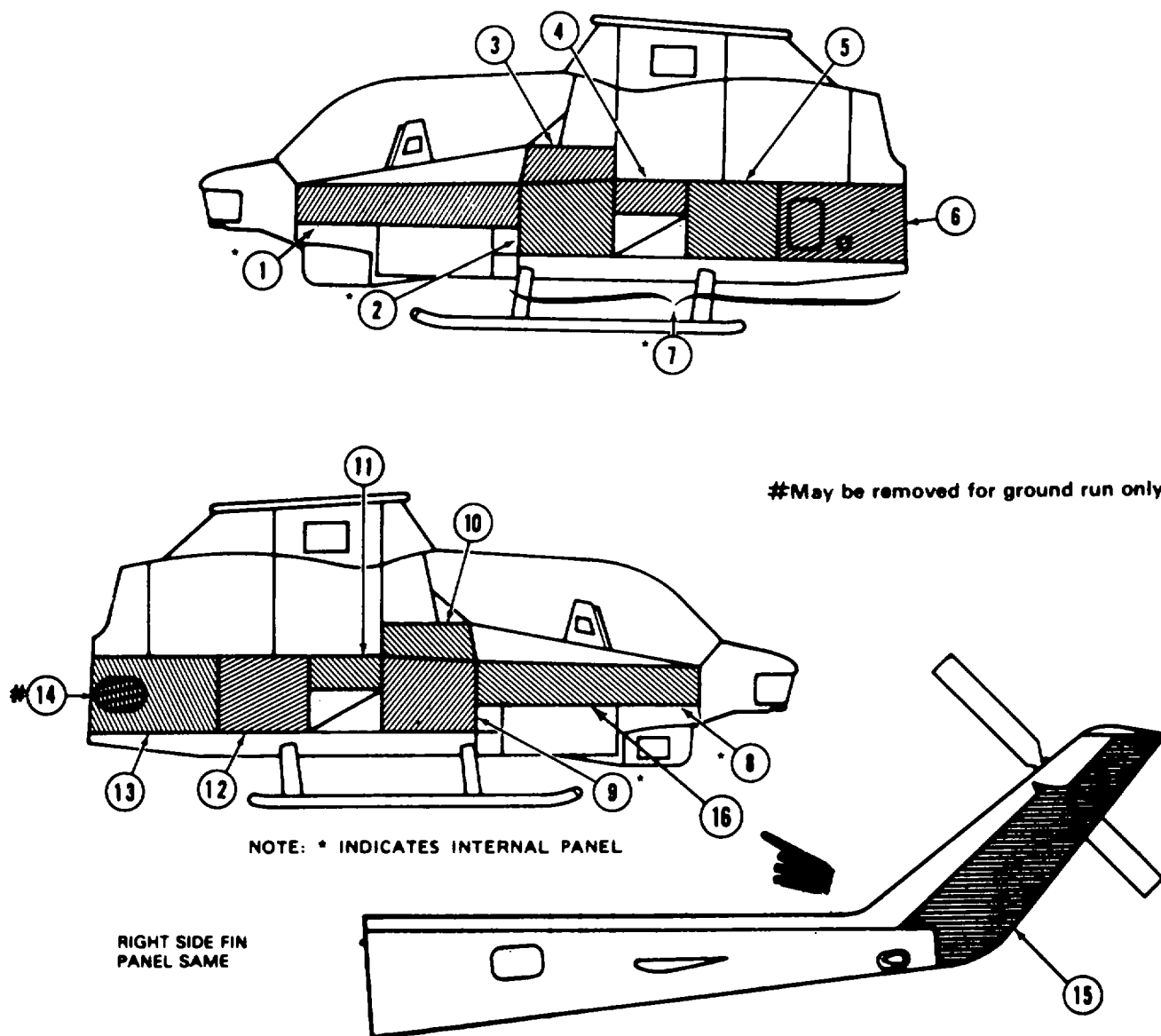
c. *Test to determine seal material.* If the type material from which the seal is made must be determined, cut a small sample of material from

(1) Clean new seal and the metal where it is to be applied with methyl-ethyl-ketone (C87) and dry with a clean cloth. Sand the mating surfaces of



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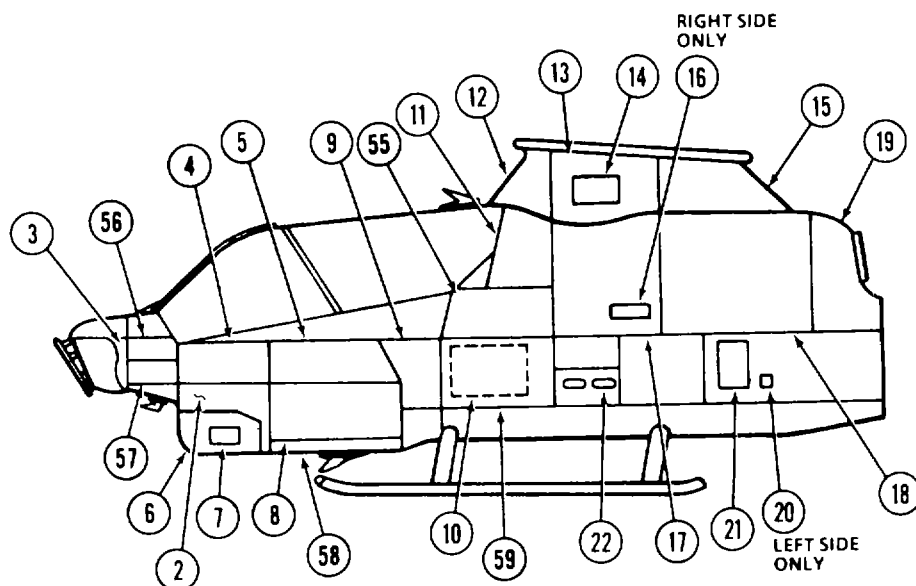
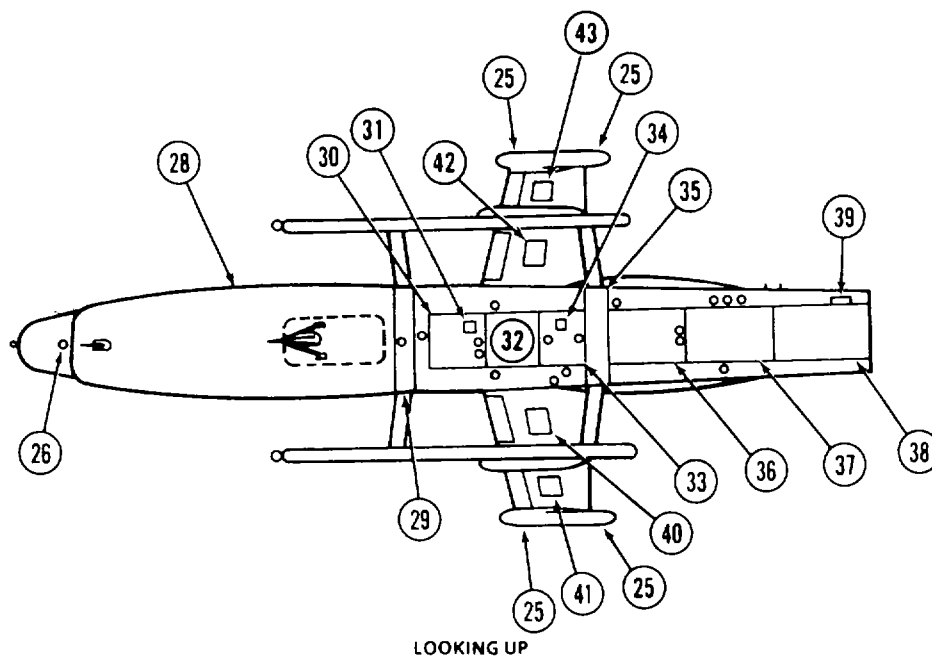
Figure 2-1. Fuselage, wings, pylon mount and tailboom



NOMENCLATURE	TYPE FASTENER	NOMENCLATURE	TYPE FASTENER
1. Beam Panel	Rivet	9. Beam Panel	Rivets
2. Fuel Cell Access Panel	Screws	10. Fuel Cell Support Panel	Rivets
3. Upper Fuel Cell Panel	Screws	11. Pylon Support	Rivets
4. Pylon Support	Rivets	12. Fuel Cell Access Panel	Screws
5. Beam Panel	Rivets	13. Beam Panel	Rivets
6. Beam Panel	Rivets	*14. Access Panel	Turnlocks
7. Lower Beam Panels	Rivets	15. Fin Panel	Rivets
8. Beam Panel	Rivets	16. Ammunition Compartment Upper Panel	Screws

209030-307B

Figure 2-2. Structural panels

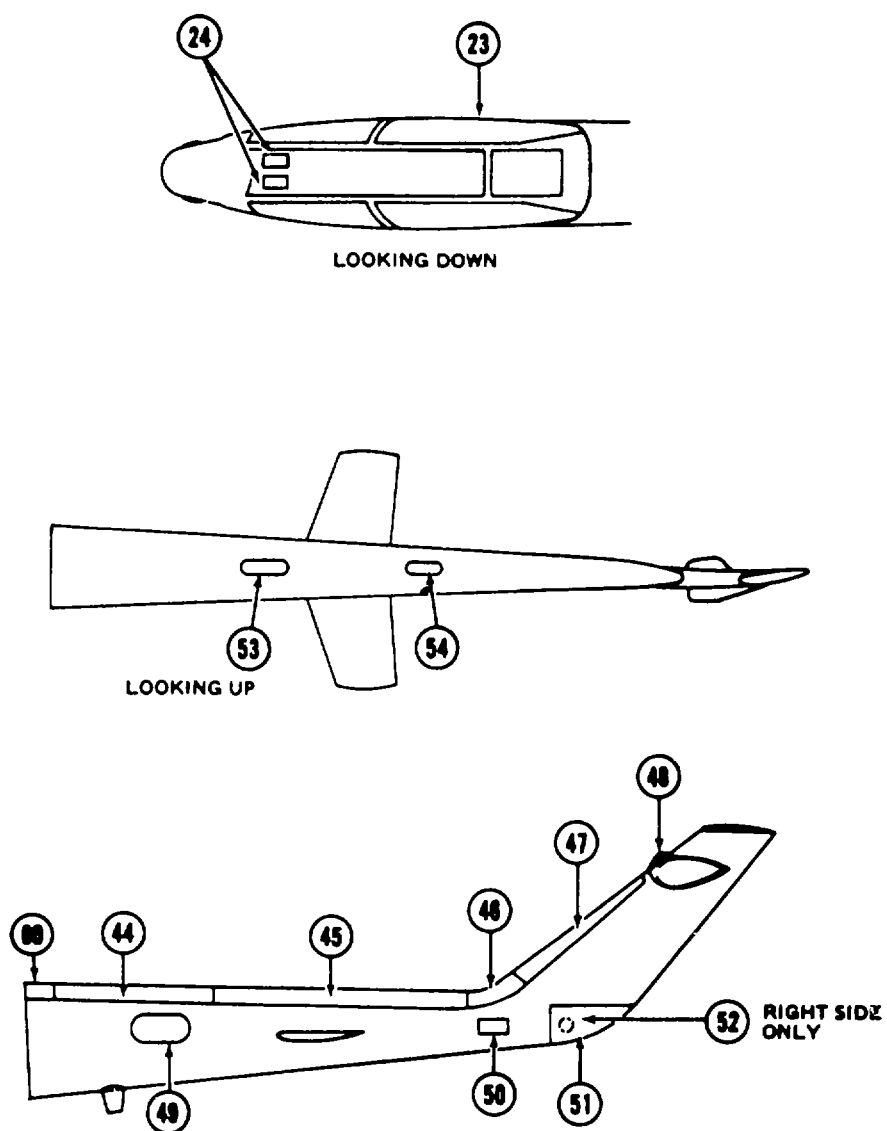


NOTE

Wire strike protection system installed by
MWO 55-1520-234-50-2 and MWO 55-1520-234-50-3.

209030-395-1

Figure 2-3. Non-structural access panels, doors and fairings (Sheet 1 of 4)



209030-231-2C

Figure 2-3. Non-structural access panels, doors and fairings (Sheet 2 of 4)

ITEM	ACCESS TO:
1. Deleted	Deleted
2. Lower Fairing (left and right)	Armament
3. Lower Fairing (left and right)	Telescopic sight unit
4. Outer Panel (left and right)	Flight controls
5. Outer Panel (left and right)	Flight controls
6. Turret Fairing (left and right)	Turret exterior
7. Turret Access Door (left and right)	Armament
8. Ammunition Compartment Door (left and right)	Ammunition stowage, leveling points
9. Outer Panel (left and right)	Flight controls
10. Outer Panel (left and right)	Structural fuel cell panel (left access)
11. Access Door (left and right)	Hydraulic reservoirs and modules, air distribution ducts
12. Forward Pylon Fairing	Cabin air intake, rotating controls
13. Center Pylon Fairing (left and right)	Rotating controls, mast rotating beacon
14. Access Door (left and right)	Rotating controls
15. Aft Pylon Fairing	Engine Oil Tank
16. Window	Transmission oil sight gage
17. Transmission Cowl Assembly (left and right)	Transmission, driveshafts, engine air induction
18. Engine Cowl Assembly (left and right)	Engine compartment
19. Tailpipe Fairing driveshaft	Exhaust tailpipe, tail rotor
20. External Power Door (left side only)	External power receptacle
21. Oil Cooler Duct Panel (left side only)	Oil coolers, turbine fan
22. Access Panels Assembly (left and right)	Lower transmission, lift beam, hydraulic units, control linkage
23. Access Door	Tow interface unit
24. Gunners Floor Access Panel (left side)	Armament turret
25. Pylon Access Panels	Pylon hydraulic and electrical units
26. Access Plate and Plug	Telescopic sight unit test connection
27. Deleted	Deleted
28. Ammunition Compartment Aft Panel	SCAS transducer, hydraulic lines
29. Forward Crosstube Fairing	Forward crosstube supports
30. Lower Skin Panel	Forward fuel cell sump
31. Drain Cover	Forward fuel drain
32. *Lower Skin Panel	Deleted
33. Lower Skin Panel	Aft fuel cell sump
34. Drain Cover	Aft fuel drain
35. Aft Crosstube Fairing	Aft crosstube supports
36. Lower Skin Panel	Control linkages
37. Lower Skin Panel	Electrical cables
38. FM Sense Antenna	Antenna and SCAS control tube
39. Jack Point Opening	Jack and mooring point
40. Wing Inboard Access Covers (right)	Tow hydraulic and electrical installation

*NOTE

After incorporation of MWO 55-1520-234-50-3, lower skin panel is replaced by relocated loop antenna.

209030-395-2

Figure 2-3. Non-structural access panels, doors and fairings (Sheet 3 of 4)

41.	Wing Outboard Covers (right)	Tow hydraulic and electrical installation
42.	Wing Inboard Covers (left)	Tow hydraulic and electrical installation
43.	Wing Outboard Access Covers (left)	Tow hydraulic and electrical installation
44.	Driveshaft Center Cover	Tail rotor driveshaft
45.	Driveshaft Aft Cover	Tail rotor driveshaft
46.	Gearbox Cover	42 degree gearbox
47.	Fin Driveshaft Cover	Tail rotor driveshaft, control cables
48.	Gearbox Fairing and Cover	90 degree gearbox
49.	Avionics Compartment Door (left)	Avionics. electronics equipment and cooling fan
50.	Tail Skid Access Covers	Tail skid attach point
51.	Aft Fin Fairing	Tail structure
52.	Lower Fin Inspection Cover	Tail structure
53.	Tail Boom Access Door	Control linkage
54.	Tail Boom Access Door	Cooling fan
55.	Fuel Cell Access Panel	Fuel Cell
56.	Access Panel	Telescopic sight unit wiring
57.	Access Panel	Controls - gunner
58.	Access Panel	Telescopic sight unit wiring
59.	Access Door (right side only)	Interface control unit
60.	Driveshaft Forward Cover	Tail rotor driveshaft

209030-231-4C

Figure 2-3. Non-structural access panels, doors and fairings (Sheet 4 of 4)

both seal and metal with 180 grit sandpaper (C112). Clean the sanded surface with methyl-ethyl-ketone (C87).

(2) Bond rubber-type seals as follows:

(a) Clean surfaces as outlined in step (1).

(b) Refer to step c for instructions to identify rubber-type seals.

(c) Apply an even coat of rubber adhesive (C14) to the mating surfaces of the seal and the metal.

(d) Allow adhesive to air dry 10 to 15 minutes at 75 degrees F. or above. Check adhesive by touching with finger. When adhesive will adhere to finger but not transfer, apply a second coat of adhesive and air dry to the same degree.

(e) When second coat of adhesive has air dried until tacky, install seal on metal. Start at one end and roll seal onto metal. Press down on seal to ensure that all air is expelled and that the seal is in full contact with the metal.

NOTE

Adhesive (C14) will cure at temperatures as low as 50 degrees F. For each 12 degrees F below 75 degrees F the cure time must be doubled. No attempt to bond should be made when temperature is below 50 degrees F. Where possible bond surfaces should be heated to 75 degrees F by use of heat lamp or heat gun.

(f) Allow bond to air dry for a minimum of four hours at 75 degrees F or above.

(3) Bond silicone composition seals as follows:

(a) Clean surface, as outlined in step (1).

(b) Refer to step c for instructions to identify silicone composition seals.

CAUTION

Do not place a cap on the adhesive used in the following step after it is mixed. This two-part adhesive releases hydrogen gas

after mixing which could result in high pressures. The pot life on the mixed adhesive is six hours.

(c) Mix adhesive (C18) in accordance with instructions on the container. Apply an even coat of adhesive to the mating surfaces of the seal and the metal.

(d) Allow the adhesive to air dry at 75 degrees F. or above for at least one hour but not more than eight hours. Install seal on metal. Start at one end and roll seal onto metal. Press down on seal to ensure that all air is expelled and that the seal is in full contact with the metal.

NOTE

Adhesive (C 18) will cure at temperatures as low as 50 degrees F. For each 12 degrees F below 75 degrees F the cure time must be doubled. No attempt to bond should be made when temperature is below 50 degrees F. Where possible bond surfaces should be heated to 75 degrees F by use of heat lamp or heat gun.

(e) Allow bond to cure for a minimum of twelve hours at 75 degrees F. or above.

(4) Functional check. Install door, cowling or fairing and check to ensure that the new seal fits properly.

2-4. Honeycomb Construction Fuselage and Tailboom Fin Panels.

The principal part of the fuselage and fin structure is honeycomb panels. The panels have an aluminum core that resembles honeycomb. Facings are bonded to the honeycomb to form the panel. The facings may be fiberglass or metal. The fuselage panels are joined together and supported by the primary structural caps which are shown on figure 2-4 by solid black shading. Panels on the unshaded portion of figure 2-2 are either of honeycomb panel construction or of conventional sheet metal construction. Refer to TM 55-1500-204-25/1 for repair instructions for the sheet metal construction panels.

a. *Inspection.* Inspect honeycomb panels for cracks, punctures, corrosion, delamination and damaged inserts. Refer to figures 2-5 through 2-19

and 2-68A for specific damage limits. Replace panels with damage in excess of the limits shown on the illustrations. Refer to paragraph 2-13 for instructions to replace panels.

b. Repair mechanical damage to fuselage and tailboom fin honeycomb panels as outlined in this paragraph. Repair damaged fasteners (inserts) as outlined in paragraphs 2-5 through 2-10.

c. *Dent, Scratch, Void and Penetration Damage Repair.* Damage to honeycomb panels varying from minor dents to penetration completely through the panel is classified as type A, type B, type C or type D damage. The damage descriptions, damage limits and repair procedures are shown in figures 2-20 through 2-23. Specific damage limits for tailboom vertical fin panels are shown in figure 2-68A. When type A through type D damage is present on a panel and is in the "repair permissible" area as shown on figures 2-5 through 2-19, repair the damage as shown on figures 2-20 through 2-23 as applicable.

d. Standard Patch Repairs for Honeycomb Panels.

(1) Use the same materials to fabricate patches that were used in the original construction with two exceptions: Stainless steel (item 58, table 2-2) 1/4 hard or harder may be used to repair honeycomb panels which have titanium skin. Other material substitutions can be made when qualified authority approves the substitute material.

(2) Repair damage that is within limits shown on figures 2-5 through 2-23 and 2-68A. Materials required and repair procedures are shown on the illustrations. The chemicals, adhesives and compounds required are listed in the consumable materials table. Instructions for using these materials are on the containers.

e. Edge Repairs for Honeycomb Panels.

Repair damage that is within limits as shown on figure 2-5 through 2-19. Comply with the following additional instructions for fiberglass and metal faced panels shown on figures 2-24 through 2-28.

(1) Fiberglass

(a) Use only type C fiberglass cloth 0.010 inch thick (C46) when making edge repairs. The repair must equal or exceed the number of plies lost.

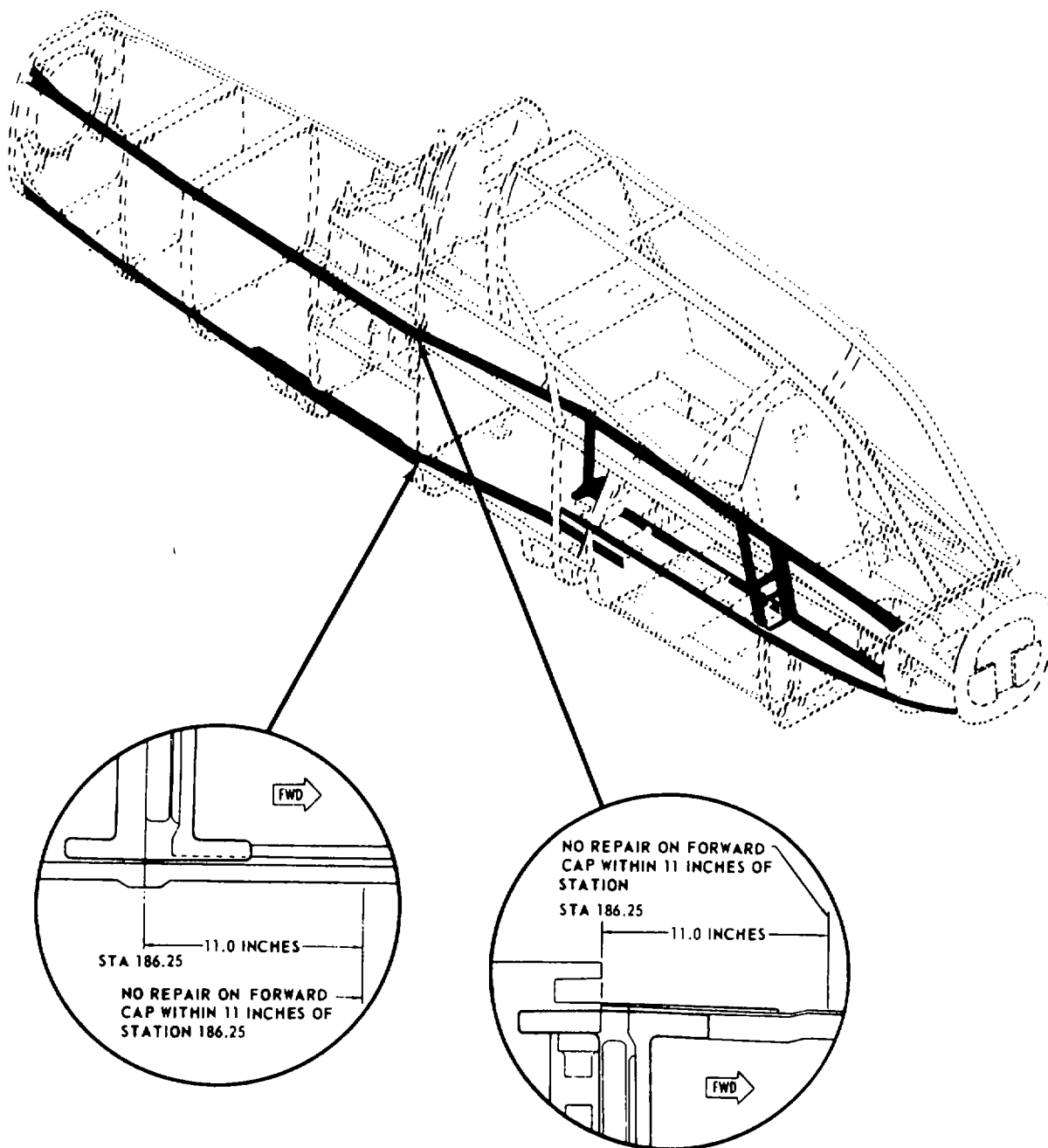
(b) Remove all old finish from repair area with varying grades of sandpaper (C112).

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

(c) Clean sanded area with clean cloth moistened with methyl-ethyl-ketone (C87).

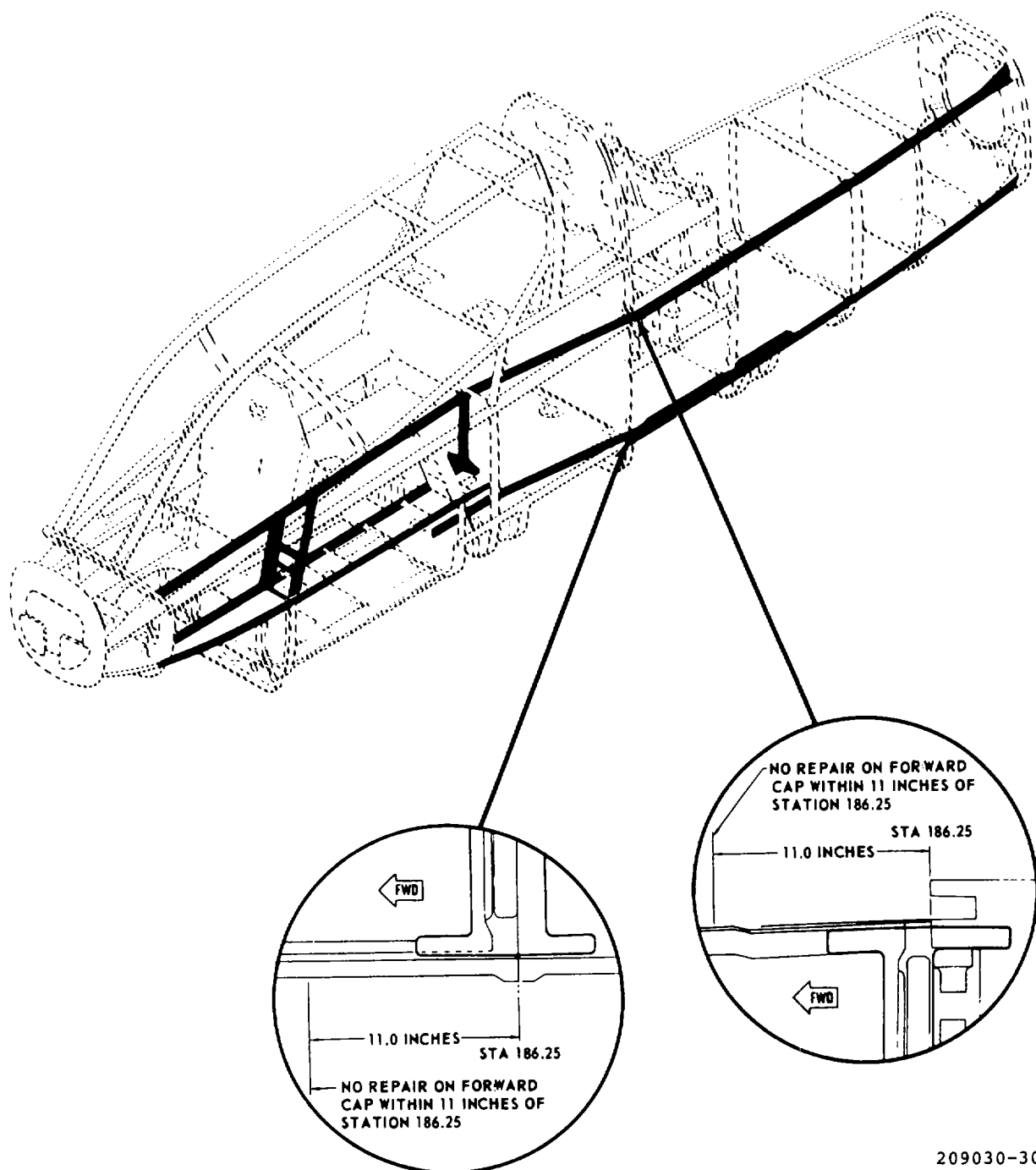
Primary structural caps. No repairs permitted except with specific approval by engineering authority. Replace damaged caps.



205030-1002

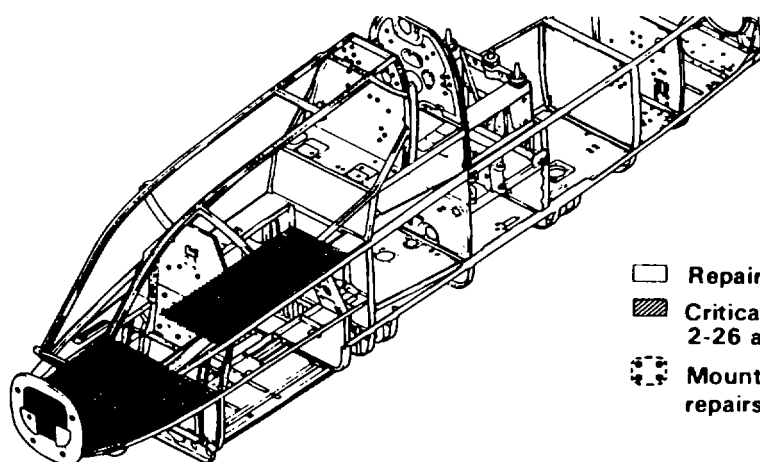
Figure 2-4. Primary structural cap. (Sheet 1 of 2)

Primary structural caps. No repairs permitted except with specific approval by engineering authority.



209030-306

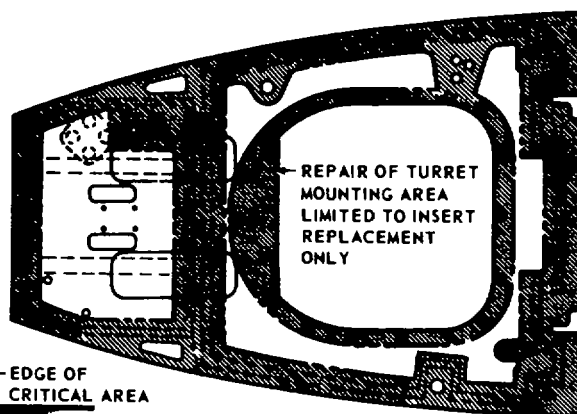
Figure 2-4. Primary structural caps (Sheet 2 of 2)



NOTES

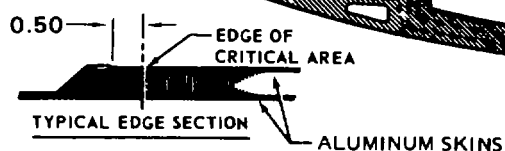
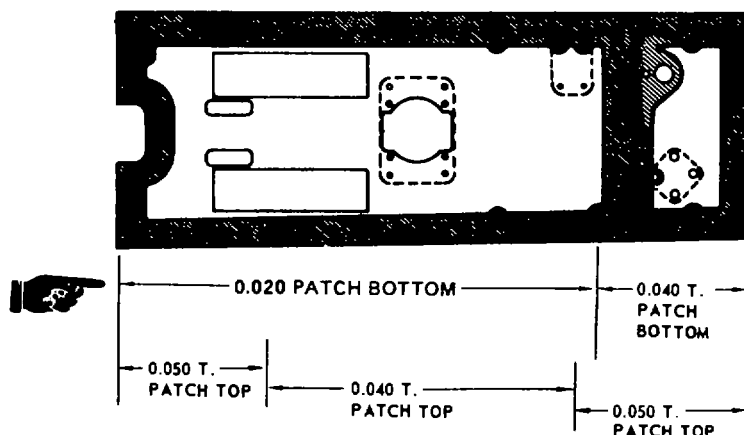
- Repairs permissible
- ▨ Critical area. Repair I/A/W Figures 2-25, 2-26 and 2-27
- ⊕ Mounting surfaces — must be kept level by repairs.

GUNNER FLOOR
209-030-201
MOD. 209-961-231



REPAIR OF TURRET
MOUNTING AREA
LIMITED TO INSERT
REPLACEMENT
ONLY

GUNNER FLOOR REPAIR
0.020 T. TOP
0.032 T. BOTTOM
2024-T3 AL. ALY. PATCH



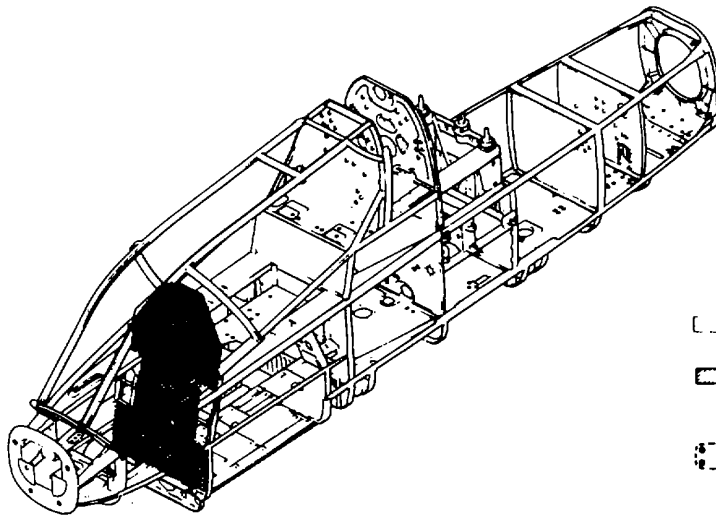
PILOT FLOOR
209-030-202
MOD. 209-961-231

REPAIR MATERIALS
2024 T3 AL ALY FOR
ALL METAL SKIN

FIBERGLASS CLOTH (C46)
ALL FIBERGLASS SKIN
AREA

209030-31H

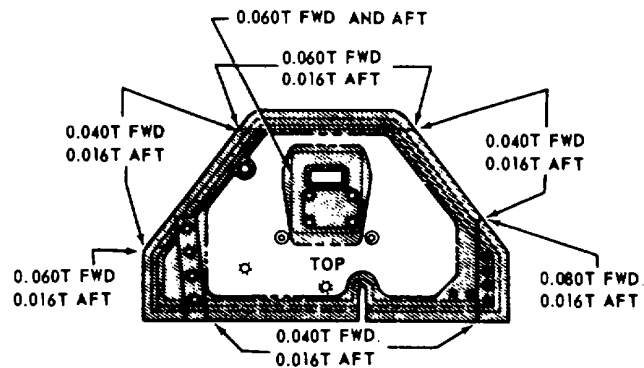
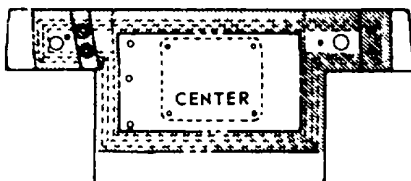
Figure 2-5. Pilot and gunner floor panels



Notes

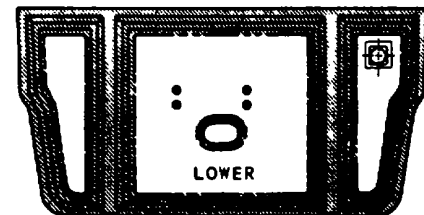
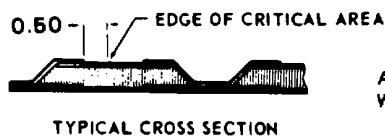
- Repairs permissible
- ▣ Critical area. Repair IAW Figures 2-25, 2-26, and 2-27
- ⊞ Mounting surfaces — must be kept level by repairs

209-030-102, MOD 209-961-231-1
TOP SECTION
REPAIR MATERIAL
AL. ALY. PATCH 2024T3 BOTH FWD
AND AFT, THICKNESS AS INDICATED
FIBERGLASS EDGING (C46)



CENTER SECTION REPAIR MATERIAL
AL. ALY. PATCH 2024T3 0.040T FWD
0.040T AFT. FIBERGLASS EDGING (C46)

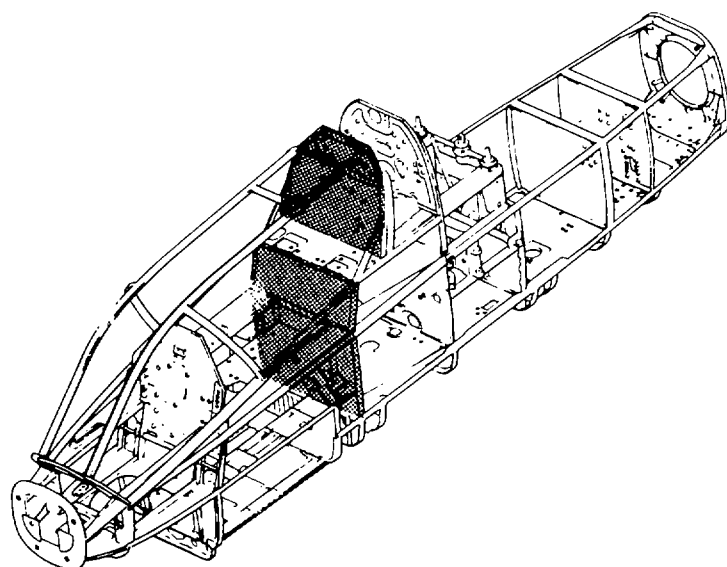
LOWER SECTION REPAIR MATERIAL
AL. ALY. PATCH 2024T3 0.040T FWD
0.040T AFT. FIBERGLASS EDGING (C46)



AL. ALY. OPPOSITE AL. ALY.
WITH FIBERGLASS EDGES (C46)

209030-32G

Figure 2-6. Bulkhead of station 93.0



Notes

- Repairs permissible
- Critical area. Repair IAW repair Figures 2-24, 2-25, 2-26 and 2-27
- Mounting surfaces — must be kept level by repairs

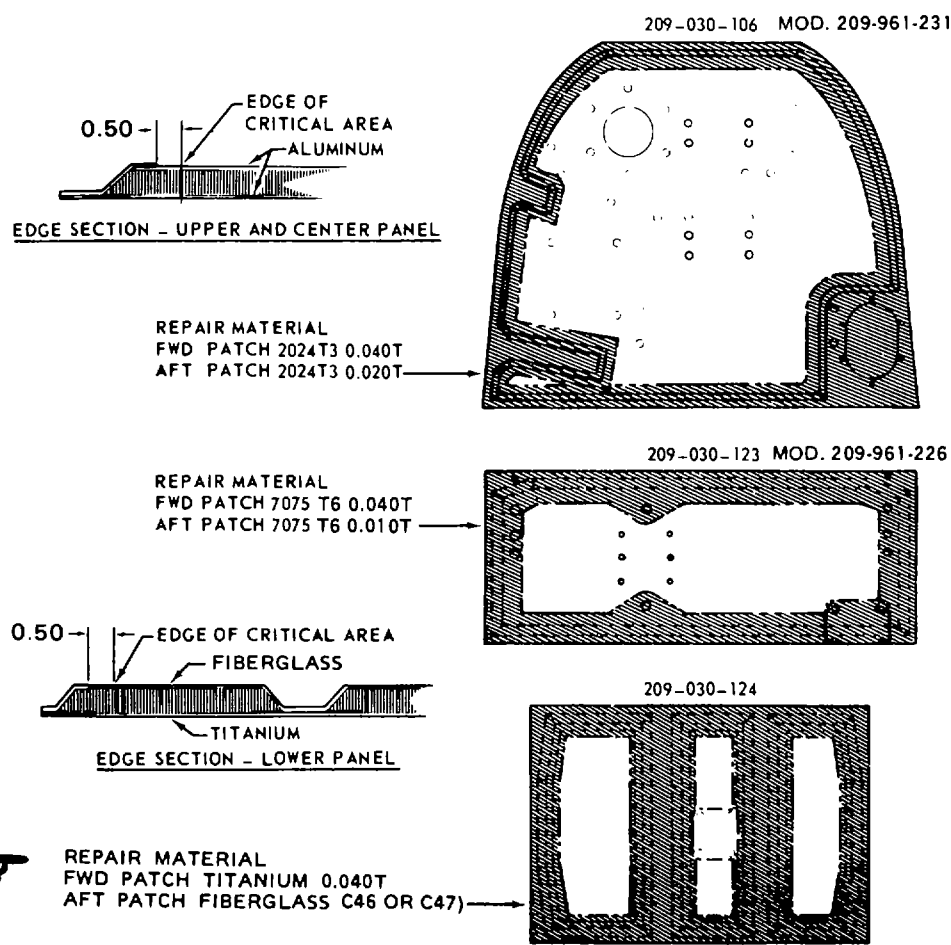
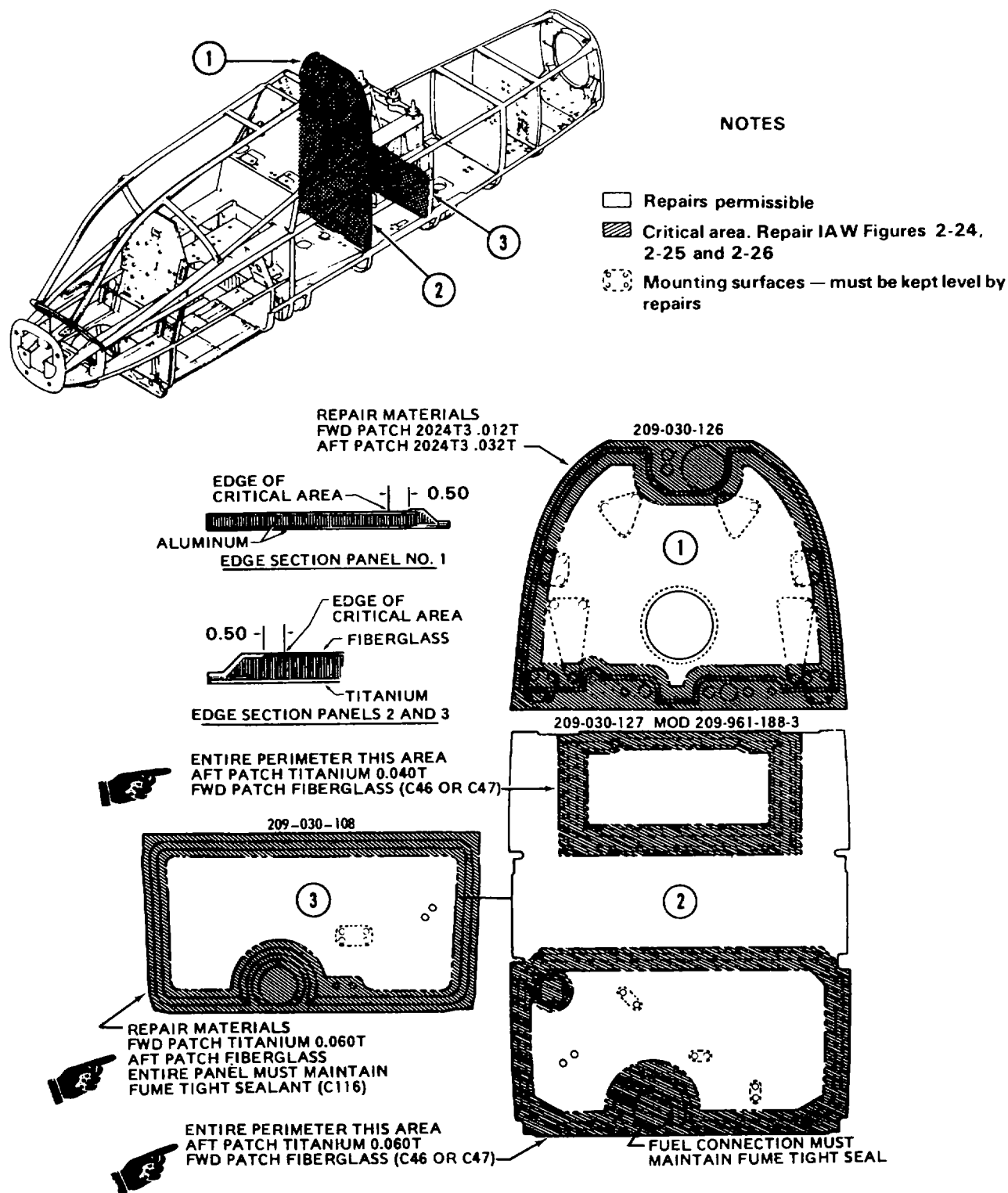
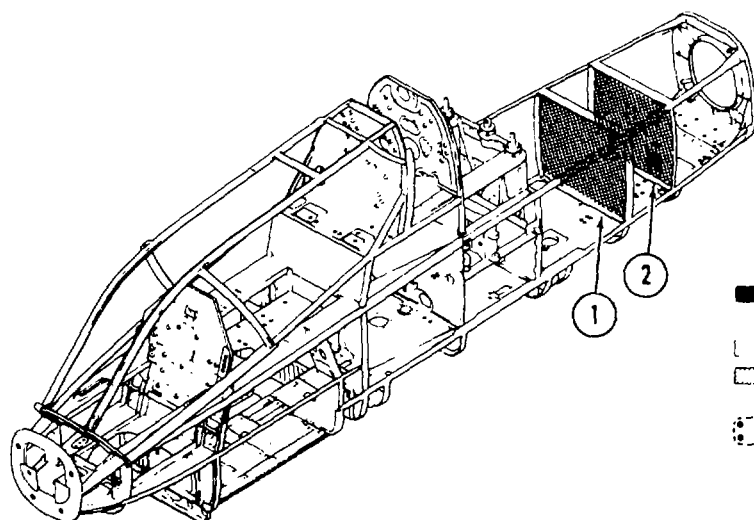


Figure 2-7. Bulkheads at stations 148.5 and 171.61



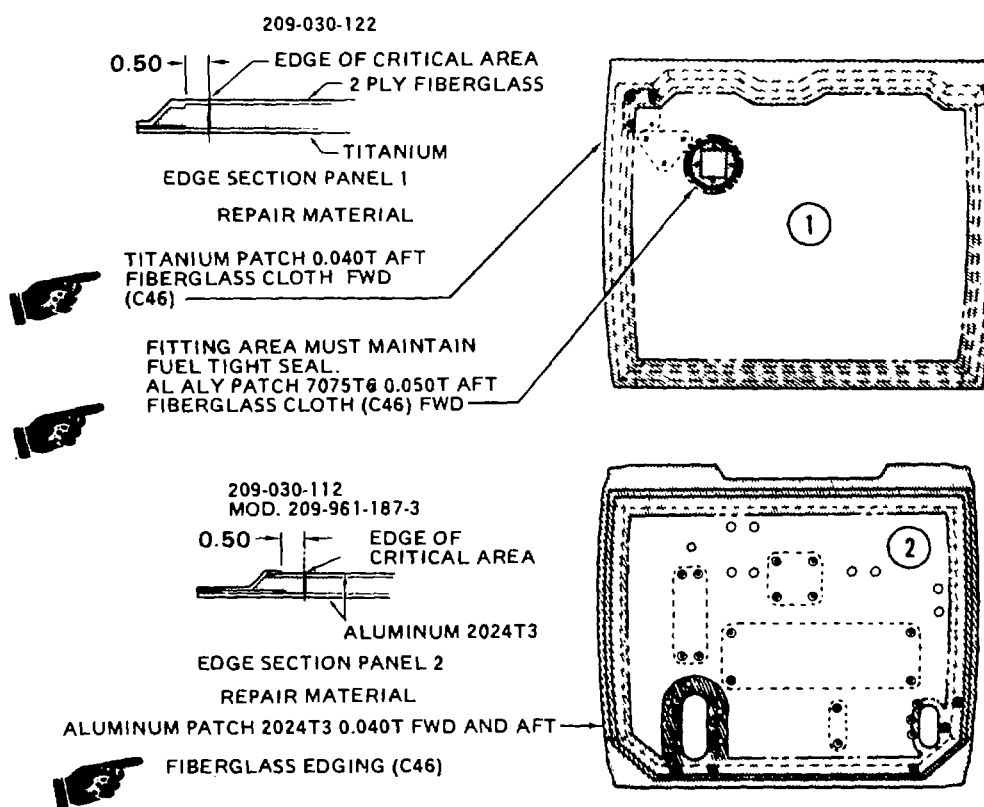
209030-34F

Figure 2-8. Bulkheads at stations 184.5 and 213.94



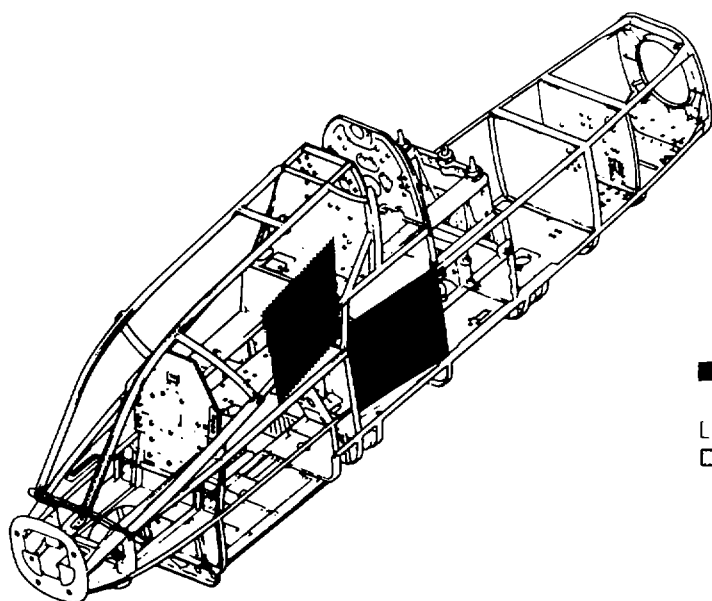
NOTES

- Repair only with approval of qualified Engineering authority
- [ ] Repairs permissible
- ▭ Critical area. Repair 1 A W Figures 2-24, 2-25 and 2-26
- ⊞ Mounting surfaces — must be kept level by repairs



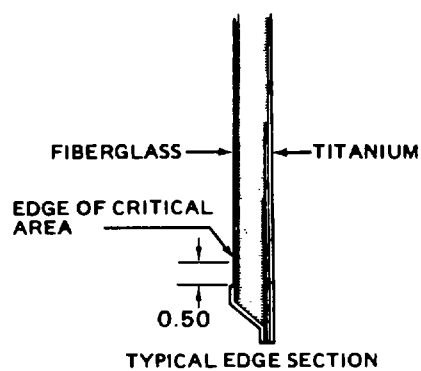
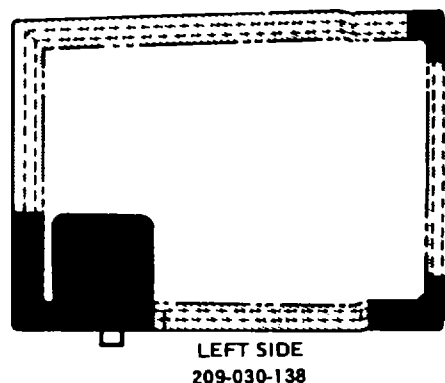
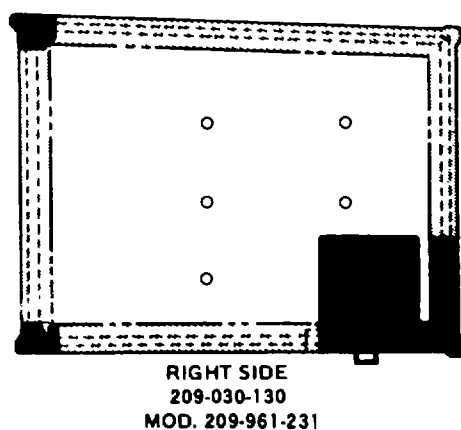
209030-35F

Figure 2-9. Bulkheads at stations 250.0 and 268.5



NOTES

- Repair only with approval of qualified Engineering authority
- Repairs permissible
- Critical area. Repair IAW Figure 2-24



REPAIR MATERIALS

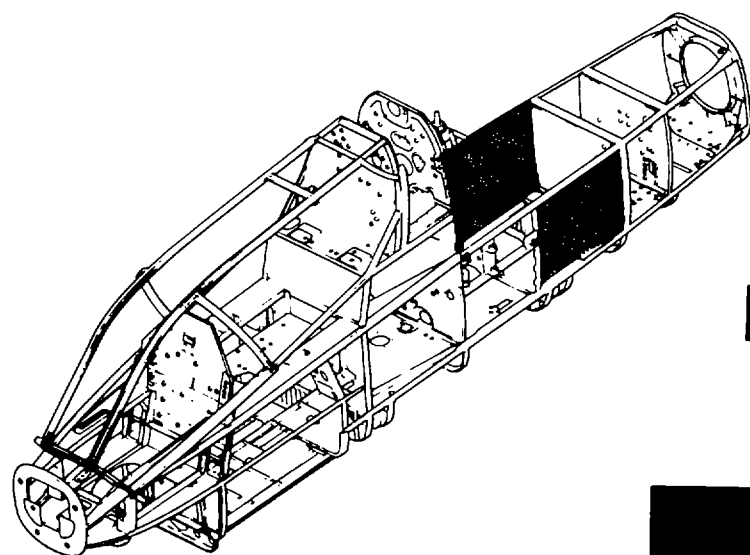
TITANIUM PATCH 0.050 THICK
FOR ALL METAL SKIN AREA.

FIBERGLASS CLOTH (C46)
FOR ALL FIBERGLASS
SKIN AREA



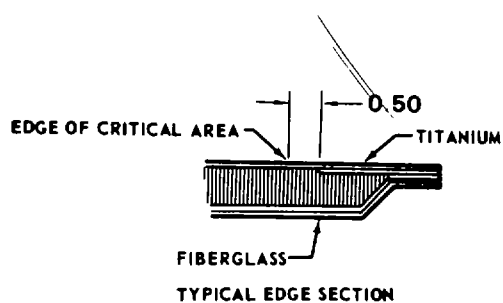
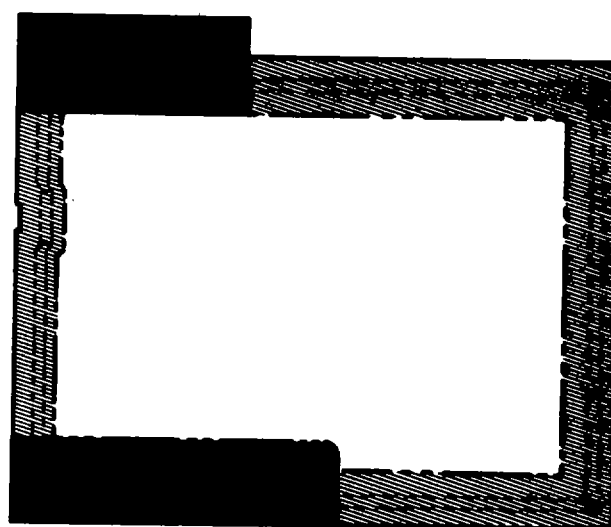
209030-36G

Figure 2-10. Right and left main beam panels at station 148.5 to 186.25

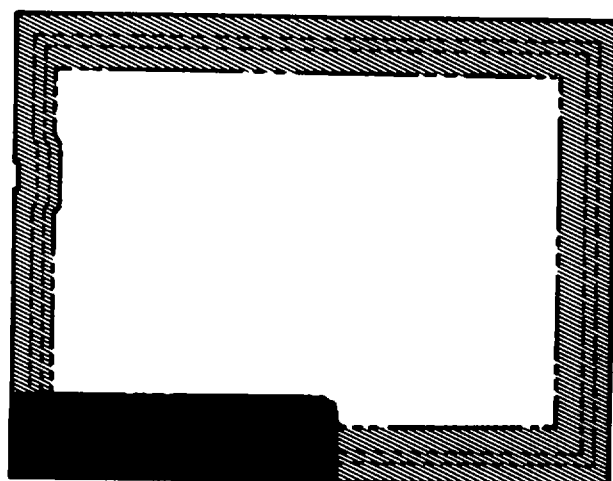


NOTES

- Repair only with approval of qualified Engineering authority
- Repairs permissible
- Critical area. Repair I/A/W
- Figure 2-24
- Mounting surfaces — must be kept level by repairs



LEFT SIDE
209-030-119



RIGHT SIDE
209-030-120

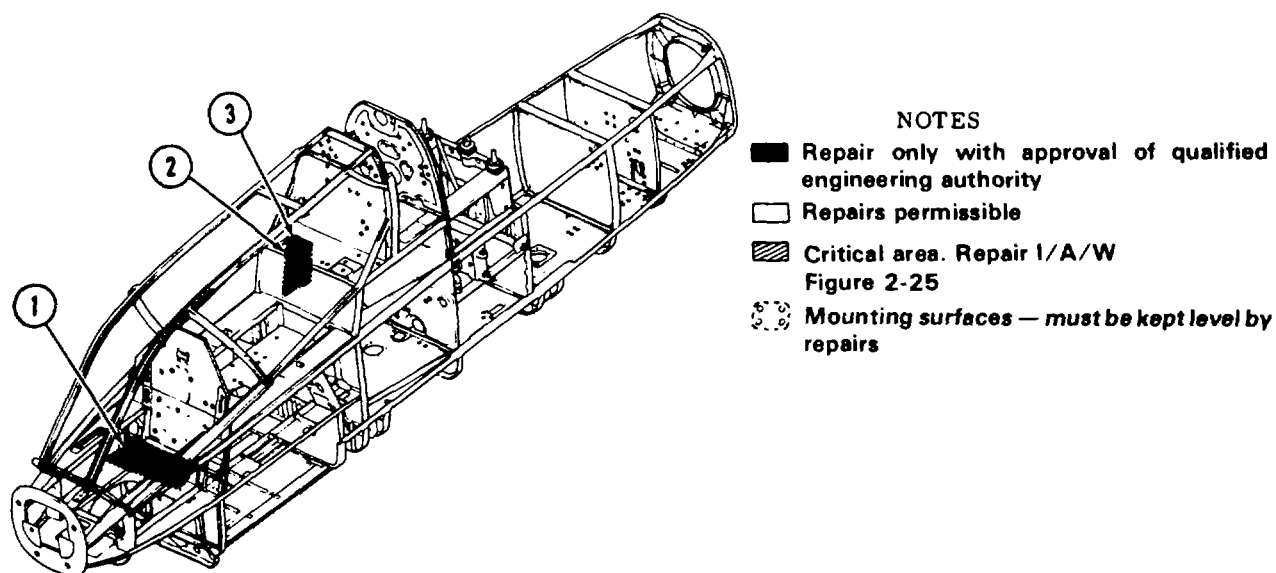
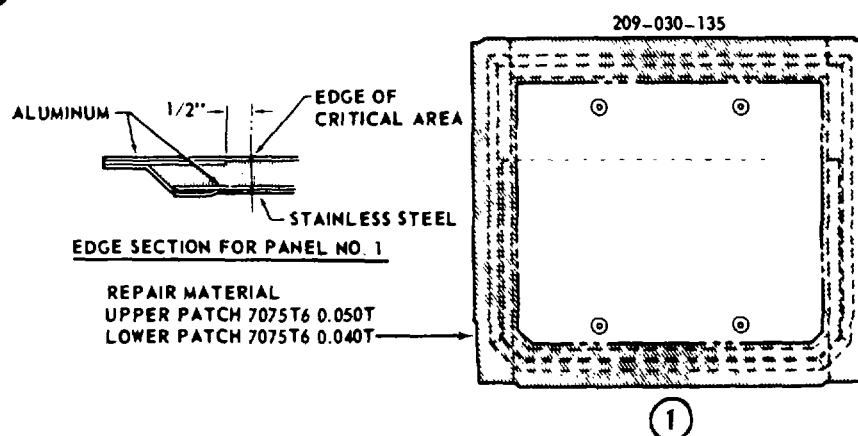
REPAIR MATERIAL

TITANIUM PATCH 0.060 THICK
FOR ALL METAL SKIN AREA

FIBERGLASS CLOTH TYPE C
MIL-C-9084 FOR ALL FIBERGLASS
SKIN AREA

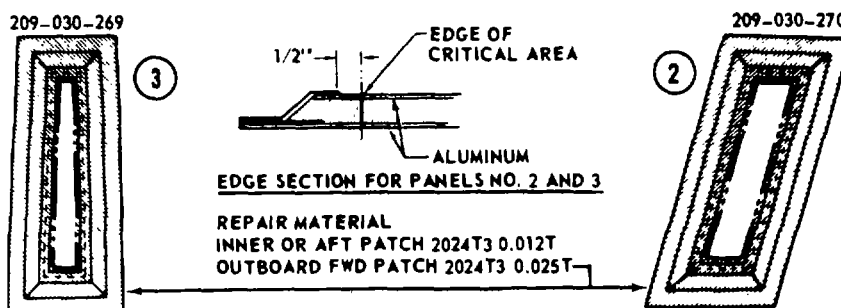
209030-37F

Figure 2-11. Right and left main beam panes at station 213.94 to 250.0



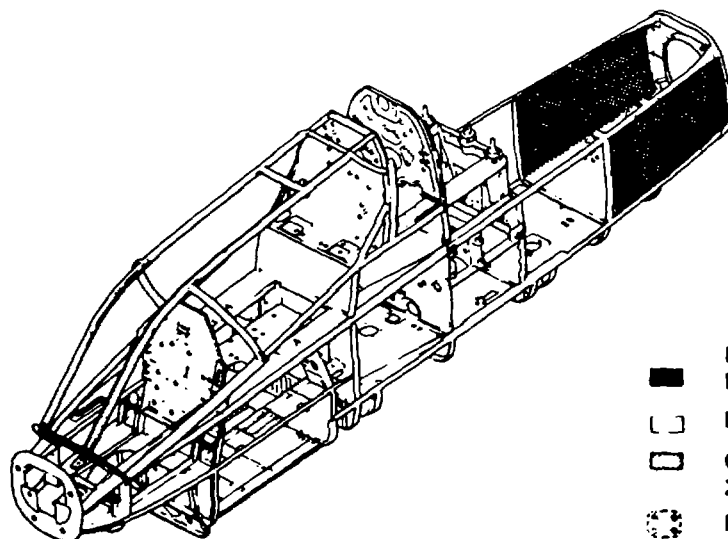
NOTE

Stainless steel plate lower is for crew protection, non-structural, hole may be plugged with bonded stainless steel patch.



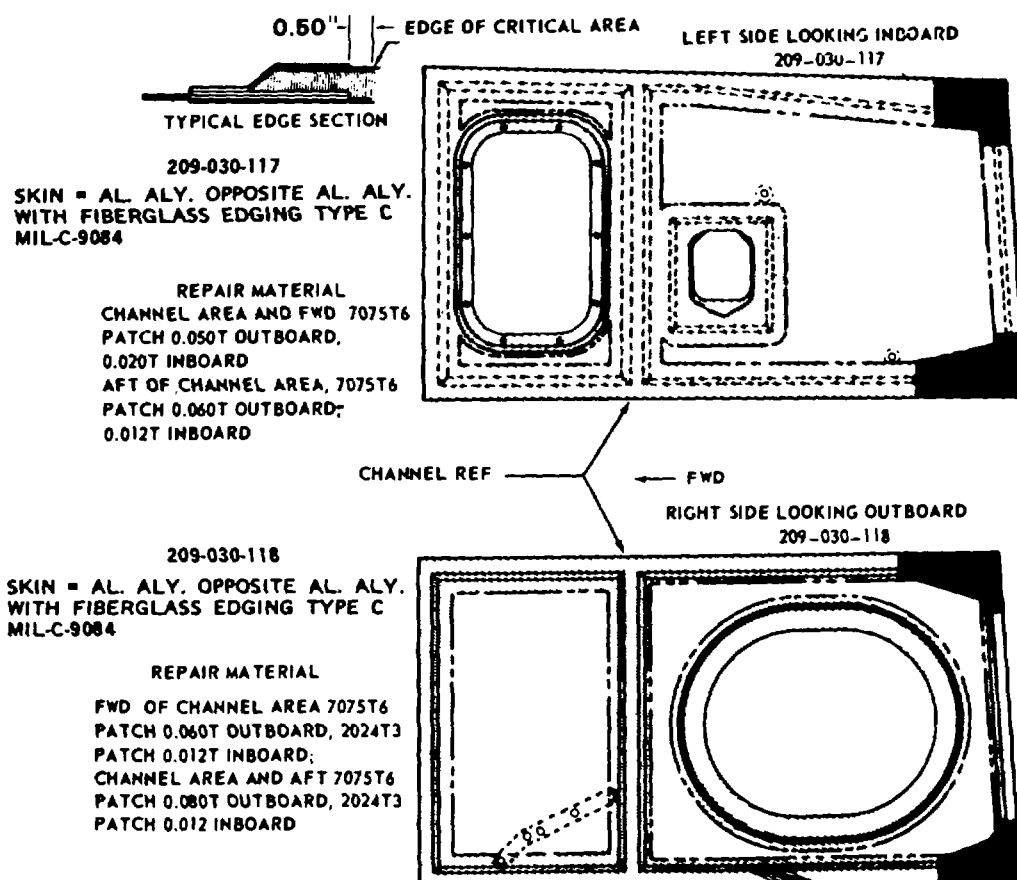
209030-30D

Figure 2-12. Panel at forward fuel cell at right side and gunners floor



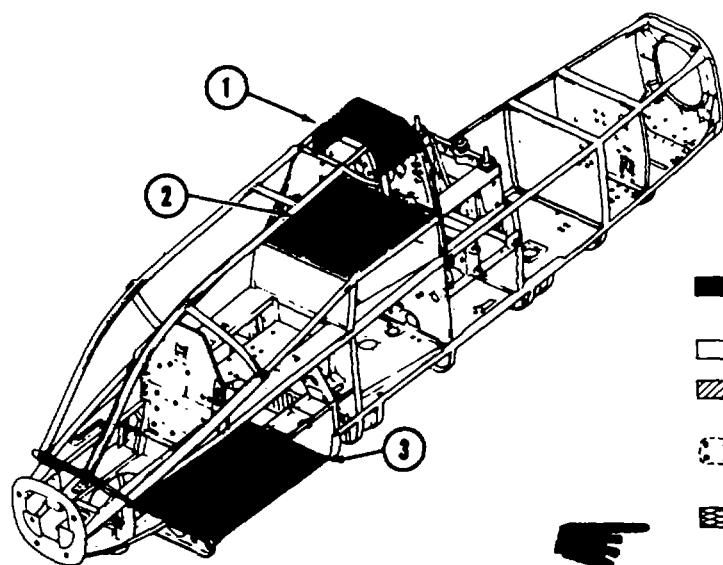
NOTES

- Repair only with approval of qualified Engineering authority.
- Repairs permissible.
- ▭ Critical area. Repair I/A/W Figures 2-25, 2-26, and 2-27
- ⊙ Mounting surfaces — must be kept level by repairs



209030-38E

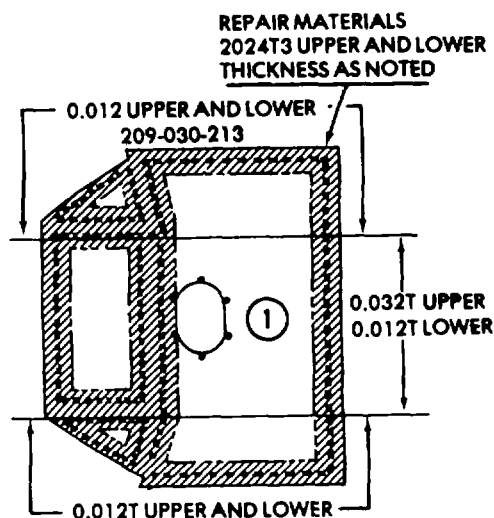
Figure 2-13. Left and right beam panels at station 250.0 to boom station 41.32



NOTES

-  Repair only with approval of qualified Engineering authority
-  Repairs permissible
-  Critical area. Repair I/A/W Figures 2-25 2-26 and 2-27
-  Mounting Surface — must be kept level by repairs
-  Repair I/A/W Paragraph 2-12

209-030-208 MOD. 209-961-317-3



REPAIR MATERIAL
2024T3 PATCH 0.025T OVER
LAID WITH 2 LAYERS OF
FIBERGLASS UPPER.
2024T3 PATCH 0.070T LOWER.

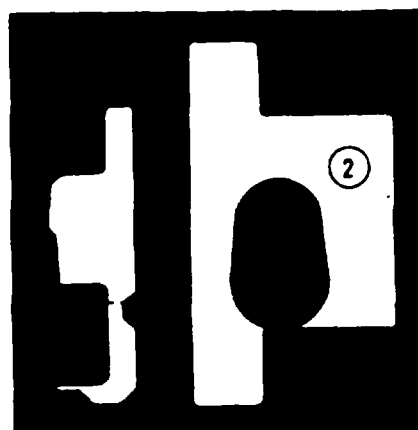
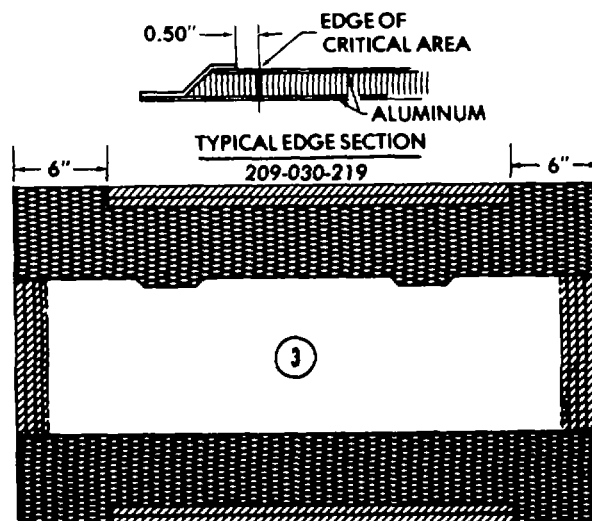
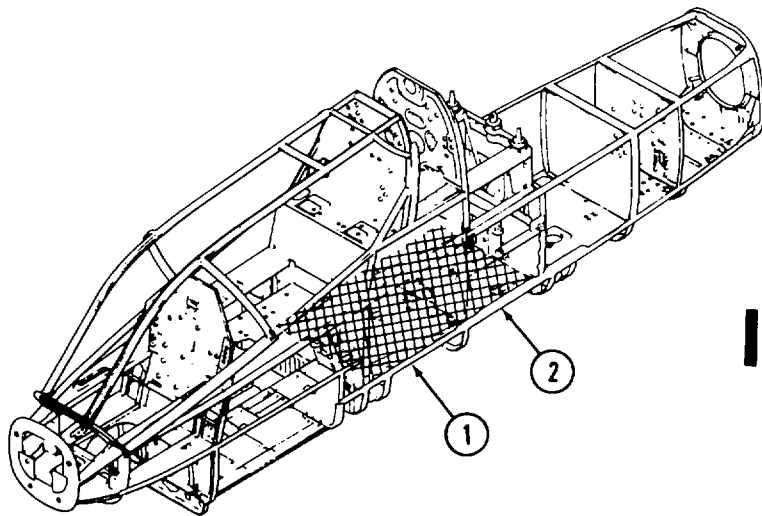
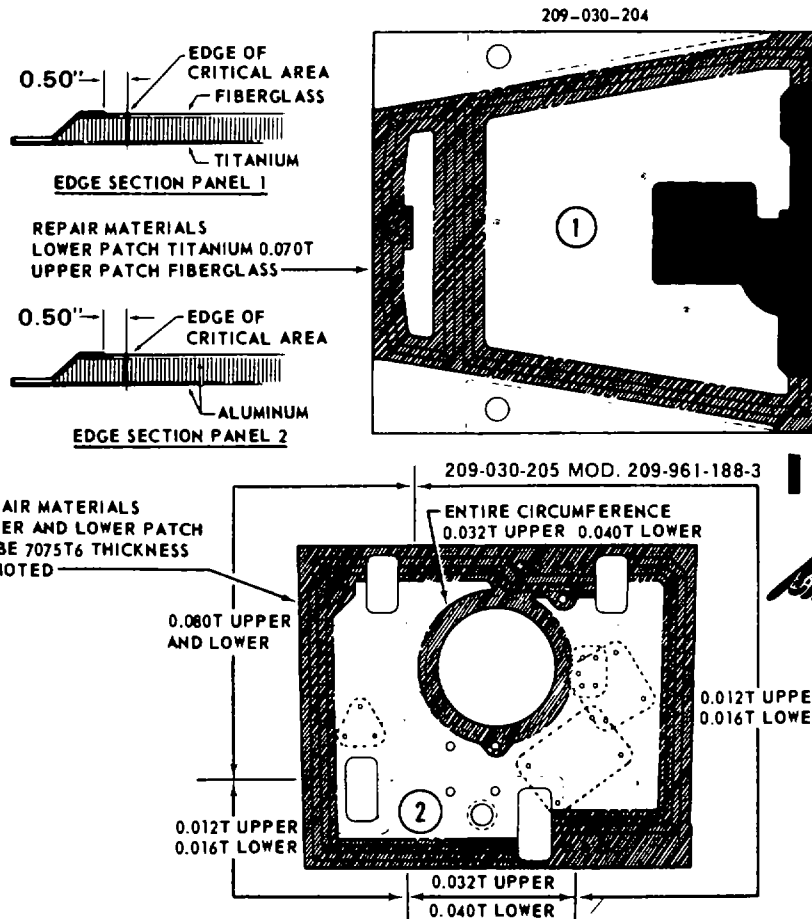


Figure 2-14. AmmoFloor, Support Panel and Forward Fuel Cell Panel at Station 213.94.



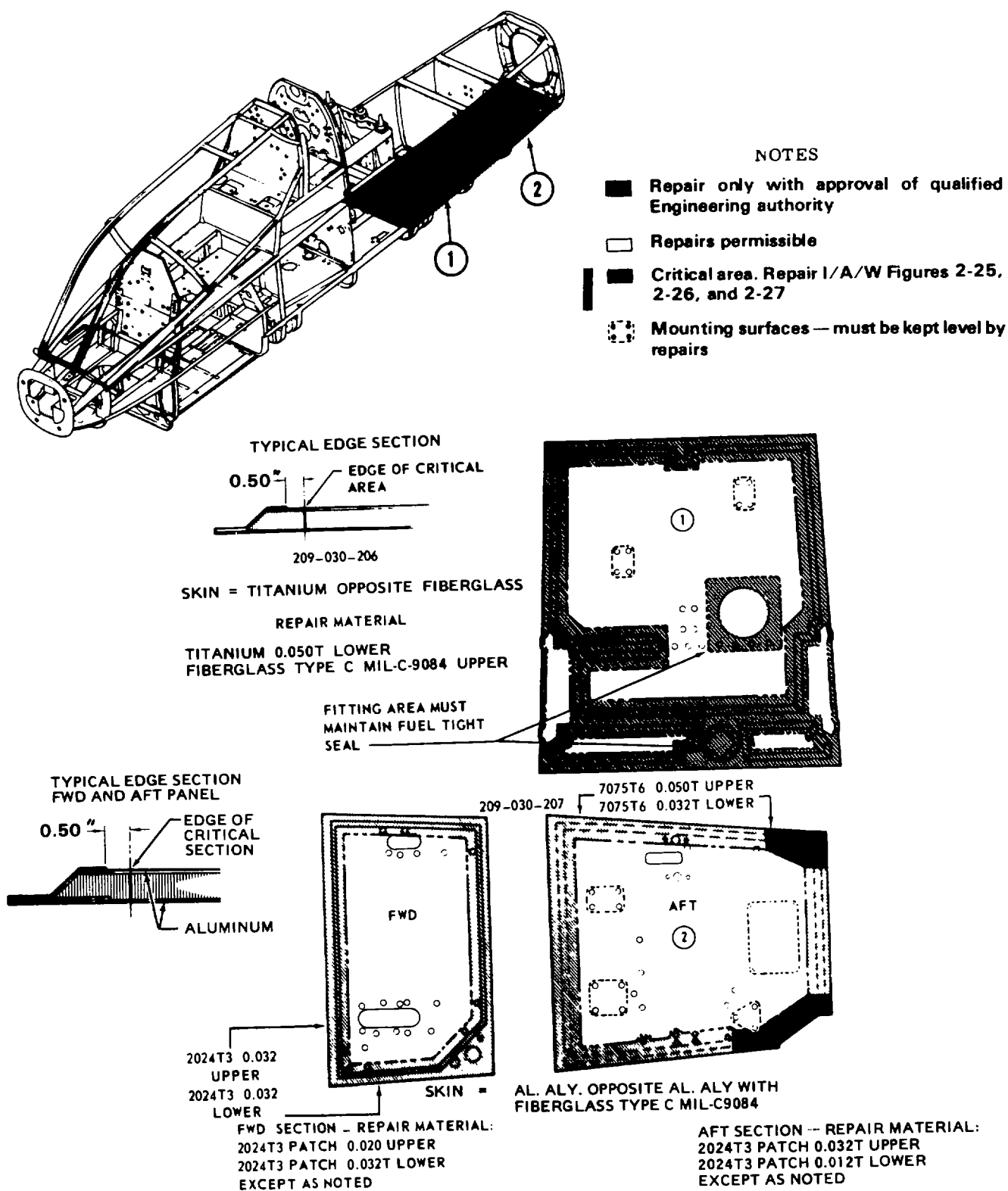
NOTES

- Repair only with approval of qualified Engineering authority
- Repairs permissible
- ▨ Critical area. Repair I/A/W figures 2-24, 2-25, 2-26 and 2-27
- ⊞ Mounting surfaces — must be kept level by repairs



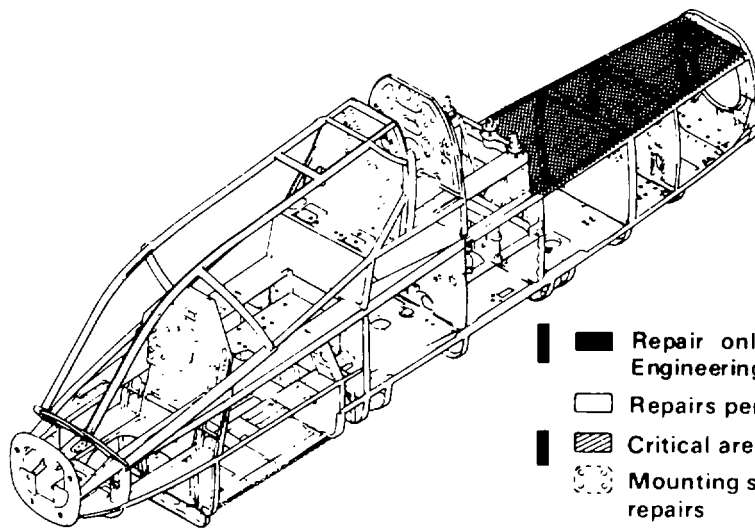
209030-40E

Figure 2-15. Forward fuel cell floor and lower panel at station 186.256 to 213.94



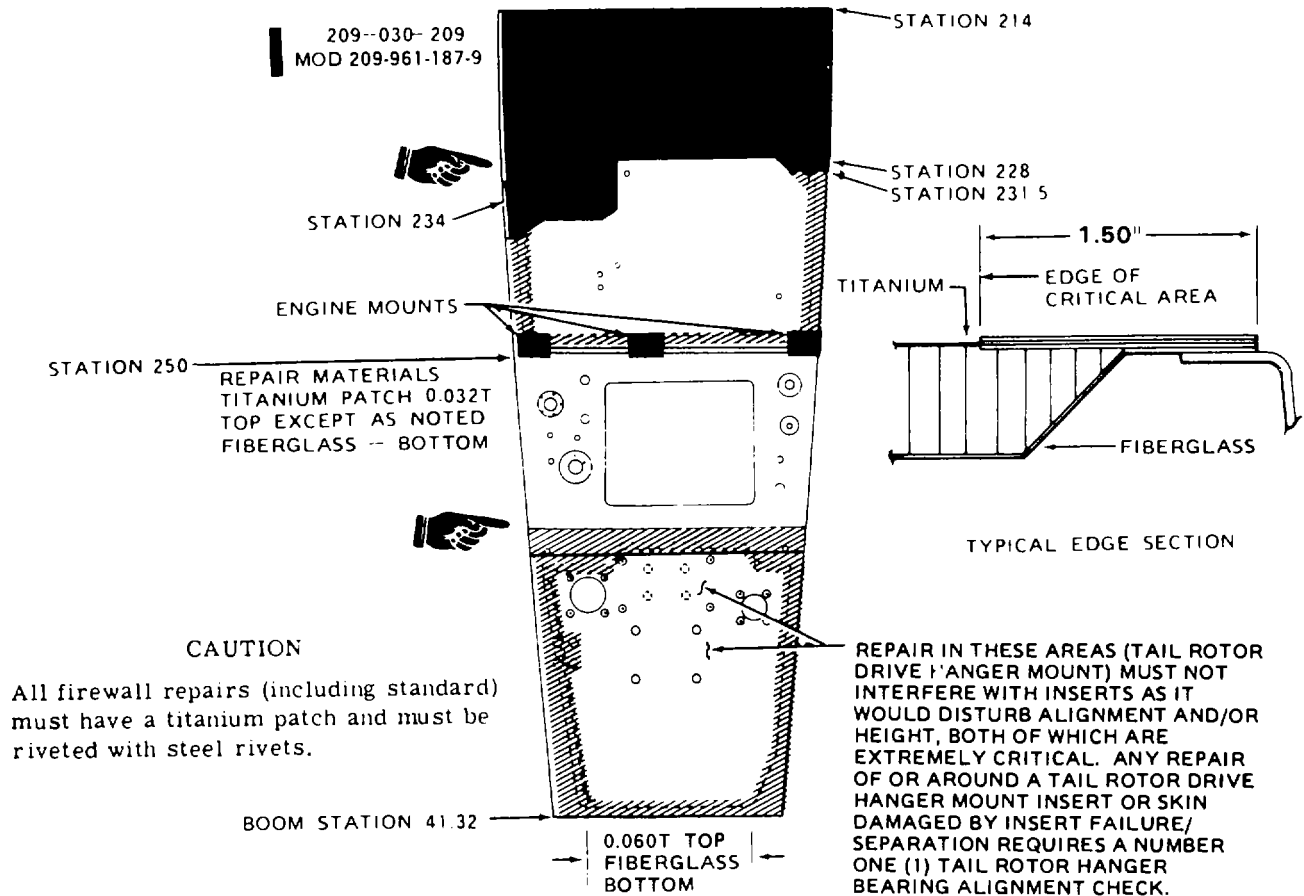
209030-41F

Figure 2-16. Lower aft fuel cell panel and bottom panel at station 250.0 to boom station 41.32



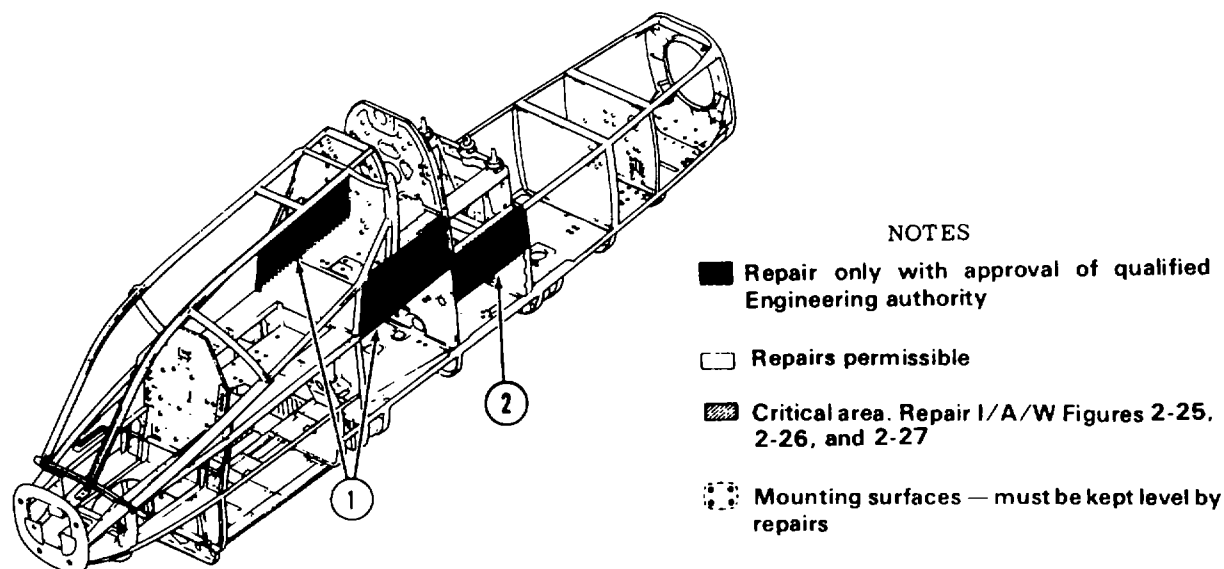
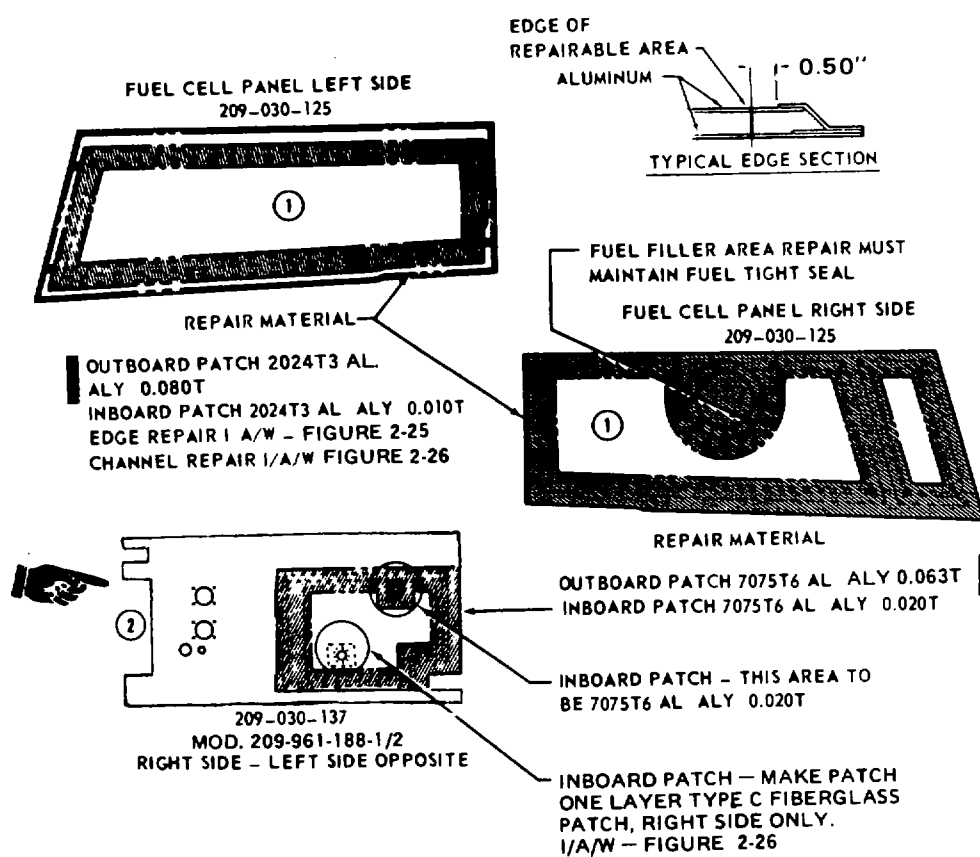
NOTES

- Repair only with approval of qualified Engineering authority
- Repairs permissible
- ▨ Critical area. Repair I/A/W Figure 2-24
- Mounting surfaces — must be kept level by repairs



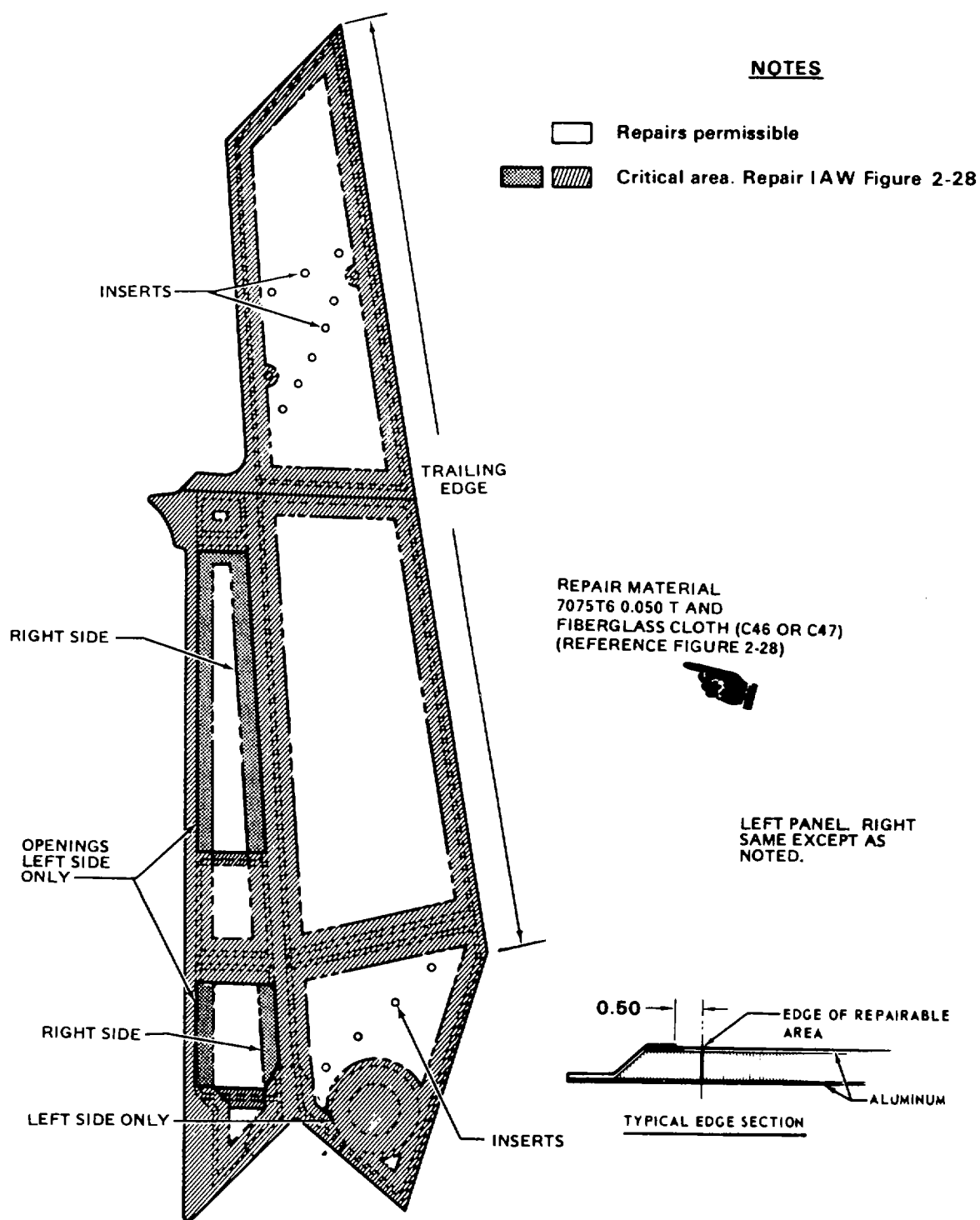
209030-304A

Figure 2-17. Engine deck installation at stations 213.94 to 298.75



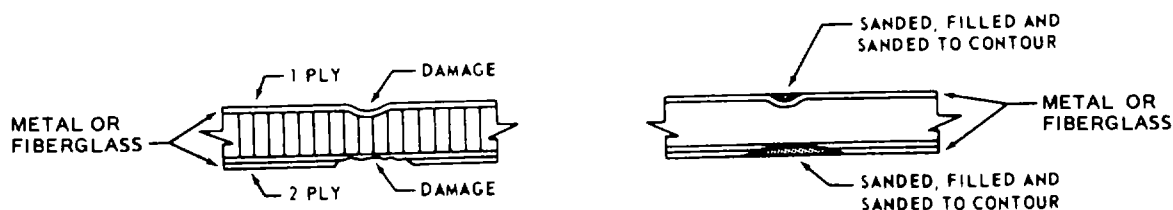
209030-42E

Figure 2-18. Forward fuel cell panels and main beam panels at station 186.25 to 214.0



209030-27H

Figure 2-19. Vertical fin honeycomb panels



FIBERGLASS OR METAL FACINGS

FIBERGLASS OR METAL FACINGS

FIBERGLASS FACED PANELS

METAL FACED PANELS

DESCRIPTION

Dents, scratches, scars, or erosion in facings with no holes, cracks, or voids.

Smooth dents or depressions in the skins with no holes or cracks. (See Type C damage for repairs to penetrating damage.)

LIMITS - REPAIRABLE DAMAGE

1. Maximum depth: 25% of panel thickness. 2. Minimum distance from an edge bevel: 0.5 inch	1. Maximum diameter of damage: 0.50 inch. 2. Maximum depth: 20% of panel thickness. 3. Maximum area of all dents combined: 5% of panel surface area. 4. Maximum of five dents in a 3.0 square inch area. 5. No voids may be present under the damage.

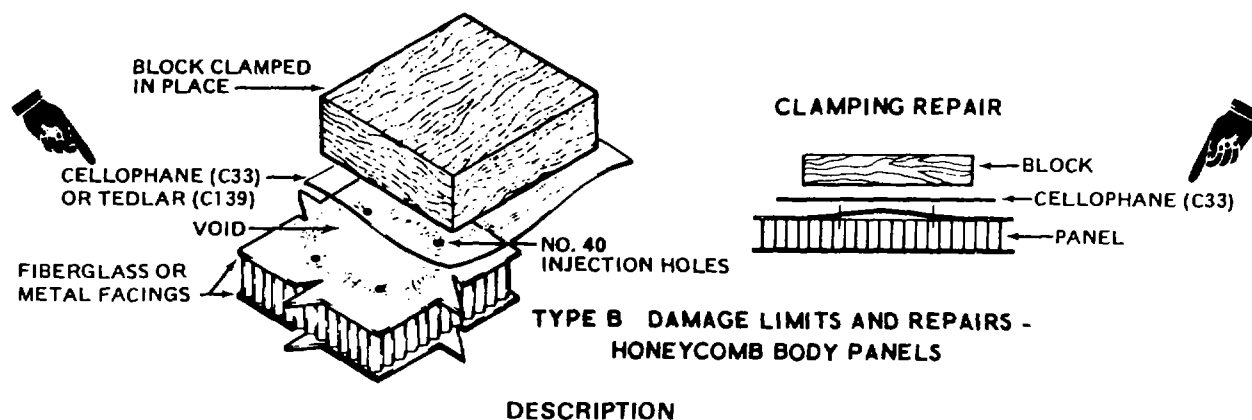
REPAIR PROCEDURES

1. Smooth out damaged area by lightly sanding.
2. Clean with methyl-ethyl-ketone (C87) and allow to dry.
3. Brush on adhesive (C123) to level to contour and allow to cure.
4. When cured, sand smooth and refinish if required.

SAME AS FIBERGLASS REPAIR

209030-19G

Figure 2-20. Type A damage - body panel repairs



Voids between the facings and core and separations between laminations of facings on metal or fiberglass panels.

FIBERGLASS FACED PANELS

METAL FACED PANELS

LIMITS - REPAIRABLE DAMAGE

1. Maximum area of all damage: 4.0 square inches or 5% of panel surface area whether as a single void or combination of separate voids. 2. Maximum length of a void: 4.0 inches in any direction. 3. Damage is not repairable within 0.50 inch of any beveled edge.	1. Maximum area of all damage: 5% of total area of panel with aluminum or stainless steel skin and 3% with titanium skin. 2. Maximum area of single void: 1.5 square inches for aluminum and stainless steel. 1.0 square inch for titanium. 3. Voids within 3.0 inches of any structural member and within 0.50 inch of a beveled edge are not repairable. 4. Maximum length of a void 3.0 inches in any direction for aluminum and stainless steel and 2.5 inches for titanium.

REPAIR PROCEDURES

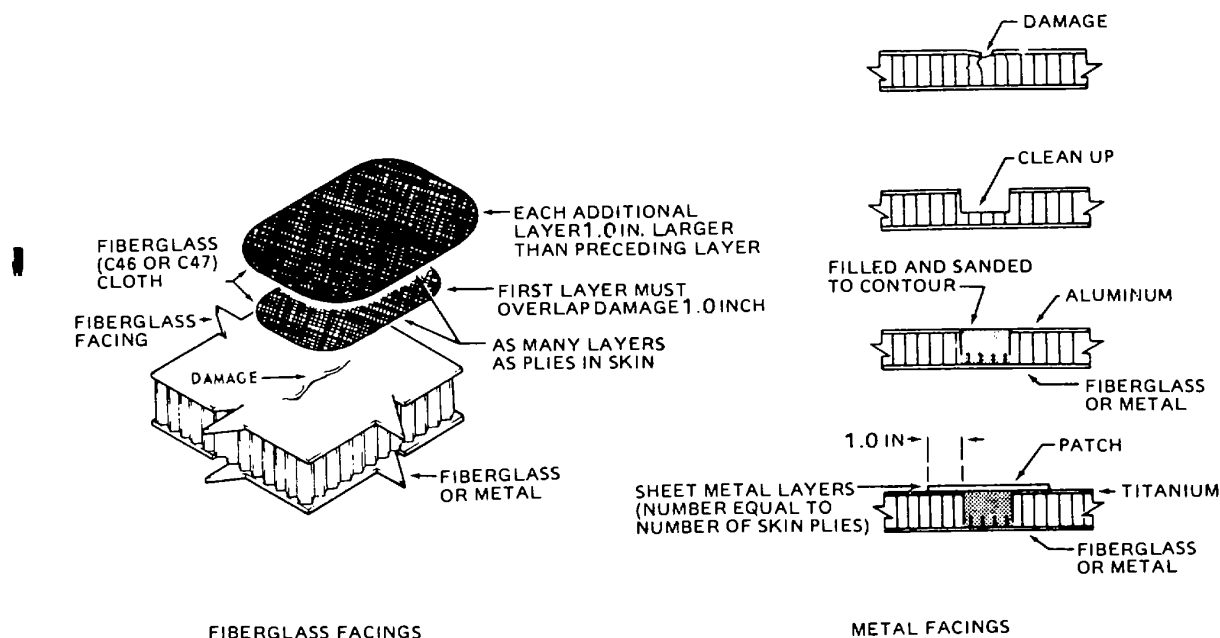
1. Drill No. 40 ((or smaller) holes around edge of damage a minimum of 1.0 inch apart. Use as many holes as required to ensure complete filling of cavity.
2. Inject epoxy resin (C107) with hypodermic syringe until resin is forced out opposite hole.
3. Cover repair with cellophane (C33) and level out by clamping with blocks. Allow to cure.
4. Seal holes with adhesive (C123).
5. Clean up and smooth with fine sandpaper (112). Refinish if required.

SAME AS FIBERGLASS REPAIR

Figure 2-21. Type B damage - body panel repairs

Change 7 2-27

209030-20G



FIBERGLASS FACED PANELS

METAL FACED PANELS

DESCRIPTION

Tears, fractures, and holes through fabric skins with no damage to core. (See Type D damage limits for core damage, figure 2-23)

Sharp dents and dents containing holes and cracks built not extending completely through panel. (See Type D for through limits and damage greater than 0.50 inch diameter, figure 2-23)

LIMITS - REPAIRABLE DAMAGE

1. Maximum area of damage 9.0 square Inches or 5% of total panel area whether a single area or combination of separate areas
2. Maximum number of repairs per panel: One.
3. Minimum distance from structural member fitting, or insert: 1.0 inch.
4. Minimum distance from beveled edges: 0.50 inch.
5. Maximum diameter of hole after cleanup: 0.50 inch. (See Type D for damage over 0.50 inch.)

209030-21-1G

Figure 2-22. Type C damage - body panel repairs (Sheet 1 of 2)

REPAIR PROCEDURES**FIBERGLASS FACED PANELS**

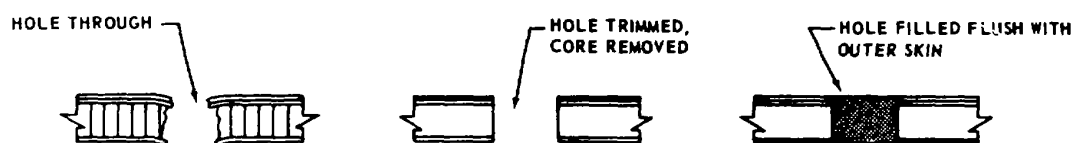
1. Smooth damaged surface by light sanding.
2. Cut the required number of plies from fiberglass cloth (C46 or C47).
3. Saturate each ply with epoxy resin (C107) and place over damage.
4. Cover patch with cellophane (C33) or Tedlar (C139). Press down to smooth and allow to cure.
5. If necessary sand repair to smooth out and refinish if required.

METAL FACED PANELS

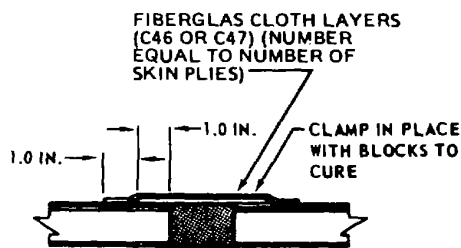
1. Counterbore area to the diameter and depth required to clean out damage. (Maximum diameter 0.50 inch.)
2. Pack cavity with adhesive (C17).
3. Level out flush with skin and cure.
4. Cut required number of doublers from the same material as the skin. If titanium is not available, use equivalent thickness stainless steel to patch titanium skin.
5. Bevel the edges of doublers on top side.
6. Clean all surfaces with methyl-ethyl-keytone (C87).
7. Apply adhesive (C17) and center doublers over damage. Clamp smoothly with blocks and allow to cure. Refinish if required.

209030-21-2E

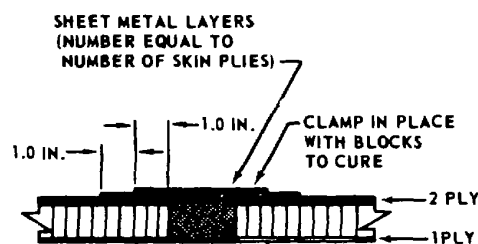
Figure 2-22. Type C damage - body panel repairs (Sheet 2 of 2)



METAL AND FIBERGLASS FACINGS — STRUCTURAL



FIBERGLASS FACINGS



METAL FACINGS

FIBERGLASS FACED PANELS

DESCRIPTION

Damage penetrating the facings and extending into core. Same limits apply to damage through one skin only and damage completely through panel.

METAL FACED PANELS

Damage penetrating metal skins greater than 0.50 inch diameter, and damage extending completely through panel.

LIMITS - REPARABLE DAMAGE

1. Maximum damaged area after clean up: Total of 9.0 square inches or 5% of panel surface area per panel. Applies whether a single area or combination of separate areas. 2. Maximum length of damage: 4.0 inches in any direction 3. Maximum diameter of clean up counterbore: 3.75 inches. 4. Minimum distance from an edge bevel 0.50 inch.	1. Maximum area of damage after clean up 6.0 square inches, whether a single area or combination of separate areas. 2. Maximum length: 3.5 inches in any direction. 3. Minimum distance from structural members or other repair: 3.0 inches. 4. Minimum distance from an edge bevel: 0.50 inches.

209030-22-1H

Figure 2-23. Type D damage - body panel repairs (Sheet 1 of 2)

REPAIR PROCEDURES**FIBERGLASS FACED PANELS**

1. Clean up damage with counterbore or hole cutter. If damage is limited to one side of panel, counterbore only deep enough for proper cleanup.
2. Pack hole with adhesive (C17). Level out flush with surface of panel. Allow to cure.
3. Cut required number of patch layers from fiberglass cloth (C46 or C47) as shown.
4. Saturate each cloth layer with epoxy resin (C107) and place over damage.
5. Cover patch with cellophane (C33) or Tedlar (C139). Press down smoothly and allow to cure.
6. If necessary, sand smooth and refinish.

METAL FACED PANELS

1. Clean up damage with counterbore or hole cutter. If damage is limited to one side of panel, counterbore only deep enough for proper cleanup.
2. Pack cavity with adhesive (C17). Smooth flush with surface of panel and allow to cure.
3. Cut required number of doublers from the same material as the skin. If titanium is not available use equivalent thickness stainless steel to patch titanium skin.
4. Clean all surfaces with methyl-ethyl-ketone (C87).
5. Apply adhesive (C17) and center doublers over damage. Clamp smoothly with blocks and allow to cure. Refinish if required.

209030-22

Figure 2-23. Type D damage - body panel repairs (Sheet 2 of 2)

EDGE REPAIR OF HONEYCOMB PANELS

NOTE	APPLICABLE PANELS	REF. FIG.
Typical edge repair of applicable panels, for cross hatched area as illustrated on referenced figure. Maximum repairable damage is 1.25 inch diameter after cleanup. Repair of damage exceeding 1.25 inch diameter must be approved by qualified Engineering authority.	209-030-119	Left Fuel Cell
	209-030-120	Right Fuel Cell
	209-030-122	Bulkhead
	209-030-206	Bottom of Fuel Tank
	209-030-127	Lower Bulkhead Sta. 186.25
	209-030-108	Bulkhead Sta. 213.94
	209-030-123	Upper Bulkhead Sta. 148.56
	209-030-124	Lower Bulkhead Sta. 148.50
	209-030-204	Forward Fuel Cell Floor
	209-030-209	Engine Deck Sta. 213.94 and Sta. 298.75
	209-030-801	Tail Fin
	209-030-130	Right Main Beam
	209-030-138	Left Main Beam

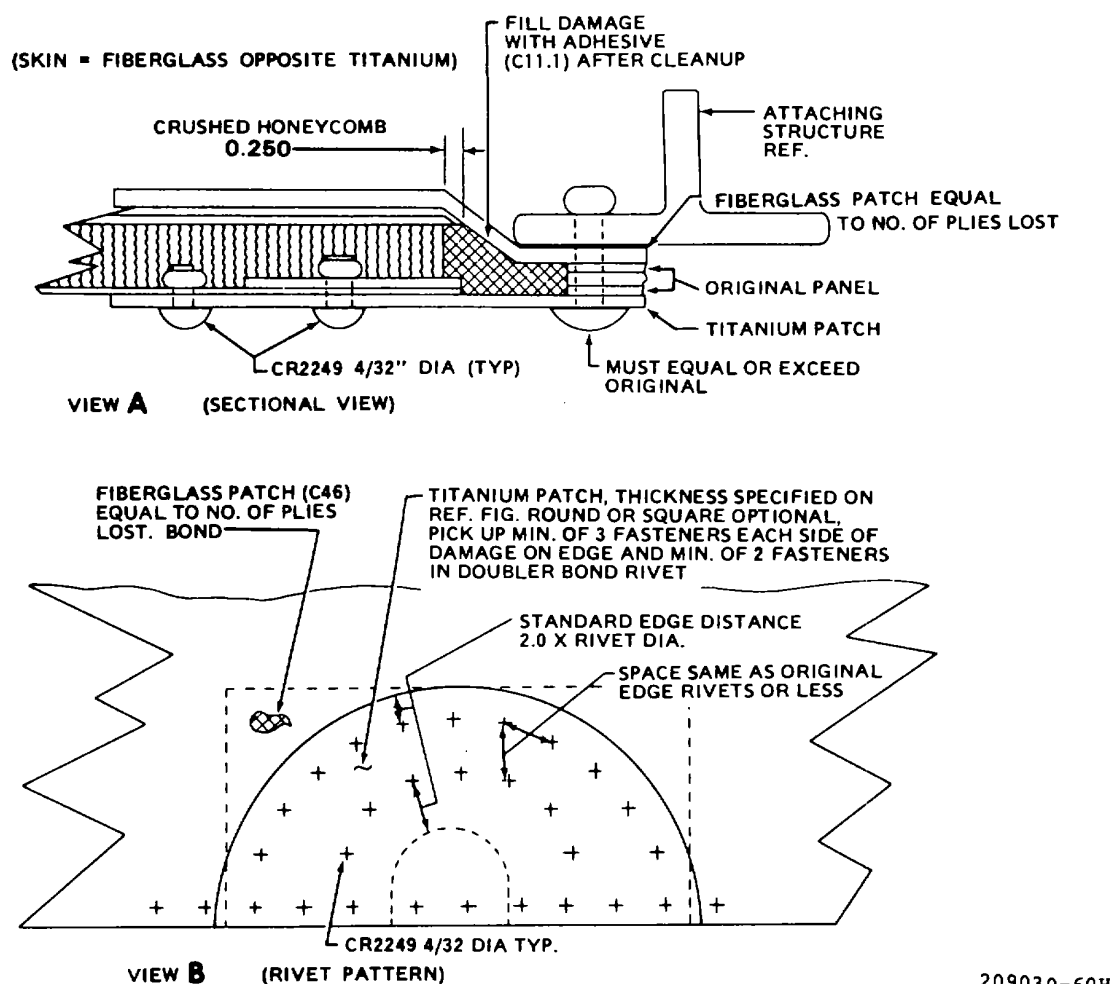
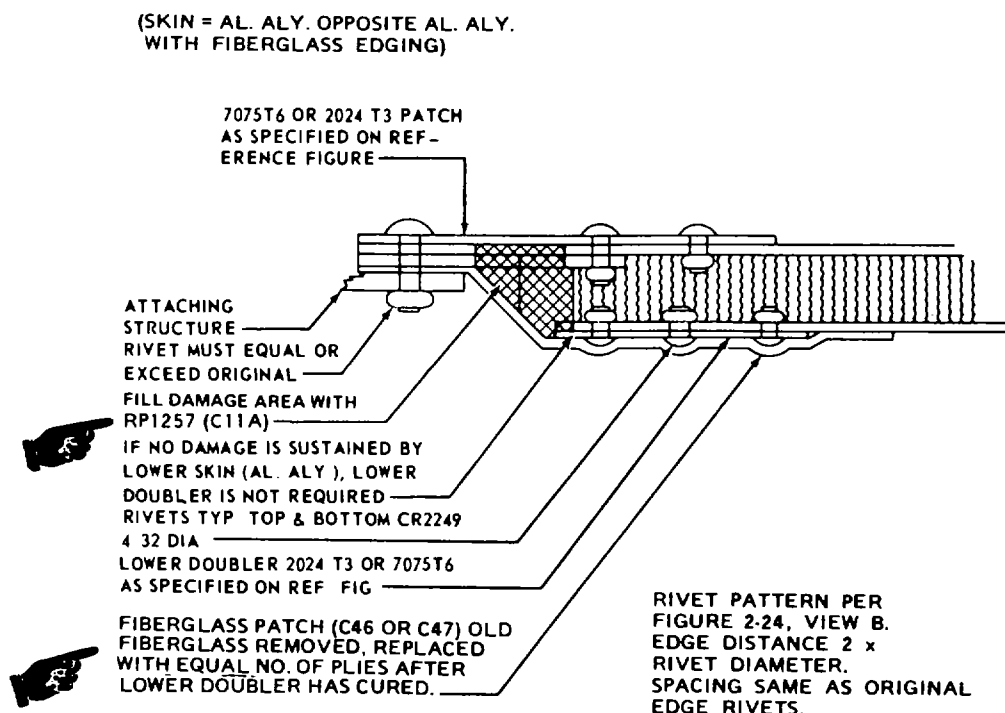


Figure 2-24. Edge repair for honeycomb panel with fiberglass skin opposite titanium

EDGE REPAIR OF HONEYCOMB PANELS

	APPLICABLE PANELS		REF. FIG.
NOTE Typical edge repair of applicable panels for cross hatched area as illustrated on reference Figure. Maximum repairable damage 1.25 in. dia. Repair of damage greater than 1.25 in. dia. must be approved by qualified Engineering authority.	209-030-201	Gunners Floor	2-5
	209-030-202	Pilots Floor	2-5
	209-030-125	Upper Fuel Cell	2-18
	209-030-137	Main Beam	2-18
	209-030-112	Bulkhead Sta. 268.65	2-9
	209-030-102	Bulkhead Sta. 93.0	2-6
	209-030-207	Floor	2-16
	209-030-117	Left Beam	2-13
	209-030-118	Right Beam	2-13
	209-030-126	Upper Bulkhead Sta. 186.25	2-8
	209-030-106	Center Bulkhead Sta. 164 to 171.61	2-7
	209-030-135	Gunners Seat	2-12
	209-030-269	Panel Sta. 155.97	2-12
	209-030-270	Fwd. Fuel Tank Support	2-12
	209-030-205	Panel (Sta. 186.25 to 213.94)	2-15
	209-030-213	Pylon Support	2-14
	209-030-219	Ammo. Floor	2-14



209030-61G

Figure 2-25. Edge repair for honeycomb panel with aluminum alloy skin opposite aluminum alloy with fiberglass edging

REPAIR OF CHANNEL SECTION OF HONEYCOMB PANELS

NOTE

Typical repair at channel section of applicable panels, cross hatched on reference figure. Maximum repairable damage 1.25 inch diameter after cleanup. Repair damage greater than 1.25 inch diameter must be approved by qualified Engineering authority.

APPLICABLE PANELS

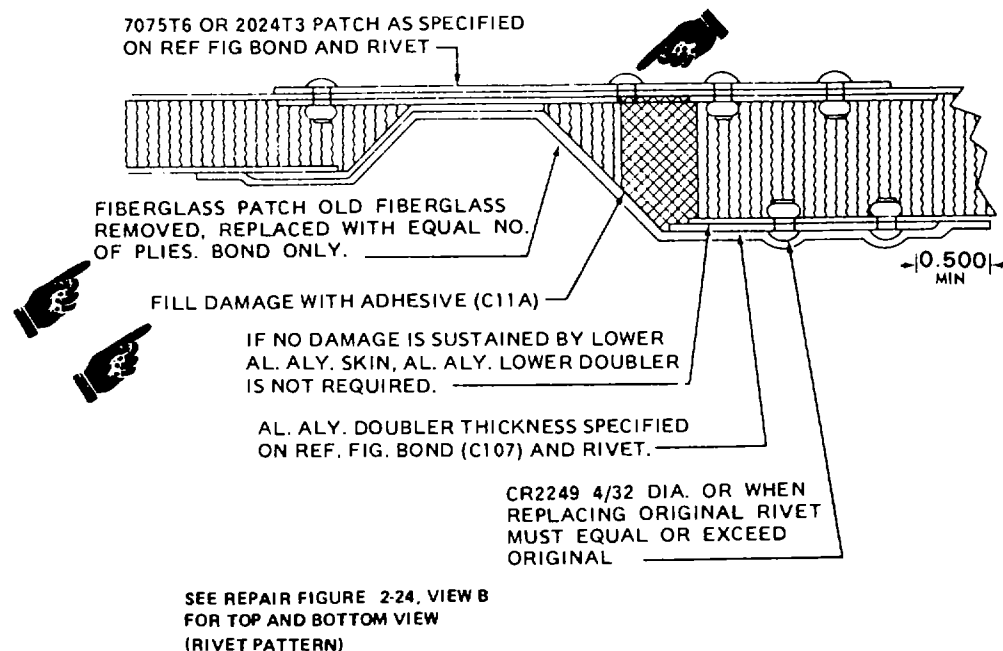
209-030-201	Gunner's Floor
209-030-202	Pilot's Floor
209-030-125	Upper Fuel Cell
209-030-137	Main Beam
209-030-102	Bulkhead Sta. 268.65
209-030-117	Left Beam
209-030-118	Right Beam
209-030-124	Lower Bulkhead Sta. 148.50
209-030-204	Fwd. Fuel Cell Floor
209-030-213	Pylon Support
209-030-219	Ammo Floor
209-030-206	Lower Aft Fuel Cell Panel

REF. FIG.

2-5
2-5
2-18
2-18
2-6
2-13
2-13
2-7
2-15
2-14
2-14
2-16

(SKIN = AL. ALY. OPPOSITE AL. ALY.
WITH FIBERGLASS FINISH AT CHANNEL)

NOTE: Titanium skin repair should comply with paragraph 2-4d(2).

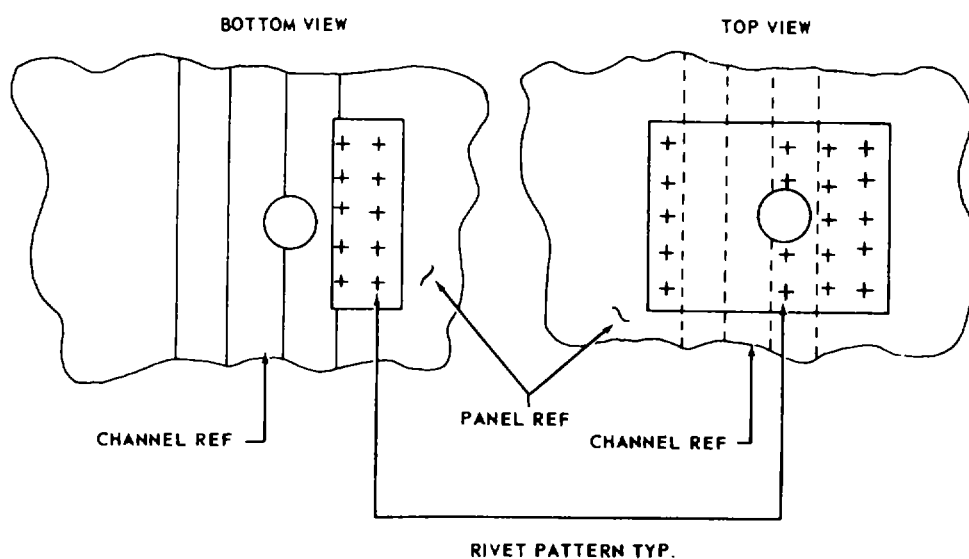


209030-62G

Figure 2-26. Edge repair for honeycomb panels with aluminum alloy skin opposite aluminum alloy with fiberglass finish at channel

REPAIR OF CHANNEL SECTION OF HONEYCOMB PANELS

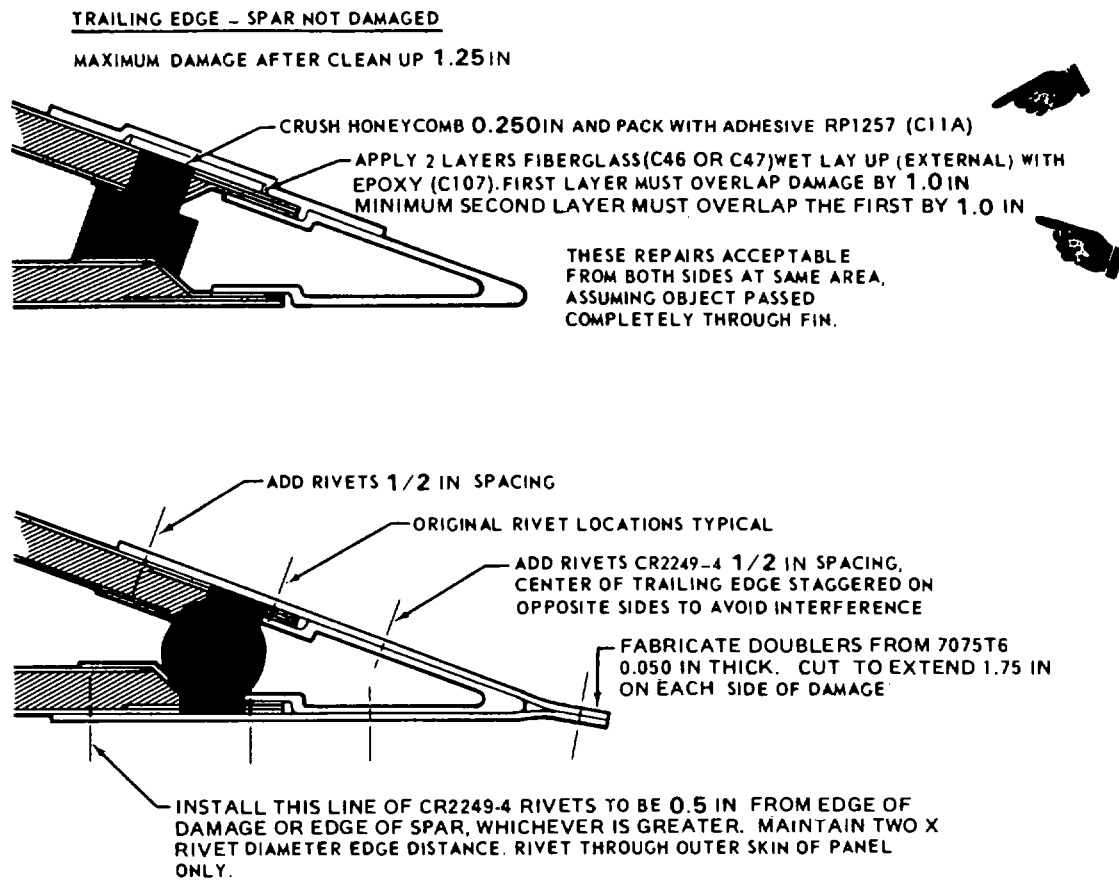
APPLICABLE PANELS		REF. FIG.
209-030-201	Gunner's Floor	2-5
209-030-202	Pilot's Floor	2-5
209-030-125	Upper Fuel Cell	2-18
209-030-137	Main Beam	2-18
209-030-102	Bulkhead Sta. 268.65	2-6
209-030-117	Left Beam	2-13
209-030-118	Right Beam	2-13
209-030-124	Lower Bulkhead Sta. 148.50	2-7
209-030-204	Forward Fuel Cell Floor	2-15
209-030-213	Pylon Support	2-14
209-030-219	Ammo Floor	2-14
209-030-206	Lower Aft Fuel Cell Panel	2-16



EDGE DISTANCE $2.0 \times \text{DIA. OF RIVET}$.
 RIVET SPACING SAME AS EDGE RIVETS
 OR SAME AS OPPOSITE LIKE PANEL.
 MINIMUM OF TWO FASTENERS EACH
 SIDE OF DAMAGE.

209030-64D

Figure 2-27. Typical rivet pattern for channel section repair



NOTE: Repair critical areas, other than trailing edge, as shown on figure 2-19. Use 7075T6 aluminum patch for outer skin and two layers of fiberglass cloth (C46 or C47) with one inch overlap for inner patch.

209030-67E

Figure 2-28. Edge repair on vertical fin

(d) Cut fiberglass cloth (C46) to correct size and saturate with epoxy resin (C107) and apply as a patch.

(e) If multiple layers of fiberglass are required, overlap each successive patch for a minimum distance of one inch.

(2) Metal (Aluminum alloy, titanium or stainless steel).

(a) Stainless steel (item 58, Table 2-2) 1/4 hard or harder may be substituted for titanium. Use stainless steel of same thickness as that specified for titanium patch.

(b) The minimum thickness of patches are specified on figures 2-24 through 2-26.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

(c) Remove all old finish from repair area with varying grades of sandpaper (C112). Clean sanded area with clean cloth moistened with methyl-ethyl-ketone (C87).

(d) Bond metal patches with adhesive (C17).

(e) After adhesive (C17) has cured, apply sealant (C 115) to entire surface of titanium patch.

(f) Rivet patch with rivets of equator larger size than original rivets in areas that were riveted prior to application of patch. Use the standard edge distance of two rivet diameters or space the rivets the same as the original panel. If the panel being worked is not riveted, use rivet spacing in opposite panel.

(g) Fastener (Insert) Repairs. Repair loose and/or damaged fasteners (inserts) as described in applicable paragraph 2-5 through 2-10.

2-5. Loose Fastener (Insert) In Vertical Fin Panel - Repair.

a. Drill one, or two where possible, 1/16 inch diameter holes in surface of panel near edge of fastener. Drill the hole or holes at an angle in direction of fastener (insert).

b. Inject adhesive (C12) in drilled hole or holes with a syringe. Fill the cavity. If there are two holes, fill until adhesive exudes from the second hole.

c. Allow adhesive to cure for 24 hours at room temperature.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

d. Remove excessive adhesive with cloth moistened with methyl-ethyl-ketone (C87) or naphtha (C88).

2-6. Damage Fastener (Insert) In Vertical Fin Panel - Replacement.

a. Remove damaged fastener (insert) by machining with counter bore of the same diameter. If the fastener (insert) is loose and turns, drill out two holes shown for injecting adhesive on figure 2-29. Use a spacer on twist drill while drilling out holes to avoid drilling too deep and damaging panel. Attach a puller to fastener (insert) with self-taping screws and remove the fastener (insert) from the panel.

b. Crush back honeycomb core a minimum of 0.063 inch and maximum of 0.25 inch on figure 2-29. Clean all metal particles out of hole.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing vapors and avoid prolonged skin contact.

CAUTION

Do not use methyl-ethyl-ketone to clean hole in panel.

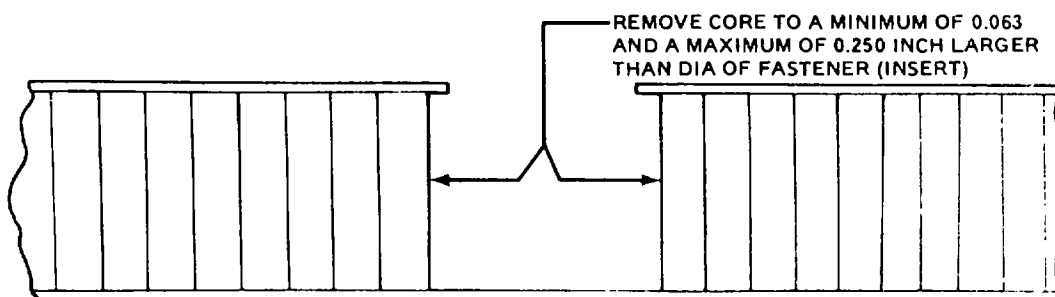
c. Immediately prior to installation, clean new fastener (insert) with methyl-ethyl-ketone (C87) and air dry until moisture free. Handle fastener (insert) with clean gloves after cleaning.

d. Cover threaded hole and injection holes with masking tape then open the injection holes with a pointed instrument. Apply adhesive (C12) to bottom of fastener (insert) as shown on figure 2-29 and position in hole in panel. Inject adhesive (C 12) in one injection hole with a syringe until it comes out of the opposite injection hole as shown on figure 2-29.

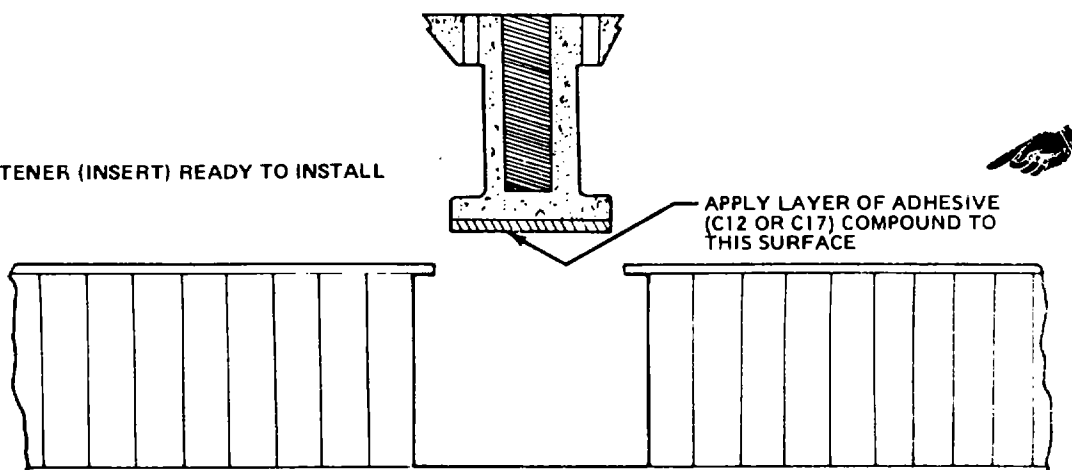
e. Remove excess adhesive with cloth dampened with methyl-ethyl-ketone (Cb7) or naphtha (C33).

f. Touch up paint to match surrounding area.

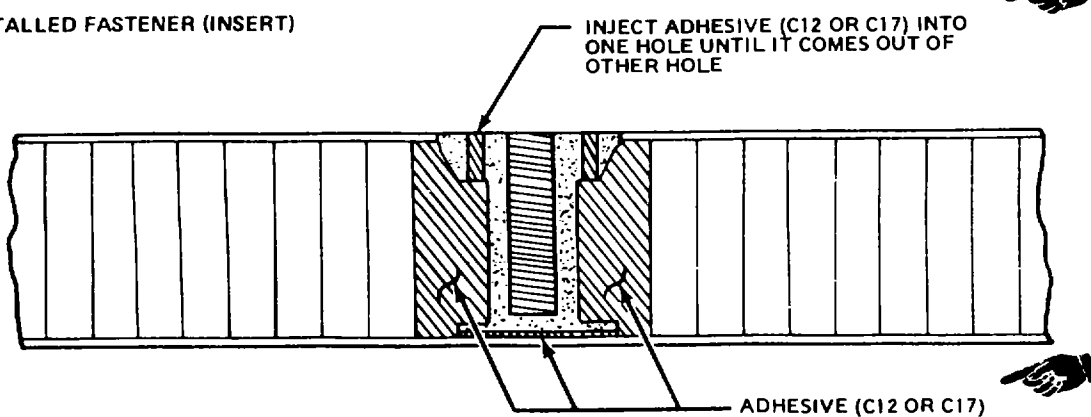
A. CROSS SECTION OF HOLE FOR FASTENER (INSERT)



B. FASTENER (INSERT) READY TO INSTALL



C. INSTALLED FASTENER (INSERT)



209030-297B

Figure 2-29. Injection - type fastener (insert) in vertical fin panel

2-7. Damaged Fastener (Insert) In Fuselage Honeycomb Panels - Replacement.

a. Determine whether the fastener (insert) is a potted - type, Injection - type or Grommet - type. See figure 2-30 for view of the fasteners (inserts).

b. Remove damaged fastener (insert) by machining with a counterbore of the same diameter as the fastener. Note that the grommet - type fastener (insert) flanges overlap the skin of the honeycomb panel.

c. Install new fastener (insert) as outlined in paragraphs 2-8 through 2-10.

2-8. Potted - Type Fastener (Insert) Installation in Honeycomb Panel.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

a. Immediately prior to installation, clean new fastener (insert) by soaking in methyl-ethyl-ketone (C87). Air dry until moisture free.

b. Place masking tape (C134) over threads of fastener (insert) to prevent entry of adhesive.

CAUTION

An insufficient amount of adhesive will allow moisture or other fluids to enter the honeycomb panel core. This will result in ultimate failure of the panel.

c. Fill cavity approximately two-thirds full of adhesive as shown on figure 2-30. Use metal set A4 adhesive (C 12) in areas where temperature will not exceed 180 degrees F (82 degrees C). Use adhesive (C17) in areas where panel will be subjected to higher temperatures but not exceeding 300 degrees F (149 degrees C). Install fastener (insert) while adhesive is in tacky state. Ensure that there are no pin holes in the adhesive, and that the fastener (insert) is properly aligned and is a snug fit where the fastener (insert) flange mates with the honeycomb panel face.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

d. Remove excess adhesive from honeycomb panel before adhesive sets up. Use cheese cloth (C36) dampened with methyl-ethyl-ketone (C87). Exercise caution to prevent the methyl-ethyl-ketone from diluting the adhesive in the potted areas.

e. Touch up paint to match surrounding area.

2-9. Injection - Type Fastener (Insert) Installation in Honeycomb Panel.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing vapors and avoid prolonged skin contact.

a. Immediately prior to installation, clean new fastener (insert) by soaking in methyl-ethyl-ketone (C87). Air dry until moisture free.

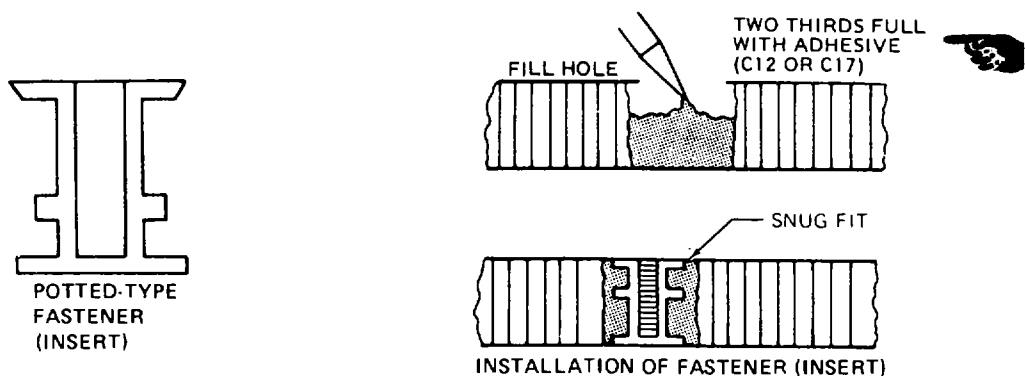
b. Place masking tape (C134) over threads and injection holes of fastener (insert) to prevent entry of adhesive. Open holes in the tape at the injection holes with a pointed instrument to permit injection of adhesive compound.

c. Apply a layer of adhesive to bottom of fastener as shown in figure 2-29. Use adhesive (C12) in areas where temperature will not exceed 180 degrees F (82 degrees C). Use adhesive (C17) in areas where panel will be subjected to higher temperatures but not exceeding 300 degrees F (149 degrees C). Position the fastener (insert) in the hole.

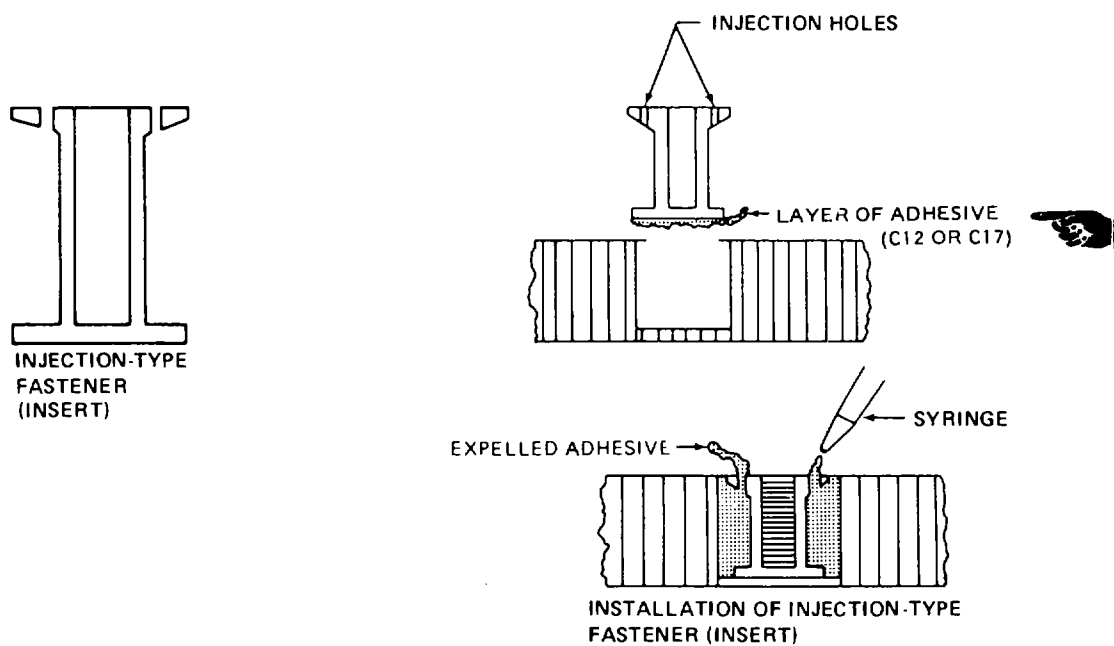
CAUTION

An insufficient amount of adhesive will allow moisture or other fluids to enter the honeycomb panel core. This will result in ultimate failure of the panel.

d. Inject same adhesive used in the preceding step into one injection hole until a steady stream of adhesive, without air bubbles, flows out of the



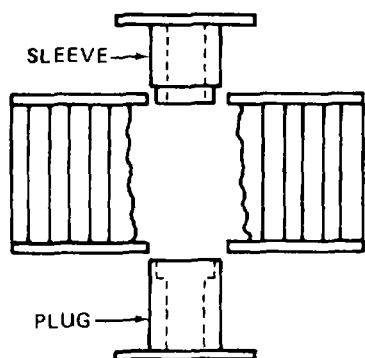
POTTED-TYPE FASTENER (INSERT)



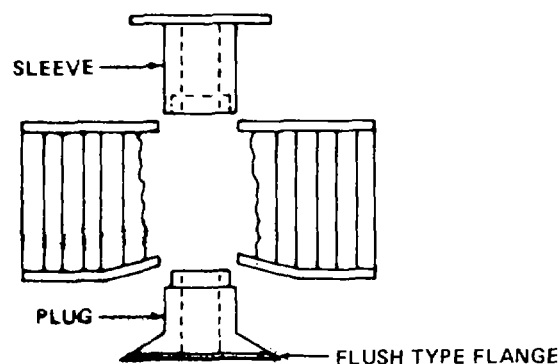
INJECTION-TYPE FASTENER (INSERT)

209030-298-1A

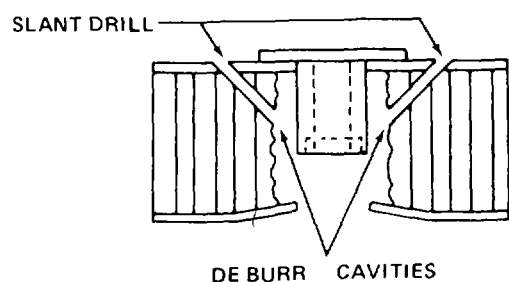
Figure 2-30. Potted - type, injection - type, and grommet - type fasteners (inserts) (Sheet 1 of 2)



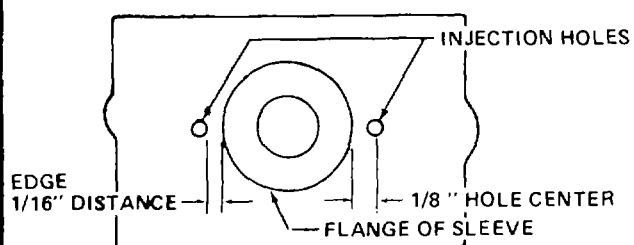
GROMMET TYPE FASTENER (INSERT)
WITH PROTRUDING FLANGE



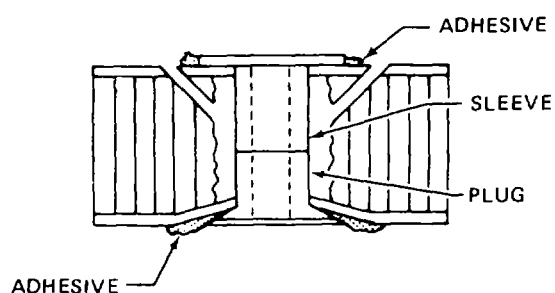
GROMMET TYPE FASTENER (INSERT)
WITH FLUSH TYPE FLANGE



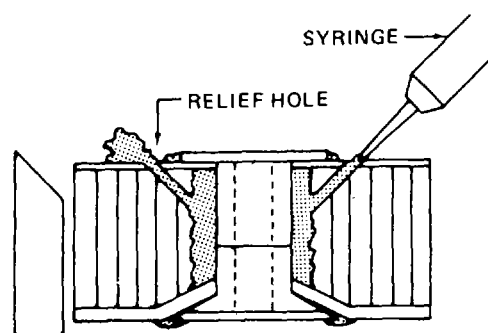
SECTIONAL VIEW OF INJECTION HOLES



TOP VIEW OF INJECTION HOLES



INSTALLATION OF GROMMET-TYPE FASTENER (INSERT)



APPLICATION OF ADHESIVE AFTER INSTALLATION
OF GROMMET-TYPE FASTENER (INSERT)

209030-293-2

Figure 2-30. Potted - type, injection - type, and grommet - type fasteners (inserts) (Sheet 2 of 2)

opposite injection hole. Use a syringe to inject adhesive as shown on figure 2-30.

- e. Ensure that fastener (insert) is properly aligned.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

- f. Remove excess adhesive from honeycomb panel before adhesive sets up. Use cheese cloth (C36) dampened with methyl-ethyl-ketone (C87). Exercise caution to prevent the methyl-ethyl-ketone from diluting the adhesive in the potted areas.

- g. Touch up paint to match the surrounding area.

2-10. Grommet - Type Fastener (Insert) Installation In Honeycomb Panel.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

- a. Immediately prior to installation, clean new fastener (insert) by soaking in methyl-ethyl-ketone (C87). Air dry until moisture free. Handle fastener (insert) with clean white gloves after cleaning.

- b. Place masking tape (C134) over threads of fastener (insert) to prevent entry of adhesive.

- c. Position the sleeve half of fastener (insert) in honeycomb panel and mark location of two injection holes as shown in figure 2-30. Make hole centers $\frac{1}{8}$ inch from edge of flange as illustrated. Remove sleeve and drill two holes with size 42 twist drill. Make hole through honeycomb panel face at ninety degrees, then slant drill as illustrated. Deburr holes and clean all debris from cavity.

- d. Apply a small bead of adhesive under flanges of sleeve and plug as illustrated on figure 2-30. Use adhesive (C12) in areas where temperature will not exceed 180°F. Use adhesive (C17) in areas where

panel will be subjected to higher temperatures but not exceeding 300°F. Install the sleeve and the plug in their correct relative position in the panel. Lightly tap the two parts together. Ensure that the flanges are seated and properly aligned with the panel.

NOTE

A screw and washer may be installed in the fastener (insert) to hold it in position and prevent adhesive from getting on threads. Use a parting material, such as cellophane, under the washer to prevent it from adhering to the fastener (insert).

CAUTION

An insufficient amount of adhesive will allow moisture or other fluids to enter the honeycomb panel core. This will result in ultimate failure of the panel.

- e. Inject the same adhesive used in the preceding step into one injection hole until a steady flow of adhesive, without air bubbles, comes out of the opposite hole.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone (C87). Avoid breathing vapors and avoid prolonged skin contact.

- f. Remove excess adhesive from honeycomb panel before adhesive sets up. Use cheese cloth (C36) dampened with methyl-ethyl-ketone (C87). Exercise caution to prevent the methyl-ethyl-ketone from diluting the adhesive in the potted areas.

- g. Touch up paint to match the surrounding area.

2-11. Honeycomb Construction Pylon Fairings.

The pylon fairing portion of the fairing and cowling shown on figure 2-31 is honeycomb construction. The honeycomb cores are either fiberglass or aluminum. Facings are fiberglass. These fairings are not structural in nature and do not carry primary loads; therefore, larger size

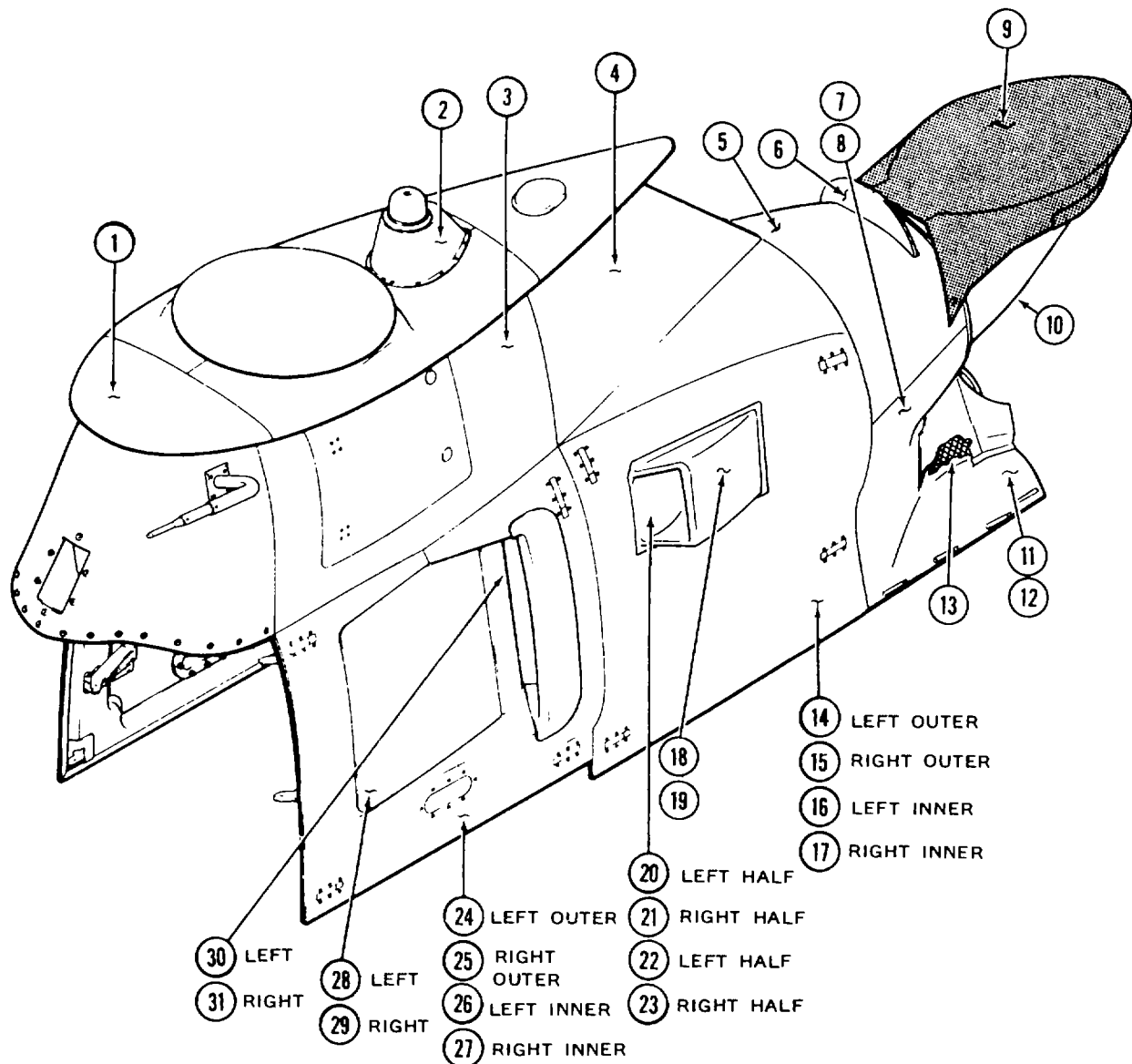
damage may be repaired on these fairings then can be repaired on the fuselage honeycomb panels. It is necessary to maintain contours and restore the fairings to original strength when repair is accomplished.

a. *Inspection.* Inspect honeycomb construction pylon fairings for cracks, punctures and delamination.

(1) Compare any damage that is present with the limits shown on figures 2-20 through 2-23 for

fuselage honeycomb panel damage. Record whether damage is within limits.

(2) If there is any damage present that is in excess of the limits noted in step (1), inspect to determine whether the damage affects portions of the honeycomb fairing that contain attachment holes and/or fasteners. Panels with damage that affects attachment holes and/or fasteners is not repairable.



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Figure 2-31. Fairing and cowling for pylon, transmission, engine, and tail pipe (Sheet 1 of 4)

ITEM	DESCRIPTION	PART NUMBER	MATERIAL	SPECIFICATION	CONDITION	THICKNESS	SIZE
1	Fairing Assembly, Forward Pylon • Outer Skin, 2 Ply Inner Skin, 1 Ply Core, Nonmetallic	209-060-805-5 N/A N/A N/A N/A	Fiberglass Cloth Fiberglass Cloth Fiberglass Cloth Honeycomb, Nonmetallic	MIL-C-9084, Type III (120) MIL-C-9084, Type VIII MIL-C-9084, Type III (120) Bell Helicopter Specification 299-947-103 Grade II, General Purpose Class I, Temperature up to 180 F Type 1-1/4 Hexagonal Cells Density 4.0 American Cyanamid Co. Harve de Grace, Maryland, 21078 Orbitex, Inc., 3550 N. W. 49th St. Miami, Florida, 33148 (FMC 30137) Hexcel, 11711 Dublin Blvd Dublin, California, 94566 (FMC 91610)	N/A N/A N/A	Variable Variable Variable	56.0 x 160.0 56.0 x 160.0 56.0 x 80.0
2	Support Assembly • Outer Skin, 2 Ply Inner Skin, 1 Ply	209-060-812-17 N/A N/A N/A	Fiberglass Cloth Fiberglass Cloth Fiberglass Cloth	MIL-C-9084, Type III (120) MIL-C-9084, Type III (120) MIL-C-9084, Type III (120)	N/A N/A N/A	Variable Variable Variable	23.0 x 4.7 23.0 x 4.70 23.0 x 23.5
3	Fairing Assembly, Left • Outer Skin, 2 Ply • Inner Skin, 2 Ply Core, Nonmetallic Fairing Assembly, Right, (same as listed above for 209-060-811-97)	209-060-811-97 N/A N/A N/A N/A N/A 209-060-811-98	Fiberglass Cloth Fiberglass Cloth Fiberglass Cloth Fiberglass Cloth Honeycomb, Nonmetallic	MIL-C-9084, Type III (120) MIL-C-9084, Type VIII MIL-C-9084, Type III (120) MIL-C-9084, Type VIII Same as Specification for core, nonmetallic in item 1.	N/A N/A N/A N/A	Variable Variable Variable Variable	42.0 x 46.0 42.0 x 46.0 42.0 x 46.0 42.0 x 46.0
4	Fairing Assembly, Aft Pylon • Outer Skin, 2 Ply Inner Skin, 1 Ply Core, Nonmetallic	209-060-807-13 N/A N/A N/A N/A	Fiberglass Cloth Fiberglass Cloth Fiberglass Cloth Honeycomb, Nonmetallic	MIL-C-9084, Type III (120) MIL-C-9084, Type VIII MIL-C-9084, Type III (120) Same as Specification for core, nonmetallic in item 1.	N/A N/A N/A	Variable Variable Variable	54.0 x 154.0 54.0 x 154.0 54.0 x 154.0
5	Fairing, Tail Pipe Assembly of Outer Skin	209-060-810-1 209-060-810-3 209-060-810-5 N/A	Al Aly 2024	QQA250/5 Temp 0	T42	0.025	22.0 x 45.0
6	Spoiler Stiffener Stiffener	209-060-307-15 209-060-307-17 209-060-307-18	Al Aly 2024 Al Aly 2024 Al Aly 2024	QQA250/5, Temp 0 QQA250/5, Temp T3 QQA250/5, Temp T3	T42 T3 T3	0.050 0.032 0.032	7.0 x 16.0 1.5 x 4.0 1.5 x 4.0

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Figure 2-31. Fairing and cowling for pylon, transmission, engine, and tail pipe (Sheet 2 of 4)

ITEM	DESCRIPTION	PART NUMBER	MATERIAL	SPECIFICATION	CONDITION	THICKNESS	SIZE
7	Fairing, Tail Pipe Assembly of Outer Skin	209-060-810-1 209-060-810-3 209-060-810-5 N/A	Al Aly 2024	QQA250/5, Temp 0	T0	0.025	26.0 x 35.0
8	Fairing, Tail Pipe Assembly of Outer Skin	209-060-810-1 209-060-810-3 209-060-810-5 N/A	Al Aly 2024	QQA250/5, Temp 0	T0	0.025	26.0 x 35.0
9	Cover, Exhaust Duct	205-070-389-1					
10	Dust Assembly	205-060-303-3					
11	Fairing, Tail Pipe Assembly of Outer Skin	209-060-810-1 209-060-810-3 209-060-810-5 N/A	Al Aly 2024	QQA250/5, Temp 0	T42	0.025	14.0 x 32.0
12	Fairing, Tail Pipe Assembly of Outer Skin	209-060-810-1 209-060-810-3 209-060-810-5 N/A	Al Aly 2024	QQA250/5, Temp 0	T42	0.025	14.0 x 32.0
13	Screen (Nonreparable — replace screen)	209-060-810-75	N/A	N/A	N/A	N/A	N/A
14	Cowl Assembly, Left Outer Skin	209-060-809-11 N/A	Al Aly 2024	QQA250/5, Temp 0	T42	0.025	43.0 x 45.0
15	Cowl Assembly, Right Outer Skin	209-060-809-12 N/A	Al Aly 2024	QQA250/5, Temp 0	T42	0.025	43.0 x 45.0
16	Cowl Assembly, Left Inner Skin	209-060-809-11 N/A	Al Aly 2024	QQA250/5, Temp 0	T42	0.025	43.0 x 45.0
17	Cowl Assembly, Right Inner Skin	209-060-809-12 N/A	Al Aly 2024	QQA250/5, Temp 0	T42	0.025	43.0 x 45.0
18	Ram Air Inlet Assembly, Left Reinforcement Reinforcement Reinforcement Reinforcement Skin Outer Skin Inner Honeycomb Core, Aluminum	209-060-815-1 N/A N/A N/A N/A N/A N/A N/A	Al Aly 2024 Al Aly 2024 Al Aly 2024 Al Aly 2024 Fiberglass Cloth Fiberglass Cloth	QQA250/5, Temp T3 QQA250/5, Temp T3 QQA250/5, Temp T3 QQA250/5, Temp T3 MIL-C-9084, Type III (120) MIL-C-9084, Type VIII Bell Helicopter Specification 299-947-059, Type II	T3 T3 T3 T3 N/A N/A	0.025 0.025 0.025 0.025 Variable Variable 0.250	1.0 x 19.0 1.0 x 20.0 1.2 x 10.0 2.6 x 10.0 36.0 x 36.0 72.0 x 72.0 10.0 x 14.0 and 7.0 x 8.0
19	Ram Air Inlet Assembly, Right (Same as listed above for 209-060-015-1)	209-060-815-2					
20	Air Scoop, Left Outer Skin	209-060-809-9 N/A	Al Aly 6061	QQA250/11, Temp	T0	0.032	14.0 x 6.0

209-060-66-3

Figure 2-31. Fairings and cowling for pylon, transmission, engine, and tail pipe (Sheet 3 of 4)

ITEM	DESCRIPTION	PART NUMBER	MATERIAL	SPECIFICATION	CONDITION	THICKNESS	SIZE
21	Air Scoop, Right Outer Skin	209-060-809-10 N/A	Al Aly 6061	QQA250/11, Temp 0	T0	0.032	14.0 x 6.0
22	Air Scoop, Left Outer Skin	209-060-809-9 N/A	Al Aly 6061	QQA250/11, Temp 0	T0	0.032	14.0 x 6.0
23	Air Scoop, Right Outer Skin	209-060-809-10 N/A	Al Aly 6061	QQA250/11, Temp 0	T0	0.032	14.0 x 6.0
24	Cowl Assembly, Left Outer Skin	209-060-808-195 N/A	Al Aly 2024	QQA250/5, Temp 0	T42	0.025	40.0 x 43.0
25	Cowl Assembly, Right Outer Skin	209-060-808-12 N/A	Al Aly 2024	QQA250/5, Temp 0	T42	0.025	40.0 x 43.0
26	Cowl Assembly, Left Inner Skin	209-060-808-195 N/A	Al Aly 2024	QQA250/5, Temp 0	T42	0.025	40.0 x 43.0
27	Cowl Assembly, Right Inner Skin	209-060-808-12 N/A	Al Aly 2024	QQA250/5, Temp 0	T42	0.025	40.0 x 43.0
28	Intake Ramp, Left Outer Skin	N/A N/A	Al Aly 2024	QQA250/5, Temp 0	T42	0.025	22.8 x 23.5
29	Intake Ramp, Right Outer Skin	N/A N/A	Al Aly 2024	QQA250/5, Temp 0	T42	0.025	22.8 x 23.5
30	Intake Lip, Left Outer Skin	N/A N/A	Al Aly 6061	QQA250/11, Temp 0	T6	0.032	25.0 x 25.0
31	Intake Lip, Right Outer Skin	N/A N/A	Al Aly 6061	QQA250/11, Temp 0	T6	0.032	25.0 x 25.0

* Inner and outer 2 ply skins are constructed from the following materials:
 Outer Ply: MIL-C-9084, Type III (120)
 Inner Ply: MIL-C-9084, Type VIII

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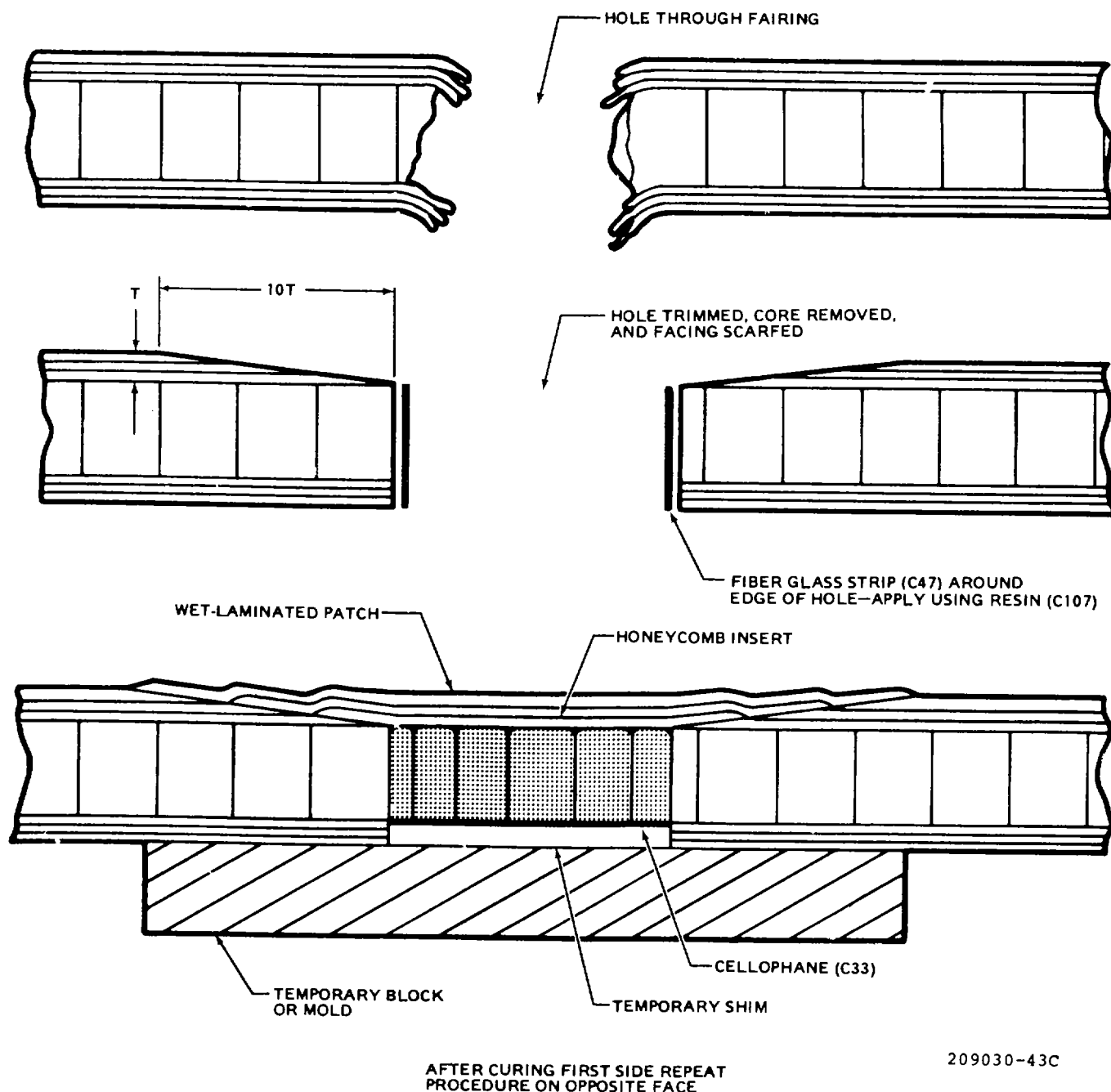
Figure 2-31. Fairing and cowling for pylon

NOTE

This procedure describes repairs for damage penetrating both faces of the panel. When damage extends through one face and into the core with no damage to the opposite face, leave the undamaged face

intact. Take care to avoid cutting into the opposite facing when removing damaged core. The remainder of the repair procedure is the same.

(b) Sand a scarf (bevel) in the top facing around the edge of the hole. Make the width of the bevel about 10 times the thickness of the facing.



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Figure 2-32. Fiberglass honeycomb fairing repair

WARNING

The dust given off by sanding fiberglass may irritate the skin or cause injury to the respiratory system.

(c) Cut a strip of fiberglass cloth (C47) and apply to the edge of the hole with resin (C107).

(d) Cut an insert of new core from material of the same thickness as the original. Make the insert fit snugly in the hole.

(e) Place repair area over a form shaped to the contour of the fairing and hold in place with weights or other suitable means.

(f) Make a temporary shim of the same thickness as the inner facing, place in opening against from and cover with cellophane (C33).

(g) Coat the replacement core around the edge and over the top surface with resin (C107) and place into hole.

(h) Cut the required number of fiberglass both plies (C47). Make the largest piece to fit the outside edge of the scarf. Cut each additional piece to match the edges of each lower ply in the facing. Use as many patch pieces as there are plies in the panel facing.

(i) Starting with the smallest piece, saturate each one with resin (C107) and place over the repair. As each piece is put down, smooth and lightly work out excess resin and air pockets. Do not squeeze out.

(j) Lay a sheet of cellophane (C33) over the patch after the final cloth piece has been put down. Carefully work patch to smooth out and remove excess resin and air pockets.

(k) Apply light pressure on patch with sandbags or other weights and allow epoxy resin to cure.

(l) After curing, remove weight and finish opposite side as was done in the preceding steps.

(m) When second side of patch is completely cured, finish by lightly sanding exterior side of patch to the proper contour. Refinish with paint as necessary.

2-12. Ammo Floor Honeycomb Panel. Repair by installation of scuff doublers.

a. Repair damage that is within allowable limits as outlined in paragraph 2-4.

b. Fabricate scuff doublers from stainless steel (item 58, table 2-2) as shown in figure 2-33. The required stock size is 0.016 x 7.0 x 44.20 inches.

c. Make the 45 degree bend shown on figure 2-33 with a 0.06 inch radius.

d. Remove teflon rub strips. Retain the strips and screws for reinstallation.

e. Use a hole finder tool to locate four holes in the stainless steel doublers to match holes for screws that retained the teflon rub strip. Drill holes in doubler.

b. Repair.

(1) Repair damage to the honeycomb fairings that is within the limits described in step a(1) in the same manner prescribed for fuselage panels in paragraph 2-4.

(2) Repair damage to the honeycomb fairings that is within the limits described in step a(2) by cutting out the damaged area and inserting a new section of honeycomb

(a) Trim-out the damaged material to a circular or oval shape. Remove all rough and irregular edges. See figure 2-32.

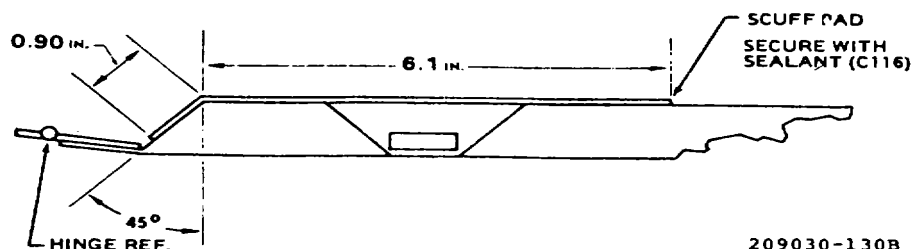


Figure 2-33. Ammo floor scuff doubler installation

f. Remove and replace rub strip (209-030-224-13) on track assembly (209-030-224-19) if worn or damaged. Use adhesive (C17).

g. Position doublers on both sides of the ammo floor panel. Place teflon strips removed in step *d* on the scuff doublers and secure with original screws.

2-13. Honeycomb Panel Removal and Installation.

a. Replace honeycomb panels that have damage in excess of limits specified in paragraph 2-4.

CAUTION

When replacing any riveted structural honeycomb panels or the right fuel cell panel which is installed with screws, structural loads must be relieved to maintain alignment of airframe.

b. Use the following procedures to ensure that airframe alignment is maintained.

CAUTION

Do not use aircraft structure as work platform when structural panels or engine decks are removed. Require that all personnel use work stands or airframe warpage may result.

(1) Attach hoist to mast retaining nut and support the main rotor by hoisting vertically until the lift link retaining bolt can be freely rotated. Check vertical alignment of hoist with a spirit level or a clinometer. A free lift link retaining bolt indicates that the load has been removed.

Alternate method: Remove main rotor, mast, controls, and transmission.

(2) Attach engine sling (T7) and hoist to engine. Loosen pillow blocks on engine mounts. Support the engine by hoisting vertically until engine is loose in the pillow blocks. Check vertical alignment of hoist with a spirit level.

Alternate method: Remove engine. Refer to Chapter 4.

(3) Support tailboom at two locations, forward

and aft, to remove load from forward fuselage.

Alternate procedure: Remove tailboom.

(4) Place jacks under jack points and raise until hand-tight against fittings.

CAUTION

Remove and install the panels listed in the following step one at a time unless a work aid fixture is used to restrain the structure and maintain alignment or damage to the fuselage may result.

(5) Remove and install the panels listed below one at a time. See figure 2-34 for fuselage station locations.

Panel, Main Beam - left and right Sta 61.0-148.5 P/N 209-030-129

Panel, Main Beam - left Sta 148.5-186.25 P/N 209-030-138 (Figure 2-10)

Panel, Main Beam - right Sta 148.5-186.25 P/N 209-030-130 (Figure 2-10)

Panel, Main Beam - left and right Sta 186.25-214.0 P/N 209-030-137 (Figure 2-18)

Panel, Main Beam - left Sta 214.0-250.0 P/N 209-030-119 (Figure 2-11)

Panel, Main Beam - right Sta 214.0-250.0 P/N 209-030-120 (Figure 2-11)

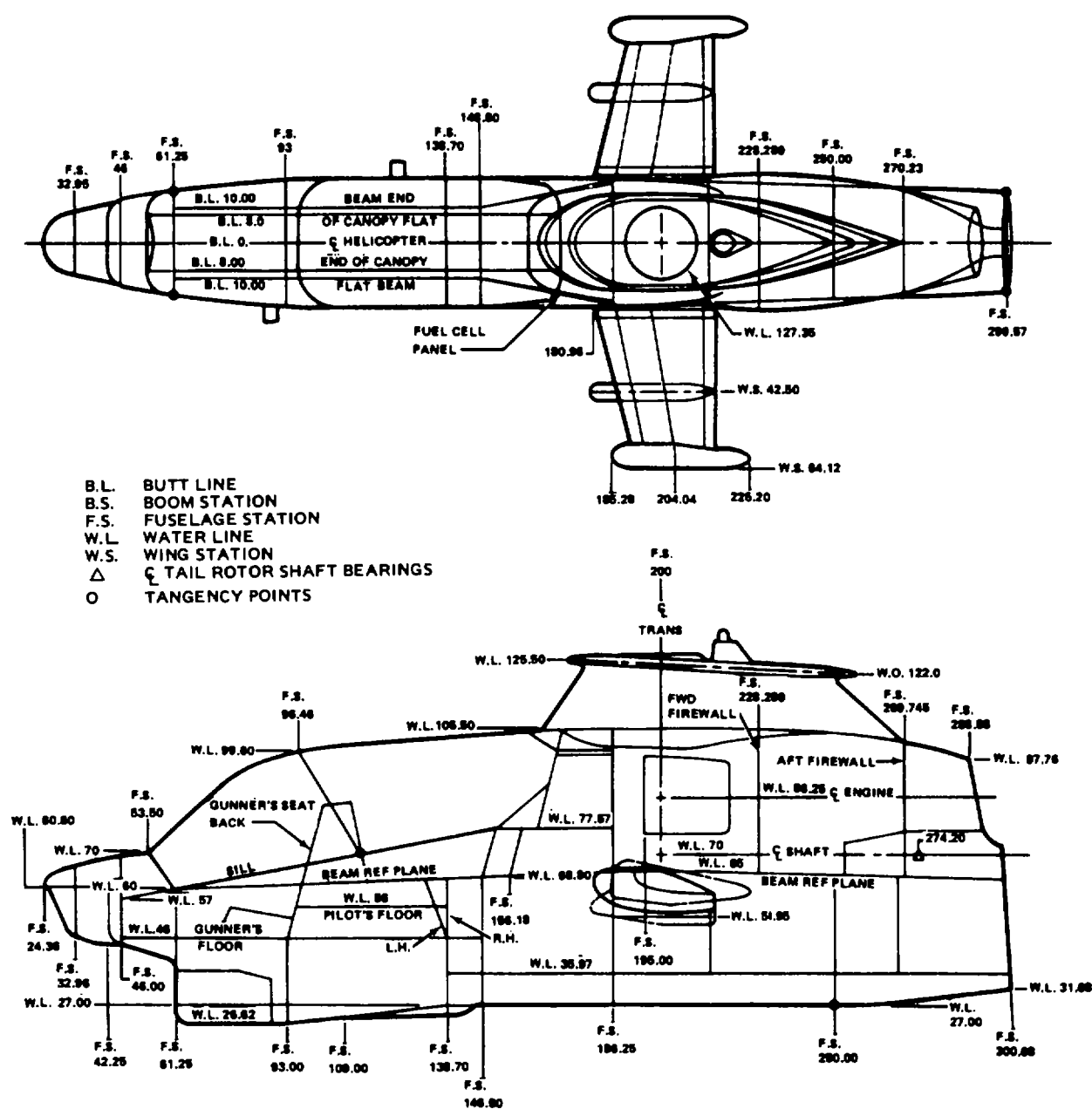
Panel, Main Beam - left Sta 250.0-Boom Sta 41.32 P/N 209-030-117 (Figure 2-13)

Panel, Main Beam - right Sta 250.0-Boom Sta 41.32 P/N 209-030-118 (Figure 2-13)

(6) If the aft engine deck panel (Figure 2-7) must be replaced, contact, AVSCOM, AMSAV- MEA for information.

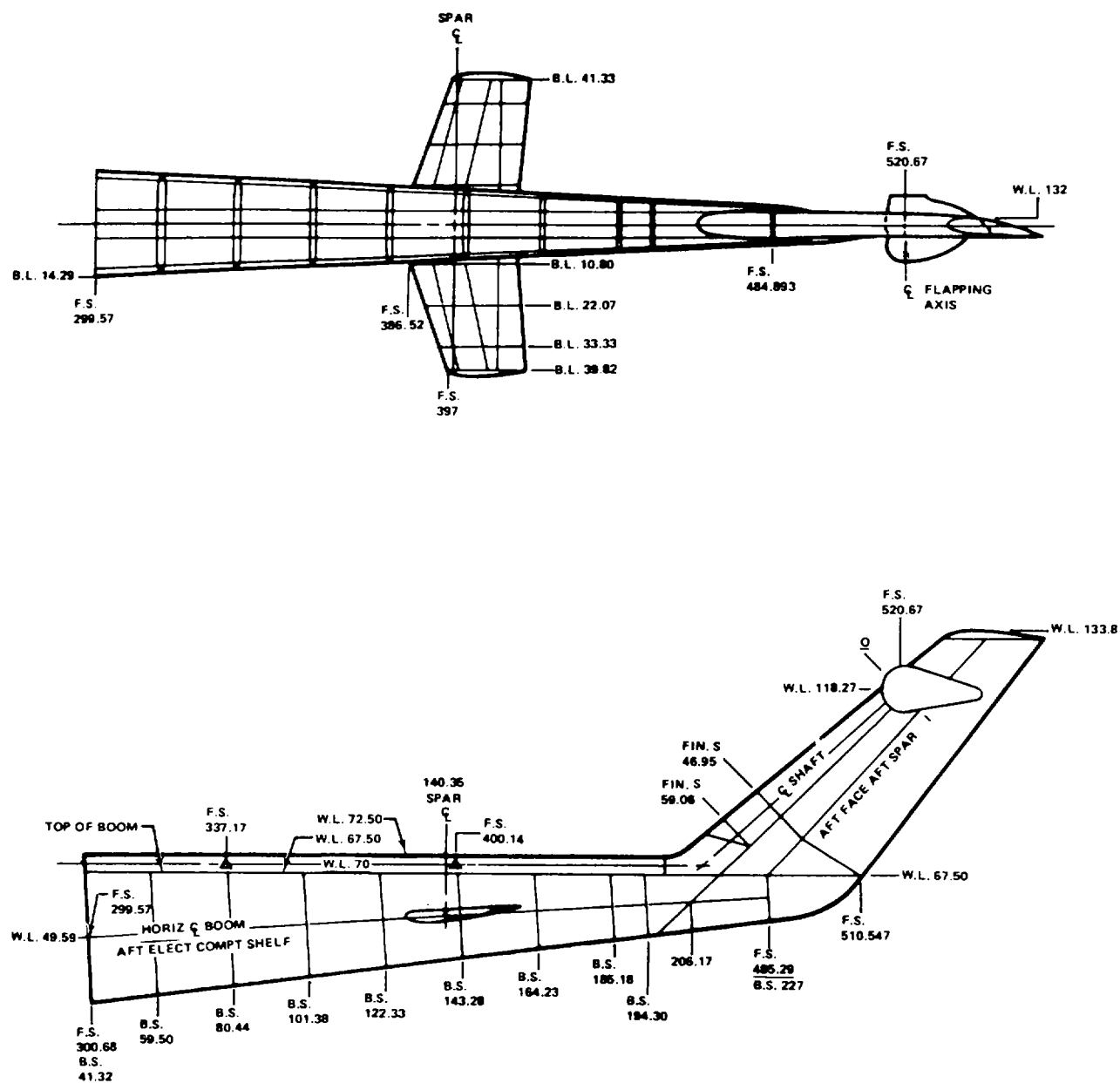
2-14. Sheetmetal Panels, Cowlings, and Fairings.

Sheet metal panels, cowlings and fairings are used to cover openings and give an aerodynamically clean contour. Honeycomb-constructed panels, cowlings and fairings, which were discussed in



209030-247-1

Figure 2-34. Station diagram (Sheet 1 of 2)



209030-247-2A

Figure 2-34. Station diagram (Sheet 2 of 2)

preceding paragraphs, are used for the same purpose. Sheetmetal panels, cowlings and fairings are secured in place by rivets, screws, twist-type fasteners or latches. Refer to paragraphs 2-15 and 2-16 for transmission and engine cowling instructions.

a. Inspection. Inspect sheet metal panels, cowlings and fairings for holes, cracks, corrosion, deformation, and condition of seals and/or fasteners if applicable

b. Removal. Remove screws or twist-type fasteners and remove, panel, cowling or fairing. Do not remove riveted panels unless the entire panel is to be replaced.

c. Repair.

(1) Replace unsatisfactory or missing seals. Refer to paragraph 2-3.

(2) Repair holes, cracks and deformation in accordance with TM 55-1500-204-25/1.

(3) Repair corrosion damage as outlined in paragraph 2-66.

(4) Replace worn, damaged and missing twist-type fasteners.

d. Installation. Install panels, cowlings and fairings with screws or twist-type fasteners as applicable.

2-15. Transmission Cowl Assemblies (Figure 2-31).

The transmission is cowed on each side by cowling assemblies which swing open fore and aft on articulated hinges. Openings in the transmission cowl assemblies form the engine air inlet ducts. A small window in the right hand transmission door permits viewing the transmission oil level. A safety indicator is located at each cowling latch. The indicator will protrude slightly past cowling skin when the latch is properly engaged.

a. Inspection.

(1) Cowl assemblies for cracks, dents, holes, deformation and corrosion.

(2) Latch assemblies for wear and damage that affects function.

(3) Cowl assembly hinges for wear and damage that affects function.

(4) Window in transmission cowl for damage that affects function.

(5) Cowl assembly standoff for damage that affects function.

b. Removal.

(1) Remove shields, if installed, from engine air inlet ducts in transmission cowling.

(2) Remove bolts that attach hinges to fittings on cowl frame. Identify washers and shims for reinstallation in the same relative location to avoid requirement to align cowling assembly when it is re-installed.

(3) Remove cowling assembly from helicopter.

c. Repair

(1) Repair cracks, dents, holes and deformation in accordance with TM 55-1500-204-25/1. See figure 2-31 for list of materials that cowling is constructed from.

(2) Repair corrosion damage in accordance with paragraph 2-68.

(3) Remove damaged or worn cowl assembly hinges and latches and install new parts.

(4) Remove damaged window and replace with new window. Install new seal with the window if the old seal is not serviceable.

(5) Remove damaged or worn cowling standoff and replace with new standoff. Replace standoff retaining spring clip if the old clip is not serviceable.

d. Installation.

(1) Position cowling on helicopter and install bolts, washers, shims, and nuts to attach hinges to fittings on cowl frame. Install the shims in the same location from which removed. Refer to step b above.

(2) Close cowling and check alignment of cowling and operation of latches, adjust shims on hinges and/or latch bolt assemblies if required. See figure 2-55.

(3) Open cowling and check standoff to ensure that it operates properly.

2-16. Engine Cowl Assemblies and Tailpipe Fairing.

The engine is cowled on each side by cowling assemblies which swing open fore and aft on articulated hinges. Each of the cowlings has a small air scoop. A safety indicator is located at each cowling latch. The indicator will protrude slightly past cowling skin when the latch is properly engaged.

a. Inspection. See figure 2-31.

(1) Cowl assemblies for cracks, dents, holes, deformation and corrosion.

(2) Latch assemblies for wear and damage that affects function.

(3) Cowl assembly hinges for wear and damage that affects function.

(4) Screens (9, figure 2-31) for distortion and other damage that results in significantly enlarged holes.

b. Removal.

(1) Open the cowling assembly that is to be removed.

(2) Remove bolts that attach hinges to fittings on cowl frame. Identify washers for reinstallation in the same relative location to avoid requirement to align cowling assembly when it is reinstalled.

(3) Remove cowling assembly from helicopter.

c. Repair.

(1) Repair cracks, dents, holes and deformation in accordance with TM 55-1500-204-25/1. See figure 2-31 for list of materials that cowling is constructed from.

(2) Repair corrosion damage in accordance with paragraph 2-66.

(3) Remove damaged or worn cowl assembly hinges and latches and install new parts.

(4) Replace damaged screen (9, figure 2-31). Carefully drill out rivets and remove the aluminum alloy spoiler to gain access to the rivets that retain the

screen. Carefully drill out the rivets that retain the screen. Remove the damaged screen and retainer strips. Deburr holes and touch up bare metal with chemical film (C37) and primer (C102). Trim new screen to fit. Install new screen, retainer strips and spoiler with rivets (item 47, table 2-2). Touch up paint.

d. Installation.

(1) Position cowling on helicopter and install bolts, washers and nuts to attach hinges to fittings on cowl frame. Install the washers in the same location from which removed. Refer to step b above.

(2) Close cowling and check alignment of cowling and operation of latches. Adjust washers on hinges and/or latch bolt assemblies if required. See figure 2-55.

2-17. Tailpipe Assembly Fairing. See figure 2-31.

The tailpipe assembly fairing encloses the engine tailpipe and supports the infrared suppression exhaust duct.

a. Inspection. See figure 2-31.

(1) Fairings (5, 7, 8, 11 and 12) and spoiler (6) for cracks, dents, holes, deformation and corrosion.

(2) Fairing assembly installation turnlock and machine screw fasteners for wear, damage and secure installation.

(3) Screens (13) for distortion and other damage that results in significantly enlarged holes.

(4) Spoiler (6) for secure installation.

b. Removal. See figure 2-31.

(1) Remove infrared suppression duct assembly (10) from aft end of tailpipe assembly fairing. Refer to Chapter 4.

(2) Disconnect turnlock fasteners and remove machine screws to release tailpipe assembly fairing from fuselage and from pylon fairing. Remove tailpipe assembly fairing.

c. Repair. See figure 2-31.

(1) Repair cracks, dents, holes and deformation in accordance with TM

55-1500-204-25/1. See figure 2-31 for list of materials that fairing and spoiler are constructed from.

(2) Repair corrosion damage in accordance with paragraph 2-68.

(3) Replace damaged and missing turnlock and machine screw fasteners.

d. Installation. See figure 2-31.

(1) Place tailpipe assembly fairing on fuselage. Install machine screws, and secure turnlock fasteners.

(2) Install infrared suppression duct (10). Refer to Chapter 4.

2-18. Infrared Suppression Duct Assembly. See figure 2-31.

Refer to Chapter 4 for inspection, removal, repair and installation instructions for the infrared suppression duct assembly.

2-19. Access Covers and Doors.

The access covers and doors are shown on figure 2-3. The components which are accessible through each cover and door are listed on the illustration. Refer to paragraphs 2-20 and 2-21 for instructions on hydraulic compartment doors and ammunition compartment doors.

2-20. Hydraulic Compartment Doors.

The two hydraulic compartment doors (11, figure 2-3) are constructed of laminated fiberglass edges, honeycomb core and aluminum skin.

a. Inspection. Inspect both doors as follows:

(1) Latches for correct operation.

(2) Seals for cuts, chaffing and secure adhesion to door surface.

(3) Hinges for cracks. If cracks are suspected for any reason, remove hinges and inspect by fluorescent penetrant method.

(4) Doors for cracks, dents, holes, deformation and corrosion.

b. Removal.

(1) Release latches and open door.

(2) Remove bolt to separate door-holding spring (restrainer) at the lower hinge. Remove bolts to disconnect hinges from hinge supports and remove door.

c. Repair.

(1) Replace faulty latches.

(2) Replace damaged seals or rebond seals with adhesive. Refer to paragraph 2-3 for procedure.

(3) Replace faulty hinges.

(4) Repair cracks, dents and holes that are within limits shown on figures 2-20 through 2-23. Use repair procedures shown on the illustrations.

(5) Repair corrosion damage. Refer to paragraph 2-68.

(6) Replace door if it is distorted to the degree that it will not close properly and fit smoothly with the fuselage.

d. Installation.

Position door on fuselage and install bolts to attach hinges to supports. Attach door-holding spring at the lower hinge. Open and close door several times to ensure that latches operate properly.

2-21. Ammunition Compartment Doors.

The two ammunition compartment doors (8, figure 2-3) immediately aft of the gun turret give access to the ammunition compartment. The door hinges are at the bottom of the doors. The doors hinge open to the horizontal position and are supported by cables. Construction is aluminum frame and skin.

a. Inspection: Inspect both doors as follows:

(1) Catch assemblies for correct, operation and damage. Catch assembly covers and strips for damage.

(2) Door support cables and cable fasteners for proper safetying and condition.

(3) Doors for cracks, dents, holes, deformation and corrosion.

(4) Door hinges for damage.

(5) Door rubber strips (seals) for cuts, chaffing and secure adhesion to door surface.

b. Removal.

(1) Release latches and open door.

(2) Support door in horizontal position and disconnect the support cables.

(3) Remove hinge pin from hinge and remove door.

c. Repair.

(1) Replace faulty catch assemblies, damaged catch assembly covers, and strips.

(2) Replace damaged door support cables and cable fasteners (attachment brackets).

(3) Repair cracks, dents, holes, deformation and corrosion. Refer to TM 55-1500-204-25/1 for general repair instructions. Refer to paragraph 2-68 for corrosion damage repair instructions. Repair fatigue-type vertical cracks along aft spot weld seam on outer skin of ammunition compartment doors as follows:

(a) Stop drill ends of cracks.

(b) Remove rubber strip (seal) from inside aft edge of door.

(c) Fabricate doubler of 2024T3 aluminum alloy 0.040 inch thick. Make doubler to fit the width and length of the inside edge of door.

(d) Fabricate overlay patch for outside skin of door of 2024 TO aluminum alloy 0.025 inch thick. Make overlay patch to overlap cracks in skin by 1½ inches.

(e) Clamp inside doubler and overlay patch to door. Drill holes for rivets (item 51, table 2-2) through overlay patch, aft edge of door and doubler. Use one inch spacing between rivets and 1/4 inch edge distance. Countersink the doubler for installation of these rivets. Drill holes for bulbed-type cherry rivets (item 32, table 2-2) on remaining three edges of patch. Use the same spacing.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

(f) Remove overlay patch and doubler from door. Clean and deburr parts and coat outside surface with primer (C102). Clean inside surface of doubler, patch and mating surfaces on door with methyl-ethyl-ketone (C87).

(g) Apply a thin smooth layer of adhesive (C17) on mating surfaces of door, patch and doubler. Position the patch and doubler in the door. Install rivets (item 51, table 2-2) in holes prepared in step (e). Install cherry rivets (item 32, table 2-2) in remaining three sides of patch.

(h) Install rubber strip (seal) that was removed in step (b). Refer to paragraph 2-3 for procedure.

(i) Touch up paint to match surrounding area.

(4) Replace damaged rubber strips (seals) or rebond with adhesive. Refer to paragraph 2-3 for procedure.

(5) Replace faulty hinges.

d. Installation.

(1) Align door hinge half with the mating hinge half on the fuselage and install pin.

(2) Install two door support cables.

(3) Check operation of door catches to ensure that they function properly. Check that door fits smoothly with fuselage and that rubber strips (seals) are in position on the door.

2-22. Structural Members.

Three types of structural members are included in this manual. They are the primary structural caps (figure 2-4), structural members other than

honeycomb panels, and diagonal braces (figure 2-35). Refer to paragraph 2-23 for maintenance information on the diagonal brace tubes.

a. Inspection.

(1) Inspect the primary structural caps (figure 2-4) for cracks, corrosion and distortion.

(2) Inspect the other structural members, except honeycomb panels, shown on figure 2-4 for cracks, corrosion and distortion.

b. Repair.

NOTE

Damage that requires jigs and fixtures for repair must be repaired at Depot Level Maintenance.

(1) Repair limits for primary structural caps are shown on figure 2-4. Repair requires approval by engineering authority.

(2) Repair structural members, other than honeycomb panels and primary structural caps, shown on figure 2-4 in accordance with TM 55-1500-204-25/1.

2-23. Diagonal Brace Tube Assemblies.

The diagonal brace tubes are located in the fuselage adjacent to the wing attachment area.

NOTE

Diagonal brace tube assemblies must be installed prior to flight.

a. Inspection. Remove right and left access panels (22, figure 2-3) and inspect both diagonal brace tube assemblies (figure 2-35) for damage in excess of the following limits:

(1) Dents in excess of 0.010 inch. Smooth dents up to 0.010 inch deep are acceptable without polishing out.

(2) Nicks and scratches in excess of 0.010 inch depth. Nick and scratch damage less than 0.010 inch deep is acceptable if the damage is polished out.

(3) Corrosion damage in excess of 0.010 inch deep after polishing out and/or which affects over twenty percent of the area of the tube is not acceptable. Replace tube.

(4) Wear in bolt holes in fittings in ends of diagonal brace assemblies in excess of 0.005 inch is not acceptable. Make the inspection for bolt hole wear only if the diagonal brace tubes are removed for some other purpose.

(5) Distortion of the diagonal brace assemblies that can be detected visually is not acceptable. Replace tube.

b. Removal.

(1) Remove right and left access panels (22, figure 2-3).

(2) Remove bolts (10 and 18, figure 2-35) and remove right diagonal brace tube (15).

(3) Remove bolts (1 and 9, figure 2-35) and remove left diagonal brace tube (5).

c. Repair.

(1) Polish out nicks, scratches and corrosion damage that is within limits.

(2) Touch up repair area with primer (C102).

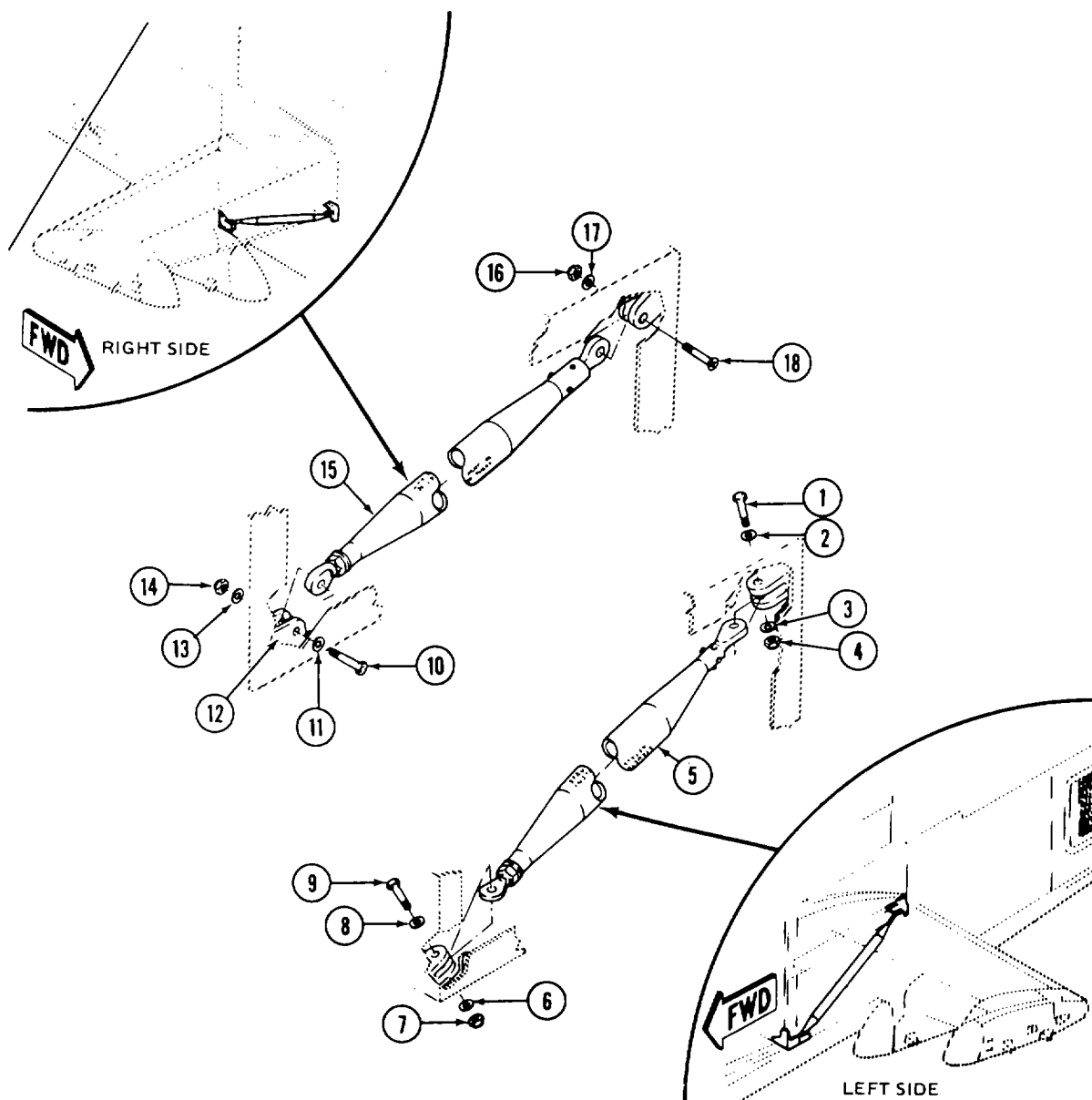
(3) Replace adjustable rod end connector if bolt hole is worn beyond 0.005 inch limit. Replace entire diagonal brace tube assembly if the bolt hole in the fixed fitting is worn beyond the 0.005 inch limit.

d. Installation.

(1) Position left diagonal brace tube assembly (5) figure 2-35 in helicopter. Install bolt (1), washers (2 and 3) and nut (4). Adjust rod end connector in opposite end of left diagonal brace tube assembly if necessary and install bolt (9), washers (6 and 8) and nut (7).

(2) Install right diagonal brace tube assembly (15) in the same manner with the exception that special bolt (18) is used in the forward end.

(3) Install right and left access panels (22, figure 2-3).



NOTE

1. Diagonal brace tubes must be installed prior to flight.
2. The right diagonal brace (15) is larger in diameter than the left diagonal brace (5). When diagonal brace tubes are being installed, refer to current Repair Parts and Special Tools List to ensure that correct P/N diagonal braces are installed.

1. Bolt	7. Nut	13. Washer
2. Washer	8. Washer	14. Nut
3. Washer	9. Bolt	15. Right Diagonal Brace Tube Assembly
4. Nut	10. Bolt	16. Nut
5. Left Diagonal Brace Tube Assembly	11. Washer	17. Washer
6. Washer	12. Fitting	18. Special Bolt

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Figure 2-35. Diagonal brace tube installation

2-24. Canopy.

The canopy over the pilot and gunners stations consists of acrylic plastic windows mounted in a supporting framework of aluminum alloy. The pilot and gunners doors form a portion of the canopy. The windows in the pilot and gunners doors and the windows in the frames opposite the doors are equipped with linear explosive window cutting assemblies for emergency removal of the four windows. Engine bleed air is utilized for rain removal.

2-25. Canopy Assembly Frames.

The aluminum canopy assembly frames support the acrylic plastic windows and the pilot and gunners doors.

a. *Inspection.* Canopy frames (2 and 6) and cross member (3) shown in figure 2-36 shall be inspected.

(1) No cracks are allowed.

(2) No holes are allowed.

(3) Corrosion is not acceptable, but the frames and cross members may be cleaned up to make them acceptable. Do not reduce frame or cross member thickness by more than 3 percent.

(4) Distortion is acceptable, but must be negligible enough that fit and function is not adversely affected.

WARNING

Ensure that both the pilot and gunners arming/firing mechanism handles are secured with safety pins prior to entry into the cockpit area.

b. *Removal - Left Canopy Frame*

WARNING

Ensure that both the pilot and gunners arming/firing mechanism handles are secured with safety pins prior to entry into the cockpit area.

NOTE

Canopy frame removal/installation instructions apply only when there is damage to the frame. If damage is confined to a window, replace only the window.

(1) Remove pilot and gunners doors. Refer to paragraph 2-27.

(2) Remove bracket of gunners door strut (4, figure 2-45) from structure.

(3) Remove all hinge halves from left canopy frame (2, figure 2-36).

(4) Remove window cutting assembly junction manifold from bracket on frame. Remove rivets to detach bracket and interconnect lines from canopy. Record locations for installation of parts on new canopy frame.

(5) Remove all screws attaching center window (1, figure 2-36).

(6) Insert blade of putty knife between center window and canopy frame to separate center window from sealant. Force putty knife around entire mating surface and remove window.

(7) Drill out rivets attaching left end of cross members (3, figure 2-36) to left canopy frame (2).

(8) Remove the tees supporting the antenna. Remove screws attaching left canopy frame to top roof section.

NOTE

Keep all parts removed for use as templates for installation of new parts on canopy structure.

(9) Remove rivets attaching left canopy frame to structure as follows:

(a) Drill out all rivets attaching left canopy frame to front of bulkhead. Remove two screws from inboard side of forward bulkhead which are secured by rivnuts on inboard side of left canopy.

(b) Drill out the two vertical rivets attaching canopy frame and tab to bulkhead at left rear corner of rear bulkhead and leave the tab. See

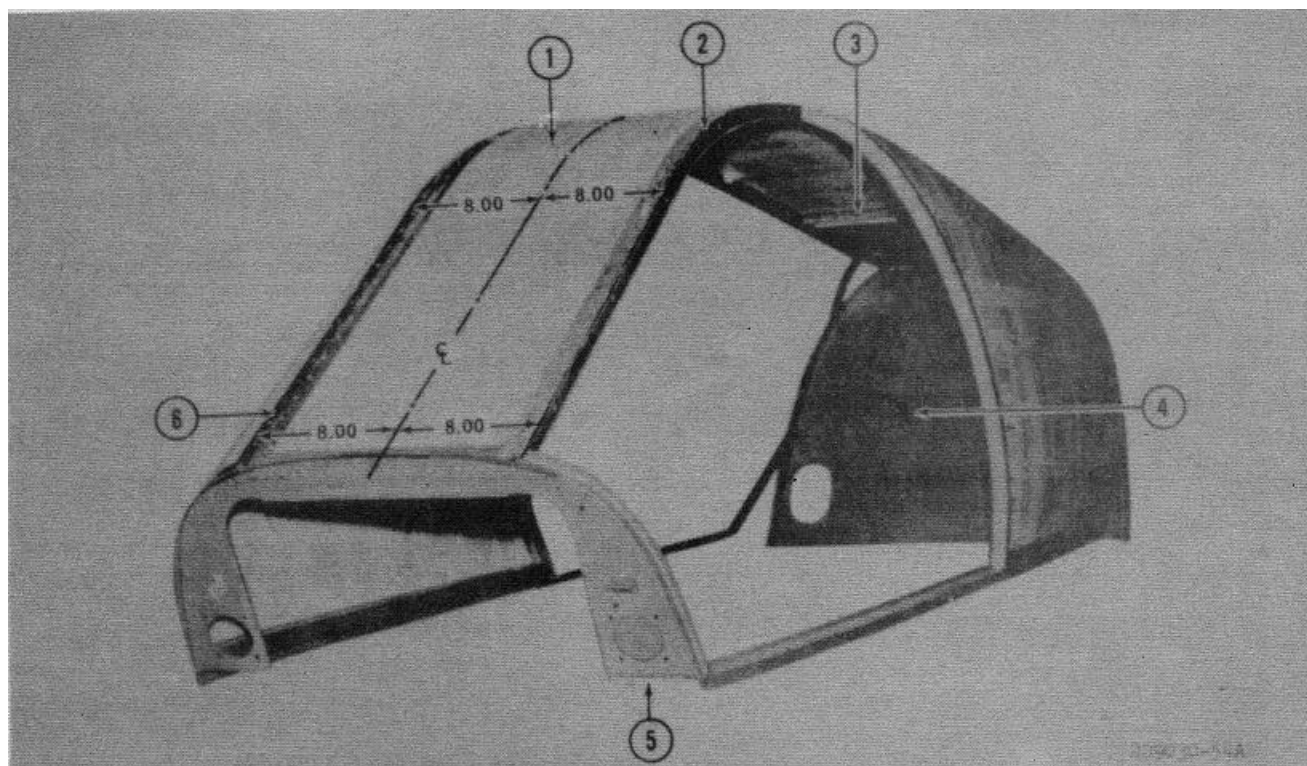
figure 2-37. Remove the balance of rivets attaching frame to rear bulkhead.

(c) Drill out vertical rivets attaching left side of pilots console to left frame.

(d) Drill out vertical rivets that attach left frame to tabs of vertical stringers of structure. Drill these rivets out from below.

(e) Drill out all remaining horizontal rivets that attach lower canopy frame to structure.

Change 48   2-58A/(2-58B blank) I



1. Center Window	4. Aft Bulkhead (Reference)
2. Left Canopy Frame	5. Forward Bulkhead (Reference)
3. Cross Member (4 places)	6. Right Canopy Frame

Figure 2-36. Canopy frames and center window

(10) Carefully separate upper part of left canopy frame (2, figure 2-36) from upper cross members, forward roof section, forward bulkhead and aft bulkhead. Remove left canopy frame from structure. Avoid distorting the left canopy frame because dimensions on the old frame can be used to locate rivet holes on the new frame.

c. Installation - Left Canopy Frame

WARNING

Ensure that both the pilot and gunners arming/firing mechanism handles are secured with safety pins prior to entry into the cockpit area.

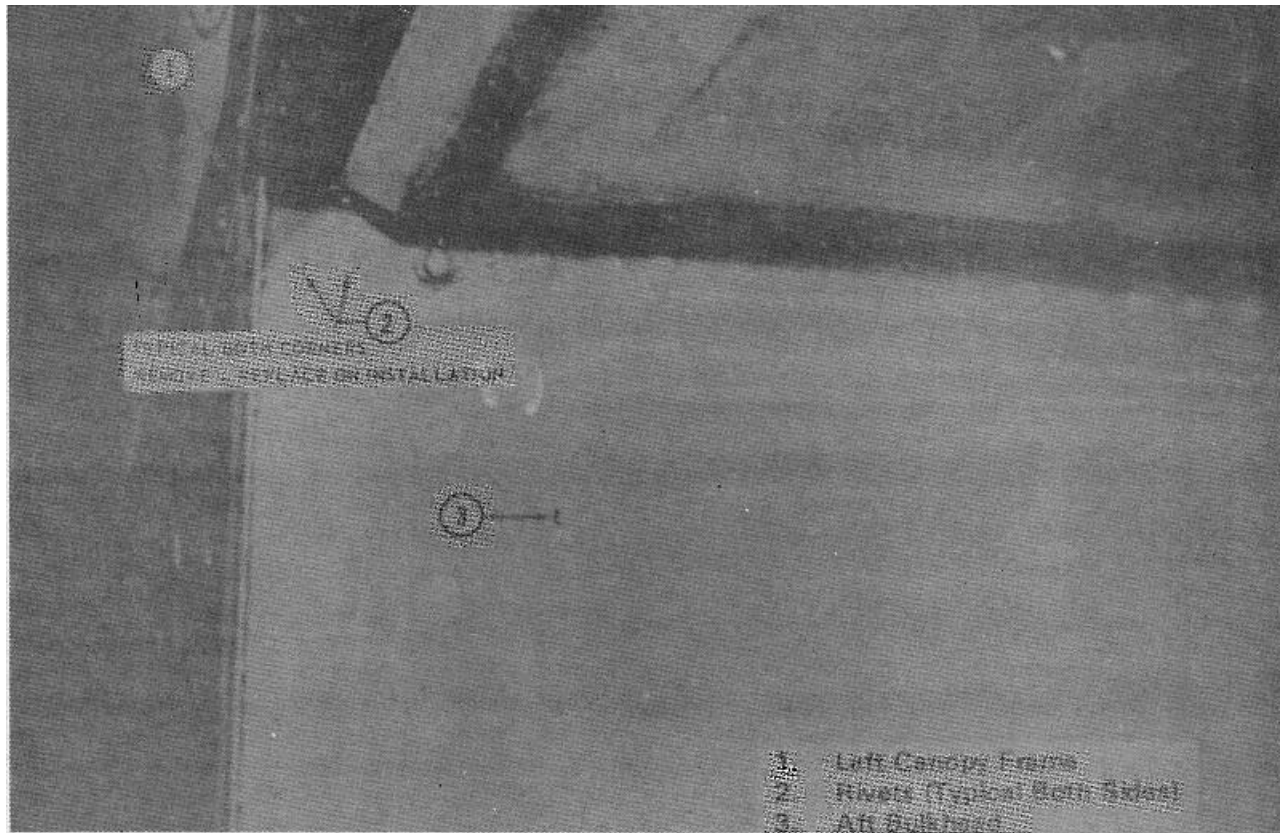
(1) Remove all burrs and rough spots on helicopter structure where canopy frame is to be installed. Give special attention to rivet holes.

(2) Position new left frame (2, figure 2-36) on helicopter.

NOTE

There are no horizontal pilot rivet holes in the lower section of new canopy frame when received for installation. The rivnuts for door hinge attachment are installed. The rivnuts for attachment of center window are not installed but are supplied separately.

(3) Attach left canopy frame to structure as follows: See figures 2-36 and 2-38.



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Figure 2-37. Aft bulkhead rivet removal (typical two places)

NOTE

Use the old left canopy frame and remaining canopy structure as template for rivet patterns and attachment points.

(a) Align the upper edge of left canopy frame along left buttock line eight. See figure 2-38. Align upper edge of right canopy frame along right buttock line eight. Maintain 16 inch distance between frames, measured from outboard surface. Use clamps or other suitable method. Clamp upper left edge of canopy frame to forward and aft bulkheads.

(b) Use holes existing in forward bulkhead as template and mark the centers of the two holes on inboard side of new left canopy frame.

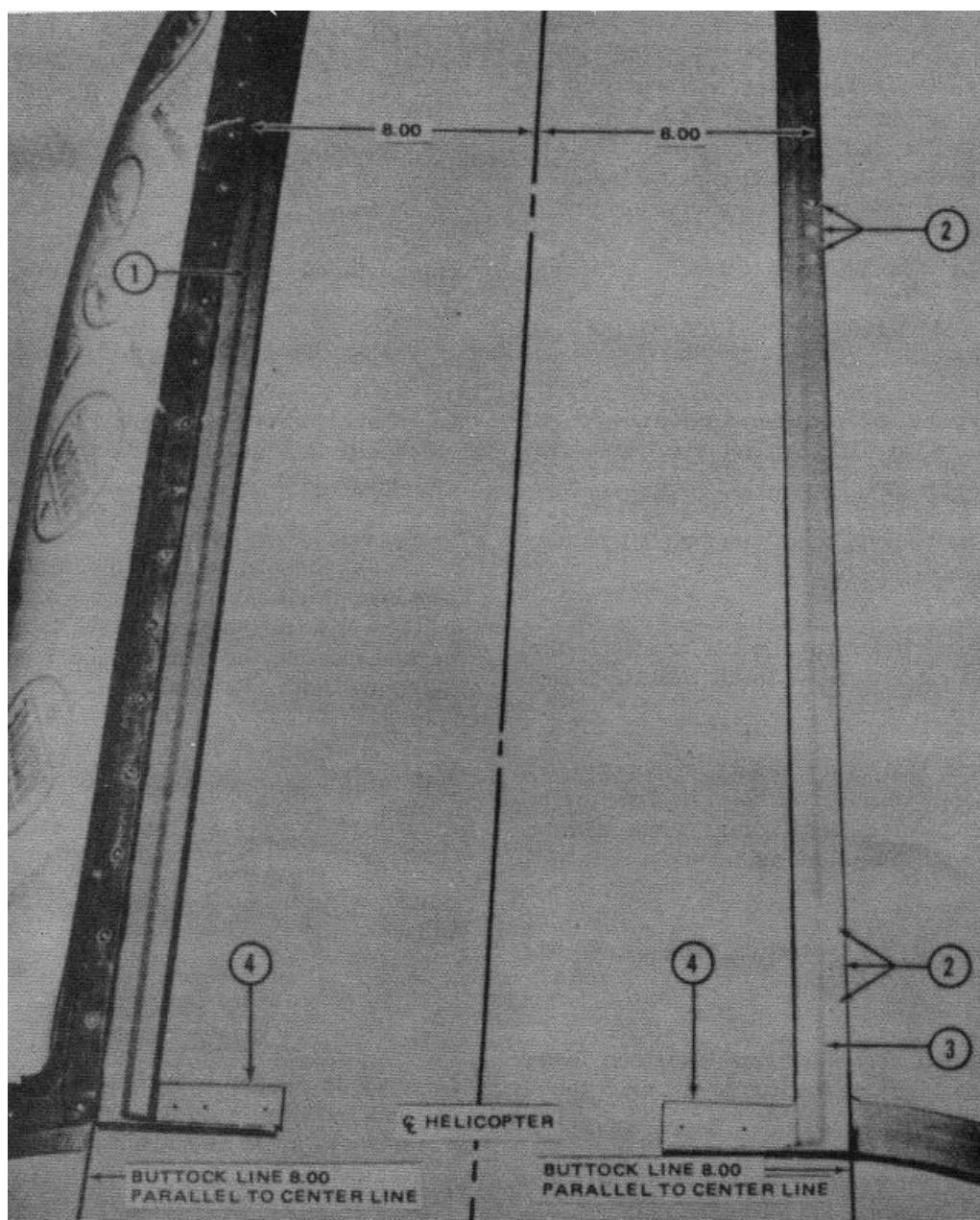
(c) Position left ends of cross members on

upper edge of left canopy frame, and back drill corresponding rivet holes from cross members to left canopy edge.

(d) Remove left canopy frame from structure. Drill a 0.221 to 0.226 inch hole at each of two spots marked on forward end of canopy from forward bulkhead. At each of two holes drilled in forward canopy edge, install a rivnut (item 62, table 2-2).

(e) Again place upper edge of left canopy frame along left buttock line eight, which is eight inches left of helicopter center line, and again anchor upper edge of left canopy frame to structure. See figure 2-38.

(f) Install two screws through existing holes in left side of forward bulkhead and secure screws in rivnuts installed in left canopy frame.



1. Left Canopy Frame	3. Right Canopy Frame
2. Rivnuts - Door Hinge	4. Cross Member Attach Angles

209030-56B

Figure 2-38. Alignment - upper right and left canopy frames

(g) Align rivet holes from upper cross members with corresponding holes drilled in canopy frame and install rivets of same type, size and dimension as in original installation, and attach cross members to left canopy frame.

(h) Use the rivet holes in structure as template and, beginning at upper rivet hole over forward bulkhead, backdrill a corresponding hole of same size in forward edge of left canopy. Install a rivet of same size, type and dimension as original.

NOTE

Refer to TM 55-1500-204-25/1 for riveting procedures.

(i) Repeat procedure as outlined in paragraph above, at each existing rivet hole over forward bulkhead.

(j) Install rivets at aft end of left canopy frame to structure bulkhead.

(k) Install two corner rivets to attach clip and aft end of canopy frame to aft bulkhead. See figure 2-37.

(l) Back drill lower section of canopy left frame using longitudinal rivet holes in structure as a rivet pattern. Install longitudinal rivets of same type, size and dimension as used in original structure.

(m) Install rivets attaching left side of pilots console to left canopy frame.

(n) Install vertical rivets to attach lower side of left canopy frame to structure at each tab of vertical stringers.

(4) Install previously installed center window as follows: See figures 2-39, 2-40 and 2-41.

NOTE

Due to the difference in procedure for reinstallation of a center window and of a new, undrilled window, the two procedures will be discussed separately. Refer to paragraph 2-26, f if a new center window is to be installed.

(a) Place center window in installed position

and align attachment holes in right side of window, with the corresponding rivnuts in right frame.

(b) Install several attachment screws through attachment holes along right side of window and thread into corresponding rivnuts in right canopy frame to prevent movement of window.

(c) Use center window as template and mark attachment hole locations from window to new left canopy frame and new cross members, if installed, for rivnut installation. Also mark hole locations for center window and for roof structure aft of center window.

NOTE

If areas of original canopy frame are too badly damaged for use as template, see figure 2-40.

(d) Remove center window. At the marked locations on left canopy and cross members, if new, drill and install rivnuts (item 62, table 2-2) at each marked location for window and roof attachment. See figure 2-40.

(e) Remove burrs and filings or anything that might damage window or prevent it from seating.

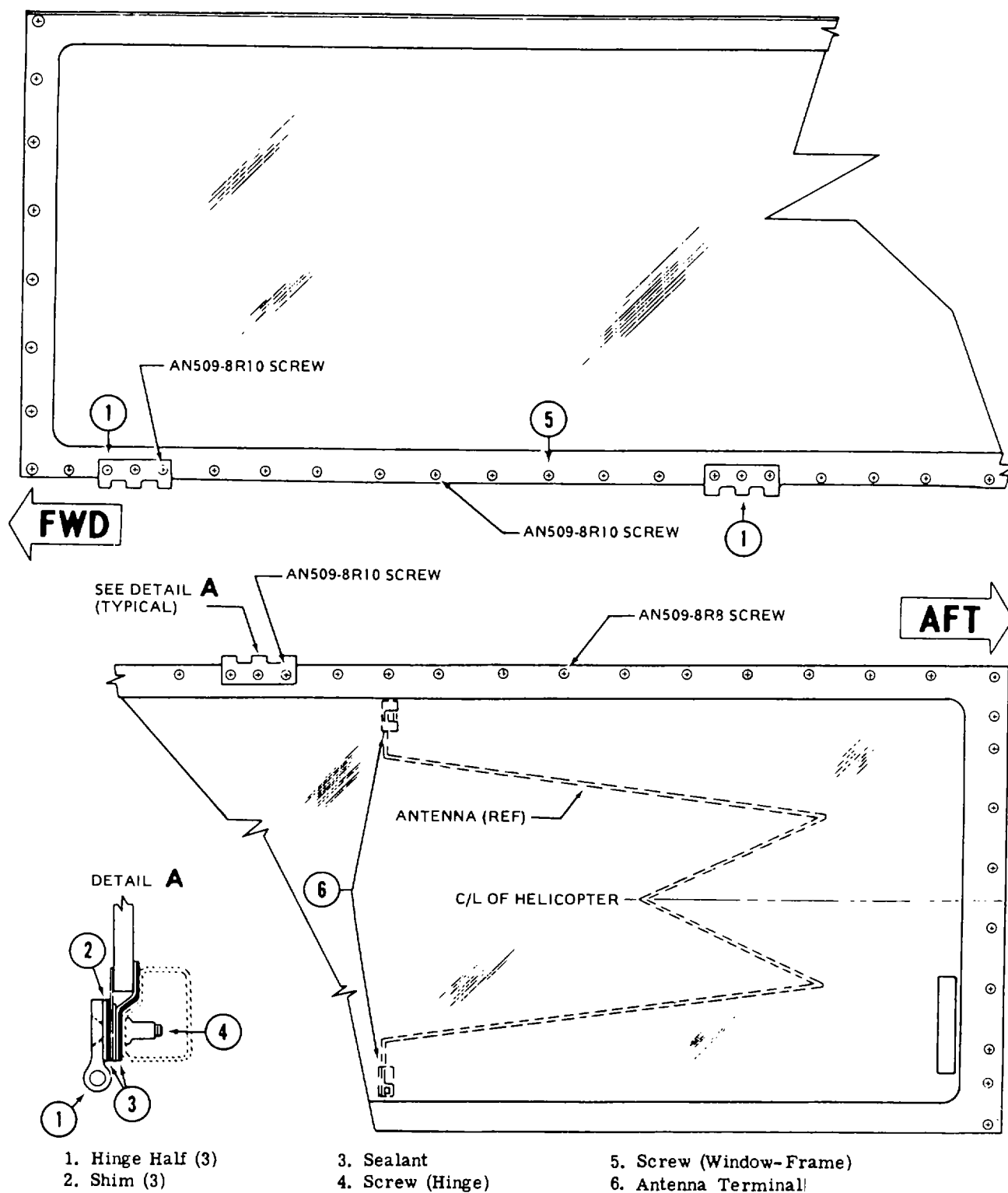
(f) Apply sealant (CI16) to mating surface of center window and canopy mating surface as follows:

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

1 Thoroughly clean canopy mating surface with clean cloth, saturated with methyl-ethyl-ketone (C87). Wipe cleaned area dry before cleaner evaporates.

2 Apply masking tape (C134) adjacent to inboard mating edge of center window to prevent excessive adhesive from smearing on window beyond mating area.

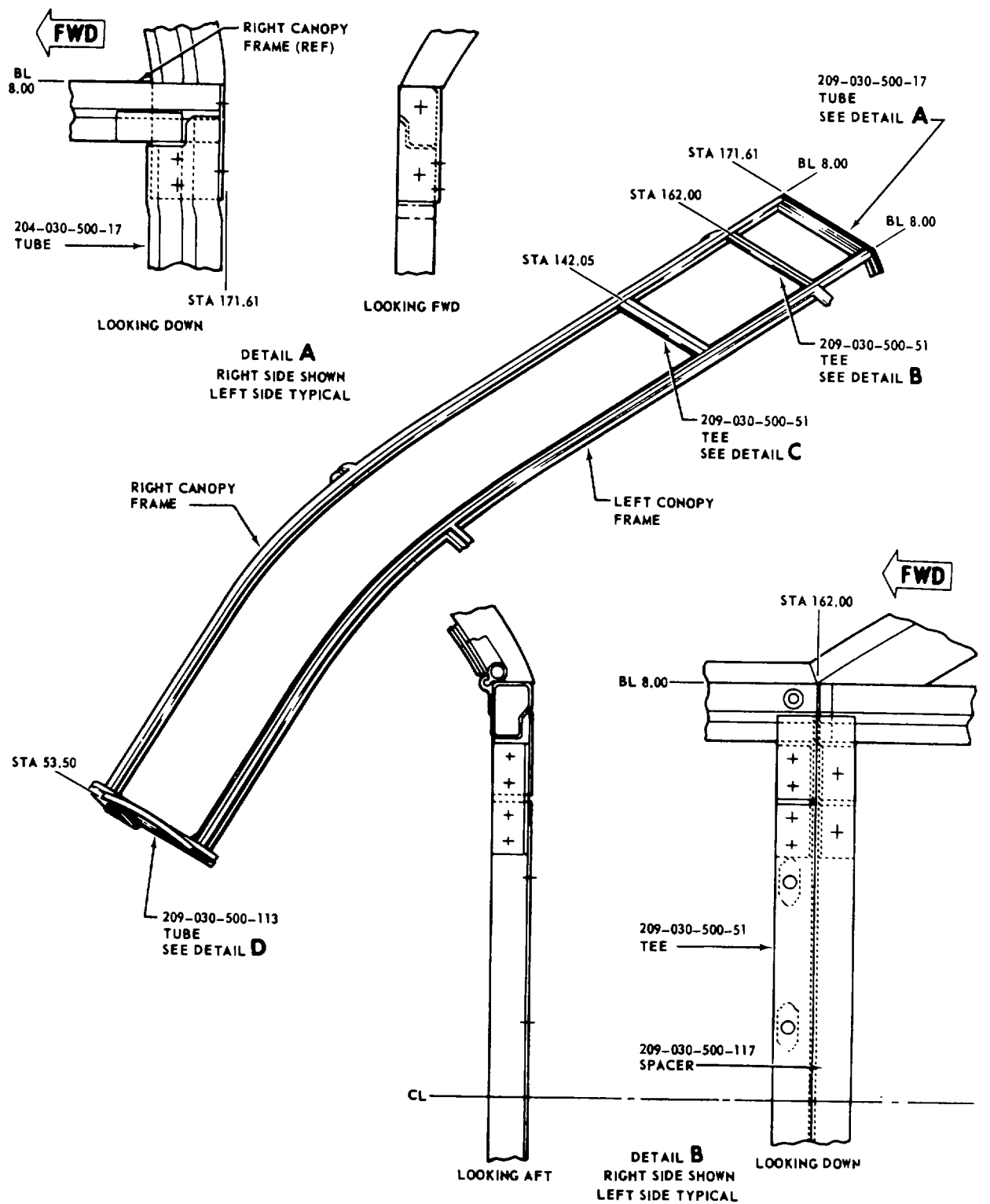


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Figure 2-39. Upper center window

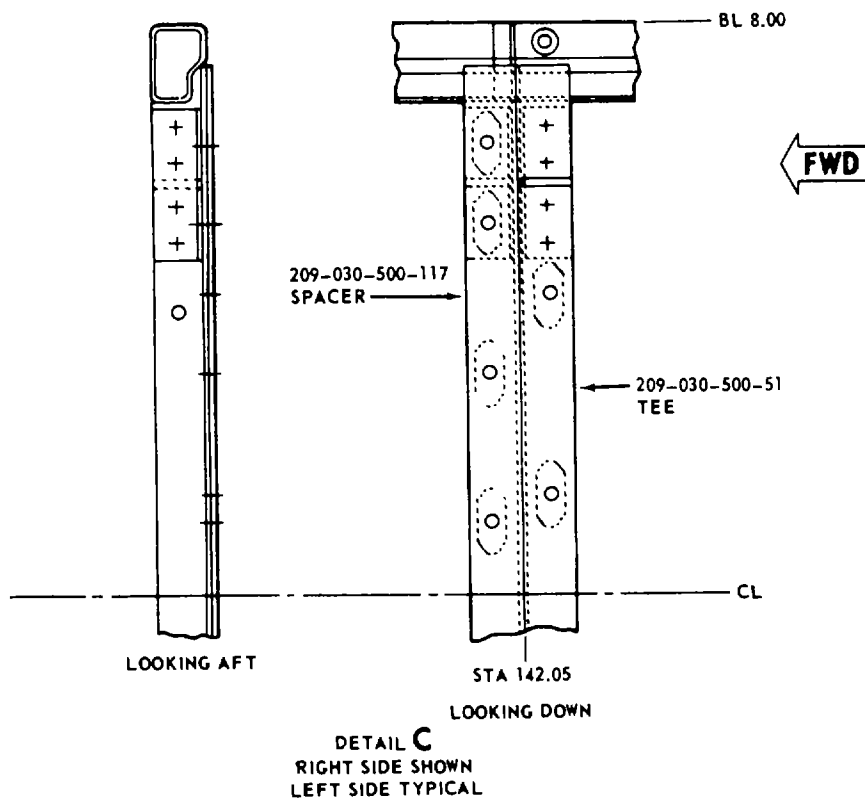
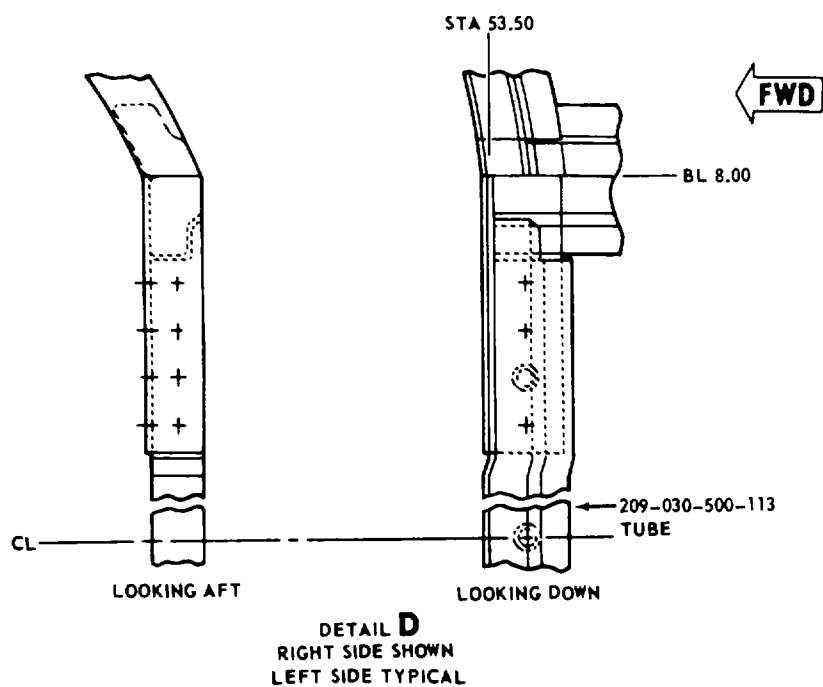
Foldout Figure 2-40. Center window rivnut hole dimensions

(Located in back of manual)



209030-59-1B

Figure 2-41. Canopy frame and cross member installation (Sheet 1 of 2)



209030-59-2A

Figure 2-41. Canopy frame and cross member installation (Sheet 2 of 2)

CAUTION

Do not use aliphatic naphtha type I in or around cockpit. Use of this solvent can result in damage to acrylic plastic and window cutting assembly.

3 Clean mating area of window with clean cloth, saturated with naphtha. Wipe dry before cleaner evaporates.

4 Apply a thin coat of sealant (C116) to mating area of window.

(g) Place center window in install position, with attachment holes in window aligned with corresponding rivnuts in canopy frame.

(h) Install center window in canopy frame, with original hardware (short screws). Start at forward end and work progressively aft.

NOTE

Separate the 12 longer screws which are used for attachment of four door hinge halves.

(i) Remove masking tape from inside window surface..

(5) Place gunners door on canopy in closed position.

(6) Assemble a blank hinge half on each door hinge half with a headed pin, washer and cotter pin.

(7) Use a hole finder to mark location for three holes in hinge to match rivnuts in canopy frame. Drill 0.170 to 0.176 inch diameter holes and countersink to match attaching screws.

(8) Place a shim (2, figure 2-39) under each hinge half and install screws to secure hinges to center window and to left frame.

(9) Install window cutting assembly in the window that was installed with the left canopy frame. Refer to Chapter 17 for instructions to install the window cutting assembly. Also ensure that the window cutting assembly is positioned properly for connection to the manifold in the following steps.

(10) Install the window cutting

assembly junction manifold bracket that was removed in step b, (4). Locate the bracket in the same relative position it was in on the old left canopy frame. Also ensure that the bracket is located with 0.06 inch clearance between top of bracket and surface of window edging and is positioned for good routing of interconnect lines.

(11) Install the window cutting assembly junction manifold on the bracket.

(12) Remove cover or cap from transfer lines and inspect tips for damage. If the tip surface is marred, replace the transfer line. If the tips are satisfactory, attach the transfer lines to the manifold. Ensure that all window cutting assembly transfer lines for the doors and windows are connected.

(13) Position door strut attachment fitting on upright frame member. Secure with two bolts and thin washers to rivnuts on aft side. Install two countersunk screws from outboard side and install washers and nuts at inboard side. Install a support clip that extends across retainer of window cutting assembly of fixed window with the upper screw.

(14) Install gunners door strut. Refer to paragraph 2-27.

(15) Check operation of gunners door latch and adjust if required. Refer to paragraph 2-30.

*d. Removal - Right Canopy Frame***WARNING**

Ensure that both the pilot and gunners arming/firing mechanism handles are secured with safety pins prior to entry into the cockpit area.

Remove the right canopy frame (6, figure 2-36) by the same procedure outlined for the left canopy frame in the preceding step d with the following exceptions:

(1) The right side of the pilots console is not attached to the right canopy frame; therefore, there are no rivets to be removed in that area.

(2) Transpose "left" to "right" and "gunners" to "pilots" throughout procedure.

e. *Installation - Right Canopy Frame***WARNING**

Ensure that both the pilot and gunners arming/firing mechanism handles are secured with safety pins prior to entry into the cockpit area.

Install the right canopy frame (6, figure 2-36) by the same procedure outlined for the left canopy frame in preceding step c with the following exceptions:

(1) The right side of the pilots console is not attached to the right canopy frame; therefore, there are no rivets to be installed in that area.

(2) Transpose "left" to "right" and "gunners" to "pilots" throughout procedure.

f. *Removal - Both Left Canopy Frame and Right Canopy Frame***WARNING**

Ensure that both the pilot and gunners arming/firing mechanism handles are secured with safety pins prior to entry into the cockpit area.

NOTE

Do not remove both right and left canopy frames unless both frames are damaged. Alignment during installation is more difficult if both frames are removed.

(1) Remove left canopy frame. Refer to step b.

(2) Remove right canopy frame. Refer to step d.

g. *Installation - Both Left Canopy Frame and Right Canopy Frame***WARNING**

Ensure that both the pilots and gunners arming/firing mechanism handles are secured with safety pins prior to entry into the cockpit area.

(1) Remove all burrs and rough spots on helicopter structure where canopy frame is to be installed. Give special attention to rivet holes.

(2) Position new left canopy frame (2, figure 2-36) and right canopy frame (6) on helicopter and clamp in position with top edge of canopy frames on buttock lines 8 as shown on figure 2-38.

(3) Position cross members (3, figure 2-36) between top edges of left and right canopy frames and attach to frames at same stations as old canopy. Take dimensions from old canopy parts and see figure 2-41 for station locations.

(4) Install rivnuts (item 62, table 2-2), that were furnished with left and right frame assemblies, in top sides of canopy frames for installation of center window. Use old center window and roof section aft of center window as templates for rivnut locations. See figure 2-41 for station locations.

(5) Install center window. Refer to paragraph 2-26.

(6) Install gunners door, window cutting assembly, and gunners door strut. Refer to steps c,5 through c,15.

(7) Install pilots door in same manner described in preceding step. Transpose "left" to "right" and "gunners" to "pilots" throughout procedure.

2-26. Canopy Assembly Windows.**WARNING**

Ensure that both the pilot and gunners arming/firing mechanism handles are secured with safety pins prior to entry into the cockpit area.

The canopy assembly windows are the upper center window, fixed windows in the left canopy frame and the right canopy frame. All the windows are acrylic plastic.

NOTE

The canopy and windows are subjected to aerodynamic stress loads which apply a negative or outward pressure to the

canopy doors and windows. The windows transfer the applied stress loads from window edges to the mating edges of the canopy frame. See figure 2-42.

a. Cleaning.

CAUTION

Do not use aliphatic naphtha Type I in or around cockpit. Use of this solvent can result in damage to acrylic, plastic and window cutting assembly.

CAUTION

Do not use compounds that contain any abrasive material or solutions that contain chlorinated carbons. Avoid excessive scrubbing of plastic panels during washing operation.

(1) Clean the transparent plastic windows with cleaning compound (C41) and water. Gently free all caked mud or dirt with fingers. Do not use sponges or coarse cloths. Rinse frequently with water while removing mud.

(2) Remove any grease or oil that remains on windows after washing as described in step (1), with naphtha (C88) and repeat cleaning with cleaning compound as described in step (1).

(3) Allow surfaces to drip dry.

(4) Polish out minor scratches which may interfere with pilot or gunners vision.

(5) Apply rain repellant.

b. Application of Chemical Rain Repellant. Refer to TM55-150-204-25/1 for cleaning and application instructions.

c. Inspection. Inspect canopy windows and classify damage according to limits stated below.

(1) Scratches up to 0.016 inch deep and not exceeding 1.0 inch in length allowed if no other damage occurs within 1.0 inch.

(2) Nicks, chips, and gouges are allowed if not deeper than 0.050 inch and not larger than can be

enclosed with a 0.50 inch diameter circle after clean-up. If more than two such damage areas fall within a 3.0 inch circle, replace the panel.

(3) Inspect the canopy windows for crazing. Crazing is small minute cracks on the surface of the material. No crazing is acceptable which impairs vision of crew members.

NOTE

If crazing has penetrated the plastic sheet, classify it as cracks and refer to following step.

(4) Inspect the canopy windows for cracks. No cracks are allowed.

(5) Inspect for holes in windows. Holes that can be cleaned up not to exceed 0.75 inches in diameter can be patched with a tapered plug if there is no other damage within three inches.

(6) Inspect for delamination or bond separation between windows and reinforcement edges. Delamination is reparable if not over three inches in length with the following exceptions:

(a) No delamination repairs are allowed within five inches fore and aft of door hinges. See figure 2-42.

(b) No delamination repairs are allowed in the first 27 inches of the upper center window. See figure 2-42.

(7) Inspect for failure at attachment holes in window and door frame edge members. Attachment hole failures are reparable if not more than two adjoining fasteners are involved except that no two missing fasteners are acceptable within five inches of a door hinge. See figure 2-42.

d. Repair.

(1) Blend out small scratches that do not exceed damage limits. Refer to TM55-1500-204-25/1. Refer to TM55-1520-234-23P for windshield maintenance kit and plexiglass repair kit.

(2) Repair delamination damage that is within limits by injecting adhesive (C34) in delaminated area with a syringe. If delamination damage exceeds limits, replace window or door as applicable.

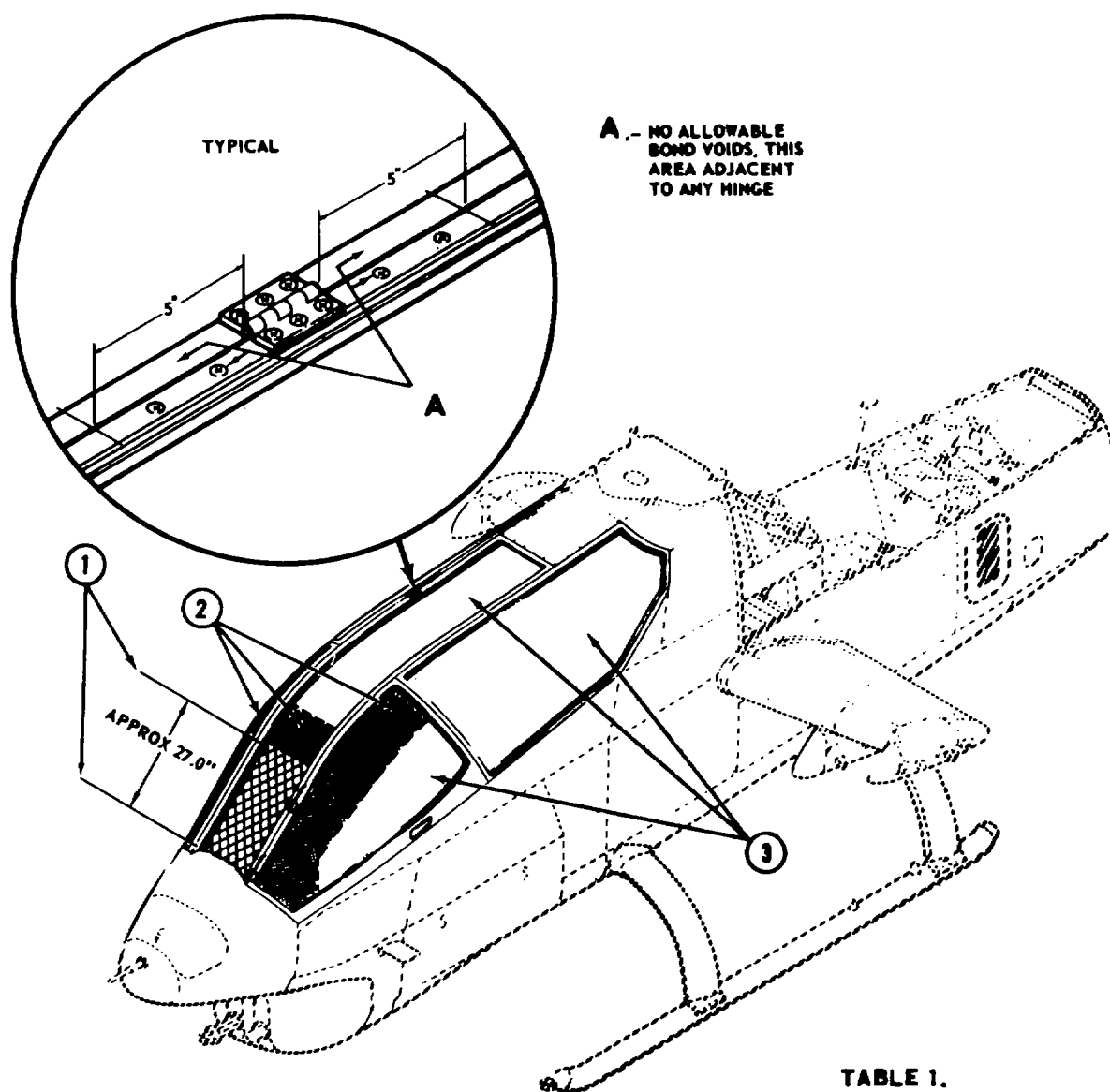


**TABLE 1.
LOAD DATA**

ZONE	PRESSURE	STRESS
1	Maximum	High
2	Medium	Normal
3	Low	Low

Condition - 10° nose down,
15° yaw, 222 knots

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Figure 2-42. Stress loads - canopy windows

(3) Repair attachment hole failures that are within limits as shown on figure 2-43.

e. Removal.

NOTE

Refer to paragraph 2-27 for instructions to remove windows from pilot and gunners doors.

(1) Upper center window removal.

(a) Remove gunner and pilots doors. Refer to paragraph 2-27.

(b) Disconnect leads from each antenna terminal (6, figure 2-39) mounted on inside surface of center window. Remove antenna.

(c) Remove three hinge halves (1, figure 2-39) with shims (2) and screws (4).

(d) Remove remaining screws attaching center window to canopy frames.

(e) Apply outward pressure on center Window and insert a putty knife or other suitable tool between window surface and canopy frame.

(f) Free window from frame by sliding blade of tool around window edge to break adhesive seal.

(g) Remove upper center window.

(h) Smooth up and clean canopy mating surface. Remove old sealant with a sharp plastic scraper and sandpaper (C112) of various grits. Touch up bare metal with primer (C102).

(2) Fixed Side Window Removal.

NOTE

These instructions are for either of two fixed canopy windows, located at right side of gunners and at left side of pilots station.

(a) Remove screws attaching window edges to canopy frame. This will include screw passing through window frame and window cutting assembly flange and secured by nuts and washers at lower aft corner of gunners window and at lower forward corner of

pilots window.

CAUTION

Protect window cutting assembly lead-covered linear explosive charge and back-up cushion from damage when exposed.

(b) Carefully loosen window from sealant around mating surface of canopy, frame and explosive window cutting assembly with a putty knife or other suitable tool. Remove window.

(c) Smooth up and clean canopy window. Remove old sealant with a sharp plastic scraper and sandpaper (C112) of various grits. Touch up bare metal with primer (C102).

f. Installation.

NOTE

Refer to paragraph 2-29 for instructions to install windows in pilot and gunners doors.

(1) Center window installation.

(a) Make sure that window mating surface of canopy frame is clean and smooth to prevent damage to window.

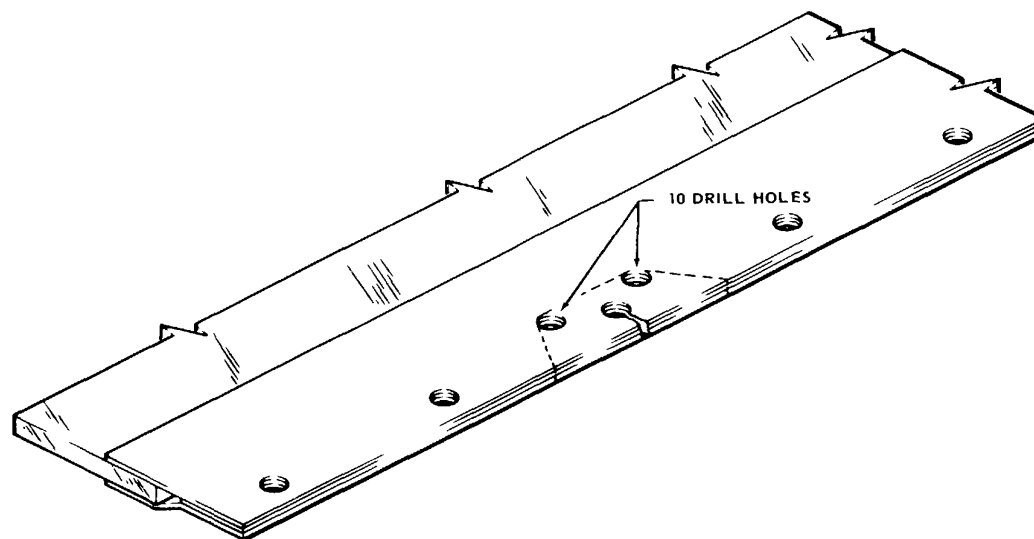
(b) Place upper center window in position and check fit.

NOTE

Maximum clearance between edges of window and adjacent structure is to be no more than 0.030 inch. Replacement windows are purposely oversize and usually require trimming.

(c) Trim edges of window to fit canopy frame.

(d) Place window again in position. Using a hole finder, drill holes around window edge to match existing rivnuts in canopy frame. Make all holes 0.184 to 0.190 inch diameter, except nine hinge attachment holes. Make hinge attachment holes 0.170 to 0.176 inch diameter.



1. LOCATE DIMENSIONS FOR CUT-OUT AS SHOWN IN VIEW **A**

Note

LAYOUT TRIM LINES DIRECTLY ON MATERIAL WITH SHARP SCRIBE OR OTHER SUITABLE INSTRUMENT.

2. DRILL NO. 10 HOLES (2) PLACES.
3. CUT OUT AREA TO BE REPAIRED ALONG TRIM LINE IN VIEW **A**

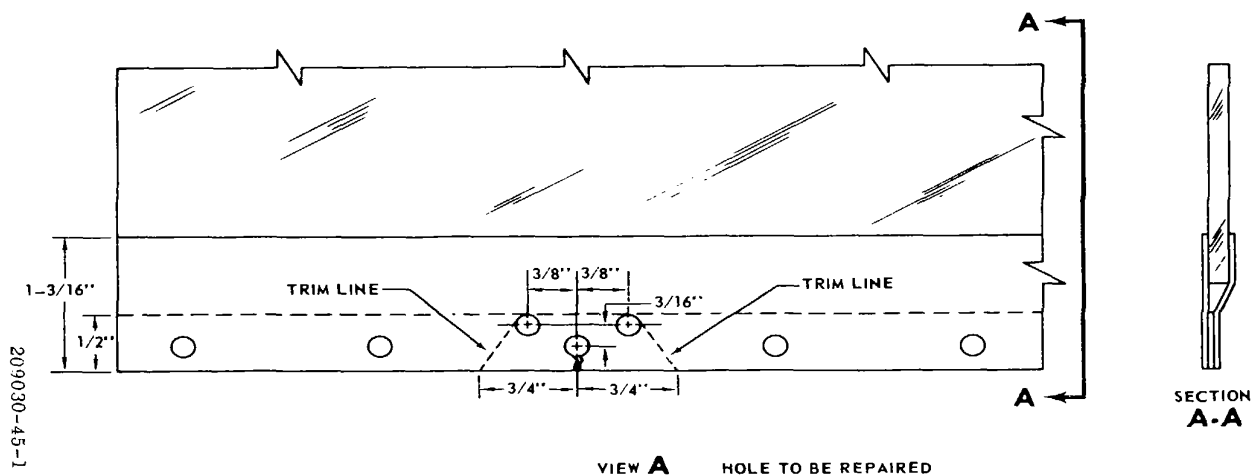
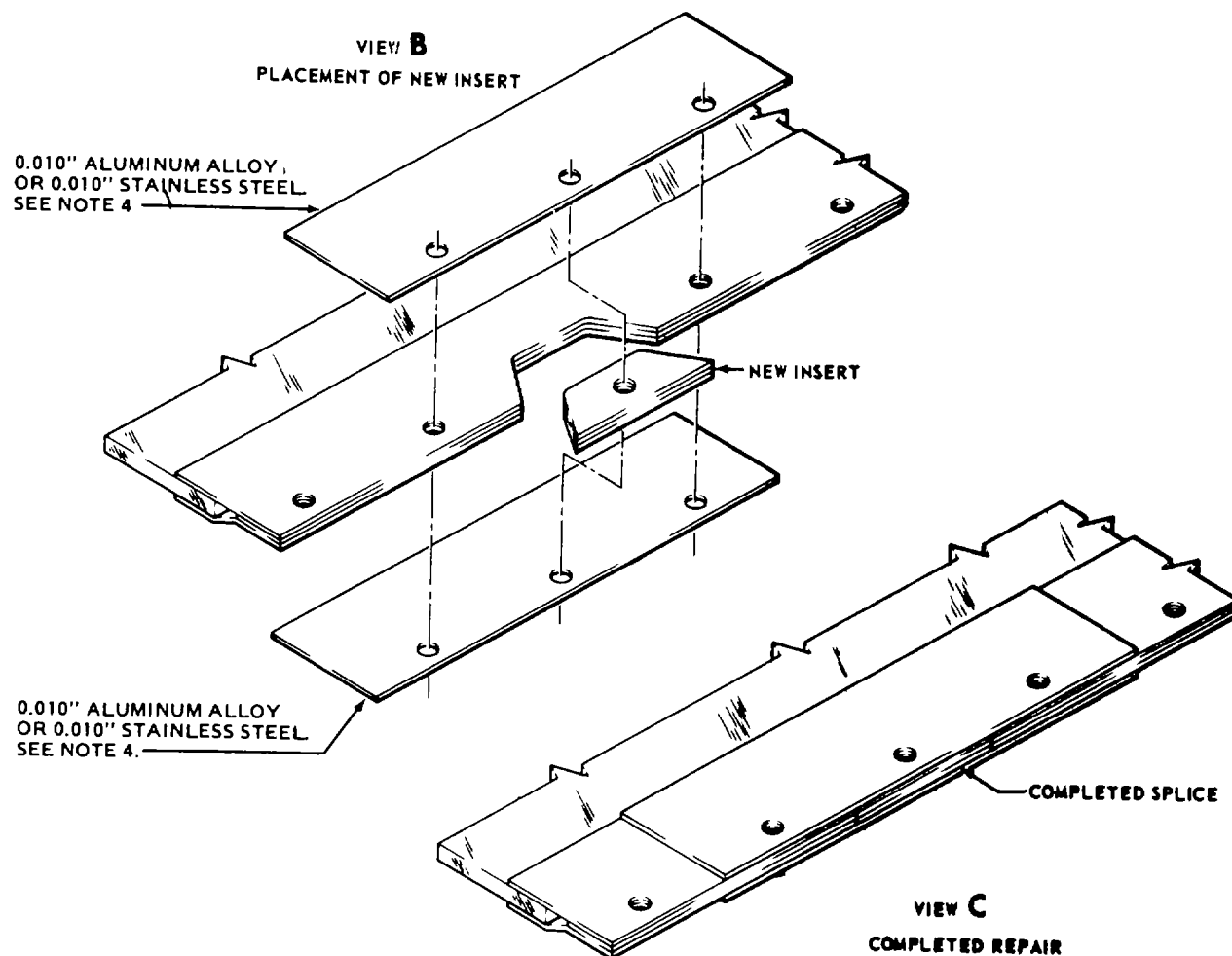


Figure 2-43. Insert repair to edge of windows (Sheet 1 of 2)



NOTES

4. Fabricate two plates from aluminum or stainless steel as shown on View B. Use aluminum for repair of canopy side windows. Use stainless steel for repair of upper center window and for door windows.
5. Fabricate insert as shown on View B.
6. Fit plates and insert as shown on View C.

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Figure 2-43. Insert repair to edge of windows (Sheet 2 of 2)

CAUTION

Use caution to avoid making countersink for screw heads too deep.

(e) Countersink drilled holes, except at hinge locations, with 100 degree countersink. Remove window, deburr holes and round all window edges.

(f) Prepare mating surfaces of window and canopy as follows:

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

1 Thoroughly clean canopy mating surface with a clean cloth saturated with methyl-ethyl-ketone (C87). Wipe cleaned area dry with clean cloth before solvent evaporates.

2 Mask inside surface of window adjacent to mating area.

CAUTION

Do not use aliphatic naphtha, Type I, in or around cockpit. Use of this solvent can result in damage to acrylic plastic and window cutting assembly.

3 Clean mating surface of window with naphtha (C88). Wipe dry with clean cloth before cleaner evaporates:

4 Apply thin coat of sealant (C116) to mating surface of window. Position window in canopy frame.

(g) Align drilled holes in window with rivnuts in canopy frame and install screws fingertight. Work from middle of window toward each end.

(h) Install three hinges halves (1), each with a shim (2) and three screws (4) (longer than other window screws).

(i) Tighten screws evenly. Remove sealant squeeze-out and masking material

(j) Install heat shield as follows:

1 Cut shield material 5x13.25 inches, from asbestos sheet (C66A) and fit to front end of center window. Trim to fit contour of nose section where it joins windows.

2 Mask window above heat shield.

3 Remove heat shield. Brush a coating of adhesive (C12A) on exposed window surface below masking.

4 Fit heat shield over prepared area and roll out all air bubbles with roller. Remove excess adhesive and masking, and allow to cure.

(k) Install antenna and connect antenna terminal (6, figure 2-39).

(l) Install gunner and pilots doors. Refer to paragraph 2-27.

(2) Fixed side windows installation.

(a) Make sure that window mating surface of canopy frame is clean and smooth to prevent damage to window.

(b) Position new window in canopy frame. Maintain equal clearances between window and frame.

(c) Locate and drill holes for window attaching screws.

1 At middle of contour on forward and aft edge, drill 0.184 to 0.190 inch diameter holes through window to match rivnuts in frame. Install screws as required.

2 Continue match-drilling holes and installing screws, working in both directions from attached points, until all holes matching rivnuts are drilled.

Figure 2-43A deleted.

3 Also drill 0.170 to 0.176 inch holes to match existing holes through explosive window cutting assembly flange and canopy frame at lower corner of window adjacent to crew door or forward lower corner of pilot window, or aft lower corner of gunner window.

4 Mark trim line on edges of window to fit frame.

5 Remove window from frame. Trim, smooth and round all edges.

6 Countersink holes 100 degrees on outer surface of window. Deburr holes on inner surface.

7 Prepare mating surfaces of window and canopy frame:

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact. Do not allow methyl-ethyl-ketone to contact window cutting assemblies.

prolonged skin contact. Do not allow methyl-ethyl-ketone (C87) to contact window cutting assemblies.

(a) Clean mating surface of canopy frame with methyl-ethyl-ketone (C87) and wipe dry with clean cloth before solvent evaporates.

(b) Mask inside surface of window adjacent to mating area with masking tape (C134).

(c) Clean mating surfaces with methyl-ethyl-ketone (C87) and wipe dry with clean cloth before solvent evaporates.

(d) Apply a bead of sealant (C116) on mating surface of window.

(d) Position window in canopy frame and install screws finger-tight.

(e) Tighten screws on forward and aft edges of window, working from middle of contour in both directions. Tighten screws on top and bottom edge in same manner. On screws that pass through frame and are secured by nut and washer apply tightening force to screws only.

(f) Wipe off excess sealant around window. Remove masking material.

2-27. Door Assemblies, Pilot and Gunners .

WARNING

Maximum permissible standoff distance between Explosive Cord (LES) and window is 0.10 inch, without repair.

The pilot and gunner door assemblies consist of formed acrylic plastic mounted in supporting framework of aluminum alloy tubes. The doors are incorporated in the canopy. The forward left side panel is the gunner door. The aft right side panel is the pilot door. Both doors are equipped with linear explosive window cutting assemblies connected to arming/firing mechanisms at pilot and gunner station for emergency removal of canopy windows.

a. Removal.

CAUTION

Removal of pilot or gunner door requires two persons to hold the door.

NOTE

Removal procedure for pilot door is given. The procedure for gunner door is similar. See figure 2-45 for view of gunner door.

(1) Open pilot door. See figure 2-44.

(2) Disconnect flexible interconnecting line of window cutting assembly from adapter of the window cutting assembly mounted in the door. Install protective steel plug and cap to protect the window cutting assembly connections from damage. Refer to Chapter 17 for more information on the window cutting assembly.

(3) Disconnect cables from door struts (1 and 2, figure 2-44). See figure 2-46 for detail view of strut installation. Loosen set screw and remove collar from cable tip. Loosen screw in cable positioning clamp and slide cable assembly out of cable positioning clamp. Retain collar, cable positioning clamp and horseshoe-shaped clamp for reinstallation.

(4) Detach door strut (1, figure 2-44) from lower fitting by removing cotter pin, washer and headed pin. Detach door strut (2) in the same manner.

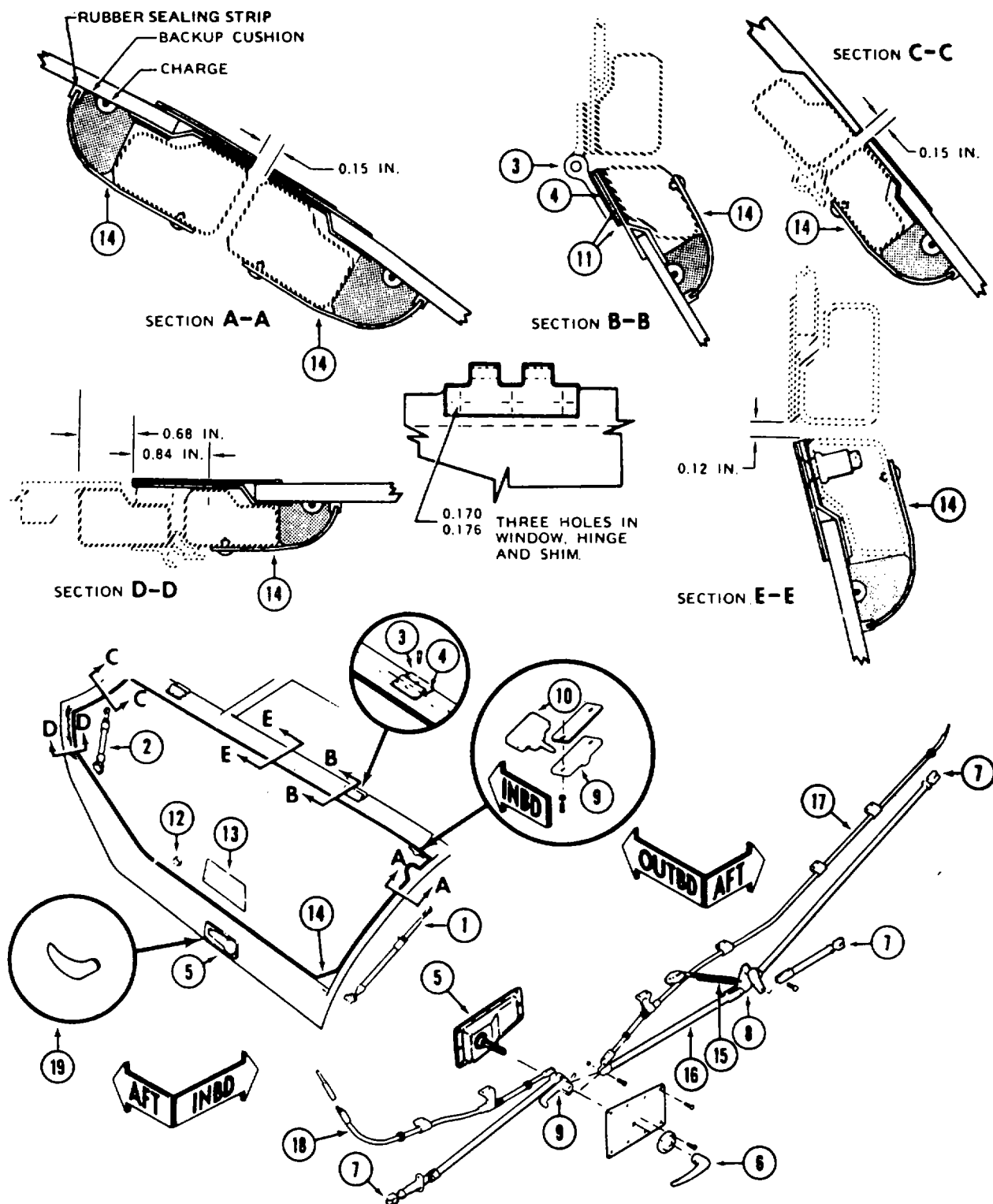
(5) If door struts are to be removed from helicopter, proceed as follows:

(a) Remove cotter pins, washers, headed pins, shims, and pivot pin shown in figure 2-46, detail A. Remove forward door strut (1, figure 2-44).

(b) Remove aft door strut (2, figure 2-44) in the same manner with the exception that a screw is used in lieu of the pivot pin arrangement used on the forward door strut (1).

(6) Support door and remove cotter pins, washers, and headed pins from two hinges (3, figure 2-44). Remove door.

(7) Remove gunners door in a similar manner. See figure 2-45.



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Figure 2-44. Pilots door (Sheet 1 of 2)

1. Strut (Forward)	11. Sealant
2. Strut (Aft)	12. Plug Button
3. Hinge (2)	13. Access Cover
4. Shim (2)	14. Window Cutting Assy.
5. Handle (Outboard) (Flush-type)	15. Spring
6. Latch Handle (Inboard)	16. Rod
7. Roller Assembly (3)	17. Cable Assembly
8. Bellcrank (Aft Roller Rods)	18. Cable Assembly
9. Latch Assembly	19. Handle (Outboard) (Non-flush-type)
10. Guide Pin	

209030-28-2D

Figure 2-44. Pilots door (Sheet 2 of 2)*b. Installation.***NOTE**

Installation procedure for pilots door is given. The procedure for the gunners door is similar. See figure 2-45 for view of gunners door.

(1) Identify door struts (1 and 2, figure 2-44) for installation in the correct position by measuring distance between centers of rod end bearings with the strut in minimum length position. Dimensions are as follows:

Strut (1, figure 2-44)	15.00 inches
Strut (2, figure 2-44)	11.84 inches
Strut (4, figure 2-45)	19.50 inches

(2) Install forward door strut (1, figure 2-44) on pilots door. Attach strut to door with pivot pin, shims, headed pins, washers and cotter pins as shown in figure 2-46, detail A. Shim to 0.005 - 0.015 inch dimension as illustrated.

NOTE

The procedure for installation of gunners door strut (4, figure 2-45) is the same as for the forward strut on the pilots door given in the preceding paragraph.

(3) Install aft door strut (2, figure 2-44) on pilots door with screw nut and washer.

(4) Position pilots door on canopy. Line up two hinges (3, figure 2-44) and install headed pins, washers and cotter pins.

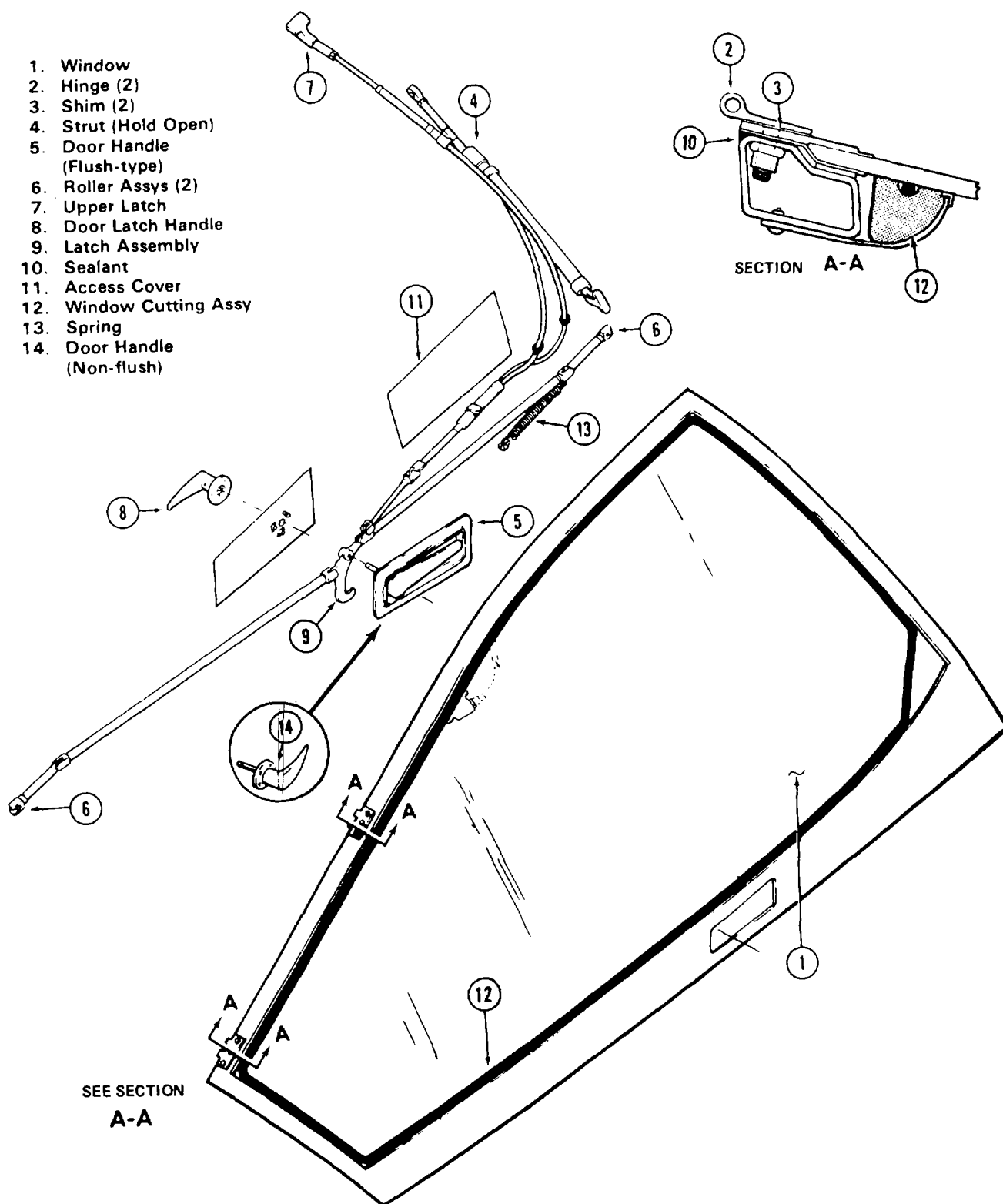
(5) Hold pilots door in open position and align door strut (1, figure 2-44) in lower fitting. Install headed pin, washer, and cotter pin. Install door strut (2) in same manner.

(6) Assemble cable assembly cable positioning clamp, horseshoe-shaped clamp, sleeves, and collar on strut (1, figure 2-44). See detail view B on figure 2-46. Set cable positioning clamp to dimension shown and tighten screw to hold cable positioning clamp in position on door strut and to hold the cable assembly in position. Position collar on cable tip and tighten set screw in collar. Adjust collar position on cable tip as necessary so that collar will actuate sleeve to release internal locking mechanism in strut when door handle is turned to unlatch door.

(7) Assemble and adjust cable assembly on strut (2, figure 2-44) in the same manner outlined in the preceding step.

(8) Adjust roller ends (7, figure 2-44) on latch rods to obtain proper engagement in closed position tighten locknut after adjustment.

(9) Adjust shims under striker plates and/or move striker plates on serrated plates to obtain



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Figure 2-45. Gunners door

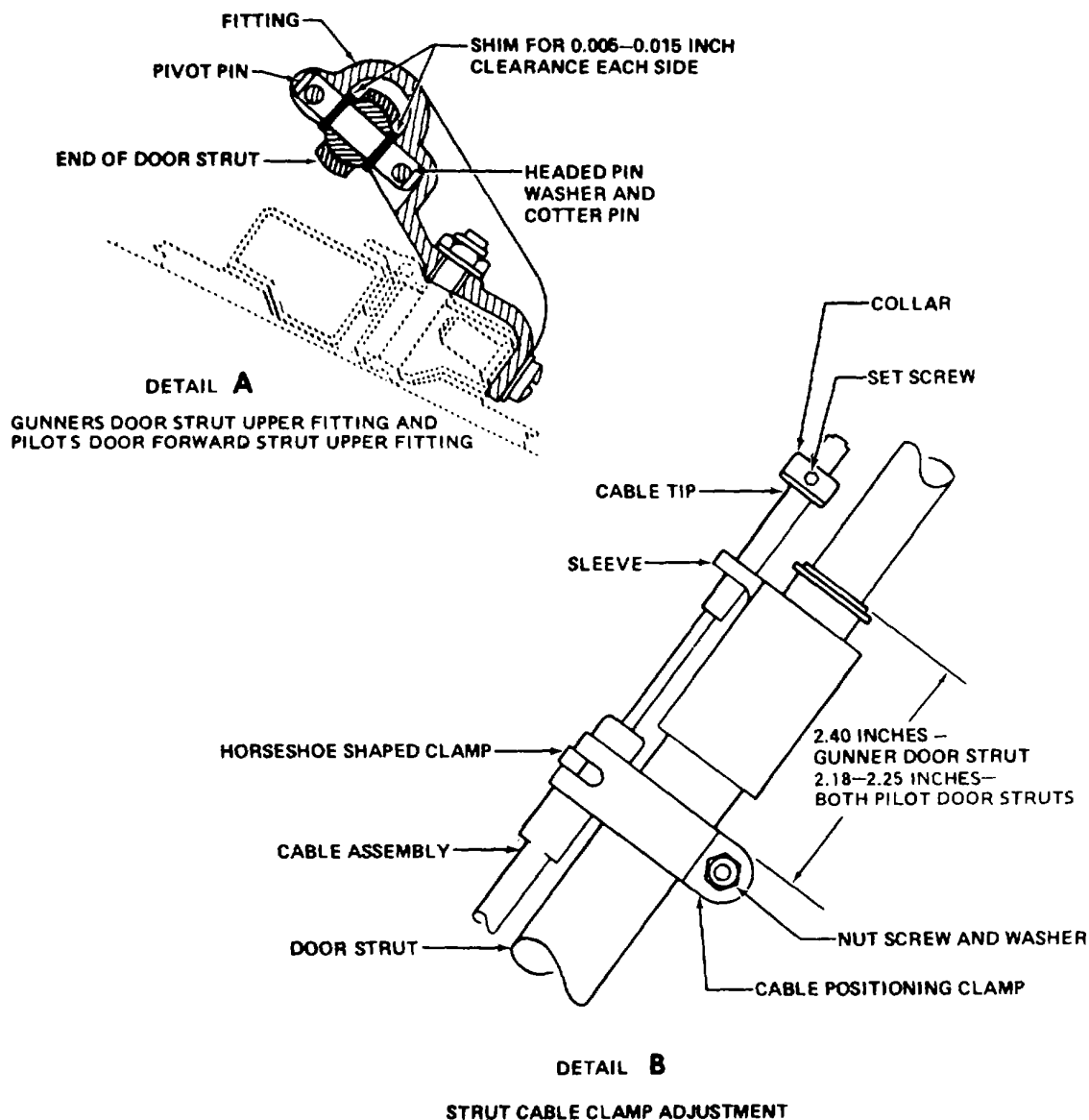


Figure 2-46. Strut Installation - pilot and gunners doors

secure locking action with roller ends (7, figure 2-44) and latch assembly (9).

NOTE

The maximum contour mismatch of doors to the adjacent surfaces shall be 0.12 along forward edges and 0.25 along all other edges. The maximum gap between door frames and adjacent structure to be 0.20.

(10) Close door and check for gaps between door and adjacent surfaces. Maximum allowable gap is 0.20

inch. If necessary, make additional adjustments at hinge shims, roller ends and strikers to obtain proper closing.

(11) Check door struts to ensure that they both lock to hold the door open at three positions.

(12) Remove protective cap and plug at window cutting assembly interconnect line and adapter of window cutting assembly in door. Attach the flexible interconnect line to the adapter and **TORQUE TO 30-45 INCH-POUNDS**. Secure with lockwire (C151).

2-28. Door Assembly Frame, Pilot and Gunners.

WARNING

Ensure that both pilot and gunners arming/firing mechanism handles are secured with safety pins prior to entry into the cockpit area.

The door frames are constructed from aluminum alloy extrusions which are assembled by welding. Gussets and doublers are used to increase strength. The frames support the acrylic plastic windows, window cutting assemblies, handles and latches.

a. Inspection. Inspect the door frames for cracks, corrosion and distortion.

b. Repair.

(1) Repair small cracks in the sheetmetal portion of the frame by stop drilling.

(2) Polish out minor corrosion damage and touch up paint to match surrounding area.

(3) Replace the door assembly if the frame is distorted to the degree that it affects opening and closing the door.

2-29. Door Assembly Windows, Pilot and Gunners.

WARNING

Ensure that both pilot and gunners arming/firing mechanism handles are secured with safety pins prior to entry into the cockpit area.

a. Cleaning. Clean the door windows in the same manner outlined for the fixed windows. Refer to paragraph 2-26.

b. Inspection. Inspect the door windows in the same manner outlined for the fixed windows. Refer to paragraph 2-26.

c. Repair. Repair the door windows in the same manner outlined for the fixed windows. Refer to paragraph 2-26.

d. Removal. Remove door windows as follows.

(1) Remove pilots door from helicopter. Refer to paragraph 2-27.

(2) Remove hinges (3, figure 2-44) and shims (4). Identify hinges and shims for reinstallation in same location.

(3) Remove screws around outside door handle (5, figure 2-44).

(4) Remove screws around outside side of door frame that retain window in frame.

CAUTION

Use caution to avoid damage to window cutting assembly during following step.

(5) Use a putty knife or similar tool to separate window from frame and window cutting assembly. Remove window from frame.

(6) Remove gunners door window in same manner outlined above for pilots door window.

e. Installation. Install door windows as follows:

CAUTION

Install canopy windows at 70°F or above. The windows should be installed with door frame installed in closed position on aircraft. When possible, only one canopy glass should be removed from canopy structure when replacing glass. The remainder should remain in place to shape canopy.

(1) Remove all old sealant from door structure with sharp plastic scrapers and sandpaper (CI112). Touch up bare metal with primer (C102).

(2) Position new window in door frame. Trim window edges if necessary.

(3) Place door frame and window on helicopter. Locate and drill holes for attaching screw around outside edge of windows as follows: use a hole finder to locate holes. At middle of contour on forward and aft edges, drill 0.184 to 0.190 inch diameter holes to match rivnuts in door frame. Install setup screws. Continue match-drilling and

install screws as needed, work both directions from attached points but omit hinge locations.

(4) At each of two hinge locations, drill three 0.170 to 0.176 inch diameter holes to match rivets in door frame. Mark cut-out for latch (9, figure 2-44). Remove window.

(5) Trim cut-out for latch.

(6) Countersink all holes, except at two hinge locations, to 100 degrees on outer surface of window.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone (C87). Avoid breathing solvent vapors and avoid prolonged skin contact.

(7) Clean mating surfaces of door with methyl-ethyl-ketone (C87) and wipe dry with clean cloth before solvent evaporates.

(8) Mask inside surface of window adjacent to mating areas.

CAUTION

Do not use aliphatic naphtha, Type I, in or around cockpit. Use of this solvent can result in damage to acrylic plastic and window cutting assembly.

(9) Clean mating surface of window with naphtha (C88) and wipe dry with clean cloth before solvent evaporates.

(10) Apply sealant (C116) on mating surface of window.

(11) Position door handle (5 or 19, figure 2-44) on door.

(12) Position window on door and install screws fingertight in all countersunk holes.

(13) Install two hinges (3, figure 2-44) and shims (4) with sealant (C116) between shim and window. Align hinge halves and install hinge pins.

(14) Tighten window attaching screws and hinge screws evenly.

(15) Remove residual sealant and masking tape.

(16) Attach flexible connection to window cutting assembly. Refer to Chapter 17.

(17) Attach door struts to door.

(18) Perform functional check of door handle latch and door struts.

(19) Install gunners door window and functional check door handle latch and door strut in same manner outlined above for pilots door window.

2-30. Door Handles and Latches, Pilot and Gunners.

WARNING

Ensure that both pilot and gunners arming/firing mechanism handles are secured with safety pins prior to entry into cockpit area.

a. Inspection. Inspect handles and latches (figure 2-47), roller assemblies (7, figure 2-44) and associated rods and bellcranks for the following defects: Also inspect the corresponding parts on the gunners door.

(1) Cracks. No cracked parts are acceptable.

(2) Wear severe enough to affect function.

(3) Corrosion severe enough to affect function.

(4) Binding when door handles are moved to open or close door.

b. Removal.

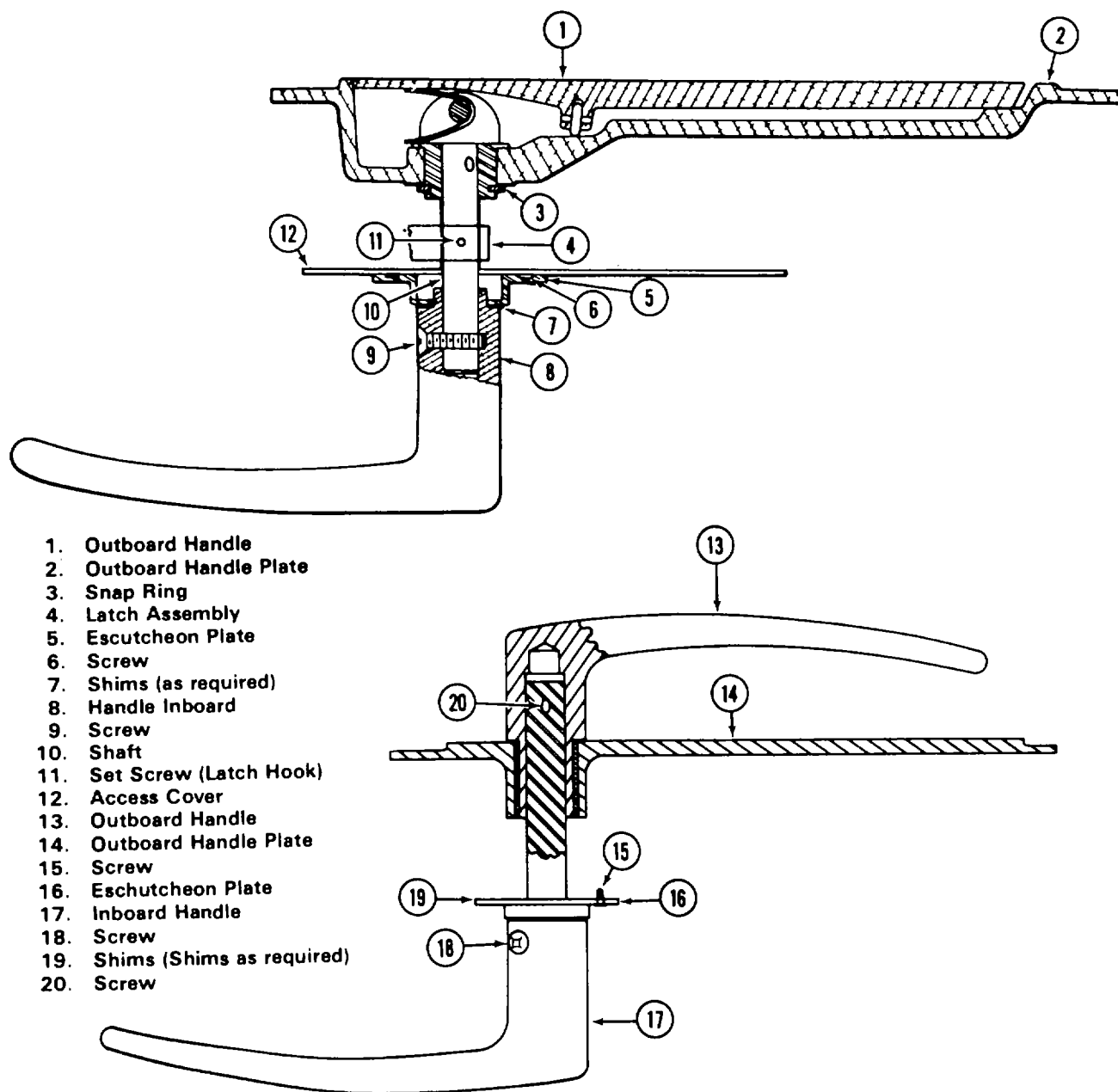
NOTE

Removal procedure for pilots door handle and latches is given. Procedure for gunners door is similar.

NOTE

Removal procedure for flush-type door handle is given. Procedure for non-flush-type is similar. See figure 2-47.

(1) Remove screws around edge of outboard handle plate (2, figure 2-47).



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Figure 2-47. Door handles - pilot and gunners doors

(2) Loosen screw (9, figure 2-47) and remove inboard handle (8). Retain shims (7) for reinstallation in same location.

(3) Remove access cover (12, figure 2-47).

(4) Remove three roller assemblies (7, figure 2-44).

(5) Remove the pins that attach rods and cables to latch assembly (9, figure 2-44).

(6) Loosen set screw (11, figure 2-47) and remove latch assembly (4) from shaft (10).

(7) Remove outboard handle (1, figure 2-47) and handle plate (2) from door.

(8) Remove pin attaching rod assembly to bellcrank (8, figure 2-44).

c. Repair.

(1) Replace any part of the door handles or latch mechanism that is cracked.

(2) Replace door handle or latch mechanism parts that are worn enough to affect function.

(3) Polish out minor corrosion damage and touch up with primer (C102). Replace door handle assembly or latch mechanism parts that have corrosion damage severe enough to affect function.

(4) Replace door handle assembly or latch mechanism parts if binding cannot be corrected by adjustment.

d. Installation.

(1) Install two roller assemblies (7, figure 2-44) and rod assembly (16) on bellcrank (8) with pins and cotter pins.

(2) Position outboard handle (1, figure 2-47) and handle plate (2) on door.

(3) Position latch assembly (4, figure 2-47) on shaft (10) and tighten set screw (11).

(4) Attach rod (16, figure 2-44), cable assembly (17), cable assembly (18), and forward roller assembly (7) to latch assembly (9) with pins and cotter pins.

(5) Install access cover (12, figure 2-47).

(6) Install escutcheon plate (5, figure 2-47), screws (6), shims (7), inboard handle (8), and setscrew (9).

NOTE

Ensure that screws (6, figure 2-47) that secure escutcheon plate are self-locking setscrews P/N NAS 1189-06P6L.

(7) Install screws around outboard handle (13) to plate (2, figure 2-47).

e. Functional check.

(1) Close the door and check operation of door handles and latches. Also check for gap in excess of 0.020 inch between door and adjacent surfaces. If excessive gap exists and/or handle and latch

mechanism operation is not satisfactory, adjust roller assemblies and strikers. Refer to paragraph 2-27.

(2) Check operation of door struts to ensure that they will hold the door open at three positions. If operation is not satisfactory, adjust as required. Refer to paragraph 2-27.

2-31. Door Hinges - Pilots and Gunners Doors.

WARNING

Ensure that both pilot and gunners arming/firing mechanism handles are secured with safety pins prior to entry into cockpit area.

NOTE

Removal and installation instructions are given for pilots door hinges. Procedure for gunners door hinges is similar.

a. Inspection. Inspect door hinges (3, figure 2-44) and corresponding hinges on gunners door for the following defects.

- (1) Cracks. No cracks are acceptable.
- (2) Wear severe enough to affect function.
- (3) Corrosion severe enough to affect function.
- (4) Binding when door is opened or closed.

b. Removal.

(1) Remove cotter pins, washers, and headed pins to separate halves of hinge halves (3, figure 2-44).

(2) Remove screws, hinge halves (3, figure 2-44) and shims (4). Identify parts for reinstallation in the same location.

c. Repair.

(1) Replace hinges if cracked.

(2) Replace hinges if worn enough to affect functions.

(3) Polish out minor corrosion damage and touch up with primer (C102). Replace hinges that have corrosion damage severe enough to affect function.

(4) Replace hinges that were found to be binding during inspection.

d. Installation.

(1) Position shims (4, figure 2-44) and hinges (3) on door and canopy frame and install screws.

(2) Install headed pins, washers, and cotter pins to complete installation of hinges.

e. Functional check.

(1) Check hinges for binding when door is opened and closed.

(2) Check door for proper operation of door handles and latches. Also check for gap in excess of 0.020 inch between door and surrounding surfaces. If excessive gap exists and/or handle and latch mechanism operation is not satisfactory, adjust shims under hinges. Refer to paragraph 2-27.

2-32. Strut Assemblies - Pilot and Gunners Doors. P/N 209-030-640-1, -3, and -5.

NOTE

Pilot and gunners door struts P/N 209-030-687-1/ -3 and -5 are not reparable. The disassembly, inspection and repair instructions in this paragraph apply to struts P/N 209-030-640-1/ -3 and -5.

The door strut assemblies serve to hold the pilot and gunners doors open at three positions from partially open to full open. When balls (4, figure 2-48) drop in detents in rod assembly (1) the strut locks in position. When the door handle is turned, cable assemblies (17 and 18, figure 2-44) are actuated. The cables move sleeves, shown on figure 2-46, which allows the strut to unlock and permits the door to be opened or closed. The pilots door has two struts (1 and 2, figure 2-44). The gunners door has one strut (4, figure 2-45).

a. Inspection. Inspect pilot and gunners door struts for damage visually. Open and close the doors

and check the struts to ensure they operate freely and will lock at all three positions.

b. Removal. Remove the pilot and gunners door struts. Refer to paragraph 2-27.

c. Disassembly.

(1) Remove snap ring (2, figure 2-48) from housing (6).

(2) Extend rod (1) until the six balls (4) seat in rod recesses and slide sleeve (3) off end of housing (6).

NOTE

Be careful that none of the six balls are lost.

(3) Remove balls (4) and spring (5) from assembly.

(4) Remove rod assembly (1) from housing (6).

(5) Loosen jam nut and remove rod end bearing (10).

(6) Remove pin (8) from retainer (7) and remove rod end bearing (9).

d. Inspection.

(1) Inspect rod assembly (1, figure 2-48) for roughness and/or wear that affects function of strut, cracks, and corrosion.

(2) Inspect snap ring (2, figure 2-48) for defects.

(3) Inspect sleeve (3, figure 2-48) for cracks, wear, corrosion and nicks.

(4) Inspect six balls (4, figure 2-48) for deformity, wear, and corrosion.

(5) Inspect spring (5, figure 2-48) for cracks, corrosion and loss of tension.

(6) Inspect housing (6, figure 2-48) for cracks, corrosion and thread damage. Inspect solid film lubricant (11) on housing for continuous unbroken film of serviceable lubricant.

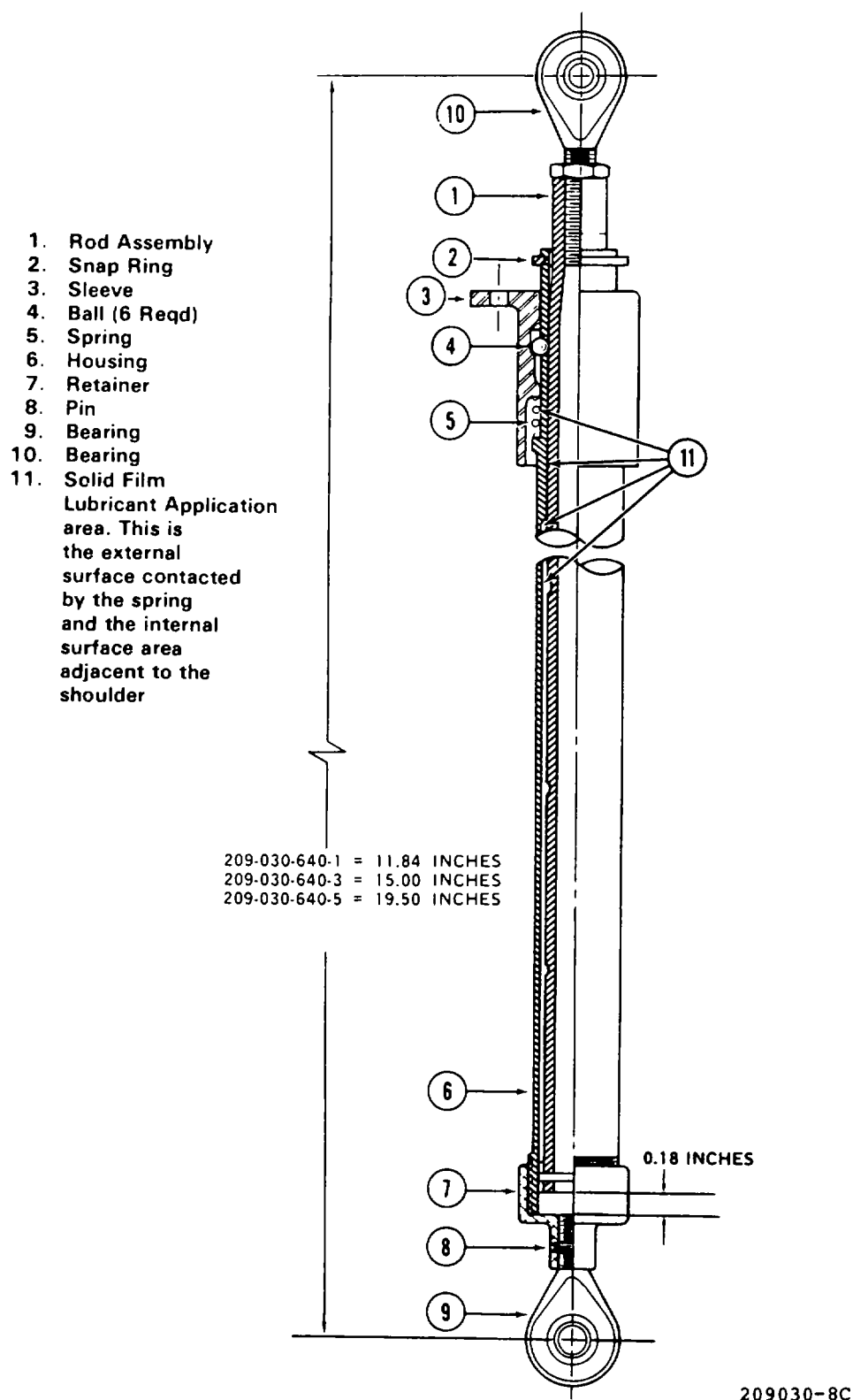


Figure 2-48. Door strut assembly PIN 209-030-640-1, -3, and -5

(7) Inspect retainer (7, figure 2-48) for cracks, corrosion and thread damage.

(8) Inspect pin (8, figure 2-48) for cracks, corrosion and deformity.

(9) Inspect rod end bearings (9 and 10, figure 2-48) for cracks, roughness or binding when bearing is moved by hand, corrosion and thread damage.

e. Repair.

(1) Repair rod assembly (1, figure 2-48) as follows:

(a) Replace rod assembly that failed inspection for roughness. Polish out minor roughness with fine crocus cloth (C44).

(b) Replace rod assembly if cracked.

(c) Replace rod assembly that failed inspection for corrosion. Polish out minor corrosion damage with fine crocus cloth.

(2) Repair snap ring (2, figure 2-48) as follows:

(a) Replace snap ring that failed inspection for corrosion, resiliency or loss of tension.

(b) Polish out minor corrosion with fine crocus cloth and touch up with primer (C102).

(3) Repair sleeve (3, figure 2-48) as follows:

(a) Replace sleeve if cracked.

(b) Replace sleeve that failed inspection for wear.

(c) Replace sleeve that failed inspection for corrosion. Polish out minor corrosion with fine crocus cloth and touch up with primer (C102).

(4) Repair balls (4, figure 2-48) as follows:

(a) Replace balls that failed deformity, wear, or corrosion inspections.

(b) Polish out minor corrosion with fine crocus cloth (C45).

(5) Repair spring (5, figure 2-48) as follows:

(a) Replace spring if cracked or if it failed resilience or corrosion inspection.

(b) Polish out minor corrosion damage with fine crocus cloth (C45).

(6) Repair housing (6, figure 2-48) as follows:

(a) Replace housing if cracked or if it failed corrosion or thread damage inspection.

(b) Clean up minor thread damage.

(c) Polish out minor damage with fine crocus cloth (C45).

(d) Apply new solid film lubricant if old lubricant failed inspection. (AVIM)

1 Clean the housing with clean cheese cloth (C36) dampened with naphtha (C88), dry before naphtha evaporates with clean cheese cloth.

2 Mask off external surface that is not to be coated with lubricant.

3 Apply lubricant (C85) to the area shown on figure 2-48 to a depth of approximately 0.002 inch.

4 Remove masking material and cure housing at 275°F for sixty minutes in a recirculating-type, automatically controlled oven.

5 Test the solid film lubricant for adequate adhesion. Apply a strip of adhesive tape with firm finger pressure, and then remove the tape with one abrupt motion. If large particles or flakes of lubricant peel off with the tape, reapply the lubricant and repeat the test.

(7) Repair retainer (7, figure 2-48) as follows:

(a) Replace retainer if cracked or if it failed corrosion or thread damage inspection.

(b) Polish out minor corrosion damage with fine crocus cloth (C45).

(c) Clean up minor thread damage.

(8) Repair pin (8, figure 2-48) as follows:

(a) Replace pin if cracked or if it failed corrosion or wear inspection.

(b) Polish out minor corrosion damage with fine crocus cloth (C45).

(9) Repair rod end bearing (9 and 10, figure 2-48) as follows:

(a) Replace rod end bearing if cracked or if it failed thread damage, roughness or corrosion inspection.

(b) Clean up minor thread damage.

(c) Polish out minor corrosion damage with fine crocus cloth (C45).

f. Assembly.

(1) Install rod end bearing (9, figure 2-48) in retainer (7) and secure with pin (8).

(2) Thread nut on rod end bearing (10) and install bearing in rod assembly (1).

(3) Install retainer (7) on housing (6).

(4) Place spring (5) on housing. Slide sleeve (3) on housing until ball recess of sleeve extends slightly outboard from end of housing and install six balls (4) into sleeve recess, then slide sleeve further onto housing.

(5) Install rod assembly (1) in housing (6) to full retract position.

(6) Adjust rod end bearing (10) to obtain strut length dimension illustrated and tighten nut on rod end bearing (10) to hold it in position.

g. Installation. Refer to paragraph 2-27.

h. Functional Check. Open door and check to ensure that struts will lock at all three positions.

2-33. Striker Assembly, Pilot and Gunners Doors.

When closing the gunners door, the forward roller assembly (6, figure 2-45) and aft roller assembly (6, figure 2-45) extends and makes contact with forward and aft door latch strikers. The pilots door has one forward roller assembly (7, figure 2-44) and two aft roller assemblies (7, figure 2-44) that extend and make contact with one forward door latch striker and two aft door latch strikers. The latch assembly (9, figure 2-44) and (9, figure 2-45) goes through the center striker plate on canopy sill and locks the door securely. The gunners door has two retainers located forward and aft of center striker plate on canopy sill. The retainers line up with door and go into slotted recesses in gunners door.

a. Inspection. Inspect door latch strikers, serrated plates and attaching parts that are contacted by roller assemblies (7, figure 2-44) and (6, figure 2-45) for the defects listed below. Also inspect the retainers located forward and aft of the gunners door latch (9, figure 2-45) for the same defects.

(1) Cracks. No cracked parts are acceptable.

(2) Corrosion damage severe enough to affect function.

(3) Loose and missing screws in latch strikers, retainers, and plate.

(4) Wear in door latches, strikers, retainers and plates severe enough to affect function.

b. Removal.

(1) Remove screws from latch strikers. Remove strikers, shims and associated parts. Identify parts for reinstallation in same location.

(2) Remove screws from retainers on canopy sill of gunners door. Remove the retainers and identify for reinstallation in same location.

(3) Remove screws from center striker plate. Remove striker plate, shims and serrated plate. Identify parts for reinstallation in same location.

c. Repair.

(1) Replace any parts that are cracked.

(2) Polish out corrosion damage with crocus cloth (C45) and paint with primer (C102). If corrosion damage is excessive and severe enough to affect function of parts, replace affected parts.

(3) Replace loose and missing screws in door striker latches, retainers, and serrated plates.

(4) Replace worn or defective door strikers, serrated plates and retainers.

d. Installation.

(1) Position door latch strikers on canopy frame. Secure door latch strikers with screws.

(2) Position retainer on canopy sill. Secure retainer with screws and washers.

(3) Position center striker plate, shims and serrated plate on canopy sill. Secure with screws, washers, and nuts.

e. Functional Check. Open and close the pilots, and gunners door and check operation of door latches. Also check for gap in excess of 0.020 between door and adjacent surfaces. If excessive gap exists and/or if door latch operation is not satisfactory, adjust roller assemblies and strikers. Refer to paragraph 2-27 to check the operation of door struts.

2-33A. Vent and Drain Locations.

Fuel, oil, hydraulic, and battery installations are vented and drained through a series of common and individual lines. Most lines exit the underside of the fuselage, and are identified by decals adjacent to the exit point. Typical locations of vents and drains are shown in figure 2-48A.

2-34. Vent and Drain Installation - Fuel.

Vent and drain installations for the fuel system are shown in figure 2-48A.

The engine fuel filter assembly, mounted on a bracket located on left side of engine compartment, has an overboard drain line (8) with a manually operated poppet cock drain valve incorporated into the line.

The fuel control and overspeed governor (power turbine governor), located on left side of engine, each have a vent line that drains into a common overboard drain line (8).

The flow divider pump valve and the combustion chamber drain valve, located on the lower side of the combustion chamber housing, drain into a common overboard drain line (8).

The ejector (tailpipe cooling assembly), located at the aft end of the engine, has an overboard drain line (8).

a. Inspection. Inspect the engine fuel filter assembly, fuel control and overspeed governor, flow divider and dump valve assembly, combustion chamber drain valve, and ejector (tailpipe cooling assembly) drain lines for the following defects:

(1) Clogging.

(2) Breaks in line. No breaks are acceptable.

(3) Pinched line. No pinched lines are acceptable if area of line is reduced significantly.

(4) Chafing. Determine cause of chafing and extent of damage. Parts with severe chafing damage are not acceptable. Refer to TM 55-1500-204-25/1.

(5) Loose or missing support clamps.

b. Removal. Remove the B-nut of fuel vent drain line at nearest connection or fitting. Remove screws from clamps. Retain screws, nut and washers for reinstallation.

c. Repair.

(1) Clean clogged vent tube with lockwire (C152).

(2) Replace lines with breaks, cracks, severely pinched areas or severely chafed areas.

(3) Correct conditions that cause chafing damage.

d. Installation. Connect the B-nut of drain line tube to fittings or connections. Position clamps on the tubes to structure and secure with screws, washers, and nuts.

2-35. Vent and Drain Line - Engine Oil Tank.

The engine oil tank scupper, oil tank, oil cooler, and transmission drain into common lines (9 and 11, figure 2-48A) which carry oil to lower surface of helicopter. A vent line from the top of the oil tank extends to the cowling directly above the oil tank.

a. Inspect for the following defects:

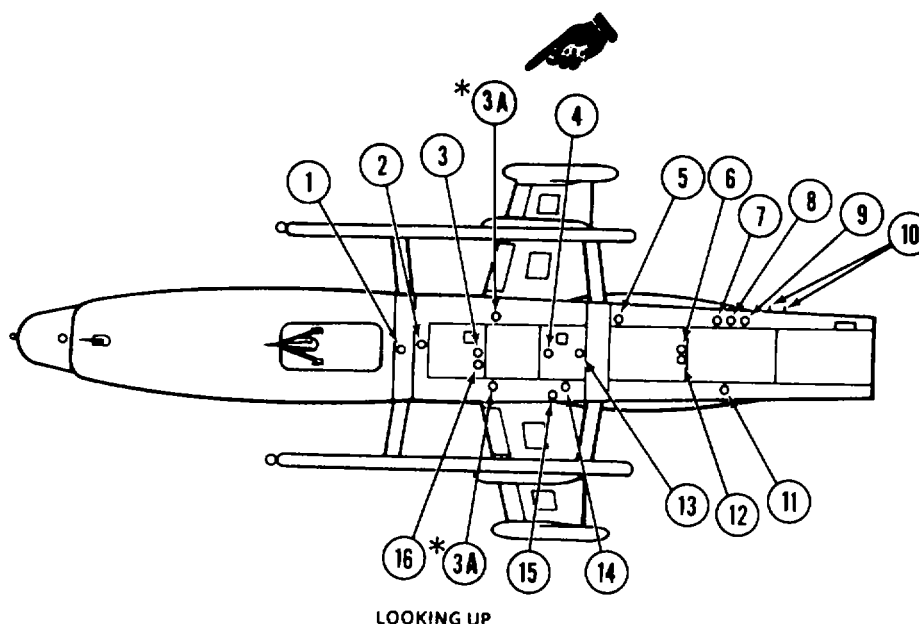
(1) Clogging.

(2) Breaks in line - no breaks are acceptable.

(3) Pinched line - no pinched lines are acceptable if area of line is reduced significantly.

(4) Chafing. Determine cause of chafing and extent of damage. Parts with severe chafing damage are not acceptable.

(5) Loose or missing supporting clamps.



*NOTE

Wire strike protection system installed by
MWO 55-1520-234-50-2 and MWO 55-1520-234-50-3.

1. Fuel cell cavity drain and vent Hydraulic deck drain	9. Oil cooler compartment drain
2. Fuel pump drain	10. Battery vent
3. Fuel cell cavity drain and vent Hydraulic deck drain	11. Oil cooler compartment drain
*3A. Loop antenna drain	12. Fuel cell cavity drain and vent
4. Fuel cell drain	13. Fuel cell cavity drain and vent
5. Fuel pump drain	14. Hydraulic reservoir scupper drain Hydraulic pump drain
6. Fuel sump drain	Transmission oil drain
7. Starter generator pad drain	15. Fuel cell vent
8. Fuel Filter, Engine deck, Engine Tailpipe, Engine Fuel control, Engine combustion chamber drain	16. Fuel cell drain

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Figure 2-48A. Vent and drain locations

b. Removal. Remove the B-nut of tube at nearest fitting or connection. Remove screws from clamps. Retain screws, washers and nut for reinstallation.

c. Repair.

- (1) Clean clogged vent tube with lockwire (C152).

(2) Replace lines with breaks, cracks, severely pinched areas or severely chafed areas.

(3) Correct conditions that caused chafing damage.

d. Installation. Connect the B-nut of drain line tube to fittings or connections. Position clamps on tubes to structure and secure with screws, washers, and nuts.

2-36. Vent and Drain Installation, Hydraulic.

Drain installations for the hydraulic system are shown in figure 2-48A.

Each of the two hydraulic reservoirs, located in the hydraulic compartment, are equipped with scupper drain lines and reservoir drain lines which connect into common overboard drain lines (14, figure 2-48A).

Each of the two hydraulic pumps, located on lower side of the transmission, have seal drain lines which connect into a common overboard drain line (14).

a. Inspection. Inspect reservoir and pump seal drain lines for the following defects.

(1) Clogging.

(2) Breaks in line. No breaks are acceptable.

(3) Pinched line. No pinched lines are acceptable if area of line is reduced significantly.

(4) Chafing. Determine cause of chafing and extent of damage. Parts with severe chafing damage are not acceptable.

(5) Loose or missing support clamps.

b. Removal. Remove the B-nut of tube at nearest fitting or connection. Remove screws. Remove screws from clamps. Retain screws, washers, and nut for reinstallation. Disconnect the B-nut at each end of flexible hose assembly and remove the hose.

c. Repair.

(1) Clean clogged vent tube with safety wire (C152).

(2) Replace lines with breaks, cracks, severely pinched areas or severely chafed areas.

(3) Correct conditions that cause chafing damage.

d. Installation. Connect the B-nut of drain line tube to fittings or connections. Position clamps or

tubes to structure and secure with screws, washers, and nuts. Connect the B-nut of flexible hose assembly to fitting or connection at each end of hose.

2-37. Vent and Drain Installation - Battery.

The nickel-cadmium battery is mounted in the helicopter battery compartment. See figure 1-1. Two overflow, or vent tube assemblies, extend from the battery to the left side of the fuselage (10, figure 2-48A). The vent tube assemblies are constructed of rubber material.

a. Inspection.

(1) Clogged condition.

(2) Breaks in line. No breaks or cracks are acceptable.

(3) Pinched tube. Pinched tube walls that significantly reduce area and could possibly result in clogging are not acceptable.

(4) Chafing. Determine cause of chafing and extent of damage. Parts with severe chafing damage are not acceptable.

(5) Loose or missing supporting clamps.

b. Removal. Remove clamps from both ends of two vent tube assemblies and remove vent tubes. Retain clamp for reinstallation.

c. Repair.

(1) Clear clogged vent tube with probes and blow out particles with compressed air regulated to low pressure.

(2) Replace lines with breaks, cracks, severely pinched areas or severely chafed areas.

(3) Correct conditions that caused chafing damage.

d. Installation.

(1) Position vent tube assemblies in helicopter with lower scarf facing forward and vent flush with aircraft outer skin to cause air flow through battery compartment.

- (2) Install clamps.

2-38. Seat - Pilots.

WARNING

Ensure that both pilot and gunners arming/firing mechanism handles are secured by safety pins prior to entry into the cockpit area.

The pilots seat is one-piece, bucket-type seat mounted on two vertical tubes which hold it in place on the airframe structure and serve to make the seat adjustable vertically. See figure 2-49. The seat is constructed of armor steel with fittings for armor side panels.

a. Inspection. Inspect installed pilots seat for the following defects:

(1) Refer to paragraph 2-43 for inspection procedure for side armor panels (1, figure 2-49) and armor steel seat (2, figure 2-50).

(2) Cracks. No cracked parts are acceptable.

(3) Secure mounting of the seat in the helicopter and secure installation of the inertia reel and armor panels.

(4) Seat cushion band back cushion for wear and damage, sun fading is not cause for rejection, but wear and damage that affects comfort must be corrected by repair or replacement.

(5) Check seat vertical adjustment, ease of operation and secure locking in various height positions.

b. Removal. See figure 2-49.

(1) Loosen clamp and disconnect air distribution duct from duct cushion air inlet (2).

(2) Remove seat back cushion (3) and air ducts (4).

(3) Remove seat cushion (5).

CAUTION

Handle side armor panels with care; ceramic tile is easily broken.

- (4) Remove side armor panels (1).

(5) Detach inertia reel control (6) from side of cockpit by removing screws, washers and spacers.

(6) Remove seat attaching parts (7) holding seat assembly (8) to support brackets and remove seat assembly from helicopter.

(7) Remove nuts, washers and bolts and remove seat lap belt (9).

(8) Detach shoulder harness (10) from inertia reel strap by removing nut, washer and bolt.

(9) Remove four nuts, washers and screws attaching inertia reel (11) and remove inertia reel.

c. Disassembly. See figure 2-50.

(1) Adjust the seat to "up" position on support tubes (3). Remove two return springs (5).

(2) Pull up on handle (1) to withdraw pins (10) from tubes (3). Pull upward on tubes (3) and remove them from fittings (4 and 7).

(3) Disconnect handle levers (6) from latch pins (10).

(4) Remove retainer plates (8) from lower fittings (7) and remove latch pins (10) and springs (9).

(5) Remove two upper fittings (4) and lower fittings (7) from seat (2).

d. Inspection. See figure 2-50.

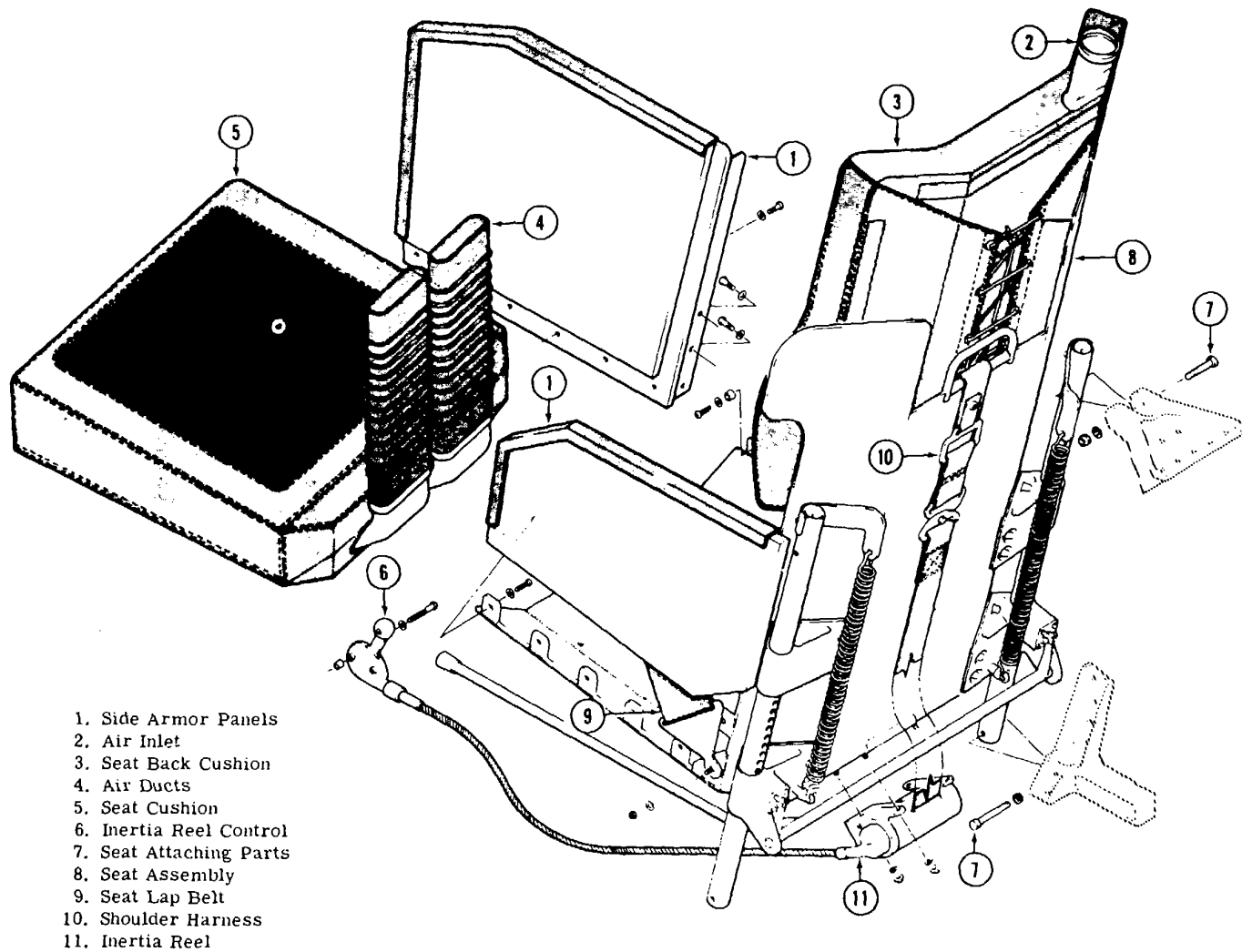
(1) Inspect upper guide fittings (4) and lower guide fittings (7) by fluorescent penetrant method.

(2) Inspect handle assembly (1), support tubes

(3), latch springs (9), return springs (5) and latch pins (10) by magnetic particle method.

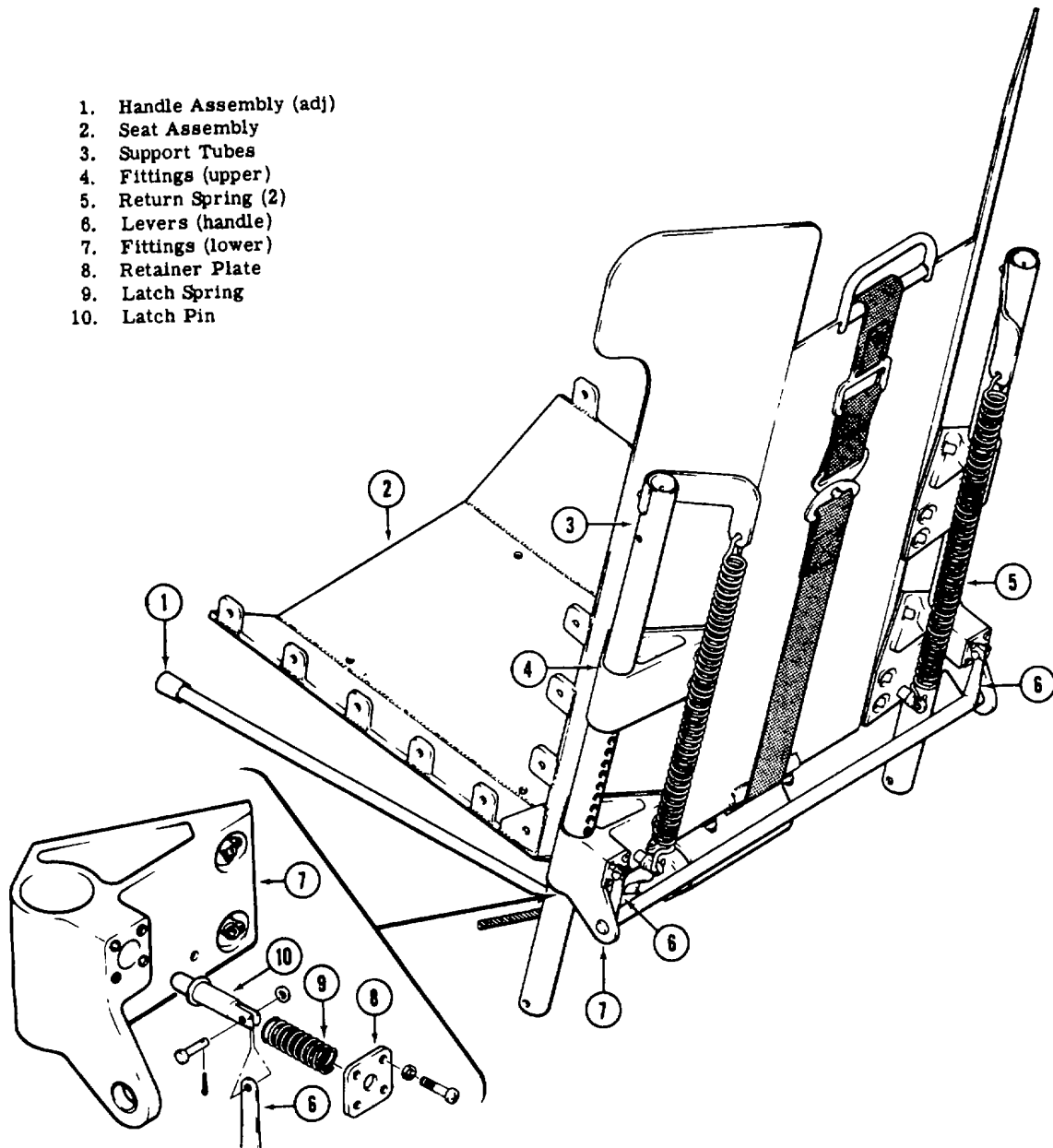
(3) Inspect seat netting for tears, cuts and holes. Damage greater than one inch in length or diameter is not repairable. Temporary repairs can be made to damage less than one inch in length or diameter.

(4) Inspect seat netting for deterioration and discoloration which indicates a decrease in strength. If integrity of netting is doubtful, the netting must be replaced.



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Figure 2-49. Pilots seat installation



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Figure 2-50. Pilots seat assembly

e. Repair.

(1) Refer to paragraph 2-43 for repair procedure for side armor panels (1, figure 2-49) and armor steel seat (2, figure 2-50).

(2) Replace any parts found to be cracked during fluorescent penetrant and magnetic particle inspections in preceding paragraph.

(3) Repair tears, cuts or holes in netting that are within one inch maximum length or diameter if new cushion is not available. Use nylon thread, 16 pound test, FSM 8310-227- 1244 to repair by darning procedure. Pick up at least 1/4 inch of good material around the repair area. Maintain thread tension to produce a mend that disturbs the natural lines of the seat netting as little as possible.

(4) Replace cushion if deteriorated or damaged beyond repair limits. Comfort is the determining factor for replacement of cushions.

(5) Replace any parts of the seat vertical adjustment mechanism that are damaged to the degree that function is affected.

f. Assembly. See figure 2-50.

(1) Position handle assemblies (1) in place in each lower fitting (7).

(2) Install lower fittings (7) on seat assembly (2).

(3) Install upper fittings (4) on seat assembly.

(4) Install a latch pin (10) and latch spring (9) in each lower fitting (7). Install retainer plates (8) to secure latch pins and springs.

(5) Connect latch pins (10) to levers (6) of handle assembly (1) with clevis pins, washers and cotter keys.

(6) Install support tubes (3) down through upper fittings (4) and lower fittings (7). Hold handle (1) in UP position to permit passage of support tubes through lower fittings (7).

(7) Install return springs (5).

g. Installation. See figure 2-49.

(1) Position inertia reel (11) on back of seat bottom and install attaching screws, washers and nuts with heads of screws on inside of seat bucket.

(2) Thread shoulder harness (10) through guide at top of seat back and attach to inertia reel strap with bolt washer and nut. Install the bolt with head facing seat back.

(3) Install seat lap belt (9) with bolts, washers and nuts. Install belt half with latch on left side. Install bolts with heads of bolts on inside of seat bucket.

(4) Position seat assembly (8) in helicopter and fit support tubes into support brackets with inertia reel cable routed inboard of left support tube as illustrated. Install seat attaching bolts, washers and nuts (7).

(5) Install inertia reel control (6) on side of cockpit with spacers, washers and screws.

(6) Install seat cushion (5), air ducts (4) and back cushion (3).

(7) Position air distribution duct on air inlet (2) and tighten clamp to secure air distribution duct.

(8) Install side armor panels (1).

(9) Functional check inertia reel (11) and control (6) to ensure the reel will lock, unlock and rewind.

(10) Functional check operation of seat vertical adjustment.

2-39. Seat - Gunners.

WARNING

Before any maintenance in or near the cockpit area, ensure that both pilot and gunners arming/firing mechanism handles are secured by safety pins.

The gunners seat is a two-piece, bucket-type seat. The two major components are the back and the bottom. See figure 2-51. Construction is ceramic plate armor.

a. Inspection. Inspect installed gunners seat for the following defects. See figure 2-51.

(1) Refer to paragraph 2-43 for inspection procedure for side armor panels (1, figure 2-51), seat back (7) and seat bottom panel (9).

(2) Seat cushion (3) and back cushion (5) for wear and damage. Use same procedure described for pilots seat cushions. Refer to paragraph 2-38.

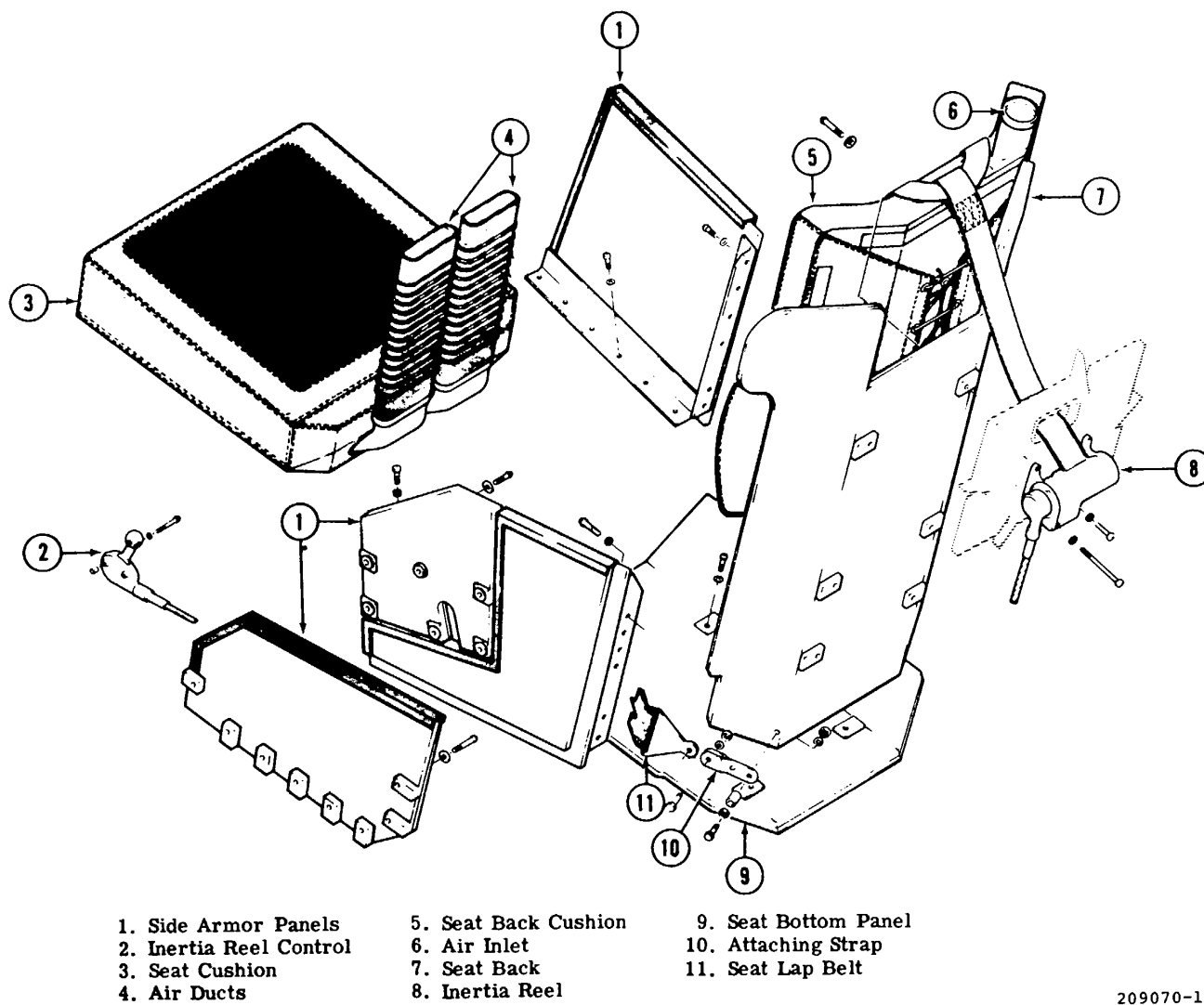
(3) Secure mounting of the seat in the helicopter and secure installation of the inertia reel and armor panels.

b. Removal. See figure 2-51.

(1) Loosen clamp and disconnect air distribution duct from air inlet (6).

(2) Remove seat cushion (3) and air ducts (4).

(3) Remove seat back cushion (5).



1. Side Armor Panels	5. Seat Back Cushion	9. Seat Bottom Panel
2. Inertia Reel Control	6. Air Inlet	10. Attaching Strap
3. Seat Cushion	7. Seat Back	11. Seat Lap Belt
4. Air Ducts	8. Inertia Reel	

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Figure 2-51. Gunners seat installation.

CAUTION

Handle side armor panels with care; ceramic is easily broken.

(4) Remove side armor panels (1).

(5) Remove six screws and washers which attach seat back (7) to bulkhead and remove seat back.

(6) Remove screws, washers and spacers which attach inertia reel control (2) to side of cockpit. Loosen knurled nut and disconnect control cable from handle.

(7) Remove four screws and washers which attach inertia reel (8) to bulkhead. Work shoulder harness back through bulkhead and remove with inertia reel.

(8) Remove bolts, washers and nuts which attach seat lap belt (11) to attaching strap (10) and remove bolt.

CAUTION

Handle armor panels with care, ceramic is easily cracked.

(9) Remove screws which attach seat bottom panel (9) to structure and remove seat bottom panel.

c. Repair.

(1) Refer to paragraph 2-43 for repair procedure for side armor panels (1, figure 2-51), seat back (7) and seat bottom panel (9).

(2) Repair tears, cuts and holes in seat cushion (3) and back cushion (5). Use same procedure described for pilots seat cushions. Refer to paragraph 2-38.

d. Installation. See figure 2-51.

(1) Place seat bottom (9) in helicopter and secure with screws and washers.

(2) Place seat back (7) in helicopter and secure with bolts and washers.

CAUTION

The pilot's and gunner's shoulder harness inertia reels are not interchangeable.

(3) Work shoulder harness through bulkhead and position inertia reel (8) against bulkhead. Secure with four screws and eight washers. Place one washer under each screw head and one washer under each inertia reel attachment lug.

(4) Route inertia reel control cable along left hand side of seat and connect to inertia reel control (2). Tighten knurled nut and position control on beam. Install attaching spacers, washers and screws. Lockwire knurled nut.

(5) Attach seat lap belt (11) to attaching strap assembly (10) with bolts, washers and nuts.

(6) Connect air ducts (4) on seat cushion (3) and install cushion.

(7) Connect air ducts (4) to seat back cushion (5) and install cushion.

(8) Position air distribution duct on air inlet (6) and tighten clamp.

(9) Install side armor panels (1).

(10) Functional check inertia reel (8) and control (2) to ensure the reel will lock, unlock, and rewind.

2-40. Inertia Reel (Shoulder Harness).

WARNING

Before any maintenance in or near the cockpit area, ensure that both pilot and gunner arming/firing mechanism handles are secured by safety pins.

Inertia reels (11, figure 2-49) and (8, figure 2-51) serve to control the pilot and gunners shoulder harness. The pilot can select "Lock" or "Auto" with control (6, figure 2-49). The gunner has a similar control.

a. Inspection. See figure 2-49.

NOTE

Instructions to inspect pilots inertia reel follow. Inspect gunners inertia reel in the same manner.

(1) Place control (6) in LOCK position and pull on shoulder harness; the inertia reel should hold the shoulder harness and not extend. Inertia reels that will not lock are not acceptable.

(2) Place control (6) in AUTO position and pull on shoulder harness; the inertia reel should permit the shoulder harness to be pulled out against spring tension and should rewind when pulling pressure on shoulder harness is decreased. Inertia reels that will not operate as described in this paragraph are not acceptable.

(3) Inspect inertia reel strap for wear fraying and general condition. (Refer to TM 55-1500-204-25/1.)

(4) Inspect inertia reel (11) and control (6) for secure mounting and damage.

(5) Inspect cable between inertia reel (11) and control (6) visually for fraying and damage.

b. Removal. Refer to paragraphs 2-38 or 2-39 as applicable.

c. Repair.

(1) Replace inertia reel that fails to pass functional check in preceding inspection paragraph b, steps (1) and (2).

(2) Replace worn inertia reel strap as follows:

(a) Move inertia reel control handle to AUTO position and pull out slowly on strap assembly until web retaining insert is visible through lower slot in reel housing.

CAUTION

If reel is inadvertently released while strap is removed, replace entire reel assembly.

(b) Move control handle to LOCK position.

(c) Remove web retaining insert and withdraw strap from reel.

(d) Insert end of new strap through upper slot in reel housing and through slot in main shaft until end of strap protrudes through lower slot in reel housing. Install web retaining insert. Pull

upward on strap with at least six pounds of force and hold. Move control handle to AUTO position and allow strap to rewind.

(3) Replace inertia reel and/or control if cable is frayed or if the components have incurred damage that may affect function.

d. Installation. Refer to paragraph 2-38 or 2-39 as applicable for installation and functional check instructions.

2-41. Shoulder Harness and Seat Belts.

WARNING

Ensure that both pilot and gunner arming/firing mechanism handles are secured by safety pins prior to entry into the cockpit area.

The shoulder harness and the seat belt installations for the pilot and gunner seats is similar. See figures 2-49 and 2-51.

NOTE

Gunner's shoulder harness webbing adjuster, part number ASE443030, does not require a Webbing Adjuster Spring. If spring is installed, it should be removed.

a. Inspection.

(1) Inspect pilot and gunner seat lap belts and shoulder harnesses for fraying, wear, tears, and general condition. Refer to TM 55-1500-204-25/1.

(2) Inspect to verify belt can be released by gloved hand.

(a) Using a steel scale, measure the distance from the top of the webbing where it encircles the latch to the inside of the release plate. This is the space where gloved fingers must be inserted to release the latch.

(b) If the measured space is 0.8 inch or greater, the belt is satisfactory.

(c) If the measured space is less than 0.8 inch, the belt is unsatisfactory. The belt must be altered in accordance with TM 55-1500-204-25/1 to provide clearance specified in step (b) above.

b. Removal. Refer to paragraph 2-38 or 2-39 as applicable.

c. Installation. Refer to paragraph 2-38 or 2-39 as applicable.

2-42. Soundproofing Blanket Assembly.

WARNING

Ensure that both pilot and gunner arming/firing mechanism handles are secured by safety pins prior to entry into the cockpit area.

A soundproofing blanket assembly is installed behind the pilot station to reduce the noise level during flight operations.

a. Inspection. Inspect the soundproofing blanket for fraying, wear, tears and secure installation.

b. Removal.

(1) Remove electronic interface assembly. Refer to TM 9-1270-212-14.

(2) Removal - Release hook and pile fasteners and remove soundproofing blanket.

c. Repair. Refer to TM 55-1500-204-25/1 for instructions to make minor repairs to soundproofing blanket.

d. Installation. Position the soundproofing blanket assembly behind the pilots station and fasten the hook and pile fasteners. Install electrical interface assembly removed in step b.

2-42A. Deleted.

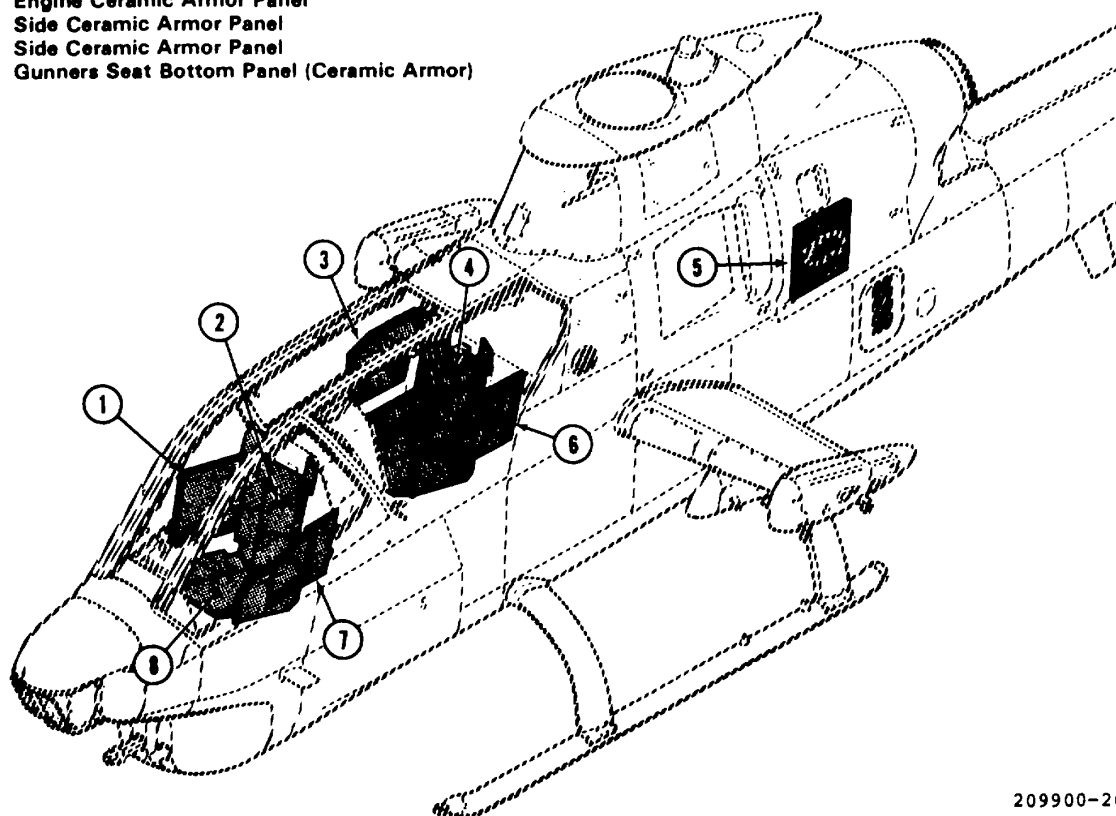
2-43. Armor - Protective.

WARNING

Ensure that both pilot and gunners arming/firing mechanism handles are secured with safety pins prior to entry into the cockpit area.

The crew and engine are protected against hostile arms fire by ceramic and steel armor panels. See figure 2-42.

1. Side Ceramic Armor Panel
2. Gunners Seat Back Panel (Ceramic Armor)
3. Side Ceramic Armor Panel
4. Pilots Armor Steel Seat
5. Engine Ceramic Armor Panel
6. Side Ceramic Armor Panel
7. Side Ceramic Armor Panel
8. Gunners Seat Bottom Panel (Ceramic Armor)



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Figure 2-52. Armor panels

NOTE

Temporary removal of armor panels: All of the armor shown of figure 2-52 may be removed in non-combat areas at the discretion of the unit commander. If armor is removed, comply with the following requirements:

Identify armor panels for reinstallation and retain as flyaway equipment in a safe storage area where it is readily available.

Reinstall armor prior to transfer of helicopter.

Make entries in helicopter weighing record and chart C, basic weight and balance record, when armor is removed and again when it is reinstalled.

a Inspection.

(1) Inspect pilots armor steel seat (4, figure 2-52) for damaged brackets and cracks.

(2) Inspect ceramic-type armor panels (1, 2, 3, 5, 6, 7, and 8, figure 2-52) for the following defects:

(a) Damage caused by a ballistic projectile. Panels with this type damage are not reparable and must be replaced.

(b) Cracks in ceramic armor and damage to the glass reinforced plastic backing. Hairline cracks are reparable if the glass reinforced plastic backing is not damaged. If cracks are wider than hairline and the glass reinforced plastic backing is damaged, the panel must be replaced.

(c) Chipping and spalling damage. Minor damage on the edges and up to x inch from the edges is acceptable without repair. If chipping or spalling damage is present elsewhere on the panel, the panel must be replaced.

(d) Damage that results in loose nylon cloth shield and/or loose neoprene rubber edge moulding. Mark loose areas for rebonding.

(e). Damage that results in delamination is not reparable.

(f) Damage to threads in threaded inserts, loose bonding of threaded inserts to panel and missing threaded inserts.

(g) Damage to armor panel attaching brackets. Minor damage is reparable.

(h) Refer to TM 55-1500-204-25/1 for additional inspection criteria if required.

b. Removal.

(1) Refer to paragraphs 2-36 and 2-37 for removal of armor panels at pilot and gunners seats.

(2) Open engine cowling and remove engine ceramic armor panels (5, figure 2-52).

C Repair

(1) Repair hairline cracks in ceramic armor panels that are within repair limits by laminating fiberglass plies (C47) with resin (C 107) over the crack and under the spall shield to a thickness of **0.25** inch and overlapping the crack by **3** inches on each side. Cover with cellophane (C33), squeeze and cure at room temperature (**77 °F**) for a minimum of **8** hours, or for 2 hours at **105° F**.

(2) Rebond loose nylon cloth shield or neoprene rubber edge moulding with adhesive (C20).

(3) Repair threaded fasteners with slightly damaged threads by cleaning up threads with a tap. Replace the threaded fastener with a new fastener if thread damage is severe. Refer to step (5) for bonding procedure.

(4) Repair a loose threaded fastener by rebonding. Drill two small holes in the backing at an angle down to bottom of threaded insert and clean out holes. Place masking tape over the two small holes and the threaded hole in the insert to keep adhesive out of the threads. Use a sharp pointed tool to open holes through the masking tape at the two drilled holes. Inject adhesive (C12) into one hole with a syringe. Continue injecting adhesive until it is forced from the second hole. Allow to cure for 24 hours.

(5) Repair threaded fastener with faulty threads or one that is very loose in the panel by replacing with a new threaded fastener. Drill out the old fastener carefully to avoid damage to the panel. Clean out the hole and bond a new fastener in the panel in the same manner outlined in the preceding step.

(6) Repair cracked or distorted armor panel attaching brackets with standard metalworking

procedures if practical. Replace brackets that are not repairable.

d. Installation.

(1) Refer to paragraphs 2-38 and 2-39 for Installation of armor panels at pilot and gunners seats.

(2) Open engine cowling, install armor panel (5, figure 2-52) and close engine cowling.

2-44. Engine Mount Installation.

The engine is supported on the three engine mounts shown on figure 2-53. The mounts are made primarily of steel tubing and rod end bearings. Hinged pillow block assemblies on the bipod and tripod mounts attach to fittings on the engine diffuser housing. The rigid connecting link attaches to a fitting on the engine inlet housing. The three engine mounts attach to fittings on the engine compartment deck. Shims are installed under the fittings to align the engine with the transmission at original installation.

a. Inspection.

(1) Inspect engine tripod, bipod and rigid connecting link (5, 11 and 19, figure 2-53) for the following defects.

(a) Dents. Small, smooth dents which have not removed material from tubing and occur at least one and one-half inches from weld clusters or from points where tubes intersect gussets are considered negligible and do not require repair. Dents greater than negligible are cause for replacement of the affected engine mount.

(b) Scratches. Transverse scratches longer than 5/16 inch are cause for replacement of the mount. Other scratches that are less than 0.010 inch deep may be polished out.

(c) Distortion. Inspect for bends, nicks and similar damage. Any distortion-type damage that can be detected visually is cause for replacement of the affected mount.

(d) Wear. Inspect for worn rod end bearings in the engine mount tubes. If noticeable wear is present, remove the affected engine mount and check bearing wear with a dial indicator. Refer to step b for removal instructions. Maximum allowable radial play is 0.008 inch. Maximum allowable axial play is 0.016 inch.

(e) Corrosion. Inspect for corrosion damage that could affect function of engine mounts.

(f) Cracks. Inspect for cracks visually. If any areas are suspect, inspect by dye penetrant method. No cracks are acceptable.

(g) Security. Check for secure installation of all bolts and rivets in each of the three mounts.

(2) Inspect pillow blocks (4 and 10, figure 2-53) for the following defects:

(a) Cracks. No cracks are acceptable.

(b) Nicks, scratches and dents severe enough to affect function.

(c) Wear. If noticeable wear is present, check bearing with dial indicator. Maximum allowable play is 0.006 inch radial and 0.012 inch axial.

(3) Inspect eye bolts (3 and 9, figure 2-53) for damaged threads.

(4) Inspect fittings (1, 8, 13, 15, 16, and 20, figure 2-53) for the following defects:

(a) Cracks. No cracks are acceptable.

(b) Nicks and dents severe enough to affect function.

(c) Secure attachment to deck.

(d) Corrosion damage severe enough to affect function.

b. Removal.



Do not remove fittings (1, figure 2-53) or similar fittings under engine mounts unless fitting must be replaced.

(1) Support engine with suitable support to relieve weight from mounts.

(2) Remove engine fuel control linkage and bellcrank from tripod mount on left side. Remove hose clamps from mount tubes.

(3) Remove bolts, nuts and washers (2 and 7, figure 2-53) and remove engine mount (5). Remove engine mounts (11 and 19) in the same manner.

(4) If fittings (1, figure 2-53) or similar fittings under other engine mounts must be removed, remove the bolts that secure the fitting to the deck and remove fittings.

(5) If pillow blocks (4 and 10, figure 2-53) must be removed, remove two bolts (6) and remove pillow block (4). Remove pillow block (10) in the same manner.

c Repair.

(1) Polish out minor corrosion damage and touch up with primer (C102).

(2) Replace engine mount parts that are damaged or worn beyond allowable limits.

NOTE

209-062-127-1 rod end allows removal and replacement of the bearing uni-ball.

(3) Rotate uni-ball bearing one-half turn and remove uni-ball bearing. Install new uni-ball bearing in a reverse manner.

(4) Recheck engine mount rod end bearing for radial and axial play. Refer to paragraph a.(d).

(5) Rod ends that are worn beyond allowable limits may be replaced as follows:

(a) If not previously accomplished, fabricate a four-part work aid as shown on figure 2- 54.

(b) Grind off bucked ends of rivets which secure the unserviceable rod end to engine mount. Use caution to avoid damaging engine mount. Drive rivets out with a punch and remove unserviceable rod end.

(c) Temporarily reinstall unserviceable rod end in mount and align with one new rivet, but do not buck rivet.

Install mount in work aid as shown on sheet 3 of figure 2-54. Tighten bolts (1), (2), and (6).

(d) Install mount and work aid on a universal drill press table and adjust so that a 3/16 twist drill mounted in drill press will pass smoothly through open rivet holes in mount and rod end. Remove bolt (1, figure 2-54), rivet and unserviceable rod end. Install new rod end and tighten bolt (1). Install a 7/32 inch, No. 2 (0.2210 inch) twist drill in drill press and drill through a new rod end. Remove rod end, deburr and inspect mount to ensure that drill did not go off center and enlarge the hole on lower side of mount.

(e) Reinstall unserviceable rod end in mount and use same procedure outlined in preceding step to align and drill out second rivet hole.

(f) Inspect engine mount to ensure that the drill did not go off center and enlarge rivet holes. Scrap mount and rod end if damaged during drilling operation.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

(g) Use crocus cloth (C45) to roughen mating surface of new rod end and mount. Clean area with cloth dampened with solvent (C87).

CAUTION

Ensure that correct part number rivet is installed in following step. Refer to TM 55-1520-234-23P.

(h) Apply a light coating of adhesive (C12) to mating surfaces of new rod end and mount. Position rod end in mount and install rivets. Allow adhesive to cure for 24 hours.

(i) Mark and center punch one location 1.75 inch from each end of mount tube. Drill a number 30 (0.128 inch) hole at each of the marked locations. Fill mount tube with lacquer (C78) and allow to drain. Install rivets, P/N MS20600B4K-1, in the holes.

d. *Installation.*

NOTE

After proper shim thickness has been selected, apply proseal (C 119) under the engine mount fitting.

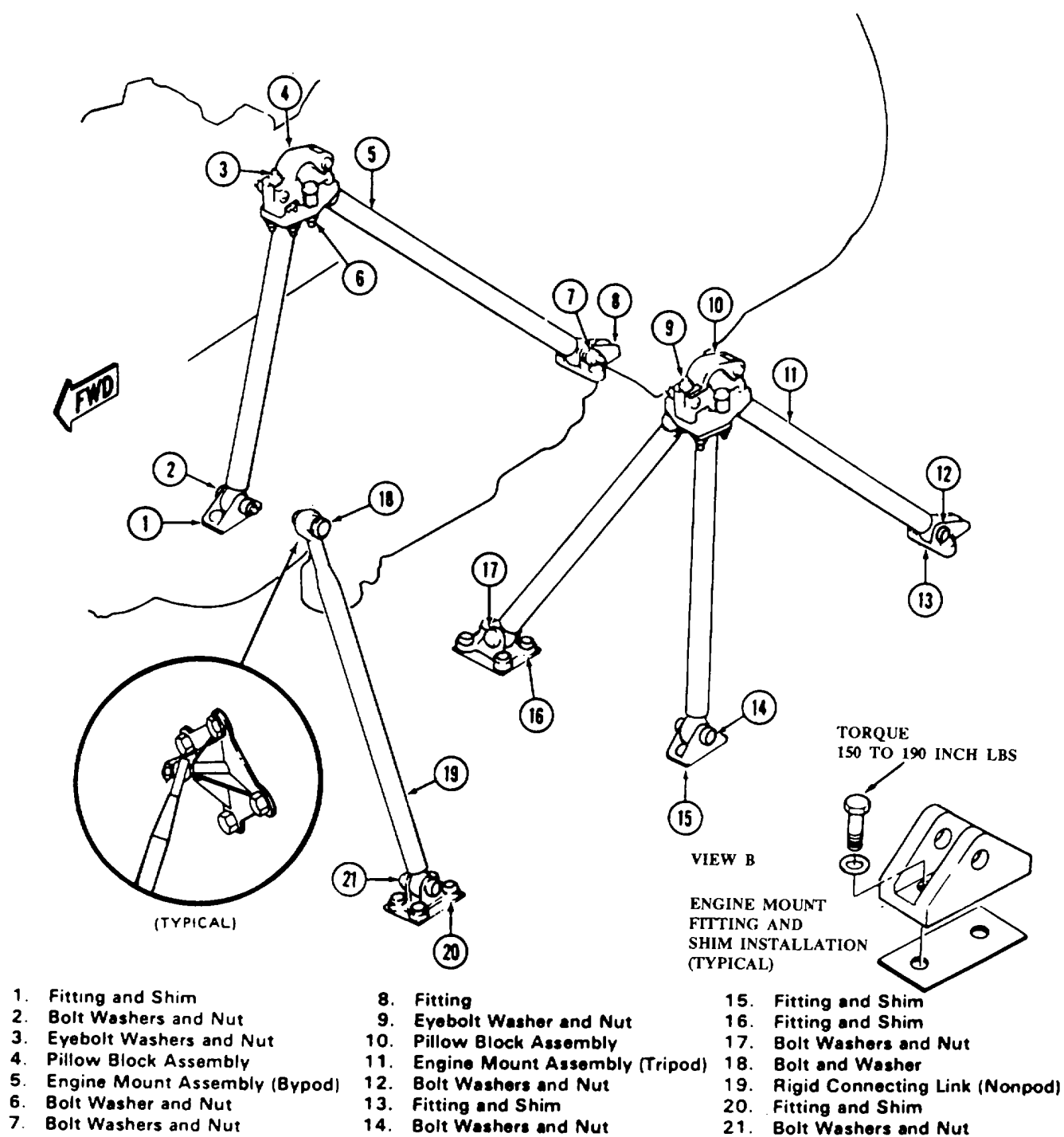
(1) Install fitting (1, figure 2-53) or similar fittings under engine mounts if removed. Install the fittings temporarily. It may be necessary to change shim thickness under fittings after engine alignment.

(2) Position engine mount (5, figure 2-53) on deck fittings and install bolts, washers and nuts (2 and 7). Install mounts (11 and 19, figure 2-53) in the same manner.

(2) Secure connecting link (19, figure 2-53) with bolt and washer (18) to forward trunnion fitting. Torque bolt 50 to 70 inch-pounds.,

(3) Install hose clamps on mount tubes that were removed in step b.

(4) Install pillow blocks (4 and 10, figure 2-53) if not previously accomplished. Position pillow block (4) on bipod mount with eye bolt forward as



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Figure 2-53. Engine mount Installation

All data on pages 2-102 thru 2-104 including figure 2-54 deleted

Change 64 2-101

illustrated. Install two bolts, washers and nuts (6). Install pillow block (10) in the same manner.

(5) Install fuel control bellcrank and linkage that was removed in step b.

(6) Remove engine support.

(7) Perform an engine to transmission alignment check, refer to paragraph 6-8, when any engine mount component is replaced or when any engine deck mount fitting is removed and reinstalled.

2-44A. Wire Strike Protection System (After MWO 55-1520-234-50-2 and MWO 55-1520-234-50-3).

The wire strike protection system consists of three cutters, and three deflectors. See figure 2-54A for view of system. A deflector is mounted on the nose of the helicopter between the telescope sight window and the laser sight window. Two deflector assemblies, each consisting of a channel with an insert, are mounted on the right and left center canopy frames. Two nose deflectors are mounted on each side of the nose and at the forward end of each deflector assembly. A wire cutter is mounted on a honeycomb panel and secured on the aft end of the pilot overhead window. A second wire cutter is mounted on the access door below the turret sight unit and forward of the turret. The third wire cutter is mounted on the access door below the ammunition compartment.

a. Removal- Wire Strike Cutter (Upper).

(1) Remove screws (13, figure 2-54A), and remove cutter (8) and panel (4) as a unit.

(2) Remove attaching screws (1 and 10), and remove cutter from panel.

(3) Remove bolt (5), washer (6), and nut (7) and remove struts (9).

b. Inspection - Wire Strike Cutter (Upper).

(1) Inspect cutter for bends, cracks, nicks, alignment, and presence of protective sealing compound on blade.

(2) Inspect panel for cracks, punctures, delamination, and pulled or loose inserts.

c Repair-- Wire Strike Cutter (Upper).

(1) Recoat cutter blades with sealant (C119E) that have protective sealant missing. Replace blade (48 and/or 50, detail C) which shows evidence of wire strike as follows:

(a) Remove screws (12), washers (2 and 11), and nuts (3) and remove blade (48) or blade (50) and shims (49) as required. Retain shims (49) for reuse.

(b) Coat replacement blade (48 and 50) with sealing compound (C1 19E) to seal gaps between blade and cheekplate (51).

(c) Position replacement blade in cheekplate and shim as required to achieve a maximum gap of 0.16 inch. Shim equally either on both sides or same side of blade to ensure cutting edge alignment.

(d) Install screws (12), washers (2 and 11), and nuts (3). Do not torque.

(e) Ensure gap, shown in detail F, measures 0.020 inch maximum with back of blades (48 and 50) forced apart. If overlap exceeds 0.010 inch, dress corner of lower blade (50) to reduce overlap.

(f) Torque screws (12) **30 - 35** in-lbs.

(g) Coat cutting edge of replacement blade with sealing compound (C119E).

(2) Touch up damaged paint to match existing finish using olive drab paint (C75A).

(3) Repair panel in accordance with paragraph 2-4.

d Installation - Wire Strike Cutter (Upper).

(1) Install struts (9, figure 2-54A) on cutter (8) with nut (7), washer (6), and bolt (5).

(2) Position panel (4) and cutter (8) on aft end of pilot upper window.

(3) Apply a 2-inch wide bead of sealing compound (C116) to fill gap between the window and the bottom of the cutter panel.

(4) Secure panel (4) and cutter (8) with screws (1, 10 and 13).

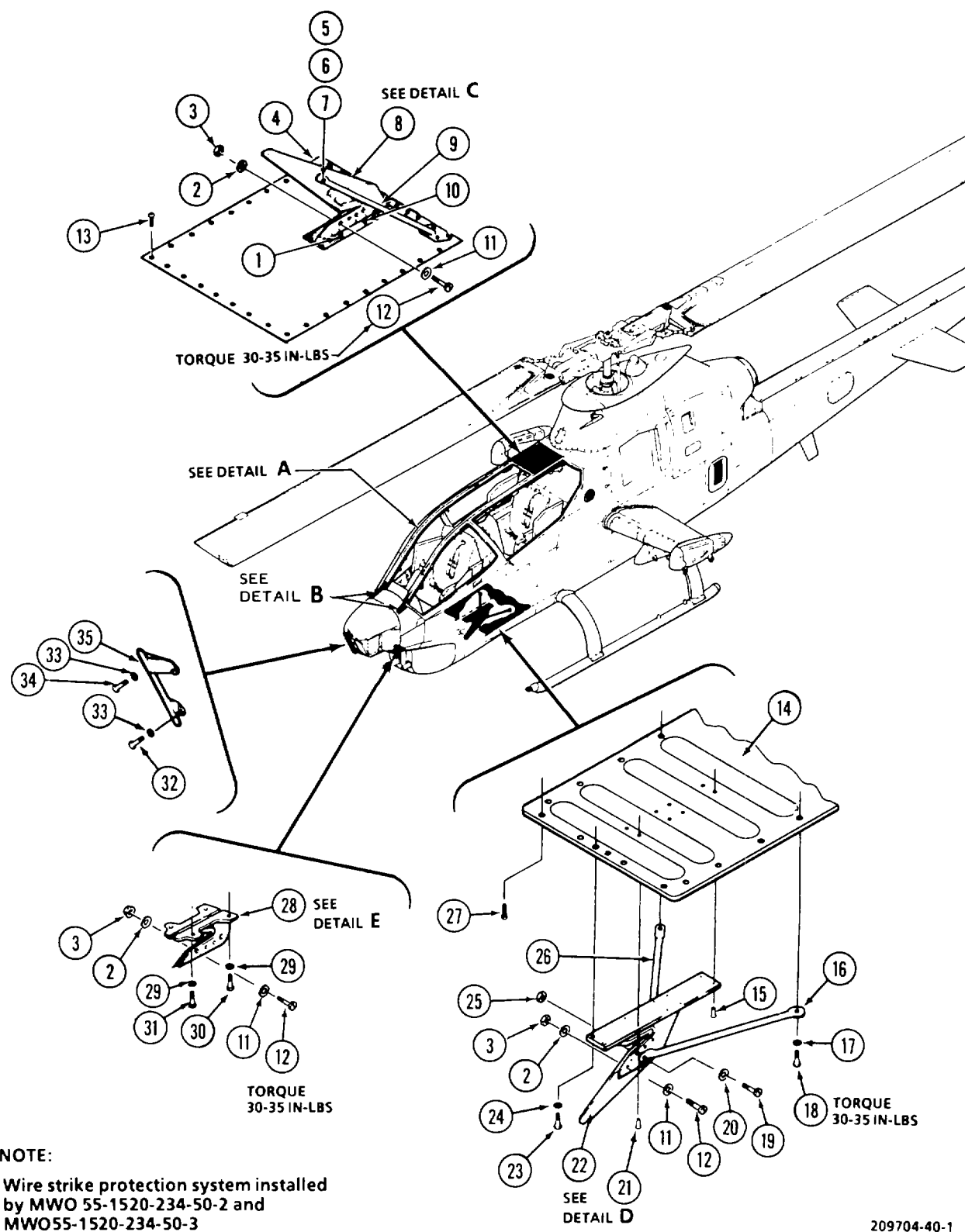
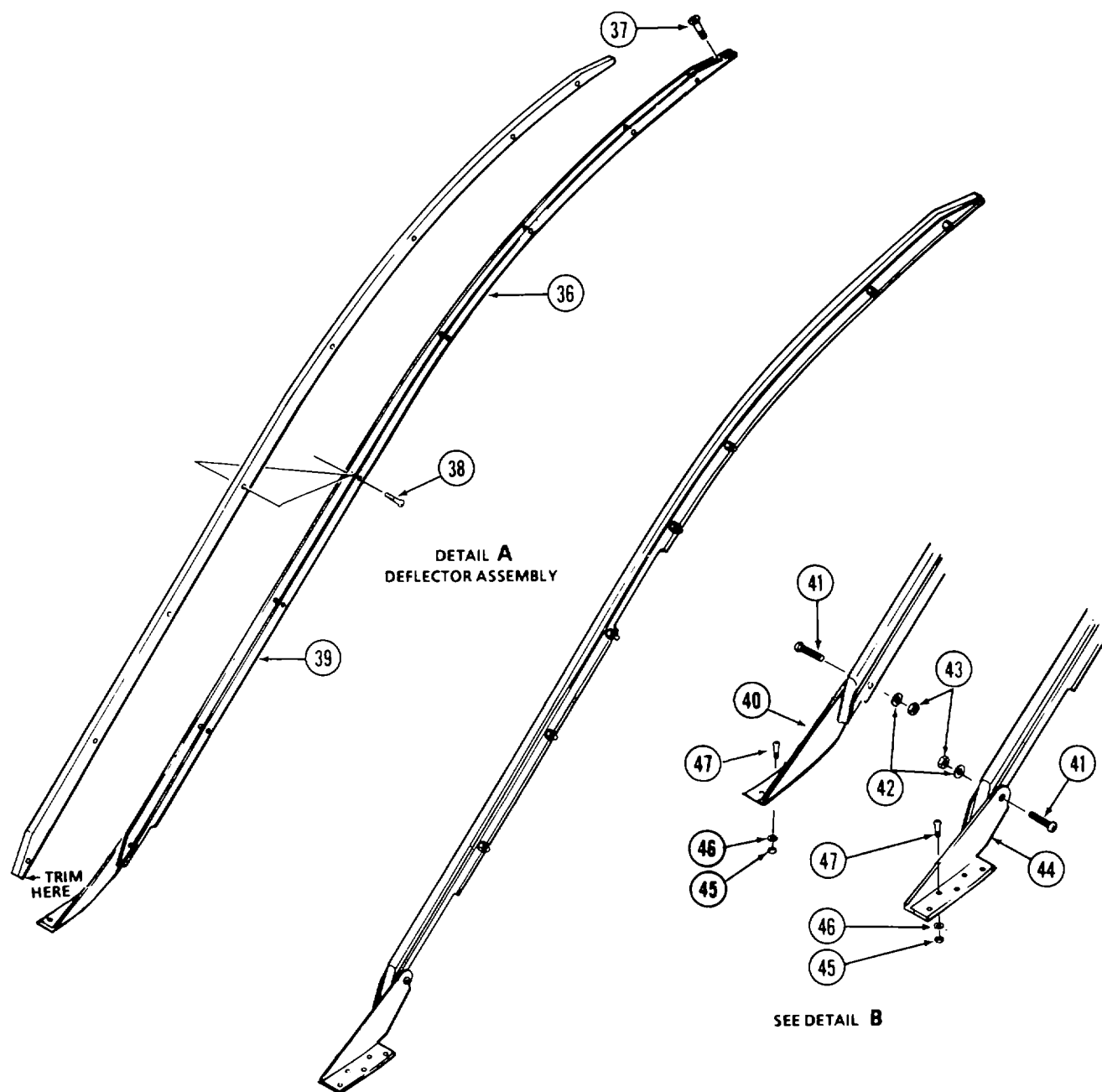


Figure 2-54A. Wire strike protection system (Sheet 1 of 4)



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Figure 2-54A. Wire strike protection system (Sheet 2 of 4)

Change 44   2-104C

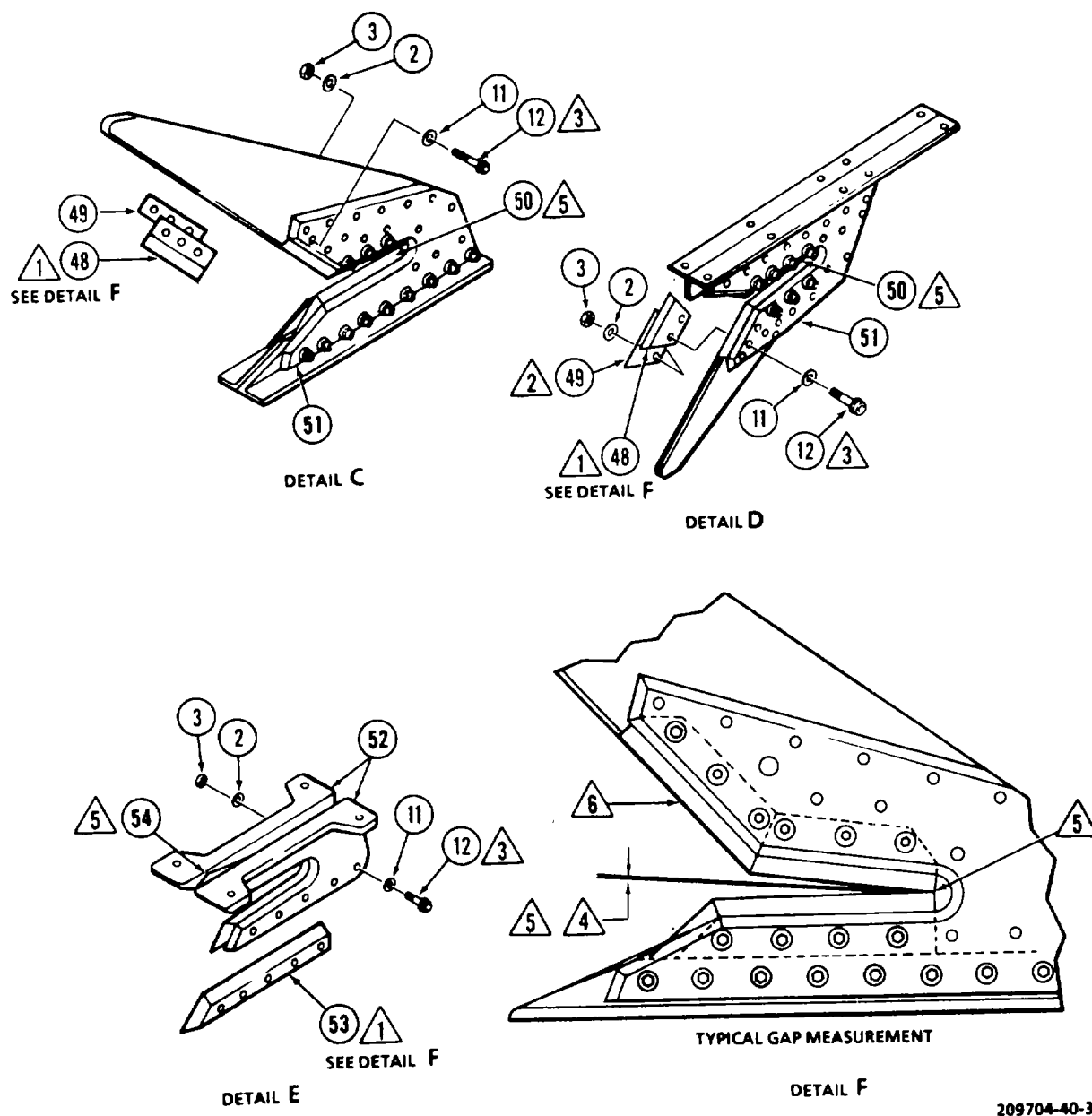


Figure 2-54A. Wire strike protection system (Sheet 3 of 4)

1. SCREW	28. CUTTER
2. WASHER	29. WASHER
3. NUT	30. BOLT
4. PANEL	31. BOLT
5. BOLT	32. BOLT
6. WASHER	33. WASHER
7. NUT	34. BOLT
8. CUTTER	35. DEFLECTOR
9. STRUT	36. INSERT
10. SCREW	37. SCREW
11. WASHER	38. SCREW
12. SCREW	39. CHANNEL
13. SCREW	40. RIGHT NOSE DEFLECTOR
14. DOOR	41. SCREW
15. RIVET	42. WASHER
16. STRUT	43. NUT
17. WASHER	44. LEFT NOSE DEFLECTOR
18. BOLT	45. NUT
19. BOLT	46. WASHER
20. WASHER	47. SCREW
21. RIVET	48. BLADE
22. CUTTER	49. SHIM
23. BOLT	50. BLADE
24. WASHER	51. CHEEKPLATE
25. NUT	52. CHEEKPLATE
26. STRUT	53. BLADE
27. SCREW	54. BLADE

NOTES

1. SEAL GAPS BETWEEN CHEEKPLATES AND BLADES BY WET INSTALLING BLADES COATED WITH SEALING COMPOUND (C119E).
2. SHIM AS REQUIRED BETWEEN CHEEKPLATES AND BLADES TO ACHIEVE A MAXIMUM GAP OF 0.16 INCH TOTAL. SHIM EQUALLY ON BOTH SIDES OR SAME SIDE OF ALL BLADES TO ENSURE ALIGNMENT OF CUTTING EDGE.
3. TORQUE SCREWS 30-35 IN-LBS. ,/A GAP 0.020 INCH MAXIMUM WITH BACK OF BLADES FORCED APART BEFORE TIGHTENING SCREWS.
4. OVERLAP EXCEEDING 0.010 INCH SHALL BE REDUCED BY DRESSING CORNER OF INDICATED BLADE.
5. COAT CUTTING EDGE OF ALL BLADES WITH MINIMAL APPLICATION OF SEALING COMPOUND (C119E). 209704-40-4

Figure 2-54A. Wire strike protection system (Sheet 4 of 4)

e Removal- Channel and Insert (Wire Strike).

(1) Remove screws (38, detail A, figure 2-54A) and remove insert (36).

(2) Remove screws (37) and remove channel (39).

f Inspection-- Channel and Insert (Wire Strike).

(1) Inspect inserts (36, figure 2-54A) for bends, cracks, or loose or missing fasteners or protective sealing compound.

(2) Inspect channels (39) for distortion, loose or missing fasteners, and damage to paint.

(3) Inspect channel attach holes in center canopy frames for loose or missing flush filler.

g Repair-- Channel and Insert (Wire Strike).

(1) Replace insert which has protective sealing compound missing or which shows evidence of wire strike.

(2) Flush exposed channel attach countersunk holes with adhesive, Hysol (C17).

(3) Touch up damaged paint on channel using olive drab paint (C75A).

h. Installation - Channel and Insert (Wire Strike).

(1) Position channels (39, figure 2-54A) on canopy structure and secure with screws (37).

(2) Position inserts (36) in channels (39) and secure with screws (38).

I. Removal-- Nose Deflector, Right and Left (Wire Strike).

(1) Remove screws (41), washers (42), and nuts (43).

(2) Remove screws (47), washers (46), and nuts (45). Remove nose deflectors (40 and 44) as required.

j. Inspection-- Nose Deflector, Right and Left (Wire Strike). Inspect right and left nose deflectors for evidence of wire strike and damage to paint.

k. Repair - Nose Deflector, Right and Left (Wire Strike).

(1) Replace nose deflector which shows evidence of wire strike.

(2) Touch up damaged paint on nose deflector using olive drab paint (C75A).

l. Installation - Nose Deflector, Right and Left (Wire Strike).

(1) Position right nose deflector (40) in place and secure with screws (41 and 47), washers (42 and 46), and nuts (43 and 45).

(2) Position left nose deflector (44) in place and secure with screws (41 and 47), washers (42 and 46), and nuts (43 and 45).

m Removal- Wire Strike Cutter (Nose).

(1) Remove bolts (30 and 31, figure 2-54A) and washers (29).

(2) Remove cutter (28).

m Inspection- Wire Strike Cutter (Nose).

(1) Inspect cutter (28, figure 2-54A) for bends, cracks, nicks, and alignment.

(2) Inspect condition of protective sealing compound on cutter blade.

o. Repair-- Wire Strike Cutter (Nose).

(1) Recoat cutter blades with sealant (CI19E) that have protective sealant missing. Replace blade (53 or 54, detail E) which shows evidence of wire strike as follows:

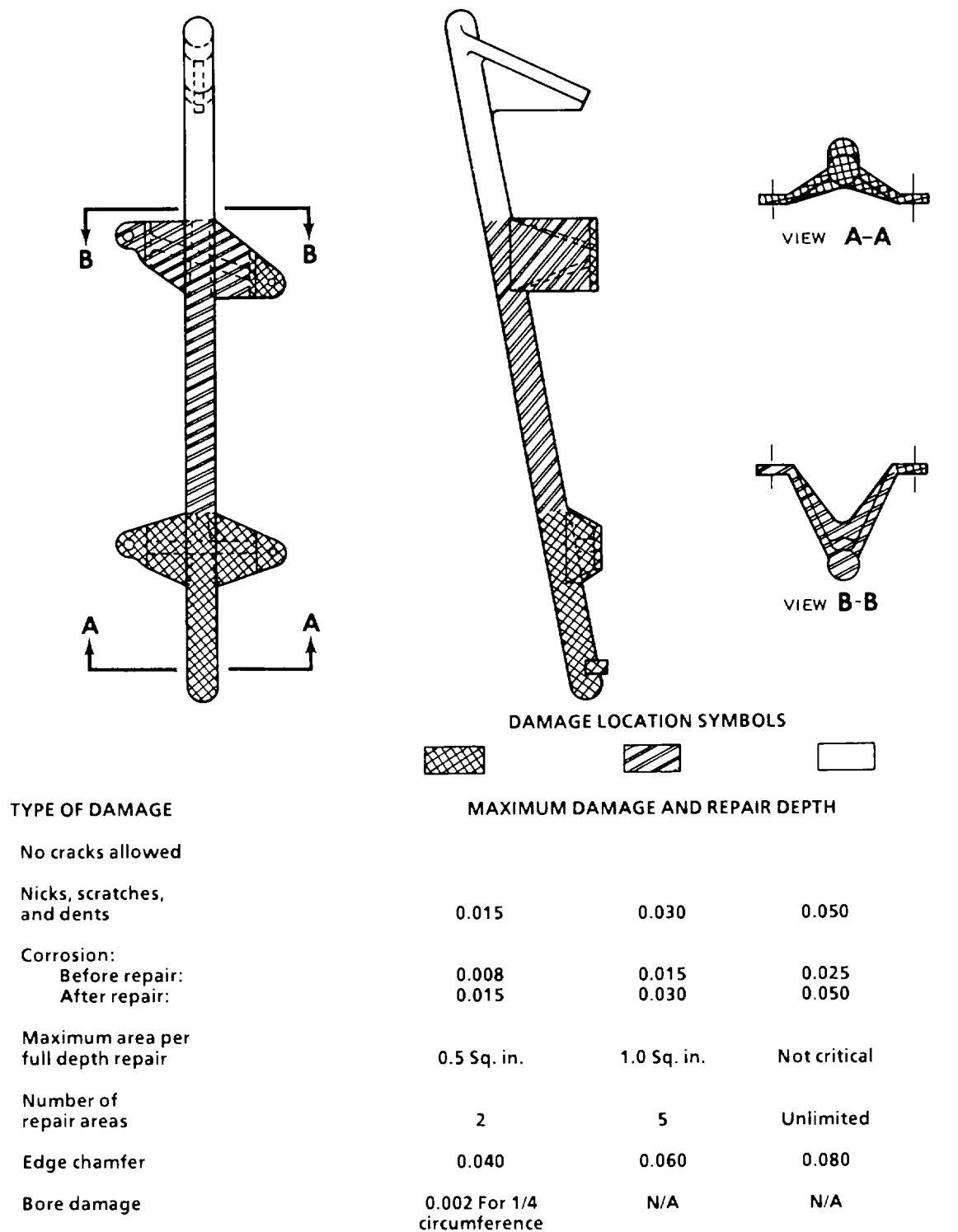
(a) Remove screws (12), washers (2 and 11), and nuts (3). Remove blades (53 or 54) as required.

(b) Coat replacement blades (53 and 54) with sealing compound (C119E) to seal gaps between each blade and cheekplates (52).

(c) Position blades (53 and 54) in cheekplates (52).

(d) Install screws (12), washers (2 and 11), and nuts (3). Do not torque.

(e) Ensure gap, shown in detail F, measures 0.020 inch maximum with blades forced apart. If overlap exceeds 0.010 inch, dress corner of upper blade (54) to reduce overlap.



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Figure 2-54B. Damage limits - wire strike deflector

(f) Torque screws (12) 30 - 35 in-lbs.

(g) Coat cutting edge of replacement blade with sealing compound (C 119E).

(2) Touch up damaged paint using olive drab paint (C75A).

p. Installation - Wire Strike Cutter (Nose).

(1) Position cutter (28, figure 2-54A) on nose.

(2) Secure cutter (28) to nose with bolts (30 and 31) and washers (29).

q. Removal-- Wire Strike Cutter (Lower).

(1) Remove screws (27, figure 2-54A), bolts (18 and 23), and washers (17 and 24), securing door (14) to bottom of ammunition compartment. Remove door (14) with cutter (22) attached.

(2) Remove rivets (15 and 21). Remove cutter (22) from door (14).

(3) Remove bolt (19), washer (20), and nut (25). Remove struts (16 and 26).

r. Inspection-- Wire Strike Cutter (Lower).

(1) Inspect cutter (22, figure 2-54A) for bends, cracks, and alignment.

(2) Inspect condition of protective sealing compound on cutter blade.

(3) Inspect door (14) for delamination, impact damage, and loose inserts.

s. Repair-- Wire Strike Cutter (Lower).

(1) Recoat cutter blades with sealant (CI19E) that have protective sealant missing. Replace blade (48 and/or 50, detail D) which shows evidence of wire strike as follows:

(a) Remove screws (12), washers (2 and 11), and nuts (3) and remove blade (48) or blade (50) and shims (49) as required. Retain shims (49) for reuse.

(b) Coat replacement blade (48 and 50) with sealing compound (C119E) to seal gaps between blade and cheekplate (51).

(c) Position replacement blade in cheekplate and shim as required to achieve a maximum gap of 0.16 inch. Shim equally either on both sides or same side of blade to ensure cutting edge alignment.

(d) Install screws (12), washers (2 and 11), and nuts (3). Do not torque.

(e) Ensure gap, shown in detail F, measures 0.020 inch maximum with back of blades (48 and 50) forced apart. If overlap exceeds 0.010 inch, dress corner or upper blade (50) to reduce overlap.

(f) Torque screws (12) 30 - 35 in-lbs.

(g) Coat cutting edge of replacement blade with sealing compound (C 119E).

(2) Touch up paint to match existing finish using olive drab paint (C75A).

(3) Repair door (14) in accordance with paragraph 2-4.

t Installation-- Wire Strike Cutter (Lower).

(1) Install struts (16 and 26, figure 2-54A) on cutter (22) with bolt (19), washer (20), and nut (25).

(2) Install cutter (22) on door (14) with new rivets (15 and 21).

(3) Install door (14), with cutter (22) attached, on helicopter using bolts (18 and 23), washers (17 and 24), and screws (27).

U Removal-- Wire Strike Deflector (Nose).

(1) Remove bolts (32 and 34, figure 2-54A) and washers (33).

(2) Remove deflector (35) from nose.

v. Inspection-- Wire Strike Deflector (Nose).

Inspect deflector (35, figure 2-54A) for damage in accordance with figure 2-54B.

w Repair-- Wire Strike Deflector (Nose).

(1) Replace deflector (35, figure 2-54A) if damaged beyond limits shown in figure 2-54B.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

(2) Polish out corrosion, nicks, scratches, and dents not severe enough to reject deflector (35, figure 254A). Use 300 grit sandpaper (C112). Clean sanding residue with MEK (C87), and touchup bare metal with primer (C100) and paint to match existing finish. Refer to TB 746-93-2.

x. *Installation - Wire Strike Deflector (Nose).*

NOTE

When installing a new wire strike deflector, the unit must be demagnetized prior to installation.

- (1) Position deflector (35, figure 2-54A) on nose.
- (2) Install bolts (32 and 34) and washers (33).
- (3) Position TSU and laser window covers, and check clearance around deflector (35). Install covers

Section II. TAILBOOM

2-45. Tailboom Assembly.

The tailboom (11, figure 2-55) is an aluminum alloy semi-monocoque structure made up of bulkheads, longerons and stringers covered by aluminum skins. The tail fin is an integral part of the tailboom and is made up of aluminum ribs, a spar and honeycomb panels. The tailboom supports the synchronized elevator, tail rotor, tail rotor driveshaft, control systems, avionics equipment, armament system equipment, and cooling equipment for the avionics equipment.

Premaintenance Requirements for Tailboom.

<u>Condition</u>	<u>Installation Requirements</u>
Model	AH-IS
Part No. or Serial No.	All
Special Tools	None
Test Equipment	Torque Wrench 1050-1150 inch-pounds
Support Equipment	Tailboom, Support Stand
Minimum Personnel	
Required	Five
Consumable Materials	(C77)
Special Environmental Condition	None

a. *Removal.*

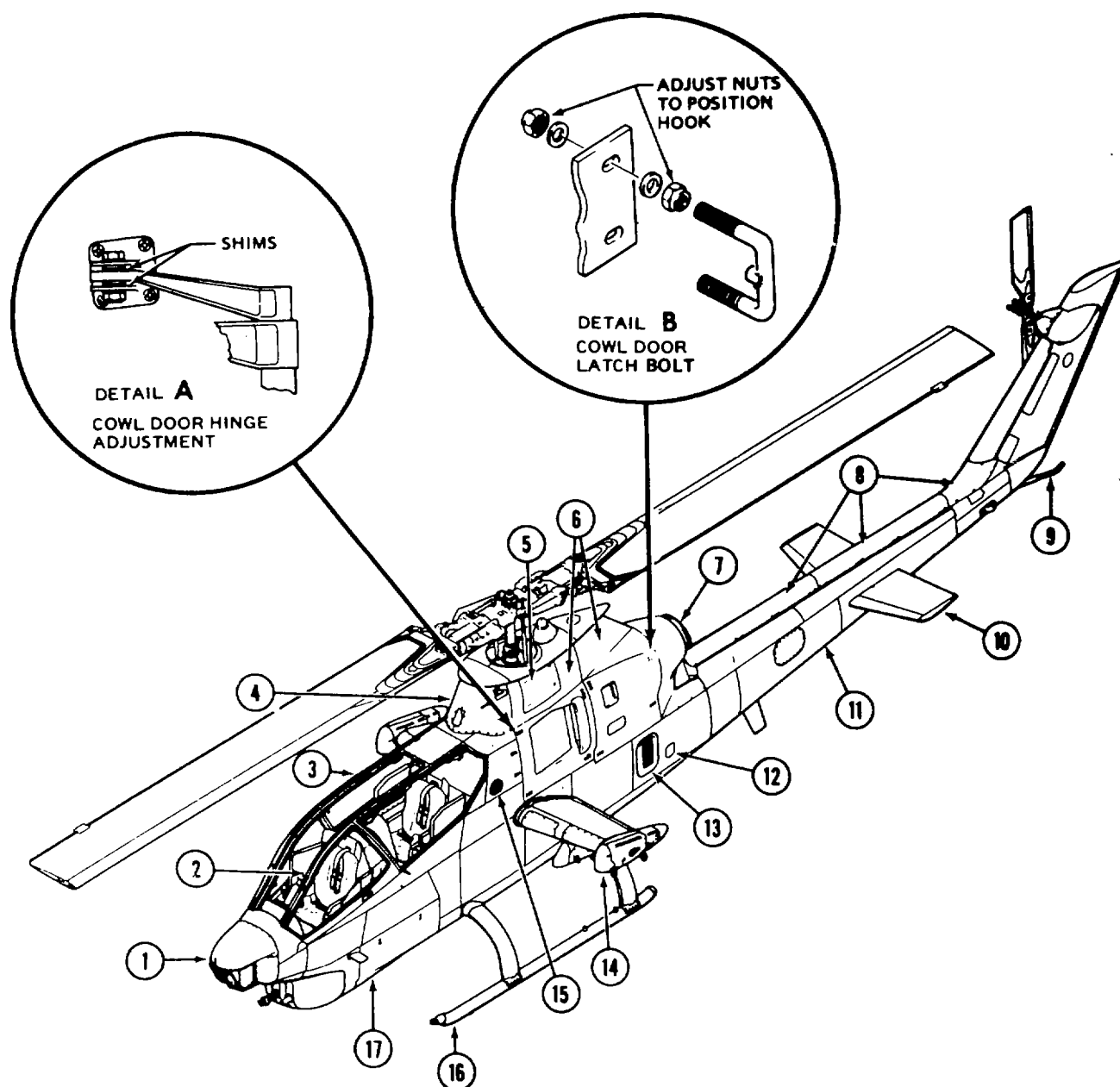
- (1) Remove tail pipe fairing and open tail rotor driveshaft covers.
- (2) Remove clamps on tail rotor driveshaft section at forward end of tail boom and remove section of driveshaft.
- (3) Open access panel on right side of fuselage and just forward of tailboom attachment point.

- (4) Disconnect electrical connectors.
- (5) Disconnect tail rotor control.
- (6) Disconnect synchronized elevator controls.
- (7) Fabricate a stand or padded support to hold the tailboom after removal. See figure 2-56.
- (8) Place stands, prepared in preceding step, under tailboom.
- (9) Position two men on each side of tailboom forward of synchronized elevator to support the tailboom and lower it into stands. Remove two lower bolts (15 and 16, figure 2-57). Direct men to support tailboom. Remove two upper bolts (1 and 6). Lift up on vertical fin and slide tailboom back to clear helicopter. Lower tailboom into position on stands and install bolts to secure Tailbot to forward stand as shown on figure 2-56.

b. *Installation.*

NOTE

- If a new tailboom is being installed, install electrical/avionics equipment, synchronized elevator and controls as outlined in steps (1) through (6). If the same tailboom is being installed, proceed to step (7).
- (1) Install electrical and avionics equipment in tailboom.
  - (2) Install synchronized elevator and control system. Refer to paragraph 2-0.
  - (3) Install tail rotor control linkage. Refer to Chapter 11.
  - (4) Install forty-two degree and ninety degree gearboxes. Refer to Chapter 6.



1. Telescopic Sight Unit (TSU)	10. Synchronized Elevator
2. Gunner's Access Door	11. Tail Boom
3. Pilot's Access Door	12. External Power Plug Door
4. Pylon Fairing	13. Oil Cooler Access
5. Mast Controls Access Door	14. Wing and Articulated Pylon
6. Transmission and Engine Cowl Doors	15. Hydraulic Compartment Door
7. Tail Pipe Fairing	16. Skid Gear
8. Tail Rotor Drive Shaft Covers	17. Ammunition Compartment Door
9. Tail Skid	

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Figure 2-55. Airframe external components

(5) Install tail rotor drive shaft. Refer to Chapter 6.

(6) Install tail rotor assembly. Refer to Chapter 5.

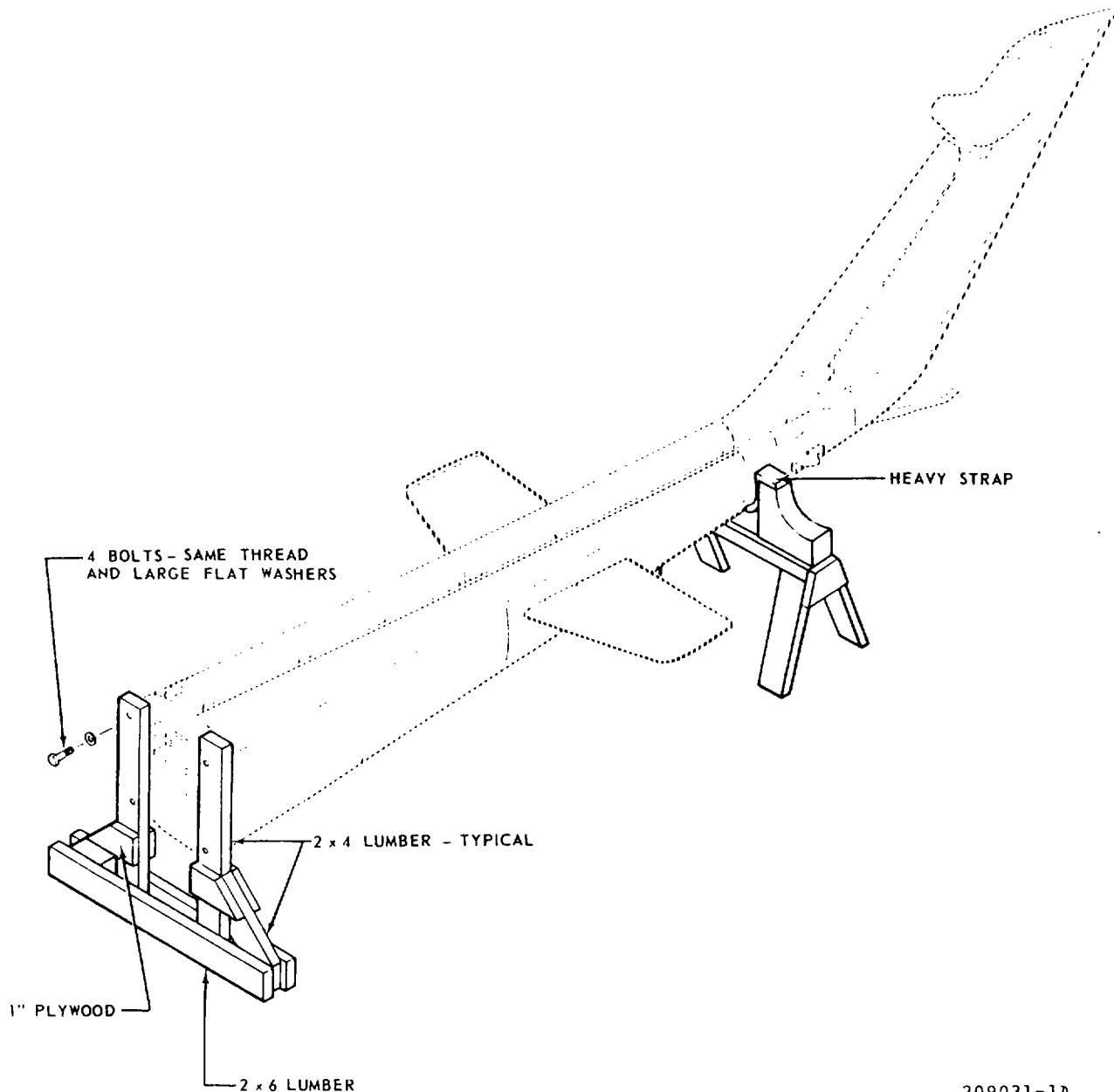
(7) Open access panel on right side of fuselage and just forward of tailboom attachment point.

(8) Place countersunk washers (2, 7, 15 and 17, figure 2-57) on tailboom attaching bolts with countersunk side of washers toward bolt heads. Note

that the bolts are of varying lengths. Identify bolts so they can be installed in the proper location.

(9) Position two men on each side of tailboom forward of synchronized elevator to lift the tailboom into position for installation. Direct men to support tailboom. Remove bolts that secure front stand to tailboom. See figure 2-61.

(10) Ensure that four retainers (5, 9, 11, and 20, figure 2-57) are in place and that barrel nuts (5, 9, 11, and 20) are aligned for installation of bolts.



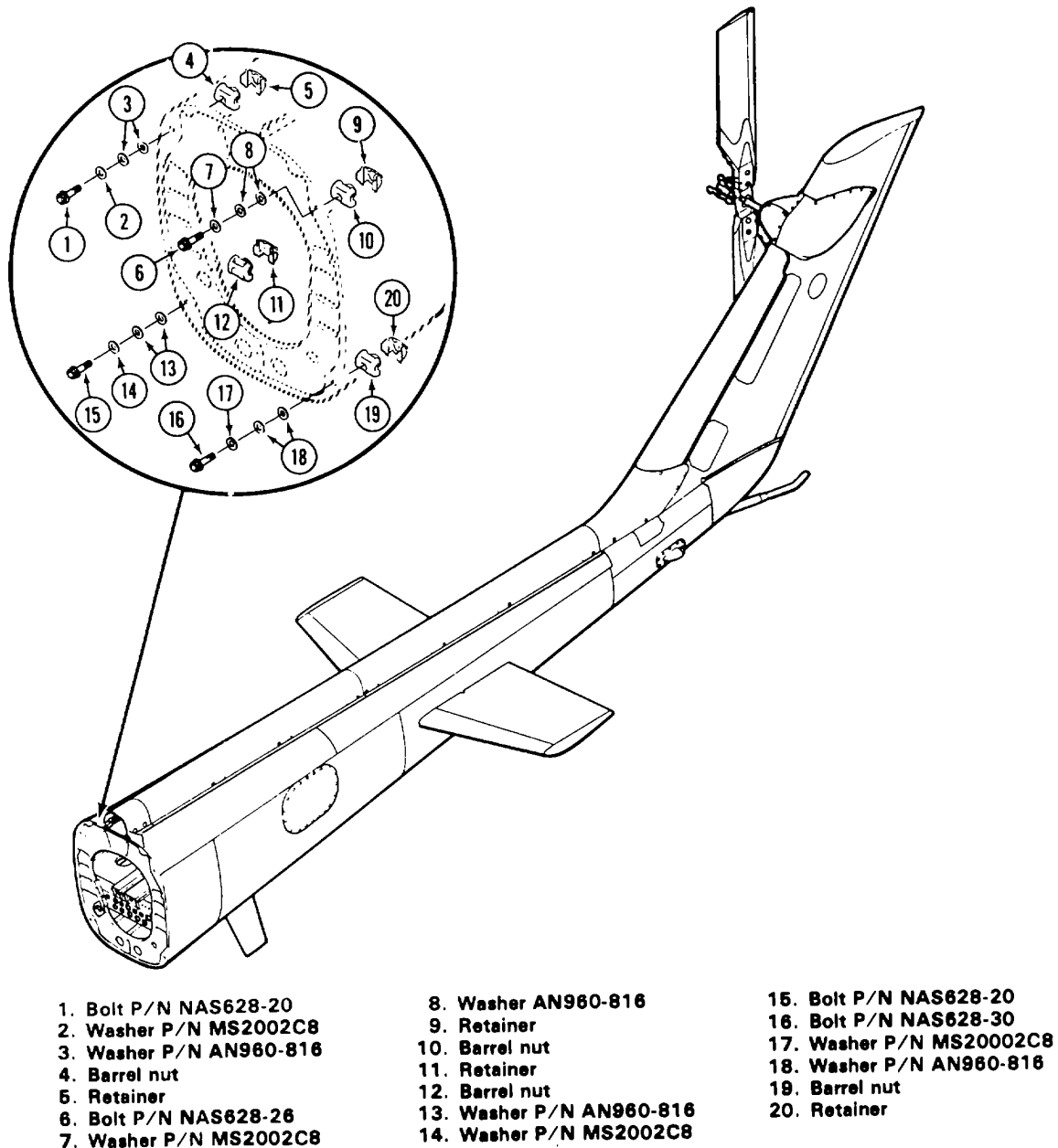
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Figure 2-56. Work aid - tailboom support stand

NOTE

Proper tailboom attachment bolt thread engagement has been achieved when one thread and not more than three threads are showing on bolt.

(11) Lift tailboom into position and install bolts with countersunk washers that were prepared in step (8). Ensure that the correct length bolt is installed for each location. Install two upper bolts (1 and 6, figure 2-57) first, then install two lower bolts. Tighten bolts carefully to ensure that bolt threads do not bottom in barrel nuts. If necessary, install flat



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Figure 2-57. Tailboom Installation

steel washers (3, figure 2-57), or similar washers on remaining three bolts, between countersunk washer (2) and fuselage fittings to obtain proper thread engagement. Torque the four bolts (1, 6, 15 and 16) **1100 TO 1300** inch-pounds. Retorque bolts after first flight and apply slippage index marks with lacquer (C77) or other suitable marking material. Apply a thin bead of proseal (C1]6) around tail boom to fuselage attachment point to minimize water intrusion.

(12) Install tail rotor driveshaft section.

(13) Connect synchronized elevator controls and check rigging.

(14) Connect tail rotor controls and check rigging.

NOTE

If tail rotor controls are found to be out of rig during preceding step, determine whether tail rotor has been removed and reinstalled. If tail rotor has been removed and reinstalled, check for proper installation of nylatron washer under bearing at outboard end of crosshead that supports tail rotor counterweights. Refer to Chapter 5 for illustration and installation instructions for nylatron washer.

(15) Connect electrical connectors for electrical and avionics.

(16) Install access panels.

(17) Perform functional check of electrical/avionics/armament equipment in the tailboom and perform maintenance test flight. Refer to TM55-1520-234MTF.

2-46. Tailboom Assembly Skin.

NOTE

Repair is limited to repair of minor cracks, holes, scratches, corrosion and replacement of loose or missing hardware. If major damage occurs which requires use of jigs and fixtures to repair, forward tailboom to Depot Level Maintenance for repair.

a. Inspection.

(1) Wrinkles and buckled areas. All damage of this type must be repaired.

(2) Popped and cocked rivets. All damage of this type must be repaired.

(3) Dents, cracks, holes, tears, nicks, scratches, corrosion and trapped or stretched skin. Damage limits are given in table 2-1.

Table 2-1. Tailboom Skin and Structure Classification of Damage

ITEM	DEFECT	NEGLIGIBLE DAMAGE LIMITS		REPAIRABLE DAMAGE LIMITS	DAMAGE REQUIRING REPLACEMENT
		Depth	Diameter		
1. TAIL- BOOM SKINS See figure 2-58	a. Dents.	a. Smooth contour free of cracks, nicks, or wrinkles. Depth and diameter not to exceed:		a. Cracks or sharp nick in dent. Damage areas after cleanup (including prior repairs) shall not exceed 20 of total area for a single skin panel. Damage 6.0 inch minimum from similar repair.	a. Total damage (including prior repairs) exceeds 20 percent of total area of a single percent skin panel, or damage spans entire distance between two bulkheads or or two stringers.
		0.0156	1.0 inch		
		0.0468	2.0 inch		
		0.0625	3.0 inch		

Table 2-1. Tailboom Skin and Structure Classification of Damage (Cont)

ITEM	DEFECT	NEGLIGIBLE DAMAGE LIMITS	REPAIRABLE DAMAGE LIMITS	DAMAGE REQUIRING REPLACEMENT
1. TAIL- BOOM SKINS See figure 2-58 (Cont)		3.0 inch minimum undamaged material between dents and 1.0 inch minimum from internal structure. Nicks and scratches which can be blended out not to exceed 10 percent of material depth.		
	b. Cracks, holes, tears, nicks, scratches, and corrosion.	b. Nicks and scratches no deeper than 10 percent of material thickness and not exceeding 1.0 inch length by 0.25 inch width after cleanup. Corrosion damage less than 10 percent of material thickness and not exceeding 4.0 square inch after cleanup. Damage no closer than 1.0 inch to a supporting structure.	b. Damage exceeds negligible limits but does not exceed 25 percent (including prior repairs) of total area for a single skin panel.	b. Same as dents.
	c. Trapped or stretched skin.	c. Inward or outward bulges located in a sectional area, that can be corrected by removing attaching hardware, allowing skin to shift. Mismatch of rivet holes shall not exceed that which can be cleaned up by drilling and installing one size larger rivet and maintain proper rivet edge distance. However, if condition does not disappear after unloading panel,	c. Creased dents not classified as oil can or stretched skin, not exceeding 25 percent of a sectional area and no closer than 1.0 inch to a supporting structure. Oil can condition, free of sharp dents or creases and not extending over or into supporting structure may be repaired by inserting a backup stiffener over the damaged area.	c. Stretched skin, oil cans, or creased dents that cannot be repaired by unloading insertion repair or back up stiffeners.

Table 2-1. Tailboom Skin and Structure Classification of Damage (Cont)

ITEM	DEFECT	NEGLIGIBLE DAMAGE LIMITS	REPAIRABLE DAMAGE LIMITS	DAMAGE REQUIRING REPLACEMENT
1. TAIL BOOM SKINS See figure 2-58 (Cont)		area is stretched or oil canned and must be replaced or repaired. Oil canning can be determined by pressing in on a sectional area and that section remains depressed and a bulge appears in that section or adjacent structure.		
2. TAIL- BOOM STRING- ERS AND STIFF- ENERS	Dents, cracks, holes, tears, corrosion and distortion. NOTE Dye penetrant inspect bent stringers not requiring sectional removal (after rework)	Scratches or smooth shallow dents not extending into formed radius and less than 10 percent of material thickness and 0.50 inch length after cleanup. Damage in radius treat as a crack. One treated area per length between bulkheads. Edge damage not to exceed 0.025 inch depth and 0.75 inch length after cleanup. One repair per length between bulkheads.	a. Damage Repairable by Patching: cracks and smooth contour dents less than 1.0 inch depth that are less than 0.50 stringer width and do not extend into radius, stringer splice or bulkhead. Longitudinal cracks maximum 0.10 inch width and 1.0 inch length. b. Damage Repairable by Insertion: Damage exceeds limits for patching but does not exceed 3.0 inch length after Cleanup. One repair per length between bulkheads. Damage not to extend into splice or bulkheads. If combined stringer and skin damage is present, above limits and limits for skin damage shall not be exceeded.	Damage requires more than one insertion type repair between bulkheads. Damage exceeds repairable limits or repair does not warrant time expended.

Table 2-1. Tailboom Skin and Structure Classification of Damage (Cont)

ITEM	DEFECT	NEGLIGIBLE DAMAGE LIMITS	DAMAGE REPAIRABLE DAMAGE LIMITS	REQUIRING REPLACEMENT
3. TAIL- BOOM DOUB- LERS.	a. Cracks and scratches. b. Nicks, scratches, and dents. c. Holes, tears, and other damage exceeding the limits in a and b. above. than 4.0 inches or greater than 6.0 square inches may be repaired by patching.		Cracks and scratches that are no deeper than 20 percent of double thickness, and not exceeding one inch in length can be stop drilled at each end provided the crack is not closer than one inch to any adjacent structure. Nicks, scratches and dents that are no deeper than 20 percent of the doubler thickness and not exceeding one inch in length, or 0.025 inch in width may be polished out and require no patching. Holes, tears, and other damage exceeding the limits in steps a. and b. above and no longer	
4. LON- GER- ONS (EX- CLUD- ING TAIL- BOOM ATTACH FIT- TINGS) See figure	a. Cracks, corrosion, dents, holes, tears, nicks, scratches, buckle or wrinkled.	a. Nicks and Scratches: Not to exceed 10 percent of material thickness, 0.010 inch width and 0.75 inch length after cleanup. Scratches in web area that extend into radius or at angle greater than 45 degrees into critical area, treat as a crack (See figure 2-66A, detail B.)	a. Damage Repairable by Patching: Smooth contoured dents, length not exceeding 1.0 inch longitudinal, 0.5 inch lateral and 0.050 inch depth. If dent limits are exceeded, treat as a crack. (See figure 2-66A, detail A) 2. Nick and scratch damage exceeds negligible limits but does	a Damage exceeds repairable limits or two or more repairs required in a single bay. b. Damage other than negligible. occurs in a bay containing either a splice joint or a previous repair. c. Damage other 2-66A than negligible in forward bay. d. Splice required

Table 2-1. Tailboom Skin and Structure Classification of Damage (Cont)

ITEM	DEFECT	NEGLIGIBLE DAMAGE LIMITS	REPAIRABLE DAMAGE LIMITS	DAMAGE REQUIRING REPLACEMENT
4.	LON- GER- ONS (EX- CLUD- ING TAIL BOOM ATTACH FIT- TINGS) See figure 2-66A	Nicks or notches in flange area not to exceed 0.80 inch length, 0.04 inch width and no deeper than 10 percent of material thickness after cleanup. See figure 2-66A, Details B and C.) No repair closer than 1.0 inch to a bulkhead, splice or doubler. Refer to attach fitting illustration for damage limits to fittings. b. Corrosion: Less than 10 percent of material thickness and not exceeding an area 0.10 inch width by 0.75 inch cleanup. Damage confined to web area only and no closer than 1.0 inch to a splice, doubler or bulkhead. One repair for each longeron in a bay area. No damage in forward bay. See figure 2-66A, Detail B.)	not exceed 1.0 inch width by 0.38 inch height and does not extend into critical area after cleanup. (See figure 2-66A, detail F, section F-F.) Damage in critical area does not exceed 2.0 inch length and 0.40 inch depth after cleanup. See detail F, section G-G.) 3. Crack, hole or tear damage not exceeding limits of figure 2-66A, Details D and E, and extending no closer than 1.0 inch to a splice, doubler or bulkhead after repair. b. Damage Repairable by Insertion: 1. Repairable by patching limits exceeded but less than 2.50 inch length after cleanup. (See figure 2-66A, Details F and G.) 2. Cracks or sharp nicks in dent or damage exceeds repair by patching, but less than 2.50 inch after cleanup.	in second bay. e. Damage other than negligible comes closer than 1.0 inch to a doubler, splice or bulkhead. f. Any longerons damaged a sufficient amount to cause permanent buckles in tailboom, sharp wrinkles in skin or excessive misalignment. NOTE Damage in forward bay area (other than negligible). Requires replacement of both the longerons and fitting. Longerons are replaced at Depot Maintenance Level.

Table 2-1. Tailboom Skin and Structure Classification of Damage (Cont)

ITEM	DEFECT	NEGLIGIBLE DAMAGE LIMITS	REPAIRABLE DAMAGE LIMITS	DAMAGE REQUIRING REPLACEMENT
5.	TAIL Corrosion, dents, BOOM cracks, holes, BULK- nicks and HEADS wrinkles. (Does not include canted bulkhead) See figure 2-66B	Corrosion less than 10 percent of web material thickness and not exceeding 4.0 square inch after cleanup. Damage no closer than 0.260 inch to a former, stiffener or radius. Dents nicks, scratches in bulkhead web, refer to skin damage limits, item 1. Damage in a radius treat as a crack	a. Damage Repairable by Patching. 1. Corrosion damage greater than negligible but does not exceed 0.70 inch width or .33 percent of a cross section after cleanup. (See figure 2-66B, detail B.) Damage no closer than 0.50 inch to a stiffener or attaching parts after cleanup. 2. Dent, cracks holes and scratches greater than negligible but does not exceed limits of figure 2-66B Details A and B. Maximum three damages not to exceed limits of detail A allowed for each bulkhead quadrant. Cracks or damage in radius of former on forward bulkhead except in area of attach fittings. b. Damage Repairable by Insertion: 1. Corrosion damage exceeds repairable by patching but does not exceed limits of figure 2-66B, Detail C. 2. Dent, cracks or hole damage exceeds limits of figure 2-66B, Details A and B, but less than limits of Details C and D.	Replace stiffeners or any attaching parts for damage other than negligible. Replace bulkhead if repairable limits are exceeded or if more than one repair to the limits of figure 2-66B, Detail D, is required. NOTE Bulkheads are replaced by depot maintenance.

Table 2-1. Tailboom Skin and Structure Classification of Damage (Cont)

ITEM	DEFECT	NEGLIGIBLE DAMAGE LIMITS	REPAIRABLE DAMAGE LIMITS	DAMAGE REQUIRING REPLACEMENT
6. TAIL- BOOM CANTED BIJLK- HEAD	Cracks, holes, nicks and wrinkles.	Corrosion not to exceed 1.0 square inch for single area, 4.0 square inch total area and 10 percent material thickness after cleanup. Nicks and scratches not to exceed 1.0 inch length, 0.025 inch width and 10 percent material thickness after cleanup. Treat damage in radius as a crack.	Three holes maximum not exceeding 1.0 inch diameter in web area and 3.0 inch minimum distance between damage. Cracks in nutplate hole but not extending into radius. Cracks in web area not ex- ceeding 1.0 inch length after cleanup. No damage to come closer than 0.50 inch to stringer, longeron or structure attach- ing point and no closer than 1.0 inch to a spar cap.	Cracks or holes in area of longeron, stringer, or spar cap attachment points. Damage exceeds repairable damage limits.

b. Repair.

(1) Replace loose, missing or cocked rivets if no other structural damage is present.

(2) Repair cracks, holes and tears less than three inches in length as follows:

(a) Stop drill cracks.

(b) Smooth out edges of holes and tears.

(c) Apply a lay-on patch of like material. See figure 2-58. Install a minimum of four rivets on each side of patch. Refer to TM 551500-204-25/1 standard repair instructions.

(3) Repair cracks, holes and tears more than three inches in length as follows:

(a) Remove all the damaged skin and fabricate a filler plate of the same material as the skin to match the hole in the skin. Fabricate a backing patch of the same material. See figure 2- 58.

(b) Rivet filler plate and backing patch in place. Refer to TM55-1500-204-25/1 for standard repair instructions.

(4) Repair corrosion damage as follows:

(a) Polish out minor corrosion damage.

(b) Apply chemical film (C37) to bare aluminum surfaces.

(c) Prime repaired area with primer (C101).

(d) Touch up paint to match surrounding area.

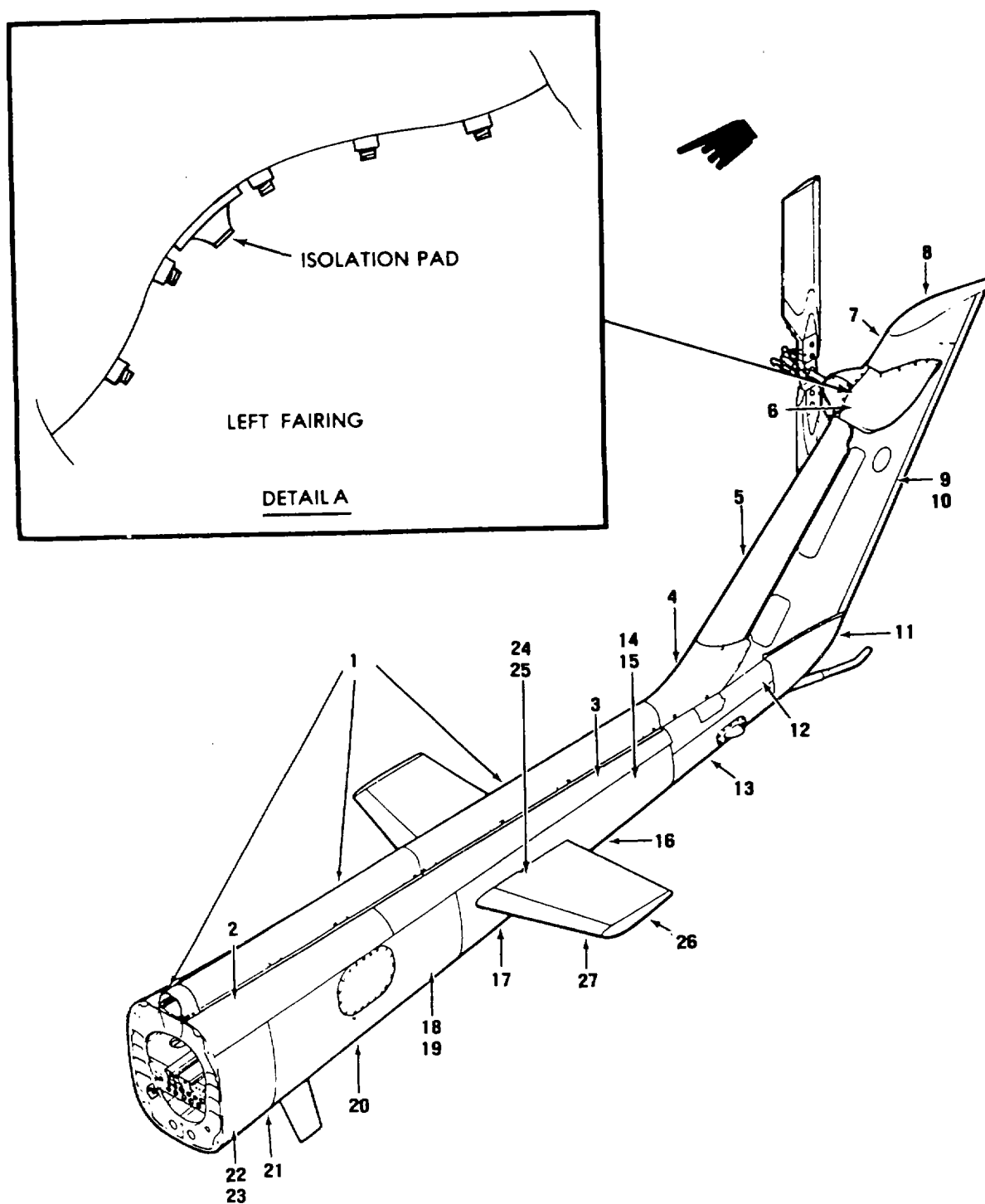


Figure 2-58. Tailboom and elevator skins (Sheet 1 of 2).

ITEM	MATERIAL	SPECIFICATION	CONDITION	THICKNESS
1.	5062 Al. Alloy	QQA250/8	TO	0.040
2.	7075 Al. Alloy	QCLA250/13	T6	0.032
3.	7075 Al. Alloy	QQA250/13	T6	0.032
4.	6061 Al. Alloy	QQA260/11	T6	0.040
5.	Fiberglass			
6.	Fiberglass			
7.	7075 Al. Alloy	QQA260/13	T6	0.025
8.	Kydex 100			
9.	Al. Faced Honeycomb Sandwich			Variable
10.	Al. Faced Honeycomb Sandwich			Variable
11.	Fiberglass			
12.	7075 Al. Alloy	QQA250/13	T6	0.050
13.	7075 Al. Alloy	QQA250/13	T6	0.050
14.	7075 Al. Alloy	QQA250/13	T6	0.032
15.	7075 Al. Alloy	QQA250/13	T6	0.032
16.	7075 Al. Alloy	QQA250/13	T6	0.032
17.	7075 Al. Alloy	QQA250/13	T6	0.025
18.	7075 Al. Alloy	QQA250/13	T6	0.025
19.	7075 Al. Alloy	QQA250/13	T6	0.025
20.	7075 Al. Alloy	QQA250/13	T6	0.025
21.	7075 Al. Alloy	QQA250/13	T6	0.025
22.	7076 Al. Alloy	QQA250/13	T6	0.040
23.	7075 Al. Alloy	QQA250/13	T6	0.040
24.	2024 Al. Alloy	QQA250/6	T3	0.040
25.	2024 Al. Alloy	QQA250/6	T3	0.040
26.	6061 Al. Alloy	QQA250/11	TO	
27.	2024 Al. Alloy	QQA250/6	TO	0.050

209030-300-2A

Figure 2-58. Tailboom and elevator skins (Sheet 2 of 2)**2-47. Tailboom Assembly Doors and Panels.**

Premaintenance Requirements for
Tailboom Doors and Panels

<u>Condition</u>	<u>Requirements</u>
Model	AH-1S Mod
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	One
Consumable Materials	(C130)
Special Environmental Condition	None

Access doors, panels and fairing on the tailboom make the tail rotor drive shaft, gearboxes, and internal components of the tailboom accessible. See figure 2-3, items 44 through 54 for view of doors, panels and fairings.

a. Inspection. Inspect doors, panels and fairings (44, 45, 46, 47, 48, 49, 50, 51, 52, 53 and 54, figure 2-3) for the following defects.

- (1) Cracks.
- (2) Corrosion on metallic parts.
- (3) Secure installation of fasteners and of hinges where applicable.
- (4) Deformity that causes improper fit.

(5) Deteriorated or missing chafing stripe.

(6) Security and condition of isolation pad on 90 degree gearbox fairing. (See figure 2-58, Detail A.)

b. Removal. Remove doors, panels and fairings (44, 45, 46, 47, 48, 49, 50, 51, 52, 53 and 54, figure 2-3) as follows:

(1) Remove attaching screws or loosen turnlock fasteners as applicable.

(2) Remove non-hinged panels.

(3) Disengage fasteners and remove hinge pins. Remove hinged covers.

c. Repair.

(1) Repair minor cracks. Refer to TM55-1500-204-25/1.

(2) Polish out minor corrosion on aluminum parts. Apply chemical film (C37) to bare metal surfaces. Touch up with primer (C102) and paint to match surrounding area.

(3) Replace missing and unserviceable turnlock fasteners, hinges and screws.

(4) Replace access doors, panels and fairings that are deformed to the degree that it does not fit when installed.

(5) Replace deteriorated or missing chafing strips. Use anti-chafe tape (C130) for driveshaft cover on leading edge of fin.

d. Installation. Install doors, panels and fairings (44, 45, 46, 47, 48, 49, 50, 51, 62, 53, and 54, figure 2-3) as follows:

(1) Position hinged covers on tailboom and install hinge pin. Close cover and engage fasteners.

(2) Position non-hinged panels on tailboom and engage fasteners.

2-48. Tailboom Assembly Structure.

NOTE

Repair is limited to repair of minor cracks, scratches, corrosion and replacement of loose

or missing hardware. If damage exceeds limits of table 2-1, or requires use of jigs and fixtures to repair, forward tailboom to depot level maintenance for repair.

The tailboom structure consists of bulkheads, longerons, stringers, stiffeners, and doublers. See figures 2-59 through 246.

a. Inspection.

(1) Inspect tailboom structure for defects. Refer to table 2-1 and figures 2-66A and 2-66B.

WARNING

Any cracks to the longeron attach fittings forward of boom station 70.00 or damage exceeding the following limitations requires depot maintenance.

(2) Inspect longeron attach fittings between boom stations 37.37 and 70.00. Nicks, scratches, and gouges may be polished with fine India stone (C126) provided they do not exceed following limitations.

(a) Axial damage (parallel to bolt axis) must not exceed 0.020 inch in depth or 3.00 inches in length.

(b) Radial damage (normal to bolt axis) must not exceed 0.010 inch in depth or 3.00 inches in length.

(c) Nicks, scratches or gouges are not allowed within one diameter of bolt hole, longeron splice rivets or within 0.250 inch of end of longeron at splice.

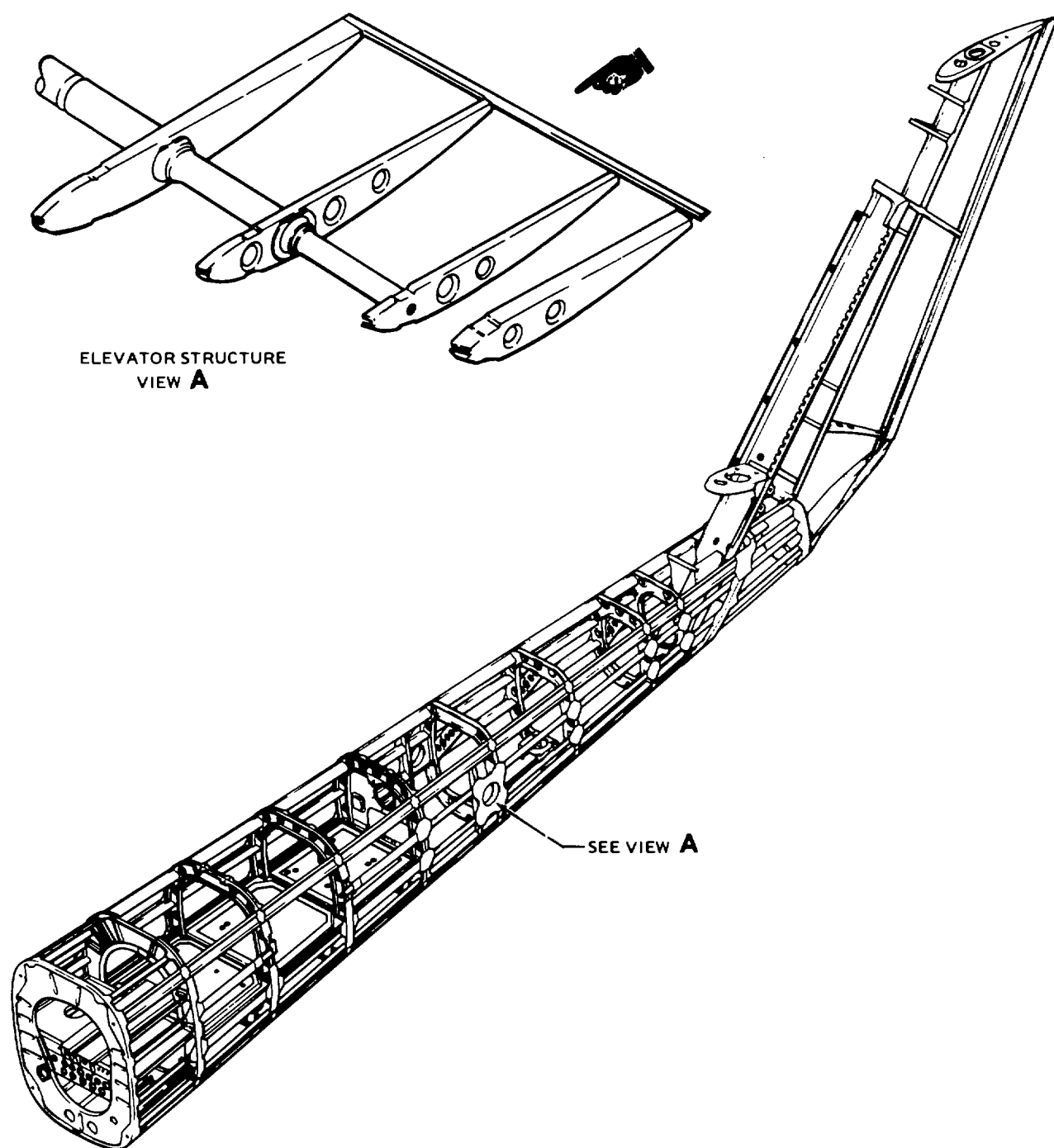
(3) Inspect attachment bolt holes in tailboom and fuselage fittings. Maximum diameter allowed is 0.5616 inch.

(4) Inspect attachment bolts for wear.

b. Repair - General.

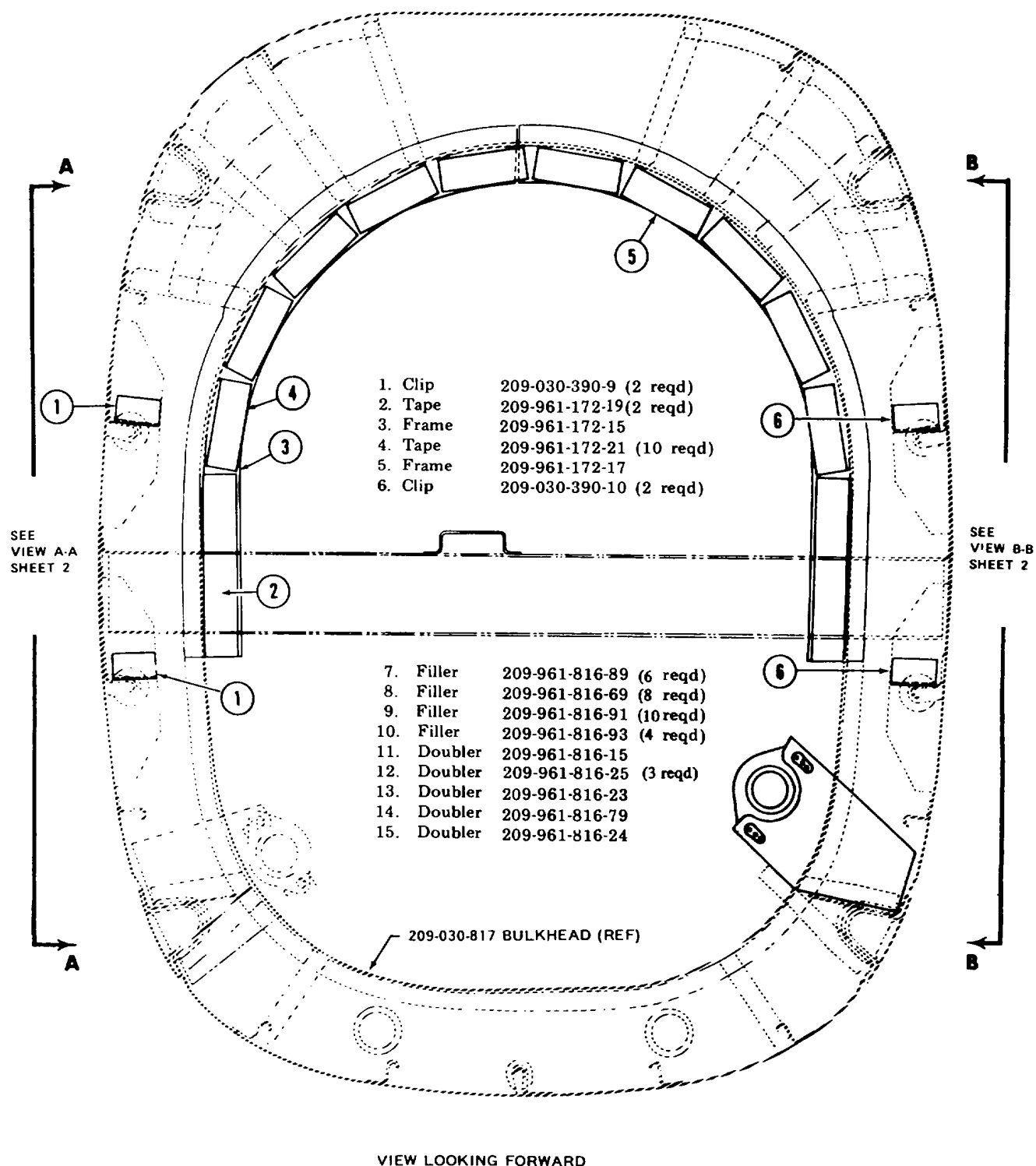
(1) Cracks or damage resulting in distortion of structural members is not repairable. Send tailboom to depot level maintenance for repair.

(2) Defects within the limits of table 2-1 may be repaired by the procedures in this section. If a



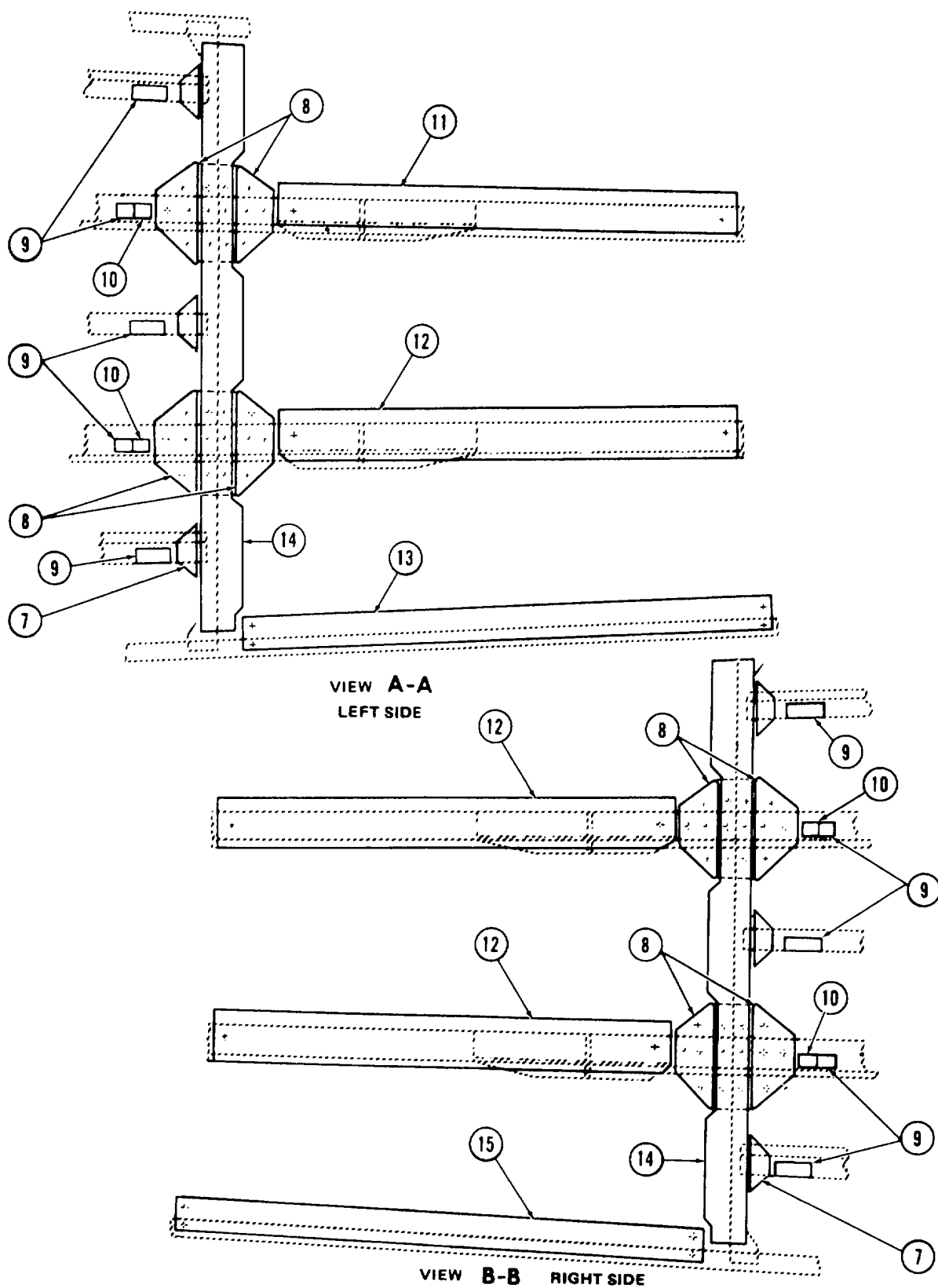
209030-301A

Figure 2-59. Tailboom and synchronized elevator structure



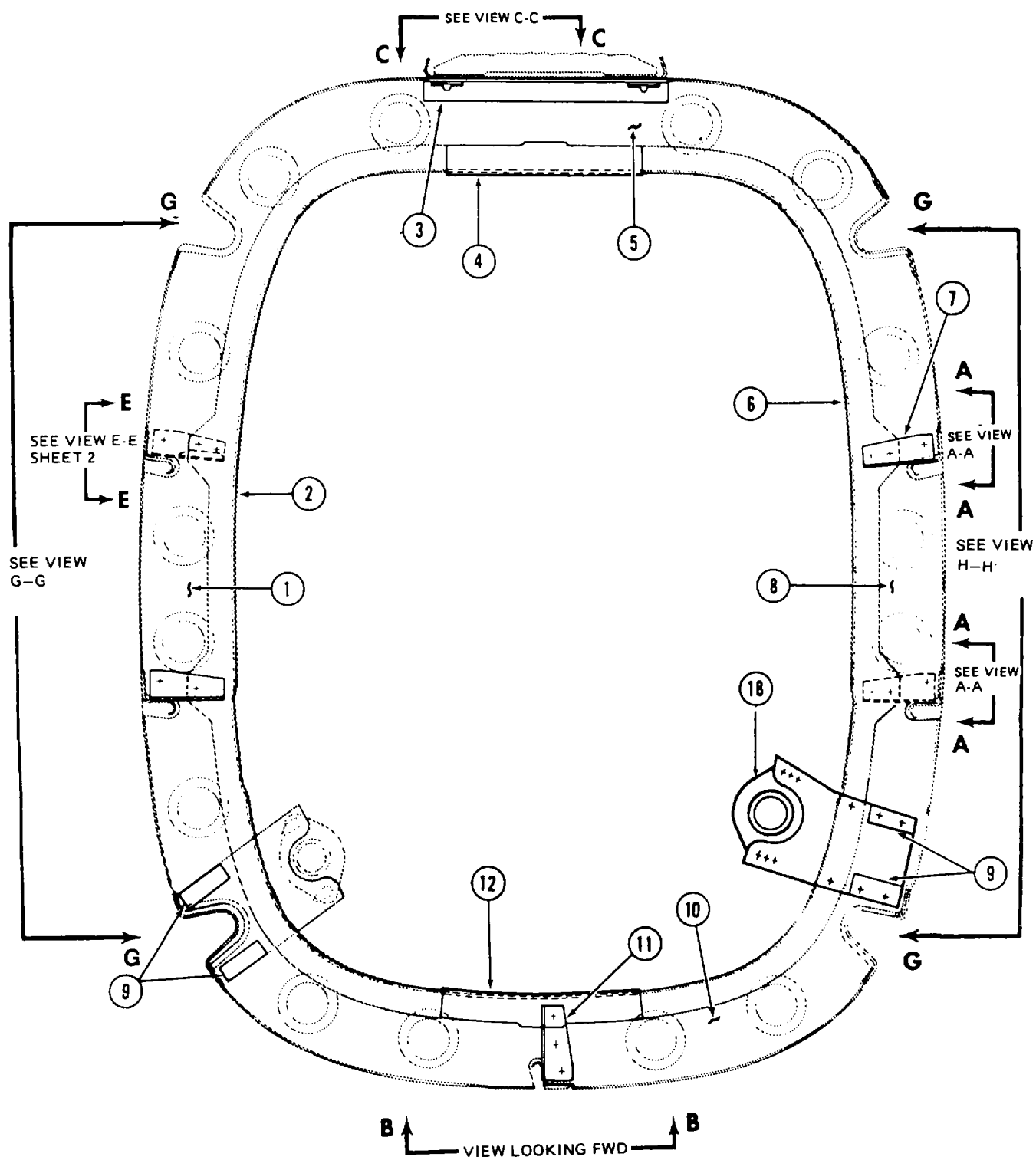
209-030-310-1

Figure 2-60. Bulkhead at boom station 59.50 (Sheet 1 of 2)



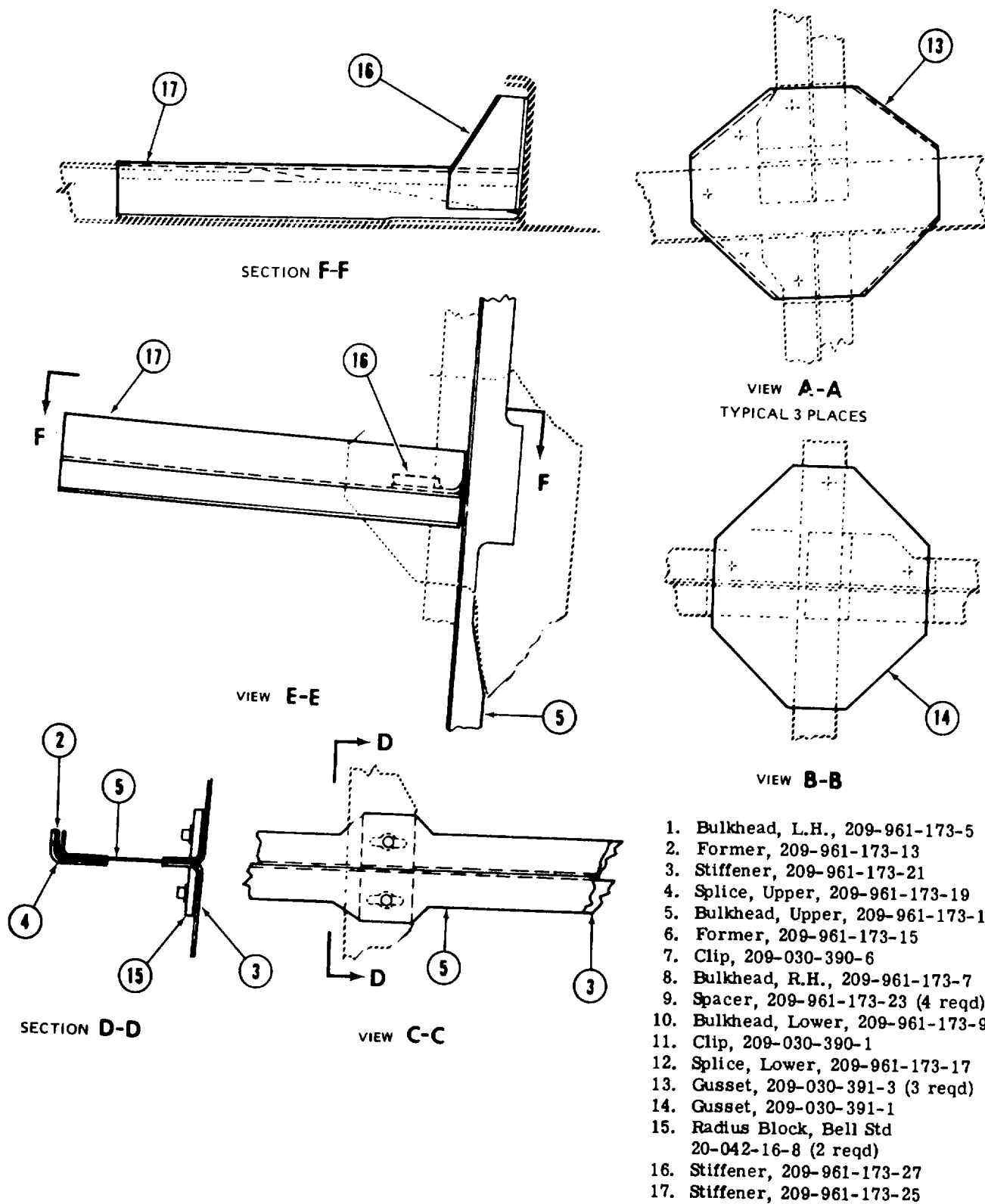
209-030-310-2

Figure 2-60. Bulkhead at boom station 59.50 (Sheet 2 of 2)



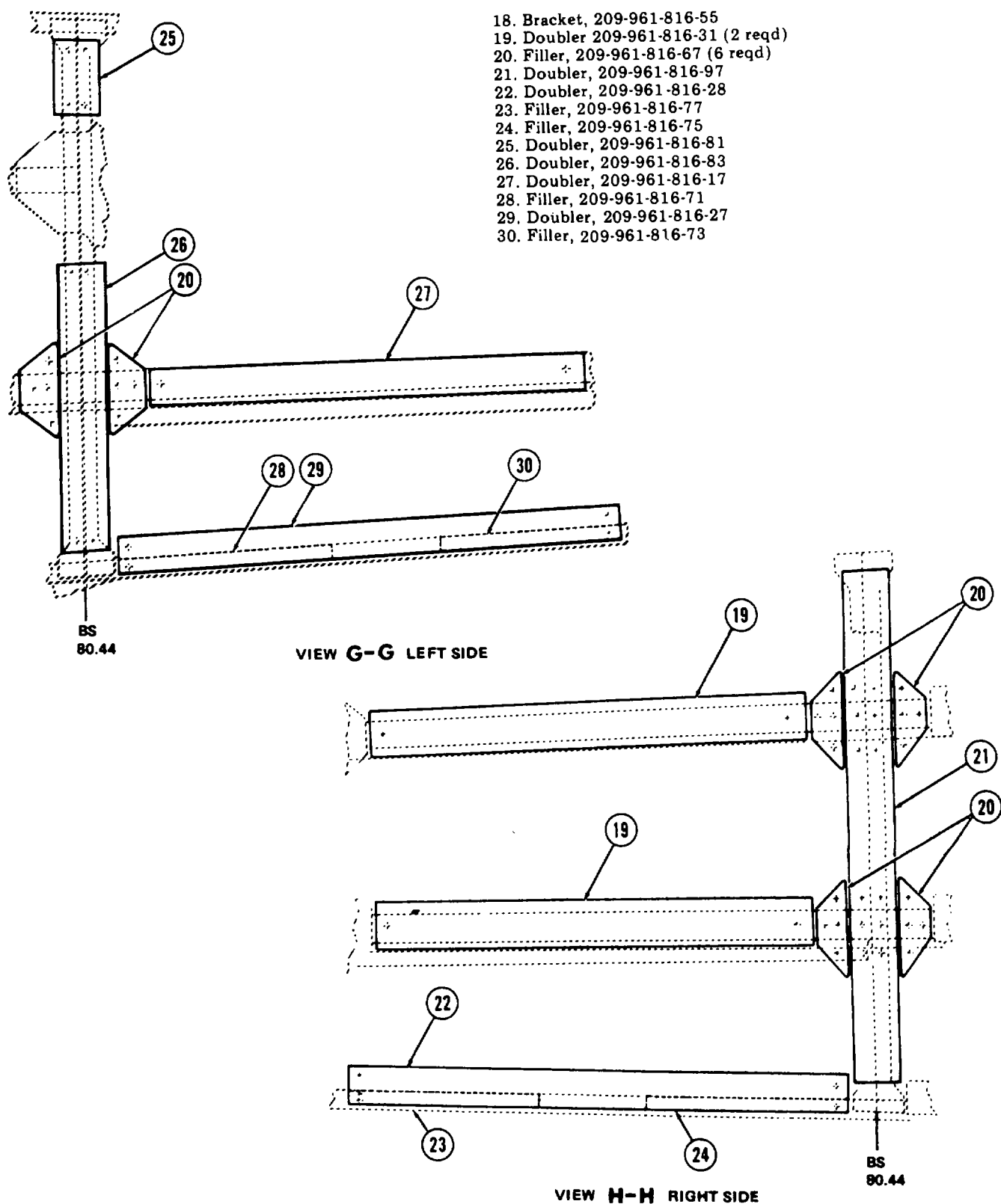
209-030-311-1

Figure 2-61. Bulkhead at boom station 80.44 (Sheet 1 of 3)



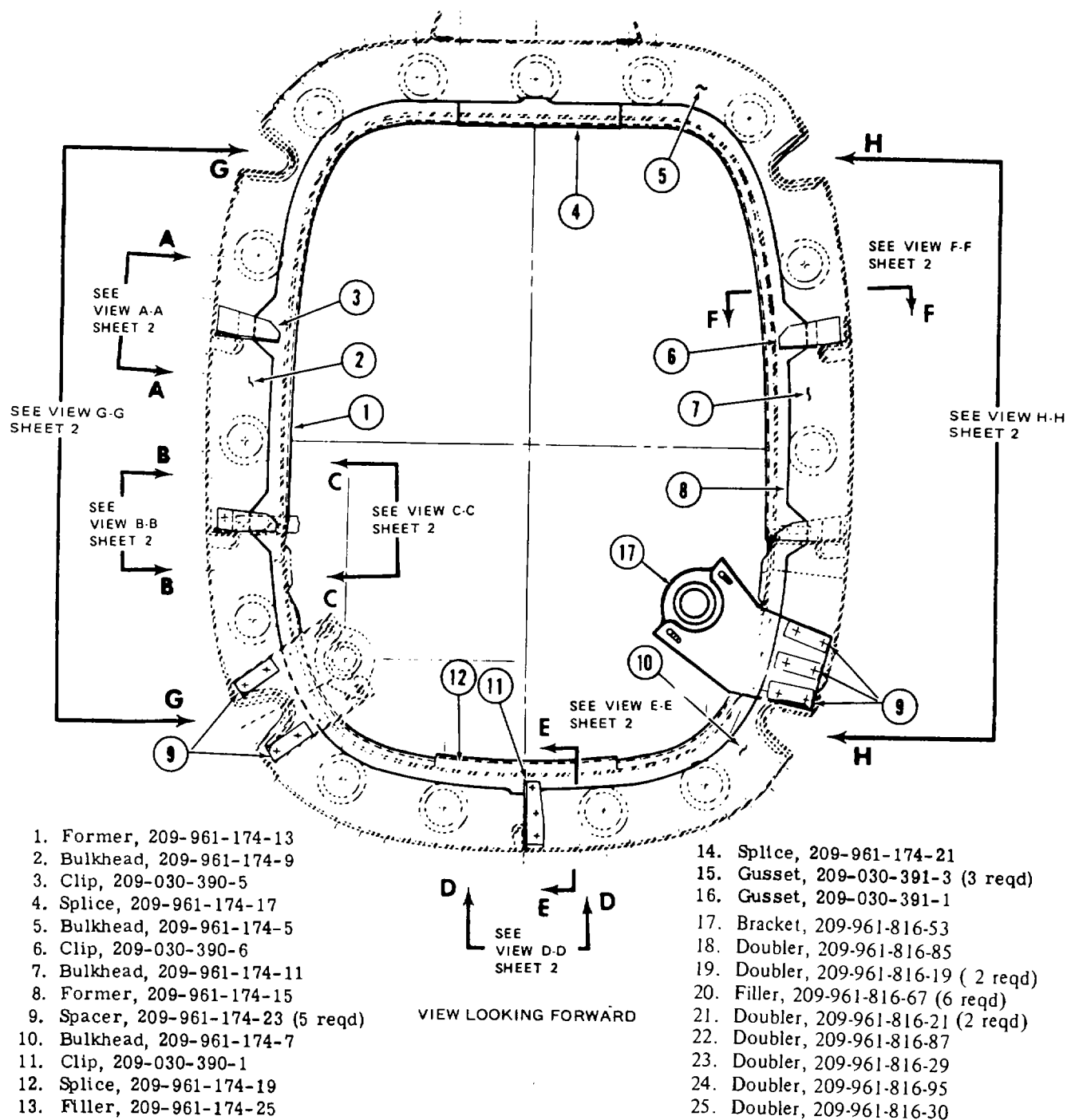
209-030-311-2

Figure 2-61. Bulkhead at boom station 80.44 (Sheet 2 of 3)



209-030-311-3

Figure 2-61. Bulkhead at boom station 80.44 (Sheet 3 of 3)



209-030-312-1

Figure 2-62. Bulkhead at boom station 101.38 (Sheet 1 of 3)

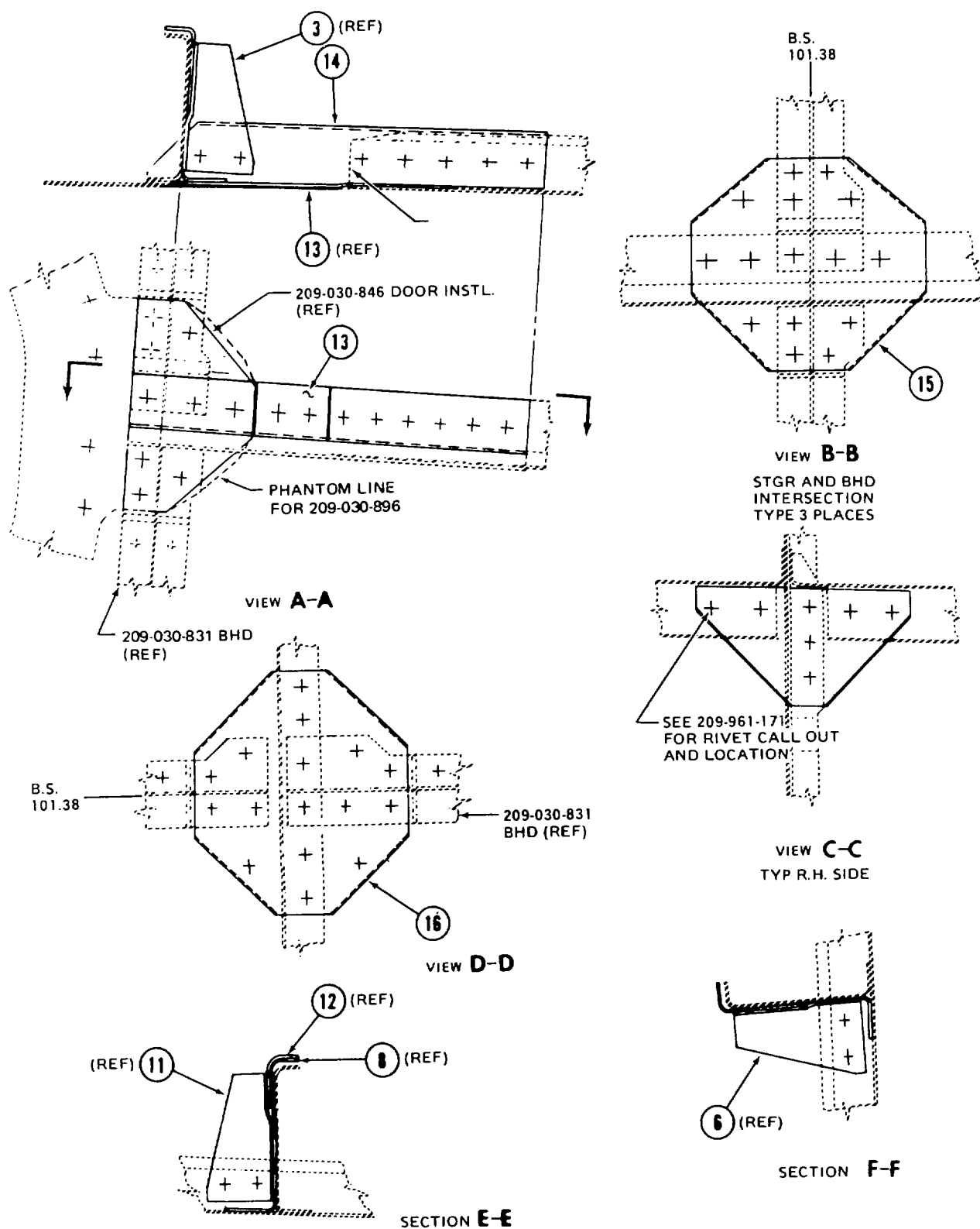
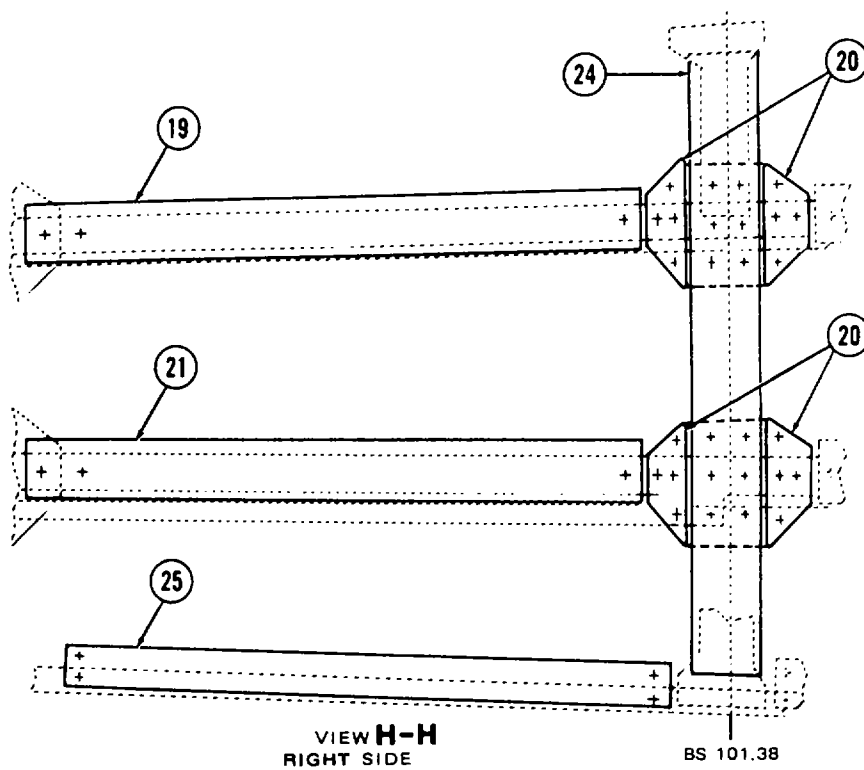
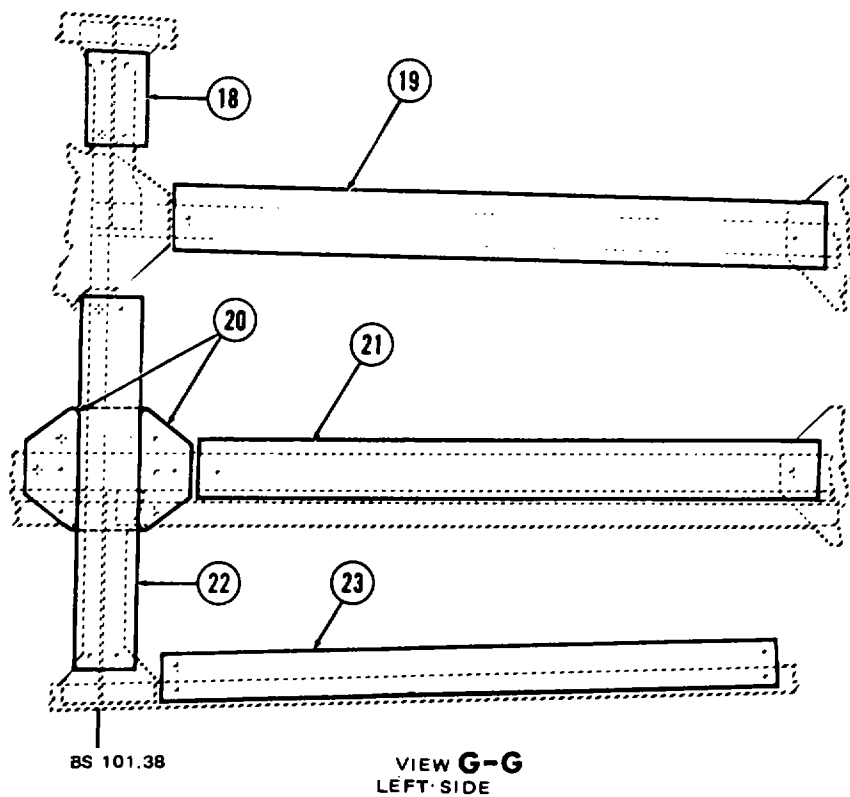
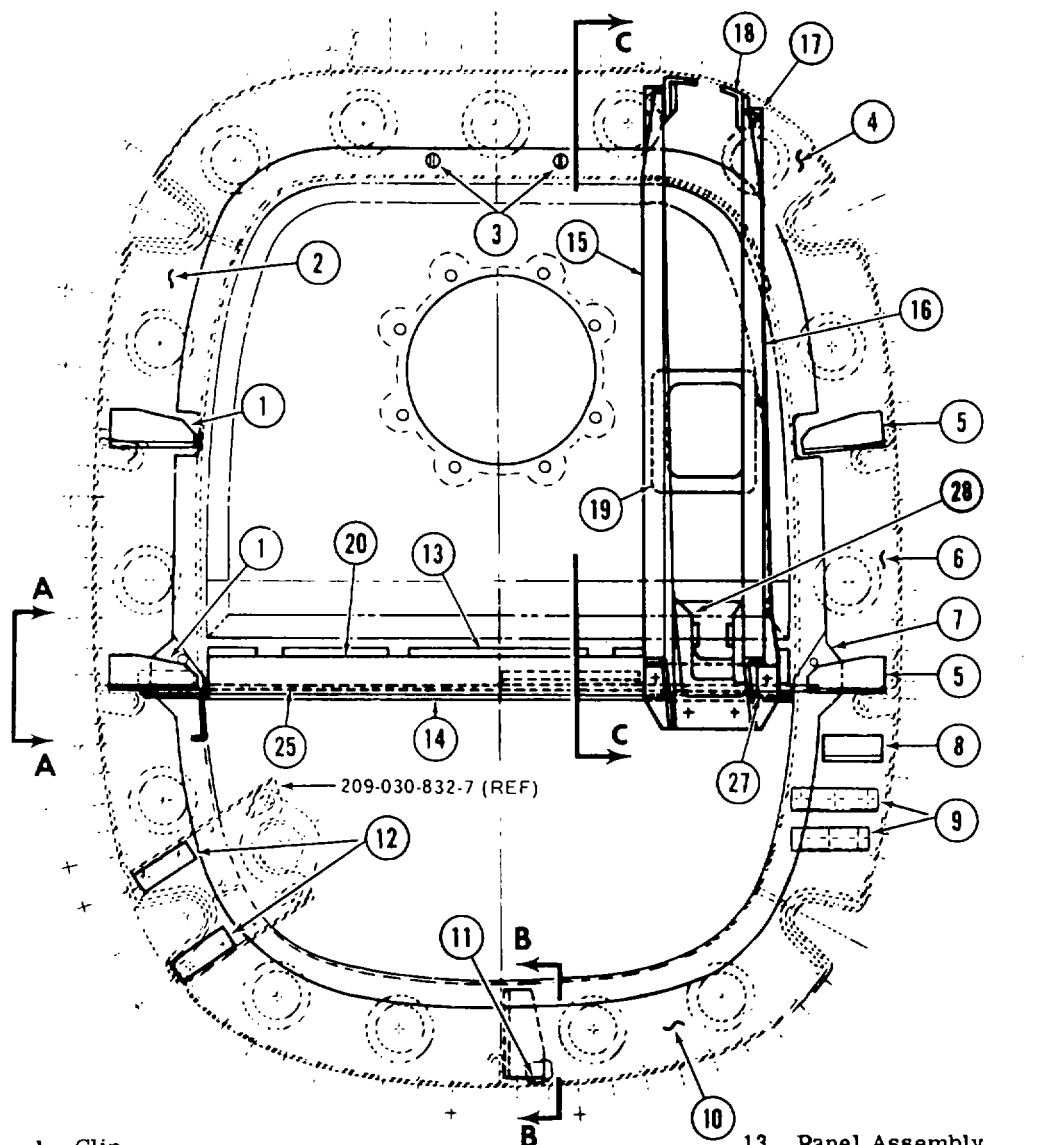


Figure 2-62. Bulkhead at boom station 101.38 (Sheet 2 of 3)



209-030-312-3

Figure 2-62. Bulkhead at boom station 101.38 (Sheet 3 of 3)



1. Clip,
209-030-390-5
(2 reqd)
2. Bulkhead
209-961-175-9
3. Eyebolt
AN42B3A
(2 reqd)
4. Bulkhead, Upper,
209-961-175-5
5. Clip,
209-030-390-6
(2 reqd)
6. Bulkhead, R.H.,
209-961-175-11
7. Former,
209-961-175-13

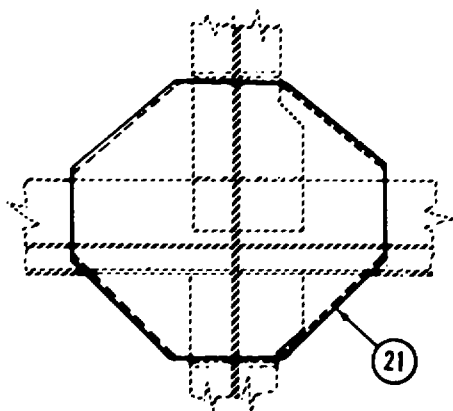
VIEW LOOKING FORWARD

8. Clip,
209-961-175-23
9. Clip,
209-961-175-19
10. Bulkhead, Lower,
209-961-175-7
11. Clip,
209-030-390-3
12. Spacer,
209-961-175-21
(2 reqd)

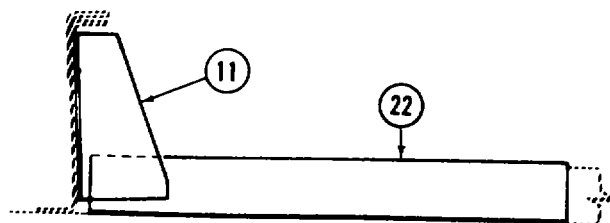
13. Panel Assembly,
209-030-404-1
14. Support,
209-961-175-15
15. Bracket,
209-961-816-35
16. Bracket,
209-961-816-37
17. Peel Shim,
209-961-816-65 (2 reqd)
18. Clip,
209-961-816-51
19. Doubler,
209-961-816-63
20. Support,
209-961-816-47

209-030-313-1

Figure 2-63. Bulkhead at boom station 122.33 (Sheet 1 of 2)

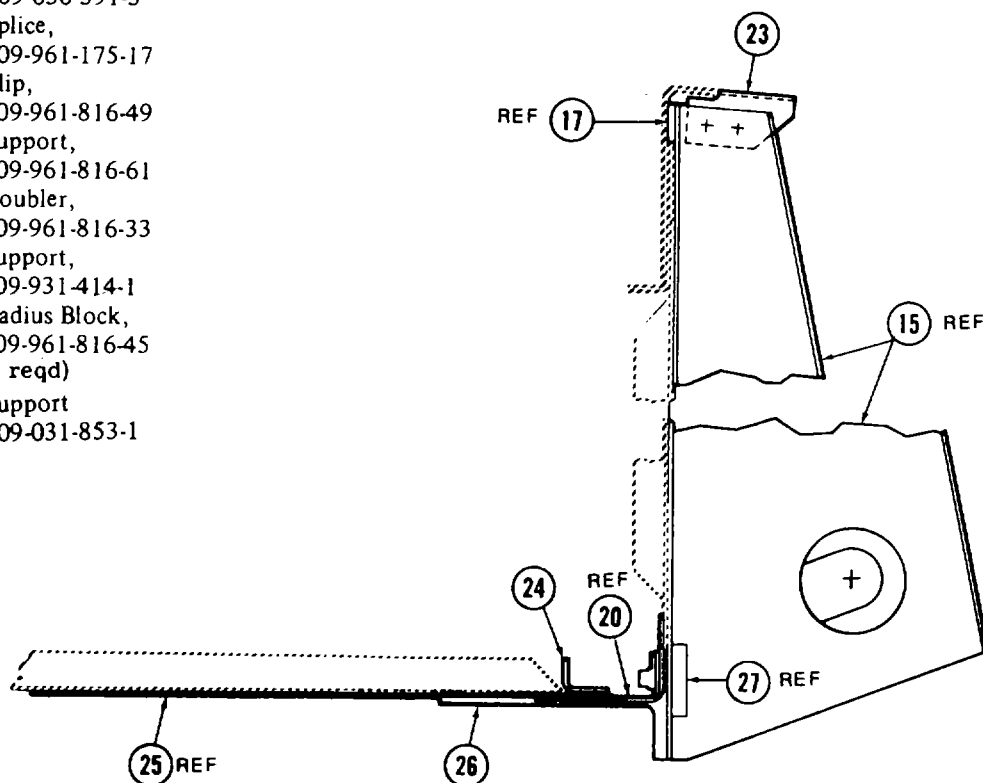


VIEW A-A
TYPICAL 4 PLACES



VIEW B-B

- 21. Gusset,
209-030-391-3
- 22. Splice,
209-961-175-17
- 23. Clip,
209-961-816-49
- 24. Support,
209-961-816-61
- 25. Doubler,
209-961-816-33
- 26. Support,
209-931-414-1
- 27. Radius Block,
209-961-816-45
(2 reqd)
- 28. Support
209-031-853-1



VIEW C-C

209-030-313-2

Figure 2-63. Bulkhead at boom station 122.33 (Sheet 2 of 2)

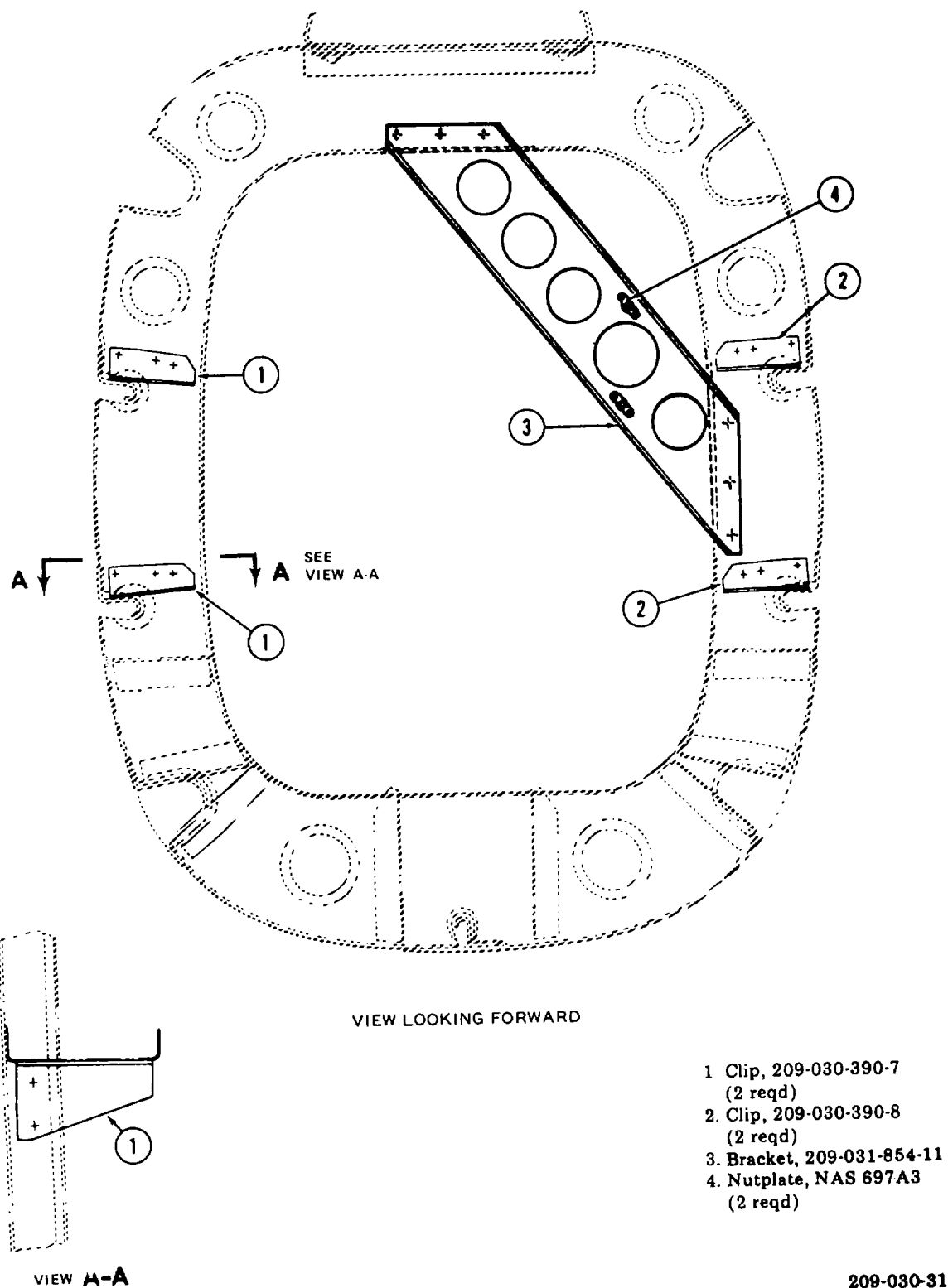
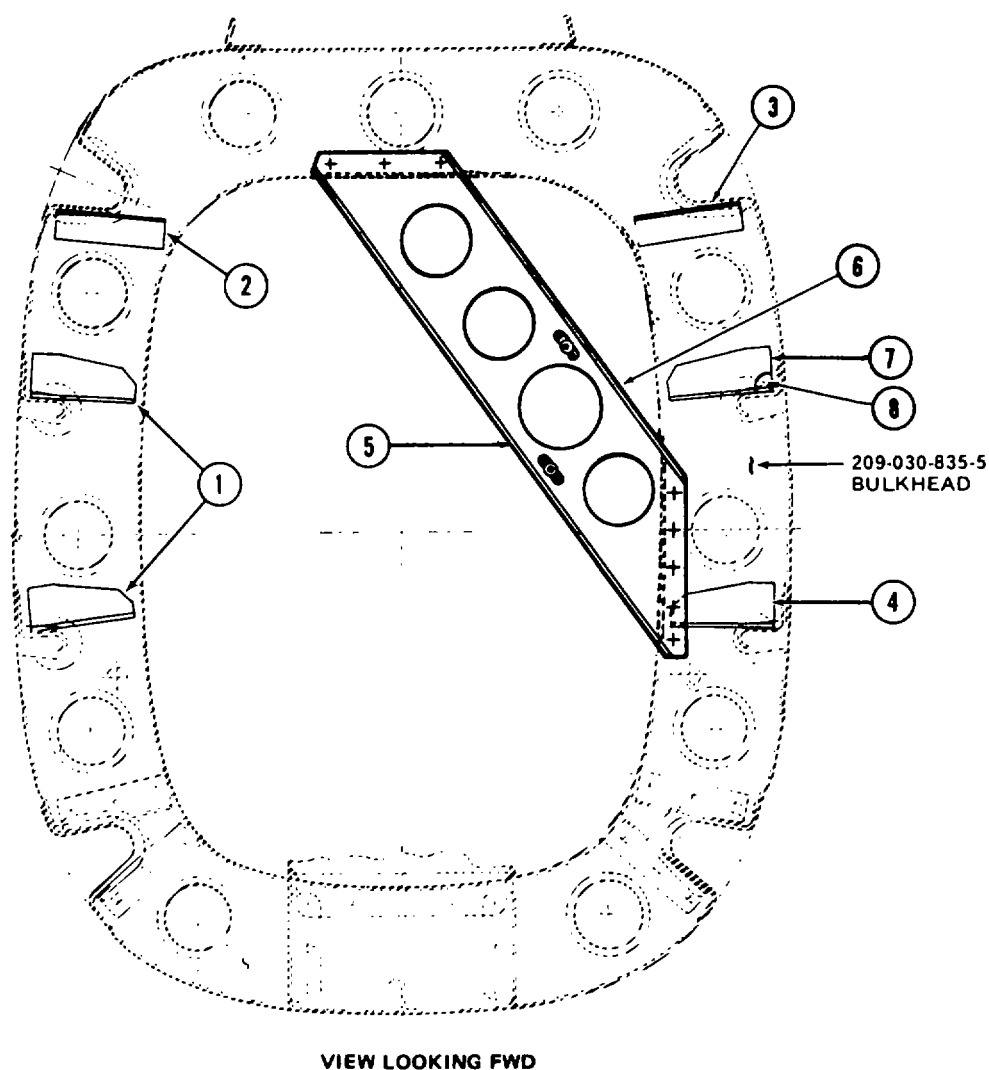


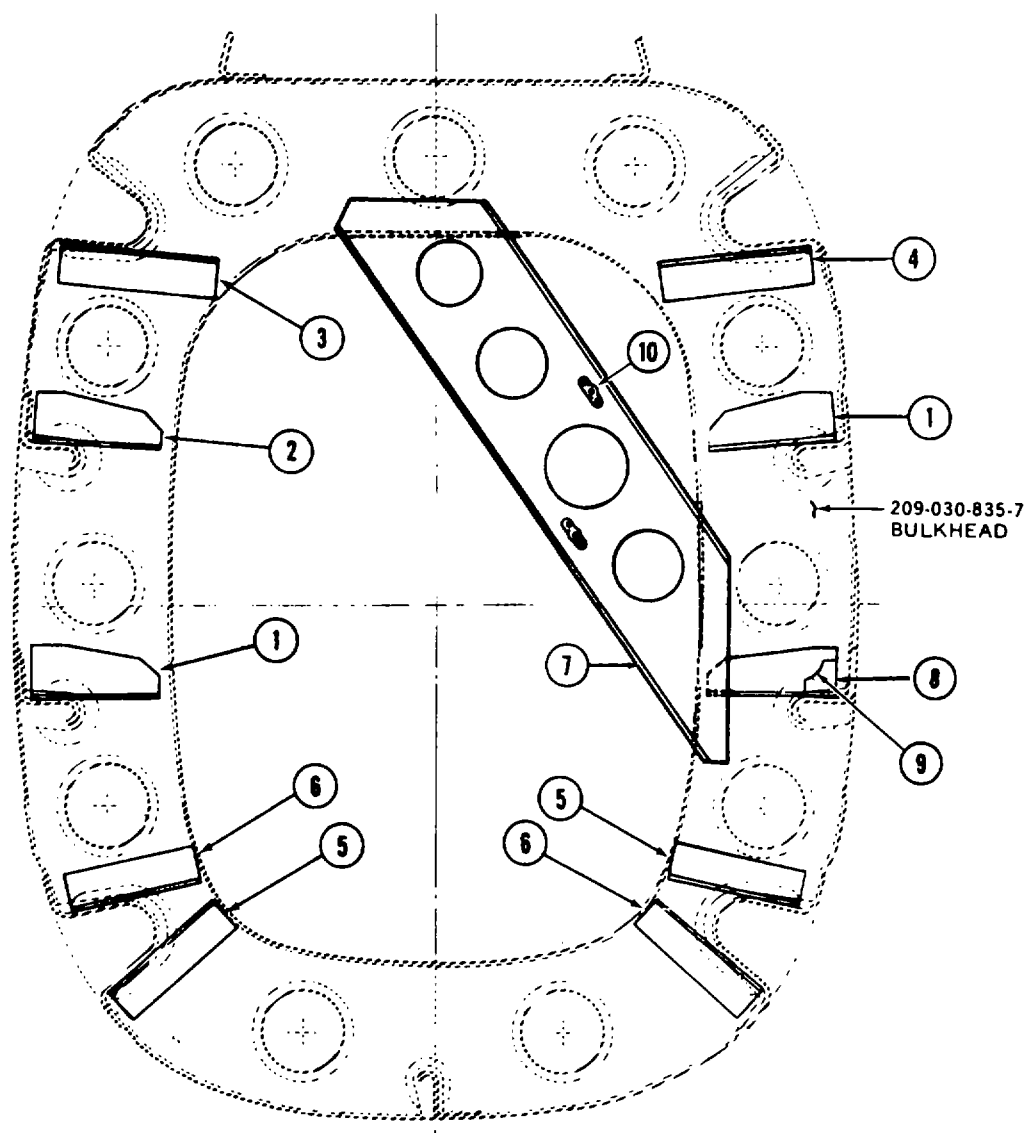
Figure 2-64. Bulkhead at boom station 143.28



1. Clip, 209-030-7 (2 reqd)
2. Clip, 209-961-189-15
3. Clip, 209-961-189-16
4. Clip, 209-030-390-8
5. Bracket 209-031-855-17
6. Nutplate, NAS697A3
(2 Reqd)
7. Clip, 209-961-189-19
8. Filler, 209-961-189-21

209-030-315

Figure 2-65. Bulkhead at boom station 164.23



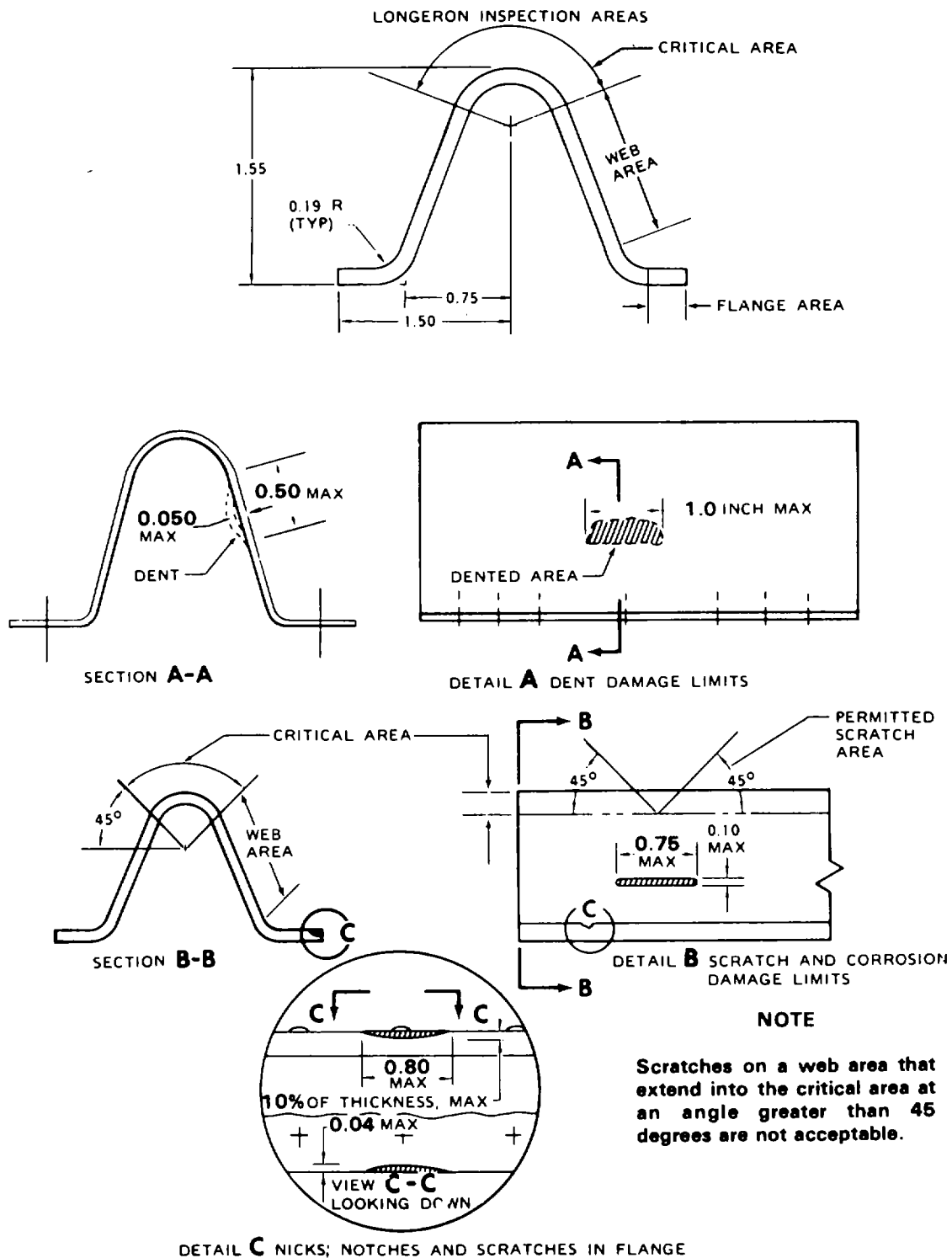
VIEW LOOKING FORWARD
BOOM STATION 185.18

1. Clip, 209-030-390-7 (2 reqd)
2. Clip, 209-030-390-8
3. Clip, 209-961-189-17
4. Clip, 209-961-189-18
5. Clip, 209-961-189-15 (2 reqd)
6. Clip, 209-961-189-16 (2 reqd)

7. Bracket Assy, 209-031-856-11
8. Clip, 209-961-189-19
9. Filler, 209-961-182-21
10. Nutplate, NAS697A3
(2 Reqd)

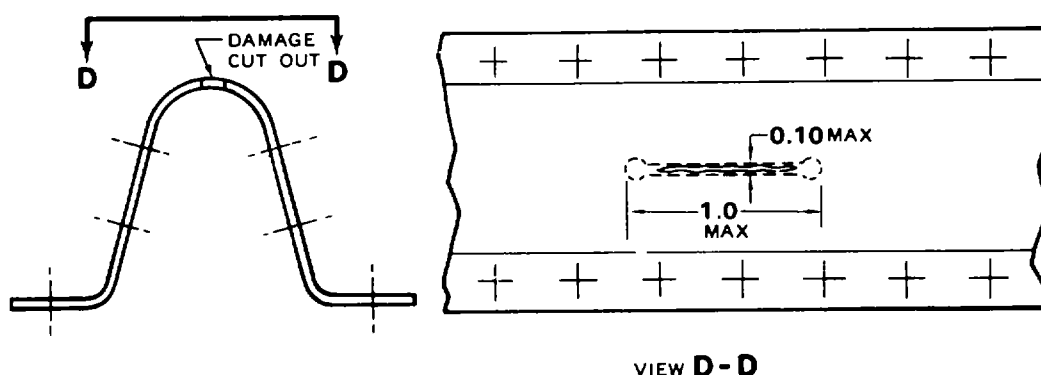
209-030-316

Figure 2-66. Bulkhead at boom station 186.18 (part no. 209-961-189-7)

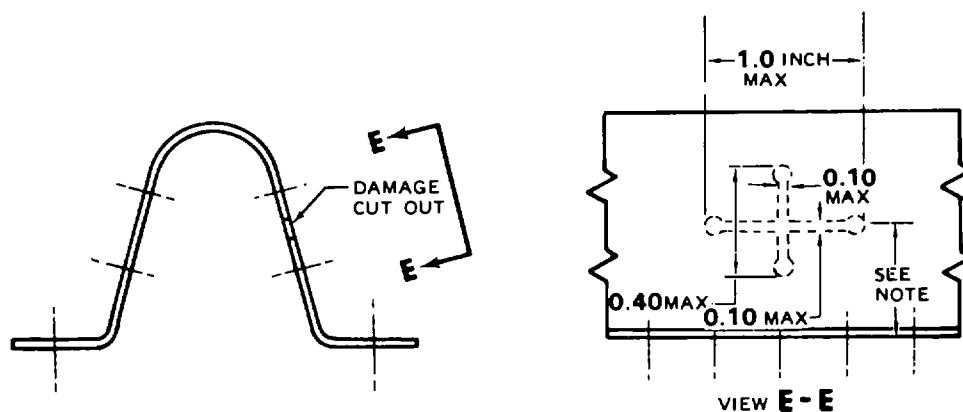


204030-183-1A

Figure 2-66A. Longeron damage limits (Sheet 1 of 3)



DETAIL **D** LONGITUDINAL CRACKS IN CRITICAL AREA



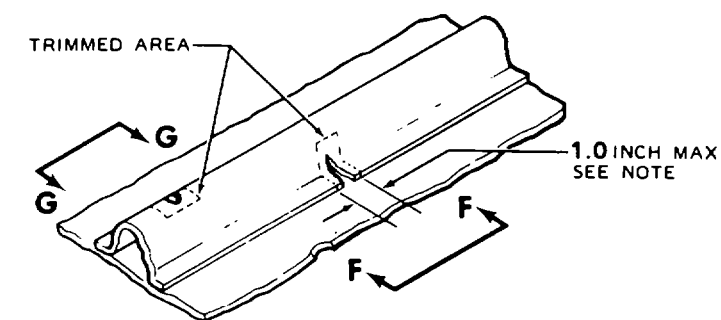
NOTE

All longitudinal cracks are repairable if they are located within the following limits: 0.45 inch minimum height from longeron flange, 1.04 inches maximum height from longeron flange.

DETAIL **E** LONGITUDINAL OR LATERAL CRACKS IN WEB AREA

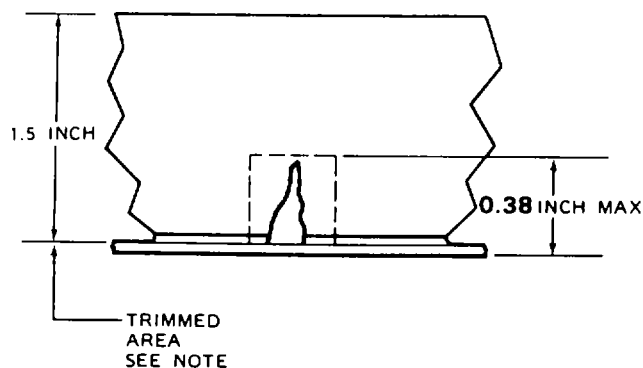
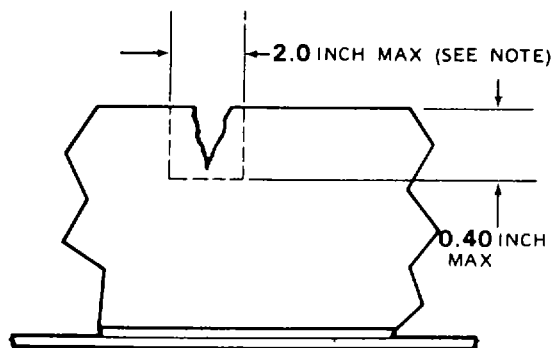
204030-183-2

Figure 2-66A. Longeron damage limits (Sheet 2 of 3)



NOTE

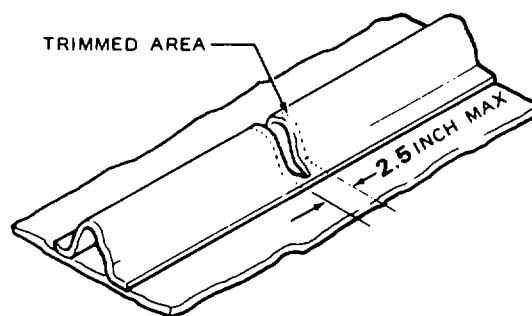
When trimmed area exceeds limits shown for either critical area or flange and web, or if combined damage extends from the flange and web into critical area, inspect to limits of detail G.



SECTION F-F
FLANGE AND WEB

SECTION G-G
CRITICAL AREA

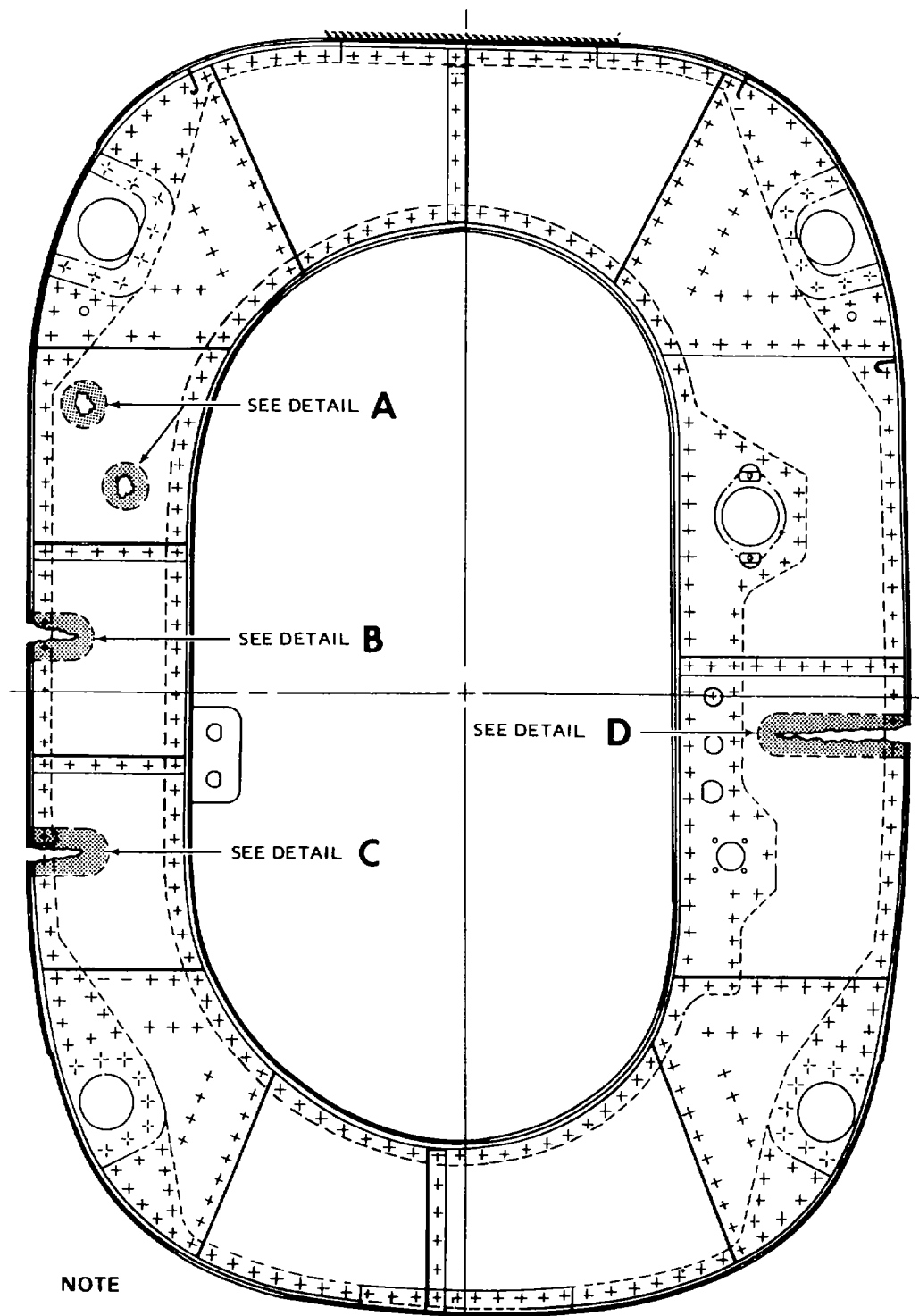
DETAIL F DAMAGE LIMIT TO CRITICAL AREA, FLANGE OR WEB



DETAIL G DAMAGE LIMIT TO CRITICAL AREA, FLANGE AND WEB

204030-183-3

Figure 2-66A. Longerons damage limits (Sheet 3 of 3)



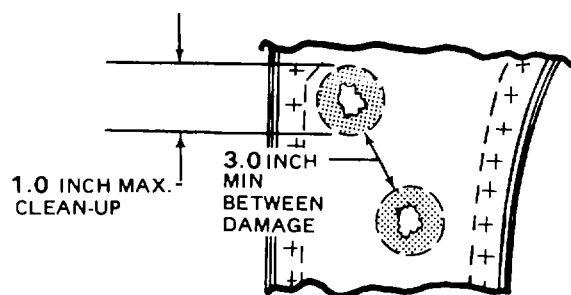
NOTE

Three repairs not exceeding the limits of detail "A" or "B" and minimum 3.0 inches between damage areas are allowed for each quadrant of a bulkhead. One repair not exceeding the limits of detail "C" is

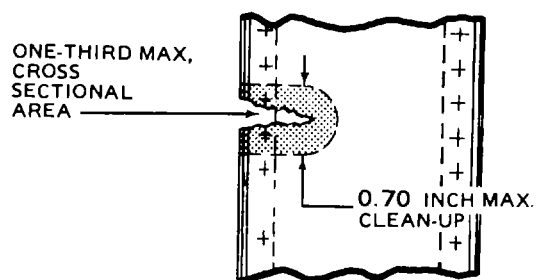
allowed in each quadrant of a bulkhead. One repair not exceeding the limits of detail "D" is allowed for each bulkhead. Damage affecting more than one-half of a cross sectional area requires a full splice.

214030-15-1

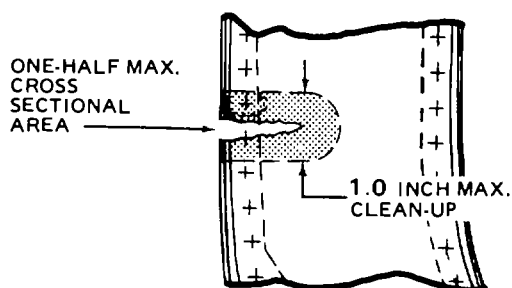
Figure 2-66B. Typical tailboom bulkhead damage limits (Sheet 1 of 2)



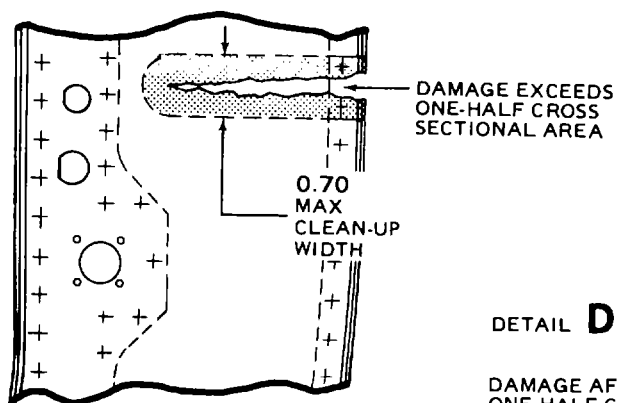
DETAIL **A** (SEE NOTE ON SHEET 1)
HOLE DAMAGE LIMITS



DETAIL **B** (SEE NOTE ON SHEET 1)
DAMAGE LIMITS AFFECTING ONE-THIRD
OR LESS OF CROSS SECTION



DETAIL **C** (SEE NOTE ON SHEET 1)
DAMAGE LIMITS AFFECTING ONE-HALF
OR LESS OF CROSS SECTION



DETAIL **D** (SEE NOTE ON SHEET 1)
DAMAGE AFFECTS MORE THAN
ONE-HALF CROSS SECTIONAL AREA

214030-15-2B

Figure 2-66B. Typical tailboom bulkhead damage limits (Sheet 2 of 2)

specific procedure is not given for a repairable defect, use standard repair procedures in TM 55-1500-204-25/1.

(3) Corrosion. Polish out minor corrosion damage to structural members. Apply chemical film (C37) to bare metal. Prime repair area with primer (C102).

(4) Replace worn attaching bolts.

c. Repair - Tailboom Stringers.

(1) Patching. Cracks, tears and punctures in the stringer may be repaired by patching, provided they do not extend more than one-half the width of the stringer. Repair damaged stringer as follows:

(a) Check to see that rivets are not bent or damaged and that rivet holes are not enlarged or torn.

(b) Remove damaged and loose rivets.

(c) Stop drill end of crack and, if necessary, cut away damaged part taking care not to cut away more than necessary.

(d) Re-form damaged stringer and other displaced areas into correct position.

(e) Form a reinforcing patch of same material and one gage heavier than damaged stringer. The patch should extend at least four inches beyond each end of cutout section. Maximum length of patch is 12 inches. (Figure 2-66C)

WARNING

Naphtha is extremely flammable. Ground container before dispensing. Use with adequate ventilation. Avoid repeated skin contact.

(f) Clean dirt from around damaged area and from both sides of reinforcing patch using a clean cloth saturated with Naphtha (C88).

(g) Secure reinforcing patch firmly in place and drill rivet holes through patch and damaged stringer the same size and pitch as existing rivet holes. Deburr all holes.

(h) Apply a coat of primer (C102) to both sides of patch and damaged stringer.

(i) Secure reinforcing patch in position and rivet into place.

(j) Apply a coat of primer (C102) over repaired area.

(2) Insertion. Complete stringer breaks and cracks extending more than one-half the width of the stringer which make patching inadequate, necessitates repair by insertion (splicing). Repair as follows:

(a) Check to see that rivets are not bent or damaged and that the rivet holes are not elongated or torn.

(b) Remove damaged or loose rivets.

(c) Trim damaged edge of break in stringer. Do not trim more than necessary. Reform and return damaged stringer to correct position.

(d) Cut and form an insert of same material and gage as damaged stringer. Cut and form a reinforcing patch of same material and one gage heavier than damaged stringer. The patch should extend at least four inches beyond each end of the cutout section.

CAUTION

A filler splice should never exceed 12 inches in length.

(e) Clean dirt from around damaged area and from both sides of insert and reinforcing patch.

(f) Secure the insert and reinforcing patch firmly in place. Drill rivet holes through reinforcing patch, insert, and damaged stringer, the same size, and pitch, as existing rivet holes. Remove burrs from all holes.

(g) Apply a coat of primer (C102) to damaged area on both sides of insert and patch.

(h) Secure insert and patch. Rivet in place.

d. *Repair - Tailboom Longerons.* Repair damaged longeron aft of Boom Station 70.00 as follows:

WARNING

No repairs allowed forward of boom station 70.00 other than longeron attach fittings. Refer to paragraph 2-48a. (2).

(1) Check to see if there is any damage to skin such as bent or damaged rivets or torn rivet holes.

(2) Cut out damaged area, centering the cut edges between holes to permit retention of existing rivet pattern. Do not cut more than necessary. Leave a generous radii at corners (0.250 inch minimum).

(3) Cut and form a reinforcing patch of the same material and one gage heavier than the longeron and long enough to extend at least 4.50 inches on each side of the damage (after cleanup). (Figure 2-66D).

(4) Secure the reinforcing patch in position and drill out rivet holes of the same size and pitch as in the existing structure or as specified in TM 55-1500-204-25/1.

(5) Mark a line around outer edge of patch using a soft pencil. Remove patch and deburr holes.

WARNING

Avoid breathing vapors. Provide adequate ventilation. Avoid prolonged contact with the skin.

(6) Remove paint from between previously marked lines of damaged area using a clean cloth saturated with methyl-ethyl-ketone (C87).

(7) Buff both sides of patch with Scotchbrite (C113) and wipe with a clean cloth.

CAUTION

Do not touch patch with bare hands after cleaning.

(8) Apply adhesive (C12) to mating surface of patch.

(9) Secure reinforcing patch in position and rivet in place while adhesive is still wet.

(10) Apply a coat of primer (C102) over the repaired area.

e. *Repair - Tailboom Bulkheads.*

(1) Patching. Cracks, tears, and punctures in the bulkhead, web and flanges may be repaired by patching, provided the damage does not extend more than one-half the width of the bulkhead. Repair damage as follows:

(a) Check that rivets are not bent or damaged and that rivet holes are not elongated or torn.

(b) Remove damaged and loose rivets.

(c) Stop drill end of crack, or if a tear or puncture exists, cut away damaged part, taking care not to cut away more than necessary.

(d) Reform damaged member and other displaced areas into correct position.

(e) Form a reinforcing patch of same material and one gage heavier than damaged member, and sufficiently long to give sturdy support. (Figure 2-66E).

WARNING

Naphtha is extremely flammable. Ground containers before dispensing. Use with adequate ventilation. Avoid repeated skin contact.

(f) Clean dirt from around damaged area and from both sides of reinforcing patch using a clean cloth saturated with naphtha (C88).

(g) Secure reinforcing patch firmly in place and drill rivet holes through patch and damaged member, and same size, and pitch as existing rivet holes. Deburr all holes.

(h) Apply a coat of primer (C102) to both sides of patch and damaged member.

(i) Secure reinforcing patch in position and rivet into place.

(j) Apply a coat of primer (C102) over repaired area.

(2) Insertion. Complete bulkhead breaks, and cracks, extending more than one-half the width of the member, which make patching inadequate, must be repaired by insertion (splicing).

(a) Check that rivets are not bent or damaged and that rivet holes are not enlarged or torn.

(b) Remove damaged or loose rivets.

(c) Trim damaged edge of the break in bulkhead. Do not trim more than necessary.

(d) Re-form and return damaged bulkhead to correct position and contour.

(e) Cut and form an insert of same material and gage as damaged bulkhead.

(f) Cut and form a reinforcing patch of same material and one gage heavier than damaged bulkhead, and sufficiently long to give sturdy support.

WARNING

Use naphtha (C88) in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

(g) Clean both sides of insert and patch with naphtha (C88). Position insert and patch to drill rivet holes through patch insert and damaged area. Drill holes same size and pitch as existing rivet holes. Deburr all holes.

(h) Apply a coat of primer (C102) to both sides of insert, reinforcing patch, and damaged bulkhead.

(i) Secure insert and reinforcing patch in position and rivet into place.

(j) Apply a coat of primer (C102) over repaired area.

(3) Repair damaged bulkhead web - cracks, tears and punctures as follows:

(a) Stop drill extreme ends of crack or cut a round or elongated hole according to the length or shape of crack, puncture, or tear in order to clean up ragged edges and stretched metal. Allow generous radii at all corners.

(b) Cut and form a patch of same material and thickness as damaged web.

WARNING

Use naphtha (C88) in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

(c) Remove dirt from around damaged area using clean cloth saturated with naphtha (C88).

(d) Secure patch in position and drill out a double row of holes of same size and pitch as surrounding areas. Remove patch and deburr holes.

(e) Apply a coat of primer (C102) to damaged area and both sides of patch.

(f) Secure patch and rivet in place.

(g) Apply a coat of primer (C102) over repaired area.

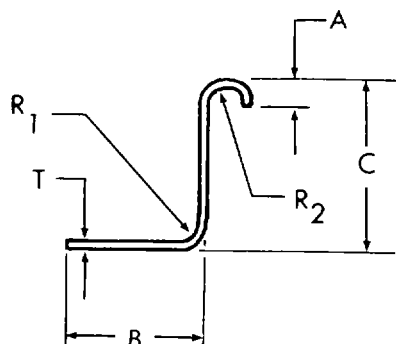
2-49. Tail Rotor Drive 90 Degree Gearbox Support Fitting.

Premaintenance Requirements for 90 Degree Gearbox Support Fitting.

<u>Condition</u>	<u>Requirements</u>
Model	AH1S
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	One
Consumable Materials	(C12), (C87), (C102), (C112), (C113), (C137)
Special Environmental Condition	None

MATERIAL

1. Patches shall be of same material or one gauge heavier than damaged stringer.
2. For insertion repairs requiring like material, Bell Standard 110-001 must be used. Dash number is determined by existing stringer size and thickness.



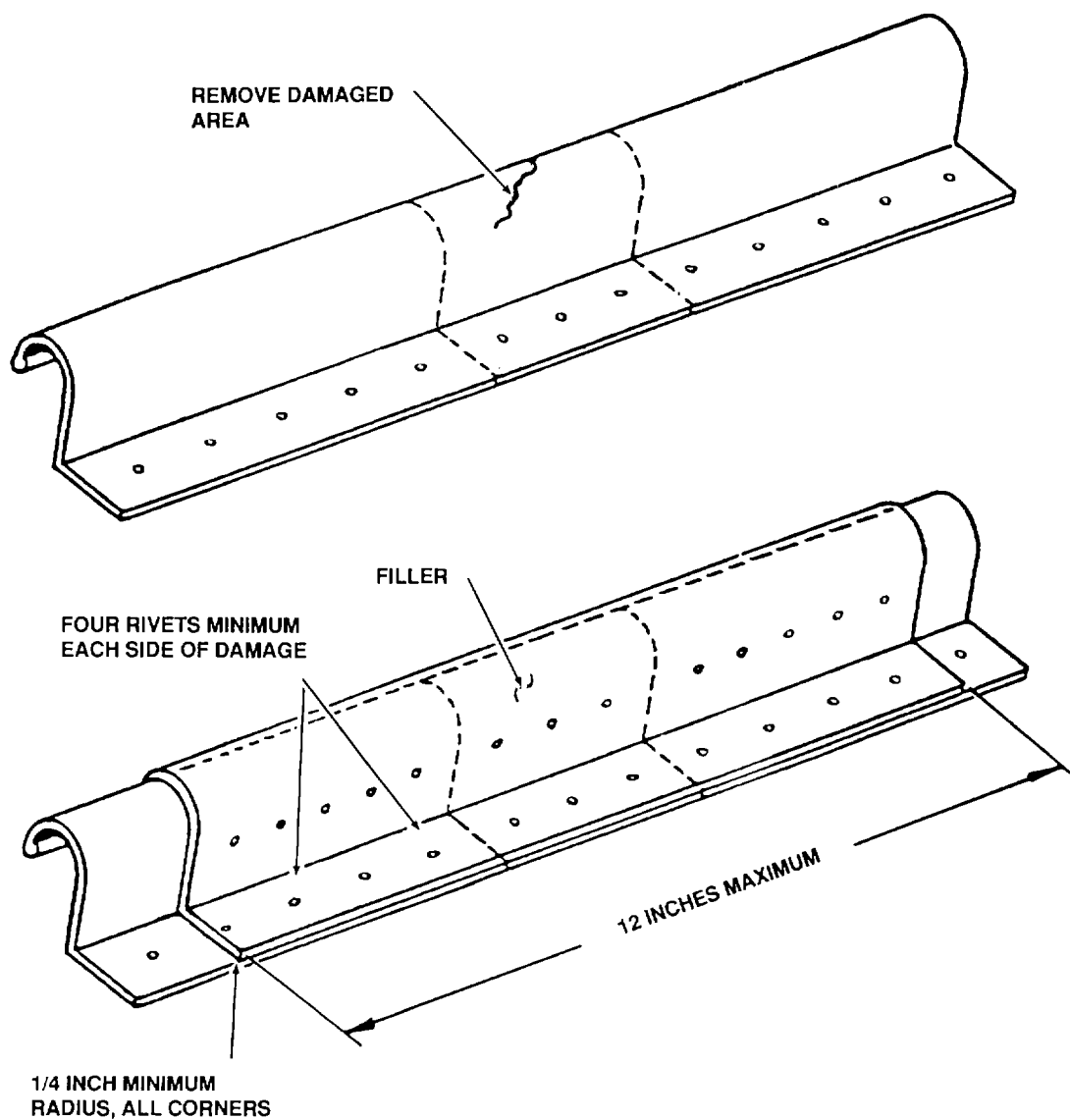
PART NUMBER (BELL STANDARD)	± 0.015	B	C ± 0.015	R ₁	R ₂	T	DEVEL. WIDTH
110-001-1	0.175	0.75	0.815	0.09	0.12	0.032	1.775
110-001-3	0.175	0.75	0.815	0.09	0.12	0.040	1.775
110-001-5	0.220	0.93	1.000	0.16	0.16	0.063	2.163
110-001-7	0.215	0.71	0.815	0.09	0.16	0.040	1.818
110-001-9	0.283	0.87	1.000	0.12	0.22	0.063	2.246

MATERIAL: Aluminum Alloy Clad, 7075-0, QQ-A-250/13

TENSILE: Heat Treat to T-6 in Accordance with MIL-H-6088

LIMITS UNLESS OTHERWISE NOTED: .XX ± 0.03
 .XXX ± 0.010

Figure 2-66C. Stringer Repair (Sheet 1 of 2)



CONDITION

This repair shall be used for cracks, tears, punctures, breaks in J-Stringer.

RESTRICTIONS

1. Maximum length of doubler is 12 inches.
2. Repair must not extend into bulkhead.
3. One repair per length between bulkheads.

Figure 2-66C. Stringer Repair (Sheet 2 of 2)

RESTRICTIONS

1. Only one repair may be made on each longeron in any one bay area.
2. No repairs allowed in forward bay.
3. Holes in longerons must not exceed 1.0 inches in diameter after cleanup.

MATERIAL CHART									
NOTE: On all repairs requiring like material, 7075-T6 Al Aly is to be used with the following thickness.									
TAILBOOM MODEL	QUADRANT LOCATION	BOOM STATION LOCATION	NOMEN- CLATURE	MATERIAL THICKNESS					
				0.025	0.032	0.040	0.050	0.063	0.071
209	Upper L.H.	B.S. 41-94	Longeron			X			
209	Upper L.H.	B.S. 94 Aft	Longeron	X					
209	Lower L.H.	All	Longeron					X	
209	Upper R.H.	B.S. 41-133	Longeron					X	
209	Upper R.H.	B.S. 133 Aft	Longeron				X		
209	Lower R.H.	B.S. 41-94	Longeron						X
209	Lower R.H.	B.S. 94 Aft	Longeron					X	

Figure 2-66.D Longerons Material Chart

NAME	MATERIAL/ SPECIFICATION	HEAT TREAT CONDITION	THICKNESS
1. Bulkhead	Al Alloy 7075, QQ-A-250/13	T6	0.040
2. Bulkhead	Al Alloy 7075, QQ-A-250/13	T6	0.040
3. Bulkhead	Al Alloy 7075, QQ-A-250/13	T6	0.040
4. Bulkhead	Al Alloy 7075, QQ-A-250/13	T6	0.040
5. Bulkhead	Al Alloy 7075, QQ-A-250/13	T6	0.032
6. Bulkhead	Al Alloy 7075, QQ-A-250/13	T6	0.040
7. Bulkhead	Al Alloy 2024, QQ-A-250/5	T42	0.032
8. Bulkhead	Al Alloy 2024, QQ-A-250/5	T42	0.032

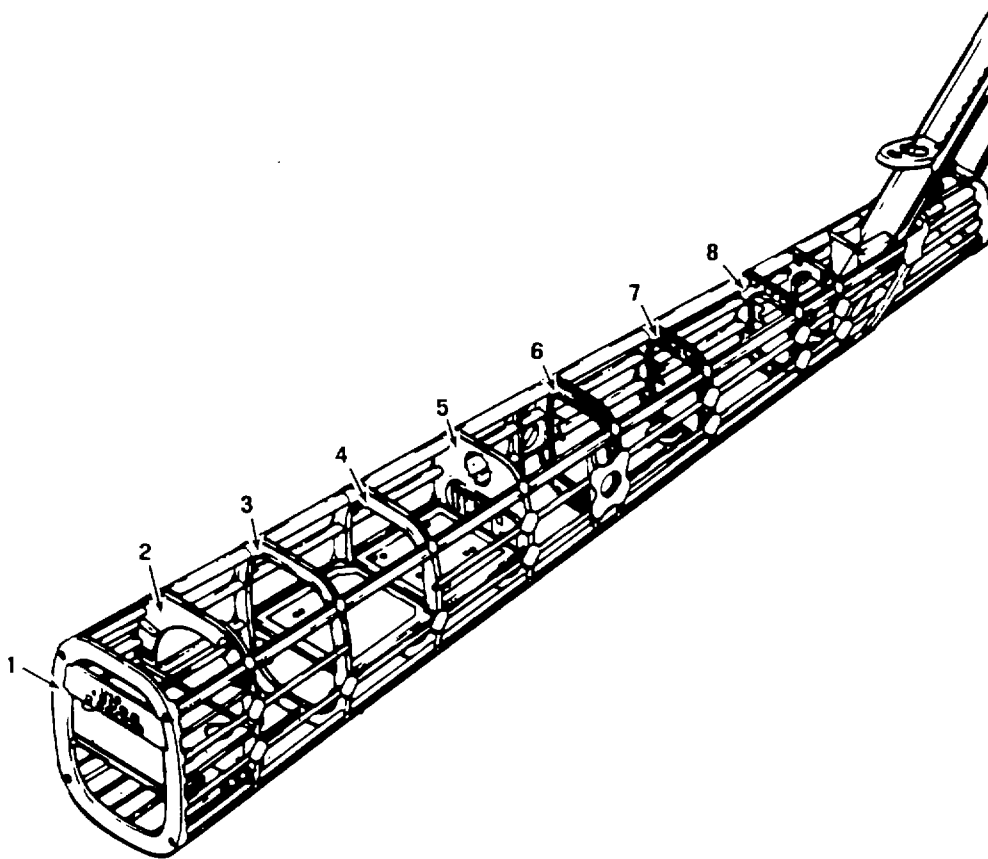
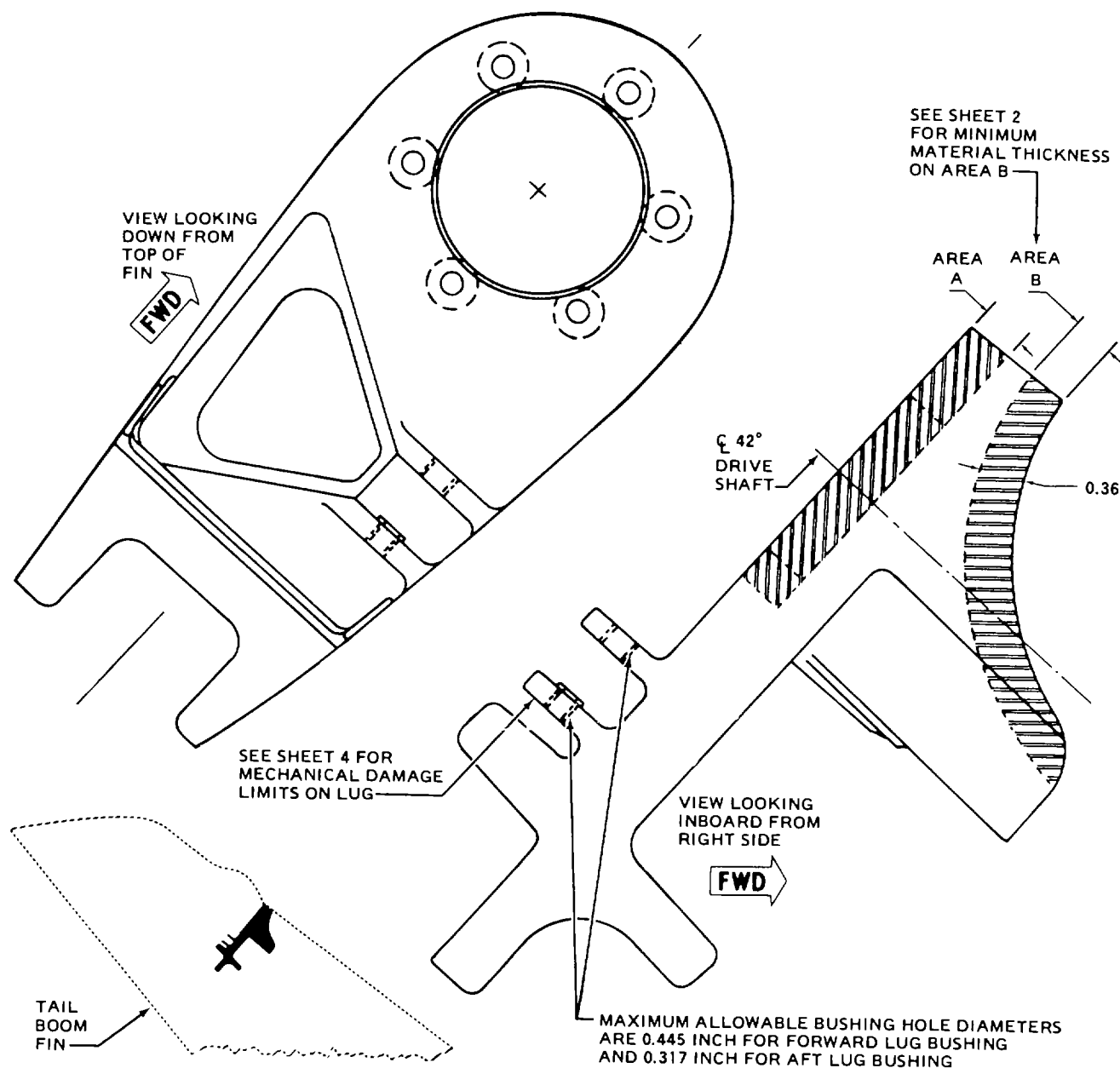


Figure 2-66E. Tailboom Structural Material

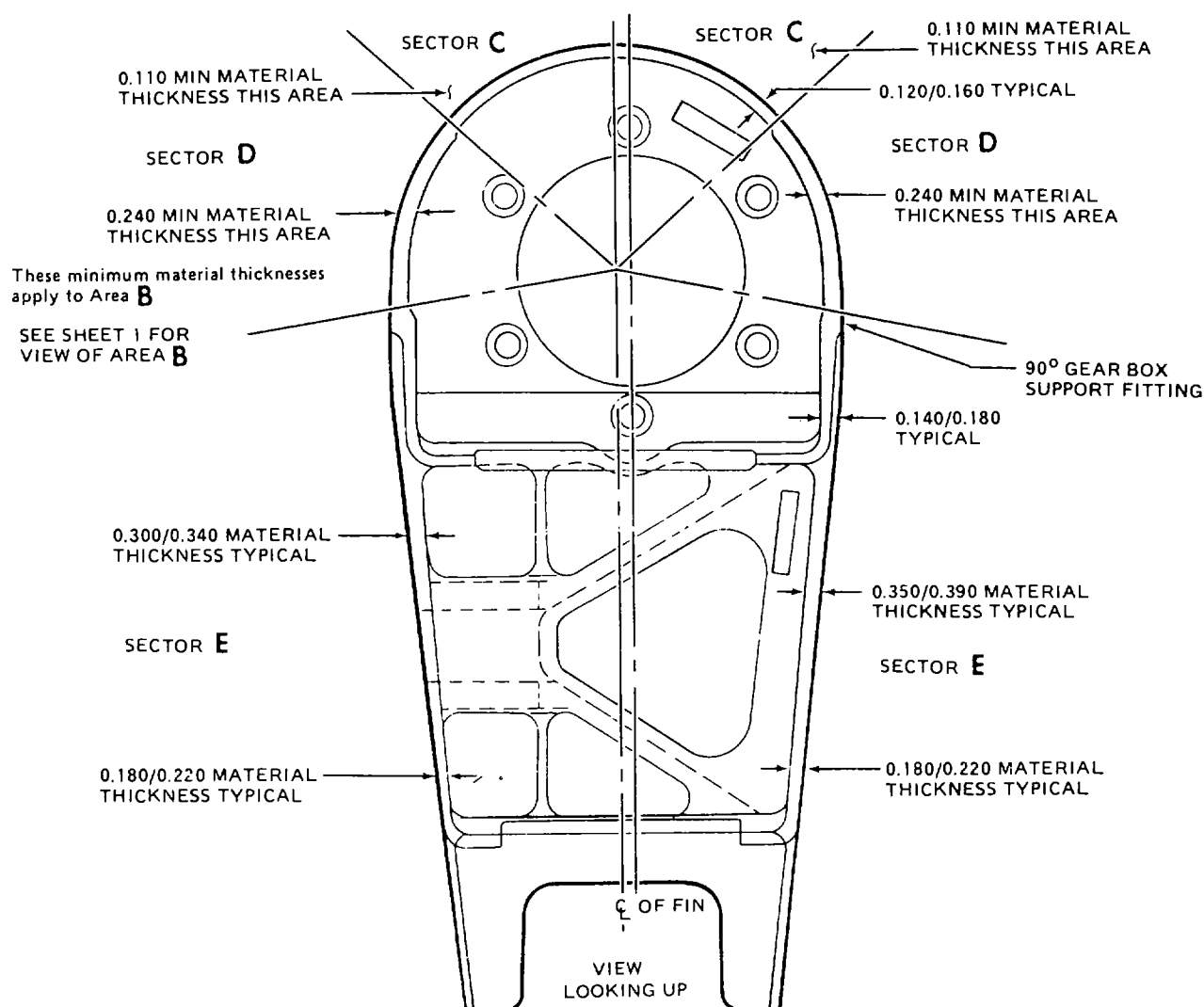


NOTES:

1. Chafing damage limit in area B is shown on sheet 2 as "minimum material thickness."
2. Chafing damage limit in area A is 0.075 inch total depth of chafing.
3. Nick, scratch, dent and corrosion damage limits on the top surface of the fitting are shown on sheet 3.

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Figure 2-67. Damage limits - tail rotor drive support fitting (Sheet 1 of 4)

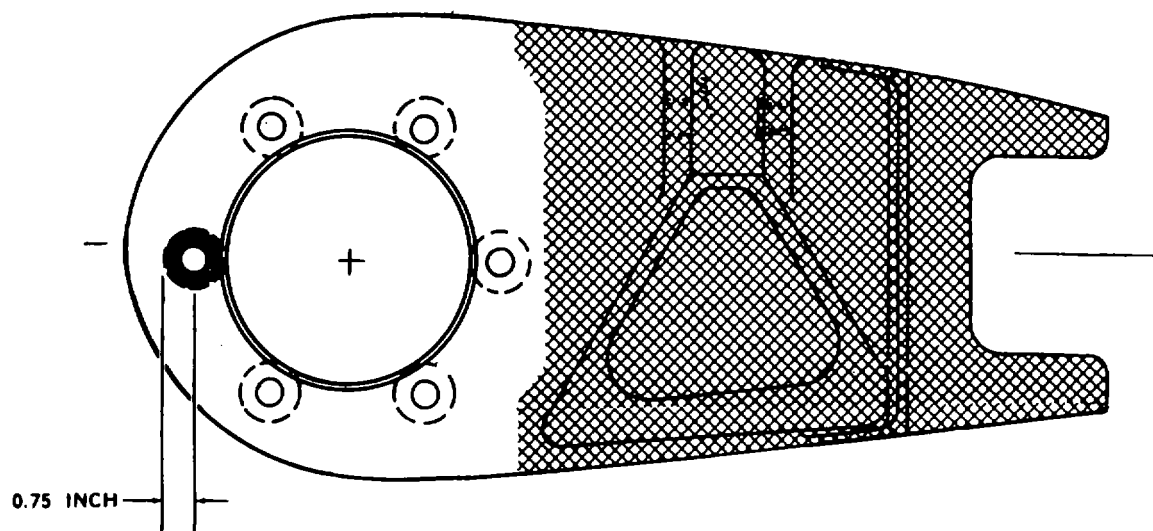


DAMAGE LIMITS FOR AREAS BEYOND AREA B.
SEE SHEET 1 FOR VIEW OF AREA B

DAMAGE SECTOR	DAMAGE QUANTITY	MAX. LENGTH	MAX. DEPTH	MAX. BLEND DEPTH	MIN. DAMAGE SPACING
C-LEFT C-RIGHT	3 2	0.75 0.75	0.005 0.005	0.006 0.006	2X LENGTH OF LONGEST DAMAGE
D-LEFT D-RIGHT	2 3	1.00 1.00	0.01 0.01	0.012 0.012	2X LENGTH OF LONGEST DAMAGE
E	3	0.75	0.01	0.012	2X LENGTH OF LONGEST DAMAGE

209031-106-2

Figure 2-67. Damage limits - tail rotor drive support fitting (Sheet 2 of 4)



VIEW LOOKING DOWN ON TOP OF SUPPORT FITTING

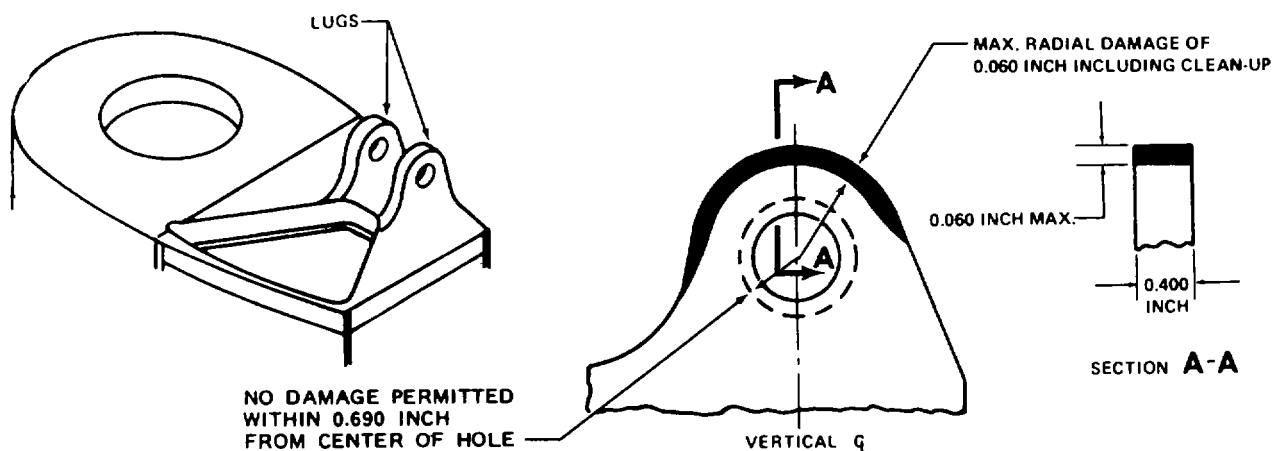
TYPE OF DAMAGE	DAMAGE LOCATION SYMBOLS			
NICKS, SCRATCHES, SHARP DENTS AND CORROSION				
	MAXIMUM DEPTH AND REPAIR AREAS ALLOWED ON EXPOSED UPPER SURFACE			
	0.025 in. maximum depth after blending	0.060 in. maximum depth after blending	0.080 in. maximum depth after blending 0.200 in. maximum width	0.010 in. maximum depth after blending

NOTES

1. Damage limits adjacent to holes are applicable to each of six gearbox stud holes; however, if area around two or more holes is damaged to limits shown, part must be replaced.
2. Total reworked area on top surface of fitting must not exceed 30 percent of total area.
3. Wear Limit: Maximum diameter of holes for gearbox studs is 0.400 inch.
4. See sheet 4 for additional limits in area of lugs.

209031-106-3

Figure 2-67. Damage limits - tall rotor drive support fitting (Sheet 3 of 4)

**NOTES:**

1. Nicks and scratches on fitting lug faces to a maximum depth of 0.010 inch and a maximum length of 0.500 inch are repairable.
2. Only two repairs allowed on each lug face.
3. Both damages should not occur on same side of vertical lug face.

209031-106-4

Figure 2-67. Damage limits - tail rotor drive support fitting (Sheet 4 of 4)**a. Inspection.** See figure 2-67.

(1) Inspect fitting for nicks, scratches, sharp dents and corrosion.

(2) Inspect fitting for chafing damage where driveshaft cover and tail rotor gearbox cover contact the fitting.

(3) Inspect fitting for worn bushings in bellcrank support lugs.

(4) Inspect fitting for worn bushings in six holes for gearbox studs.

b. Repair. See figure 2-67.

(1) Polish out mechanical and corrosion damage that is within repair limits. Use 400 grit sandpaper (C112) or Scotchbrite (C113). Remove all traces of corrosion damage. Ensure that damage limits were not exceeded during polishing out procedure. Touch up repair areas with primer (C102).

(2) Repair chafing damage that is within repair limits as follows:

NOTE

Chafed areas on the fitting, that are not worn beyond minimum material thickness, may be built-up with adhesive to form a new seat for the tail rotor driveshaft cover and for the tail rotor gearbox cover.

(a) Ensure that minimum material thickness limits defined on Sheet 1 and Sheet 2 for chafing damage have not been exceeded.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone (C87). Avoid breathing solvent vapors and avoid prolonged skin contact.

(b) Clean the chafed area with methyl ethyl-ketone (C87).

(c) Polish chafed area with 400 grit sandpaper (C112) or Scotchbrite (C113).

(d) Apply adhesive (C12) to build-up chafed areas to provide a new seat for the covers.

1 Build-up area B shown on Sheet 1 to a thickness of **0.12 TO 0.15** inch in damage sector C shown on Sheet 2.

2 Build-up area B shown on Sheet 1 to a thickness of **0.25 TO 0.29** inch in damage sector D shown on Sheet 2.

3 Build-up area A shown on Sheet 1 to a thickness of **0.80 TO 0.82 inch**.

(e) Allow adhesive applied in step (d) to dry thoroughly. Apply two coats of primer (C102) to repair area.

(f) Touch-up repair area with paint to match surrounding area.

(g) Apply tape (C137) on forward upper edge of fitting where corner of drive shaft cover contacts fitting.

2-50. Tailboom Synchronized Elevator.

Premaintenance Requirements for Tailboom Synchronized Elevator.

<u>Condition</u>	<u>Requirements</u>
Model	AH-1S
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	Torque wrench Force Gauge (Fish Scale)
Minimum Personnel Required	Two
Consumable Materials	None
Special Environmental Condition	None

The synchronized elevator consists of the right and left elevators, horn, supports and attaching parts. See figure 2-68. The elevators are built up on a tubular spar with aluminum ribs and skin. The horn is mounted inside the tailboom in supports which act as bearings and permit rotational movement of the horn. The synchronized ele-

vator control linkage from the swashplate is attached to the horn and controls the rotational movement. The two elevators are mounted on the horn. Their position is determined by relational movement of the horn.

a. Inspection.

(1) Scratches within the following limits are reparable. Replace part if damage exceeds limits:

(a) Minor scratches on the elevator skins are negligible if no crack damage is involved with the scratches.

(b) Scratches less than **0.005** inch deep on the horn (11, figure 2-68) are reparable by polishing out. Refer to paragraph 11-3 for specific damage limits.

(2) Cracks, tears, holes and nicks within the following limits are reparable. Replace part if damage exceeds limits.

(a) Cracks in elevator skin are reparable by patching if they do not exceed the following limits:

1 On leading edge-**6** inches long

2 Between spars-**6** inches long

3 On tip-**6** inches long.

(b) Holes, tears and cracks in elevator skins are reparable by cutting out damaged area and patching with insert plate and backup plate when the repaired area is not over **three** inches in diameter. Also, no damage to the tubular elevator spar is allowed.

(c) No mechanical damage is allowed on supports (8).

(d) Nicks in elevator trailing edge that are less than **0.25** inch deep are reparable by rounding and polishing out.

(e) Prior to removal of elevator, inspect support brackets (4) on both sides of tailboom for loose attaching rivets. Inspect rivets visually and by hand contact for signs of movement. Replace loose, damaged, or missing rivets.

NOTE

Apply a moderate force when moving the elevator and use care not to bend the elevator thus causing false indications.

(f) Check axial play of elevator horn assembly (11) in support assemblies (8) as follows:

1 Mount dial indicator inside of the tailboom placing the stylus against the elevator horn at the pivot point.

2 Move elevator inboard and outboard (spanwise) and observe the total indicator reading. A minimum of 0.005 inch and maximum of 0.030 inch play should be indicated (figure 2-68).

3 If the indicator readings are not within tolerance, adjust shims (7) as necessary.

(g) Check radial play as follows:

1 Mount dial indicator inside tailboom with stylus in contact with the upper surface of elevator horn near the inboard edge of pivot point.

2 Lightly move elevator up and down and observe total reading on dial indicator. A maximum reading of 0.010 inch is permissible (figure 2-68).

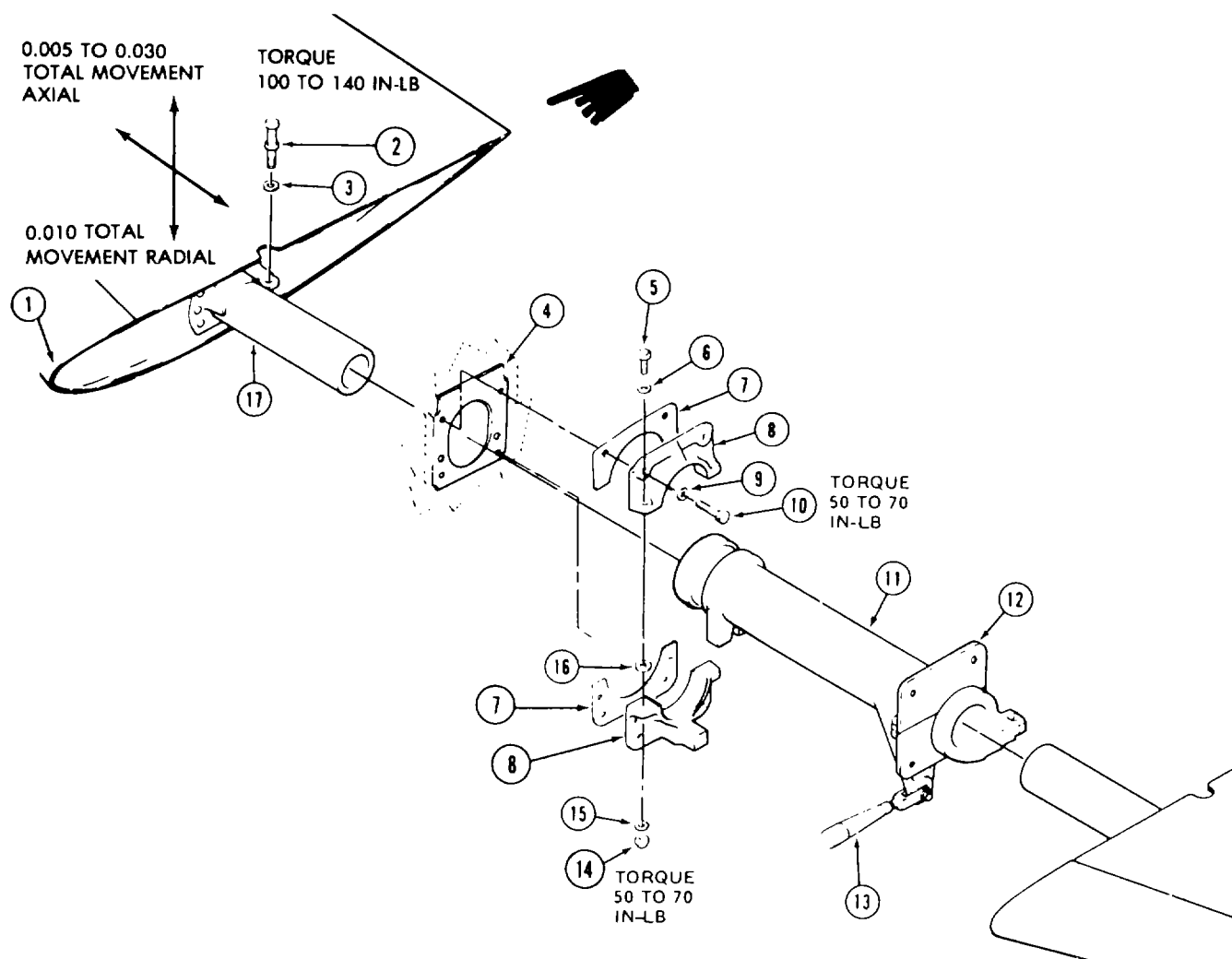
NOTE

Heavy force in moving the elevator will cause flexing of elevator spar tube thus producing false indications of excess radial play.

3 If dial indicator readings are not within tolerance, adjust shims (16) as necessary.

(3) *Corrosion.* Inspect elevators, horn and supports for corrosion damage. Polish out minor corrosion damage that does not exceed **0.003** inch in depth. Maximum allowable corroded area is **four** square inches in a single area or **twenty** percent of the elevator skin area.

(4) No damage to elevator spar (17, figure 2-68) is allowed.



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Figure 2-68. Elevator installation

Change 42 2-132A

b. Removal.

(1) Remove bolt (2, figure 2-68) and washer (3). Slide elevator (1) outboard until elevator tubular spar is clear of horn (11). Remove opposite elevator in same manner.

(2) Remove access door on lower side of tailboom below horn (11).

(3) Disconnect control tube (13) from horn (11).

(4) Remove four bolts (10) and washers (9).

NOTE

Ensure that shims (7), shims (16) and upper and lower support assemblies are indexed during accomplishment of the following step.

(5) Remove two nuts (14), washers (15) and screws (5). Remove support assembly (8), shims (7) and shims (16). Index these parts for reinstallation in the same location.

(6) Remove support assembly on opposite end of horn in same manner described in preceding step and remove horn (11).

NOTE

Handle support assemblies (8) with care to avoid damage to bearing surfaces.

c. Repair.

(1) Polish out minor scratch damage on elevators. Apply primer (C101) and touch up paint to match adjacent area.

(2) Polish out scratch damage on horn that is within limits. Apply primer (C102) to repair area. Refer to paragraph 11-3.

(3) Repair elevators with crack damage that is within limits for patch repairs as follows:

(a) Stop drill each end of crack.

(b) Ensure that tubular spar inside elevator has not been damaged if the spar can be inspected in the area of the crack.

(c) Fabricate a patch from the same material as the skin. See figure 2-58 for description of elevator skin. Install patch in accordance with standard instructions in TM 55-1500-204-25/1.

(4) Repair holes, tears and jagged cracks that are within **three** inch diameter limit as follows:

(a) Cutout the damaged area. Ensure that tubular spar inside elevator has not been damaged if the spar can be inspected in the area of the cutout.

(b) Fabricate a filler plate, to fit the cutout prepared in the preceding step, from the same material as the skin. See figure 2-58 for description of elevator skin. Fabricate backup patch from the same material to use with filler plate. Install filler plate and backup patch in accordance with standard instructions in TM 55-1500-204-25/1.

(5) Repair minor corrosion damage on elevators, horn and supports. Polish out corrosion and apply primer (C102). Touch up paint on elevators to match adjacent area.

(6) Repair smooth dents by using a suction cup. Only one pull per dent is allowed. Inspect for cracks after repair. If only one crack is found, repair per paragraph 2-50c(3). If two or more cracks are found, send elevator to depot for repair.

(7) If dents are found in rivet pattern, send elevator to depot for repair.

d. Installation.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

NOTE

If solid film lubricant is accidentally removed, it may be reapplied to the area from which it was removed.

(1) Clean the inside part of the horn (11, figure 2-68) that mates with the tubular spars of the elevators. Also clean the tubular spars. If there is any zinc chromate or similar material in these mating surfaces, clean down to bare metal with methyl-ethyl-ketone (C87) and clean cheesecloth

(C36). Do not use excess methyl-ethyl-ketone or allow it to saturate the tubular spar as it may remove the solid film lubricant. Allow the methyl- ethyl-ketone to dry.

(2) Deleted.

(3) Place the horn (11) inside the tailboom with the arm that connects to control tube (13) toward the left side of the tailboom. Position the horn control arm that attaches to control tube (13) vertical and insert the left end of the horn through tailboom bracket in left side of tailboom. This bracket is similar to bracket (4). Raise the right side of the horn, rotate the horn control arm downward and insert the right end of the horn through tailboom bracket (4).

CAUTION

Ensure that correct length bolts (10) are installed. Refer to TM 55-1520-234- 23P.

NOTE

If no new parts are to be used when installing the elevator, ensure that shims (7), shims (16) and upper and lower support assemblies are installed in the same location from which removed.

(4) Position support assembly (8) and shim set (7) on each end of horn. Install washers (9) and bolts (10) but do not torque.

(5) Install shims (16) screws (5) aluminum washers (6 and 15) and nuts (14).

(6) Adjust thickness of laminated shim set (7) to obtain **0.005 TO 0.030** inch lateral free play of horn.

(7) Adjust thickness of laminated shims (16) as follows:

(a) Torque two nuts (14) on right end of horn **50 TO 70** inch-pounds, loosen similar nuts on left end of horn. Attach a spring scale to horn control arm at the point where control tube (13) attaches and check amount of force required to rotate the horn in the support assembly (8). Hold spring scale 90 degrees to control arm while taking reading. Adjust thickness of shims (16) until force required to rotate horn is **13 TO 16** pounds with nuts (14) torqued **50 TO 70** inch-pounds.

(b) After shims (16) are properly adjusted on right end of horn, repeat the procedure on the left end of the-horn. The required spring scale reading is **26 TO 32** pounds when shims are properly adjusted on both ends of horn and all nuts (14) torqued **50 TO 70** inch-pounds.

(8) Torque bolts (10).

(9) Apply coat of compound (C52) or (C53) to surfaces of horn (11) contacted by elevator spars.

(10) Install control tube (13).

(10A) Position elevator (1) tubular spar in horn and secure with washer (3) and bolt (2). Torque bolts (2) **100 TO 140** inch-pounds.

(10B) Inspect elevator (1) and the opposite elevator for adequate clearance with the external surface of the tailboom while the elevators are moved through full throw. If clearance is not approximately equal for both elevators, redistribute shim set (7) under support assembly (8) and support assembly (12) as necessary to obtain equal clearance.

(11) Check rigging of elevator. Refer to Chapter 11.

(12) Install access door on lower side of tailboom.

2-51. Tailboom Fin.

The tailboom fin is an integral part of the tailboom. It is made up of a spar, aluminum ribs and honeycomb panels. See figure 2-59.

a. Inspection.

(1) Cracks: No cracks are allowed in structure. Minor cracks in ninety degree gearbox cover are reparable.

(2) Buckled and wrinkled skin.

(3) Loose, cocked and missing rivets.

(4) Loose and/or missing fasteners (inserts).

(5) Corrosion.

(6) Voids, cracks, dents, and other damage in honeycomb panels. See figure 2-68A for damage limits.

b. Repair. If repair requires use of jigs or fixtures, forward tailboom to depot level maintenance for repair.

(1) Repair cracked ninety degree gearbox cover as follows:

(a) Remove cover from helicopter.

(b) Saturate fiberglass repair material with epoxy resin (C107) and apply over cracked area.

(c) Allow adhesive to cure and touch up paint to match adjacent area.

(2) Polish out minor corrosion damage. Apply primer (C102) and touch up paint to match adjacent area.

(3) Replace loose or missing inserts. See paragraphs 2-5 and 2-6 and figure 2-68A.

(4) Replace honeycomb panels if damage exceeds limits in figure 2-68A.

2-52. Tailboom Skid.

The tailboom skid is located at the aft end of the tailboom. The purpose of the tail skid is to warn the pilot of a tail-low attitude when landing.

a. Inspection.

(1) Scratches and nicks. Minor surface scratches and nicks are negligible and do not require repair. Slight scratches and nicks require polishing out. Replace tail skid if very deep scratches or nicks are present.

(2) Dents. Smooth dents up to **0.062** inch deep are negligible and do not require repair. Replace tail skid if dents deeper than **0.062** inch are present.

(3) Cracks. Replace tail skid if any cracks are present.

(4) Deformity. Replace tail skid if deformed (bent) to the degree that it can be detected visually.

(5) Loose attachment to tailboom. Determine cause for loose attachment.

b. Removal.

(1) Remove access covers (50, figure 2-3).

(2) Remove nut, washer and bolt that attach forward end of skid to tailboom and pull tail skid aft out through support block.

c. Repair.

(1) Polish out slight scratches and nicks. If complete clean up of damage results in removal of enough material to weaken the tail skid, replace the

tall skid. Apply primer (C102) to bare metal surfaces and touch up paint to match surrounding surfaces.

(2) Replace tail skids that are cracked, deformed, or have dents in excess of 0.062 inch limit.

WARNING

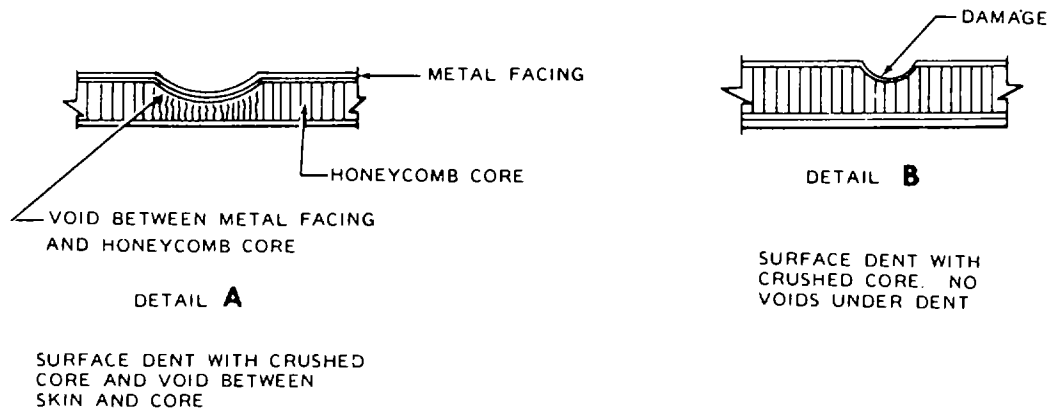
It is possible to erroneously install tailboom skids on MOD S helicopters that are components of tailboom skid installation P/N

204-030-947-17. The-17 tailboom skid installation includes a tube assembly filled with lead shot. Ensure that the components of tailboom skid installation P/N 204-030-947-13 are used on MOD S helicopters.

d. Installation.

(1) Position tail skid through support block and install bolt, washer and nut to secure forward end of tail skid to tailboom.

(2) Install access covers (50, figure 2-3).



LIMITS

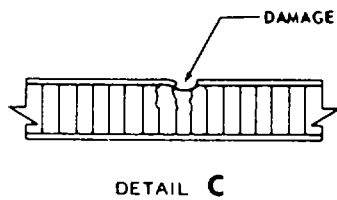
1. No sharp dents, holes, or damages that penetrate metal facing.
2. Maximum diameter of damage **2.0** inches, or maximum length of damage **1.50** inches.
3. Maximum depth of damage **20** percent of panel thickness.
4. Total damage not to exceed **10** percent of a bay area.
5. Minimum distance of **0.5** inch from adjacent structure, inserts or beveled edge.

LIMITS

1. Smooth, crack free dent.
2. Maximum diameter of single dent **1.0** inch. Two or more dents in any **6.0** inch diameter area, consider as one dent.
3. Maximum depth: **20** percent of panel thickness.
4. Maximum area of all dents combined: **10** percent of a bay area.
5. Maximum of five dents in a **9.0** square inch area.
6. No voids may be present under tile damage.
7. Minimum distance of **0.5** inch from inserts or beveled edge.

214020-2-2

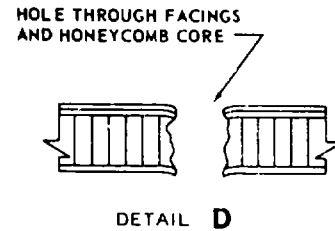
Figure 2-68A. Vertical fin honeycomb panels damage limits (Sheet 1 of 3)



OUTER SKIN AND CORE
DAMAGED. DAMAGE
PENETRATES OUTER
SKIN AND CORE ONLY

LIMITS

1. Maximum diameter of **3.0** inches after clean-up.
2. Maximum of three patch repairs in a panel. Damage after clean-up comes no closer than **1.5** inch to a similar repair or insert and no closer than **1.5** inches to a beveled edge.
3. Replace panel if water or corrosion found in core.
4. Total damage not to exceed 10 percent of total panel area or **25** percent of a single bay area after clean-up.



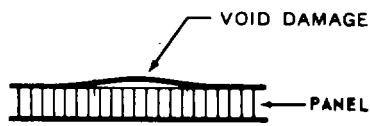
DAMAGE PENETRATES THROUGH
BOTH SKINS AND CORE

LIMITS

1. Maximum diameter of hole **3.0** inches, after clean-up.
2. Minimum distance from structural members or other repair: **2.0** inches.
3. Minimum distance of completed repair from an edge bevel: **0.50** inches.
4. Total damage not to exceed **10** percent of a bay area.
5. Maximum of three patch repairs in a panel.
6. Replace panel if water or corrosion found in core.

214020-2-3

Figure 2-68A. Vertical fin honeycomb panels damage limits (Sheet 2 of 3)

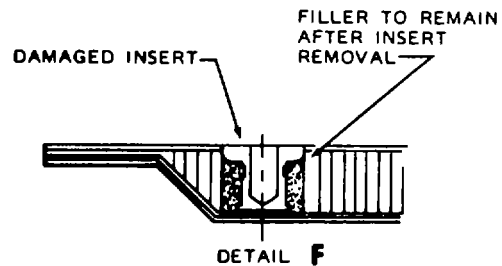


DETAIL E

VOID AREA BETWEEN
METAL FACING AND
CORE

LIMITS

1. Maximum total void are not to exceed 5 percent of panel surface area.
2. Maximum area of a single void: 1. square inch and a minimum of 2.0 inches between voids. Maximum length of a void: 3.0 inches in any direction.
3. Damage not closer than 1.0 inch of a beveled edge, hole or adjacent structure, or within 3.0 inches of an insert. Void in area of insert limited to 0.62 square inch with no damage to insert.



DETAIL F

DAMAGED OR LOOSE INSERTS

LIMITS

1. Remove insert by counter boring without enlarging hole size in panel facing.
2. Original hole diameter in panel facing must be maintained in the replacement process.
3. No damage in area adjacent to insert.

214020-2-4A

Figure 2-68A. Vertical fin honeycomb panels damage limits (Sheet 3 of 3)

Section III. PYLON

2-53. Pylon Support Installation.

The pylon support installation consists of the provisions for mounting the transmission in the airframe, see figure 2-69. Major components of the pylon support installation are as follows:

- a. Four transmission mount assemblies.
- b. Two damper assemblies.
- c. Two damper fittings.
- d. One fifth mount support fitting assembly.
- e. One lift beam assembly.

2-54. Transmission Mounts.

Refer to Chapter 6.

2-55. Transmission Mount Dampers.

Refer to Chapter 6.

2-56. Transmission Mount Bushings.

Refer to Chapter 6.

2-57. Fittings and Supports.

Refer to paragraphs 2-58 through 2-62 for instructions to repair or replace supports.

2-58. Support (1, figure 2-70). (AVIM)

Premaintenance Requirements for Support.

<u>Condition</u>	<u>Requirements</u>
Model	AH-1S
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	Hydraulic test stand Riveting equipment
Minimum Personnel Required	One man
Consumable Materials	None
Special Environmental Condition	NA

a. *Inspection.* Inspect support for cracks, corrosion damage, and secure attachment to lift beam.

b. *Removal.* See figure 2-70. (1) Remove hydraulic lines and fittings from support (1). Cap or plug hydraulic lines to prevent entry of foreign material.

(2) Remove nut, screw and clamp from outboard side of support (1).

(3) Carefully remove six rivets which secure support to lift beam and remove support. Do not elongate holes in lift beam.

c. *Repair.* Fabricate a new support in accordance with instructions in appendix D. Supports presently installed may be either 0.040 inch or 0.050 inch thick. Fabricate the new support from 0.050 inch thick material as shown in appendix D.

d. *Installation.* See figure 2-70.

(1) Position support (1) on lift beam in original position so that hydraulic fittings can be reinstalled and clamp in place. Drill out holes for six rivets to match holes in lift beam. Remove support and deburr holes. Position support on lift beam and install six rivets (item 53, table 2-1).

(2) Install hydraulic fittings on support and install hydraulic lines on fittings.

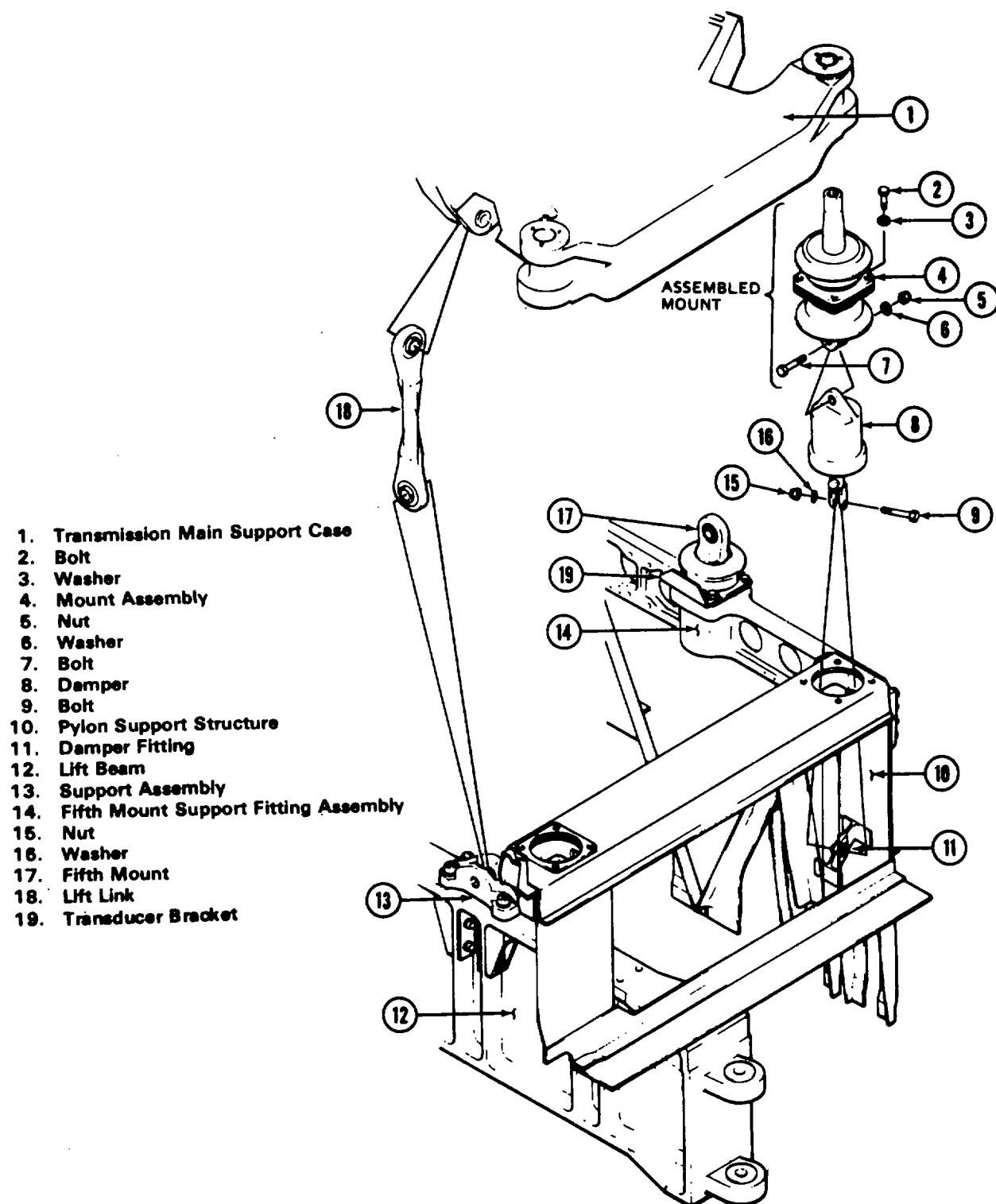
(3) Install clamp removed in step b above.

(4) Perform functional check of hydraulic system with hydraulic test stand or by ground run of helicopter. Check for correct operation of hydraulic system and for hydraulic fluid leaks.

2-59. Support Assembly (2, figure 2-70). (AVIM)

Premaintenance Requirements for
Support Assembly.

<u>Condition</u>	<u>Requirements</u>
Model	AH-1S
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None



209030-302

Figure 2-69. Pylon support installation

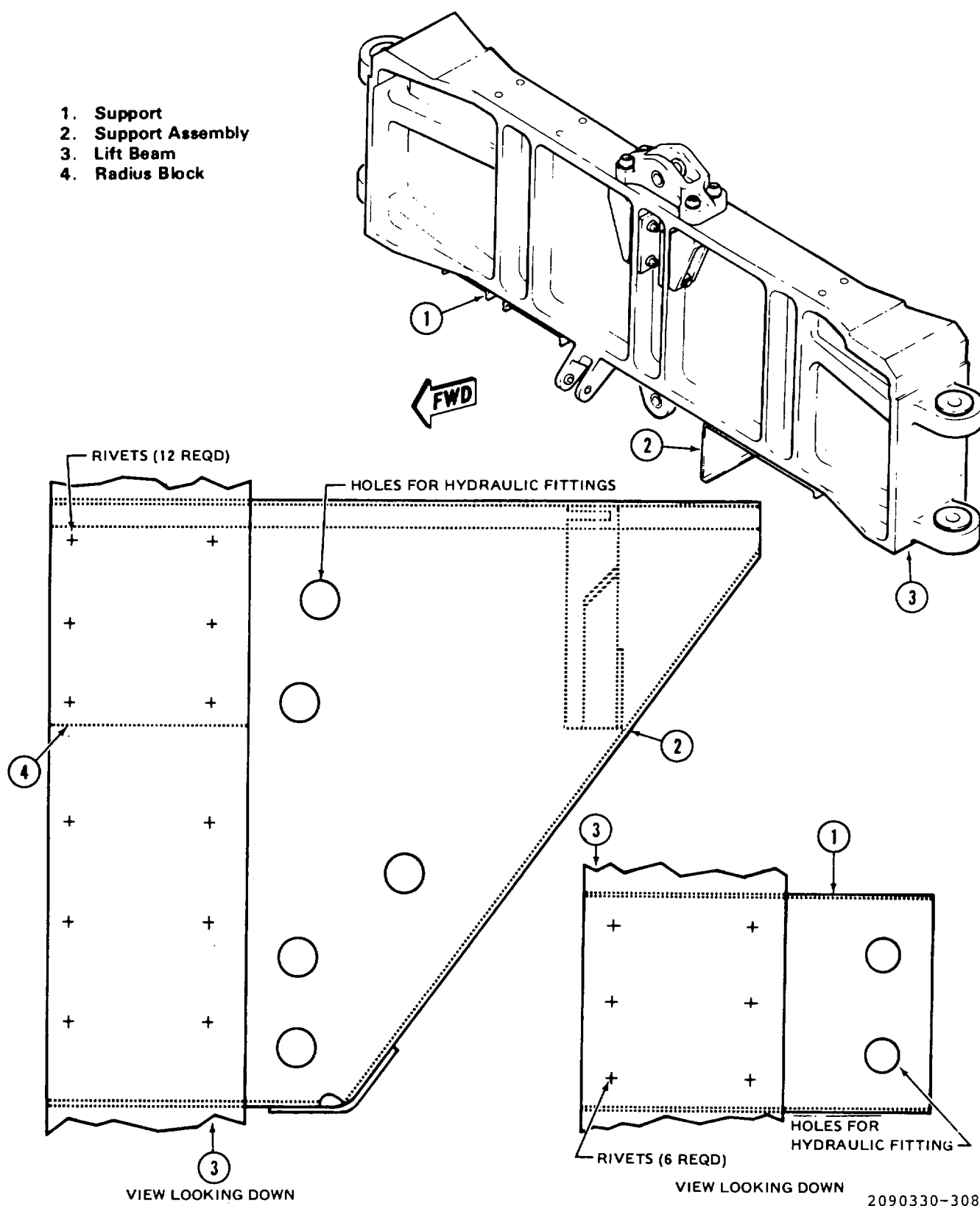


Figure 2-70. Hydraulic fitting supports PIN 209-030-267-11 and 209-030-267-29 installation

Premaintenance Requirements for Support Assembly (Cont).

<u>Condition</u>	<u>Requirements</u>
Support Equipment	Hydraulic test stand, Riveting equipment
Minimum Personnel Required	One man
Consumable Materials	(C17), (C87), (C112), (C102)
Special Environmental Condition	NA

a. *Inspection.* Inspect support assembly for cracks, corrosion damage, and secure attachment to lift beam.

b. *Removal.* See figure 2-70.

(1) Remove hydraulic lines and fittings from support assembly (2). Cap or plug hydraulic lines to prevent entry of foreign material.

(2) Carefully remove twelve rivets which secure support assembly (2) and radius block (4) to lift beam. Do not elongate rivet holes in lift beam.

c. *Repair.* See figure 2-70.

(1) Do not repair a damaged support assembly. Procure a new support assembly through normal supply channels.

(2) Remove radius block (4) from old support assembly or fabricate a new support in accordance with instructions in appendix D.

d. *Installation.* See figure 2-70.

(1) Clamp support assembly (2) and radius block (4) on lift beam at position illustrated. Ensure that radius block (4) is nested against mating radius of the support assembly.

(2) Drill out rivet holes in new support assembly (2) and radius block to match holes in lift beam. Remove support and radius block (4). Deburr holes.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone (C87). Avoid breathing vapors and avoid prolonged skin contact.

(3) Clean mating surfaces at support assembly (2) and radius block (4) with 400 grit sandpaper (C112). Remove all residue with methyl-ethyl-ketone (C87).

(4) Mix a small quantity of adhesive (C17) according to directions on container and apply a thin coat of adhesive to mating surfaces of support assembly and radius block.

NOTE

Pot life of adhesive (C17) is 30 to 50 minutes. Cure time is 24 hours at 70 to 90 degrees F. Maximum strength is attained in 6 or 7 days.

(5) Place a four mil glass yarn string in bond line at one inch intervals. The glass yarn will serve as a spacer to ensure that adhesive thickness will be 3 to 8 mils after curing.

(6) Clamp support assembly (2) and radius block (4) in position on lift beam with radius block radius nested in support assembly radius. Install twelve rivets (item 53, table 2-2).

(7) Clean all adhesive squeeze out from the parts before adhesive hardens.

(8) Paint support assembly (2) and radius block (4) with primer (C102).

(9) Install hydraulic fittings on support (2) and install hydraulic lines on fittings.

(10) Perform functional check for correct operation of hydraulic system with hydraulic test stand or by ground run of helicopter. Check for correct operation of hydraulic system and for hydraulic fluid leaks.

2-60. Pylon Damper Fittings.

One pylon damper fitting (11, figure 2-69) is installed below each of the two dampers (8). The fittings form the structural attachment point for the lower end of the dampers.

Premaintenance Requirements for Pylon Damper Fittings.

<u>Condition</u>	<u>Requirements</u>
Model	AH-1S
Part No. or Serial No.	All
Special Tools	None

Premaintenance Requirements for
Pylon Damper Fittings (Cont).

<u>Condition</u>	<u>Requirements</u>
Test Equipment	None
Support Equipment	Roll staking tool
Minimum Personnel	
Required	Two
Consumable Materials	(C102)
Special Environmental	
Condition	None

a. *Inspection.* Inspect damper fittings (11, figure 2-69) for the following defects:

- (1) Cracks. No cracks are acceptable.
- (2) Corrosion. Severe corrosion damage is cause for replacement of damper fittings. Minor corrosion damage may be repaired.
- (3) Secure installation of all rivets which attach the two fittings (11, figure 2-69) to the structure.
- (4) Secure installation of bearing in damper fitting and condition of bearing. Maximum allowable radial play **0.006** inch.

b. *Removal.* (AVIM)

- (1) Remove transmission. Refer to Chapter 6.
- (2) Remove the two aft transmission mount assemblies (4, figure 2-69). Refer to Chapter 6.
- (3) Carefully drill out rivets which secure damper fittings to structure and remove fitting. See figure 2-71 for detail view of rivet. Remove fitting.

c. *Repair.* (AVIM).

- (1) Replace damper fitting if cracked.
- (2) Polish out superficial corrosion damage and apply primer (C102) to bare metal surfaces.
- (3) If bearing in pylon damper fitting failed to meet inspection requirements, remove old bearing and install new bearing by roll staking method. Refer to Chapter 5 for general instructions to remove and install roll staked bearings. If roll staking tools are not available, procure a new fitting through normal supply channels.

(4) If rivet holes in pylon damper fitting are elongated, procure a new fitting through normal supply channels.

(5) If rivet holes in helicopter structure for rivets (1, figure 2-71) are not elongated, proceed to step (10). If any holes in structure are elongated, install bushings as outlined in steps (6) through (9).

(6) Drill out elongated holes in web (3, figure 2-71) and extrusion (4) as shown in figure 2-71. Use a letter size N twist drill. Ream the hole for a class FN2 fit with a 77-3-31 bushing. Make the hole **0.0004 TO 0.0014** inch smaller than the bushing.

(7) Coat bushing (2, figure 2-71) and the hole with primer (C102) and press bushing into position while primer is wet. Install the bushing with the flanged end on the opposite side of the structure from fitting (6) as illustrated. The bushing must extend through the web (3) and extrusion (4). Face off bushing flush with extrusion (4) as shown on detail view A.

(8) Repair all elongated holes as described in steps (6) and (7).

(9) Touch up bare metal with primer (C102).

CAUTION

Do not replace loose or missing rivets with steel fasteners unless it is a Hi-Lok rivet (HL20PB86-5-6 (forward) HP20PB86-6-6 (aft)). Rivets are designed to shear before doing excessive damage to pylon.

d. *Installation* (AVIM).

(1) Position fitting in helicopter and install rivets (1, figure 2-71). Use one of the rivets or the Hi Lock fastener listed in the preceding "Caution."

(a) If the Hi-Lok rivet is installed, remove the two forward 5/32 inch rivets and the two aft 3/16 inch rivets. Exercise extreme caution to preclude further enlargement of original hole.

(b) Ream original 5/32 inch holes 0.1615 to 0.1635 and install HL20PB6-5-6 Hi-Lok pin with HL86PB-5 collars.

(c) Ream original 3/16 inch holes 0.1885 to 0.1895 and install HP20PB6-6-6 Hi-Lok pin with HL86PB-6 collars.

(d) One flat washer (AN960 series or equivalent) may be used under the collar with the nut if the Hi-Lok rivet shows 1/8 inch or more of unthreaded shank.

(2) Install damper (8, figure 2-69), mount assembly (4) and transmission. Refer to Chapter 6.

(3) Perform ground run for functional check of flight controls and hydraulic system components affected by transmission removal/installation.

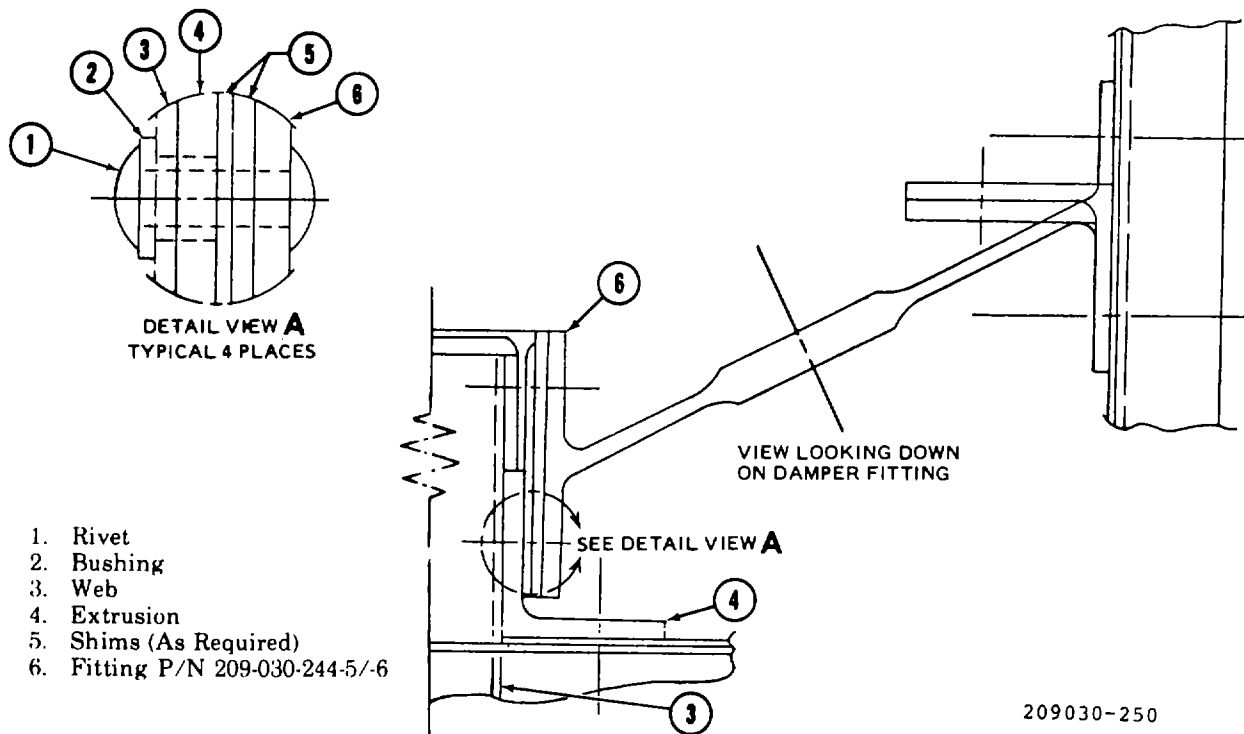


Figure 2-71. Pylon damper fitting supporting structure-repair of elongated holes

2-61. Flight Control Power Cylinder Support.

The flight control power cylinder supports are the structural mounting points for the three flight control hydraulic cylinders.

a. Inspection. Inspect each of the three supports for mechanical damage, corrosion, thread damage and elongation of holes (bore damage) in excess of limits shown on figure 2-72.

b. Removal. Refer to Chapter 11.

c. Repair.

(1) Polish out minor corrosion and mechanical damage that does not exceed inspection limits. Do not remove more material than necessary to blend repair smoothly into surrounding surface. Use fine or medium grades of sandpaper (C112) or crocus cloth (C45). Do not use grinding wheels. Polish out mechanical damage only deep enough to remove traces of damage. Polish out corrosion damage to twice depth of the deepest pit.

(2) Touch up repair area on aluminum parts with chemical film (C37) and primer (C102).

(3) Replace supports that have damage in excess of inspection limits.

d. Installation. Refer to Chapter 11.

2-62. Fifth Mount Support Fitting Assembly.

a. Inspection. Inspect fifth mount support fitting assembly (13, figure 2-69) for damage in excess of limits shown on figure 2-73.

*b. Removal-*Refer to Chapter 6.

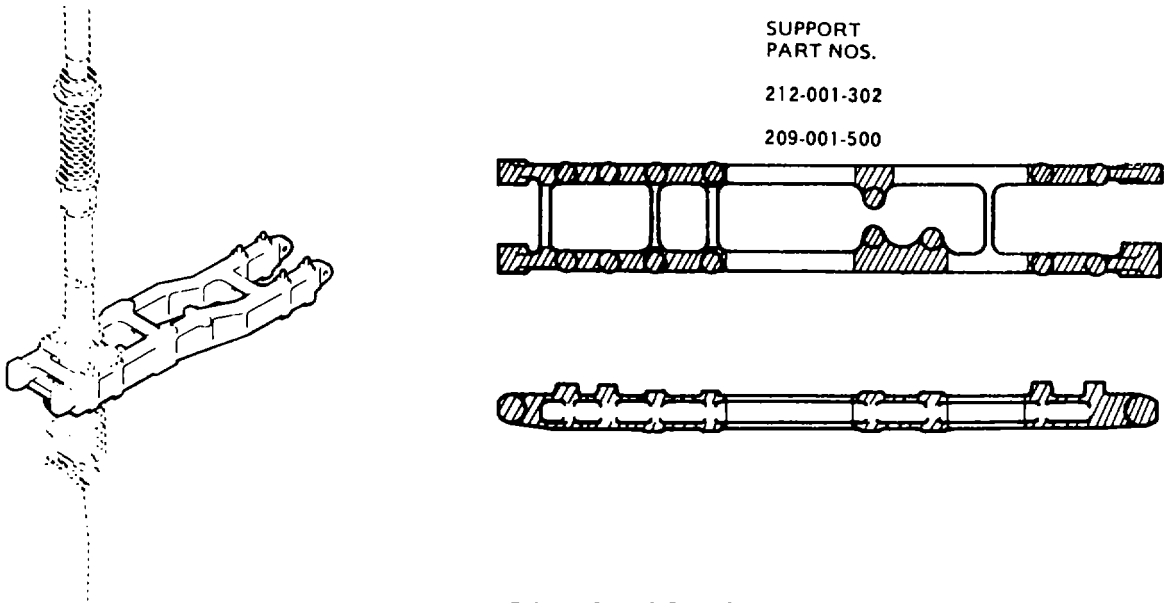
c. Repair.

(1) Polish out mechanical and corrosion damage that is within limits shown on figure 2-73.

(2) Replace support fitting if damage exceeds limits or if any cracks are detected.

(3) Touch-up repair areas with chemical film (C37) and primer (C102).

*d. Installation-*Refer to Chapter 6.

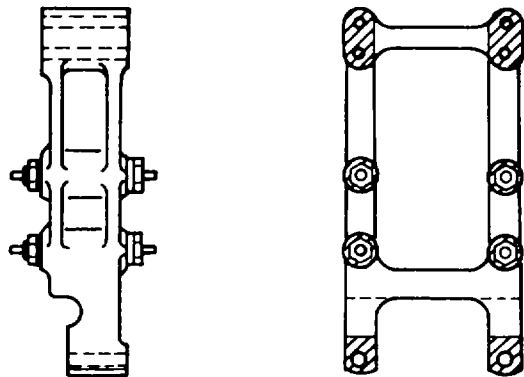


DAMAGE LOCATION SYMBOLS



TYPE OF DAMAGE		MAXIMUM DEPTHS AND REPAIR AREAS ALLOWED	
MECHANICAL	0.020		0.030
CORROSION	0.010		0.015
MAXIMUM AREA PER FULL DEPTH REPAIR	0.25 Sq. In.		0.50 Sq. In.
NUMBER OF REPAIRS	Two Per Segment		
EDGE CHAMFER	0.040		0.060
SURFACE COATING	Brush Alodine		
BORE REPAIR	0.002 Inch — 1/4 Circumference		
THREAD DAMAGE:			
DEPTH:	ONE-THIRD OF THREAD		
LENGTH:	ONE-TENTH INCH		
NUMBER:	ONE PER THREADED SEGMENT		
BORE ELONGATION:	0.0015 MAXIMUM		209001-51A

Figure 2-72. Damage limits-flight control power cylinder supports (Sheet 1 of 2)



ALLOWABLE DAMAGE LIMITS	
TYPE OF DAMAGE	
MECHANICAL DAMAGE	0.030 In. 0.020 In.
CORROSION DAMAGE	
BEFORE CLEANUP	0.015 In.
AFTER CLEANUP	0.030 In.
AREA OF FULL DEPTH REPAIR	0.50 Sq. In.
NUMBER OF REPAIRS	NOT CRITICAL
EDGE CHAMFER	0.050 In.
BORE DAMAGE	0.002 Inch for Full Circumference
THREAD DAMAGE	
DEPTH OF REPAIR — 1/3 thread	
LENGTH OF REPAIR — Total accumulative damage not to exceed 1/4 circumference.	
Exposed threads above the nut have unlimited repair.	
1 Repair under nuts not to exceed 1/4 circumference.	
NO CRACKS ALLOWED	

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Figure 2-72. Damage limits-flight control power cylinder supports (Sheet 2 of 2)

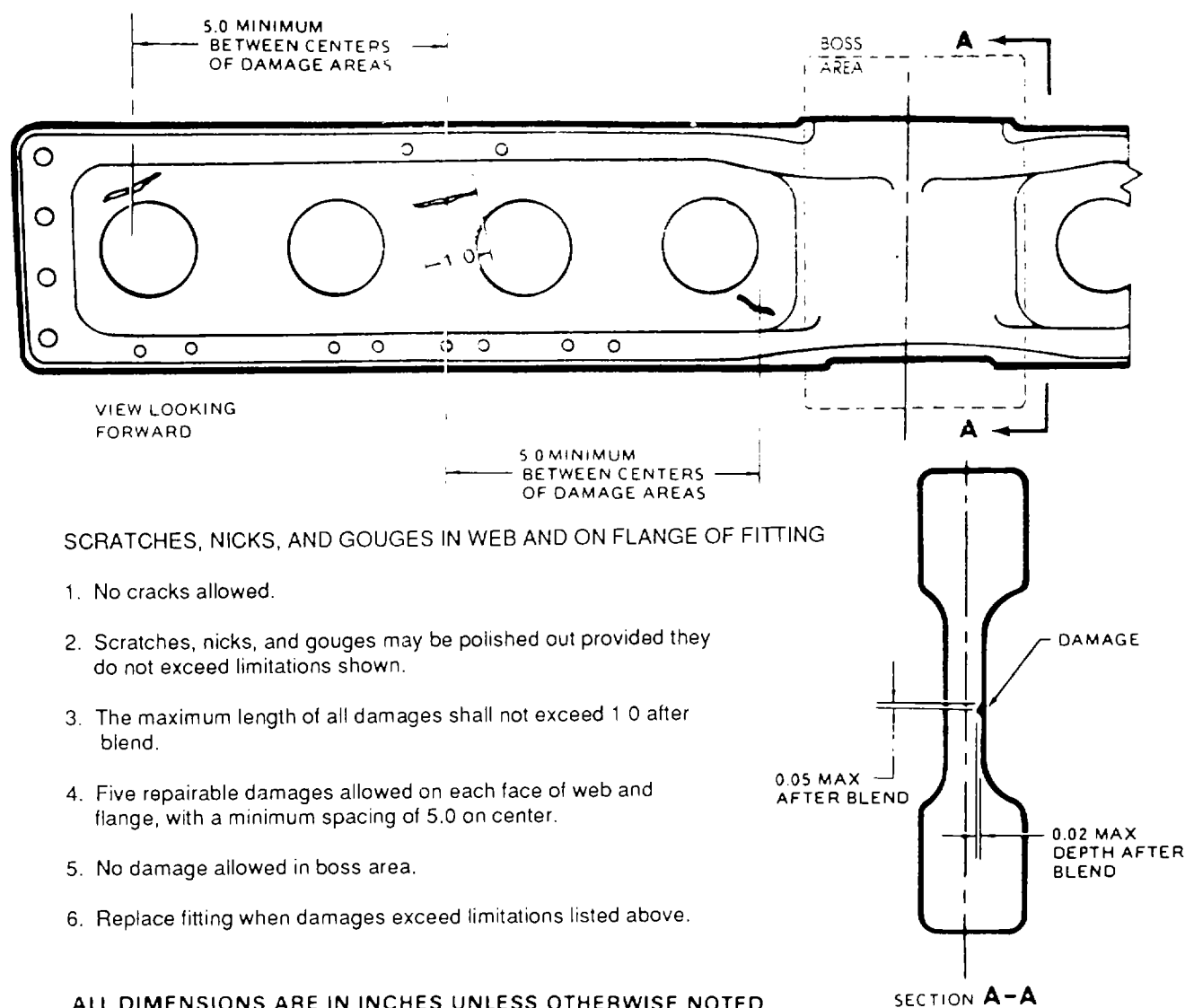


Figure 2-73. Damage limits-Fifth mount support fitting assembly

Section IV. WING

2-63. Wing. See figure 2-74.

Stub wings, mounted on the fuselage, supply additional lift and provide mounting accommodations for weapons pylons. The structure is built up with aluminum alloy spars and ribs covered with sheet aluminum skin. Each wing is attached to fuselage fittings with attaching bolts. Four removable panels allow access to internal provisions.

a. *Removal.* See figure 2-74.

NOTE

The removal procedure is the same for both wings.

- (1) Remove external stores from weapon pylon, if installed. Refer to Chapter 16.
- (2) Remove lower access panel (6) on each wing.
- (3) Disconnect two pylon hydraulic connections (5) in each wing. Cap all open lines.

CAUTION

Support wings to prevent bolts from binding. Remove bolts in sequence as shown in figure 2-74, detail A.

(4) Remove five attachment bolts (3) and separate wing from fuselage.

(5) Disconnect electrical connection (4) between wing root and fuselage.

b. Inspect wing fitting bushings for damage and for wear beyond limits of figure 2-75. Bushings worn beyond limits must be replaced by depot level maintenance. Inspect barrel nuts for adequate self-locking feature. Inspect wing bumper. Refer to paragraph 2-65.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone (C87). Avoid breathing solvent vapors and avoid prolonged skin contact.

b. Inspect washers (8) for looseness or damage. Remove loose or damaged washers. Use a heat lamp or heat gun and apply 200°F (93°C) maximum to soften old adhesive. Use care not to damage fitting. After removing washer clean fitting with a plastic scraper and methyl-ethyl-ketone (C87). Wipe dry with clean cloth (C36).

c. Installation. See figure 2-74.

NOTE

Installation procedure is the same for both wings.

(1) Install and align barrel nuts in fittings.

(2) Connect and lockwire electrical connections (4).

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone (C87). Avoid breathing solvent vapors and avoid prolonged skin contact.

(2.1) If washers (8) were removed in step b.1, install washers as follows:

(a) Clean fitting and washer with methyl-ethyl-ketone (C87). Wipe dry with cloth (C36).

(b) Apply a small quantity of adhesive (C17) to chamfered edge of washer and install wet washer into fitting. Proceed immediately with steps (4), (5), and (6).

NOTE

Excess adhesive must be wiped from fitting and washer to prevent bonding bolt to washer.

(3) Mount wing in fuselage fittings.

(3.1) Apply anti-seize compound (C26) to bolt shank and install bolts (3). If MWO 55-1520-244-30-3 has been incorporated, tiedown fitting (9), washer (10), and washer (11) must be installed on each of the three lower bolts (3).

(3.2) After MWO 55-1520-244-30-3, torque as follows:

(a) Torque two front bolts **400 inch-pounds**. Torque two center bolts **400** inch-pounds.

(b) Back off to zero torque or until threads are disengaged.

(c) Gradually retighten bolts until contact occurs between bolt head and washer or until torque begins to increase. Note contact torque level.

(d) Apply an additional 100 inch-pounds of torque above the contact torque to ensure a snug fit, but do not exceed **450** inch-pounds torque.

NOTE

Some bolts may have a drilled head. Do not lockwire.

(e) Torque aft bolt 80 to 100 inch-pounds.

(4) Before MWO 55-1520-244-30-3, torque two front bolts **100 TO 150** inch-pounds, two center bolts **100 TO 150** inch-pounds, and aft bolt **80 TO 100** inch-pounds.

(5) Remove caps from hydraulic connections (5) and connect.

(6) Install lower access panel (6).

(7) Attach weapons pylon to wing, if required. Refer to Installation-Outboard Ejection Rack and Installation Inboard Ejector Rack, Chapter 16.

(8) Perform functional check of hydraulically actuated articulated pylon and all electrical circuits in the wing. Refer to paragraph 9-91.

2-64. Wing Skins and Panels. See figures 2-76 and figure 2-77.

a. Inspection. Inspect the wing skins and panels for the following defects.

(1) Cracks, holes and tears in the skin and/or panels. If damage is less than **1.25** inches long and does not involve damage to the structure, it is reparable by patching.

(2) Corrosion. Minor corrosion damage is reparable.

(3) *Distortion.* Inspect for wrinkles and buckled skin. If this type damage is detected, inspect the wing structure for damage. Damage involving the wing structure is not reparable at AVIM level.

(4) *Rivet condition.* Inspect for loose, cocked and/or missing rivets. Rivet damage may be repaired by replacing rivets if damage does not involve structural repair.

b. Repair.

(1) Repair crack, tear and hole damage in skin by patching as shown on figure 2-78.

(2) Polish out minor corrosion damage, apply primer (C102) and touch up paint to match surrounding area.

(3) Replace wing if skin is wrinkled and buckled to the degree that the wing internal structure is involved.

(4) Replace loose, cocked or missing rivets if no other structural damage is present.

2-65. Wing Bumpers. See figure 2-74.

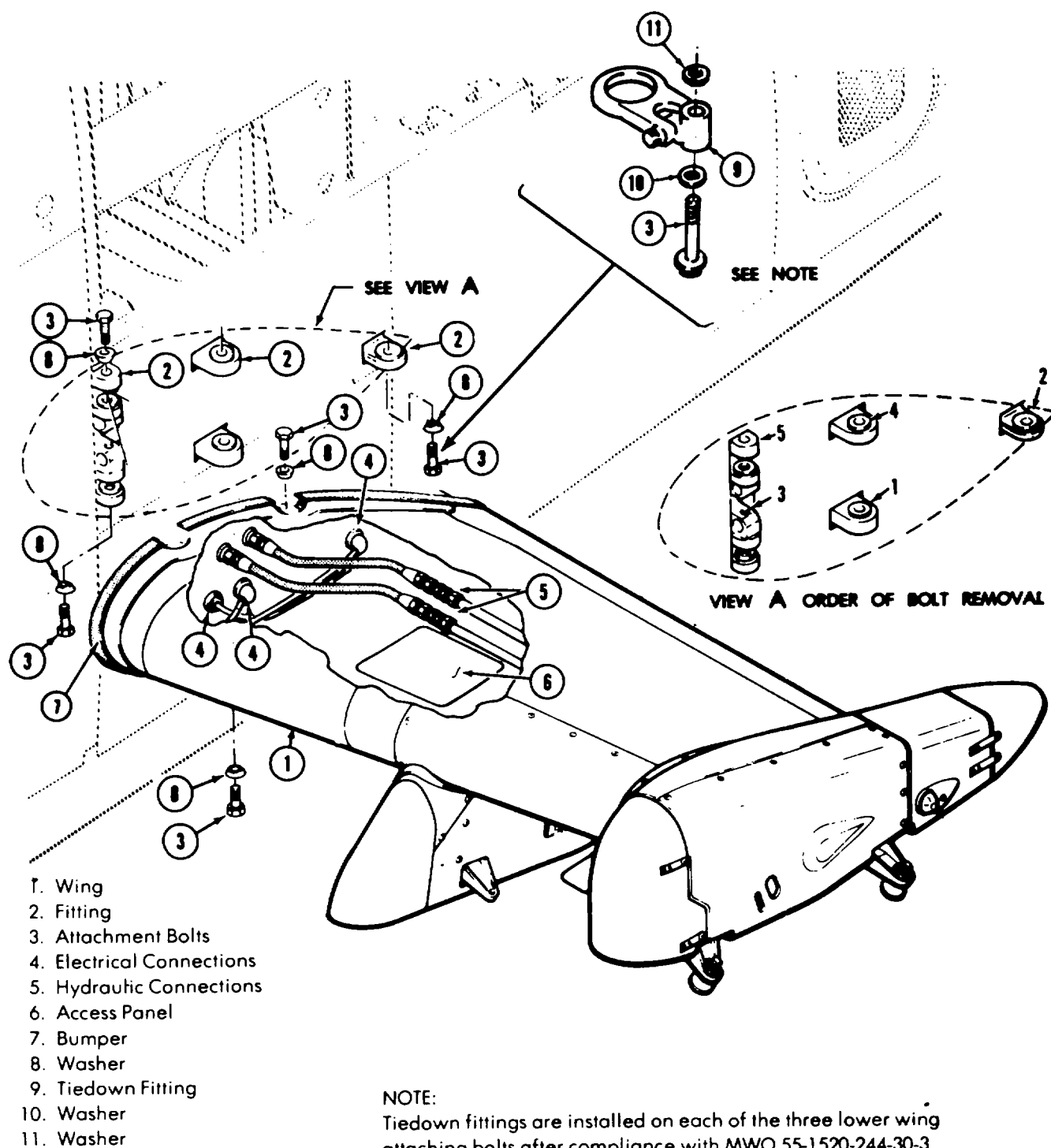
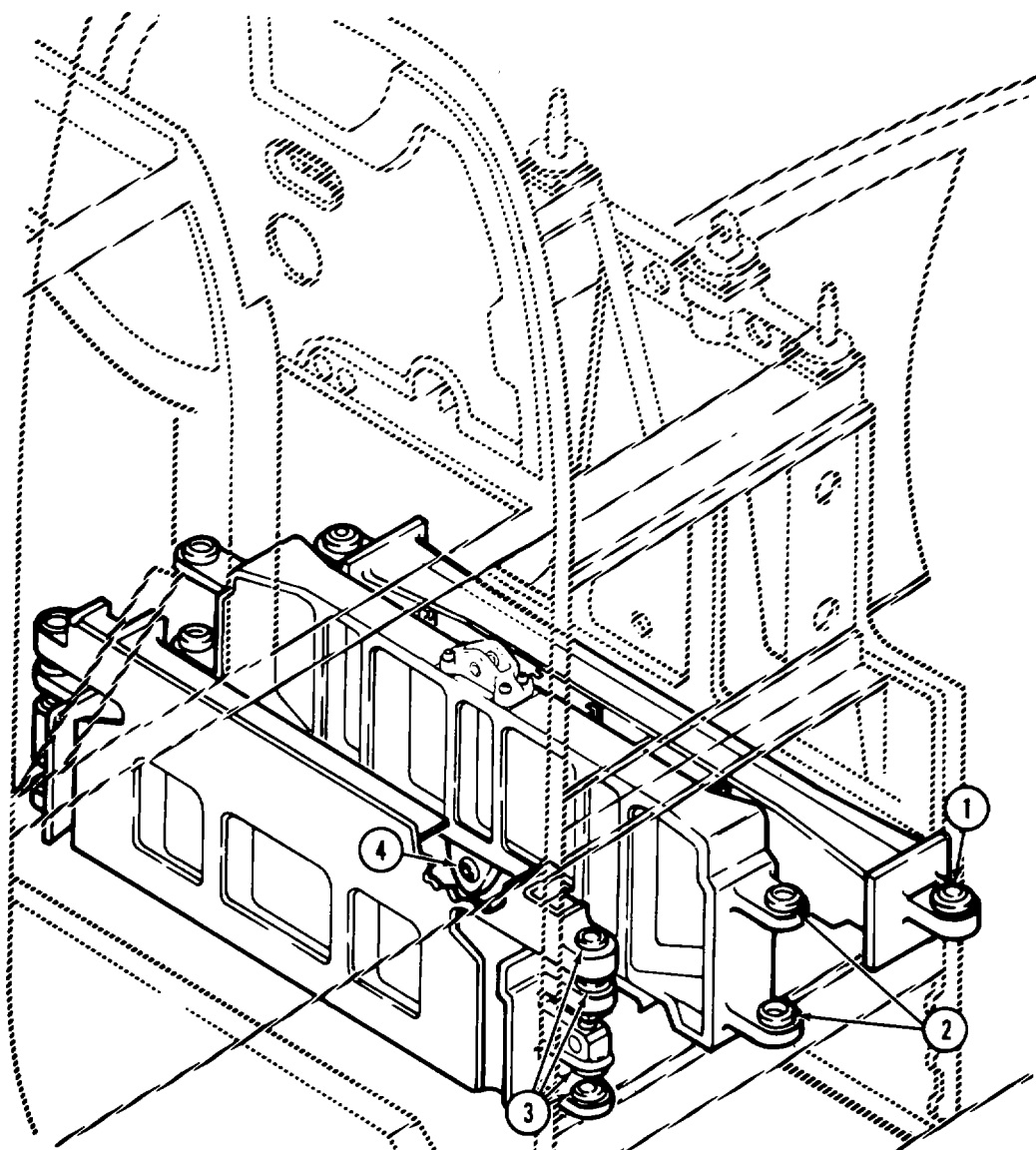


Figure 2-74. Wing installation

Change 16 2-144

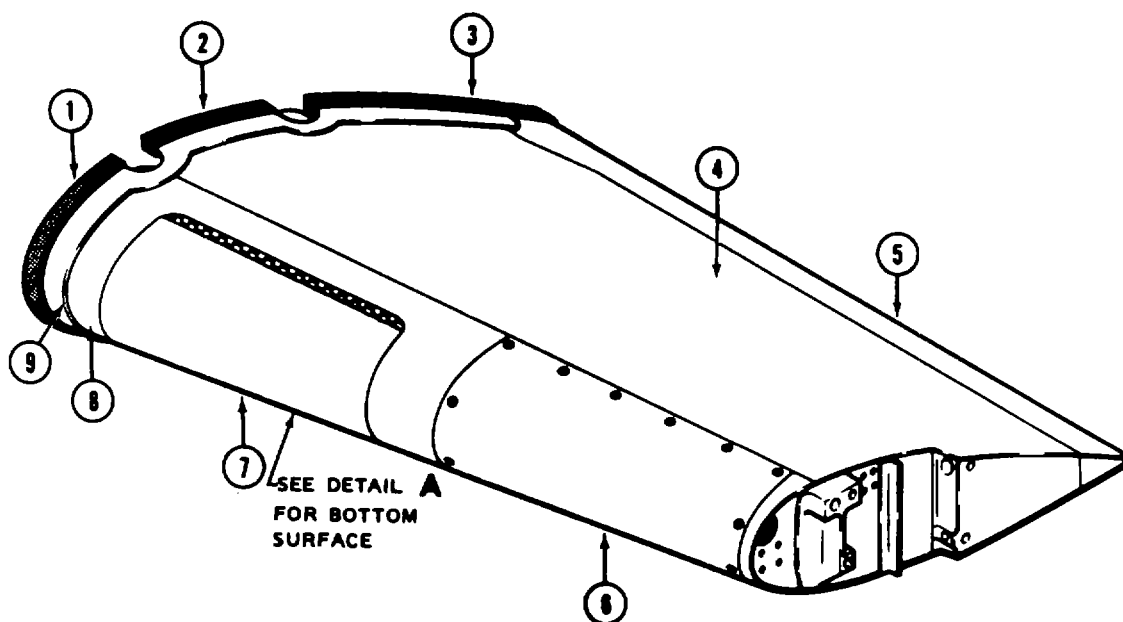
- a. Inspect wing bumper (7) for the following defects:
  - (1) Cuts and tears severe enough to affect function.
  - (2) Debonding.
  - (3) Deterioration.
- b. Replace damaged bumper.
  - (1) Remove wing if not previously accomplished. Refer to paragraph 2-63.
  - (2) Remove faulty bumper from wing with sharp plastic scraper. Clean residual particles of, bumper and adhesive with naphtha (C87). Wipe the area dry with a clean cloth.



ITEM	NOMENCLATURE	P/N	MAXIMUM INSIDE DIAMETER
1	BUSHINGS	209-030-142-11	0.3775
	OR BUSHINGS	209-030-319-1	0.3775
2	BUSHINGS	209-030-319-3	0.6260
	OR BUSHINGS	209-030-141-13	0.6260
3	BUSHINGS	209-030-319-11	0.6260
	BUSHINGS	209-030-319-13	0.6260
	BUSHINGS	209-030-319-15	0.6260
4	BUSHINGS	21-010-15.5-11	0.5001

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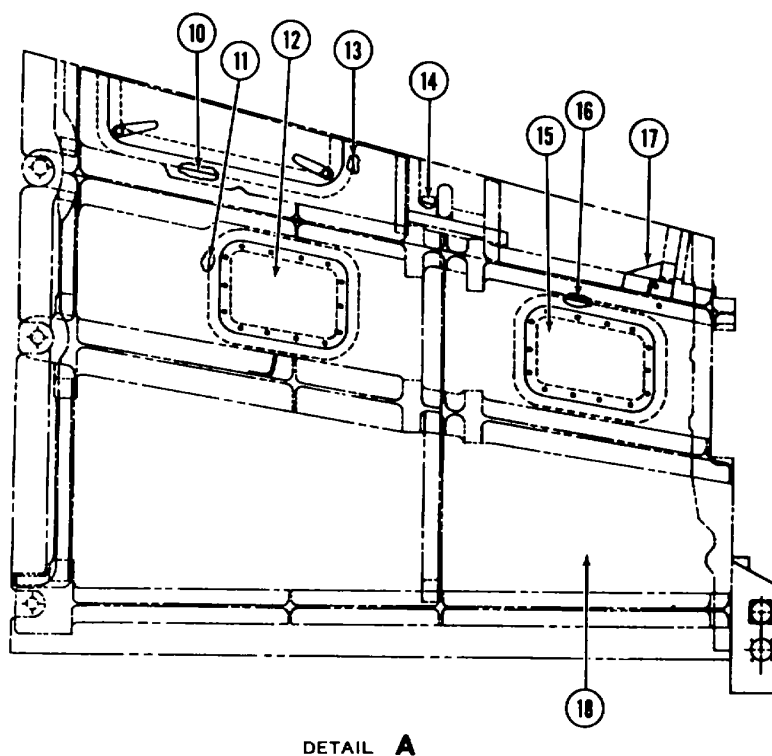
Figure 2-75. Limits chart-bushings



209020-42-1

INDEX NO.	NOMENCLATURE	MATERIAL	SPECIFICATION	CONDITION	THICKNESS
1	Bumper	Rubber synthetic extruded	MIL-R-6855, Class 3, Grade 60		
2	Bumper	Same	Same		
3	Bumper	Same	Same		
4	Skin, upper	7075 Al. alloy	QQ-A-250/13	T6	0.063
5	Fairing, aft	2024 Al. alloy	QQ-A-250/5	T3	0.032
6	Cover	2024 Al. alloy	QQ-A-250/5	T3	0.032
7	Cover	2024 Al. alloy	QQ-A-250/5	T3	0.032
8	Fairing	2024 Al. alloy	QQ-A-250/5	T3	0.032
9	Closure	2024 Al. alloy	QQ-A-250/5	T3	0.040

Figure 2-76. Wing skins, doors and doublers (Sheet 1 of 2)



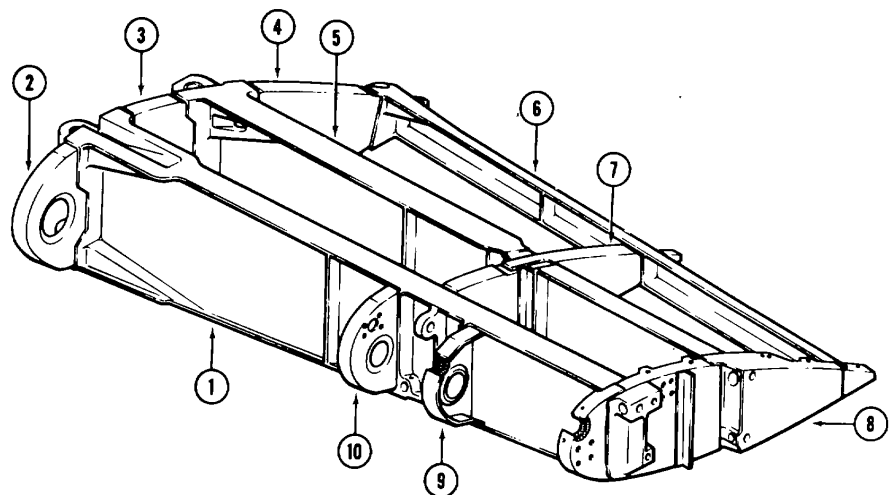
DETAIL A

209020-42-2

INDEX NO.	NOMENCLATURE	MATERIAL	SPECIFICATION	CONDITION	THICKNESS
10	Doubler	2024 Al. alloy	QQ-A-250/5	T3	0.020
11	Doubler	7075 Al. alloy	QQ-A-250/13	T6	0.063
12	Door	7075 Al. alloy	QQ-A-250/13	T6	0.063
13	Doubler	2024 Al. alloy	QQ-A-250/5	T3	0.032
14	Doubler	2024 Al. alloy	QQ-A-250/5	T3	0.040
15	Door	7075 Al. alloy	QQ-A-250/13	T6	0.063
16	Doubler	7075 Al. alloy	QQ-A-250/13	T6	0.063
17	Doubler	2024 Al. alloy	QQ-A-250/5	T3	0.032
18	Skin, lower	7075 Al. alloy	QQ-A-250/13	T6	0.063

Figure 2-76. Wing skins, doors and doublers (Sheet 2 of 2)

Change 2 2-146A/(2-146B blank



ITEM	MATERIAL	SPECIFICATION	CONDITION
1	Al Alloy	QQA-367	T411
2	Al Alloy	QQA-250/5	T0
3	Al. Alloy	QQA-250/5	T0
4	Al. Alloy	QQA-250/5	T3
5	Al. Alloy	QQA-367	T411
6	Al. Alloy	QQA-367	T411
7	Al. Alloy	QQA-250/5	T3
8	Al. Alloy	QQA-250/13	T0
9	Al. Alloy	QQA-250/5	T3
10	Al. Alloy	QQA-250/5	T3

209020-1

Figure 2-77. Wing structure

WARNING

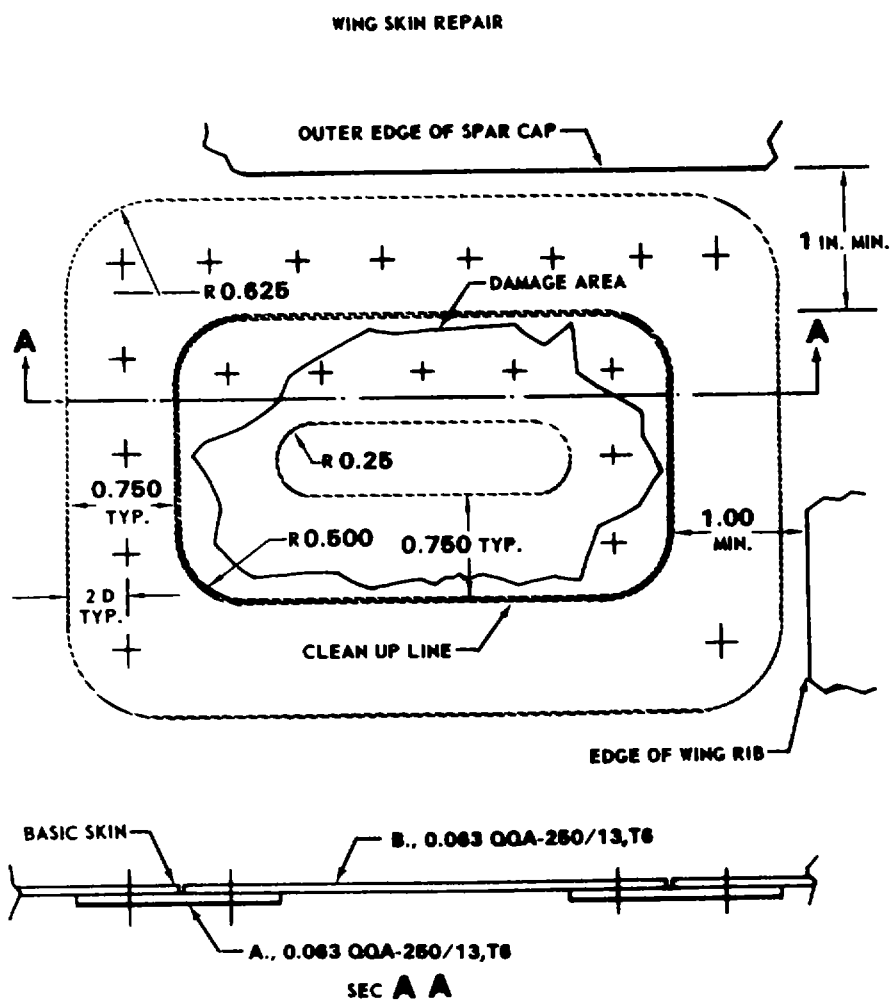
Provide adequate ventilation when using methyl-ethyl-ketone (C87). Avoid breathing solvent vapors and avoid prolonged skin contact.

(3) Sand the area where the new bumper will be installed with 400 grit sandpaper (C 112). Remove residue of sanding with methyl-ethyl-ketone (C87).

(4) Apply a thin coat of adhesive (C14) to mating surfaces of wing and new bumper. Allow the adhesive to dry to tacky stage evidenced by adhering but not transferring to the finger when touched.

(5) Position bumper on the wing. Start at one edge of wing and roll or press the bumper firmly against the wing. Remove excessive adhesive with a cloth dampened with methyl-ethyl-ketone (C87). Allow adhesive to cure for four hours minimum.

(6) Install wing on helicopter. Refer to paragraph 2-63.



NOTE

1. Clean up damage area.
2. Install plates A and B with CR2249, 5/32 or MS20470AD5 rivets at 4D pitch.

NOTE

If patch is installed in blind area, 5/32 CR2249 cherry blind rivets may be used.

209020-7B

Figure 2-78. Wing skin repair.

SECTION V.

(Deleted)

Pages 2-149 thru 2-172, including figure 2-79, deleted

Section VI. CORROSION CONTROL

2-67. Corrosion.

Corrosion is usually attributed to two factors: location of helicopter operations and fabrication process of parts. Corrosion is caused by presence of salt in moist air, certain chemicals in water, elements in the metal, treatment of parts, and contact of dissimilar metals. Corrosion will not normally be as prevalent on painted, clad, or plated surfaces as untreated surfaces. However, corrosion can attack painted parts as moisture can penetrate enamels, lacquers, and primer. Corrosion on painted parts is usually characterized by a scaly or blistered appearance, and sometimes by discoloration of paint. Corrosion on clad or plated parts is recognized by a dulling and pitting of the surface and is sometimes accompanied by a whitish or reddish powdery deposit. The extent and forms of corrosion may be determined by examination and visual inspection. A pointed instrument may be used to make the test. Care should be taken to avoid further damage. In some cases the area must be cleaned to remove scales and powdery deposits before examination can be made. See table 2-1A for forms and types of corrosion and cleaning and treating methods.

a. *Superficial Corrosion.* This type is the least serious on alclad parts. After deposits are removed, an etching will be noticed which results in the clad surface having a series of hills and valleys. Provided the etching has not reached the core, the effect on the strength of the metal is negligible. Corrosion of this

same type on non-clad alloy parts is serious.

b. *Electrolytic Corrosion.* There are two major causes for this type corrosion. Contact between dissimilar metals and condensation. When dissimilar metals come in contact with each other with moisture present, an electrical current flows between the metals producing chemical by-products that dissolve one of the metals. Corrosion caused by condensation is a result of exhaust gases, battery acid, etc., contacting the metal.

c. *Intergranular Corrosion.* This form of corrosion is not easily detected. It is caused by imperfect heat treatment and occurs mostly in unclad structural alloy parts. It is the most dangerous form of corrosion for sheet stock because the strength of the metal can be lowered without visible surface indications.

d. *Stress Corrosion.* This form of corrosion is caused by the action of sustained tension stresses in the presence of a corrosive environment.

e. *Hygroscopic Material Corrosion.* This form of corrosion is caused by such materials as sponge rubber, felt, cork, etc., absorbing water and holding it in contact with the part.

2-68. Corrosion - Removal and Treatment.

Procedures for repairing corroded surfaces are given in the following table.

Table 2-1A. Treatment of Corroded Surfaces

METAL	FORM	CLEANING	TREATMENT
Aluminum Alclad Surfaces	Mild or heavy pitting, staining and superficial etching	Apply biodegradable clearing compound (C39) and rinse with water. Do not use abrasives.	Apply paint as required. On internal surface use one coat of zinc chromate primer, (C102).

Table 2-1A. Treatment of Corroded Surfaces (Cont)

METAL	FORM	CLEANING	TREATMENT
	Mild surface pitting, staining and superficial etching	Clean with biodegradable cleaning compound (C39). Remove products of corrosion with scotch-brite (C 113).	Paint unfinished external surfaces with aluminum pigmented lacquer (C78). Apply paint as required. On internal surfaces use one coat of zinc chromate primer, (C102). Paint unfinished external surfaces with aluminum pigmented lacquer (C78).
Aluminum	Intergranular corrosion	Remove corroded area. Burnish part to remove sharp edges.	Treat with a five percent solution of Potassium Dichromate (C98.1) and allow to dry. Brush off excess crystals. Spray with zinc chromate primer, (C102).
Magnesium	Surface pitting	Remove corrosion with a stiff bristle brush.	Apply chrome-pickle solution (C38) for one minute. Rinse with fresh water.
Steel	Lightly rusted parts. No pitting.	Clean parts with biodegradable cleaning compound (C39) and rinse with fresh water. Use steel wool to remove compound, if necessary.	Apply a coat of zinc chromate primer, (C102) on previously cadmium plated parts.
Badly rusted.	Not applicable.	Replace parts.	

Section VII. STRUCTURAL REPAIR MATERIALS

Table 2-2. Structural Repair Materials.

ITEM NO.	DESCRIPTION	REF. NO. AND FSCM	NSN
1	Aluminum Alloy Sheet, 0.010 inch thick, 2024-T3	QQ-A-250/5 (81348)	
2	Aluminum Alloy Sheet, 0.012 inch thick, 2024-T3	QQ-A-250/5 (81348)	9535-00-167-2274
3	Aluminum Alloy Sheet, 0.016 inch thick, 2024-T3	QQ-A-250/5 (81348)	9535-00-232-0543
4	Aluminum Alloy Sheet, 0.020 inch thick, 2024-T3	QQ-A-250/5 (81348)	9535-00-167-2277
5	Aluminum Alloy Sheet, 0.025 inch thick, 2024-T3	QQ-A-240/5 (81348)	9535-00-167-2278
6	Aluminum Alloy Sheet, 0.032 inch thick, 2024-T3	QQ-A-250/5 (81348)	9535-00-086-9729
7	Aluminum Alloy Sheet, 0.040 inch thick, 2024-T3	QQ-A-250/5 (81348)	9535-00-167-2280
8	Aluminum Alloy Sheet, 0.050 inch thick, 2024-T3	QQ-A-250/5 (81348)	9535-00-232-0569
9	Aluminum Alloy Sheet, 0.060 inch thick, 2024-T3	QQ-A-250/5 (81348)	
10	Aluminum Alloy Sheet 0.070 inch thick, 2024-T3	QQ-A-250/5 (81348)	
11	Aluminum Alloy Sheet, 0.080 inch thick, 2024-T3	QQ-A-250/5 (81348)	9535-00-232-0398
12	Aluminum Alloy Sheet, 0.100 inch thick, 2024-T3	QQ-A-250/5 (81348)	9535-00-288-0675
13	Aluminum Alloy Sheet, 0.020 inch thick, 5052-	QQ-A-250/8 (81348)	9535-00-832-1868
14	Aluminum Alloy Sheet, 0.025 inch thick, 5052-	QQ-A-250/8 (81348)	9535-00-832-1868
15	Aluminum Alloy Sheet, 0.040 inch thick 5052-	QQ-A-250/8 (81348)	9535-00-232-6864

Table 2-2. Structural repair materials (Cont)

ITEM NO.	DESCRIPTION	REF. NO. AND FSCM	NSN
16	Aluminum Alloy Sheet, 0.025 inch thick, 6061-T6	QQ-A-250/11 (81348)	9535-00-250-6502
17	Aluminum Alloy Sheet, 0.032 inch thick, 6061-T6	QQ-A-250/11 (81348)	9535-00-085-4133
18	Aluminum Alloy Sheet 0.010 inch thick, 7075-T6	QQ-A-250/13 (81348)	
19	Aluminum Alloy Sheet 0.012 inch thick, 7075-T6	QQ-A-250/13 (81348)	9535-00-236-7091
20	Aluminum Alloy Sheet, 0.016 inch thick, 7075-T6	QQ-A-250/13 (81348)	9535-00-084-4438
21	Aluminum Alloy Sheet, 0.020 inch thick, 7075-T6	QQ-A-250/13 (81348)	9535-00-086-9808
22	Aluminum Alloy Sheet, 0.025 inch thick, 7075-T6	QQ-A-250/13 (81348)	9535-00-086-9864
23	Aluminum Alloy Sheet, 0.032 inch thick, 7075-T6	QQ-A-250/13 (81348)	9535-00-249-5811
24	Aluminum Alloy Sheet, 0.040 inch thick, 7075-T6	QQ-A-250/13 (81348)	9535-00-084-4581
25	Aluminum Alloy Sheet 0.050 inch thick, 7075-T6	QQ-A-250/13 (81348)	9535-00-086-9465
26	Aluminum Alloy Sheet 0.063 inch thick, 7075-T6	QQ-A-250/13 (81348)	9535-00-088-6599
27	Aluminum Alloy Tubing (4" Dia.) 0.083 thickness, 2024-T3	QQ-A-300-3B	
28	Magnesium Alloy	AMS4350	
29	Rivet, Blind, Flush Head	CR2263-4-1 (11815)	
30	Rivet, Blind, Flush Head	CR2248-4 (11815)	
31	Rivet, Blind, Flush Head	CR2248-6-3	5320-00-916-9534
32	Rivet, Universal	CR2249-6-3 (11815)	

Table 2-2. Structural repair materials (Cont)

ITEM NO.	DESCRIPTION	REF. NO. AND FSCM	NSN
33	Rivet, Blind, Flush Head, Monel Sleeve and Inconel Nickle Spindle	NAS1739MW5 (80205)	
34	Rivet, Blind, Protruding Head	NAS1738B-4 (80205)	
35	Rivet, Blind, Protruding Head	NAS1738B-5 (80205)	
36	Rivet, Blind, Protruding Head	NAS1738B-6 (80205)	
37	Rivet, Blind, Protruding Head, Locked Spindle	NAS1398-6 (80205)	
38	Rivet, Blind, Structural Pull, Stem, Protruding Head	MS20600BK-1 (80205)	
39	Rivet, Blind, Structural Pull Stem, Protruding Head	MS20600-B4-W1 (80205)	5320-00-582-3273
40	Rivet, Blind, Structural Pull Stem, Protruding Head	MS20600M6 (80205)	
41	Rivet, Blind, Universal Head	CR2249-3 (11815)	
42	Rivet, Blind, Universal Head	CR2249-4-1 (11815)	5320-00-866-6114
43	Rivet, Blind, Universal Head	CR2249-4-5 (11815)	5320-00-349-5132
44	Rivet, Blind, Universal Head	CR2249-6-3 (11815)	5320-00-779-0300
45	Rivet, Hi-Loc	HL2086W-5 (73197)	
6	Rivet, Hi-Loc	HL2086W-6 (73197)	
47	Rivet, Solid, Aluminum Alloy, Flat Head	MS20426AD3 (80205)	
48	Rivet, Solid, Aluminum Alloy, Flat Head	MS20426AD4 (80205)	5320-00-117-6948

Table 2-2. Structural repair materials (Cont)

ITEM NO.	DESCRIPTION	REF. NO. AND FSCM	NSN
49	Rivet, Solid, Aluminum Alloy, Flat Head	MS20426AD5 (80205)	
50	Rivet, Solid, Aluminum Alloy, Flat	MS20426DD4 (80205)	
51	Rivet, Solid, Aluminum Alloy, Universal Head	MS20470AD3 (80205)	
52	Rivet, Solid, Aluminum Alloy, Universal Head	MS20470-AD4 (80205)	
53	Rivet, Solid, Aluminum Alloy, Universal Head	MS20470-AD5 (80205)	
54	Rivet, Solid, Aluminum Alloy, Universal Head	MS20470-DD6 (80205)	
55	Rivet, Solid, Universal Head	MS20615-3M3 (80205)	
56	Rivet, Solid, Universal Head	MS20615-3M4 (80205)	
57	Rubber, Type II, Grade A Soft, 0.125 x 0.190	MIL-R-6130	
58	Steel Sheet, Stainless, 0.016 inch thick	MIL-S-5059A	
59	Steel Sheet, 0.032 inch thick, N-155	9515-00-632-2982	
60	Steel Sheet, 0.063 inch thick, 4130 COND-N	MIL-S-18729	
61	Titanium	M/L-T-9046 Type 1, Comp. C	
62	Rivnut P/N 2R1393		

CHAPTER 3

ALIGHTING GEAR

3-1. Landing Gear.

The landing gear consists of two skid tubes (2, figure 3-1) and two arched cross tubes (8) of formed aluminum alloy. The assembly is attached to the lower fuselage structure with clamps at four points. The part of the cross tubes extending from the fuselage are enclosed with thermoplastic fairings (5), which are streamlined to reduce aerodynamic drag. (It is permissible to fly this aircraft with both cross tube fairings removed. No additional flight restrictions will be required when both fairings are removed.) The lower fuselage openings, to accept the cross tubes, are covered with aluminum alloy fairings. Eyebolts (13) are provided on the skid tubes (2) to accommodate ground handling wheels. To prevent abrasion and damage from contact with the ground, replaceable steel skid shoes (3) cover the bottom side of the skid tubes.

Pre-Maintenance Requirements for Landing Gear

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	Jacks
Minimum Personnel Required	Three
Consumable Materials	(C47) (C87) (C102) (C107) (C118)
Special Environmental Conditions	None

a. Removal. Complete landing gear can be removed as an assembly, or skid tubes (2, figure 3-1) and cross tubes (8) can be removed separately.

(1) To remove complete landing gear: (a) Jack or hoist helicopter off ground. If using jacks, align legs to allow clearance for removing landing gear. (Refer to Chapter 1.)

(b) Remove step (6), fairing (5), and seal (7). Remove covers (10) under cross tubes.

(c) Remove bolts and four supports (11) and (12) and lower landing gear to ground. Turn assembly to clear jacks and slide from under fuselage.

(2) To remove fairing from cross tubes (8), remove screws and detach from cross tubes.

(3) To remove skid tubes from cross tubes, remove screws from saddles (4) and detach skid tubes.

b. Inspection.

(1) Covers (10, figure 3-1) for cracks, holes and corrosion. Standard structural repair procedures are acceptable if repairs are made.

(1)A Inspect support assemblies (11 and 12) as follows:

(a) Presence of deteriorated or worn rubber bumpers is not cause to replace the support assembly. Missing rubber bumpers is cause to change the support assembly:

(b) Inspect metal portion of the support assemblies for cracks, distortion, and elongated holes. Obvious damage is cause to replace the support assembly.

(2) Landing gear skid tubes (2), skid tubes in area between cross tube saddles, and cross tubes (8) for scratches, scuffs, nicks, dents and holes.

NOTE

Smooth dents, not exceeding 0.25 inch in depth and 1.0 TO 1.2 inches in diameter, between the cross tube saddles may be disregarded.

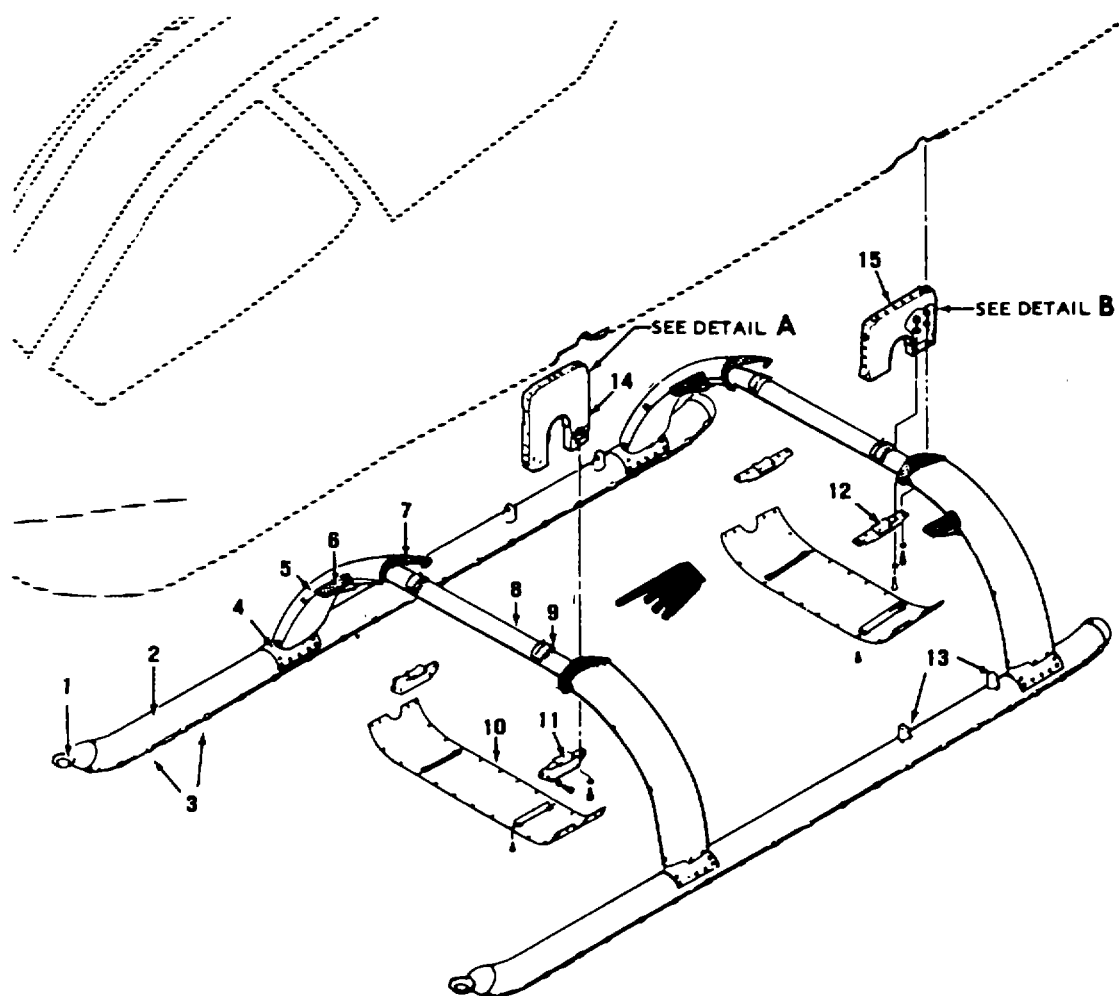
(3) Skid shoes (3) for damage, wear, and loose or missing fasteners.

(4) Cross tube retainers (9) for looseness and for cracks and the cross tubes for cracks per (5) below.

(5) If it is suspected that the cross tubes are cracked due to a hard landing or other cause, prepare the cross tubes for inspection and perform same as outlined below. (Figure 3-3 specifies the minimum areas that must be evaluated.)

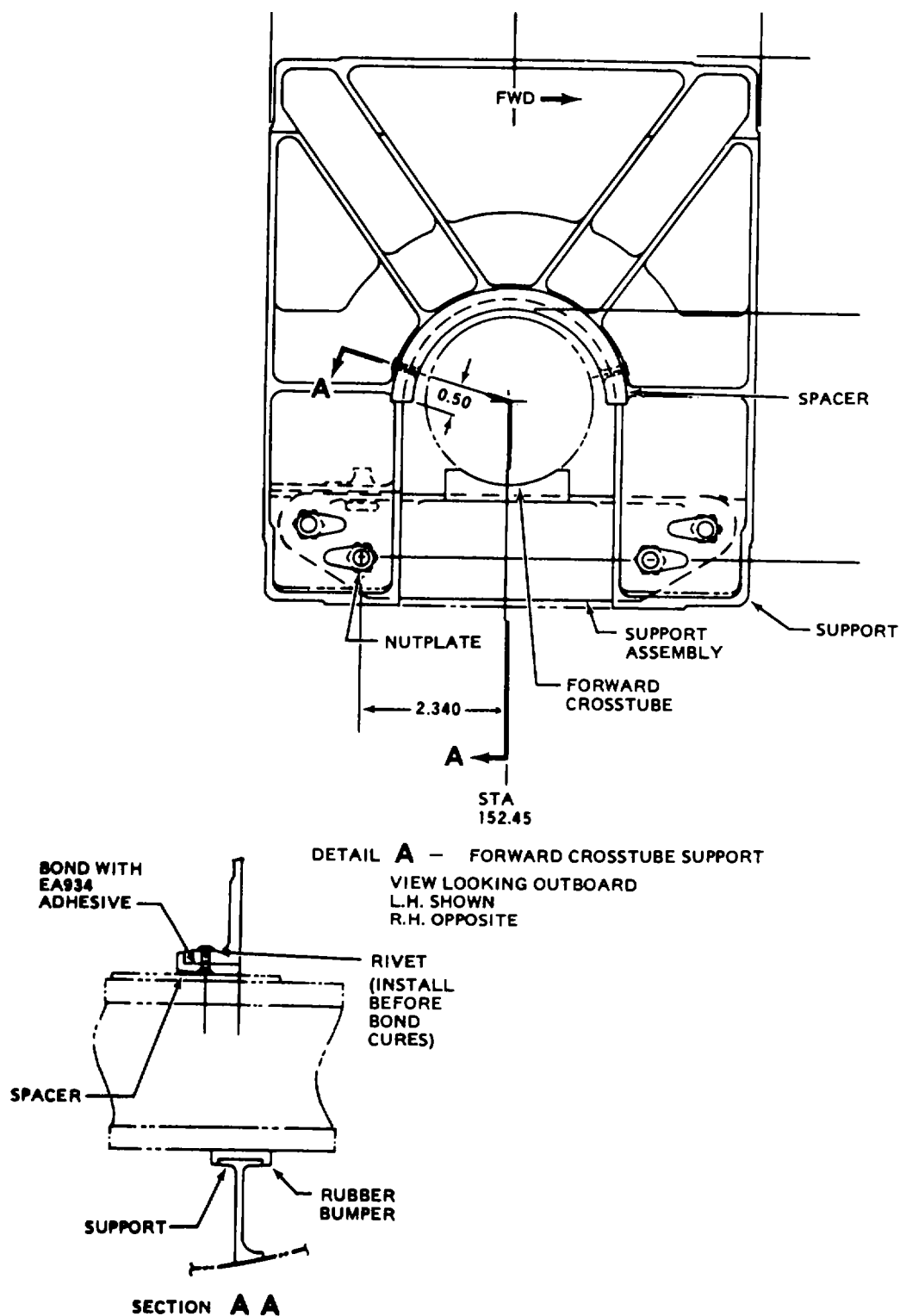
NOTE

The cross tubes may be inspected by fluorescent dye penetrant inspection (TM 43-0103, Chapter 6), ultrasonic inspection (TB 55-1520-243-50-2), or radiographic inspection (TM 43-103, Chapter 5). Replace cross tube or cross tube saddle if any cracks are detected



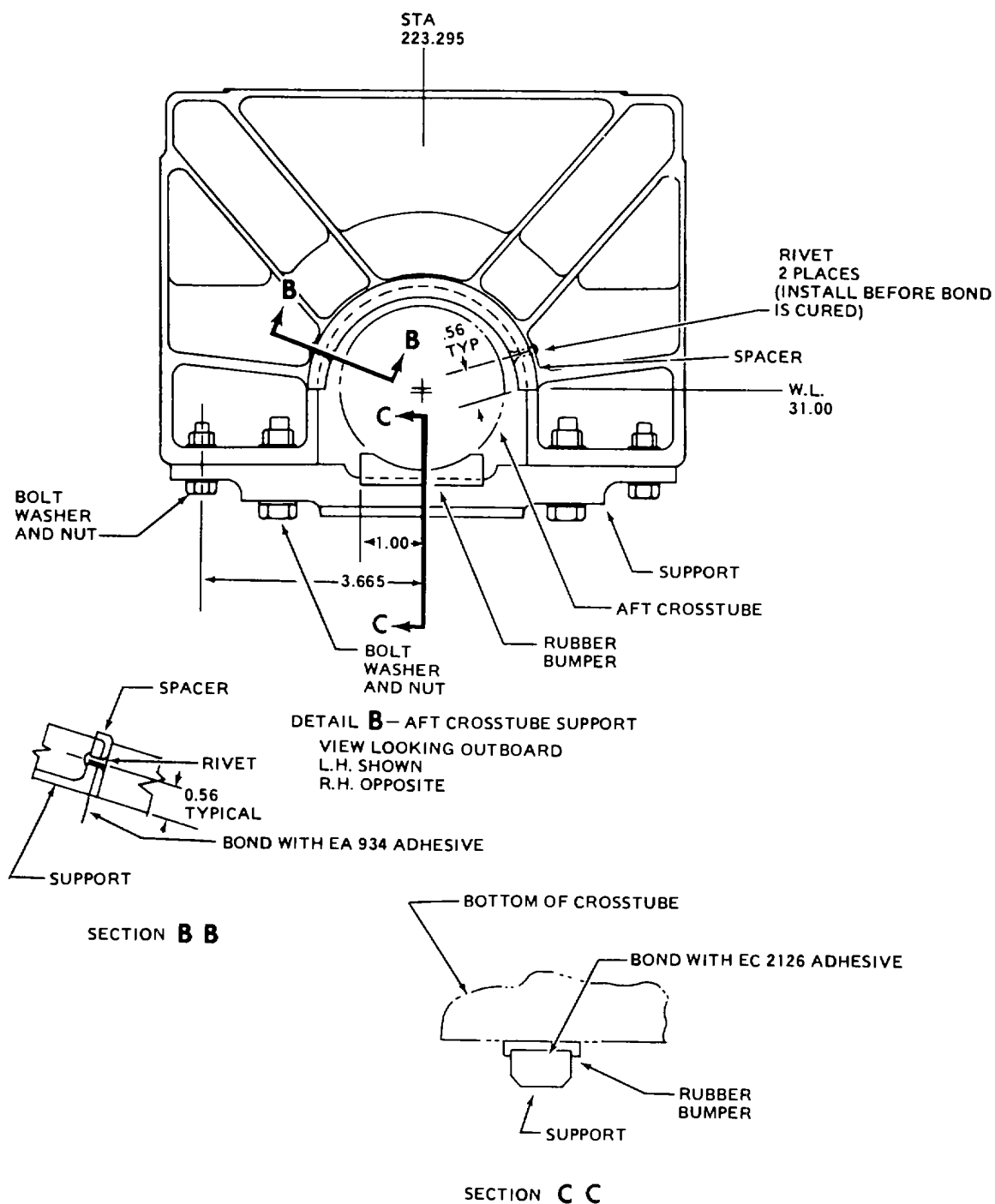
1. Tow ring	9. Retainer
2. Skid tube	10. Cover
3. Skid shoes	11. Support
4. Saddle	12. Support
5. Fairing	13. Eyebolts
6. Step	(for ground handling gear)
7. Seal	14. Forward cross tube support
8. Cross tube	15. Aft cross tube support

Figure 3-1. Alighting Gear and Support Installation (Sheet 1 of 3)



209050-24-2

Figure 3-1. Alighting Gear and Support Installation (Sheet 2 of 3)



209050-24-3

Figure 3-1. Alighting Gear and Support Installation (Sheet 3 of 3)

3-2B

Change 2

(a) Remove retainers (9, Figure 3-1). Prepare areas in Figure 3-3 for dye penetrant inspection.

NOTE

The success and reliability of penetrant inspection depends upon the thoroughness with which inspector prepares the part from the pre-cleaning process all the way through to the final interpretation of the indications. All inspections should be with the fluorescent penetrant (Type I, Method C) in strict accordance with TM43-0103.

WARNING

Prolonged or repeated inhalation of vapors or powders may result in irritation of the mucous membrane areas of the body. Provide adequate ventilation.

WARNING

Continual exposure to penetrant inspection materials may cause skin irritation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

WARNING

Injury to eyes and skin may occur when blacklight is not used in accordance with manufacturer's inspections. Unfiltered light sources (if filter is required) may possibly damage the eyes.

WARNING

Temperatures in excess of 120 degree F may cause bursting of pressurized cans and injury to personnel.

WARNING

Volatile fumes may occur, creating both a fire and health hazard.

NOTE

Paint will not be removed by any mechanical means under any circumstances because it may mask over any potential surface cracks.

(b) With a soft hair brush, apply

Change 23

MEK (Methyl- Ethyl-Ketone (C74)) or paint remover (TTR) 248B) and remove the paint.

(c) Clean the prepared surfaces with a soft cloth.

(d) Apply a fluorescent dye penetrant to the prepared surfaces from either a spray can or with a soft hair brush and in strict conformance to the procedures specified in TM 43-0103, Chapter 6.

(e) Allow penetrant to dwell for a minimum of 30 minutes.

(f) Clean off all excess penetrant in accordance with TM 43-0103, standard procedures. (Check for complete excess penetrant removal from surface by using a blacklight.)

(g) Apply applicable developer consistent with Type I, Method C penetrant method in TM 43-0103.

(h) Inspect suspected area with blacklight source in subdued white light.

NOTE

Normal manufacturing machining marks may be observed on the tube surfaces. These will not be cause of part rejection.

(i) Clean tube with solvent and wipe dry. U) Recoat cross tube surfaces to be covered by retainer plates with sealant (C116). Install retainer plates with rivets coated with primer (C102).

(k) Repaint cross tubes with primer (C102).

(6) Fairings for cracks and security.

(7) After hard landing or overloading, check landing gear to determine if cross tubes (8, figure 3-1) have taken a permanent set at excessive spread.

(a) Position the helicopter on a smooth surface.

(b) Raise the helicopter off the surface with jacks removing all weight from the landing gear.

(c) Level the helicopter. (Refer to Chapter 1.)

(d) Measure the distance between the cross tube retainers and divide that distance to determine the helicopters center line. (See figure 3-2.)

NOTE

Distance should be **38 to 40 inches** from inside edge of skid tube to plumb line. If distance exceeds **40 inches** from the inside edge of either skid tube, replace cross tubes.

(e) Drop a plumb line from helicopter center line to ground, or floor surface. Measure from plumb line to the inside of each skid tube at cross tube locations.

(f) Lower helicopter to surface and remove jacks.

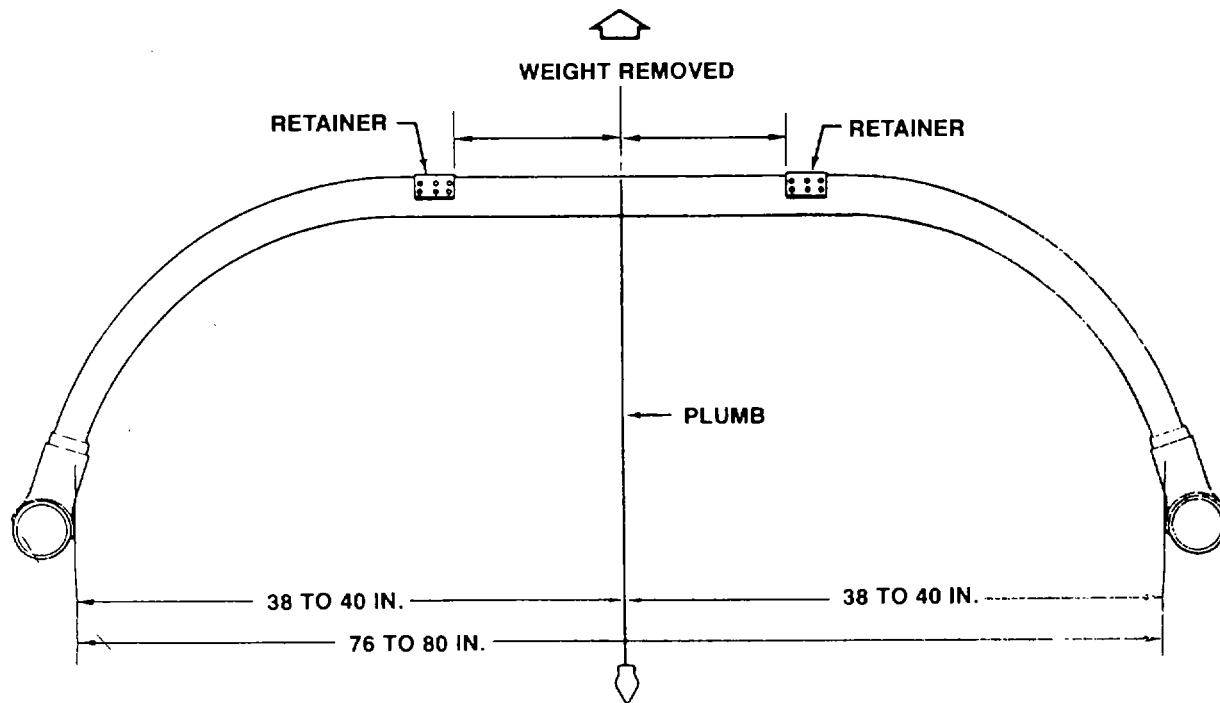


Figure 3-2. Checking deflection of cross tube

c. *Repair or Replacement.*

(1) *Cross tubes:*

(a) Minor scratches, scuffs, and nicks may be polished out to depth of damage, but not to exceed depth limits as indicated in figure 3-3.

(b) All other damage requires replacement of cross tubes.

(c) Replace cross tubes if deflection dimension exceeds inspection requirements. (Refer to paragraph 3-1, step b.)

(1)A *Cross tube support assembly.*

(a) All traces of fuel, oil, and grease will be removed. Clean support assembly with MEK (C87) and dry.

(b) Apply adhesive EC-2126 (C21A) to support assembly and allow adhesive to dry tack free. Align rubber bumper on support assembly and hold firm contact pressure. Place support assembly in oven and heat to 250° to 260°F.

(c) Allow support assembly to cool before installation on crosstubes.

(2) *Skid tubes:*

(a) Scratches up to 0.03 inch deep and 1.0 to 1.2 inches long, running directly across top of tube between cross tube saddles may be polished out. Scratches beyond these limits require repair as shown in paragraph 3-2.

(b) Dents over 0.25 inch deep and 1.0 to 1.2 inches in diameter between the cross tube saddles require repair as shown in paragraph 3-2.

(c) Holes in skid tubes require repair as shown in paragraph 3-2.

(d) Replace skid tubes which show excessive wear or damage.

(3) Replace skid shoes if damaged or if they no longer protect skid tube. Replace missing fasteners.

NOTE

Improper length screws and method of removing and installing skid tube assemblies may cause rivnuts to come loose.

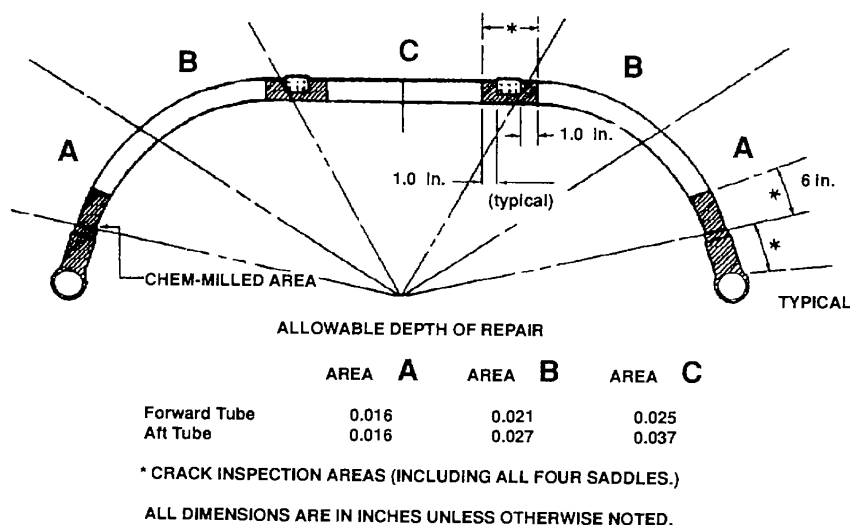
(4) Ensure proper alignment of saddle and skid tube to prevent damage to retaining screw threads.

(5) Use C clamps on forward and aft ends of saddle (each side of cross tube), clamping skid tube on lower side and tighten to prevent movement of parts.

(6) Use new retaining screws on each side of the saddle when replacing skid tube.

(7) Apply sealing compound (C118) to rivnut and skid tube surfaces for installation.

(8) Repair damaged fairings as follows:



209050-15A

Figure 3-3. Damage Limits - Crosstubes

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

(a) Clean area around the crack perimeter, using a clean cloth dampened with methyl-ethyl-ketone (C87). Lightly sand area using fine grade of sandpaper (C112). Clean the surface as described above with methyl-ethyl-ketone after sanding.

(b) Two layers of fiberglass are required. Measure and cut one fiberglass patch from fiberglass cloth (C47) to cover cracks by a minimum of one inch around the perimeter. Cut a second patch to overlap the first patch by one inch on all sides.

(c) Using a brush, apply a coat of epoxy (C107) to the cleaned surface of fairing to match size of patch. Apply fiberglass patch and brush epoxy to cover patch completely, using brush to work out air bubbles.

(d) Apply another coat of epoxy (C107) to cover area for second patch. Apply fiberglass patch and brush epoxy to completely cover and saturate fiberglass patch. Work out air bubbles.

(e) Allow epoxy (C107) to cure for four hours at room temperature prior to flying helicopter. The complete cure time for epoxy is 24 hours at room temperature. Refinish repaired area to match surrounding surface.

(f) There is no limit to the number, size, or length of cracks allowed to be repaired.

d. Installation.

CAUTION

It is possible to erroneously interchange the fore and aft crosstubes during assembly to the skid tubes. Consult TM 55-1520-234-23P to ensure the tubes are installed in the proper

location.

(1) If separated, assemble skid tubes (2, figure 3-1) to cross tubes (8). Align holes in cross tube saddles (4) with holes in skid tubes and install screws.

(2) Lift and support landing gear in position in fuselage fittings.

NOTE

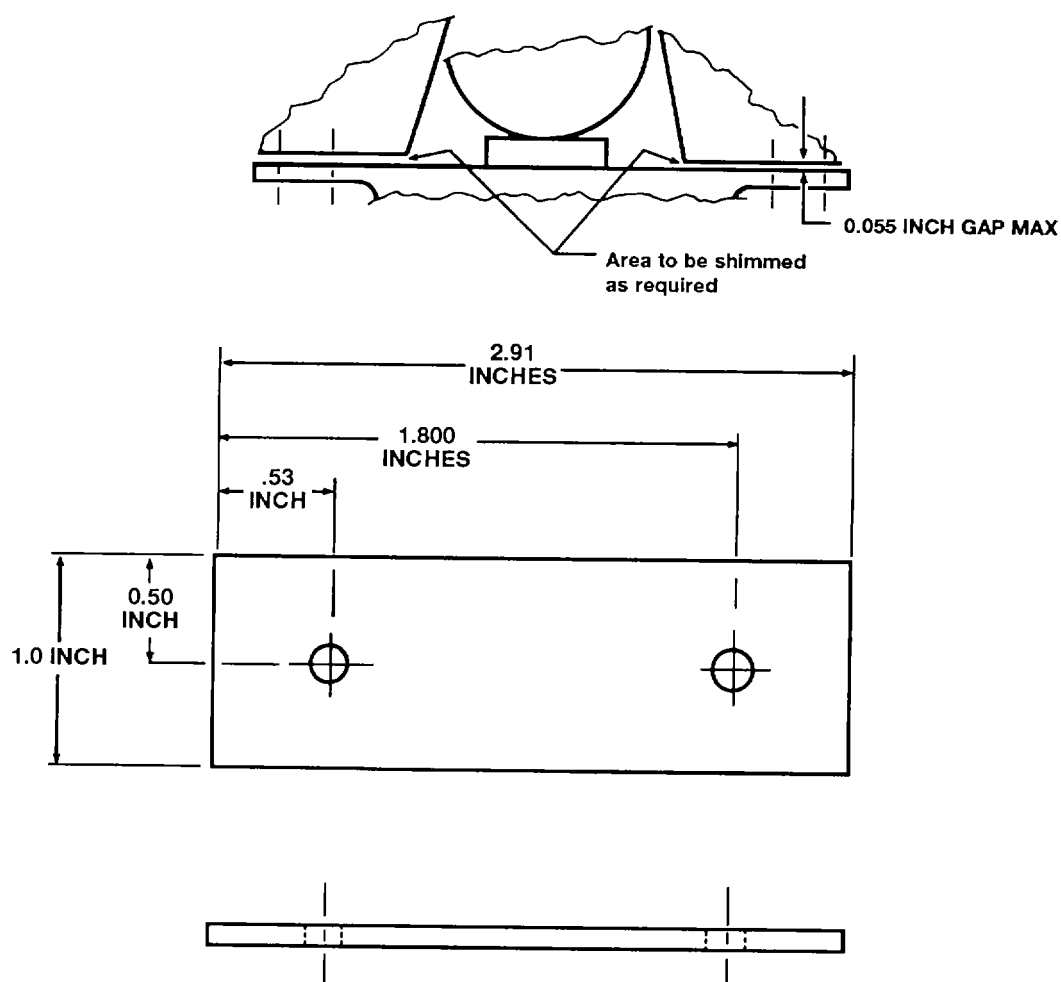
Prior to torque application, the gap between the top of the support assembly and the bottom of the fuselage at the crosstube mounting area should be in accordance with figure 3-3A. The gap shall be measured with appropriate feeler gage. If the gap is larger than recommended, fabricate shims per figure 3-3A. If the gap is smaller than recommended, the rubber pad is worn and the cap should be replaced. Tighten bolts to a snug fit, while aircraft is still supported by jacks or hoists. Depending on thickness of shim required, longer bolts of the same part number may be needed to install caps.

(3) Attach each forward support with one bolt, installed up through support into upper fitting. Tighten only enough to align four mounting holes and install four bolts from outboard side, tighten 60 TO 80 inch-pounds torque. No further tightening of vertical bolt is required.

NOTE

Check for minimum of 0.020 inch gap between support bracket assembly at vertical bolt location and support of aircraft. This is to insure there is no preloaded shear stress on lateral support bolts.

(4) Install aft support (12) with four bolts and washers up through support and install four nuts with washers. Tighten bolts to a snug fit.



Fabricate Shim from Aluminum Alloy 2024T3

Figure 3-3A. Crosstube Shim Fabrication

(5) Lower helicopter to ground and torque aft support bolts **70 TO 80** inch-pounds.

(6) Install seal (7), fairing (5), step (6), and covers (10)).

3-2. Skid Tube Repair.

a. *Damage Repairable by Patching.* Repair scratches running directly across top of tube more than **0.03** inch deep and **1.2** inches to a maximum of **4.0** inches long, dents more than **0.25** inch deep and 1.2 inches to a maximum of **4.0** inches across and any holes up to **4.0** inches in diameter through one surface of tube only as follows:

(1) Lift helicopter and remove skid tube in accordance with instructions contained in paragraph 3-1. a.

(2) Polish out scratches, trim and smooth rough edges of holes.

(3) Fabricate a patch from 0.100 inch thick aluminum alloy (item 12, table 2-1) of the required size as shown in figure 34 or make a patch from material salvaged from scrap skid tube.

(4) Lay out the rivet hole pattern and form patch to fit contour of skid tube as shown in figure 34.

(5) Locate and securely clamp patch to skid tube and drill rivet holes with a No. 10 drill.

(6) Rivet patch in place using blind rivets (item 32, table 2-1).

(7) Apply primer and lacquer in accordance with painting instructions in TB 746-93-2.

(8) Install skid tube in accordance with paragraph 3-1. d. and lower helicopter.

b. *Damage Repairable by Insertion.* Repair dents and holes on either top or bottom side of skid tube which is greater than FOUR inches across in any direction by inserting a splice of new tubing. Such repairs are restricted to the areas shown in figure 3-4.

(1) Jack helicopter and remove skid tube in accordance with instructions in paragraph 3-1.a.

(2) Cut out damaged portion of skid tube with hand or powered metal saw.

(3) Fabricate an insert of the required length from tubing 0.083 inch wall thickness (item 27, table 2-1) or from scrap skid tube, as shown in figure 34.

(4) Fabricate splice plates as follows:

(a) Cut four plates to the required dimensions as shown in figure 3-4 from sheet stock 0.100 inch thick (item 12, table 2-1), or use material salvaged from scrap skid tube.

(b) Form two plates to fit the outside diameter of skid tube and the other two plates to fit the inside diameter as shown in figure 34.

(5) Apply a coat of primor (C102) to plates and tubes.

(6) Lay out rivet hole pattern on upper splice plates and lower side of tubes as shown in figure 3-4.

(7) Maintain proper alignment and securely clamp splice plates and tubes together.

(8) Drill rivet holes in plates and tubes with No. 10 drill. Countersink lower holes with 100 degree countersink. Install blind rivets (item 31, table 2-1) in upper half of splice and flush rivets (item 31, table 2-1) in lower half of splice as shown in figure 3-4.

(9) If repair involves removal of skid shoe bolt sleeves, mark sleeve locations using skid shoe as a template and install new sleeves.

(10) Apply a touch-up coat of primer followed by lacquer in accordance with TB 746-93-2.

(11) Install skid tube in accordance with paragraph 3-1. d., and lower helicopter.

c. *Damage Necessitating Replacement.* Damage to the skid tubes beyond the limits given for repairs by patching or insertion as shown in figure 3-4 requires replacement of the skid tube.

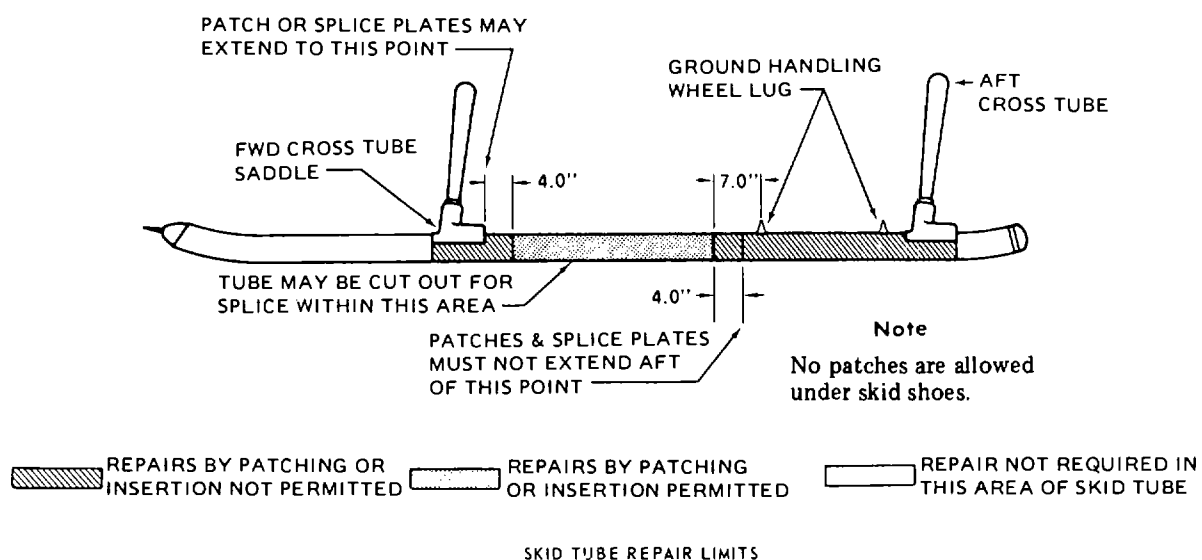
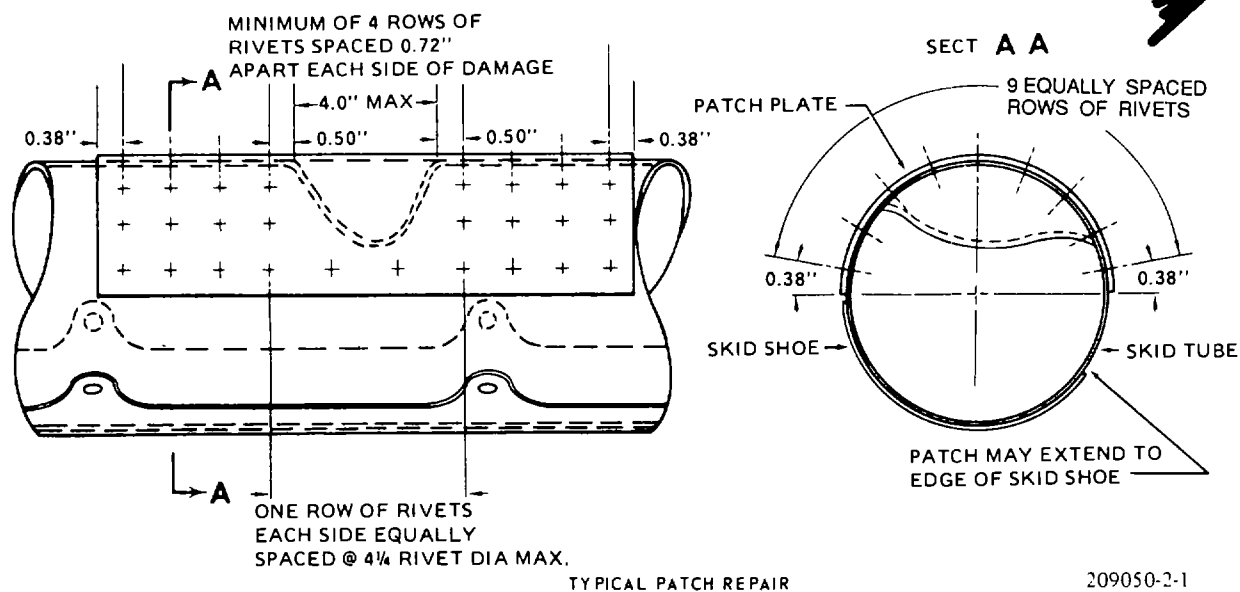


Figure 3-4. Skid tube repairs (Sheet 1 of 2)

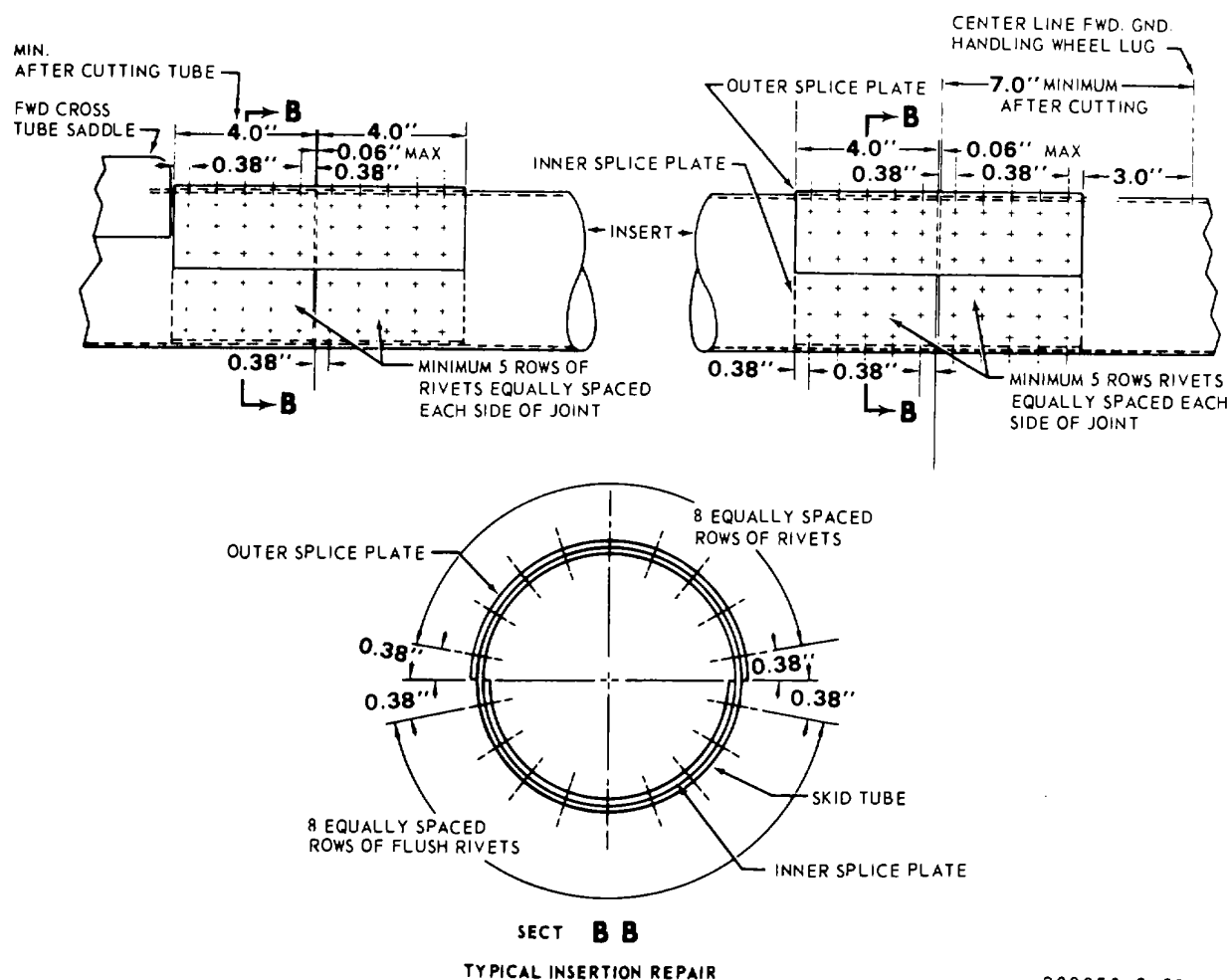


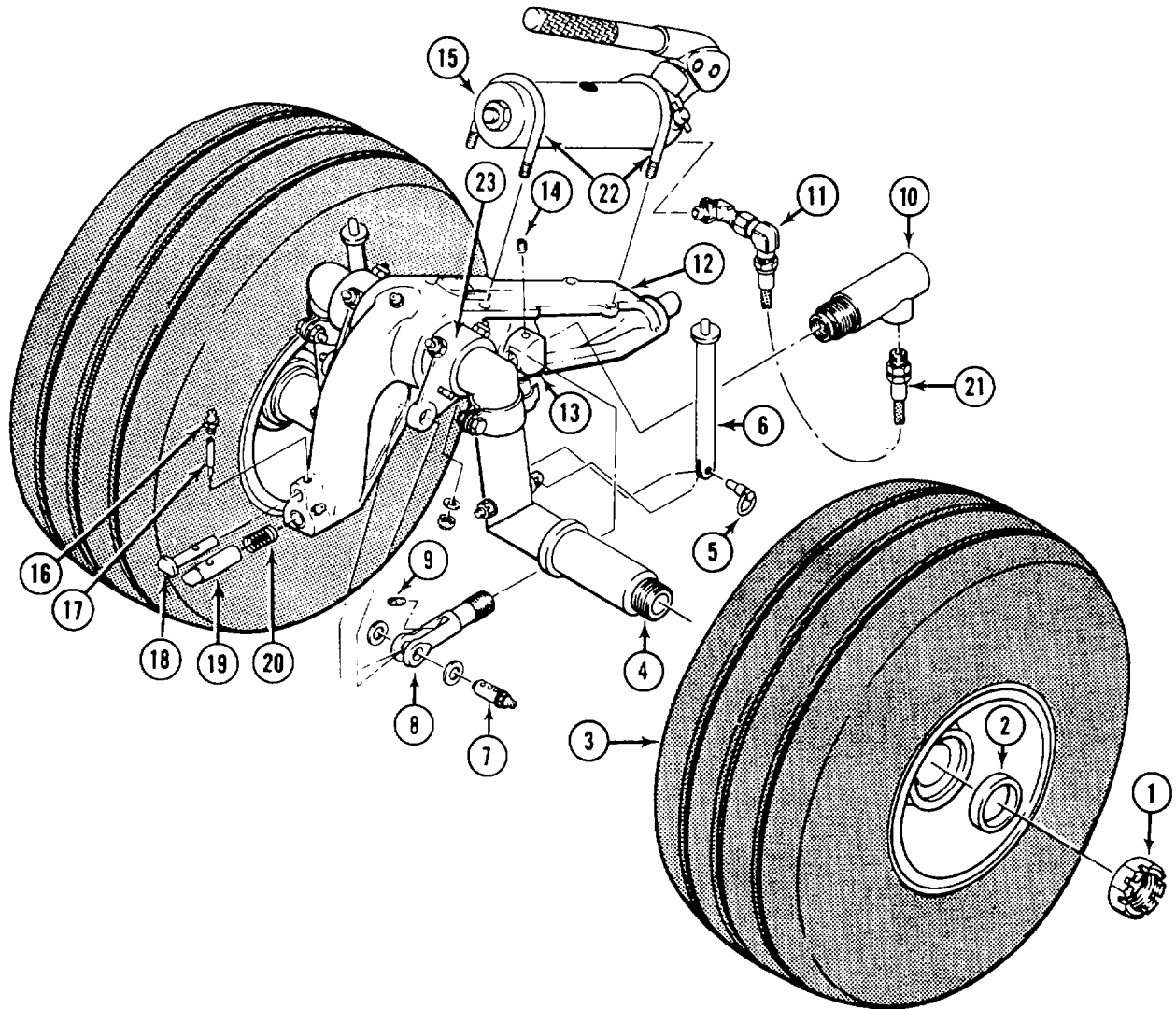
Figure 3-4. Skid tube repairs (Sheet 2 of 2)

3-3. Ground Handling Wheel Actuating Mechanbm.

Two ground handling wheel assemblies are provided for quick mounting on landing skids to facilitate moving aircraft on ground. Each assembly consists of two wheels on an offset axle, a supporting cradle, and a hand-operated hydraulic jack with two rams which actuate axle to extend or retract wheels. (See figure 3-5.) The cradle is mounted on eyebolts on landing skid by means of a fixed rear pin and a spring-loaded front pin.

Pre-Maintenance Requirements For Ground Handling Wheels

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	T15) (T16)
Test Equipment	None
Support Equipment	None
Minimum Personnel	One
Required	
Consumable Materials	(C45) (C74) (C124)
Special Environmental	Dust Free
Conditions	



205050-2A

1. Nut	9. Set-Screw	17. Connecting Pin
2. Retainer	10. Hydraulic Ram	18. Release Pin
3. Wheel Assembly	11. Hose and Fittings	19. Support Pin
4. Axle	12. Cradle Assembly	20. Spring
5. Ball-Lock Pin	13. Trunnion	21. Hose
6. Support Rod	14. Set-Screw	22. U-Bolts
7. Lubricator Pin	15. Hydraulic Pump	23. Ram Arm
8. Clevis	16. Lubricator Fitting	

Figure 3-5. Ground handling wheels

a. *Disassembly.*

(1) Remove ball-lock pin (5, figure 3-5) and remove support rod (6) from axle (4).

WARNING

Deflate tire prior to wheel assembly removal.

(2) Remove wheel (3) with tire and tube assembled.

(3) Disconnect and remove flexible hose (21) from tee on hydraulic pump (15) and hydraulic ram (10).

(4) Remove nuts and washers and lift U-bolt (22) attaching hydraulic pump (15) to cradle assembly (12). Remove hydraulic pump (15).

(5) Disassemble hydraulic pump as follows:

(a) Remove retaining rings (1, figure 3-6), fulcrum pins (2) and separate handle assembly (3) from pump body (4).

(b) Remove tank filler hole screw (6) and drain oil from tank.

(c) Pull out piston (7) and remove clip (8) by spreading clip slightly. Unscrew gland nut (9) using adjustable spanner wrench and remove packing support (10), leather packing (11), rubber packing (12) and spreader (13).

(d) Pry out filter screen (14) from hose hole. Remove retaining screw (15), discharge valve spring (16), 5/16 inch diameter ball (17), suction valve spring (18) and 3/16 inch diameter ball (19).

(e) Remove screw (32). Grasp knob (33) and detach from valve stem (34). Unhook loop of spring (35) from pin on pump body (4). Slip knob (33) onto valve stem (34). Remove spring (37), steel washer (38), packing (39) and 5/16 inch diameter ball (40).

(f) Remove nut (20) and **packing** (21). Twist tank (22) off pump body (4). Remove seal (23).

(g) Remove screw (24) and screen (25). Discard screen.

(h) Remove overload valve body (26) from tie rod (28). Remove spring (27) and plunger (29) from body (26).

(6) Remove cotter pin, washer and lubrication pin (7, figure 3-5) attaching ram arm (23) to clevis (8) of hydraulic ram (10).

(7) Back out set screw (14) and remove hydraulic ram (10) from trunnion (13). Using clevis (8) as handle, hold ram housing or cylinder. Separate ram piston from cylinder.

(8) Remove lubrication fittings (16), unscrew and remove connecting pin (17) and release pin (18).

NOTE

When connecting pin (17) is removed, support pin (19) can be released and spring (20) will slide from cradle.

(9) Remove trunnion (13) from cradle (12).

b. *Cleaning.*

(1) All foreign particles from magnet assembly (30, figure 3-6) with clean cheese cloth (C36).

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

(2) Recessed hole, into which filter screen (25) fits, with solvent (C124).

(3) Inside of overload valve body (26) with solvent (C 1 24).

(4) Rod (28) with solvent (C124) to assure clear passage through hole in end of rod.

c. *Inspection.*

(1) Ball-lock pins (5, figure 3-5) for cracks, corrosion, wear and distortion.

(2) Wheels (3) for cracks, distortion, corrosion and damage.

(3) Tires and tubes for cracks, wear and abrasion.

(4) Lubricator pin (7) for damage, distortion and wear.

(5) Internal threads of trunnion (13) for damage and set screw (14) and its internal threads in trunnion for damage.

(6) Lubrication fitting for serviceability.

(7) Connecting pin (19) and spring (20) for damage or distortion.

(8) Flexible hose (21) for leaks, damage, and serviceability.

(9) Axle (4), cradle (12) and sleeve for wear, corrosion damage and cracks.

(10) Hydraulic ram assembly (10) for leaks, security, corrosion and damage.

(11) Hydraulic pump (15) for leaks, security, corrosion and damage.

(12) Packings, seals, and gaskets of hydraulic pump for distortion, wear or damage.

(13) Washers, screws, retaining rings, clips and springs of hydraulic pump for damage and serviceability.

(14) Screens of hydraulic pump for damage and serviceability.

(15) Balls of hydraulic pump for corrosion and mechanical damage.

(16) Hole in rod (28, figure 3-) for clear passage.

d. Repair or Replacement.

(1) Replace ball-lock pins if unserviceable.

WARNING

Deflate tire prior to wheel assembly removal.

(2) Replace cracked or damaged wheels,

tires, tubes (3, figure 3-).

(3) Replace lubricator pin (7) if worn or distorted.

(4) Replace trunnion (13) if internal threads are damaged.

(5) Replace lubricator fitting (16) if damaged.

(6) Replace connecting pin (17), support pin (19), and spring (20) if distorted or damaged.

(7) Replace flexible hose (21) if leaking or damaged.

(8) Replace axle sleeve or cradle if cracked or damaged.

(9) Repair hydraulic pump P/N BU953B if leaking. (See figure 3-6.)

(a) If the hydraulic pump is to be repaired, procure a hydraulic pump parts kit P/N JS953. Refer to TM 55-1520-234-23P.

(b) Replace clip (8, figure 3-6) leather packings (11), and rubber packing (12).

(c) Replace filter screen (14), discharge valve spring (16), 0.3125 inch ball (17), suction valve spring (18), and 0.1875 inch ball (19).

(d) Replace release valve spring (37), washer (38), packing (39), and 0.3125 inch ball (40).

(e) Replace packing (21) and seal (23).

(f) Replace screw (24) and screen (25).

(10) Repair hydraulic ram (10, figure 3-5) as follows:

NOTE

If hydraulic ram does not have piston P/N 330617, which is machined for packing and backup ring, requisition new piston P/N 330617.

(a) Carefully slip new backup ring over inboard end of piston P/N 330617 and into packing groove.

(b) Carefully slip new packing over inboard end of piston and into packing groove.

NOTE

Ensure each packing is not spiraled in groove.

(c) Burnish scratches inside hydraulic ram cylinder that are less than 0.005 inch deep using crocus cloth (C45).

(11) Replace hydraulic ram if inside of cylinder has nicks, scratches, or pits deeper than 0.006 inch.

d.1. Repair hydraulic pump, P/N HP9902-41-10, if leaking. (See figure 3-6A.)

(1) Procure a hydraulic pump service kit, P/N KH9000. Refer to TM 55-1520-234-23P.

(2) Replace packing (6), cup retainer (7), pump cup (8), and spreader (9).

(3) Replace release packing (18).

(4) Replace outlet check spring (32), 0.3125 inch diameter ball (30) and 0.2187 inch diameter ball (31).

(5) Replace three gaskets (23).

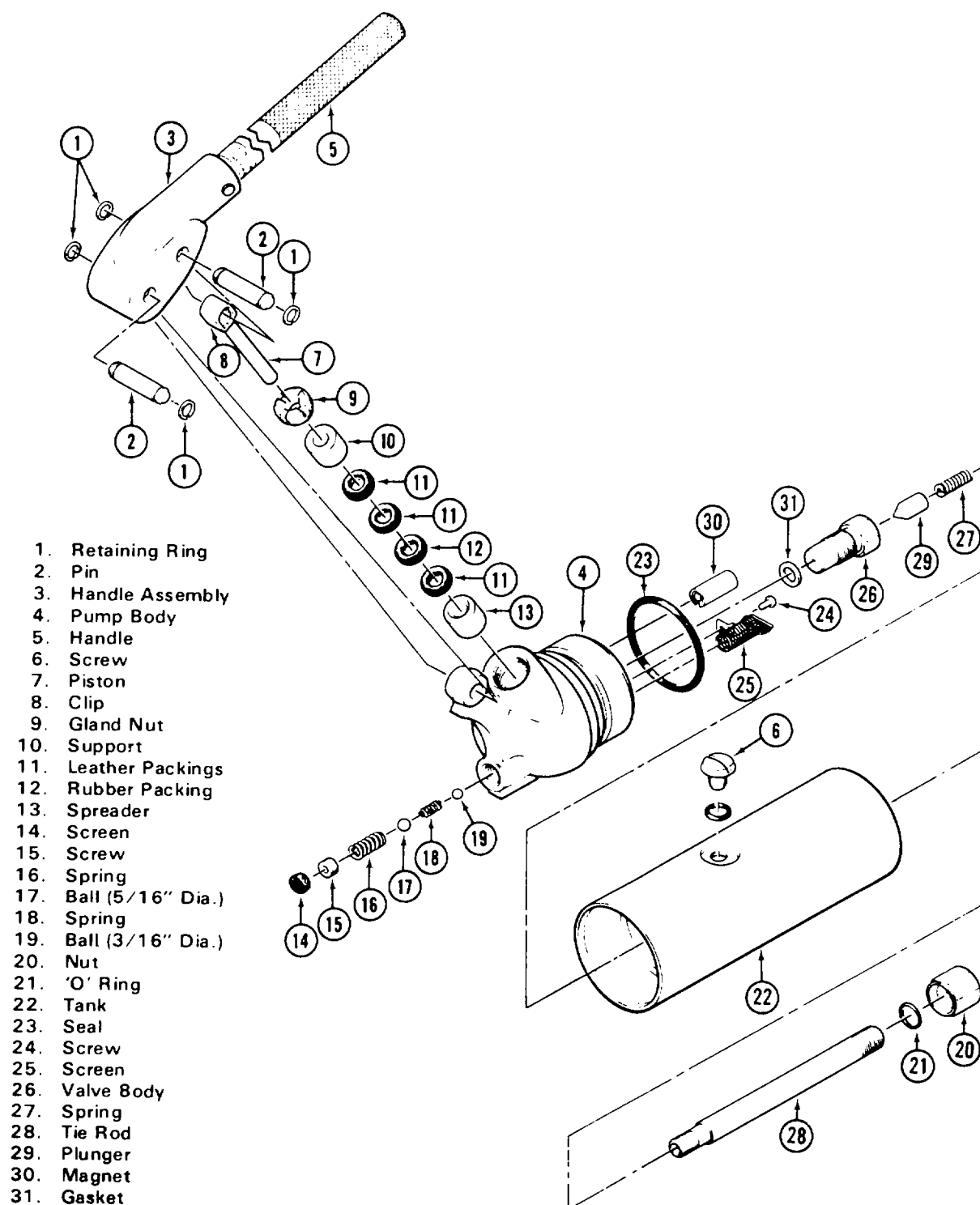
e. *Assembly.*

(1) Insert trunnion (13, figure 3-5) in cradle (12) with threaded openings aft.

NOTE

Steps (2) through (24) are for assembly of hydraulic pump, P/N BU953B. Step (24A), substeps (a) through (t) are for assembly of hydraulic pump P/N HP9902-41-10.

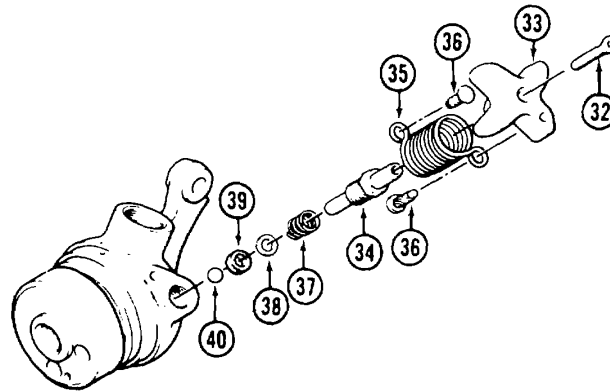
(2) Insert brass spreader (13, figure 3-6) in body (4), flat side down.



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Figure 3-6. Ground handling gear pump assembly (Sheet 1 of 2)

- 32. Screw
- 33. Knob
- 34. Stem
- 35. Spring
- 36. Pin
- 37. Spring
- 38. Washer
- 39. Packing
- 40. Ball (5/16" Dia.)



204050-1003-2

Figure 3-6. Ground handling gear pump assembly (Sheet 2 of 2)

- (7). (3) Slide packing support (10) onto piston

NOTE

The "V" must face away from groove on piston.

- (4) Dip two leather packings (11), one rubber packing (12), and third leather packing in hydraulic fluid (C74) and assemble in that order over bottom end of piston.

NOTE

The "V" on packing must rest on brass spreader.

- (5) Place assembly bushing tool (T15) into top of hole in pump body (4).

- (6) Insert piston (7) with packings installed into bellmouth of assembly bushing toll (T15).

- (7) Slip packing seating tool (T16) over piston.

- (8) Drive piston and packing down solid, using medium weight hammer on seating tool.

- (9) Remove packing seating tool and assembly bushing tool.

- (10) Install and tighten gland nut (9) using an adjustable spanner wrench.

- (11) Replace clip (8).

- (12) Insert 3/16 inch diameter ball (19), suction valve spring (18), 5/16 inch diameter ball (17) and discharge valve spring (16). Install screw (15).

- (13) Install filter screen (14) in hose hole.

- (14) Insert 5/16 inch diameter ball (40), rubber packing (39), steel washer (38) and spring (37) into pump body (4).

(15) Install valve stem (34) in base and turn down against ball by slipping knob (21) into stem and tightening.

CAUTION

Do not force down tight.

(16) Remove knob (33) from stem (34).

(17) Position spring (35) over release knob (33) and hook one eye of spring onto pin (36). Place knob and spring over valve stem (34) and hook eye to spring onto pin (36) in pump body (4).

NOTE

Do not place knob onto hex of valve stem.

NOTE

Knob and valve stem should work free and valve should close firmly when opened and released.

CAUTION

An improperly operating valve means improper assembly and an inoperative pump.

(18) Hold pump body (4) and valve stem (34) firmly and twist knob (33) to the left two faces of the hex. Push knob onto the hex of the valve stem at this position. Insert flat head socket screw (32) and tighten. Try knob action to see if closing is positive. If action is not positive, move knob to the left another face on hex, and recheck closing.

(19) Install filter screen (25) in pump body (4) and secure with screw (24).

(20) Install plunger (29) and spring (27) in overload valve body (26). Screw tie rod (28) into valve body (26) and position in tank (22).

(21) Install gasket (31) and seal (23) and assemble tank (22) to body (4).

(22) Install packing (21) and nut (20) and tighten nut lightly. Rotate tank so that filler hole is on

top and in line with pump handle. Tighten nut (20).

(23) Replace tank filler hole screw (6).

(24) Position handle assembly (3) to body (4) and secure with fulcrum pins (2) and retaining rings (1).

(24A) Assemble hydraulic pump, P/N HP9902-41-10, as follows:

NOTE

Procedure outlined in this step is for assembly of hydraulic pump, P/N HP9902-41-10. For assembly of hydraulic pump, P/N BU953B, refer to steps (1) through (24) above.

(a) Insert spreader (9, figure 3-6A) into pump base (10) flat side down.

(b) Slide packing nut (5) onto plunger (4).

(c) Dip packing (6), cup retainer (7), and pump cap (8) into hydraulic fluid (C74), and assemble in that order over bottom end of plunger (4).

NOTE

The "V" on pump cup must rest on spreader.

(d) Place assembly bushing tool (T15) into top hole in pump base (10).

(e) Insert plunger (4) with packing nut, packing, cup retainer, and pump cup installed into bellmouth of assembly bushing tool (T15).

(f) Slip packing seating tool (T16) over plunger.

(g) Drive plunger and assembled parts down solid, using medium weight hammer on packing seating tool.

(h) Remove packing seating tool and assembly bushing tool.

(i) Tighten packing nut (5) using packing nut tool. (Refer to figure 3-6B.)

(j) Insert 0.3125 inch diameter ball (31, figure 3-6A), 0.2187 inch diameter ball (30), and outlet check spring (32) into base(10). Install valve plug (33) into base (10).

(k) Install screen (21) in pump base (10).

(l) Install release packing nut (19) on release spindle (12). Check threads on release packing nut (19) and release spindle (12) for free turning. Remove release packing nut (19) from release spindle (12).

NOTE

Touch up threads if damaged or binding.

(m) Dip release packing (18), release packing nut (19) and release spindle (12) into hydraulic fluid (C74) and assemble parts in that order. Install release spindle (12) with release packing (18) and release packing nut (19) in pump base (10). Tighten release packing nut (19) until release packing (18) bottoms out in pump base (10). Loosen release packing nut (19) and torque to **20** inch-pounds.

(n) Position return spring (20) over release spindle (12). Use capscrew (17) and washer (16) to attach return spring (20) to pump base (10).

(o) Hold pump base (10) and release spindle (12) firmly. Place handle (13) on release spindle. Handle shall be vertical with release valve in closed position. Install screw (15) and lock washer (14). Hook return spring (20) around handle (13). Try handle action to check for positive closing of release valve.

NOTE

If handle action is not positive, move handle to the left another **face** on **hex** shank of release spindle, and check again for positive closing.

(p) Install relief valve (22) and gasket (23) in pump base (10).

(q) Set relief valve as follows:

1 Connect hydraulic pump to hydraulic test stand.

2 Set relief valve to open at **8500** (plus or minus 300) psi.

3 Release pressure. Then increase pressure to **8000** psi. Observe for 15 seconds. Loss of pressure in excess of **500** psi is cause for rejection.

4 Open release valve to drop pressure. From a 10 degree open position on handle (13), release quickly, letting return spring (20) close release valve.

NOTE

Do not push on handle.

5 Increase pressure to **8000** psi. Observe for 15 seconds. Loss of pressure in excess of **500** psi is cause for rejection

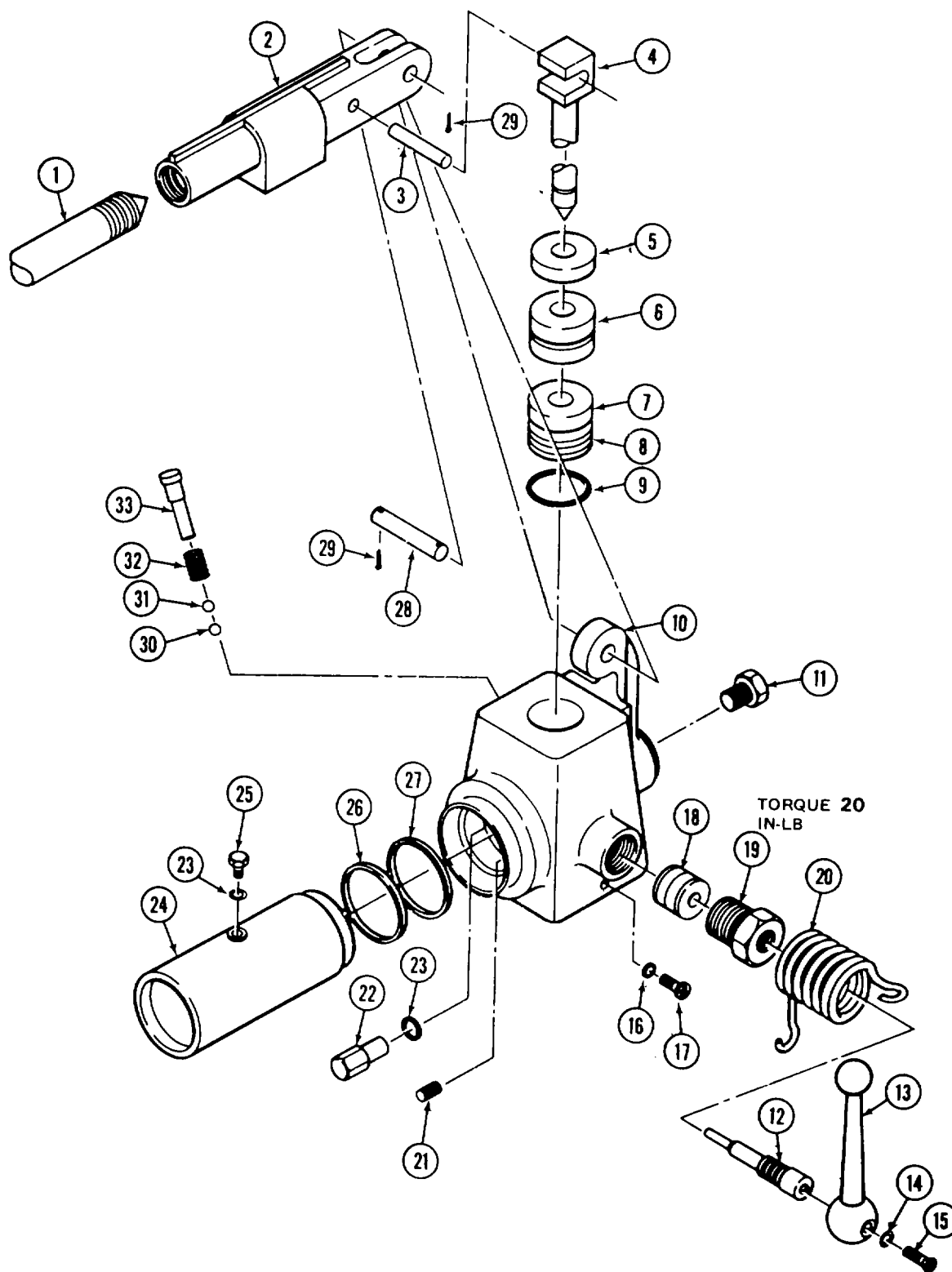
(r) Install shim washer (27) and/or reservoir shim washer (26) as required to line up filler plug (25) on reservoir (24) with top of pump within plus or minimum 10 degrees. Use of shim washers (27) and reservoir shim washers (26) varies from 0 to a total of 4. Install reservoir (24) in pump base (10). Ensure that filler plug on reservoir (24) lines up with top of pump within plus or minus 10 degrees.

(s) Position beam (2) to plunger (4) and pump base (10). Install plunger cross pin (3) and beam pin (28). Secure beam pin (28) and cross pins (3) with two cotter pins (29).

(t) Install reducer bushing (11).

(u) Connect air line to fill port in reservoir (24). Apply 100 psi air pressure, and check hydraulic pump under water for signs of leakage. Reject hydraulic pump if there are signs of leakage. Remove hydraulic pump from water. Remove air line from reservoir (24). Install gasket (23) and filler plug (25).

(v) Install handle (1) to beam (2).



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Figure 3-6A. Ground handling gear pump, P/N HP-9902-41-10 (Sheet 1 of 2)
Change 7 3-14A

1. Handle	17. Capscrew
2. Beam	18. Release packing
3. Plunger cross pin	19. Release packing nut
4. Plunger	20. Return spring
5. Packing nut	21. Screen
6. Packing	22. Relief valve
7. Cup retainer	23. Gasket (copper)
8. Pump cup	24. Reservoir
9. Spreader	25. Filler plug
10. Base	26. Reservoir shim washer
11. Reducer bushing	27. Shim washer
12. Release spindle	28. Beam pin
13. Handle	29. Cotter pin
14. Lockwasher	30. Ball (0.2187 inch diameter)
15. Capscrew	31. Ball (0.3125 inch diameter)
16. Washer	32. Outlet check spring
	33. Valve plug

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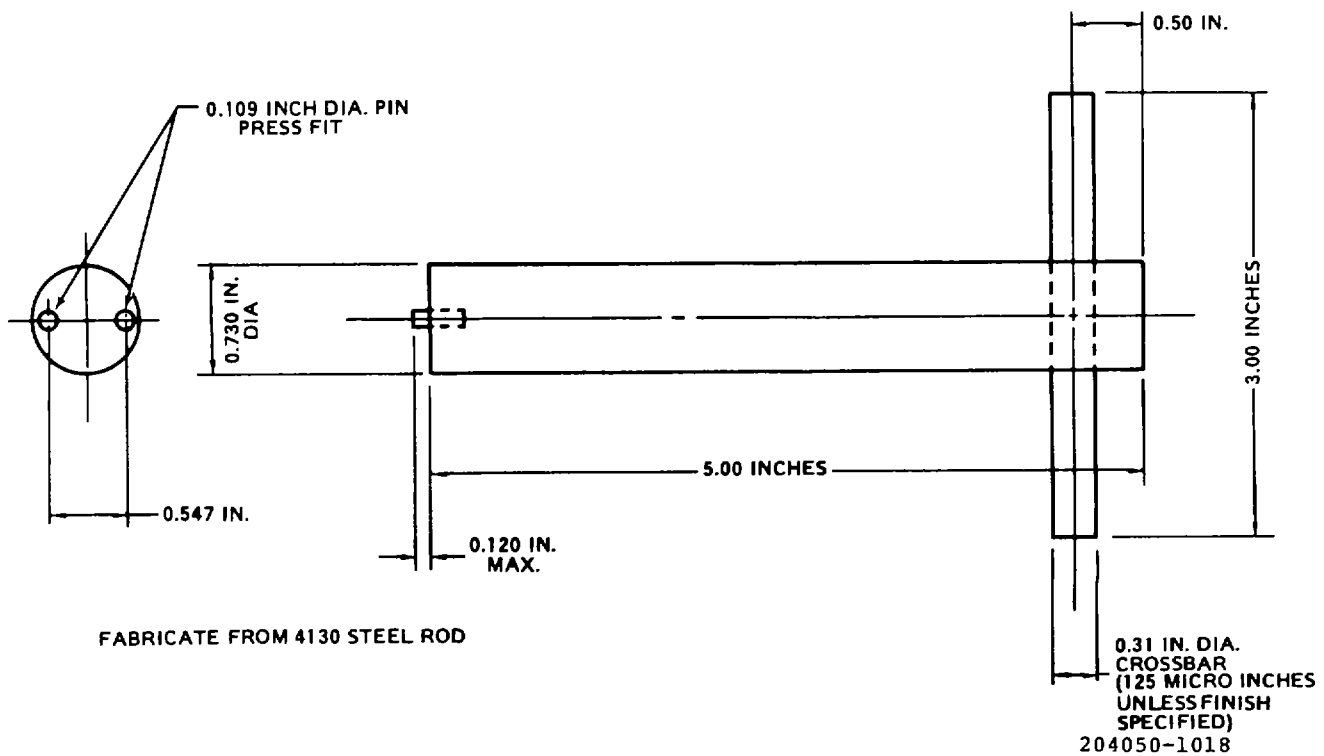


Figure 3-6B. Packing nut tool

NOTE

To prepare a new hydraulic pump (15, figure 3-5) and hydraulic ram (10) assembly for installation, remove pipe plug on each and drain original fluid.

(25) Install hydraulic ram (10, figure 3-5) on each end of trunnion (13) to bottom out in hole. Back off until hydraulic outlet is directed down. Secure with set screw (14).

(26) Position hydraulic ram arm (23, figure 3-4)

on sleeve, insert axle (4), and secure with bolts. Insert sleeve through cradle (12) and install hydraulic ram arm (23) and axle on opposite end. Hydraulic ram must be forward of wheel hub center line 1.98 inches. (Refer to figure 3-7.)

(27) Position hydraulic pump (15, figure 3-5) on cradle (12) and secure with U-bolts (22).

(28) Install ram clevis (8, figure 3-5) and with hydraulic ram fully extended, adjust clevis to hold 1.48 inches diameter. Refer to figure 3-7.

- (29) Insert support pin in aft end of cradle, align holes and secure with spring pin.
  - (30) Insert release pin (18, figure 3-5) in upper forward orifice of cradle, align holes in both pins and install connecting pin (17).
  - (31) Attach support rod (6) to clevis pin and insert ball-lock pin (5).
  - (32) Install tire, tube and wheel.
- f. *Bleeding - Hydraulic Pump.*
- (1) Fill hydraulic cylinder (15, figure 3-5) with hydraulic fluid (C73).
  - (2) Operate pump handle for several strokes to build up pressure.

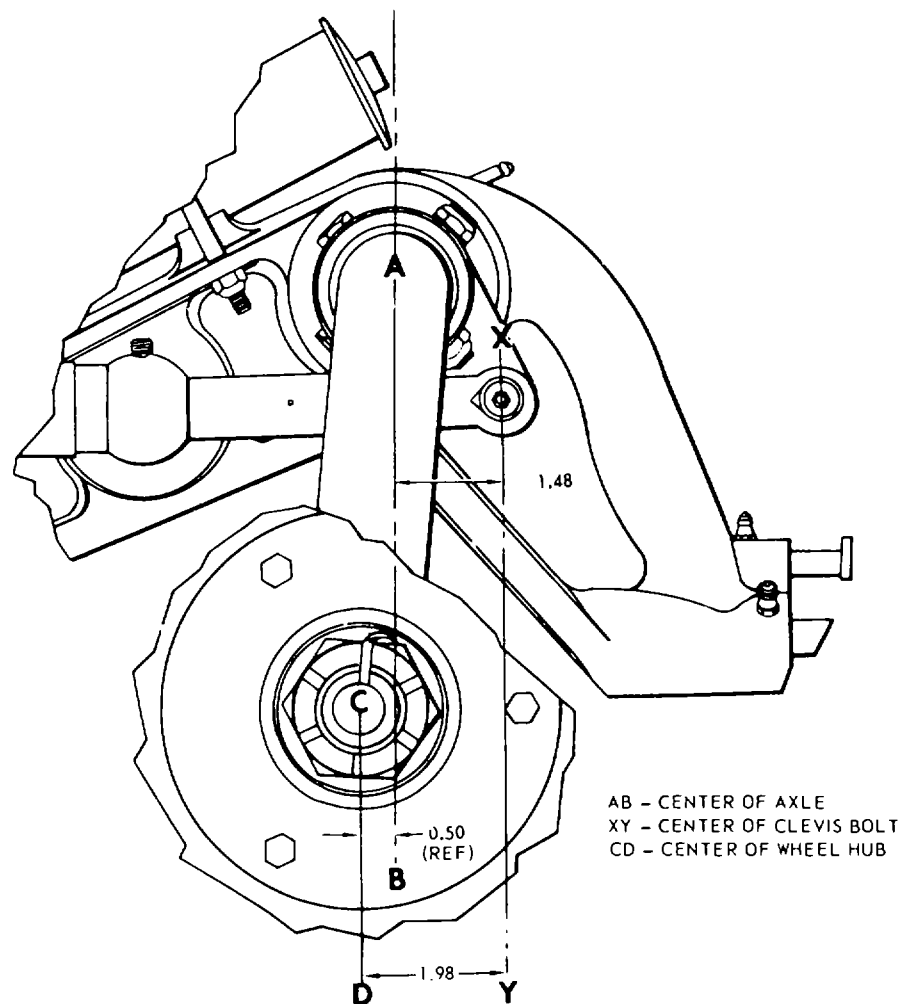


Figure 3-7. Ground handling wheels adjustment dimensions

(3) Crack (loosen) hose coupling (21) at tee on pump (15).

(4) Operate pump handle until air bubbles no longer show at loose hose coupling (21) and fluid runs smoothly.

(5) Refill hydraulic pump and repeat previous steps to be sure all air is expelled from system.

(6) Tighten hose coupling (21) to pump (15) and refill cylinder.

g. Testing - Hydraulic Pump (A VIM).

(1) Fill the oil tank to proper level with hydraulic fluid (C73).

(2) Connect a 10,000 psi pressure gage to outlet hole.

(3) Operate pump until pressure builds up and overload valve unloads. Proper setting is 8300 to 8800 psi. If pressure goes too high, turn the tie rod (28, figure 36) counterclockwise, using a screw driver. If pressure

is too low, turn the rod clockwise. Test and readjust as necessary until proper setting is obtained.

(4) When proper setting is obtained, tighten hex nut (20).

NOTE

Hold tie rod in position using screw driver in slot to prevent rod turning with the nut.

h. Testing - Hydraulic Ram.

(1) Screw ram assembly into trunnion (13, figure 3,5) and connect ram to pump (15).

(2) Pump until overload in pump goes off with ram against trunnion stop.

(3) Check for leaks.

(4) Release pressure and pump ram out halfway. Allow to stand a few minutes.

(5) Check for leaks. Ram is ready for service when no leaks are found.

CHAPTER 4 - POWER PLANT

Section I. POWER PLANT

4-1. Power Plant.

The power plant consists of a T53-L-703 series shaft turbine engine mounted horizontally on the fuselage behind the main rotor pylon, with adapting parts and connections to the airframe structure and to fuel, oil, electrical, instrument, and engine control systems. (See figures 4-1 and 4- 2.) The engine and transmission are enclosed by cowling and fairing. Hinged pylon fairing doors at each side give access to the air induction and drive shaft area ahead of the engine forward firewall. These doors also have engine air inlet shield. The engine compartment between forward and rear firewalls has hinged side doors equipped with cooling air inlets. Doors also have armor panels to protect the fuel control and compressor section. The exhaust area, behind the rear firewall, is enclosed by removable fairing.

4-2. Engine Maintenance.

Servicing and lubrication information will be found in Chapter 1. Special inspections, and schedules for overhaul and retirement of components are in Chapter 1. Daily, intermediate, and periodic inspection requirements are in Preventive Maintenance Checklists, TM 55-1520- 234PMS. To accomplish maintenance procedures refer to TM 55-2840-229-23.

4-3. Engine Mounts.

The engine is suspended on two mount assemblies at the diffuser housing and one leg assembly at left side of the inlet housing. For maintenance on the engine mounts refer to paragraph 2-44.

4-4. Engine Vibration Tests. (AVIM)

- a. Refer to TM 55-2840-229-23 for instructions to perform engine vibration check.
- b. Route pickup cables as follows:

WARNING

To prevent a possible hazard to personnel and damage to equipment, set meter power switch to OFF, while breaking or making connections to a source of electrical power.

CAUTION

Leave enough slack in cables to prevent unnecessary strain on pickups and connectors. Avoid conditions that would cause cables to deteriorate from heat or abrasion.

(1) Route all three cables aft to one location and secure to engine bleed air tube adjacent to engine ignition exciter box with one MS21919H-15 and one MS21919H-10 cable clamp. See figure 4-3.

(2) Route cables out left engine compartment door ventilation opening. Make sure cables are clear of engine throttle control linkages. Close and secure engine compartment door.

(3) Route cable forward, over wing, along left side of aircraft to gunners station. Remove screws in access panel as shown in diagram. Retain screws for later installation.

(4) Install one MS21919H-10 clamp at each location shown. Replace screws with AN3 bolts and secure clamp and cables. (5) Route cables inboard into gunners compartment.

NOTE

During test it will be necessary to compress seal on gunners access door under cables to allow closing of the door for flight

(6) (Deleted)

(7) After test, remove all test equipment, cables and clamp. Remove all AN3 bolts installed for test and replace with original screws.

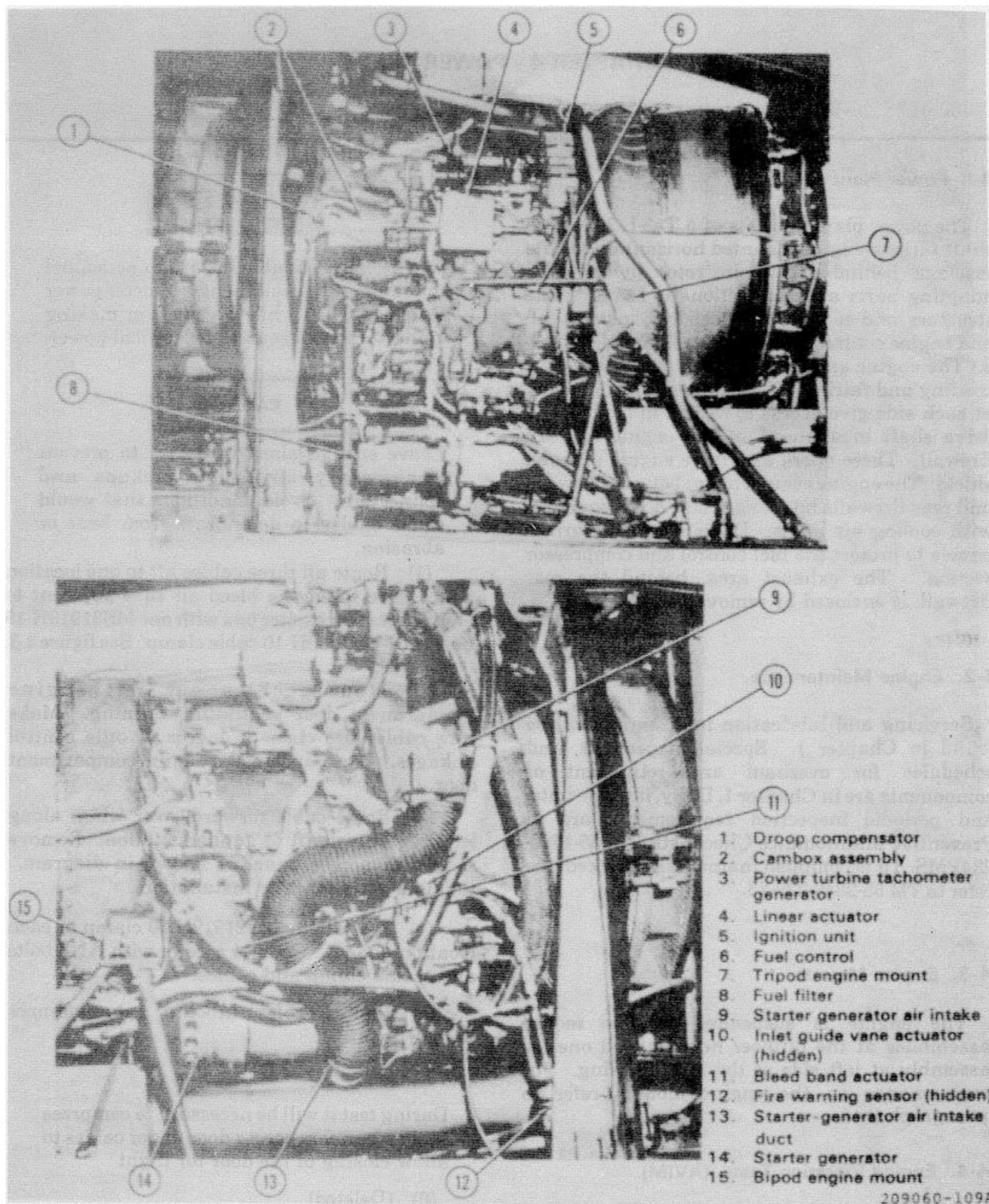


Figure 4-1. Power plant installation

4-5. Engine Assembly.

NOTE

When parts are removed, use care to avoid entry of dirt or foreign material into engine or components. Seal opening with caps, plugs or temporary covers.

Premaintenance requirements for engine assembly.

<u>Conditions</u>	<u>Requirements</u>
Model	AH-1S
Part No. or Serial No.	All
Special Tools	(T7)
Test Equipment	None
Support Equipment	Hoist, Lifting
Sling, Stand	
Minimum Personnel Required	Three
Consumable Materials	(C97)
Special Environmental	
Conditions	None

a. Removal of Engine Assembly (See figure 4-3A)

(1) Disconnect battery. Refer to paragraph 9-9.

(2) Remove engine cowling and tailpipe fairing. Refer to paragraph 2-16.

(3) Remove transmission cowling. Refer to paragraph 2-15.

(4) Remove particle separator. Refer to paragraph 4-8.

(5) Remove main driveshaft. Refer to paragraph 6-7.

(6) Remove IR suppressor (if installed), ejector and tailpipe. Refer to paragraph 4-12 and 4-13.

NOTE

When electrical cables and plugs are disconnected from airframe plugs; cables, and plugs should be secured to engine in a manner that will avoid interference when removing engine assembly.

(7) Disconnect electrical cables and plugs on airframe as shown in figure 4-3A as follows:

(a) Remove two clamps (5 and 10) securing harness assembly (6) to left side of engine mount tubes.

(b) Disconnect plug of electrical harness assembly (6) from aft firewall on left side of engine.

(c) Remove clamp securing fuel filter cable assembly (13) and disconnect plug from fuel filter.

(d) Disconnect plug of cable assembly (15) from engine oil bypass valve.

(e) Remove clamp (28) securing harness assembly (29) to right side aft engine mount tube.

(f) Disconnect plug of harness assembly (29) from aft right side firewall.

(g) Disconnect exhaust thermocouple harness plug (30) from aft right side firewall.

(h) Disconnect electrical plug (1) at bleed air valve.

(i) Disconnect oil tank low level switch electrical plug (2) at airframe plug.

(8) Disconnect fuel, oil, and bleed air hoses, lines and tubes as follows:

NOTE

When removing fuel and oil hoses, lines, fittings, ensure residual fluids have been drained. Cap all open ports until reinstallation. All parts removed should be inspected for serviceability.

(a) If not previously accomplished, disconnect hose assembly (25, figure 4-3A) at oil tank disconnect fitting.

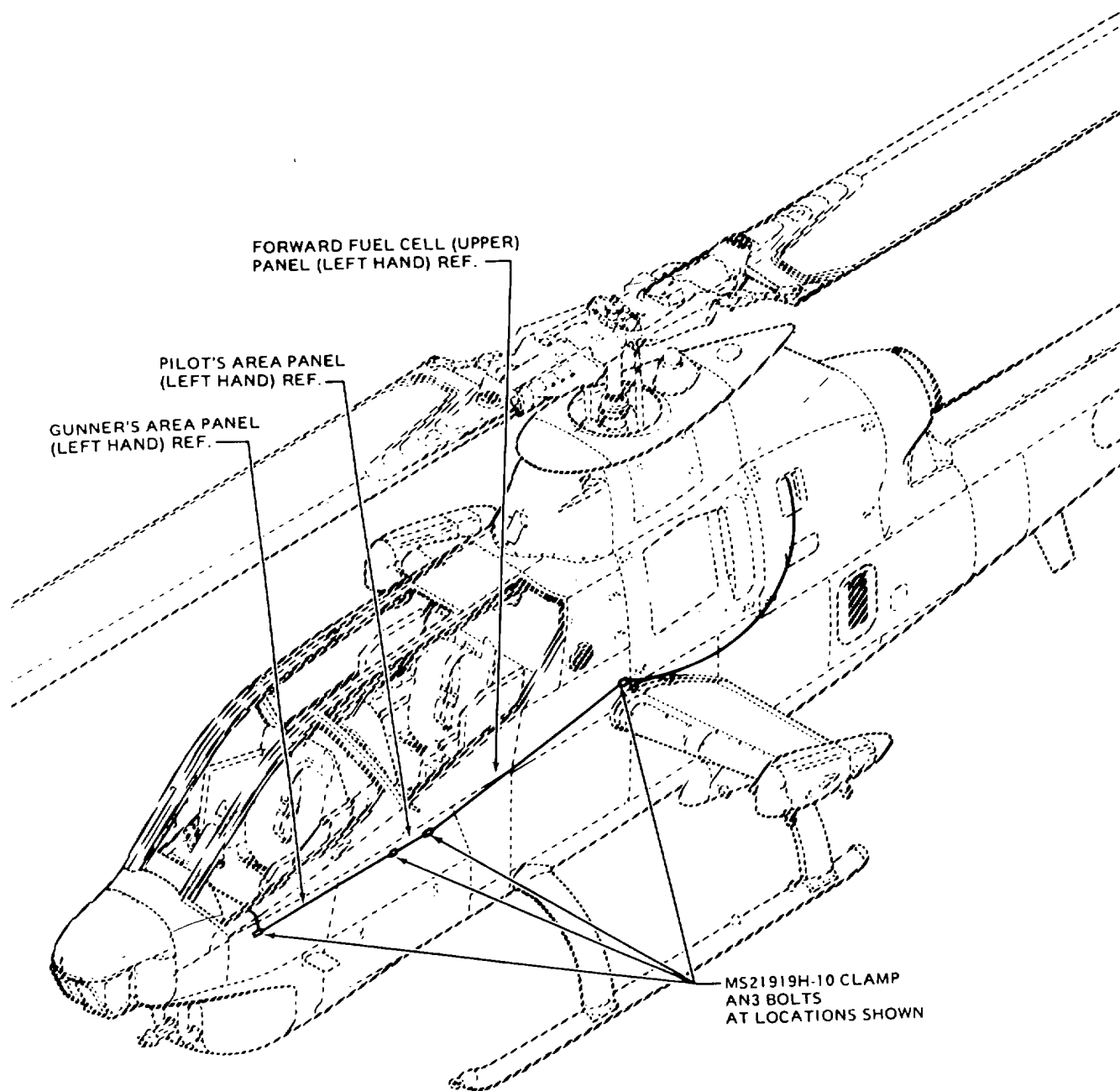
(b) If not previously accomplished, disconnect hose assembly (26) at oil tank disconnect.

(c) Disconnect fuel drain disconnect (27) from right side engine deck fitting.

(d) Disconnect oil bypass valve hose (16) at engine deck fitting on left forward side of engine.

(e) Disconnect fuel filter hose (14) at engine deck disconnect fitting.

(f) Disconnect starter seal drain hose disconnect (9) at engine deck.



209200-28

Figure 4-3. Engine vibration test equipment cabling tiedown

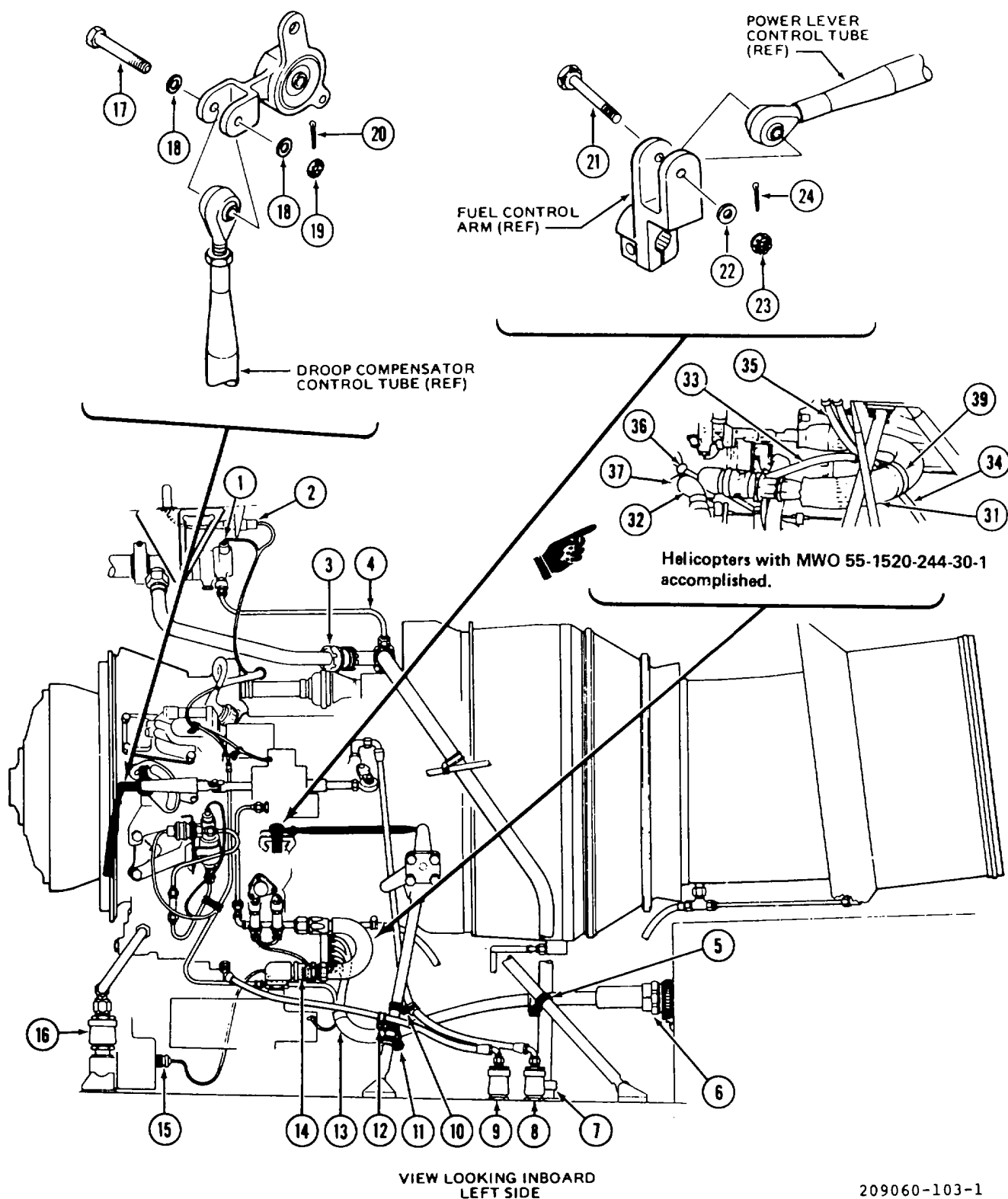
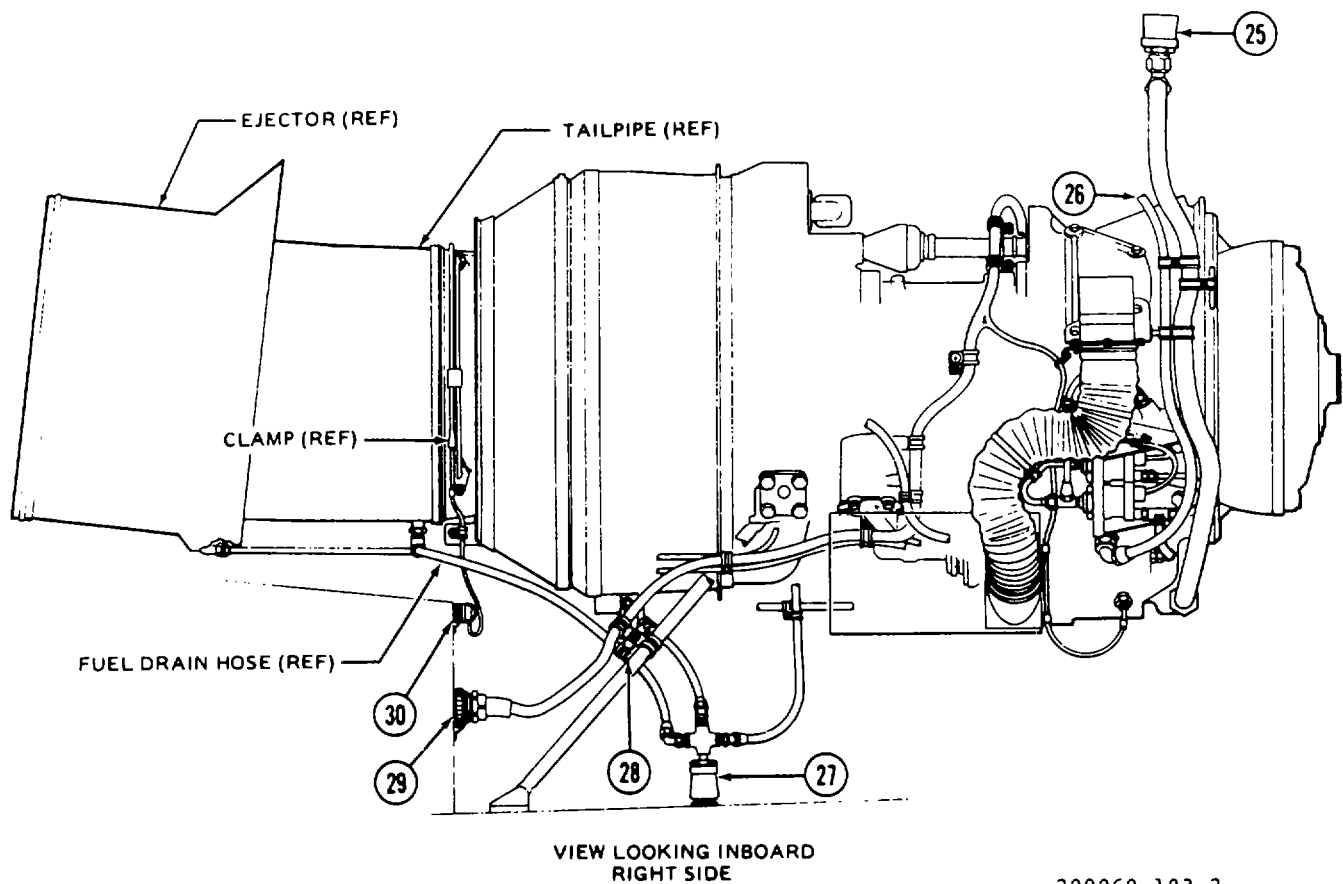


Figure 4-3A. Engine assembly removal/installation (Sheet 1 of 2)



209060-103-2

1. Electrical Plug (Bleed Air Valve)	19. Nut
2. Electrical Plug (Oil Tank Low Level Switch)	20. Cotter Pin
3. Coupling (Bleed Air)	21. Bolt
4. Tube Assembly	22. Washer
5. Clamp	23. Nut
6. Electrical Harness Assembly	24. Cotter Pin
7. Coupling (Bleed Air)	25. Hose Assembly (Oil In)
8. Fuel Drain Disconnect (Governor bleed)	26. Hose Assembly (Oil Breather)
9. Oil Drain Disconnect (Starter Seal)	27. Fuel Drain Disconnect
10. Clamp	28. Clamp
11. Clamp	29. Electrical Harness Assembly
12. Clamp	30. Exhaust Thermocouple Cable
13. Cable Assembly (Fuel Filter)	31. Hose Assembly, Fuel
14. Fuel Disconnect (Fuel Filter to Engine)	32. Hose Assembly, Fuel
15. Cable Assembly (Oil Bypass Valve)	33. Hose Assembly, Fuel
16. Oil Hose Disconnect (Oil Out to Oil Bypass Valve)	34. Hose Assembly, Fuel
17. Bolt	35. Hose Assembly, Fuel
18. Washer (2 reqd)	36. Clamp
	37. Clamp
	38. Clamp (Not visible)
	39. Clamp

Figure 4-3A. Engine assembly removal/installation (Sheet 2 of 2)

Change 22 4-4B

(g) Disconnect governor and filter bleed hose disconnect (8) at engine deck.

(h) Disconnect bleed air line coupling (7) at engine deck coupling.

(i) Disconnect tube assembly (4) from top of engine. Disconnect opposite end at bleed air valve and remove tube assembly (4).

(j) Disconnect bleed air tube coupling (3) at top of engine. Disconnect opposite end and remove bleed air tube.

(k) Remove cotter pin (20), nut (19) washers (18), and bolt (17) securing droop compensator control tube to cambox assembly. Disconnect upper end of control tube from cambox.

CAUTION

To prevent possible damage to engine mount, ensure weight is removed from forward engine mount bolt before removal.

(l) Remove cotter pin (24), nut (23), washer (22), and bolt (21) securing power lever control tube to fuel control arm. Disconnect control tube from arm.

(9) Attach engine lifting sling (T7) to engine assembly. Attach a suitable hoist to sling. Take slack out of hoist and sling.

(10) Loosen bolts from left and right side pillow blocks. Disengage pillow blocks. Remove bolt from forward engine mount trunnion.

(11) Slowly hoist engine from helicopter structure ensuring all necessary hoses, tubing, and electrical cables are disconnected and cleared of airframe.

(12) Install engine on work stand or trailer as required.

b. Removal of Engine Adapting Parts. To convert a quick change engine assembly to a basic engine, remove all parts not included on or with engines as supplied in the shipping container. Remove all adapting parts when preparing an engine for shipment or storage in container. With engine on stand, remove parts as follows:

(1) Remove output driveshaft adapter. Use LTCT962 torque adjustment fixture (T7A). See paragraph 6-7.

(2) Remove air inlet duct.

(3) Remove electrical cables.

(4) Remove starter generator and tachometer. Remove oil pressure transmitter and pressure switch.

(5) Remove cambox assembly, actuator and all connecting linkage.

(6) Remove fuel, oil, vent and drainhoses and connections.

(7) Remove engine mount trunnions and any support brackets and bellcranks normally attached.

(8) Check engine and remove remaining fittings and adapters. Install caps, plugs, and covers over openings.

c. Installation of Engine Adapting Parts.

CAUTION

If the engine was removed prior to normal overhaul for internal failure, flush all lines, replace oil cooler and engine oil filter. Tag removed oil cooler as contaminated and forward to depot.

(1) Install engine mount trunnions; also install any support brackets or bellcranks normally attached to same bolts.

(2) Install oil system fittings and hoses.

(3) Install cam box assembly, actuator and connecting linkage.

(4) Lubricate splines with plastilube (C97) and install starter-generator and tachometer generators. Install oil pressure transmitter and pressure switch.

WARNING

Disconnect low tension lead prior to connecting igniters. Tag lead with red tag and note on tag "Do Not Hook Up Until Ground Run."

(5) Install necessary connections and hoses. Install air inlet duct and electrical cables. Connect engine igniters.

(6) Install output driveshaft adapter. Refer to paragraph 6-7. Check over engine and remove any remaining plugs or covers.

d. Installation of Engine Assembly.

NOTE

Inspect all removed components for serviceability prior to installing on new engine.

(1) Attach engine lifting sling (T7) to engine assembly.

(2) Attach lifting sling to suitable hoist. Take up slack in hoist and remove hardware securing engine to work stand or transportation trailer.

(3) Hoist engine to clear airframe engine mounts. Ensure airframe pillow blocks are open and slowly lower engine assembly aligning engine trunnion bearings over engine mount pillow blocks.

(4) Align forward trunnion with forward engine mount tube. Install bolt through tube to forward trunnion. Tighten bolt **50 TO 70** inch-pounds torque. Lockwire (C151).

(5) Close pillow blocks over left and right side aft trunnion bearings. Tighten nuts on pillow blocks **50 TO 70** inch-pounds torque. Lockwire (C151).

(6) Connect electrical cable harness and cable assemblies as follows:

(a) Connect plug of electrical harness assembly (29, figure 4-3A) to aft right side of firewall plug.

(b) Connect exhaust thermocouple harness plug (30) to aft right side firewall plug.

(c) Connect plug of electrical harness assembly (6) to aft left side firewall plug.

(d) Connect plug of cable assembly (13) to fuel filter plug.

(e) Connect plug of cable assembly (15) to

oil bypass valve.

(f) Attach clamps (5 and 10) to existing clamps on engine mount tubes.

(g) Secure cable assembly (13) to fuel filter using existing clamp on fuel filter.

(h) Connect electrical plug (1) to bleed air valve.

(i) Connect electrical plug (2) to airframe mounted plug for oil tank low level switch.

(7) Connect engine fuel, oil and bleed air hoses and tubing as follows:

(a) Connect fuel disconnect (27) to engine deck fitting.

(b) Secure clamp (28) to two fuel drain hose clamps and clamp on engine mount tube.

(c) Connect fuel disconnect (14) to fuel filter.

(d) Connect oil hose disconnect (16) to oil bypass valve.

(e) Connect oil drain disconnect (9) to engine deck fitting.

(f) Connect fuel drain disconnect (8) to engine deck fitting.

(g) Connect engine bleed air tube coupling (7) to engine deck fitting.

(h) Connect coupling of oil breather hose assembly (26) to engine oil tank.

(i) Connect coupling of hose assembly (25) to engine oil tank.

(j) Install tube assembly (4) between bleed air valve and bleed air fitting on top of engine.

(k) Install bleed air tube and coupling (3) between bleed air line and fitting.

(7) Install droop compensator control tube to droop compensator using bolt (17), two washers (18), and nut (19). Tighten nut (19) and install cotter pin (20).

(m) Install power lever control tube to fuel control lever using bolt (21), washer (22) and nut (23). Tighten nut and install cotter pin (24).

(n) Install ejector, IR suppressor (if installed), and tailpipe assembly. (Refer to paragraph 4-12 and 4-13).

(o) Install main driveshaft. (Refer to paragraph 6-7).

(p) Install particle separator. (Refer to paragraph 4-8).

(q) Install engine cowling and tailpipe fairing. Install transmission cowling. (Refer to paragraphs 2-16 and 2-15.)

(r) Connect battery.

4-5.1 ENGINE MOUNT FITTINGS (TRUNNIONS).

4-5.2 DESCRIPTION-ENGINE MOUNT FITTINGS (TRUNNIONS).

Engine mount fittings (trunnions) are the part of the engine mounts that are installed on the engine. The forward fitting (trunnion) is bolted to the forward left side mount pad. The two aft fittings (trunnions) are bolted to the rear mounting pads, one left and one right.

4-5.3 REMOVAL-FORWARD ENGINE MOUNT FITTING (TRUNNION).

a. Attach engine lifting sling (T7) to engine assembly. Attach hoist (T49) to sling. Take up slack between hoist and sling.

NOTE

Engine may be supported with suitable strap running underneath combustion section and spreader bar to clear strap from aft pylon fairing.

b. Cut lockwire attached to bolt (8, figure 4-3B). Remove lockwire.

c. Remove bolt (8) and washer (9) from

trunnion (1).

d. Cut lockwire attached to bolts (5 and 6). Remove lockwire.

e. Remove bolts (5 and 6), washers (4, 7, and 11).

f. Remove cambox assembly bracket (2) and transducer bracket (3).

g. Remove trunnion (1).

4-5.4 REMOVAL-AFT ENGINE MOUNT FITTINGS (TRUNNIONS).

a. Attach engine sling (T7) to engine assembly. Attach hoist (T49) to sling. Take up slack in hoist cable to relieve weight from engine mount.

NOTE

Engine may be supported with suitable strap running underneath combustion section and a spreader bar to clear strap from aft pylon fairing.

b. Remove left aft fitting (trunnion) (13, figure 4-3B) as follows:

CAUTION

Ensure that engine is supported by hoist and sling prior to removal of pillow block.

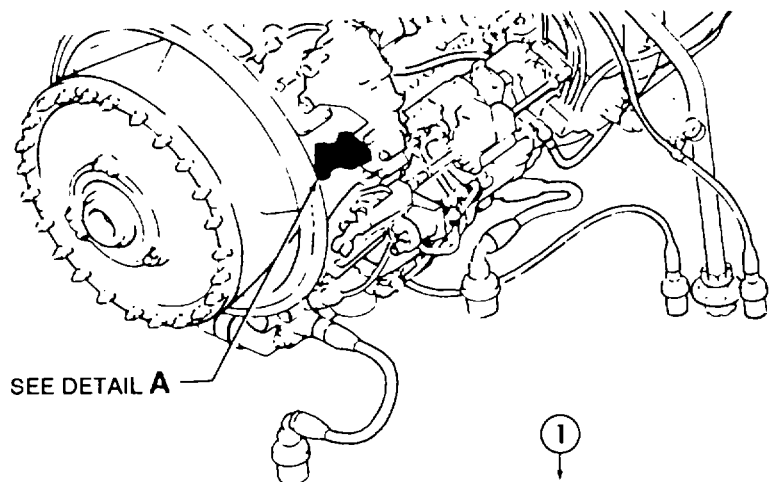
(1) Remove left pillow block assembly (17) by procedure outlined in paragraph 2-44.

(2) Remove self-locking nuts (16), washer (15), and bearing (14) from trunnion on left side of engine.

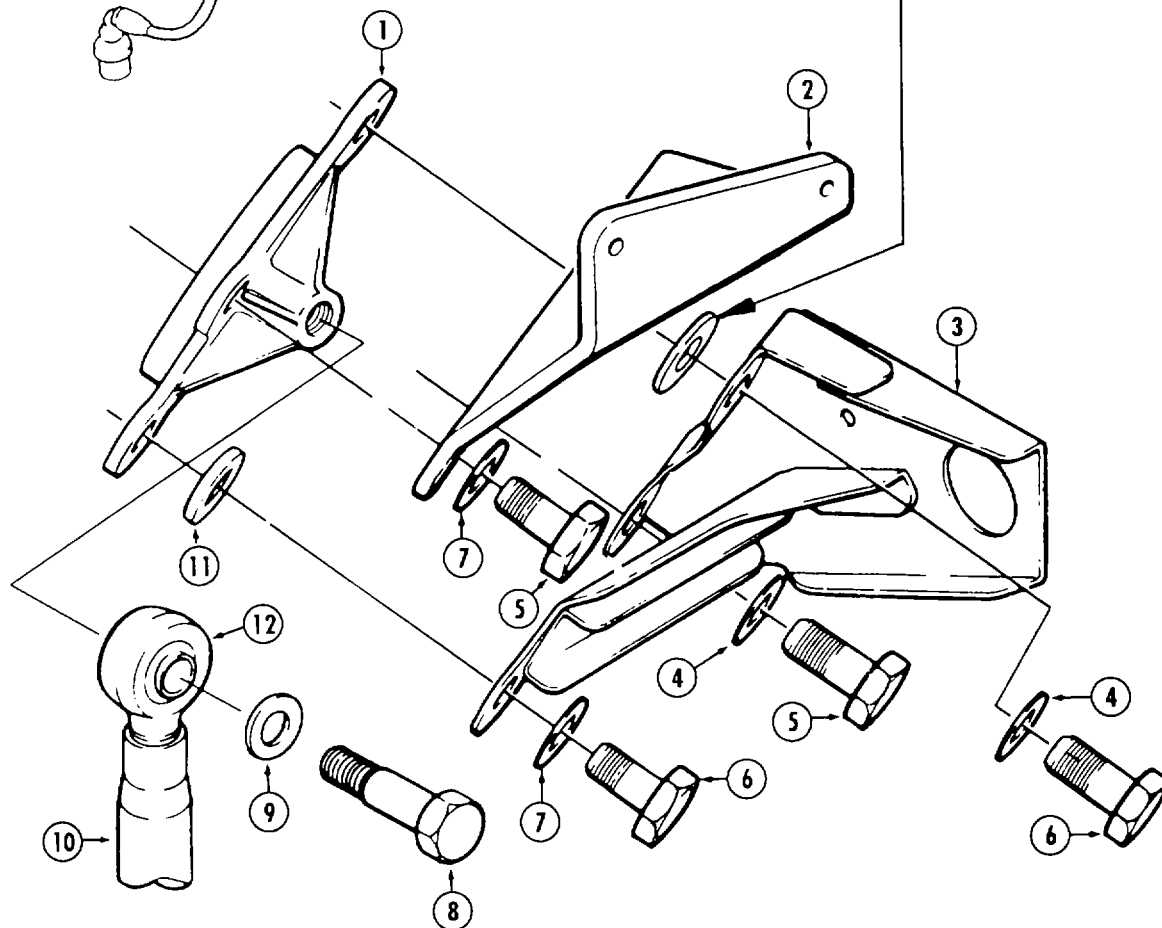
(3) Remove lockwire from four bolts (20). Remove bolts (20) and washers (21).

(4) Remove trunnion (13).

c. Remove aft right engine mount fitting (trunnion) by same procedure outlined in step b.



NOTE: ADD AN960C816 AND/OR AN960C816L WASHERS AS REQ'D (3) MAX FOR FLUSH FIT BETWEEN 204-060-786 BRACKET AND 209-060-528 SUPPORT.

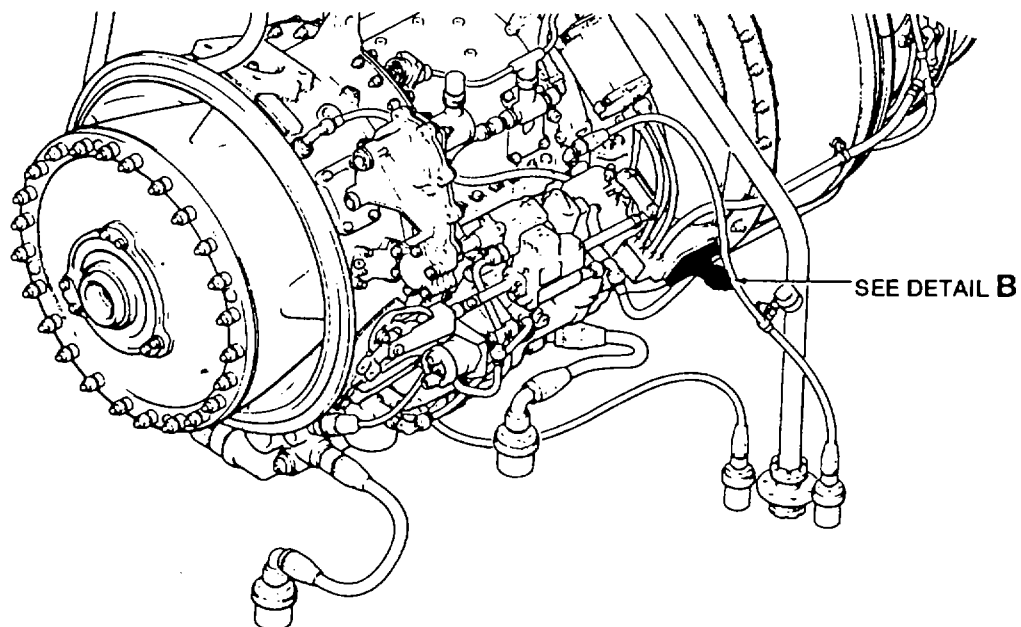
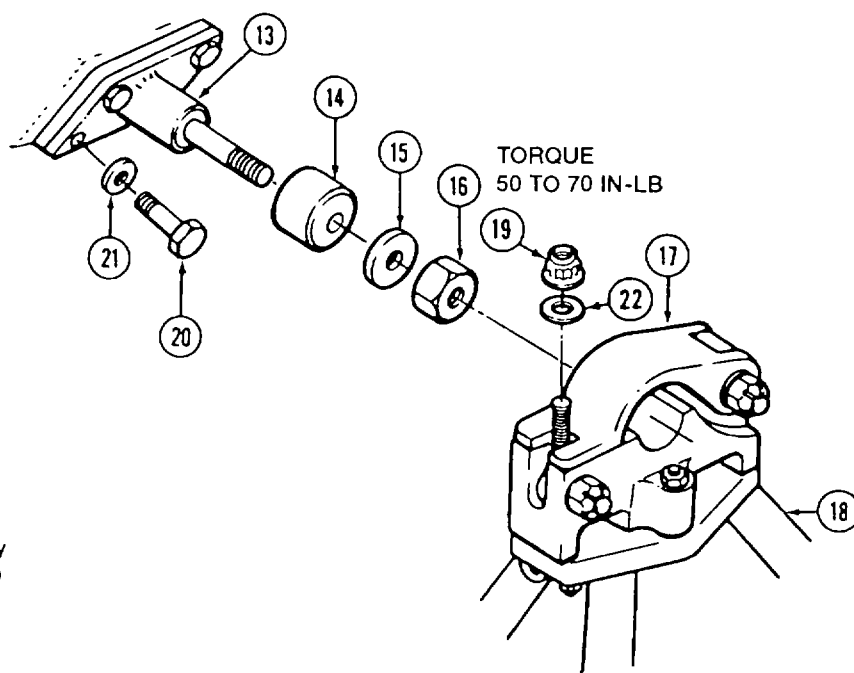


DETAIL A

1. Trunnion	7. Thin steel washer
2. Cambox assembly bracket	8. Special bolt
3. Transducer bracket	9. Thin steel washer
4. Thin steel washer	10. Engine mount forward
5. Bolt	11. Steel washer
6. Bolt	12. Rod end bearing

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Figure 4-3B. Engine Mount Fittings (Trunnions) Installation (Sheet 1 of 2)



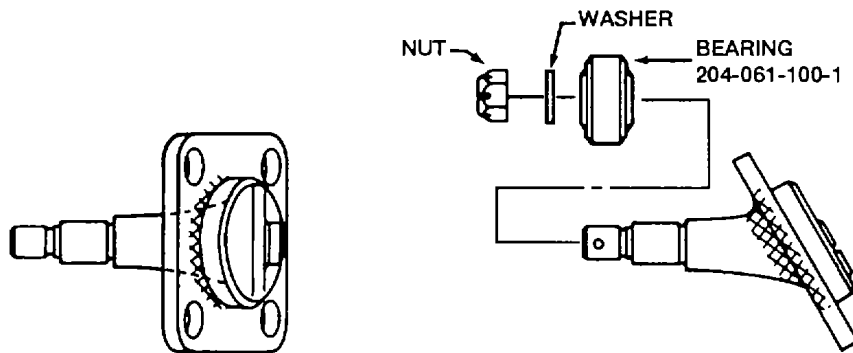
- 13. Trunnion
- 14. Bearing
- 15. Thin steel washer
- 16. Nut
- 17. Pillow block assembly
- 18. Engine mount (tripod)
- 19. Ring base nut
- 20. Bolt
- 21. Thin steel washer
- 22. Special washer

DETAIL B

209060-121-2A

Figure 4-3B. Engine Mount Fittings (Trunnions) Installation (Sheet 2 of 2)

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ENGINE MOUNT FITTING (TRUNNION) 204-060-152-1

DAMAGE LOCATION SYMBOLS



TYPE OF DAMAGE	MAXIMUM DEPTH AND REPAIR AREAS ALLOWED	
CRACKS	None	None
NICKS, SCRATCHES, DENTS AND CORROSION	0.010	.0020
MAXIMUM AREA PER FULL DEPTH REPAIR	Not Critical	Not Critical
NUMBER OF REPAIR AREAS	Not Critical	Not Critical
EDGE CHAMFER	0.010	0.020
BORE DAMAGE	0.002 for 1/4 Circumference	
THREAD DAMAGE ON FITTING AND NUT	None Acceptable	
BEARING WEAR (LOOSENESS)		
Radial	0.006	
Axial	0.012	

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

Figure 4-3C. Damage Limits - Aft Engine Mount Fittings (Trunnions) and Bearings

4-5.5 INSPECTION - ENGINE MOUNT FITTINGS (TRUN NIONS).

a. Inspect aft engine mount fittings (trunnions) for damage in excess of limits shown in figure 4-3C.

b. Inspect bearings on aft engine mount fittings (trunnions) for damage and wear (looseness) in excess of limits shown in figure 4-3C.

c. Inspect forward engine mount fitting (trunnion) (1, figure 4-3B) for nicks, scratches, cracks and thread damage. No cracks, thread damage or severe mechanical damage is acceptable.

4-5.6 REPAIR OR REPLACEMENT-ENGINE MOUNT FITTINGS (TRUNNIONS).

a. Replace bearings if damaged or worn in excess of limits (paragraph 4-5.5b).

(1) Remove nut (16, figure 4-38) washer (15) and bearing (14).

(2) Position serviceable bearing (14) on fitting (trunnion). Install thin steel washer (15) and self-locking nut (16). Torque 50 TO 70 inch-pounds.

b. Replace engine mount fittings (trunnions) if damaged in excess of limits (paragraph 4-5.5).

c. Polish out mechanical and corrosion damage that is within limits shown on figure 4-3C with fine India stone (C128). Touch up repair area with primer (C100 or C102).

4-5.7 INSTALLATION-FORWARD ENGINE MOUNT FITTING (TRUNNION).

NOTE

If trunnion was removed from an installed engine, the engine should be supported by a hoist (paragraph 4-5.3).

a. Position trunnion (1, figure 4-3B) on engine forward left mount pad.

b. Position cambox assembly bracket (2) on top mounting holes of trunnion. Position transducer bracket (3) on lower portion of trunnion (1) with washer (11) between bracket and trunnion.

c. Install two thin steel washers (4) and bolts (5). Do not tighten bolts. If required, add a maximum of three AN960C816 and/or AN960C816L washers (paragraph 4-120) to obtain a flush fit between transducer bracket (3) and trunnion (1).

d. Install two bolts (6) and thin steel washers (7).

Torque bolts (5) and bolts (6) 290 to 410 inch-pounds.

e. Position forward engine mount (10) on trunnion (1) and install special bolt (8) and thin steel washer (9). Torque bolt (8) 50 to 70 inch-pounds.

f. Lockwire (C151) bolt (8) to upper forward bolt (6), then to lower forward bolt (6). Lockwire (C151) lower aft bolts (5), to upper aft bolts (5).

4-5.8 INSTALLATION-AFT ENGINE MOUNT FITTINGS (TRUNNIONS).

NOTE

If trunnions were removed from an installed engine, the engine should be supported by a hoist (paragraph 4-5.4).

a. Install left aft trunnion (13, figure 4-3B) as follows:

(1) Position trunnion (13) on engine left aft mount pad.

(2) Install four bolts (20) and thin steel washers (21). Torque bolts (20) **95 to 110** inch-pounds. Lockwire (C151) bolts in pairs.

b. Install right aft trunnion in same manner outlined in step a.

c. Remove hoist and engine sling if applicable.

d. Install main driveshaft (paragraph 6-7).

e. Install particle separator (paragraph 4-8).

f. Install engine cowl and transmission cowl (chapter 2).

g. Connect battery.

h. Perform runup and maintenance test flight.

Section II. COOLING SYSTEM

4-6. Cooling System.

All power plant cooling is entirely automatic in operation, having no direct controls.

a. Engine Internal Cooling. Internal parts of the engine are cooled (and main bearing seals pressurized against internal oil leakage) by compressed air diverted from the main stream of air flow through the engine, and by external air admitted through the hollow struts of the exhaust diffuser. This cooling air passes out of the engine with exhaust gases.

b. Engine External Cooling. The exterior of the engine is cooled by air entering scoops on cowling doors

and flowing aft to the tailpipe area, where it is drawn out through the ejector by the exhaust gas stream. (Refer to Chapter 2 for further information on cowling, and to Section IV of this chapter for description and maintenance of the ejector.)

c. Starter - Generator Cooling. The starter- generator is equipped with an integral fan and an inlet shroud connected by a flexible hose to a screened intake duct, mounted on right side of engine inlet housing, near the cowling air scoop. The duct and hose must be kept free from obstruction and securely mounted. (Refer to Chapter 9 for further information and maintenance of the starter-generator.)

Section III. AIR INDUCTION SYSTEM

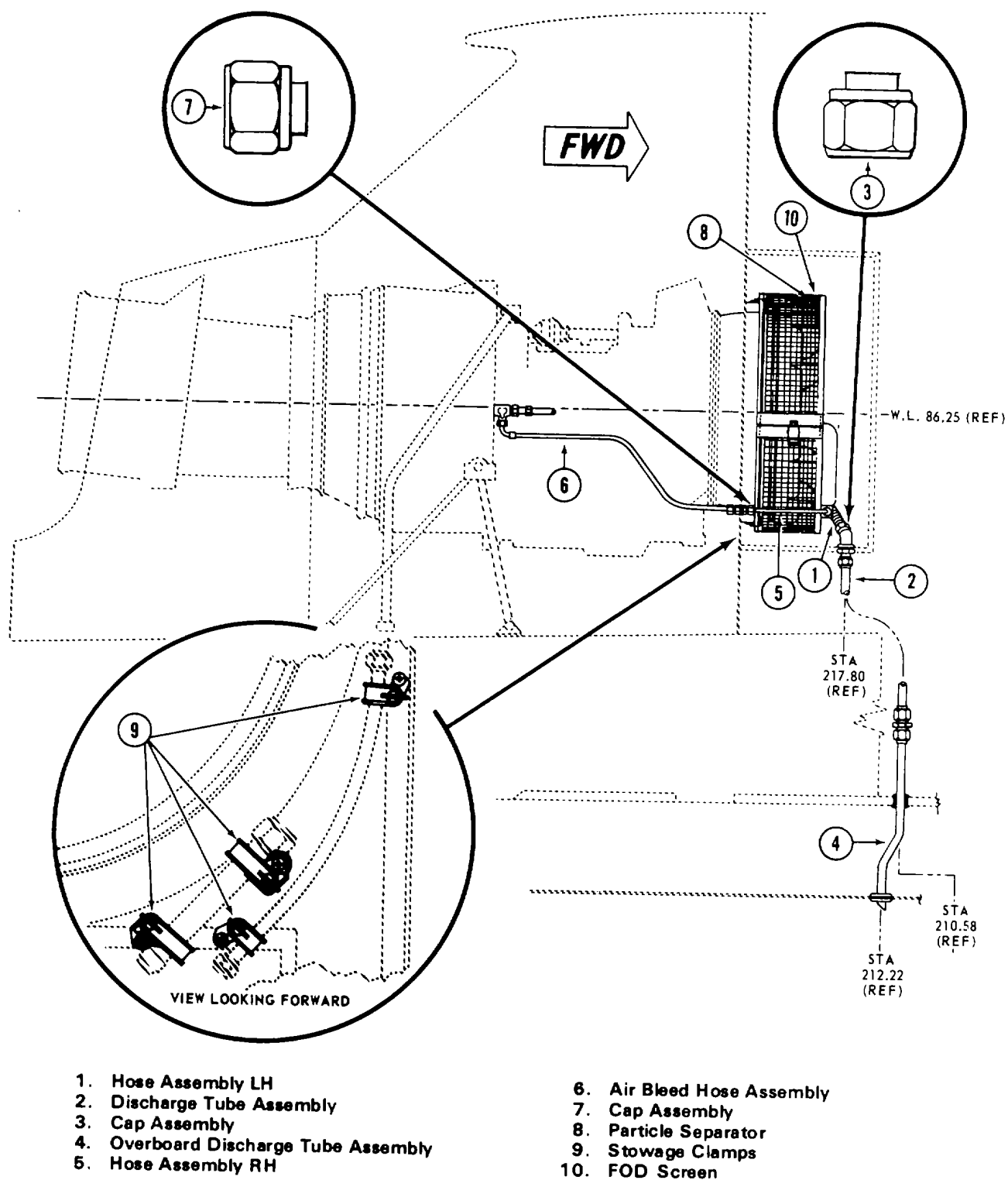
4-7. Air Induction System.

Engine intake air passes through grass filter screens and large vertical scoops on both transmission cowling doors, into a chamber enclosed by induction baffles and the forward firewall. From this chamber, air is drawn into the engine inlet through a particle separator which removes particles of foreign matter.

4-8. Particle Separator.

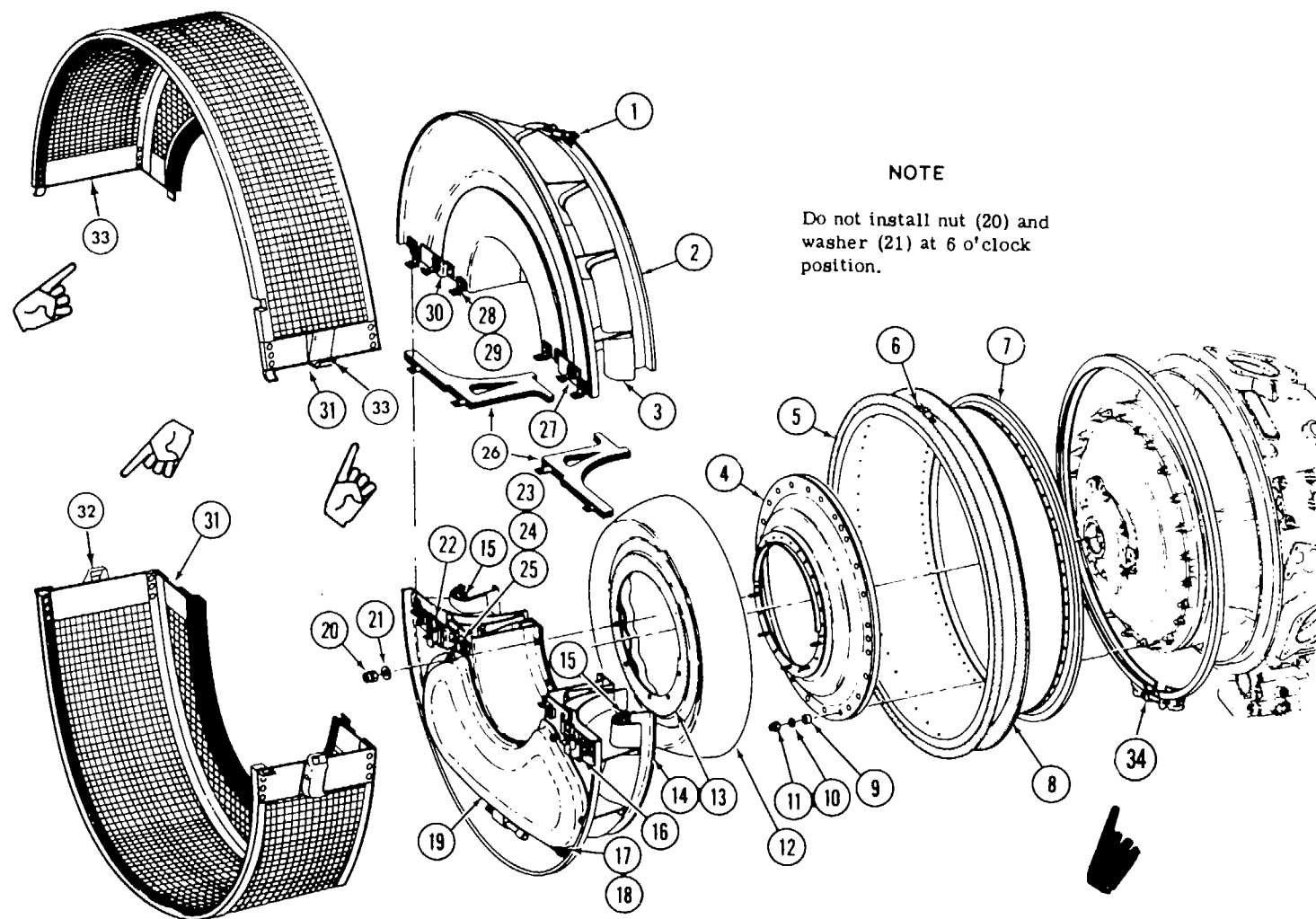
The particle separator is an inertial-type separator consisting of an upper and lower assembly half, a FOD screen, a deflector, a mounting ring assembly, a flange assembly and seal, gaskets, and attaching hardware. (See figures 4-4, 4-5 and 4-6.) Removal of the upper assembly half permits maintaining aircraft drive shaft and inspecting the engine inlet. The lower assembly half mounts the air cleaner which collects particles removed from the engine inlet air and ejects them overboard. A flange assembly provides means of attaching the separator to the engine inlet housing. The

foreign object damage screen consists of two halves which fit around the sand and dust separator inlet to prevent large foreign objects from entering the engine. Two latch assemblies hold the halves together. (See figure 4-5.) Engine inlet air passes through the FOD screen, where any large particles are caught immediately, and enters the separator through a curved, annular, radial inflow bellmouth provided in the upper and lower assembly halves. Separation occurs when the contaminated air is drawn through a turn, causing particles to be forced to the concave inner flow wall and caught by a protruding lip of the deflector assembly. Clean air continues into the engine inlet area while contaminated portion of the air is drawn through a second turn causing further separation. The clean air resulting from the second turn is returned to the engine inlet area while particle- laden air flows into a large annular chamber and through an air cleaner mounted on the lower half of the separator. Engine compressor discharge (P3) air from a fitting mounted on the engine air diffuser flows through the venturi effect ejector and carries the particles overboard through airframe plumbing.



209900-475A

Figure 4-4. Particle separator



209900-325-1A

Figure 4-5. Particle separator - exploded view (Sheet 1 of 2)

4-8 Change 65

1. Latch	12. Deflector Assembly	23. Positioning Pin
2. Upper Assembly Half	13. Gasket	24. Angle Bracket
3. Hook	14. Lower Assembly Half	25. Spacer
4. Mounting Ring Assembly	15. Latch	26. Gasket Assembly
5. Seal	16. Latch Assembly (RH)	27. Hook Assembly
6. Hook Assembly	17. Nut	28. Angle Bracket
7. Mounting Flange Assembly	18. Washer	29. Spacer
8. Gasket	19. Air Cleaner	30. Hook Assembly
9. Sleeve Spacer	20. Nut	31. FOD Screen
10. Washer	21. Washer	32. Latch
11. Nut	22. Latch Assembly (LH)	33. Hook
		34. V-Band Coupling

Figure 4-5. Particle separator - exploded view (sheet 2 of 2)

Premaintenance Requirements for Particle Separator

<u>Conditions</u>	<u>Requirements</u>
Model	AH-1S
Part. No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	Torque Wrench
Minimum Personnel Required	One
Consumable Materials	(C14) (C15) (C35) (C87) (C108) (C112) (C124) (C138) (C142)
Special Environmental Conditions	None

a. Removal.

(1) Remove top half of foreign object (damage screen. (Refer to paragraph 4-11.)

(2) Release two latches (15, figure 4-5) and latch assemblies (16 and 22) on front and rear faces of upper and lower separator halves (2 and 14) by simultaneously pressing the safety latch up and lifting the release catch. Release latch (1) on top of separator upper half and remove the upper half.

(3) Remove gasket assemblies (26).

NOTE

It is not necessary to further disassemble the separator unless the inspection procedures indicate that gaskets and seals may be damaged. If further inspection is required, proceed with the following steps.

(4) Remove the lower half of the foreign object damage screen. (Refer to paragraph 4-11.)

(5) Remove main drive shaft from aircraft as a complete assembly, and remove curvic coupling adapter from engine output shaft.

(6) Disconnect pressure and overboard plumbing from air cleaner fittings.

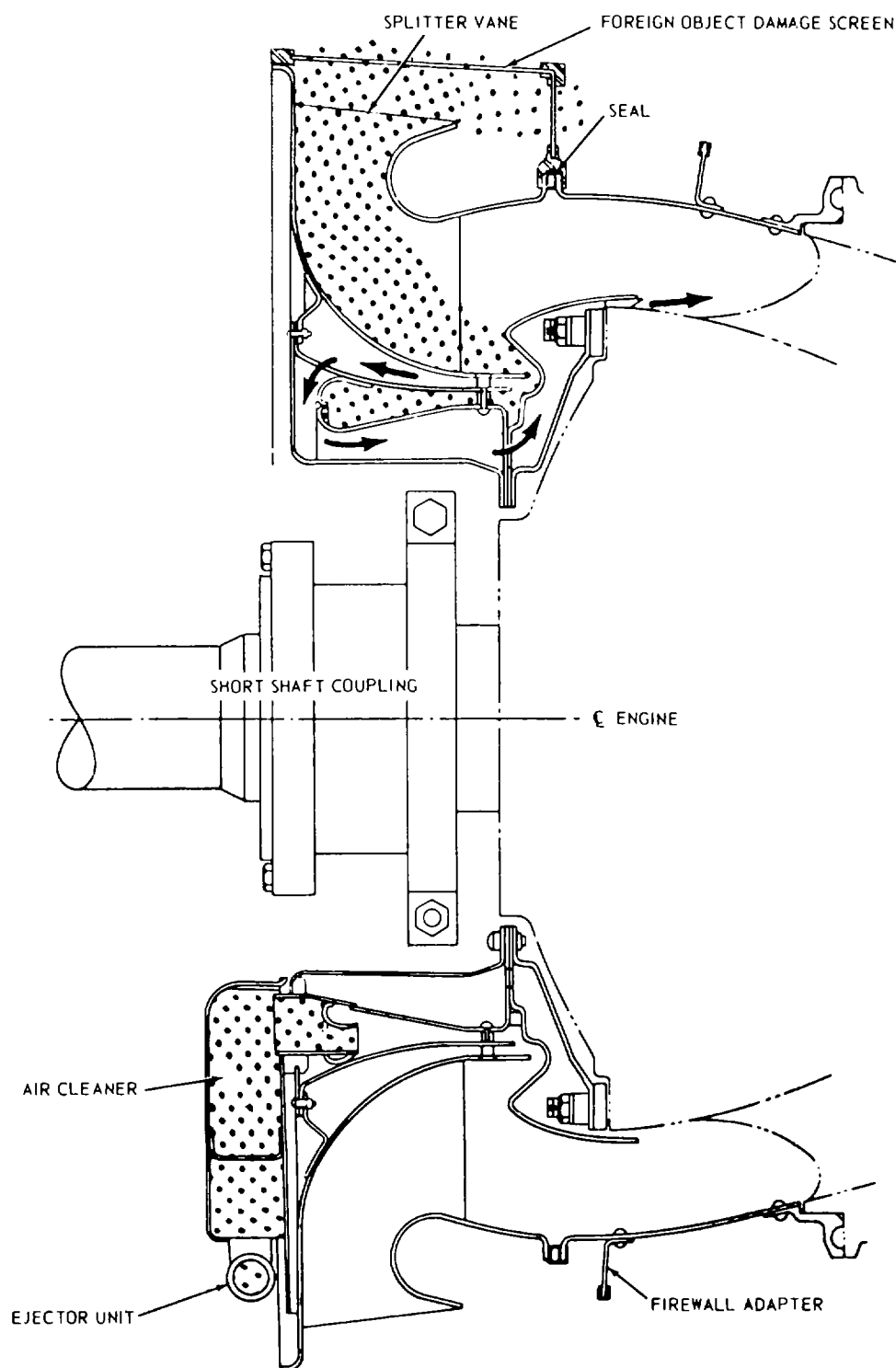
(7) Remove five nuts (20, figure 4-5) and five washers (21). Remove lower half(14) of separator and deflector assembly (12).

(8) Remove 24 nuts (11), 24 washers (10), 24 sleeve spacers (9) and remove mounting ring assembly (4).

NOTE

Loosely install spacers, washers, and nuts on engine inlet housing studs.

(9) Remove washers, screws, and split ring assembly that secure mounting flange assembly (7) to aircraft.



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Figure 4-6. Airflow diagram

4-10 Change 7

(10) Loosen V-band coupling and remove mounting flange assembly.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

b. Cleaning. Clean parts only as required to facilitate inspection using solvent (C124).

c. Inspection.

(1) Inspection seal (5, figure 4-5) on mounting flange assembly (7) for tearing and/or ripping at the edges and for lack of adhesion.

(2) Inspect gasket (8) on each side of mounting flange assembly (7) for lack of adhesion.

(3) Inspect gasket assemblies (26) for a permanent set and lack of adhesion.

(4) Inspect all metal surfaces for cracks or other damage.

(5) Inspect for loose or missing rivets. If rivets are loose or missing in upper or lower assembly half perform FOD inspection. Replace the assembly half or repair in accordance with step d.

(6) Inspect for weld cracks or weld separation (particularly in the area of the inlet vanes in both the upper and lower assembly halves). If cracks or separation is evident, replace affected assembly half or repair in accordance with step d.

(7) Inspect for damaged or inoperable safety latches, damaged positioning pins (23), and angle brackets (24 and 28). If damage is evident, replace the affected assembly half or repair in accordance with step d.

(8) Inspect air cleaner (19) for evidence of erosion.

(9) Inspect all other parts for evidence of erosion. Replace damaged parts.

d. Repair or Replacement.

(1) Repair loose seal and gaskets as follows:

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

(a) Repair loose gasket (8, figure 4-5) by recementing gasket to mounting flange assembly with cement (C35). Clean mating surfaces with methyl-ethyl-ketone (C87).

(b) Repair loose gaskets (13 and 26, figure 4-5) by recementing gaskets to mating surface with adhesive (C14). Clean mating surfaces with methyl-ethyl-ketone (C87).

(c) Repair loose seal (5, figure 4-5) by recementing seal to mating surface, using adhesive (C15). Clean mating surfaces with trichloroethylene (C142) and then with methyl-ethyl-ketone (C87).

(2) Replace damaged gaskets (13) as follows:

(a) Remove defective gasket and oil adhesive from deflector assembly.

(b) Wipe all metal surfaces to be bonded with lint-free gauze moistened (not dripping) with methyl-ethyl-ketone (C87). Continue wiping surface, changing gauze frequently, until gauze remains clean.

NOTE

All grease, oil, or other surface contaminants must be removed from the bonding surface.

(c) Using clean, stiff brush, remove contaminants from surface of new gasket.

NOTE

Porous surfaces which have been contaminated with oil or grease cannot be satisfactorily cleaned to ensure proper bonding and shall be discarded.

(d) Using clean applicator, apply a continuous uniform film of adhesive (C14) to surfaces to be bonded. Allow adhesive to thoroughly air dry for approximately 3 hours.

(e) After adhesive coating has dried, apply a second uniform, continuous film of adhesive to surfaces to be bonded. Allow adhesive to thoroughly air dry for approximately 3 hours.

(f) Align surfaces to be bonded to obtain contact over entire surface.

(g) Apply light load to surfaces being bonded. Allow adhesive to cure under this pressure for a minimum of 4 hours.

(3) Replace damaged seal (5, figure 4-5) on mounting flange assembly (7) as follows:

(a) Remove defective seal. Remove old adhesive film from metal surfaces with a knife blade. Complete cleaning with sandpaper (C112).

WARNING

Use trichloroethylene and methyl-ethyl-ketone in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

(b) Wipe metal surfaces to be bonded with lint-free gauze, moistened (not dripping) with trichloroethylene (C142) followed by methyl-ethyl-ketone (C87). Continue wiping, changing gauze frequently, until gauze remains dry.

CAUTION

To ensure proper bonding of seal, ensure that all grease, oil, or other surface contaminants are removed.

NOTE

Determine whether new seal is proper size by fitting it to metal mating flange of mounting

flange assembly. Do not stretch seal when installing it for fit. If the seal is too large, it may have developed an oversize set during shipment. If so, cut the seal to the required circumferential length and adhere as a strip with the "butt joint" located at either the 6- or 12-o'clock position.

(c) Using sandpaper (C112), roughen seal surfaces to be bonded.

(d) Using lint-free gauze, thoroughly clean all surfaces to be bonded with trichloroethylene (C142).

(e) Apply a uniform layer (**0.010 TO 0.030** inch thick) of adhesive (C15) to surfaces to be bonded.

(f) Fit seal to flange of the mounting flange assembly and press surfaces together.

NOTE

Use only enough pressure to displace air, but not so much that the adhesive is forced out of the joint.

(g) Allow adhesive to cure undisturbed.

NOTE

Under light pressure, the adhesive will take 24 hours to cure. Under warm, damp conditions the adhesive may cure sufficiently in 4 hours to permit reinstallation of mounting flange assembly.

(4) Replace damaged gasket (8, figure 4-5) on each side of support of mounting flange assembly (7) as follows:

(a) Remove gasket material.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

(b) Wipe metal surfaces to be bonded with lint-free gauze moistened (not dripping) with methyl-ethyl-ketone (C87). Continue wiping and changing gauze frequently, until gauze remains clean.

CAUTION

For proper bonding of gasket, ensure that all grease, oil, and other surface contaminants are removed.

(c) Fit new gasket (**0.047** inch thick) to mounting flange assembly.

(d) Using sandpaper (C112) roughen surface of gasket to be bonded.

(e) Wipe all gasket surfaces to be bonded with lint-free gauze moistened (not dripping) with **methyl-ethyl-ketone (C87) to remove all powder and surface contaminants. Allow gasket to dry for 15 minutes.**

(f) Apply a continuous uniform film of cement (C35) to both metal and rubber surfaces to be bonded. Allow approximately 2 to 3 hours drying time.

(g) Wipe the surface of one adhesive film with gauze moistened with methyl-ethyl-ketone (C87), one section at a time. The reactive surface should immediately become tacky.

(h) Align mating surfaces, one section at a time, to obtain contact over entire surface, and press tacky surface to dry surface. Allow adhesive to cure under light pressure for a minimum of 4 hours.

(5) Replace air cleaner (19, figure 4-5) as follows:

(a) Remove six nuts (17) and six washers (18). Remove air cleaner from lower assembly half.

(b) Position new air cleaner on lower assembly half and secure with six washers (18) and six nuts (17).

(6) (AVIM) Repair nonconverging cracks by stopdrilling crack ends. Where necessary to prevent air leakage, seal with tape or silicone rubber, RTV (C108). Torque nuts 30 to 35 inch-pounds.

(7) (AVIM) Use rivets or tack welds to patch-repair converging cracks. Follow standard airframe sheet metal repair procedures.

NOTE

Any standard aluminum aircraft rivets, including Huck, Cherry, etc., of proper size may be used for all rivet repairs except hardware replacement.

(8) (AVIM) Patch-repair punctures too large to repair with silicone rubber. Follow standard airframe sheet metal repair procedures. Secure patches with rivets or tack welds.

(9) (AVIM) Repair torn tack and spot welds with tack, interrupted, or plug weld repairs; use doublers as needed. See figure 4-7. Rivet repairs, using doublers as needed, are also acceptable.

(10) Repair serious erosion damage by replacing damaged parts or using doublers.

(11) Reshape deformed parts if feasible. If reasonable conformity cannot be achieved, particularly at mating edges, sealing surfaces, etc., replace part.

(12) Replace damaged latches on lower assembly half as follows:

NOTE

Tape (C130) patch between hardware items and assembly half must be replaced if damaged during removal of hardware.

(a) Remove two rivets and remove latch.

(b) Assemble upper and lower assembly halves without gaskets installed between halves.

(c) Position latch on lower assembly half in line with hook or upper assembly half. Mark lines to position latch.

(d) Separate assembly halves.

(e) Position latch on lower assembly half within marked lines, and drill 0.128 to 0.133 inch holes for rivets.

NOTE

If rivet holes are elongated during drilling or if new holes are drilled, back up sheet metal with doubler before riveting.

(f) Secure latch with two rivets.

(13) Replace damaged positioning pins or angle brackets on lower assembly half as follows:

(a) Remove rivets, bracket and spacer.

(b) Assemble upper and lower assembly halves without gaskets.

(c) Position spacer and bracket on lower assembly half in line with bracket on upper assembly half. Top of bracket will be slightly higher than the edge of the assembly half. Mark lines to position spacer and bracket.

(d) Separate assembly halves.

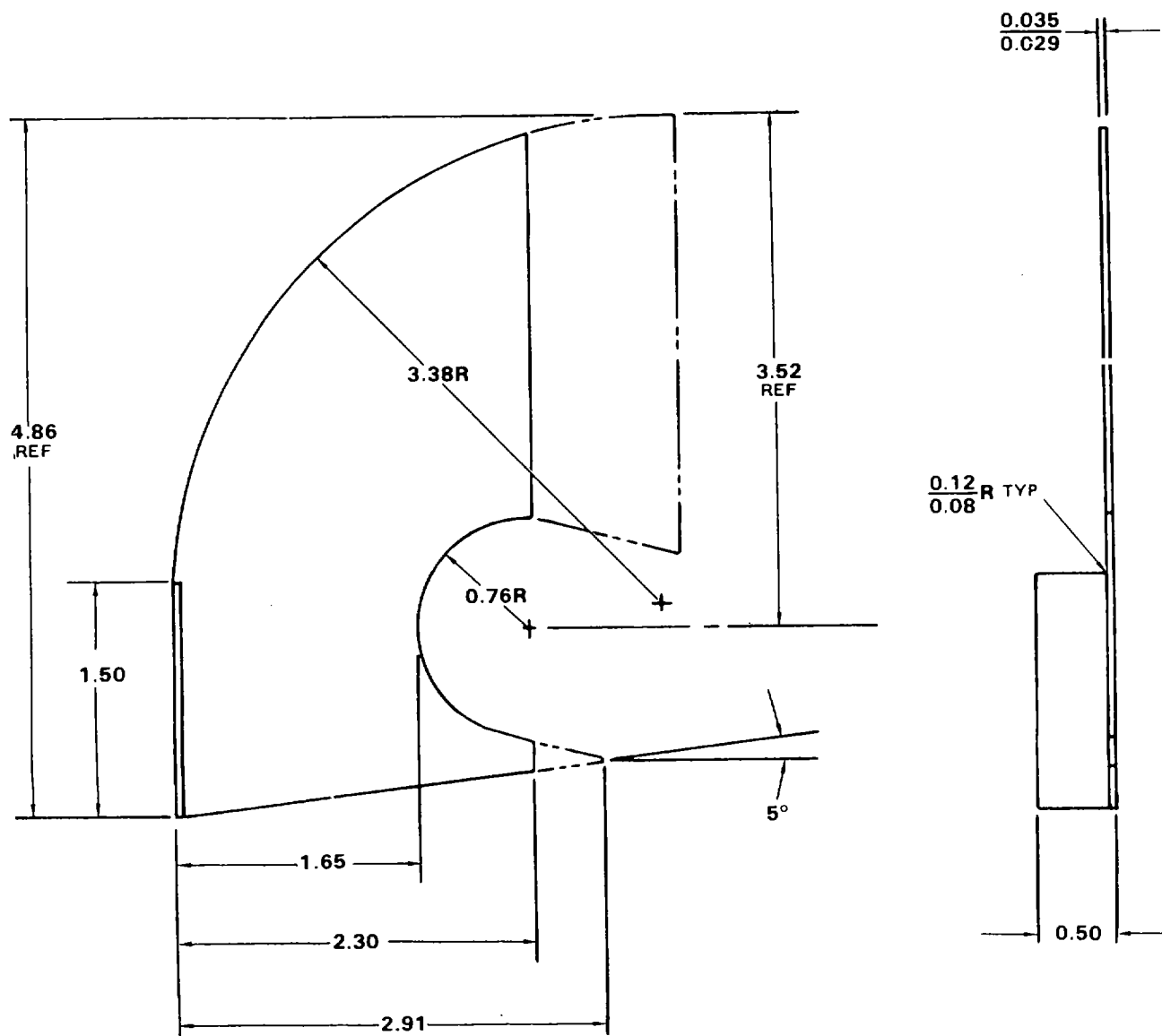
(e) Position spacer and bracket within mark lines and drill two 0.128 to 0.133 inch holes for rivets.

NOTE

Use vinyl tape (C138) between spacer and bracket.

(f) Secure bracket to spacer with two rivets.

(g) Align assembly halves and identify center on bracket in line with hole of bracket on upper assembly half.



ALL DIMENSIONS ARE IN INCHES

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MATERIAL: 6061-T6 ALUM (ITEM 17, TABLE 2-2)

Figure 4-7. Doubler for inlet vane reinforcement

(h) Drill a 0.250 to 0.252 inch hole through bracket.

(i) (AVIM) Install new pin in bracket, and tack weld in two places, 180 degrees apart.

(14) (AVIM) Replace new pin in bracket, and tack assembly half as follows:

(a) Remove rivets, and remove hook.

(b) Assemble upper and lower assembly halves without gasket assemblies.

(c) Position hook on upper assembly half in line with latch on lower assembly half. Mark lines to position.

(d) Separate assembly halves.

(e) Position latch within marked lines and drill 0.128 to 0.133 inch holes for rivets.

NOTE

Use vinyl tape (C138) between hook and mounting surface.

NOTE

If rivet holes are elongated during drilling or if new holes are drilled, back up sheet metal with doubler before riveting.

(f) Secure hook with two rivets.

e. Installation.

(1) Wipe engine inlet housing clean with clean cloth moistened with solvent (C124).

(2) Position mounting flange assembly (7, figure 4-5) in front of airframe firewall and on engine inlet housing. Retain mounting flange loosely with V-band coupling and on firewall with split ring assembly, P/N 204-060-868-7. Insert screws with washers from back of firewall to secure ring assembly.

NOTE

Leave mounting flange assembly (7) loose enough to be rotated

(3) Remove spacers, washers, and nuts from engine inlet housing studs and discard.

(4) Position mounting ring assembly (4) on engine inlet housing studs.

NOTE

Ensure that five studs on ring assembly are at the bottom, with the center stud located at the 6 o'clock position.

(5) Secure mounting ring assembly with 24 sleeve spacers (9), 24 washers (10), and 24 nuts (11). **TORQUE NUTS TO 70-80 INCH-POUNDS.**

(6) Position deflector assembly (12) over locating pins and studs on mounting ring assembly (4) and press in until firmly seated.

NOTE

Secure lines to ejector inlet and discharge ports before installing lower assembly half (14).

(7) Position lower assembly half (14) on locating pins and studs on mounting ring assembly (4). Secure with washers (21) and nuts (20). **TORQUE NUTS TO 30-35 INCH-POUNDS.**

NOTE

Washer (21) and nut (20) may be omitted from 6 o'clock position to eliminate having to remove main drive shaft and engine adapter at next separator removal.

(8) Position upper assembly half (2) on lower assembly half (14).

NOTE

Do not install two gasket assemblies (26) at this time.

(9) Rotate mounting flange assembly (7) on inlet housing to align hook assembly (6) with latch (1) on upper assembly half (2). Secure mounting flange assembly (7) with V-band coupling. **TORQUE V-BAND COUPLING NUT TO 40-50 INCH-POUNDS.** Tap around coupling from middle toward each end with a soft-faced mallet to seat properly.

NOTE

Install V-band clamp assembly (34) with clamp latch on left side of engine and gap (drain) at the 6 o'clock position.

(10) Tighten screws to secure flange assembly to firewall

(11) Remove upper assembly half (2).

(12) Install curvic coupling in output shaft of engine and install main drive shaft if removed.

(13) Connect pressure and overboard plumbing to air cleaner fittings

(14) Install baffle panels.

(15) Position gasket assemblies (26) over positioning pins (23) on lower assembly half.

(16) If FOD screen is to be installed, install lower half.

(17) Position upper assembly half (2) on lower assembly half (14).

NOTE

Tilt top slightly forward to position assembly or four positioning pins (23).

(18) Engage upper assembly half (2) to mounting flange assembly (7) with latch (1).

(19) Engage latch assemblies (16 and 22) on front face and latch assemblies (15) on rear curl of separator

CAUTION

Ensure that safety catch on latches is engaged by exerting a slight pull on release catch. Catch should not open.

(20) Check for proper seating of seals by appearance. Approximately 1/8 inch of rubber on gasket assemblies will be uniformly exposed. Seal (5) on flange assembly will be approximately half way compressed.

(21) Install top half of FOD screen. (Refer to paragraph 4-9.)

4-9. Foreign Object Damage Screen.

The foreign object damage screen is mounted on the forward side of the particle separator and prevents large foreign objects from entering particle separator.

a. *Removal.* (Refer to figures 4-8 and 4-9.)

(1) Remove top half of FOD screen from the particle separator as follows-

(a) Unlock both latches.

(b) Disengage hook portions.

(c) Lift screen free of the sand and dust separator.

NOTE

Do not remove lower half of screen during periodic inspection unless additional inspection is required.

(2) If required, remove upper assembly half of particle separator. (Refer to paragraph 4-8.)

(3) Remove bottom half of FOD screen from the sand and dust separator as follows:

(a) Lift forward split portion of the butt molding free of the vane and hold in that position.

(b) Lift rear (notched) portion free of the curled inlet of the sand and dust separator.

(c) Repeat preceding steps (a) and (b) for the other side.

(d) Withdraw bottom half of FOD screen from under the sand and dust separator.

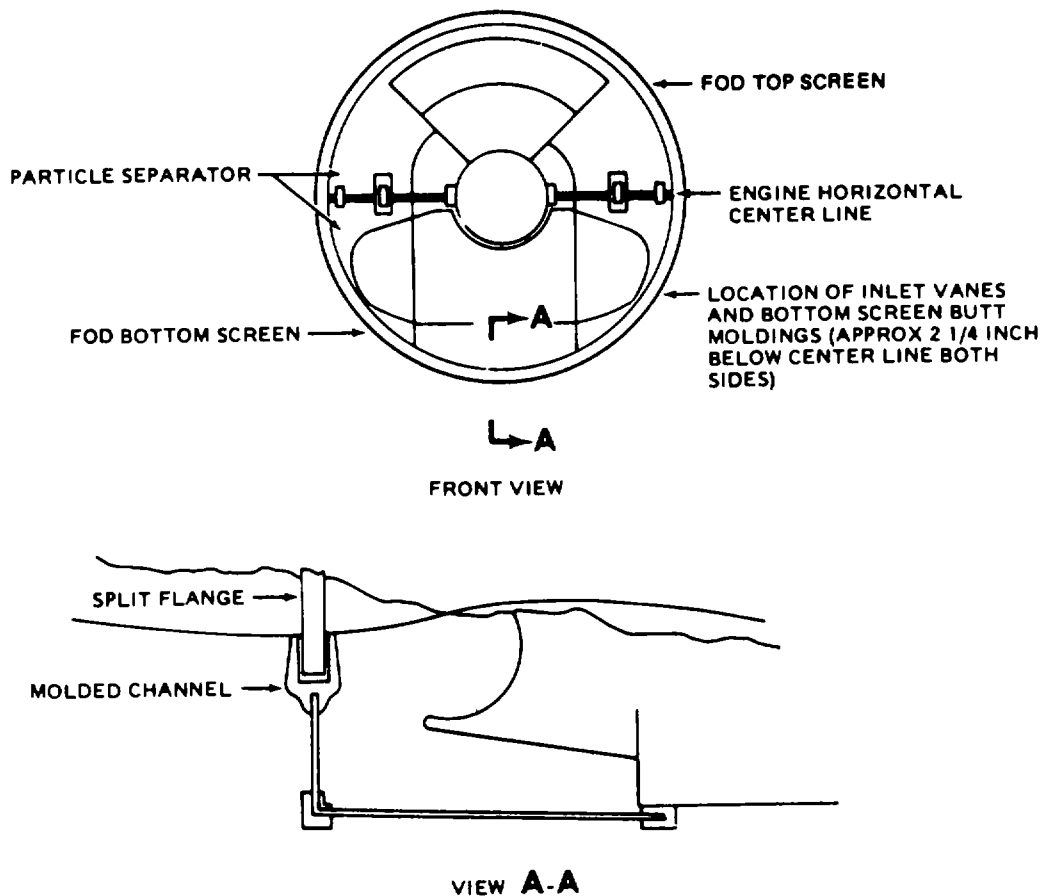
b. *Cleaning*

(1) Clean all parts as required to facilitate inspection, using solvent (C124).

c. *Inspection.*

(1) FOD screen for damage which would permit foreign object entry.

(2) Aft molding for cuts or other damage.



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Figure 4-8. Removal/installation foreign object damage screen

- (3) Latch assemblies for damage as follows:
  - (a) Erosion or damage that may cause tightness or binding.
  - (b) Cracks.
  - (c) Loose or missing rivets.

- (4) FOD screen for deformation.

d. Repair and Replacement.

- (1) Reshape deformed parts, if feasible. If reasonable conformity cannot be obtained, replace either half or both as required.
- (2) Replace parts having severe damage or mutilation.
- (3) Replace screen halves with missing or loose rivets.

- (4) Replace FOD small mesh screen.
  - (a) Cut screen (1560-AH-1-080-3) in half lengthwise. (See Appendix D.)

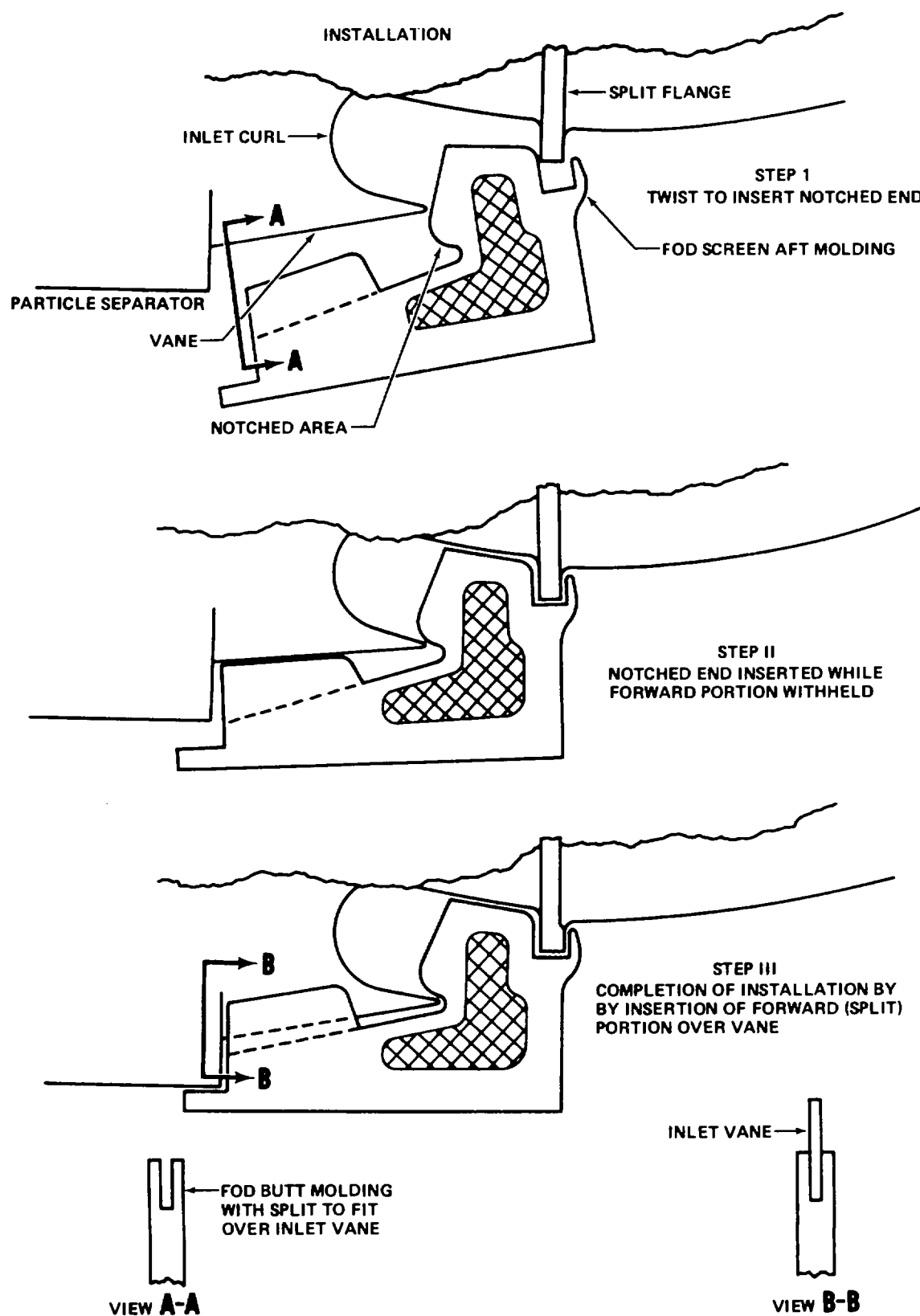
CAUTION

Maximum allowable overlay is 2 mesh openings and .070 inch gap.

NOTE

To prevent overlapping of screen on back edges FOD screen some wedge cuts in screen will be necessary.

- (b) Line screen (1560-AH-1-080-3) along leading edge of FOD screen. Form screen to existing FOD screen.



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Figure 4-9. Procedural steps installing foreign object damage screen (bottom half)

(c) Using safety wire (C151), secure one end and single wire lace every fifth opening along outer perimeter of screen (1560-AH-1-080-3) to existing FOD screen.

(d) Repeat steps (3) and (4) for other half of FOD screen.

(5) Replace damaged hooks on upper screen as follows:

- (a) Remove rivets and remove hook.
- (b) Assemble upper and lower screens and position hook in line with latch on lower screen.
- (c) Mark lines to position hook.
- (d) Separate assembly halves.
- (e) Position latch within marked lines and drill 0.128 to 0.133 inch holes for rivets.

NOTE

If rivet holes are elongated during drilling or if new holes are drilled, back up sheet metal with a doubler before riveting.

(f) Secure hook with two rivets.
(6) Replace damaged latches on lower screen as follows:

- (a) Remove rivets and latch.
- (b) Assemble upper and lower screens and position latch on lower screen in line with hook on upper screen.
- (c) Mark lines to position latch.
- (d) Separate assembly halves.
- (e) Position latch within marked lines and drill 0.128 to 0.133 inch holes for rivets.

NOTE

If rivet holes are elongated during drilling or if new holes are drilled, back up sheet metal with a doubler before riveting.

(f) Secure latch with two rivets.
e. *Installation.* (Refer to figures 4-8 and 4-9).

CAUTION

Ensure integrity of repairs. Materials used to make repairs may be ingested by engine if not properly secured.

(1) Position bottom half of the foreign object damage screen, aft molding side toward engine inlet, under the sand and dust separator so butt molding is approximately 2-1/4 inches below horizontal centerline, and aft molding is seated over the particle separator split flange.

CAUTION

Improper seating of the aft molding over the separator split flange can result in cuts or other damage to the molding as well as placing excessive stress on all portions of the screens and latches. To check for proper seating, run hand along the lower split flange to ensure that the molded channel is properly fitted over both sides of the split flange. (See figure 4-8.)

(2) Insert aft molding while holding butt molding away from the vane in the separator. (Refer to steps I and II, figure 4-9.)

(3) Line up the slot in forward portion of butt molding with the vane over which it is to be fitted, and press into place. (Refer to step III, figure 4-9.)

NOTE

When properly installed, the notched area of the butt molding should be positioned behind the sand and dust separator inlet curl, and the forward portion of the molding should have one part of the split on the top of the vane and one part underneath the vane as shown in figure 4-9.

(4) If removed, install top half of the particle separator. (Refer to paragraph 4-8e.)

(5) Position top half of the FOD screen so as to engage the aft screen molding slot over the separator split flange. Position the screen cut out over the latch at the 12-o'clock position of the separator.

(6) Secure top half to the bottom by engaging and locking both latches.

NOTE

Both latches must be engaged with the mating hooks before closing either latch to a locked position.

4-10. Air Induction Baffle.

The air induction baffle consists of panels enclosing the engine air inlet area, ahead of the

engine forward firewall and within the transmission cowling. (See figure 4-10.) Panels are formed of aluminum sheet with riveted doublers, clips, fasteners and edge seals.

a. Removal.

- (1) Open transmission cowling.
- (2) Replace fasteners and pull shaft access panel from left front of forward induction baffle panel.
- (3) If so equipped, detach support clamps of UHF-VHF antenna leads for clips on top and forward baffle panels. Keep attaching parts with clamps.
- (4) Release fasteners and remove top panel.
- (5) Remove upper air filter assembly of particle separator, main drive shaft, and lower air filter assembly.

- (6) Release fasteners and remove forward and floor panels from right side of compartment.

b. Cleaning. Clean all panels with solvent (C124).

c. Inspection. Panels for cracks, damaged seals, general condition, and security of fasteners.

d. Repair or Replacement. Make temporary repair of cracks by drilling a small hole just beyond end of crack. Replace any panel if damaged so that baffle cannot be securely fastened or will allow foreign material to enter induction area.

e. Installation.

(1) Lift floor and forward baffle panels into place from right side of transmission compartment. Align on brackets on engine firewall and pylon fifth-mount support. Secure fasteners.

(2) Install particle separator lower air filter, main drive shaft, and upper air filter.

(3) Place top panel on upper edge of forward panel and on two firewall brackets, and secure fasteners.

(4) If so equipped, attach support clamps of UHF-VHF antenna leads to clips on top and forward baffle panels, using attaching parts previously removed.

(5) Position shaft access panel in opening at left front of baffle. Insert inboard edge into slip joint of forward panel. Align and secure fasteners.

Section IV. EXHAUST SYSTEM

4-11. Exhaust System.

The exhaust diffuser section, on rear of the engine, provides passage for gas flow from the combustion chamber. The exhaust passage is extended aft and slightly upward by a tailpipe and an ejector assembly. A thermocouple assembly, mounted on the diffuser, has probes in the exhaust stream to provide continuous indication through the exhaust temperature gage system. For purpose of engine compartment cooling, a heat shield is mounted around the end of the diffuser, the tailpipe is covered by an insulation blanket, and the ejector surrounds the exhaust gas flow with a cooling air stream. For helicopters which have IFR suppression systems installed, refer to paragraph 4-13.

4-12. Tailpipe, Ejector and Heatshield.

The exhaust tailpipe and the heatshield are mounted on flanges of the engine exhaust diffuser by V-band clamps. (See figure 4-11.)

Premaintenance Requirements for Tailpipe Ejector and Heatshield

<u>Conditions</u>	<u>Requirements</u>
Model	AH-1S
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	One
Consumable Materials	(C116)(C124)
Special Environmental Conditions	None

a. Removal.

(1) Disconnect drain lines from fittings or tailpipe and ejector.

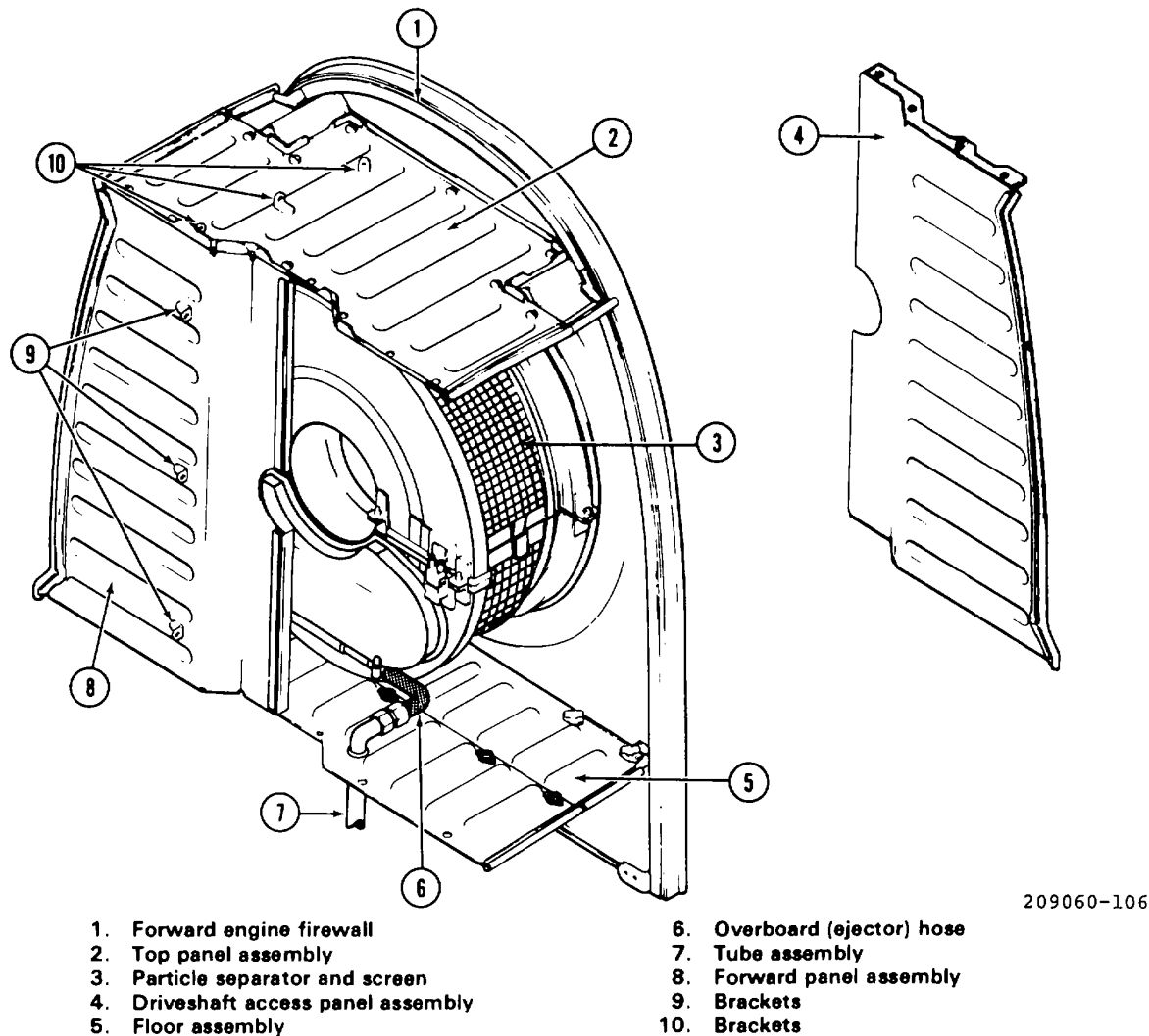


Figure 4-10. Air induction area (cowling omitted)

(2) Remove ejector and tailpipe fairing as follows:

(a) If ejector is attached to tailpipe, remove screws and washers at five sets of brackets to detach and remove ejector. Release fasteners along lower edge of fairing, and lift off fairing rearward.

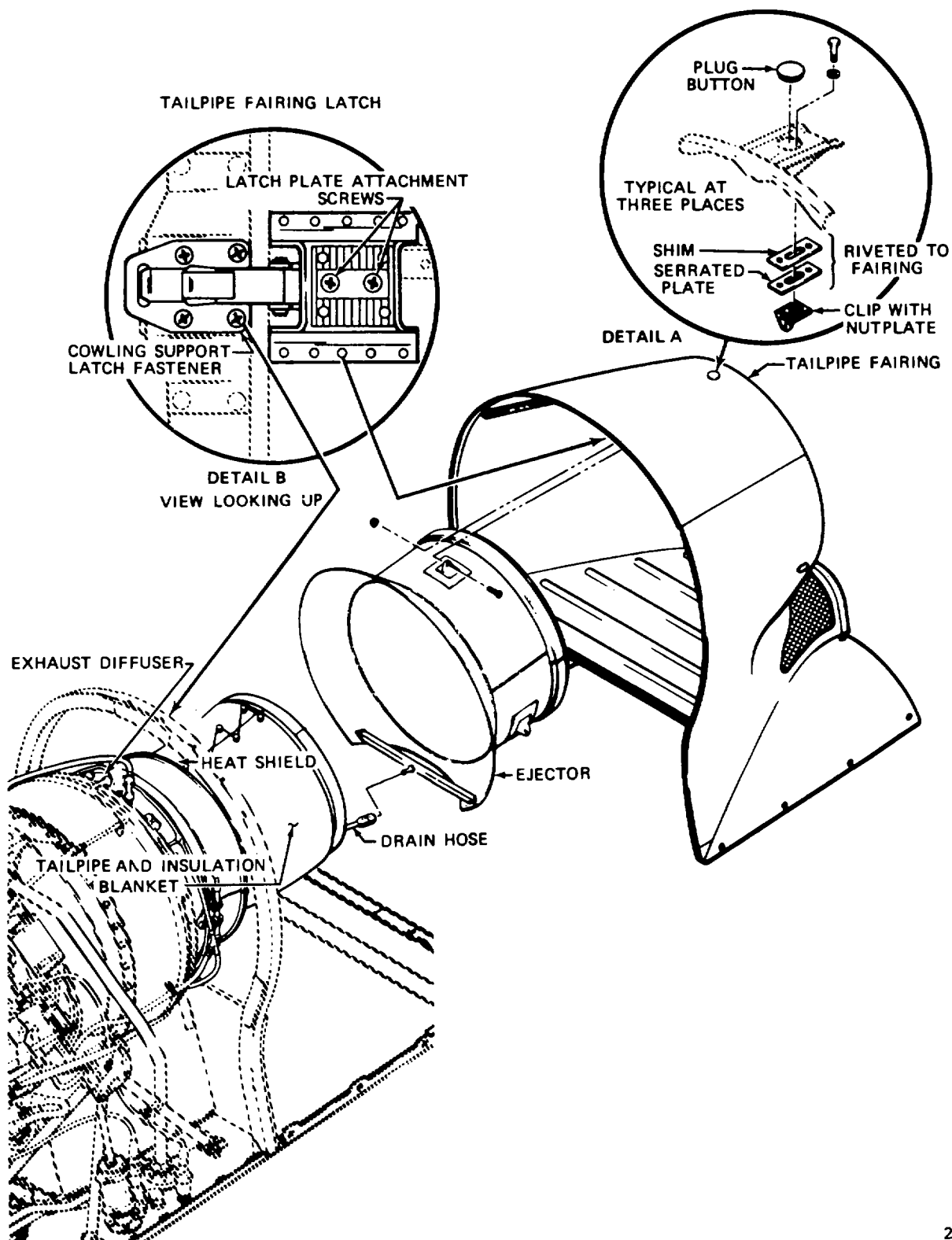
(b) If ejector is attached to fairing, release fasteners and remove fairing with ejector attached. Detach ejector from fairing by removing screws and nuts at three mounting clips.

(3) Loosen nuts to open V-band clamp which secures tailpipe to engine diffuser flange. Pull aft to disengage locating pins, and remove tailpipe.

(4) When required, remove lockwire and unwrap insulation blanket from tailpipe.

(5) Remove V-band clamp and heat shield from flange of diffuser support cone.

(6) Cover exhaust diffuser opening.



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Figure 4-11. Exhaust system components

b. Cleaning. Clean tailpipe and ejector with wire brush and solvent (C124) when necessary. Clean clamps and heat shield with solvent. Do not use solvent on insulation blanket.

c. Inspection.

(1) Tailpipe and ejector for cracks, dents, and burned out or buckled areas.

(2) Insulation blanket for visible damage.

(3) Heat shield for cracks and distortion.

d. Repair or Replacement. (AVIM)

(1) Ejector

(a) Shallow dents and scratches may be disregarded.

(b) (AVIM) Cracks three inches or less in length may be welded. Welds must be ground down as smooth as possible to match contour of ejector.

(c) (AVIM) Cracks in excess of 3 inches, tears or small bullet holes in any area of the ejector may be repaired by stopdrilling ends of each crack or tear and welding a patch of titanium, MIL-T- 9046, Type 1, Composition C, over the crack or tear on both inside and outside of the ejector. Patch edge distance to be a minimum of 0.5 inch beyond stop-drill.

(d) Cracks in the bellmouth-to-tube weld joint at angle bracket may be repaired and future cracking eliminated as follows:

1 Remove angle bracket and spotwelded doubler. Fabricate a new doubler from titanium (item 61, table 2-1), of same width but 0.5 inch longer than removed doubler. Position doubler so that it extends past cracked weld joint up onto bellmouth 0.5 inch. Form doubler to fit contour.

2 Clean and reweld cracked joint. Grind weld smooth. Place new doubler in position and weld to assembly.

3 Attach angle bracket per d(l)(e) below, using rivet holes in ejector as a guide to drill through doubler.

(e) Replace brackets as follows:

1 Drill out six rivets which attach angle to be repaired. Use rivet holes in ejector as a guide to align new angle, mark locations and drill six Number 30 (0.128) holes in angle.

NOTE

Prior to riveting new angle to ejector to tail pipe, align flange of new angle with flange of angle to tail pipe. Mark location for attachment bolt hole in new angle using mating hole in tail pipe angle as a guide. Maintain flat plane between the two angles within 0.020 inch TIR.

2 Drill one number 1 (0.288) hole in angle flange at location determined in note above. Attach new angle to ejector with six rivets.

(f) Burned out parts or dents which cannot be smoothed out to original contour are cause for replacement.

(2) Tailpipe.

(a) Scratches and shallow dents may be ignored.

(b) (AVIM) Cracks or tears in any area of the tailpipe may be repaired by stop drilling ends of each crack, and welding a patch of steel (item 59 table 2-2) over the crack or tear, if damage area does not exceed **4.0** inches, after clean-up. Adjacent repairs on exterior surface must have at least **2.0** inches of parent material between patches. Patch edge distance must be a minimum of **0.5** inch beyond the stop-drill. See figure 4-12. The patch shall be welded on both inside and outside of the tailpipe. If the tailpipe ring is welded, care must be taken that the flange is filed or machined to a flat surface after welding to provide a flat seat against the attachment point on the engine.

(c) Burned out parts or damage greater than that which is repairable by patching is cause for replacement.

(d) Replace insulation blanket if damaged.

(3) Heat shield.

(a) Replace heat shield for cracks or distortion that cannot be straightened.

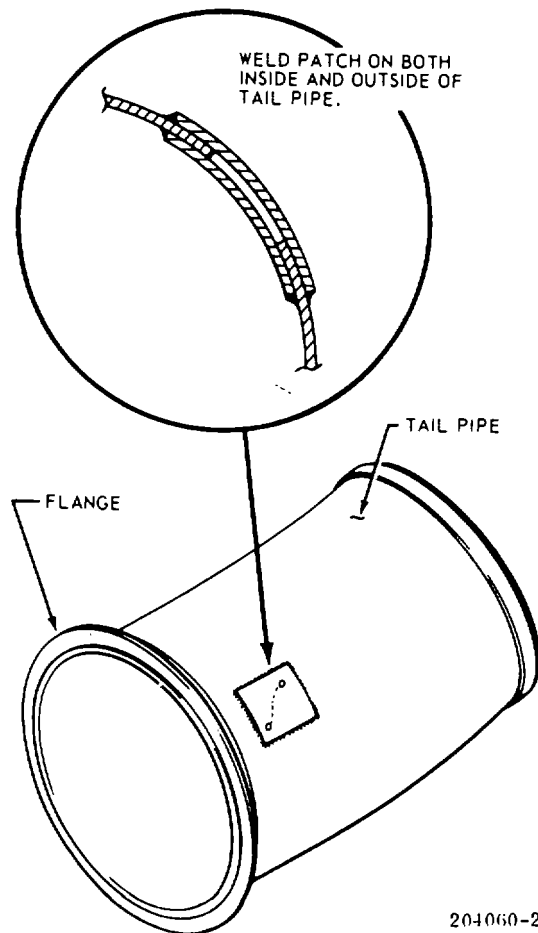


Figure 4-12. Engine tailpipe repair

e. Installation.

(1) Remove protective cover from engine exhaust diffuser.

(2) Position tailpipe, with drain fitting down, on flange of exhaust diffuser. Make sure locating dowels are engaged, and that inside of pipe aligns with diffuser. Secure with V-band clamp around mating flanges.

(a) Seat clamp by tapping with soft mallet, from middle toward ends, while tightening nuts to **100 TO 130 INCH-POUNDS TORQUE**.

(b) Check torque again after first ground run-up.

(3) If removed, install insulation blanket around tailpipe with joint at top. Secure with lockwire (C151) installed in zig-zag pattern. (See figure 4-11).

(4) Position heat shield against flange of diffuser support cone. Secure with V-band clamp around mating flanges. **TORQUE CLAMP NUTS 40 TO 50 INCH-POUNDS.**

(5) Install ejector and tailpipe fairing as follows:

CAUTION

Adjustment of latch mating fitting may be necessary to ensure proper closing of latch. Do not force latch closed. Slight tension shall remain on latch in the closed position.

(a) Place ejector into fairing, align clips and secure at three locations with screws and nuts. If necessary, remove plug buttons Detail A, figure 4-11) and loosen bolts to realign clips on serrated plates, tighten bolts and reinstall plug buttons. Install fairing with attached ejector.

(b) Measure gap between tailpipe fairing, engine cowl doors and pylon fairing. Inspect for a gap of 0.040 inch at the lower extremities of cowl components to a maximum of 0.190 inch at tile top. If adjustment is necessary, proceed as follows:

1 Loosen two attachment screws securing latch plate to tailpipe fairing bracket (Detail B, figure 4-11). Latch shall remain fastened during adjustment.

2 Adjust fairing to proper clearance allowing serrated plate to self-adjust.

3 After proper clearance is obtained tighten two attachment screws.

(6) Connect drain lines to fittings on tailpipe and ejector.

(7) Seal all open areas between base of forward and/or aft firewall and engine deck per figure 4-13 using sealant (C116).

4-13. Infra-red Exhaust Suppression System.

The infra-red exhaust suppression system includes an upturned insulated exhaust duct assembly, an exhaust extension and forward duct assembly. For helicopters which do not have IRS systems installed, refer to paragraph 4-12.

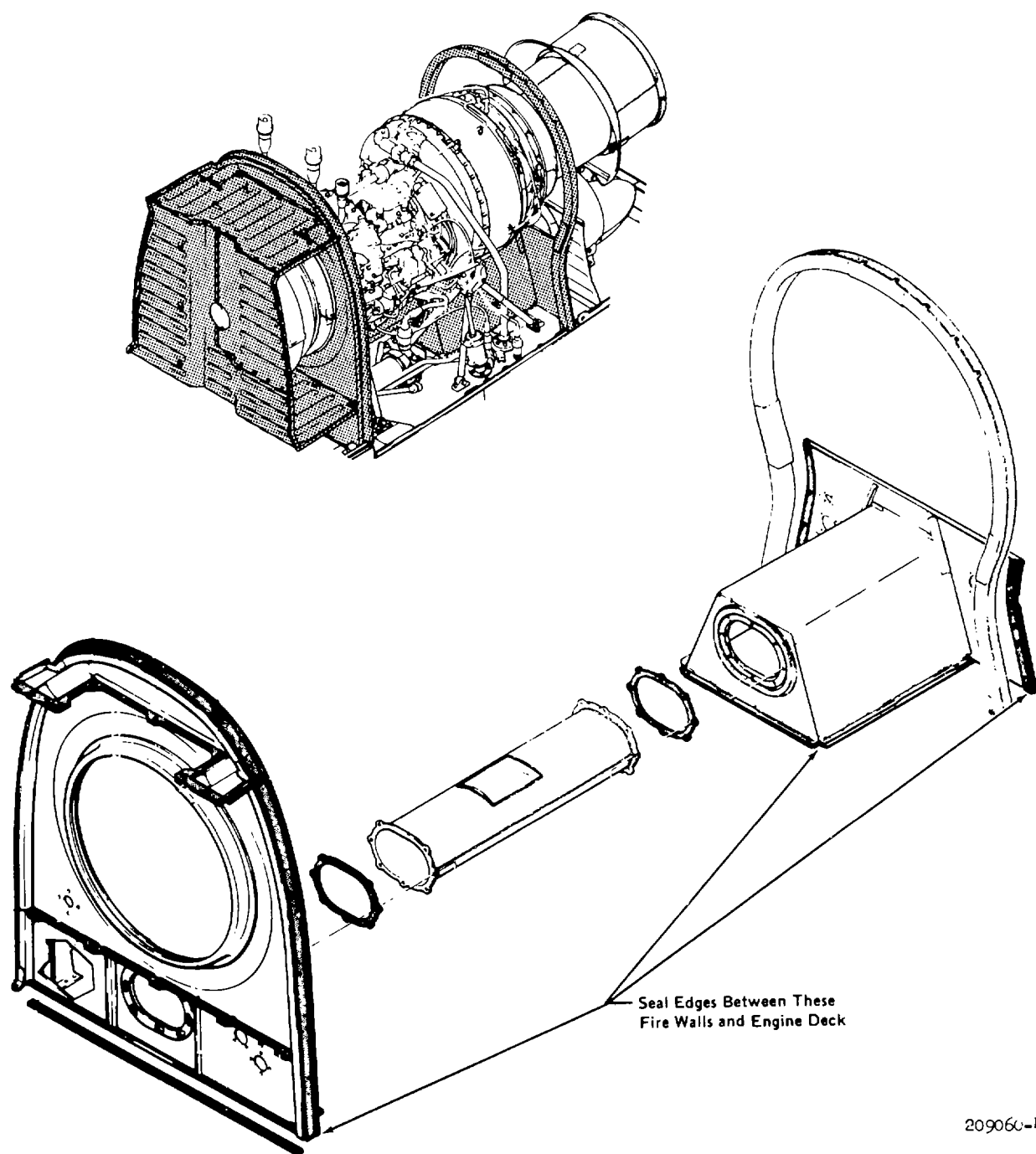


Figure 4-13. Engine deck and firewall sealing

Premaintenance requirements for infrared suppression system.

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	Two
Consumable Materials	(C17) (C56) (C87) C106A) (C124)
Special Environmental Conditions	None

a. Removal.

(1) Disconnect drain line (6, figure 4-14) from fitting on exhaust tailpipe (1).

(2) Release fasteners on tailpipe fairing (4) and remove tailpipe fairing, duct assemblies (2 and 5) and exhaust extension (3) as an assembly.

(3) Detach forward duct assembly (2) from exhaust extension (3) by removing first V-band clamp (8).

(4) Detach exhaust extension (3) from aft duct assembly (5) by removing second V-band clamp (8).

(5) Remove 10 screws and washers and remove fairing assembly (7) from aft duct assembly (5) and fairing (4).

(6) Detach aft duct assembly (5) from tailpipe fairing (4) by removing 12 bolts and washers.

(7) Loosen nuts on third V-band clamp (8) which secures exhaust tailpipe (1) to engine diffuser (9). Pull aft to disengage locating pins and remove exhaust tailpipe.

(8) Remove lockwire (11) and unwrap insulation blanket (10) from exhaust tailpipe (1).

NOTE

See figure 4-11 for view of heat shield.

(9) Remove third V-band clamp (8) and heat shield from engine diffuser (9). Cover

engine diffuser opening to prevent entry of foreign material.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

b. Cleaning. Clean exhaust tailpipe (1), duct assemblies (2 and 5) and exhaust extension (3) with a wire brush and solvent (C124). Clean clamps, heat shield, and tailpipe fairing (4) with solvent (C124). Do not use solvent on insulation blanket (10).

c. Inspection.

(1) Forward exhaust duct and exhaust extension.

(a) Inspect ducts for cracks, dents, and overheating.

1 Cracks and holes in the surface of the duct should not exceed 3.0 inches in diameter after cleanup. Adjacent repair areas must allow a minimum of 2.0 inches of parent metal between patches.

2 Heating as evidenced merely by discoloration of the metal is permissible. However, if the condition becomes progressive, indicating a possible burn-through, the part should be replaced.

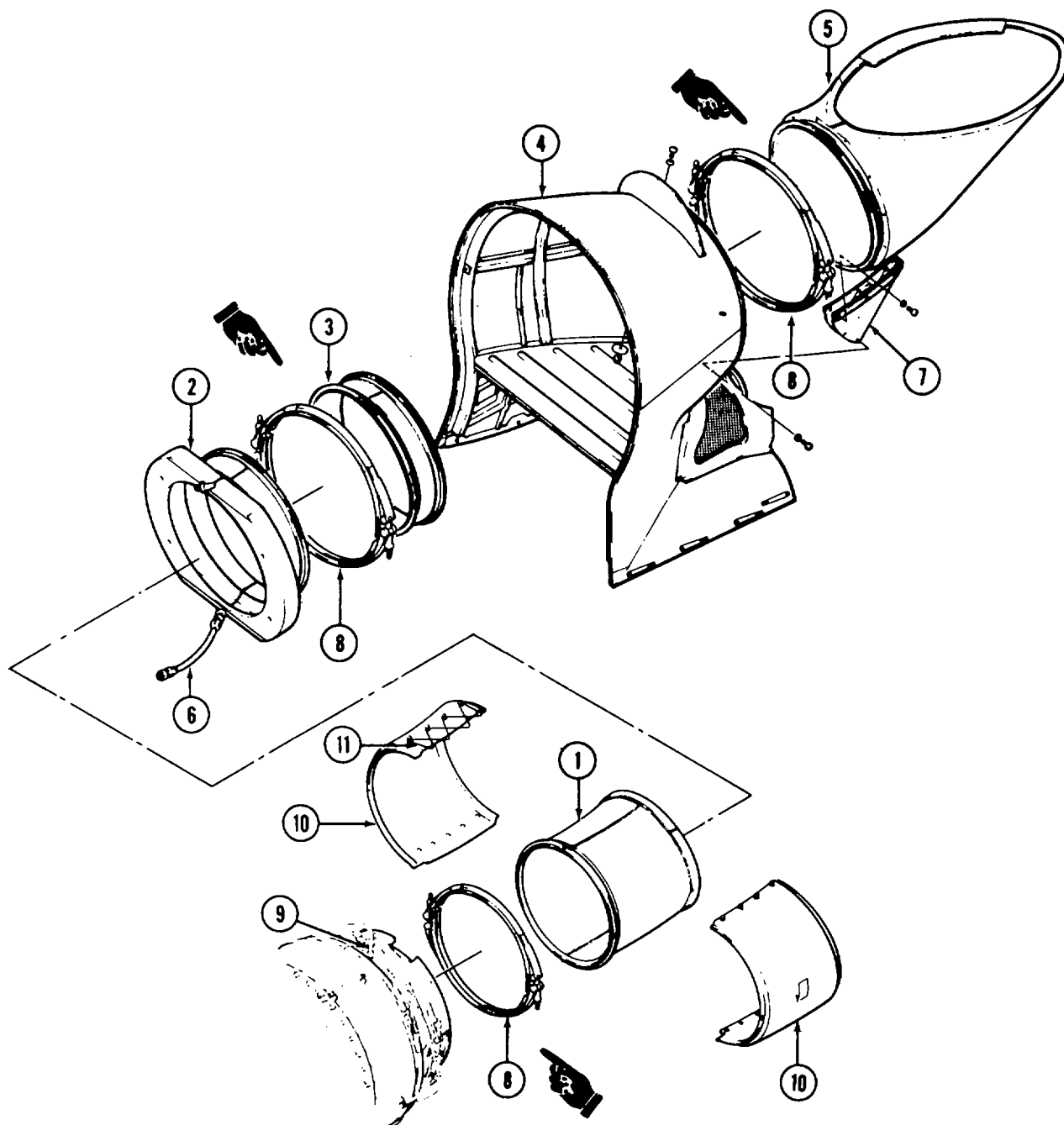
3 Dents in the surface of the duct are permissible, providing the surface is not broken, and there are no sharp creases or projections into the exhaust stream.

4 Damage to circumferential mounting frames shall be evaluated locally as to feasibility to repair or need for replacement. It is deemed not feasible to replace the frame on the duct.

(b) Ensure that all attaching bolts are secure.

(c) Ensure that drain hose on forward exhaust duct is intact and securely attached.

(2) Aft exhaust duct.



1. Exhaust tailpipe	7. Fairing assembly
2. Duct assembly (forward)	8. V-band clamp
3. Exhaust extension	9. Engine diffuser
4. Tail pipe fairing	10. Insulation blanket
5. Duct assembly (aft)	11. Lockwire
6. Drain line	

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Figure 4-14. Exhaust infrared suppression system

(a) Inspect interior and exterior surface of duct for cracks, nicks, dents, and overheating.

1 Cracks and holes in the interior surface of the duct shall not exceed 3.0 inches in diameter after cleanup. Adjacent repair areas must allow a minimum of 2.0 inches of parent metal between patches.

2 Cracks and holes in the exterior surface of the duct shall not exceed 4.0 inches in diameter after cleanup. Adjacent repair areas must allow a minimum of 2.0 inches of parent metal between patches.

3 Damage which penetrates the temp-mat insulation between the interior and exterior surfaces of the duct shall not exceed 4.0 inches in diameter after cleanup.

4 Dents in the interior or exterior surfaces are permissible, providing the surfaces are not broken, and there are no sharp projections into the exhaust stream.

5 Damage to the mounting flange and outlet rim of the duct shall be evaluated locally as to feasibility to repair, or need for replacement.

(b) Check duct and supporting fairing for security of mounting and for loose or missing rivets.

d. *Repair or Replacement.* A repair kit (C106A) is available for use in repairing damaged components.

(1) *Dents.*

(a) Minor dents in exterior surfaces require no rework if the surface is not broken, or if no sharp crease or projection exists in the interior surface.

(b) Work out minor dents having sharp projections into the interior of the duct, by restoring to original contour and smoothing off any sharp projections with fine abrasive paper.

(c) Large dents (surface impressions) shall be worked out by restoring the surface to original contour.

(2) *Cracks.*

(a) All cracks shall be stopdrilled to prevent continuation.

(b) Cracks which penetrate interior surfaces of the forward exhaust duct or exhaust extension, shall be repaired using method I. See table 4-1 and figure 4-15, detail A.

(c) Cracks in interior surface of aft exhaust duct shall be repaired using method II. See table 4-1, and figure 4-15, detail B.

(d) Cracks in exterior of aft duct shall be repaired using method III. See table 4-1.

(e) Two or more adjacent cracks, or two or more converging cracks, shall be treated as a single repair area, within limitations specified in Section III.

(3) *Holes.*

(a) Holes in the forward exhaust duct, or in the exhaust extension, shall be repaired using method I. See Table 4-1.

(b) Holes in the interior surface only of the aft exhaust duct, shall be repaired using method II. See Table 4-1.

(c) Holes which penetrate only the outer surface of the exhaust duct, shall be repaired using method III.

(d) Holes which penetrate completely through exterior and interior surfaces of aft exhaust duct, shall be repaired using method II. See Table 4-1.

Table 4-1. Repair Methods

METHOD I. (See figure 4-15, detail A.)

- a. Stop drill crack at both ends.
- b. If two or more cracks converge, cutout area encompassed by cracks and smooth out edges to form a hole, not to exceed 3.0 inches.

Table 4-1. Repair Methods (Cont)**METHOD I. (See figure 4-15, detail A.) (Cont)**

- c. Trim patch, 205-706-083-3, as necessary, to provide a minimum of **0.25** inch edge distance between rivets and hole in parent metal, and between rivets and edge of patch.
- d. Position patch and layout rivet hole locations.
- e. Drill rivet holes and install rivets, (item 56, table 2-2), with heads on interior of duct.

METHOD II. (See figure 4-15, detail B.)

- a. Cut hole through outer surface of duct to encompass damaged area, not to exceed 4.0 inches in diameter.
- b. Cut out and remove insulation material (temp-mat) not to exceed 4.0 inches.
- c. Cut out damaged area of interior surface of duct, not to exceed 3.0 inches in diameter.
- d. Trim patch, 205-706-083-3, as necessary to provide a minimum of 0.25 inch edge distance between rivets and hole, and between rivets and edge of patch.
- e. Position patch on outside of interior surface, and layout rivet hole locations.
- f. Drill rivet holes, and install rivets, (item 56, table 2-2) with heads on interior of duct.
- g. Cut patch, 205-706-0835, to fit insulating core area.
- h. Apply adhesive paste, No. 19, and install patch.
- i. Trim patch, 205-706-083-7, to provide a minimum of 0.50 inch overlap on outer surface of duct.

WARNING

Provide adequate ventilation when using methylethylketone. Avoid breathing solvent vapors and avoid skin contact.

- j. Lightly abrade area 0.60 inch wide around hole in outer surface. Clean area with methyl-ethyl-ketone (C87).
- k. Apply adhesive (C17) to area around hole.
- l. Remove backing from patch, and apply over hole. Press smoothly into place.
- m. Allow adhesive to cure.

NOTE

Preferred cure time is 24 hours at room temperature. Cure time may be reduced by applying heat not to exceed 175 degrees F (79 degrees C) for one hour.

Table 4-1. Repair Methods (Cont)

METHOD III. (Figure 4-15, Detail B, View C-C.)

- a. Cut out damaged area of outer skin, not to exceed **4.0** inches in diameter.
- b. Trim patch, 205-706483-7, to provide a minimum of 0.50 inch overlap on outer surface of duct.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

- c. Lightly abrade area 0.60 inch wide around hole. Clean area with methyl-ethyl-ketone (C87).
- d. Apply adhesive (C17) to area around hole.
- e. Remove backing from patch, and apply patch over hole. Press smoothly into place.
- f. Allow adhesive to cure. (See note in Method II.)

e. *Installation.***CAUTION**

Use extreme care in positioning aft duct assembly (5, figure 4-14). Failure to do so will damage gasket.

(1) Loosely install third V-band clamp (8) on exhaust tailpipe (1).

(2) Install the two insulation blankets (10) with lockwire (11) on exhaust tailpipe (1).

NOTE

See figure 4-11 for view of heat shield.

(3) Engage locating pin and install heat shield and exhaust tailpipe (1) on engine diffuser (9) with third V-band clamp (8). Seat V-band clamp by tapping with a soft mallet, from middle toward ends, while tightening nuts 100 TO 130 inch-pounds.

(4) Position aft duct assembly (5) on rear flange of tailpipe fairing (4) with lower external supports

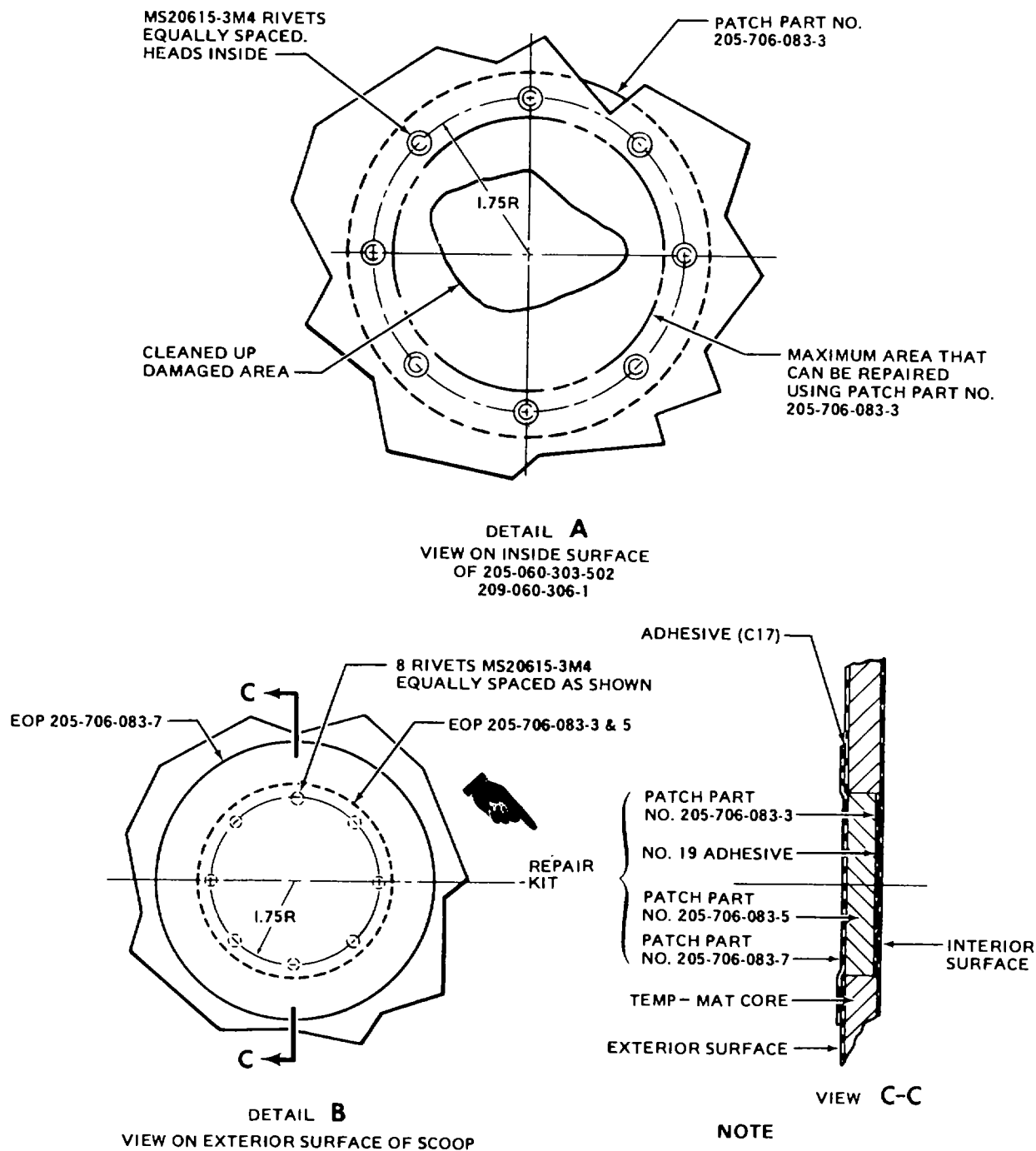
extending over the external supports mounted on the fairing transition section. Support aft duct assembly (5) with 12 bolts and washers. Position fairing assembly (7) in place and secure to aft duct assembly (5) and tailpipe fairing (4) with 10 screws and washers.

(5) Position exhaust extension (3) inside fairing (4) and mount to forward section of aft duct assembly (5) with second V-band clamp (8). Seat V-band clamp (8) by tapping with a soft mallet, from middle toward ends, while tightening nuts 100 TO 130 inch-pounds.

(6) Install forward duct assembly (2) on forward section of exhaust extension (3) with first V-band clamp (8). Seat V-band clamp (8) by tapping with a soft mallet, from middle toward ends, while tightening nuts 100 TO 130 inch-pounds.

(7) Place tailpipe fairing (4), with exhaust extension (3), and duct assemblies (2 and 5) installed, in place and over tailpipe (1). Engage fasteners around tailpipe fairing (4).

(8) Connect drain line (6) to fitting on tailpipe (1).



Sheet metal patches should have at least 2.0 inches of parent metal spacing between patch edges. No limit on number of patches.

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Figure 4-15. Repair procedures - infrared suppression

Section V. - OIL SYSTEM

4-14. Oil System.

Oil is supplied to the engine from a self-sealing tank mounted in the aft fairing above the engine. (See figure 4-16). After passing through the engine, oil is delivered from the scavenge side of the engine oil pump to an oil cooler bypass valve mounted on the engine compartment deck at left side. In normal operation, oil passes through the oil cooler and then returns to the tank. The cooler is mounted below an engine deck opening, under a metal plenum. Cooling air is drawn in through a screened duct on left side of the fuselage up through the cooler, then aft to pass out through screened openings of the tailpipe fairing. A turbine fan driven by engine bleed air is mounted under the cooler. The oil cooler emergency bypass valve

is controlled by a float switch in the oil tank and a switch on the pilots console. If oil level in the tank becomes low enough to operate the float switch, (3.8 quarts low from spill over) the ENGINE OIL BYPASS caution panel segment will light, and the valve will automatically shut off flow to the cooler and return engine oil directly to the tank. The pilot can use his switch to reopen the valve and use oil cooling when conditions warrant such action.

4-14A. Troubleshooting - Oil System.

Table 4-2 is provided as an aid in troubleshooting malfunctions in the oil supply system.

Table 4-2. Troubleshooting - Engine Oil System

NOTE

Before using this table, be sure all normal operational checks have been performed.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

CAUTION

Do not operate engine until it is determined that oil pump failure or oil starvation has not occurred.

1. No engine oil pressure.
STEP 1. Ensure that tank is filled to proper level.

Fill tank to proper level if required. (Refer to paragraph 1-3a.)

STEP 2. Check for loose connection and/or clogged hose.

Inspect entire lubrication system for leaks and obstruction. Pay particular attention to quick disconnect fittings.

Table 4-2. Troubleshooting - Engine Oil System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

STEP 3. Check for proper operation of oil pressure transmitting system.

Check system using pressure source at pressure tap. Replace oil pressure transmitter if faulty. (Refer to paragraph 8-12f.) Replace oil pressure indicator if faulty. Check continuity of wiring circuit between transmitter and indicator. (Refer to paragraph 8-11 c and 8-12 c.)

STEP 4. Check that oil pump coupling is not sheared and female spline on oil pump driveshaft gear is not worn.

Replace oil pump for sheared coupling. Inspect for worn spline on shaft gear. (Refer to TM 55-2840-229-23.)

2. Fluctuating oil pressure.

STEP 1. Check oil quantity in tank.

Fill tank to proper level. (Refer to paragraph 1-3a.)

STEP 2. Check for dirty piston in oil pump pressure regulating valve.

Remove, clean, and reinstall piston. (Refer to TM 55-2840-229-23).

STEP 3. Check oil pump and/or oil pump driveshaft gear for failure.

Remove and replace oil pump or oil pump driveshaft gear. (Refer to TM 55-2840-229-23).

STEP 4. Check for faulty transmitter or circuit to indicator.

Perform continuity check and replace components as necessary. (Refer to paragraph 8-12c and 8-12e.)

3. Low engine oil pressure.

STEP 1. Check for low quantity in tank.

Fill tank to proper level. (Refer to paragraph 1-3a.)

STEP 2. Check oil pump pressure regulating valve for proper adjustment.

Adjust regulating valve. If no response, remove valve, clean and reinstall. (Refer to TM 55-2840-229-23.)

STEP 3. Check for clogged oil filter.

Clean oil filter. (Refer to TM 55-2840-229-23.)

Table 4-2. Troubleshooting - Engine Oil System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

STEP 4. Check oil pressure transmitter for faulty operation. (Refer to paragraph 8-14c.)

Remove and replace faulty transmitter. (Refer to paragraph 8-14f.)

STEP 5. Check oil pump for faulty operation.

Remove and replace faulty oil pump. (Refer to TM 55-2840-229-23.)

4. High engine oil pressure.

STEP 1. Check for restrictions in oil flow lines.

Check quick disconnect couplings for proper connections. Clear oil lines of restrictions.

STEP 2. Check oil pump pressure regulating valve for proper adjustment.

Adjust regulating valve. If no response, remove valve, clean and reinstall. (Refer to TM 55-2840-229-23.)

STEP 3. Check oil pressure transmitter for faulty operation. (Refer to paragraph 8-14c.)

Remove and replace faulty oil pressure transmitter. (Refer to paragraph 8-14f.)

NOTE

High engine oil pressure may be due to cold oil on start.
Allow engine to reach operating temperature by
operating engine at idle.

5. High engine oil temperature.

STEP 1. Check that oil cooler bypass valve is not stuck in bypass position.

If valve is stuck in bypass position, remove and replace valve. (Refer to paragraph 4-19a.)

STEP 2. Check that emergency bypass valve is not stuck in bypass position.

If valve is stuck in bypass position, remove and replace valve. (Refer to paragraph 4-19a.)

STEP 3. Ensure that oil cooler blower is operating correctly.

Check for proper blower operation. Repair and replace as necessary. (Refer to paragraph 4-18a.)

Table 4-2. Troubleshooting - Engine Oil System (Cont)

CONDITION	TEST OR INSPECTION	CORRECTIVE ACTION
	STEP 4. Ensure that cooling air inlet is not blocked.	Inspect screened inlet and remove all grass, leaves, and other foreign material. Also, check cooler core air passage and remove any grass, dirt or other foreign material. (Refer to paragraph 4-7 and 4-8.)
	STEP 5. Check engine oil level.	Fill tank to proper level. (Refer to paragraph 1-3a.)
	STEP 6. Ensure that temperature indicating system is operating correctly.	Check operation of oil temperature indicator, resistance bulb and related circuitry. Replace faulty components. (Refer to paragraph 8-49, 8-50, and 8-49f. and 8-50e.)
	STEP 7. Check for bleed air leak between engine and oil cooler turbine fan.	Isolate and correct any leaks.
	STEP 8. Check operation of low level emergency system float switch in oil tank. (Refer to paragraph 4-14.)	Replace faulty float switch in oil tank. (Refer to paragraph 4-14e.)
6. Low oil temperature.	STEP 1. Check that oil cooler bypass valve is not stuck in failure to bypass position.	Repair or replace valve as necessary. (Refer to paragraph 4-19a.)
	STEP 2. Check operation of temperature indicating system.	Check operation of oil temperature indicator, resistance bulb, and related circuitry. Replace faulty components. (Refer to paragraph 8-49, 8-50, and 8-49f. and 8-50e.)
7. No oil temperature.	STEP 1. Check operation of temperature indicating system.	Check operation of oil temperature indicator, resistance bulb, and related circuitry. Replace faulty components. (Refer to paragraph 8-49, 8-50, and 8-49f, and 8-50e.)

Table 4-2. Troubleshooting - Engine Oil System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

8. Excessive engine oil consumption.

STEP 1. Check for leakage at fittings and hose connection.

Tighten or replace fittings or hose assemblies.

NOTE

Refer to TM 55-2840-229-23 for additional excessive engine oil consumption troubleshooting procedures.

4-15. Pressure Transmitters and Switch. (Refer to Chapter 8.)

4-16. Engine Oil Tank.

The engine oil system tank is a self sealing cell equipped with a filler cap, an oil level sight glass, and a scupper with drain line. (See figure 4-16.) The tank is located in the aft fairing, secured by bolts on a horizontal firewall above the engine, and accessible for service through right side of transmission cowling. Bosses on bottom of the tank provide mounting for an outlet coupling, a drain valve, and a float switch. A plate on top of the tank provides connections for a vent tube, and for oil return and engine breather line tubes.

NOTE

The oil level sight gage is provided for the purpose of determining a low oil condition. When oil level is at sight gage level, oil supply is $2.75 \pm .25$ quarts low. When servicing oil tank, fill completely to a spill over condition.

a. Removal.

(1) Open engine compartment cowling. Remove center fairing to allow access through front of aft fairing.

WARNING

Prolonged contact with lubricating oil may cause a skin rash. Those areas of skin and clothing that come in contact with lubricating oil should be thoroughly washed immediately. Areas in which lubricating oil is used should be adequately ventilated to keep mist and fumes to a minimum.

(2) Place a suitable vessel under drain line. Drain oil tank by opening valve.

(3) Disconnect hoses from outlet coupling and coupling of breather line and return line. Remove breather and return lines, and vent tubes from top plate of tank.

(4) Disconnect drain tubes from tank scupper and from drain valve. Remove valve from tank boss.

(5) Disconnect electrical leads of float switch from relay on underside of firewall. Remove support and float switch assembly and outlet coupling, with gaskets, from tank bosses.

(6) Remove three bolts and washers to detach tank from horizontal firewall.

(7) Remove oil tank. Cover open ports and ends of tubes.

b. Cleaning. Clean oil tank with solvent (C124). Drain off solvent and dry with filtered compressed air.

CAUTION

Do not pressurize tank with compressed air.

c. Inspection. Tank for evidence of damage or leaks; bosses and fittings for damaged threads. Sight glass for clear condition.

d. Repair or Replacement.

(1) Replace packings or gaskets under tank fittings when leaks occur.

(2) Replace any damaged fittings.

(3) Replace tank if punctured, cut or otherwise damaged.

(4) For repair of self-sealing tank refer to TM 55-1500-204-25/1.

e. Installation.

NOTE

Check protrusion of three indicator pins to ensure security of quick-disconnect couplings.

(1) Check that filler cap, scupper, sight glass, and top plate are securely installed on tank.

(2) Place tank in position on horizontal firewall of aft fairing, with filler cap forward. Align holes and install three bolts, with washers, through firewall into threaded inserts of tank.

(3) Install and connect vent tube. Connect breather tube and return tube to top plate of tank.

(4) Install drain valve and connect tube. Connect scupper drain line.

(5) Assemble float switch, with gasket, on support. Install support, with gasket into tank boss. Connect electrical leads to relay located on underside of firewall near tank. (Refer to Appendix F for circuit wiring diagram.)

(6) Install outlet coupling, with gasket, in tank boss. Connect hose from engine oil pump inlet.

(7) Connect hose from engine breather (on accessory drive gear box) to coupling on tube. Connect oil return hose to coupling on tube.

(8) Service tank. Check for leaks. Reinstall cowling.

4-17. Engine Oil Cooler.

The engine oil cooler is mounted on underside of the engine compartment deck. Its inboard side is attached to mating flanges of the transmission oil cooler, but there is no oil connection between the two coolers.

NOTE

If oil cooler is known to have been contaminated with metal particles. Replace cooler and tag removed cooler as being contaminated. Forward to depot.

CAUTION

Use back-up wrenches when removing and installing oil cooler drain fittings, valves and lines.

Premaintenance Requirements for Engine Oil Cooler.

Conditions

Model
Part No. or Serial No.

Requirements

AH-1S
All

Premaintenance Requirements for Engine Oil Cooler (Cont)

b. Cleaning. (A VIM)

Conditions	Requirements
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	One
Consumable Materials	(C14), (C43) (C90), (C110) (C124)
Special Environmental Conditions	Dust Free

a. Removal.

(1) Remove oil cooling duct from left side and access door from right side of fuselage. Remove turbine fan and duct. (Refer to paragraph 4-19 a.)

(2) Drain trapped oil from cooler.

(3) Disconnect oil lines from cooler fittings. Cap open lines.

WARNING

Prolonged contact with lubricator oil may cause a skin rash. Those areas of skin and clothing that come in contact with lubricating oil should be thoroughly washed immediately. Areas in which lubricating oil is used should be adequately ventilated to keep mist and fumes to a minimum.

(4) Remove bolts, nuts and washers that attach engine oil cooler to transmission oil cooler.

(5) Remove bolts and washers around mounting flange of engine oil cooler. Remove cooler from fuselage.

(6) If cooler is being replaced, remove inlet and outlet fittings for use on replacement assembly.

CAUTION

When using steam and compressed air, be careful not to damage air fins by high pressures.

(1) Steam clean the exterior surfaces and corrugated air fins of each core. Remove obstructions from air fins with a pick and compressed air.

(2) Prepare oil cooler for internal cleaning as follows:

(a) Remove lockwire and unscrew by-pass control valve body from valve housing in cooler.

(b) Press a rubber plug into the by-pass opening in the valve housing.

(c) Reinstall by-pass valve into valve housing so valve body bears up against the rubber plug.

(3) Connect oil cooler in line with cleaning equipment in reverse of normal flow for first flush. See figure 4-17.

NOTE

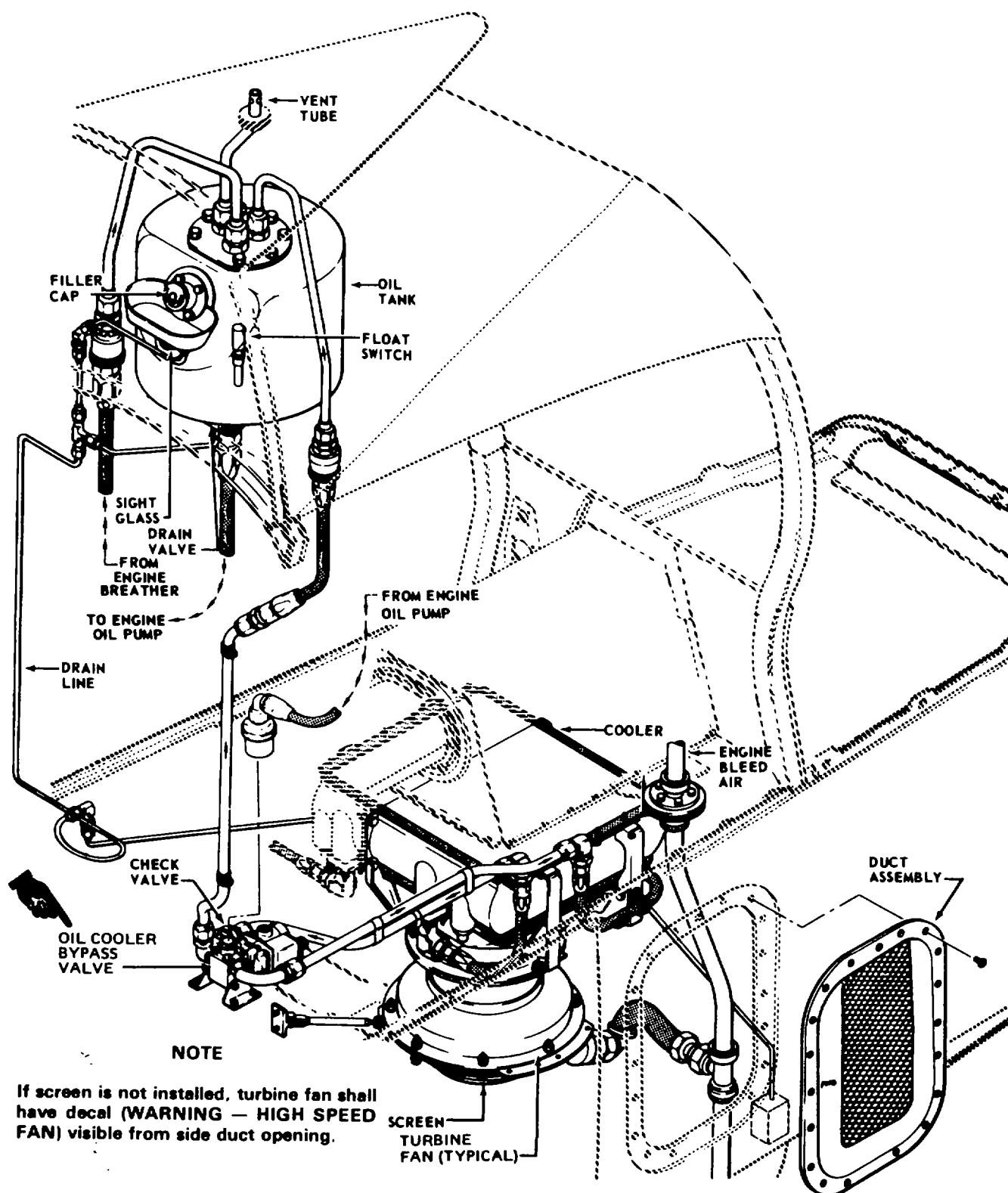
Centrifugal pump in cleaning equipment must be capable of supplying fluid at approximately 40 gpm while maintaining pressure of 75 psi.

(4) To remove oil and loose sludge and to reduce contamination of cleaning solutions during following operations, pre-clean cooler interior as follows:

WARNING

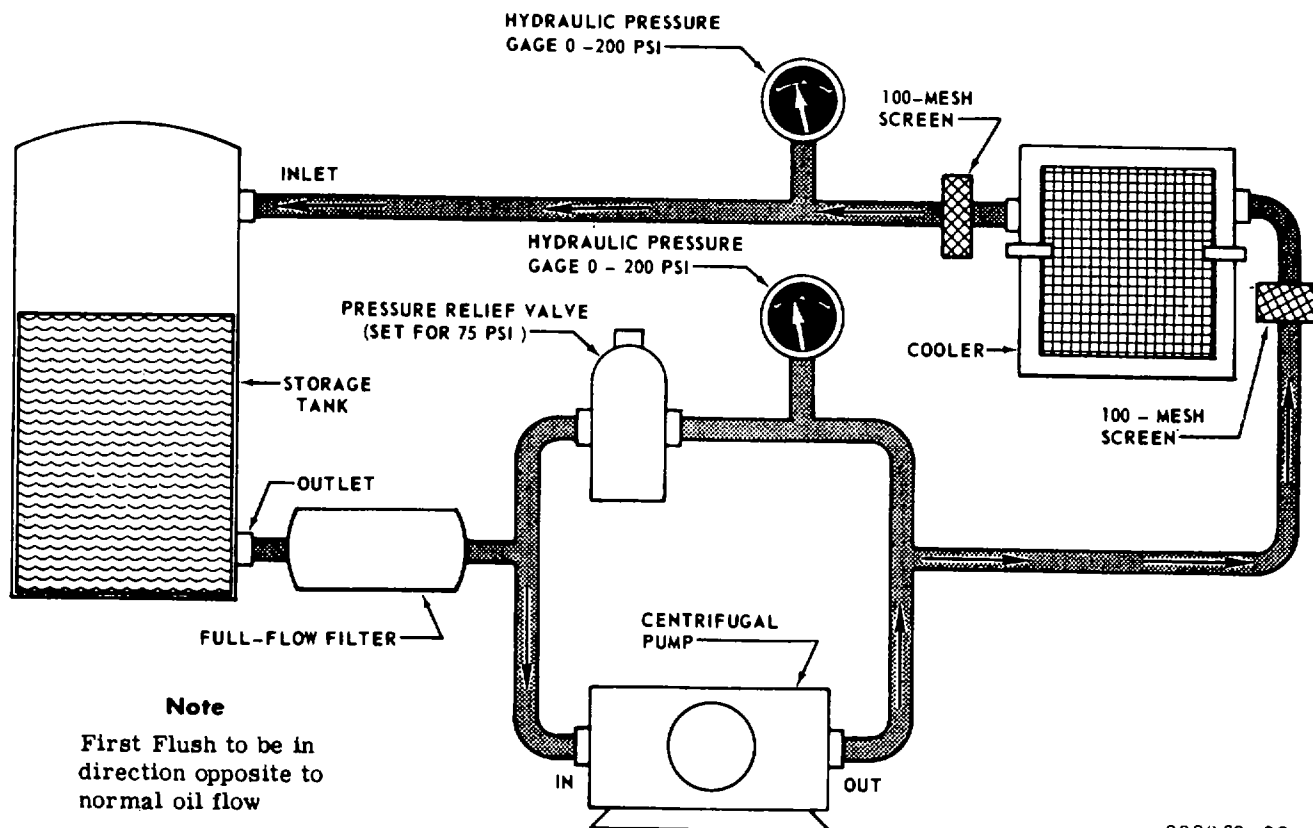
Use solvent in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

(a) Flush core, in. reverse direction, with solvent (C124) for 30 minutes or until solvent appears clean.



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Figure 4-16. Engine oil supply and cooling system with bleed air-driven fan



209060-33

Figure 4-17. Oil cooler cleaning equipment setup - typical

(b) Reverse lines to cooler and flush core in direction of normal flow for approximately 15 minutes.

(c) Remove oil cooler from cleaning equipment and drain all fluid from cooler.

(5) Remove dirt, carbon deposits, oil gum, lead deposits, and other contaminants by **connecting oil cooler to cleaning equipment. See figure 4-17. Use cleaning compound (C43).**

(a) Flush core 30 to 60 minutes in direction opposite to normal flow.

(b) Reverse lines and flush core in normal direction for 15 minutes.

(c) Remove plug installed in by-pass opening of valve housing and insert plug in cooling section opening. Reinstall by-pass valve.

(d) Flush oil cooler in normal direction for 15 minutes to clean by-pass passage.

(e) Remove plug from cooling section opening in valve housing and install into by-pass **opening. Reinstall by-pass valve.**

WARNING

Use solvent (C124) in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

(6) Connect oil cooler to cleaning equipment containing cleaning solvent (C124). Install 100-mesh screen at inlet and outlet ports of oil cooler.

(a) Flush core for 10 minutes in each direction.

(b) Check 100-mesh screens between each flush.

(c) If screens are not clear, reflush core for 5 minutes in each direction, repeat until screens are clear.

(7) Remove rubber plug from by-pass valve housing in oil cooler.

c. Inspection.

(1) Inspect air fins and air passages for distortion and foreign particles that may obstruct air flow.

(2) Inspect cooler for damaged or bulged plates, cracked castings and flanges, and broken welds. Inspect studs for stripped threads and cracked or ineffective lock rings.

(3) Inspect all openings in oil cooler for evidence of foreign matter inside of the cooler.

(4) Inspect rubber gaskets on top of cooler for security, rips, tears, or scores, and missing sections that may prevent gaskets from sealing.

(5) Inspect by-pass control valve and valve housing for stripped threads and distortion, scoring, or wear of the seat surfaces. Check functioning of by-pass control valve as follows:

(a) Submerge valve in water heated to 150° to 155° F for 5 minutes. Valve should open.

(b) Remove valve and measure length.

(c) Submerge valve in water heated to 176° to 180°F for 5 minutes. Valve should open.

(d) Remove valve and measure length. Minimum increase in valve length is **0.090** inches.

(6) With by-pass control valve installed, pressure-check oil cooler.

(a) Make preliminary check of oil cooler for air leaks as follows:

1 Plug outlet port and connect an air line to inlet port.

2 Connect other end of air line to an adjustable air pressure source and adjust pressure to 12 psig.

3 Submerge cooler in water at approximately 140°F (60°C). Gradually heat water to 180°F (85°C) and check for leaks.

WARNING

Increase air pressure gradually to avoid burns from leakage and hot water.

4 After 5 minutes of submersion, gradually increase air pressure to 100 psig. Inspect cooler for leaks as evidenced by presence of air bubbles.

5 Remove cooler from water and relieve air pressure.

(b) Make final check of oil cooler as follows:

1 Dry oil cooler externally using compressed air.

2 Plug outlet port and apply room temperature water at 400 psig to the other (inlet) port.

3 Lock liquid in oil cooler for 10 minutes.

4 Inspect cooler for any visible leaks and blown or bulged plates.

5 Release pressure and drain cooler.

d. Repair or Replacement. (AVIM)

(1) Replace oil cooler if damage, other than minor distortion to air fins, is detected or if cooler fails to meet inspection requirements. Tag oil cooler as applicable and forward to depot.

(2) Repair minor bends or distortion of accessible air fins with flat duckbill pliers.

(3) Replace missing, torn, ripped, and scored gaskets with rubber (C110). Attach gaskets to oil cooler surface with rubber adhesive (C14). Replace by-pass control valve seal.

(4) Replace damage or faulty by-pass control valve.

(5) (AVIM) If oil cooler is serviceable, flush thoroughly with preventive oil (C90) as follows:

NOTE

The interior of the cooler should be completely dry before final flush with preventive oil to prevent fouling of the mixture.

(a) Connect cooler to cleaning equipment containing preventive oil and 100-mesh screens.

(b) Flush oil through cooler in each direction for 10 minutes.

(c) Check 100-mesh screens between each flush to ensure that no metal particles have appeared.

(d) Drain cooler and install plugs in both inlet and outlet ports. Secure by-pass control valve with lockwire.

e. Installation.

(1) If replacing cooler, install inlet and outlet fittings with new gaskets.

(2) Position cooler on underside of support, below engine deck, and secure with bolts and washers. Install bolts through mating flanges of engine and transmission oil coolers, and secure with nuts and washers.

(3) Install turbine fan. (Refer to paragraph 4-18 1.)

CAUTION

Check proper alignment of flared ends of tubing to valves and fittings. Do not allow preloading or stresses due to misalignment or improper fit.

(4) Align and connect oil lines to cooler fittings.

(5) Install cooling duct and access door.

(6) Service oil tank. Check for leaks and proper operation at next ground run.

f. Preparation for Storage and Shipment.

(1) Flush oil cooler thoroughly with preventive oil (C90).

(2) Place cooler in container which will prevent damage during shipment or storage.

4-18. Oil Cooling Turbine Fan.

A turbine fan driven by engine bleed air is used to blow air through the engine and transmission oil coolers. (See figure 4-16.) The fan is suspended on an adapting duct under the coolers, in the fuselage compartment below the engine deck.

Premaintenance Requirements for
Oil Cooling Turbine Fan.

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	One
Consumable Materials	(C37) (C45) (C90) (C102) (C124)
Special Environmental Conditions	None

a. Removal.

(1) Remove oil cooling duct from left side of fuselage. (See figure 4-16.) Remove access door from right side.

(2) Disconnect bleed air hose from inlet fitting of turbine fan. Cover open end of hose.

NOTE

Keep attaching parts in sets, and avoid changing adjustment.

(3) Detach two brace tubes and brackets from flange of fan.

(4) Remove eight screws and washers that secure fan to bottom flange of duct. Remove fan assembly.

(5) Match-mark four hanger brackets to mating brackets on sides of duct. Detach each hanger bracket from duct bracket by removing two bolts and washers.

(6) At forward and rear sides, detach duct brackets from lower bolts that secure flanges of two coolers together. Remove duct. Reinstall bolts through cooler flanges, adding washers as needed.

(7) Detach four hanger brackets from bolts that secure coolers to deck structure.

(8) Detach screen if installed from fan assembly by removing two remaining bolts with nuts, washers and vibration-isolating grommets. When replacing turbine fan, also remove inlet fitting and cap open port.

b (A VIM) Disassembly (Janitrol). Disassemble turbine fan, P/N 158001-1 as follows: See figure 4-18.

(1) Remove nuts (3), washers (4), and bolts

(2) and remove cover and bellmouth assembly (1) from housing (16).

(2) Remove nut (14) and washer (15) from end of shaft (10).

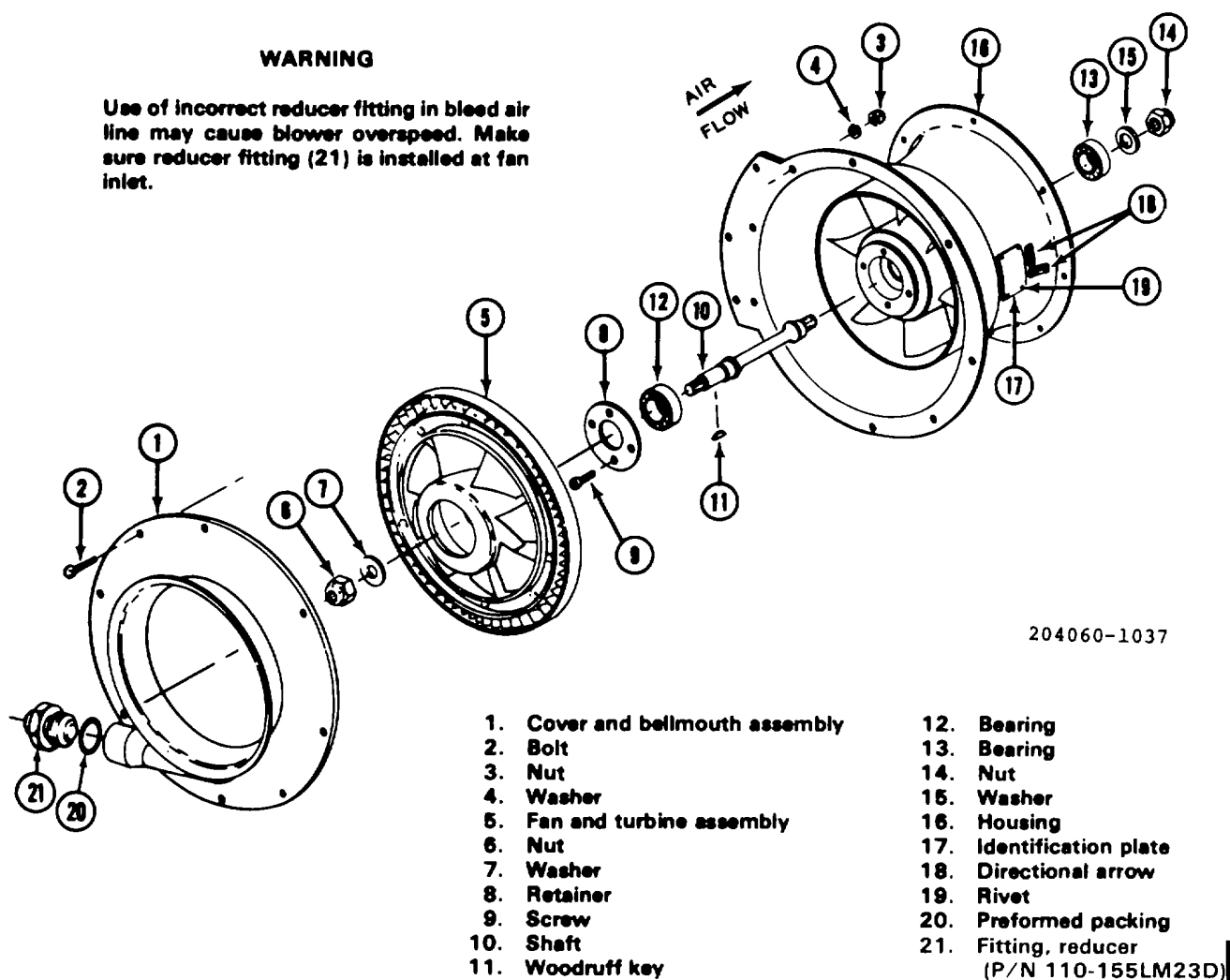


Figure 4-18. Oil cooling turbine fan (Janitrol)

(3) Remove nut (6) and washer (7) from shaft (10); then remove fan and turbine assembly (5) and key (11) from shaft.

(4) Cut lockwire and remove four screws (9) and retainer (8) from housing.

(5) Carefully pull shaft (10) with bearings (12 and 13) from housing, as a unit.

NOTE

Do not remove identification plate (17) or rotation directional arrows from housing unless damaged.

(6) Using a suitable bearing puller, remove bearings (12 and 13) from shaft (10).

c. (Deleted.)

d. *(A VIM) Cleaning (Janitrol).*

(1) Clean all parts with lint-free cloths saturated with solvent (C 124). A soft bristle brush

may be used to dislodge stubborn deposits. Wipe clean and dry with filtered compressed air.

(2) Remove corrosion deposits on shaft (10, figure 4-18) and housing (16) bearing liners using fine crocus cloth (C45). Clean parts after removing corrosion with corrosion preventive oil (C90).

e. (Deleted.)

f. *(A VIM) Inspection (Janitrol).*

(1) Visually inspect all parts for nicks, burrs, scratches, dents and weldment cracks and for evidence of excessive wear.

(2) Inspect ball bearings (12 and 13, figure 4-18) for wear or damage.

(3) Inspect fan and turbine assembly (5) for cracks, nicks, and scratches and for bent or cracked fan blades.

(4) Inspect parts for dimensional tolerances. See table 4-3.

(5) General pitting to a depth of 0.060 inch is acceptable on the fan housing.

g. (Deleted.)

All data on page 4-41 including Figure 4-19 deleted

Table 4-3. Dimension Tolerance - Turbine Fan

FIG. NO.	INDEX NO.	NOMENCLATURE	REMARKS
JANITROL			
4-18	1	Cover & Bellmouth Assy Nozzle	Replace if throat diameter is over 0.324 inch.
4-18	10	Shaft	Replace if front end bearing journal is not within 0.6695 TO 0.6691 inch diameter or if rear end bearing journal is not within 0.4726 TO 0.4722 inch diameter.
4-18	16	Housing	Replace if front bearing liner I.D. is greater than 1.3791 inches or if rear bearing liner I.D. is greater than 1.1034 inches.
4-18	Deleted		
4-19	Deleted		

h. Repair or Replacement. (Janitrol) (AVIM)

(1) Remove burrs and blend minor nicks and scratches from fan with a fine india (C128) or carborundum stone (C128).

CAUTION

Do not attempt to remove nicks or scratches from turbine blades. If the turbine blades are damaged, replace fan and turbine assembly (5, figure 4-18).

(2) Refinish all exposed aluminum surfaces, after repair, with chemical film (C37) and repaint with one coat of primer (C102) as required.

(3) Replace bearings (12 and 13) if they do not meet inspection criteria.

(4) Replace components which do not meet the dimensional tolerances set forth in table 4-3.

(5) Replace nuts (3, 6 and 14) regardless of condition.

(6) Match-drill any replacement hanger brackets at installation, with 0.280 TO 0.297 inch diameter holes through ends to match existing bolt holes in cooler flanges and deck structure, and 0.266 TO 0.263 inch diameter holes in lower legs of hanger brackets to match existing holes in brackets on duct.

i. (Deleted.)

j. (AVIM) Assembly. (Janitrol) Assemble turbine fan, P/N 158001-1 as follows: See figure 4-18.

CAUTION

Do not force bearings into housing. If bearings do not slip in place with slight hand pressure, check bearing liners for burrs or corrosion.

(1) Press bearings (12) on shaft (10) to seat firmly against shoulder on shaft. Insert shaft and bearing into housing (16).

(2) Press bearing (13) on shaft (10) and into housing (16).

(3) Position retainer (8) in housing with four screws (9). Tighten screws and secure with lockwire.

(4) Install key (11) in shaft (10) and install fan and turbine assembly (5) on shaft, align keyway in fan with key in shaft.

(5) Install washer (7) and nut (6) on shaft and, holding fan and turbine assembly to prevent rotation, torque nut **115 TO 140** inch-pounds.

(6) Install washer (15) and nut (14) on shaft and torque nut **48 TO 55** inch-pounds.

(7) Position cover and bellmouth assembly (1) on housing (16) and secure with bolts (2), washers (4), and nuts (3).

k. (Deleted)

l. Installation.

(1) At each side of cooler, attach two hanger brackets on second bolt from each end in row of five bolts that attach cooler flange to deck structure.

(2) At forward and rear sides of coolers, remove lower bolts that attach coolers to each other. Lift duct to position under coolers. Align bolt holes of two duct brackets to holes in cooler

flanges. Install bolts from left side, using washers, between brackets and flanges and thin washers under bolt head and nuts.

(3) Attach each hanger bracket to mating bracket on duct with two bolts and washers.

WARNING

Use of incorrect reducer fitting (204-060-494-1) in bleed air line may cause blower overspeed.

(4) Check installation of restrictor fitting with preformed packing in air inlet port of turbine fan.

WARNING

Use of a screen on turbine fan is optional. A defective screen may be removed and discarded. If screen is not installed, ensure decal (WARNING- HIGH SPEED FAN) is installed and is visible from side duct opening.

(5) Position screen over intake end of fan assembly, with screen cut-out next to air inlet. Secure two screen legs located nearest cutout on bolts through fan flange. On each bolt install a grommet and a thin washer between flange and screen, and use a washer under bolt head and under nut.

(6) At two bolt holes of fan flange that align with two remaining legs of screen, install bracket instead of grommets and install bolts in same manner as in step (6).

(7) Position fan assembly under duct, and align with air inlet at left side pointing aft. Install eight screws and washers to attach fan to duct.

(8) Attach two brace tubes between brackets on right side of fan and on fuselage structure. If necessary, adjust inboard ends of braces.

(9) Connect engine bleed air hose to fan inlet fitting.

(10) Reinstall access door and cooling duct on fuselage openings.

(11) At next ground run-up, check installation for proper operation.

4-19. Engine Oil Bypass Valve.

A two-position motorized valve, located on left side of the engine compartment deck, is connected in the engine oil return line. (See figure 4-16.)

a. Removal.

(1) Open engine compartment cowling at left side.

WARNING

Prolonged contact with lubricating oil may cause a skin rash. Those areas of skin and clothing that come in contact with lubricating oil should be thoroughly washed immediately. Saturated clothing should be removed immediately. Areas in which lubricating oil is used should be adequately ventilated to keep mist and fumes to a minimum.

(2) Remove oil cooling duct from left side of fuselage. Drain oil cooler and lines.

(3) Disconnect electrical cable connector from valve.

(4) Disconnect engine scavenge oil hose from valve coupling. Disconnect oil cooler lines and tank return line from valve fittings. Cap open ends of lines.

(5) Detach valve from brackets by removing two screws at each side. Lift out valve assembly.

(6) Remove fittings from valve by removing attachment screws. Remove check valve and gasket from right-hand fitting.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

CAUTION

Do not immerse valve motor in solvent.

b *Cleaning.* Clean valve and attaching fittings with solvent (C124).

c. *Inspection.* Mating surfaces of valve and fittings for nicks and burrs and threads for damage.

d. *Repair or Replacement.* Replace any damaged fittings or attaching parts. Replace valve assembly if malfunction occurs.

e. *Installation.*

NOTE

Be sure flow arrow is toward fitting.

(1) Assemble fittings on valve with attaching screws. Use new gasket when installing check valve in return line fitting.

(2) Position valve assembly between brackets and install two screws at each side.

(3) Connect oil cooler lines and tank return line valve fittings. Connect engine scavenge oil hose to coupling.

(4) Connect electrical cable to connector on valve.

(5) Service oil tank. Reinstall oil cooling duct with screws. Close cowl.

(6) Check for leaks and proper operation at next ground run.

4-20. Engine Chip Detector.

A chip detector is installed in the lower right side of the accessory drive gearbox. This unit is wired into the master caution panel. (Refer to TM 55-2840-229-23.)

CAUTION

No more than **15 INCH-POUNDS OF TORQUE** shall be applied to the chip detector centerpost nut when installing the chip detector wire.

Section VI. IGNITION SYSTEM

Refer to TM 55-2840-229-23 for maintenance instructions.

Section VII. POWER CONTROLS

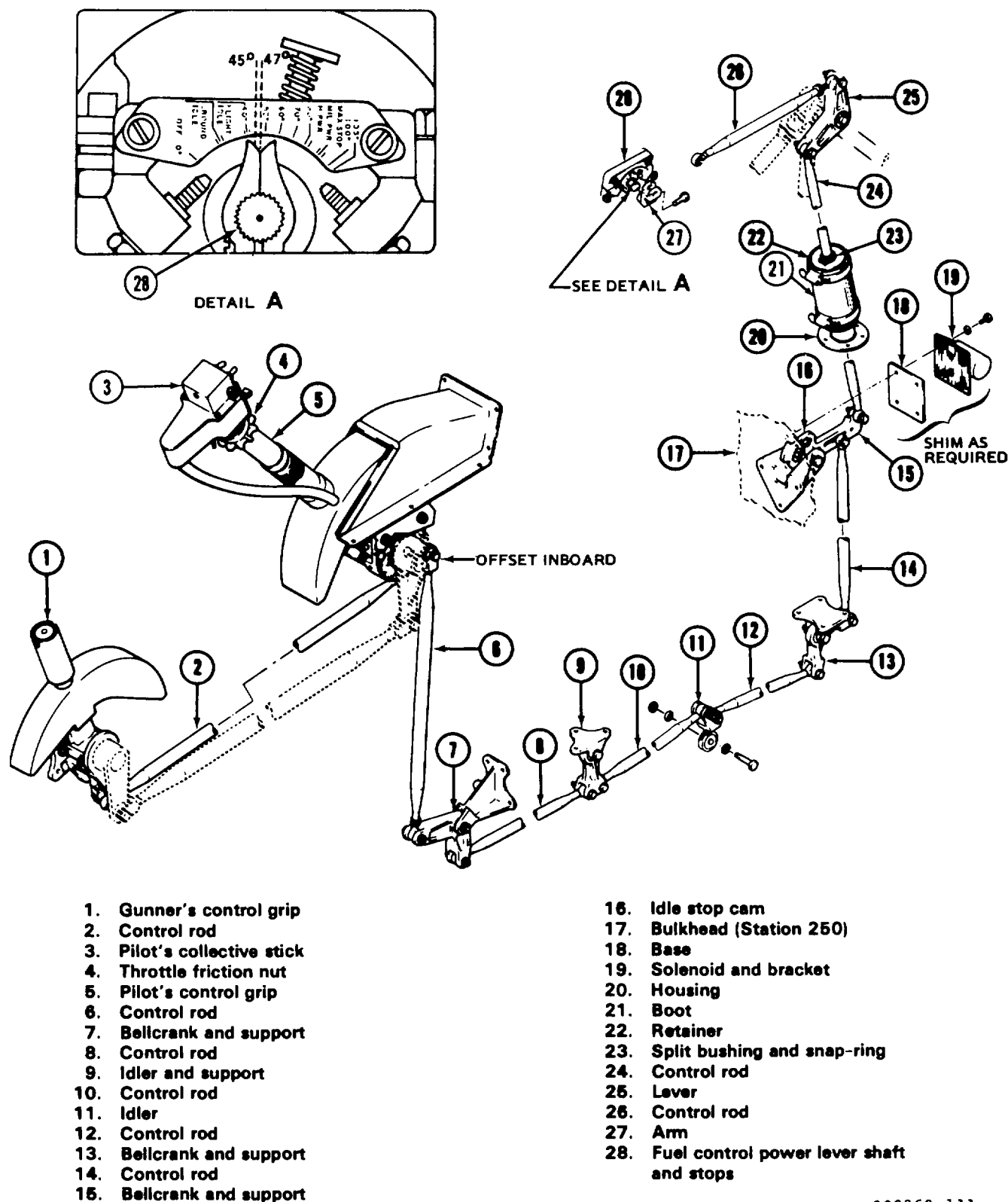
4-21. Power Controls.

A mechanical linkage system, actuated by twist-grips on collective pitch control sticks, provides manual control of the power lever on the engine fuel control unit. The power lever modulates the engine from zero to full power by controlling the gas producer (N1) turbine rpm.

4-22. Power Lever Control Linkage.

The power lever shaft (28, figure 4-20) is serrated and grooved to accept a control arm (27), and has a

quadrant marked with power settings in its range of travel between stops which are pre-adjusted by the engine manufacturer or overhaul facility. The linkage is a series of control rods, bellcranks, idlers and levers. Control rods (6 and 26), at each end of the series, are adjustable. Bellcrank (15) has an adjustable connection for control rod (14), which determines the travel of linkage above the bellcrank. An adjustable cam (16) will make contact with the spring-loaded plunger of a solenoid (19) to arrest linkage motion at the flight idle position when power is being reduced from higher settings. The solenoid plunger can be



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Figure 4-20. Power lever control system

retracted by use of the ENGINE IDLE STOP REL, pushbutton switch, located on the pilot's collective stick to allow control movements in the OFF position.

WARNING

a. Removal.

(1) To remove control rod (6, figure 4- 20): Remove Screw-mounted access panel from left side of fuselage in line with lower end of pilot's collective control stick. Detach rod from bellcrank on control stick and bellcrank (7) by removing bolts with nuts, washers and cotter pins.

(2) Leave lower linkage (7 through 13) in place for normal maintenance and inspection. If necessary to replace damaged parts, obtain access by removing screw-mounted panels from lower skin and detach parts by removing bolts, washers and nuts.

(3) To remove bellcrank (15) and cam (16): Obtain access to compartment, below engine and behind aft fuel cell, by removing oil cooler air intake duct from left side of fuselage. Disconnect control rods (14 and 24) from bellcrank, keeping attaching parts with rod-ends. Remove attaching bolt and lift out bellcrank with cam attached. To remove cam, use an allen wrench to remove two special bolts and serrated washers.

(4) To remove solenoid (19): Obtain access as in step (3). Disconnect electrical connector from solenoid. Remove four bolts and washers to detach solenoid assembly and base (18) from bulkhead (17).

(5) To remove control rod (24) and boot (21): Loosen upper clamp on boot. Disconnect control rod from bellcrank (15) and lever (25). Remove rod with retainer (22) attached. Remove snap-ring and split bushing (23) and separate retainer from rod. Remove boot and clamps from housing (20).

(6) To remove lever (25): Disconnect control rods. Remove bolt with nut, washer, spacer and cotter pin to detach bellcrank from engine mount pillow block.

(7) To remove control arm (27): Disconnect control rod (26). Remove lockwire and screw from arm. Pull arm from fuel control power lever shaft (28). Keep screw with arm.

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

b. Cleaning. Clean external surfaces of parts by wiping with a cloth moistened with solvent (C124). Do not permit solvent to enter bearings or solenoid.

c. Inspection.

(1) Control rods for cracks and general condition, end fittings for security, bearings for binding or rough operation.

(2) Bellcranks, levers and idlers for security, cracks or damage, and binding or rough bearings.

(3) Solenoid for security and proper operation.

(4) Boot assembly for cracks and wear.

d. Repair or Replacement.

(1) Replace control rods for cracks, distortion, or loose or binding end fittings.

(2) Replace bellcranks, levers and idlers for cracks, or for loose or binding bearings.

(3) Replace solenoid if malfunction occurs. Secure replacement solenoid in bracket with four countersunk screws, using shims as required so that solenoid plunger operates freely in bracket bushing.

(4) Replace boot if cracked or damaged.

e. Installation.

(1) Place arm (27, figure 4-20) on fuel control power lever shaft (28), aligned with stop arm. Install screw through arm and groove of shaft. After rigging controls, lockwire screw.

(2) Position lever (25) on outboard side of engine mount pillow block, with spacer between lever and block and with marked arm of lever pointing up. Insert bolt through large safety washer, lever bearing, spacer and pillow block. Secure bolt with thin washer, nut and cotter pin at inboard end.

(3) **Adjust control rod (26) to nominal length of 11.17 inches between centers of rod end bearings. Attach adjustable end of lever (25) with bolt, washers, nut, and cotter pin. Forward end of rod will be corrected to arm (27) in rigging procedure.**

(4) Place smooth side of cam (16) on bellcrank (15). Place a serrated washer on each of two special bolts and start through slotted holes of cam and into nutplates of bellcrank. (See figure 4- 21.) Use allen wrench at shank ends to tighten bolts. Place bellcrank in support and install bolt, thin washers, nut and cotter pin. Cam position will be adjusted during rigging.

(5) Attach solenoid assembly (19, figure 4- 20) and base (18) to mounting holes in bulkhead (17) with four bolts and washers. Set solenoid position so that plunger will not engage stop cam, until ready for adjustment during rigging.

NOTE

If bracket (19) P/N 204-060-797-1 is installed, use shims P/N 120-031-12-7 to adjust solenoid. If bracket P/N 204-060-797- 5 is installed, shims are not required.

(6) Place retainer (22) on control rod (24). Insert split bushing (23) between rod and retainer and secure with snapping. Secure boot (21) with clamp on housing (20). Insert rod down through boot and housing. Connect rod to lever (25) and bellcrank (15). At lower rod-end, insert bolt through large safety washer, rod-end, aluminum alloy washer, and bellcrank. Secure bolt with aluminum-alloy washer, nut and cotter pin. Attach boot to retainer with clamp.

NOTE

Check for 0.06 inch minimum clearance between rod and engine mount leg. If needed, install not more than three thin steel washers under spacer on pivot bolt of lever (25).

(7) Connect control rod (14) to bellcrank (13) with bolt, two thin washers, nut and cotter pin. At upper end, insert bolt through large safety washer, rod-end, aluminum-alloy washer, slot of bellcrank and a serrated washer. Set rod-end at middle of bellcrank slot and secure with nut and washer. Install cotter pin after rigging is complete.

(8) Adjust control rod (6) to nominal length of **20.0** inches between center of rod-end bearing and clevis. Position clevis, with rod offset inboard, on throttle control bellcrank of pilot's collective stick (3). Install bolt from inboard side, with thin washers under bolt head and nut. Connect lever rod-end to bellcrank (7) in the same manner. Install cotter pins when rigging is complete.

f. Rigging.

(1) Check the power lever control linkage is completely installed except as follows:

(a) Idle stop solenoid (19, figure 4- 20) should not make contact with stop cam (16).

(b) Arm (27) should be installed in fuel control power lever shaft (28) as nearly parallel to shaft stop arm as serration alignment permits. Control rod (26) should not be connected to arm (27).

NOTE

Before starting rigging procedure, make sure rod (6) and rod (26) are at nominal length.

(2) Center control rod (14) in bellcrank (15) before trying to obtain center of travel in step (3).

(3) Support free end of control rod (26) level with fuel control power lever shaft (28). Operate pilot control grip (5) to full on to full off, and check that end of control rod (26) moves equal distances from centerline of shaft (28) at both positions. Adjust control rods (26 and 6) as close to nominal lengths as possible. Refer to paragraph 4-22e, step (3) and step (8) for nominal lengths.

(4) Position control rod (26) in arm (27). Install bolt.

(5) Turn pilot control grip (5) in one direction until fuel control shaft bottoms on stop. Disconnect control rod (26) from arm and check that control grip (5) will turn approximately 5 degrees further before bottoming. Repeat procedure with grip rotated in opposite direction.

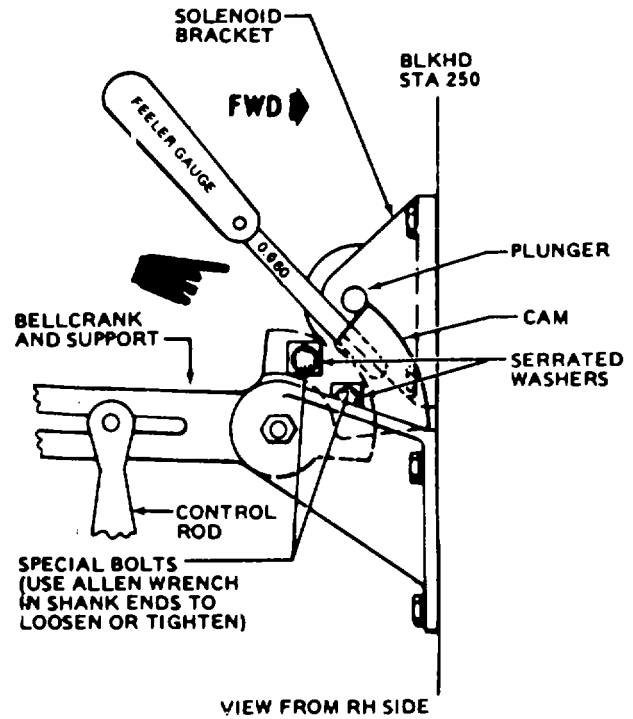
Make corrections by adjusting position of control rod (14) on slotted bellcrank (15). When satisfactory, leave control rod (26) connected to arm (27). Install cotter pin.

- (6) Operate control grip (5) to set power lever shaft stop arm (27) to 47 degree mark on fuel control. Adjust positions of idle stop cam (16) and solenoid (19) so that cam rests against extended plunger of solenoid. Check that solenoid bracket clears cam by 0.06 inch in all conditions (figure 4-21).

CAUTION

Serrations of cam and square washers must be matched.

- (7) In next ground run, make final adjustment of idle stop cam to obtain **68 TO 72** percent gas producer rpm.



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Figure 4-21. Flight idle stop installation

a. *Removal-Actuator and Control Lever.*

- (1) Open engine compartment cowling at left side.
- (2) Remove terminal cover with attaching screws from top of linear actuator (20, figure 4-22). Disconnect and stow electrical leads. Reinstall cover.
- (3) Detach actuator jackshaft end-fittings from lever (21) on governor control shaft, and from slider of cambox (19), by removing bolts with nuts, washers and cotter pins. Use care to avoid losing spring washer, which is installed between actuator clevis and slider, also washers installed between rod-end and lever (21).
- (4) Remove lockwire and clamping bolt, and pull lever from serrated shaft at top of overspeed governor.

b. *Removal-Cambox and Linkage.*

- (1) Disconnect control rod (18, figure 4-22) from bellcrank of cambox (19) by removing bolt with nut, washers and cotter pin.
- (2) Remove nuts and washers from inboard ends of two bolts that attach cambox to support bracket. Remove cambox with bolts in place. Reinstall nuts and washers on bolts, with care that shims remain in place on bellcrank pivot bolt between bearing and sides of housing.

4-23. Power Turbine Governor RPM Controls.

Engine power turbine speed (N2 rpm) is controlled through the overspeed governor by means of an actuator and a droop compensator cam and linkage.

4-24. Governor Actuator and Droop Compensator Linkage.

An electrically operated linear actuator (20, figure 4-22) controlled by the GOV RPM INCR/ DECR switch on the pilot's collective pitch control stick, moves a lever (21) on the fuel control overspeed governor to change settings of power turbine rpm. Droop compensation, to stabilize rpm as engine load fluctuates with changes of main rotor pitch, is provided by mounting the actuator to a cambox (19) which is mechanically linked to a bellcrank (2) in the collective pitch control system. The droop compensator linkage consists of control rods, levers, arms and bellcranks. Bellcrank (4) is attached on shaft (7) by means of a shear pin (9), which is designed to shear to allow unhindered operation of the collective pitch controls if the compensator linkage should become fouled.

NOTE

As an alternate method, remove cambox and bracket as an assembly by removing two bolts that secure bracket to forward engine mount trunnion. Reinstall bolts to secure mount trunnion.

- (3) To remove bellcrank (4) and shaft (7) and associated parts: Disconnect control rods (3 and 13). Remove nut and washer from inboard end of shaft. Remove three attaching bolts and bracket (11) from outboard end of shaft. Pull shaft free of inboard bracket (8). Remove shaft assembly with bellcrank, shear pin (9), shims (5) and special washer (6). When replacement of shear pin is required, remove parts from inboard end of shaft.

- (4) Remove other components of linkage as required.

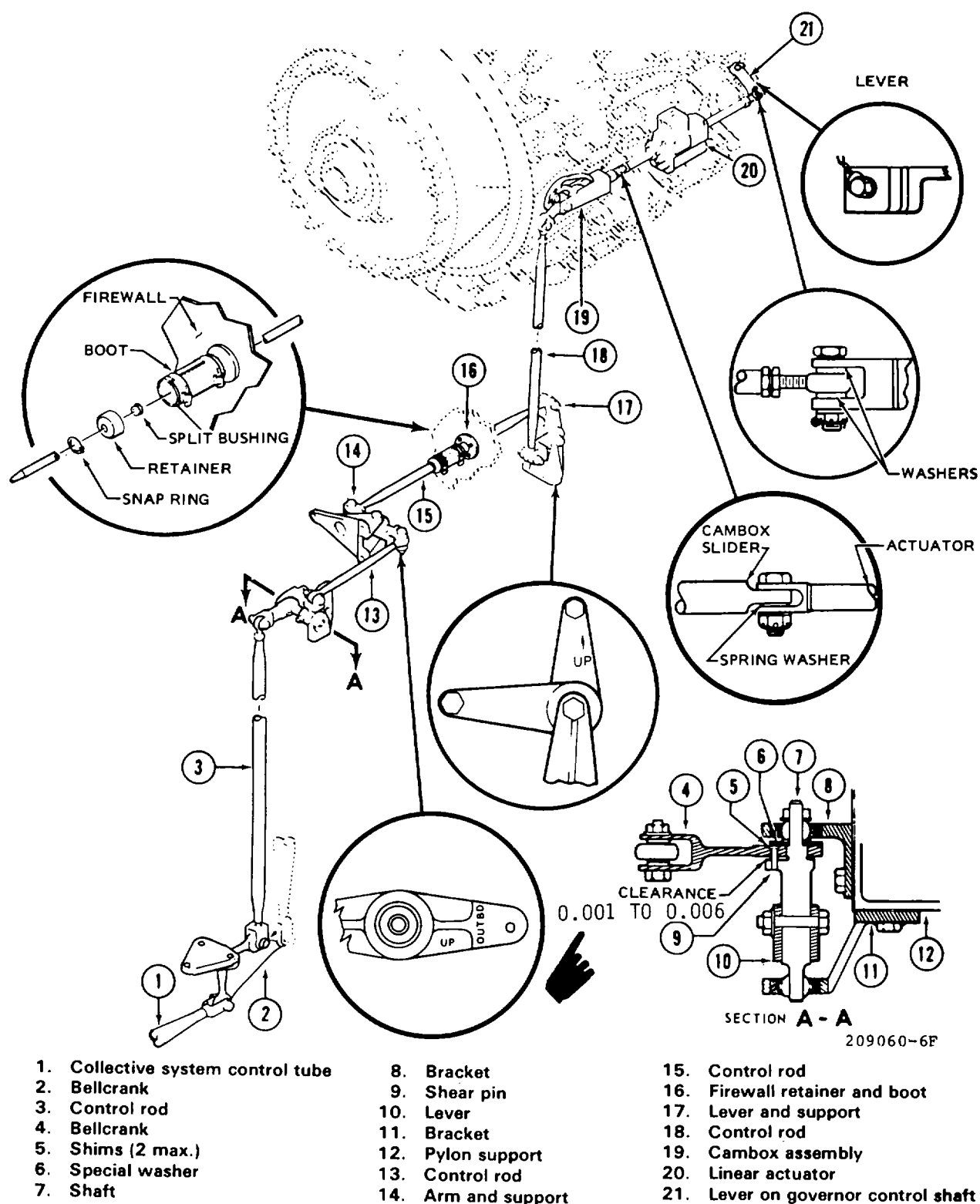


Figure 4-22. Power turbine governor rpm controls

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

c. Cleaning-Governor Actuator and Droop Compensator Linkage. Clean external surfaces of parts by wiping with a cloth moistened with solvent (C124). Do not permit solvent to enter bearings or actuator.

d. Inspection-Governor Actuator and Droop Compensator Linkage.

(1) Linear actuator for evidence of damage or malfunction.

(2) Cambox for security of parts and smooth operation with no evidence of binding. Check for proper clearance of **0.001 to 0.006** inch between bellcrank (4) and flange of shaft (7). Refer to figure 4-22. view A-A.

(3) Check for broken shear pin (9, figure 4- 22) by manually holding lever (10) and applying slight force to bellcrank (4).

(4) Other parts of droop compensator linkage for freedom of operation, looseness and damage.

(5) Boot (16) for cracks, wear, and security.

(6) Inspect adjustment shaft of single screw for not more than 4 threads showing beyond the locknut.

e. Repair or Replacement-Governor Actuator and Droop Compensator.

(1) Replace actuator if damage or malfunction occurs.

(2) Replace cambox and bracket assembly if damaged or failing to operate smoothly.

(3) Replace shear pin (9, figure 4-22) in event of failure. Investigate cause of failure and correct any fouling of linkage or other faulty condition.

(4) Replace other parts in droop compensator linkage where found unserviceable.

f. Installation-Cambox and Linkage.

(1) Position cambox (19, figure 4-22) on outboard side of bracket. Insert two bolts and secure with nuts and washers. Be sure shims are in place on bellcrank pivot bolt.

NOTE

If bracket was also removed reinstall on two upper bolts of engine forward mount trunnion. Lockwire both heads.

(2) Adjust control rod (18) to nominal length of 19.0 inches between centers of rod end hearings. Connect nonadjustable end to forward arm of lever (17) with bolt, thin aluminum alloy washers, nut, and cotter pin. Adjustable end will be connected to bellcrank of cambox (19) during rigging.

(3) If bellcrank (4), shaft (7), and associated parts are removed, reinstall as follows: Attach bracket (8) on pylon support with two bolts and washers. Place shims (5), special washer (6) and thin steel washer on shaft. Insert shaft through bearing of inboard bracket and secure with thin steel washer and nut, fingertight. Install bracket (11) over outboard end of shaft and attach to pylon support with two bolts and washers. Tighten nut on inboard end of shaft. Check for **0.001 to 0.006** inch clearance between bellcrank and shaft as shown. (See Section A-A.) If necessary, disassemble to change shim thickness and reassemble.

(4) Adjust control rod (3) to nominal length of 32.46 inches between center of bolt holes in rod end and clevis. Connect clevis to collective system bellcrank (2) with bolt, thin aluminum alloy washers, nut, and cotter pin. Align upper rod end in fork of bellcrank (4), with a thin steel washer between each side of bearing and inside of fork. Install bolt, secured by washer, nut and cotter pin.

(5) Assemble retainer, split bushing, snap ring and boot with clamps on rod (15). Insert rod- end aft through firewall retainer and connect to upper arm of lever (17) with bolt, thin aluminum alloy washers, nut and cotter pin. Connect forward end of rod to inboard end of arm (14) in the same manner. Secure boot with clamps on retainers.

CAUTION

Arm (14) should be installed with angled clevis outboard and sloping down forward to meet with control rod (13).

NOTE

If rod (15) is not fixed-length type, adjust to nominal length of 16.82 inches between center of rod ends and install adjustable end aft.

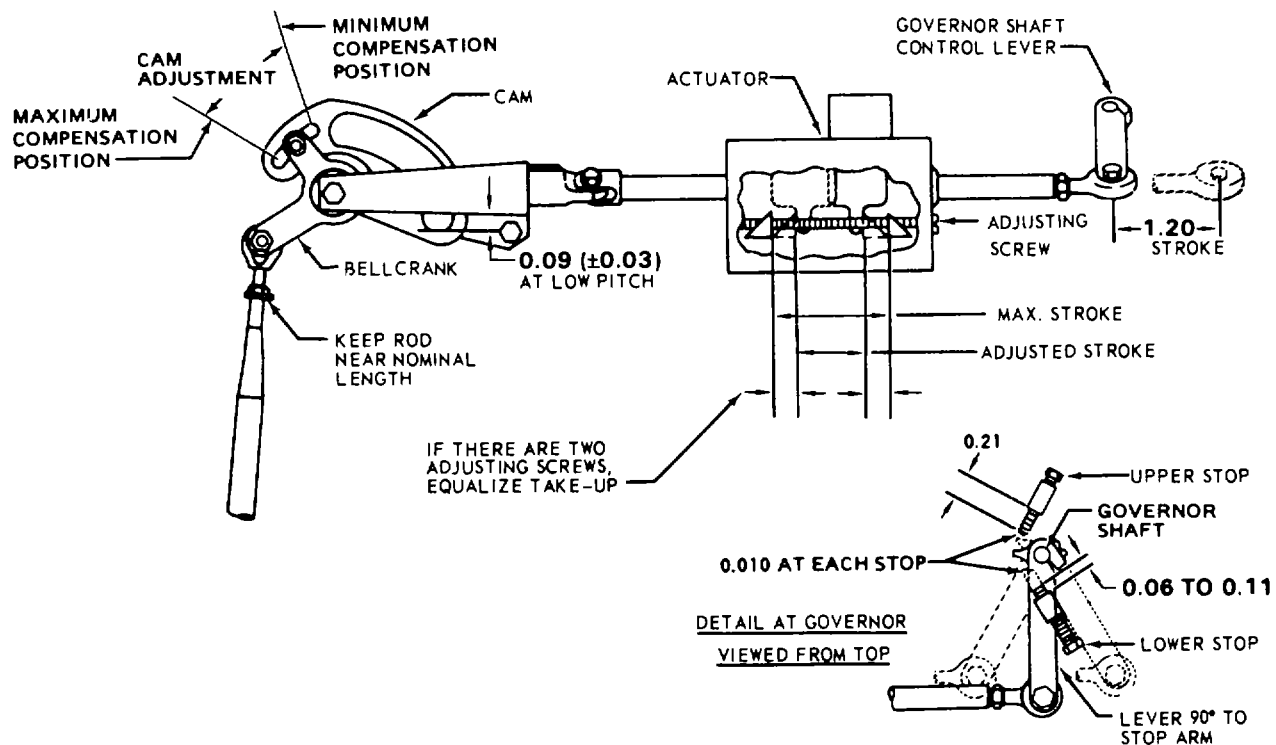
g. Installation-Actuator and Control Lever.

(1) Place control lever (21, figure 4-22) on control shaft of fuel control overspeed governor, approximately 90 degrees to centerline of stop arm on shaft. Install retaining bolt into lever and through shaft groove. Torque bolt 12 TO 15 inch- pounds. Secure bolt to lever to with lockwire (C151).

(2) Align actuator (20) with front end-fitting clevis on end of cambox slider. Insert spring washer between clevis and underside of slider and install bolt from top, secured with washer and nut. Torque nut **5 TO 15** inch-pounds and insert cotter pin.

(3) Attach actuator shaft rod end with a thin steel washer on each side of rod end bearing into clevis of governor control lever with bolt (washer under head). Install washer and nut, omit cotter pin until rigging is complete. If necessary, loosen bolts attaching cambox bracket on engine to align actuator to lever. After installing actuator, tighten and lockwire bracket bolts.

(4) Remove actuator terminal cover. Connect electrical leads on terminals. (See wiring diagrams, Appendix F.) Reinstall terminal cover.

h. Rigging-Power Turbine Governor RPM Controls. (See figure 4-22 and 4-23.)

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Figure 4-23. Rigging diagram-governor rpm controls

NOTE

Collective pitch control system rigging must be complete before using this procedure.

CAUTION

The engine should be at flight idle before the rod end bearing is disconnected from the governor control lever.

(1) Check that installation of governor control linkage is complete except:

(a) Linear actuator (20, figure 4-22) disconnected from governor control shaft lever. Support actuator near normal position, so that its jackshaft rod end can be moved freely.

(b) Vertical control rod (18) disconnected from bellcrank of cambox (19).

(1.1) Set control rod (3) to nominal length of **32.46** inches.

(1.2) Set control rod (18) to nominal length of **19.0** inches.

(2) Set cam adjustment bolt in middle of slot, within **0.06** inch. Match serrations of square washer and cam while tightening nut on bolt. Refer to figure 4-23.

(3) Measure stroke of actuator jackshaft rod end while operating GOV RPM switch, on collective control stick, to INCR and DECR. Set actuator adjusting screw (or screws) to limit stroke to **1.20** inches. After adjustment, leave actuator at full INCR (retracted) position.

NOTE

If actuator has two adjustment screws: Electrically position actuator shaft to approximately midpoint of stroke. Turn both adjusting screws to obtain maximum stroke. Reduce stroke by turning each screw equal number of turns away from maximum adjustment until rod end travel length is **1.20** inches.

(4) Place collective stick full down. Manually position cambox bellcrank so that **0.09 (± 0.03)** inch of cam slot is visible below cambox housing. Adjust two vertical control rods (3 and 18, figure , 4-22) equally and in opposite directions, to align and connect upper rod to

cambox bellcrank at this setting.

NOTE

Keep control rods as near as possible to nominal lengths, for safe thread engagement of rod ends (Refer to paragraph 4-24f.)

(5) At overspeed governor control shaft, adjust upper stop screw to extend **0.21** inch from its mounting boss. Adjust lower stop screw to extend not less than **0.06** inch from its boss. (See figure 4-23.) Check installation of lever on governor shaft, to be as nearly 90 degrees to shaft stop arm as serrations permit.

NOTE

Never shorten either-stop screw on governor to less than **0.06** inch length from inner side of boss.

(6) Move collective stick to full up position.

(7) Manually position lever so that shaft stop arm is 0.010 inch from upper stop screw (figure 4-23). Adjust actuator jack shaft rod end and connect to lever at this setting. Install washers on both sides of rod end bearing between bearing and level (one washer on each side). Install rod end bolt, washers and nut (one washer under head of bolt and one washer under nut). Torque **12 TO 15** inch-pounds and install cotter pin. Check that rod end is centered and torque jam nut **60 TO 85** inch-pounds and lockwire.

(8) Place collective control stick full down. Hold GOV RPM switch to DECR until actuator is fully extended. Adjust lower stop screw on governor to be **0.010** inch away from governor shaft stop arm. Tighten jam- nuts and lockwire both stop screws s.

CAUTION

Any adjustments after preliminary rigging will require recheck and adjustment of governor stop screws for **0.010** inch clearance of upper and lower stop bolts according to steps (7) and (8).

(9) After preliminary rigging by preceding steps, final rigging adjustments will be made as required in next ground-run or flight:

(a) With collective control stick full down, full throttle, and governor rpm increase/decrease switch at full decrease, the rpm should be **6000**. At full increase, the rpm should be 6700. Readjust linear actuator screws to obtain 6000 + 50 to **6700 ± 50** rpm range.

NOTE

If linear actuator has only one adjustment screw, adjust screw to obtain a 700 rpm range. Then adjust linear actuator rod end to obtain **6000 ± 50** to **6700 ± 50** rpm range.

(b) Set droop compensator cam to maintain **6600 (± 40)** rpm engine output shaft speed from flat pitch to full power. If rpm droop occurs, move cam adjustment bolt toward forward (max compensation) end of slot. If maximum cam compensation does not correct rpm droop, lengthen control rod attached to cambox bellcrank, increasing amount of cam slot visible below cambox housing. Cam slot must not bottom out against follower in either extreme collective stick position.

4-25. Installation-Engine Electrical Cables.

NOTE

Refer to wiring diagram in Appendix F for wiring or connector identification.

a. Install nipples over ends of wires of starter-generator cable (6, figure 4-24).

- (1) One nipple on wires K5C4 and K5A1.
- (2) One nipple on wires P26A1 and P26C4.
- (3) One nipple on wires K4B4 and K4D4.
- (4) One nipple on wire P25A16.

b. Remove nuts and washers from terminals C, B, and E of starter-generator.

NOTE

If terminals of starter-generator are too short, thin washers may be used.

c. Position wires K5C4 and K5A1 on terminal E, wires P26A1 and P26C4 on terminal B, wires K4B4 and K4D4 on terminal C and wire P25A16 on terminal A. Reinstall washers and nuts. Place nipples over terminals.

d. Loosely assemble clamps on starter-generator cable. Clamps are used to secure cable during engine installation. See Detail B.

e. Position main engine cable (10) on engine and connect electrical connector (3) to airframe main connector.

f. Remove cover from linear actuator wire terminals and connect wiring (figure 4-24) as follows:

- (1) Connect wire Q23C18 to terminal R.
- (2) Connect wire Q22C18 to terminal E.
- (3) Connect wire Q26A18N to terminal GND.

g. Secure wiring with bracket and clamp. See Detail A.

h. Connect electrical connector (8) to engine oil pressure transducer and connect electrical connector (9) to engine oil pressure switch.

i. Secure cable with clamps as shown in details D and E.

j. Install one nipple on wire W71D18 and one nipple on wire W71E18.

k. Remove nuts and washers from terminals of fuel pressure switches (4). Position one wire on each pressure switch and reinstall washers and nuts. Place nipples over terminals.

l. Connect electrical connector (5) to fuel filter bypass switch and connect electrical connector (7) to engine oil bypass valve.

m. Secure cable with bracket and clamp. See detail C.

n. Connect electrical connector (2) to bleed air valve and connect electrical connector (1) to engine oil low level switch receptacle.

o. Secure harness to bleed air duct with clamps. See figure 4-25, detail C.

p. Connect electrical connectors (1 and 2) to torque pressure transducers.

q. Assemble terminal board assembly details (6 thru 11) to engine support. Connect engine ground wires to terminal board 1TB1. Secure wires to terminal board with washers (5), nuts (4), and cover (3).

r. Secure cable with clamps. See detail D.

s. Install nipple on wire W10C18. Remove nut and washer from terminal of chip detector (12).

t. Install wire W10C18 on chip detector terminal. Reinstall washer and nut and place nipple over terminal. Secure wire with clamps. See detail E.

u. Secure remainder of harness to engine using clamps and brackets. See details A, B, F, G, and H.

v. Secure exhaust thermocouple cable (13) to engine with clamp and bracket. See detail I.

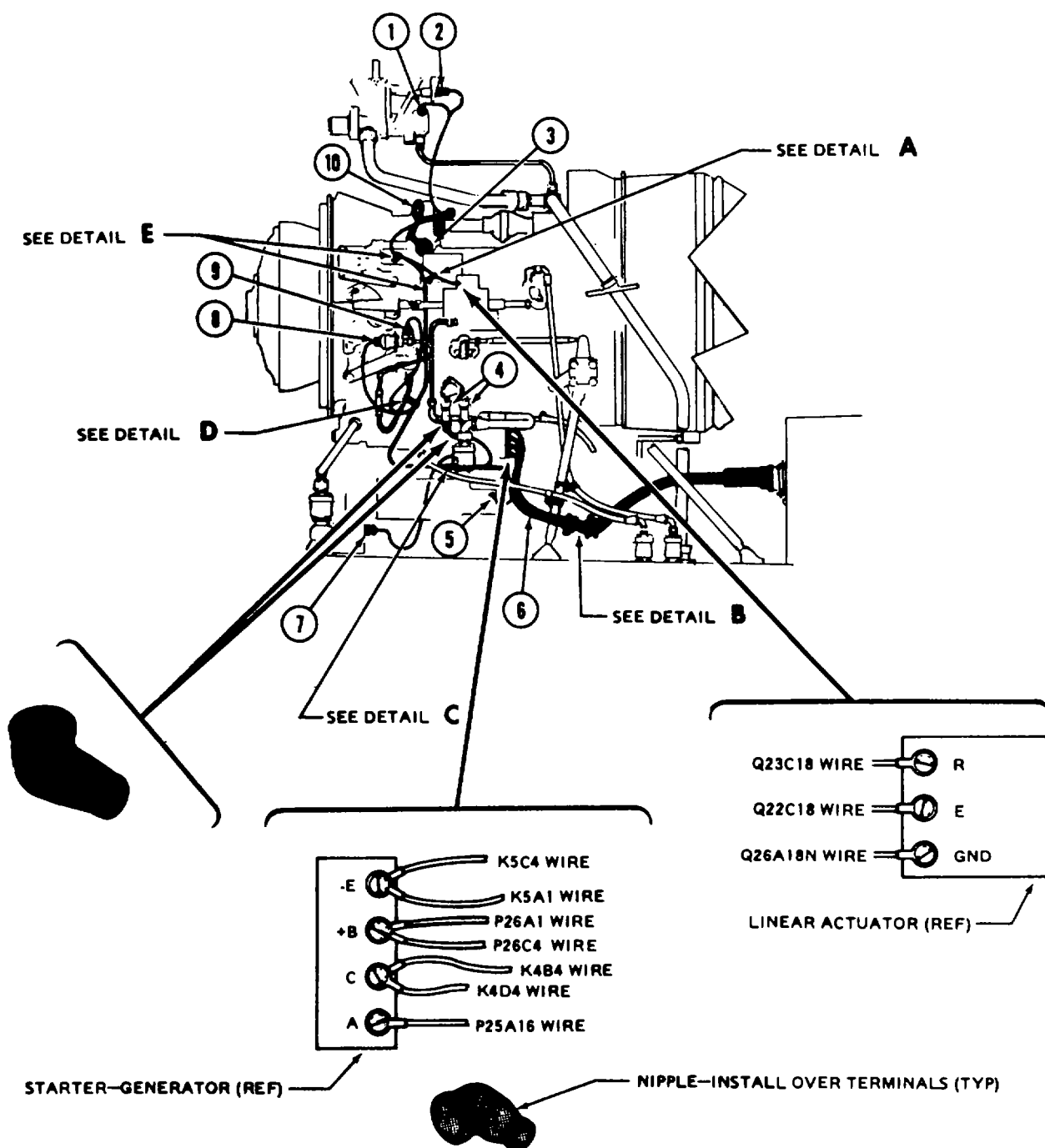
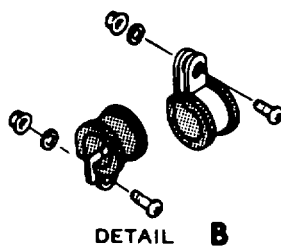
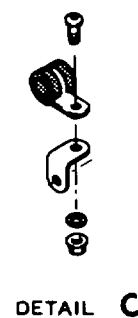
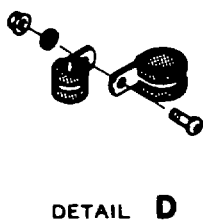
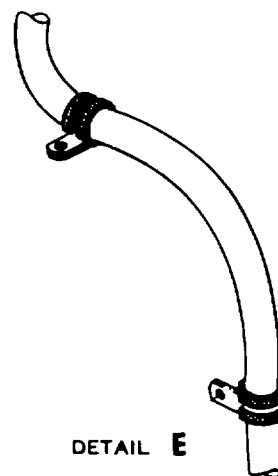


Figure 4-24. Electrical Cable Installation-Engine Left Side (Sheet 1 of 2).



1. Electrical connector (engine oil low level switch)	6. Starter—generator cable
2. Electrical connector (bleed air low level switch)	7. Electrical connector (engine oil bypass valve)
3. Electrical connector	8. Electrical connector (engine oil pressure transducer)
4. Fuel pressure switches	9. Electrical connector (engine oil pressure switch)
5. Electrical connector (fuel filter bypass)	10. Main engine cable

Figure 424. Electrical Cable Installation-Engine Left Side (Sheet 2 of 2).

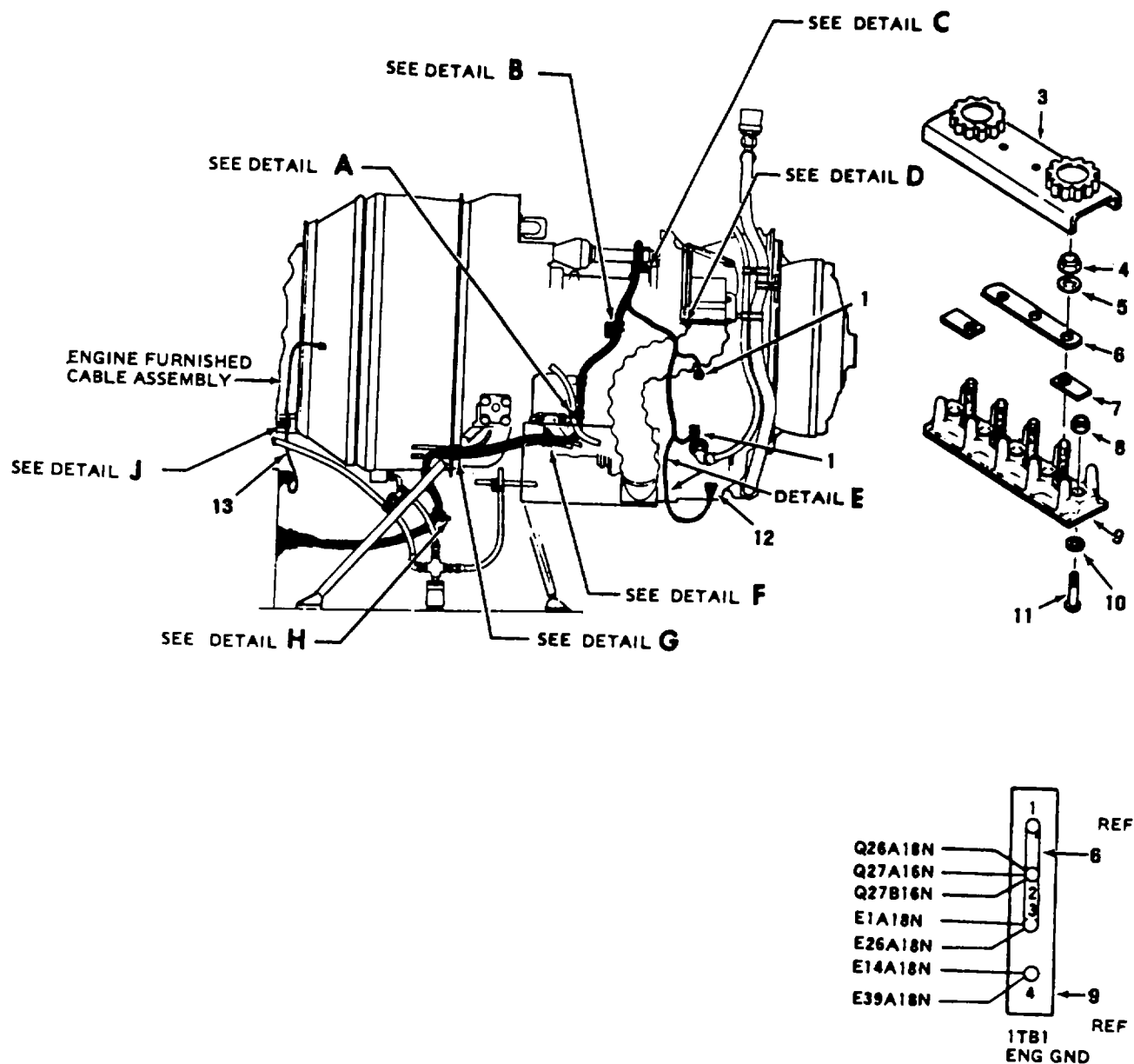


Figure 4-25. Electrical Cable Installation-Engine Right Side (Sheet 1 of 2).



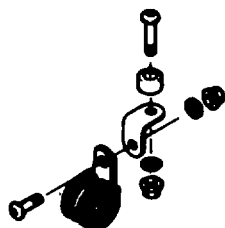
DETAIL A



DETAIL B



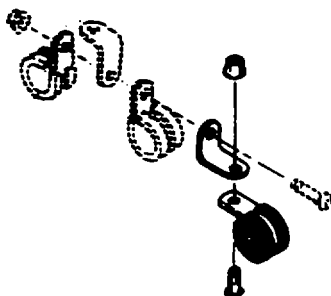
DETAIL C



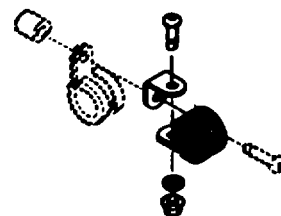
DETAIL D



DETAIL E



DETAIL F



DETAIL G



DETAIL H



DETAIL J

1. Electrical connector
2. Electrical connector
3. Terminal board cover
4. Nut
5. Washer
6. Link

7. Insulator
8. Nut
9. Terminal board
10. Washer
11. Screw
12. Chip detector
13. Exhaust thermocouple cable

Figure 4-25. Electrical Cable Installation - Engine Right Side (Sheet 2 of 2).

CHAPTER 5

ROTOR SYSTEM

5-1. Rotor System.

The rotor system is comprised of the main rotor system and the tail rotor system.

Section I. MAIN ROTOR SYSTEM

5-2 Main Rotor System.

The main rotor system consists of the main rotor hub and blade assembly, swashplate assembly, scissors and sleeve assembly, and connecting tubes (pitch links.) See figure 5-1.

5-3. Troubleshooting and Operational Check-Main Rotor System.

Premaintenance Requirements for Troubleshooting and Operational Check of Main Rotor System.

Condition	Requirements
Model	AH-1S
Part No. or Serial No.	A11
Special Tools	(T44) (T51)
Test Equipment	Two fifteen-inch crescent wrenches
Support Equipment	Tracking Flag Grease pencils for tracking blades

Condition	Requirements
Minimum Personnel Required	Three Men
Consumable Materials	(C151)
Special Environmental Condition	NA

a. Troubleshooting-Main Rotor System.

Troubleshoot the main rotor system in accordance with table 5-1 and the specific procedures set forth in "Operational Checks", in step b.

Table 5-1. Troubleshooting-Main Rotor System

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

- 1. Lateral vibration.

STEP 1. Rotor spanwise unbalance.

Balance dynamically with weight in blade bolt. (Refer to paragraph 5-3).

Table 5-1. Troubleshooting-Main Rotor System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

STEP 2. Rotor chordwise unbalance.

Balance dynamically by adjusting drag brace (sweeping blade). (Refer to paragraph 5-3.b)

2. Vertical 1/rev vibration.

STEP 1. Rotor blades out of tracks.

Track rotor blades. (Refer to paragraph 5-3.b)

3. Steady or intermittent 1/rev vertical vibration.

STEP 1. Loose collective mast friction assembly.

Check friction sleeve force adjustment. (Refer to paragraph 5-7.g.)

STEP 2. Worn bearings in lever assembly and link.

Replace worn bearings. (Refer to paragraph 11-5.d.)

STEP 3. Worn pitch link rod end bearing.

Replace if wear is excessive. (Refer to paragraph 11-6.d.)

STEP 4. Swashplate pivot ball adjustment incorrect.

Adjust swashplate pivot ball with AVIM assistance. (Refer to paragraph 6-8g(13).)

STEP 5. Excessive wear in scissors assembly.

Replace scissors and sleeve assembly. (Refer to paragraph 5-7.e.)

STEP 6. Internal wear or damage in main rotor hub assembly.

Replace hub. (Refer to paragraph 5-6.e.)

NOTE

Wear at one bearing or combined wear at these locations significantly contributes to vibration.

4. Pylon rock.

STEP 1. Defective fifth mount.

Replace mount. (Refer to paragraph 6-14.)

Table 5-1. Troubleshooting-Main Rotor System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

STEP 2. Defective transmission mount dampers.

Repair or replace transmission dampers. (Refer to paragraph 6-16.)

STEP 3. Mount bolts bottomed or stripped.

Replace bolts. (Refer to paragraph 6-16.)

STEP 4. Worn or dirty trunnion bearings.

Inspect, clean, or replace trunnion bearings. (Refer to paragraph 5-4.)

STEP 5. Loose trunnion.

Adjust trunnion, with AVIM assistance.

5. 2/rev vibration, approximately ten per second.

STEP 1. Transmission mounts deteriorated.

Replace transmission mounts. (Refer to paragraph 6-12.d.)

6. High frequency vibration.

STEP 1. Loose elevator linkage at swashplate horn.

Replace worn parts. (Refer to paragraph 2-50.)

STEP 2. Loose elevator.

Reshim bearing. (Refer to paragraph 2-50.)

7. Rotor RPM high or low in autorotation.

STEP 1. Low pitch blade angle incorrect.

Adjust both pitch links equally. (Refer to paragraph 5-36b(7) for B540 blades or paragraph 5-3c(7) for K747 blades.)

8. Slow control response.

STEP 1. Internal leakage in servo cylinder.

Replace cylinder or seals as necessary. (Refer to paragraph 7-11 .h.)

Table 5-1. Troubleshooting-Main Rotor System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

9. 2/1 rev vertical vibration.

STEP 1. Worn or dirty grip/feather bearing.

Inspect. clean. or replace bearing. (Refer to paragraph 5-5.)

10. Unable to get full stroke on the collective during bleed down.

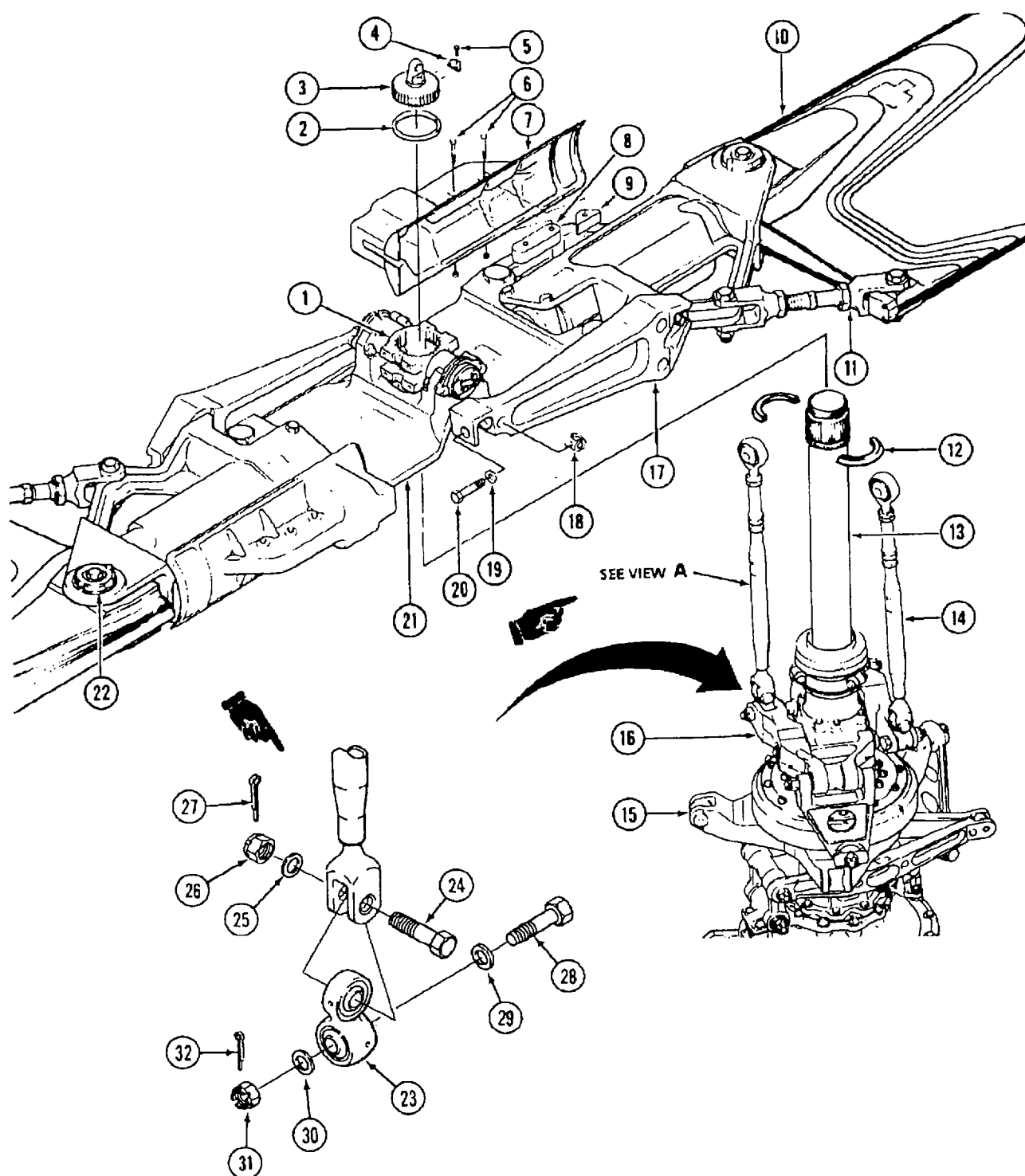
STEP 1. Worn or dirty grip/feather bearing.

Inspect, clean, or replace bearing. (Refer to paragraph 5-5.)

*b. Operational Checks-Main Rotor System
(B540 Blades).*

NOTE

The strobe-type tracking device may be used if available.
Instructions for use are provided with the device.

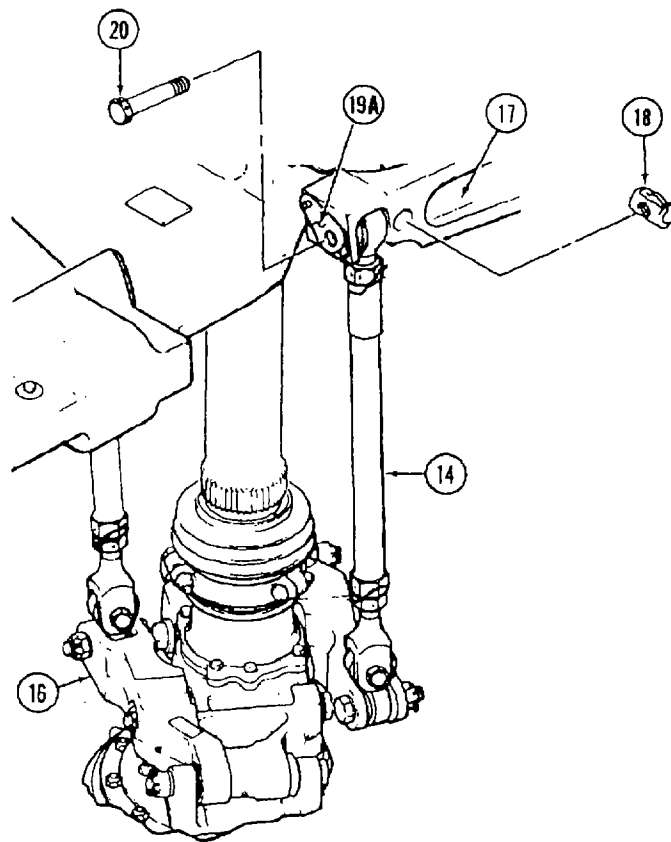


209200-84-1

Figure 5-1. Main rotor installation (Sheet 1 of 2)

Change 71

5-2C



VIEW A

1. Main Rotor Hub Trunnion	17. Pitch Horn
2. Washer	18. Barrel Nut and Retainer
3. Mast Nut	19. Washer
4. Lock	19A. Bushing Assembly
5. Bolt	20. Bolt
6. Bolts	21. Main Rotor Hub Assembly
7. Sand Deflector	22. Blade Retaining Bolt Assembly
8. Spacer	23. Universal Bearing
9. Spacer	24. Bolt
10. Main Rotor Blade	25. Washer
11. Drag Brace Assembly	26. Nut
12. Cone Set	27. Cotter Pin
13. Mast	28. Shear Bolt
14. Pitch Link	29. Recessed Washer
15. Swashplate and Support Assembly	30. Recessed Washer
16. Scissors and Sleeve Assembly	31. Nut

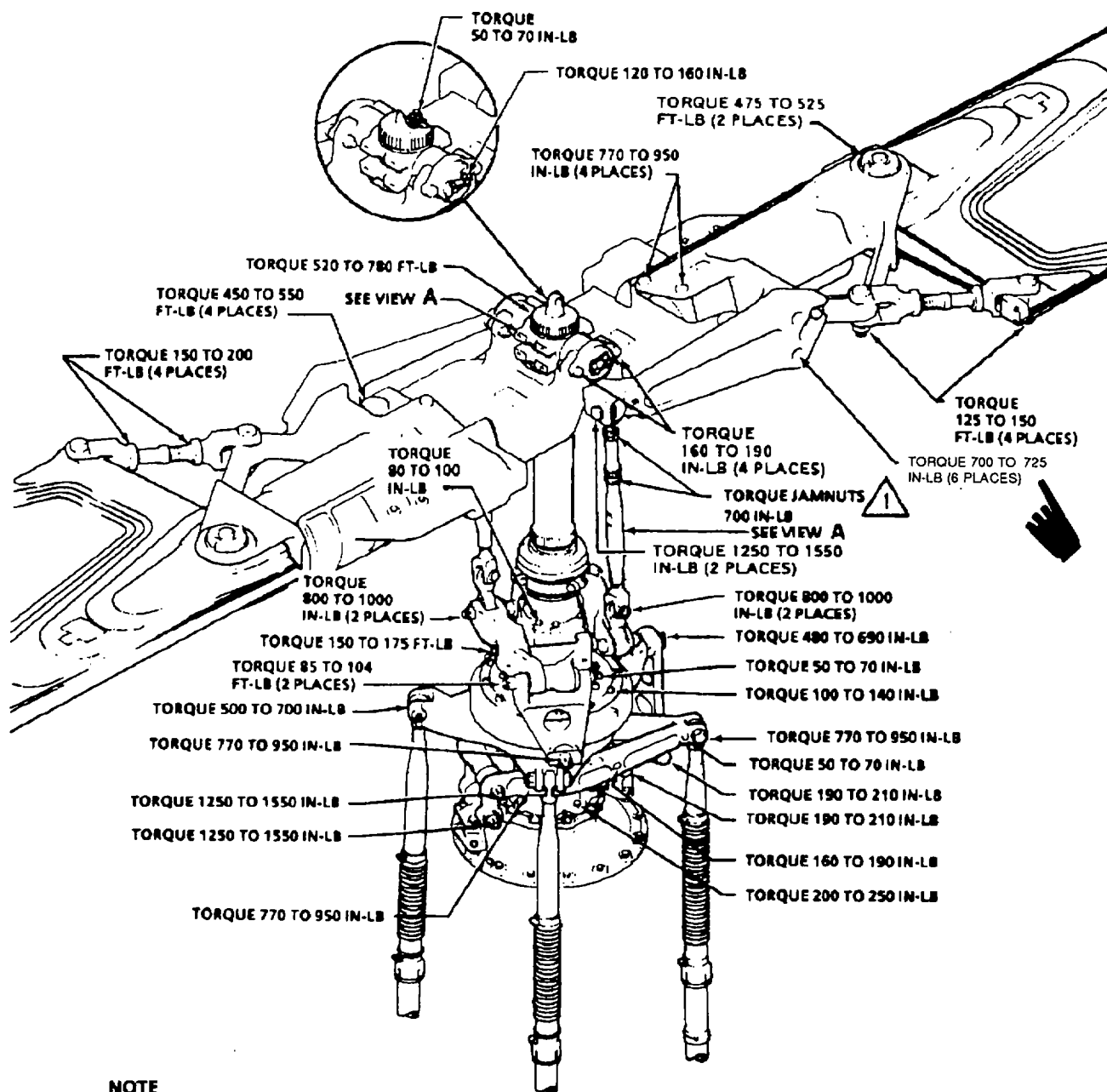
NOTE: View A applicable after MWO 55-1520-244-50-9 is accomplished.

209200-84-4

Figure 5-1. Main rotor installation (Sheet 2 of 2)

Change 71

5-2D



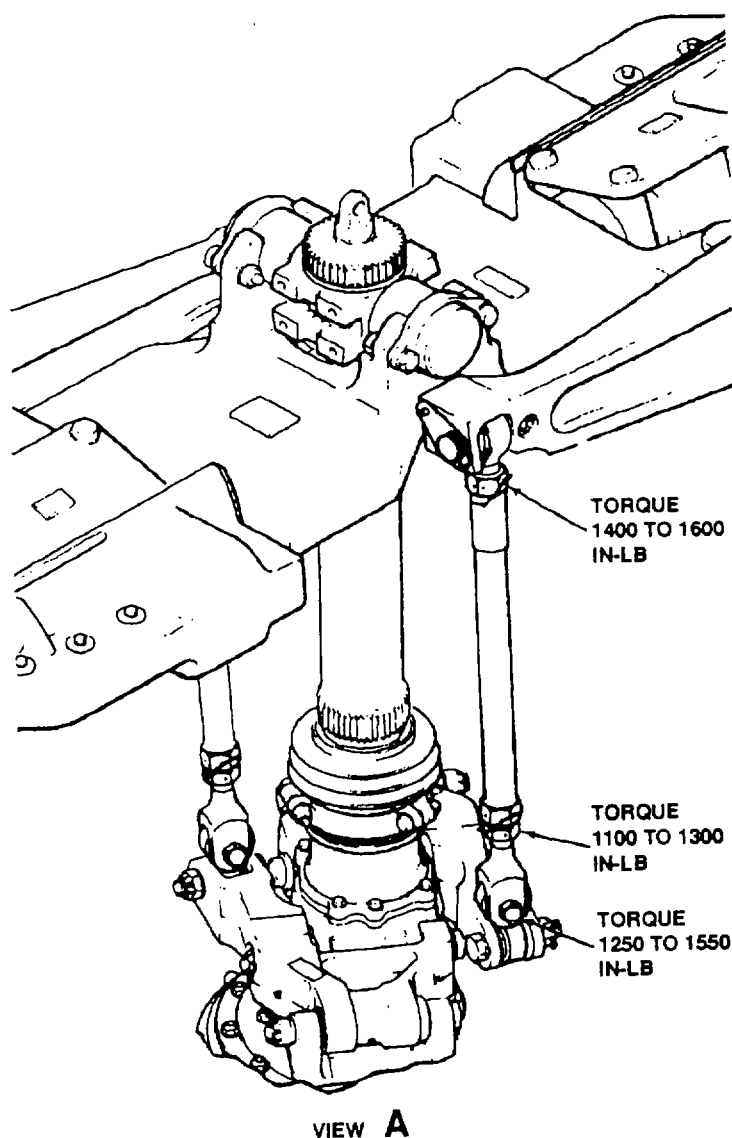
NOTE



Torques shown are applicable prior to incorporation of MWO 55-1520-244-50-9. See View A for torques after incorporation of MWO 55-1520-244-50-9.

209200-84-2A

Figure 5-1A. Main rotor installation torque values (Sheet 1 of 2)



NOTE:

View A applicable after MWO 55-1520-244-50-9 is accomplished.

209200-84-3

Figure 5-1A. Main rotor installation torque values (Sheet 2 of 2)

Perform following procedures as required for acceptable smooth operation of main rotor. Recommended sequence of procedures is also provided in charts. See figures 5-2, 5-3 and 5-4.

CAUTION

Run-up of helicopter shall be performed only by personnel authorized by AR95-1.

NOTE

Designate blades as A and B. Keep a running record of check results and any adjustments.

(1) Coat tracking tips of rotor blades with suitable grease pencils, different colors on each blade, as preparation for use of tracking flag. Set both trim tabs at trail (zero degrees) using gage (T44) and tab bender (T51).

(2) Perform a low speed blade track at 4700 rpm. See figure 5-6. If track is satisfactory, omit step (3) and proceed to step (4).

(3) Prior to accomplishment of MWO 65- 1520-244-50-9 correct a low speed out-of-track condition by shortening pitch link attached to the low blade to roll the blade up. See figure 5-6. Loosen jamnuts and turn barrel to shorten tube. Turn barrel ten flats will change blade track approximately 3/8 inch. Torque 700 inch-pounds and lockwire (C152) nuts. Repeat checks and adjustments until satisfactory.

(3A) After accomplishment of MWO 55-1520-244- 50-9 correct a low speed out of track condition by shortening pitch link attached to the low blade to roll the blade up. See figure 5-6A. Loosen jamnuts and turn entire tube assembly to shorten tube. Turning tube assembly five flats will change blade track approximately 3/8 inch. Torque jamnut closest to rod end bearing 1400 TO 1600 inch-pounds and torque jamnut closest to universal bearing 1100 TO 1300 inch-pounds. Lockwire (C-152) jamnuts. Repeat checks and adjustments until satisfactory.

(4) Perform a high speed track at 6600 rpm. If out-of-track, record which blade is low but make no adjustments.

(5) Test fly helicopter. If vertical vibration is not evident, proceed to step (6). If vertical vibration requires correction, begin sequence of adjustments indicated on figure 5-3 according to airspeed where vibration occurs.

NOTE

After alignment, ensure that all inner threads of the clevis ends are in contact with those of the drag brace and the drag brace is no less than flush with the clevis ends.

(a) When bending blade trim tabs, do not exceed eight degrees up and/or eight degrees down (16 degrees maximum both blades).

(b) To roll a blade: Adjust pitch link as in steps (3) and (3A) above.

(c) To sweep a blade: Loosen jamnuts on blade drag brace (11, figure 5-1) enough to turn barrel one full turn AFT as shown by decal arrows. Torque jamnuts 150 TO 200 foot-pounds without moving barrel. Record all such adjustments, and do not exceed two full turns total adjustment.

NOTE

The blade sweep adjustment is also used to correct lateral vibration. Refer to step (6).

NOTE

If maximum blade sweep adjustment fails to correct rotor vibrations, remove main rotor hub and blade assembly and align blades. Refer to paragraph 5-5.

(d) After each adjustment, test fly helicopter to observe effect. Continue until vertical vibration is reduced to acceptable level.

(6) Test fly helicopter through full airspeed range to check for lateral vibrations. The lateral vibrations are usually more pronounced in hover. If lateral vibration is severe enough to require correction, follow the sequence shown in figure 5-4.

(a) Use two-inch width masking tape (C134) and apply to blade near the tip. When satisfactory operation is obtained, remove the tape and count number of wraps as the tape is removed. Remove hex-head plug from top of blade retaining bolt assembly (22, figure 5-1) on taped blade. For each full wrap of tape, add 2.4 ounces of lead in bolt. Reinstall plug.

(b) Refer to paragraph 5-3, b, (5), (c) for instructions to sweep a blade.

(c) Refer to paragraph 5-6 for grip spacing and paragraph 5-5 for alignment instructions.

(7) Prior to accomplishment of MWO 55-1520-244-50-9 check rotor rpm in autorotation. If rotor overspeeds, shorten both pitch links equally. If rotor underspeeds, lengthen both pitch links equally. One turn of barrels will change rotor rpm approximately 3 percent. Torque 700 inch-pounds and lockwire (C152) jamnuts. Repeat flight check and adjustment as necessary.

(7A) After incorporation of MWO 55-1520- 244-50-9 check rotor rpm in autorotation. If rotor overspeeds, shorten both pitch links equally. If rotor underspeeds, lengthen both pitch links equally. One-half turn of tube assemblies will change rotor rpm approximately 3 percent. Torque jamnut closest to rod end bearing 1400 TO 1600 inch-pounds, and jamnut closest to universal bearing 1100 TO 1300 inch- pounds. Lockwire (C152)jamnuts. Repeat flight check and adjustment as necessary.

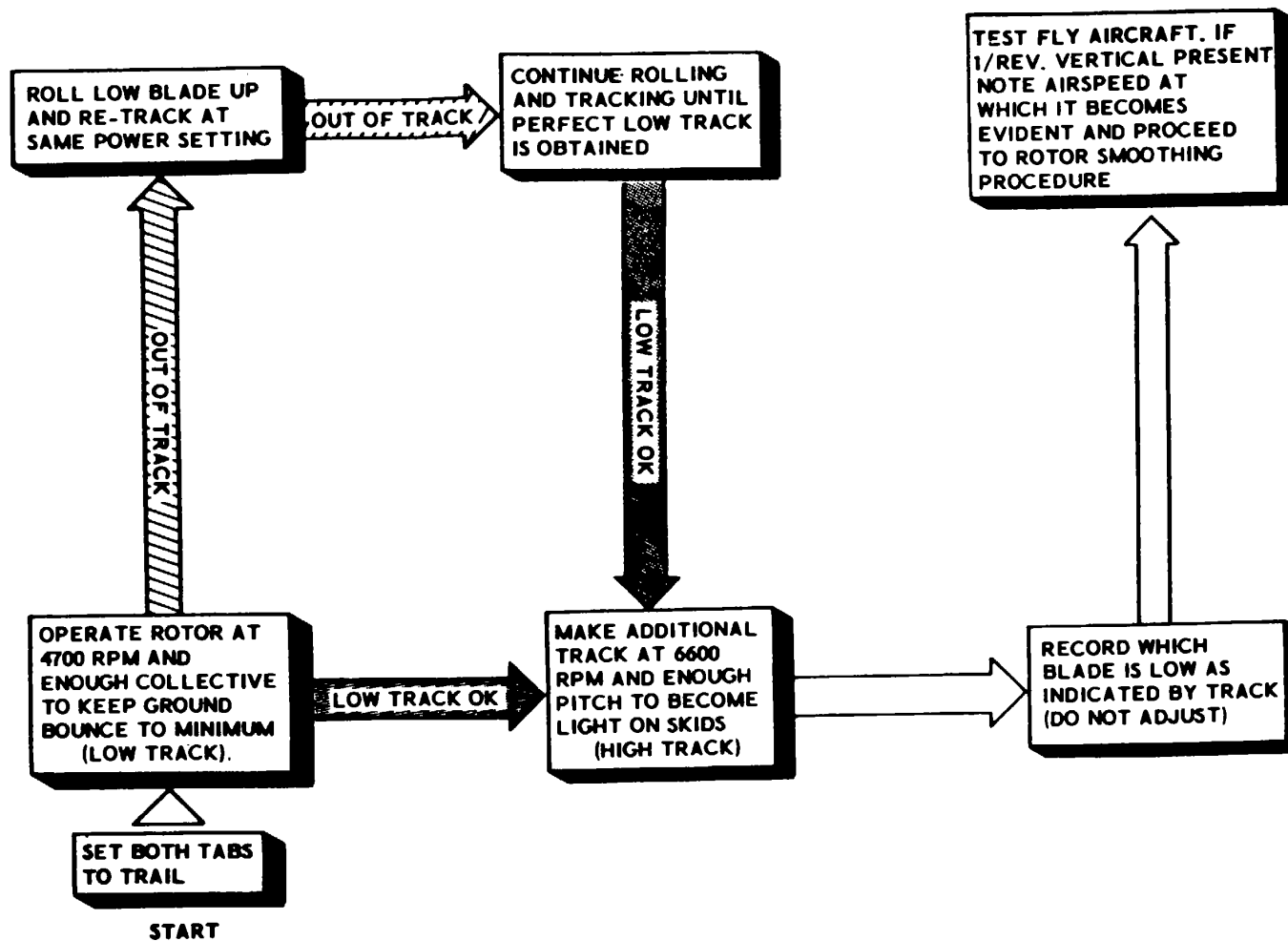
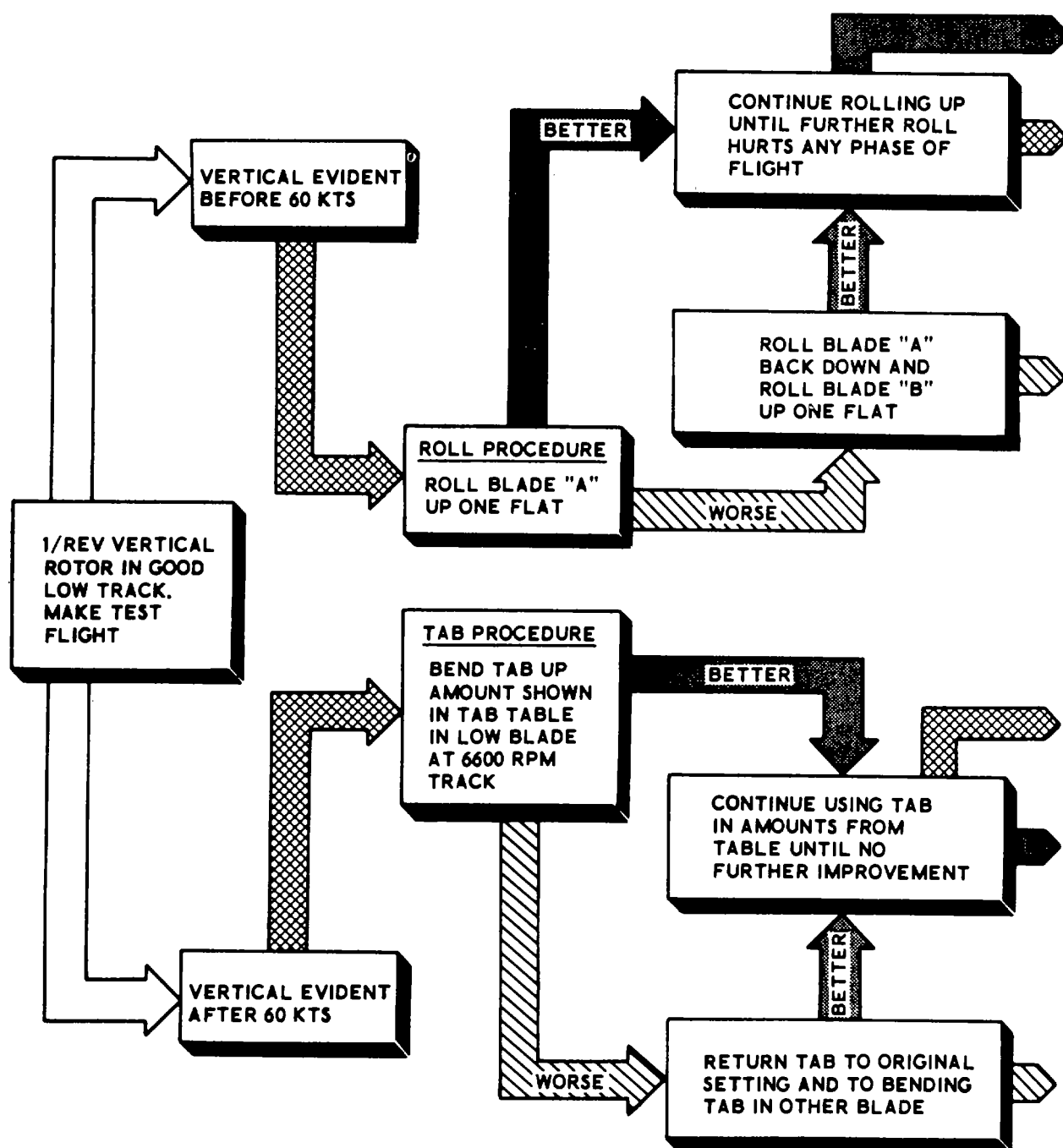
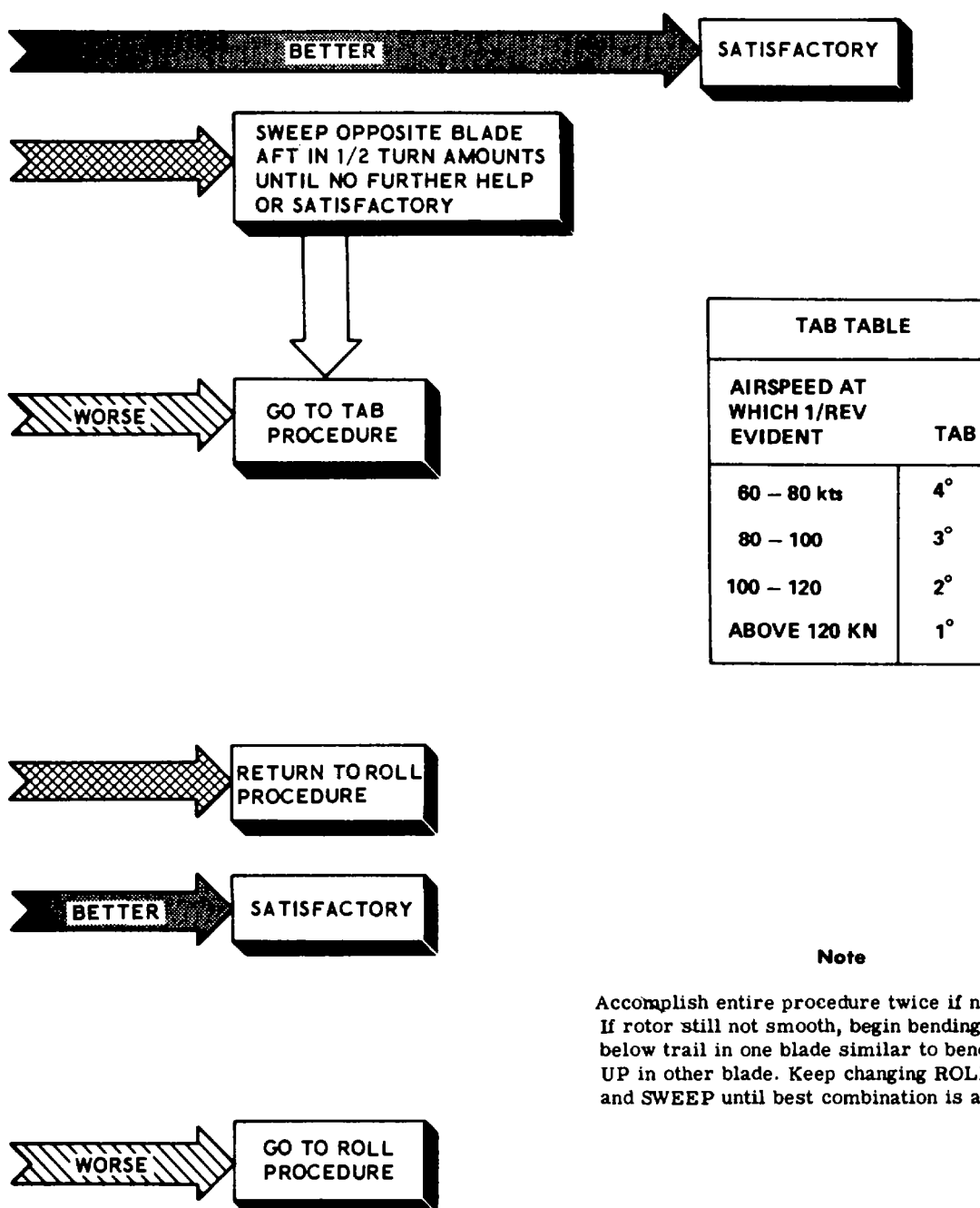


Figure 5-2. Main rotor tracking chart



209200-7-1

Figure 5-3. Vertical vibration correction chart (Sheet 1 of 2)

**Note**

Accomplish entire procedure twice if necessary. If rotor still not smooth, begin bending tab **DOWN** below trail in one blade similar to bending tab **UP** in other blade. Keep changing **ROLL**, **TAB** and **SWEEP** until best combination is achieved.

209200-7-2B

Figure 5-3. Vertical vibration correction chart (Sheet 2 of 2)

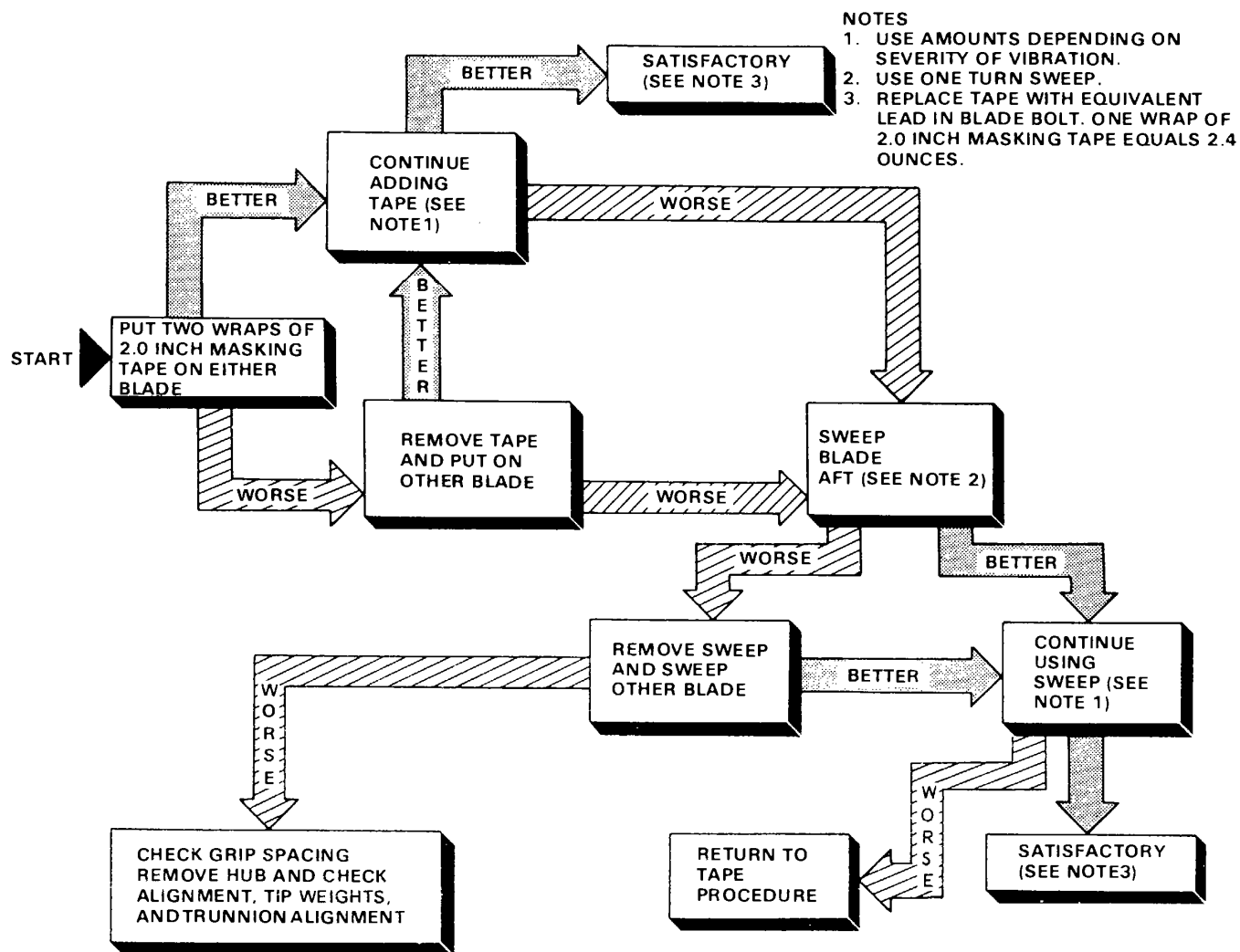
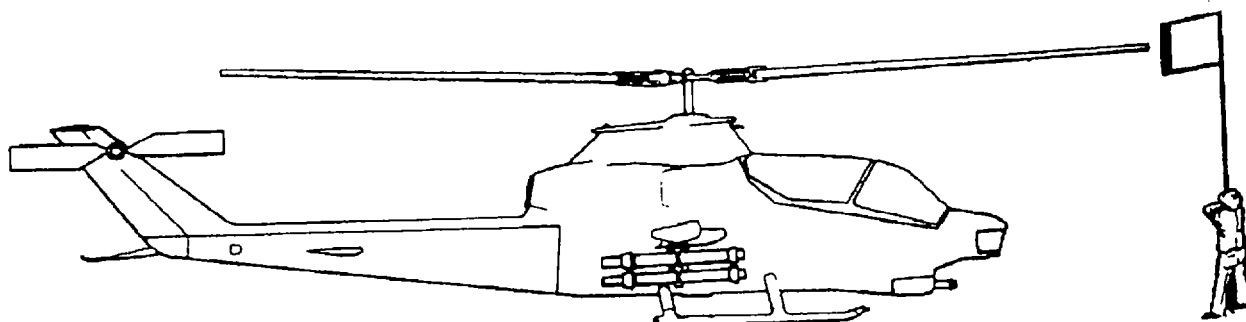
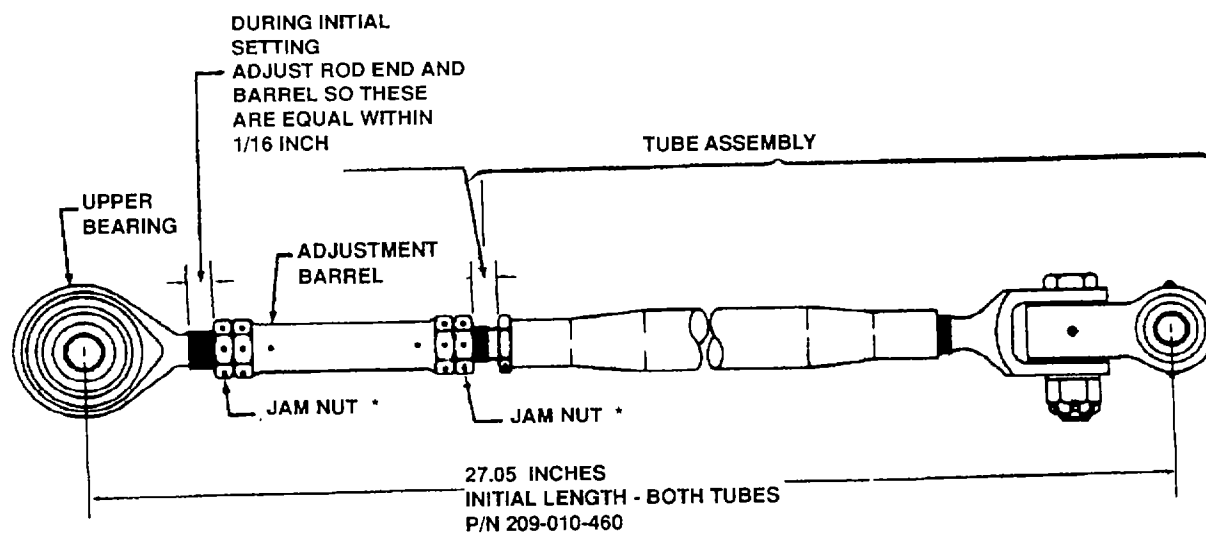


Figure 5-4. Lateral vibration correction chart



209900-478

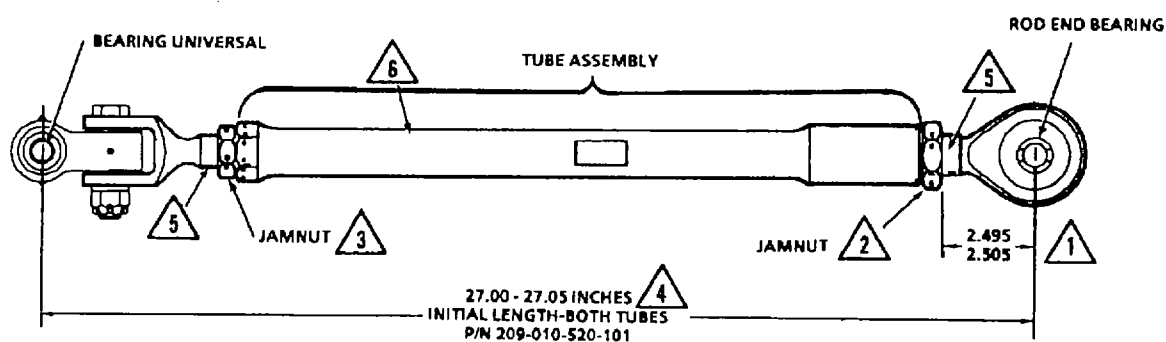
Figure 5-5. Tracking main rotor



* Torque 700 Inch-pounds after upper end is centered in pitch horn.

209200-3D

Figure 5-6. Pitch link adjustment (Prior to accomplishment of MWO 55-1520-244-50-9)



NOTES:

- 1 During initial setting adjust rod end bearing to a dimension of 2.495 to 2.505 inches from center of bolt hole on rod end to top of jamnut.
- 2 Torque 1400 to 1600 inch-pounds after rod end is centered in pitch horn.
- 3 Torque 1100 to 1300 inch-pounds.
- 4 Adjust clevis to a dimension of 27.00 to 27.05 inches between center on rod end bearing to center of bolt on bearing universal.
- 5 During initial setting make adjustments to rod end bearing and clevis so that exposed threads are equal at each end within 0.12 inch.
- 6 Pitch link 209-010-520-101 applicable after MWO-1520-244-50-9 is accomplished.

209010-241

209010-241

Figure 5-6A. Pitch link adjustment (After accomplishment of MWO 55-1520-244-50-9)

c. *Operational Checks- Main Rotor System(K747 Blades)*. Perform following procedures as required for acceptable smooth operation of main rotor. Recommended sequence of procedures is also provided in charts (figures 5-2, 5-3, and 5-6B).

WARNING

Runup of helicopter shall be performed only by personnel authorized by AR 95-1.

K747 main rotor blades have a tendency to attain a higher percent RPM during autorotation, than B540 main rotor blades. DO NOT RIG (adjust length of pitch change links) beyond the limits established in paragraph 5-4b(13) to obtain a lower main rotor percent RPM.

(1) Adjust pitch links (figure 5-10) to accomplish main rotor tracking for K747 blades.

(2) Perform a low speed blade track at 91 percent rpm. track is satisfactory, omit step (3) and proceed to step (4).

(3) Prior to accomplishment of MWO 55-1520-244-50-9 correct a low speed out-of-track condition by shortening pitch link attachment to the low blade to roll the blade up (figure 5-10). Loosen jam-nuts and turn barrel to shorten tube. Turning barrel **three** turns will change blade track approximately 0.375 inch. Tighten and lockwire (C152) nuts. Repeat checks and adjustments until satisfactory.

(3A) After accomplishment of MWO 55-1520-244-50-9 correct a low speed out of track condition by shortening pitch link attached to the low blade to roll the blade up (figure 5-10). Loosen jamnuts and turn entire tube assembly to shorten tube. Turning barrel one and one-half turns will change blade track approximately 0.375 inch. Torque jamnut closest to rod end bearing **1400 TO 1600** inch pounds and torque jamnut closest to universal bearing **1100 TO 1300** inch-pounds. Lockwire jamnuts using lockwire (C-152).

(4) Perform a high speed track at 100 percent rpm. If out-of-track, record which blade is low but make no adjustments.

(5) Test fly helicopter. If vertical vibration is not evident, proceed to step (6). If vertical vibration requires correction, begin sequence of adjustments indicated in figure 5-6B as applicable according to airspeed where vibration occurs.

(a) To roll a blade, adjust pitch link as in step (3) above.

(b) To sweep a blade, loosen jamnuts on blade drag brace (11, figure 5-1) enough to turn barrel one full turn as shown by decal arrows. Torque jam-nuts 150 TO 200 foot pounds without moving barrel. Record all such adjustments, and do not exceed TWO full turns total adjustments.

NOTE

The blade sweep adjustment is also used to correct lateral vibration. Refer to step (6).

If maximum blade sweep adjustment fails to correct rotor vibrations, remove main rotor hub and blade assembly and align blades (paragraphs 5-4a and 5-5h).

(c) After each adjustment, test fly helicopter to observe effect. Continue until vertical vibration is reduced to acceptable level.

NOTE

The amount of lead in blade bolt shall be changed only by AVIM to statically balance uninstalled hub without rotor blades.

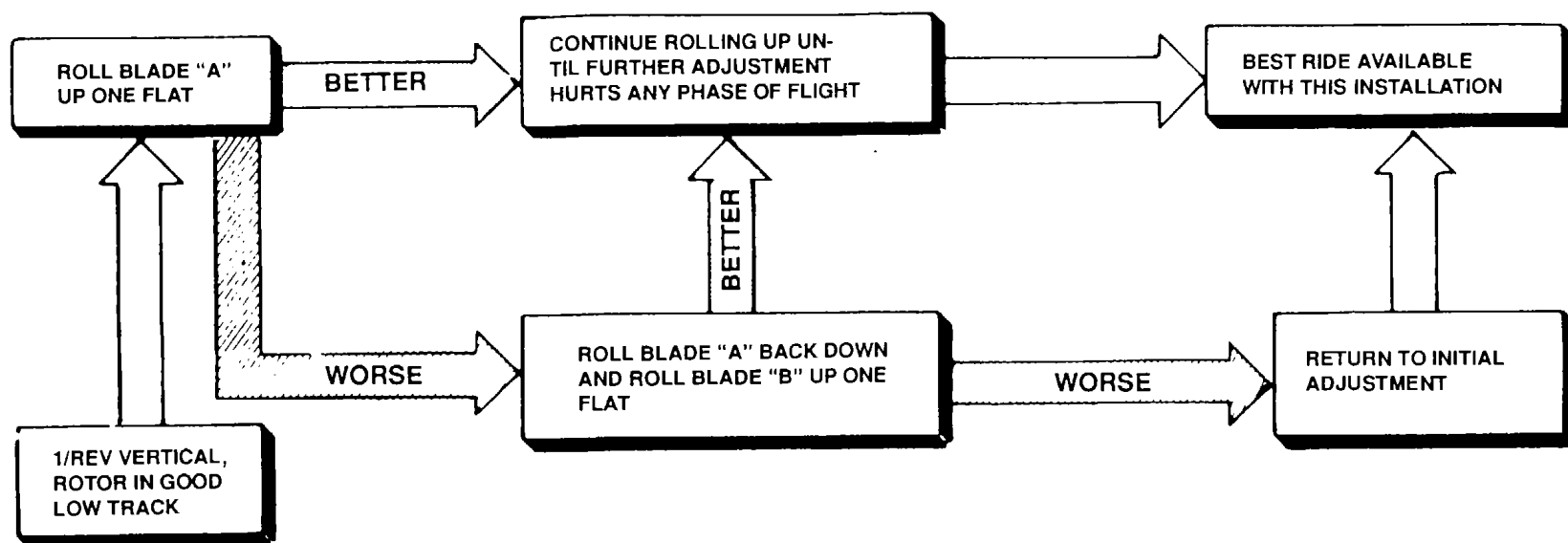
(6) Test fly helicopter through full airspeed range to check for lateral vibrations. If lateral vibration is severe enough to require correction, request AVIM assistance to check alignment of installed blades (sweep).

WARNING

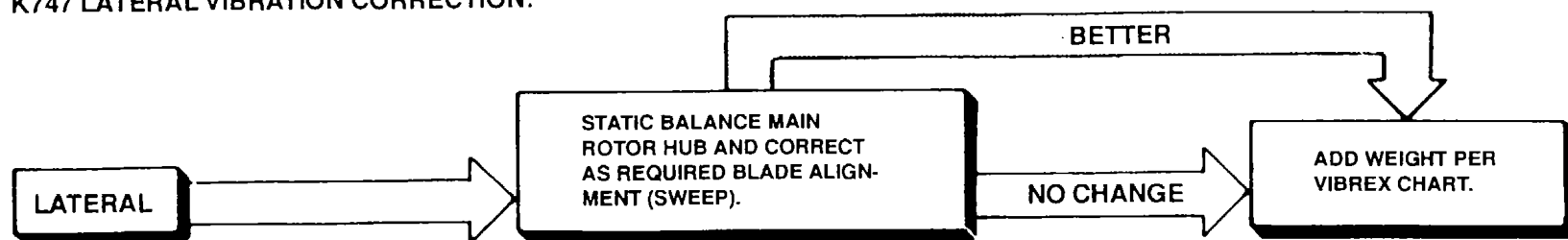
K747 main rotor blades have a tendency to attain a higher percent RPM during autorotation than B540 main rotor blades. DO NOT RIG (adjust length of pitch links) beyond the limits established in paragraph 54b(13) to obtain a lower main rotor percent RPM.

(7) Prior to accomplishment of MWO 55-1520-244-50-9 check rotor rpm in autorotation. If rotor overspeeds, shorten both pitch links equally. If rotor underspeeds, lengthen both pitch links equally. **One turn** of barrels will change rotor rpm approximately 3 percent. Lockwire (C152) jamnuts. Repeat flight check and adjustment as necessary.

(7A) After incorporation of MWO 55-1520-244-50-9 check rotor rpm in autorotation. If rotor overspeeds, shorten both pitch links equally. If rotor underspeeds, lengthen both pitch links equally. **One-half turn** of tube assemblies will change rotor rpm approximately 3 percent. Lockwire (C152) jamnuts. Repeat flight check and adjustment as necessary.



K747 LATERAL VIBRATION CORRECTION:



209747-18

Figure 5-6B. Vertical and lateral vibration chart for K747 rotor blades

5-4. Main Rotor Hub and Blade Assembly

The main rotor hub and blade assembly consists of the main rotor hub assembly and the main rotor blades. See figure 5-1.

Premaintenance Requirements for Main Rotor Hub and Blade Assembly

Condition	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	(T8) (T13) (T14) (T21) (T26) (T34) (T49) (T59)
Test Equipment	NA
Support Equipment	NA
Minimum Personnel Required	2
Consumable Materials	(C51) or (C52) (C136) (C151)
Special Environmental Condition	NA

a. Removal.

(1) Remove bolts (20, figure 5-1) at each pitch horn (17). Secure pitch links (14) to mast to prevent damage to these parts.

(2) Install grip locks (T59) on each pitch horn. See figure 5-7.

(3) Remove bolt (5, figure 5-1) and lock (4).

(4) Install socket (T13) (8, figure 5-8) on mast nut. Position adapter (T14) (9) between stabilizer bar mounts and ensure that it sits level on top of trunnion. Position power wrench (T8) (3) onto adapter (9) and ensure that the through pins on the wrench reaction arm engage the holes in the adapter. Position the 3/4 inch square drive bar (4) into the square drive of the power wrench and turn the ratchet indexer (2) counterclockwise until the drive bar drops into socket (8). Install crank handle (1) and turn in a counterclockwise direction. Observe the indicator on the power wrench as crank handle is turned. When breakaway torque of approximately 650 foot-pounds is reached, the indicator will reverse as the mast nut loosens. Remove the special tools and complete removal of the mast nut manually.

(5) Remove three bolts (6, figure 5-1), sand deflector (7), spacer (8) and spacer (9). Remove opposite sand deflector in the same manner.

(6) Install maintenance hoist (T49) or position other suitable hoist directly over mast. Refer to Chapter 1 for instructions for installation of maintenance

hoist.

(7) Position two slings (T21) on main rotor hub and attach to hoist. Do not wrap lifting sling cable around sharp corners on rotor hub.

(8) Attach a tie down assembly on each rotor blade to use to guide and steady rotor during removal.

(9) Carefully hoist the main rotor hub and blade assembly clear of the mast and remove cone set (12, figure 5-1). Attach cone set halves together and retain as a matched set.

(10) Place adapter plate (T34) on build-up bench (T26) and position hub and blade assembly on the bench. Place padded supports under each blade. See figure 5-17 for view of hub mounted on build-up bench.

(11) Install deflectors that were removed in step (5).

b. Installation.

(1) Install grip locks (T59) on each pitch horn if not previously accomplished. See figure 5-7.

(2) Remove sand deflectors if not previously accomplished. Refer to step (5) in step a above.

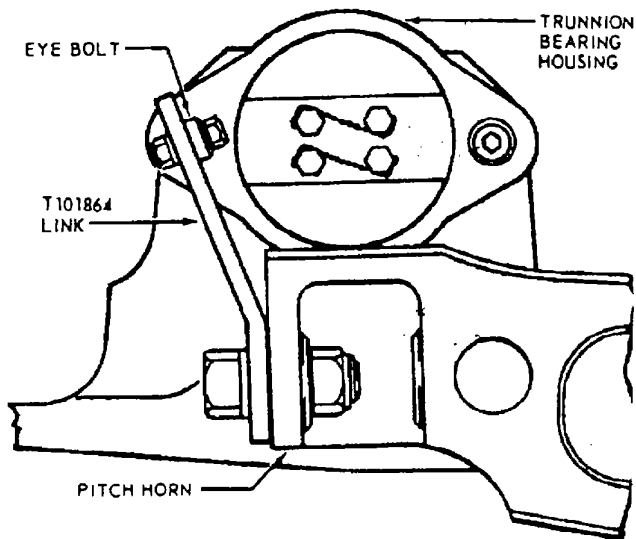
(3) Position two slings (T21) on main rotor hub and attach to hoist. Refer to step (a) above for description of hoist. Do not wrap lifting sling cable around sharp corners on rotor hub. Hoist hub and blade assembly into position above mast. Use blade tie down assemblies to guide and steady the blades during hoisting.

CAUTION

Never apply corrosion preventive compound or any kind of grease on or near teflon bearings. Teflon bearings are used in the hub, the friction collet, and the swashplate and support assembly. This instruction applies regardless of helicopter status; operation, in storage, or in preparation for overseas shipment.

NOTE

Do not coat the mast threads or split cone groove with corrosion preventive compound (C70). Split cones are installed with equal end gap spacing. If the split cones touch at any time after maximum torque is reached, there is no need to respace them.



540011-61B

Figure 5-7. Tool application-grip lock installation on pitch horn

NOTE

Consult TM 55-1500-322-24, pages 13-6 and 13-7, paragraph 13.57 for inspection of teflon lined bearings.

(4) Coat splines of mast (13, figure 5-1) with compound (C52) or compound (C51).

(5) Inspect split cones for any nicks, scratches, indentions and deformities of any type. Dropping the split cone does not constitute automatic replacement unless the damage limits shown in figure 5-9 are exceeded. Place cone set (12, figure 5-1) in groove of mast upper splines with bevel side up and the gaps evenly spaced.

CAUTION

ROTOR HUB MUST BE ALIGNED CAREFULLY TO
AVOID DAMAGING MAST THREADS.

NOTE

Install split cones as matched set only.

(6) Align master spline in hub with master spline on mast. Carefully lower the hub and blade on the mast splines to avoid damage to mast threads. Lower the hub assembly slowly until it rests on the cone set.

(7) Remove excess corrosion preventive compound with clean cloths.

NOTE

Before installing retaining nut, be sure cap plug is installed in mast.

(8) Remove hoisting slings. Install washer (2, figure 5-1) and mast nut (3). Tighten mast nut snug with socket wrench. Install main rotor mast nut special installation tools in same manner described in paragraph a. Turn input crank handle (1, figure 5-8) in a clockwise direction and observe indicator on power wrench. Torque to **650** foot-pounds. Continue to observe the indicator for three full minutes. It will be normal if the indicator reading decreases. This is caused by the cone set setting. Do not back-off torque if the indicator reading decreases.

(9) If the indicator reading decreases during the three minute observation period in the preceding step, re-torque to **650** foot-pounds and monitor for one minute. Repeat one additional time if necessary. After obtaining 650 foot-pound indication with no loss, turn the crank counterclockwise until the torque indicator returns to zero (green) to remove holding force on the wrench.

(10) Remove input handle, power wrench, drive bar, adapter and socket. Check cone set (12, figure 5-1) for even gap. Check lock (4) installation to ensure that it will align. If lock (4) will not align, reinstall the power wrench and increase torque, but do not exceed 780 foot-pounds. Use the protractor on the face of the power wrench (3, figure 5-8) to estimate the degree of turn required to obtain alignment.

(11) Install lock (4, figure 5-1) and bolt (5).
Lockwire bolt head.

(12) Remove locks (T59) from pitch horns. Remove eye bolts shown on figure 5-7 and replace with trunnion bearing retaining bolts. Torque nuts **160 TO 190** inch-pounds. If more than five threads show at nut, add a washer under the nut.

CAUTION

Close-tolerance, high-tensile bolts and special washers are used in the main rotor flight control linkage. Refer to TM 55-1520-234-23P for part numbers.

NOTE

If same rotor and associated parts are being reinstalled, the pitch links (14, figure 5-1) should already be installed on the scissors and it will not be necessary to adjust pitch links to nominal length. Skip step (a) and (b) and install pitch links per steps (c) through (f).

(13) Install pitch links (14). If previously removed, install universal bearing (23) on pitch link (14) with bolt (24) installed through clevis of pitch link (14) and universal bearing (23). Then install washer (25) and nut (26). Prior to accomplishment of MWO 55-1520-

244-50-9 torque nuts (26) **800 TO 1000** inch- pounds and install cotter pin (27). After accomplishment of MWO 55-1520-244-50-9 torque nuts (26) **1250 TO 1550** inch-pounds and install cotter pin (27). Repeat for other pitch link.

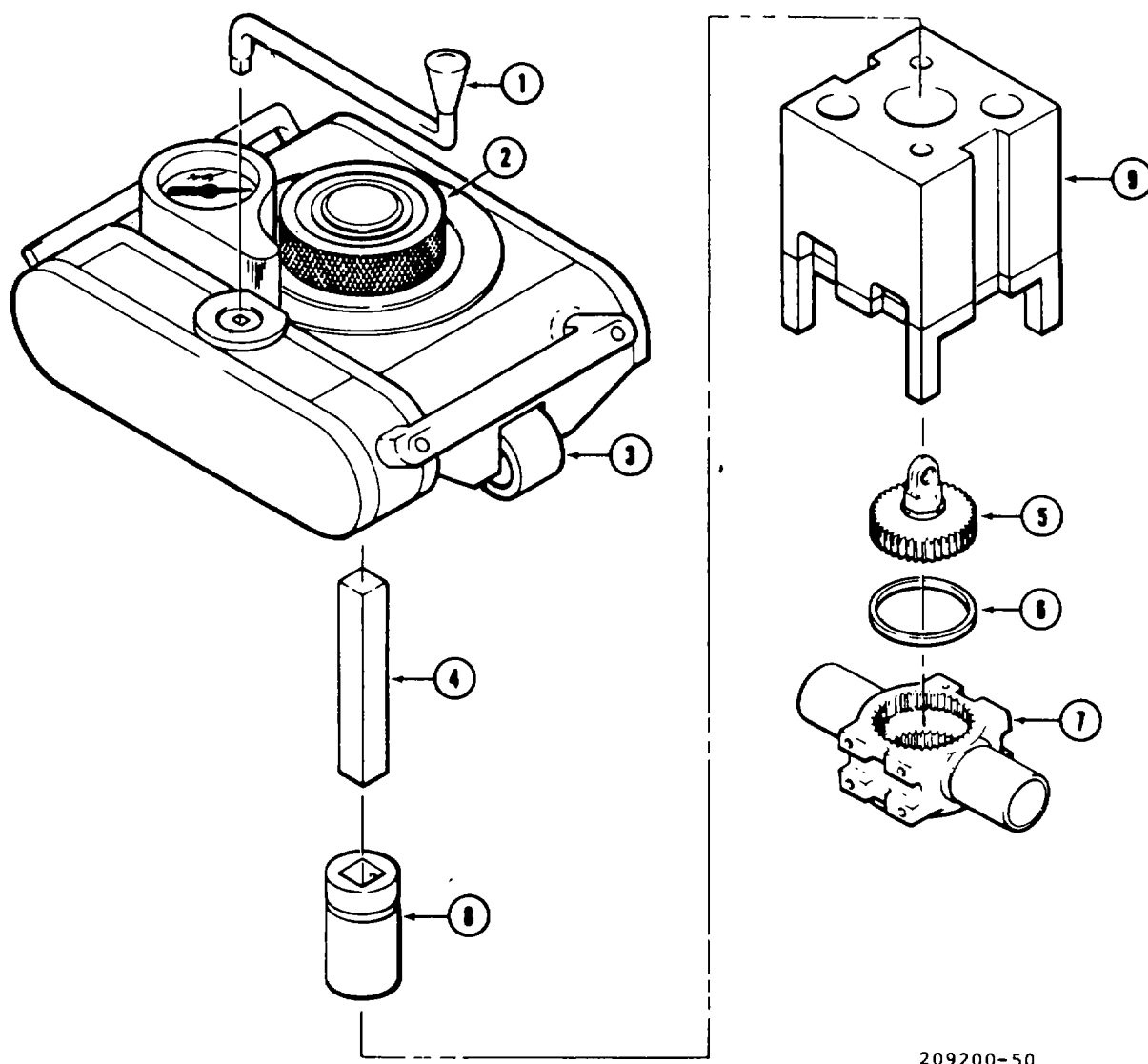
NOTE

Use only new unused nut referenced for installation in step (13).

(a) Measure both pitch links and if necessary adjust length as shown on figures 5-6 and 5-6A. Also comply with the equal thread requirement shown on these figures. Prior to accomplishment of MWO 55-1520-244-50-9 tighten jamnut nuts at each end of barrel snug but do not torque at this time. After accomplishment of MWO 55-1520-244-50-9 tighten jamnuts at each end of tube assembly finger tight.

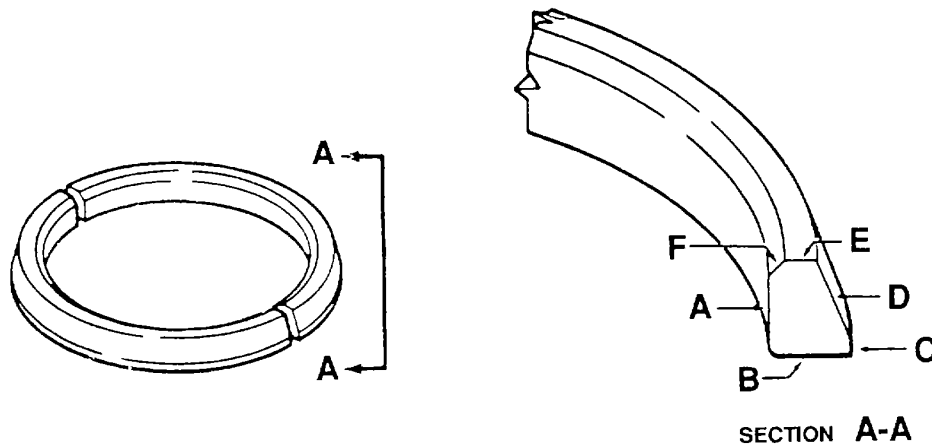
NOTE

The adhesive bond can be broken when the adjustment barrel jam nuts are loosened and torqued without using a back-up wrench on the adjustment barrel wrench flats.



1. Input crank handle
2. Knurled ratched indexer
3. Power wrench PD1201
4. Drive bar
5. Retaining nut
6. Washer
7. Trunnion
8. Socket PD2659
9. Reaction torque adapter PD2660

Figure 5-8. Tool application - main rotor mast nut removal/installation



1. Damage to surfaces A, C, E and F may be considered negligible and not requiring repair if the depth of damage does not exceed 0.010 inch and if the minimum radii observed in the damage area are not less than 0.025 inch.
2. Damage to surface B requires replacement of cone set.
3. Surfaces A and D must not have any protrusions above the surrounding surface. Dents, corrosion, and scratches not in excess of 0.010 inch in depth may be polished out with crocus cloth (C45).
4. All edges may be chamfered 0.030 inch.

Figure 5-9. Corrosion and damage limits-split cones

CAUTION

Do not reuse nuts P/N MS17825.

(b) Before installing pitch change link check clevis end of scissor (16) in bushing bore. If recess between bushing end and clevis outer surface exceeds **0.004** inch a shim is required, refer to paragraph 5-7.e. (6)(g). Prior to accomplishment of MWO 55-1520-244-50-9, install pitch link (14, figure 5-1) on scissors (16) if not previously accomplished. The universal end of the connecting tubes (pitch links) is the end that attaches to the pitch links. Install recessed washer (29) on shear bolt (28) and install shear bolt. Install recessed washer (30) and nut (31). Repeat procedure to install opposite pitch link (14). Torque nut of upper bearing bolt **1250 TO 1550** inch-pounds. Torque nuts on shear bolt (28) **800 TO 1000** inch-pounds and install cotter pins.

NOTE

During installation of pitch link universal bearing, assure that the bolts are installed and torqued correctly. The upper bolt (24) will be installed with the bolt head inboard (towards

mast). The lower bolt (28) will be installed with the bolt head toward opposite scissors link.

WARNING

Ensure that the self locking feature of barrel nut (18, fig. 5-1) has adequate tare torque, minimum of 32 inch-pounds.

Ensure that the correct recessed washer (19) is being used and that the recess is turned toward the bolt head.

Ensure that the safety wire is installed correctly.

Bushing assembly, P/N 209-010-523-107 is required in modified pitch horn assembly, P/N 209-010-109-109 to properly install old pitch link assembly, P/N 209-010-523-107 is not used in modified pitch horn assembly, P/N 209-010-109-109 to install new pitch link assembly, P/N 209-010-520-103.

NOTE

Bolt (20) may not extend past barrel nut (18) the necessary minimum three threads. As long as the end of the bolt is visible and flush with the aft side of barrel nut and proper torque has been accomplished, this is an acceptable condition.

(c) Prior to accomplishment of MWO 55-1520-244-50-9, install barrel nut (18, figure 5-1) if not previously accomplished, in pitch horn (17). Prior to installing pitch link insert bolt (20), check and record tare torque (friction torque). Tare torque must be a minimum of 32 inch-pounds. If tare torque is below limits replace barrel nut (18) and recheck.

(d) Prior to accomplishment of MWO 55-1520-244-50-9, remove bolt (20) and install barrel end of pitch link (14) to pitch horn (17). Install recessed washer (19) with recess toward bolt head) and install bolt (20). Torque bolt (20) 1250 TO 1550 inch-pounds above the tare torque previously recorded. For example: If tare torque was **100** inch pounds you would torque the bolt **1350 TO 1650** inch-pounds. Lockwire (C151) bolt (20) to hole in pitch horn (17). Repeat the procedure for the opposite side.

WARNING

Ensure that the self locking feature of barrel nut (18) has adequate tare torque, minimum of 32 inch-pounds.

Ensure that the correct recessed washer (19) is being used and that the recess is turned toward the bolt head.

Ensure that the lockwire is installed correctly.

NOTE

Bolt (20) may not extend past barrel nut (18) the necessary minimum three threads. As long as the end of the bolt is visible and flush with the aft side of barrel nut and proper torque has been accomplished, this is an acceptable condition.

(e) After accomplishment of MWO 55-1520-244-50-9, install barrel nut (18) if not previously accomplished, in pitch horn (17). Prior to installing pitch link insert bolt (20), check and record tare torque

(friction torque). Tare torque must be a minimum of 32 inch-pounds. If tare torque is below limits replace barrel nut (18) and recheck.

CAUTION

Assure tangs on bushing assembly (19A, Figure 5-1), are engaged into slots on upper rod end of pitch link (14).

(f) After accomplishment of MWO 55-1520-244-50-9, remove bolt (20) and install barrel end of pitch link (14) to pitch horn (17). Install bushing assembly (19A) on pitch horn (17) and install bolt (20). Torque bolt (20) **1250 TO 1550** inch pounds above the tare torque previously recorded. For example: If tare torque was **100** inch-pounds you would torque the bolt **1350 TO 1650** inch-pounds. Lockwire (C151) bolt (20) to hole in bushing (19A). Repeat the procedure to install opposite pitch link (14).

CAUTION

Do not reuse nut MS17825.

NOTE

During installation of pitch links (14) assure bolts (24 and 28) are installed and torqued correctly. The upper bolt (24) will be installed with the bolt head inboard (towards mast). The lower bolt (28) will be installed with the bolt head toward opposite scissors link.

(g) After accomplishment of MWO 55-1520-244-50-9, install pitch link (14) on scissors and sleeve assembly (16) if not previously accomplished. The universal bearing end of the connecting tube (pitch link) is the end that attaches to the pitch link. Install recessed washer (29) on shear bolt (28) and install shear bolt. Install recessed washer (30) and nut (31). Torque nuts on shear bolts (28) **800 TO 1000** inch-pounds and install cotter pins.

(h) B540. Adjust length of pitch links to set main rotor blades to a minimum pitch angle of **8 1/4** degrees (plus or minus **1/4** degree) as follows:

1 Position collective controls to full down position and center cyclic stick.

2 Place a protractor on machined surface of one blade grip near blade retention bolt and measure pitch angle. Record reading and repeat for opposite blade. The total reading for both blades should be **17** degrees ($\pm 1/2$ degree). If pitch angle is not within limits, adjust both pitch links in same direction and in equal amounts until blade pitch angle is within limits.

WARNING

Additional pitch link adjustment may be required at time of maintenance test flight. It is not necessary to maintain exposed threads equal within **1/6** inch after initial adjustment, but threads must show in barrel inspection holes.

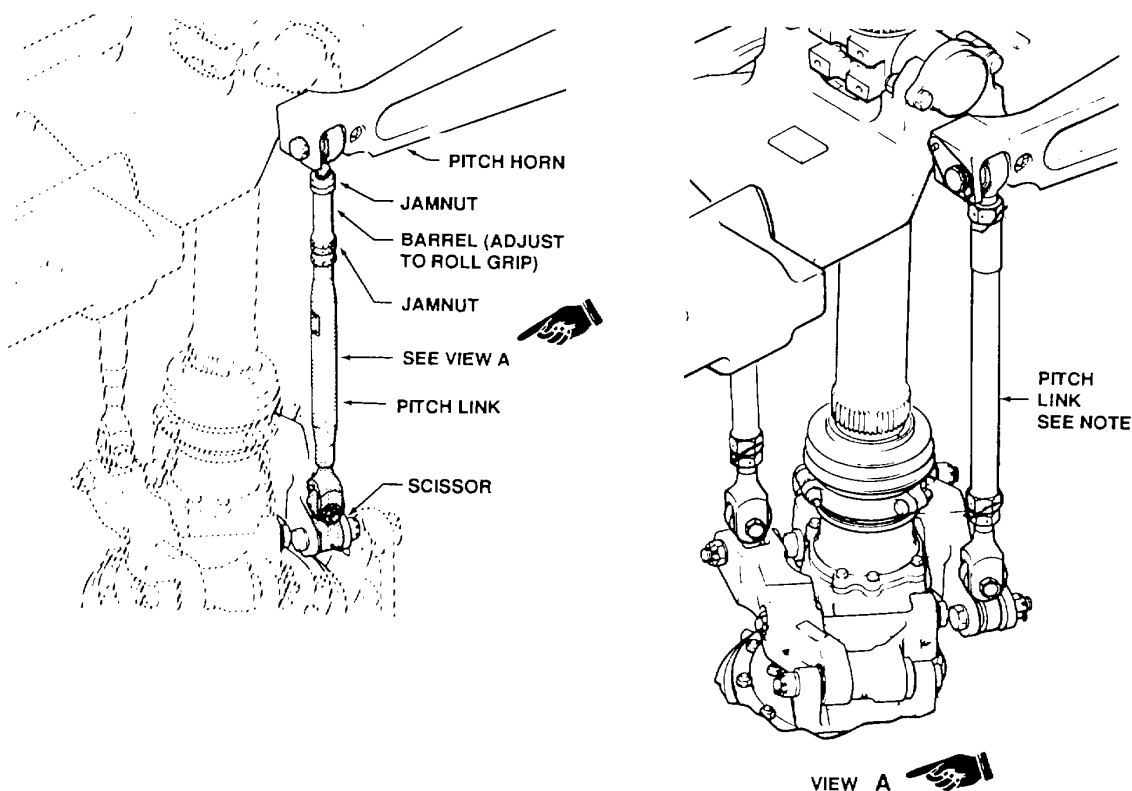
3 Prior to accomplishment of MWO 55-1520-244-50-9 check rod end bearings on both pitch links to ensure that both are centered (figures 5-6 and 5-10). Adjust upper rod end bearing to obtain alignment if necessary. After alignment is correct, torque both jamnuts on barrel **700** inch-pounds.

Lockwire (C152) upper jamnut to barrel. Lockwire (C152) barrel and lower jamnut to pitch link tube.

WARNING

After accomplishment of MWO 55-1520- 244-50-9 additional pitch link adjustment may be required at time of maintenance test flight. It is not necessary to maintain exposed threads equal within **0.12** inch after initial adjustment, however exposed threads shall not exceed **1.00** inch per end.

3A After accomplishment of MWO 55-1520-244-50-9 check rod end bearings on both pitch links to ensure that both are centered (figures 5-6A and 5-10). Adjust upper rod end bearing to obtain alignment if necessary. After alignment is correct, torque upper jamnut **1400 TO 1600** inch-pounds and lower jamnut **1100 TO 1300** inch-pounds. Lockwire (C152)jamnuts to tube assembly.



NOTE: View A applicable after accomplishment of MWO 55-1520-244-50-9.

Figure 5-10. Pitch link assembly

4 Lubricate lower bearing on pitch links (14, figure 5-1). (See figure 1-2.)

5 Ensure that sand deflectors (7, figure 5-1) have the same part numbers, including dash numbers, and install with spacers (8 and 9). If spacers are not a snug fit in sand deflector, wrap with tape (C135).

6 Perform maintenance test flight to ensure that main rotor rigging is satisfactory.

(i) K747. Adjust length of pitch links to set main rotor hub grips to a minimum pitch angle of $9\frac{3}{4}$ degrees ($\pm 1/2$ degree) as follows:

1 Position collective controls to full down position. Set cyclic to center position.

2 Place a protractor on machined surface of one blade grip near blade retention bolt and measure angle. Record reading and repeat for opposite grip.

The total reading for both blades should be $19\frac{1}{2}$ degrees (± 1 degree). If angle is not within limits, adjust both pitch links in same direction and in equal amounts until angle is within limits.

WARNING

Additional pitch link adjustment may be required at time of maintenance test flight. It is not necessary to maintain exposed threads equal within **0.060** inch after initial adjustment, but threads shall show in barrel inspection holes.

3 Prior to accomplishment of MWO 55-1520-244-50-9 check rod end bearings on both pitch links to ensure that both are centered (figures 5-6 and 5-10). Adjust upper rod end bearing to obtain alignment if necessary. After alignment is correct, torque both jamnuts on barrel **700** inch-pounds. Lockwire (C152) upper jamnut to barrel. Lockwire (C152) barrel and lower jamnut to pitch link tube.

WARNING

After accomplishment of MWO 55-1520-244-50-9 additional pitch link adjustment may be required at time of maintenance test flight. It is not necessary to maintain exposed threads equal within 0.12 inch after initial adjustment, however exposed threads shall not exceed 1.00 inch per end.

CAUTION

Assure tangs on bushing assembly (19A, Figure 5-1) are engaged into slots on upper rod end of pitch link (14).

3A After accomplishment of MWO 55-1520-244-50-9 check rod end bearings of both pitch links to ensure that both are centered (figures 5-6A and 5-10). Adjust upper rod end bearing to obtain alignment if necessary. After alignment is correct, torque upper jamnut **1400 TO 1600** inch- pounds and lower jamnut **1100 TO 1300** inch- pounds. Lockwire (C152) jamnuts to tube assembly.

4 Lubricate lower bearing on pitch links (14, figure 5-1) with grease (C70).

WARNING

K747 main rotor blades have a tendency to attain a higher percent RPM during autorotation than B540 main rotor blades. DO NOT RIG beyond the limits established in paragraph 5-4b (13) to obtain a lower main rotor percent RPM.

5 Perform maintenance test flight to ensure that main rotor rigging is satisfactory.

6 If the maintenance test flight indicates the need for rotor adjustment, recheck blade alignment with blades on helicopter. Using alignment scope (T30), make required adjustments. (Maximum tolerance of alignment between two blades is 0.050 inch.)

5-5. Main Rotor Blade Assembly.

The main rotor blades are metal, bonded assemblies.

Each blade is attached in the hub with a retaining bolt assembly and is held in alignment by adjustable drag braces.

Premaintenance requirements for main rotor blades.

Condition	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	(T26) (T31) (T34) (T44) (T59)
Test Equipment	NA
Support Equipment	Work aid for removal of blade retaining bolt
Minimum Personnel	Four
Consumable	(C3) (C7) (C11) (C12) (C17) (C23) (C24) (C30) (C37) (C39) (C41) (C44) (C67) (C76) (C77) (C87) (C88) (C91) (C10000) (C102) (C112) (C113) (C124) (C127) (C136) (C134A) (C149)
Materials	
Special Environmental Conditions	NA

a. Removal.

(1) Position main rotor hub and blade assembly on build-up bench. Refer to paragraph 5-4. Place padded supports under blades so that leading edge is approximately straight.

(2) Remove nut(11, figure 5-11) and bolt (14). Loosen nut (21) and swing drag brace (15) away from rotor blade. Retain shims (10) for reinstallation.

(3) Remove locking screw (20, figure 5-11).

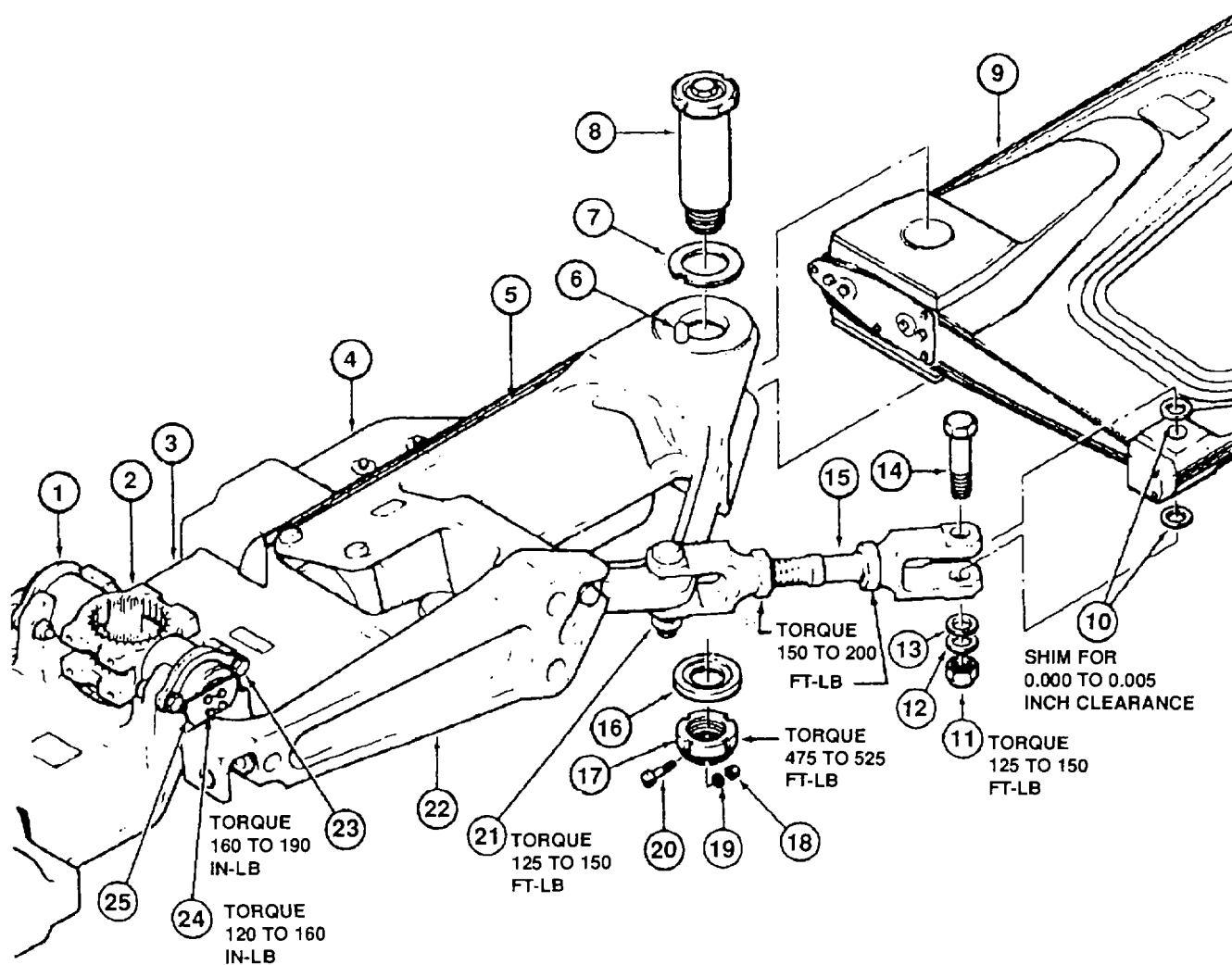
(4) Remove nut (17, figure 5-11) with socket wrench (T31).

CAUTION

Avoid blade contact with the drag brace during removal procedure to prevent possible blade damage.

(5) Remove blade retaining bolt (8, figure 5-11). Slowly raise and lower blade tip while tapping bolt with fiber mallet. If bolt is difficult to remove, use a bolt removal work aid similar to the one shown on figure 5-12. Remove blade retaining bolt as follows.

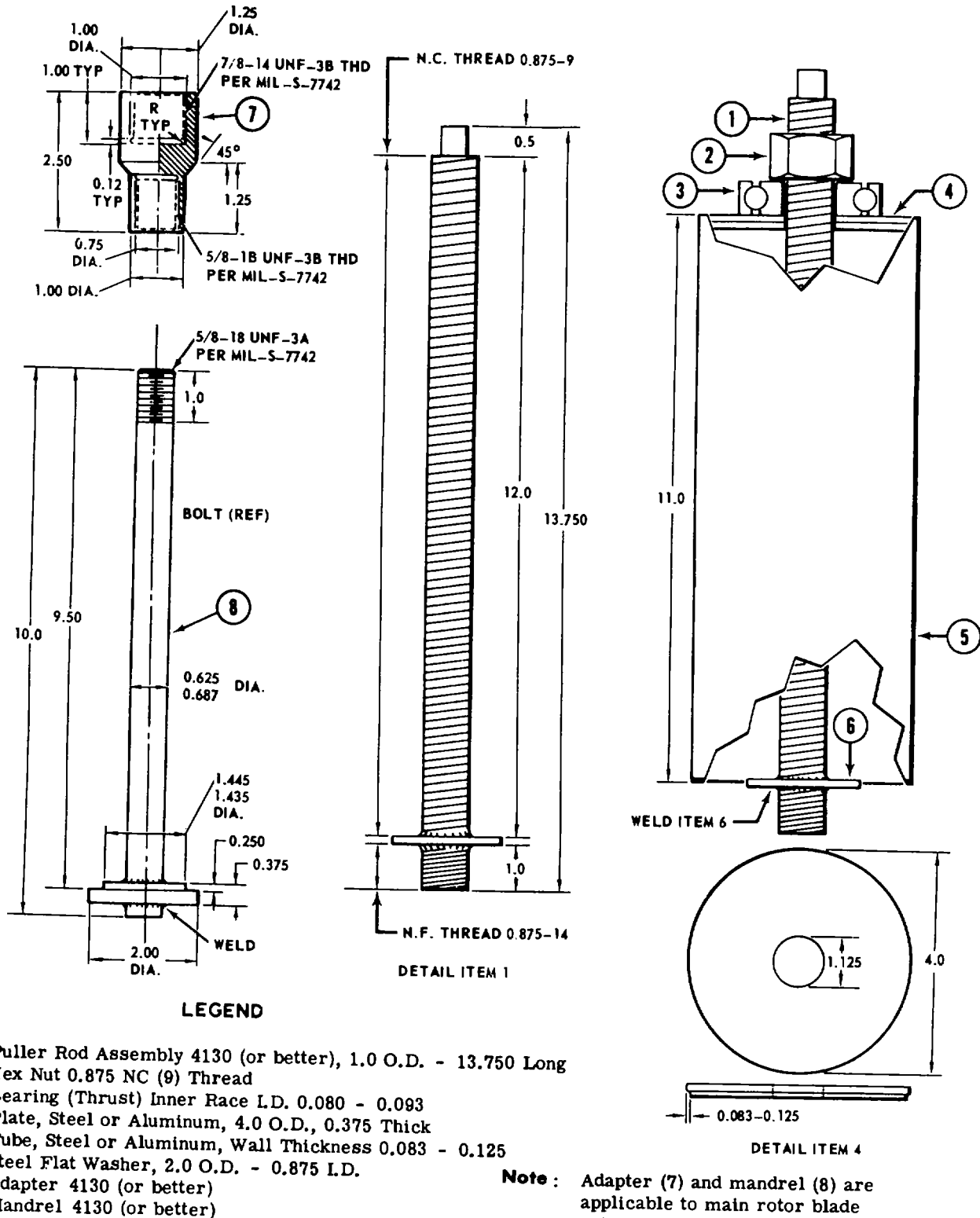
(a) Remove threaded plugs from upper and lower ends of blade retaining bolt. If weights are present in bolt, retain for reinstallation.



1. Elastomeric Bearing	14. Bolt
2. Trunnion	15. Drag Brace
3. Yoke	16. Washer
4. Sand Deflector	17. Nut
5. Grip	18. Nut
6. Locating Pin	19. Washer
7. Washer	20. Screw
8. Blade Retaining Bolt	21. Nut
9. Main Rotor Blade	22. Pitch Horn
10. Shims	23. Bolt
11. Nut	24. Bolts
12. Washer	25. Retainer
13. Washer	

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Figure 5-11. Main rotor hub and blade assembly



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Figure 5-12. Work aid for main rotor blade bolt removal - fabrication instructions (AVIM)

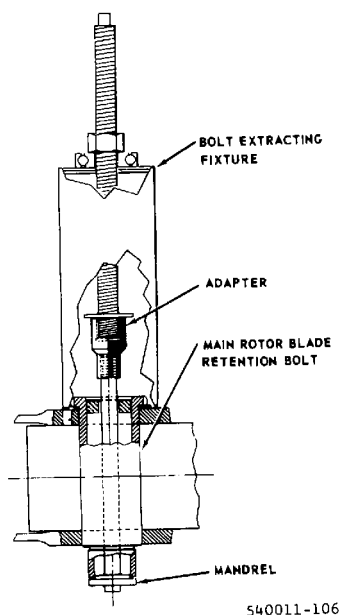


Figure 5-13. Work aid application - removal of main rotor blade retaining bolt

(b) Position work aid on bolt as shown on figure 5-13 and also place a piece of hard rubber or similar material between work aid tube and grip to prevent marring the grip. Hold puller rod (1, figure 5-12) and tighten nut (2) to remove blade retaining bolt.

(c) Remove work aid from blade retaining bolt. Reinstall weight and plugs in blade retaining bolt and identify the blade retaining bolt for reinstallation in the same grip.

(6) Remove blade from grip and place in a padded stand.

(7) Remove opposite blade from hub in same manner.

b. Cleaning.

(1) Clean main rotor blade with cleaning compound (C41).

WARNING

Cleaning solvent is flammable and toxic. Provide

adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

(2) Remove stubborn deposits with a cloth dampened with solvent (C124).

c. Inspection.

(1) Inspect blade historical records and the blade for evidence that the blade has been subjected to an accident or incident outside the realm of normal usage. If such evidence exists, perform Special Inspections outlined in Chapter 1.

(2) Inspect blade for nick, scratch, dent and erosion damage. See figure 5-14.

(a) Nicks and scratches anywhere on the surface of the skins or trailing edge strip that do not exceed **0.008** inch in depth are acceptable if they are polished out.

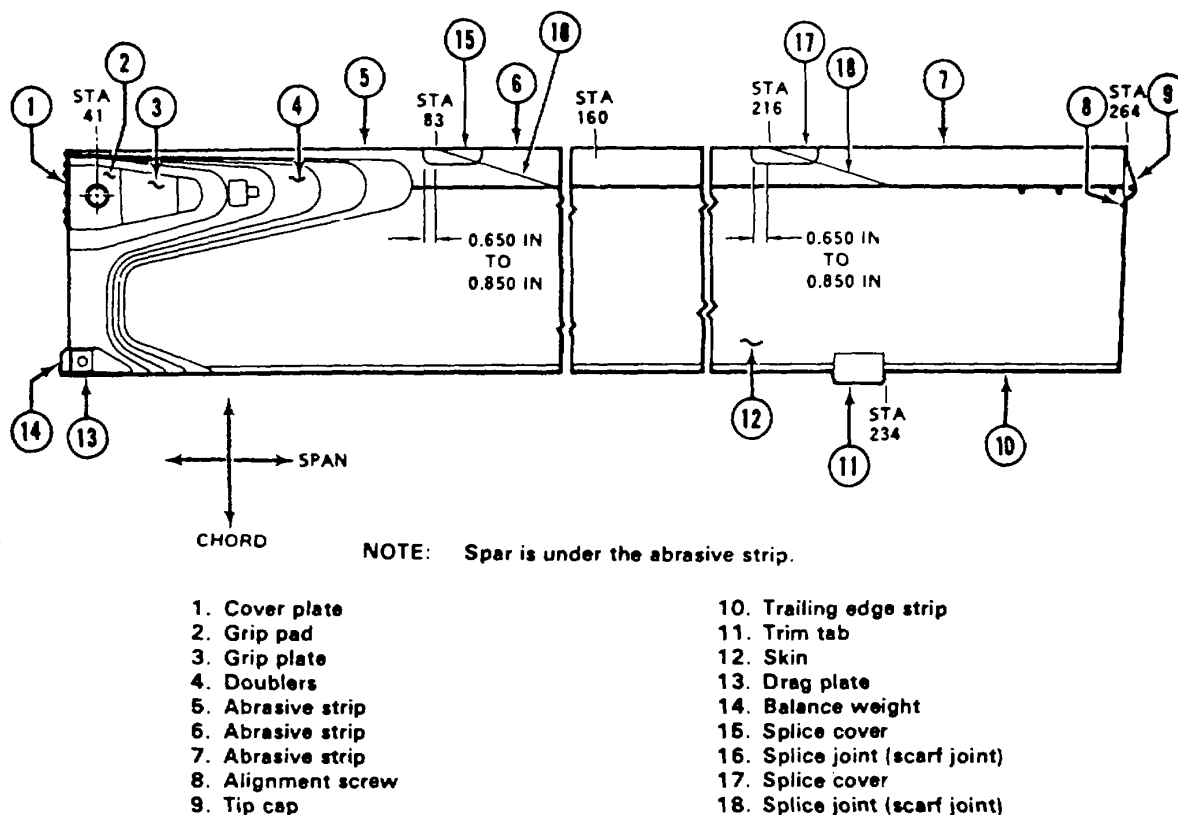
NOTE

If a nick or scratch in the skin in excess of **0.008** inch depth can be polished smooth without leaving the skin in the polished area so thin that skin can be dented with fingernail pressure, a patch may be applied over the area. Refer to paragraph e. for instructions to apply patch to this type damage.

(b) Dents in the trailing edge strip that are between **0.020** and **0.040** inch deep are reparable by working the metal with a plastic mallet. Nicks and notches in the extreme trailing edge of the blade that are between **0.040** and **0.120** inch in depth are acceptable if they are polished and faired out over a minimum distance of **2** inches on each side of the nick or notch.

(c) Any dent in the skin in the outboard four feet of the blade that does not tear the skin, produce a void detectable by tapping with a coin, or affect flight characteristics, is acceptable without repair.

(d) Dents in the skin inboard of the station located four feet inboard of the tip of the blade that do not exceed **0.060** inch are acceptable without repair.



540011-9C

Figure 5-14. Main rotor blade

(e) If a nick or scratch exists in a sharp dent in the skin, the total depth of both *must* not exceed **0.060** inch if scratch or nick does not exceed **0.010** inch. Nicks and scratches must be polished out. Refer to step (a).

(f) Nicks or scratches in the abrasive strips, doublers, grip plates or drag plates that are not in excess of **0.012** inch in depth are acceptable if they are polished out.

(g) If a leading edge abrasive strip is worn, eroded or damaged so that any holes appear, the blade must be sent to an overhaul facility for repair.

NOTE

Main rotor blade abrasive strip splice joints (16 and 18, figure 5-14) may have no covers, may be covered with polyurethane tape, or may have splice covers (15 and 17 installed).

(h) Inspect scarf joints at leading

edge stations 83 and 216 for loss of filler material and corrosion. Filler material will be replaced at depot level of maintenance.

(i) Application of scarf joint protection tape. Polyurethane tape bonded in place over the scarf joint is recommended for dusty (sandy) environments as protection for the scarf joint filler material. Apply as follows:

1 Clean leading edge with aliphatic in aphtha (C88).

2 Cut a piece of tape (C154) seven inches long.

3 Center the piece of tape over the scarf joint. Press in place.

4 Replace tape when worn or as required.

(j) If no covers are installed on splice joints (16 and 18), inspect for loss of filler material and for corrosion. Replace filler material at next higher level of maintenance.

(3) Inspect blade for void damage.

NOTE

A void is defined as an unbonded area that is supposed to be bonded. Many sub-definitions of voids are often given such as lack of adhesive, gas pocket, misfit, etc. This manual makes no distinction among these, but groups them in the one general term of "Void." All dimensions are in inches.

(a) Voids between the spar assembly and the adhesive strip outboard of station 100:00.

1 1.0 inch wide maximum void between abrasive strip and spar at extreme leading edge is acceptable, to within 1.0 inch of the tip of the blades.

2 Voids not exceeding 30 square inches with a maximum of 10 square inches in any single void are acceptable. If voids come closer than 1.0 inch to each other consider them a single void.

3 Voids within 0.38 inch of edge of abrasive strip are not acceptable.

(b) Voids between the spar assembly and the abrasive strip inboard of station 100:00.

1 1.0 inch wide maximum void between abrasive strip and spar is acceptable. Refer to step 4.

2 Voids between abrasive strip and spar not exceeding 10.0 square inches with a maximum of 2.0 square inches in any single void are acceptable. Minimum spacing between void center must exceed 3.0 inches. Refer to step 4.

3 Voids within 0.38 inch of edge of the abrasive strip are not acceptable except at the butt end, per step 1 above. Refer to step 4.

4 Voids defined in steps 1, 2, and 3 that are apparent at the butt end of the blade must be sealed with adhesive. Refer to paragraph d. for instructions to apply adhesive.

(c) Voids at butt end of blade.

1 Void between trailing edge extrusion and skin not deeper than 1.0 inch nor wider than 1.0 inch is acceptable if sealed. Refer to step 4.

2 Any other void not longer than 1.0 inch or deeper than 0.35 inch is acceptable if sealed.

Refer to step 4.

3 Voids are not acceptable within 0.5 inch of the front or rear edge of either grip plate or grip pads, viewing the "Section" of the butt end, if sealed. Refer to step 4.

4 Voids defined in steps 1, 2, and 3 must be sealed with adhesive. Refer to paragraph d. for instructions to apply adhesive.

(d) Voids in the retention area, inboard of Station 100:00.

1 Single voids of 0.06 inch maximum depth on leading edge of doublers and 0.10 inch of trailing edge of doublers are acceptable if sealed. Edge voids are not acceptable in outboard seven inches of each finger of the doublers. Edge voids in the outer three inches of the grip plate and outer 1.5 inches of the drag plate are not acceptable. Up to 0.5 inch maximum may be removed from the outboard tip of the drag plate tang, grip plate tang, or outboard tip of doublers to eliminate a void. Refer to paragraph 5-5, d, (6).

2 Voids between the doublers, doubler and skin, doubler and grip plate, grip plate and grip pad are not acceptable, except as allowed in steps (c) 2, (c) 3 and (d) 1 above.

3 Voids between the skin and the core in a five-inch-wide region running adjacent to the trailing edge extrusion, not wider than 1.0 inch nor longer than 10.0 inches with a minimum width of 1.0 inch of good bond between them, are permissible. In the remaining area, the width of the void must not exceed 0.5 inch. The total area of all voids must not exceed 30 square inches.

4 Edge voids between the edge of the skin and the trailing edge extrusion, that are less than 0.06 inches wide by any length or less than 0.25 inches wide by 7 inches long are acceptable if they are sealed with adhesive (C7), adhesive (C11), adhesive (C12) or adhesive (C17).

5 Voids within one inch of the main retention bolt, in any bond line, are not permissible.

6 Other voids between the skin and the trailing edge extrusion which do not exceed one third the width of the facing surfaces by 10.0 inches long are acceptable.

(e) Voids under skin, outboard of Station 100.0.

1 Voids between the skin and the trailing edge extrusion shall not exceed one third the width of the faying surfaces.

2 Voids between the skin and the core must not exceed **1.0** inch in width chordwise. If two voids are within **1.0** inch of each other, consider them as one void.

3 Voids between the skin and the spar not wider (chordwise) than 1/3 the width of the mating surfaces are acceptable. Edge voids are not acceptable.

4 Edge voids between the edge of the skin and the trailing edge extrusion that are less than 0.06 inches wide by any length or less than 0.25 inches wide by 10.0 inches long are acceptable if they are sealed with adhesive (C7), adhesive (C11), adhesive (C12) or adhesive (C17).

NOTE

Where two voids of two different types are closer than 1.0 inch apart, consider them as one void and apply the more strict limitations. (Example: Voids between skin and trailing edge extrusion next to a void between the skin and the core).

(4) Inspect blade for worn retention bolt hole and worn drag brace bolt hole.

(a) If wear allowance listed in steps (b), (c), or (d) is exceeded, send blade to Depot Level Maintenance for repair.

(b) Main retention bolt hole is oversize when the diameter exceeds 2.505 inches.

(c) Drag plate bolt hole is oversize when the diameter exceeds 0.877 inches.

(d) Polish out any corrosion or pitting from either bushing (Figure 5-15, Items 12 or 13). Inside diameter of bushing will not exceed limits of steps (b) and (c) above after polishing.

(5) Inspect blade for cracks.

(a) Visually inspect top and bottom surfaces along entire length of blade for damage. Any fatigue crack in any location is cause for blade scrapping. Evaluate cracks caused by strikes and other damage to other damage criteria.

(b) Penetration through spar or trailing edge strip is cause for blade replacement.

(c) Damage penetrating skin and at least one inch from doublers may be repaired, provided that after cleanup damage does not exceed two inches in diameter.

(d) Spanwise cracks penetrating skin and at least one inch from doublers may be repaired, provided that after cleanup, using an oblong hole, damage does not exceed four inches by one inch and direction of oblong hole falls within 15 degrees of a line parallel to leading or trailing edge of blade.

(6) Inspect blade for holes in skin. If any holes are found, classify them as reparable or non-reparable by patching in accordance with the following limits: See figure 5-15.

CAUTION

Repairs inboard of Station 210 must be inspected daily for cracks.

(a) No patches are permitted within 1.0 inch of doublers.

(b) Inboard of Station 216, only one repair on the same chordline is permitted. After cleanup, holes are limited to 2.0 inches maximum diameter and are restricted to a minimum of 2.0 inches between repairs.

(c) Between Station 216 and Station 240, two holes are permitted on same chordline on same skin surface. Maximum diameter of holes is 2.0 inches and a minimum spacing of 2.0 inches after cleanup is required between repairs.

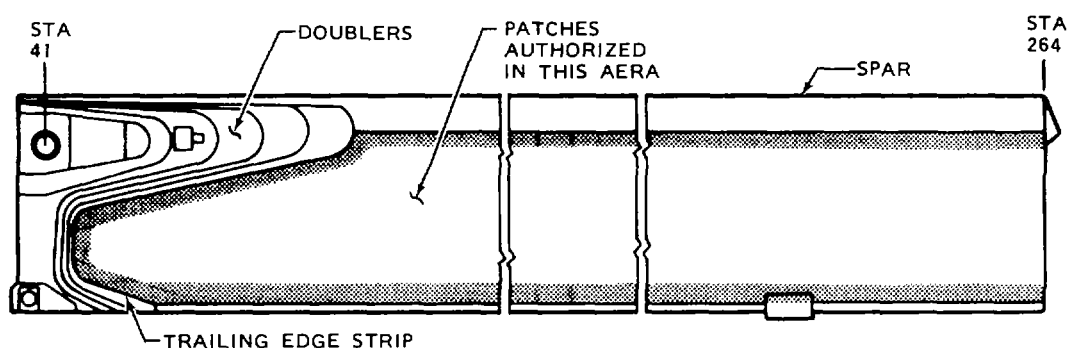
(d) Between Station 240 and outboard tip of blade, two holes are permitted on same chordline on same skin surface. Maximum diameter of holes is 3.0 inches and a minimum spacing of 2.0 inches after cleanup is required between repairs.

(e) Spanwise holes may be repaired providing that after cleanup making an oblong hole, damage does not exceed 1.0 inch wide and 4.0 inches long. Direction of oblong hole must fall within 15 degrees of a line parallel to leading or trailing edge of blade. Ends of the hole must have a minimum radius of 0.25 inch to break corners.

(f) Any damage or defect in the skin that can be polished smooth without leaving the skin in the area so thin that it can be dented with fingernail pressure does not require a cut out. In these cases a patch must be applied as though a hole exists. Maximum diameter of a patch of this type is 4.0 inches with a minimum of 0.75 inch of bonded area around the perimeter of the dent.

(7) Inspect main rotor blade for the following defects. If blades are damaged to the extent described, condemn and demilitarize locally rather than returning blade to an overhaul facility.

(a) Any penetration damage through spar or trailing edge strip, doublers, grip plates or drag plates.



No patches are permitted within one inch of the doublers, spar, trailing edge strip and the tip of the blade. This is the shaded area in the illustration above. Refer to notes 1 through 4 and the table to accurately define the patchable area.

NOTES:

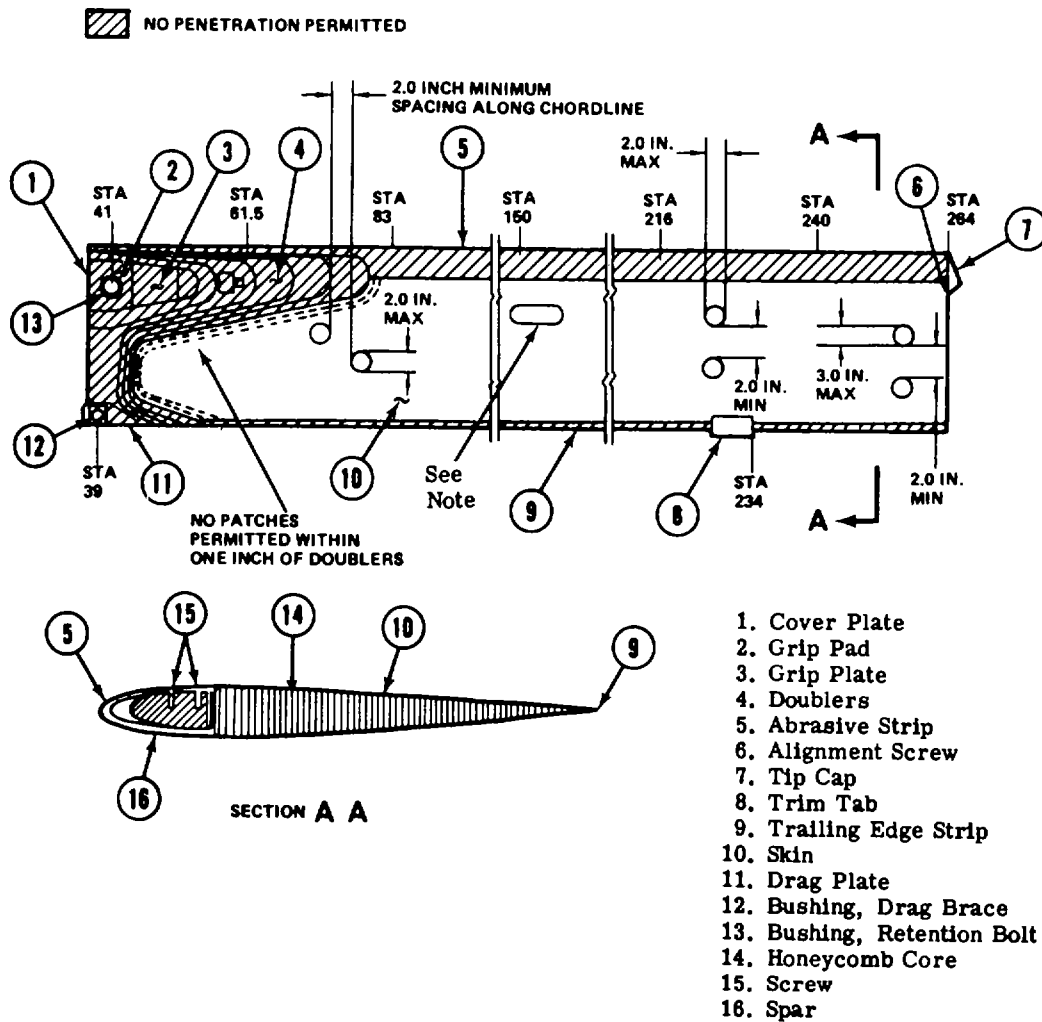
1. On blades P/N 540-011-001-5, P/N 540-011-250-1, and 540-015-001-1, -3 and -5 the spar tapers uniformly between blade stations 80.0 and 140.0. The spar width is constant either side of these stations.
2. On blade P/N 540-011-001-5 the trailing edge strip tapers uniformly between blade stations 61.5 and 150.0. Trailing edge strip width is constant either side of these stations.
3. On blade P/N 540-011-250-1 and 540-015-001-1, -3 and -5 the trailing edge strip tapers uniformly between station 95.0 and 220.0. Trailing edge strip width is constant either side of these stations.
4. All dimensions are in inches.

Chordwise limits of patchable area at various stations for blades P/N 540-011-001-5, 540-011-250-1 and 540-015-001-1, -3 and -5.

BLADE P/N	BLADE STATION	AFT OF LEADING EDGE	FORWARD OF AFT EDGE
540-011-001-5	80.0	9.76	
540-011-001-5	140.0	6.70	--
540-011-001-5	61.5	--	4.145
540-011-001-5	150.0	--	2.245
540-011-250-1	80.0	9.76	--
540-011-250-1	140.0	6.70	--
540-011-250-1	95.0	--	4.145
540-011-250-1	220.0	--	2.245
540-015-001-1, -3 and -5	80.0	9.76	--
540-015-001-1, -3 and -5	140.0	6.70	--
540-015-001-1, -3 and -5	95.0	--	4.145
540-015-001-1, -3 and -5	220.0	--	2.245

540011-142-1B

Figure 5-15. Main rotor blade authorized patch area (Sheet 1 of 2) (AVIM)



Note

An oblong hole is permissible if the general direction of the hole is within 15 degrees of a line parallel to the leading or trailing edge of the blade. Maximum size of the hole shall not exceed 1 inch wide by 4 inches long. The ends of the hole must have a minimum radius of 0.25 inch to break corners.

540011-122

Figure 5-15. Main rotor blade authorized patch area (Sheet 2 of 2) (AVIM)

(b) Skin penetration in any area larger than 2.0 inches in diameter after cleanup or oblong penetration larger than 1.0 inch by 4.0 inches after cleanup.

(c) Water in honeycomb core.

(d) Voids between skin and honeycomb core larger than 30 square inches.

(e) Edge voids deeper than 0.50 inch in tip end of any of doublers or grip plates.

(f) Edge voids in the leading edge of the doublers that exceed 0.060 inch in depth and at the trailing edge of the doublers that exceed 0.10 in depth.

(g) Any corrosion that penetrates entirely through skin.

(h) If one or more cracks develop and extend from a previously repaired area.

(i) More than one patch on the same chordline on the same side.

(j) Obvious deformation of blade.

(8) Inspect main rotor blade trim tab for the following defects:

(a) Distortion that can be repaired BY straightening.

(b) Cracks, tears, rips and holes. This type damage must be repaired by replacement of the trim tab.

(9) Tip balance weight inspection.

(a) Remove tip cap from rotor blade.

(b) Visually inspect lead weights for distortion. Distorted weights are cause for blade removal.

(c) Inspect for loose weights. Loose weights alone are not cause for blade removal. Inspect stud retention nuts for looseness by applying 30 inch pound torque. Torque loose stud retention nuts to 130 to 145 inch pound.

(d) Striking of rotor blades to check for loose balance weights is not an acceptable

inspection procedure.

(e). Inspect studs for looseness and distortion. Loose or distorted studs are unacceptable and is cause for blade removal.

d. Repair.

(1) Polish out nick and scratch damage in skin that is within limits stated in inspection paragraph c. Use 320 grit sandpaper (C112) to polish out damage. Use fine aluminum wool (C24) or Scotchbrite (C113) to finish polish the area. Rub spanwise to remove sandpaper marks and polish to a finish of 32 RMS. Touch-up repair area with chemical film (C37), primer (C102) and paint to match surrounding area. Refer to paragraph e.

(2) Polish out nick and scratch damage in the abrasive strips, doublers, grip plates and drag plates that is within limits stated in inspection paragraph c. Use 400 grit sandpaper (C112) or equivalent. Steel wool (C127) may also be used providing that no aluminum parts are touched with it. Touch up repair area with primer and paint to match surrounding area.

(3) Repair minor dent damage in the trailing edge strip that is within limits stated in inspection paragraph c. Use a plastic mallet to work the metal slightly.

(4) Repair nick, scratch, and notch damage in the trailing edge strip that is within limits stated in inspection paragraph c. Use varying grades of sandpaper to polish out damage and fair out over a distance of 2.0 inch minimum on each side of damage. Touch up repair area with primer and paint to match surrounding area.

(5) (AVIM) Repair hole damage and nick or scratch damage in skin that is within limits stated in inspection paragraph c as follows:

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone (C87). Avoid breathing vapors and avoid prolonged contact with skin.

(a) Remove paint from repair area with methyl-ethyl-ketone (C87). Dry with a clean cloth. Do not allow cleaner to enter the blade.

NOTE

If a nick or scratch in the skin in excess of 0.008 inch depth can be polished smooth without leaving the skin in the polished area so thin that skin can be dented with fingernail pressure, apply a patch over the area without cutting a hole. Comply with step (a). Skip steps (b) and (c) and proceed with step (d).

(b) Draw a circle around the damaged area just large enough to encompass damage.

(c) Remove skin just inside the circled area, disturbing the honeycomb core as little as possible. Heat the cut out disk to 200°F maximum and lift out the disk of skin while heated.

(d) Deburr edges of hole and polish out scratches and nicks.

(e) Prepare a patch to cover the hole that will overlap by 0.75 inch. Fabricate patch from 2024 T3 aluminum 0.020 inch thick (item 4, table 2-1) large enough to overlap the hole at least 0.75 inch all around the perimeter. Deburr and blend out edges. Sand the bond area of the patch and blade with 400 grit paper (C112).

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone (C87). Avoid breathing vapors and avoid prolonged contact with skin.

(f) Clean bond area on patch and blade with methyl-ethyl-ketone (C87). Dry with a clean cloth.

CAUTION

Area must be clean, dry and free of grease, oil and wax.

(g) Apply adhesive (C12) or adhesive (C17) to patch area around hole and to patch. Apply patch to blade and move slightly under pressure to expel air and prevent voids in bond. Blend out excess adhesive.

(h) Hold patch in place with rubber bands, made from inner tube, or other mechanical means while curing. Allow adhesive (C12) to cure at 70 to 90 degrees F for 24 hours or 145 to 155 degrees for 30 minutes until completely firm. Allow adhesive (C-17) to cure at 75°F minimum for 5 days, or at 180°F for 60 minutes.

(6) Repair voids up to a maximum of 0.50 inch from tips of drag plate tang, grip plate tang, or outboard tip of doublers as follows:

(a) Cut material from doubler, maximum of 0.50 inch, following the same radius as original tip. Use extreme care to avoid cutting into adjacent parts.

(b) After cutting, debur and break sharp edges.

(c) Refinish in accordance with procedures in paragraph 5-5, e.

(7) Repair distorted main rotor blade trim tab that is within limits stated in inspection paragraph c. as follows:

(a) Straighten the trailing edge of the main rotor trim tab with a mallet and a heavy back-up block.

(b) Set trim tab to trail with tab bending tool (T51) and tab bending gage (T44).

(8) (AVIM) Remove damaged main rotor blade trim tab and install new trim tab if replacement is indicated by inspection paragraph c.

(a) Cut through the trim tab (8, figure 5-15) at a line approximately one-eighth inch aft, and parallel to blade trailing edge.

(b) Drill out all rivets attaching trim tabs to rotor blade, if existing.

(c) Apply heat to tab with a heat gun, but do not exceed 200°F. Start at outer corner of trim tab and peel tab off blade in spanwise direction.

(d) Mask blade area around trim tab; allow one-half inch border from trim edge for squeeze-out.

(e) Remove old adhesive in masked area by sanding spanwise with 180 grit sandpaper (C111). Use progressively finer sandpaper 320 and 400 grit to obtain a smooth finish.

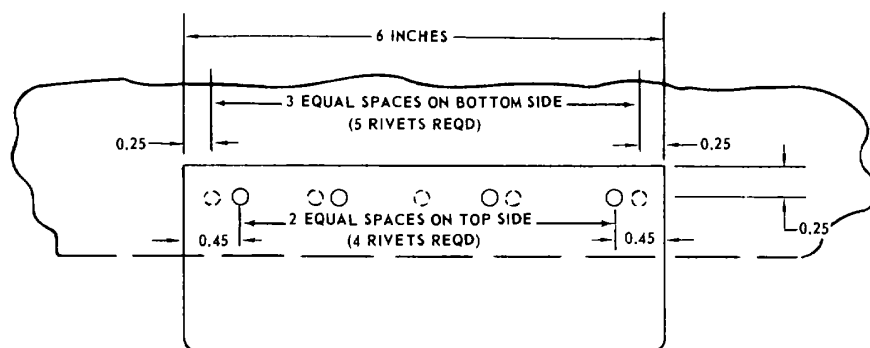
WARNING

Provide adequate ventilation when using methyl-ethyl-ketone (C87). Avoid breathing solvent vapors and avoid prolonged contact with skin.

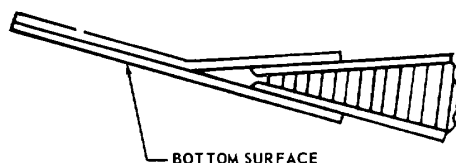
(f) Clean trim tab area of blade with cloths moistened with methyl-ethyl-ketone (C87). Dry the area with dry, clean cloth.

(g) Fill rivet holes in trim tab area of rotor blade, if existing, with adhesive (C12).

(h) Drill nine 0.129-0.132 inch diameter holes in new trim tab as illustrated on figure 5-16. If the previous trim tab was riveted, reverse top and bottom hole locations in trim tab.

**Note**

Drill .129
.132 Dia. Using No. 30
Drill 9 places (4 on Top, 5 on
Bottom). Deburr all holes.



209011-5

Figure 5-16. Main rotor blade trim tab installation

(i) Position trim tab on rotor blade in the install position and, using holes in trim tab as template, drill corresponding 0.129-0.132 inch diameter holes to a maximum depth 0.125 inch in rotor blade.

(j) Remove trim tab from rotor blade, sand and smooth areas around drilled holes in trim tab and blade.

(k) Sand inside mating sides of trim tab with 200 grit sandpaper (C112) and finish with 400 grit sandpaper (C112).

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone (C87). Avoid breathing solvent vapors and avoid prolonged contact with skin.

(l) Clean mating surfaces of rotor blade and trim tab with cloth, moistened with

methylethyl-ketone (C87); then dry surfaces with clean, dry cloth.

(m) Spread a thin film of adhesive (C12) to mating areas of rotor blade and trim tab.

(n) Position and secure trim tab in install position on rotor blade, with holes in trim tab aligned with corresponding holes in rotor blade.

(o) Install a rivet (CR2263-4-1) in each of nine holes drilled in trim tab and blade; dip each rivet in adhesive (C12) before installation.

(p) Use two wooden blocks approximately the same size as trim tab and two sections of hard rubber one sixteenth inch thick and approximately the same size as the wooden blocks to use as pressure pads. Place the rubber sections next to the trim tab bend area and place the wooden blocks over the rubber sections, apply two to ten PSI pressure on the trim tab bend area and maintain for a minimum of 24 hours at 70° to 90°F.

NOTE

Curing time may be accelerated by application of heat of **145 TO 155** degrees F (63 TO 69 degrees C) for approximately 30 minutes, or until squeeze-out resists fingernail penetration.

(q) Remove pressure pads after curing time and smooth squeeze-out with 180, 320, and 400 grit sandpaper (C112).

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

(r) Clean up adhesive squeeze out in trim tab area with methyl-ethyl-ketone (C87) and dry with clean, dry cloth.

(s) Apply chromic acid solution (C3) and dry with clean, dry cloth.

(t) Apply one coat of primer (C100) to trim tab, and adjacent blade area and allow to dry for period of 30 minutes to four hours.

(u) Apply lacquer (C76) to trim tab and adjacent blade area.

NOTE

Adhesion difficulty will be encountered if acrylic lacquer is not applied within a four hour period.

(9) Remove damaged polyurethane tape at splice joints (16 and 18, figure 5-14) and install new tape if replacement is indicated by inspection paragraph c.

NOTE

Polyurethane tape bonded in place over the scarfjoint is recommended for dusty (sandy) environments as protection for the scarf joint filler material.

(a) Remove old polyurethane tape from rotor blade leading edge.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged contact with skin.

1 Use sharp plastic scrapers and small amount of methyl-ethyl-keytone (C87) to remove the tape.

2 Remove residual parts of tape with 100 grit or finer sandpaper (C112). Sand in spanwise direction.

WARNING

Provide adequate ventilation when using naphtha. Avoid breathing solvent vapors and avoid prolonged contact with skin.

3 Clean leading edge of rotor blade, in area where tape will be applied, with clean cloths dampened with aliphatic naphtha (C88).

(b) Cut a piece of polyurethane tape (C134.1) seven inches long.

(c) Center polyurethane tape chordwise over the splice joint, press into place and force out all air bubbles. If necessary, make pin hole in tape to allow trapped air to escape.

(10) Remove damaged splice cover (15 or 17, figure 5-14) and install new splice cover if replacement is indicated by inspection paragraph c.

CAUTION

Do not exceed **200** degrees F (**93** degrees C) during splice cover removal or damage to rotor blade may result.

(a) Heat splice cover to **200** degrees F (**93** degrees C) maximum with a heat gun. Maintain temperature during removal procedure.

(b) Carefully remove old splice cover with a putty knife or chisel. Do not damage rotor blade.

(c) After splice cover has been removed, clean old adhesive, paint, and other contaminants from the abrasive strips in the area where the splice cover will be installed. Use 100 grit or finer sandpaper (C 112). Sand in spanwise direction.

(11) Prepare a new splice cover P/N 204-015-011-1 and the rotor blade for installation of the splice cover as follows:

(a) Wear clean, dry gloves when handling parts that have been prepared for bonding. Avoid contaminating parts with oil, grease, or mold.

(b) Mask the area of the rotor blade around the splice cover installation area. Leave a one inch border between the splice cover and the masking tape. Use tuck tape (C134.2).

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing vapors and avoid prolonged contact with skin.

(c) Clean the area of the rotor blade where the splice cover will be installed. Use 100 grit or finer sandpaper (C112). Sand in spanwise direction and remove old adhesive, paint, and other contaminants. Clean the area with clean cloths dampened with methyl-ethyl-keytone (C87) and wipe dry with clean cloths.

(d) Remove peel ply from the inside surface of the splice cover.

(e) Lightly sand the cured adhesive on the splice cover with 300 grit sandpaper (C112). Wipe with clean cloth to remove residue.

CAUTION

EA 9340 adhesive is the only adhesive of the consumable materials (C12) group that is authorized for splice cover installation.

(f) Apply thin coat of EA 9340 adhesive (C12) to the inside of the splice cover and to the mating surface of the rotor blade. Use wooden

spatula and rub adhesive around on the splice cover and the blade to assure complete "wetting" of the mating surfaces.

(12) Bond new splice cover to rotor blade as follows:

(a) Position splice cover (15 or 17, figure 5-14) as applicable on rotor blade with the inboard end of the cover **0.650 TO 0.850 inch** inboard of the most inboard end of the splice joint as illustrated.

(b) Move splice cover back and forth slightly to expel air pockets.

(c) Wipe off excess adhesive and fair in adhesive at edges of cover.

(d) Place a sheet of peel ply (C95.1) over splice cover to prevent adhesion to bands to be installed in the following step.

(e) Hold splice cover in place with heavy rubber bands or bungee cords.

(f) Allow adhesive to cure for 24 hour at room temperature or for 30 minutes at **145 TO 180 degrees F (63 TO 82 degrees C)**.

(g) Touch up finish on rotor blade. Refer to paragraph e.

e. *Refinish.* (AVIM)

(1) Remove the tip cap assembly and plug the holes in the end of the spar and inertia weight to keep out paint.

(2) Degrease with naphtha (C88) or any good degreasing solvent.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

(3) If entire blade is to be refinished, strip old paint from blade with methyl-ethyl-ketone (C87).

(4) If skins are pitted or eroded in the area just behind the abrasion strip, polish out the pits with 320 grit sandpaper (C112). Use fine aluminum wool (C24) and 320 grit sandpaper (C112) to finish polish the damaged area. Rub spanwise to remove burnishing or sandpaper marks and all traces of pitting. Finish must be minimum of 32 RMS. If the depth of the repaired area is no greater than **0.008** inch the repair is satisfactory.

NOTE

Prior to refinishing, blade must have all scratches, nicks, dents, etc., repaired as shown under repair of nicks, dents, scratches, notches and bent trim tab.

(5) Using abrasive cloth (C44) or equivalent, remove all surface oxides and all aged chemical conversion coatings from all bare aluminum surfaces.

(6) Wash blade with compound (C39) or equivalent. Achieve water break free surface, which will be evident by continuous unbroken film of water on the surface after thoroughly rinsing the soap from the surface.

NOTE

From completion of this step through final paint, surfaces of blades should not be handled with bare hands.

(7) On all bare aluminum, apply brush or spray application of chemical film (C37). If not available, use application of phosphoric solution (C23) or a ten percent solution of chromic acid (C3).

(8) Thoroughly dry the cleaned surfaces. Apply a **0.3** to **0.5** mils thick coat of primer (C100). Allow to air dry from 45 minutes to 4 hours before next step.

(9) Apply first coat of lacquer (C74A) to the upper and lower surface of the blade. Allow one hour minimum drying time, then apply second coat. Allow one hour minimum drying time before putting any other paint over the second coat. Spray only the repaired areas.

(10) Deleted.

(11) Unplug holes in end of spar and inertia weight and install tip cap assembly. Apply

sealant (C116) around cap.

f. *Preparation for Storage or Shipment.*

NOTE

The following instructions cover storage or shipment of main rotor blades in either cardboard or metal containers.

(1) Condemn and demilitarize locally any blade which has incurred non-reparable damage. Refer to inspection paragraph c, step (7).

(2) Thoroughly remove foreign matter from entire exterior surface of blade. Use cleancheese cloth dampened with naphtha (C88).

(3) Tape (C134) all holes in the blade such as bullet damage, tree damage, foreign object damage, etc. to protect the interior of the blade.

(4) Apply a coating of wax (C149) to all exterior surfaces of the blade, except the main retention bolt hole and the drag brace retention hole. If non-siliconized composition wax is not available, coat exterior blade surfaces with oil (C91).

(5) Apply grease (C67) to main bolt hole and drag brace retention bolt hole.

(6) Wrap blade with barrier material (C30), shiny side next to the blade, at all locations when the blade will contact the hog hair supports (5 places) and secure with tape (C136).

(7) Secure contours to the blade at the paper wrapped areas.

(8) Attach a properly filled out DD Form 15772 (Unserviceable/Reparable Tag) directly to the blade.

(9) Secure blade to shock mounted support.

(10) Secure lid. If cardboard container is used, band container shut with 0.50 inch steel bands. If metal container is used, install top half of container, with top cushions attached, on lower half of container and secure with camlock fasteners.

g. Installation.

(1) Support main rotor hub on a build-up bench. Refer to paragraph 5-4. Check that locating pin (6, figure 5-11) is installed in upper surface of each grip (5) at inboard side of retaining bolt hole.

CAUTION

Do not intermix main rotor blades P/N 540-011-001-5 with main rotor blades P/N 540-011-250-1/540-015-001-1 on the same helicopter because of chordwind moment differences. Main rotor blades P/N 540-011-250-1 and main rotor blade P/N 540-015-001-1 may be intermixed on the same helicopter.

NOTE

Corrosion preventive compound (C52) shall be applied to blade retaining bolts and holes, drag brace bolts, clevis holes, and to blade butts.

(2) Insert blade (9) in grip. Place washer (7) on retaining bolt (8). Align bolt holes carefully and insert bolt from top. If bolt binds, move tip of blade up and down slowly to find position which allows bolt to

pass through without binding. Seat bolt and washer with notches on locating pin (6). Apply corrosion preventive compound (C52) to blade retaining bolts and holes in hub grip and blade butts.

(3) Place padded support under blade approximately one third blade length inboard from blade tip.

CAUTION

Install washer (16) with counterbore up facing grip.

(4) Install washer (16) with counterbore up as illustrated and install nut (17). Do not tighten nut at this time.

(5) Align clevis of drag brace (15) on bolt holes of the blade drag plate. Install shims (10) equally between clevis and upper and lower drag plates, to obtain 0.000 to 0.005 inch clearance. Install bolt (14) and secure with two washers (13 and 12) and nut (11) on lower side as illustrated. Do not tighten nut (11) at this time. Apply corrosion preventive compound (C52) to drag brace bolt and clevis holes.

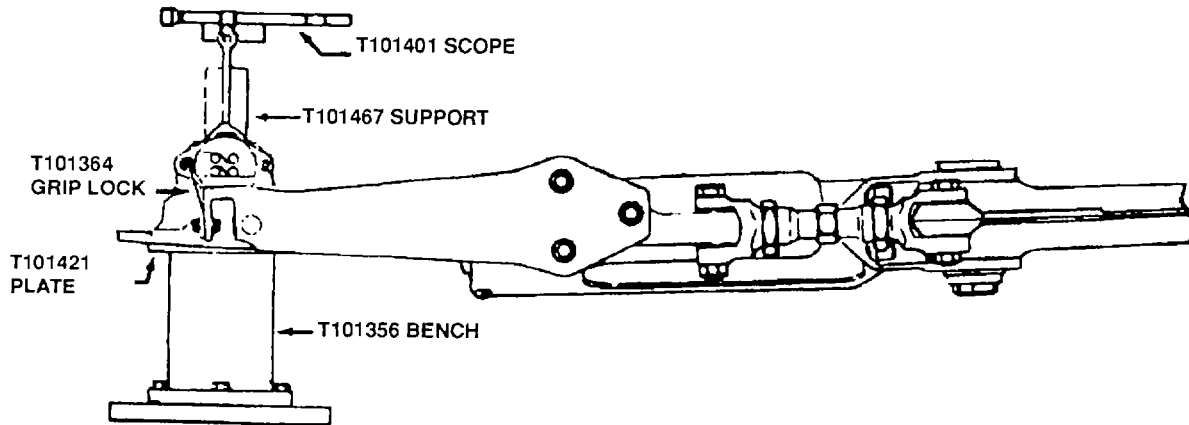


Figure 5-17. Tool application - alignment of main rotor hub and blades

(6) Install opposite blade in the same manner.

(7) If the blades are to be aligned in the hub, proceed to paragraph h.

(8) If the blades are not to be aligned in the hub, torque nuts (11) **125 TO 150** foot-pounds. Torque barrel jam nuts **150 TO 200** foot-pounds.

(9) Use wrench (T31) to tighten nuts (17) to a torque of 475 TO 525 foot pounds. Align a notch in the nut with a hole in the bolt. Install locking screw (20) with head in a direction so that centrifugal force will keep the locking screw in. In some cases, this may mean the locking screw may be installed from the inside of the bolt. Install washer (19) and nut (18).

(10) Install grip locks (T59) on each pitch horn if not previously accomplished. See figure 5-7.

h. Alignment.

(1) Install grip locks (T59) on each pitch horn if not previously accomplished. See figure 5-7.

(2) Place adapter plate (T34) on buildup bench (T26). Place main rotor hub and blade assembly on buildup bench. Place a support equipped with wheels under each blade to support the blades at a precon angle of 2 1/2 degrees up. The flap stops (T42) may be installed with 540 side down to ensure stability (figure 5-35). Place a bubble protractor on the machined surface

adjacent to blade retaining bolts. Both blades should be at zero degrees chordwise. Remove grip locks (T59) and set blades to zero degrees chordwise.

(3) Position scope support (T42) over elastomeric bearings as shown on figure 5-17.

(4) Install scope assembly (T30) on support. Zero crosshair on an object approximately 50 feet away. Draw a vertical line on the object. Loosen clamp screws and rotate scope tube 180 degrees on tube axis in scope clamp and repeat check. If vertical crosshair does not align with drawn line, draw a second vertical line on object that will align with vertical crosshairs. Measure one half the distance between drawn lines, one and two, and draw a third vertical line. Adjust screw on side of scope to align vertical crosshairs with third drawn line. Rotate scope 180 degrees on tube axis in scope clamp and check that crosshair aligns with third drawn line. Repeat above steps until satisfactory adjustment is accomplished.

(5) Locate alignment drive screw (item 8, figure 5-14 or item 17, figure 5-17a). Sight through the scope assembly, installed in step (4), and determine whether the alignment drive screw is lined up with the scope crosshair within **0.000** inch forward to **0.100** inch aft. If drive is not aligned within tolerance, adjust drag brace (15, figure 5-11) to move blade tip and bring alignment drive screw within tolerance. Be sure that the wheels under the stand supporting the blade are free to roll when the drag brace is adjusted. After the blade is aligned, torque jam nuts on the drag brace **150 TO 200** foot-pounds and recheck to ensure that blade alignment is still within limits.

(6) Reverse scope to check and adjust alignment of opposite blade. Maximum tolerance of alignment between two blades is 0.050 inch difference or one-half rivet head diameter.

(7) Torque nuts (11, figure 5-11) on both blades **125 TO 150** foot pounds after blades are aligned.

(8) Torque nuts (17, figure 5-11) on both blades **475 TO 525** foot-pounds after blades are aligned. Use socket wrench, T101414 to tighten nuts. Select a notch in the nut with a hole in the bolt and install locking screw (20) with head in a direction so that centrifugal force will keep the lockscrew in. In some cases, this may mean the locking screw may be installed from the outside of the bolt. Install washer (19) and nut (18).

(9) Verify blade alignment.

(10) Remove grip locks (T59) and flap stops (T42).

5-5A. K747 MAIN ROTOR BLADES

5-5B. DESCRIPTION-K747 MAIN ROTOR BLADES.

NOTE

After incorporation of drag strut K747-082-1 and root fitting K747-083-1, per MWO 55-1520-244-50-11, main rotor blades K747-003-205, -209, and -303, become K747-003-309, -401, and -403, respectively.

a. The K747-003 improved main rotor blade (figures 5-17A and 5-17B) is an advanced technology composite structure which offers improved performance, reliability, maintainability, and reduced radar cross section. It is a glass fiber epoxy resin bonded assembly with an elastomeric erosion guard. The blade is attached in the hub with a retaining bolt assembly (root fitting) and is held in alignment by a drag strut.

b. Difference Between Models. K747-003 series main rotor blades have the following part numbers and differences as noted. (See table 5-1A).

(1) K747-003-205/309 incorporates an improved blade weight retention (IBWR) feature not implemented in earlier K747 blades. (See figures 5-17B and 5-17C). This change alters physical appearance in that a slightly raised area is visible on the top and bottom of the leading edge (LE) erosion guard surfaces

between stations 213.5 and 260.0. An almost invisible seam may be detected at station 213.5. The leading edge erosion guard is completely composed of estane material. No other material composition is used.

(2) K747-003-205/309 Deviation implements the use of fluorocarbon leading edge erosion guard material between stations 213.5 and 260.0. This is a higher impact resistant material covering implemented IBWR features. A very slight difference in sheen between the estane and fluorocarbon material may be detected. A very slight seam may be visible at station 213.5. If these differences are not readily apparent, the blade log component DA Form 2408-16 must be consulted.

(3) K747-003-209/401 is visually the same as the -205/309 blade with the exception of the leading edge erosion guard. A full fluorocarbon guard is used instead of a full guard composed of estane materials. If there is any doubt as to material composition, the blade log component DA Form 2408-16 and blade ID plate must be consulted.

CAUTION

K747-003-303/-403 blades shall only be flown with other -303/-403 blades. They shall not be flown with K747-003-205/-309, -205/-309 deviation, -209/-401, or -303/-403 field modified blades. The K747-003-303/-403 blade can be easily identified by the stainless steel erosion guard installed on the outboard leading edge. Do not mistake a -303/-403 field modified blade (stainless steel guard removed and screws and shields installed) for -303/-403 blade.

(4) K747-003-303/-403 incorporates all the improvements of the -209/-401 blade and adds a stainless steel erosion guard over the fluorocarbon guard on the blade outer leading edge. Stainless steel guard location is between stations 217.5 and 261.0. The -303/-403 blade cannot be mixed with other blade models for flight. All skin/core repairs and repair kits used to repair -205/-309, -205/-309 deviation, and -209/-401 blades can be used to repair the -303/-403 blade.

CAUTION

K747-003-303/-403 field modified blades shall not be flown with K747-003-303/-403 blades. K747-003-303/-403 field modified blades are easily identified by the absence of a stainless steel erosion guard and by six shields secured by self-locking screws located on the outboard area of the fluorocarbon erosion guard.

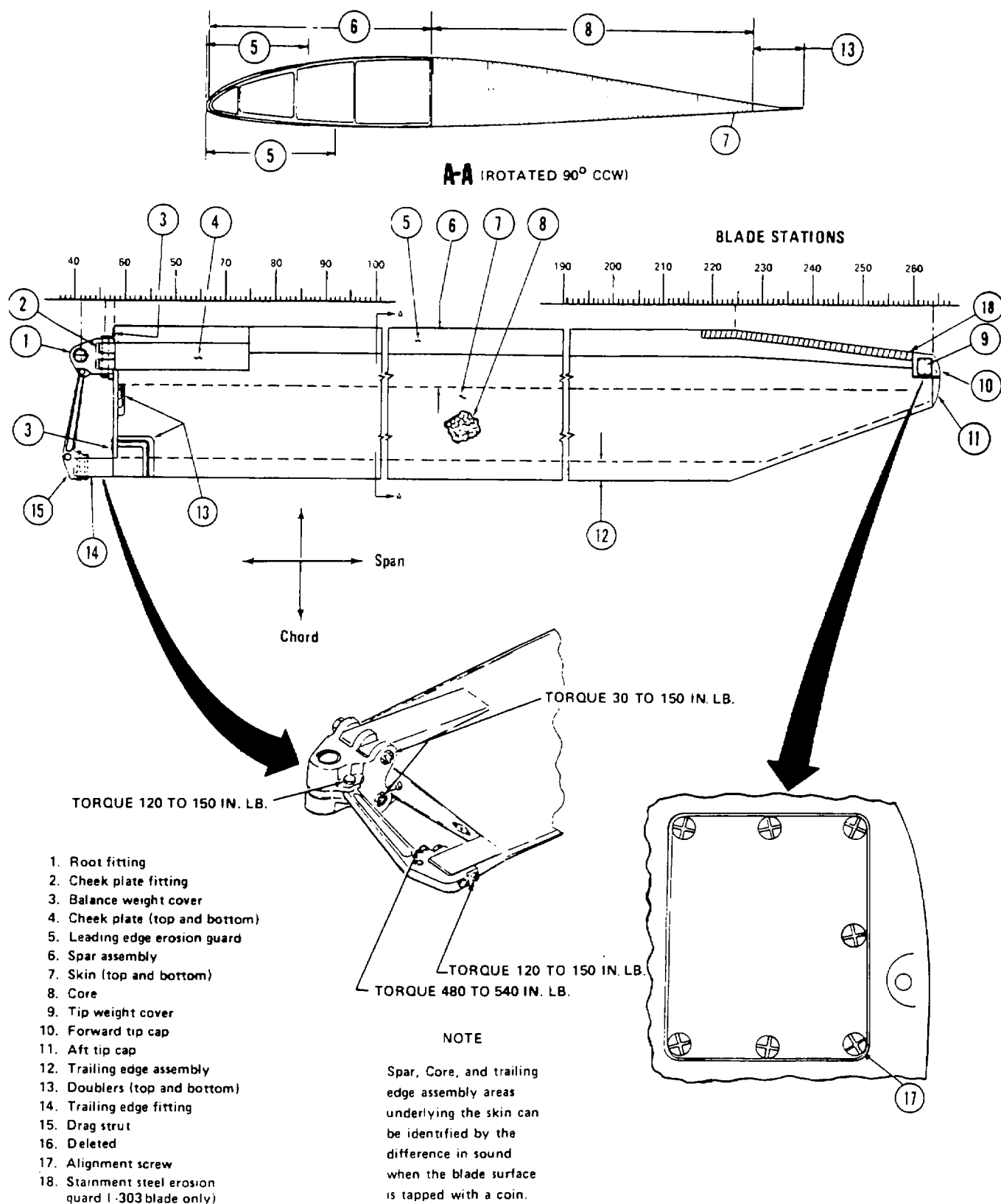


Figure 5-17A. K747 Main Rotor Blade (Part Numbers K747-003-205, -209, -303)

Change 65 5-30A/(5-30B blank)

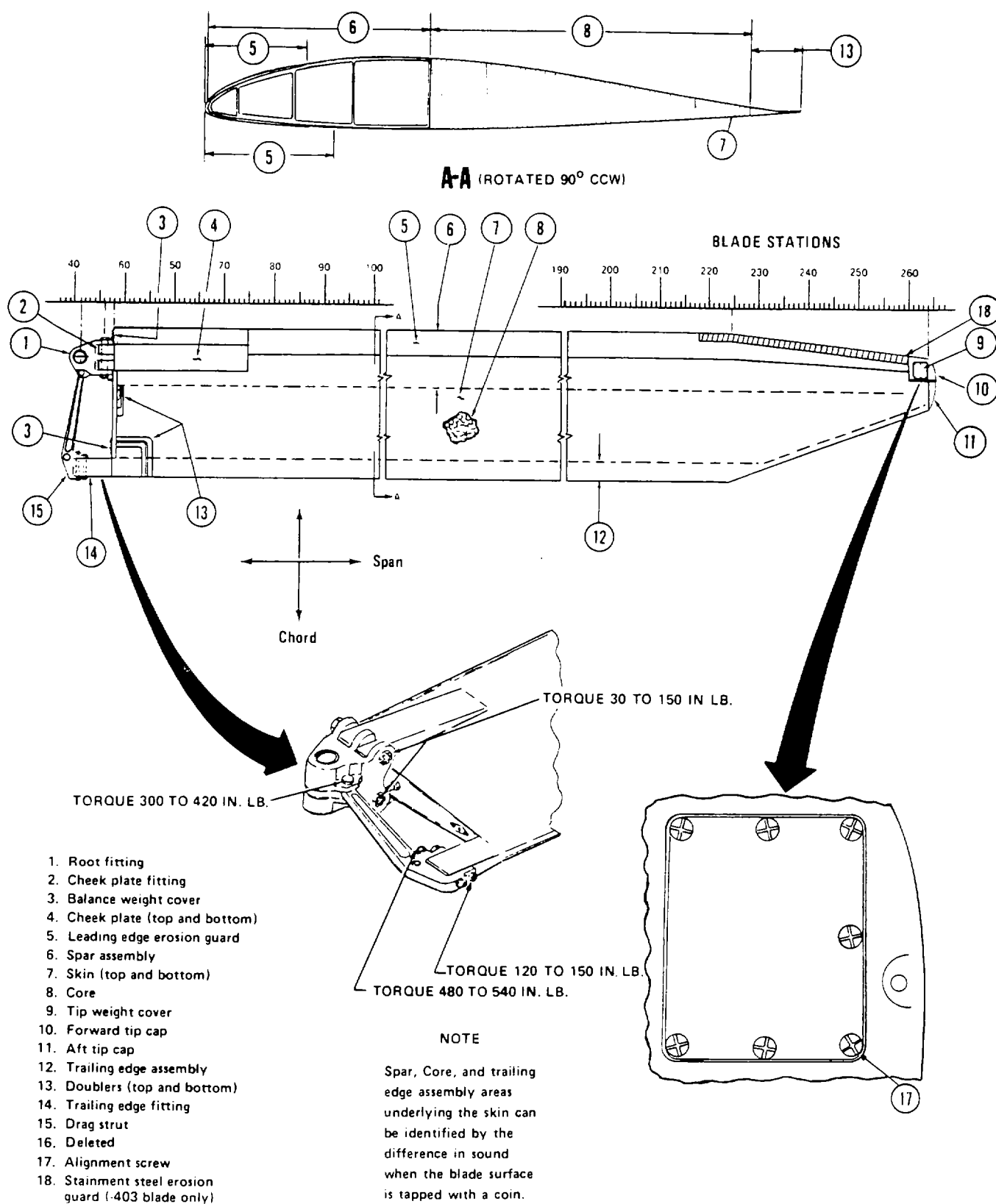
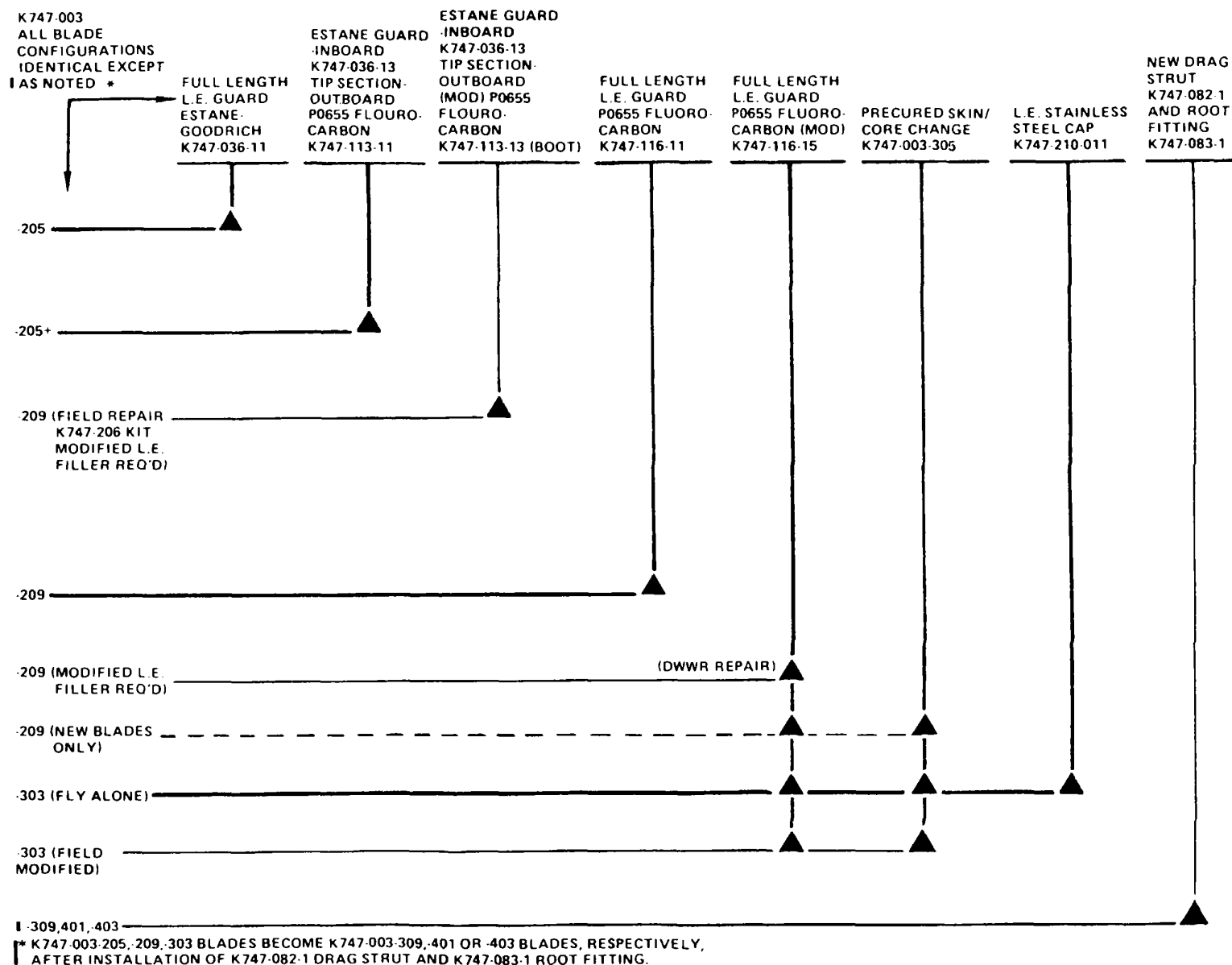
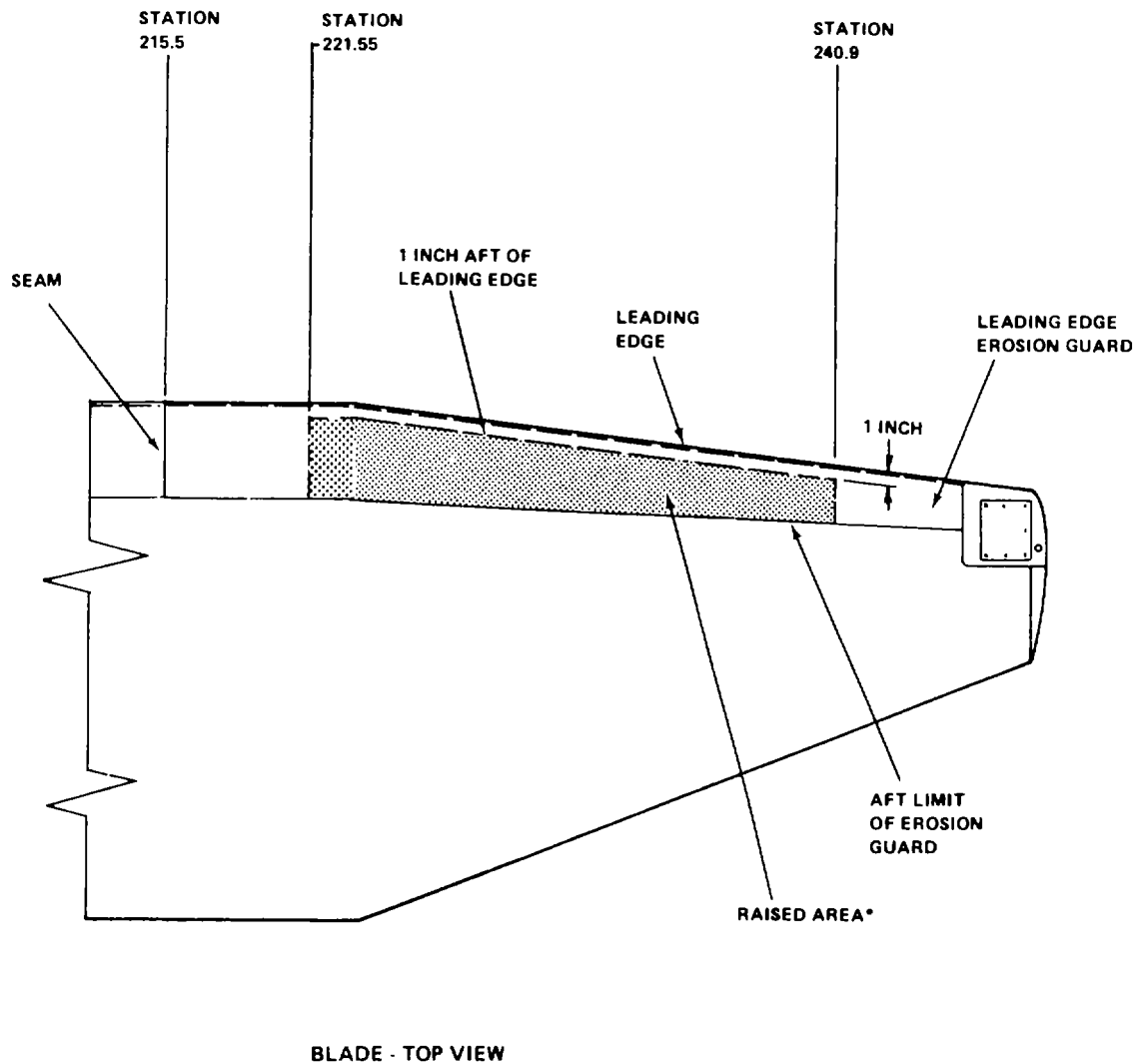


Figure 5-17A.1. K747 Main Rotor Blade (Part Numbers K747-003-309, -401, -403)

TABLE 5-1A. DIFFERENCE BETWEEN MODELS





*AREA RAISED APPROXIMATELY .040 INCH ABOVE SURROUNDING BLADE SURFACES. SPANWISE, AREA EXTENDS FROM STATION 221.55 TO STATION 240.9. AREA EXTENDS CHORDWISE FROM 1 INCH AFT OF LEADING EDGE TO AFT LIMITS OF EROSION GUARD. (RAISED AREA EXISTS ON TOP AND BOTTOM BLADE SURFACES) THE FINISH OF THE RAISED AREA MAY EXHIBIT REDUCED SHEEN.

Figure 5-17B. External Appearance Changes to K747-003-205/-309, -209/-401, and -303/-403 Blades Resulting From Improved Weight Retention Features.

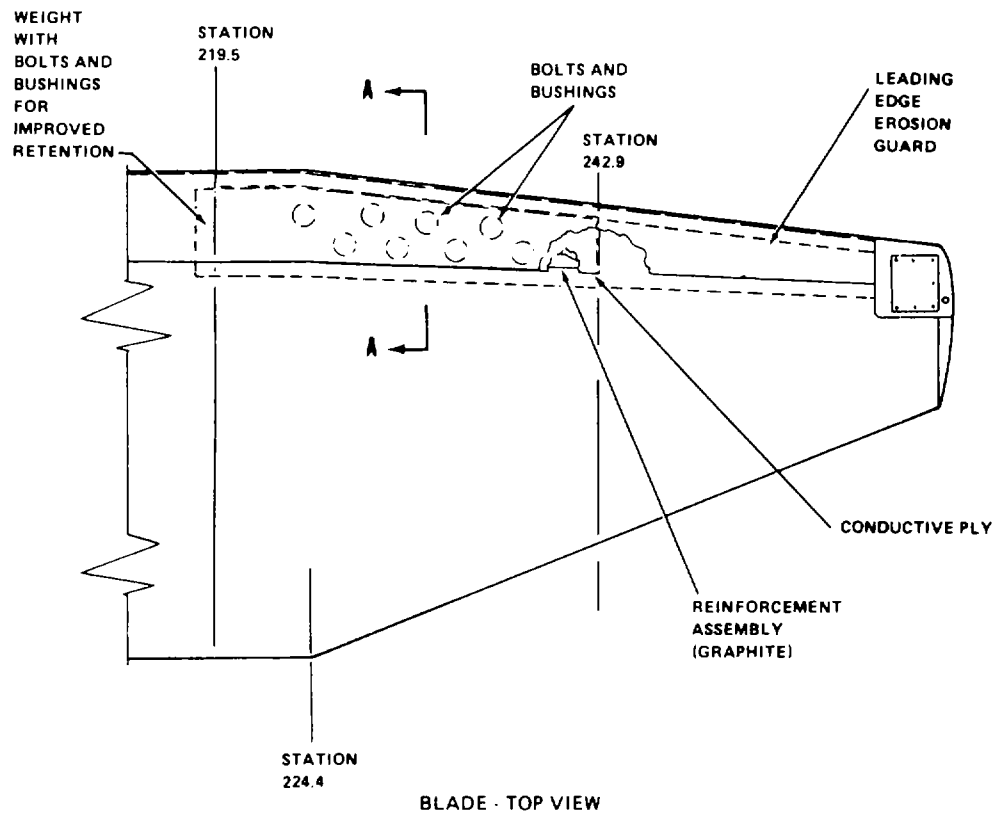
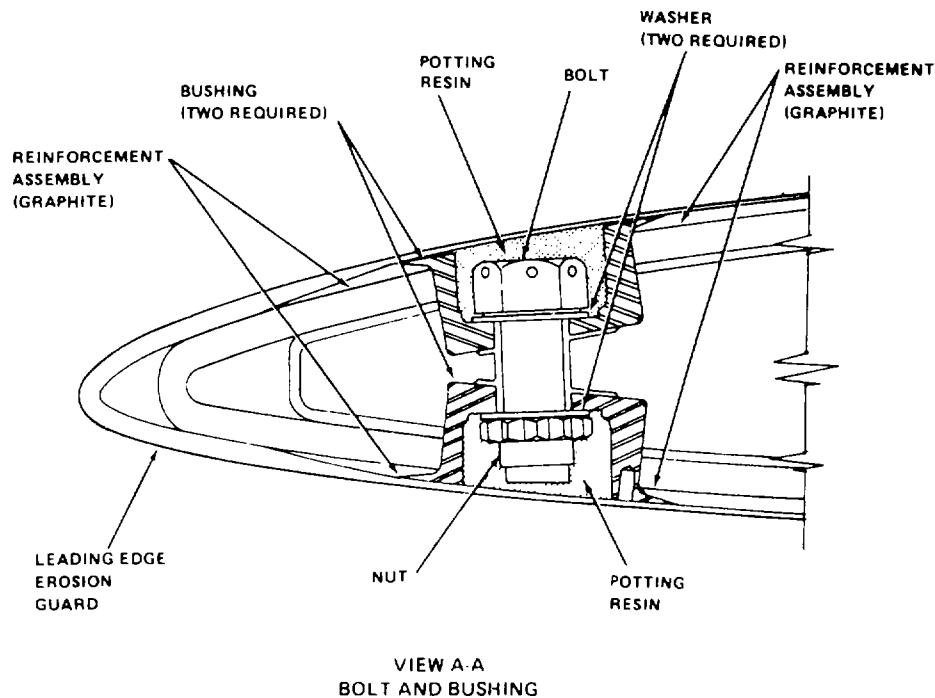


Figure 5-17C. Internal Modifications Incorporated in K747-003-205/-309, -209/-401, and -303/-403 Blades for Improved Weight Retention.

(5) K747-003-303/-403 field modification removes the stainless steel erosion guard from the -303/-403 blade. This modification makes the -303/403 blade compatible for use with the -205/-309, -205/-309 deviation, -209/-401, and other -303/-403 field modified blades only. All skin/core repairs and repair kits used to repair -205/-309, -205/-309 deviation, and -209/-401 blades can be used to repair -303/-403 field modified blades.

5-5C. REMOVAL - K747 MAIN ROTOR BLADES.

a. Position main rotor hub and blade assembly on build-up bench (paragraph 5-4). Place padded supports under blades so that leading edge is approximately straight.

b. Remove locking screw (20, figure 6-11).

c. Remove nut (17) and washer (16) with blade bolt wrench (T31).

d. Remove nut (11), washers (12 and 13), and bolt (14). Loosen nut (121) and swing drag brace (15) away from rotor blade. Retain shims (10) for reinstallation.

CAUTION

Avoid blade contact with the drag brace and hub during removal procedure to prevent possible blade damage.

e. Remove blade retaining bolt (8) and washer (17). Slowly raise and lower blade tip while tapping bolt with fiber mallet. If bolt is difficult to remove, use a bolt removal work aid similar to the one shown in figure 5-12. Remove blade retaining bolt as follows:

(1) Remove threaded plugs from upper and lower ends of blade retaining bolt. If weights are present in bolt, retain for reinstallation.

(2) Position work aid on bolt as shown in figure 5-13, and also place a piece of hard rubber or similar material between work aid tube and grip to prevent marring the grip. Hold puller rod and tighten hexagon nut to remove blade retaining bolt.

(3) Remove work aid from blade retaining bolt. Reinstall weight and plugs in blade retaining bolt and identify the blade retaining bolt for reinstallation in the same grip.

f. Remove blade from grip and place in a padded stand.

g. Remove opposite blade from hub in same manner.

5-5D. CLEANING - K747 MAIN ROTOR BLADES.

a. Clean main rotor blade with one part cleaning compound (C41) and nine parts water.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

CAUTION

The erosion boot is very susceptible to solvents. Use care to prevent spillage or run-off of solvents onto the boot.

b. Remove stubborn deposits with a cloth dampened with solvent (C124) except the boot shall be cleaned only with detergent (C59BI or one part cleaning compound (C41) and nine parts water.

5-5E. INSPECTION - K747 MAIN ROTOR BLADES.

a. Inspect blade historical records and the blade for evidence that the blade has been subjected to an accident, overspeed or incident outside the realm of normal usage. If such evidence exists, perform special inspections outlined in paragraph 1-31.

b. Inspect blades for damage. Classify damage as acceptable or repairable, using the limits in table 5-1B and table 5-1C. Acceptable damage shall not be repaired.

c. The top of the painted surface shall be used to measure dents, cuts and scratches by using a dial indicator with a probe. The fibers of the basketweave may appear to be raised or rough; this is not cause for rejection.

NOTE

Faces of the spar wrap fittings with cracks at the 6 o'clock and 12 o'clock positions.

plus or minus 30°, are acceptable. Cracks on all eight faces and across the bolt hole on one blade are acceptable. Multiple cracks on one face at the 6 and/or 12 o'clock position are acceptable providing no metal is lost.

d. Inspect root fitting for damage in accordance with figure 5-17D and figure 5-17D.1.

NOTE

Ensure the cotter pins are installed in the castellated nuts on the attaching hardware of the root fitting. Root fitting attaching hardware may turn by hand. This is not an indication of a loss of torque and is an acceptable installation.

e. Inspect drag strut for damage in accordance with figure 5-17E and figure 5-17E.1.

f. Tap test blade spar area for cracks between station 70 to 90 from leading edge erosion guard to back side of spar. The tap sound from uncracked area to cracked area is from a solid sound to a highly muffled sound.

5-5F. INSPECTION - K747 MAIN ROTOR BLADE TIP WEIGHT RETENTION.

a. Inspect blades in tip area of leading edge of erosion guard. Both upper and lower surfaces of the

blade must be inspected. Inspect for crescent-shaped, raised areas or circular delaminations of the erosion guard from the spar. These will appear as circular raised areas approximately 2.0 inches in diameter, not to exceed 0.060 inch in height. (See figure 5-17F.)

b. If the discrepancy noted in step a above is detected, replace the blade.

5-5G. REPAIR OR REPLACEMENT - K747 MAIN ROTOR BLADES.

WARNING

The following protective equipment must be used when working with fiberglass repair kits:

Respirator, Chemical Cartridge
Respirator, Disposable Half-Mask
Gloves, Rubber: Acid, Alkali Resistant, Black
Apron, Impermeable: Duck, Rubber Coated
Goggles, Industrial for Chemical Handling
Faceshield, Industrial, Hinged Window

CAUTION

Use only tools specified for repair of K747 main rotor blades.

a. Main rotor blades meeting all of the following requirements shall be repaired.

Table 5-1B. Classification of Damage - K747 Main Rotor Blades

MAIN ROTOR BLADE COMPONENT	TYPE OF DAMAGE A Acceptable Do not repair U=Unacceptable, replace R Repairable if within requirements of paragraph 5-5A,c					ALL DIMENSIONS ARE IN INCHES.
	SKIN EROSION NICKS, SCRATCHES	DENTS	VOIDS	CUTS, TEARS, CRACKS	OTHER	
a. Skin Over Core (Top or Bottom) NOTE 0.015 is approximately full depth of skin	A To 0.005 deep. If 0.005 deep any intersections must be 0.50 apart min. R 0.005-0.015 deep if within area of 7.0 dia circle. (by skin patch)	A To 0.050 deep if no cracks or voids. If 0.050 deep must be 6.0 apart min. R If within area of 7.0 dia circle. (under 1.0 dia by skin patch, over 1.0 dia by plug patch)	A To 2.0 dia, and must be 2.0 apart min. R If within area of 7.0 dia circle. (by plug patch) NOTE Voids may be detected by difference in sound when blade surface is tapped with a coin.	R If within area of 7.0 dia circle. (under 1.0 dia by skin patch, over 1.0 dia by plug patch) R Resin starved skin is revealed along the 45° basket- weave. The dry roving stop where it goes under the adja- cent basketweave. The paint system will be cracked & the fiberglass will show as white strains. Repair with skin patch.	Punctures R If within area of 7.0 dia circle. (under 1.0 dia by skin patch, over 1.0 dia by plug patch) R Erosion of Paint IAW 5-5AC refinishing paint. A Chordwise ridges or raised area at stations 86 and 177. Diagonal ripples aft. of spar stations 48-70 & 224-260	
b. Skin Over Spar or Trailing Edge Assy. (Top or Bottom) NOTES (1) 0.015 is approximatly fill depth of skin. (2) Critical areas are two bands ex- tending length of blade 0.5 fwd from spar/core joint, and 0.5 aft from trailing edge/core joint.	A No limit on length proximity or inter- sections. (1) To 0.005 deep in critical areas. (2) To 0.015 deep in other areas. R To 0.015 deep in crit- ical areas if within area of 7.0 dia circle. (by skin patch)	A To 0.015 deep if no cracks or voids. If 0.015 deep center must not be in critical area, and must be 1.5 apart min. R Outboard of STA 65.7: over 0.015 deep, if not over 1.0 from blade trail- ing edge, and not over 3.0 spanwise. (by trailing edge doubler)	A (1) Within 0.25 of blade trailing edge, no limit on length. (2) Over 0.25 from blade trailing edge, to 1.0 dia and must be 2.0 apart min.	R (1) Outboard of STA 65.7: if not over 1.0 from blade trailing edge, and not over 3.0 span- wise. (by trail- ing edge doubler) (2) If 0.50 min IAW para 5-5AC trailing edge assy. and within area of 7.0 dia circle (by skin patch)	R Blisters: Remove point with 220 sandpaper (C112) & repaint IAW para 5-5AC	
c. Skin Doublers at Inboard end. (Top or Bottom)	A To 0.015 deep on ex- posed surfaces only. No limit on proximity.	A To 0.015 deep if no cracks or voids. No limit on proximity.	A (1) Leading edge doublers: 0.125 max at any edge. No limit on cumulative length.			

Table 5-1B. Classification of Damage - K747 Main Rotor Blades (Continued)

MAIN ROTOR BLADE COMPONENT	TYPE OF DAMAGE A = Acceptable. Do not Repair U = Unacceptable - replace R = Repairable if within requirements of paragraph 5-5A.c				
	Nick,Scratches,Skin Erosion	Dents	Voids	Cuts,Tears,Cracks	Other
d. Trailing Edge Assembly.	A		(a) 0.025 max at any edge. No limit on cumulative length. (b) 1.0 max dia if at least 2.0 from edge and any other void. A	A	Punctures
NOTE	(1) Inboard of STA 48.0: to 0.015 deep. (2) STA 48.0 to 65.7 (a) To 0.010 deep any length. (b) 0.010-0.030 deep, total cumulative length must be under 5.0 in any 10.0 length of span. (3) Outboard of STA 65.7 (a) To 0.010 deep. (b) To 0.030 deep if within 1.0 of trailing edge, total cumulative length must be under 5.0 in any 10.0 length of span.		(1) Inboard of STA 48.0 if not within 0.50 of blade trailing edge or joint with core. (2) Outboard of STA 48.0: to 0.125 forward from blade trailing edge R	Inboard of STA 48.0 to 0.015 deep R	R
e. Trailing Edges Filled Area Sta 48 to 66.	R		Outboard of STA 65.7: if not over 1.0 from blade trailing edge and not over 3.0 span-wise. (by trailing edge doubler) patch	Outboard of STA 65.7: if not over 1.0 from blade trailing edge and not over 3.0 span-wise. (by trailing edge doubler) patch	Outboard of STA 65.7: if not over 1.0 from blade trailing edge and not over 3.0 span-wise (by trailing edge doubler) patch
f. Leading Edge Erosion Guard.	A		A	A To 0.150 deep. R Greater than 0.150 deep. U Penetration of gold/brown substrate (spline).	Erosion A Until loss of weight causes helicopter vibration Return to Depot
(1) Estane Material Seal all blemishes regardless of depth with sealing iron.	(1) To 0.050 if distance from guard trailing edge is over 1.0 on top or 2.0 on bottom.		(1) Deleted		

Table 5-1B. Classification of Damage - K747 Main Rotor Blades (Continued)

MAIN ROTOR BLADE COMPONENT	TYPE OF DAMAGE A = Acceptable - Do not Repair U = Unacceptable - replace R = Repairable if within requirements of paragraph 5-5A,c				
	Nicks,Scratches,Skin erosion	Dents	Voids	Cuts,Tears,Cracks	Other
(2) Fluorocarbon Material Use Kit K747-207 for filling damage less than 3 sq. inches. Use Kit K747-206 for replacement of guard out-board of STA 213.5 for damage greater than 1 sq. inch. Fill all blemishes.	(2) To a depth that does not expose under surface if distance from guard edge is not over 1.0 on top or 2.0 on bottom R Up to 1 sq. inch in area. Up to full depth.		(2) 1.5 max dia if at least 4.0 from edge and any other void R (1) Edge void of any length to 1/2 of guard chordal width top or bottom (2) At spanwise ends (STA 75.0 and 260.0) to 2.0 spanwise (3) Voids in midspan shall be injected with (C98) and apply pressure		Punctures R (1) To 0.125 width any length (2) To 0.5 width 6.0 max length (3) To 0.75 width 1.0 max length U Circular delaminations or crescent shaped raised areas over blade weight retention from Station 224.4 to Station 238.0 unacceptable if height exceeds 0.060 inch
	(3) Stainless Steel erosion guard - K747-003-303 blade. A •Surface nicks causing metal displacement of 0.002 inch or less. •Edge nicks of 0.002 inch depth or less. R •Surface nicks causing metal displacement greater than 0.002 inch and less than 0.015 inch deep and not exceeding a concentration of more than 1 sq. inch in a 4-inch diameter circle - repair by blending •Edge nicks greater than 0.002 and less than 0.015 inch deep - repair by blending. U Any nicks greater than 0.015 inch deep - replace guard.	A Smooth edge/smooth bottom surface dents less than 0.015 inch deep and not exceeding 4 dents per 4 inch dia. circle. Dents within circle must be separated by at least the minimum dimension of smallest dent. The maximum minimum dimension is 0.250 inch. R Sharp edged dents not exceeding 0.005 inch depth or concentration of 10 for any given 4 inch circle - repair by blending. U •Smooth edge/smooth bottom surface dents exceeding requirements of "A" - replace S/S guard.	R Up to 3 sq. inches in area Up to full depth	R Up to 3 sq. inches in area Up to full depth	EROSION A Until loss of weight causes helicopter vibration. U Circular delaminations or crescent shaped raised areas over blade weight retention from Station 224.4 to Station 238.0 unacceptable if height exceeds 0.060 inch. Tapered seats at fastener locations. A •Up to 0.002 inch coring depth caused by fastener. •Smooth abrasion due to fastener head contact. U Greater than 0.002 inch coring depth caused by fastener replacement required.

Table 5-1B. Classification of Damage - K747 Main Rotor Blades (Continued)

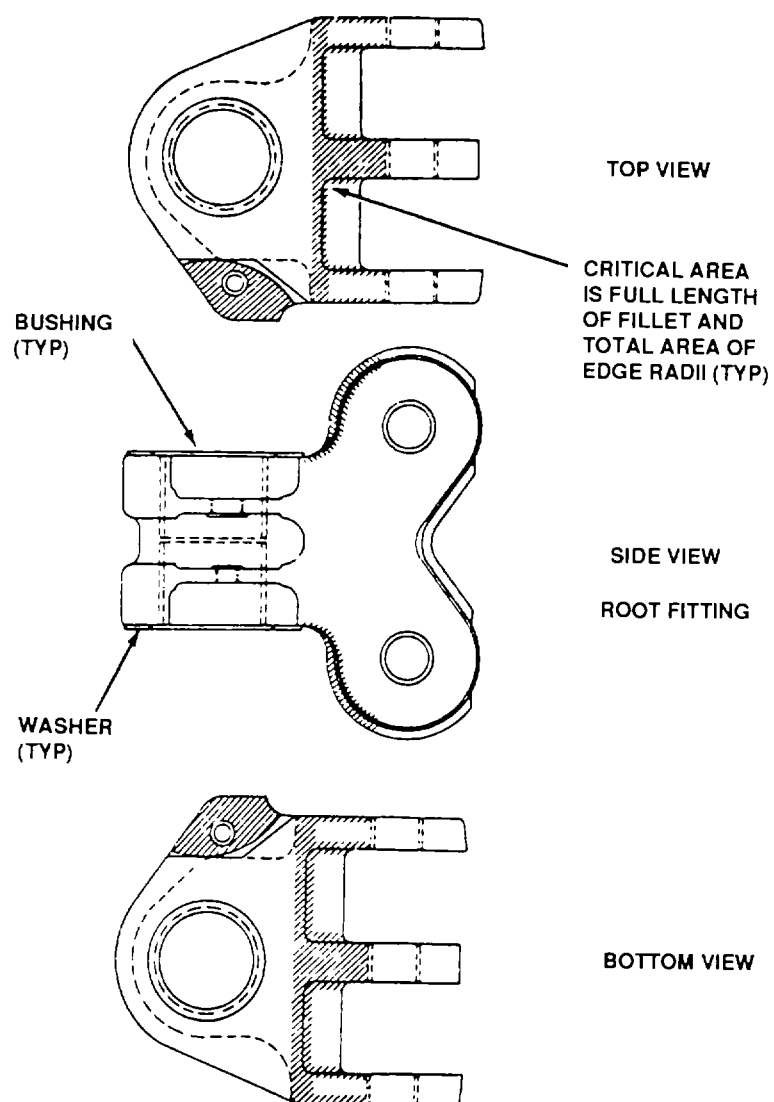
MAIN ROTOR BLADE COMPONENT	TYPE OF DAMAGE A = Acceptable. Do not repair. U = Unacceptable, Replace R = Repairable if within requirements of paragraph 5-30					ALL DIMENSIONS ARE IN INCHES.
	NICKS, SCRATCHES, SKIN EROSION	DENTS	VOIDS	CUTS, TEARS, CRACKS	OTHER	
g. Stainless Steel erosion guard K747-003-303/-403 Blade.	A - Surface nicks causing metal displacement of 0.002 inch or less. - Edge nicks of 0.002 inch depth or less R - Surface nicks causing metal displacement greater than 0.002 inch and less than 0.015 inch deep and not exceeding a concentration of more than 1 sq. inch in a 4-inch diameter circle repair by blending. - Edge nicks greater than 0.002 and less than 0.015 inch deep - repair by blending. U Any nicks greater than 0.015 inch deep - replace guard.	• Sharp edged dents exceeding requirements of "R" - replace guard. A Smooth edge/smooth bottom surface dents less than 0.015 inch deep and not exceeding 4 dents per 4 inch dia. circle. Dents within circle must be separated by at least the minimum dimension of smallest dent. The maximum minimum dimension is 0.250 inch. R Sharp edged dents not exceeding 0.005 inch depth or concentration of 10 for any given 4 inch circle - repair by blending. U - Smooth edge/smooth bottom surface dents exceeding requirements of "A" - replace S/S guard - Sharp edged dents exceeding requirements of "R" - replace guard.		U None permitted Replace guard	Tapered seats at fastener locations. A - Up to 0.002 inch coining depth caused by fastener - Smooth abrasion due to fastener head contact. U Greater than 0.002 inch coining depth caused by fastener - replacement required	
h. Aft Tip Cap.	A To 0.060 deep. No limit on length or number.				R Cracks - Rout out damage to 0.060. Bond with C14.	

Table 5-1C. Classification of Damage - K747 Main Rotor Blades

TYPE OF DAMAGE		A-Acceptable. Do not repair. U -Unacceptable. Replace. R - Reparable if within requirements of paragraph 5-30	ALL DIMENSIONS ARE IN INCHES
COMPONENT	NICKS, SCRATCHES, SKIN EROSION	CORROSION	
a. Root fitting	See figure 5-17D	See figure 5-17D	
b. Drag strut	See figure 5-17E	See figure 5-17E	
c. Root fitting bolt	A To 0.050 deep on hex and exposed thread area.	R To 0.050 deep on hex head and exposed thread area (by polishing).	
d. Cheek plate assembly	A Inboard of sta 48 to 0.015, no limit on length or number.	R To 0.035 deep.	
e. Cheek plate fitting	A To 0.015 deep on exposed surfaces. A Cracks at 12 & 6 o'clock positions on faces with root fitting removed. R 0.015-0.030 deep on exposed surfaces(by polishing).	R To 0.030 deep on exposed surfaces (by polishing).	
f. Balance weight covers	A Nicks, scratches, dents, and bends to 0.035 deep. R Bends and distortion over 0.035 deep (by mechanical straightening).		
g. Trailing edge fitting	A To 0.015 deep on exposed surfaces.	R To 0.030 deep on exposed surfaces (by polishing).	

Table 5-1C. Classification of Damage - K747 Main Rotor Blades (Continued)

TYPE OF DAMAGE		A-Acceptable. Do not repair. U -Unacceptable. Replace. R - Repairable if within requirements of paragraph 5-30	ALL DIMENSIONS ARE IN INCHES
COMPONENT	NICKS, SCRATCHES, SKIN EROSION	CORROSION	
h. Tip cap forward (see note)	R 0.015-0.030 deep on exposed surfaces (by polishing). No limit on length or number.		
	A To 0.030 deep.	Erosion:	
i. Tip weight cover	R 0.030-0.060 deep (by polishing).	A Until loss of weight causes helicopter vibration.	
	No limit on length or number.	R Gap around tip cap. Sealer missing. Apply sealant (C107).	
	A To 0.030 deep.	Erosion:	
	R 0.030-0.060 deep (by polishing).	A To 0.030 deep.	
NOTE			
The balance weights consist of several metal plates that are free to move within the cavity of the tip-balance weight cap. If the cavity is not full, the balance weight plates are able to move, producing the clicking noise during the static vertical movement of the blade. The clicking noise is to be considered normal, unless the tip balance weight cap is not properly secured to its attaching pocket bracket.			



NO CRACKS PERMITTED

TYPE OF DAMAGE	MAXIMUM DEPTH ALLOWED	
	CRITICAL AREA	NON-CRITICAL AREA
NICKS, SCRATCHES	0.005 IN. ACCEPTABLE *0.010 IN. REPARABLE	† 0.015 IN. ACCEPTABLE † 0.030 IN. REPARABLE ‡
CORROSION	*0.010 IN. REPARABLE	0.030 IN. REPARABLE ‡

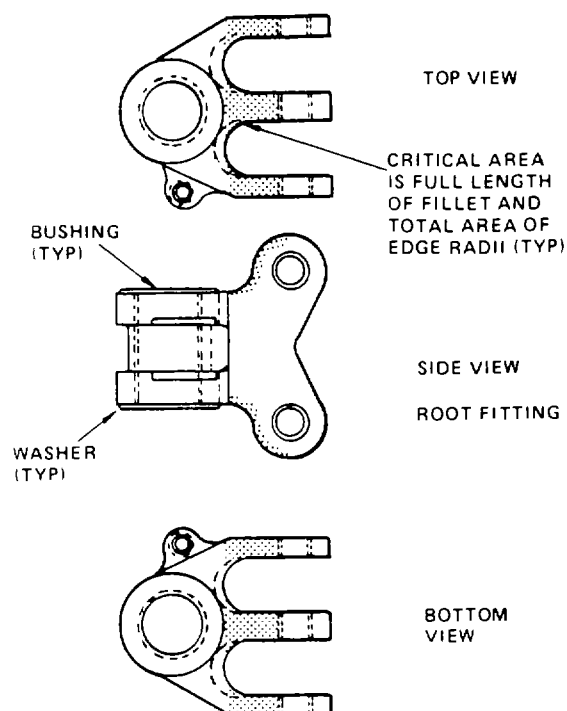
† EXCEPT FOR EXTERIOR SURFACES OF K747-012-19 BUSHING FLANGE AND K747-012-17 WASHER. THESE LIMITS ARE: 0.030 IN. IS ACCEPTABLE.

0.030 - 0.060 IN. IS REPARABLE TO 20% OF SURFACE AREA.

* REWORK MAY EXTEND TO 100% OF SURFACE AREA.

‡ BY POLISHING.

Figure 5-17D. Damage Limits - Root Fittings (P/N K747-061-5) (K747 Blade)

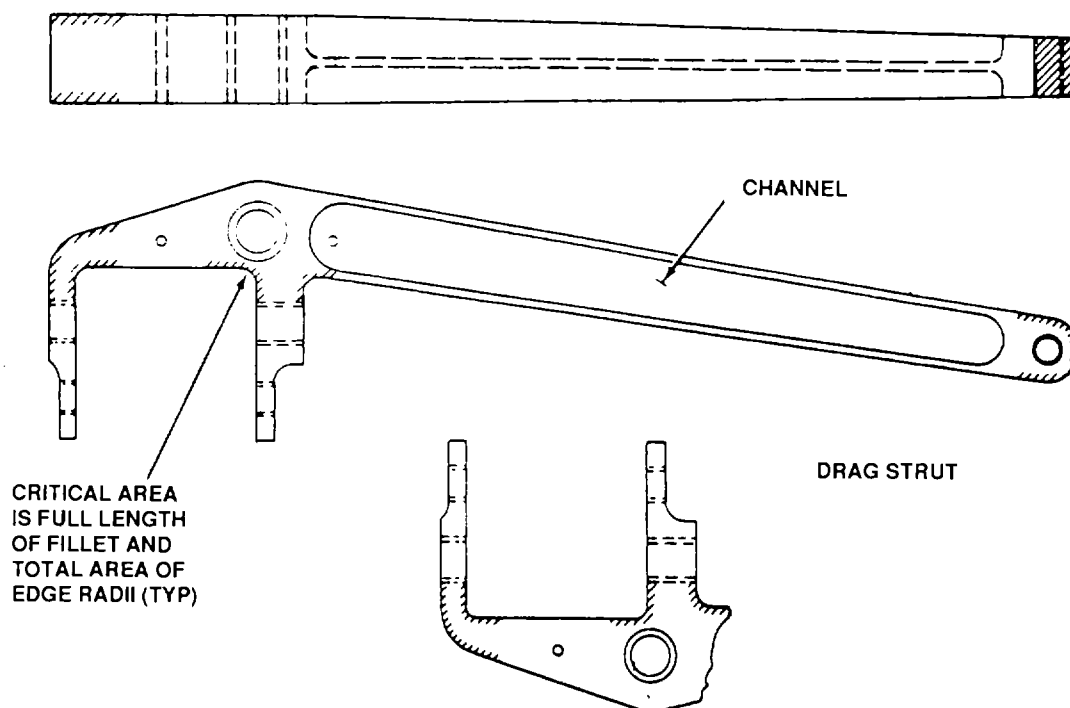


NO CRACKS PERMITTED

TYPE OF DAMAGE	MAXIMUM DEPTH ALLOWED	
NICKS, SCRATCHES	CRITICAL AREA 0.005 IN. ACCEPTABLE *0.015 IN. REPAIRABLE †	NON - CRITICAL AREA † 0.010 IN. ACCEPTABLE † 0.030 IN. REPAIRABLE †
	CORROSION *0.015 IN. REPAIRABLE †	0.030 IN. REPAIRABLE †

† EXCEPT FOR EXTERIOR SURFACES OF THE BUSHING FLANGE AND WASHER
 THESE LIMITS ARE: 0.030 IN. IS ACCEPTABLE.
 0.030 - 0.060 IN. IS REPAIRABLE TO 20% OF SURFACE AREA.
 * REWORK MAY EXTEND TO 100% OF SURFACE AREA.
 † BY POLISHING.

Figure 5-17D.1. Damage Limits - Root Fittings - P/N K747-083-1 (K747 Blade)



NO CRACKS PERMITTED

TYPE OF DAMAGE

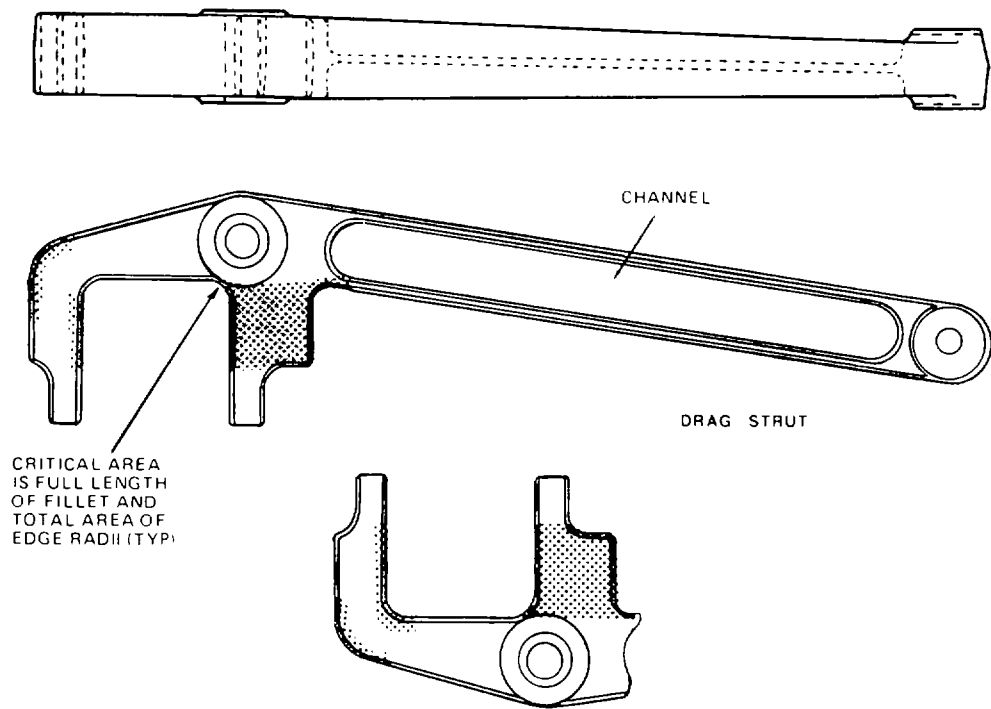
MAXIMUM DEPTH ALLOWED

	 CRITICAL AREA	 NON-CRITICAL AREA
NICKS, SCRATCHES	0.005 IN. ACCEPTABLE 0.015 IN. REPARABLE ‡	† 0.005 IN. ACCEPTABLE † 0.030 IN. REPARABLE ‡
DENTS		†† 0.020 IN. ACCEPTABLE
CORROSION	0.015 IN. REPARABLE ‡	*† 0.030 IN. REPARABLE ‡

NOTES

- † IF BOTH SURFACES OF THE CHANNEL MUST BE REWORKED, MINIMUM THICKNESS OF CHANNEL WELL SHALL BE 0.150 IN.
- †† PROVIDED DENT HAS RADIUS LARGER THAN 0.50 INCH. IF RADIUS IS SMALLER THAN 0.50 INCH AND DENT IS SHORT, TREAT AS NICK AND BLEND TO 0.020 IN.
- * REWORK MAY EXTEND TO 100% OF SURFACE AREA.
- ‡ BY POLISHING.

Figure 5-17E. Damage Limits - Drag Strut - P/N K747-072-1 (K747 Blade)



NO CRACKS PERMITTED

TYPE OF DAMAGE	MAXIMUM DEPTH ALLOWED	
	CRITICAL AREA	NON CRITICAL AREA
NICKS, SCRATCHES	0.005 INCH ACCEPTABLE ±0.015 INCH REPAIRABLE	±0.005 INCH ACCEPTABLE †±0.030 INCH REPAIRABLE
DENTS		†±0.020 INCH ACCEPTABLE
CORROSION	±0.015 INCH REPAIRABLE	†*±0.030 INCH REPAIRABLE

† IF BOTH SURFACES OF THE CHANNEL MUST BE REWORKED, MINIMUM THICKNESS OF CHANNEL WELL SHALL BE 0.150 INCH.

†† PROVIDED DENT HAS RADIUS LARGER THAN 0.50 INCH. IF RADIUS IS SMALLER THAN 0.50 INCH AND DENT IS SHORT, TREAT AS NICK AND BLEND TO 0.020 INCH

* REWORK MAY EXTEND TO 100% OF SURFACE AREA

± BY POLISHING.

Figure 5-17E.1. Damage Limits - Drag Strut - P/N K747-082-1 (K747 Blade)

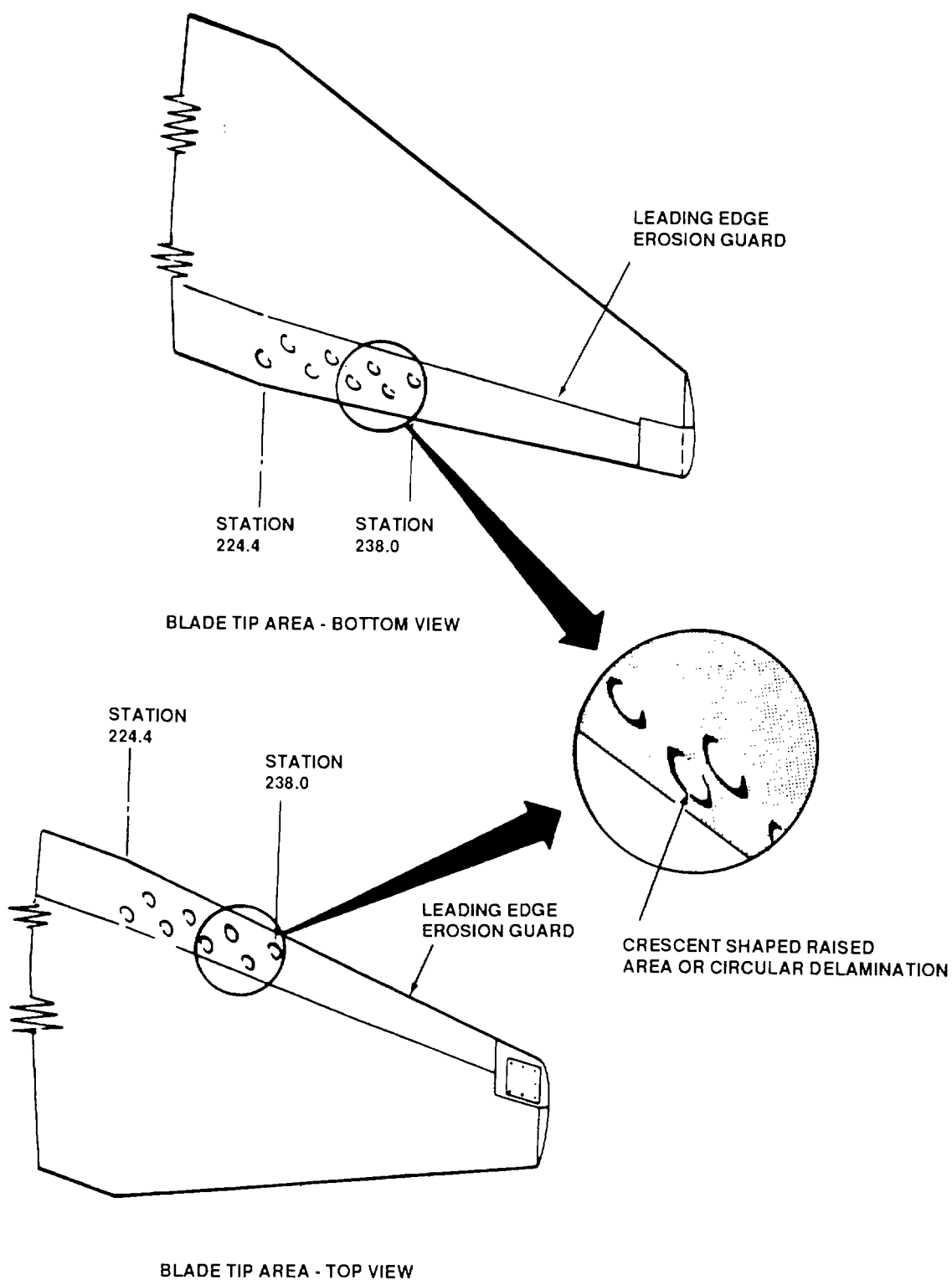


Figure 5-17F. Inspection of K747-003-205/-309, 209/-401, and -303/-403 Blade for Loss of Blade Weight Retention Integrity.

(1) Blade shall have only damage that is listed as repairable or acceptable in table 5-1B and table 5-1C, and damage shall not be in any area previously repaired. Damage listed as acceptable shall not be repaired.

(2) All required repairs shall be within the proximity limits shown in figure 5-17G.

(3) Blade shall contain sufficient existing balance weight to permit adjustment of blade balance as shown in figure 5-17H.

(4) Blades showing evidence of blade weight retention failure as defined in paragraph 5-5F shall not be repaired.

b. Main rotor blades not meeting the requirements of step a. above, shall be replaced.

WARNING

K747 main rotor blades shall not be intermixed with main rotor blades of any other type on the same helicopter, because of performance difference.

NOTE

The following repairs can be made on the top and bottom of main rotor blade while blades are installed on helicopter. When repair limits are questioned, proceed to next critical repair procedure.

5-5H. REMOVAL AND REPLACEMENT OF ROOT FITTING - K747 MAIN ROTOR BLADES (K747-003-205, -209, AND -303 BLADES).

a. Remove K747 main rotor blade assembly (paragraph 5-5C).

b. Remove cotter pin (1, figure 5-17J), nut (2), washers (3), bushing (3.1), and bolt (4).

c. Remove cotter pins (5 and 10), nuts (6 and 11), washers (7, 12 and 12.1), and bolts (9 and 14). Using tapered pin, gently drive bushings (8 and 13) aft to remove.

d. Remove drag strut (15) and set aside.

NOTE

Drag strut (15) is not interchangeable between rotor blades and must be reinstalled to match up with the rotor blade from which it was removed.

e. Remove cotter pins (16), nuts (17), washers (18, 19, and 21), and bolt (22) to remove root fitting (23). Do not remove bushings (20).

f. Replace root fitting (23) with a serviceable root fitting.

g. To install root fitting (23), position on blade, using a soft-headed mallet.

h. Insert two locator pins, to assure holes are in alignment. Dowel pins are acceptable.

i. Remove top locator pin and install washers (21) as required on bolt (22). Drive bolt into position using soft-headed mallet.

j. Remove lower locator pin and install washers (21) as required on bolt (22). Drive bolt into position using soft-headed mallet.

k. Install washers (18 and 19) and nut (17) on each bolt (22).

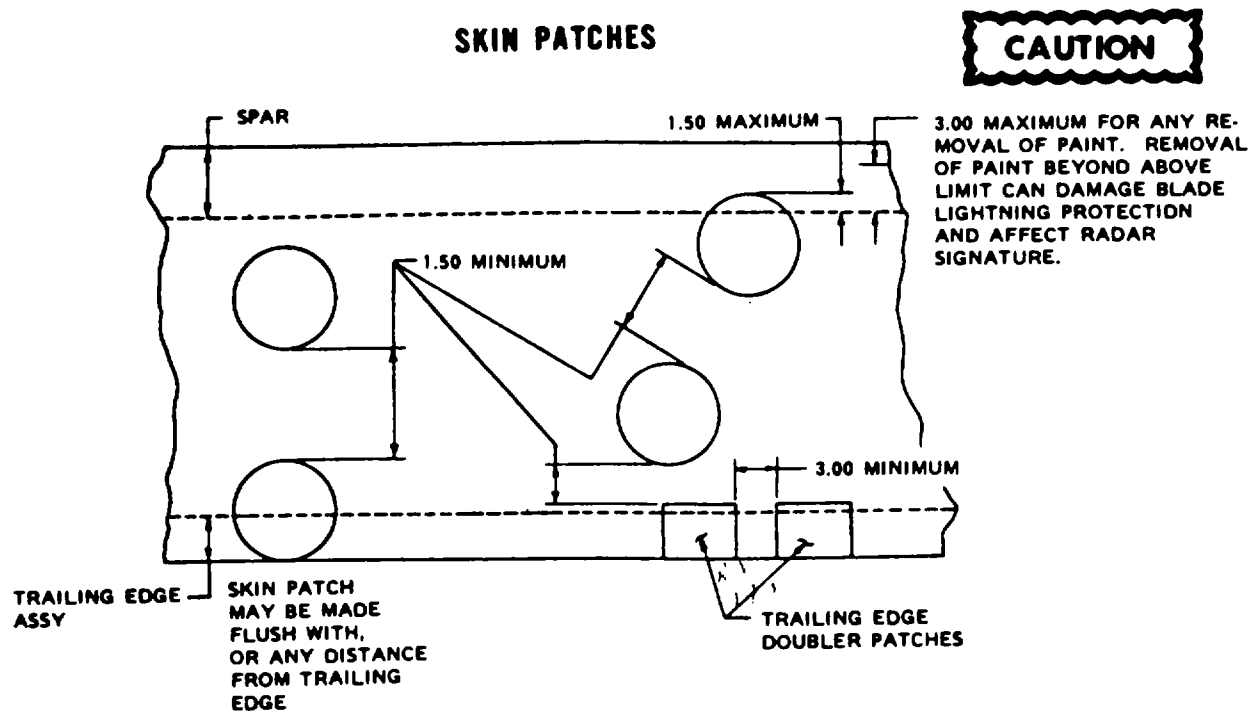
l. Draw nuts up tight to ensure bolt heads are properly seated. This prevents any possibility of false readings when torquing nuts to specification.

m. Back off nuts for torquing. Torque nuts 30 to 150 inch-pounds. Adjust to ensure cotter pin hole alignment. Shim as necessary to gain hole alignment within torque range. Use washers (19) for shimming.

n. Install new cotter pin (16) in bolts. Trim cotter pin length. Bend long cotter pin length over end of bolt and short length towards bolt head.

o. Position drag strut (15) on blade. Align aft inboard and outboard bushings of drag strut with bushing holes in trailing edge wrap fitting.

p. Install aft inboard bushing (8) and outboard bushing (13). Use a soft-headed mallet, if necessary. Install bushing in aft to forward direction (trailing edge).



NOTE

FOR EACH KIND OF PATCH (SKIN, TRAILING EDGE, OR PLUG) MINIMUM PROXIMITY LIMITS SHOWN FOR DISTANCES BETWEEN PATCHES ARE ALSO THE MINIMUM PROXIMITY LIMITS BETWEEN THE PATCH SHOWN AND:

1. CHEEK PLATES
2. DOUBLES
3. ANY OTHER PATCH OF ANY KIND

ALL DIMENSIONS ARE IN INCHES

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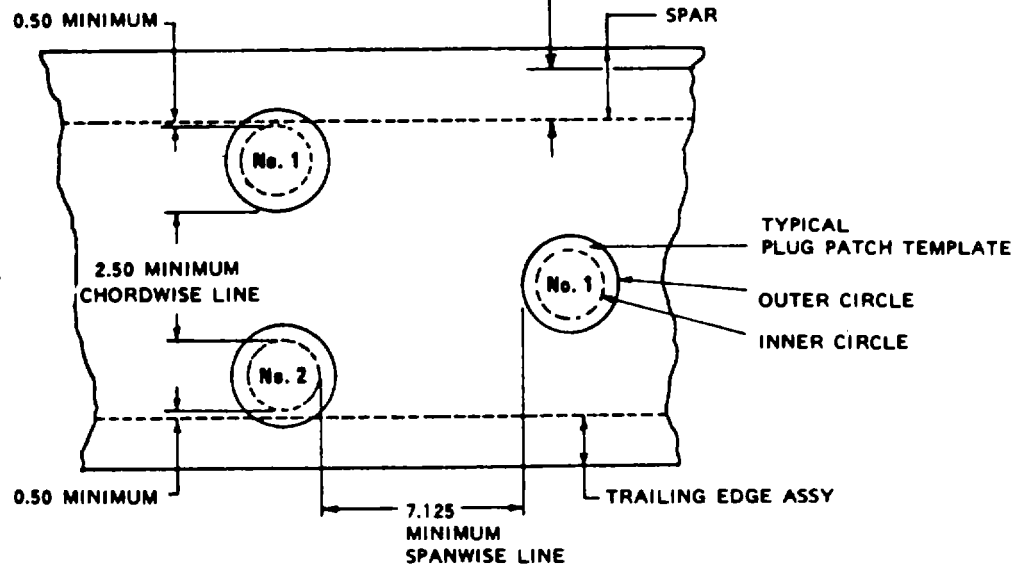
Figure 5-17G. Proximity Limits for Patches - K747 Main Rotor Blades (Sheet 1 of 3)

CAUTION

PLUG PATCHES

3.00 MAXIMUM FOR ANY REMOVAL OF PAINT. REMOVAL OF PAINT BEYOND ABOVE LIMIT CAN DAMAGE BLADE LIGHTNING PROTECTION AND AFFECT RADAR SIGNATURE.

USE DIMENSIONS SHOWN ON SHEET 3 TO ASSURE THAT INNER CIRCLE OF PLUG PATCH TEMPLATE IS 0.50 MINIMUM FROM SPAR OR TRAILING EDGE ASSY.



NOTE

FOR EACH KIND OF PATCH (SKIN, TRAILING EDGE, OR PLUG) MINIMUM PROXIMITY LIMITS SHOWN FOR DISTANCES BETWEEN PATCHES ARE ALSO THE MINIMUM PROXIMITY LIMITS BETWEEN THE PATCH SHOWN AND:

1. CHEEK PLATES
2. DOUBLES
3. ANY OTHER PATCH OF ANY KIND

ALL DIMENSIONS ARE IN INCHES.

208747-5-2

Figure 5-17G. Proximity Limits for Patches - K747 MAIN ROTOR BLADES (Sheet 2 of 3)

NOTE

THESE DIMENSIONS APPLY TO BOTH TOP AND BOTTOM OF BLADE.

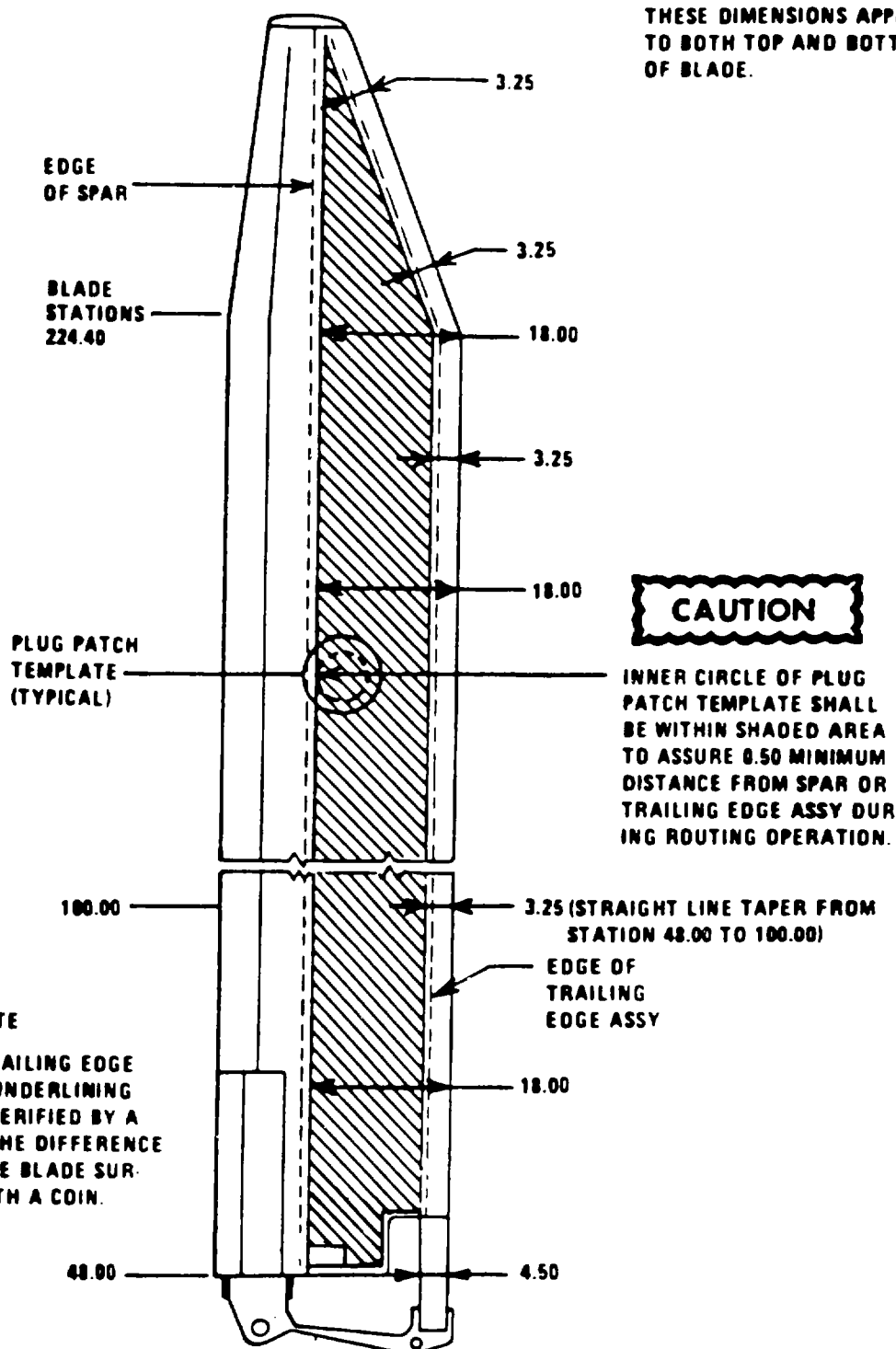
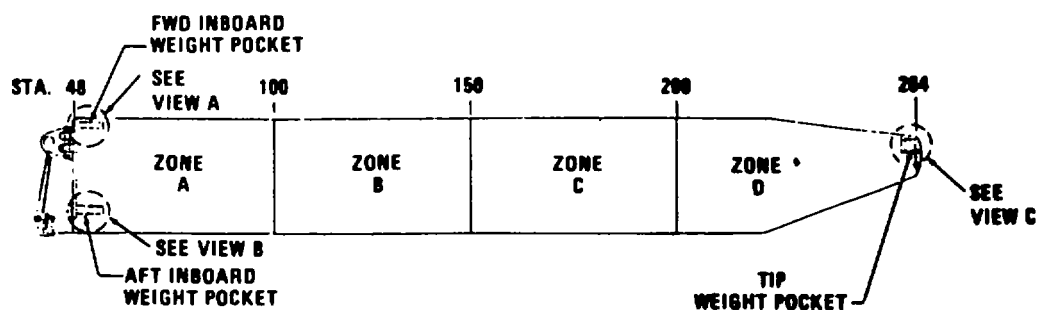


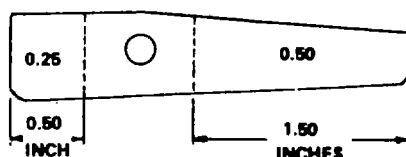
Figure 5-17G. Proximity Limits for Patches - K747 Main Rotor Blades (Sheet 3 of 3)



TYPE OF PATCH	SPANWISE CORRECTION SEE NOTES 1 AND 2				CHORDWISE CORRECTION SEE NOTE 3
	ZONE A	ZONE B	ZONE C	ZONE D	QUANTITY OF WEIGHTS
TRAILING EDGE DOUBLER	0.75	1.25	1.75	2.00	3
3 - IN. SKIN	0.00	0.25	0.25	0.25	0
5 - IN. SKIN	0.50	0.75	1.00	1.25	1
9 - IN. SKIN	1.25	2.00	2.75	3.75	3
3 x 0.25 - IN. PLUG	0.25	0.75	1.00	1.25	1
3 x 0.50 - IN. PLUG	0.50	0.75	1.00	1.25	1
3 x 1.25 - IN. PLUG	0.75	1.25	1.75	2.00	1
3 x 1.75 - IN. PLUG	0.75	1.25	1.75	2.00	1
7 x 0.25 - IN. PLUG	1.75	2.75	3.75	4.75	4
7 x 0.50 - IN. PLUG	1.75	2.75	3.75	4.75	4
7 x 1.25 - IN. PLUG	2.25	3.75	5.00	6.25	4
7 x 1.75 - IN. PLUG	2.50	4.25	5.75	7.00	4
EROSION GUARD PATCH (SEE NOTE 4)	0.50	0.75	1.00	1.25	1

NOTES

1. Remove listed quantity of K747-063-11 tip weights for each patch made in each zone. See view C, sheet 2.
2. To remove partial K747-063-11 tip weights, cut off 0.25 and/or 0.50 using following dimensions:



3. Move listed quantity of K747-056-11 weight washers from aft inboard weight pocket to forward inboard weight pocket for each blade patch made. See views A and B, sheet 2.
4. For each leading edge erosion guard patch made, move one K747-056-11 weight washer from forward inboard weight pocket to aft inboard weight pocket. See views A and B, sheet 2.
5. If a single patch is in two zones, use data for the most outboard of the two zones.

Figure 5-17H. Balance Adjustment for Patches (K747 Blade) (Sheet 1 of 2)

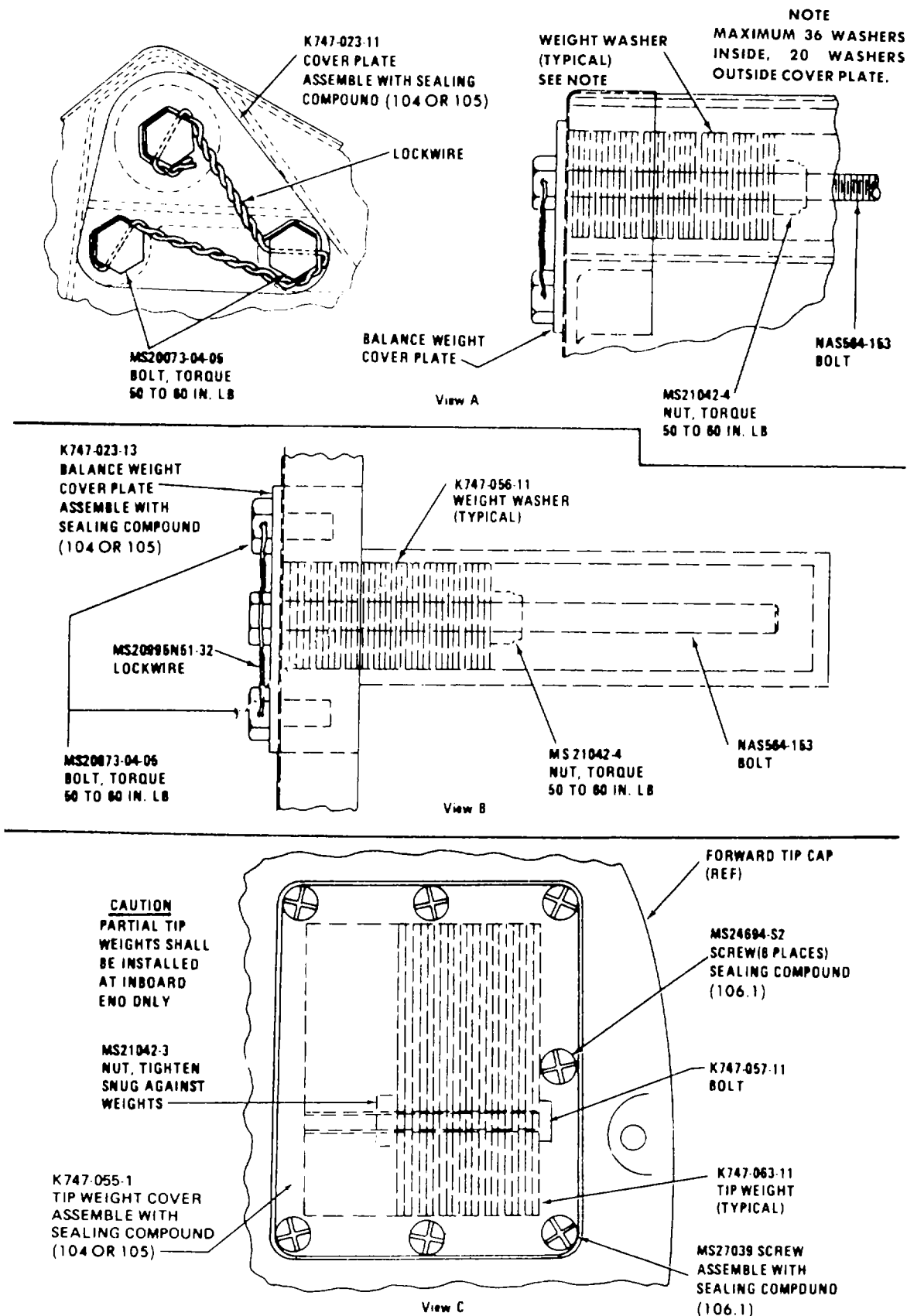
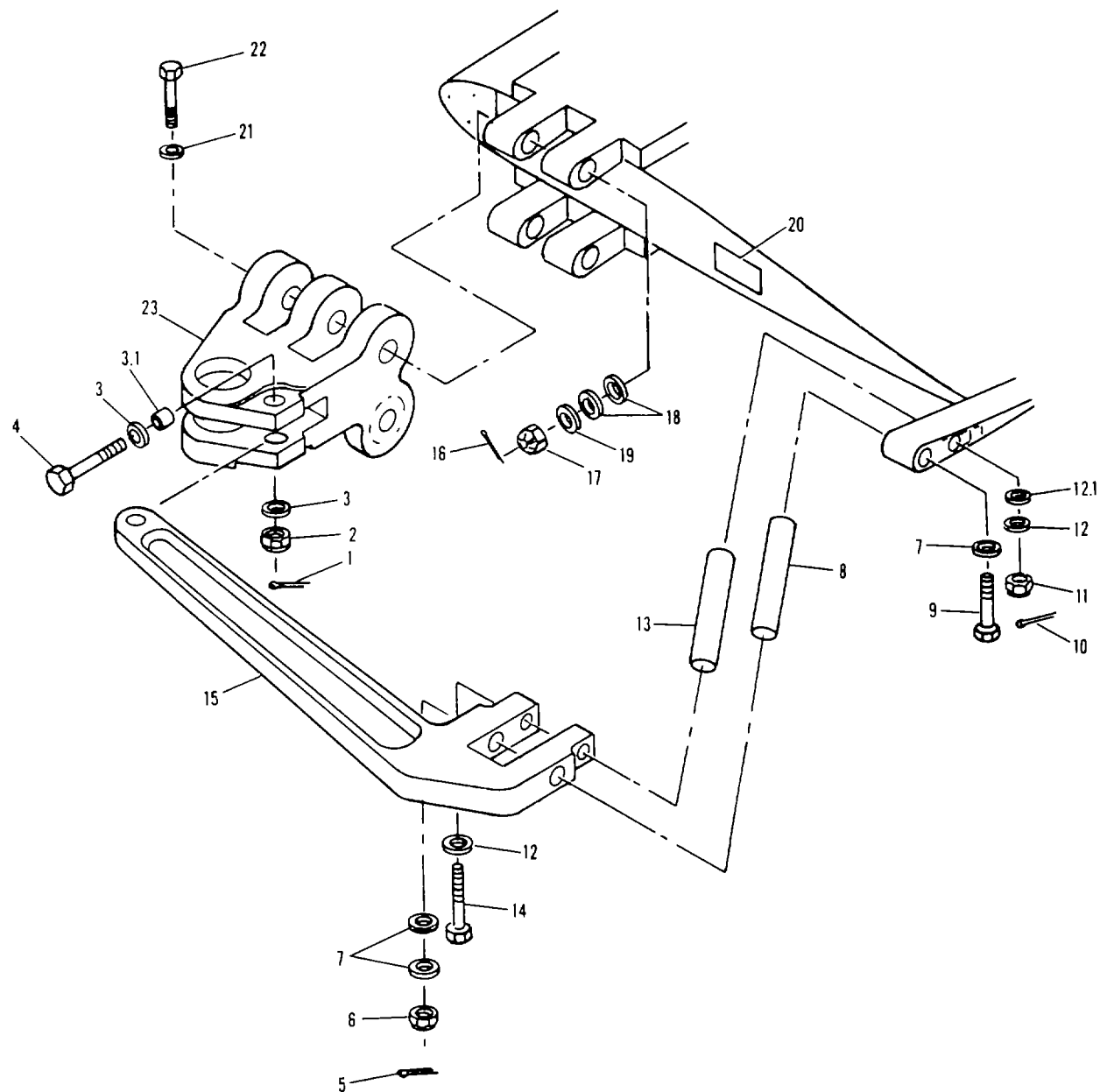


Figure 5-17H. Balance Adjustment for Patches (K747 Blade) (Sheet 2 of 2)



- 1. COTTER
- 2. NUT
- 3. WASHER
- 3.1. BUSHING
- 4. BOLT
- 5. COTTER PIN
- 6. NUT
- 7. WASHER
- 8. BOLT
- 10. COTTER PIN
- 11. NUT
- 12. WASHER

- 12.1. WASHER
- 13. BUSHING
- 14. BOLT
- 15. DRAG STRUT
- 16. COTTER PIN
- 17. NUT
- 18. WASHER
- 19. WASHER
- 20. PLATE, IDENTIFICATION
- 21. WASHER
- 22. BOLT
- 23. ROOT FITTING

Figure 5-17J. Root Fitting Assembly (K747-205, -209, -303 Blades)

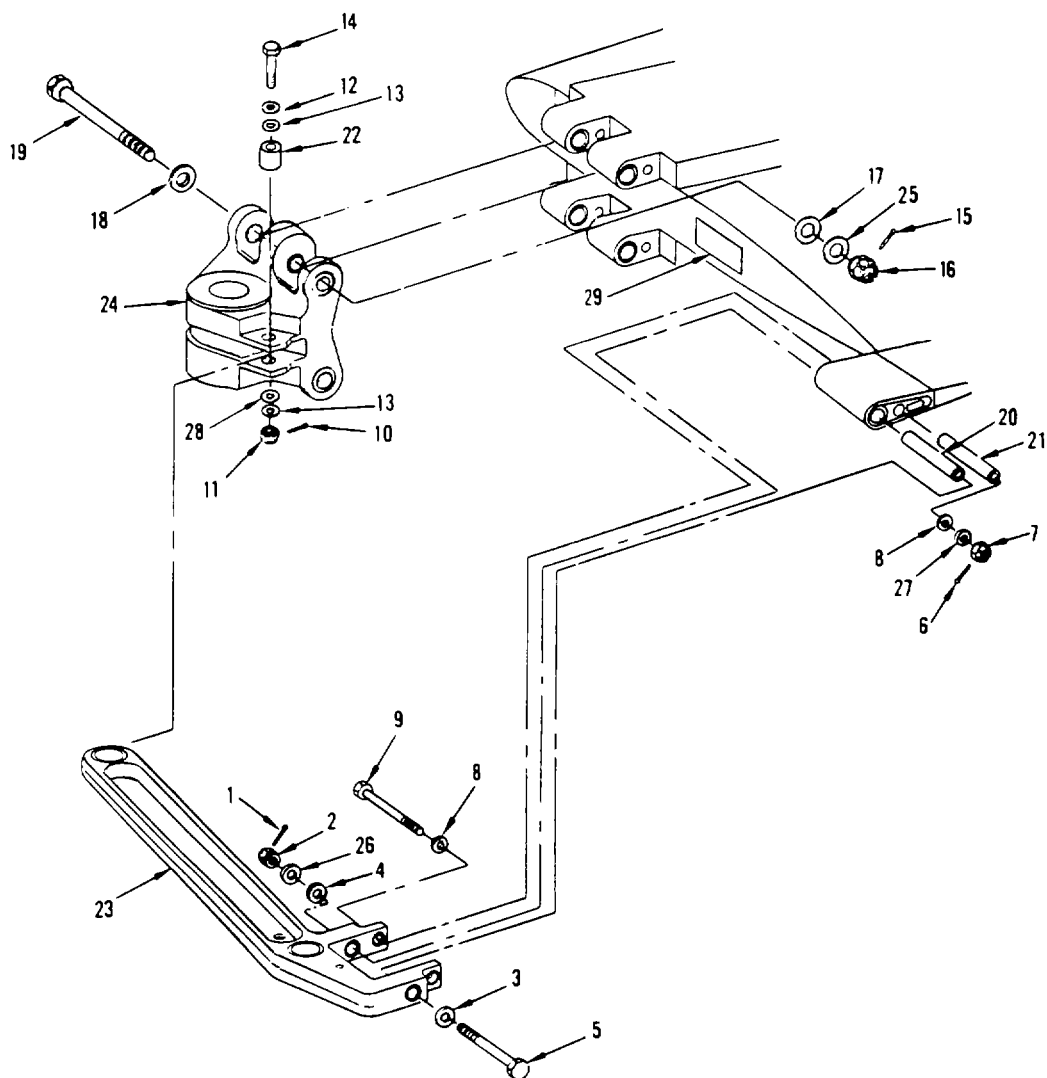


Figure 5-17J.1. Root Fitting Assembly (K747-309, -401, -403 Blades) (Sheet 1 of 2)

Change 65 5-30Z.1

1. COTTER PIN
2. NUT
3. WASHER
4. WASHER
5. BOLT
6. COTTER PIN
7. NUT
8. WASHER
9. BOLT
10. COTTER PIN
11. NUT
12. WASHER
13. WASHER
14. BOLT
15. COTTER PIN
16. NUT
17. WASHER
18. WASHER
19. BOLT
20. BUSHING, INBOARD
21. BUSHING, OUTBOARD
22. BUSHING, SLIP FIT
23. DRAG STRUT
24. ROOT FITTING
25. WASHER
26. WASHER
27. WASHER
28. WASHER
29. PLATE IDENTIFICATION

Figure 5-17J.1. Root Fitting Assembly (K747-309, -401, -403 Blades)
(Sheet 2 of 2)

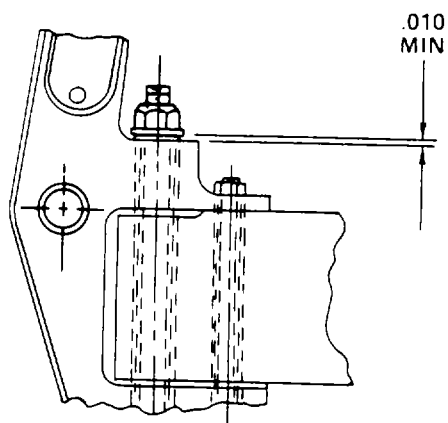


Figure 5-17J.2. Drag Strut Assembly (K747-309, -401, -403 Blades)

Change 65 5-30Z.3/(5-30Z.4 blank)

q. Install washer (7) on inboard bolt (9). Insert bolt (9) through trailing edge wrap fitting and drag strut (15) in an aft to forward direction. Use a soft-headed mallet. Install washer (7) and nut (6) on bolt (9).

r. Install washers (12 and 12.1) on outboard bolt (14). Insert bolt (14) through drag strut (15) and trailing edge wrap fitting in forward to aft direction. Use a soft-headed mallet. Install washer (12) and nut (11) on bolt (14).

s. Install bushing (3.1) in root fitting (23). Install washer (3) on bolt (4). Insert bolt (4) through root fitting (23) and drag strut (15). Install washer (3) and nut (2).

t. Draw nuts (2, 6, and 11) up tight to ensure bolt heads are properly seated. This prevents any possibility of false readings when torquing nuts to specification.

u. Torque nut (6) to 480 to 540 inch-pounds. Ensure cotter pin hole alignment. Torque nuts (2 and 11) to 120 to 150 inch-pounds. Ensure cotter pin alignment.

v. Install new cotter pins (1, 5, and 10). Trim cotter pin length. Bend long cotter pin of bolt and short length towards bolt head.

5-5H.1. REMOVAL AND REINSTALLATION OF ROOT FITTING-K747 MAIN ROTOR BLADES (K747-003-309, -401, -403 BLADES).

a. Remove K747 main rotor blade assembly (paragraph 5-27).

b. Remove cotter pins (1 and 6, Figure 5-24.2), nuts, (2 and 7), washers (3, 4, 8, 26, 27), and bolts (5 and 9), from drag strut at trailing edge wrap fitting.

c. Remove cotter pin (10), nut (11), washers (12, 13, and 28), and bolt (14), securing drag strut to root fitting.

d. Remove bushing (22) from leading edge of drag strut at root fitting.

CAUTION

Do not drive inboard aft drag strut bushing out in direction of leading edge. Irreparable damage to the drag strut could result. Support drag strut assembly during bushing removal.

e. Drive two bushings (20 and 21) out of drag strut and trailing edge wrap fitting in aft direction, supporting drag strut assembly during bushing removal, using a phenolic, aluminum, or wooden dowel and a soft-headed hammer. Keep dowel axis in line with axis of bushing being removed.

f. Remove drag strut from blade and set aside.

NOTE

Drag strut (23) is not interchangeable between rotor blades and must be reinstalled to match up with the rotor blade from which it was removed.

g. Remove cotter pins (15), nuts (16), washers (17, 18, 25), and bolts (19), to remove root fitting.

h. Replace root fitting (24) only if required. Refer to Table 5.1.1 and Figure 5-19.2.

i. To install root fitting (24), position on blade using a soft-headed mallet.

j. Insert two locator pins, to ensure holes are in alignment. Dowel pins are acceptable.

CAUTION

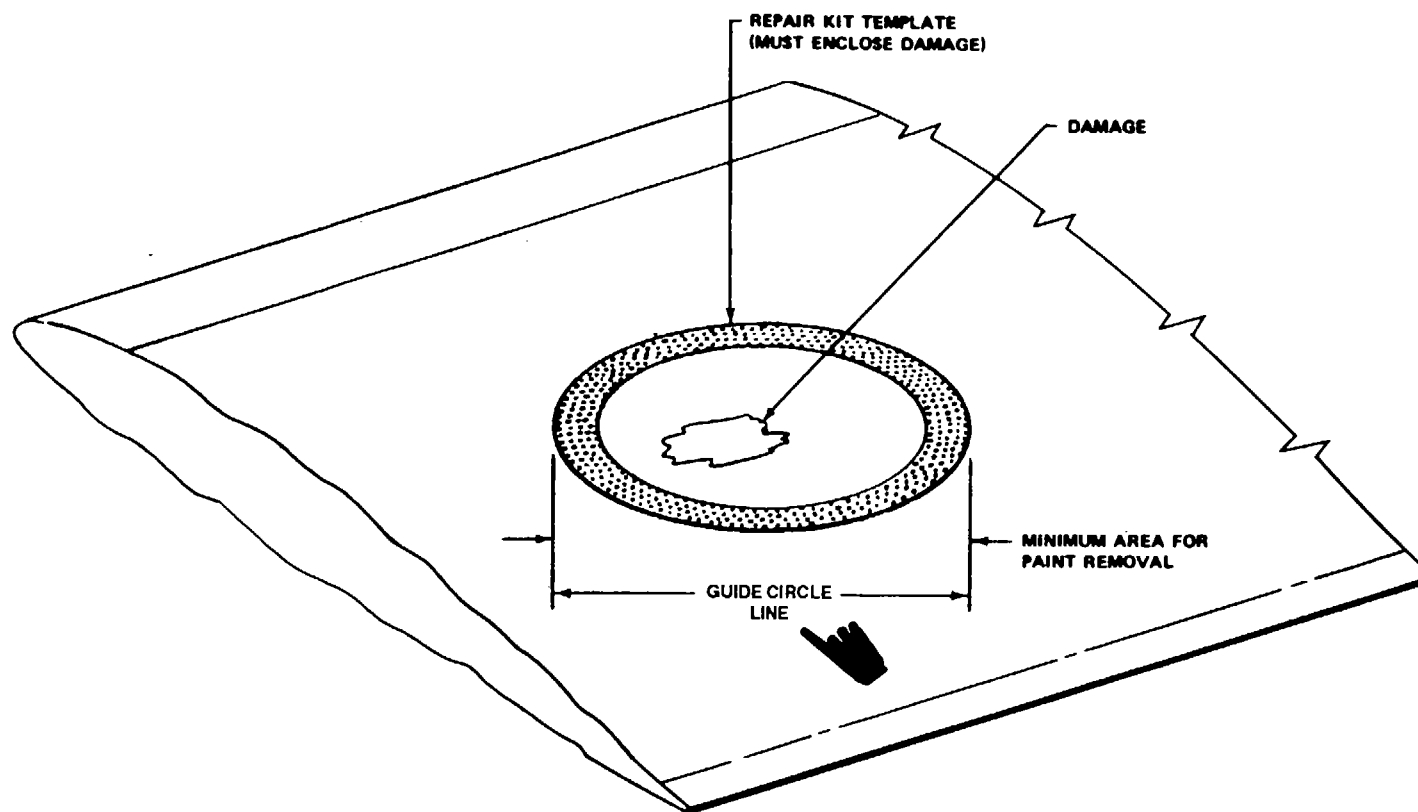
Beveled ID on washer (18) must face bolt head. Do not damage bolt threads or bushing bores when installing bolts.

k. Apply corrosion preventive compound, Brayco 599 (C44.1) to bolt shank. Remove top locator pin and install washer (18), beveled ID toward bolthead, on bolt (19). Drive bolt into position using a soft-headed mallet.

l. Apply corrosion preventive compound, Brayco 599 (C44.1) to bolt shank. Remove lower locator pin and install washer (18), beveled ID toward bolthead, on bolt (19). Drive bolt into position using a soft-headed mallet.

m. Install washer (17) under nut (16) on each bolt. If required, add washers (17 and/or 25) under nut (16) on each bolt to obtain cotter pin hole alignment.

n. Draw all nuts up tight to ensure boltheads are properly seated. This prevents any possibility of false readings when torquing nuts to specification.



View A. Marking work area

209747-7-1

Figure 5-17K. Application of Skin Patch (K747 Balde) (sheet 1 of 2)

o. Back off nuts for torquing. Torque nuts to 30 to 150 inch-pounds. Adjust to ensure cotter pin hole alignment.

p. Insert two cotter pins (15) in bolts. Bend long cotter pin length over end of bolt and bend short length toward bolthead.

q. Position drag strut (23) on blade. Align aft inboard and outboard bushings with bushing holes in trailing edge spline wrap fitting.

r. Apply corrosion preventive concentrate, Brayco 599 (C44.1), to the outside diameters and install aft inboard and outboard bushings (20 and 21) in an aft-to-forward direction, using a soft-headed mallet, if necessary.

s. Install washer (3), with bevel to bolthead, on larger bolt (5). Apply corrosion preventive concentrate, Brayco 599 (C44.1), to bolt shank and insert bolt through drag strut and trailing edge wrap fitting in an aft-to-forward direction. Check for binding; none allowed. Install washer (4) and castellated nut (2) on bolt (5). If required, add washers (4 and/or 26) under nut (2) to obtain cotter pin hole alignment.

NOTE

This stack-up may be capable of being turned by hand after proper installation.

t. Install washer (8) on smaller outboard bolt (9). Apply corrosion preventive concentrate Brayco 599 (C44.1) to bolt shank and insert bolt through drag strut and trailing edge spline wrap fitting in forward-to-aft direction. Install washer (8) and castellated nut (7) on bolt. If required, add washers (8 and/or 27) under nut (7) to obtain cotter pin hole alignment.

NOTE

A loose slip fit of this installation stack-up is acceptable.

u. Apply corrosion preventive concentrate, Brayco 599 (C44.1), to outside diameter of slip fit bushing (22) and install bushing in top clevis of root fitting.

v. Ensure that slip fit bushing (22) has been in-

stalled, then install washer (12), with bevel to bolt head, and washer (13) on bolt (14). Apply corrosion preventive concentrate Brayco 599 (C44.1) to bolt shank and insert bolt through root fitting and drag strut from root fitting top side. Install washer (13) and castellated nut (11) on bolt. If required, add washers (13 and/or 28) under nut (11) to obtain cotter pin hole alignment.

w. Ensure that head of bolt (5) and washer (3) are flush against the aft surface of the drag strut. If necessary, tap bolthead forward using a soft headed mallet.

NOTE

To improve fatigue-loading capabilities of the drag strut at the inboard connection to blade trailing edge, there shall be a minimum of 0.010 inch clearance between washer(s) and forward surface of fitting after torquing. (Figure 5-24.3)

x. Torque large inboard nut (2, Figure 5-24.2) to 480 to 540 inch-pounds to include torque drag. Ensure cotter pin hole alignment.

y. Torque smaller outboard nut (7) to 120 to 150 inch-pounds to include torque drag. Ensure cotter pin hole alignment.

z. Torque root fitting nut (11) to 300 to 420 inch-pounds to include torque drag. Ensure cotter pin hole alignment.

aa. Install new cotter pins (1, 6, and 10). Trim cotter pin length. Bend long cotter pin length over end of bolt and bend short length toward bolt head. Ensure that no sharp edges are exposed.

5-5J. POLISHING AND CORROSION TREATMENT-K747 MAIN ROTOR BLADES (AVUTM).

a. Polish out nicks, scratches, and corrosion on exposed metallic parts with No. 320 or finer sandpaper (C112) and touchup as required in accordance with paragraph 5-5AC.

b. Repairs requiring removal of drag strut (15, figure 5-17A) may be made by removing attaching hardware. Following repairs as specified in step a. above, reinstall drag strut using figure 5-17A as a guide.

5-5K. APPLICATION OF SKIN PATCH-K747 MAIN ROTOR BLADES (AVIM).**CAUTION**

Blade must contain sufficient balance weight to permit adjustment of blade balance after repair. Refer to paragraph 5-5G before starting any repair.

Grease or lead pencils will not be used. Only ball point pens will be used to make lines as shown. Marks other than those specified can weaken the repair.

- a. Obtain blade repair tool set P/N K747-401-1 (T91).
- b. Position blade for access to damaged area (figure 5-17K). Support blade to prevent movement and droop.
- c. Measure diameter of damage.
- d. Obtain adhesive package (C7A) or alternate (C17).
- e. Obtain skin patch repair kit no larger than necessary to overlap damage 1 inch all around. Skin

patch kits are available in the following sizes.

Kit No.	Patch Diameter
K747-201-1	3 inch
K747-201-3	5 inch
K747-201-5	9 inch

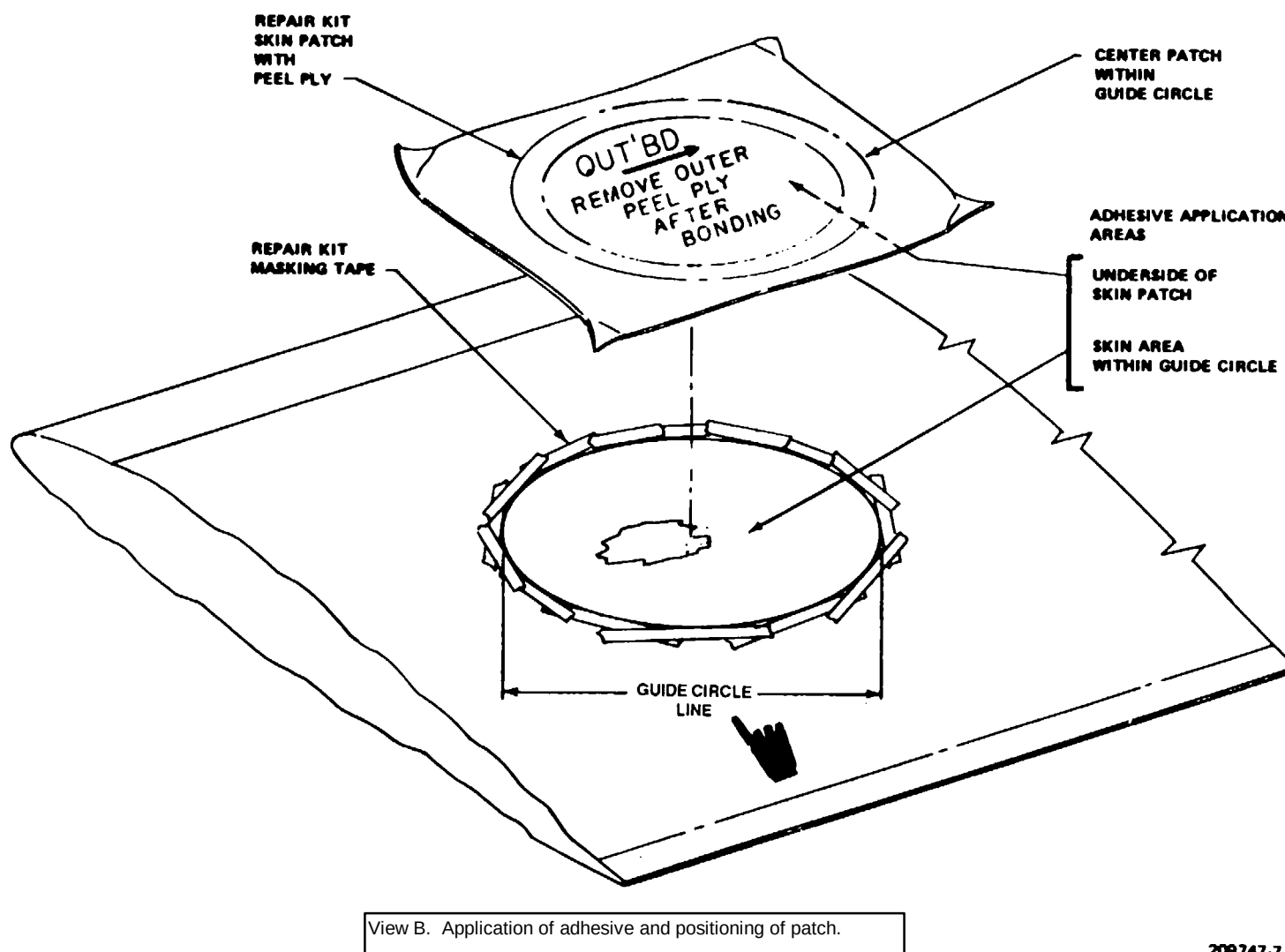
f. Damage passing through both skins with core damage of less than 1 inch diameter shall be repaired by applying a skin patch to both top and bottom sides of blade.

g. Place the template (kit) on the blade. Position the inner circle to enclose the damage. Hold the template from slipping, and draw a line around the outer circle of the template (View A, figure 5-17K).

CAUTION

Excessive sanding will weaken blade skin. Sand only until yellow color is removed.

h. Starting with 120 grit and finishing with 220 grit abrasive paper (kit), sand the paint and yellow primer from the blade from the area within the guide circle. Sand only until yellow color is removed. Do not sand skin fibers. Also, sand off any damaged material raised above normal contour of blade (View A, figure 5-17K).



208747-7-2

Figure 5-17K. Application of Skin Patch (K747 Blade) (Sheet 2 of 2)

Change 67 5-30AC

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

CAUTION

Care shall be taken to prevent MEK from entering core area of blade. Spillage shall be avoided. MEK can damage leading edge erosion guard.

i. Put on cotton gloves (kit), then plastic gloves (kit). Leave on until completion of step r. Dampen cheesecloth (kit) with MEK (C 87).

j. Wipe off all sanding dust.

k. Use template to redraw guide circle.

l. Cut short lengths of the masking tape (kit) and mask around the outside of guide circle (View B, figure 5-17K).

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

CAUTION

Care shall be taken to prevent MEK from entering core area of blade. Spillage shall be avoided. MEK can damage leading edge erosion guard.

m. Dampen clean cheesecloth (kit) with MEK (C87) and clean inside masked area. Wipe with clean dry cheesecloth before dampness evaporates.

WARNING

Adhesive contains toxic ingredients. Provide adequate ventilation and protect the skin and eyes from contact with uncured resins or curing agent. Wash off uncured resins and curing agent from skin with warm water and soap. Avoid use of solvents for cleaning the skin.

NOTE

Never mix less than a complete two-part package of adhesive (C7A). Mix the full batch and then discard the excess after the repair is completed.

n. Mix adhesive (C7A) per manufacturer's instructions. Stir with wooden spatula until color is uniform and all streaks have disappeared. Adhesive (C17) may be used as an alternate.

NOTE

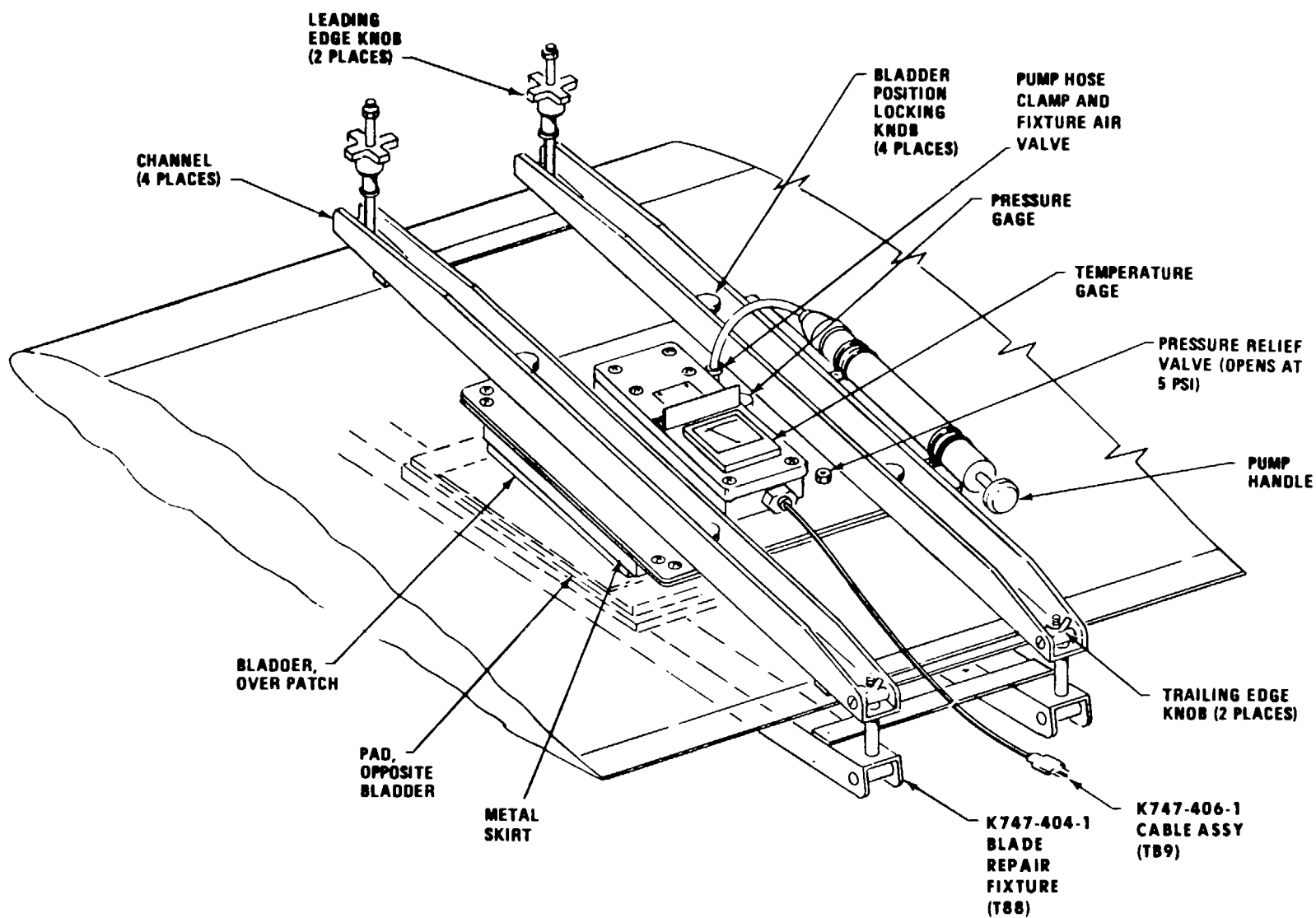
Pot life of adhesive (C7A) is 15 minutes at 75 degrees F (23.8 degrees C). It is shorter at higher temperatures. Always check package dates to make sure the maximum adhesive life time limit of 1 year is not exceeded. Pot life of adhesive (C17) is approximately 1/2 to 1 hour at 75 degrees F (23.8 degrees C).

o. Using clean one inch brush (kit), apply a light coat of adhesive to blade skin, within guide circle, and to underside of skin patch (View B, figure 5-17K).

p. Center skin patch within guide circle, with stenciled arrow pointing outboard (spanwise), and press firmly into place. Slide patch back and forth slightly under hand pressure to even adhesive. Use light hand pressure to squeeze the patch from the center to edge to work out any air bubbles.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.



209-747-8

Figure 5-17L. Curing Patch with Blade Repair Fixture (K747 Blade)

Change 49 5-30AE

CAUTION

Care shall be taken to prevent MEK from entering core area of blade. Spillage shall be avoided. MEK can damage leading edge erosion guard.

q. Using clean cheesecloth (kit) dampened with MEK (C87), temporarily lift edges of peel-ply and wipe off excess adhesive.

r. Place masking tape over edge of patch in four places to prevent movement of patch. Place two long pieces of masking tape at right angles, centered over the patch spanwise and chordwise and extending beyond the dimensions of the blade repair fixture bladder.

s. Install blade repair fixture (T88) (figure 5-17L).

(1) Install from trailing edge side of blades only.

(2) Center bladder over repair area and secure.

(3) Center pad opposite bladder and secure.

CAUTION

Tightening of locking knobs so that metal skirt around bladder is closer than 0.125 inch to blade can damage blade.

(4) Tighten fixture channel locking knobs until metal skirt around bladder is approximately 0.125 inch from blade skin.

(5) Actuate hand pump to obtain 4 psi minimum reading on pressure gage. Disconnect pump hose clamp from air valve.

NOTE

During curing, it may be necessary to periodically reconnect hose and to actuate pump to maintain 4 psi minimum.

(6) Connect 110 volt ac electrical power for curing time shown in table 5-1D.

(7) At end of curing time, disconnect electrical

power and relieve air pressure by lifting center portion of relief valve.

t. Remove repair fixture from blade.

u. Refinish repair area.

(1) Remove peel-ply and masking tape from blade.

CAUTION

Sanding skin fibers can weaken blade.

(2) Using 220 or finer grit abrasive paper (kit), feather edge of adhesive squeeze-out around patch.

(3) Paint repaired area in accordance with paragraph 5-5AC.

v. Adjust blade balance weights as required by figure 5-17H.

w. K747 blade repairs are required to be logged in DA Form 2408-13 and -16. A permanent record must be maintained to determine the minimum spacing requirement between repairs. Once a repair has been made, it is not possible to determine which type of repair has been applied.

5-5L. INSTALLATION OF PLUG PATCH - K747 MAIN ROTOR BLADES (AVIM).

CAUTION

Blade must contain sufficient balance weight to permit adjustment of blade balance after repair. Refer to paragraph 5-5G before starting any repair.

a. Position blade for access to damaged area. Support blade to prevent movement and droop.

b. Measure diameter and depth of damage. (See figure 5-17M.)

c. Obtain plug patch repair kit no larger than necessary to replace damage. A core void 1 inch or less in diameter is permitted after repair. Plug patch kits are available as shown in table 5-1D.

d. Damage not more than 1.750 inches deep can be repaired with a single patch. Damage that passes completely through blade and is larger than 1 inch in diameter, will be repaired by installing plug patches from both top and bottom sides of blade. Install larger diameter and depth plug patch first figure (5-17N).

e. Obtain required number of adhesive packages (C7A) as shown in table 5-1D. If adhesive (C17) is used, obtain an equal amount.

CAUTION

Grease or lead pencils will not be used. Only ball point pens will be used to make lines as shown. Marks other than those specified can weaken the repair.

f. Place the template (kit) on the blade. Position the inner circle to enclose the damage. Hold the template from slipping and draw lines around the inner and outer circles of the template (View A, figure 5-17M).

CAUTION

Excessive sanding will weaken blade skin. Sand only until yellow color is removed.

g. Starting with 120 grit and finishing with 220 grit abrasive paper (kit), sand the paint and the yellow primer from the blade from the area between circles A and B. Sand only until yellow color is removed. Do not sand skin fibers (View A, figure 5-17M).

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

CAUTION

Care shall be taken to prevent MEK from entering core area of blade. Spillage shall be avoided. MEK can damage leading edge erosion guard.

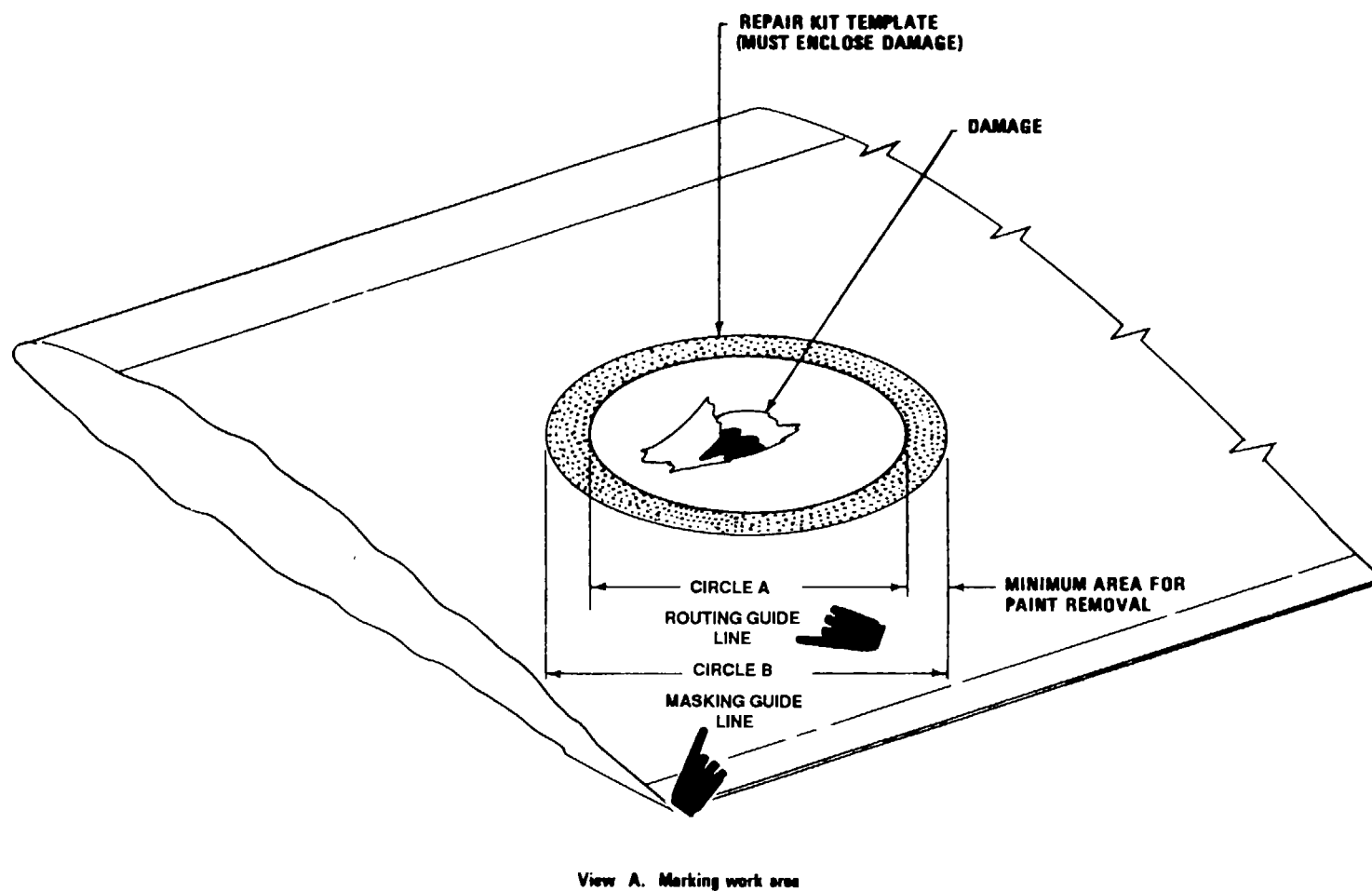
h. Put on cotton gloves (kit), then plastic gloves (kit). Dampen cheesecloth (kit) with MEK (C87). Wipe off sanding dust.

i. Redraw circle A. This circle is the routing guideline.

Table 5-1D. Plug Patch Data

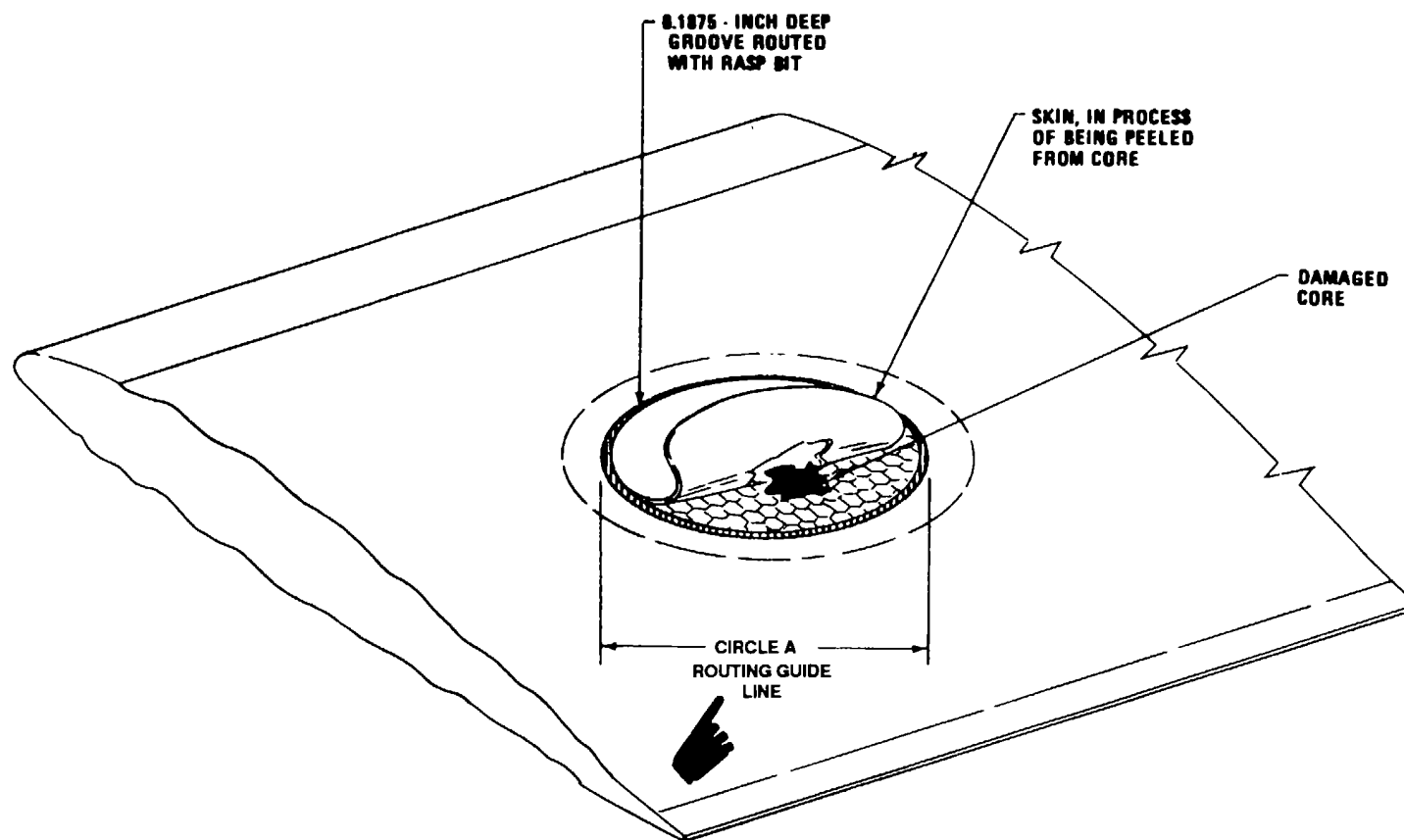
Kit Part No.	Plug Dia.	Plug Depth	Adhesive Pkg. Req. (32 gm each) See note	Patch Over Core Only	Minutes Cure Patch Over Core/Spar Core/Trailing Edge
K747-201-7	3 in.	0.250 in.	0.333	15	30
K747-201-9	3 in.	0.500 in.	0.333	15	30
K747-201-101	3 in.	1.250 in.	0.666	30	30
K747-201-103	3 in.	1.750 in.	1.0	30	30
K747-201-105	7 in.	0.250 in.	1.0	15	30
K747-201-107	7 in.	0.500 in.	1.250	15	20
K747-201-109	7 in.	1.250 in.	2.0	45	45
K747-201-111	7 in.	1.750	2.500	45	45

NOTE: 32 gm of mixed alternate adhesive (C17) bulk materials will be equal to one adhesive kit (C7A).



209747-9-1

Figure 5-17M. Installation of Plug Patch (K747 Blade (Sheet 1 of 4)



View B. Removal of damaged skin

209747-9-2

Figure 5-17M. Installation of Plug Patch (K747 Blade) (Sheet 2 of 4)

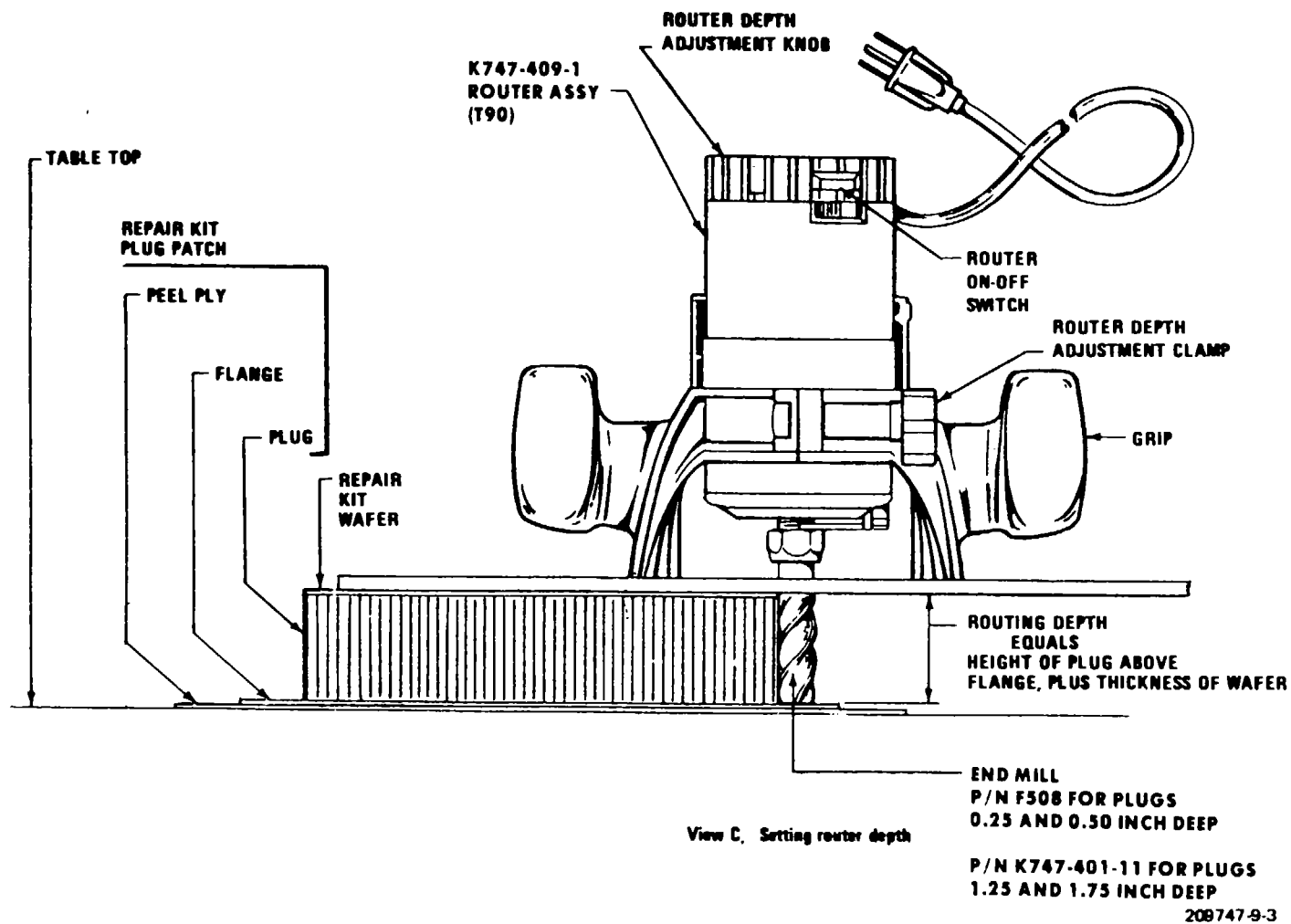
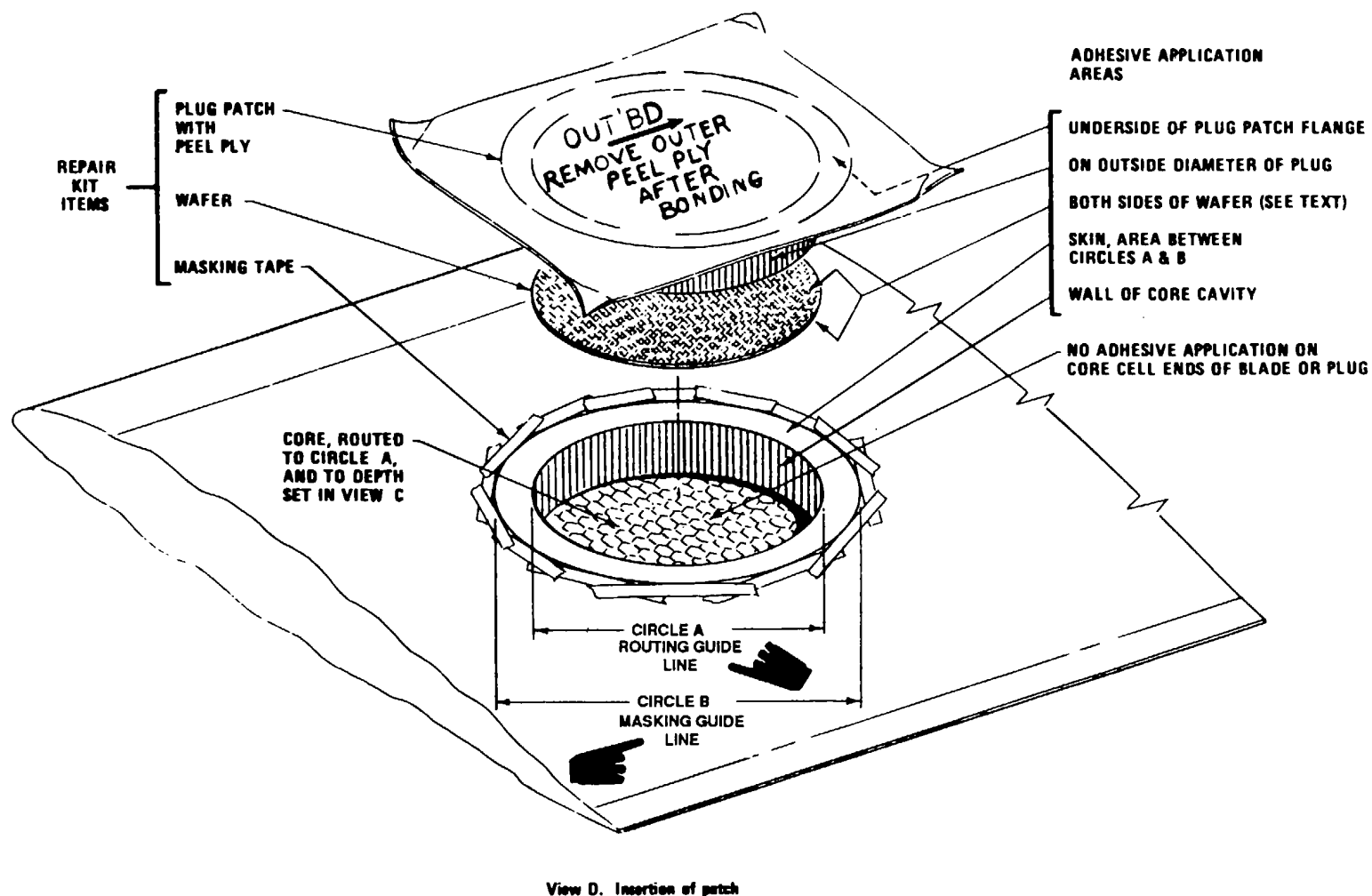
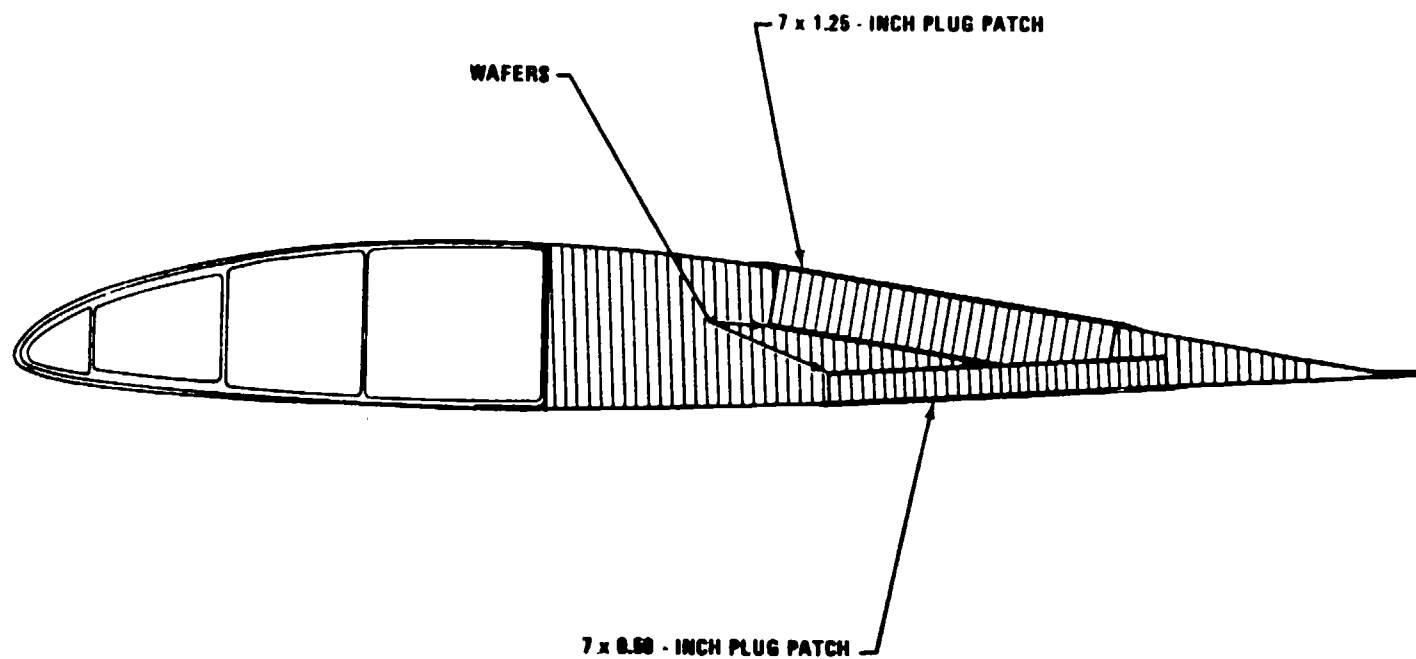


Figure 5-17M. Installation of Plug Patch (K747 Blade (Sheet 3 of 4))



209747-9-4

Figure 5-17M. Installation of Plug Patch (K747 Blade) (Sheet 4 of 4)



NOTE
LARGER PLUG PATCH
IS INSTALLED FIRST

200747-11



Figure 5-17N. Typical Double Plug Patch Repair (K747 Blade)

WARNING

Disconnect router cord from outlet before changing or installing bits or end mills, or making adjustments.

Ensure router switch is in off position before connecting router to electrical power.

Keep hands and fingers away from rotating bits and end mills.

Guide router with both hands on router grip.

Use personal protection equipment; respirator, goggles, apron, etc.

CAUTION

During all routing operations, long dimension of route base shall be kept in spanwise direction.

End mills will burn out if used to cut skin.

It is absolutely necessary to take every precaution not to damage the spar and trailing edge during routing. The spar in the leading edge and trailing edge can be located by using the instructions in figure 5-17G.

j. Insert rasp-type bit, P/N 4-BR, in router collet. Set router depth of cut for 0.1875 inch. Rout a complete circle through the skin, inside of, and following circle A (View B, figure 5-17M).

k. Using duckbill pliers, lift the edge of the cut circle of skin and peel the cut circle of skin off core (View B, figure 5-17M). After removing skin, check depth of core at trailing edge of circle. Core thickness at trailing edge side less than depth of plug selected will require use of more shallow plug or a double plug patch repair.

l. Insert end mill in router collet. Set router depth of cut to match depth of plug plus thickness of wafer (kit) (View C, figure 5-17M). Rout out core. First rout a complete circle, following inside circle A. Then rout out remainder of core moving router in chordwise direction (View D, figure 5-17M).

m. Wipe off all cuttings, sanding dust, etc. from repair area.

n. Use template to redraw circle B.

o. Cut short lengths of masking tape (kit) and mask around the outside of circle B (View D, figure 5-17M).

p. Put on cotton gloves (kit), then plastic gloves (kit). Leave on until completion of step y.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

CAUTION

Care shall be taken to prevent MEK from entering core area of blade. Spillage shall be avoided. MEK can damage leading edge erosion guard.

Surfaces to be bonded must be clean, dry, and free of finger prints and all foreign matter.

q. Dampen clean cheesecloth (kit) with MEK (C87) and clean skin inside masked area. Also, clean both sides of wafer (kit) and underside of plug patch flange. Wipe with clean, dry cheesecloth before dampness evaporates.

WARNING

Adhesive contains toxic ingredients. Provide adequate ventilation and protect the skin and eyes from contact with uncured resins or curing agent. Wash off uncured resins and curing agent from skin with warm water and soap. Avoid use of solvents for cleaning the skin.

NOTE

Never mix less than a complete two- part package of adhesive (C7A). When less than a full batch is required, mix the full batch and then discard the excess after the repair is completed.

Pot life of adhesive (C7A) is 15 minutes at 75 degrees F (23.8 degrees C). It is shorter at higher temperatures. Always check package dates to make sure the adhesive life limit of 1 year is not exceeded. Work without delay. Pot life of adhesive (C17) is approximately 1/2 to 1 hour at 75 degrees F (23.8 degrees C).

r. Mix adhesive (C7A) per manufacturer's instructions. Stir with wooden spatula until color is uniform and all streaks have disappeared. Repeat if more than one package is needed. Transfer adhesive to plastic coated paper cups.

s. Using clean one inch brush (kit), apply a liberal coat of adhesive to one side of wafer (kit) (View D, figure 5-17M).

t. If repair is on top of blade, place wafer in routed cavity with adhesive side down.

u. If blade is installed on helicopter and repair is on bottom of blade, place adhesive side of wafer against plug (kit) with open ends of plug core up.

CAUTION

Adhesive should not be packed into cells of blade core or plug patch. Excess adhesive can cause blade to be out of balance.

v. Using spatula or brush (kit), apply a liberal coat of adhesive to walls of cavity in blade core.

w. Using brush (kit), apply a light coat of adhesive to:

- (1) Blade skin in masked off area around core cavity.
- (2) Plug patch flange surrounding plug.
- (3) Outside diameter of plug.
- (4) Second side of wafer.

x. Position plug patch in cavity with stenciled arrow pointing outboard (spanwise) and press firmly into place. Use light hand pressure to squeeze patch area overlapping blade skin to expel excess adhesive and air bubbles.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

CAUTION

Care shall be taken to prevent MEK from entering core area of blade. Spillage shall be avoided. MEK can damage leading edge erosion guard.

y. Using clean cheesecloth (kit) dampened with MEK (C87), temporarily life edges of peel-ply and wipe off excess adhesive.

z. Place two long pieces of masking tape at right angles, centered over the patch spanwise and chordwise and extending beyond the dimensions of the blade repair fixture bladder.

aa. Install blade repair fixture (figure 5-17L).

- (1) Install from trailing edge side of blade only.
- (2) Center bladder over repair area and secure.
- (3) Center pad opposite bladder and secure.

CAUTION

Tightening of locking knobs so that metal skirt around bladder is closer than 0.125 inch to blade can damage blade.

(4) Tighten fixture channel locking knobs until metal skirt around bladder is approximately 0.125 inch from blade skin.

(5) Actuate hand pump to obtain 4 psi minimum reading on pressure gage. Disconnect pump hose clamp from air valve.

NOTE

During curing, it may be necessary to periodically reconnect hose, and to actuate pump to maintain 4 psi minimum.

(6) Connect 110 volt ac electrical power for curing time shown in table 5-1D.

(7) At end of curing time, disconnect electrical power, and relieve air pressure by lifting center portion of relief valve.

ab. Remove repair fixture from blade.

ac. Refinish repair area.

(1) Remove peel-ply and masking tape from blade.

CAUTION

Sanding skin fibers can weaken blade skin.

(2) Using 220 grit abrasive paper (kit), feather edge of adhesive squeeze out around plug patch.

(3) Paint repaired area in accordance with paragraph 5-5AC.

ad. Adjust blade balance weights as required by figure 5-17H.

ae. K747 blade repairs are required to be logged in DA Form 2408-13 and -16. A permanent record must be maintained to determine the minimum spacing requirement between repairs. Once a repair has been made, it is not possible to determine which type of repair has been applied.

5-5M. REPAIR OF TRAILING EDGE FILLED AREAS - K747 MAIN ROTOR BLADES (AVIM).

a. This repair is for cracks, chips or missing pieces of trailing edge filler substance which has been applied to the trailing edge between stations 48.0 and 66.0.

b. Determine depth of damage at deepest point. If depth of damage is less than 0.150 inch, no repair is necessary. If depth of damage is greater than 0.150 inch but less than 0.250 inch, proceed to step f. If depth of damage is greater than 0.250 inch, proceed as follows.

c. Remove paint from surface of damaged area by hand abrading with 220 grit abrasive paper to expose red/purple filler and clear skin bonding resin.

CAUTION

Remove only red/purple colored filler. Do not chip toward skin surface as damage to bonded skin may result. Do not penetrate the gold/brown substrate under the red/purple filler.

d. Carefully enlarge damaged area at deepest point of damage, exposing gold/brown substrate.

e. Inspect gold/brown substrate for cracks. If there are cracks in gold/brown substrate, blade is not repairable. If there are no cracks, proceed as follows.

f. Obtain adhesive package (C7A) or alternate (C17).

g. Remove paint from surface of damaged area by hand abrading with 220 grit abrasive paper.

WARNING

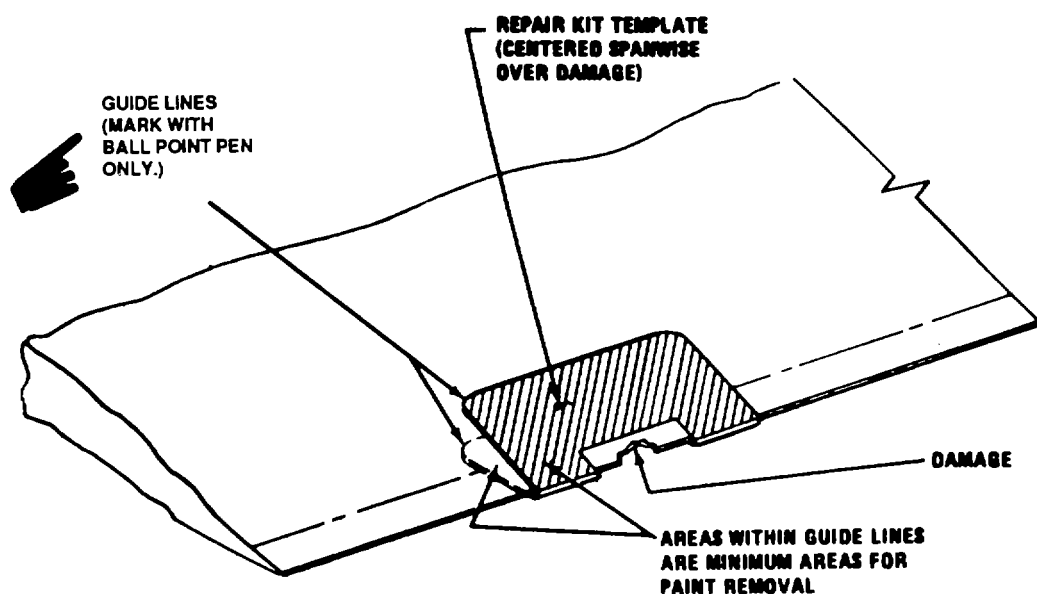
Adhesive contains toxic ingredients. Provide adequate ventilation and protect the skin and eyes from contact with uncured resins or curing agent. Wash off uncured resins and curing agent from skin with warm water and soap. Avoid use of solvents for cleaning the skin.

NOTE

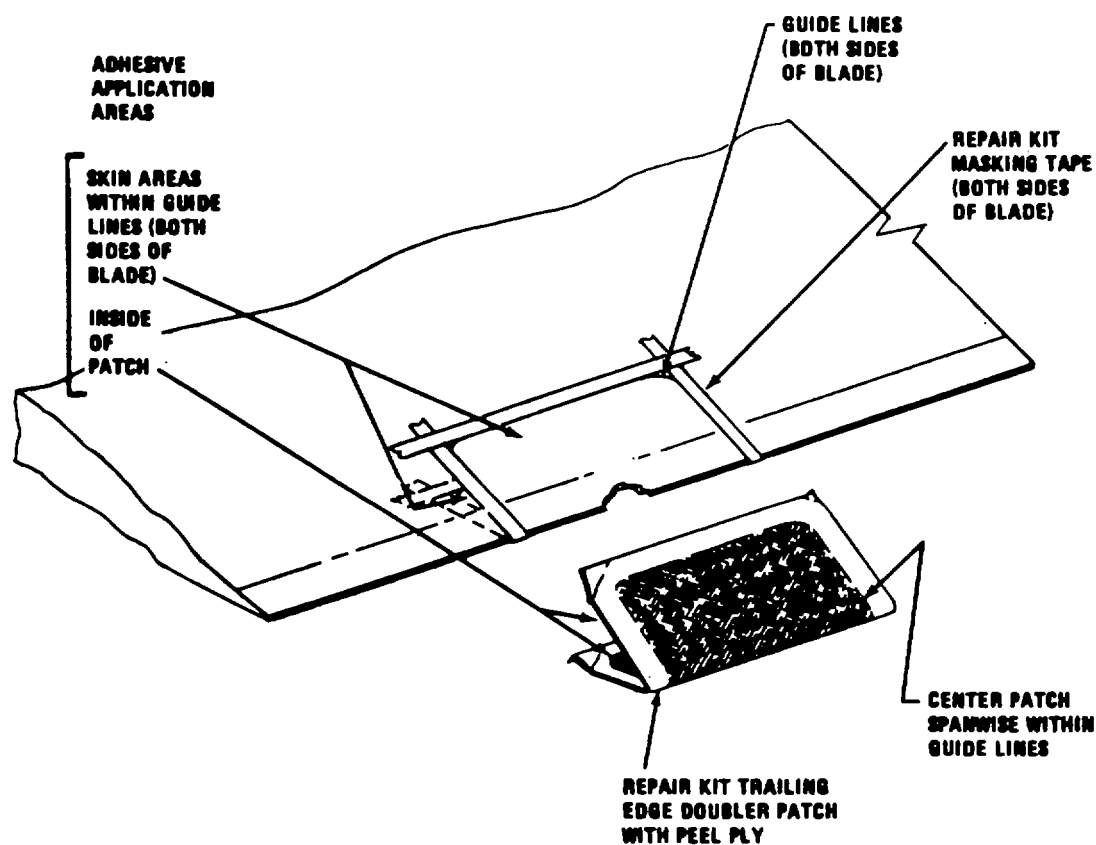
Never mix less than a complete two- part package of adhesive (C7A). When less than a full batch is required, mix the full batch and then discard the excess after the repair is completed.

Pot life of adhesive (C7A) is 15 minutes at 75 degrees F (23.8 degrees C). It is shorter at higher temperatures. Always check package dates to make sure the adhesive life limit of 1 year is not exceeded. Work without delay. Pot life of adhesive (C17) is approximately 1/2 to 1 hour at 75 degrees F (23.8 degrees C).

h. Mix adhesive (C7A) per manufacturer's instructions. Stir with wooden spatula until color is uniform and all streaks have disappeared. Transfer adhesive to plastic coated paper cup.



View A. Marking work area



View B. Application of adhesive and positioning of patch

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Figure 5-17P. Application of Trailing Edge Doubler Patch (K747 Blade)

i. Using a wooden spatula, fill the damaged area with adhesive.

j. Allow adhesive to cure at room temperature for 8 hours.

k. Use 220 grit abrasive paper and hand abrade adhesive to the contour of the trailing edge.

l. Refinish repair area in accordance with paragraph 5-5AC.

5-5N. APPLICATION OF TRAILING EDGE DOUBLER PATCH - K747 MAIN ROTOR BLADES (AVIM).

CAUTION

Blade must contain sufficient balance weight to permit adjustment of blade balance after repair. Refer to paragraph 5-5G before starting any repair.

a. Position blade for access to damaged area. (See figure 5-17P.)

b. Support blade to prevent movement and droop.

c. Obtain trailing edge doubler patch repair kit P/N K747-201-113, and adhesive package (C7A). Adhesive (C17) may be used as an alternate.

CAUTION

Grease or lead pencils will not be used. Only ball point pens will be used to make lines as shown. Marks other than those specified can weaken the repair.

d. Place the template (kit) on the blade, centering it spanwise over the damage. Hold the template from slipping and draw a line around the template on both the top and bottom of the blade (View A, figure 5-17P).

CAUTION

Excessive sanding will weaken blade skin. Sand only until yellow color is removed.

e. Starting with 120 grit and finishing with 220 grit abrasive paper (kit), sand the paint and the yellow primer from the blade from the area within the guide lines on both sides of blade and along trailing edge. Sand only until yellow color is removed. Also sand off any material that may be raised above the normal contour of the blade at edges of damage. Do not sand undamaged skin fibers (View A, figure 5-17P).

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

CAUTION

Spillage of MEK shall be avoided. MEK can damage leading edge erosion guard.

f. Put on cotton gloves (kit), then plastic gloves (kit). Leave on until completion of step o. Dampen cheesecloth (kit) with MEK (C87).

g. Wipe off all cuttings, sanding dust, etc., from repair area.

h. Use template to redraw guide lines (View A, figure 5-17P).

i. Cut lengths of masking tape (kit) and mask around the outside of the guide lines (View B, figure 5-17P).

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

CAUTION

Spillage of MEK shall be avoided. MEK can damage leading edge erosion guard.

Surfaces to be bonded must be clean, dry and free of finger prints and all foreign matter.

j. Dampen clean cheesecloth (kit) with MEK (C87) and clean skin inside masked area. Wipe with clean dry cheesecloth before dampness evaporates.

WARNING

Adhesive contains toxic ingredients. Provide adequate ventilation and protect the skin and eyes from contact with uncured resins or curing agent. Wash off uncured resins and curing agent from skin with warm water and soap. Avoid use of solvents for cleaning the skin.

NOTE

Never mix less than a complete two-part package of adhesive (C7A). When less than a full batch is required, mix the full batch and then discard the excess after the repair is completed.

Pot life of adhesive (C7A) is 15 minutes at 75 degrees F (23.8 degrees C). It is shorter at higher temperatures. Always check package dates to make sure the adhesive life limit of 1 year is not exceeded. Work without delay. Pot life of adhesive (C17) is approximately 1/2 to 1 hour at 75 degrees F (23.8 degrees C).

k. Mix adhesive (C7A) per manufacturer's instructions. Stir with wooded spatula until color is uniform and all streaks have disappeared. Transfer to plastic coated paper cup.

l. Using clean one inch brush (kit), apply a light coat of adhesive to inside surfaces of doubler patch (View B, figure 5-17P) and to skin.

m. Center doubler patch within guide lines and press into place. Slide patch back and forth slightly under hand pressure to even adhesive. Push patch firmly against trailing edge and center within guide lines. Use light hand pressure to squeeze the patch from the center to edges to work out any air bubbles.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid

prolonged breathing of vapors and contact with skin or eyes.

CAUTION

Spillage of MEK shall be avoided. MEK can damage leading edge erosion guard.

n. Using clean cheesecloth (kit) dampened with MEK (C87), temporarily lift edges of peel-ply and wipe off excess adhesive.

o. Place masking tape over edges of patch to prevent movement of patch. p. Install blade repair fixture (figure 5-17L).

(1) Install from trailing edge side of blade only with bladder side on blade upper surface.

(2) Position bladder over repair area and secure.

(3) Center pad opposite bladder and secure.

CAUTION

Tightening of locking knobs so that metal skirt around bladder is closer than 0.125 inch to blade can damage blade.

(4) Tighten fixture channel locking knobs until metal skirt around bladder is approximately 0.125 inch from blade skin.

(5) Actuate hand pump to obtain 4 psi minimum reading on pressure gage. Disconnect pump hose from air valve.

NOTE

During curing, it may be necessary to periodically reconnect hose and to actuate pump to maintain 4 psi minimum.

(6) Connect 110 volt ac electrical power for 30 minutes, or 2 hours if adhesive (C17) is used.

(7) At end of 30 minutes, disconnect electrical power and relieve air pressure by lifting center portion of relief valve.

q. Remove repair fixture from blade.

r. Refinish repair area.

(1) Remove peel-ply and masking tape from blade.

CAUTION

Sanding fibers can weaken blade skin.

(2) Using 220 grit abrasive paper (kit), feather edge of adhesive squeeze-out around patch.

(3) Paint repaired area in accordance with paragraph 5-5AC.

s. Adjust blade balance weights as required by figure 5-17H.

t. K747 blade repairs are required to be logged in DA Form 2408-13 and -16. A permanent record must be maintained to determine the minimum spacing requirement between repairs.

**5-5P. FIBER SEPARATION AND RESIN
CRACKS - TRAILING EDGE
SPLINE - K747 MAIN ROTOR BLADES.
BLADES.**

a. The trailing edge spline, located at station 49.00 to 41.00, is made up of Kevlar fibers in a matrix of cured resin. Fiber separations may give the false appearance of a crack. Fiber separations filled and unfilled with resin are acceptable to the standards specified below. (See figure 5-17Q.)

NOTE

There is no limit on length, location, or closeness of separations in each respective area.

b. Area A. Fiber separations not filled with resin are acceptable to a depth of 0.060 inch. Fiber separations with a depth of 0.060 to 0, 200 inch shall be filled with sealer (C116) or adhesive (C17). Fibers are oriented spanwise in this area, therefore, separations are generally oriented spanwise, too.

c. Area B. Fiber separations not filled with resin are acceptable to a depth of 0.025 inch. Fiber separations with a depth greater than 0.025 inch have penetrated into the area A type composite material and, therefore, fall under the area

A allowables. Fiber separations may be filled with sealer (C116) or adhesive (C17) as desired.

d. K747 blade repairs are required to be logged in DA Form 2408-13 and -16. A permanent record must be maintained to determine the minimum spacing requirement between repairs. Once a repair has been made, it is not possible to determine which type of repair has been applied.

**5-5Q. REBONDING DELAMINATED
LEADING EDGE EROSION GUARD
- K747 MAIN ROTOR BLADES
(AVIM).**

a. Position blade for access to delaminated erosion guard. Support blade to prevent movement and droop. (See figure 5-17R.)

b. Obtain erosion guard patch kit P/N K747-201-119 and epoxy resin (C107).

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

CAUTION

Isopropyl alcohol can damage leading edge erosion guard. Avoid spillage.

c. Prior to cleaning both the erosion guard and the blade surface, peel back the erosion guard approximately 0.5 inch to insure that total void or delaminated area is identified for repair. Using cotton tipped swab (kit) dipped in isopropyl alcohol (C23) solvent, clean surfaces to be bonded.

d. Using masking tape (kit), mask blade along trailing edge of boot to prevent squeezed-out adhesive from coming in contact with the exposed blade surface.

e. Put on cotton gloves (kit), then plastic gloves (kit).

WARNING

Adhesive contains toxic ingredients. Provide adequate ventilation and protect the skin and eyes from contact

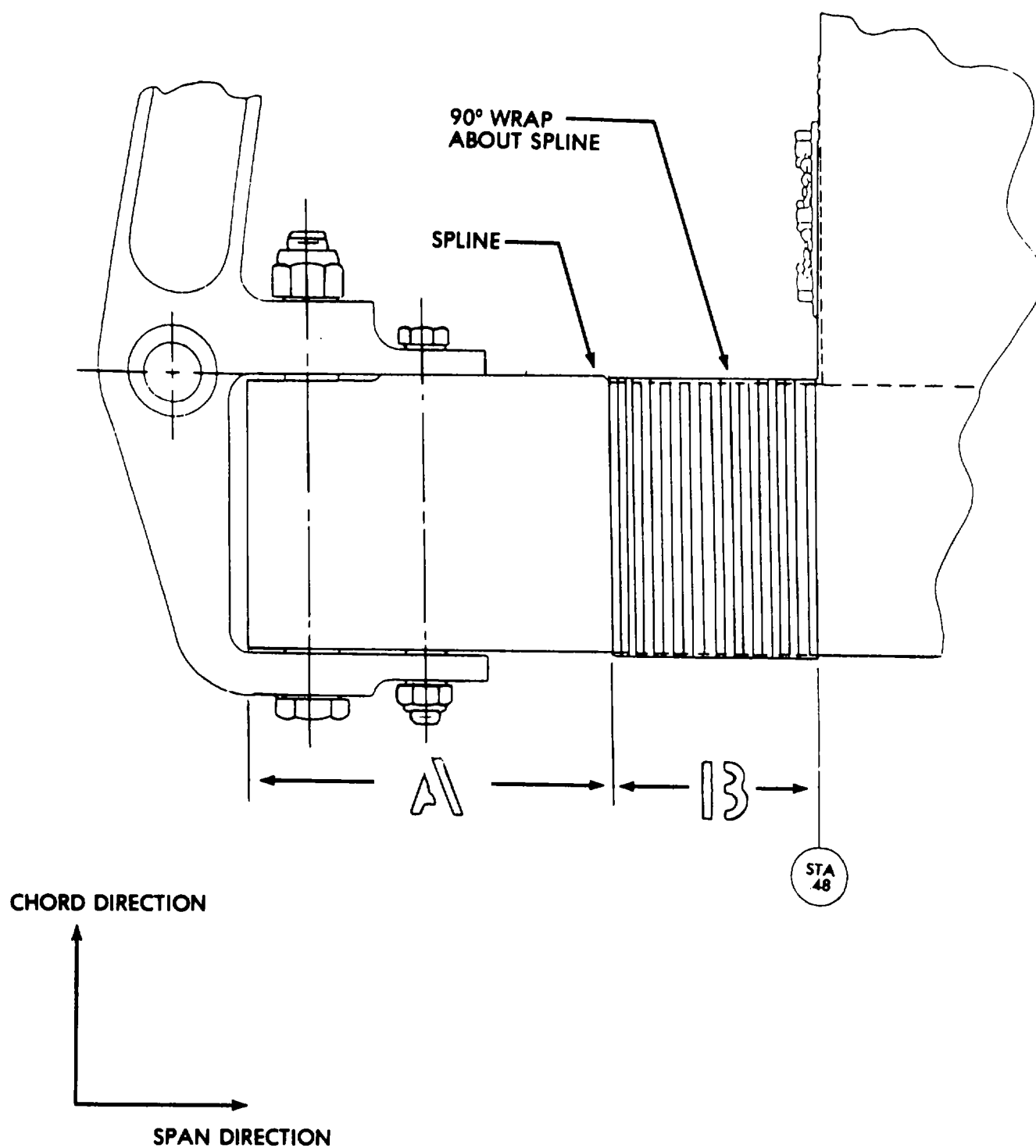


Figure 5-17Q. Spline Repair (K747 Blade)

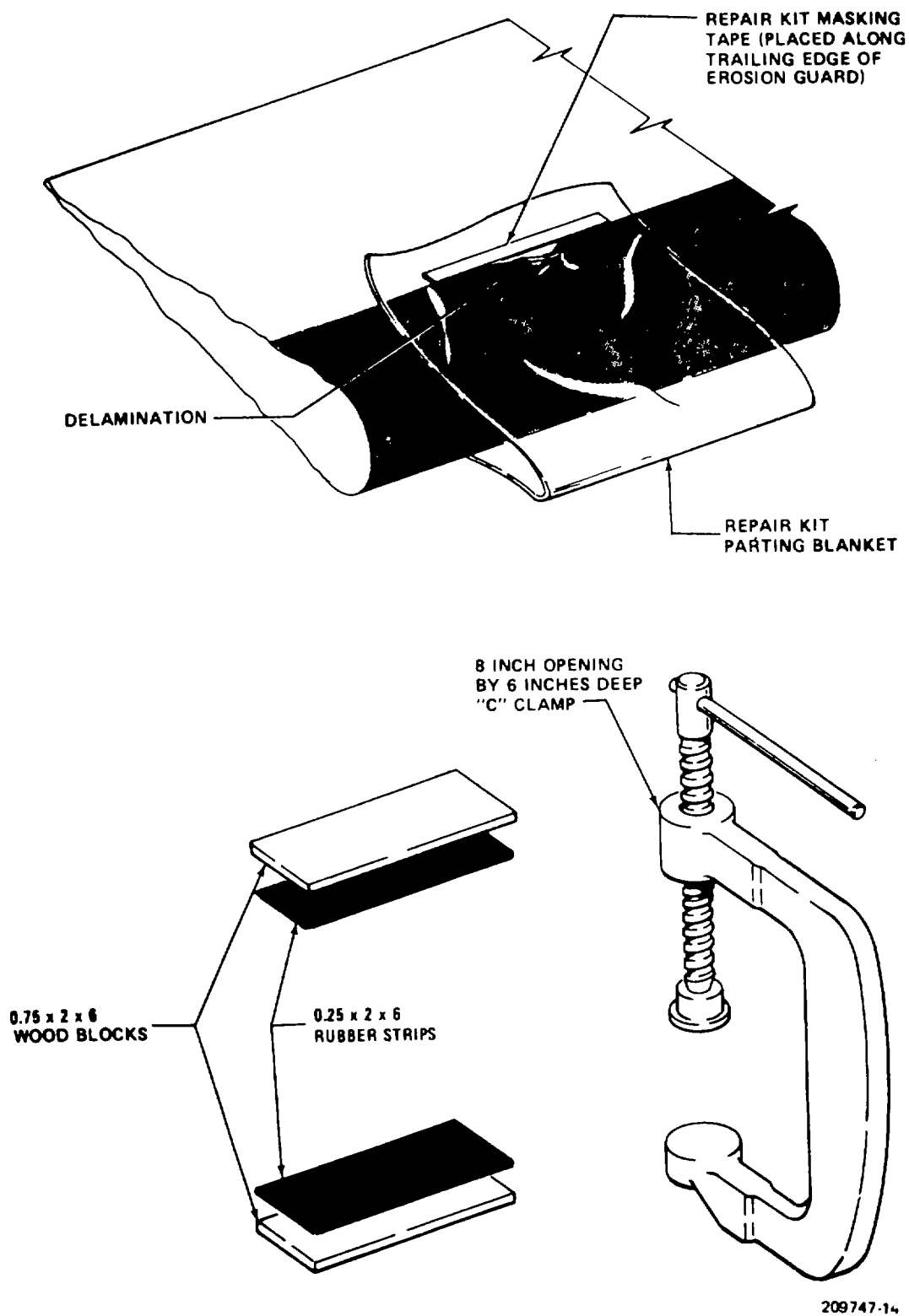


Figure 5-17R. Rebonding Delaminated Leading Edge Erosion Guard (K747 Blade)

with uncured resins or curing agent. Wash off uncured resins and curing agent from skin with warm water and soap. Avoid use of solvents for cleaning the skin.

Protective equipment must be used when performing these repairs.

CAUTION

Both erosion guard and blade leading edge surfaces must be clean, dry, and free of finger prints and foreign matter.

f. Mix 100 parts/weight of epoxy resin (C107) with 12 parts/weight of DTA activator (C107) in a clean glass, metal, polyethylene, or plastic coated paper container.

NOTE

Pot life of adhesive is 15 minutes at 75 degrees F (23.8 degrees C). It is shorter at higher temperatures. Always check package dates to make sure the adhesive life limit of 1 year is not exceeded. Work without delay.

g. Using clean 0.25 inch brush (kit), apply a light coat of adhesive (C107) to both surfaces to be bonded.

h. Using finger pressure, press erosion guard to blade while working out excess adhesive from under the erosion guard. Wipe away excess adhesive with clean cheesecloth (kit) to prevent adhesive from running off the masking tape onto the exposed blade surface.

i. Lay teflon parting blanket (kit) over repair. Place masking tape (kit) over edges of parting blanket to prevent movement.

j. Obtain two wooden blocks approximately 0.75 x 2 x 6 inches and a C clamp (8 inch opening by 6 inches deep). Place 0.25 x 2 x 6 inches strip of rubber between block and parting blanket. Place remaining block and rubber strip on opposite surface and, using C clamp, apply light pressure to rebonded area.

k. At end of four hours, at room temperature, remove clamp, blocks, rubber strip, parting blanket and masking tape.

5-5R. REPAIR OF ESTANE EROSION GUARD —K747-003-205/-309 MAIN ROTOR BLADES (AVIM1).

a. This repair is for station 213.5 inboard, however, may be used outboard of station 213.5 (on estane material only) when time requirements dictate a need for quick repair. Obtain leading edge erosion guard patch kit P/N K747-201-119.

CAUTION

Excessive heat will cause the estane to lose its properties and bulge. Use care to keep at low heat.

b. The cuts and nicks are repaired by softening the guard with sealing iron (T63).

c. Set the temperature at the minimum. Use just enough heat to cause the estane guard material to be soft. Keep the iron moving.

d. Small damage can be repaired by moving the material from each side of the damage with the sealing iron.

e. A 0.25 inch damage can be repaired by adding slivers of estane guard (kit).

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

f. Using a clean 1-inch brush, apply one coat of MEK (C87). Do not overbrush the same area more than three times.

g. Allow to air dry for a minimum of 1 hour.

NOTE

The coating will develop optimum durability in approximately 6 to 8 hours. Flying in rain conditions with less drying time may cause rapid erosion of resurfaced area.

5-5S. REPAIR OF FLUOROCARBON EROSION GUARD - K747 MAIN ROTOR BLADES (AVIM).

a. This procedure uses kit P/N K747-207-1 for the repair of nicks and cuts which involve less than one square inch of damaged area in the following areas:

(1) K747-003-205/-309, between stations 213.5 and 260.0 where fluorocarbon leading edge erosion guard replacement has been accomplished. Check blade DA Form 2408-16 to determine this fact.

(2) K747-003-209/-401, and -303/-403, any leading edge erosion guard surface.

CAUTION

Do not cut into the spar when cutting away damaged leading edge erosion guard areas.

b. Remove damaged leading edge erosion guard in area being repaired. Cut material away using a razor blade or equivalent to form an oval area. The sides of cut must slope inward toward center of damaged area. (See figure 5-17S.)

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

c. Wipe exposed area with a cheesecloth (C36) dampened with MEK (C87).

d. Form a mold to contain injected adhesive. Proceed as follows:

(1) Cut a piece of #Y8412 tape (kit) in a rectangle which is approximately 1/2 inch larger than repair area.

(2) Cut a second piece of #Y8412 tape (kit) one inch larger in length and width than the piece cut above.

(3) Position smaller piece of tape (mating the adhesive surfaces) in the center of the larger one. A 1/2 inch exposed adhesive border will result. (See figure 5-17S.)

(4) Locate tape mold centrally over damaged area so mating surface (adhesive border) faces outward. Poke two holes in the tape, one

at each end of major axis of cut out repair area. The two holes should be made with a 5/64 inch diameter drill bit and be large enough to accept syringe supplied with kit

(5) Turn tape over (mating surface toward blade and press into position as shown in figure 5-17S. Ensure good tape adhesion is made. Do not press tape mold into void.

WARNING

Adhesive contains toxic ingredients. Provide adequate ventilation and protect the skin and eyes from contact with uncured resins or curing agent. Wash off uncured resins and curing agent from skin with warm water and soap. Avoid use of solvents for cleaning the skin. Wear polyethylene gloves while mixing and injecting adhesive material.

NOTE

Pot life of adhesive is approximately 15 to 20 minutes. Do not use out-of-date adhesive. Work without delay.

e. Mix adhesive filler in plastic syringe by following manufacturer's instructions.

f. Inject adhesive filler into one hole until it seeps from second hole. Reverse action by injecting into second hole until the adhesive filler seeps from first hole. Ensure no air pockets are left beneath tape mold.

g. Cure repair using one of the following procedures:

(1) Three days at room temperature.

(2) Four hours at room temperature followed by 4 hours at 160 ± 10 degrees F (71 ± 6 degrees C). (Heat can be applied by lamps or a hot air gun.)

h. Cut excess adhesive protruding from injection holes with a razor blade.

i. Remove tape mold and abrade any high spots or excess material from erosion guard surface. Blend patch to match contour of surrounding areas using 240 grit abrasive paper

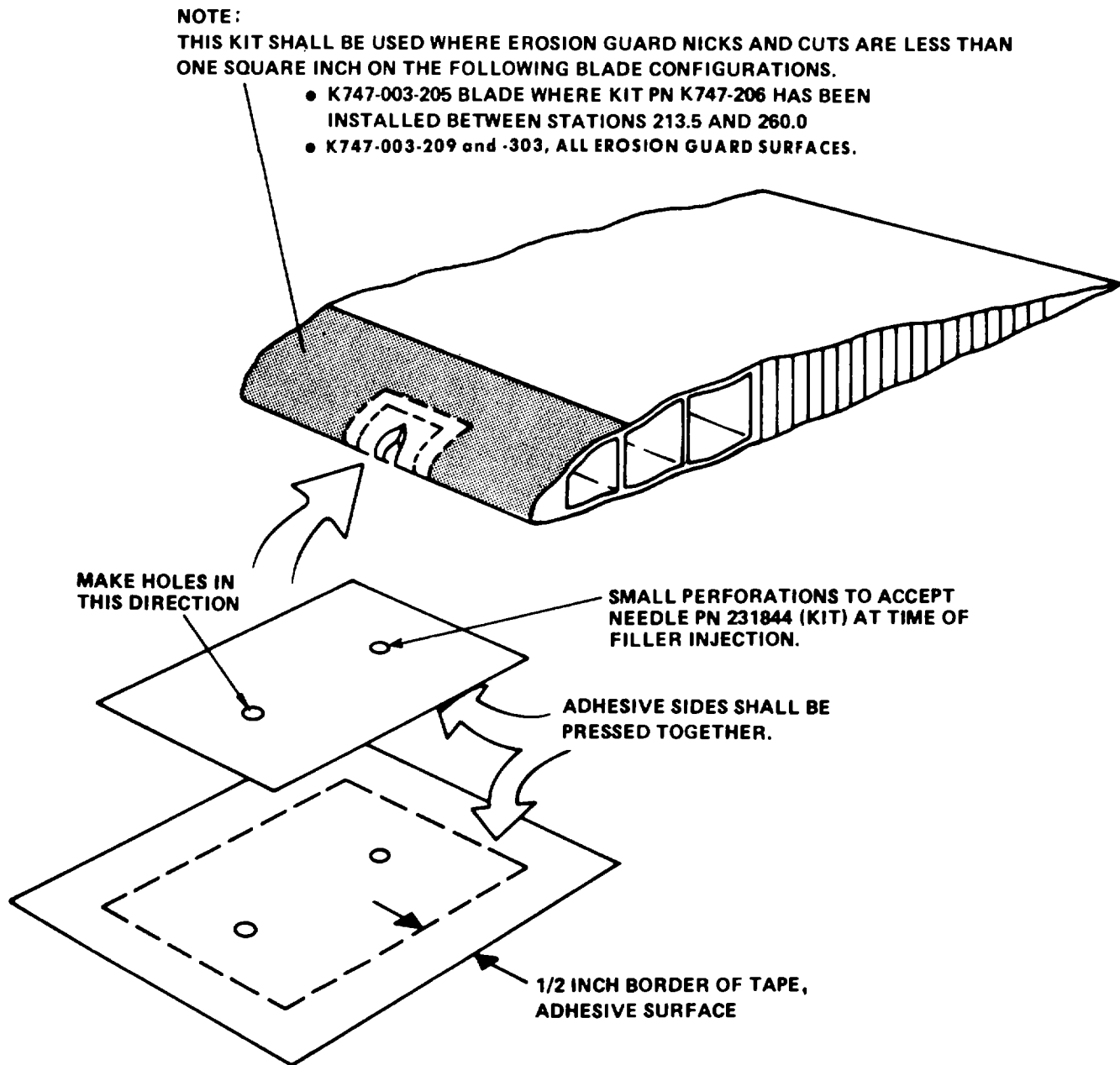
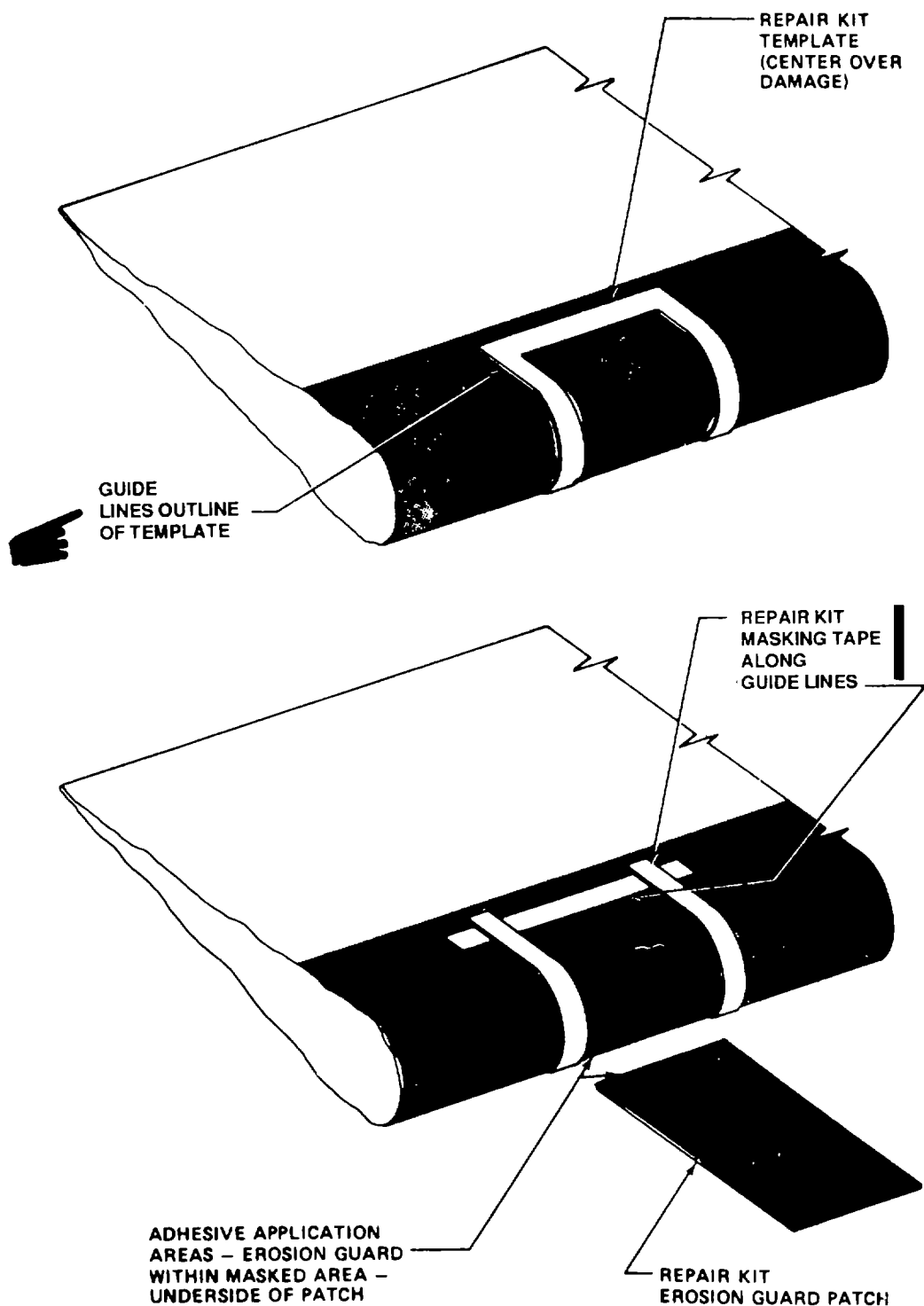


Figure 5-17S. Typical Repair of Fluorocarbon Erosion Guard Nicks and Cuts Using Kit, PN. K747-207



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Figure 5-17T. Application of Loading Edge Erosion Guard Patch (K747 Blade)

5-5T. APPLICATION OF LEADING EDGE EROSION GUARD PATCH- K747-003-205/-309 MAIN ROTOR BLADES (AVIM)

a. This repair is for station 213.5 inboard, however, may be used outboard of station 213.5 (on estane material only) when time requirements dictate a need for quick repair.

CAUTION

Blade must contain sufficient balance weight to permit adjustment of blade balance after repair. Refer to paragraph 5-5G before starting any repair.

b. Position blade for access to damaged leading edge erosion guard. Support blade to prevent movement and droop.

c. Obtain leading edge erosion guard patch kit P/N K747-201-119 and estane contact cement. Prepare estane contact cement for estane erosion guards as follows:

(1) Obtain a piece of estane material and some MEK (C87).

(2) Cut estane material into very small slivers approximately 0.025 inch in size.

(3) Combine estane and MEK. Suggested mix ratio is 15 grams of estane to 85 grams of MEK. Allow to stand for 24 hours. Agitate intermittently throughout this 24 hour period to ensure that the estane is totally dissolved.

(4) The solution is now ready to use and should be agitated before any such use.

CAUTION

Grease or lead pencils will not be used. Only ball point pens will be used to make lines as shown. Marks other than those specified can weaken the repair.

d. Place the template (kit) on the erosion guard centering it over the damage. Hold template from slipping and mark outline of template on erosion guard. (See figure 5-17T.)

e. Cut lengths of masking tape (kit) and mask around outside of the guide lines.

f. Using 180 or 220 grit sandpaper (kit), abrade area of erosion guard inside guidelines and underside surface of patch.

g. Put on cotton gloves (kit) and then plastic gloves (kit). Leave on until completion of step 1.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

h. Using clean cheesecloth (kit) and isopropyl alcohol (C23) solvent, wipe surfaces to be bonded.

i. Using clean one inch brush (kit), apply a light coat of estane contact cement within masked area of erosion guard and to the underside surface of the patch. Allow to air dry for five minutes.

CAUTION

Patch will adhere to erosion guard on contact. Make certain that patch is correctly aligned before making contact.

j. Starting towards leading edge of blade, install patch, working it carefully into place with fingers, using extreme care not to entrap air under patch. Press all areas of patch firmly into contact with erosion guard.

k. Remove masking tape.

l. Using one inch brush (kit), apply a medium thick coat of estane contact cement to the patch, extending over the edges of the patch to blend into adjacent area of the erosion guard.

m. Adjust blade balance weights as required by figure 5-17H.

n. Allow to air dry 12 hours.

5-5U. APPLICATION OF LEADING EDGE EROSION GUARD-K747 MAIN ROTOR BLADES (AVIM).

a. This repair is for use between stations 213.5 and 260.0 using kit P/N K747-206-1.

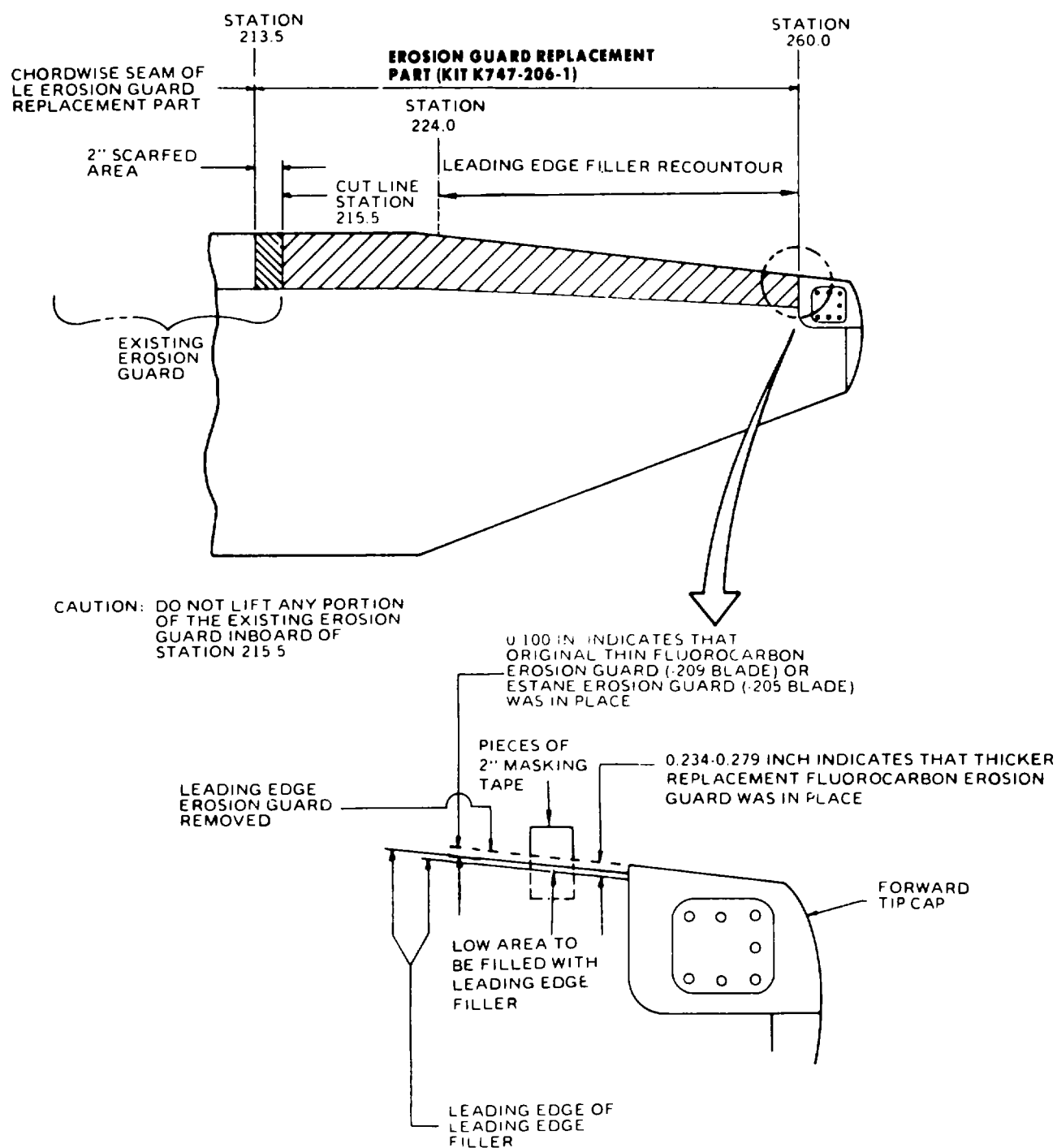


Figure 5-17U. Placement of Erosion Guard Replacement Part (Kit K747-206-1) And Method for Determining Current Boot Material And Thickness (K747 Blade Series)

b. Remove the leading edge erosion guard between stations 215.5 and 260.0.

CAUTION

**Grease or lead pencils will not be used.
Use only a ball point pen.**

(1) Mark a straight line chordwise on the top, bottom, and leading edge erosion guard surfaces at station 215.5 for defining the cut line. (See figure 5-17U.)

CAUTION

Care must be exercised when cutting, lifting, or peeling leading edge erosion guard from skin, spar and filler surfaces. Damage to the spar or graphite/doubler components could result in scrapping of blade.

(2) Cut with a sharp knife and lift the leading edge erosion guard edge at station 215.5 on blade top surface using a one inch chisel or sharpened file blank. Peel leading edge erosion guard away in the outboard direction, working it loose by hand with a sharpened file blank.

(3) Repeat preceding step for blade bottom surfaces. Observe the necessary caution.

NOTE

A new thicker erosion guard repair part is supplied in kit K747-206-1. Some blades may still have a thinner original or replacement fluorocarbon erosion part in position. It is necessary to check each blade prior to application of a repair part to determine if the part being removed is the early thin or later thick dimension. All blades having a full estane or early fluorocarbon erosion guard, or a thin replacement fluorocarbon outboard guard section will require recontouring of the blade leading edge filler material.

c. Check dimensions of blades as shown in figure 5-17U. If it is determined that the erosion guard just removed was one of the early thin parts, it will be necessary to recontour the leading edge filler to accommodate the new thicker replacement part. Do so using the following procedure.

(1) Using a ball point pen, locate and mark station 224.0 on leading edge of blade.

(2) At station 260.0 joint of forward tip cap and blade, measure distance from leading edge of tip cap to leading edge of blade. This dimension should be 0.234 to 0.279 inch. If dimension is not within the range, proceed to next step. If dimension is within the range, proceed to step d.

(3) Measure distance of 0.250 inch from leading edge of tip cap and mark blade top and bottom surface. Draw a line on the blade top and bottom surface using a ball point pen and a straight edge between station 224.0 leading edge and set back dimension at station 260.0.

(4) Abrade a flat vertical surface of the leading edge filler along the two lines just drawn. Use 50 to 80 grit abrasive paper wrapped on a wooded block.

(5) Radius the flat vertical surface of the leading edge filler just abraded. First radius at station 260.0 using a 5/64 radius gage. Then radius the leading edge from the existing radius at station 224.0 to the 5/64 radius at station 260.0.

(6) Lay a straight edge with edge coated with chalk, against leading edge of blade between the station 260.0 indent and station 224.0 as marked. There should be no gap greater than 0.010 inch between them. To bring any gaps within tolerance, proceed as follows:

(a) For any high spots, hand abrade using 50 and 80 grit abrasive paper wrapped on a wooden block for a straight edge contour.

(b) For any low spots, it will be necessary to fill with leading edge filler. Refer to paragraph 5-5W for mixing filler resin (C64A). Refer to figure 5-17U for attaching masking tape mold. Using wooden spatula, apply a sufficient amount of filler at low spot to do the repair. Wrap masking tape over repair surface and let dry for 15 minutes. Abrade as in step (a) above for a straight edge contour.

CAUTION

Use protective equipment over eyes and mouth when abrading. Be careful not to abrade or nick spar surfaces.

(7) Check leading edge filler on both top and bottom surfaces for any depressions between stations 260.0 and 224.0 and fill as in step (b) above. Using a right angle air motor and a 3 inch x 80 grit abrasive disc, abrade surfaces to a smooth contour.

(8) Using a vacuum or a clean, dry, oil- free cloth, clean both blade surfaces of any abrading dust.

d. Prepare blade surfaces for application of leading edge erosion guard part.

CAUTION

Care must be exercised not to abrade spar surfaces.

Removal of paint from blade surface any distance greater than 1/4 inch aft of erosion guard trailing edge will destroy blade lightning protection.

(1) Abrade faying surfaces of blade to remove any adhesive residue left from erosion guard removal. Use a disc sander and a 3 inch x 120 grit abrasive disc.

CAUTION

Grease or lead pencils will not be used. Use only a ball point pen.

(2) Mark a straight line parallel to cut line on the top, bottom, and leading edge erosion guard surfaces at station 213.5 for defining the scarf line. (See figure 5-17U.)

(3) Scarf remaining leading edge erosion guard from surface at station 213.5 down to spar at station 215.5. Use marks made in step (2) above as guidelines. Check scarfed surface with a straight edge. Use a disc sander and a 3 inch x 24 grit, then 80 grit abrasive disc.

(4) Abrade blade bottom surface to accept a 1 x 6 inch test sample. Use 120 grit abrasive paper. (See figure 5-17X.)

(5) Restore any uralite surfaces (over weight retention bolts) which may have been damaged during leading edge erosion guard removal using the following method. If no damage occurred in this area, proceed to step (6).

(a) Remove any loose uralite from damaged area.

(b) Place bag sealant, if needed around damaged uralite area to act as a dam as shown in figure 5-17V.

CAUTION

Filler resin contains toxic ingredients. Provide adequate ventilation and protect skin and eyes from contact with uncured resins or curing agent. Wash off uncured resins or curing agent from skin with warm water and soap. Avoid use of solvents for cleaning skin.

NOTE

Filler resin should be thoroughly mixed until all streaks in the mixture are eliminated. Do not whip any air into mixture.

Blade may be tilted to level resin in the dam around the repair area.

(c) Mix enough potting resin (C98B) part A 100 parts/weight with part B 40 parts/weight to restore area being repaired.

(d) Pour resin into and fill area dammed by bag sealant (if used) or wipe in place with a squeegee.

(e) Allow resin to cure for a minimum of 12 hours at 75 degrees F (23.8 degrees C).

CAUTION

Do not abrade any surface surrounding uralite potting resin. Damage would be inflicted that would require depot repair.

(f) Remove bag sealant dam surrounding the cast resin (if used). Abrade resin flush with blade contour using a 3 inch x 24 grit then 80 grit sanding disc.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

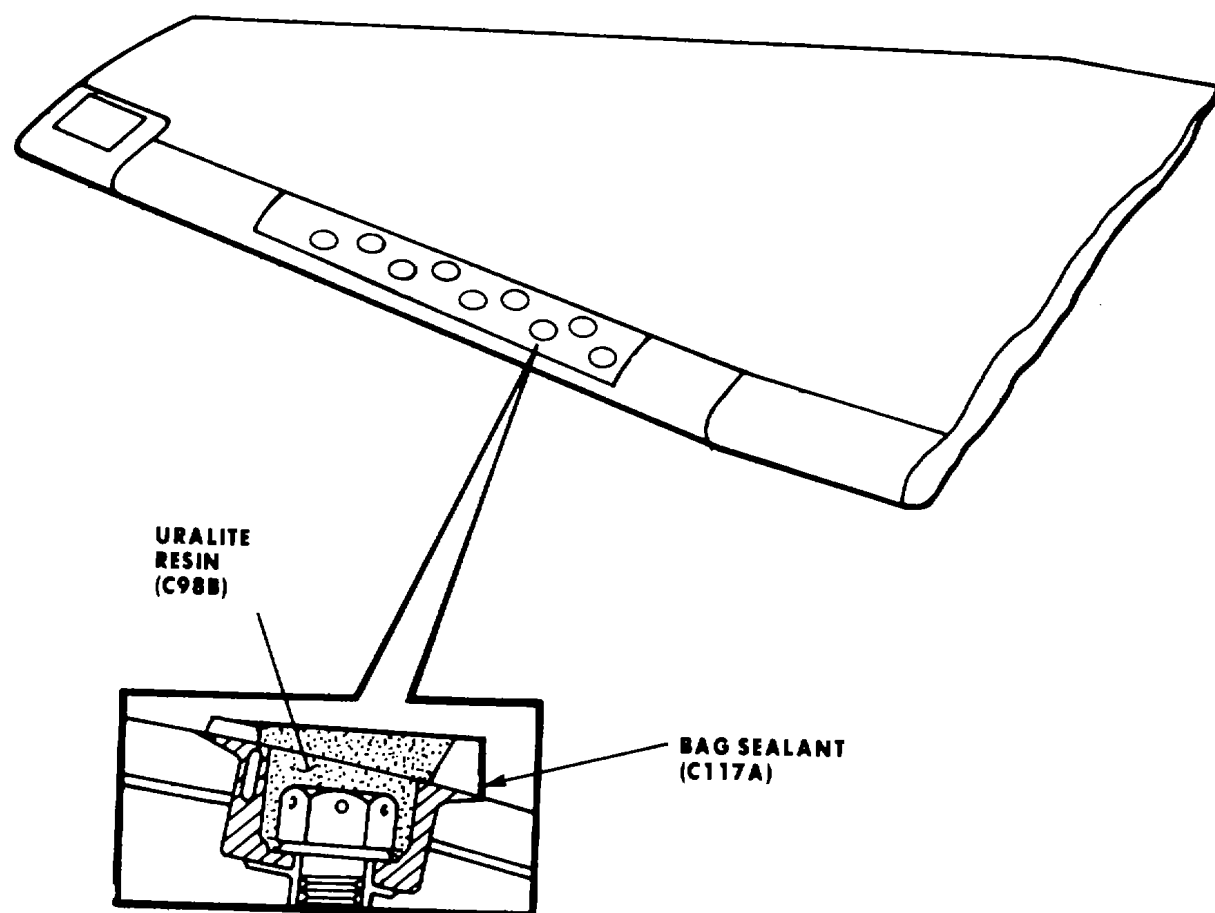


Figure 5-17V. K747 Blade Uralite Repair

(6) Wipe any foreign material from blade repair area using a cheesecloth (C36) dampened with solvent (C142). Repeat this step two more times, wiping solvent dry before it evaporates. Allow 15 minutes for solvent evaporation.

(7) Wipe replacement erosion guard on mating and outside surfaces with MEK (C87). Repeat this step two more times, wiping solvent dry before it evaporates. Allow 15 minutes to dry.

(8) Apply 2 inch wide nylon tape to both top and bottom blade surfaces as shown in figure 5-17W, detail A. The tape should be 0.250 inch aft of erosion guard trailing edge on blade top and bottom surfaces. This will provide an area to include a test specimen under vacuum bagging on blade bottom surface as shown in figures 5-17W, detail A, and 5-17X.

NOTE

Do not remove paper backing on bag sealant or double faced tape. Keep adhesive bonding surfaces clean.

(9) Apply bag sealant and tabs of double faced tape (C135). Secure vacuum hoses and vacuum gage as shown in figure 5-17W, detail B. A vacuum hose should be applied to both blade sides.

(10) Pre-fit 2.50 inch wide bleeder cloth to the blade as shown in figure 5-17W, detail C, and remove.

(11) Pre-fit replacement erosion guard part to blade.

(a) Trim extreme ends of replacement guard at flash lines.

NOTE

Guard material may be slightly stretched to fit.

(b) Fit erosion guard to blade leading edge. Temporarily secure in position with strips of masking tape. (See figure 5-17W, detail D.)

(c) Trim extreme ends of replacement guard part at station 213.5 and then at station 260.0 to fit, if necessary.

(d) Apply a wrap of 1 inch wide nylon tape to one end of 1 x 6 inch test specimen as shown in figure

5-17X.

(e) Remove erosion guard and the masking tape securing it.

(12) Abrade mating surfaces of replacement erosion guard and test specimen as follows:

CAUTION

Abrasion should be done on smooth, hard surface at low rpm.

(a) Abrade inboard end of replacement erosion guard part that will be fitted between stations 213.5 and 215.5. Taper guard material from stations 215.5 to 213.5 to fit scarfed surface of existing guard. Use a disc sander and 3 inch x 60 grit abrasive disc.

CAUTION

Care must be exercised not to rip or gouge material when abrading replacement guard part.

(b) Hand abrade remaining replacement part mating surface. Use 180 grit abrasive paper.

(c) Abrade mating surface of test specimen. Use a disc sander and a 3 inch x 80 grit abrasive disc.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

(13) Wipe replacement erosion guard on mating and outside surfaces with MEK (C87). Repeat this step two more times. Wipe solvent dry before it evaporates. Allow 15 minutes to dry.

(14) Wipe blade repair area surfaces with cheesecloth (C36) dampened with solvent (C142). Repeat this step two more times, wiping solvent dry before it evaporates. Allow 15 minutes to dry.

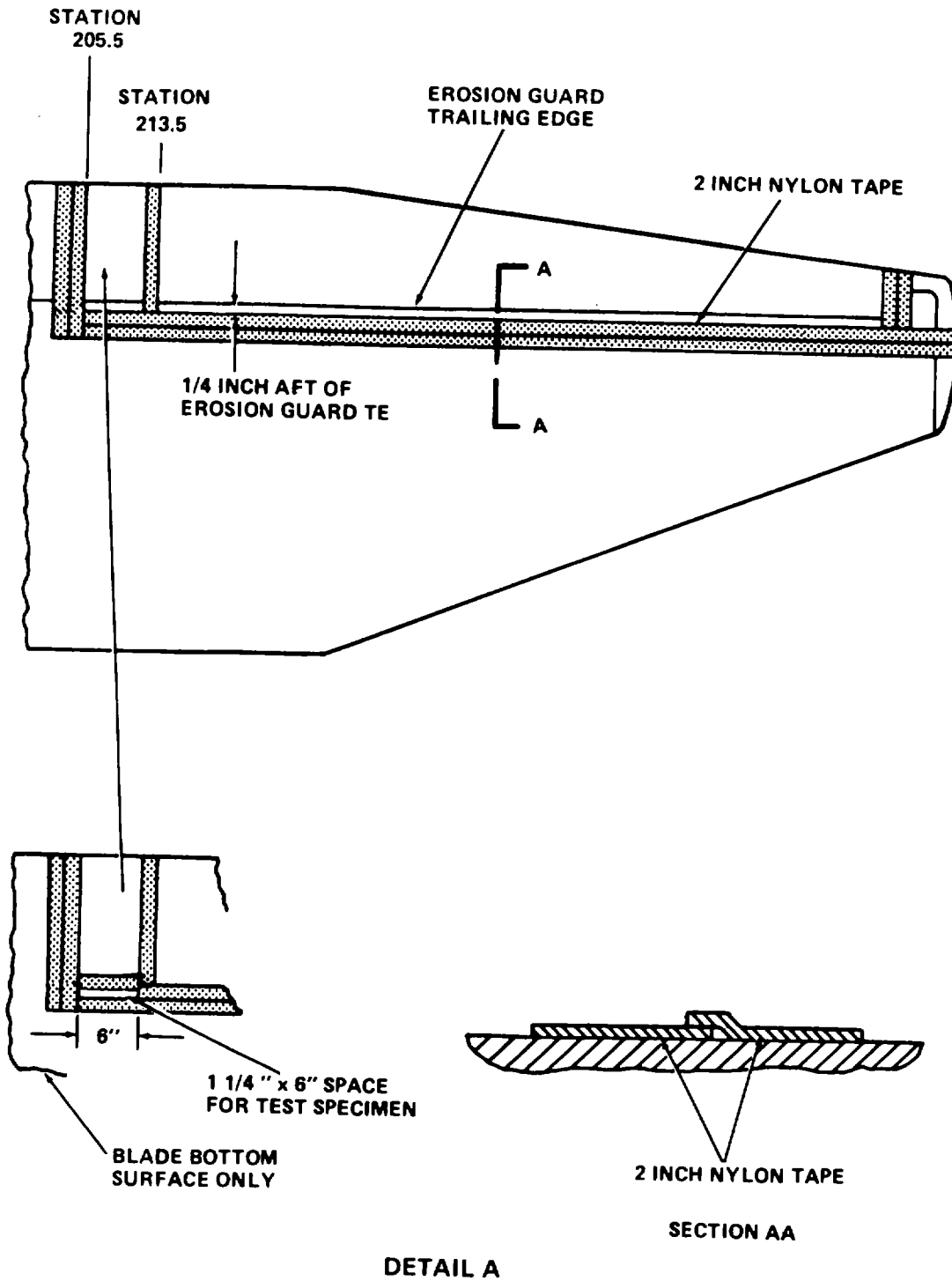


Figure 5-17W. Application of Vacuum Bagging Materials and Placement of Erosion Guard (Sheet 1 of 4)

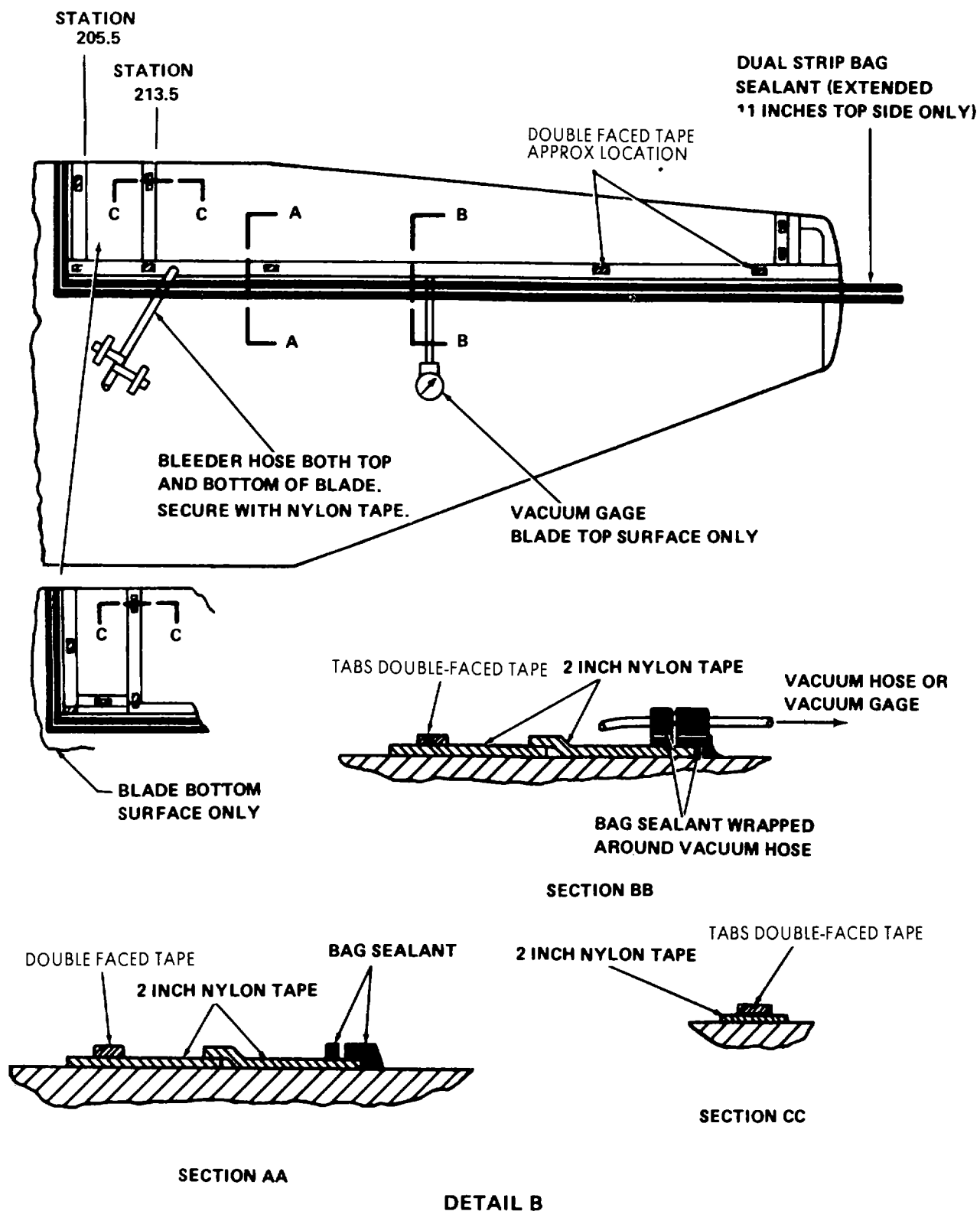


Figure 5-17W. Application of Vacuum Bagging Materials and Placement of Erosion Guard (Sheet 2 of 4)

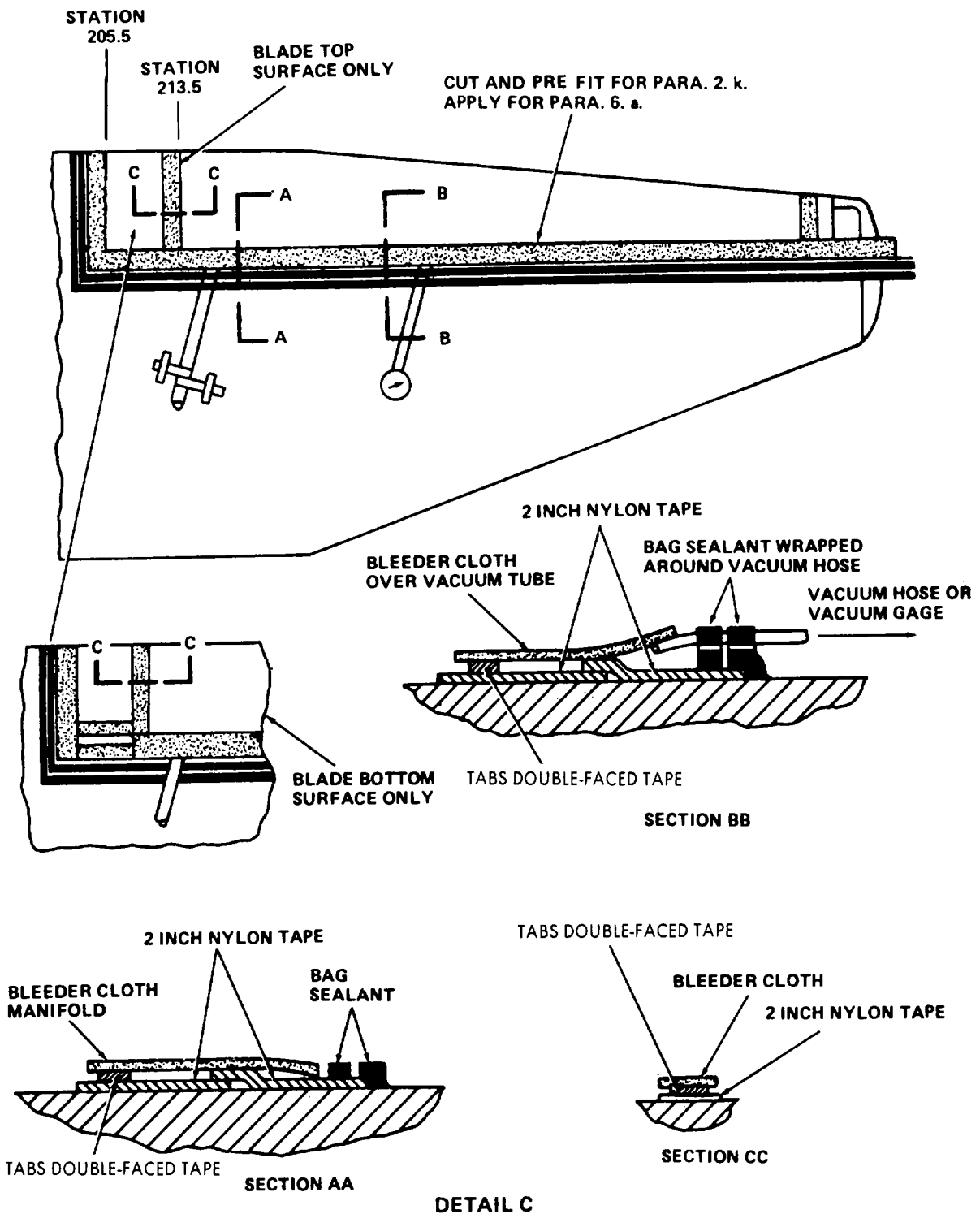


Figure 5-17W. Application of Vacuum Bagging Materials and Placement of Erosion Guard (Sheet 3 of 4)

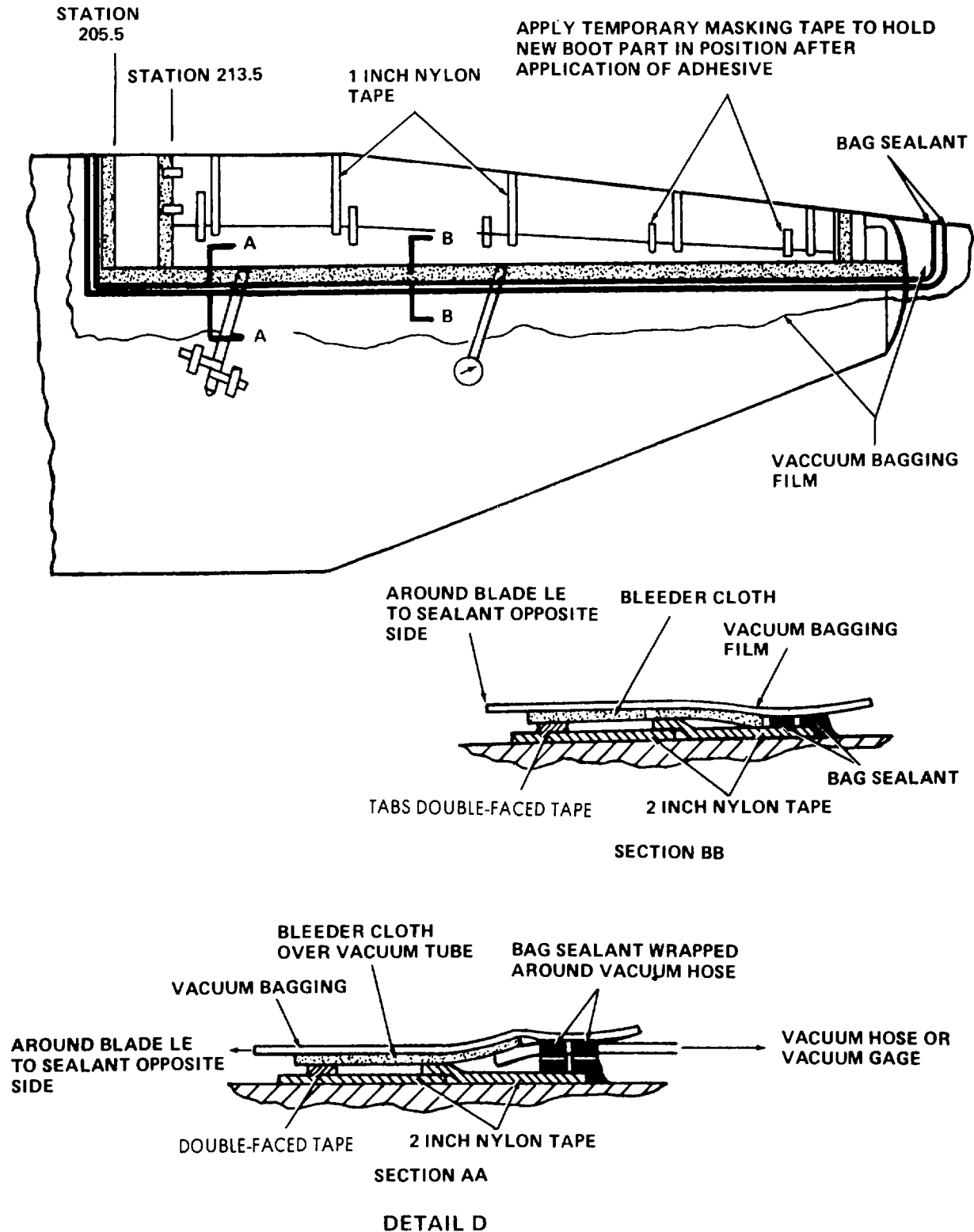


Figure 5-17W. Application of Vacuum Bagging Materials and Placement of Erosion Guard (Sheet 4 of 4)

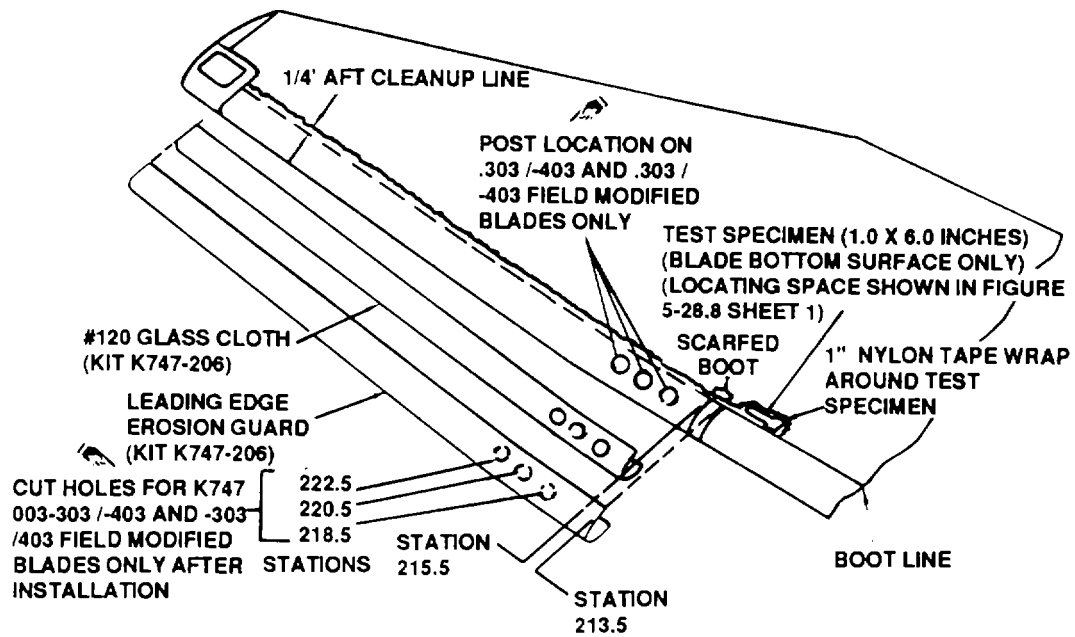


Figure 5-17X. Repair Parts and Specimen Orientation (Kit, P/N K747-206)

NOTE

Wear clean white gloves from this point in repair until the vacuum bagging material is in place. This will aid in preventing contamination of bond surface preparation.

(15) Inspect repair for cleanliness and surface preparation.

WARNING

Adhesive contains toxic ingredients. Provide adequate ventilation and protect the skin and eyes from contact with uncured resins or curing agent. DTA can cause blindness and burns. Wash off uncured resins and curing agent from skin with warm water and soap. Avoid use of solvents for cleaning the skin. Wear polyethylene gloves over cotton gloves for this task.

NOTE

Pot life of adhesive is approximately 30 minutes at 75 degrees F (23.8 degrees C). It is shorter at higher temperatures. Always check package dates to make sure the adhesive life limit is not exceeded. Work without delay. Record time at which adhesive was mixed as an aid in determining pot life.

e. Mix and apply adhesive(C13A).

(1) Mix 100 parts/weight of epoxy resin (Epon 826) with 10 parts/weight of Versamid 125 and 6 parts/weight DTA activator. Stir until streaks disappear. Do not induce air bubbles while stirring.

(2) Apply a uniform light coat of adhesive to blade bottom surface, leading edge, and top surface. Use a 3 inch paint roller for adhesive application.

f. Apply the #120 glass cloth, leading edge guard, and test specimen to blade.

(1) Place #120 glass cloth in position as shown in figure 5-17X. Smooth into place by hand. Using scissors, trim glass cloth to fit exactly.

(2) Using a 3 inch paint roller, apply a uniform coat of adhesive to the glass cloth just positioned.

g. Install leading edge erosion guard and test specimen in position on blade.

(1) Using a 3 inch paint roller, apply a uniform light coat of adhesive to mating surface of the replacement guard.

(2) Apply a light coat of adhesive to mating surface of test specimen.

(3) Place test specimen in position on blade bottom surface in areas shown in figure 5-17X.

(4) Position guard replacement on the blade and hand work it around the leading edge chordwise for full span length of the part. It may be necessary to stretch replacement part for a good spanwise fit.

(5) Remove any adhesive on the outside surface of the leading edge erosion guard with solvent (C 142).

(6) Temporarily tape leading edge guard and test specimen in place with masking tape. Apply 1 inch wide nylon tape to hold part and test specimen in position. Remove masking tape carefully. (See figure 5-17W, detail D.)

h. Vacuum bag repair in accordance with the following procedures after reviewing figures 5-17W and 5-17X.

(1) Remove backing of double faced tape and bag sealant.

(2) Apply bleeder cloth as shown in figure 5-17W, detail C.

(3) Install vacuum bagging and press into position on bag sealant. Smooth out any wrinkles in bagging material. Keep tension on bagging material as it is pulled into position. Ensure a good seal. (See figure 5-17W, detail D.)

(4) Apply vacuum to vacuum hose and obtain 20 inches Hg vacuum under bagging.

(5) Coat bagging material with petrolatum (C96) to act as a lubricant for the squeegee.

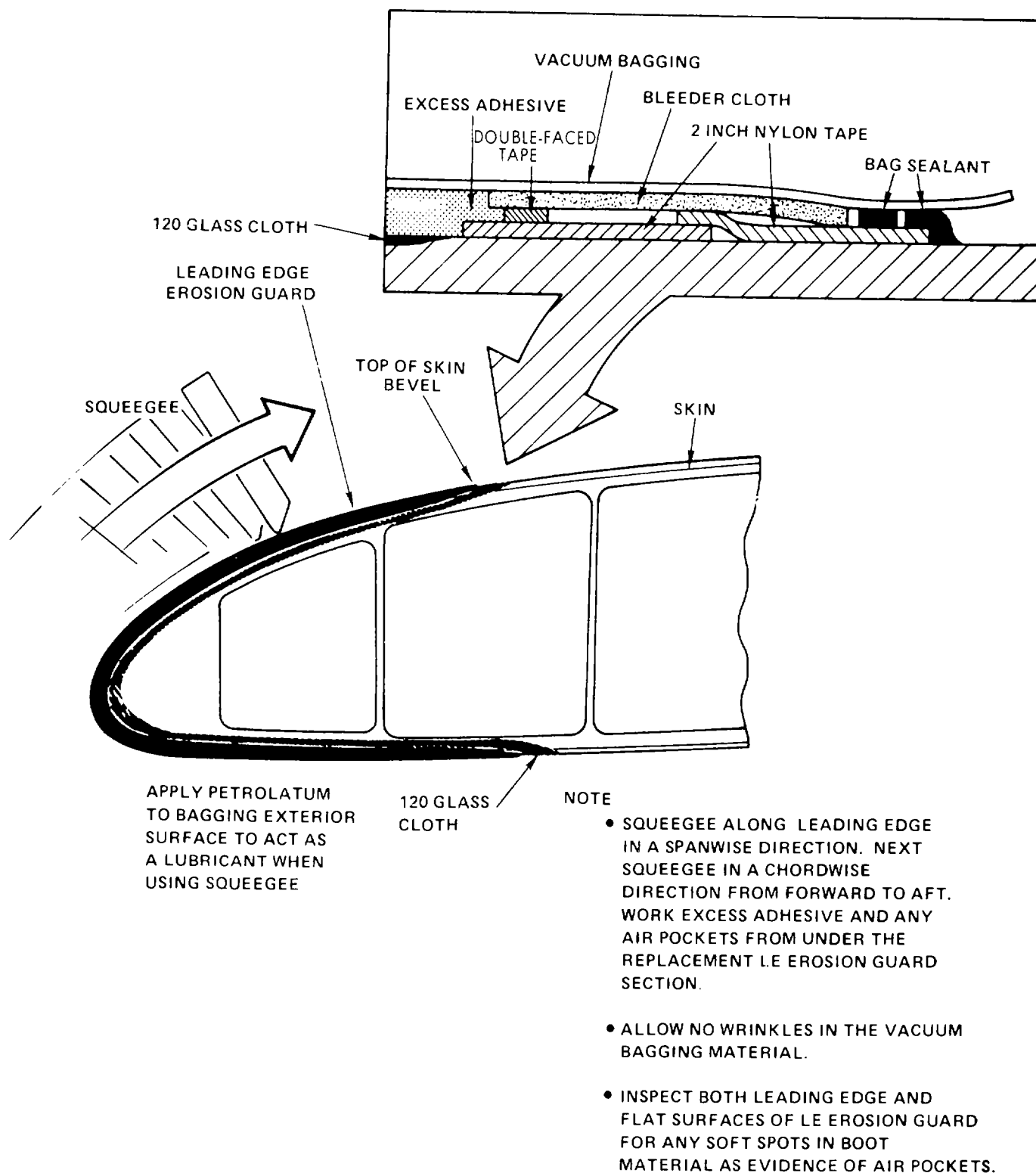


Figure 5-17Y. Vacuum Bagging For Installation of Erosion Guard Repair Kit, PN K747-206

(6) Squeegee leading edge erosion guard along leading edge and test specimen. Roll any excess adhesive outboard toward bleeder cloth eliminating any air pockets under leading edge erosion guard. (See figure 5-17Y.) Do top surface first, then bottom.

(7) Inspect leading edge erosion guard surface for any soft spots including the test specimen. Soft spots are an indication of air pockets. Rework bagging using a squeegee to remove air pockets, as required, by doing bottom surface, then top.

(8) Check for any vacuum leaks by pressing vacuum bagging firmly against vacuum sealant and eliminating any leaking bag creases.

i. Cure repair using one of three following time temperature sequences.

(1) Room temperature (75 degrees F (23.8 degrees C)) for 24 hours minimum. Vacuum bagging, bleeder and masking material may be removed from blade after 12 hours (optional 24 hours).

CAUTION

Do not heat any estane leading edge erosion guard material if it exists (in-board of station 213.5) above 140 degrees F (60 degrees C).

(2) Room temperature (75 degrees F (23.8 degrees C)) for 16 hours minimum followed by 130 ± 10 degrees F (54.4 ± 6 degrees C) for 2 hours minimum. Remove bagging, bleeder and masking materials.

(3) 130 ± 10 degrees F (54.4 ± 6 degrees C) for 4 hours minimum. Remove bagging, bleeder and masking materials.

j. Remove all vacuum bagging materials from blade. Use care not to disturb test specimen.

k. Remove any excess adhesive from leading edge erosion guard and blade areas using putty knife, solvent (C142), and scotch brite (C113).

CAUTION

When feathering chordwise seam at station 213.5, extreme caution must be

exercised not to frictionally heat the guard material. Use short, light, quick strokes with the sanding tools.

l. Feather peripheral seams of repair area and test specimen. Use a disc sander and 3 inch x 80 grit abrasive disc. Follow with 120 grit if necessary. Do not feather trailing edge of leading edge erosion guard.

NOTE

A peel test will be performed 24 hours after the cure cycle is completed. Do not exceed limits of fish scale during the peel test.

m. Perform a peel test on test specimen attached to blade surface.

(1) Securely attach a C clamp to taped end of test specimen.

(2) Attach a fish scale (capable of measuring 15 or 20 pounds) to C clamp.

(3) Pull specimen back across its longitudinal axis. Record on component DA Form 2408-16, the amount of force measured on the scale to peel specimen from blade. The minimum accepted peel strength is 6 pounds which ensures a good adhesive bond. This step will be verified by a QA/QC inspector.

(4) If peel test results are less than 6 pounds, the bond is unacceptable. The new leading edge erosion guard must be replaced by repeating this procedure.

n. Remove the test specimen (if it did not come off during peel test) and any residue left by test specimen. Use a disc sander with 3 inch x 80 grit abrasive disc. Follow with 120 grit if necessary.

o. Restore blade finish in accordance with paragraph 5-5AC.

5-5V. BONDING OF LEADING EDGE EROSION GUARD STATION 213.5 OUTBOARD - K747-003-303/-403 AND -303/-403 FIELD I MODIFIED MAIN ROTOR BLADES (AVIM).

a. Make up six bonding intensifiers by attaching together two AN960-1416 washers, one

AN970-5 washer, and one AN960-1416 washer in that sequence. Attach by spot welding or using a suitable adhesive.

CAUTION

When using the squeegee to eliminate any air pockets under leading edge erosion guard, extra care should be exercised to press erosion guard securely around circumferences of posts, both blade surfaces.

b. Install the fluorocarbon erosion guard in accordance with paragraph 5-5U.a thru h. Be sure to cover both ends of posts with circular tabs of masking tape to prevent entry of adhesive into post holes.

c. After vacuum bagging has been completed, install the six intensifiers, made in step a above.

(1) Position an intensifier, with the two AN960-1416 washer side towards blade surface, over opposite post humps on both blade surfaces. Make sure the two intensifiers are seated evenly around humps. Install a C clamp around them and tighten clamp only until intensifiers are bottomed around post circumferences. Repeat for other two posts.

(2) Squeegee area around post to remove any air bubbles that may have formed when securing clamps.

d. Cure repair in accordance with paragraph 5-5U.i. Remove clamps, intensifiers, and vacuum bagging materials.

e. Cut holes in fluorocarbon erosion guard over ends of posts, both blade surfaces, as follows:

(1) Manufacture a 2 x 6 inch hole cutting template out of any suitable material. Drill three 1 inch diameter holes with their centers spaced 2 inches apart.

(2) Place template over post hole area with template holes seated evenly around the humps. Scribe circles at humps using a lead pencil.

(3) With template removed and using a utility knife with a sharp cutting edge, cut around circumference of marked circles with cutting plane of blade slanted towards posts. Ensure that erosion guard and fiberglass layer is completely severed and pry off the rubber plugs. Remove masking tape over ends of posts.

(4) Using a right angle air motor with a 1-1/2 inch x 80 grit abrasive disc, chamfer edge of rubber around holes.

(5) Repeat steps (2) thru (4) above for other side of blade.

f. Proceed with paragraph 5-5U.k thru p.

5-5W. REPAIR OF DAMAGED PORTION OF LEADING EDGE FILLER - K747 MAIN ROTOR BLADES (AVIM).

NOTE

Repair of leading edge filler is limited to replacement of the filler, not to exceed 6 inches in length and only one repair per blade.

a. This repair is to be used for damage between stations 224.4 and 260.0.

b. Position blade, top surface up, in fixed blade rack.

CAUTION

Provide adequate ventilation to remove any vapor concentrations in the area.

Wear polyethylene gloves over cotton gloves to prevent skin contact with solvent and eliminate possibility of getting skin oils on blade surfaces.

Wear splash-proof goggles when working with solvent.

c. Remove any contamination by wiping repair area with a cheesecloth (C36) dampened with solvent (C142). Repeat this step three times, wiping solvent dry before it evaporates.

d. Apply several strips of 2 inch wide masking tape (to form a mold) to blade bottom surface. (See figure 5-17Z.) Do not attach tape to blade top surface.

NOTE

Both parts of two-part urethane filler must be at room temperature (70 degrees F (21 degrees C)) before use.

Two - part urethane filler must be

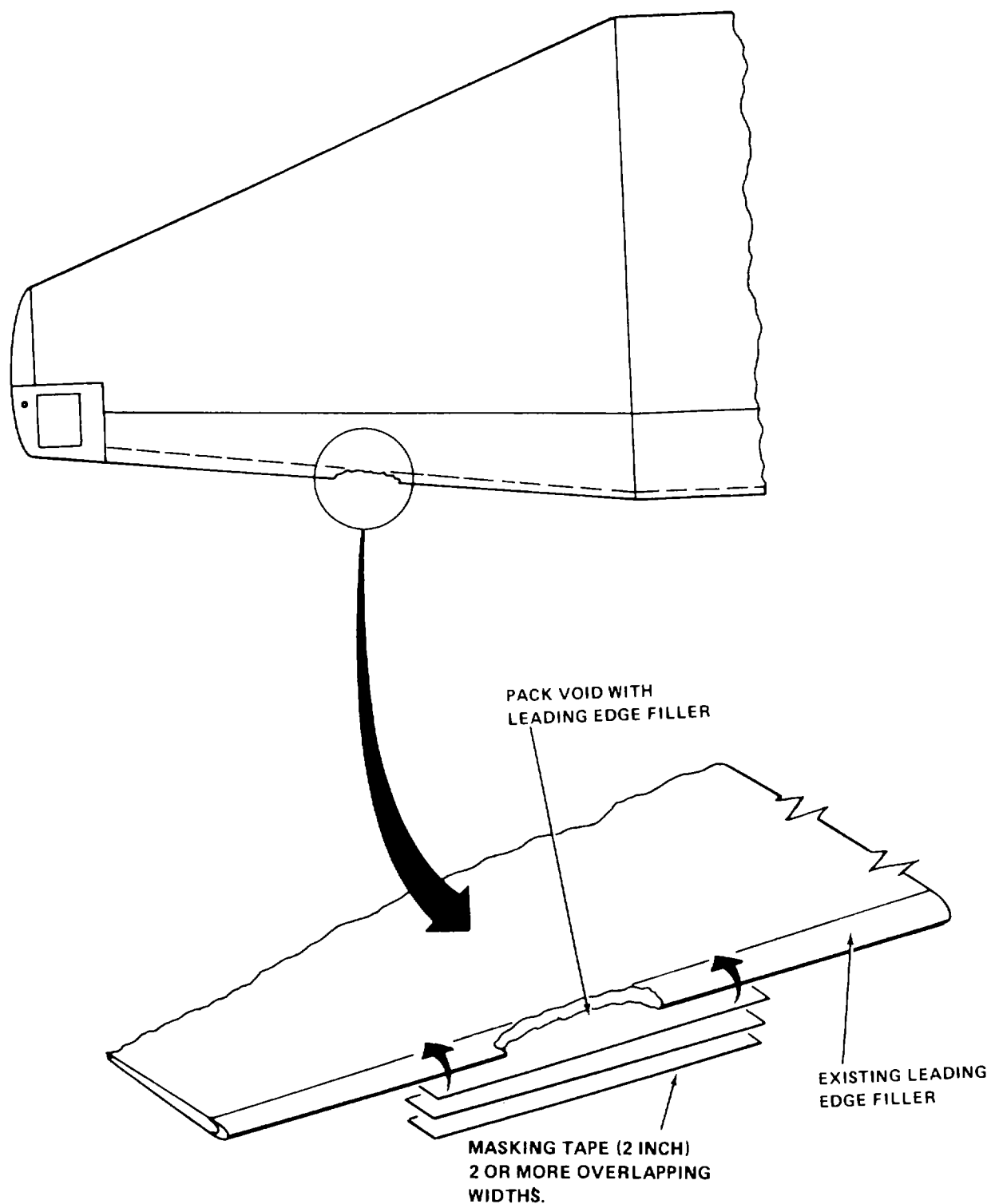


Figure 5-17Z. Improvised Mold For Casting A Small Section Of Leading Edge Filler

thoroughly mixed in order to preserve repair strength.

Surfaces to be bonded must be clean, dry, and free of finger prints and all foreign matter.

The resin compound used in casting leading edge filler is fast setting lap- proximately 15 minutes between mix- ing and gelling). Work without delay.

e. Mix filler resin (C64A).

(1) Stir base and catalyst components in their respective supply containers until thoroughly mixed.

(2) Weigh out equal amounts by weight (as required) of catalyst and base material in separate paper cups.

(3) Combine catalyst into base and stir with a wooden spatula. Ensure a thorough mixture is obtained.

f. Pour filler into the masking tape mold applied to blade surface. Fold masking tape over blade leading edge and attach to blade top surface. (See figure 5-17Z.)

g. Remove masking tape mold after 15 to 20 minutes. Rough sand the filler, removing high spots and excess material. Use right angle air motor and 3 inch x 60 grit adhesive disc.

NOTE

A straight edge used as a guide and flat wood block covered by 50 grit abrasive paper provides a means of obtaining finished contour and leading edge acceptable limits.

h. Fine sand filler to match blade outline and contour. Place a straight edge across the leading edge to gage leading edge outline. Use a wooden block (approximately 10 to 12 inches in length) covered with 50 grit abrasive paper.

i. Repeat previous task for both top and bottom filler surfaces. Always use the straight edge as a guide in obtaining proper contour.

j. Install leading edge erosion guard in accordance with paragraph 5-5U.

k. Refinish by painting affected areas in accordance with paragraph 5-5AC.

l. K747 blade repairs are required to be logged in DA Form 2408-13 and -16. A permanent record must be maintained to determine the minimum spacing requirement between repairs. Once a repair has been made it is not possible to determine which type of repair has been applied.

5-5X. REMOVAL OF STAINLESS STEEL EROSION GUARD - K747-003-303/-403 MAIN ROTOR BLADE.

a. Inspect erosion guard for damage. Refer to table 5-1B for limits.

b. Remove six screws (3, figure 5-17AA) securing erosion guard (1) to blade posts (4), using a No. 4 Philips screwdriver. Remove two screws (2) securing erosion guard to forward tip cap, using a standard Philips screwdriver. Retain screws (2 and 3) for later use.

CAUTION

To prevent scoring of primer coating on inside surface of stainless steel erosion guard and surface of fluorocarbon erosion guard when prying them apart, file a radius on working edges and corners of putty knife.

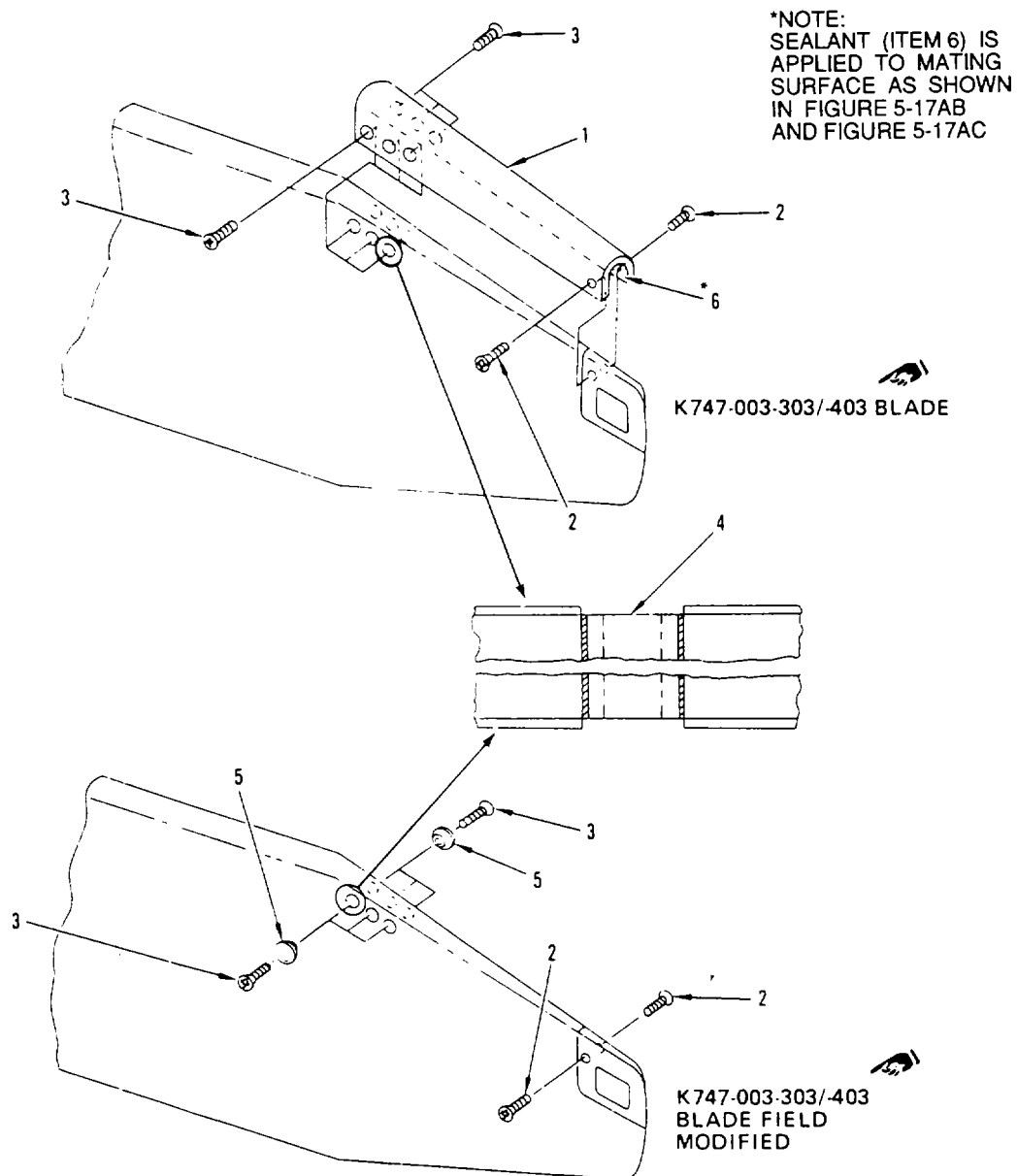
NOTE

It is advisable to wear a leather glove to cushion the palm for this task.

c. Insert putty knife under lip of stainless steel erosion guard, with rounded underside edge against fluorocarbon erosion guard. Start- ing at outboard end of guard and working towards inboard end, apply a firm wedging force to pry stainless steel guard loose from sealant.

d. Turn blade over in rack and repeat step b above for loosening stainless steel guard on underside of blade. Remove guard when completely broken free of sealant.

e. The sealer residue can be removed from fluorocarbon erosion guard by rubbing with the open palm or a cloth. Lightly abrade both top and bottom surfaces of fluorocarbon erosion



INDEX	NOMENCLATURE	QTY
1	EROSION GUARD, STAINLESS STEEL	1
2	SCREW, SELF-LOCKING	2
3	SCREW, SELF-LOCKING	6
4	POST	3
5	SHIELD	6
*6	SEALANT - PROSEAL 890 (C105)	A/R

Figure 5-17AA. Repair Parts Orientation Use for Removal and Installation of Stainless Steel erosion Guard- K747-003-303/-403 and -303/-403 Filed Modified Blades

guard with a layer of screen cloth (C44B) wrapped around a wooden block only to give erosion guard surface a dull finish.

f. Remove any foreign material and residue from blade surfaces. Use a vacuum or clean, dry, oil-free cloth.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

g. If the stainless steel erosion guard is to be reinstalled, lightly wipe inside surface with cheesecloth dampened with MEK (C87) to remove sealant residue.

5-5Y. INSTALLATION OF STAINLESS STEEL EROSION GUARD - K747-003-303/-403 MAIN ROTOR BLADES (AVIM).

a. Prepare blade for installation of stainless steel erosion guard.

(1) Locate stainless steel erosion guard on fluorocarbon erosion guard to align mounting holes. Install screws (2 and 3, figure 5-17Z) and tighten until they bottom out.

(2) Mask erosion guard area using one inch nylon tape (C135A) positioned 1/4 inch from periphery of stainless steel erosion guard, both surfaces of blade. (See figure 5-17AB.)

(3) Remove the eight self-locking screws from stainless steel erosion guard and remove guard from blade. Discard screws.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

(4) Wipe both surfaces of fluorocarbon erosion guard with cheesecloth (C36) dampened with MEK (C87) to remove contamination in area framed by nylon tape.

CAUTION

Surfaces to be bonded must be clean, dry, and free of finger prints and all foreign matter. Wear cotton gloves when handling these surfaces.

b. Prepare the replacement stainless steel erosion guard for installation by masking outside surface using masking tape (C134) to protect the surface from sealant. Using a sharp knife, cut out the eight mounting holes in tape.

WARNING

Sealant contains toxic ingredients. Provide adequate ventilation to remove any vapor concentrations in the area. Wear polyethylene gloves over cotton gloves to prevent skin contact with sealant ingredients and eliminate possibility of getting skin oils on repair area surfaces. Wear splash-proof goggles when working with sealant.

NOTE

Pot life of sealant is 30 minutes at 75 degrees F (23.8 degrees C). It is shorter at higher temperatures. Work without delay.

c. Prepare Proseal 890 (C105). Mix 1 part/weight of accelerator to 10 parts/weight of base in a plastic coated paper container. Use a wooden stirrer and mix sealant to a uniform color and consistency.

d. Apply sealant with a stiff-bristled brush, to inner surface of stainless steel erosion guard and framed area of fluorocarbon erosion guard. Apply only to area shown in figure 5-17AC.

NOTE

Exercise care to prevent sealant from entering threaded area of post holes.

e. Position stainless steel erosion guard over fluorocarbon erosion guard, until mounting holes are aligned.

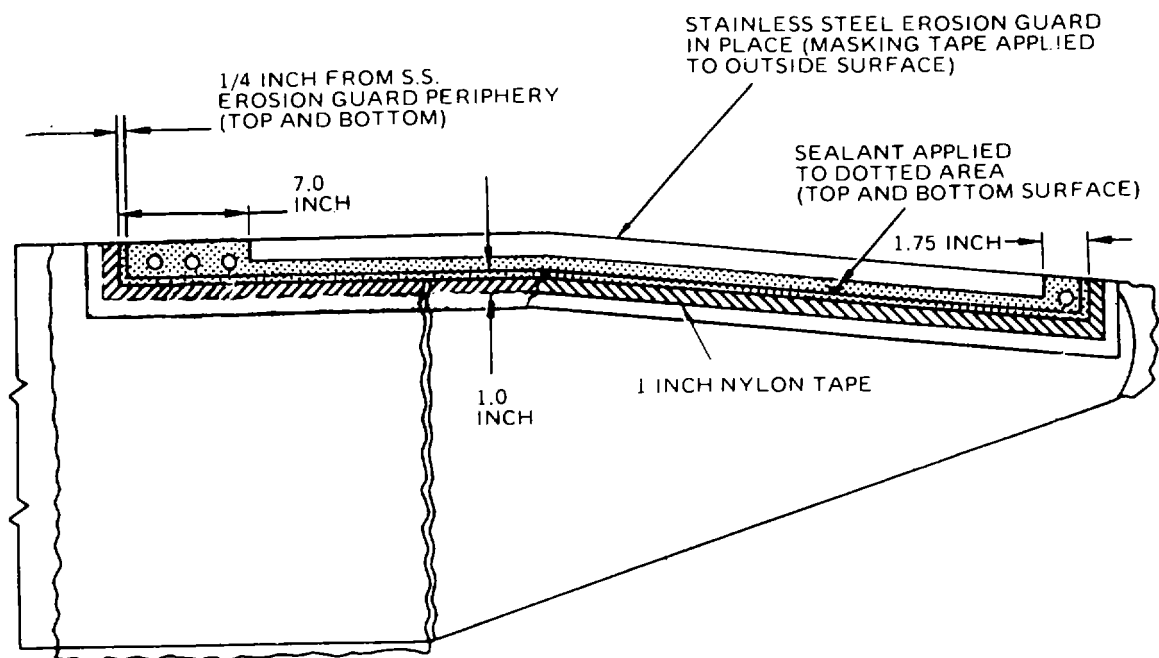


Figure 5-17AB. Preparation of K747-003-303/-403 Blade for Application of Sealant

CAUTION

The self-locking screws can be used on once. New screws are required for each installation.

f. Install six NAS1189E5P8B screws (3, figure 5-17AA) in blade posts (4) and two NAS1189E4P6B screws (2) in forward tip cap, using a No. 4 Philips screwdriver and a standard Philips screwdriver, respectively. Hand tighten all screws to achieve clamping of stainless steel erosion guard. QA/QC inspection is required.

g. Manufacture a holding fixture out of plywood stock and install over stainless steel guard as shown in figure 5-17AD. The strips of industrial tape around the three leading edge contour block details and trailing edge of blade are to be wrapped tight enough to seat blocks evenly and securely against leading edge contour of guard. Tighten the six 6 inch C clamps sufficiently to seat the two spanwise details securely against top and bottom surfaces of guard.

h. Cure Proseal 890 (C105) at room temperature (70 degrees F (21 degrees C)) for 24 hours. An alternate method is to apply heat using a sufficient number of infrared lamps to provide 140 to 180 degrees F for one hour.

i. Upon completion of cure, remove holding fixture and tape from blade surfaces.

j. Remove masking tape from stainless steel erosion guard and feather sealant at trailing edge of guard using a layer of screen cloth (C44B) wrapped around a wooden block.

5-5Z. CHANGING K747-003-303/-403 BLADE TO-303/-403 FIELD MODIFIED BLADE (AVIM).

a. Remove the stainless steel erosion guard in accordance with paragraph 5-5X. The shields and installation instructions which come with the-303 blade are always retained for use when converting.

CAUTION

The self-locking screws can be used only once. New screws are required for each installation.

b. Insert three K747-209-11 shields (5, figure 5-17Z) into the fluorocarbon erosion guard holes on the top blade surface. Install three new NAS1189E5P8B screws (3) into the blade posts (4) using a No. 4 Philips screwdriver. Install one new NAS1189E4P6B screw (2) into the forward tip cap using a standard Philips screwdriver. The four screws are to be hand tightened only. Turn blade over in rack and repeat procedure for bottom blade surface.

5-5AA. CHANGING K747-003-303/-403 FIELD MODIFIED BLADE TO-303/-403 BLADE (AVIM).

a. Remove screws (2 and 3, figure 5-17Z) and six shields (5) from their locations on top and bottom blade surfaces. Discard screws.

b. Install K747-210-11 stainless steel erosion guard (1) in accordance with paragraph 5-5Y.

c. Retain shields and installation instructions for use during any future conversion to K747-003-303/-403 field I modified blade.

5-5AB. REPLACING SECTIONS OF EROSION GUARD - K747-003-205/-309 MAIN ROTOR BLADE (AVIM).

a. This repair is for station 213.5 inboard. Obtain kit P/N K747-201-119.

b. Position blade for access to damaged leading edge erosion guard. Support blade to prevent movement and droop.

c. Using sharp knife, remove all damage from guard including separated guard. Cut the guard in such a pattern that can be duplicated with a like patch (circle, square, rectangle).

d. Use 180 to 240 grit abrasive paper (C112) to remove guard adhesive. Avoid removing any of the spar. This will appear as white dust.

WARNING

Isopropyl alcohol is flammable. Keep away from heat and open flame. Provide adequate ventilation when using. Avoid breathing vapors and prolonged contact with skin.

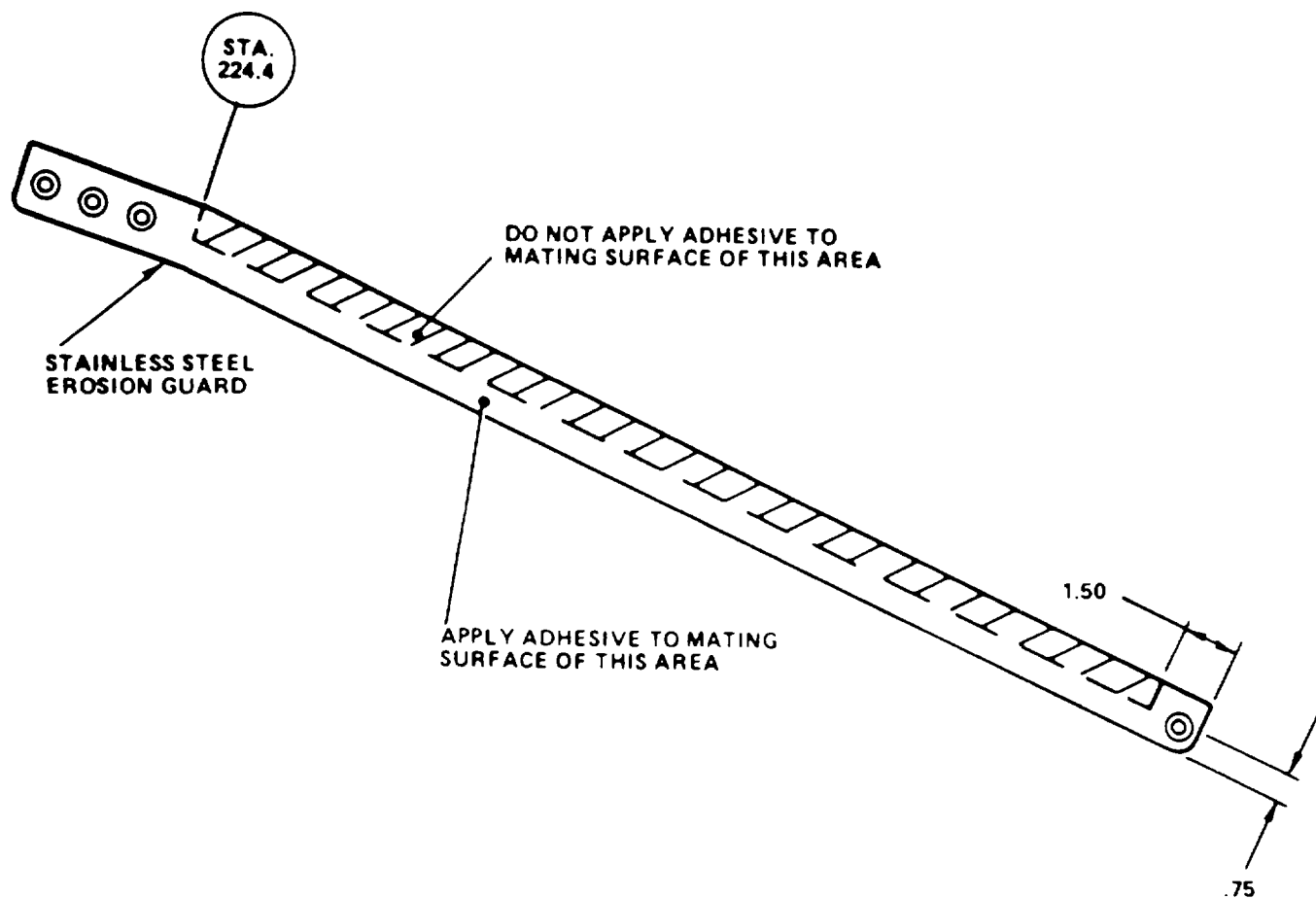


Figure 5-17AC. Application of Sealant to Stainless Steel Guard for K747-003-303/403 Blade.

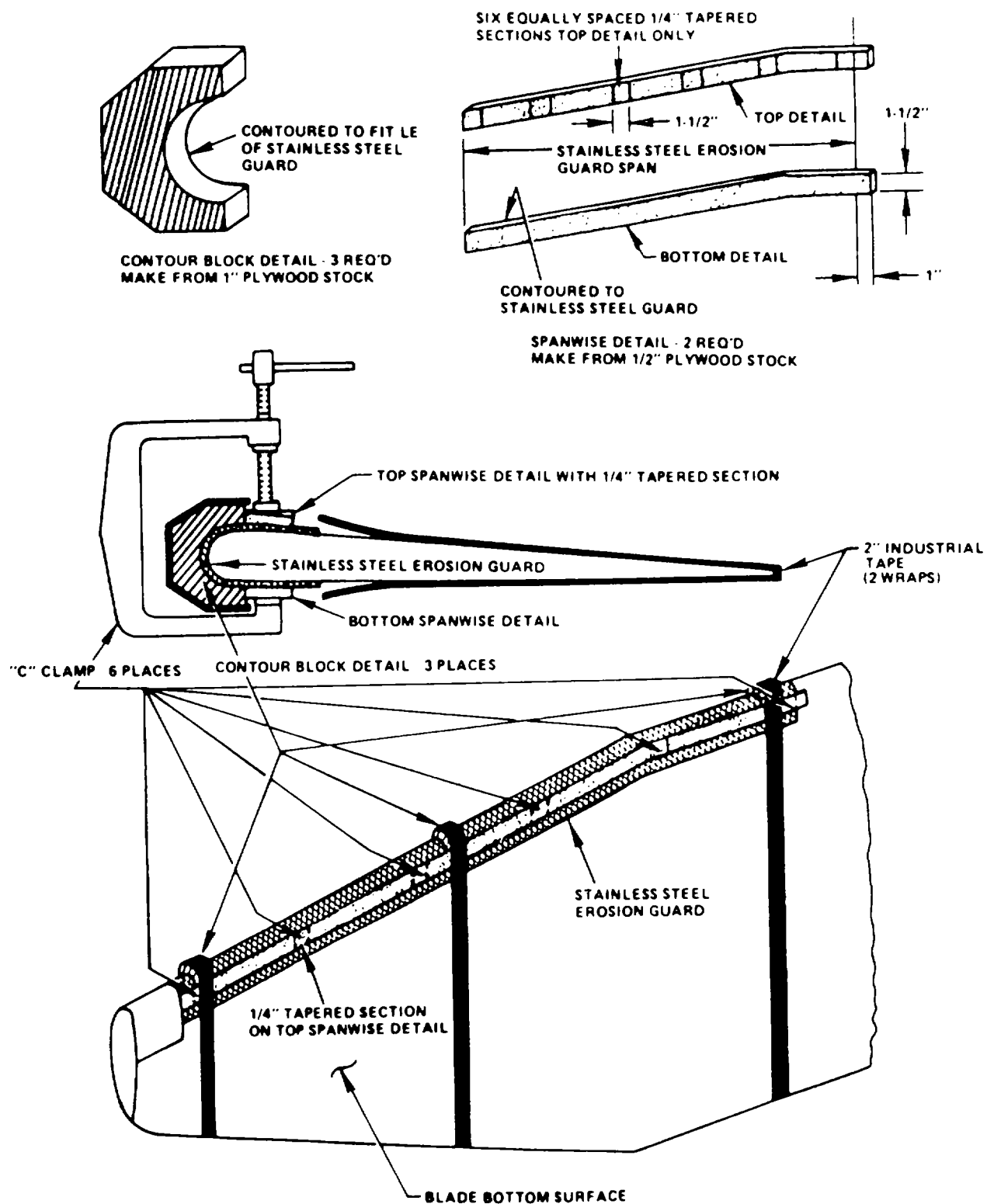


Figure 5-17AD. Stainless Steel Erosion Guard Holding Fixture

CAUTION

Isopropyl alcohol can damage leading edge erosion guard. Avoid spillage.

e. Using cotton tipped swab (kit), dip in isopropyl alcohol (C23) solvent. Clean surfaces to be bonded.

f. Using masking tape (kit), mask around cut out section to protect guard from solvents and adhesive.

g. Make a pattern from cut out section. This pattern will be used to make the replacement patch. Use the 4 x 8 inch patch from kit. Fit patch to mate removed section.

WARNING

Adhesive contains toxic ingredients. Provide adequate ventilation and protect the skin and eyes from contact with uncured resins or curing agent. DTA can cause blindness and burns. Wash off uncured resins and curing agent from skin with warm water and soap. Avoid use of solvents for cleaning the skin. Wear polyethylene gloves over cotton gloves for this task.

Once the contact cement and the patch come in contact, the patch cannot be moved if it is mislocated. It will be necessary to enlarge the repair sections.

CAUTION

Surfaces to be bonded must be clean, dry, and free of finger prints and all foreign matter.

h. Bonding the guard patches. The preferred method to secure the guard patch to the guard is to use contact cement. Suggested mix ratio is 15 grams of estane to 85 grams of MEK (C87). Cure time is 30 minutes.

NOTE

Patch should overlap by 0.50 inch.

NOTE

Pot life of adhesive is 15 minutes at 75 degrees F (23.8 degrees C). It is shorter at higher temperatures. Work without delay.

i. Alternate method.

(1) The alternate method to secure the guard patch is to use epoxy resin EA828 (C107). The patch can be moved into position after contacting the adhesive.

(2) Mix 100 parts/weight of resin EA828 with 10 parts/weight of DTA activator (C107) in a clean glass, metal, polyethylene, or plastic coated paper container.

(3) Using 0.25 inch brush (kit), apply a light coat of adhesive to both surfaces to be bonded.

(4) Using finger pressure, press erosion guard to blade while working out excess adhesive from under the erosion guard. Wipe away excess adhesive with clean cheesecloth (kit) to prevent adhesive from running off the masking onto the exposed blade surface.

(5) Lay teflon parting blanket (kit) over repair. Place masking tape (kit) over edges of parting blanket to prevent movement.

(6) Obtain two wooden blocks approximately 0.75 x 2 x 6 inches and a C clamp (8 inch opening by 6 inches deep). Place 0.25 x 2 x 1 inch rubber thick strip (or suitable substitute) between block and parting blanket. Place remaining block and rubber strip on opposite surface and, using C clamp, apply light pressure to rebonded area.

NOTE

Pressure can be applied by vacuum or strips of rubber around the blade. These methods should be used on the leading edge where clamps would not be practical.

(7) After four hours at room temperature, remove clamp, blocks, rubber strip, parting blanket, and masking tape.

(8) After cure cycle, bond the patch to the guard by applying heat with a sealing iron as described in paragraph 5-5R.

5-5AC. REFINISHING PAINT-K747 MAIN ROTOR BLADES (AVUM).

NOTE

When actual operational emergencies require immediate use of the helicopter, touchup painting may be deferred until termination of the actual emergency.

CAUTION

The only paint refinishing authorized is the touchup of repaired areas and areas immediately adjacent to repaired areas. This restriction is necessary to maintain lightning protection and radar signature characteristics of the blade. Refinishing paint must not be applied to leading edge erosion guard.

Only material from the same kit shall be mixed, except that two or more kits may be mixed in the same vessel, provided the kits are all manufactured by the same vendor. Established mixing ratios must be followed closely; otherwise, the primer will exhibit unsatisfactory film properties, such as poor adhesion, poor chemical resistance, or inadequate drying. Component II shall always be added to component I.

NOTE

The epoxy polyamide primer is supplied as a two component kit. Pot life is limited and only that amount which can be used in less than 8 hours should be mixed.

a. Mix component I and II in a one to one ratio by volume. Each component shall be well agitated and shall be poured separately into the proper container. The material temperature should be at least 70 degrees F (21 degrees C). Component I shall be poured into the empty container, then component II shall be slowly poured into component I with constant stirring.

b. Thinning (for spraying). The mixed epoxy polyamide primer shall be reduced for spraying with one volume of thinner (C142A) to two volumes of mixed primer. The thinned primer shall be stirred thoroughly, strained, and allowed to stand for about 30 minutes prior to use. The thinning ratio may be varied slightly to obtain the proper spraying viscosity. The 30 minute standing period is necessary to:

- (1) Permit the chemical components to partly react.
- (2) Shorten the drying time.
- (3) Reduce cratering.
- (4) Preclude component II from sweating out or migrating.
- (5) Allow any bubbles (formed while stirring) to escape.

c. Feather edges of finish next to repair area with 400 grit abrasive paper.

d. Remove sanding dust using clean cheesecloth (C36) dampened with thinner (C 142A).

e. Mask off touchup area.

f. Wipe area with 50/50 mix of MEK (C87) and lacquer thinner (C140).

g. Apply primer (C100) slightly overlapping repair area. Allow to dry approximately 5 minutes.

h. Apply a cross coat of primer and allow to dry about 30 minutes. If temperature is below 70 degrees F (21 degrees C), allow to dry about 2 to 3 hours. Do not apply below 50 degrees F (10 degrees C).

i. Brush application. Mix one volume of component I to one volume of component II. If thinning is required, use thinner (C142A). Apply only one brush coat of primer. The same temperature limitations in step h above apply.

j. Mix component I and II of polyurethane (C98) in the correct ratio according to manufacturer's instructions.

k. Cross spray polyurethane (C98) over the primer to a thickness of 0.0010 to 0.0015 inch.

NOTE

Avoid overspray onto existing polyurethane finish. Polyurethane will not adhere properly to a previously coated area.

1. Allow to dry approximately 6 hours before releasing helicopter for flight.

5-5AD. MASKING AND REFINISHING LEADING EDGE EROSION GUARD- K747 MAIN ROTOR BLADES (AVIM).

NOTE

This procedure is for use at station 213.5 outboard after installation of repair kit P/N K747-206.

- a. Ensure blade is properly grounded.
- b. Mask area for application of primer.

(1) Apply masking tape and brown paper at the forward side of the erosion guard trailing edge on both blade top and bottom surfaces. Brown paper will be applied to cover unaffected blade surfaces and erosion guard area from primer and polyurethane overspray. (See detail A, figure 5-17AE.)

(2) Apply a second strip of masking tape overlapping the first strip applied. The trailing edge of the second masking being applied must be along a line 0.100 inch aft of the erosion guard trailing edge. (See detail B, figure 5-17AE.)

CAUTION

When abrading the polyurethane finish, care must be exercised to only scuff the surface to allow primer adhesion. Do not remove the full coating thickness.

- c. Abrade the polyurethane top coat on exposed blade top and bottom surfaces from station 205.5 outboard. Use 360 grit abrasive paper and just scuff the surface lightly.

WARNING

Primer and thinner mixture contains toxic ingredients. Provide adequate ventilation and protect

the skin and eyes from contact with uncured resins or curing agent. Wash off any primer from skin with warm water and soap. Avoid use of solvents for cleaning the skin.

NOTE

Epoxy polyamide primer is supplied as a two component kit. Pot life is limited to 8 hours from mixing. Mix only the amount needed. Material temperature shall be at least 70 degrees F (21 degrees C) before mixing.

- d. Mix and prepare primer for use.

(1) Stir component I and II in their respective supply containers. Ensure thorough mixing occurs.

(2) Combine an equal volume of component II into component I. Stir constantly while combining mixing. Do not induce air bubbles in the mixture.

NOTE

Thinning ratio of mixed primer and thinner may be varied slightly to obtain a proper spraying viscosity.

(3) Thin the mixed primer for spraying using a volume ratio of 1 part primer to 2 parts thinner (C142A). Stir the thinned mixture thoroughly. Do not induce air bubbles. Strain the mixture and allow to stand for 30 minutes prior to use.

CAUTION

Surfaces to be primed must be clean, dry and free of finger prints and all foreign matter.

- e. Wipe the scuffed area with a 50/50 mixture of MEK (C87) and lacquer thinner (C140).

WARNING

Primer and thinner mixture contains toxic ingredients. Provide adequate ventilation and protect the skin and eyes from contact with uncured resins or curing agent. Wash off any primer from skin with warm water and soap. Avoid use of solvents for cleaning the skin.

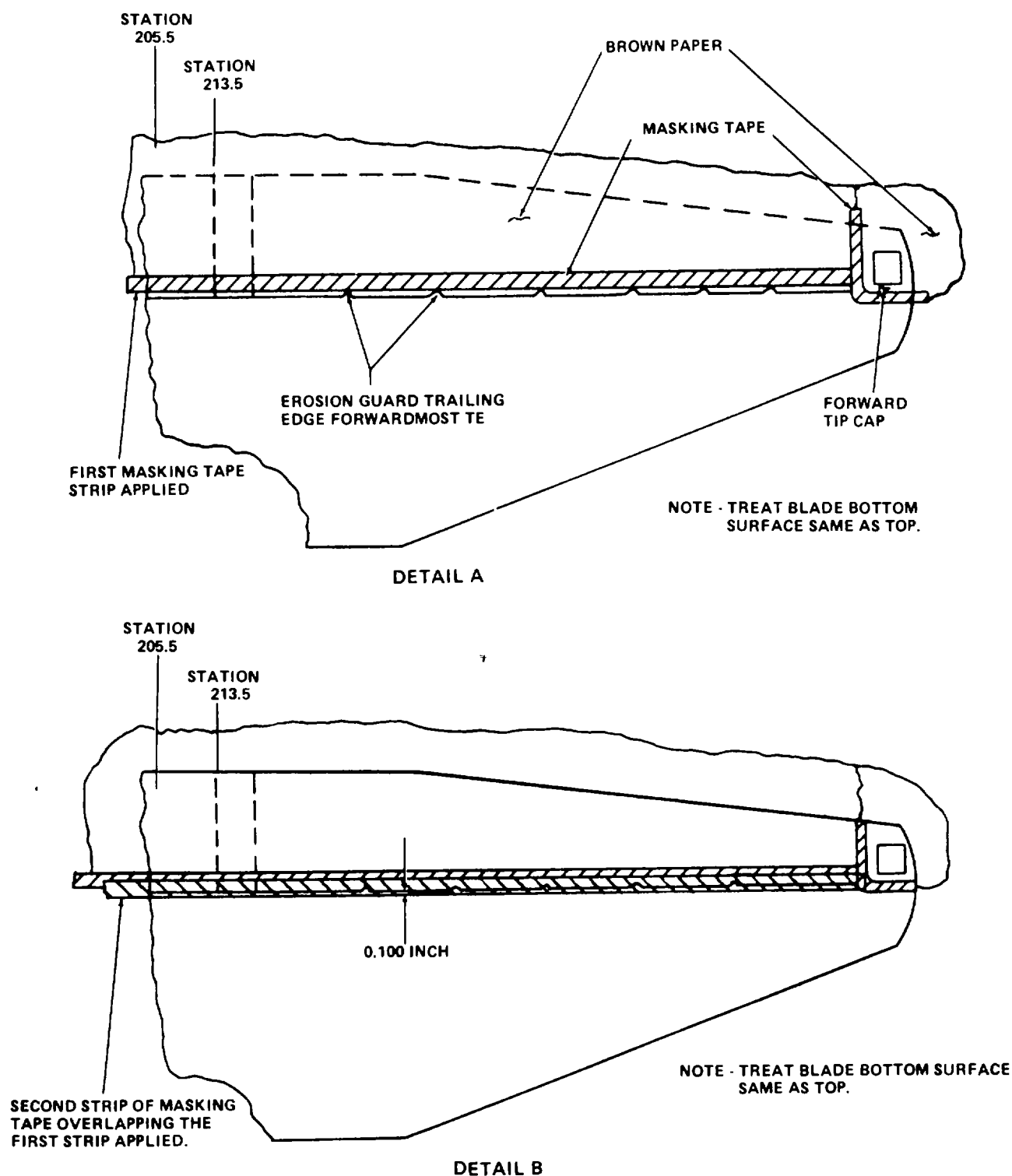


Figure 5-17AE. Masking for Paint Touch-up After Installation of Kit K747-206.

f. Apply a full coat of primer to the bare area next to the second masking tape applied. Apply a mist coat of primer to the areas scuffed. Allow 1 hour drying time prior to application of polyurethane paint.

g. Remove the second piece of masking tape applied which extends 0.100 inch aft of the erosion guard trailing edge.

h. Hand abrade the ridge where the epoxy primer ends. Use 360 grit abrasive paper.

i. Mix components I and II of the paint (C98) as per manufacturer's instructions. Heed the manufacturer's warnings and cautions.

j. Dust sanding residue from the blade surface.

k. Apply a mist coat of paint (C98) to the blade areas framed by masking tape. Allow the mist coat to dry for 30 minutes.

l. Apply a full coat of paint (C98) to the misted area. Do not exceed 0.0010 to 0.0015 inch thick.

m. Remove remaining masking and allow to dry for 6 hours minimum before blade is used for flight.

5-5AE. REPAIR OF AFT TIP CAP-K747 MAIN ROTOR BLADES (AVIM).

a. Cracks in aft tip cap may be sanded and routed to a depth of 0.060 inch.

b. Apply adhesive EA934NA (C17). Smooth to contour of cap by sanding.

c. Paint repair area in accordance with paragraph 5-17AC.

5-5AF. PREPARATION FOR STORAGE OR SHIPMENT-K747 MAIN ROTOR BLADES.

a. The following instructions cover storage or shipment of main rotor blades in container P/N K747-001.

(1) Thoroughly remove foreign matter from entire exterior surface of blade using clean cheesecloth (C36).

NOTE

Tape all holes in the blade (bullet damage, tree damage, foreign object damage, etc.) to protect the interior of the blade.

(2) Thoroughly clean root fitting. Apply grease (C67) to root fitting bolt hole, drag brace bolt hole, and all exposed unpainted surfaces.

(3) Wrap blade with barrier material (C29), shiny side next to blade, at all locations where blade will contact the molded hair supports (5 places) and secure with pressure sensitive tape (C136).

(4) Attach a properly filled out DD Form 1577-2 (Unserviceable/Repairable) tag directly to the blade.

(5) Place blade in container.

(6) Secure blade to shock mounted support.

(7) Secure lid.

(8) Secure blade log in container log compartment.

5-5AG. INSTALLATION-K747 MAIN ROTOR BLADES.

a. Obtain a balanced main rotor hub (paragraph 5-6A).

b. Support main rotor hub on a build-up bench in accordance with paragraph 5-4a. Check that locating pin (6, figure 5-11) is installed in upper surface of each grip (5) at inboard side of retaining bolt hole.

c. Install drag strut (15, figure 5-17A).

d. Remove preservative grease from blade grip bore and retaining bolt.

e. Apply corrosion preventive compound (C53) to blade retaining bolt, hub grip, blade butts, and washer with notches on locating pin (6). Slide blade (9, figure 5-11) gently into grip (use of sling is optional). Place washer (7) on retaining bolt (8). Align bolt holes carefully and insert bolt from top. If bolt binds, move tip of blade up and down slowly to find position which

allows bolt to pass through without binding. Seat bolt and washer with notches on locating pin (6).

f. Place padded support under blade approximately one third blade length inboard from blade fin.

CAUTION

Install washer (16) with counterbore up facing grip.

The erosion guard is a polycarbonate material which will cut easily upon impact with a rigid structure. Seal all openings immediately with sealing iron.

g. Install washer (16) with counterbore up as illustrated and install nut (17). Do not tighten nut at this time.

h. Preset drag brace (15) length to 14.750 inches, hole center to hole center. Align clevis of drag brace (15) on bolt hole of the blade drag plates. Install shims (10) equally between clevis and upper and lower drag plates to obtain 0.000 to 0.005 inch clearance. Install bolt (14) and secure with two washers (12 and 13) and nut (11) on lower end. Do not tighten at this time.

i. Install opposite blade in the same manner.

j. If the blades are to be aligned in the hub, follow instructions in paragraph 5-4.

k. If the blades are not to be aligned in the hub, torque both nuts (11) 125 to 150 foot-pounds.

l. If the blades are not to be aligned in the hub, use wrench (T31) to tighten nuts (17) to a torque of 475 to 525 foot-pounds. Align a notch in the nut with a hole in the bolt. Install locking screw (20) with head in a direction so that centrifugal force will keep the locking screw in. In some cases, this may mean the locking screw may be installed from the inside of the bolt. Install washer (19) and nut (18).

m. Install grip locks (T59) on each pitch horn, if not previously accomplished (figure 5-7).

5-5AH. ALIGNMENT-K747 MAIN ROTOR BLADES.

Refer to paragraph 5-4.

5-6. Main Rotor Hub Assembly. (AVIM)

The Main Rotor Hub major components are the yoke, trunnion extensions, blade grips, drag braces, pitch horns, and elastomeric bearings. See figures 5-18 and 5-19. The elastomeric bearings (6, figure 5-19) are composed of alternating layers of an elastic material (elastomer) with concentric cylindrical metal laminations molded to steel inner and outer housings. The bearing outer housing is bolted to the rotor yoke. The bearing inner housing is bolted to the trunnion. Movement of the yoke and blades on the flapping axis is by flexing of the bearing elastomer.

Premaintenance Requirements for Main Rotor Hub

Condition	Requirements
Model	AH-1S
Part No. or Serial No.	540-011-101-17
Special Tools	(T26) (T31) (T34) (T42) (T43) (T45) (T47) (T56) (T59) (T79) (T80) (T81)
Test Equipment	NA
Support Equipment	Work aid for removal of blade retaining bolt
Minimum Personnel Required	Two
Consumable Materials	(C9) (C12) (C17) (C32) (C37) (C44) (C45) (C62) (C82) (C87) (C88) (C99) (C112) (C113) (C116) (C136) (C151)
Special Environmental Condition	NA

a. Inspection-Assembled Main Rotor Hub.

(1) Inspect exposed surfaces of assembled main rotor hub for nicks scratches and corrosion. See figures 5-21, 5-23, 5-24, 5-25, 5-26, 5-26A, 5-27, 5-28 and 5-29 for damage limits.

(2) Inspect open bolt holes for scratches, gouges and corrosion.

(3) Inspect elastomeric bearings for elastomer squeeze-out and delamination. Cracking and slight cracking of elastomer due to weather exposure is not cause for replacement.

(4) Inspect for scuffing due to contact between parts.

NOTE

Interference will not occur in normal operation, but can occur at extreme control positions during ground operation of controls with external hydraulic power applied while main rotor is static.

(5) Inspect trunnion for damaged splines. See figure 5-28 for allowable damage limits.

(6) If any damage is present for which no limits are specified and/or there is damage beyond limits shown on figure 5-28, replace the affected part.

(7) Inspect hub historical records and the hub for evidence that the hub has been subjected to an accident or incident outside the realm of normal usage. If such evidence exists, perform special inspections outlined in Chapter 1.

(8) Identify hub components which will reach retirement time prior to next scheduled inspection for replacement. Refer to Overhaul and Retirement Schedule.

(9) Inspect sand deflectors for cracks and deflection doublers for corrosion.

(10) Remove two sand deflectors, if installed, from each main rotor hub to be inspected.

(11) Check the clearance between each extension and grip assembly by inserting the 0.100 to 0.125 inch thick strap between them. Move the strap through the full range of gap between grip and extension.

(a) The hub and metal blade angle set in accordance with paragraph 5-4.b. (13) (d).

(b) The hub and fiberglass blade angle set in accordance with paragraph 5-4.b. (13) (e).

(c) Disconnect the pitch links per paragraph 5-4.a.(1).

(d) Rotate hub and blade and check for clearance with a total positive angle of attack of 17 degrees on hub with metal blades or 20 degrees on hub with fiberglass blades.

(e) Rotate hub and blades and check for clearance with zero angle of attack.

(f) Main rotor hubs which do not allow the 0.100 to 0.125 inch thick strap to pass should be disassembled for visual check for interference rubbing or other signs of contact between grip and extension. Inspect carefully the outboard end of extension barrel and grip for interference. If there are no visual signs of contact on grip and extension the hub may be reassembled. All parts with signs of interference must be replaced.

(12) Replace extension assembly if any clearances cannot be met.

b. Disassembly.

(1) Position main rotor hub on build-up bench (T26) equipped with adapter plate (T34) if not previously accomplished. Refer to paragraph 5-4, for procedure.

(2) Remove main rotor blades from hub if not previously accomplished. Refer to paragraph 6-5.

(3) Identify blade retaining bolt assemblies (6, figure 5-18) for reinstallation in the same grip. Use paint or felt tip pen. Remove both bolts. Use socket wrench (T31) to remove nuts from blade retaining bolts. Use work aid shown on figure 5-12 to remove blade retaining bolts if necessary. Refer to paragraph 5-5 for procedure.

NOTE

Units operating AH-1 aircraft may remove the sand deflectors P/N 540-011- 174-11, NSN 1615-00-116-7110 from the rotor head. Upon removal, deflectors should be inspected for serviceability and repaired as required. The deflectors will be retained as part of the aircraft mission equipment. Deflectors will be installed in extreme sand/dust conditions or in arctic areas where there are extreme ice/snow conditions. Both deflectors must be either installed on the aircraft or removed from the aircraft.

(4) Remove three bolts (2, figure 5-18), sand deflector (1), and spacers (3). Remove opposite sand deflector in the same manner.

(5) Remove bolt (18, figure 5-18) and drag brace (15). Remove opposite drag brace in same manner.

(6) Remove bolts (19 and 21, figure 5-18) and pitch horn (23). Remove opposite pitch horn in the same manner.

(7) Remove cotter pin (57, figure 5-18) nut (55) and washer (56) from bolt (42). Remove bolt (42), clamp (43) and lock (44). Remove dome nut (45).

(8) Remove nuts (48, figure 5-18) and washers (47) from bolts (60). Remove bolts. Remove blade grip (41) from yoke extension (28). Use care to prevent damage to threads on fitting (52) and damage to dust seal (51). The dust seal (51) bearing (50) and strap indexing ring (49) should be bonded to the grip near the outboard end.

(9) Remove the opposite grip in the same manner outlined in steps (7) and (8).

(10) Remove nuts (40, figure 5-18) washers (29), bolts (27) and washers (26). Remove yoke extension (28) and housing (38) from yoke (25). Remove housing (38) from extension. Remove opposite yoke extension in the same manner.

(11) Clean sealant from retainer rings (31 and 34, figure 5-18) with a sharp plastic scraper. Remove pin (33) and strap (54). Remove opposite strap in the same manner.

(12) Remove yoke and trunnion from buildup stand and place on a work bench with supports under the flat portion of the yoke.

(13) Identify elastomeric bearings (6, figure 5-19) trunnion (9) and yoke (12) with felt-tipped marker so the bearings and trunnion can be reinstalled in the same position on the yoke.

(14) Remove four bolts (1, figure 5-19), washers (2) and retainer (3) from each side of trunnion.

(15) Remove two nuts (11, figure 5-19), washers (10), bolts (4) and washers (5) to free one elastomeric bearing from yoke. Thread a bolt with 1/2 -x 20 UNF threads into tapped hole in elastomeric bearing (6). Tighten bolt so that it bears against disk (8) and pulls elastomeric bearing free of yoke and trunnion. Remove opposite elastomeric bearing in the same manner and remove trunnion from yoke.

(16) Remove shims (7, figure 5-19) from both sides of trunnion and identify for reinstallation in the same location.

c. *Cleaning.*

WARNING

Use solvent (C-124) in a well-ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

(1) Clean all metal parts with solvent (C124) and dry with compressed air.

WARNING

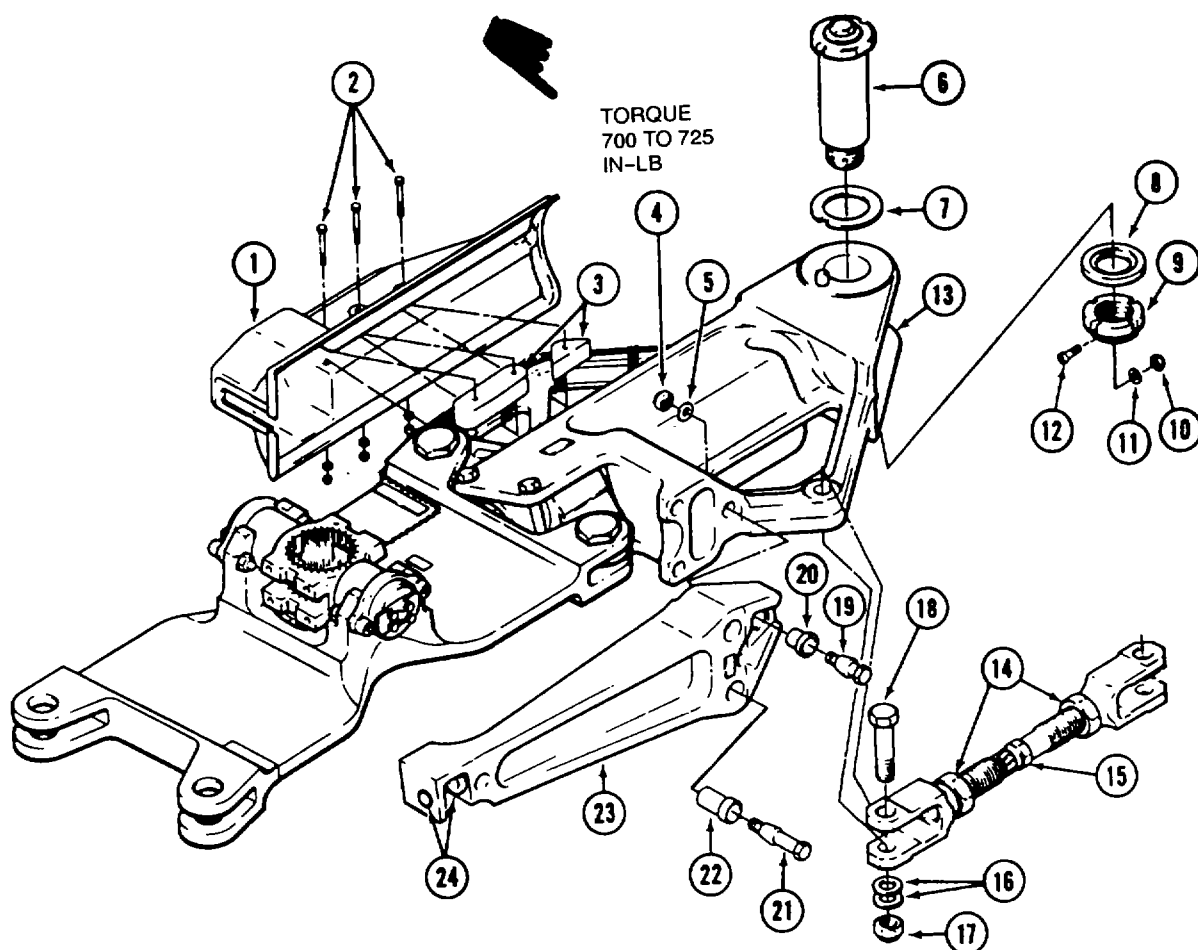
Provide adequate ventilation when using methyl-ethyl-ketone (C87). Avoid breathing solvent vapors and avoid prolonged contact with skin.

CAUTION

Do not allow methyl-ethyl-ketone (C87) to saturate the teflon bearings or contact the elastomer portion of elastomeric bearings.

(2) Clean teflon bearings in housing (38, figure 5-18) and grip (41) with clean cloths dampened with methyl-ethyl-ketone (C87).

(3) Clean old sealant and zinc chromate primer from spindles of trunnion and inner metal housing of elastomeric bearings (6, figure 5-18). Use a sharp plastic scraper and cloths moistened with methyl-ethyl-ketone (C87). Do not allow the

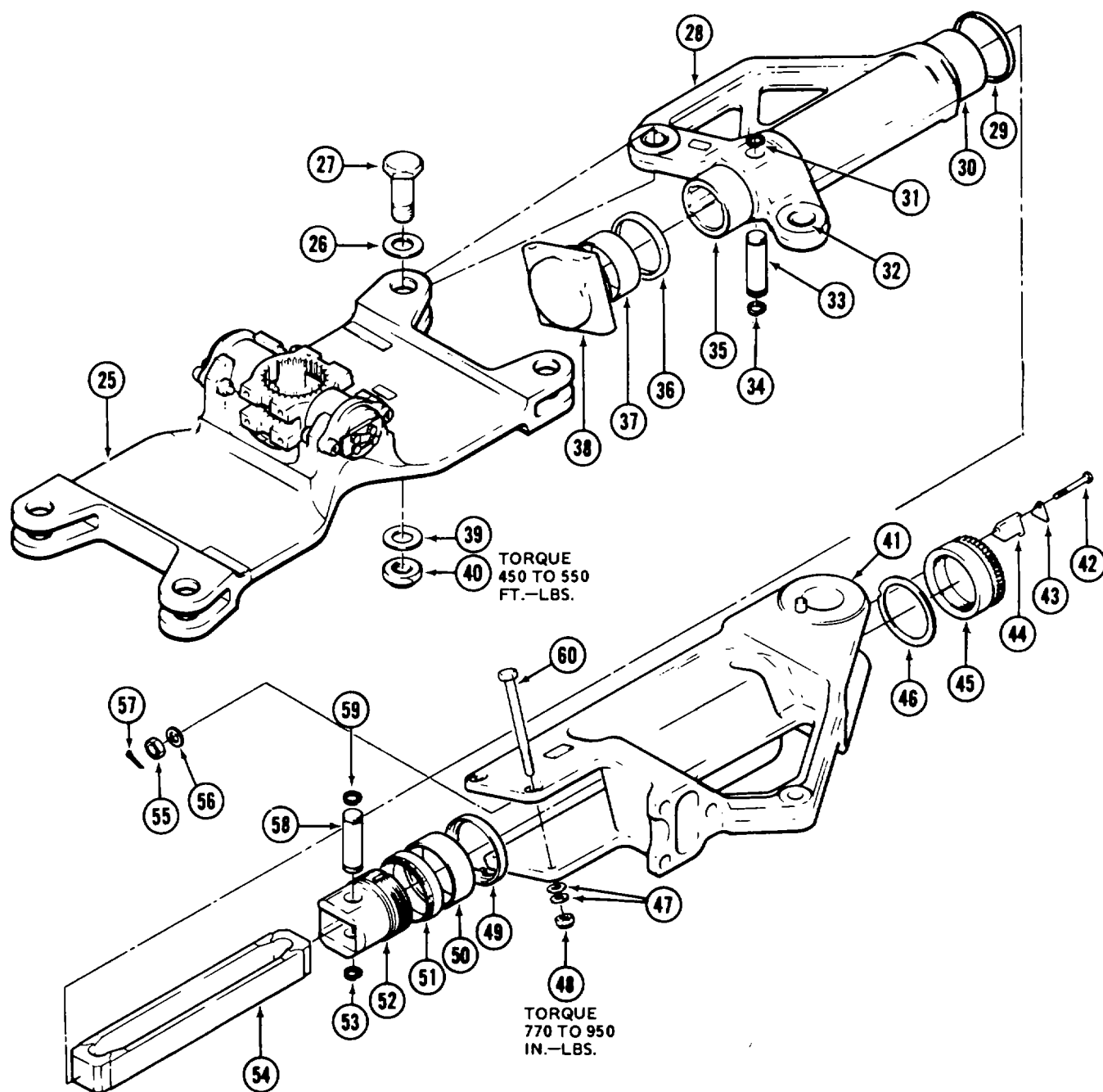


1. Sand Deflector	13. Grip
2. Bolts	14. Jam Nut
3. Shims (Spacers)	15. Drag Brace
4. Special Nut	16. Steel Washers
5. Special Washer	17. Nut
6. Bolt Assembly	18. Bolt
7. Keyway Washer	19. Special Bolt
8. Special Washer	20. Bushing
9. Special Nut	21. Special Bolt
10. Extended Washer Nut	22. Bushing
11. Steel Washer	23. Pitch Horn Assembly
12. Screw	24. Bushings

540011-141-1

Figure 5-18. Main rotor hub yoke extension and grip assembly (Sheet 1 of 3)

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540011-141-2

Figure 5-18. Main rotor hub yoke extension and grip assembly (sheet 2 of 3)

25.	Yoke	43.	Clamp
26.	Special Washer	44.	Retainer (Lock)
27.	Bolt	45.	Dome Nut
28.	Yoke Extension	46.	Washer
29.	Yoke Ring (Radius Rings)	47.	Steel Washer
30.	Sleeve	48.	Self Locking Nut
31.	Retaining Ring	49.	Strap Indexing Ring
32.	Shim (Buffer Pad)	50.	Bearing
33.	Pin	51.	Grip Bearing Dust Seal
34.	Retaining Ring	52.	Fitting
35.	Sleeve	53.	Retaining Ring
36.	Seal	54.	Strap
37.	Bearing	55.	Slotted Nut
38.	Housing	56.	Thin Steel Washer
39.	Special Washer	57.	Cotter Pin
40.	Self-Locking Nut	58.	Pin
41.	Grip	59.	Retaining Ring
42.	Bolt	60.	Bolt

540011-141-3A

Figure 5-18. Main rotor hub yoke extension and grip assembly (Sheet 3 of 3)

methyl-ethyl-ketone to contact the elastomer portion of the elastomeric bearings.

d. Inspection-Disassembled Main Rotor Hub.

(1) Inspect teflon bearings in housings (38, figure 5-18) and grips (41) for wear and damage. Compare the bearings with the examples shown on figure 5-20 to determine whether the bearings are suitable for further service. Also inspect teflon bearings for secure bonding of fabric.

(2) Inspect yoke extension for damaged, worn or loose bearing sleeves (30 and 35, figure 5-18). If the bearing sleeves are loose or have damage in excess of limits shown in figure 5-21, the yoke extension must be replaced. If the bearing sleeves have any superficial marks, polish out the marks with Scotchbrite (C113) and reinspect the bearing sleeves.

(3) Inspect yoke extensions for worn or missing buffer pads (32, figure 5-18).

(4) Inspect mating surfaces of the hub components for damage in excess of the following limits:

NOTE

Mating surfaces are the surfaces of a component that come in contact with another component when the hub is assembled.

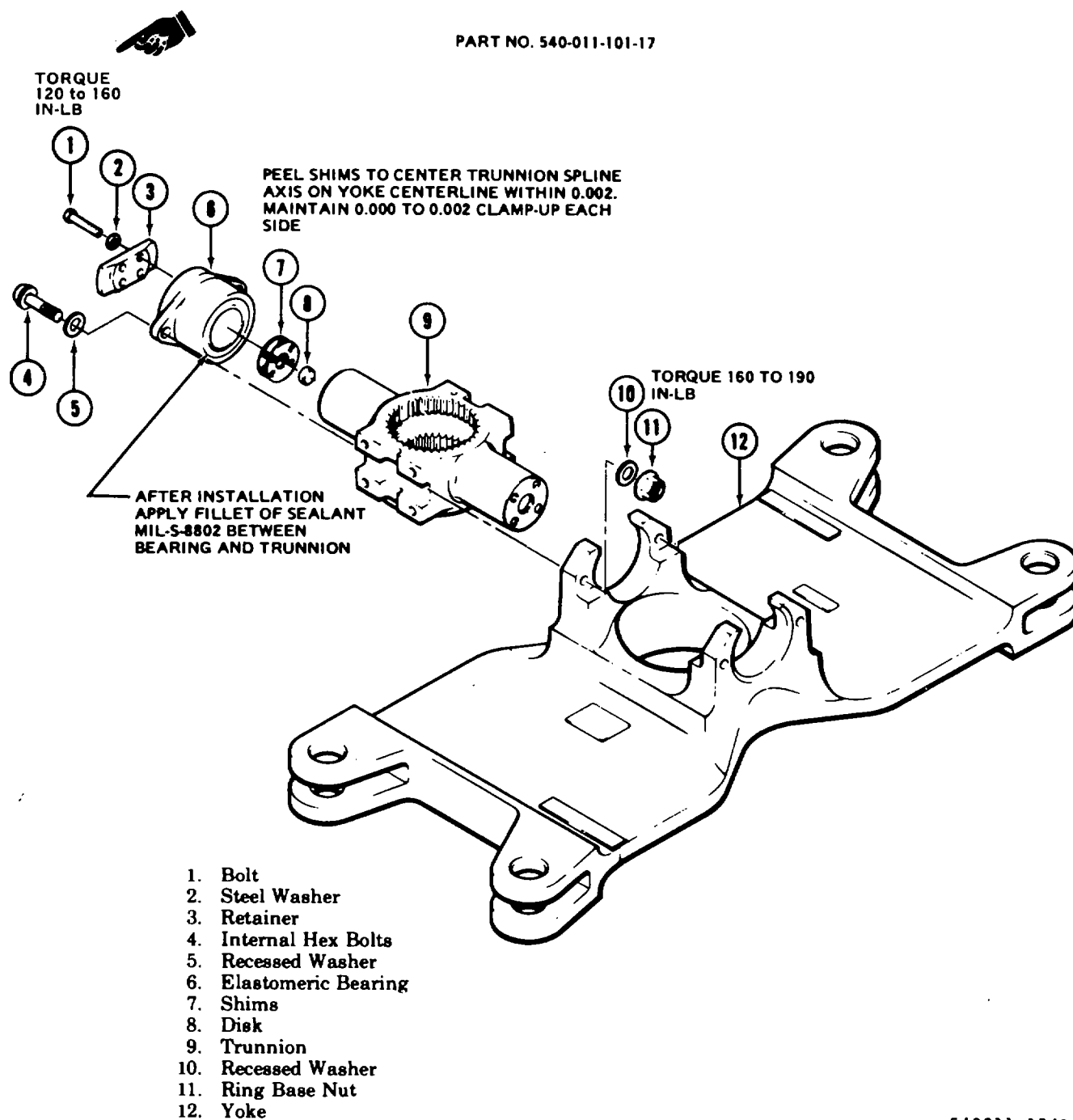
(a) Mechanical and corrosion damage limits on mating surfaces are 0.020 inch in depth and one-half of the quadrant of area around bolt holes. Closer tolerances apply when specified in inspection instructions for individual components; i.e., the limit for yoke extension bearing sleeves is 0.002 inch as shown on figure 5-21.

(b) All hub components must assemble without misalignment or cocking after polishing out mechanical and corrosion damage.

(5) Inspect the holes in the hub components illustrated on figure 5-22 for wear in excess of limits.

(6) Inspect seals (36, figure 5-18) for damage which would affect function and for secure bonding to housings.

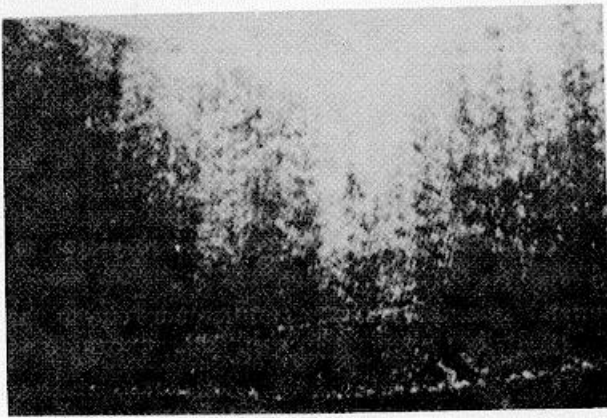
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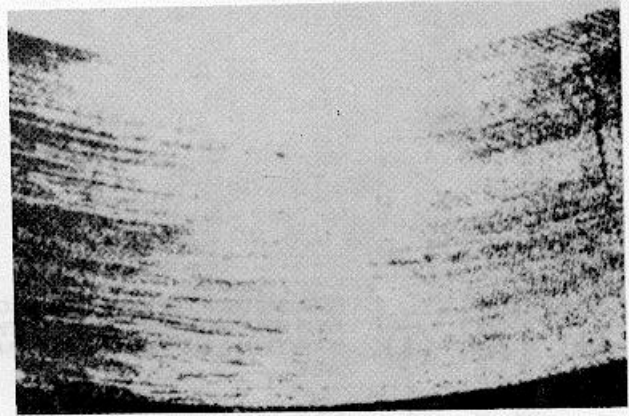
Figure 5-19. Main rotor hub yoke and trunnion for main rotor hub

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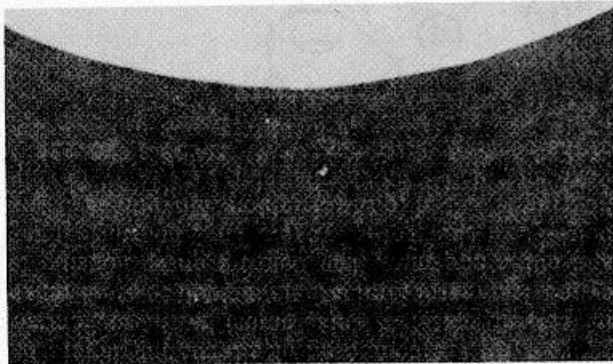
DETAIL A

New Shafer bearing. Identified by vertical weave in fabric. Replacement on condition



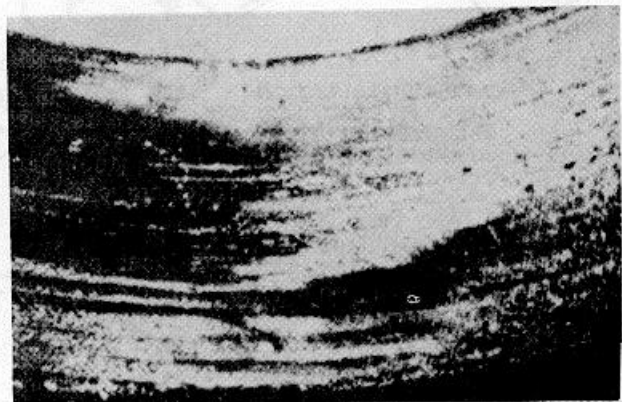
DETAIL D

Slight wear resulting from normal usage. Bearing is reusable. Wipe surface clean with M.E.K. (Methyl-Ethyl-Ketone). Do not saturate bearing during cleaning.



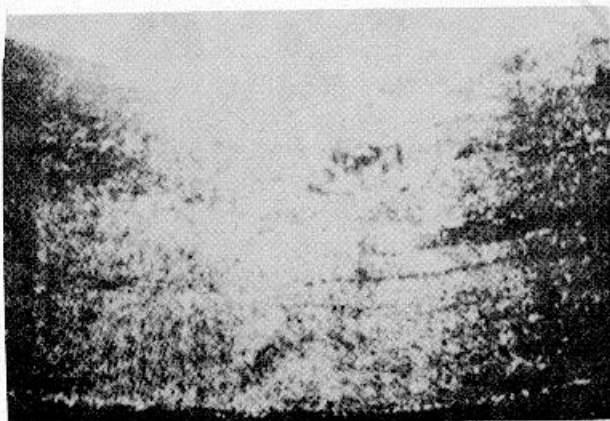
DETAIL B

New Kahr bearing identified by diagonal weave in fabric. Replacement on condition only.



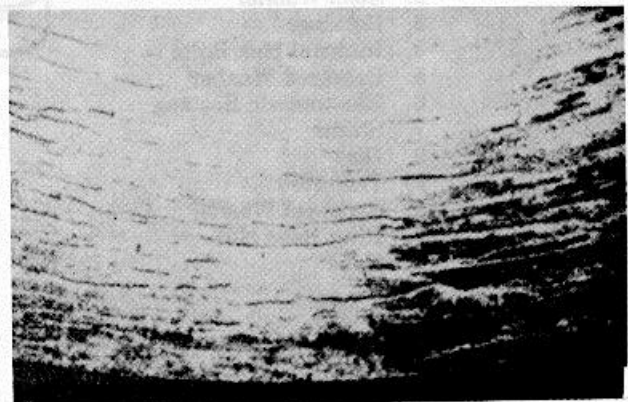
DETAIL E

Acceptable wear pattern, will appear to be glazed. Wipe surface clean with M.E.K. (Methyl-Ethyl-Ketone). Do not saturate bearing during cleaning.



DETAIL C

Typical bearing surface satisfactory for reuse. Transfer of material is normal, will appear as glazed surface.

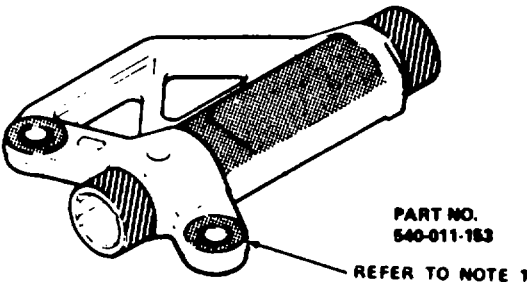


DETAIL F

Unacceptable. Bearing must be replaced.

540011-23B

Figure 5-20. Main rotor hub teflon bearing wear patterns
5-36



TYPE OF DAMAGE	DAMAGE LOCATION SYMBOLS		
			
MAXIMUM DEPTHS AND REPAIR AREAS ALLOWED			
NICKS, SCRATCHES, DENTS AND CORROSION	0.020 In.	0.080 In.	0.002 In.
MAXIMUM AREA PER FULL DEPTH REPAIR	Not Critical	Not Critical	0.25 Sq. In.
NUMBER OF REPAIR AREAS	---	Not Critical	---
EDGE CHAMFER	0.040 In.	0.080 In.	0.040 In.
BORE DAMAGE:	0.002 Inch for 1/4 Circumference		
NO CRACKS ALLOWED			
NOTES			

1. The area of repair on surfaces mating with the yoke should not exceed one-half of any quadrant.
2. Thickness of barrel wall is 0.100 inch minimum.

540011-126-3D

Figure 5-21. Damage limits - main rotor yoke extension.

(7) Inspect grip bearing dust seals (51, figure 5-18) for damage which would affect function and for secure bonding to grips.

(8) Inspect radius rings (29, figure 5-18) for damage and wear. Replace radius rings if the following limits are exceeded.

(a) Cracks in the carbon face running from the inside diameter to the outside diameter.

(b) Grooves in the carbon face which reveal uneven contact with the seal.

(c) Any chips of carbon missing from the carbon face.

(d) Unbonded abrasion shield.

NOTE

Partially unbonded abrasion shield, discoloration of the shield and/or less than 10 cracks in the shield are not cause for replacement.

(9) Inspect straps (54, figure 5-18) for damage and wear in excess of the following maximum limits:

(a) Fifty loose wire ends protruding through the urethane coating of strap in any one corner and/or 400 loose ends over the entire strap assembly. If a lesser number of wire ends are found, record the serial number of the strap and the number of wire ends found in the historical record of the main rotor hub.

(b) Use a ten power magnifying glass to check for cracks in flanges of strap bushings and urethane wedges. A crack in these parts is cause for rejection of the strap.

(c) Severe rupture of the urethane coating is cause for rejection due to difficulty of installation of the damaged strap in the yoke extension.

(d) Displacement of urethane wedges between bushing and inner surface of wire bundle.

(e) Pins (33 and 58) for presence of retaining rings (31, 34 and 53, 59).

NOTE

A permanent set twist in the strap and/or a slight bulging of wire cross section is normal and not cause for rejection of the strap.

(10) Inspect attaching bolts, nuts and washers for damage and corrosion.

(11) Inspect retainers (3, figure 5-19) for obvious damage.

(12) Inspect disks (8, figure 5-19) for obvious damage.

(13) Inspect sand deflectors (1, figure 5-18) for cracks, abrasion damage, oversize bolt holes and corroded, worn, damaged, separated or missing washers. Replace sand deflectors having any cracks greater than two inches in length in any portion. Cracks less than two inches in length are acceptable if stop drilled, provided crack does not permit material fallout.

(14) Inspect elastomeric bearing housing for cracks by the magnetic particle methods, TM 43-0103 (figure 5-29). If there is any doubt about serviceability of elastomeric bearings after inspection, forward the bearings to higher level of maintenance for evaluation. Inspect elastomeric bearings with a 10 power magnifying glass for delamination of the concentric metal laminations and the elastomer. Also inspect for delamination of the bearing inner and outer housings. Cracking or cracking of the elastomer or shedding off of small scraps at end of bearing due to weather exposure is not cause for rejection. Use a standard 0.005 inch, blunt-end, feeler gage to check for delamination in excess of the following limits:

Gage Penetration	% Area/Laminate
0.000 TO 0.250	50%
0.000 TO 0.500	25%

Replace any bearing found to have a cracked concentric metal laminations. Cracked concentric metal laminations may be detected by either visual inspection or by running a fingernail along the edge of the shim.

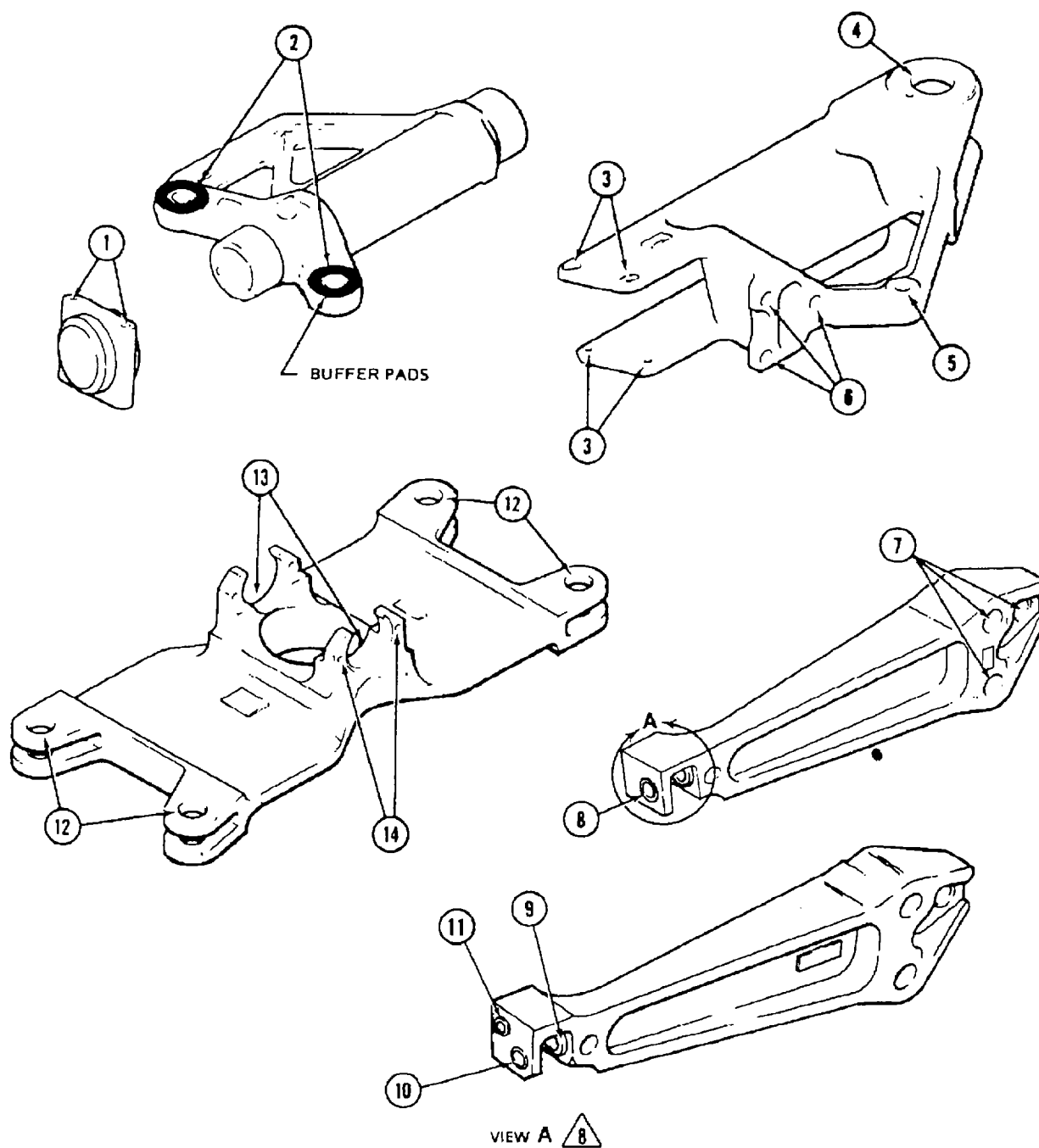
(15) Inspect hub components illustrated on figures 5-21, 5-22, 5-23, 5-24, 5-25, 5-26, 5-27, 5-28 and 5-29 for damage in excess of limits.

(16) Deleted.

e. Repair.

(1) Polish out all traces of corrosion and mechanical damage on hub components. Polish out corrosion damage on aluminum parts to twice the depth of the pit. Use fine to medium grades of abrasive cloth (C44) or fine in-dia stone (C128). Blend the edges of the repair into the surrounding area with a smooth contour. Make final cleanup with crocus cloth (C45) to obtain a smooth, scratch-free surface. If damage exceeds limits specified in paragraph c. scrap the part.

(2) If cadmium plate is removed, touch up with a brush coat of cadmium plate (C32).



540011-253-1

Figure 5-22. Damage limits - main rotor hub holes (Sheet 1 of 2)

Change 71 5-39

MAIN ROTOR HUB BORE INSPECTION

NOMENCLATURE	HOLE NO.	BORE	MAX. I.D. (INCH)
Inboard Bearing Housing	1	Attachment Bolt Holes I.D.	0.5030
Yoke Extension	2	Attachment Bolt Holes	1.2502
Grip	3	Inboard Bearing Housing Attachment Bolt Holes	0.5025
	4	Blade Retention Bolt Holes	2.5015
	5	Drag Brace Attachment Bolt Holes	0.8760
	6	Pitch Horn Bushing Holes	0.8735
Pitch Horn	7	Attachment Bolt Holes	0.8728
	8	Inboard Bushing	0.6267
	9	Bushing (Installed) Bore	0.6267
		Bushing (Removed) Bore	0.8760
	10	Bushing (Installed) Bore Bushing (Removed) Bore	0.8785 1.0990
Yoke	11	Anti-torque Pin (Installed) Bore Anti-torque Pin (Removed) Bore	N/A 0.2505
	12	Extension Attachment Bushing Holes	1.2502
	13	Trunnion Bore	3.2530
	14	Trunnion Attach Holes	0.3850

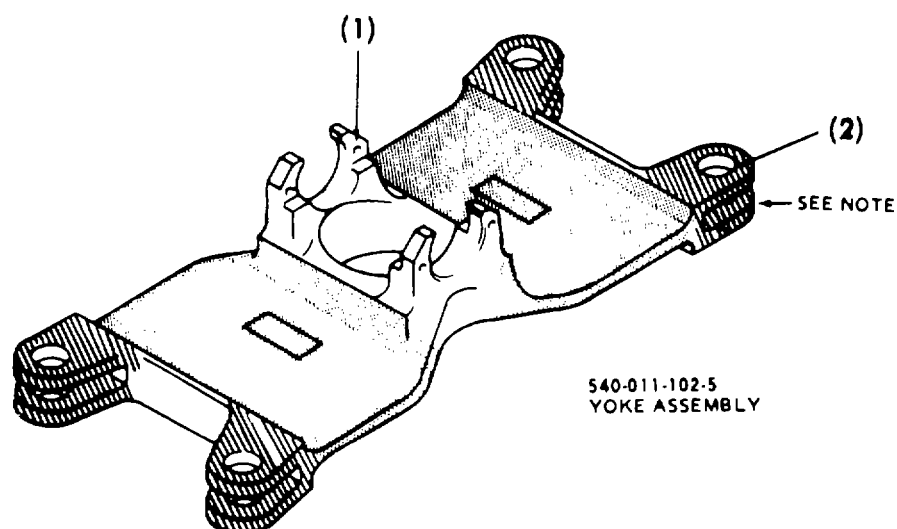
NOTES

1. Damage and repair to the walls of hole No. 3 are limited to maximum depth of 0.005 inch and to holes No. 10, 0.002 inch.
2. Repaired area in trunnion bore, hole No. 10, may not exceed one-fourth the circumference.
3. Damage and repairs on the walls of bolt holes 2, 4, 5, 9 is limited to a maximum depth of 0.010 inch.
4. Damage and repairs on the walls of bolt holes No. 7 is limited to a maximum depth of 0.001 inch.
5. Damage and repair limit on trunnion attach holes, No. 11, is 0.002 inch on the full circumference.
6. Damage and repair on walls is limited to a maximum depth of 0.001 inch for one-fourth the circumference for holes No. 9, 10, 11.
7. No cracks allowed.
8. View A applicable after accomplishment of MWO 55-1520-244-50-6

540011-253-2

Figure 5-22. Damage limits - main rotor hub bolt holes (Sheet 2 of 2)

Change 71 5-40



DAMAGE LOCATION SYMBOLS

TYPE OF DAMAGE	MAXIMUM DEPTHS AND REPAIR AREAS ALLOWED		
			
CRACKS ALLOWED	None	None	None
NICKS, SCRATCHES DENTS AND CORROSION	0.010	0.010	0.020
MAXIMUM AREA PER FULL DEPTH REPAIR	Not Critical	0.10 Sq. In.	Not Critical
NUMBER OF REPAIRS	Not Critical	Not Critical	Not Critical
EDGE CHAMFER	0.040	0.060	0.10

INSIDE DIAMETER of	MFG. DIM.	MAX. SERVICE LIMIT
1. Trunnion Bearing Mounting Holes (4 places)	0.376 - 0.383	0.385
2. Bushings (4 places)	1.2495 - 1.2500	1.2520

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

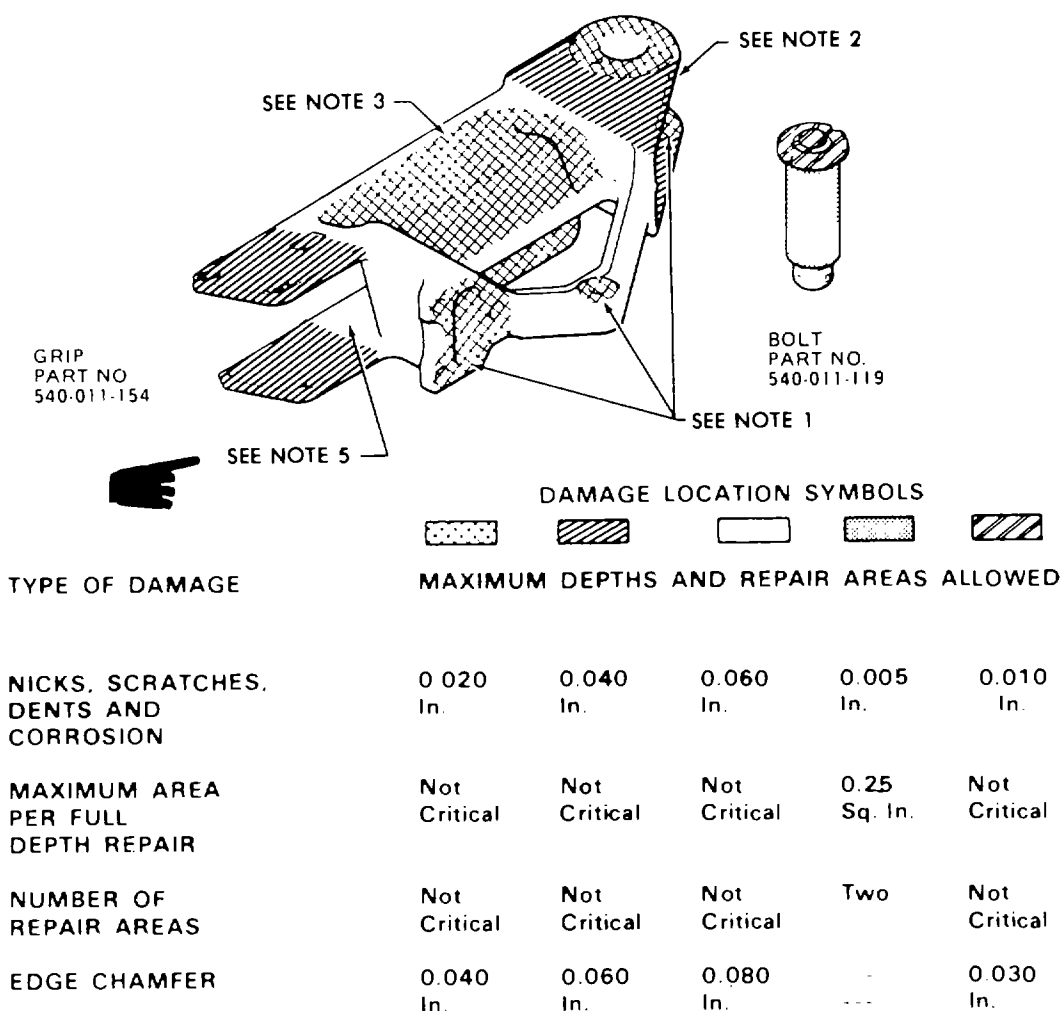
NOTE:

The maximum area of repair on inner surfaces of lugs is one-half of any quadrant.

540011-194D

Figure 5-23. Damage Limits - Main Rotor Hub Yoke

Change 65 5-41



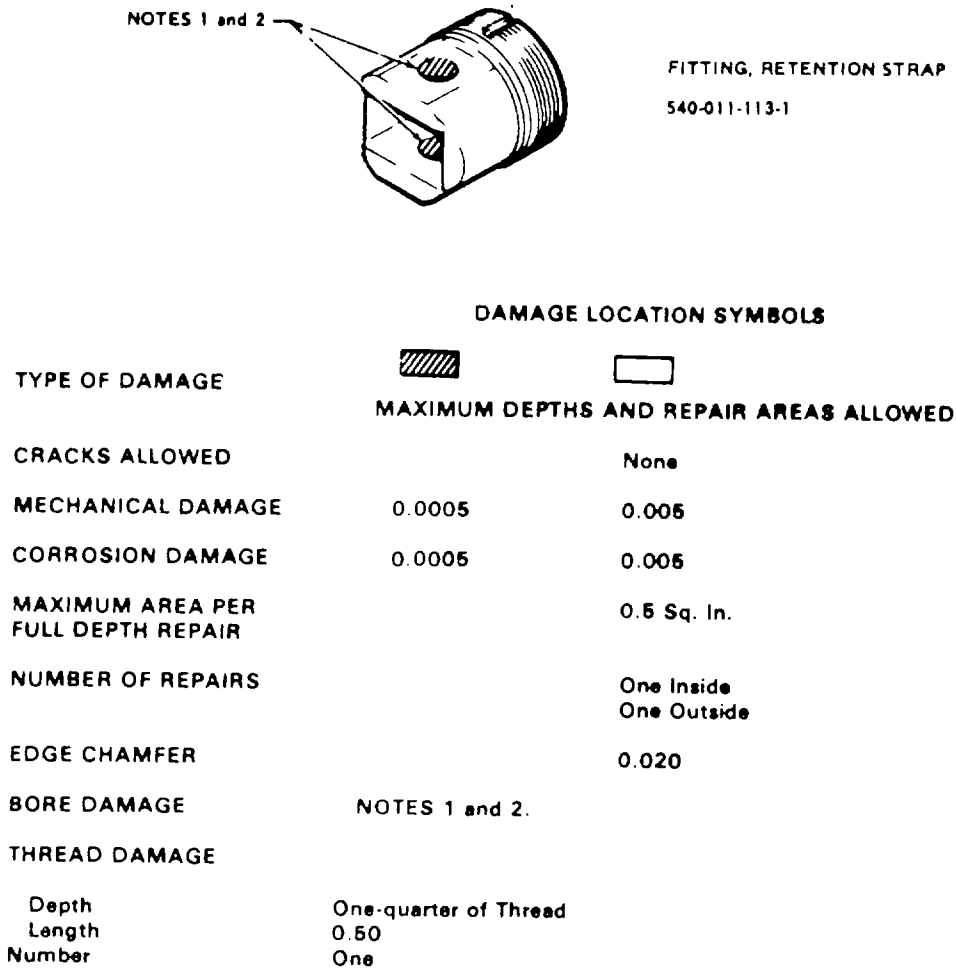
BORE DAMAGE: 0.002 Inch for 1/4 Circumference

NO CRACKS ALLOWED.

NOTES:

1. The maximum allowable area of repair on surfaces mating with the blade, drag brace and pitch horn is one-half of any quadrant.
2. Thickness of blade tang must be 0.280 minimum.
3. Thickness of wall must be 0.090 minimum.
4. Thread damage:
  - Depth: One-third of thread
  - Length: One-half inch
  - Number: One
5. Inside diameter of grip with bearing removed: 4.501 inches maximum.
 Scratches and scoring: 0.001 inch maximum.
 Corrosion before or after cleanup: None
 Repair criteria: None

Figure 5-24. Damage limits - main rotor hub grip

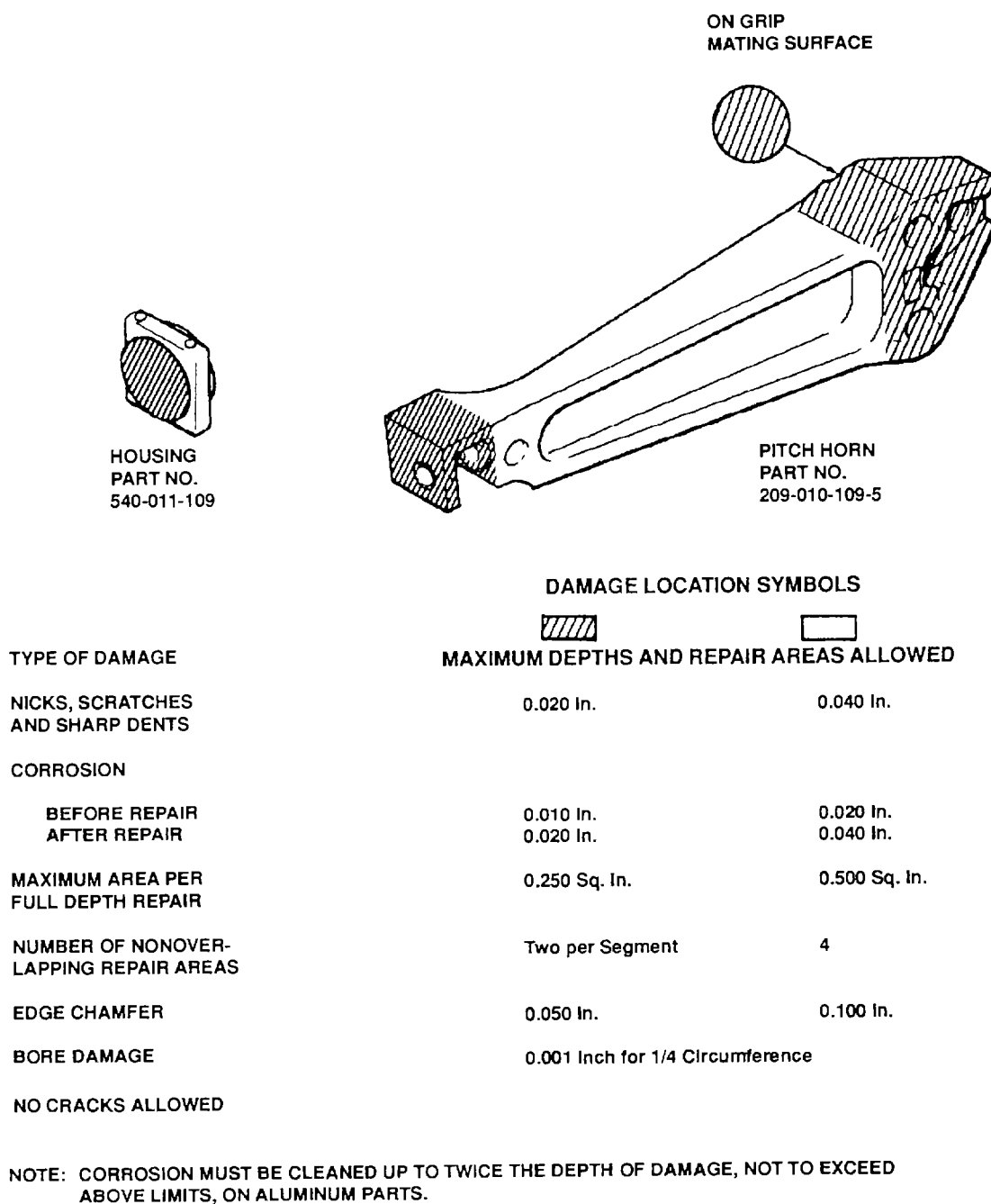


NOTES:

1. If retention strap pin holes are out of round in excess of 0.001, replace retention strap fitting.
2. If retention strap pin holes are out of round in excess of 0.0015 with the larger dimension in spanwise direction, scrap the main rotor hub assembly that the retention strap fitting was installed.

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

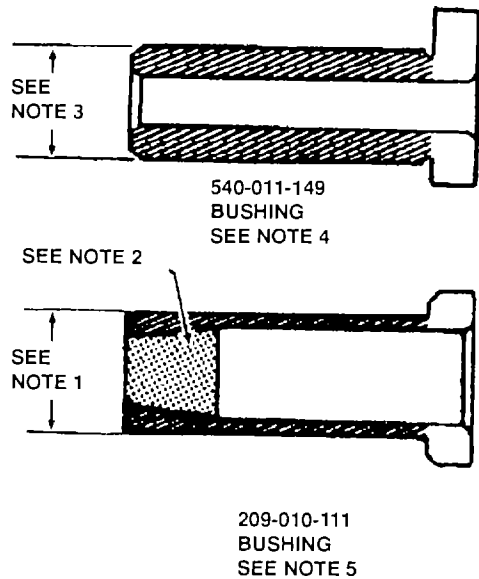
Figure 5-25. Damage limits - main rotor hub extension and strap fitting



540011-254

Figure 5-26. Damage limits - main rotor hub pitch horn and inboard bearing housing
(Prior to accomplishment of MWO 55-1520-244-50-6) and pitch horn bushing
(Sheet 1 of 2)

Change 71 5-44

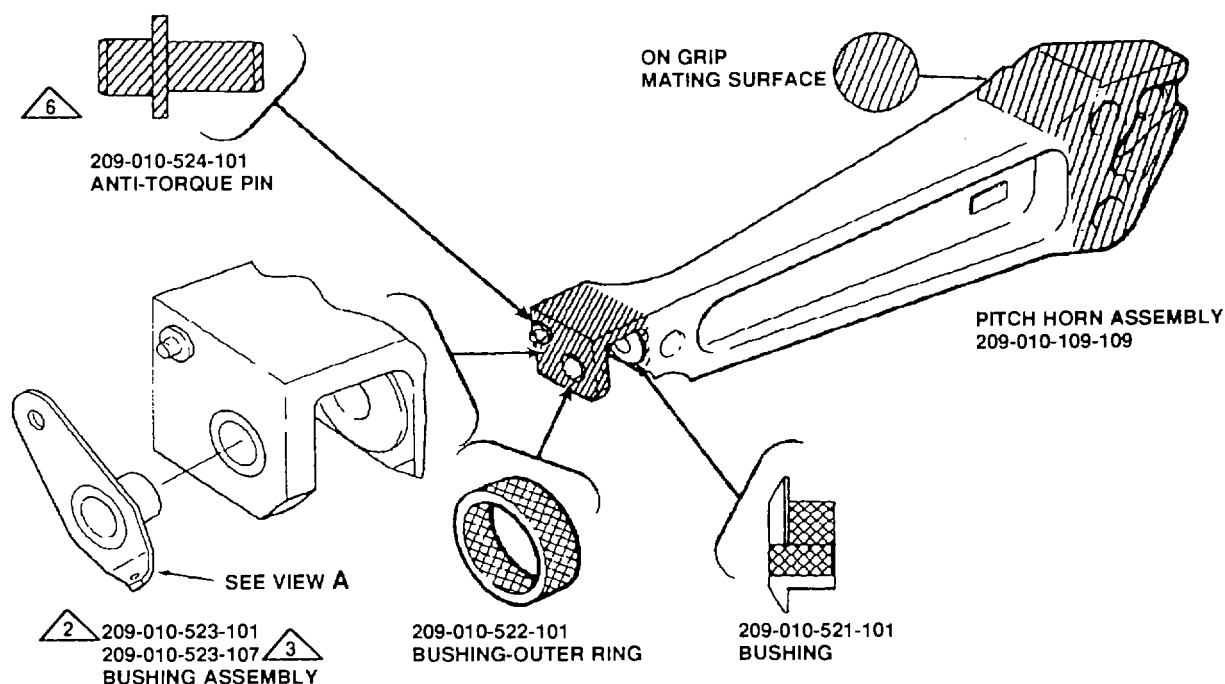


TYPE OF DAMAGE	DAMAGE AREA REPAIR SYMBOLS		
			
MECHANICAL AND CORROSION	0.002 In.	0.002 In.	0.010 In.
MAXIMUM AREA PER FULL DEPTH REPAIR	Not critical	Not critical	Not critical
NUMBER OF REPAIRS	Not critical	Not critical	Not critical

NOTES:

1. Outside diameter to be within 0.8679 to 0.8721 Inches.
2. Internal tapered area only.
3. Outside diameter to be within 0.8725 to 0.8730 Inches.
4. Usable on pitch horn (P/N 540-011-147).
5. Usable on pitch horn (P/N 209-010-109).

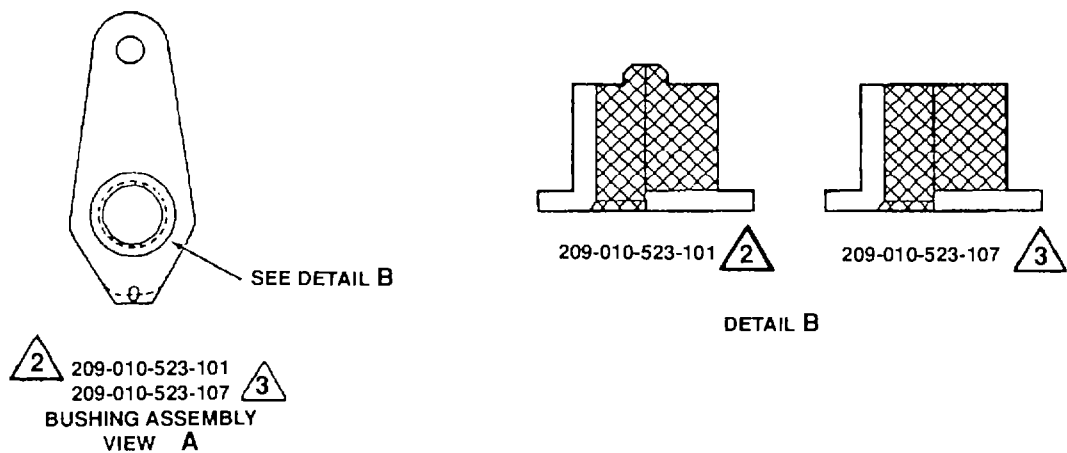
Figure 5-26. Damage limits - main rotor hub pitch horn and inboard bearing housing
(Prior to accomplishment of MWO 55-1520-244-50-6) and pitch horn bushing
(Sheet 2 of 2)



TYPE OF DAMAGE	DAMAGE LOCATIONS SYMBOLS FOR PITCH HORN		
			
	MAXIMUM DEPTHS AND REPAIR AREAS ALLOWED		
CRACKS ALLOWED	None	None	None
NICKS, SCRATCHES AND SHARP DENTS	0.020 In.	0.001 In.	0.040 In.
CORROSION			
BEFORE REPAIR	0.010 In.	0.001 In.	0.020 In.
AFTER REPAIR	0.020 In.	0.001 In.	0.040 In.
MAXIMUM AREA PER FULL DEPTH REPAIR	 0.250 Sq. In.	0.050 Sq. In.	0.500 Sq. In.
NUMBER OF NONOVERLAPPING REPAIRS	Two Per Segment	4	4
EDGE OF CHAMFER	0.050 In.	0.010 In.	0.100 In.
BORE DAMAGE	0.001 In. for 1/4 Circumference		

209010-242-1A

Figure 5-26A. Damage limits - main rotor hub pitch horn and inboard bearing housing
(Prior to accomplishment of MWO 55-1520-244-50-6) and pitch horn bushing
(Sheet 1 of 2)



TYPE OF DAMAGE	DAMAGE LOCATION SYMBOLS FOR BUSHINGS	
		
MECHANICAL CORROSION	0.001 In. for 1/4 circumference	0.010 In.
MAXIMUM AREA PER FULL DEPTH REPAIR	0.050 Sq. In.	0.100 Sq. In.
NUMBER OF REPAIRS	4	4
CRACKS	None	None

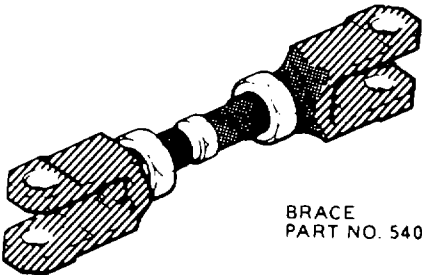
NOTE:

1. Pitch horn 209-010-109-109 applicable after accomplishment of MWO 55-1520-244-50-6.
-  2. Supersedes 209-010-523-107 bushing assembly after accomplishment of MWO 55-1520-244-50-9.
-  3. Installed during accomplishment of MWO 55-1520-244-50-6.
-  4. Shaded area represents inner and outer diameter surface of bushings.
5. Corrosion must be cleaned up to twice the depth of damage, not to exceed above limits, on aluminum parts.
-  6. Repair area not to exceed 1/3 circumference of pin.

209010-242-2A

Figure 5-26A. Damage limits - main rotor hub pitch horn and inboard bearing housing (After accomplishment of MWO 55-1520-244-50-6 and MWO 55-1520-244-50-9 (Sheet 2 of 2)

Change 71 5-44C/(5-44D blank)



BRACE
PART NO. 540-011-116

DAMAGE LOCATION SYMBOLS

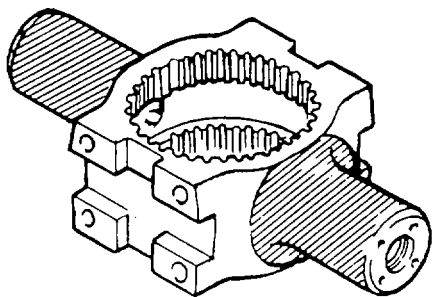


TYPE OF DAMAGE	MAXIMUM DEPTHS AND REPAIR AREAS ALLOWED		
NICKS, SCRATCHES, DENTS AND CORROSION	0.010 In.	0.020 In.	0.030 In.
MAXIMUM AREA PER FULL DEPTH REPAIR	0.25 Sq. In.	0.25 Sq. In.	Not Critical
NUMBER OF REPAIRS	One Per Tang	Two Per Segment	Not Critical
EDGE CHAMFER	0.030 In.	0.030 In.	0.060 In.
THREAD DAMAGE:			
Depth:	One-Third of Thread		
Length:	One-Quarter Inch		
Number:	Two Per Segment		
BORE DAMAGE:	0.001 for 1/4 Circumference		
NO CRACKS ALLOWED.			

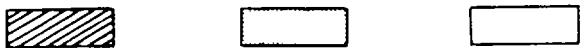
540011-132D

Figure 5-27. Damage limits - main rotor drag brace

840-011-192
TRUNNION



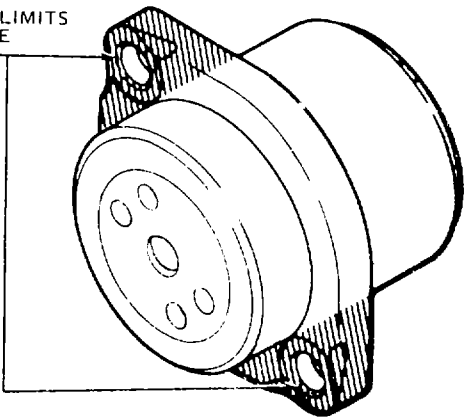
DAMAGE AREA REPAIR SYMBOLS



TYPE OF DAMAGE	MAXIMUM DEPTHS AND REPAIR AREAS ALLOWED		
MECHANICAL AND CORROSION	0.002 in.	0.010 in.	0.020 in.
MAXIMUM AREA PER FULL DEPTH REPAIR	0.10 sq. in.	0.10 sq in.	0.50 sq. in.
NUMBER OF REPAIRS	Not critical	One per segment	Not critical
EDGE CHAMFER	0.040 in.	0.040 in.	0.040 in.
SPLINE DAMAGE			
Depth: One third of spline			
Length: One half spline			
Number: Three splines			
(SPLINES ARE NOT PART OF THE WHITE AREA WHEN USING THE DAMAGE SYMBOLS)			
THREAD DAMAGE:			
Depth: One-third of thread			
Length: 0.25 inch			
Number: One per segment			

Figure 5-28. Damage Limits - Main Rotor Hub Trunnion.

BORE DAMAGE LIMITS
APPLY TO THESE
TWO HOLES



BEARING
PART NO.
540-011-193

DAMAGE LOCATION SYMBOLS



TYPE OF DAMAGE	MAXIMUM DEPTHS AND REPAIR AREAS ALLOWED	
NICKS, SCRATCHES, SHARP DENTS AND CORROSION	0.010 In.	0.010 In.
MAXIMUM AREA PER FULL DEPTH REPAIR	0.10 Sq. In.	0.10 Sq. In.
NUMBER OF REPAIRS	One Per Lug	One Per Segment
EDGE CHAMFER	0.030 In.	0.060 In.

BORE DAMAGE: 0.002 Inch for 1/4 Circumference

NO CRACKS ALLOWED

540011-126-6G

Figure 5-29. Damage limits - main rotor hub elastomeric bearing

(3) Touch up rework areas on aluminum parts with chemical film (C37).

(4) Replace damaged or missing buffer pads (32, figure 5-18) as follows:

CAUTION

Do not remove cadmium plate from yoke extension except in the area where buffer pads will be installed.

(a) Remove any buffer pad material that remains bonded to the yoke extension with a plastic or aluminum scraper.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

(b) Clean area where new buffer pad will be installed with 400 grit sandpaper (C112). Remove residue with clean cloths dampened with methyl-ethyl-ketone (C87). Clean the side of the new buffer pad that will be bonded in the same manner.

WARNING

Use primer in a well ventilated area and away from open flame.

(c) Apply a coat of primer (C99) to the cleaned surfaces of the yoke extension and allow to cure for thirty minutes.

(d) Mix adhesive (C12 or C14a) in accordance with instructions on the container. Apply a thin coat of adhesive to the mating surfaces of the buffer pad and the yoke extension. Position the buffer pad on the yoke extension and clamp in place. Use a C-clamp and two flat smooth plates, or use a bolt and two plates with holes in the plates for the bolt. Use cellophane (C33) or polyurethane tape (C134.1) between the buffer pad and the plates. Cure adhesive for 12 hours at 80 degrees F (27 degrees C) or for one hour at 160 degrees F (71 degrees C).

(e) Remove clamp and use 180 grit sandpaper (C112) to remove any excess adhesive that was squeezed out during bonding. Avoid removing

cadmium plate from yoke extension. If necessary, touch up cadmium plate. Refer to step (2).

(f) Check fit of yoke extension to yoke. If the new buffer pads are too thick, sand the pads with fine grit sandpaper (C112) to obtain a slip fit. The correct dimension is 1.377 TO 1.379 inch over the yoke extension and the buffer pad on each side of the extension.

(5) Replace radius ring (29, figure 5-18) which failed to pass inspection as follows:

(a) Remove radius ring (29) with a soft aluminum drift.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

(b) Clean old adhesive from yoke extension with a plastic scraper and clean cloths, moistened with methyl-ethyl-ketone (C87).

WARNING

Use primer in a well ventilated area and away from open flame.

(c) Apply a light coat of primer (C99) to mating surfaces of yoke extension and radius ring and allow to cure for thirty minutes.

(d) Mix adhesive (C12) in accordance with instructions on the container. Apply a thin coat of adhesive to the mating surfaces of the yoke extension and the radius ring.

(e) Press the radius ring into position on the yoke extension. Ensure that the radius ring is completely seated. Wipe off excess adhesive. Install grip (41) and housing (38) on yoke extension (28). Install dome nut (45) and tighten until grip bearing dust seal (51) evenly contacts radius ring (29) and then tighten an additional 1/2 turn. Allow adhesive to cure for 24 hours at room temperature or for thirty minutes at 150 degrees F (66 degrees C).

(f) Remove dome nut (45), grip and housing installed in preceding step and ensure that radius

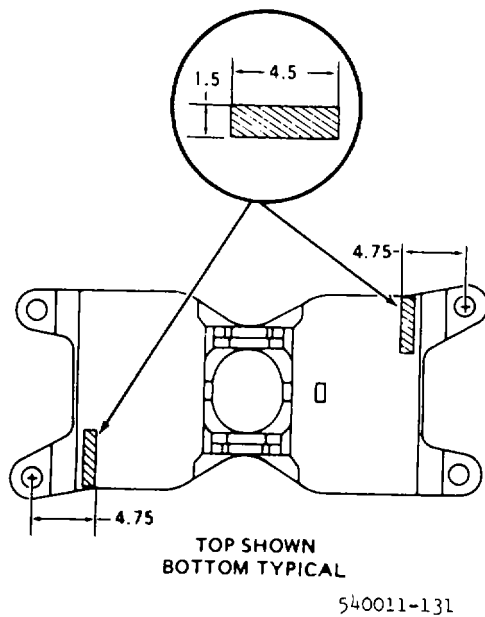


Figure 5-30. Main rotor hub yoke chafing pad installation dimensions

ring is completely seated on yoke extension.

- (6) Replace damaged or missing pads (figure 5-30).

NOTE

Chafing pads are located on the upper and the lower surfaces of the yoke.

- (a) Remove any chafing pad material that remains on the yoke with a plastic scraper and clean cloths dampened with naphtha (C88). Do not remove paint.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged contact with skin.

- (b) Clean new chafing pad with methyl-ethyl-ketone (C87). Treat the side of the pad that is to be bonded with tetra-etch (C62).

- (c) After etching, rinse the chafing pad with methyl-ethyl-ketone (C87).

- (d) Mix adhesive (C17) according to directions on the container. Apply a thin coat of adhesive to the mating surfaces of the chafing pad and the yoke.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

- (e) When adhesive applied in preceding step becomes tacky, install chafing pad at location illustrated on figure 5-30. Work out any air pockets and wipe up any excess adhesive with a cloth dampened with methyl-ethyl-ketone (C87). Apply weights or use a clamp to hold chafing strip firmly in position. Cure adhesive for 24 hours at room temperature or one hour at 176 TO 190 degrees F (79 TO 88 degrees C).

- (7) Replace seal (36, figure 5-18) and bearing (37) in bearing housing (38) as follows:

- (a) Grasp seal (36) with "duck bill" pliers and tap pliers with mallet to remove the seal.

- (b) Install bearing puller (T47) into housing (38). Use the aluminum block as shown in figure 5-31 to prevent damage to the housing. Apply moderate tension with puller.

CAUTION

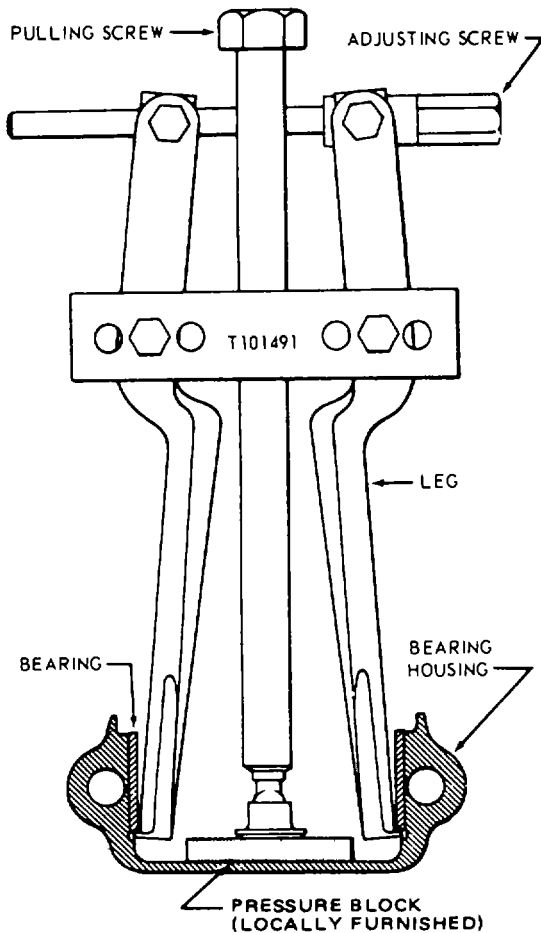
Do not use flame of any form on the housing assembly.

- (c) Apply heat to housing with heat lamp for approximately thirty minutes or until yielding of adhesive is evident. Increase tension with puller and remove bearing.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged contact with skin.

- (d) Clean all traces of adhesive from bearing housing (38, figure 5-18) with a plastic scraper and cloths moistened with methyl-ethyl-ketone (C87).



209011-2

Figure 5-31. Tool application-bearing removal from housing

WARNING

Use primer in a well ventilated area away from open flame.

(e) Apply a light coat of primer (C99) and allow to cure for thirty minutes.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

CAUTION

Ensure that adhesive does not get on teflon bearing fabric.

NOTE

Larger metal surface of seal which is marked with part number will be installed flush against bearing, inboard of bearing cap.

(f) Mix adhesive (C12) according to directions on container: Apply a coat of adhesive to the mating surfaces of bearing (37, figure 5-18) and housing (38). Install bearing in housing and seat fully as shown in figure (5-31). Wipe off excess adhesive with a cheese cloth moistened with methyl-ethyl-ketone (C87). Cure for 24 hours at room temperature or for fifteen minutes at 1650 degrees F (66 degrees C).

(g) Apply a thin, even coat of adhesive (C9) to mating surface of seal (36, figure 5-18). Allow cement to dry about ten minutes or until it becomes tacky and press seal into housing (38) with lip of seal facing outboard. Allow to cure for four hours at room temperature.

(8) Replace seal (51, figure 5-18) and bearing (50) in grip (41) as follows:

NOTE

If bearing (50) is satisfactory for further service, perform only the steps applicable to removal and installation of seal (51).

(a) Grasp seal (51, figure 5-18) with "duck bill" pliers and tap pliers with mallet to remove seal.

(b) Install bearing remover (T43) in grip with slot of tool over tang of strap indexing ring (49, figure 5-18). See figure 5-32 for view of installed tool. Drive ring and bearing from grip.

(c) Clean all old adhesive from grip with plastic scrapers.

(d) Install strap index ring (49, figure 5-18) in grip with lugs on ring engaged with slots in grip. Fill keyway gap between strap index ring and grip with sealant (C116).

NOTE

No adhesive is required on bearing (50, figure 5-18) if it is P/N 540-011-110-7 or 540-011-110-13.

(e) Press new bearing (50, figure 5-18) into grip with arbor (T45). See figure 5-33 for view of installed tool with ring of tool positioned to engage bearing. Press bearing into grip as described in the note on figure 5-33 until it fully engages the strap indexing ring. Remove dome nut and special tools.

(f) Apply a thin even coat of adhesive (C9) to mating surfaces of dust seal (51, figure 5-18) and grip (41). Allow cement to dry about ten minutes or until it becomes tacky. Position dust seal on tool (T45) as shown on figure 5-33 and position in grip. Press dust seal into grip as described in the note on figure 5-33 until it fully engages the seat. Remove dome nut and special tools. Spread any excess cement that has squeezed out to form a fillet between the dust seal and the grip.

(g) Repair sand deflector. Cracks of two inches in length or less may be stop drilled. Corrosion, erosion, or damage to doublers may be polished out and painted with primer (C102).

(h) Bonding of washer (AN970-4). Replace if corroded, worn or damaged, separated or missing.

1 Remove all remaining adhesive using aluminum or plastic scraper.

2 After removing all traces of oil adhesive, wipe area with cleaner (C87), allow to dry.

3 Lightly sand surface on one side of new washer using 320 grit sandpaper (C112). Clean with cleaner (C87), allow to dry.

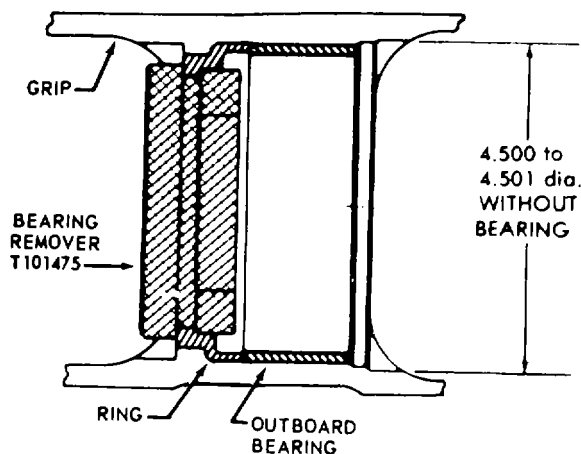


Figure 5-32. Tool application-bearing removal from grip

4 Apply a thin coat of adhesive (C12) to sanded and cleaned surface of washer and position on deflector.

NOTE

The installation of standard dust deflector is optional.

(9) Pitch horn (P/N 209-010-109). Replace worn or damaged bushings (20), and (22), figure (5-18) in pitch horn (30). Replace bushings (20) and (21), exceeding the limits of figure 5-26A.

NOTE

Bushings are the expandable type and should not be a tight fit, except under torque load.

(a) Press out bushings using a plug slightly smaller than O.D. of bushings.

WARNING

Before using methyl-ethyl-ketone, extinguish all open flames and turn off electrical equipment. Vapors are highly flammable, avoid prolonged breathing of vapors and repeated skin contact. Use in well ventilated area.

(b) Clean primer from bores using cheesecloth (C36) dampened with methyl-ethyl-ketone (C87).

(c) Inspect pitch horn bores for damage. Damage not to exceed **0.002** inch for one-fourth circumference.

(d) New bushings will be installed during assembly.

f. Assembly.

(1) Install trunnion (9, figure (5-19) on yoke (12) as follows:

(a) Position trunnion (9) in bosses on yoke (12).

(b) Install disk (8) in counterbore in end of each trunnion spindle.

(c) Select two new shims (7) to be installed in each elastomeric bearing (6). The total thickness of two

shims to go in the bearing on one side of the yoke must be equal, within **0.002** inch, to the total thickness of the two shims to go in the opposite bearing.

(d) Place the new shims (7) selected in the preceeding step in elastomeric bearings (6). Align holes in shims and bearings and insert two bolts (1) to maintain alignment.

(e) Carefully push bearings over end of trunnion spindle and align bolts (1) installed in previous step with holes in end of trunnion spindle. Thread bolts into trunnion finger tight.

(f) Install two bolts (4) to secure each elastomeric bearing (6) to the yoke (12). Install recessed washers (5) on bolts (4) with recessed side toward bolt heads. Install recessed washers (10) with recessed side toward nuts (11). Tighten nuts (11) on one bearing (6) sufficiently to hold flanges of bearing against yoke. Leave nuts (11) on opposite bearing loose.

(g) Ensure that trunnion spindles are fully seated in bearings (6) against shims (7).

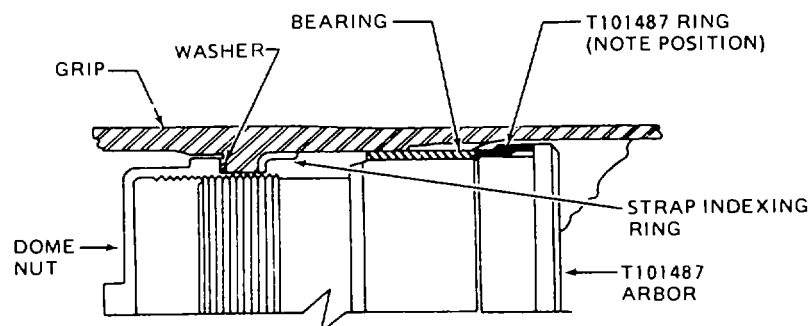
(h) Measure gap between flange of elastomeric bearing (6) and yoke (12) on the side where nuts (11) were left loose. Use a feeler gage to make measurement and record the dimension. If no gap is present, shims (7) are not thick enough. Remove elastomeric bearings and add an equal amount of shims (7) to each bearing. Measure and record gap dimension as described above.

(i) Remove elastomeric bearings (6) from trunnion and remove shims (7) from bearings. Keep shims with the bearing from which they were removed.

(j) Divide the dimension recorded in step (h) by two. Record this dimension. Peel laminations equal to this dimension plus **0.002** minus **0.000** from shim (7) for each bearing (6). See the following example:

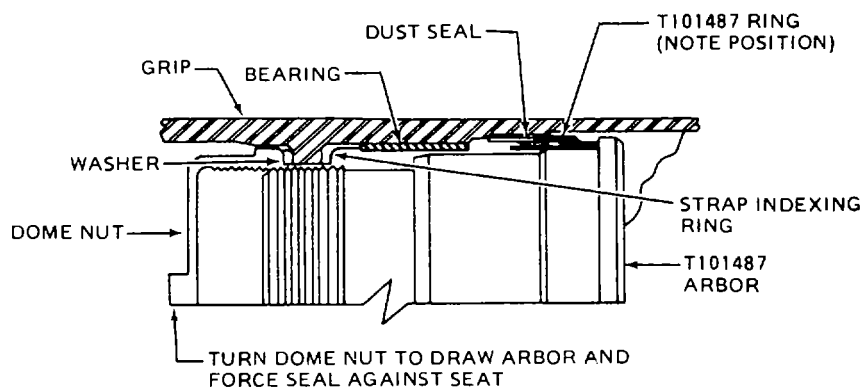
Dimension of original measured gap	0.022 inch
Original gap divided by two	0.011 inch
Thickness of laminations to be removed from shim for each bearing	0.012 inch

(k) Measure thickness of shims after adjustment. The thickness of shims (7) for each elastomeric bearing must be equal within **0.002** inch.



CAREFULLY TAP TOOL INTO GRIP UNTIL DOME NUT CAN BE ENGAGED. DRAW BEARING INTO POSITION AGAINST SEAT BY TURNING NUT. ADD WASHERS UNDER NUT AS THREADS BOTTOM OUT

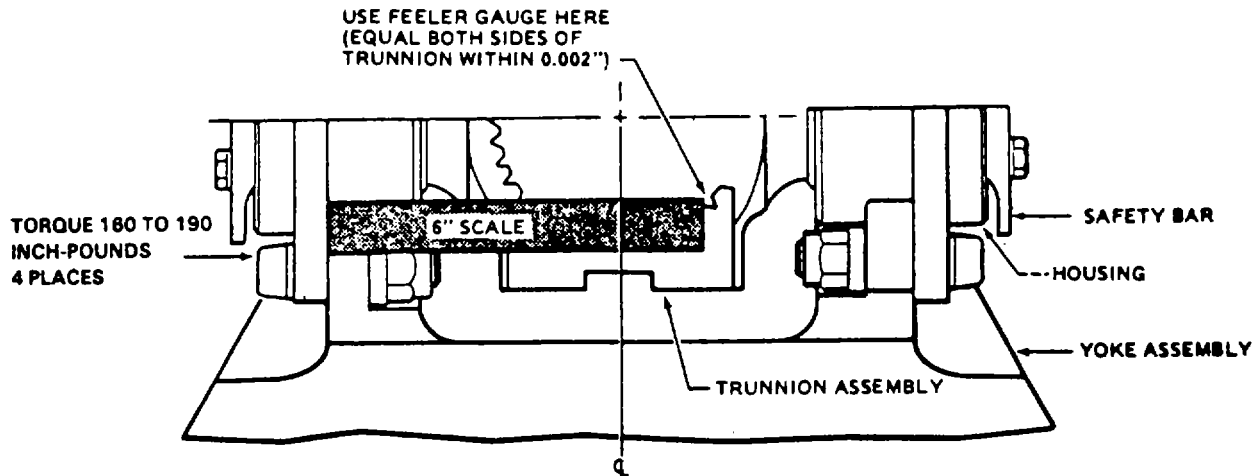
BEARING INSTALLATION



DUST SEAL INSTALLATION

209011-3A

Figure 5-33. Tool application - bearing and seal installation in grip



549011

Figure 5-34. Main rotor hub trunnion centering measurement

(l) Place shims (7) prepared in preceding steps in elastomeric bearings (6). Align holes in shims and bearings and install two bolts (1) in each bearing to maintain alignment.

(m) Apply un-reduced primer (C102) to mating surfaces of elastomeric bearings (6) and yoke (12). Position trunnion (9) in bosses of yoke (12). Install disk (8) in counterbore in each end of each trunnion spindle. Carefully push bearings over end of trunnion spindle while primer is still wet. Align holes in elastomeric bearings and shims with holes in end of spindle. Remove two bolts (1) installed for alignment and install retainer (3) on each elastomeric bearing with four bolts (1) and washers (2). Do not torque bolts at this time.

(m.1) Bond elastomeric bearings (6) to trunnion (9) as follows:

1 Abrade mating areas of trunnion (9) and elastomeric bearing (6) with 400 grit abrasive cloth (C44).

2 Clean abraded areas of trunnion and bearings with alcohol (C22).

3 Apply a heavy coat of prepared adhesive (7B) to spindles of trunnion (9).

4 Allow adhesive to cure for 24 hours before using hub assembly.

(n) Install two bolts (4) to secure each elastomeric bearing (6) to the yoke (12). Install recessed washers (5) to bolts (4) with recessed side toward bolt heads. Install recessed washers (1) with recessed side toward nuts (11). Torque nuts (11) 160 TO 190 inch-pounds. If more than five threads show at nut, add a steel washer under the nut.

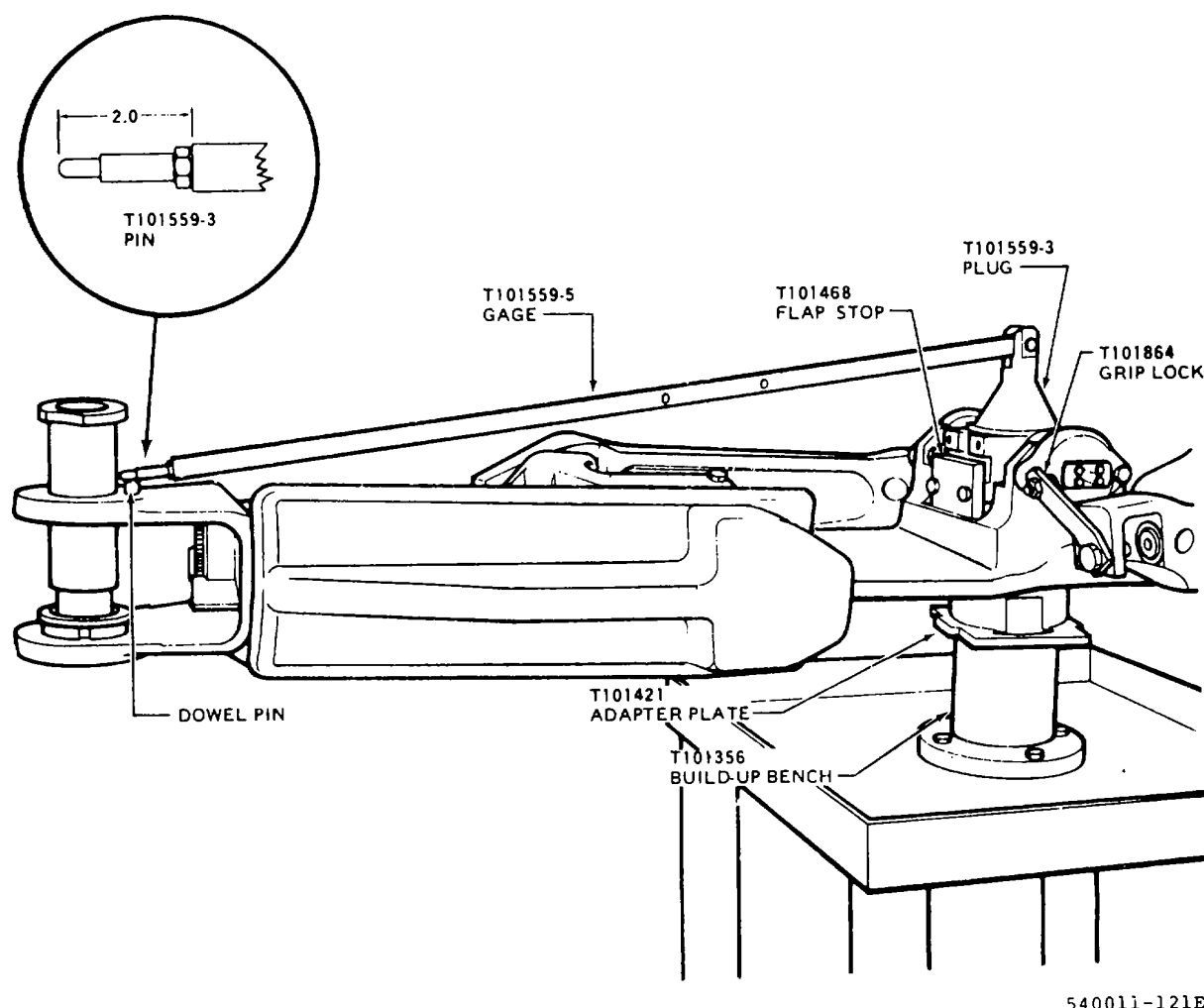
(o) Torque bolts (1) 120 TO 160 inch-pounds and lockwire (C151) in pairs.

(p) Apply a fillet of sealant (C116) around trunnion spindles at inboard end of elastomeric bearings.

(q) Check to ensure that hub is centered by method shown on figure 5-34. This method, using a six inch scale, is considered to be less accurate than the method used in the preceding steps but can be used as a check.

(2) Place an adapter plate (T34) on build-up bench (T26). Install the yoke and trunnion on the build-up bench. See figure 5-35.

(3) Inspect both yoke extensions (28, figure 5-18) to ensure that radius rings (29) are installed and are in satisfactory condition. Position yoke extension (28) on yoke with web on leading edge side and install bolt (27), special washers (26 and 39) and nut (40) at this time. Install opposite yoke extension in the same manner.



540011-121E

Figure 5-35. Tool application-grip spacing adjustment

WARNING

Main rotor hub retention straps P/N 204-012-1223 and-7 are spare part replacements for straps P/N 20012- 112-7. Replace straps in pair Do not intermix P/N 204-012122-3 straps, P/N 204-01122-7 straps or 204-012-112-7 straps in the same main rotor hub.

(4) Position strap (54, figure 518) in fitting (52). Install retaining ring (59) on pin (53). Install pin through fitting and strap. Install retaining ring (53). Coat ends of pin with sealant (C116). Assemble opposite strap and fitting in same manner.

(5) Insert assembled strap (54, figure 5-18) and fitting into outboard end of yoke extension (28). Install retaining ring (31) on pin (33) and

install pin through yoke extension and strap. Install retaining ring (34). Coat both ends of pin with sealant (C116) described in step (4). Install opposite strap in same manner.

(6) Hinge yoke extension (28, figure 5-18) forward on bolt (27). Inspect housing (38) to ensure that a serviceable bearing (37) and seal (36) are properly installed. Position housing (38) on yoke extension: Hinge the yoke extension back into position and install bolt (27), special washers (26 and 39) and nut (40) in trailing edge hole. torque nut (40) **450 TO 550** foot-pounds. Install opposite housing in the same manner.

(7) Inspect grip (41, figure 5-18) to ensure that strap indexing ring (49), bearing (50) and dust seal (51) are properly installed. Apply a coating of sealant (C116) to both slots in fitting (52) so that this area will be sealed when the grip

is installed. Slide the grip (41) on the grip extension with the side with provisions for mounting the pitch horn on the trailing edge side. Engage the lugs on the strap indexing ring in the grip with the slots in fitting (52). Work grip onto extension far enough to expose three threads on fitting (52). Use a fiber mallet to tap grip onto extension. Install washer (46) and start dome nut (45). Install two bolts (60) through grip and housing. Install a maximum of four steel washers (47) on each bolt as required and install nuts (48). Torque nuts **770 TO 950** inch-pounds. Install opposite grip in same manner. Rotate grips gently through their full travel, ensuring there is no interference between grip and extension.

NOTE

Check clearance of extension and grip assembly. Refer to paragraph 5-6a (11).

CAUTION

Do not install washers under heads of bolts (60).

(8) If drag brace (15, figure 5-18) was disassembled, install nuts (14) and clevis ends on drag brace. Adjust clevis until approximately 0.25 inch of threads are exposed on each end and the dimension between centers of clevis holes is 14.732 inches. Tighten nuts (14) snug but do not torque. Position drag brace on grip and install bolt (18), washers (16) and nut (17). Do not torque nut (17) at this time. Install opposite drag brace in the same manner.

CAUTION

Only bolts, nuts, washers, and bushings that have been degreased will be used to attach pitch horn to grip. During reassembly of pitch horn to grip care should be taken to ensure that the bolts, nuts, washers, and bushings are clean and free of any lubricant other than the dry film lubricant.

NOTE

Bolt 209-010-112-1 may be used in place of bolt 209-010-112-3.

NOTE

If new bolts are not available, old bolts may be reused after disassembly of pitch horn from grips. Reused bolts must be degreased and pass visual and magnetic particle inspection prior to reinstallation. Bolts, nuts, washers, and bushings will be vapor degreased using PD680, Type 2. If vapor degreasing equipment is not available, soak in PD680, Type 2 for one hour and wipe off grease and PD680 using a lint free cloth prior to installation. Use of alternate cleaning agents is not recommended as it may remove dry film lubricant protective coating.

(9) Install bushings (20 and 22, figure 5-18) in pitch horn (23). Position pitch horn on grip and install special bolts (19 and 21). Install the longer bolts in the inboard holes. Install a maximum of two washers (5) under each nut (4). Torque nuts (4) to **700 TO 725** inch-pounds. Tap the pitch horn and grip around the bolted area to set the parts. Use a rawhide or non-metal hammer. Retorque to **700 TO 725** inch pounds. Fly main rotor head for one hour and retorque to **700 TO 725** inch-pounds. Install opposite pitch horn in the same manner.

NOTE

The pitch horn bolts are properly installed when tapered shoulders on bolts are seated in bushings in the pitch horn. The bolt heads will not be in contact with the pitch horn or bushings.

(10) Replace tape (C136) on inboard spacer (3, figure 5-18) if required to obtain a snug fit. Position two spacers (3) in web of yoke extension. If previously removed, position sand deflector (1) on yoke extension and install three bolts (2) through sand deflector and spacers. Ensure that there is adequate clearance between deflector and yoke (25) at both upper and lower surfaces. Install opposite sand deflector in the same manner.

(11) If grip spacing tool is available, proceed as follows:

(a) Install bolt assembly (6, figure 5-18) in each grip.

(b) Install two flap stops, (T42), on trunnion with 540 side down as shown on figure 5-35. Use 3/8 inch UNF threaded bolts of suitable length to secure flap stops to trunnion.

(c) Remove one bolt (4, figure 5-19) from each trunnion bearing and install two grip locks (T59) as shown on figure 5-34.

CAUTION

Insure that during all grip spacing procedures, the grips are seated against dome nuts. To insure proper seating, back off dome nut one full turn in excess of that required for adjustment while tapping grip outboard with a fiber mallet. Then, turn dome nut clockwise while observing the dimension to insure grip is properly seated against the dome nut. If dimension does not close, grip is not properly seated.

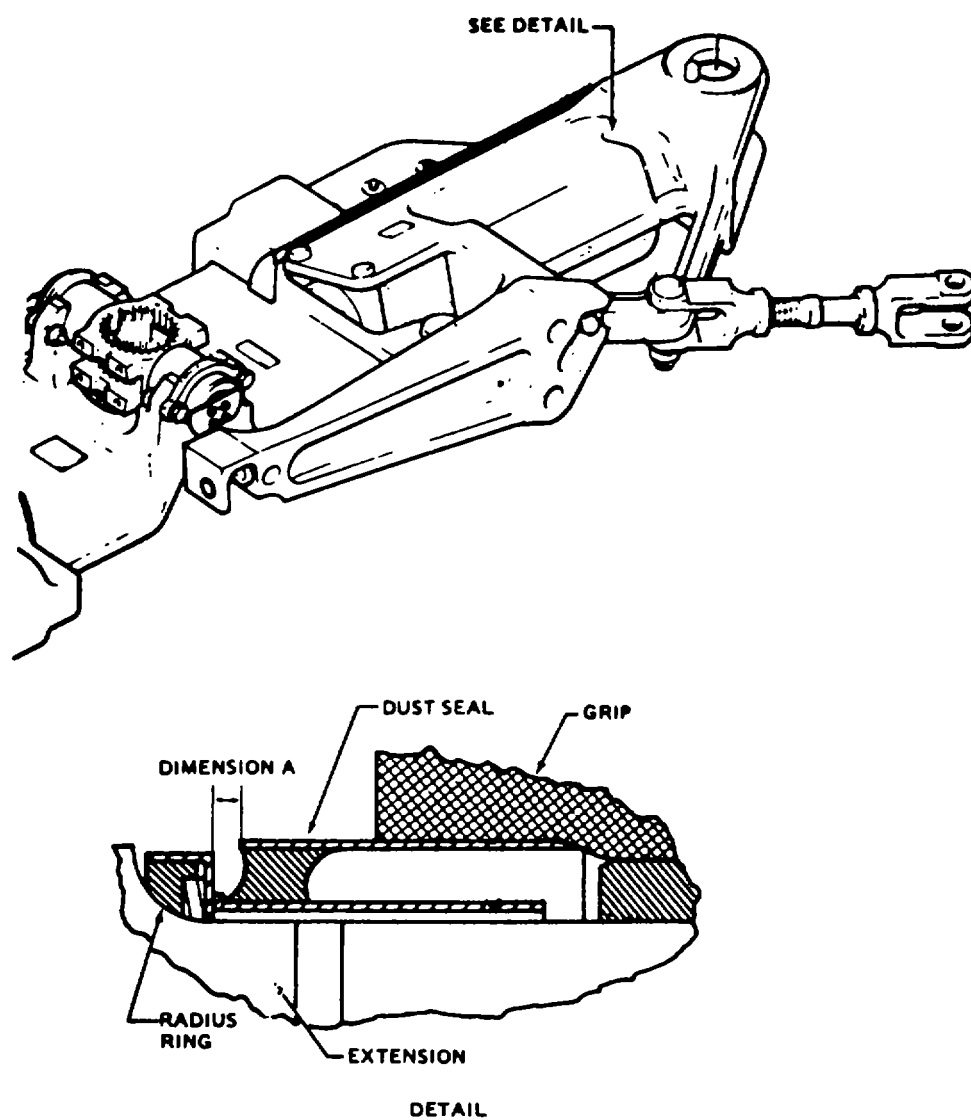
(d) Tighten dome nut (45, figure 5-18), which was installed in step (7), until dimension between radius ring (29) and dust seal (51) is 0.001 inch. See dimension "A" on figure 5-36. Adjust opposite grip in the same manner.

(e) Install grip spacing tool (T56). See figure 5-35 for view of installed grip spacing tool. Adjust tip, T101559-3, on gage, T101559-5, to 2.0 inch dimension as illustrated. Install plug, T101559-3, above rotor hub trunnion and secure with knurled screw. Locate hole marked "540-011-101" on gage of spacing tool (T56), and attach gage to plug with bolt through this hole. Raise blade bolt and position tip of spacing tool (T56) so that it rests on dowel pin in grip as shown. Measure and record distance between blade bolt and tip of grip spacing tool. Reverse grip spacing tool and measure distance on opposite blade bolt.

CAUTION

Insure that during all grip spacing procedures, the grips are seated against dome nuts. To insure proper seating, back off dome nut one full turn in excess of that required for adjustment while tapping grip outboard with a fiber mallet. Then, turn dome nut clockwise while observing the dimension to insure grip is properly seated against the dome nut. If dimension does not close, grip is not properly seated.

(f) Loosen dome nut (45, figure 5-18) on grip (41) that was found to be most inboard in the preceding step. Adjust this dome nut as required until the dimension is equal to that of the most outboard grip within 0.002 inch.



540011-21H

Figure 5-36. Main Rotor hub - grip dust seal to radius ring

(g) Check **seal gap dimension "A" shown** on figure 5-36 on both grips. Dimension "A" must be 0.001 to 0.040 inch.

NOTE

The tolerance dimension "A" can be eased up to 0.060, provided an assurance check will be made anytime the grip spacing exceeds 0.040. Correct procedures and seal to radius ring will be verified.

(h) Install lock (44, figure 5-18), clamp (43), bolt (42), thin steel washer (56), nut (55), and cotter pin (57).

(i) Remove grip spacing tool.

(j) Install blade bolt (6, figure 5-18) keyway washer (7), extended washer (8), special

nut (9), screw (12), washer (11), and nut (10). Do not torque special nut (9).

(k) Remove two flap stops (T42) that were installed in step (b).

(l) Remove two grip locks (T59) that were installed in step (c). Install bolts (4, figure 5-19) with recessed washers (5). Install washer with recessed side toward bolt head. Install recessed washer (10) with recessed side next to nut (11). Use more than one special washer (10) to obtain proper engagement of nut if necessary. Torque all four nuts (11) **160 TO 190** inch-pounds.

CAUTION

After nuts (11) are tightened, no more than five threads of bolts are permitted to be exposed beyond nuts (11), and a minimum of three threads must be exposed to ensure the self-locking feature of the nuts is engaged.

(12) Installation of identification plate.

CAUTION

Stamping directly on the surface of any detail hub part or installed data plate is prohibited.

(a) Stamp applicable data on replacement plate using 1/16 inch characters.

(b) Lightly sand contact area on component and mating surface with No. 180 grit abrasive cloth (C44).

WARNING

Before using naphtha or methyl-ethyl-ketone, extinguish all open flames and turn off electrical equipment. Vapors are highly flammable. Avoid prolonged breathing of vapors and repeated skin contact. Use in well ventilated area.

(c) Remove sanding residue using cheesecloth (C36) dampened with naphtha (C88).

(d) Mix EC2216 adhesive (C11) 100 parts base to 140 parts hardener. Apply adhesive within 20 minutes to both mating surfaces and join parts.

NOTE

Pot life of adhesive is 110 to 130 minutes.

(e) Fair out adhesive. Remove excess adhesive using cheesecloth (C36) dampened with methyl-ethyl-ketone (C87).

(f) Maintain firm contact pressure and cure for 24 hours at 70°F (21°C) or 30 to 60 minutes at 200°F (93°C). Edge voids are not allowed. Maximum strength achieved in 6 to 7 days.

(13) Balance main rotor hub assembly (paragraph 5-6A).

5-6A. Balancing - Main Rotor Hub Assembly.

NOTE

Refer to TM 55-4920-201-15 for additional information on balancing tools if required.

(1) Set up the hub balancing stand and accessories from balance kit (T80) as follows: See figures 5-37 and 5-38.

(a) Assemble hoist support structure with tube assembly P/N 2769 instead of tube assembly P/N 2288 shown on figure 5-37 to provide additional hoist arm height.

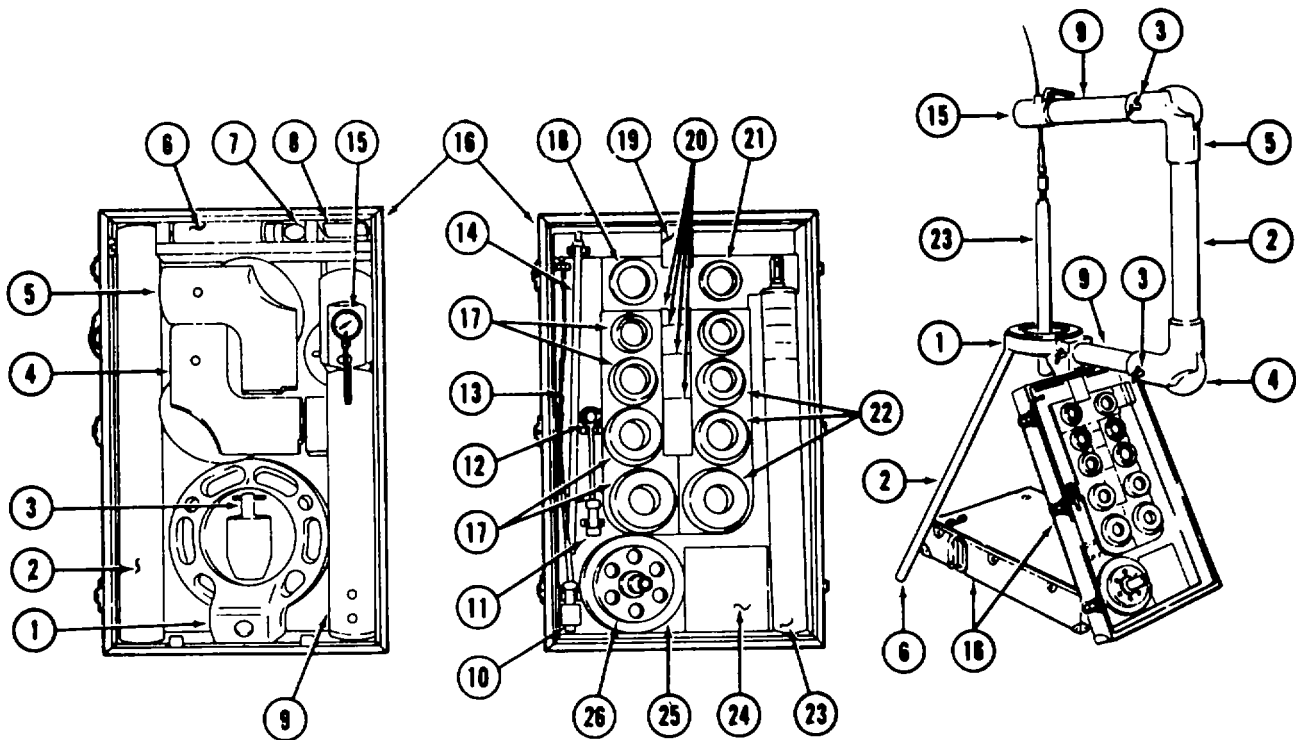
(b) Center fixture (1, figure 5-38) from kit (T80) on work stand.

(c) Install adapter (2), heavy end downward, over top of fixture (1) and seat on upper shoulder of fixture central projection. Lock adapter in this position by tightening adapter setscrew (3) using 1/8 inch hex wrench (T79, T80 and T81 kits.)

(2) Balance main rotor hub assembly as follows: See figure 5-38.

(a) Carefully lower rotor hub assembly (8) over fixture (1); align inside diameter of splined trunnion with piloting diameter of adapter (2), and ensure that cone surface of splined trunnion seats firmly on cone surface of adapter (2).

(b) Install yoke (4), legs downward, on arbor (5) and position so that top surface of its locking collar sensitivity setting reference (figure 5-38) aligns with 15-3/8



1. Stand Table Assembly (2291)
2. Tube, 2-7/8 Inch Diameter Long (2288) with Leg Assemblies-Stand Long (2364)
3. Pin-Hoist Support (2285)
4. Elbow (2284-1)
5. Elbow (2284-2)
6. Stand Leg Extensions (2365)
7. Stub Leg (2366)
8. 1/8 Inch Hex Wrench
9. Tube, 3 Inch Diameter (2286) with Tube, 2-7/8 Inch Diameter-Short (2287)
10. Quick-Disconnect Coupling (2266)
11. "Quickie" Coupling (2260-1)
12. Alternate Hoist Eye Assembly
13. 3/16 Inch Suspension Cable (2264)
14. 1/16 Inch Suspension Cable (2262)
15. Hydraulic Pump Assembly (2282)
16. Storage, Carrying, and Work Support Case (2272)
17. SAE 20, 30, 40, 50, and 51 Spline Rear Cones (2223, 2205, 2207, and 2228)
18. Flange Type 1, 2, 3, and 4 Rear Bushing (2210)
19. Work Stand Stub Leg Support
20. Spacers (2201, 2202, 2203, and 2204)
21. SAE 20 Spline Front Bushing (2211)
22. SAE 20, 30, 40, 50, and 51 Spline Front Cones (2224, 2206, 2208 and 2227)
23. Balancing Arbor (2259)
24. Packing Layout
25. Flanged Type 1, 2, 3, and 4 Front Plate (2209)
26. Hand Wheel (2215)

540001-2A

Figure 5-37. Rotor balancing kit P/N 7A050

inch position on arbor scale (6). Lock yoke firmly in this position on arbor with its collar screw, using 3/16 inch hex wrench from kit (T81).

(c) Install arbor downward through rotor trunnion and fixture assembly. Seat legs of yoke in milled areas on top surfaces of hub yoke; center with scribed lines.

(d) Position jacks (7) on top surface of the rotor hub yoke so that their inboard ends bear against the central boss of the hub yoke, centered below the scribe lines mentioned in paragraph (4), and their outboard ends bear centrally against the shoulders of the inboard bearing housing of the blade grip assemblies. Adjust jacks to provide uniform outward pressure sufficient to ensure blade grips are seated in their full outward positions.

(e) Install spacer (13) over lower end of arbor; install handwheel (14) in lower end of arbor and tighten to clamp both legs of yoke firmly against top

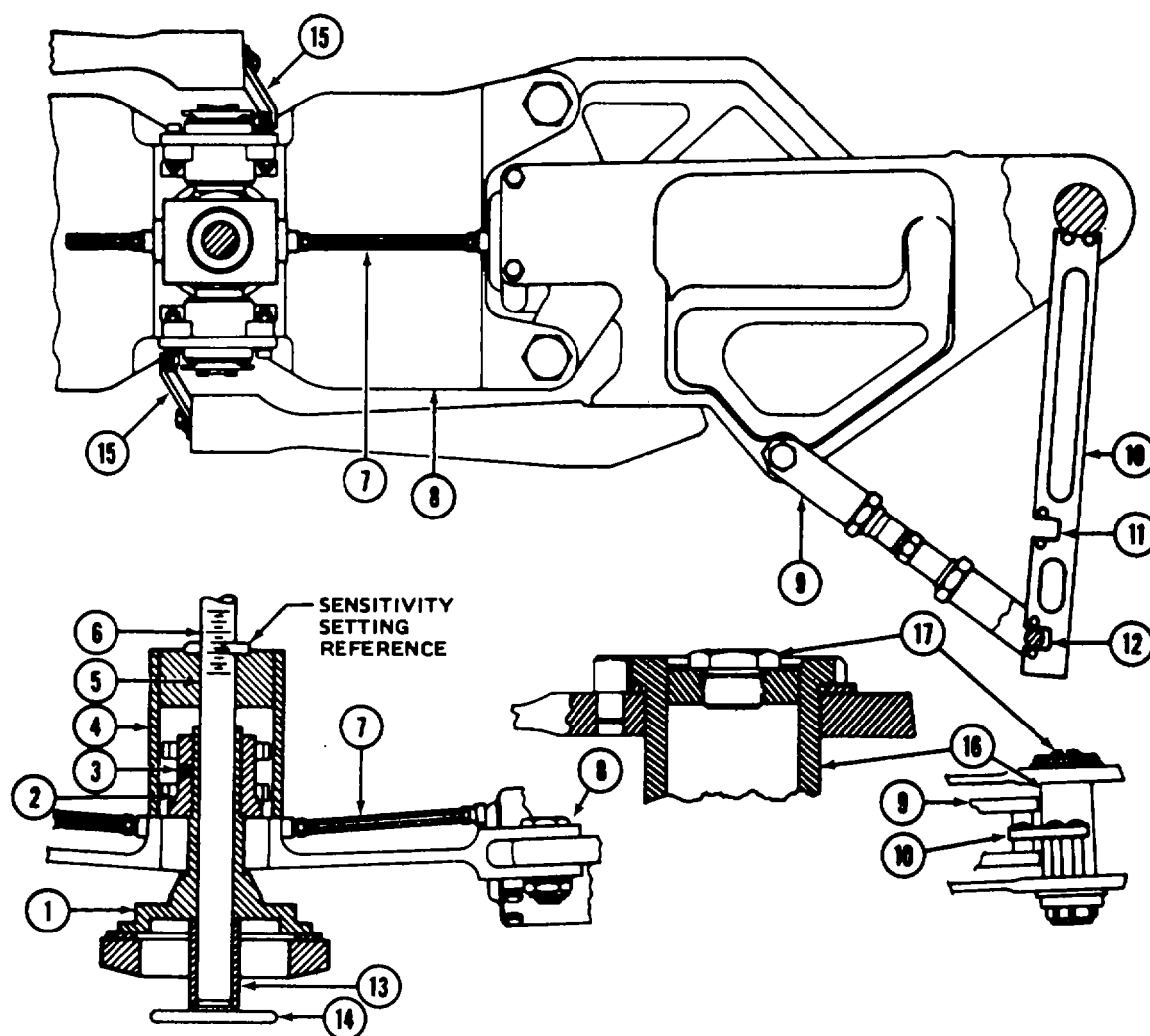
surfaces of hub yoke.

(f) Using gage (10) as shown, adjust drag braces (9) to symmetrical angular positions. Remove gage from rotor hub during subsequent balance check.

(g) Install quick-disconnect assembly with 3/16 inch cable from kit (T79) on arbor suspension rod and hoist balancing assembly approximately 1/4 inch off work stand with hydraulic pump (15). Check to ensure that suspended assembly is free from interference with work stand and adjacent objects, and note balance condition indicated at top end of arbor. (See figure 5-39.)

NOTE

In order to ensure that the handwheel P/N 2315 suspends free of interference within the inside diameter of the stand table, it may be necessary to adjust the level of the stand assembly by installing suitable blocks under the two tubular stand legs (6, figure 5-37).

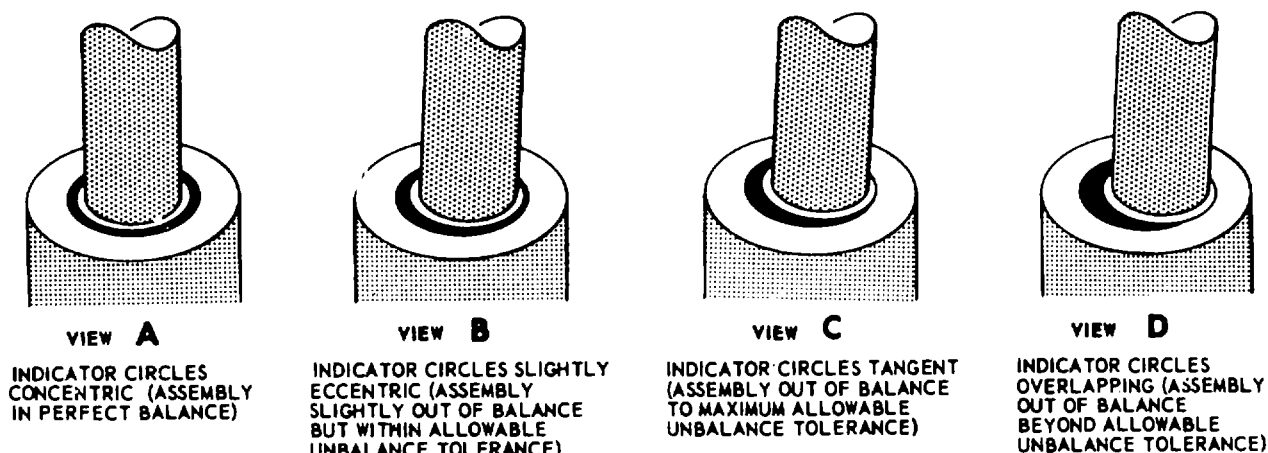


1. Fixture (2337, 7HEL054 Kit)
2. Adapter (2588, 7HEL066 Kit)
3. Adapter Set Screw
4. Yoke (2846, 7HEL066 Kit)
5. Balancing Arbor (2259, 7A050 Kit)
6. Arbor Scale
7. Jack (2865, 7HEL066 Kit)
8. Rotor Hub Assembly
9. Drag Brace

10. Gage (2486, 7HEL066 Kit)
11. Gage Inner Position
12. Gage Outer Position
13. Spacer (2203, 7A050 Kit)
14. Handwheel (2215, 7A050 Kit)
15. Grip Lock (Bell No. T101864)
16. Blade Bolt
17. Plug (AN814-10D)

540011-19E

Figure 5-38. Tool application - main rotor hub balancing



204011-7

Figure 5-39. Interpretation of balancer indication

(h) After it is determined that the handwheel, P/N 2315, suspends free of interference, lower the hub to rest on the stand.

(i) Use a protractor on the machined surface next to the blade retaining bolt and set both blade grips to zero degrees. Both grips must be equal within zero degrees, five minutes.

(j) Raise assembly approximately 1/4 inch off work stand to obtain balance readings.

(k) Balance the hub chordwise within 12 inch-pounds. Place weight on the light pitch horn at hub station zero to obtain balance within limits. Chordwise balance is used as an aid to spanwise balance. Remove weight from pitch horn after completion of spanwise balance.

(l) Balance spanwise within one half inch-pound about blade station 0.000, by inserting lead wire, lead wool slugs (C82) or 0.44 inch diameter shot into cavity of blade bolt assembly (16, figure 5-38).

(m) Install a plug (17) into blade bolt (16) when balance has been accomplished.

(n) Color band hub assembly parts after balance to ensure that parts of hub remain in same respective position as they were when hub was balanced.

(o) Remove hub balance stand and

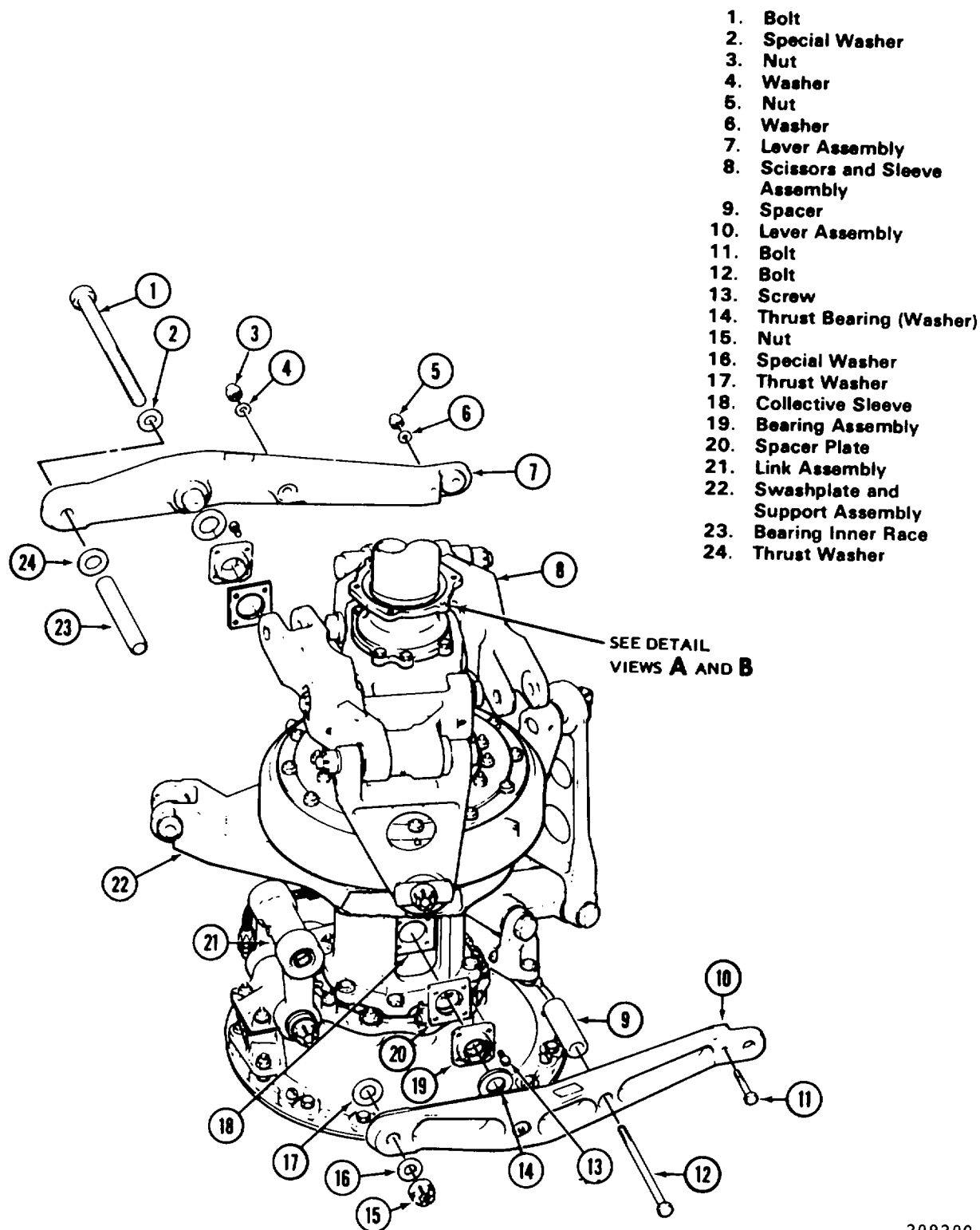
accessories.

5-7. Scissors and Sleeve Assembly

The scissors and sleeve assembly is a component of the mast controls. See figure 5-40. The scissors are attached to the swashplate by the drive links for cyclic control of the main rotor. The scissors are attached to the collective control system through the collective sleeve (18) and levers (10) for collective pitch control of the main rotor.

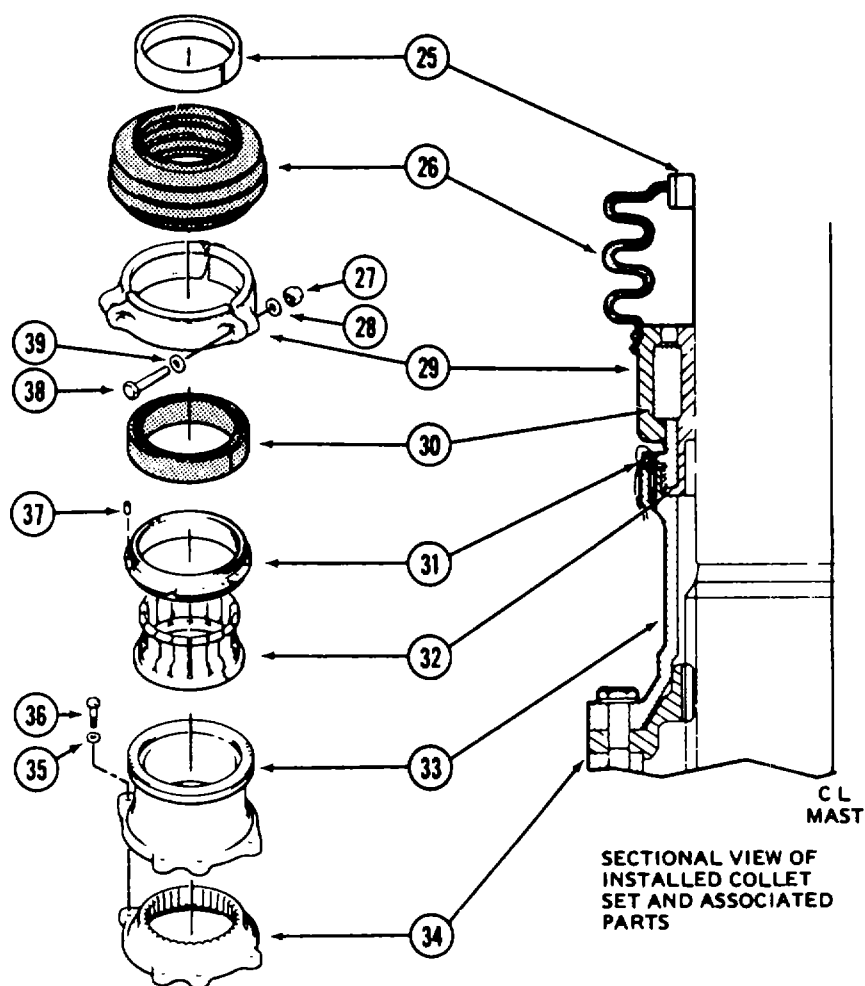
Premaintenance Requirements for Scissors and Sleeve Assembly

Condition	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	(T2) (T27) (T28) (T29)
(T35) (T48)	
Test Equipment	Force Gauge (fish scale) capable of measuring up to 150 pounds Dial Indicator
Support Equipment	NA
Minimum Personnel Required	2
Consumable Materials	(C44) (C45) (C70) (C87) (C102) (C124) (C128)
Special Environmental Condition	None



209200-32-1

Figure 5-40. Mast controls installation (Sheet 1 of 4)

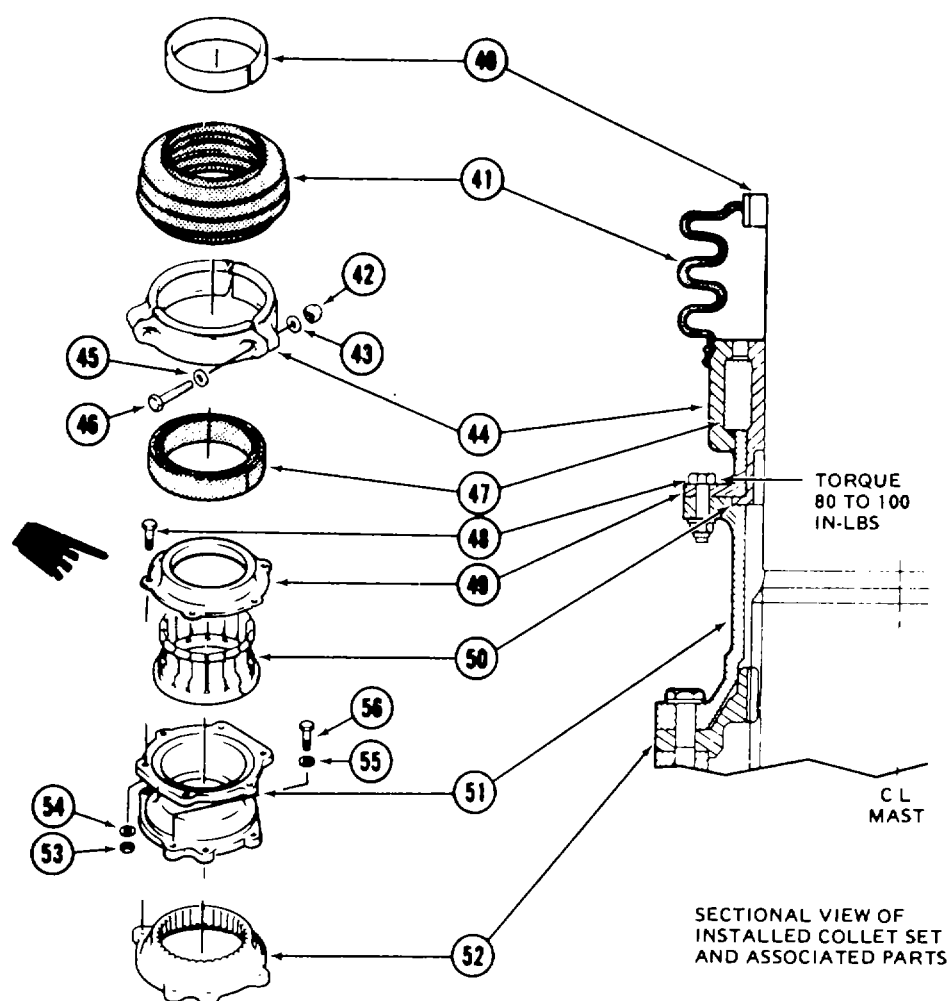


DETAIL VIEW **A** EXTENSION P/N 540-011-487-1 INSTALLATION

25. Spacer	32. Collet Set
26. Upper Boot	33. Extension P/N 540-011-487-1
27. Nut	34. Spline Plate
28. Washer	35. Washer
29. Clamp Assembly	36. Bolt
30. Rubber Ring	37. Spring Pin
31. Externally Threaded Ring (Nut)	38. Bolt
	39. Washer

209200-32-2

Figure 5-40. Mast controls installation (Sheet 2 of 4)



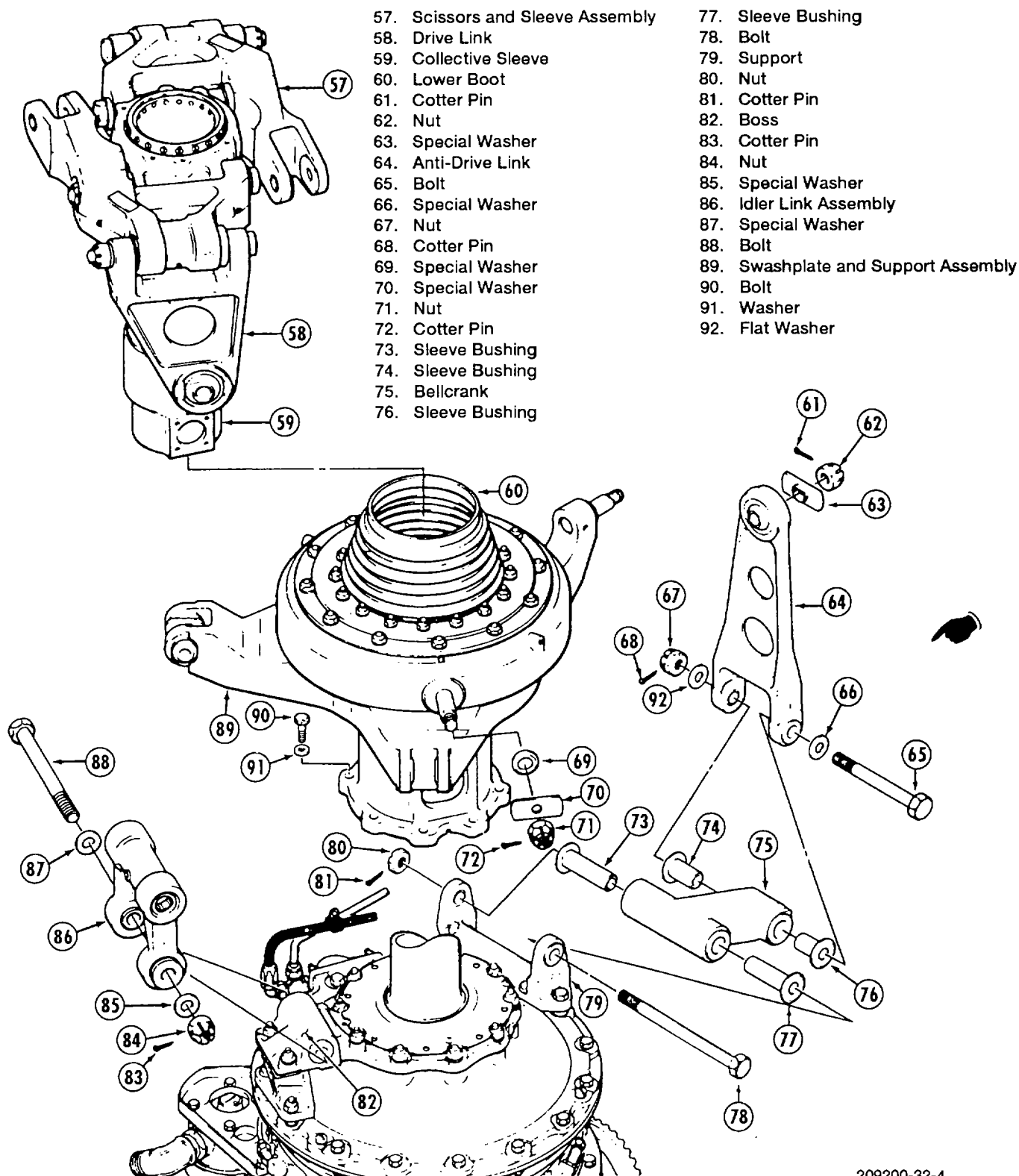
DETAIL VIEW B EXTENSION P/N 209-010-464-1 INSTALLATION

40. Spacer	49. Retainer
41. Upper Boot	50. Collet Set
42. Nut	51. Extension P/N 209-010-464-1
43. Washer	52. Spline Plate
44. Clamp Assembly	53. Nut
45. Washer	54. Washer
46. Bolt	55. Washer
47. Rubber Ring	56. Bolt
48. Bolt	

209200-32-3

Figure 5-40. Mast controls installation (Sheet 3 of 4)

Change 38 5-63



209200-32-4

Figure 5-40. Mast controls installation (Sheet 4 of 4)

a. *Removal.* See figure 5-40.

CAUTION

Remove scissors and sleeve with caution to avoid damage to mast.

(1) Remove main rotor. Refer to paragraph 5-4.

(2) Determine whether the extension installed above the scissors and sleeve assembly is P/N 540-011-487-1 as shown on detail view A or P/N 209-010-464-1 as shown on Detail view B and remove parts as described in step (a) or step (b) as applicable.

(a) Helicopters with extension P/N 540-011-487-1:

1 Cut lockwire and remove spacer (25) and upper boot (26).

2 Remove bolts and remove clamp assembly (29).

3 Remove rubber ring (30).

4 Cut lockwire and remove spring pin (37). Use spanner wrench (T2) to loosen threaded ring (31). Remove the threaded ring and collet set (32). Identify collect set for reinstallation as a set.

(b) Helicopters with extension P/N 209-010-464-1:

1 Cut lockwire and remove spacer (40) and upper boot (41).

2 Remove bolts and remove clamp assembly (44).

3 Remove rubber ring (47).

4 Remove nuts (53), washer (54), and bolts (48). Remove retainer (49) and collet set (50). Identify collet set for reinstallation as a set.

(3) Check wear on spline plate prior to removal. See figure 5-41.

NOTE

The procedure for checking wear on spline plates is the same for installations with extensions P/N 540-011-487-1 and extensions P/N 209-010-464-1.

(a) Attach dial indicator on mast as shown on figure 5-41 with indicator probe against flat of one of the attachment bolts.

(b) Measure and record amount of radial play by rotating scissors and sleeve assembly hub (6) forward and then back to spline contact. Maximum allowable amount of radial play, measured in this manner, is **0.040** inch.

(4) If scissors and sleeve assembly is to be reinstalled without complete disassembly and inspection, check wear on thrust washers (6, figure 5-42) prior to removal. Maximum allowable play at thrust washers is **0.060** inch as shown on illustration.

(5) Remove bolts (36, figure 5-40) or bolts (56) as applicable and remove extension and spline plate. Identify spline plate as satisfactory or as worn beyond limits noted in preceding step.

(6) Disconnect collective system control tube from collective lever assemblies (7 and 10, figure 5-40). Remove bolts (1, 11, and 12). Separate collective lever halves (7 and 10) from collective sleeve (18) and link (21). Keep spacer (9), thrust bearing washer (14), thrust washer (17), be ring inner race (23) and similar parts on the opposite side with the collective lever halves for reassembly.

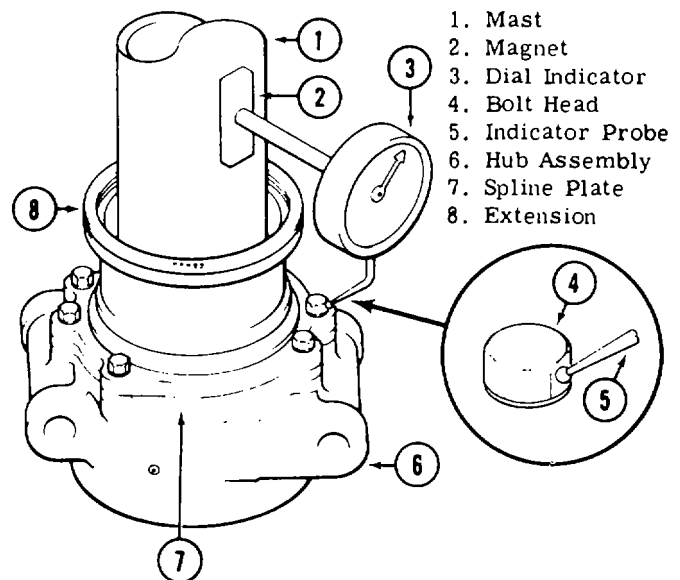
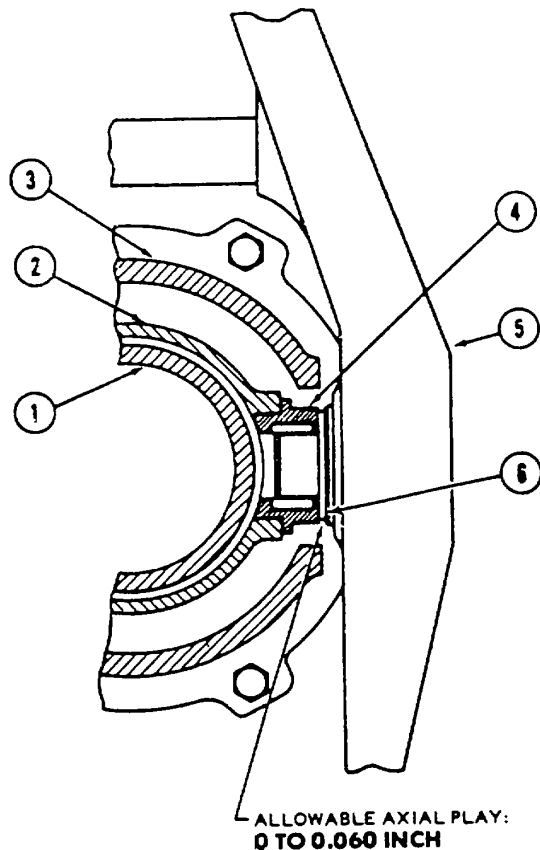


Figure 5-41. Tool application - drive plate spline wear measurement



1. Mast	4. Bearing housing
2. Collective sleeve	5. Lever
3. Swashplate support	6. Thrust washer

209200-8A

Figure 5-42. Collective lever thrust washer wear limits

(7) Remove screws (13, figure 5-40) bearing assembly (19) and spacer plate (20). Remove similar parts from opposite side.

(8) Remove cotter pin (72, figure 5-40), nut (71), and special washer (70). Remove drive link from swashplate. Remove special washer (69). Remove opposite drive link in the same manner.

(9) Cut lockwire and detach lower boot (60, figure 5-40) from collective sleeve.

CAUTION

Do not allow scissors lever to contact scissors hub as damage to lever could result. Block scissors lever with wood or other suitable material to prevent damage.

(10) Lift scissors and sleeve assembly (57, figure 5-40) out of swashplate and off mast. Use caution to prevent damage to friction sleeve and mast splines during removal.

(11) If swashplate is not to be removed, cover open area around top of lower boot (60, figure 5-40) to prevent entry of foreign materials.

(12) If scissors and sleeve assembly is to be reinstalled without complete disassembly and inspection, make the following inspections to ensure that parts are suitable for reinstallation on helicopter.

(a) Check end play between scissors and sleeve assembly (57, figure 5-40) and link (58) for maximum axial looseness of 0.090 inch.

(b) Upper and lower boots (41 and 60, figure 5-40) for tears and deterioration.

(c) Rubber ring (47, figure 5-40) for deterioration and damage.

(d) Collet (50, figure 5-40) for missing fingers, cracks, scoring, or other damage.

(e) Bearing assemblies (19, figure 5-40) for binding, roughness and maximum radial play of 0.010 inch.

(f) Inspect drive link (58, figure 5-40), spherical bearing for roughness, binding, axial play, slippage mark, and alignment. A maximum of 0.015 inch axial play is permissible if excessive vibration does not occur.

NOTE

The spherical bearing wear will be in both the radial and axial direction. However, the only criteria necessary for determining serviceability will be to measure the axial play.

(g) Scissors levers for gouges and scratches especially on underside of pivot leg. See figure 5-44.

(h) Check clevis end of scissors, outboard of bushing, if recess between bushing end and clevis outside surface exceed **0.004** inch a shim is required, refer to paragraph 5-7.e. (6) (g) for installation procedures.

(i) Swashplate horns for scoring.

(i) Spline plate wear in excess of 0.040 inch limit measured in step (3).

(k) Inspect clamp assembly (29 or 44) segments for cracks, corrosion/mechanical damage deformation and/or elongation of bolt holes. Replace if any of the above conditions exist.

(l) Measure clearance between link (86) bushing and head of boss bushing (82). Minimum allowable clearance is 0.0615 inch, and clearance between end of boss bushing and link, minimum allowable clearance is 0.0595 inch.

b. *Disassembly.* See figure 5-43.

CAUTION

Inspect scissors and sleeve and scissors and sleeve historical records for evidence that the assembly has been subjected to an accident or incident such as an overtorque. If scissors and sleeve assembly has been subjected to an accident or incident outside the realm of normal usage, perform conditional inspection of step d. (1) prior to disassembly.

(1) Remove bolt (30) and remove link (32). Retain shim (17) for reassembly.

(2) Remove housing (18), washer (19) and inner race (20) from scissors.

(3) Remove opposite scissors and link in the same manner.

(4) (AVIM) Remove nut (29), bolt (9) and washers (10, 25, 26 and 27) and remove scissors assembly (16) from hub.

(5) Remove inner races (11 and 3) and spacer (4).

(6) Install wrench (T29) on top of hub (2) with two bolts. Invert assembly and secure wrench in a vise.

(7) Remove two screws (8) and lock plate (7). Disengage spiral retaining rings (40 and 42) and move spacer (boot support ring) (41) away from mounting shoulder for access to bottom of hub.

(8) Use wrench (T48) to turn nut (44) out of hub. Remove assembly from vise and remove tools.

(9) Place sleeve assembly on a press with halves of support (T27) placed under hub. Insert small end of ram adapter (T28) in top of sleeve. Press sleeve assembly out of hub. Remove seal (1) from hub. Remove spacer ring (49) from bearing stack on sleeve.

(10) Remove lockwire and pin (50). Install wrench (T29) with pins engaged in holes of nut (48). Insert bar (T35) in holes at lower end of sleeve and hold against turning while removing left-hand threaded nut. Remove tools.

(11) Place sleeve assembly on a press with support halves (T27) placed under inner race of lower bearing. Remove bearing sets (47 and 45) and spacer

set (46) by pressing out sleeve assembly.

(12) Remove loose nut, two retaining rings and boot support ring from sleeve assembly. Use adapter (T28) to remove seal (43) from nut (44).

(13) Remove retaining rings (37 and 39) and bearing sleeve (38) from collective sleeve (36).

c. *Cleaning.* (AVIM)

WARNING

Use solvent (C124) in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

(1) Clean scissors and sleeve assembly parts, drive links, mast friction parts, spline plate collective lever halves, link and support with solvent (C124).

(2) Dry parts with dry, filtered, compressed air. Do not allow bearings (45 or 47, figure 5-43) to spin while drying.

(3) Protect bearings (45 and 47) from contamination. Keep bearings together in sets.

d. *Inspection.* (AVIM)

(1) Visually inspect visible parts of scissors hub assembly and boat for signs of heat. Any heat discoloration or distortion of components is cause for replacement.

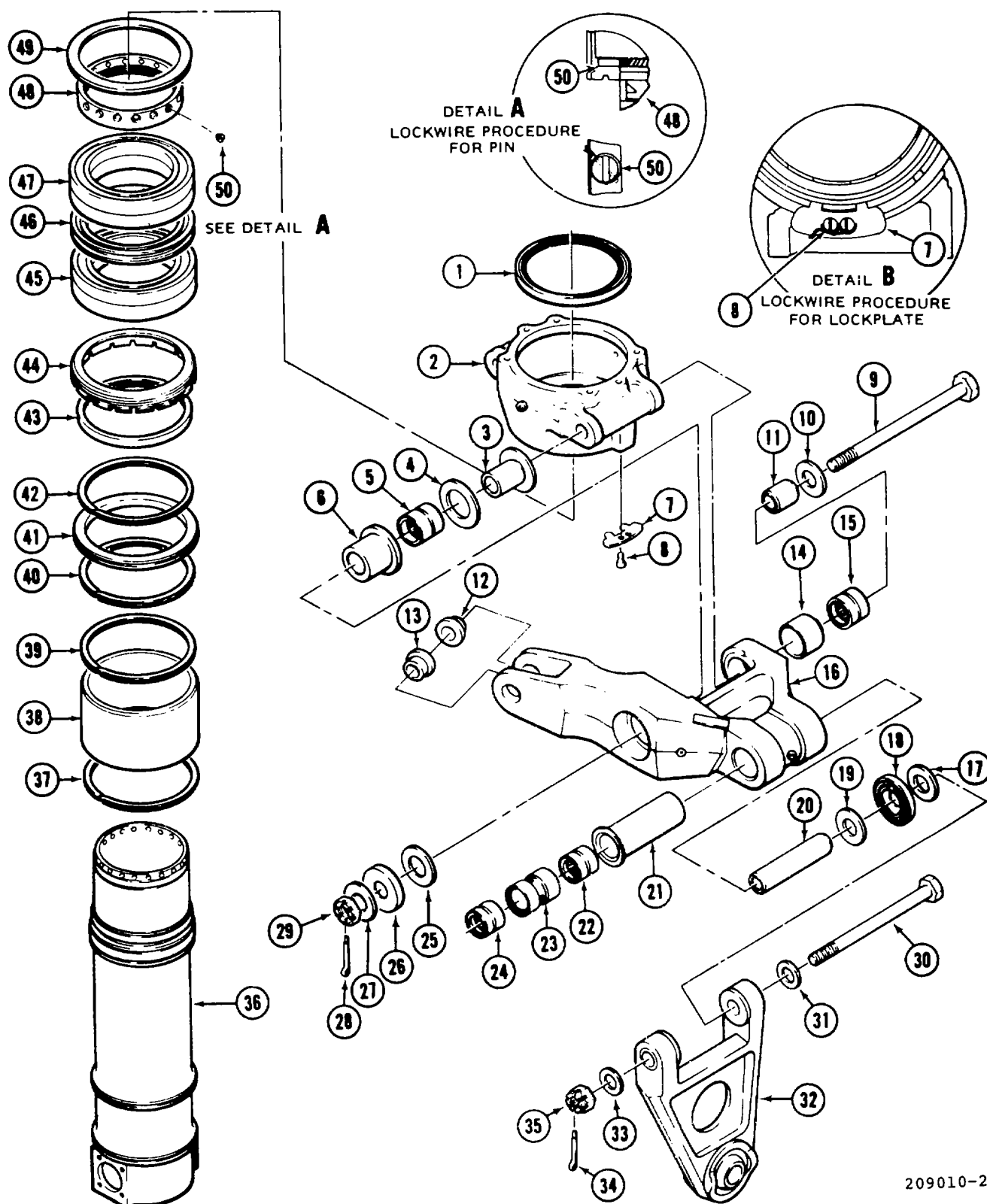
(1a) If the assembly has been involved in an accident or incident, perform conditional inspection of scissors and sleeve as follows.

NOTE

The scissors and sleeve assembly should not have been disassembled if a conditional inspection is required. Refer to step b.

(a) Carefully inspect the assembled component visually for apparent damage and for abnormal appearance. Obvious defects which are cause to scrap the entire assembly are:

- 1 Severe binding in any of the pivot joints.



209010-2-1C

Figure 5-43. Scissors and sleeve assembly (Sheet 1 of 2)

1. Seal	14. Sleeve Bushing	27. Special Washer	40. Retaining Ring
2. Hub	15. Bearing	28. Cotter Pin	41. Spacer
3. Bearing Inner Race	16. Scissor Assembly	29. Nut	42. Retaining Ring
4. Spacer	17. Shim	30. Bolt	43. Seal
5. Bearing	18. Housing and Seal	31. Washer	44. Nut
6. Retainer	19. Thrust Washer	32. Link Assembly	45. Bearing Set
7. Lockplate	20. Bearing Inner Race	33. Washer	46. Spacer
8. Screw	21. Retainer	34. Cotter Pin	47. Bearing Set
9. Bolt	22. Bearing	35. Nut	48. Nut
10. Special Washer	23. Sleeve Spacer	36. Collective Sleeve	49. Spacer Ring
11. Bearing Inner Race	24. Bearing	37. Retaining Ring	50. Pin
12. Bushing Assembly	25. Special Washer	38. Bearing Sleeve	
13. Bushing Assembly	26. Cap Washer	39. Retaining Ring	

Figure 5-43. Scissors and sleeve assembly (Sheet 2 of 2)

2 Severe binding between the hub and sleeve.

(b) Inspect components for surface damage in accordance with normal inspection paragraph. Surface damage in excess of established limits will require scrapping only the damaged part.

(c) Position an unworn bolt (30, figure 5-43) in link (32). If the bolt does not fit freely through bushings, scrap the link. Check the opposite link in the same manner.

(d) With a straight edge, check the cylindrical portion of the collective sleeve for deformation. If warpage is in excess of **0.005** inch in a **5.0** inch length, scrap the sleeve.

(e) Check all machined flat surfaces surrounding lugs, holes and bushings for deformation with a straight edge. If deviations from flat in excess of **0.002** inch are found, scrap the part.

(f) Inspect clevis end of scissors, outboard of bushing. If recess between bushing end and clevis outside surface exceeds **0.004** inch a shim is required, refer to paragraph 5-7.e. (6) (g) for installation procedures.

(2) Identify scissors and sleeve components which will reach retirement time prior to next scheduled inspection for replacement. Refer to overhaul and retirement schedule.

(3) Inspect upper and lower boots (26, 41, and 60, figure 5-40) for damage and deterioration.

(4) Inspect rubber ring (30 or 47, figure 5-40) for damage and deterioration.

(5) Inspect collect (32 or 50, figure 5-40) for missing fingers, cracks and scoring.

(6) Bearing assemblies (19, figure 5-40) for binding, roughness and radial play in excess of 0.010 inch.

(7) Inspect hub, sleeve, scissors and link for corrosion and mechanical damage in excess of limits shown on figure 5-44.

(8) Inspect drive link (32, figure 5-43), spherical bearing for roughness, binding and axial play. A maximum of 0.015 inch axial play is permissible if excessive vibration does not occur.

NOTE

The spherical bearing wear will be in both the radial and axial directions. However, the only criteria necessary for determining serviceability will be to measure the axial play.

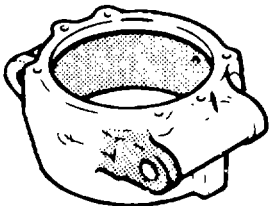
(9) Inspect bolts (9 and 30, figure 5-43), washers (4, 19, 25, and 27) and inner races (3, 11 and 20) for damage. If other than a smooth, unscored surface is found, replace affected part. Maximum lateral chucking of the scissors lever (16) will be 0.020. There will be no longitudinal chucking permissible of bolt (9).

(10) Inspect bearing sets (45 and 47, figure 5-43) as follows:

(a) Inspect for roughness and/or brinelling. Reject bearings with brinelling damage that is visible under 5 power magnification.

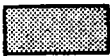
(b) Inspect for galled or flaked areas on balls and raceways. Use a strong light when making this inspection.

(c) Inspect retainers (6 and 21, figure 5-4:3) for damage.



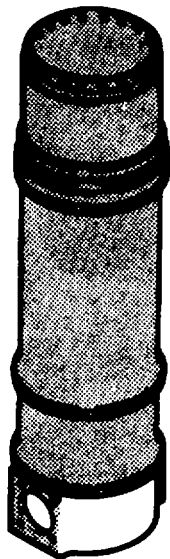
209-010-407
HUB

DAMAGE LOCATION SYMBOLS



TYPE OF DAMAGE	MAXIMUM DEPTHS AND REPAIR AREAS ALLOWED	
SCRATCHES, DENTS AND CORROSION	0.010 In.	0.035 In.
MAXIMUM AREA PER FULL DEPTH REPAIR	0.15 Sq. In.	0.25 Sq. In.
NUMBER OF REPAIRS	One Per Lug	Not Critical
EDGE CHAMFER	0.020 In.	0.050 In.
THREAD DAMAGE:		
DEPTH:	One-Third of Thread	
LENGTH:	One-Half of Thread	
NUMBER:	Two	
BORE DAMAGE:	0.002 for 1/4 Circumference.	209010-77B

Figure 5-44. Damage limits - hub, sleeve, scissors and link (Sheet 1 of 4)



SLEEVE
PART NO.
540-011-456

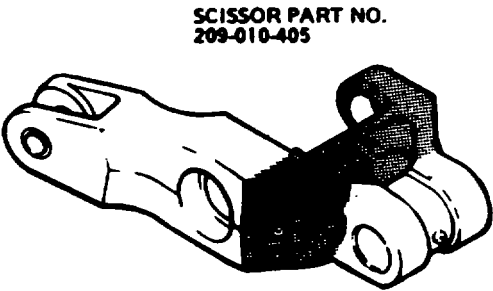
DAMAGE LOCATION SYMBOLS



TYPE OF DAMAGE	MAXIMUM DEPTHS AND REPAIR AREAS ALLOWED	
NICKS, SCRATCHES, SHARP DENTS AND CORROSION	0.010 In.	0.020 In.
MAXIMUM AREA PER FULL DEPTH REPAIR	0.50 In. Sq.	0.50 In. Sq.
NUMBER OF REPAIR AREAS	Not Critical	Not Critical
EDGE CHAMFER	0.020 In.	0.040 In.
THREAD DAMAGE:		
DEPTH:	One-Third of Thread	
LENGTH:	One-Quarter Inch	
NUMBER:	Two Per Segment	
BORE DAMAGE:	0.002 for 1/4 Circumference.	
NO CRACKS ALLOWED		

540011-152B

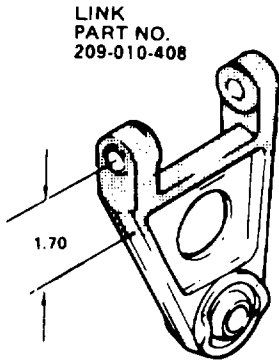
Figure 5-44. Damage limits - hub, sleeve, scissors and link (Sheet 2 of 4)



TYPE OF DAMAGE	DAMAGE LOCATION SYMBOLS	
		
MAXIMUM DEPTHS AND REPAIR AREAS ALLOWED		
NICKS, SCRATCHES, SHARP DENTS	0.020 In.	0.030 In.
CORROSION	0.010 In. Before Repair 0.020 In. After Repair	0.015 In. Before Repair 0.030 In. After Repair
MAXIMUM AREA PER FULL DEPTH REPAIR	0.25 Sq. In.	0.40 Sq. In.
NUMBER OF REPAIR AREAS	Not Critical	Not Critical
EDGE CHAMFER	0.040 In.	0.060 In.
BORE DAMAGE:	0.001 for 1/4 Circumference.	
NO CRACKS ALLOWED		

209010-78B

Figure 5-44. Damage limits - hub, sleeve, scissors and link (Sheet 3 of 4)



TYPE OF DAMAGE	DAMAGE LOCATION SYMBOLS	
		
	MAXIMUM DEPTH AND REPAIR AREAS ALLOWED	
NICKS, SCRATCHES, SHARP DENTS	0.020 In.	0.030 In.
CORROSION	0.010 In. Before Repair 0.020 In. After Repair	0.015 In. Before Repair 0.030 In. After Repair
MAXIMUM AREA PER FULL DEPTH REPAIR	0.10 Sq. In.	0.25 Sq. In.
NUMBER OF REPAIRS	One Per Lug	Not Critical
EDGE CHAMFER	0.040 In.	0.060 In.
BORE DAMAGE:	0.001 for 1/4 Circumference.	
NO CRACKS ALLOWED		

209010-79B

Figure 5-44. Damage limits - hub, sleeve, scissors and link (Sheet 4 of 4)

(d) Inspect bearing races for damage.

(11) Inspect nuts (44 and 48, figure 5-43) for damage with special attention to threads.

(12) Inspect the following parts by magnetic particle method, code M, per MIL-16868 or fluorescent penetrant method, code F, per MIL-1-6866. Items are indexed to figure indicated.

FIGURE	ITEM	NOMENCLATURE	CODE
5-43	16	Scissors	F
5-43	9	Bolt	M
5-43	30	Bolt	M
5-43	32	Link	F
5-43	36	Sleeve, Collective	M
5-43	44	Nut	M
5-43	2	Hub	M
5-43	48	Nut	M
5-40	34 or 52	Spline plate	F
5-40	7 and 10	Collective Lever	M
5-40	86	Idler Link Assembly	F

(13) Inspect lockplate (7, figure 5-43) for broken or deformed tangs.

(14) Inspect spacer sets (41 and 46, figure 5-43) for corrosion, scoring and other mechanical damage. No repair authorized.

(15) Inspect bolts (9 and 30, figure 5-43), inner races (3, 11, and 20), and thrust washers (4, 19 and 25) for scoring. No repair is authorized. If bearing inner race outside diameter is scored, the race and the matching bearing (5, 15, 22, or 24) must be replaced.

(16) Visually inspect sleeve (38, figure 5-43) for indications of wear at contact points with retaining rings (37 and 39).

(17) Visually inspect cap washer (26, figure 5-43), housing (18), retaining rings (37, 39, 40, and 42), spacer (41), lock plate (7), pin (50), spacer ring (49) and spacer (46) for cracks, corrosion and deformation.

(a) Inspect pin (50) for security and presence of lockwire.

(b) Inspect two screws (8) and lockplate (7) for security and presence of lockwire.

(c) If pin, screws or lockplate are loose, remove (paragraph 5-7a), disassemble (paragraph 5-7b) and clean (paragraph 5-7c).

(18) Inspect spline plate for damage in excess of limits shown on figure 5-45.

(19) Inspect collective lever halves (7 and 10, figure 5-40) for damage in excess of limits shown on figure 5-46.

(20) Inspect collective lever idler link for the following:

(a) Damage in excess of limits shown on figure 5-47.

(b) Bearings for elongation looseness and damage. Maximum allowable radial play is **0.010** inch.

(c) Rubber elements in lower end of link for deterioration and separation.

(21) Dimensionally inspect the following parts if visual inspection indicates wear. Items are indexed to figure 5-43.

ITEM	NOMENCLATURE	REPLACE AT
36	Sleeve, Bearing Seat OD	4.248 Min.
2	Hub Bearing Seat ID	5.2520 Max.
2	Hub Pivot Bolt Hole ID	0.7520 Max.

(22) Refer to paragraph 5-8 for inspection and repair procedures for swashplate anti-drive link (64, figure 5-40), bellcrank (75) and support (79).

(23) Inspect Collet sets for missing fingers, cracks, and scoring. Inspect fingers for missing and badly worn teflon.

e. *Repair.* (AVIM)

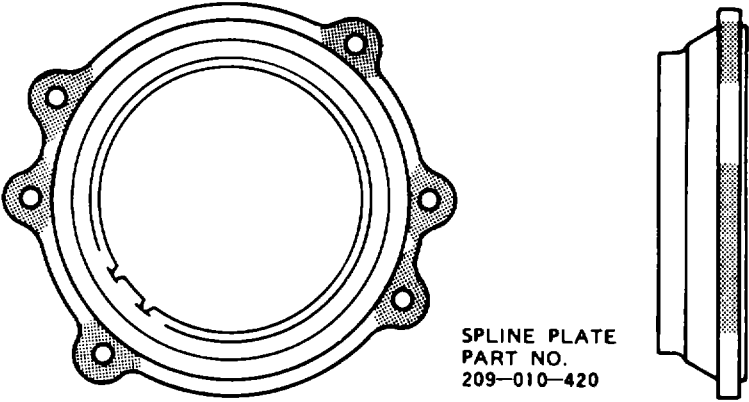
CAUTION

Repair by use of grinding wheel is not allowed.

(1) Polish out corrosion and mechanical damage in parts inspected in preceding step. Use fine to medium abrasive cloth (C44), crocus cloth (C45) or fine India stone (C128). Blend repair smoothly into surrounding area. Replace part if repair exceeds allowable area and/or depth limits.

(2) Replace defective scissors hearings (22 and 24, figure 5-43) as follows:

(a) Insert a punch through retainer (21) and tap out bearings (22 and 24) and spacer (23). Inspect retainer ID for scoring. Maximum allowable depth of score marks after clean up is **0.002** inch. Clean retainer and apply a light film of grease (C70) to retainer bearing bore.



DAMAGE LOCATION SYMBOLS



TYPE OF DAMAGE	MAXIMUM DEPTHS AND REPAIR AREAS ALLOWED	
NICKS AND DENTS	0.010 In.	0.020 In.
CORROSION	0.005 In.	0.010 In.
MAXIMUM AREA PER FULL DEPTH REPAIR	0.10 Sq. In.	0.25 Sq. In.
NUMBER OF REPAIRS	One Per Segment	Not Critical
EDGE CHAMFER	0.030 In.	0.060

SPLINE DAMAGE:

DEPTH: One-Third of Spline
LENGTH: One-Half of Spline
NUMBER: Three

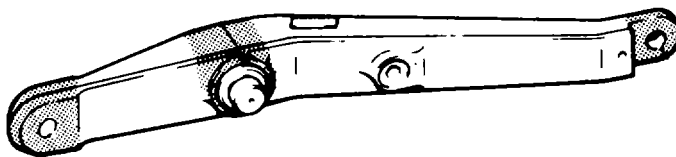
BOLT BORE DAMAGE: 0.002 Full Circumference.

NO CRACKS ALLOWED

209010-80B

Figure 5-45. Damage limits - spline plate

PART NO. 209-010-406



COLLECTIVE LEVER
PART NO. 209-010-406

DAMAGE LOCATION SYMBOLS



TYPE OF DAMAGE

MAXIMUM DEPTHS AND REPAIR AREAS ALLOWED

NICKS, SCRATCHES, DENTS
AND CORROSION

0.010 In.

0.020 In.

MAXIMUM AREA PER FULL
DEPTH REPAIR

0.10 Sq. In.

0.50 Sq. In.

NUMBER OF REPAIRS

Two Per Segment

Not Critical

EDGE CHAMFER

0.030 In.

0.060 In.

BORE DAMAGE

0.002 In. Depth for 1/4 Circumference

NO CRACKS ALLOWED

209010-75B

Figure 5-46. Damage limits - collective lever

WARNING

Use solvent in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

(b) Clean bearings with solvent (C124) and hand pack bearings with grease (C70).

(c) Press bearing (22) into retainer (21) and then press spacer (23) into retainer.

(d) Press bearing (24) into retainer with the seal side of the bearing facing outboard.

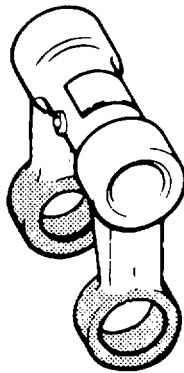
(3) Replace defective bearing (5, figure 5-43.) Replacement procedures for bearing (5) are the same as bearings (22 and 24, step 2 above).

WARNING

Use solvent in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

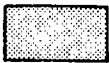
(4) Replace defective bearing (15, figure 5-43). Position scissors on a suitable support and apply pressure to bearing race. Inspect sleeve (14) for scoring. Score marks must not exceed 0.002 inch depth after cleanup. Clean new bearing with solvent (C124) and hand pack bearing with grease (C-70). Apply heat lamp to scissors and press in new bearing (15). Check that bearing ends are equally spaced on each side of scissors tang.

(5) Protect bearings from contamination until reassembly.



COLLECTIVE LEVER IDLER LINK
PART NO.
209-010-409

DAMAGE LOCATION SYMBOLS



TYPE OF DAMAGE	MAXIMUM DEPTHS AND REPAIR AREAS ALLOWED	
NICKS, SCRATCHES, DENTS AND CORROSION	0.010 In.	0.030 In.
MAXIMUM AREA PER FULL DEPTH REPAIR	0.10 Sq. In.	0.25 Sq. In.
NUMBER OF REPAIRS	One Per Lug	Not Critical
EDGE CHAMFER	0.030 In.	0.060 In.
BORE DAMAGE:	0.002 for 1/4 circumference	
NO CRACKS ALLOWED		

209010-76B

Figure 5-47. Damage limits - collective lever idler link

(6) Replace damaged or worn bushings (12 and 13, figure 5-43) as follows:

(a) Support the clevis end of scissors so as to prevent a bending load on tang, and press defective bushing from scissors.



(b) Inspect bushing bores in scissors for scoring after bushings are pressed out. Polish out scoring type damage to 0.002 inch maximum depth. Clean holes in clevis and clevis inboard faces with solvent (C124).

(c) Coat bushing OD with wet, unreduced primer (C102). Ensure that primer does not contact buffer material on underside of bushing flange. Apply a heat lamp to end of scissors and press bushings into clevis holes with bushing flanges facing inboard. Check that bushings are fully seated.

(d) Line ream bushings to 0.6250 TO 0.6255 inch diameter.

Use solvent in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

(e) Mill inboard bushing faces to establish 1.250 TO 1.252 inch dimension between faces. Keep flange wall thickness equal within 0.005 inch.

(f) Chamfer the edge I.D. on inboard side of bushings **0.005 TO 0.010 x 45** degrees.

(g) When recess exceeds 0.004 maximum (figure 5-47A) between end of the bushing {items 12, 13, figure 5-43} and outboard surface of the scissors, install a 120-006C27E21 shim and peel as required to meet 0.002 to 0.004 maximum recess. Bond shim in place on end of bushing using a cyanoacrylate adhesive (C14A).

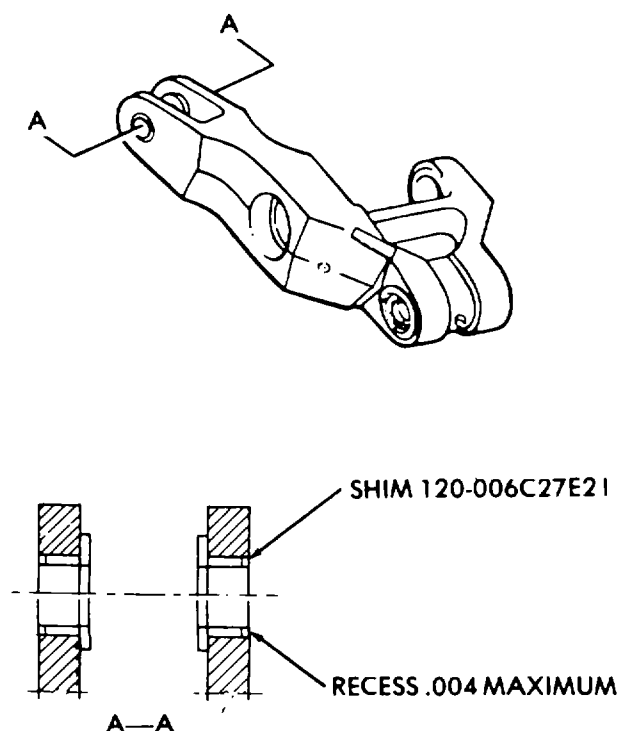
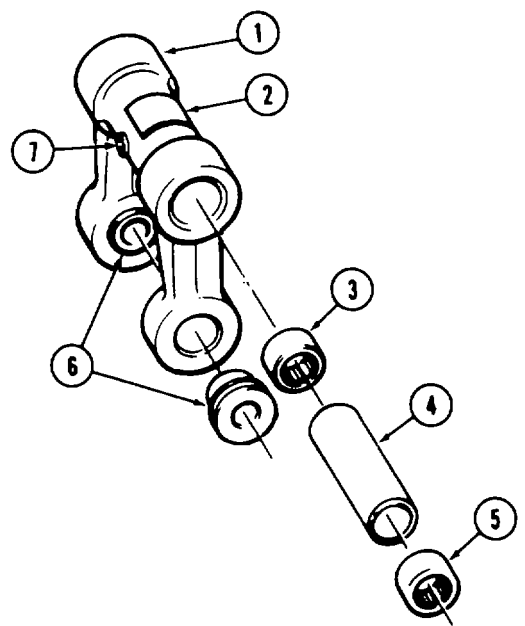


Figure 5-47A. Installation of Shims

(7) Replace components of collective lever idler link (86, figure 5-40) which have damage in excess of limits specified in inspection paragraph 5-7d(20) as follows:



209010-10

1. Link assembly
2. Identification plate
3. Roller bearing
4. Sleeve
5. Roller bearing
6. Bushing
7. Lubrication fitting

Figure 5-47B. Collective Lever Idler Link Assembly

(a) Replace damaged lubrication fitting {7, figure 5-47B) as follows:

1 Carefully remove old lubrication fitting to avoid damage to link.

2 Press new lubrication fitting into link.

3 Attach a grease gun serviced with clean grease (C70) to fitting and check to ensure that fitting is properly installed

(b) Replace damaged identification plate (2) as follows:

NOTE

If data to be stamped on identification plate is not available, send affected assembly to Depot Maintenance for evaluation.

1 Stamp all data from the old identification plate on the new identification plate.

CAUTION

Do not heat link assembly (1) to temperature above limit noted in following step.

2 Remove old identification plate from link assembly. Heat link assembly to 200 ± 15 degrees F (93 ± 9 degrees C) to loosen adhesive.

3 Mask off face side of new identification plate and the area of the link assembly where identification plate will be installed.

4 Clean masked-off area on link assembly with 300 grit or finer sandpaper (C112A).

5 Form new identification plate to fit closely on link assembly.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

6 Scrub mating surfaces of identification plate and link assembly with cheesecloth (C36) dampened with aliphatic naphtha (C88). Wear clean white cotton gloves (C66B) when handling parts after cleaning and prior to bonding.

7 Mix two-part adhesive (C11) in accordance with instructions on container. Apply a thin coat of adhesive to each of the mating surfaces as soon as possible after mixing. Place identification plate on link and anchor in position with clamps or rubber bands.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

8 Clean adhesive squeeze-out from parts with cheesecloth and MEK (C87) before adhesive cures.

9 Remove masking tape before adhesive cures.

10 Allow adhesive to cure for 24 hours at room temperature (approximately 75 degrees F) (24 degrees C). Full strength will be reached in six to seven days.

(c) Replace damaged bushing (6) as follows:

CAUTION

Do not heat link assembly (1) to temperature above limits noted in following step.

1 Support link assembly with suitable sleeves and supports to avoid distortion and press out two bushings (6). The bushings must be pressed outboard from the link as illustrated. If bushings are a tight fit in the link, to a maximum of 200 ± 15 degrees F (93 ± 9 degrees C). Then press bushings out.

2 Clean bores where two bushings (6) will be installed.

3 Select suitable sleeves and support blocks to support legs of link assembly (1) during installation of bushings (6).

CAUTION

Do not heat link assembly (1) to temperature above limited noted in following step.

Do not chill bushings (elastomeric-type bushings) (6) during installation procedure.

4 Heat link assembly (1) to 200 ± 15 degrees F (93 ± 9 degrees C). Coat mating surface of bushings (6) with primer (C100 or C102) and install with flanges outboard as illustrated while primer is wet.

(d) Replace damaged bearings (3) and (5) as follows:

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

1 Clean bore of link assembly (1) where bearings will be installed. Clean new bearings (3 and 5) and sleeve (4) with dry cleaning solvent (C124). Allow bearings to dry thoroughly and hand pack with grease (C70).

2 Apply a thin coat of corrosion preventive compound (C53) to mating surfaces of sleeve (4) and bearings (3 and 5). Press spacer and bearings into link.

3 Polish out mechanical and corrosion damage that is within limits shown in figure 5-47.

f. Assembly. (AVIM)

(1) Lubricate bearing sets (45 and 47, figure 5-43) as follows:

WARNING

Use solvent in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

(a) Wash bearing sets (45 and 47), in solvent (C124) and air dry.

(b) hand pack bearing sets (45 and 47) with grease (C70).

(c) Protect bearing sets (45 and 47) from contamination until installation.

(2) Position bearing sleeve (38, figure 5-43) on collective sleeve (36), and install retaining rings (37 and 39) in grooves near lower end of sleeve.

(3) Position spacer (41) and retaining rings (40 and 42), loosely on collective sleeve. Use adapter (T28) to press seal (43) into nut (44), with seal lip toward notched side of nut. Place nut, notched side down, loosely on sleeve below shoulder. Take suitable precautions to avoid marring loose parts in handling.

NOTE

The mating surface of the bearings in the bearing set should be wiped free of excess grease before they are installed.

(4) Assemble bearing sets (45 and 47) and spacer (46) according to etched numbers and V-mark on outer races of bearings. Use adapter (T28) to press bearing stack on upper end of sleeve, with V-mark pointing up.

(5) Start left-hand threaded nut (48) on sleeve. Install wrench (T29.3) with pins engaged in holes of nut. Hold sleeve with bar (T34.1) through holes at lower end. Apply maximum torque, **200** foot-pounds, to nut (48). Allow the stack-up to set for 10 minutes, release the torque, and then torque to **150** foot-pounds. Increase torque as needed, maximum **200** foot-pounds, to align a hole in the nut with a hole in the collective sleeve. Do not loosen the nut, reduce torque, to align the holes. Install pin (50). Remove tools. Secure pin with lockwire; insert lockwire through drilled head and twist in space between sleeve and nut.

(6) Use adapter (T28) to press seal (1), with lip upward, into lop of hub) until bottom of seal is flush with or slightly below lower edge of hub seal bore.

(7) Place sleeve assembly on a press with support halves (T27) under bottom bearing of stack. Place spacer ring (49) on top bearing stack. Press hub assembly from press.

(8) Install wrench (T29) on top of hub with two bolts. Secure wrench in vise. Start lower nut (44) into hub and torque **400 TO 500** foot-pounds. Use wrench (T4).

(9) Position lockplate (7)

(10) Install ring (41) ,on collective sleeve with retaining rings (40 and 42) in mounting grooves of collective sleeve below hub.

(11) (AVUM) Assemble inner race (20) washer (19) and housing (18) to scissors.

(12) Attach link (32) to scissors (16) with inner race {20}, washer (19), and housing (18) in position, but (do not install shim (17) at this time. Install nut (35) on bolt (30) finger tight.

(13) Measure gap between housing (18) and bushing face of drive link (32) with feeler gauge. Record this figure. Prepare a shim (17) by peeling off laminations to obtain a shim thickness **0.000 TO 0.002** inch less than measured gap. Remove bolt (30) and reinstall with inner race (20) shim (17), washers (19, 31 and 33) and housing (18) in position. Torque nut (35) **85 TO 104** foot-pounds and install cotter pin (34). Repeat for opposite scissors and link.

NOTE

End play between scissors and drive link is necessary after establishing torque. Maximum end play shall not exceed **0.116** inch.

(14) (AVIM) Install scissors (16) on hub with inner races (3 and 14), spacer (4), washer (25), cap washer (26), and special washers (10 and 27) in position. One special washer (10) must be under bolt head and one special washer (27) must be under nut. The bolt head must face in direction of rotation. TORQUE NUT (29) TO 150 - 175 FOOT-POUNDS and install cotter pin. Repeat for opposite scissors.

(15) Lubricate all bearings in scissors and hub as specified in Chapter 1.

(16) Collet finger teflon can be rebonded with versilock 204, (C156) and accelerator No. 5, (C157), using work aid (figure 5-47C). Teflon pads from one collet set may be used on other collet sets.

(17) Collets may be used in mixed sets providing minimum gap of **0.040** inch each side is maintained.

(18) No missing fingers, badly worn teflon pads, cracks or scoring allowed.

g. Installation. See Figure 5-40.

(1) Install swashplate and lower boot if not previously accomplished. Refer to paragraph 5-8.

(2) Coat mating splines on mast and in scissors and sleeve assembly spline plate (34 or 52) with grease (C70).

(3) Carefully lower scissors and sleeve assembly over mast. Insert lower end of collective sleeve down through lower boot (60) and top of swashplate support. Use care to avoid damage to teflon-lined bearing inside support.

(4) Turn collective sleeve (18) so that the two bearing mounting bosses at lower end are aligned with openings in swashplate support as illustrated. Position spacer plate (20) and bearing assembly on boss with the "TOP" marking up so that curve inner surface of bearing housing is aligned to mast surface. Install screws (13) and lockwire (C151) in pairs. Install opposite bearing assembly in same manner.

(5) Install collective lever halves (7 and 10) as follows:

(a) Place a thrust washer (14) over the bearing boss of each lever half.

(b) Mount lever halves on bearing assemblies (19) and install bolt (11), washer (6) and nut (5). Install nut finger tight.

(c) Position lever halves on link (21) with inner race (23) and thrust washers (17 and 24) in place. Install bolt (1) washers (2 and 16) and nut (15). Install nut finger tight.

(d) Position spacer (9) between levers and install bolt (12). Install washer (4) and nut (3). Install

nut finger tight

(e) **TORQUE NUT (5) TO 50 - 70 INCH-POUNDS.**

(f) **TORQUE NUT (3) TO 160 - 190 INCH-POUNDS.**

(g) **TORQUE NUT (15) TO 1250 - 1550 INCH POUNDS** and install cotter pin.

(h) Check for a maximum of 0.060 inch clearance between thrust washers and bearing housings. A minimum zero clearance is acceptable as long as no binding is evident. The clearance is to be measured collectively from both levers.

CAUTION

Special washers (63 and 70, figure 5-40) are not interchangeable and must be installed in correct location to perform fail-safe function.

(6) Place a special washer (69, figure 5-40), with chamfer facing outboard, on swashplate outer ring as illustrated. Position drive link (58) on swashplate then install special washer (70) with collar inboard and the letters "AFT" facing out-board. Install nut (71) and **TORQUE TO 770-950 INCH-POUNDS** and install cotter pin. Bend cotter pins ends closely around nut to avoid contact with swashplate during operation. Install opposite drive link in the same manner.

WARNING

Measure vertical clearance from the bottom of both drive links, P/N 209-010-408-7, to all three horns of stationary swashplate. The minimum clearance must not be less than .035 (thirty five thousandths) inch. Replace swashplate if clearance is below minimum.

(7) Slip lower boot (60, figure 5-40) on grooved ring on collective sleeve hub and on grooved ring on collective sleeve below hub. Secure both ends of boot with lockwire.

(8) Determine whether the extension to be installed above the scissors and sleeve assembly is P/N 540-011-487-1 as shown in detail view A, figure 5-40 or is P/N 209-010-464-1 as shown on detail view B.

Install parts as described in step (a) or step (b) as applicable.

(a) Install extension (33, figure 5-40) and associated parts shown on detail view A as follows:

1 Coat mating splines on mast and spline plate (34) with grease (C70). Position spline plate and extension (33) on mast and install bolts (36) and washers (35). Lockwire bolt heads in sets of three.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing vapors and avoid prolonged skin contact.

2 Clean friction sleeve on mast, clamp assembly (29), nut (31) collet set (32) and extension (33) with methyl-ethyl-ketone (C87).

3 Seat collet set (32) in top of extension (33) and install nut (31). **TORQUE NUT TO 140 - 180 FOOT-POUNDS.** Check that no gap exists between collet set and friction sleeve on mast. Install spring pin (37) through aligned holes in nut and extension and secure with lockwire looped through spring pin and over edge of nut and extension.

4 Position rubber ring (30) around collet set (32) and top of nut (31). Place clamp assembly (29) around rubber ring and install bolts (38), washers (28 and 39) and nuts (27). Tighten nuts evenly so that gaps between clamp sections are equal within 1/16 inch.

5 Adjust collective friction. Refer to step (9).

(b) Install extension (51, figure 5-40) and associated parts shown on detail view B as follows:

1 Coat mating splines on mast and spline plate (52) with grease (C70). Position spline and extension (51) on mast and install bolts (56) and washers (55). **TORQUE BOLTS EVENLY TO 80 - 100 INCH-POUNDS** and lockwire in sets of three.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone (C87). Avoid breathing solvent vapors and avoid prolonged skin contact.

2 Clean friction sleeve on mast, clamp assembly (44), retainer (49) collet set (50) and extension (51) with methyl-ethyl-ketone (C87).

3 Seat collet set (50) in top of extension (51) and install retainer (49) with bolts (48) washers (54) and nuts (53). **TORQUE NUTS EVENLY TO 80 - 100 INCH-POUNDS.** Check that no gap exists between collet set and friction sleeve on mast.

4 Position rubber ring (47) around collet set (50) and on top of retainer (49). Place clamp assembly (44) around rubber ring and install bolts (46), washers (43 and 45) and nuts (42). Tighten nuts evenly so that gaps between clamp sections are equal within 1/16 inch.

5 Adjust collective friction. Refer to step (9).

(9) Adjustment - collective mast friction collet. See figure 5-40.

(a) Disconnect collective controls from collective lever halves (7 and 10) if connected.

(b) Attach a force gauge (fish scale) to collective lever halves (7 and 10) at point where collective controls are normally attached. Place lever halves in full down position and measure amount of force in pounds required to raise the lever halves. Adjust bolts (38 or 46) as applicable until a load of 125 to 135 pounds on the spring scale is required to raise the lever halves.

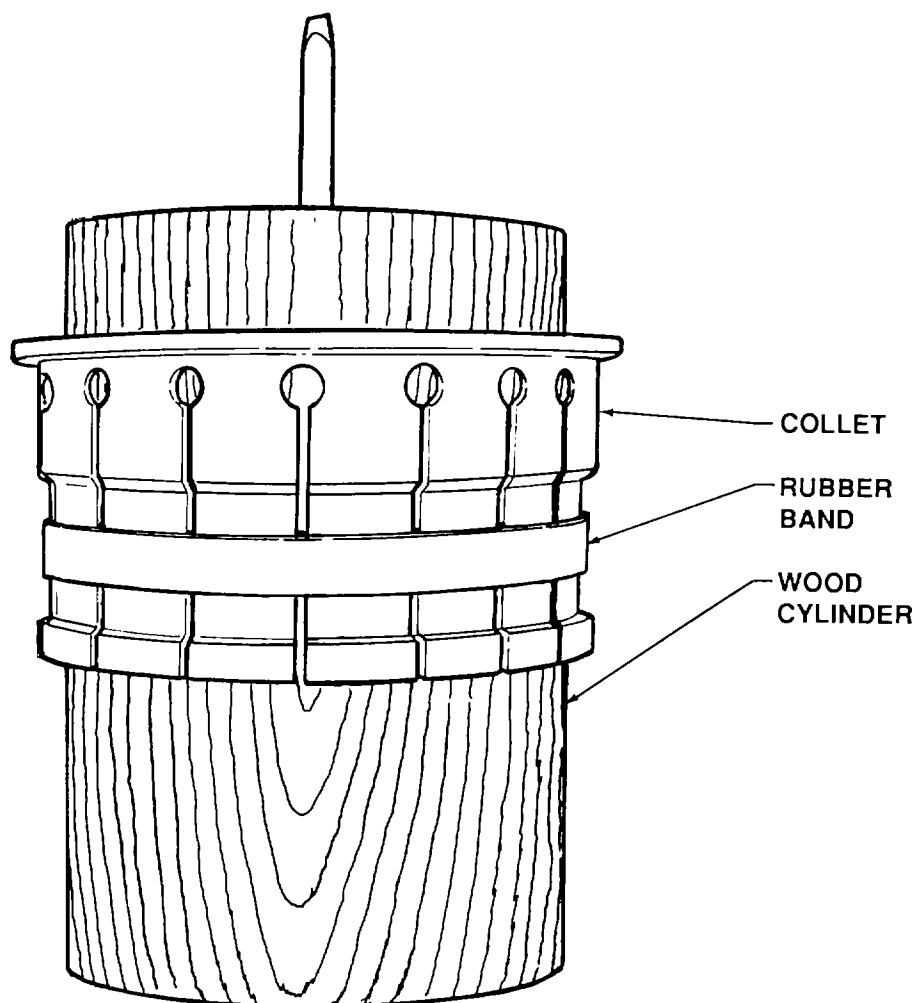
NOTE

Between five and ten hours of operation following installation, recheck friction as outlined in preceding step. If friction setting is not within limits, readjust. Do not exceed 130 inch-pounds torque on clamp bolts. If correct friction cannot be obtained within this limit, check for grease on mast friction sleeve and clean with methyl-ethyl-ketone (C87).

(c) Attach collective controls to lever halves (7 and 10) with bolt, washers, nut, and cotterpin.

(10) Install upper boot (26, figure 5-40) with spacer (25) or upper boot (41) with spacer (40) as applicable. Secure upper boot with lockwire. Apply a small bead of sealant (C116) around top of upper boot.

(11) Install main rotor hub and blade assembly and perform maintenance test flight. Refer to paragraph 5-4.



MAKE FROM SIX INCH PIECE OF WOOD
(TURN TO 3 5/8 INCH DIAMETER CYLINDER)

Figure 5-47C. Collet Work Aid

5-8. Swashplate and Support

a. Description

The swashplate and support assembly is a component of the main rotor controls (figure 548). The swashplate support is an open cylinder with a flange for mounting to the transmission at the lower end and spherical surface or uniball at the upper end for mounting the swashplate. Side openings are provided to accommodate the collective lever halves which move the collective sleeve. The swashplate inner ring is clamped on the pivot ball of the support by upper and lower sets of contoured, teflon-lined bearings. This design allows the swashplate to tilt in any direction when actuated by the cyclic control rods. The anti-drive link prevents the inner ring from rotating. The swashplate outer ring tilts with the inner ring, but rotates with the scissors and mast. It is mounted to the inner ring through a duplex ball thrust bearing, and is connected to the scissors with two drive links.

Premaintenance Requirements for Swashplate and Support

Condition	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	NA
Test Equipment	Force gauge (fish scale) capable of measuring up to 30 pounds
Support Equipment	
Minimum Personnel Required	Two
Consumable Materials	(C9) (C32) (C37) (C44) (C45) (C52) (C76) (C87) (C102) (C116) (C124)
Special Environmental Condition	None

b. Adjustment

(1) Adjust friction on swashplate installed on helicopter as follows:

NOTE

Prior to disconnecting anti-drive link, check for excessive wear in drive link bearings. Rotation of the swashplate inner ring, measured at the swashplate aft horn pin, in excess of 0.110 inch indicates worn anti-drive link bearing and bushings.

(a) Disconnect anti-drive link (64, figure 540), lateral control tube and fore and aft control tube from swashplate inner ring assembly.

(b) Disconnect scissors and sleeve drive links (58), from swashplate outer ring assembly.

(c) Apply a force gage (fish scale) to bolts inserted through both the lateral and fore and aft devices on control horn inner ring.

(d) Check for 15.5 TO 20 pounds of force required to actuate swashplate about the uniball at each clevis. If friction is within limits, reconnect the items that were disconnected in steps (a) and (b). If friction is not within limits, adjust and recheck thickness of shim (3, figure 5-48).

CAUTION

Ensure that wood wedges remain in position to support inner ring during shim adjustment procedure or uniball damage may result.

1 Insert two wood wedges under swashplate inner ring to support the ring during shim adjustment procedure.

NOTE

A one piece stainless steel shim (3) may be used in place of the four piece shim in the steps below.

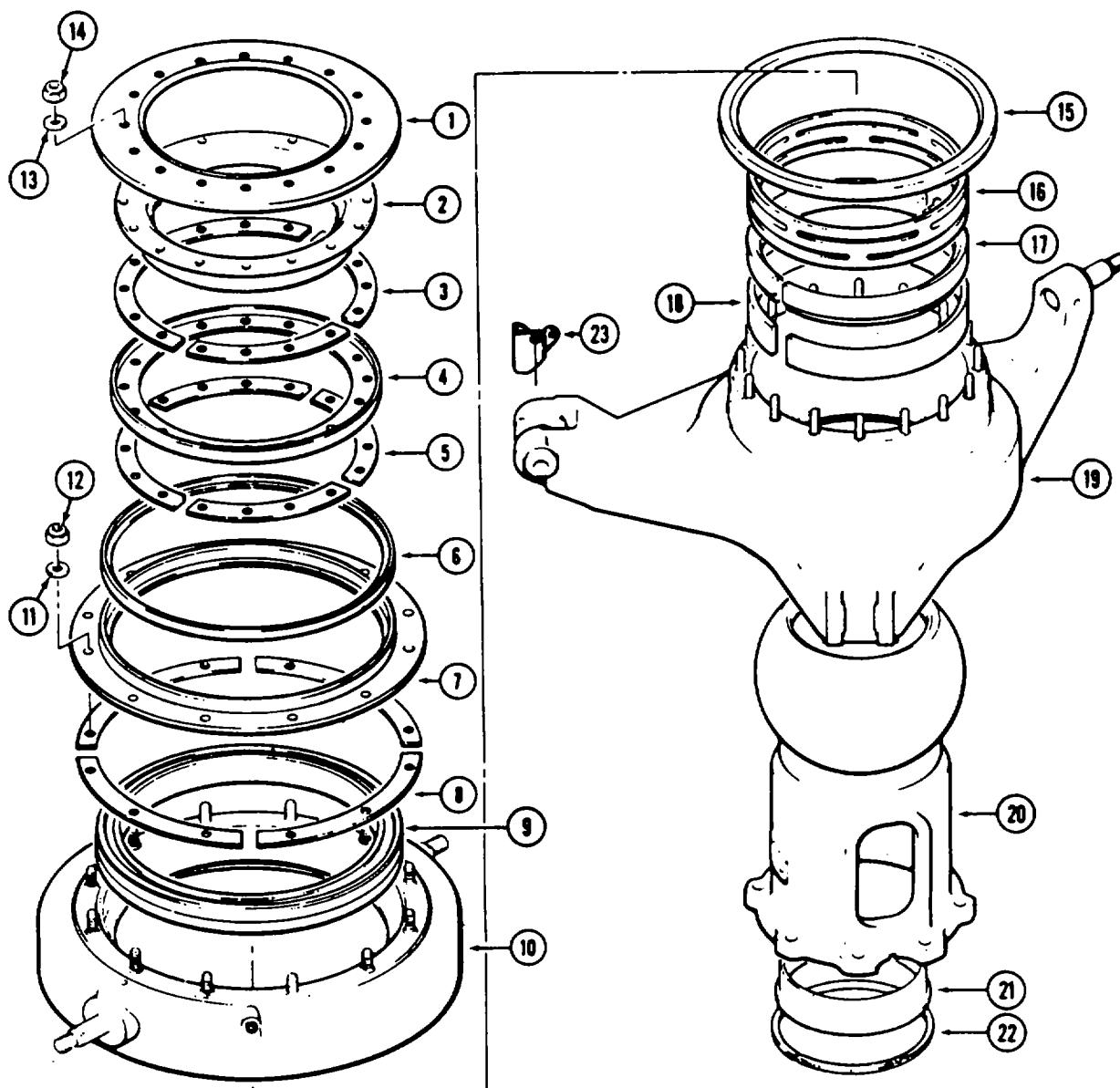
2 Remove shield (1), upper bearing (2) and shims (3). Measure thickness of each section of shim with a micrometer. All four shim sections must be the same thickness.

3 Remove or add one shim laminate to each of the four shim sections (pieces).

CAUTION

Do not apply more than 70 inch-pounds torque to nuts (14) that secure upper bearing and shield (1) for any reason.

4 Recheck shim (3) to be sure all sections (pieces) are the same thickness and install the shim. Ensure that the inner diameter of shim (3)



1. Shield
2. Upper Bearing
3. Shims
4. Inner Cap
5. Shims
6. Upper Seal
7. Outer Cap

8. Shims
9. Thrust Bearing
10. Outer Ring
11. Aluminum Washer
12. Nut
13. Aluminum Washer
14. Nut

15. Lower Seal
16. Spring
17. Lower Bearing Set
18. Spacer Ring
19. Inner Ring Assembly
20. Support Assembly
21. Bearing Bushing
22. Retaining Ring
23. Bracket

209010-83A

Figure 5-48. Swashplate and support assembly

PAGE 5-82A/5-82B DELETED

does not extend over the edge of inner ring (4). Fill gaps between ends of sections of shim (3) with corrosion preventive compound (C52). Install upper bearing (2) and shield (1). Install aluminum washers (13) and nuts (14). Torque nuts evenly 50 TO 70 inch-pounds while rocking ring assembly to ensure seating of bearings.

5 Repeat friction check and if friction is not within limits, disassemble and make additional adjustment of thickness of shims (3).

6 Deleted.

7 Remove wood wedges that were placed under inner ring in step (a).

8 Lubricate thrust bearing through fittings on outer ring (10) with grease (C70).

(e) Install anti-drive link (64, figure 5-40) and drive links (58).

(2) Install hydraulic control cylinders for lateral and fore and aft controls.

c. Lubrication.

Lubricate swashplate and support as shown on lubrication chart in Chapter 1.

d. Removal. See figure 5-40.

CAUTION

Remove swashplate and support carefully to avoid damage to mast.

(1) Remove main rotor hub and blade assembly. Refer to paragraph 5-4.

(2) Remove scissors and sleeve assembly. Refer to paragraph 5-7.

(3) Remove nut (62), special washer (63) and disconnect anti-drive link (64) from rear horn of swashplate.

(4) Disconnect cyclic control cylinder tube and elevator control tube from forward horn of

swashplate.

(5) Disconnect cyclic control cylinder and spring from right control horn.

CAUTION

Do not rotate inner ring unnecessarily while swashplate linkage is disconnected.

(6) Remove bolts (90) and washers (91). Lift swashplate and support off mast. Use caution to avoid damage to mast friction sleeve and mast splines.

(7) Remove cotter pin (68), nut (67), flat washer (92), bolt (65), special washer (66), and remove anti-drive link (64). Remove bolt (78) and remove bellcrank (75). Remove support (79).

e. Inspection.

NOTE

If allowable inspection limits are exceeded, forward swashplate and support to depot maintenance.

(1) Inspect swashplate inner ring horns for wear caused by improperly installed cotter pins in drive link to swashplate attachment bolts. Maximum permissible wear is 0.060 inch.

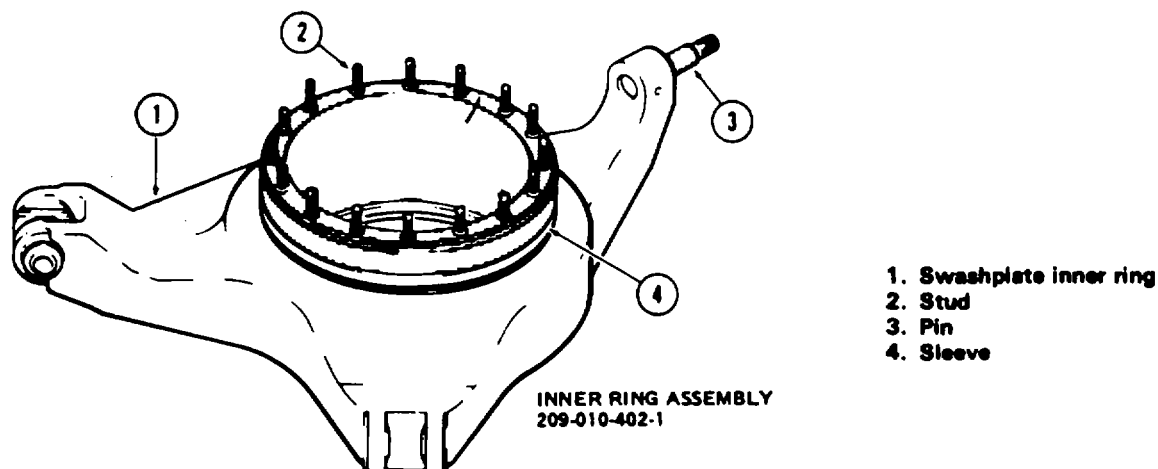
(2) Rotate outer ring and check for binding and roughness of bearings. No binding or roughness is acceptable.

NOTE

Do not disassemble swashplate and support for inspection.

(3) Check visible portions of assembly for nicks, dents and corrosion in accordance with limits shown in figure 5-49 and 5-50 for limits (4).

(4) Check security of pin in aft horn of swashplate inner ring. No noticeable looseness is acceptable.



DAMAGE LOCATION SYMBOLS



TYPE OF DAMAGE	MAXIMUM DEPTH AND REPAIR AREAS ALLOWED	
CRACKS ALLOWED	None	None
NICKS, SCRATCHES, AND SHARP DENTS	0.010	0.040
CORROSION DAMAGE		
Before Repair	0.005	0.020
After Repair	0.010	0.040
MAXIMUM AREA PER FULL DEPTH REPAIR	0.10 Sq. In.	Not Critical
NUMBER OF REPAIRS	Not Critical	Not Critical
EDGE CHAMFER	0.060	0.060
BORE DAMAGE	0.001 for 1/4 Circumference	

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

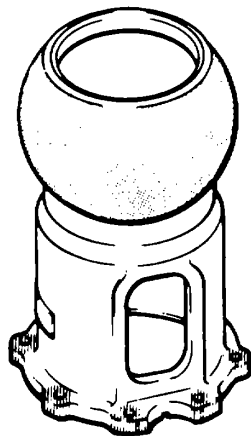
NOTES:

- Pivot bore damage is 0.001 for one-fourth of circumference.
- Thread Damage:

Depth:	One-Third of Thread
Length:	0.25
Number:	One Stud or Pin
- Replace sleeve (4) if seal mating surface is damaged.
- Damage to anti-drive gear by cotter pin may be polished to 0.060 maximum depth.

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Figure 5-49. Damage limits - swashplate and support assembly (Sheet 1 of 3)



SUPPORT ASSEMBLY
209-010-404-1

DAMAGE LOCATION SYMBOLS



TYPE OF DAMAGE	MAXIMUM DEPTH AND REPAIR AREAS ALLOWED		
CRACKS ALLOWED	None	None	None
NICKS, SCRATCHES, AND SHARP DENTS	0.020	This is Hard Anodized Surface	0.040
CORROSION DAMAGE			
Before Repair	0.010		0.020
After Repair	0.020		0.040
MAXIMUM AREA PER FULL DEPTH REPAIR	0.10 Sq. In.	See Note 2 Below	Not Critical
NUMBER OF REPAIRS	One Per Lug		Not Critical
EDGE OF CHAMFER	0.060		0.060

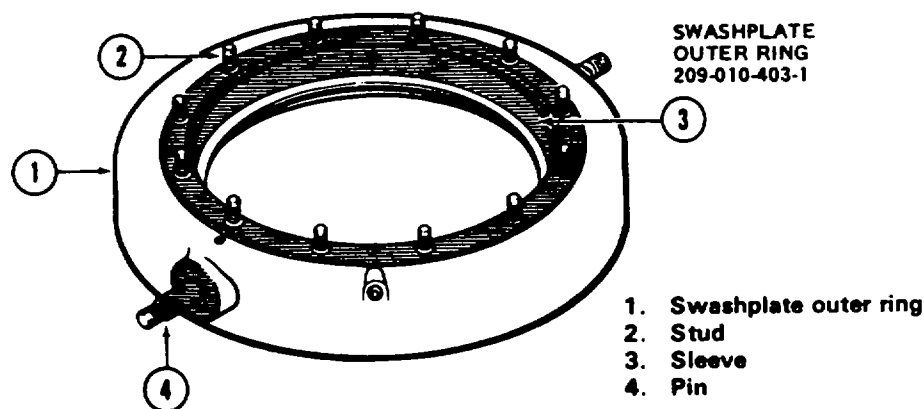
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

NOTES:

1. Mount bolt hole bore damage limit is 0.002 on full circumference.
2. If mechanical or corrosion damage penetrates the hard anodized surface, replace the support. Polish out minor damage that does not penetrate the hard anodized surface as described in the text.

209010-72F

Figure 5-49. Damage limits - swashplate and support assembly (Sheet 2 of 3)



DAMAGE LOCATION SYMBOLS



TYPE OF DAMAGE	MAXIMUM DEPTH AND REPAIR AREAS ALLOWED	
CRACKS ALLOWED	None	None
NICKS, SCRATCHES, AND SHARP DENTS	0.010	0.040
CORROSION DAMAGE		
Before Repair	0.005	0.020
After Repair	0.010	0.040
MAXIMUM AREA PER FULL DEPTH REPAIR	0.10 Sq. In.	Not Critical
NUMBER OF REPAIRS	Not Critical	Not Critical
EDGE CHAMFER	0.060	0.060
THREAD DAMAGE		
Depth	One-Third of Thread	
Length	0.25	
Number	One Per Stud or Pin	

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

209010-74F

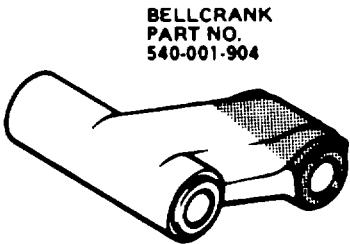
Figure 5-49. Damage limits - swashplate and support assembly (Sheet 3 of 3)



ANTI-DRIVE LINK
P/N 209-010-410-5

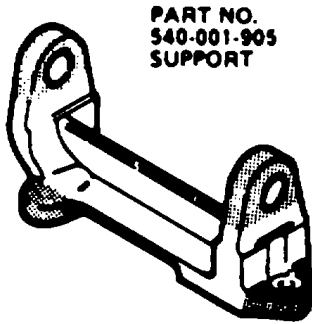
TYPE OF DAMAGE	DAMAGE LOCATION SYMBOLS	
		
MAXIMUM DEPTHS AND REPAIR AREAS ALLOWED		
NICKS, SCRATCHES, SHARP DENTS	0.010 In. Before and After Repair	0.020 In. Before and After Repair
CORROSION	0.005 In. Before Repair 0.010 In. After Repair	0.010 In. Before Repair 0.020 In. After Repair
AREA OF FULL DEPTH REPAIR	0.10 Sq. In.	0.25 Sq. In.
NUMBER OF REPAIR AREAS	One Per Lug	Not Critical
EDGE CHAMFER	0.030 In.	0.060 In.
NO CRACKS ALLOWED		
BORE DAMAGE	0.002 In. Depth for 1 / 4 Circumference	
BUSHING OR BEARING SHELL LOOSENESS	Scrap Link if Bushings or Bearing Shell is Loose in Link.	
BEARING AXIAL PLAY	Maximum Allowable Axial Play in Bearing is 0.015 Inch.	
NOTE		
The spherical bearing wear will be in both the radial and axial directions. However, the only criteria necessary for deter- mining serviceability will be to measure the axial play.		
BEARING BREAKAWAY TORQUE	Maximum Allowable Breakaway Torque is 20 inch-pounds.	

Figure 5-50. Damage limits - swashplate anti-drive link, bellcrank, and support (Sheet 1 of 3)



TYPE OF DAMAGE	DAMAGE LOCATION SYMBOLS	
		
	MAXIMUM DEPTHS AND REPAIR AREAS ALLOWED	
NICKS, SCRATCHES AND DENTS	0.040 In.	0.020 In.
CORROSION	0.020 In.	0.010 In.
MAXIMUM AREA PER FULL DEPTH REPAIR	Not Critical	Not Critical
NUMBER OF REPAIRS	Not Critical	Two
EDGE CHAMFER	0.080 In.	0.040 In.
BORE DAMAGE:	0.002 for 1/4 Circumference.	
NO CRACKS ALLOWED		540001-14B

Figure 5-50. Damage limits - swashplate anti-drive link, bellcrank, and support (Sheet 2 of 3)



TYPE OF DAMAGE	DAMAGE LOCATION SYMBOLS	
		
MAXIMUM DEPTHS AND REPAIR AREAS ALLOWED		
NICKS, DENTS AND SCRATCHES	0.040 in.	0.020 in.
CORROSION	0.020 in.	0.010 in.
MAXIMUM AREA PER FULL DEPTH REPAIR	Not Critical	0.10 Sq. in.
NUMBER OF REPAIRS	Not Critical	One Per Lug
EDGE CHAMFER	0.060 in.	0.040 in.
BORE DAMAGE:	0.002 for 1/4 Circumference.	
NO CRACKS ALLOWED	540001-13B	

Figure 5-50. Damage limits - swashplate anti-drive link, bellcrank, and support (Sheet 3 of 3)

NOTE

If friction check in step 5 below is made with swashplate and support installed on transmission, disconnect drive links, antidrive links, control tubes and spring on inner ring.

(5) Check friction of swashplate to uniball. (Refer to step b.)

(6) Inspect bushings in inner ring at attachment points, and control tubes for looseness, wear and mechanical damage. Maximum allowable wear on bushing inner faces contacted by control tube bearings is 0.060 inch.

(7) Visually inspect swashplate support, inner ring and outer ring for damaged grease fitting, missing or damaged identification plates or other damage in excess of limits shown in figure 5-49.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

(8) Inspect bracket (23, figure 5-48). Replace if loose or missing. Clean mating surface of inner ring (19) with MEK (C87) and wipe dry with a clean cloth. Apply primer (C99) to surface and allow to air dry. Remove protective peel ply from film adhesive on bracket (23). Coat mating surface of bracket (23) with adhesive (C17). Install bracket (23) on inner ring (19) with radius of bracket parallel to edge of inner ring and with holes aligned. Use caution to prevent adhesive squeeze-out from obstructing bolt hole. Maximum allowable wear on bushing inner faces contacted by control tube bearings is **0.060** inch.

f. Repair.

NOTE

Replace swashplate and support if allowable inspection limits are exceeded. Send unserviceable swashplate and support to next higher level of maintenance.

(1) Replace damaged or missing grease fitting.

(2) Replace damaged or missing identification plates (AVIM).

NOTE

If data to be stamped on identification plate and is not available, send affected assembly to Depot Maintenance.

(a) Stamp all data from old identification plate on the new identification plate.

(b) Remove screws and remove old identification plate from support assembly.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

(3) Clean area for identification plate on support assembly with clean cloth saturated with solvent (C124).

CAUTION

Do not overtighten screws.

(4) Position new identification plate on support (20). Place drive screw through identification plate and in hole in support. Drive screw in until identification plate is tight against support.

(5) Remove and replace retaining ring (22 and bearing bushing (21) if damaged.

g. Installation.

NOTE

If swashplate and support assembly is new, lubricate in accordance with Figure 1-2, item 7, prior to installation.

**Figure 5-51 deleted.
Pages 5-91 and 5-92 deleted.**

(1) Install swashplate and support as follows:

(a) Install support assembly (79, figure 5-40) on transmission.

(b) Install bellcrank (75) on support (79) with bolt (78) and nut (80). Torque nut **190 TO 210** inch-pounds and install cotter pin.

(c) Install anti-drive link (64) on bellcrank with bolt (65), washer (66), (92), and nut (67). Torque nut **190 TO 210** inch-pounds and install cotter pin.

NOTE

The raised letters "AFT" identify the rear side of the anti-drive link, and must be positioned toward rear of helicopter.

(d) Lower swashplate and support assembly over mast on to top of transmission. Avoid damage to mast splines.

(e) Align holes in swashplate support with holes in transmission cap. Install bolts (90) with washers (91) and torque **200 TO 250** inch-pounds. Lockwire bolt heads in pairs.

(f) Turn swashplate inner ring to align stud with anti-drive link (64). Position link on stud and install special washer (63) with marked surface facing aft. Install nut (62) and torque **480 TO 690** inch-pounds. Install cotter pin.

(2) Connect lateral control tube to left horn of swashplate inner ring.

(3) Connect fore-and-aft hydraulic cylinder control tube, elevator control tube, and spring to right horn of swashplate.

(4) Position lower boot (60, figure 5-40) loosely on swashplate.

(5) Install scissors and sleeve assembly (paragraph 5-7).

5-9. Pitch Link Assembly.

The pitch links (14, figure 5-1) are attached to the main rotor hub pitch horns (17) and to the scissors and sleeve assembly (16).

a. Removal.

(1) Prior to accomplishment of MWO 55-1520-244-50-9, remove lockwire from bolt (20). Remove bolt (20) and washer (19). Disconnect pitch links (14) from rotor hub pitch horns.

(1A) After accomplishment of MWO 55-1520-244-50-9, remove lockwire from bolt (20). Remove bolt (20) and bushing assembly (19A, view A, figure 5-1). Disconnect pitch link (14) from pitch horn (17).

(2) Remove cotter pin (27), nut (26), washer (25) and bolts (24) at lower end of pitch links. Remove pitch links (14) from scissors and sleeve assembly (16).

(3) Repeat steps a(1) or a(1a) through a(3) to remove opposite pitch link (14).

(4) When maintenance requires removal of universal bearing (23) proceed as follows. Remove cotter pin (32), nut (31), recessed washers (29 and 30) and bolt (28). Remove universal bearing (23) from scissor and sleeve assembly (16).

b. *Inspection.* Inspect pitch links (14, figure 5-1) for damage such as metal to metal contact on upper bearing housing, normal bearing wear, surface wear and straightness of tube assembly. All damage limits are given in figures 5-52 and 5-52A.

(1) When inspecting ends of pitch tube remove the first three inches of paint and primer

material from contacting the metal set material. Mask the center of the tube length so that only the top and bottom three inches of the tube are exposed.

NOTE

The success and reliability of penetrant inspection depends upon the thoroughness with which inspector prepares the part from the process all the way through to the final interpretation of the indications. All inspections should be with the fluorescent penetrant (Type I, Method C) in strict accordance with TM 43-0103.

WARNING

Prolonged or repeated inhalation of vapors or powders may result in irritation of the mucous membrane areas of the body. Provide adequate ventilation.

WARNING

Continual exposure to penetrant inspection materials may cause skin irritation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

WARNING

Injury to eyes and skin may occur when blacklight is not used in accordance with manufacturer's instructions. Unfiltered light sources (if filter is required) may possibly damage the eyes.

WARNING

Temperatures in excess of 120 degree F may cause bursting of pressurized cans and injury to personnel.

WARNING

Volatile fumes may occur, creating both a fire and health hazard.

NOTE

Paint will not be removed by any mechanical means under any circumstances because it may mask over any potential surface cracks.

(2) With a soft hair brush, apply MEK (Methyl-Ethyl-Ketone (C87)) or paint remover and

remove the paint.

NOTE

The gold colored finish on the metal is a very thin chemcoat metal primer. This material is not, repeat not to be removed.

(3) Clean the prepared surfaces with a soft cloth.

(4) Apply a fluorescent dye penetrant to the prepared surfaces from either a spray can or with a soft hair brush and in strict conformance to the procedure specified in TM 43-0103, Chapter 6.

(5) Allow penetrant to dwell for a minimum of 30 minutes.

(6) Clean off all excess penetrant in accordance with TM 43-0103 standard procedures. (Check for complete excess penetrant removal from surface by using a blacklight.)

(7) Apply applicable developer consistent with Type I, Method C penetrant method in TM 43-0103.

(8) Inspect suspected area with blacklight source in subdued white light.

NOTE

Normal manufacturing machining marks may be observed on the tube surfaces. These will not be cause of part rejection.

(9) If any apparent cracks appear (or suspect surface defects), the suspect area must be reevaluated utilizing certified NDI personnel with the Eddy Current method per TM 43-0103, Chapter 3. (Tube material is 2024 aluminum.)

NOTE

If a physical or penetrant crack is observed and confirmed, report failures or QDR Form 368 in accordance with TM38-750 and hold tube as an exhibit.

(10) Clean tube with solvent and wipe dry.

(11) Inspecting for straightness is done by doing a Total Inline Runout (TIR).

(12) Deleted.

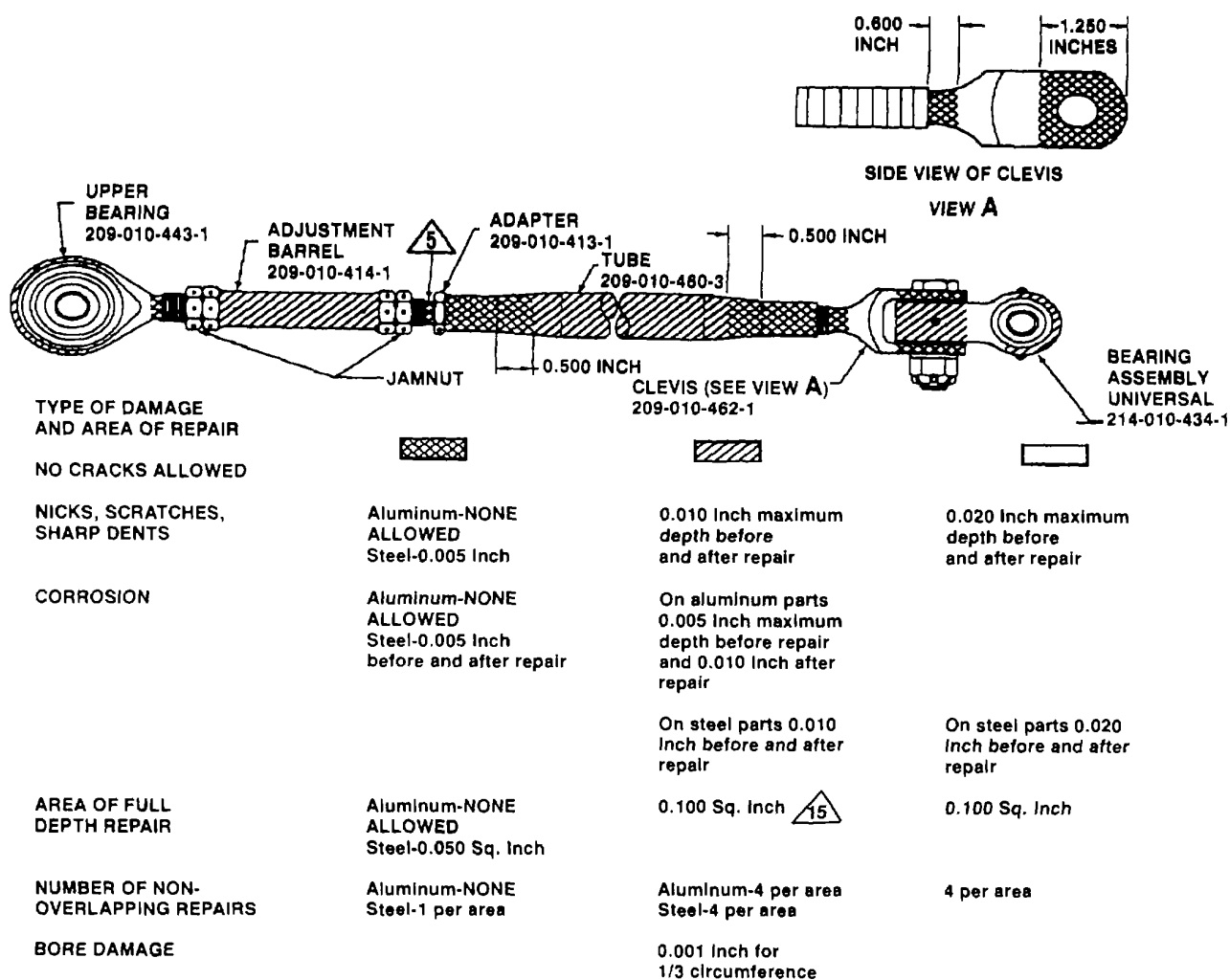
(13) Set up bearing blocks for pitch tube so that the edges of tube are resting between roller bearings.

(14) Set up indicator within a 1/4-inch from the edge of the larger diameter of the pitch tube. Dial indicator must not contact necked down area.

(15) Rotate pitch tube to find highest and lowest reading and zero dial at that position.

(16) Rotate pitch tube and record the total bend. Maximum allowed TIR is 0.020 inch; tubes in excess of 0.020 inch shall be reported and held as an exhibit.

(17) Repaint areas to original color (C80) of tube.



209010-105-1B

Figure 5-52. Damage limits-pitch link assembly
(prior to accomplishment of MWO 55-11520-244-50-9) (Sheet 1 of 2)

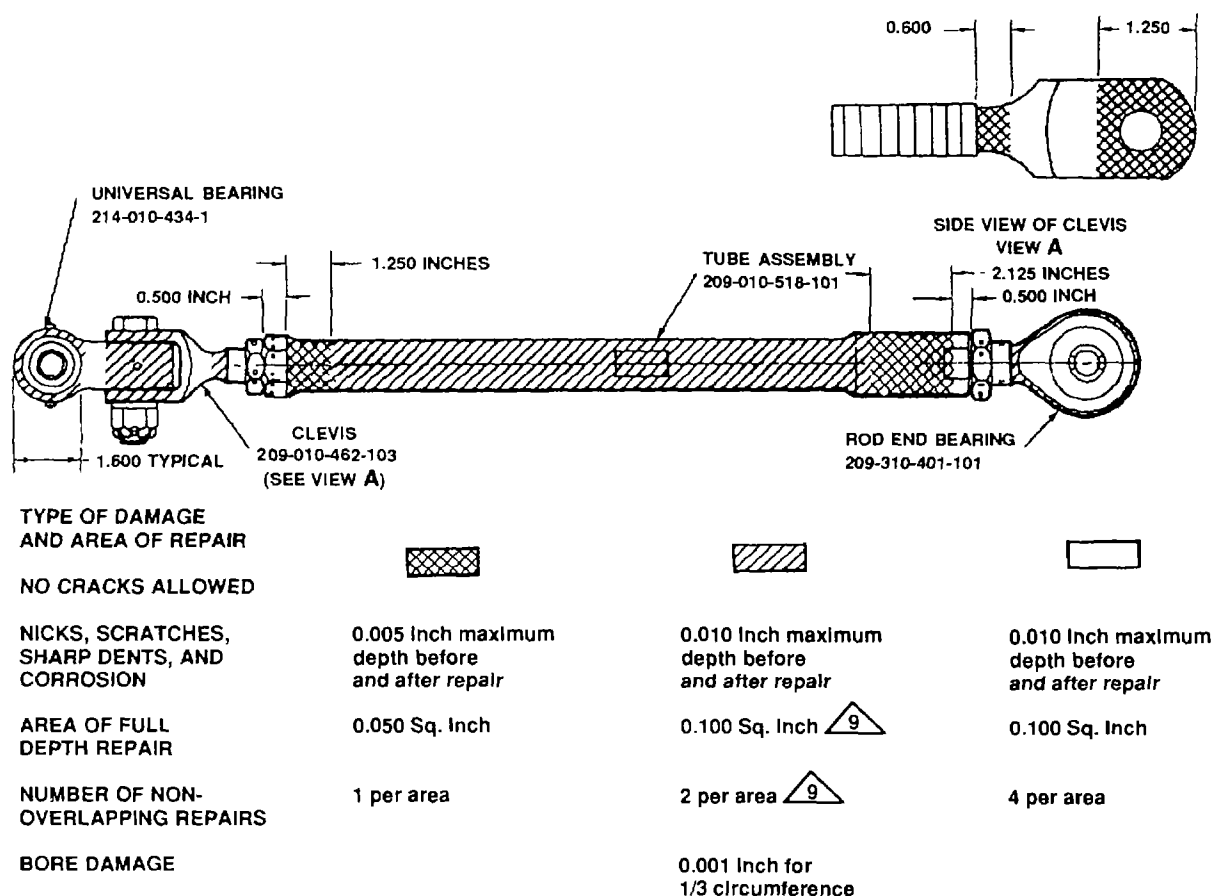
NOTES:

1. All edges may be radiused or chamfered 0.030 inch to remove nicks or dents.
2. Repair of nicks and dents on threads must not exceed one-third of the thread depth. Length of repair shall not exceed 0.250 inch. Each threaded segment may have two repair areas.
3. Coat repair areas on steel parts with brush cadmium or zinc chromate and aluminum parts with zinc chromate. Do not use zinc chromate on threads.
4. Corrosion must be cleaned up to twice the depth of damage on aluminum. Corrosion must be cleaned up to remove all traces of damage on steel.

5. Minimum radius of repair on adapter is 0.100 inch. The repair must be polished to match the surrounding surfaces.
6. Maximum play in bearing Part No. 209-010-443-1 is 0.020 inch axial or radial.
7. Maximum play in bearings in universal Part No. 214-010-434-1 is 0.010 inch axial or radial.
8. Do not remove adapter or clevis from tube.
9. Visual irregularities caused by swaging operation at each end considered acceptable provided there are no sharp ridges or grooves.
10. Visually inspect tubes for any indications of bending. No bending allowed.
11. Do not change color of tube when repainting or touching-up.
12. Every 150 hours at phase inspection, inspect control tubes of TIR. No more than 0.020 inch is allowed at one inch from each end of control tube.
13. Repaired areas may not overlap.
14. No cracks allowed.
15. Width of repairs to the 209-010-460-3 tube cannot exceed 1/3 of the tube circumference.

209010-105-2B

**Figure 5-52. Damage limits-pitch link assembly
(Prior to accomplishment of MWO 55-1520-244-50-9) (Sheet 2 of 2)**

**NOTES:**

1. All edges may be radiused or chamfered 0.030 inch to remove nicks or dents.
2. Repair of nicks and dents on threads must not exceed one-third of the thread depth. Length of repair shall not exceed 0.250 inch. Each threaded segment may have two repair areas.
3. Coat repair areas on steel parts with brush cadmium or zinc chromate and aluminum parts with zinc chromate. Do not use zinc chromate on threads.
4. Corrosion must be cleaned up to remove all traces of damage on steel.
5. Minimum radius of repair on adapter is 0.100 inch. The repair must be polished to match the surrounding surfaces.
6. Maximum play in bearing in universal Part No. 214-310-401-101 is 0.020 inch axial or radial.
7. Maximum play in bearings in universal Part No. 214-010-434-1 is 0.010 inch axial or radial.
8. Do not change color of tube when repainting or touching-up.
9. Width of repairs to 209-010-518-101 tube cannot exceed 1/3 or tube circumference. Four repairs are allowed on 209-010-518-101 tube in this area.
10. Repairs may not overlap.

Figure 5-52A. Damage limits-pitch link assembly
(After accomplishment of MWO 55-1520-224-50-9)
 Change 71 5-94D

- c. *Repair.*
- (1) Polish out corrosion and mechanical damage that is within limits and touch up repair areas in accordance with figures 5-52 and 5-52A.
- (2) Replace bearings if worn beyond limits shown on figures 5-52 and 5-52A.

- d. *Adjustment.*
- Adjust both pitch links to length between centers of bearings as shown on figure 5-6.
- e. *Installation.*
- Refer to paragraph 54.

Section II. TAIL ROTOR SYSTEM

5-10. Tail Rotor System.

The tail rotor system consists of the tail rotor hub and blade assembly and the tail rotor controls installed on the tail rotor gear box with the tail rotor.

5-11. Troubleshooting and Tracking Check-Tail Rotor System.

Premaintenance Requirements for Troubleshooting and Tracking Check of Tail Rotor System

Special Tools	NA
Condition	Requirements
Test Equipment	Tracking stick
Support Equipment	NA
Minimum Personnel Required	Two men
Consumable Materials	(C103)
Special Environmental Condition	None

Condition	Requirements
Model	AH-1S
Part No. or Serial No.	All

a. *Troubleshooting.*

Troubleshoot the tail rotor system in accordance with table 5-2. Refer to step b for tracking instructions.

Table 5-2. Troubleshooting-Tail Rotor System

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. High Frequency Vibration.
- STEP 1. Check tail rotor track.
- Adjust pitch link to bring tail rotor in track. (Refer to paragraph 5-11.b.)
- STEP 2. Tail rotor out of balance.
- Remove tail rotor and balance. (Refer to paragraph 5-12a. and b.)

Table 5-2. Troubleshooting - Tail Rotor System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

STEP 3. Check for worn or loose trunnion bearings. (Refer to paragraph 5-14c.)

Replace trunnion bearings. (Refer to paragraph 5-14d.)

STEP 4. Check for loose or worn blade retention bearings. (Refer to paragraph 5-14c.)

Replace blade retention bearings. (Refer to paragraph 5-14d.)

STEP 5. Cracked or loose tail rotor hub retaining nut.

Inspect and retorque nut. (Refer to paragraph 5-12c.)

STEP 6. Check for unserviceable pitch change links.

(Refer to paragraph 5-15d.)

STEP 7. Check for worn or loose pitch change link bearings. (Refer to paragraph 5-15d.)

Replace pitch change link. (Refer to paragraph 5-15f.)

STEP 8. Check for worn or loose pitch change crosshead bearing.

Replace pitch change bearing. (Refer to paragraph 5-15d.)

STEP 9. Check for loose or improperly torqued bipod and tripod engine mounts. Refer to paragraph 2-44a.)

Torque bipod and tripod engine mount bolts. (Refer to paragraph 2-44d.)

STEP 10. Check for loose mounting bolts on intermediate and tail rotor gearboxes.

Torque mounting bolts. (Refer to paragraphs 6-25e and 6-27f.)

STEP II. Check for elongated mounting bolt holes for intermediate and tail rotor gearboxes. (Refer to paragraph 6-25c and 6-27c for limits for tail rotor gearbox mounting bolt holes in support fitting.) (Refer to paragraph 6-25c and 6-27c for limits for intermediate gearbox mounting bolt holes.)

2. Inability to make normal right or left turn in flight.

STEP 1. Not applicable.

Check tail rotor rigging. Refer to paragraph 11-13a for rigging check. Return to paragraph 5-11b for tracking instructions.

b. Tracking Check.

Following replacement or installation of the tail rotor hub, blades or pitch change systems, check the tail rotor system rigging and track the tail rotor blades.

(1) Make a tracking stick by attaching a small piece of sponge rubber 1/8 to 1/4 inch thick to end of a 1/2 x 1/2 inch pine stick or any other flexible device. Coat sponge rubber with Prussion blue (C103) or similar type of coloring thinned with oil.

NOTE

The runup shall be performed by personnel authorized in accordance with AR95-1.

WARNING

Do not approach the tail rotor area for the purpose of tracking until 6600 rpm has been established and it is certain that the aircraft is not going to yaw left or right due to rigging error or slippery parking surface. Severe injury or death could result from being struck by the tail rotor blades.

(2) Start engine. Run at 100% with pedals in neutral position. Rest tracking stick on underside of tail fin assembly as shown on figure 5-53. Slowly move tracking stick toward disc of tail rotor just far enough to lightly contact a blade approximately one inch from tip. Pull stick back immediately.

(3) After contact is made, stop engine and allow rotor to stop. Shorten pitch link of unmarked blade 1/2 turn of rod end. Reinstall pitch link bolt, washers and cotter pin.

(4) Recheck track of blades. Proceed with adjustments if required by adjusting pitch links equally in opposite directions.

(5) Make operational test flight and check that normal right and left turn can be made in autorotational and powered flight.

(6) Check tail rotor forces as follows:

(a) Start engine and run at 6600 rpm, with pedals in neutral position.

(b) Turn force trim-OFF. Place HYD control switch to SYS 2-ON, so tail rotor hydraulic cylinder is not powered. Observe for pedals remaining at neutral when foot pressure is removed.

(c) If left pedal creeps forward less weight is needed on tail rotor counterweight.

(d) If right pedal creeps forward more weight is needed on tail rotor counterweight.

(e) Move HYDR switch to ON position and shut down engine.

CAUTION

Identical weight must be maintained at all four positions on bellcrank (P/N 212-010-709-1). Use a maximum of two weights (P/N 212-010-710-1) and one washer (P/NAN960-416) or a minimum of one weight and five washers.

(7) Adjust tail rotor forces as follows (see figure 5-67):

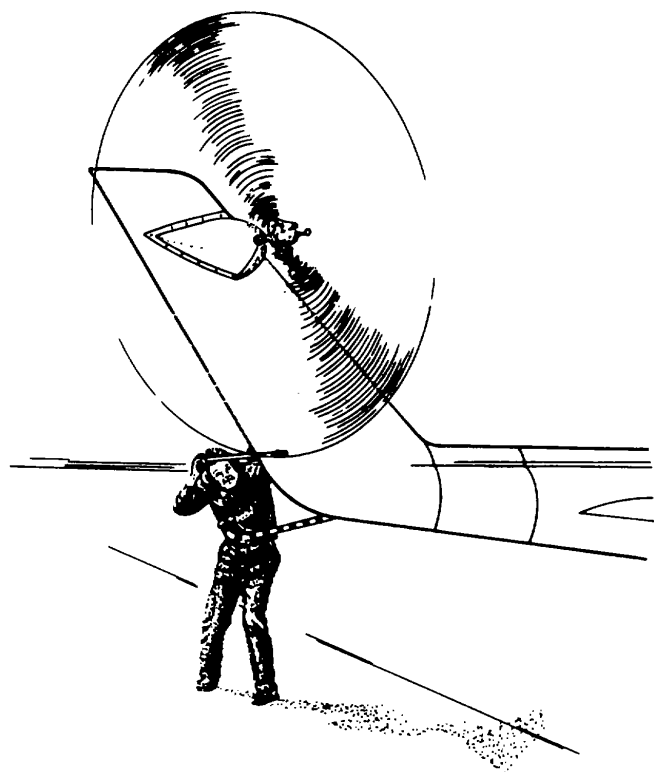
(a) Remove nut (P/N MS21042L4) and washer (P/N AN960-416) from bolt (P/N AN4-10A).

(b) Add or remove weight as determined in steps (6)(c) or (6)(d). Remove only one weight at each position. Replace with AN960 or AN970 washers, or a combination of both types.

(c) Install washer and nut on bolt. Torque nut 50 to 70 inch-pounds.

(d) Repeat steps (6) and (7) until forces are satisfactory.

(e) Track tail rotor blades. Tail rotors with pitch link measurements as stated in paragraph 5-15.f.(4) do not require tracking.



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Figure 5-53. Tracking tall rotor

5-12. Tail Rotor Hub and Blade Assembly.

The tail rotor hub and blade assembly counteracts torque of the main rotor and provides directional control. It consists of the hub and two blades. The hub assembly has a preconed, flex-beamed-type yoke and a two-piece, delta-hinged trunnion to rotor flapping. The trunnion is splined to the tail rotor gear box shaft and drives the rotor. The yoke has two self-lubricated; spherical bearings for attaching points for each- rotor blade. Rotor pitch change is accomplished at these bearings. The blades are all metal bonded assemblies with a stainless steel spar and honeycomb core. A system of counterweights is attached to the pitch control system to balance control forces and assist in controlling blade pitch. Pre-maintenance Requirements for Tail Rotor Hub and Blade Assembly

Condition	Requirements
Model	AH-IS
Part No. or Serial No.	212-010-701-11
Special Tools	(T1) (T79) (T82) (T83)
Test Equipment	NA
Support Equipment	NA
Minimum Personnel Required	1
Consumable Materials (C151)	(C51) (C70) (C124)
Special Environmental Condition	None

a. *Removal.* See figure 5-54.

(1) If the rotor and controls are to be reinstalled, check color code dots and, if missing,

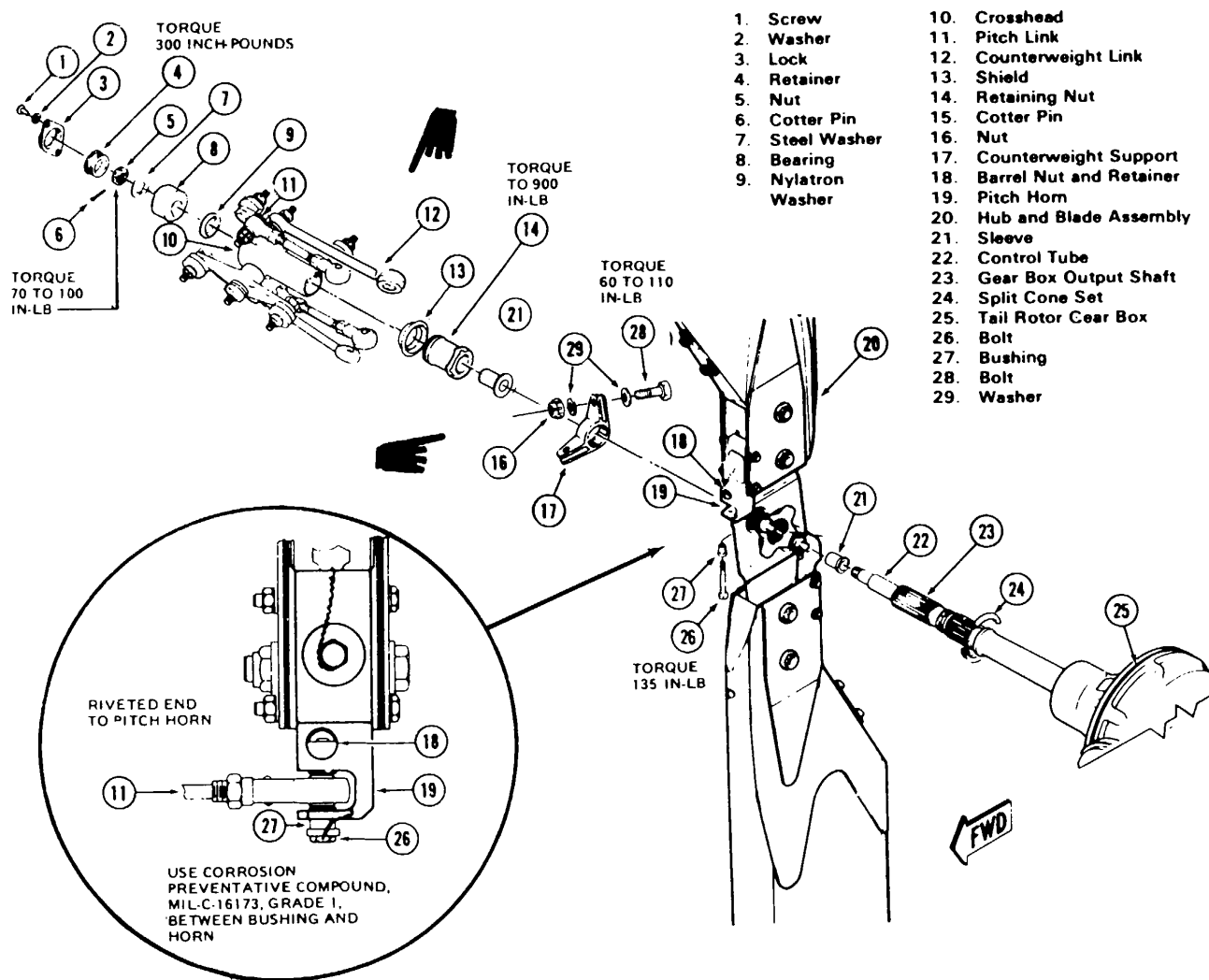


Figure 5-54. Tail rotor installation

re apply color code so that parts can be reinstalled in the same relative position.

(2) Remove bolts and separate both counterweight links (12) from counterweight support (17).

(3) Remove lockwire, screws (1), washer (2), lock (3) and retainer (4) from crosshead (10).

(4) Push right pedal forward against stop and remove cotter pin (6), nut (5) and washer (7) from end of pitch change control tube (21).

(5) Grip both tail rotor blades firmly with hands and twist blades to disengage bearing (8) from control tube (22). Remove nylatron washer (9) from crosshead.

NOTE

If outer race of bearing (8) separates from inner race, reprove inner race as outlined in step (6) and scrap bearing.

(6) Push left pedal forward against stop and place 11/16 wrench between inner race of bearing (8) and crosshead (10). Push right pedal to disengage inner race from control tube (22).

(7) Disconnect pitch links (11) from each tail rotor blade pitch horn (19) by removing lockwire and bolt (26). If same tail rotor is to be reinstalled, secure bushing (27) and barrel nut and retainer (18) in place with bolt (26). If tail rotor is being replaced, remove bushing (27) and barrel nut and retainer (18).

(8) Remove crosshead assembly (10) from gearbox output shaft (23).

(9) Cut lockwire and remove shield (13) and retaining nut (14) as an assembly using spanner wrench (T1). Remove counterweight support (17).

(10) Move hub and blade assembly (20) outboard on splines and remove split cone set (24) as it is released. Remove hub and blade assembly from gearbox and place on a rack to prevent damage to blades.

NOTE

Sleeve (21) normally remains on control tube (22) unless the sleeve or control is to be replaced. If sleeve is to be replaced, pull sleeve outboard to engage threads and turn until disengaged.

b. Balancing.

NOTE

The special tools required to balance the tail rotor hub and blade assembly are contained in the special tool kits listed in the premaintenance requirements list preceding step a.

The specific tools from these kits that are required for the balancing procedure are illustrated in figures 5-37 and 5-55. The tools are identified in the legend by part number and/or by the number of the kit which contains that particular tool.

NOTE

The area used for balancing must be a room which can be closed off to provide a draft free environment.

(1) Assemble parts of rotor balancing kit (T79) that are shown on the right side of figure 5-37 except do not install balancing arbor (23). Use arbor (6, figure 5-55) to balance this tail rotor.

(2) Install fixture (2, figure 5-55) on lower end of arbor (6) and tighten the two lower set screws (10). There are a total of four set screws in fixture (2). Do not tighten the two upper set screws (10).

NOTE

Prior to installing post assemblies (15), adjust movable index pin (8) of the positioning post to a dimension of 1.765 inch. (Length "L" in view "B".) Tighten the locking set screw in index pin (8), using 3/32 inch hex wrench to maintain proper setting. (1.765 inch will achieve a zero degree pitch in the tail rotor blades.)

(3) Install two post assemblies (15, figure 5-55) in the outboard holes in fixture (2). These holes are designated "A" on detail view A. Thread the posts into the fitting to full thread depth and tighten finger tight.

(4) Place the arbor and fixture on a work bench with the arbor vertical. Install pilot bushing (4, figure 5-55) on arbor with larger diameter end down as illustrated.

(5) Place the tail rotor hub and blade assembly on the arbor with the data plate side of the rotor yoke (3, figure 5-55) facing up.

(6) Install a floating bushing (9) in each pitch horn (16) if not previously accomplished. Rotate the rotor on the arbor until indexing pins (8) are fully seated with the set screw side of index pin in the floating bushings and the floating bushing are fully seated in the pitch horn.

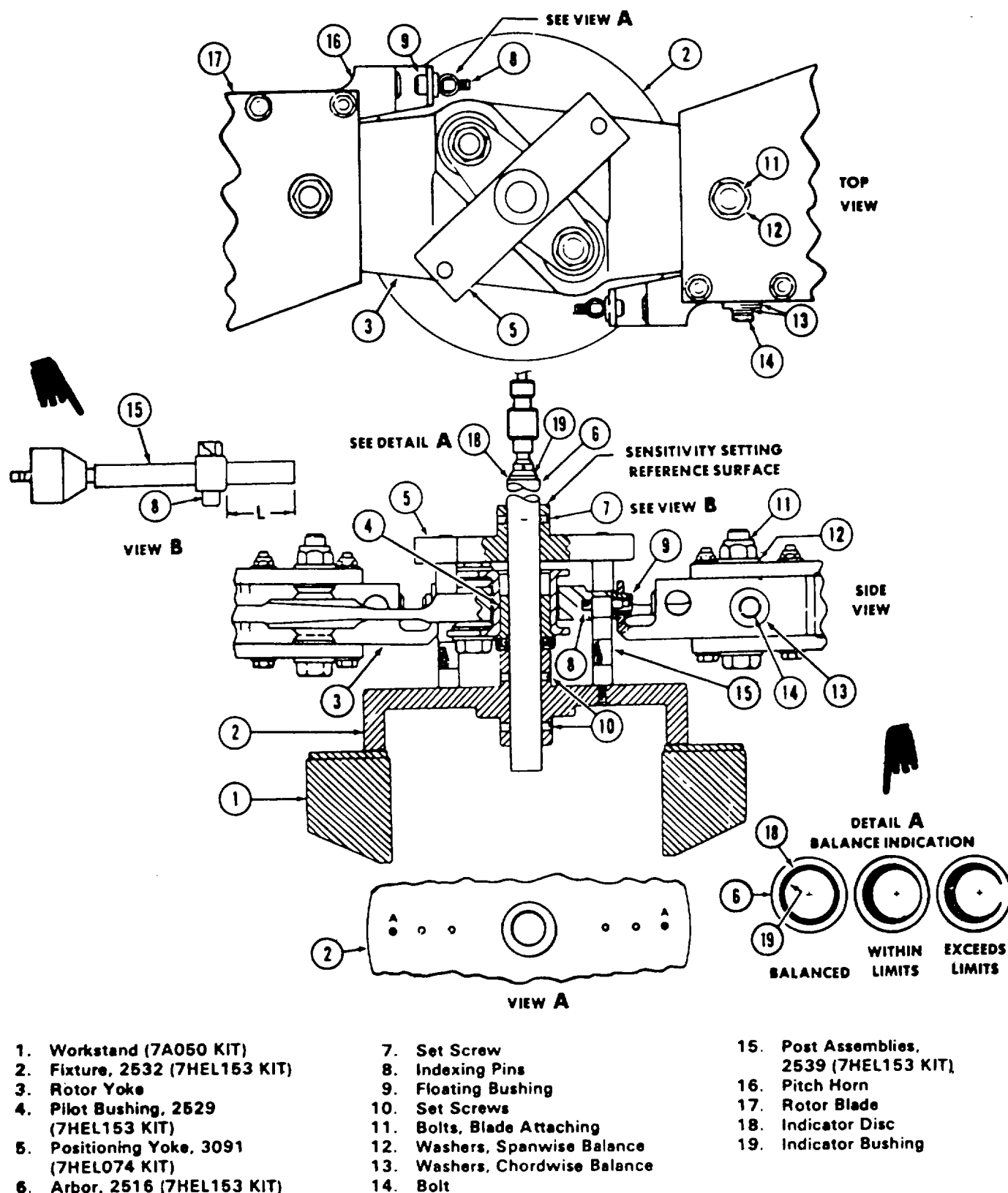


Figure 5-55. Tool Application - Tail Rotor Hub and Plate Assembly Balancing

(7) Install positioning yoke (5, figure 5-55) on arbor in same relative position to rotor yoke as illustrated in "top view". Locate the 6-3/8 inch mark on the scale marked on arbor (6). Align the upper surface of the positioning yoke, which is identified on figure 5-55 the "Sensitivity Setting Reference Surface", with the 6-3/8 inch mark on the scale. Tighten two set screws (7) to secure the positioning yoke to the arbor.

(8) Move the tail rotor assembly and balancing tools to the stand that was assembled in step (1). Attach arbor (6, figure 5-55) to the stand with cable P/N 2264, (13, figure 5-37) and quick disconnect coupling P/N 2266 (10). Operate hydraulic pump (15) to take up slack in cable.

(9) Loosen two lower set screws (10, figure 5-55). The two upper set screws should already be loose as directed in step (2). This will allow fixture (2) to slide down and contact workstand (1). Open the hydraulic pump valve to lower the arbor and rotor assembly until these parts are resting on fixture (2). Ensure that all the following conditions are met, and then tighten two lower set screws (10).

(a) Fixture (2) must be seated firmly on workstand (1).

(b) Pilot bushing (4) must be seated firmly on fixture (2).

(c) The rotor yoke (3) must be seated firmly on pilot bushing (4).

(d) The pitch horns (16), floating bushings (9) and indexing pins (8) must be fully engaged.

(e) The positioning yoke (5) must be oriented with the rotor yoke as shown on the "top view". The legs of positioning yoke (5) must contact a flat surface of the rotor yoke.

(10) Operate hydraulic pump (15, figure 5-37) to raise the assembly approximately 1/4 inch above stand table, close doors and windows, stop fans, etc., to make the area draft free. Allow the rotor to stabilize and observe the balance indication on the black disc. See figure 5-39. Record the indication and correct imbalance as outlined in steps (11) and (12).

(11) Correct chordwise imbalance by adding special washers (18, figure 5-56) and steel washers (17). Comply with the following limitations.

(a) Use any combination of special

washer (18) P/N AN970-4 and steel washers (17) P/N AN960-416, but only a maximum of ten washers can be used on one bolt.

(b) Use a bolt (16) of proper length to accommodate washers. Minimum length bolt is P/N AN4H-4A. Maximum length bolt is P/N AN4H-10A.

(c) At least one washer (17) or (18) must be used if a bolt (16) is installed.

(d) After chordwise balance is attained, lower the assembly until it rests on stand. Torque bolts (16) **50 TO 70** inch-pounds. Do not lockwire at this time.

(12) Correct spanwise imbalance by adjusting special washers (2, 3, 11, and 12, figure 5-56) and steel washers (4 and 11). Operate hydraulic pump on stand to raise the rotor assembly approximately 1/4 inch above stand table. Comply with the following limitations:

(a) When adding washers to balance the rotor assembly spanwise, leave special washers (2, 26, 19, and 13) P/N 140-007-33-32C4 next to blade. Assemble the washers listed in step (b) with the heaviest washers next to washers (2, 26, 19 and 13).

(b) Use combinations of special washers (3 and 12) P/N AN970-8, steel washers (4 and 11) P/N AN960-816 and thin steel washers P/N AN960-816L (not illustrated) as required to balance the assembly.

(c) Use bolts (20) and (25) of the proper length to accommodate washers. Minimum length bolt is P/N NAS 1308-34. Maximum length bolt is P/N NAS 1308-36.

(d) After spanwise balance is attained, recheck chordwise balance and then lower the rotor assembly until it rests on the stand. Torque nuts (5 and 10) and corresponding nuts on opposite blade to **500** inch-pounds.

(e) Lockwire two bolts (S)(16) to hole in pitch horn with lockwire (C 151).

(13) Remove tail rotor assembly from balancing tools as follows:

(a) Disconnect arbor (6, figure 5-55) from stand

(b) Remove the tail rotor assembly and arbor from the stand and place on a work bench.

(c) Loosen two set screws (7, figure 5-55) and remove positioning yoke (5) from arbor (6).

(d) Rotate tail rotor assembly to disengage indexing pins (8, figure 5-55) from pitch horns and remove tail rotor assembly from arbor (6). Secure floating bushings (9) to pitch horns.

(e) Disassemble pilot bushing (4), arbor (6), post assemblies (15) and fixture (2).
c. *Installation.* See figure 5-54.

(1) Position hub and blade assembly (20) on gearbox output shaft (23) with data plate side of hub outboard and trunnion flap stops inboard. Align master tooth of trunnion with master spline of gearbox output shaft and slide hub and blade assembly on shaft until trunnion is just started on second set of splines.

(2) Place split cone set (24), with bevel outboard, in groove between splines and shoulder on gearbox output shaft. Ensure that split cone end gaps are equal and slide hub and blade assembly inboard to seat trunnion on split cone set.

(3) Install counterweight support (17) on gearbox output shaft and seat against hub. Install retaining nut (14) and shield (13) as an assembly. Hold rotor at hub, rotate counterweight support (17) as far clockwise as possible and hold in position. Torque retaining nut (14) to **900** inch-pounds with spanner wrench (T1). Make final check to ensure that split cone set (24) is properly **seated and end gaps equally spaced.** **Lockwire retaining nut (14) to counterweight support with** lockwire (C151). Prior to installation, inspect split cones for any nicks, scratches, indentations or any type deformities in the cones. If damaged, replace.

NOTE

Install split cones as matched set only.

Spacing between split cone sets may vary after operation. This variation of spacing does not adversely affect the assembly.

(4) Install control tube (22) and sleeve (21) if **not** previously accomplished. Refer to paragraph 5-14.

(5) Assemble crosshead and controls if not previous accomplished. Refer to paragraph 5-14.

WARNING

Use solvent in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

(6) Wash bearing (8) and cavity of retainer (4) with solvent (C124) and allow to air dry.

(7) Handpack bearing (8), fill cavity of retainer (4) and lubricate spline surfaces of crosshead (10) with grease (C70).

WARNING

Ensure that cotterpin (6) is properly installed during the following step. After installation of retainer (4) it will not be possible to inspect cotter pin.

(8) Place nyatron washer (9) and bearing (8) in outboard end of crosshead (10). Align master splines and position crosshead assembly on gear box output shaft. Install steel washer (7) and new nut (5) on end of control tube (22). Ensure that nyatron washer (9) is properly seated. Torque nut **70 TO 100** inch-pounds and install cotter pin.

NOTE

Do not intermix counterweight links P/N 212-010-711-1 and -3.

(9) Connect counterweight link (12) to counterweight support (17) with bolt (28) two washers (29) and nut (16). Torque nut **60 TO 110** inch-pounds and install cotter pin (15). Install opposite link in same manner.

(10) Coat mating surface of both bushings (27) and pitch horns (19) with compound (C51).

(11) Position barrel nut and retainer (18) in hole in pitch horn (19). Position pitch link (11) in pitch horn (19) and install bolt (26) and bushing (27) with flange next to bolt head. Torque bolt to 136 inch-pounds and lockwire bolt to pitch horn with (C151) lockwire. Install opposite pitch link in same manner. Check both bushings (27) to ensure that bushing flanges do not seat against pitch horn (19).

WARNING

Ensure that cotter pin (6) is correctly installed prior to installation of retainer (4).

(12) Install retainer (4) on crosshead (10) and torque retainer to **300** inch-pounds.

WARNING

Ensure that lock (3) is properly installed to secure retainer (4) to crosshead (10). Failure to comply can result in loss of directional control.

(13) Install lock (3) on crosshead with two washers (2) and two screws (1). Lockwire (C151) screws and deform lock (3) into notches of retainer (4) in two places near screws (1).

(14) Lubricate grease fitting in end of retainer (4) with two shots of grease (C70).

(15) Perform rigging check. Refer to Chapter 11.

(16) Perform tracking checks. Refer to paragraph 5-11.

5-13. Tail Rotor Blade Assembly.

a. Description.

The tail rotor blade is of all-metal, bonded construction. Upper and lower aluminum alloy skins are bonded to an aluminum honeycomb core. Externally attached balance weights and balance screws inside the blade tip facilitate blade balancing.

Premaintenance requirements for tail rotor blade assembly.

Condition	Requirements
Model	AH-1S
Part No. or Serial No	212-010-750-13
Special Tools	None
Test Equipment	None
Support Equipment	Paint spray equipment
Minimum Personnel Required	One
Consumable Material	(C3) (C7) (C 1) (C12) (C17) (C23) (C24) (C37) (C39) (C41) (C53) (C76) (C77) (C87) (C88) (C100) (C112) (C123) (C124) (C128)
Special Environmental Condition	NA

b. Removal. See figure 556.

(1) Remove tail rotor, hub and blade

assembly from helicopter (paragraph 5-12). Place the tail rotor assembly on a padded bench or similar work area to prevent damage.

NOTE

The tail rotor hub and blade assembly must be rebalanced if any parts are replaced or repaired. It is good practice to index special balance washers and bolts at time of disassembly so that these parts can be reassembled in the same location. This will make rebalancing easier.

(2) Cut lockwire and remove bolt (16) and washers (17 and 18) from blade. Remove corresponding parts from opposite blade.

(3) Remove nuts (7 and 8) and washers (6 and 9). Re- move bolts (23 and 22) and washers (24 and 21). Remove pitch horn. Remove opposite pitch horn in same manner.

c. Inspection.

NOTE

If during a movement a tinkle or a sandy sound emits from inside of blades, the presence of this condition is not cause for rejection of the blades. This sound is debris (particles of aluminum honeycomb) that were not thoroughly removed during blade manufacture.

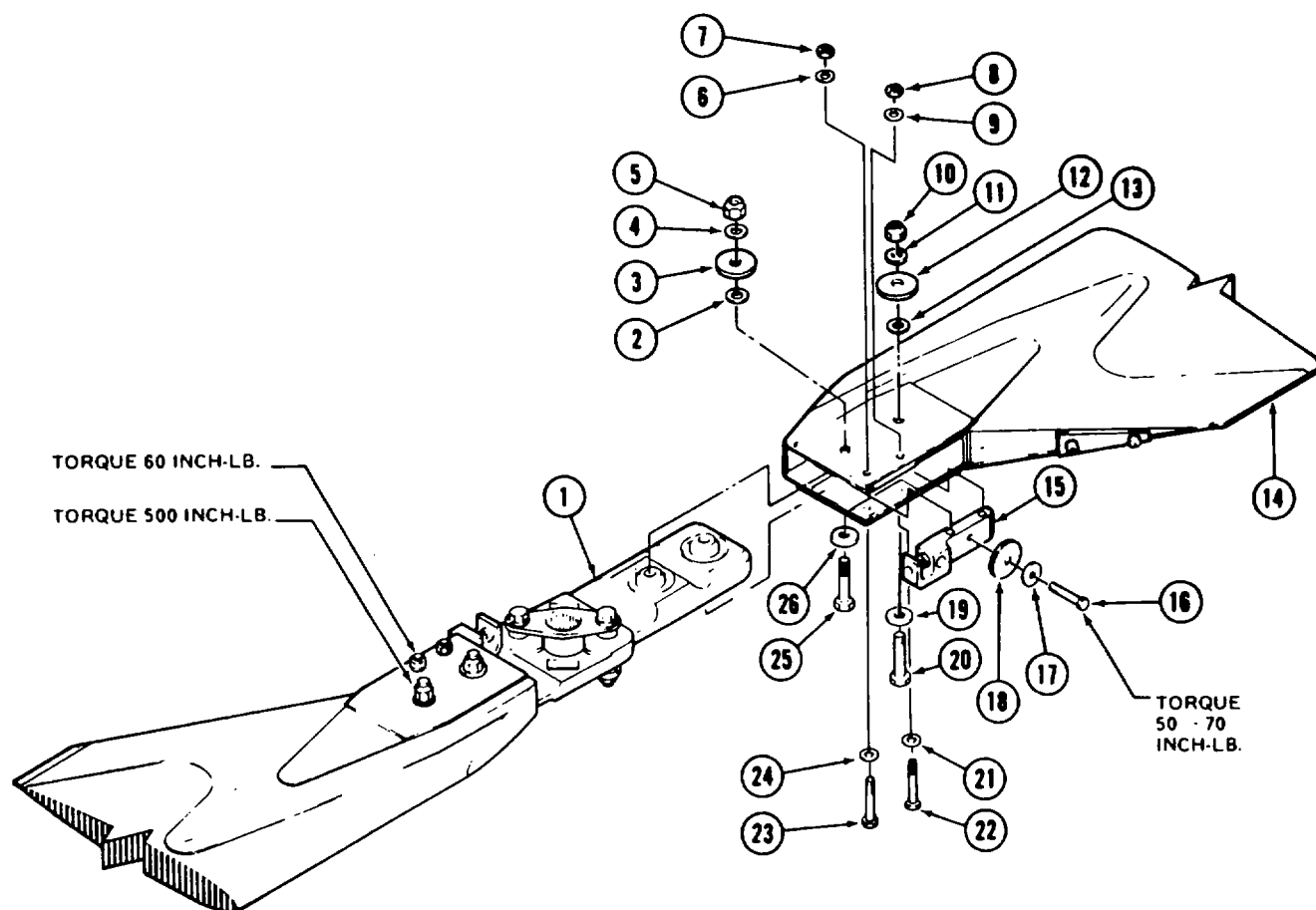
NOTE

Any damage caused by external forces to installed blades that requires blade replacement will cause mandatory tail rotor yoke replacement. Evidence or documentation of any abnormal side load applied to the blade as a result of ground mishap sufficient to cause yoke to impact severely on flapping stop is cause for removal.

(1) Inspect tail rotor historical records and tail rotor blades for evidence that the blades have been subjected to an accident or incident outside realm of normal usage. If such evidence exists, perform applicable special inspections for overspeed, sudden stoppage, hard landing and overtorque outlined in Chapter 1 and the following:

NOTE

If there is no evidence of accident or incident, proceed to step (2).



1. Hub	14. Blade
2. Special Washer	15. Pitch Horn
3. Special Washer	16. Bolt
4. Special Washer	17. Steel Washer
5. Nut	18. Special Washer
6. Steel Washer	19. Special Washer
7. Nut	20. Bolt
8. Nut	21. Steel Washer
9. Steel Washer	22. Bolt
10. Nut	23. Bolt
11. Special Washer	24. Steel Washer
12. Special Washer	25. Bolt
13. Special Washer	26. Special Washer

212010-35C

Figure 5-56. Tail rotor and blade assembly

(a) Overspeed inspection:

1 Check for bond separation anywhere on the blade. If any separation exists, dispose of the blade locally.

2 Check balance screws (9, figure 5-57) and external balance weights (3) for movement. If any of these parts have moved outboard due to centrifugal force, dispose of blade locally.

3 Check the blade grip bolt hole bushings (2) for evidence of looseness. If any of the four bushings are loose, forward the blade to next higher maintenance level for repair.

4 Inspect four external buffer pads (figure 5-60) for looseness or damage. If any of the four buffer pads are loose or damaged, forward the blade to next higher maintenance level for repair.

5 If blade inspection is noted in steps 1, 2, 3 and 4, and there is no other visible damage, the blade is serviceable.

(b) Sudden stoppage inspection:

1 Inspect the blade visually for evidence that the blade has come in contact with the ground, tailboom or other foreign object. If such evidence is found replace both blades.

2 Inspect the blade skin visually for wrinkles and deformations. If this damage is present, replace damaged blade. Inspect opposite blade for damage and replace as necessary.

3 If blade passes inspections noted in steps 1 and 2, and there is no other visible damage due to sudden stoppage, the blade is serviceable.

(c) Hard landing inspection:

1 Inspect the blade visually for evidence that the blade has come in contact with the ground, tailboom or other foreign object. If such evidence is found replace both blades.

2 Check for bond separation anywhere on the blade. If any separations exist, dispose of blade locally.

3 Check root end weights for evidence of being moved. If such evidence is found, dispose of blade locally.

4 If one of the blades, of a pair, has been damaged badly enough that the metal has been torn or any bond lines have been separated, dispose of blade locally.

5 If one of the blades, of a pair, has been damaged slightly by denting, scrap the blade; but the other blade may be reused after inspection by depot level maintenance for water tightness and spanwise balance.

(2) Accomplish normal inspection of tail rotor blades and pitch horns by inspecting blades visually and with standard inspection equipment. Classify any damage present as negligible at AVIM level, repairable at depot, or nonrepairable.

NOTE

Blades with only negligible damage may be returned to service without repair.

1 Non-sharp dents located inboard of station 30.0 that are not in excess of 0.015 inch deep are negligible (figure 5-58).

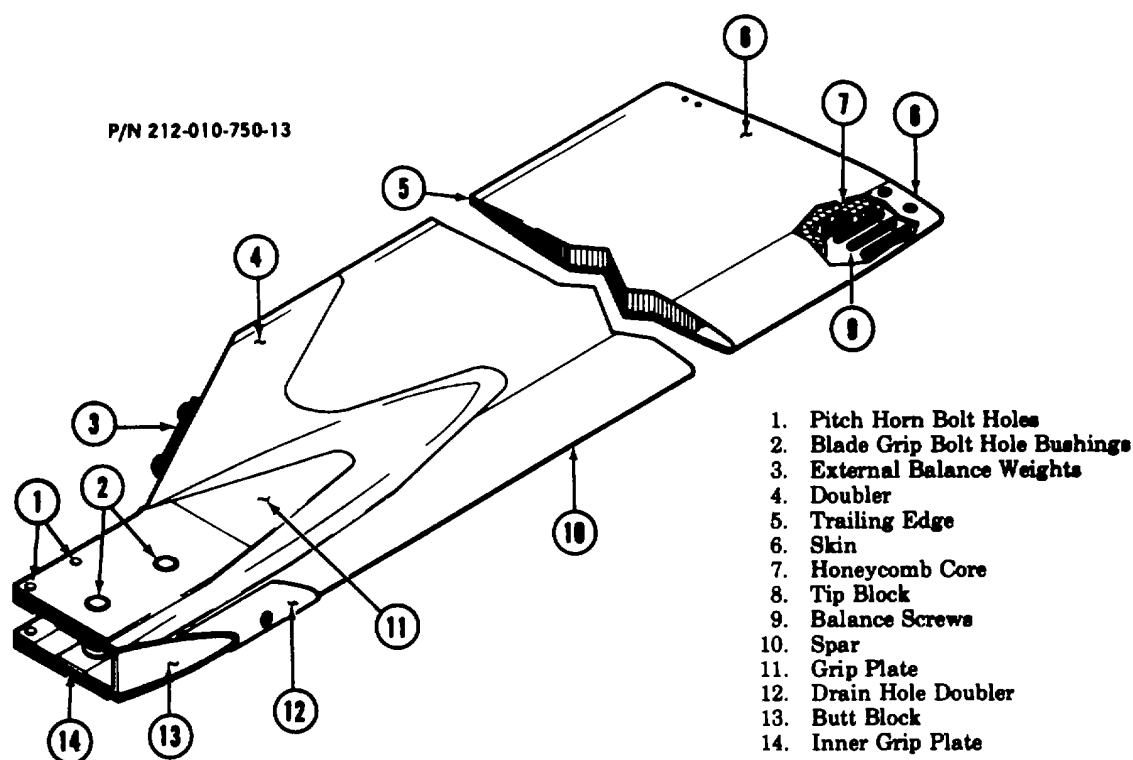
2 Non-sharp dents located outboard of station 30.0 that are not in excess of **0.030** inch are negligible (figure 5-58).

3 Voids between doublers (4, figure 5-57) and skin (6) or spar (10) which do not exceed **0.50** inch chordwise by 2.0 inches spanwise and are not within **0.50** inch of the edge of doubler are negligible.

4 Voids between the skin (6) and spar (10) which do not exceed **0.50** inch chordwise by 2.0 inchs spanwise and are not within **0.250** inch of the edge of the skin and are not in the outboard area where skin overlaps the spar are negligible. Voids between the skin and spar in the outboard area where the skin overlaps the spar which do not exceed **0.250** inch chordwise and 2.0 inches spanwise are negligible.

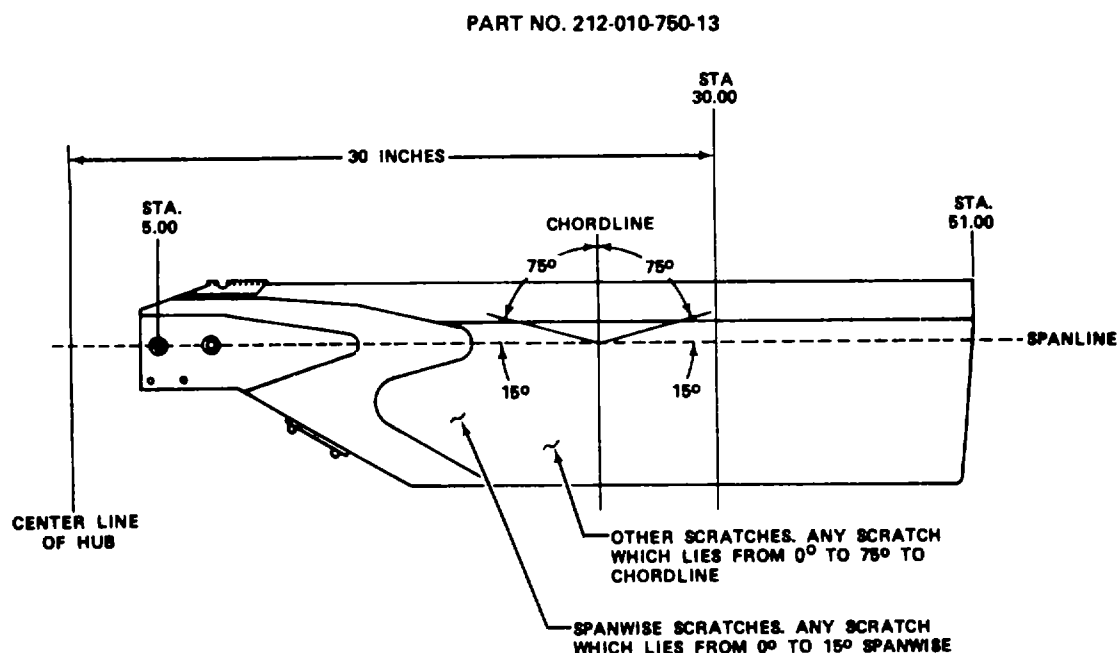
5 Voids between the skin (6) and honeycomb core (7) which do not exceed **0.50** inch chordwise by 2.0 inches spanwise are negligible.

(b) Nick, dent and scratch type damage repairable at AVIM level maintenance:



212010-37

Figure 5-57. Tail rotor blade assembly



212010-38

Figure 5-58. Tail rotor blade station diagram and scratch-type damage area locations

NOTE

Blades with the type damage defined in this paragraph require that the damage be polished out to the depth required to remove the damage including any nicks or scratches which may be present in dents. Use 300 grit or finer sandpaper (C112) and scotchbrite (C113). Do not fair-in or fill sharp or non-sharp dents with adhesive as this would interfere with subsequent inspections for cracks. Touch-up paint in areas where mechanical damage is polished out.

1 Nicks and scratches inboard of Station 30.0 which run within **0 TO 15** degrees of the span line and are not in excess of **0.005** inch depth (figure 5-58).

2 Nicks and scratches inboard of Station 30.0 which run within **0 TO 75** degrees of the chordline and are not in excess of **0.003** inch in depth (figure 5-58).

3 Sharp dents inboard of Station 30.0 which are not in excess of 0.010 inch in depth.

4 Non-sharp dents inboard of Station 30.0 which are not in excess of **0.030** inch in depth.

5 Nicks and scratches outboard of Station 30.0 which are not in excess of 0.010 inch in depth.

6 Sharp dents outboard of Station 30.0 which are not in excess of **0.015** inch in depth.

7 Non-sharp dents outboard of Station 30.0 and also outside of patchable area which are not in excess of **0.040** inch in depth.

8 Non-sharp dents outboard of Station 30.0 and also within patchable area as shown in figure 5-59 which are not in excess of **0.125** inch in depth.

9 Nicks and scratches in the trailing edge up to **0.030** inch in depth chordwise are repairable, but the damage must be polished out over a distance of three inches on each side of the defect.

(c) Voids reparable at AVIM level maintenance:

NOTE

Blades which have voids within the limits defined in this paragraph require that the voids be repaired to return the blades to servicable condition. Refer to paragraph 5-13d. for repair instructions.

A void is defined as an unbonded area that is supposed to be bonded. Many sub definitions of voids have been made such as lack of adhesive, gas pocket, misfits, etc. However, the general term "void" as used herein makes no distinction between those definitions.

1 Determination of limits when two or more separate voids are involved:

a When separate voids are closer together than one inch, consider them as one void.

b If the voids are in two areas, such as one void between the core and the skin that is located within one inch of a void between the skin and the doubler, consider them as one void and use the limits for the area that are most strict.

2 Edge voids between butt block (13, figure 5-57) and spar (10) or inner grip plates (14) within the following limits:

a Butt block and spar: any length and **0.250** inch in depth.

b Butt block and inner grip plate: **1.50** inches in length and **0.250** inch in depth.

3 Edge voids which are a maximum of **0.060** inch in depth or 2.0 inches in length and are located between the following components.

a Grip plates (11) and doublers (4).

b Doublers (4) and skin (6).

c Doublers (4) and spar (10).

d Inner grip plates (14) and skin (6).

e Inner grip plates (14) and spar (10).

f Butt block (13) and skin (6).

g Skin (6) and spar (10).

4 Edge voids which are a maximum of **0.20** inch in depth (chordwise) and **3.0** inches in length (spanwise) and are located between skin (6) and trailing edge strip (5).

5 Edge voids which are a maximum of **0.50** inch in width (chordwise) between the spar (10) and tip block (8).

(d) Damage to skins that is repairable at AVIM level maintenance.

1 Damage caused by a foreign object that results in a crack or hole in the skin and is located in the authorized area for repair by patching as shown in figure 5-59.

2 Nick and scratch type damage that exceeds the limits defined in step b.(2), and is located in the authorized area for repair by patching as shown in figure 5-59.

3 The maximum size of hole that can be repaired is restricted by the requirement that all of the defect must be cut out and the maximum size of cut is 1-1/2 inch diameter.

(e) Cracks in adhesive at bond line that are repairable at AVIM level maintenance:

1 Cracks in adhesive at bond line between the phenolic blocks and skin, spar inside the drain hole, inner grip plates or joint between phenolic blocks are repairable by sealing. Inspect adhesive at bond lines in blade butt area for cracks. Place inspection emphasis on the areas shown in figure 5-60.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

CAUTION

Do not saturate the bond lines with MEK as it will soften the adhesive.

2 If cracks in adhesive are suspected, remove paint from area with clean cloths dampened with MEK (C87) and reinspect.

(f) Blade damage that is nonrepairable:

1 Fatigue cracks at any location on the blade require local disposition of the cracked blade.

2 A blade with water in honeycomb core.

3 A blade with one or more cracks developed in a previously repaired area.

4 A blade with nicks or cracks that are located in dents and the total depth is in excess of the limits specified in steps c(2)(b)3 through 8 if damage is not within area where patches are allowed.

5 A blade with any void within 0.50 inch of the edges of the drain hole doubler (12, figure 5- 57).

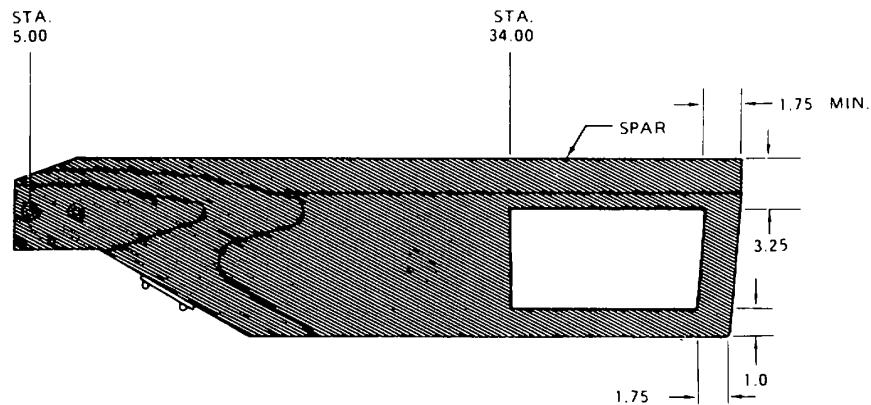
6 A blade with any void between the drain hole doubler (12) and spar (10) within .50 inch of the edge of the drain hole.

7 A blade with one or more holes that do not fall within the area authorized for patches as shown in figure 5-59 and/or a blade with a hole that exceeds the 1.5 inch diameter restriction noted in step c(2)(d)3.

8 A blade with any corrosion that penetrates entirely through the skin.

9 A blade that is worn completely through the spar at the tip.

10 A blade with edge voids deeper than 0.1 inch at the tip end of any of the root end doublers or grip plates.



ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED.

NOTE: NO REPAIR PERMITTED IN HATCHED AREA EXCEPT AS NOTED IN TEXT.

209010-39C

Figure 5-59. Tail Rotor Blade - Area Authorized for Patch-Type Repair

11 A blade with edge voids in the leading edge or trailing edge of the doublers that are 0.25 inch or more in depth and show indications of corrosion in the void.

12 A blade that failed to pass the special inspections for overspeed, overtorque and sudden stoppage.

(g) Inspect tail rotor pitch horns as follows:

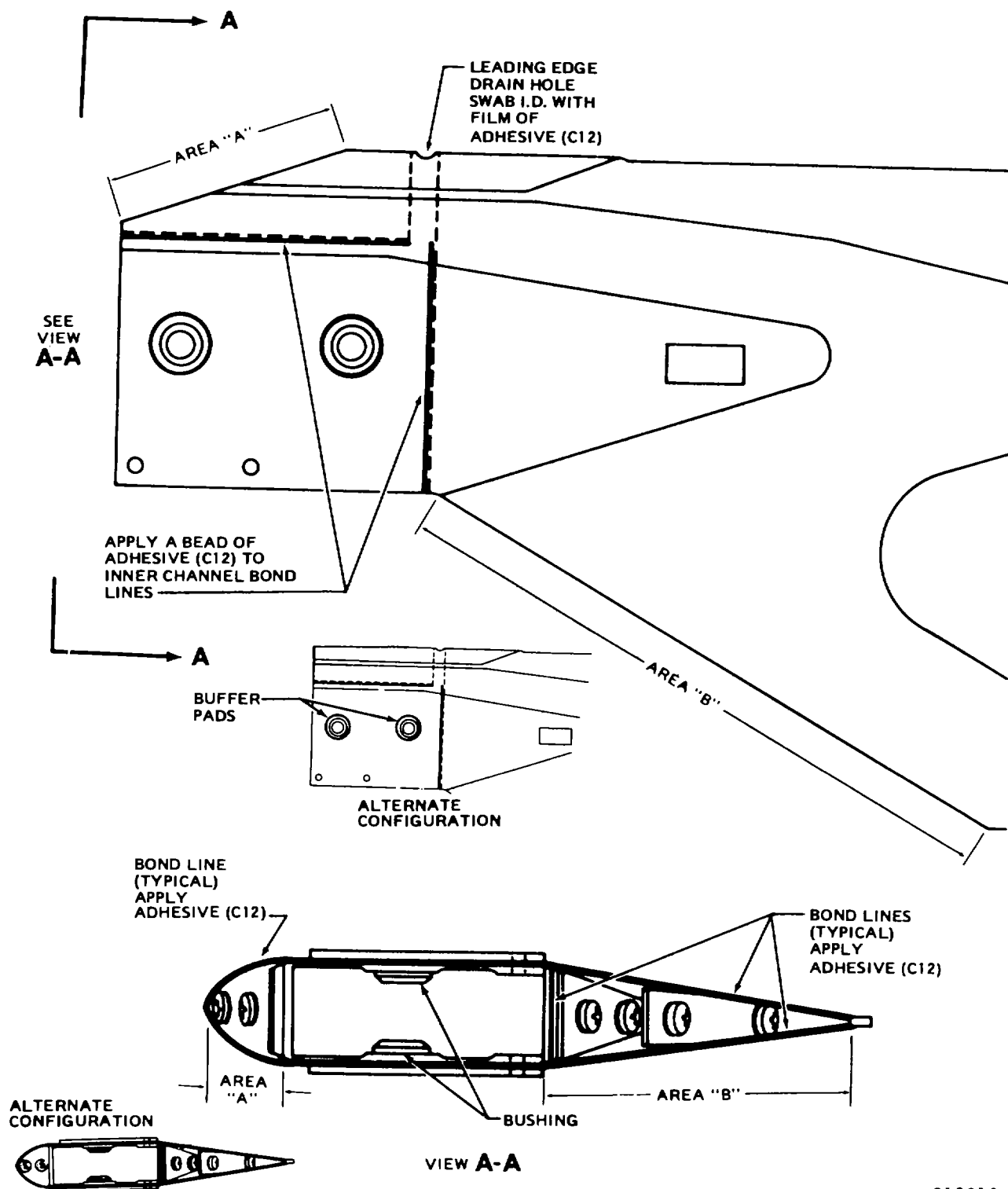
1 Inspect pitch horns for damage in excess of the limits shown in figure 5-61.

2 Inspect threaded insert for damage to 1 threads.

3 Slide a new pitch link bolt through the bushing and matching hole used for attaching the pitch link. If the bolt does not fit freely through the holes, the pitch horn is not suitable for further service.

4 Inspect for distortion of the pitch horns with a straight edge placed against the machined surfaces. Any distinct deviation from flat indicates that the pitch horn is distorted and not suitable for further service.

5 Inspect pitch horns for cracks BY fluorescent penetrant method (TM 43-0103).



212010-40F

Figure 5-60. Tail rotor blade butt area repair



HORN
PART NO: 212-010-716-9

DAMAGE LOCATION SYMBOLS		
		
TYPE OF DAMAGE	MAXIMUM DEPTH AND REPAIR AREAS ALLOWED	
NICKS, SCRATCHES, AND DENTS	0.010 In.	0.020 In.
CORROSION	0.005 In. Before Repair 0.010 In. After Repair	0.010 In. Before Repair 0.020 In. After Repair
MAXIMUM AREA PER FULL DEPTH REPAIR	0.05 Sq. In.	0.10 Sq. In.
NUMBER OF REPAIR AREAS	One	Two
EDGE CHAMFER	0.020 In.	0.040 In.
BORE DAMAGE	0.002 for 1/4 Circumference	
NO CRACKS ALLOWED		

212010-46D

Figure 5-61. Damage limits - tail rotor blade pitch horn

d. Repair (A VIM).

(1) Replace any blade which has incurred nonreparable damage (paragraph 5-13c.)

(2) Repair blades with voids that are within the limits specified in paragraph 5-13c.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

CAUTION

Do not allow MEK to enter rotor blade when removing paint to inspect for cracks or when cleaning prior to sealing edge voids. MEK will soften the adhesive used in manufacture of the rotor blades.

(a) Clean area around reparable edge voids with a clean cloth moistened with MEK (C87) and dry with a clean cloth.

(b) Prepare a small quantity of adhesive (C12) in accordance with the manufacturers instructions. Apply the adhesive to the edge void with the flat side of an applicator such as wooden tongue depressor. Fill the void with adhesive as deeply as possible.

(3) Repair blades with crack and hole type damage in the skin by patching if the damage is within limits specified in paragraph 5-13c.

(a) Ensure that the damage to be patched is in the authorized area for patches (figure 5-59).

(b) Remove paint in area to be patched with 120 grit sandpaper (C112). After paint is removed, smooth the area with 250 grit sandpaper (C12).

(c) Cut out the damaged skin with a hole saw or use a sharp instrument to cut through the skin. Do not exceed the 1.50 inch-diameter maximum cut out.

(d) Heat the cut out size of skin to 200 degrees F (maximum) and remove the disc while it is heated. Avoid damage to the honeycomb core.

(e) Deburr the edges of the hole and polish out any scratches and nicks. Use 350 grit or finer sandpaper (C112) and scotchbrite (C113).

(f) Cut a patch from aluminum alloy sheet 0.020 inch thick. The patch must be large enough to overlap the hole at least 0.750 inch all around the perimeter. Deburr the edges of the patch.

(g) Clean the side of the patch that will be bonded by sanding with 250 grit sandpaper (C112).

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

(h) Wipe the mating surfaces of the patch and blade with a clean cloth dampened with MEK (C87).

(i) Apply a thin coat of adhesive (C12 or C17) to the mating surfaces of the patch and blade. Place the patch on the blade, press down on the patch and move it back and forth slightly to expel all air pockets in the adhesive. Blend the excess adhesive around the edge of the patch.

(j) Maintain pressure on the patch. Use weights, clamps or rubber bands cut from inner tubes.

(k) Cure (C17) adhesive at 75°F for five days or at 180°F for sixty minutes. Cure adhesive (C12) at 80 to 90°F for 24 hours or at 140° to 155°F for thirty minutes.

(l) Touch up paint in area of patch (paragraph 5-13c and TM 55-1500-345-23).

(4) Repair blades with nick, scratch, dent and notch damage that is within the limits specified in paragraph 5-13.

(a) Polish out all nicks and scratches. Use aluminum wool (C24) on aluminum parts. Use sandpaper (C112) on stainless steel spar.

(b) Polish out damage in trailing edge over distance of three inches on each side of the defect. Use a steel hand file to remove most of the damage then smooth out the area with aluminum wool (C24).

(c) Touch up paint in area of repair (paragraph 5-13a and TM 55-1500-345-23).

(5) Replace loose or damaged buffer pads.

NOTE

Exercise extreme care to ensure grip plates are not gouged or otherwise damaged.

(a) Remove old pad, using a knife or similar tool.

(b) Remove any remaining adhesive by sanding in a spanwise direction to bare metal. Surface finish shall be 32 RMS or better.

NOTE

Use cellophane or similar material between washers and buffer pads to prevent adhesive squeeze-out from contacting washers.

(c) Bond new buffer pads to blade, using adhesive (C17). Apply pressure to pad by installing a 0.5 inch diameter bolt through a blade bolt hole with an AN970-8 washer under both the bolt head and the nut. Tighten nut to apply pressure on buffer pad.

(d) Refinish blade as required.

(6) Repair blades with cracks in adhesive at bond line detected in inspection described in paragraph 5-13c, as follows:

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

CAUTION

Do not saturate the bond lines with MEK as it will soften the adhesive.

(a) Clean area around cracks in adhesive at bond line in area illustrated in figure 5-60 with MEK (C87). Dry area with clean cloths.

(b) Apply a thin film of adhesive (C17) to the bond lines shown in figure 5-60 areas A and B.

(c) Apply a small bead of adhesive (C17) to area shown in figure 5-60.

(d) Swab the inside diameter of the leading edge drain hole with a thin film of adhesive (C17) to ensure that adequate sealing exists (figure 5-60).

(e) Touch up paint in repair area (paragraph 5-13c and TM 55-1500-345-23).

(f) Balance the tail rotor hub and blade assembly prior to installation on helicopter (paragraph 5-12).

(7) Repair pitch horn as follows:

(a) Polish out mechanical and corrosion damage on pitch horns. Use 300 grit or finer sandpaper (C112) and scotchbrite (C113). Inspect repaired areas to ensure that limits shown in figure 5-61 have not been exceeded.

(b) Touch up repaired areas with chemical film (C37).

(c) Replace pitch horn (5, figure 5-56) if hole for floating bushing exceeds 0.5005 inch or is corroded.

(d) Replace bushing (27, fig. 5-54) if bolt is loose in bushing or if bushing is loose in pitch horn.

e. *Painting (A VIM).*

(1) Paint touch-up is required when paint is deteriorated and/or the paint is removed to repair scratches, nicks, or dents. Refer to TM 55-1500-345-23.

(2) Prepare blade for painting as follows:

(a) Polish out nick, scratch, and dent damage (Paragraph 5-13d).

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

(b) Clean area where paint is to be applied with aliphatic naphtha (C88).

(c) Mask off or plug retention bolt holes and mask off holes for attaching the pitch horns to prevent entry of refinishing materials.

(d) Remove all surface oxides and aged paint from aluminum surfaces.

(e) Wash blade with cleaning and polishing compound (C39). Thoroughly rinse soap from blade and check for a water break free surface, which is, a continuous unbroken film of water on the surface. Repeat washing as required until the water break free surface is attained.

CAUTION

Do not touch blades with bare hands during remaining procedures or quality of paint will be adversely affected.

(f) Apply coat of chemical film (C37) to bare aluminum surfaces.

NOTE

If chemical film is not available, substitute commercial "Metal-Prep", alcoholic phosphoric solution (C23) or solution of chromic acid (C3).

(3) Apply finish to blade as follows:

(a) Apply one coat of primer (C100) to the touch up area.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of vapors and contact with skin or eyes.

(b) Mix a small quantity of adhesive (C7) according to directions on container. Mix 13 to 15 percent by weight of primer (C100) into the adhesive (C7). Mix thoroughly and thin to sprayable consistency by adding MEK (C87). Do not exceed 50 percent by volume; 35 percent should produce a sprayable consistency. The pot life of the epoxy primer mixture is approximately **three** hours.

(c) Ensure that masking tape applied in step b. (3) is still in place. Apply **three** wet spray coats of the adhesive prepared in the preceding step to all surfaces at the root of the blade for a distance of **0.750** inch to 2 inches outboard of the perimeter of the doublers. Allow each coat to dry 45 to 60 minutes. Make each coat 1.5 to 2.0 mils thick. Apply **one** wet spray coat of the same adhesive material to the entire length of the blade on both sides. Use the leading edge of the skin as the centerline of the spray.

(d) After the final coat is applied in preceding step, allow the blade to air dry for 16 TO 24 hours.

(e) Apply one thin mist coat of primer (C100) to all touch up areas and allow to dry for a minimum of 45 minutes and a maximum of 8 hours prior to applying next coat.

NOTE

It is necessary to cover all touch up areas with primer (C100) and comply with the time limit noted in step (e) or the finish coat of lacquer will not adhere to the blade.

(f) Apply the final coats of lacquer to the touch up areas only. Use lacquer (C76) to touch up areas except on the blade tip. Use lacquer (C77) on

touch up areas of the six inch wide band on the blade tip. Paint thickness to be approximately 1.2 TO 1.5 mils.

(g) Air dry the blade for 3 hours prior to handling and for **48** hours prior to flying. If a faster cure time is required, air dry the blade 1 hour. Remove the masking tape and oven dry the blade at **180 TO 190 degrees F(82 TO 88 degrees C)** for 1 hour.

(h) Apply a coating of corrosion preventive compound (C53) to the inside of the retention bolt bushings.

f. Installation

CAUTION

Check for correct washers with chamfered internal diameter under bolt head.

(1) Position hub assembly (1, figure 5-56) on bench with data plate side up. Slide blade (14) on hub yoke with the data plate side up. Install bolts (20 and 25) with special washers (19 and 26) under bolt heads. Install special washers (2 and 13) next to blade. If special balance washers were indexed at time of disassembly, reinstall them in the same position. If they were not indexed, do not install them until the assembly is balanced. Install nuts (5 and 10) but do not torque until after the assembly has been balanced.

(2) Install opposite blade in the same manner. The four blade retention bolts (20 and 25) may be installed from either side but all four bolts must be installed from the same side.

(3) Position pitch horn (15, figure 5-56) on blade and install bolts (22 and 23) with steel washers (21 and 24) under heads. Install bolts with heads facing same direction as blade retention bolts (20 and 25, figure 5-56). Install steel washers (6 and 9, figure 5-56) and nuts (7 and 8). Torque nuts **50 TO 70** inch-pounds. If special washer (18) was indexed at disassembly, install it at this time with steel washer (17) and bolt (16). If special washer (18) was not indexed, install steel washer (17) and bolt (16). Do not torque until assembly has been balanced.

(4) Install the opposite pitch horn in the same manner.

5-14. Tail Rotor Hub Assembly.

Premaintenance requirements for tail rotor hub.

Condition	Requirements
Model	AH-1S
Part No. or Serial No.	212-010701-9
Special Tools	(T57)
Test Equipment	NA
Support equipment	Drill press
Minimum Personnel Required	One
Consumable Materials	(C32) (C45) (C102) (C112) (C119) (C124)
Special Environmental Condition	NA

(a) Inspect yoke (5, figure 5-62) and trunnion halves for obvious damage such as deformation. Reject hub if any part is deformed.

a. *Disassembly.* (AVIM)

(1) Remove nut (9, figure 5-62), washer (8), bolt (1), and washer (2). Remove similar parts on the opposite side of the trunnion.

(2) Remove trunnion halves (3 and 7). The trunnion halves are a matched set; keep those parts together for reinstallation on the same hub.

Use solvent in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

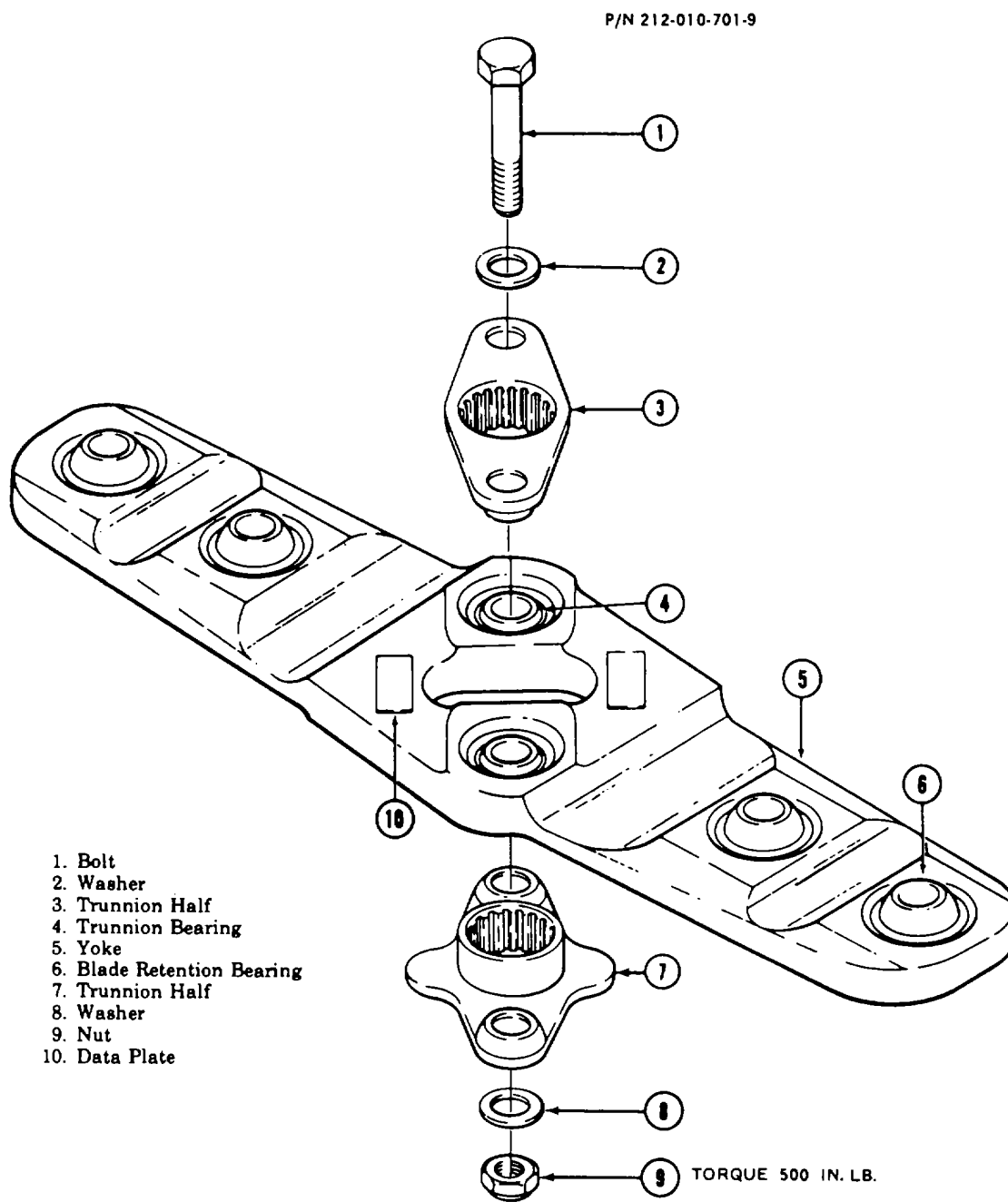


Use solvent in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

b. *Cleaning.* (AVIM) Clean the disassembled tail rotor hub assembly parts with solvent (C124).

c. *Inspection.* (AVIM)

(1) Inspect the tail rotor historical records, and the tail rotor hub for evidence that the tail rotor has been subjected to an accident or incident outside the realm of normal usage. If such evidence exists, perform applicable special inspections for overspeed, sudden stoppage, engine compressor stall and overtorque outlined in chapter 1 and the following.



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Figure 5-62. Tail rotor hub assembly
5-115

(b) Inspect parts for surface damage in excess of limits shown on figures 5-63 and 5-64.

(c) Inspect trunnion retention bolts (1, figure 5-62) and blade retention bolts for shear offset. Reject hub if any bolts show shear offset.

(d) Inspect bearings (4 and 6) for looseness in yoke. Replace yoke if bearings are loose.

(e) Inspect yoke (5, figure 5-62) and trunnion halves (3 and 7) by fluorescent penetrant method, MIL-I-6866.

NOTE

When finish is removed from yoke, repaint, using primer (C100) and overspray with lacquer (C75).

Bearing removal is not necessary for yoke penetrant inspection. Bearings should be covered to prevent entry of penetrant.

(2) Normal Inspection of tail rotor hub:

(a) Move bearings (4 and 6, figure 5-62) through lull throw and check for corrosion. If any corrosion is detected, remove the products of corrosion with Scotchbrite (C 113) and clean cloths.

(b) Check bearings (4 and 6) for indication of teflon deterioration, bond separation, and teflon protruding from bearing. Replace bearings if any of these conditions exist. Check bearings (4 and 6) for axial looseness. Maximum allowable axial looseness is 0.015 inch. Replace bearings if axial limits are exceeded.

NOTE

Due to the spherical shape of the bearing, any looseness in the radial direction will also result in axial looseness. For this reason, measuring axial looseness only is adequate for determining bearing serviceability.

(c) Deleted.

(d) Inspect yoke for mechanical and corrosion damage. If damage exceeds limits shown on figure 5-63, scrap the yoke.

(e) Inspect trunnion set for mechanical and corrosion damage and also wear damage on the splines. If damage and/or wear exceeds the limits shown on figure 5-64 on either trunnion half, scrap both halves of the set.

d. Repair. (AVIM)

(1) Replace bearings (4 and 6, figure 5-62) which did not pass inspection.

(a) Press faulty bearings out of yoke. Use a sleeve of slightly larger diameter than the bearing outside diameter to support the yoke. Use a sleeve of slightly smaller diameter than the bearing sleeve to press the bearing and bearing sleeve out of the yoke.

(b) Clean aged primer and dirt from the yoke.

NOTE

Remove preservative oil from bearings (6) using solvent (C124 or C142) prior to installing new bearings.

(c) Apply primer.(C102) to mating surfaces of yoke and of new bearing.

(d) Position bearing in yoke while primer (C102) is still wet. Use a backstop so that bearing can be set with one operation. Clean off excess primer and prevent it from entering bearing.

(e) Select proper anvil (backstop) and staking tool from staking tool set (T57) for the bearing being installed. Use staking tool, T101577-11, and anvil (backstop), T101557-13, to stake bearings (6, figure 5-62). Use staking tool, T101577-17, and anvil (backstop), T101577-19, to stake bearings (4, figure 5-62). See figure 5-65, sheet 1 and sheet 2 for views of assembled staking tools.

(f) Install staking tool, selected in preceding step, in chuck of a hand-feed-type drill press. Lubricate staking tool rollers with lubricating oil (C92).

(g) Place anvil (backstop) selected in step (e) on drill press table with flanged side down. See figure 5-66, detail A. Position yoke on drill press with data plate side up and with bearing to be staked in contact with anvil. Lower the drill press chuck and the staking tool and check to ensure that the anvil bearing and staking tool are aligned and that the staking tool rollers are in contact with the groove in the bearing.

(h) Set drill press speed at 250 to 350 rpm. Start the drill press and apply steady hand pressure. to the feed lever for a minimum of ten seconds. Raise drill press chuck and staking tool. Check to determine the amount that the bearing has been staked in comparison with figure 5-66, view B.

NOTE

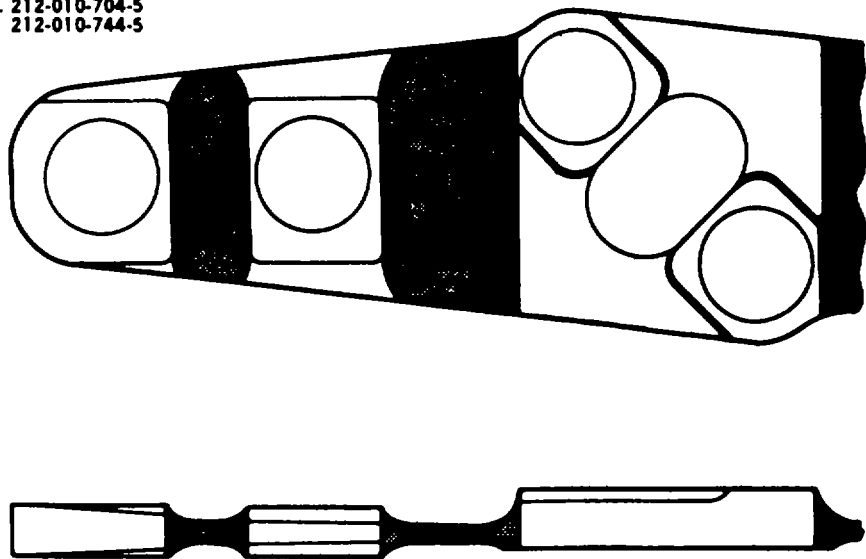
Rotating the yoke 90 degrees while maintaining applied pressure will help to ensure uniform staking.

(i) Reposition the anvil (backstop) with the flanged side up. Invert the yoke and stake the opposite side of the bearing in the same manner. Repeat staking the bearing in small increments to attain the 0.008 inch maximum gap shown on figure 5-66, detail B.

(j) Check the bearing axial position in the yoke to ensure that it is within the limits shown on figure 5-66, detail B.

(k) Check the bearing by feel for smooth operation. Check the bearing visually to ensure that the ball was not scored by the staking tool.

HUB YOKE
PART NO. 212-010-704-5
212-010-744-5



DAMAGE LOCATION SYMBOLS



TYPE OF DAMAGE	MAXIMUM DEPTH AND REPAIR AREAS ALLOWED	
NICKS, SCRATCHES, DENTS AND CORROSION	0.002 In.	0.005 In.
MAXIMUM AREA PER FULL DEPTH REPAIR	0.10 Sq. In.	0.15 Sq. In.
NUMBER OF REPAIR AREAS	One Per Segment	Not Critical
EDGE CHAMFER	0.010 In.	0.020 In.
BORE DAMAGE:	0.002 for 1/4 circumference	
NO CRACKS ALLOWED		212010-42G
MAXIMUM HUB YOKE DIAMETER		
BLADE RETENTION BEARING 1.4385 IN.		
TRUNNION BEARING 1.1885 IN.		

Figure 5-63. Damage limits - tall rotor hub yoke

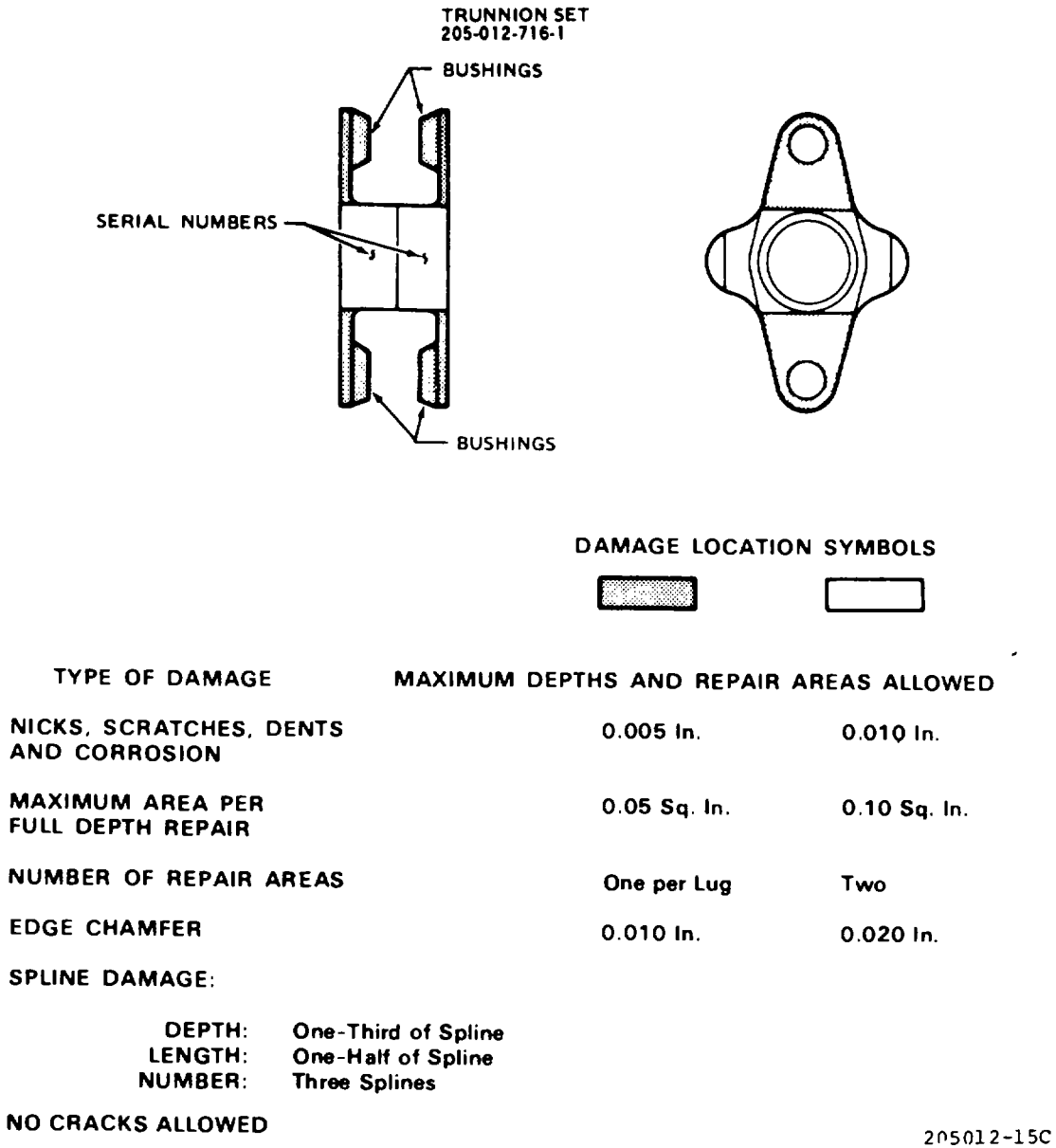
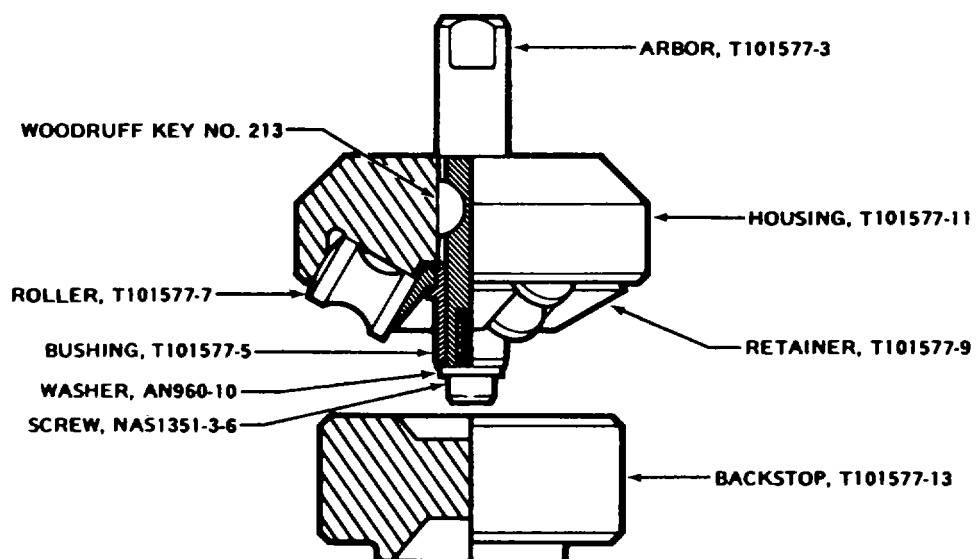


Figure 5-64. Damage limits - tail rotor trunnion set

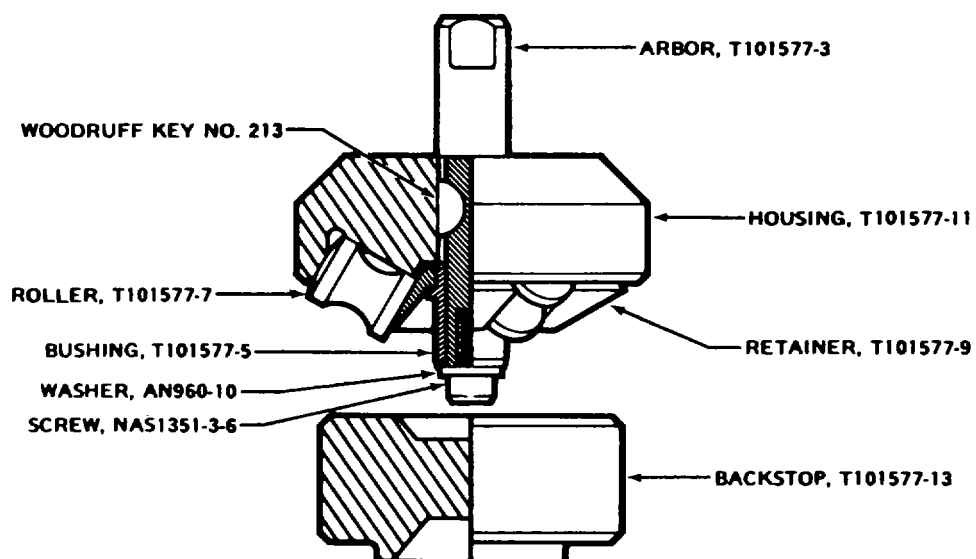


Note

Assemble tool as illustrated above for staking tail rotor blade retention (pitch change) bearings.

212900-84-1B

Figure 5-65. Bearing staking tool P/N T101577 (Sheet 1 of 2)

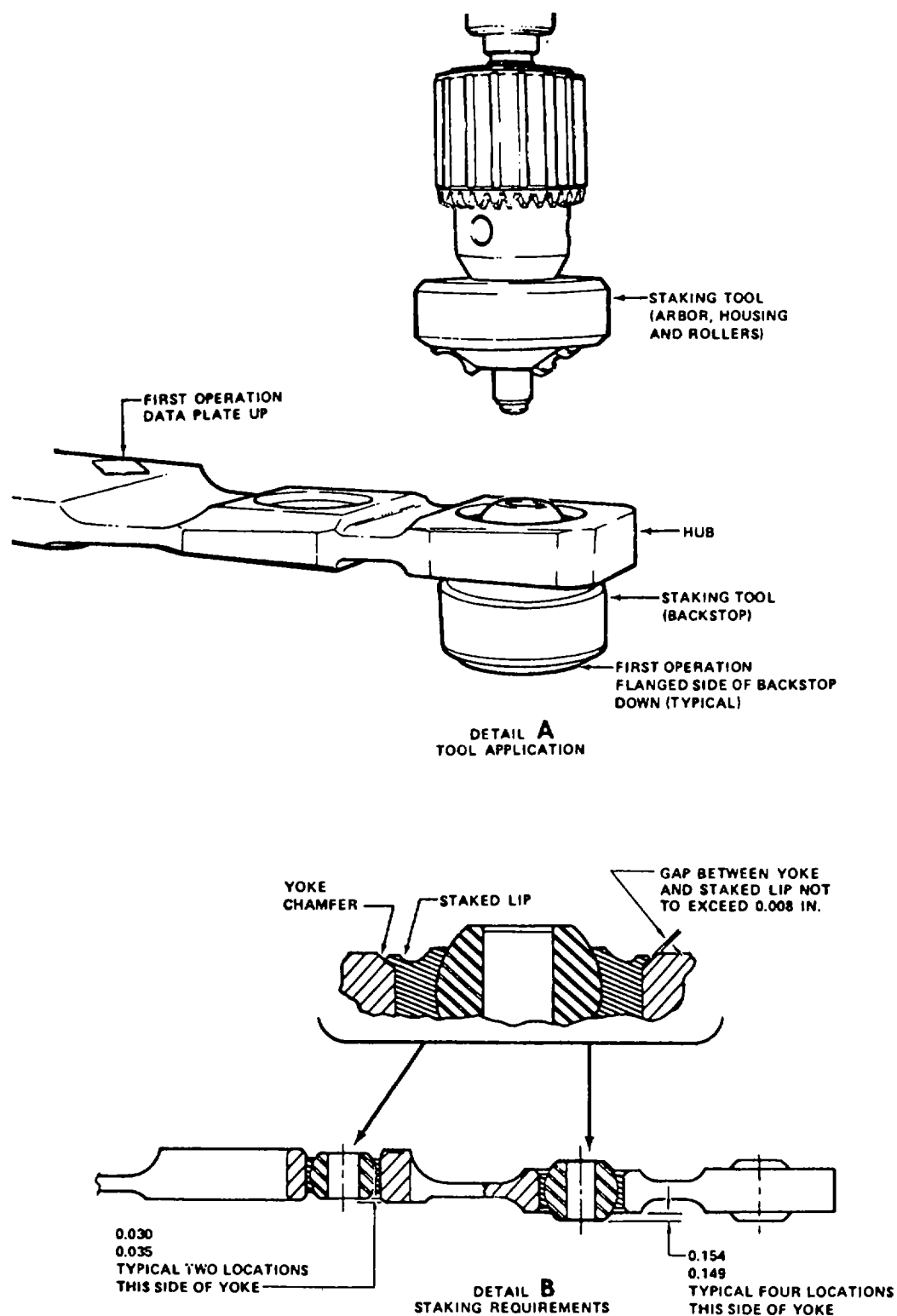


Note

Assemble tool as illustrated above for staking tail rotor blade retention (pitch change) bearings.

212900-84-1B

Figure 5-65. Bearing staking tool P/N T101577 (Sheet 2 of 2)



212010-12C

Figure 5-66. Tool application - bearing installation (staking) in tail rotor yoke
5-121

(2) Polish out any mechanical damage and corrosion damage on the yoke and on the trunnion that was not accomplished during inspection. Polish out damage on trunnion splines as well as the outer surfaces. Use crocus cloth (C45), sandpaper (C 112), and india stone (C128) of correct grades to polish out the damage and to leave a smooth, scratch-free surface. If damage exceeds the limits shown on figures 5-63 and 5-4, scrap the affected part.

(3) Touch up repair areas with brush cadmium plate (C32) or primer (C102). Do not apply coating to trunnion splines.

e. Assembly. See figure 5-62.

(1) Inspect trunnion halves (3 and 7) to ensure that they are a matched set.

(2) Position trunnion half (3) on the data plate side of yoke (5). Position trunnion half (7), with the static stop ear, on the opposite side of yoke with the master spline of trunnion halves aligned.

CAUTION

Check for correct washers with chamfered internal diameter under bolt head.

(3) Install two bolts (1) with washers (2) under bolt heads and washers (8) under nuts (9). Torque nuts evenly to 500 inch-pounds.

5-15. Tail Rotor Controls - Crosshead, Weights, Links and Control Tube.

The tail rotor controls crosshead, weights, links and control tube and associated linkage control tail rotor pitch. The control tube is attached to the anti-torque pedals through control linkage. The crosshead, weights and links balance control forces and assist in controlling blade pitch.

a. Removal. See figure 5-67.

(1) Remove crosshead, weights and links as an assembly. Refer to paragraph 5-12, step a.

(2) Remove counterweight support. Refer to paragraph 5-12, step a.

(3) Slide sleeve (35, figure 5-67) outboard on control tube (34) slightly and rotate counterclockwise to engage internal threads in sleeve. Continue to rotate counterclockwise until threads are disengaged and remove sleeve.

(4) Remove attaching bolts and remove lever (48, figure 5-67), idler (47) and link (51).

(5) Remove control tube (34, figure 5-7) from left

side of gearbox.

(6) Remove nuts and washers (38, figure 5-67). Remove housing (40). Remove retaining ring (42), housing (41), excluder (43) and bearing (52).

b. Disassembly. See figure 5-67.

(1) Remove tail rotor retaining nut (36) and shield (37) from crosshead (131 if not previously accomplished).

(2) Remove cotter pin (10). Remove nut (11), bolt (15) and pitch link (31). Remove opposite pitch link in the same manner.

(3) Remove nut (19), bolt (16), washer (18) and weights (17). The quantity of weights and washers may vary from those illustrated. Record the quantity of weights and washers removed. Remove remaining weights in the same manner.

(4) Remove cotter pin (21). Remove nut (20), washer (22), bolt (39), washer (29) and counterweight link (26). Remove opposite counterweight link in the same manner.

(5) Remove cotter pin (23). Remove nut (24), washer (25), bellcrank (27), and washer (29). Remove opposite bellcrank in the same manner.

WARNING

Use solvent in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

c. Cleaning. Clean the parts disassembled in paragraphs a. and b. with solvent (C124) and dry with filtered compressed air. Use only solvent (C124) on bearing (8, figure 5-67).

d. Inspection.

(1) Inspect cross head for damage in excess of limits shown on figure 5-68.

(2) Inspect counterweight bellcrank for wear and damage in excess of limits shown on figure 569. Maximum allowable radial play between bellcrank (item 27, figure 5-67) and crosshead (13) is 0.010 inch. Maximum axial play not to exceed .015 inch.

(3) Inspect pitch links for damage in excess of limits shown on figure 5-70.

(4) Inspect counterweight links for damage in excess of limits shown on figure 5-71.

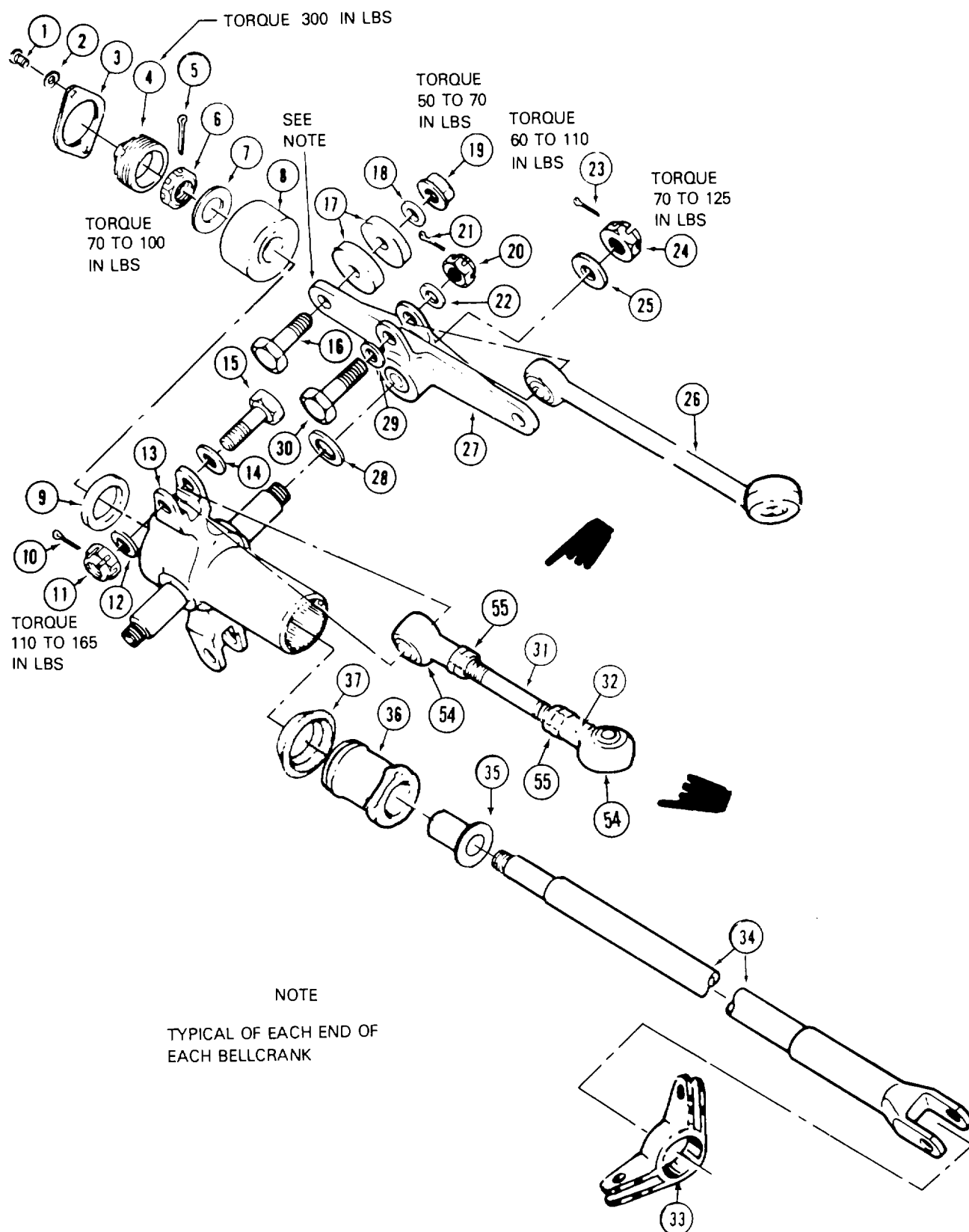
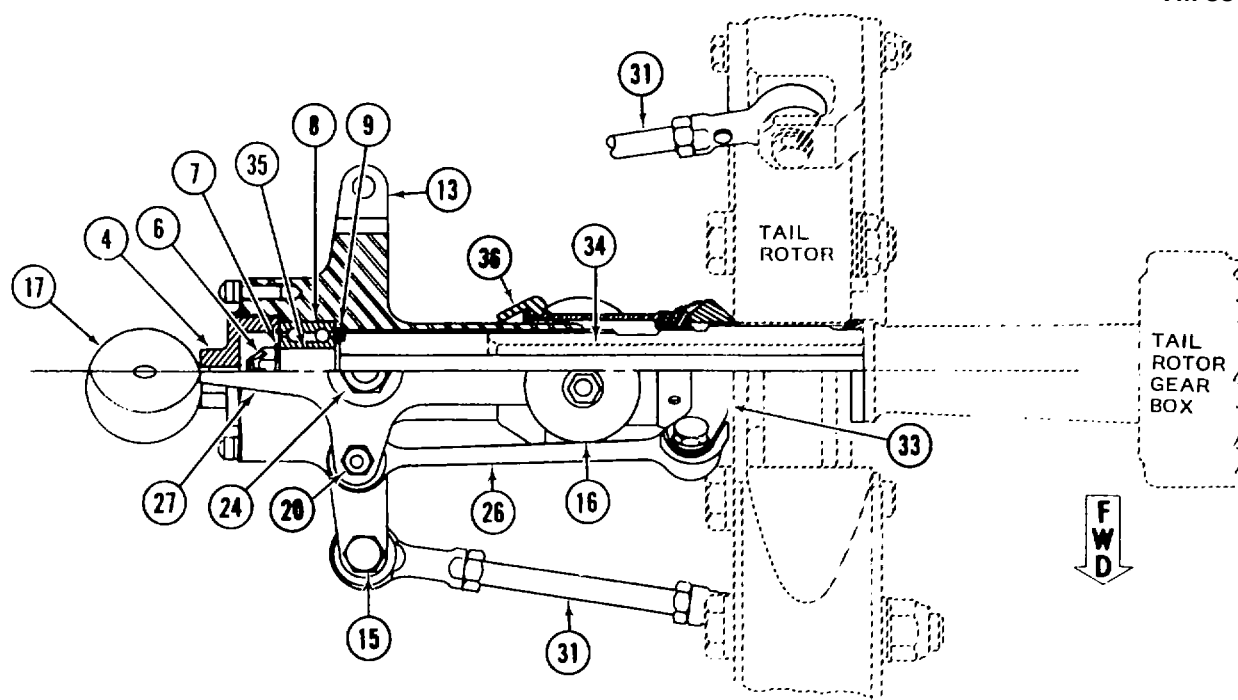


Figure 5-67. Tail Rotor Control - Crosshead, Weights, Links and Control Tube (Sheet 1 of 3)
Change 65 5-123



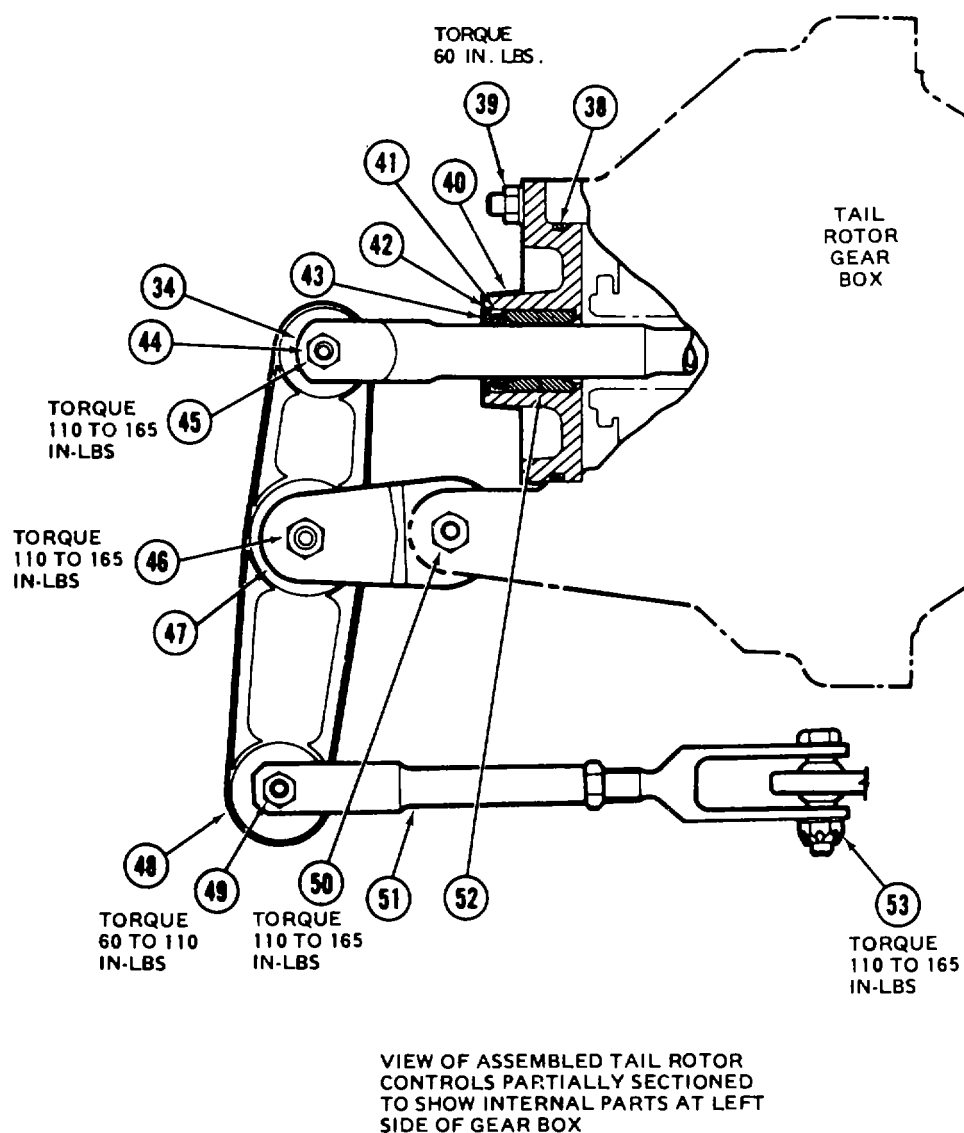
VIEW OF ASSEMBLED TAIL ROTOR
CONTROLS PARTIALLY SECTIONED
TO SHOW INTERNAL PARTS

1. Screw	30. Bolt
2. Steel Washer	31. Pitch Link
3. Lock	* 32. Rivet
4. Retainer	33. Counterweight Support
5. Cotter Pin	34. Control Tube
6. Nut	35. Sleeve
7. Steel Washer	36. Tail Rotor Retaining Nut
8. Bearing	37. Shield
9. Nylatron Washer	38. Packing
10. Cotter Pin	39. Nut and Steel Washer
11. Nut	40. Housing
12. Steel Washer	41. Housing
13. Crosshead	42. Retaining Ring
14. Steel Washer	43. Excluder
15. Bolt	44. Race
16. Bolt	45. Bolt, Steel Washer, Nut and Cotter Pin
17. Weight	46. Bolt, Steel Washers, Nut and Cotter Pin
18. Steel Washer	47. Idler
19. Nut	48. Lever Assembly
20. Nut	49. Bolt, Steel Washers, Nut and Cotter Pin
21. Cotter Pin	50. Bolt, Steel Washers, Nut and Cotter Pin
22. Steel Washer	51. Link Assembly
23. Cotter Pin	52. Bearing
24. Nut	53. Bolt, Steel Washers, Nut and Cotter Pin
25. Special Washer	54. Rod End Assy
26. Counterweight Link	55. Jam Nut
27. Counterweight Bellcrank	
28. Nylatron Washer	
29. Steel Washer	

*NOTE: Enlarge hole to size of rivet.

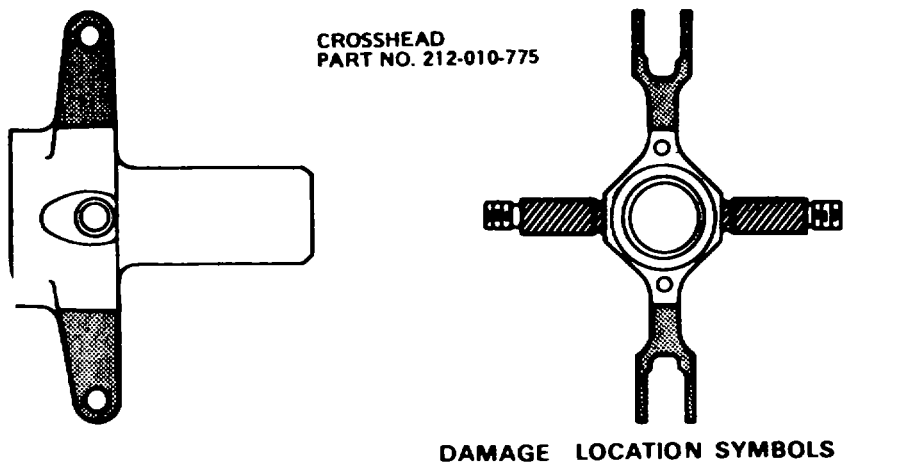
209010-84-2

Figure 5-67. Tail rotor control - crosshead, weights, links and control tube (Sheet 2 of 3)
5-124 Change 65

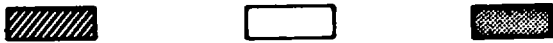


209010-84-3

Figure 5-67. Tail Rotor Control - crosshead, weights, links and control tube (Sheet 3 of 3)



TYPE OF DAMAGE

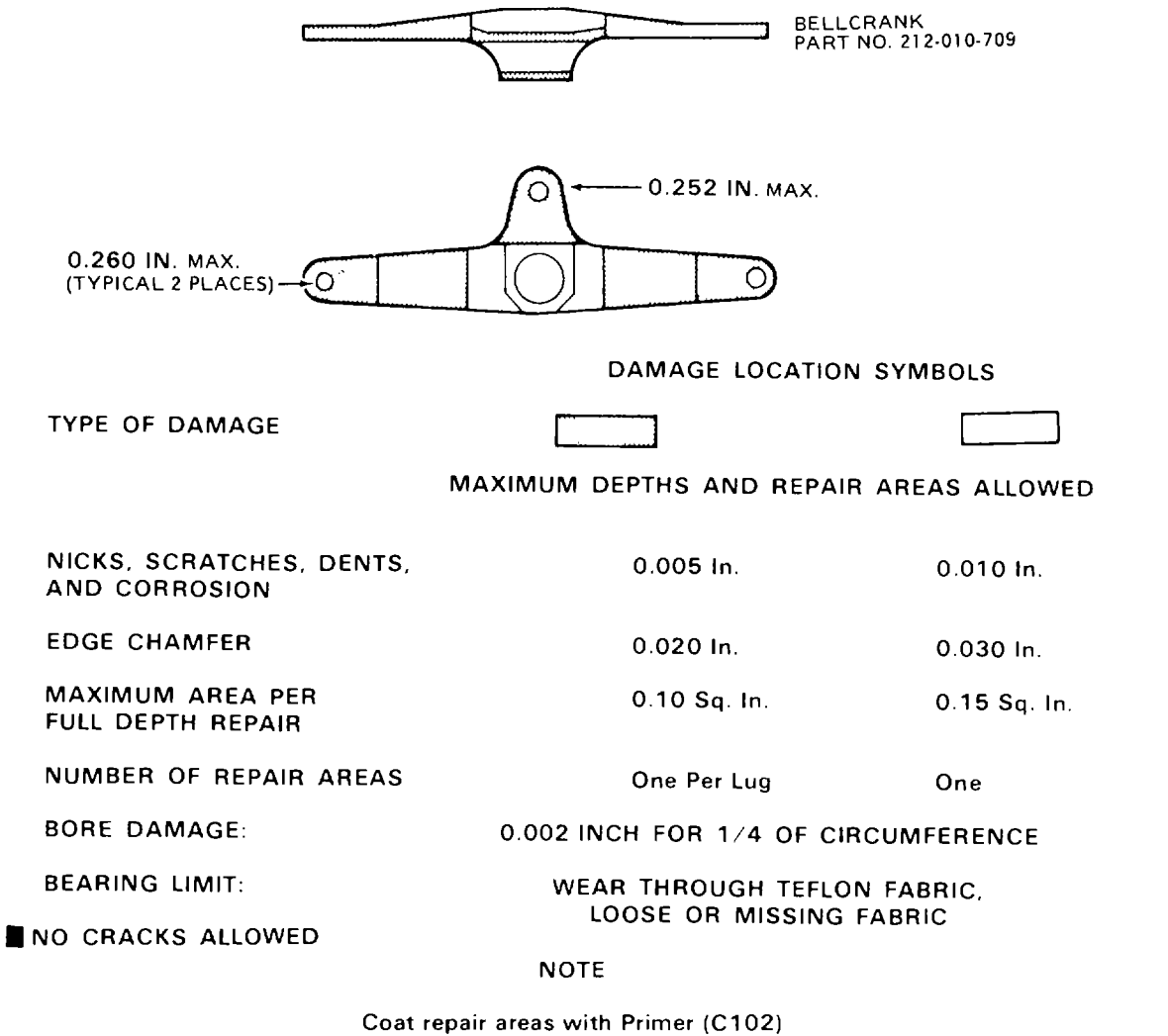


MAXIMUM DEPTH AND REPAIR AREAS ALLOWED

NICKS, SCRATCHES DENTS & CORROSION	0.002	0.010	0.005
MAXIMUM AREA PER FULL DEPTH REPAIR	0.05 Sq. In.	0.15 Sq. In.	0.05 Sq. In.
NUMBER OF REPAIR AREAS	One Per Zone	Not Critical	One Per Lug
EDGE CHAMFER	Not Applicable	0.020	0.010
SPLINE DAMAGE:	DEPTH: One Third of Spline LENGTH: One Third of Spline NUMBER: Two		
THREAD DAMAGE:	DEPTH: One Third of Thread LENGTH: One Quarter Inch NUMBER: One Per Segment		
BORE DAMAGE:	0.002 for 1/4 Circumference		
NO CRACKS ALLOWED			

212010-45D

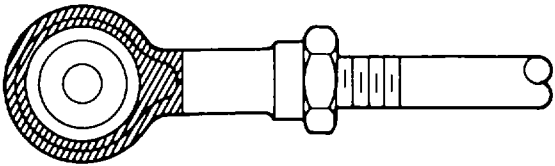
Figure 5-68. Damage limits - tail rotor control crosshead



212010-43E

Figure 5-69. Damage limits - tail rotor control counterweight bellcrank

PITCH LINK
PART NO. 212-010-712



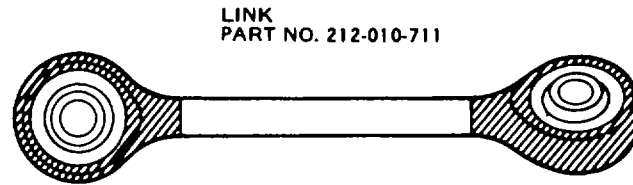
DAMAGE LOCATION SYMBOLS



TYPE OF DAMAGE	MAXIMUM DEPTHS AND REPAIR AREAS ALLOWED	
NICKS, SCRATCHES, DENTS AND CORROSION	0.005 In.	0.010 In.
EDGE CHAMFER	0.010 In.	0.020 In.
MAXIMUM AREA PER FULL DEPTH REPAIR	0.05 Sq. In.	0.10 Sq. In.
NUMBER OF REPAIR AREAS	One Per Segment	One Per Segment
NO CRACKS ALLOWED		

1. Repair of nicks and dents on threads must not exceed one-third of the thread depth.
Length of repair shall not exceed 0.025 inch. Each threaded segment may have one repair.
2. Minor damage to jam nut is acceptable.
3. Coat repair areas with primer (C102).
4. Replace rod end if axial or radial play in either bearing exceeds 0.020 inch.
5. Maximum width of polish- out repair on rod is one-third of the circumference of the rod.

Figure 5-70. Damage limits - tail rotor control pitch link



DAMAGE LOCATION SYMBOLS



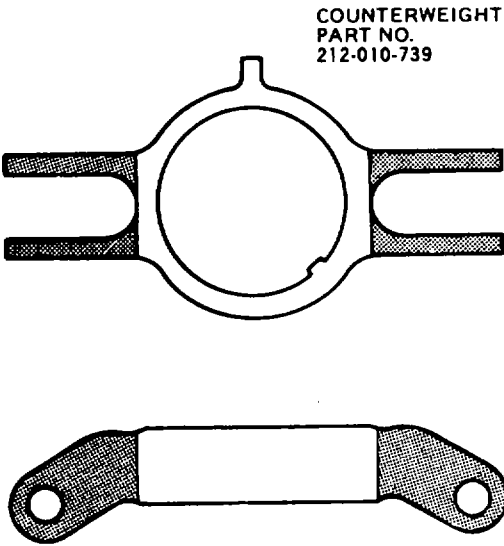
TYPE OF DAMAGE	MAXIMUM DEPTH AND REPAIR AREAS ALLOWED	
NICKS, SCRATCHES AND DENTS	0.005 In.	0.010 In.
MAXIMUM AREA PER FULL DEPTH REPAIR	0.05 Sq. In.	0.10 Sq. In.
NUMBER OF REPAIR AREAS	One Per End	One
EDGE CHAMFER	0.020 In.	Not Applicable
NO CRACKS ALLOWED		

NOTES:

1. Polish out nicks and dents in edges to remove all damage and finish with a smooth radius or chamfer. If maximum depth to remove all damage exceeds 0.020 inch and/or the width of the repair exceeds one-third the circumference, dispose of link locally.
2. Touch up repair area with primer (C102).
3. Spherical bearing axial wear limit is 0.020 inch. If either bearing is worn beyond this limit, scrap the link. Repair of the link by replacement of bearings is not authorized.

212010-47G

Figure 5-71. Damage limits - tail rotor control counterweight link
Change 7 5-129



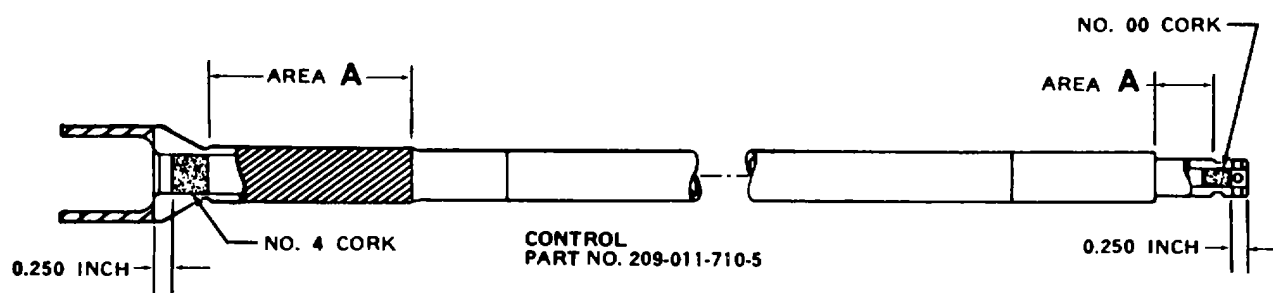
TYPE OF DAMAGE	DAMAGE LOCATION SYMBOLS	
		
	MAXIMUM DEPTH AND REPAIR AREAS ALLOWED	
NICKS, SCRATCHES, DENTS AND CORROSION	0.005 In.	0.010 In.
EDGE CHAMFER	0.010 In.	0.020 In.
MAXIMUM AREA PER FULL DEPTH REPAIR	0.05 Sq. In.	0.10 Sq. In.
NUMBER OF REPAIR AREAS	One Per Lug	Two
BORE DAMAGE: 0.002 FOR 1/4 CIRCUMFERENCE		

NOTE

Coat repair areas with primer (C102).

NO CRACKS ALLOWED

Figure 5-72. Damage limits - tail rotor active counterweight support
5-130 Change 7



DAMAGE LOCATION SYMBOLS



TYPE OF DAMAGE	MAXIMUM DEPTHS AND REPAIR AREAS ALLOWED		
NICKS, SCRATCHES, DENTS AND CORROSION	0.002 In.	0.005 In.	0.010 In.
MAXIMUM AREA PER FULL DEPTH REPAIR	0.05 Sq. In.	0.05 Sq. In.	0.25 Sq. In.
NUMBER OF REPAIRS	One per tang	Two	NOT CRITICAL
EDGE CHAMFER	0.010 In.	0.020 In.	0.030 In.
THREAD DAMAGE:	DEPTH: One-third of thread LENGTH: One-tenth inch NUMBER: Two		

NOTE: Maximum allowable runout, with control tube mounted on center, is 0.010 inch TIR (Total Indicator Reading) in areas designated A. Maximum allowable run out in other areas is 0.020 inch T.I.R.

NO CRACKS ALLOWED

209011-28B

Figure 5-73. Damage limits - tail rotor control tube

(5) Inspect counterweight support for damage in excess of limits shown on figure 5-72.

NOTE

The control tube support can be any fixture, locally manufactured which can be placed on a flat surface and the tube rotated along the center axis in order To check for straightness using a dial indicator.

(6) Inspect tail rotor control tube for damage in excess of limits shown in figure 5-73. Mount the control

tube on centers and check run out. Maximum allowable run out in areas designated Area A is **0.010** inch. Maximum allowable run out in other areas is **0.020** inch. Inspect two corks for secure installation in tube and for damage. Inspect threads for damage.

(7) Inspect link assembly for damage in excess of limits shown on figure 5-74.

(8) Inspect idler for damage in excess of limits shown on figure 5-75.

(9) Inspect lever for damage in excess of limits shown on figure 5-76. Inspect bearings in lever for wear.

(10) Inspect housing (40, figure 5-67) for corrosion and mechanical damage.

(11) Inspect retaining ring (42, figure 5-67) for damage that would affect function.

(12) Inspect housing (41, figure 5-67) and excluder (43) for damage that would affect function.

(13) Inspect bearing (52, figure 5-67) for damage that would affect function.

(14) Inspect shield (37, figure 5-67) for cuts and deterioration.

(15) Inspect tail rotor retaining nut (36, figure 5-67) for damaged threads, corrosion, nicks and dents.

(16) Inspect race (44, figure 5-67) for corrosion and wear that would affect function.

(17) Inspect sleeve (35, figure 5-67) for corrosion, wear, and damaged threads.

(18) Inspect bearing (8, figure 5-67) for evidence of separation of races. Rotate bearing manually. If roughness is noted or if axial looseness exceeds **0.005** inch, replace bearing.

(19) Inspect following parts by magnetic particle method, MIL-I-6868 Code M, or fluorescent penetrant method, MIL-I-6866 Code F. If damage occurs inspect following parts. See figure 5-67.

ITEM	NOMENCLATURE	CODE
13	Tail Rotor Controls Crosshead	F
26	Counterweight Link	F
27	Counterweight Bellcrank	F
34	Tail Rotor Control Tube	M
33	Counterweight Support	F
36	Tail Rotor Retaining Nut	M
47	Idler	F
48	Lever Assembly	F
51	Link Assembly	M

e. Repair.

(1) Replace any part which failed to pass inspection in paragraph d.

(2) Polish out mechanical and corrosion damage that is within limits specified in paragraph d. Touch up repair areas with primer (C102).

WARNING

Use solvent (C124) in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

(3) Replace loose or damaged corks in control tube. Clean area where cork will be installed with solvent (C124) and allow to dry. Coat new cork with shellac (C120) and press into position illustrated on figure 5-73.

(4) Remove worn bushing in bellcrank (27, figure 5-67). Install new bushing using wet zinc chromate primer (C102) between mating surfaces.

f Assembly. See figure 5-67.

(1) Position nylatron washer (28), bellcrank (27) and special washer (25) on crosshead (13). Install nut (24) and torque **70 TO 125** inch-pounds. Install cotter pin (23). Install opposite bellcrank in the same manner. If cotter pins do not engage castellations in nuts, add one thin steel washer under nuts (24).

CAUTION

Weights (17, figure 5-67) must be installed on outboard side of bellcranks (27) as illustrated or interference may occur.

(2) Install weights on each end of the two bellcranks (27). Install the same weights that were removed if they were indexed; if not, install two weights (17) and one steel washer (18) at each of the four locations. Install bolt (16) and nut (19). Torque nut **50 TO 70** inch-pounds.

(3) Position counterweight link (26) in bellcrank (27) and install bolt (30) with steel washer (29) under head and steel washer (22) under nut (20). Torque nut **60 TO 110** inch-pounds and install cotter pin (21). Install

opposite counterweight link in the same manner. If cotter pins do not engage castellations in nuts, add one thin steel washer under nuts (20).

(4) Adjust both pitch links (31) to **6.105** to 6.125 inch dimension between centers of bearings. This will yield a distance of 2.72-2.92 inches between inside face of jam nuts.

(5) Position pitch link (31), in crosshead (13) with the end with rivet (32) installed away from the crosshead as illustrated. Install bolt (15) with steel washer (14) under head and steel washer (12) under nut (11). Torque nut **110 TO 165** inch-pounds and install cotter pin (10). Install opposite pitch link in same manner. If cotter pins do not engage castellations in nuts, add one thin steel washer under nuts (11).

g. Installation. See figure 5-67.

5-15.1. Disassembly-Tail Rotor Pitch Change Link (AVIM).

a. Remove rivet (32, figure 5-67) from rod end.

b. Loosen jam nuts (55) and remove rod end assemblies (54).

c. Remove jam nuts (55).

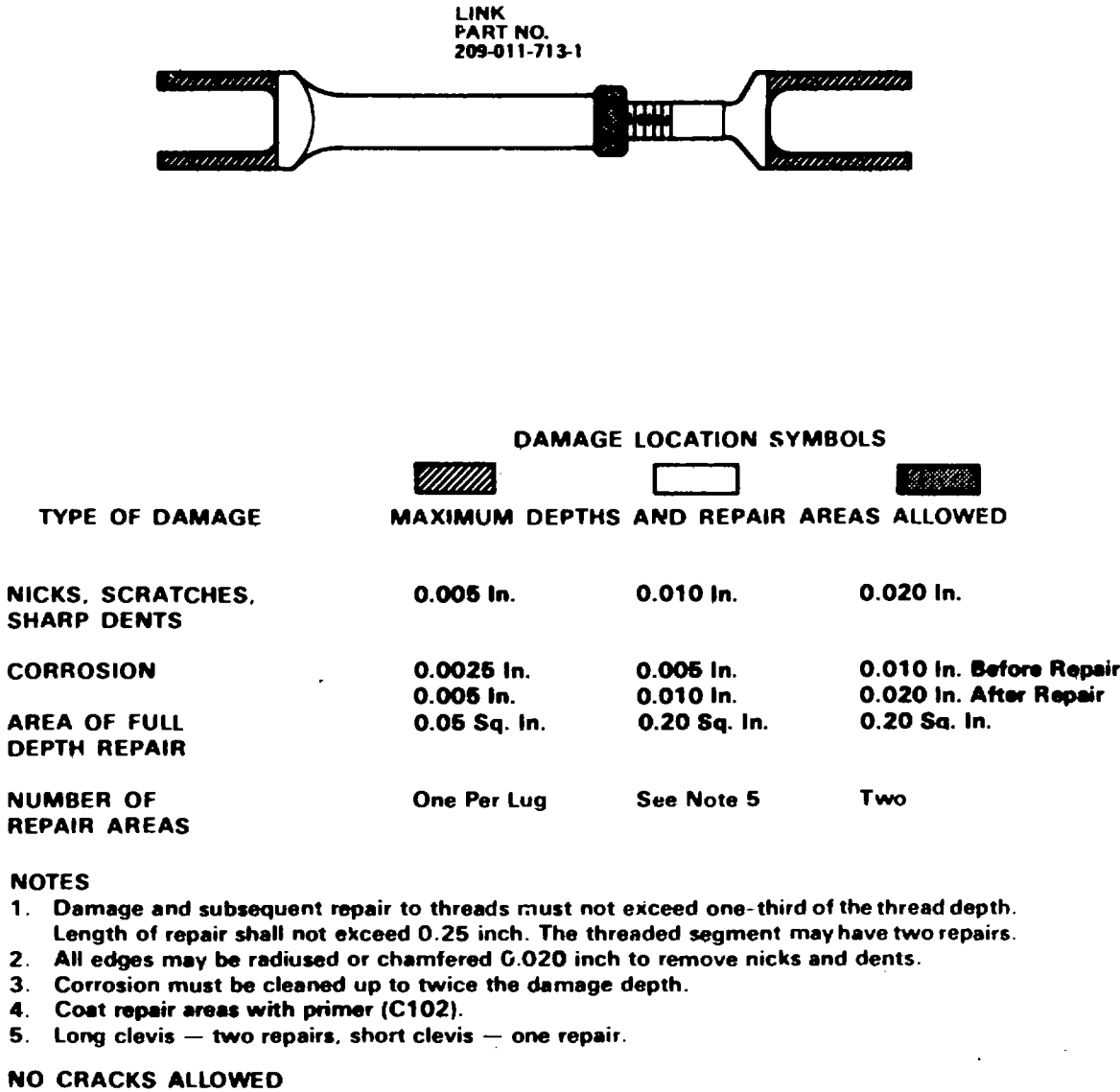
5-15.2. Assembly-Tail Rotor Pitch Change Link (AVIM).

a. Thread jam nuts (55) onto link (31).

b. Thread rod end assemblies (54) onto link (31).

c. Align rivet hole in rod end (54) and link (31), install rivet (32).

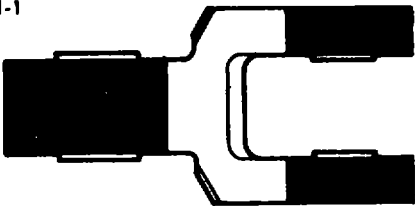
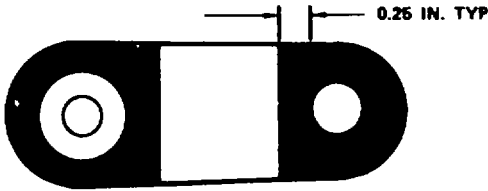
d. Torque jam nuts (55).



209011-29B

Figure 5-74. Damage limits - link assembly

IDLER
PART NO.
209-011-711-1



DAMAGE LOCATION SYMBOLS



TYPE OF DAMAGE	MAXIMUM DEPTH AND REPAIR AREAS ALLOWED	
NICKS, SCRATCHES, SHARP DENTS	0.010 In.	0.030 In.
CORROSION	0.005 In. Before Repair 0.010 In. After Repair	0.015 In. Before Repair 0.030 In. After Repair
AREA OF FULL DEPTH REPAIR	0.25 Sq. In.	0.50 Sq. In.
NUMBER OF REPAIR AREAS	One Per Segment	Two

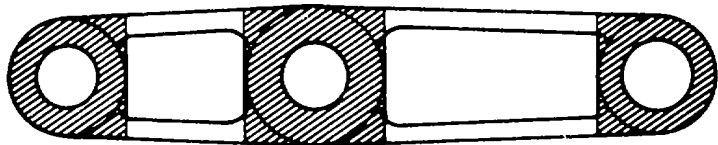
NOTES:

1. Edges may be radiused or chamfered 0.040 inch to remove nicks and dents.
2. Corrosion must be cleaned up to twice damage depth.
3. Coat repair areas with brush alodine (C37).
4. Maximum radial wear for bearing is 0.004 inch.

209011-13B

NO CRACKS ALLOWED

Figure 5-75. Damage limits - idler



LEVER
PART NO.
209-011-712-1

DAMAGE LOCATION SYMBOLS



TYPE OF DAMAGE	MAXIMUM DEPTH AND REPAIR AREAS ALLOWED	
NICKS, SCRATCHES, SHARP DENTS	0.010 In.	0.020 In.
CORROSION	0.005 In. Before Repair 0.010 In. After Repair	0.010 In. Before Repair 0.020 In. After Repair
AREA OF FULL DEPTH REPAIR	One-Half of Any Quadrant	0.50 Sq. In.
NUMBER OF REPAIR AREAS	One Per Segment	One Per Segment

NOTES:

1. Edges may be radiused or chamfered 0.040 inch to remove nicks and dents.
2. Corrosion must be cleaned up to twice the depth of damage.
3. Coat repair areas with brush alodine (C37).
4. Maximum radial wear for bearing is 0.004 inch.

NO CRACKS ALLOWED

209011-12F

Figure 5-76. Damage limits-lever

(1) Install bearing (52) in housing (40). Install excluder (43) with lip containing packing, outboard and housing (41) in housing (40) and secure with retaining ring (42).

(2) Install new packing (38) on housing (40).

(3) Apply unreduced primer (C102) to surface of housing (40) that contacts gearbox and install housing while primer is wet.

(4) Install steel washers and nuts (39). Torque evenly to 60 inch-pounds.

(5) Apply sealant (C119) around joint where housing contacts gearbox. TM 55-1520-234-23

(6) Position idler (47) on gearbox case and secure with bolts, steel washers and nuts (50). Apply sealant (C119) to mating surfaces of washers and case during assembly procedure. Torque nut **110 TO 165** inch-pounds and install cotter pin.

WARNING

Use solvent in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

(7) Wash bearing in lever assembly (48) which attaches to control tube (34) to remove preservative and/or dirt. Use solvent (C124). Hand-pack bearing with grease (C70).

(8) Position lever assembly (48) on idler (47) and install bolt, steel washer and nut (46). Torque nut 110 TO 1 65 inch-pounds and install cotter pin.

(9) Disassemble link assembly (51). Apply preventive compound (C51) to the threads and barrel section of the link assembly but not to the clevis section. Assemble the link and adjust to length of 7.5 inches between centers of bolt holes. Tighten jam nut to secure link assembly parts in position.

(10) Secure link assembly (51) to lever (48) with bolt, steel washers, and nut (49). Torque nut 60 TO 100 inch-pounds and install cotter pin.

(11) Secure link assembly (51) to control linkage with bolt, steel washers and nut (53). Torque nut 1 10 TO 1 65 inch-pounds and install cotter pin.

(12) Secure control tube (34) to lever assembly (48). Position race (44) through bearing in lever and secure with bolt, steel washers and nut (45). Torque nut 1 10 TO 165 inch-pounds and install cotter pin.

(13) Position sleeve (35) on control tube (34) with flange inboard. Rotate sleeve clockwise to engage threads. Continue to rotate until sleeve is past threads and fully seated on control tube shoulder.

(14) Install assembled crosshead, weights, and links. Ensure that weights (17) are installed on outboard side of bellcranks as illustrated and that weights do not contact other parts when controls are moved through full throw. Check rigging and track tail rotor. Refer to paragraph 5-11.

5-15. DESCRIPTION -- VIBREX 4591 SYSTEM.

a. The Vibrex 4591 System may be used to electronically track and balance main and tail rotor blades and troubleshoot other rotating elements. See figure 5-99 for view of Vibrex System components

b. Description and specifications of the Vibrex 4591 System are presented in F03 (foldout 3). Using the

synchronized Strobex, track is visually displayed by rotor Tip Targets. One-per-revolution vibration is measured from an Accelerometer mounted laterally on the airframe to indicate the condition of the main rotor balance. Another Accelerometer, mounted vertically in the front cockpit, reads vertical vibration from out-of-track. The Balancer meter indicates amount, and the Phazor shows location of the required correction, when interpreted by the Track and Balance Charts. Tail rotor balancing is done by mounting an Accelerometer on the fin near the tail rotor gear box. Amplitude of vibration is read from the Balancer meter to indicate the amount of weight change required, and the Strobex, triggered by the Balancer, shows "Clock Angle" that tells where to put the weight. Tail rotor Balance Charts interpret these readings. To locate sources of vibration other than the rotors, the Accelerometer is relocated and the Balancer's filter is tuned to the peak vibration levels. The RPM rate of these vibrations is related to known component RPM to identify the offending element.

c. Track and Balance Charts, Checklist, and "Clock Angle" Corrector. Charts tell what to do to rotor, in response to reading from Balancer, to correct track or balance.

d. Magnetic Pickup, Bracket, and Cable. Mounted on stationary swashplate of main rotor, the Magnetic Pickup delivers an electrical pulse that serves as a trigger for the Strobex for main rotor tracking, and as a phase reference for the phase meter in the Balancer.

e. Accelerometers, Accelerometer Bracket, and Cable. Accelerometers sense the vibration induced by rotors, shafts, fans, bearings, gears, etc.

f. Tip Targets. One is mounted on each main rotor blade tip. Used for viewing main rotor track.

g. VIBREX Tester. For functional test of the VIBREX 4591 System.

h. Strobex Blade Tracker. Used for tracking both main and tail rotors, and for measuring "Clock Angle" when balancing tail rotors.

i. Gram Scale. For weighing balance weights.

j. Carrying Case. For all the equipment.

k. Interrupters. Two Interrupters are mounted on the rotating swashplate of the main rotor, 180° apart. Each time an Interrupter passes the Magnetic Pickup, an electrical pulse is generated in the Pickup. These pulses cause the Strobex to flash twice-per-revolution to illuminate reflect Ave Targets on the blade tips for visual tracking. One of the Interrupters is double, delivering a double pulse from the Magnetic Pickup, once-per-revolution.

CHAPTER 6

DRIVE TRAIN SYSTEM

Section I. DRIVE TRAIN

6-1. Drive Train.

The drive train is a system of shafts and gearboxes through which the engine drives the main rotor, tail rotor, and accessories such as rotor tachometer generator and hydraulic pump. (See figure 6-1.) The system consists of a main driveshaft, a main transmission which includes input and output drives and the main rotor mast, and a series of driveshafts with two gearboxes through which the tail rotor is driven.

6-2. Troubleshooting - Drive Train.

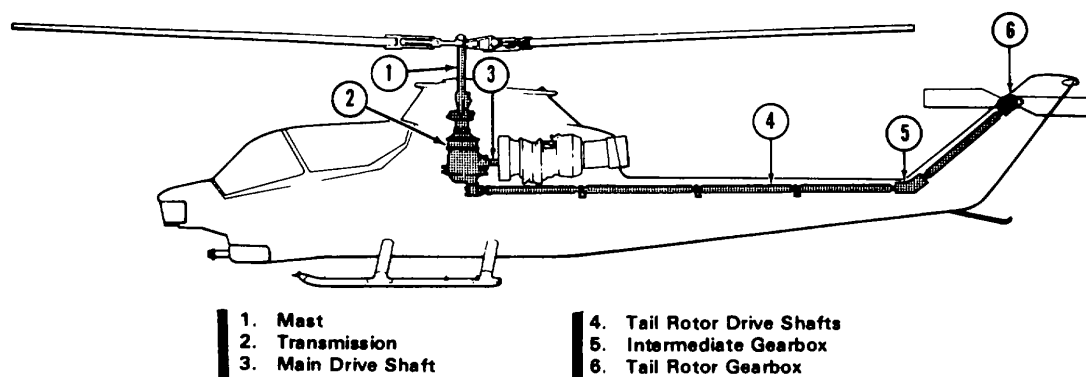
Table 6-1 is a brief summary of drive train troubles which may be encountered in Aviation Unit and Intermediate Maintenance. Conditions and possible causes listed have been limited to those reasonably probable (though not necessarily frequent in normal service) which could become known through pilot reports or by inspection methods applicable in Aviation Unit and Intermediate Maintenance, and which would be subject to some evaluation by Aviation Unit and Intermediate Maintenance personnel. Final corrective action by a higher level of maintenance might be

required in some instances. Conditions involving obvious major damage are omitted as are those caused by accident or an unusual chain of events which would require evaluation by a competent authority.

a. In transmission troubleshooting observe the following:

(1) Low oil level will not cause a low oil pressure indication, provided sump contains enough oil to cover pump inlet. Oil temperature might rise, however.

(2) Effects of an oil leak will depend on its location in system and rate of leakage. An external leak can eventually allow sump to be pumped dry, causing internal failure of transmission. While oil remains to supply the pump, the pressure relief valve would tend to maintain normal system pressure, compensating for leakage. This applies especially to leaks located between the pump and the relief valve. Leaks occurring beyond the valve could cause some indication of low oil pressure.



209910-17G

Figure 6-1. Power train diagram

Leakage to interior of transmission, while not affecting oil level, could starve lubrication areas beyond the leak and might affect indicated oil pressure and temperature. Leakage in the oil cooler circuit, unless very minor, causes the oil cooler bypass valve to shift and direct oil directly to the transmission manifold instead of directing it through the oil cooler. Leaks in the oil cooler and connecting lines may cause above normal oil temperatures.

(3) Cumulative clogging of oil filter screens will not be shown by a gradual drop of indicated oil pressure. Pressure relief valve would maintain normal system pressure even if filter screens became so clogged as to force oil flow through filter bypass valve.

(4) "Use of wrong oil" is omitted from troubleshooting chart because such a case would require special investigation as to damage and corrective action. As to detecting such a condition, little can be said except that most oils which might be available to use by error would tend to cause high oil pressure and high oil temperature indications, or excessive seal leakage.

b. For main driveshaft troubleshooting, apply the

following:

(1) Trouble conditions of main driveshaft can seldom be detected in operation, since there are no reliable indications except possibly in an extreme condition. "Suspected vibration" is only partially accurate as a term for such conditions as dynamic out-of-balance or faulty coupling action. Vibration would result, as well as abnormal stresses and wear, but would be absorbed in structure and pylon mounts or effectively masked by normal vibrations of the helicopter, providing no distinct indication to pilot.

(2) Driveshaft conditions are, therefore, usually those revealed by careful inspection.

(3) The principal causes of driveshaft trouble are faulty installation procedures and inadequate or improper lubrication of spherical tooth couplings.

c. For tail rotor drive system troubleshooting, apply same principles as for main driveshaft.

d. Condition, test or inspection and corrective action are shown in table 6-1.

Table 6-1. Troubleshooting - Drive Train System

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

Transmission

1. Low oil pressure on caution panel or pressure gage, but not both.

STEP 1. Faulty caution panel or gage circuit or unit.

Repair electrical circuit or replace faulty valve. {Refer to paragraph 8-46.}

2. Low oil pressure shown by both caution panel and gage.

STEP 1. Pressure relief valve malfunction.

Repair or replace valve. (Refer to paragraph 6-30.)

Table 6-1. Troubleshooting - Drive Train System (Cont)

CONDITION	TEST OR INSPECTION	CORRECTIVE ACTION
	STEP 2.. Clogged pump screen.	Clean screen, check oil for chips or contamination. (Refer to paragraph 6-34.c.)
	STEP 3. Faulty oil pump.	Replace oil pump. (Refer to paragraph 6-40.a.)
	STEP 4. Leakage or restriction between pressure relief valve and transmitter.	Replace oil line connections or replace seals. (Refer to paragraph 6-9.a.)
3. No oil pressure indication with normal oil level.	STEP 1. Faulty gage, transmitter, or circuit.	Replace oil pressure gage or transmitter, or repair circuit. (Refer to paragraph 8-46.f. and 8-47.f.)
	STEP 2. Oil pump failure.	Replace transmission, or replace pump, if transmission is not internally damaged. (Refer to paragraph 6-9.a.)
4. No oil pressure indication and no oil supply.	STEP 1. Leak in system or failure to service.	Replace transmission and oil cooler, flush and repair external lines. (Refer to paragraphs 6-9.a. and 6-37.d.)
5. High oil pressure indication.	STEP 1. Faulty gage, transmitter, or circuit.	Replace oil pressure gage or transmitter, or repair circuit. (Refer to paragraph 8-46.f. and 8-47.f.)
	STEP 2. Pressure relief valve malfunction.	Replace oil pressure relief valve. (Refer to paragraph 6-30.)
6. High oil temperature indication on caution panel or gage.	STEP 2. Faulty caution panel or gage.	Replace oil temp gage or repair circuit. (Refer to paragraph 8-49.f.)

Table 6-1. Troubleshooting-Drive Train System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

7. High oil temperature indication on both caution panel and gage.

STEP 1. Obstructed air flow around transmission.

Clean cowl openings and sump area. (Refer to paragraph 6-9.)

STEP 2. Clogged oil jets.

Check serviceability of transmission, if serviceable clean or replace oil jets. (Refer to paragraph 6-9.a.)

STEP 3. Seized bearings or other transmission failure.

Replace transmission and oil cooler, and flush external oil lines. (Refer to paragraph 6-9.)

STEP 4. Oil cooler clogged or obstructed.

Clean cooler core air passages. Replace cooler, if internally clogged, and flush oil lines. Check transmission filters, pump screen, and magnetic plug. (Refer to paragraph 6-35.)

STEP 5. Oil cooler thermostatic valve malfunction.

Replace thermostatic valve. (Refer to paragraph 6-37.d.)

STEP 6. Oil cooler bypass valve "activated."

Replace oil cooler or repair leak. (Refer to paragraph 6-37.d.)

8. Oil bypass caution light ON.

STEP 1. Faulty caution light.

Repair circuit. (Refer to paragraph 6-38.)

STEP 2. Low oil level.

Service system. (Refer to paragraph 1-4.)

STEP 3. Leak in oil cooler or connecting lines.

Replace oil cooler or connecting lines. (Refer to paragraph 6-37.d.)

STEP 4. Bypass valve malfunctions.

Replace oil cooler bypass valve. (Refer to paragraph 6-38.e.)

9. Metal chips found on magnetic sump plug or pump screen.

Table 6-1. Troubleshooting-Drive Train System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

STEP 1. Internal transmission failure of gears or bearings.

Replace transmission. (Refer to paragraph 6-9.a.) Replace oil cooler and flush piping. Drain and refill with oil. (Refer to paragraph 6-37.d. and 1-4.)

10. Excessive pylon motion (approx. 1/2/rev.)

STEP 1. Pylon mounts worn or installed wrong.

Repair or replace mounts. (Refer to paragraph 6-12.d.)

STEP 2. Leaking pylon mount dampers.

Replace or repair dampers. (Refer to paragraph 6-16.)

11. Water in transmission.

STEP 1. Water in drain lines.

Clear obstructions from lines. Disconnect lines and purge with compressed air.

MAIN DRIVESHAFT:

1. Grease leakage.

STEP 1. Cut or torn preformed packing.

Replace packing. (Assemble with care.) (Refer to paragraph 6-7.d.)

2. Abnormal coupling wear.

STEP 1. Faulty lubrication or wrong lubricant.

Clean and lubricate coupling or replace driveshaft. (Refer to paragraph 6-7 and 6-7.d.)

3. Lubricant breakdown in forward coupling.

STEP 1. Misalignment or wrong lubricant.

Align engine and transmission, replace driveshaft and associated parts as required. (Refer to paragraphs 6-8.d. and 6-7.d.)

4. Suspected vibration.

STEP 1. Coupling clamps loose, improperly installed, or not matched.

Install clamp sets by instructions. (Refer to paragraph 6-7.)

Table 6-1. Troubleshooting - Drive Train System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

STEP 2. Loose engine adapter.

Replace adapter and any worn associated parts. (Refer to paragraph 6-7.)

STEP 3. Main driveshaft improperly assembled or missing spring.

Disassemble. Inspect and assemble properly. (Refer to paragraph 6-7.d.)

TAIL ROTOR DRIVE SYSTEM:

1. Suspected vibration.

STEP 1. Worn hanger bearings or couplings.

Replace hanger assembly. (Refer to paragraph 6-24.f.)

STEP 2. Shaft balance weights lost or shaft bent.

Replace shaft section. (Refer to paragraph 6-23.)

STEP 3. Misaligned driveshaft clamps.

Align clamps properly. (Refer to paragraph 6-23.)

2. Binding or roughness when manually checked.

STEP 1. Dry or faulty bearing.

Isolate faulty hanger by disconnecting shafts, replace hanger assy. (Refer to paragraph 6-24.f.)

STEP 2. Defective gearbox.

Check gearboxes, replace defective unit. (Refer to paragraph 6-29.c.)

STEP 3. Faulty lubrication of couplings.

Replace hanger, gearbox, or gearbox quills. (Refer to paragraphs 6-24.f and 6-29.c.)

3. Metal chips on gearbox chip detector.

STEP 1. Internal failure of gears or bearings.

Replace gearbox. (Refer to paragraph 6-29.c.)

6-3. Metal Particles Contamination of Gearboxes.

Metal particles found on gearbox oil strainer screens, oil filters or chip detectors may indicate failure of an internal part of the gearbox. The presence of metal particles, however, is not necessarily an indication that the gearbox is no longer serviceable. The quantity, source, form and type of metal found, together with the service history of the particular gearbox, must be taken into consideration. The time accumulated since the gearbox was new or overhauled, previous failures and the type of operation are important factors in determining the further serviceability of the unit. The particles found may be steel, tin, lead, cadmium, aluminum, magnesium, copper (bronze) or phenolic in various shapes and quantities. For a detailed explanation of the action made necessary by the presence of various types of particles in the gearbox, see figure 6-2.

WARNING

When any particles found are readily identifiable as fragments of gearbox parts, such as gears, nuts, bearings, oil slingers, thrust washers, snaprings, safety wire or other components, replace gearbox.

6-4. Identification of Metal Particles.

A visual inspection of color and hardness will occasionally suffice to identify the particles. When visual inspection does not positively identify the particle, the kind of particle present may be determined by a few simple tests. Equipment to perform tests includes a permanent magnet, an electric soldering iron, hydrochloric (muriatic) acid (C4) and nitric acid (C5). Proceed as follows: (See figure 6-2)

a. *Steel.* Isolate steel particles with permanent magnet.

b. *Tin and Lead.* Distinguish tin and lead by their low melting points. Clean soldering iron; heat it to about 500°F; then tin it with 50-50 solder (50 percent lead and 50 percent tin). Wipe off excess solder. Tin or lead particles dropped onto hot, tinned, soldering iron will

melt and fuse with solder. Do not overheat iron.

c. *Aluminum.* Determine aluminum particles by their reaction to hydrochloric acid. When a particle of aluminum is dropped into hydrochloric acid it will fizz with a rapid emission of bubbles. The particles will gradually disintegrate and form a black residue.

NOTE

Since magnesium and aluminum react similarly in hydrochloric acid, when in doubt drop particle into nitric acid. Aluminum does not react noticeably in nitric acid.

d. *Copper or Bronze and Magnesium* Differentiate copper or bronze and magnesium by their respective reactions to nitric acid. When a particle of copper or bronze is dropped into nitric acid it forms a bright green cloud in the acid. When a particle of magnesium is dropped into nitric acid it fizzes with a rapid emission of bubbles. Phenolic and aluminum do not react noticeably to nitric acid.

6-5. Army Oil Analysis Program.

When the spectrographic oil analysis program is being utilized for transmission, intermediate and tail rotor gearboxes, refer to paragraph 6-6 for instructions for taking oil sample and description of probable source of particle. (AR 750-22 and TB 43-0106).

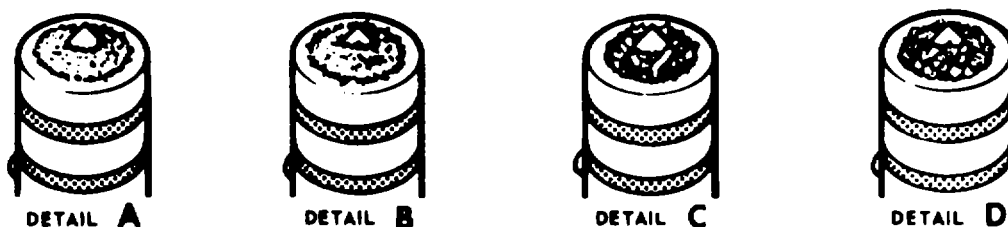
6-6. Source of Metal Particles.

Check for particles at three places; the transmission, intermediate gearbox, and tail rotor gearbox.

a. *Transmission.* Take a sample from sump drain immediately after engine shut down. Allow 1/2 to 3/4 pint of oil to drain through the line before taking sample.

(1) Any of the gear trains, bearings, or a loose or worn shim under the mast bearing will give a high count of iron, copper, aluminum, and magnesium.

(2) A loose fitting on the sump may also show the same trace elements. The rate of increase suspected to be slightly above normal.



METAL PARTICLES CONTAMINATION - GEAR BOX OIL

KIND OF METAL	QUANTITY AND/OR SIZE	ACTION REQUIRED	NOTES
Steel	Fuzz, fine hair-like particles. (See detail A.)	None	Result of normal wear. May have exaggerated appearance because of oil.
	Particles in splinter or granular form. (See details B and C.)	Take oil sample from sump drain for spectro-graph oil analysis. Examine oil filter and determine if chips are excessive. If chips are not excessive, flush gearbox oil system and refill with new oil. Accomplish aircraft ground run, take oil sample, check chip detector and oil filter for metal. If no particles are found, hover aircraft for 30 minutes, take oil sample, check chip detector and oil filter for metal. If no metal is present, release helicopter for flight. If metal is present, replace gearbox.	Usually indicates failure.
	Thin flakes not exceeding 1/64(0.015) inch in thickness and 1/16 (0.060) inch in length. Quantity not to exceed 10 flakes. (See detail D.)	Replace gearbox.	Small quantity may not indicate bearing failure.
	More than 10 flakes not exceeding 1/64 (0.015) inch in diameter and 1/16 (0.060) inch in length; and quantity of flakes exceeding the above dimensions.	Replace gearbox.	Usually indicates failure. May be bearing in one of accessory quills.

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Figure 6-2. Metal Particles Contamination of Gearbox Oil (sheet 1 of 2)

METAL PARTICLES CONTAMINATION -GEAR BOX OIL (CONT)

KIND OF METAL	QUANTITY AND/OR SIZE	ACTION REQUIRED	NOTES
Aluminum or Magnesium	Particles in granular form, or like miniature lathe turnings.	Replace gearbox.	May be result of use of these materials as mallets or drifts during assembly. May indicate wear of oil pump interior surfaces or abnormal interference.
Copper (Bronze)	Particles in granular form.	Replace gearbox.	May indicate excessive wear of bearing cages as result of bearing failure.
Phenolic		None	Result of the use of mallets and drifts during assembly or same as Copper (Bronze) above.

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Figure 6-2. Metal Particles Contamination of Gearbox Oil (sheet 2 of 2)

(3) A high iron, copper, and aluminum count could be caused by one or both of the planetary systems. Rate of increase suspected to be above that for normal wear rate.

(4) High iron, high copper and aluminum content could be from the input quill triplex bearing or the mast bearing. This will increase rapidly and will probably progress to failure.

b. Intermediate Gearbox. Take sample from gearbox drain immediately after shut down. Clean area before removing drain.

(1) High copper count, suspect bearing case on input and output pinion. This is suspected to increase slightly above normal wear rate.

(2) High iron content, suspected gear scuffing or

fretting of bearing inner races.

c. Tail Rotor Gearbox. Take sample from gearbox immediately after shut down. Use a plastic syringe or take from drain. Clean area before removing drain plug.

(1) High iron count, suspect gear scuffing or bearing inner races fretting. Suspected rate of increase slightly above normal.

(2) High iron and copper count could be roller bearings and cage or duplex bearings in quills.

(3) High copper count, the pitch change mechanism is suspected. The reason this assembly is suspected is that when the pitch change quill is lubricated, wear particles from the pitch change quill are forced into the gearbox.

Section II. MAIN DRIVESHAFT**6-7. Main Driveshaft.**

A main driveshaft with flexible splined couplings is installed between an adapter on engine output shaft and the freewheel coupling of the transmission input drive quill. (See figure 6-3.) Two clamp sets, of split V-band type, hold the mating curvic splined faces of couplings in secure contact. Flexibility of couplings is provided by

an inner coupling sliding in splines of an outer coupling to accommodate movement of transmission on pylon mounts. A spring in each coupling assists centering of shaft during operation, and tends to hold shaft assembly in place if clamps are removed during maintenance.

Premaintenance Requirements for Main Driveshaft

NOTE

Do not use cleaning solvent inside shaft couplings.

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	(T22) (T33)
Test Equipment	None
Support Equipment	None
Minimum Personnel Req'd	One
Consumable Materials	(C28) (C45) (C53) (C59) (C68) (C102) (C124) (C136)
Special Environmental Conditions	None

a. Removal.

(1) Open cowling on left and right side of pylon. Remove baffle panels (1 and 2, figure 6-3).

(2) Remove upper air filter assembly (3). (Refer to Chapter 4.) Cover open ends of lower air filter assembly to keep out dirt and foreign objects.

(3) Remove clamp sets (4) from each end of shaft, with attaching parts (5 through 10). Keep parts in sets.

(4) Push shaft assembly (11) toward either end to shift one coupling inward and disengage coupling at opposite end. Remove shaft assembly. Apply enough force to compress springs in couplings.

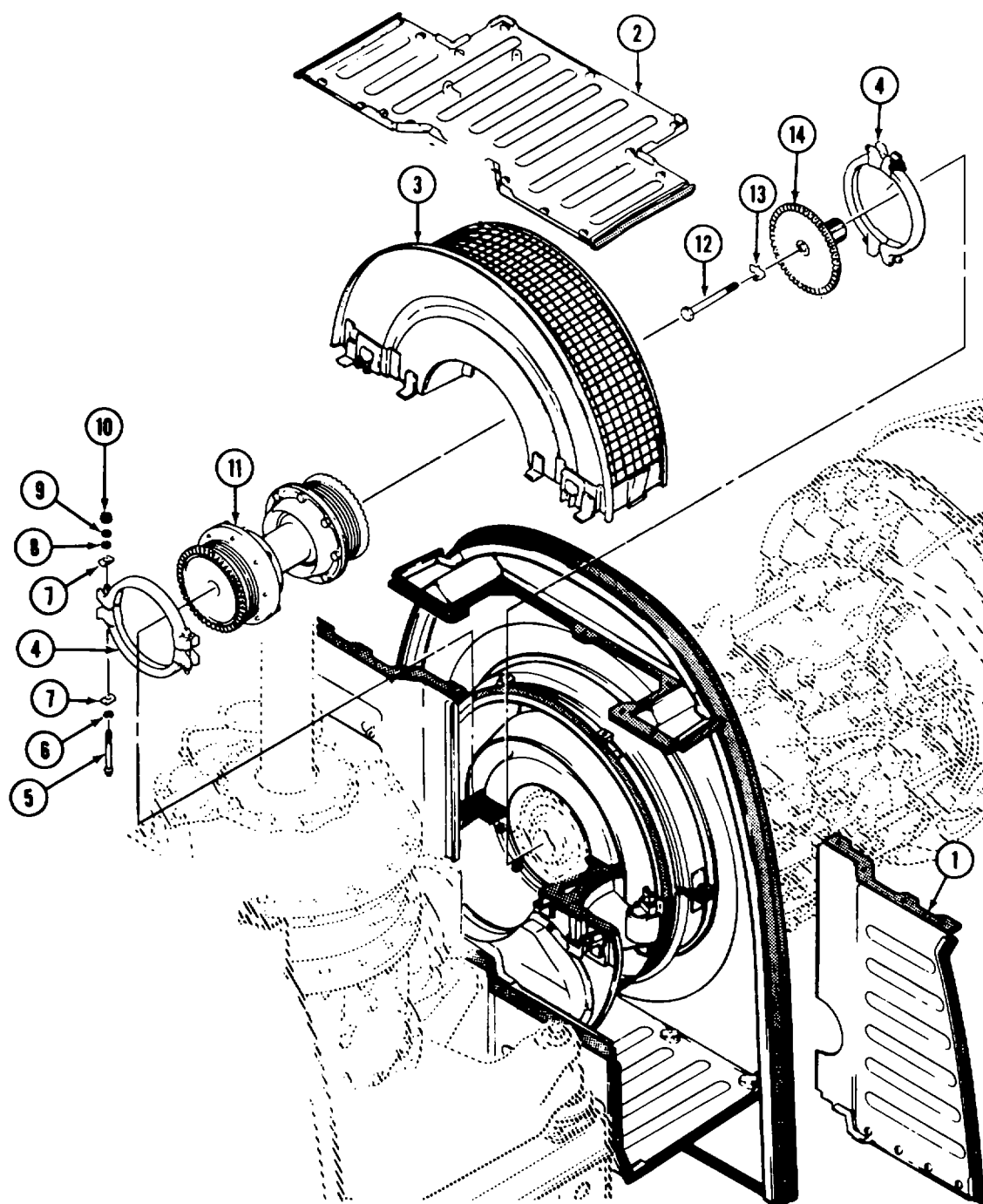
(5) When required, remove lockwire, retaining bolt (12), and washer (13). Pull adapter (14) out of engine output shaft.

b. Cleaning.

WARNING

Cleaning materials are flammable and toxic. Avoid skin contact and breathing of solvent vapors.

(1) Clean shaft assembly, adapter, and attaching parts by wiping with clean cloth. For external parts and surfaces only, cloth can be moistened with cleaning solvent (C124).



1. Baffle panel	5. Bolt	10. Nut
2. Baffle panel	6. Chamfered washer	11. Main driveshaft assembly
3. Upper air filter assembly and screen	7. Pivots	12. Bolt
4. Clamp sets	8. Steel washer	13. Locking washer
	9. Thin steel washer (if reqd)	14. Adapter

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Figure 6-3. Main driveshaft installation

(2) Remove all grease from inner and outer couplings.

c. Inspection Lubrication of Couplings. Inspect driveshaft while installed for security, grease leakage, and evidence of damage.

(1) Remove main driveshaft. (Refer to step a. above.) Keep clamps (4, figure 6-3) in matched sets, and leave adapter (14) installed on engine.

d. Disassembly. Main Driveshaft.

WARNING

Complete disassembly is required to perform inspection and relubrication at each 600 hour/one year interval.

NOTE

Refer to figure 6-5 for views of disassembly.

(1) Secure holding fixture (T-33) to curvic spline of coupling (27, figure 6-4) with clamp set (9) and bolts (1). Secure bar of fixture in a vise.

(2) At opposite end, carefully remove retaining ring (10). Remove grease retainer (12) by pressing down on outer coupling (18). Be prepared for retainer (12) to pop loose by holding it with thumbs. Remove packing (11) from retainer (12).

(3) Remove centering spring (13) and locking spring (14) from splined nut (15). Loosen splined nut (15) using splined wrench (T-22), but do not remove nut.

(4) Remove main drive shaft from fixture. Reinstall grease retainer (12) without packing (11). Secure partially disassembled coupling end to fixture.

(5) Repeat disassembly on opposite end as outlined in steps (2) and (3). Remove shaft from fixture.

(6) Remove splined nuts (15 & 33) and retainers (16 & 32). Remove inner and outer couplings as a unit.

NOTE

If the driveshaft has been dynamically balanced, the outer couplings (18 and 27), inner couplings (17 and 28) and the driveshaft (24) will be indexed as shown on figure 6-4, Sheet 3. Also, one or more lamination weights (21 and 29) will be installed.

(7) If driveshaft has been dynamically balanced (at CCAD), use marking ink to temporarily index relative positions of laminated balance weights (21 & 29), boots (20 & 25), and outer couplings (18 & 27). Mark each end of shaft with different colors or marks. Disassemble as follows:

(a) Cut lockwire and remove bolts (23 & 31), separate outer couplings (18 & 27) from boots.

(b) Temporarily secure laminated balance weights to boots in original positions using lockwire through bolt holes.

(8) If driveshaft has not been dynamically balanced, cut lockwire and remove bolts (23 & 31), separate outer couplings (18 & 27) from boots. Remove outer couplings (18 & 27) and carefully separate boots (20 & 25) from inner couplings (17 & 28).

d.1. Cleaning. Main Driveshaft.

WARNING

Cleaning materials are flammable and toxic. Avoid skin contact and breathing of solvent vapors.

CAUTION

Do not use solvent to clean boot. Solvents may damage boot material.

(1) When driveshaft is completely disassembled clean parts, except boot, with solvent (C124) and dry with filtered dry.

compressed air. Clean boots by wiping with clean dry cloth.

(2) Clean corrosion products from parts prior to inspecting. Use wire brush or scotch-brite.

(3) Remove fingerprints and coat unprotected surfaces with Corrosion Preventive (C55) when disassembled parts are to remain unassembled beyond the current workday. Degrease/depreserve prior to reassembly.

CAUTION

Bare metal surfaces may corrode rapidly if not protected.

d.2. Inspection. Main Driveshaft (Disassembled).

(1) Inspect boots (20 and 25, figure 6-4) for cracks, tears and wrinkles.

(2) Inspect inner couplings (17 and 28, figure 6-4) and outer couplings (18 and 27) as follows:

(a) Visually inspect coupling teeth for wear. (Refer to figure 6-6.)

NOTE

If any defects are noted on inner coupling teeth, the outer coupling teeth will also be damaged.

(b) Inspect couplings for chipped or burned teeth. Inspect each tooth of inner coupling for wear. Use a white card or tongue depressor at root of teeth to deflect light (figure 6-5, detail K). See figure 6-5 for allowable damage criteria.

(c) Inspect visually for cracks.

(d) Inspect visually the area on the two outer couplings over which the performed packings must pass during installation for burrs and sharp edges.

(e) Inspect visually for corrosion and pitting on inner couplings and outer couplings.

(3) Inspect driveshaft (24, figure 6-4) as follows:

(a) Inspect splines visually for chipped teeth.

(b) Inspect splines for local damage.

(c) Inspect for mechanical damage and corrosion.

(4) Inspect splined nut (15 and 33, figure 6-4) as follows:

(a) Inspect splines for broken, chipped or worn teeth.

(b) Inspect area "A", figure 6-6A, for wear in excess of **0.005** inch.

(c) Inspect visually for burrs and scratches.

(d) Inspect visually for cracks and dents.

(e) Inspect for corrosion and pitting. Pits to a maximum depth of **0.030** inch are acceptable and inboard end face (see Area D, figure 6-6A). Apply thin film of coupling lubricant to entire surface of nut.

(4A) Coupling overheat detector paint strip. A 1.0 by 1.1 inch strip of zinc-chromate primer is painted on each side (180° apart) of every flexible driveshaft coupling. The green zinc-chromate primer (TT-P-1757) will turn brown at $375 \pm 5^\circ \text{ F}$, indicating:

(a) Loss of lubricant due to seal failure.

(b) Contaminated or improper lubricant.

(c) Incorrect cleaning and lubricating procedures.

(d) Drive train misalignment.

(5) Visually inspect spring retainer (16 and 32, figure 6-4) for nicks and corrosion.

(6) Visually inspect centering spring (13 and 35) for nicks and corrosion.

(7) Visually inspect retaining ring (10 and 38) and locking spring (14 and 34) for distortion and damage.

(8) Inspect clamp sets (9 and 42) as follows;

(a) Check for matched sets.

(b) Inspect visually for wear.

(c) Inspect visually for cracks.

(d) Inspect visually for corrosion and pitting.

(9) Visually inspect engine adapter (41,

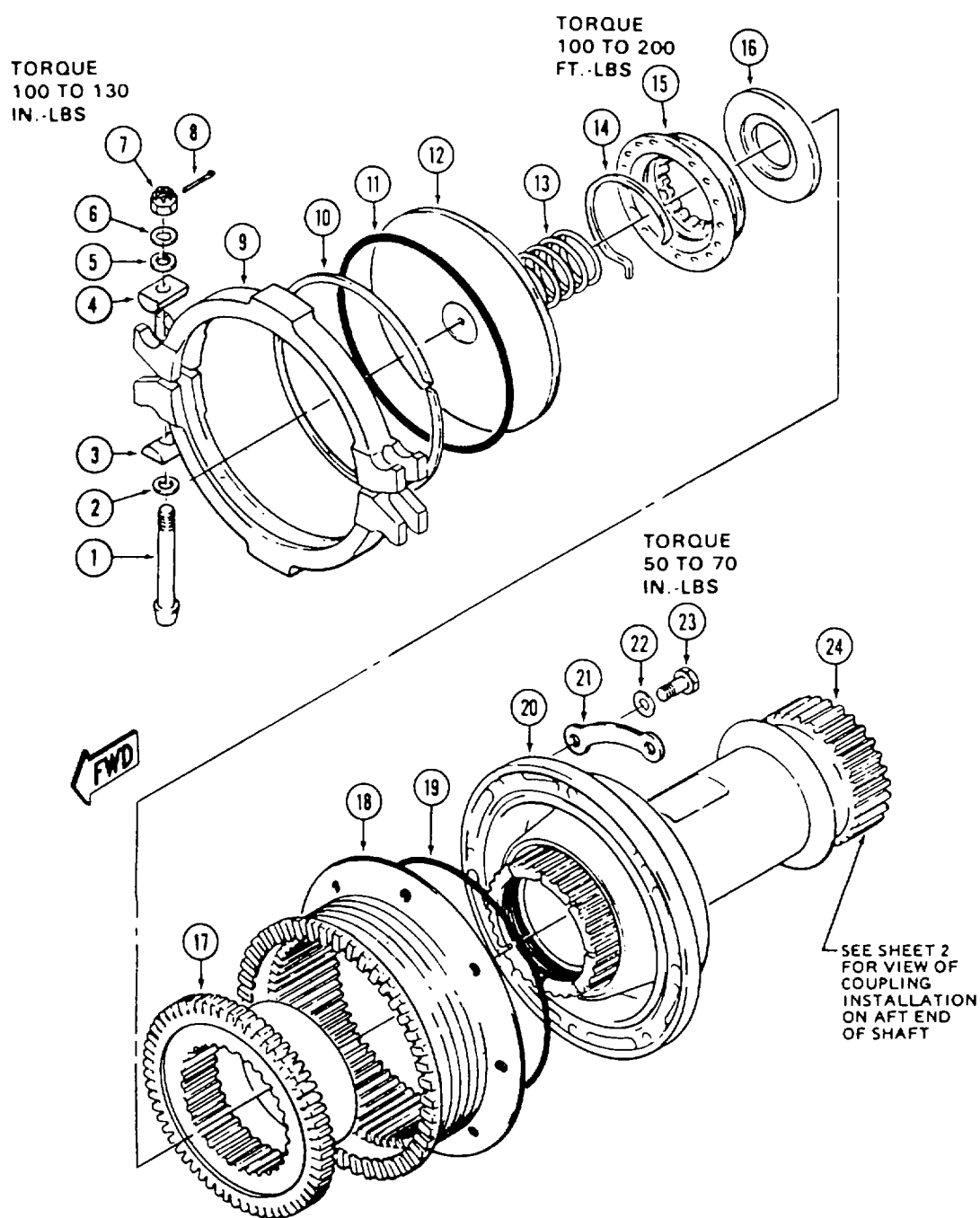


Figure 6-4. Main Driveshaft Assembly (Sheet 1 of 4)

Change 66

6-10B

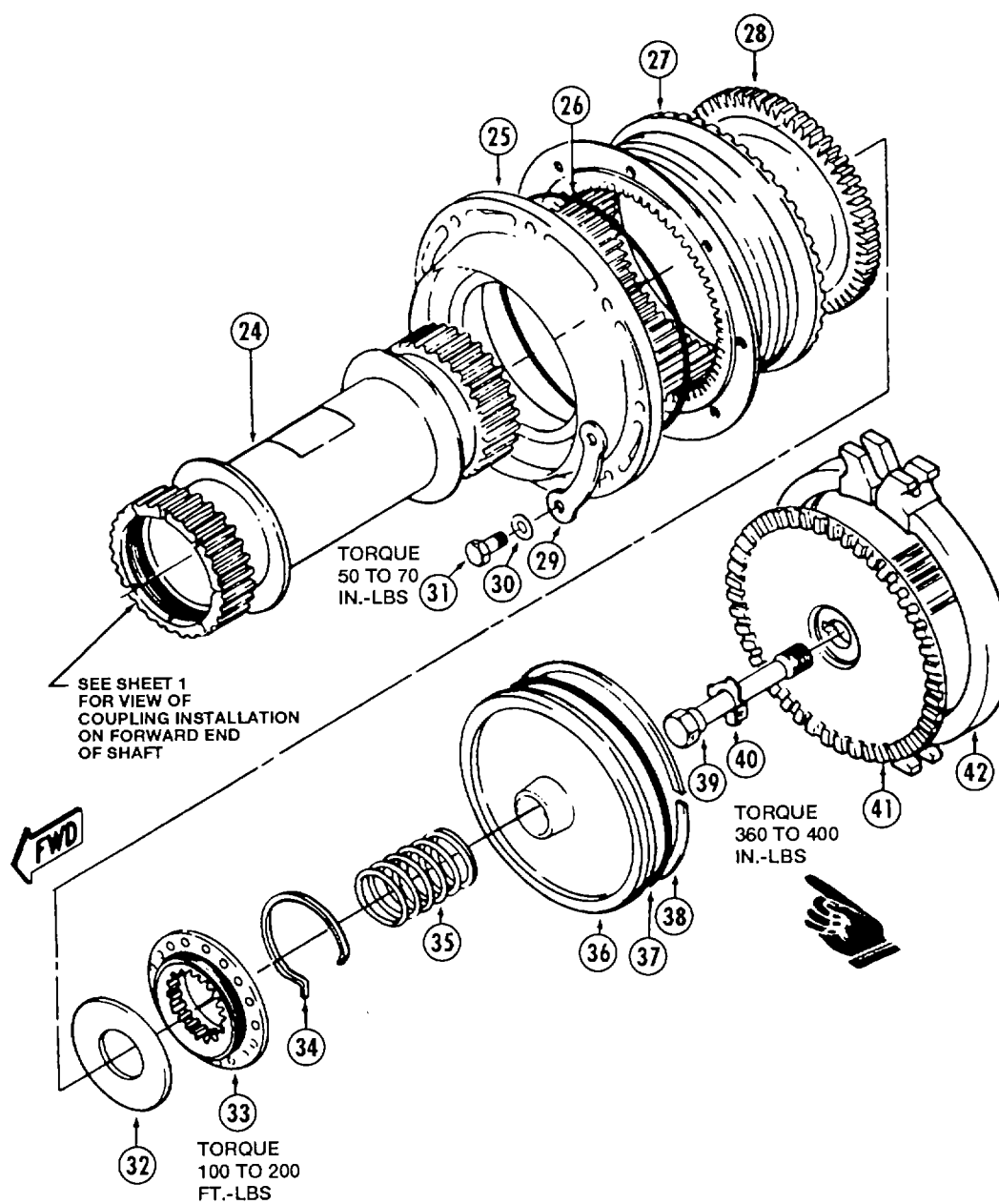
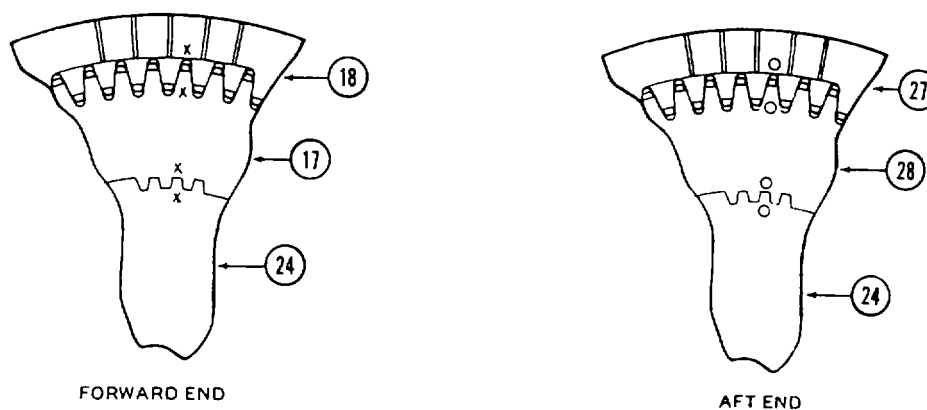


Figure 6-4. Main Driveshaft Assembly (Sheet 2 of 4)

Change 71

6-10C

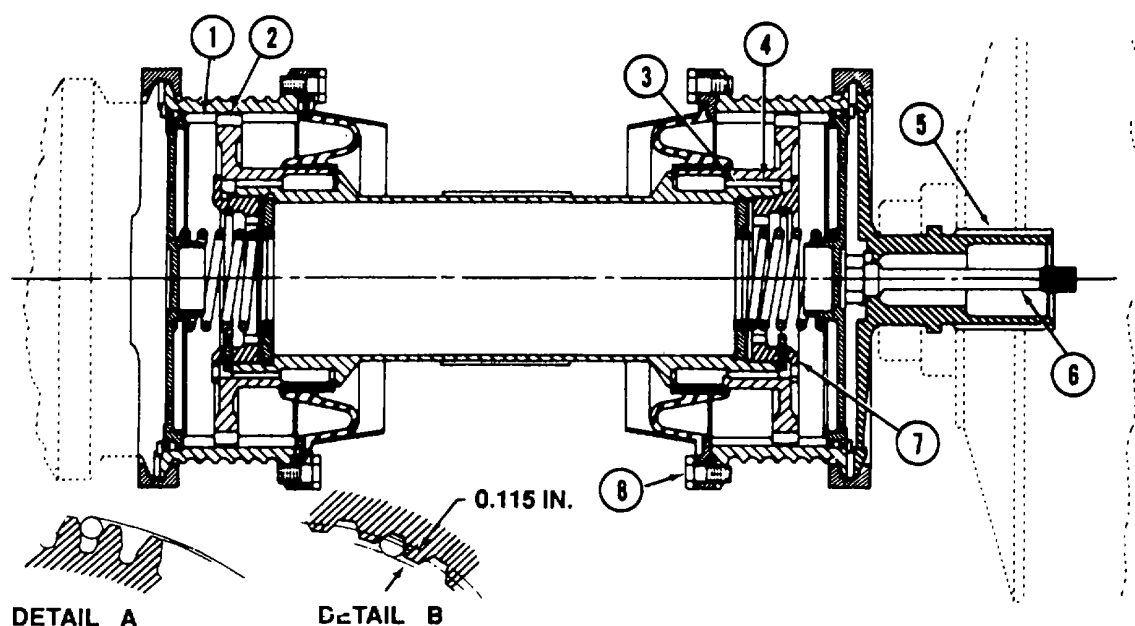


DETAIL VIEW ILLUSTRATING INDEXING OF MAIN DRIVE SHAFT PARTS

1. Bolt	22. Thin aluminum washer
2. Special washer	23. Bolt
3. Pivot	24. Driveshaft
4. Pivot	25. Boot
5. Steel washer	26. Packing
6. Thin steel washer	27. Outer coupling
7. Nut	28. Inner Coupling
8. Cotter pin	29. Laminated balance weight
9. Clamp set (coupling)	30. Thin aluminum washer
10. Retaining ring	31. Bolt
11. Packing	32. Retainer
12. Grease retainer	33. Splined Nut
13. Centering spring	34. Locking spring
14. Locking spring	35. Centering spring
15. Splined nut	36. Grease retainer
16. Retainer	37. Packing
17. Inner coupling	38. Retaining ring
18. Outer coupling	39. Bolt
19. Packing	40. Locking washer
20. Boot	41. Engine driveshaft adapter
21. Laminated balance weight	42. Clamp set (coupling)

Figure 6-4. Main Driveshaft Assembly (Sheet 3 of 4)

Damage Limits



ITEM	NOMENCLATURE	DIMENSIONS (Inches)		
		MIN	MAX	REPLACE
	Cracks	None		
1	Outer coupling — internal spline (dim between pins) (use 0.1440 dia pins) (detail B)	4.8812	4.8852	
2	Inner coupling — spherical teeth (dim over pins) (use 0.1440 dia pins) (detail A)	5.1800	5.1841	5.1549
3	Inner coupling — internal spline (dim between pins) (use 0.1440 dia pins) (detail B)	2.8427	2.8445	**2.8464
4	Shaft — spline (use 0.1920 dia pins) (dim over pins)	3.2928	3.2952	3.2909
5	Adapter — spline (use 0.1200 dia pins) (dim over pins)	1.8067	1.8088	1.8017
		TORQUE		
6	Bolts — adapter retaining	160	200	in-lb.
7	Nuts — coupling retaining	100	200	ft-lb.
8	Bolts — seal housing retaining	50	70	in-lb.

NOTE

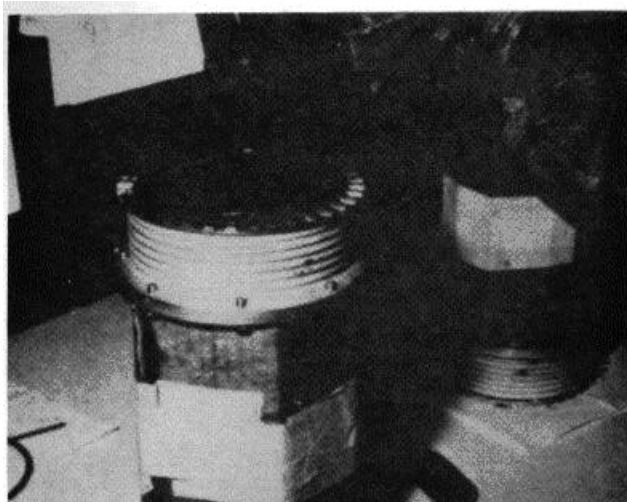
*Maximum allowable depth of wear 0.0055 (measure from unworn face of tooth) (Dimension between pins is mfg. dimension for new parts).

NOTE

**Use pins with one side ground flat to provide clearance between pins and root of spline teeth.

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED.

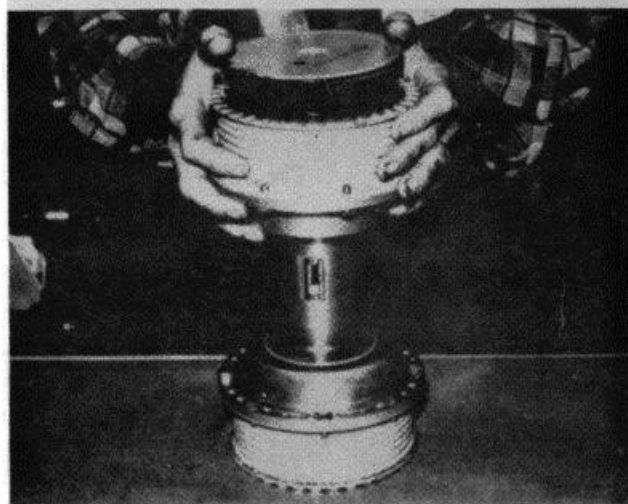
Figure 6-4. Main Driveshaft Assembly (Sheet 4 of 4)



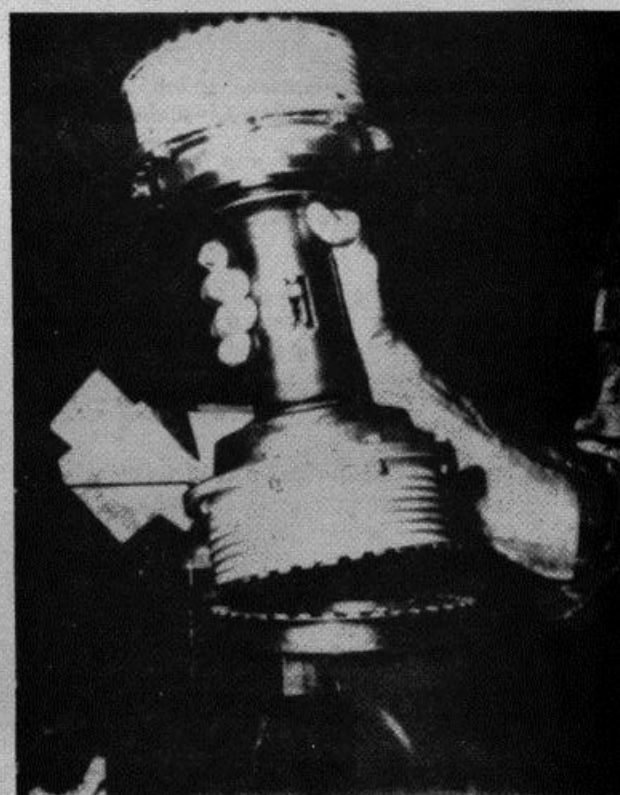
DETAIL A



DETAIL D



DETAIL B



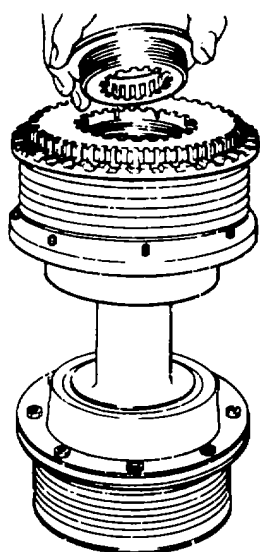
DETAIL E



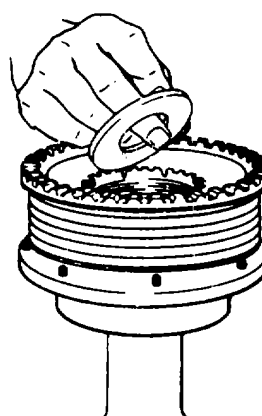
DETAIL C

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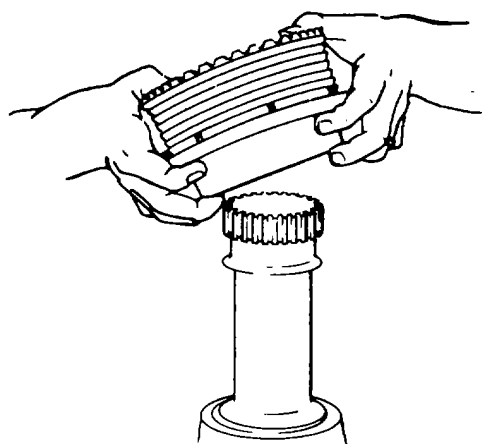
Figure 6-5. Input Driveshaft - Lubrication and Assembly (Sheet 1 of 3)



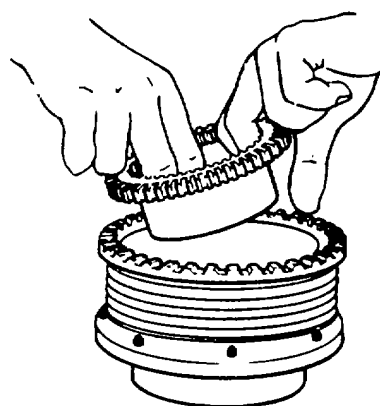
DETAIL G



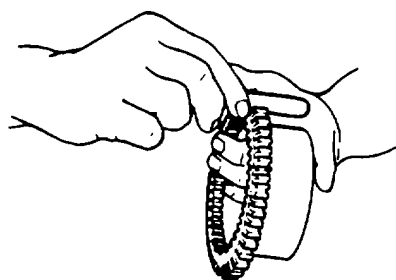
DETAIL H



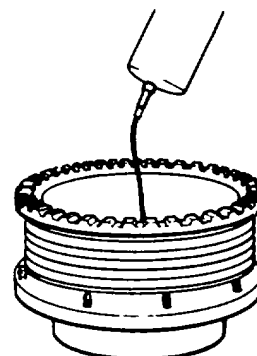
DETAIL I



DETAIL J



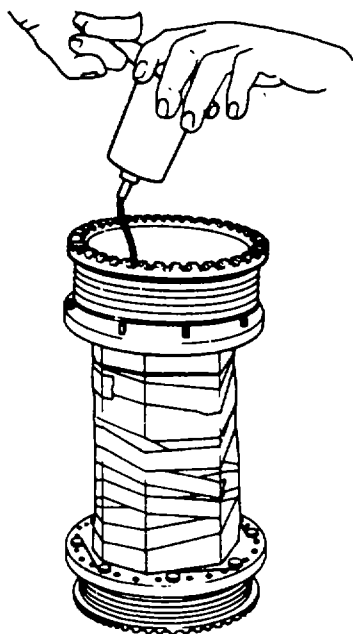
DETAIL K



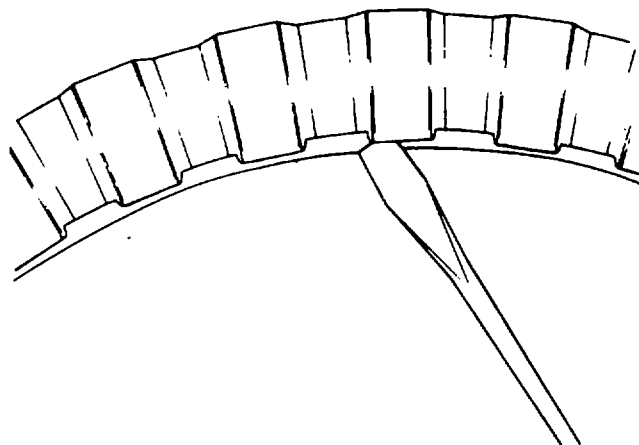
DETAIL L

205040-1085-2

Figure 6-5. Input Driveshaft - Lubrication and Assembly (Sheet 2 of 3)



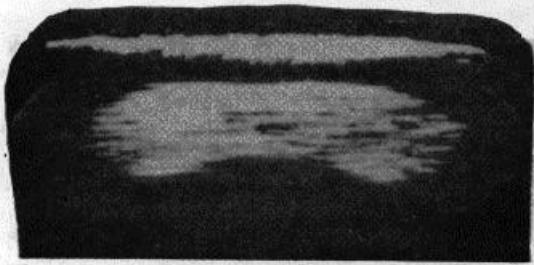
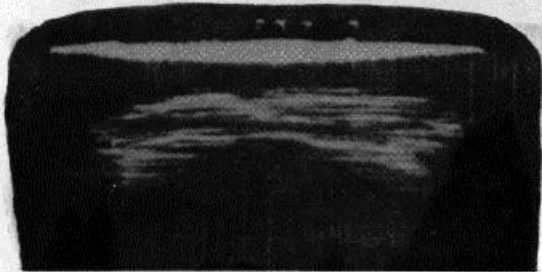
DETAIL M



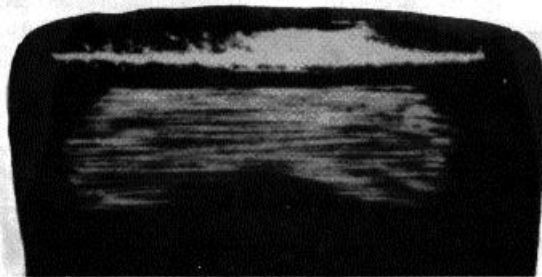
DETAIL N

205040-1085-3

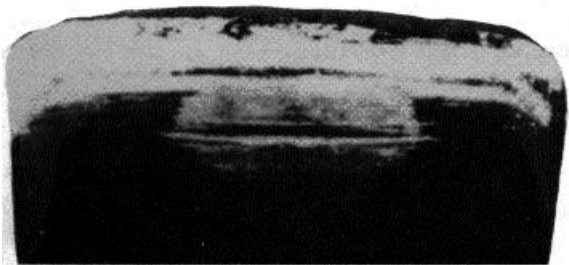
Figure 6-5. Input Driveshaft - Lubrication and Assembly (Sheet 3 of 3)

**DETAIL A****DETAIL B**

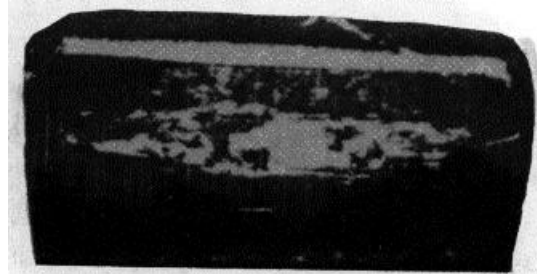
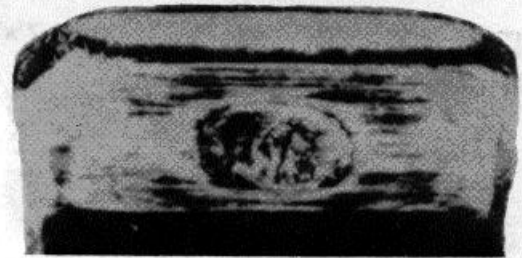
Details A and B show typical acceptable patterns of wear on spherical teeth of male coupling. Patterns will vary due to differences in time in service, alignment, and extent of operation at high power.

**Detail C**

Small defects as shown in Detail C can occur in either Detail A or B. This type of defect is not detrimental to the coupling.

**Detail D**

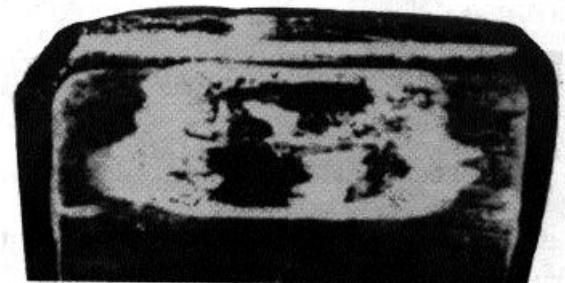
Grooves, as shown in Detail D, of any length are acceptable on not more than twelve consecutive teeth or twenty-four teeth total.

**DETAIL E****DETAIL F**

Condition as shown in Detail E or F are acceptable on not more than five consecutive teeth or twelve teeth total.

Note

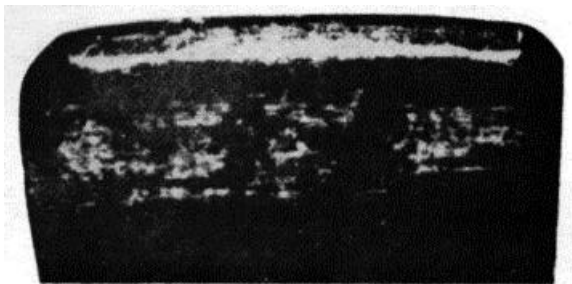
When male coupling is replaced for defects like Detail E or F, female coupling may require honing to remove any buildup of transferred metal.

**Detail G**

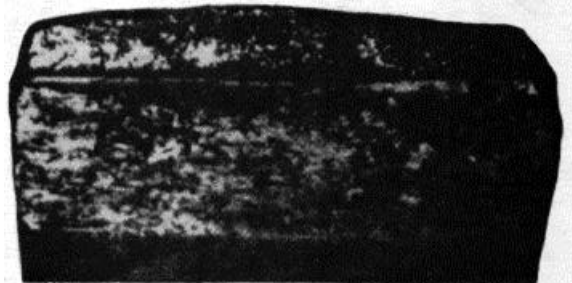
Defects as in Detail G which cover over $\frac{1}{2}$ the tooth length and $\frac{1}{2}$ the tooth depth are to be rejected. Care should be taken in inspection of the female. If metal build-up is not excessive it may be honed down.

205040-1015-1

Figure 6-6. Inspection Criteria for Spherical Inner Couplings on Main Driveshaft (Sheet 1 of 2)



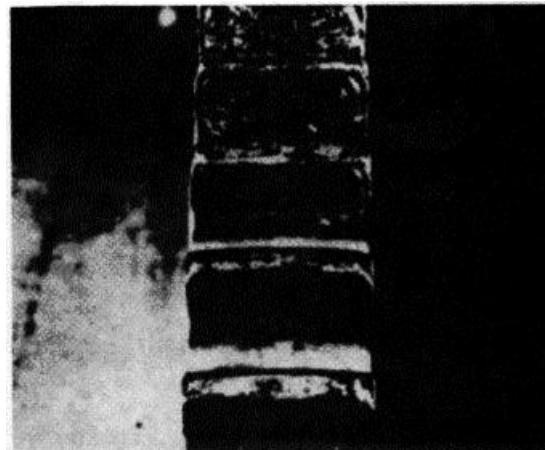
DETAIL H



Conditions shown in Detail H or I are not acceptable. This type of failure has only been found when an improper lubricant had been used. These photos show that the entire tooth surface has been spalled.

All of at least 30 of the 60 teeth will exhibit this failure. Check for the proper kind of lubricant, and be sure the proper amount of lubricant is installed.

Normally if the male coupling is as shown in Details H, I, or J the surface of the female will be damaged and should be scrapped.



Detail J

Detail J shows a group of teeth from a coupling which was run with an improper lubricant. The type of failure as shown in Details H and I.

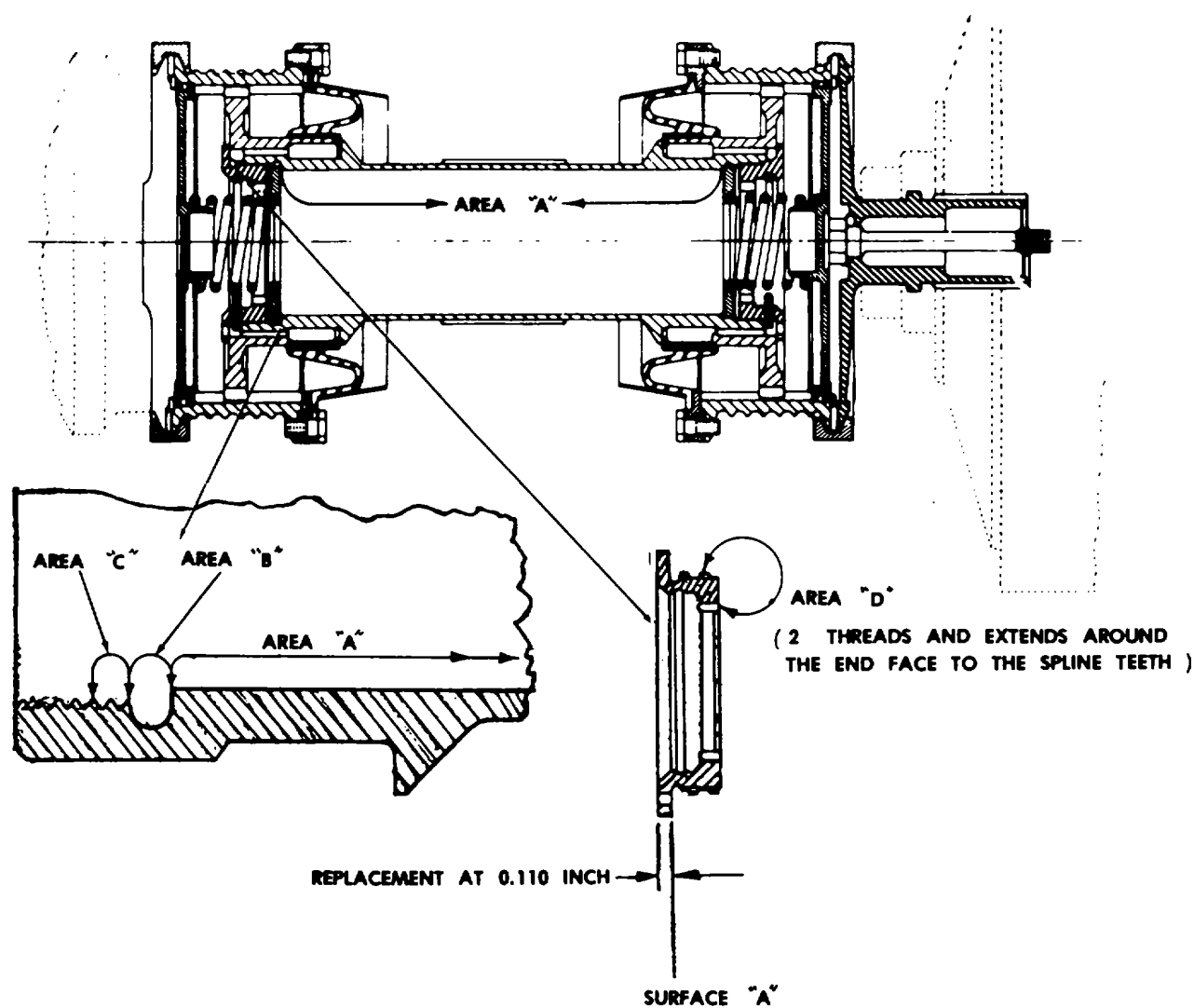
205040-1015-2

Figure 6-6. Inspection Criteria for Spherical Inner Couplings on Main Driveshaft (Sheet 2 of 2)

figure 6-4) as follows:

- (a) Visually inspect splines for chipped or damaged teeth.
- (b) Visually inspect for nicks and burns.
- (c) Visually inspect bolt (31, figure 6-4) for damaged threads and corrosion.
- (10) Visually inspect bolt (31, figure 6-4) for damaged threads and corrosion.
- (11) Inspect the following parts by magnetic particle method (code M) or fluorescent particle method (code F) if cracks are suspected. Refer to TM 43-0103.

FIGURE 6-4 ITEM	NOMENCLATURE	CODE
9 and 42	Clamp Sets	M
12 and 36	Grease Retainer	F
15 and 33	Splined Nut	M
17 and 28	Inner Coupling	M
18 and 27	Outer Coupling	M
24	Driveshaft	M
39	Bolt	M
41	Engine Adapter	M



	A	B	C	D
DAMAGE	(CENTERBORE)	(THREAD RELIEF)	(2 INBOARD THREADS)	(2 INBOARD THREADS AND END FACE)
Allowable Depth W/O Repair	0.005	0.010	0.030	0.030
Max Depth After Repair	0.015	0.025	N/A	N/A
Min Blend Radius	0.500	0.090	N/A	N/A
Max I.D. (If Honed)	2.430	N/A	N/A	N/A
Surface Finish	63 RMS	63 RMS	N/A	N/A

Figure 6-6A. Limits Chart - Main Driveshaft Assembly

d.3. Repair. Main Driveshaft.

(1) Replace Main Driveshaft if extensive or excessive corrosion/damage exists.

(2) Repair outer couplings (18 & 27, figure 6-4) and inner couplings (17 & 28) as follows:

(a) Replace, without repair, if outer couplings (18 & 27) internal spline wear exceeds 0.005 inch depth (measure from unworn face of tooth).

(b) Replace, without repair, if coupling teeth damage is not within acceptable limits. (See figure 6-6.)

(c) Replace, without repair, if couplings are discolored or blistered due to overheating.

(d) Replace, without repair, if coupling teeth are chipped.

(e) Replace, without repair, if couplings are cracked.

(f) Replace, without repair, if superficial corrosion on spline teeth is in excess of amount removable by using abrasive pad (C113) and hand polishing. Corrosion pits on spline teeth are not allowable.

(g) Polish out burrs and sharp edges on outer couplings in area where packing must pass during installation. Use a fine India Stone (C128).

(3) Repair exterior surface of driveshaft (24) as follows:

(a) Replace, without repair, if driveshaft is extensively or excessively corroded.

(b) Replace, without repair, if nicks or scratches exceed **0.010** inch in depth.

(c) Replace, without repair, if driveshaft is cracked.

(d) Replace, without repair, if local damage on splines exceeds 0.002 inch in depth and/or 10 percent of the total effective spline surface area.

(e) Polish out burrs and scratches on driveshaft (24) exterior surface as follows:

NOTE

Nicks and scratches deep enough to require polishing out must have the repair area finished with a minimum radius of **0.500** inch. All repair areas must be touched-up with two (2) coats of primer (C102).

1 Nicks and scratches running parallel to or within **15** degrees of shaft axis.

a Not exceeding **0.005** inch in depth permissible without polishing out.

b Not exceeding **0.010** inch in depth permissible if polished out using a **0.050** inch radius and provided total polished area does not exceed 25 percent of circumference at any point.

2 Nicks and scratches not running within **15** degrees of axis must be polished out using fine abrasive cloth (C44). Finish with a **0.500** inch minimum radius.

a If not exceeding **0.005** inch in depth, must be polished out using abrasive cloth (C44) by hand. Repair may extend around **100** percent of circumference.

b If not exceeding **0.010** inch in depth, must be polished out provided total does not exceed 20 percent of circumference at any point. Also, maximum total cumulative rework in this step is 25 percent of circumference at any point.

c Replace, without repair, if nicks and scratches exceed **0.010** inch depth.

d Replace, without repair, if rework of area in excess of **5** percent of the plated area is required. If area is less than **5** percent, repair and touch-up with primer (C102) after rework.

(4) Repair inner surface of driveshaft (24) as follows: (see figure 6-6A for limits).

(a) Replace, without repair, if driveshaft is extensively or excessively corroded.

(b) Repair inner surface of driveshaft (24) due to corrosion damage as follows:

NOTE

Repairs in Areas A & B must be touched-up with two coats of primer (C102) after removal of all corrosion products. Mask thread area to prevent application of primer.

1 In Area A, pits to a maximum depth of **0.005** inch are acceptable without polishing out. Pits greater than **0.005** inch in depth must be polished out. Maximum acceptable depth of rework to completely polish out pits is **0.015** inch, or to a maximum inside diameter of **2.430** inch, provided rework is done by honing or other suitable means, such that material removal is uniform around the full inside diameter.

2 In Area B, pits to a maximum depth of **0.010** inch are acceptable without polishing out. Pits greater than **0.010** inch in depth must be polished out. Maximum acceptable depth of rework to completely polish out pits is **0.025** inch. Minimum acceptable radius in rework area is **0.090** inch and surface finish must be **63** RMS or better.

3 In Area C, pits to a maximum depth of **0.030** inch are acceptable without rework. Apply thin film of coupling lubricant to entire thread area.

(5) Repair splined nut (15 & 33) as follows: (refer to figure 6-6A for limits).

(a) Replace, without repair, any nut with damage/galled threads or chipped/broken teeth.

(b) Replace, without repair, if evidence of cracks is found.

(c) Replace, without repair, if nut is extensively or excessively corroded.

(d) Polish out nicks, burrs, and scratches (except threads) with fine India Stone (C128).

(e) Pits due to corrosion to a depth of 0.030 inch are acceptable without rework on the two (2) inboard threads and inboard end face. Apply thin film of coupling lubricant to entire surface of nut.

(6) Repair spring retainer (16 & 32) as follows:

(a) Replace, without repair, if retainer is extensively or excessively corroded.

(b) Pits due to corrosion to a maximum depth of **0.030** inch are acceptable without rework. Treat with brush alodine (C37).

(7) Repair centering spring (13 & 35) as follows:

(a) Replace, without repair, if spring is extensively or excessively corroded.

(b) Replace, without repair, if spring is nicked, gouged, or deeply scratched.

(c) Remove superficial corrosion by polishing with scotch-brite. Corrosion pits are not acceptable. Apply thin film of coupling lubricant to entire spring.

(8) Replace, without repair, retaining ring (10 & 38) and locking spring (14 & 34) if bent or distorted.

(9) Repair engine driveshaft adapter (41) as follows:

(a) Replace, without repair, if extensively or excessively corroded.

(b) Replace, without repair, if teeth are chipped or excessively worn.

(c) Repair burrs or scratches as follows:

1 Polish out minor damage covering less than **5** percent of plated area using fine stone (C128). After repair touch-up with primer (C102).

2 Replace, without repair, if rework exceeds **5** percent of plated area.

(d) Repair splines on engine driveshaft adapter (41) as follows:

1 Replace, without repair, if crack or dent damage exists.

2 Replace, without repair, if damage on splines exceeds **0.002** inch depth and/or **10** percent of the effective spine area.

(e) Remove superficial corrosion damage with abrasive pad (C113). Touch-up with primer (C102).

(10) Replace bolt (39) if damage or corrosion exists.

(11) Repair clamp sets (9 & 42, figure 6-4) as follows:

(a) Replace, without repair, if clamps are not matched set.

(b) Replace, without repair, if worn excessively.

(c) Replace, without repair, if cracked.

(d) Inspect for corrosion. Remove superficial corrosion with abrasive pad (C113). Replace clamp set, if corrosion is severe.

d.4. *Lubrication and Assembly.* Main Driveshaft (figure 6-5).

NOTE

One six ounce tube of coupling lubricant (P/N 204-040-755-5, Syntech 3913-G1) provides correct amount of grease in one end of driveshaft.

If main driveshaft has not been dynamically balanced or if driveshaft (24) or couplings were replaced, disregard use of laminated balance weights and indexing of parts.

(1) Lubricate new packing (19) with coupling lubricant and install in groove of boot (20). Install boot on coupling, making sure that large holes in boot mate with the tapped holes in the outer coupling (18). Install, as necessary, balance weights (21) indexed to coupling (18). Install eight bolts (23) with thin aluminum washers (22). Torque bolts evenly **60 to 70** inch-pounds.

Lockwire (C151) bolts in pairs.

(2) Assemble opposite outer coupling (27), packing (26), boot (25), and weights (29) in the same manner as in step (1).

(3) Position each coupling and boot assembly with boot down. Squeeze one-fourth of a tube of lubricant (C68) into outer coupling splines next to boot. Save remainder of tube for later use. Apply one-fourth tube of lubricant from a second tube into other coupling splines in the same manner.

(4) Carefully place inner couplings into outer couplings. Assure that index parts "X" and "O" are indexed per figure 6-4 (sheet 3 of 3), to maintain a dynamically balanced shaft.

(5) Determine the correct end of driveshaft (24), on which to install couplings. Inspect driveshaft (24) and couplings for "X" and "O" index marks.

(6) Apply a thin film of coupling lubricant to all internal portions of driveshaft (24), which may not be primed, retainer (16 & 32), splined nut (15 & 33), and centering spring (13 & 35).

(7) Place a coupling assembly on end of driveshaft (24), indexing splines as required. Install retainer (16) and splined nut (15) finger tight to hold parts in place. Repeat procedure at opposite end of driveshaft (24).

(8) Install grease retainer (12) in outer coupling (18), without packing (11). (Retainer will serve as a spacer to prevent accidental disengagement of coupling splines.) Secure shaft assembly, end with grease retainer (12) on holding fixture (T33), in a vise.

CAUTION

Before applying torque on splined nuts, be sure splines of inner and outer couplings are fully engaged to avoid wrinkling and damaging boots.

(9) Torque splined nut (33) **100 to 200** foot-pounds, using splined wrench (T22). Install locking spring (34). Ensure that spring tang is fully engaged with slot in end of driveshaft (24).

(10) Repeat steps (8) and (9) on opposite end of shaft. Remove tools.

(11) Full extend couplings outward on the shaft. A piece of corrugated cardboard approximately 7.25 by 16 inches, wrapped around shaft may be used to hold coupling position.

(12) Apply remaining three-fourths tube of lubricant (C68) evenly over internal splines of outer coupling.

NOTE

One six-ounce tube of coupling lubricant provides correct amount of grease in one end of shaft.

(13) Lubricate a new packing (11) with coupling lubricant and install a groove around grease retainer (12). Install centering spring (13) and grease retainer (12) in outer coupling (18). Use caution to prevent damage to packing (11). If there is evidence of damage, such as a sliver of packing being cut off, remove retainer and install new packing.

(14) Install retaining ring (10) and ensure that it is seated securely in groove of outer coupling (18).

(15) Turn shaft over, with incomplete coupling up, and repeat process in steps (12), (13), and (14) on opposite end of shaft.

(16) Remove cardboard from shaft and clean all traces of lubricant from exterior of driveshaft assembly with clean dry cloth.

e. Installation.

NOTE

Before installing driveshaft, carefully wipe clean the area surrounding the driveshaft, especially the dust separator, fifth mount beam, and collective tube.

(1) If removed, coat adapter (14, figure 6-3) with lubricant (C68) and install into engine shaft. Install bolt (12) and locking washer (13), with short tab of washer in slot of adapter. Torque bolt **360 TO 400 INCH-POUNDS** and secure head to tab on washer (13), using lockwire (C151).

(2) Place driveshaft assembly (11) between engine adapter and transmission input drive quill.

(3) Install clamp sets (4) to secure each end of shaft.

(a) Wipe inside grooves of clamps (4, figure 6-3) clean of grease. Fit clamp halves around coupling joint, checking that serial numbers on both halves are alike and on same side. Clamp halves should fit snugly and hold themselves in place without bolts.

(b) Place washer (6, figure 6-3) on bolt (5) with chamfer against head. Install bolt, with head in direction of rotation, through pivots (7) and clamp ends. Install washer (8) and nut (10).

(c) **TORQUE NUT 100 to 130 INCH-POUNDS**, keeping equal gaps between ends of clamps within 0.030 inch. Tap around outside of clamp set to ensure good seating, and recheck torque. Install cotter pins.

NOTE

Thin steel washers may be added if required under nut, use equally on opposite bolt to maintain balance.

(d) Install opposite end clamp set, positioned 90° around shaft in relation to previously installed clamp set. Wipe any grease from shaft exterior. Install upper air filter assembly. (Refer to Chapter 4.) Close cowling.

(4) After first ground run-up, inspect areas around both main driveshaft couplings, in line with coupling clamps, for evidence of grease slinging. If grease leakage is indicated:

(a) Remove clamp sets to check for grease in grooves. If grease is found in clamp grooves, remove shaft and inspect couplings for lubrication and proper installation of packings. (Refer to preceding step c.)

(b) If no grease is found, reinstall clamps. Watch for further evidence of leakage in next runup.

f. Preparation for Storage or Shipment.

- (1) Clean and dry main driveshaft, (see paragraph b.)
- (2) Apply compound, (C53), to unplated steel surfaces.
- (3) Wrap assembly in barrier material (C29), and secure with pressure-sensitive tape (C136). Shape wrapper to contour of assembly.
- (4) Place driveshaft into contoured bottom cushion of metal container, and align to fit contour.
- (5) Align top contoured cushion to fit driveshaft and lower into container.
- (6) Place 10 eight-unit bags (total 80 units) of desiccant, (C59) in container.
- (7) Place rubber gasket on lower half of container and install container lid.
- (8) Install locking ring over lip of container lid and container and secure with bolt and nut. Tighten nut sufficiently to ensure a moisture-vapor proof closure.

6-8. Driveshaft Alignment.

a. Reason for check. Check alignment for main driveshaft installation between transmission input drive quill coupling and engine output shaft adapter when any of the following conditions apply:

- (1) Main driveshaft inspection reveals excessive wear of coupling splines.
- (2) Main driveshaft has multi-color appearance indicating excessive heating.
- (3) Driveshaft misalignment is suspected for any reason.
- (4) Engine tripod mount, engine bipod mount or engine forward support tube mount is replaced.
- (5) Any engine mount to service deck fitting is changed.

(6) Shim stack-up under any engine mount to service deck fitting is changed.

(7) Major repair to the center fuselage section and tailboom.

(8) Driveshaft couplings have multi-colored or straw colored appearance, indicating over heating.

NOTE

When engine is replaced, driveshaft alignment check is not required, provided engine mount components, deck fittings, or shim stack-up is not changed.

b. Alignment Procedure.

(1) Remove main driveshaft (paragraph 6-7). Leave adapter (41, figure 6-4) installed in end of engine output shaft.

CAUTION

Do not attempt to raise transmission with jacks only. Hoist must be used in conjunction with jacks while lifting.

(2) Attach (T49) or other suitable hoist to main rotor retaining nut at top of mast. Install four (T36) jacks, two at each side between transmission support case and top of pylon supports. (See figure 6-7.)

(3) Remove nut and washer from lower bolt of lift link, and operate hoist to raise transmission until bolt can be freely moved with fingers or wrench. Adjust jacks to hold pylon at this position with hoist slack. Replace bolt if binding occurs due to corrosion or galling.

(4) Check that transmission support points are parallel symmetrically with pylon support structure, by measuring at each mount with a micrometer depth gage as shown in figure 6-7.

(a) Measure dimension from top surface of support case mounting plate to top of pylon support. All four dimensions should now be equal within **0.020** inch.

(b) When all four points cannot be adjusted to same dimension, take average of two front points and adjust two rear points accordingly.

(5) Install target plate of alignment tool set, (T32), on transmission input quill coupling, index arrow of center at **3.5** on inner scale. Secure by tightening two washer-head screws at back of plate. Position plate on coupling with **1.75** index of outer scale at top on vertical centerline. (See figure 6-8.) Secure with coupling clamp set.

(6) Install alignment gage of tool set on engine output shaft adapter. Secure with coupling clamp set.

(7) Check horizontal and vertical alignment by extending plunger of gage toward target plate hole. Push plunger forward against tension of retracting spring.

(a) Largest diameter of plunger must enter target hole to indicate correct alignment.

(b) If misalignment is indicated, observe amount and direction.

NOTE

No correction should be attempted before completing angularity check in following step. Shim requirements can be determined best on basis of both checks.

(8) Perform angularity check with dial indicator mounted on end of alignment gage housing as follows:

(a) Position indicator for contact at **2.5** inch radius (just inside outer scale numerals) on target plate (part of T32).

(b) Rotate gage through a full turn to find area of plate nearest to engine. This should occur at left side of plate between 8 and 10 o'clock position. Zero indicator in this area.

(c) Check run-out through a full turn of gage to be within **0.016** inch maximum total indicator reading. If run-out is greater than 0.016 inch, make correction of engine alignment by use of shims under engine mount deck fitting as required.

NOTE

A plus (+) indicator reading indicated flange of transmission is closer to flange of engine.

CAUTION

Do not exceed 0.312 inch shim thickness under any fitting.

(9) Repeat alignment and angularity checks after any change of shims.

(10) When alignment is complete, reinstall washer and nut on lift link lower bolt. Torque nut **30 to 50** foot-pounds. Remove jacks (T36) and hoist (figure 6-7).

(11) Install driveshaft. (Refer to paragraph 6-7, e.)

NOTE

After alignment and angularity adjustments perform the following:

Power level control rigging.

Power turbine governor rigging.

Droop cam rigging.

Vibration analysis.

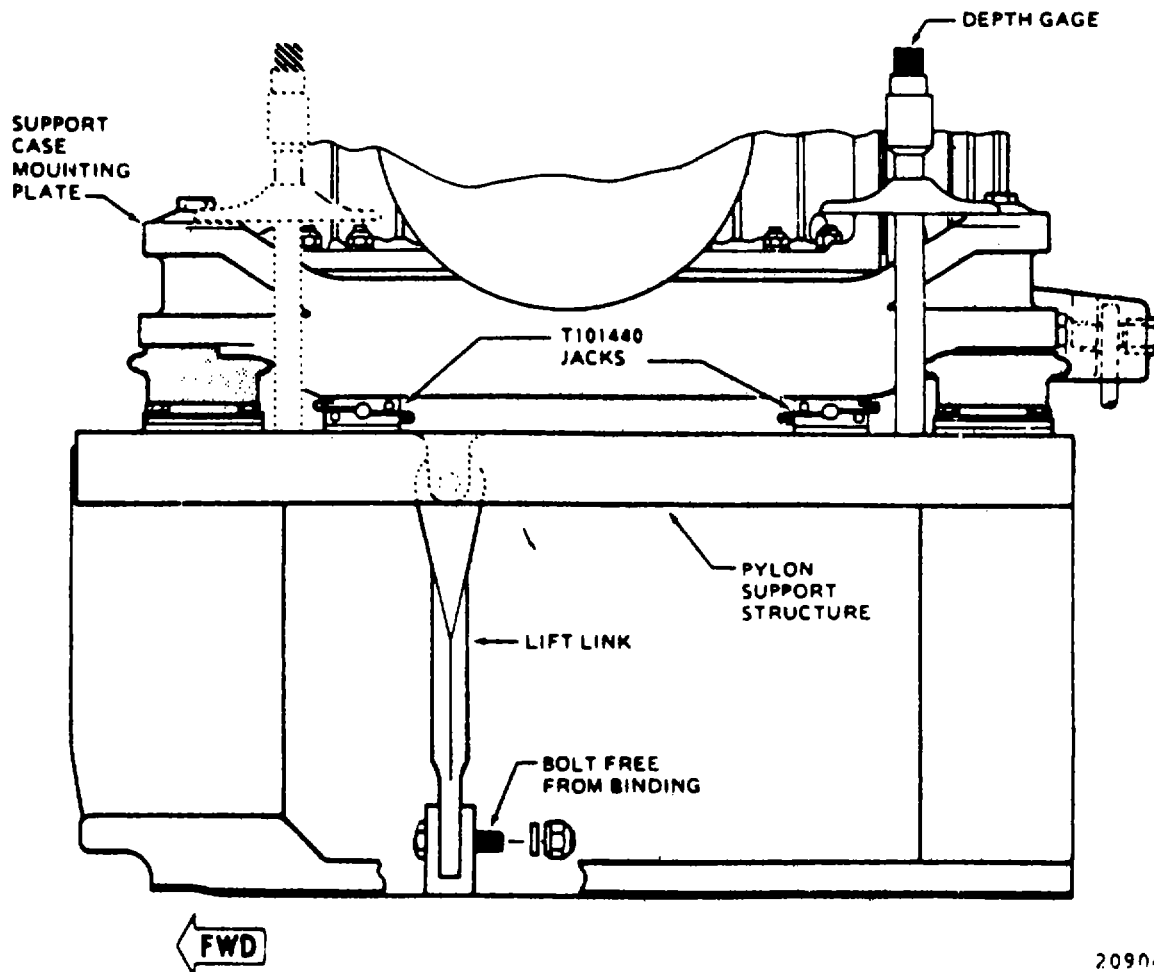
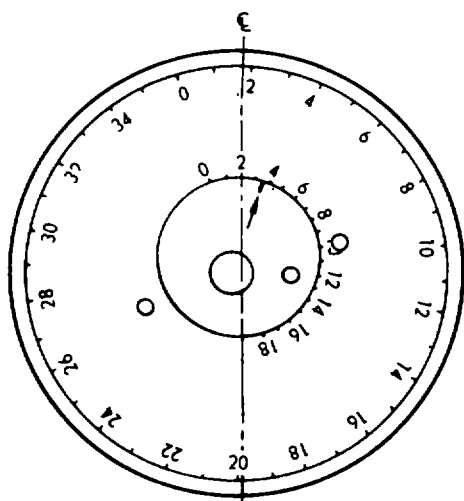
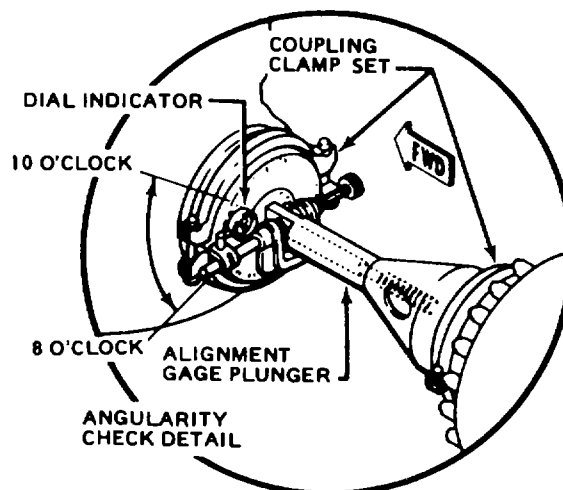


Figure 6-7. Positioning pylon with T101440 jacks (T36)



TARGET PLATE SETTINGS

INNER SCALE INDEX: 3.5
OUTER SCALE: TOP 1.75



ZERO DIAL INDICATOR AT 2.5
INCH RADIUS IN AREA SHOWN
ON LEFT SIDE OF PLATE
MAX. TIR 0.016 INCH

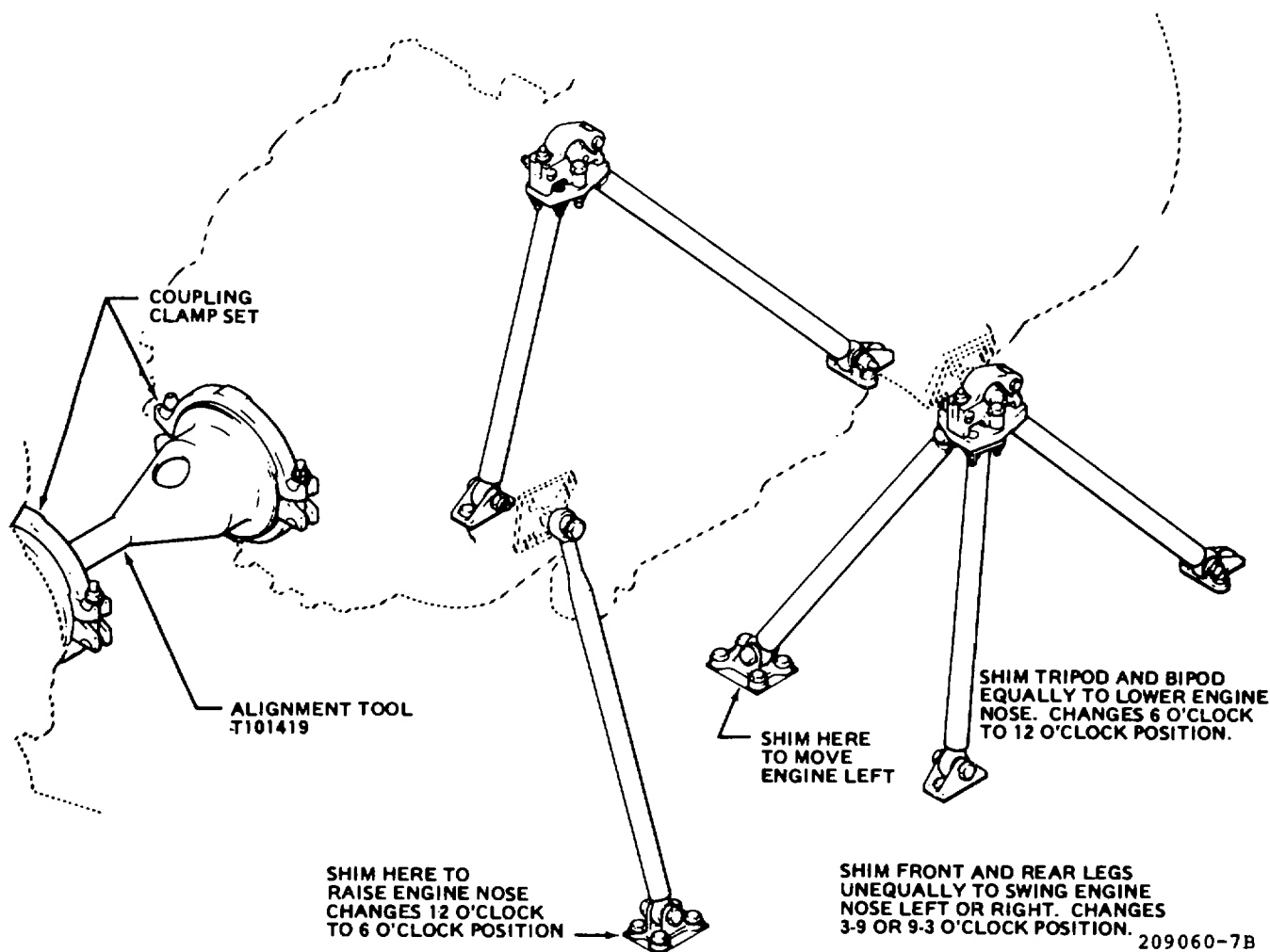


Figure 6-8. Checking driveshaft alignment

6-8A. MAIN DRIVESHAFT (Flexible Plate)

a. Description - Main Driveshaft.

(1) A main driveshaft (figure 6-8A) with flexible plate couplings is installed between an adapter on engine output and the freewheel unit on transmission input drive quill. Two coupling clamp sets of split v-band type, hold mating curvic-splined faces of end fittings in secure contact.

(2) Flexibility of shaft is provided by rectangular plates four in each coupling. Each plate flexes providing both angular misalignment and length changes to accommodate movement of transmission on pylon mounts. Each coupling can be considered a truss-work, in which torque loads are carried as axial loads in straight members of each plate.

(3) A fail-safe feature exists which enables uninterrupted drive of the shaft after a failure has occurred in one of the dual load paths provided by the plate couplings. In normal operation a radial clearance exists between center shaft internal diameter and the internal protruding hub of the end fitting (see Figure 6-8A). Upon the unlikely event of a plate failure, the center shaft shifts contacting the hub surface which restores the load balance, contains the whirling parts and restores stable operation. The off-center operation of center shaft is sufficient to cause a noticeable unbalance which signals that a partial failure has occurred and fail-safe mode is in operation with last remaining load path.

(4) The shaft is dynamically balanced at time of manufacture by the use of washer(s) and screw(s) which are used as balance weights. These weights may be found inside the shaft end fittings. To assure screws are securely fastened a high grade of adhesive is used on the threads. Do not attempt to turn screws as breakage may result due to high lockage force of the adhesive.

b. Removal- Main Driveshaft.

(1) Open cowl on left and right side of pylon. Remove baffle panel.

(2) Remove top half of FOD screen.

(3) Remove particle separator. Cover open ends of lower air filter assembly to keep out dirt and foreign objects.

(4) Remove coupling clamps at each end of main driveshaft, keep clamps together as matched sets after removal.

WARNING

Compression of shaft is usually necessary to clear the engine adapter and transmission freewheeling unit.

DO NOT APPLY ANY TOOLS OR CLAMPS TO COUPLING PLATES.

To prevent critical damage to plates and/or shaft, locally obtain and make two installation clamp aids. Refer to Figure 6-8B.

(5) Position two installation clamp aids over bolts heads located on the arms of the end fittings. (See Figure 6-8C.) Tighten clamps to allow removal of shaft. Remove shaft assembly, remove clamp aids.

(6) To remove engine shaft adapter, remove lockwire, retaining bolt and key washer. Pull adapter out of engine output shaft.

c. Cleaning- Main Driveshaft.

(1) Clean shaft assembly, adapter, and attaching parts with dry cleaning solvent (C124) or Methyl-Ethyl-Ketone (C87).

(2) Dry with filtered compressed air or clean cloth.

d. Inspection and Repair - Main Driveshaft.

CAUTION

Do not attempt to loosen or tighten any hardware. Any reason for necessary part removal is cause for shaft replacement.

(1) Visually inspect shaft for cracks.

(2) Visually inspect shaft for nicks, dents, scratches and corrosion. Refer to Figure 6-8D for limits.

(a) Superficial scratches not exceeding 0.002 inch in depth or well rounded dents on part edges not exceeding 0.005 inch in depth do not require repair.

(b) Scratches in the metal deeper than 0.002 inch or with sharp notches shall be smoothly blended into surrounding area so that no sharp indentations or edges remain. Repair must be within the limits specified in Figure 6-9D. Accomplish repair by careful hand filing or stoning, using fine emery cloth for final polishing. Minimize removal of protective coating during repair.

(c) Damage to the protective coating (removal to base metal) which exceeds 0.25 inch in width may be touched-up with aluminum colored paint for appearance and minimal protection from corrosion. Smaller areas left bare will not corrode due to sacrificial properties of the original protective coating.

NOTE

Black residue developing around flex plates is not reason for rejection of driveshaft.

(3) Check for legibility of stenciled serial number, and/or existence of data plate on main driveshaft. If discrepancy exists, stencil serial number on shaft.

e. Installation - Main Driveshaft.

(1) If removed, insert adapter (11, Figure 6-8A) into engine shaft. Install retaining bolt (9) P/N 204-040-813-101 and key washer (10) with short tab of washer to adapter slot. Torque bolt **360 TO 400** inch-pounds. Lockwire (C151) bolt head to outer tab of key washer.

(2) Position two installation clamp aids over bolt heads located on arms of the end fitting. Tighten clamps to allow installation of shaft between engine adapter and transmission freewheel unit. Install main driveshaft in either direction. Remove both clamps from shaft after installation.

(3) Install coupling clamps (2, Figure 6-8A) to secure both ends of shaft as follows:

(a) Check the serial numbers on each clamp set ensuring both halves are alike and on the same side for installation.

(b) Position clamp set so that gap is in line with index mark (circular indentation) on the shaft end fitting. (See Figure 6-8A.)

(c) Clamp halves should fit snugly and hold themselves in place without bolts.

(d) Place washer (4, Figure 6-8A) on bolt (3) with chamfer against head. Install bolts, with head in direction of shaft rotation, through pivots (5) and clamp ends. Install washers (6, 7) and nut (8).

NOTE

Thick or thin steel washers may be added if required under nut; and using like quantity on opposite bolt to maintain balance.

(e) Torque nut **100-130** inch-pounds, keeping equal gaps between ends of clamp set within 0.030 inch. Tap around outside of clamp set to ensure good seating, and recheck torque. Install cotter pin.

(f) Install opposite end clamp set, in the same manner, positioned 90° around shaft in relation to previously installed clamp set.

f. Alignment - Main Driveshaft. (See paragraph 6-8b for alignment instructions.)

NOTE

Aircraft with MWO 55-1520-244-50-10
 applied torque item (9) retaining bolt P/N
 204-040-813-101, 360-400 inch-pounds.

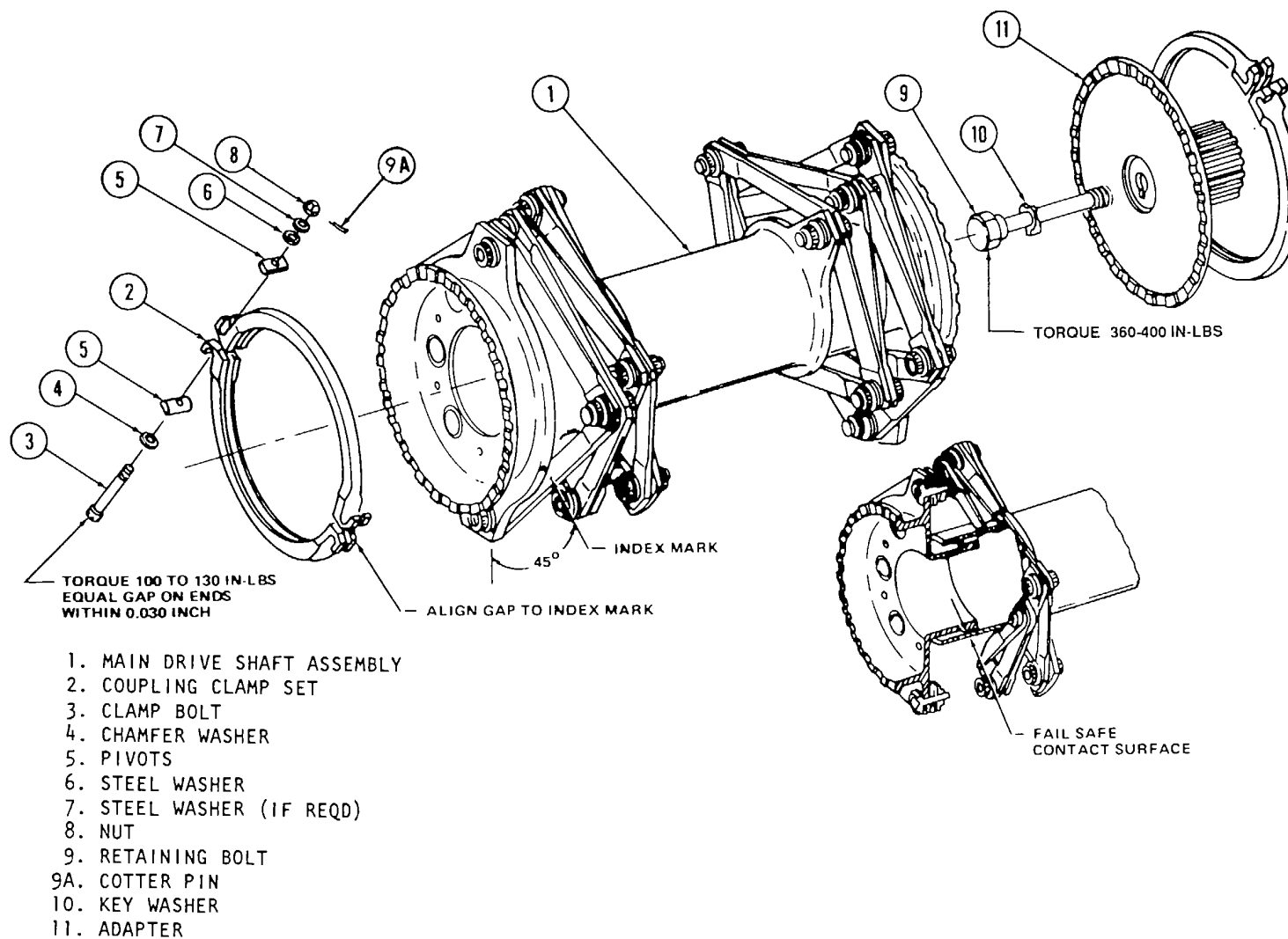


Figure 6-8A. Main Driveshaft
 Change 65 6-20C

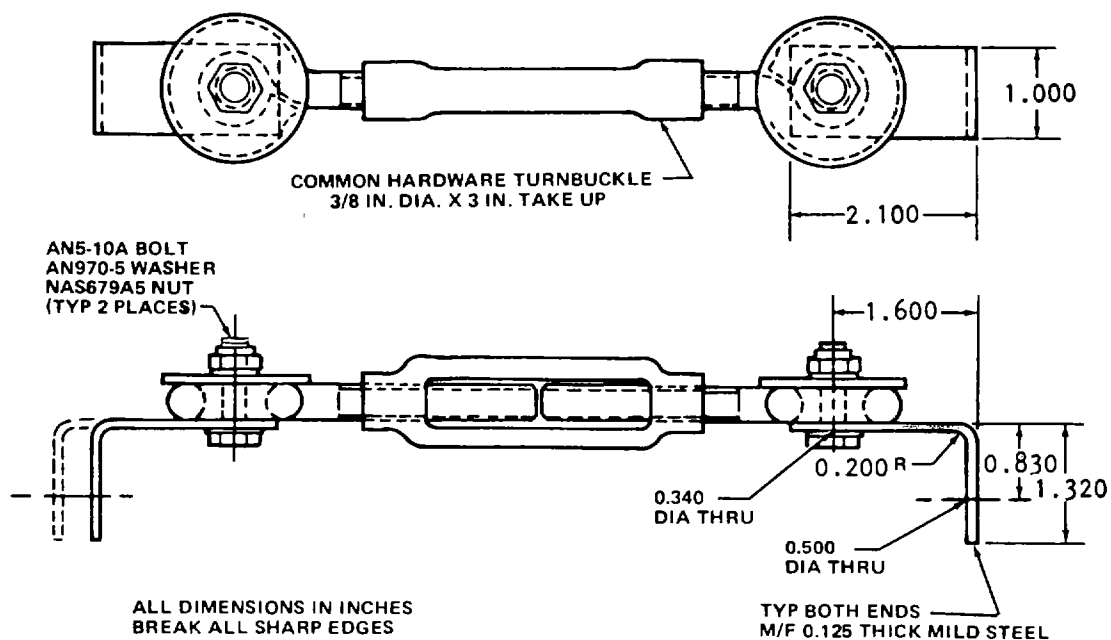


Figure 6-8B. Main Driveshaft Installation & Removal Tool

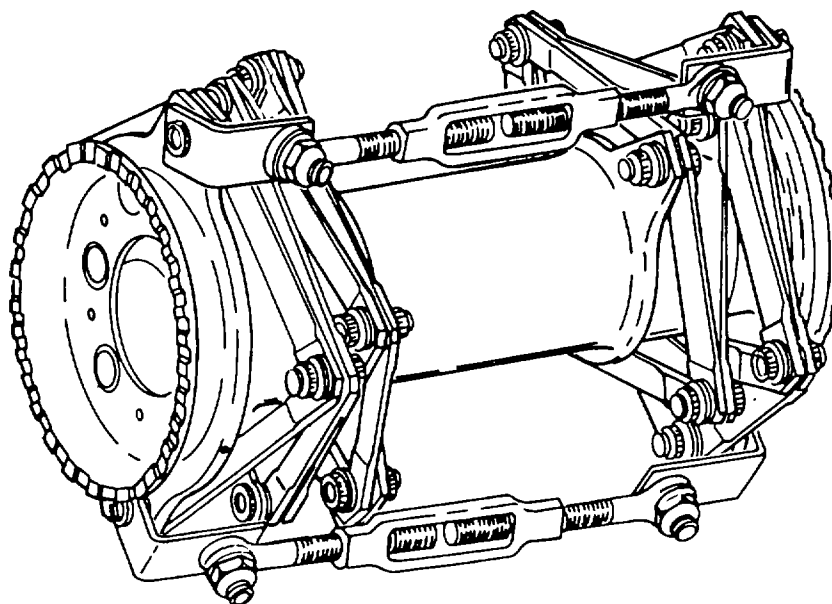
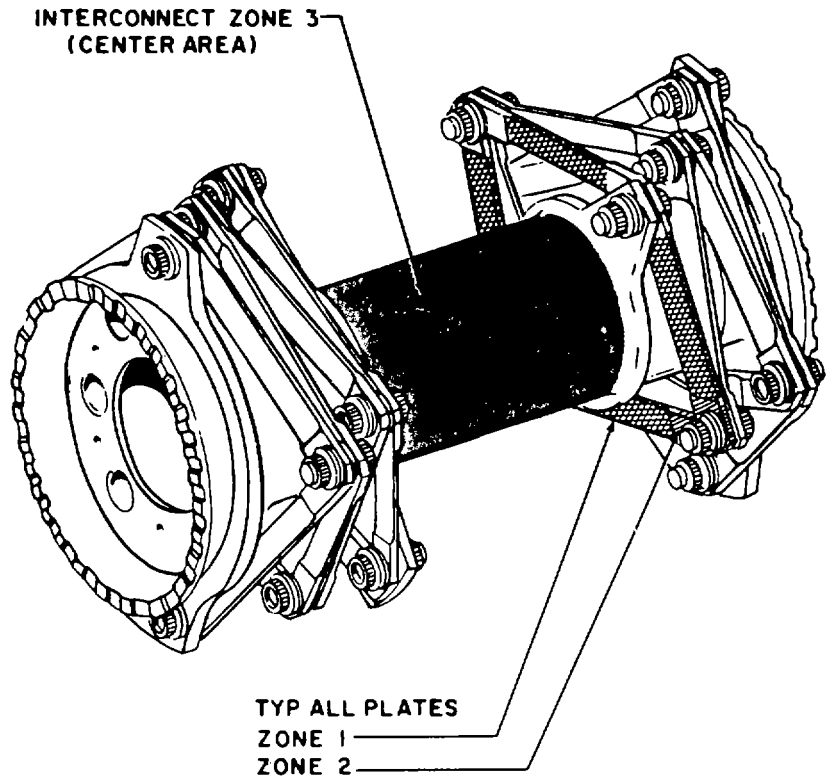


Figure 6-8C. Work Aid Tool Installed on Main Driveshaft.



TYPE OF DAMAGE				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4
NICKS, SCRATCHES, CORROSION	0.002	0.005	0.010	0.040
EDGE DENTS, NICKS	0.005	0.010	N/A	0.060
MAX AREA FOR FULL DEPTH REPAIRS	0.05 sq in.	0.10 sq in.	-not critical- (local area only)	
NUMBER OF REPAIRS	2 max	- not critical (not to overlap)		

Figure 6-8D. Main Driveshaft Damage Limits

Change 38

6-20E/6-20F blank)

Section III. CLUTCHES

(Not Applicable)

Section IV. MAIN TRANSMISSION

6-9. Transmission.

The transmission is located directly ahead of engine and is suspended by pylon-isolating mounts on structural supports extending above powerplant deck. (See figures 6-9 and 6-10.) The unit is coupled to the engine through a short driveshaft, and drives the main rotor mast through a train of spiral bevel gears and two-stage planetary gears. A free-wheeling unit in the input quill coupling disengages to allow main rotor and gear train to turn freely when engine is stopped or is idling below rotor-driving speed, as in autorotational descent. Secondary gear trains drive tail rotor shaft, rotor tachometer generator, hydraulic pumps, and transmission oil pump. The input bevel gear drives a cockpit air blower quill on the front side of the transmission.

Output reduction ratios, expressed as revolutions of each driven unit per engine output revolution are as follows: (See figure 6-11.)

Main Rotor Mast	0.0491
Tail Rotor Driveshaft	0.6516
Hydraulic Pumps	0.6516
Tachometer Generator	0.6516
Oil Pump	0.6274
Cockpit Air Blow	1.0

NOTE

After further reduction in 90 degree gearbox, tail rotor turns at 0.25 engine rpm.

Premaintenance Requirements For
Transmission

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	(T17) (T78)
Test Equipment	None

Premaintenance Requirements For
Transmission (Cont)

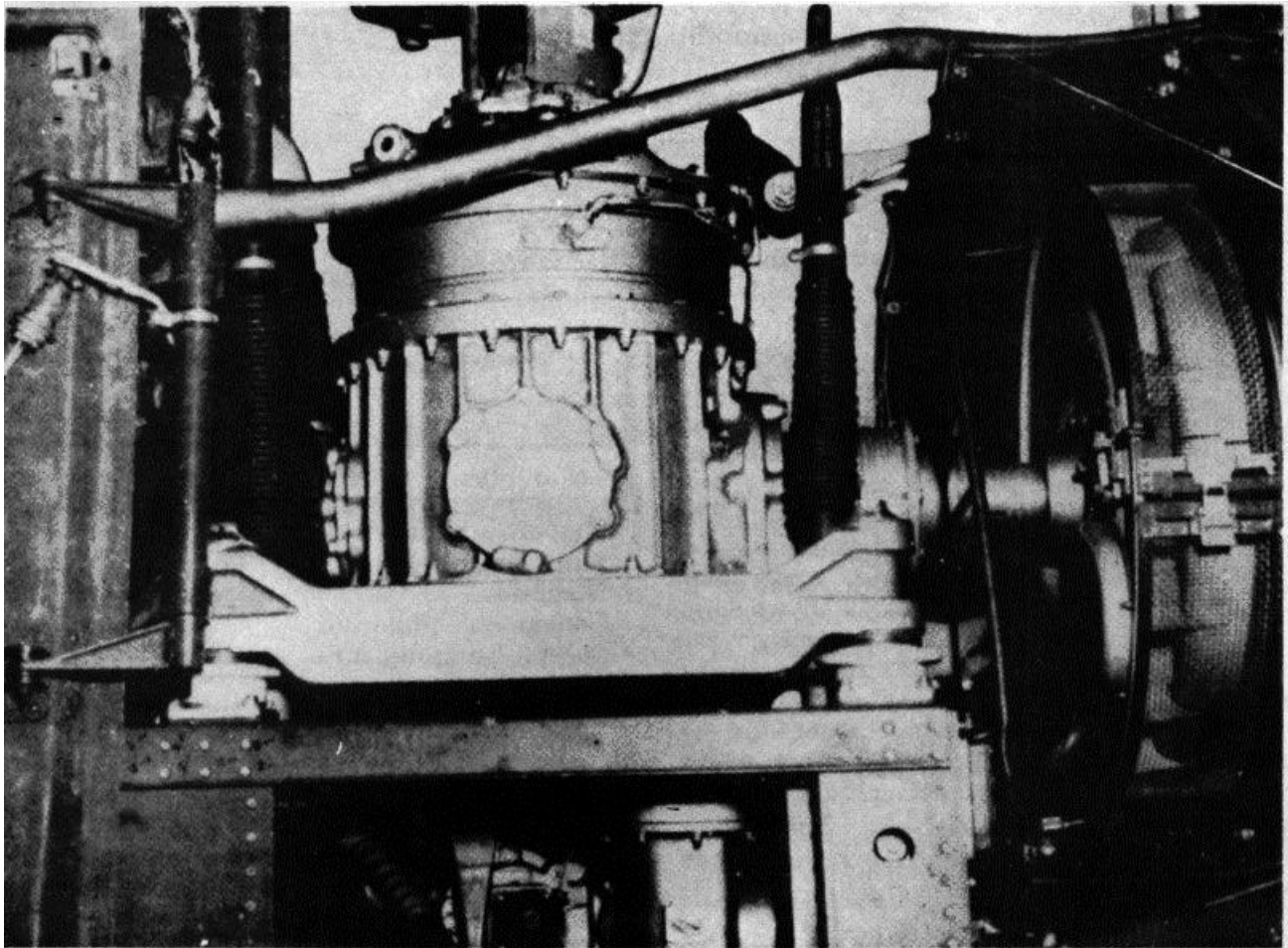
Conditions	Requirements
Support Equipment	None
Minimum Personnel Required	Two
Consumable Materials	(C93) (C94) (C116)
Special Environmental Conditions	Dust Free

a. Removal.

(1) When the transmission is to be replaced, unless conditions prevent operation, perform a ten minute ground runup and drain operating oil. If runup is not practical, remove mast assembly and spray the interior of the transmission through the top opening with approximately one gallon lubricating oil of the type that has been used in the transmission (C93) or (C94). While spraying, manually rotate internal gears and bearings with input drive quill, then drain oil. Attach tag to the transmission stating: **TRANSMISSION PRESERVED WITH LUBRICATING OIL, MIL-L-7808 or MIL-L-23699**, as applicable. If the transmission is to be repaired and stored at the Intermediate maintenance level, refer to paragraph 6-11, a through k. for further preservation and packaging requirements as applicable.



Any time transmission mount bolts (1, figure 6-13) are loosened or removed, care must be taken to ensure they do not fall. Damage to the airframe panels could occur.



20906-86-1

Figure 6-9. Transmission - left side

NOTE

Transmission and mast may be removed with swashplate and support, collective and links attached.

(2) Open cowl doors on both sides of engine compartment. Detach both aft doors from helicopter by removing nuts, washers and bolts in hinges. Disconnect electrical harness at door.

(3) Remove both upper fairing side panels.

(4) Disconnect battery and electrical connections.

(5) Remove induction baffle aft of transmission and particle separator(7, figure 6-12) from engine. Remove main driveshaft (4). Refer to paragraph 6-7a.

(6) Remove clamps from aft and front end of

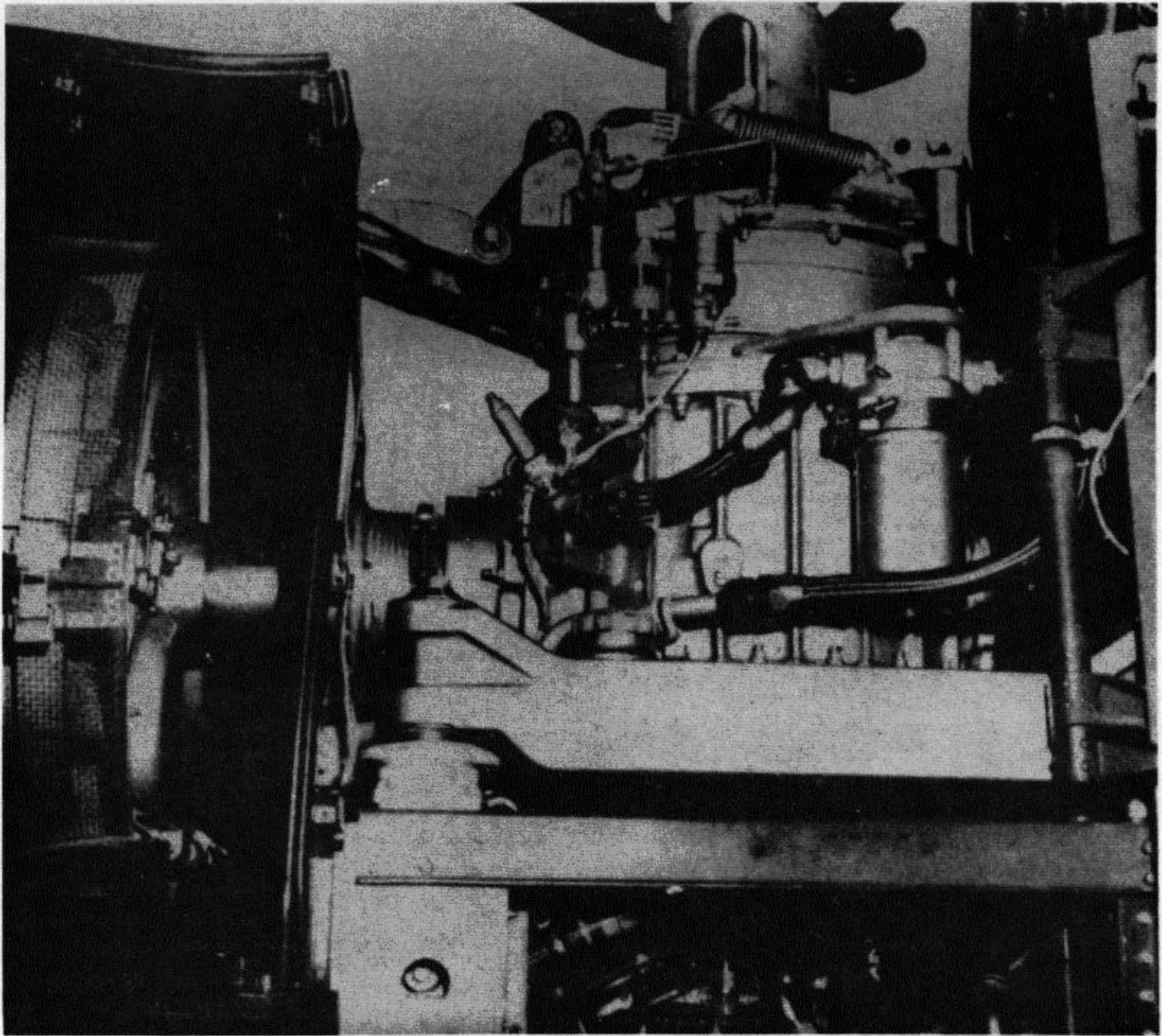
forward tail rotor driveshaft.

(7) Without disconnecting hydraulic lines, remove the two hydraulic pumps from drive pad on right hand side of transmission sump case and set back clear of transmission. Remove oil tube from sump case (13). Disconnect oil hose at oil filter on right side of transmission and oil sump hose at connection beneath sump.

(8) Disconnect oil hose at upper case connection at left rear of transmission and remove left rear oil tube from transmission.

(9) Detach ducting from blower at front of transmission.

(10) Remove main rotor. Refer to Chapter 5. If mast controls are to be removed, refer to Chapter 11.



209060-86-2

Figure 6-10. Transmission - right side

(11) Install cover nut on mast (1), attach hoist and take up cable slack.

(12) Disconnect cyclic control tubes and elevator control tube from collective lever.

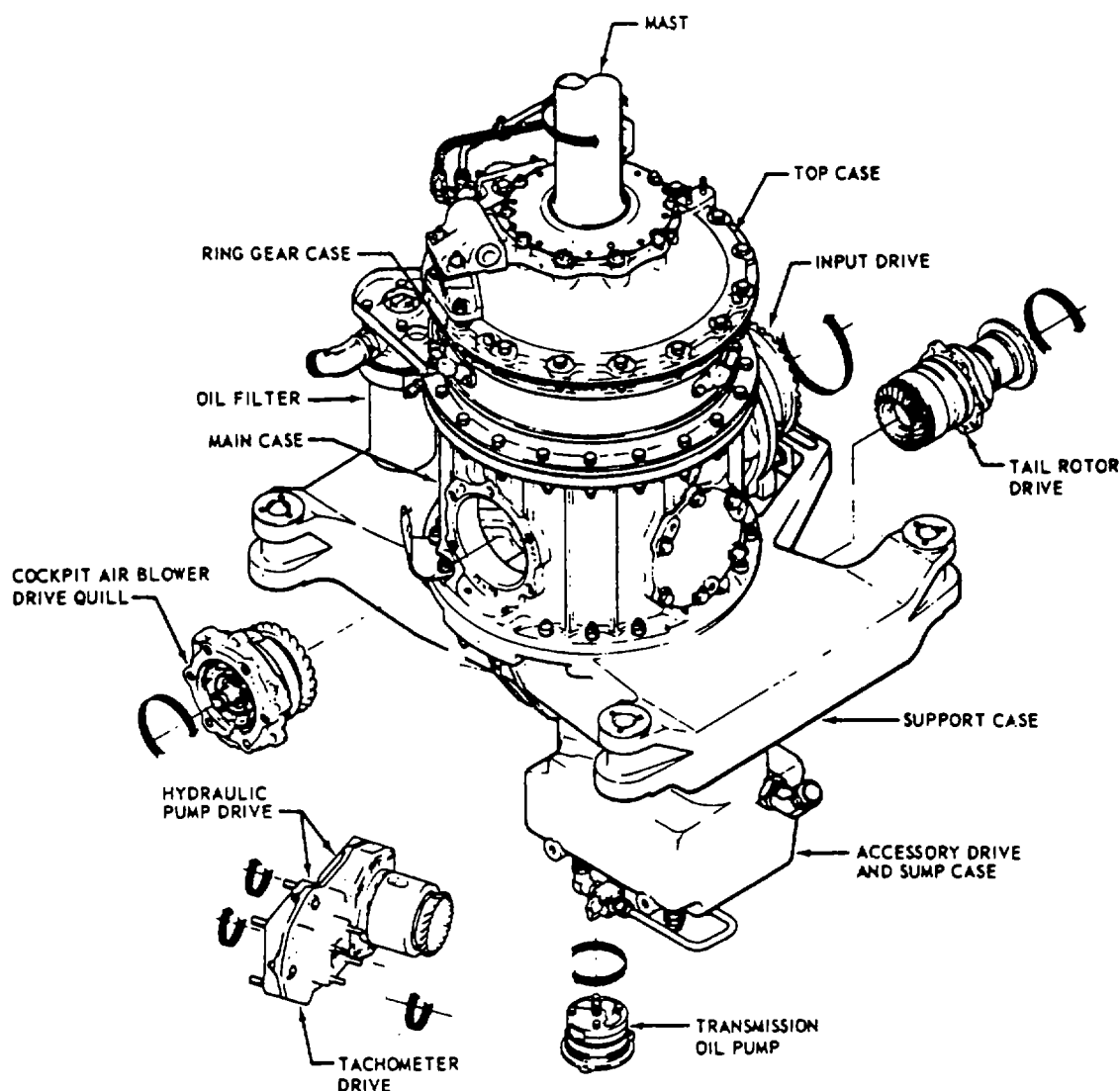
(13) Disconnect lift link (3, Figure 6-13) from lift beam. Keep attaching parts (18, 22, 23, 24 and 25) with link. Remove retaining bolts (7), plain washer, and shouldered retaining washer (6) from top end of forward and aft main mount bolts on right legs of transmission support case. Remove retaining bolts from mounts on left legs.

(14) Remove fifth mount support fitting from aft side of pylon structure. Refer to paragraph 6-14a. Transducer bracket installation is shown in figure 6-14.

(15) Mark shim location between fifth mount support fitting and pylon support for ease of installation.

CAUTION

Extreme care must be taken when removing transmission to prevent damage to lines, hoses and air frame components.



204040-1011

Figure 6-11. Transmission drive quill diagram

(16) Carefully hoist mast and transmission assembly clear of fuselage structure.

(17) Disconnect lift link from transmission case.

(18) Place transmission on stand, (T78), equipped with adapter, (T17). Secure with bolts through support case legs.

(19) If transmission is being replaced, transfer all accessories and electrical harness to new transmission.

(20) Remove cockpit air blower. Refer to Chapter 13.

a1 *Inspection* - Installed transmission and Mast Assembly.

(1) Inspect the following oil filters and transmission chip detector for metal particles. If any particles are found, refer to paragraph 6-3 for required corrective action.

(a) Transmission chip detector (paragraph 6-35).

(b) External oil filter (paragraph 6-32).

(2) Inspect transmission for loose, missing and damaged bolts or studs.

(3) Inspect transmission for damage in accordance with figure 6-11A..

(4) Inspect transmission for oil leakage. If any defects are noted, refer to appropriate paragraph in Section IV.

(5) Inspect transmission for corrosion and mechanical damage.

(6) Inspect main rotor mast (paragraph 6-17a).

a2. *Repair or Replacement.*

(1) Replace transmission if damaged in excess of repairable limits.

(2) Replace any loose or damaged standard type studs as follows:

NOTE

These instructions are for studs of standard type: threaded directly into transmission case and for studs and thread inserts which have a serrated locking ring, with inner teeth engaged on a serrated collar of stud or insert and outer teeth broached into material of transmission case. Tools for installation and removal are made by manufacturer of these parts. When such tools are not available, replacement can be accomplished with other tools, provided careful workmanship is applied.

(a) Measure stud height, if possible, before removal. Use suitable tool to grip stud and turn out slowly, and evenly to avoid seizure and breakage. If broken off, drill hole in stud on center to use any easy-out type extractor.

(b) If tapped hole in case has small vent hole at the bottom of the tapped hole, ensure that the vent hole is open prior to installing the new stud.

(c) Select replacement stud by reference to Illustrated Parts Breakdown (TM 55-1520-234-23P). Start new stud into tapped hole with fingers. If it turns freely beyond two turns, select next over-size which engage in one or two turns with fingers.

(d) Remove replacement stud and coat with

primer (C 102) to prevent contact of dissimilar metals. Start stud into tapped hole.

(e) Use a suitable tool to turn stud slowly and evenly into hole. Check stud for squareness with machined surface of case. As stud is installed to proper depth, check that torque is within limits of following table:

Stud Size	Inch-Pounds Torque
1/4	50 TO 95
5/16	100 TO 225
3/8	175 TO 375

(3) Replace loose or damaged lock-in studs as follows:

(a) To remove a threaded insert, select a drill equal in diameter to that of serrations between locking ring and insert. Drill to depth equal to ring thickness. Remove insert with a square-type extracting tool. If locking fails to come out collapse remaining portion of ring with punch.

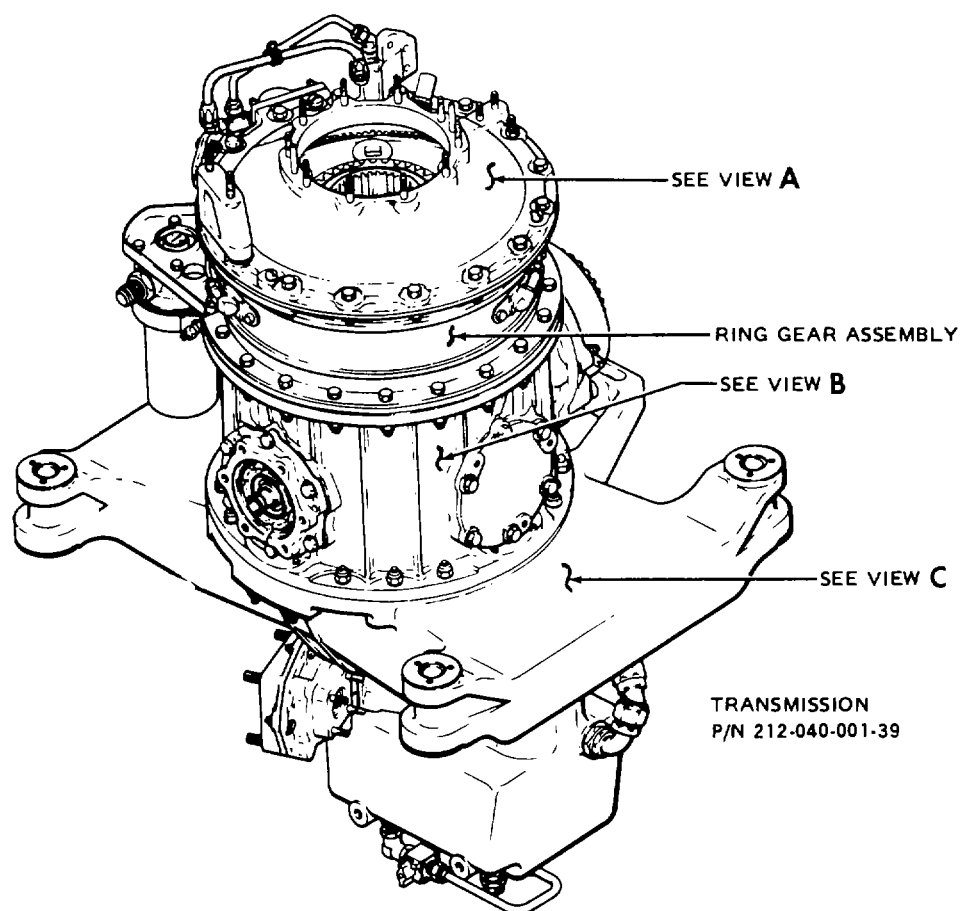
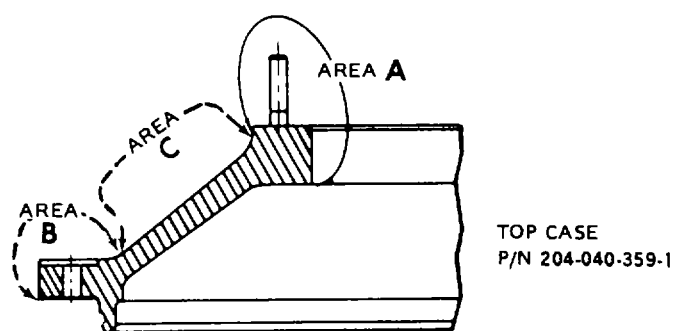
(b) To remove a stud, use a hollow mill with outside diameter **1/64** inch less than root diameter of outer serrations of locking. Mill to depth equal to ring thickness. Remove stud and any remaining portion of ring. If hollow mill is not available, saw stud off, use drill as in step (a), and remove stud with an easy-out extractor.

(c) Check condition of tapped hole and counter-bore. Holes are tapped with standard Class 3 tap. Counterbore has 90 degree shoulder and can be cleaned up as necessary. Avoid enlargement of holes, since this would require oversize parts.

(d) If tapped hole in case has a small vent hole at the bottom of the tapped hole, ensure that the vent hole is open prior to installing the new stud.

(e) Coat threads of new stud or insert with un-reduced primer (C102). Install the new stud or insert into tapped hole with suitable tool until top surface of serrated collar is 0.010 TO 0.020 inch below surface of parent material.

(f) Place locking ring over stud or insert and line up teeth of ring with teeth of serrated.



VIEW A

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Figure 6-11A. Damage Limits - Transmission (Sheet 1 of 6)

Change 22

6-24B

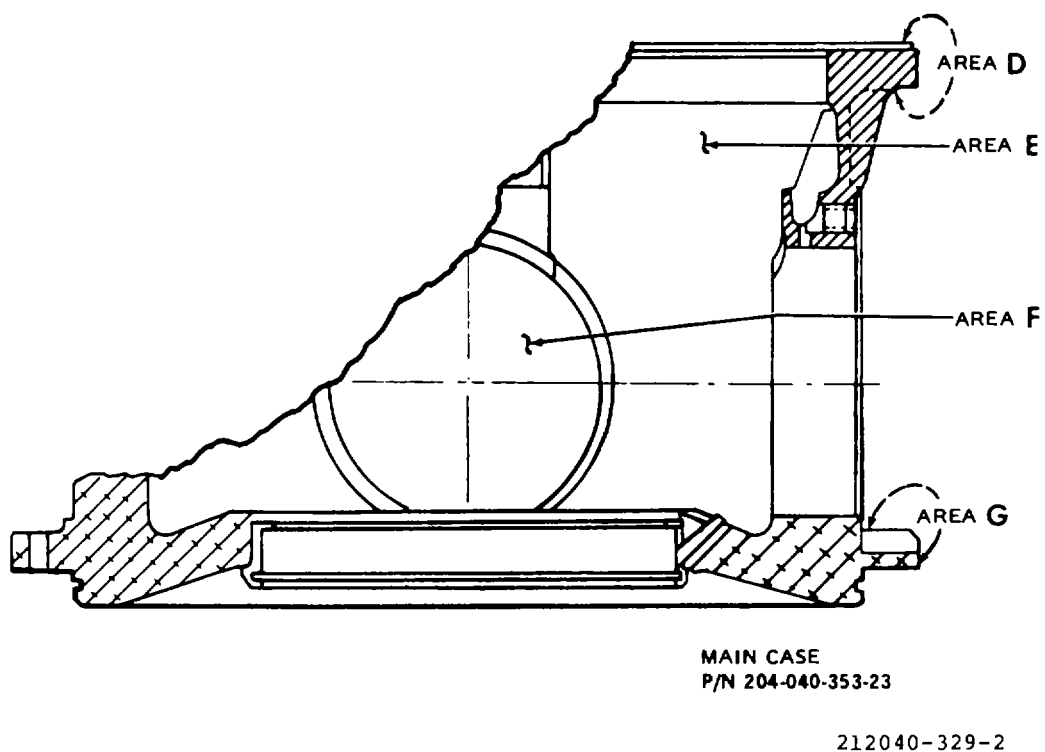


Figure 6-11A. Damage Limits - Transmission (Sheet 2 of 6)

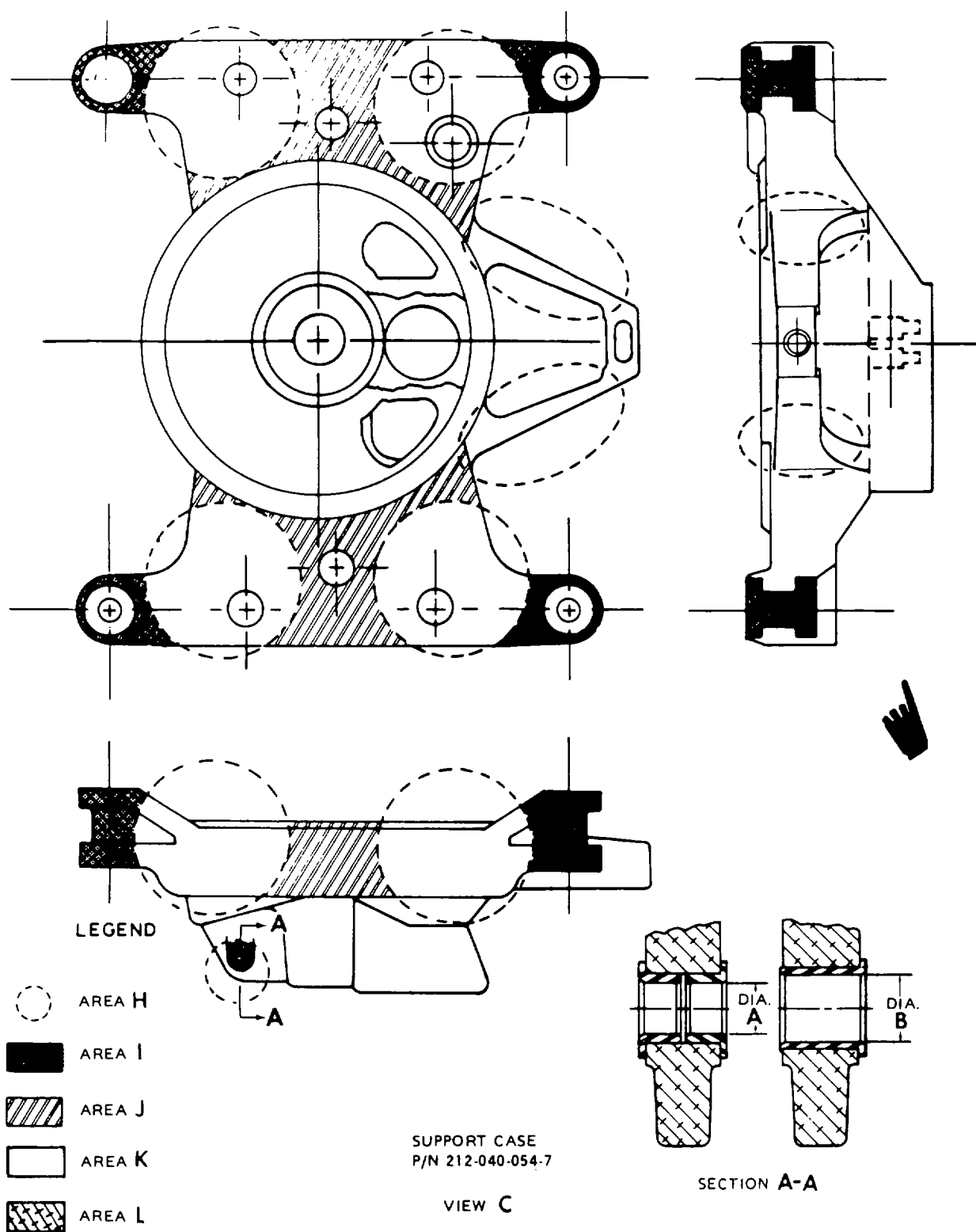


Figure 6-11A. Damage Limits - Transmission (Sheet 3 of 6)

AREA	LIMITS
All	No cracks allowed.
A and B	Corrosion in Area "A" at mast mounting port or in Area "B" where top case to ring gear assembly attaching bolts are installed is cause to replace transmission.
C	Mechanical or corrosion damage on top case outside areas noted in preceding paragraph is acceptable if following conditions are met: 1. Maximum depth after polishing out damage is 0.020 inch. 2. Maximum area of damage is 25 percent of the total area. 3. Damaged area is treated for corrosion protection in accordance with general instructions.
D	Corrosion in Area "D" where main case to ring gear attaching bolts are installed is cause to replace transmission.
E	Mechanical and corrosion damage limits on exterior surface of main case and outside Area "D" and "G" are the same as stated for Area "C".
F	A loose bearing liner for the bearing that supports the forward end of the input drive quill and/or corrosion between the bearing liner and the case is cause to replace the transmission.
D and G	Corrosion in Area "D" where main case to ring gear attaching bolts are installed is cause to replace transmission. Corrosion in Area "G" where main case to support case attaching studs are installed is cause to replace transmission. Mechanical or corrosion damage in Area "D" and Area "G" that does not extend under nuts and washers is acceptable if following conditions are met: 1. Maximum depth after polishing out damage is 0.020 inch. 2. Maximum area of damage within any one square inch is 20 percent. 3. Maximum area of damage in total area is 10 percent. 4. Damaged area is treated for corrosion protection in accordance with general instructions.
H	Mechanical or corrosion damage in Area "H" is acceptable if following conditions are met: 1. Maximum depth after polishing out damage on flat surfaces is 0.010 inch, and maximum length is 1.0 inch. 2. Maximum depth after polishing out damage on radii is 0.030 inch, and maximum length is two inches.

Figure 6-11A. Damage Limits - Transmission (Sheet 4 of 6)

212040-329-4

AREA	LIMITS
H	- Damage is polished out and blended smoothly into surrounding surface. - Damaged area is treated for corrosion protection in accordance with general instructions.
I	Mechanical or corrosion damage in Area "I" is acceptable if following conditions are met: - Maximum depth after polishing out damage on flat surfaces is 0.040 inch. - Maximum depth after polishing out damage on radii is 0.060 inch. - Damaged area is treated for corrosion protection in accordance with general instructions.
J	Mechanical or corrosion damage in Area "J" is acceptable if following conditions are met: - Maximum depth after polishing out damage on flat surfaces and radii is 0.060 inch. - Damaged area is treated for corrosion protection in accordance with general instructions.
K	Mechanical or corrosion damage in Area "K". which consists of all areas not covered by Areas "H", "I", and "J". is acceptable if following conditions are met: - Maximum depth after polishing out damage is 0.010 inch. - Damage area is treated for corrosion protection in accordance with general instructions.
L	Wear and damage to lift link bushings installed in Area "L" is acceptable if following conditions are met: - Diameter "A" must not be greater than 0.7505 inch. - Diameter "B" must not be greater than 0.1005 inch. - Surface finish inside bushings must be 40 RHS (roughness height ratio) or better. - Bushings must be securely mounted in case. Loose bushings, signs of yielding, and/or cracks in lift link bushing support lugs is cause to replace transmission.

GENERAL INSTRUCTIONS

- Evidence of corrosion under shim plates at quill mounting ports is cause to replace the transmission and/or affected quill.
- Loose or damaged studs at Area "A" and loose studs or inserts at any of the quill mounting ports are cause to replace the transmission.

212040-329-5

Figure 6-11A. Damage Limits - Transmission (Sheet 5 of 6)

GENERAL INSTRUCTIONS (Continued)

3. Polish out corrosion damage to twice the depth of the corrosion. Finish polishing out with 400 grit abrasive paper (C112) to blend repairs smoothly into surrounding surface. Ensure that depth and/or area of repair does not exceed acceptable limits specified for the areas designated above. Treat reworked areas for corrosion protection with MIL-M-3171C, Type VI treatment. This is commercial designation Dow No. 19. Refer to TM 43-0105 for application procedures. Prime all rework areas that were painted prior to repair. Use polyamide epoxy primer(C100). Paint to match existing finish.
4. Polish out mechanical damage to depth to remove all traces of the damage. Finish polishing out with 400 grit abrasive paper (C112) to blend repair smoothly into surrounding surface. Ensure that damage does not exceed acceptable limits. Apply corrosion protection, prime, and paint in same manner prescribed in preceding step.

212040-329-6

Figure 6-11A. Damage Limits - Transmission (Sheet 6 of 6)

collar. Drive ring into material flush with top of insert or stud collar.

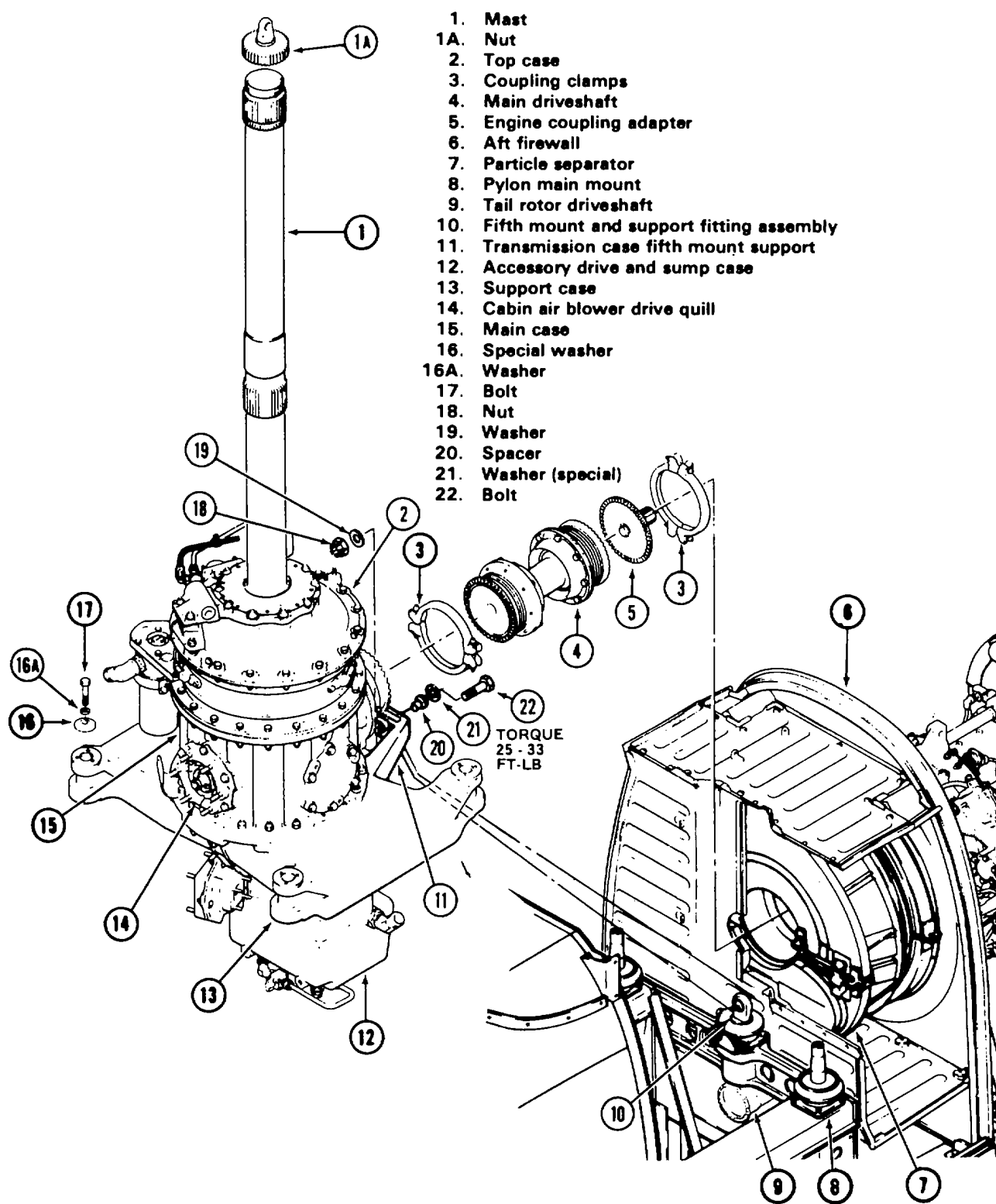
(4) Replace transmission oil system components that fail to pass inspection requirements.

(5) Repair transmission oil system components that have damage within repairable limits.

b. Removal - Transmission Adapting Parts.

CAUTION

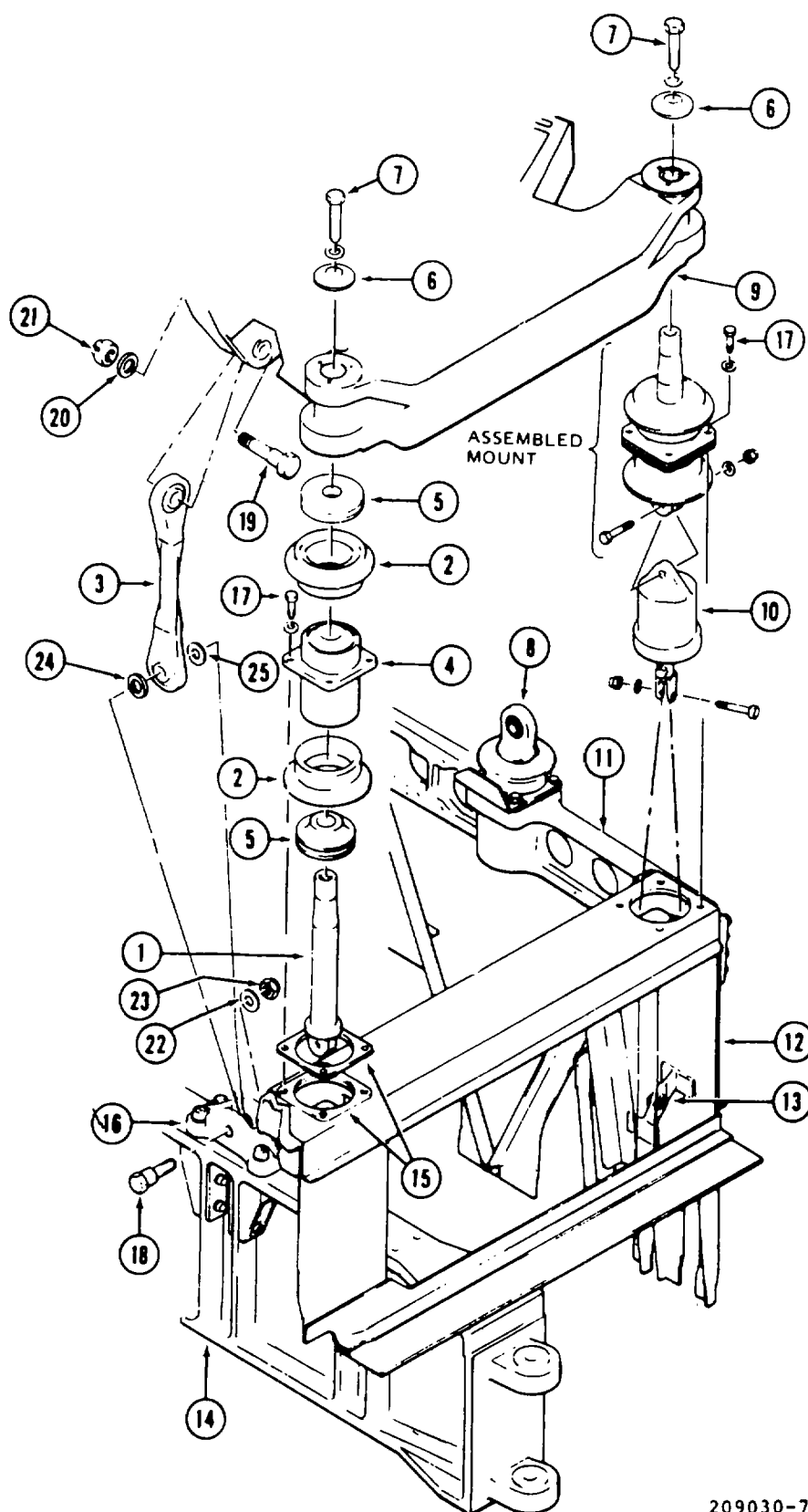
If the transmission was removed prior to normal overhaul for internal failure or metal particles, clean all oil lines, replace cockpit air blower drive quill, hydraulic pump and tachometer drive quill, oil cooler, mast assembly, and transmission external oil filter.



209040-7-2M

Figure 6-12. Transmission installation

1. Mount Bolt
2. Boot
3. Lift Link
4. Mount
5. Bushing
6. Retaining Washer
7. Retaining Bolt
8. Fifth Mount
9. Transmission
10. Damper
11. Fifth Mount Support Fitting Assembly
12. Pylon Support
13. Damper Fitting
14. Lift Beam
15. Filler Plates
16. Support
17. Bolt
18. Bolt Assembly
19. Bolt Assembly
20. WASHER
21. NUT
22. WASHER
23. NUT
24. WASHER
25. WASHER



209030-7J

Figure 6-13. Pylon lift link and main mounts

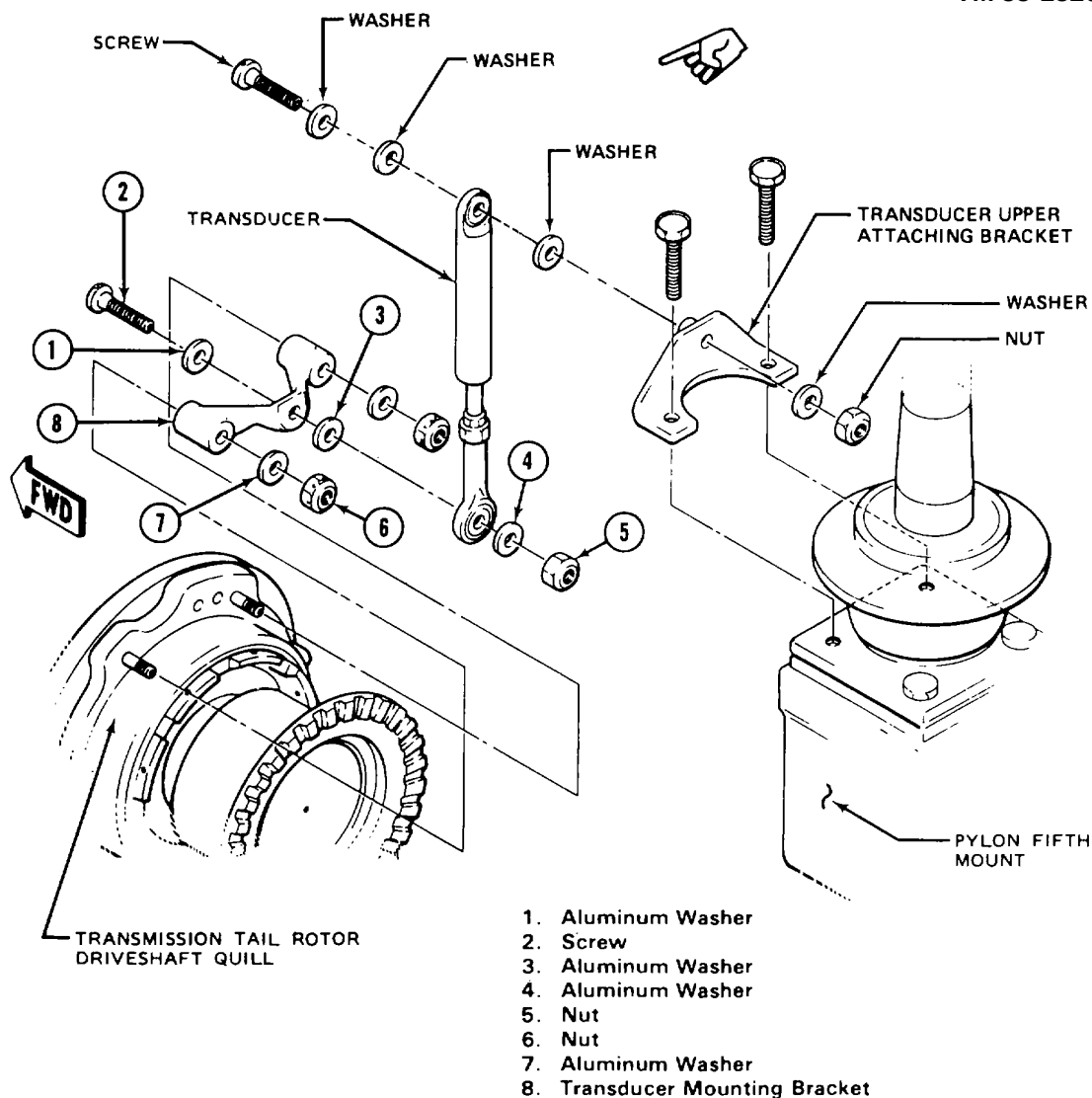


Figure 6-14. Transducer bracket installation

NOTE

Disassemble parts only to the extent necessary for removal from transmission.

(1) Remove hydraulic pump and tachometer drive quill (1, figure 6-15). Refer to paragraph 6- 20b. Discard packing (2).

(2) Remove cockpit air blower drive quill

(3). Refer to paragraph 6-21. Discard packing (4).

(3) Remove cyclic spring bracket (5). Reinstall bolts, washers and nuts in top case flange, with aluminum washers next to top case flange and steel washers next to nut and bolt head.

(4) Remove number 8 oil jet hose (6) and clamp.

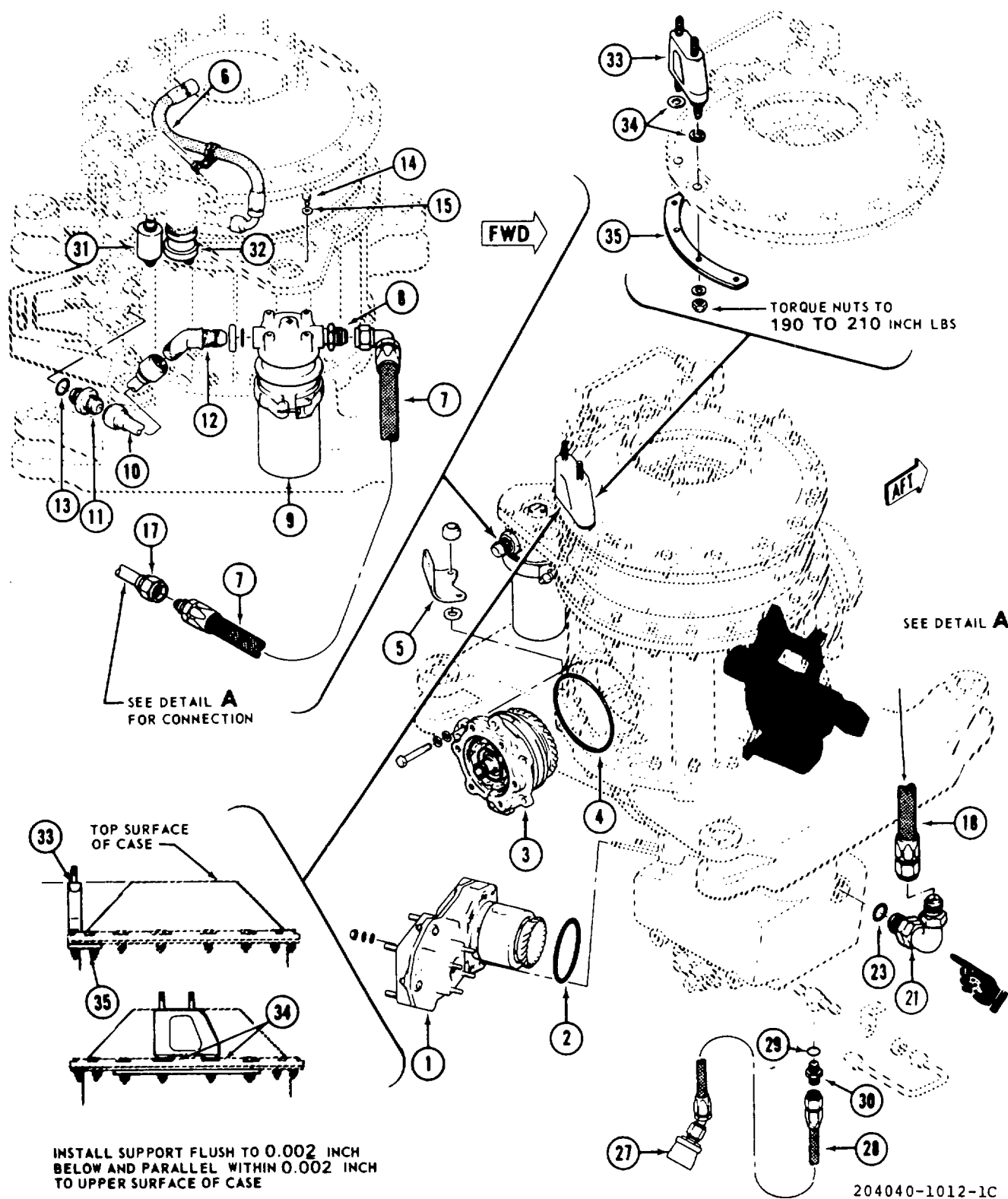
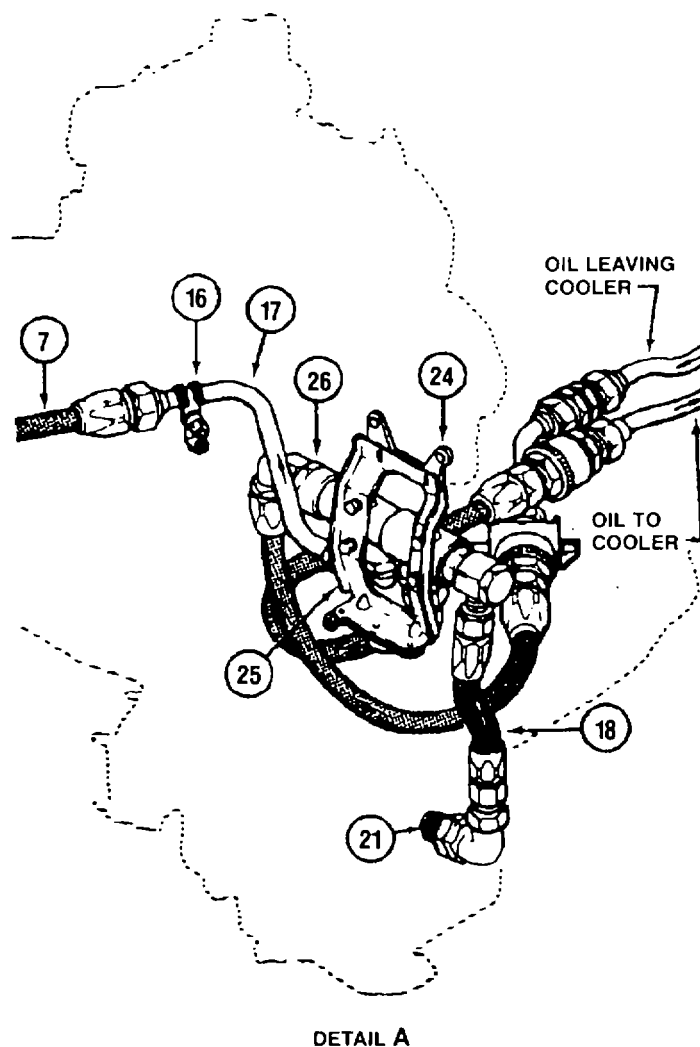


Figure 6-15. Transmission buildup (Sheet 1 of 3)

Change 7 6-28

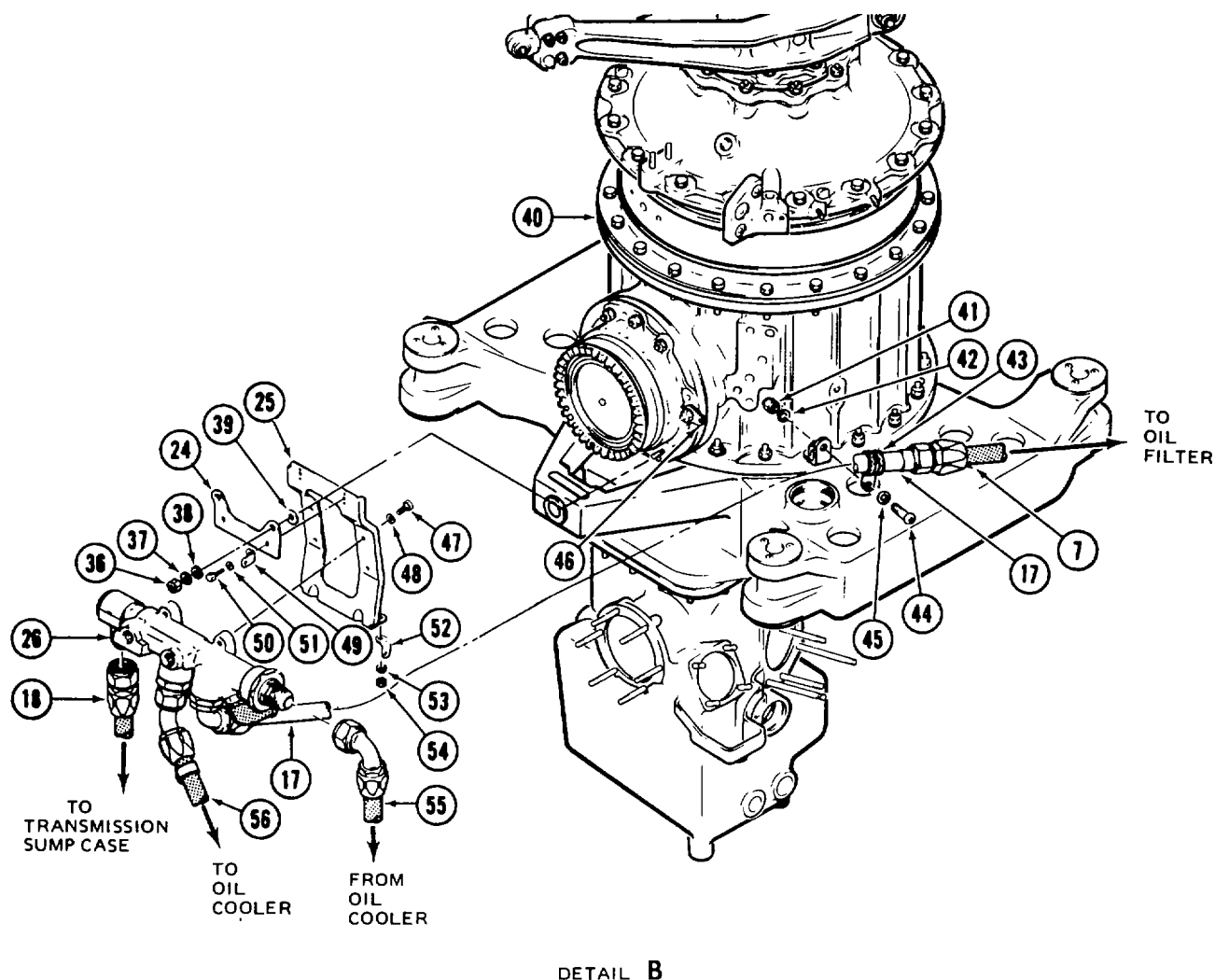
1. Hydraulic Pump and Tachometer Drive Quill
2. Packing
3. Cockpit Air Blower Drive Quill
4. Packing
5. Bracket
6. Hose Assembly
7. Hose
8. Union
9. External Oil Filter
10. Tube
11. Union
12. Elbow
13. Packing
14. Bolt
15. Washer
16. Clamp
17. Tube
18. Hose Assembly
19. Deleted
20. Deleted
21. Elbow Adapter
22. Deleted
23. Packing
24. Bracket
25. Bracket
26. Bypass Valve
27. Coupling Half
28. Hose Assembly
29. Packing
30. Union
31. Oil Pressure Switch
32. Oil Pressure Transmitter
33. Support
34. Shim
35. Support Plate.



204040-1012-2C
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Figure 6-15. Transmission buildup (Sheet 2 of 3)

Change 71   6-29



36. Nut	47. Bolt
37. Thin Steel Washer	48. Thin Steel Washer
38. Aluminum Washer	49. Bracket
39. Aluminum Washer	50. Steel Washer
40. Transmission	51. Bolt
41. Nut	52. Bracket
42. Thin Aluminum Washer	53. Thin Aluminum Washer
43. Clamp	54. Nut
44. Screw	55. Hose
45. Thin Aluminum Washer	56. Hose
46. Strap	

204040-1012-3

Figure 6-15. Transmission buildup (Sheet 3 of 3)

(5) Remove hose (7) from union (8) in external oil filter (9).

(6) Disconnect tube (10) from union (11) and elbow (12) in oil filter (9).

(7) Remove union (11) and packing (13). Discard packing.

(8) Remove bolt (14), washer (15) and remove external oil filter (9) from transmission.

(9) Remove bosc clamp (16) from bracket on transmission.

(10) Disconnect hose assembly (17) from 90 degree fitting on lower right hand side of oil bypass valve. Remove hose (7), hose assembly (17), and clamp (16).

(11) Disconnect hose assembly (18) from adapter (21).

(12) Remove adapter (21) and packing (23) from sump. Discard packing.

(13) Disconnect electrical wiring from bypass valve (26).

(14) Remove hose clamp securing hose to sump on right hand side.

(15) Deleted.

(16) Remove drain coupling half (27), hose assembly (28), and remove union (30) and packing (29). Discard packing.

(17) Remove mast assembly. Refer to paragraph 6-17.

(18) Remove support (33), shims (34), and support plate (35) from transmission. Keep shims with support

(19) Remove oil pressure switch (31), oil pressure transmitter (32), electrical harness, clamps and hardware.

(20) Remove two nuts (6, figure 6-14) aluminum washers (7) and transducer mounting bracket from tail rotor driveshaft quill.

c. Inspection - Transmission Adapting Parts.

CAUTION

All parts removed from the removed transmission must be inspected to determine serviceability. If the transmission was removed prior to normal overhaul because of metal in the oil, the cockpit air blower drive quill and hydraulic pump quill

shall not be used on the replacement transmission.

(1) Inspect cockpit air blower drive quill (3, figure 6-15). Refer to paragraph 6-21.

(2) Inspect hydraulic pump and tachometer drive quill (1). Refer to paragraph 6-20c.

(3) Inspect chip detector on sump assembly of removed transmission for metal chips.

(4) Inspect all threaded fittings for damaged threads or cracks.

(5) Inspect all hoses and tubes for damage and serviceability.

(6) General pitting throughout the case is acceptable, when the pitting depth does not exceed 0.030 inch. Pitting in machined areas not exceeding 0.010 inch is acceptable, provided that it does not allow seals to leak. Pitting in the mounting flange of 0.020 inch is permitted provided it does not extend through the bolt/stud hole, the standard wear criterion (high side of dimension +0.005 inch) would apply. Treat all corrosion in accordance with TM43-0105.

(7) External or internal fluid loss is undesirable; however, the design of sealing mechanisms will not always ensure that a joint will be completely free of fluid loss. The terminology for leakage is defined as follows:

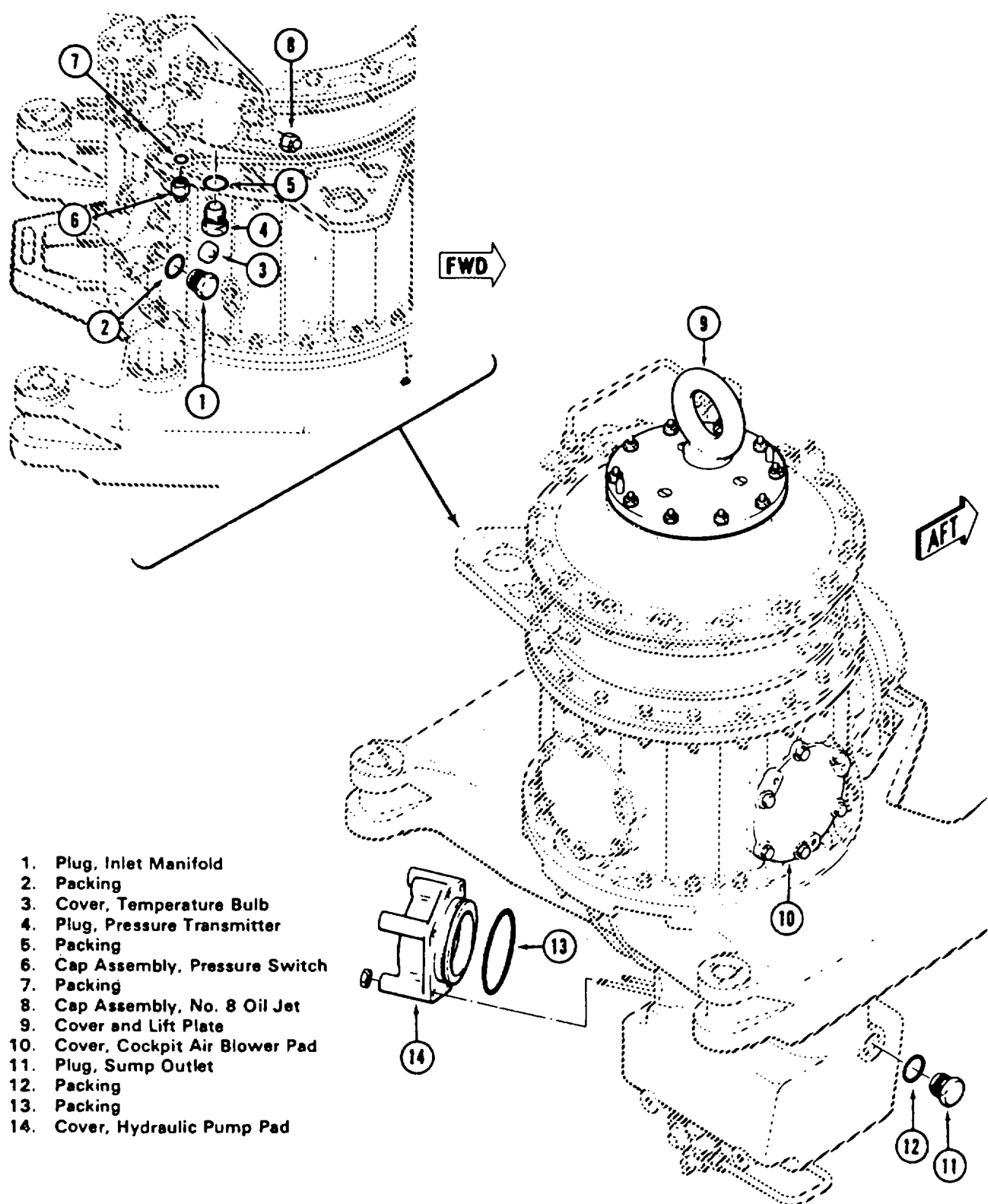
(a) Weep. Slight loss of fluid beyond a sealing mechanism which causes staining or discoloration of painted surfaces, usually dry to the touch.

(b) Seep. Slight loss of fluid beyond the sealing mechanism which does not form droplets but is moist to the touch.

NOTE

Fluid loss from a joint defined as a weep or seep is acceptable although efforts shall be taken to keep the fluid loss to a minimum.

(c) Leak. Loss of fluid beyond a sealing mechanism which forms droplets.



204040-1013A

Figure 6-16. Transmission shipping covers, caps, and plugs

(d) Drip. Loss of fluid beyond a sealing mechanism which forms drops that roll or drop away from the point of leakage.

NOTE

Leaks and drips are not acceptable and the source of the fluid loss must definitely be established by observing the component suspected of leakage, after prior residue of leakage evidence has been removed. If leaks or drips apply to your transmission, remove item from service and return to depot through normal supply channels for overhaul.

d. *Repair or Replacement Transmission Adapting Parts.*

CAUTION

If metal chips are found in magnetic drain plug of sump assembly, thoroughly flush and clean all hoses, tubes, and fittings to be used in building up the transmission before installation.

(1) Replace all aluminum washers, peel shims and packings that have been disturbed.

(2) Replace external filter element. Refer to paragraph 6-32a.

e. *Installation - Transmission Adapting Parts.*

(1) Remove serviceable transmission from shipping container and place on suitable stand.

(2) Remove pad covers, caps, and plugs from serviceable transmission. See figure 6-16.

(3) Install pad covers, caps and plugs on unserviceable transmission.

(4) Thoroughly clean all sealant from case where port covers were removed.

(5) Install hydraulic pump and tachometer drive quill (1, figure 6-15). Refer to paragraph 6-20e.

(6) Apply sealant (C116) at junction of quill with case after installation.

(7) Install cockpit air blower drive quill (3). Refer to paragraph 6-21e.

(8) Apply sealant (C116) at junction of quill with case after installation.

(9) Install oil pressure switch (31, figure 6-15) and oil pressure transmitter (32).

(10) Install electrical harness using clamps and hardware. Attach harness to electrical components.

(11) Install support (33) and shims (34); peel shims as necessary to adjust top surface of support (33) flush to 0.002 inch below and parallel within 0.002 inch of upper surface of case assembly. Install support plate (35) and nuts and washers. **TORQUE NUTS 190 - 210 INCH-POUNDS.**

(12) Install mast assembly. Refer to paragraph 6-17j.

(13) Install new packing (29) and union (30) in tee.

(14) Connect hose (28) to union (30).

(15) Deleted

(16) Install bolt (20) with packing (22), fitting (19), and packing (23) in sump.

(17) Connect hose (18) to fitting (19).

(18) Connect hose assembly (17) to 90 degree fitting on lower right hand side of oil bypass valve (26). Secure hose (17) to bracket with clamp (16).

(19) Connect hose (18) to fitting (19) and sump. Secure hose to sump with clamps previously removed.

(20) Attach external oil filter (9) to transmission with bolt (14) and washer (15). Refer to paragraph 6-31e.

(21) Install new packing (13) and union (11) in transmission case. Connect tube assembly (10) to union (11) and elbow (12).

(22) Connect hose (7) to union (8) in external oil filter.

(23) Connect number 8 oil jet hose (6) and secure with clamp.

(24) Install cyclic spring bracket (5). Secure with washers and nut

(25) Install transducer mounting bracket (8, figure 6-14).

f. Installation.

(1) If replacing transmission, install accessories and electrical harness from old transmission while assembly is on stand. Install mast assembly, if removed. Refer to paragraph 6-17j.

(2) Install cockpit air blower. Refer to Chapter 13.

(3) Check installation of four main mounts on pylon support structure of fuselage. Refer to paragraph 6-12.

(4) Attach hoist to cover nut on top of mast (1, figure 6-12) lift transmission and lower to position just above mounts.

(5) Connect lift link (3, figure 6-13) to transmission support case with bolt (19), washer, and nut. **TORQUE NUT 60 - 80 FOOT-POUNDS** and install cotter pin.

(6) Lower transmission carefully to position on mount bolts, guiding lift link (3, figure 6-13) into clevis on lift beam and fifth mount (10, figure 6-12) in to support (11) on transmission case. Connect lift link to lift beam. Refer to paragraph 6-13d.

(7) Install a serviceable nylon insert retaining bolt (7, figure 6-13) with plain washer and shouldered washer (6) into top of each main mount bolt (1, figure 6-13) on right side. Install a serviceable nylon insert retaining bolt (7) with plain washer and shouldered washer (6) into top of each main mount bolts on left side. Check the breakaway torque of the bolt (7), which should be a minimum of **24 INCH-POUNDS**.

NOTE

The minimum breakaway torque is the minimum torque required to start removal of the bolt (7, figure 6-13) from the completely installed untorqued position. This is to ensure that the self-locking feature of the nylon insert bolt is serviceable.

(8) Torque bolts to 90 to 105 foot-pounds.

(9) Connect fifth mount support fitting to transmission case. (Refer to paragraph 6-14e.)

(10) Install and connect mast controls, and install main rotor. Refer to Chapter 11 and Chapter 5. Remove maintenance hoist.

WARNING

Ensure that crowned tooth coupling is properly lubricated prior to installation of driveshaft.

(11) Connect forward section of tail rotor driveshaft with clamps at coupling of drive quill on sump case.

(12) When required, level transmission and check alignment between input quill coupling and engine output shaft adapter. Refer to paragraph 6-8b.

(13) Install main driveshaft. Refer to paragraph 6-7e. Install air induction baffle and dust separator. Refer to Chapter 4.

(14) Install oil tube on left rear of

transmission and connect oil hose at top end of tube.

(15) Connect sump oil hose beneath sump. Install oil tube at lower right side of sump case and mount the two hydraulic pumps on drive pad. Connect hose to filter on right side of transmission.

(16) Hook up electrical connections and battery.

(17) Install two upper fairing side panels.

(18) Install tailpipe fairing assembly and connect two lines on baffle beneath tailpipe. Install aft cowl doors.

(19) Service transmission with oil (C93) or (C94).

6-10. Replacing Studs -- Transmission. (AVIM)

These instructions are for studs of standard type; threaded directly into transmission case and studs and thread inserts which have a serrated locking ring, with inner teeth engaged on a serrated collar of stud or insert and outer teeth broached into material of transmission case. Tools for installation and removal are made by manufacturer of these parts. When such tools are not available, replacement can be accomplished with other tools, provided careful workmanship is applied.

a. *Standard studs.*

(1) Measure stud height, if possible, before removal. Use suitable tool to grip stud and turn out slowly and evenly to avoid seizure and breakage. If broken off, drill hole in stud on center to use any easy-out type extractor.

(2) Select replacement stud by reference to Repair Parts Appendix, which provides an undersize and four oversizes (by 0.003 inch increments) to each standard stud. Generally, next larger oversize will be required for proper installation torque. Start new stud into tapped hole with fingers. If it turns freely beyond two turns, select next oversize which will engage in one or two turns with fingers.

(3) Remove replacement stud, and coat coarse end with unreduced primer (C102), to prevent contact of dissimilar metals. Start stud into tapped hole.

(4) Use a suitable tool to turn stud slowly and evenly into hole, and check stud for squareness with machined surface of case. As stud is installed to proper depth, check that torque is within limits of following table:

Stud Size	Inch-Pounds Torque
1/4	50 - 95
5/16	100 - 125
3/8	175 - 375

b. Locked-in Studs or Inserts.

(1) To remove a thread insert, select a drill equal in diameter to that of serrations between locking ring and insert. Drill to depth equal to ring thickness. Remove insert with a square-type extracting tool. If lock-ring fails to come out, collapse remaining portion of ring with punch.

(2) To remove a stud, use a hollow mill with outside diameter 1/64 inch less than root diameter of outer serrations of lock ring. Mill to depth equal to ring thickness. Remove stud and any remaining portion of ring. If hollow mill is not available, saw stud off, use drill as in step (1), and remove stud with an easy-out extractor.

(3) Check condition of tapped hole and counterbore. Holes are tapped with standard Class 3 tap and counterbore has 90 degree shoulder and can be cleaned up as necessary. Avoid enlargement of holes, since this would require oversize parts.

CAUTION

Ensure that bleed holes in case are open before installing stud.

NOTE

In following steps, coat surface of parts which will be in contact with material of case with un-reduced primer (C102).

(4) Install new stud or insert into tapped hole with wrench tool until top surface of serrated collar is 0.010 TO 0.020 inch below surface of parent material.

(5) Place locking ring over stud (or on insert) and line up teeth of ring with teeth of serrated collar. Drive ring into material flush with top of insert or stud collar.

6-11. Preparation of Transmission for Shipment.

a. With mast assembly removed, spray the interior of the transmission through the top openings with approximately one gallon lubricating oil (C94). While spraying manually, rotate by turning input drive

quill and drain preserving compound.

NOTE

Install transmission cover assembly P/N 205-040-929-29 immediately after the mast has been removed from the transmission assembly and the interior preservation has been completed. Keep rubber portions of the transmission pylon mounts free of any oil, grease, or solvents to prevent deterioration and weakening of bonds between rubber and metal.

WARNING

Use solvent (C124) in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

b. Clean the exterior of the transmission to include splines and the threaded areas with solvent (C124). Air dry or wipe with a clean lint-free cloth.

c. Cap or plug all lines, as applicable, see figure 6-16. Cover breather hole and all other openings with barrier material (C30) and secure with tape (C136). Secure all loose wires and lines to assembly with tape (C136) to prevent damage during shipment.

d. Apply corrosion preventive compound (C53) to all exterior bare metal surfaces to include splines, studs, and threaded areas.

CAUTION

Do not allow corrosion preventive compound to contact rubber parts.

e. Attach a tag to the transmission stating:
TRANSMISSION PRESERVED WITH CORROSION PREVENTIVE OIL, MIL-L-23699.

f. Fill out a DD form 1577-2 (Unserviceable/Reparable tag) and attach it directly to the transmission.

g. Fill out a DD form 1577-3 (tag or label) and attach it to the exterior of the transmission container in such a manner that will afford maximum protection from handling and weather. Refer to TB750-126.

h. Fill out a DA form 2410, component removal and repair/overhaul record, in accordance with TM38-750.

i. Cover the couplings on the input and tail rotor drive quills and all open accessory mounting pads with barrier material (C30) and secure with tape (C136).

j. Install the transmission in a metal storage and shipping container, NSN 8115-0-701-9867, as follows:

NOTE

If the container noted is not available, proceed to step k.

(1) Inspect the shipping container to be sure it is clean and satisfactory for use. Repair and/or clean the container if necessary.

(2) Carefully lower the transmission into the shipping container and align with shock mounts in the container. Install four mounting bolts, washers and nuts. **TORQUE NUTS 700 - 900 INCH-POUNDS.**

CAUTION

Desiccant bags must be secured in the transmission container in a manner to prevent contact with the transmission or corrosion damage will result. Do not use desiccant bags if an air tight container is not available.

(3) Place 56 units of dry desiccant(C59) into the transmission container in such a manner that the desiccant cannot touch the transmission during shipment.

(4) Position top of container over transmission and install bolts, washers and nuts, **TORQUE NUTS 265 - 285 INCH-POUNDS.**

(5) Paint over old markings that do not apply to transmission in container. Mark container in accordance with MIL-STD-129.

k. If a metal storage and shipping container is not available, prepare the transmission for shipment as follows:

NOTE

This procedure is based on the assumption the provisions of paragraph j cannot be complied with, that the work will be done under less than ideal conditions with limited equipment, and that on some occasions by personnel who are not experts in the field of preservation. Use this procedure only at locations where facilities for the application of normal preservation procedures do not exist.

(1) Comply with steps a through i.

(2) If caps, plugs and barrier materials specified in steps c and i are not available, use substitute barrier material and tape.

(3) If corrosion preventive compound specified in step d is not available, substitute other grease-type corrosion preventive compound or bearing grease (C67).

(4) Cover the transmission with barrier material (C29) and secure with tape. Do not use desiccant.

(5) Install the transmission in the best available container or stand. Cushion, block and brace the transmission as necessary to prevent damage.

(6) Mark the container as follows: Paint over old markings that do not apply to transmission in container. Mark the container in accordance with MIL-STD-129 and also include the following: **THIS TRANSMISSION IS NOT PRESERVED FOR STORAGE. OVERHAUL OR PRESERVE FOR STORAGE AS SOON AS PRACTICABLE.**

6-12. Pylon Mounts.

Four isolation mounts are located on pylon supports under corners of the transmission support case. (See figure 6-17.) Each consists of a cylindrical molded rubber core bonded between steel outer and inner sleeves, with outer sleeve flange secured on the pylon support by four bolts. A large mount bolt extends up through the mount inner sleeve to seat in tapered bushing of transmission support case leg, and is secured by a retaining bolt installed from top through a broad special washer and threaded into tapped upper end of the mount bolt. Silicone rubber protective boots, with supporting bushings, cover both ends of mount. A fifth isolation mount, similar to the four main mounts, is located at the center aft of pylon of a support fitting bridged across rear side of pylon supports. The mount bolt has a self-aligning bearing at upper end, which is attached by a bolt to the transmission support case. The two aft pylon isolation mounts are restrained by fluid-type dampers, which are cylindrical units connected between lower ends of aft main mount bolts and fittings on the deck structure.

Premaintenance requirements for pylon mounts.

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	One
Consumable Materials	(C14) (C102)
Special Environmental Conditions	None

- a. Removal.
- (1) Remove transmission. Refer to paragraph 6-9a.

NOTE

To aid in removing and installing bolts attaching mount bolts (1, figure 6-13) to dampers (10) holes may be drilled in pylon support. See figure 6-18. Use a hole cutter

or other suitable tool. Care must be taken to prevent damage to adjacent parts. Clean and deburr edges of holes to preclude stress risers. Apply primer (C102) to edges of hole.

- (2) Remove four bolts (17, figure 6-13) with washers from flange of each main mount (4) on right side. Remove bolts and washers from flange of main mount bolts on left side.

(a) Keep filler plates (15) at location to avoid possible error in installation.

(b) On rear mounts, damper (10) can be left in place by removing bolt, nut and washer which attach upper end of damper to clevis of mount bolt; or, damper can be lifted out with mount assembly by removing bolt which attaches lower end of damper to its mount fitting (13) inside pylon support. Remove hydraulic cylinders if dampers are to be removed. Refer to Chapter 7.



Do not remove slotted head bolt through damper piston to remove damper.

- (3) Separate upper and lower bushings (5), boots (2), and mount (4) from bolt (1).

b. Cleaning. Wipe exposed surfaces clean with dry cloth. Keep rubber of mounts clean of any oil, grease, or solvents to prevent deterioration and weakening of bond between rubber and metal. Protective boots are silicone rubber, not affected by oil, and should be kept carefully in place while mount is installed.

c. Inspection.

- (1) Inspect mount bolts, bushings, and retaining washers for wear, nicks or cracks.

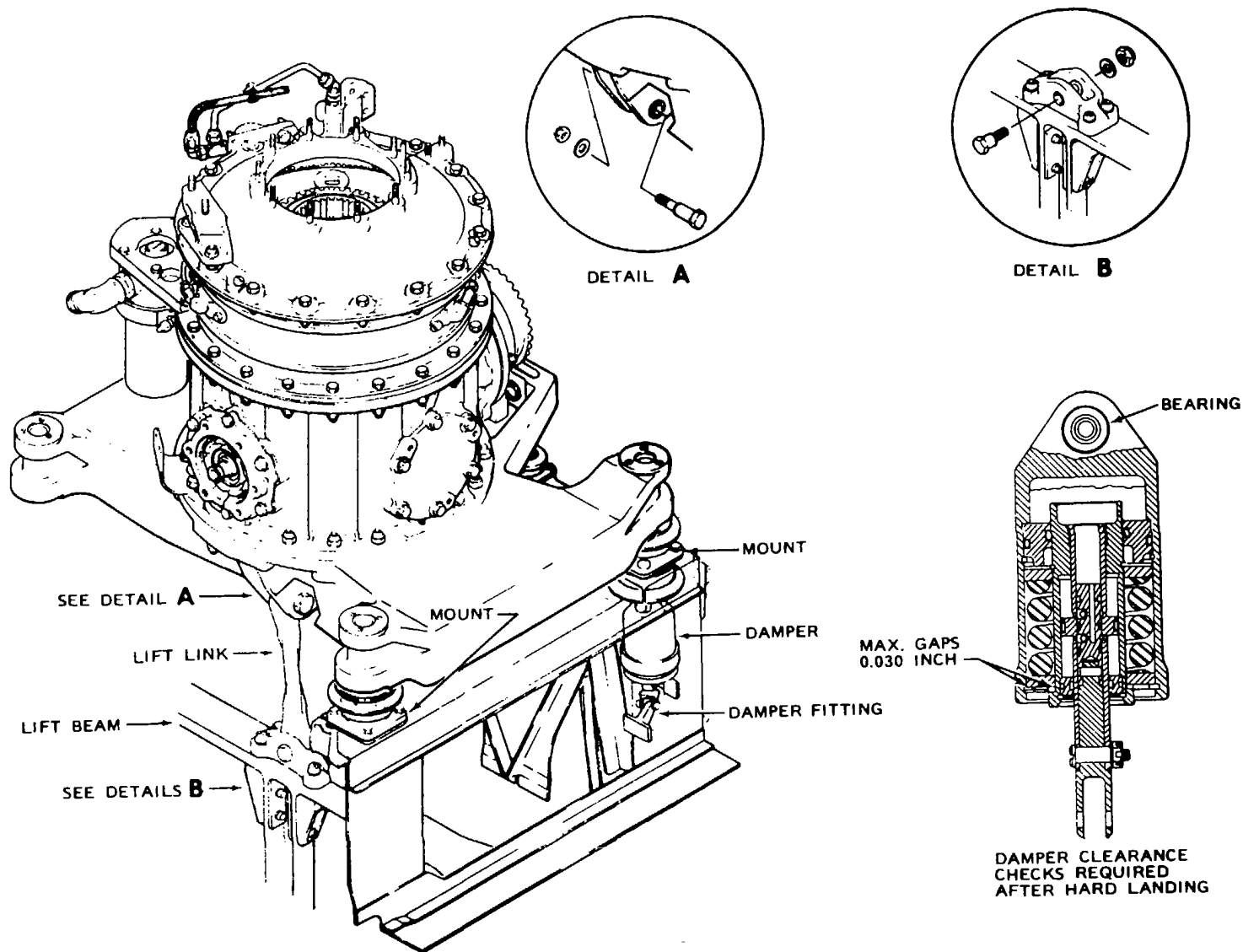
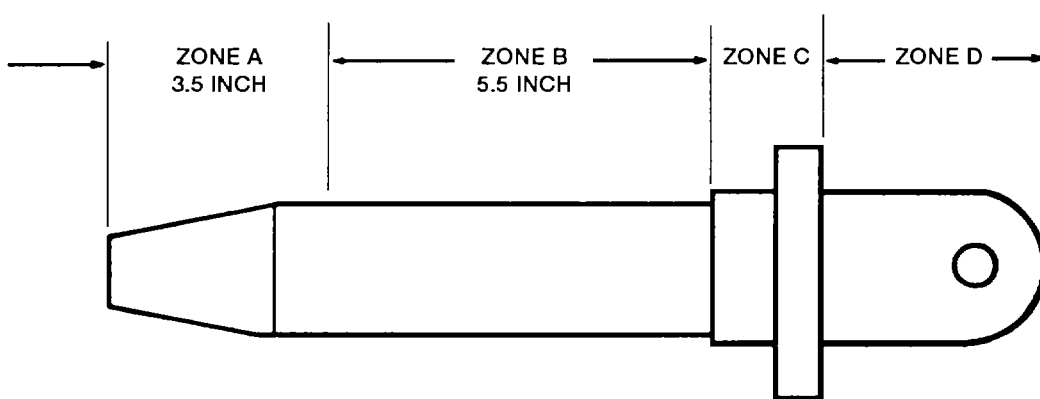


Figure 6-17. Pylon mounts and dampers

209030-57E

**NOTES:**

1. IN ZONE A, WEAR OR NICKS TO A DEPTH OF 0.002 IS ACCEPTABLE.
NO CRACKS ARE ALLOWED.
2. IN ZONE B, WEAR, NICKS OR SCORING TO A DEPTH OF 0.005 IS ACCEPTABLE.
NO CRACKS ARE ALLOWED.
3. IN ZONE C, WEAR OR NICKS TO A DEPTH OF 0.002 IS ACCEPTABLE.
NO CRACKS ARE ALLOWED.
4. IN ZONE D, WEAR OR NICKS TO A DEPTH OF 0.002 IS ACCEPTABLE.
NO CRACKS ARE ALLOWED. DAMAGE OF 0.020 IS ACCEPTABLE
AFTER REMOVAL OF BURRS IF TREATED WITH ZINC CHROMATE SPRAY.

Figure 6-17A. Pylon Mount Bolt Inspection Criteria

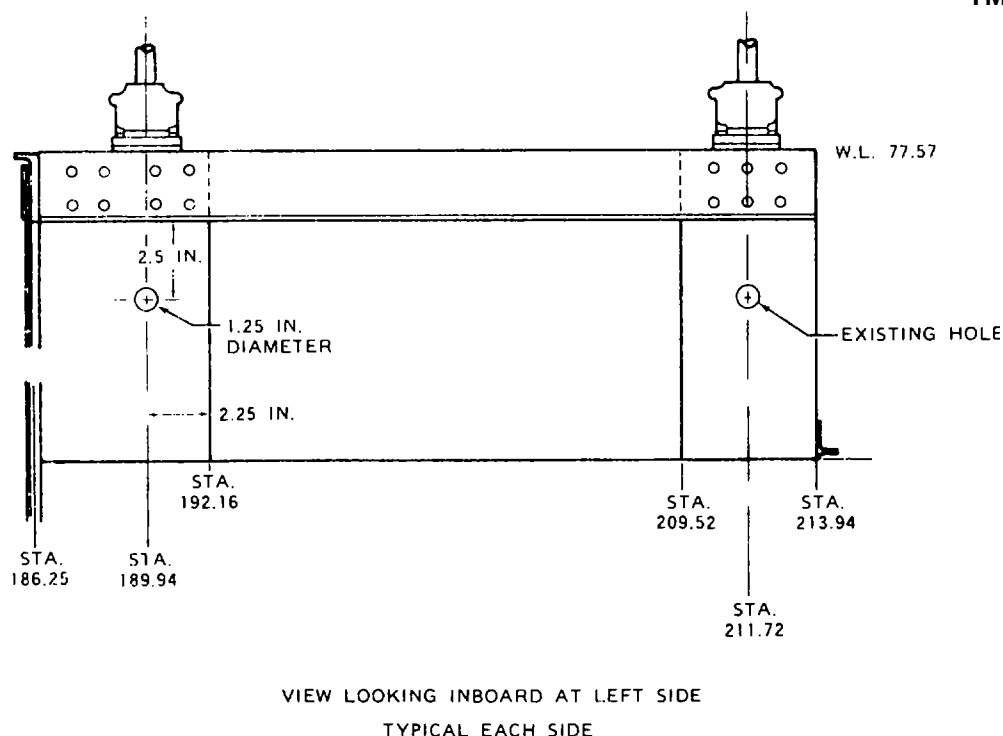


Figure 6-18. Pylon support access hole

203030-1+6

(2) Inspect boots for tears or deterioration.

(2) Replace defective mounts or boots.

(3) Inspect rubber and steel washers on inner face of bushing for security of bonding.

CAUTION

Exercise care in inserting feeler gage to avoid damaging rubber core.

(4) Inspect rubber core at both ends of mount for deterioration and separation. If vibration, roughness or mount bottoming was noted, inspect mount for bond separation between rubber core and inner and outer sleeves with a 0.010 inch feeler gage. If any separation exceeds 0.250 inch maximum depth for 1/3 of the circumference or if separation exceeds 0.750 inch at any one point, replace the mount.

d. Repair or Replacement.

(1) Replace mount dampers if leaking or if found to be yielded after a hard landing. (Refer to paragraph 6-16.)

NOTE

It is important to note that a properly installed boot will extend the service life of the mount by keeping it free and clean of oil contamination. Any boot that is ripped or cut should be replaced.

(3) Replace mount bolts, bushings, or retaining washers when worn, scored or nicked, or for any indication of cracks. Replace unserviceable protective boots.

(4) If rubber and steel washers on inner face of bushing become detached, rebond with adhesive (C14) or replace bushing assembly.

(5) Replace mounts under following conditions:

(a) When excessive vibration in operation is believed to indicate that mounts no longer have corrected spring rate to isolate normal pylon vibrations.

(b) When rubber-to-metal bond has separated deeper than raised rubber fillets at inner or outer metal sleeves.

e. Installation.

NOTE

Bushings P/N 212-030-199-1 and P/N 204-030-930-19 are not interchangeable.

(1) Assemble a boot (2, Figure 6-13) and support bushing (5) P/N 212-030-199-1 at bottom of mount (4) and boot (2) and support bushing (5) P/N 204-030-930-19 at top of mount (4). Insert mount bolt (1) through assembly from lower end of mount.

CAUTION

Ensure that replacement filler plates (15) are correct part number, check TM 55-1520-234-23P. The filler plates used under all four mounts are the same thickness.

(2) Position assembled mounts in pylon support (12) and on filler plates (15) on left side. Secure mounts to support with bolts (17) and recessed washers. Lockwire bolt heads in pairs with lockwire (C151).

NOTE

If pylon damper has been removed, attach damper to each rear mount with bolt, nut, and thin washer before lowering assembly into pylon support. Attach lower end of damper to its fitting inside pylon support with bolts, nut, and thin washer. To reduce the possibility of misalignment, support main transmission with a suitable hoist to relieve tension on eye bolt that attaches to fifth mount beam.

(3) Position assembled mounts in pylon support (12) and on filler plates (15) on right side. Secure mounts to support with bolts (17) and recessed washers. Torque bolts **100 TO 140** inch-pounds. Lockwire bolt heads in pairs with lockwire (C151).

(4) Install transmission. Refer to paragraph 6-9f.

6-13. Lift Link-Transmission.

A lift link is used to attach transmission to helicopter

fuselage. The lift link is used to transmit rotor lift to fuselage structure. Lift link is of forged steel with self-aligning end bearings and is connected between transmission support case and a fuselage beam.

Premaintenance requirements for transmission lift link.

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	(T49)
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	Two
Consumable Materials	(C41) (C87) (C102) (C106)
Special Conditions	Environmental None

a. Removal.

(1) Open and secure transmission cowl door on left side.

(2) Attach hoist (T49) or other suitable hoist to main rotor retaining nut.

(3) Remove cotter pins, nuts, and washer from both lift link bolts.

(4) Using hoist, raise transmission until lift link bolts can be removed. Remove both bolts and lift link.

b. Inspection.

(1) Inspect upper and lower lift link lugs using 10X magnifying glass. Particular attention should be given to the lift link lugs on transmission in area of bushings.

(2) Suspected cracks should be inspected by the dye penetrant method as follows:

WARNING

Paint remover (C106) is toxic and contains ingredients harmful to skin and eyes. Observe safety precautions printed on container.

(a) Remove paint from lug area using remover (C106).

(b) Perform dye penetrant inspection per MIL-I-6866.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

(c) After inspection thoroughly clean and dry area using cleaning compound (C41) and methyl-ethyl-ketone (C87).

(d) Apply two coats of primer (C102) to stripped area.

(3) If cracks are suspected, inspect lift link using magnetic particle method. Scrap link if any cracks are found. (AVIM)

(4) Mechanical or corrosion damage, not exceeding 0.005 inch is permissible after cleanup except in outboard 2.50 inches. No damage permitted in outboard 2.50 inches on each end of link.

(5) Inspect bearings for a maximum of 0.008 inch radial or 0.016 inch axial movement. Replace link if bearings have excessive movement.

c. Repair or Replacement.

(1) Replace lift link if cracked, damaged beyond allowable limits, or if bearing wear exceeds limits.

(2) Polish out mechanical damage or corrosion within allowable limits.

(3) Refinish polished area with primer (102).

d. Installation.

(1) Position lift link in transmission case recess and install shouldered bolt, washer, and nut (see Figure 6-13). Torque nut **60 TO 80** foot-pounds and install cotter pin.

(2) Align lower end of link and install bolt (18), washers (24) and/or (25) as required, washer (22) and nut (23) (see Figure 6-13). Torque nut **30 TO 50** foot-pounds.

(3) Remove maintenance hoist.

(4) Close and secure transmission cowl.

6-14. Pylon Fifth Mount.

A fifth pylon isolation mount, similar to the four main mounts is installed on a support fitting across the rear of the pylon support structure. The mount is attached to the transmission case by a self-aligning bearing installed in the mount upper end.

Premaintenance requirements for pylon fifth mount.

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	Two
Consumable Materials	(C12) (C17) (C87)
Special Environmental Conditions	None

a. Removal.

(1) Remove induction baffle, mounted on aft side of fifth mount support fitting.

(2) Remove nut (18, figure 6-12), washers (19, and 21) and bolt (22). Remove spacer (20) from fifth mount support (11).

(3) Remove transducer in accordance with instructions contained in Chapter 9.

(4) Remove four bolts securing support fitting (11, figure 6-13) to pylon support structure (12) on each end. Remove support fitting. Keep shims, if not bonded on pylon support, for reinstallation at same location.

(5) Remove lockwire and four bolts (5, figure 6-19) with washers and bracket (6) which secure mount (2) on support fitting (4). Lift off mount assembly and shim (3).

(6) Remove boot (1) from top of mount.

b. Cleaning. Wipe exposed surfaces clean with dry cloth. Keep mounts clean of any oil, grease, or solvents to prevent deterioration and

weakening of bond between rubber and metal. Protective boots are silicone rubber, not affected by oil; keep boots in place while mount is installed.

c. Inspection.

- (1) Inspect mount bolts (5, figure 6-19) for wear, nicks or cracks.
- (2) Inspect boot for tears or deterioration.
- (3) Inspect bracket (6) for damage.

CAUTION

Exercise care in inserting feeler gage to avoid damaging rubber core.

- (4) Inspect rubber core at both ends of mount for deterioration and separation. If vibration, roughness or mount bottoming was noted, inspect mount for bond separation between rubber core and inner and outer sleeves with a 0.010 feeler gage. If any separation exceeds 0.250 inch maximum depth for 1/3 of the circumference or if separation exceeds 0.750 inch

at any one point, replace the mount.

- (5) Inspect bearing in mount for excessive play; 0.008 inch radial and 0.016 axial minimum.

- (6) Inspect support fitting (4) for damage. (Refer to Chapter 2.)

- (7) Inspect spacer (20, figure 6-12), washer (21) and bolt (22) for cracks, wear and damage.

d. Repair or Replacement.

- (1) Replace mount bolts (5, figure 6-19) when worn, scored or nicked, or for any indication of cracks.

- (2) Replace or repair mount under following conditions:

- (a) When excessive vibration in operation is believed to indicate that mount no longer has correct spring rate to isolate normal pylon vibration.

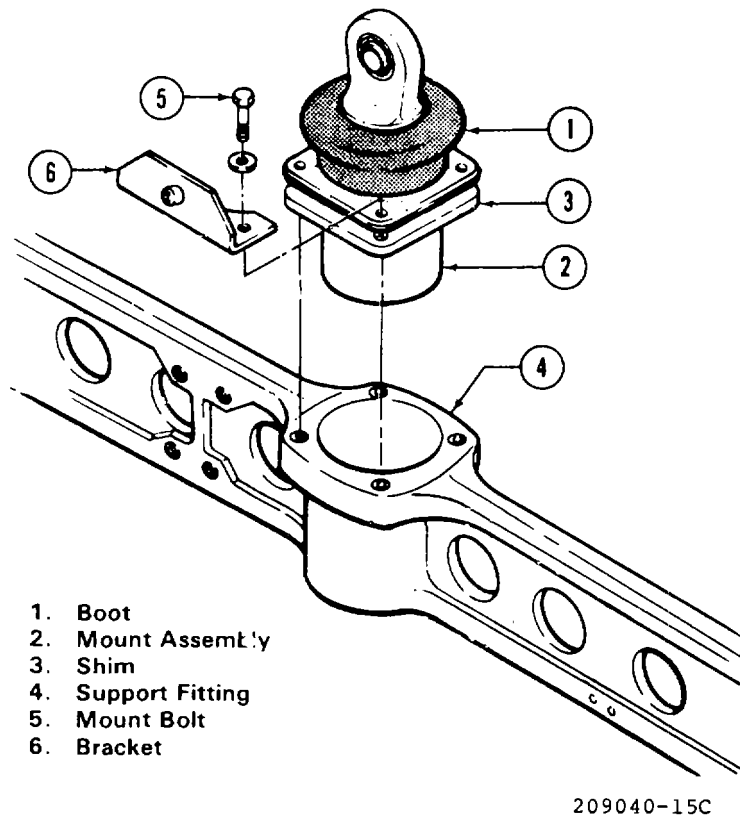


Figure 6-19. Pylon fifth mount assembly.

(b) When rubber-to-metal bond has separated deeper than raised rubber fillets at inner or outer metal sleeves.

(c) When bearing in mount has excessive play repair bearing and bushing as follows:

1 Removal/Disassembly.

a Remove P/N J- 12292-1 mount assembly from aircraft.

b Visually inspect elastomer end (Figure 6-19.2).

c No cracks, gouges and/or separations are allowed on elastomer surface. If they do, contact LAR or AVSCOM Engineering for guidance.

d If elastomer is acceptable, remove bushing and bearings in accordance with the following procedures:

(1) Place mount on tool LT-40-9. Care should be taken not to puncture boot during entire replacement operations.

(2) Press bushing and bearing out of housing by using a hydraulic press and tools LT-40-8 and LT-40-9 per figure 6-19.2.

CAUTION

Care should be taken to properly align tools (LT-40-8 and LT-40-9) to avoid interference during normal operation.

(3) After bushing and bearing removal, inspect hole diameter using an inside micrometer or equivalent. Hole diameter should be 1.2182/1.2162 (see Figure 2).

2 Assembly.

a Preparation for Assembly.

(1) De-burr all edges using crocus cloth (C37).

(2) Thoroughly clean housing and bushing using Toluene/Xylene (C130) or similar, applied with cheesecloth (C30), then alcohol (C64) applied with clean cheesecloth (C30), giving special attention to comers and any gouges (caused by

removal of bushing and bearing).

(3) Do not handle new or cleaned bearings and bushings with bare hands. Use white cotton gloves (C54) to avoid contamination to the bearing/bushing and housing mating surfaces.

b Assembly of Bearings. (Reference figure 6-19.1 tool kit).

(1) Apply a thin coat of zinc chromate primer (C91) to the 1.2182/1.2162 diameter hole in housing (see Figure 6-19.3).

(2) Using a hydraulic press, align nest (LT-40-1) with ram adapter (LT-40-2) using tools LT-40-3 and LT-40-4 for alignment.

(3) Place mount P/N J- 12292-1, onto nest (LT-40-1).

(4) Press bushing into housing using tools LT-40-3 and LT-40-4 using a load setting of one ton on press.

CAUTION

If extreme interference fit occurs at the beginning of the press fit operation, stop, determine and eliminate cause before proceeding.

(5) Check size of inside diameter (1.0935/1.0932) of bushing using a micrometer (refer to Figure 6-19.4). Insure roundness.

(6) Apply a thin coat of zinc chromate primer (C91) on 1.0935/1.0932 diameter of bushing surface.

(7) With hydraulic press set to one ton, press bearing into bushing using tools LT-40-4 and LT-40-5 (refer to Figure 6-19.3).

CAUTION

If extreme interference fit occurs at the beginning of the press fit operation, stop and determine cause. Do not proceed unless cause of interference can be determined and eliminated.

3 Staking.

a Set load setting on hydraulic press to 8 tons, then ring stake bushing using tool LT-40-6 and LT-40-7. This tool ring stakes both sides of bushing at the same time.

b Staked bushing should look like Figure 6-19.4.

c Inspect bearing per paragraph 5.

4 Final Operations.

a Brush staked area (both sides of bushing) with thin coat of zinc chromate primer (C91).

b Apply slippage marks (one on each side of housing) as shown in Figure 6-19.2. This is to be done after the staked area has been inspected per paragraph 5.

c The slippage marks also indicate that the bearing has been inspected 100%.

5 Inspection.

a Mechanically inspect; with the aid of a 4" long bolt placed through the bearing diameter. Rotate with hand pressure, bearing must move freely and easily.

b 100% inspect .040/.020 dimension (see Figure 6-19.5) on both sides of bushing. If the staked contour is on low side of dimensions, then restake bearing with an 8 ton load setting. If the staked contour is on high side of dimensions, dismantle and reassemble using a new bushing.

c If .040/.020 dimension is met, apply a slippage mark per paragraph 4, b above.

d Visually inspect for general appearance. Check for loose plating in the staking area. Remove any loose plating.

(d) When mount is cracked.

(3) Replace boot (1) if found to be

deteriorated using the following procedures:

(a) Remove all traces of old boot from mount by lightly sanding.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged contact with the skin.

(b) Clean area using methyl-ethyl- ketone (C87).

(c) Apply adhesive (C17) to area where boot makes contact with mount.

(d) Position new boot on mount and let cure.

(4) Replace bracket (6) if damaged.

(5) Replace support (4) if damage limits in Chapter 2 are exceeded.

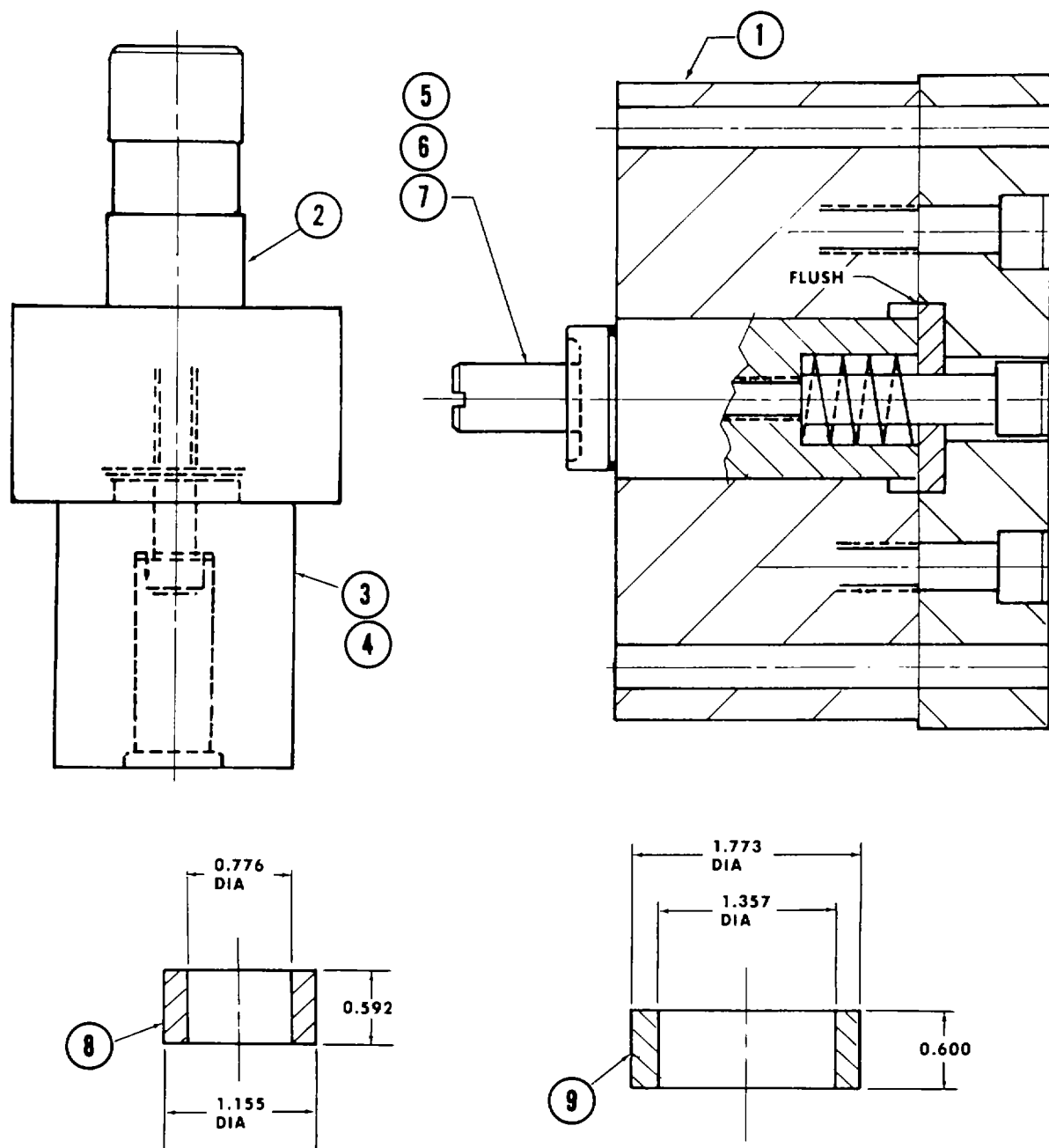
(6) Replace spacer (20, figure 6-12), washer (21) or bolt (22) if cracked, worn or damaged.

e. Installation.

(1) Place mount assembly (2, figure 6-19) with shim (3) under mount flange into support fitting (4). Install bracket (6) and four bolts (5) with washers.

(2) Check that shims are in place on aft side of pylon support (12, figure 6-13) at two locations for ends of fifth mount support fitting (11). Shims are originally 0.313 inch thick, with 0.125 inch laminations. Bond solid sides to pylon support with adhesive (C12). Place ends of support fitting on shims, align holes and install bolts with aluminum alloy washers under heads.

(3) Check alignment of fifth mount eye bolt to bushing at middle of support (11, figure 6-12) on transmission. Bolt (22) should be easily inserted through both parts without need for moving transmission. If necessary, peel shims under fifth mount and/or at ends of support fitting. After alignment, lockwire heads of fifth mount and support fitting attaching bolts.



1. Nest LT-40-1 (T95)
2. Ram Adapter LT-40-2 (T96)
3. Bushing Tool LT-40-3 (T97)
4. Staking Tool LT-40-7 (T101)
5. Bushing Tool LT-40-4 (T98)

6. Bearing Tool LT-40-5 (T99)
7. Staking Tool LT-40-6 (T100)
- * 8. Piercing Tool LT-40-8 (T102)
- * 9. Piercing Tool LT-40-9 (T103)

*Not part of tool kit

Figure 6-19.1. Bushing and Bearing Tool Kit LT-40

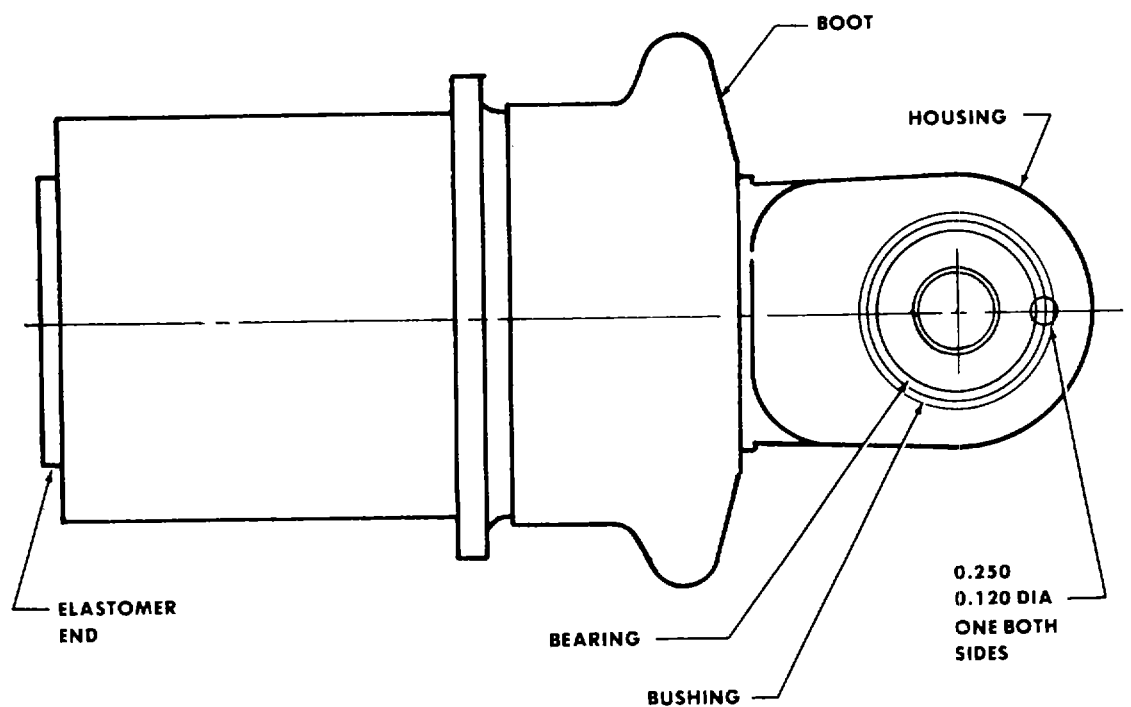


Figure 6-19.2 Fifth Mount Assembly

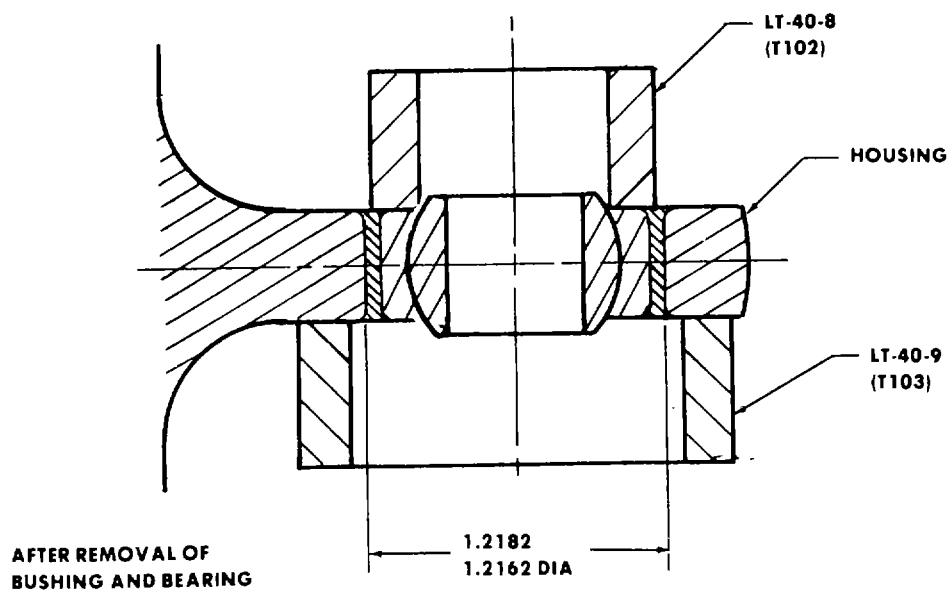


Figure 6-19.3. Fifth Mount Bushing and Bearing Removal

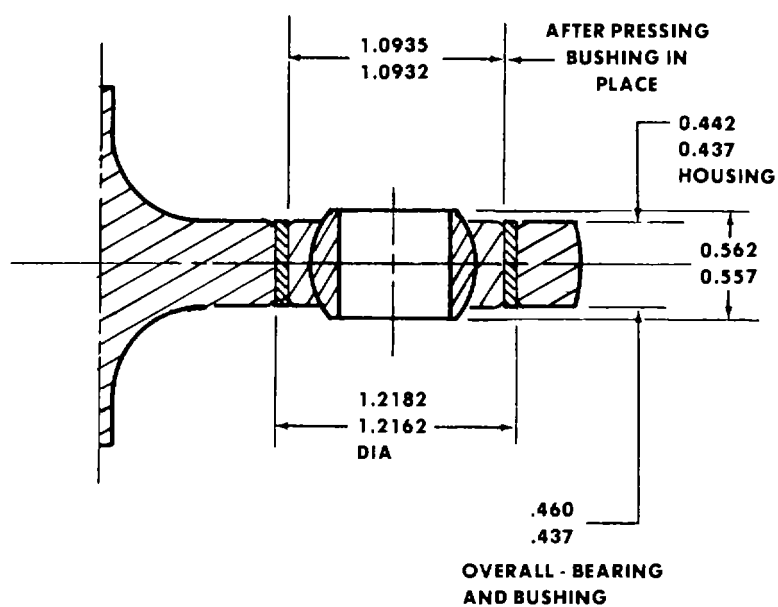


Figure 6-19.4. Fifth Mount Bushing and Bearing Installation

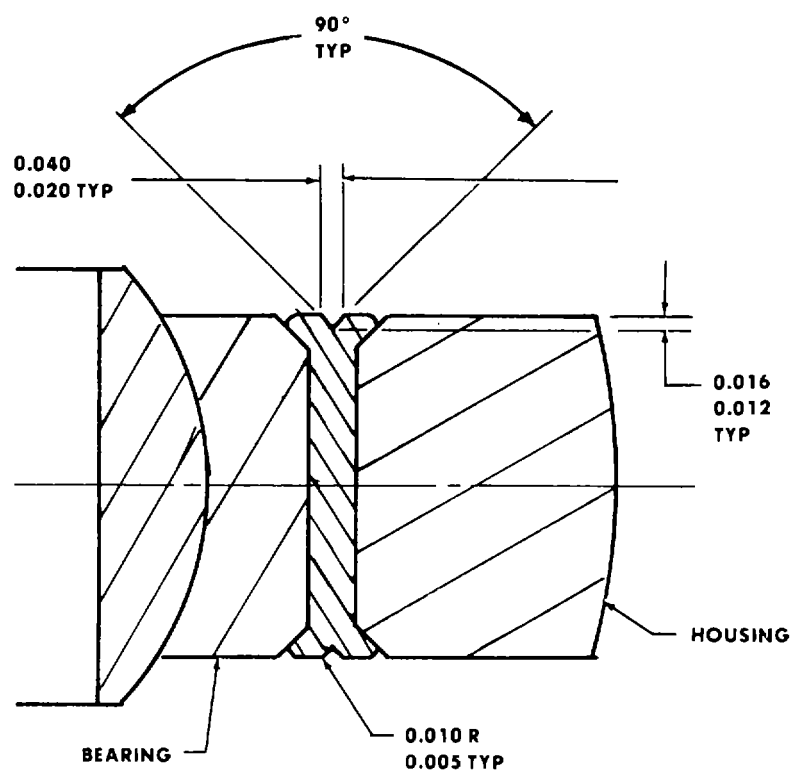


Figure 6-19.5. Fifth Mount Bushing Staking

Change 65 6-42E/(6-42F blank)

NOTE

Bolts must not bottom out. For each 0.06 inch of shim removed, install a steel washer under each bolt head at that location.

(4) Install spacer (20) in fifth mount support (11). Install bolt (22, figure 6-12) with special washer (21), (countersink against bolt head) through support fitting (10) and fifth mount support (11) on transmission case. Install washer (19) and nut (18). Torque bolt **25 TO 33** foot-pounds. Install cotter pin.

(5) Install transducer in accordance with instructions contained in Chapter 9.

(6) Reinstall induction baffle, securing fasteners to receptacles in two clips on fifth mount support fitting.

6-15. Lift Link Supporting Attachment (AVIM).*a Removal*

(1) Remove nut, washer, and bolt securing lift link to support (14, figure 6-20).

(2) Remove nuts (7), washers (6 and 2), and bolts (3) securing support (1) to lift beam (16, figure 6-13).

(3) Remove lift link attaching support (1, figure 6-20) from helicopter.

(4) Remove shims (15) and mark for reinstallation (subparagraph e).

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

(5) Remove bolts (13), chamfered washers (12), washers (9), and nuts (8) to remove supports (14), shims (10), and chamfered plates (11).

b. Cleaning. Clean support thoroughly with solvent (C124). Dry with filtered compressed air.

c. Inspection.

(1) Inspect support (1, figure 6-20) by Magnetic Particle method per MIL-I-6868.

(2) Inspect support for corrosion.

(3) Inspect bushings for wear.

d. Repair or Replacement.

(1) Replace support if it fails to meet Magnetic Particle inspection.

(2) Replace support if excessively corroded.

(3) Replace bushings if excessively worn or damaged.

(a) Press bushings from support.

(b) Press in new bushings.

(c) Line ream holes through bushings (5, figure 6-20) 0.749 TO 0.750 inch diameter.

(d) Ream hole through bushings (4) 0.8745 TO 0.8755 inch diameter.

(e) Coat inside of bushings with compound (C51) after reaming.

e. Installation.

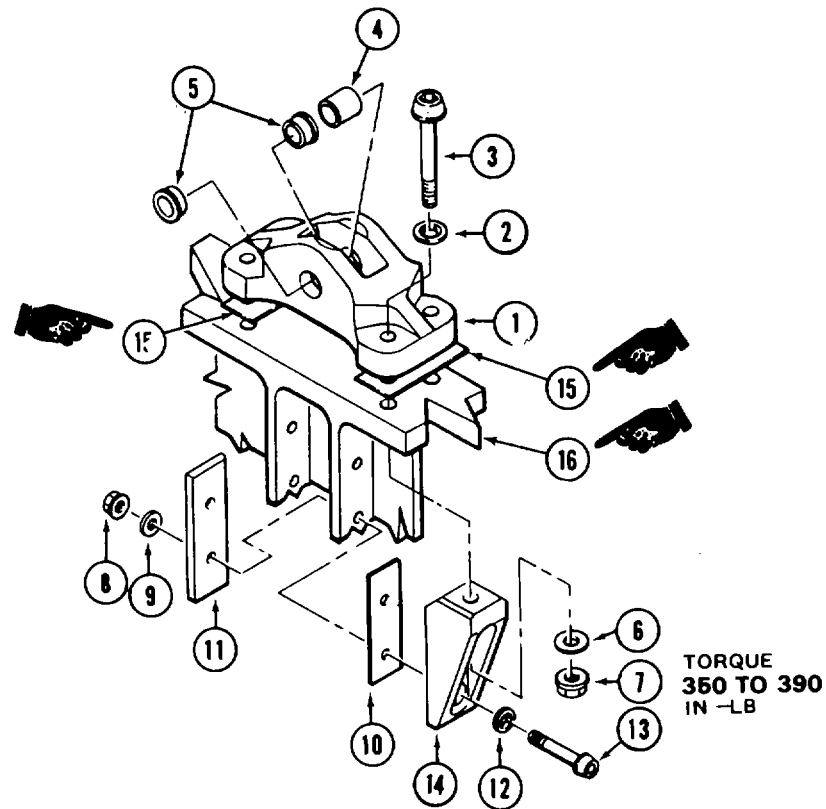
(1) Coat mating surfaces of support (14, figure 6-20) and lift beam (16) thoroughly with primer (C102).

(2) Install supports (14) to lift beam (16), using shims (10), plates (11) with chamfered edge nested in beam (16), bolts (13), washers (9 and 12), and nuts (8). Ensure that chamfered side of washers (12) are facing head of bolt (13).

(3) Coat mating surface of lift link support (1) and lift beam (16) thoroughly with primer (C102).

(4) Deleted

(5) Install four bolts (3) and washers (2) with chamfered side facing bolt head down through support (1), shims (15), lift beam (16), and support (14). Secure with washers (6) and nuts (7). Torque nuts **350 TO 390** inch-pounds.



1. Lift Link Attaching Support
2. Washer, Chamfer
3. Bolt
4. Bushing
5. Bushing
6. Washer
7. Nut
8. Nut
9. Washer
10. Shim
11. Plate
12. Chamfered Washer
13. Bolt
14. Support
15. Shim
16. Lift Beam

209030-49C

Figure 6-20. Pylon lift link attachment

6-16. Pylon Dampers.

Two fluid-type dampers are used in the pylon mounting system to help control motion of the

pylon and prevent vibration. One damper is connected between the pylon support structure and the lower end of each of the rear pylon mounts. See figure 6-13.

Premaintenance requirements for pylon dampers.

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	(T60)
Test Equipment	None
Support Equipment	None
Minimum Personnel	One
Required	
Consumable Materials	(C67) (C73) (C124)
Special Environmental	Dust Free
Conditions	

a. Inspection.

(1) Mount boots for proper installation and deterioration.

(2) Mounts for evidence of bottoming out and deterioration.

(3) Underside of dampers for leaks.

(4) Bearing in damper and damper fitting for maximum of 0.012 axial and 0.006 inch radial play, before replacement.

(5) After any hard landing, remove mount dampers to check for possible internal yielding. (See figure 6-17.)

(a) Use a feeler gage to measure gap between spiral lock-ring and spring seat.

(b) Measure gap between spring seat and shims under end of cylinder barrel.

(c) Damper is unserviceable if either measured gap exceeds 0.030 inch. (See figure 6-17.)

b. Removal. (See figure 6-17.) To remove dampers with transmission and mounts installed, remove bolts from upper and lower attachment fittings. Remove hydraulic cylinder for access, where necessary.

b.1. Repair.

(1) Replace deteriorated boots.

(2) Replace bearing that fails to meet inspection requirements.

c. Disassembly. (AVIM)

(1) Remove cotter pin (17, figure 6-21), nut (16), washer (15), and bolt (12) from piston (11) and clevis end (29).

(2) Remove clevis end (29), pin (30), and spool assembly (27) from piston (11).

(3) Remove pin (30) from spool assembly (27) and separate clevis end (29) from spool assembly. Remove and discard packings (28) from spool assembly.

(4) Remove retainer (10), upper shim (7), barrel (8), and lower shim (9) from body assembly (2).

NOTE

Shims must be placed in the same position on reassembly. Tag and identify the upper and lower shim.

(5) Remove retainer (26), end cap (24), and piston (11) from barrel (8).

(6) Remove retainer (21), spring seats (19), spring (20), and shim (18) from barrel (22). Discard retainer (21).

(7) Remove and discard packing (31), double delta seal (25), and packing (32) from end cap (24).

(8) Remove and discard double delta seal (14) and packing (13) from piston (11).

(9) Remove retaining ring (6), and retainer (3) from body assembly (2).

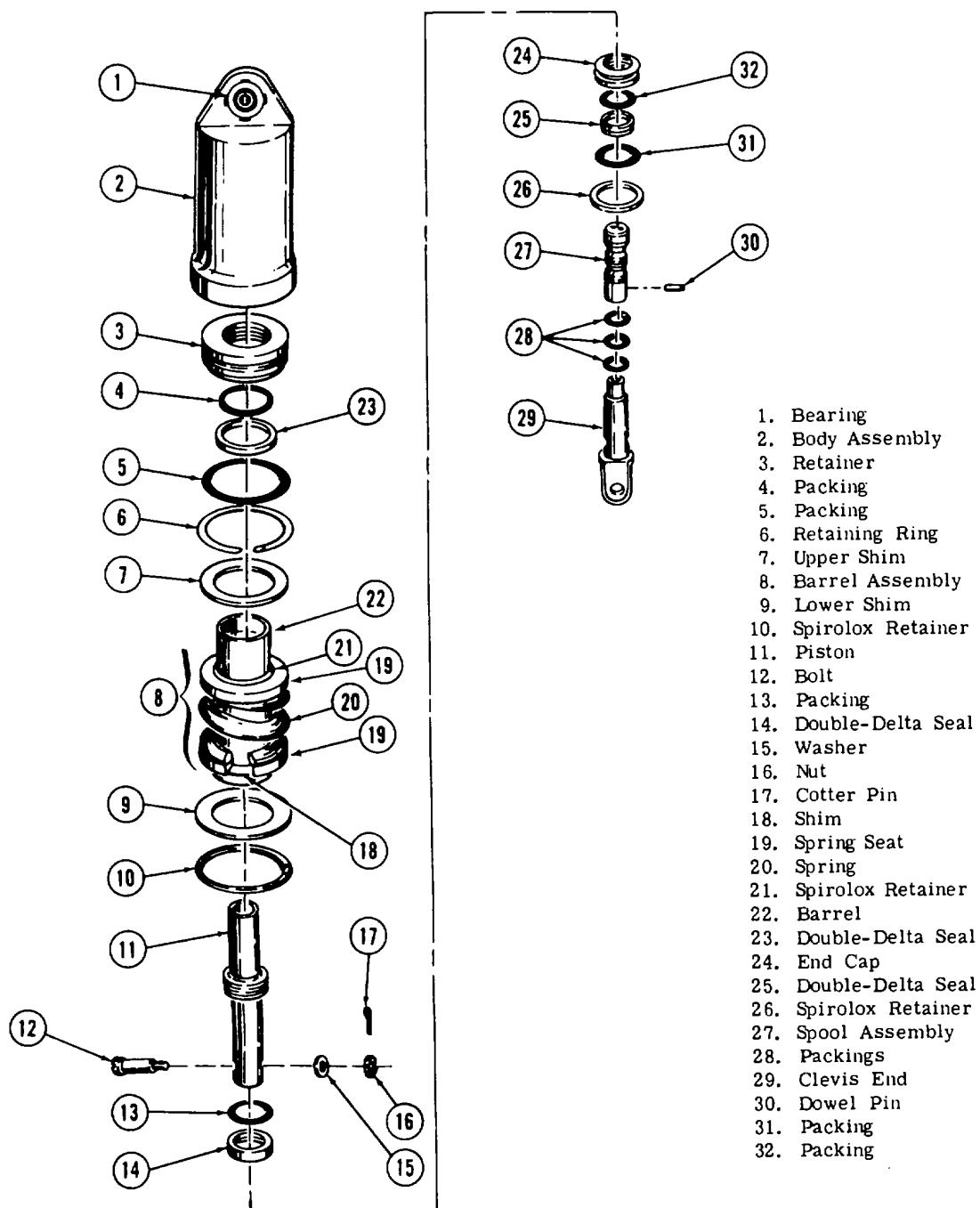
(10) Remove and discard double delta seal (23), packing (4), and packing (5) from retainer (3).

d. Cleaning and Inspection. (AVIM)

WARNING

Use solvent in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

(1) Clean disassembled parts with solvent (C124).



100-0-660

Figure 6-21. Pylon dampers

(2) Dry with a clean lint-free cloth or impressed air not to exceed 4 psig.

(3) Inspect detail parts for nicks, scratches, minor corrosion, wear, and broken shims.

NOTE

The mechanical and corrosion damage limits for the external part of the pylon damper housing assembly should not exceed 0.010 before cleanup (sanding, etc.) and 0.020 after cleanup. There are no damage limits required for the inner pylon housing adjacent to the shim retainer.

e. *Assembly. (AVIM)*

(1) Lubricate all packings and seals with hydraulic fluid (C73) prior to assembly.

(2) Install packing (13, figure 6-21) in groove of piston (11). Install double delta seal (14) over packing (13). Use care to prevent stretching and malforming of seal and packing.

(3) Assemble pylon damper seal installation tool (T60) and pylon damper piston as follows:

(a) Place seal holder (2, figure 6-22) on shaft (1).

(b) Place bolt end of piston (11, figure 6-21) on shaft assembled in step (a).

(c) Thread guide (3, figure 6-22) into shaft (1).

(4) Work double delta seal (14, figure 6-21) under lip of seal holder and hold in position. Insert the guide end of these assembled parts into the large hole of barrel (22) until the seal holder bottoms

inside barrel (22). Hold these parts in position.

CAUTION

Maintain pressure to hold lip of double delta seal (14, figure 6-21) under lip of seal holder and to keep the assembled parts bottomed inside barrel (22), or double delta seal (14) may be damaged.

(5) Hold barrel (22, figure 6-21) firmly and rap shaft (1, figure 6-22) with heel of hand to force piston (11, figure 6-21) into position within barrel (22).

(6) Remove guide (3, figure 6-22) from shaft (1) and remove shaft and seal holder from barrel and piston assembled in preceding step. Remove seal holder (2) from shaft (1).

(7) Insert shaft (1, figure 6-22) through piston (11, figure 6-21), thread guide (3, figure 6-22) into shaft (1), and align holes in piston and guide.

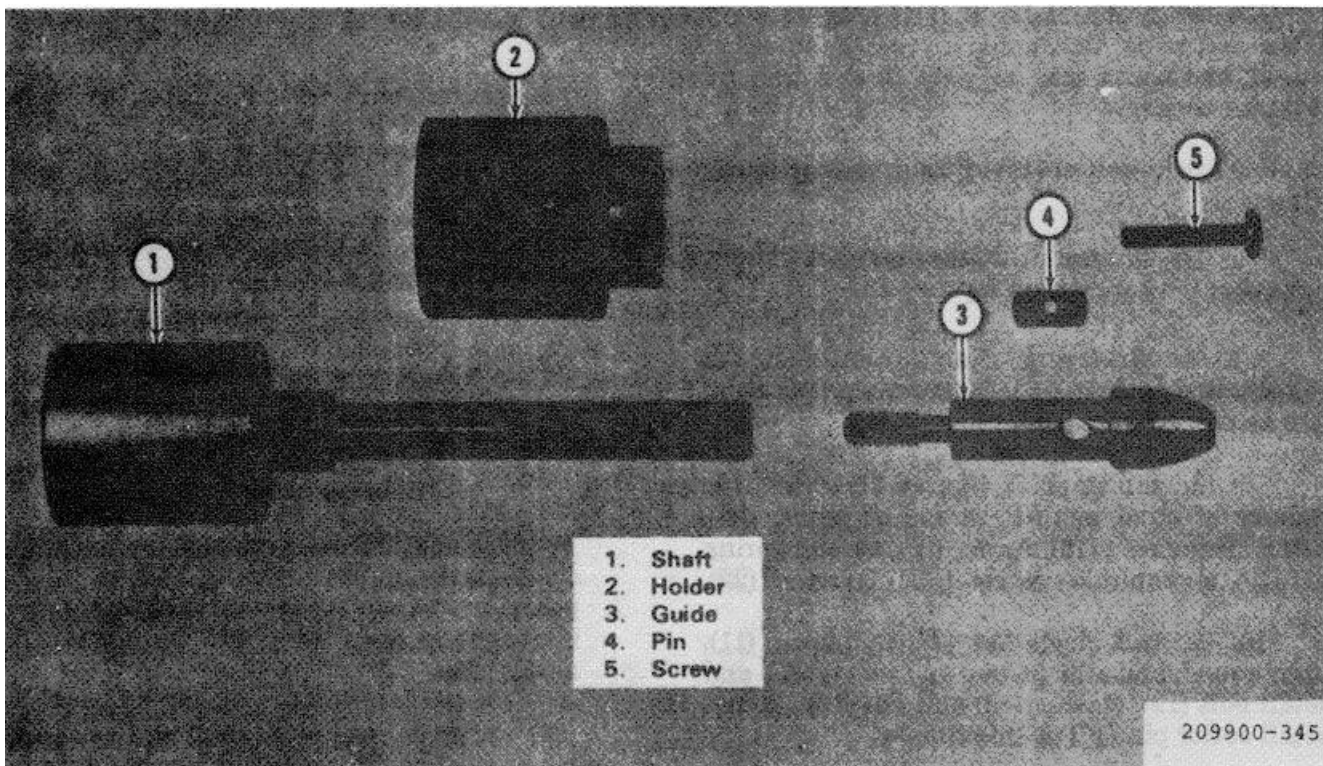


Figure 6-22. Pylon dampers seal installation tool, P/N 5120-EG-007

Install pin (4, figure 6-22) in aligned holes and install screw (5) in pin (4) to lock the special tools to the piston.

(8) Install packing (32, figure 6-21) inside groove of end cap (24). Place double delta seal (25) over packing (32). Install packing (31) in groove on outside of end cap.

(9) Place beveled end of end cap (24) down on guide that was pinned to piston (11) in step (7). Force end cap into position within barrel (22).

(10) Remove screw (5, figure 6-22), pin (4), and guide (3) from shaft (1). Remove shaft (1).

(11) Install spirolox retainer (26, figure 6-21) into barrel (8).

(12) Install packing (4) in retainer (3) and install double-delta seal (23) over packing. Install packing (5) on retainer. Install retainer (3) and packings on barrel (22). Turn retainer on barrel to seat and size double-delta seal (23). After a minimum of five minutes, remove retainer from barrel and inspect double delta seal for correct seating and for damage.

(13) If double delta seal (23) is properly seated and is not damaged, install the retainer, seal, and packings into body (2) and secure with retaining ring (6).

(14) Select shim (18) of proper thickness as follows:

(a) Determine dimension A and dimension B as shown on figure 6-23.

(b) Subtract dimension B from dimension A to obtain measured gap. Determine proper shim from table on figure 6-23.

(15) Install shim (18, figure 6-21) with inside chamfer of shim against radius of barrel (22). Install spring seat (19), spring (20), second spring seat (19), and spirolox retainer (21) on barrel (22).

(16) Install clevis-end (29) in piston (11). Align round holes in piston and clevis-end and install bolt (12), washer (15) and nut (16). Do not install cotter pin (17) at this time.

(17) Select upper shim (7) of proper thickness as follows:

(a) Determine dimension C as shown on figure 6-24.

(b) Subtract dimension C from 5.82 inches to obtain measured gap. Determine proper shim by using table on figure 6-24.

(18) Remove barrel assembly (8, figure 6-21, from body assembly (2). Install upper shim (7) in body assembly (2) and reinstall barrel assembly (8).

(19) Temporarily install spirolox retainer (10). Using feeler gage measure gap between spring seat and spirolox retainer as shown on figure 6-25. Select proper lower shim based on measured gap from table on figure 6-25.

(20) Remove spirolox retainer (10, figure 6-21). Install lower shim (9) and reinstall spirolox retainer (10).

(21) Remove bolt (12) and clevis-end (29) from piston (11).

(22) With damper held in vertical position, add hydraulic fluid (C73) through piston rod (11), slowly cycling piston rod (11) until air is removed leave piston rod (11) in retracted position.

(23) Install packings (28) on spool assembly (27). Align holes in spool assembly (27) and clevis end (29) and insert dowel pin (30).

(24) Install spool assembly (27) in piston (11). Align holes in piston and clevis end (29) and install bolt (12) washer (15), nut (16), and cotter pin (17).

(25) Pack bearing (1) with grease (C67).

CAUTION

Any attempt to move the piston, spool, or clevis assembly with the damper in a position other than vertical may introduce air into the piston and spool assemblies.

(26) After damper is serviced and spool and clevis assembly is installed, hold damper assembly vertical with piston (clevis end) down and check for free movement or play of piston. 1

there is any free movement or play, the pylon damper is not properly serviced and/or not properly assembled.

(27) If laminated shims were replaced with solid shims during assembly, stamp a letter "C" after serial number.

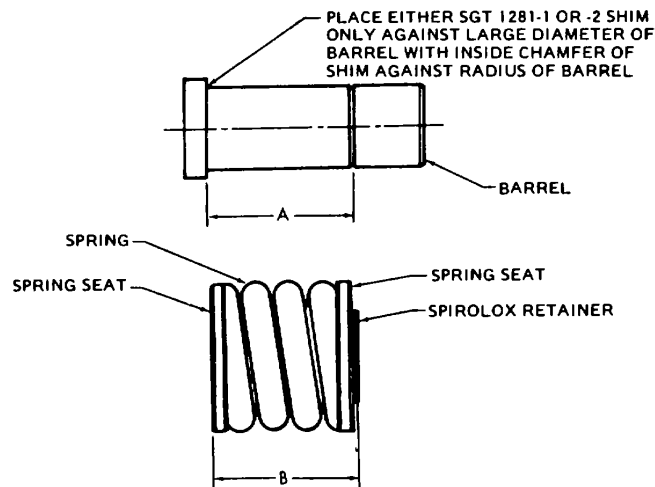
f. Installation.

(1) Place damper, with cylinder up, into pylon support from inboard side.

(2) Align cylinder bearings in eyebolt of aft mount, and clevis on support fitting in structure.

(3) Install bolts, nuts, and washers.

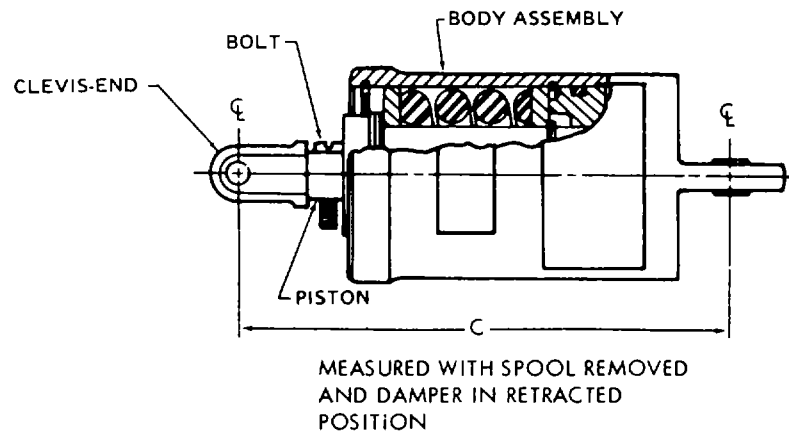
(4) Reinstall hydraulic cylinder removed for access.



		SGT 1281 SHIM REQUIRED					
		-1	-2	-3	-4	-5	-6
MEASURED GAP		.070	.050	.040	.035	.030	.025
.070		1					
.071	.075		1				1
.076	.080		1			1	
.081	.085		1		1		
.086	.090		1	1			
.091	.095	1					1
.096	.100	1				1	
.101	.105	1			1		
.106	.110	1		1			
.111	.115		1		1	1	
.116	.120	1	1				
.121	.125		1	1	1		
.126	.130	1			1		1
.131	.135	1			1	1	

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Figure 6-23. Shim replacement - damper barrel assembly

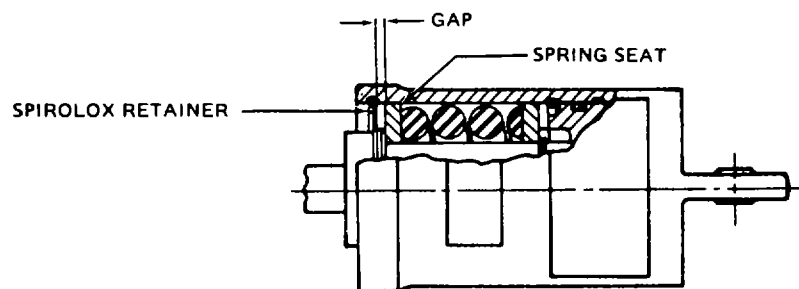


SGT 1282 SHIM REQUIRED

	-1	-2	-3	-4	-5	-6	-7
MEASURED GAP	.060	.040	.035	.030	.025	.020	.015
.015							1
.016 .020						1	
.021 .025					1		
.026 .030				1			
.031 .035			1				
.036 .040		1					
.041 .045					1	1	
.045 .050				1		1	
.051 .055				1	1		
.056 .060	1						
.061 .065		1			1		
.066 .070		1		1			
.071 .075		1	1				
.076 .080	1					1	
.081 .085	1				1		
.086 .090	1			1			
.091 .095	1		1				
.096 .100	1	1					
.101 .105	1				1	1	
.106 .110	1			1		1	
.111 .115	1			1	1		
.116 .120	1		1		1		

20,030-10A

Figure 6-24. Shim replacement - damper upper shim



SGT 1282 SHIM REQUIRED (OUTBOARD)

		-1	-2	-3	-4	-5	-6	-7
MEASURED GAP		.060	.040	.035	.030	.025	.020	.015
.015	.019							1
.020	.024						1	
.025	.029					1		
.030	.034				1			
.035	.039			1				
.040	.044		1					
.045	.049					1	1	
.050	.054				1		1	
.055	.059				1	1		
.060	.064	1						
.065	.069		1			1		
.070	.074		1		1			
.075	.079		1	1				
.080	.084	1					1	
.085	.089	1				1		
.090	.094	1			1			
.095	.099	1		1				
.100	.104	1	1					
.105	.109	1				1	1	
.110	.114	1			1		1	
.115	.119	1			1	1		
.120	.124	1		1		1		
.125	.129	1	1			1		
.130	.134	1	1		1			
.135	.139	1	1	1				
.140	.144	2					1	
.145	.149	2				1		
.150	.154	2			1			
.155	.159	2		1				
.160	.164	2						
.165	.169	2				1	1	
.170	.174	2			1		1	
.175	.179	2			1	1		
.180	.184	2		1		1		
.185	.189	2		1	1			
.190	.194	2	1		1			
.195	.199	2	1	1				

Figure 6-25. Shim replacement - damper lower shim

6-17. Main Rotor Mast.

The main rotor mast assembly is a tubular steel shaft fitted with two bearings, which support it vertically in the transmission. Mast driving splines are engaged with transmission upper stage planetary gear providing counterclockwise rotation as viewed from above. Splines on upper portion of mast provide mounting for main rotor and control assemblies.

Premaintenance Requirements For
Main Rotor Mast

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	(T8) (T9) (T10) (T11) (T12) (T13) (39)
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	Two
Consumable Materials	(C45) (C52) (C57) (C67) (C87) (C94) (C102) (C115) (C116) (C124) (C128) (C136)
Special Environmental Conditions	Dust Free

a. Inspection.

(1) Exposed surfaces of mast for damage. Nicks, scratches, or corrosion are reparable, not to exceed 0.010 inch depth after repair.

(2) Areas of mast which might be touched by rotor hub for any evidence of deformation.

(3) During scheduled inspection of collective friction collet, inspect friction sleeve on mast as follows:

(a) With friction collet partially disassembled for inspection, detach and lift spine plate and extension up mast to expose mast sleeve. (Refer to Chapter 5.)

(b) Use a soft carbon pencil to lay out four reference marks, 90 degrees apart, along entire length of sleeve.

(c) Use standard 3-to-4 inch micrometer to check sleeve diameter over full length at reference marks. Maximum allowable taper or out-of-round is 0.007 inch.

NOTE

Permissible bond void between sleeve and mast is 0.625 inch at the top and bottom, full circumference. At the butt joint the permissible void is 0.125 inch, full length. Void depth can be determined by using a size 0.002 inch feeler gage.

(d) Before reinstalling spline plate and extension, check that mating splines of mast and plate are coated with grease (C67).

NOTE

Mast sleeve must be kept clean of grease or dirt.

b. Repair or Replacement. If inspection limits are exceeded, replace mast. Any deformation in area of rotor hub contact is cause for sending mast to overhaul for evaluation.

c. Removal.

(1) Install nut (1, figure 6-26) on top of mast. Attach hoist to nut and take up cable slack.

(2) Remove nuts holding upper bearing retainer plate (5) to transmission and bolts attaching boss extension of plate to support on transmission.

(3) Disconnect oil line from jet (15) in bearing plate.

(4) Carefully lift mast out of transmission with hoist and place in a suitable stand. Cover opening in top of transmission.

d. Inspection-Mast Bearing. (AVIM)

(1) Check visually for evidence of spalling, corrosion, or mechanical damage on lower bearing race (13). Check security of nut and cotter pin below race.

(2) Inspect upper bearing visually and by slowly rotating to check for freedom of rotation.

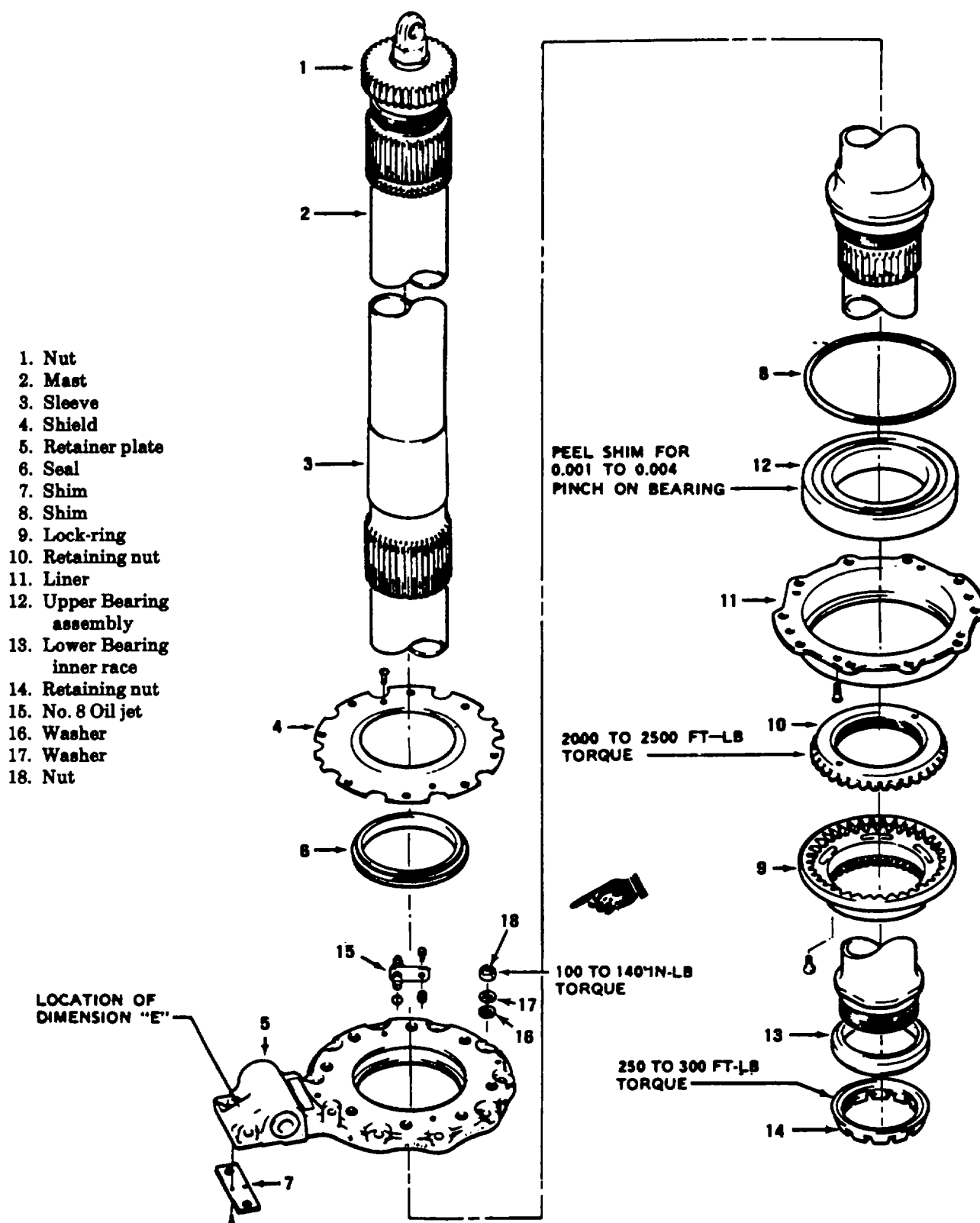


Figure 6-26. Main Rotor Mast.

Figure 6-27. Deleted.**e. Disassembly. (AVIM)**

(1) Support mast assembly in a suitable stand. Keep nut (1, figure 6-26) installed on mast to protect threads.

(2) Remove two screws and remove shield (4) from bearing retainer plate (5). Remove four countersunk screws to detach plate from bearing liner (11). Carefully lift plate assembly off mast. Press out seal (6). Keep shims (8) with plate. Remove oil jet (15) with attaching screw.

(3) Remove two lockwired screws and lockring (9) from retaining nut (10). Position adapter (T10) or (T12) over mast drive splines and position socket (T13) or (T11) on nut. Use power wrench (T8) and power wrench multiplier (T9) to break nut torque.

Remove tools and nut.

(4) Remove liner (11) and upper bearing(12) with both halves of inner race.

(5) At low end of mast, remove two cotter pins and use wrench, (T39), to remove bearing retainer nut (14). Carefully tap inner race (13) of lower bearing from end of mast.

WARNING

Use solvent (C124) in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

f. Cleaning. (AVIM) Clean all mast parts with solvent (C124) and dry with filtered compressed air. Keep solvent off seal.

g. Inspection. (AVIM)

WARNING

Inspect mast for the word "REWOR KED" on flange in area I figure 6-28. If the word "REWORKED" is on the flange and there is corrosion damage that will require polishing out in accordance with paragraph h (2) (e), reject the mast; rework is permitted one time only.

(1) Inspect parts for wear, damage and condition of bearings.

(2) Inspect retainer plate for corrosion or pitting in area of seal seat. Any corrosion pitting in this area is cause for rejection.

(3) Inspect mast for:

(a) Corrosion damage in excess of limits on Figure 6-28.

(b) Damage in the area of main rotor hub flapping stop contact in excess of the deformation limits on Figure 6-28.1

(4) Inspect mast for scratches with particular attention to the radius immediately above the upper bearing seat and to tapered section below lower splines.

(5) Check sleeve (3, figure 6-26) for bond void between the sleeve and mast (2).

NOTE

Permissible bond void between mast and sleeve is 0.625 inch around top and bottom circumference and 0.125 inch at the sleeve butt joint for full length. Check with 0.002 inch feeler gage.

(6) Inspect sleeve (3) for wear and taper as follows: See figure 6-29.

(a) Lay out four reference lines for full length of sleeve. Locate lines 90 degrees apart. Use a soft carbon pencil to make marks.

(b) Use standard three to four-inch micrometer to check sleeve for taper and for out of round.

Make several measurements along lines for entire length of sleeve and record. The maximum allowable out of round or taper is 0.007 inch.

(7) Inspect mast dimensionally. See figure 6-30.

(8) Inspect the following parts by magnetic particle method, MIL-L-6868, (Code M) or fluorescent penetrant method, MIL-I-6866 (Code F). See figure 6-26.

ITEM	NOMENCLATURE	CODE
2	Mast	M
10	Nut	M
11	Liner	M
14	Nut	M
5	Plate	F

(9) Inspect mast for deformation in area where hub yoke may have contacted the mast

h. Repair or Replacement.

(1) Nonreparable damage: Replace the mast if the conditions in the following warning and steps (a) through (e) exist. Condemn and demilitarize the mast locally. Do not return the mast to an overhaul facility. If any of the inspections in steps (a) through (e) cannot be performed and the mast passed those inspections that were performed, send the mast to an overhaul facility for further evaluation.

WARNING

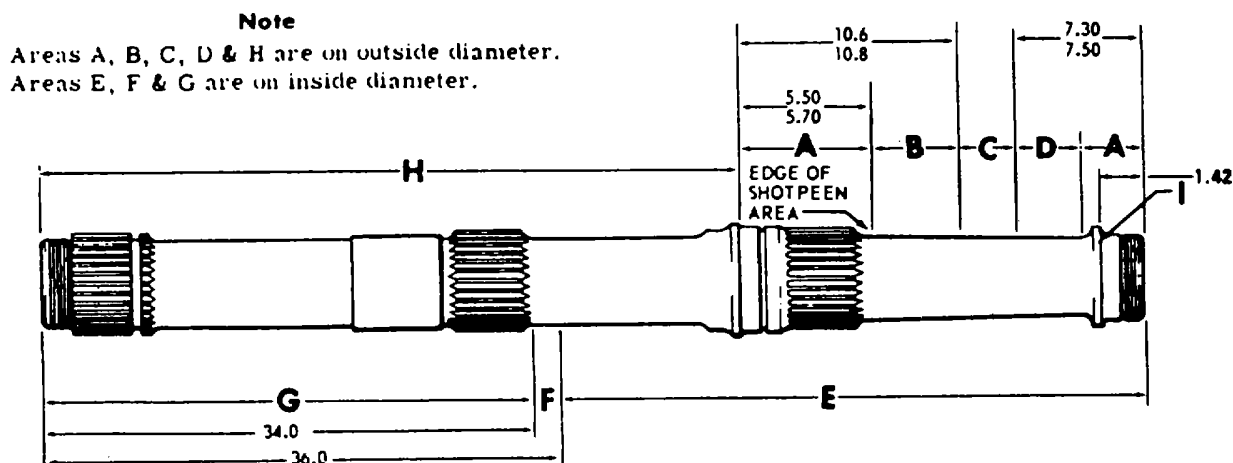
Replace mast if the word "REWORKED" has been placed on the flange in area I, figure 6-28 and there is corrosion damage that will require polishing out in accordance with paragraph h (2) (e). Rework that requires polishing out is permitted onetime only.

(a) Replace mast if mechanical damage or corrosion exceeds limits shown on figure 6-28.

(b) Replace mast if seal seat is corroded or pitted.

(c) Replace any part failing Magnetic Particle or Fluorescent Penetrant Inspection.

(d) Replace mast if deformation is evident in area where hub yoke may have contacted mast



MAXIMUM ALLOWABLE DEPTH OF CLEANUP TO REMOVE CORROSION AND MECHANICAL DAMAGE

- AREA A - Surface Corrosion. Only That Which Can Be Removed By Wire Brush or Steel Wool.
- AREA B - 0.002 Inch
- AREA C - 0.015 Inch
- AREA D - 0.020 Inch

NOTE

Do not touch mast in areas B, C, D. If touched, remove fingerprints within two hours with fingerprint remover (C55). Cotton gloves (C66B) should be worn when handling the mast in these areas.

Note

Cleanup on the inner diameter is allowable within the following limits provided cleanup is accomplished by honing or similar method so that material removal is uniform around the diameter.

- AREA E - 0.005 Inch - Or to a Maximum I.D. of 2.980 Inches.
- AREA F - 2.970 Inch Maximum I.D.
- AREA G - See table below:

Note

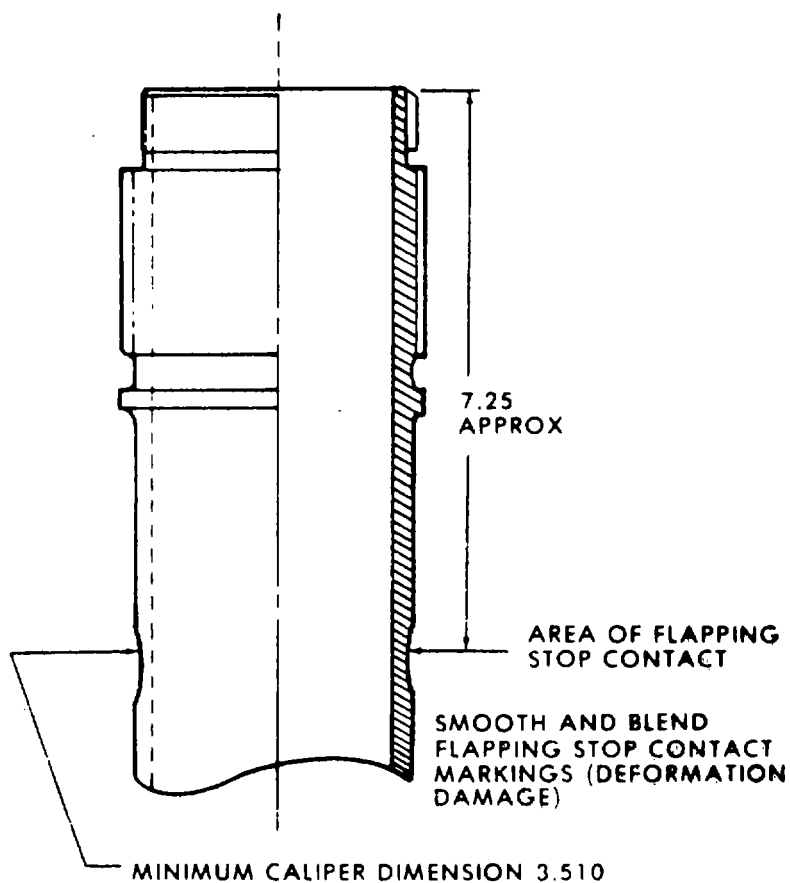
Table for AREA G, indicates maximum allowable I.D. for various O.D.'s at stations measured in inches from top of mast.

O.D. →	3.545	3.550	3.555
Max. I.D. Sta. 0-10	2.980	2.986	2.993
Max. I.D. Sta. 10-20	2.976	2.982	2.989
Max. I.D. Sta. 20-34	2.970	2.976	2.983

- AREA H - 0.010 Inch Local Cleanup
- AREA I - After cleanup; mark "REWORKED" on flange, using vibration stylus. This does not apply if rework is limited to removal of surface corrosion that can be removed by wire brush or steel wool.

Note: Pitting must be completely removed within allowable cleanup depth for mast to be acceptable. Finish reworked areas to 32 RMS.

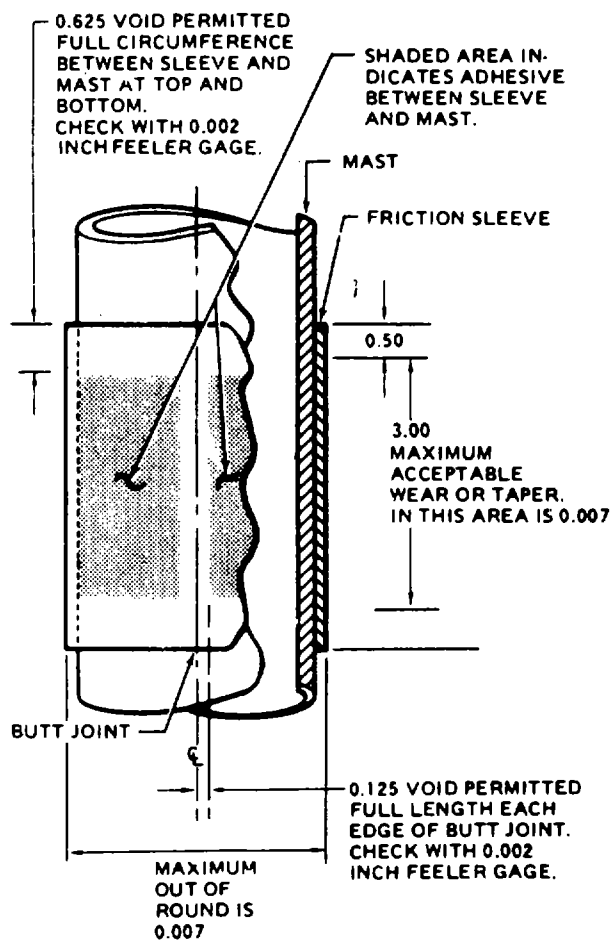
Figure 6-28. Main rotor mast - damage limits



ALL DIMENSIONS ARE IN INCHES UNLESS
OTHERWISE NOTED.

209040-12D

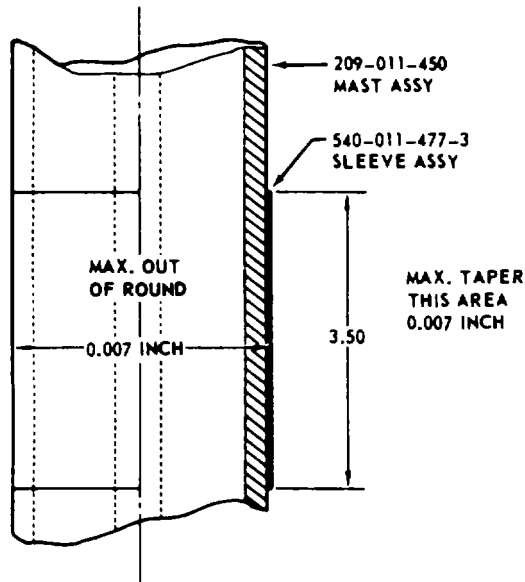
Figure 6-28A. Damage Limits - Main Rotor Mast (Sheet 1 of 2)



COLLECTIVE PITCH FRICTION SLEEVE
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

209010-118-1

Figure 6-28A. Damage Limits - Main Rotor Mast (Sheet 2 of 2)



Note

Use 3 to 4-inch Micrometer in 10 to 12 places

209010-23

Figure 6-29. Mast sleeve taper and out of round

(e) Replace mast if it exceeds dimensional limits shown on figure 6-30.

(2) Repair.

(a) Dress splines with fine india stone (C128) to remove burrs, small nicks, and scratches.

(b) Polish out mechanical damage not exceeding limits shown on figure 6-28 with crocus cloth (C45). Blend repairs into surrounding area to a smooth contour.

(c) On repaired areas above upper bearing, apply a spray coat of primer (C102), followed by a thin coat of aluminum lacquer (C78).

(d) Remove superficial corrosion from area A, figure 6-28, with a fine wire brush or steel wool (C127).

(e) Remove corrosion in figure 6-28, areas A, B, C, D, and E, with fine india or fine carborundum stone (C128). To be reparable, depth of corrosion in these areas must not exceed limits specified. Replace mast if

limits are exceeded.

After this type of repair has been made in these areas, mark upper side of lower bearing flange as shown on figure 6-28.

(f) Replace all unserviceable parts.

(g) Replace upper bearing if limits were exceeded during inspection.

NOTE

Parts of upper bearing are in matched sets numbered on outer race and both halves of inner race. Parts of different numbers may not be combined. Lower bearing parts are not matched and may be interchanged.

(h) Replace seal (6, figure 6-26) if evidence of oil leakage is found or seal is damaged as follows:

(1) Remove mast from helicopter.

(2) Support mast assembly in a suitable stand. Keep nut (1, figure 6-26) installed in mast to protect threads.

(3) Remove two screws and remove shield (4) from bearing retainer plate (5). Remove four countersunk screws to detach plate from bearing liner. Carefully lift plate from bearing liner. Carefully lift plate assembly off mast. Press out seal (6). Keep shims with plate for reinstallation.

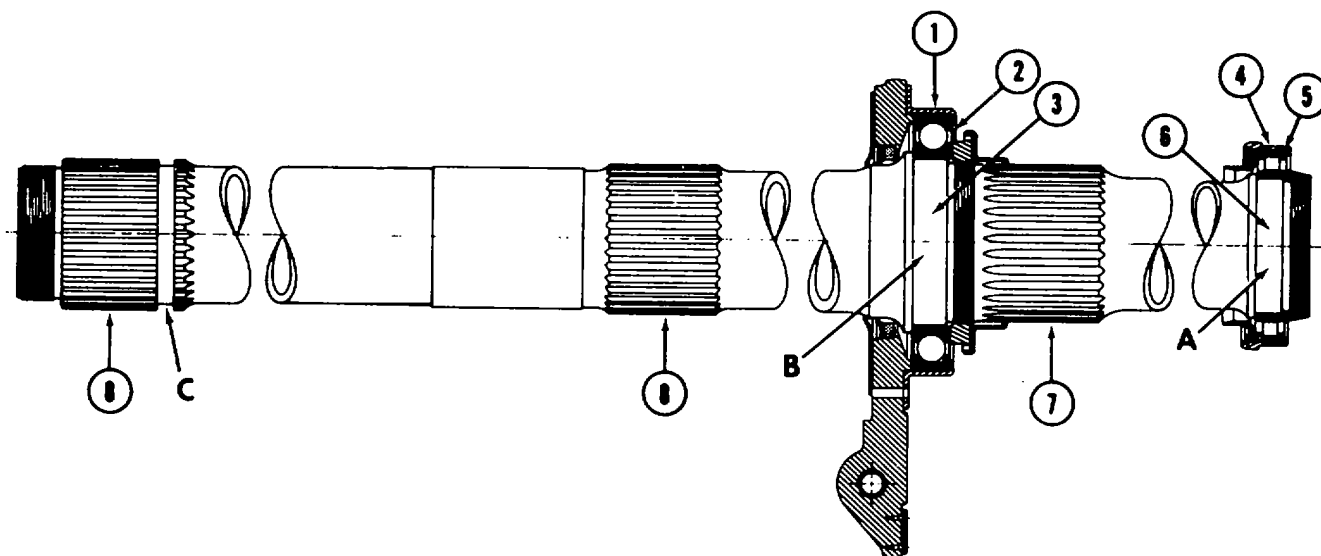
(4) Place shim into liner against outer race of upper bearing. Install retainer plate assembly (5) on mast with care to avoid damaging seal on mast splines. Secure bearing liner to plate with four countersunk screws; ensure screw heads are below liner surface.

(5) Install shield (4) and secure on top of retainer plate with two screws.

i. Assembly. (AVIM)

(1) Press outer race of bearing (12, figure 6-26) into liner (11).

(2) Determine thickness of shim (8, figure 6-26) as follows: (See figure 6-31)



ITEM	NOMENCLATURE	REPLACEMENT LIMITS (INCHES)	
1	Liner - Thrust Bearing	ID	6.6929
2	Bearing - Thrust	OD	6.6922
		ID	4.3308
3	Mast - Bearing Seat	OD	4.3307
4	Liner - Roller Bearing	ID	5.0003
5	Bearing - Roller	OD	4.9984
		ID	3.5001
6	Mast - Bearing Seat	OD	3.5003
7	Splines (Use 0.1920 Dia Pins)		4.2913

PART NUMBER 209-010-450-5

209010-71

Figure 6-30. Main rotor mast - wear limits.

(a) Measure dimension A with a depth gage.

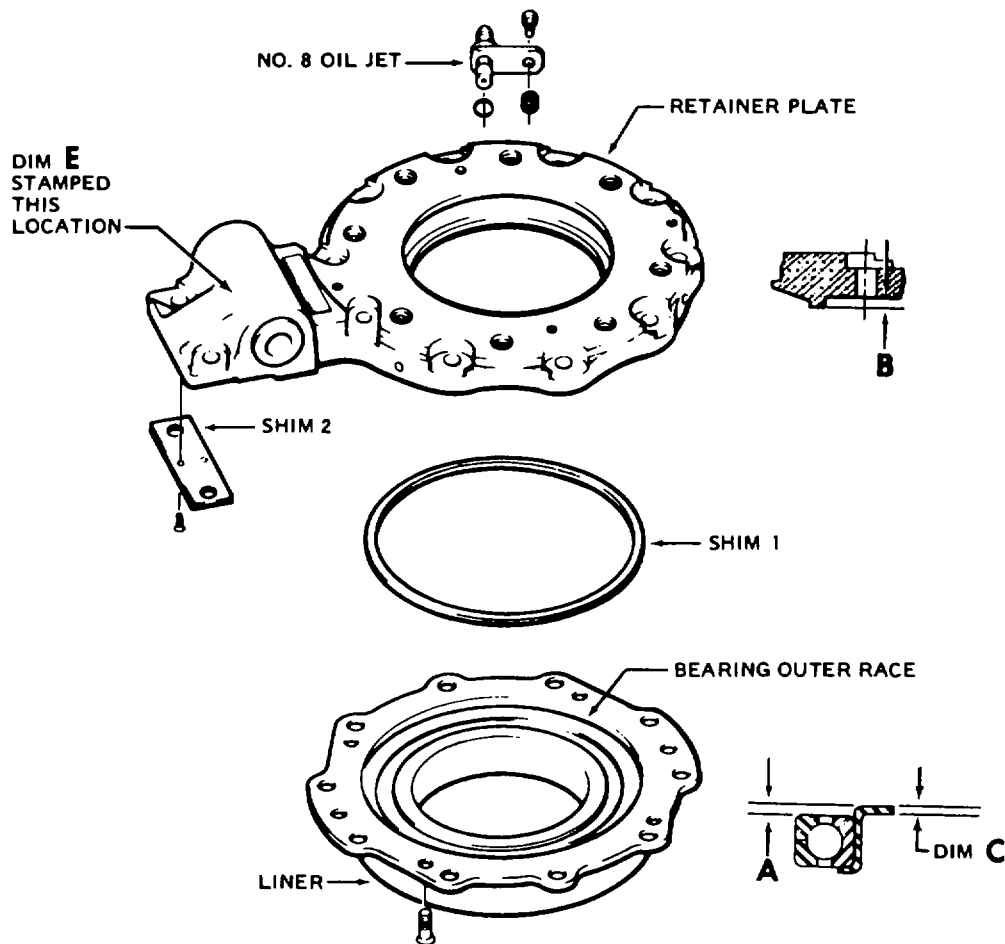
(b) Measure dimension B with a depth gage.

(c) Subtract dimension B from dimension A.

(3) Prepare a laminated shim from 0.001 TO 0.004 inch greater thickness than the resulting dimension. This provides the proper pinch fit on the bearing. Set aside with liner assembly for later installation.

(4) With mast suitably supported, start upper half of thrust bearing inner race on mast bearing seat. Use retaining nut (10, figure 6-26) to push race as far as threads allow and remove nut. Using a soft faced drift, carefully tap race 1 /1 6 inch further onto mast to provide a positive pilot for starting lower half of race.

(5) Measure thickness of flange of liner and record dimension "C" on figure 6-31 for later reference.



209040-5A

Figure 6-31. Upper mast bearing - shim adjustment

(6) Place assembled liner and outer race on mast against upper half inner race. Start lower half of inner race on mast with match marks on race halves aligned.

CAUTION

Use extreme care in starting lower half of race onto mast. Do not allow bearing balls to bounce in races during assembly.

(7) Install bearing retaining nut (10, figure 6-26) hand-tight, with splined flange down and threads lubricated with oil (C94).

(8) Position adapter, (T12) over mast drive splines, and socket, (T13), on bearing retainer nut. Using power wrench (T8) and power wrench multiplier (T9), tighten nut to push assembled bearing to position against mast shoulder. Continue tightening nut to low side of required **2000 - 2500 FOOT-POUNDS TORQUE**, then remove tools.

NOTE

During seating and torquing procedure, rotate bearing outer race to check for freedom of movement.

(9) Place lockring (9) over mast drive splines and engage with splines of retaining nut (10). Secure to nut with screws at opposite sides of mast. Lockwire screw heads together.

(10) Apply sealant (C116) on surfaces where seal (6) will seat in retainer plate (5). Press seal, with lip up, into plate. Clean off any excess sealant. Be sure four drain holes, in retainer plate above seal, remain clear. Install oil jet (15) and secure in plate with screw. Lockwire screw.

(11) Place shim (8) into liner against outer race of upper bearing. Install retainer plate assembly (5) on mast with care to avoid damaging seal on mast splines. Secure bearing liner to plate with four countersunk screws; ensure screw heads are below liner surface.

(12) Install shield (4) and secure on top of retainer plate with two screws.

(13) Install nut (1) on mast (2) to protect threads.

(14) Carefully press lower bearing inner race (13) onto seat at lower end of mast. Install retaining nut (14), tighten nut with adapter, (T10), socket, (T11), and power wrench, (TS), **TORQUE NUT TO 260 - 300 FOOT-POUNDS** and align two nut slots with holes at opposite sides of mast. Insert two cotter pins, with splits horizontal, from inside mast. Bend both ends of each cotter pin down and in against mast end, to lie below or flush with outer surface of nut.

(15) Suspend mast on hoist and remove shim (7, figure 6-26) from boss extension on retainer plate (5).

(16) Adjust shim (7, figure 6-26) as follows: See figure 6-31 for illustration of dimension locations.

(a) Note "dimension E" stamped on retainer plate.

(b) Obtain dimension "F" by subtracting dimension "E" from dimension of flange measured and recorded in step (5).

(c) Make thickness of shim (7, figure 6-26) equal to 0.002 inch greater than dimension "F." Peel or add laminations as needed.

(17) Install shim (7) of correct thickness on retainer plate (5). Ensure that heads of screws are below surface of shim.

j. *Installation.*

WARNING

Ensure that correct part number mast is installed in transmission. Refer to TM 55-1530-234-23P

(1) Uncover opening in top of transmission.

(2) Perform dimensional check between upper surface of transmission case and upper surface of planetary adapter, as follows:

(a) Place a straightedge across opening in top surface of adapter. See figure 632. Distance shall be a minimum of 2.570 inches.

WARNING

Exercise caution during reindexing of parts to prevent the possibility of injury to fingertips.

(b) If minimum measurement is not obtained, examine upper and lower sun gear in planetary assemblies to determine if tangs of planetary support liner are engaged with mating slots of lower planetary liner. This can be determined by use of fingertips. If tangs are disengaged, a gap of approximately 0.250 inch will be felt between the two liners.

(c) If gap exists, reindex two liners by inserting the hands into the adapter and liner, palms outboard, lifting adapter slightly and rotating until the liners are correctly aligned.

(3) Seal mating surface of the transmission and the mast liner (11, figure 6-26) prior to the installation of the mast. Use the following procedure:

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone (C87). Avoid breathing solvent vapors and prolonged contact with the skin.

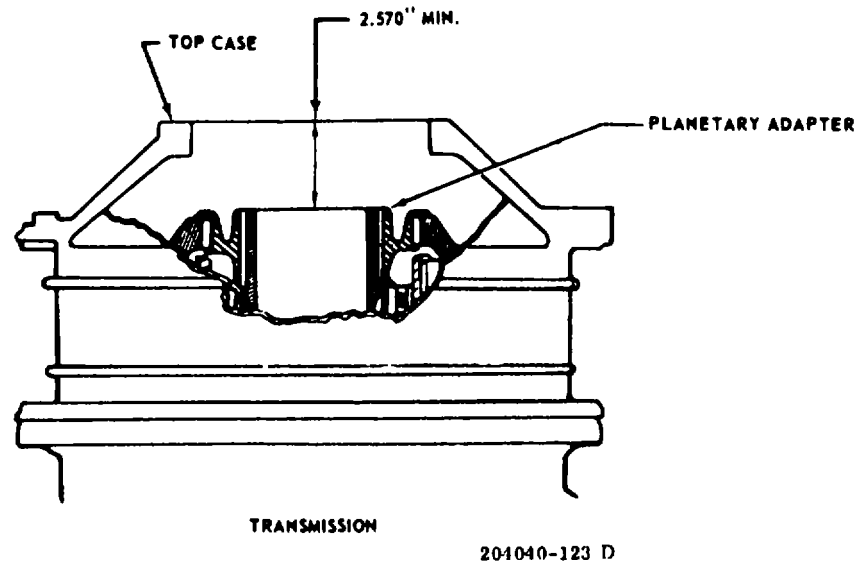


Figure 6-32. Transmission top case -- dimension check

(a) Clean the mating surfaces of the transmission top case and the mast liner (11) with methyl-ethyl-ketone (C87). Wipe dry with a clean cloth before solvent evaporates.

(b) Mix two-part sealant (C116) in accordance with directions on the container. Use the sealant before the pot life time expires.

(c) Run a small bead of sealant (C116) on both mating surfaces and smooth with a wooden spatula. The correct amount of sealant application will result in a small amount of squeeze-out when the mast is installed.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged skin contact.

(d) If the sealant cures before the mast can be installed, clean the sealant from both surfaces with a sharp plastic scraper and repeat cleaning procedure with methyl-ethyl-ketone (C87). Reapply sealant as outlined in steps (b) and (c).

(4) Lift mast assembly to position directly over transmission opening. Carefully lower the mast assembly into the transmission opening, guiding lower end into bearing.

(5) Install a thick aluminum alloy washer (16), a thin steel washer (17), and a nut (18) on each of the ten transmission case studs (Fig. 6-26). Torque 100 TO 140 inch-pounds.

(6) Seal area where flange of retainer plate (5, figure 6-26) joins transmission. Use the following procedure:

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and prolonged contact with skin.

(a) Clean the area where sealant is to be applied with methyl-ethyl-ketone (C87) and wipe dry with a clean cloth before solvent evaporates.

(b) Mix two-part sealant (C116) in accordance with directions on the container.

(c) Run a small bead of sealant (C116) around the mating flanges and fill jackscrew holes with plastic caps or sealant (C116). Use an extrusion gun if available. If necessary, smooth the sealant before it cures, using with a wooden spatula wetted with methyl-ethyl-ketone (C87), or use finger wetted with water.

NOTE

Four drain holes in retainer plate must be free of sealant or foreign materials after installation.

(7) Connect oil hose from tee fitting on left rear side of transmission top case to oil jet on mast bearing retainer plate.

k. Preparation of Mast for Shipment.

(1) Clean main rotor mast assembly in accordance with paragraph 6-17f.

NOTE

Do not coat bearings with oil. Refer to subparagraph (3) below.

(2) Remove corrosion from the mast in accordance with paragraph 6-17h.

(3) Coat the entire mast assembly, including bearings with compound (C52).

(4) Attach an unserviceable tag, DD Form 1577-2, which has been properly filled out, to the mast assembly.

(5) Prepare DA Form 2410 (Component Removal and Repair/Overhaul Record) in accordance with TM 38-750.

(6) Place copies of the DA Form 2410 in a grease-proof envelope and stow them with the mast in the container after completion of step (8) or step (9) as applicable.

(7) Wrap entire mast assembly with barrier material (C28), and securely wrap with pressure-sensitive tape (C136) to protect mast from cushioning material and prevent preservative from rubbing off.

(8) Reusable Metal Container (Preferred Method). If a reusable metal container, P/N 204-040-366MUSC-A19, NSN 8115-00-083-8335, complete with

molded hair pads is available, insert the wrapped mast in the container. If hair pads are not available, follow procedures as closely as possible, center the wrapped mast assembly in container with adequate cushioning material (C57) surrounding assembly. Be certain the mast assembly is held firmly in the container and that all open spaces are filled with cushioning material.

(9) Plywood Container (Alternate Method). If a plywood shipping container is available, place the preserved mast assembly in the plywood container between the molded hair pads and secure lid.

(10) Obliterate old markings from the container that do not coincide with the item to be returned. Mark container in accordance with MIL STD-129. Stencil DA Form 2410 control number on exterior of container.

6-18. Transmission Drive Quills.

The transmission contains a varied assortment of input and drive quills, which are replaceable, to facilitate easier maintenance.

6-19. Input Drive Quill.

The input drive quill is located on the aft side of the transmission. (See figure 6-11.) It transfers power from the engine and main driveshaft to the transmission gears. The quill incorporates a freewheeling clutch which automatically engages during power input and disengages in a no-power condition as in autorotation and engine shut down.

Premaintenance requirements for input drive quill.

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	(T24) (T46)
Test Equipment	None
Support Equipment	None
Minimum Personnel	Two
Required .	
Consumable Materials	(C27) (C29) (C30) (C52) (C58) (C59) (C68) (C70) (C87) (C94) (C123) (C124) (C136)
Special Environmental Conditions	Dust free

a. Inspection. Drive quill for security of mounting, evidence of oil leakage, damage and corrosion.

NOTE

External leakage is not permitted around seals; however, a small amount of seepage is permissible and does not indicate an unsatisfactory seal condition. Continuous flow (droplets) is considered excessive and requires seal replacement.

b. Removal.

(1) Open cowling on both sides of pylon. Remove baffling and particle separator from intake section. Refer to Chapter 4.

(2) Remove driveshaft. Refer to paragraph 6-7a.

(3) Disconnect drain tube (18, figure 6-33) from union (17) at lower side of input quill.

(4) Use sharp plastic scraper and cut sealant around periphery of quill and from jackscrew holes or remove lockwire, plug, and gasket from jackscrew holes. Remove seven nuts and washers from mounting studs around flange of input quill. Remove clip (15) and bracket (24, figure 6-15).

CAUTION

Do not apply uneven pressure to input quill with jackscrews during removal procedure.

Do not pry behind input quill flange during removal procedure.

Do not use open flame to heat transmission case during input quill removal procedure.

(5) Install three jackscrews, (T24), in holes provided in input quill. Tighten jackscrews evenly to remove quill. If the quill is difficult to remove, apply heat to the transmission case with a heat lamp and then remove the quill with the jackscrews.

NOTE

Do not remove shims from quill, sleeve, or transmission case.

(6) Remove drain tube (10, figure 6-33).

(7) Cover mounting port to prevent accidental

entry of foreign objects into transmission.

c. Replacement of Seals. (AVIM)

(1) Fabricate a workaid (Figure 6-33A, Sheet 1 of 2). Secure workaid to Clutch Assembly (Figure 6-33A, Sheet 2 of 2) using tape or other suitable material.

(2) Remove retaining ring (6, Figure 6-33) and grease retainer (5) from input drive quill. Remove packing (4) from grease retainer.

(3) Remove locking spring (3). Insert wrench (T46), into the quill; match the spline teeth on the tool with splines of nut (2). Insert a 3/4 inch square drive extension through wrench and engage inner end of pinion gear (8). Remove nut (2).

(4) Reinstall grease cap (5, Figure 6-33) (without packing (4)), and retaining ring (6). Remove workaid (Figure 6-33A, Sheet 2 of 2).

CAUTION

Handle clutch assembly carefully and do not disassemble clutch when replacing input drive seal.

(5) Replacement of Wear Sleeve.

(a) Remove freewheeling unit from quill (use tool 22, Table 1-4, P/N T101306, NSN 4920-00-797-3672).

(b) Discard preformed packing (Item 4, Figure 6-33).

(c) Remove seal (Item 14, Figure 6-33) from Sleeve Assembly (Item 11, Figure 6-33).

(d) Remove RR511 retaining ring (Item 6, Figure 6-33) and shield (Item 20, Figure 6-33).

CAUTION

After removal of RR511 retaining ring (Item 6, Figure 6-33) do not allow freewheeling coupling outer race to move axially relative to the coupling inner race.

(e) Drive pins from wear sleeve with a punch.

(f) Remove old wear sleeve from outer race.

(g) Prepare surfaces for bonding as follows:

CAUTION

Replace grease retainer (Item 5, Figure 6-33) prior to surface preparation and make every effort to ensure bearings remain clean and free of contaminants during sleeve replacement.

1 Initially remove old adhesive using plastic scraper.

2 Lightly abrade faying surfaces with 400 grit abrasive paper or scotchbrite (C113) and then clean with MEK (C87).

(h) After thoroughly mixing adhesive (C17) per manufacturers instructions apply to wear sleeve ID as per illustration (Figure 6-33B) 3 to 8 mils thick.

(i) Press new sleeve (Item 19, Figure 6-33) onto outer race (ensure wear sleeve is pressed onto the race with the internal radius first). Also, the outer edge of wear sleeve (see Figure 6-33B) shall be recessed flush to 0.020 inch from outer races edge.

(j) After installation, ensure a 0.06R fillet of adhesive is provided on the inside diameter chamfer of wear sleeve as shown in Figure 6-33B.

(k) Clean up any excess adhesive that may have seeped through the holes where pins were previously installed.

(l) Cure adhesive at room temperature for 24 hours, at 70 to 95 degrees F.

CAUTION

If heat is used to accelerate cure time do not exceed 250 degrees F.

(m) Reinstall shield (Item 20, Figure 6-33) and RR511 retaining ring (Item 6, Figure 6-33).

(n) Mask off all surfaces except O.D. of wear sleeve. Spray O.D. of wear sleeve. Spray O.D. of installed wear sleeve with teflon-fluoroglide (NSN 6810-00-184-4800). Allow five minutes for drying then buff with a clean dry lint free cloth.

(o) Install new seal (Item 14, Figure 6-33) in Sleeve Assembly (paragraph 6-19.c.(8)). Coat the seal lip (Item 14, Figure 6-33) and wear sleeve (Item 19, Figure 6-33) with a light film of grease (C70).

(p) Upon installation of the freewheeling unit inspect for proper direction of freewheeling (outer race of clutch drives clockwise).

NOTE

When installing nut (Item 2, Figure 6-33) torque to 350 to 400 in. lbs. (use tool 22, Table 1-4, P/N T101306, NSN 4920-00-797-3672).

(q) Install new preformed packing (Item 4, Figure 6-33) and reinstall the grease retainer (Item 5, Figure 6-33) and secure with RR511 retaining ring (Item 6, Figure 6-33).

(6) Deleted.

(7) Deleted.

(8) Install a new seal (14) in sleeve assembly (11) as follows:

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and prolonged contact with skin.

(a) Clean sleeve assembly in area where seal is to be installed with methyl-ethyl-ketone (C87).

(b) Apply 1/4 inch band of sealant (C119) to O.D. of the seal (14).

NOTE

Apply the 1/4 inch band of sealant to the area of the seal to ensure that no adhesive is forced ahead of seal when pressed into sleeve.

(c) Press seal (14) into sleeve assembly (11). Wipe excess adhesive off parts.

(d) Cure at room temperature for 24 hours.

(e) Install workaid (Figure 6-33A) and secure with tape or other suitable material. Remove retaining ring (6) and grease cap (5).

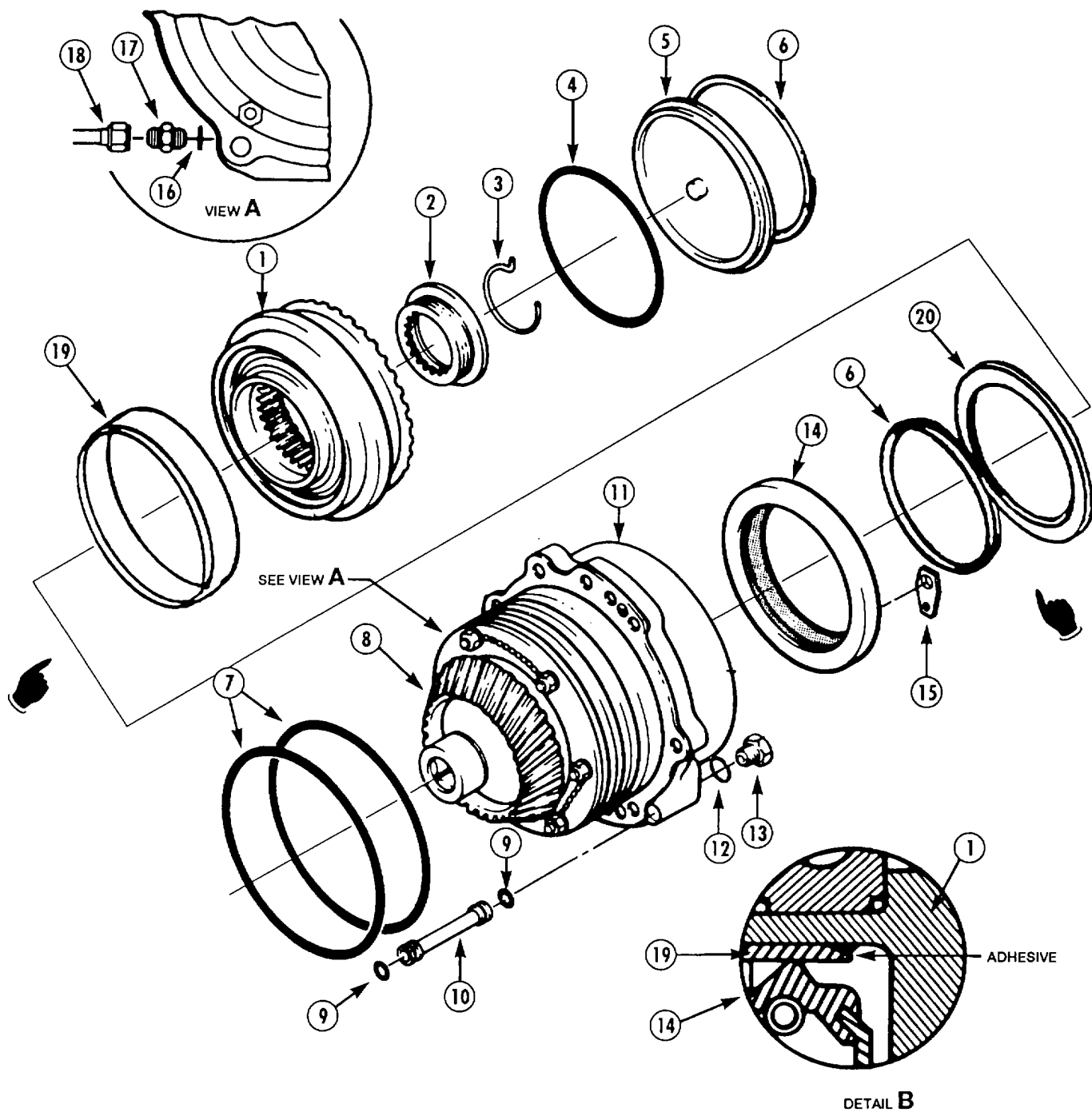
(9) Lubricate seal (14) with transmission oil and position clutch assembly (1) in sleeve (11). Install nut (2) and TORQUE 350-400 FOOT-POUNDS with tools described in step (3).

(10) Install locking spring (3). Ensure that spring tang engages nut and pinion properly to perform locking function.

(11) Inspect groove in grease retainer (5) provided for packing. Install new packing (4) on retainer (5). Lubricate packing with transmission oil and install retainer in sleeve (11). Install retaining ring (6).

(12) Remove workaid (Figure 6-33A,

Sheet 2
of 2).



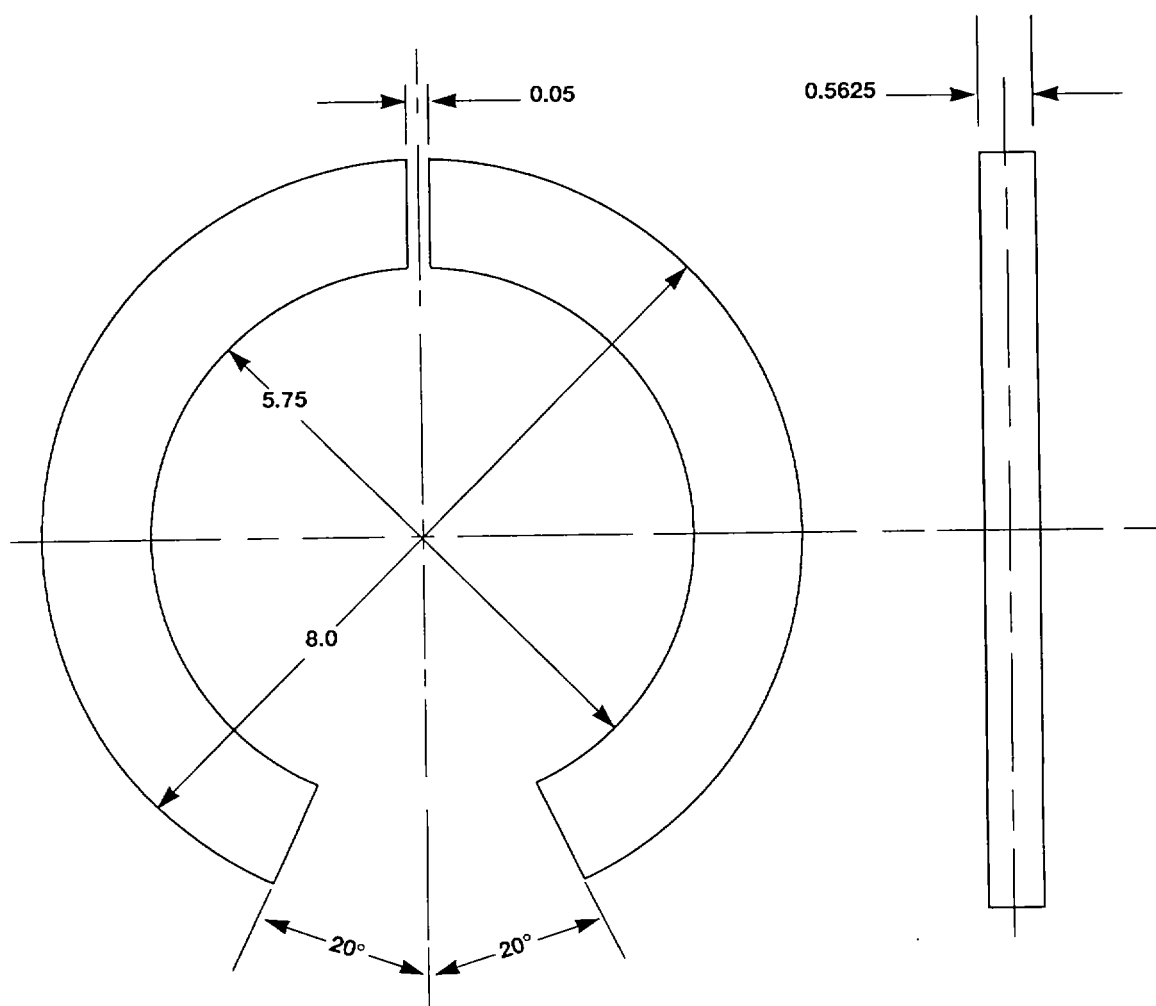
1. Freewheeling Clutch Assembly
2. Nut
3. Locking Spring
4. Preformed Packing
5. Grease Retainer
6. Retaining ring
7. Preformed Packing (2)
8. Pinion gear
9. Preformed Packing (3)
10. Drain tube

11. Sleeve assembly
12. Preformed Packing
13. Plug
14. Seal
15. Clip
16. Preformed Packing
17. Union
18. Tube assembly
19. Wear sleeve
20. Shield

Figure 6-33. Input Drive Quill Assembly

Change 71 6-64A

205040-38B



MAKE FROM BAKELITE OR OTHER SIMILAR MATERIAL

Figure 6-33A. Transmission Input Quill Workaid Application (Sheet 1 of 2)

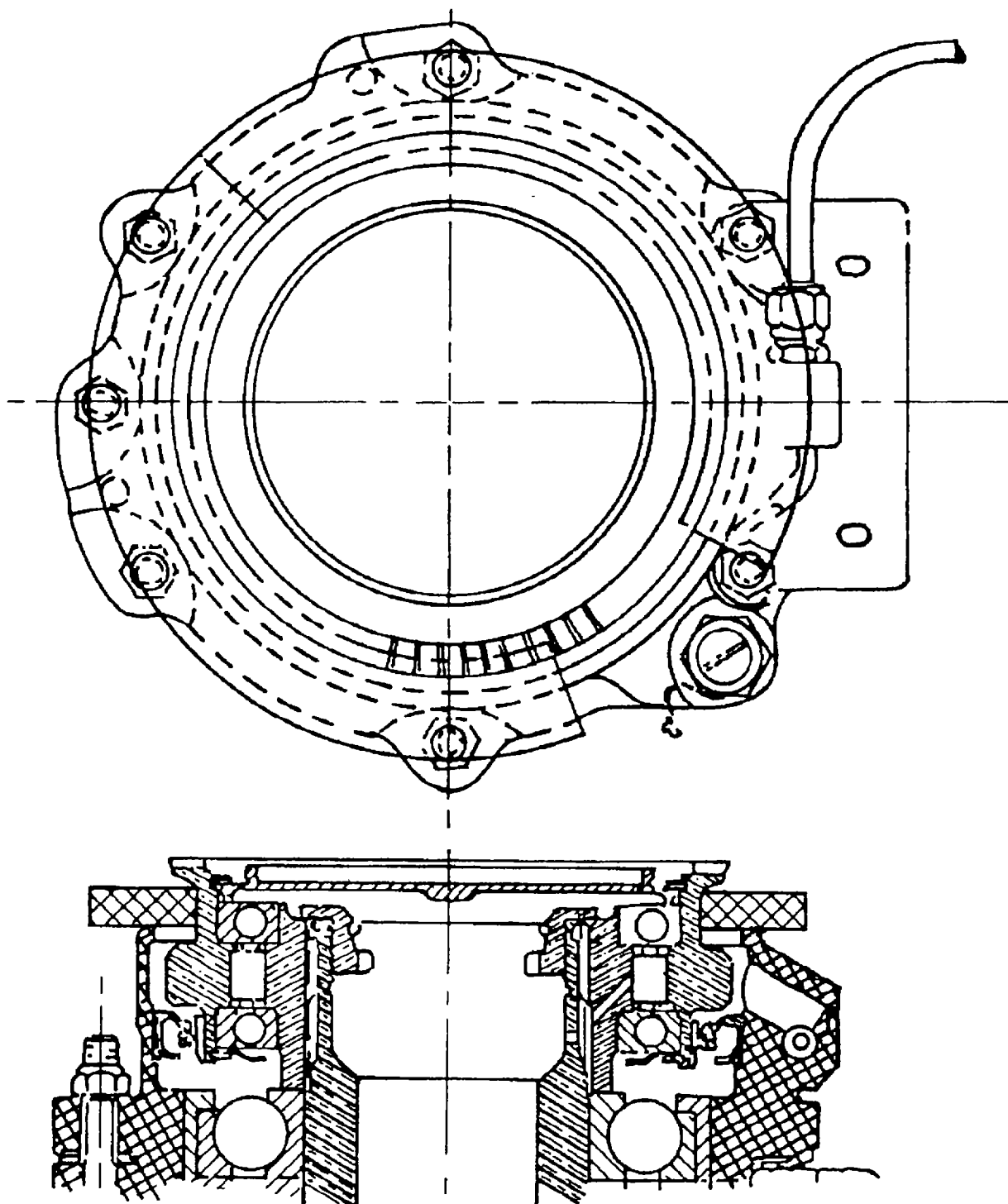


Figure 6-33A. Transmission Input Quill Workaid Application (Sheet 2 of 2)

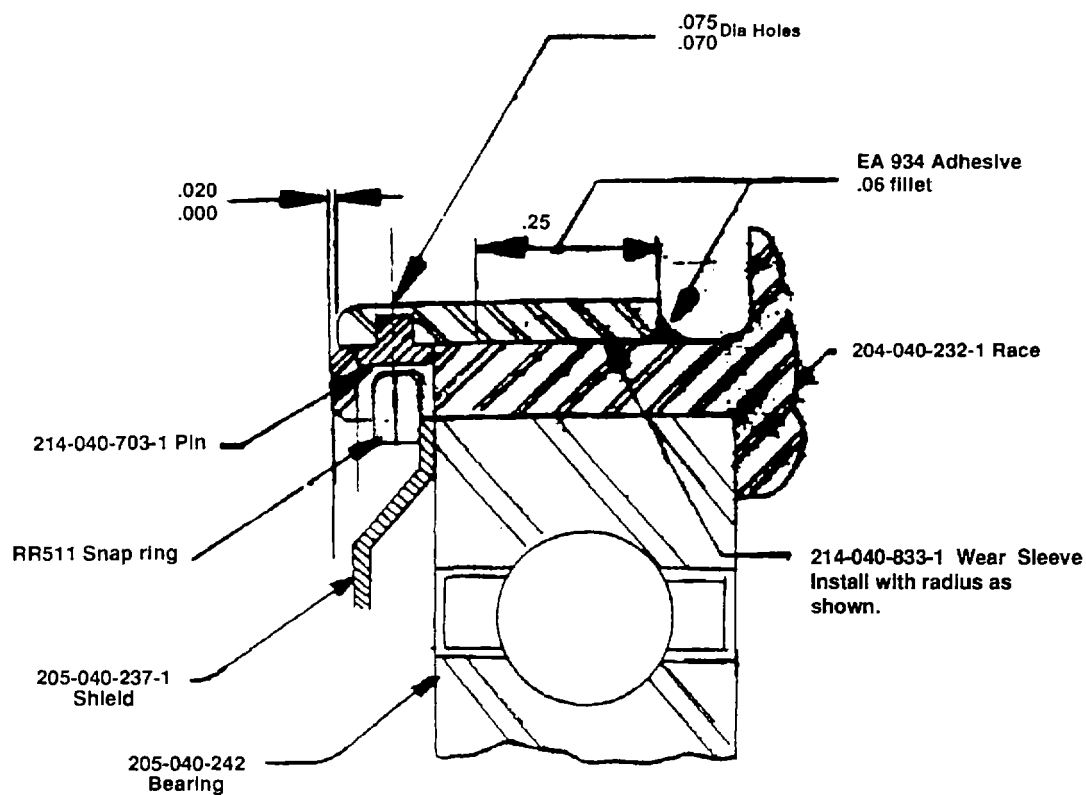


Figure 6-33B. Input Drive Quill Wear Sleeve Replacement

d. Installation.

(1) Uncover mounting port on aft side of transmission case section. Check that mating surfaces of case and quill are clean. Inspect grooves provided for packings (7 and 9, figure 6-33). Remove any burrs which might damage packing.

(2) Remove cover from unused mounting port at left side of transmission.

CAUTION

Rubber plug installation procedure must be followed to prevent damage to bearings.

(3) Cut a rubber plug slightly larger than the diameter of the roller bearing liner race on the inboard end of the input pinion (8, figure 6-33). Insert a 3/32 inch cotter pin through center of rubber plug and through a washer. Bend ends of cotter pin back against washer and plug. Attach a piece of light chain or 1/8 inch nylon cord approximately two feet long, to the eye of the cotter pin. See figure 6-34 for view of rubber plug.

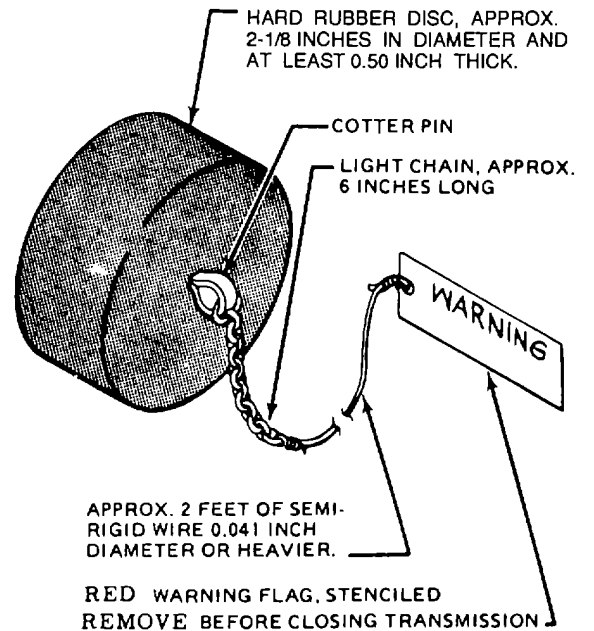
(4) Position the rubber plug in the bearing from inside of the transmission in such a manner that the rollers are held against the bearing outer race. Chain or cord will extend outside uncovered quill port.

CAUTION

Rubber plug installation procedure must be followed to prevent damage to bearing.

(5) Install two new packings (9, figure 6-33) on drain tube (10). Lubricate packings with transmission oil (C94) and install tube (10) in hole provided in transmission case.

(6) Install two packings on sleeve (11). Lubricate packings (7) with transmission oil and position quill in transmission. Exercise care to engage gear teeth and to align nose of pinion into roller bearings as quill is installed and be sure tube (10) is properly installed. Do not tap on freewheeling clutch.



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Figure 6-34. Input drive quill installation - work aid

(7) Place seven aluminum washers on studs. Position bracket (24, figure 6-33) on next lower stud to right of bracket and steel washers on other studs. Install nuts on all studs and torque 160-190 inch-pounds. Carefully add a bead of sealing compound (C116) around flange of quill sleeve and transmission case at mating point and install plugs (MS24391D2L) and gaskets (MS28777-2) in jackscrew holes and lockwire (C151).

(8) Remove rubber plug installed in step (4), and reinstall cover removed in step (2). Apply sealant (C116) to cover and install plugs (MS24391D2L) and gaskets (MS28777-2) in jackscrew holes and lockwire (C151).

(9) Install union (17) with new packing and connect tube assembly (18).

(10) Install plug at lower right side of quill with new packing and lockwire.

e. Preparation of Transmission Quills for Shipment.

WARNING

Use solvent in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

(1) Thoroughly clean transmission quills with solvent, (C124) and blow out all crevices and holes with dry, filtered, low pressure, compressed air.

(2) Coat entire quill with corrosion preventive compound (C52). If a preservative compound is not available, use aircraft grease (C70) as an alternate.

(3) Attach directly to the respective quill an Unserviceable (Reparable) Tag, DD Form 1577.2, properly filled out.

(4) Annotate DA Form 2410, Component Removal and Repair/Overhaul Record, per TB 55-1500-307-24 in accordance with DA PAM 738-751.

NOTE

Place copies of the DA Form 2410 in a greaseproof envelope and stow them with the

quill in the container.

(5) If fresh dry desiccant (C59) is available, wrap quill with barrier material (C29) and secure barrier material with tape (C136). If fresh dry desiccant is not available, place quill in a waterproof vaporproof bag (C27), evacuate air, and heat seal.

(6) Place wrapped transmission quill, in its reusable metal shipping container with molded hair pads, insert 48 units of desiccant if applicable. Refer to subparagraph (5) above, and cover quill with molded cushioning material. Secure lid of container. If molded cushioning material is not available, follow procedures as closely as possible, centering transmission quill in the container with adequate cushioning material (C58) surrounding quill. Ensure that quill is held firmly in position and all voids filled with cushioning material. Secure lid of container.

(7) As a field expedient only, prepare transmission quill for shipment as stated below:

(a) Clean quill to the extent possible with available materials and dry with a clean cloth. Prepare necessary forms and tags in accordance with subparagraphs (3) and (4) above.

(b) Coat entire quill with a heavy coat of any grease type corrosion preventive compound that is available, or in the absence of that material, apply a light coat of aircraft grease (C70).

(c) Wrap transmission quill with barrier material (C30), and secure barrier material with tape (C136).

(d) Insert wrapped quill in the best available container (constructed if necessary) of metal, wood, or weather resistant fiberboard. Cushion, block, and brace as necessary.

(8) Obliterate old markings from container that do not comply with item to be returned. Mark container in accordance with MILSTD-129. Stencil DA Form L2410 control number on exterior of container.

6-20. Hydraulic Pump and Tachometer Drive Quill.

This quill is located on the right side of the transmission sump case. (See figure 6-11.) The quill has drive pads for two hydraulic pumps and the rotor tachometer generator.

Premaintenance requirements for hydraulic pump and tachometer drive quill.

Condition	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	(T24)
Test Equipment	None
Support Equipment	None
Minimum Personnel	One
Required	
Consumable Materials	(C116)
Special Environmental Conditions	Dust Free

a. *Inspection.* Drive quill for security of mounting, evidence of oil leakage, damage and corrosion.

NOTE

External leakage is not permitted around seals; however, a small amount of seepage is permissible and does not indicate an unsatisfactory seal condition. Continuous flow (droplets) is considered excessive and requires seal replacement.

b. *Removal.*

(1) Open cowling at right side of transmission.

(2) Remove rotor tachometer generator by disconnecting electrical connector and removing nuts and washers from four mounting studs.

CAUTION

Do not kink hoses. Refer to TM 55-1500-204-25/1 for hose limitations.

(3) Detach hydraulic pump or pumps from four mounting studs by removing nuts and washers. Leave hoses connected except seal drain hose at lower side next to mounting flange. Stow pumps on service deck.

(4) Use sharp plastic scraper and cut sealant around periphery of quill and from jackscrew holes or remove lockwire, plug and U gasket. Remove nuts and washers from two remaining studs through flange of drive quill.

CAUTION

Do not apply uneven pressure to hydraulic pump and tachometer drive quill with jack screws during removal procedure.

Do not pry behind quill flange during removal procedure.

Do not use open flame to heat transmission case during removal procedure.

(5) Install three jack screws, (T24), in holes provided in quill. Tighten jack screws evenly to remove quill. If the quill is difficult to remove, apply heat to the transmission case with a heat lamp and then remove quill with jack screws. Cover the quill mounting port to prevent accidental entry of foreign objects into the transmission.

c. *Inspection.*

(1) Visually inspect all accessible parts for damage.

(2) Inspect outer quill sleeve for wear and corrosion.

(3) Inspect bearings for smoothness, binding and freedom of operation.

(4) Inspect gear teeth for cracks, chipping, scoring and excessive wear.

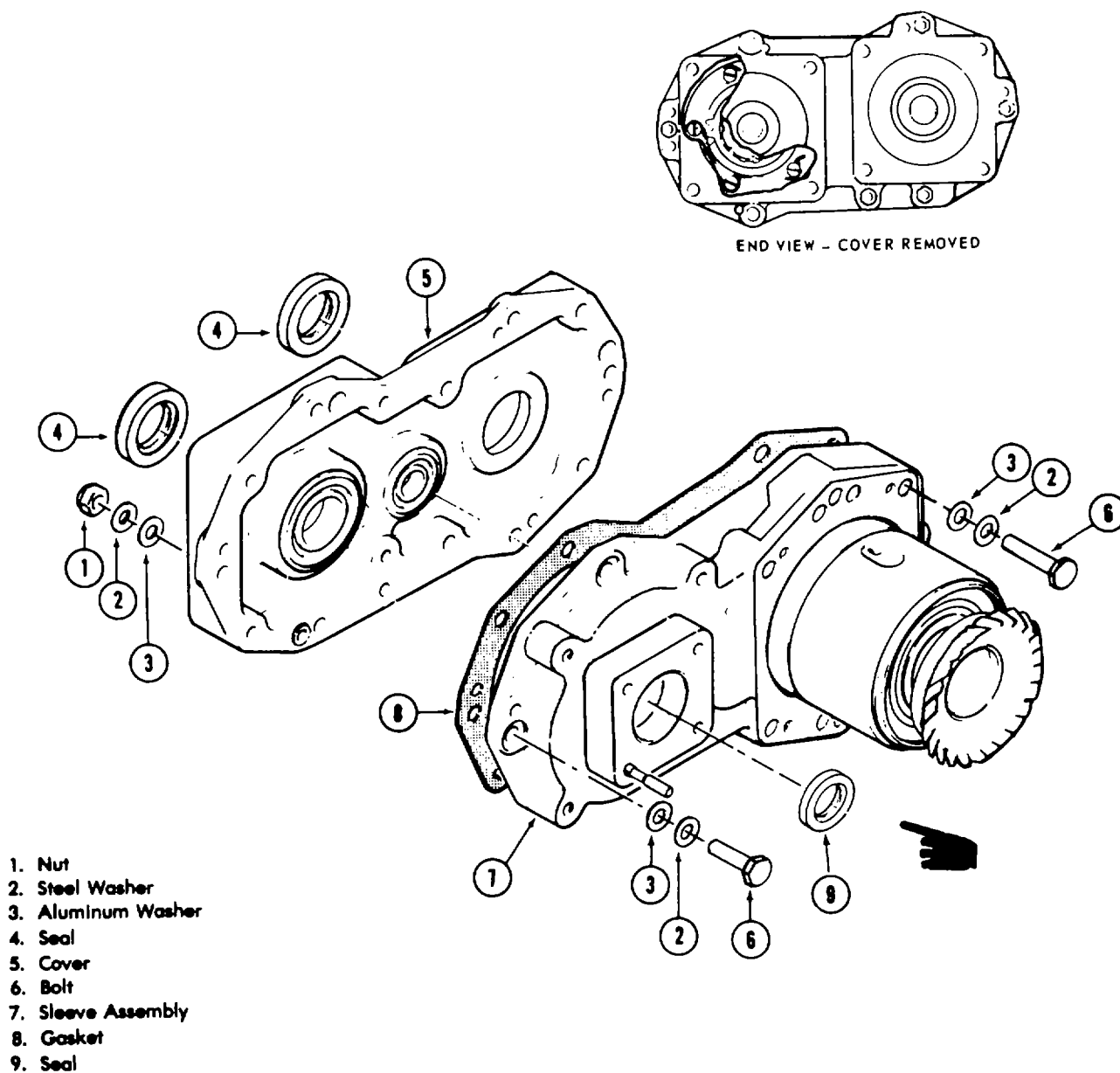
(5) Inspect seals in cover for evidence of leakage.

d. *Repair or Replacement.*

(1) Replace quill as a complete assembly when quill does not meet inspection requirements, abnormal gear pattern is evident, or there is evidence of bearing failure.

(2) Replace seals in cover assembly as follows:

(a) Remove nuts (1, figure 6-35), washers (2 and 3), and bolts (6) securing cover (5) to sleeve assembly (7).



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Figure 6-35. Hydraulic pump and tachometer drive assembly

(b) Using jackscrews, (T24), carefully remove cover (5) from housing sleeve assembly.

NOTE

As sleeve and cover separate, tap splined end of gear shafts with soft mallet where they protrude through seals to eliminate binding of shaft bearing in sleeve assembly.

(c) Remove gasket (8) from sleeve studs and press seals (4 and 9) from cover (5).

(d) Clean any dirt or grease from seal housing in cover and press in replacement seals.

(e) Position serviceable gasket (8) on sleeve assembly studs. Install cover assembly (5).

(f) Install aluminum washers (3) next to cover (5) and sleeve assembly (7). Install steel washers (2) next to bolt heads (6) and nuts (1).

e. Installation.

(1) Install packing in groove around quill sleeve.

CAUTION

When inserting drive quill, exercise care to engage gear teeth properly to avoid damage.

(2) Uncover mounting pad at right-hand side of transmission sump case. Heat sump case at drive quill mounting pad with a heat lamp until drive quill can be installed. Insert drive quill, engaging studs through mounting flange.

(3) Install washers and nuts on two shortest studs, at top and bottom of drive quill flange. Use thin aluminum washer next to flange, and standard steel washer next to each nut.

NOTE

Check backlash between mating teeth by slight back and forth movement of quill coupling until metal to metal contact is felt and heard. Backlash must be evident.

(4) Install hydraulic pump, or pumps, on studs, engaging pump shaft in drive quill. Secure with nuts and washers. Connect hydraulic hoses as required. Install plugs (MS24391D2L) and gaskets (MS28777-2) in jackscrew holes and lockwire (C151). Apply sealant (C116) to seal periphery of case.

(5) Install rotor tachometer generator with electrical connector 180 degrees down. Secure with nuts and washers on four studs. Connect and lockwire (C150) electrical cable connector.

6-21. Cockpit Air Blower Drive Quill.

This quill is located on the front side of the transmission. (See figure 6-11.) Its purpose is to take power from the input bevel gear to drive the cockpit air blower.

Premaintenance requirements for cockpit air blower drive quill.

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	(T20) (T37) (T38)
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	One
Consumable Materials	(C116)
Special Environmental Conditions	None

a. Inspection. Quill for security of mounting, evidence of oil leakage, damage and corrosion.

NOTE

External leakage is not permitted around seals; however, a small amount of seepage is permissible and does not indicate an unsatisfactory seal condition. Continuous flow (droplets) is considered excessive and requires seal replacement.

b. Removal.

(1) Open cowling at left side of transmission.

(2) Remove cockpit air blower.

(3) Remove lockwire and six bolts, with washers, around flange of drive quill (3, figure 6 15).

(4) Using a sharp plastic scraper, remove sealant around periphery of quill and jackscrew hole, or remove lockwire, plugs, and gaskets from jackscrew holes.

CAUTION

Apply even pressure to quill with jackscrews during removal procedure. Do not pry behind quill flange during removal procedure. Do not use open flame to heat transmission case during quill removal procedure.

(5) Install three jackscrews (T20), in threaded holes provided in quill. Tighten jackscrews evenly to remove quill. If the quill is difficult to remove, apply heat to the transmission case with a heat lamp and then remove the quill with the jackscrews.

(6) Cover the quill mounting port to prevent accidental entry of foreign objects into transmission.

c. Inspection.

(1) Visually inspect all accessible parts for damage.

(2) Inspect outer quill sleeve for wear and corrosion.

(3) Inspect bearing for smoothness, binding and freedom of operation.

(4) Inspect gear teeth for cracks, chipping, scoring and wear.

(5) Inspect seal for leakage.

d. Replacement of Seals. (AVIM)

(1) Mount quill over pins in holding fixture (T37).

(2) Use sharp plastic scraper and cut sealant from seal (1, figure 6-36) and nut (2) for removal. Remove nut in front side of sleeve with wrench (T38). (See figure 6-36.)

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

(3) Press seal from nut. Remove old sealant and clean with solvent (C87).

(4) Apply sealant (C119) to outer surface of seal (1) and press new seal into nut (2) with open side of lip positioned toward inboard side of nut. Wipe off excess sealant.

(5) Lubricate and install new packing on outside of nut and thread into sleeve. Torque nut 150 TO 250 footpounds. Apply sealant (C119) at juncture of nut (2) and quill assembly (4). Wipe off excess sealant.

(6) Remove quill assembly (4) from fixture and install new packing, which has been lubricated, in sleeve groove.

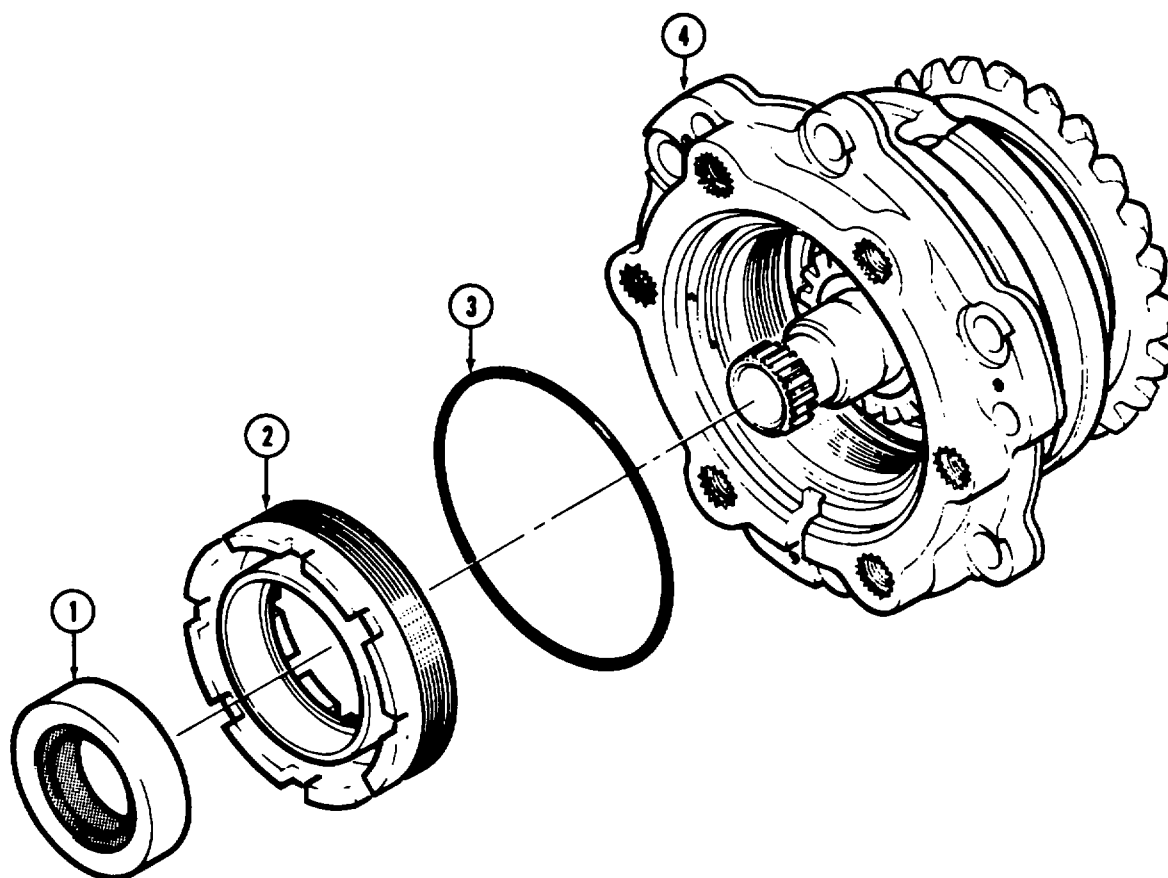
e. Installation.

(1) Install packing (3) in groove around quill sleeve.

CAUTION

When inserting cockpit air blower drive quill, exercise care to engage gear teeth properly to avoid damage.

(2) Uncover mounting port at forward side of transmission case. Heat main case at mounting port for cockpit air blower drive quill with a heat lamp until drive quill can be installed.



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- 1. Seal
- 2. Nut
- 3. Packing
- 4. Quill assembly

Figure 6-36. Cockpit air blower quill - seal replacement

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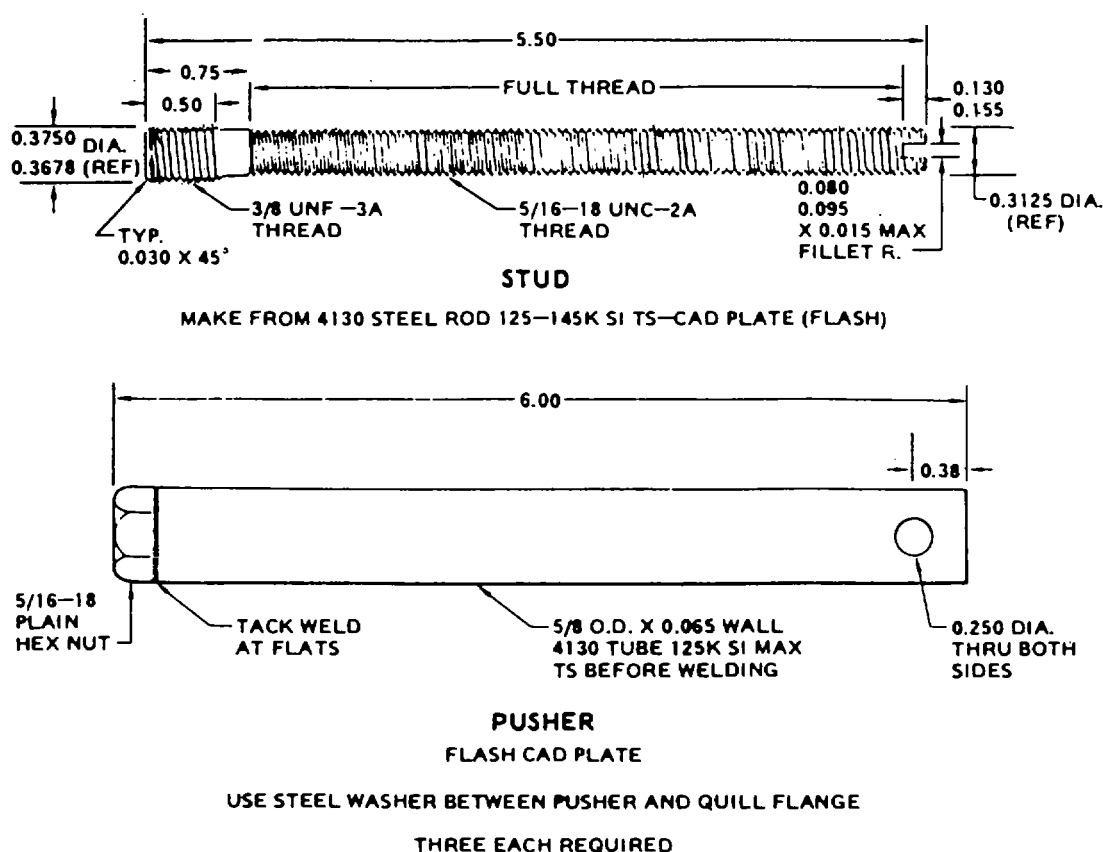


Figure 6-37. Work aid for quill installation

(3) Use three studs and three pushers as shown on figure 6-37 to push quill into transmission. Install three studs into case threads at equally spaced intervals.

(4) Start the quill into the case port.

(5) Install a steel washer on the top of the quill sleeve flange, then thread the pusher onto the stud.

CAUTION

Be sure gears of quill and driving gear are properly meshed before seating the quill.

(6) Tighten pushers evenly until the quill is seated.

(7) Remove pushers and studs. Install six bolts through sleeve flange into threaded inserts of transmission case.

(8) Use thin aluminum washer next to quill flange, and standard steel washer next to each bolt head. Torque bolts evenly 160 to 190 inch lbs and lockwire with C150. Add sealant (C116) around periphery of quill and install plugs (MS24391D2L) and gaskets (MS28777-2) into jackscrew holes and lockwire (C151).

CAUTION

Check for backlash between mating teeth by slight back and forth movement of quill coupling until metal to metal contact is felt and heard. Backlash must be evident.

(9) Install cockpit air blower. Refer to Chapter 13.

6-22. Tall Rotor Drive Quill.

Tall rotor driveshaft is driven from a transmission output quill located in aft side of sump case. (See figure 6-11.) This quill is driven by an accessory gear train and is provided with a flexible splined coupling.

Premaintenance requirements for tail rotor drive quill.

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	(T25) CT58)
Test Equipment	None
Support Equipment	None
Minimum Personnel	Two
Required Consumable Materials	(C68) (C92) (C93) (C106) (C116)
Special Environmental Conditions	Dust Free

a. Inspection.

NOTE

External leakage is not permitted around seals; however, a small amount of seepage is permissible and does not indicate an unsatisfactory seal condition. Continuous flow (droplets) is considered excessive and requires seal replacement.

(1) Quill for security of mounting, evidence of oil leakage, damage and corrosion.

(2) When required in Special Inspection, After Tail Rotor Drive System Over-torque, inspect gear teeth for scoring.

(3) Inspect driveshaft coupling (10) and Spherical Coupling (9) per paragraph 6-29.1. Coupling must be removed and disassembled for inspection.

b. *Lubrication.* Internal splines of coupling on tail rotor drive quill are packed with grease during assembly. If need occurs between normal overhaul periods, coupling splines can be repacked as described below. This procedure can be accomplished with drive quill in place on transmission and tail rotor shaft disconnected

(1) Remove spiral lock-ring from coupling while

holding seal plate against spring pressure.

(2) Remove seal plate and spring.

(3) Hold coupling at full outward position. Remove all old grease and clean coupling splines thoroughly.

(4) Inspect coupling splines for excessive wear after cleaning.

(5) Hand pack grease to 0.12 inch deep over top of internal spline teeth. Use lubricant, (C68).

(6) Keeping coupling at full outward position, reinstall spring, seal plate, and spiral lock-ring.

c. Removal.

(1) Open cowling at either side of transmission.

(2) Remove forward section of tail rotor driveshaft. Refer to paragraph 6-23a.

(3) Drain oil to level below quill mounting port.

(4) Remove transducer from mounting bracket and pylon fifth mount (Refer to Chapter 9.)

(5) Use sharp plastic scraper and cut sealant from periphery of quill flange. Remove nuts, washers, and spacers from six mounting studs around quill flange. Remove transducer mounting bracket from two top studs. Remove sealant, or plugs and gaskets from jackscrew holes. Use jackscrews (T25) through three tapped holes in flange to pull drive quill from sump case. Cover port immediately.

(a) Three jackscrews must be screwed in evenly to exert equal pressure on quill sleeve to prevent damage to flanges.

(b) Do not use force by prying to remove quill; in the event quill cannot be removed by using jackscrews, heat case with a heat lamp and then use jackscrews. Do not use torch or open flame to heat the case.

NOTE

Do not remove shims from quill sleeve or transmission case.

d. Inspect all accessible parts of quill as follows:

(1) Inspect sleeve (22, figure 6-38) for corrosion and mechanical damage (damage limits to be furnished). Polish out corrosion damage to twice the damage depth and reinspect to determine whether damage is in excess of limits. Treat corrosion damage area in accordance with TM 43-0105.

(2) Inspect sleeve (22) in area that contacts the transmission sump assembly for wear by measuring diameter of sleeve with micrometer. If average dimension is 3.624.7 inches or less, replace the quill.

(3) Inspect gear teeth on pinion (17) for spalled, scuffed, pitted, chipped, dented or scored teeth. See figure 6-42 for example of scoring damage on gear teeth. If damage is present on the gear teeth, the accessory and tail rotor drive quill inside the transmission sump case must be inspected. Return the transmission to a higher level of maintenance for this inspection.

e. *Seal Replacement.*

NOTE

Remove seal plate (2, figure 6-38) slowly so centering spring (3) will not fly out.

(1) Remove retaining ring (1, figure 6-38), seal plate (2), and centering spring (3).

(2) Remove lock-spring (4) and retainer plug (5).

(3) Remove bolt (7) with 1/2 inch square drive extension. Remove washer (8).

(4) Remove inner coupling (9) with outer coupling (10), and spacer (12).

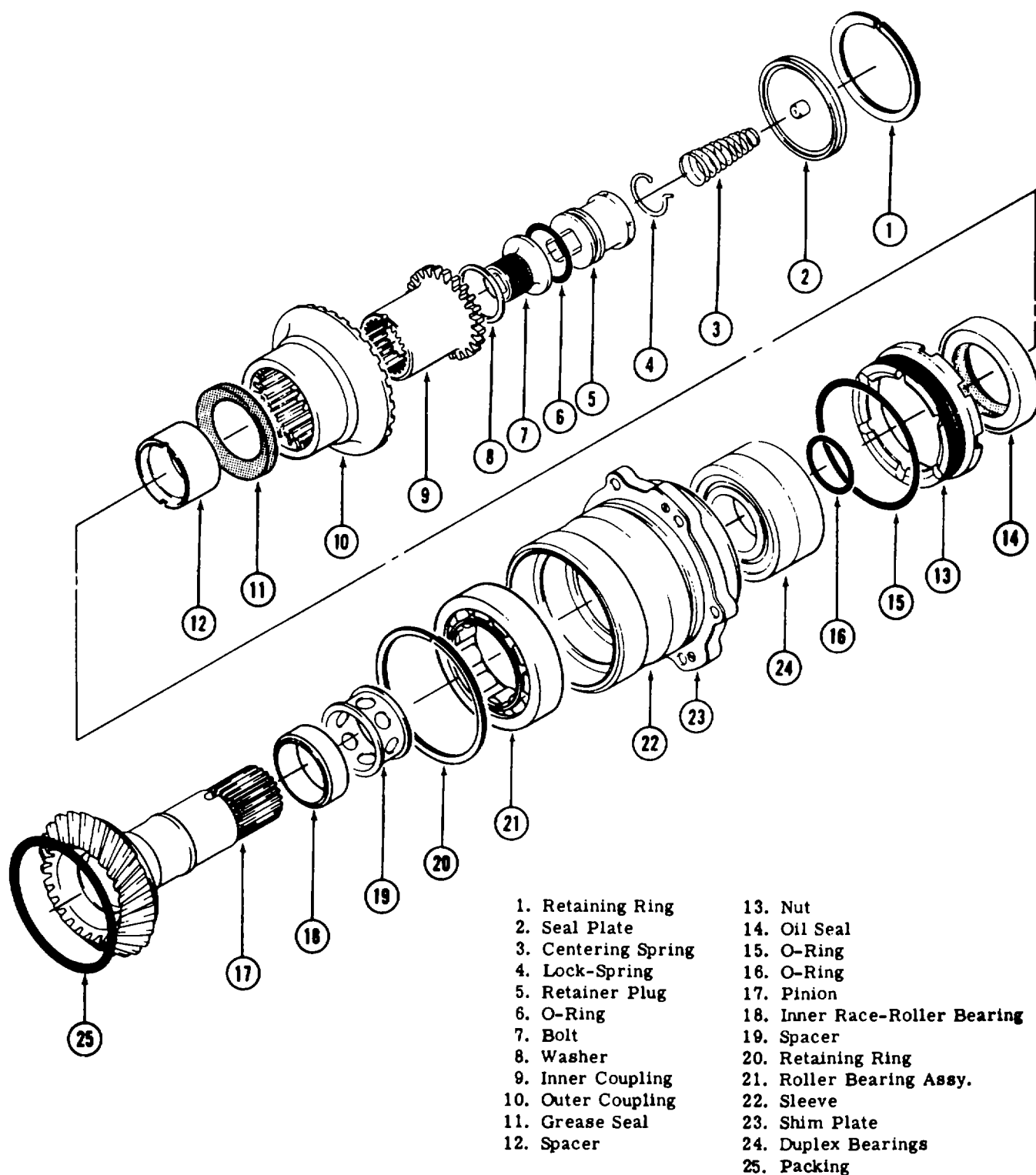
(5) Cut and remove lockwire from nut (13).

(6) Remove nut (13) with wrench (T58).

(7) Pull oil seal (14) from nut (13). Apply sealant (C119) to outside diameter of new seal and install in nut (13). Remove packing (15) from nut and install new packing.

(8) Install nut (13) with wrench (T58). Torque **1200 TO 1800** inch-pounds and lockwire (C151). Apply sealant (C 116) around nut (13) where it mates with sleeve (22).

(8A) Clean grease from inner coupling (9, figure 6-38) and outer coupling (10) with clean cloths. Do not use any solvents. Inspect teeth on inner and outer coupling for discoloration from high temperature, spalled, scuffed, pitted, chipped, dented, or scored teeth. Inspect wear patterns in accordance with figure 6-44. Inspect coupling per paragraph 6-29.1.



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Figure 6-38. Tail rotor drive quill

(9) Replace grease seal (11) by installing new seal in small end of outer coupling (10) with seal lip toward flange end of coupling.

(10) Press seal, using burnishing tool, into slot between end of coupling teeth and flange and hand pack inner coupling splines with grease (C68).

(11) Install packing (16), spacer (12), outer coupling (10), with inner coupling (9).

(12) Install washer (8) and coupling bolt (7). Torque coupling bolt **960 TO 1200** inch-pounds.

(13) Install new packing (6) on retainer plug (5). Install retainer plug (5) and secure with lock-spring (4).

(14) Install centering spring (3), seal plate (2), and retaining ring (1).

f. Repair or Replacement.

(1) Replace packing on drive quill sleeve.

(2) Replace tail rotor drive quill as a complete assembly when quill does not meet inspection requirements, abnormal gear pattern is evident, or if there is evidence of bearing failure.

g. Installation.

CAUTION

Do not use torch or open flame to heat quill and/or cases during installation of transmission quills.

(1) Uncover mounting port on aft side of transmission sump case.

(2) Install packing in groove around quill sleeve. Lubricate packing and mating surfaces of sleeve and case port with lubricating oil (C93 or C94).

NOTE

When inserting tail rotor drive quill, exercise care to engage gear teeth properly to avoid damage.

(3) Heat sump case at tail rotor drive quill mounting port with a heat lamp until drive quill can be installed. Insert tail rotor drive quill into case and engage studs through mounting flange.

(4) Install transducer mounting bracket (8, figure 6-14) on two top studs. Assemble thin aluminum washer, spacer, thin steel washer, and nut on each of six studs. Torque nuts **50 TO 70** inch-pounds evenly.

(5) Install set screws P/N 120-152-5-6 with sealant (C116) in jack screw holes of quill sleeve.

NOTE

Check for backlash between mating gear teeth by slight back and forth movement of quill coupling to feel metal to metal contact. Backlash must be evident. Allowances must be made for backlash in couplings.

(6) Install transducer on mounting bracket and pylon fifth mount (Refer to Chapter 9).

(7) Install forward section of tail rotor driveshaft and secure with clamps to couplings of drive quill and first bearing hanger. Refer to paragraph 6-23f.

(8) Fill sump to proper level (C93 or C94). (Refer to Chapter 1.) Close cowling.

Section V. TAIL ROTOR DRIVESHAFT

6-23. Tail Rotor Driveshaft.

Five driveshaft sections transmit power from the transmission to the tail rotor through two gear boxes. (See figure 6-39.) The shaft sections are identical, and are supported by three hanger assemblies on the tailboom and engine deck. Premaintenance requirements for tail rotor driveshaft.

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	One
Consumable Materials	(C45)(C124)(C131)
Special Environmental Conditions	None

a. Removal.

(1) Open hinged access doors along top of tailboom and vertical fin by releasing fasteners on sides. Also remove tailpipe fairing, and cover over intermediate gearbox, as necessary.

CAUTION

Clamp set must be removed from both ends of shaft before removing either end of shaft from its mating curve coupling to avoid coupling tooth or bearing damage.

NOTE

Retain clamp set as a unit when removed to preclude intermix of set halves.

(2) Remove clamp set (2, figure 6-39) from coupling at each end of shaft (1). Push shaft against flexible coupling to disengage opposite end, and lift out shaft. Remove other shafts aft of forward bearing

hanger in same manner,

(3) To remove forward shaft, also open cowling on both sides of transmission to remove clamp set from tail rotor drive quill coupling. With tailpipe fairing removed and shaft disconnected from hanger coupling, disengage and remove shaft carefully rearward and to right through firewall tunnel.

(4) Remove second shaft section.

b. Cleaning. Clean all shaft surfaces with clean cloth moistened with dry cleaning solvent (C124) with care to avoid marring anodized surfaces, dry with filtered compressed air.

c. Inspection.

(1) Replace shaft for any of the following conditions:

(a) Any crack.

(b) Any sign of rivet failure.

(c) Total indicated run-out, using dial indicator and V-blocks, in excess of 0.060 inch at any area on shaft. No straightening procedures are prescribed.

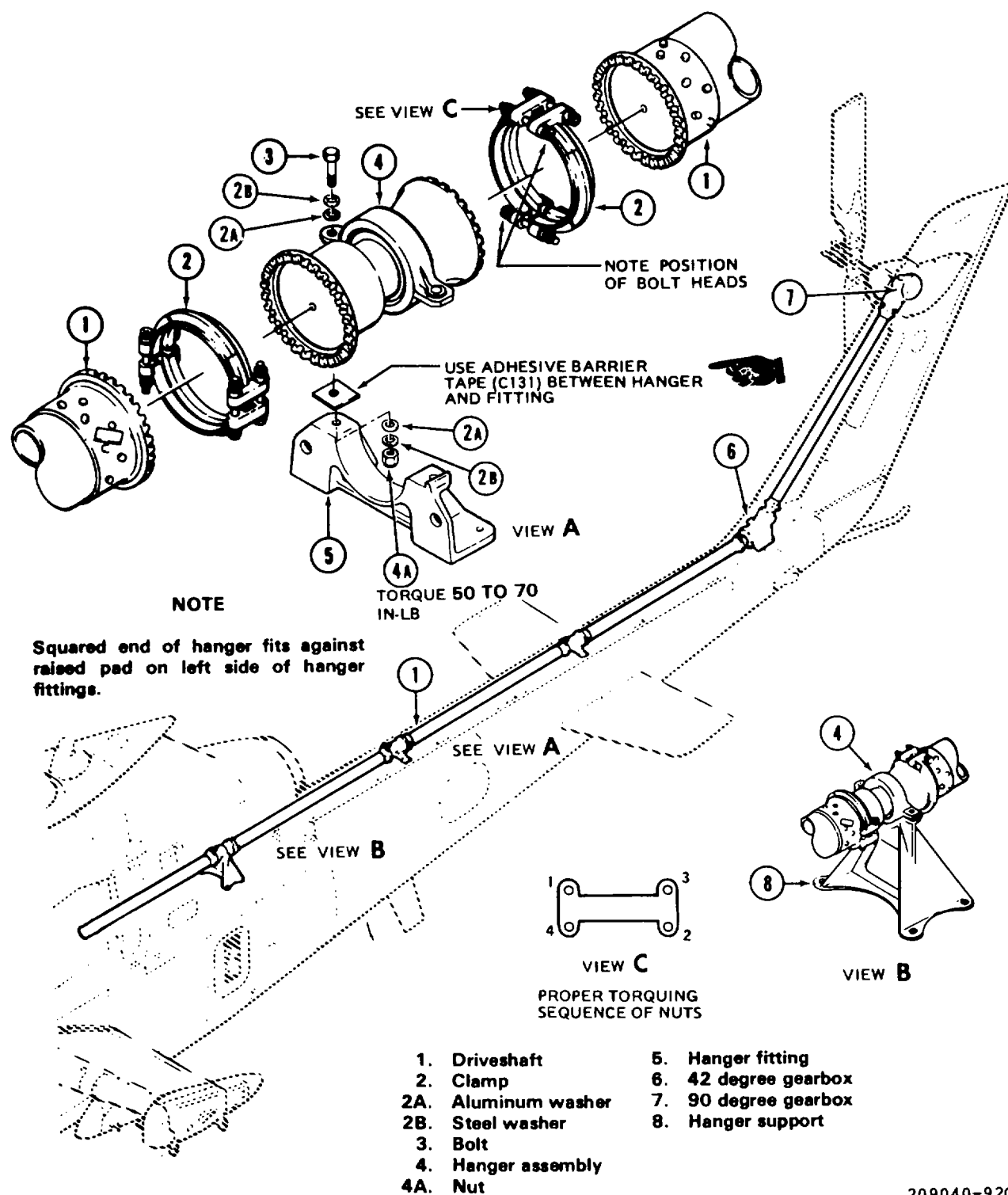
(d) Loss or partial detachment of balance strips which are bonded on tube near center.

NOTE

Do not mistake a single empty imprint, in bonding material next to balance strip, as an indication of a missing balance strip. This spot results from removal of a test coupon to inspect for bonding voids.

(e) **Inspect driveshafte** which **have more** than a **single empty bonding imprint for the** following configurations:

1 Review last dated balance strip for vibro-etched note "BALANCED (DATE)CCAD".



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Figure 6-39. Tail rotor driveshaft installation

Change 7 6-76

2 Review area B (figure 6-40) of shaft for an ARADMAC tab and note **"REWORKED AT CCAD (NUMBER)*STRIPS"**. *Number of remaining balance strips, less data plate.

3 Driveshaft identified by either of the above configurations has been properly balanced by CCAD and are serviceable. Epoxy paint applied at time of shaft rework is optional.

(f) Damaged or excessively worn curve coupling teeth. There should be no radial play or backlash between mating teeth when fully meshed with V-band clamp removed.

(g) Grooves worn by V-band clamp on shaft coupling to extent that such wear prevents proper clamping.

(h) Surface damage of shaft tube exceeding limits in (2) below.

(2) Classify surface damage on shaft tube as acceptable, reparable, or excessive by following limits. Define "Area" as central portion of shaft, and "Area B" as portions within 14 inches of ends. (See figure 6-40.)

(a) Any damage to anodized finish or grey epoxy paint requires anti-corrosion treatment in accordance with TM 55-1500-204-25/1.

(b) Nicks or scratches aligned within 15 degrees of span wise axis are acceptable without repair to maximum depth of 0.002 inch in "Area A" or 0.004 inch in "Area B."

(c) Other nicks or scratches must be polished out with crocus cloth (C45), provided depth of material removed does not exceed 0.008 inch in "Area A" or 0.012 inch in "Area B."

NOTE

If total reworked area on one side of shaft is 8 square inches greater than on opposite side, shaft will be out of balance and should be replaced.

(d) Sharp dents are permissible to maximum depth of 0.010 inch in "Area A" and 0.015 inch in "Area B."

(e) Nonsharp dents are permissible to maximum depth of 0.020 inch in "Area A" and 0.030 inch in "Area B."

NOTE

All dents should be carefully inspected for cracks, nicks and scratches. No cracks permitted. Nicks or scratches shall be within limits. When nicks or scratches are present in a dent, total depth of a dent and nick or scratch combined may not exceed the limits for dent above.

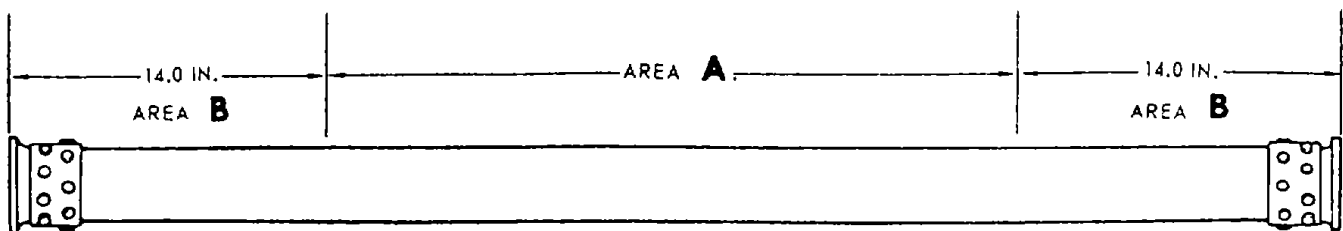
(f) Corrosion must be polished out with crocus cloth (C45), provided depth of material removal does not exceed 0.012 inch in Area B. Deeper corrosion is cause for rejection.

NOTE

If total reworked surface on one side exceeds the reworked surface on the opposite side by eight square inches, the shaft may be out of balance and should be replaced.

d. *Inspection - Driveshaft Clamps.*

(1) Bolt holes for wear, nicks and scratches.



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Figure 6-40. Tail rotor driveshaft Inspection diagram.

(2) Spot face, lug fillets and internal V groove for nicks and scratches in excess of 0.008 inch, and gouges or wear pattern extending into the fillet radius at bottom of internal V.

(3) All remaining surfaces for nicks and gouges exceeding 0.010 inch.

e. Repair or Replacement.

(1) Replace shaft if dented beyond limits or bent or fails to meet inspection requirements.

(2) Replace shaft for loss or partial detachment of balance strips which are bonded on tube near middle.

(3) Replace shaft if damaged or excessively worn curve coupling teeth are found.

(4) Replace unserviceable clamp sets, bolts or nuts that fail to meet inspection requirements.

CAUTION

Shafts that require repainting must be sent to depot level of maintenance for painting and balancing.

f Installation.

(1) Engage shaft couplings with mating couplings. Install clamp sets at each end with nuts trailing direction of rotation, and bolted joints indexed within 1/8 inch of 90 degrees measured at perimeter of clamps for balance in operation.

NOTE

Clamp halves are matched by identical vendor and forging lot numbers, or by weight. Every effort should be made to retain clamp halves as matched sets. All nuts on any one clamp set must be identical part numbers. Random clamp halves of some part numbers may be paired if they meet either of the following criteria: (1) Weight differential of the two halves does not exceed one gram, or (2) No excessive high frequency vibrations are introduced during a maintenance test flight when matched with unknown weight difference.

NOTE

Use new nuts each time clamps are installed.

(2) Install tail rotor clamp set (2, Figure 6-39),

bolts and nuts as follows:

(a) Start four new nuts onto clamp bolts by hand.

(b) Thread new nuts on bolts to obtain complete thread engagement.

(c) Measure and record tare torque for each nut.

(3) Torque each nut in sequence illustrated in Figure 6-39, 30 TO 35 inch-pounds above tare torque recorded in preceding step. Keep gaps in ends of clamp set (2) equal within 0.020 inch.

(4) Tap very lightly around outer surface of clamp with fiber mallet and re-check torque.

(5) Install tailpipe fairing or gearbox cover as required. Close access doors and cowling.

6-24. Driveshaft Hanger Assemblies.

Three hanger assemblies connect and support tail rotor driveshafts along top of tailboom and above the engine deck. Each assembly consists of couplings on a short, splined shaft, mounted through a single-row sealed ball bearing in a ring-shaped hanger equipped with two mounting lugs for attachment on a support fitting. (See figure 6-39.)

Premaintenance Requirements For Driveshaft Hangers

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	One
Consumable Materials	(C37) (C44) (C45) (C68) (C102) (C112) (C124) (C131)
Special Environmental Conditions	None

a. Removal.

(1) Open hinged access doors along top of tailboom by releasing fasteners on left side. Open engine access doors.

(2) Remove tail rotor driveshafts from each side of hanger.

(3) Remove bolt (3, figure 639) with nut and washers at each side to detach hanger assembly (4) from its support fitting (5 or 8).

CAUTION

Do not use compressed air for drying or cleaning as solvents or dirt may be forced into bearing of flexible coupling.

b. Cleaning. Clean exterior surfaces by wiping with clean dry cloth.

c Inspection

(1) Hanger assemblies for excessive bearing wear, toughness, or binding. If condition of bearing is in doubt check as follows:

(a) Disconnect driveshaft from each end of hanger assembly.

(b) Rotate bearing while pressing in axially on end of hanger while turning. Bearing may feel smooth when turned with no load but rough when loaded by pressing in with hand.

(c) Obvious roughness, catching or binding when turned by hand is cause for replacement of hanger assembly.

(2) Hanger assemblies and adjacent area for evidence of grease leakage. Wetting of adjacent structure by slinging of grease from flex couplings and/or bearings is cause for replacement of hanger assembly. A small amount of grease expelled from around lip of bearing seal indicates slight over-lubrication and is not cause for hanger replacement. Perform an evaluation of hanger as follows:

CAUTION

Do not clean or spray bearing or hanger assembly with any type of solvent during inspection. Use only clean cloths without solvent to clean exterior of hanger.

(a) Wipe grease from seal with clean lint-free cloth.

(b) Record on DA Form 2408-13, indicating bearing by location and keep under observation.

(c) If grease continues to be expelled from the bearing seal after one flight of the aircraft, replace the hanger assembly.

(2A) Seal (9, figure 6-40A) for cuts, tears and leaks. Seal may be replaced. Refer to paragraph 6-24f.

(3) Inspect hanger assembly and bearing for evidence of overheating as follows:

(a) Paint a 0.5 x 0.5 inch zinc chromate primer strip on the top of the bearing and shaft assembly (reference item 10, figure 6-40A) 0.06 inch away from the identification plate (reference item 17, figure 6-40A).

(b) Indications of overheating such as discoloration of bearing (blue to blue/black in color) or multicolor appearance of couplings and hanger that darkens adjacent to bearing is cause for replacement.

(c) Brown coloring of bearing shield is normal and is not an indication of overheating.

(3A) Coupling overheat detector paint strip. A 1.0 by 1.1 inch strip of zinc-chromate primer is painted on each side (1800 apart) of every flexible driveshaft coupling. The green zinc-chromate primer (TT-P-1757) will turn brown at 375 ± 5 F, indicating:

(a) Loss of lubricant due to seal failure.

(b) Contaminated or improper lubricant

(c) Incorrect cleaning and lubricating procedures.

(d) Drive train misalignment

(4) Rust colored fretting debris in areas adjacent to bearing OD/ID is cause for replacement

(5) Hanger ring and attachment lugs for cracks, elongated bolt holes, or other obvious damage.

(6) Couplings for damage or excessive wear using the following criteria:

(a) There should be no radial play or backlash between mating teeth of coupling and driveshaft when fully meshed with V-band clamp removed.

(b) Grooves worn by V-band clamp on coupling to extent that wear prevents proper clamping.

(c) Remove retaining ring (1, figure 640A), seal plate (2), and spring (3).

CAUTION

Do not use cleaning solvent inside coupling.

(d) Hold coupling at full outward position. Remove all old grease and clean coupling splines thoroughly.

(e) Inspect driveshaft couplings per paragraph 6-29.1.

(f) If couplings are serviceable, refer to paragraph 6-24e for lubrication.

(g) If ratcheting noise is detected when coupling assembly is spun, while attached to airframe, replace bearing.

(7) Hanger support fitting on tailboom and engine deck for security of attachment and evidence of cracks and damage.

CAUTION

Do not attempt to remove or change shims under fittings.

d. *Lubrication Bearings.* Bearings are permanently lubricated at time of manufacture. No further lubrication is required.

WARNING

Attempting to lubricate bearing will cause damage to seal and render the bearing unserviceable.

e. *Lubrication - Driveshaft Hanger.* Couplings splines can be lubricated as described below. This procedure can be accomplished with hangers installed on tailboom.

(1) Remove retaining ring (1, figure 6-40A) while holding seal plate (2) against spring pressure.

(2) Remove seal plate (2) and spring (3).

CAUTION

Do not use cleaning solvent inside coupling.

(3) Hold couplings at full outward position. Remove old grease as thoroughly as possible.

(4) Inspect driveshaft coupling (8) and spherical coupling (7) per paragraph 6-29.1.

(5) Hand pack grease to 0.12 inch depth over top of internal spline teeth. Use grease (C68).

CAUTION

Ensure seal plate (2) vent hole is not clogged.

(6) Keep coupling at full outward position. Install spring (3), plate (2) and retaining ring (1).

f. *Repair or Replacement.*

(1) Replace bearing if excessive bearing wear, roughness or binding exists.

(1A) If bearing replacement is necessary, proceed as follows:

(a) Press shaft (10D) from bearing and shaft assembly (10).

(b) Remove retaining ring (10C) from bearing and hanger (10A).

(c) Press bearing (10B) out of hanger (10A) through retaining ring end.

(1B) Assemble bearing and shaft assembly as follows:

(a) Press new bearing (O1B) into hanger (100A) through retaining ring end. Press on bearing outer race only.

(b) Support inner race of bearing (100B) and press shaft (10D) into bearing. Bearing journal of shaft must center within **0.003 to 0.016** inch.

(c) Install retaining ring (10C) in hanger and shaft assembly (10).

(2) Replace hanger assembly if ring or attachment lugs are cracked, holes are elongated or other visible damage exists.

CAUTION

Do not use any solvent to clean external or internal parts.

(3) Disassemble hanger for repair.

(a) Remove retaining ring (1, figure 6-40A) while holding seal plate (2) against spring pressure.

(b) Remove seal plate (2) and spring (3).

(c) Remove cotter pin (16), nut (15), washers (13 and 14) and plate (12) from retaining bolt (4).

(d) Remove bolt (4), washer (5) and plate (6).

(e) Remove inner coupling (7) and forward coupling (8). Remove and discard seal (9) from forward coupling (8). Remove rear coupling (11).

(4) Clean all parts by wiping with clean lint-free cloth.

(5) Inspect disassembled hanger.

(a) Visually inspect all parts for wear and damage. Inspect bearing for roughness, lack of lubrication, or signs of overheating. If damage or wear is evident, reassemble hanger assembly and forward to depot for overhaul.

(b) Inspect driveshaft couplings per paragraph 6-29.1.

(c) Inspect contact surface of seal (9) on inner coupling (7). Surface must be smooth, free from nicks and scratches. Replace couplings which fail to meet inspection requirements.

(d) Inspect retaining ring (1), seal plate (2) and spring (3) for serviceability. Inspect center spring (3) by applying a test load of 5.0 plus or minus 0.5 pounds to compress spring to 1.50 plus or minus 0.10 inches.

(6) Assemble driveshaft hanger.

CAUTION

Ensure that inner coupling P/N 2004-040-603-9, outer coupling P/N 204-040-604-5, hanger P/N 204-040-617-17, and rear coupling P/N 204-040-614-1 are used. Refer to TM 55-1520234-23P.

(a) Install seal (9, figure 6-40A) into groove at small end of forward coupling (8). Seal lip must be toward large end of coupling. Use burnishing tool to seat seal into groove.

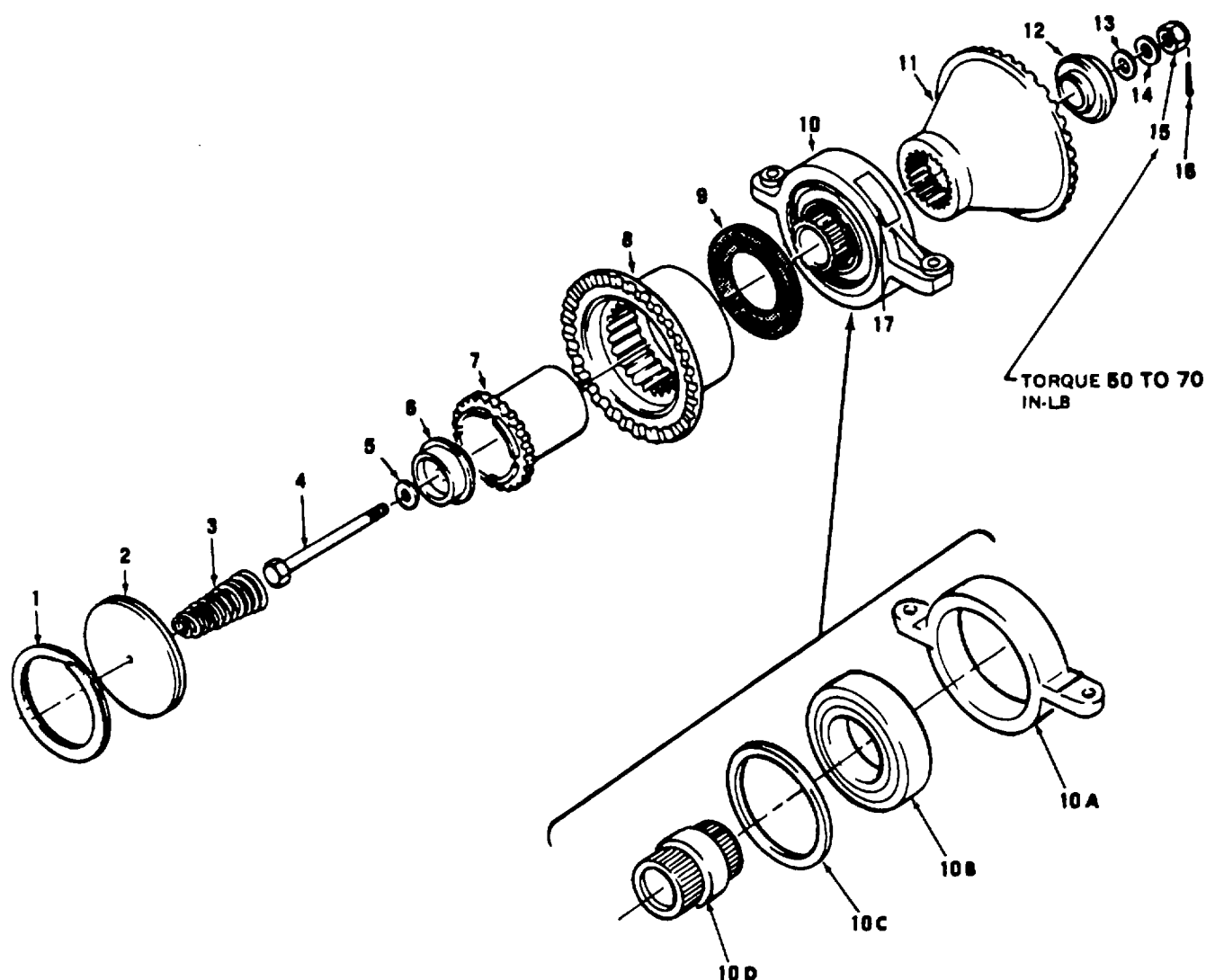
(b) Apply lubricant (C68) to splines of inner coupling (7) and insert into forward coupling (8).

(c) Install rear coupling (11) to side of bearing and shaft assembly (10) opposite retaining ring. Install mated inner and forward couplings (7 and 8).

NOTE

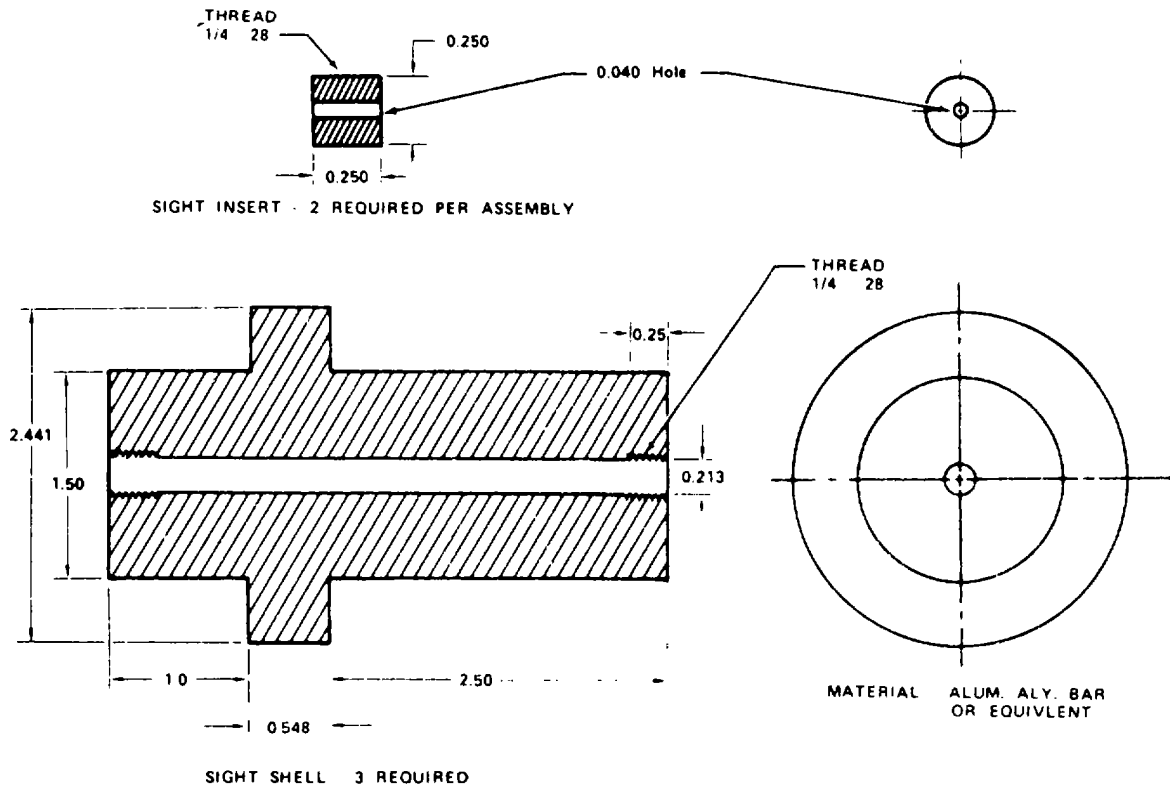
Correct hanger bearing and shaft assembly has left mounting ear squared. Squared end mates against raised pad on tailboom or fuselage fitting. See figure 6-39.

(d) Install aluminum washer (5) and plate (6) against head of retaining bolt (4). Insert bolt into forward end of assembly.



1. Retaining ring	6. Plate	10A. Hanger	12. Plate
2. Seal plate	7. Inner (spherical) coupling	10B. Hanger bearing	13. Washer (aluminum)
3. Spring	8. Forward coupling	10C. Retaining pin	14. Washer (steel)
4. Retaining bolt	9. Seal	10D. Coupling shaft	15. Nut
5. Washer (aluminum)	10. Bearing and shaft assembly	11. Rear coupling	16. Cotter pin
			17. Identification plate

Figure 6-40A. Tail totor Driveshaft Hanger.



MATERIALS

Aluminum Alloy Bar Stock 2.5 IN X 12.5 IN	1 each
Bolts, AN-4	6 each
Hanger, T/R Driveshaft P/N 204-040-617	3 each
Ring, Lock P/N R244C	3 each

1. Fabricate three alignment sight shells from aluminum bar stock to dimensions shown.
2. Fabricate six sight inserts from AN-4 bolts. Install bolts in threaded ends of sight shells and cut off flush with face of shell. Center drill bolts to 0.040 inch diameter, using a no. 60 drill.
3. Press each the sight shell into a tail rotor driveshaft hanger P/N 204-040-617 and secure with a lock ring P/N RR244C.

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Figure 6-40B. Work aid for driveshaft hanger support alignment - fabrication instructions

(e) Install plate (12), aluminum washer (13), steel washer (14) and nut (15) on retaining bolt (4). Torque nut (15) 50 TO 70 inch-pounds. Install cotter pin (16).

(f) Hold forward coupling (8) at full outward position. Hand-pack lubricant (C68) 0.12 inch deep over top of internal spline teeth.

(g) Install spring (3), seal plate (2), and retaining ring (1).

g. Installation.

(1) Position hanger assembly, with flexible coupling forward, on support fitting. Use tape (C 131) between hanger and fitting.

NOTE

Only aluminum washers are permitted to be in contact with magnesium surfaces. Steel washers must not contact magnesium surfaces. Use additional steel or aluminum washers on bolts (3, figure 639) as required to obtain proper thread engagement with nuts (4A).

(2) Install two bolts (3, figure 6-39). Place one steel washer (2B) under bolt heads. If bearing hanger is magnesium, place one aluminum washer (2A) next to bearing hanger. If bearing hanger is steel or stainless steel, omit aluminum washer (2A) next to the bearing hanger. Place aluminum washer (2A) next to hanger fitting (5). Place steel washers (2B) and nuts (4A) on bolts. Torque nuts after driveshafts are installed.

(3) Install driveshafts. Refer to paragraph 6-23, f.

(4) Torque nuts (4A, figure 6-39) evenly to 50 TO 70 inch-pounds.

6-24A. Alignment-Tail Rot or Driveshaft No. 1 Hanger Mount.

The following procedures outline the details for fabrication and employment of work aids to facilitate alignment of tail rotor driveshaft No. 1 hanger bearing support for AH-1 helicopters. The application entails a simple approach to line-of-sight alignment using a beam of light as a reference.

a. Fabricate three alignment work aid sight shells as shown in figure 6-40B.

b. Remove hanger and bearing assemblies from number 1, 2, and 3 hanger supports.

c. Procure three hangers (P/N 204-040-617) and press one sight assembly into each of the hangers. Secure sight in each hanger with retaining ring (P/N RR244C).

d. Install hangers, with sight shell assemblies, in the numbers 1, 2, and 3 hanger supports.

e. Place a flashlight, or any other suitable light source, against the forward hanger support sight shell assembly, allowing the light to be seen through the sight shell insert, when viewed from the tailboom, looking forward.

f. Sight from number 3 hanger support through sight shell inserts to the light source. Note any deviation of the number 1 hanger support. Shim as necessary under number 1 hanger support, until light is clearly visible through all three sight shell assemblies.

g. Remove tooling and bond any added shims, using adhesive (item 17).

6-24B. Replacement of No. 1 Hanger Bearing Support Assembly (P/N 209-03-265-1).

a. Clean surfaces of alignment tool P/N 70 SAVAE D 0060 which interface with the aircraft fuselage and the No. 1 hanger bearing support.

b. Clean surfaces of fuselage which interface with alignment tool and the hanger bearing support.

c. Using two (2) each 0.375 inch diameter and 0.50 inch diameter close tolerance bolts, attach the alignment tool to the aft fuselage bulkhead at the tailboom attachment points with the arm of the tool extending forward and above the engine deck.

d. After alignment tool installation, selectively loosen each of the four attachment bolts one at a time to determine if the bulkhead is in the correct plane i.e., the wear pads are of the correct thickness. If there is a discrepancy in the wear pad thickness the tool will spring out as one bolt is loosened.

e. If a discrepancy exists, shim the tool as required at the location(s) where the tool does not seat properly so as to provide proper tool placement against the fuselage bulkhead.

f. Attach the No. 1 hanger bearing support to the alignment tool using two (2) .250 inch diameter close tolerance bolts. Insert the 0.062 inch thick shim provided with the tool between the hanger bearing support and the alignment tool. The base of the support should be down and parallel to the engine deck.

g. Using the sliding adjustment on the alignment tool, align the bolt holes in the base of the hanger bearing support with the corresponding holes in the engine deck until the attaching bolts for the hanger bearing support slide freely through the support base into the holes in the engine deck.

CAUTION

Do not use force on the alignment tool while aligning the holes in the hanger bearing support and the engine deck. Excessive forcing will result in possible misalignment or damage to tool.

h. Using feeler gauges, determine the required shim thickness for shim to be inserted between the base

of the hanger bearing support and the engine deck. When determining final shim thickness account for thickness of dissimilar metal tape between the shim and the hanger support.

NOTE

The hanger bearing support is to be shimmed to a position .003 inch of and square within 1/4 degree of the drive shaft centerline.

i. Insert the required thickness under the hanger support (under LIH aft leg and under R/H and LIH fwd legs) as determined in Step 8.

j. Insert the four (4) hanger support attaching bolts through the hanger bearing support into the engine deck. Do not force the bolts through the installation. If force is required to install the bolts, realign the support as described in Steps 7 and 8 above.

k. Removed the 1/4 inch diameter close tolerance bolts securing the hanger bearing support to the alignment tool. Remove the 0.062 inch thick shim from the hanger bearing support

l. Torque the 1/4 inch diameter close tolerance bolts securing the hanger bearing support to the engine deck. After torquing the support attaching bolts, the 1/4 inch diameter close tolerance bolts in the arm of the alignment tool must be in line with the holes in the top of the hanger bearing support, i.e., the bolts must pass through the alignment tool into the support without binding.

m. Using a feeler gauge, check the gap between the alignment tool and the hanger bearing support. The gap measured must not exceed 0.062 inch :0.015: The gap measured forward to aft must not taper more than 0.004 inch.

n. If the gap does not meet the requirements as stipulated in Step 13 above or the bolts will not pass through the support as per Step 12, repeat Steps 7 through 13 and either add or subtract from and/or taper the shims between the engine deck and the hanger bearing support as required to meet the tolerances stipulated.

o. Remove alignment tool from the fuselage bulkhead and store in a cool, dry place free from possible accidental bumping and damage.

p. If during Step 4 a need for shimming one or more of the four attachment points was required to achieve proper tool positioning, determine if the wear pad thickness at each tailboom attachment point is

correct.

q. If the thickness of any wear pad is not correct, install new wear pad(s) at location(s) determined in Step 4 such that the alignment tool will be positioned flat against the fuselage bulkhead.

Section VI. INTERMEDIATE GEARBOX

6-25. Intermediate Gearbox.

The intermediate gearbox (15, figure 6-41) is located on the tailboom at the base of the vertical fin. The gearhox provides a 42 degree change in direction of tail rotor driveshaft. It consists of a case with a gear quill in each end. The case is fitted with a breather-type oil filler cap, an oil level sight gage and a drain plug equipped with a chip detector which activates warning lights on the pilot and gunner caution panels and the miscellaneous controls panel when excessive metal particle contamination occurs. The input and output quills have flexible couplings for attachment of driveshafts. Access is provided by a cover with quick-release fasteners.

a. Lubrication.

(1) Service gearbox with oil to proper level (paragraph 1-5).

(2) Lubricate gearbox flexible couplings as follows:

NOTE

Couplings can be lubricated with gearbox installed on tailboom and driveshafts disconnected.

(a) Remove retaining ring (1, figure 6-43) while holding seal plate (2) against pressure of centering spring (3).

(b) Remove seal plate (2), centering spring (3), and spacer (5).

CAUTION

Do not use cleaning solvent inside coupling. Solvent leaves residue.

NOTE

Care must be taken to ensure that the retainer plug does not become unsealed from inner coupling.

(c) Hold couplings at full outward position. Remove old grease as thoroughly as possible.

(d) Inspect driveshaft couplings per paragraph 6-29.1.

(e) Hand pack grease (C68) to 0.12 inch depth over top of internal spline teeth.

(f) Keep coupling at full outward position. Ensure retainer (6) and lock spring (4) are properly seated. Reinstall spacer (5), centering spring (3), seal plate (2), and spiral retaining ring (1).

b. Inspection.

NOTE

External leakage is not permitted around seal; however, a small amount of seepage is permissible and does not indicate an unsatisfactory seal condition. Continuous flow (droplets) is considered excessive and requires seal replacement.

(1) Remove intermediate gearbox cover (fairing).

(2) Inspect installed intermediate gearbox (15, figure 6-41) as follows:

(a) Obvious mechanical and corrosion damage. Refer to paragraph 6-25e for acceptable limits.

(b) Oil sight glass for correct oil level.

(c) Oil leakage.

(d) Lubricant, leakage at flexible couplings (24) on input quill and output quill.

(e) Secure installation of four bolts (12) that secure gearbox to tailboom. If lockwire and/or torque lacquer on bolts indicates that bolts have moved, remove all four bolts, inspect, and reinstall (paragraph 6-25h).

(f) Shake gearbox and check for looseness on tailboom. No looseness is acceptable.

(g) Check for evidence of fretting corrosion at mating surface between gearbox and tailboom that could be caused by movement of the gearbox on the tailboom.

(h) Magnetic chip detector (4) and wiring for secure installation and for damage.

(i) Inspect oil filler cap (10) for security of installation.

(j) Inspect tail rotor driveshaft clamp set (four bolts) for security of installation

(k) Check for overheating of two flexible couplings (24) evidenced by multi-color appearance. Refer to paragraph 6-26c if overheating is suspected.

(1) Ensure number five drive shaft does not bottom-out. If number five drive shaft is bottomed-out, replace output coupling centering spring. See paragraph 6-26 for repair procedures.

(3) Install tail rotor gearbox covers (fairings) and close vertical fin driveshaft door.

c. Removal.

(1) When the immediate gearbox is to be replaced, unless conditions prevent operation, perform a

ten minute ground runup and drain operation of. If runup is not practical, remove intermediate gearbox and flush with its own operating oil. Attach Tag to intermediate gearbox stating: "PRESERVED WITH OPERATING LUBRICANT."

(2) Remove gearbox cover and open tail rotor driveshaft access doors.

(3) Disconnect tail rotor driveshaft's from gearbox input and output couplings (paragraph 6-23a).

CAUTION

To avoid damage to driveshaft hanger bearing or coupling, either remove clamp set from both ends of driveshaft before removing either end of shaft from its mating curve coupling, or support unattached end of shaft to hold shaft aligned on normal operating axis while gearbox is removed.

(4) Disconnect electrical lead from chip detector (4, figure 6-41).

(5) Remove lockwire. four bolts (12), and washers (13 and 14). Remove gearbox (15) from tailboom. Do not remove shims (18).

*d. Cleaning.***WARNING**

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

CAUTION

Do not force dirt or solvent into bearings or flexible couplings by use of compressed air.

Clean removed parts and exterior of gearbox assembly with solvent (C 124).

e. Inspection (Gearbox Removed from Helicopter).

(1) Inspect gearbox and historical records for evidence gearbox has been involved in an accident or incident that requires special inspection (paragraph 6-25f).

(2) Inspect gearbox for oil leakage.

(3) Inspect both gearbox flexible couplings for lubricant leakage.

NOTE

To remove chip detector (4, figure 6-41) push body of detector in and turn left to disengage bayonet pins, then withdraw from chip detector self-closing valve (2).

(4) Inspect chip detector (4) for metal particles (paragraph 6-3).

(5) Inspect gearbox for elongated mounting bolt holes. See figure 6-42 for maximum acceptable elongation.

(6) Inspect gearbox for mechanical and corrosion damage. See figure 6-42 for acceptable damage limits and instructions to rework damaged gearbox cases.

(7) Inspect oil filler cap (10, figure 6-41) for damage that would affect function.

(8) Inspect sight glass (8) for damage that could cause leakage and for staining that would prevent seeing oil level.

(9) Inspect shims (18) for secure installation on tailboom.

(10) If quill or quills are removed, refer to paragraph 6-26c for inspection procedure for gear wear patterns.

(11) Inspect driveshaft couplings per paragraph 6-29.1.

*f. Special Inspection.***NOTE**

Special inspections of intermediate gearbox are required after tail rotor drive system overtorque, sudden stoppage, compressor stall, etc. Refer to paragraph 1-29, Special Inspection.

(1) Remove output quill from intermediate gearbox (paragraph 6-26a).

(2) Inspect output quill gear teeth for scoring. See scribe having a **0.002** inch spherical point.

(3) Inspect output quill gear teeth for wear patterns outside acceptable limits. See figure 6-42 for instructions to evaluate gear patterns.

(4) If scoring, abnormal wear patterns, or other discrepancies are detected, send gearbox to next higher maintenance level.

g. Repair.

(1) Replace gearbox if damaged in excess of acceptable limits (paragraphs 6-25e and f).

(2) Repair leaking quills by replacing seals or packings (paragraph 6-26d).

(3) Replace oil filler cap and packing if damaged or unserviceable. If filler cap contains an insufficient amount of aluminum wool, replace as follows:

(a) Remove pin (1, figure 6.45) from cap (10).

(b) Remove ring (11), cap (10), and spring assembly (9) from plug (7).

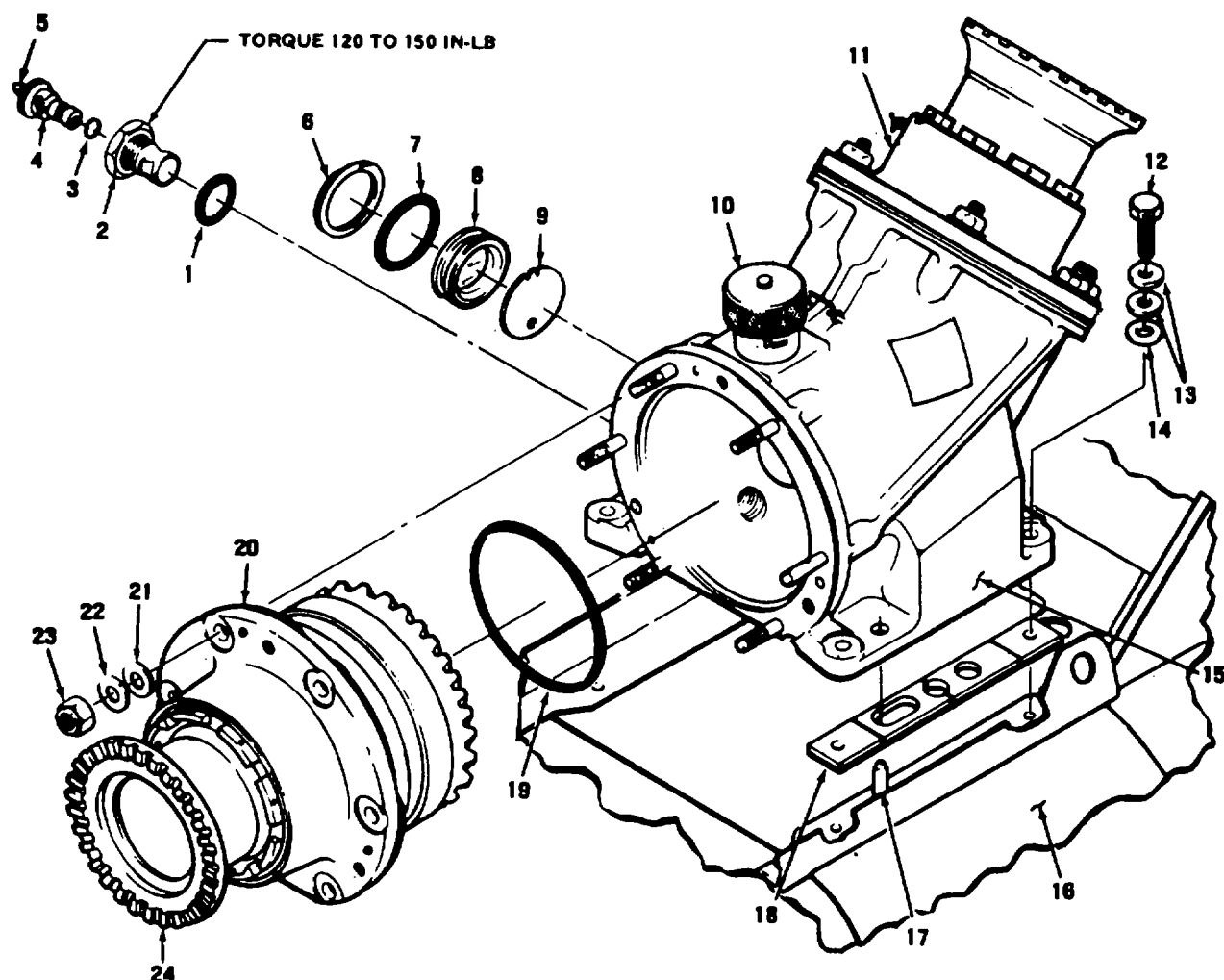
(c) Remove packing (8) from plug (7). Discard packing.

(d) Remove ring spiralo (4), washer (5), and packing (6) from plug (7). Discard packing (6).

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

(e) Clean parts with solvent (C124).



- 1. Gasket
- 2. Chip detector self-closing valve
- 3. Packing
- 4. Chip detector
- 5. Nut
- 6. Retaining ring
- 7. Packing
- 8. Sight glass

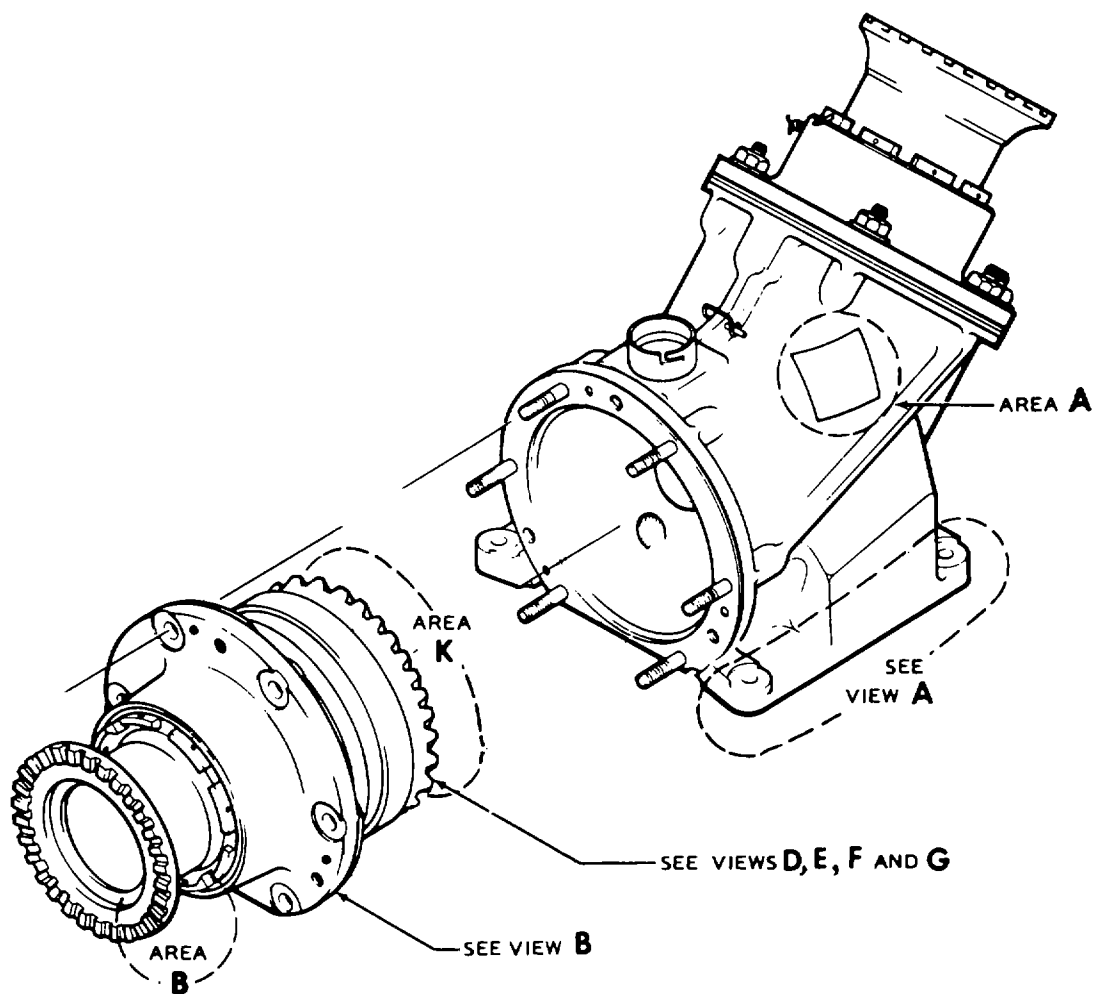
- 9. Sight gage
- 10. Filler cap
- 11. Output quill
- 12. Bolt
- 13. Steel washer
- 14. Aluminum washer
- 15. Gearbox
- 16. Tail boom

- 17. Alignment pin
- 18. Shim
- 19. Packing
- 20. Input quill
- 21. Aluminum washer
- 22. Steel washer
- 23. Nut
- 24. Flexible coupling

Figure 6-41. Intermediate Gearbox Installation

Change 29 6-82

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NOTE: The damage limits shown for the input quill are also applicable to the output quill.

Figure 6-42. Damage Limits - Intermediate Gearbox (Sheet 1 of 7)

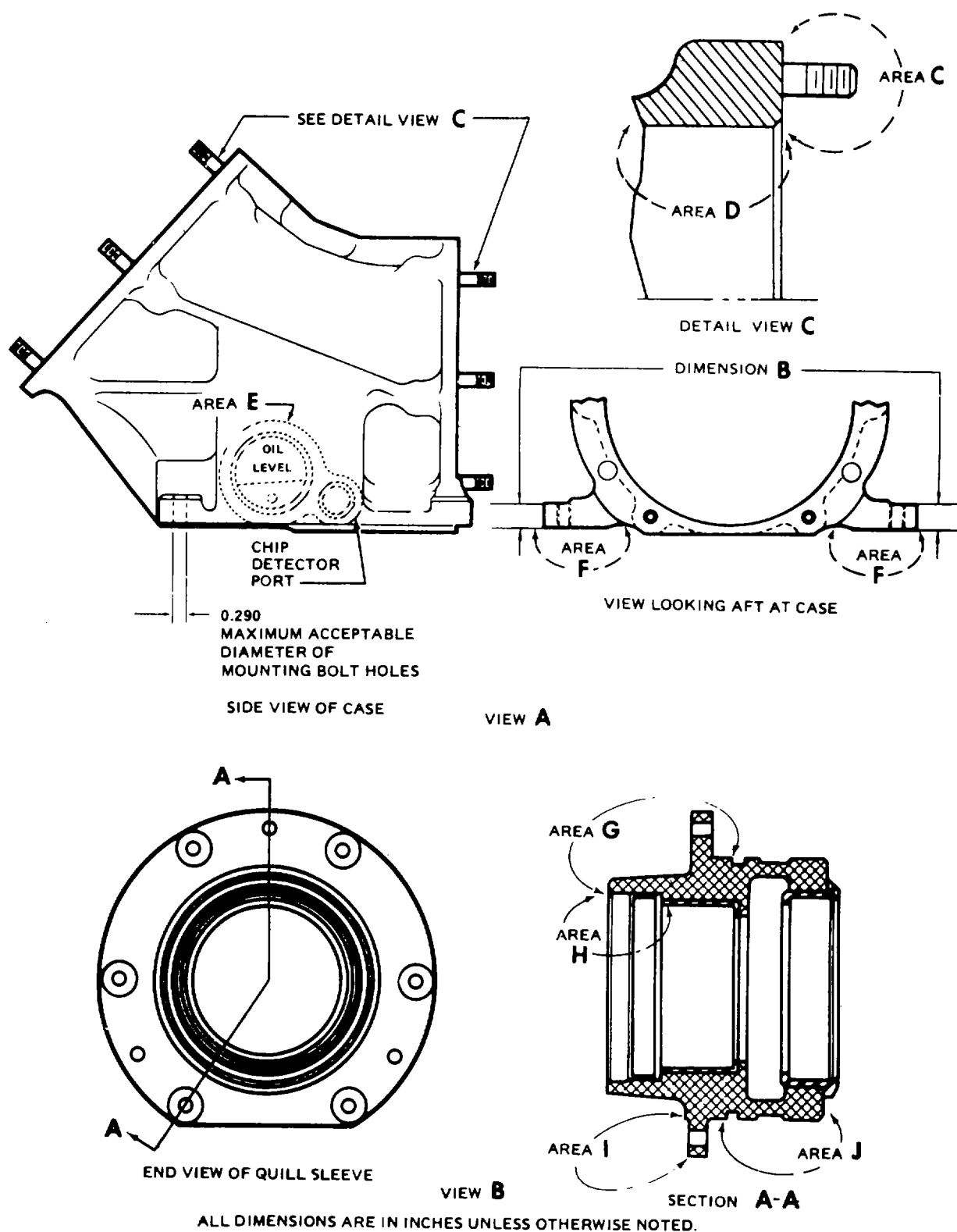
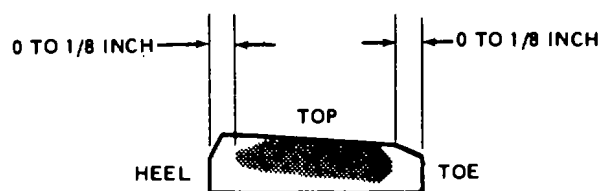


Figure 6-42. Damage Limits - Intermediate Gearbox (Sheet 2 of 7)

Change 29 6-84

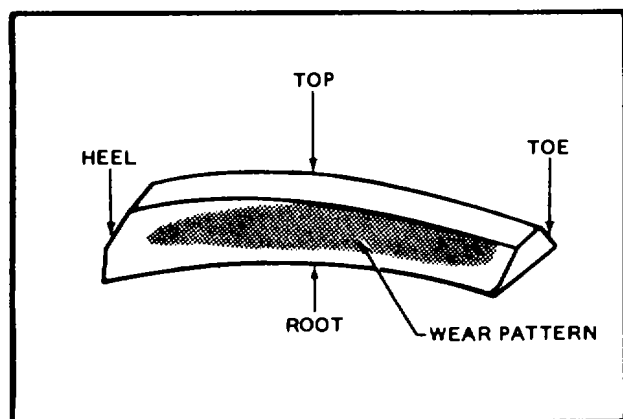
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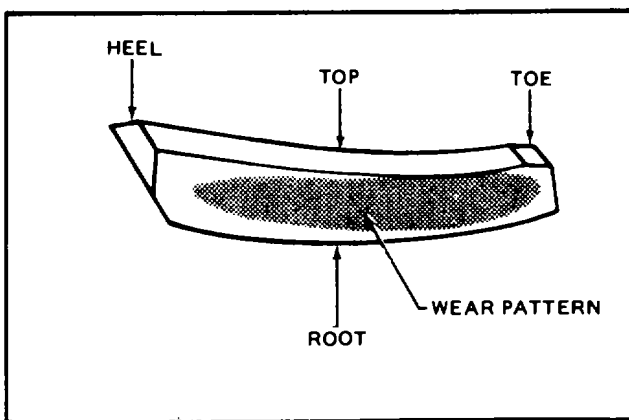
ROOT (CONVEX SIDE)

GEAR P/N 212-040-500-6

VIEW D PATTERN TOLERANCES AT TOE AND HEEL

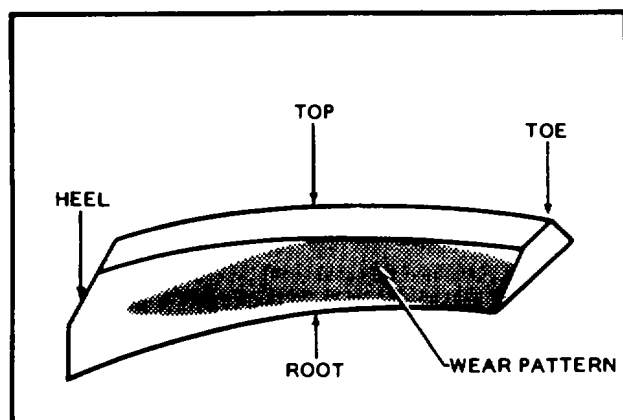


PINION P/N 212-040-500-7

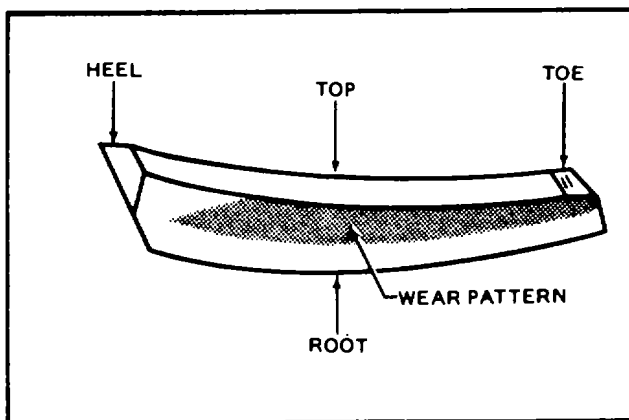


GEAR P/N 212-040-500-6

VIEW E DESIRED WEAR PATTERN



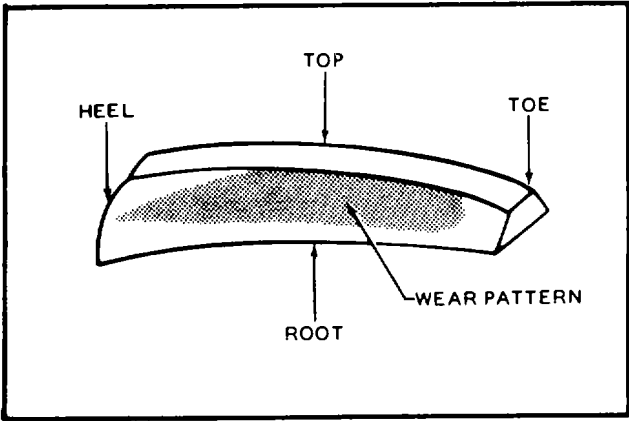
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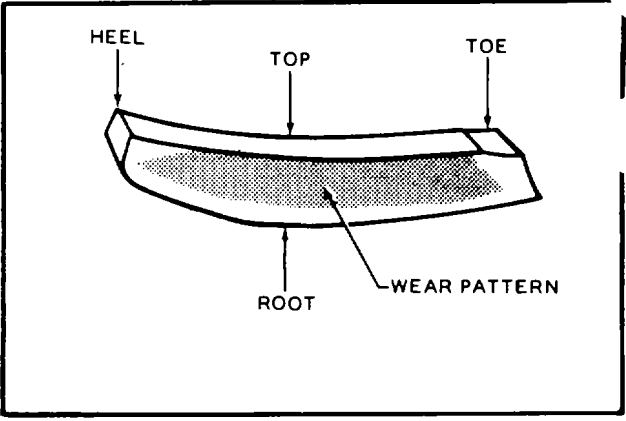
GEAR P/N 212-040-500-6

VIEW F ACCEPTABLE WEAR PATTERN TOUCHING TOE

Figure 6-42. Damage Limits - Intermediate Gearbox (Sheet 3 of 7)



PINION P/N 212-040-500-7



GEAR P/N 212-040-500-6

VIEW G ACCEPTABLE WEAR PATTERN

AREA	LIMITS
All - - - - -	No cracks acceptable
Case Assembly Undesignated areas	Mechanical damage and/or corrosion pitting on the case outside "designated" areas is acceptable provided the damage is polished out and the rework to completely remove the damage is within the following limits: 1. Rework is no more than 0.020 inch deep. 2. No more than forty percent of the area within one square inch or more than twenty percent of the total area is damaged. 3. Damaged area must be treated for corrosion protection in accordance with general instructions
A - - - - -	Identification plate legible and securely bonded to case.
B - - - - -	Minor scratches and burrs on external surface of coupling are acceptable if polished out with India stone. Indication of overheating of coupling, such as multi-color appearance, is cause to remove the outer coupling and inspect splines and teeth. Inspection procedure is furnished in text. These limits are also applicable to the coupling on the output quill.
C - - - - -	Corrosion damage in area C may be reparable at higher level of maintenance. If there is evidence of corrosion under shims or around base of studs, send gear box to higher level of maintenance.

Figure 6-42. Damage Limits - Intermediate Gearbox (Sheet 4 of 7)

Change 29 6-86

ALL DATA ON PAGE 6-86A/ 6-86B HAS BEEN DELETED

AREA	LIMITS
D - - - - -	Mechanical damage and/or corrosion pitting on case in area D is acceptable provided the damage is polished out and the rework to completely remove the damage is within the following limits: 1. Rework is no more than 0.010 inch deep. 2. No more than twenty percent of the total surface area and no more than ten percent of any one inch square is damaged. 3. Damaged area must be treated for corrosion protection in accordance with general instructions.
E - - - - -	Mechanical and corrosion damage limits for area E are the same as limits for area D.
F - - - - -	Mechanical damage and/or corrosion fittings in area F on the lower surface of the case is acceptable provided the damage is polished out and the rework to completely remove the damage is within the following limits: 1. Rework is no more than 0.030 inch deep. 2. No more than forty percent of area within any one inch square or more than twenty percent of the total surface is damaged. Mechanical damage and/or corrosion pitting on upper machined surface at four mounting bolt holes is acceptable provided the damage is polished out and the rework to completely remove the damage is within the following limits: 1. Rework is no more than 0.020 inch deep. 2. No more than twenty percent of total area is damaged. 3. No more than ten percent of the area contacted by the washer is damaged. 4. Minimum thickness of flange in damaged area is no less than 0.430 inch. 5. Damaged area must be treated for corrosion protection in accordance with general instructions.
NOTE Damage on area F that is in excess of limits noted above may be reparable at higher level of maintenance. Elongation of four mounting bolt holes is acceptable up to maximum diameter of 0.290 inch.	
G - - - - -	Mechanical damage and/or corrosion pitting on quill sleeves in area G (exclusive of area I and under shim) is acceptable provided the damage is polished out and the rework to completely remove the damage is within the following limits: 1. Rework is no more than 0.030 inch deep.

Figure 6-42. Damage Limits - Intermediate Gearbox (Sheet 5 of 7)

AREA	LIMITS
	2. No more than forty percent of the area within any one inch square or more than twenty percent of the total area of any surface or diameter is damaged.
	NOTE Corrosion damage under shim may be reparable at higher level of maintenance. If there is evidence of corrosion under shim, send gear box to higher level of maintenance.
H - - - - -	Mechanical damage and/or corrosion pitting in area H is acceptable provided the damage is polished out and the rework to completely remove the damage is within the following limits: 1. Rework is no more than 0.010 inch deep. 2. No more than twenty percent of the total area and no more than thirty percent of any one inch square is damaged. 3. No sharp corners that could damage packings are acceptable. 4. Damaged area must be treated for corrosion protection in accordance with general instructions.
I - - - - -	Mechanical damage and/or corrosion pitting on the spot faced surface at holes for quill attaching studs is acceptable provided the damage is polished out and the rework to completely remove the damage is within the following limits: 1. Rework is no more than 0.020 inch deep. 2. No more than twenty percent of the spot faced area of any hole is pitted. 3. No more than twenty percent of the total area normally contacted by the washer is pitted. 4. No more than fifty percent of the width of the area normally contacted by the washer may be pitted at any point around the hole.
J - - - - -	Mechanical and corrosion damage limits for area J are the same as limits for area H.
K - - - - -	The wear pattern information in this section is applicable to input quill pinions P/N 212-040-500-7 and output quill gear P/N 212-040-500-6. The wear pattern appears on the concave side of the pinion teeth and on the convex side of the gear teeth. Wear patterns on any tooth of the pinion or gear that are defined as unacceptable are cause to replace the intermediate gearbox. 1. Desired Wear Pattern: The desired wear pattern is shown in view C. A speckled or mottled appearance in the flank of the pinion or top of the gear due to dulite removal is permissible. The wide and not too well defined toe pattern is characteristic of this gear set. The area of the wear pattern in the flank of the gear is very faint and proper lighting must be used in order to see it.

Figure 6-42. Damage Limits - Intermediate Gearbox (Sheet 6 of 7)

AREA

LIMITS

2. **Acceptable Wear Patterns:** Examples of acceptable wear patterns are shown in views F and G. These figures show various pattern toe and heel locations.

3. **Pattern Limits at Toe:** The pattern may touch the toe or be a maximum of 1/8 inch from toe on gear number, see view D. Usually, the pattern will touch the toe in the flank of the pinion and at the top of the gear as shown on view F. If the pattern touches the toe, but is more than 1/8 inch from heel on gear member, then the pattern is off the toe and is unacceptable. This method of inspection must be used, due to the wide toe pattern, to determine whether the pattern is just touching the toe or is running off the toe. If pattern variation at the toe exceeds 1/32 inch, it is unacceptable.

4. **Pattern Limits at Heel:** The pattern may touch the heel or be maximum of 1/8 inch from heel on gear member, see view D. If pattern variation of the heel exceeds 1/32 inch it is unacceptable.

5. **Pattern Profile:** The pattern in the profile direction must touch or extend over the top of the pinion as shown by views E, F, and G. On the gear, the pattern may be 1/32 inch from the top or may extend over the top. Most of the gear patterns will extend over the top as shown by views E, F, and G. A bright line occurring at the top of pinion or in the flank of the gear is unacceptable.

6. In addition to pattern size and location, examine the drive face of all gear teeth for the following unacceptable defects: non-clean up, grinding scratches, pitting, corrosion, cuts, nicks, dents, grinding flats or barber poling (evidenced by diagonal streaks in the wear pattern), scuffing, scoring, or inclusions. If any of these defects can be felt with a scribe having a 0.002 inch radius spherical point, the affected part is unacceptable.

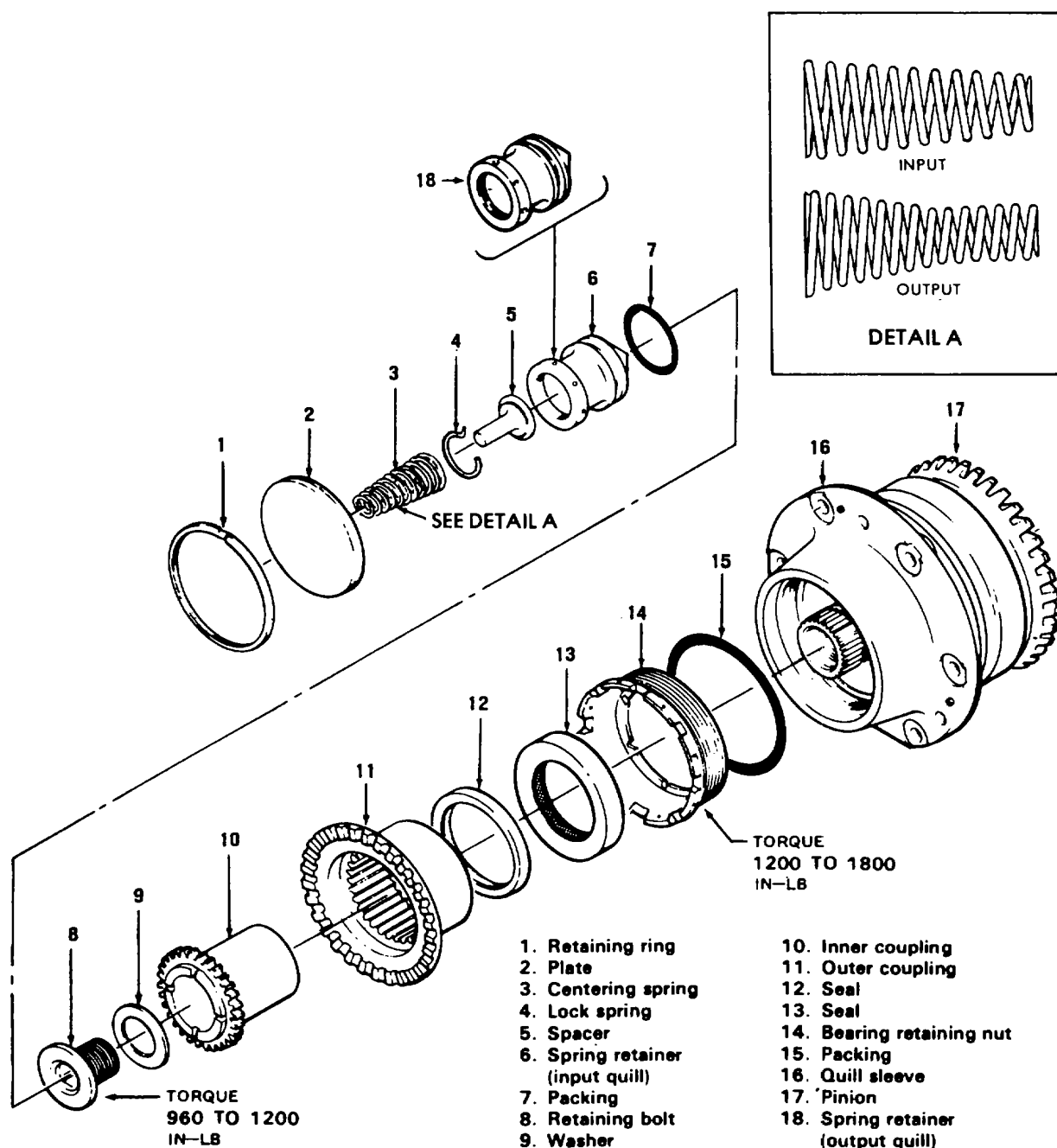
GENERAL INSTRUCTIONS.

Repair mechanical and corrosion damage to case and quill sleeve as follows:

1. Polish out corrosion damage to completely clean up surface. Use sandpaper (C102) or crocus cloth (C37). Blend repair in with surrounding surface and make minimum radius 0.250 inch. Use 400 grit abrasive paper (C102) to make repair area surface 63 microinches or better. Ensure that depth and/or area of repair does not exceed acceptable limits specified for the areas designated above. Treat reworked areas for corrosion protection with MIL-M-3171C, Type VI treatment (commercial designation Dow No. 19) (C42). Refer to TM 43-0105 for application procedures. Prime all rework areas that were painted prior to repair. Use polyamide epoxy primer (C88). Point to match existing finish.

2. Polish out mechanical damage to depth to remove all traces of the damage. Finish polishing out with 400 grit abrasive paper (C102) to blend repair smoothly into surrounding surface. Ensure that damage does not exceed acceptable limits. Apply corrosion protection, prime, and paint in the same manner as described in preceding step.

Figure 6-42. Damage Limits - Intermediate Gearbox (Sheet 7 of 7)



CAUTION

Input quill spring retainer (6) P/N 204-040-607-7 and output quill spring retainer (18) P/N 204-040-607-5 are not interchangeable.

Input centering spring is not interchangeable with output centering spring.

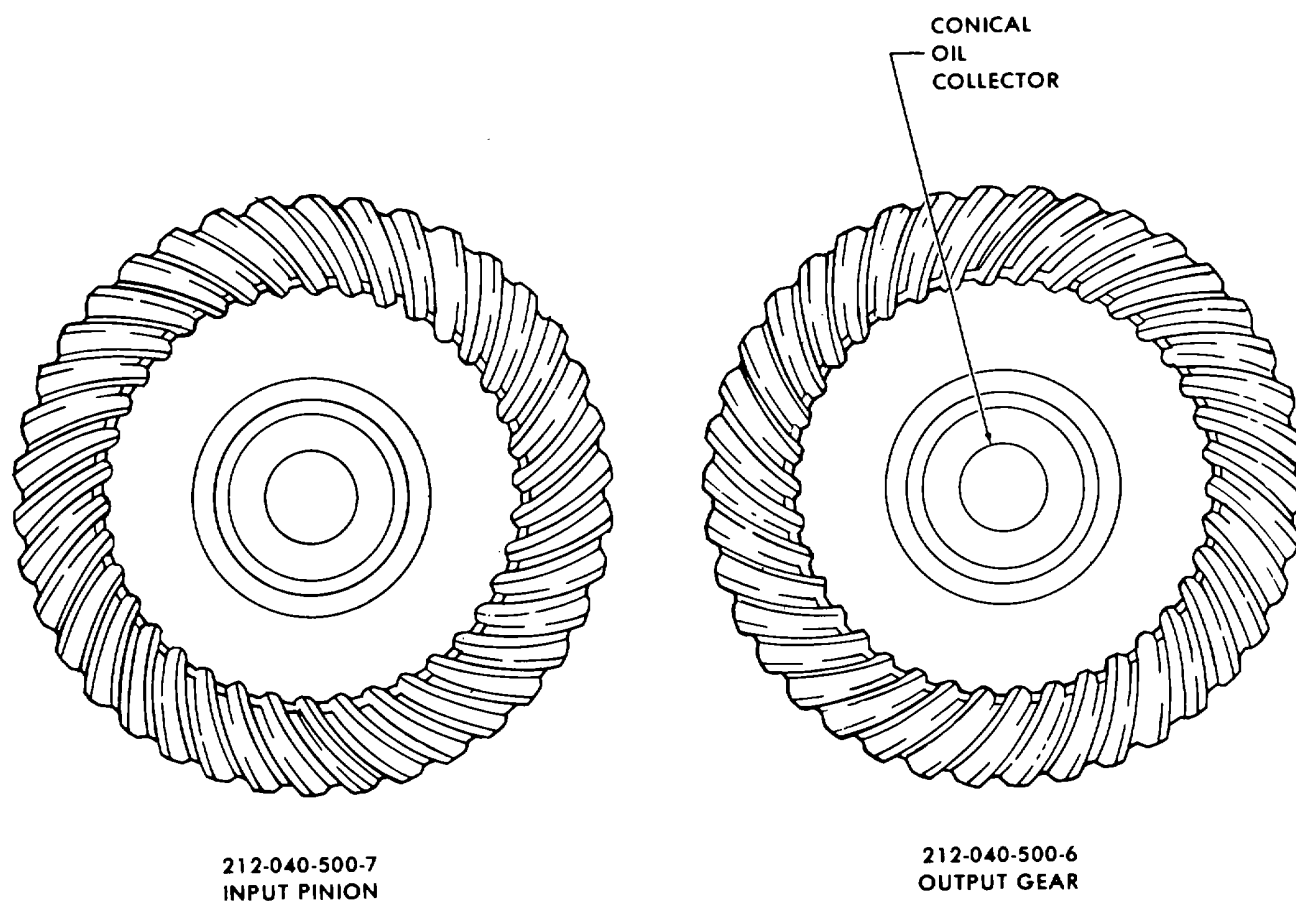
Input quill pinion (17) P/N 212-040-500-7 and output quill gear (not illustrated) P/N 212-040-500-6 are not interchangeable.

Be sure correct part number is installed in each quill.

NOTE

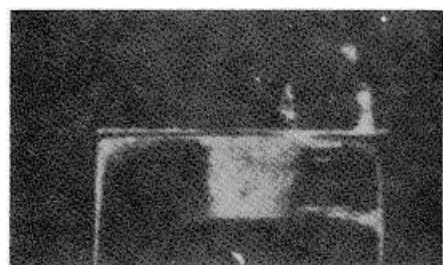
Physical difference in coupling springs.

Figure 6-43. Intermediate Gearbox Quill, Seals, and Couplings (Typical) (Sheet 1 of 2)

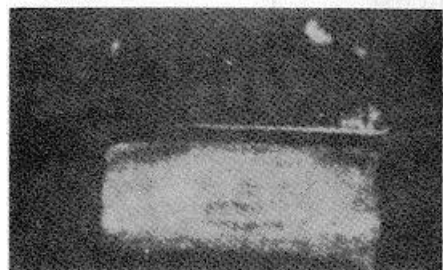


Note:
Conical oil collector must be
installed in output gear
P/N 212-040-500-6 as illustrated

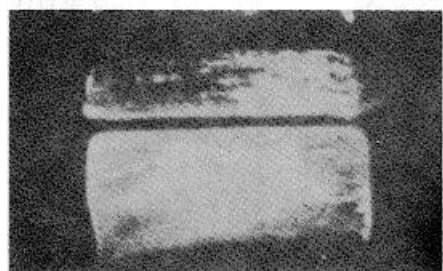
Figure 6-43. Intermediate Gearbox Quill, Seals, and Couplings (Typical) (Sheet 2 of 2)



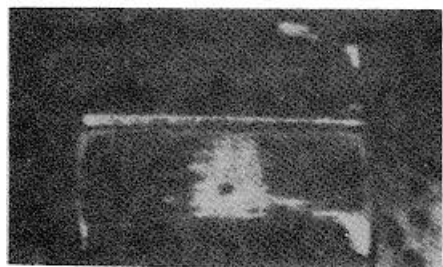
A Acceptable pattern typical of low operating time.



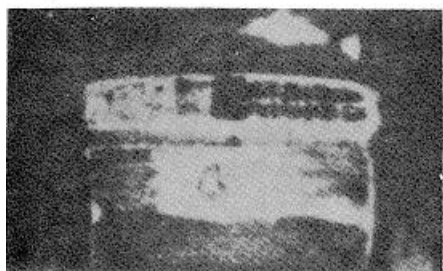
B Acceptable pattern typical of couplings which have operated with normal misalignment for a longer period of time than that shown in A.



C Acceptable pattern denoting operation at higher torque than that shown in A and B.



D Acceptable pattern showing a pitted tooth. This condition is acceptable on no more than 10 percent of the teeth.



E Pattern shows a more severe condition of tooth pitting than that shown in D. There is no metal projecting above the normal face of the tooth, indicating that the pitted area is polishing over. This condition may exist on no more than 10 percent of the teeth. Couplings with pits larger than 0.03125 inches diameter should be replaced.

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Figure 6-44. Coupling teeth wear patterns

sight gage (9) with solvent (C124).

(b) Position sight gage (9) in gearbox. Place new packing (7) on sight glass (8). Install sight glass with flat side out. Install retaining ring (6).

(5) Polish out mechanical and corrosion damage on gearbox case that is within limits shown on figure 6-42. Comply with "General Instructions" on figure 6-42.

(6) Replace gasket (1, figure 6-41) if leaking. Torque self-closing valve (2) to 150 inch-pounds and secure with lockwire (C152).

h. Installation.

CAUTION

Do not remove or change shims installed on tailboom under gearbox, as any resulting misalignment could cause excessive stresses, vibration, wear, and possible eventual failure of components in tail rotor drive train.

(1) Apply primer (C100 or C102) to mating surfaces of gearbox (15, figure 6-41), shims (18) and tailboom (16).

(2) Position intermediate gearbox, with oil sight gage and chip detector at right side, on tailboom. Ensure that hole in gearbox case is positioned over alignment pin (17).

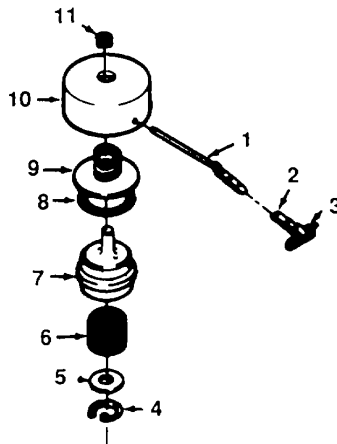
NOTE

Steel washers (13) may be removed or added to insure proper thread engagement. Minimum acceptable washers are one steel and one aluminum with steel washer under bolt head.

(3) Install four bolts (12) with steel washers (13) next to bolt heads and aluminum washers (14) next to gearbox. Torque bolts evenly 50 TO 70 inch-pounds. Secure bolts with lockwire (C152). Lockwire left rear bolt to left forward bolt. Lockwire right rear bolt to drain plug, then lockwire right forward bolt to drain plug. Cover the four mounting bolt heads with proseal (C116) to prevent moisture from standing in or entering bolt holes.

WARNING

Ensure that flexible coupling is properly lubricated prior to installation of driveshaft (paragraph 1-18).



1. Pin
2. Chain
3. Pin (safety)
4. Ring spiralox
5. Washer
6. Packing (aluminum wool)
7. Plug
8. Packing
9. Spring Assembly
10. Cap
11. Ring

Figure 6-45. Oil Filter Cap Assembly

(f) Fill plug (7) with new aluminum wool packing (6) (C24) and place washer (5) in plug. Check to determine whether correct amount of aluminum wool is installed. Push washer (5) inward 0.06 inch. If washer springs back to its original position, the correct amount of aluminum wool is installed. Add or remove aluminum wool as required. Secure washer (5) in place with ring spiralox (4).

(g) Coat packing (8) with oil (C93 or C94) and position packing on plug (7).

(h) Install spring assembly (9), cap (10), and ring (11) on plug (7). Insert pin (1) through cap (10) and bend end of pin to secure.

(4) Replace sight glass (8, figure 6-41) if damaged or leaking.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

(a) Remove retaining ring (6, figure 6-41), packing (7), sight glass (8), and sight gage (9). Clean

(4) Install driveshafts (per paragraph 6-23f).

(5) Connect electrical wire to chip detector (4) with nut (5). Do not overtorque nut (5).

6-26. Intermediate Gearbox Quills.

The intermediate gearbox input and output quills consist of a pinion gear bearing mounted in a sleeve. Each quill has a flexible coupling for attachment of driveshafts. The output quill has an oil collector cone installed on the inboard end of the pinion gear.

a. Removal.

Premaintenance Requirements for Removal of Intermediate Gearbox Quills

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	(T23) (T24) (T39) (T58)
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	One
Consumable Materials	(C68) (C118) (C124) (C128) (C151)
Special Environmental Conditions	None

(1) Remove gearbox and drain oil (paragraph 6-25b).

NOTE

Either quill can be removed using the following procedures.

(2) Remove nuts (23, figure 6-41) and aluminum and steel washers (21 and 22).

(3) Cut sealant around quill sleeve and gearbox case with a sharp plastic scraper. Remove sealant or lockwire, plugs and gaskets from jackscrew holes.

(4) Install three jackscrews (T24) in jackscrew holes in quill sleeve. Tighten jackscrews evenly to pull quill from case.

NOTE

Do not remove shims from quill sleeve or from gearbox case.

(5) Cover opening in gear case port to prevent entry of foreign material.

b. Cleaning.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

CAUTION

Do not force dirt or solvent into bearings or flexible couplings by use of compressed air.

(1) Prior to cleaning inspect quills for evidence of oil and/or grease leakage (paragraph 6-26c).

(2) Clean exterior of quill with solvent (C124).

(3) Clean sealant from quill sleeve and gearbox case with a plastic scraper.

NOTE

The following pertains to a disassembled quill. Do not use cleaning solvent inside couplings. Solvent leaves residue.

(4) Use a clean dry cloth to clean lubricant from inner and outer coupling.

(5) Clean old sealant from bearing retaining nut and inside of quill sleeve with a plastic scraper. Ensure that sealant does not contaminate quill bearings.

c. Inspection.

(1) Inspect quills for evidence of oil leakage at seal (13, figure 6-43).

(2) Inspect quills for evidence of grease leakage at seal (12).

(3) Inspect inner couplings (.10) on both quills for wear and damage on surface contacted by seal (13) during operation. Wear is allowable to minimum diameter of 1.587 inches, provided groove is uniform and smooth.

(4) Inspect outer coupling (11) on input and output quills for discoloration due to overheating. If the coupling has a multi-color appearance, disassemble the coupling and inspect splines and teeth as outlined in step (1).

(5) Inspect outer couplings (11) on input and output quills for scratches, nicks, dents, and cracks. Minor damage that can be polished out with fine India stone (C128) is acceptable.

(6) Inspect seals (12) on input and output quills for protrusion, leakage, cuts, tears, and deterioration.

(7) Disassemble outer couplings (11) from inner couplings (10) and inspect as follows:

(a) Remove retaining ring (1). At the same time, hold seal plate (2) against spring pressure.

(b) Remove seal plate (2) and centering spring (3).

1 Inspect input coupling centering spring (3) by applying a test load of 5.0 ± 0.5 pounds to compress spring to 1.50 ± 0.03 inches, release test load, spring should return to free length of 2.00 ± 0.03 inches. Replace spring if it does not meet above test.

2 Inspect output coupling centering spring (3) by applying a test load of 15.0 ± 2.0 pounds to compress spring to 1.17 ± 0.03 inches, release test load, spring should return to free length of 2.00 ± 0.03 inches. Replace spring if it does not meet above test.

CAUTION

Do not use cleaning solvent inside coupling. Solvent leaves residue.

(c) Inspect driveshaft couplings per paragraph 6-29.1.

(d) Visually inspect splines of outer coupling (11) for unusual wear patterns, nicks, dents, and cracks. Inspect inner coupling (10) teeth for unusual wear patterns, nicks, dents, and cracks. See figure 6-44 for examples of acceptable wear patterns. Maximum acceptable wear is 0.005 inch measured from unworn surface of tooth.

(e) Lubricate and assemble outer coupling (11) and inner coupling (10) (paragraph 6-26d).

(8) Inspect teeth on input quill pinion and output quill gear for abnormal wear patterns, roughness and cracks. See figure 6-42 for instructions to perform this inspection.

(9) Inspect quill sleeves for mechanical and corrosion damage. See figure 6-42 for damage limits and instructions to rework damaged quills.

d. Repair (AVIM).

(1) Replace quills (or intermediate gearbox if required) that have damage in excess of limits noted in paragraph 6-26c.

(2) Polish out mechanical and corrosion damage that is within limits shown on figure 6-42. Comply with "General Instructions" on figure 6-42.

(3) Disassemble quill as follows:

(a) Remove retaining ring (1, figure 6-43), plate (2), centering spring (3), lock spring (4), and spacer (5).

(b) Remove retainer (6) with packing (7). If retainer is difficult to remove, install a 1/4-20 threaded bolt in center of retainer and pull on bolt to withdraw retainer. Remove packing.

(c) Install wrench assembly (T23) on outer coupling (11). Insert a square-drive tool through wrench and remove retaining bolt (8) and washer (9).

(d) Remove and separate inner and outer couplings (10 and 11). Remove seal (12) from outer coupling.

(e) Position holding plate (T39) on quill sleeve (16) with pins engaged in bolt holes. Remove lockwire and use wrench (T58) to remove bearing retaining nut (14). Remove packing (15) and press seal (13) from nut.

(f) Clean disassembled quill (paragraph 6-26b).

(g) Inspect disassembled quill (paragraph 6-26b).

(4) Assemble quill as follows:

(a) Apply sealant (C1119) to outside diameter of seal (13). Press seal into bearing retaining nut (14) from outboard side, with lip of seal facing inboard. Place new packing (15) on nut.

(b) Position holding plate (T39) on quill sleeve (16) with pins engaged in bolt holes. Coat threads of bearing retaining nut (14) with oil used in gearbox and start into sleeve. Use wrench (T58) to torque nut **1200 TO 1800** inch-pounds. Remove tools. Secure nut to sleeve with lockwire (C152).

(c) Examine inner coupling (10) for damage or wear on surface contacted by seal (12). Polish out any minor nicks, dents, burrs, or scratches. Wear is allowable to minimum diameter of 1.587 inches, if groove is uniform and smooth.

(d) Install new seal (12) onto outer coupling (11) with lip of seal facing outboard. Place a small amount of grease (C68) on internal splines of coupling. Insert inner coupling (10) into outer coupling (11).

(e) Position coupling assembly on splined shaft of gear (17). Place washer (9) on retaining bolt (8), coat bolt threads with oil and start into end of gear shaft. Hold outer coupling (11) with wrench (T23) and use a squaredrive extension to torque retaining bolt (8) **960 TO 1200** inch-pounds.

(f) Coat internal splines of outer coupling with grease (C68) to 0.12 inch depth over top of spline teeth.

CAUTION

Input quill spring retainer (6) P/N 204-040-6077 and output quill spring retainer (18) P/N 204-040-607-5 are not interchangeable.

Input quill pinion (17) P/N 212-040-500-7 and output quill gear (not illustrated) P/N 212-040-507-6 are not interchangeable.

Be sure correct part number is installed in each quill.

(g) Place packing (7) on retainer (6). Insert retainer into retaining bolt (8). Check for alignment of one hole in rim of retainer with a notch in end of inner coupling

(10) If necessary, reposition retainer by one-fourth turn increments to obtain alignment.

(h) Place spacer (5) into retainer (6). Install lock spring (4) with tang through aligned hole and notch. Place small end of centering spring (3) on boss of plate (2), and insert large end of spring into retainer. Compress plate into coupling and secure with retaining ring (1).

(i) Hold quill sleeve and manually turn coupling.

Check for smooth rotation of gear with only a very light drag caused by preload of bearings.

e. Installation.

(1) Remove gearbox port cover.

NOTE

Output quill has conical oil collector projecting from center of gear.

(2) Ensure that input drive quill is installed in forward port of gear case and output drive quill is installed in aft port of gear case.

(3) Install new packing (19, figure 641) on quill (20). Carefully align holes in mounting flange of sleeve with studs on gearbox and position flange.

(4) Install aluminum washer (21), steel washer (22), and nut (23) on each stud. Manually check meshing of gears while tightening nuts evenly to seat quill sleeve flange on gear case. Torque nuts **50 TO 70** inch-pounds.

(5) Check backlash between mating teeth by slight back and forth rotary movement of quill coupling until metal-to-metal contact is felt and heard. Backlash must be evident.

NOTE

Backlash has been permanently set with shims during manufacture. Measurement is not required. Do not change shims on gearbox quill case.

(6) Apply a bead of sealant (C116) around joint of quill flange and gearbox. Install plugs (MS24391D2L) and gaskets (MS28777-2) in jackscrew holes and lockwire (C151).

(7) Install and service gearbox. Refer to paragraph 6-25h.

Figure 6-46. Deleted.

Section VII. TAIL ROTOR GEARBOX

6-27. Tail Rotor Gearbox.

A gearbox at top of tailboom vertical fin provides 90-degree change in direction of drive and speed reduction between the input drive shaft and the output shaft on which the tail rotor is mounted. See figure 6-47. The gearbox consists of mating input and output gear quill assemblies set into gear case provided with a breather-type oil filler cap, and oil level sight gage, and a drain plug with a chip detector. The input quill has a flexible coupling for attachment of drive shaft. Control linkage is attached on the left side, with a control rod extending through the rotor shaft.

Premaintenance requirements for tail rotor gearbox.

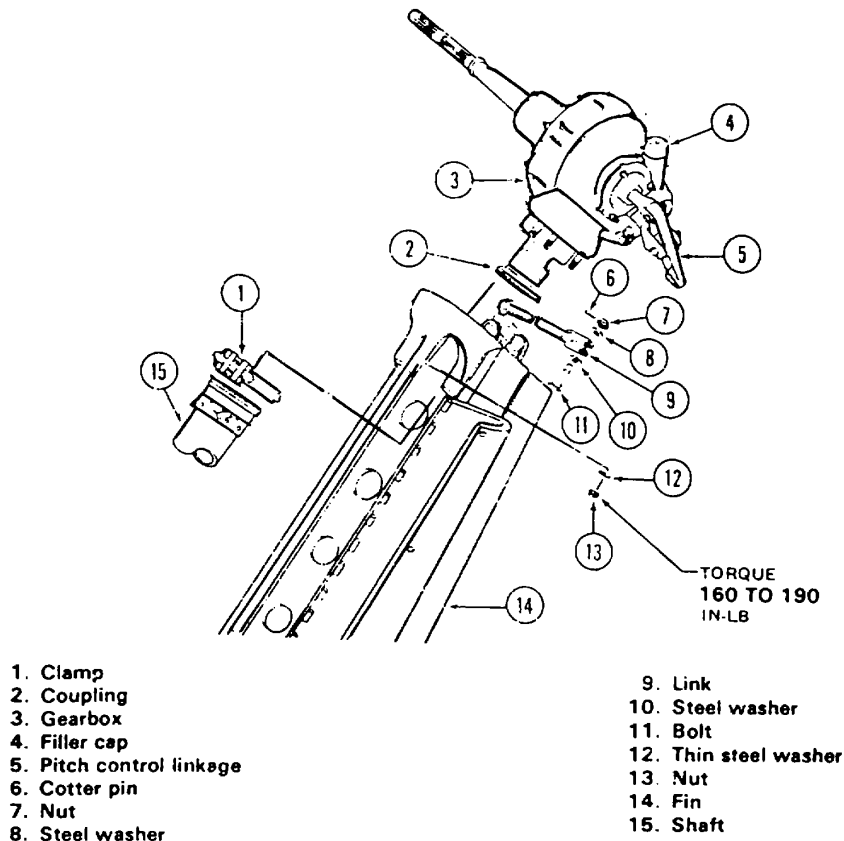
Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel	Two
Required	
Consumable Materials	(C28) (C53) (C56) (C59) (C68) (C93) (C94) (C102) (C124)
Special Environmental Conditions	Dust Free

a. Removal.

- (1) Remove tail rotor. (Refer to Chapter 5).
- (2) Disconnect control link from lever attached on left side of gearbox. If replacing gearbox, also remove idler and lever, control rod and bearing housing for use on replacement assembly. Install a cover on opening from which bearing housing was removed.
- (3) Disconnect electrical lead from chip detector.
- (4) Open cover on front of vertical fin. Remove driveshaft. (Refer to paragraph 6-23a).
- (5) Remove nuts (13, figure 6-47) and washers (12) from six studs to detach gearbox from support fitting on vertical fin. Lift off gearbox.
- (6) Reinstall nuts and washers with suitable spacers on input quill mounting studs to hold parts securely during handling after removal.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.



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Figure 6-47. Tall rotor gearbox Installation

CAUTION

Do not permit solvent or dirt to be forced into flexible coupling by use of compressed air.

b. *Cleaning.* Clean exterior of gearbox assembly, or removed parts, with solvent (C124).

c. *Inspection.*

NOTE

External leakage is not permitted around seal; however, a small amount of seepage is permissible and does not indicate an unsatisfactory seal condition. Continuous flow (droplets) is considered excessive and requires seal replacement

(1) Gearbox case for cracks and damage.

(2) Gearbox support fitting for cracks or damage. Inspect fitting attachment holes for wear (elongation) in excess of **0.400** inch diameter.

(3) Check oil filter cap and packings for serviceability.

(4) Chip detector for excessive accumulation of metal particles. (Refer to paragraph 6-3.)

NOTE

To remove chip detector, push body of detector in and turn left to disengage bayonet pins and withdraw from drain plug.

(5) Check gearbox case for corrosion.

(6) Inspect driveshaft couplings per paragraph 6-29.1.

cl. Inspection. Tail Rotor Gearbox (installed). (See figure 6-47A.)

(1) Inspect for evidence of fretting between the mating surfaces of the tail rotor gearbox and the tail rotor gearbox support fitting. A gray residue will be an indication of fretting. Remove gearbox if residue is present, refer to removal steps.

(2) Check to ensure that hold-down studs have proper torque on nuts, refer to installation steps for torque values and procedures.

d. Repair or Replacement.

(1) Replace gearbox if cracks are found in the case.

CAUTION

Prior to installation of a replacement gearbox, drain gearbox. Also inspect splined coupling of input quill for proper lubrication. (Refer to paragraph 6-27e.)

(2) Replace unserviceable oil filler cap (4) or packing as required.

(3) Secure cap chain by safety pin through drilled hole in filler neck boss of case.

(4) To replace other gearbox fittings, drain oil by removing drain plug.

(5) Replace packing on chip detector and gasket on drain plug as required. Install drain plug and chip detector.

(6) When installed, lockwire drain plug to adjacent drilled hole in boss of case.

e. Lubrication. Before servicing gearbox to sight gage level with oil, determine whether system contains oil (C93) or oil (C94). If type of oil used cannot be determined, refer to Chapter 1. Splined input coupling is lubricated at assembly with lubricant (C68) and packed to 0.12 inch deep over internal spline teeth, in same manner as tail rotor drive quill couplings. (Refer to paragraph 6-22b).

f. Installation.

(1) Inspect tail rotor gearbox support fitting on tailboom for wear and damage limits. (Refer to Chapter 2.) Repair damage, if within limits, prior to installation of gearbox. If damage exceeds limits, request assistance of Intermediate maintenance.

NOTE

Check mounting flange of gearbox for sealant protruding from three puller screw holes. Trim off sealant flush to allow proper seating of flange on mating surface.

(2) Remove nuts (13, figure 6-47), washers (12), and spacers (not illustrated) from studs around input drive quill. Apply primer (C102) to mating surfaces of gearbox (3) and to gearbox support fitting on fin (14).

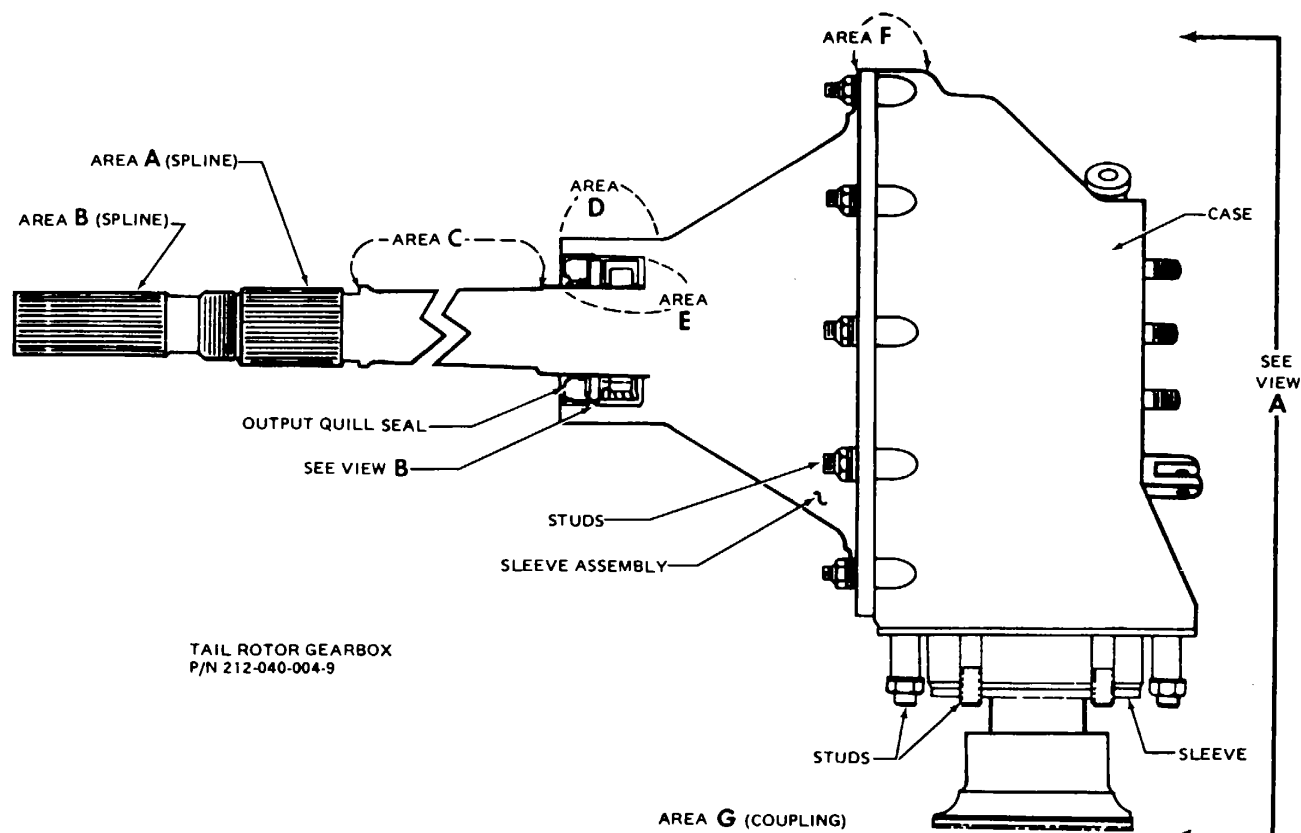
NOTE

Spacers removed in preceding step are used to hold input quill in gearbox when the gearbox is removed from the helicopter. The spacers are not used on an installed gearbox.

(3) Position gearbox (3) on support fitting on fin (14) with input coupling (2) and mounting studs through holes in support fitting. Install one thin steel washer (12) and nut (13) on each stud. Torque nuts evenly **160 TO 190** inch-pounds. Ensure that a minimum to two thread pitches, including the chamfer, extend through the nuts (13). Ensure that the nuts do not bottom on the grip portion of the studs. Apply sealant (C116) around edges of mating surfaces of gearbox and support fitting to prevent corrosion.

NOTE

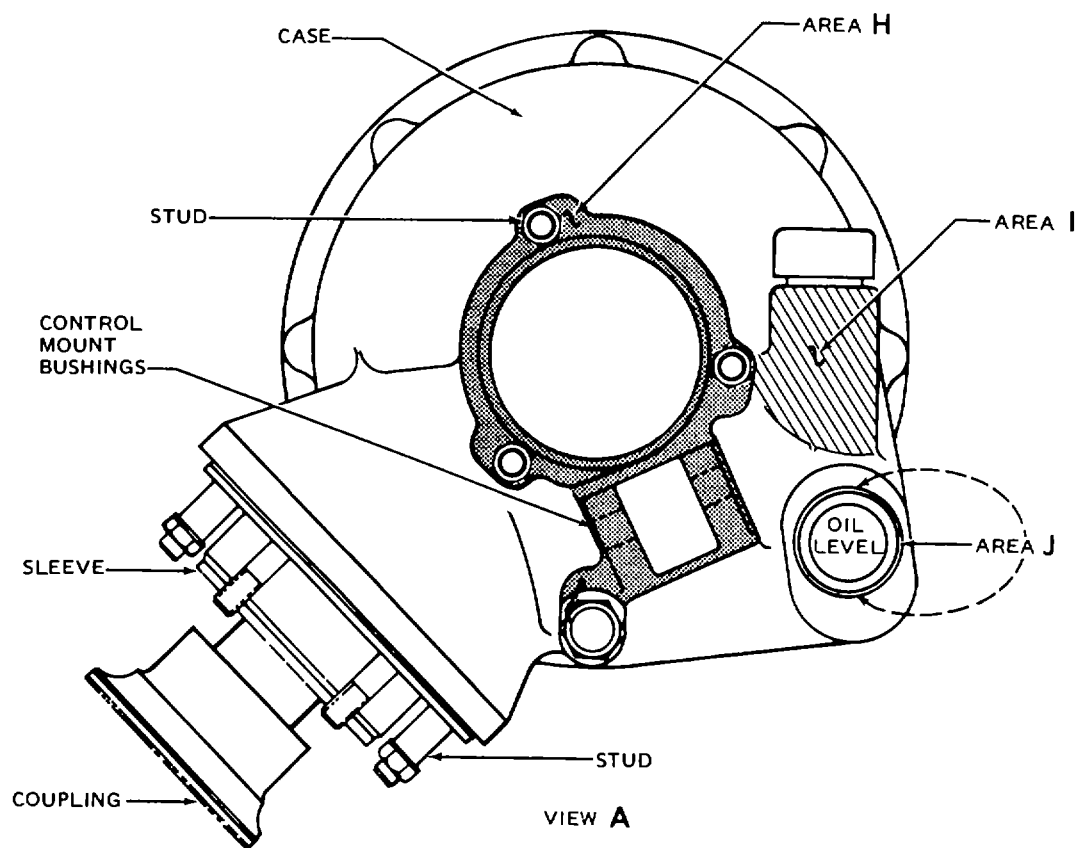
Repeat the torquing pattern until all the nuts retain the torque value that was initially applied to the first nut in the pattern. The torque value of the first nut will decrease as the other nuts are torqued.



ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

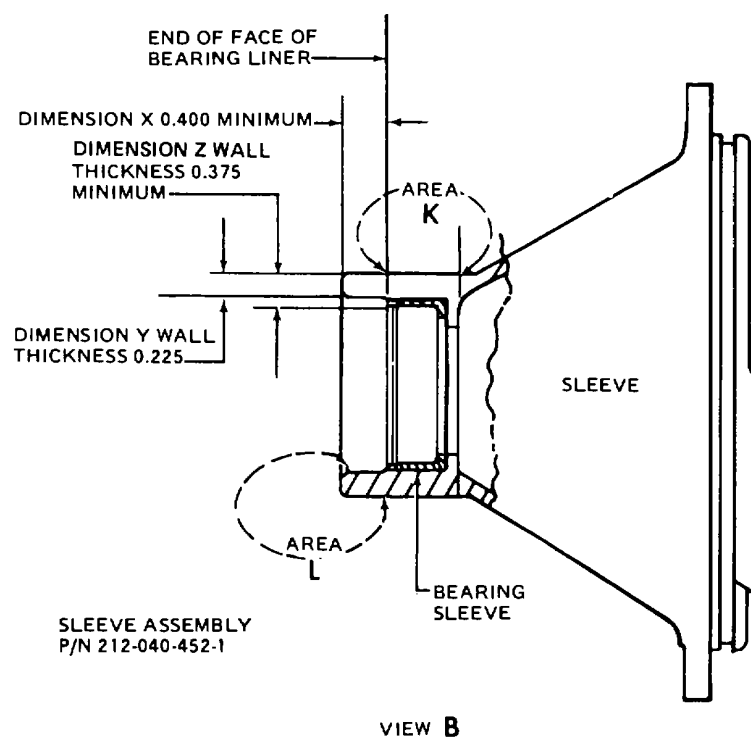
AREA	LIMITS
A	Small nicks, burrs, and scratches on splines are acceptable if they are blended out with fine India stone (C116).
B	Same as Area A.

Figure 6-47A. Damage Limits - Tail Rotor Drive Gearbox (Sheet 1 of 5)



212040-321-2

Figure 6-47A. Damage Limits - Tail Rotor Drive Gearbox (Sheet 2 of 5)



ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

NOTES:

1. Minimum acceptable wall thickness (dimension Y) in area L is 0.225 at any location after rework is complete.
2. Minimum acceptable wall thickness (dimension Z) in area K is 0.375 at any location after rework is complete.
3. Minimum acceptable dimension X is 0.400 at any location after rework is complete.

212040-321-3A

Figure 6-47A. Damage Limits - Tail Rotor Drive Gearbox (Sheet 3 of 5)

AREA	LIMITS
ALL	No cracks allowed.
C	Nicks, dents, scratches, and corrosion up to 0.005 inch deep are acceptable if polished out with 400 grit emery cloth to blend with surrounding area and have a bottom radius of 0.50 inch. Area C is the outer diameter of the portion of the shaft outside the gearbox between the diameter of the oil seal and the shoulder adjacent to the splines.
D	Nicks, dents, and scratches up to 0.030 inch deep are acceptable if polished out and treated in accordance with general instructions. Corrosion damage up to 0.030 inch deep after clean-up, is acceptable. Treat in accordance with general instructions. Mechanical and corrosion damage maximum area after polishing out is forty percent of the area within one square inch and/or twenty percent of the total area. Also, minimum wall thickness and dimension X specified in notes 1, 2, and 3 in view B must be maintained.
E	Wear limit on the shaft in the area contacted by the output quill seal is 0.002 inch or a minimum shaft diameter of 1.430 inch. Check prior to installing a new output quill seal. Corrosion damage up to 0.005 inch deep is acceptable on the case in the area contacted by the output quill seal if polished out to twice the depth of the corrosion and treated in accordance with general instructions. Mechanical damage up to 0.010 inch deep is acceptable on the case in the area contacted by the output quill seal if polished out and treated in accordance with general instructions. Also lubricating oil must not leak past the seal after installation. Mechanical and corrosion damage maximum area after polishing out is twenty percent of the total area contacted by the output quill seal. Also, minimum wall thickness and dimension X specified in notes 1, 2, and 3 in view B must be maintained. When output quill seal is removed, bearing sleeve shown in view B may be inspected. Evidence of corrosion between bearing sleeve and the sleeve and/or a loose bearing sleeve is cause for replacement of the gearbox.
F	Mechanical and corrosion damage limits are the same as the limits for Area D except that evidence of corrosion under shims and around base of studs is cause to replace gearbox.
G	Small nicks, burrs, and scratches on couplings are acceptable if they are blended out with fine India stone (C128).
H	Mechanical and corrosion damage limits are the same as limits for area D with the exception that no damage is permissible in the following areas: 1. Adjacent to studs. 2. Adjacent to control mount bushings. 3. Inside case bore where pitch change control shaft seal housing pilots.
I	Nicks, dents, and scratches up to 0.040 inch deep are acceptable if polished out and treated in accordance with general instructions.

212040-321-4A

Figure 6-47A. Damage Limits - Tail Rotor Drive Gearbox (Sheet 4 of 5)

AREA	LIMITS
I	Corrosion damage up to 0.040 inch deep, after clean-up, is acceptable. Treat in accordance with general instructions.
	Mechanical and corrosion damage maximum area after polishing out is thirty percent of the total area.
J	Mechanical damage in machined area of case, where oil level sight gage is installed, up to 0.010 inch deep is acceptable if polished out to form a smooth contour and treated in accordance with general instructions. Also, lubricating oil must not leak past sight gage.
	Corrosion damage limits in area J are 0.010 inch after clean-up. Corrosion prevention treatment and lubricating oil leakage requirements are the same as noted for mechanical damage limits.
All areas of the case and sleeve except areas previously designated D, E, etc.	Nicks, dents, and scratches up to 0.010 inch deep are acceptable if polished out and treated in accordance with general instructions.
	Corrosion damage up to 0.010 inch deep, after clean-up, is acceptable. Treat in accordance with general instructions.
	Mechanical and corrosion damage maximum area after polishing out is forty percent of the area within one square inch and/or twenty percent of the total area.

GENERAL INSTRUCTIONS

1. Repair mechanical and corrosion damage to case and sleeve as follows:
  - a. Polish to remove corrosion damage. Use sandpaper and/or crocus cloth (C45). Blend repair in with surrounding surface and make minimum radius 0.250 inch. Use 400 grit crocus cloth (C45) to make repair area surface 63 microinches or better. Inspect to ensure that depth and/or area of repair does not exceed acceptable limits specified for the various areas above. Treat reworked areas for corrosion protection with MIL-M-2171C, type VI treatment (commercial designation DOW No. 19). Refer to TM 43-0105 for additional procedures. Prime with polyamide epoxy primer (C100) and paint all areas that were painted prior to repair to match existing finish.
  - b. Polish out mechanical damage to remove all traces of the damage. Complete repair in same manner prescribed for corrosion damage in step a.
2. Evidence of corrosion damage around base of studs is cause to replace the gearbox. Structural damage to threads in case is not acceptable.
3. Evidence of corrosion damage under the shims where quills are attached to case is cause to replace the gearbox.

212040-321-5A

Figure 6-47A. Damage Limits - Tail Rotor Drive Gearbox (Sheet 5 of 5)

(4) Install driveshaft. (Refer to paragraph 6-23,f.)

(5) If gearbox was replaced, remove cover from left side of case. Install and connect control rod, bearing housing, and control linkage (5, figure 6-47), and install and rig tail rotor. (Refer to Chapters 5 and 11.)

(6) Install chip detector drain plug (14, figure 6-481. Torque **120 TO 150** inch-pounds. Connect electrical lead.

(7) Service gearbox with oil (C93 or C94).

NOTE

Before installing tail rotor gearbox fairings, ensure that the isolation pad is securely attached (figure 2- 58). Ensure fairing attachment hardware are installed in the proper locations. Use of incorrect length screws can damage gearbox casing.

(8) Close cover on vertical fin.

g. Preparation of Gearbox for Shipment.

(1) Clean and dry tail rotor gearbox in accordance with step b.

(2) Flush tail rotor gearbox with operating oil. Apply corrosion preventive compound (C53} to all exposed, unpainted, uncoated, bare metal surfaces of tail rotor gearbox. Attach tag to tail rotor gearbox stating:

"PRESERVED WITH OPERATING OIL"

If tail rotor gearbox is to be repaired, attach a completed DA Form 1577-2 (Unserviceable Repairable Tag) to gearbox.

(3) Wrap assembly in grease proof barrier material (C28). Secure with pressure sensitive tape (C136).

(4) Line bottom of metal reuseable container (MS27683-13) NSN 8110-00-082-2629 with a minimum of 2 inches of bound fiber cushioning material (C56). Place wrapped tail rotor gearbox in container. Stuff bound fiber cushioning material (C56) firmly and evenly around sides and top of tail rotor gearbox.

(5) Initiate DA Form 2410 and place in a grease proof envelope MIL-B-117 and stow in container.

(6) Place 40 units of clean dry desiccant (C59) in container.

(7) Put lid of container and rubber gasket in place. Position locking ring on container lid and tighten to ensure a moisture vapor proof closure.

(8) As a field expedient only, prepare the tail rotor gearbox for return to overhaul facility as follows:

NOTE

This procedure is based on the assumption that the provisions of sub step (4) cannot be fulfilled. The work will be done under adverse conditions with in- adequate equipment by personnel inexperienced in the field of packaging and preservation.

(a) Comply with subparagraph (1) through (7) to the greatest extent possible with available means.

(b) Mount the tail rotor gearbox in the best available container (constructed if necessary) of wood or metal. Cushion block and brace with best available material. Substitute and improvise as needed.

(c) If the field expediency procedure was used, mark the outside of container as follows:

"THIS GEARBOX IS NOT PRESERVED FOR STORAGE. STORE INDOORS AND PROCESS AS SOON AS PRACTICABLE."

(d) Obliterate old markings from container that do not coincide with item to be returned.

6-27A. Tail Rotor Gearbox Input Quill Seal Replacement (with Gearbox Installed on Helicopter).

a. Disassembly.

(1) Drain oil from tail rotor gearbox. (Refer to paragraph 1-6.)

(2) Open access cover on front of vertical fin.

CAUTION

Clamp set must be removed from both ends of shaft before removing either end of shaft from its mating curvic coupling to avoid coupling tooth or bearing damage.

NOTE

Retain clamp set as a unit when removed to preclude intermix of set halves.

WARNING

Secure the tail rotor blades to prevent personnel injury and equipment damage any time a segment of the tail rotor drive system is disconnected. The tail rotor blades may cause uncontrolled system rotation should there be a sudden gust of wind when they are not secured.

(3) Remove clamp set from curvic couplings (both ends of shaft).

(4) Push shaft against coupling to disengage opposite end and remove driveshaft.

(5) Remove curvic coupling as follows (figure 6-51):

(a) Remove retaining plug (15), plate (17), centering spring (16), and spacer (14). Thread a 1/4-20 bolt into

center of retaining plug (13) and pull retainer with lockspring (15) and packing (12) from inner coupling. Remove lockspring and packing from retainer.

(b) Hold outer coupling (1) with wrench, T101307 and use square adapter through wrench to remove coupling retaining bolt (11) and washer (10).

(c) Remove inner coupling (9), outer coupling (1), from pinion splines.

(d) Remove inner coupling (9) from outer coupling (1). Remove seal (2) from outer coupling (1).

(6) Remove sealer and lockwire from retaining nut (4). Remove retaining nut using special socket 68SPL-12757-0136.

(7) Remove packing (5) from nut (4).

(8) Press seal (3) from retaining nut (4).

b. Reassembly.

NOTE

Replace all removed seals and packings with new items.

(1) Apply sealant (C119) to outside diameter of seal (3). Press seal (3) into retaining nut (4) with lip of seal facing inboard (toward gearbox). Install packing (5) on nut (4).

(2) Deleted.

NOTE

Deleted.

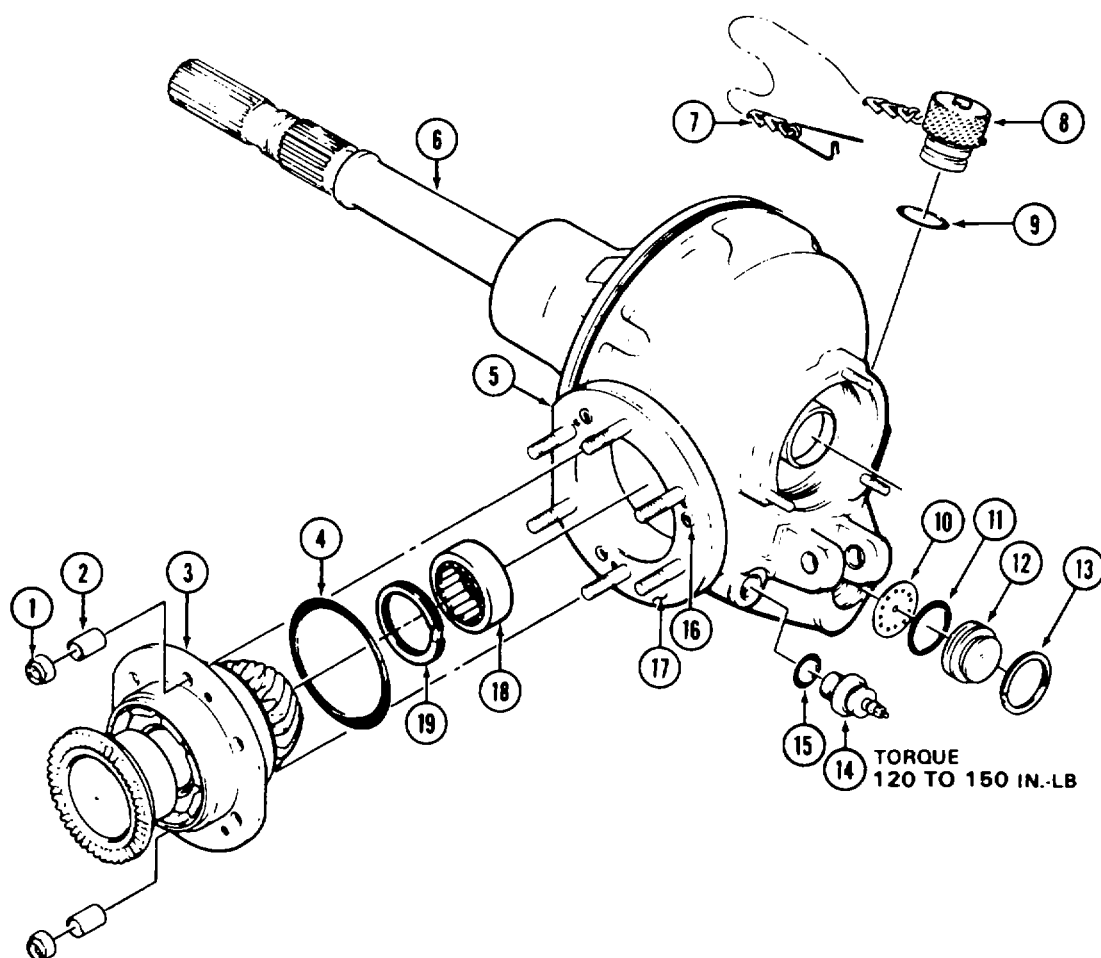
(3) Using special socket 68SPL-12757-0136, install nut (4). Torque nut **100 TO 150** foot-pounds. Lockwire (C151) nut (4) to sleeve. Apply a bead of sealer (C119) around mating joint of nut and sleeve.

(4) Lubricate OD of seal (2) with grease (C68) and press into outer coupling (1) with lip of seal facing toward coupling splines.

(5) Place a small amount of grease (C68) in internal splines of coupling (1), on lip of seal (2) and mating surface of coupling (9). Insert coupling (9) into coupling (1).

(6) Install couplings (1 and 9) on spline end of pinion.

(7) Place washer (10) on bolt (11) and thread bolt into pinion shaft (6).



1. Nut	11. Packing
2. Shipping spacer	12. Glass
3. Input quill	13. Retaining ring
4. Packing	14. Chip detector
5. Case	15. Packing
6. Rotor shaft	16. Screw
7. Chain and pin	17. Shim plate
8. Cap, vented	18. Bearing
9. Packing	19. Retaining ring
10. Indicator	

209040-105

Figure 6-48. Tail rotor gearbox assembly

(8) Hold outer coupling (1) with wrench, T101307. Position square adapter through wrench and torque bolt (11) 80 TO 100 foot-pounds.

(9) Place packing (12) on retainer (13). Insert retainer into bolt (11). If one hole in rim of retainer does not align with notch of inner coupling (9), pull out retainer, rotate it 90 degrees and reinstall. Repeat if necessary to obtain alignment. Install lock spring (15).

(10) Extend outer coupling (1) so that seal (2) is against the teeth of inner coupling (9). Coat internal splines of outer coupling with grease (C68) to 0.12 inch depth over top of spline teeth.

(11) Place small end of centering spring (16) on boss of plate (17). Install spacer (14), spring (16) and plate (17) into coupling and install retaining ring (18).

(12) Install drive shaft by pushing shaft against one coupling while mating shaft couplings with gearbox couplings.

(13) Install clamp set at each end of shaft as follows.

CAUTION

Use new nuts each time clamps are installed.

NOTE

Insure clamp halves are matched. All bolts and nuts on any one clamp must be identical parts to maintain balance.

(a) Position clamps with bolted joints indexed 90 degrees to those of adjacent clamps for balance in operation.

(b) Install four bolts with heads in direction of rotation of tail rotor driveshaft. Start four new nuts on clamp bolts to obtain complete thread engagement in nut.

(c) Measure and record tare torque for each nut.

(d) Torque each nut in sequence illustrated (figure 6-39, view C) **30 TO 35** inch-pounds above tare torque recorded in preceding step. Keep end gaps of clamp set equal within 0.020 inch.

(e) Tap lightly around outer surface of clamp with fiber mallet and recheck torque.

(14) Service tail rotor gearbox with oil to proper level. (Refer to paragraph 1-6).

(15) Close access cover on vertical fin.

6-28. Tail Rotor Gearbox Input Drive Quill.

Premaintenance requirements for tail rotor gearbox input quill.

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	(T23) (T25)
(T39A) (T58)	
Test Equipment	None
Support Equipment	None
Minimum Personnel	Two
Required	
Consumable Materials	(C68) (C92) (C94)
	(C114) (C124) (C151)
Special Environmental	Dust Free
Conditions	

a. Removal.

(1) Remove gearbox from helicopter and drain oil. Refer to paragraph 6-27a.

(2) Remove nuts (1, figure 6-48) and spacers (2). The spacers are used to hold the input quill in position during shipment. They may not be present on all gearboxes received for repair.

(3) Remove sealant from three threaded holes provided for jackscrews in the input quill sleeve and from the groove at the point where the quill (3) and the case (5) join.

NOTE

Do not remove shims from quill sleeve (3) or gearbox case (5).

(4) Install three jackscrews (T25) in threaded holes in input quill (3), tighten jackscrews evenly to remove input quill. Use heat lamp on case (5) if quill is very hard to remove, but do not use open flame. Remove input quill (3) and discard packing (4).

CAUTION

Do not remove screws (16, figure 6-48) and shim plate (17) or the matching shim plate and screws installed on input quill. The correct thickness for these shim plates is determined at time of manufacture and they must not be removed except at a depot level maintenance facility.

(5) Immediately after quill removal, inspect for evidence of corrosion around edges of the two shim plates described in the caution above, but do not remove the shim plates. If there is any evidence of corrosion, preserve and reassemble the gearbox and forward it to a maintenance facility authorized to perform depot level maintenance on this gearbox.

(6) Cover opening in case (5) and also cover the open end of the quill to prevent contamination by dust or other foreign material until the gearbox can be inspected.

b. Inspection Prior to Disassembly.

(1) Inspect bearing (18, figure 6-48), for spalling, scoring, pitting, brinnelling, flaking, corrosion, cracked or broken retainers, discoloration due to overheating and for roughness when the bearing is rolled by hand. See figure 6-49 for typical views of acceptable and unacceptable roller bearings.

(2) Inspect teeth on input quill pinion for abnormal wear and chipped teeth. See figure 650 for views of acceptable and unacceptable wear patterns. If the output quill is not to be removed, inspect the teeth on the output quill for abnormal wear and damage.

(3) If inspections in steps (1) and (2) reveal unacceptable wear or damage, do not disassemble quill, but proceed to step e.

c. Disassembly for Replacement of Seal and Inspection of Couplings.

(1) Remove retaining ring (18, figure 6-51), plate (17), spring (16) and spacer (14).

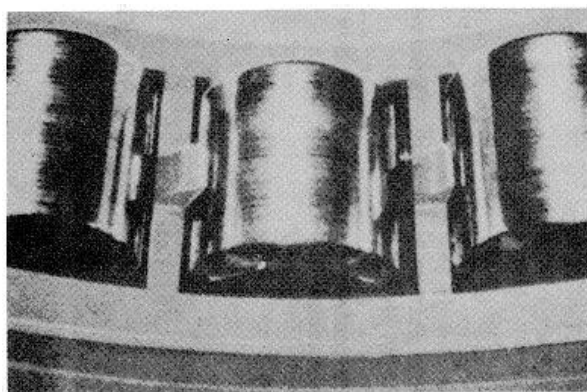
(2) Remove lock spring (15), retainer plug (13), and packing (12).

(3) Place holding plate, (T39A), in a vise and secure quill in holding plate. Secure wrench, (T23), to quill as shown on figure 6-52.

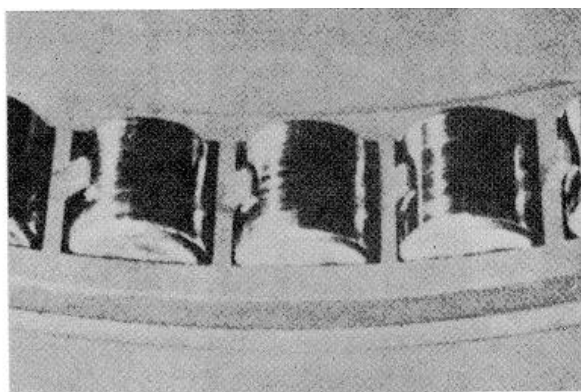
(4) Install square drive extension in retainer bolt, hold wrench, (T23), and loosen retainer bolt. Remove retainer bolt (11, figure 6-51) and washer (10).

(5) Remove outer coupling (1), and inner coupling (9). Remove seal (2) from outer coupling.

(6) Cut lockwire on retainer nut (4). Install wrench (T58) as shown in figure 6-53 and remove retainer nut (4, figure 6-51).



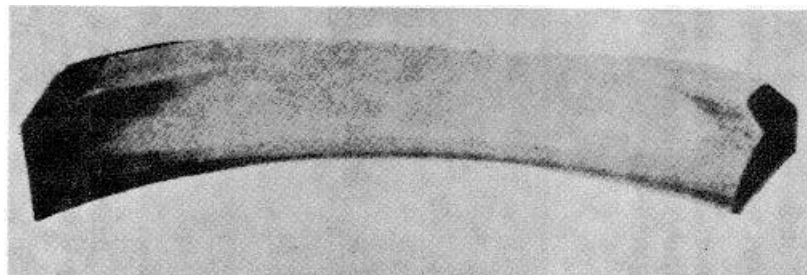
Acceptable



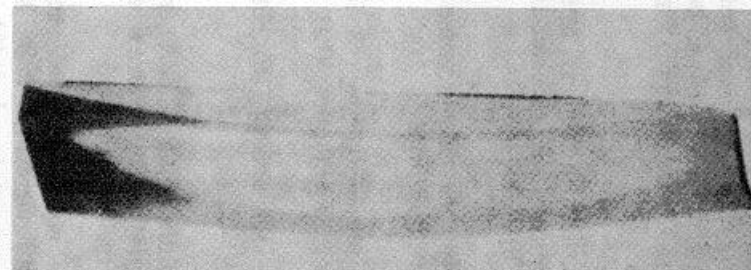
Unacceptable

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Figure 6-49. Roller bearing wear patterns (typical)



Desired wear pattern on pinion
View A



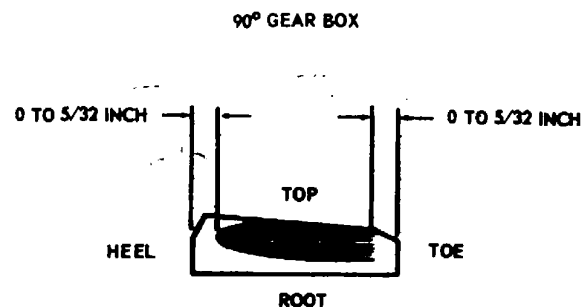
Desired wear pattern on gear
View B

NOTES

1. **Wear Pattern Inspection:** Observe the visible gear contact wear pattern on the concave side of the pinion teeth and on the convex side of the gear teeth.
2. The desired wear pattern is shown in views A and B. A slight bright line at top of pattern on gear and in flank of pinion is permissible.

212040-64-1

Figure 6-50. Gear patterns - ninety degree gearbox (Sheet 1 of 4)



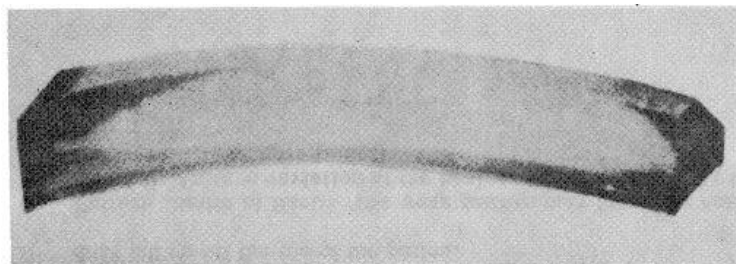
**Pattern tolerances at toe and heel on gear and pinion
View C**

NOTES

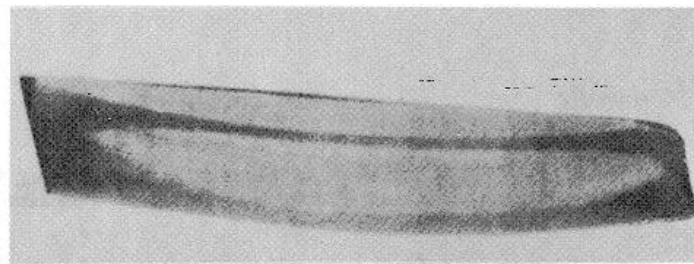
3. Acceptable wear patterns are shown in views D, E, F, G, H and I. View C is furnished to further define wear limits.
4. Pattern Limits at Toe: The wear pattern may touch the toe or may be a maximum of 5/32 inch from the toe (see views C, D, G and I). Pattern variation at the toe must not exceed 1/32 inch. Normally, the pattern will touch the toe on the pinion but will not touch the toe on the gear (see views D and E). It is permissible for the pattern to touch the toe on the gear if the pattern does not go off the toe of the pinion.
5. Pattern Limits at Heel: The wear pattern may touch the heel or may be a maximum of 5/32 inch from the heel. (See views C and I). Pattern variation at the heel must not exceed 1/32 inch. The heel positions shown in views A, B, D, E, F, G, H and I are within these limits.

212040-64-2

Figure 6-50. Gear patterns - ninety degree gearbox (Sheet 2 of 4)



Acceptable wear pattern on pinion
(touching toe)
View D



Acceptable wear pattern on gear
View E

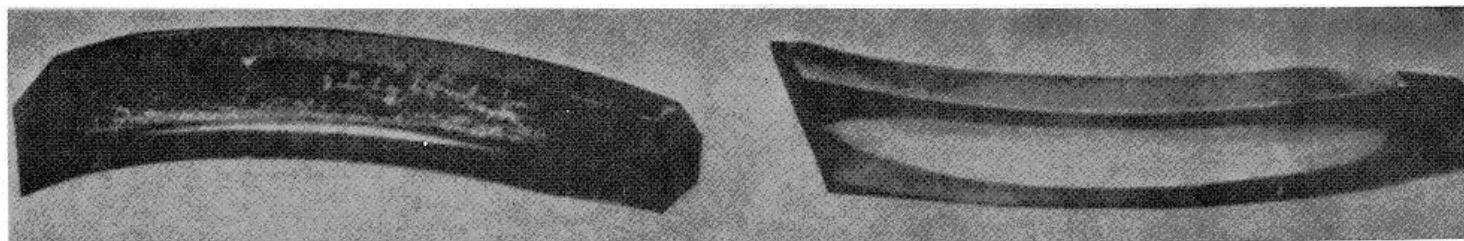
NOTES

6. **Pattern Profile:** The pattern must be positioned on the tooth in a profile direction such that the pattern extends over the top of the pinion and is 1/32 to 1/16 inch from the top of the gear (see views A, B, D, E, F, G, H and I). A pattern which does not extend over the top of the pinion or touches the top of the gear shall be rejected. A bright line occurring at the top of the pinion or in the flank of the gear is also cause for rejection.
7. **Unacceptable defects:** In addition to pattern size and location, examine the drive face of all gear teeth for the following defects which are not acceptable if they can be felt with a scribe having a 0.002 inch spherical point:

a. non clean up b. grinding scratches c. pitting d. corrosion e. cuts f. nicks g. dents	h. grinding flats or barber poling (evidenced by diagonal streaks in the wear pattern) i. scuffing j. scoring k. inclusions

212040-64-3

Figure 6-50. Gear patterns - ninety degree gearbox (Sheet 3 of 4)

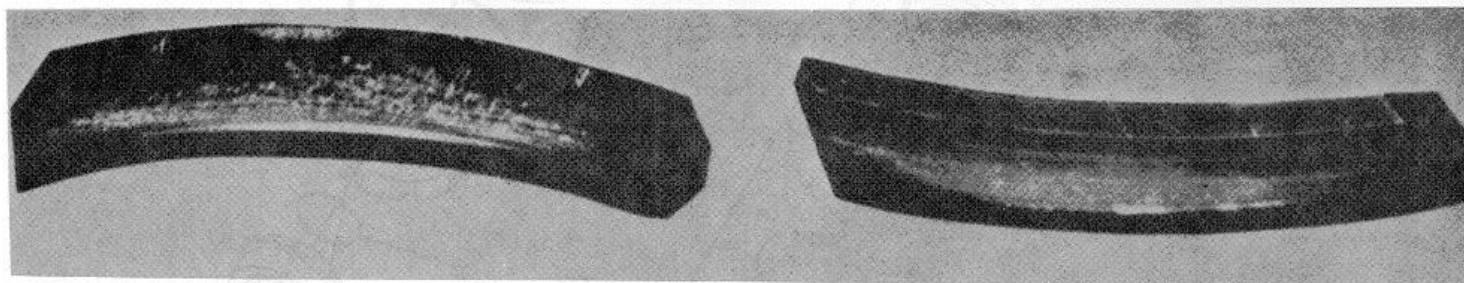


Acceptable wear pattern on pinion

View F

Acceptable wear pattern on gear
(5/32 inch from toe)

View G



Acceptable wear pattern on pinion

View H

Acceptable wear pattern on gear
(touching heel and 5/32 from toe)

View I

212040-64-4

Figure 6-50. Gear patterns - ninety degree gearbox (Sheet 4 of 4)

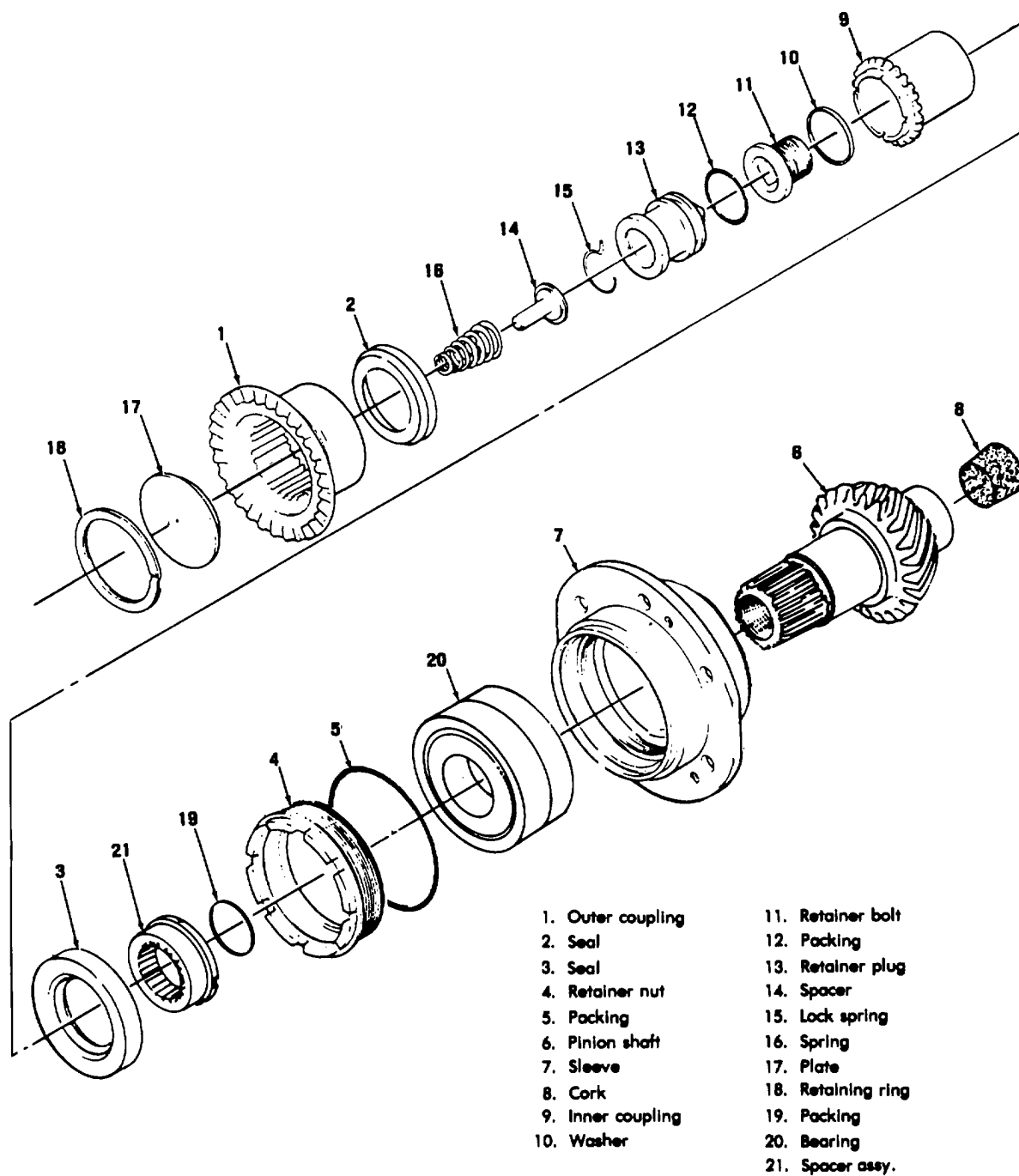


Figure 6-51. Tail Rotor Drive Gearbox Input Quill.

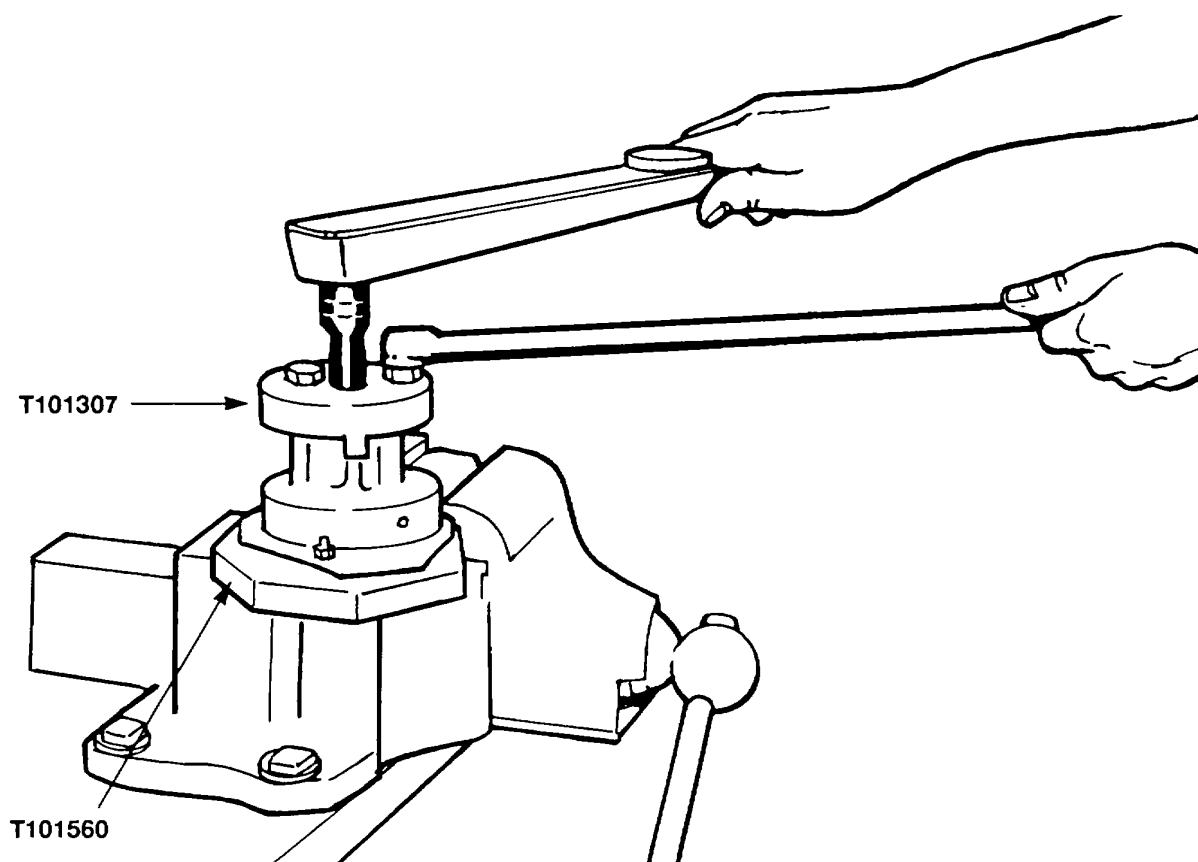


Figure 6-52. Tool application - retainer bolt removal and Installation

(7) Press seal (3) from retainer nut (4) and remove packing (5). Remove spacer assembly (21) from pinion shaft (6). Inspect packing (19) for damage. Replace packing (19) if damage is found.

WARNING

Use solvent (C124) in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

(8) Clean parts with solvent (C124) and dry with clean lint free cloths.

d. Inspection of Disassembled Input Quill.

(1) Inspect inner coupling (9, figure 6-51) for wear in the area contacted by seal (3). Measure the diameter

of the coupling in the worn area and in the adjacent unworn area. A maximum of **0.002** inch of wear is allowable if the diameter in the worn area is not less than **1.587** inch. The worn area must be free of nicks and dents that would affect function of seal (3). Wear limit on the wear sleeve on the spacer assembly (21) in the area contacted by seal (3) is 0.002 inch or a minimum shaft diameter of 1.430 inches. Check prior to installing a new seal (3). Corrosion damage up to 0.005 inch deep is acceptable in the area contacted by the seal if polished out to twice the depth of the corrosion and treated in accordance with general instructions. Lubricating oil must not leak past the seal after installation.

(2) Inspect driveshaft couplings per paragraph 6-29.1.

(3) Inspect retainer nut (4) for damaged threads.

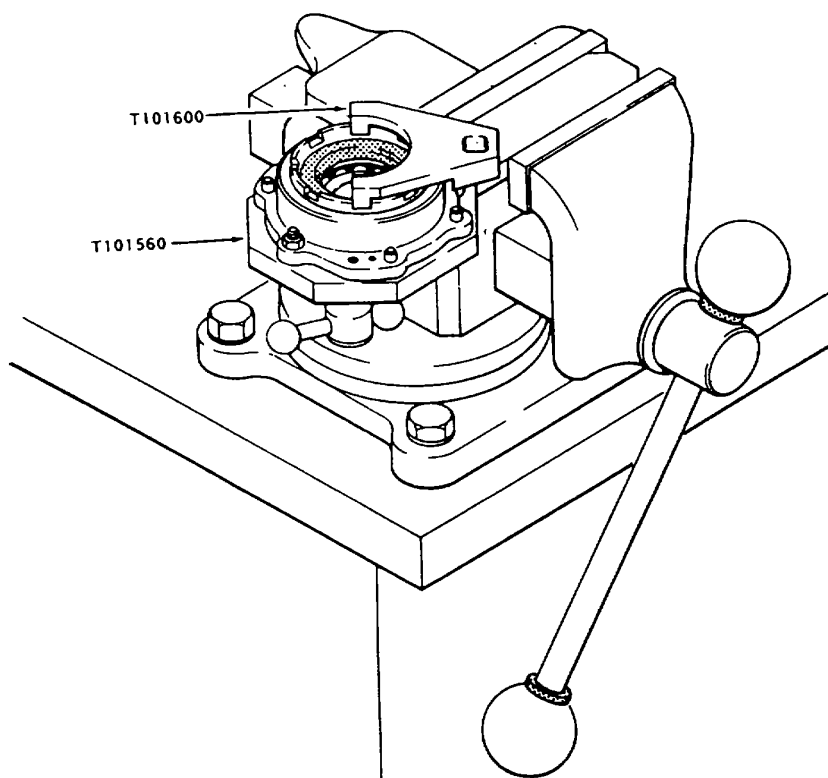


Figure 6-53. Tool application - retainer nut removal and Installation

(4) Inspect sleeve (7) for nicks, dents and scratches and for damaged threads for jack screws.

(5) Inspect retainer bolt (11) for damaged threads.

(6) Inspect washer (10), retainer plug (13), spacer (14), and plate (17) for nicks, dents and scratches that would affect function of parts after the damage was polished out. Nick/scratch damage within 0.030 inch of the seal area on plate (17) or within 0.030 inch of the packing groove in retainer plug (13) is not repairable by polishing out the damage.

(7) Inspect lock spring (15), retainer ring (18), and spring (16) for deformation or other damage which would affect function.

e. *Repair and Replacement.*

NOTE

Either input quill or output quill can be replaced with a new quill but it is not recommended. When one quill has defective gear teeth, other parts are usually affected. The best practice is to replace the entire gearbox.

(1) Replace seals (2 and 3, figure 6-51) and packings (5 and 12) when quill is assembled.

(2) Polish out raised metal on curvic coupling teeth on coupling (1, figure 6-51) when the raised metal is caused by dents, nicks or scratches. Use crocus cloth (C45) to remove the raised metal. Do not rework the internal teeth in the coupling.

(3) If the gearbox shows evidence of abnormal wear, forward the gearbox to depot.

(4) If roller bearing (18, figure 6-48) failed inspection in step b, forward gearbox to depot.

(f) Assembly.

(1) Install new packing (19, figure 6-51) on pinion shaft (6) if necessary, and install spacer assembly (21). Apply sealant (C119) to outside diameter of seal (3). Press seal (3) in nut (4) with the lip of seal facing inboard. Position packing (5) on nut (4). Lubricate packing, seal, and threads of nut with the type oil used in the gearbox (C93 or C94).

(2) Place holding plate (T39A) in a vise and secure quill sleeve in holding plate as shown in figure 6-53.

(3) Install nut (4, figure 6-51) in quill with wrench (T58), as shown in figure 6-53. Torque nut 100 TO 150 foot-pounds. Lockwire (C151) nut to sleeve. Apply a bead of sealer (C119) around mating joint of nut and sleeve.

(4) Use clean lint free cloths to remove any film of grease or cleaning solvent from inner and outer couplings (1 and 9, figure 6-51).

(5) Lubricate new seal (2) with grease (C68) and press into outer coupling (1) with lip of seal facing toward curvic coupling teeth on coupling. Coat teeth of inner coupling (9) with grease (C68) and install inner coupling in outer coupling. Hold the inner coupling against seal (2) and add grease (C68) to outer coupling to cover teeth to a depth of 0.120 inch.

(6) Install the couplings on pinion shaft (6, figure 6-51). Place washer (10) on retaining bolt (11) and thread into coupling as shown on figure 6-52. Torque retaining bolt **80 TO 100** foot-pounds with a square drive extension as illustrated.

(7) Position packing (12, figure 6-51) on retainer plug (13) and lubricate with small amount of grease from coupling. Install retainer plug and lock spring (15).

(8) Install spacer (14), spring (16), plate (17), and retaining ring (18).

g. Installation.

CAUTION

Exercise care during installation of quill to engage gear teeth and to keep quill aligned so that nose of pinion enters the roller bearing properly to avoid damage.

NOTE

Shims of correct thickness to give proper gear backlash are permanently attached with screws to quill sleeves and gearbox case.

(1) Heat gear case (5, figure 6-48) with a heat lamp. Lubricate new packing (4) and mating surfaces of quill and case with oil (C93) or (C94). Install packing on quill and install quill into case. Use care to engage bearing and gear teeth properly. Install spacers (2) and nuts (1). Torque nuts **100 TO 140** inch-pounds to hold input quill in place.

(2) Rotate quill by hand and check for free rotation and for a small amount of backlash clearance.

(3) Apply a bead of sealant (C116) around mating joint of quill and case, also fill three jackscrew holes.

6-29. Tail Rotor Gearbox-Output Quill.

Premaintenance requirements for tail rotor gearbox output quill.

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	(T24)
Test Equipment	None
Support Equipment	None
Minimum Personnel	Two
Required	
Consumable Materials	(C93) (C94) (C116)
Special Environmental	Dust Free
Conditions	

6-29.1 Inspection - Tall Rotor Driveshaft Coupling and Spherical Coupling

NOTE

Couplings must be disassembled from the tail rotor drive quill, hanger assembly, 42 degree gearbox, or the tail rotor gearbox before proceeding with inspection of the couplings.

a. Inspect coupling teeth for pitting and unusual wear patterns (figure 644).

b. Inspect coupling teeth for overheating. Refer to paragraph 6-26.c if overheating is suspected.

NOTE

Blackening of spline teeth and grease often occurs and is NOT a result of overheating. Overheating will be evidenced by heavy spline wear, the presence of many steel particles in the grease, and/or very heavy corrosion formation in the splines.

c. Inspect couplings for evidence of corrosion. Superficial corrosion (removable with abrasive pads (C01) is the only corrosion repair allowed).

d. Inspect external splines of spherical coupling for wear.

(1) Secure spherical coupling (1) figure 6-54A) in vise or other suitable fixture being careful not to damage the coupling. The seal (2) may remain installed on the coupling to aid in alignment of the coupling during inspection.

(2) Using the driveshaft coupling (3) as an inspection aid, slide the driveshaft coupling onto the spherical coupling and position as shown in figure 6-54B.

(3) Rotate the driveshaft coupling as shown in figure 6-54B to take out all of the play between the splines being careful to keep the couplings in line (avoid cocking the driveshaft coupling).

(4) Insert wire gage (table 1-4, item 93) between

the back side of the spherical coupling splines and the driveshaft coupling splines, approximately half way between the root and the top of the splines as shown in figure 6-54B. Record the size of the largest wire which can be inserted. Repeat this procedure in three locations, approximately 120 degrees apart.

(5) If the largest wire that can be inserted is greater than .027 inch, the spherical coupling is worn beyond limits and must be replaced.

e. Inspect internal splines of driveshaft coupling for wear.

NOTE

Inspection of the driveshaft coupling requires the use of a Spherical Coupling which has been inspected for wear per paragraph 6-29.1.a. To reduce inspection time, the use of one spherical coupling to inspect several driveshaft couplings is recommended.

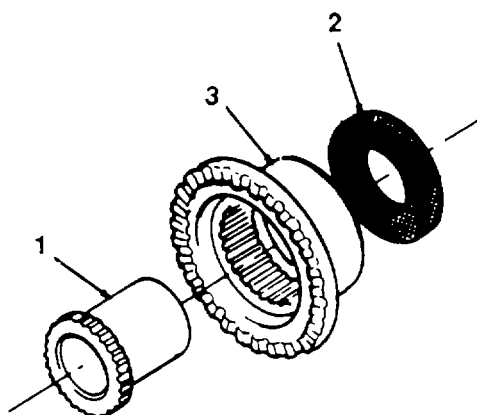
f. Retain the spherical coupling (1) in a fixture as directed in paragraph 6-29.1.d(1).

g. Slide the driveshaft coupling onto the spherical coupling so that the splines align in the most severe wear area as shown in figure 6-54B.

h. To determine the appropriate wire size to use for inspection of the driveshaft coupling, add .005 inches to the diameter of the largest wire identified in paragraph 6-29.1.d(5). As an example, if the largest wire diameter was .025 inches, adding .005 inches would result in .030 inches.

i. Rotate the driveshaft coupling in the drive direction being careful not to cock the coupling. Attempt to insert the appropriate wire gage (table 14, item 93) between the back side of the spherical coupling splines and the driveshaft coupling splines approximately halfway between the root and the top of the splines (figure 6-54C). Repeat this procedure at three locations approximately 120 degrees apart.

j. If the wire can be inserted at any one of the three locations, the driveshaft coupling is worn beyond limits and should be replaced.



- 1. SPHERICAL COUPLING
- 2. SEAL
- 3. DRIVESHAFT COUPLING

Figure 6-54A. Driveshaft/Spherical Couplings

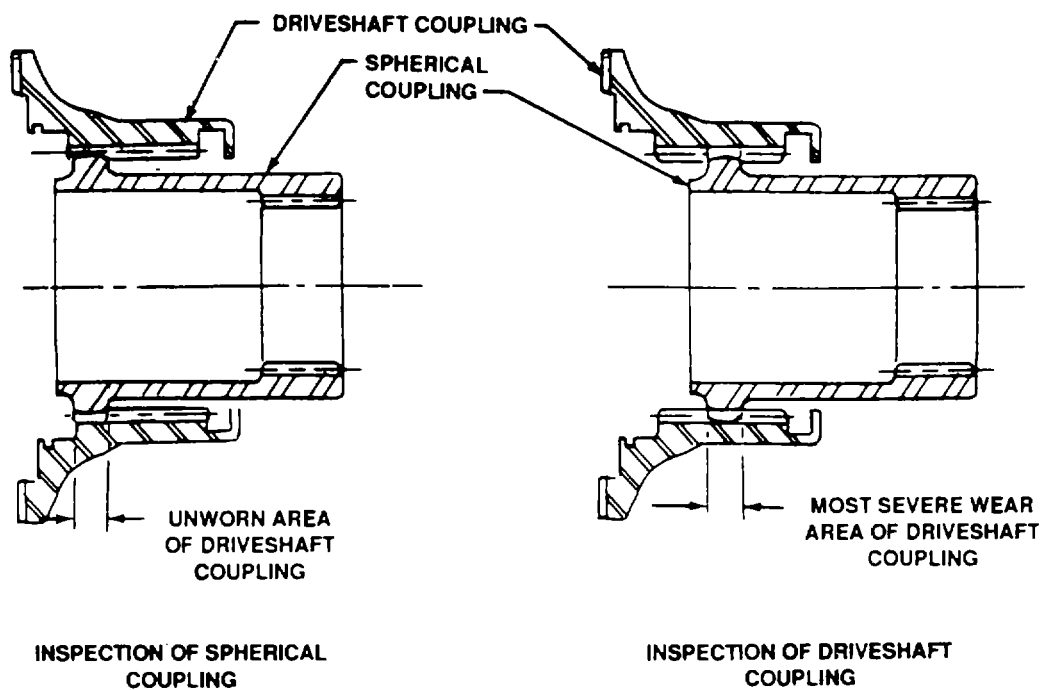
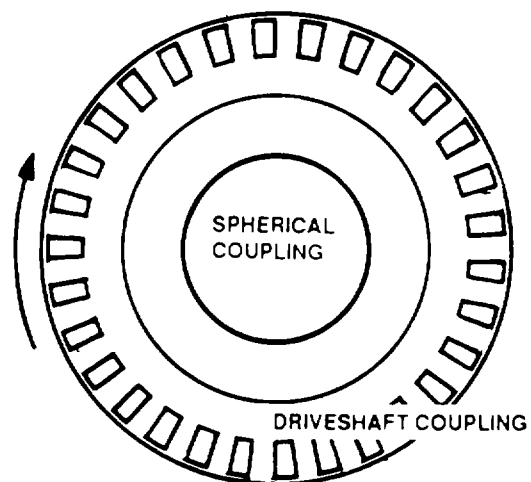


Figure 6-54B. Coupling Inspection (Sheet 1 of 2)

ROTATE DRIVESHAFT
COUPLING IN THIS
DIRECTION TO
INSPECT



DRIVESHAFT
COUPLING

INSERT GAGE IN THIS AREA

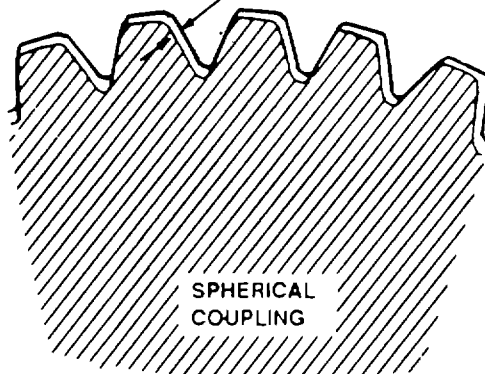


Figure 6-54C. Coupling Inspection (Sheet 2 of 2)

Section VIII. TRANSMISSION OIL SYSTEM

6-30. Transmission Oil System.

The transmission oil system is entirely separate from that of the engine. It includes a pump, an external and an internal filter, a pressure relief valve, an automatic emergency bypass valve, an oil cooler, and connecting lines. (See figure 6-55 and 6-56.) Oil is distributed within the transmission by a series of jets and internal passages. Oil pressure and temperature indications are provided by a thermobulb and a pressure transmitter. A thermoswitch and a pressure switch illuminate caution panels lettered XMSN OIL HOT and XMSN OIL PRESS to warn of abnormal conditions. Servicing and drain provisions are located on the right side of the transmission. Oil level sight gages on the sump case can be viewed through window in the right cowl door. Access through this same door is provided to the oil filter on the main case and to the oil filter screen, and chip detector on the sump case. A manual valve,

located beneath the sump, drains oil overboard through an outlet in the bottom of the fuselage. Access to this valve is through the access panel under the right wing.

6-31. Transmission Primary Oil Filter.

An internal oil filter (6, figure 6-6) is located in the upper right aft corner of the transmission sump case. The filter assembly consists of a stack of wafer-disc screens assembled with spacers on a perforated tube, attached on a body which incorporates two bypass valves to allow continued oil flow in the event screens become clogged. The filter is mounted into a sump case chamber with inlet and outlet through internal passages. A cast scupper on the sump case is located below the filter mounting pad and connected to the overboard oil drain line to dispose of any oil spilled when servicing filter.

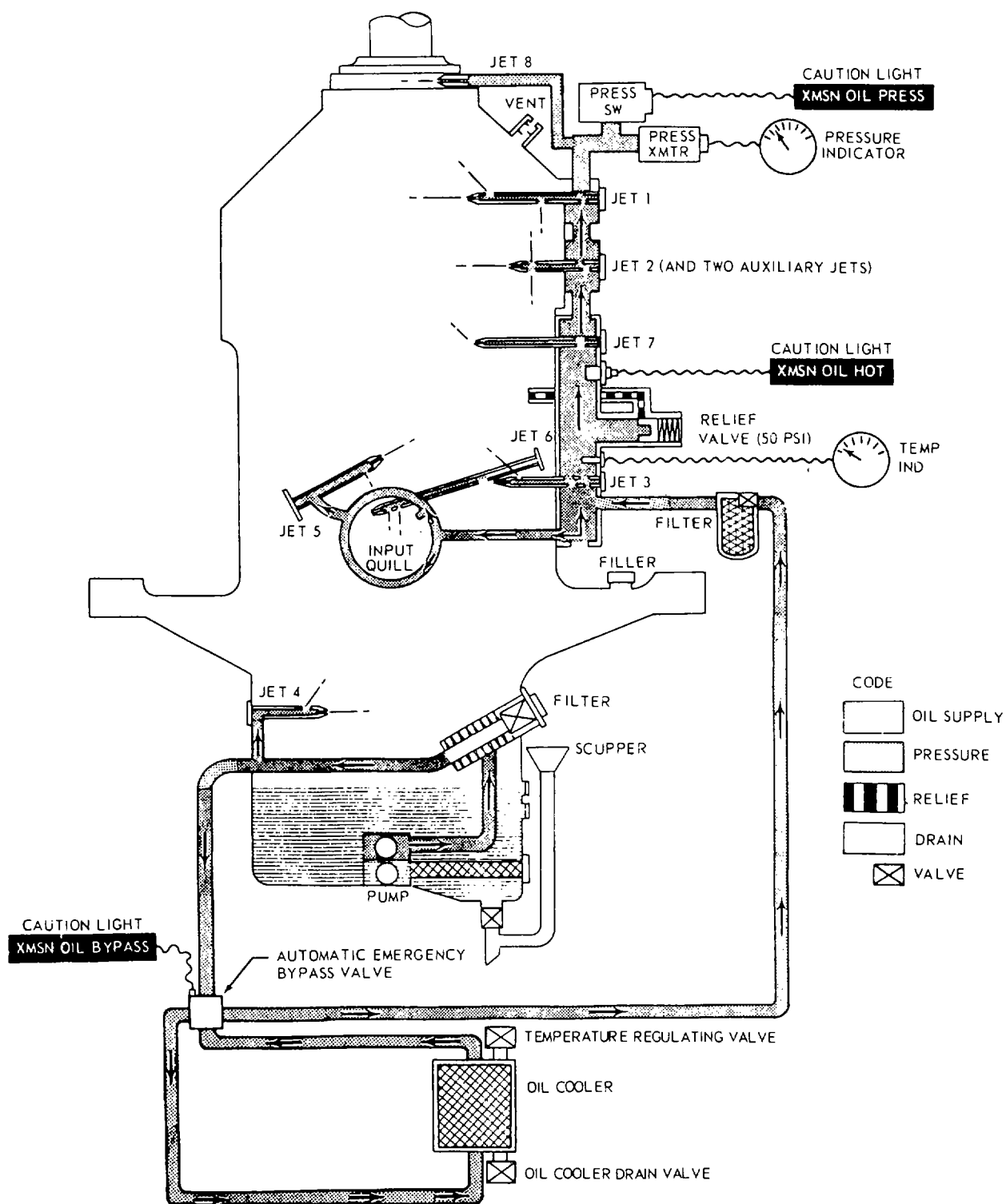


Figure 6-55. Transmission oil system schematic

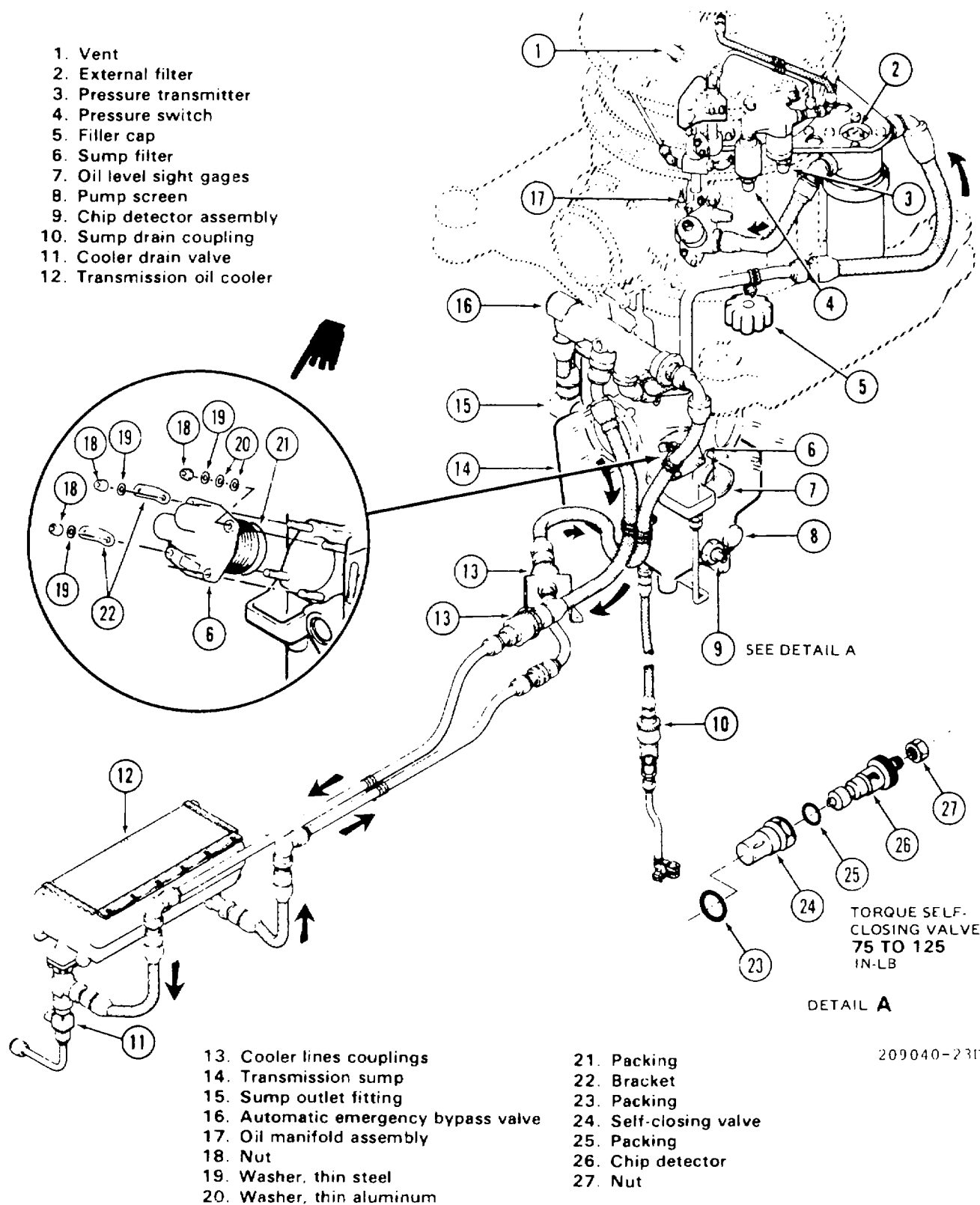


Figure 6-56. Transmission oil system install

a. *Removal.*

(1) Remove nuts (18, Figure 6-56), washers (19 and 20), and oil hose brackets (22) from four mounting studs at corners of filter body (6).

(2) Pull filter from sump case chamber. Allow excess oil to drain through scupper into suitable container placed under overboard drain outlet at left underside of fuselage.

a.1. *Inspection.*

(1) Inspect for metal particles or contamination which indicates damage to filter or transmission components. If any particles are found refer to paragraph 6-4.

(2) Visually inspect screens (2, figure 6-57) for damage.

b. *Cleaning Assembled Filter.*

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

(1) Plug or cap end of tube and wash filter in solvent (C124). Dry thoroughly with filtered compressed air. Use small, soft bristle brush to assist in cleaning.

(2) Remove plug or cap from end of tube prior to installation.

b.1. *Disassembly.*

(1) Disassemble only if required by one or more of the following:

(a) Screens require additional cleaning.

(b) Filter screens (2, figure 6-57) can be rotated on valve body by hand.

(c) Screens or other parts are distorted or damaged.

(2) Straighten tang on lockwasher (4) and remove nut (5) and lockwasher (4).

NOTE

Remove used tang from lockwasher (4) while disassembled for inspection.

(3) Remove spacers (3) and screens (2).

b.2. *Inspection Disassembled Filter.*

(1) Inspect spacers (3) for evidence of crushing. Required dimension (width) is **0.068 TO 0.062 inch**.

(2) Inspect filter screens (2) for evidence of crushing. Required dimension is a width of **0.115 TO 0.130** inch in area that contacts spacers.

(3) Ensure that inner surfaces of screens do not become contaminated before reassembly.

b.3. *Cleaning Disassembled Filter.*

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

(1) Wash filter screens (2) and spacers (3) in solvent (C124). Use a small soft bristle brush to assist in cleaning.

(2) Dry thoroughly with filtered compressed air.

b.4. *Assembly.*

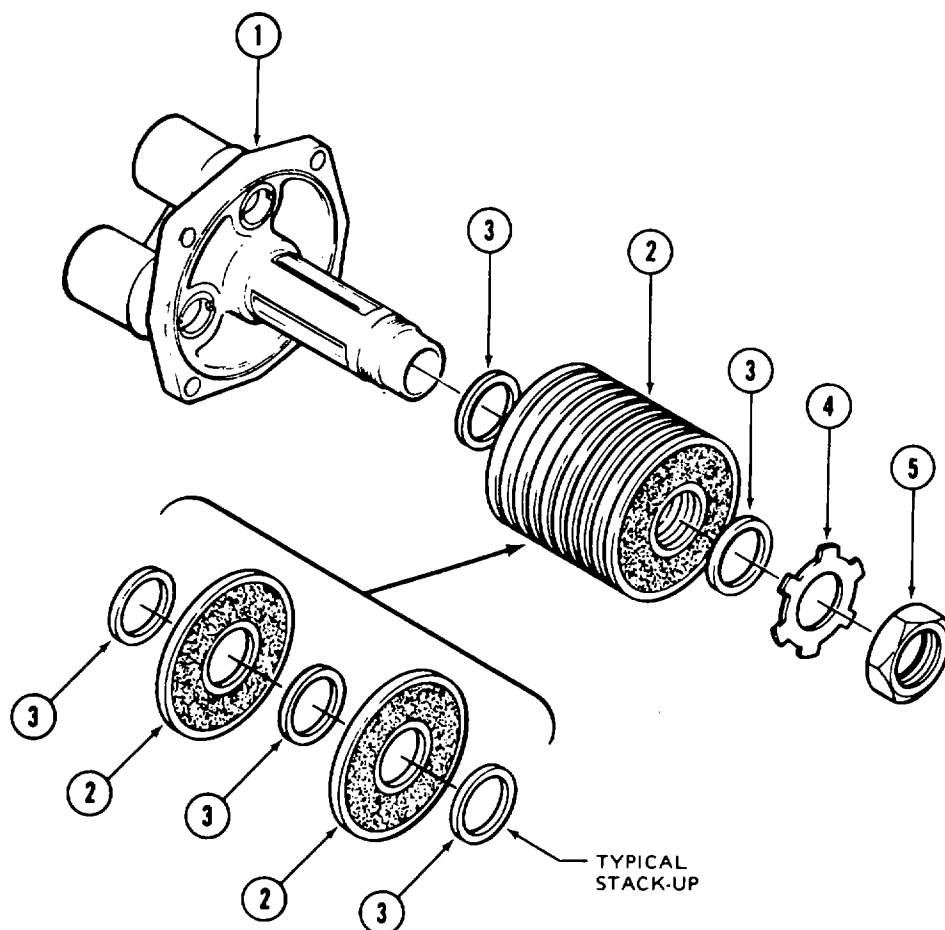
(1) Install eleven spacers (3) and ten screens (2) alternately as shown in figure 6-57 on valve body (1).

(2) Install lockwasher (4) and nut (5).

(3) Tighten nut (5) just enough to keep screens (2) from rotating freely; then tighten nut (5) an additional 1/4 turn.

(4) If nut (5) bottoms out on threaded portion of body (1), repeat steps b. 1. and b.2. Do not add spacers to compensate for crushed screens (2) or spacers (3).

(5) Bend tang of lockwasher (4) over a flat of nut (5).



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1. Valve Body, Oil Filter
2. Screen, (10 Req'd)
3. Spacer, (11 Req'd)
4. Lock Washer
5. Nut

Figure 6-57. Oil filter, transmission sump

c. Installation.

(1) Install new packing (21, figure 6-56) on filter (6).

(2) Insert filter into sump case, making sure one bypass valve is located at top. Place two oil hose brackets (22) on aft studs and two thin aluminum washers (20) on forward studs. Place thin steel washers (19) and nuts (18) on all four studs.

(3) Torque nuts (18) **50 TO 70** inch-pounds. Wait a minimum of 15 minutes, then check the torque on nuts (18) **50 TO 70** inch-pounds.

(4) Check transmission oil level, service as necessary (C93 or C94) (see Chapter 1).

NOTE

At next runup check for oil leaks.

6-32. Transmission External Oil Filter.

An external oil filter (2, figure 6-56) is installed in conjunction with the transmission oil cooler. This filter is bracket-mounted on the right side of the transmission main case and is connected to the external oil line between cooler and pressure relief valve manifold. The unit contains a pleated-paper type filter element, and incorporates a bypass valve set to open at 18 TO 22 psi to assure oil flow if filter element should become clogged. A visual indicator at top of filter will pop out when bypass occurs, but has a temperature lock-out device to prevent actuation below 50 degrees F (10 degrees C). If the visual indicator button pops out, run up helicopter and push button in. If button pops out again, replace filter element.

a. Removal.

(1) Open cowl door at right side of transmission.

(2) Remove filter element for inspection or replacement.

(a) Place suitable container below filter to catch trapped oil.

(b) Open V-band clamp.

(c) Remove filter body downward.

(d) Remove filter element.

(3) When necessary to remove filter head assembly or head and mounting bracket.

(a) Disconnect inlet hose and outlet tube from fittings of filter head, draining trapped oil into container. Cap open lines.

(b) Remove lockwire and four bolts with washers to detach filter head from bracket.

(c) If necessary to replace bracket, detach by removing four bolts with nuts and washers at flange of ring gear case.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing, of solvent vapors and contact with skin or eyes.

b. Cleaning. Clean filter body, and head assembly if removed, with solvent (C124). Dry thoroughly with filtered compressed air.

c. Inspection. Inspect mounting bracket for cracks or damage.

d. Repair or Replacement.

(1) Replace mounting bracket if cracked or damaged.

(2) Replace preformed packing.

e. Installation.

(1) Reinstall bracket and filter head, if removed.

(a) Attach bracket on ring gear case flange at right side by installing four bolts. Use thin aluminum alloy washer next to main case flange on each bolt, and thin steel washers under bolt head, between bracket and case, and next to nut.

(b) Position filter head under bracket, with outlet aft, and install four bolts with washers. Lockwire heads in pairs.

(c) Connect hose between coupling on right pylon support and inlet elbow on filter head. Connect tube between filter head outlet union and inlet elbow on pressure relief valve manifold.

(d) Manually reset bypass indicator.

(2) Install filter element and body.

(a) Install preformed packing on boss in bottom of filter body.

(b) Place filter element in body, seated firmly on boss.

(c) Install packing around upper lip of body, next to flange.

(d) Install packing around center boss in underside of filter head.

(e) Install body assembly into filter head, pressing upward to seat.

(f) Install V-band clamp around mating flanges of filter head and body. Torque clamp nut 50 inch-pounds.

6-33. Transmission Oil Manifold Assembly.

An oil manifold assembly (17, figure 6-56) on the right aft side of the transmission main case is provided with a relief valve to regulate system pressure, a thermobulb for oil temperature indicator and a thermoswitch for caution panel. An external line from sump delivers oil into manifold to be distributed through various outlets. The pressure relief valve, which is an adjustable spring-loaded type, allows some oil to bypass through a port on inner face of manifold into main case interior. An outlet at top of manifold delivers oil through an external tube to upper part of system. No. 3 oil jet is mounted through lower end of manifold. A tube on the outside of manifold delivers oil to input drive quill area. A second port on inner face of manifold delivers oil to internal passages leading to input drive quill bearings. Manifold also contains No. 7 oil jet which extends into the main case.

a. Inspection.

(1) Manifold for oil leaks.

(2) All parts for evidence of damage and faulty connections.

(3) Check during operation for oil system malfunctions due to faulty components on manifold. (Refer to troubleshooting chart, paragraph 6-2.)

b. Repair or Replacement.

(1) Replace gaskets or packings on thermoswitch, temperature bulb, pressure relief valve or inlet fitting as necessary to correct leaks.

(2) Replace thermoswitch if malfunction occurs. Apply not more than 12 inch-pounds torque on hexagon shoulder of switch body. When connecting electrical leads, use not more than 6 inch-pounds torque on terminal stud nut.

(3) Replace temperature bulb if malfunction occurs. Lockwire to adjacent bolt head on manifold and to relief valve.

(4) Deleted

c. Replacement and Repair.- Pressure Relief Valve.

(1) Remove lockwire and remove pressure relief valve.

NOTE

If pressure relief valve is repaired or replaced, transmission oil pressure must be checked and adjusted. Refer to step d.

(2) Repair pressure relief valve as follows:

(a) Remove retaining ring (5, figure 6-57A) from valve body (3).

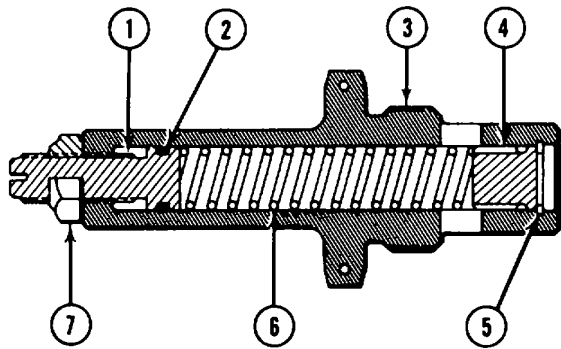
(b) Remove piston (4) and spring (6) from valve body. If there has been leakage at top of valve, also remove nut (7) and screw (1), replace packing (2), and reinstall screw and nut.

(c) Check valve body (3) and piston (4) for damage or obstruction.

(d) Install serviceable spring (6) and piston (4) in valve.

(e) Install retaining ring (5).

(3) Install pressure relief valve with new gasket. Lockwire (C150) valve to temperature bulb and thermoswitch. Check and adjust relief valve.



1. Screw
2. Packing
3. Body
4. Piston
5. Retaining ring
6. Spring
7. Nut

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Figure 6-57A. Transmission Oil Pressure Relief Valve

d. If pressure relief valve was replaced or repaired, adjust as follows:

- (1) Check transmission oil pressure on runup. Correct oil pressure is 50 +5 psi.
- (2) Loosen nut (7, figure 6-57A) while holding screw (1) at top of body (3).
- (3) Turn screw (1) in to increase, or out to decrease indicated oil pressure.
- (4) Tighten jam nut (7).
- (5) Recheck oil pressure in operation.

6-34. Transmission Oil Pump Screen.

The intake screen (8, figure 6-56) for transmission oil pump is a wire mesh cylinder attached to a threaded plug, externally accessible at a marked location on lower right of sump case.

a. Removal.

- (1) Drain oil by opening valve undersump.

(2) Remove lockwire from hexagonal plug head below cast legend "PUMP SCREEN". Remove screen assembly with gasket.

b. Inspection.

(1) Check for metallic particles or other material collected on pump screen as indication of oil contamination or internal failure of transmission. (Refer to paragraph 6-3.)

- (2) Screen for holes or other damage.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

c. *Cleaning.* Wash screen with solvent(C124). Dry with filtered compressed air.

d. *Repair or Replacement.* Replace screen if torn or damaged; replace gasket as required.

e. Installation.

- (1) Place new gasket on screen assembly next to plug head.
- (2) Insert screen in pump case. Torque plug head 300 TO 400 inch-pounds. Lockwire to adjacent sump plug.

6-35. Transmission Chip Detector.

The transmission is equipped with a chip detector (9, figure 6-56) located in the right side of the sump. It is wired to lights on the pilot and gunner panels and the pilot miscellaneous control panel. The lights are illuminated when metal particles are present insufficient quantity on the

detector element. The element is held in the sump plug by a bayonet type connector. Removal without loss of oil is made possible by a self-closing valve which seats when the detector is withdrawn.

a. Removal.

(1) Remove nut (27, figure 6-56). Disconnect the electrical lead from chip detector (26).

(2) Press chip detector (26) in, turn to left, and remove from self-closing valve (24).

(3) If self-closing valve (24) is defective, drain oil from transmission and remove self-closing valve.

b. Inspection.

(1) Check for accumulation of metal particles on magnet. Presence of metal may indicate need for further investigation and corrective action. (Refer to paragraph 6-3.)

(2) Seals for damage.

c. Installation.

(1) If self-closing valve (24, figure 6-56) was removed, install valve with new gasket (23). Torque self-closing valve (24) **75 TO 125** inch-pounds. Lockwire (C151) self-closing valve to sump.

(2) Insert chip detector (26) into self-closing valve, press in and turn to right to engage bayonet pins.

(3) Position electrical lead on chip detector (26) and secure with nut (27).

6-36. Transmission Oil Level Sight Gages.

Visual indication of oil level in transmission is provided by two transparent sight gages (7, figure 6-56) set into right side of sump case, backed by indicator discs with FULL and LOW markings.

a. Removal.

(1) Drain oil below gage level.

(2) Remove spiral retaining ring, sight glass, packings and indicator disk.

b. Inspection.

(1) Sight gage plastic plugs for oil stain internally, cracks, or excessive scratches.

(2) Retainers and packings for damage.

c. Repair or Replacement.

(1) Replace sight glass if badly oil stained, cracked, excessively scratched or if giving erroneous indication of proper oil level.

(2) Replace packings and retainers if damaged or distorted.

d. Installation.

(1) Insert correctly marked indicator disk in port, with indexing tab in notch of inner lip. Install new packing in groove around sight glass. Insert glass with flat side out. Install retaining ring.

(2) Fill sump with oil (C93 or C94). Check for leaks.

6-37. Transmission Oil Cooler.

A radiator type oil cooler (12, figure 6-56), with an internal bypass control valve, is connected into the transmission oil pressure external lines. The cooler is mounted beside the engine oil system cooler, under an opening in the engine compartment deck. The two coolers are bolted together and share the same cooling air flow, but have no oil circulation between them. On some helicopters, the cooler can be drained by removing plugs from inlet and outlet fittings. On some helicopters, the inlet fitting is equipped with a manual drain valve and overboard drain line.

CAUTION

Use back-up wrenches when removing and installing oil cooler drain fittings, valves and lines.

a. Removal.

(1) Remove oil cooler duct on left side of fuselage below engine combustion section.

(2) Drain oil from both coolers.

(3) Disconnect hoses from both oil coolers. Cover open fittings and hose ends.

(4) If so equipped, remove bleed air-driven turbine fan and duct. (Refer to Chapter 4.)

(5) Remove all retaining bolts and lower cooler assembly out of compartment.

(6) Remove bolts and separate transmission cooler from engine cooler.

(7) If cooler is being replaced, remove inlet and outlet fittings for use on replacement assembly.

b. Cleaning Clean air passages of cooler core at specified Inspection Intervals or as often as operating conditions require.

c. Cleaning - Oil Cooler (AVIM) Reference Figure 6-5 7B

CAUTION

When using steam and compressed air, be careful not to damage air fins by high pressures

(1) Steam clean the exterior surfaces and corrugated air fins of each core. Remove obstructions from air fins with a pick and compressed air.

(2) Prepare oil cooler for internal cleaning as follows:

(a) Remove lockwire and unscrew oil cooler bypass valve body from valve housing in cooler.

(b) Press a rubber plug into the bypass opening in the valve housing.

(c) Reinstall temperature regulating valve into valve housing so valve body bears up against the rubber plug.

(3) Connect oil cooler in line with cleaning equipment in reverse of normal flow for first flush.

NOTE

Centrifugal pump in cleaning equipment must be capable of supplying fluid at approximately 40 gpm while maintaining pressure of 75 psi.

(4) To remove oil and loose sludge and to reduce contamination of cleaning solutions during following operations, pre-clean cooler interior as follows:

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

(a) Flush core, in reverse direction, with solvent (C112) for 30 minutes or until solvent appears clean.

(b) Reverse lines to cooler and flush core in direction of normal flow for approximately **15** minutes.

(c) Remove oil cooler from cleaning equipment and drain all fluid from cooler.

(5) Remove dirt, carbon deposits, oil gum, lead deposits, and other contaminants by connecting oil cooler to cleaning equipment. Use cleaning compound (43).

(a) Flush core **30 TO 60** minutes in direction opposite to normal flow.

(b) Reverse lines and flush core in normal direction for **15** minutes.

(c) Remove plug installed in bypass opening of valve housing and insert plug in cooling section opening. Reinstall temperature regulating valve.

(d) Flush oil cooler in normal direction for 15 minutes to clean bypass passage.

(e) Remove plug from cooling section opening in valve housing and install into bypass opening. Reinstall temperature regulating valve.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

(6) Connect oil cooler to cleaning equipment containing cleaning compound (C35). Install 100- mesh screen at inlet and outlet ports of oil cooler.

(a) Flush core for 10 minutes in each direction.

(b) Check 100-mesh screens between each flush.

(c) If screens are not clear, reflush core for 5 minutes in each direction, repeat until screens are clear.

(7) Remove rubber plug from bypass valve housing in oil cooler.

d. Inspection.

(1) Fittings for damage.

(2) Core and body for evidence of oil leakage.

(3) Core externally for clogged air passages and cleanliness.

(4) Inspect temperature regulating valve and valve housing for stripped threads and distortion, scoring, or wear of the seal surfaces. Check functioning of bypass control valve as follows:

(a) Submerge valve in water heated to 150 to 155 degrees F (66 to 68 degrees C) for five minutes. Valve should open.

(b) Remove valve from water and measure length and record.

(c) Submerge valve in water heated to 176 to 180 degrees F (80 to 82 degrees C) for five minutes. Valve should open.

(d) Remove valve from water and measure length. Minimum acceptable increase in valve length from dimension recorded in step (2) is 0.090 inch.

(e) If valve fails inspection, replace.

e. Repair or Replacement.

(1) Replace cooler if damaged or leaking.

(2) Replace damaged fittings.

WARNING

If transmission internal failure has occurred, replace cooler and bypass valve and thoroughly flush all connecting lines and fittings with solvent (C124). Dry with filtered compressed air.

f. Installation.

(1) If replacing cooler, install inlet and outlet fittings with new gaskets.

(2) Bolt the transmission oil cooler to the engine oil cooler.

(3) Lift the assembly into position on the supports and hold in place with suitable clamps. Install retaining bolts.

(4) Install turbine fan and duct. (Refer to Chapter 4.)

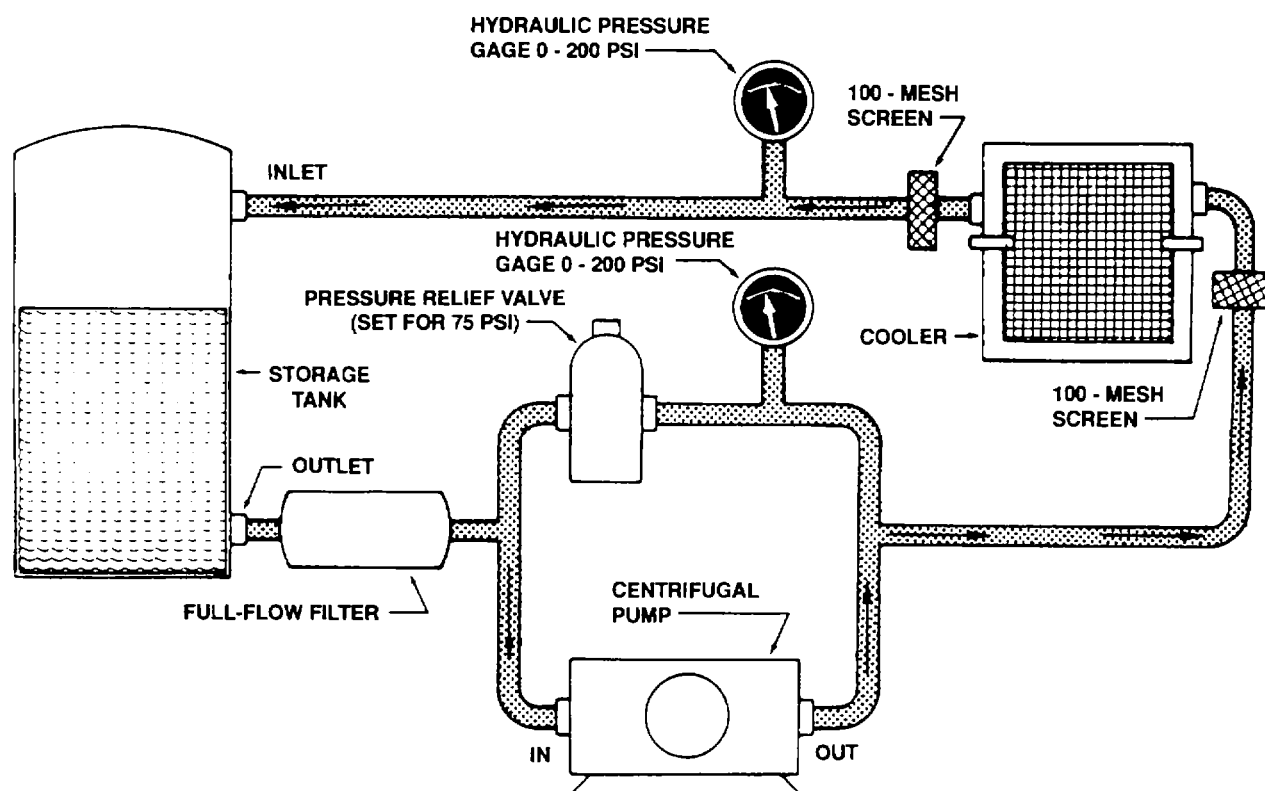
CAUTION

Check proper fit of flared ends of tubing to valves and fittings. Do not allow preloading or stresses due to misalignment or improper fit.

(5) Connect hoses and drain lines or install drain plugs.

(6) Install oil cooling duct on left side of fuselage compartment.

(7) During first run-up after installing cooler, carefully observe transmission and engine instruments. Check oil cooler installation for leaks. After a brief period of running, add oil (C93) or (C94) to transmission and engine oil tank as oil level will have lowered by the filling of empty lines and cooler.



NOTES

1. First flush to be in direction opposite to normal oil flow.
2. Arrows show normal flow.

Figure 6-57B. Oil Cooler Cleaning Schematic

6-38. Transmission Oil Emergency Bypass Valve.

The bypass valve (16, figure 6-56) is located on the aft side of the transmission below the power input quill. The valve protects the transmission against total loss of oil if a leak occurs in the oil cooler and its connecting lines, by isolating the cooler circuit from the oil system proper. It consists of a body enclosing nozzles, piston assemblies, a compensating spring and a warning switch. Passageways within the valve provide for normal and bypass flow of transmission oil. The warning switch illuminates a light on the pilots caution panel when the valve shifts into the bypass position. No field adjustments may be made.

Pre-Maintenance Requirements for Transmission Oil Emergency Bypass Valve

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	(T52) (T53) (T54) (T55)

Pre-Maintenance Requirements for
Transmission Oil Emergency Bypass Valve
(Cont)

Conditions	Requirements
Test Equipment	Test Stand
Support Equipment	None
Minimum Personnel Required	Two
Consumable Materials	(C87) (C93) (C102) (C112) (C116)(C124)
Special Environment Conditions	Dust Free

a. Removal.

(1) Disconnect electrical lead from terminal at right lower side of valve (16, figure 6-56).

(2) Disconnect outlet tube and three oil hoses from fittings on valve. Cap fittings and open ends of tube and hoses.

CAUTION

When disconnecting hose from right end of valve, do not allow nut on fitting to turn while loosening flare nut of hose elbow. Any turning of valve fitting nut will destroy calibration of valve.

(3) Remove three nuts which secure bottom of valve mounting bracket on transmission case studs.

NOTE

In steps (3) and (4), two electrical cable brackets will be detached but remain on wiring.

(4) Remove two bolts to detach top of valve bracket from upper bracket which remains attached on input drive quill studs.

(5) Remove valve and bracket assembly.

(6) Detach valve from bracket by removing lockwire, four bolts and washers.

b. Disassembly (AVIM).

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone (C87). Avoid breathing solvent vapors and avoid prolonged contact with skin.

(1) Soak "return end" of oil cooler bypass valve assembly P/N 204-040-816-3, in methyl-ethyl-ketone (C87) for one hour, then remove sealant. See figure 6-58.

NOTE

Be careful not to damage valve components while removing sealant. Sealant not used on P/N 204-040816-1 bypass valve assembly.

(2) Clamp fixture (T52) in vise with drilled surface in horizontal position. Attach oil cooler valve assembly to the tool with four bolts (AN4-5A) or equivalent.

(3) Cut and remove lockwire from fitting (27, figure 6-58), nut (10), and switch (1).

(4) Remove union (5).

(5) Loosen checknut on elbow fitting (2), loosen adapter (4), and remove fitting.

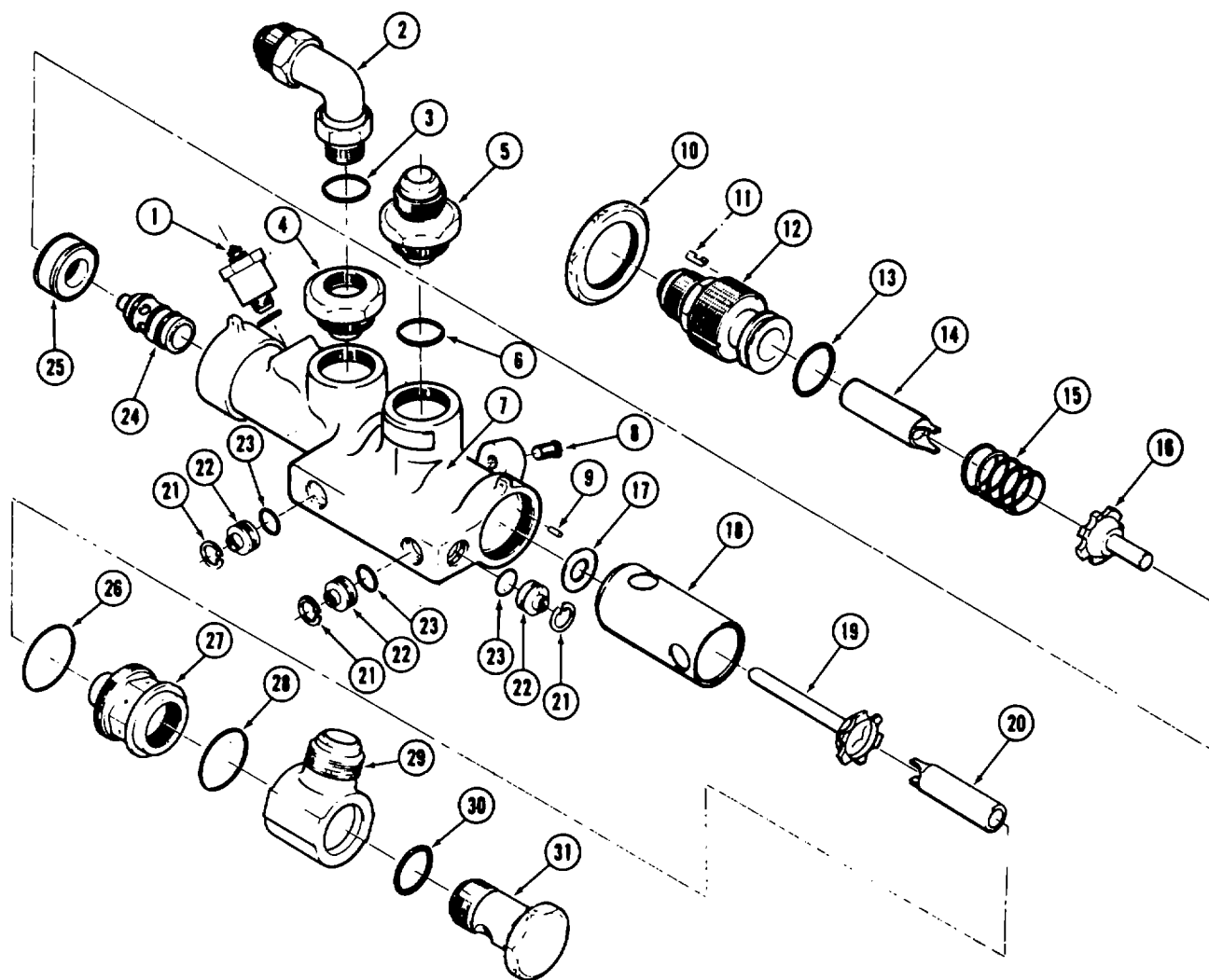
(6) Remove switch (1).

(7) Remove nut (10), key (11), bolt (31), and elbow (29). Discard bolt (31), P/N 204-40-830-1, if used in assembly.

CAUTION

Use extreme care in disassembly of remaining valve parts to avoid nicking or scratching. Package each part individually to avoid damage while handling.

(8) Remove fitting (27).



1. Switch	9. Pin	18. Sleeve	25. Seat
2. Fitting and Checknut	10. Nut	19. Piston	26. Packing
3. Packing	11. Key	20. Nozzle	27. Inlet Fitting
4. Adapter	12. Fitting	21. Retaining Ring	28. Packing
5. Union	13. Packing	22. Plug	29. Elbow
6. Packing	14. Nozzle	23. Packing	30. Packing
7. Valve Housing	15. Spring	24. Plunger and Retaining Ring	31. Bolt
8. Rosan Insert (Typical 4 places)	16. Piston		
	17. Washer		

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Figure 6-58. Oil cooler bypass valve assembly

NOTE

Nozzle (20) will come out with the fitting; therefore, hold threaded end of fitting upward after removal to prevent dropping nozzle.

(9) Remove nozzle (20) from fitting (27).

(10) Insert end of finger into open end of valve assembly and gently remove sleeve (18) and piston (19) from valve assembly.

(11) Remove piston (19) from sleeve (18), being very careful not to bend or scratch the piston stem.

(12) Remove and discard washer (17) from sleeve (18).

(13) Loosen nut(10)and remove nut and key (11) from fitting (12). Remove fitting (12) and nozzle (14) from valve housing (7).

NOTE

Be careful not to drop nozzle when removing fitting because nozzle comes out with the fitting.

(14) Remove nozzle (14) from fitting (12).

(15) Remove spring (15) from valve housing (17).

(16) Remove piston (16) from valve housing (7) as follows:

(a) Insert finger into end of valve housing (7) from which fitting (12) was removed, and push piston (19) as far as possible toward opposite end of housing.

(b) Pull three plugs (22) and packings (23) from valve housing (7) by use of puller (T54), after removing retaining rings (21).

(c) Insert tool (T53) into transfeed port and separate plunger (24).

(d) Remove plunger (24) from housing (7).

NOTE

Plunger (24) and housing (7) are match fitted and are either discarded or reused as a unit.

(17) Remove temporary cloth plug from end of valve housing (7), and remove plunger by inserting finger into open end of plunger (24) and slowly pulling plunger from valve housing.

(18) Remove and discard all packings from valve components.

c. *Cleaning (A VIM).*

WARNING

Use solvent (C124) in a well ventilated area. Avoid prolonged breathing of vapors and do not use in area with open flame or high temperature.

(1) Clean oil cooler bypass valve as follows:

(a) Clean detail parts (27, 12,19, 18,20,14, 15, 18, and 14, figure 6-58) individually with 3solvent (C124).

CAUTION

Wash and clean each of the above items carefully and individually to prevent nicking, scratching, or other damage to the parts.

(b) Plug all ports and holes in oil cooler bypass housing (7) to prevent entrance of any liquid into internal areas of valve housing.

WARNING

Provide adequate ventilation when using methyl-ethyl-ketone. Avoid breathing solvent vapors and avoid prolonged contact with skin.

(c) Remove paint from exterior portion of oil cooler bypass housing (7) by use of methyl-ethyl-ketone (C87) and a suitable brush.

(d) Dry detail parts of oil cooler bypass valve assembly by use of low pressure, filtered air, or by placing parts on dry clean cloth in such manner that no part will contact any other part of the assembly.

d. Inspection (A VIM).

(1) Inspect all threaded parts of oil cooler bypass valve for torn, crossed, or otherwise damaged threads. See figure 6-58.

(2) Inspect all metal detail parts of oil cooler bypass valve assembly for nicks, scratches, surface finishes and all other limits as shown and designated in figures 6-59 through 6-68.

NOTE

Housing assembly and plunger (7 and 24, figure 6-58) are mated parts and are used, or discarded, as a unit.

e. Repair or Replacement (A VIM).

(1) Discard all used packings (3, 6, 13, 23, 26, 28 and 30, figure 6-58), and replace with new ones on assembly.

(2) Do not attempt repairs on the following parts (1, 2, 4, 5, 9, 10, 11, 15, 16, 17, 18, 19, 21, 22, 25, 29, and 31). Do not attempt to rework nicks or scratches within tolerance as indicated in figures 6-59 through 6-8. Replace any of the above items having nicks, corrosion or finish scratches, not within inspection limits and tolerances.

(3) Replace fittings (12 or 27, figure 6-58) if threads are damaged.

(4) Repair fittings (12 or 27) by using a fine, round india stone (C128) to break sharp edges, and remove other damage, to the tolerances shown in figure 6-69. Replace fittings if damage exceeds the allowable limits in accordance with figures 6-9 or 6-0.

(5) Repair nozzles (14 and 20, figure 6-58) as follows:

(a) Use a fine, round india stone (C128) I and break the outside sharp edge within 0.002 TO 0.006 inch limit as shown in figure 6-70.

(b) Remove nicks and scratches on nozzles (14 and 20, figure 6-58) to depth and width illustrated in figure 6-70.

(c) Replace nozzles if inspection limits of figure 663 are exceeded.

(6) Rework plunger (24, figure 6-58) as follows:

CAUTION

Use extreme care mounting plunger in collet, to prevent damage to the plunger.

(a) Chuck or mount plunger (3, figure 6-71) in a suitable resilient chuck, and with O.D. of plunger true within 0.0005, machine the retention ring (1, figure 6-71) 0.648 TO 0.660 inch diameter for width of 0.166 TO 0.178 inch.

(b) Split and remove the remainder of retention ring (1) from plunger with suitable sharp pointed tool; use care not to nick or scratch the plunger.

(c) Remove and discard packing (2).

(d) Clean plunger (3) with solvent (C124) and coat with oil (C93).

(e) Lubricate new packing (2) with oil (C93) and install in groove of plunger.

(f) Heat new retention ring (1) 140 TO 170 degrees F (60 TO 77 degrees C) and lubricate retention ring I.D. with oil (C92).

(g) Position plunger (3) into holding fixture (T55) and press new retention ring (1) into place using tool (T55).

(h) Break sharp edges 0.002 TO 0.005 inch as shown on figure 6-71.

(i) Replace plunger if it fails to meet inspection requirements of figure 6-67.

(7) Repair housing (7, figure 6-58) as follows:

(a) Replace any broken thread inserts, rosans, in housing mount pads, to depth of 0.000 TO 0.010 below the surface, after coating the external insert threads with unreduced primer (C102).

(b) Remove nicks and scratches from exterior of housing (7) by filing, then polish with 320 grit sandpaper (C112).

CAUTION

Make certain that thickness of housing wall is at least 0.090 inch after rework.

(c) Do not attempt to remove all traces of nicks or scratches on ports or bosses on valve housing. Remove only the raised, disturbed metal.

(d) Replace housing and mating plunger if housing fails inspection requirements of figure 6- 66.

f. Assembly. (AVIM)

(1) Position holding fixture (T52) in vise. Attach valve housing to fixture in horizontal position with four bolts and nuts.

(2) Lubricate internal ports and passages of housing (7, figure 6-58) with oil, (C93).

NOTE

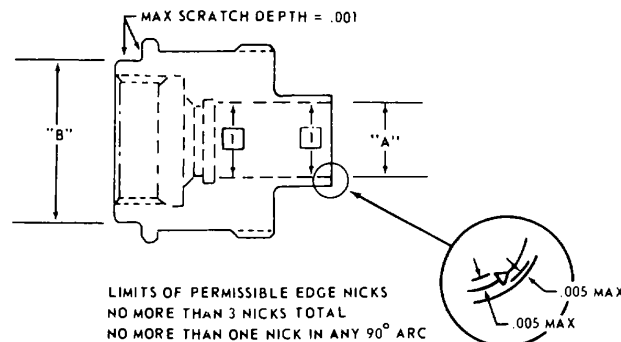
Make certain that plunger (24) and housing (7) carry same serial number. They are mated pairs and are to be used or discarded as a unit.

(3) Lubricate plunger (24) with oil (C93). Place plunger on end of finger and insert plunger in housing (7).

(4) Attach plunger (24) to piston (16) by exerting pressure on outboard ends of wooden dowel pins held in contact with outboard ends of plunger and piston. See figure 6-72.

(5) Rotate housing (7, figure 658) end-for- end several times to check freedom of movement of plunger and piston.

209-040-819 FITTING



DIA "A"		
! MEASURE DIA WHERE INDICATED		
MIN	MAX	REPLACE
.6255	.6260	.6267
SURFACE FINISH		
	16	REPLACE AT 20
NICKS, SCRATCHES, CORROSION		
REPLACE FITTING IF SCRATCHES, NICKS, CORROSION VISIBLE		

DIA "B"		
MIN	MAX	REPLACE
1.313	1.315	1.312
SURFACE FINISH		
	32	15

209040-25

Figure 6-59. Damage limits - inlet fitting

NOTE

Plunger (24) and piston (16) assembly should slide the full length of their travel with no applied force other than their own weight. If plunger binds in its housing, check serial numbers of plunger and housing for mating. Also inspect for nicks, scratches and foreign particles.

(6) Lubricate a new washer (17), with oil (C92) and install in groove at end of sleeve (18).

(7) Install sleeve (18) in inlet end of housing (7), with pin (9) at end of sleeve inserted into index hole in bottom of housing bore.

(8) Install piston (19) in sleeve (18) after first lubricating piston stem with oil (C93).

(9) Lubricate packing (26) with oil and install in housing (7) around end of sleeve (18).

(10) Lubricate nozzle (20) with oil (C93) and insert in end of fitting (27).

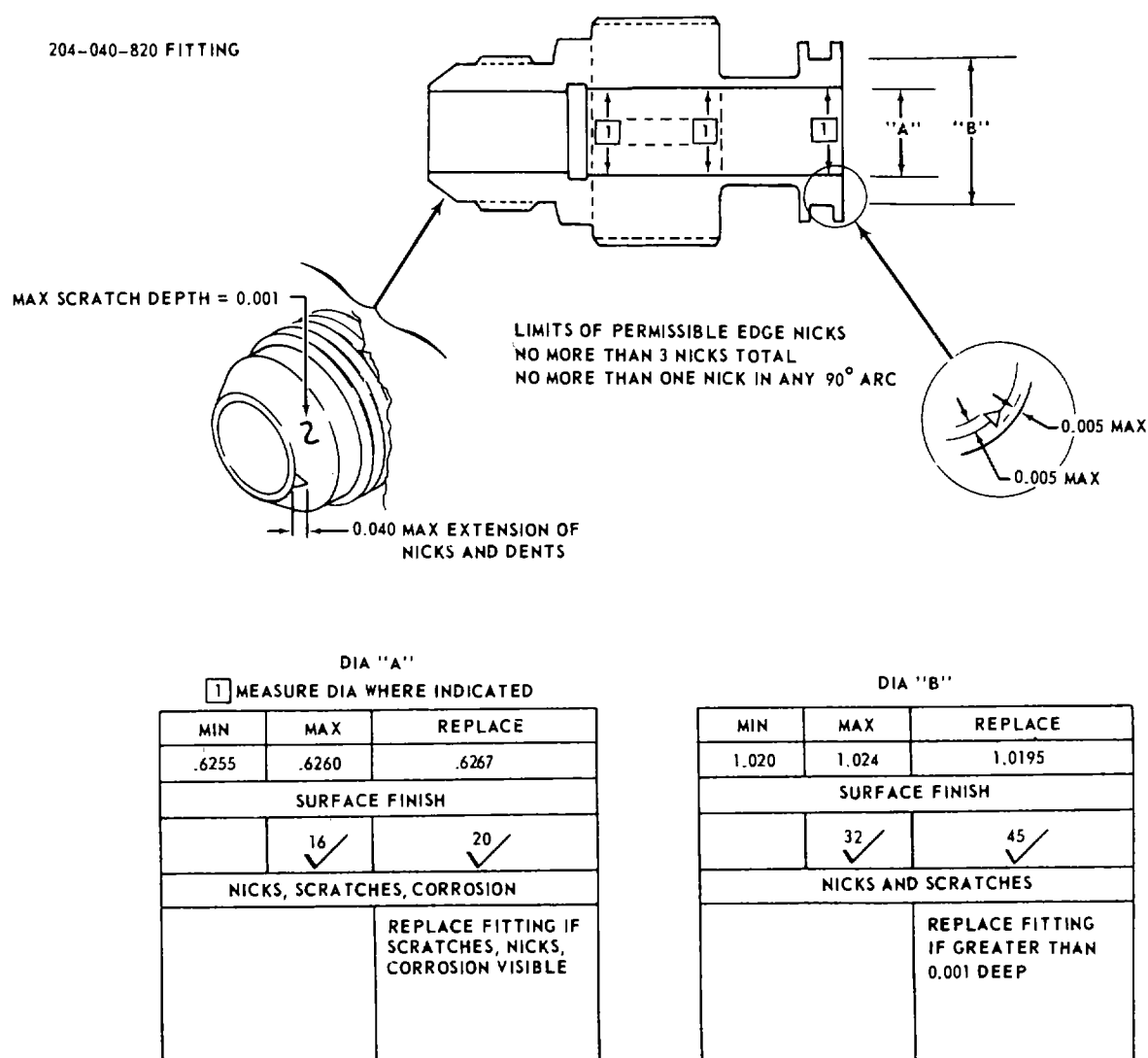


Figure 6-60. Damage limits - return bypass fitting

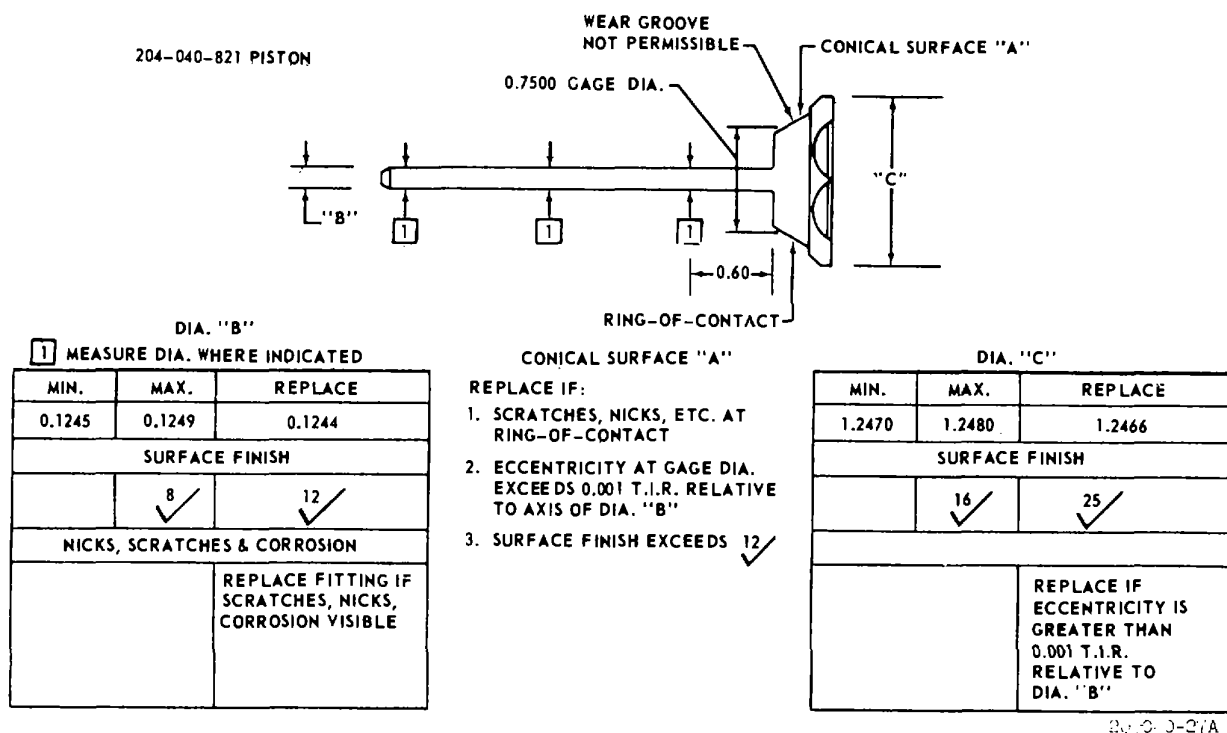


Figure 6-61. Damage limits - inlet bypass piston

204-040-822 PISTON

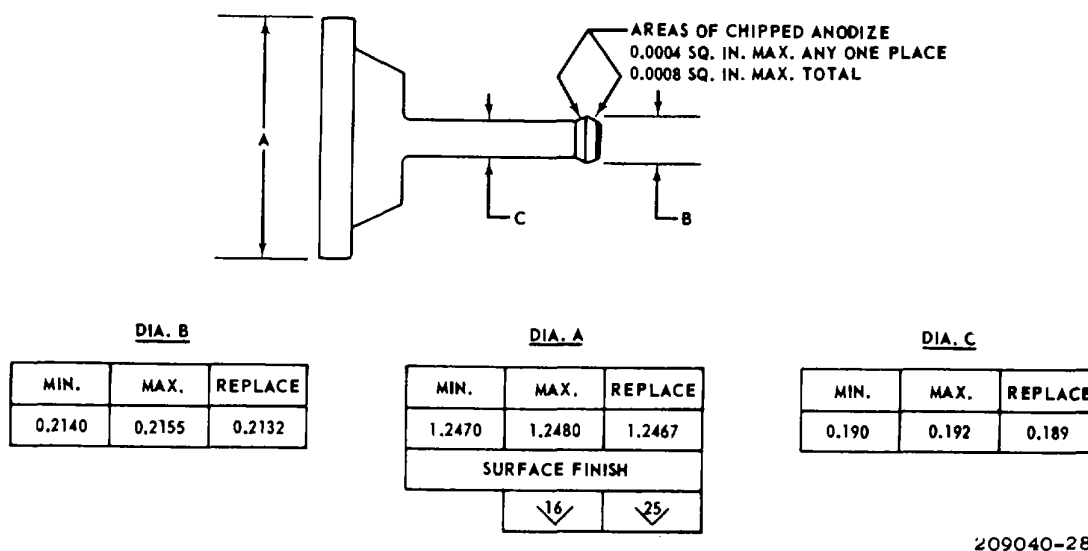
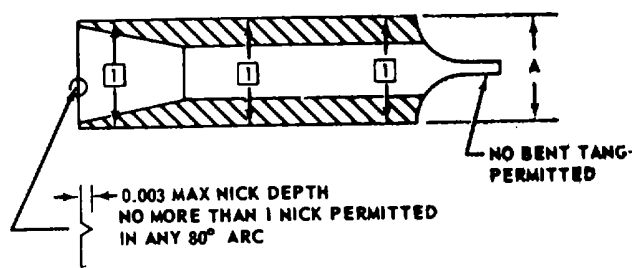


Figure 6-62. Damage limits - piston

204-040-823-1 & -3 NOZZLES

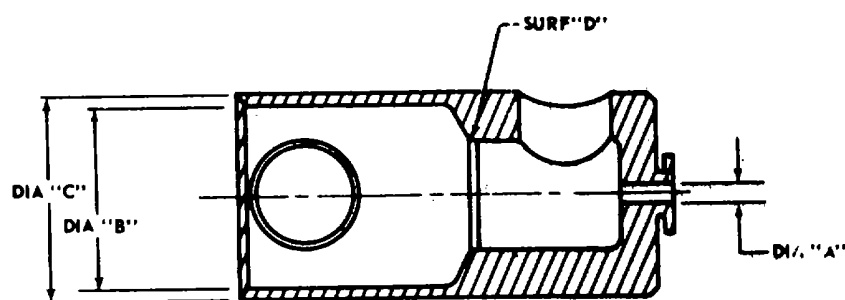
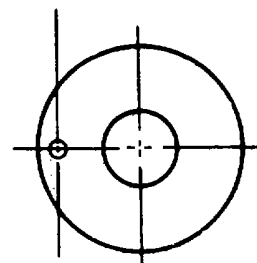


DIA. A
1 MEASURE DIA WHERE INDICATED

MIN.	MAX.	REPLACE
0.6247	0.6250	0.6240
SURF. FINISH		
	16	20
REPLACE FOR ANY VISIBLE EVIDENCE OF NICKS, SCRATCHES OR CORROSION.		

209040-34

Figure 6-63. Damage limits - nozzles



DIA A

MIN	MAX	REPLACE
0.1252	0.1255	0.1256
SURFACE FINISH		
	16	REPLACE IF 20
ECCENTRICITY		

REPLACE IF ECCENTRICITY EXCEEDS 0.001 T.I.R. RELATIVE TO DIA B

REPLACE FOR ANY VISIBLE EVIDENCE OF NICKS, SCRATCHES OR CORROSION

DIA B

MIN	MAX	REPLACE
1.2475	1.2500	1.2502
SURFACE FINISH		
	16	REPLACE IF 20

DIA C

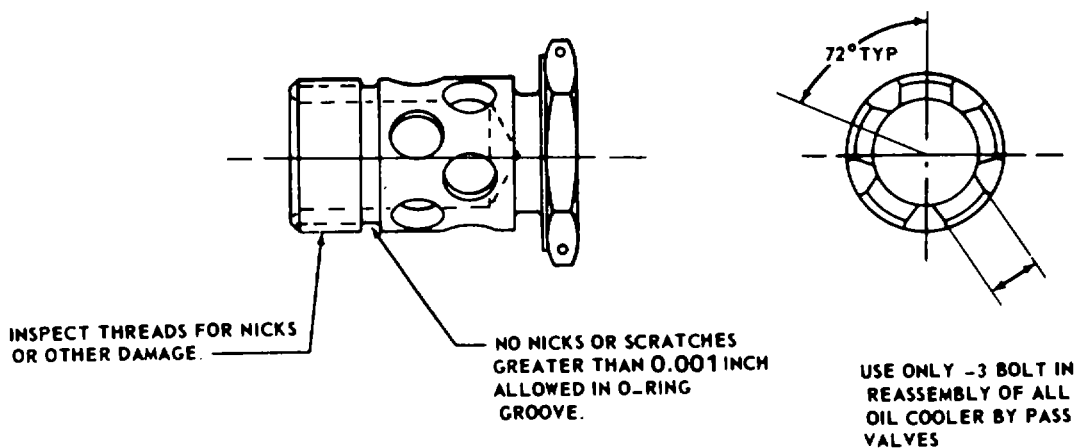
MIN	MAX	REPLACE
1.3742	1.3747	1.3741

SURF. 'D'

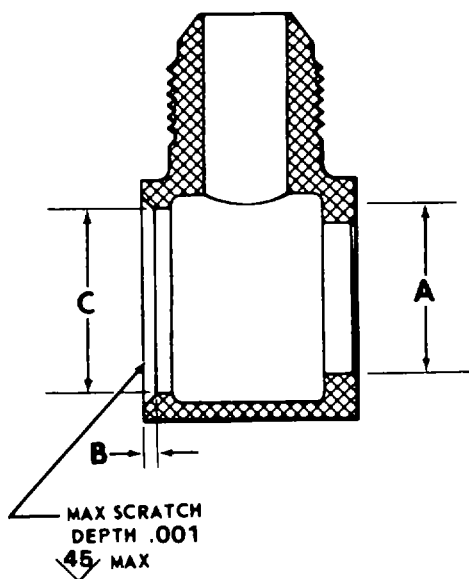
CONICAL SEAT MUST BE FREE OF ALL NICKS, SCRATCHES & CORROSION

209-090-826 SLEEVE

Figure 6-64. Damage limits - sleeve

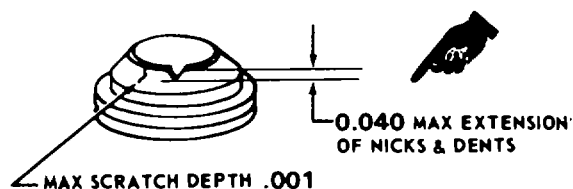


204-040-831 ELBOW



DIA C

MIN	MAX	REPLACE
1.316	1.317	1.318



DIA A

MIN	MAX	REPLACE
1.062	1.064	1.065
SURFACE FINISH		
	32	REPLACE AT 45

DIM B

MIN	MAX	REPLACE
.092	.097	.098

209040-29B

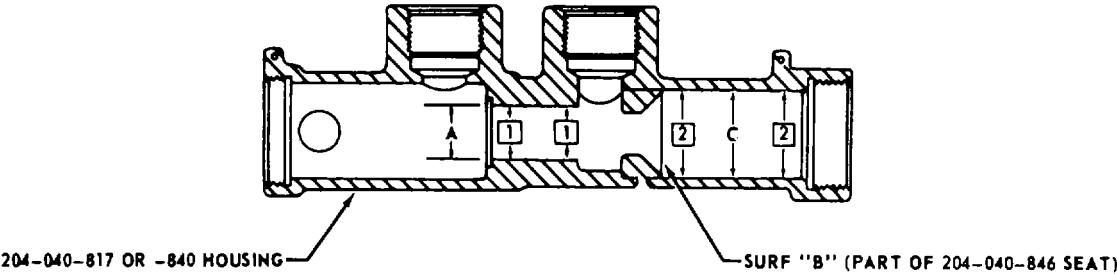
Figure 6-65. Damage limits - universal fitting bolt

204-040-833 HOUSING - PLUNGER ASSY

Note

Housing and mating -832 plunger are selectively fitted. Replacement of either housing or plunger necessitates replacement of the mating part.

HOUSING ASSY



INSPECT HOUSING BY FLUORESCENT PENETRANT INSPECTION IN ACCORDANCE WITH MIL-I-6866

DIA. A

1 MEASURE DIA. WHERE INDICATED

MIN.	MAX.	REPLACE
CLEARANCE BETWEEN THIS DIA. & DIA. "A" OF MATING 204-040-832 PLUNGER IS AS FOLLOWS		
0.00030	0.00045	0.00050
SCRATCHES, NICKS, & CORROSION		
REPLACE IF ANY VISIBLE EVIDENCE OF SCRATCHES, NICKS OR CORROSION		
SURFACE FINISH (-840 HOUSING)		
	MAX. $\sqrt{4}$	REPLACE IF $\sqrt{6}$
SURFACE FINISH (-817 HOUSING)		
	MAX $\sqrt{50}$	REPLACE IF $\sqrt{60}$

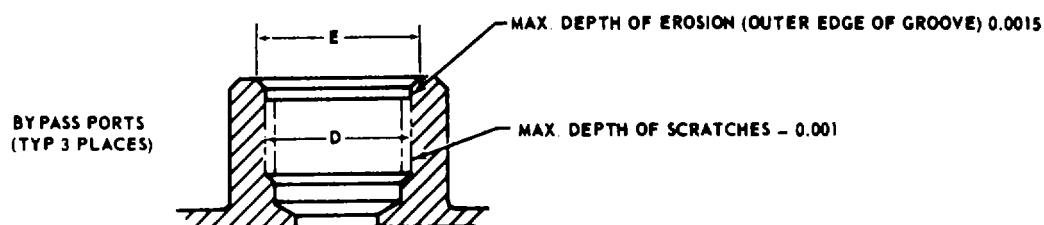
DIA. C

2 MEASURE DIA. WHERE INDICATED

MIN.	MAX.	REPLACE
1.2495	1.2500	1.2503
SCRATCHES, NICKS, & CORROSION		
REPLACE FOR ANY SIGN OF CORROSION. MAXIMUM DEPTH OF NICK OR SCRATCH - 0.0005 INCH.		
SURFACE FINISH (-840)		
	MAX. $\sqrt{16}$	REPLACE IF $\sqrt{25}$
SURFACE FINISH (-817)		
	MAX. $\sqrt{80}$	REPLACE IF $\sqrt{100}$

209040-30

Figure 6-66. Damage limits - housing assembly (Sheet 1 of 2)



DIA E		
MIN	MAX	REPLACE
0.663	0.667	0.669

DIA. D		
MIN	MAX	REPLACE
0.625	0.630	0.631

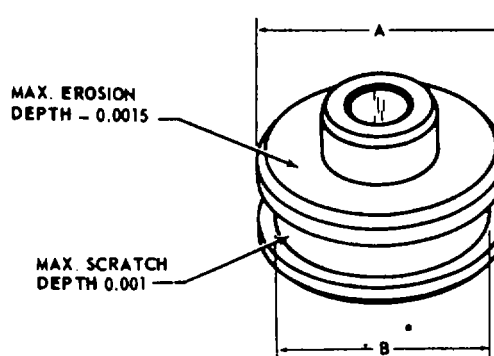
SURFACE "B"

REPLACE HOUSING ASSEMBLY IF

(1) VISIBLE EVIDENCE OF NICKS, SCRATCHES OR CORROSION IN PLUNGER-CONTACT AREA

(2) SEAT WEAR AT PLUNGER-CONTACT AREA IS 0.0015 OR GREATER

(3) SURF (AT PLUNGER CONTACT AREA) IS OUT OF SQUARE MORE THAN 0.001 RELATIVE TO AXIS OF DIA. "A"



DIA. "A"		
MIN.	MAX.	REPLACE
0.621	0.623	0.620

DIA "B"		
MIN	MAX	REPLACE
0.514	0.525	0.513

209040-31

Figure 6-66. Damage limits - housing assembly (Sheet 2 of 2)

NOTE

Nozzle should slide freely under its own weight. If drag exists, again inspect for burrs on nozzle edges, on fitting (2) and/or dirt on components.

(11) Install fitting (27), and nozzle (20), in the inlet port of housing (7). TORQUE FITTING (27) 250 - 300 INCH-POUNDS.

(12) Install spring (15) in return port of housing (7).

(13) Lubricate packing (13) with oil (C93) and install on fitting (12).

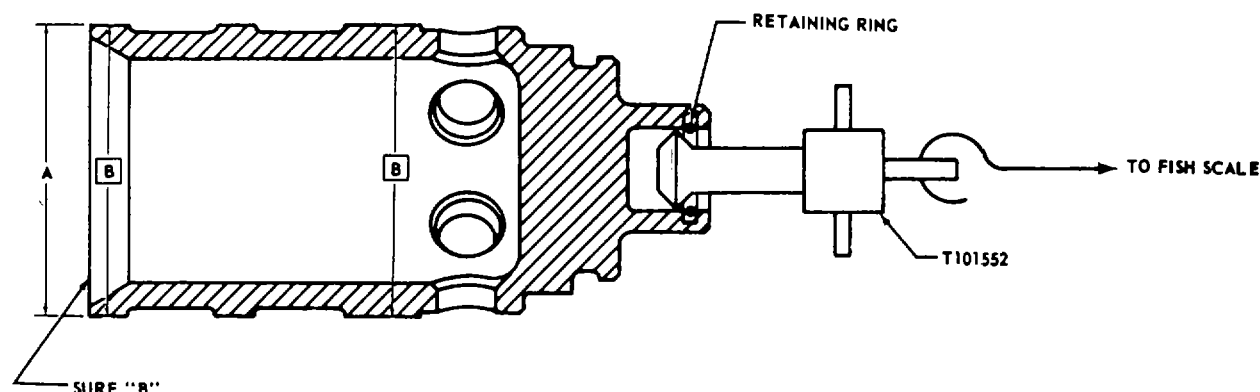
(14) Lubricate nozzle (14) with oil (C93) and insert in fitting (12).

NOTE

Nozzle should slide freely under its own weight.

(15) Install fitting (12), and nozzle (14), in return end of valve housing (7), approximately three and one-half turns.

(16) Install nut (10), on exposed threads of fitting (12) on P/N 204-040-816-1 bypass Valve Assembly. Install nut (10) and key (11) on P/N 204-0408163 bypass Valve Assembly and snug up against housing (7).



DIA A		
B MEASURE DIA WHERE INDICATED		
MIN	MAX	REPLACE
CLEARANCE BETWEEN THIS DIA & DIA "B" OF MATING VALVE HOUSING IS AS FOLLOWS		
0.00030	0.00045	0.00050
NICKS, SCRATCHES & CORROSION		
REPLACE FOR ANY VISIBLE EVIDENCE OF NICKS, CRACKS OR CORROSION		

SURF B
REPLACE IF
(1) ANY NICKS & SCRATCHES GREATER THAN 0.001 DEEP
(2) OUT OF SQUARE RELATIVE TO AXIS OF DIA "A" MORE THAN 0.001 T.I.R.

REPLACE RING IF
(1) IF BROKEN
(2) IF FORCE REQUIRED TO PULL T101552 FROM PLUNGER IS LESS THAN 70Z
(3) IF EXCESSIVE BURRS ARE PRESENT AT RING GAP (CHECK NOSE OF MATING 204-040-822 PISTON FOR EXCESSIVE ANODIZE CHIPPING)

209040-32

Figure 6-67. Damage limits - plunger

(17) Lubricate packing (30) with oil (C93) and install against head of bolt (31).

NOTE

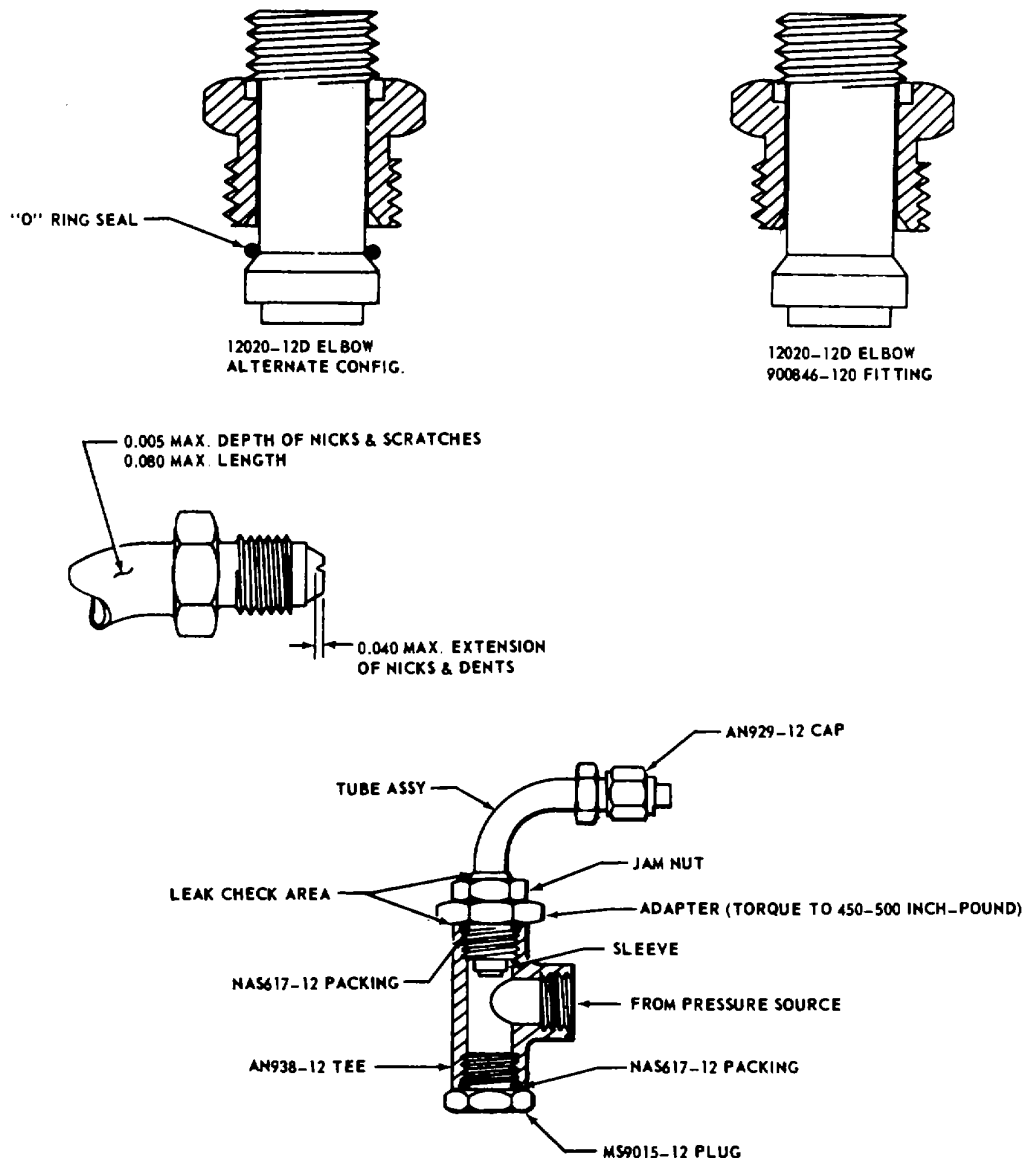
Bolt P/N 204-040-830-3 should be used in assembly.

(18) Lubricate packing (28) and install on end of fitting (27).

(19) Install elbow (29) on fitting (27) with countersunk end of elbow (29) against packing (28), on end of fitting (27).

(20) Insert bolt (31) through elbow (29), thread into fitting (27) and snug up bolt.

(21) Lubricate packing (3 and 6) with oil (C93). Install one packing on adapter end of elbow fitting (2) and one on union (5).



209040-33

Figure 6-68. Damage limits - elbow fitting

(22) Install adapter (4) in transmission feed port of housing (7) and TORQUE 500 - 6550 INCH-POUNDS: install fitting and checknut (2) into adapter (4). Install union (5) into cooler feed port and TORQUE 600 - 550 INCH-POUNDS.

(23) Lubricate packing with oil (C93): install packing on switch (1). Install switch (1) in valve housing (7) and TORQUE 40 - 60 INCH- POUNDS.

(24) Lubricate three packings (23) with oil (C93), and install one packing (23), one plug (22) and one retaining ring (21) in each of by-pass ports.

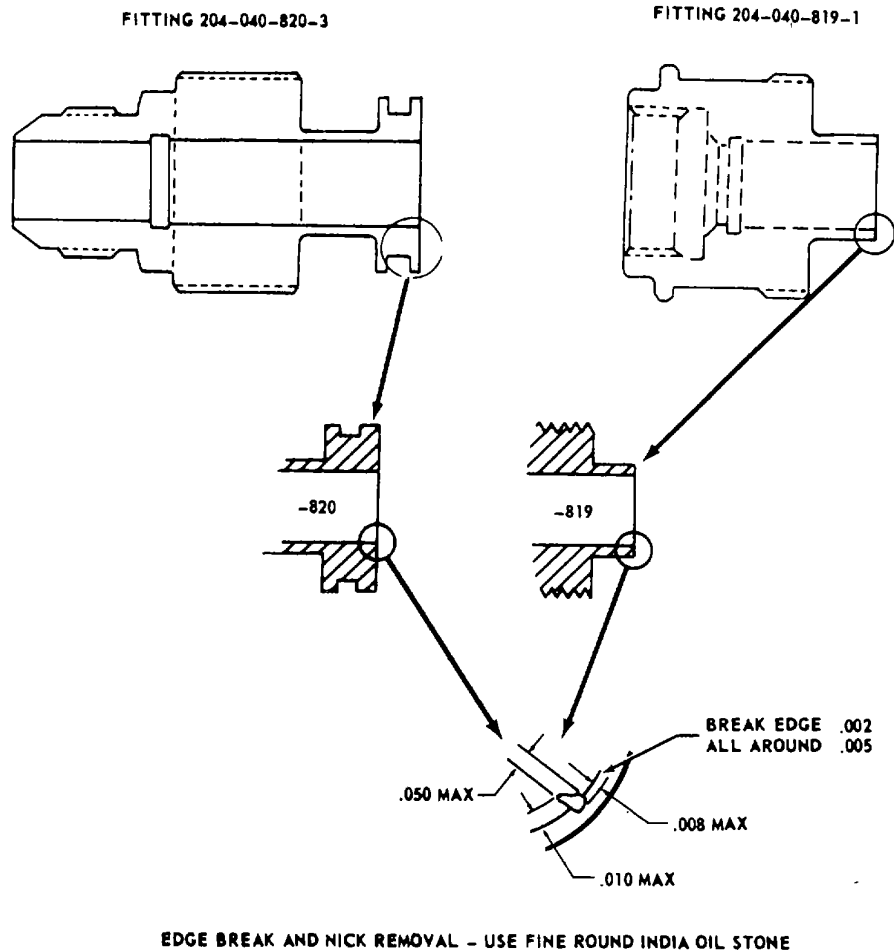
g. Functional Test and Final Adjustment (A VIM).

(1) Install the bypass valve in a test stand. See figure 6-73 for schematic of test stand. The accuracy of the test equipment must be certified within following tolerances: pressure gages: 1%, temperature gages: 2%.

(2) Complete the following tests on oil cooler bypass valve. See figure 6-73.

(a) Seal bond test.

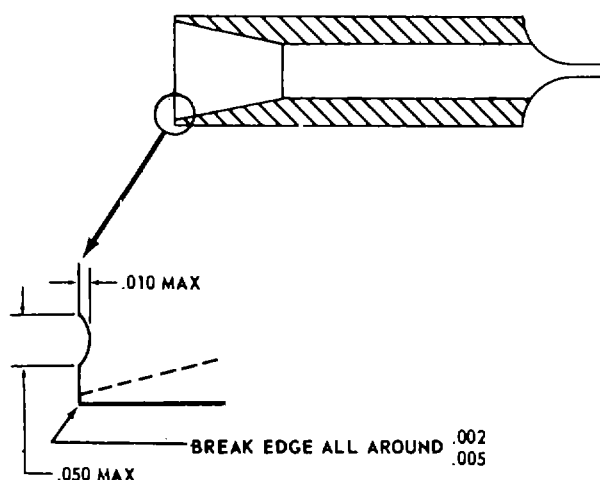
1 Tighten checknut on fitting and checknut (2, figure 6-58) not to exceed 200 INCH- POUNDS TORQUE.



209040-36

Figure 6-69. Repair - fittings

204-099-823-1 & -3 NOZZLES



EDGE BREAK AND NICK REMOVAL - USE FINE ROUND INDIA OIL STONE

209040-37

Figure 6-70. Repair - nozzles

2 Remove compensator spring (15, figure 6-58) in order to ensure proper placement of other shifting elements of valve.

3 Position valves: V1-closed; V2-open; and V3-closed. See figure 6-73.

4 Monitor fluid discharged by means of V2 by flowmeter No. 2 and P1, at pressures of 13.5 and 210 + 10 pounds per square inch. Leakage at the higher pressure must be no more than 5cc/min greater than the flow at the lower pressure.

(b) Valve Sensitivity Test.

1 Install compensator spring (15, figure 6-58) in the oil cooler bypass valve and complete assembly of valve.

2 Set pressures as follows: See figure 6-73.

P1 = 115 ±2 PSIG
 P2 = 95 ±2 PSIG
 P3 = 84 ±2 PSIG
 P4 = 64 ±2 PSIG

3 Set valves in position as follows: See figure 6-73.

V1 = Open
 V2 = Open at controlled rate to measure valve sensitivity.
 V3 = Open

4 Adjust oil temperature so that it reads 160° ±5°F on circuit temperature gage.

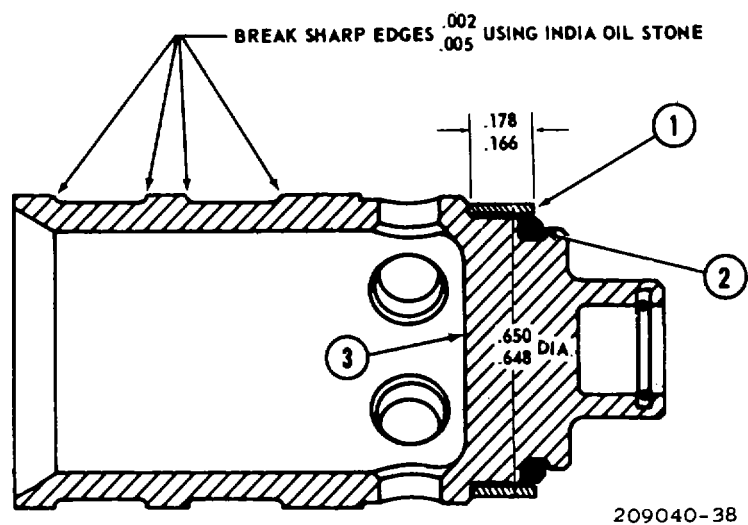
5 Adjust input flow rate, which is regulated by pump, to read 11.8 gal per minute on flow meter No. 1.

6 Adjust the valve sensitivity to sense and shift oil flow to bypass the cooler as follows: See figure 6-73.

NOTE

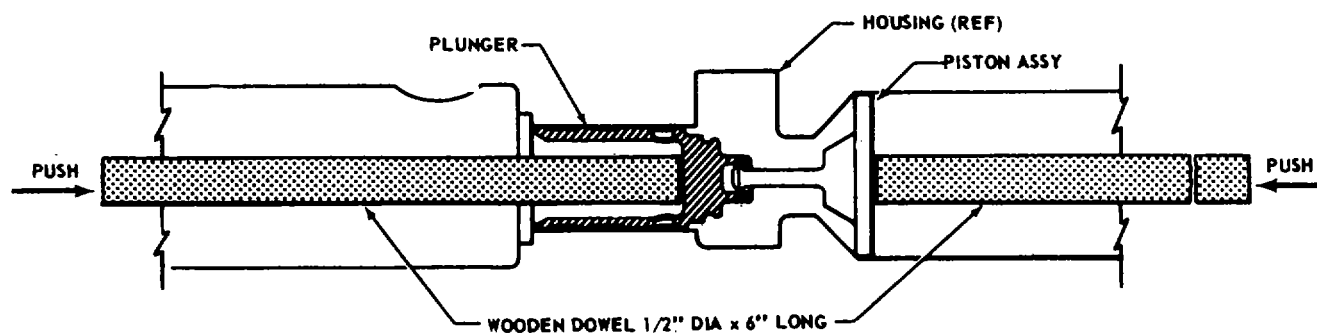
The bypass valve must sense and shift at a cooler leakage rate of 1.12 to 1.37 gallons per minute.

PLUNGER 204-040-832-1



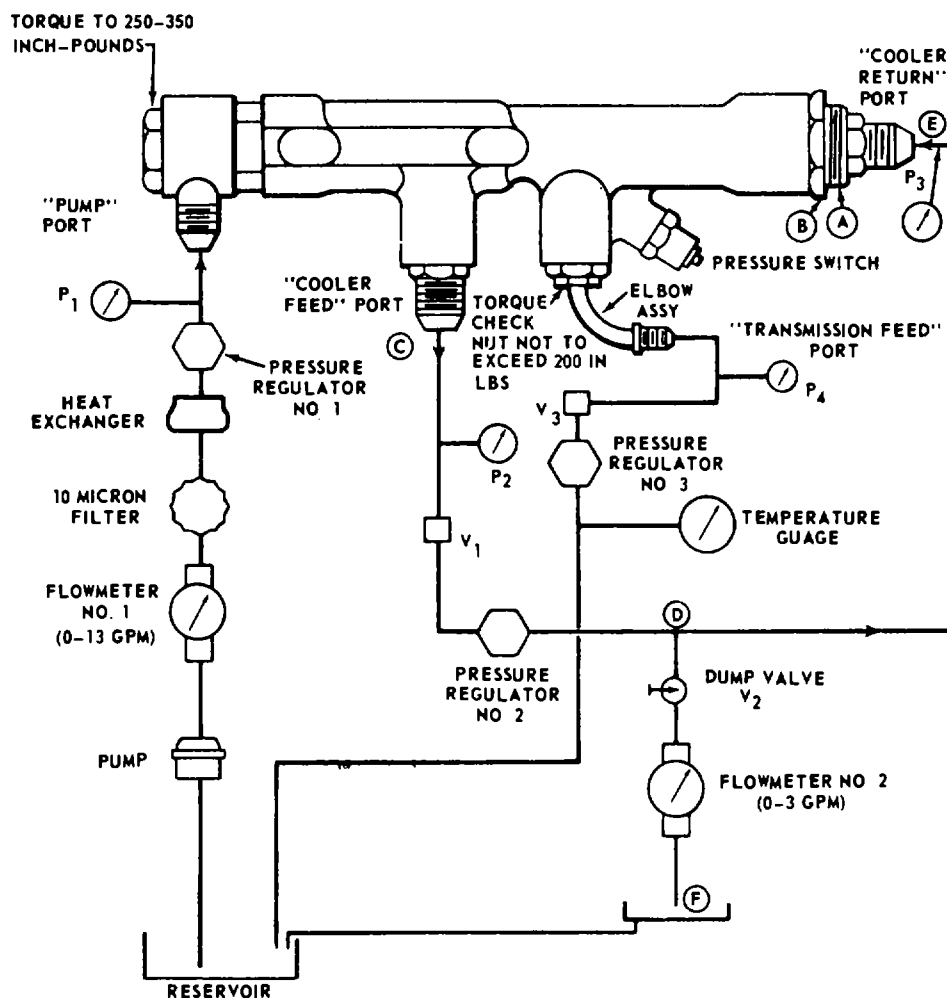
1. Retention Ring
2. O-Ring
3. Plunger

Figure 6-71. Repair - plunger



209040-39

Figure 6-72. Work aid application - plunger and piston



Note 10 micron filter and flowmeter may be placed in any convenient sequence between pump and P_1 gauge. Heat exchanger may be located at any convenient point between reservoir and valve under test. No point in circuits C-D-F or E-D-F may be more than 22 inches higher or lower than point "C"

204-040-816-1 & -3 BENCH TEST SCHEMATIC

209040-40

Figure 6-73. Bench test - oil cooler bypass valve

a Regulate leakage flow with valve V2 and measure by flowmeter number 2. See figure 6-73. Adjust the valve shift to open oil bypass at leakage rate of 1.12 to 1.37 gallons per minute.

b. Adjust bypass valve sensitivity by threading fitting (A), in or out of valve housing. Decrease sensitivity by turning the fitting clockwise. See figure 6-73.

c Tighten checknut (B), on fitting (A, figure 6-73) and lockwire nut to hole provided in valve housing (7, figure 658).

d Tighten checknut and key (10 and 11, figure 6-58) and lockwire checknut and key to hole in valve housing (7).

e After completion of step d the valve must reset when input flow rate is reduced to zero gallons per minute and input pressure is zero PSIG. Operate valve through at least six consecutive cycles. Make certain that valve resets at completion of each cycle.

NOTE

Pump run up time, which is time lapse between start of pump and attainment of required system pressure and flow rate, must not be less than 10 seconds or more than 15 seconds.

f Apply sealant (C116) as a fairing to fill open key slots in nut (10) and around fitting (12), next to nut. See figure 6-58.

g Loosen checknut on fitting and checknut (2) after completing test.

h. Installation.

(1) Attach valve (16, figure 6-56) to mounting bracket with four bolts and washers. Lockwire bolt heads in pairs.

(2) Position valve bracket on transmission, with lower flange on three sump case mounting studs and upper end aligned on inner side of upper bracket (which is attached on input drive quill mounting studs).

(3) Attach valve bracket to upper bracket with two bolts, using a washer on left bolt and attaching electrical cable bracket on right bolt.

(4) Attach lower end of bracket with nuts on studs, using a washer on left stud and attaching electrical cable bracket on right stud.

(5) Connect hose from transmission sump to inlet fitting at left end of valve.

(6) Connect valve-to-cooler hose on fitting at center underside of valve.

(7) Connect valve-to-filter tube on elbow fitting at right underside of valve.

(8) Connect cooler-to-valve hose on fitting at right end of valve.

CAUTION

Do not allow nut on valve fitting to turn when tightening flare nut of hose elbow. Any turning of this nut will destroy calibration of valve.

(9) Connect electrical lead of caution panel circuit to terminal at right underside of valve. Cover terminal with rubber nipple.

(10) At next ground run, check for leaks and proper operation of oil system.

6-39. Transmission Oil Emergency Bypass Valve Switch.

a. Removal.

(1) Remove electrical wiring from switch on emergency bypass valve (16, figure 656).

(2) Remove switch from bypass valve.

b. Installation

(1) Install switch, with new packing, in bypass valve (16, figure 666). Lubricate packing with transmission lubrication oil (C94). **TORQUE SWITCH TO 40 - 60 INCH-POUNDS.**

(2) Attach electrical wiring to switch and position insulating protector over terminal.

(3) Perform functional check of switch and check for oil leaks. The worded segment XMSN OIL BYPASS on the caution panel should be

illuminated until transmission oil pressure reaches 38 psi; it should then go out and remain out until transmission oil pressure decreases to 32 psi on shutdown when it will again be illuminated. If there is an oil leak in the oil cooler or oil cooler lines, the valve will remain in bypass condition and the worded segment will remain illuminated.

6-39A. Transmission -Vent Valve.

- a. Inspect vent valve (1, figure 6-56) for clogged condition.
- b. Clean with dry compressed air.
- c. Install vent using new gasket. **TORQUE 80 TO 120 INCH-POUNDS.** Lockwire (C151) to drilled hole in case.

6-40. Transmission Oil Pump.

Pre-Maintenance Requirements for Transmission Oil Pump

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel	One
Required	
Consumable Materials	(C93) (C124)
Special Environmental Conditions	None

a. Removal.

- (1) Open access panel under wing on right side of helicopter.
- (2) Place a container under oil drain outlet beneath fuselage. Open valve beneath sump and drain oil.
- (3) Disconnect drain tubes from valve and tee. Provide a container to collect trapped oil as pump is removed.
- (4) Remove pump retaining nuts and drain tee bracket from three mounting studs.

CAUTION

Hole is for attaching puller only. Do not attempt to use for a jackscrew.

- (5) Pull pump from sump. When necessary, use threaded puller in 1/4 UNF tapped hole in base at center of pump body.

WARNING

Use solvent (C124) in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

- (6) Wash assembled pump in solvent (C124) prior to disassembly. Drain thoroughly and dry with filtered compressed air.

b. Disassembly (AVIM).

NOTE

Do not remove any part of pump by forcing or prying. Loosen parts by tapping lightly with a fiber hammer. Do not disassembly pump in a damp or dusty room.

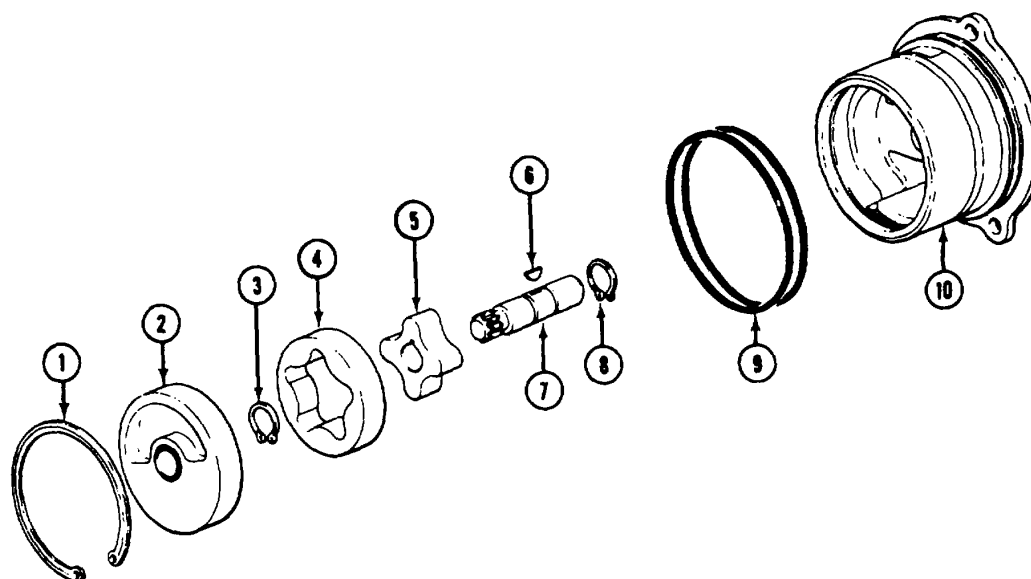
- (1) Remove retainer ring (1, figure 6-74) from body (10).
- (2) Remove retainer plate (2). Do not remove bearing from plate.
- (3) Remove retainer ring (3), inner gerotor (4), outer gerotor (5), and key (6) from shaft (7).
- (4) Remove retainer ring (8).
- (5) Do not remove bearing from body (10).

c. Cleaning.

WARNING

Use solvent (C124) in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

- (1) Wash all metal parts with solvent(C124) and dry with clean, filtered compressed air.



204040-113A

1. Retaining Ring
2. Retainer Plate
3. Retaining Ring
4. Outer Gerotor

5. Inner Gerotor
6. Woodruff Key
7. Drive Shaft

8. Retaining Ring
9. Preformed Packing
10. Body

Figure 6-74. Transmission oil pump

(2) Clean corners, grooves and threads with a short-bristled brush, such as a toothbrush.

d. Inspection (AVIM).

(1) Check corners, grooves and oil passageways for sludge.

(2) Inspect parts for damage and excessive wear. Use following table showing dimensions of new parts in parentheses and allowable clearances after wear in last column:

Outer Gerotor Body	Width (0.7080/0.7085)
Chamber	Width (0.7200/0.7105)
Allowable Chamfer	0.0015/0.0027
Face Clearance	
Outer Gerotor OD	(2.1220/2.225)
Body ID	(2.1250/2.1255)
Allowable Clearance	0.0025/0.0040
Driveshaft OD	(0.4985/0.4990)
Bearings ID	(0.5000/0.5005)
Allowable Clearance	0.0010/0.0025

e. Repair or Replacement (AVIM).

(1) Replace excessively worn or damaged parts with new parts.

(2) Replace all packings at each overhaul.

(3) When it is necessary to replace gerotors, replace as a matched set.

NOTE

Due to the small tolerances used in the construction of this pump, further repair of its parts is not recommended.

f. Assembly (A VIM).

(1) Lubricate parts with oil (C93) for ease in assembly.

(2) Install retainer ring (8, figure 6-74) on shaft (7) inboard groove.

(3) Insert key (6) in shaft (7) and install inner gerotor (4) so that key way engages key. Install retainer ring (3) on outboard end of shaft (7).

(4) Install shaft(7) in body (10). Install outer gerotor (5) over inner gerotor (4).

(5) Install retainer ring (1) in body (10). If retainer ring becomes difficult to install, reverse the ring, make sure ring is firmly seated in body groove. Install four machine bolts and washers, torque and lockwire.

g. Test Procedure (AVIM).

(1) Use lubricating oil (C93). Oil must be clean and free from foreign matter.

(2) Oil must be 120 degrees plus or minus 100F for duration of test.

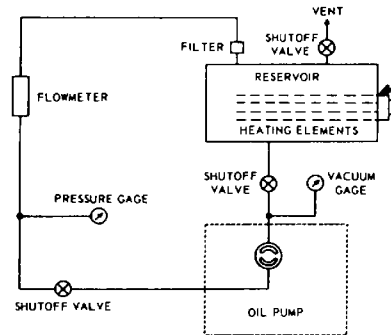
(3) Check pump shaft rotation in both directions. Shaft must rotate freely; replace the pump if any binding is noted.

(4) Place pressure and vacuum gages as close to the pump as possible. See figure 6-75. Use piping that will cause no appreciable pressure changes between the gages and the pumps. Use gages which are accurate within 0.5 percent full scale.

CAUTION

Be sure throttle valves are open before starting pump.

(5) Make flow measurements with a meter that is accurate within plus or minus 1.0 percent.



204040-121

Figure 6-75. Test setup-transmission oil pump

(6) Measure pump speed with a tachometer directly coupled to the pump shaft. The tachometer must be accurate within plus or minus 1.0 percent or 20 RPM, whichever is greater.

(7) Observe the following:

(a) Operate pump at 3575 RPM.

(b) Oil temperature of 120°F, plus or minus

100

(c) Inlet pressure of 24 to 30 inches of mercury.

(d) Discharge pressure shall be 50 psig.

(8) Minimum pump flow shall be 10.5gpm.

h. Installation.

(1) Install packing in two grooves around pump housing.

(2) Insert pump into mounting port, while main rotor is slowly rotated until pump shaft is positively engaged to splined driveshaft in transmission sump. Install washers and nuts on studs, with drain tee bracket on forward stud.

(3) Connect drain line tubes to valve and tee.

(4) Fill sump with oil (C93) or (C94) to normal level on sight gages. Close access openings and cowl.

CHAPTER 7

HYDRAULIC AND PNEUMATIC SYSTEM

7-1. Flight Control Hydraulic System.

Two similar but separate hydraulic systems are used to operate flight controls power cylinders, stability and control augmentation system (SCAS or SAS) servo actuators, the armament turret, and the XM65 TOW missile launcher actuator. (See figures 7-1 and 7-2.) Systems No. 1 and No. 2 are exactly alike as to their reservoirs, transmission driven pumps, and module assemblies which contain system filters, solenoid valves, relief valves and pressure switches for the caution panel. Although both systems operate three dual servo hydraulic cylinders in main rotor controls there is no connection between systems because they use separate passages and piston chambers inside each dual cylinder and valve assembly. Both systems also have other hydraulic circuits and functions different and separate from each other. If one system is disabled the other system can still operate normally.

a. Principles of Operation (Typical for Both Systems). In normal operation of each system, hydraulic fluid is supplied from its non-pressurized reservoir by gravity feed and suction to a transmission-driven pump. The pump is a variable-displacement type with internal pressure compensation, preset to provide 1500 (plus or minus 25) psi output pressure and 6.1 gallons per minute flow rate at operating rpm, according to system demands. Fluid bypassed in pump, to regulate pressure and flow, is released through a line to the return side of the system module. Pump output is delivered to the module and passes through the pressure filter. A relief valve in the module guards the system against excessive pressure, relief valve is set to open at 1626 to 2140 psi. The system solenoid valve is normally de-energized and open to the SYS PRESS outlet of the module but can be electrically energized to bypass position by placing the HYD TEST switch to position marked for opposite system. A pressure switch will cause the caution panel to light if module outlet pressure decreases (at 600 to 400 psi).

(1) Beyond the module, fluid under pressure is delivered through tubes and hoses to three dual hydraulic servo cylinders in main rotor cyclic and collective control systems. Fluid is let into and out of one functional half of each dual cylinder when its servo control valve is moved mechanically by linkage from a control stick, causing the cylinder piston rod to make corresponding movements of linkages to the main rotor. The cylinder valves also have internal functions which tend to prevent feedback of motion from the rotor to the control stick. Either system alone can operate the cylinders, but the dual (or tandem) arrangement is used for added safety of operation.

(2) Fluid is returned from power cylinders and other units through external lines to the SYS RET inlet of the module, to pass through the return filter. Normal return flow from module to reservoir is through a hose connected on the quick-disconnect coupling which is at other times used to connect ground test equipment. However, if this hose has not been connected, a low pressure (45 psi) will open a relief valve and allow flow through another line from the module RES RET outlet to the reservoir BYPASS inlet.

(3) Both system modules are equipped with quick-disconnect couplings to allow ground operation with a portable hydraulic test unit. System operation with such a unit is the same as described for normal operation, except that the reservoir and transmission-driven pump are not being used. External dc power will also be required for electrically operated valves and caution panels when engine is not operating.

b. Special Functions of System No. 1. In addition to typical operation described in preceding paragraphs for both systems, hydraulic system No. 1 has the following special functions:

(1) Tail rotor controls hydraulic cylinder. This is a single hydraulic cylinder and servo valve assembly, mechanically connected into control linkage to the tail rotor.

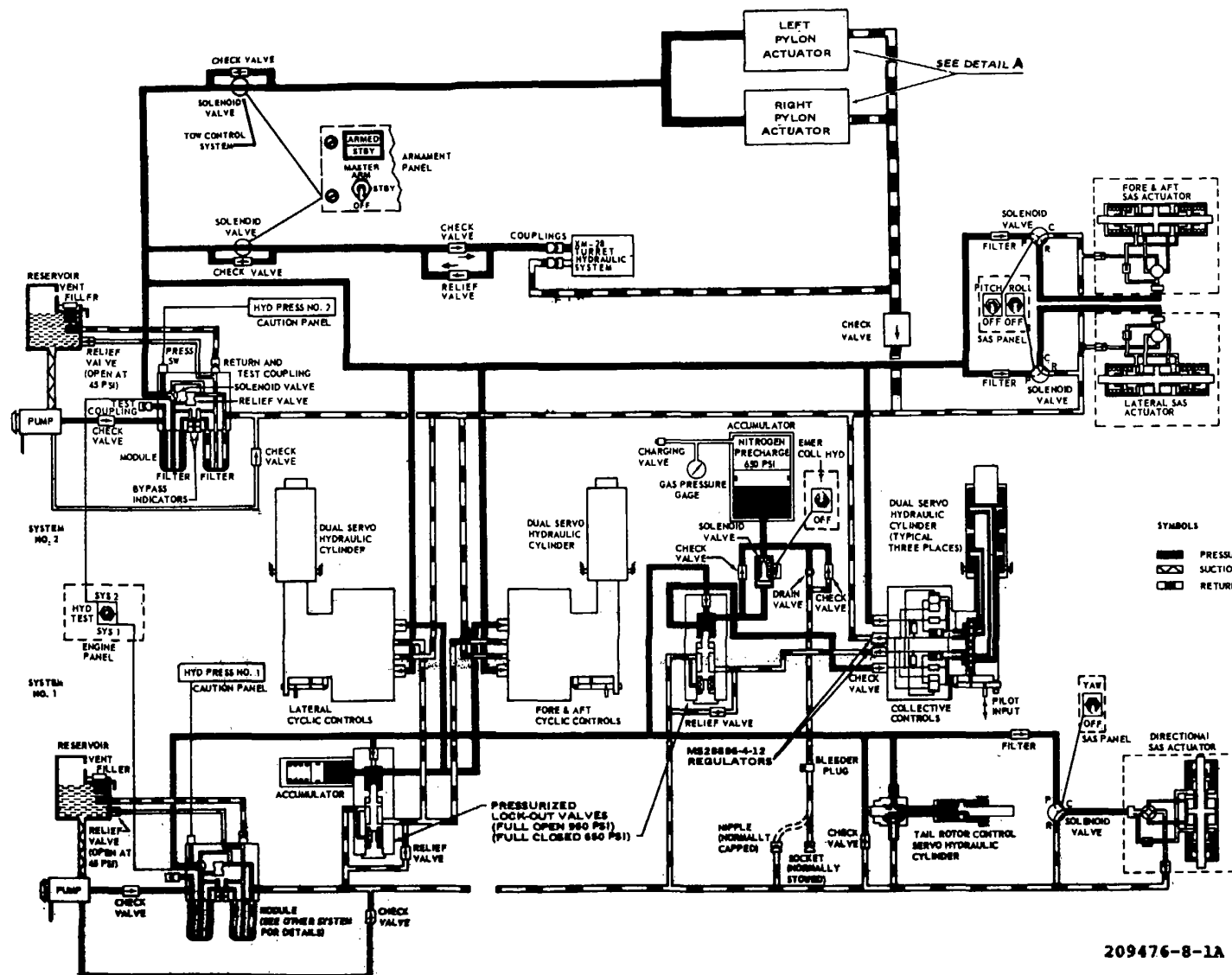
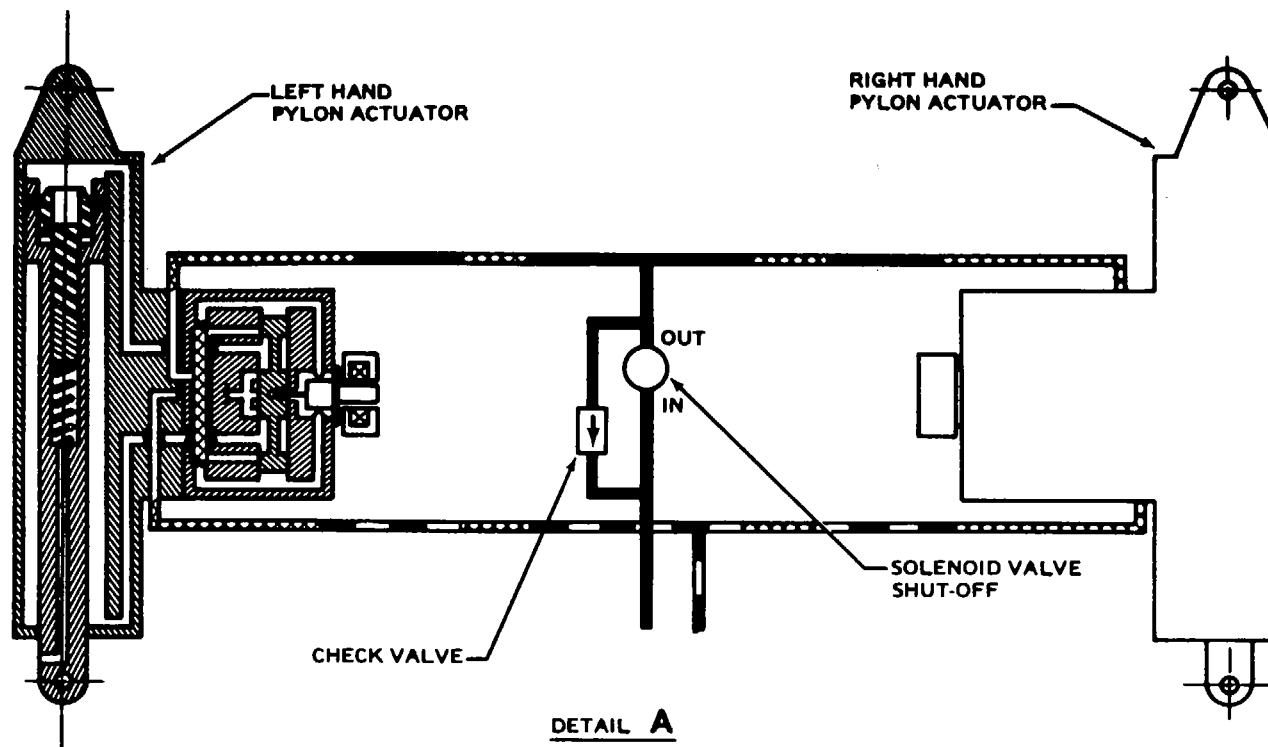


Figure 7-1. Hydraulic schematic (Sheet 1 of 2)



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Figure 7-1. Hydraulic schematic (Sheet 2 of 2)

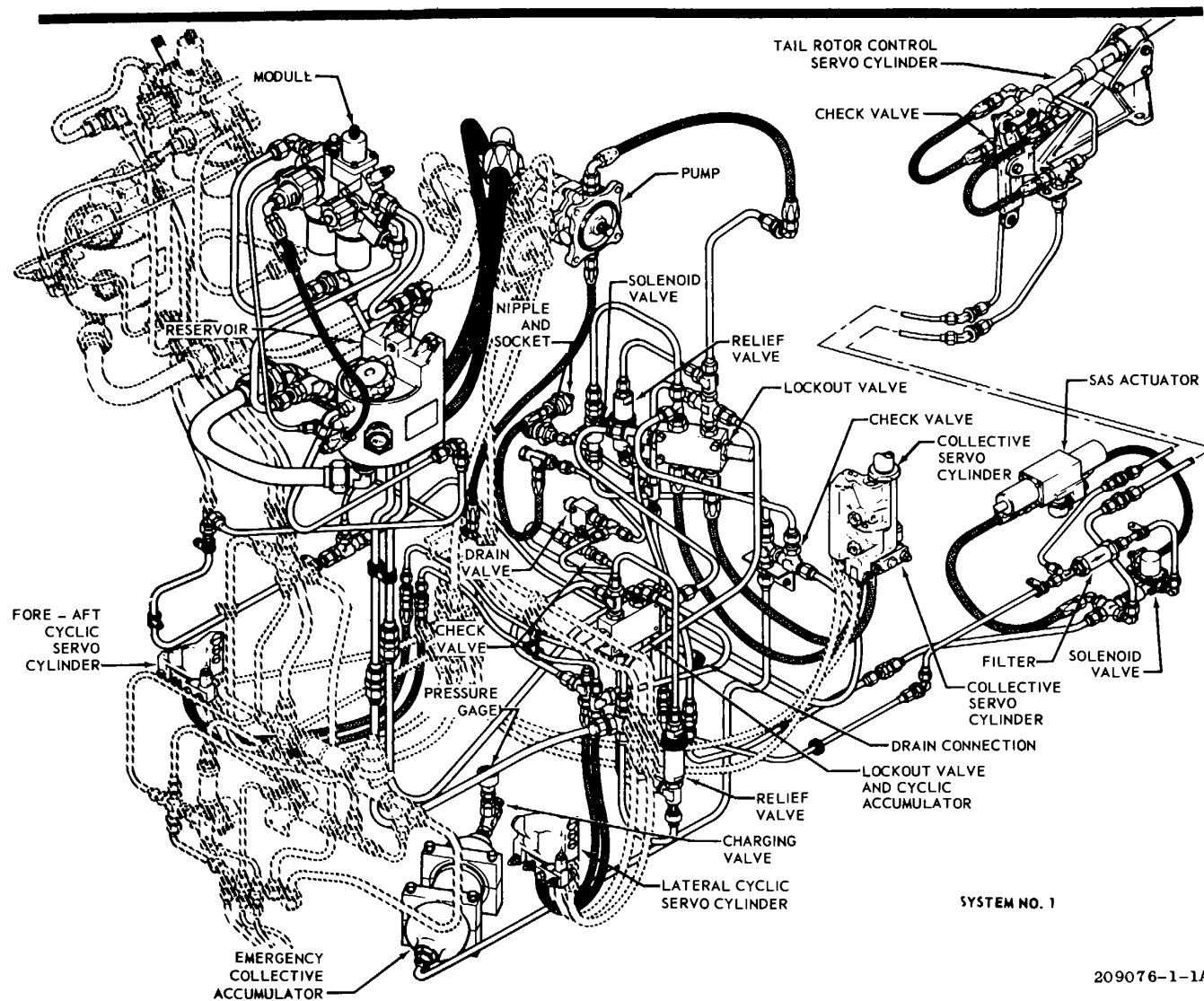
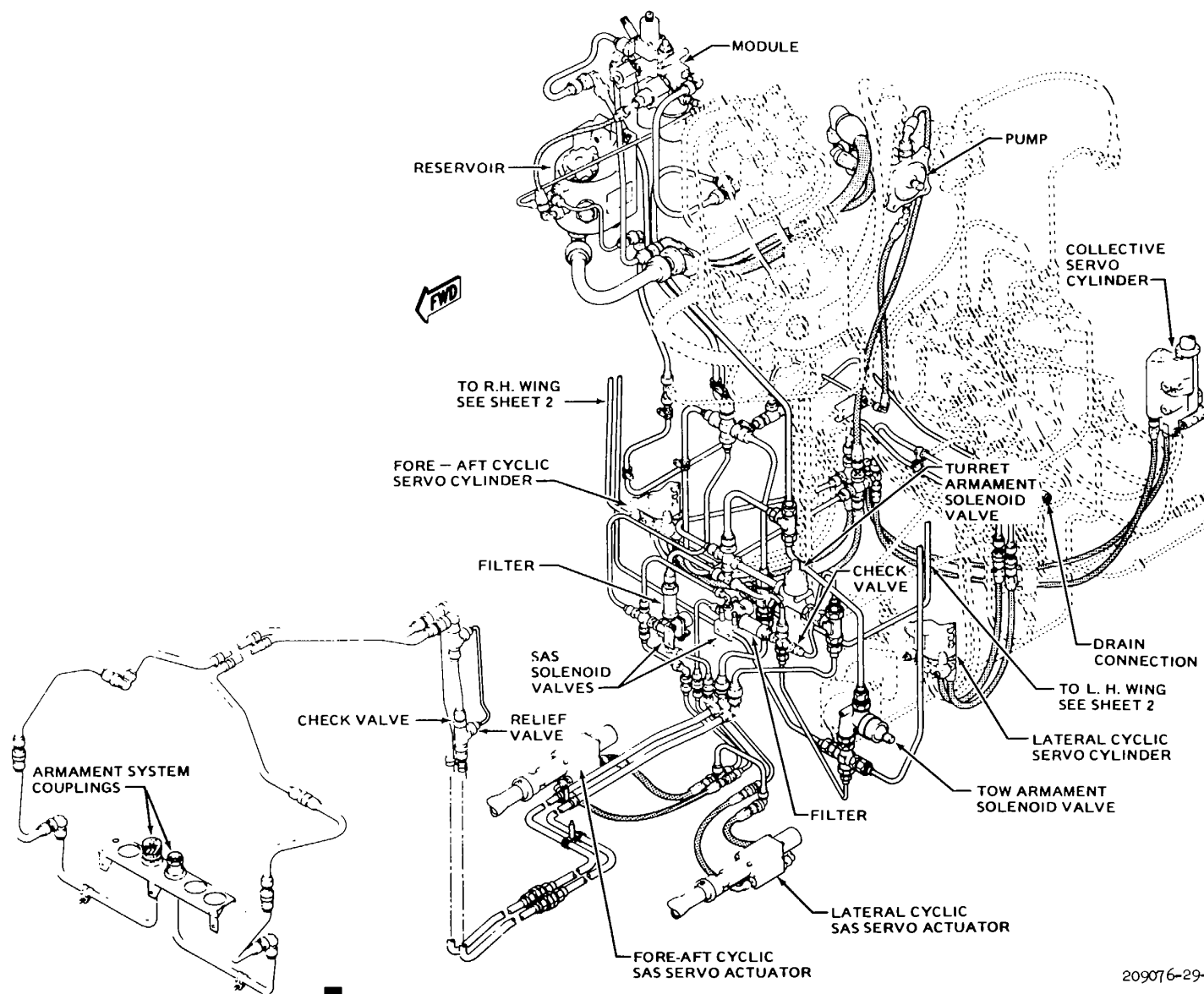
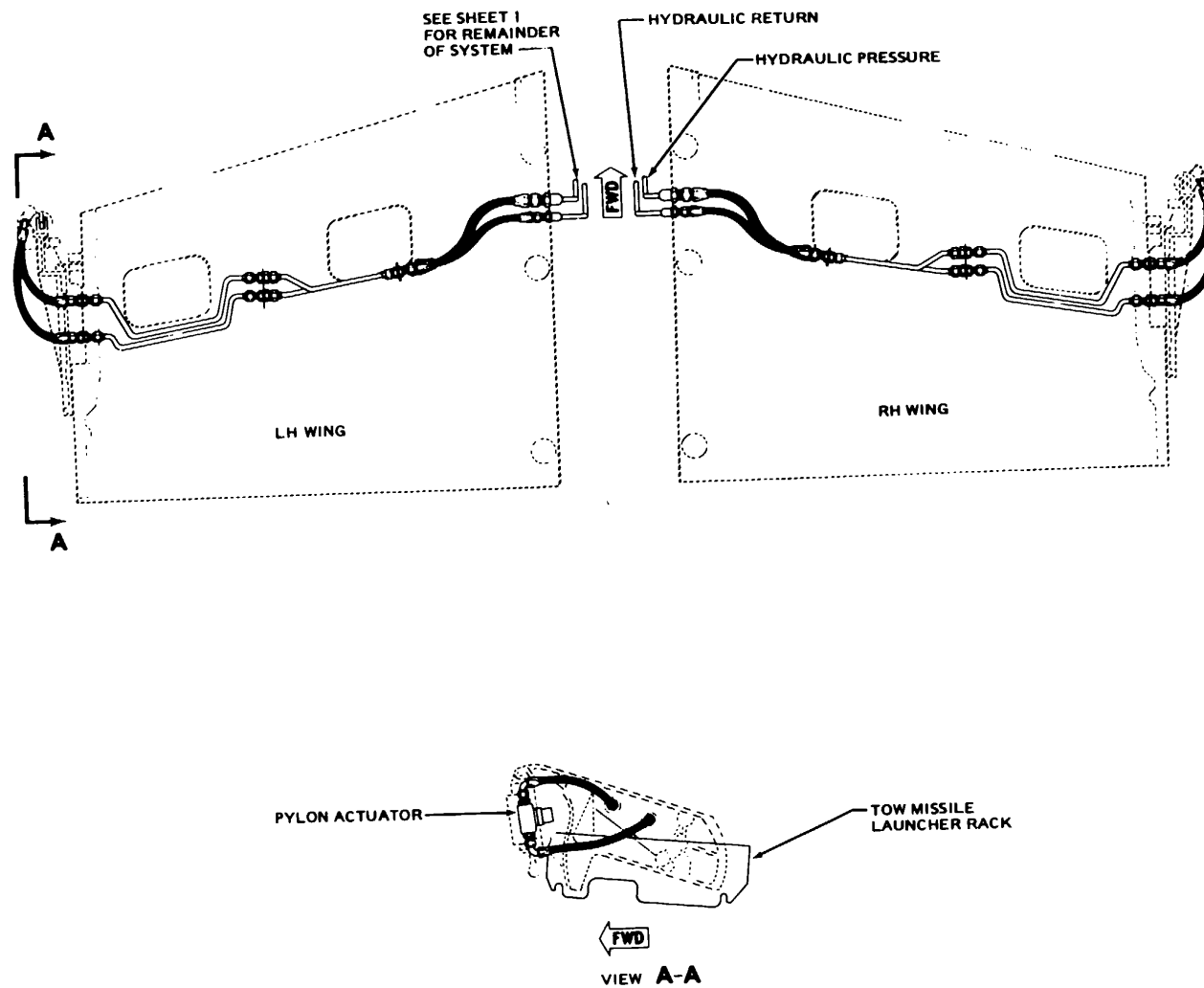


Figure 7-1A. Hydraulic system No. 1



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Figure 7-2. Hydraulic system No. 2 (Sheet 1 of 2)



209076-29-2

Figure 7-2. Hydraulic system No. 2 (Sheet 2 of 2)

(2) Yaw stability and control augmentation system (SCAS) servo actuator. This circuit includes a pressure line filter, a three-way, two-position solenoid valve, and an electro-hydraulic servo actuator connected in the tail rotor control linkage.

(3) Emergency collective hydraulic power provisions. This equipment is intended to provide emergency capability of operating the collective pitch hydraulic cylinder when neither hydraulic system provides normal operating pressure. The circuit includes a pressurized lock-out valve, a hydraulic accumulator precharged with compressed nitrogen, and a solenoid valve controlled by the EMER COLL HYD switch on instrument panels. The accumulator becomes hydraulically charged during normal operation, in either switch position. The solenoid valve is spring-loaded to be open when electrically deenergized (switch ON, or without electrical power), but can be electrically energized (switch OFF) to be closed and holding stored fluid under pressure accumulator. If system pressure drops, the lock-out valve becomes fully closed (at not lower than 650 psi) to isolate the cylinder and accumulator circuit from the system. When switch is placed ON, the solenoid valve de-energizes and opens, allowing the accumulator to be used to operate the collective control power cylinder for at least four full strokes of the control stick (A stroke is a maximum movement in one direction.) A drain valve and stowed line are provided for maintenance use, to drain fluid from the accumulator to the system return line, when checking accumulator gas charge.

(4) Cyclic controls accumulator and lock-out valve. In event of failure of both hydraulic systems this valve traps fluid within the cyclic actuators. The lock-out valve is identical to that used in collective system. The accumulator is a small unit, using spring pressure instead of compressed gas, and has no external means of control.

c. *Special functions of system No. 2.* In addition to typical operation described for both systems in paragraph 7-1, step a., hydraulic system No. 2 has the following special functions:

(1) Armament system hydraulic power provisions. (See figure 7-1 and 7-2.) This circuit provides pressure and return hydraulic lines to couplings where the armament turret hydraulic system is connected. The pressure line includes a solenoid shutoff valve, controlled by the armament panel MASTER ARM switch, a directional flow check valve, and a bypass with a check valve to relieve pressure when solenoid is off. The return line has a directional flow check valve. A bypass line with a relief valve is installed around the flow check valve in the pressure line.

(2) Pitch and roll stability and control augmentation system (SCAS) actuators. Circuits are provided for pitch and roll functions of stability augmentation system. Each of the two circuits includes a pressure line filter, a three-way two-position solenoid valve, and an electro-hydraulic servo actuator connected into the fore- and-aft or lateral cyclic control linkage.

(3) Hydraulic provisions for XM65 TOW missile launchers. This circuit provides pressure and return hydraulic lines to a hydraulic actuator mounted at the forward end of the TOW missile launcher racks. The master armament switch controls the XM65 TOW missile launcher rack hydraulic actuator ON-OFF solenoid valve. The solenoid valve can be de-energized (turned off) by the gunners pilot override switch.

7-2. Troubleshooting.

Table 7-1 is intended to aid in hydraulic system troubleshooting. This guide should be used with other sources of information, such as: (1) Hydraulic System Schematic Illustration; (2) Electrical diagrams; and (3) Operational Ground Test and other detailed procedures in this section.

Table 7-1. Troubleshooting - Hydraulic System

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Hydraulic pressure caution panel (either system) reported being lighted during normal operation.

STEP 1. Loss of fluid and pressure by leakage.

Locate and repair leaks. (Refer to paragraph 7-3.)
Replace faulty lines and seals. (Refer to paragraph 7-4.)
Service system. (Refer to paragraph 1-7.)

STEP 2. Unknown malfunction in system.

Perform operational check with ground test hydraulic unit. (Refer to paragraph 7-3.)

2. Caution panel does not light, system operates normally with ground test equipment.

STEP 1. Pump defective.

Replace defective pump. (Refer to paragraph 7-5. b.)

STEP 2. Pump pressure line restricted or check valve reversed.

Replace or correct installation of parts. (Refer to paragraph 7-4.)

3. SCAS actuator will not unlock from its center position.

STEP 1. Faulty wiring switches or connections.

Refer to paragraph 1 1-9, Troubleshooting Stability and Control Augmentation System (SCAS).

STEP 2. Filter clogged.

Replace in line hydraulic filter. (Refer to paragraph 7-7. a.)

STEP 3. Restricted flow in pump suction line.

Inspect reservoir and line, replace faulty parts. (Refer to paragraph 7-8. b.)

4. If system actuators operate normally on ground test equipment, but caution panel is lighted, warning circuit may be faulty.

Table 7-1. Troubleshooting - Hydraulic System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

STEP 1. Pressure switch faulty.

Replace pressure switch in system module. (Refer to paragraph 7-3.)

STEP 2. Electrical circuit malfunction.

Check and repair electrical circuit. (Refer to paragraph 9-2. c.)

5. If caution panel is lighted and system actuators do not operate normally with ground test equipment, trouble may be in module or in system beyond module.

STEP 1. System solenoid valve staying at OFF position.

Replace solenoid valve or repair electrical circuit. (Refer to paragraph 7-6.)

STEP 2. System relief valve staying open or relieving at too low pressure.

Adjust relief valve if relieving at a low pressure, or replace if defective. (Refer to paragraph 7-9. a.)

STEP 3. Internal leakage through system components.

Isolate and replace defective component. (Refer to paragraph 7-6.)

6. Caution panel of a system fails to light when HYD TEST switch is at another system position.

STEP 1. Caution panel lamp or panel segment failed.

Replace lamp or panel.

STEP 2. Pressure switch or wiring faulty.

Replace pressure switch or repair electrical circuit. (Refer to paragraph 7-6.)

STEP 3. System solenoid or electrical circuit faulty.

Replace solenoid valve in module, or repair electrical circuit. (Refer to paragraph 7-6.)

7. Filter bypass indicators tripped.

STEP 1. Low fluid temperature.

Operate until fluid temperature is normal, then reset indicators by pushing buttons in. If indicators (buttons) remain in, no further action is needed. (Refer to paragraph 7-3.)

Table 7-1. Troubleshooting - Hydraulic Systems (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

STEP 2. Indicators tripped by unusual vibration or module being struck.

Check module for damage, reset indicators. If indicators remain in, no further action is needed. (Refer to paragraph 7-3.)

STEP 3. Clogged filters.

Inspect and clean, or replace the filter elements. Reset indicators. (Refer to paragraph 7-7. c.)

STEP 4. Defective indicator assembly.

Replace indicator assembly in housing. (Refer to paragraph 9-70.)

8. Servo cylinders chatter when controls are moved. (Some chatter in tail rotor control cylinder is normal when using ground test hydraulic unit).

STEP 1. Air in system.

Cyclic controls at least ten full strokes at normal operating pressure to work out air. (Refer to paragraph 7-3.)

STEP 2. Loose mounting bearing on cylinder (7-11. h.)

Adjust bearing nut. (Refer to paragraph 7-1 1. h.)

STEP 3. Internal looseness in cylinder assembly.

Replace cylinder assembly. (Refer to paragraph 7-11. h.)

9. Controls do not operate smoothly.

STEP 1. Servo valve binding. (Requires more than 12 oz. force to operate valve.)

Ensure all bolts at servohead linkage are free to rotate by finger pressure. Replace cylinder assembly. (Refer to paragraph 7-11. h.)

STEP 2. Incorrect bolts inserted.

Check valve linkage bolts. Install correct bolts. (Refer to paragraph 7-11. h.)

10. Excessive feedback in operation of controls.

STEP 1. Air in servo cylinders.

Cycle controls at least ten times to work air out. (Refer to paragraph 7-3.)

Table 7-1. Troubleshooting - Hydraulic System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

STEP 2. Loose or worn bearing housing mounting studs.

Tighten or replace mounting studs. (Refer to paragraph 7-11.)

11. Inadequate EMER COLL HYD operation available (minimum four full strokes of control stick).

STEP 1. Accumulator nitrogen pressure incorrect.

Check and precharge accumulator with nitrogen. (Refer to paragraph 7-9. d.)

STEP 2. Accumulator valve or fittings leak.

Replace accumulator valve or fittings, precharge with nitrogen again. (Refer to paragraph 7-9. c.)

STEP 3. Accumulator leaks internally.

Replace accumulator assembly, and precharge. (Refer to paragraph 7-9. c.)

STEP 4. Internal leakage in collective servo cylinder.

Replace cylinder assembly. (Refer to paragraph 7-11. c.)

STEP 5. EMER COLL HYD solenoid valve stuck closed or electrical wiring incorrect.

Replace valve or repair electrical circuit. (Refer to paragraph 7-9.)

STEP 6. Accumulator drain line left connected and valve leaking.

Replace defective valve, disconnect and stow drain line. (Refer to paragraph 7-9.)

STEP 7. Accumulator or connections defective.

Replace faulty accumulator or connections. (Refer to paragraph 7-9. c.)

12. Hydraulic power inadequate or lacking at couplings for armament turret (other indications normal).

STEP 1. Faulty circuit to armament couplings, or System No. 2, pressure is marginally low.

Check operation with portable hydraulic test unit. (Refer to paragraph 7-16.)

13. No pressure improvement when using hydraulic test unit for normal system pressure.

STEP 1. Armament solenoid valve inoperative.

Replace solenoid valve or repair electrical circuit. (Refer to paragraph 7-16.)

Table 7-1. Troubleshooting - Hydraulic System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

STEP 2. Restriction in couplings or lines.

Replace defective parts. (Refer to paragraph 7-16.)

14. System appears normal with test unit hydraulic pressure.

STEP 1. System No. 2 pump or lines defective.

Replace pump or faulty lines. (Refer to paragraph 7-5. b.)

15. System cavitates.

STEP 1. Loss of fluid and pressure by overflow of No. 2 hyd. reservoir due to hydraulic test switch left in the off position.

Place the No. 2 hyd. test switch in the ON position. Replenish fluid in reservoir after cavitation ceases. Place test switch in neutral. (Refer to paragraph 7-16.)

16. With battery switch ON and emergency hydraulic switch ON the collective controls lock.

STEP 1. Malfunction of solenoid valve.

Remove and replace solenoid valve with new valve. (Refer to paragraph 7-6.)

STEP 2. Check valves installed in wrong ports of servo valve assembly.

Install check valves in proper port location, see figure 7-16. (Refer to paragraph 7-11.)

17. With battery switch OFF and emergency hydraulic switch OFF the collective controls lock.

STEP.1 Check faulty wiring.

Repair faulty wiring. (Refer to paragraph 9-2. c.)

STEP 2. If wiring checks OK.

Replace valve. (Refer to paragraph 7-6. a.)

18. Both left and right TOW pylons inoperative or operate sluggish.

STEP 1. Electrical wiring faulty.

Repair electrical circuit. (Refer to paragraph 9-2. c.)

STEP 2. Faulty electrical circuit to actuator.

Repair electrical circuit. (Refer to paragraph 9-2. c.)

Table 7-1. Troubleshooting - Hydraulic System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

19. No. 2 system operation otherwise normal.

STEP 1. TOW solenoid shutoff valve stuck closed.

Replace valve. (Refer to paragraph 7-20.)

20. Only one TOW pylon operative or one operates sluggish and other TOW pylon operates normally.

STEP 1. Restricted hydraulic flow in circuit of affected actuator.

Inspect hoses and tubes; replace faulty parts. (Refer to paragraph 7-19. b.)

STEP 2. Faulty electrical circuit to affected actuator.

Repair electrical circuit. (Refer to paragraph 9-2. c.)

STEP 3. Defective pylon actuator.

Replace actuator. (Refer to paragraph 7-19. c.)

21. Pylons do not remain in stowed position with TOW system OFF, hydraulic system ON. (Both sides).

STEP 1. Fault in electrical wiring.

Repair electrical circuit. (Refer to paragraph 9-2. c.)

STEP 2. Faulty electrical circuit to actuators.

Repair electrical circuit. (Refer to paragraph 9-2. c.)

STEP 3. TOW solenoid shutoff valve stuck open.

Replace valve. (Refer to paragraph 7-20.)

STEP 4. Check valve installed backwards or stuck open.

Reverse or replace check valve. (Refer to paragraph 7-20.)

22. Only one side of TOW pylon operational.

STEP 1. Faulty electrical circuit to actuator.

Repair electrical circuit. (Refer to paragraph 9-2. c.)

Table 7-1. Troubleshooting - Hydraulic System (Cont)

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

STEP 2. Defective actuator.

Replace actuator.

STEP 3. Inoperative lock in actuator.

With XM65 TOW system OFF, manually cycle actuator through locked position. Replace actuator if lock fails to engage. (Refer to paragraph 7-19. e.)

7-3. Operational Check.

This procedure is for ground operational check of the hydraulic systems to aid in troubleshooting or test for proper functioning of the system after maintenance. Whenever possible both hydraulic systems should be pressurized simultaneously to avoid introducing air into the unpressurized system. When this is not possible, avoid rapid control movement when operating with a single pressurized system.

a. Provide a portable hydraulic test unit conforming to the following requirements:

(1) Thoroughly clean, and service with prescribed hydraulic fluid (C73).

(2) Equipped with 10 micron filter through which all fluid passes before leaving unit.

(3) Capable of 2300 psi pressure and at least 6 gallons per minute flow rate.

(4) Having a calibrated pressure gage of 2500 psi capacity.

(5) Pressure and return lines equipped to connect to both hydraulic systems for simultaneous operation.

b. Visually inspect entire hydraulic system of helicopter to make sure all lines and components are secure and appear capable of operation. Obtain access as follows:

(1) Open both side doors of hydraulic reservoir compartment, located between canopy and transmission cowl.

(2) Open both sides of transmission hinged cowl.

(3) Remove panel doors attached with cowl fasteners directly below wings at both sides.

(4) Remove panel door, attached with cowl fasteners on right side of fuselage below tailpipe fairing, for access to tail rotor control power cylinder.

(5) Remove screw-mounted panels from sides of fuselage for access to lines leading to armament hydraulic connections and stability augmentation system actuators.

(6) Remove cowl from right and left TOW pylons for access to hydraulic cylinders.

c. Prepare portable test unit for operation. Pressure relief valve set for 2100 psig cracking pressure; pump set to provide at least 6 gallons per minute flow; pressure compensation set at **1475 TO 1525** psig.

d. On each of two hydraulic system modules, located above reservoirs, prepare ground test couplings by removing cap from pressure coupling and disconnecting reservoir return hose from return coupling. Connect test unit hoses to both modules.

CAUTION

Be sure main rotor tiedown is removed to minimize possible contact of main rotor hub components with each other in extreme positions during ground operation with external power. Assure that gun is unloaded.

e. Remove main rotor tie-down. Apply 28 Vdc to external power receptacle at left side of fuselage. On pilots console, set switches to activate both hydraulic systems, armament system, and stability augmentation system.

f. Operate test unit, applying pressure (**1475 TO 1526** psig) to hydraulic systems for at least 15 minutes. During this time, perform the following:

(1) Observe all parts of systems for evidence of leakage, taking corrective action as necessary. See table 7-2 for maximum allowable leakage.

(2) Slowly cycle all controls to limits of stroke, observing movement of hydraulic power cylinders. Check that all moving parts have clearance so that there is no fouling or binding. Give particular attention to flexible connections, to make sure hoses are not pinched and that vibration does not tend to loosen fittings.

NOTE

It is possible to cause contact between parts of main rotor hub at full up collective and full forward or aft cyclic stick positions, in ground operation with external hydraulic power and with rotor at static position. This condition will not occur when rotor is turning at normal operating speeds.

Table 7-2. Maximum Allowable Leakage for Hydraulic System

COMPONENT	FUNCTION	TYPE	LEAKAGE RATE
SERVO ACTUATORS	Tandem piston	D	2 drops/5 cycles
	(Intersystem vent)	S-D	4 drops/15 min.
	Rod Seal cycles	D	1 drop/flt. hr. or 1 drop/20 full stroke
	Rod Seal	S-D	1 drop/15 min.
	End cap	S	1 drop/5 cycles or 2 drops/day
	Valve input	D	1 drop/5 cycles
	Valve input	S-D	1 drop/5 min.
	Servo ram	D	1 drop/5 cycles
	(Transducer)		
	Pressure switch	S-D	1 drop/5 min.
	Valve body (Weep holes)	S-D	1 drop/5 min.
PUMPS	Output shaft	D	8 drops/min
	Output shaft	S-D	1 drop/min.
	Housing (mating surfaces)	S	2 drops/day
VALVES	Body (weep hole)	S	1 drop/5 cycles or 2 drops/day
	Manual stem	D	1 drop/5 cycles
	Manual stem	S-D	1 drop/15 min.
	Dump valve	S	1 drop/5 cycles or 2 drops/day
FITTINGS	Flared or flareless	S	None
	Compression seals	S	1 drop/30 min. - lower rate if fitting is readily accessible

Table 7-2. Maximum Allowable Leakage for Hydraulic System

COMPONENT	FUNCTION	TYPE	LEAKAGE RATE
Codes:			
D-Dynamic	S - D Static leakage through dynamic seal		
S-Static	* -20 Drops cc.		
NOTE			
1. Components in a static condition, as in a parked aircraft, are allowed a maximum leakage of two drops per seal or packing per day.			
2. When the fluid escaping is of an insignificant quantity and will have no detrimental effect on aircraft operation, and when correction of this slight leakage does not warrant the maintenance time involved, the leakage is then termed "allowable".			
3. If the fluid leakage is such that the hydraulic reservoir level may be depleted or dangerously lowered during normal operation, a fire hazard created or the air worthiness of the aircraft otherwise compromised, the leakage is termed "excessive". Under certain circumstances it may be possible to have enough components with allowable leakages such that their combined leakage will come under the classification of "excessive".			
4. Leakage checks should not be immediately performed on helicopter hydraulic systems and components that have remained in a static unpressurized condition for an appreciable period of time. The systems should be activated first and the components operated a number of times after which any hydraulic fluid should be wiped off before making leakage checks.			
5. Where fluid dropping from a component may be directly observed, do not wipe surfaces but pressurize and cycle the component until a drop falls free. Continue operating the component until another drop falls and compare results with leakage criteria.			
6. For tests requiring long period of time, and where fluid can drop, wipe the surface clean and dry but do not use a solvent. Check for leakage after the system has operated or has been idle the required period of time.			

(3) Work out any air from systems by actuating each of flight controls (cyclic stick, collective stick and tail rotor control pedals) through at least ten full strokes. Some chatter in tail rotor controls is normal with test unit.

NOTE

If air is not eliminated by procedure outlined in step (3), feedback may be experienced during flight. If feed back is experienced, accomplish step (4).

(4) Attach hydraulic test unit as outlined in preceding steps. Disconnect cyclic and collective cylinders at swashplate and collective lever. (See figure 7-3.) Ensure cylinder tubes will not strike any structure when actuated. Cycle collective and cyclic controls through ten full strokes by moving cyclic stick and collective lever. Reinstall cylinders to swashplate and collective lever. Disconnect hydraulic test unit.

g. Check operation of caution panel circuits.

(1) Reduce test unit pressure to zero, and cycle controls to lose residual pressure. Caution panel segments HYD PRESS #2 should be lighted.

(2) Slowly increase operation pressure. Both panel segment lights should go out at **700 TO 900** psig pressure.

(3) Slowly reduce pressure. Both segments should light at **600 TO 400** psig.

h. Check operation of single systems:

(1) Operate test unit at **1476 TO 1525** psig pressure.

(2) On console, place HYD TEST switch to SYS 1. Check that HYD PRESS #2 caution panel segment is lighted and HYD PRESS #1 is unlighted. Operate cyclic, collective and tail rotor controls, checking for smooth and positive response.

(3) Place HYD TEST switch to SYS 2. Check that HYD PRESS #1 caution panel segment is lighted, and HYD PRESS #2 unlighted. Operate flight controls. Cyclic and collective controls should be fully powered, smooth and positive. Tail rotor controls will lack hydraulic power, and should require more force than in normal operation.

NOTE

It is possible to overflow the #2 hydraulic reservoir if the aircraft is operated for prolonged periods with the #2 system switch in the OFF position. Always place the test switch in neutral after performing hydraulic system test.

(4) Return HYD TEST switch to center position after completing single-system checks.

i. Check emergency collective hydraulic power operation:

(1) On instrument panel, place EMER COLL HYD switch to OFF. Reduce test unit hydraulic pressure to zero. Try collective control stick, which should be very stiff in operation.

(2) Place EMER COLL HYD switch ON. Operate collective control stick, checking for not less than four full strokes obtainable before hydraulic accumulator pressure is depleted and operation of stick

becomes very stiff.

(3) If less than four full strokes of collective stick are obtainable on emergency hydraulic power, the accumulator must be checked for proper charge. (Refer to paragraph 7-9, step d.)

j. Perform operational checks of armament hydraulics system in accordance with applicable instructions.

k. Check filter bypass indicators on each hydraulic system module. Replace filters where required. (Refer to paragraph 7-7.) After replacing any filters, operate test unit to check for leaks and replenish fluid in system.

NOTE

Before shut-down of operation on external hydraulic power, center cyclic and place collective stick full down.

l. Disconnect external dc power from helicopter. Shut down hydraulic test unit and disconnect hoses from couplings on modules. Install caps on pressure test couplings. Connect hoses from reservoirs to return test couplings on modules.

m. Install fuselage panels removed for access. Close cowlings and compartment doors.

7-4. Hose, Tubing and Fittings.

When installing hydraulic fittings, hoses, or tubing, use the following as a guide:

a. *Fittings.*

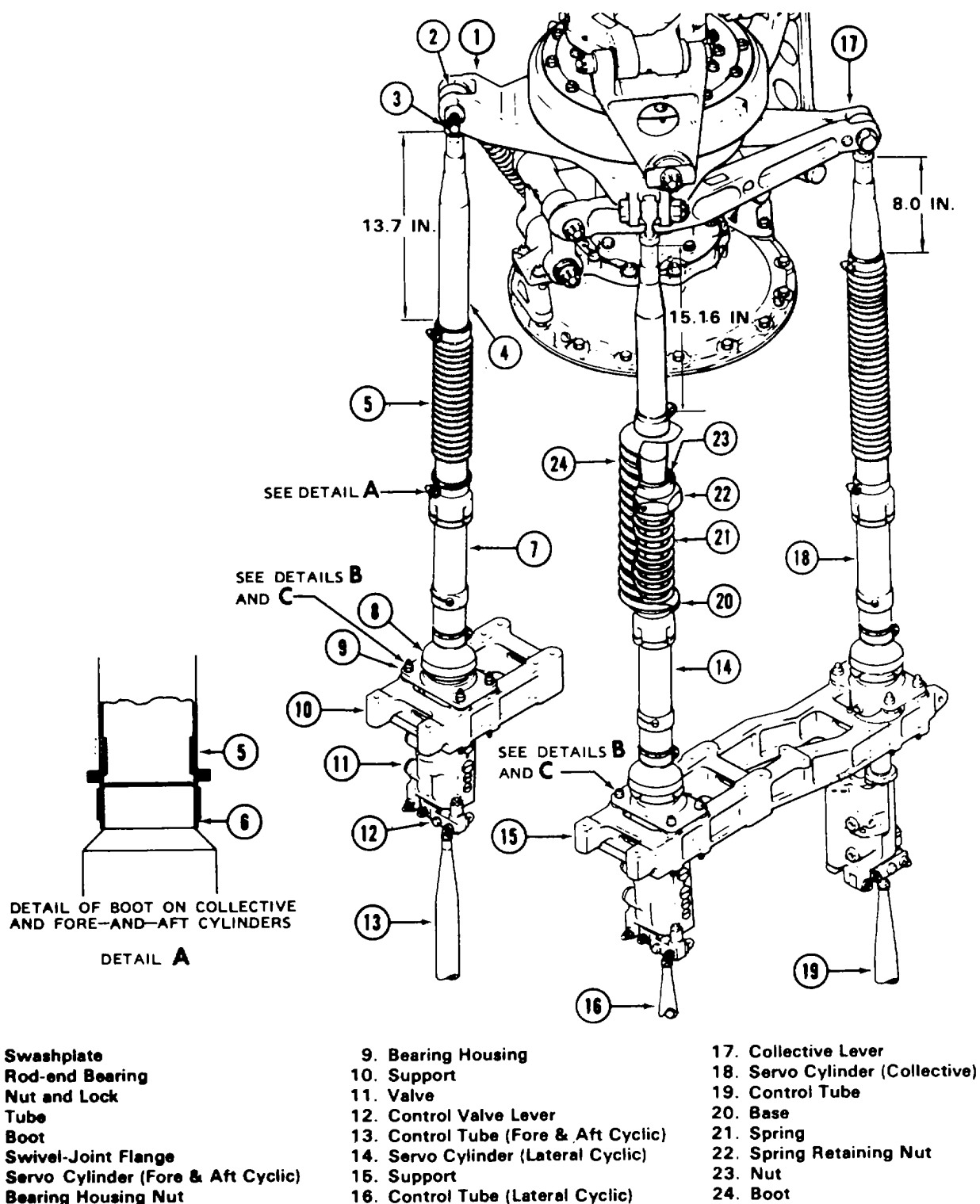
(1) Clear fittings with compressed air.

(2) Install new packings, seals, or gaskets.

(3) Make sure thread is not stripped or burred.

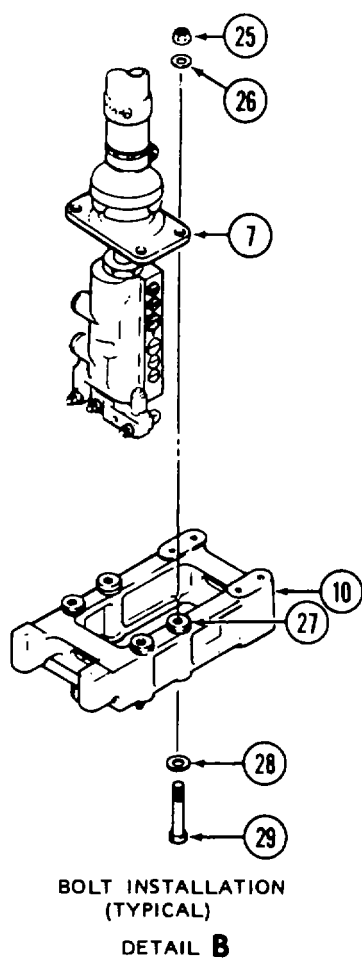
(4) Coat all seals, packing and threads with clean hydraulic fluid (C73).

(5) Align fittings with attaching lines prior to final tightening.

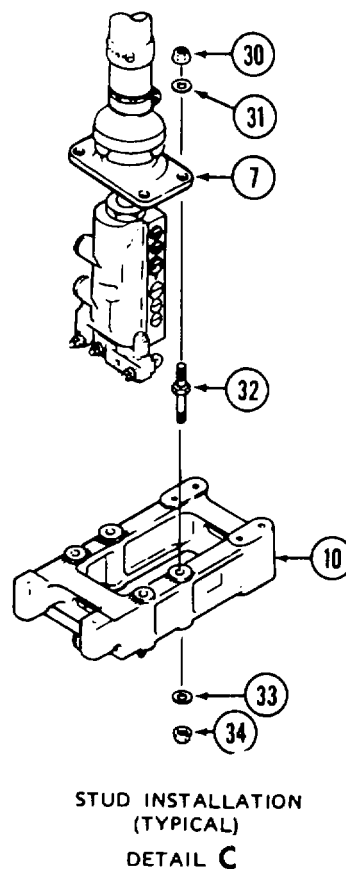


209001-119-1A

Figure 7-3. Dual hydraulic servo cylinders installation (Sheet 1 of 2)



- 25. Nut
- 26. Flat Washer
- 27. Special Washer (Bonded to Support)
- 28. Countersunk Washer
- 29. Internal Wrenching Bolt



- 30. Nut
- 31. Aluminum Washer
- 32. Stud
- 33. Aluminum Washer
- 34. Nut

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Figure 7-3. Dual hydraulic servo cylinders installation (Sheet 2 of 2)

b. Hoses.

(1) Clear hoses with compressed air before installing.

(2) Make sure thread is not stripped or burred.

(3) Make sure hoses are not frayed, cut, worn or weather-cracked.

CAUTION

Straightening bends in a used hose can result in hose becoming flattened and kinked. Do not try to straighten bends in used hoses.

(4) Make sure hoses do not become twisted during tightening of end fittings or nuts.

(5) Make sure hose is free to follow movement of components. Make sure hose does not have bends that will restrict fluid flow.

(6) Spiral wrap all areas on hoses where chafing may occur. Use teflon tape (C137).

(7) Make sure hoses are properly anchored to prevent chafing.

(8) Torque hose end fittings. (Refer to table 7-3.)

c. Tubes:

(1) Clear tubes with compressed air before installing.

(2) Make sure tubes are free from nicks, dents and deep scratches.

Table 7-3. Torque Values for Fluid Connections

*TORQUE VALUES FOR AIRFRAME FLUID CONNECTIONS
WRENCH TORQUES FOR TIGHTENING
AN 818 NUT (inch/pounds)

Dash Number Reference	Tubing OD (Inches)	Al. Aly. Tubing (Flare AND 10061 or AND 10078)		Steel Tubing (Flare AND 10061)		Hose End Fittings and Hose Assemblies (MS 28740) (AN 6292)	
		Min.	Max.	Min.	Max.	Min.	Max.
-3	1/8	-	-	-	-	-	-
-4	3/16	-	-	90	100	70	100
-5	1/4	40	65	135	150	70	120
-6	5/16	60	80	180	200	85	180
-8	3/8	75	125	270	300	100	250
-10	1/2	150	250	450	500	210	420
-12	5/8	200	350	650	700	300	480
-16	3/4	300	500	900	1000	500	850
-20	1	500	700	1200	1400	700	1150
-24	1-1/4	600	900	-	-	-	-
-28	1-1/2	600	900	-	-	-	-
-32	1-3/4	-	-	-	-	-	-
-32	2	-	-	-	-	-	-

*Flareless tubing connections shall be tightened as follows: Tighten the MS21921 nut 1/6 to 1/3 turns (1-2 HEX flats) past the point of sharp torque rise on all sizes and materials for all types of fittings or tubes.

Note: The 1/6 to 1/3 turns (performed after the presetting operation) is the final installation torque.

(3) Do not try to pull tubes into position by tightening nuts. Position tubes properly between connecting points to avoid stressing.

(4) Do not bend installed tubes. Remove tubes and bend to proper configuration, using proper tools.

(5) Spiral wrap all areas on tubes where they contact supports. Tape should extend a minimum of 3/8 inch from each end of support. Tape thickness to be **0.006** inch. Use insulation tape (C133).

(6) Make sure tubes are properly anchored to prevent chafing.

(7) Plug all open ends if tubes will not be connected immediately.

(8) Torque nuts. (Refer to table 7-3.) If leaks occur, back off nut and examine parts for damage, replace parts if necessary, and torque.

7-5. Hydraulic Pumps.

Both hydraulic system pumps are mounted on a drive quill on the right-hand side of the transmission lower case, accessible by opening transmission cowling door. System No. 1 pump is on aft pad of drive quill, and System No. 2 pump is on forward pad.

a. Inspection. Pump for leaks, damage, and security. Check drive pad on transmission for leaks.

b. Removal. Either pump can be removed in the same manner.

(1) Open transmission cowling at right hand side. Place a suitable container under pump to catch spilled fluid.

(2) Loosen hose nuts on suction port fitting on outboard end of pump and pressure port fitting at forward side. Allow fluid to drain into container. Disconnect both hoses. Cap hoses and fittings.

(3) Disconnect hose from case drain port fitting at top inboard on pump. Cap hose and fitting.

(4) Disconnect hose from seal drain port fitting at bottom inboard on pump. Cap hose and fitting.

(5) Remove washers and nuts from four mounting studs at flange of pump. Pull pump and gasket from drive pad. Cover drive pad to protect from dirt.

(6) If pump is being replaced, remove fittings from ports for use on replacement pump. Cover open pump ports. Protect driveshaft from dirt and damage.

c. Installation. Either pump can be installed in the same manner.

CAUTION

Install P/N 212-076-364-3 or vendor P/N 2514-6 in pump case drain port.

NOTE

Before installing fittings on a new pump, fill with hydraulic fluid through case drain port at top inboard side of pump.

(1) If pump is being replaced, install fittings from old pump at suction port on outboard end, pressure port on forward side, case drain port at top inboard end, and seal drain port at bottom inboard end. Use new packings.

(2) Apply a thin film of antiseize compound (C26) to pump splines and to mating splines in transmission.

(3) Position new gasket and pump to drive pad. Engage pump shaft to splines of pad, and pump flange over four studs. Install washers and nuts on studs.

(4) Connect hoses to suction, pressure, case drain and seal drain port fittings.

(5) Refill reservoir. Bleed system. Check operation of system at next ground run-up of helicopter.

7-6. Modules Unit.

Two hydraulic system module assemblies are located in a compartment at top of the fuselage between pilots canopy and the pylon, on front of bulkhead at Station 186.25. (See figures 7-4 and 75.) Hinged doors at each side give access to the compartment. Each module consists of a housing equipped with the system solenoid valve, relief valve, pressure switch for caution panel light, pressure and return filters, filter indicators, marked ports for system connections, and two quick-disconnect couplings for connection of ground test equipment (one coupling is also used in normal operation for the return hose to the reservoir). System No. 1 module is at left, and System No. 2 module at right on bulkhead.

a. *Removal.* Either module can be removed in the same manner.

NOTE

Modules will normally be left in place, since filters, valves, and other components can be replaced without removing the module housing.

(1) Open compartment door. Place a suitable container below module to catch spilled fluid.

(2) Disconnect electrical connectors from solenoid and pressure switch at top of module.

(3) Disconnect return line hose from quick disconnect coupling on front of module, and four tubes from fittings at side ports. Cap fittings and open ends of tubes.

(4) Remove three bolts, with washers and nuts, to detach module from bulkhead. Remove module from compartment.

(5) If module is being replaced, remove fittings as necessary for use on replacement module.

b. *Cleaning.* Clean electrical components with dry, filtered compressed air. Clean other parts with

solvent(C124) and flush with hydraulic fluid (C73).

c. *Inspection.* For cleanliness and damage. For leaks and malfunctions in operational checks. (Refer to paragraph 7-3.)

d. *Repair or Replacement.*

(1) Replace damaged or malfunctioning fittings, seals, and component assemblies, observing torque requirements. (See figure 74 and 7-5.)

(2) Replace filters as required. (Refer to paragraph 7-7.)

(3) Replace module housing if cracked or otherwise damaged so as to be unserviceable.

e. *Installation.* Either module can be installed in the same manner. Modules are interchangeable, but are reversed in relation to each other in mounting. Alternate pairs of ports are provided, so that quick disconnect couplings are installed on front of module housing and **plugs** are installed in the unused pair of ports on the side next to the bulkhead.

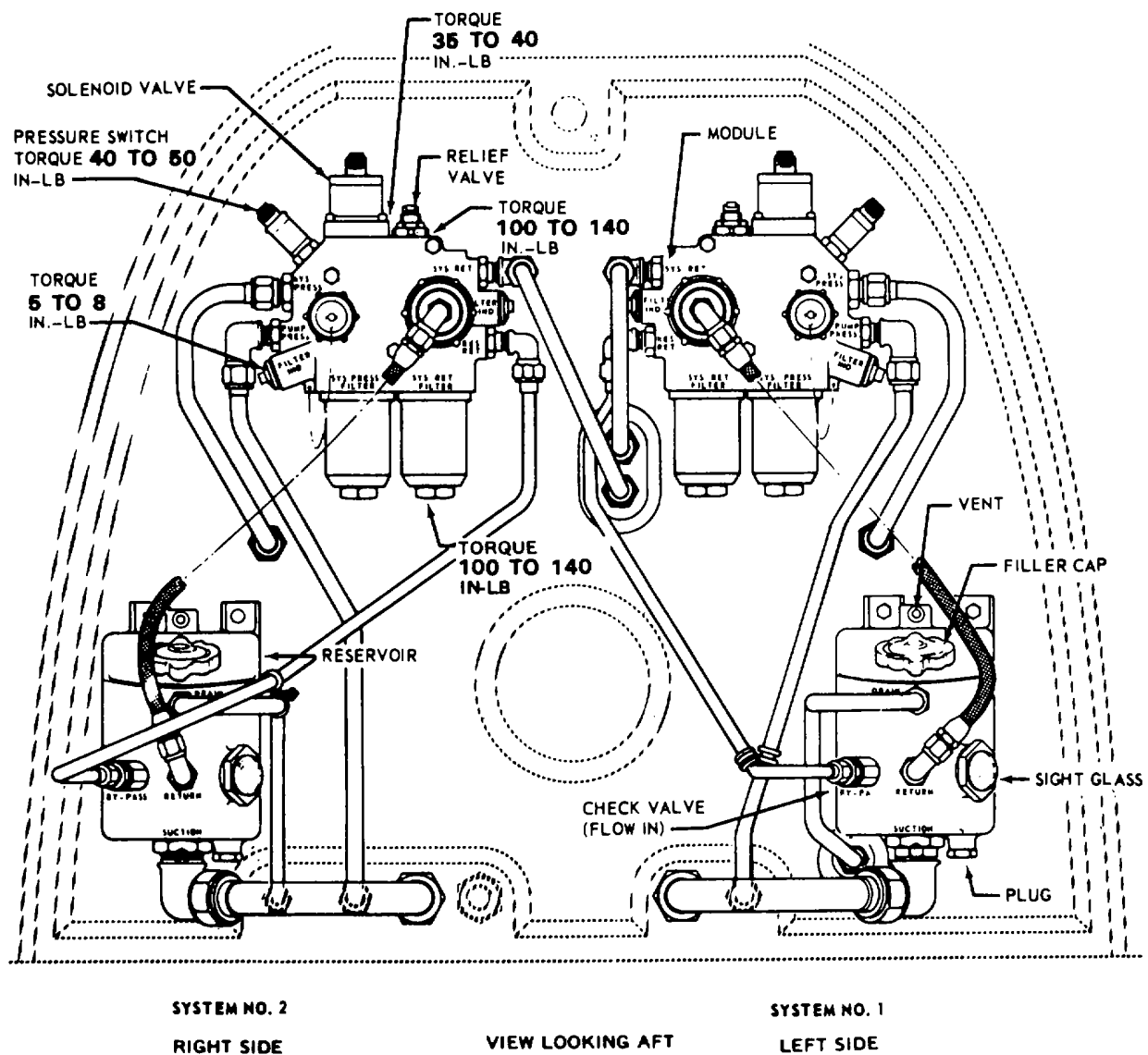
(1) If module is being replace, install serviceable fittings, and assemblies from old module as needed. Use new packings and gaskets. Replace safety wire (C161) as required.

(2) Position module to bulkhead, with pressure ports at outboard side. Align mounting holes. Insert three bolts through module holding and bulkhead, and install washers and nuts at back of bulkhead.

(3) Connect hydraulic system tubes to fittings at marked ports. Connect hose from reservoir RETURN port to quick-disconnect coupling.

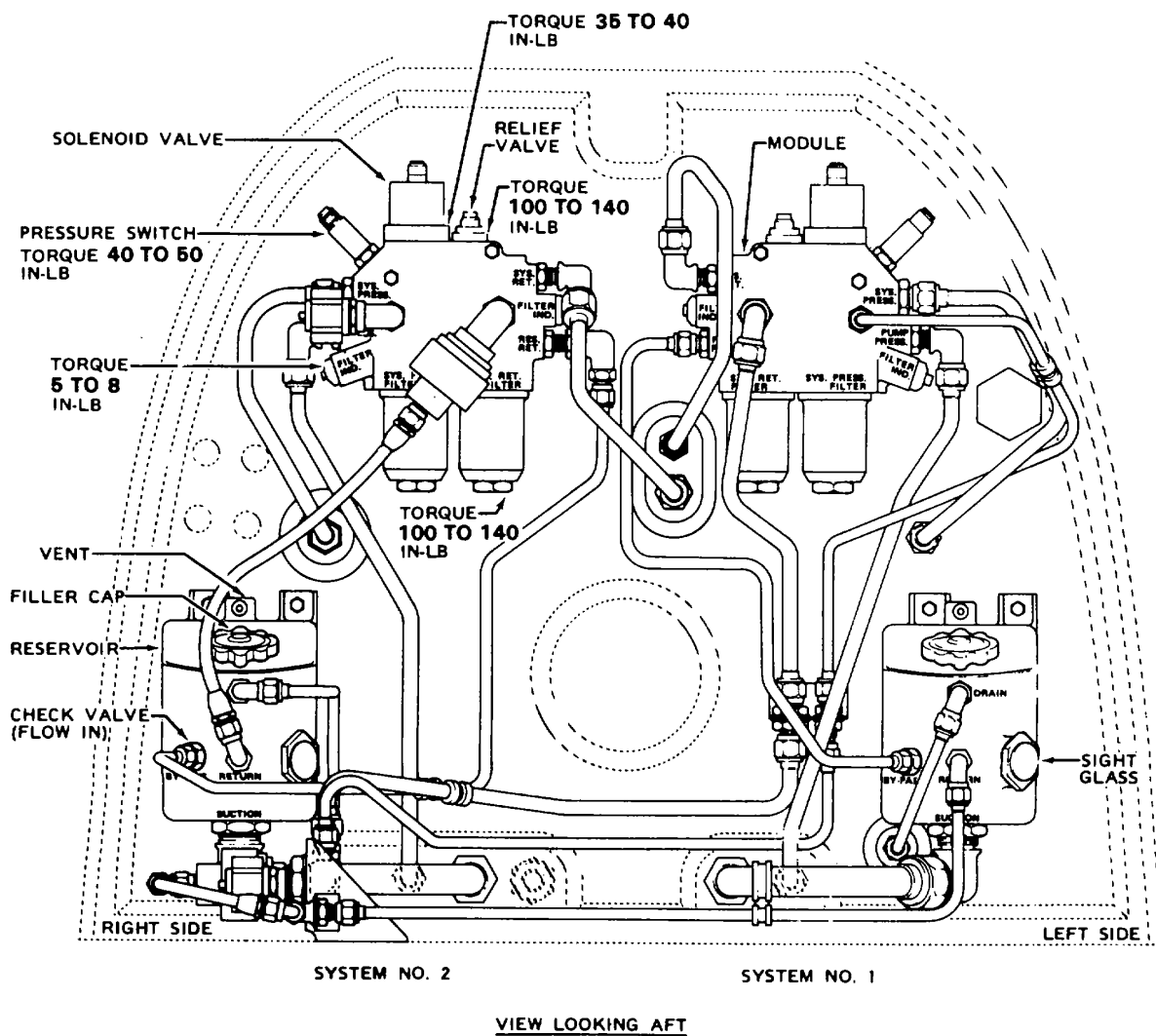
(4) Connect electrical wiring connectors to solenoid valve and pressure switch.

(5) Perform operational check. (Refer to paragraph 7-3.)



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Figure 7-4. Hydraulic reservoirs and modules (prior to Serial No. 69-16447)



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Figure 7-5. Hydraulic reservoirs and modules (Serial No. 70-15936 and Sub)

7-7. Module Filters.

Two filter elements are installed in each hydraulic modular unit. The filter elements are enclosed in filter bowls. The filter elements are the noncleanable type and are replaced at the scheduled interval. Refer to aircraft inspection check sheet. In addition, filter elements must be replaced when their respective indicator buttons are tripped during operation, except when the indicator can be reset and does not trip again, or when the condition is known to be caused by low fluid temperatures (below approximately 20°F (-6.6°C)).

Premaintenance Requirements for
Module Filter

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	One
Consumable Materials	(C124)
Special Environmental Conditions	None

a. Removal.

(1) Open compartment door. Place a suitable container below module to catch fluid.

(2) Cut lockwire from filter bowl. Use wrench to loosen and remove bowl assembly from module housing (3, figure 7-6).

(3) Remove packing (4) from housing. Remove retainer (5) and filter (7) from bowl (8).

NOTE

Filter elements must be replaced when spectrometric analysis fluid sample shows signs of contamination.

(4) Examine filter and all fluid in filter bowl for unusual contamination which might indicate need for corrective action beyond replacement of filter.

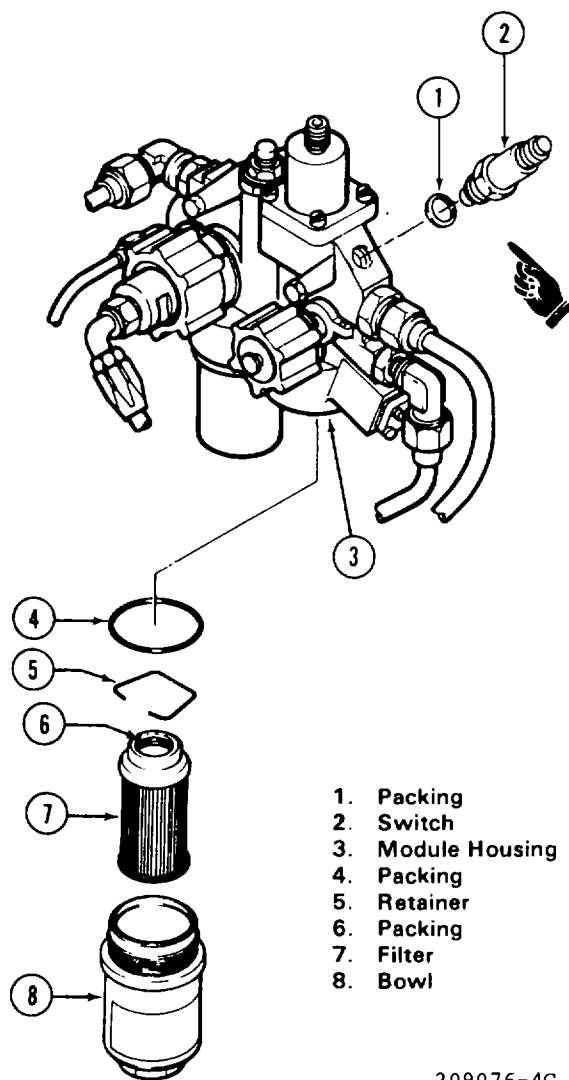
(5) Remove other filters in the same manner.

b. Cleaning.

(1) Clean filter bowl with solvent (C124), dry and flush with hydraulic fluid. (The same type hydraulic fluid that is being used in the system).

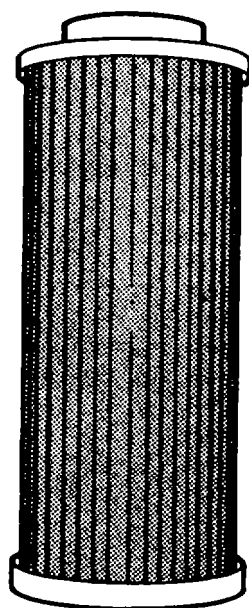
(2) Filter elements are non-cleanable. A new filter element will be installed.

c. Deleted.



209076-4C

Figure 7-6. Replacing hydraulic module filters



NON-CLEANABLE

Figure 7-7. Non-Cleanable Filter Element

All data on page 7-24, including Figure 7-8, is deleted

d. Installation.

(1) Wipe filter bowl and mating surfaces of module housing clean. Install a new packing (4, figure 7-6) into groove in housing.

(2) Inspect packing (6) for condition. If the packing is nicked, cracked, cut, or has deteriorated, replace with a MS28775212 packing.

(3) Insert filter (7) in bowl (8) and secure with retainer (5).

(4) Install bowl assembly into module housing (3). Torque bowl with 100 TO 140 inch-pounds. Lockwire bowl to housing.

(5) Install other filters in the same manner.

7-8. Hydraulic Reservoirs.

Two separate hydraulic reservoirs are located in a compartment directly aft of the pilots canopy. Both are mounted on Station 186.25 bulkhead, with System No. 1 reservoir near left side and System No. 2 reservoir near right side. (See figures 7-4 and 7-5.) Each is a non-pressurized reservoir of 3.2 pints capacity, equipped with a filler cap and screened adapter, an overflow scupper, a screened vent, a fluid vent, a fluid level sight plug, and marked ports for system connections. Hinged doors provide access to both sides of compartment, and fluid level sight plugs are placed for view from left side door.

Premaintenance Requirements for
Hydraulic Reservoir

Conditions	Requirements
Model	AH-IS
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	One
Consumable Materials	(C73) (C102) (C124)
Special Environmental Conditions	None

a. Removal. Either reservoir can be removed in the following manner.

(1) Open transmission cowling at right side for access to hydraulic pumps. Using a suitable container to catch fluid, disconnect reservoir suction hose from pump inlet fitting and allow fluid to drain from reservoir and connecting lines. Reconnect hose to pump.

(2) Open hinged door for access to reservoir compartment. Disconnect all lines and hoses from reservoir fittings. Cap or cover all open fittings. Cap or cover all open fittings and lines.

(3) Remove three bolts, with nuts and washers, to detach reservoir from bulkhead. Lift reservoir from compartment.

(4) If reservoir is being replaced, remove fittings from ports marked SUCTION, BYPASS, and DRAIN (scupper) for use in new reservoir.

b. Cleaning.

(1) Thoroughly wash and clean inside and outside of reservoir and fittings with solvent (C124). Drain completely and dry with filtered compressed air, with care to avoid pressurizing the reservoir.

(2) Flush inside of reservoir with hydraulic fluid (C73).

c. Inspection.

(1) Visually inspect filler cap adapter and strainer screen for cleanliness, damage and corrosion.

(2) Fluid level sight plug for scratches, cracks, checks, internal staining and other defects of transparency which could prevent proper sight of fluid level.

(3) Vent screen for cleanliness, damage and corrosion.

(4) Screen on inner end of RETURN port fitting for cleanliness and damage.

(5) Bosses for damaged threads and seal contact surfaces.

(6) Fitting (10) for damaged threads.

(7) Inspect reservoir for security and leaks.

(8) Inspect reservoir for cracks, nicks, and scratches. No cracks are acceptable.

(9) Check all drain line tee boss fittings in hydraulic lines for clogging.

d. Repair or Replacement.

(1) Replace filtercap strainer(3, figure 7-A) if corroded or damaged.

(a) Remove cap (1) from adapter (2).

(b) Remove adapter (2) and screen (3) from reservoir (5).

(c) Clean threads of adapter (2) and opening of reservoir.

(d) Place screen (3) into port of reservoir (5).

(e) Apply a light coat of primer (C-102) to threads of adapter (2) and install adapter in reservoir (5).

(2) Replace vent screen (4) if required due to damage or clogging.

(a) Three point stake areas securing screen (4) must be removed, by grinding or sanding, to remove screen (4).

(b) Place screen (4) into port of reservoir (5) and point stake in three places.

(c) Ensure security of vent screen.

(3) Replace sight-gage (8) if unserviceable due to staining or damage.

(a) Remove lockwire from sight gage (8). Remove sight gage (8) from reservoir (5). Discard packing (9).

(b) Install new packing (9) on sight gage (8) and install sight gage to reservoir (5). Secure sight gage to reservoir with lockwire (C161).

(4) Replace fitting (10) if unserviceable due to corrosion or cracks.

(a) Break torque on nut (11) and remove fitting (10). Remove packing (13), ring (12) and nut (11) from fitting (10).

(b) Install nut (11, ring (12) and new packing (13) on fitting (10). Install fitting (10) to reservoir (5).

e. Installation Either reservoir can be installed in the following manner.

(1) Check reservoir assembly to make sure all fittings are properly installed. If replacing a reservoir assembly, install the following parts which are not included on spares:

(a) For SUCTION boss, assemble and install an elbow, nut, packing and ring. Position elbow to point forward and inboard when reservoir is in place.

(b) For BY-PASS boss, assemble and install a bushing, two packings, and a relief valve with flow arrow pointing toward reservoir.

(c) For scupper DRAIN boss, assemble and install an elbow, nut, packing, and ring. On System No. 1 reservoir, elbow should point down between RETURN and BY-PASS fittings. On System No. 2 reservoir, elbow should point slightly down but above sight plug.

(2) Position reservoir on lower front of bulkhead Station 186.25. Align mounting lugs to holes provided. Install three attaching bolts, secured by washers and nuts on aft side of bulkhead.

(3) Connect lines and hose to reservoir fittings. (See figure 7-2.)

(4) Service and test hydraulic system. (Refer to paragraph 7-3.)

7-9. Accumulator (Emergency Collective).

A piston type air-oil pressure accumulator is incorporated into System No. pressure lines to the collective control hydraulic power cylinder. The installation includes the accumulator with its air pressure gage and valve, a pressurized lockout

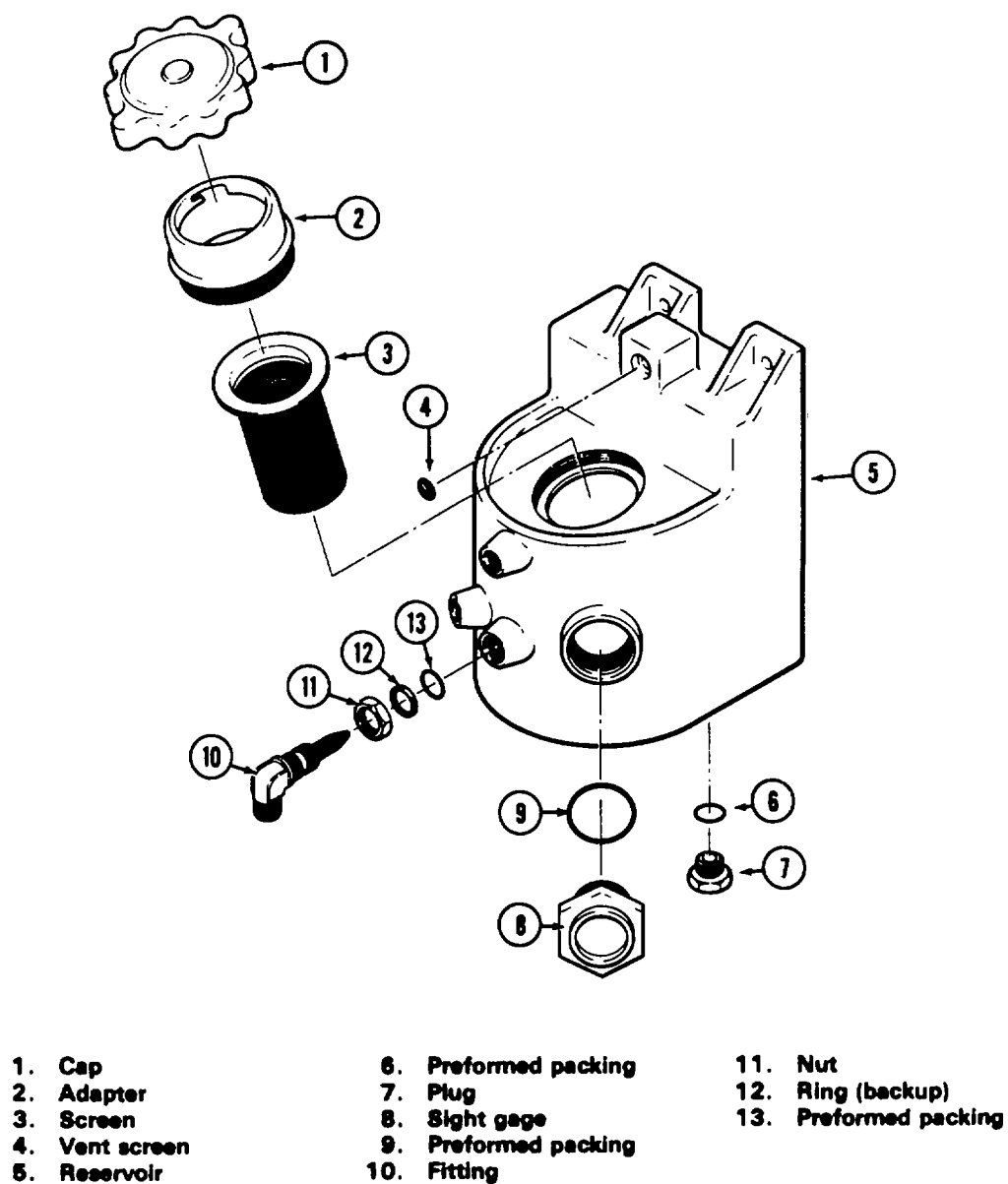
valve with a relief valve and line, a solenoid valve, check valves, a manual drain valve, a bleeder plug, and return hoses with couplings which are normally disconnected and stowed. (See figure 7-1 and figure 7-2.) These parts are located in the compartment below the transmission pylon, with access by doors attached with cowling fasteners on each side of fuselage below wings.

Premaintenance Requirements for
Emergency Collective Accumulator

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel	Two
Required	
Consumable Materials	(C73) (C89) (C96) (C124)
Special Environmental Conditions	None

a. *Cleaning.* Clean external surfaces of accumulator and attached parts by wiping with a cloth moistened with solvent (C124).

b. *Inspection.* Accumulator assembly for general condition, evidence of leaks, security of fitting, and indications of damage to gage. Fittings for damaged threads. Malfunctions will be found in operational check. Check accumulator for state of charge.



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Figure 7-8A. Hydraulic reservoir assembly - exploded view

c. *Repair or Replacement.*

- (1) Replace valve for leaks or other malfunction.
- (2) Replace pressure gage for leaks, damage, or malfunction.
- (3) Replace accumulator for leaks, damage or malfunction.
- (4) Replace fittings, supports, or attaching parts for damage or worn threads.
- (5) Recharge accumulator if required.

d. *Charging.* **When a pilot report or ground operational check reveals that emergency collective hydraulic power is not sufficient for four full strokes of collective control stick (with system hydraulic power off and EMER COLL HYD switch on), proceed as follows:**

- (1) Obtain access to hydraulic accumulator by removing panel door attached with cowl fasteners on right side of fuselage directly below wing.
- (2) Deplete accumulator of hydraulic pressure before checking gas pressure gage reading.
  - (a) Operate collective stick in short strokes until stiff operation indicates lack of accumulator pressure.
  - (b) To drain any remaining fluid from accumulator, use the stowed drain hose provided. Remove cap from return line nipple located on right side of bracket above accumulator, near bulkhead Station 213.94 and just inside access opening. Disconnect hose socket from dummy coupling on front side of bracket. Connect hose to return line nipple. (If hose cannot be coupled due to pressure in line, bleed off pressure by slightly loosening bleeder plug in tee on which hose is connected. Retighten plug after relieving pressure.) Depress drain valve and hold for 30 seconds to drain fluid. Release valve.

CAUTION

Never use this drain valve with hydraulic system operating.

(c) Disconnect hose and stow on dummy coupling. Install cap on nipple.

(3) Check accumulator pressure gage. Pointer will be in green marking if accumulator gas pressure precharge is correct (650 to 850 psi).

(a) If gage pointer is below green area, remove cap from accumulator valve and attach hose from a cylinder of compressed nitrogen (C89). (See figure 7-9.) Using 650 to 850 psig supply pressure, charge accumulator until gage pointers in green area. Disconnect supply hose.

CAUTION

Do not overcharge accumulator gas pressure in attempt to obtain more strokes of control stick in emergency collective operation. Excessive gas precharge will actually reduce strokes available by reducing amount of hydraulic fluid in accumulator.

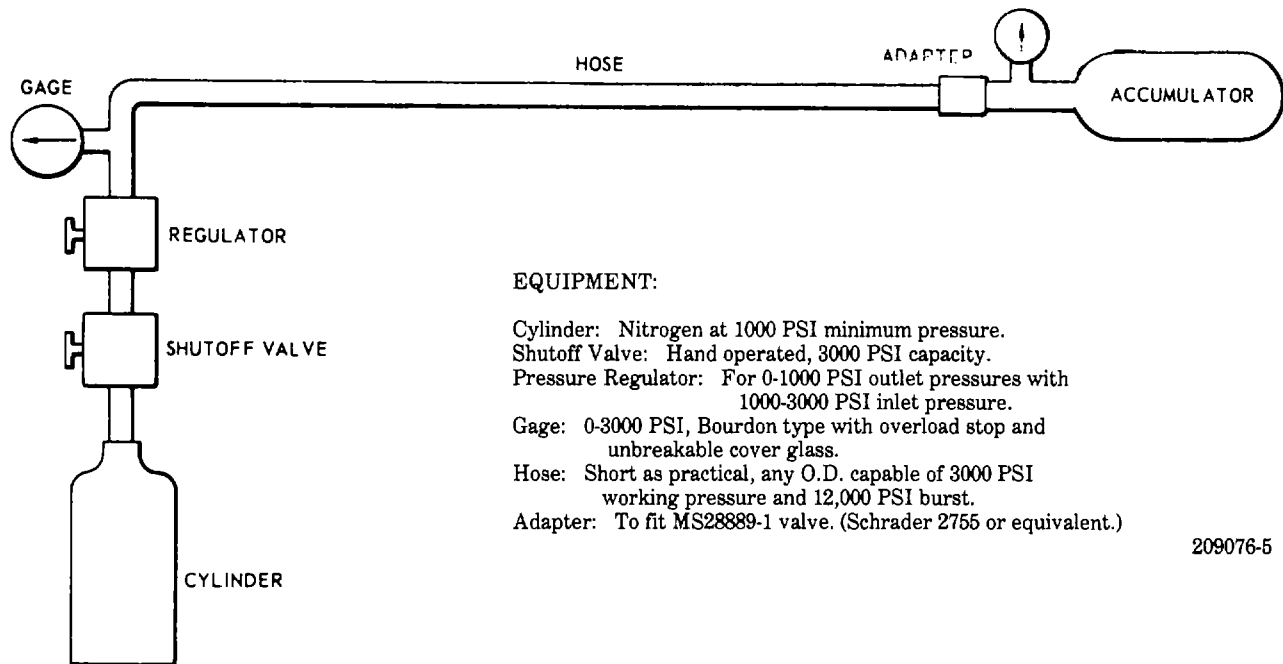
(b) If accumulator is overcharged, with pressure gage pointer above green marking, bleed off excessive pressure through accumulator valve. Install cap on valve when precharge is correct.

(c) If gas leakage is suspected, recheck gage reading after a suitable time interval.

(4) After charging accumulator, use a portable test unit to repeat operational check of emergency collective hydraulic power. (Refer to paragraph 7-3.)

(5) When operation is satisfactory, remove test unit and close access openings.

e. *Maintenance of Valves.* The valves used in the emergency collective hydraulic installation are located near Station 213.94, in the right side of the fuselage compartment below the transmission pylon. These include the pressurized lockout valve, solenoid valve, check valves, relief valve and pressure drain valve. (See figure 7-2.) Any of the valves and lines of the accumulator installation can be replaced if malfunction occurs. Perform operational check after replacing or reinstalling any components.



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Figure 7-9. Emergency Hydraulic accumulator charging diagram

CAUTION

Before loosening any connections in accumulator circuit, be certain that trapped hydraulic pressure is released. (Refer to paragraph 7-9, step d.)

NOTE

When installing solenoid valve in Emergency Hydraulic Accumulator System (figure 7-2, sheet 1) install valve with arrow pointing down regardless of valve part number.

f. Removal.

CAUTION

Before disconnecting any lines associated with the accumulator, be certain that trapped hydraulic pressure is released.

(1) Drain hydraulic fluid from accumulator as though

preparing to precharge. (Refer to paragraph 7-9, step d.)

(2) Remove cap from charging valve and release nitrogen pressure.

(3) Disconnect hydraulic line from fitting on inboard end of accumulator. Cap open line and fitting.

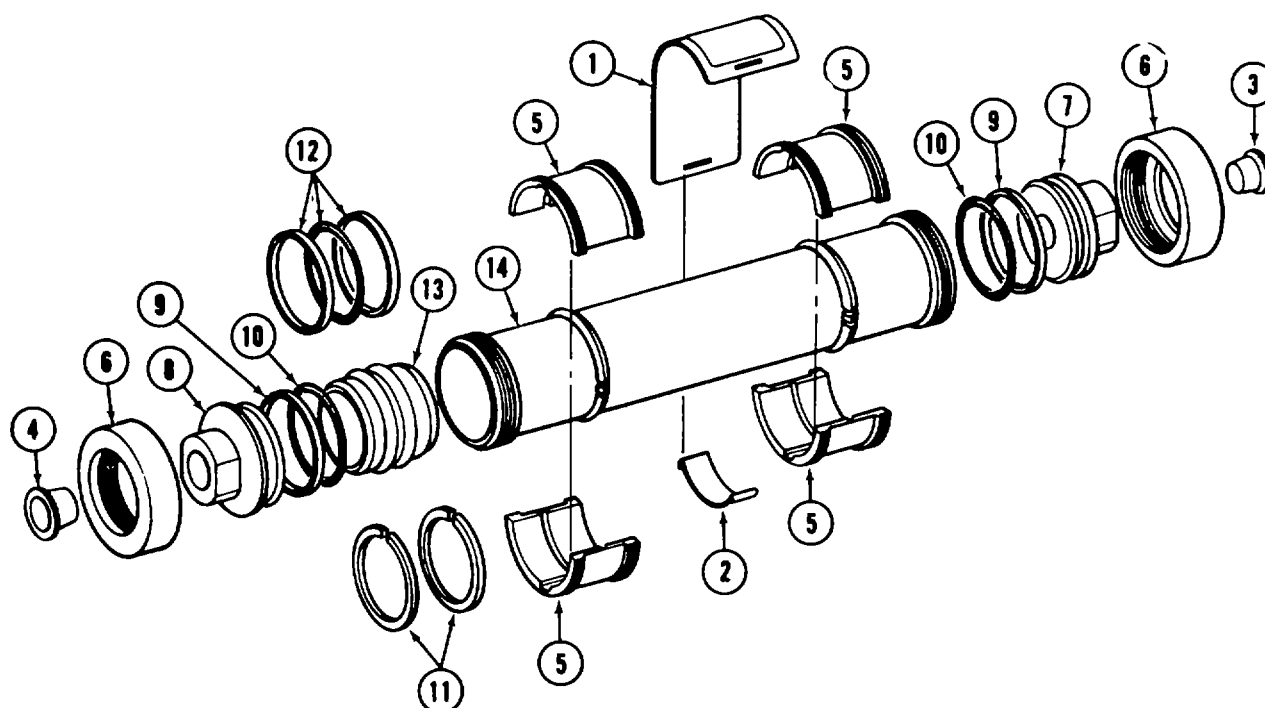
(4) Remove bolts securing supports. Remove accumulator assembly through access door.

g. Disassembly.

NOTE

Determine whether the accumulator to be repaired is manufactured by Parker-Hannifin Corporation or Sprague Engineering. Refer to appropriate figure 7-10 or figure 7-11 for disassembly.

(1) Remove lockwire and half mounting rings (5, figure 7-10) on Parker Hannifin accumulator.



1. Identification Band	8. Hydraulic End Cap
2. Strap	9. Back-up Ring
3. Plug	10. Packing
4. Plug	11. Aligning Ring
5. Half-Mounting Ring	12. Seal Assembly "T"
6. Nut	13. Piston
7. Air End Cap	14. Cylinder

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Figure 7-10. Hydraulic accumulator assembly (Parker-Hannifin)

(2) Remove safety wire and pins (1, figure 7-11) from end caps on Sprague accumulator.

CAUTION

The holding device used must encase the accumulator with equal tightness around its circumference. Vice jaws should not be used because the tightness will be unequally distributed and will distort the accumulator cylinder.

Do not use a sharp or pointed object to remove piston from cylinder.

(3) Place accumulator in bench clamp fixture to hold accumulator during disassembly.

(4) Disassemble the remaining parts of the accumulator according to the sequence of index

numbers in figures 7-10 or figure 7-11. Keep the identification band with the accumulator from which it was taken.

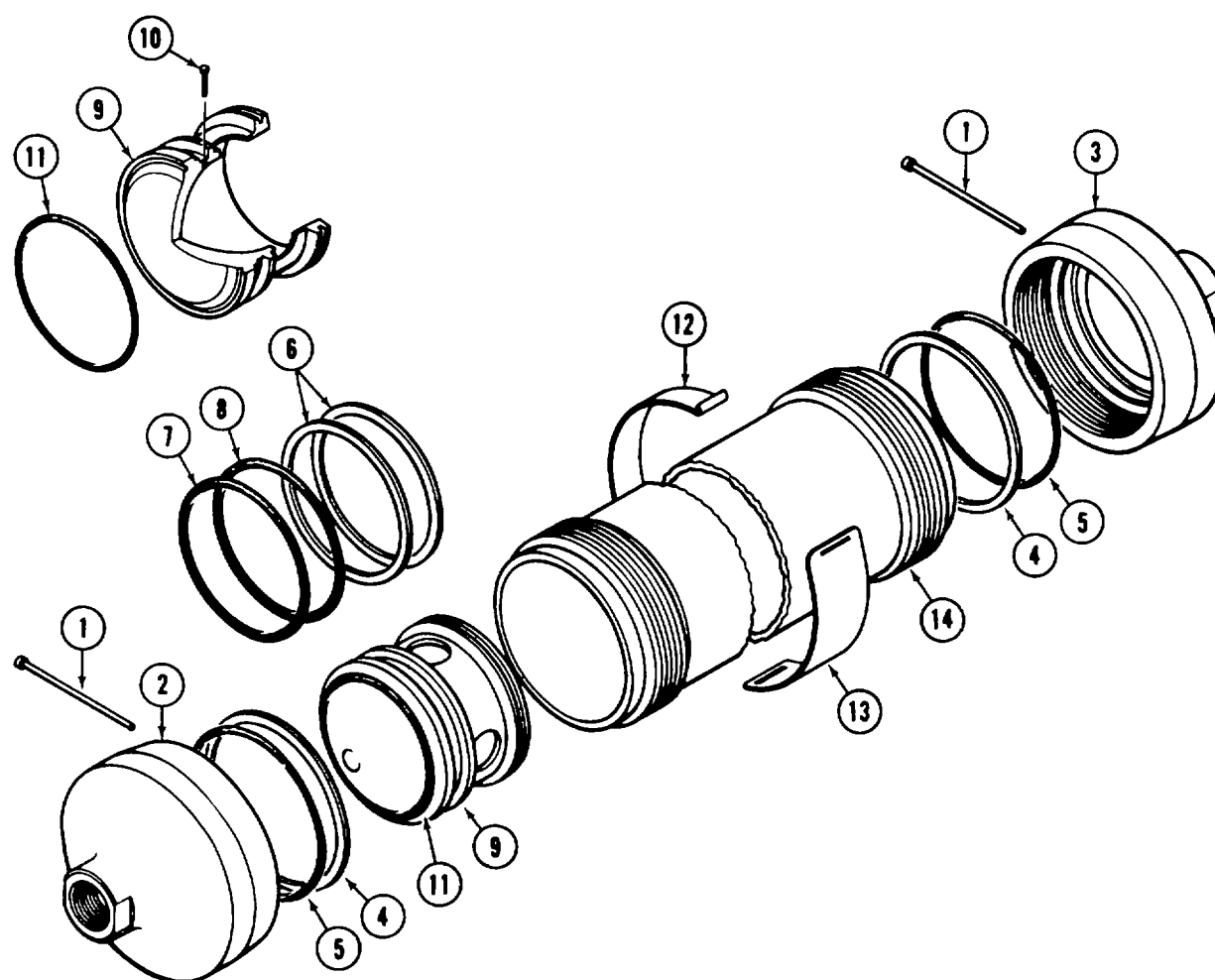
h. Cleaning.

WARNING

Use solvent (C124) in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

(1) Wash all metal parts with solvent (C124).

(2) Dry with filtered, compressed air.



1. Pin	8. Packing
2. Air End Cap	9. Piston
3. Hydraulic End Cap	10. Pin
4. Backup Retainer	11. Packing
5. Packing	12. Strap
6. Backup Retainer	13. Identification Band
7. Packing	14. Cylinder

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Figure 7-11. Hydraulic accumulator assembly (Sprague)

i. Inspection.

(1) Inspect ID of cylinder and OD of piston for evidence of scratches, scoring, or other damage affecting free sliding motion of piston in cylinder.

(2) Check threads for condition and cleanliness.

(3) Inspect metal parts for structural damage.

(4) Check proper fit of piston in cylinder. There should be no points of wear.

j. Repair and Replacement.

(1) Do not attempt repair or replacement of metal parts.

(2) Replace rings (9 and 11 figure 7-10), packing (10) and seal assembly "T" (12) on Parker Hannifin accumulator. Replace all backup retainers (4 and 6, figure 7-11) packings (5, 7, 8, 11) on Sprague accumulator.

k. Lubrication.

(1) Apply light coating of hydraulic fluid, (C73) to all internal packings and backup rings.

(2) Lubricate threads with hydraulic fluid (C73) or petrolatum (C96) to facilitate reassembly.

l. Assembly.

(1) Assemble in the reverse of disassembly.

NOTE

Replace piston in cylinder with face of piston toward hydraulic end cap of cylinder.

(2) Screw end caps onto cylinder. Hold accumulator by flats on one end cap and torque other end cap 1400 TO 16500 inch-pounds torque.

(3) Lockwire half-mounting rings to cylinder (on Parker- Hannifin accumulator).

(4) Safety wire the hydraulic and air end cap retaining pins in position (on Sprague accumulator).

(5) Check that identification band is in

place on accumulator.

m. Testing.

(1) Test equipment must have capability to provide controlled hydraulic fluid pressures to 3000 psig and air, or nitrogen, pressures to 1000 psig.

WARNING

Exercise extreme caution with test equipment as the air or nitrogen is under pressure.

NOTE

Use nitrogen or dry air for testing. Fluid used for testing must be the same as that used for installed accumulator to prevent contamination.

(2) Piston seizure test.

(a) Connect pressure source to end cap nearest to piston and slowly apply pressure not to exceed 50 psig. The piston should move the entire length of the cylinder with no seizing or binding.

(b) Connect pressure source to other end cap and repeat same procedure as in (2) (a).

(c) Repeat (2) (a) and (b). If the accumulator fails any part of the test, improper fit or surface damage is indicated.

(d) After test is completed, connect pressure source to an end cap and apply pressure to move piston to approximate center of accumulator.

(3) Proof pressure test:

WARNING

Remove all air from both air and hydraulic chambers of the accumulator and connecting lines. Be certain that connecting lines and connections are capable of withstanding 3000 psig

(a) Fill hydraulic end and air end of accumulator with hydraulic fluid. Plug one end cap port and apply 3000 psig hydraulic pressure to other port.

(b) Hold pressure for five minutes. If there is any external or internal fluid leakage or evidence of damage or deformation, correct the discrepancy and repeat the test.

(4) Hydraulic leakage test.

(a) With air port open, apply 3000 psig hydraulic pressure and hold for three minutes. If there is any external or internal fluid leakage, correct the discrepancy and repeat the test.

(b) Repeat the test outlined in step (a) with 2 psig hydraulic pressure.

(5) Air leakage test: air end cap.

(a) Remove all fluid hydraulic pressure from hydraulic chamber of accumulator.

(b) Apply 200 psig air pressure into air chamber and hold for three minutes. If there is any external air leakage at air end cap, correct the discrepancy and repeat the test.

NOTE

A leakage test check can be performed by making a continuous ring of oil on groove formed by air end cap and cylinder. Bubbles that form and do not dissipate in one minute indicate a leak.

(6) Air leakage test: fluid end cap.

NOTE

A leakage test check can be performed by filling hydraulic end cap port with hydraulic fluid. Bubbles that form indicate a leak.

In an emergency, the accumulator may be installed and operated in the aircraft, in lieu of this test.

(a) With hydraulic port open, apply 200 psig air pressure to accumulator and hold for three minutes. There should be no leakage at hydraulic port.

(b) Repeat test (6) (a) using 1000 psig air pressure.

n. Testing accumulator Drain Valve. (AVIM)

(1) Connect valve assembly to test stand capable of delivering hydraulic fluid (C73) at a rate of 5 gallons per minute at a pressure of 3000 PSIG. Oil must be continuously filtered thru a 10 micron filter.

(2) Pressure.

(a) Operating, 1500 PSI.

(b) Proof, 2250 PSI.

(c) Burst, 3750 PSI.

(3) leakage:

(a) External: None

(b) Internal: One drop in 15 minutes at 5 to 1500 PSIG.

(4) Flow: 1.25 cubic inch minimum in 30 seconds at 900 PSIG maximum.

(5) Maximum load to open: 30 pounds at 1500 PSIG.

o. Installation.

(1) Check that pressure gage, charging valve, and fittings are installed on accumulator.

NOTE

If clamp loop (P/N MBS65462) is installed in place of the phenolic block support, align clamp loop holes with holes in panel and install bolts (AN 45A) using standard torque (**50 TO 70** inch-pounds)

(2) Position accumulator, with valve pointing aft and outboard, in two pairs of phenolic block supports on horizontal panel in fuselage compartment below right wing. Align supports to mounting holes in panel, and insert bolts with washers under heads. To prevent excessive clamping, use washers for **0.100 TO 0.140** shim thickness to fill gap between supports on each bolt. bolt.

(3) Connect hydraulic line to fittings at inboard end of accumulator.

(4) Charge accumulator. (Refer to paragraph 7-9, step d.)

CAUTION

If diagonal structural tube was removed from access opening, it must be reinstalled before flight.

(5) Perform operational check. (Refer to paragraph 7-3.)

7-10. Lockout Valve and Accumulator (Cyclic Control).

The hydraulic accumulator and lock-out valve assembly, in System No. 1 pressure line to cyclic control hydraulic cylinders, is located beneath the

pylon lift beam. The accumulator and valve are automatic in operation, with no electrical or manual controls, and do not require any charging procedure. The lock-out valve is interchangeable with the valve used in the collective controls hydraulic circuit.

a. Removal.

(1) Remove fuselage access door below left wing.

(2) Move pilots cyclic stick until movement becomes difficult as accumulator pressure is depleted.

(3) Place a suitable container below accumulator and valve assembly to catch trapped fluid.

(4) Using care to avoid spraying of fluid if any pressure is still trapped, disconnect hydraulic connections from fittings in ports of lock-out valve marked PRESS, SYS PRESS, SYS RET, and RES RET. Cap ends of hydraulic lines.

(5) Detach valve (26, figure 7-IIA) from mounting bracket by removing three bolts (25) with nuts (23), washers (21 and 24), and spacers (22). Remove valve and accumulator assembly.

(6) When replacement of parts is necessary, remove fittings and packings from marked ports of valve. Cover open ports.

CAUTION

Do not disturb valve spring housing which extends from end of valve directly opposite port marked PRESS.

(7) Using a wrench on two milled flats on accumulator, loosen and remove accumulator and packing from lock-out valve. Cover openings.

b. Cleaning. Clean external surfaces of accumulator and valve by wiping with a cloth moistened with solvent (C124), but do allow solvent to enter units.

c. Inspection. Valve, accumulator, and fittings for external damage and defective threads or sealing surfaces.

d. Repair or Replacement.

(1) Replace accumulator or lock-out valve or both if malfunction or damage occurs.

(2) Replace any defective fittings.

(3) Replace packings at reassembly.

e. Installation.

(1) Assemble accumulator, valve, and fittings if parts were removed:

(a) Place new packing (16, figure 7-11A) lubricated with hydraulic fluid (C73), on accumulator (17). Screw accumulator into valve port (26) until it bottoms tightly on valve body.

(b) Install union (19) with packing (20) in RES RET port.

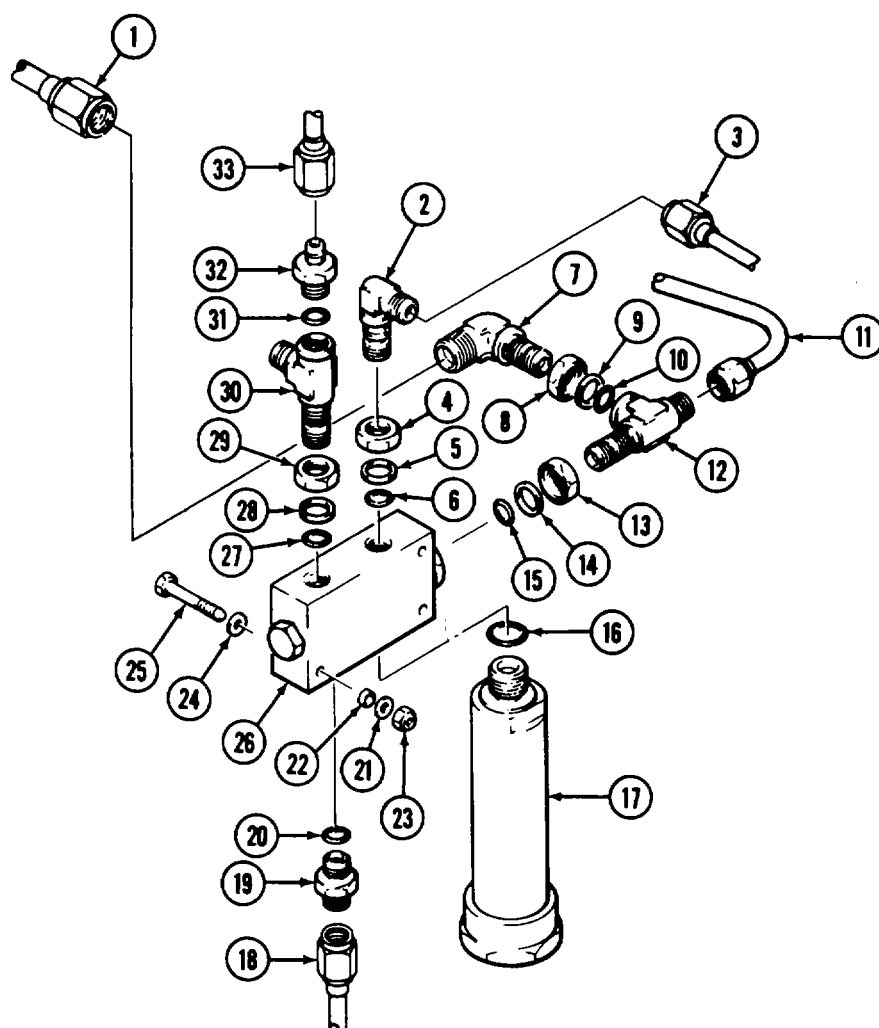
(c) Install elbow (2) with nut (4), back-up ring (5), and packing (6), in SYS PRESS port.

(d) Install tee (30) with nut (29), ring (28), and packing (27) in SYS RET port. Install reducer (32) with packing (31) in outer end of tee.

(e) Install tee (12) with nut (13), ring (14), and packing (15) in PRESS port. Install elbow (7) with nut (8), ring (9), and packing (10) in tee.

(2) Position valve (26), with accumulator (17) down and PRESS port aft, on inboard side of mounting bracket below and aft of lift beam. Attach valve (26) with three bolts (25), with washers (21 and 24) under heads and nuts (23), and spacers (22) between valve and bracket.

(3) Align fittings and connect hydraulic tubes. (See figures 7-1 and 7-2.)



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1. Tube Assembly	12. Tee	23. Nut
2. Elbow	13. Nut	24. Washer
3. Tube Assembly	14. Ring (Backup)	25. Bolt
4. Nut	15. Preformed Packing	26. Lockout Valve Assembly
5. Ring (Backup)	16. Preformed Packing	27. Preformed Packing
6. Preformed Packing	17. Accumulator Assembly	28. Ring (Backup)
7. Elbow	18. Tube Assembly	29. Nut
8. Nut	19. Fitting	30. Tee
9. Ring (Backup)	20. Preformed Packing	31. Preformed Packing
10. Preformed Packing	21. Washer	32. Fitting
11. Tube Assembly	22. Spacer	33. Tube Assembly

Figure 7-11A. Lockout valve and accumulator

(4) Perform operational check before flight. Reinstall access doors.

7-11. Dual Hydraulic Servo Cylinders.

Three dual hydraulic actuated servo cylinders are used in collective, lateral cyclic, and fore-hand cyclic controls. (See figure 7-3.) Each cylinder assembly consists of a dual cylinder and valve combination, a bearing and housing, and an extension tube on the cylinder piston rod. All three have the same cylinder and valve group, but use different extension tubes. Valves and rod end bearings are aligned in each assembly by locks in slots provided.

Premaintenance requirements for dual hydraulic servo cylinders

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel	Two
Required Consumable Materials	(C52)(C73)(C102) (C124)(C134)
Special Environmental Conditions	Dust free

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

a. *Cleaning* Clean external surfaces, except polished surfaces of piston rod and control valve, by wiping with a cloth moistened with solvent (C124). Carefully clean exposed polished surfaces of piston rod and control valve with a soft cloth moistened with hydraulic fluid (C73).

b. *Inspection.*

(1) All parts for damage, corrosion or pitting, and exposed threads for distortion.

(a) No elongation in holes allowed.

(b) Black residue around the piston rod is not a reason for replacement of the servo cylinder.

(2) Piston rod for nicks, scratches, or scoring, and for smooth operation in cylinder. A friction drag of approximately 2.5 pounds is considered normal.

NOTE

*Hydraulic Cylinder Assemblies containing Bearing P/N KSP 6099-1 do not require spring scale check. The required friction has been built into this bearing during manufacturing process and requires no further adjustment. The bearing is designed to gimbal freely, thus does not have the characteristic tightness as the unbalanced bearing which requires the spring scale check. The rotational freedom of the KSP 6099-1 bearing should not be interpreted as wear, and the axial movement should not be considered as excessive unless feed back is felt in the controls. The KSP 6099-1 bearing does not require lubrication, and should have plugs in the grease fitting (23, Figure 7-14) holes. Installation of KSP 6099-1 bearing requires that the bearing housing nut (25) be torque 1100 to 1180 inch-pounds. This torque does not affect the friction of the bearing. KSP 9046-5 shield replaces **the rubber boot on the bearing housing nut (25), when KSP 6099-1 bearing is used.***

(3) Check bearing installation for looseness or binding. To check the bearing installation, perform the following:

(a) Disconnect the cyclic servo actuator upper control tubes from swashplate and collective servo actuator upper control tubes from the collective lever.

(b) Disconnect the push-pull tubes from the bottom of all three servo actuators.

(c) Bottom servos in full up position. Inspect servo valve for serviceability. Check selector set for sticking or binding. Inspect lever stop for distortion. Inspect bolts through arm lever for wear and distortion; bolts to be finger tight only. Check cotter pins for security. Inspect bearing housing for damage (figure 7-13) and flange for cracks and elongation of holes; holes not to exceed 0.001 beyond dimensions shown in view A, figure 7-12.

(d) Attach a pound reading spring scale to the cleaning- is or rod end at the top of the control tube. Working with each servo independently, move the actuators laterally until they bottom out. A force

of **1 TO 2.5 pounds** should be required to move bearing through its full travel with the servo fully extended.

(e) If the force required to move the bearing is above or below the requirements established in step (d) above, lubricate the bearing (refer to chapter 1), tighten bearing housing nut (8, figure 73) to a torque of **400 to 450** inch-pounds and rotate the cylinder inside the housing through full travel several times to ensure proper seating of the bearing surfaces. Loosen the nut (8) and retighten to obtain **1 to 2.5** pounds drag on the bearing. Measure with spring scale, as described in step (d) above.

1. Torque lower retaining nut (22, figure 7-14) **900 TO 1000** inch-pounds. Make sure nut is safetied properly with tab washer (21).

NOTE

To properly assemble tab washer on cylinder assembly, fit the tab on the inside of washer into machined slot of cylinder barrel before retainer nut is tightened.

2. Torque the bearing housing nut (25) **400 to 450** inch-pounds to ensure proper seating of the bearing surfaces.

3. Loosen nut (25) and retorqued until a force of **1 to 2.5** pounds is required to move cylinder laterally.

4. Double lockwire retaining nut 180 degrees apart. One lockwire shall be a positive lock and one negative. Paint slip marks on bearing retaining nut and bearing housing.

NOTE

It is permissible for the main rotor cylinder barrel to rotate within the housing assembly providing there is no vertical barrel movement. When vertical movement is apparent, retorqued the lower retaining nut (22, figure 7-14). Recheck force required to move the cylinder. Refer

to paragraph 3. above.

NOTE

Ensure support mounts are lubricated every 100 hours of operation. To properly grease, detach the rod end from the pitch control lever or a wash plate horn. Rotate the cylinder assembly in the bearing housing while applying grease. Rotating the cylinder will assure complete lubrication of the bearing. Assemble rod end to the pitch control lever or to swahplate horn.

(f) Reinstall and safety all control tubes previously removed in preceding step (a) and (b).

(g) For cylinder assembly P/N 209-001-362.

1. Verify rotational freedom of bearing. Freedom of bearing rotation and axial play are acceptable unless there is excessive feedback in the controls.

2. Verify plugs installed in lieu of grease fittings (figure 7-12, view C). these bearings do not require lubrication.

3. Verify bearing housing retaining nut torque **1100 TO 1180** inch-pounds.

4. Verify protective shield assembly installed in lieu of rubber boot.

5. Verify lockwire as shown in figure 7-12, view A, but install only one lockwire. This bearing does not require double lockwire (safety).

(4) Isolated external pits (gouge marks) on cylinder barrel not exceeding **0.030** inch depth are acceptable. External scoring not exceeding **0.010** inch depth may extend 360 degrees around cylinder wells. Remove stress risers by blending scored and pitted area. Treat rework area with Chemical film (C37). Cylinders with anodized damage one-half inch or less in tunnel area may be spot repaired by brush type coating.

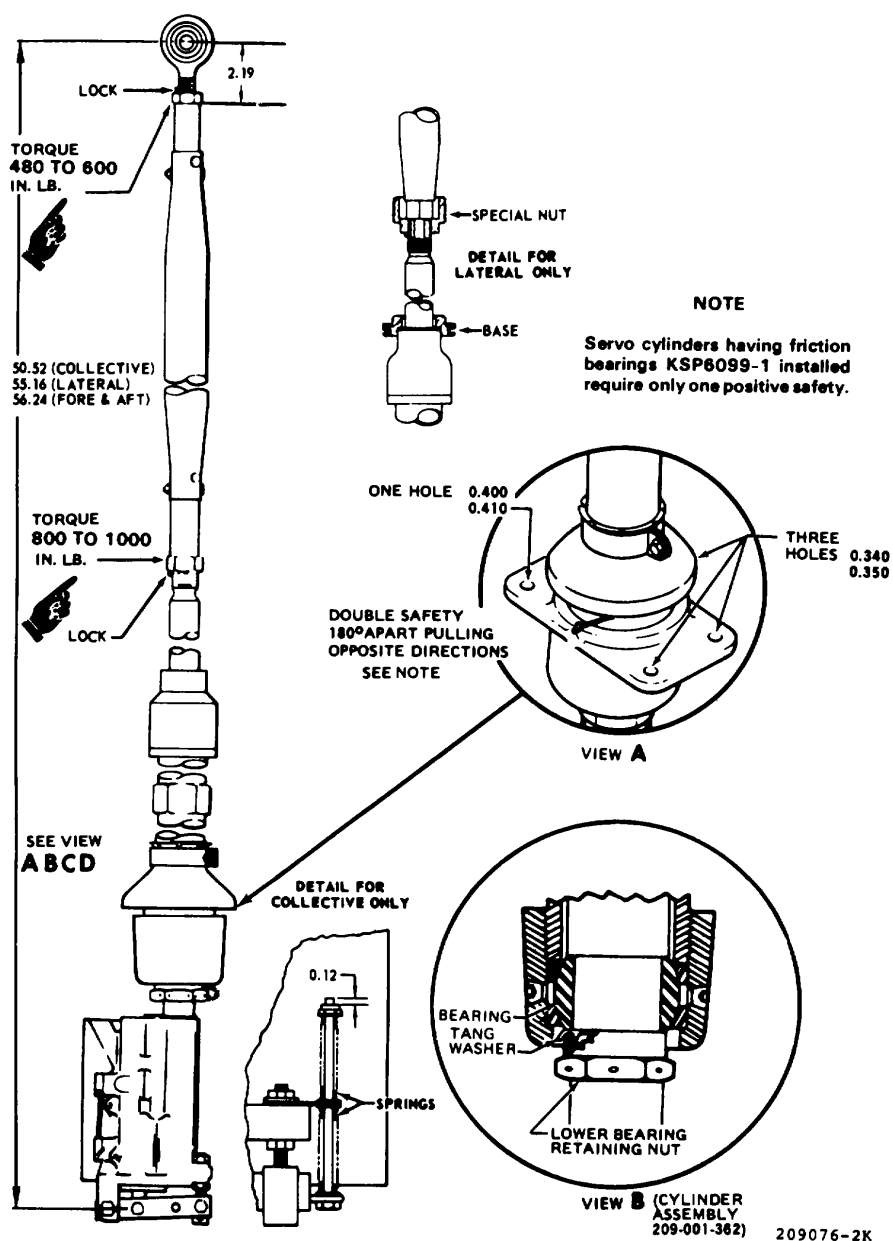


Figure 7-12. Dual hydraulic servo cylinder assembly (typical) (Sheet 1 of 2)

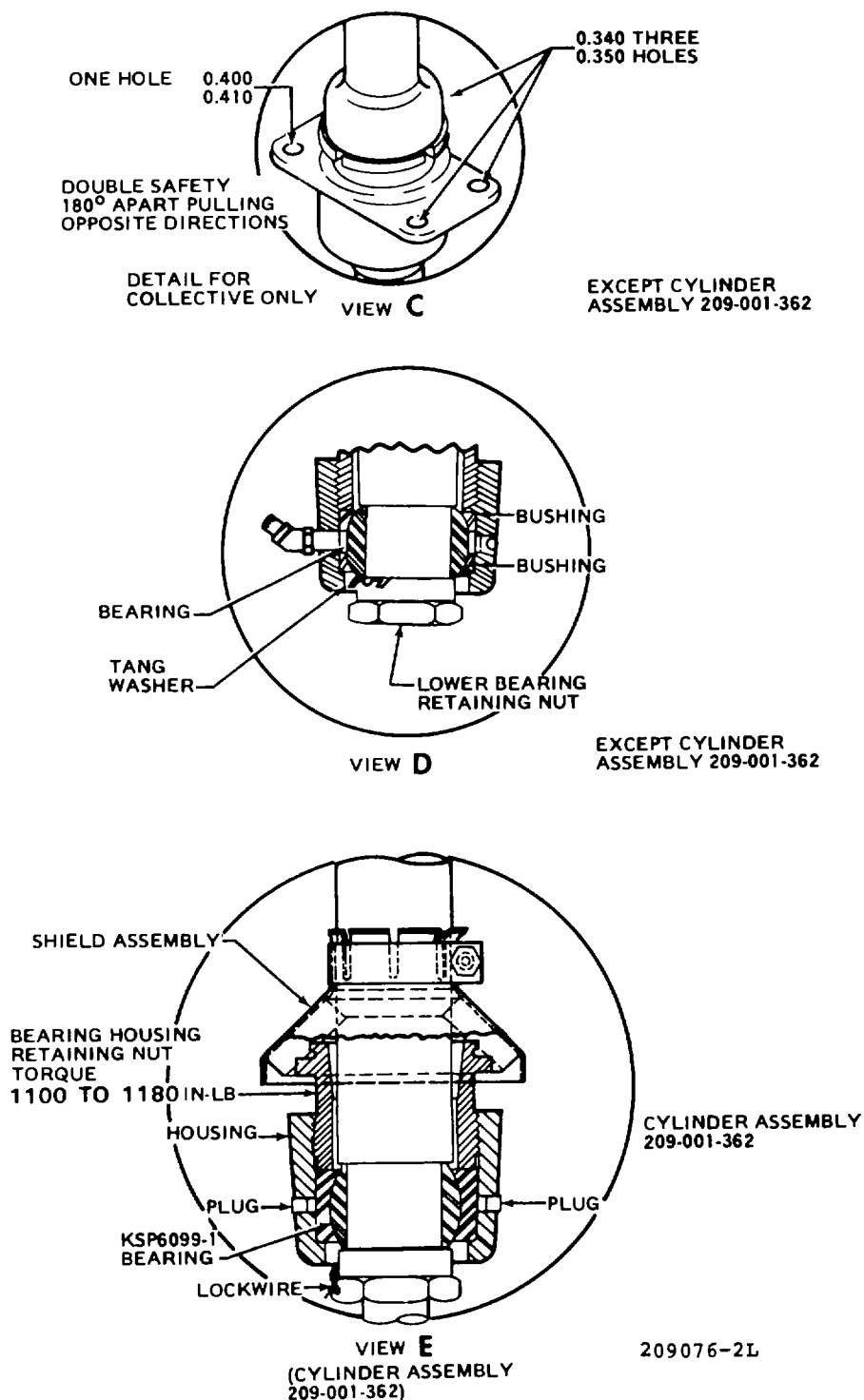
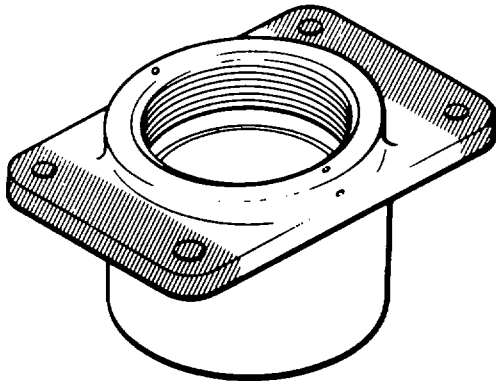


Figure 7-12. Dual hydraulic servo cylinder assembly (typical) (Sheet 2 of 2)



TYPE OF DAMAGE	DAMAGE AREA REPAIR SYMBOLS	
	PARTICULAR	GENERAL
NO CRACKS ALLOWED		
NICKS, SCRATCHES, AND SHARP DENTS	0.020 IN.	0.040 IN.
CORROSION	0.010 IN.	0.020 IN.
MAXIMUM AREA PER FULL DEPTH REPAIR	0.10 SQ. IN.	NOT CRITICAL
NUMBER OF REPAIRS	NOT CRITICAL	NOT CRITICAL
EDGE CHAMFER	0.040 IN.	0.060 IN.
BORE DAMAGE	0.002 INCH FOR 1/2 CIRCUMFERENCE	
THREAD DAMAGE:		
DEPTH:	ONE-THIRD OF THREAD	
LENGTH:	ONE INCH	
NUMBER:	THREE	

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Figure 7-13. Damage limits for hydraulic cylinder bearing housing

NOTE

It is possible for the cylinder barrel to turn within the housing assembly providing there is no vertical barrel movement. When vertical movement is apparent, request assistance from AVIM.

(4) Cylinder assembly for leaks at all connections and fittings. Seepage around piston rod seals during operation is permissible, but not to exceed one drop every 20 cycles. The maximum leakage allowed at the cylinder bleed hole is 3 drops in 25 cycles. Accumulation of the equivalent of, one drop of static leakage at the valve and sleeve assembly in 24 hours is permissible.

(5) Protective boot for damage and deterioration.

(6) Nuts and locks for proper safetying in accordance with TM 55-1500-204-25/1.

c. Repair or Replacement.

(1) Replace protective boot or attaching parts if damaged or unserviceable.

(2) Replace cylinders that fail to meet inspection requirements.

(3) When replacing cylinder assembly, check that overall length is correct for control system location. (See figure 7-12.) Servo cylinders are interchangeable, but extension tubes are different lengths for use in collective, lateral, and fore-and-aft controls.

(4) When replacing servo cylinder in an assembly, perform the following:

CAUTION

Do not allow collective lever to contact anti-drive link support bracket during removal of collective cylinder.

(a) after removing rod end and tube, inspect fittings in upper and lower ends of tube for corrosion in internal areas.

(b) If corrosion is present, tube should be replaced. If replacement is not available, tube may be temporarily kept in service by applying preventive compound (C52) to retard corrosion until tube can be replaced at next scheduled maintenance

inspection.

(c) Before installing a new tube, flush internal surfaces with primer (C102). Stop one end of tube, pour primer into other end, rotate tube to obtain full coverage of primer in both end fittings, and drain for **10 TO 20** minutes before installation.

NOTE

On a new complete cylinder assembly, tube can be left in place and treated as in step (c) above by removing rod end to apply primer.

(d) During reassembly, set rod end dimensions first, then adjust assembly length by screwing tube on cylinder piston rod. (See figure 7-12.) Use locks in slots to obtain correct alignment, torque nuts as shown, and lockwire nuts and locks.

(5) When replacing cylinder, make sure that lubrication fitting in bearing housing is on side nearest to transmission and is pointing upward. A plugged alternate port is provided on opposite side of housing.

(6) On lateral system cylinder, base and special nut must be in place to allow installation of spring. (See detail, figure 7-12.)

(7) On collective system cylinder, check that two springs are installed on valve as shown. (See detail, figure 7-12.)

d. *Lubrication.* Hydraulic cylinder and valve are self-lubricating with fluid. Rod end bearing is sealed and requires no lubrication. Lubricate bearing housing with grease according to Lubrication Chart.

e. *Removal.* Any of three cylinder assemblies can be removed by the same typical procedure.

CAUTION

Before loosening any connections in accumulator circuit, be certain that trapped hydraulic pressure is released.

(1) Open transmission cowl. Remove access door on side of fuselage below wing.

(2) Disconnect rod end bearing (2, figure 7-3) at top of cylinder tube from swashplate horn (1) or

collective lever (17) by removing cotter pin, nut, bolt and washers.

(3) Disconnect control tube (13, 16, or 19) from control valve lever (12) by removing cotter pin, nut, bolt and washers.

(4) Place a container to catch spilled fluid. Disconnect hydraulic hoses from valve (11). Cap open hoses and fittings.

(5) Determine whether servo cylinders (7, 14, and 18, figure 7-3) are secured to supports with internal wrenching bolts (29) as shown in detail B or with studs (32) as shown in detail C. Remove servo cylinders that are installed with internal wrenching bolts (29) in accordance with step (a). Remove servo cylinders that are installed with studs (32) in accordance with step (b).

(a) If internal wrenching bolts (29) are installed, use work aid shown on figure 7-13A to prevent internal wrenching bolts from turning. Remove nut (25), washers (26 and 28), and bolt (29). Remove remaining three bolts in the same manner. Remove servo cylinder (7) from support (10). Four washers (27) should be bonded to support (10). If washers are not bonded, secure the washers to the support with wire and bond them in place prior to reinstallation of the servo cylinder. Remove servo cylinders (14 and 18) in the same manner.

(b) If studs (32) are installed, remove four nuts (30) and washers (31). Remove servo cylinder (7) from support (10). Do not remove studs (32) from support (10) unless the studs are damaged, and require replacement with new studs.

(6) Loosen or remove bolts and nuts of upper and lower clamps on protective bolt (5). Slide boot assembly and clamps off top end of cylinder tube. Compress flange (6) to detach lip from collar of boot.

(7) On lateral system servo cylinder (14) remove lockwire and loosen retaining nut (22). Remove retaining nut and spring (21). Use tape (C134) to secure base (20) in place, and to protect threads of inner nut (23).

f. Disassembly. (Figure 7-14.)

(1) Collective flight control servo cylinder.

(a) Cut lockwire, loosen nut (3, figure 7-14) and remove rod end (1) from end of tube assembly. **Remove nut (3) and lock (2).**

(b) Remove clamps (27) then remove dust boot (26). Cut lockwire, and loosen nut (5). Remove tube (4) from shaft of servo cylinder (7). Remove nut (5) and lock (6).

(c) Remove springs (15 and 16) from collective servo by removing nut (13), washers (14), and bolt (17).

(2) Lateral and fore and aft control servo cylinder.

(a) Cut lockwire and loosen nut (3, figure 7-14) remove rod end (1).

(b) Remove nut (3) and lock (2) from tube end.

(c) Lateral cylinder:

1 Remove clamp (27) then remove boot (26). Cut lockwire securing nuts (8 and 9) and remove nut (8) and spring (11).

2 Cut lockwire and loosen nut (9). Remove tube (4) from servo cylinder. Remove nut (9) and lock (10).

3 Remove spring base (12) from servo cylinder (7).

(d) Fore and aft cylinder:

1 Remove boot (26). Cut lockwire and loosen nut (5).

2 Remove tube (4) from servo cylinder (7).

3 Remove nut (5) and lock (6).

g. Inspection.

(1) Collective flight control servo cylinder.

(a) Inspect rod end bearing for roughness and freedom of movement.

(b) Inspect lock (2, figure 7-14) for deformity and excessive wear.

(c) Inspect tube (4) for mechanical, corrosion, rod end bearing and thread damage. Refer to Chapter 11, for damage limits on flight control tubes.

(d) Inspect nut (5) for cracks and for damaged threads.

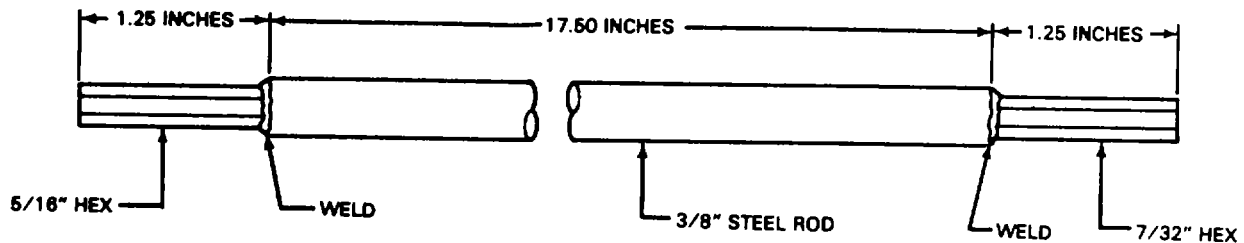
(e) Inspect lock (6) for cracks and deformity.

(f) Remove and visually inspect servo springs (15 and 16) and bolt (17) for excessive

wear.

(2) Fore and aft and lateral control cylinders.

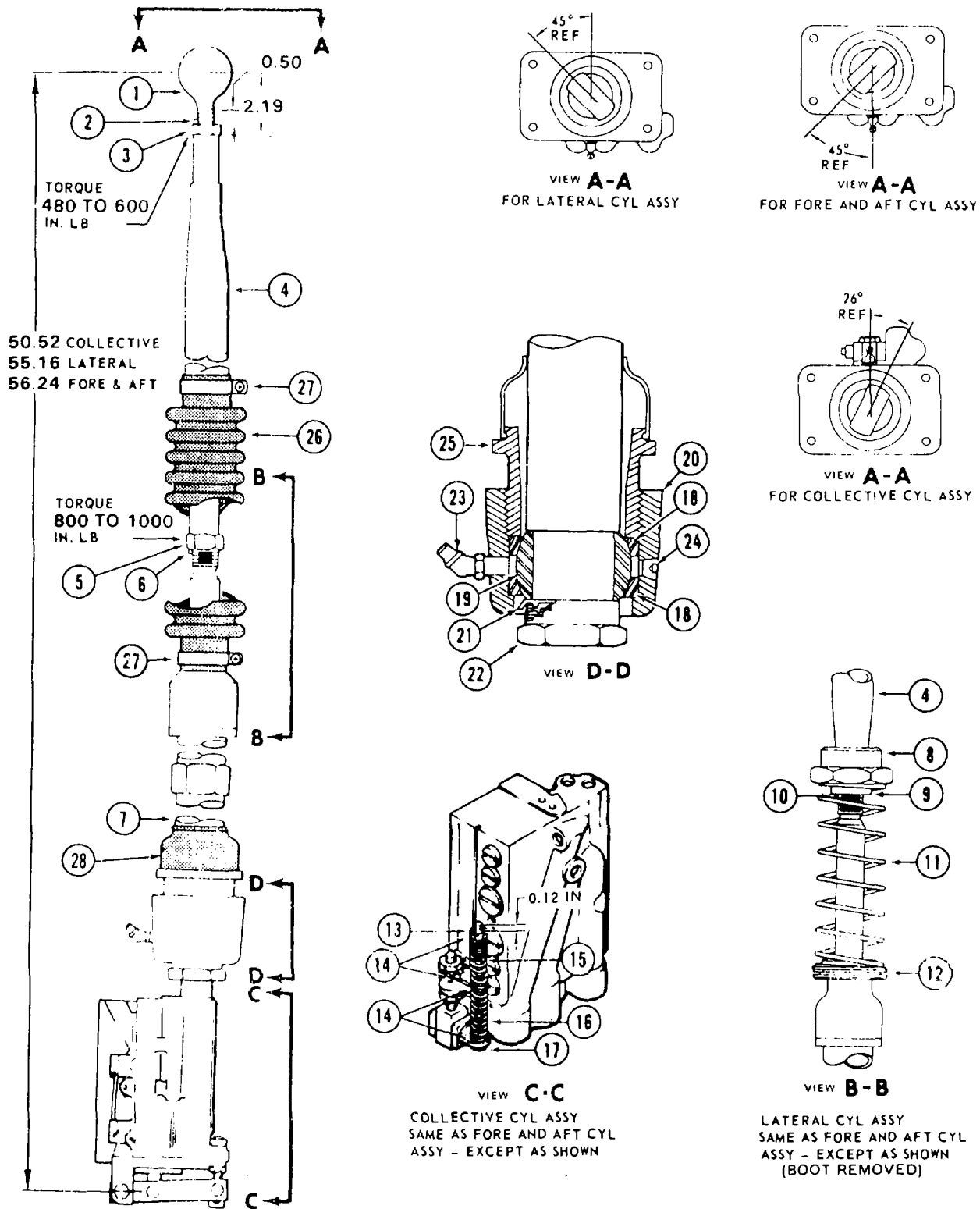
(a) Inspect rod end (1, figure 7-14) for roughness and for freedom of movement.



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Figure 7-13A. Servo-cylinder removal work aid

Change 2 7-38A/(7-38B blank)



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Figure 7-14. Hydraulic servo cylinder dimensions for collective, lateral cyclic, and fore and aft cyclic assemblies (Sheet 1 of 2)

1. Rod end bearing	11. Spring	20. Bearing housing
2. Lock	12. Base	21. Tab washer
3. Nut	13. Nut	22. Lower retaining nut
4. Tube	14. Washers	23. Fitting
5. Nut	15. Spring (O 034 wire)	24. Plug
6. Lock	16. Spring (0.047 wire)	25. Bearing housing nut
7. Servo cylinder	17. Bolt	26. Boot
8. Nut	18. Bushing	27. Clamp-
9. Nut	19. Bearing	28. Boot
10. Lock		

209076-6-2H

Figure 7-14. Hydraulic servo cylinder dimensions for collective, lateral cyclic, and fore and aft cyclic assemblies (Sheet 2 of 2)

(b) Inspect nut (3) for cracks and for damaged threads.

(c) Inspect locks (2, 6 or 10) for cracks and deformity.

(d) Inspect tube (4) for cracks and for damaged threads.

(e) Inspect nut (5 and 9) for cracks, excessive wear and bonded washer for adhesion.

(f) Inspect nut (8) for cracks and for damaged threads.

(g) Inspect spring (11) for cracks and for free length of spring, which must be 8.9 to 9.2 inches in length. Compress the spring six inches and release. Remeasure spring length. If spring is shorter, replace the spring.

(h) Inspect base (12) for cracks, excessive wear, and bonded washer for excessive wear and for adhesion to base.

h. Repair or Replacement.

(1) Collective flight control servo cylinder.

(a) Replace rod end, nuts, and locks if they fail inspection.

(b) Repair minor surface damage on tube (4) that is within allowable limits in step g. above. Refer to Chapter 11, for repair procedure on flight control tubes. Replace rod end bearing (1) if it is worn beyond allowable limits in step g. Replace tube (4) if mechanical damage is in excess of allowable limits in step g. (1) (f).

(c) Repair cylinder (7) in accordance with paragraph 7-12.

(d) Replace excessively worn servo-springs (15 and 16) and bolts (17).

(2) Fore and aft and lateral control servo cylinders.

(a) Repair leaking servo cylinder as follows:

1 Cut and remove lockwire securing locknut (1, figure 7-15) to lock (2) and loosen lock and locknut from upper end of cylinder.

2 Unscrew cap (3) from cylinder.

3 Remove packing retainers (4) and packing (5) from inside cap (3) and replace with like serviceable items.

4 Remove internal retainer ring (10) from cap (3).

5 Remove two scraper rings (8), scraper ring retainer (9) from cap (3), and replace with like serviceable items.

6 Remove packing (6) and packing retainer (7) from cap (3) and replace with like serviceable items.

7 Install retainer ring (10) in cap (3).

8 Screw cap (3) on upper end of cylinder and tighten until it bottoms out then loosen sufficiently to allow alignment of lock (2).

9 Tighten locknut (1) snug against cap (3) and secure locknut (1) to lock (2) with lockwire.

(b) Replace lock (2) if damaged or broken as follows:

1 Remove cap (3).

2 Remove locknut (1) and lock (2) from cylinder.

3 Install lock (2) in keyway of cylinder and screw locknut (1) and lock (2) on cylinder.

(c) Repair leaking bleed plug in pilot valve as follows:

1 Remove bleed plug (12) from pilot valve (13).

2 Remove packing (11) from body of bleed plug (12) and replace with new packing.

3 Replace bleed plug (12) in pilot valve and tighten.

(d) Clean filters (14 and 15) with clean, dry compressed air. Remove packings (16 and 17) and replace with new packing.

i. Assembly.

(1) Collective Flight Control Servo Cylinder.

(a) Position lock (2, figure 7-14) in nut (3) and install nut on rod end (1) with lock positioned in slot of rod end.

(b) Insert threads of rod end (1) into end of tube (4) until distance from tube end to hole center of rod end is 2.19 inches and torque nut (3) **480 TO 600** inch-pounds down against tube end as locknut.

(c) Make certain that no more than **0.50** inch of rod end thread is exposed beyond nut (3). Safety lock (2) to nut (3) with lockwire (C152). Position boot (26) onto threaded tube (4). Apply sealant (C116) to threads of upper end of tube (4), nut (3), and rod end bearing (1).

(d) Position lock (6) into nut (5) and thread nut onto shaft of servo cylinder (7) with lock positioned in keyway on shaft of servo cylinder (7).

(e) Thread tube (4) on threads of shaft of servo valve (7) until the overall length of cylinder is 50.52 inches from bolt centers on outboard end of servo cylinder to center of rod end hole.

(f) Maintain the length of cylinder established in step (e) above, and torque nut (5) **800 TO 1000** inch-pounds.

(g) Safety lock (6) to nut (5) with lockwire (C152). Secure boot (26) with clamps (27).

(h) Install eyebolt through lever with washer and nut finger tight and secure with cotter pin. Install springs (15 and 16, figure 7-14) on servo cylinder (7) with bolt (17), and nut (13).

NOTE

Make certain that spring of larger diameter wire (16, figure 7-14) is installed where illustrated.

When assembling, each end of the two springs must have a washer (AN960PD10L) installed (total of 4). Additional washers (AN960-10) may be added later (maximum of 6) to nut end of bolt and spring assembly to balance collective (paragraph 11-6).

(i) Thread nut (13) onto bolt (17) until distance from top of nut (13) is 0.12 inch from top of the bolt (17). See View C-C, figure 7-14.

(2) Fore and Aft and Lateral Control Servo Cylinder.

(a) Position lock (2, figure 7-14) into nut (3). Thread nut (3) onto rod end (1) a sufficient distance for clearance and with lock (2) positioned in keyway of rod end.

(b) Install rod end (1) into tube (4) until the distance from tube end of the bolt hole center of rod end is **2.19** inches. Maintain **2.19** inches distance and tighten nut (3). Apply sealant (C 116) to threads of upper end of tube (4), nut (3), and rod end bearing (1).

(c) Safety lock (2) to nut (3) with lockwire. (C152).

(d) Lateral servo cylinder.

1 Slide base (12) over shaft of servo cylinder (7) and position on end of valve body.

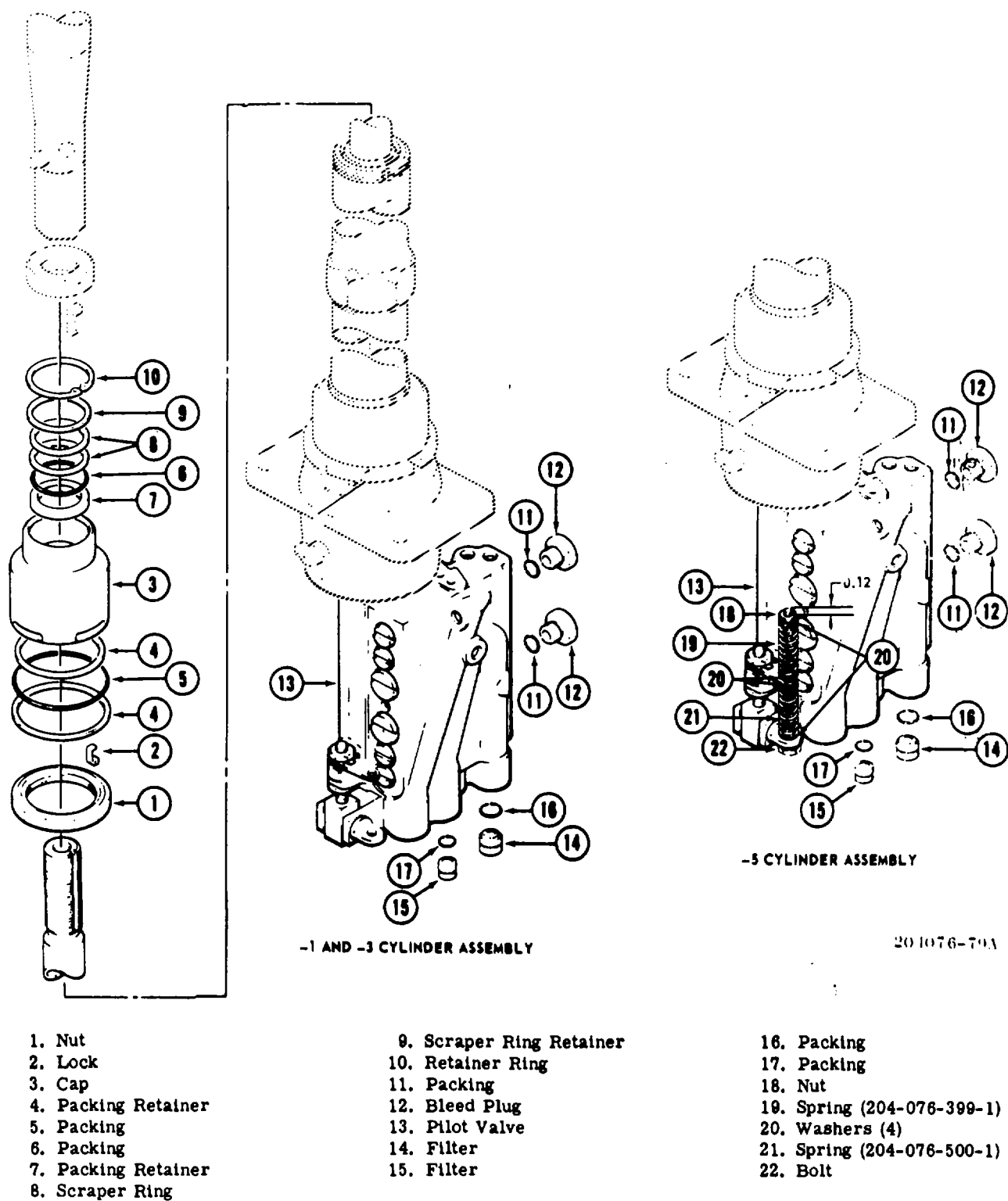


Figure 7-15. Flight control hydraulic servo cylinder

2 Position lock (10) in nut (9) and thread nut onto shaft end of servo cylinder (7) with lock positioned in key- way slot.

3 Install tube (4) onto shaft of servo cylinder until length is **55.16** inches from center of bolts on outboard end of servo cylinder to center of hole in rod end (1).

4 Maintain overall length of cylinder and torque nut (9) **800 TO 1000** inch-pounds. Safety Lock (10) to nut (9) with lockwire (C152).

5 Install spring (11) over tube (4) and seat against base (12).

6 Install nut (8) over nut (9) until upper surfaces of both nuts are flush.

7 Safety nut (8) to nut (9) with lockwire (C151). Double lockwire retaining nut 1800 apart. One lockwire shall be positive lock and one negative. Paint slipmarks on bearing retaining nut and bearing housing.

8 Install dust boot.

(e) Fore and aft cylinder:

1 Position lock (6) in nut (5) and thread nut onto shaft end of servo cylinder (7) with lock positioned in key- way slot.

2 Install dust boot.

3 Install tube (4) onto shaft of servo cylinder until length is **56.24** inches from center of

bolts on outboard end of servo cylinder to center of hole in rod end (1).

4 Maintain overall length of cylinder and torque nut (5) **800 TO 1000** inch-pounds. Safety lock (6) to nut (5) with lockwire (C152).

j. Installation. Any of three cylinder assemblies can be installed using the following procedures. (Refer to figure 7-3.)

NOTE

Self locking nuts will be used one time only in this application.

(1) Make certain that cylinder assembly is correct for control system in which it is to be installed. (Refer to paragraph 7-11, step c.)

(2) On collective and fore-and-aft cylinders install protective boot (5, figure 7-3).

(a) Compress and insert swivel-joint flange (6) into lower end of boot. Engage flange lip in collar.

(b) Slip flange and boot down over cylinder tube. Seat flange on shoulder of cylinder cap. Install clamp on flange, secured with screw, washers and nut.

(c) Place clamp around top of boot. Set top of boot to dimension shown, according to cylinder location. (See figure 7-3.) Secure clamp with screw, washers, and nut.

NOTE

Ensure lubrication fittings are properly located on side nearest access for greasing. (Refer to paragraph 7-11 c.)

(3) Determine whether servo cylinders (7, 14, and 18, figure 7-3) are secured to supports with internal wrenching bolts (29) as shown in detail B or with studs (32) as shown in detail C. Install servo cylinders that are installed with internal wrenching bolts (29) in accordance with step (a). Install servo cylinders that are installed with studs (32) in accordance with step (6).

(a) If internal wrenching bolts (29) are to be

used to secure the servo cylinder to the support, install as follows:

1 Inspect support (10) or (15) as applicable for secure bonding of washers (27) to the support. If one or more washers (27) are not bonded, bond the washer or washers to the support with adhesive (C12). Three 5/16 inch ID washers (27) and one 3/8 inch ID washer (27) are required at each servo cylinder installation position when internal wrenching bolts are used. Washers (27) are not used with studs (32). Ensure that washers are bonded in correct position to match hole in support and that top surface of the four washers is level.

2 With Servo Cylinder on lower end of Piston Rod positioned as shown in View A-A, Figure 7-14, carefully lower dual Hydraulic Cylinder Assembly down through support assembly (10 or 15). Rotate servo cylinder to align with three 5/16 inch diameter holes and one 3/8 inch diameter hole.

3 Position countersunk washer (28) on the 3/8 inch diameter internal wrenching bolt (29) with the chamfered side of the washer against the radius of the bolt head. Install 3/8 inch diameter bolt (29) and washer (28) from the lower side. Hold bolt (29) with work aid shown in figure 7-13A. Install washer (26) and nut (25). Do not torque nut at this time.

4 Install remaining three 5/16 inch diameter bolts (29), countersunk washers (28), float washers (26) and nuts (25) in the same manner.

5 Tighten four nuts (25) evenly.

6 Install servo cylinders (14 and 18) in the same manner.

(b) If studs (32) are to be used to secure the servo cylinder to the support, install servo cylinder as follows:

1 With servo cylinder on lower end of piston rod positioned as shown in view A-A, figure 7-14, carefully lower dual hydraulic cylinder assembly down through support assembly (10 or 15, figure 7-3). Rotate servo cylinder to align with three 5/16 inch diameter studs (32) and one 3/8 inch

diameter stud (32) and position the servo cylinder on the studs.

NOTE

The torque on nuts (25) will depend on the type of bolt being used. Torque to values indicated:

Bolt	NAS 1305-48	100 TO 140 in lb
Bolt	NAS 1306-48	160 TO 190 in lb
Bolt	MS 2000548	120 TO 160 in lb
Bolt	MS 20006-48	300 TO 330 in lb

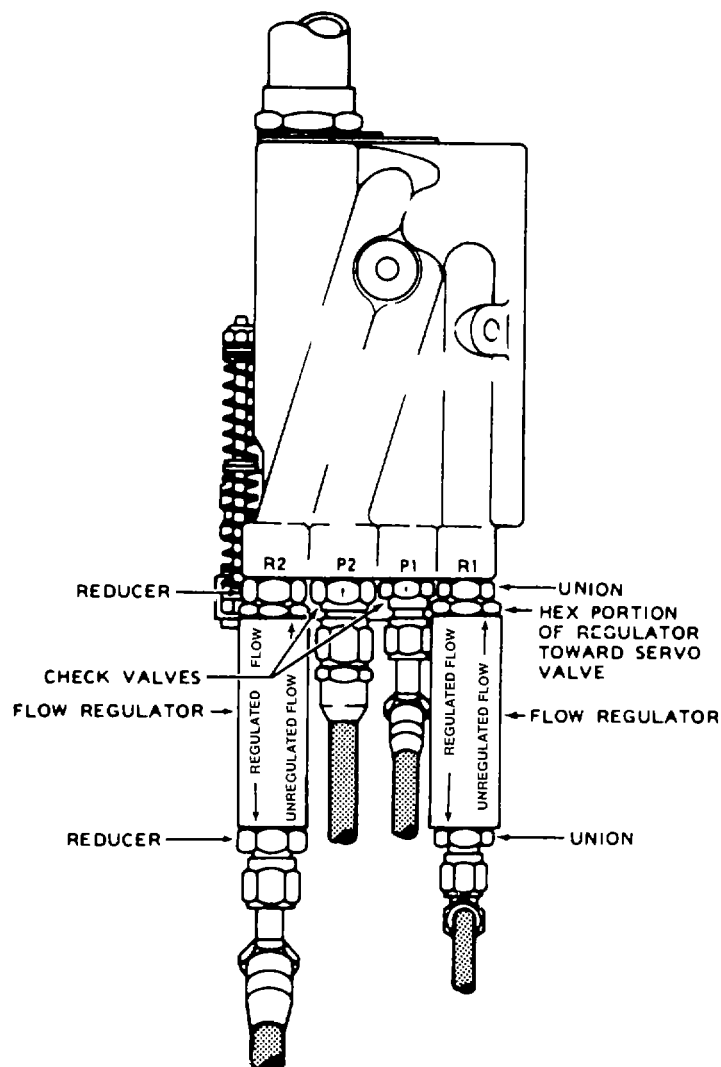


Figure 7-16. Dual hydraulic cylinder valve connections

2 Install four washers (31) and nuts (30). Tighten nuts evenly.

3 Refer to TM 55-1500-204-25/1 for recommended torque values.

4 Apply slippage index marks with lacquer (C77) or other suitable marking material.

CAUTION

Ensure check valves are installed with flow arrows toward valve in pressure ports P1 and P2. (See figure 7-16.)

(4) Connect hydraulic hoses to fittings in ports at bottom of cylinder valve (11). Be sure flow regulators on collective servo cylinders are installed with regulated flow arrows pointing away from servo valve and uncontrolled flow arrows pointing toward servo valve. (See figure 7-16).

WARNING

Check that all four bolts through the servo lever assembly have a self-locking castellated nut safetied with a cotter pin. Check that nuts and bolts as an assembly can be turned by hand after cotter pin installation. (Four places, see figure 7-3.)

(5) Connect rod end bearing at lower servo control tube assembly to servo lever assembly (13, 16 or 19) with bolt, washer, self-locking castellated nut and cotter pin. Hold nut on the blind side with wrench and turn the head of the bolt with wrench until nut slot is in

alignment with bolt shank hole for cotter pin installation. Make sure nut and bolt as an assembly can be turned by hand. Install cotter pin.

NOTE

Collective cylinder springs must be removed before checking that eyebolt through lever can be turned with fingers.

(6) On lateral system cylinder (14, figure 7-3), install spring (21) and retaining nut (22). Seat spring on base (20) and in recess in retaining nut. Start nut on inner nut (23). Tighten until tops of nuts are flush, and lockwire. Install boot (24).

(7) Connect cylinder to swashplate horn or collective lever, using attaching parts as shown. (See figure 7-17.) Check rigging of control system. (Refer to Flight Controls.)

k Intersystem Leakage - Cyclic or Collective Hydraulic Cylinders.

(1) Intersystem leakage may occur in one or more dual hydraulic cylinders. If one system reservoir consistently overflows while the other reservoir shows low fluid level, intersystem leakage may be indicated.

(2) To check for intersystem leakage and to isolate the faulty cylinder(s) proceed as follows:

WARNING

Extreme caution should be exercised when accomplishing the following. Damage to helicopter or physical injury to maintenance personnel may result from improper action.

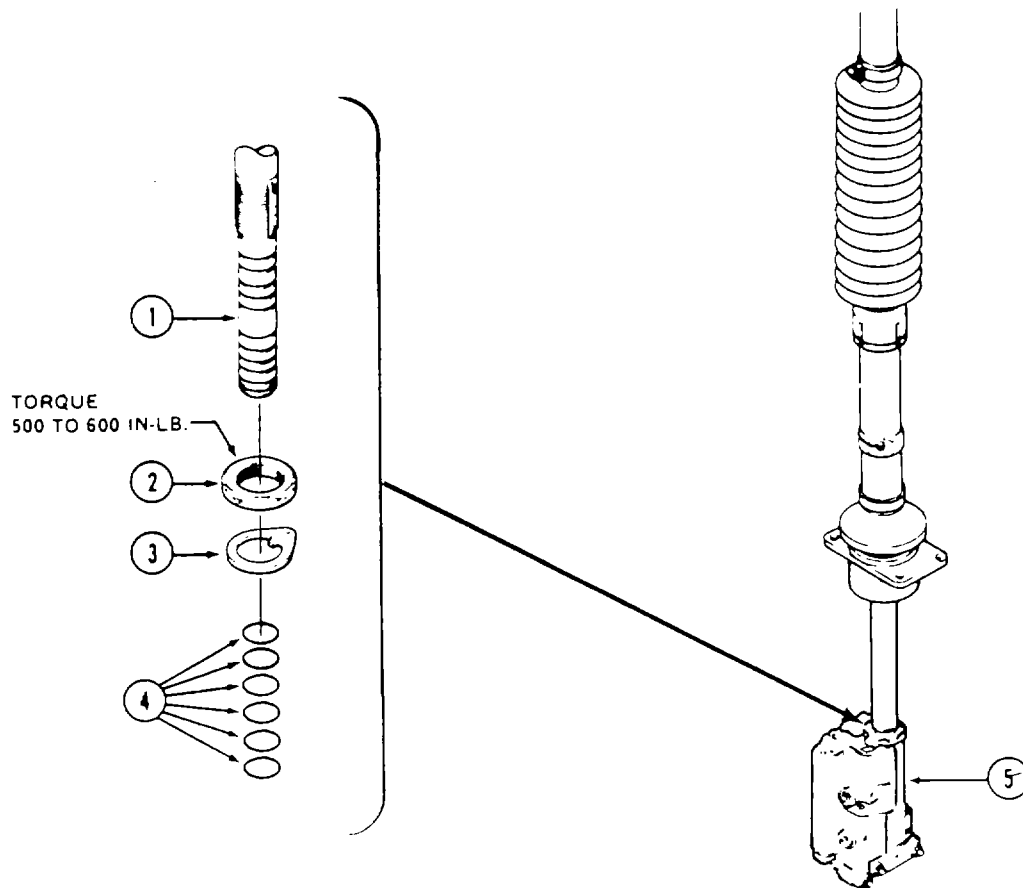


Figure 7-16A. Dual Hydraulic Cylinder Servo Valve Installation

1. Piston rod
2. Nut
3. Tab lockwasher
4. Packing
5. Servo valve

(a) Bleed all residual pressure from system.

(b) Trace return lines from the overflowing reservoir to each cylinder. Mark lines for subsequent removal.

(a) Bleed all residual pressure from system.

(b) Trace return lines. from the overflowing reservoir to each cylinder. Mark lines for subsequent removal.

(c) Connect hydraulic test unit hoses to system which shows low fluid level.

(d) Disconnect control tube (13, 16 or 19, figure 7-3) from control valve lever (12) of cylinder being tested. Disconnect upper end of cylinder from swashplate horn or collective lever. Disconnect previously located return line.

CAUTION

Position cylinder so that movement of cylinder will not result in damage to swashplate or push-pull tube or injury to maintenance personnel.

(e) Set hydraulic test unit for approximately 6 gpm flow at 125 to 175 psig pressure.

(f) Extend cylinder to full travel. Leakage from cylinder return port after the cylinder is bottomed indicates intersystem leakage. Increase pressure to 1475 to 1525 psig and check both open ports.

(g) Repeat (e) and (f) in retract position.

NOTE

Oil will flow from open ports during actuator travel but should stop after piston bottoms.

(h) Stop flow from test unit. Connect upper control tube to swashplate horns or collective lever and lower control tube at servo valve lever. Connect previously removed return line to servo cylinder.

(i) Repeat for each cylinder being sure that residual hydraulic pressure is bled off before proceeding.

(j) Remove faulty cylinder(s), to higher maintenance level for repair or overhaul.

(k) Refill and bleed hydraulic system.

7-12. Replacing Valve - Dual Hydraulic Cylinders. (AVIM).

With cylinder assembly removed and in a clean, sheltered work area proceed as follows to replace valve on a dual cylinder assembly.

a. Loosen jam nut (1, figure 7-15) enough to release lockwasher (2) tab from slot in top of valve housing. Unscrew valve from piston rod.

b. With nut and lockwasher in place, screw valve replacement onto threaded end of piston rod until bottomed. Back off valve one-half to one and one-half turns to align and insert lockwasher tab into slot at top of valve housing. Turn nut down to hold washer in slot.

c. Torque nut **200 TO 225** inch-pounds and lockwire.

d. Install check valves in pressure ports and install fittings in return ports of valve.

7-13. SCAS Servo Actuators, Solenoid Valves, And Filters.

Hydraulic components of stability and control augmentation system (SCAS or SAS) are the pitch, roll, and yaw servo actuators and associated pressure line filters, solenoid valves, and connecting lines. Each actuator assembly consists of an electro-hydraulic servo actuator, fitted with a tube assembly at one end and a clevis at the other for connection into cyclic and tail rotor control linkages ahead of hydraulic power cylinders. Filters, rated 10 micron, are in pressure lines to protect each actuator. Solenoid valves have two positions, pressure to cylinder when electrically energized, or cylinder to return when de-energized.

Premaintenance requirements for SCAS servo actuators

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	Two

Premaintenance requirements for SCAS
servo actuators (Cont)

(Refer to Chapter 11.)

(2) Replace tube assembly or clevis if damaged beyond specified limits.

Conditions	Requirements
Consumable Materials	(C73) (C124) (C1S1)
Special Environmental Conditions	None



Do not cross hoses.

(3) Replace servo actuator if malfunction occurs. If both the roll and the pitch actuators must be replaced, remove and reinstall one at a time to avoid possibility of crossing hoses.

(4) When replacing actuator assembly, remove hydraulic fittings for use on new assembly.

(5) When replacing tube assembly, make certain that tube is correct part for control system in which it is to be used. Decals are provided on tubes for this purpose.

(a) Tubes for lateral cyclic and fore-and aft cyclic systems are identical, and have an internal rod in riveted joint at inboard end.

(b) Tube for directional (tailrotor) control system omits the internal rod because of vibration conditions at its location, and is marked by orange yellow paint on outer end.

(6) When assembling tube and clevis on servo actuator, adjust to length and apply torque and lock as illustrated. Lockwire (C151) spanner nut and clevis lock.

e. Installation.

(1) Connect servo actuator into control linkage according to instructions for flight control system.

(2) Connect hydraulic hoses to fittings on servo actuator. (See figures 7-1 and 7-2.)

(3) Connect electrical connectors to actuator.

(4) Perform operational check.

NOTE

Check that hydraulic hoses do not chafe when flight control system is operated through full travel.

a. Removal.

(1) Remove doors on underside of fuselage for access.

(2) Disconnect electrical connectors and hydraulic hoses from servo actuator. Cap hose and cover open ports on actuator.

(3) Remove bolts to disconnect actuator tube and clevis from control system bellcranks. Remove actuator assembly.



Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

b. Cleaning. Clean external surfaces, except polished surfaces of piston rod and valve, by wiping with cloth moistened with solvent (C124). Carefully clean polished surfaces of piston rod and valve with a soft cloth moistened with hydraulic fluid (C73)

c. Inspection.

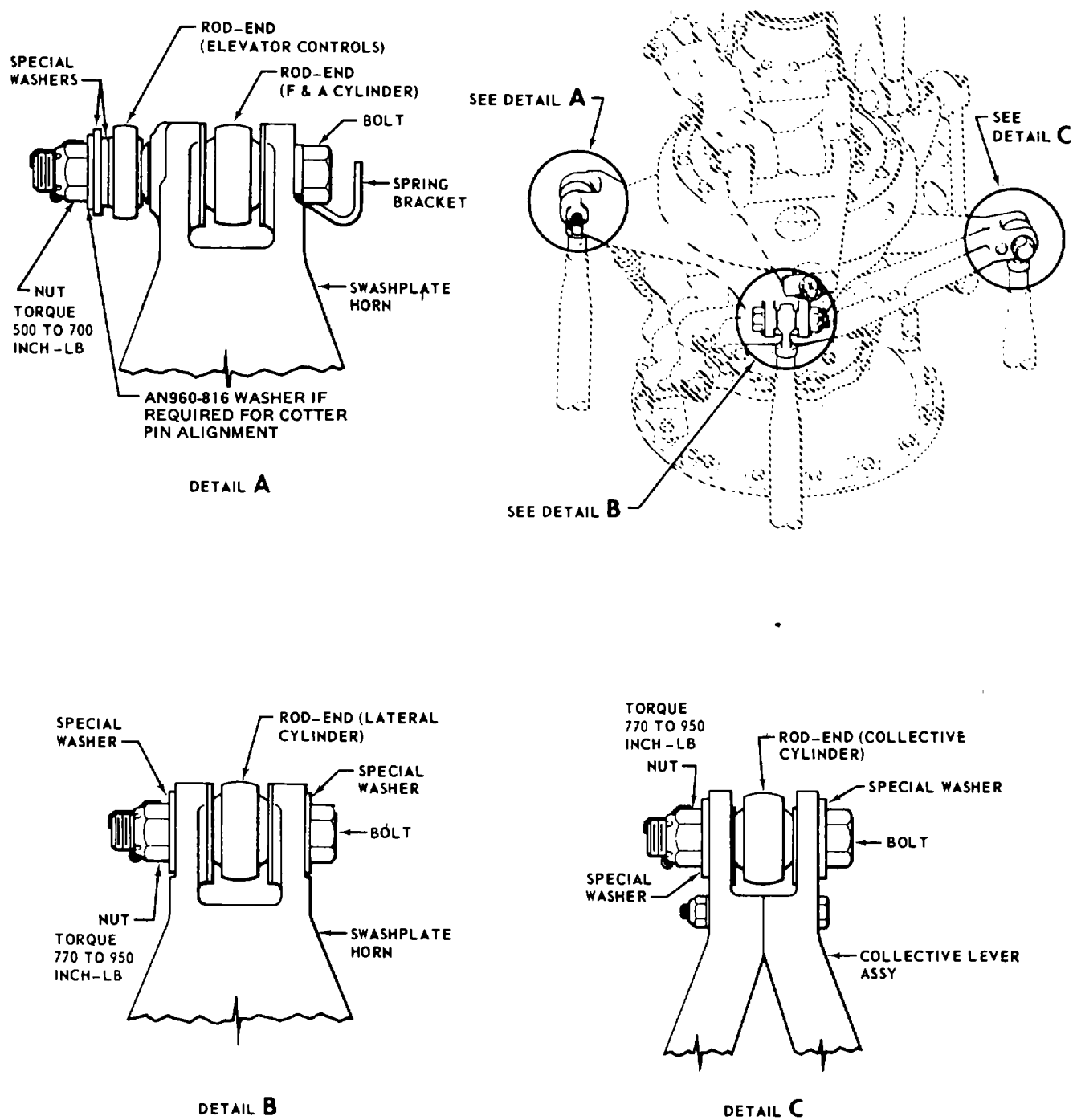
(1) Tube assembly and clevis for surface damage and corrosion according to limits for flight control tubes. (Refer to Chapter 11.)

(2) Replace tube assembly or clevis if damaged beyond specified limits.

(3) Assembly for security of nuts and locks.

d. Repair or Replacement. (See figure 7-18.) (AVIM)

(1) Repair surface damage on tube assembly or clevis according to instructions for flight control tubes.



209001-19C

Figure 7-17. Connection of hydraulic cylinders to swashplate

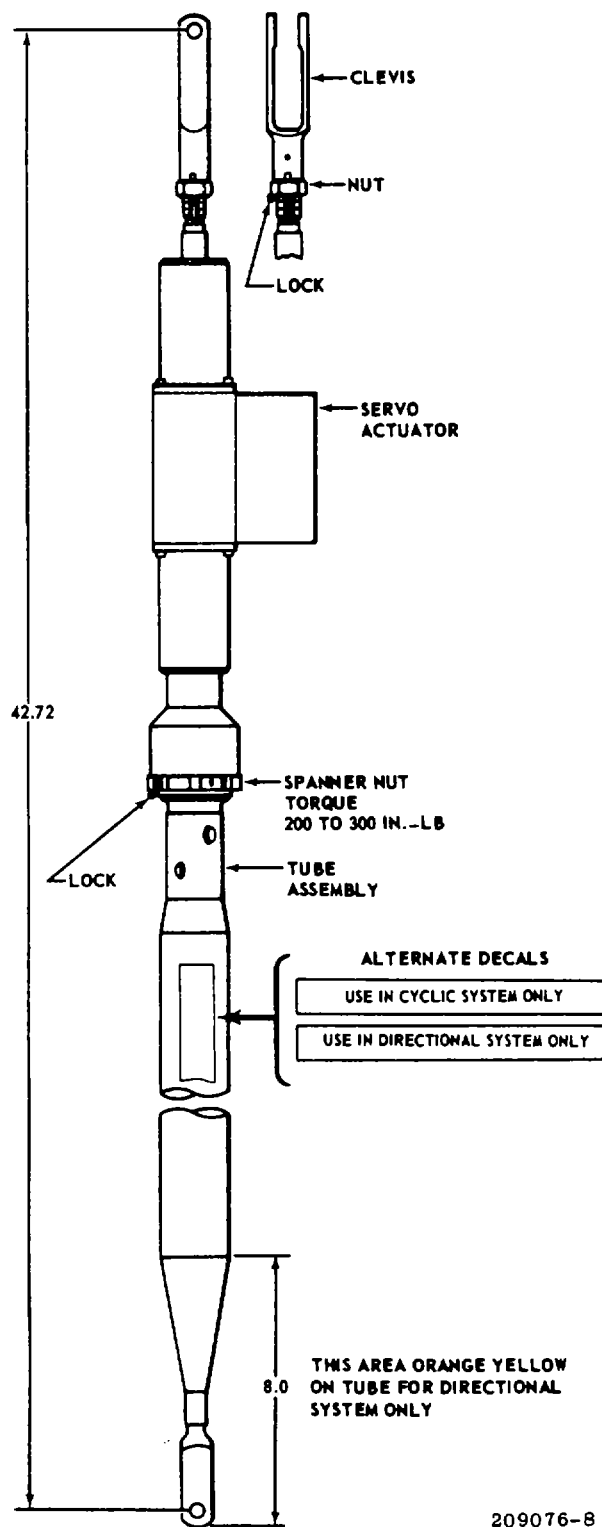


Figure 7-18. SCAS servo actuator assembly

NOTE

Change filter(s) ONLY if SCAS malfunctions because of restricted hydraulic flow.

(1) Identify the in line filter which is to be replaced. The two filters for the cyclic SCAS actuators are located in the compartment below the transmission. Remove panels on both sides of the fuselage below wings to gain access to the compartment. The filter for the directional (anti- torque) SCAS actuator is located in a compartment in the lower part of the fuselage below the engine. Remove access panel aft of the aft landing gear cross tube to gain entry to the compartment.

(2) Before removal of filter note flow direction arrow on filter and decal on adjacent structure. Use standard precautions to prevent spillage of hydraulic fluid and remove filter. If new filter is not to be installed immediately, cap or plug open lines.

(3) Install new filter with flow arrow properly oriented. Use new packings.

(4) Perform functional check to ensure SCAS actuator operates properly, and that there are no hydraulic leaks (refer to paragraph 7-3). Install access panels.

7-14. Tail Rotor Control Cylinder And Support.

The hydraulic cylinder and support assembly used in tail rotor control system is mounted horizontally in the fuselage compartment just ahead of the tail boom. Access is by a door attached with cowling fasteners on right side of the fuselage. The assembly includes a power cylinder and a walking beam mounted together in a support. (See figure 7-19.) The cylinder is connected by hoses into hydraulic system No. 1.

Premaintenance Requirements for Tail Rotor Control Cylinder and Support

Conditions	Requirements
Model	AH-18
Part No. or Serial No.	209-001-700-1

Premaintenance Requirements for Tail Rotor Control Cylinder and Support. (Cont)

Conditions	Requirements
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	Two
Consumable Materials	(C30) (C73) (C102) (C129) (C131) (C136)
Special Environmental	Clean, dust free
Conditions	area

a. Removal.

(1) Remove access door at right side of fuselage below engine. Also remove FM sense antenna to gain access.

(2) Provide a small suitable container to catch spilled fluid when removing hose assembly (2 and 21, figure 7-19) and tube assembly (16).

(3) Remove hose assembly (2) from elbow (6). Install protective dust cover to connector of hose assembly.

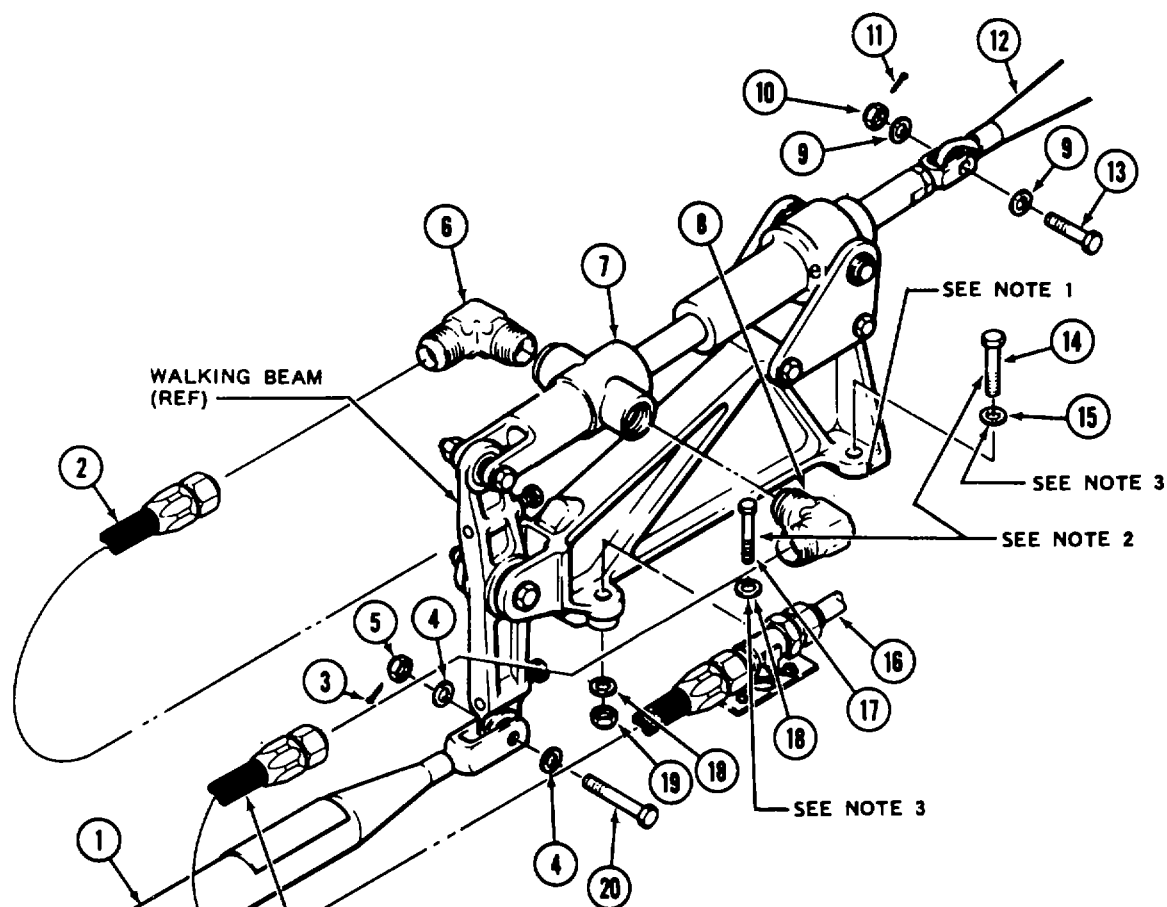
(4) Remove hose assembly (21) from elbow (8). Install protective dust cover to connector of hose assembly.

(5) Remove tube assembly (16). Install protective dust covers to open fittings and tube assembly connectors.

(6) Remove cotter pin (11), nut (10), two washers (9), and bolt (13) from clevis of cylinder and support assembly (7) and remove control tube (12) from clevis.

(7) Remove cotter pin (3), nut (5), two washers (4), and bolt (20) from control tube (1) and remove control tube from cylinder and support assembly (7).

(8) Remove two nuts (19), four washers (18) and two bolts (17) attaching cylinder and support assembly (7) to floor panel of fuselage.



NOTES

1. Install dissimilar metal separation tape (C131) around mating surface of bolt hole, with 1/4 inch overlap beyond part prior to assembly.
2. Apply unreduced zinc chromate primer (C102) to bolt prior to installation.
3. Place NAS1197-516 washers adjacent to magnesium ONLY.

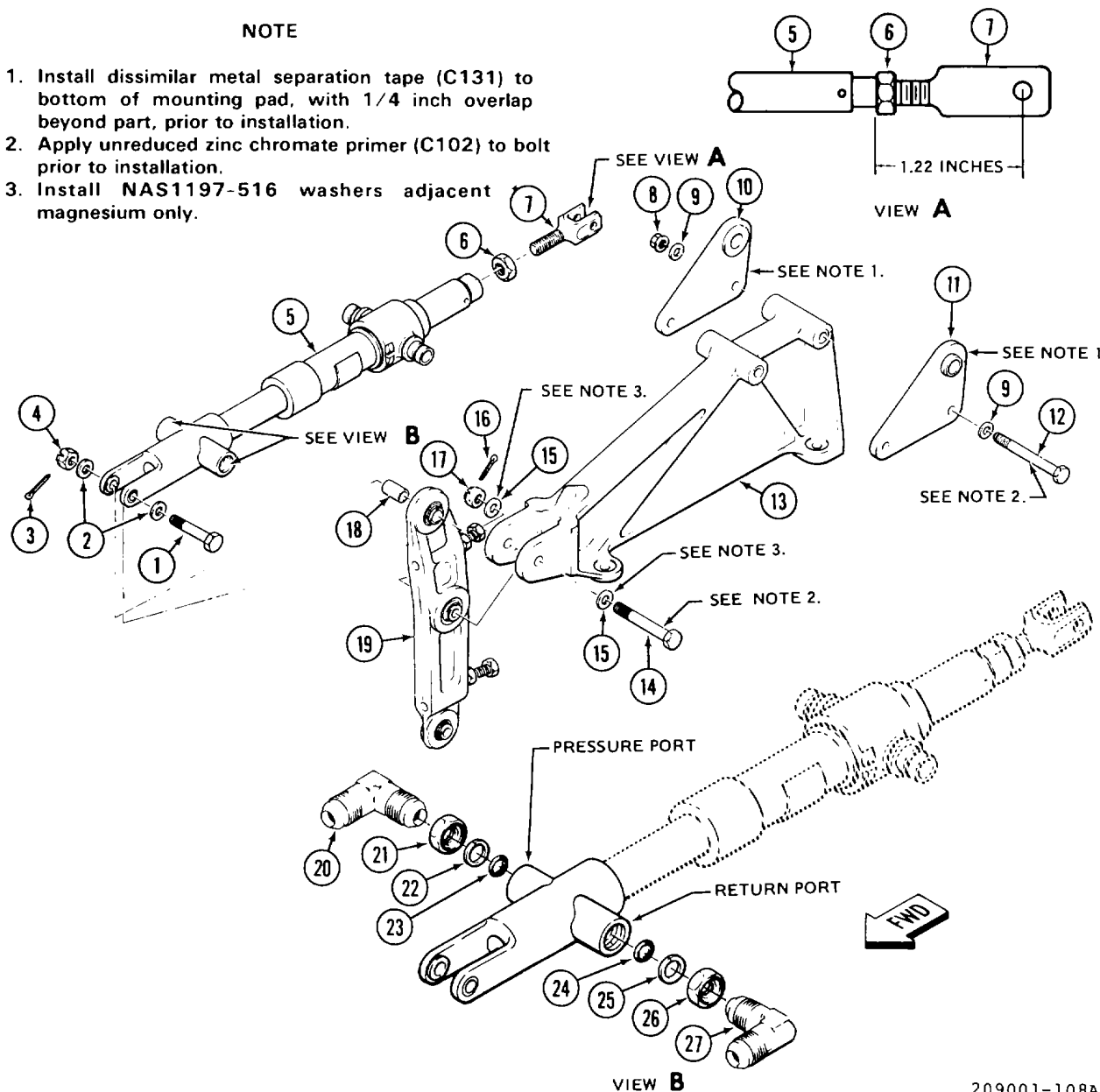
209001-107A

1. Control tube	12. Control tube
2. Hose assembly	13. Bolt
3. Cotter pin	14. Bolt
4. Washers	15. Washer
5. Nut	16. Tube assembly
6. Elbow	17. Bolt
7. Cylinder and support assembly	18. Washers
8. Elbow	19. Nut
9. Washers	20. Bolt
10. Nut	21. Hose assembly
11. Cotter pin	

Figure 7-19. Tail rotor control cylinder and support assembly-removal and installation

NOTE

1. Install dissimilar metal separation tape (C131) to bottom of mounting pad, with 1/4 inch overlap beyond part, prior to installation.
2. Apply unreduced zinc chromate primer (C102) to bolt prior to installation.
3. Install NAS1197-516 washers adjacent magnesium only.



209001-108A

1. Bolt	10. Plate assembly	19. Walking beam
2. Washers	11. Plate assembly	20. Elbow
3. Cotter pin	12. Bolt	21. Nut
4. Nut	13. Support assembly	22. Ring
5. Cylinder assembly	14. Bolt	23. Preformed packing
6. Nut	15. Washers	24. Preformed packing
7. Clevis	16. Cotter pin	25. Ring
8. Nut	17. Nut	26. Nut
9. Washers	18. Spacer	27. Elbow

Figure 7-19A. Tail rotor control cylinder and support assembly-disassembled

(9) Remove two bolts (14) and two washers (15) attaching cylinder and support assembly (7) to floor panel of fuselage and remove cylinder and support assembly. Cap open ports of elbows (6 and 8).

a.1. Disassembly.

(1) Provide a clean work area. Remove cotter pin (3, figure 7-19A), nut (4), two washers (2), and bolt (1) from cylinder assembly (5) and walking beam (19). Remove spacer (18) from walking beam (19).

(2) Break torque on nut (6) and remove clevis (7) from piston rod of cylinder assembly (5). Remove nut (6) from clevis (7).

(3) Remove two nuts (8), four washers (9), two bolts (12) and plate assemblies (10 and 11) from cylinder assembly (5) and support assembly (13).

(4) Remove cotter pin (16), nut (17), two washers (15), and bolt (14) from support assembly (13) and walking beam (19). Remove walking beam from support assembly.

a.2. Cleaning.

WARNING

Dry cleaning solvent is highly flammable with a flash point of 140 degrees F (60 degrees C) and must be used in a well ventilated area. Avoid breathing vapors and do not allow to come in contact with skin or clothing.

CAUTION

To prevent damaging internal components, do not submerge cylinder assembly (5, figure 7-19A) or walking beam (19) in solvent. Ensure that PRESSURE and RETURN ports in cylinder assembly (5) are capped prior to cleaning.

(1) Wash external surfaces of cylinder and support assembly with clean cloth saturated with solvent (C 124). A soft bristle brush may be necessary to loosen hardened deposits.

(2) Allow to air dry or blow dry with clean, filtered, compressed air.

b. Inspection.

(1) Inspect cylinder assembly (5, figure 7- 19A) for damage, evidence of leaks and freedom of operation of control valve.

(2) Inspect support assembly (13) and plate assemblies (10 and 11) for cracks, elongated bolt holes, corrosion damage, and surface damage, such as nicks or scratches. The following limits apply:

(a) Cracks are not acceptable in any part.

(b) Reaction plate Teflon-lined bushing radial wear (or egging) limit at contact point with cylinder is 0.003 inch.

(c) Bolt hole elongation not to exceed 0.010 inch.

(d) Maximum depth of reparable damage is 0.060 inch for mechanical damage (nicks or scratches), and 0.030 inch for corrosion damage. Maximum depth after cleanup for either type damage is 0.060 inch.

(e) No single area of rework shall exceed 3.5 inches length and 0.5 inch width. Two or more rework areas within 2 inches of each other shall be considered as a single area. Total of all rework areas on any one surface must not exceed one-quarter of the surface area.

c. Repair or Replacement.

(1) Replace defective elbows (20 or 27, figure 7-19A), fittings, and preformed packings at cylinder PRESSURE or RETURN ports.

(2) Deleted.

CAUTION

Do not use high-speed grinding wheels to repair surface damage.

(3) Rework damaged surfaces of support assembly (13) and plate assemblies (10 and 11) by polishing out and blending edges of damaged area into surrounding surface with a smooth contour. Cleanup depth of mechanical damage (nicks, scratches, or dents) need not be greater than depth of damage, provided none of the damage remains. Cleanup depth of corrosion pitting should be at least twice as deep as the deepest pit. Total depth and area of rework shall not exceed limits specified above. (Refer to paragraph 7-14.d.)

(4) Replace any parts that are cracked or where damage is not within repairable limits.

c.1. Repair Tail Rotor Control Cylinder.

Premaintenance Requirements for T/R Control
Cylinder P/N 1660

Condition	Requirements
Model	AH-1S
Special tools	N/A
Test equipment	Hydraulic Test Stand
Consumable Materials	(C45) (C73) (C74) (C96) (C102) (C124) (C151)

(1) Disassembly.

(a) Disassembly procedures.

NOTE

Use a clean working area for disassembly. As parts are removed, place in a clean container for protection against dirt and rough handling. If unit is to remain disassembled for a considerable length of time, protect parts from moisture by immersing in preservative hydraulic fluid.

1 Remove cotter pin (3), nut (4), washer (5) and bracket (6). Remove bolt (7) from body (2). (Ref. fig. 7-19B).

CAUTION

Shaft and body assembly (23 and 2, fig. 7-19B) are select-fit, matched, and precision lapped parts. If either part is damaged, the complete assembly must be replaced as a single unit. Use extreme caution when handling to prevent damage to grooves and adjacent surfaces. Wrap parts after disassembly for protection and retain in set.

Slide body (2) off of shaft (23).

NOTE

If filter (10) is damaged, remove retaining ring (8), washer (9) and filter.

2 Remove preformed packings (11) from body (2).

3 Cut lockwire and loosen jam nut (15) from barrel (17) and separate barrel from head (28).

4 Remove packing (26) from head (28).

5 Remove shaft (23) and tube assembly (13) from shaft. Remove preformed packings (12 and 14).

6 Remove cap seal (25) and preformed packing or ring seal (24).

7 Remove retaining rings (22), washers (21), scraper rings (20), channel seals (19) and preformed packings (18) from both barrel (17) and head (28).

NOTE

Do not remove bushings (1) from body (2), bushings (27) from head (28), or name plate (16) unless replacement is necessary.

WARNING

Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100 degrees F to 138 degrees F (38 degrees C to 59 degrees C).

CAUTION

Do not drop body (2) or shaft (23) into container of cleaning solvent. Hand hold to prevent damage to precision-machined surfaces.

(b) Cleaning.

1 Immerse and wash all metallic parts in dry-cleaning solvent, (C124). Pay particular attention to passages and threaded areas. Remove stubborn dirt with a stiff-bristled, nonmetallic brush moistened in solvent.

WARNING

Do not direct compressed air against skin.

2 Dry all parts with dry, compressed air not in excess of 125 psig (1.06 kg/sq cm).

3 If components are not to be used immediately after cleaning, flush all parts with preservative hydraulic fluid (C74) and place in a plastic bag and dust-free containers.

(c) Inspection.

1 Inspect all surfaces and threaded areas for damage, signs of wear, burrs, cross-threading, scoring, nicks, and/or corrosion. (Refer to table 7-4.)

NOTE

Excessive wear is defined as any obvious deformation or deterioration of parts which may render the unit inoperative. If doubt exists concerning the serviceability of a part, replace the part.

2 Mating surfaces and grooves on shaft (23, fig. 7-19B and body (2) must be smooth and free of scratches, scoring, feathered edges, and damage from corrosion.

3 Check identification plate (16) for security of attachment and legibility.

4 Examine parts for wear to excess of allowable wear limits as specified in table 7-4.

NOTE

Wear on shaft (23) is acceptable if chrome plating is not worn through or is chipped. Wear on body (2) is acceptable if cylinder assembly leakage is within limits as specified in final test procedures.

5 Make visual check, using 10-power glass, of all radii and corners.

(2) Repair.

(a) Except for critical surfaces (lapped parts) on body (2, fig. 7-19B) and shaft (23), polish out minor scoring on nonsealing and nonbearing ferrous parts with crocus cloth, (C45). Use polishing cloth to polish out minor scoring on aluminum parts. Thoroughly clean any polished parts.

(b) Replace any parts not repairable by minor polishing and any part worn beyond the allowable wear limits specified in table 7-4.

NOTE

Body (2, fig. 7-19B) and shaft (23) are precision-matched parts. If either body or shaft requires replacement, replace them as an assembly.

(c) Replace all packings, cotter pin, scraper rings, and retaining rings whenever these parts are removed during disassembly.

(3) Assembly.

(a) Lubrication. Lubricate all internal parts at final assembly in hydraulic fluid (C73) and lubricate all preformed packings with technical petrolatum (C96) prior to installation.

WARNING

Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100 degrees F to 138 degrees F (38 degrees C to 59 degrees C).

Table 7-4. Inspection Criteria

ITEM NUMBER	NOMENCLATURE	INSPECT FOR		
-1	Bushing	ID wear 0.252 inch maximum		
-2	Body	Thread damage Superficial damage and corrosion Cracks and distortion		
-7	Bolt	Damaged threads and corrosion		
-13	Tube	Cracks, distortion, and superficial damage		
-15	Jamnut	Thread damage Crack distortion and superficial damage		
-17	Barrel	Major ID 0.9405 inch max Minor ID 0.6275 inch max Thread damage Cracks, distortion and superficial damage		
-23	Shaft	Thread damage Cracks and distortion		
-27	Bushing	OD 0.498 minimum		
-28	Head	ID 0.6275 maximum Thread damage Cracks, distortion, and superficial damage		

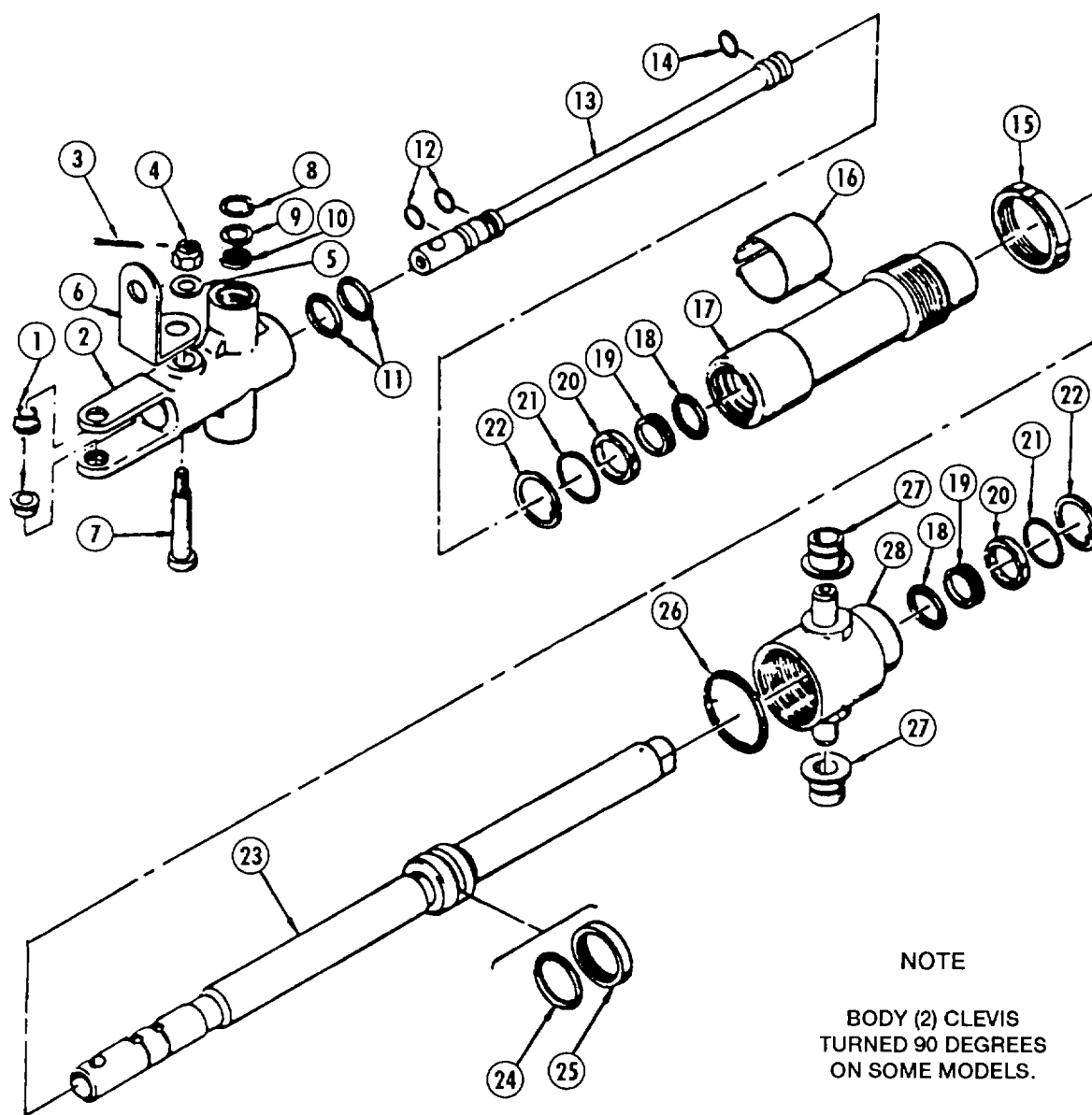


Figure 7-19B. Hydraulic Servocylinder, Part No. 1660 Series (Typical), Exploded View

(b) Reassembly Procedures.

NOTE

Coat all internal parts with clean hydraulic fluid (C73) to facilitate reassembly.

1 If removed, press new bushings (1, fig. 7-19B) into body (2) and bushings (27) onto head (28).

2 When installing packings, visually inspect new packings for cuts, nicks or flaws and discard when any evidence of these defects are present.

3 Ensure that packings are of proper size. Uniform pressure on packings when installed is necessary for satisfactory operation of servo-cylinder and to prevent leakage.

NOTE

Ensure retaining ring is installed with flat side outboard.

4 Install preformed packings (18), channel seals (19), scraper rings (20) and washers (21) and secure with retaining ring (22); in both head (28) and barrel (17).

5 Install preformed packing (26) into head (28).

6 Assemble ring seal on preformed packing (24) and cap seal (25) onto shaft (23).

7 Install preformed packings (12 and 14) on tube assembly (13) and insert tube into shaft (23).

CAUTION

Use care when torquing jam nut to preclude damage to barrel (17) and head (28).

8 Install barrel (17) and head (28) on shaft (23) and fasten together with jam nut (15). Torque jam nut to **200-250** in-lb. Lockwire after testing.

9 Install preformed packings (11) in body (2) and, if removed, install filter (10), washer (9) and retaining ring (8).

10 Install body (2) on shaft (23). Insert shoulder bolt (7) through body and shaft and install bracket (6), washer (5), nut (4) and cotter pin (3).

(4) Final Performance Check.

(a) Test Procedures.

1 Install cylinder assembly in a
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suitable hydraulic test stand capable of delivering hydraulic fluid continuously filtered to 10 microns, at pressures up to 2250 psig (158.3 kg/sq cm) at 26.7 degrees C (80 degrees F to 100 degrees F), as test medium. Hydraulic test stand.

2 Bleed all air from cylinder before testing.

3 Connect PRESS and RET ports to hydraulic pressure source, and apply 2 psig for three minutes. There shall be no external leakage.

4 Slowly increase pressure to 2250 psig (158.3 kg/sq cm) and hold for three minutes. There shall be no external leakage.

5 Place servo body in center position and barrel in approximately mid position of travel. Apply 1100 psig (77.4 kg/sq cm) at PRESS port and hold pressure for two minutes. Leakage from RET port must not exceed 60 cubic centimeters per minute.

6 Apply 1100 psi (77.4 kg/sq cm) at PRESS port and cycle cylinder several times. Position body to actuate barrel to fully extended position. After two minutes in this position, leakage at RET port must not exceed 100 cubic centimeters per minute.

7 Actuate barrel to fully retracted position, and repeat step f. Same leakage requirements must be met.

8 With 1500 psi (105.6 kg/sq cm) applied at PRESS port, force necessary to move servo valve body from any position must not exceed 2-1/2 lb (1.135 kg).

9 Apply 50 psi (9.5 kg/sq cm) to return port for three minutes. If seepage is present, continue test.

NOTE

Combined leakage out of servo valve ends shall not exceed 1 drop in 15 minutes.

10 Trouble Analysis. If any malfunction or leakage is observed during tests, refer to table 7-5 troubleshooting chart, for probable cause and remedy. Replace parts if required and repeat all test procedures.

(b) Post-Test Procedures.

1 After satisfactory completion of all tests, flush cylinder assembly with preservative hydraulic fluid (C73).

2 Lockwire jamnut (15), using lockwire (C151).

Table 7-5. Troubleshooting Chart

TROUBLE	PROBABLE CAUSE	REMEDY
Leakage during test procedure step e.	Faulty shaft and/or body	Replace shaft (23, fig. 7-22.1) and body (2).
Leakage during test procedure, steps f., and g.	Faulty shaft and/or body	Replace shaft (23) and body (2).
	Tube packings (12) or packing (24) nicked	Replace packings as required.
Leakage from either end of piston	Faulty packings	Replace packings as required.
Excessive force required to move barrel	Shaft in barrel binding	Replace barrel (17) and/or shaft (23) and body (2) and/or head (28).
Valve travel check out of limits	Faulty shaft and/or body	Replace shaft (23, fig. 7-22.1) and body (2) and retest.

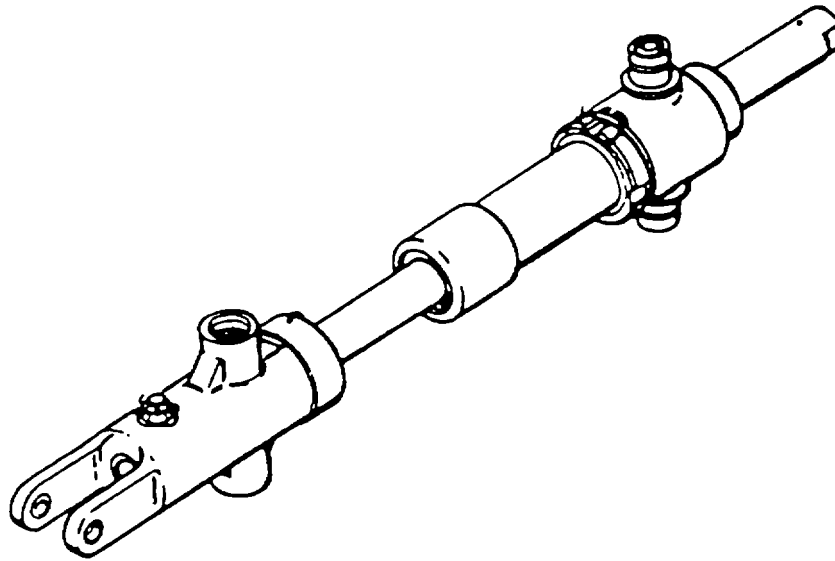


Figure 7-19C. Hydraulic Servocylinder

Table 7-6. Leading Particulars T/R Control Cylinder

Pressure Data:	
Operating	1500 psig (105.6 kg/sq cm)
Proof	2250 psig (158.3 kg/sq cm)
Burst	3750 psig (263.9 kg/sq cm)
Cylinder Stroke	3.500 to 3.540 in. (8.89 to 8.992 cm)
Effective Area	0.38 in. ² (2.45 sq/cm)
Port Data:	
PRESS	per AND 10050-4 for 1/4 in. Tube
RET	per AND 10050-5 for 5/16 in. Tube
Servo Valve Data:	
Servo Valve Stroke from Neutral	±0.035 in. (+0.089 cm)
CYL 1 and CYL 2 to RET	0.004 to 0.006 in. (0.010 to 0.015 cm) overlap
PRESS to CYL 1 and CYL 2	0.001 to 0.002 in. (0.003 to 0.005 cm) underlap
Pilot Input Force (after static for 5 minutes and 1500 psi) (105.6 kg/sq cm)	2.5 lb (1.14 kg) (max.)
Hot Load on Valve	1000 lb (454 kg) (max.)
Breakout Force (Ports Open)	5.0 lb (2.27 kg) (max.) (P/N1660-9, -11, -15) 10.0 lb (4.54 kg) (max.) (P/N1660-17, -23)
Overall Dimensions (approx):	
Length	14 in. (35.6 cm)
Width	1.5 in. (3.8 cm)
Height	2.56 in. (6.50 cm)
Weight (Dry)	1.75 lb (max.) (0.79 kg)
Operating Medium	Hydraulic fluid, MIL-H-83282A
Operating Temperature Range	-53.9°C to +82.2°C (-65°F to +180°F)

c.2. Assembly.

(1) Provide a clean work area and place nut (6, figure 7-19A) on clevis (7). Thread clevis into end of cylinder assembly (5) piston rod. Adjust clevis (7) 1.22 inches from end of rod to center of clevis bolt holes (see View A), with clevis aligned same direction as valve clevis as shown. Tighten nut (6).

(2) Install tape (C131) to inboard surface of plate assembly (10 and 11) bolt holes. Tape must extend 0.25 inch beyond edges of plate assembly.

(3) Place plate assemblies (10 and 11) on trunnions of cylinder assembly (5). Position cylinder assembly (5) to support assembly (13). Apply unreduced primer (C102) to two bolts (12) and install bolt with four washers (9) and two nuts (8) through plate assemblies (10 and 11) and support assembly (13).

(4) Insert spacer (18) in bearing of walking beam (19). Position cylinder assembly (5) with PRESSURE port at right and align clevis of cylinder assembly on ends of spacer (18). Install bolt (1) with two washers (2) and nut (4). Secure nut (4) with cotter pin (3).

(5) Place one washer (15) on bolt (14). Apply unreduced primer (C102) to bolt (14). Position walking beam (19) in clevis of support assembly (13) and install bolt (14), washer (15) and nut (17). Secure nut (17) with cotter pin (16).

(6) Install nut (26), ring (25) and preformed packing (24) on elbow (27). Apply a light film of hydraulic fluid (C73) to threads of elbow (27) and packing (24) and thread elbow in RETURN port of cylinder assembly (5). Position elbow (27) forward as shown in view B and tighten nut (26).

(7) Install nut (21), ring (22) and preformed packing (23) on elbow (20). Apply a light film of hydraulic fluid (C73) to threads of elbow (20) and packing (23) and thread elbow in PRESSURE port of cylinder assembly (5). Position elbow (20) forward as shown in view B and tighten nut (21).

(8) If cylinder and support assembly is not immediately being installed, install protective dust caps to open ports of elbows (20 and 27) and wrap with barrier material (C30) and secure with tape (C136).

d. Installation.

(1) Apply tape (C131) to bottom of four mounting pads of cylinder and support assembly (7, figure 7-19). (See NOTE 1 of figure 7-19).

(2) Position cylinder and support assembly (7) to floor panel. Place two washers (18) on two bolts (17) and two washers (15) on two bolts (14). Install bolts (17) through the floor panel and stabilization stop. (Ensure the stop is installed with the flat side toward the rear.) Apply a light coat of unreduced primer (C102) to bolts (14 and 17), and install bolts. Install two washers (18) and two nuts (19) to bolts (17) (lower side of floor panel).

(3) Position clevis of control tube (1) to walking beam and install bolt (20), two washers (4) and nut (5). Secure nut (5) with cotter pin (3).

(4) Position bearing end of control tube (12) to clevis of cylinder and support assembly (7) and install bolt (13), two washers (9), and nut (10). Secure nut (10) with cotter pin (11).

(5) Remove protective dust covers from hydraulic fittings (located on floor panel, inboard and outboard of cylinder and support assembly) and connectors of tube assembly (16). Install tube assembly (16). Apply standard torque to connectors.

(6) Remove protective dust covers from elbows (6 and 8) and connectors of hose assemblies (2 and 21). Install hose assemblies (2 and 21) and connectors. Apply a standard torque to connectors. Check cylinder and support assembly (7) for freedom of movement. Ensure hose assemblies (2 and 21) do not restrict cylinder movement.

(7) Move anti-torque pedals through full throw ten times while pressure is on system to eliminate air. Operate helicopter engine, or use hydraulic test unit, to pressurize hydraulic system. (Refer to paragraph 7-3.)

NOTE

If air is not eliminated by procedure outlined in step (7), feedback may be experienced during flight. If feedback is experienced, accomplish step (8).

(8) Attach hydraulic test unit. (Refer to paragraph 7-3.) Disconnect controls at aft end of power cylinder and at lower end of walking beam. (See figure 7-19.) Ensure that cylinder will not strike any structure when actuated. Move walking beam to cause power cylinder to move through full throw ten times. Reinstall

control. Disconnect hydraulic test unit.

7-15. Solenoid Valve.

a. Inspection.

(1) Visually inspect for nicks, scratches, dents, and/or corrosion; corrosion treat as necessary.

(2) Check threaded areas for damaged threads.

(3) Check paint and touch up as necessary.

b. Function, Check & Test. (A VIM)

(1) Apply 1500 psi at inlet. Apply 18 volts dc to solenoid. Set test stand at six gallons per minute. Energize and deenergize solenoid for 25 cycles. Reject valve if there is any malfunction or hesitation.

(2) Plug outlet and apply 25 psi pressure to inlet. Energize and deenergize solenoid to equalize pressure. Reject valve if there is any external leakage or distortion within two minutes. Repeat test with 2250 psi applied at inlet.

(3) Operating voltage: Apply 1500 psi at inlet. Apply 15.3 volts dc at solenoid. Energize and deenergize solenoid several times. Reject valve if there is any hesitation. Repeat test with 2250 psi applied at inlet and 28 volts dc applied to solenoid.

(4) Internal leakage: Apply 1500 psi to inlet, wait two minutes then measure leakage. If leakage exceeds 10 cc per minute reject the valve.

(5) Pressure drop: Set test stand at six gallons per minute. Apply 50 psi to valve inlet. Measure flow at valve outlet. If flow is less than six gallons per minute, reject the valve.

(6) Dielectric strength: Apply 1000 volts ac rms between both receptacle pins and solenoid case for 1 minute. If there is any breakdown or flushover, reject valve.

(7) Insulation resistance: Apply 500 volts dc between receptacle pins and solenoid case. If there is less than five megohms resistance, reject the valve.

7-16. Armament Hydraulic Provisions.

a. Hydraulic power for the armament turret is provided through quick-disconnect couplings located in the ammunition compartment. Components include a priority valve, a solenoid shutoff valve, a check valve in a bypass line around the solenoid valve, and a check valve in the return line. Valves are located in fuselage compartment, below transmission and just aft of station 186.25 bulkhead, accessible through door below wing at left side.

b. Valves, lines, and couplings can be replaced, if malfunction occurs, by standard practices for hydraulic systems. Electrical circuit diagrams for solenoid connections will be found in Chapter 9. Operational and maintenance procedures for the turret hydraulic system will be found in the applicable armament manual.

7-17. Hydraulic Flushing Instructions.

Prior to flushing the hydraulic system, functionally check the hydraulic test unit to assure that it is operating properly. Install new and unused hydraulic filter elements in the test unit to assure maximum fluid filtration. Fill the test unit hydraulic reservoir to capacity with fresh hydraulic fluid (C73). Inspect pressure and return hoses to hydraulic test unit for cleanliness. Manufacture a drain line from rubber hose, eight foot in length, and a quick disconnect coupling half. Prepare the aircraft for flushing as follows:

NOTE

Systems must be flushed individually at 1000 PSI.

Premaintenance Requirements for Flushing Hydraulic System

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	None
Test Equipment	Hydraulic Test unit
Support Equipment	None
Minimum Personnel Required	Two

Premaintenance Requirements for Flushing Hydraulic System (Cont)

Conditions	Requirements
Consumable Materials	(C73) (C124)
Special Environmental Conditions	None

a. Heavy Contamination.

(1) Remove filter elements (5, figure 7-6) from contaminated system module. (Refer to paragraph 7-7.)

(2) Clean and store elements in clean plastic bags.

(3) Replace filter bowls (6, figure 7-6) and torque **100 TO 140** inch-pounds.

(4) Remove drain plug (7, figure 7-8A) from contaminated reservoir assembly and drain reservoir.

(5) Remove reservoir assembly (5) from helicopter. (Refer to paragraph 7-8.)

(6) Unscrew reservoir filter adapter (2) from reservoir (5) and remove filter screen (3). Unscrew return line fitting (10) and remove strainer. Remove sight gage (8).

(7) Flush all components with solvent (C124).

(8) Remove reservoir return line (see figure 7-4 and 7-5) and bypass return lines from the filter module. Remove pump pressure line, pump inlet line, and pump bypass line.

(9) Flush all removed lines with solvent (C124).

(10) Remove pump from contaminated system and forward to depot facility to be flushed, tested, and repaired as required. (Refer to paragraph 6-20.)

NOTE

If the #2 system is the only system contaminated, proceed to step 17.

(11) Check accumulator for adequate pressure. Recharge to **650 TO 850** psig if necessary.

(12) Connect pressure line from the test unit to the #1 system pressure ground service coupling on the aircraft. Attach the manufactured drain line to the #1 return ground service coupling. Place unattached end of the drain line in an open container. (See figure 7-4 and figure 7-5.)

(13) Connect external 28 volts dc power source to the aircraft. Set hydraulic test unit to 3 GPM flow at 1000 PSI.

(14) Depress SCAS CONT (CB1) and SCAS PWR(CB12) circuit breakers. Set power switch on the control panel to POWER. When NO GO indicator lights for PITCH, ROLL and YAW go out, set PITCH, ROLL and YAW switches to engage.

(15) Move collective stick through ten full strokes in each direction. Move cyclic stick fore and aft, then right and left ten (10) full strokes in each direction. Alternately depress the right and left tail rotor control pedals ten (10) full strokes in each direction. Check system for leaks. Depress emergency disengage switch on the pilots control cyclic stick. Observe all SCAS actuators center and lock.

(16) Disconnect test unit from the #1 system ground service connections.

(17) Connect the accumulator disconnect (see figure 7-1A) to the return line disconnect and discharge the accumulator by depressing the drain valve button. Check the accumulator nitrogen charge, disconnect the connector in the return line and reconnect to the stowage socket. Secure all electrical switches, relieve hydraulic pressure at the test unit. (Refer to paragraph 7-9.)

NOTE

If #2 system is not contaminated, omit steps 18. through 23. and proceed to step 24.

(18) Connect test unit to #2 system pressure ground service connections. Connect drain line to #2 system return ground service connection. Place unattached end of drain line in an open container.

(19) Refill test unit reservoir with clean hydraulic fluid (C73). Pressurize the system.

WARNING

Assure that weapons are unloaded.

(20) Energize gun system solenoid by positioning the following switches and circuit breakers.

Turret Power Circuit	
Breaker	ON
Weapons Fire Circuit	
Breaker	ON
Weapons Sight Circuit	
Breaker	ON
Battery Switch	OFF
Inverter Switch	Main
Master Arm Switch	Standby
Turret Select Switch	Gunner
TOW Power Circuit	
Breaker	ON
Reference Transformer	
Circuit Breaker	ON
SECU Power	
Circuit Breaker	ON
TCP Mode Select	
Switch	TSU/GUN
Stow/TRK/ACQ	
Switch	TRK

Depress "Action" switch on left grip of TSU.

(21) Assure that all is clear in turret area. Operate turret fully left and full right ten complete cycles. Elevate and lower turret fully ten complete cycles.

(22) Select TCP Mode Select Switch to Tow Armed.

(23) Elevate and lower pylons fully ten complete cycles. Move cyclic stick fore and aft, then right and left ten full strokes in each direction. Alternately depress right and left tail rotor control pedals ten full strokes each. Move collective stick through ten full strokes in each direction. Check system for leaks.

(24) After completion of system flushing, de-energize armament system, move cyclic stick away from stop and place collective full down.

(25) Secure all electrical switches, relieve hydraulic pressure at the test unit, disconnect test unit and external power unit from the aircraft. Remove line and cap ground service couplings.

CAUTION

Take care when installing filter elements that no damage to mesh is incurred and that the element is properly seated prior to torquing.

(26) Install filter elements (5, figure 7-6) and torque filter bowls (6, figure 7-6) **100 TO 140 inch-pounds** and lockwire (C151).

(27) Reinstall lines that were removed and flushed. (See figure 7-4 and 7-5.)

(28) Reassemble reservoir and reinstall on helicopter. (Refer to paragraph 7-8.)

(29) Install serviceable hydraulic pump. (Refer to paragraph 6-20.)

(30) Fill hydraulic reservoirs with clean fluid (C73). Check systems for leaks.

b. Light to Moderate Contamination.

(1) Disconnect pump outlet line at filter module. (See figure 7-4 and 7-5.)

(2) Remove filter elements (5, figure 7-6) from contaminated system module.

(3) Clean and store the elements in clean plastic bags.

(4) Replace the filter bowls and torque **100 TO 140** inch-pounds. (Refer to paragraph 7-7.)

(5) If #2 system is the only system contaminated, omit steps 6. through 10. and proceed to step 1 i.

(6) Connect pressure line from the test unit to the #1 system pressure ground service coupling on the aircraft. Attach the manufactured drain

line to the #1 return ground service coupling. Place unattached end of the drain line in an open container.

(7) Connect external 28 volt dc power source to the aircraft. Set hydraulic test unit to 3 GPM flow at 1000 PSI.

(8) Depress SCAS CONT (CB1) and SCAS PWR (CB12) circuit breakers. Set power switch on the control panel to POWER. When NO GO indicator lights, for PITCH, ROLL and YAW go out, set PITCH, ROLL and YAW switches to engage.

(9) Move collective stick through ten full strokes in each direction. Move cyclic stick fore and aft, then right, and left ten (10) full strokes in each direction. Alternately depress the right and left tail rotor control pedals ten (10) full strokes in each direction. Check systems for leaks. Depress emergency disengage switch on the pilots control cyclic stick. Observe all SCAS actuators center and lock.

(10) Relieve the pressure on the test unit and disconnect the unit from the #1 system ground service couplings.

(11) Connect the accumulator disconnect (see figure 7-1A) to the return line disconnect and discharge the accumulator by depressing the drain valve button. Check the accumulator nitrogen charge, disconnect the connector in the return line and reconnect to the stowage socket. Secure all electrical switches, relieve hydraulic pressure at the test unit. (Refer to paragraph 7-9.)

(12) If #1 system is the only system contaminated, omit steps 13. through 17. And proceed to step 18.

(13) Connect test unit to the #2 system ground service couplings.

(14) Pressurize system.



Assure that weapons are unloaded.

(15) Energize gun system solenoid by positioning the following switches and circuit breakers.

Turret Power Circuit	
Breaker	ON
Weapons Fire Circuit	
Breaker	ON
Weapons Sight Circuit	
Breaker	ON
Battery Switch	OFF
Inverter Switch	Main
Master Arm Switch	Standby
Turret Select Switch	Gunner
TOW Power Circuit	
Breaker	ON
Reference Transformer	
Circuit Breaker	ON
Secure Power Circuit	
Breaker	ON
TCP Mode Select	
Switch	TSU/GUN
Stow/TRK/ACQ Switch	TRK

Depress "Action" switch on Left Grip of TSU.

(16) Assure that all is clear in turret area. Operate turret fully left and full right ten complete cycles. Elevate and lower turret fully ten complete cycles.

(a) Select TCP Mode Select switch to TOW Armed. Elevate and lower pylons fully ten complete cycles. Move cyclic stick fore and aft, then right and left ten full strokes in each direction. Alternately depress right and left tail rotor control pedals ten full strokes each. Move collective stick through ten full strokes in each direction. Check system for leaks.

(17) De-energize armament system, move cyclic stick away from stops and place collective full down.

(18) Remove return drain line, and reconnect system return line. (On Serial No. 70- 15936 and subsequent, the system return line is already connected.)

(19) Momentarily pressurize the system to purge return line.

(20) Drain reservoir (5, figure 7-8A) by removing drain plug (7). Reinstall drain plug (7) and lockwire (C151).

WARNING

Use solvent (C124) in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

(21) Fill reservoir (5) with solvent (C124).

(22) Motor engine just long enough to pump all of solvent (C124) through pump.

(23) Disconnect the test unit and external power unit from the aircraft. Cap ground service couplings.

(24) Connect pump outlet line to filter module. (Refer to figure 7-4 or 7-5.)

CAUTION

Take care when installing filter elements that no damage to mesh is incurred and that the element is properly seated prior to torquing.

(25) Replace filter elements (5, figure 7-6) and torque filter bowls (6, figure 7-6) **100 TO 140** inch-pounds. Lockwire bowls (C151).

(26) Fill hydraulic reservoirs with hydraulic fluid (C73).

(27) Check system for leaks.

7-18. (AVIM) Hydraulic Line Fabrication. Refer to Appendix D.

7-19. Armament Pylon Servo Actuator.

Premaintenance Requirements for Armament
Pylon Actuator

Conditions	Requirements
Model	AH-1S
Part No. or Serial No.	All
Special Tools	None

Premaintenance Requirements for Armament
Pylon Actuator (Cont)

Conditions	Requirements
Test Equipment	Control Box ED 0933 (Decoto Aircraft P/N) Backlash Fixture ED 0889 (Decoto Aircraft P/N) 500 ML Graduated Breaker 0 - 500 psi Hydraulic Pressure Gage 0 - 2000 psi Hydraulic Test Bench Serviced with Hydraulic Fluid (C73)
Support Equipment	None
Minimum Personnel Required	Two
Consumable Materials	(C73)
Special Environmental Conditions	Test Bench must maintain the fluid temperature at 90°F ±20°F and be located in an area where the temperature can be maintained at 80°F ±10°F.

a. Cleaning. Clean external surfaces, except polished surfaces of piston rod by wiping with a cloth moistened with solvent (C124). Carefully clean exposed polished surfaces of piston rod with a soft cloth moistened with hydraulic fluid (C73).

b. Inspection.

(1) All parts for damage, corrosion or pitting, and exposed threads for distortion.

(2) Black residue around the piston rod is not a reason for replacement of the servo cylinder.

(3) Piston rod for nicks, scratches, or scoring, and for smooth operation in cylinder.

c. Removal.

- (1) Remove cowling from rack assembly.
- (2) Provide a suitable container to catch spilled hydraulic fluid.
- (3) Disconnect electrical connector from actuator.
- (4) Disconnect hose from fittings at pressure and return port on actuator. Cover openings.
- (5) Disconnect actuator from fittings by removing bolts, nuts and washers.

d. Disassembly. (Figure 7-20.) (AVIM)

- (1) Remove lockwire (4), cap screws (2) and servo valve (5) from body assembly (14 or 15). Install protective cover on servo valve (5).
- (2) Remove lockwire (4) from cap screws (7).
- (3) Remove cap screws (7).
- (4) Remove rod end assembly (30), jam nut (28), and locking key (item 29) from piston (20).
- (5) Remove retaining plate (26) and rod scraper (27).
- (6) Insert work aid (figure 7-21) into piston (20, figure 7-22) and screw tool into piston lock (17). Tighten nut on installation tool until piston lock bottoms in piston (20). Remove piston (20), seal retainer (12), foot seal (24), preformed packing (25) and rod bearing (10) from body assembly (14 or 15) as a group.
- (7) Remove seal retainer (12), foot seal (24) and preformed packing (25) from piston (20).
- (8) Remove rod bearing (10) from piston (20).
- (9) Loosen nut on installation tool until free. Remove installation tool.
- (10) Remove piston lock (17), spring (23), and spring set (28) from piston (20).
- (11) Do not remove lock ring (16) from piston (20) unless damage is evident.
- (12) Remove performed packing (11) from rod bearing (10).

(13) Remove performed packing (21) and backup rings (22) from piston lock (17).

(14) Remove performed packing (18) and channel seal (19) from piston (20).

e. Assembly. (Figure 7-20.) (AVIM)

(1) Lubricate all performed packings, channel seal and foot seal with hydraulic fluid (C73).

(2) Install packing (18, figure 7-20) into channel seal (19).

NOTE

Install may be aided by heating channel seal and packing with a heat lamp; however, heating is not mandatory.

(3) Install performed packing (18) and channel seal (19) in piston (20) with a conical sleeve type work aid. See figure 7-22 for instructions to fabricate work aid.

(4) Install performed packing (25) onto rod bearing (10).

(5) Install performed packing (21) and channel seal (22) onto piston lock (17).

(6) If lock ring (16) was removed at disassembly, install lock ring (16) onto piston (20).

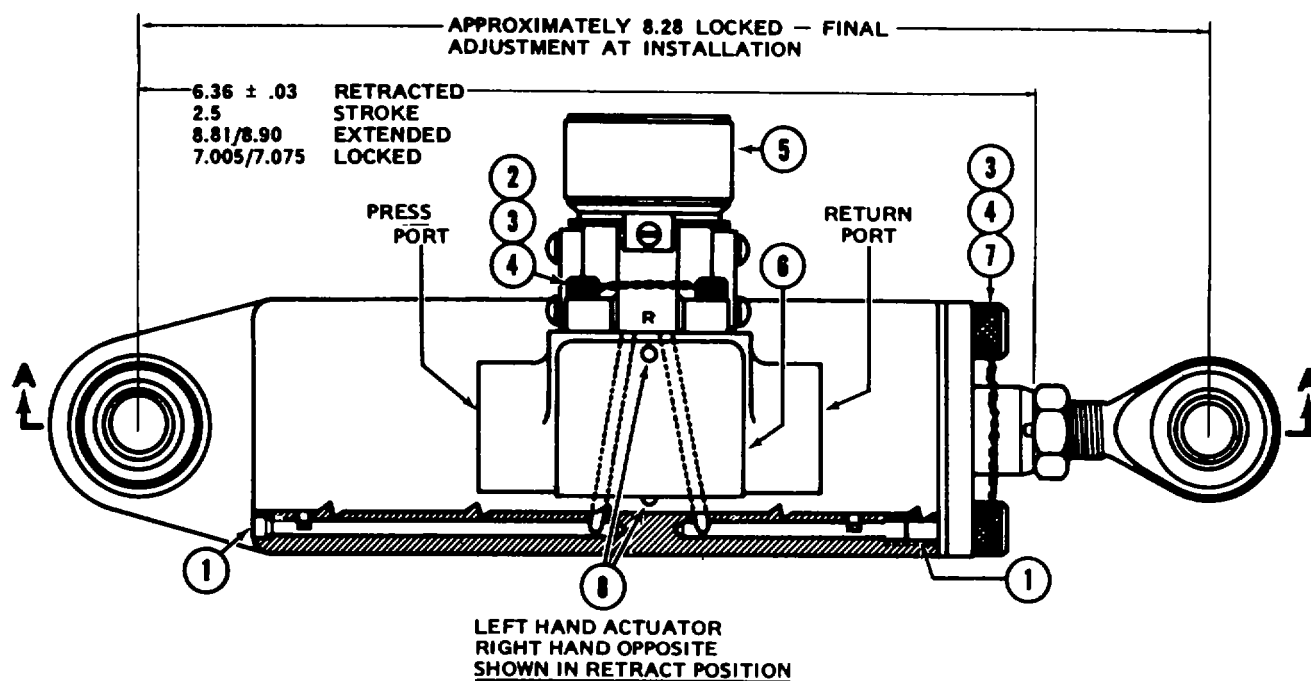
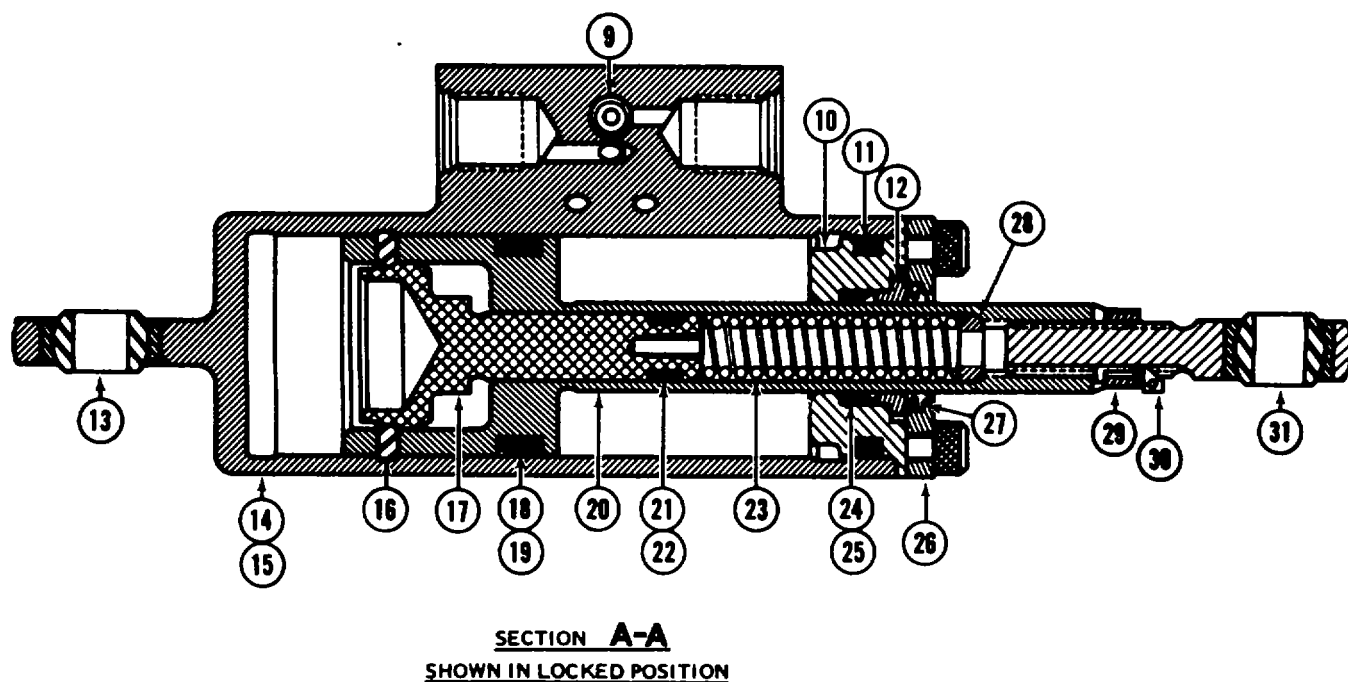
NOTE

Install lock ring with chamfer on inside diameter toward channel seal in piston.

(7) Install spring seat (28) and spring (23) into piston (20).

(8) Insert piston lock (17) into piston (20) until both ends are flush. While holding the piston lock in this position, insert installation tool (figure 7-21) into piston lock and tighten nut until piston lock bottoms in piston. When the piston lock bottoms in piston, the lock ring should be fully contracted in the piston.

(9) Install piston (20, figure 7-20) into body assembly (14 and 15) approximately halfway down. Remove installation tool.



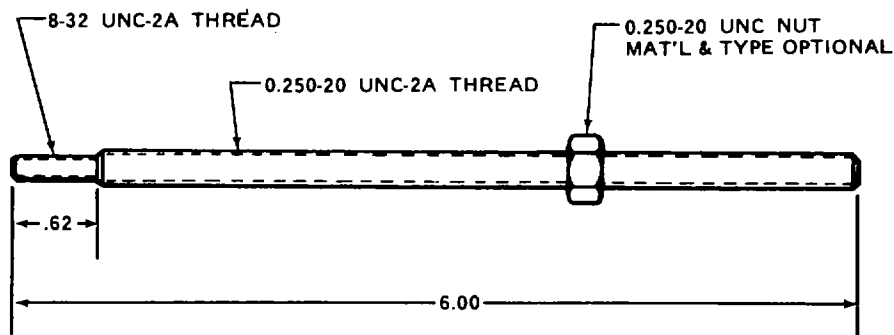
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Figure 7-20. Armament pylon actuator (Sheet 1 of 2)

1. Permanent Plug	11. Preformed Packing	21. Preformed Packing
2. Cap Screw	12. Seal Retainer	22. Backup Ring
3. Aluminum-Seal	13. Spherical Bearing	23. Spring
4. Lockwire	14. Body Assembly, LH Shown	24. Foot Seal
5. Servo Valve	15. Body Assembly, RH Not Shown	25. Preformed Packing
6. Nameplate	16. Lock Ring	26. Retaining Plate
7. Cap Screw	17. Piston Lock	27. Rod Scraper
8. Drive Screw	18. Preformed Packing	28. Spring Seat
9. Check Valve	19. Channel Seal	29. Jam Nut
10. Rod Bearing	20. Piston	30. Locking Key
31. Bearing		

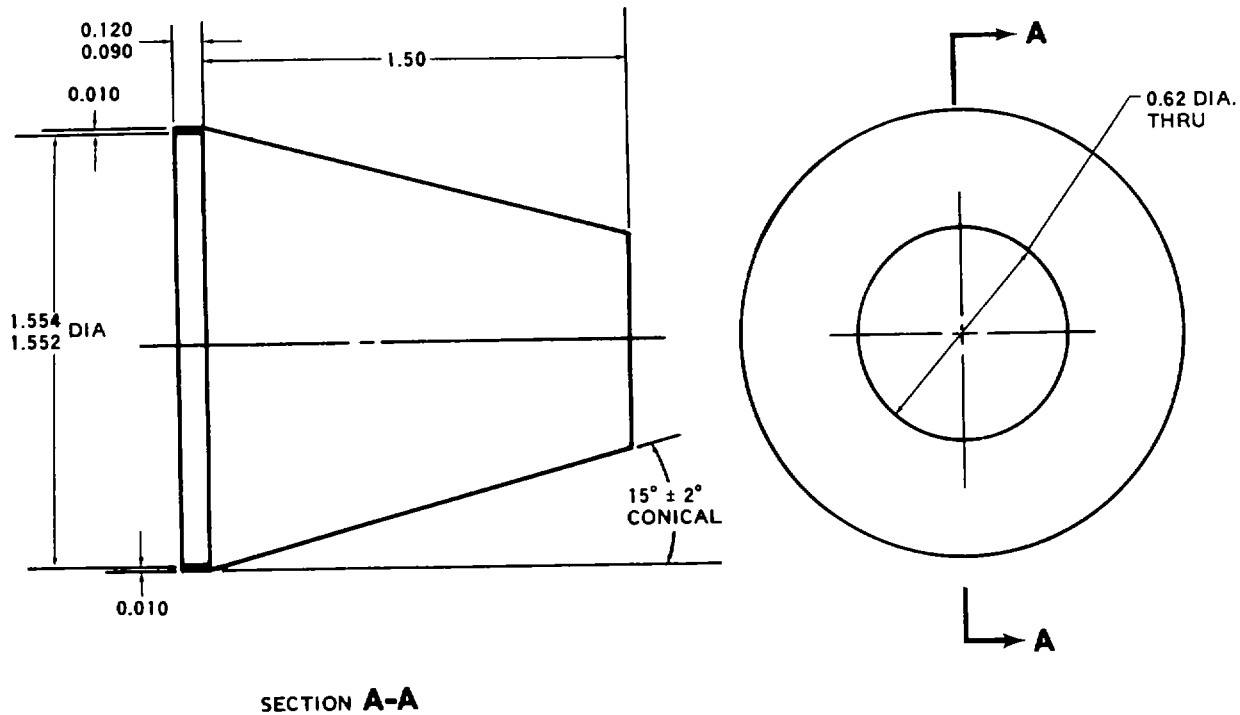
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Figure 7-20. Armament pylon actuator (Sheet 2 of 2)



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Figure 7-21. Work aid for armament pylon actuator disassembly/assembly



SECTION A-A

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Make seal installation tool from aluminum alloy

Figure 7-22. Work aid for seal installation on armament pylon actuator

(10) Install performed packing (25) onto foot seal (24).

(11) Install rod bearing (10) into body assembly (14 or 15).

(12) Install foot seal and performed packing onto piston (20). Push foot seal and performed packing into cavity in rod bearing.

(13) Install seal retainer (12) onto piston (20) and push into foot seal cavity.

(14) Install rod scraper (27) onto piston (20).

(15) Install retaining plate (26) onto piston (20). Position area of plate without tapped hole toward return fluid port.

(16) Install cap screws (7) through retaining plate (26) and into body assembly (14 or 15). **TORQUE CAP SCREWS 50 TO 60 INCH- POUNDS.**

(17) Install jam nut (29) and locking key (30) onto bearing (31).

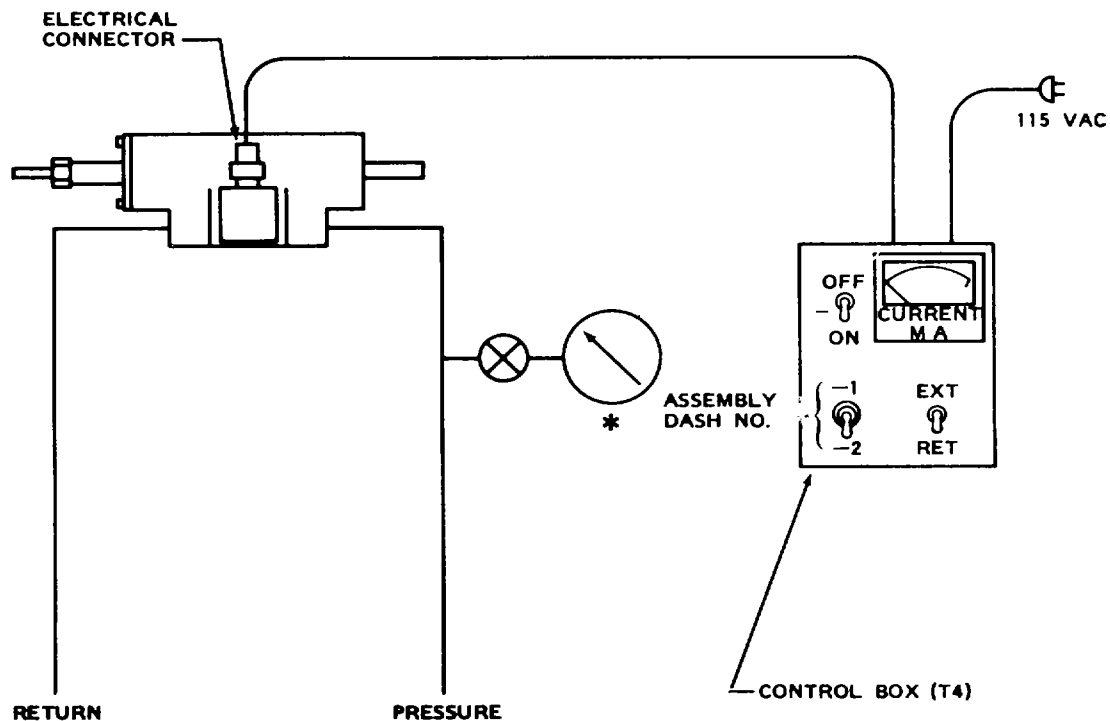
(18) Install bearing (31) into piston (20).

(19) Perform functional test on actuator as follows:

(a) Hook up the actuator that is to be tested as shown in figure 7-23. Apply a pressure of 1500 psig to the pressure port and cycle the actuator until all air is bled. Maintain 1500 psig pressure and proceed to step (b).

(b) Apply a differential current of 5 ma to extend the servo actuator and then to retract. The servo actuator must move to its full stroke position in the proper direction.

(c) Make lock pressure test: Apply 1500 psig to the pressure port and move the actuator to its retracted position. Reduce the pressure to 250 psig and slowly extend the actuator until the lock position is reached. If the actuator does not lock, reduce the pressure 5 psig and repeat the test. If necessary continue reducing the pressure in 5 pound increments and repeating the lock test. The actuator must lock at a pressure of 100 to 250 psig. Record the pressure at which the actuator locks.



* 0-2000 PSI GAUGE FOR
OPERATION TEST,
DIRECTION TEST,
LEAKAGE TESTS

0-500 PSI GAUGE FOR
LOCK AND UNLOCK
TESTS

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Figure 7-23. Schematic diagram of connections to armament pylon actuator for bench test

(d) Make unlock pressure test: With the actuator in the locked condition, apply an extend signal and slowly increase the pressure at the pressure port until the actuator unlocks. Record the unlock pressure. Rotate the piston rod 90 degrees and repeat the test. Make ten unlock tests. Rotate the piston rod 900 each time. The unlock pressure must be 100 to 250 psig.

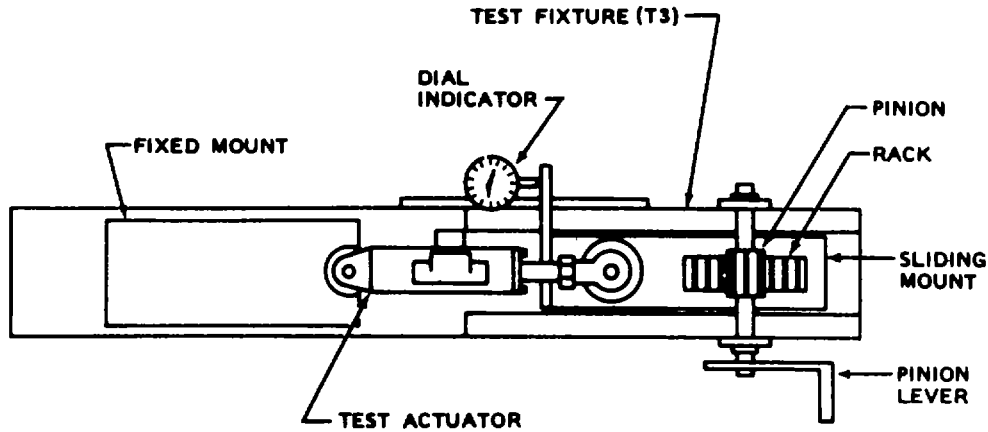
(e) Backlash test: Install the servo actuator in test fixture (T3) as shown in figure 7- 24. Apply a 200 pound tension load and then a 200 pound compression load on the actuator piston rod. Measure the total free play and record. Maximum permissible free play is 0.017 inch.

(f) Proof pressure test: Set the actuator to its mid-stroke position and block the return port. Apply 2250 psig to the pressure port for two minutes. Reduce

the pressure to 5 psig for two minutes. Check for evidence of external leakage, loosening, permanent deformation and rupture of parts. Record the results and if any of these discrepancies were noted, reject the actuator. Repeat the proof pressure test with the pressure port blocked and 1500 psig applied to the return port. Inspect for leaks, distortion, etc., as listed above. Record results.

(g) Leakage tests:

1 External leakage: Hook up the servo actuator as shown in figure 7-23 and apply 1500 psig to the pressure port. Cycle the actuator through 25 complete cycles. Check leakage at the rod seal and record. Maximum allowable leakage is one drop in 25 cycles.



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Figure 7-24. Armament pylon actuator installed in test fixture

2 Internal leakage: Disconnect the electrical connector from the servo actuator. Apply 1500 psig to the pressure port. Attach a filled drip spout to the return port. Measure and record amount of leakage at return port for one minute. Maximum allowable leakage is 37.8 cubic centimeters.

(h) Servo valve frequency response: Attach copies of the frequency response characteristics, that are delivered with each servo valve, to the test results recorded in the preceding steps. The servo valve frequency response must not have resonance below 160 Hz. The amplitude ratio must be down less than 3 dB at 100 Hz and the phase lag must be less than 55 degrees at 100 Hz.

(i) After completion of the test, unlock the servo actuator and move the piston rod to its retracted position. Plug the pressure and return ports. Wipe off all hydraulic fluid.

(j) If the servo actuator is not to be installed immediately, package in an individual container that will provide adequate protection.

f. Installation.

- (1) If actuator is being replaced, install adapting

parts from old actuator.

(2) The hydraulic actuator is factory adjusted and calibrated for proper length. Adjustment of the actuator will be accomplished during final alignment and boresighting of the system.

(3) Install hydraulic actuator on rack assembly and secure with attaching bolts, nuts and washers. Torque (top) bolt EWSB22-6-14, **60 TO 85** inch-pounds, torque (lower) bolt EWSB22-6-16 to 5 inch-pounds maximum.

(4) Connect electrical connector to actuator.

(5) Connect hydraulic lines to actuator, bleed hydraulic system and functionally check elevation of ejector rack. (Refer to Chapter 16.)

7-20. TOW Solenoid Shutoff Valve (see figure 7-2).

a. Removal.

- (1) Ensure electrical power to solenoid valve is off.

(2) Gain access to Tow solenoid valve through access panel, right side.

(3) Disconnect electrical connector from valve.

(4) Install a plug in each hydraulic line end fitting as each is disconnected from the valve and cross fitting.

(5) Remove two mount bolts and remove solenoid valve and cross fitting from helicopter as a unit.

(6) Unscrew union fitting out of top of solenoid valve.

(7) Loosen union lock nut on bottom of solenoid valve, and screw cross fitting and union out of valve.

b. Inspection.

(1) Visually inspect solenoid valve for nicks, cracks, scratches, dents, and corrosion. Treat for corrosion as necessary.

(2) Check for damage to threads.

(3) Check paint and touch up as necessary.

c. Installation.

(1) Install new preformed packing and retainer ring on union fitting. Screw union fitting and cross fitting into bottom of solenoid valve as a unit. Leave lock nut loose.

(2) Install new preformed packing on union and screw it into top of solenoid valve. Tighten union.

(3) Position solenoid valve on helicopter and secure in position with two bolts and washers. Tighten bolts.

(4) Secure each hydraulic line to union fittings in the solenoid valve and cross fitting as each plug is removed from the end fittings. Tighten hydraulic connections.

(5) Tighten lock nut on union fitting at bottom of solenoid valve.

(6) Secure electrical wire to solenoid valve connector.

(7) Clean spilled hydraulic fluid from compartment.

(8) Operate pylon actuators to functionally check solenoid valve. (Refer to Chapter 7.)

CHAPTER 8 INSTRUMENT SYSTEMS

Section I. INSTRUMENT MAINTENANCE

8-1. Instrument Maintenance.

The following general instrument maintenance procedures are applicable to all instruments mounted in either the pitots or gunners instrument panel. (See figure 8-1 for instrument systems equipment location.)

a. Cleaning. Clean panel and instrument cover glasses with a suitable soft, lint-free cloth.

b. Inspection.

(1) Inspect for loose, cracked, or broken cover glasses.

(2) Inspect for proper and secure mounting.

(3) Inspect range markings and decals for completeness and legibility.

(4) Inspect for proper operation.

c. Removal. Remove any instrument from pitots or gunners instrument panel by the following general procedures:

(1) Be sure all electrical power is OFF.

(2) Disconnect electrical leads and/or instrument piping from back of panel. Necessary access may be made through side panels to pitots instrument panel, and through panel at back of console to gunners instrument panel.

(3) Protect ends of electrical leads with electrical tape. Cap open piping and openings on instrument.

(4) Remove mounting screws, or loosen mounting clamp screw. Remove instrument.

d. Repair or Replacement.

(1) Replace missing or illegible range markings on cover glasses of instruments.

(2) Replace any required decals which are

not clearly legible.

(3) Replace any instrument if cover glass is loose, cracked or broken, or when found to be unserviceable.

e. Installation. Install any instrument in pitots or gunners instrument panel by the following general procedures:

(1) Check instrument for correct markings on cover glass.

CAUTION

Do not tighten clamps more than necessary to hold instrument as excessive tension may deform instrument case, causing erroneous reading.

(2) Position instrument in panel. Install mounting screws, or tighten screw of mounting clamp.

CAUTION

When connecting electrical plugs to dual tachometer indicator, ensure that plugs are connected to correct receptacle.

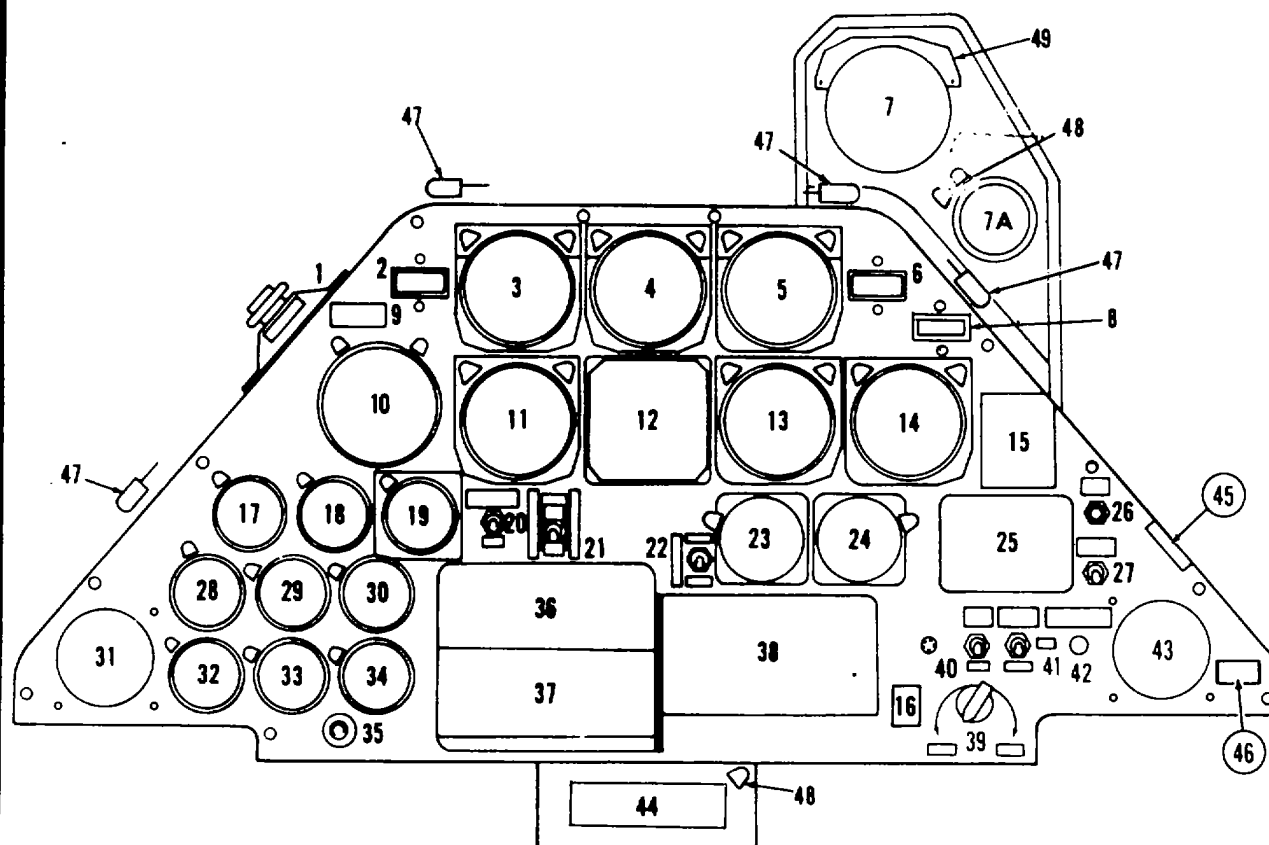
(3) Remove protective caps or covers, as necessary. Connect electrical leads and/or instrument piping. Use silicone compound (C121) on threads of nylon fittings.

(4) Torque coupling nuts fingertight.

(5) Check operation of instrument.

8-2. Instrument Premaintenance Requirements.

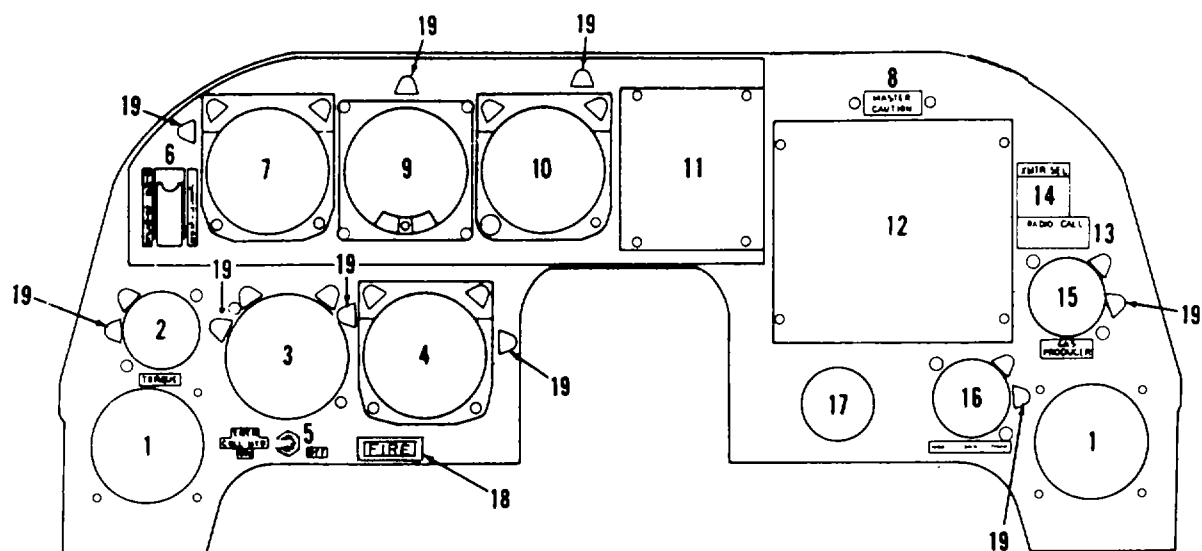
Throughout this chapter, unless otherwise specified, instrument maintenance, testing, and troubleshooting procedures will utilize only tools and equipment contained in Electronic Equipment Tool Kit, TK100/G and multimeter (AN/PSM-6A, or equivalent).



1. Canopy Removal Arming/Firing Mechanism	26. IFF Mode 4 Indicator Light
2. RPM Warning Light w/NVG Cover	27. Code Hold Switch
3. Airspeed Indicator	28. Fuel Pressure Indicator
4. Attitude Indicator	29. Transmission Oil Temperature Indicator
5. Pressure Altimeter	30. Engine Oil Temperature Indicator
6. Master Caution Light w/NVG Cover	31. Air Vent
7. Pilot Steering Indicator	32. Fuel Quantity Indicator
7.1. Torquemeter	33. Transmission Oil Pressure Indicator
8. Fire Warning Light w/NVG Cover	34. Engine Oil Pressure Indicator
9. Radio Call Letters	35. Fuel Gage Test Switch
10. Dual Tachometer	36. Armament Control Panel
11. Turn and Slip Indicator	37. Wing Stores Control Panel
12. Radio Magnetic Indicator	38. FM Control Panel
13. Vertical Velocity Indicator	39. Temperature Selector Control
14. Course Indicator	40. Pitot Heat Switch
15. Operating Limits Decal	41. Rain Removal - ENVR CONT Switch
16. ECU Decal	42. Heat and Vent Control
17. Turbine Gas Temperature Indicator	43. Air Vent
18. Gas Producer Tachometer	44. Missile Status Panel
19. Torquemeter or Blank Panel	45. Minimum Crew Weight Decal
20. Emergency Collective Hydraulic Switch	46. Crashworthy Fuel System Decal
21. Wing Stores Jettison Switch	47. NVG Flood Lights
22. Compass Slaving Switch	48. NVG Post Lights
23. Clock	49. NVG Eye Brow Light
24. Volt-Ammeter Indicator	
25. Ash Tray	

Figure 8-1. Instrument systems equipment location (Sheet 1 of 5)

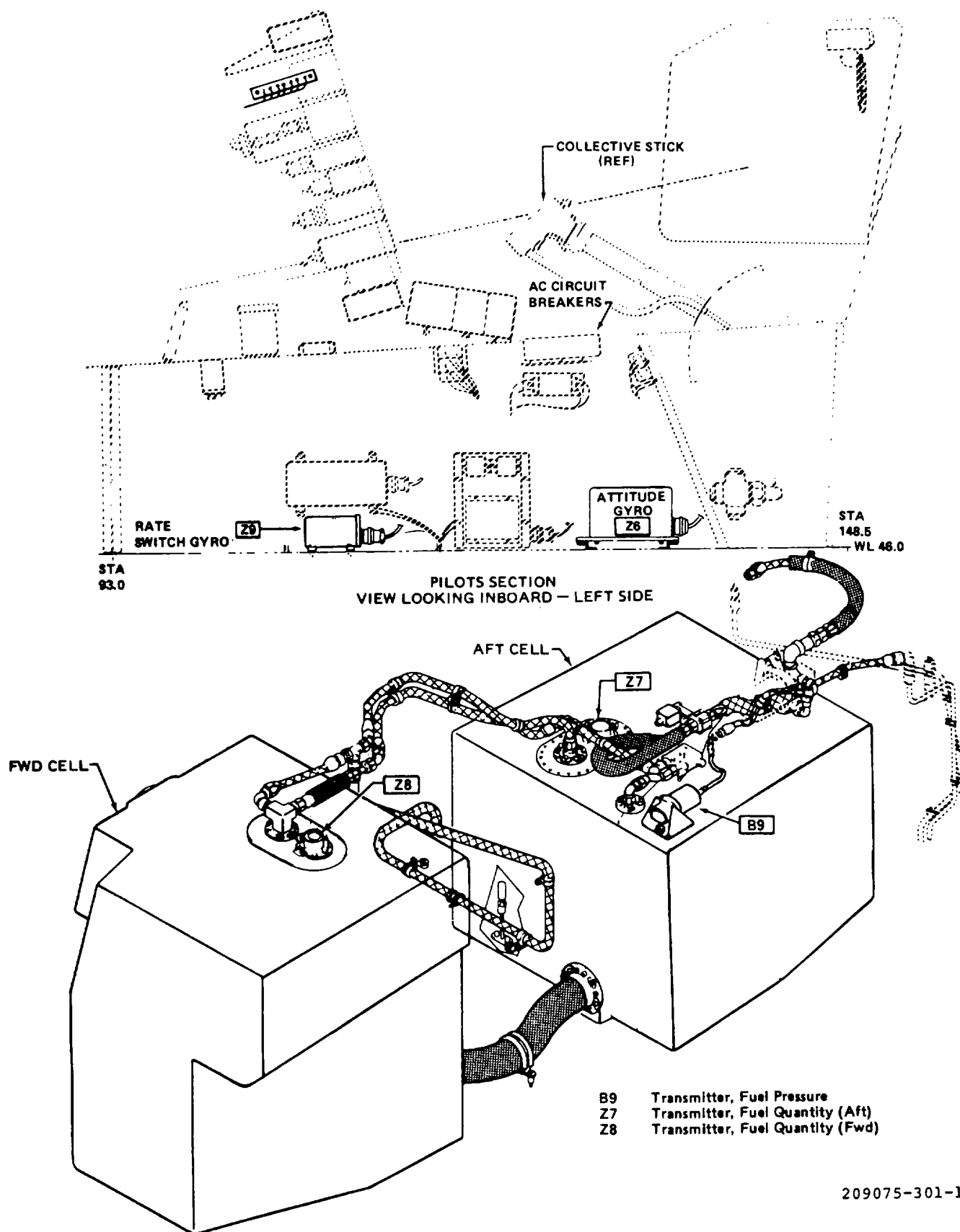
8-2 Change 19



1. Air Vent
2. Torquemeter
3. Dual Tachometer
4. Radio Magnetic Indicator
5. Emergency Collective Hydraulic Switch
6. Wind Stores Jettison Switch
7. Airspeed Indicator
8. Master Caution Light w/NVG Cover
9. Attitude Indicator
10. Pressure Altimeter

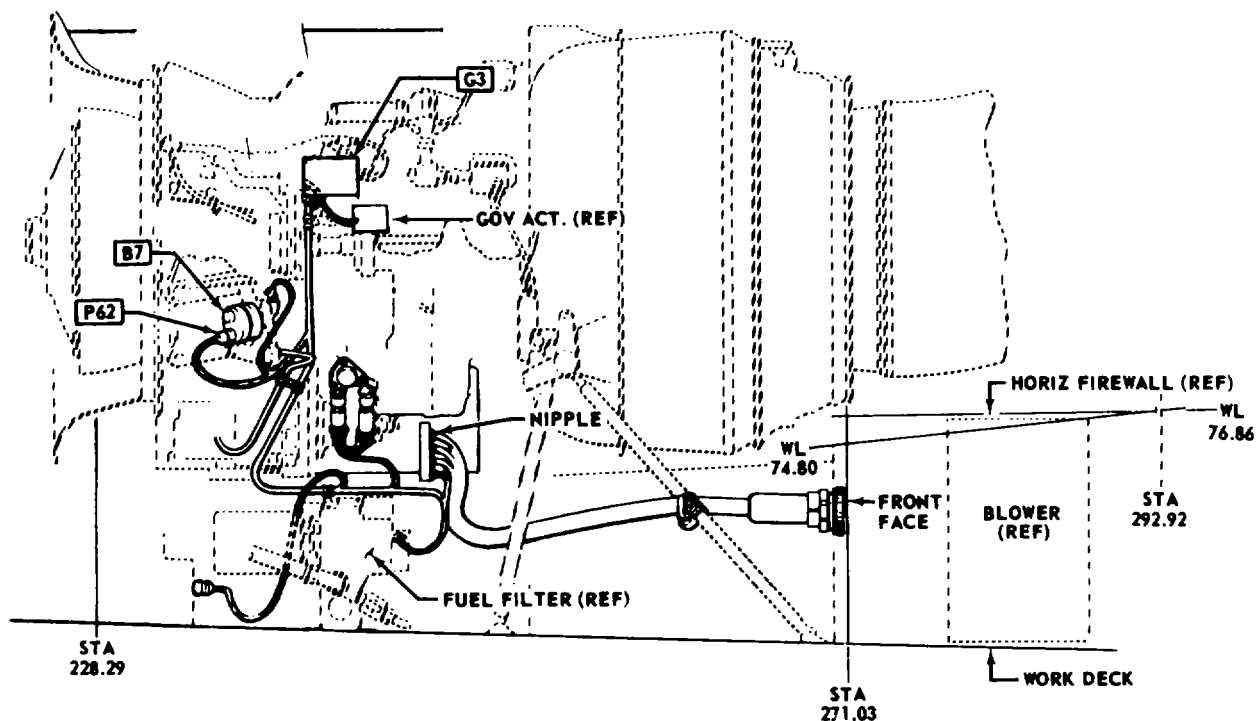
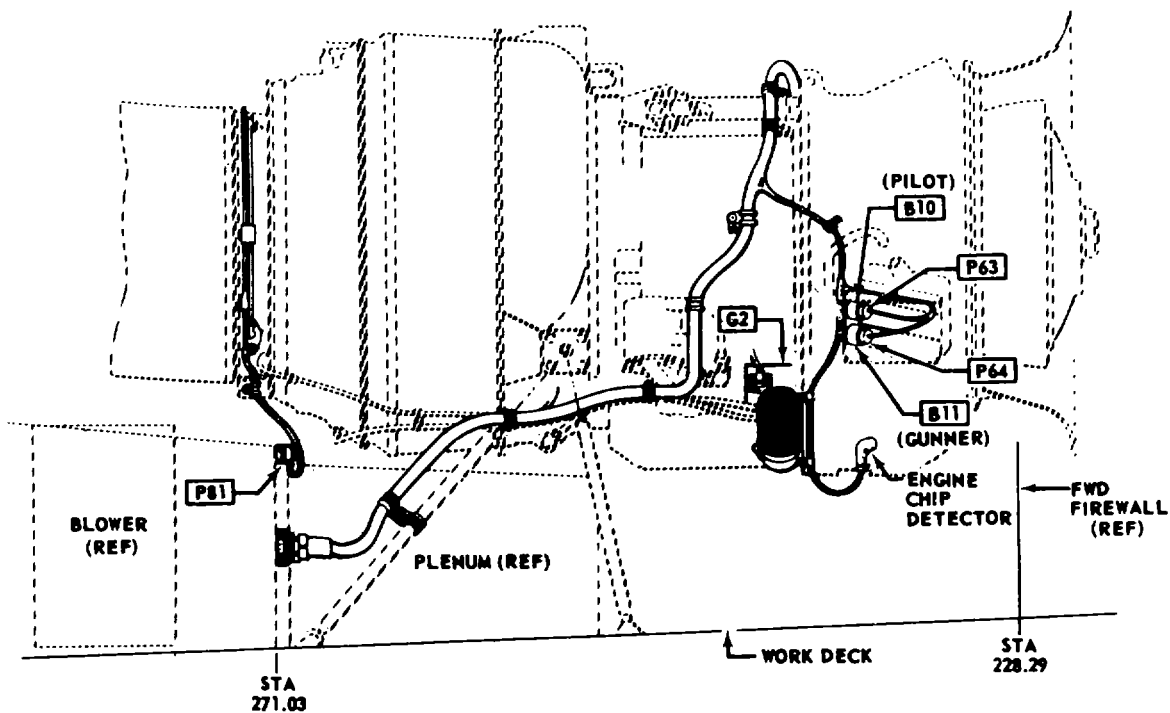
11. Caution Panel
12. TOW Control Panel
13. Radio Call Letters
14. Transmission Select Decal
15. Gas Producer Tachometer
16. Turbine Gas Temperature Indicator
17. TSU Cable Passage
18. Fire Warning Light w/NVG Cover
19. NVG Post Lights

Figure 8-1. Instrument systems equipment location (Sheet 2 of 5)



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Figure 8-1. Instrument systems equipment location (Sheet 3 of 5)

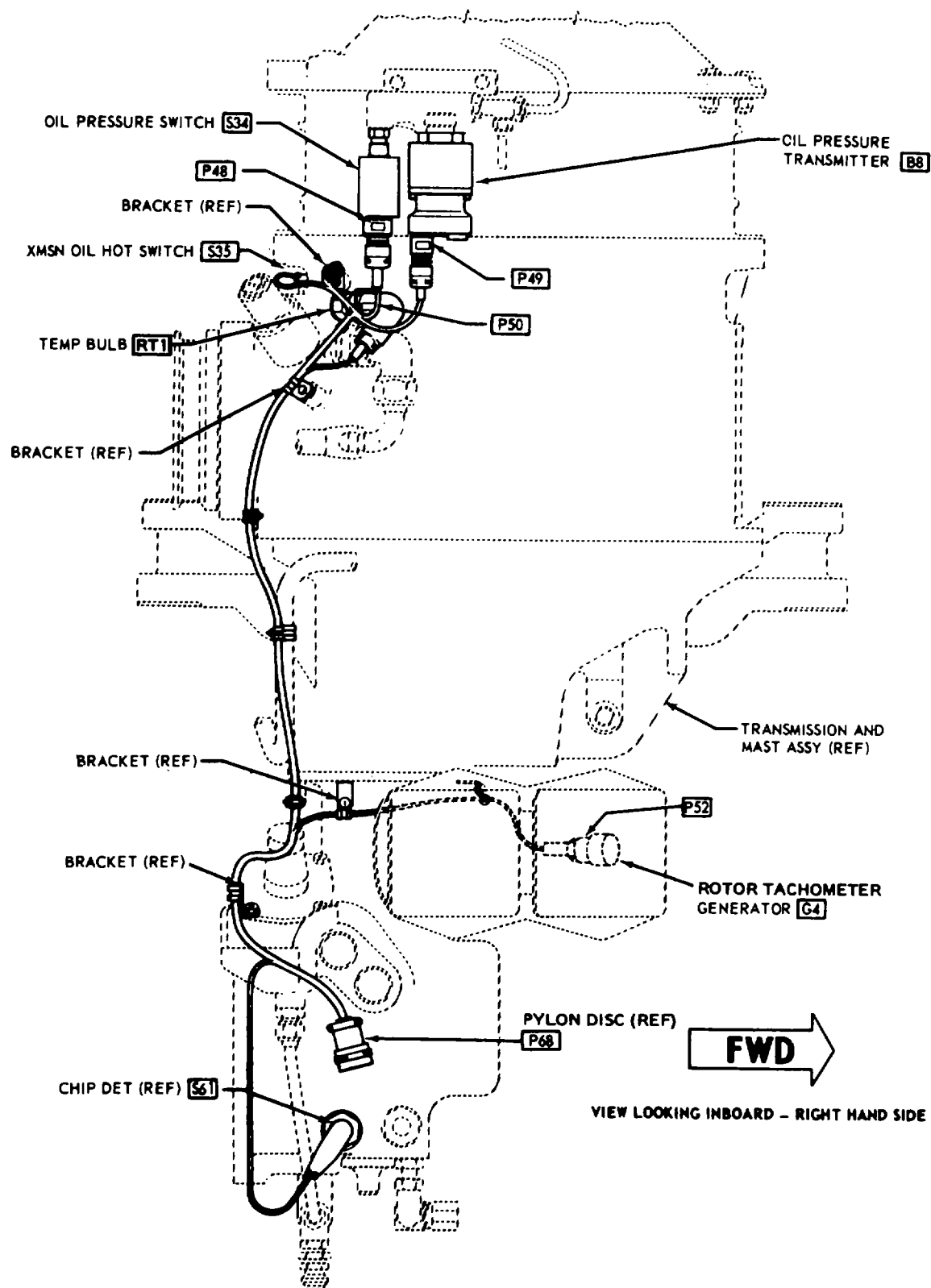


B7 Transmitter, Engine Oil Pressure
 B10 Transmitter, Torque Pressure - Pilot
 B11 Transmitter, Torque Pressure - Gunner
 G2 Generator, Gas Producer Tachometer
 G3 Generator, Power Turbine Tachometer

P62 Plug, Engine Oil Pressure Transmitter
 P63 Plug, Engine Torque Pressure Transmitter - Pilot
 P64 Plug, Engine Torque Pressure Transmitter - Gunner
 P81 Plug, Turbine Gas Temperature Disconnect

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Figure 8-1. Instrument systems equipment location (Sheet 4 of 5)
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Figure 8-1. Instrument systems equipment location (Sheet 5 of 5)

Section II. Engine Instruments

8-3. Engine Instruments.

Engine instruments include the tachometer, engine oil pressure, engine oil temperature, exhaust gas temperature, fuel pressure, and torque pressure indicating systems.

Premaintenance requirements for engine instruments.

Condition	Requirements
Model	AH-18
Part No. or Serial No.	All
Special Tools	None
Test Equipment	AN/USM-223, or equivalent MP-1, or equivalent TTU-27E N-3, or N-3A or equivalent Wheatstone Bridge, ZM4AU, ZM4BU

NOTE

Multimeter AN/USM-303A (6625-168 0585) is an acceptable substitute for Wheatstone bridge.

Support Equipment	None
Minimum Personnel Required	One
Consumable Materials	(C26) (C93) (C94) (C97) (C121) (C124)
Special Environmental Conditions	None

8-4. Tachometer Indicating Systems.

The tachometer indicating systems are self-generating rotary type systems consisting of the pitots dual tachometer, gunners dual tachometer, rotor tachometer generator, and power turbine tachometer generator as one system; and the pitots gas producer tachometer, gunners gas producer tachometer, and gas producer tachometer generator as the other system.

8-5. Dual Tachometers.

The pitots and gunners dual tachometers, each located on the respective instrument panel, indicate both main rotor rpm and engine output shaft rpm. Each tachometer has a synchronous motor connected electrically to a separate tachometer generator. The system operates independently of helicopter electrical power systems. The rotor rpm pointer indicates on the inner scale of instrument, and the engine rpm pointer indicates on the outer scale. The pointers will be aligned when engine and rotor speeds are synchronized in normal operation.

- a. *Cleaning.* (Refer to paragraph 8-1a.)
- b. *Inspection.* (Refer to paragraph 8-1b.)
- c. *Functional Test.*

(1) Disconnect plug (F'52). from rotor tachometer generator. Connect plug to the MASTER GENERATOR output plug on tachometer tester TTU-27E. Energize test stand and set controls according to the instructions on the cover of the tester.

(2) Check that the rotor tachometer portion of the indicator indicates within tolerance of the various check points in the following chart:

TEST POINTS (RPM)	INDICATOR (RPM)	TOLERANCE
0	0	±3
531	40	±4
1063	80	±4
1992	150	±4
2532	190	±4
3055	230	±4
3320	250	±4
3580	270	±3
3851	290	±2
3984	300	±2
4117	310	±2
4250	320	±2
4383	330	±3
4649	350	±3

(3) Disconnect plug (P52) from the TTU-27E tester and reconnect it to the rotor tachometer generator. Check that connector is properly mated and secure.

(4) Disconnect plug (P71) from the power turbine tachometer generator. Connect plug to the MASTER GENERATOR output plug on the TTU-27E tester. Energize test stand and set controls according to the tester instructions on the cover of the tester.

(5) Check that the power turbine portion of the indicator indicates within tolerance of the various check

points in the following chart:

TEST POINTS (RPM)	INDICATOR (RPM)	TOLERANCE
0	0	±50
511	800	±70
956	1500	±70
1480	3100	±70
2491	3900	±70
2938	4600	±70
3257	5100	±50
3576	5600	±50

TEST POINTS (RPM)	INDICATOR (RPM)	TOLERANCE
3832	6000	±30
3954	6200	±30
4023	6300	±20
4151	6500	±30
4342	6800	±40
4534	7100	±60

(6) Disconnect plug (P71) from the test stand and reconnect it to the power turbine tachometer generator. Check that connector is properly mated and secure.

d. *Troubleshooting.* (See figure F-31 and table 8-1.)

Table 8-1. Troubleshooting - Dual and Gas Producer Tachometers

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

1. Tachometer has excessive scale error.

STEP 1. Determine if indicator has weak magnet assembly by substitution of known good indicator.

Replace indicator if defective. (Refer to paragraph 8-1.)

2. Tachometer indication is only half of actual speed.

STEP 1. Check if electrical connectors are connected to correct receptacle on indicator. Refer to wiring diagram.

Reconnect electrical connectors if reversed at indicator.

3. One of the pointers on pitots or gunners dual tachometer fails to respond.

STEP 1. Check for defective tach generator by substitution of known good tach generator.

Replace tach generator if defective. (Refer to paragraph 8-6.)

Table 8-1. Troubleshooting - Dual Tachometers (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

STEP 2. Check for defective tachometer by substitution of known good tachometer.

Replace tachometer if defective. (Refer to paragraph 8-1.)

STEP 3. Check for poor connection at indicator or generator.

Clean or tighten connections.

4. High or low reading on indicator, either constant or intermittent.

STEP 1. Determine if indicator resistance is out of adjustment. Refer to paragraph 85 c., Functional Test.

Replace indicator if defective. (Refer to paragraph 8-1.)

5. Any pointer on either the pitots or gunners tachometer indicates backwards.

STEP 1. Check if wires are reversed at pins of tach generator plugs.

Remove plug and reverse wires.

Gas Producer Tachometer

1. Gas producer tachometer fails to respond.

STEP 1. Determine if tach generator is defective by substitution of known good tach generator.

Replace tach generator if defective. (Refer to paragraph 8-6.)

STEP 2. Determine if tachometer is defective by substitution of known good tachometer.

Replace tachometer if defective. (Refer to paragraph 8-1.)

2. Gas producer tachometer indicates incorrectly.

STEP 1. Determine if tach generator is defective by substitution of known good tach generator.

Replace tach generator if defective. (Refer to paragraph 8-6.)

STEP 2. Determine if tachometer is defective by substitution of known good tachometer.

Replace tachometer if defective. (Refer to paragraph 8-1.)

3. Gas producer tachometer indicates backwards.

STEP 1. Check if wires are reversed at pins of tach generator plug.

Remove plug and reverse wires.

e. *Removal.* (Refer to paragraph 8-1c.)

f. *Repair or Replacement.* (Refer to paragraph 8-1d.)

g. *Installation.* (Refer to paragraph 8-1e.)

8-6. Power Turbine Tachometer Generator.

The power turbine tachometer generator is mounted on the governor and tachometer drive gearbox on the left upper side of the engine, and is connected to the dual tachometer indicators on the instrument panels.

a. *Cleaning.*

(1) Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

(2) Remove grease, fungus, and ground-in dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

(3) Remove dirt from electrical connectors with a bristle brush.

b. *Inspection.*

(1) Inspect tachometer generator case for cracks, excessive wear, or any visible damage.

(2) Check connector for damaged or bent pins and cracked inserts.

(3) Check that rotor turns freely and there is no visible indication of excessive wear to bearings.

c. *Troubleshooting.* (Refer to paragraph 8-5d.)

d. *Removal.*

(1) Remove cowl from left side of engine.

(2) Disconnect electrical receptacle, remove mounting nuts and washers and lift tachometer generator from engine.

e. *Repair or Replacement.*

(1) Replace tachometer generator if case is cracked or damaged.

(2) Replace tachometer generator if rotor does not turn freely or for visible indication of excessive wear to bearings.

NOTE

Replacement of power turbine tachometer generator will require testing the rpm limit warning system. (Refer to Chapter 9.)

(3) Repair damaged connectors.

f. *Functional Test - Bench (AVIM).*

(1) Remove tachometer generator from helicopter and mount on tachometer tester TTU-27E. Connect generator to the TEST GENERATOR INPUT. Operate tester according to instructions on cover and check voltage outputs of the tachometer generator. With a 40 ohm "Y" connected resistance and a shaft speed of 4200 rpm, check voltage output across each phase of the generator (A-B, A-C, and B-C). The three voltage outputs should be 21 ± 0.5 Vac.

(2) Decrease generator speed to 1,000 rpm with a 20 ohm "Y" connected resistance.

(3) Check the voltage output of the three phases. Voltage should not go below 3.5 Vac.

(4) Disconnect tachometer generator and remove from the TTU-27E.

(5) Measure the resistance of each phase (A-B, A-C, and B-C). At 25° Celsius (77°F), the resistance should be between 15 and 20 ohms. Each phase should be within one (1) ohm of each other.

(6) At completion of testing, install tachometer generator and connect electrical plug and check for proper mating and security.

g. *Installation.*

(1) Position tachometer generator and gasket on studs and install nuts.

- (2) Connect electrical receptacle and install cowling.

NOTE

Coat tachometer generator shaft and pack mating splines of shaft in accessory drive gearbox 2/3 full with lubricant (C97).

8-7. Rotor Tachometer Generator.

The rotor tachometer generator is located on the lower left side of the transmission. The generator is mounted on the hydraulic pump and tachometer drive quill assembly and is connected to the dual tachometer indicators on the instrument panels.

- a. *Cleaning.* (Refer to paragraph 8-6a, procedures are the same.)
- b. *Inspection.* (Refer to paragraph 8-6b, procedures are the same.)
- c. *Troubleshooting.* (Refer to paragraph 8-5d.)
- d. *Removal.*

- (1) Remove cowling from left side of transmission.

- (2) Disconnect electrical receptacle, remove mounting nuts and washers, and lift rotor tachometer generator from helicopter.

- e. *Repair or Replacement.*

- (1) Replace tachometer generator if case is cracked or damaged.

- (2) Replace tachometer generator if rotor does not turn freely or if visible indication of excessive wear to bearings.

NOTE

Replacement of rotor tachometer generator will require testing the rpm limits warning system. (Refer to Chapter 9.)

- f. *Functional Test - Bench (AVIM).* (Refer to paragraph 8-6f, procedures are the same.)

- g. *Installation.*

- (1) Apply a thin film of antiseize compound (C26) to tachometer generator splines and to mating splines in transmission.

- (2) Position tachometer generator on mounting studs and install mounting washers and nuts.

- (3) Connect electrical receptacle and install cowling.

8-8. Gas Producer Tachometers.

The pitots and gunners gas producer tachometers, each located on the respective instrument panel, provide indication in percent rpm of the engine gas producer (first stage on N1 turbine and compressor) by connection to a common synchronous generator, mounted on engine accessory drive section. The indicator and generator circuit are independent of helicopter electrical power system.

- a. *Cleaning.* (Refer to paragraph 8-1a.)

- b. *Inspection.* (Refer to paragraph 8-b.)

- c. *Troubleshooting.* (Refer to paragraph 8-5c, procedures are the same.)

- d. *Removal.* (Refer to paragraph 8-1c.)

- e. *Repair or Replacement.* (Refer to paragraph 8-1d.)

- f. *Functional Test - Bench (AVIM).*

- (1) Disconnect plug (P72) from gas producer tachometer generator. Connect plug to the MASTER GENERATOR output plug on the TU-27E tester. Energize the test stand and set controls according to the instructions on the cover of the tester.

- (2) Check that the gas producer tachometer indicator indicates within tolerance of the various check points in the following chart:

TEST POINTS	INDICATOR	TOLERANCE
5%	5%	±1.00
20%	20%	+1.25
70%	70%	±1.25
100%	100%	+1.00

5%	5%	±1.00
20%	20%	+1.25
70%	70%	±1.25
100%	100%	+1.00

(3) Disconnect plug (P72) from TTU-27E tester and reconnect it to gas producer tachometer generator. Check that connector is properly mated and secure.

g. *Installation.* (Refer to paragraph 8-1e.)

8-9. Gas Producer Tachometer Generator.

The gas producer tachometer generator, located on the right side of the engine on the accessory gearbox, monitors the rpm of the gas producer turbine and transmits voltage signals to drive the gas producer tachometer indicators.

a. *Cleaning.* (Refer to paragraph 8-6a, procedure are the same.)

b. *Inspection.* (Refer to paragraph 8-6b, procedures are the same.)

c. *Troubleshooting.* (Refer to paragraph 8-5d.)

d. *Removal.* (Refer to paragraph 8-6d, procedures are the same.)

e. *Repair or Replacement.* (Refer to paragraph 8-4e, procedures are the same.)

f. *Functional Test - Bench (AVIM).* Refer to paragraph 8-6f, procedures are the same.)

g. *Installation.* (Refer to paragraph 8-6g, procedures are the same.)

8-10. Engine Oil Pressure Indicating System.

The engine oil pressure indicating system includes the pitots engine oil pressure indicator and the engine oil

pressure transmitter. The system is powered from the 26 Vac bus, and is protected by a 1 ampere ENG OIL PRESSURE IND circuit breaker.

8-11. Engine Oil Pressure Indicator.

The engine oil pressure indicator, located on the pitots instrument panel, indicates engine oil pressure in psi by means of the engine oil pressure transmitter.

a. *Cleaning.* (Refer to paragraph 8-1a.)

b. *Inspection.* (Refer to paragraph 8-1b.)

c. *Functional Test.*

(1) Disconnect pressure line from the engine oil pressure transmitter.

(2) Connect variable pressure (0 - 150 psi) tester (MP-1 or equivalent) to input line on engine oil pressure transmitter.

(3) Energize main or standby inverter. Close 28V XFMR circuit breaker and ENG OIL PRESSURE IND circuit breaker.

(4) Apply pressure to the transmitter input port while monitoring the engine oil pressure indicator. Indicated pressure should be 100 psi when applied pressure is 100 psi ± 10.

(5) Various pressure and tolerances are listed in the following chart:

INDICATOR	APPLIED PRESSURE	TOLERANCE
100 PSI	100 PSI	±10
80 PSI	80 PSI	±8
60 PSI	60 PSI	±6
40 PSI	40 PSI	±4
20 PSI	20 PSI	±2

d. *Troubleshooting.* (See figure F-26 and table 8-2.)

Table 8-2. Troubleshooting - Engine Oil Pressure Indicating Systems

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

1. Low pressure indication on indicator.

STEP 1. Check for kinked or obstructed pressure line.

Replace or clean pressure line.

2. Indicator has inaccurate or sticking pressure indication.

STEP 1. Check for defective indicator by substitution of a known good indicator.

Replace indicator if defective. (Refer to paragraph 8-1.)

3. Indicator has sluggish pressure indication.

STEP 1. Check for sludge in pressure line.

Bleed pressure line.

4. Indicator has fluctuating pressure indication.

STEP 1. Check for loose electrical connection, or instrument clamped **too tight**.

Check connections and/or readjust clamp.

STEP 2. Incorrect restrictor installed in system.

Install correct restrictor (0.018 to 0.020 inch opening).

STEP 3. Check for blocked or clogged restrictor.

Clean restrictor opening.

5. Indicator has no pressure indication.

STEP 1. Check for defective transmitter by substitution of known good transmitter or refer to paragraph 8-11 c. for functional test.

Replace transmitter if defective. (Refer to paragraph 8-12.)

Table 8-2. Troubleshooting-Engine Oil Pressure Indicating Systems (Cont)**CONDITION****TEST OR INSPECTION****CORRECTIVE ACTION**

STEP 2. Check for defective indicator by substitution of known good indicator or refer to paragraph 8-11c for functional test.

Replace indicator if defective. (Refer to paragraph 8-1.)

e. *Removal.* (Refer to paragraph 8-1c.)

f. *Repair or Replacement.* (Refer to paragraph 8-1d.)

g. *Installation.* (Refer to paragraph 8-1e.)

(2) Inspect oil line and fitting connection for leaks and proper installation.

(3) Inspect electrical connector for damaged or bent pins and cracked inserts.

8-12. Engine Oil Pressure Transmitter

The engine oil pressure transmitter, located on the engine inlet section, monitors engine oil pressure and transmits voltage signals to the engine oil pressure indicator.

a. *Cleaning.*

(1) Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

(2) Remove oil, grease, fungus, and ground in dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

(3) Remove dirt from electrical connectors with a bristle brush.

b. *Inspection.*

(1) Inspect pressure transmitter for cracks, secure and proper mounting, and proper operation.

c. *Functional Test.* The pressure transmitter is functionally tested during testing of the pressure indicator using variable pressure tester, paragraph 8-11c. The following electrical resistance check may be conducted on the pressure transmitter independently from the pressure indicator.

(1) Using multimeter (AN/PSM-6A, or equivalent), check resistance between contacts of electrical receptacle on top of transmitter.

(2) Resistance should be approximately 10 ohms across contacts A to C and B to C, and approximately 20 ohms across contacts A to B.

d. *Troubleshooting.* (Refer to paragraph 8-11d.)

e. *Removal.*

(1) Remove cowl from engine.

(2) Disconnect electrical connector. Disconnect oil line. Place protective covers over connector and oil line.

(3) Remove lockwire and mounting screws and lift transmitter from mounting bracket.

f. Repair or Replacement.

- (1) Repair damaged electrical connectors.
- (2) Tighten loose oil line or fitting connection.
- (3) Replace defective or damaged oil line or fitting.
- (4) Replace pressure transmitter if cracked or damaged.
- (5) Re-install improperly mounted pressure transmitter.

g. Installation.

- (1) Position transmitter on bracket and install mounting screws. Install lockwire.
- (2) Remove protective covers and connect electrical receptacle and oil line. Install cowling.

8-13. Engine Oil Temperature Indicating System.

The engine oil temperature indicating system includes

the pitots engine oil temperature indicator and the engine oil temperature bulb. The system is powered from the 28 Vdc essential bus and is protected by a 5 ampere ENG & XMSN TEMP IND circuit breaker.

8-14. Engine Oil Temperature Indicator.

The engine oil temperature indicator, located on the pitots instrument panel, indicates engine oil temperature in degrees Celsius by means of an electrical resistance type thermobulb.

- a. Cleaning.* (Refer to paragraph 8-1a.)
- b. Inspection.* (Refer to paragraph 8-1b.)
- c. Functional Test.*

(1) Place BAT switch to ON. Close ENG & XMSN TEMP IND circuit breaker.

(2) Check that temperature indicators indicate approximately ambient temperature.

- d. Troubleshooting.* (See figure F-32 and table 8-3).

Table 8-3. Troubleshooting Engine Oil Temperature Indicator

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Low pressure indication on indicator.

STEP 1. Check for kinked or obstructed pressure line.

Replace or clean pressure line.

2. Indicator has inaccurate or sticking pressure indication.

STEP 1. Check for defective indicator by substitution of a known good indicator.

Replace indicator if defective. (Refer to paragraph 8-1.)

Table 8-3. Engine Oil Temperature Indicator (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

3. Indicator has sluggish pressure indication.

STEP 1. Check for sludge in pressure line.

4. Indicator has fluctuating pressure indication.

STEP 1. Check for loose electrical connection, or instrument clamped too tight.

Check connections and/or readjust clamp.

STEP 2. Incorrect restrictor installed in system.

Install correct restrictor (0.018 to 0.020 inch opening).

STEP 3. Check for blocked or clogged restrictor.

Clean restrictor opening.

5. Indicator has no pressure indication.

STEP 1. Check for defective transmitter by substitution of known good transmitter or refer to paragraph 8-11 c. for functional test.

Replace transmitter if defective. (Refer to paragraph 8-12.)

STEP 2. Check for defective indicator by substitution of known good indicator or refer to paragraph 8-11 c. for functional test.

Replace indicator if defective. (Refer to paragraph 8-1.)

6. Oil temperature indication off scale at low end, or low reading - either constant or intermittent.

STEP 1. Check for defective indicator by substitution of known good indicator or refer to paragraph 8-14 c. for functional test.

Replace indicator if defective. (Refer to paragraph 8-1.)

STEP 2. Short circuit in leads from thermobulb to indicator.

Make continuity check and repair or replace leads. (Refer to paragraph 9-2.)

7. Oil temperature indication off scale at high end, or high reading - either constant or intermittent.

STEP 1. Check for open circuit in thermobulb.

Check continuity and repair wiring, or replace defective bulb. (Refer to paragraph 8-16.)

Table 8-3. Engine Oil Temperature Indicator (Cont)

CONDITION	
TEST OR INSPECTION	
CORRECTIVE ACTION	
STEP 2. Check for defective indicator by substitution of known good indicator or refer to paragraph 8-14 c. for functional test. Check continuity and repair wiring, or replace defective bulb. (Refer to paragraph 8-15.)	
8. No indication of pressure or temperature on indicator. STEP 1. Check for defective circuit breaker by use of multimeter or substitution of known good circuit breaker. Replace circuit breaker if defective. (Refer to paragraph 9-5.) STEP 2. Check for defective indicator by substitution of known good indicator or refer to paragraph 8-14 c. for functional test. Replace indicator if defective. (Refer to paragraph 8-1.)	

- e. *Removal.* (Refer to paragraph 8-1c.)
- f. *Repair or Replacement.* (Refer to paragraph 8-1d.)
- g. *Functional Test - Bench (AVIM).*

(1) Disconnect electrical plug in back of oil temperature indicator. Remove indicator from instrument panel. Connect indicator to electric thermometer tester, field type (N-3A, or equivalent) using the appropriate adapter cable provided with the teeter.



Always be certain that the indicator is connected before turning switch (7) to the "24" volt position.

(2) Check zero setting of the voltmeter (1) and adjust if necessary. Turn switch (7) to the "24" volt position.

(3) Adjust pointer of voltmeter (1) to coincide with the red line at 28.60 volts by operating rheostat (5). Position switch (8) to the left and single position.

(4) Set temperature selector switch (2) to

temperature points on the "left inner scale" (90.38 ohms at zero degrees temperature).

(5) Rotate switch (2) to required test points. Tap the indicator before taking a reading. The test points and tolerances are listed in the following chart:

<u>TEST POINTS</u>	<u>INDICATOR READING</u>	<u>TOLERANCE</u>
-70	-70°C	±4
-30	-30°C	±3
0	0°C	±2
+30	30°C	±2
+80	80°C	±2
+120	120°C	±3
+150	150°C	±4

(6) Turn switch (7) to the "OFF" position and disconnect indicator from tester. Install indicator in instrument panel and check for security.

h. *Installation.* (Refer to paragraph 8-1e.)

8-15. Engine Oil Temperature Bulb.

The engine oil temperature bulb, installed in the engine oil pump housing is a resistance type

thermobulb which monitors the engine oil temperature and transmits varying voltage signals to the engine oil temperature indicator.

a. *Cleaning.*

(1) Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

(2) Remove oil, grease, fungus, and ground-in dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

(3) Remove dirt from electrical connectors with a bristle brush.

b. Inspection.

(1) Inspect temperature bulb for cracks, leaks, security and proper mounting.

(2) Inspect electrical connector for damaged or bent pins and cracked inserts.

c. Troubleshooting. (Refer to paragraph 8-14d.)

d. Removal.

(1) Cut lockwire and disconnect electrical connector.

(2) Remove lockwire and unscrew temperature bulb from oil manifold.

(3) Remove gasket.

e. Repair or Replacement.

(1) Repair damaged electrical connectors.

(2) Replace damaged or worn gasket.

(3) Replace temperature bulb if cracked or damaged.

f. Functional Test - Bench (AVIM).

(1) Resistance Check.

(a) Remove oil temperature bulb to be checked and allow sufficient time to adjust to ambient temperature.

(b) With a Wheatstone bridge, measure the resistance of the temperature bulb between pin A and B. Ambient temperature test points and tolerances are listed in the following chart:

AMBIENT TEMPERATURE TEST POINT DEGREES	RESISTANCE (OHMS)	TOLERANCE (OHMS)
-20° Celsius (-4°F)	83.77	±0.4
-10° Celsius (14°F)	87.04	±0.4
0° Celsius (32°F)	90.38	±0.4
10° Celsius (50°F)	93.80	±0.4
20° Celsius (68°F)	97.80	±0.4
30° Celsius (86°F)	100.91	±0.4
40° Celsius (104°F)	104.60	±0.4

(2) Insulation Leakage Test. With the temperature bulb subjected to a 100 volt potential between any electrical pin and the bulb housing, the minimum resistance shall be 5 megohms.

(3) Reinstall temperature bulb.

g. Installation.

(1) Coat threads and gasket with lubricating oil (C93 or C94) when installing gasket on temperature bulb.

(2) Install temperature bulb and gasket in manifold.

(3) Lockwire to adjacent bolt head on manifold.

(4) Connect and lockwire electrical connector.

8-16. Turbine Gas Temperature Indicating System.

The turbine gas temperature indicating system includes the pitots and gunners turbine gas temperature indicators and the turbine temperature thermocouple lead spool resistor. The system is self-generating, operating on electrical potential from the twelve probe thermocouple harness assembly.

8-17. Turbine Gas Temperature Indicators.

The pitots and gunners turbine gas temperature indicators, located on the respective instrument panel, indicate turbine gas temperature in degrees Celsius. The indicators operate on electrical potential from the thermocouple harness assembly, mounted on the first stage power turbine nozzle of the combustor turbine assembly.

- a. *Cleaning.* (Refer to paragraph 8-1a.)
- b. *Inspection.* (Refer to paragraph 8-lb.)
- c. *Functional Test (Circuit Resistance Check).*

CAUTION

When removing TGT gages place a short piece of wire between the instrument terminal posts to prevent damage by static electricity.

(1) Disconnect plug P81 from receptacle J81. Connect a Wheatstone bridge to pins A and B of P81 and measure the resistance of the thermocouple loop in the engine. Check that resistance of thermocouple loop. Refer to TM 55-2840-229-23.

(2) Remove Wheatstone bridge leads and reconnect plug P81 to J81. Check that connector is properly mated, tight and secure.

(3) Disconnect wiring from positive and negative terminals of the pitot and gunner Turbine Gas Temperature (TGT) indicators. Temporarily short terminals 1 and 2 at TB13. Measure resistance of TGT wires at each indicator with a Wheatstone bridge. Check that resistance of each pair of wires is 0.50 (± 0.03) ohm.

(4) Remove the temporary short at TB13, but do not reconnect either indicator. Measure the resistance of the entire TGT wiring loop at each indicator end with a Wheatstone bridge, TGT wiring shall include resistance spool and engine thermocouple loop. Adjust spool, if necessary, to obtain a total resistance of 4.25 (± 0.07)

ohms.

(5) Remove Wheatstone bridge and reconnect wires to each indicator. Check that proper polarity is observed.

d. *Functional Test (Thermocouple harness assembly resistance check).* (AVIM).

(1) Perform cockpit TGT indicator check using adapter (T6).

(2) Disconnect engine harness from airframe leads at engine/airframe firewall. Set range scale of multimeter, P/N AN/USM223, or equivalent, to either 0.0 to 1.0 ohm or 1.0 to 5.0 ohms. Insert probes of multimeter into engine harness jacks.

(3) If engine harness resistance is not within limits at particular soak temperature, replace thermocouple harness assembly. Refer to TM-55-2840-229-23.

(4) Reconnect thermocouple harness assembly to airframe leads at engine/airframe firewall.

e. *TGT Indicator and circuit calibration.*

NOTE

To avoid possible inaccuracies, the following calibration procedure should be performed only after the resistance checks and adjustment procedures of paragraph 8-17c. have been satisfactorily completed.

(1) Set the Tester, Electric Thermometer, Field Type N-3 of N-3A or equivalent on the left hand ammo door.

(2) Disconnect the Chromel (+) lead (white wire) from the engine side at TB13 and clip the + (red insulator) alligator clip from the Tester to TB13 terminal from which the Chromel (+) lead was removed. Clip the - (black insulator) alligator clip to the disconnected thermocouple lead.

Figure 8-1A. Deleted

CAUTION

The engine thermocouple lead must be the one disconnected because if either indicator lead is disconnected and the tester placed in series with either indicator, a loop is obtained between the indicators and the engine loop is bypassed.

(3) Using a glass thermometer determine the cold junction temperature by reading the ambient temperature adjacent to the engine thermocouples and the indicators.

NOTE

The thermocouples in the engine and the indicators should be allowed to stabilize at ambient temperature prior to running this test. The cold junction temperature must be subtracted from the subsequent test readings. The tester applies millivoltage based on 0.0°C (32°F) (chromel-alumel thermocouples); therefore, the tester will

make the indicator read too high by the amount that the cold junction temperature is above 0.0°C (32°F).

(4) A digital voltmeter may be used if desired to monitor the millivolt output of the Type N-3 tester by connecting test leads at the tester alligator clips. This monitoring should not be required if the Type N-3 tester is in calibration.

(5) Set the pointer of the 29 position switch to the starting temperature 700°C (1292°F) of the chromel-alumel scale.

(6) Turn the ZERO ADJUST of the Meter M-1 on the panel of the tester, until the pointer is directly over the line at zero (left) end of scale.

(7) Turn the 6 position switch to AIRPLANE TEST 0 ohm.

(8) Adjust the COARSE and FINE rheostats until the pointer of the Meter M-1 on the tester is over the red line at the right end of its scale.

(9) The indicators should read the same temperature as the starting temperature 700°C (+10) (1292° (±41) F) plus the cold junction temperature. The indicators shall read through out the range given below. Tap indicators lightly prior to each reading.

Temperature		Scale Error		Millivolts
(°C)	(°F)	(+°C)	(+°F)	(+0.06)
500	932	25	77	20.64
600	1112	15	59	24.90
700	1292	10	41	29.14
800	1472	15	59	33.31
1000	1832	30	86	41.31

Table 8-4. Deleted

NOTE

Make sure the pointer on the meter M-1 on the tester is over the red line at each position. Each indicator must agree with the tester plus the cold junction temperature within the tolerance specified for the indicator.

(10) Disconnect the Type N-3 tester and reconnect the engine thermocouple lead to TB13.

f. *Deleted*

- g. *Removal.* (Refer to paragraph 8-1c.)
- h. *Repair or Replacement.* (Refer to paragraph 8-1d.)
- i. *Installation.* (Refer to paragraph 8-1e.)

8-18. Turbine Temperature Thermocouple Lead Spool Resistor.

The turbine temperature thermocouple lead spool resistor, located in the aft compartment, provides a means of adjusting the resistance within the system circuitry to calibrate the turbine temperature indicator.

- a. *Cleaning.* Remove moisture and dirt from cover with a clean, lint-free cloth.
- b. *Inspection.* Inspect resistor for loose connections, corrosion, broken wires, broken terminals, and damage to cover or cover fasteners.
- c. *Functional Test.* (Refer to paragraph 8-17c.)
- d. *Removal.*
  - (1) Remove cover.
  - (2) Remove alumel lead to resistor.
  - (3) Unsolder resistor spool lead and remove spool.
- e. *Installation.*
  - (1) Position resistor spool in place, solder lead to spool.
  - (2) Attach alumel lead to resistor lug.

8-19. Fuel Pressure Indicating System.

The fuel pressure indicating system includes the pitots fuel pressure indicator and the fuel pressure

transmitter. The system is powered by the 26 Vac bus, and is protected by a 1 ampere FUEL PRESSURE IND circuit breaker.

8-20. Fuel Pressure Indicator.

The fuel pressure indicator, located on the pitots instrument panel, provides indication in psi of pressure in the main fuel supply line by means of an electrical fuel pressure transmitter.

a. *Cleaning.* (Refer to paragraph 8-1a.)

b. *Inspection.* (Refer to paragraph 8-1b.)

c. *Functional Test.*

(1) Energize main inverter by placing INV

switch to MAIN.

(2) Clone FUEL PRESSURE IND circuit breaker.

(3) Disconnect the fuel pressure line from fuel pressure transmitter. Using variable pressure tester (MP-1, or equivalent), apply pressure while monitoring pitots fuel pressure indicator. Indicated pressure shall be 50 + 7 psi when applied pressure is 50 psi.

(4) Repeat step (3) for gunners fuel pressure transmitter and indicator.

(5) Open FUEL PRESSURE IND circuit breaker and reconnect the fuel pressure lines.

d. *Troubleshooting.* (See figure F-26 and table 8-5.

Table 8-5. Troubleshooting - Fuel Pressure Indicator

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Low pressure indication on indicator.

STEP 1. Check for kinked or obstructed pressure line.

Replace or clean pressure line.

2. Indicator has inaccurate or sticking pressure indication.

STEP 1. Check for defective indicator by substitution of a known good indicator.

Replace indicator if defective. (Refer to paragraph 8-1.)

3. Indicator has no pressure indication.

STEP 1. Check for defective transmitter by substitution of known good transmitter.

Replace transmitter if defective. (Refer to paragraph 8-21.)

STEP 2. Check for defective indicator by substitution of known good indicator.

Replace indicator if defective. (Refer to paragraph 8-1.)

Table 8-5. Troubleshooting - Fuel Pressure Indicator Cont.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

STEP 3. Check for loose electrical connection.

Tighten electrical connections.

- e. *Removal.* (Refer to paragraph 8-1c.)
- f. *Repair or Replacement.* (Refer to paragraph 8-1d.)
- g. *Installation.* (Refer to paragraph 8-1e.)

8-21. Fuel Pressure Transmitter.

The fuel pressure transmitter, mounted on the aft fuel cell, monitors pressure in the main fuel supply line and transmits voltage signals to the fuel pressure indicator.

a. *Cleaning.*

- (1) Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

- (2) Remove oil, grease, fungus, and ground-in dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

- (3) Remove dirt from electrical connectors with a bristle brush.

b. *Inspection.*

- (1) Inspect pressure transmitter for cracks, secure and proper mounting, and proper operation.

- (2) Inspect fuel line and fitting connection for leaks and proper installation.

- (3) Inspect electrical connector for damaged or bent pins and cracked inserts.

- c. *Functional Test.* (Refer to paragraph 8-20c.)

- d. *Troubleshooting.* (Refer to paragraph 8-20d and table 8-5.)

e. *Removal.*

- (1) Check that electrical power is OFF.
- (2) Gain access to fuel pressure transmitter.
- (3) Cut lockwire and disconnect electrical connector from transmitter.
- (4) Disconnect pressure hose from transmitter mount.
- (5) Remove four screws and washers from transmitter mount.
- (6) Remove transmitter.

f. *Repair or Replacement.*

- (1) Repair damaged electrical connectors.
- (2) Tighten loose fuel line or fitting connection.
- (3) Replace defective or damaged fuel line or fitting.
- (4) Replace pressure transmitter if cracked or damaged.
- (5) Re-install improperly mounted pressure transmitter.

g. *Installation.*

- (1) Install transmitter in mount using four screws and four washers.

(2) Connect fuel pressure hose to union and connect electrical connector and lockwire.

8-22. Torque Pressure Indicating System.

The torque pressure indicating system includes the pitots and gunners torque pressure indicators and separate pitots and gunners torque pressure transmitters. The torque pressure indicators indicate engine output shaft torque pressure in psi by means of the respective torque pressure transmitter. The system is powered from the 26 Vac bus, and is protected by a 1 ampere TORQUE PRESSURE IND circuit breaker.

8-23. Torque Pressure Indicators.

The pitots and gunners torque pressure indicators, mounted in the respective instrument panel, indicate engine output shaft torque pressure in psi by means of respective pitots and gunners torque pressure transmitters.

- a. *Cleaning.* (Refer to paragraph 8-1a.)
- b. *Inspection.* (Refer to paragraph 8-1b.)
- c. *Functional Test.*

(1) Disconnect pressure line from the torque pressure transmitter.

(2) Connect variable pressure (0 - 150 psi) tester

(MP-1, or equivalent) to input line on torque pressure transmitter

(3) Energize main or standby inverter. Close 28V XFMR circuit breaker and TORQUE PRESSURE IND circuit breaker.

(4) Apply pressure to the transmitter input port while monitoring the engine torque pressure indicator. Indicated pressure shall be 50 ± 2 psi when applied pressure is 50 psi.

NOTE

The following Torque Pressure Indicator / Torque Pressure Transmitter combinations are required for torque system applications:

- (a) Edison Transmitter with Edison Indicator.
  - (b) Edison Transmitter with Courter Indicator.
  - (c) Edison Transmitter with General Aero Products Indicator.
  - (d) Bendix Transmitter with Edison Indicator.
  - (e) Bendix Transmitter with Courter Indicator.
- d. *Troubleshooting.* (See figure F-26 and table 8-6).

Table 8-6. Troubleshooting - Torque Pressure Indicator**NOTE**

Before you use this table, be sure you have performed all normal operational checks.

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

1. Either indicator has inaccurate or sticking pressure indication.

STEP 1. Check for defective indicator by substitution of known good indicator.

Replace indicator if defective. (Refer to paragraph 8-1.)

2. Indicator has sluggish pressure indication.

STEP 1. Check for sludge in pressure line.

Bleed pressure line.

3. Both indicators have no or low reading.

STEP 1. Check for kinked or obstructed pressure line.

Replace or clean line.

STEP 2. Determine if transmitters are defective by substitution of **known** good transmitter. (Refer to paragraph 8-83c for functional test.)

Replace transmitters if defective. (Refer to paragraph 8-24.)

STEP 3. Check for open circuit between transmitter and indicator.

Make continuity check and replace or repair leads (Refer to paragraph 9-2.)

4. Indicator has fluctuating pressure indication.

STEP 1. Check for loose electrical connections, or instrument clamped too tight.

Check connections and/or re-adjust clamp.

STEP 2. Determine if incorrect restrictor is installed in *system*.

Install correct restrictor if incorrect (0.025 to 0.027 hole opening).

e. *Removal.* (Refer to paragraph 8-1c.)

f. *Repair or Replacement.* (Refer to paragraph 8-1d.)

g. *Installation.* (Refer to paragraph 8-1e.)

8-24. Torque Pressure Transmitters.

The pitots and gunners torque pressure transmitters, mounted on a bracket on the right side of the engine, monitor engine output shaft torque and transmit varying voltage signals to the respective torque pressure indicator.

a. *Cleaning.*

(1) Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

(2) Remove oil, grease, fungus, and ground-in dirt with a clean lint-free cloth dampened with dry cleaning solvent (C124).

(3) Remove dirt from electrical connectors with a bristle brush.

b. *Inspection.*

(1) Inspect pressure transmitter for cracks, secure and proper mounting, and proper operation.

(2) Inspect oil line and fitting connection for leaks and proper installation.

(3) Inspect electrical connector for damaged or bent pins and cracked inserts.

c. *Functional Test.* (Refer to paragraph 8-23c.)

d. *Troubleshooting.* (Refer to paragraph 8-23d.)

e. *Removal.*

(1) Remove cowling from engine.

(2) Disconnect electrical connector and oil line from transmitter to be removed (pitots - top, gunners - bottom).

(3) Cap openings of oil line and protect electrical connector with electrical tape.

(4) Cut lockwire, remove mounting screws and washers, and lift transmitter from helicopter.

f. *Repair or Replacement.*

(1) Repair damaged electrical connectors.

(2) Tighten loose fuel line or fitting connection.

(3) Replace defective or damaged fuel line or fitting.

(4) Replace pressure transmitter if cracked or damaged.

(5) Re-install improperly mounted pressure transmitter.

g. *Installation.*

(1) Position transmitter on bracket and install mounting screws. Install lockwire.

(2) Remove protective covers and connect oil line and electrical connector to transmitter. Install cowling.

Section III. FLIGHT INSTRUMENTS

8-25. Flight Instruments.

Flight instruments include the pitot-static system, airspeed indicators, altimeters, attitude indicating system, turn and slip indicator, and vertical velocity indicator.

8-26. Pitot-Static System.

The pitot-static system (figure 8-2) consists of the electrically heated pitot tube, two static ports, pitot and static drains, and pitot and static lines necessary to connect to airspeed indicators, altimeters, vertical velocity indicator, and the air

data pressure transducer. (The air data pressure transducer is a component of the M28AIE1 turret system, refer to TM 91090-23 series maintenance manuals.) The pitot tube is mounted on the upper left side of the forward pylon fairing. The static ports are located one on each side of the pitots section, in line with the instrument panel. For information pertaining to the pitot heater electrical system, refer to Chapter 9.

CAUTION

Do not apply suction to pitot lines or pressure to static lines except as instructed in paragraph 8-26A.

NOTE

Assure pitot static tester has a current calibration label (DA Form 80). Use appropriate power supply in accordance with pitot static tester requirements.

NOTE

Except for the use of system drain, a functional check of the pitot static system and pitot static instruments will be performed following any opening and closing of the pitot static system.

8-26A. Functional Check - Pitot Static System.

a. Pitot Line Leak Check.

(1) Seal pitot tube drain holes air tight with pressure sensitive tape (C134).

(2) Hook up airspeed outlet of pitot static tester to pitot system in accordance with figure 8-2A. Close pitot static tester pressure down valve.

(3) Slowly apply pressure to pitot line until the airspeed indicator reads 120 knots.

(4) Tap instrument to remove friction effects. When indicator pointer drops more than 10 mph (8.7 knots) in one minute, a leak is indicated. Slowly decrease pressure to return tester airspeed indicator to zero, repair any faults if necessary, and repeat step above.

b. Airspeed Indicator Functional Check.

(1) Slowly apply pressure to pitot line to obtain airspeed readings in table 8-6A. Indicator should be gently tapped prior to reading. Check need not exceed 120 knots.

Table 8-6A. Tolerance -Knots)

Airspeed Check Points (Knots)	MS28045 10 to 150 Knots	MS28021 20 to 250 Knots	MS28046 40 to 400 Knots
40	3	5	4
60	3	3	3
80	3	3	3
100	3	4	3
120	3	4	3
140	3	5	4
160		5	4

(2) If readings are not within tolerance of table 8-6A, slowly relieve pressure on pitot line until airspeed indicator reads zero. Replace indicator with serviceable one and repeat steps b (1) and (2) above.

(3) Airspeed indicators that fail test shall be turned in for overhaul.

(4) Bleed pitot static tester pressure system.

c. Static Line Leak Check.

(1) Hook up pitot static tester, rate of climb and altimeter outlet, to pitot and static system in accordance with figure 8-2B.

CAUTION

Make sure that both aircraft pitot and static lines are connected to airspeed indicator to prevent possible damage to airspeed indicator.

NOTE

Hooking up the pitot line to the tester vacuum source will only be done during the following check to equalize the pressure in the airspeed indicator case to prevent damage to its diaphragm.

(2) Tape all unused static ports.

(3) Adjust test set and aircraft altimeter barometric scales to read 29.92. Gently tap test set altimeter, and check to insure that aircraft altimeters read within 70 feet of test set altimeter and report of calibration data card located across the top of tester outlet valve cover.

(4) If aircraft altimeters fail to meet this check, remove and install a serviceable instrument and repeat step c(3) above.

(5) Slowly apply vacuum to pitot and static lines (figure 8-2B) until the altimeter reads 1000

feet above reading obtained from step c(3). Close vacuum source and gently tap altimeter at same time until rate of climb indicator stabilizes at zero. After stabilization, the altimeter should not drop more than 100 feet in one minute. Slowly decrease vacuum until rate of climb stabilizes at zero. Repair any faults if necessary and repeat this step.

d. Vertical Velocity Indicator Functional Check (1) Slowly apply vacuum to aircraft system to obtain rate of climb readings in table 8-6B. After vertical velocity indicator stabilizes at desired reading, instrument shall be subjected to gentle tapping, and readings compared to report of calibration data card across the top of tester. After completion of checks, close both pitot static tester vacuum valves.

Table 8-6B. Vertical Velocity Tolerance Feet Scale

Standard Altitude Check Interval (Feet)	Accuracy	
	Check Rate Ascent or or Descent (fpm)	Tolerance Scale Error (fpm)
2000 to 2500	500	±100
2000 to 3000	1000	±200
2000 to 4000	2000	±300
2000 to 5000	3000	±300
15,000 to 17,000	2000	±300

(2) Slowly decrease vacuum until desired rate of descent is obtained from table 8-6B. After vertical velocity indicator stabilizes at desired readings, subject instrument to gentle tapping and compare readings to tester rate of climb indicator and calibration data card.

(3) Instruments that fail check and tolerances shall be replaced with a serviceable unit and steps d(1) and (2) above repeated.

(4) Vertical velocity indicators that fail check will be turned in for overhaul.

e. Altimeter Functional Check.

(1) Apply 28 volt power to aircraft electrical system to provide electrical power for counter drum altimeter vibrators.

(2) Slowly apply vacuum to aircraft system at a rate not to exceed 3000 feet per minute. Continue to apply vacuum until altimeter readings reach the next higher reading on table 8-6C above altimeter altitude indicated when barometric scale is set at 29.92.

Table 8-6C. Altimeter Scale Error

Altitude (feet)	Tolerance	Tolerance (± feet)
0		70
500		70
1000		70
2000		70
3000		70
5000		100
10,000		130
15,000		140

(3) Close vacuum valve and keep altimeter at this setting for at least one minute, but not more than five minutes, then gently tap three pointer type altimeters before reading. Assure that vibrators are operative on counter drum altimeters before readings are compared to tolerance shown in table 8-6C.

(4) Compare the readings of the installed instruments against readings on the tester and calibration data card at the check points shown in table 8-6C.

NOTE

Altimeters that do not pass the performance requirements of table 8-6C shall be removed from aircraft and shop tested in accordance with the test procedures in TM 55-1500-204-25/1 to verify malfunctions. Install serviceable altimeter and repeat steps e(3) and (4).

(5) Remove pitot static tester and all tape from pitot/static lines and openings.

8-27. Pitot-Static Piping and Fittings.

The pitot-static piping and fittings consist of flexible piping lines routed from the pitot tube and static ports to the airspeed indicators, altimeters, vertical velocity indicator, and air data pressure transducer. The piping lines are connected with nylon fittings and contain a pitot drain and static drain.

a. *Cleaning.*

NOTE

The air data pressure transducer is located above and aft of the left ammunition bay door, and is connected to the pitot-static system.

(1) Disconnect pitot and static lines from airspeed indicators and air data pressure

transducer. Disconnect static lines from altimeters and vertical velocity indicator. Cap openings in indicators and pressure transducer to prevent entrance of foreign material.

(2) Remove caps and open pitot drain valve and static drain valve.

(3) Blow all lines clean with filtered, compressed air.

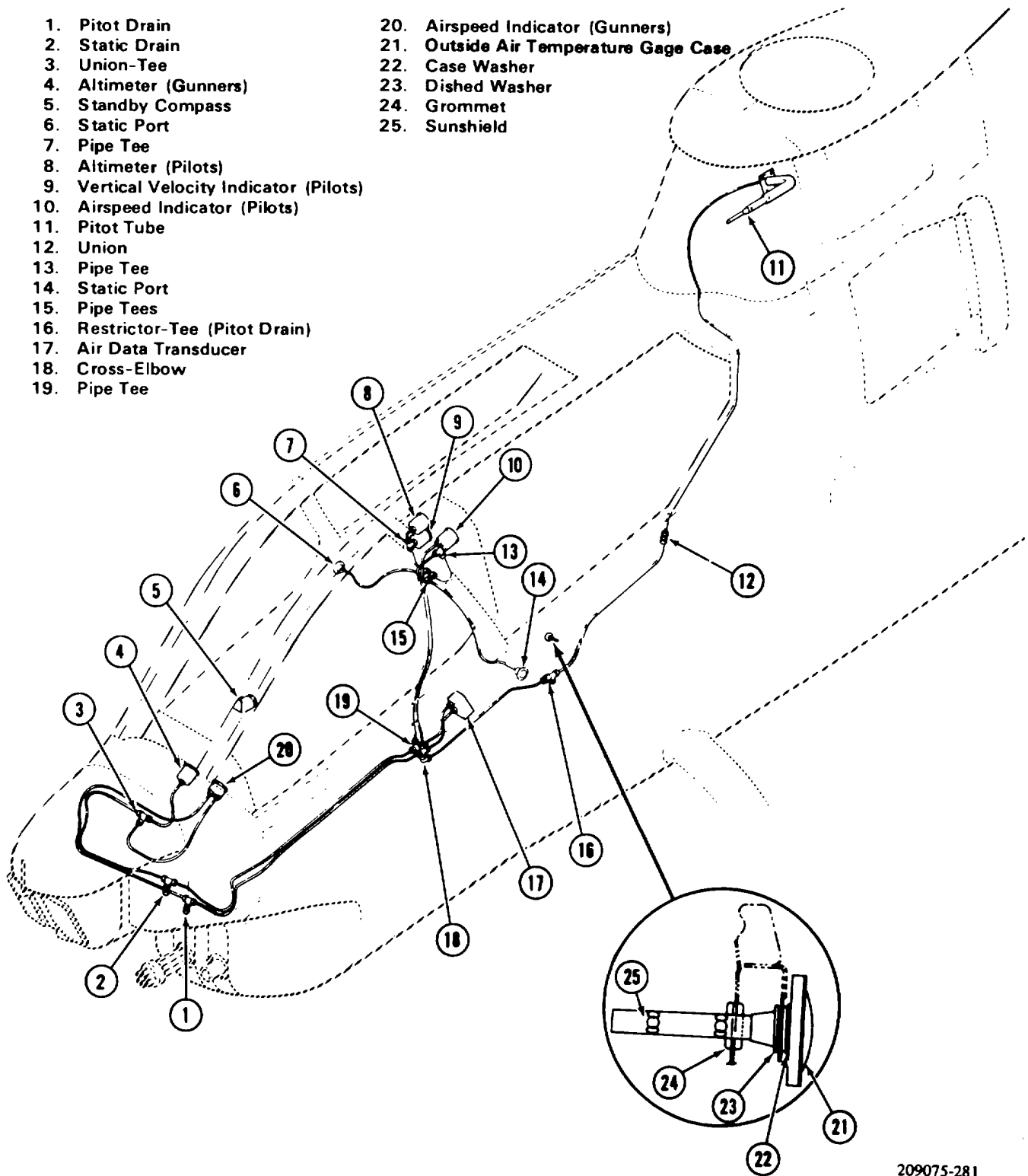
(4) Uncap openings in indicators and transducer and reconnect all lines.

(5) Assemble nylon fittings as follows:

(a) Install coupling nut on nylon tubing.

(b) Install insert into end of nylon tubing.

(c) Apply silicone compound (C121) to threads of nylon nut and fitting.



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Figure 8-2. Pitot-static system

(d) Connect coupling nut to fitting and torque nut fingertight.

(6) Close pitot and static drain valves and install drain caps.

b. Inspection.

(1) Inspect pitot and static piping and fittings for leaks, chafing, crimping, or other visible damage.

(2) Inspect system for improperly installed fittings and clamps.

c. Functional Check. (Refer to paragraph 8-26A.)

d. Troubleshooting. (Refer to applicable portions of airspeed indicator, altimeters, and vertical velocity indicator troubleshooting procedures, paragraphs 8-29d, 8-30d, and 8-34d.) (See figure 8-2.)

e. Removal.

(1) Disconnect pitot and static lines from indicators and air data pressure transducer. Cap openings in indicators and pressure transducer to prevent entrance of foreign material.

(2) Disconnect applicable nylon fittings and clamps.

(3) Remove pitot and static lines.

f. Repair or Replacement.

(1) Replace defective or damaged pitot and static lines.

(2) Tighten or properly install fittings and clamps.

(3) Replace defective or damaged nylon fittings or clamps.

g. Installation.

(1) Route pitot and static lines through clamps in place. Tighten clamps. Connect pitot and static lines to indicators and air data pressure transducer.

(2) Apply silicone compound (C121) to threads of fitting couplings.

(3) Connect nylon fittings. Torque coupling

nuts fingertight.

(4) Conduct functional check. Refer to paragraph 8-26A.

8-28. Pitot Tube Head.

The electrically heated pitot tube head and mount is located on the upper left side of the forward pylon fairing. For information pertaining to the pitot heater electrical system, refer to Chapter 9.

a. Cleaning.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

(1) Clean pitot tube head with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

(2) Clean mount with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

b. Inspection.

(1) Inspect pitot tube for clogged or obstructed inlet opening, and clogged drain hole on bottom of tube. (See figure 8-2.)

(2) Inspect pitot tube for cracks or damage.

(3) If pitot tube head is removed, inspect electrical receptacle, pins, and sockets for damage.

c. Removal.

(1) Check that system electrical power is OFF.

(2) Open access door on left center pylon fairing.

(3) From inside the left forward pylon fairing, remove the clamps securing the pitot line and pitot heater electrical wires.

(4) Disconnect union assembly and install protective caps on open ends.

(5) From outside the helicopter, remove the three screws and lockwashers attaching pitot tube head to mount.

(6) Carefully pull pitot tube from mount to expose electrical connector and pitot line coupling. Disconnect electrical connector. Disconnect coupling from adapter. Cap open adapter and tape electrical connector to prevent entrance of foreign material.

d. Repair or Replacement.

(1) Replace pitot tube head if inlet opening is clogged or obstructed, drain hole is clogged, or electrical connector is damaged.

(2) Replace pitot tube head if cracked or damaged to the extent it would restrict impact air pressure.

(3) Replace defective or damaged pitot electrical connector.

(4) Tighten or properly install fittings.

e. Installation.

(1) At pitot tube mount, remove protective cap from adapter and remove tape from electrical connector.

(2) Apply silicone compound (C121) to threads of coupling.

(3) Connect pitot line coupling to adapter. Torque coupling fingertight.

(4) Connect electrical connector to pitot tube head connector.

(5) Carefully position pitot tube into mount and install three mounting screws and lockwashers.

(6) From inside left forward pylon fairing, remove protective caps from union and nut. Apply silicone compound (C121) to threads of union.

(7) Connect union assembly. Torque union nut fingertight. Install pitot line clamp and electrical clamp.

(8) Close pylon fairing access door.

8-29. Airspeed Indicators.

The pitots and gunners airspeed indicators, located on the respective instrument panel, are standard pitot-static instruments. The single-scale indicator provides airspeed indication in knots by measuring differences between impact air pressure from the pitot tube and atmospheric pressure from the static pressure ports.

a. Cleaning. (Refer to paragraph 8-1a.)

b. Inspection. (Refer to paragraph 8-1b.)

c. Functional Check. (Refer to paragraph 8-26A..)

d. Troubleshooting. (See figure 8-2 and table 8-7.)

Table 8-7. Troubleshooting - Airspeed Indicators

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Indicators fail to respond.

STEP 1.- Check for pressure line not connected.

Connect line. (Refer to paragraph 8-27.)

Table 8-7. Troubleshooting - Airspeed Indicators (Cont)**CONDITION****TEST OR INSPECTION****CORRECTIVE ACTION**

2. Indicator pointer indicates incorrectly.

STEP 1. Check for lines clogged by water or dirt.

Disconnect and blow lines clear, while actuating drain valve. (Refer to paragraph 8-27.)

STEP 2. Determine if indicator is defective or leaking by substitution of known good indicator or refer to functional check, paragraph 8-26A.

Replace indicator if defective. (Refer to paragraph 8-1.).

e. Removal. (Refer to paragraph 8-1c.)

f. Repair or Replacement. (Refer to paragraph 8-1d.)

g. Installation. (Refer to paragraph 8-1e.)

sense atmospheric pressure. An external adjustment knob is provided to make compensation for variations of prevailing barometric pressure.

a. Cleaning. (Refer to paragraph 8-1a)

b. Inspection. (Refer to paragraph 8-1b.)

c. Functional Check. (Refer to paragraph 8-26A.)

d Troubleshooting. (See figure 8-2and table 8-8.)

8-30. Altimeters.

The pitots and gunners altimeter, located on the respective instrument panel, furnish direct readings of helicopter height in feet above sea level. The altimeters are connected through piping to static pressure ports to

Table 8-8. Troubleshooting - Altimeters**NOTE**

Before you use this table, be sure you have performed all normal operational checks.

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

1. Indicator has incorrect reading.

STEP 1. Check for leaks in static pressure line. Refer to paragraph 8-26A.

Correct leaks in line. (Refer to paragraph 8-27.)

Table 8-8. Troubleshooting - Altimeters (Cont)

CONDITION	
TEST OR INSPECTION	
CORRECTIVE ACTION	
STEP 2. Check for clogged static port or piping .	
Clean port or piping. (Refer to paragraph 8-27.)	
STEP 3. Determine if indicator is defective by substitution of known good indicator or refer to functional check, paragraph 8-26A.	
Replace indicator if defective. (Refer to paragraph 8-1.)	

e. <i>Removal.</i> (Refer to paragraph 8-1c.)	a. <i>Cleaning.</i> (Refer to paragraph 8-1a.)
f. <i>Repair or Replacement.</i> (Refer to paragraph 8-1d.)	b. <i>Inspection.</i> (Refer to paragraph 8-1b.)
g. <i>Installation.</i> (Refer to paragraph 8-1e.)	c. <i>Functional Test.</i>

8-31. Attitude Indicating System.

This dual remote indicating system includes a pilots attitude indicator, a gunners attitude indicator, a rate switch gyro, and separately mounted attitude gyro. The system is supplied from the 115 Vac bus. (Refer to TM 11-1520-221 series maintenance manuals for information and procedures pertaining to the rate switch gyro and attitude gyro.)

- (1) Energize main inverter by placing INV switch to MAIN.
- (2) Close ATTD IND PILOT circuit breaker. Check that the power OFF flag on the pilots attitude indicator disappears within 1 minute. Check that the display erects to within ± 2 degrees in pitch and roll within 3 minutes.
- (3) Rotate the pitch trim knob, located on the lower right corner of the indicator face, fully

8-32. Attitude Indicators

The pilots and gunners attitude indicators, mounted in the respective instrument panels, display flight attitude of the helicopter relative to the earth. Pitch attitude is indicated by motion of the sphere with respect to the miniature airplane. Roll attitude is indicated by motion of the roll pointer with respect to the fixed roll scale located at the top of the display. The indicator sphere can be adjusted to zero indication by the pitch trim knob which is located on the face of the instrument in the lower right corner, and a roll trim control located at the rear of the instrument. The power OFF flag, located in the lower left portion of the display, is energized (out of view) by a tap on the power transformer. Any interruption of indicator power will indicate a failure and the flag will be exposed.

- clockwise. Check that the horizon line deflects 10 to 20 degrees upward from its zero trim position (indicating a dive).
- (4) Rotate the pitch trim knob fully counterclockwise. Check that the horizon line deflects downward 6 to 10 degrees from its zero trim position (indicating a climb). Return the pitch trim knob to zero trim.
- (5) Close ATTD IND GUNNER circuit breaker. Check that the power OFF flag on the
- gunners attitude indicator disappears within 1 minute.
- (6) Repeat steps (3) and (4) for the gunners attitude indicator.
- (7) Turn off the main inverter and after a few seconds delay, turn on the spare inverter. Check that the pitch and roll axes remain stable within ± 1 degree.
- d. Troubleshooting. (See figure F-8 and table 8-9.)

Table 8-9. Troubleshooting - Attitude Indicators

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Both pilots and gunners indicators fail to operate.
- STEP 1. Check for inadequate power supply at inverter output (115 Vac).
- Repair or replace power supply. (Refer to paragraph 9-25.)
- STEP 2. Check for defective circuit breaker by use of multimeter or substitution of known good circuit breaker.
- Replace circuit breaker if defective. (Refer to paragraph 9-5.)
- STEP 3. Check for defective attitude gyro. Refer to TM 11-1520-221-20.
- Replace gyro if defective. (Refer to TM 11-1520-221-20.)
2. Either pilots or gunners indicator display fails to erect to within ± 2 degrees in pitch and roll within 3 minutes after turn on.
- STEP 1. Check for defective indicator by substitution of known good indicator.
- Replace indicator if defective.
3. System functions properly, but gunners power OFF flag does not lift.
- STEP 1. Check for defective indicator by substitution of known good indicator.
- Replace indicator if defective. (Refer to paragraph 8-1.)

- e. *Removal.* (Refer to paragraph 8-1c.)
- f. *Repair or Replacement.* (Refer to paragraph 8-1d.)
- g. *Installation.* (Refer to paragraph 8-1e.)

when the helicopter is in directional balance, either in a turn or in straight and level flight. If the helicopter is yawing or slipping, the ball will be off center. The needle indicates in which direction and at what rate the helicopter is turning.

- a. *Cleaning.* (Refer to paragraph 8-1a.)
- b. *Inspection.* (Refer to paragraph 8-1b.)
- c. *Functional Test.*
  - (1) Close TURN & SLIP IND circuit breaker.
  - (2) Check that indicator gyro is running.
- d. *Troubleshooting.* (See figure F-34 and table 8-10.)

8-33. Turn and Slip Indicator.

The turn and slip indicator, located on the pilots instrument panel, is controlled by an electrically actuated gyro. This instrument has a needle (turn indicator) and a ball (slip indicator). Although the needle and ball are combined in one instrument and are normally read and interpreted together, each has its own specific function, and operates independently of the other. The ball indicates

Table 8-10. Troubleshooting - Turn and Slip Indicator

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Pointer remains centered, either constantly or intermittently.

STEP 1. Check for sticking gyro.

Replace gyro, if defective. (Refer to TM 11-1620-221-20.)

2. Ball too sensitive.

STEP 1. Check for proper electrical power to indicator.

Repair defective wiring.

STEP 2. Check if damping fluid has leaked out.

Replace indicator, if defective. (Refer to paragraph 8-1.)

- e. *Removal.* (Refer to paragraph 8-1c.)

f. *Repair or Replacement.* (Refer to paragraph 8-1d.)

g. *Installation.* (Refer to paragraph 8-1e.)
- system to sense the rate of atmospheric pressure change.
The indicator registers ascent or descent in feet.
- a. *Cleaning.* (Refer to paragraph 8-1a.)
- b. *Inspection.* (Refer to paragraph 8-1b.)
- c. *Functional Check.* (Refer to paragraph 8- 26A.)
- d. *Troubleshooting.* (See figure 8-2 and table 8-11.)

8-34. Vertical Velocity Indicator.

The vertical velocity indicator, located on the pilots instrument panel, is connected to the static air

Table 8-11. Troubleshooting - Vertical Velocity Indicator

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Indicator points off zero.

STEP 1. Determine if mechanism shifted by substitution of known good indicator.

Return pointer to zero by turning adjustment screw on face of instrument; tap face of indicator lightly while adjusting.
2. Indicator has inaccurate readings.

STEP 1. Check for defective indicator by substitution of known good indicator.

Replace indicator if defective. (Refer to paragraph 8-1.)

STEP 2. Check for loose connection in static line.

Tighten connections.

STEP 3. Determine if indicator case leaks by substitution of known good indicator or refer to paragraph 8-26A.

Replace indicator if defective. (Refer to paragraph 8-1.)
3. Indicator has excessive pointer oscillation.

STEP 1. Check for leaks in static line. Refer to paragraph 8-26A.

Tighten connections; replace leaky lines. (Refer to paragraph 8-27.)

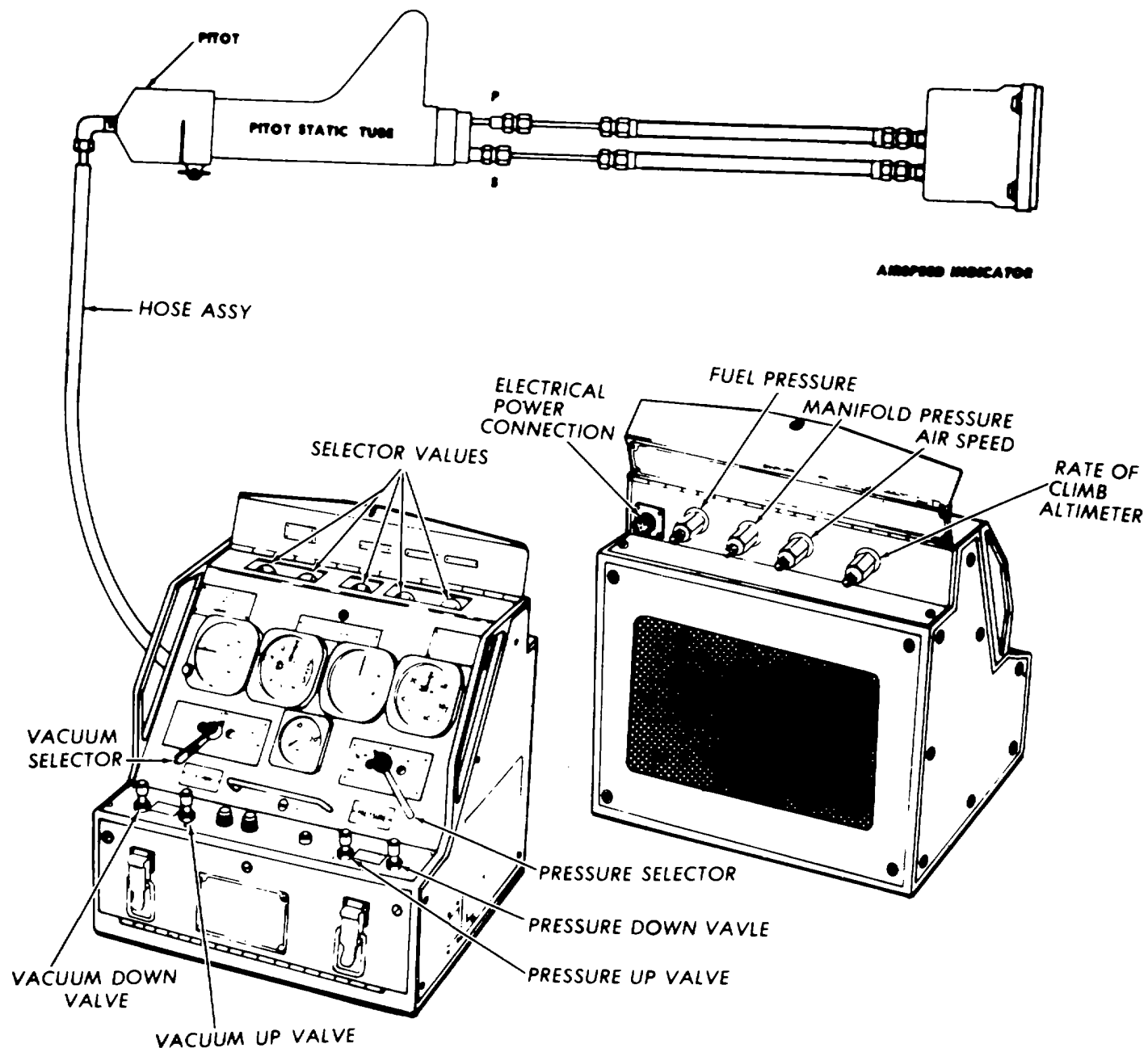


Figure 8-2A. Connection for Pitot Leak Check (Typical)

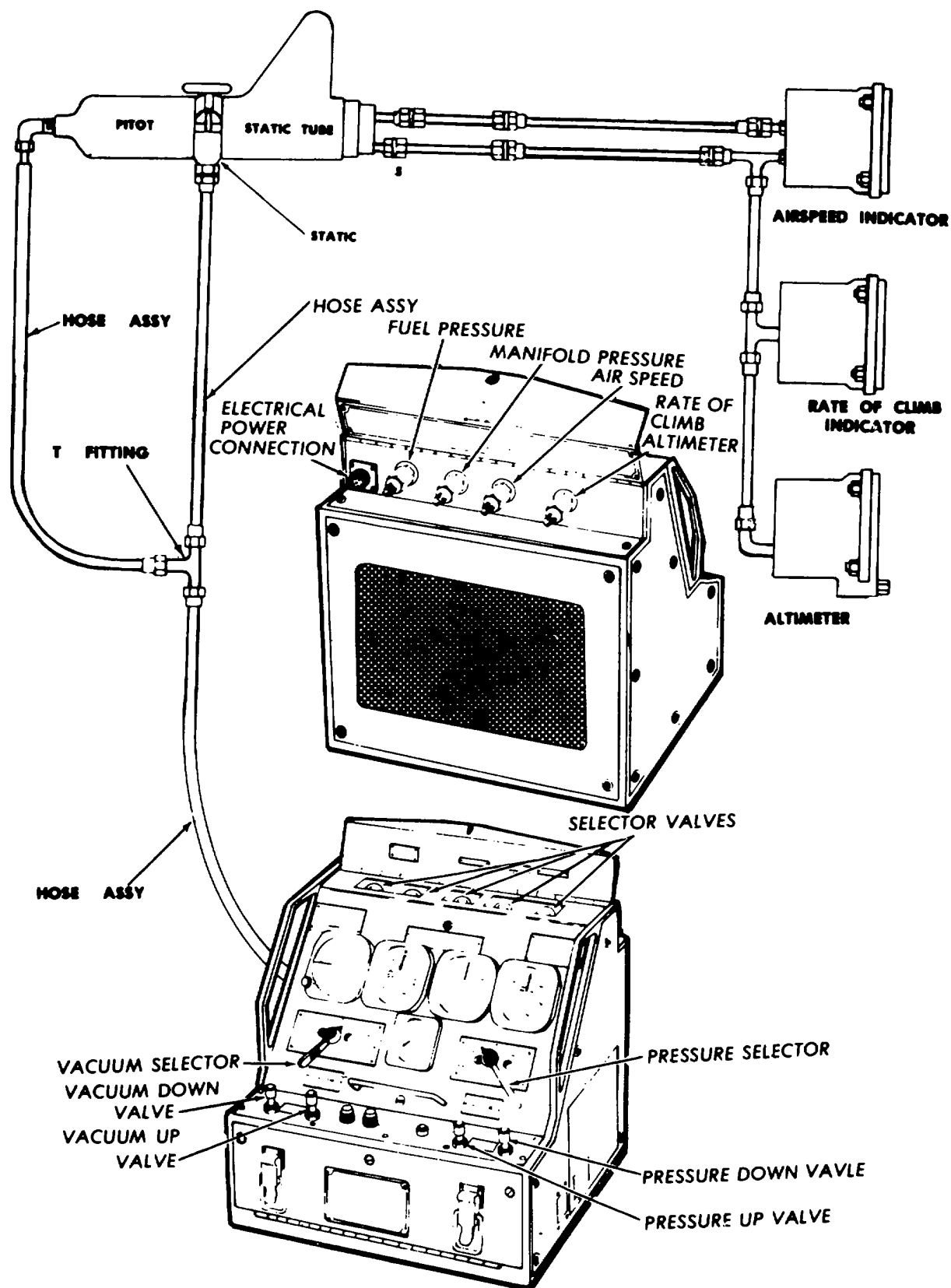


Figure 8-2B. Connections for Static Leak Check (Typical)

Table 8-11. Troubleshooting - Vertical Velocity Indicator (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

STEP 2. Check for defective indicator by substitution of known good indicator.

Replace indicator if defective. (Refer to paragraph 8-1.)

- e. Removal. (Refer to paragraph 8-1c.)
- g. Installation. (Refer to paragraph 8-1e.)
- f. Repair or Replacement. (Refer to paragraph 8-1d.)

Section IV. NAVIGATION INSTRUMENTS

8-35. Navigation Instruments.

Navigation instruments include the course indicator, bearing heading indicator, and standby compass.

8-36. Course Indicator (ID-48( )/ARN).

The ID-48( )/ARN course indicator, located on the pilots instrument panel, is used only when the FM radio is operating in the homing mode. The course indicator provides visual indication of the position of the helicopter in relation to the station being received. The vertical pointer provides fly right, fly left, and on station indications. The horizontal pointer indicates passage over the station and signal strength. Two power OFF flags (vertical and horizontal) come into view when power is interrupted or unreliaibly weak. The power OFF flags disappear from view under normal operating conditions. (Refer to TM 11-1520-221-20 for description, operational check, troubleshooting, and maintenance of system components.) (Refer to paragraph 8-1a through e for instrument maintenance.)

8-37. Radio Magnetic Indicators (ID-998( )/ASN and ID-250( )/ARN).

The pilots ID-998( )/ASN and gunners ID-250( )/ARN RMI indicators are dual pointer, moving dial type indicators. The ID-250( )/ARN is a repeater type indicator driven by the ID-998( )/ASN indicator. The compass dial on each indicator rotates under the fixed index reference mark to indicate compass heading information from the gyromagnetic compass system AN/ASN-43. Pointer number one of each indicator displays radio magnetic bearing information received from the ADF set AN/ARN-83. Pointer number two is not used. The ID-998( )/ASN is located on the pilots instrument panel and the ID-250 ( )/ARN located on the gunners instrument panel. (Refer to TM 11-1520-221-20 for description, operational check, troubleshooting, and maintenance of system components.) (Refer to paragraph 8-1a through e for instrument maintenance.)

8-38. Standby Compass.

One standby compass of standard magnetic type is mounted on the windshield support. The standby compass is utilized by both pilot and gunner. The compass correction card is located adjacent to the compass.

- a. *Cleaning.* (Refer to paragraph 8-1a.)
- b. *Inspection.* (Refer to paragraph 8-1b.)
- c. *Troubleshooting.* (See figure 8-2 and table 8-12.)

Table 8-12. Troubleshooting - Standby Compass

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Standby compass has excessive card error.

STEP 1. Determine if compass is improperly compensated.

Compensate compass. (Refer to TM 11-1520-221 series.)

STEP 2. Check for external magnetic interference.

Locate source of magnetic interference and eliminate it, if possible.

STEP 3. Check for air in bowl.

Replace compass. (Refer to paragraph 8-1.)

STEP 4. Check liquid level in bowl.

Replace compass if liquid level is low. (Refer to paragraph 8-1.)

2. Card element not level.

STEP 1. Check for leaks in float chamber.

Replace compass, if defective. (Refer to paragraph 8-1.)

STEP 2. Check for detached magnet card.

Replace compass, if defective. (Refer to paragraph 8-1.)

3. Card is sluggish.

STEP 1. Check for dirty pivots or jewels that restrict rotation.

Replace compass, if defective. (Refer to paragraph 8-1.)

STEP 2. Check for weak magnet card.

Replace compass. (Refer to paragraph 8-1.)

d. *Compensation (Swinging).*

The standby magnetic compass may be calibrated concurrently with the ASN-43 compass system. Refer to TM 11-1520-221 series maintenance manuals.

e. *Removal.* (Refer to paragraph 8-1c.)

f. *Repair or Replacement.* (Refer to paragraph 8-1d.)

g. *Installation.* (Refer to paragraph 8-1e.)

Section V. MISCELLANEOUS INSTRUMENTS

8-39. Miscellaneous Instruments.

The miscellaneous instruments include the clock, fuel quantity indicating system, free air temperature gage, transmission oil pressure indicating system, transmission oil temperature indicating system, voltmeter/ammeter, pilots steering indicator, and radar warning indicator.

totalizer hand to indicate elapsed time. A control knob on the case starts the pointers when pressed, stops both pointers when pressed a second time, and returns pointers to 12 o'clock when pressed a third time. A separate control knob winds and sets the clock.

8-40. Clock.

The clock, located on the pilots instrument panel, is an 8 day clock with added stopwatch feature for elapsed time. The clock has a sweep-second pointer and a minute

a. *Cleaning.* (Refer to paragraph 8-1a.)

b. *Inspection.* (Refer to paragraph 8-1b.)

- c. *Functional Test.* Check that control knob on the both pointers when pressed a third time. case starts the pointers when pressed, stops both pointers when pressed a second time and returns
- d. *Troubleshooting.* (Refer to table 8-13.)

Table 8-13. Troubleshooting - Clock**NOTE**

Before you use this table, be sure you have performed all normal operational checks.

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

1. Clock does not run.

CAUTION

Do not overwind.

STEP 1. Determine if clock needs winding.

Wind clock if needed.

STEP 2. Determine if clock is defective.

Replace clock if defective. (Refer to paragraph 8-1.)

2. Clock does not keep accurate time.

STEP 1. Determine if clock is out of adjustment.

Adjust clock to run faster or slower as needed. (Refer to paragraph 8-40 a.)

STEP 2. Determine if clock is defective.

Replace clock if defective. (Refer to paragraph 8-1.)

3. Pointers do not start, stop, or return when control knob is pressed through three time cycles.

STEP 1. Determine, if control knob, pointer(s), or instrument is defective.

Replace clock if defective. (Refer to paragraph 8-1.)

e. *Adjustment.* Remove clock from instrument panel. Adjustment is on back of clock which adjusts clock to run faster or slower.

f. *Removal.* (Refer to paragraph 8-1c.)

g. *Repair or Replacement.* (Refer to paragraph 8-1d.)

h. *Installation.* (Refer to paragraph 8-1e.)

fuel quantity transmitters; one located in the forward fuel cell, and the other located in the aft fuel cell. The system is powered from the 115 Vac bus, and is protected by a 1 ampere FUEL QTY IND circuit breaker. Pressing the FUEL GAUGE TEST SWITCH, located on the pilots instrument panel, checks the fuel quantity indicator for zero return. Fuel quantity indicator in pilots instrument panel registers fuel quantity in pounds.

8-42. Fuel Quantity Indicator.

a. *Cleaning.* (Refer to paragraph 8-1a.)

b. *Inspection.* (Refer to paragraph 8-1b.)

c. *Troubleshooting.* (See figure F-18 and table 8-14.)

8-41. Fuel Quantity Indicating System.

The fuel quantity indicating system is a bridge capacitance, balance type system which includes a fuel quantity indicator, located on the pilots instrument panel, and two

Table 8-14. Troubleshooting - Fuel Quantity Indicator

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Fuel quantity indicator reads low.

STEP 1. Determine if system is out of adjustment. Refer to paragraph 8-42 e. (AVIM).

Perform adjustment procedures (AVIM).

STEP 2. Check tank unit for low capacitance. Refer to paragraph 8-42 e. (AVIM).

Replace tank unit if faulty.

STEP 3. Check for compensator capacitance too high. Refer to paragraph 8-42 e. (AVIM).

Replace tank unit if faulty.

2. Fuel quantity indicator reads high.

STEP 1. Determine if system is out of adjustment. Refer to paragraph 8-42 e. (AVIM).

Perform adjustment procedures (AVIM).

STEP 2. Check tank unit for high capacitance. Refer to paragraph 8-42 e. (AVIM).

Change tank unit if faulty.

Table 8-14. Troubleshooting - Fuel Quantity Indicator (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

STEP 3. Check for open lead on compensator circuit.

Repair wiring if defective.

STEP 4. Check for compensator section of tank unit open. Refer to paragraph 8-42 e. (AVIM).

Change tank unit if faulty.

3. Indicator remains at one point on scale.

STEP 1. Check for no power. Refer to paragraph 9-25.

Repair 115 Vac power system.

STEP 2. Check for defective indicator by substitution of known good indicator or refer to paragraph 8-42 e. for functional test.

Replace indicator if defective. Refer to paragraph 8-1.

STEP 3. Check for grounded coaxial lead.

Check wiring and/or replace indicator assembly. Refer to paragraph 8-1.

STEP 4. Check for grounded 400 Hz lead. (Prolonged existence of this condition will burn out fire hazard resistor in indicator.)

Repair or replace wiring.

4. Indicator remains at zero or below.

STEP 1. Check for open wiring.

Repair or replace wiring.

STEP 2. Check for defective indicator by substitution of known good indicator or refer to paragraph 8-42 e. for functional test.

Replace indicator if defective. Refer to paragraph 8-1.

5. Indicator operation is sluggish.

STEP 1. Check for low insulation of the circuit. Refer to paragraph 8-42 e.

Repair or replace wiring and/or tank unit.

d. *Removal.* (Refer to paragraph 8-1c.)

e. *Functional Test - Bench (AVIM).*

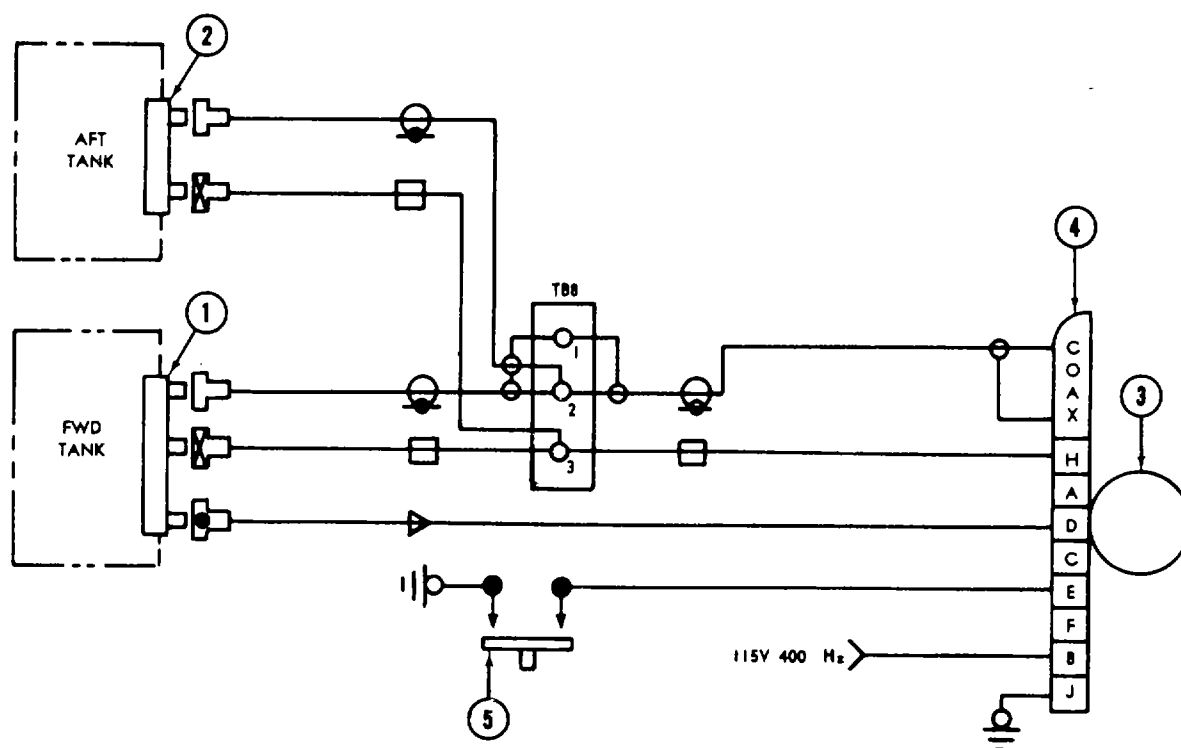
(1) *Tank Unit Capacitance Test.* Use the Simmonds 387011 Automatic Capacitance Bridge, the bridge section of the Simmonds 387991-003 Field Calibration Unit, or equivalent to measure the capacitance between the coaxial and 400 hertz receptacles, and also between the coaxial and compensator receptacles. When measuring the tank unit section on the 381075-008 tank unit, ground the compensator 400 hertz connection. When measuring the compensator section, ground the tank unit 400 hertz connection. Ground the tank unit flange to the measuring device while measuring the capacitance. The unit capacitances should be as shown below. (See figure 8-3.)

<u>Tank Unit</u>	<u>Capacitance (mmf)</u>
381075-008	126.4 ± 1.3
381065-007	97.4 ± 1.0
(Compensator)	25.0 ± 0.3

NOTE

Tolerance of measuring equipment must be taken into consideration in making all capacitance measurements.

(2) *Tank Unit Insulation Resistance Test.* Using the three wire insulation resistance tester, or the insulation resistance section of the 387991-003



	PART NAME	PART NUMBER	REQD
1	TANK UNIT (BELL 209-060-602-1)	381075-008	1
2	TANK UNIT (BELL 209-060-602-3)	381065-007	1
3	INDICATOR (BELL 209-060-602-5)	393004-048	1
4	PLUG (AMPHENOL)	165-61	1
5	TEST SWITCH	MS25089-4C	1
	COMP PLUG (DAGE)	1728-1	1
	400 Hz PLUG (DAGE)	1690-1	2
	COAX PLUG (DAGE)	1905-1	2
	COMP LEAD		AS REQD
	400 Hz LEAD		"
	COAX CABLE		"

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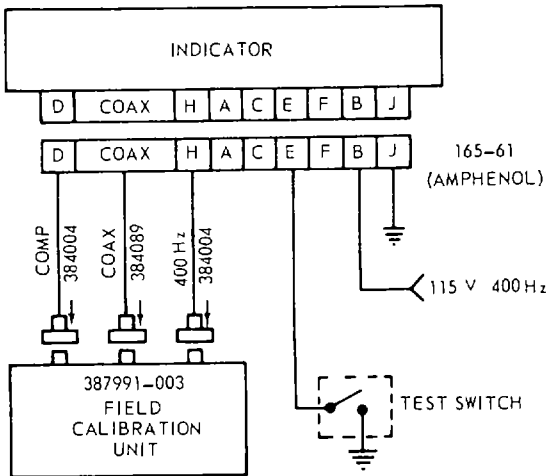
Figure 8-3. Test circuit setup for fuel tank unit capacitance and resistance tests.

tester, measure the insulation resistance between the points listed below. The mounting flange is considered "ground".

- (a) Center of coaxial connector to ground - not less than one megohm.
- (b) Center of 400 hertz connector to ground - not less than one megohm.
- (c) Center of compensator connector to ground - not less than one megohm.
- (d) Center of coaxial connector to center of 400 hertz connector of tank unit 381075-008 - not less than 650 megohms.
- (e) Center of coaxial connector to center of 400 hertz connector of tank unit 381065-007 - not less than 850 megohms.
- (f) Center of coaxial connector to center of compensator connector - not less than 3500 megohms.

(3) Indicator Test.

- (a) Set up test circuit. (See figure 8-4.)



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Figure 8-4. Test circuit setup for fuel quantity indicator bench test.

NOTE

The adjustment controls require 40 complete turns to travel from end to end. Also no stops are incorporated so that when control runs off end of winding, indicator pointer will jump; continuous rotation in same direction will result in pointer returning to its correct position.

- (b) Set up capacitance of 223.8 mmf on tank unit section of tester and 50.7 mmf on compensator section. Adjust empty control until pointer reads zero.
- (c) Set tank unit section of tester to 480.0 mmf and leave compensator section set at 50.7 mmf. Adjust full control until pointer reads 1975 pounds.
- (d) With compensator section set at 50.7mmf, vary tank unit section of tester so that pointer reads at graduations shown. Capacitance must be as shown opposite indicator reading.

Indicator Reading (LBS X 100)	Capacitance (mmf)
0	223.8 ± 0.0
2	249.8 ± 1.3
4	275.7 ± 1.3
6	301.6 ± 1.3
8	327.6 ± 1.3
10	353.5 ± 1.3
12	379.5 ± 1.3
14	405.4 ± 1.3
16	431.3 ± 1.3
18	457.3 ± 1.3
19.75	480.0 ± 0.0

- (e) Cause indicator to travel from 0 to 1975 pounds and from 1975 to 0 pounds. The travel time must not be more than 30 seconds.
- (f) Adjust tester so that indicator is upscale. Close test switch. Indicator should go to zero. Release test switch. Pointer should go back to its original position.

(4) Insulation Resistance Test. After all tank units and wiring have been installed in the aircraft, test the insulation resistance of the circuits. Use a three-wire insulation resistance tester and make the following insulation resistance tests at the amphenol connector. Disconnect the connector from the indicator prior to making tests and reconnect after tests are completed.

(a) Between compensator (Pin D) and ground (Pin J) - not less than **one** megohm.

(b) Between coaxial and ground - not less than **one** megohm.

(c) Between 400 hertz (Pin H) and ground - not less than **one** megohm.

(d) Between coaxial and 400 hertz (Pin H) - not less than **350** megohms.

(e) Between 400 hertz (Pin H) and compensator (Pin D) - not less than **10** megohms.

(f). Use the bridge section of the Simmonds 387991-03 Field Calibration Unit (T76A) or equivalent, to measure the capacitance of the tank circuit. Ground the compensator lead (Pin D) at indicator when measuring the tank section, and ground the tank section (Pin H) at indicator when measuring the compensator. The values should be as listed in table 8-15.

(5) Adjustment Procedure - Preferred Method With Fuel Tanks Empty. Adjust fuel tank gage as follows:

(a) Check that all connecting cables and units have been installed properly, and connections are tight.

(b) Make sure all tanks are empty and turn on power.

Table 8-15. Fuel Tank Table of Limits.

a. Tank Unit Empty Capacitance Values.

<u>Circuit</u>	<u>Capacitance</u>
Tank Unit (Dry)	$223 \pm 2.3 \text{ mmf}$
Compensator Section (Dry)	25.0 ± 0.5

b. Added and Full Capacitance Values.

<u>Capacitance (μmf)</u>		<u>Indicator Readings</u>
Added	Full	(Pounds)
256.2	480.0	1975

(c) Turn "EMPTY" control until indicator reads exactly **zero**.

(d) Connect Simmonds 387991-003 Tester, or equivalent, in parallel with ships wiring. (See figure 8-5.)

(e) Set compensator section of Tester to **25.7pF**. and the tank unit section to **256.2pF**.

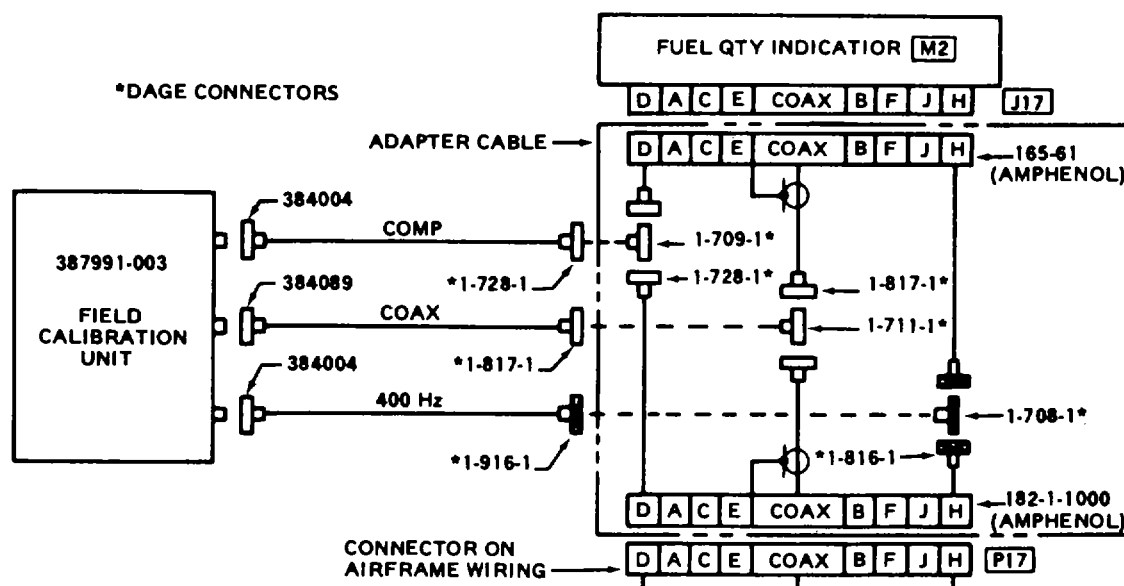


Figure 8-5. Circuit arrangement and adapter cable for fuel quantity adjustment procedures on installed system.

(f) Adjust "FULL" control on indicator to cause pointer to read at last dial division (1975 pounds).

(g) Disconnect adapter cable and reconnect airframe wiring to indicator.

(6) *Adjustment Procedure - Alternate Method With Fuel in Tanks.*

(a) Disconnect the amphenol connector at the indicator and insert the adapter cable. (See figure 8-5.) Connect Simmonds 387991-003 Tester and leave cables marked 1, 2 and 3 disconnected.

(b) Set the compensator section of the Tester to 50.7 Of and the tank unit section to 223.8 *mmf*. Adjust the "EMPTY" control on the indicator to cause pointer to read zero.

(c) Leave compensator section set at 50.7 *mmf* and set tank unit section to 480.0*mmf*. Adjust "FULL" control so that indicator pointer reads at last dial division (1975 pounds).

f. Repair or Replacement. (Refer to paragraph 8-1d.)

g. Installation. (Refer to paragraph 8-1e.)

8-43. Fuel Quantity Transmitters.

Two fuel quantity transmitter probes are installed, one each in the forward and aft fuel cells, and are electrically connected to the fuel quantity indicating system. External ends of the transmitters are located in the hydraulic reservoir compartment at left side, and in the transmission compartment deck below the induction baffle and slightly to right of center.

a. Cleaning.

(1) Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

(2) Remove oil, grease, fungus, and ground-in dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

(3) Remove dirt from electrical connectors with a bristle brush.

b. Inspection.

(1) Inspect pressure transmitter for cracks, secure and proper mounting, and proper operation.

(2) Inspect fuel line and fitting connection for leaks and proper installation.

(3) Inspect electrical connector for damaged or bent pins and cracked inserts.

c. Removal.

(1) Open left door of hydraulic reservoir compartment for access to forward fuel quantity transmitter.

(2) Disconnect electrical connectors from transmitter.

(3) Remove ram air intake duct.

(4) Remove four bolts and washers from mounting flange, and remove the two frangible clips. Carefully withdraw transmitter upward from fuel cell, tilting as necessary for clearance. Cover open port.

(5) Open transmission cowling and remove air induction baffle for access to aft fuel quantity transmitter. (Refer to Chapter 4, Section III.)

(6) Remove transmitter in same manner as for forward unit. (Refer to steps (2), (3), and (4).)

d. Repair or Replacement.

(1) Repair damaged electrical connectors.

(2) Tighten loose fuel line or fitting connection.

(3) Replace defective or damaged fuel line or fitting connection.

(4) Replace transmitter if cracked.

(5) Reinstall improperly mounted transmitter.

e. *Installation.* Install forward and aft transmitters in the same manner, except for location and parts removed for access.

(1) Uncover fuel cell port. Place a new packing in groove of transmitter mounting flange. Insert transmitter carefully into cell. Install frangible clips for aft cell at aft and right side bolts. On forward fuel cell install frangible clips at forward and right side bolts. Install bolts and washers. Add bead of sealant (C116) around periphery of part.

(2) Connect electrical connectors to transmitter. Perform a functional fuel quantity indicating system test. (Refer to paragraph 8-42.)

(3) Re-install parts removed for access. Close cowling or access doors.

8-44. Free Air Temperature Gage.

The free air temperature gage is bimetallic, probe type thermometer mounted on the left side of the pilots

compartment. The probe portion is exposed to free temperatures through a rubber grommet mounted on the skin of the helicopter. The indicator is calibrated in degrees celsius.

a. *Cleaning.* (Refer to paragraph 8-1a.)

b. *Inspection.* Inspect and replace free air temperature gage if any of the following conditions exist:

(1) Discoloration.

(2) Leaking seals.

(3) Temperature indication reading does not agree with that of a standard indicator.

c. *Functional Test - Free Air Temperature Gage.* Refer to TM 55-1500-204-25/1.

d. *Troubleshooting.* (See figure 8-2 and table 8-16.)

Table 8-16. Troubleshooting - Free Air Temperature Gage

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

- 1. Gage has reading upscale of free air temperature.

STEP 1. Check for missing or improperly installed sunshield.

Install or properly install sunshield. (Refer to paragraph 8-44.)

STEP 2. Determine if gage is defective. Refer to paragraph 8-44 c. for functional test.

Replace gage if defective. (Refer to paragraph 8-44.)

- 2. Gage has reading downscale of free air temperature.

STEP 1. Check for defective gage. Refer to paragraph 8-44 c. for functional test.

<i>e. Removal.</i>	(4) Test free air temperature gage in accordance with TM 55-1500-204-25/1.
(1) Unscrew and remove sunshield, dished washer, and one case washer from outer end of thermometer.	
(2) Remove thermometer and other case washer from inside of pilots compartment.	
<i>f. Repair and Replacement.</i> Replace gage if any of the inspection requirements are not met.	
<i>g. Installation.</i>	
(1) Hold washers and thermometer case in position at mounting flange. (See figure 8-2.)	
(2) Insert probe through grommet and mounting flange.	
(3) Place sunshield over thermometer probe and tighten.	

8-45. Transmission Oil Pressure Indicating System.

The transmission oil pressure indicating system consists of the transmission oil pressure indicator and transmission oil pressure transmitter.

8-46. Transmission Oil Pressure Indicator.

The transmission oil pressure indicator, located on the pilots instrument panel, indicates transmission oil pressure in psi by means of a transmission oil pressure transmitter. The system is powered from the 26 Vac bus, and is protected by a 1 ampere TORQUE PRESSURE IND circuit breaker.

- a. *Cleaning.* (Refer to paragraph 8-1a.)
- b. *Inspection.* (Refer to paragraph 8-1b.)
- c. *Functional Test.* (Refer to paragraph 8-1c, except close XMSN OIL PRESSURE IND circuit breaker.
- d. *Troubleshooting.* (Refer to paragraph 8-10d.)
- e. *Removal.* (Refer to paragraph 8-1c.)
- f. *Repair or Replacement.* (Refer to paragraph 8-1d.)
- g. *Installation.* (Refer to paragraph 8-1e.)

8-47. Transmission Oil Pressure Transmitter.

The transmission oil pressure transmitter, located on the right side of the transmission, monitors transmission oil pressure and transmits voltage signals to the transmission oil pressure indicator.

- a. *Cleaning.* (Refer to paragraph 8-12a.)
- b. *Inspection.* (Refer to paragraph 8-12b.)
- c. *Functional Test.* (Refer to paragraph 8-12c.)
- d. *Troubleshooting.* (Refer to paragraph 8-1d.)
- e. *Removal.* (Refer to paragraph 8-12e.)
- f. *Repair and Replacement.* (Refer to paragraph 8-12f.)
- g. *Installation.* (Refer to paragraph 8-12g.)

8-48. Transmission Oil Temperature Indicating System.

The transmission oil temperature indicating system consists of the transmission oil temperature indicator and an electrical resistance type thermobulb. The system is powered from the 28 Vdc essential bus, and is protected by a 5 ampere ENG & XMSN TEMP IND circuit breaker.

8-49. Transmission Oil Temperature Indicator.

The transmission oil temperature indicator, located on the pilots instrument panel, indicates transmission oil temperature in degrees celsius by means of an electrical resistance type thermobulb.

- a. *Cleaning.* (Refer to paragraph 8-1a.)
- b. *Inspection.* (Refer to paragraph 8-1b.)
- c. *Functional Test.* (Refer to paragraph 8-14c and g.)
- d. *Troubleshooting.* (Refer to paragraph 8-14d.)
- e. *Removal.* (Refer to paragraph 8-1c.)
- f. *Repair and Replacement.* (Refer to paragraph 8-1d.)
- g. *Installation.* (Refer to paragraph 8-1e.)

8-50. Transmission Oil Temperature Bulb.

The transmission oil temperature bulb, installed in the transmission oil manifold, monitors transmission oil temperature and transmits voltage signals to the transmission oil temperature indicator.

- a. *Cleaning.* (Refer to paragraph 8-15a.)
- b. *Inspection.* (Refer to paragraph 8-15b.)
- c. *Troubleshooting.* (Refer to paragraph 8-14d.)
- d. *Removal.* (Refer to paragraph 8-15d.)
- e. *Repair and Replacement.* (Refer to paragraph 8-15c.)
- f. *Functional Test - Bench.* (Refer to paragraph 8-15f.)
- g. *Installation.* (Refer to paragraph 8-15g.)

8-51. Voltmeter/Ammeter.

The dc voltmeter, which is in the same case with the ammeter, monitors and indicates the voltage of the 28 Vdc essential bus. The dc voltmeter is protected by a 5 ampere DC VOLTMETER circuit

breaker. The dc ammeter indicates the output in amperes of the generator portion of the starter-generator. The dc ammeter is protected by two 5 ampere circuit breakers, one wired in series with the positive lead, and the other wired in series with the negative lead. The two dc ammeter circuit breakers are located in the aft compartment below the generator-ammeter shunt.

- a. *Cleaning.* (Refer to paragraph 8-1a.)
- b. *Inspection.* (Refer to paragraph 8-1b.)
- c. *Troubleshooting.* (See figure F-19 and table 8-17.)

Table 8-17. Troubleshooting - Voltmeter/Ammeter

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

- 1. Indicator has no reading or erratic reading.

STEP 1. Check for open or short circuit in instrument by substitution of known good instrument.

Replace indicator if defective. (Refer to paragraph 8-44.)

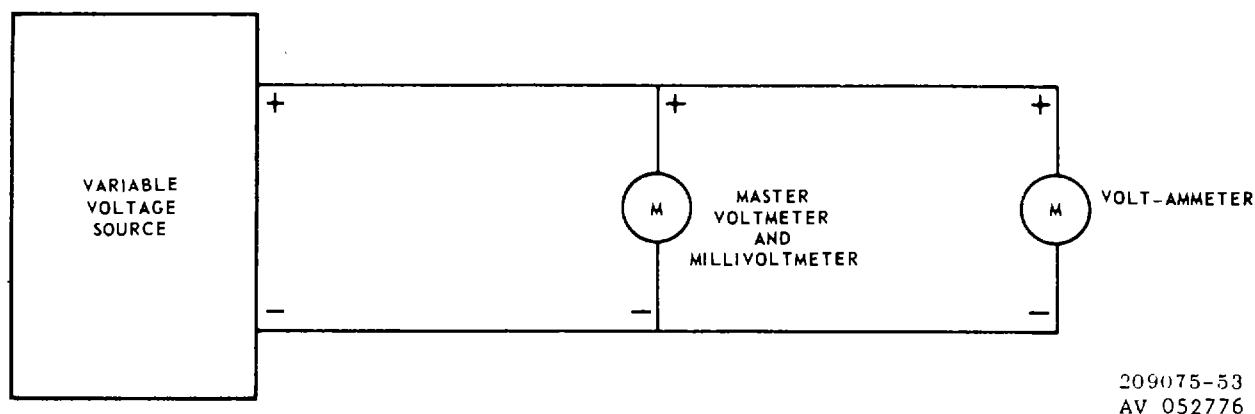
STEP 2. Check for dirty or worn mechanism in instrument by substitution of known good instrument.

Replace indicator if defective. (Refer to paragraph 8-44.)

STEP 3. Check for instrument scale error. Refer to paragraph 8-51 f. for functional test (AVIM).

Make adjustments to indicator. Refer to paragraph 8-51 f.

- d. *Removal.* (Refer to paragraph 8-1c.)
  - e. *Repair and Replacement.* (Refer to paragraph 8-1d.)
  - f. *Functional Test - Bench (AVIM).*
    - (1) Test Equipment Required. (See figure 8-6.)
      - (a) Dc voltmeter, 0 to 30 volt with 1/4 volt accuracy or better.
    - (2) Test Procedure.
      - (a) Connect the equipment as shown in figure 8-6.
- (b) Dc millivoltmeter, 0 to 50 millivolts with 1/4 millivolt accuracy or better.
  - (c) Variable dc voltage source, 0 to 30 volts and sufficient current capability to drive the reference meter.



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Figure 8-6. Volt-ammeter test set-up

(b) With zero input to the voltmeter, adjust the mechanical zero adjustment so that it indicates zero (for P/N 260173 only).

(c) With 50 millivolts input to the ammeter, adjust the mechanical zero adjustment so that it indicates 300 amperes (for P/N 260173 only).

(3) Movement Balance Test.

(a) Adjust the voltage source so that the volt-ammeter indicates any convenient reading on scale.

(b) Rotate the instrument so that the pointer is vertical and note the indication.

(c) Rotate the instrument so that the pointer is horizontal and note the indication.

(d) The difference between the indications noted in steps (b) and (c) should not exceed two percent of full scale.

(4) Friction Test. Vary the voltage source so that the indication of the volt-ammeter varies from zero to full scale. If any signs of the pointers sticking are observed, stop and note the indication before and after tapping the meter. The friction error should not exceed two percent of full scale.

(5) Scale Error Test.

NOTE

Support the instrument in its normal operating position and tap or vibrate the instrument before each reading.

(a) Adjust the voltage source so that the master meter indicates a convenient value. Note the indication of the volt-ammeter; it should not exceed two percent of master meter indication.

(b) Repeat step (a) above at a minimum of five equally spaced intervals over the range of the volt-ammeter.

g. Installation. (Refer to paragraph 8-1e.)

8-52. Pilots Steering Indicator (PSI).

The pilots steering indicator, mounted on the top right side of the pilots instrument panel, is a component of the XM65 TOW missile subsystem. The pilots steering indicator provides the pilot with steering information for prelaunch helicopter alignment or postlaunch maneuver. The PSI also indicates status of attack and constraint boundaries. The visual display indicators and their functions are as follows:

Indicator

ATTK annunciator.

RDY annunciator.

Function

Indicates when XM65 is in attack mode.

Indicates when XM65 is in fire mode and the pilot is flying within prelaunch constraints.

<u>Indicator</u>	<u>Function</u>
FIRE annunciator.	Indicates that gunner has initiated missile launch sequence.
Sightline position bars.	Vertical and horizontal bars indicate azimuth and elevation position of sightline with respect to helicopter reference axis and the prelaunch constraints boundary.
Reference ring.	Indicates the helicopter reference axis.
Azimuth angle markers.	Fixed TSU azimuth angle limit references.
Course scale azimuth pointer.	Indicates TSU angular azimuth position within fixed angle limit references.
Ascend-descend pointers.	Indicate to the pilot how to fly the pitch plane of the helicopter in the prelaunch condition. When the helicopter flight path needs correction, only the pointer which indicates the correction sense will be displayed.
Prelaunch constraint boundary	Indicates boundary within which the pilot must keep the sightline position bars during the attack and fire modes.
Postlaunch constraint boundary.	Indicates boundary within which the pilot must keep the sightline position bars during the maneuver mode.

The PSI visual display indicators are energized and actuated by the stabilization control amplifier (SCA). For additional information of the XM65 TOW missile subsystem, refer to TM 9-1425-473 series maintenance manuals.

a. Cleaning.

- (1) Remove dust and clean indicator cover glass with a clean, soft, lint-free cloth.
- (2) Remove moisture with a clean, dry cloth.

b. Inspection.

- (1) Inspect for loose, cracked, or broken cover glass.
- (2) Inspect for security of mounting.

c. Functional Test. The PSI operational check is conducted as a portion of the XM65 TOW missile subsystem operational test procedures, Chapter 9.

d. Troubleshooting. (See figure F-7 and table 8-18.)

Table 8-18. Troubleshooting - Pilots Steering Indicator

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

1. One or more visual indicators inoperative.

STEP 1. Check for defective wiring from PSI to SCA.

Check continuity of wiring; repair defective wiring. (Refer to paragraph 9-2.)

STEP 2. Check for defective connector at PSI, tailboom disconnect, or SCA.

Repair or replace defective connectors.

STEP 3. Check for defective PSI by substitution of known good indicator or refer to paragraph 8-62 c. for functional test.

Replace indicator if defective. (Refer to paragraph 8-1.).

---

e. Removal.

- (1) Ensure all system power is off.
- (2) Remove mounting screws and carefully lift indicator out of shroud just far enough to expose electrical connector at rear of indicator.
- (3) Disconnect electrical connector.
- (4) Cap electrical connector on indicator and protect disconnected plug with electrical tape.

f. Repair or Replacement.

- (1) Replace indicator if cover is loose, cracked, or broken.
- (2) Replace indicator if inoperative, defective, or damaged.

g. Installation.

(1) Remove protective cap, from electrical connector on indicator and remove protective tape from plug (10P01).

(2) Connect plug (10P01) to PSI and carefully position PSI in place in mounting shroud.

8-52A. Radar Warning System (AN/APR-39) (When Installed).

The radar warning system provides the pilot with both visual and audible warning when a high radar threat environment is encountered. The system is effectively operated by use of a control panel located on the pilots right console and an indicator on the instrument panel. Refer to TM 11-1520-221-20 for description, operational check, troubleshooting, and maintenance of system components. Refer to paragraph 8-1. a., through e., for instrument maintenance.

Section VI. INSTRUMENT PANELS**8-53. Instrument Panels.**

The instrument panels are mounted on the forward center section of the respective console and contain instruments for the pilot and gunner. Each instrument panel is mounted to the formed center section of the respective console by mounting screws or shock mounts, located around edge of panel. No adjustment of the instrument panel is required.

a. Cleaning.

- (1) Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

- (2) Remove grease, fungus, and ground-in dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

b. Inspection.

Visually inspect panels for surface scratches, warpage, cracks, and loose mounting screws.

c. Removal.

- (1) Ensure all electrical power is off.
- (2) Disconnect all electrical receptacles and hoses from instruments.
- (3) Cover all receptacles and hoses to prevent entrance of foreign particles.
- (4) Cover openings in instruments.
- (5) Remove mounting hardware and lift panel from helicopter.

d. Repair or Replacement.

- (1) Repair cracks (Refer to TM 55-1500-204-25/1.)
- (2) Replace shock mount if warped.

- (3) Replace loose or worn mounting screws.
- (3) Connect electrical receptacles to instruments.
- e. *Installation.*
  - (1) Install shock mounts if removed.
  - (4) Apply silicone compound (C121) to threads of pitot-static fittings.
  - (2) Position panel in place on console and install mounting hardware.
  - (5) Connect nylon fittings. Torque coupling nuts finger tight.

CHAPTER 9

ELECTRICAL SYSTEMS

Section I. ELECTRICAL SYSTEMS MAINTENANCE

9-1. Electrical Systems Maintenance.

NOTE

Power loading charts and detail system wiring diagrams are contained in Appendix F. Aviation Unit Maintenance activities shall request Intermediate Maintenance assistance for electrical system repairs in accordance with the maintenance allocation chart, Appendix B.

CAUTION

Before performing any maintenance checks on electrical panel which require power be applied to the panel, open the panel before applying power and ensure no contact of energized panel is made with outside frame.

a. *Primary Electrical Power.* The primary electrical power on the helicopter is a 28 volt direct current system supplied by the engine driven 30 volt, 300 ampere starter-generator derated to 200 ampere (G1). Secondary alternating current power is supplied by the 115 volt, 750 volt/ampere, 400 hertz, solid state, three-phase, delta-connected main inverter (PSI), powered from the main 28 volt dc bus. (Refer to paragraph 9-25.)

b. *Emergency Dc Power.* In the event of starter-generator failure, dc power is supplied by the 24 volt, 22 ampere/hour battery (BT1). The battery, assuming an 85 percent charge, can supply the essential loads under emergency conditions for a period of approximately 27.7 minutes.

c. *Emergency Ac Power.* In the event of main inverter failure, ac power is supplied by the 115 volt, 250 volt/ampere, 400 hertz, rotary, single-phase standby inverter (MG1). The standby inverter is powered from the main 28 volt dc bus.

d. *Electrical Bus Wiring Schematic.* A single-line, simplified electrical bus wiring schematic of the electrical power system is shown on figure 9-1. Primary power is distributed by a dual-bus arrangement so that non-essential dc loads are automatically deenergized in the event of a

starter-generator failure. A bus-reset feature is provided to permit reactivation of these loads at the pilots discretion.

e. *Starting Power.* Starting power is supplied by the 24 volt, 22 ampere/hour battery (or alternate 24 volt, 34 ampere/hour battery) or by an external power source.

f. *Control Panels.* The control panels for the ac and dc electrical systems are located in the pilots and gunners consoles. The ac and dc circuit breaker panels are located in the pilots console. Control relays, power relays, voltage regulator, transformers, and other equipment required to control, regulate; effect power transfer and for malfunction monitoring are located in the gunners and pilots sections (right and left wells) and aft compartment. Refer to Chapter 2 for information on access panels and doors. See figures 9-2 through 9-4 for equipment location.

9-2. General Maintenance Procedures.

NOTE

Throughout this chapter, unless otherwise specified, electrical maintenance, testing, and troubleshooting procedures will utilize only tools and equipment contained in Electronic Equipment Tool Kit, TK100/G and multimeter (AN/PSM-6A, or equivalent).

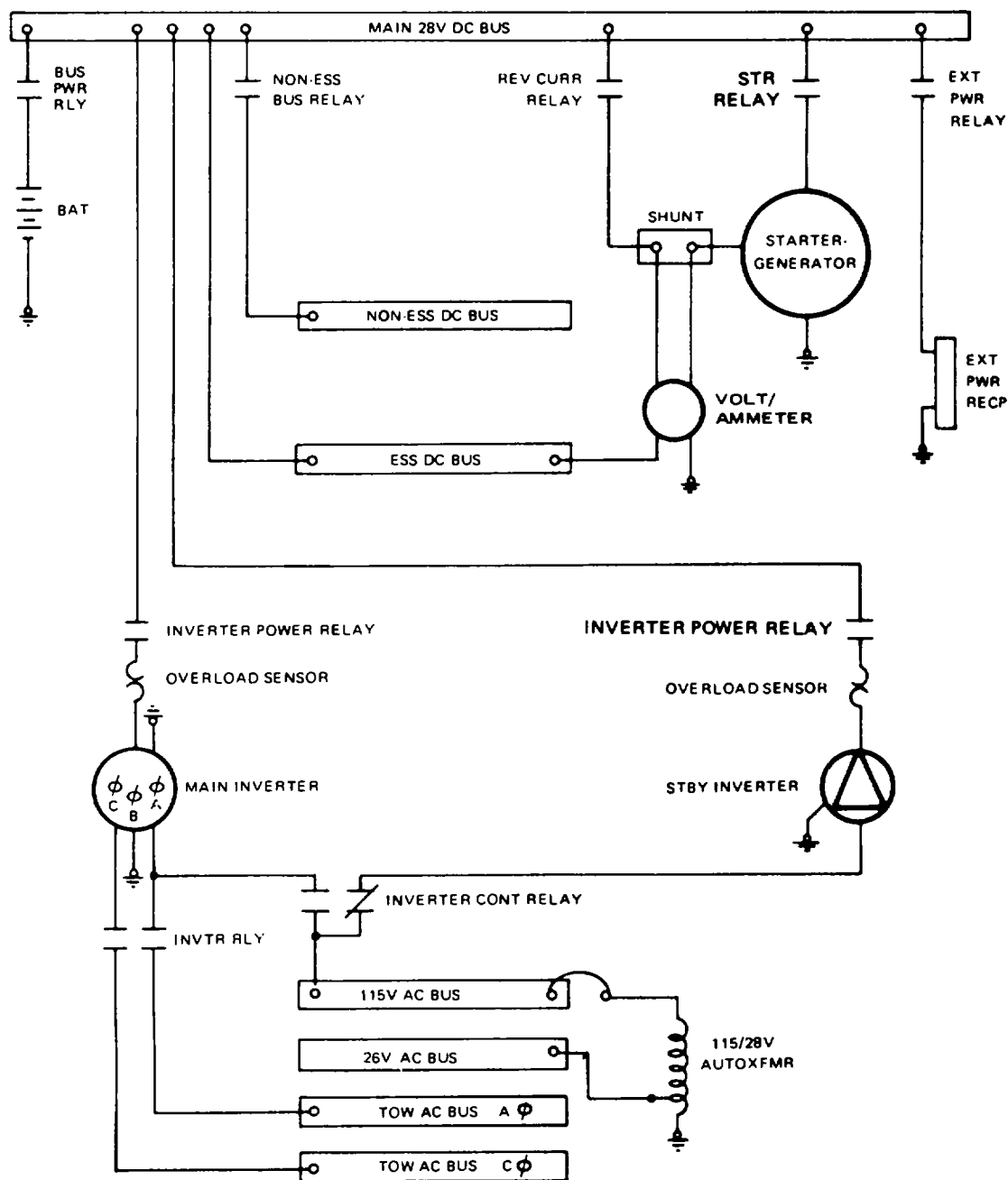
a. *Visual Inspection - Electrical Equipment.* Inspect electrical and electronic equipment installation items for dirt and corrosion. The surfaces should be free of dirt, grease, and fungus.

(1) Remove moisture, dust, and loose dirt with a clean soft cloth.

WARNING

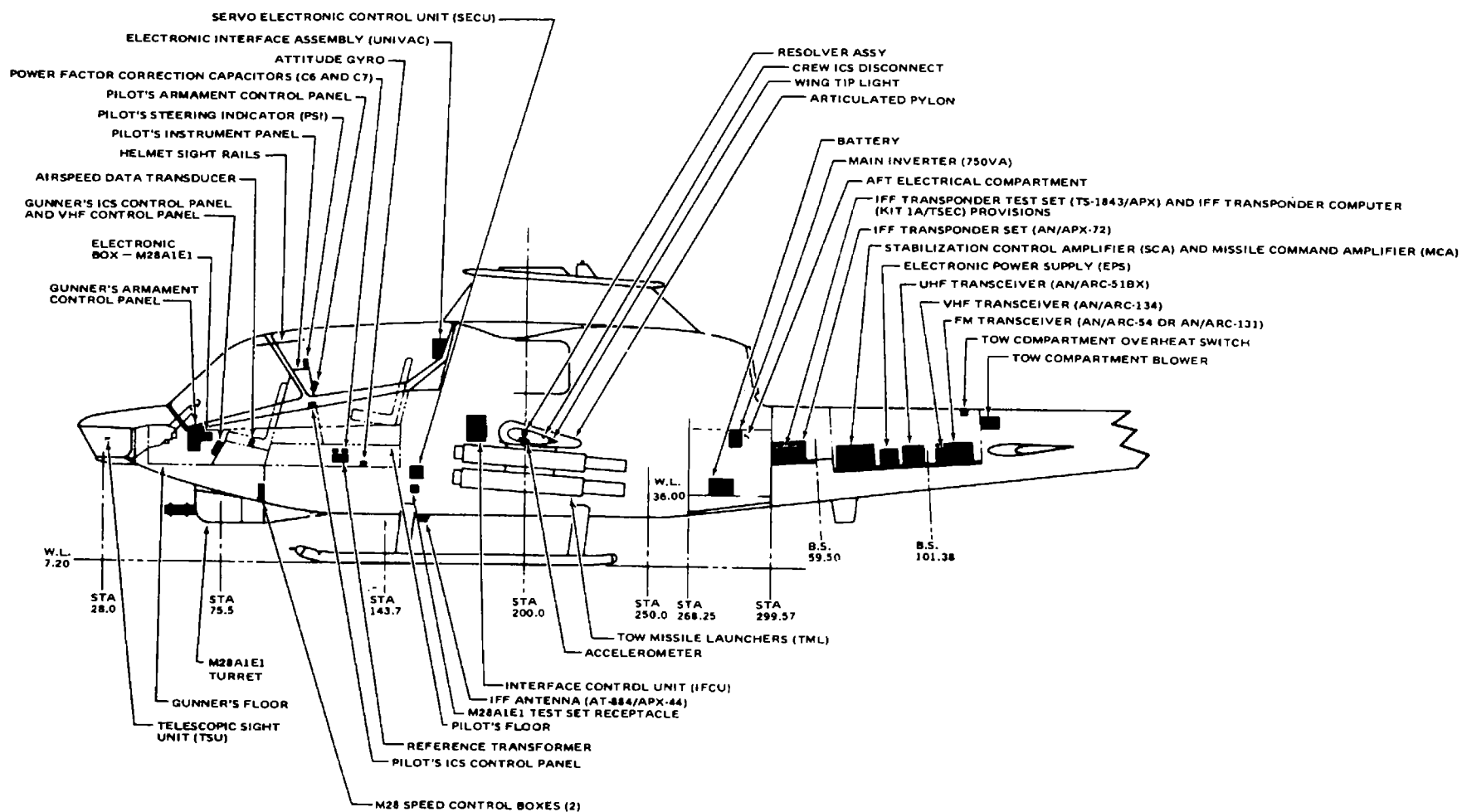
Cleaning compound is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

(2) Remove grease, fungus, and ground-in dirt from the equipment cases and mountings; use a cloth dampened (not wet) with approved dry cleaning compound, (C124).



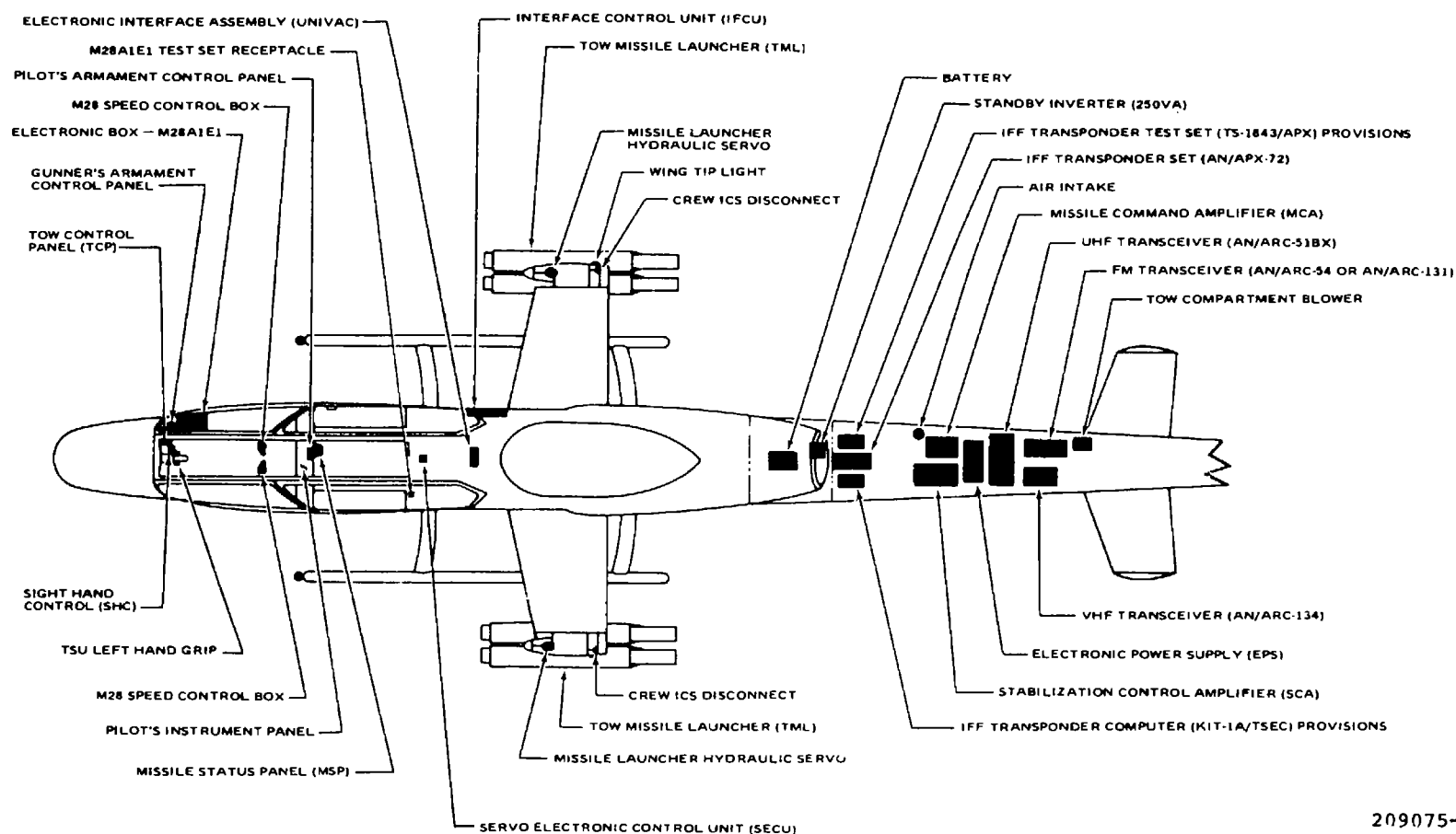
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Figure 9-1. Simplified electrical bus wiring schematic



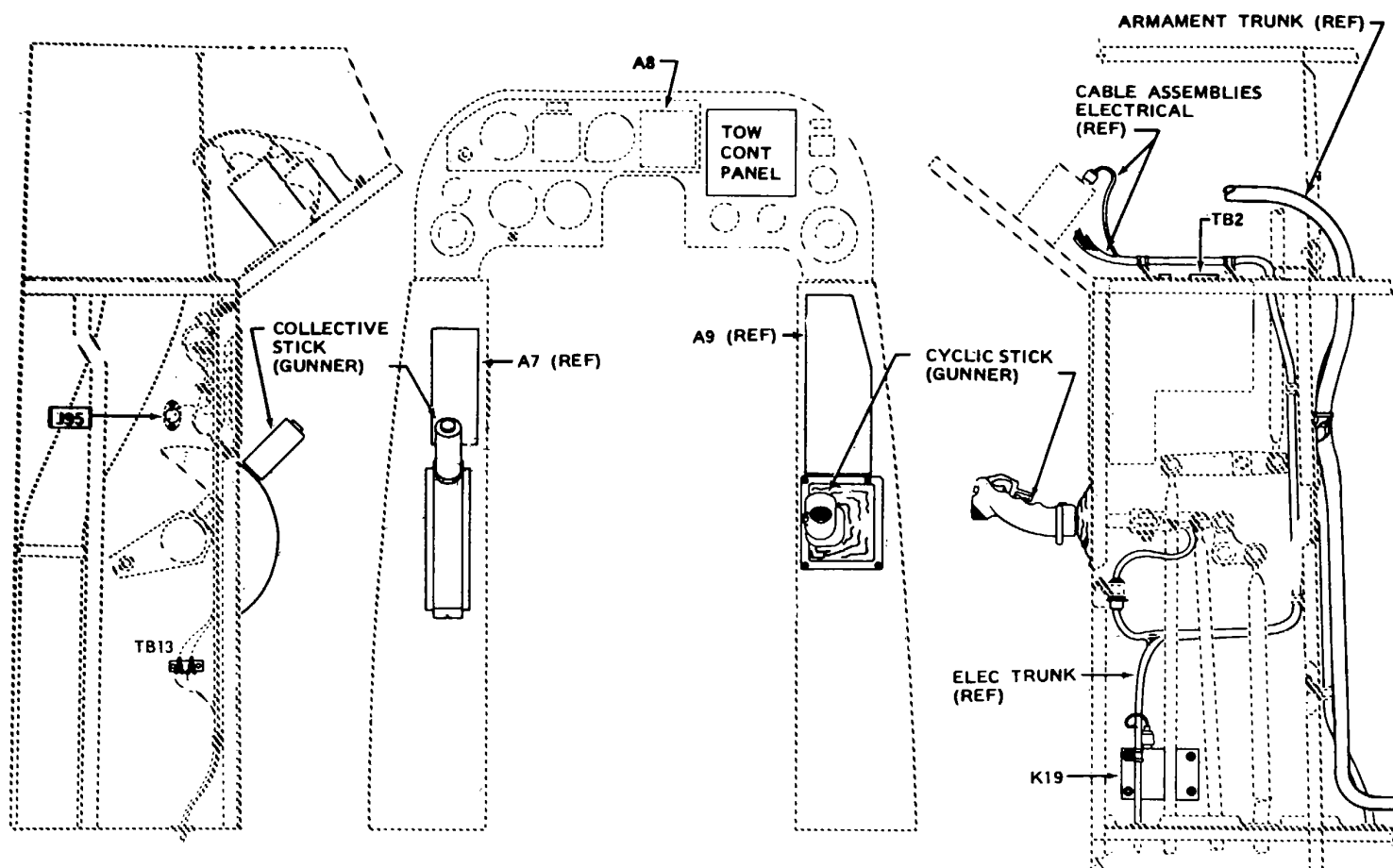
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Figure 9-2. Equipment location (Sheet 1 of 2)



209075-299-2

Figure 9-2. Equipment location (Sheet 2 of 2)



CODE
ITEM

DESCRIPTION

A7 Panel, Gunners Miscellaneous Control
A8 Panel, Gunners Caution
A9 Panel, Gunners Armament Control
J95 Receptacle, Engine Vibration Meter
K19 Magnetic Brake, Fore and Aft Force Trim

CODE
ITEM

DESCRIPTION

TB2 Terminal Board, Gunners Instrument
TB13 Terminal Board, Thermocouple Wire Junction

Figure 9-3. Gunners section - equipment location

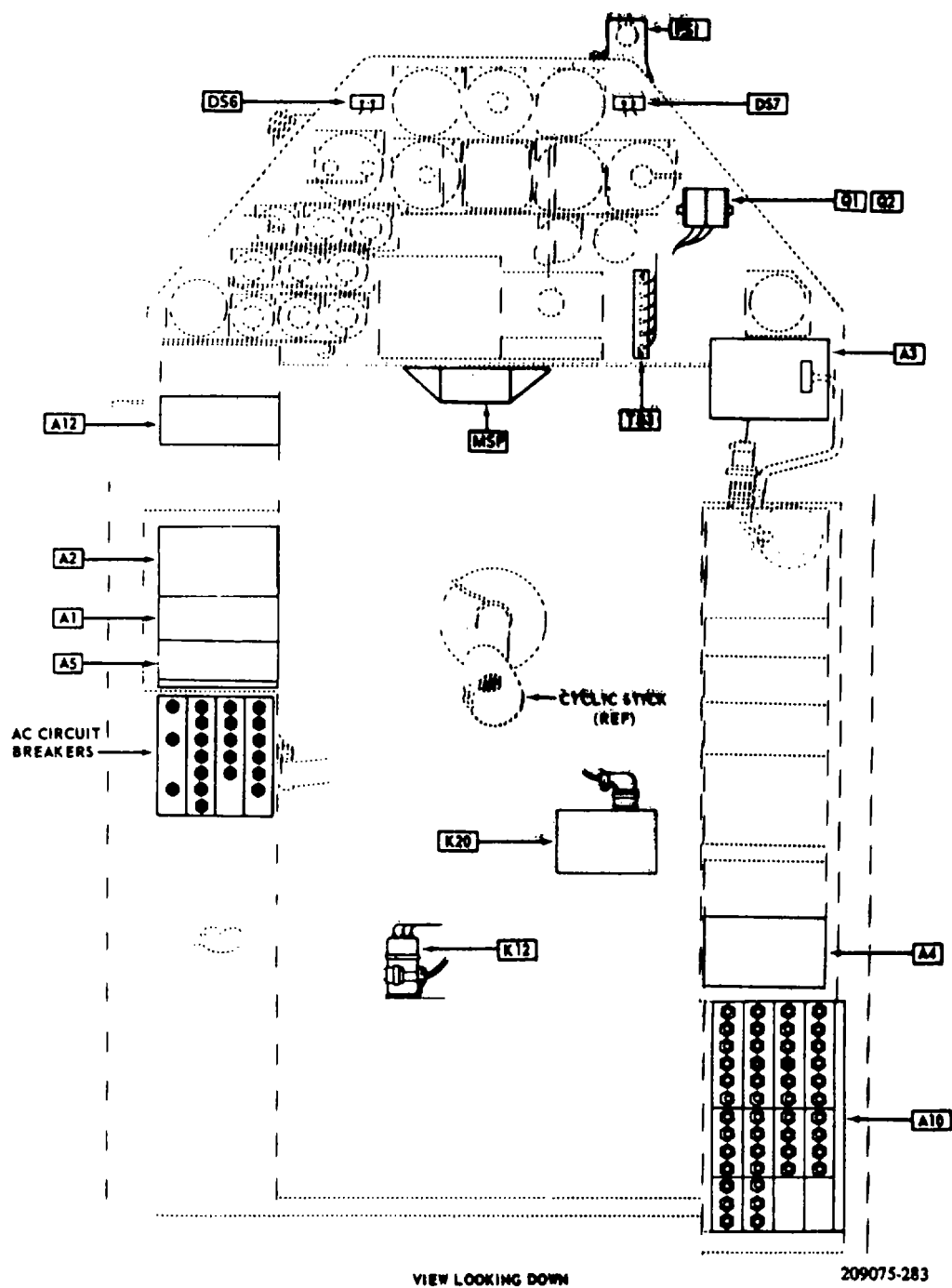
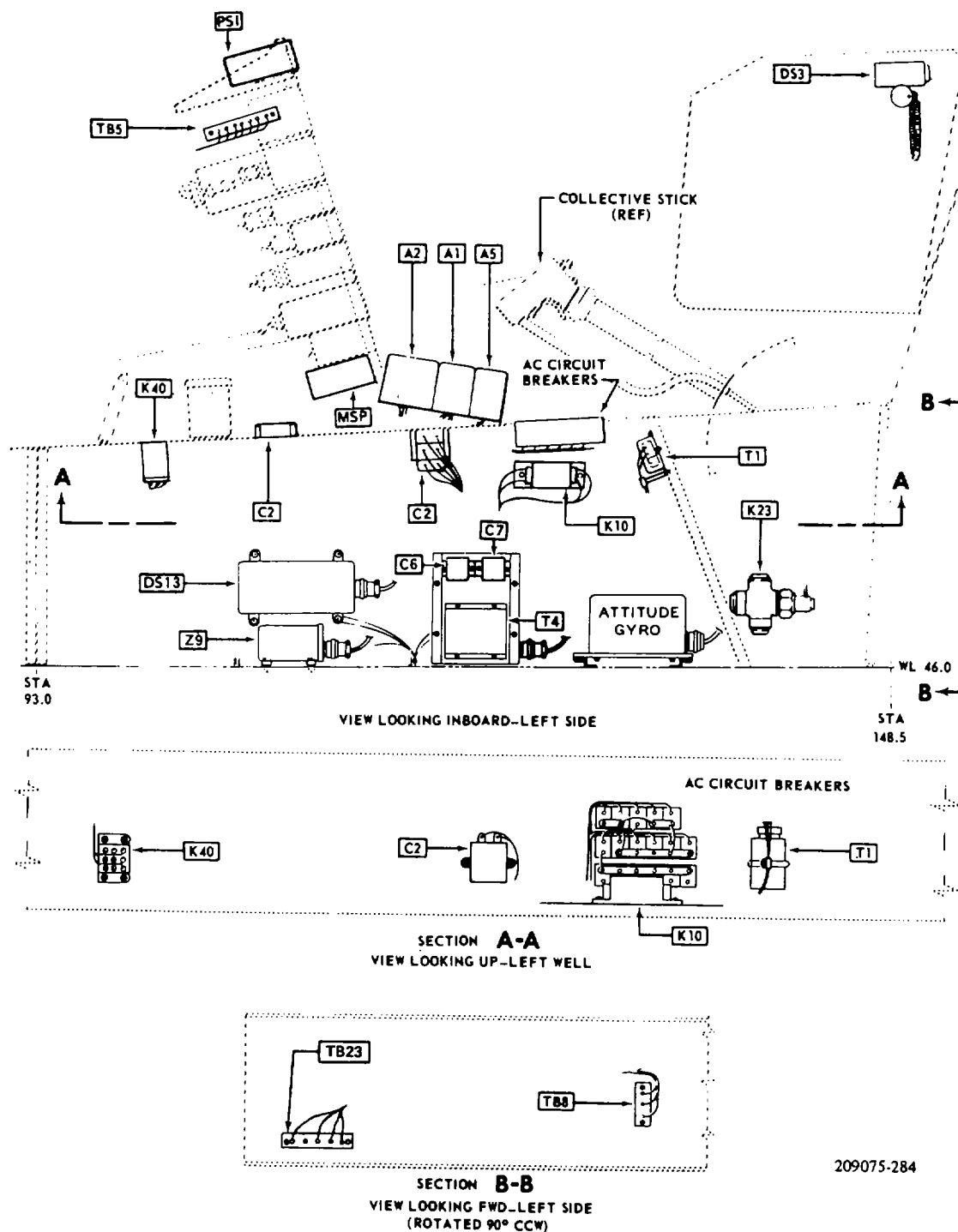
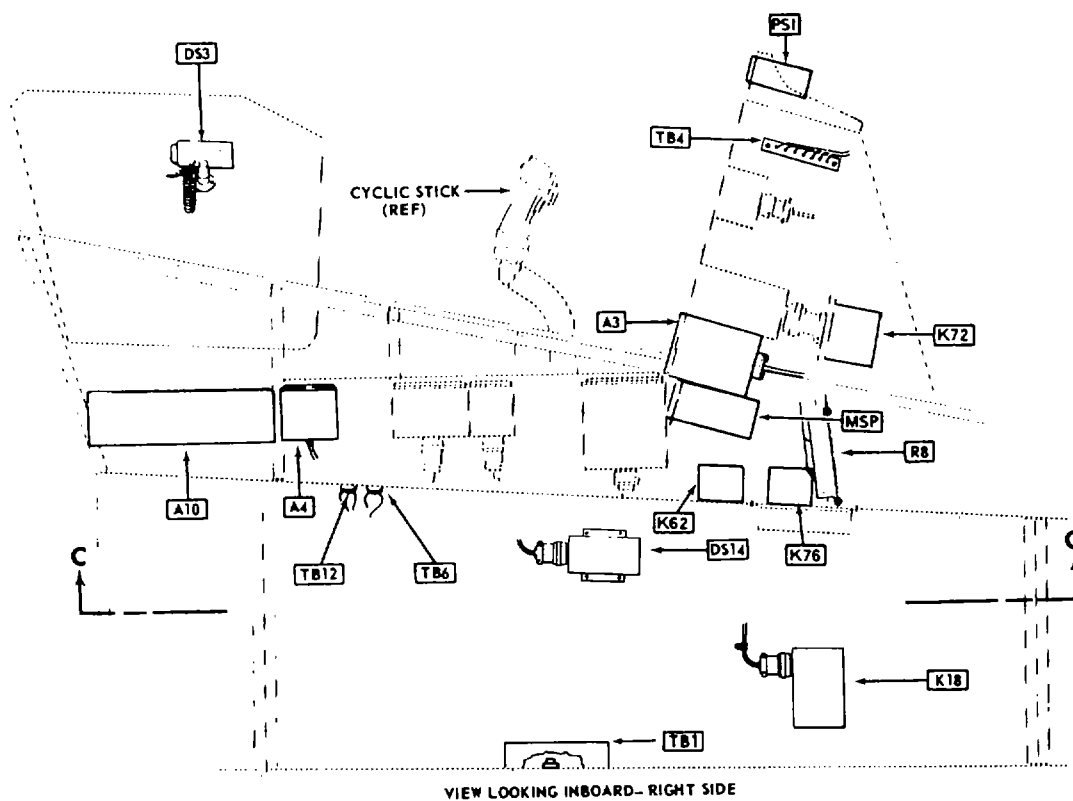
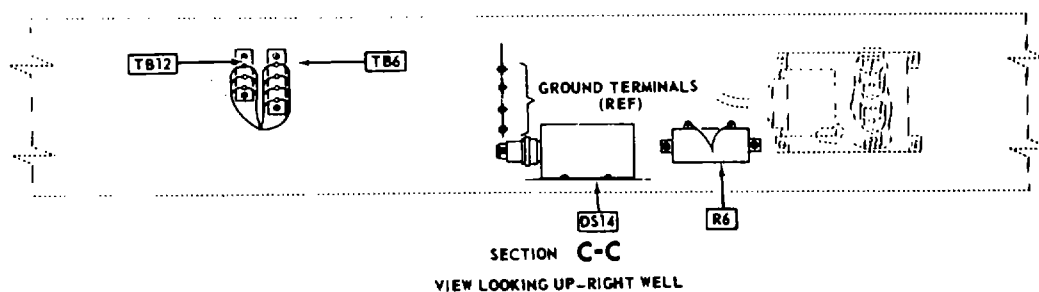


Figure 9-4. Pilots section - equipment location (Sheet 1 of 4)



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Figure 9-4. Pilots section - equipment location (Sheet 2 of 4)



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Figure 9-4. Pilots section - equipment location (Sheet 3 of 4)

(Sheet 1 of 4) View Looking Down

CODE ITEM	DESCRIPTION
A1	Panel, Electrical Power Control
A2	Panel, Engine Control
A3	Panel, Caution - Pilots
A4	Panel, Lights Control
A5	Panel, Miscellaneous Control
A10	Panel, Dc Circuit Breaker
A12	Panel, SAS Control
DS6	Light, Master Caution - Pilots
DS7	Light, Engine Rpm Warning - Pilots
K12	Relay, Heater Control
K20	Magnetic Brake, Lateral Force Trim
MSP	Panel, Missile Status
PSI	Indicator, Pilots Steering
Q1	Transistor, Pilots Instrument Lights Control
Q2	Transistor, Pilots Console Lights
TB3	Terminal Board, Pilots Instrument Panel Lights

(Sheet 2 of 4) View Looking Inboard

CODE ITEM	DESCRIPTION
A1	Panel, Control Assembly - Electrical Power
A2	Panel, Control Assembly - Engine
A5	Panel, Control Assembly - Miscellaneous
C2	Capacitor, Power Factor Correction
C6	Capacitor, Power Factor Correction
C7	Capacitor, Power Factor Correction
DS3	Light, Cockpit - Pilots Left
DS13	Control Assembly, Engine Rpm Warning
K10	Relay, Ac Failure
K23	Solenoid, Rain Removal
K40	Relay, Air Filter
MSP	Panel, Missile Status
PSI	Indicator, Pilots Steering
T1	Transformer, 115V/28Vac
T4	Transformer, Reference
TB5	Terminal Board, Instrument Junction Pilot and Gunner
Z9	Gyro, Rate Switching

(Sheet 2 of 4) Section A-A

CODE ITEM	DESCRIPTION
C2	Capacitors, Power Factor Correction
K10	Relay, Ac Failure
K40	Relay, Air Filter
T1	Transformer, 115V/28Vac

(Sheet 2 of 4) Section B-B

CODE ITEM	DESCRIPTION
TB8	Terminal Board, Fwd & Aft Fuel Cell Junction
TB23	Terminal Board, Pilots Headset

(Sheet 3 of 4) View Looking Inboard

CODE ITEM	DESCRIPTION
A3	Panel, Caution - Pilots
A4	Panel, Control Assembly - Lighting
A10	Panel, Assembly Dc Circuit Breaker
DS3	Light, Cockpit - Pilots Right
DS14	Flasher Unit, Navigation Lights
K18	Magnetic Brake, Anti-Torque Force Trim
K72	Relay, 40mm Trigger Enable
MSP	Panel, Missile Status
PSI	Indicator, Pilots Steering
R8	Resistor, ID-998 Lighting
TB1	Terminal Board, Dc Feeder
TB4	Terminal Board, Pilots Instrument Grounds
TB6	Terminal Board, Pilots Console Lighting Bus
TB12	Terminal Board, Navigation Lights Dimming Bus

(Sheet 3 of 4) Section C-C

CODE ITEM	DESCRIPTION
DS14	Flasher Unit, Navigation Lights
R8	Resistor, Navigation Lights Dimming
TB6	Terminal Board, Pilots Console Lighting Bus
TB12	Terminal Board, Navigation Lights Dimming Bus

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Figure 9-4. Pilots section-equipment location (Sheet 4 of 4)

(3) Before performing Operational Procedures on an electrical system, visually inspect or check that the installation is free of DEFECTS or DAMAGE. If any of the following conditions exist on the affected components or equipment, make necessary repairs (using standard practice) or replace.

(4) The term DEFECT primarily includes the following conditions:

- (a) Connectors with corroded or bent pins.
- (b) Connectors with broken safety wire.
- (c) Frayed or broken insulation on conductors or interconnecting cabling.
- (d) Faulty circuit breakers (will not remain closed when pressed) serving normal loads.
- (e) Switches (rotary, sliding, tumbler, push-pull types) with loose mounting, weak position detents, and intermittent circuit connection.
- (f) Panels with poor legibility of switch and selector setting markings and lighting.
- (g) Loose knobs on control panels.
- (h) Burned panel lights.
- (i) Faulty (cracked, corroded, intermittent) or loose connectors and mounting.
- (j) Burned, discolored, corroded, cracked, and broken components (diodes, resistors, capacitors, inductors, transistors, relays, etc).
- (k) Relays (dented, cracked, or corroded connectors) loose in receptacle or mounting, intermittent when lightly tapped with hand or small insulated object.

(1) Loose terminal boards and faulty mounted components (components that are cracked, dented, chipped, discolored from overload or open circuit including resistor, diodes, and condensers).

(5) The term DAMAGE primarily includes the following conditions:

- (a) Broken connectors, terminal boards, and conductors.

- (b) Corroded, dented, cracked, or broken equipment and/or mountings.

b. Voltage Measurements.

NOTE

Make certain that the multimeter (AN/PSM-6A, or equivalent) is in normal operating condition. Select applicable voltage range for the most accurate reading to match the value given on the respective electrical system wiring diagrams.

(1) Perform voltage measurements (ac and dc) where applicable if equipment and airframe component(s) of the respective system malfunctions while conducting the operational procedures.

(2) Check voltage of respective systems at test points and terminal boards on the airframe as per system wiring diagrams.

(3) Check the primary voltage input on load side of respective circuit breaker as per system wiring diagram.

c. Continuity Trace. Conduct resistance measurement (continuity trace) using resistance selection on multimeter (AN/PSM-6A, or equivalent) with primary electrical power removed from the helicopter. Conduct continuity trace for localization of INVISIBLE defects of connectors, conductors, terminal boards, diodes, resistors, condensers, transistors, relays, inductors, switches, selectors, and equipments. For a logical approach to a rapid analysis of faulty airframe conductors and components within an electrical system, that cannot be determined by visual inspection, follow the suggested sequential steps below:

NOTE

If respective system does not perform normally during operational test procedures, remove dc power from helicopter and conduct continuity trace to suspected components and/or equipment within the circuitry.

Under certain conditions of component and/or equipment malfunction it may be necessary to make voltage measurements and/or continuity trace combinations to "pin point" the trouble.

(1) Analyze the respective system wiring diagram for airframe interunit conductor paths (single, paralleled, and series); consider resistors, diodes and relay holding coils, etc, which may alter the sum total resistance of conductor paths.

NOTE

On multimeter, check that meter movement is free and that ohms selection and ranges will zero with ohms adjust knob.

When performing resistance measurements, select the range to give the most accurate reading of the path (conductor, resistor, diode, relay holding coil, transistor, and condenser) selected from the electrical system wiring diagram.

(2) Check continuity and resistance of individual conductors within the respective interconnecting cabling.

(3) Check continuity and resistance of individual conductors for abnormal conductivity with adjacent conductors, shielding and common ground.

(4) Check resistors for normal value.

(5) Check diodes for front-to-back ratio.

(6) Check condensers for retention factor (deflection and rate of return of multimeter pointer).

d. General Repair Techniques.

(1) Repair of the electrical configuration, with certain exceptions, consists of removal of defective components and replacement of these components with known serviceable components from maintenance stocks. When removal and replacement of an electrical component or other repair procedures require performing repairs on the airframe, aircraft engine controls, or other items that directly affect the flight of the helicopter, the repair effort must be performed by or coordinated with the aircraft crew chief.

(2) When a troubleshooting procedure indicates that a component is defective, follow the applicable removal procedures in this section.

Replace the removed component with a known serviceable equivalent component. After the component has been replaced, install safety wiring, as required, on the mounting hardware and electrical connectors.

CAUTION

Ensure that the battery is disconnected before attempting any removal or replacement procedures.

e. Operational Checks - Electrical. Utilize system wiring diagrams in accomplishing functional tests of electrical circuits and components. Conduct tests after installation, repair, or replacement of equipment.

9-3. Common Electrical Components.

Common electrical components consist of miscellaneous electrical components, circuit breakers, and control panels.

9-4. Miscellaneous Electrical Components.

Miscellaneous electrical components included in this category are capacitors, conduits, connectors, diodes, leads, panel lights, plugs, receptacles, relays, rheostats, shock mounts, shunts, switches, and wiring.

a. Cleaning (General).

(1) Remove moisture, dust, and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

(2) Remove grease, fungus, and ground-in dirt from the equipment cases and mountings; use a cloth dampened (not wet) with dry cleaning solvent (C124).

b. Inspection - Miscellaneous Electrical Components.

(1) Inspect rheostats for security, corrosion, burned element, damaged wiper, cracks, and correct resistance.

(2) Inspect switches for weak detents, security, corrosion, faulty operation, and continuity in ON and infinity in OFF position.

(3) Inspect plugs, connectors and receptacles for security, contact corrosion, damaged contacts, broken wires, faulty contacts, insert cracks, and faulty insulation.

(4) Inspect leads and wiring for loose terminals, chafing, corrosion or deteriorated condition, faulty or damaged insulation, excessive mechanical stress, broken strands, damaged shielding, shorted shielding, routing and mounting conditions.

(5) Inspect conduits for security, surface damage, cracks, dents, corrosion, and deterioration.

(6) Inspect shunts and bus bars for corrosion, security, deep scratches, physical damage, deformity, and discoloration (indicating excessive overloading).

(7) Inspect shockmounts for binding, compression, retention, security, cracks, distortion, and corroded bonding.

(8) Inspect relays for loose connections, damaged or broken contact pins or terminals, damage to case or insulation between contact pins, and evidence of corrosion, pits, or discoloration (indicating arcing due to loose connections, internal shorting, or excessive overload).

(9) Inspect terminal boards for cracks, corrosion, security, and damaged threads.

(10) Inspect panel lights for faulty bulbs, security, and corrosion.

(11) Visually check capacitors for loose connections, security of mounting, seeping dielectric, and apparent damage.

(12) Visually check diodes for loose connection and broken leads. Check suspected faulty diode front to back conductivity ratio with standard ohmmeter.

(13) Visually check transistor mount for security. Check suspected faulty transistor by voltmeter.

CAUTION

Before removing or adjusting any electrical component, disconnect battery.

(1) Remove attaching hardware, clamps, connectors or conductors; identify connectors and/or conductors.

(2) Remove component.

d. Repair or Replacement.

(1) Tighten loose terminal connectors, mounting and attachments of electrical components.

(2) Replace miscellaneous electrical components that fail to meet inspection requirements.

(3) Remove corrosion from electrical connectors with cleaner (C143).

e. Installation (General).

(1) Install component and secure with attaching hardware or clamps.

(2) Attach identified terminals and/or connectors.

9-5. Circuit Breakers.

The circuit breakers are mounted in the ac and dc circuit breaker panels in the pilots side console. Circuits can be opened and closed by operating these trip-free, push-pull circuit breakers. (Some armament circuit breakers may be toggle circuit breakers.)

a. Cleaning (General). Refer to paragraph 9-4a.

b. Inspection. Inspect circuit breakers for reset retention, actuation for circuit power _{ON} and power OFF, faulty operation, corrosion and security.

c. Removal.

(1) Be sure all electrical power is OFF. Disconnect battery.

(2) Disconnect wiring to appropriate breaker and cover wire ends with electrical tape.

(3) Remove mounting hardware and lift breaker from panel assembly.

c. Removal (General).

d. Repair and Replacement.

(1) Repair is limited to tightening or properly installing any loose or improperly installed mounting hardware and connectors.

(2) Replace circuit breaker if any other inspection requirements are not met.

e. Installation.

(1) Position breaker in panel assembly and install mounting hardware.

(2) Remove cover from wire ends and connect to breaker.

9-6. Control Panels.

The control panels are mounted in the consoles at the pilots and gunners stations.

a. Cleaning (General). Refer to paragraph 9-4a.

b. Inspection. Visually inspect for scratches, chipped edges, faulty edge light panels and bulbs, broken edge light panels, damaged or faulty switches, loose or damaged wiring and connectors, and broken or missing mounting fasteners.

c. Removal.

NOTE

The removal procedures for all electrical control panels are relatively the same. A single removal procedure may be used for any electrical control panel.

(1) Be sure all electrical power is **OFF**.

(2) Disengage fasteners holding panel mounting.

(3) Carefully lift panel from mount.

(4) Disconnect electrical connector(s).

d. Repair or Replacement.

(1) Repair any scratches or chipped **edge light** panels.

(2) Replace any burned out or defective **bulbs** on edge light panels.

NOTE

Failure of integrally lit panels to illuminate will require replacement of control panel.

(3) Replace control panel if any other inspection requirements are not met.

e. Installation.

(1) Connect electrical connector(s).

(2) Position panel in mount, being careful not to damage wiring. Engage fasteners.

(3) Apply power and check components for proper operation.

Section II. DIRECT CURRENT POWER DISTRIBUTION SYSTEM

9-7. Direct Current Power Distribution System.

The direct current power distribution system provides all basic power for operation of electrical components installed in the helicopter and consist of the battery, external power, and generator and dc bus systems.

9-8. Battery System.

a. Description. The battery system is comprised of the battery (BT1), bus power relay (K44), feeder power relay (K50), BAT switch (S1), feeder power relay terminal board (TB31), and utilizes the ELEC PWR position of the gunners ELEC PWR-EMER OFF selector switch (S21). The battery weapons power system is comprised of WPNS FIRE circuit breaker (CB1>, XM-28 clearing time delay relay (K45), and TURRET OVLD circuit breakers (CB68 and CB69). The battery system is associated with the non-essential bus relay (K4), NON-ESS BUS switch (S4), pilots voltmeter (M26), and DC VOLT METER circuit breaker. The battery also furnishes power to the XMSN OIL LEVEL LT and WING STORES JETTISON circuit breakers.

b. Function. The battery circuit is actuated by placing the pilots BAT switch to the ON position and the gunners ELEC PWR-EMER OFF selector switch to the ELEC PWR position (the ELEC PWR-EMER OFF selector switch is normally locked in the ELEC PWR position). Bus power relay (K44) is energized through the contacts of XM-28 clearing time delay relay (K45), and battery power is transferred through the contacts of bus power relay (K44) to the main and essential dc buses. The non-essential bus relay (K4) is energized when the NON-ESS BUS switch (S4), on the pilots electrical control panel, is set to MANUAL and battery power is applied through the contacts of (K4) to the non-essential bus. The voltmeter (M26) monitors the essential bus battery voltage when DC VOLT METER circuit breaker is closed. This voltage will be approximately 24 Vdc when the battery is reasonably well charged. After the battery has been used for engine starting and the starter-generator becomes operational, the voltmeter will indicate high current (dependent upon state of charge of the battery). As the battery becomes recharged, the voltmeter reading will decrease gradually until the battery becomes completely recharged. When battery is completely

recharged, there will be no perceptible difference (5 amperes or less differential) in voltmeter reading when BAT switch is moved from ON to OFF.

c. Battery Weapons Power System. Due to the high current demand of turret weapons, battery power is used to supply the left and right turret weapons speed controllers, and the battery is isolated from the main dc bus during turret firing. XM-28 clearing time delay relay (K45) is energized when cyclic stick trigger is depressed. This de-energizes (opens) bus power relay (K44), removing the battery from the main dc bus and energizes (closes) feeder power relay (K50), thereby energizing feeder wires which supply power to the turret weapons speed controllers for gun drive power. When the cyclic trigger is released, relay (K45) remains energized for approximately one-half second (to allow for gun clearing), then opens. This action de-energizes (opens) relay (K50) removing power from speed controllers, and energizes relay (K44) reconnecting battery to the main dc bus for recharging.

d. Functional Test. The following tests of the battery circuitry shall be performed using the installed 24 Vdc battery as a power source, or alternatively, an external 24 Vdc power source connected to the battery connector.

(1) Before connecting power to battery circuitry, open all circuit breakers and place all switches to their open positions. Check that an open circuit exists between positive terminals of the battery quick-disconnect and ground.

(2) Check all battery circuitry connections for tightness and correct polarity.

(3) Connect the battery, or external power source, to power cables at the battery quick-disconnect. Close DC VOLT METER circuit breaker. Position ELEC PWR-EMER OFF switch (S21), on gunners miscellaneous control panel, to EMER OFF (switch toggle must be pulled out to actuate switch). Position BAT switch (S1) on pilots electrical control panel, to ON. Check that voltmeter indicates no voltage.

(4) Place gunners ELEC PWR-EMER OFF switch (S2) to ELEC PWR. Check that voltmeter now indicates battery or external power source voltage.

(5) Return BAT switch (S1) to OFF. Check that voltmeter indicates no voltage.

Return BAT switch (S1) to OFF. Disconnect external power source, if used

(6) Place BAT switch (S1) to ON. Check that voltmeter indicates battery or power source voltage.

e. *Troubleshooting.* (See figure F-9 and table 9-1.)

Table 9-1. Troubleshooting - Battery System

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Voltmeter indicates zero volts with DC VM circuit breaker closed, ELEC PWR-- EMER OFF switch on gunners miscellaneous control panel to ELEC PWR position and BAT switch in ON position.

STEP 1. With a multimeter, determine if voltage is present on 28 Vdc essential bus.

If voltage is present on essential bus continue with Step 2. If voltage is not present, continue with Step 4.

STEP 2. Check for bus voltage on voltmeter side of DC VM circuit breaker.

Replace circuit breaker if defective. (Refer to paragraph 9-5.)

STEP 3. Check for bus voltage at pins A and G of volt/loadmeter connector (P6).

Replace volt/loadmeter (M26) if voltage is present. (Refer to paragraph 8-1.)

STEP 4. Ensure that ground potential is present at terminal 2 of BAT switch (S1). Check for ground potential at terminal 3 of BAT switch.

Replace switch if defective. (Refer to paragraph 9-6.)

STEP 5. Ensure that ground potential is present at terminal 2 of ELEC PWR - EMER OFF switch (S21). Check for ground potential at terminal 1.

Replace switch if defective. (Refer to paragraph 9-6.)

STEP 6. Ensure that ground potential is present at terminal X2 and check for actuating voltage at terminal X1 of bus power relay (K44).

Replace battery relay if defective. (Refer to paragraph 9-4.)

Table 9-1. Troubleshooting Battery System

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

2. Voltmeter indicates plus 28 volts dc with ELEC PWR - EMER OFF switch in the EMER OFF position, DC VM circuit breaker closed, and BAT switch in ON position.

STEP 1. Check for continuity between terminals 1 and 2 with ELEC PWR- EMER OFF switch in EMER OFF position.

Replace switch if defective. (Refer to paragraph 9-6.)

3. Battery does not provide power to nonessential bus with ELEC PWR - EMER OFF switch set to ELEC PWR BAT switch set to ON, NON-ESNTL BUS switch (2S2) set to MANUAL position, and GEN BUS RESET circuit breaker closed.

STEP 1. With a multimeter, determine if voltage is present on 28 Vdc essential bus.

If voltage is present on essential bus, continue with Step 2. If voltage is not present on essential bus, accomplish Steps 4 through 7 of condition 1.

STEP 2. Check for bus voltage on switch side of GEN BUS RESET circuit breaker.

Replace circuit breaker if defective. (Refer to paragraph 9-6.)

STEP 3. Check for bus voltage at terminals 1 and 2 of NON-ESNTL BUS switch (S2).

Replace switch if defective. (Refer to paragraph 9-6.)

STEP 4. Ensure that ground potential is present at terminal X2 and check for bus voltage at terminal X1 non-essential bus relay (K4).

Replace non-essential bus relay if actuating voltage is present and relay is not actuated. (Refer to paragraph 9-4.)

9-9. Battery.

The 24-volt, 22-ampere/hour nickel-cadmium type battery is installed in the aft electrical compartment. The battery provides engine starting power, back-up emergency power, and gun drive power during firing of the turret weapons. The battery installation includes vent tubes, eyebolts for attaching tiedown rods, and a battery cable.

a. Cleaning. Clean battery IAW TM 11-6140-203-14-2. Clean battery compartment IAW TM 55-1500-333-24.

b. Inspection. Inspect battery IAW TM 11-6140-203-14-2.

c. Condition. A fully charged battery can be determined only by moving the battery switch from ON to OFF and observing the effect on the generator loadmeter. If the change in indications is less than 5 amperes, the battery is fully charged. No other maintenance, servicing, or inspection of the battery is authorized at organizational maintenance level.

d. Service. (Refer to TM 11-6140-203-14-2.)

e. *Removal.***WARNING**

The electrolyte used in nickel-cadmium batteries contains potassium hydroxide (KOH), which is a caustic chemical agent. Serious and deep burns of body tissue will result if the electrolyte comes in contact with the eyes or any part of the body.

Use rubber gloves, rubber apron, and protective eye covering when handling the battery. If accidental contact with the electrolyte is made, use ONI,Y clean water and immediately (seconds count) flush contaminated areas. Continue flushing with large quantities of clean water. Seek medical attention immediately.

Before removing or installing the battery, insure that the battery switch is off and the battery has cooled down if overheated. Removal or installation of the battery connector while the battery is under load may result in explosion, electrical arcing and possible severe burns to personnel.

CAUTION

Take every possible step to keep the nickel-cadmium battery as far away as possible from the lead-acid type of battery.

Do not use the same tools and materials (screwdrivers, wrenches, gloves, apron, etc.) for both types of batteries.

Anything associated with the lead-acid battery, even the air, must never come in contact with the nickel-cadmium battery or its electrolyte. Even a trace of sulphric acid fumes from a lead-acid battery may result in damage to the nickel-cadmium battery. If sulphric acid has been inadvertently mixed with the electrolyte in the battery, the upper areas of the cells will appear greenish in color. In such cases, the battery must be replaced.

(1) Check that BAT switch is OFF, and external power is not applied. Open compartment door.

(2) Disconnect battery cable connector by turning knob counterclockwise.

(3) Disconnect two vent tubes from battery case.

(4) Open tie-down clamps and disengage rods from battery cover. Lift battery from compartment.

(5) Close compartment door.

f. Repair or Replacement. (Refer to TM 11-6140-203-14-2.)

g. Installation.

(1) Open compartment door.

(2) Place battery on shelf, aligned for connections. Engage tie-down rods to strap on cover. Secure and lockwire.

(3) Connect two vent tubes to battery case and tighten clamps finger Light. Check vent lines for | obstruction

(4) Insert cable connector in battery receptacle and secure by turning knob clockwise.

(5) Check that battery voltmeter circuit breaker near battery is closed and that voltmeter/ammeter will show indication when BAT switch is ON. Return switch to OFF after test. Close compartment door.

9-10. Bus Power Relay.

The bus power relay is located in the aft compartment and serves to control battery power as described in paragraph 9-8a through c. (Refer to paragraph 9-4 for maintenance procedures.)

9-11. Feeder Power Relay.

The feeder power relay is located in the aft compartment and serves to control battery power as described in paragraphs 9-8a through c. (Refer to paragraph 9-4 for maintenance procedures.)

9-12. M28 Cleaning Time Delay Relay.

The time delay relay is located in pilots section right well and serves to control battery power to turret system as described in paragraphs 9-8a through c. (Refer to paragraph 9-4 for maintenance procedures.)

9-13. External Power System.

During ground operations, external power may be connected to the systems through an external power receptacle (J97), located on the aft left side of fuselage. No special action or switching is necessary to connect external power. If external power connections are of the correct polarity, the external power relay (K1), located in the aft electrical compartment, closes automatically, and connects the ground unit to the main power cables energizing the essential bus, if not, no action occurs. The non-essential bus may be energized by placing NON-ESS BUS switch (S4), located on the pilots electrical control panel, to NORMAL position. This allows current to flow through the bus control relay (K7), located in the aft electrical compartment, to the actuating coil of the non-essential bus relay (K4), also located in the aft electrical compartment. All circuits in the helicopter, with exception of the overvoltage protection circuit, function the same as external power as on helicopter power. Helicopter circuits are not protected against overvoltage when operating on external power.

a. Functional Test.

Before connecting external power for the first time, check for correct polarity and terminations, and accomplish following steps:

NOTE

Unless otherwise specified, the voltmeter circuit breaker is to remain closed throughout all operational checks.

NOTE

Except where otherwise specified, all operational checks shall utilize external power. All circuit breakers shall be opened before external power is connected to the helicopter.

(1) Apply 28 Vdc of reverse polarity between the small pin on the external power receptacle and the frame of the helicopter. Check that the external power relay does not close. Remove 28 Vdc reverse polarity.

(2) Connect a 28 Vdc external power source to the helicopter external power receptacle (J97). Energize power source. Close DC VOLT METER circuit breaker. DC voltmeter should indicate external power on the essential bus.

(3) Place NON-ESS BUS switch (S4) in the NORMAL position. Check for 28 Vdc on terminal (A2) of non-essential bus relay (K4) in aft electrical compartment. Close MAIN INV circuit breaker. Momentarily place INVERTER SELECT switch (S3) to MAIN. Check that main inverter starts to operate. This indicates that non-essential bus is energized.

(4) Close GEN BUS RESET circuit breaker. Momentarily place GEN switch (S2) to RESET. This sets generator-field relay (K6) to proper position for tests described in following paragraph 9-16a. Open GEN BUS RESET circuit breaker. Remove external power from receptacle (J97).

b. Troubleshooting. (See figure F-14 and table 9-2.)

Table 9-2. Troubleshooting - External Power System

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

1. Lack of power when external power plug is inserted into connector (J97).

STEP 1. Ensure that connection between external power plug and connector (J97) is tight. Check for reversed polarity in external power plug connections at external power source.

Reconnect power cable at external power source attachment points if reversed.

Table 9-2. Troubleshooting - External Power System (Cont)

CONDION**TEST OR INSPECTION****CORRECTIVE ACTION**

STEP 2. Check external power source for correct output voltage.

Adjust external power source for correct output voltage.

STEP 3. Ensure that ground potential is present at terminal X2 and actuating voltage is present at terminal X1 of external power relay (K1). Check that relay (K1) is actuated.

Replace external power relay if defective. (Refer to paragraph 9-4.)

2. Voltmeter indicates zero voltage, EXT PWR caution light is not illuminated with DC VM circuit breaker closed; caution lights circuit breaker closed; and external power applied to helicopter.

STEP 1. Ensure that ground potential is present at terminal X2 and actuating voltage is present at terminal X1 of external power relay (K1). Check that relay is actuated.

Replace external power relay if defective. (Refer to paragraph 9-4.)

STEP 2. Determine if diode (CR1) across terminals 1 and 2 of terminal board (TB 18) is defective.

Replace diode if defective. (Refer to paragraph 9-4.)

3. Voltmeter indicates zero voltage, EXT PWR caution light is illuminated; DC VM circuit breaker closed; caution lights circuit breaker closed; and external power is applied to helicopter.

STEP 1. Check for essential bus voltage at pins R and N of connector (JS8).

Replace volt-loadmeter (M26) if defective. (Refer to paragraph 8-1.)

STEP 2. Check for essential bus voltage on volt-loadmeter side of DC VM circuit breaker.

Replace circuit breaker if defective. (Refer to paragraph 9-5.)

4. External power relay is energized with reverse polarity voltage applied to external power receptacle.

STEP 1. Determine if diode (CR1) across terminals 1 and 2 of terminal board (TB18) is defective or installed incorrectly.

Replace diode (CR1) if defective. Reverse diode (CR1) if installed incorrectly. (Refer to paragraph 9-4.)

9-14. External Power Receptacle.**NOTE**

The external power receptacle (J97) provides connection of an external power source to the helicopter. The receptacle is covered by an access door.

External power is not required for starting the helicopter.

a. *Cleaning.* (Refer to paragraph 9-4a.)

b. Inspection. (Refer to paragraph 9-4b.)

c. Removal.

(1) Be sure all electrical power is OFF.

(2) Remove nuts and washers from terminal posts of receptacle, identify and remove wires to receptacle from bracket. Cover wire ends with electrical tape.

(3) Remove mounting screws and lift receptacle from bracket.

d. Repair or Replacement. (Refer to paragraph 9-4d.)

e. Installation.

(1) Position receptacle on bracket and install mounting screws.

(2) Remove protective cover from electrical wires, and connect wires to respective receptacle terminals.

9-15. External Power Relay.

The external power relay (K1) connects an external source of power through the external power receptacle to the electrical system of the helicopter. A diode (CR1), mounted on (TB18), is located near the relay, and serves to complete ground return for the holding coil and prevents reverse polarity to the helicopter electrical system. (Refer to paragraph 9-4 for maintenance procedures.)

9-16. Generator and Dc Bus System.

The dc bus system supplies regulated power for all dc electrical components of the helicopter. This system is fed by external power, battery (BT1), or the self-excited starter-generator (G1) which normally switches onto the main power cables after the engine start procedure when the generated voltage exceeds the voltage on the bus by 0.30 TO 0.42 volt. The application and regulation of power to the bus system is controlled by the generator shunt (R1), reverse current relay (K5), non-essential bus relay (K4), generator field relay (K6), voltage regulator (VR1), and the bus control relay (K7), all of which are located in the aft compartment.

a. Functional Test. Disconnect wires P26A1 and P26C4 from positive terminal B, and disconnect wires K5A1 and K5C4 from negative terminal E on the starter-generator. Observing proper polarity, connect these wires to an adjustable dc power source (26 TO 33 volts). Set voltage to 28 volts and accomplish the following steps:

(1) Energize the power source. Check that there is no voltage on the main bus in the electrical compartment, or on terminal (A1) of starter relay (K2).

(2) Close GEN FIELD, GEN BUS RESET, DC VOLT METER, and CAUTION LT circuit breakers. Place BAT switch (S1) to the ON position. Check that DC GENERATOR caution lights on pilots and gunners caution panels are illuminated.

(3) Return BAT switch (S1) to OFF position.

(4) Place GEN switch (S2) to ON position. Reverse current relay (K5) should close and both essential and non-essential buses should be energized. Check that DC GEN lights on pilots and gunners caution panels are not illuminated.

(5) Close both ammeter circuit breakers. Momentarily turn on a load, such as the main inverter, and check that ammeter on pilots instrument panel reads upscale.

(6) Slowly increase voltage of the power source. At 31 TO 33 volts, over-voltage relay in generator voltage regulator should actuate, causing field relay (K6) to trip and reverse current relay (K5) to open and thus remove voltage from all buses. Do not exceed 33 volts. Reduce voltage to 28 volts. Position BAT switch (S1) to ON. Reset generator system by placing GEN switch (S2) to RESET position and then to OFF. Return BAT switch (S1) to OFF. Position GEN switch (S2) to ON. Field relay (K6) should reset and reverse current relay (K5) should reclose, again energizing both dc buses. Return GEN switch (S2) to OFF. Open all circuit breakers and reconnect wires to their proper terminals.

b. Troubleshooting. (See figure F-19 and table 9-3.)

Table 9-3. Troubleshooting - Generator and DC Bus System

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

1. DC GEN caution lights fail to illuminate with caution lights circuit breaker closed; BAT switch set to ON; voltmeter indicating battery voltage.

STEP 1. Check for defective lights.

Replace lights if defective. (Refer to paragraph 9-48.)

STEP 2. Ensure that ground potential is present at terminal A2 and check for continuity between terminals A2 and A3 of bus control relay (K7).

Replace relay if defective. (Refer to paragraph 9-4.)

2. DC GEN caution lights do not go out and non-essential dc bus is not energized under these conditions: GEN BUS RESET circuit breaker closed; CAUT LT circuit breaker closed; BAT switch set to ON; helicopter engine running; GEN FIELD circuit breaker closed; NON-ESNTL BUS switch set to NORMAL.

STEP 1. Ensure that actuating voltage is present at terminal X1 and ground potential is present at terminal X2 of bus control relay (K7). Determine if relay is actuated.

Replace relay if defective. (Refer to paragraph 9-4.)

STEP 2. Check for dc voltage on SW terminal of reverse current relay (K5). Determine if relay is actuated.

Replace relay if defective. (Refer to paragraph 9-4.)

STEP 3. Determine if generator field relay (K6) is tripped or defective.

Replace relay if defective. (Refer to paragraph 9-4.)

STEP 4. Check for proper operation of GEN switch (S2).

Replace switch if defective. (Refer to paragraph 9-6.)

STEP 5. Determine if ELECT PWR - EMER OFF switch (S21) is defective.

Replace switch if defective. (Refer to paragraph 9-6.)

Table 9-3. Troubleshooting - Generator and DC Bus System (Cont)

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

STEP 6. Determine if generator is defective.

Replace starter-generator (G1) if defective. (Refer to paragraph 9-17.)

3. DC GEN caution lights are not illuminated with essential dc bus energized: NON-ESNTL BUS switch in NORM position; ELECT PWR - EMER OFF switch in ELECT PWR position; GEN BUS RESET circuit breaker closed; GEN FIELD circuit breaker closed; CAUT LT circuit breaker closed and helicopter engine running.

STEP 1. Ensure that actuating voltage is present at terminal X1 and ground potential is present at terminal X2 of bus control relay (K7). Determine if relay is actuated.

Replace relay if defective. (Refer to paragraph 9-4.)

STEP 2. Check for bus voltage on switch side of GEN BUS RESET circuit breaker.

Replace circuit breaker if defective. (Refer to paragraph 9-5.)

STEP 3. Check NON-ESNTL BUS switch for proper operation.

Replace switch if defective. (Refer to paragraph 9-6.)

4. Conditions same as described in condition 3 above, except DC GEN caution light is illuminated and GEN switch (S2) has been positioned to RESET and returned to ON.

STEP 1. Ensure that actuating voltage is present at SW terminal of reverse current relay (K5) and check for defective relay.

Replace relay if defective. (Refer to paragraph 9-4.)

STEP 2. Determine if generator field relay (K6) is tripped.

Replace relay if defective. (Refer to paragraph 9-4.)

STEP 3. Check for defective GEN switch (S2).

Replace switch if defective. (Refer to paragraph 9-6.)

STEP 4. Check for bus voltage on switch side of GEN BUS RESET circuit breaker (CB19).

Replace circuit breaker if defective. (Refer to paragraph 9-6.)

STEP 5. Check for defective ELECT PWR - EMER OFF switch (S21).

Replace switch if defective. (Refer to paragraph 9-6.)

Table 9-3. Troubleshooting - Generator and DC Bus System (Cont)

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

STEP 6. Check for bus voltage on relay side of GEN FIELD circuit breaker (CB20).

Replace circuit breaker if defective. (Refer to paragraph 9-5.)

STEP 7. Determine if generator voltage regulator (VRI) is defective.

Replace generator voltage regulator if defective. (Refer to paragraph 9-19.)

STEP 8. Determine if starter-generator is defective.

Replace starter-generator if defective. (Refer to paragraph 9-17.)

5. Loss of dc voltage on non-essential bus. NON-ESNTL BUS switch (S4) is in NORMAL position.

STEP 1. Determine if starter-generator is defective.

Replace starter-generator if defective. (Refer to paragraph 9-17.)

STEP 2. Ensure that actuating voltage is present on terminal X1 of non-essential bus relay (K4) and determine if relay is defective.

Replace relay if defective. (Refer to paragraph 9-4.)

STEP 3. Determine if NON-ESNTL BUS switch (S4) is defective.

Replace switch if defective. (Refer to paragraph 9-6.)

STEP 4. Ensure that actuating voltage is present on terminal X1 of bus control relay (K7) and determine if relay is defective.

Replace relay if defective. (Refer to paragraph 9-4.)

6. Loss of dc voltage on non-essential bus when NON-ESNTL BUS switch is in MANUAL position and GEN BUS RESET circuit breaker is closed.

STEP 1. Check for defective NON-ESNTL BUS switch (S4).

Replace switch if defective. (Refer to paragraph 9-6.)

STEP 2. Ensure that actuating voltage is present on terminal X1 of non-essential bus relay (K4) and determine if relay is defective.

Replace relay if defective. (Refer to paragraph 9-4.)

STEP 3. Check for bus voltage on switch side of GEN BUS RESET circuit breaker.

Replace circuit breaker if defective. (Refer to paragraph 9-4.)

Table 9-3. Troubleshooting - Generator and DC Bus System (Cont)

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

7. Volt-loadmeter does not indicate proper load with normal loads operating.

STEP 1. Check for defective loadmeter circuit breakers (CB66 and CB67).

Replace circuit breaker if defective. (Refer to paragraph 9-5.)

STEP 2. Determine if volt-loadmeter is defective.

Replace volt-loadmeter if defective. (Refer to paragraph 8-1.)

STEP 3. Check for defective shunt (R1).

Replace shunt if defective. (Refer to paragraph 9-18.)

9-17. Generator.

The engine driven 30 volt, 300 ampere starter-generator supplies the primary 28 volt direct current electrical power on the helicopter.

a. Cleaning.

(1) Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

(2) Remove grease, fungus, and ground-in dirt, with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

(3) Remove dirt from electrical connectors with a bristle brush.

b. Inspection.

(1) Inspect generator case, terminal boards, and brush cover for cracks, excessive wear, or any visible damage.

(2) Check generator for damaged insulation.

(3) Check for proper mounting and condition of mounting flange.

(4) Check drive spline for excessive wear by rocking armature back and forth. If rocking occurs, remove generator. (Refer to paragraph 9-17c.)

(5) Check drive shaft assembly splines for wear by measuring the top land of each tooth. If top land dimension is 0.015 inch or less, replace generator.

c. Removal.

(1) Open engine cowling.

(2) Remove gas producer (N1) tachometer generator. (Refer to paragraph 8-9 d.)

(3) Disconnect two engine oil lines located just below gas producer tachometer generator mounting pad.

(4) Remove screws to detach forward and aft ends of tail rotor driveshaft tunnel from engine firewalls, allowing tunnel to be lowered.

(5) Disconnect electrical leads from starter-generator.

(5.1) Disconnect main fuel inlet line at fuel control.

(6) Remove clamp and detach flexible hose duct from shroud on forward end of starter-generator. Loosen two clamping bolts at left side of inlet shroud, and slide shroud aft for access to starter mounting studs.

(7) Loosen nuts and washers on six mounting studs. Turn starter-generator clockwise and pull straight aft until free of studs and driveshaft engagement. Cover mounting pad.

NOTE

Observe position of terminal block in relation to engine and reinstall starter-generator in same position.

(8) Remove inlet shroud from forward end of starter-generator.

d. Repair or Replacement.

(1) Repair brush cover dents. (Refer to TM 551500-204-25/1.)

(2) Replace defective or worn brushes.

(3) Replace warped or cracked terminal boards.

(4) No other repairs are authorized.

e. Installation.

(1) On a new starter-generator, place inlet shroud on forward end of starter-generator, far enough aft to allow access to mounting flange. Install two bolts, with washers, at shroud clamping joint. Tighten bolts to hold temporary position of shroud with inlet pointing to right.

NOTE

Shaft splines may be aligned by rotating gas producer tachometer generator drive with one-quarter inch drive extension and ratchet.

NOTE

Due to the limited accessibility of the nut and washer at the eleven o'clock position, this nut and washer may be left off.

(2) Remove mounting pad cover. Install new gasket. Coat starter-generator shaft and pack female splines of shaft in gearbox 2/3 full with lubricant (item 97, table 1-3). Lift starter-generator to position on studs, meshing shaft splines. Turn counterclockwise and tighten mounting nuts.

(2.1) Install main fuel inlet line at fuel control.

(3) Slide inlet shroud forward to normal position. Connect flexible duct to inlet, and secure by clamp. Tighten two bolts at shroud clamping joint.

(4) Connect electrical cable leads to starter-generator terminals.

(5) Position forward and aft ends of tail rotor driveshaft tunnel to engine firewalls, and attach with screws.

(6) Reconnect two engine oil lines which were disconnected in step (c) (3) above.

(7) Install gas producer tachometer generator. (Refer to paragraph 89 g.)

(8) Close-engine cowling.

(9) Perform operational and voltage check. Adjust voltage regulator as required (paragraph 9-19c).

9-18. Generator Shut.

The generator shunt (R1) provides a voltage drop, proportional to the current, to operate the ammeter. (Refer to paragraph 9-4 for maintenance procedures.)

9-19. Voltage Regulator.

The voltage regulator (VR1) regulates the voltage of the generator by increasing or decreasing resistance of the shunt field circuit. The voltage regulator is adjustable from **27.0 TO 29.0** Vdc.

a. Cleaning.

(1) Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

(2) Remove grease, fungus, and ground-in dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

(3) Remove dirt from electrical connectors with a bristle brush.

b. Inspection. Visually inspect regulator case for physical damage that could impair normal efficient operation of the unit, (cracked case, damaged contact pins). Check for secure mounting of regulator.

c. Adjustment. Adjust voltage regulator in accordance with TM 55-1500-204-25/1, paragraph 3-281.

d. Removal.

(1) Be sure all electrical power is OFF.

(2) Disengage connector from voltage regulator. Cover connector openings. Remove mounting screws and remove regulator.

e. Repair or Replacement. Other than replacing loose or missing mounting screws, no other repairs are authorized.

f Installation.

(1) Position regulator on mounting bracket and secure with mounting screws.

(2) Remove protective covers from plug and receptacle. Engage connector and secure.

9-20. Generator Field Relay.

The generator field relay (K6) provides control of the generator (G1) by opening and closing the generator shunt field. The relay is tripped by the generator overvoltage applied through the voltage regulator (VR1), and may be reset electrically by generator reset switch (S2), which is located on pilots electrical panel (A1). (Refer to paragraph 9-4 for maintenance procedures.)

9-21. Reverse Current Relay.

The reverse current relay (K5) prevents the generator from being connected to the line until operating voltage is attained, and prevents reverse current flow and holds generator on line unless voltage drops to a point where continued operation would be detrimental to the electrical equipment. (Refer to paragraph 9-4 for maintenance procedures.)

9-22. Bus Control Relay.

The bus control relay (K7) is actuated from the indicator terminal of the generator reverse current relay (K5). It also provides the following functions: energizes the non-essential bus relay (K4), and allows power to be supplied to non-essential bus from either external power or generator. It also completes the circuit to illuminate DC GENERATOR warning light segment on caution panels, (A3 and A8). (Refer to paragraph 9-4 for maintenance procedures.)

9-23. Non-essential Bus Relay.

The non-essential bus relay (K4) is an electrically operated switch between the main bus bar and the non-essential bus. It is controlled by the non-essential bus switch (S4), which opens or closes the circuit to the actuating coil of the relay. (Refer to paragraph 9-4 for maintenance procedures.)

Section III. ALTERNATING CURRENT POWER DISTRIBUTION SYSTEM

9-24. Alternating Current Power Distribution System.

The alternating current power distribution system provides all secondary power (115 volt alternating current) to the essential and non-essential ac buses, which supplies ac power to the instruments, formation lights, avionics systems, and armament subsystems.

9-25. Inverter System.

a. *Description.* The inverter system is a dual system consisting of a 750 VA solid state, static main inverter, and a 250 VA motor driven standby inverter. Both units produce 115 ± 3 Vac with a frequency response of 400 Hz. The inverter system is comprised of the main inverter (PS1), standby inverter (MG1), inverter relay (K73), main inverter overload sensor switch (S126), main inverter control relay (K69), standby inverter overload sensor switch (S88), standby inverter control relay (K52), inverter selector switch (S3), ac failure relay (K10), INST INVERTER segment of pilots caution panel, TOW reference transformer (T4, to include power factor correction capacitors C6 and C7), dc circuit breakers INV MAIN (CB8) and INV STBY (CB39), and one ampere ac circuit breaker REF XFMR (CB77). The inverter system is powered from the main 28 Vdc bus and is protected by two one-ampere dc circuit breakers, INV MAIN (CB8), and INV STBY (CB39). The TOW reference transformer (T4) is powered from the main inverter (C phase) and the 115 Vac bus (A phase), and the primary windings of T4 are protected by a one-ampere ac circuit breaker REF XFMR (CB77). The main inverter, standby inverter, inverter relay, main inverter overload sensor, main inverter control relay, standby inverter overload relay, and standby inverter control relay are all located in the aft electrical compartment. The TOW reference transformer and power factor correction capacitors are located in the pilots section - left well. The inverter switch is located in pilots electrical power panel (AI) and the circuit breakers are located in the applicable circuit breaker panel.

b. *System Function.* The main inverter supplies single-phase power to the ac bus system until TOW is selected, then switches to three-phase power wired delta to feed the TOW missile subsystem and the reference transformer to supply the necessary power for the XM65 TOW missile subsystem and XM128 helmet sight subsystem. The standby

inverter provides normal single-phase power for the 115 Vac bus and is a backup unit for the main inverter. The standby inverter will not power the TOW missile subsystem and the reference transformer. With the inverter switch positioned to MAIN, dc power from the 28 Vdc essential bus is routed through the main inverter control relay and main inverter overload sensor switch to the main inverter. The ac output of the main inverter is routed through the inverter relay and main inverter control relay to the 115 volt feeder bus. In the event that the inverter overload control trips, the standby inverter must be manually energized to supply ac power to the ac equipment. With the inverter switch positioned to STBY, dc power from the main 28 Vdc essential bus is routed through the standby inverter control relay, and standby inverter overload control to the standby inverter. The ac output of the standby inverter is routed through the main inverter control relay to the 115 Vac bus. The autotransformer (T1) reduces 115 Vac to 26 Vac for instrument power. The thermal actuated overload sensors (S126 and S88) provide overload protection for main and standby inverters respectively. The ac failure relay (K10) monitors the 115 Vac feeder bus and causes INST INVERTER caution panel segment to illuminate when the 115 Vac bus is de-energized.

c. *Functional Test.*

(1) Open all circuit breakers and place all switches to their OFF or normal positions. Connect 28 Vdc power source to external power receptacle (J97). Energize power source.

(2) Place NON-ESS BUS switch (S4) to MANUAL. Close MAIN INV, STBY INV, CAUTION LT, GYRO CMPS IND, PWR FACTOR CORR, and all other ac circuit breakers. Check that INST INVERTER caution light illuminates.

(3) Place INV selector switch (S3) located on pilots electrical control panel to MAIN position. Check that main inverter and all ac instruments are energized. Check that INST INVERTER caution light is extinguished.

(4) Connect multimeter (AN/PSM-6A, or equivalent) and frequency meter (JTB Model 33FS, or equivalent) to the 115 Vac bus at engine vibration meter receptacle or other convenient monitoring point. Close all ac circuit breakers. Set essential bus

voltage to 28 ± 0.5 Vdc. Check that under preceding conditions, ac bus voltage is 115 ± 2.5 or -7.5 Vac and that frequency is 400 ± 18 Hz.

(5) Open MAIN INV circuit breaker. Check that main inverter is de-energized, that all ac instruments are de-energized, and that INST INVERTER caution light is illuminated.

(6) Place the INV selector switch to STBY. Check that standby inverter is energized, that all ac instruments are energized, and that INST INVERTER caution light is extinguished.

(7) Connect the multimeter and frequency meter to the 115 Vac bus at engine vibration meter receptacle or other convenient monitoring point. With essential dc bus voltage at 28 ± 0.5 Vdc, check that the ac bus voltage is 113 ± 0.5 Vac, and that frequency is 400 ± 18 Hz.

(8) Open the STBY INV circuit breaker. Check that standby inverter is de-energized, that all ac instruments are de-energized, and that INST INVERTER caution light is illuminated.

(9) Place INV selector switch to OFF and close INV MAIN and INV STBY circuit breakers. Check that INST INVERTER caution light remains illuminated. Check that main and standby inverters and all ac instruments are de-energized.

(10) Close GEN BUS RESET circuit breaker. Place INV selector switch to MAIN. Check that no voltage is present on terminals (A1 and B1) of inverter relay (K73), and that INST INVERTER caution light is extinguished.

(11) Place the MODE SELECT switch on the gunners TOW control panel to GUN position. Check that 115 ± 2.5 or -7.5 Vac at a frequency of 400 ± 8 Hz, is present on terminals (A1 and B1) of the inverter relay (K73) with respect to helicopter structure (grounded). Check that INST INVERTER caution light is extinguished.

(12) Place the MODE SELECT switch to the STBY TOW, ARMED MAN, and then ARMED AUTO position. Check that the ac voltage and frequency are 113.5 ± 0.5 Vac, and 400 ± 18 Hz, respectively, at terminals (A1 and B1) of the inverter relay (K73) for each of these switch positions. Check that INST INVERTER caution light remains extinguished.

(13) Place INV selector switch to STBY position. Check that there is no voltage at terminals (A1 and B1) of the inverter relay (K73), and that INST INVERTER caution light remains extinguished. Place INV selector switch to OFF.

d. Troubleshooting. (See figure F- and table 9-4.)

Table 9-4. Troubleshooting - Inverter System

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Main inverter (PS1) fails to operate.

STEP 1. Ensure that voltage is present on 28 Vdc essential bus and check for bus voltage on switch side of MAIN INVTR circuit breaker.

Replace circuit breaker if defective. (Refer to paragraph 9-5.)

STEP 2. With inverter switch (S3) in MAIN position, check for ground on terminal 3 of switch.

Replace switch if defective. (Refer to paragraph 9-6.)

Table 9-4. Troubleshooting - Inverter System (Cont)

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

STEP 3. Check for bus voltage at terminals SI, S2, LI, and L2 of main inverter overload sensor switch (S126).

Replace main inverter overload sensor switch if defective. (Refer to paragraph 9-4.)

NOTE

If main inverter overload sensor switch is tripped due to overload condition, terminal S1 will be grounded causing INV MAIN circuit breaker (CB8) to strip.

STEP 4. Ensure that actuating voltage is present at terminal X2 and ground potential is present at terminal X1 of main inverter control relay (K69). Determine if relay is actuated.

Replace relay if defective. (Refer to paragraph 9-4.)

STEP 5. Determine if main inverter (PS1) is defective.

Replace inverter if defective. (Refer to paragraph 9-26.)

Table 9-4. Troubleshooting - Inverter System (Cont)

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

2. Standby inverter (MG1) fails to operate.

STEP 1. Ensure that voltage is present on 28 Vdc non-essential bus and check for bus voltage on load side of INV STBY circuit breaker (CB39).

Replace circuit breaker if defective. (Refer to paragraph 9-5.)

STEP 2. Check for bus voltage at terminals S1, S2, L1, and L2 of standby inverter overload sensor switch (S3).

Replace standby inverter overload sensor switch if defective. (Refer to paragraph 9-4.)

NOTE

If standby inverter overload sensor switch is tripped due to overload condition, terminal S1 will be grounded causing INV STBY circuit breaker (CB39) to trip.

STEP 3. Ensure that bus voltage is present at terminal X1 and ground potentials present at terminal X2 of standby inverter control relay (K52). Determine if relay is actuated.

Replace relay if defective. (Refer to paragraph 9-4.)

STEP 4. Determine if standby inverter is defective.

Replace inverter if defective. (Refer to paragraph 9-27.)

3. Inverter (either PSI or MG1) operates, but no ac output to instruments.

STEP 1. With inverter operating, check for 115 Vac output.

Replace inverter if defective. (Refer to paragraph 9-26 or 9-27.)

STEP 2. With main inverter operating, check that ac power control relay (K77) is actuated.

Replace relay if defective. (Refer to paragraph 9-4.)

STEP 3. With standby inverter operating, check that ac power control relay (K77) is de-energized.

Replace relay if defective. (Refer to paragraph 9-4.)

4. Improper inverter output voltage or frequency (either main inverter or standby inverter).

STEP 1. Check for low input voltage to inverter.

Correct the cause of low primary voltage condition.

9-26. Main Inverter.

The main inverter is a 750 VA solid state, single-phase or 3-phase delta-connected with an output of 115 ± 3 Vac, 400 ± 7 Hz, 0.75 lagging to 0.95 leading power factor, 65 percent efficiency. The main inverter supplies single-phase power to the ac bus system until TOW is selected, then switches to three-phase power wired delta to power the TOW missile system and reference transformer which supplies necessary power for the XM65 TOW missile subsystem and XM128 helmet sight subsystem.

a. Cleaning.

(1) Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

(2) Remove grease, fungus, and ground-in dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

(3) Remove dirt from electrical connectors with a bristle brush.

b. Inspection.

(1) Inspect case for cracks or damage.

(2) Inspect electrical connectors for broken pins or cracked connector inserts.

(3) Check for bonding and security of mounting.

(4) Check for faulty operation.

c. Adjustment. No adjustment can be made. (Refer to TM 11-6130-385-34.)

d. Removal.

(1) Ensure all electrical power is OFF.

(2) Disconnect electrical connectors from inverter. Protect receptacles and plugs with caps or electrical tape.

(3) Remove mounting bolts, washers, and nuts. Carefully lift inverter from compartment.

e. Repair or Replacement. Repair connectors, and replace missing mounting bolts. For further repair refer to TM 11-6130-385-34.

f. Installation.

(1) Ensure all electrical power is OFF.

(2) Carefully position and secure inverter in compartment with mounting bolts, washers, and nuts.

(3) Remove caps or electrical tape from plugs and receptacles.

(4) Connect electrical connectors to the inverter.

9-27. Standby Inverter.

The standby inverter is a 250 VA motor-driven, delta connected to single-phase inverter with an output of 115 ± 3 Vac, 400 ± 7 Hz, 0.80 lagging to 0.9 leading power factor. The standby provides norms single-phase power for the 115 Vac bus and is a backup unit for the main inverter.

a. Cleaning.

(1) Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

(2) Remove grease, fungus, and ground-in dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

(3) Remove dirt from electrical connectors with a bristle brush.

b. Inspection.

(1) Inspect case for cracks or damage.

(2) Inspect electrical connectors for broken pins or cracked connector inserts.

(3) Check for bonding and security of mounting.

(4) Check for faulty operation.

c. Adjustment.

(1) Open aft compartment access door to gain access to the inverter.

NOTE

To properly conduct the inverter check, apply a regulated 28 Vdc external power source or ground run the helicopter to assure an adequate source of dc power for inverter operation. Do not use helicopter battery power.

(2) Turn on inverter. Close all ac circuit breakers. Actuate the following ac circuits to produce maximum demand on inverter:

15 Vac Bus

Attitude indicator, pilot

Attitude indicator, gunner

Fuel quantity indicator

26 Vac Bus

ADF receiver indicator

Engine oil pressure indicator

Fuel pressure indicator

Radio magnetic indicator

115 Vac Bus

28 Vac Instrument transformer

Gyro compass

SAS power

26 Vac Bus

Torque pressure indicator

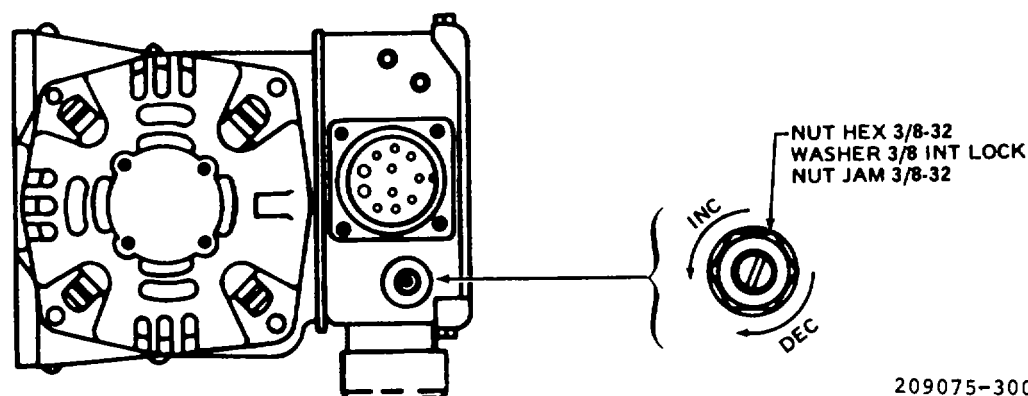
Transmission oil pressure indicator

(3) Using multimeter (AN/PSM-6A, or equivalent) and frequency meter (JTB Model 33FS, or equivalent), check output voltage and frequency at the 115 Vac bus (engine vibration receptacle or other convenient monitoring point).

(4) If the output voltage is 115 ± 2.5 Vac, and the frequency is between 380 and 420 Hz, no adjustment is necessary.

(5) If the output voltage is above or below the limits prescribed in the proceeding step, proceed as follows: Turn off dc power to inverter. Remove cover from end of inverter. (It may be necessary to remove the inverter from mounting.) Loosen hex-head jam nut securing adjustment screw.

(6) Close all ac circuit breakers. Actuate all ac circuits. Turn on inverter power. Connect multimeter and frequency meter at one of the test points described in step (3) and note reading. Turn inverter output adjustment screw counterclockwise to increase or clockwise to decrease inverter output. Nominal setting of 111 volts at full output load should produce an output frequency within limits of 380 to 420 Hz. See figure 9-5 for directional references.



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Figure 9-5. Standby inverter adjustment

d. Removal.

(1) Ensure all electrical power is OFF.

(2) Disconnect electrical connectors from inverter. Protect receptacles and plugs with caps or electrical tape.

(3) Remove mounting bolts, washers, and nuts. Carefully lift inverter from compartment.

e. Repair or Replacement. Repair connectors, replace missing mounting bolts, and replace unit if other inspection requirements are not met.

f. Installation.

(1) Ensure all electrical power is OFF.

(2) Careful position and secure inverter in compartment with mounting bolts, washers, and nuts.

(3) Remove caps or electrical tape from plugs and receptacles.

(4) Connect electrical connectors to the inverter.

9-28. Main Inverter Control Relay.

The main inverter control relay (K69) is used as a double-pole, double-throw remote controlled switch. When energized, 28 Vdc is routed from the essential bus through the main inverter overload sensor (S126) to the main inverter (PS1), also when energized, 115 Vac is routed from the main inverter to the 115 Vac bus. In the de-energized position, the relay permits 115 Vac from the standby inverter (MG1) to be routed to the 115 Vac bus. (Refer to paragraph 9-4 for maintenance procedures.)

9-29. Standby Inverter Control Relay.

The standby inverter control relay (K52) is used as a remote controlled switch. When energized, 28 Vdc is routed from the essential bus through the standby inverter overload sensor (S88) to the standby inverter (MG1). (Refer to paragraph 9-4 for maintenance procedures.)

9-30. Main Inverter Overload Sensor.

The main inverter overload sensor (S126) is used to automatically de-energize the main inverter

control relay (K69) when an overload of current exists between the main inverter (PS1) and the 28 Vdc essential bus. (Refer to paragraph 9-4 for maintenance procedures.)

9-31. Standby Inverter Overload Sensor.

The standby inverter overload sensor (S88) is used to automatically de-energize the standby inverter control relay (K52) when an overload of current exists between the standby inverter (MG1) and the 28 Vdc essential bus. (Refer to paragraph 9-4 for maintenance procedures.)

9-32. Main Inverter Relay.

The main inverter relay (K73) is used as a four-pole, double-throw remote controlled switch. When energized, 115 Vac 3-phase is routed from the main inverter (PS1) through the reference transformer circuit breaker (CB77) and the TOW power circuit breaker (CB76) to TOW reference transformer (T4). When K73 is de-energized, 115 Vac single-phase is routed to T4. (Refer to paragraph 9-4 for maintenance procedures.)

9-33. TOW Reference Transformer.

The TOW reference transformer (T4) furnishes varying voltages (0.5, 5, 10, 26, and 115 Vac) required by the armament subsystems. The 115 Vac input and variable output power is routed through an 18 pin receptacle mounted on T4.

a. Cleaning.

(1) Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

(2) Remove grease, fungus, and ground-in dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

b. Inspection.

(1) Inspect transformer for broken contact pins.

- (2) Inspect transformer case for damage.
- (3) Inspect for damaged insulation between pins.
- (4) Check for discoloration that would indicate internal shorting or excessive overload.
- (5) Check for security of mounting.

c. Removal.

- (1) Be sure all electrical power is OFF.
- (2) Disconnect electrical connector from transformer. Protect receptacle and plug with cap or electrical tape.
- (3) Remove mounting screws and lift transformer from compartment.

d. Repair or Replacement.

- (1) Replace transformer if case is damaged or discolored.
- (2) Replace transformer, if insulation between pins is damaged or broken, or contact pins are broken.
- (3) Repair is limited to tightening or properly installing any loose or improperly installed mounting hardware.

e. Installation.

- (1) Be sure all electrical power is OFF.
- (2) Position transformer in compartment and secure with mounting screws.
- (3) Remove protective cap or electrical tape from electrical connector and connect to transformer.

9-34. Ac Power Control Relay.

The ac power control relay (K77) is used as a double-pole, double-throw remote controlled switch. When energized, 115 Vac is routed from TOW reference transformer (T4) through the energized contacts of K77 to the pilot and gunner attitude indicators, also 115 Vac is routed through K77 from the main inverter (PS1) to the gyro compass indicator and 26 Vac transformer bus. When

de-energized, 115 Vac is routed from the main inverter A phase through K77 de-energized contacts to ac systems. (Refer to paragraph 9-4 for maintenance procedures.)

9-35. Ac Failure Relay.

The ac failure relay (K10) monitors the 115 Vac bus, and when the bus is de-energized, the INST INVERTER caution panel segment will illuminate to warn the pilot that the 115 Vac bus is no longer energized. (Refer to paragraph 9-4 for maintenance procedures.)

9-36. Ac Transformer.

The ac transformer (T1), which is an autotransformer, reduces 115 Vac to 26 Vac for instrument power.

a. Cleaning.

- (1) Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

- (2) Remove grease, fungus, and ground-in dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

b. Inspection.

- (1) Inspect transformer for broken contact pins.
- (2) Inspect transformer case for damage.
- (3) Inspect for damaged insulation between pins.
- (4) Check for discoloration that would indicate internal shorting or excessive overload.
- (5) Check for security of mounting.

c. Removal.

- (1) Be sure all electrical power is OFF.

(2) Disconnect wiring from transformer and cover wire ends. Tag wires for proper identification.

(3) Remove mounting screws and lift transformer from compartment.

d. *Repair or Replacement.*

(1) Replace transformer if case is damaged or discolored.

(2) Replace transformer if insulation between pins is damaged or broken, or contact pins are broken.

(3) Repair is limited to tightening or properly installing any loose or improperly installed mounting hardware.

e. *Installation.*

(1) Be sure all electrical power is OFF.

(2) Position transformer in compartment and secure with mounting screws.

(3) Remove cover from wire ends and connect tagged wires to transformer.

9-37. **Engine Vibration Meter Receptacle.**

The engine vibration meter receptacle, powered from the 115 Vac essential bus, is used as a source of 115 Vac power for the vibration meter during engine vibration tests. It is also used as a convenient point to monitor ac voltage from the 115 Vac essential bus during functional tests or troubleshooting. (Refer to paragraph 9-4 for maintenance procedures.)

Section IV. **STARTING SYSTEM.**

9-38. **Starting System.**

The starting system requires 24 Vdc power to activate the starter portion of the starter-generator during the starting cycle. The 24 Vdc power source may be either from the battery or external power source. The starting system consists of the starter and starter relay (K2).

a. *Functional Test.*

(1) Disconnect wires K4B4 and K4D4 from terminal C of the starter-generator. Close

START RLY circuit breaker. Actuate starter switch (S25) on pilots collective stick and check that starter relay (K2) closes, and that voltage is present at the ends of the disconnected wires.

(2) Open START RLY circuit breaker.

(3) Reconnect wires K4B4 and K4D4 after check.

b. *Troubleshooting.* (See figure F-30 and table 9-5.)

Table 9-6. **Troubleshooting - Starting System**

NOTE	
Before you use this table, be sure you have performed all normal operational checks.	
CONDITION	
TEST OR INSPECTION	
CORRECTIVE ACTION	
1. Starter fails to operate when start switch is depressed.	
STEP 1. Determine if START RLY circuit breaker (CB1) is defective.	
Replace circuit breaker if defective. (Refer to paragraph 9-4.)	

Table 9-5. Troubleshooting - Starting System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

STEP 2. Determine if starter switch (S25) is defective.

Replace starter switch if defective. (Refer to paragraph 9-4.)

STEP 3. With starter switch depressed, ensure that actuating voltage is present on terminal X1 and ground potential is present on terminal X2 of starter relay (K2). Determine if relay actuates.

Replace starter relay if defective. (Refer to paragraph 9-4.)

STEP 4. Determine if starter-generator brushes are excessively worn.

Replace brushes if worn excessively. (Refer to paragraph 9-17.)

STEP 5. Determine if starter-generator armature is burned out.

Replace starter-generator if defective. (Refer to paragraph 9-17.)

2. Starter fails to produce sufficient rpm during start cycle.

STEP 1. Determine if power source is producing sufficient current.

Use fully charged battery or connect an external power source.

STEP 2. Determine if starter-generator armature bearings are excessively worn.

Replace starter-generator if defective. (Refer to paragraph 9-17.)

STEP 3. Determine if malfunction is caused by excessive friction or hang up in engine drive train.

Shutdown and correct mechanical malfunction.

9-39. Starter.

The starter-generator (G1) is located on the underside of the engine. This unit is used to start the engine, charge the battery, and supply power for operation of dc equipment. (Refer to paragraph 9-17 for maintenance procedures.)

9-40. Starter Relay.

The starter-relay (K2) is an electrically operated switch between the main bus bar and the starter-generator. It is energized when the starter switch (S25) on the pilots collective stick is depressed. (Refer to paragraph 9-4 for maintenance procedures.)

Section V. IGNITION SYSTEM

9-41. Ignition System.

The ignition system is energized during the starting cycle and controls fuel flow into the power plant and initiates ignition in the combustion chamber. A key lock ignition switch (S85) is installed on the pilots left hand console (MWO 55-1520-221-30-51). The ignition system consists of the igniter pack (Z1), and the engine primer solenoid valve (K13).

a. Functional Test.

(1) Disconnect starter wires.

(2) Close IGN SYS & IGN SOL circuit breaker. Position FUEL switch (S5) on pilots engine control panel and key lock ignition switch (S85) to ON. Actuate pilots START switch (S25) on pilots collective stick and check that ignition unit and primer solenoid valve both operate.

(3) Position FUEL switch (S5) to OFF. Actuate pilots START switch (S25) and check that neither the ignition nor the solenoid valve operates.

(4) Reconnect starter wires.

b. Troubleshooting. (See figure F-23 and table 9-6).

Table 9-6. Troubleshooting - Ignition System

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

Igniter or primer valve fails to operate when starter switch (S25) is depressed.

STEP 1. Determine that starter switch (S25) contacts are not corroded or burned.

If starter switch (S25) contacts are corroded or burned, replace switch. (Refer to paragraph 9-4.)

STEP 2. Determine that key lock ignition switch (S85) is functional.

If key lock ignition switch is not functioning properly, replace switch. (Refer to paragraph 9-4.)

STEP 3. Determine that fuel switch (S5) is functional.

If fuel switch is not functioning properly, replace switch. (Refer to paragraph 9-4.)

STEP 4. Ensure igniter is functioning properly.

Replace igniter as required. (Refer to TM 66-2840-229-24.)

STEP 5. Determine that primer valve is functioning properly.

If primer valve is not functioning properly, replace valve. (Refer to TM 55-2840-229-24.)

9-42. Igniter Pack.

Ignition to the power plant is provided by the igniter pack (Z1) furnished with and attached to the engine. This unit provides a continuous ignition arc during engine start cycle. (Refer to TM 55-2840-229-23 for maintenance procedures.)

9-43. Engine Primer Solenoid Valve.

The engine primer solenoid valve (K13), located on the engine, also operates during this cycle to direct fuel to the starting fuel nozzle during engine start. (Refer to TM 55-2840-229-23 for maintenance procedures.)

Section VI. LIGHTING PROVISIONS

9-44. Lighting Provisions.

The lighting provisions include cockpit lights, instrument panel and console lights, caution and warning lights systems, position lights, anti-collision light, searchlight, and transmission oil level light systems. When night vision feature is installed, NVG/OFF switch installed on the gunners miscellaneous panel (A7) and pilots lighting control panel (A4) is provided to light the cockpit for night vision goggle (NVG) compatibility (NVG position) or normal lighting conditions (OFF position). The exterior lighting for night vision goggle compatibility, when installed, will include NVG position lights, a skid crosstube mounted landing light, and an IR lens installed on the existing searchlight.

9-45. Cockpit (Map) Lights.

The cockpit (map) lights are multi-purpose utility lights designed to selectively provide illumination utilizing a narrow spotlight beam or a wide floodlight beam, and protected by a five ampere COCKPIT LTS circuit breaker. When the night vi-

sion feature is installed, blue-green or white illumination is provided. If the night vision feature is not installed, red or white illumination is provided. Controls necessary to obtain operation, all modes of ON-OFF, dim-bright, spot-flood, and, blue-green/red or white illumination are incorporated into the light body.

- a. *Cleaning.* (Refer to paragraph 9-4a.)
- b. *Inspection.* Inspect lights for corroded lamp socket terminals, shorted or broken wires, cracked lens, or burned out lamp bulbs.
- c. *Functional Test.*
  - (1) Open all circuit breakers.
  - (2) Close COCKPIT LTS circuit breaker. Check that pilot and gunner utility lights are operational in each mode (ON-OFF, dim-bright, and spot-flood on both blue-green and white).
  - (3) Open COCKPIT LTS circuit breaker.
- d. *Troubleshooting.* (See figure F-24 and table 9-7.)

Table 9-7. Troubleshooting - Cockpit (MAP) Lights

NOTE	
Before you use this table, be sure you have performed all normal operational checks.	
CONDITION	
TEST OR INSPECTION	
CORRECTIVE ACTION	
1. Switch fails to operate lights.	
STEP 1. Determine that lighting switch/rheostat is functioning properly.	
If lighting switch/rheostat is functioning properly, replace light. (Refer to paragraph 9-4.)	
Change 48	9-34A/(9-34B blank)

Table 9-7. Troubleshooting - Cockpit Lights (Cont)

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

2. One light dim or out intermittent

STEP 1. Check that light is properly grounded.

If light is not properly grounded. remove light and clean ground. (Refer to paragraph 9-4.)

STEP 2. Check for corrosion in light socket.

Clean light socket terminals or replace light if required. (Refer to paragraph 9-4.)

e. Removal.

(1) Disengage appropriate circuit breaker.

(2) Remove mounting hardware, lift out light assembly, and disconnect light wire.

f. Repair or Replacement. Light assembly may be repaired by replacing damaged or defective component parts. If light case is damaged beyond repair, complete unit must be replaced.

g. Installation.

(1) Connect light wire and install light assembly with mounting hardware.

(2) Engage appropriate circuit breaker and check light for proper operation.

lighting is accomplished by use of pilots CONSOLE LTS rheostat knob, and the gunners INST LTS rheostat knob.

a. Cleaning. (Refer to paragraph 9-4a.)

b. Inspection. (Refer to paragraph 9-4b.)

c. Functional Test (normal lighting conditions).

(1) Open all circuit breakers.

(2) Close INSTR LTS circuit breaker(s). Rotate pilots INST LTS rheostat slightly in a clockwise direction and note that attached switch (S14) closes. Continue clockwise rotation. Check that all instrument lights on the pilots instrument panel become illuminated and increase in brightness with clockwise rotation of the rheostat.

(3) Rotate CONSOLE LTS rheostat (R5) clockwise. Check that all instrument lights on the pilots engine panel, pilots caution panel, pilots electrical panel, and pilots miscellaneous control panel, and avionics system panels become illuminated and increase in brightness with clockwise rotation of the rheostat.

(4) Rotate gunners INST LTS rheostat slightly in a clockwise direction and note that attached switch (S32) closes. Continue clockwise rotation. Check that VHF panel lights, ICS panel lights, armament console lights, standby compass lights, and all panel lights on gunner instrument panel become illuminated and increase in brightness with clockwise rotation of the rheostat.

(5) Open all circuit breakers.

9-46. Instrument Panel and Console Lights.

The instrument panel and console lights are energized by the 28 Vdc essential bus and protected by five ampere circuit breakers PILOT INST LTS and GUNNER INST LTS. When the pilots NVG/OFF switch is in the OFF position, two rheostats (R4 and R5) mounted on the pilots lighting control panel, control on- dimming-off of pilots instrument lights. When the gunners NVG/OFF switch is in the OFF position, one rheostat (R3) mounted on the gunners miscellaneous control panel, controls on-dimming-off of gunners instrument lights. When the NVG/OFF switch is in the NVG position, only those blue-green lights associated with the night vision feature will be lit. The intensity of NVG

d. Functional Test (night vision feature).

(1) Open all circuit breakers

(2) Close INSTR LTS circuit breakers

(3) Place pilots NVG/OFF switch in NVG position. Rotate CONSOLE LTS rheostat in a clockwise direction. Check that four blue-green floodlights mounted on glareshield, pilots steering indicator blue-green eye brow light, and torque meter (2 each), and missile status panel blue-green post lights are lit and brightness increases with clockwise rotation. Check master caution panel segments and push-to-test lights for installation of blue-green lenses. Check Master Caution, RPM Limit, and Fire warning lights for installation of blue-green covers. Check armament control panel for installation of tape, PPP-T-60, on indicator lights.

(4) Place gunner NVG/OFF switch in NVG position. Rotate INST LTS rheostat in a clockwise direction. Check that blue-green post lights for gunners gas producer, exhaust temperature, airspeed, attitude, altitude, radio magnetic (2

each), torque meter, and engine rotor RPM indicators, standby compass, and armament control (2 each) and miscellaneous panels are lit and brightness increases with clockwise rotation. Check master caution panel segments and armament control panel push-to-test light for installation of blue-green lenses. Check armament control panel for installation of tape, PPP-T-60, on indicator lights.

(5) Return NVG/OFF switch (es) to OFF position. Open all circuit breakers.

e. Troubleshooting. (See figure F-24 and table 9-8 for normal lighting circuitry. For night vision lighting circuitry, see figure 9-5A (pilots) and figure 9-5b (gunners), and table 9-8).

f. Removal. (Refer to paragraph 9-4c.)

g. Repair and Replacement. (Refer to paragraph 9-4d.)

h. Installation. (Refer to paragraph 9-4e.)

Table 9-8. Troubleshooting - Instrument Panel and Console Lights

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Instrument lights switch/rheostat fails to operate lights.

STEP 1. Determine that instrument lighting switch/rheostat is functioning properly.

If lighting switch/rheostat is functioning properly, replace light. (Refer to paragraph 9-6.)

2. One light dim or out intermittent.

STEP 1. Check that light is properly grounded.

If light is not properly grounded, remove light and clean ground. (Refer to paragraph 9-4.)

STEP 2. Check for corrosion in light socket.

Clean light socket terminals or replace light if required. (Refer to paragraph 9-4.)

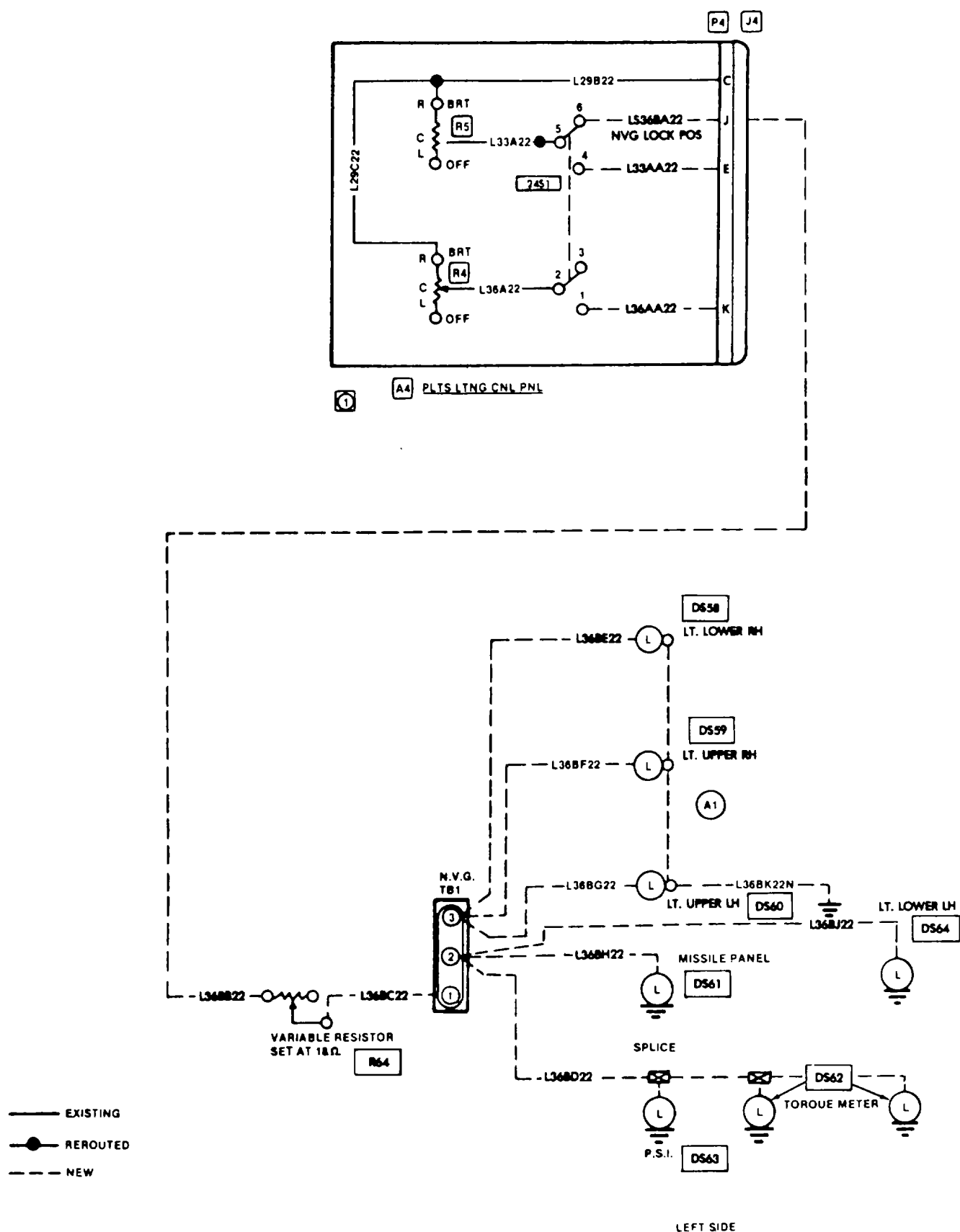


Figure 9-5A. Pilots Night Vision Lighting Circuitry

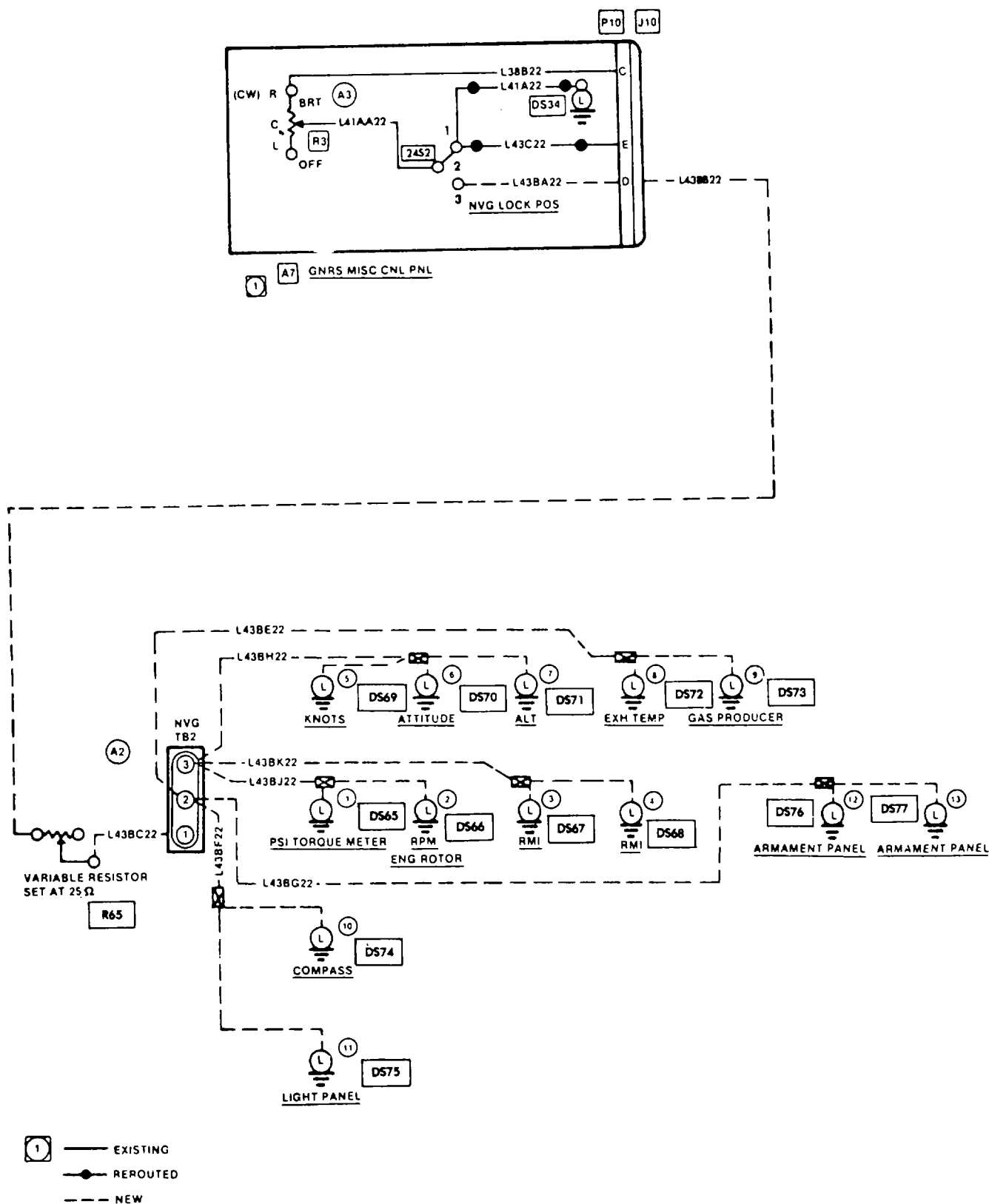


Figure 9-5B. Gunners Night Vision Lighting Circuitry

Change 57 9-36B

9-47. Caution and Warning Lights Systems.

The caution and warning lights systems include the pilots master caution panel, the gunners master caution panel, and the RPM limit (pilot only) warning lights. Those aircraft with the night vision feature installed have blue-green lenses in the caution panels and blue-green, hinged covers on the warning lights. The purpose of these units is to provide a visual warning (RPM provides a visual and an audio warning) in the event of system malfunctions in the helicopter.

9-48. Description - Caution Panel Systems.

The pilots and gunners master caution panels (see figures 9-5C and 9-5D respectively) contain independent lights and internal lamp driver circuits. The lights are arranged in two columns. Each light has its own unique nomenclature filter and two individual lamps. These illuminate when associated sensor/switches, located in the helicopter to monitor various systems, actuate to complete circuits indicating malfunctions. The panels are energized from a 28 Vdc essential bus and protected by a 5 ampere CAUTION LTS circuit breaker located in the pilots dc circuit breaker panel (A10), pilots right side console. The caution panel units are designed for panel mounting, using four turnlock stud fasteners. Electrical connections are made with a single connector at the rear of each unit. A detailed description of each system is provided.

a. *Functional Test* - Pilots and Gunners Master Caution Panels. During the following checks, MASTER CAUTION lights on pilots and gunners instrument panels should illuminate each time a caution panel segment illuminates, and shall be reset each time in readiness for another fault indication. All checks shall apply to both pilots and gunners caution panels as applicable. If either caution panel fails this functional test, remove that unit and replace it with a serviceable unit. The malfunctioning unit must be bench checked.

(1) Close CAUTION LTS and GOV CONT circuit breakers. Check that MASTER CAUTION lights illuminate and that each caution light segment operates as indicated below.

(2) Reset MASTER CAUTION light by placing the RESET/TEST switch to RESET and releasing. Check that MASTER CAUTION lights extinguish

and the caution light segments remain as indicated below.

Pilots Master Caution Panel

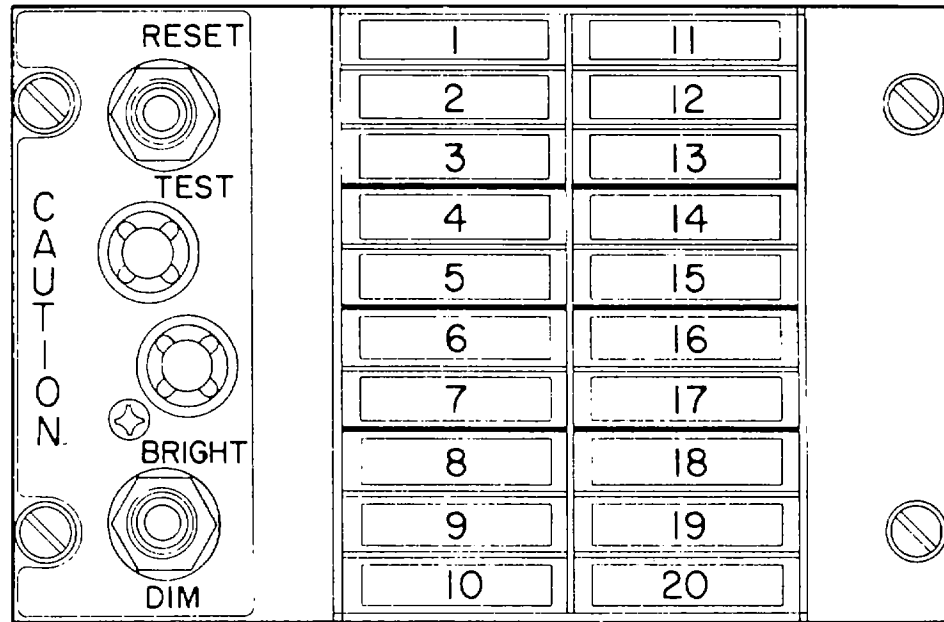
ENGINE OIL PRESS (SPARE)	(ON)
ENGINE OIL BYPASS (SPARE)	(EITHER)
FWD FUEL BOOST	(ON)
AFT FUEL BOOST	(ON)
ENG FUEL PUMP	(ON)
10% FUEL	(EITHER)
FUEL FILTER	(OFF)
GOV EMER	(OFF)
XMSN OIL BYPASS	(ON)
XMSN OIL PRESS	(ON)
XMSN OIL HOT	(OFF)
HYD PRESS #1	(ON)
HYD PRESS #2	(ON)
INST INVERTER	(ON)
DC GENERATOR	(ON)
EXTERNAL POWER	(ON)
CHIP DETECTOR	(OFF)
IFF	(OFF)

Gunnery Master Caution Panel

ENGINE OIL PRESS (SPARE)	(ON)
ENGINE FUEL PUMP (SPARE)	(ON)
FUEL FILTER	(OFF)
10% FUEL	(EITHER)
GOV EMER	(OFF)
DC GENERATOR	(ON)
XMSN OIL PRESS	(ON)
XMSN OIL HOT	(OFF)
CHIP DETECTOR	(OFF)
HYD PRESS #1	(ON)
HYD PRESS #2 (SPARE)	(ON)

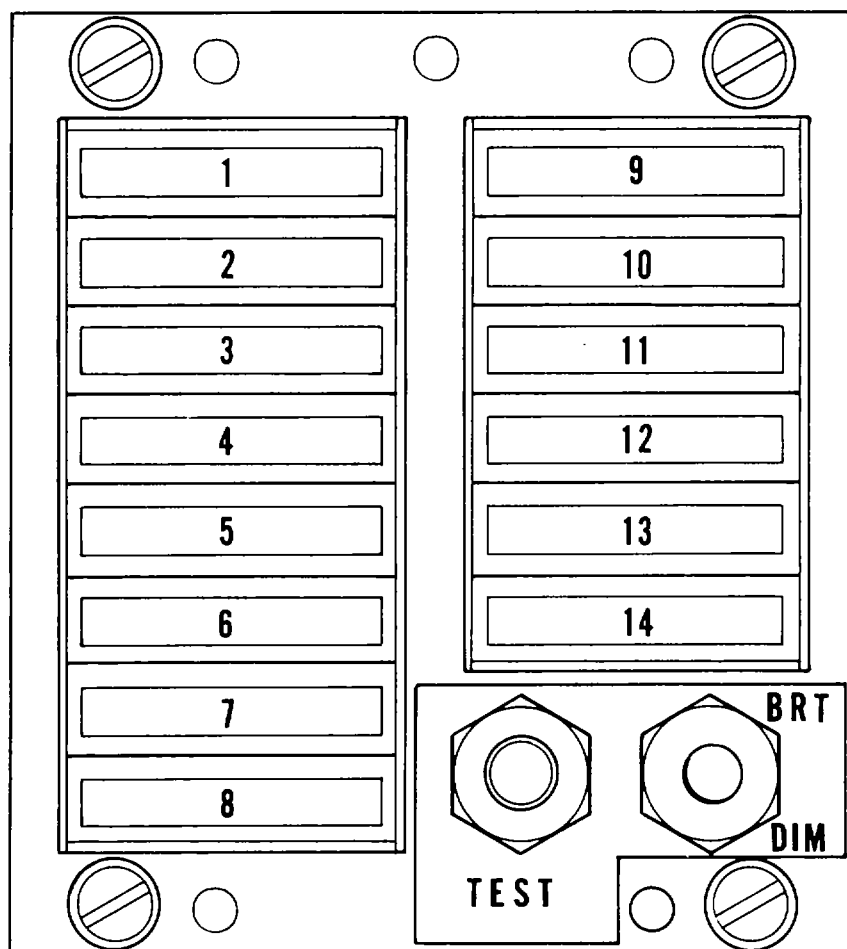
(3) Test caution light by placing the RESET/TEST switch to TEST and releasing. Check that each MASTER CAUTION indicator lights brightly and momentarily and then goes off, and that all caution light segments momentarily illuminate brightly and return to their previous condition.

(4) Push BRIGHT/DIM switch to DIM and release. Check that caution lights do not dim.



POS. NO.	NOMENCLATURE	PIN LETTER	TYPE INPUT	P.C. BOARD PART NO.
1	ENGINE OIL PRESS	A	NEG	81-0821-1
2	SPARE	B	NEG	81-0821-1
3	ENGINE OIL BYPASS	C	NEG	81-0821-1
4	SPARE	P	NEG	81-0821-1
5	FWD. FUEL BOOST	D	NEG	81-0821-1
6	AFT FUEL BOOST	E	NEG	81-0821-1
7	ENG. FUEL PUMP	F	NEG	81-0821-1
8	10% FUEL	H	NEG	81-0821-1
9	FUEL FILTER	J	NEG	81-0821-1
10	GOV. EMER.	R	POS	81-0819-1
11	XMSN OIL BYPASS	K	NEG	81-0821-1
12	XMSN OIL PRESS	L	NEG	81-0821-1
13	XMSN OIL HOT	Y	NEG	81-0821-1
14	HYD PRESS #1	M	NEG	81-0821-1
15	HYD PRESS #2	G	NEG	81-0821-1
16	INST. INVERTER	N	NEG	81-0821-1
17	DC GENERATOR	Z	NEG	81-0821-1
18	EXTERNAL POWER	<u>a</u>	NEG	81-0821-1
19	CHIP DETECTOR	<u>b</u>	NEG	81-0821-1
20	IFF	<u>c</u>	POS	81-0819-1

Figure 9-5C. Pilots master caution panel assembly-front view.



13179A

POS. NO.	NOMENCLATURE	PIN LETTER	TYPE INPUT
1	ENGINE OIL PRESS	A	NEG
2	SPARE	B	NEG
3	ENGINE FUEL PUMP	C	NEG
4	SPARE	P	NEG
5	FUEL FILTER	H	NEG
6	10% FUEL	F	NEG
7	GOV EMER	R	POS
8	DC GENERATOR	Z	NEG
9	XMSN OIL PRESS	L	NEG
10	XMSN OIL HOT	Y	NEG
11	CHIP DETECTOR	<u>b</u>	NEG
12	HYD PRESS #1	M	NEG
13	HYD PRESS #2	G	NEG
14	SPARE	<u>c</u>	NEG

Figure 9-5D. Gunners master caution panel assembly-front view

(5) Rotate pilots INST LTS rheostat clockwise from OFF. Place the DIM/BRIGHT switch to DIM and release. Check that the lights dim and hold.

(6) Rotate INST LTS rheostat counterclockwise to OFF and check that the lights return to bright.

b. Functional Test Pilots and Gunners Master Caution Panel Systems.

During the following checks, the MASTER CAUTION lights should illuminate each time a caution panel segment illuminates, and shall be reset each time in readiness for another fault indication. All checks shall apply to both pilots and gunners caution panels, as applicable. Accomplish these steps in the following sequence:

(1) Engine Oil Pressure Lights.

(a) Connect a pressure gun to engine oil pressure switch and apply pressure. Check that ENGINE OIL PRESS caution lights extinguish with increasing pressure at 27 ± 1 psig.

(b) Relieve pressure on engine oil pressure switch. Check that ENGINE OIL PRESS caution lights illuminate before 25 psig decreasing pressure.

(2) (Spare).

(3) Engine Oil Bypass Light. (Procedure for empty oil tank condition).

(a) Disconnect wire Q34A20 from terminal 2 of terminal board (TB14). Check that ENG OIL BYPASS caution light on pilots caution panel extinguishes.

(b) Reconnect wire Q34A20 on terminal 2 of terminal board (TB14). Check that ENG OIL BYPASS light on pilots caution panel illuminates.

(4) Engine Oil Bypass Light. (Procedures for oil in tank condition).

(a) Temporarily place jumper wire between terminals 1 and 2 on terminal board (TB14). Check that ENGINE OIL BYPASS caution light is illuminated.

(b) Disconnect jumper wire from between terminals 1 and 2 on terminal board (TB14). Check that

ENGINE OIL BYPASS caution light is again extinguished.

(5) Forward Fuel Boost Light.

NOTE

Fuel boost caution lights tests may be performed simultaneously with low fuel level tests.

(a) Disconnect plug (P92) on fuel manifold valve. Check that FWD FUEL BOOST caution light extinguishes.

(b) Reconnect plug. Check that FWD FUEL BOOST caution light is illuminated.

(6) Aft Fuel Boost Light.

(a) Disconnect plug (P92) on fuel manifold valve. Check that AFT FUEL BOOST caution light extinguishes.

(b) Reconnect plug. Check that AFT FUEL BOOST caution light is illuminated.

(7) Engine Fuel Pump Lights.

CAUTION

Do not allow electrical wires to make contact with each other or with helicopter structure (ground).

(a) Disconnect wires Q19B18 and Q19C18 from forward fuel pressure switch (S50) terminal on left side of the engine. Check that both pilots and gunners ENG FUEL PUMP caution lights are extinguished.

(b) Temporarily connect wires Q19B18 and Q19C18 to each other, but do not permit electrical contact with forward fuel pressure switch terminal or ground. Check that both pilots and gunners ENG FUEL PUMP caution lights are illuminated.

(c) Disconnect wires Q19B18 and Q19C18 from each other and do not allow them to make electrical contact with ground. Check that both pilots and gunners ENG FUEL PUMP caution lights are extinguished.

(d) Reconnect wire Q19B18 to forward fuel pressure switch (S50) terminal, but leave wire Q19C18 disconnected. Check that both pilots and gunners ENG FUEL PUMP caution lights are illuminated.

(e) Reconnect wire Q19C18 to forward fuel pressure switch (S50) terminal, thus returning the wiring to its normally installed position. Check that both ENG FUEL PUMP caution lights are illuminated.

(8) *10% Fuel Light.* (Procedure for low fuel level 215 pounds or less).

NOTE

This test and fuel boost caution lights tests may be performed simultaneously if desired.

If there is low fuel in tanks, low level switches (S67) and (S68) will be closed and both pilots and gunners 10% fuel caution lights will illuminate when aircraft is nose down at 7 degrees, gauge indication will read 215-234 pounds (actual fuel 209 pounds).

(a) Disconnect plug (P92) from forward fuel boost pressure switch (S36) and plug (P93) from aft fuel boost pressure switch (S37). Check that both 10% FUEL caution lights remain illuminated.

(b) Disconnect wire W34A22 from terminal 4 of terminal board (TB9). Check that both 10% FUEL caution lights extinguish.

(c) Reconnect plug (P92) to forward fuel boost pressure switch (S36). Check that both 10% FUEL caution lights illuminate.

(d) Disconnect plug (P92) from forward fuel boost pressure switch (S36). Check that both 10% FUEL caution lights are extinguished.

(e) Connect plug (P93) to aft fuel boost pressure switch (S37). Check that both 10% FUEL caution lights are illuminated.

(f) Disconnect plug (P93). Check that both 10% FUEL caution lights are extinguished.

(g) Reconnect wire W34A22 from terminal 4 on terminal board (TB9). Check that both 10% FUEL caution lights are illuminated.

(h) Disconnect wire W36A22 from terminal 3 of terminal board (TB10). Check that both 10% FUEL caution lights are extinguished.

(i) Connect plug (P92) to forward fuel boost pressure switch (S36). Check that both 10% FUEL caution lights are illuminated.

(j) Disconnect plug (P92). Check that both 10% FUEL caution lights are extinguished.

(k) Reconnect wire W36A22 to terminal 3 of terminal board (TB10). Check that both 10% FUEL caution lights are illuminated.

(l) Disconnect wire W37B22 from terminal 4 of terminal board (TB10). Check that both 10% FUEL caution lights are extinguished.

(m) Connect plugs (P92) and (P93). Check that 10% FUEL caution lights do not illuminate.

(n) Reconnect wire W37B22 to terminal 4 of terminal board (TB10). Check that both 10% FUEL caution lights are illuminated.

(o) Visually check that plugs (P92) and (P93) and wires W37B22, W36B22, and W34A22 are properly reinstalled on their proper receptacles and terminals. Check that each connection is tight and secure.

(9) *10% Fuel Light.* (Procedure for fuel in tanks 235 pounds or greater.)

NOTE

If tanks have more than 235 pounds of fuel, when aircraft is nose down at 7 degrees low level switches, (S67 and S68), will be open and both pilots and gunners 10% FUEL caution lights will be extinguished.

(a) Disconnect wire W37B22 from terminal 4 of terminal board (TB10) and temporarily connect the wire to ground. Check that both 10% FUEL caution lights illuminate.

(b) Remove wire W37B22 from ground and reconnect to terminal 4 of terminal board (TB10). Check that 10% FUEL caution lights are extinguished.

(c) Remove wire W34A22 from terminal 4 of terminal board (TB9) and temporarily connect to ground. Check that 10% FUEL caution lights are illuminated.

(d) Remove wire W34A22 from ground and reconnect to terminal 4 of terminal board (TB9). Check that 10% FUEL caution lights are extinguished.

(10) *Fuel Filter Light.*

(a) Disconnect plug (P59) from fuel filter bypass switch (S33). Short pin A to pin B and check that both FUEL FILTER caution lights illuminate.

(b) Remove short from between pins A and B of plug (P59) and check that FUEL FILTER caution lights extinguish. Reconnect plug.

(11) *Governor Emergency Lights.*

(a) Verify that GOV CONT circuit breaker is closed. Position both GOV SW switch (S6) on pilots control panel and GOV SW switch (S17) on gunners miscellaneous panel to AUTO. Check that both GOV EMER caution lights extinguish.

(b) Place GOV SW on pilots control panel to EMER. Check that both GOV EMER caution lights illuminate.

(c) Return GOV SW on pilots control panel to AUTO. Check that both GOV EMER caution lights extinguish.

(d) Place GOV SW on gunners miscellaneous panel to EMER. Check that both GOV EMER caution lights extinguish.

(e) Return GOV SW on gunners miscellaneous panel to AUTO. Check that GOV EMER caution lights extinguish.

(12) *Transmission Oil Bypass Light.*

(a) Disconnect wire D22A20 from transmission oil bypass switch (S56). Check that XMSN OIL BYPASS caution light extinguishes.

(b) Temporarily connect wire D22A20 to ground. Check that XMSN OIL BYPASS caution light illuminates.

(c) Reconnect wire D22A20 to terminal on transmission oil bypass switch (S56). Check that connection is properly mated and secure.

(13) *Transmission Oil Pressure Lights.*

(a) Apply pressure at transmission oil pressure switch (S34) and check that both XMSN OIL PRESS caution lights extinguish at an increasing pressure of 38 psig maximum.

(b) Relieve pressure n transmission oil pressure switch (S34) and check that both XMSN OIL PRESS caution lights illuminate at 30 ± 3 psig decreasing pressure.

(14) *Transmission Oil Hot Lights.*

(a) Connect stud on top of transmission oil temperature switch (S35) (located on transmission) to ground and check that both XMSN OIL HOT caution lights illuminate,

(b) Remove ground from transmission oil temperature switch (S35) and check that both XMSN OIL HOT caution lights extinguish.

(15) *Hydraulic Pressure Lights.*

(a) Apply external hydraulic pressure to hydraulic system No. 1 and check that both pilots and gunners HYI PRESS #1 caution lights extinguish at 800 ± 100 psig increasing pressure.

(b) Relieve pressure applied to hydraulic system No. 1 and check that both HYD PRESS #1 caution lights illuminate at 500 ± 100 psig decreasing pressure.

(c) Apply external hydraulic pressure to hydraulic system No. 2 and check that both pilots and gunners HYD PRESS #2 caution lights extinguish at 800 ± 100 psig increasing pressure.

(d) Relieve pressure applied to hydraulic system No. 2 and check that both HYD PRESS #2 caution lights illuminate at 500 ± 100 psig decreasing pressure.

(16) *Instrument Inverter Light.* The INST INVERTER caution light is checked as a part of the inverter system. Refer to paragraph 9-25c.

(17) *DC Generator Lights.* The DC GENERATOR caution lights are checked as a part of the dc generator system. (Refer to paragraph 9-16a.)

(18) *Chip Detector Lights.*

(a) Depress PRESS/TEST switch (S53) on pilots miscellaneous panel. Check that chip detector lights, XMSN, 90 degrees, 42 degrees, and ENG on pilots miscellaneous panel all illuminate.

(b) Short transmission chip detector (S61) output wire to ground. Check that CHIP DETECTOR caution lights on the pilots and gunners caution panels both illuminate.

(c) Depress CHIP DET light (S16) on pilots miscellaneous panel. Check that XMSN light on pilots miscellaneous panel illuminates and that CHIP DETECTOR indicators on both panels extinguish.

(d) Release CHIP DET light. Check that XMSN light extinguishes and CHIP DETECTOR caution lights on both caution panels illuminate.

(e) Remove short between transmission chip detector (S61) output wire and ground. Check that CHIP DETECTOR caution lights extinguish.

(f) Short 90 degree gearbox chip detector (S62) output wire to ground. Check that CHIP DETECTOR caution lights on both pilots and gunners caution panels illuminate.

(g) Repeat steps (c), (d), and (e), except substitute 90 degrees light for XMSN light.

(h) Short 42 degrees gearbox chip detector (S63) output wire to ground. Check that CHIP DETECTOR caution lights on both pilots and gunners caution panels illuminate.

(i) Repeat steps (c), (d), and (e), except substitute 42 degree light for XMSN light.

(j) Short engine chip detector (S64) output wire to ground. Check that CHIP DETECTOR caution lights on both pilots and gunners caution panels illuminate.

(k) Repeat step (c), (d), and (e), except substitute ENG light for XMSN light.

(19) *Rpm Limit Warning.* In addition to a check of the warning light, this test shall include a check of the audio warning signal. Open all circuit breakers and apply external power.

(a) Close RPM WARN circuit breaker. Check that RPM limit indicator light on the pilots instrument panel illuminates and remains illuminated.

(b) Position RPM WARNING switch (S7) to RPM WARNING. Check for audio warning in both pilots and gunners headsets.

(c) Position RPM WARNING switch (S7) to OFF. Check that audio warning in both pilots and gunners headsets ceases.

(d) Momentarily, open RPM WARN circuit breaker and check that RPM WARNING switch (S7) returns automatically to RPM WARNING position.

(e) Close RPM WARN circuit breaker. Check that audio signal is again audible in both pilots and gunners headsets.

(20) *External Power Light.*

(a) Position BAT switch (S1) to ON. Open external power access door and check that EXTERNAL POWER caution light on pilots caution panel illuminates.

(b) Close external power access door and check that EXTERNAL POWER caution light extinguishes.

c. Troubleshooting. Refer to system diagram (figure F-10) and trace malfunctioning circuit. Localize malfunctioning circuit component(s), and repair or replace as required.

9-49. Pilots Master Caution Panel (BHT P/N 204-075-705-81).

a. *Description.* Refer to figure 9-5E. There are twenty lamp driver circuit boards; one for each light position. Eighteen of the lamp driver boards (P/N 810821-1) are for negative (ground) fault inputs. The two remaining positions, circuit boards (P/N 810819-1) require a positive fault input (+28 Vdc). Bright and dim control of the lights, the lamp test circuitry, and the master caution reset circuitry are on a separate printed circuit board (P/N 81-0815-1) that is common to all lamp positions. There is also an inter-connection board (P/N 81-0823-1) that has no active components.

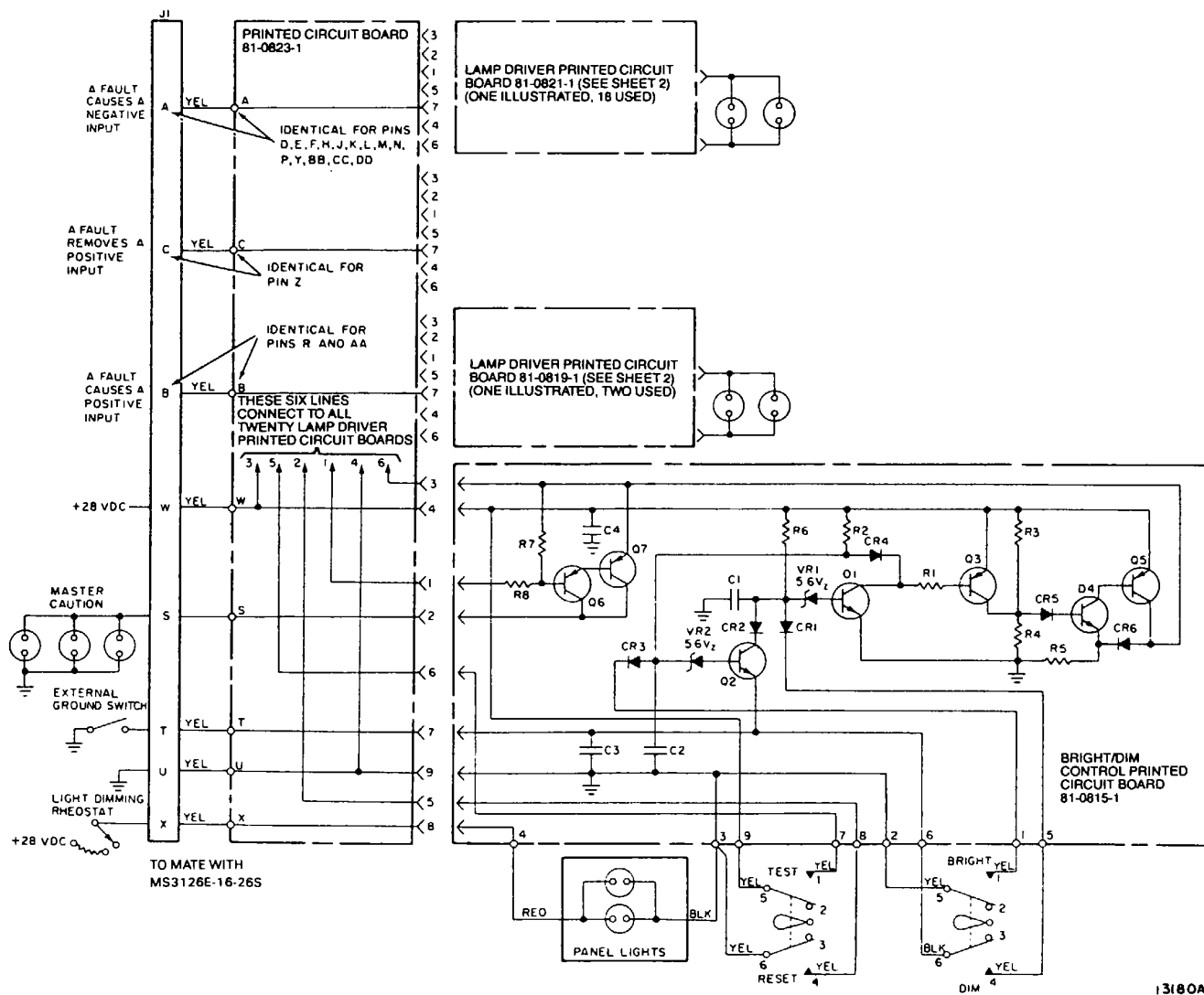
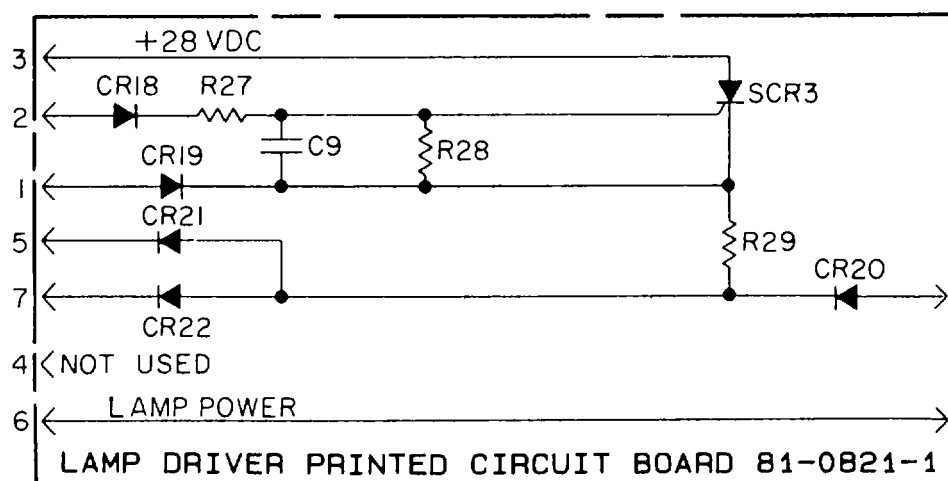
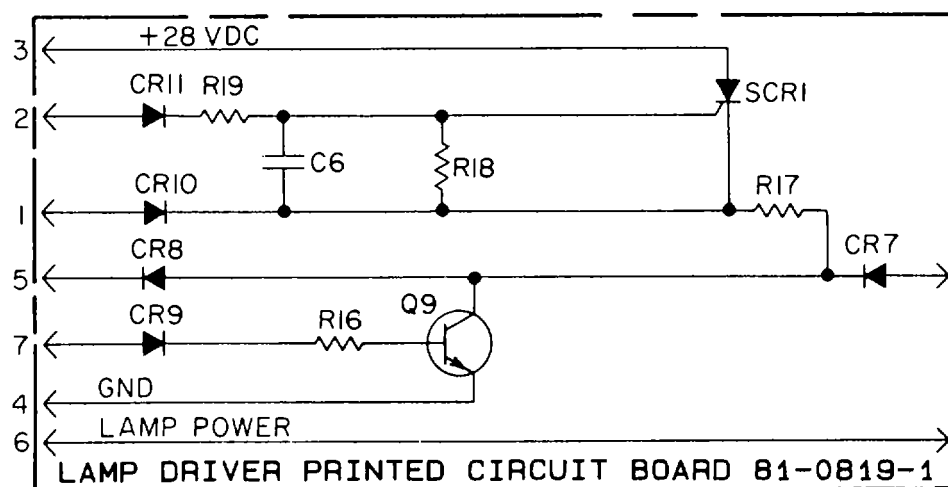


Figure 9-5E. Pilots master caution panel schematic (Sheet 1 of 2)



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Figure 9-5E. Pilots master caution panel schematic (Sheet 2 of 2)

(1) Negative Input Lamp Driver printed circuit board (P/N 81-0821-1). Power is routed directly to the lamps from edge connector pin 6. When a fault input (ground) is present at edge connector pin 7, the circuit is complete, causing the lamps to illuminate. Edge connector pin 5 and diode CR21 are used for the lamp test and provide isolation between the various lamp driver boards. Edge connector pin 1 is an output which directs the BRIGHT/DIM control board to turn on the MASTER CAUTION light. Edge connector pin 2 is connected to the TEST/ RESET switch and is normally open. When the TEST/RESET switch is placed in RESET, ground is applied at edge connector pin 2 which fires SCR3 and it will remain on. With SCR3 on, the output on edge connector pin 1 is held at near +28 Vdc, which inhibits the turn-on signal to the BRIGHT/DIM control board for the MASTER CAUTION light. This allows the individual warning light to be illuminated, but the MASTER CAUTION light to be extinguished.

(2) Positive Input Lamp Driver printed circuit board (P/N 81-0819-1). This board operates in the same manner as the negative input board explained above, except that transistor Q9 provides the inversion, converting the positive input on edge connector pin 7 to a negative signal.

(3) Bright/Dim Control printed circuit board (P/ N 81-0815-1). Lamp brightness is controlled by power transistor Q5. On dim, Q4 and in turn Q5 are biased by the voltage between resistors R3 and R4. On bright, Q3 is on, providing a higher base voltage to Q4, which in turn provides greater drive to Q5 and higher voltage to the lamps.

(a) Selection of bright or dim is accomplished with the front panel toggle switch and the external ground switch. (The external ground switch must be closed to maintain the dim condition.) Transistors Q1 and Q2 serve as collector to base clamps for each other, making a two way latch, to maintain a bright or dim condition.

(b) When power is first applied to the unit, capacitor C1 charges faster than C2, allowing transistor Q1 to turn on. Transistor Q1 clamps off Q2. Transistor Q1 also turns on Q3 causing Q4 and Q5 to operate in the bright condition.

(4) When the operator wishes to select the dim condition, he must close the external ground switch and then place the BRIGHT/DIM switch to DIM.

(This switch is a momentary/maintained/ momentary switch.) The ground through the switch and diode CR1

discharges capacitor C1 and turns off transistor Q1. During the brief time the switch is held in the dim position, capacitor C2 is charged. When the switch is returned to the center position, transistor Q2 turns on before transistor Q1 because capacitor C2 is already charged. Turning on transistor Q2 clamps off transistor Q1 which in turn holds transistor Q3 off, allowing Q4 and Q5 to operate in the dim condition. If the external ground switch is opened while the unit is in the dim condition, the ground is removed from the emitter of transistor Q2, causing it to turn off. Transistor Q1 is no longer clamped and will turn on, allowing Q3, Q4, and Q5 to operate in the bright condition.

(5) Control of the external MASTER CAUTION light is performed as follows: When a fault (or a lamp test) is present, a low is fed from the lamp driver printed circuit board to edge connector pin 1. This turns on transistor Q6 and in turn Q7 which powers the external MASTER CAUTION light. When the low input is removed from pin 1 (the BRIGHT/DIM switch fired and SCR on the driver printed circuit board), transistors Q6 and Q7 turn off and the MASTER CAUTION light extinguishes.

b. Removal

(1) Loosen four turnlock stud assemblies and lift caution panel from panel.

(2) Disconnect electrical connector from back of unit.

c. Bench Testing. Bench testing procedures consist of connecting the external electrical connections to connector J1 as shown in figure 9-5E, and then supplying the fault inputs as specified. Th do this, proceed as follows:

(1) Vary the rheostat from one extreme to the other. Both panel lights shall increase and decrease in brightness accordingly.

(2) Momentarily place the TEST/RESET switch to the TEST position. All twenty positions shall illuminate to full brightness.

(3) Check BRIGHT/DIM operation:

(a) Hold the TEST/RESET switch in the TEST position, and close the external ground switch. All twenty positions shall remain brightly illuminated.

(b) Momentarily place the BRIGHT/DIM switch to DIM. All twenty positions shall reduce in illumination and remain dim after the switch is released.

(c) Momentarily place the BRIGHT/DIM switch to BRIGHT. All twenty positions shall brightly illuminate.

(d) Repeat step (b), then open the external ground switch. All twenty positions shall brightly illuminate.

(4) One at a time, check lamp driver circuits by connecting a simulated fault input. Refer to figure 9-5E for type and pin number. Only the corresponding position shall illuminate in each case.

NOTE

The external Master Caution lamps shall illuminate when one or more of the individual panel lamps are illuminated.

(5) Supply a simulated fault input on any one pin. The Master Caution light shall illuminate. Momentarily place the TEST/RESET switch to the RESET position, then release. The Master Caution lamp shall extinguish, but the individual position lamp shall remain illuminated.

d. *Troubleshooting.* (See figure 9-5F and table 9-8A.)

Table 9-8A. Troubleshooting - Pilots Master Caution Panel Assembly

NOTE

Before you use this table, be sure you have performed all operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Panel lamps fail to illuminate.

STEP 1. Substitute known good lamps.

If lamps are defective install serviceable lamps.

STEP 2. Check for corrosion in lamp socket.

If required, clean lamp socket terminals or replace lamp.

2. All 20 positions fail to illuminate on lamp test.

STEP 1. Test operation with multimeter.

If TEST switch or wiring is damaged, replace. (Refer to paragraph 9-2.)

3. During lamp test, one position only is dim.

STEP 1. Substitute two known good lamps.

If one of two lamps is defective, replace with serviceable lamp.

STEP 2. Check for corrosion in lamp socket.

If required, clean lamp socket terminals or replace lamp.

Table 9-8A. Troubleshooting - Pilots Master Caution Panel Assembly-Continued

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

STEP 3. Substitute a known good printed circuit board into circuit.

If problem is solved, replace defective printed circuit board with a serviceable one. (Refer to figure 9-2.)

4. During lamp TEST, one position does not illuminate.

STEP 1. Using multimeter, ensure lamp is properly grounded.

If lamp is not properly grounded, remove lamp and clean ground.

STEP 2. Check for corrosion in lamp socket.

If required, clean lamp socket terminals or replace lamp.

5. On lamp test, external MASTER CAUTION lamp does not illuminate.

STEP 1. Check BRIGHT/DIM control printed circuit board for proper transistor switching.

If transistor switching is incorrect, replace defective components on printed circuit board.

6. MASTER CAUTION lamp fails to illuminate with one position illuminated.

STEP 1. Substitute a known good printed circuit board for printed circuit board that drives that lamp position.

If known good printed circuit board corrects problem, install a serviceable printed circuit board in that position. (Refer to figure 9-2.)

7. With one individual position illuminated, the MASTER CAUTION lamp fails to extinguish when TEST/RESET switch is placed to RESET.

STEP 1. Substitute a known good printed circuit board for printed circuit board that drives that lamp position.

If known good printed circuit board corrects problem, install a serviceable printed circuit board in that position. (Refer to figure 9-2.)

8. One side or adjacent positions fail to illuminate.

STEP 1. Check for defective wiring with multimeter.

If wiring is defective, repair or replace. (Refer to paragraph 9-2.)

STEP 2. Substitute a known good printed circuit board (8, figure 9-5F) in unit.

If that corrects problem, install a serviceable printed circuit board in unit. (Refer to paragraph 9-2.)

Table 9-8A. Troubleshooting - Pilots Master Caution Panel-Continued**CONDITION****TEST OR INSPECTION****CORRECTIVE ACTION**

9. All lamps fail to dim or return to bright.

STEP 1. Check for defective wiring with multimeter.

If wiring is defective, repair or replace. (Refer to paragraph 9-2.)

STEP 2. Check test setup connection and position of external ground switch.

Refer to figure 9-5E for proper connections and position of switch.

STEP 3. Check for proper operation of BRIGHT/DIM switch with multimeter.

If switch is defective, replace with a serviceable switch.

STEP 4. Substitute a known good printed circuit board (11, figure 9-5G) in unit.

If that corrects problem, install a serviceable printed circuit board in unit. (Refer to paragraph 9-2.)

10. Printed circuit board (8, figure 9-5F) fails to operate.

STEP 1. Check printed circuit board for cracks, distortion, or burnt circuit tracks.

If any damage is found, replace printed circuit board.

STEP 2. Check components for cracks, broken leads, signs of overheating, or other physical damage.

If any components are damaged, replace them. (Refer to paragraph 9-49.h.)

STEP 3. Check for loose, broken, or "cold" solder joints using a multimeter.

If any defective solder joints are found, repair them. (Refer to paragraph 9-49.h.)

STEP 4. Use a multimeter to check components for electrical shorts.

If defective components are found, replace them. (Refer to paragraph 9-49.h.)

11. Printed circuit board (27, figure 9-5F) fails to operate.

STEP 1. Check printed circuit board for cracks, distortion, or burnt circuit tracks.

If any damage is found, replace printed circuit board.

STEP 2. Check components for cracks, broken leads, signs of overheating, or other physical damage.

If any components are damaged, replace them. (Refer to paragraph 9-49.h.)

STEP 3. Check for loose, broken, or "cold" solder joints using a multimeter.

If any defective solder joints are found, repair them. (Refer to paragraph 9-49.h.)

Table 9-8A. Troubleshooting - Pilots Master Caution Panel-Continued

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

STEP 4. Use a multimeter to check components for electrical shorts.

If defective components are found, replace them. (Refer to paragraph 9-49.h.)

12. Printed circuit board (33, figure 9-5F) fails to operate

STEP 1. Check printed circuit board for cracks, distortion, or burnt circuit tracks.

If any damage is found, replace printed circuit board.

STEP 2. Check components for cracks, broken leads, signs of overheating, or other physical damage.

If any components are damaged, replace them. (Refer to paragraph 9-49.h.)

STEP 3. Check for loose, broken, or "cold" solder joints using a multimeter.

If any defective solder joints are found, repair them. (Refer to paragraph 9-49.h.)

STEP 4. Use a multimeter to check components for electrical shorts.

If defective components are found, replace them. (Refer to paragraph 9-49.h.)

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1. Lamp	17. Connector	33. Printed Circuit Board
2. Lens Retainer	18. Terminal	34. Diode
3. Gray Filter	19. Connector	35. Resistor
4. Legend	20. Dust Plug	36. Resistor
5. Clear Filter	21. Connector	37. Resistor
6. Cover Assembly	22. Sealing Plug	38. Diode
7. Screw	23. Contact	39. Capacitor
8. Printed Circuit Board	24. Plate Spacer	40. Transistor
9. Screw	25. Self-Locking Nuts	41. Housing and Filter Assembly
10. Insulator	26. Screw	42. Grommet
11. Insulator	27. Printed Circuit Board	43. Lamp
12. Connecting Rod	28. Diode	44. Panel
13. Washer	29. Resistor	45. Screw
14. Screw	30. Resistor	46. Identification Plate
15. Tiedown Strap	31. Capacitor	47. Housing Assembly
16. Connector	32. Diode	48. Clinch Nut

Figure 9-5F. Pilots master caution panel assembly (Sheet 1 of 2)

e. *Disassembly.* Refer to figure 9-5F and disassemble unit only as required for parts replacement. Proceed as follows:

NOTE

Perform steps (1) and (2) only when these parts must be replaced. These steps are not required for other disassembly steps (for example, removing a printed circuit board).

(1) Remove lamp (1) by first pressing in on left edge of respective reflector assembly (1, figure 9-5G), causing right side of reflector assembly (1) to pivot outward. Insert a thin edged tool or fingernail under lamp base and gently pry out lamp (1, figure 9-5F). Remove second lamp (1) in same manner.

(2) Remove lens retainer (2) by first unhooking its right end from reflector assembly (1, figure 9-5G). Then, unhook left end and remove it. Remove filters (3 and 5, figure 9-5F) and legend (4) in that position.

(3) Remove lens retainers (2), filters (3 and 5), and legend (4) only as required.

(4) Remove cover assembly (6) by removing four screws (7) and sliding out cover assembly (6). If cover assembly (6) fits tightly, it may be necessary to gently pry out each corner to work out cover assembly (6). Printed circuit board (8) and associated parts are held in cover assembly (6). Some printed circuit boards (27 and 33) may slide out with cover assembly (6).

(5) If required, disassemble cover assembly (6) as follows:

(a) Remove nine screws (9) and five insulators (10). Separate printed circuit board (8) from cover assembly (6) as far as wiring will permit.

(b) Remove insulators (11), nine screws (14), connecting rods (12), and washers (13).

(c) Cut and remove tiedown straps (15) as required.

(d) If connector (21) must be removed, tag and unsolder wires from terminals on printed circuit board (8). Remove four self-locking nuts (25) and screws (26), connector (21), and plate spacer (24). Remove sealing plug (22) and contacts (23) only if required.

(e) If components (16, 17, 18, and 19) on printed circuit board (8) are defective, refer to paragraph 9-4 to remove them.

(6) Remove printed circuit boards (27 and 33) by sliding them out the back of housing assembly (47).

(a) If components (28, 29, 30, 31, and 32) on printed circuit board (27) are defective, refer to paragraphs 9-4 and 9-49.h. to remove them.

(b) If components (34, 35, 36, 37, 38, 39, and 40) on printed circuit board (33) are defective, refer to paragraph 9-4 to remove them.

(7) Remove identification plate (46) only if damaged or illegible.

(8) Remove housing and filter assemblies (41). Grommets (42) will come free. Remove lamps (43) from housing and filter assemblies (41).

(9) Remove screw (45) and lift off panel (44).

(10) Remove eight screws (2, figure 9-5G) and lift out connecting rods (3) with components (1, 4, 5, 6, and 7) still assembled. Remove connecting rods (3) with components (1, 4, and 5) still assembled. Slide out connecting rods (3) to free spacer assemblies (6 and 7), reflector assemblies (1) and base assemblies (4 and 5).

(11) Remove eight nuts (9), screws (10), and two bracket assemblies (8).

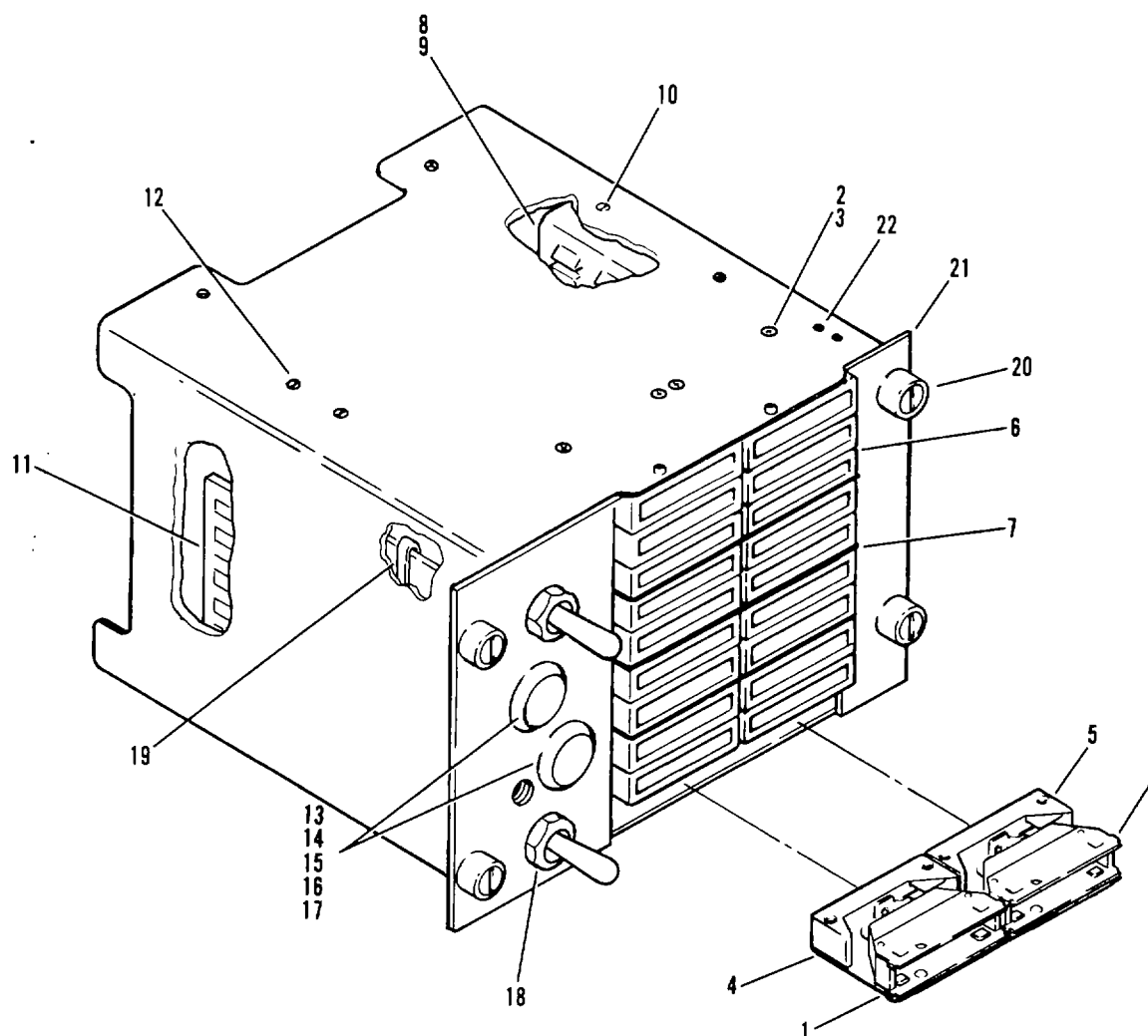
(12) Remove four screws (12). Slide printed circuit board (11) out of housing assembly (47, figure 9-5F) as far as wiring will permit. Identify, tag, and unsolder wires, if required.

(a) If components (1 thru 19, figure 9-5H) on printed circuit board (11, figure 9-5G) are defective, refer to paragraph 9-4 to remove them.

(b) Remove components (20 thru 31, figure 9-5H) only if required.

(13) Identify, tag, and unsolder wire. Remove terminal lugs (13, figure 9-5G) by unscrewing nuts (14). Lockwashers (15) will also be freed.

(14) Remove retainer (17) from terminal assembly (16). Remove terminal assembly (16) from retainer (17) only if required.

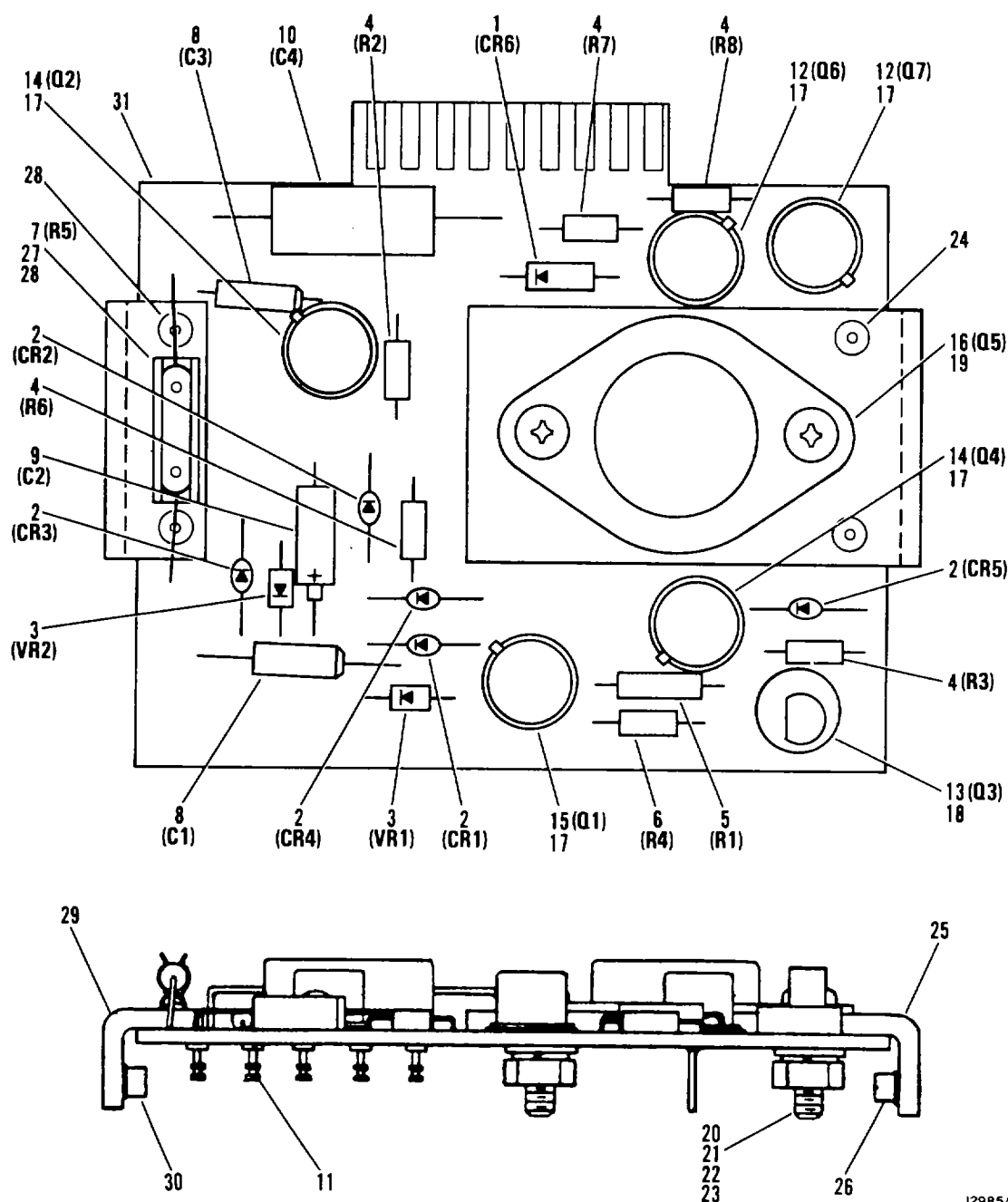


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1. Reflector Assembly	9. Nut	17. Retainer
2. Screw	10. Screw	18. Switch
3. Connecting Rod	11. Printed Circuit Board	19. Tiedown Strap
4. Base Assembly	12. Screw	20. Turnlock Stud Assembly
5. Base Assembly	13. Terminal Lug	21. Panel Assembly
6. Spacer Assembly	14. Nut	22. Screw
7. Spacer Assembly	15. Lockwasher	
8. Bracket Assembly	16. Terminal Assembly	

Figure 9-5G. Pilots master caution panel subassembly

Change 57 9-42J



1. Diode	9. Capacitor	17. Mounting Pad	25. Bracket Assembly
2. Diode	10. Capacitor	18. Mounting Pad	26. Nut
3. Diode	11. Stud Terminal	19. Mounting Pad	27. Clip
4. Resistor	12. Transistor	20. Screw	28. Rivet
5. Resistor	13. Transistor	21. Flat Washer	29. Bracket Assembly
6. Resistor	14. Transistor	22. Lock Washer	30. Nut
7. Resistor	15. Transistor	23. Nut	31. Printed Wiring Board
8. Capacitor	16. Transistor	24. Rivet	

Figure 9-5H. Control panel printed circuit board 81-0815-1

(15) Remove two switches (18) by removing their mounting nuts, lockwashers, and key washers.

(16) Remove and discard tiedown straps (19) and heat shrinkable tubing as required.

(17) Remove turn lock stud assemblies (20) if damaged.

(18) Remove nine screws (22) and panel assembly (21).

(19) If installed, remove dust plug (20, figure 9-5F) from connector (21). Dust plug (20) covers connector (21) during shipping and storage.

f. *Cleaning.* With unit disassembled only as required for parts replacement, proceed as follows:

(1) Clean electrical parts and printed circuit boards with a clean, soft, lint-free cloth moistened with isopropyl alcohol (C23). Allow to air dry. Use care to prevent damage to printed circuits.

(2) Clean metal parts with safety solvent (C124A).

g. *Inspection* There are no regularly scheduled inspection procedures, and no tolerance or wear limits for this unit. Perform the following:

(1) Refer to paragraph 9-2. Inspect parts of caution panel for damage or defects.

(2) Inspect printed circuit boards for clean electrical contacts, firm mounting of components, and evidence of component overheating.

(3) Check wiring for damaged insulation, and for good solder connections.

(4) Check filters for color, transparency, and for legibility and correct location of legends (see figure 9-5C for proper locations).

h. *Repair:* Repair procedures for caution panel consist of replacement of damaged or defective parts with serviceable ones. Removal and installation, by riveting or soldering, of any part or parts are covered in this paragraph.

(1) When replacing any part or subassembly secured by rivets, proceed as follows:

- (a) Drill out rivets with proper size drill.
- (b) Deburr and assemble new parts.

(c) Secure parts with new rivets of size and type indicated in Repair Parts and Special Tools List (RPSTL).

(2) When replacing components on printed circuit boards use the following precautions:

(a) Use a low wattage (25 watts or less) soldering iron.

(b) Ground circuit track adjacent to components.

(c) Use heat sinks to avoid overheating adjacent components.

(d) Coat printed circuit boards with insulating compound (C74B).

(3) Finish all visible exterior surfaces with black anodic (C25A).

(4) If damaged, replace clinch nuts (48, figure 9-5F).

i. *Assembly.* Refer to figure 9-5G and assemble unit as follows:

(1) Install panel assembly (21) using nine screws (22).

(2) Install turn lock stud assemblies (20).

(3) Install two switches (18) using their key washers, lockwashers, and mounting nuts.

(4) If removed, install terminal assemblies (16) in retainers (17). Install retainers (17) and terminal lugs (13) using lockwashers (15) and nuts (14).

(5) Install heat shrinkable tubing and tiedown straps (19) to bundle the interconnecting wiring.

(6) Install printed circuit board (11) using four screws (12).

(7) Install both bracket assemblies (8) using eight screws (10) and nuts (9).

(8) Assemble connecting rods (3), spacer assemblies (6 and 7), reflector assemblies (1), and base assemblies (4 and 5). Refer to figure 9-5C for proper

location of these components. Install assemblies using eight screws (2, figure 9-5G).

(9) Install panel (44, figure 9-5F) using screw (45).

(10) Install a lamp (43) in each housing and filter assembly (41).

(11) Thread a grommet (42) into each housing and filter assembly (41).

(12) If removed, install a new identification plate (46).

(13) Install printed circuit boards (27 and 33) in housing assembly (46). Refer to figure 9-5C for location of printed circuit boards in unit.

(14) Assemble cover assembly (6, figure 9-5F), printed circuit board (8), and connector (21) as follows:

(a) Install sealing plug (22) and contacts (23) in connector (21). Install plate spacer (24) and connector (21) using four screws (26) and self-locking nuts (25).

(b) Install nine connecting rods (12) and washers (13) using screws (14).

(c) Install insulators (11) on each connecting rod (12).

(d) Solder wires to printed circuit board. Install printed circuit board (8) using nine screws (9) and six insulators (10). Insulators (10) are used on six inside positions.

(e) Install tiedown straps (15) to bundle wires.

(15) Install cover assembly (6) using four screws (7).

(16) Install following components as a stack in lens retainer (2).

(a) Install gray filter (3), dull side out.

WARNING

Ensure correct legends are installed in correct indicator light positions. If legends are installed in wrong positions, air crew will receive false information during in flight malfunctions.

(b) Install correct legend (4). Refer to figure 9-5C.

(c) Install clear filter (5, figure 9-5F).

(17) Carefully hold stack in lens retainer (2). Install lens retainer (2) on reflector assembly (1, figure 9-5G), left side first, then pushing on right side until it engages.

(18) Press in on left edge of each reflector assembly (1), causing them to pivot outward. Install two lamps (1, figure 9-5F) in each indicator position. Close reflector assembly (1, figure 9-5G).

(19) Perform checkout procedures per paragraph 9-48.a. to verify performance of assembled unit.

j. Installation.

(1) Connect electrical connector to back of unit.

(2) Tighten four turn lock stud assemblies to install unit in panel of helicopter.

9-49A. Pilots Master Caution Panel (BHT P/N 204-075-705-43).

a. *Description* The caution panel contains a number of internally lighted segments that illuminate when associated switches, located at different places in the helicopter, actuate to complete circuits thus indicating malfunctions in respective systems. The unit is energized from 28 Vdc essential bus and protected by a 5 ampere CAUTION LTS circuit breaker located in the pilots dc circuit breaker panel (A10), pilots console right.

b. *Removal* Refer to paragraph 9-49.b.

c. *Bench Testing.* Refer to paragraph 9-49.c.

d *Troubleshooting.* Refer to caution panel internal schematic (figure F-11) and trace malfunctioning circuit or loop, using standard electronic troubleshooting procedures and standard test equipment. Localize malfunctioning switch components, and repair or replace as required.

e. *Disassembly.* (See figure 9-6.)

(1) Loosen three fasteners (1) and remove cover (2) from assembly.

NOTE

Disassemble panel in order indexed. Disassemble only to extent necessary to accomplish replacement of damaged parts, as determined by inspection or troubleshooting procedures.

(2) If malfunction has been traced to a component of one of the printed circuit board assemblies (3, 4, or 5) remove the circuit board involved by removing screws (6) and unplugging board from respective electrical connector (7, 8, or 9).

(3) Before disconnecting any electrical leads, tag wire leads to aid in replacement of wiring at reassembly.

f. *Cleaning.*

(1) Remove loose dust or dirt from exposed surfaces with dry compressed air at a maximum pressure of 10 psig.

WARNING

Use dry cleaning solvent in a well ventilated area. Avoid prolonged breathing of vapors and do not use in an area with open flame or high temperature.

(2) Remove corrosion, dirt, or other foreign matter from parts with dry cleaning solvent (C124) and clean, lint-free cloth or a soft bristle brush.

(3) Thoroughly dry all parts after cleaning with a clean, lint-free cloth or with compressed air at 10 psig.

g. *Inspection.*

(1) Inspect all components for security of connections and bent or broken pins, contacts, and terminals.

(2) Inspect wiring and connections to all parts; look for loose connections, burned or broken wires, cracked or deteriorated insulation, and proper grounding.

(3) Inspect resistors for evidence of loose or broken terminals and wire leads, burned or swollen bodies, or other visual signs of damage.

(4) Inspect coils for evidence of damage. If necessary, check continuity of coils with an ohmmeter.

(5) Inspect removed printed circuit boards for broken leads, shorts, or damaged components. Inspect relays and diodes for broken glass envelopes.

h. *Repair or Replacement.*

(1) Repair of the caution panel is limited to minor repairs, such as soldering loose connections and straightening bent connector pins. Replace (do not repair) damaged or malfunctioning components.

NOTE

In each case, replace components in the exact location from which the replaced part was removed.

(2) Replace lamps in indicators of the rototellite assembly by rotating the indicator to reach the lamps in base of the unit. Lamps are held in place by spring clips.

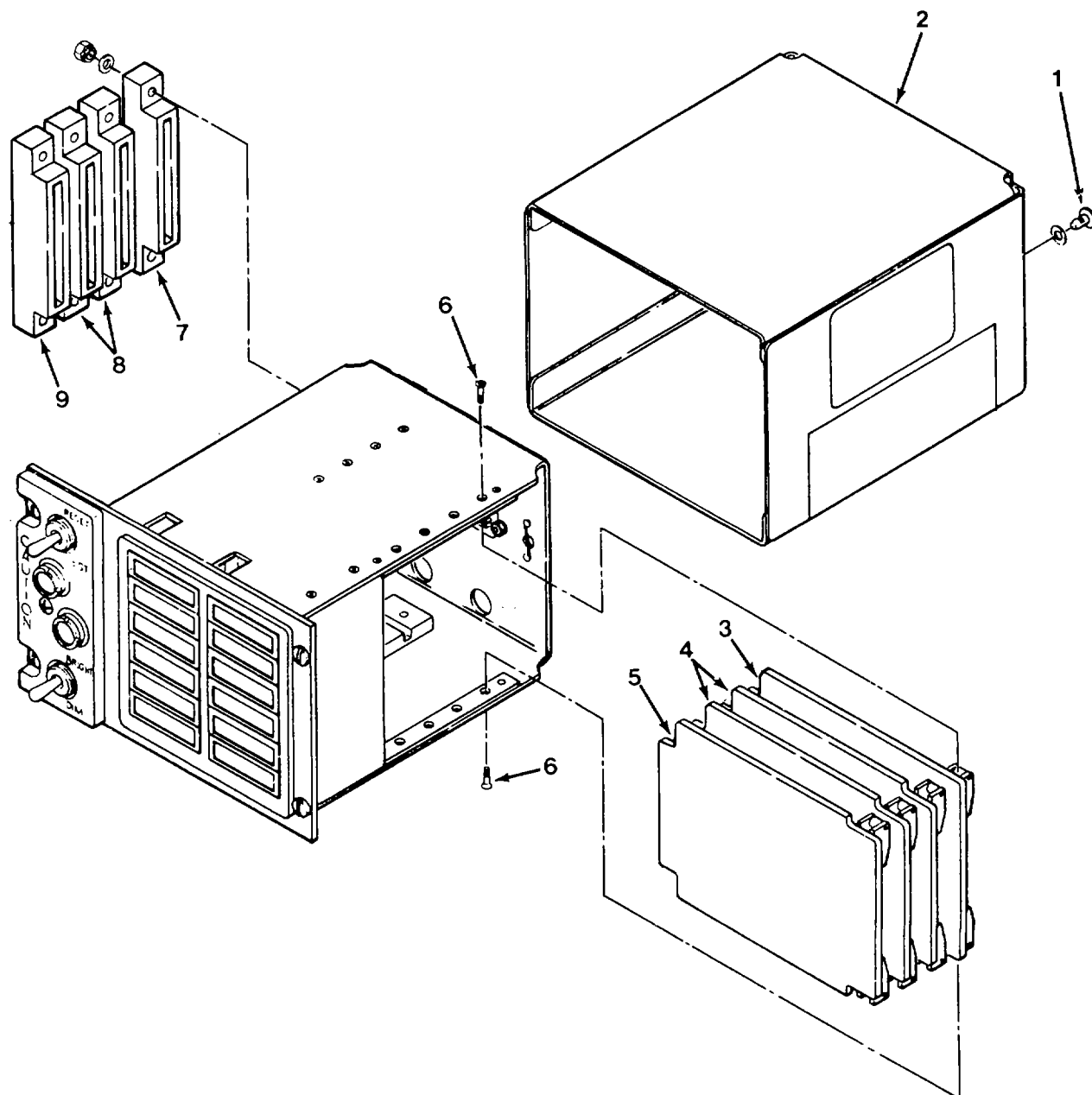
i. *Assembly.* Assemble caution panel in reverse order of index numbers assigned in figure 9-6, noting the following:

(1) Refer to internal schematic diagram (figure F-11) when installing new components or wiring.

(2) If new parts are installed, trim excess wire leads after soldering.

(3) Install all attaching hardware in same location from which removed.

j. *Installation.* Refer to paragraph 9-49 j.



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1. Fastener	6. Screw
2. Cover	7. Electrical Connector
3. Printed Circuit Board Assembly	8. Electrical Connector
4. Printed Circuit Board Assembly	9. Electrical Connector
5. Printed Circuit Board Assembly	

Figure 9-6. Caution panel assembly (BHT P/N 204-075-705-43)

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9-49B. Gunners Master Caution Panel (BHT P/N 204-075-705-79).

a. *Description.* Refer to figure 9-6A. There are 14 indicator lamp positions in the unit. Thirteen of the positions use negative fault (ground) applied from the sensors/switches monitoring the helicopter systems. One circuit requires a positive fault (+28 Vdc) apply. Two printed circuit boards (P/N 76-0546 and P/N 76-0548) contain components used in each of the circuits. Two controls are located on the face of the unit: a BRT/DIM switch and a TEST button. When the BRT/DIM switch is placed to the BRT position, it causes any of the 14 indicators to light brightly when a fault signal is received. When the switch is placed to the DIM position, any of the 14 indicators will light in the dim mode when a fault signal is received. When the TEST button is pressed, all 14 indicator lamps will light either brightly or dimly, depending upon the setting of the BRT/DIM switch. Any fault input will activate the MASTER CAUTION indicator on the gunners instrument panel. It will remain lit until acknowledged. A provision is also made for external dimming by the EXTERNAL GROUND-DIMMING CONTROL CIRCUIT. See figure 9-6B for schematic.

(1) Printed circuit board (P/N 76-0546). This printed circuit board (9, figure 9-6A) contains 28 diodes (10). Fourteen are input diodes used to route the input signals, received through connector J1, to the lamps. The 14 other diodes are used to route test signals to the indicator lamps when the TEST button is pressed. All input and test signals for each indicator pass through this printed circuit board.

(2) Printed circuit board (P/N 76-0548). This printed circuit board (11) contains 14 resistors (12) and 14 diodes (13). The 14 resistors (12) are used in series with each indicator lamp circuit as a voltage divider. This causes the indicator lamps to light dimly when the DIM mode of operation is selected. The diodes provide the path for the +28 Vdc to brightly light the lamps during the BRT mode of operation.

(3) BRT/DIM switch. The operation of the BRT/DIM modes is controlled by relays K1 and K2, and the external ground switch through J1-T.

(a) Dim operation. During DIM operation, relay K1 is actuated when the BRT/DIM switch is placed in the DIM position. The +28 Vdc passes

through connector J1-W actuating and latching relay K1. The direct path to ground through the diode for the positive fault apply circuit is removed. The circuit finds ground through the voltage divider resistor which dims the indicator lamps. The direct path of +28 Vdc through the diodes for the negative apply circuits is also removed. These circuits find their power through voltage dividing resistors, dimming the indicators.

(b) Bright operation. In BRT operation, relay K2 is actuated causing relay K1 to open. This provides a direct path to ground through a diode for the positive apply circuit (+28 Vdc at J1-R) indicator. This also provides +28 Vdc (J1-W) through diodes for the negative apply circuits. In both cases the voltage dividing resistors, in series with the indicator lamps, are bypassed allowing the lamps to light brightly. If the external grounding switch (J1-T) is opened, the unit will also operate in the bright mode as described above in this paragraph.

(4) TEST button. When the TEST button is pressed, +28 Vdc (J1-W) is applied across a diode to light the positive apply fault indicator lamps. Ground is applied to the 13 negative apply fault circuits (J1) diodes to light the negative apply indicators.

b. Removal

(1) Loosen four turnlock stud assemblies (43) and lift caution panel from helicopter instrument panel.

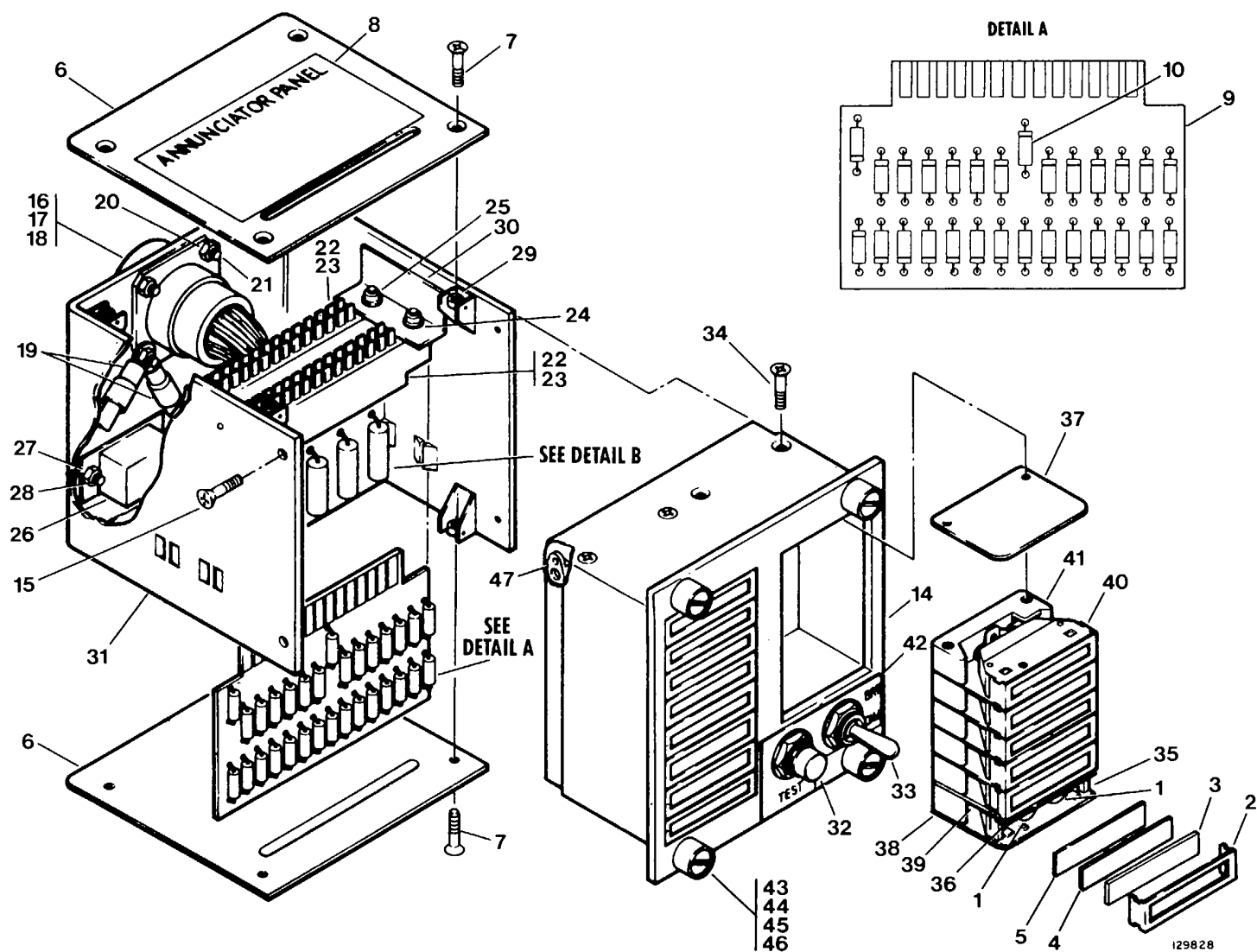
(2) Disconnect electrical connector from back of unit.

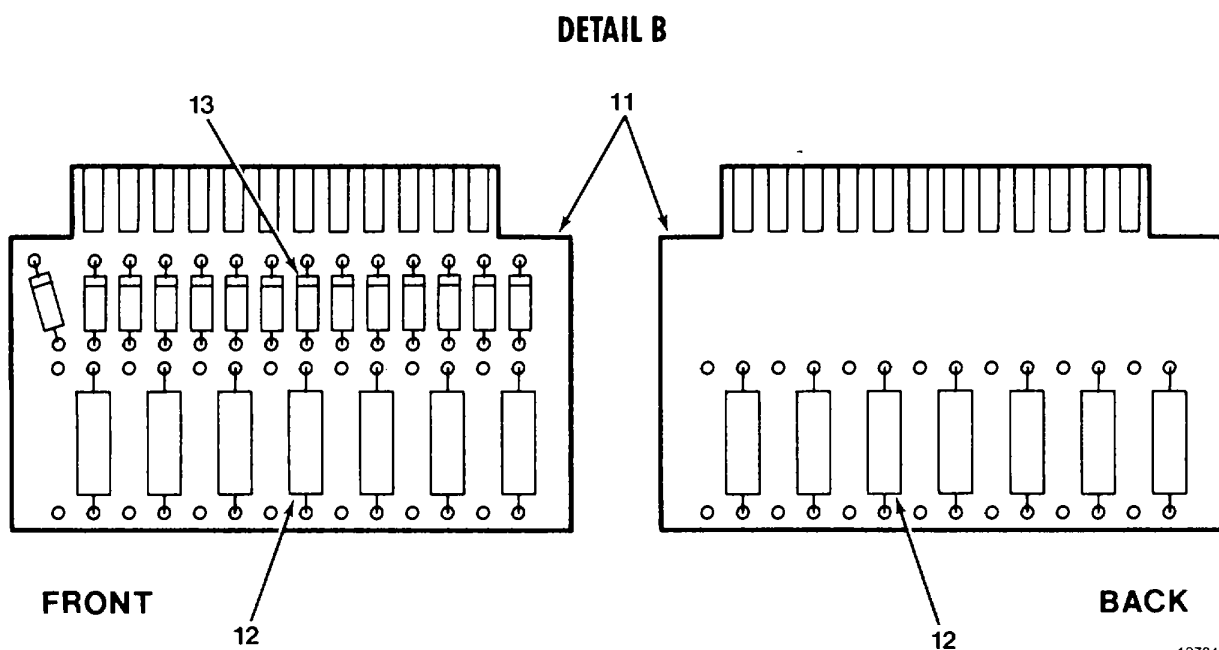
c. *Bench Testing.* Bench testing procedures consist of connecting the external electrical connections to connector J1 as shown in figure 9-6B, and then supplying the fault inputs as required. To do this, proceed as follows:

(1) Momentarily press and hold the TEST button. All twenty positions shall illuminate.

(2) Check BRT/DIM operation:

(a) Hold the TEST button in the TEST position and close the external ground switch. All 14 positions shall remain brightly illuminated.





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1. Lamp	17. Sealing Plug	33. Toggle Switch
2. Lens Retainer	18. Contact	34. Screw
3. Gray Filter	19. Lug Terminal	35. Electrical Post
4. Legend	20. Self-locking Nut	36. Electrical Post
5. White Filter	21. Screw	37. Spacer Assembly
6. End Cover	22. Receptacle Connector	38. Spacer Assembly
7. Screw	23. Polarizing Key	39. Spacer Assembly
8. Identification Plate	24. Self-locking Nut	40. Reflector Assembly
9. Printed Circuit Board	25. Screw	41. Base Assembly
10. Diode	26. Relay	42. Face Plate
11. Printed Circuit Board	27. Self-locking Nut	43. Turnlock Stud Assembly
12. Resistor	28. Screw	44. Turnlock Stud Fastener
13. Diode	29. Self-locking Nut	45. Helical Spring
14. Housing Assembly	30. Bracket Assembly	46. Turnlock Retainer
15. Screw	31. Main Housing	47. Self-locking Nut Plate
16. Connector	32. Push Switch	

Figure 9-6A. Gunners master caution panel assembly (Sheet 2 of 2)

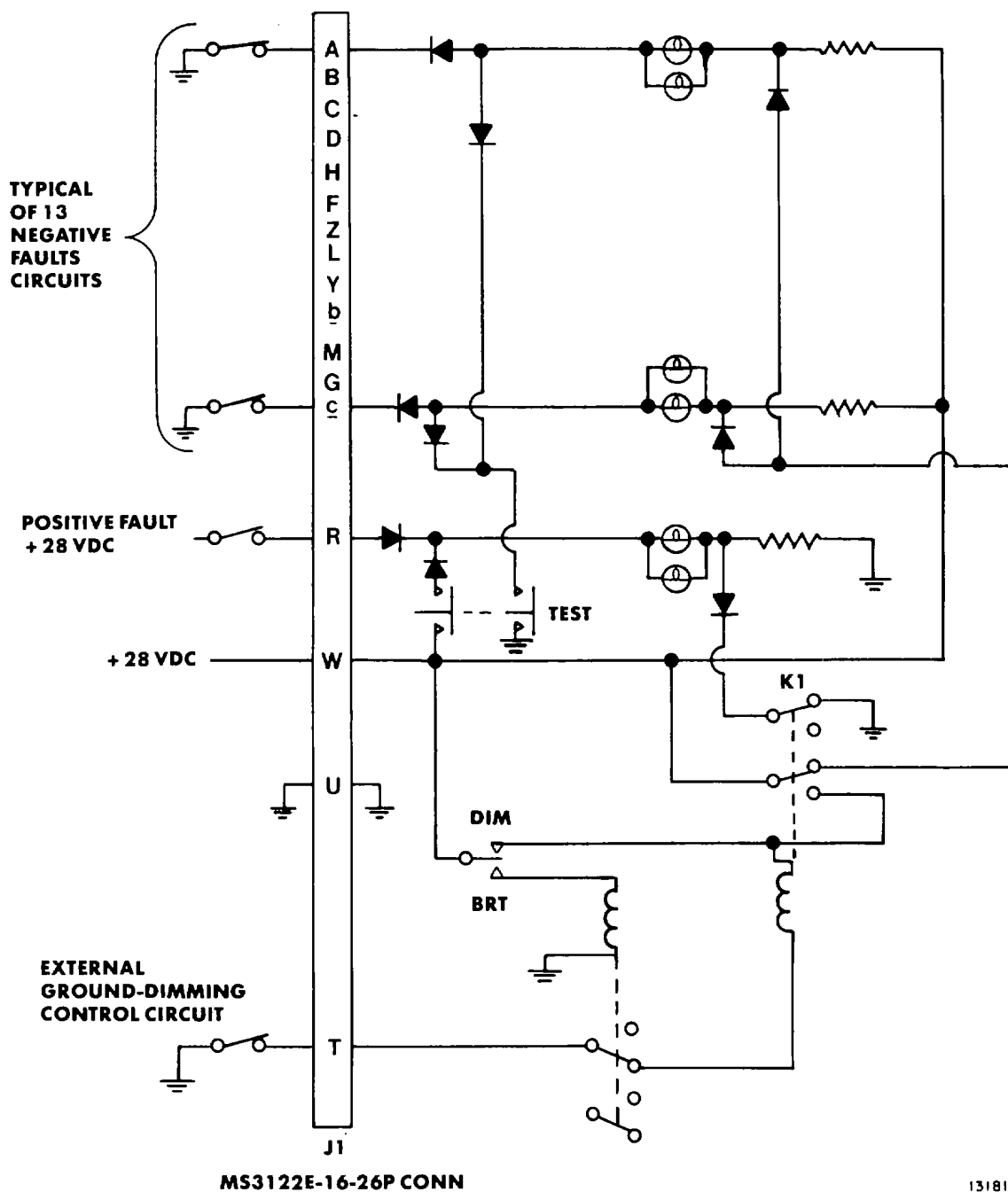


Figure 9-6B. Gunners master caution panel assembly schematic

(b) Momentarily place the BRT/DIM switch to DIM. All 14 positions shall reduce in illumination and remain dim after the switch is released.

(c) Momentarily place the BRT/DIM switch to BRT. All 14 positions shall brightly illuminate.

(d) Repeat step (b), then open the external ground switch. All 14 positions shall brightly illuminate.

(3) One at a time, check lamp driver circuits by connecting a simulated fault input. Refer to figure 9-5D

for type and pin number. Only the corresponding position shall illuminate in each case.

NOTE

The external Master Caution lamp shall illuminate when one or more of the individual panel lamps are illuminated.

d. *Troubleshooting.* (See figure 9-6A and table 9-8B.)

Table 9-8B. Troubleshooting - Gunners Master Caution Panel Assembly

NOTE

Before you use this table, be sure you have performed all operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. With TEST button pressed, one or more panel lamps fail to illuminate.

STEP 1. Substitute known good lamps.

If lamps are defective, install serviceable lamps.

STEP 2. Using multimeter, ensure lamp is properly grounded.

If lamp is not properly grounded, remove lamp and clean ground.

STEP 3. Check for corrosion in lamp socket.

If required, clean lamp socket terminals or replace lamp.

STEP 4. Substitute known good printed circuit board A1.

**If known good printed circuit board corrects problem, install serviceable printed circuit board A1.
(Refer to paragraph 9-2.)**

STEP 5. Substitute known good printed circuit board A2.

**If known good printed circuit board corrects problem, install serviceable printed circuit board A2.
(Refer to paragraph 9-2.)**

Table 9-8B. Troubleshooting - Gunners Master Caution Panel-Continued

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

2. All 14 positions fail to illuminate when TEST button is pressed.

STEP 1. Test operation of TEST switch with multimeter.

If TEST switch or wiring is damaged, replace. (Refer to paragraph 9-2.)

STEP 2. Test operation of BRT/DIM switch with multimeter.

If BRT/DIM switch is damaged, replace. (Refer to paragraph 9-2.)

STEP 3. Test operation of relay K1 with multimeter.

If relay K1 is defective, replace. (Refer to paragraph 9-2.)

3. During lamp test, one position is dim only with BRT/DIM switch placed to BRT.

STEP 1. Substitute two known good lamps.

If one of two lamps is defective, replace with serviceable lamp.

STEP 2. Check for corrosion in lamp socket.

If required, clean lamp socket terminals or replace lamp.

STEP 3. Test operation of relay K1 with multimeter.

If relay K1 is defective, replace. (Refer to paragraph 9-2.)

STEP 4. Test wiring with multimeter.

If wiring is damaged, replace. (Refer to paragraph 9-2.)

4. With BRT/DIM switch in BRT position and TEST button pressed, one position remains dimly illuminated.

STEP 1. Test operation of relays K1 or K2 with multimeter.

If relays are defective, replace. (Refer to paragraph 9-2.)

STEP 2. Test operation of BRT/DIM switch with multimeter.

If BRT/DIM switch is damaged, replace. (Refer to paragraph 9-2.)

Table 9-8B. Troubleshooting - Gunners Master Caution Panel-Continued**CONDITION****TEST OR INSPECTION****CORRECTIVE ACTION**

5. With BRT/DIM switch in DIM position and TEST button pressed, one position remains brightly illuminated.

STEP 1. Substitute known good printed circuit board A2.

If known good printed circuit board corrects problem, install serviceable printed circuit board A2. (Refer to paragraph 9-2.)

6. With BRT/DIM switch in DIM position and TEST button pressed, one position fails to illuminate.

STEP 1. Substitute known good printed circuit board A2.

If known good printed circuit board corrects problem, install serviceable printed circuit board A2. (Refer to paragraph 9-2.)

7. With BRT/DIM switch in DIM position and TEST button pressed, all positions remain brightly illuminated.

STEP 1. Test operation of relays K1 or K2 with multimeter.

If relays are defective, replace. (Refer to paragraph 9-2.)

STEP 2. Test operation of BRT/DIM switch with multimeter.

If BRT/DIM switch is damaged, replace. (Refer to paragraph 9-2.)

STEP 3. Ensure test setup is correct.

If test setup is not correct make required changes.

STEP 4. Ensure external ground switch is closed.

If external ground switch is not closed, close it.

8. Printed circuit board (9, figure 9-6A) fails to operate.

STEP 1. Check printed circuit board for cracks, distortion, or burnt circuit tracks.

If any damage is found, replace printed circuit board.

STEP 2. Check components for cracks, broken leads, signs of overheating, or other physical damage.

If any components are damaged, replace them. (Refer to paragraph 9-49B.h.)

STEP 3. Check for loose, broken, or "cold" solder joints using a multimeter.

If any defective solder joints are found, repair them. (Refer to paragraph 9-49B.h.)

Table 9-8B. Troubleshooting - Gunners Master Caution Panel-Continued**CONDITION****TEST OR INSPECTION****CORRECTIVE ACTION**

STEP 4. Use a multimeter to check components for electrical shorts.

If defective components are found, replace them. (Refer to paragraph 9-49B.h.)

9. Printed circuit board (11, figure 9-6A) fails to operate.

STEP 1. Check printed circuit board for cracks, distortion, or burnt circuit tracks.

If any damage is found, replace printed circuit board.

STEP 2. Check components for cracks, broken leads, signs of overheating, or other physical damage.

If any components are damaged, replace them. (Refer to paragraph 9-49B.h.)

STEP 3. Check for loose, broken, or "cold" solder joints using a multimeter.

If any defective solder joints are found, repair them. (Refer to paragraph 9-49B.h.)

STEP 4. Use a multimeter to check components for electrical shorts.

If defective components are found, replace them. (Refer to paragraph 9-49B.h.)

e. *Disassembly.* Refer to figure 9-6A and disassemble unit only as required for parts replacement. Proceed as follows:

NOTE

Perform steps (1) and (2) only when these parts must be replaced. These steps are not required for other disassembly steps (for example, removing a printed circuit board).

(1) Remove lamp (1) by first pressing in on left edge of respective reflector assembly (40), causing right side of reflector assembly (40) to pivot outward. Insert a thin edged tool or fingernail under lamp base and gently pry out lamp (1). Remove second lamp (1) in same manner.

(2) Remove lens retainer (2) by first unhooking its right end from reflector assembly (40). Then, unhook left end and remove it. Remove filters (3 and 5) and legend (4) in that position.

(3) Remove lens retainers (2), filters (3 and 5), and legend (4) only as required.,

(4) Remove eight screws (7) and lift off two end covers (6). If end covers (6) fit tightly, it may be necessary to gently pry up each corner to remove them.

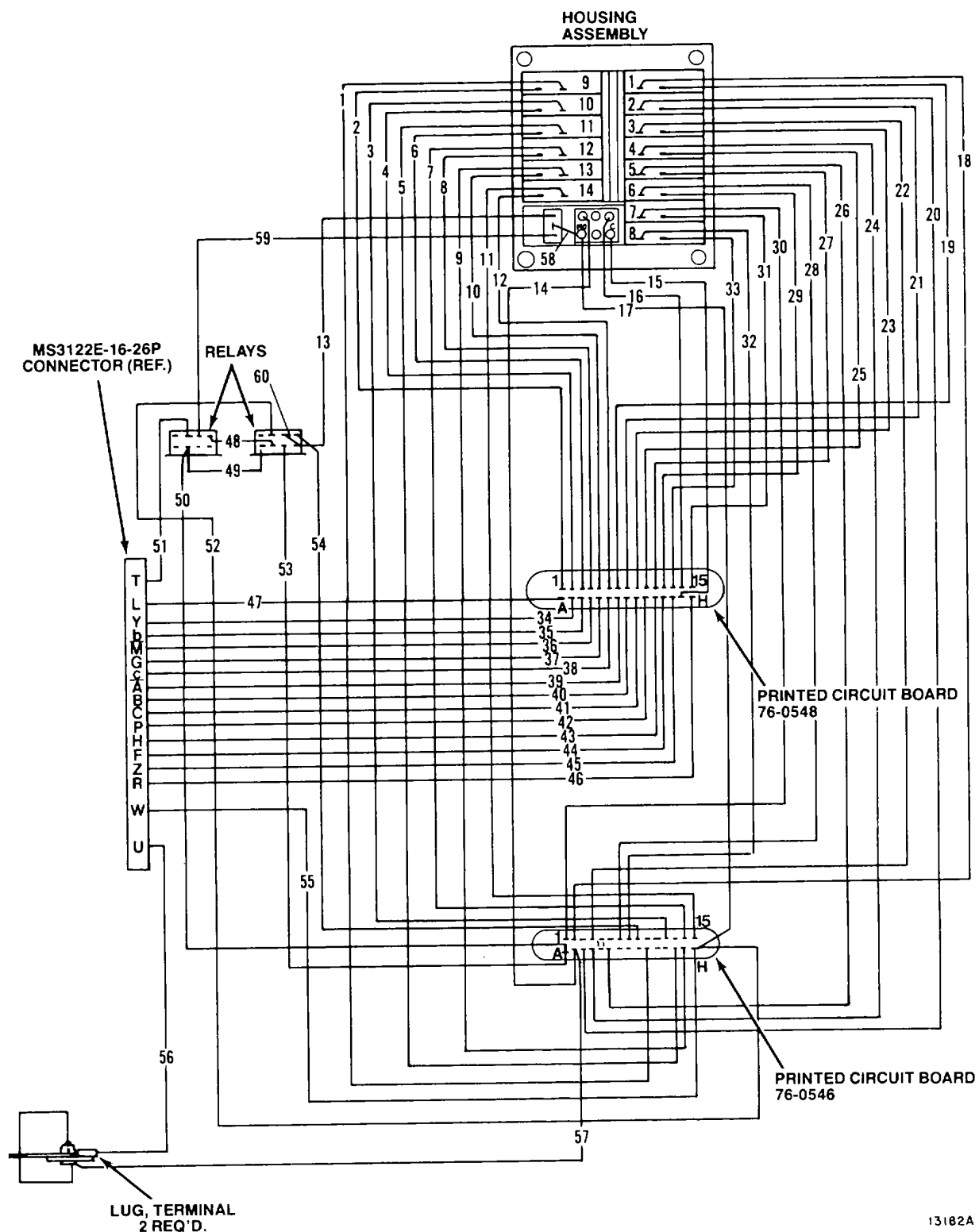
(5) Remove identification plate (8) from top of end cover (6) if damaged or illegible.

(6) Using printed circuit board puller (T92) unplug printed circuit boards (9 and 11) from receptacle connectors (22). The each printed circuit board (9 and 11).

(7) Remove four screws (15) from main housing (31).

(8) Gently pull housing assembly (14) free as far as wires will permit.

(9) Identify, tag, and unsolder wires from housing assembly (14). Refer to figure 9-6C.



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Figure 9-6C. Gunners master caution panel assembly interconnecting wiring diagram (Sheet 1 of 2)

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Wire No. Wire Color	Wire No. Wire Color	Wire No. Wire Color	Wire No. Wire Color
1 White	16 Black	31 White	46 Pink
2 White	17 Red	32 White	47 Gray
3 White	18 White	33 White	48 Red
4 White	19 White	34 Orange	49 Red
5 White	20 White	35 Orange	50 Black
6 White	21 White	36 Blue	51 Brown
7 White	22 White	37 Yellow	52 Pink
8 White	23 White	38 Green	53 Orange
9 White	24 White	39 Red	54 Green
10 White	25 White	40 Blue	55 Blue
11 White	26 White	41 White	56 Black
12 White	27 White	42 Brown	57 Green
13 Gray	28 White	43 Purple	58 Bus Wire
14 Green	29 White	44 Pink	59 Red
15 Brown	30 White	45 Red	60 Green

Figure 9-6C. Gunners master caution panel assembly interconnecting wiring diagram (Sheet 2 of 2)

(10) Remove four self-locking nuts (20) and screws (21), connector (16), and two lug terminals (19). Remove lug terminals (19) from wires only if replacement is required.

(11) Identify and tag wires. Remove sealing plug (17) and contacts (18) from connector (16).

(12) Remove four self-locking nuts (24) and screws (25), and two receptacle connectors (22).

(13) Note position and remove polarizing keys (23) from receptacle connectors (22) if required.

(14) Remove four self-locking nuts (27) and screws (28), and two relays (26).

(15) Identify, tag, and unsolder wires from relays (26).

(16) Remove self-locking nuts (29) from main housing (31) if damaged.

(17) Disassemble housing assembly (14) as follows:

(a) Remove nuts, lockwashers, and switches (32 and 33).

(b) Identify, tag, and unsolder wires from switches (32 and 33).

(c) Remove eight screws (34) from housing assembly (14).

(d) Lift out both groups of components (35 thru 41).

(e) For positions 9 thru 14, slide out electrical posts (35) with components (37 thru 41) still assembled. Free spacer assemblies (37 and 38) and remove them. Mark and tag spacer assembly (37) as top piece.

(f) Separate base assemblies (41) from spacer assemblies (39) and reflector assemblies (40).

(g) For positions 1 thru 8, slide out electrical posts (36) with components (37 thru 41) still assembled. Free spacer assemblies (37 and 38) and remove them. Mark and tag spacer assembly (37) as top piece.

(h) Separate base assemblies (41) from spacer assemblies (39) and reflector assemblies (40).

(18) Remove face plate (42) if damaged.

(19) Remove turnlock stud assemblies (43) if damaged.

f. Cleaning. With unit disassembled only as required for parts replacement, proceed as follows:

(1) Clean electrical parts and printed circuit boards with a clean, soft, lint-free cloth moistened with isopropyl alcohol (C23). Allow to air dry. Use care to prevent damage to printed circuits.

(2) Clean metal parts with safety solvent (C 124A).

g. Inspection There are no regularly scheduled inspection procedures, and no tolerance or wear limits for this unit. Perform the following:

(1) Refer to paragraph 9-2. Inspect parts of caution panel for damage or defects.

(2) Inspect printed circuit boards for clean electrical contacts, firm mounting of components, and evidence of component overheating.

(3) Check wiring for damaged insulation and good solder connections.

(4) Check filters for color, transparency, and for legibility and correct location of legends (see figure 9-5D for proper locations).

h. Repair: Repair procedures for unit consist of replacement of damaged or defective parts with serviceable ones. Removal and installation, by riveting or soldering, of any part or parts are covered in this paragraph.

(1) When replacing any part or subassembly secured by rivets, proceed as follows:

(a) Drill out rivets with proper size drill.

(b) Deburr and assemble new parts.

(c) Secure parts with new rivets of size and type indicated in Repair Parts and Special Tools List (RPSTL).

(2) When replacing components on printed circuit boards use the following precautions:

(a) Use a low wattage (25 watts or less) soldering iron.

(b) Ground circuit track adjacent to components.

(c) Use heat sinks to avoid overheating adjacent components.

(d) Coat printed circuit boards with insulating compound (C74B).

(3) Refer to figure 9-6D, removal of finish for electrical bonding, before applying finish. Finish all visible exterior surfaces with black anodic (C25A).

i. Assembly. Refer to figure 9-6A and assemble unit as follows:

(1) Assemble turn lock stud components (44, 45, and 46).

(2) Install turn lock stud assemblies (43).

(3) If removed, install face plate (42).

(4) Assemble housing assembly (14) as follows:

(a) Assemble base assemblies (41) to spacer assemblies (39) and reflector assemblies (40).

(b) For positions 1 thru 8, install electrical posts (36) thru base (41).

(c) For positions 9 thru 14, install electrical posts (35) thru base (41).

(d) Install spacer assemblies (37 and 38) on stacks of components (39 thru 41). Refer to tag and install spacer assembly (37) on top of each stack.

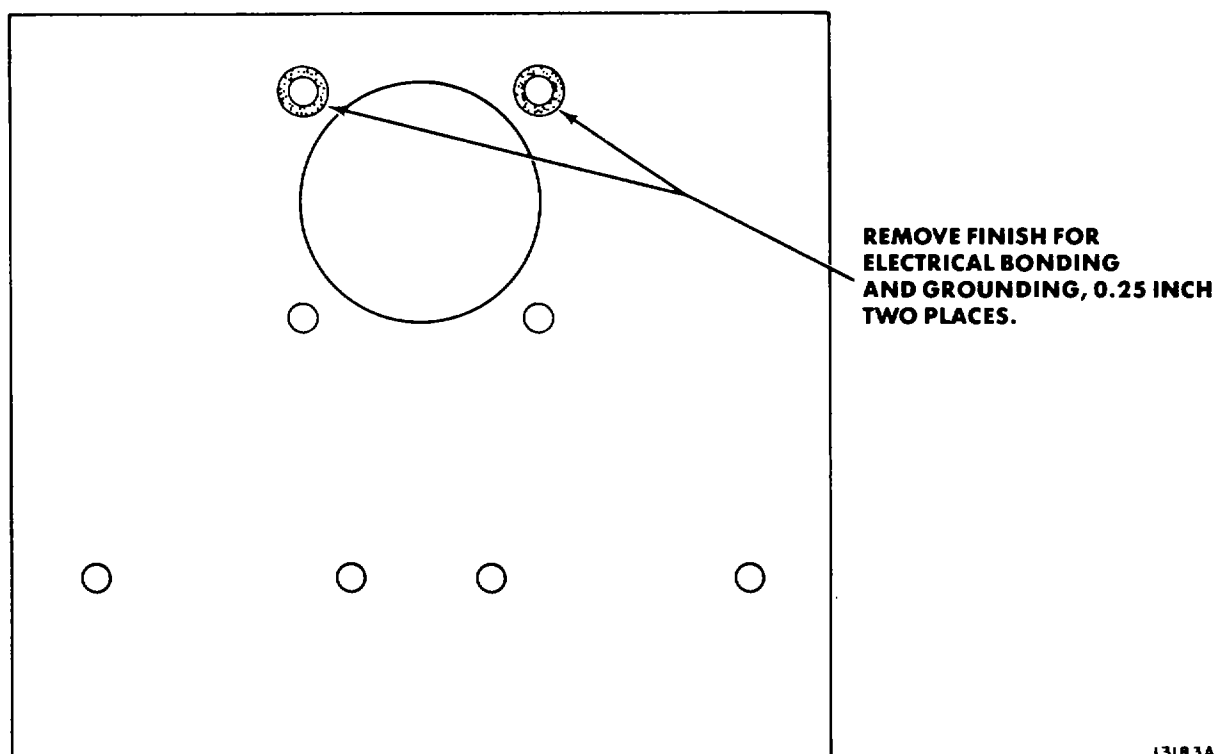
(e) Install assembled stacks using eight screws (34).

(5) Install switches (32 and 33), with keyways down, using lockwashers and nuts.

(6) Solder wires to relays (26). Install relays (26) using four screws (28) and self-locking nuts (27).

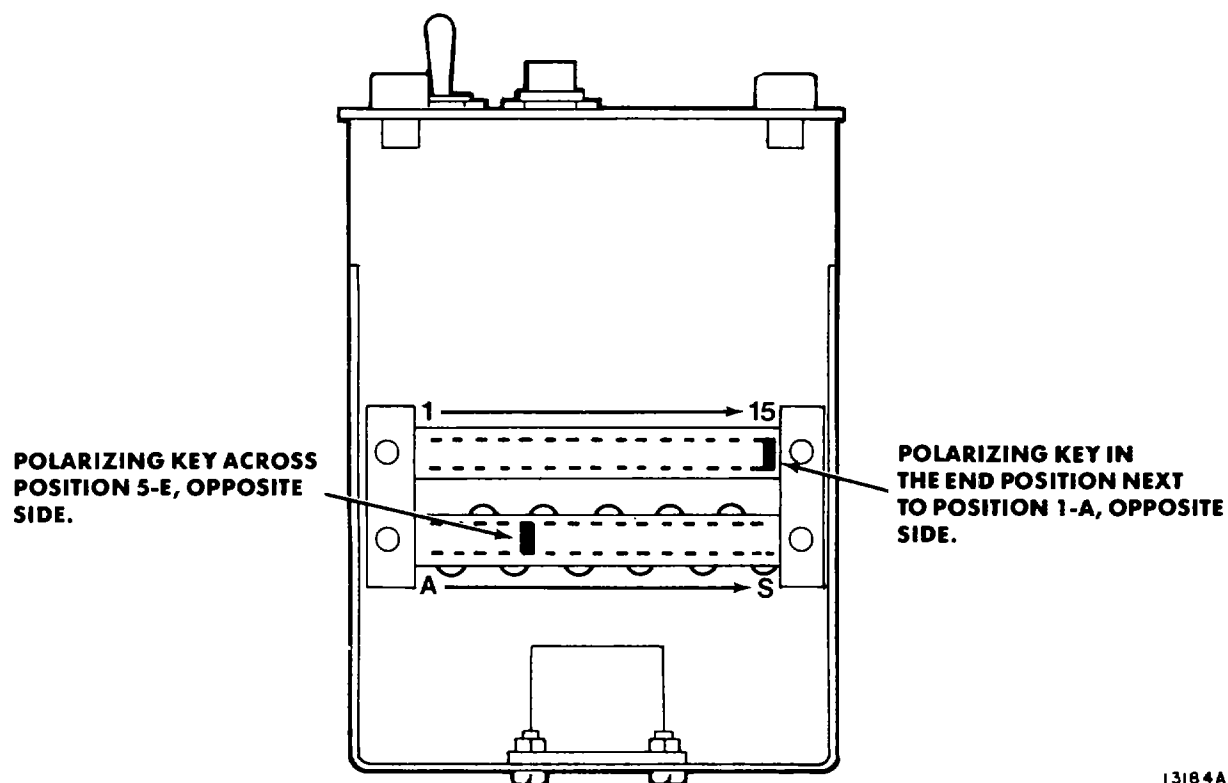
(7) Install contacts (18) in connector (16).

(8) Install connector (16) and two lug terminals (19) using four screws (21) and self-locking nuts (20).



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Figure 9-6D. Removal of finish for electrical bonding



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Figure 9-6E. Gunners master caution panel assembly polarizing keys locator

(9) Install polarizing keys (23) in receptacle connectors (22). For positions refer to figure 9-6E.

(10) Solder wires to receptacle connectors (22). Install two receptacle connectors (22) using four screws (25) and self-locking nuts (24).

(11) Position housing assembly (14) in main housing (31) and install with four screws (15).

(12) Install two printed circuit boards (9 and 11) in receptacle connectors (22).

(13) Attach identification plate (8) to top end cover (6).

(14) Install two end covers (6) on main housing (31) using eight screws (7).

(15) Install following components as a stack in lens retainer (2).

(a) Install gray filter (3), dull side out.



Ensure correct legends are installed in correct indicator light positions. If legends are installed in wrong positions, air crew will receive false information during In flight malfunctions.

(b) Install correct legend (4). Refer to figure 9-5D.

(c) Install white filter (5, figure 9-6A).

(16) Carefully hold stack in lens retainer (2). Install lens retainer (2) on reflector assembly (40), left side first, then pushing on right side until it engages.

(17) Press in on left edge of each reflector assembly (40), causing them to pivot outward. Install two lamps (1) in each indicator position. Close reflector assembly (40).

j. Installation

(1) Connect electrical connector to back of unit.

(2) Tighten four turnlock stud assemblies to install unit in panel of helicopter.

9-50. Rpm Limit Warning System.

The rpm limit warning system includes a 5 ampere circuit breaker located in dc circuit breaker panel (A10), a detector unit (DS13) in left forward side of pilots section, a warning light (DS7) on pilots instrument panel, an RPM WARNING switch (S7) in pilots engine control panel (A2), an audio oscillator device, electrical wiring, and connectors. Power is supplied by a 28-volt dc essential bus. Also included in the rpm limit warning system are two terminal boards, gunners headset (TB22) located on pilots section, left forward, and pilots headset (TB23) located in pilots section, right aft. The rpm limit detector, operating on dc power, senses and interprets rotor and engine rpm through connection to tachometer circuits. If the rotor rpm exceeds

normal limit, warning light will illuminate. When both rotor or engine rpm reaches low limit, an audio signal is produced in pilots and gunners headsets and warning light is illuminated. For starting and ground operation, audio tone can be turned off by the RPM WARNING switch. Before installation, the rpm warning system detector is adjusted. Readjustment may be required whenever a tachometer generator is replaced, due to tolerances on tachometer components. Replacement of an engine tachometer generator will not require a check of rotor high rpm setting.

a. *Functional Test (Low Rpm Warning).* Test the rpm limit warning system upon replacement of the limit warning detector, rotor tachometer generator or power turbine tachometer generator, by conducting following steps with helicopter engine running:

(1) Position the RPM WARNING audio switch (S7) on the pilots engine control panel to RPM WARNING.

(2) Adjust for an engine speed of approximately 6300 rpm (corresponds to 310 rotor rpm) and check that the red RPM limit warning light on the instrument panel is off and that the audio warning signal is not audible in the pilots or gunners headsets.

(3) Decrease engine speed very slowly to the point where the RPM limit warning light illuminates and a swept-frequency audio warning signal (series or audio bursts) is audible in the pilots and gunners headsets. This point should be at an engine speed of 6200 ± 100 rpm (corresponds to 305 ± 5 rotor rpm).

(4) Position the RPM WARNING audio switch (S7) to OFF. The audio signal in the headsets should cease.

(5) Adjust for an engine speed below 6000 rpm (corresponds to 295 rotor rpm), the RPM limit warning light should be illuminated, but the audio warning signal should not be audible in the pilots and gunners headsets.

(6) Increase the engine speed and verify that the RPM limit warning light extinguishes within the limits of 6200 ± 100 engine rpm (corresponds to 305 ± 5 rpm). The RPM WARNING audio switch should automatically return to RPM WARNING position.

b. *Functional Test. (High Rpm Warning.)*

(1) Position the RPM WARNING audio switch to the RPM WARNING position.

CAUTION

Do not exceed 15 psi torque pressure.

(2) With the rotor in flat pitch and the GOV AUTO/EMER governor switch set to EMER, slowly increase throttle until the RPM warning light illuminates. The warning light should illuminate at a rotor speed of 334 ± 5 rpm (corresponds to an engine speed of 6800 ± 100 rpm) and the audio warning signal should not be audible in the pilots and gunners headsets.

c. *Alignment of Low Rpm Warning.* If the rpm limit warning system does not meet the test requirements of paragraph 9-50a, align system in accordance with paragraph 9-50c(1) or 9-50c(2), whichever is applicable. If Saturn Model 2390-2 or Symbolic Display Model 700348 appears on the detector nameplate (figure 9-7), align system in accordance with paragraph 9-50c(1). All others are designed by Bell Helicopter Company (BHC) (figure 9-8) and are aligned in accordance with paragraph 9-50c(2).

CAUTION

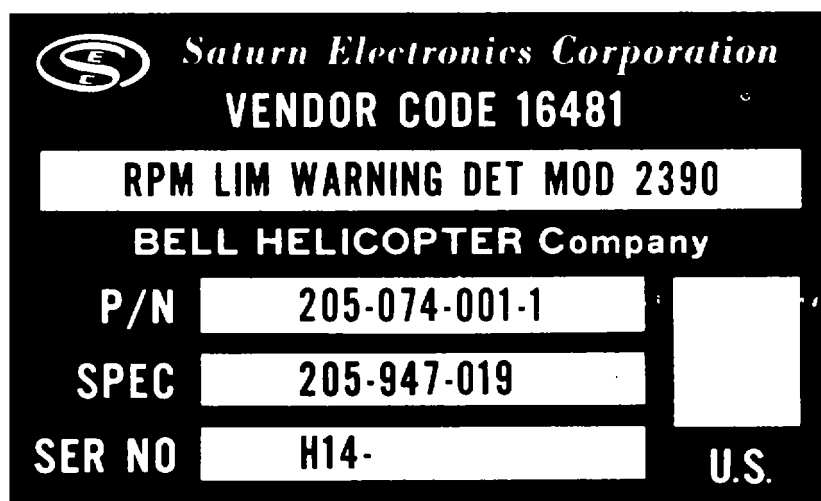
Use caution in making adjustments as excessive turning of screw or slotted adjustment can damage box.

NOTE

To increase the rpm at which the warning light will illuminate, turn clockwise either R1, R2 or R3 (Saturn or BHC detectors) or ROTOR LOWER LIMIT, ROTOR HIGH LIMIT, or ENGINE LOW LIMIT slotted adjustments (Symbolic Display detectors). One half turn of the potentiometer shaft will cause a change of 5 rotor rpm or 100 engine rpm. Do not adjust R4 and R5.

(1) *Alignment of Saturn or Symbolic Display Detectors.*

(a) Loosen screws, and slide cover strips aft to expose potentiometer shaft.



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Figure 9-7. Rpm limit warning detector nameplate (Saturn)

(b) Install jumper lead between TP6 and TP8 on Saturn detectors, or position ROTOR NORMAL/DISABLE switch to DISABLE on Symbolic Display detectors to deactivate the rotor low rpm signal. (See figure 9-9.)

(c) Start helicopter engine and increase engine speed to approximately 6300 rpm (corresponds to 310 rotor rpm).

(d) Slowly decrease engine speed to 6200 rpm (corresponds to 305 rotor rpm).

(e) If, following step (d), the RPM limit warning light is illuminated, turn T3 (Saturn detectors) or ENGINE LOWER LIMIT (Symbolic Display detectors) slowly clockwise until the warning light extinguishes and then very slowly clockwise until the warning light again illuminates. If, following step (d), the warning light is extinguished, turn R3 (Saturn detectors) or ENGINE LOWER LIMIT (Symbolic Display detectors) slowly clockwise until the warning light just illuminates.

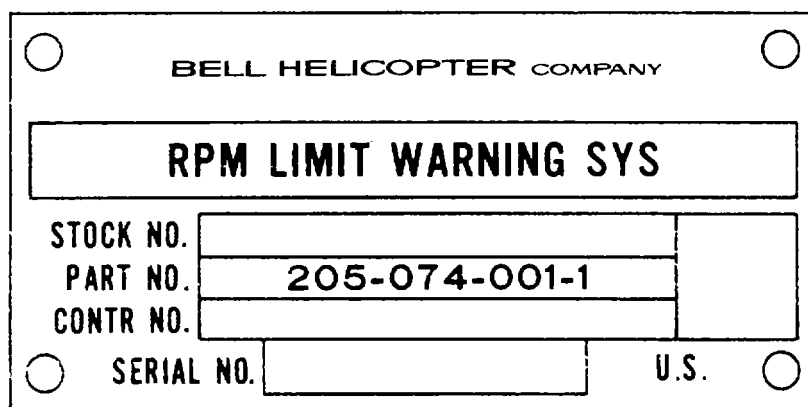
(f) Vary the engine speed slowly above and below 6200 rpm (corresponds to 305 rotor rpm) while observing the warning light. Verify that the warning occurs at an engine speed of 6200 ± 100 rpm (corresponds to 305 ± 5 rotor rpm); if not, repeat steps (d), (e), and (f).

(g) On Saturn detectors, remove jumper between TP6 and TP8, and install jumper between TP7 and TP8 (see figure 9-9) to deactivate the engine low rpm signal. On Symbolic Display detectors, position the ROTOR NORMAL/DISABLE switch to NORMAL and the ENGINE NORMAL/DISABLE switch to DISABLE (see figure 9-9) to deactivate the engine low rpm signal.

(h) Adjust for a rotor speed of 305 rpm (corresponds to 6200 engine rpm).

(i) If, following step (h), the warning light is illuminated, turn R1 (Saturn detectors) or ROTOR LOWER LIMIT (Symbolic Display detectors) slowly counterclockwise until the warning light just extinguishes, then very slowly clockwise until the light again illuminates. If, following step (h), the warning light is extinguished, turn R1 (Saturn detectors) or ROTOR LOWER LIMIT (Symbolic Display detectors) very slowly clockwise until the light just illuminates.

(j) Vary rotor speed above and below 305 rpm (corresponds to 6200 engine rpm) while observing the warning light. Verify that warning occurs at 305 ± 5 rotor rpm (corresponds to 6200 ± 100 engine rpm). If light does not illuminate, repeat steps (h), (i), and (j).



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Figure 9-8. Rpm limit warning detector nameplate (Bell)

(k) Remove jumper from Saturn detector. Return both test switches to NORMAL position on Symbolic Display detector.

(2) *Alignment of BHC Designed Detectors.*

(a) Disengage the RPM WARN SYS circuit breaker and disconnect the helicopter electrical harness from the rpm limit warning detector.

NOTE

If desired, the detector may be detached from the frame of the helicopter and moved to a more accessible location during the alignment procedure.

(b) Remove the cover of the detector and connect an alignment test set to the helicopter electrical harness and rpm limit warning detector as shown in figure 9-10, making certain that the correct lead is attached to TP1 and TP2 of the detector.

NOTE

A test light, which functions simultaneously with the helicopters RPM LIMIT warning light during calibration, is provided on the test harness so as to be readily visible to the electronic mechanic making adjustment.

(c) Engage the RPM WARN SYS circuit breaker and position RPM WARNING audio switch to RPM WARNING. An audio warning should be present in both the pilots and gunners headsets.

(d) Start the helicopter engine and increase engine speed to approximately 6300 rpm (corresponds to 310 rotor rpm). The audio signal in the headsets should cease.

(e) Position the ENGINE-NORMAL-ROTOR switch on the test set to the ENGINE position.

(f) Decrease the engine speed to 6200 rpm (corresponds to 305 rotor rpm).

(g) If, following step (f), the warning light is illuminated, turn R3 slowly counterclockwise until the warning light just extinguishes and then very slowly clockwise until the light again illuminates. If, following step (f), the warning light is extinguished, turn R3 very slowly clockwise until the light just illuminates.

(h) Vary the engine speed slowly above and below 6200 rpm (corresponds to 305 rotor rpm) while observing the warning light. Verify that the warning occurs at an engine speed of 6200 ± 100 rpm (corresponds to 305 ± 5 rotor rpm); if not, repeat steps (f), (g), and (h).

(i) Place the ENGINE-NORMAL-ROTOR switch on the test set in the ROTOR position.

(j) Adjust for a rotor speed of 305 rpm (corresponds to 6200 engine rpm).

(k) If, following step (j), the warning light is illuminated turn R1 slowly counterclockwise until the light just extinguishes, then very slowly

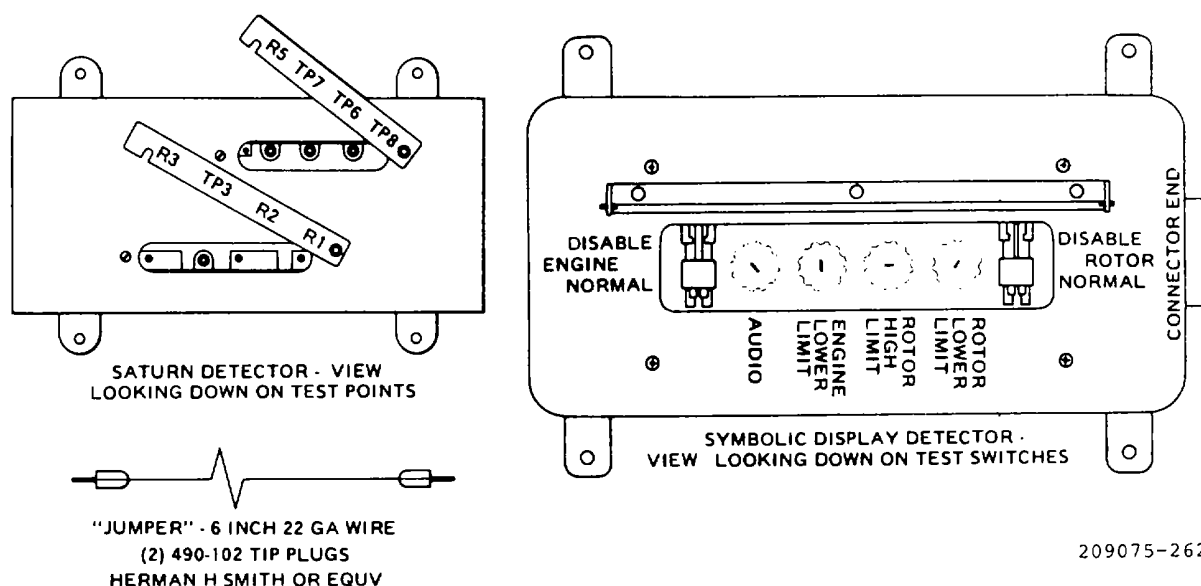


Figure 9-9. Alignment of rpm limit detector (Saturn or symbolic)

clockwise until the light illuminates. If, following step (j), the warning light is extinguished, turn R1 very slowly clockwise until the light just illuminates.

(1) Vary the rotor speed above and below 305 rpm (corresponds to 6200 engine rpm) while observing the warning light. Verify that warning occurs at 305 ± 5 rotor rpm (corresponds to 6200 ± 100 engine rpm). If not, repeat steps (j), (k), and (1).

(m) Position the ENGINE-NORMALROTOR switch on the test set to the NORMAL position.

NOTE

Alignment test set shall remain connected for the high rpm warning test.

d. *Alignment of High Rotor Rpm Warning.* If the rpm limit warning system does not meet the requirements of paragraph 9-50b, align system in accordance with the procedure of paragraph 9-50d (1) or 9-50d(2), whichever is applicable. If Saturn Model 2390-2 (figure 9-7) appears on the detectors nameplate, the system shall be aligned in accordance with following step (1). All others are BHC designed (figure 9-8) and shall be aligned in accordance with following step (2).

NOTE

For this check only, a steady state rpm of up to 6900 output shaft speed is permissible and is not to be considered an engine overspeed as long as 15 psi torque meter pressure is not exceeded. The collective pitch must be at the full down position at all times during this check.

(1) *Alignment of High Rotor Rpm Warning Saturn Designed Detectors.* (See figure 9-9.)

(a) With the rotor in flat pitch and the GOV AUTO/EMER switch set to EMER, slowly increase throttle until the rotor speed is 334 ± 5 rpm (corresponds to an engine speed of 6800 ± 100 rpm).

(b) If, following step (1), the warning light is illuminated, turn R2 clockwise until the light just extinguishes, then very slowly counterclockwise until the light just illuminates. If, following step (1), the warning light is extinguished, turn R2 very slowly counterclockwise until the warning light just illuminates.

(c) Vary the engine speed to verify that the warning light illuminates and that audio warning does not occur at 334 ± 5 rotor rpm (corresponds to 6800 ± 100 engine rpm). If the warning light does not illuminate, repeat preceding steps (a), (b), and (c).

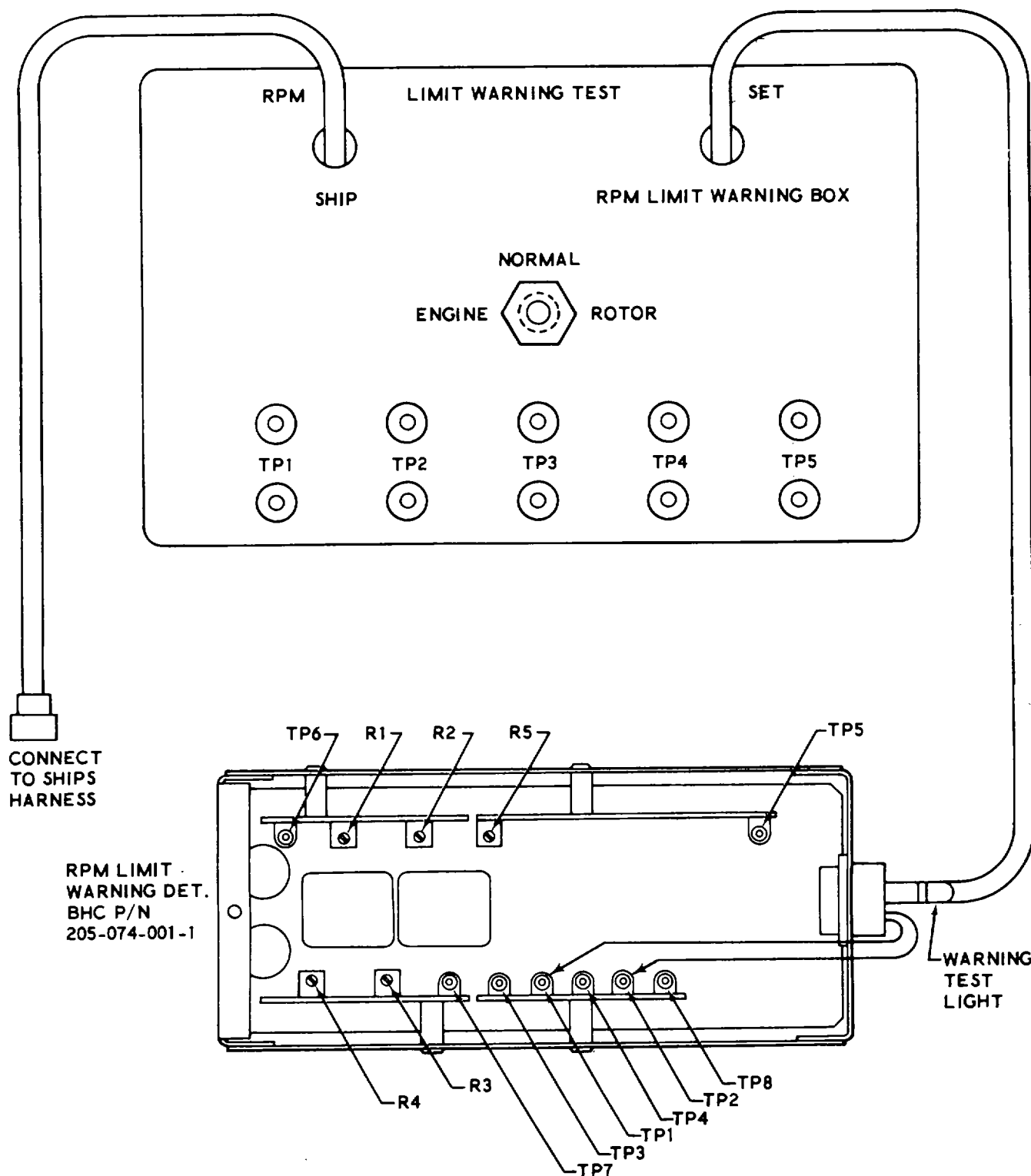
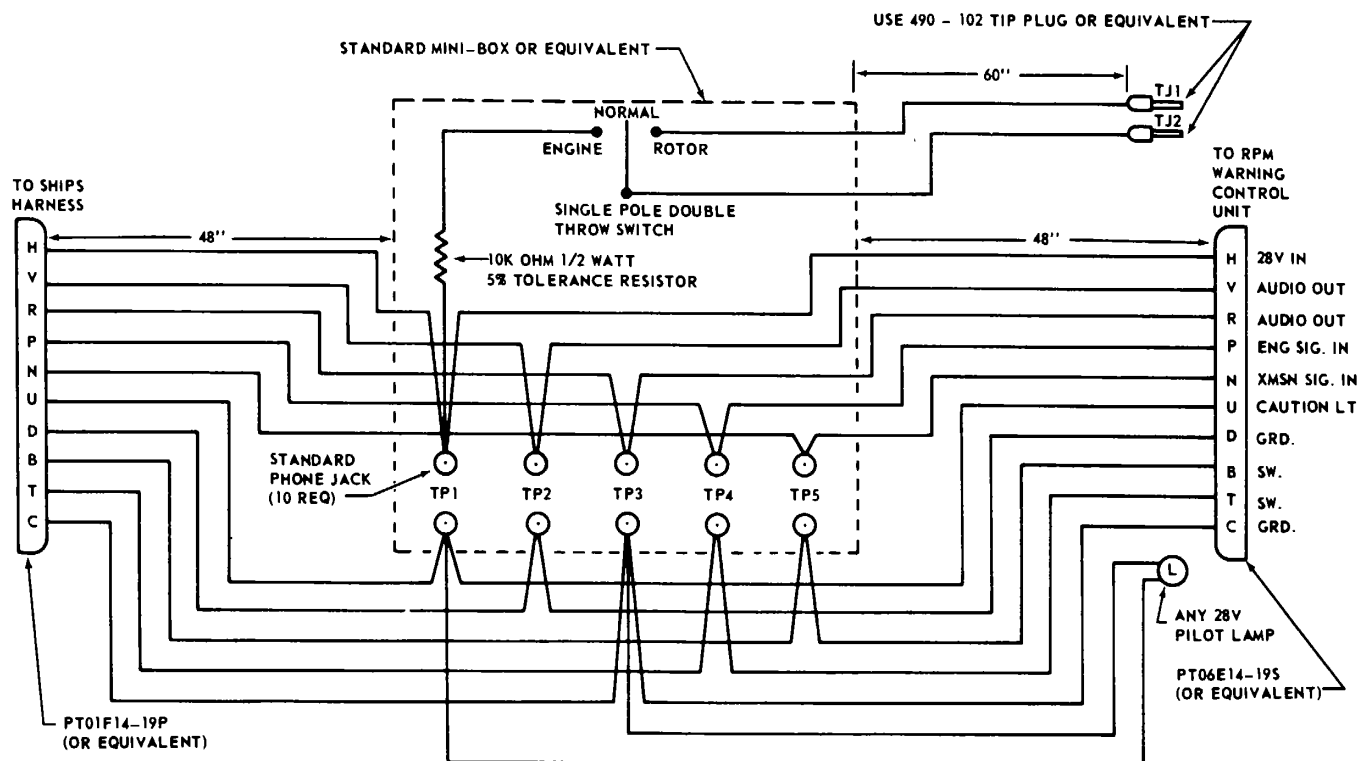


Figure 9-10. Alignment of rpm limit detector (Bell) (Sheet 1 of 2)

**Note**

Wire - 22 gage stranded.

Test points (TP) are provided for signal monitoring or continuity checking as necessary.

Note

With Engine - NORMAL ROTOR SELECTOR switch set to rotor position, TJ1 and TJ2 may be used as jumper when testing Saturn RPM warning system.

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Figure 9-10. Alignment of rpm limit detector (Bell) (Sheet 2 of 2)

(d) Repeat the low and high rpm warning tests in the manner specified.

(e) Close detector cover strips and tighten screws.

(2) *Alignment of High Rotor Rpm Warning BHC Designed Detectors.* (See figure 9-10.)

NOTE

The high engine potentiometer (R4) is factory adjusted full clockwise and is not to be adjusted.

(a) Position the ENGINE-NORMAL ROTOR switch on the test set to the ROTOR position.

(b) With the rotor in flat pitch and the GOV AUTO/EMER switch set to EMER, slowly increase throttle until the rotor speed is 334 rpm (corresponds to an engine speed of 6800±100rpm).

(c) If, following step (b), the RPM warning light is illuminated, turn R2 clockwise until the light just

extinguishes, then very slowly counterclockwise until the light just illuminates. If, following step (b), the warning light is extinguished, turn R2 very slowly counterclockwise until the warning light just illuminates.

(d) Vary the engine speed to verify that the warning light illuminates and that audio warning does not occur at 334 ± 5 rotor rpm (corresponds to 6800 ± 100 engine rpm. If the warning light does not illuminate, repeat preceding steps (b), (c), and (d).

(e) Disengage the RPM WARN SYS circuit breaker.

(f) Disconnect and remove the alignment test set and reinstall the rpm limit warning detector.

(g) Engage the RPM WARN SYS circuit breaker and repeat the low and high rpm warning tests in the manner specified.

e. Troubleshooting. (See figure F-27 and table 9-9.)

Table 9-9. Troubleshooting - RPM Limit Warning System

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. No audio tone is present in pilot or copilot headsets; engine not running and rpm warning light is illuminated.

STEP 1. Check for defective RPM WARNING switch (S7).

Replace switch if defective. (Refer to paragraph 9-6.)

STEP 2. Check for defective rpm limit warning detector.

Replace rpm limit warning detector if defective. (Refer to paragraph 9-51.)

2. Placing RPM WARNING switch (S7) to OFF does not eliminate audio tone in headsets.

STEP 1. Check for defective RPM WARNING switch (S7).

Replace switch if defective. (Refer to paragraph 9-6.)

Table 9-9. Troubleshooting - RPM Unit Warning System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

3. Rpm warning light (DS7) does not illuminate when engine is not running. Audio tone present in headsets.

STEP 1. Check for defective rpm limit warning detector (DS13).

Replace rpm limit warning detector if defective. (Refer to paragraph 9-8.)

4. Rpm warning light (DS7) does not illuminate, no audio tone present in headsets when engine is not running.

STEP 1. Check for defective RPM WARN circuit breaker (CB 15).

Replace circuit breaker if defective. (Refer to paragraph 9-5.)

STEP 2. Check for defective rpm limit warning detector (DS13).

Replace rpm limit warning detector if defective. (Refer to paragraph 9-51.)

9-51. Rpm Unit Warning Detector.**a. Cleaning.**

(1) Remove moisture and loose dirt with a clean, soft cloth.



Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

(2) Remove grease, fungus, and ground-in dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

(3) Remove dirt from electrical connectors with a bristle brush.

b. Inspection.

(1) Inspect rpm limit warning detector for cracked or distorted case.

(2) Check for bent or broken connector pins.

(3) Check for proper operation.

c. Bench Test and Adjustment (A VIM).**NOTE**

The rpm test set used in the following tests may be locally fabricated. See figure F-28 for internal schematic of test set.

Test each rpm limit warning detector in accordance with following step (1) or (2), whichever is applicable. If Saturn Model 2390-2 or Symbolic Display Model 700348 appears on the detectors nameplate, test the detector in accordance with following step (1). All others are BHC designed; test these indicators in accordance with following step (2).

(1) Saturn or Symbolic Display Detectors.

NOTE

The detectors described in the following procedure are made by two different manufacturers. When a Symbolic Display detector is installed, switches

are used to jumper the test points. Saturn detector test points are jumpered by the use of test leads. When the operational test calls for jumpers, and a detector made by Symbolic Display is installed, position the switches to the position indicated below:

Jumper between TP6 and TP8 - ROTOR NORMAL/DISABLE switch to DISABLE.

Jumper between TP7 and TP8 - ENGINE NORMAL/DISABLE switch to DISABLE.

R₁, R₂, R₃ on the symbolic display detector are marked as indicated below.

R-1 - ROTOR LOWER LIMIT.

R-2 - ROTOR HIGH LIMIT.

R-3 - ENGINE LOWER LIMIT.

R-5 - AUDIO.

(a) Loosen detector cover strip screws and move cover strips to expose test points and adjustment potentiometers.

(b) Connect detector to the bench test equipment as shown in figure 9-11. (See figure F-28 for internal schematic of rpm test set.) Set initial control positions on the test as follows:

<u>Control</u>	<u>Position</u>
PWR ON/OFF	OFF
UN-1/OH-4	UN-1
ENGINE SPEED	FULLY COUNTERCLOCKWISE
ROTOR SPEED	FULLY COUNTERCLOCKWISE
AUDIO ON/OFF	ON
SCOPE INPUT	PILOT

(c) Energize the test equipment and allow a sufficient warmup period.

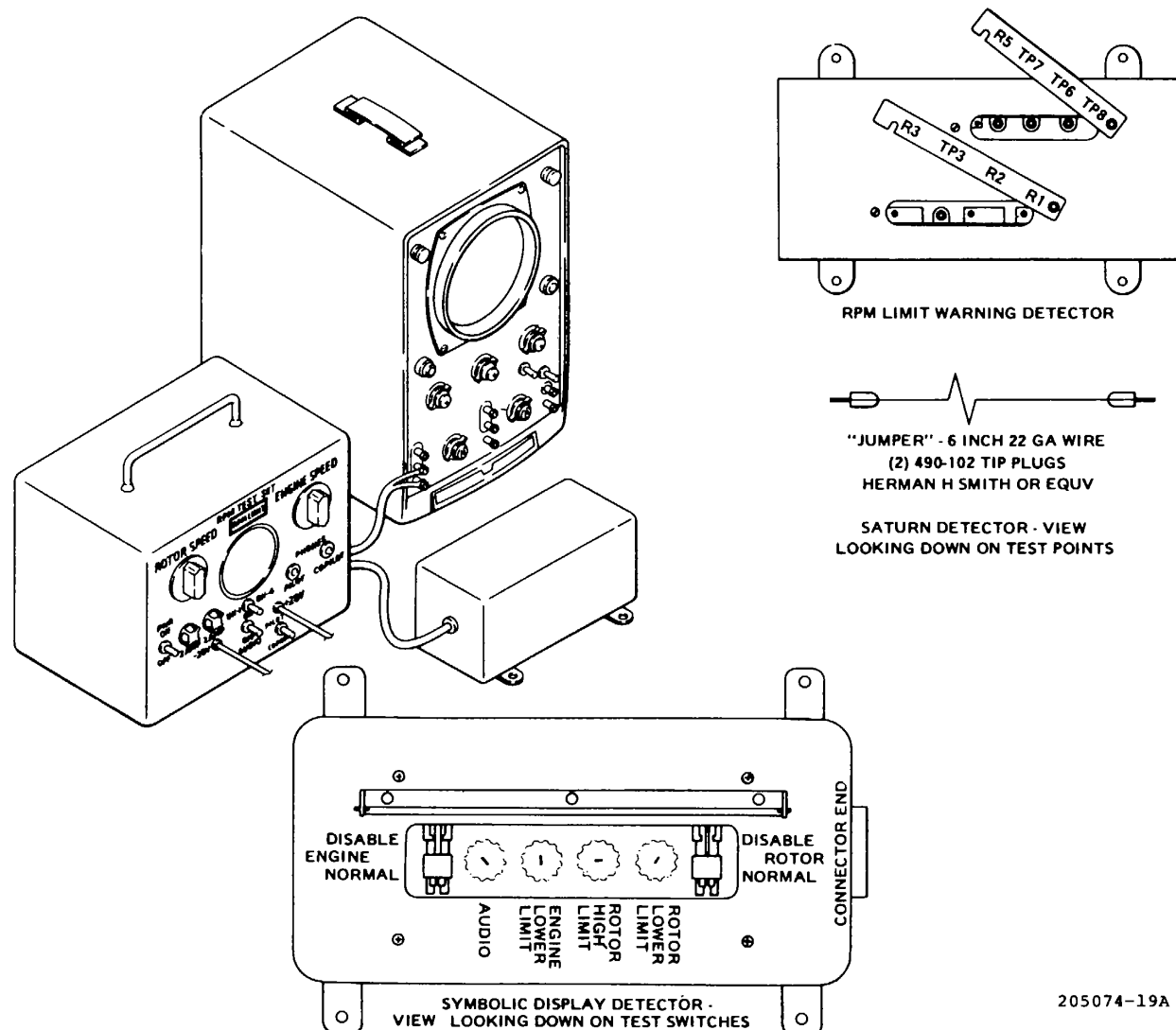


Figure 9-11. Bench test set-up for Saturn and Symbolic Display designed detectors

(d) Apply 27.5 Vdc power to the dc power packs on the front of the test set. Observe that the warning light on the test set is illuminated and that a sweeping audio signal is displayed on the oscilloscope for both the PILOT and COPILOT (gunner) positions of the scope input switch.

(e) Connect a headset to the COPILOT (gunner) phone jack and determine that the aural signal is of good quality. Disconnect headset.

(f) Repeat step (e) with headset plugged into the PILOT phone jack.

(g) On the Saturn detector, attach a test lead between TP7 and TP8 to deactivate the engine channel low rpm circuits. If a Symbolic Display detector is used, position the ENGINE NORMAL/DISABLE switch to DISABLE.

(h) On the test set, adjust for a simulated rotor speed of 300 rpm and an engine speed of 6100 rpm. If the warning light is illuminated, adjust R1 (Saturn detector) or ROTOR LOWER LIMIT (Symbolic Display detector) counterclockwise until the light just extinguishes, and then very slowly clockwise until the light just illuminates. With the light illuminated, an audio signal must be displayed on the oscilloscope for both the PILOT and COPILOT (gunner) positions of the scope input switch.

(i) Position audio ON/OFF switch to OFF. The sweeping audio signal must cease.

(j) Slowly increase simulated rotor speed through 300 rpm. Observe that the audio switch automatically returns to the ON position when the warning light extinguishes.

(k) If, after step (j), the warning light is illuminated, adjust R2 (Saturn detector), or ROTOR HIGH LIMIT (Symbolic Display detector), clockwise until the light just extinguishes, then very slowly counterclockwise until the light just illuminates.

(l) If, after step (j), the warning light is extinguished, adjust R2 (Saturn detector), or ROTOR HIGH LIMIT (Symbolic Display detector), very slowly counterclockwise until the light just illuminates.

(m) Increase simulated rotor speed to 334 rpm.

(n) Observe that an audio signal is not displayed on the oscilloscope for either PILOT or COPILOT (gunner) positions of the scope input switch.

(o) Adjust for a simulated rotor speed of 315 rpm. Observe that the warning light is extinguished and that audio signal is not displayed on the oscilloscope for either the PILOT or COPILOT (gunner) positions of the scope input switch.

NOTE

Step (p) checks the engine channel tachometer failure circuits.

(p) Momentarily adjust for a simulated engine speed of 0 rpm. Observe that the warning light illuminates and that audio signal is displayed on the oscilloscope for both PILOT and COPILOT (gunner) positions of the scope input switch.

(q) If a Saturn detector is installed, remove the jumper lead between TP7 and TP8. Reconnect the jumper between TP6 and TP8 to deactivate the rotor channel rpm circuits. If a Symbolic Display detector is installed, reposition the ENGINE NORMAL/DISABLE switch to NORMAL. Position the ROTOR NORMAL/DISABLE switch to DISABLE.

(r) With the simulated rotor speed still at 315 rpm, adjust for a simulated engine speed of 6100 rpm.

(s) If the warning light is illuminated after completion of step (r), adjust R3 (Saturn detector) or ENGINE LOWER LIMIT (Symbolic Display detector), counterclockwise until the light just illuminates.

(t) If, after step (r), the warning light is extinguished, adjust R3 (Saturn detector), or ENGINE LOWER LIMIT (Symbolic Display detector), clockwise until the light just illuminates.

(u) While the warning light is illuminated, observe that audio signal is displayed on the oscilloscope for both the PILOT and COPILOT (gunner) positions of the scope input switch.

(v) Adjust for a simulated engine speed of 6400 rpm. Observe that the warning light is extinguished and that the audio signal is not

displayed on the oscilloscope for either the PILOT or COPILOT (gunner) positions of the scope input switch.

NOTE

Step (w) checks the audio portion of the rotor channel tachometer failure circuits.

(w) Momentarily adjust the simulated rotor speed to 0 rpm. Observe that the warning light is illuminated and that audio signal is displayed on the oscilloscope for both PILOT and COPILOT positions of the scope input switch.

(x) Remove the jumper lead between TP6 and TP8, on the Saturn detector. If a Symbolic Display detector is installed, position the ROTOR NORMAL/DISABLE switch to NORMAL. Adjust rotor and engine speed controls on test set fully counterclockwise.

(y) Position scope input switch to PILOT and adjust R5 (Saturn detector), or AUDIO (Symbolic Display detector), for a waveform of 0.5 volts peak-to-peak. Position scope input switch to COPILOT (gunner) and observe that the indicated waveform is no less than 0.25 volts peak-to-peak, and not more than 0.75 volts peak-to-peak.

(z) Disconnect detector from test set and reassemble unit.

(2) BHC Designed Detectors.

(a) Remove cover from detector.

(b) Connect detector to the bench test equipment as shown in figure 9-12. Set initial control position on the test set as follows:

<u>Control</u>	<u>Position</u>
PWR ON/OFF	OFF
UN-1/OH-4	UH-1
ENGINE SPEED	FULLY COUNTERCLOCKWISE
ROTOR SPEED	FULLY COUNTERCLOCKWISE
AUDIO ON/OFF	ON
SCOPE INPUT	PILOT

(c) Energize the test equipment and allow a sufficient warmup period.

(d) Apply 27.5 Vdc power to the dc power jacks on the front of the test set. Observe that the warning light on the test set is illuminated and that a sweeping audio signal is displayed on the oscilloscope for both the PILOT and COPILOT (gunner) positions of the scope input switch.

(e) Connect a headset to the COPILOT (gunner) phone jack and determine that the aural signal is of good quality. Disconnect headset.

(f) Repeat step (e) with headset connected to the PILOT phone jack.

(g) Attach a test lead from TP1 to TP2 on the detector to deactivate the engine module.

(h) Adjust for a simulated rotor speed of 300 rpm on the test set. If the warning light is illuminated, adjust R1 counterclockwise until the light just extinguishes, and then very slowly clockwise until the light just illuminates. With the light illuminated, an audio signal must be displayed on the oscilloscope for both the PILOT and COPILOT (gunner) positions of the scope input switch.

(i) Position audio ON/OFF switch to OFF. The sweeping audio signal shall cease.

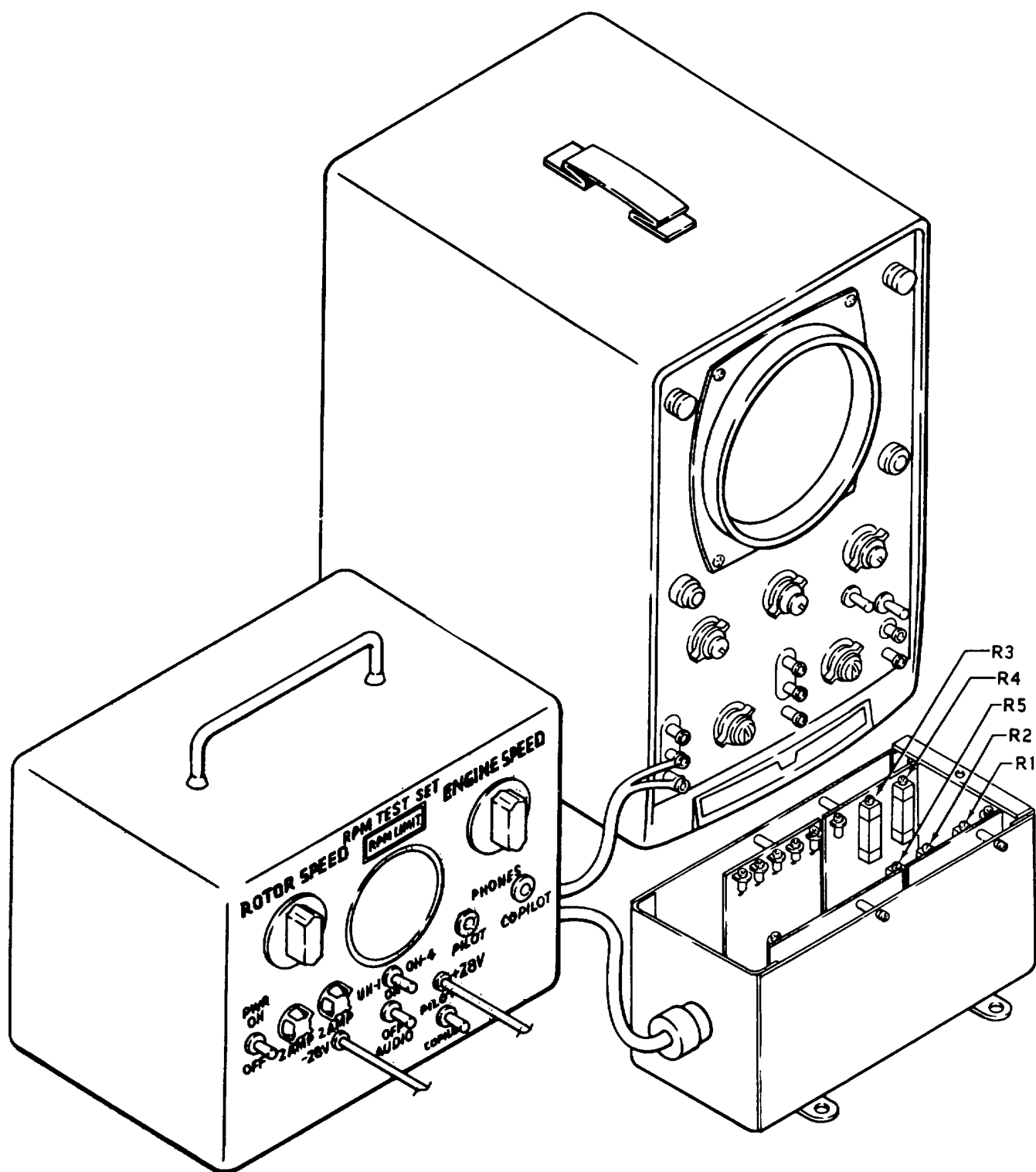
(j) Slowly increase simulated rotor speed through 300 rpm. Observe that the audio switch automatically returns to the ON position when the warning light extinguishes.

(k) If, after step (j), the warning light is illuminated, adjust R2 clockwise until the light just extinguishes, and then very slowly counterclockwise until the light just illuminates.

(l) If, after step (j), the warning light is extinguished, adjust R2 very slowly counterclockwise until the light just illuminates.

(m) Increase simulated rotor speed to 334 rpm.

(n) Observe that an audio signal is not displayed on the oscilloscope for either PILOT or COPILOT (gunner) positions of the scope input switch.



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Figure 9-12. Bench test set-up for BHC designed detectors.

(o) Remove the jumper from TP1 and TP2, and connect a test lead with a series 10,000 ohm resistor from the +27.5 Vdc source to TP1. This will deactivate the rotor module.

(p) Adjust for a simulated engine speed of 6000 rpm.

(q) If, after step (p), the warning light is illuminated, adjust R3 counterclockwise until the light just extinguishes, and then very slowly clockwise until the light just illuminates.

(r) If, after step (p), the warning light is extinguished, adjust R3 clockwise until the light just illuminates.

(s) Adjust for a simulated engine speed of 6200 rpm. Observe that the warning light is extinguished.

NOTE

The high engine potentiometer, R-4, is factory adjusted fully clockwise and is not to be adjusted.

(t) Remove the test lead and series resistor from TP1 and the +27.5 Vdc source. Adjust the engine and rotor speed controls fully counterclockwise.

(u) Position scope input switch to PILOT and adjust R5 for a waveform of 0.50 volt peak-to-peak. Position scope input switch to COPILOT and observe that the indicated waveform is no less than 0.25 volts peak-to-peak and not more than 0.75 volts peak-to-peak.

(v) Disconnect detector from test set and reassemble unit.

d. Removal.

(1) Remove attaching hardware and connector.

(2) Remove detector.

e. Repair or Replacement.

(1) Tighten or repair any loose or defective mounting hardware or connector.

(2) Replace detector if any other inspection requirements are not met.

f. Installation.

(1) Position detector into place and install mounting hardware.

(2) Connect connector.

9-52. Position Lights System.

The position lights circuit includes a 5 ampere POS LTS circuit breaker located in dc circuit breaker panel (A10), and two selector switches (S11 and S12), located on the pilots lighting control panel (A4). A flasher (DS14) is mounted in pilots section, right well. The position lights consist of a red light (DS8), a green light (DS9), and an amber light (DS10). The red light is mounted in left wing tip, the green light is mounted in right wing tip, and the amber light is located on vertical fin of tailboom. Switch (S11) controls OFF/STEADY/FLASH and switch (S12) controls BRT/DIM position. The dimming circuit is provided by a dimming resistor (R6) located adjacent to TB12, which is located in pilots section, right well.

a. Functional Test.

(1) Close POS LTS circuit breaker. Place position lights switch (S11) to STEADY. Position BRT/DIM switch (S12) to BRT. Check that the red and green navigation lights and tail light are energized and are on bright.

(2) Position BRT/DIM switch to DIM. Check that the previous lights are dim.

(3) Position POSITION LTS switch to FLASH. Check that the red and green position lights, and the tail light are all on dim and flash at a rate of approximately 85 to 15 cycles per minute.

(4) Position BRT/DIM switch to BRT and repeat step (3). Check that lights flash as before except that lights are brighter than that observed in preceding step (3).

(5) Open POS LIGHTS circuit breaker.

b. *Troubleshooting.* (See figure F-6 and table 9-10).

Table 9-10. Troubleshooting - Position Lights System

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Lights (DS8, DS9, DS18, (RH) and DS18 (LH)) fail to illuminate brightly.

STEP 1. With switch (S11) to STEADY and switch (S12) to BRT check for 28 Vdc essential bus voltage on terminals 5 and 6 of switch (S11).

Replace switch (S11) if voltage is not present on terminal 6. (Refer to paragraph 9-6.)

STEP 2. With switch (S11) to STEADY and switch (S12) to BRT, check for 28 Vdc essential bus voltage on terminals 1 and 2 of switch (S12).

2. One light is dim or intermittent.

STEP 1. Determine if light is properly grounded.

Remove light, clean ground, replace light. (Refer to paragraph 9-63.)

3. One light does not illuminate.

STEP 1. Check whether bulb is burned out and check lamp socket for corrosion.

Clean lamp socket and/or replace light. (Refer to paragraph 9-53.)

3. Lights fail to dim when switch (S12) is placed to DIM.

STEP 1. Check dimming resistor (R6).

Replace dimming resistor (R6) if it is defective. (Refer to paragraph 9-4.)

4. Lights fail to flash when switch (S11) is placed to FLASH.

STEP 1. Determine if position lights flasher is defective.

Replace flasher if defective. (Refer to paragraph 9-64.)

9-53. Position Lights.*a. Cleaning.*

(1) Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

(2) Remove grease, fungus, and ground-in dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

(3) Remove dirt from electrical connectors with a bristle brush.

b. Inspection. Inspect lights for corroded lamp socket terminals, shorted or broken wires, cracked lens, burned out lamp bulbs, or improper bonding of light case to airframe.

c. Removal.

(1) Check that all electrical power is OFF.

(2) Remove cover retaining screw. Remove screws attaching light assembly to bracket, pull assembly from helicopter, and disconnect electrical connector. Lift light assembly from helicopter. Cover loose wire with tape.

d. Repair or Replacement.

Replace faulty or damaged component parts (lens, lamp bulbs, etc.). If light case is damaged beyond repair, complete unit must be replaced.

e. Installation.

(1) Remove tape from wire and connect wire to light. Secure light to adapter bracket with screws. Install cover with screw.

(2) Check operation of light.

9-54. Position Lights Flasher.*a. Cleaning.*

(1) Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

(2) Remove grease, fungus, and ground-in dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

(3) Remove dirt from electrical connectors with a bristle brush.

b. Inspection.

Inspect flasher case for dents or damage that would impair normal operation of the unit. Check connector for broken or corroded pins and cracked inserts.

c. Removal.

(1) Be sure all electrical power is OFF.

(2) Disconnect electrical connector. Remove mounting hardware and lift from compartment.

d. Repair or Replacement.

Replace item if inspection requirements are not met.

e. Installation.

(1) Position flasher in compartment and install mounting hardware.

(2) Connect electrical connector. Check for proper operation.

9-54A. NVO Position Lights System.

The NVG position lights circuit consists of a 5 ampere NVG POSITION LT circuit breaker located in the dc circuit breaker panel, a six position switch {OFF and 5 levels of brightness) located below pilot instrument panel and five position lights (one on each wing tip, one on each aft light fairing, and one on the tail fin fairing). The position lights are compatible for use with the night vision goggles.

a. *Functional Test.* Close the NVG POSITION LT circuit breaker. With the NVG POSITION LT switch in the OFF position, all NVG position lights should be off. As the NVG POSITION LT switch is rotated through the other five positions, all NVG position lights should be energized and increase in brightness with each step to the BRT position. Rotate the switch back through five steps, all NVG position lights should decrease in brightness and should be de-energized in the OFF position.

b. *Troubleshooting.* Refer to figure F-6A for wiring diagram. Use table 9-10A and perform checks as necessary to isolate trouble. In table 9-10A, tripped circuit breakers are omitted from indications of trouble. Such trouble is usually easily detected and corrected. Broken wiring is always a probable cause of circuit malfunction or failure and has not been included.

NOTE

Before using table 9-10A, be sure you have performed the functional test.

Table 9-10A. Troubleshooting - NVG Position Lights System

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Individual NVG position light fails to illuminate.

STEP 1. Check if light is burned out.

Replace NVG position light assembly (paragraph 9-54B.c.)

2. All NVG position lights fail to illuminate.

STEP 1. With the NVG POSITION LT circuit breaker closed and the NVG POSITION LT switch in the BRT position, check for 28 Vdc non-essential bus voltage on pins 11 and 16 of NVG position light switch.

Replace NVG position light switch If voltage is present on pin 11 but not present on pin 16.

3. No brightness differential between two or more steps of NVG position light switch.

STEP 1. With the NVG POSITION LT circuit breaker closed and the NVG POSITION LT switch selecting position 1, measure and record the Vdc level at pin 16 of NVG position light switch. Rotate NVG position light switch through each position toward BRT and record the Vdc level at pin 16 of NVG position light switch.

Replace appropriate resistor(s) if there is no voltage increase between steps.

4. NVG position lights do not turn off.

Replace NVG POSITION LT switch.

9-54B. NVG Position Lights.

- a. *Cleaning.*

(1) Remove moisture and loose dirt with a clean soft cloth.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

(2) Remove grease, fungus, and ground-in dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C 124).

b. Inspection. Inspect lights for corrosion, shorted or broken wires, cracked lens or frame, burned out light, or improper security of light assembly to airframe.

c. Removal. Remove two screws, washers and nuts. Disconnect wire splices and remove NVG position light.

d. Repair. Replace faulty or damaged components.

e. Installation. Remove excess sealant from around fixture location. Apply bead of sealing compound (C 117A) and install NVG position lights with two screws, washers, and nuts. Connect wire splices.

9-55. Anticollision Light System.

The anticollision light circuit consists of a circuit breaker, a switch (S13), and anticollision light assembly (DS11). Anticollision light is installed on pylon fairing. Circuit breaker and switch are on dc circuit breaker panel (A10) and pilots lighting control panel (A4) respectively.

a. Functional Test.

(1) Close ANTI-COLL LTS circuit breaker.

(2) Position ANTI-COLL LT switch (S13) to ON and check that lamp(s) illuminate and that the light rotates at approximately 45 rpm, giving 90 flashes per minute.

b. Troubleshooting. (See figure F-6 and table 9-11.)

Table 9-11. Troubleshooting - Anticollision Light System

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Anticollision light (DS11) fails to flash.

STEP 1. Set ANTI-COLLISION LT switch (S13) to ON. Check for 28 Vdc NON-ESNTL BUS voltage on terminals 1 and 2 of switch (S13).

Replace switch If voltage is not present on terminal 1. Replace bulb or light, as needed, if voltage is present. (Refer to paragraph 9-6 or 9-56.)

2. Anticollision light (DS11) fails to rotate.

STEP 1. Set ANTI-COLLISION LT switch (S11) to ON. Check for 28 Vdc NON-ESNTL BUS voltage on terminals A and B of light (DS11).

If voltage check indicates motor is defective, replace motor. (Refer to paragraph 9-56.)

9-56. Anticollision Light.*a. Cleaning.*

(1) Remove moisture and loose dirt with a clean, soft cloth.



Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

(2) Remove grease, fungus, and ground-in dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

(3) Remove dirt from electrical connectors with a bristle brush.

b. Inspection.

(1) Inspect light for broken cover, lens or open lamp filament.

(2) Inspect light for damaged case, or broken connector pins.

(3) Inspect motor for damage and proper operation.

c. Removal.

(1) Be sure that all electrical power is OFF.

(2) Remove mounting screws around base of light, lift light up, and disconnect electrical connector.

d. Repair or Replacement.

(1) Loosen screw securing lens cover retaining ring, lift lens from light base. Install and secure lamp, lens or cover in reverse order of removal procedure.

(2) Replace complete unit if inspection requirements are not met.

(3) Replace motor if defective.

e. Installation.

(1) Connect electrical connector to light and secure with lockwire.

(2) Place light in recess and install mounting screws.

(3) Check light for proper operation.

9-57. Searchlight System.

The searchlight (DS12) is located under the gunners section and the circuit consists of one controllable light, two circuit breakers located in the dc circuit breaker panel (A10), and two switches (S48 and S49) located on the pilots collective stick. Switch (S48) control extend,

retract, rotate right, and rotate left motion. Switch (S49) controls OFF, ON, and STOW functions.

CAUTION

Do not operate searchlight in areas of combustible material, such as tall grass, etc.

a. Functional Test.

(1) Close SEARCH LT PWR and SEARCH CONT circuit breakers. Position SEARCH LT switch (S49) to ON and check that search light illuminates. Return switch (S49) to OFF.

(2) Position four-way SEARCH LT switch (S48) to extend (fwd position). Check that light extends and is stopped by extend limit switch at approximately 120 degrees extension.

(3) Position switch (S48) to RETR (aft position). Check that light retracts.

(4) With light partially extended, position switch (S48) to L and check that light rotates to the left.

(5) Position switch (S48) to R and check that light rotates to the right.

(6) With light extended and rotated, position switch (S49) to STOW. Check that light retracts and is stopped by the retract limit switch and then rotates to its level stowed position and stops.

b. Troubleshooting. (See figure F-29 and table 9-12.)

Table 9-12. Troubleshooting - Searchlight System

NOTE

Before you use this table, be sure you have performed all normal operational checks.

Table 9-12. Troubleshooting - Searchlight System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Searchlight (DS12) inoperative.

STEP 2. Set SRCH LT switch (S49) to ON. Check for 28 Vdc NON-ESNTL BUS voltage on terminals 1 and 2 of switch (S49).

Replace switch (S49) if voltage is not present on terminal 1. (Refer to paragraph 9-6.)
2. Light dim, constantly or intermittently.

STEP 1. Check for proper grounding.

Remove light, clean ground and replace light. (Refer to paragraph 9-68.)
3. Light out.

STEP 1. Remove lamp and check for open filament and corrosion.

Replace lamp unit or clean terminals as needed. (Refer to paragraph 9-58.)

9-58. Searchlight.

- a. Cleaning.

(1) Remove moisture and loose dirt with a clean, soft cloth.
- WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

(2) Remove grease, fungus, and ground-in dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

(3) Remove dirt from electrical connectors with a bristle brush.
- b. Inspection.

(1) Check light for defective or broken sealed beam unit.

- (2) Check for loose connections, and damaged or defective component parts (terminal stripe, limit switches, drive motors, relays, etc.).
- c. Removal.

(1) Be sure all electrical power is OFF.

(2) Remove attaching screws from light assembly mounting plate; lower light and plate.

(3) Remove light mounting screws.

(4) Remove terminal cover, disconnect and protect wires.

(5) Remove light assembly.
- d. Repair or Replacement.

(1) Accomplish replacement of sealed beam lamp as follows. Remove three screws from lamp retainer ring and/or IR cover, remove ring, if installed, IR cover, and gasket, lift lamp and disconnect wiring.

NOTE

Observe position of lamp before removal and install new unit in same position using reverse order of removal procedure.

(2) Replace complete unit if inspection items in preceding step b(2) are not met.

e. Installation.

(1) Connect wires and install terminal cover and clamp.

(2) Position light on mounting plate; secure with mounting screws.

(3) Position plate and light assembly on fuselage and secure with mounting screws.

(4) Check light for proper operation.

9-58A. Skid Landing Light System.

The skid landing light circuit consists of a 20 ampere SKID LDG LT circuit breaker located in the dc circuit breaker panel, an on/off switch located on the left side of the pilots cockpit, and a landing light mounted on the left side of the forward crosstube assembly.

a. Functional Test. Close the SKID LDG LT circuit breaker. Place the SKID LDG LT switch in the ON position. Check that the skid landing light is energized. Return switch to OFF and open circuit breaker.

b. Troubleshooting. Refer to figure F-29 for wiring diagram. Use table 9-12A and perform checks as necessary to isolate trouble. In table 9-12A, tripped circuit breakers are omitted from indications of trouble. Such trouble is usually easily detected and corrected. Broken wiring is always a probable cause of a circuit malfunction or failure and has not been included.

NOTE

Before using table 9-12A, be sure you have performed the functional test.

Table 9-12A. Troubleshooting - Skid Landing Light System

CONDITION	TEST OR INSPECTION	CORRECTIVE ACTION
1. Skid landing light fails to illuminate.	STEP 1. Check if bulb is burned out and check lamp connections for corrosion. Clean lamp connections and/or replace bulb. STEP 2. With the SKID LDG LT circuit breaker closed and the SKID LDG LT switch in the ON position, check for 28 Vdc essential bus voltage on both sides of switch. Replace switch if voltage is present on wire SLB12 terminal of switch but not on wire SLC12 terminal.	
2. Skid landing light does not turn off.	Replace switch.	

9-58B. Skid Landing Light.

a. *Cleaning.*

(1) Remove moisture and loose dirt with a clean soft cloth.



Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

(2) Remove grease, fungus, and ground-in dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C 124).

(3) Remove dirt from electrical connections with a bristle brush.

b. *Inspection.* Inspect light for corroded lamp terminals, shorted or broken wires, burned out lamp bulb, or improper security of light assembly.

c. *Removal.* Remove screws and ring securing bulb in canopy and remove bulb. Disconnect wires from bulb terminals. Loosen compression nut on back of canopy and remove wires. Cover wire ends with tape (C132). Remove skid landing light assembly from crosstube.

d. *Repair.* Replace faulty or damaged component parts.

e. *Installation.*

(1) Secure skid landing light assembly to forward crosstube. Remove protective tape from wires. Insert wires through insulation sleeve RNF-100-1 (3 inches long) and secure wires in light canopy. Position insulation sleeve over compression nut and apply heat as necessary. Connect

wires to bulb terminals and place bulb in light canopy. Install bulb retaining ring.

(2) Check operation of light.

9-59. Transmission Oil Level Light.

The transmission oil level light (DS2) is located inside the transmission cowling on the right side of the helicopter. The light is used to illuminate the transmission sump area so that the transmission oil level sight gages will be visible when viewing through the transmission oil level sight glass. The light is powered from the battery system through a 10 ampere XMSN OIL LEVEL LT circuit breaker (CB64) located in the aft electrical compartment. Pressing the XMSN OIL LEVEL LT switch (S22), located beside the sight glass, illuminates the light. For additional information, refer to Chapter 7. Refer to paragraphs 9-4 and 9-5 for maintenance procedures.

a. *Functional Test.*

- (1) Close XMSN OIL LEVEL LT circuit breaker.
- (2) Press pushbutton switch (S22). Check

operation of the light through the sight glass in the right hand transmission cowling.

b. *Troubleshooting.* (See figure F-9 and table 9-13.)

Table 9-13. Troubleshooting - Transmission Oil Level Light

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Transmission oil level light (DS2) fails to illuminate.

STEP 1. Check for voltage at circuit breaker (CB64) XMSN OIL LEVEL LT.

If check indicates circuit breaker (CB64) is defective, replace it. (Refer to paragraph 9-5.)

STEP 2. Set XMSN OIL LEVEL LT SW (S22) to the ON position. Check for 24 to 28 Vdc bus voltage on terminals 1 and 2 of switch (S22).

Replace switch (S22) if voltage is not present on load side of switch (S22). (Refer to paragraph 9-6.)

STEP 3. Check filament, lamp housing, and ground of XMSN OIL LEVEL LT (DS2).

Replace bulb or lamp housing and clean ground as needed. (Refer to paragraph 9-4.)

Section VII. MISCELLANEOUS EQUIPMENT

9-60. Miscellaneous Equipment.

Miscellaneous equipment includes engine controls and accessories, flight control systems, heating and cooling systems, stability and control augmentation system, and armament systems circuitry.

9-61. Engine Controls and Accessories (Electrical).

Engine controls and accessories include engine air filter and engine deicing, engine oil bypass valve, fuel valve, fuel boost pumps, governor control, and idle stop solenoid circuitry.

9-62. Engine De-ice Circuitry.

The engine de-ice system is comprised of an engine hot air de-icing valve (K16), located on the engine, pilots and gunners DE-ICE switches (S10 and S19), and is protected by a 5 ampere ENG DE-ICE circuit breaker. The system is energized from the dc essential bus. The valve may be controlled by either the gunners DE-ICE switch (S19), located on the gunners miscellaneous panel, or the pilots DE-ICE switch (S10), located on the pilots engine control panel. The de-ice system is normally energized to prevent the de-icing system from activating. If either switch (S10) or (S19) is placed

to the DE-ICE position, the circuit is broken and the de-icing system is activated. Refer to paragraph 94, 9-5 and Chapter 4 for maintenance procedures.

a. *Functional Test.*

(1) Open all circuit breakers and return all switches to their normal positions.

(2) Note that both switches (S10) and (S19) are in the OFF position, then close ENG DE-ICE circuit breaker. Check that de-icing hot air solenoid valve (K16) has actuated.

(3) Place (S10) to DE-ICE. Check that hot air solenoid valve is not energized.

(4) Return switch (2) and (3), except substitute switch (S19) for switch (S10).

(5) Repeat steps (S10) to OFF position. Check that hot air solenoid valve is again energized.

b. *Troubleshooting.* (See figure F-12 and table 9-14.)

Table 9-14. Troubleshooting - Engine De-ice Circuitry

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. De-icing hot air solenoid valve **fails** to de-energize when either DE-ICE switch (S10) or (S19) is placed to DE-ICE position.

STEP 1. Determine that DE-ICE switches (S10 and/or S19) are functional.

If DE-ICE switches (S 10 and/or 8S19) are not functioning properly, replace as required. (Refer to paragraph 9-6.)

STEP 2. Defective de-icing hot air solenoid valve.

Replace solenoid valve. (Refer to TM 66-2840-229-24.)

9-63. Engine Oil Bypass Valve Circuitry.

The engine oil bypass valve is energized from the main bus and protected by the FUEL & OIL VALVE circuit breaker. An oil bypass valve (B5), located on the lower firewall forward left side, provides a means of bypassing the flow of engine oil around the oil cooler in case of damage resulting in a leak in the cooler. The

valve is electrically actuated and is included in a circuit with ENG OIL BYP switch (S69) (manually operated), engine oil float switch (S52), and oil bypass relay (K25). Switch (S69) is located on the pilots engine control panel (A2). Switch (S52) is located in the oil tank, and relay (K25) is located beneath the upper firewall. Refer to

paragraph 9-4, paragraph 9-5, and TM 55-2840-229-24 for maintenance procedures.

a. Functional Test.

(1) Close FUEL & OIL VALVE circuit breaker.

(2) Place ENG OIL BYP switch to AUTO.

(3) Procedure for empty tank condition.

(a) Place ENG OIL BYP switch to OFF. Check that position indicator on oil bypass valve rotates counterclockwise (normal condition).

(b) Place ENG OIL BYP switch to AUTO. Check that position indicator on oil bypass valve rotates clockwise (bypass condition).

(4) Procedure for oil in tank condition.

(a) Connect a temporary short circuit between terminals 1 and 2 on TB14. After a few seconds place ENG OIL BYP switch to OFF. Remove temporary short circuit. Check that position indicator on oil bypass valve is rotated to its clockwise extreme (bypass condition).

(b) Place ENG OIL BYP switch to AUTO. Check that position indicator on oil bypass valve rotates to its counterclockwise extreme (normal condition).

(c) Place ENG OIL BYP switch to OFF. Check that position indicator on oil bypass valve is not moved from the position described in above step (4)(b).

b. Troubleshooting. (See figure F-16 and table 9-15.)

Table 9-15. Troubleshooting - Engine Oil Bypass Circuitry

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Oil bypass valve (B5) fails to operate with ENG OIL BYP switch (S69) in AUTO position and oil float switch (S52) closed (oil tank low).

STEP 1. Determine that ENG OIL BYP switch (S69) is functional.

If ENG OIL BYP switch (S69) is not functioning properly, replace as required. (Refer to paragraph 9-6.)

STEP 2. Determine that oil float switch (S52) is functional.

If oil float switch (S52) is not functioning properly, replace as required. (Refer to paragraph 9-4.)

STEP 3. Check that OIL BYPASS relay (K25) is functional.

Replace oil bypass relay (K25) as required. (Refer to paragraph 9-4.)

STEP 4. Check that oil bypass valve (B5) is functional.

Replace oil bypass valve (B5) as required. (Refer to paragraph 4-19 a.)

9-64. Fuel Valve Circuitry.

An electrically operated fuel shut-off valve (B3), located on the top of the aft fuel cell, provides a means of shutting off fuel to the engine. This valve is energized from the main bus and protected by the FUEL & OIL VALVE circuit breaker. The FUEL switch (S5), on the pilots engine control panel (A2), controls the operation of the valve. Refer to paragraph 9-4, paragraph 9-5, and Chapter 10 for maintenance procedures.

a. Functional Test.

(1) Close FUEL & OIL VALVE circuit breaker. Position FUEL switch (S5) to ON. Check that fuel valve opens.

(2) Position FUEL switch (S5) to OFF and check that fuel valve closes.

b. Troubleshooting. (See figure F-16 and table 9-16.)

Table 9-16. Troubleshooting - Fuel Valve Circuitry**NOTE**

Before you use this table, be sure you have performed all normal operational checks.

CONDITION**TEST OR INSPECTION CORRECTIVE ACTION.**

1. Fuel shutoff valve (B3) fails to open when FUEL switch (S5) is placed ON.

STEP 1. Check for 28 Vdc essential bus power on terminals 4 and 5 of fuel switch (S5).

Replace fuel switch (S5) if 28 Vdc is not on terminal 4. (Refer to paragraph 9-6.)

STEP 2. Determine that fuel shutoff valve (B5) is functional.

If fuel shutoff valve (B5) is not functioning properly, replace valve. (Refer to paragraph 10-4 a.)

9-65. Fuel Boost Pumps Circuitry.

Two electrically operated fuel boost pumps, submerged one each in the forward and aft fuel cell, are accessible from the bottom of the cell. Both pumps are connected to a common fuel line. The forward fuel boost pump (B1) is energized from the dc essential bus and protected by the FUEL BOOST FWD circuit breaker, located in the dc circuit breaker panel (A10). The aft fuel boost pump (B2) is energized from the dc non-essential bus and protected by the FUEL BOOST AFT circuit breaker in the dc circuit breaker panel. Both pumps are controlled by the FUEL switch (S5), located on the pilots engine control panel (A2). Refer to paragraphs 9-4, 9-5, and Chapter 10 for maintenance procedures.

a. Functional Test.

(1) Close FUEL BOOST FWD circuit breaker. Position FUEL switch (S5) to ON. Check that the forward fuel pump is running.

(2) Open FUEL BOOST FWD circuit breaker. Close FUEL BOOST AFT circuit breaker. Position FUEL switch (S5) to ON. Check that the aft fuel pump is running.

(3) Open FUEL BOOST AFT circuit breaker.

b. Troubleshooting. (See figure F-17 and table 9-17.)

Table 9-17. Troubleshooting - Fuel boost Pump Circuitry**NOTE**

Before you use this table, be sure you have performed all normal operational checks.

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

1. Either pump (B1) or (B2) fails to operate when FUEL switch (S5) is placed to ON.

STEP 1. Determine if fuel switch (S5) is functional.

If fuel switch (S5) is not functioning properly, replace as required. (Refer to paragraph 9-6.)

STEP 2. Determine that fuel boost pumps (B1 and/or B2) are functioning properly.

If fuel boost pumps (B1 and/or B2) are not functioning properly, replace as required. (Refer to paragraph 10-8.)

9-66. Governor Control System Circuitry.

The governor control system is comprised primarily of an engine fuel control solenoid valve (K14) located on engine, and a motor driven governor rpm actuator (B6) located on engine, left forward. The 28 Vdc power to the system is served and protected by a 5 ampere GOV CONT circuit breaker, which is located in pilots dc circuit breaker panel (A10). Actuator (B6) is energized either by GOV RPM switch (S46), located on pilots collective stick, or by RPM switch (S18), located in the gunners miscellaneous control panel. Solenoid valve (K14) is energized by GOV AUTO/EMER switch (S6), located on pilots engine control panel, or by GOV AUTO/EMER switch (S17) located on gunners miscellaneous control panel. Refer to paragraphs 9-4, 9-5, and TM 55-2840-229-24 for maintenance procedures.

- a. *Functional Test.*

- (1) Close GOV CONT circuit breaker. Position GOV switch (S6) on pilots engine control panel, and (S17) on gunners miscellaneous control panel to AUTO. Check that fuel control solenoid valve (K14) on the

engine is energized in the normal automatic position (voltage at Pin C or (P75) on valve).

- (2) Place GOV switch (S6) on pilots engine control panel to EMER. Check that fuel control solenoid valve (K14) is energized in the bypass or emergency position (voltage at Pin A of P75) and that GOV EMERGENCY indicators on the pilots and gunners caution panels are illuminated.

- (3) Return pilots GOV switch (S6) to AUTO position. Check that GOV EMERGENCY indicators on both caution panels are extinguished.

- (4) Place GOV switch (S17) on gunners miscellaneous control panel to EMER. Check that fuel control solenoid valve (K14) is energized in the bypass or emergency position (voltage at pin A of P75). Check that GOV EMERGENCY indicators on the caution panels are illuminated.

- (5) Return GOV switch (S17) to AUTO. Check that GOV EMERGENCY indicators are extinguished.

(6) Position GOV RPM switch (S46), on pilots collective stick, to INCR and check that governor rpm actuator on the engine retracts.

(8) Repeat steps (5) and (6) using RPM switch (S18) on gunners miscellaneous control panel (A7).

(7) Position GOV RPM switch (S46) to DECR and check that actuator extends.

b. Troubleshooting. (See figure F-20 and table 9-18.)

Table 9-18. Troubleshooting - Governor Control System Circuitry

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Governor actuator (B6) fails to respond when either RPM switch (S18) or (S46) is placed to INCR or DECR position.

STEP 1. Determine that RPM switches (S18 and/or S46) are functioning properly.

Replace RPM switches (S18 and/or S46) as required. (Refer to paragraph 9-6).

STEP 2. Check for defective Governor Actuator (B6).

Replace Governor Actuator if found defective. (Refer to paragraph 10-2.)

2. Actuator operates in reverse.

STEP 1. Switch (S18 and/or S46) or actuator wiring reversed.

Check Governor Control Circuitry Schematic (figure F-20) and correct wiring as necessary.

3. Fuel control solenoid valve (K14) fails to operate when either GOV switch (S6) or (S17) is actuated.

STEP 1. Determine that Governor Switches (S6 and S17) are functioning properly.

Replace Governor Switches (S6 and/or S17) as required. (Refer to paragraph 9-6.)

STEP 2. Check for defective fuel control solenoid valve (K14).

Replace fuel control solenoid valve if found defective. (Refer to paragraph 10-2.)

4. Solenoid valve operates in reverse.

STEP 1. Switches (S6 and/or S17) or solenoid valve wiring reversed.

Check governor control system wiring diagram (figure F-20) and correct wiring as necessary.

9-67. Idle Stop Solenoid Circuitry.

The idle stop system includes a 5 ampere IDLE STOP SOL circuit breaker on (A12) dc circuit breaker panel, switches (S47) and (S54), located on pilots collective and gunners miscellaneous panel (A7) respectively, and an idle stop solenoid (K17) located in oil cooler compartment engine service deck. Solenoid (K17) is energized from 28 Vdc essential bus when circuit breaker and either (S47) or (S54) is pressed. Refer to paragraphs 9-4, 9-5, and Chapter 4 for maintenance procedures.

a. *Functional Test.*

(1) Close IDLE STOP SOL circuit breaker. Actuate the idle stop release switch (S47) on the pilots collective stick and check that the solenoid retracts when power is applied.

(2) Release switch (S47). Place IDLE STOP switch (S54) on gunners miscellaneous control panel to the ON position (this bypasses switch S47). Check that idle stop solenoid (K17) retracts and remains retracted. Check that switch (S47) has no effect on idle stop solenoid operation. Place switch (S54) to OFF position. Check that idle stop solenoid (K17) is released.

b. *Troubleshooting.* (See figure F-22 and table 9-19.)

Table 9-19. Troubleshooting-Idle Stop Solenoid Circuitry.

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Engine idle stop does not retract when IDLE STOP RELEASE switches (S54) and/or (S47) are actuated.

STEP 1. Determine that idle stop switches (S54 and/or S47) are functional.

If idle stop switches (S54 and/or S47) are not functioning properly, replace as required. (Refer to paragraph 9-6.)

STEP 2. Check that idle stop solenoid (K17) is functional.

If idle stop solenoid (K17) is not functioning properly, release solenoid. (Refer to paragraph 4-22 a.)

2. Engine idle stop solenoid (K17) does not extend after IDLE STOP RELEASE switch is released from depressed position.

STEP 1. Repeat STEP 1 above.

STEP 2. Repeat STEP 2 above.

9-68. Flight Control Systems (Electrical).

Flight control systems include the force trim system and hydraulic control system circuitry.

9-69. Force Trim System Circuitry.

The force trim system consists of an anti-torque force trim magnetic brake (K18), a fore and aft force trim magnetic brake (K19), and a lateral force trim magnetic brake (K20). Magnetic brakes (K18), (K19), and (K20) are wired in parallel and energized and protected by a 5 ampere FORCE TRIM circuit breaker, which is located in the dc circuit breaker panel. The FORCE TRIM momentary switch (S27), located on pilots cyclic stick, FORCE TRIM selector switch (S9), located on pilots engine control panel (A2), FORCE TRIM selector switch (S20), located on gunners cyclic stick, are all series wired. The entire system serves to return pilots and gunners cyclic stick to desired initial position when (S9) and (S20) are set to ON position. Switch (S27) or (S30) may be triggered to de-energize brakes and eliminate centering force. With either switch

(S9) or (S20) set to OFF position, automatic trim force is de-energized. Refer to paragraphs 9-4, 9-5, and Chapter 11 for maintenance procedures.

a. Functional Test.

(1) Close FORCE TRIM circuit breaker. Position force trim switch (S9) on pilots engine control panel and (S30) on gunners miscellaneous control panel to ON. Check the cyclic stick and pedals for centering force.

(2) Depress force trim switch (S27) on the pilots cyclic stick. Check that the three magnetic brakes deenergize and that there is no centering force in the cyclic stick and pedals.

(3) Repeat step (2) using FORCE TRIM switch (S30) on the gunners cyclic stick.

b. Troubleshooting. (See figure F-15 and table 9-20.)

Table 9-20. Troubleshooting - Force Trim System Circuitry

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

1. All magnetic brakes (K18), (K19), and (K20) fail to energize with FORCE TRIM switches (S9 and S20) to ON position.

STEP 1. Determine that force trim switches (S9, S20, S27, and S30) are functioning properly.

If force trim switches (S9, S20, S27, and S30) are not functioning properly, replace as required. (Refer to paragraph 9-6.)

2. Any magnetic brake (K18), (K19), or (K20) fails to energize with FORCE TRIM switches (S9 and S20) to ON positions.

STEP 1. Determine that magnetic brakes (K18, K19, and K20) are functioning properly.

If magnetic brakes (K18, K19, and K20) are not functioning properly, replace as required. (Refer to paragraphs 11-15 and 11-16.)

Table 9-20. Troubleshooting - Force Trim System Circuitry (Cont)

CONDITION	
TEST OR INSPECTION	
CORRECTIVE ACTION	
3. All magnetic brakes (K18), K19), and (K20) fail to de-energize when FORCE TRIM switch (S27) or (S30) is depressed.	
STEP 1. Determine that force trim switches (S9, S20, S27, and S30) are functioning properly.	
If force trim switches S9, S20, S27, and S30 are not functioning properly, replace as required.	

9-70. Hydraulic Control System Circuitry.

The hydraulic control system is composed primarily of two hydraulic by-pass solenoid valves, system No. 1 (K21) and system No. 2 (K22), mounted on the bulkhead left and right, forward of the transmission. Each valve function may be tested by the HYD TEST switch (S8) on the pilots engine control panel (A2). Each by-pass solenoid valve is normally de-energized. An emergency collective hydraulic solenoid valve (K37) located in the pylon section serves to supply emergency collective hydraulic pressure from an accumulator system. The valve is normally energized to prevent hydraulic fluid flow by setting EMER COL HYD switches (S79 and S80) on either pilots or gunners instrument panel to EMER ON. The system is supplied from the 28 Vdc essential bus and protected by a 5 ampere HYD CONTROL circuit breaker which is located in pilots dc circuit breaker panel (A10). Refer to paragraph 9-4, paragraph 9-5, and Chapter 7 for maintenance procedures.

a. Functional Test.

- (1) Close HYD CONT and CAUTION LIGHTS circuit breakers. Check that HYD PRESS NO. 1 and NO. 2 caution lights on the pilots and gunners caution panels are illuminated.
- (2) Note that controls take extreme force and are very difficult to move.
- (3) Apply hydraulic pressure to system No. 1. Check that HYD PRESS NO. 1 caution light on pilots and gunners caution panels are extinguished.
- (4) Repeat step (3) for System No. 2.

- (5) Position HYD TEST switch (S8) to SYS 1 and check that hydraulic system NO. 2 bypass solenoid actuates. HYD PRESS NO. 2 caution light on pilots and gunners caution panel should illuminate.
- (6) Position HYD TEST switch (S8) to SYS 2 and check that hydraulic system No. 1 bypass solenoid actuates. HYD PRESS NO. 1 caution light on pilots and gunners caution panel should illuminate.
- (7) With hydraulic pressure applied, check that all controls take much less force to operate. Remove hydraulic pressure.
- (8) Place EMER COLL HYD switch (S79) on pilots instruments panel to OFF position. Place EMER COLL switch (S79) to ON position and operate collective controls. Check that only normal force is required to operate the controls.

NOTE

- Emergency reserve hydraulic capacity is normally sufficient for four full actuations of the collective stick.
- (9) Place EMER COLL HYD switch (S79) to OFF position. Check that collective controls now require much more force to operate.
- (10) Apply hydraulic pressure to each system. Repeat steps (8) and (9) except substitute EMER COLL HYD switch (S80) and gunners instrument panel for (S79).

b. Troubleshooting. (See figure F-21 and table 9-21.)

Table 9-21. Troubleshooting - Hydraulic Control System Circuitry**NOTE**

Before you use this table, be sure you have performed all normal operational checks.

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

1. Either bypass solenoid (K21) or (K22) fails to actuate when selected by HYDR TEST switch.

STEP 1. Check that HYDR TEST switch (S8) is functioning properly.

If HYDR TEST switch (S8) is not functioning properly, replace. (Refer to paragraph 9-6.)

STEP 2. Check that bypass solenoids (K21 and K22) are functioning properly.

If bypass solenoids (K21 and/or K22) are not functioning properly, replace module as required. (Refer to paragraph 7-6.)

2. Emergency solenoid (K37) de-energized with EMER HYDR switch (S79) and (S80) in OFF position.

STEP 1. Check that EMER HYDR pump switches (S79 and S80) are functioning properly.

If EMER HYDR pump switches (S79 and/or S80) are not functioning properly, replace as required. (Refer to paragraph 9-6.)

STEP 2. Check that EMERGENCY solenoid (K37) is functioning properly.

If EMERGENCY solenoid (K37) is not functioning properly, replace if required. (Refer to paragraph 7-9 e. and figure 7-2.)

9-71. Heating and Cooling Systems Circuitry.

The heating and cooling systems include the environmental control system and the pitot heating system.

9-72. Environmental Control System Circuitry.

The environmental control system heats, cools, and removes moisture from the air supplied to the crew compartment. It is composed of the environmental control unit (ECU) (Z12), duct overheat switch (S59), temperature sensing valve (B16), bleed air valve (L1), and the heater control relay (K12). The rain remover

system is composed of the rain remover solenoid (K23), and the heater control relay (K12). These systems are energized from the non-essential bus by the ECU CONT circuit breaker (CB9) and controlled by ENVR CONT switch (S57) and ECU temperature control (R31). Refer to paragraphs 9-4, 9-5, and Chapter 13 for maintenance procedures.

- a. *Functional Test.*

(1) Close ECU CONT circuit breaker. Position environmental control switch (S57) to RAIN REMOVAL. Check that rain removal solenoid valve opens.

(2) Position ENVR CONT switch to OFF. Check that rain removal solenoid valve closes.

(3) Position ENVR CONT switch to ENVR CONT. Check that bleed air valve opens.

(4) Simulate an overheat condition by grounding terminal X2 (low side) of heater control relay (K12). Check that heater control relay (K12) energizes and removes power from the bleed air valve causing it to close.

(5) Remove ground from relay (K12). Check that heater control relay becomes de-energized and that the bleed air valve opens.

(6) Position ENVR CONT switch to OFF. Check that bleed air valve closes.

NOTE

Steps (7) through (9) require that the helicopter engine be operating.

(7) Start helicopter engine and maintain an engine speed of 6600 rpm. Position ENVR CONT switch to ENVR CONT. Check that cooling turbine comes up to speed and that airflow is detected at the cabin air inlets.

(8) Rotate ECU temperature control to extreme COOL position. Check that cabin inlet airflow becomes cool.

(9) Rotate ECU temperature control to extreme WARM position. Check that cabin inlet airflow becomes warm. Return temperature control to midposition.

(10) Stop helicopter engine. Check that the environmental control unit stops operating and that the bleed air valve closes.

b. Troubleshooting. (See figure F-13 or table 9-22.)

Table 9-22. Troubleshooting - Environmental Control System Circuitry

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Bleed air valve (L1) fails to actuate with ENVR CONT switch (S57) set to ENVR CONT and ECU TEMP CONT (R31).

STEP 1. Ensure 28 Vdc non-essential bus voltage is present between pins 3 and 6 of bleed air valve (L1).

If bleed air valve fails to operate, replace bleed air valve. (Refer to paragraph 13-4 b.)

2. Bleed air valve (L1) fails to energize with ENVR CONT switch (S57) set to ENVR CONT.

STEP 1. Ensure 28 Vdc non-essential bus voltage is present on load side of ECU CONT (CB9). Check for presence of 28 Vdc non-essential voltage at JSH on pilots instrument panel.

If 28 Vdc non-essential bus voltage is not present at J 8-H, replace environmental control switch (S67). (Refer to paragraph 9-6.)

Table 9-22. Troubleshooting - Environmental Control System Circuitry (Cont)**CONDITION****TEST OR INSPECTION****CORRECTIVE ACTION**

STEP 2. Ensure 28 Vdc non-essential bus voltage is present at J8-H on pilots instrument panel. Check for presence of 28 Vdc at B3 of heater control relay (K12).

Replace heater control relay (K12) if 28 Vdc non-essential voltage is not present at B3. (Refer to paragraph 9-4.)

3. Environmental control unit (Z12) fails to energize with ENVR CONT switch (S57) set to ENVR CONT.

STEP 1. Check for defective overheat switch (S59).

Replace duct overheat switch (S59) if defective. (Refer to paragraph 9-4.)

4. No air is detected at cabin inlets with ENVR CONTR switch (S57) set to ENVR CONT and ECU TEMP CONT (R37) positioned to COOL or WARM.

STEP 1. Check environmental control unit (Z12). (Refer to paragraph 13-2.)

Replace or repair environmental control unit (Z12) as necessary. (Refer to paragraph 13-2 b.)

5. Environmental control unit temperature has no effect on cabin inlet air temperature.

STEP 1. Check temperature sensing valve (B16). (Refer to paragraph 13-11.)

If defective, replace temperature sensing valve (B16). (Refer to paragraph 13-11 a.)

STEP 2. Check environmental control (IOR1).

If defective, replace ECU TEMP CONT (R31). (Refer to paragraph 9-6.)

STEP 3. Check environmental control (Z12). (Refer to paragraph 13-2.)

If defective, replace environmental control unit (Z12). (Refer to paragraph 13-2 c.)

6. Rain removal solenoid (K23) fails to actuate with environmental control switch set to RAIN RMV.

STEP 1. Check rain removal solenoid (K23).

If defective, replace rain removal solenoid (K23). (Refer to paragraph 9-4.)

9-73. Pitot Heating System Circuitry.

The pitot heater system is comprised of the pitot tube heater (HR1), located on the upper left forward section of the pylon fairing; PITOT HEATER switch (S31), located on the pilots instrument panel; and a five

ampere PITOT HTR circuit breaker (CB10). The system is powered from the 28 Vdc non-essential bus. The pitot tube heater (HR1) prevents the pitot tube from icing over. The heating element is energized manually by the PITOT HEATER switch (S31). Refer to paragraphs 9-4, 9-5, and Chapter 8 for maintenance procedures.

a. *Functional Test.***CAUTION**

Do not leave pitot tube heater energized for a prolonged period of time.

- (1) Close PITOT HTR circuit breaker.
- (2) Position PITOT HEATER switch to ON.

(3) Check that pitot heating element is energized and heating.

(4) Position PITOT HEATER switch to OFF and open PITOT HTR circuit breaker.

b. *Troubleshooting.* (See figure F-25 or table 9-23.)

Table 9-23. Troubleshooting-- Pitot Heating System Circuitry

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

1. Pitot tube heater fails to heat, PITOT HTR switch (S31) to ON.

STEP 1. Check PITOT TUBE circuit breaker (CB10) on DC CIRCUIT BREAKER PANEL.

If defective, replace PITOT TUBE circuit breaker (CB10). (Refer to paragraph 9-5.)

STEP 2. Check PITOT HTR switch (S31).

If defective, replace PITOT HTR switch (S31). (Refer to paragraph 9-6.)

STEP 3. Check heating element, PITOT TUBE (HR1).

If defective, replace PITOT TUBE, heating element (HR1). (Refer to paragraph 8-28 c.)

9-74. TOW Blower Cooling System.

a. *Description.* The TOW blower electronic equipment cooling system is comprised of the TOW compartment blower (B17), TOW compartment blower overload sensor (S125), TOW compartment blower relay (K68), and TOW compartment overheat switch (S127). The system is powered from the 28 Vdc bus and protected by a one ampere TOW BLO circuit breaker (CB79). The TOW blower (B17) is located in the tail boom on the aft face of the bulkhead panel at boom station 122.2. The TOW compartment overheat

switch (S127) is installed on the mounting flange at top of forward side of the bulkhead at boom station 122.2. The TOW blower overload sensor (S125) and TOW blower relay (K68) are located in the aft electrical compartment, and the TOW BLO circuit breaker (CB79) is located on the dc circuit breaker panel (A10) on the pilots console. The TOW blower cooling system is associated with the non-essential bus relay (K4) and the NON-ESS BUS switch (S4).

b. *Purpose.* The TOW blower electronic equipment cooling system is designed for cooling the

electronic/armament/avionics equipment mounted on the TOW compartment shelf in the tail boom. The shelf is located between boom stations 59.50 and 122.33 and is enclosed with insulated blanket material. A duct and screen assembly is installed under the tail boom just aft of boom station 59.50 to supply outside air supply to the enclosed compartment during TOW blower operation.

c. Function. The TOW blower cooling circuit is controlled by the thermal actuated TOW compartment overheat switch (S127). The system is energized by closing TOW BLO circuit breaker (CB79), which applies 28 Vdc power from the essential bus through the contacts of TOW blower overload sensor (S 125) to TOW blower relay (K68) holding coil. The system is armed by actuation of the non-essential bus relay (K4) through the NON-ESS BUS switch (S4). When temperature in the TOW compartment reaches approximately 18.4° Celsius (65° F), TOW compartment overheat switch (S127) actuates (closes), sending a ground return to actuate (close) TOW blower relay (K68) contacts. Power from the main dc bus, through the contacts of the non-essential bus relay, is routed through the contacts of TOW blower relay (K68), through TOW blower overload sensor (S125), to the TOW blower (B17). Thermal activation of the TOW compartment overheat switch automatically causes the TOW blower to cycle on and remain on as long as the circuit is energized. Overload protection for the TOW blower is provided by the TOW blower overload sensor (S125).

d. Functional Test Position BAT switch (S1), on pilots electrical control panel, to ON (if battery power is used) and NON-ESS BUS switch (S4) to MANUAL. Ensure gunners ELEC PWR-EMER OFF switch (S21),

on gunners miscellaneous control panel, is positioned to ELEC PWR.

(1) *Ambient temperature below 18.4° Celsius (65°F).*

(a) Close the TOW BLO circuit breaker. Energize heat gun and direct its hot air a few inches from the TOW overheat sensor switch (S 127), being careful of other components or equipment in this area. After a few seconds, check that the TOW blower is energized and forcing air aft.

(b) De-energize the heat gun and let the TOW overheat sensor switch cool. Check that after this switch cools, the TOW blower is still energized. Open TOW BLO circuit breaker.

(2) *Ambient temperature above 18.4° Celsius (65°F).*

(a) Close the TOW BLO circuit breaker. Check that the TOW blower is energized and forcing air aft.

(b) Open the TOW BLO circuit breaker. Check that the TOW blower is de-energized and shuts off.

e. Troubleshooting. (See figure F-33 or table 9-24.)

Table 9-24. Troubleshooting - TOW Blower Cooling Systems

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. TOW blower (B17) fails to operate when temperature is above approximately 18.4° Celsius (65° F).

STEP 1. Ensure that 28 Vdc essential bus voltage is present at terminal A of connector for TOW compartment blower (B 17).

Repair connector if voltage is not present at terminal A. (Refer to paragraph 9-4.)

Table 9-24. Troubleshooting - TOW Blower Cooling Systems (Cont)

CONDITION	
TEST OR INSPECTION	
CORRECTIVE ACTION	
STEP 2.	Remove blower and inspect for worn brushes. Replace worn brushes as necessary or replace blower. (Refer to paragraph 9-75.)
STEP 3.	Check TOW compartment blower overload sensor (S125). Replace sensor (S125) if defective. (Refer to paragraph 9-4.)
STEP 4.	Check TOW compartment overheat switch (S127). Replace switch if defective. (Refer to paragraph 9-4.)
STEP 5.	Check for 28 Vdc non-essential bus voltage through TOW BLOW circuit breaker (CB79). Replace circuit breaker if defective. (Refer to paragraph 9-5.)
STEP 6.	Ensure actuating voltage is present at terminal X2 and ground potential is present at terminal X1 of TOW blower relay (K68). Check for bus voltage at terminals A1 and A2. Replace TOW COMP BLO RELAY (K68) if defective. (Refer to paragraph 9-4.)

9-75. TOW Blower.

b. Inspection.

a. Cleaning.

(1) Remove moisture and loose dirt with a clean, soft cloth.

(1) Inspect TOW blower for any visible damage, proper bonding, and security of mounting.



Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

(2) Remove grease, fungus, and ground-in dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

(3) Remove dirt from electrical connectors with a bristle brush.

(2) Check connectors for damaged or bent pins and cracked connector inserts.

(3) Check brush caps for dents.

(4) Check brushes for wear.

(5) Check for proper operation.

(6) Check case for cracks or damage.

c. *Removal.*

(1) Open access door.

(2) Disconnect electrical connector (P114) from TOW blower. Protect receptacle and plug with caps or electrical tape.

(3) Disconnect two braces from top of TOW blower case.

(4) Remove mounting screws and washers securing TOW blower to bulkhead and remove TOW blower and screen assembly.

d. *Repair or Replacement.*

(1) Tighten or correct loose or improperly installed TOW blower.

(2) Replace or repair connectors and replace brush caps or brushes as necessary.

(3) Replace unit if case is cracked or damaged, or TOW blower is defective or inoperative.

e. *Installation.*

(1) Position screen assembly and TOW blower in place on bulkhead and secure with mounting screws and washers.

(2) Connect two braces to top of TOW blower use.

(3) Remove protective caps or electrical tape from electrical connectors and connect plug (P114) to TOW blower receptacle.

(4) Close access door.

9-76. Stability and Control Augmentation System (SCAS).

The SCAS is a three axis stability and control augmentation system. It is integrated into fore and aft, lateral, and directional (anti-torque) flight controls to improve stability and handling qualities of helicopter. For a complete description and maintenance, refer to Chapter 11 for flight control portion and TM 11-1520-221 series maintenance manuals for complete information.

9-77. Armament Systems Circuitry.

The armament *systems consists of* the turret system, wing stores armament systems, smoke grenade dispenser system, and XM65 TOW missile subsystem. Functional test and troubleshooting procedures are presented for each armament subsystem circuitry. References are made to appropriate maintenance manuals and/or chapters within this maintenance manual, where applicable. (See figure 9-13 for armament equipment location illustrations and refer to Appendix F for armament wiring diagrams.)

9-78. Turret System Circuitry.

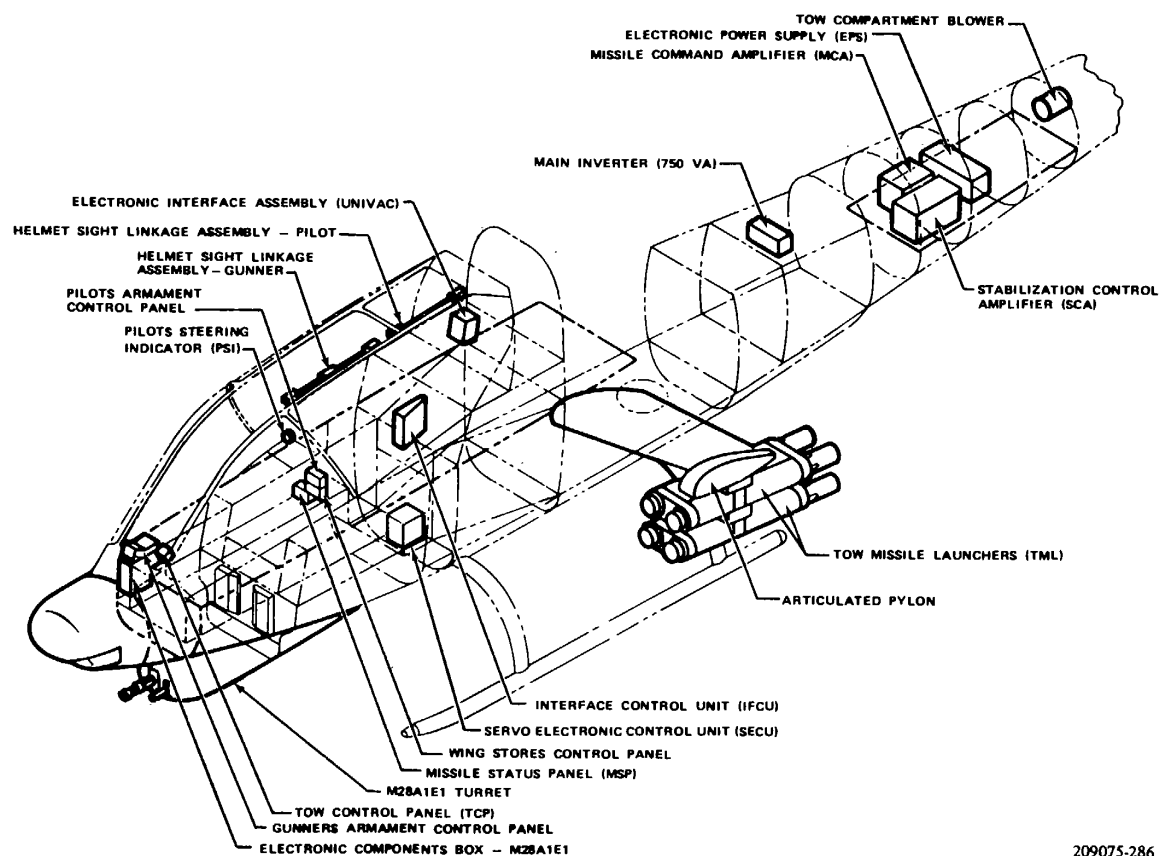
The M28A1E1 turret system interfaces, by means of auxiliary equipment, with the XM128 helmet sight subsystem (HSS) and the turret control portion of the stabilized telescopic sight unit (TSU) of the XM65 TOW missile subsystem. The interconnecting airframe wiring integrates the three subsystem components through the interface control unit, Univac electronic interface assembly, and the pilots and gunners armament control panels. For additional information pertaining to the M28A1E1 turret system, refer to TM 9-1090-203 series maintenance manuals. For additional information pertaining to the XM128 helmet sight subsystem, **refer** to TM 9-1270-212-14. For additional information pertaining to the TSU and XM65 TOW missile subsystem, refer to paragraph 9-90 and TM 9-1425-473 series maintenance manuals.

9-79. Functional Test --Turret System Circuitry.

a. *Requirements.*

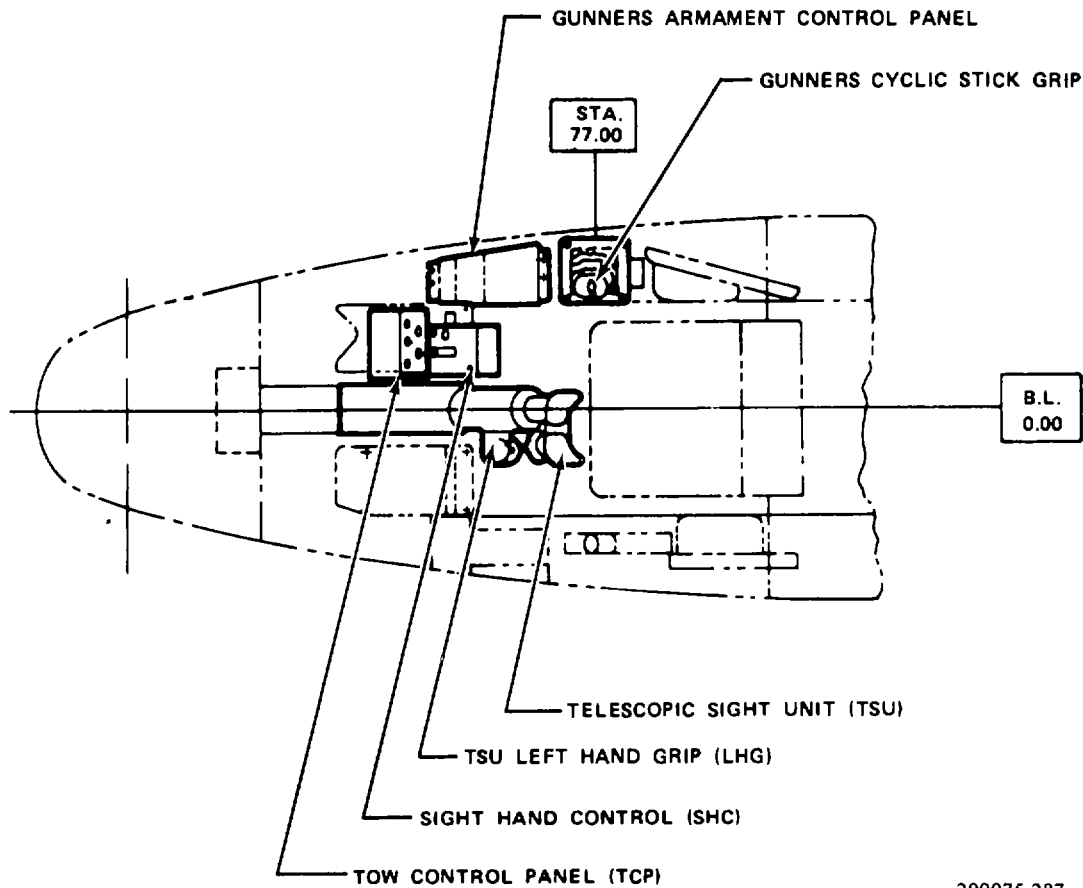
(1) *Test equipment.*

(a) Power source. One 220 Vac, 3-phase, 60-hertz, 60-ampere, continuous duty (for the power carts).



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Figure 9-13. Armament equipment location (Sheet 1 of 2)



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Figure 9-13. Armament equipment location (Sheet 2 of 2)

(b) Auxiliary power unit. 28 Vdc, 300-ampere.

(c) Hydraulic. Hydraulic ground test cart - 1500 psig minimum pressure; flow rate of 6.0 gpm; calibrated pressure gage of 2500 psig; 10 micron filter on pressure supply line; and connection fitting.

WARNING

All weapons shall be dry fired. Only dummy ammunition with smooth cases like live ammunition shall be used.

(2) Special tools.

(a) 7.62 MM ammunition drum/40 MM drum or simulator.

(b) Airspeed simulator (pitot-static tester MB1, or equivalent) NSN 492-00-475-7161.

b. Preparation for Testing.

(1) *General.* Qualified armament personnel shall be present during all tests specified herein.

(2) *7.62 MM/40 MM configuration turret.* The following tests shall be accomplished using auxiliary hydraulic and electrical power, and with the turret fairing removed.

(3) Weapon system preparation.

(a) Install the 7.62 MM ammunition drum/40 MM drum or simulator.

(b) Check all system components for proper installation.

(c) Check that the 7.62 MM weapon and feeder are properly timed.

(4) *Control switch positions.* Position the following switches as indicated:

(a) Pilots armament control panel.

MASTER ARM	OFF
WPN CONT	GUNNER
TURRET SELECT	BOTH
HS RTCL brightness knob	midpoint position

(b) Wing stores control panel.

WT ST ARM	OFF
RKT PR SEL	1
WG ST JETTISON SELECT	BOTH

(c) Gunners armament control panel.

PLT OVRD	OFF
WING STORES SELECT	OFF
AMMO RSV PCT - RIGHT	50
AMMO RSV PCT - LEFT	50
TURRET SELECT	R
COMPOFF	
HSS RETICLE brightness knob	midpoint position
TURRET DEPR LIMIT	ON
RANGE	500

(d) Smoke grenade control panel.

LH ARM (2)	OFF
RH ARM (2)	OFF

(e) TOW control panel.

MODE SELECT	OFF

(5) *Electrical power.* Check that aircraft battery is connected, then apply 28 Vdc external electrical power.

(6) *Circuit breakers.* Engage all circuit breakers except the following:

STARTER RELAY

IGN SYS IGN SOL

RPM WARN SYS

WING STORES JETTISON panel)	(dc circuit breaker

EXTERNAL STORES
EMERGENCY

(aft electrical compartment)

(7) *Power switch positions.* Position the following switches as shown:

INV	MAIN
BAT	OFF
NON-ESS BUS	NORMAL
ELECT PWR/EMER OFF	ELEC PWR

CAUTION

Do not apply hydraulic power to system unless electrical power is applied.

(8) *Hydraulic power.* Apply 1500 ± 25 psi hydraulic power.

c. *Testing Procedures.*

(1) *Gunner turret control.* With test personnel in the pilots and gunners position, connect the helmet sight linkages to the built-in test (BIT) brackets at the forward support points.

WARNING

Before proceeding, clear turret area of any obstructions and warn personnel to remain on exterior of safety barrier.

(a) Position pilots MASTER ARM switch to STBY. Observe that pilots and gunners green STBY indicators and gunners right 7.62 and left 40 blue indicators are illuminated.

(b) Position the HSS BIT switch on the gunners control panel to BIT and release. Check that a GO indication appears on the HSS indicator.

NOTE

Completion of BIT circuit requires approximately two seconds.

(c) Connect the pilots and gunners linkages to the respective helmets and check for freedom of movement in all directions. Adjust helmet sight reticle on each helmet until the full reticle pattern can be seen.

(d) Check that HSS reticle illumination control on the gunners armament control panel is functioning properly. Turn the RETICLE brightness control knob from OFF to BRT and check for corresponding proper light intensity. Move the RETICLE TEST switch to TEST and check that HSS illumination is not affected.

(e) Hold the gunners helmet sight line-of-sight (LOS) at 0 degrees elevation and 0 degrees azimuth, depress the left-hand grip ACTION switch on the TSU, and slowly rotate the LOS downward. The weapon should reach the depression limit at 20 ± 5 degrees down. The reticle should flash when the helmet LOS is out of coincidence with the commanded gun line.

(f) Position TURRET DEPR limit switch to OFF.

CAUTION

Excessive downward movement of LOS can cause barrels to strike ground.

(g) Hold the gunners helmet sight line-of-sight (LOS) at 0 degrees elevation and 0 degrees azimuth, depress the left-hand grip ACTION switch on the T9U, and slowly rotate LOS downward. Confirm that the gun barrels move past the turret depression limit switch position. Release left-hand grip ACTION switch.

(h) Return TURRET DEPR limit switch to ON.

(i) Depress left-hand grip ACTION switch and check that the turret traverses in both azimuth and elevation. Movement should be free in accordance with position commands from the sight.

(j) Move turret through total elevation, depression, and azimuth limits. Check that no binding or interference occurs.

(k) Rotate sight rapidly both in azimuth and elevation. Check that sight reticle flashes momentarily as the turret and HSS LOS are out of coincidence.

(l) Move turret against the upper elevation limit and slowly through total azimuth sweep. Check that reticle flashes while turret is against the upper limit in all azimuth positions.

(m) Move turret against left and right azimuth limit and slowly through total elevation sweep (plus and minus). Check that reticle flashes while the turret is against either azimuth limit in all elevation positions.

(n) Release the ACTION switch on the left-hand grip and check that the turret returns to the stowed (forward) position.

(o) Hold the sight in approximately the 0-0 position and depress the ACTION switch on the left-hand grip. Attempt to fire the weapons with the gunners and pilots trigger. The weapons should not fire.

(p) Position the pilots MASTER ARM switch to ARM. Check that the pilots amber ARMED, gunners blue weapon mix, and gunners amber ARMED indicators are illuminated, and that the pilots and gunners green STBY indicators are extinguished.

(q) Check that HS RTCL illumination controls on the pilots armament control panel are functioning properly. Turn the HS RTCLE brightness control knob from OFF to BRT and check for corresponding proper light intensity. Move the HS RTCL TEST switch to TEST and check that HS illumination is not affected.

(r) Depress ACTION switch. Check that turret continues to follow sight position commands. Release ACTION switch.

(s) Position the COMP switch on the gunners armament control panel to ON.

(t) Hold gunners helmet sight LOS at approximately 0 degrees EL and 90 degrees AZ. Depress the ACTION switch and move the RANGE switch to 1000, then 1500 meters. Check that the turret elevation increases with increased range settings. Return switch to 500.

(u) Depress the ACTION switch and move the left-hand grip trigger on the gunners TSU to the first detent, then the second. Check that the weapon fires at a low rate, then at a high rate. Release the ACTION switch and depress the trigger. The weapon should not fire.

NOTE

When WPN CONT switch is in GNR position, depression of pilots ACTION switch and trigger should not move turret or fire weapons.

(v) Check for proper operation of the burst limit relay. Depress ACTION switch and trigger, 7.62 MM weapon should fire a 6 + 1 second duration burst. Position TURRET SELECT switch to L, depress ACTION switch and trigger, and 40 MM weapon should fire a 10 +1 second duration burst. Trigger must be released before firing can continue.

CAUTION

Prior to conducting following steps, verify that all wing stores electrical connections (launchers, pods, etc.) have been disconnected.

(w) Position pilots WG ST ARM switch to INBD. Check that pilots amber WG ST ARMED light illuminates.

(x) While firing the 7.62 MM weapon, depress pilots cyclic stick WING ARM FIRE button. Check that weapon firing is interrupted and that, when WING ARM FIRE button is released, a time delay of 0.5 seconds occurs before the weapon resumes operation.

(y) Repeat step (x), except fire the 40 MM weapon.

(z) Position pilots WG ST ARM switch to OUTBD and repeat steps (x) and (y).

(aa) Position pilots WG ST ARM switch to OFF. Observe that pilots amber WG ST ARMED light extinguishes.

(ab) Hold gunners helmet sight LOS at approximately 0 degrees EL and 90 degrees AZ. Position the gunners TURRET SELECT switch to L. Depress the ACTION switch and move the RANGE switch to 1000 meters, then to 1500 meters. Check that turret elevation increases with increased range selection and with greater degree than previously noted for the 7.62 MM weapon. Return RANGE switch to 500. Return COMP switch to OFF.

(ac) Depress the ACTION switch and trigger. Check that the 40 MM weapon fires.

(ad) Position gunners TURRET SELECT switch to BOTH. Check that the 7.62 MM weapon fires and that the 40 MM will not fire.

(2) Pilot turret control.

(a) Position the pilots WPN CONT switch to PLT. Check that the blue PLT IN CONT indicator on the gunners control panel illuminates and that gunners blue weapon mix indicator extinguishes. Check that the pilots blue weapon mix indicator illuminates.

(b) Depress the left-hand grip ACTION switch or the gunners cyclic grip ACTION switch. Check that the gunners helmet sight has no control of the turret or weapon firing.

(c) Depress the ACTION switch on the pilots cyclic grip and check that the turret follows the pilots helmet sight LOS in the same manner as that described for the gunner in c (1) above, steps (e) through (n).

(d) Check that only the pilots cyclic stick trigger fires the 7.62 MM weapon; low rate at the first detent, and high rate at the second detent.

(e) Position the pilots TURRET switch to L. Check that only the pilots cyclic stick trigger fires the 40 MM weapon in either detent.

(f) Position the pilots TURRET switch to R. Check that the 7.62 MM weapon fires from the pilots cyclic stick trigger only.

(3) Pilot override by gunner.

(7.62 MM weapon)

(a) Position gunners PLT OVRD switch to PLT OVRD. Check that the blue weapon mix indicator on the gunners armament control panel illuminates and that the blue PILOT IN CONT extinguishes. Check that the pilots blue weapon mix indicator extinguishes.

(b) Position the gunners TURRET SELECT switch to R or BOTH. Depress the gunners cyclic stick ACTION switch and check that only the gunners cyclic stick trigger will fire the 7.62 MM weapon and that the 40 MM weapon will not fire. The gunners helmet sight subsystem (HSS) should control the turret.

(c) Depress the left-hand grip ACTION switch and trigger. Check that the turret does not respond to the helmet sight and the weapon does not fire.

(d) Depress the pilots cyclic stick ACTION switch and trigger. Check that pilots helmet sight will not control the turret and that the weapon does not fire.

NOTE

With PLT OVRD switch in PLT OVRD position, the system is armed and both ARMED lights remain illuminated until PLT OVRD switch is placed to OFF, regardless of position of MASTER ARM switch.

(e) Position pilots MASTER ARM switch to OFF and check that both pilots and gunners amber ARMED lights remain ON. Check that only gunners cyclic stick trigger will fire the 7.62 MM weapon.

(40 MM weapon)

(a) Position gunners TURRET SELECT switch to L. Check that only gunners cyclic stick trigger will fire the 40 MM weapon.

(b) Observe that both right and left round counters have moved to zero.

(4) Turret airspeed compensation.

(a) Apply air pressure to the pitot system to simulate 100 knots airspeed.

(b) Rotate turret approximately 90 degrees to the left to check airspeed compensation operation.

(c) Position COMP switch on gunners armament control panel to ON. Observe aft turret rotation (indicating airspeed data is being fed to the turret positioning circuits).

(d) Position gunners TURRET SELECT switch to R or BOTH.

(e) Check that compensation is greater for 40 MM weapon.

(f) Return PLT OVRD and COMP switches to OFF, and remove air pressure from pitot system.

d. Conclusion of Tests. Upon completion of the preceding armament circuitry tests, de-energize and disconnect auxiliary power unit and hydraulic ground test cart.

9-80. Troubleshooting - Turret System Circuitry.

a. Airframe Circuitry and Components. Refer to figure F-7, armament wiring diagram, and trace malfunctioning circuit loop, using standard electronic troubleshooting procedures, and standard test equipment. Localize malfunctioning components and repair or replace, as required.

b. Turret System. Refer to TM 9-1090-203 series maintenance manuals for troubleshooting procedures pertaining to the M28A1E1 turret system.

c. Helmet Sight Subsystem. Refer to TM 9-1270-212-14 for troubleshooting procedures pertaining to the XM128 helmet sight subsystem.

d. Telescopic Sight Unit. Refer to TM 9-1425-473 series maintenance manuals for troubleshooting procedures pertaining to the telescopic sight unit portion of the XM65 TOW missile subsystem.

9-81. UNIVAC Electronic Interface Assembly.

The electronic interface assembly is a component of the XM128 helmet sight subsystem that provides regulated 28 Vdc power and contains the electronic components necessary for the operation of the HSS. The electronic interface assembly is the point of integration with the interface control unit (IFCU) which interfaces the HSS and TSU sighting systems with the M28A1E1 turret system. The electronic interface assembly is mounted to the rear cockpit bulkhead (see figure 9-13). The electronic interface assembly contains buffer amplifiers and circuitry required by the linkage resolvers, azimuth and elevation alignment controls and associated circuitry for boresighting each linkage assembly, and the BITE circuits and controls necessary to provide the HSS self-test capability. For additional information and maintenance procedures pertaining to the electronic interface assembly, refer to TM 9-1270-212-14.

9-82. Interface Control Unit (IFCU).

The interface control unit (IFCU) contains the signal switching, buffering and alignment, range compensation, airspeed compensation, and depression limit circuitry necessary to interface the

helmet sight subsystem (HSS) and stabilized telescopic sight unit (TSU) with the M28A1E1 turret system. The IFCU is located in the right access compartment below the wing (see figure 9-13). When the gunner selects the gun mode in the TOW system, the computing resolver chain contained within the turret system is connected to similar resolvers located in the TSU. Elevation and azimuth commands and a range compensation function are then developed in the TSU which are returned to the turret system through the IFCU as positioning signals for the turret assembly. In this manner, as the TSU tracks the target, the turret assembly is commanded to follow the TSU line-of-sight. Operation with either the pilots or gunners helmet sight is accomplished in a like manner. The function of the IFCU is to receive signals from the three sighting units, control panel switching, and airspeed transducer and provide the appropriate circuit response, depending upon the mode activated by the system operator. This interchange of signals is accomplished in the IFCU with the use of relay logic. Once the sighting unit is selected, turret positioning signals are routed from the sight back through the IFCU to integrated circuit buffer amplifiers. The amplifiers ensure that the computing accuracy of the resolver chain is maintained and provide a means of changing outputs for compensation purposes. In addition to the gun mode, an acquisition mode is provided in which either helmet sight positions the TSU. The acquisition mode thus allows either the pilot or the gunner to acquire a target for the TOW missile by utilizing the helmet sight. The relay logic in the IFCU also provides a dual mode capability. If the gunner has selected the TOW mode, the pilot has the capability of directing the turret assembly with the helmet sight. In addition, either helmet sight may be directing the turret assembly while the other helmet sight is used to acquire a target for the TOW missile. Pitch and roll trim resolvers within the IFCU resolve any installation misalignment existing between the TSU and the turret assembly. These resolvers are aligned during system boresighting and then locked in the corrected position. Other IFCU inputs and outputs include airspeed data for turret compensation, helmet sight reticle voltage, and a turret coincidence signal which provides an indication as to turret/sight alignment.

a. Cleaning.

- (1) Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

- (2) Remove grease, fungus, and ground-in dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

- (3) Remove dirt from electrical connectors with a bristle brush.

b. Inspection.

- (1) Inspect IFCU case for cracks or damage.
- (2) Inspect electrical connectors for broken pins or cracked connector inserts.
- (3) Inspect IFCU for secure mounting.

c. Removal.

- (1) Ensure all electrical power is OFF.
- (2) Remove IFCU access panel (right side, below wing).
- (3) Disconnect three electrical connectors from IFCU. Protect receptacles and plugs with caps or electrical tapes.
- (4) Remove mounting screws and washers, and remove IFCU from shelf.

d. Repair or Replacement.

- (1) Repair connectors, and tighten or replace loose or missing mounting screws.
- (2) Replace IFCU if case is damaged or defective. Evacuate removed IFCU to higher echelon for disposition.

e. Installation.

- (1) Position IFCU in place on shelf and install mounting screws and washers.
- (2) Remove protective caps or electrical tape from three electrical connectors and install on IFCU.

- (3) Close and secure access panel.

9-83. Wing Stores Armament Systems Circuitry.

The wing stores armament systems consist of the rocket launcher circuitry, XM-18 minigun circuitry, and wing stores jettison circuitry. Functions of the wing stores armament systems are as follows:

a. The rocket launcher circuitry enables the pilot to select and control the release (or firing) of rockets from rocket launchers mounted on any or all of the four wing stations. With the system armed, rockets may be released (or fired) by depressing either the pilots WING ARM FIRE switch or gunners WING ARM FIRE switch (when in PILOT OVERRIDE mode).

b. The XM-18 minigun circuitry enables the pilot or gunner (when in PILOT OVERRIDE mode) to select and fire either or both XM-18 miniguns mounted on inboard wing stations. With the system armed, either or both miniguns may be fired by depressing either the pilots WING ARM FIRE switch or gunners WING ARM FIRE switch (when in PILOT OVERRIDE mode).

c. The wing stores jettison circuitry enables the pilot to select wing station weapons (inboard or outboard) to be jettisoned in an emergency situation. Selected wing station weapons are jettisoned by depressing the pilots or gunners WING STORES JETTISON switch.

9-84. Functional Test - Wing Stores Armament System Circuitry.

a. Requirements. The following functional tests are designed to be performed using a test set such as indicated by figures 9-14 and 9-15, or a suitable equivalent, and a 28 Vdc, 300 ampere auxiliary power unit.

WARNING

Ensure no live ammunition is present in any of the armament systems.

b. Preparation for Testing.

(1) Open all circuit breakers and place all switches to their OFF or normal positions. Connect the appropriate rocket test set cable to each of the four connectors (P218,

P221, P225, and P232), located at the wing stores disconnect areas in the wings of the helicopter.

(2) Connect the two XM-18 test set cables to connectors (P228 and P229) on the helicopter.

(3) Connect the test set wing stores jettison cables on the test set to their respective helicopter receptacles (J216, J217, J223, and J224).

(4) Connect a 28 Vdc external power source to helicopter external power receptacle and energize power source.

NOTE

No test set lights shall be illuminated at any time, except as indicated in the following test procedures.

c. Rocket Launcher Circuitry Test (Pilot Controlled Firing).

(1) Place XM-18/ROCKETS switch SW-1. on armament test set to INBD RKTS. Close WPNS FIRE and WING STORES ROCKETS circuit breakers. Position MASTER ARM switch to ARM. Position WG ST ARM switch to OUTBD. Place RKT PR SEL switch to position 1. Depress WING ARM FIRE switch on pilots cyclic stick. Check that No. 1 pair of OUTBOARD ROCKET lights on test set illuminate briefly and then extinguish.

(2) Depress WING ARM FIRE switch on pilots cyclic stick again. Check that No. 1 pair of OUTBOARD ROCKET lights on test set do not illuminate, and that No. 2 pair illuminate briefly, and then extinguish.

(3) Release WING ARM FIRE switch. Place RKT PR SEL switch to position 2. Depress and hold WING ARM FIRE switch on pilots cyclic stick. Check that No. 1 and No. 2 pairs of OUTBOARD ROCKET lights do not illuminate, but No. 3 pair, and then No. 4 pair, illuminate briefly, then extinguish.

(4) Release WING ARM FIRE switch. Place RKT PR SEL switch to position 4. Depress and hold WING ARM FIRE switch on pilots cyclic stick. Check that the No. 1, No. 2, No. 3, and No. 4 pairs of OUTBOARD ROCKET lights do not illuminate, but

that No. 5, No. 6, No. 7, and No. 8 pairs illuminate briefly in turn, then extinguish, leaving no lights illuminated.

(5) Release WING ARM FIRE switch. Place RKT PR SEL switch to position 7. Depress and hold WING ARM FIRE switch on pilots cyclic stick. Check that the No. 1 through No. 8 pairs of OUTBOARD ROCKET lights do not illuminate, but that No. 9 through No. 15 rocket pair lights illuminate briefly in turn, then extinguish, leaving no lights illuminated.

(6) With RKT PR SEL switch still in position 7, release and depress WING ARM FIRE switch. Check that rocket pair lights No. 1 through No. 15 do not illuminate, but No. 16 through No. 19 rocket pairs illuminate briefly in turn, then extinguish, leaving no lights illuminated.

(7) Open, then close WING STORES ROCKETS circuit breaker to reset the intervalometer memory. Place RKT PR SEL switch to position 19. Depress and hold WING ARM FIRE switch on pilots cyclic stick. Check that each pair of OUTBOARD ROCKETS

lights illuminate briefly and then extinguish, beginning with No. 1 and continuing through No. 19, and that no lights remain illuminated.

(8) Release WING ARM FIRE switch. Open and close WING STORES ROCKETS circuit breaker to reset intervalometer memory. With RKT PR SEL switch still set to position 19, depress WING ARM FIRE switch on pilots cyclic stick, and hold until 7 to 10 of the light pairs have illuminated briefly in turn, and then extinguished. Release WING ARM FIRE switch. Again depress WING ARM FIRE switch. Check that none of the previously illuminated light pairs become illuminated, and that each remaining pair illuminates briefly, and then extinguishes until all rocket pair lights have illuminated briefly and extinguished. No lights shall remain illuminated.

(9) Release WING ARM FIRE switch. Open and close the WING STORES ROCKETS circuit breaker to reset the intervalometer memory. Depress and hold, then release WING ARM FIRE

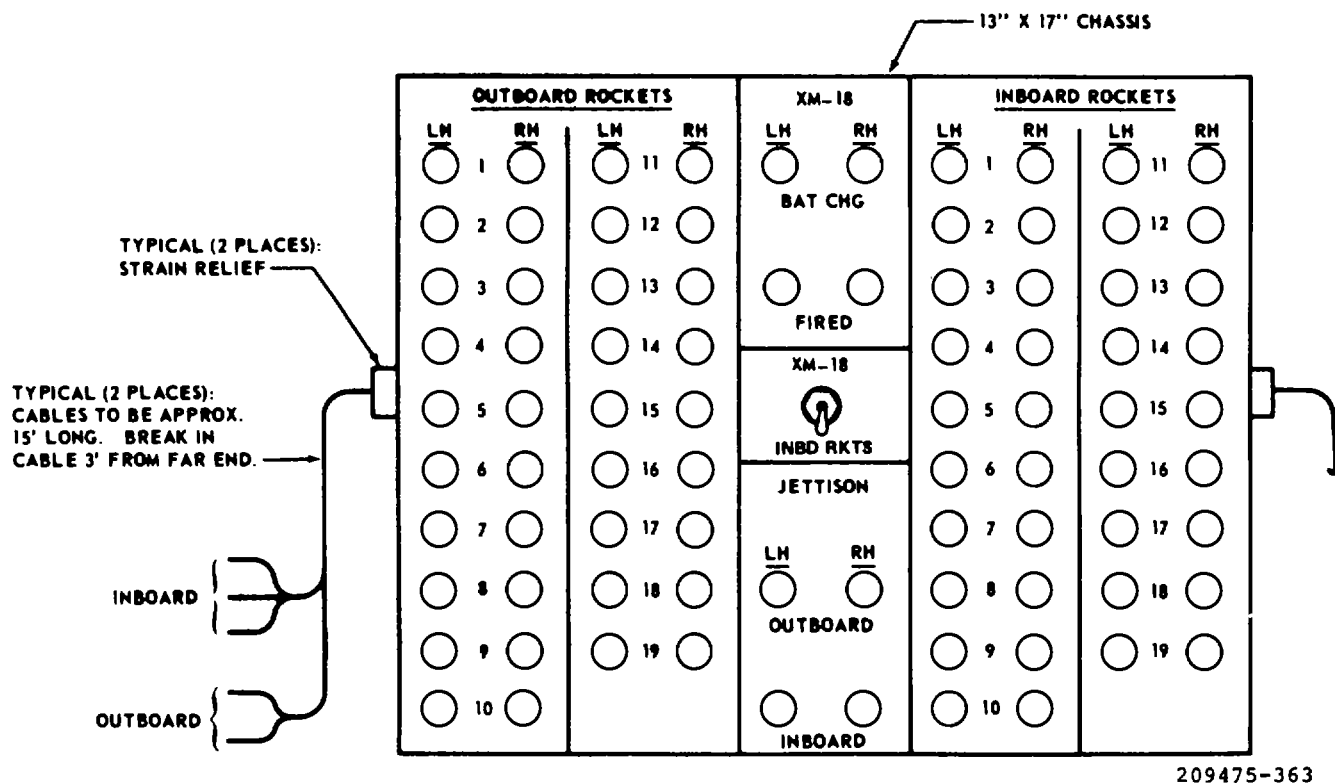


Figure 9-14. Wing stores armament test panel

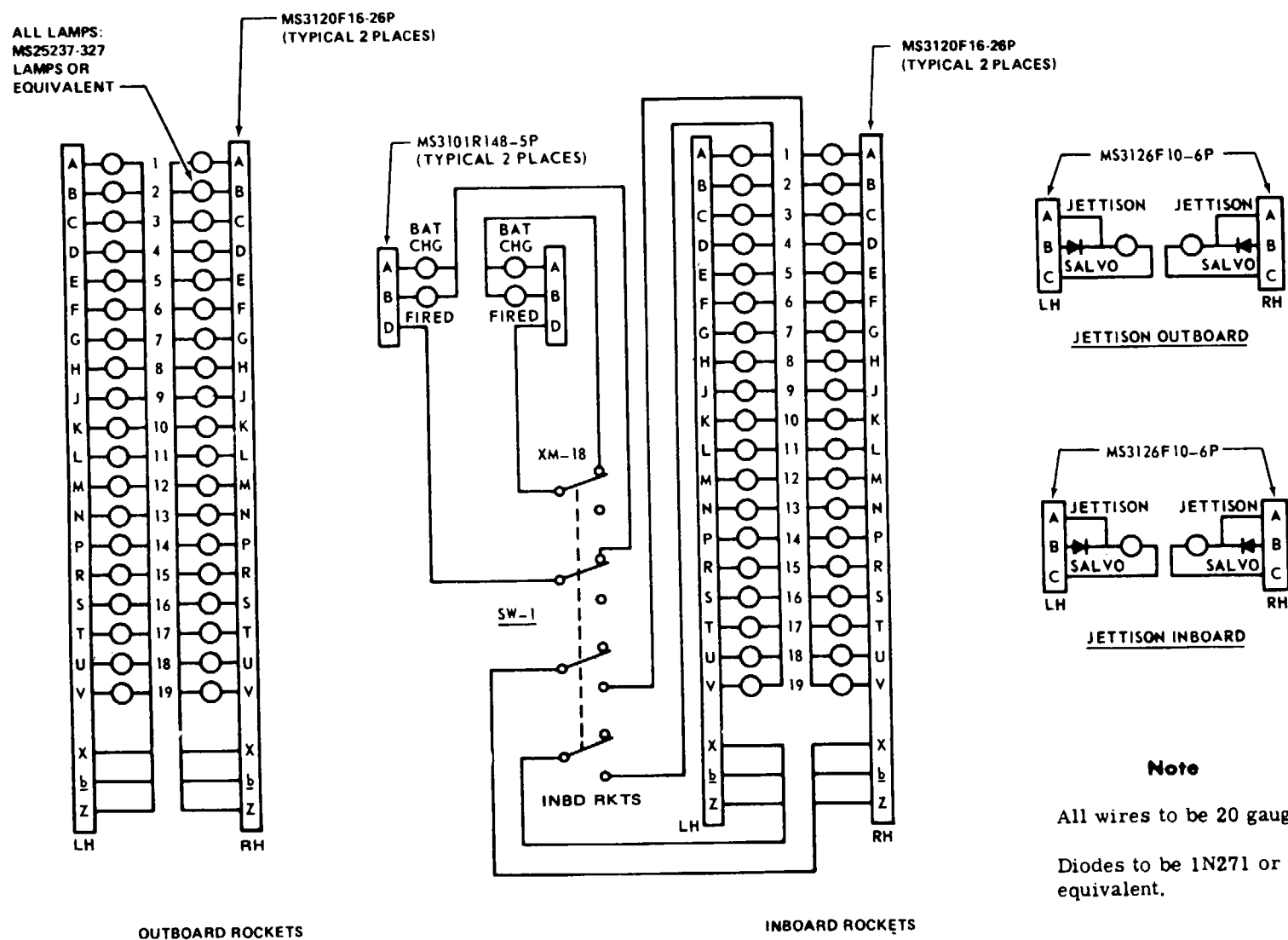


Figure 9-15. Wing stores armament test panel wiring diagram

WING ARM FIRE button has no control, and that no light pairs on test set become illuminated.

(10) Repeat steps (1) through (9), except place WG ST ARM switch to INBD position and observe INBOARD ROCKET light pairs instead of OUTBOARD ROCKET light pairs on test set.

(11) Open and close the WING STORES ROCKETS circuit breaker to reset the intervalometer memory. Set RKT PR SEL switch to position 7. Depress WING ARM FIRE switch on pilots cyclic stick and hold until 7 inboard light pairs have successively illuminated briefly and then extinguished, and no light pairs remain illuminated. Place WG ST ARM switch to OUTBD position, but do not reset intervalometer memory. Depress WING ARM FIRE switch on pilots cyclic stick and hold until 7 outboard light pairs have successively illuminated briefly and then extinguished and no light pairs remain illuminated. Place WG ST ARM switch to INBD position, but do not reset intervalometer memory. Depress and hold WING ARM FIRE switch until 7 additional pairs of inboard rockets lights beginning with No. 8 have illuminated briefly and extinguished. No light pairs shall remain illuminated.

(12) Place WG ST ARM switch to OUTBD. Do not reset the intervalometer memory. Depress and hold the pilots WING ARM FIRE switch. Check that outboard rocket light pairs No. 8 through No. 14 illuminate briefly and then extinguish. No light pairs should remain illuminated.

d. Rocket Launcher Circuitry Test (Gunner Controlled Firing).

(1) XM-18/ROCKETS switch, SW-1, on the test set shall remain in INBD RKTS position. Unlock PILOT OVRD switch on gunners armament control panel and position it to PILOT OVRD. Position MASTER ARM switch to ARM. Repeat all tests in preceding steps c(1) through c(8) and steps c(10) through c(12), except the test described in step c(9), substituting WING STORES SELECT switch for WG ST ARM switch, and WING ARM FIRE switch on gunners cyclic stick for WING ARM FIRE switch on pilots cyclic stick.

(2) Repeat test described in preceding step c(9), substituting WING ARM FIRE switch on pilots cyclic stick for WING ARM FIRE switch on gunners cyclic stick. Check that the pilots WING ARM FIRE switch will fire wing stores armament.

(3) Place MASTER ARM switch to the OFF position. Depress WING ARM FIRE switch on gunners cyclic stick. Check for no response on the test set.

e. XM-18 Minigun Circuitry Test.

(1) Place XM-18 INBD RKTS switch on test set to XM-18 position. Place gunners PILOT OVRD switch to OFF. Place pilots WG STS ARM switch to INBD. Close TURRET PWR, RH MINIGUN, and LH MINIGUN circuit breakers. Place MASTER ARM switch to STBY. Check that XM-18 BAT CHG lights on test set illuminate.

(2) Depress WING ARM FIRE switch on pilots cyclic stick. Check that XM-18 FIRED lights on test set do not illuminate.

(3) Place MASTER ARM switch to ARM. Depress and hold pilots WING ARM FIRE switch. Check that XM-18 FIRED lights illuminate.

(4) Release pilots WING ARM FIRE switch. Check that XM-18 FIRED lights extinguish.

(5) Place pilot WG STS ARM switch to OFF. Depress pilots WING ARM FIRE switch. Check XM-18 FIRED lights do not illuminate.

(6) Place OVERRIDE PILOT switch to ON. Set gunners WG STS ARM switch to INBD. Depress and hold pilots WING ARM FIRE switch. Check that XM-18 FIRED lights illuminate.

(7) Release gunners WING ARM FIRE switch. Check that XM-18 FIRED lights extinguish.

(8) Place gunners WG STS ARM switch to OFF. Depress gunners WING ARM FIRE switch. Check that XM-18 FIRED lights do not illuminate. Return gunner WG STS ARM switch to INBD.

(9) Depress pilots WING ARM FIRE switch. Check that XM-18 FIRED lights do not illuminate.

(10) Place pilots WG STORES ARM switch to INBD. Depress and hold pilots WING ARM FIRE switch. Check that XM-18 FIRED lights illuminate.

(11) Release pilots WING ARM FIRE switch. Check that XM-18 FIRED lights extinguish.

(12) Place MASTER ARM switch to OFF. Depress and hold the pilots WING ARM FIRE switch. Check that XM-18 FIRED lights illuminate.

(13) Release WING ARM FIRE switch. Check that XM-18 FIRED lights extinguish.

(14) Place gunners PILOT OVRD switch to OFF. Check that neither WING ARM FIRE switch will cause XM-18 FIRED lights to illuminate and that XM-18 BAT CHG lights are extinguished.

f: Wing Stores Jettison Circuitry Test.

(1) Open all armament circuit breakers. Ensure that WING STORES JETTISON switch on pilots instrument panel is in down position and metal guard is in place over switch toggle. Ensure that WING STORES JETTISON switch on gunners instrument panel is in the down position and metal guard is in place over switch toggle. Close WING STORES JETTISON circuit breaker (located on dc circuit breaker panel). Check that no JETTISON lights on test set are illuminated.

(2) Position pilots WG ST JETTISON select switch to BOTH. Check that no JETTISON lights on test set illuminate.

(3) Position pilots WG ST JETTISON select switch to OUTBD. Check that no JETTISON lights on test set illuminate.

(4) Position pilots WG ST JETTISON select switch to INBD. Check that no JETTISON lights on test set illuminate.

(5) Position pilots WG ST JETTISON select switch to BOTH. Lift guard and place WING STORES JETTISON switch on pilots instrument panel to the up position. Check that no JETTISON lights on test set illuminate.

(6) Position pilots WG ST JETTISON select switch to OUTBD. Check that both OUTBOARD JETTISON lights on test set illuminate.

(7) Position pilots WG ST JETTISON select switch to INBD. Check that both OUTBOARD JETTISON lights extinguish and that both INBOARD JETTISON lights on test set illuminate.

(8) Position pilots WG ST JETTISON select switch to BOTH. Check that INBOARD JETTISON lights on test set extinguish.

(9) Return WING STORES JETTISON switch on pilots instrument panel to the down position. Lift guard and position gunners WING STORES JETTISON switch to the up position. Check that no JETTISON lights on test set illuminate.

(10) Position pilots WG ST JETTISON select switch to INBD, then to OUTBD. In each case, check that no JETTISON lights on test set illuminate. Return pilots WG ST JETTISON select switch to BOTH. Return gunners WING STORES JETTISON switch to down position.

(11) With EXTERNAL STORES EMERGENCY JETTISON circuit breaker closed (located in the aft electrical compartment), check that no JETTISON lights on test set illuminate.

(12) Lift guard and position WING STORES JETTISON switch on pilots instrument panel to the up position. Check that both OUTBOARD JETTISON lights illuminate but extinguish after approximately 0.5 second, then both INBOARD JETTISON lights illuminate.

(13) Return WING STORES JETTISON switch on pilots instrument panel to the down position. Check that both INBOARD JETTISON lights on test set extinguish.

(14) Position pilots WG ST JETTISON select switch to OUTBD. Position WING STORES JETTISON switch on pilots instrument panel in the up position. Check that both OUTBOARD JETTISON lights illuminate.

(15) Return pilots WING STORES JETTISON switch to the down position. Check that both OUTBOARD JETTISON lights on test set extinguish.

(16) Position pilots WG ST JETTISON select switch to INBD. Lift guard and position pilots WING STORES JETTISON switch to the up position. Check that both INBOARD JETTISON lights on test set illuminate.

(17) Return pilots WING STORES JETTISON switch to the down position. Check that both INBOARD JETTISON lights on test set extinguish.

(18) Return pilots WG ST JETTISON select switch to BOTH. Lift guard and place WING STORES JETTISON switch on gunners instrument panel to

the up position. Check that both OUTBOARD JETTISON lights illuminate immediately but extinguish after approximately 0.5 second when both INBOARD JETTISON lights illuminate.

(19) Return WING STORES JETTISON switch on gunners instrument panel to the down position. Check that both INBOARD JETTISON lights on test set extinguish.

(20) Position pilots WG ST JETTISON select switch to OUTBD. Lift guard and place WING STORE JETTISON switch on gunners instrument panel to the up position. Check that both OUTBOARD JETTISON lights illuminate immediately but extinguish after approximately 0.5 second, when both INBOARD JETTISON lights illuminate.

(21) Return WING STORES JETTISON switch on gunners instrument panel to the down position. Check that both INBOARD JETTISON lights on test set extinguish.

(22) Position pilots WG ST JETTISON select switch to INBD. Lift guard and place WING STORES JETTISON switch on gunners instrument panel to the up position. Check that both OUTBOARD JETTISON lights illuminate immediately but extinguish after approximately 0.5 second when both INBOARD JETTISON lights illuminate.

(23) Return WING STORES JETTISON switch on gunners instrument panel to the down position. Check that both INBOARD JETTISON lights on test set extinguish.

(24) Open WING STORES JETTISON circuit breaker. Lift guard and place WING STORES JETTISON switch on pilots instrument panel to the up position. Check that both OUTBOARD JETTISON lights illuminate but extinguish after approximately 0.5 second when both INBOARD JETTISON lights illuminate.

(25) Return WING STORES JETTISON switch on pilots instrument panel to the down position. Check that both INBOARD JETTISON lights on the test set extinguish.

(26) Lift guard and place WING STORES JETTISON switch on gunners instrument panel to the up position. Check that OUTBOARD JETTISON lights illuminate immediately but extinguish after approximate-

ly 0.5 second when both INBOARD-JETTISON lights illuminate.

(27) Return WING STORES JETTISON switch on gunners instrument panel to the down position. Check that both INBOARD JETTISON lights on the test set extinguish.

(28) Connect a temporary jumper wire between pins A and B of receptacles J221 and J225 (located under aft end of each outboard wing station). Open EXTERNAL STORES EMERGENCY JETTISON circuit breaker. Close WING STORES JETTISON circuit breaker. Repeat above steps (5) through (8). Check that the same results are obtained.

(29) Reconnect the jumper wires installed in step (28) above, between pins A and C of the same receptacles, J221 and J225. Close the EXTERNAL STORES EMERGENCY circuit breaker. With pilots WG ST JETTISON select switch in the BOTH position, repeat step (12). Check that the same results are obtained. Then repeat steps (13) through (15). Check that the same results are obtained.

(30) Position pilots WG ST JETTISON switch to INBD. Lift guard and position pilots WING STORES JETTISON switch to the up position. The INBOARD JETTISON lights illuminate approximately 0.5 second after pilots WING STORES JETTISON Switch is placed to the UP position.

(31) Repeat step (13).

(32) Open WING STORES JETTISON circuit breaker (on dc circuit breaker panel) and remove jumper wires from receptacles J221 and J225.

g. Conclusion of Tests. Upon completion of the preceding armament circuitry tests, deenergize and disconnect auxiliary power unit. Remove all test set cables from their respective helicopter connectors and test set. Check that each connector on the helicopter armament circuitry is properly reconnected.

9-85. Voltage Continuity Test - Wing Stores Ejector Racks.

The following voltage continuity tests are to be performed on all new installed racks, replacement

racks, and racks that have been used to jettison stores. Racks must be mounted on the helicopter to conduct the following tests.



Remove the squibs (cartridges) (2 each) from both inboard and both outboard racks before starting test(refer to Chapter 16). Tag and identify each squib (cartridge) to determine cavity removed from for reassembly purposes.

- a. Close WING STORES JETTISON circuit breaker.
- b. Position WG ST JETTISON select switch on the pilots wing stores control panel (A13), to INBD position.
- c. Connect one lead of multimeter (AN/PSM-6A, or equivalent), set up for testing voltage, to the firing contact in the cartridge cavity of the piston block, and attach the other lead to the piston block.

d. Position WING STORES JETTISON switch on the pilots instrument panel to the up position. Observe that the voltmeter reading is between 18 and 30 Vdc. Repeat test for second firing contact.

e. Repeat steps a through d for checking outboard racks, except position WG ST JETTISON select switch to OUTBD position.

f. Mark squibs (cartridges) with indelible ink and reassemble into the same cavity from which removed. (Refer to Chapter 16.)

9-86. Troubleshooting -Wing Stores Armament Systems Circuitry.

NOTE

In the following troubleshooting charts it is assumed that power is applied to the main dc and ac buses, and the applicable circuit breakers are closed.

a. *Troubleshooting - Rocket Launcher Circuitry.* (See figure F-7 and table 9-25.)

Table 9-25. Troubleshooting - Rocket Launcher Circuitry

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. With MASTER ARM switch positioned to ARM, pilots and gunners amber ARMED indicators illuminated, and WG ST ARM switch in either INBD or OUTBD position, amber wing stores ARMED light is not illuminated.

STEP 1. Check for defective light, wiring and WG ST ARM switch.

Replace light or switch if defective. Repair any defective wiring.

STEP 2. Check for defective turret system circuitry.

Refer to TM 9-1090-203 series maintenance manuals.

Table 9-25. Troubleshooting - Rocket Launcher Circuitry (Cont)

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

2. With WPNS FIRE and WING STORES ROCKETS circuit breakers closed, MASTER ARM switch positioned to ARM, WG ST ARM switch in either INBD or OUTBD position, amber wing stores ARMED light illuminated, but rockets do not fire when WING STORES FIRE switch on pilots cyclic stick is pressed.

STEP 1. Check for defective wiring.

Repair any defective wiring.

STEP 2. Check for defective WG ST ARM switch.

If defective, replace WG ST ARM switch. (Refer to paragraph 9-6.)

STEP 3. Check for defective WING STORES FIRE switch on pilots cyclic stick.

Replace defective switch. (Refer to paragraph 11-10 d.)

STEP 4. Check for defective master arm relay (K31).

If defective, replace relay. (Refer to paragraph 9-4.)

STEP 5. Check for defective intervalometer.

If defective, replace intervalometer. (Refer to paragraph 9-4.)

3. With WPNS FIRE and WING STORES ROCKETS circuit breakers closed, MASTER ARM switch positioned to ARM, WG ST ARM switch in either INBD or OUTBD position, amber wing stores ARMED light illuminated 19 rockets fire when WING STORES FIRE switch on pilots cyclic stick is pressed, regardless of position of RKT PR SEL switch.

STEP 1. Check for defective RKT PR SEL switch.

If defective, replace switch. (Refer to paragraph 9-6.)

NOTE

Open circuit at RKT PR SEL switch fires all 19 rockets.

4. With WPNS FIRE and WING STORES ROCKETS circuit breakers closed, MASTER ARM switch positioned to ARM, WG ST ARM switch in either INBD or OUTBD position, amber wing stores ARMED light illuminated, one left wing rocket fires but the right wing rocket does not fire when WING STORES FIRE switch is pressed.

STEP 1. Inspect for defective ground connections to airframe on right wing.

If defective, repair ground connectors.

STEP 2. Check for defective wiring.

If defective, repair wiring.

Table 9-25. Troubleshooting - Rocket Launcher Circuitry (Cont)

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

STEP 3. Check for defective connector (J85), or (P85), (J222) or (P222).

If defective, replace connector.

STEP 4. Check for defective intervalometer.

If defective, replace intervalometer. (Refer to paragraph 9-4.)

5. With WPNS FIRE and WING STORES ROCKETS circuit breakers closed, MASTER ARM switch positioned to ARM, WG ST ARM switch in either INBD or OUTBD position, amber wing stores ARMED light illuminated, the right wing rocket fires but the left wing rocket does not fire when WING STORES FIRE switch is pressed.

STEP 1. Inspect for defective ground connections to airframe on left wing.

If defective, repair ground connections.

STEP 2. Check for defective wiring.

If defective, repair wiring.

STEP 3. Check for defective connector (J84) or (P84), (J215) or (P215).

If defective, replace connector.

STEP 4. Check for defective intervalometer.

If defective, replace intervalometer. (Refer to paragraph 9-4.)

6. With WPNS FIRE and WING STORES ROCKETS circuit breakers closed, MASTER ARM switch positioned to ARM, WG ST ARM switch in either INBD or OUTBD position, amber wing stores ARMED light illuminated the OUTBD rockets fire normally from both sides but the INBD rockets will not fire when pilots WING STORES FIRE switch is pressed.

STEP 1. Check for defective wiring.

If defective, repair wiring.

STEP 2. Check for defective WG ST ARM switch.

If defective, replace switch. (Refer to paragraph 9-6.)

7. With WPNS FIRE and WING STORES ROCKETS circuit breakers closed, MASTER ARM switch positioned to ARM, WG ST ARM switch in either INBD or OUTBD position, amber wing stores ARMED light illuminated, the INBD rockets fire normally from both sides but the OUTBD rockets will not fire when pilots WING STORES FIRE switch is pressed.

STEP 1. Check for defective wiring.

If defective, repair wiring.

Table 9-25. Troubleshooting - Rocket Launcher Circuitry (Cont)

CONDITION	TEST OR INSPECTION	CORRECTIVE ACTION
		STEP 2. Check for defective WG ST ARM switch. If defective, replace switch. (Refer to paragraph 9-6.)
	8. With WPNS FIRE, WING STORES ROCKETS, and TURRET PWR circuit breakers closed, PILOT OVRD switch in gunners control panel in PILOT OVRD, WING STORES SELECT switch in either INBD or OUTBD position, rockets will not fire when WING STORES FIRE switch on gunners cyclic stick is pressed.	STEP 1. Check for defective wiring. If defective, repair wiring. STEP 2. Check for defective WING STORES FIRE switch on gunners cyclic stick. Replace defective switch. (Refer to paragraph 11-10 d.) STEP 3. Check for defective RKT PR SEL switch. (See item 3.) If defective, replace switch. (Refer to paragraph 9-6.) STEP 4. Check for defective WING STORES ROCKETS circuit breaker. If defective, replace circuit breaker. (Refer to paragraph 9-5.) STEP 5. Check for defective master arm relay (K31). If defective, replace relay. (Refer to paragraph 9-4.) STEP 6. Check for defective connector (J213). If defective, replace connector. (Refer to paragraph 9-4.) STEP 7. Check for defective intervalometer. If defective, replace intervalometer. (Refer to paragraph 9-4.) STEP 8. Check for defective turret system circuitry. Refer to TM 9-1090-203 series maintenance manuals.
	9. With WPNS FIRE, WING STORES ROCKETS, and TURRET PWR circuit breakers closed, PILOT OVRD switch in gunners control panel in PILOT OVRD, WING STORES SELECT switch in either INBD or OUTBD position, the OUTBD rockets fire normally from both sides, but INBD rockets do not fire when gunners WING STORES FIRE switch is pressed.	STEP 1. Check for defective wiring. If defective, replace wiring.

Table 9-25. Troubleshooting - Rocket Launcher Circuitry (Cont)**CONDITION****TEST OR INSPECTION****CORRECTIVE ACTION**

STEP 2. Check for defective turret system circuitry.

Refer to TM 9-1090-203 series maintenance manuals.

10. With WPNS FIRE, WING STORES ROCKETS, and TURRET PWR circuit breakers closed, PILOT OVRD switch in gunners control panel in PILOT OVRD, WING STORES SELECT switch in either INBD or OUTBD position, the INBD rockets fire normally from both sides, but OUTBD rockets do not fire when gunners WING STORES FIRE switch is pressed.

STEP 1. Check for defective wiring.

If defective, replace wiring.

STEP 2. Check for defective turret system circuitry.

Refer to TM 9-1090-203 series maintenance manuals.

11. With switches and circuit breakers positioned to fire rockets, either INBD or OUTBD, rockets do not fire, from the pilots cyclic stick, in the correct numbers of pairs as indicated by the setting of the RKT PR SEL switch.

STEP 1. Check for defective wiring.

If defective, repair wiring.

STEP 2. Check for defective RKT PR SEL switch, causing 19 pairs to fire.

If defective, replace switch. (Refer to paragraph 9-6.)

STEP 3. Check for defective intervalometer.

If defective, replace intervalometer. (Refer to paragraph 9-4.)

b. Troubleshooting - XM-18 Minigun Circuitry. (See figure F-7 or table 926.)

Table 9-26. Troubleshooting - XM-18 Minigun Circuitry**NOTE**

Before you use this table, be sure you have performed all normal operational checks.

Change 2   9-90A/(9-90B blank)

Table 9-26. Troubleshooting - XM-18 Minigun Circuitry (Cont)

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

1. With WPNS FIRE and both WING STORES MINIGUN circuit breakers closed, MASTER ARM switch positioned to ARM, WG ST ARM switch in INBD position, XM-18 miniguns do not fire when pilots WING STORE FIRE switch is pressed.

STEP 1. Check for defective wiring.

If defective, repair wiring.

STEP 2. Check for defective master arm relay (K31).

If defective, replace relay. (Refer to paragraph 9-4.)

STEP 3. Check for defective WG ST ARM switch.

If defective, replace switch. (Refer to paragraph 9-6.)

STEP 4. Check for defective WING STORES FIRE switch on pilots cyclic stick.

Replace defective switch. (Refer to paragraph 11-10 d.)

2. With WPNS FIRE and both WING STORES MINIGUN circuit breakers closed, MASTER ARM switch positioned to ARM, WG ST ARM switch in INBD position, one XM-18 minigun fires, but the other does not fire.

STEP 1. Check for defective ground connection to airframe on the side which does not fire.

If defective, repair ground connection.

STEP 2. Check for defective wiring.

If defective, repair wiring.

STEP 3. Check for defective wing disconnect connector (J84 - P84) or (J85 -- P85) on the side which does not fire.

If defective, replace connector. (Refer to paragraph 9-4.)

STEP 4. Check for defective WING STORES MINIGUN circuit breaker which controls the side that does not fire.

If defective, replace circuit breaker. (Refer to paragraph 9-5.)

3. With TURRET PWR circuit breakers and both WING STORES MINIGUN circuit breakers closed, PILOT OVRD switch positioned to PILOT OVRD, and WING STORES SELECT switch in INBD position, neither XM-18 minigun fires when WING STORES FIRE switch on gunners cyclic stick is pressed.

Table 9-26. Troubleshooting - XM-18 Minigun Circuitry (Cont)

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

STEP 1. Check for defective wiring.

If defective, repair wiring.

STEP 2. Check for defective TURRET PWR circuit breaker.

If defective, replace circuit breaker. (Refer to paragraph 9-5.)

STEP 3. Check for defective WING STORES FIRE switch on gunners cyclic stick.

Replace defective switch. (Refer to paragraph 11-10 d.)

STEP 4. Check for defective connector (J206), (P228), (P229), (J84/P84), (J85/P85).

If defective, replace connector.

STEP 5. Check for defective turret system circuitry.

Refer to TM 9-1090-203 series maintenance manuals.

4. With TURRET PWR circuit breakers and both WING STORES MINIGUN circuit breakers closed, PILOT OVRD switch positioned to PILOT OVRD, and WING STORES SELECT switch in INBD position, one XM-18 minigun fires, but the other does not fire when gunners WING STORES FIRE switch is pressed.

STEP 1. Check for defective wiring.

If defective, repair wiring.

STEP 2. Check for defective TURRET PWR circuit breaker.

If defective, replace circuit breaker. (Refer to paragraph 9-5.)

STEP 3. Check for defective WING STORES FIRE switch on gunners cyclic stick.

Replace defective switch. (Refer to paragraph 11-10 d.)

STEP 4. Check for defective connector (J206), (P228), (P229), (J84/P84) (J85/P85).

If defective, replace connector. (Refer to paragraph 9-4.)

STEP 5. Check for defective turret system circuitry.

Refer to TM 9-1090-203 series maintenance manuals.

- c. *Troubleshooting - Wing Stores Jettison circuitry.* (See figure F-7 and table 927.)

Table 9-27. Troubleshooting - Wing Stores Jettison Circuitry

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. With WING STORES JETTISON circuit breaker closed, the appropriate wing stores are not jettisoned when WG ST JETTISON select switch is positioned to either INBD or OUTBD, and pilots WING STORES JETTISON switch is positioned to up position.

STEP 1. Check for defective wiring.

If defective, repair wiring.

STEP 2. Check for defective WING STORES JETTISON circuit breaker.

If defective, replace circuit breaker. (Refer to paragraph 9-5.)

STEP 3. Check for defective pilots WING STORES JETTISON switch.

If defective, replace switch. (Refer to paragraph 9-6.)

STEP 4. Check for defective WG ST JETTISON select switch.

If defective, replace switch. (Refer to paragraph 9-6.)

STEP 5. Check for defective diode between terminals 3 and 4 or 5 and 6 on terminal board (TB28).

If defective, replace diode. (Refer to paragraph 9-4.)

STEP 6. Check for defective inboard or outboard jettison select relay (K42 or K43).

If defective, replace relay. (Refer to paragraph 9-4.)

2. The appropriate wing stores are jettisoned on one side, but not the other when WG ST JETTISON select switch is positioned to either INBD or OUTBD, and pilots WING STORES JETTISON switch is positioned to up position.

STEP 1. Check for defective wiring.

If defective, repair wiring.

Table 9-27. Troubleshooting - Wing Stores Jettison Circuitry

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

STEP 2. Check for defective wing disconnect connectors (J84 - P84, J215 - P215) or (J85 - P85, J222 - P222) on the side which does not jettison.

If defective, replace connector. (Refer to paragraph 9-4.)

STEP 3. Check for defective WING STORES JETTISON circuit breaker.

If defective, replace circuit breaker. (Refer to paragraph 9-5.)

STEP 4. Check for defective WING STORES JETTISON or WG ST JETTISON select switch.

If defective, replace switch. (Refer to paragraph 9-6.)

3. With WING STORES JETTISON circuit breaker closed, wing stores are not jettisoned when gunners WING STORES JETTISON switch is positioned to up position.

STEP 1. Check for defective wiring.

If defective, repair wiring.

STEP 2. Check for defective WING STORES JETTISON circuit breaker.

If defective, replace circuit breaker. (Refer to paragraph 9-5.)

STEP 3. Check for defective gunners WING STORES JETTISON switch.

If defective, replace switch. (Refer to paragraph 9-6.)

STEP 4. Check for temporary continuity (0.5 second) between pins 6 and 7 of jettison control relay (K39) when WING STORES JETTISON switch is positioned to up position. Next check for required continuity between pin-3 6 and 5 of relay.

Replace relay if it fails check. (Refer to paragraph 9-4.)

STEP 5. Check for defective inboard or outboard jettison select relay (K42 or K43).

If defective, replace relay. (Refer to paragraph 9-4.)

STEP 6. Check for defective firing circuit in rack.

Test continuity from rack connector to firing pin using multimeter. (Refer to paragraph 9-85.) Replace rack if defective. (Refer to paragraph 9-4.)

9-87. Smoke Grenade Dispenser System Circuitry.

The smoke grenade dispenser circuitry enables the pilot to select and control the release of smoke grenades from the smoke grenade dispensers. The smoke grenade dispenser control panel contains two ARM switches for outboard wing station No. 1 dispenser and two ARM switches for outboard wing station No. 4 dispenser. Two rows (inboard and outboard) of smoke grenades are carried in each smoke grenade dispenser. Smoke grenades may be released with the MASTER ARM switch positioned to either STBY or ARM. Smoke grenade(s) are released from the selected dispenser (LH or RH)-and row (inboard or outboard) by depressing the SMOKE REL switch (S95) on the pilots collective stick panel. A headset audio tone is generated through drop signal relay (K54) when a smoke grenade is released.

9-88. Functional Test - Smoke Grenade Dispenser System Circuitry.

NON-ESS BUS	NORMAL
ELEC PWR/EMER OFF	ELEC PWR

a. Requirements.

Test equipment.

(a) Power source. One 220 Vac, 3-phase, 60-hertz, 60-ampere, continuous duty (for the power cart).

(b) Auxiliary power unit. 28 Vdc, 300-ampere.

(c) Ammunition. Dummy grenades. 24 inert smoke grenades, equivalent to AN-M8 or AN-M18.

b. Preparation for Testing.

(1) *General.* Qualified armament personnel shall be present during all tests specified herein.

(2) Weapon system preparation.

(a) Prior to applying external power, open all circuit breakers and verify that no grenades are loaded in the dispenser assemblies.

(b) Cock both grenade dispenser assemblies by pushing all four operating bars aft into the dispensers.

(3) *Electrical power.* Check that helicopter battery is connected, then apply 28 Vdc external electrical power:

(4) *Circuit breakers.* Engage the following circuit breakers:

GEN FIELD
DC VOLTMETER
CAUTION LT
WEAPON SIGHT
INV MAIN
TURRET PWR
WPNS FIRE
GEN BUS RESET
LH SMOKE GRENADE
RH SMOKE GRENADE

(5) *Control switch positions.* Position the following switches as shown:

INV	MAIN
BAT	OFF

c. Testing Procedures.

(1) Simulated firing.

(a) Position pilots two LH ARM/OFF switches to LH ARM and the two RH ARM/OFF switches to RH ARM.

(b) Position pilots MASTER ARM switch to OFF. Depress SMOKE REL pushbutton on pilots collective stick six times. Check that the four operating bars have not extended from dispenser assemblies.

(c) Position pilots MASTER ARM switch to STBY. Check that pilots and gunners green STBY indicator lights are illuminated.

(d) Depress SMOKE REL pushbutton two times. Check that each operating bar has extended two increments (approximately 1 inch).

(e) Position pilots MASTER ARM switch to ARM. Check that pilots and gunners amber ARMED indicator lights are illuminated.

(f) Depress SMOKE REL pushbutton two times. Check that each operating bar has extended two additional increments (approximately 1 inch).

(g) Manually activate the four releasing solenoids (depress buttons located on the bottom forward end of the dispenser) three additional times. Check that each operating bar has extended two additional increments (approximately 1 inch) with the first and second depression and the third depression has no effect on the operating bars.

(2) Dummy grenade firing.

(a) Open the SMOKE GRENADE and WPNS FIRE circuit breakers and position MASTER ARM switch to OFF.

(b) Load each dispenser assembly with 12 dummy grenades.

(c) Place cushioned container under each dispenser to catch ejected grenades. Remove grenade from container after each ejection to prevent damage to same.

(d) Engage the SMOKE GRENADE and WPNS FIRE circuit breakers and position the MASTER ARM switch to STBY.

NOTE

Personnel conducting functional test at pilots station must wear headset.

(e) Position pilots outboard LH ARM/OFF switch to LH ARM. Depress SMOKE REL pushbutton on pilots collective stick. Check that one grenade has been ejected from the left outboard dispenser. An audio signal should be received through the headset indicating grenade ejection.

(f) Position pilots outboard LH ARM/OFF switch to OFF and the inboard LH ARM/OFF switch to LH ARM. Depress SMOKE REL pushbutton. Check that one grenade has been ejected from the left inboard dispenser. An audio signal should be received through the headset indicating grenade ejection.

(g) Position the pilots inboard LH ARM/OFF switch to OFF and the inboard RH ARM/OFF switch to RH ARM. Depress SMOKE REL pushbutton. Check that one grenade has been ejected from the right inboard dispenser. An audio signal should be received through the headset.

(h) Position pilots inboard RH ARM/OFF switch to OFF and the outboard RH ARM/OFF switch to RH ARM. Depress SMOKE REL pushbutton. Check that one grenade has been ejected from the right outboard dispenser. An audio signal should be received through the headset.

(i) Position the pilots outboard RH ARM/OFF switch to OFF.

(j) Position pilots outboard LH ARM/OFF switch to LH ARM. Depress SMOKE REL pushbutton on pilots collective stick. Check that one grenade has been ejected from the left outboard dispenser. An audio signal should be received through the headset indicating grenade ejection.

(k) Position pilots outboard and inboard LH ARM/OFF switches to LH ARM. Depress SMOKE REL pushbutton. Check that two grenades have been ejected; one from the left inboard dispenser and one from the left outboard dispenser, and an audible signal is received through the headset.

(l) Position pilots outboard and inboard LH ARM/OFF switches to LH ARM, and the pilots inboard RH ARM/OFF switch to RH ARM. Depress SMOKE REL pushbutton. Check that three grenades have been ejected; one from the left inboard dispenser, one from the left outboard dispenser, and one from the right inboard dispenser and an audible signal is received through the headset.

(m) Position pilots outboard and inboard LH ARM/OFF switches to LH ARM and the pilots outboard and inboard RH ARM/OFF switches to RH ARM. Depress SMOKE REL pushbutton. Check that four grenades have been ejected; one from the left inboard dispenser, one from the left outboard dispenser, one from the right inboard dispenser, and one from the right outboard dispenser, and an audible signal is received through the headset.

(n) Position the two LH ARM/OFF and the two RH ARM/OFF switches to OFF.

(o) Position MASTER ARM switch to ARM.

(p) Position pilots outboard RH ARM/OFF switch to RH ARM. Depress SMOKE REL pushbutton. Check that one grenade has been ejected from the right outboard dispenser and an audio signal is received through the headset.

(q) Position pilots outboard and inboard RH ARM/OFF switches to RH ARM. Depress SMOKE REL pushbutton. Check that two grenades have been ejected; one from the right inboard dispenser, and one from the right outboard dispenser, and an audible signal is received through the headset.

(r) Position pilots outboard and inboard RH ARM/OFF switches to RH ARM, and the pilots inboard LH ARM/OFF switch to LH ARM. Depress SMOKE REL pushbutton. Check that three grenades have been ejected; one from the right inboard dispenser, one from the right outboard dispenser, and one from the left inboard dispenser, and an audible signal is received through the headset.

(s) Repeat step (m).

(t) With release of the final four grenades in step (s), a constant audible signal should be received through the headset indicating grenade ejection as well as depletion of grenades.

(u) Return all switches to the OFF position.

(3) Conclusion of Tests. Upon completion of the preceding tests, de-energize and disconnect auxiliary power unit from helicopter.

9-89. Troubleshooting - Smoke Grenade Dispense System Circuitry.

a. *Requirements.* In the following troubleshooting procedures, it is assumed that power is applied to the main dc and ac buses, and the applicable circuit breakers are closed.

b. *Troubleshooting.* (See figure F-7 and table 9-28.)

Table 9-28. Troubleshooting - Smoke Grenade Dispenser System Circuitry.

NOTE

Before you use this table, be sure you have performed all normal operational checks.

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Smoke grenade does not release from one of the racks when that respective ARM switch (S90, S91, S92, or S93) is in the ARM position and the SMOKE REL switch (S95) is depressed.

STEP 1. Check for defective SMOKE REL switch (S95).

If defective, replace switch. (Refer to paragraph 9-6.)

STEP 2. Check for defective MASTER ARM switch.

If defective, replace switch. (Refer to paragraph 9-6.)

STEP 3. Check for defective smoke grenade safe relay (K55).

If defective, replace relay. (Refer to paragraph 9-4.)

STEP 4. Check for defective smoke grenade fire control relay (K56).

If defective, replace relay. (Refer to paragraph 9-4.)

STEP 5. Check for defective WPNS FIRE or TURRET PWR circuit breakers (CB23) or (CB24).

Replace circuit breaker, if defective. (Refer to paragraph 9-5.)

STEP 6. Check for defective wiring.

Repair or replace wiring, if defective.

Table 9-28. Troubleshooting - Smoke Grenade Dispenser System Circuitry (Cont)**CONDITION****TEST OR INSPECTION****CORRECTIVE ACTION**

2. Neither INBD nor OUTBD selected left smoke grenades release when the SMOKE REL switch is depressed. Respective ARM switch (S92 or S93) is in ARM position.

STEP 1. Check for defective LH SMOKE GRENADE circuit breaker (CB26).

If defective, replace circuit breaker. (Refer to paragraph 9-5.)

STEP 2. Determine if left smoke grenade launcher is defective.

If defective, replace launcher.

STEP 3. Check for defective smoke grenade safe relay (K55) or defective smoke grenade fire control relay (K56).

If defective, replace relay. (Refer to paragraph 9-4.)

STEP 4. Check for defective wiring.

Repair or replace wiring, if defective.

3. The INBD selected left smoke grenades do not release when SMOKE REL switch is depressed. ARM switch (S92) is in ARM position.

STEP 1. Check for defective LH ARM switch (S92).

If defective, replace switch. (Refer to paragraph 9-6.)

STEP 2. Determine if left smoke grenade launcher is defective.

If defective, replace left launcher.

STEP 3. Check for defective wiring.

Repair or replace wiring, if defective.

4. The OUTBD selected left smoke grenades do not release when SMOKE REL switch is depressed. ARM switch (S93) is in ARM position.

STEP 1. Check for defective LH ARM switch (S93).

If defective, replace switch. (Refer to paragraph 9-6.)

STEP 2. Determine if left smoke grenade launcher is defective.

If defective, replace left launcher.

STEP 3. Check for defective wiring.

Repair or replace wiring, if defective.

Table 9-28. Troubleshooting - Smoke Grenade Dispenser System Circuitry (Cont)

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

5. Neither INBD nor OUTBD selected right smoke grenades release when the SMOKE REL switch is depressed. Respective ARM switch (S90 or S91) is in ARM position.

STEP 1. Check for defective RH SMOKE GRENADE circuit breaker (CB27).

If defective, replace circuit breaker. (Refer to paragraph 9-5.)

STEP 2. Determine if right smoke grenade launcher is defective.

If defective, replace launcher.

STEP 3. Check for defective smoke grenade safe relay (K55) or defective smoke grenade fire control relay (K56).

If defective, replace relay. (Refer to paragraph 9-4.)

STEP 4. Check for defective wiring.

Repair or replace wiring, if defective.

6. The INBD selected left smoke grenades do not release when SMOKE REL switch is depressed. ARM switch (S90) is in ARM position.

STEP 1. Check for defective RH ARM switch (S90).

If defective, replace switch. (Refer to paragraph 9-6.)

STEP 2. Determine if right smoke grenade launcher is defective.

If defective, replace right launcher.

STEP 3. Check for defective wiring.

Repair or replace wiring, if defective.

7. The OUTBD selected right smoke grenades do not release when SMOKE REL switch is depressed. ARM switch (S91) is in ARM position.

STEP 1. Check for defective RH ARM switch (S91).

If defective, replace switch. (Refer to paragraph 9-6.)

STEP 2. Determine if right smoke grenade launcher is defective.

If defective, replace right launcher.

STEP 3. Check for defective wiring.

Repair or replace wiring, if defective.

Table 9-28. Troubleshooting - Smoke Grenade Dispenser System Circuitry (Cont)

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

8. No. 400 Hz audio tone is heard in pilots headset as smoke grenades are released.

STEP 1. Check for defective drop signal relay (K54).

If defective, replace relay. (Refer to paragraph 9-4.)

STEP 2. Check for defective WPNS FIRE circuit breaker.

If defective, replace circuit breaker. (Refer to paragraph 9-5.)

STEP 3. Check for defective capacitor (C5) or defective resistor (R57).

If defective, replace capacitor or resistor. (Refer to paragraph 9-4.)

STEP 4. Check for defective pilots headset.

If defective, replace headset.

STEP 5. Determine if wiring is defective.

Repair or replace wiring, if defective.

9. No. 400 Hz audio tone is heard in pilots headset as LH smoke grenades are released.

STEP 1. Check for defective microswitch on trigger bar of left launcher.

If defective, replace microswitch.

STEP 2. Determine if left launcher is defective.

If defective, replace launcher.

STEP 3. Check for defective LH ARM switch (S92 or S93).

If defective, replace switch. (Refer to paragraph 9-6.)

STEP 4. Determine if wiring is defective.

Repair or replace wiring if defective.

10. No. 400 Hz audio tone is heard in pilots headset as RH smoke grenades are released.

STEP 1. Check for defective microswitch on trigger bar of right launcher.

If defective, replace microswitch. (Refer to paragraph 9-4.)

STEP 2. Determine if right launcher is defective.

If defective, replace launcher.

Table 9-28. Troubleshooting - Smoke Grenade Dispenser System Circuitry (Cont)

CONDITION**TEST OR INSPECTION****CORRECTIVE ACTION**

STEP 3. Check for defective RH ARM switch (S90 or S91).

If defective, replace switch. (Refer to paragraph 9-6.)

STEP 4. Determine if wiring is defective.

Repair or replace wiring, if defective.

9-90. XM65 TOW Missile Subsystem Circuitry.

a. *Description.* The XM65 TOW missile subsystem circuitry provides the capabilities to acquire and track a target, compensate for effects of helicopter motion, launch a TOW missile, and guide the missile to the target. The telescopic sight unit (TSU) portion of the TOW missile subsystem interfaces with the M28AIE1 turret system circuitry, serving as a flexible sighting unit, and also interfaces with the helmet sight subsystem for use during target acquisition. For description and additional information pertaining to XM65 TOW missile subsystem components, refer to TM 55-1520-234-10 and TM 9-1425-473 series maintenance manuals. For maintenance information and procedures pertaining to XM65 TOW missile subsystem components, refer to TM 9-1425-473 series maintenance manuals. (See figure F-7 for armament systems wiring diagram.) For information and maintenance procedures pertaining to the interface control unit (IFCU), refer to paragraph 9-82.

b. *Test Connectors - Test Set, Guided Missile System.* Four electrical TSGMS TEST connectors are utilized to connect Test Set, Guided Missile System (TSGMS) to the helicopter to monitor, test, and/or troubleshoot the XM65 TOW missile subsystem. The TSGMS TEST CONN POWER receptacle (J237) and TSGMS SECU TEST (TEST 1) connector (J331) are located on the aft bulkhead of the left ammunition compartment, the TSGMS FWD TEST (TEST 2) connector (J332) is located on the forward bulkhead of the left ammunition compartment, and the TSGMS AFT TEST (TEST 3) connector is located in the tailboom TOW compartment, on the top forward bulkhead at boom station 101.38. Test procedures utilizing TSGMS and the TSGMS TEST connectors are contained in TM 9-1425-

473 series maintenance manuals. (See figure F-7 for armament systems wiring diagram).

9-91. Functional Test - XM65 TOW Missile Subsystem Circuitry.a. *Requirements.*(1) *Test equipment.*

(a) Power source. One 220 Vac, 3-phase, 60-hertz, 60-ampere, continuous duty (for the power carts).

(b) Auxiliary power unit. 28 Vdc, 300 ampere.

(c) Hydraulic. Hydraulic ground test cart - 1500 psig minimum pressure; flow rate of 6.0 gpm; calibrated pressure gage of 2500 psi; 10 micron filter on pressure supply line; and connection fittings.

WARNING

All weapons shall be dry fired. Only dummy ammunition with smooth cases like live ammunition shall be used.

(2) *Special tools.*

(a) 7.62 MM ammunition drum/40 MM drum or simulator.

(b) TOW simulator evaluation missile (TSEM) HAC No. 3234107-100.

b. Preparation for Testing.

(1) *General.* Qualified armament personnel shall be present during all tests specified herein.

(2) *Configuration.* For the purpose of this test, the M28A1E1 turret will be assumed to have a 7.62 MM weapon on the right side and a 40 MM weapon on the left side.

NOTE

For functional test of XM65 TOW missile launcher system refer to TM 9-1425-473 series maintenance manuals.

(3) Weapon system preparation.

(a) Check all systems components for proper installation.

(b) Check that the M28A1E1 turret weapons are properly timed.

(c) Verify that the launchers are properly connected, four launchers installed, and the TSEM installed in No. 1 missile position. (See figure 9-16.)

(4) *Control switch positions.* Position the following switches as indicated:

(a) Pilots armament control panel.

MASTER ARM
WPN CONT
TURRET

OFF
GUNNER
RIGHT

(b) Wing stores control panel.

WG ST ARM
WG ST JETTISON SELECT

OFF
BOTH

(c) Gunners armament control panel.

WING STORES SELECT
TURRET DEPR LIMIT
PILOT OVRD
TURRET SELECT

OFF
ON
OFF
BOTH

(d) TOW control panel (TCP)

MODE SELECT
CAMERA
EXPOSURE
MISSILE SELECT

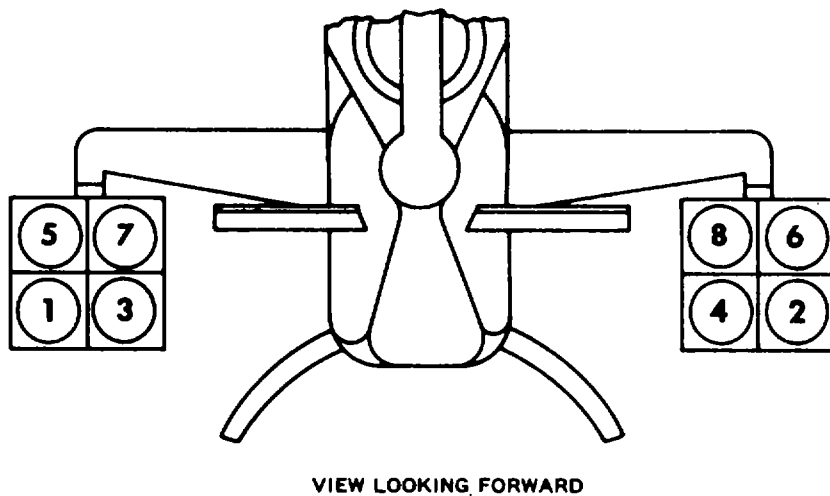
OFF
OFF
BRT
1

(e) Telescopic sight unit (TSU)

FILTER SELECT lever
Left-hand grip HI/LO
MAG switch

CLEAR

center



209075-150

Figure 9-16. TOW missile launcher positions

(f) Sight hand control (SHC)

STOW/TRACK/ACQ switch STOW

(5) *Electrical power.* Check that the aircraft battery is connected, then apply 28 Vdc external electrical power.

(6) *Circuit breakers.* Engage all circuit breakers except the following:

STARTER RELAY

IGN SYS IGN SOL

RPM WARNING SYSTEM

WING STORES JEISON (cockpit)

WING STORES JEISON (aft electrical compartment)

(7) *Power switch positions.* Position the following switches as shown:

INV	MAIN
BAT	OFF
NON-ESS BUS	NORMAL
ELECT PWR/EMER OFF	ELEC PWR

CAUTION

Do not apply hydraulic power to system unless electrical power is applied.

(8) *Hydraulic power.* Apply 1500+25 psi hydraulic power.

WARNING

Before proceeding, clear turret area of any obstructions and warn personnel to remain on exterior of safety barrier.

(9) *Special test equipment.* Position the following test equipment switches or controls as indicated:

TOW system evaluator missile (TISEM) MODE switch	OFF
AUTO/MSL GONEIMSL PRESENT switch	AUTO

c. *Testing Procedures.*

(1) *Initial system tests.* Perform the following steps for initial system tests:

NOTE

For this test, one technician will be required in the gunners position, one technician in the pilots position, and one technician outside the helicopter.

(a) Position the pilots MASTER ARM switch to STBY.

(b) Position the TCP MODE SELECT switch to TSU/GUN.

(c) Verify that the system status indicator on the TCP moves from OFF to TEST after approximately 10 seconds.

(d) Verify that within 120 seconds after the TCP system status indicator reads TEST in step (c), the TCP system status indicator moves to PWR ON.

(e) Verify that all BIT indicators on the TCP are in the "go" condition (black on black).

(f) Move HI/LO MAG switch to LO MAG.

(g) Move the STOW/TRACK/ACQ (S/T/A) switch to TRK. Observe that the TSU turret follows the inputs from the SHC transducer stick and that the status flag in the TSU shows GUNS. Move the sight through the full elevation and full azimuth.

(h) Move the S/T/A switch to STOW. Observe that the TSU turret returns to the STOW position.

CAUTION

Do not drive the M28A1E1 turret into the hard stops at full velocity.

(i) Move the S/T/A switch to TRACK and depress the ACTION switch on the left grip. Observe that the M28A1E1 turret follows the TSU turret when moved through the limits with the SHC transducer stick. Observe that the GUNS flag in the TSU sight flashes when at the limits stops of the M28A1E1 turret.

(j) Release the ACTION switch. Observe that the M28A1E1 turret returns to STOW.

(k) Move the line-of-sight on the TSU to approximately 0 degrees elevation and 0 degrees azimuth and depress the LHG ACTION switch and trigger. Observe that the M28A1E1 turret will not fire.

(L) Release the ACTION switch. Move the pilots MASTER ARM switch to ARM.

(m) Repeat preceding steps (f) through (j).

(n) Move the line-of-sight on the TSU to approximately 0 degrees elevation and 0 degrees azimuth and depress the LHG ACTION switch and trigger. Observe that the M28A1E1 turret will fire the selected weapon.

(o) Move the TSU LOS to various angles and observe that the M28A1E1 turret will fire the selected weapon.

(p) Release the ACTION switch and position the MASTER ARM switch on the pilots armament control panel to STBY.

(q) Return the S/T/A switch to STOW.

(2) *Telescopic sight unit controls.* Perform the following steps for initial system turn-on:

(a) Position the MODE SELECT switch to STBY TOW on the TOW control panel (TCP). Verify that the TCP system status indicator remains at PWR ON. Verify that the gunners blue weapon mix indicator extinguishes and that the gunners PILOT IN CONT and pilots weapon mix indicators illuminate.

(b) Depress the LHG ACTION switch and observe that the M28A1E1 turret will not follow inputs from the SHC transducer stick.

(c) Release the LHG ACTION switch.

(d) Position the TCP MODE SELECT switch from STBY TOW to ARMED MAN. Verify that the TCP system status indicator remains at PWR ON.

(e) Position the MASTER ARM switch on the pilots armament control panel from STBY to ARM, to STBY. Verify that the system status indicator on the TCP

moves from PWR ON to ARMED to PWR ON during this sequence.

(f) Position the STOW/TRACK/ACQ (S/T/A) switch on the sight hand control to TRK and return to STOW. Verify that the system status indicators remain in the PWR ON position during this sequence.

(g) Press and hold the BIT pushbutton on the TCP. Verify that the ATTK, RDY, and GUNS flags are visible in the TSU eyepiece. Verify that the ascend and descend pointers and the ATTK, RDY, and FIRE flags are visible on the pilot steering indicator. Release the BIT switch after verifying the above and verify that the system status indicator on the TCP reads TEST.

(h) Position the TCP MODE SELECT switch from STBY TOW to OFF to STBY TOW in less than 5 seconds. Verify that the system status indicator on the TCP moves from TEST to OFF to TEST. There should be no 10 second delay from OFF to TEST on the TCP system status indicator.

(i) With the system status indicator reading TEST from step (h), position the S/T/A switch on the sight hand control to TRK and return it to STOW. Verify that the system status indicator cycles from TEST to PWR ON to TEST during this sequence.

(j) With the system status indicator reading TEST from step (i), position the MASTER ARM switch on the pilots armament control panel from STBY to ARM to OFF. Verify that the system status indicator on the TCP moves from TEST to ARMED to OFF during this sequence.

(k) Position the pilots MASTER ARM switch to ARMED, the S/T/A switch on the SHC to TRK and position the TCP MODE SELECT switch to STBY TOW. Depress the ACTION switch on the LHG and observe that the M28A1E1 turret will not follow the TSU LOS as the sight is moved through its limits. Depress the trigger and observe that the M28A1E1 turret will not fire the selected weapon.

(l) Position the TSU optics to HI MAG using the HI/LO MAG switch on the TSU left-hand grip. Observe that the TSU is now in the HI MAG mode.

(m) While holding the ACTION switch, use the SHC stick to drive the TSU from stop to stop horizontally and vertically. Verify that the TSU can

be driven stop-to-stop horizontally in less than 50 seconds and vertically in less than 30 seconds.

(n) With the TSU at some position other than STOW position (straight ahead), set the S/T/A switch to STOW and verify that the TSU returns to the STOW position.

(o) Position the TSU optics to LO MAG using the HI/LO MAG switch on the TSU left-hand grip and the S/T/A switch to TRK.

(p) Use the SHC stick to drive the TSU to stop, horizontally and vertically. Verify that the TSU can be driven from stop-to-stop horizontally in less than 3 seconds and vertically in less than 2 seconds. Release ACTION switch.

(q) Position the TSU OPTICS to HI MAG using the HI/LO MAG switch and position the TCP MODE SELECT switch to TSU/GUN.

(r) While holding the ACTION switch, use the SHC stick to drive the TSU from stop-to-stop horizontally and vertically. Verify that the TSU can be driven stop-to-stop horizontally in eight seconds and vertically in four seconds.

(s) Return S/T/A switch to STOW. Release ACTION switch.

(3) *Helmet sight tracking.*

(a) Position pilots MASTER ARM switch to STBY. Observe that pilots and gunners green STBY indicators, and gunners right 7.62 and left 40 blue indicators are illuminated.

(b) Position pilots and gunners linkages to the BIT brackets.

(c) Position the HSS BIT switch on the gunners control panel to BIT and check that a GO indication appears on the HSS indicator.

NOTE

Completion of BIT circuit requires approximately two seconds.

(d) Position linkages to the helmets With the S/T/A switch in the STOW position, depress and hold the PHS ACQ switch on the SHC. Check that the TSU does

not follow the pilots helmet sight. Release PHS ACQ switch and check that the gunners HS reticle does not retract.

(e) Position the S/T/A switch to TRK. . Depress and hold the PHS ACQ switch and check that the TSU does follow the pilots helmet sight as it is aimed to left, right, up, and down. Check that the gunners helmet sight reticle retracts when the PHS ACQ switch is depressed.

(f) Return the gunners helmet sight reticle to the down position.

(g) Hold the S/T/A switch in the ACQ position. Verify that the TSU follows the gunners helmet sight as it is aimed to left, right, up, and down. Release the S/T/A switch and check that the gunners helmet sight reticle retracts.

(h) Position the S/T/A switch to STOW.

(i) Position the MODE SELECT switch on the TCP to OFF.

(j) Position MASTER ARM switch to OFF.

(4) *Pilot steering indicator commands and constraints test.* Pilot steering commands on the PSI are a function of the TSU AZ and EL gimbal angles. Azimuth PSI steering is biased plus 0.75 degree right for left missiles and minus 0.75 degree left for right missiles. Logic prevents prefiring a TOW missile until LOS rate, gimbal angle, attack logic, launcher position status, and roll constraint requirements are satisfied.

(a) Position the pilots MASTER ARM switch to ARM.

(b) Position the TCP MODE SELECT switch to ARMED MAN.

(c) Position SHC S/T/A switch to TRK and HI/LO MAG switch to HI. Select missile number 1.

(d) Depress LHG ACTION switch.

(e) Using the SHC, adjust the TSU position for the azimuth and elevation LOS to be zero.

(f) Verify the PSI azimuth needle is approximately 1/3 from center to right when the AZ and EL LOS is zero.

(g) Select missile number 2.

(h) Adjust the TSU position for the azimuth and elevation LOS to be zero and depress LHG ACTION switch.

(i) Verify the PSI azimuth needle is approximately 1/3 from center to the left when the AZ and EL LOS is zero.

(j) Move the TSU LOS through azimuth and elevation; observe that the PSI indicates the movement of the TSU LOS.

(k) Release LHG ACTION switch.

(L) Return S/T/A switch to STOW.

(5) Launcher/TSU alignment and slaving test.

(a) Apply hydraulic power to the helicopter. Position the TCP MODE SELECT switch to ARMED MAN and the MASTER ARM switch to ARM on the pilots armament control panel. Position the TSU HI/LO MAG switch to HI.

(b) Select missile number 1 on the TCP. Verify that the missile status indicator on the TCP for missile number 1 reads MSL.

(c) Set the SHC to TRK and track the TSU to 0 azimuth and 0 elevation.

(d) Depress and hold ACTION switch on the LHG. Verify that the left launcher is slaving to the TSU LOS in elevation.

(e) Drive the TSU up slowly in elevation until the elevation needle on the PSI falls outside the inner rectangle. Verify that the PSI RDY flag disappears.

(f) Recenter the elevation needle and verify the reappearance of the RDY flag. Drive the TSU down until the elevation needle falls below the inner rectangle and verify that the RDY flag disappears.

(g) Press and hold the ACTION switch on the LHG and drive the TSU with the SHC stick vertically from stop-to-stop. Verify that the right launcher does not move and that the left launcher follows the vertical motion of the TSU within the limits of the launchers mechanical stops.

(h) With the TSU at the lower stop, release the LHG ACTION switch and verify that after a short delay (0.5 second), the launcher moves back to its stowed position.

(i) Select missile number 2 and repeat steps (a) through (h), verifying the action of the right launcher.

(6) *Armament control tests.* Operation during the preparation for launch and guidance of a missile shall be verified as follows:

(a) Pilot turret control and firing while in the TOW MODE.

1 Position the WPN CONT switch on the pilots armament control panel to PLT and the MASTER ARM switch to STBY.

2 With the MODE SELECT switch on the TCP in any of the TOW MODES (STBY TOW, ARMED MAN, or ARMED AUTO), and the S/T/A switch in either TRK or STOW, check that the pilot has control of the M28A1E1 turret with his helmet sight. Check that gunners weapon mix indicators are extinguished and pilots weapon mix indicators are illuminated.

3 Position the WPN CONT switch to GUNNER and repeat step 2. Check that gunner has control of the M28A1E1 turret with his helmet sight.

(b) Manual missile selection and firing.

1 Install the TSEM in position 1. (See figure 9-16.) Turn the TSEM to ON and RESET. Apply hydraulic power to the helicopter.

2 Position the MASTER ARM switch on the pilot armament control panel to ARMED.

3 Position the MODE SELECT switch on the TCP to ARMED MAN. Verify that the MISSILE SELECT switch is in missile position number 1.

4 Verify that the missile status indicator on the TCP for missile number 1 reads MSL.

5 Verify that the indicator on the MSP for missile number 1 reads SEL and that the remaining indicators show the barber pole pattern.

6 Set the S/T/A switch on the SHC to TRK.

7 Set the HILO MAG switch on the LHG to HI.

NOTE

Press and hold the WEAPONS ACTION switch on the TSU LHG for following steps 8 through 10.

8 Verify the appearance of the ATTK flag in the eyepiece of the TSU and on the PSI.

9 While observing the PSI, maintain the maneuver indicators within constraint limitations using the SHC tracking stick. Within constraint limitations means that the elevation and azimuth needles are within the inner rectangle and the ascend and descend pointer are not visible. Verify that the RDY flags are visible on the PSI and in the eyepiece of the TSU.

10 Position the TSEM MODE SELECT switch to MSL GONE. Verify that the RDY flags disappear on the PSI and in the eyepiece of the TSU. Position the TSEM MODE SELECT switch to AUTO.

NOTE

The action and trigger on the pilots cyclic stick grip will be depressed and held through following steps 11 thru 13. Read all of these steps prior to depression of the trigger.

11 Hold the pilots helmet sight at zero degrees elevation and zero degrees azimuth and depress pilots cyclic stick action and trigger switch. Verify that the 7.62 MM weapon fires.

12 Momentarily press the trigger and ACTION switch on the LHG. Verify that the 7.62 MM weapon firing is interrupted.

13 Verify that the 7.62 MM weapon resumes firing after a time delay of 2.8 to 3.2 seconds. Release pilots cyclic stick grip trigger and WEAPONS ACTION switch.

14 Verify the appearance of the FIRE flag on the PSI. The FIRE flag will disappear at the completion of the firing sequence. (Approximately 23 seconds.)

15 Verify by means of the TSEM that a proper firing sequence takes place. Lights on the TSEM will show proper sequence.

16 Verify that the indicator for missile number 1 on the TCP switches from MSL to the barber pole pattern.

17 When the FIRE flag disappears, press reset button on the TSEM and verify that the indicator for missile number 1 on the TCP again reads MSL.

18 Press and hold WEAPONS ACTION switch on the LHG and drive the TSU LOS out of constraints in elevation.

19 Depress CONST OVRD switch on the SHC.

20 Momentarily press the trigger on the LHG. (The WEAPONS ACTION switch may be released with the trigger switch.)

21 Repeat preceding steps 13, 15, and 16.

22 Cycle the TSEM through the remaining missile positions and repeat above steps 3 through 21 for each position selected.

(c) Automatic selection and firing.

1 Set the MODE SELECT switch on the TCP to STBY TOW.

2 Install TSEM in missile position number 2 (see figure 9-16) and set the MODE SELECT switch on the TSEM to AUTO.

3 Set MISSILE SELECT switch to number 1.

4 Position the MASTER ARM switch to ARM.

5 Set the MODE SELECT switch on the TCP to ARMED AUTO and check that the MISSILE SELECT switch cycles through all positions and stops at position number 2.

6 Verify that missile number 2 is selected on the MSP.

7 Set the S/T/A switch on the SHC to TRK and the HI/LO MAG select switch on the LHG to HI.

8 Depress the LHG ACTION switch and by observing the PSI, maintain the indication within maneuver constraints.

9 Momentarily press the trigger switch on the LHG. Note the completion of the firing sequence by observing a loss of the FIRE flag on the PSI. Return the S/T/A switch to STOW.

10 Check that the MISSILE SELECT switch cycles through all positions and stops at position number 8.

11 Reset the TSEM, set the MISSILE SELECT switch to number 2, and set the CAMERA switch on the TCP to AUTO.

12 Repeat step 9 and observe that camera operations commence when the trigger is pressed and cease with the loss of FIRE flag on the PSI.

13 Check that the MISSILE SELECT switch cycles through all positions and stops at position number 8.

14 Position the gunners PILOT OVRD) switch to ON. Observe that the TCP system status indicator moves to OFF.

15 Turn TSEM to OFF.

16 Turn MASTER ARM, PILOT OVRD, and TCP MODE SELECT switches to OFF.

d. Conclusion of Tests. Upon completion of the preceding tests, de-energize and disconnect auxiliary power unit and hydraulic ground test cart. Remove TSEM from launcher.

9-92. Troubleshooting - XM65 TOW Missile Subsystem Circuitry.

a. Airframe circuitry and components. Refer to figure F-7, armament wiring diagram, and trace malfunctioning circuit loop, using standard electronic troubleshooting procedures and standard test equipment. Localize malfunctioning components and repair or replace, as required.

b. XM65 TOW Missile Subsystem. Troubleshooting of the XM65 TOW missile subsystem is accomplished during BIT (built-in test) procedures and also by use of Test Set, Guided Missile System CISGMS). Refer to TM 9-1425-473 series maintenance manuals for troubleshooting procedures.

9-93. Servo Electronic Control Unit (SECU).

The servo electronic control unit (SECU) provides regulated power and contains signal switching, resolver, logic, and buffering circuitry necessary to align the pitch angle of the TOW missile launchers with the pitch angle of the line-of-sight (LOS) of the telescopic sight unit (TSU). Slaving of the two pitch angles ensures that the TOW missile will reliably enter the field of view of the infrared receiver of the TSU. The TOW missile can be guided to target only if the initial launch thrust positions the missile within this field of view. During the attack mode, when the gunner selects a missile for firing, the launcher containing the selected missile is activated. Angular position signals from the TSU resolver are routed to the SECU, processed through buffer amplifier stages, then applied to the respective launcher resolver. The launcher resolver output provides position feedback to the servo amplifier loop, and the accelerometer provides launcher acceleration feedback to the servo amplifier loop. The servo amplifier output to the hydraulic actuator servo coil allows the hydraulic actuator to change the pitch angle of the activated launcher when hydraulic pressure is provided to the actuator. The SECU also has a detector circuit which decreases the servo amplifier gain when the launcher approaches the mechanical elevation stop at either extreme. Hydraulic pressure is applied to the activated launcher through the hydraulic solenoid valve and the launcher pitches from stow position to the correct pitch angle relative to the TSU LOS. When fired, the missile is launched into the field of view of the infrared receiver, and wire transmitted command signals from the XM65 guidance and command functional group steers the missile along the TSU LOS. Shortly after launch (0.5 second), the SECU activate signal ceases and the launcher is returned to stow position. The SECU is located on the compartment floor just aft of the left ammunition compartment (see figure 913).

a. Cleaning.

(1) Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

(2) Remove grease, fungus, and ground-in dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C124).

(3) Remove dirt from electrical connectors with a bristle brush.

b. Inspection.

(1) Inspect SECU case for cracks or dents.

(2) Inspect SECU for secure mounting.

(3) Inspect electrical connectors for broken pins or cracked inserts.

c. Removal.

(1) Ensure all electrical power is OFF.

(2) Open left access door just forward of wing.

(3) Disconnect electrical connectors from SECU. Protect receptacles and plugs with caps or electrical tape.

(4) Remove mounting screws and washers securing SECU to compartment floor and remove SECU.

d. Repair or Replacement.

(1) Repair connectors, and tighten or replace loose or missing mounting screws.

(2) Replace SECU if case is damaged or defective. Evacuate removed SECU to higher echelon for disposition.

e. Installation.

(1) Position SECU in place on compartment floor and secure with mounting screws and washers.

(2) Remove protective caps or electrical tape from connectors and connect to respective receptacles on SECU.

(3) Close and secure access door.

This manual is published for the use of all concerned.

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FRED C. WEYAND
General, United States Army
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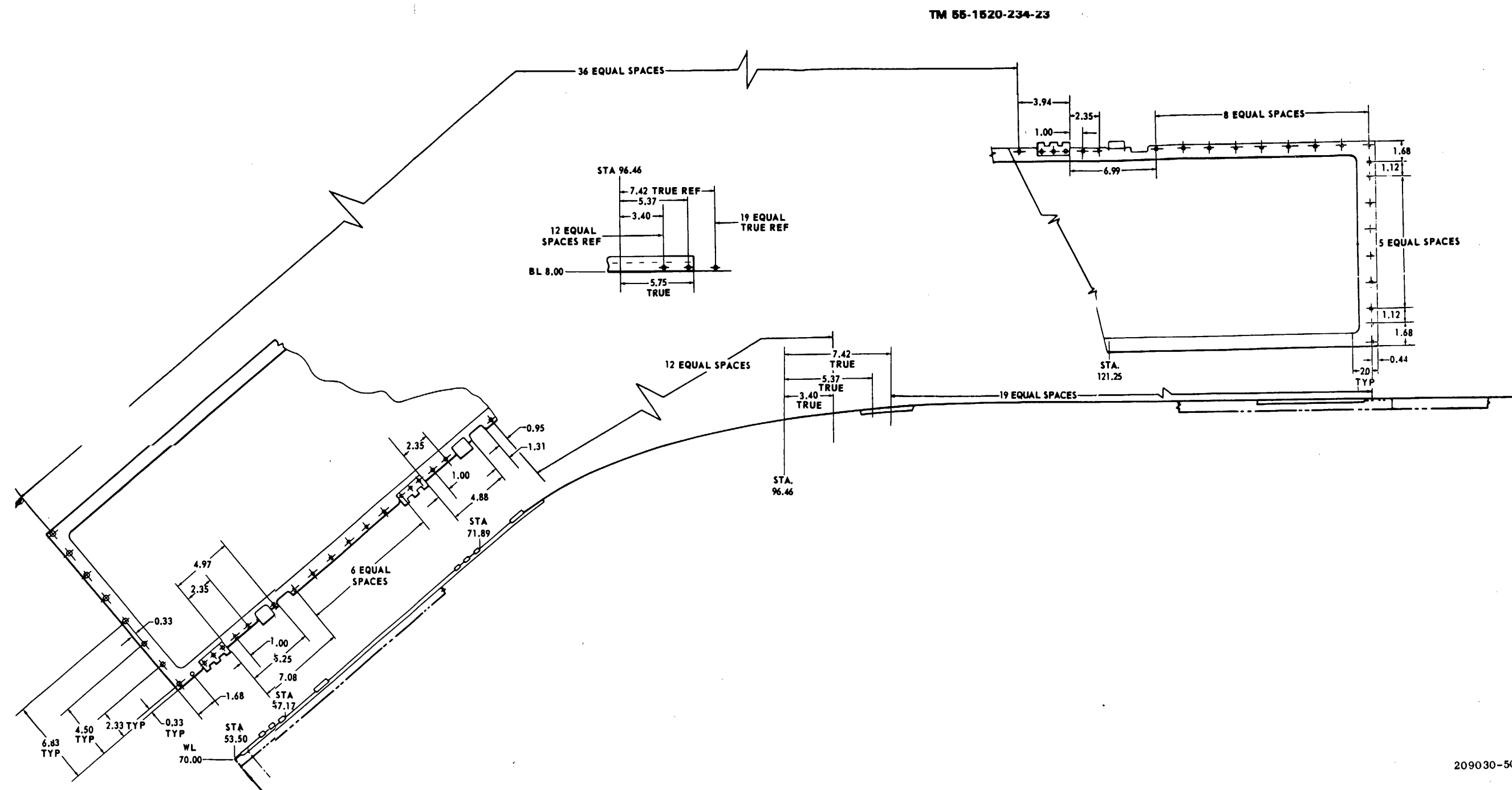
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Figure 2-40. Center window rivnut hole dimensions

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