HANDBOOK
STRUCTURAL REPAIR INSTRUCTIONS

USAF SERIES

F-86K

AIRCRAFT

THIS PUBLICATION REPLACES T.O. 1F-86K-3 DATED 22 APRIL 1955

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Page No.	Issue
Title	Original
A	Original
i thru viii	Original
1-1 thru 1-128	Original
2-1 thru 2-72	Original
3-1 thru 3-36	Original
4-1 thru 4-62	Original
5-1 thru 5-8	Original
6-1 thru 6-10	Original
7-1 thru 7-8	Original
8-1 thru 8-14	Original
9-1 thru 9-26	Original
10-1 thru 10-78	Original
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Page No.	Issue
*Title	20 March 1959
*A	20 March 1959
i	9 January 1959
ii thru viii	Original
1-1 thru 1-19	Original
*1-20	20 March 1959
1-20A thru 1-20B	9 January 1959
1-21 thru 1-32	Original
*1-32A thru 1-32B	20 March 1959
1-33 thru 1-50	Original
1-51 thru 1-52B	9 January 1959
1-53	9 January 1959
1-54 thru 1-61	Original
1-62 thru 1-62B	9 January 1959
1-63	9 January 1959
1-64 thru 1-82	Original
1-83	9 January 1959
1-84 thru 1-99	Original
*1-100	20 March 1959
1-101 thru 1-105	Original
*1-106 thru 106B	20 March 1959
1-107 thru 1-108	Original
*1-109 thru 1-110B	20 March 1959
1-111	Original
*1-112 thru 1-112D	20 March 1959
1-113 thru 1-116	Original
*1-117	20 March 1959
1-118	Original
*1-118A thru 1-118F	20 March 1959
*1-119	20 March 1959
1-120	Original
*1-120A thru 1-120B	20 March 1959
*1-121	20 March 1959
1-122 thru 1-126	Original
*1-126A thru 1-126B	20 March 1959
1-127 thru 1-128	Original
2-1 thru 2-9	Original
*2-10 thru 2-11	20 March 1959
2-12 thru 2-13	Original
2-14	9 January 1959
2-15 thru 2-21	Original
*2-22	20 March 1959
2-23	Original
*2-24	20 March 1959
2-25 thru 2-26	Original
2-27 thru 2-29	9 January 1959
2-30 thru 2-34	Original
2-34A thru 2-34B	9 January 1959
2-35	9 January 1959
2-36 thru 2-41	Original
*2-42	20 March 1959
2-43 thru 2-46	Original
2-46A thru 2-46B	9 January 1959
2-47	9 January 1959
2-48 thru 2-49	Original
2-50	9 January 1959
*2-51	20 March 1959
2-52 thru 2-54	Original
2-55	9 January 1959
2-56 thru 2-59	Original
*2-60	20 March 1959
2-60A thru 2-60B	9 January 1959
2-61	Original
2-62	9 January 1959
2-63 thru 2-71	Original
*2-72 thru 2-78	20 March 1959
3-1 thru 3-2	Original
*3-3	20 March 1959
3-4 thru 3-28	Original
*3-28A thru 3-28B	20 March 1959
*3-29	20 March 1959
3-30 thru 3-35	Original
*3-36 thru 3-38	20 March 1959
4-1	9 January 1959
4-2 thru 4-3	Original
*4-4 thru 4-4B	20 March 1959
4-5 thru 4-6	9 January 1959
4-7 thru 4-8	Original
4-9 thru 4-10H	9 January 1959
4-11	Original
4-12	9 January 1959
4-13 thru 4-19	Original
4-20 thru 4-21	9 January 1959
4-22 thru 4-30	Original
4-30A thru 4-30B	9 January 1959
4-31	9 January 1959
4-32 thru 4-37	Original
4-38 thru 4-38B	9 January 1959
4-39 thru 4-40	9 January 1959
4-41 thru 4-50	Original
*4-50A thru 4-50B	20 March 1959
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4-52	9 January 1959
*4-52A thru 4-52B	20 March 1959
*4-53	20 March 1959
4-54 thru 4-61	Original
*4-62	20 March 1959
5-1 thru 5-8	Original
6-1 thru 6-10	Original
7-1 thru 7-3	Original
7-4	9 January 1959
7-5 thru 7-6	Original
7-7 thru 7-14	9 January 1959
8-1 thru 8-14	Original
9-1 thru 9-26	Original
10-1 thru 10-78	Original
A-1 thru A-8	Original
*Index-1 thru Index-6	20 March 1959

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A.F. SMAMA 9/3/59—650

16 AUGUST 1957
CHANGED 5 JUNE 1959

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TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 548 CONSISTING OF THE FOLLOWING:

Page No.	Issue
*Title	5 June 1959
*A	5 June 1959
i	9 January 1959
ii thru viii	Original
1-1 thru 1-19	Original
1-20	20 March 1959
1-20A thru 1-20B	9 January 1959
1-21 thru 1-28	Original
*1-29 thru 1-30	5 June 1959
1-31 thru 1-32	Original
1-32A thru 1-32B	20 March 1959
1-33 thru 1-50	Original
1-51 thru 1-52B	9 January 1959
1-53	9 January 1959
1-54 thru 1-61	Original
1-62 thru 1-62B	9 January 1959
1-63	9 January 1959
1-64 thru 1-82	Original
1-83	9 January 1959
1-84 thru 1-99	Original
1-100	20 March 1959
1-101 thru 1-105	Original
1-106 thru 1-106B	20 March 1959
1-107 thru 1-108	Original
1-109 thru 1-110B	20 March 1959
1-111	Original
1-112 thru 1-112D	20 March 1959
1-113 thru 1-116	Original
1-117	20 March 1959
1-118	Original
1-118A thru 1-118F	20 March 1959
1-119	20 March 1959
1-120	Original
*1-120A thru 1-120D	5 June 1959
1-121	20 March 1959
1-122 thru 1-126	Original
1-126A thru 1-126B	20 March 1959
1-127 thru 1-128	Original
2-1 thru 2-9	Original
2-10 thru 2-11	20 March 1959
2-12 thru 2-13	Original
2-14	9 January 1959
2-15	Original
*2-16	5 June 1959
2-17 thru 2-18	Original
*2-18A thru 2-18B	5 June 1959
2-19 thru 2-21	Original
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2-23	Original
2-24	20 March 1959
2-25 thru 2-26	Original
2-27 thru 2-29	9 January 1959
2-30 thru 2-34	Original
2-34A thru 2-34B	9 January 1959
2-35	9 January 1959
2-36 thru 2-41	Original
2-42	20 March 1959
2-43 thru 2-46	Original
2-46A thru 2-46B	9 January 1959
2-47	9 January 1959
2-48 thru 2-49	Original
2-50	9 January 1959
2-51	20 March 1959
2-52 thru 2-54	Original
2-55	9 January 1959
2-56 thru 2-59	Original
2-60	20 March 1959
2-60A	9 January 1959
*2-60B thru 2-60D	5 June 1959
2-61	Original
2-62	9 January 1959
2-63 thru 2-70	Original
*2-70A thru 2-70B	5 June 1959
2-71	Original
2-72 thru 2-78	20 March 1959
3-1 thru 3-2	Original
3-3	20 March 1959
3-4 thru 3-28	Original
3-28A thru 3-28B	20 March 1959
3-29	20 March 1959
3-30 thru 3-35	Original
3-36 thru 3-38	20 March 1959
4-1	9 January 1959
4-2 thru 4-3	Original
4-4 thru 4-4B	20 March 1959
4-5 thru 4-6	9 January 1959
4-7 thru 4-8	Original
4-9 thru 4-10E	9 January 1959
*4-10F	5 June 1959
4-10G thru 4-10H	9 January 1959
4-11	Original
4-12	9 January 1959
4-13 thru 4-16	Original
*4-16A thru 4-16B	5 June 1959
*4-17	5 June 1959
4-18 thru 4-19	Original
4-20 thru 4-21	9 January 1959
4-22 thru 4-30	Original
4-30A thru 4-30B	9 January 1959
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4-32 thru 4-36	Original
*4-37 thru 4-38D	5 June 1959
*4-39	5 June 1959
4-40	9 January 1959
4-41 thru 4-50	Original
4-50A thru 4-50B	20 March 1959
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4-52	9 January 1959
4-52A	20 March 1959
*4-52B thru 4-52D	5 June 1959
*4-53	5 June 1959
4-54 thru 4-61	Original
4-62	20 March 1959
5-1 thru 5-8	Original
6-1 thru 6-10	Original
7-1	Original
*7-2 thru 7-2B	5 June 1959
7-3	Original
7-4	9 January 1959
7-5 thru 7-6	Original
7-7 thru 7-14	9 January 1959
8-1 thru 8-14	Original
9-1 thru 9-26	Original
10-1 thru 10-78	Original
A-1 thru A-8	Original
*Index-1 thru Index-6	5 June 1959

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Page No.	Issue
*Title	25 September 1959
*A	25 September 1959
i	9 January 1959
ii thru viii	Original
*1-1 thru 1-2B	25 September 1959
1-3 thru 1-19	Original
1-20	20 March 1959
1-20A	9 January 1959
*1-20B thru 1-20H	25 September 1959
1-21 thru 1-28	Original
1-29 thru 1-30	5 June 1959
1-31 thru 1-32	Original
1-32A thru 1-32B	20 March 1959
1-33 thru 1-50	Original
1-51 thru 1-52B	9 January 1959
1-53	9 January 1959
1-54 thru 1-61	Original
1-62 thru 1-62B	9 January 1959
1-63	9 January 1959
1-64 thru 1-73	Original
*1-74	25 September 1959
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2-15	Original
2-16	5 June 1959
2-17 thru 2-18	Original
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2-42	20 March 1959
2-43 thru 2-46	Original
2-46A thru 2-46B	9 January 1959
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2-60B thru 2-60D	5 June 1959
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2-62	9 January 1959
2-63 thru 2-70	Original
2-70A thru 2-70B	5 June 1959
2-71	Original
2-72 thru 2-78	20 March 1959
*3-1 thru 3-2B	25 September 1959
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3-28A thru 3-28B	20 March 1959
3-29	20 March 1959
3-30 thru 3-35	Original
3-36 thru 3-38	20 March 1959
*4-1	25 September 1959
4-2 thru 4-3	Original
*4-4 thru 4-4A	25 September 1959
4-4B	20 March 1959
4-5 thru 4-6	9 January 1959
4-7 thru 4-8	Original
4-9 thru 4-10E	9 January 1959
4-10F	5 June 1959
4-10G thru 4-10H	9 January 1959
4-11	Original
4-12	9 January 1959
4-13 thru 4-16	Original
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4-22 thru 4-30	Original
4-30A thru 4-30B	9 January 1959
4-31	9 January 1959
4-32 thru 4-36	Original
4-37 thru 4-38D	5 June 1959
4-39	5 June 1959
4-40	9 January 1959
4-41 thru 4-47	Original
*4-48	25 September 1959
4-49 thru 4-50	Original
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4-51	5 June 1959
4-52	9 January 1959
4-52A	20 March 1959
4-52B thru 4-52D	5 June 1959
4-53	5 June 1959
4-54 thru 4-61	Original
4-62	20 March 1959
*5-1 thru 5-2	25 September 1959
5-3 thru 5-7	Original
*5-8	25 September 1959
*6-1	25 September 1959
6-2 thru 6-10	Original
*7-1 thru 7-2A	25 September 1959
7-2B	5 June 1959
7-3	Original
7-4	9 January 1959
7-5 thru 7-6	Original
7-7 thru 7-14	9 January 1959
*8-1 thru 8-2B	25 September 1959
8-3 thru 8-14	Original
*9-1 thru 9-4	25 September 1959
9-5 thru 9-26	Original
*10-1 thru 10-2	25 September 1959
*10-3 thru 10-4 . . Deleted	25 September 1959
10-5 thru 10-78	Original
A-1 thru A-8	Original
*Index-1 thru Index-6	25 September 1959

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A.F. SMAMA 3/2/59—650

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*A	9 January 1959
*i	9 January 1959
ii thru viii	Original
1-1 thru 1-19	Original
*1-20 thru 1-20B	9 January 1959
1-21 thru 1-50	Original
*1-51 thru 1-52B	9 January 1959
*1-53	9 January 1959
1-54 thru 1-61	Original
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*2-35	9 January 1959
2-36 thru 2-46	Original
*2-46A thru 2-46B	9 January 1959
*2-47	9 January 1959
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*2-50	9 January 1959
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*2-55	9 January 1959
2-56 thru 2-60	Original
*2-60A thru 2-60B	9 January 1959
2-61	Original
*2-62	9 January 1959
2-63 thru 2-72	Original
3-1 thru 3-35	Original
*3-36	9 January 1959
*4-1	9 January 1959
4-2 thru 4-4	Original
*4-5 thru 4-6	9 January 1959
4-7 thru 4-8	Original
*4-9 thru 4-10H	9 January 1959
4-11	Original
*4-12	9 January 1959
4-13 thru 4-19	Original
*4-20 thru 4-21	9 January 1959
4-22 thru 4-30	Original
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*4-31	9 January 1959
4-32 thru 4-37	Original
*4-38 thru 4-38B	9 January 1959
*4-39 thru 4-40	9 January 1959
4-41 thru 4-51	Original
*4-52	9 January 1959
4-53 thru 4-62	Original
5-1 thru 5-8	Original
6-1 thru 6-10	Original
7-1 thru 7-3	Original
*7-4	9 January 1959
7-5 thru 7-6	Original
*7-7 thru 7-14	9 January 1959
8-1 thru 8-14	Original
9-1 thru 9-26	Original
10-1 thru 10-78	Original
A-1 thru A-8	Original
*Index-1 thru Index-6	9 January 1959

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AF SMAMA Mar 60, 600

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TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 604, CONSISTING OF THE FOLLOWING:

Page No.	Issue	Page No.	Issue	Page No.	Issue
*Title	22 Jan 60	1-126	Original	*3-18A thru 3-18B	22 Jan 60
*A thru C	22 Jan 60	1-126A thru 1-126B	20 Mar 59	*3-19	22 Jan 60
*i	22 Jan 60	1-127 thru 1-128	Original	3-20 thru 3-28	Original
ii thru viii	Original	2-1 thru 2-2B	25 Sep 59	3-28A thru 3-28B	20 Mar 59
1-1	25 Sep 59	2-3 thru 2-9	Original	3-29	20 Mar 59
*1-2	22 Jan 60	2-10 thru 2-11	20 Mar 59	3-30 thru 3-32	Original
1-2A thru 1-2B	25 Sep 59	2-12 thru 2-13	Original	*3-32A thru 3-32B	22 Jan 60
1-3 thru 1-4	Original	2-14	9 Jan 59	3-33 thru 3-35	Original
*1-4A thru 1-4B	22 Jan 60	2-15	Original	3-36 thru 3-38	20 Mar 59
1-5 thru 1-10	Original	2-16	5 Jun 59	4-1	25 Sep 59
*1-10A thru 1-10F	22 Jan 60	2-17 thru 2-18	Original	4-2	Original
1-11 thru 1-16	Original	2-18A	5 Jun 59	*4-3	22 Jan 60
*1-16A thru 1-16B	22 Jan 60	2-18B	25 Sep 59	4-4 thru 4-4A	25 Sep 59
1-17 thru 1-19	Original	2-19 thru 2-21	Original	4-4B	20 Mar 59
1-20	20 Mar 59	2-22	20 Mar 59	4-5 thru 4-6	9 Jan 59
1-20A	9 Jan 59	2-23	Original	4-7 thru 4-8	Original
1-20B thru 1-20H	25 Sep 59	2-24	20 Mar 59	4-9 thru 4-10E	9 Jan 59
1-21 thru 1-28	Original	2-25 thru 2-26	Original	4-10F	5 Jun 59
1-29 thru 1-30	5 Jun 59	2-27 thru 2-29	9 Jan 59	4-10G thru 4-10H	9 Jan 59
1-31 thru 1-32	Original	2-30 thru 2-34	Original	*4-10J thru 4-10K	22 Jan 60
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1-53	9 Jan 59	2-42	20 Mar 59	*4-16A	22 Jan 60
1-54 thru 1-61	Original	2-43 thru 2-46	Original	4-16B	5 Jun 59
1-62 thru 1-62B	9 Jan 59	2-46A thru 2-46B	9 Jan 59	4-17	5 Jun 59
1-63	9 Jan 59	2-47	9 Jan 59	4-18 thru 4-19	Original
1-64 thru 1-73	Original	2-48 thru 2-49	Original	4-20 thru 4-21	9 Jan 59
1-74	25 Sep 59	2-50	9 Jan 59	4-22 thru 4-30	Original
1-75 thru 1-76	Original	2-51	20 Mar 59	*4-30A thru 4-30D	22 Jan 60
1-77 thru 1-80B	25 Sep 59	2-52 thru 2-54	Original	4-31	9 Jan 59
1-81 thru 1-82	Original	2-55	9 Jan 59	4-32 thru 4-36	Original
1-83	9 Jan 59	2-56	Original	4-37 thru 4-38A	5 Jun 59
1-84 thru 1-99	Original	*2-56A thru 2-56B	22 Jan 60	*4-38B	22 Jan 60
1-100	20 Mar 59	*2-57	22 Jan 60	4-38C thru 4-38D	5 Jun 59
1-101 thru 1-102	Original	2-58 thru 2-59	Original	4-39	5 Jun 59
*1-103	22 Jan 60	2-60	20 Mar 59	4-40	9 Jan 59
1-104 thru 1-105	Original	2-60A	9 Jan 59	4-41 thru 4-47	Original
1-106 thru 1-106B	20 Mar 59	2-60B thru 2-60D	5 Jun 59	4-48	25 Sep 59
1-107 thru 1-108	Original	*2-60E thru 2-60F	22 Jan 60	4-49 thru 4-50	Original
1-109 thru 1-110B	20 Mar 59	2-61	Original	4-50A thru 4-50B	20 Mar 59
1-111	Original	2-62	9 Jan 59	4-51	5 Jun 59
1-112 thru 1-112D	20 Mar 59	2-63 thru 2-68	Original	4-52	9 Jan 59
1-113 thru 1-116	Original	*2-69	22 Jan 60	4-52A	20 Mar 59
1-117	20 Mar 59	2-70	Original	4-52B thru 4-52D	5 Jun 59
1-118	Original	*2-70A	22 Jan 60	4-53	5 Jun 59
1-118A thru 1-118F	20 Mar 59	2-70B	5 Jun 59	4-54 thru 4-61	Original
1-119	20 Mar 59	2-71	Original	4-62	20 Mar 59
1-120	Original	2-72 thru 2-78	20 Mar 59	5-1 thru 5-2	25 Sep 59
1-120A thru 1-120D	5 Jun 59	3-1 thru 3-2B	25 Sep 59	5-3 thru 5-4	Original
1-121	20 Mar 59	3-3	20 Mar 59	*5-4A thru 5-4D	22 Jan 60
1-122 thru 1-124	Original	3-4 thru 3-10	Original	*5-5	22 Jan 60
*1-124A thru 1-124B	22 Jan 60	*3-10A thru 3-10B	22 Jan 60	5-6 thru 5-7	Original
*1-125	22 Jan 60	3-11 thru 3-18	Original	5-8	25 Sep 59

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7-2B	5 Jun 59
7-3	Original
7-4	9 Jan 59
7-5 thru 7-6	Original
7-7 thru 7-14	9 Jan 59
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10-5 thru 10-78	Original
*1A-1 thru 1A-4	22 Jan 60
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INTRODUCTION

The Structural Repair Handbook is designed to guide personnel in handling, evaluating, and repairing crash-damaged airplanes. The primary purpose of this handbook is to reduce the time that airplanes remain in the crash-damaged category. This time can only be reduced with the help and cooperation of the personnel who do the work.

Evaluation of the damage serves a twofold purpose. First, the nature and extent of damaged will determine the type of facility necessary for its repair. Airplanes damaged beyond the repair capabilities of the base where the damage occurred will have to be transported to a facility capable of making the repairs. Transit time and distances will be cut by scheduling the airplanes to the proper repair bases. Second, by knowing the condition of the airplanes and the parts damaged, the time and effort required to get replacement parts will be reduced to a minimum.

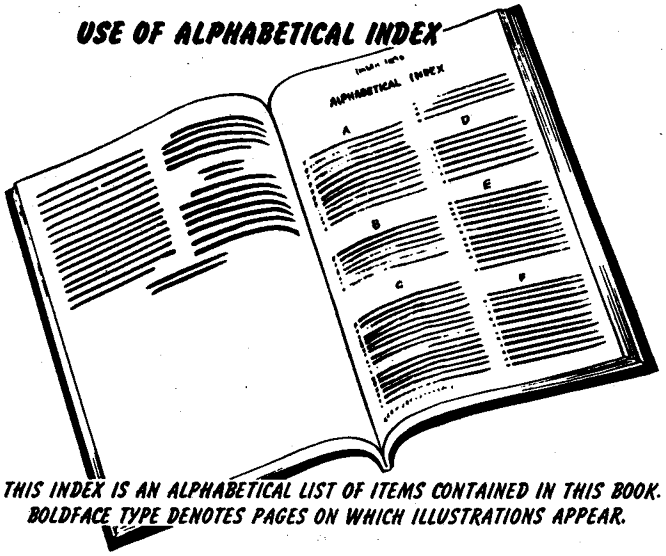
Repairs outlined provide structural maintenance coverage for the airplane. The repairs are not based on any certain extent of damage, since the scope of possible damage is so broad. It is impractical to outline procedures because, in many cases, it will be necessary to alter the repair to suit the specific situation. The material requirements, rivet specifications, etc, are the minimum allowable. For repairs of important primary structure, when excessive alteration of the repair would be required, the structural repair officer should be consulted.

Repairs for the individual components are grouped together within each section of the handbook (for instance, in the wing group, all repairs for the slat will be found in one group). Each group is preceded by an illustration showing the structural repair breakdown of the component and the repairs for that component. The structural repair breakdown is listed in the repair index in the front part of each section. Individual repairs may also be found by using the alphabetical index in the back of the book. Typical repairs covering all sections of the airplane are in Section X.

Personnel using this handbook must bear in mind that there is no substitute for sound judgment. This handbook can be used as an aid and a guide, but putting what is in the handbook into practice is the responsibility of those who are responsible for the status of the airplane.

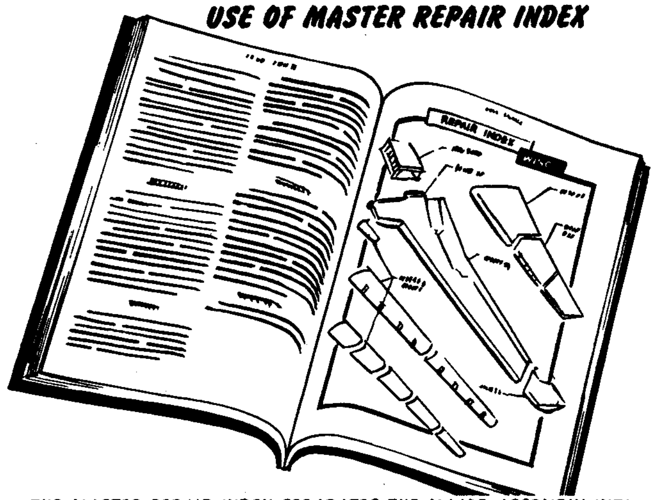
USE OF HANDBOOK...

USE OF ALPHABETICAL INDEX



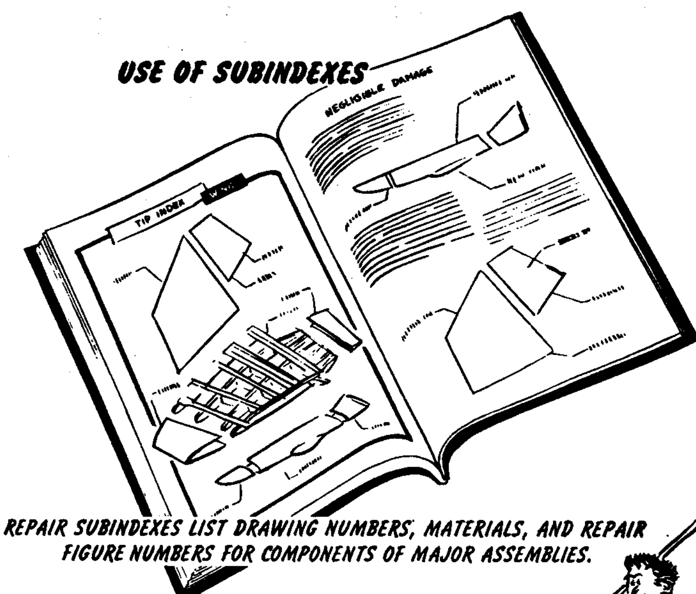
THIS INDEX IS AN ALPHABETICAL LIST OF ITEMS CONTAINED IN THIS BOOK. BOLDFACE TYPE DENOTES PAGES ON WHICH ILLUSTRATIONS APPEAR.

USE OF MASTER REPAIR INDEX

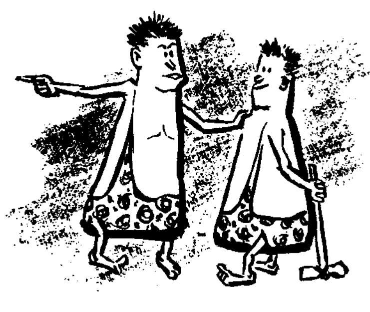


THE MASTER REPAIR INDEX SEPARATES THE MAJOR ASSEMBLY INTO COMPONENTS AND REFERS TO SUBINDEXES FOR THESE COMPONENTS.

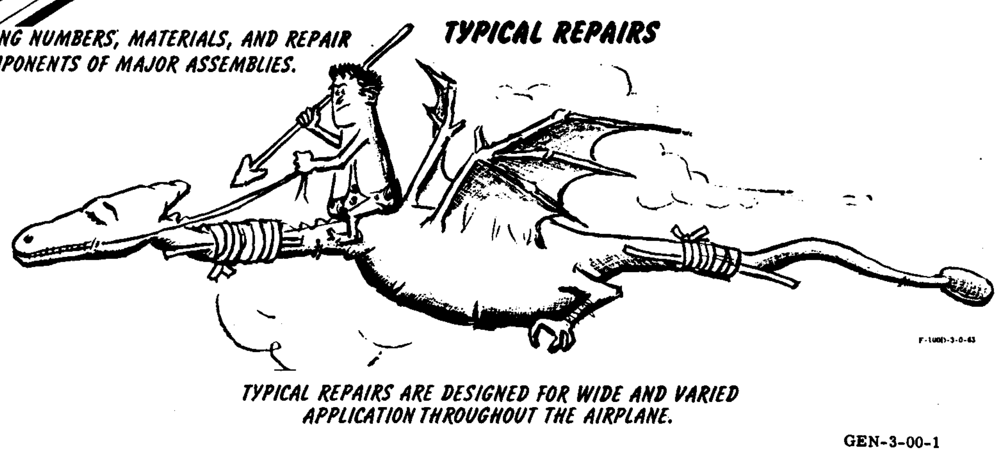
USE OF SUBINDEXES



REPAIR SUBINDEXES LIST DRAWING NUMBERS, MATERIALS, AND REPAIR FIGURE NUMBERS FOR COMPONENTS OF MAJOR ASSEMBLIES.



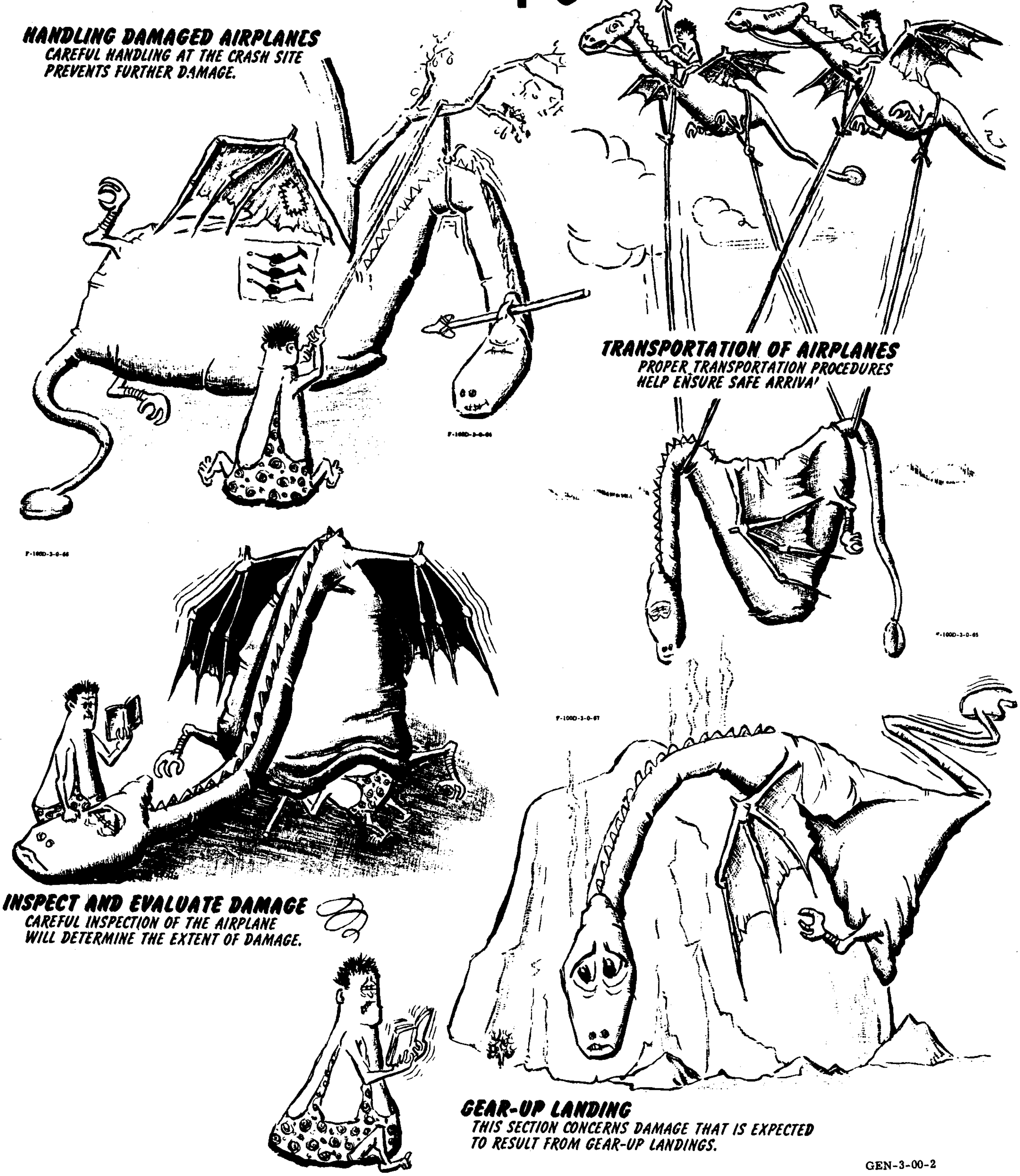
TYPICAL REPAIRS



TYPICAL REPAIRS ARE DESIGNED FOR WIDE AND VARIED APPLICATION THROUGHOUT THE AIRPLANE.

GEN-3-00-1

Let the handbook help you...



HANDLING DAMAGED AIRPLANES
CAREFUL HANDLING AT THE CRASH SITE PREVENTS FURTHER DAMAGE.

TRANSPORTATION OF AIRPLANES
PROPER TRANSPORTATION PROCEDURES HELP ENSURE SAFE ARRIVA'

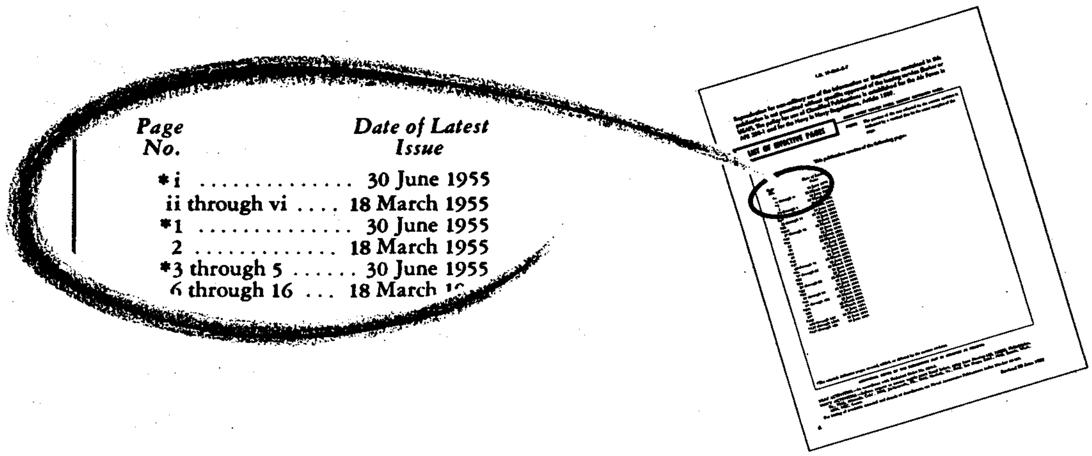
INSPECT AND EVALUATE DAMAGE
CAREFUL INSPECTION OF THE AIRPLANE WILL DETERMINE THE EXTENT OF DAMAGE.

GEAR-UP LANDING
THIS SECTION CONCERNS DAMAGE THAT IS EXPECTED TO RESULT FROM GEAR-UP LANDINGS.

GEN-3-00-2

STEP 3 (CONTINUED)

2 The "A" page shows what the revised status of the book should be since the last reissue or basic issue of the book was made. Each revised or deleted page is listed by page number and date.



3 Each revised page carries the revision date on the lower right- or left-hand corner.

4 Replace all old and like-numbered pages in your book with the new revised pages. Insert all "A" and "B" pages in alphabetical order following the page with the same basic page number.

Example: Pages 45A, 45B, etc, should follow page 45.

5 Text changes or additions on each new revised page are indicated by a black vertical line placed opposite the text lines changed. Read the lines of text so marked, and compare them with the same lines on the old page. This will give you a simple and quick method to determine a change in information. The remainder of the new page will be identical to the page it is replacing.

6 Check the bottom spacing of each new page for other revision notices. Sometimes it may be necessary to delete whole pages of information. These pages are not replaced with new pages. In this case, you will find such a notation on the revised page which precedes or follows the pages requiring deletion. For example, a notation on page 44 may say that pages 45 through 49 are deleted. If any illustrations appeared on the pages being deleted, the figure numbers of the deleted illustrations are also given in the deletion notation. Remove these pages from your handbook, as they contain obsolete information.

7 When a complete set of pages are issued, this means the entire book has been reissued. A note appears on the new title page to that effect. In this case, remove the old pages from your book and insert the new pages.

1F-86K-2-0-5

HOW TO REVISE THIS HANDBOOK

The airplanes you are working with do not remain static in design. Improvements and design changes are taking place through the entire life of the airplane.

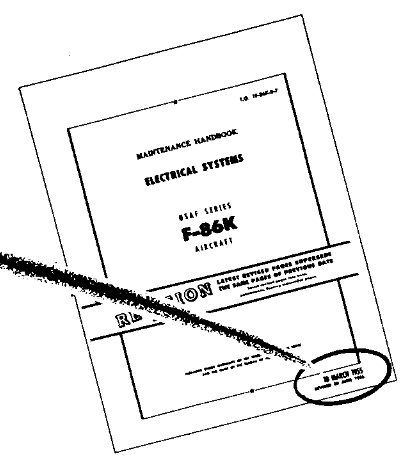
To reflect these changes, this handbook is constantly being revised. It is either revised or reissued every 90 days. The following steps will make sure you have the latest handbook and the proper method of keeping it revised.

STEP 1 **Make sure you have the latest issue of the book including all outstanding revisions. To check this, refer to T. O. 0-1-1, Numerical Index of Technical Publications. Find Model F-86K Series listing of Technical Orders. Here you will find the basic issue date for this book, the date of the latest revision, and the T. O. number and title of the book. The dates given should be identical to the dates appearing on the title page of your book. If they are not, your book is not up-to-date.**

STEP 2 **Notify your Engineering Officer if your book is not up-to-date. He can obtain the latest issue of your handbook by ordering.**

STEP 3 **When you receive revisions for your handbook, be sure you insert them in your book as soon as possible and properly.**

1 **The title page includes the basic publication date in the lower right-hand corner, with the latest revision date immediately below the basic date.**



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SECTION I

GENERAL

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TYPE OF CONSTRUCTION.

The North American F-86K Airplane is a single-place, swept-wing, all-weather fighter-interceptor. The wing, fuselage, and empennage are of all-metal construction, with the exception of some laminated glass cloth used in wing tips, vertical stabilizer tips, and radome. The fuselage is a semimonocoque structure in two sections, with a break point at fuselage station 279.3 for removal and servicing of the General Electric J47 series turbojet engine. Access doors in the fuselage make most areas accessible for repair and maintenance. The 35-degree swept-back wing is made up of a center-section panel and two outer wing panels. The outer wing panels are tied to the center section through matching bolting bars. Four-point suspension is used to attach the wing to the fuselage. The wing center section and outer panels to wing station 126 contain fuel cells. Most of the box section of the wing from this point outboard is inaccessible for repair without removing the wing outer panel lower cover. The empennage consists of a 35-degree swept-back all-movable horizontal stabilizer, a 35-degree swept-back fixed vertical stabilizer, and a movable rudder. Conventional rib-and-skin type structure is used for all parts. The landing gear is a fully retractable tricycle type. In retracted position, the gear is completely enclosed inside the fuselage and wing and covered by fairing doors. Details of the structure for each part of the airplane are contained in corresponding sections of the handbook.

GENERAL ARRANGEMENT AND FEATURES.

MAJOR ASSEMBLIES.

See figure 1-1.

ACCESS PROVISIONS.

See figures 1-3 through 1-5.

AIRPLANE DIMENSIONS.

See figure 1-2.

AIRPLANE STATIONS.

LOCATING AIRPLANE STATIONS.

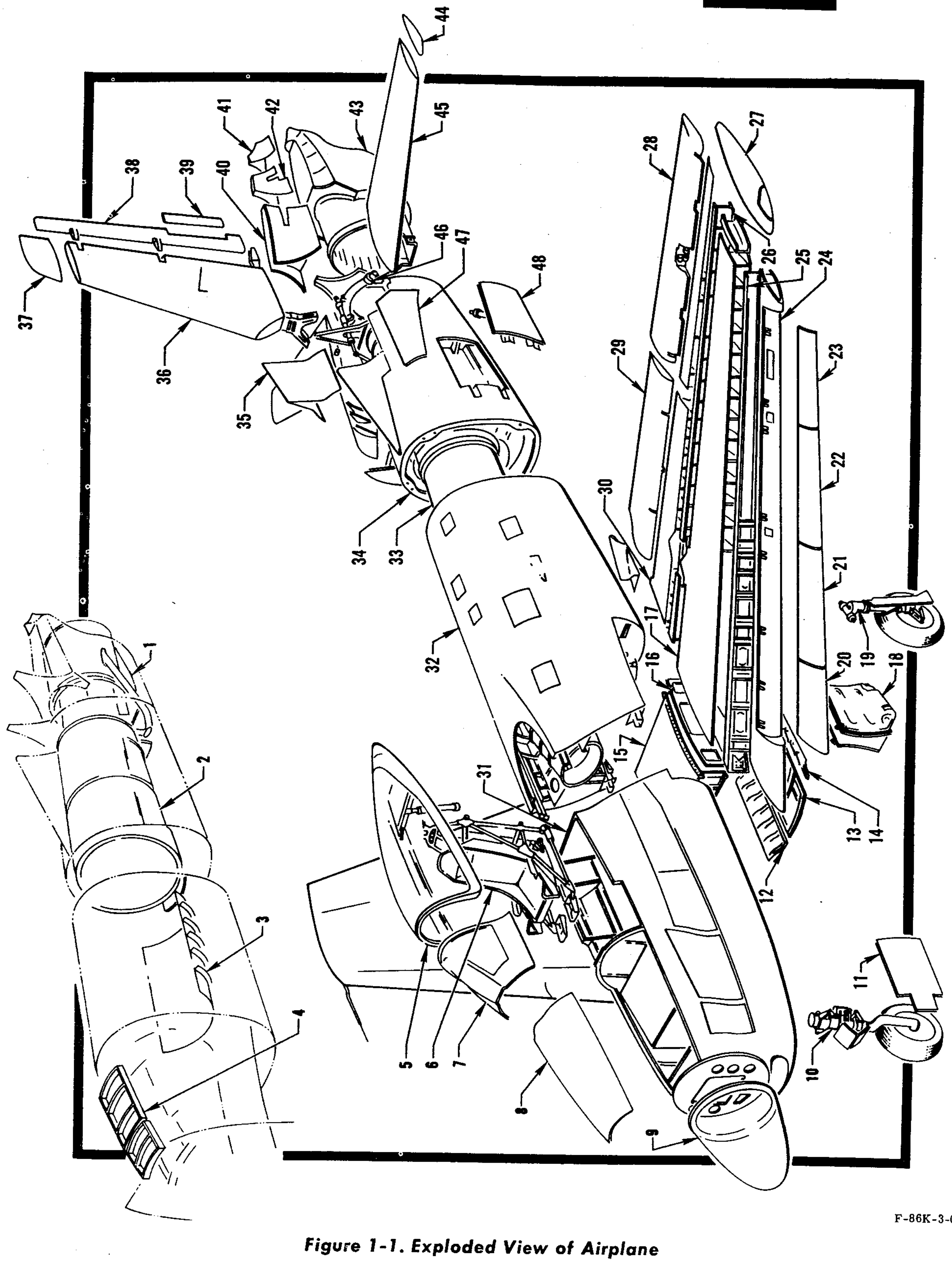
In modern day airplanes it is becoming more and more difficult to locate specific points on the airplane. With milled skin, canted ribs and frames, etc, the counting of ribs and frames to find a particular location is not practical. For this reason, basic reference planes have been set up for the fuselage, wing, and empennage, from which all other dimensions are established. (See figure 1-6.) For purposes of explanation, a line representing an edge view of a reference plane is referred to as a plane. All measurements are taken in inches.

FUSELAGE STATIONS. The fuselage is divided horizontally along the Zf plane by units referred to as water planes, vertically along the Xf plane by buttock planes, and longitudinally along the Yf plane by fuselage station planes. The Yf plane is used as a fuselage reference plane. Water plane zero, which falls on the fuselage reference plane, and station zero are arbitrarily defined by design. Buttock plane zero is defined as the vertical plane of symmetry. Water planes below the fuselage reference plane are negative (−); those above it are positive (+). Stations forward of station zero are negative (−); those aft of it are positive (+). Buttock planes to the left of buttock plane zero are positive (+); those to the right of it are negative (−). Fuselage stations are normal (at right angles) to the fuselage reference plane and to the plane of symmetry. They are measured in increments of inches forward and aft of station zero. Fuselage canted stations are diagonal to the fuselage reference plane. They are designated by their point of intersection with the fuselage reference plane.

WING STATIONS. Wing stations (Xw planes) are normal to the wing reference plane and the 25-percent plane. Wing station zero is where the 25-percent plane, projected, intersects fuselage buttock plane zero. The 25-percent plane (Yw = 0) is vertical and normal to the wing reference plane (Zw = 0). It was originally located by drawing a line through points which represent one quarter of the straight-line distance from the wing

EXPLODED VIEW OF AIRPLANE

GENERAL



F-86K-3-00-23

Figure 1-1. Exploded View of Airplane

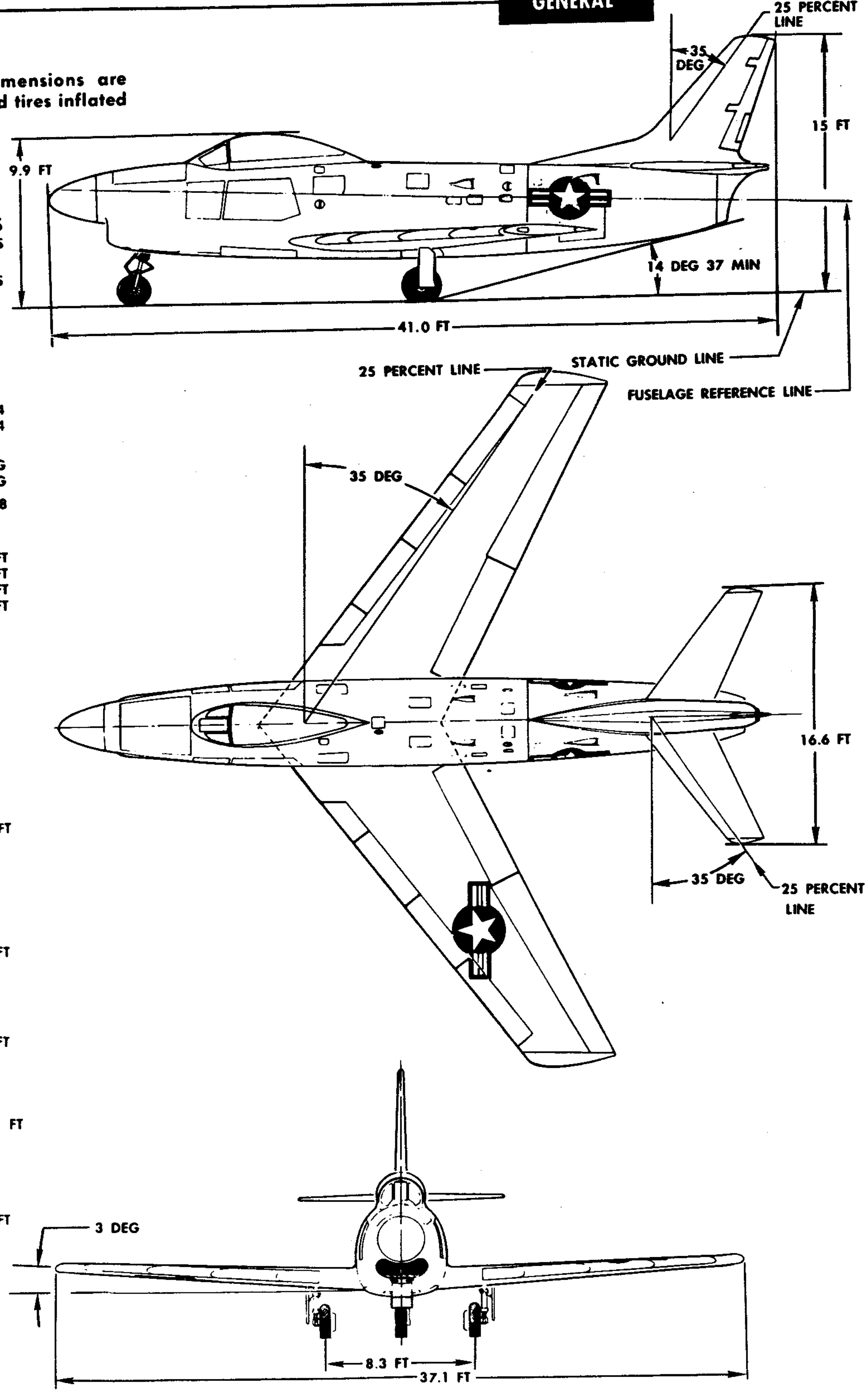
REF NO.	PART NO.	TITLE
1	165-42205	Shroud Assy
2	165-42141	Shroud Assy Eng Mtd
3	165-31463	Shroud Assy
4	165-31477	Eng Access Fus Duct Door
5	165-31802	Canopy Assy
6	190-53009	Ejection Seat
7	207-31881	Windshield
8	201-31004	Radar Access Door
9	165-31010	Radome
10	165-34011	Nose Gear Instl
11	165-34301	Nose Wheel Door
12	165-10003	Ctr Wing Fairing
13	165-10004	Ctr Wing Fairing
14	165-10005	Ctr Wing Fairing
15	165-13001	Ctr Wing Assy
16	165-13039	Attaching Joint
17	165-14002	Wing Outer Panel
18	207-33301	Main Wheel Door
19	165-33011	Main Gear Instl
20	165-17002	Slat Assy
21	165-17003	Slat Assy
22	165-17004	Slat Assy
23	165-17005	Slat Assy
24	173-14009	Leading Edge Assy
25	165-14003	Front Spar
26	165-14005	Rear Spar
27	165-14414	Wing Tip
28	165-16001	Aileron Assy
29	177-18001	Flap Assy
30	165-14006	Trailing Edge Assy
31	207-31102	Forward Fuselage
32	207-31401	Intermediate Fuselage
33	165-40001	Power Plant Instl
34	207-31604	Aft Fuselage
35	165-310124	Door Assy Dorsal Access
36	190-23001	Vertical Stab
37	165-23311	Vertical Stab Tip
38	157-24001	Rudder Assy
39	157-24501	Rudder Trim Tab
40	165-25010	Fillet Assy
41	165-25020	Cone Assy
42	165-25015	Fillet Assy
43	165-31609	Aspirator
44	165-21811	Horizontal Stab Tip
45	165-21501	Horizontal Stab
46	165-21464	Stab Beam
47	165-316126	Fillet Assy
48	165-39002	Speed Brake
	190-39002	Speed Brake Honeycomb

Key to Figure 1-1

AIRPLANE DIMENSIONS

GENERAL

NOTE Airplane principal dimensions are taken with the landing gear and tires inflated to the correct pressures.



APPROXIMATE GROSS WEIGHTS

CLEAN AIRPLANE .... 18,640 POUNDS
WITH TWO 120-GAL DROP TANKS .... 20,430 POUNDS

WING

AIRFOIL
- ROOT .... NACA 0012-64
- TIP .... NACA 0011-64

INCIDENCE
- ROOT .... +1 DEG
- TIP .... −1 DEG

ASPECT RATIO 4.8

AREAS
- WING (INCLUDING FLAPS, SLATS, AND AILERONS) ..... 287.9 SQ FT
- AILERONS (BOTH) .... 32.7 SQ FT
- FLAPS (BOTH) .... 32.5 SQ FT
- SLATS (BOTH) .... 35.4 SQ FT

HORIZONTAL STABILIZER

AREA (MOVABLE PORTIONS ONLY) .... 39.0 SQ FT

VERTICAL STABILIZER

AREA (EXCLUDING DORSAL FIN) .... 31.1 SQ FT

RUDDER

AREA .... 5.3 SQ FT

RUDDER TRIM TAB

AREA .... 0.58 SQ FT

SPEED BRAKE

AREA (EACH EFFECTIVE FRONTAL AREA) .... 5.65 SQ FT

Figure 1-2. Airplane Dimensions

BLUEPRINT NUMBERING

GENERAL

The blueprint and part numbering systems of the airplane are broken down so that all parts within the basic components of the airplane will be numbered within the same series of numbers.

Prefix numbers are used to indicate under which contract the part was originally designed.

Basic part numbers assigned to a part or blueprint are determined by the component for which the part was designed, e.g., flap, 18,000 series; aileron, 16,000 series.

Dash numbers are used to identify detail parts used in an assembly and to indicate right- and left-hand parts. Left-hand parts have an odd-numbered dash number, and right-hand parts are identified with even-numbered dash numbers.

For example, a part with a number of 165-16033-3 would indicate that the part had been designed under the 165 contract, that the part was an aileron part, and that it was intended for the left-hand aileron.

This illustration shows the basic airplane components and the number series assigned them.

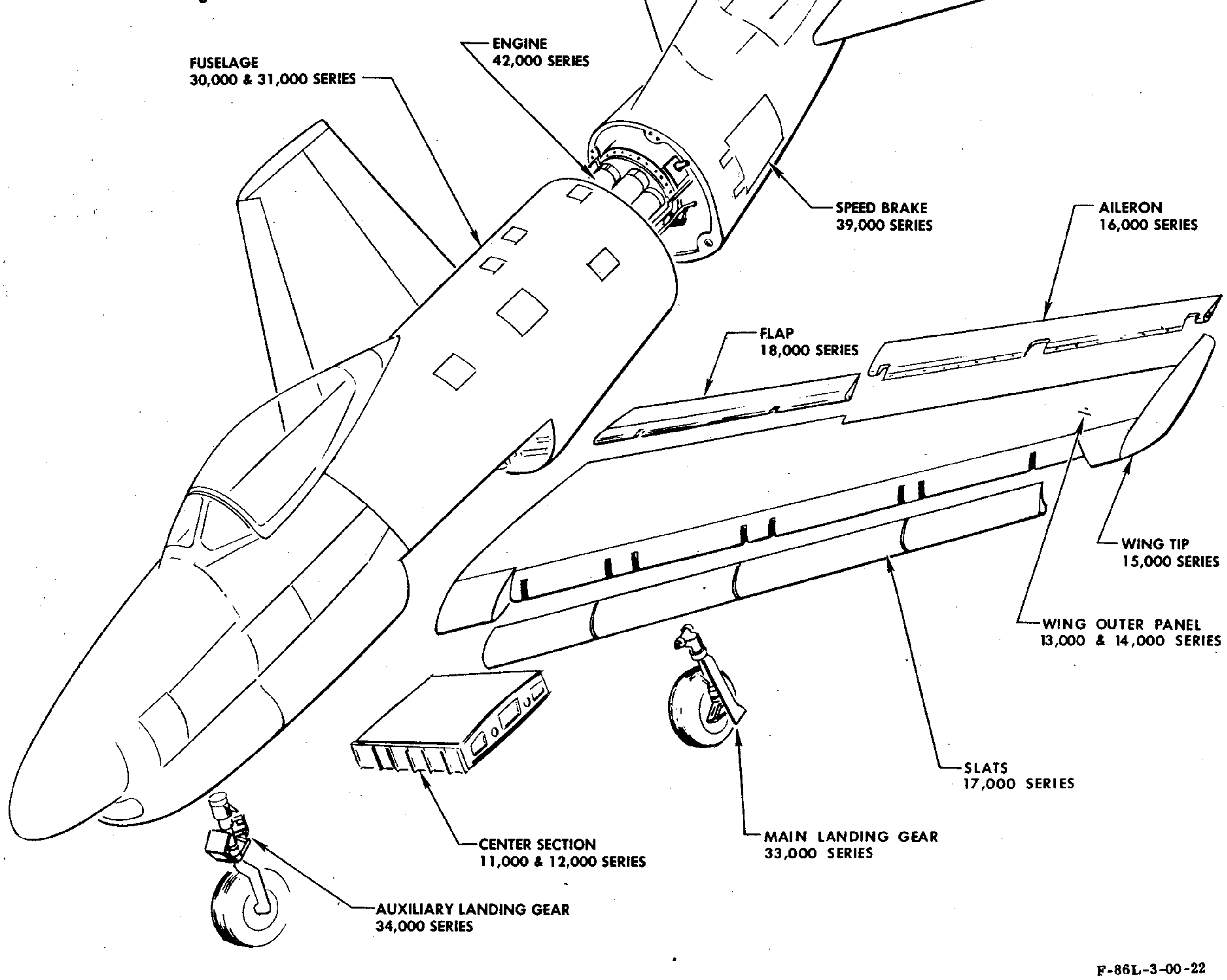


Figure 1-2A. Structural Drawing Numbering System

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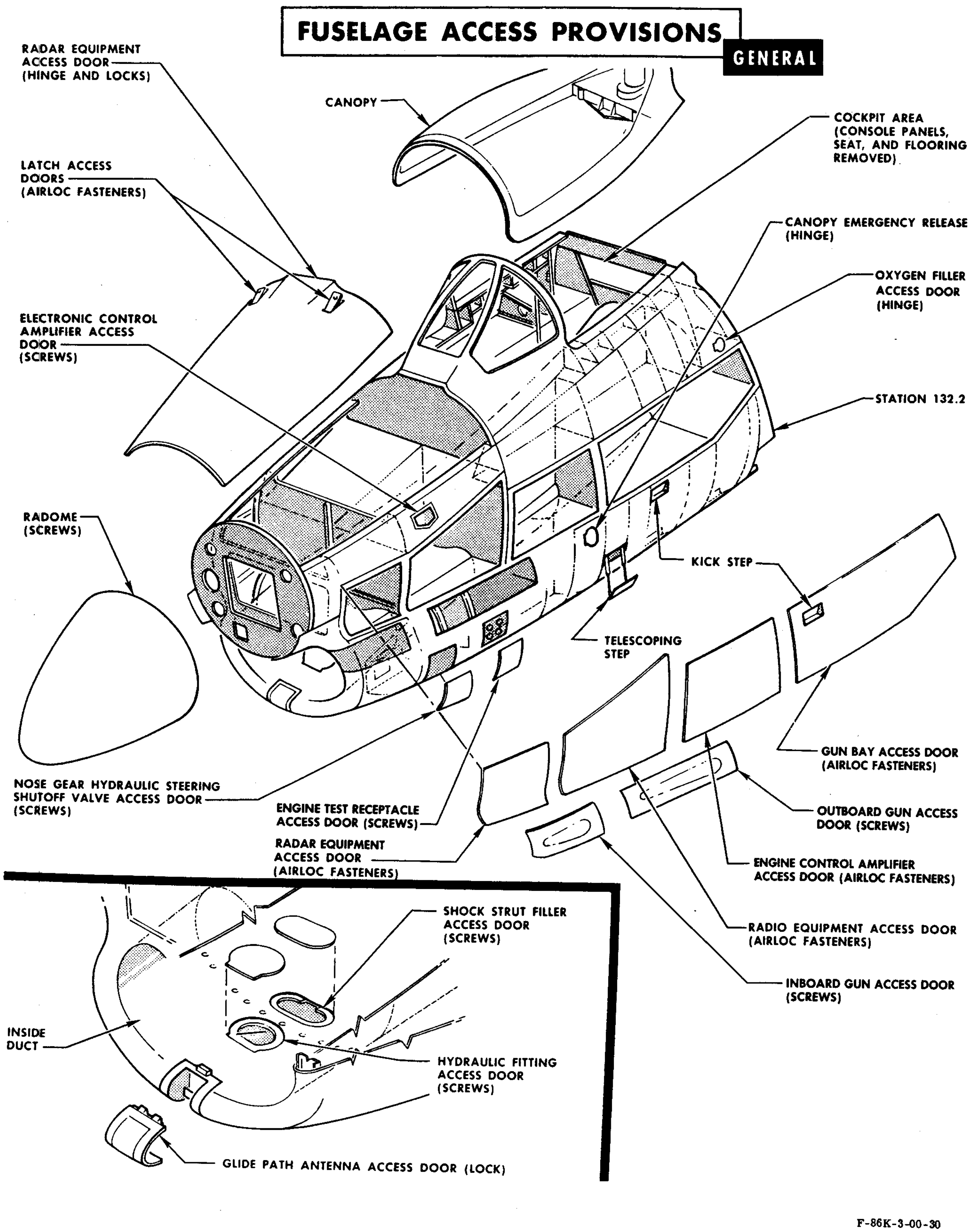


Figure 1-3. Forward Fuselage Access Provisions (Sheet 1 of 3)

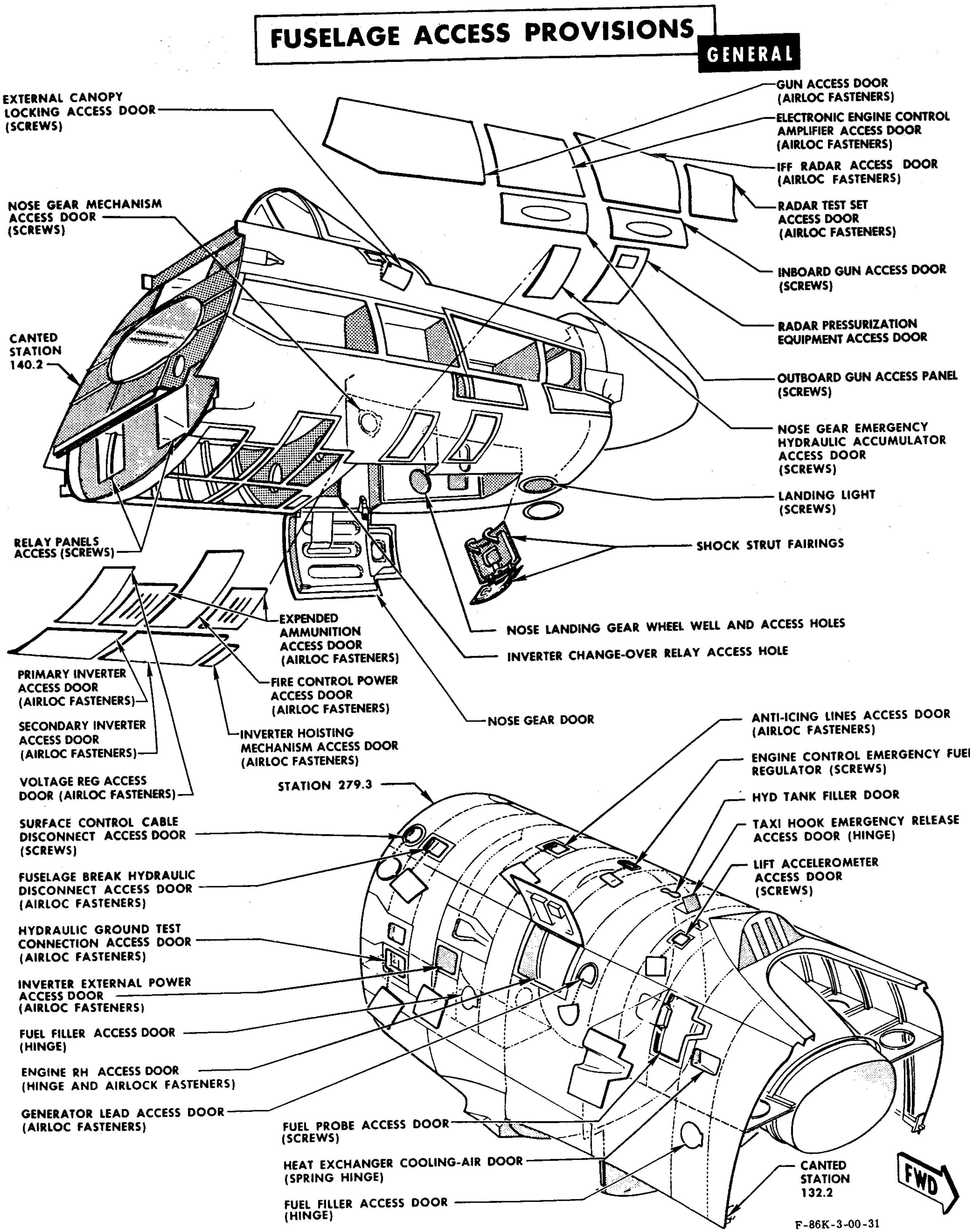


Figure 1-3. Forward Fuselage Access Provisions (Sheet 2 of 3)

FUSELAGE ACCESS PROVISIONS

GENERAL

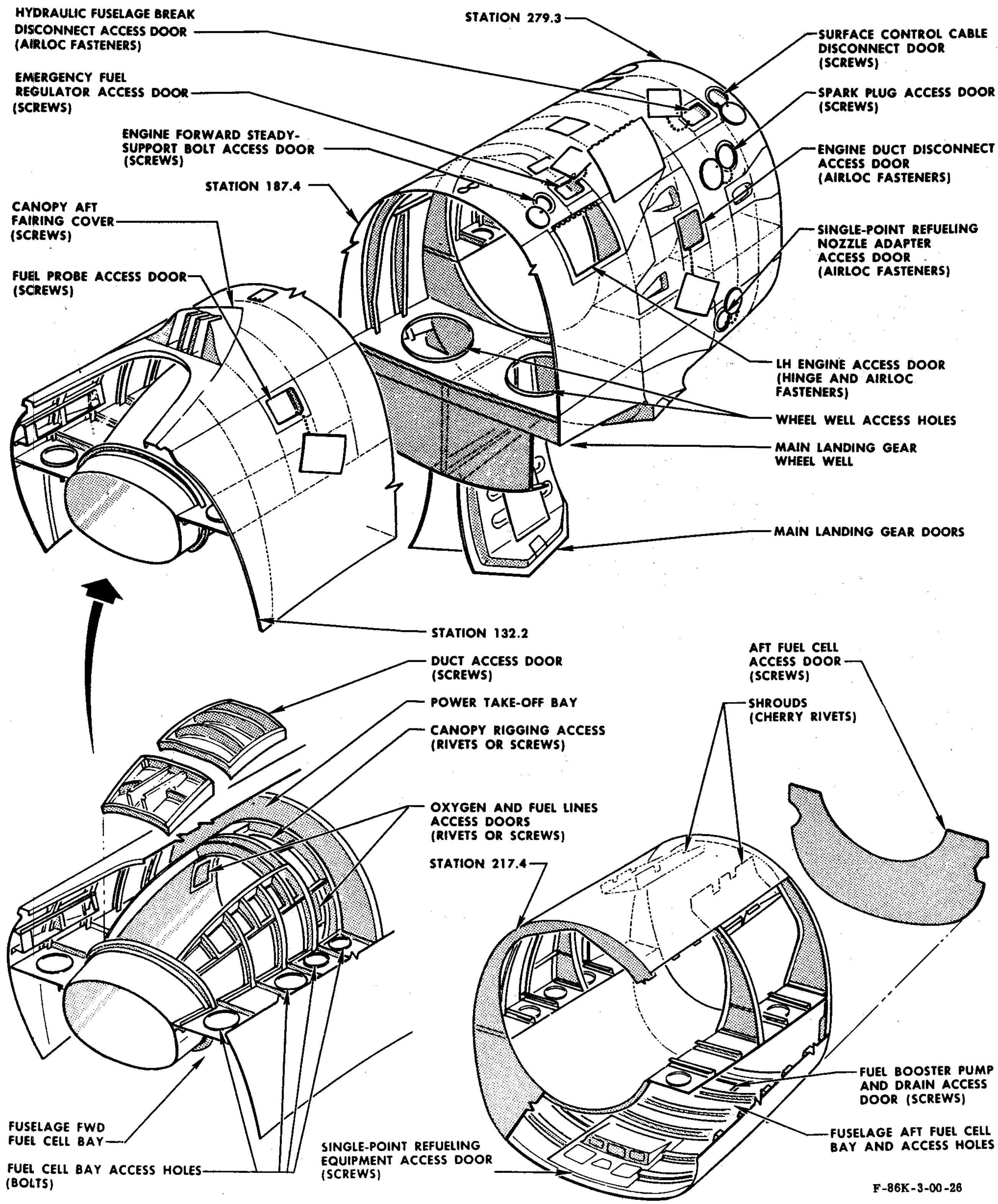
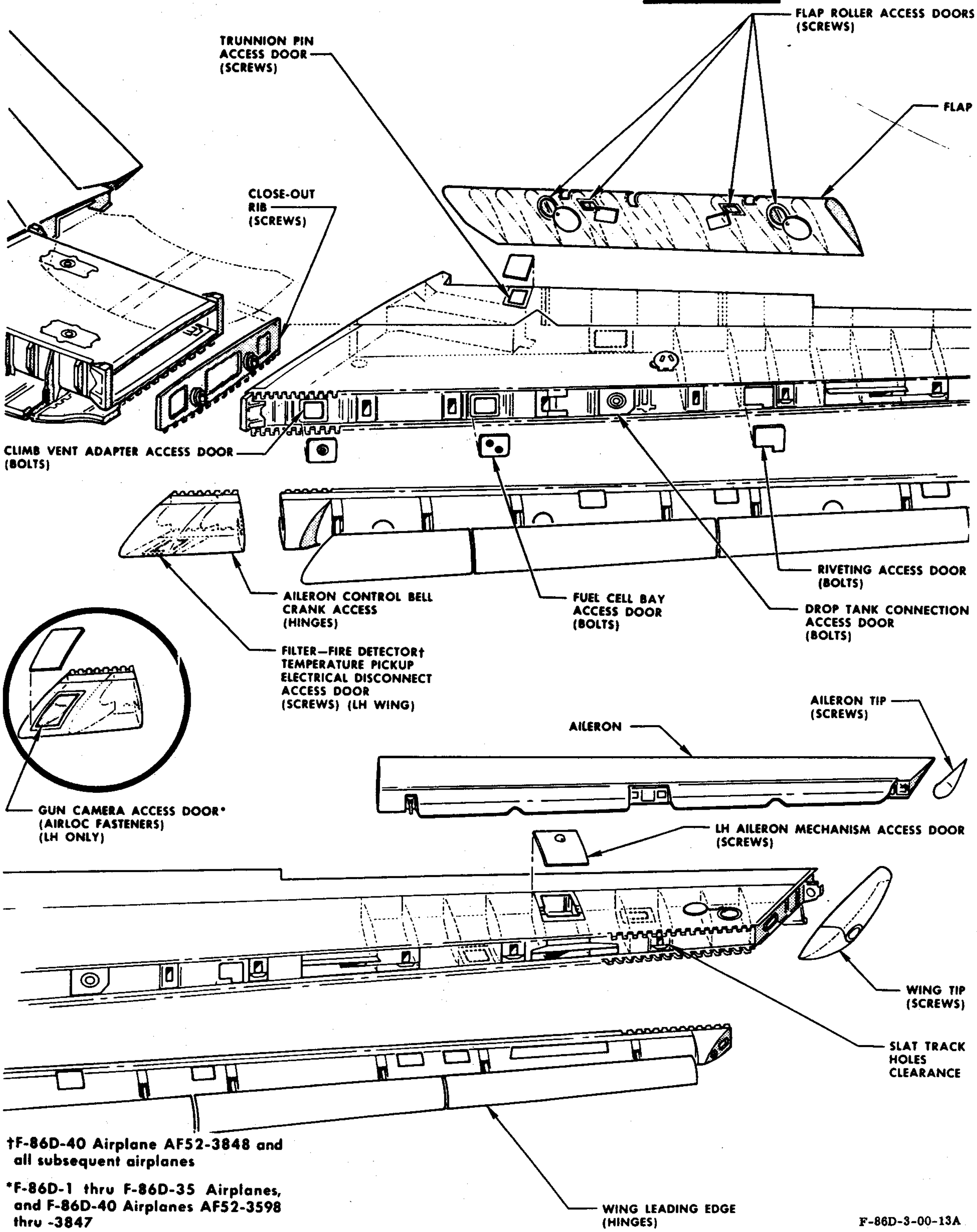


Figure 1-3. Forward Fuselage Access Provisions (Sheet 3 of 3)

WING ACCESS PROVISIONS

GENERAL



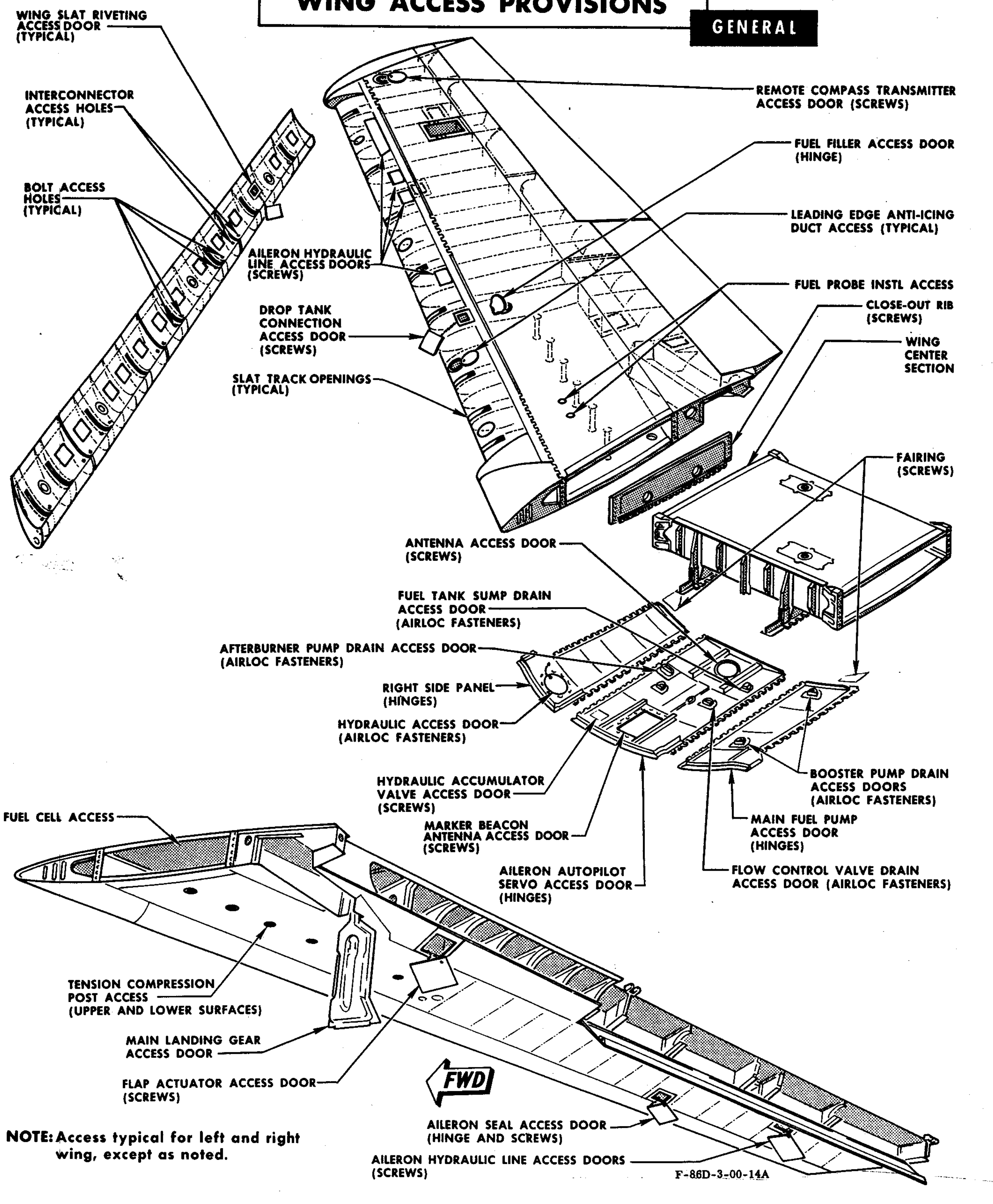
†F-86D-40 Airplane AF52-3848 and all subsequent airplanes

*F-86D-1 thru F-86D-35 Airplanes, and F-86D-40 Airplanes AF52-3598 thru -3847

Figure 1-4. Wing Access Provisions (Sheet 1 of 2)

WING ACCESS PROVISIONS

GENERAL



NOTE: Access typical for left and right wing, except as noted.

Figure 1-4. Wing Access Provisions (Sheet 2 of 2)

AFT FUSELAGE ACCESS PROVISIONS

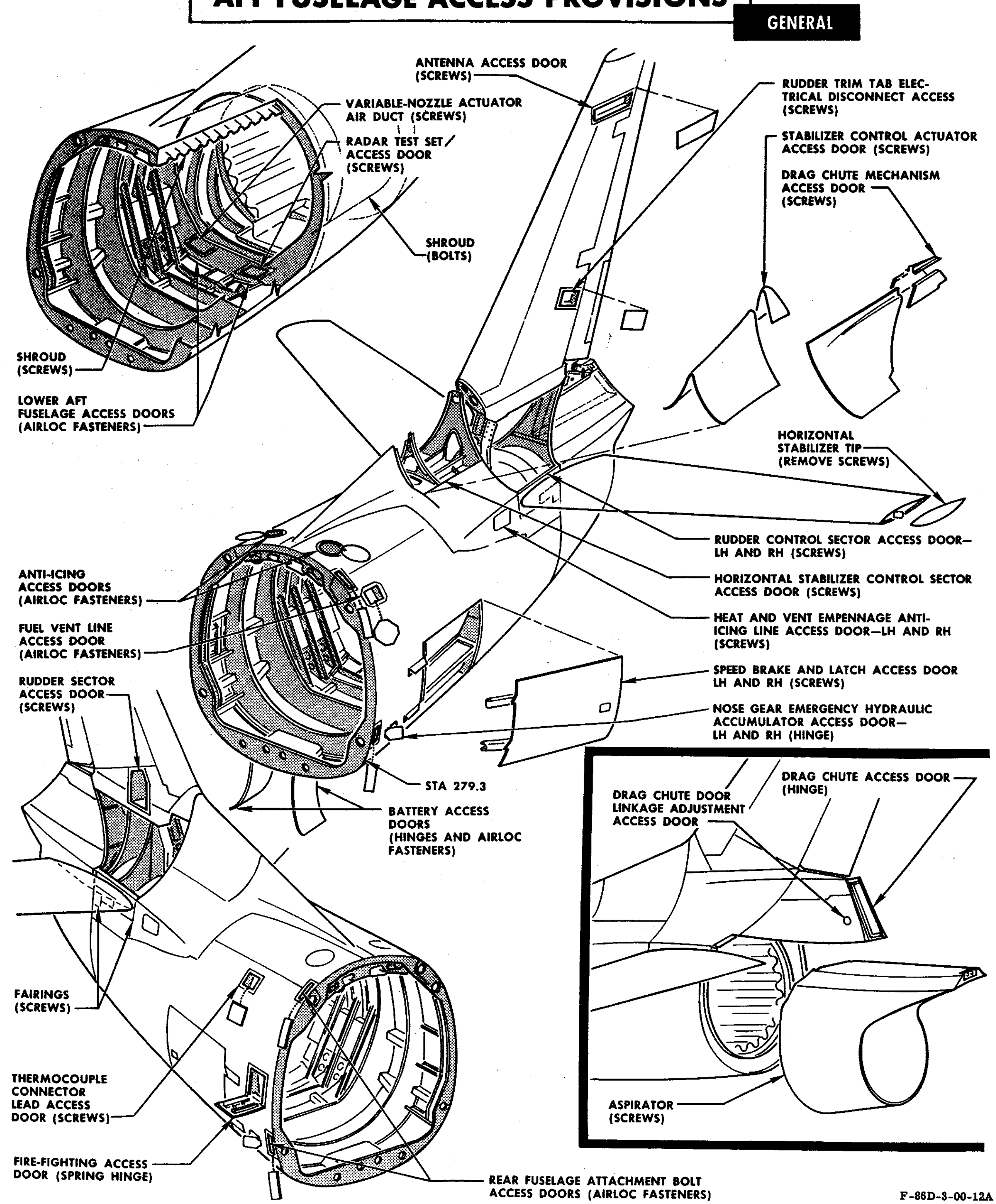


Figure 1-5. Aft Fuselage Access Provisions

ACCESS DOORS AND PANELS

GENERAL

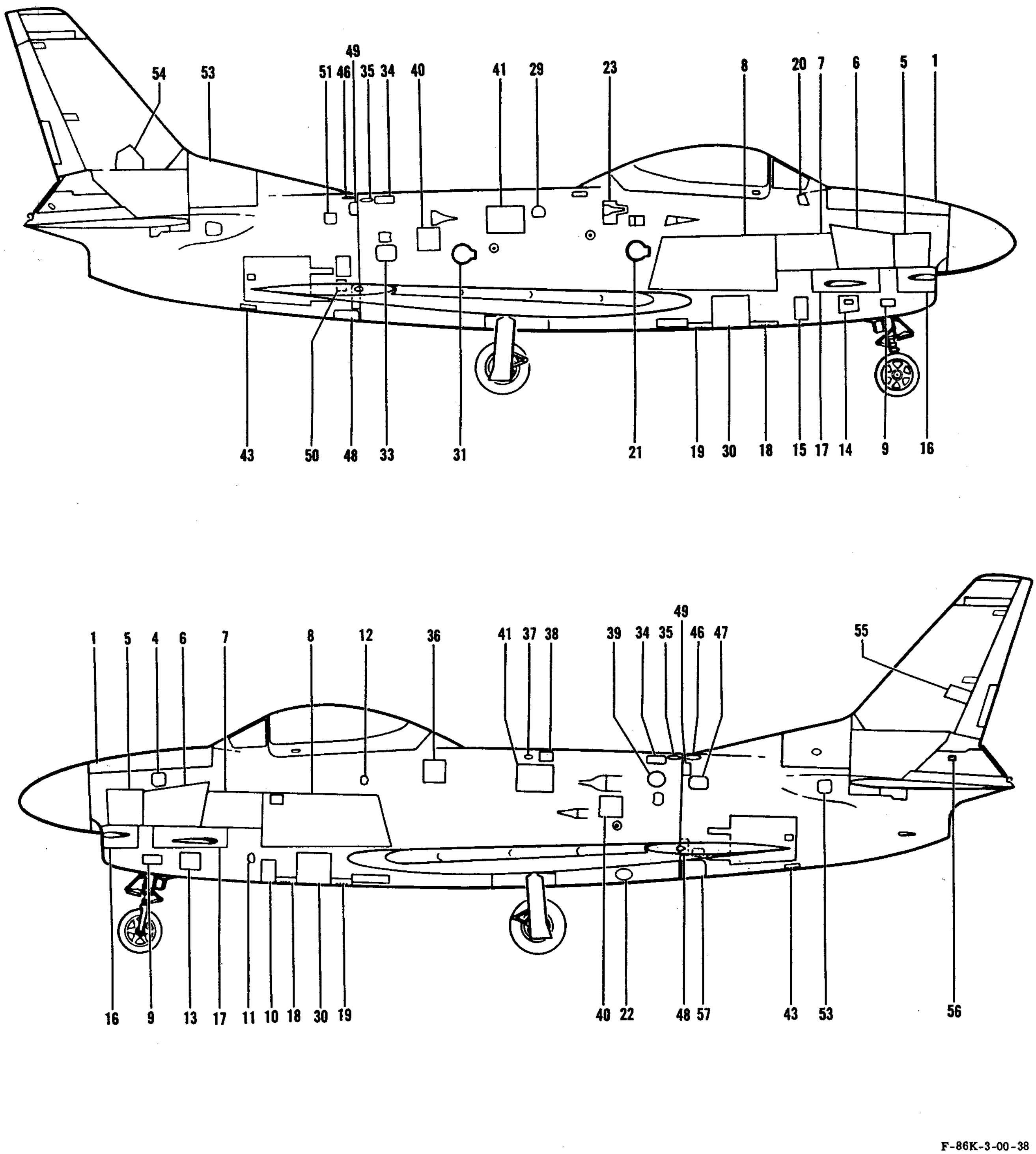


Figure 1-5A. External Removable Doors and Panels (Sheet 1 of 3)

ACCESS DOORS AND PANELS

GENERAL

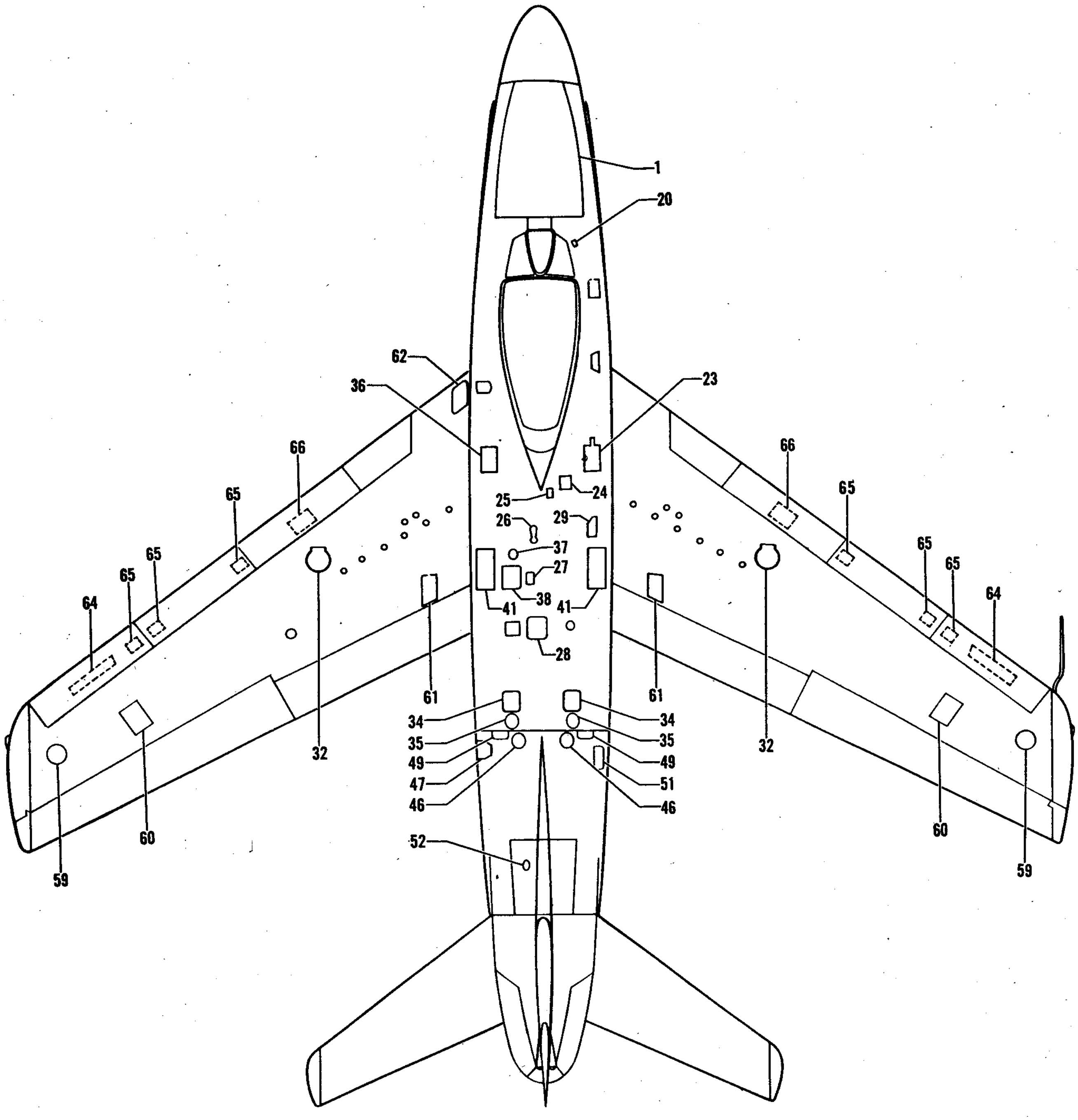


Figure 1-5A. External Removable Doors and Panels (Sheet 2 of 3)

ACCESS DOORS AND PANELS

GENERAL

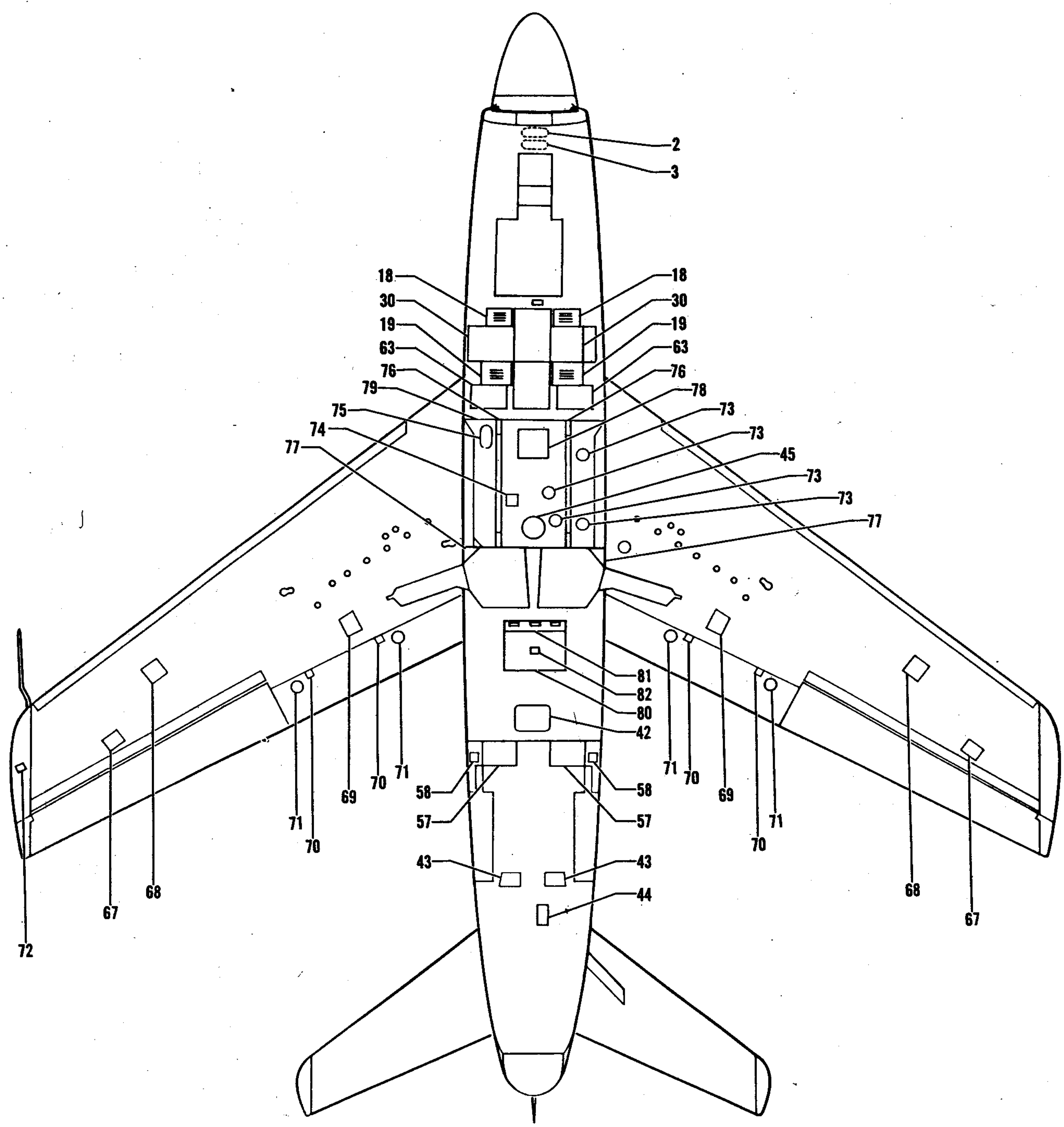


Figure 1-5A. External Removable Doors and Panels (Sheet 3 of 3)

ITEM NO.	DRAWING NO.*		SKIN GAGE	MATERIAL
1	190-31004	Radar Equiment Access	0.032	7075-T6 Clad
2	165-31091	Hydraulic Fitting Access	0.064	2024-T4 Clad
3	165-31270	Shock Strut Filler Access	0.064	7075-T6 Clad
4	207-31108	Electronic Control Amplifier Access	0.032	7075-T4 Clad
5	165-31005	Marker Beacon Receiver Access (LH door) Radar Equipment Access (RH door)	0.032	7075-T6 Clad
6	165-31006	Radio Equipment Access (LH door) IFF Radar Access (RH door)	0.032	7075-T6 Clad
7	165-31007	Primary Inverter Access (LH door) Secondary Inverter Access (RH door)	0.032	7075-T6 Clad
8	205-31008	Engine Control Thrust Selector Unit Access (LH door) Radio Access (RH door)	0.032	7075-T6 Clad
9	207-31105	Forward Fuselage Access	0.040	2024-T4 Clad
10	165-31018	Nose Gear Hydraulic Steering Shutoff Valve Access	0.032	7075-T6 Clad
11	205-31016	Canopy Emergency Release Access	0.032	2024-T4 Clad
12	165-73338	Oxygen Filler Access	0.064	2024-T4 Clad
13	165-31017	Engine Electronic Control Access	0.040	7075-T6 Clad
14	165-31062	Radar Test Set Access	0.040	7075-T6 Clad
15	165-31094	Nose Gear Emergency Hydraulic Accumulator Access	0.032	2024-T4 Clad
16	213-61040	Inboard Gun Access Panel	0.090	CRES
17	207-61041	Outboard Gun Access Panel	0.090	CRES
18	205-31012	Expended Ammunition Door	0.032	2024-T4 Clad
19	205-31013	Expended Ammunition Door	0.040	2024-T4 Clad
20	207-31882	External Canopy Locking Access	0.032	7075-T6 Clad
21	165-48305	Fuel Filler Access	0.064	2024-T4 Clad
22	165-48526	Single-point Refueling Nozzle Adapter Access	0.032	7075-T6 Clad
23	165-31043	Fuel Probe Access	0.072	2024-T4 Clad
24	173-31043	Lift Accelerometer Access	0.051	7075-T6 Clad
25	165-31070	Taxi Hook Emergency Release Access	0.040	2024-T4 Clad
26	165-31031	Hydraulic Tank Filler Access	0.125	2024-T4 Clad
27	165-31041	Engine Control Emergency Fuel Regulator Access	0.040	2024-T4 Clad
28	165-31045	Anti-icing Line Access	0.040	2024-T4 Clad
29	190-31007	Generator Lead Access	0.032	7075-T6 Clad
30	205-31010	Step Access Door	0.032	2024-T4 Clad
31	165-48405	Fuel Filler Access	0.064	2024-T4 Clad
32	165-48205	Fuel Tank Filler Access	0.081	2024-T4 Clad
33	165-31040	Hydraulic Ground Test Connection Access	0.040	2024-T4 Clad
34	165-31032	Fuselage Break Hydraulic Disconnect Access	0.040	2024-T4 Clad
35	165-31071	Surface Control Cable Disconnect Access	0.040	2024-T4 Clad
36	165-31044	Fuel Probe Access	0.072	7075-T6 Clad
37	165-314142	Engine Forward Steady-support Bolt Access	0.072	2024-T4 Clad
38	207-31404	Emergency Fuel Regulator Access	0.090	7075-T6 Clad
39	165-31069	Spark Plug Access	0.051	7075-T6 Clad
40	165-31039	Engine Duct Disconnect Access Inverter External Power Access	0.064	2024-T4 Clad
41	177-31033	Engine LH Access Engine RH Access	0.040	2024-T4 Clad
42	165-31035	Fuel Booster Pump and Drain Access	0.032	7075-T6 Clad

*Drawing numbers are for reference only, and are not to be used for ordering parts.

ITEM NO.	DRAWING NO.*		SKIN GAGE	MATERIAL
43	165-31029	Lower Aft Fuselage Access	0.040	2024-T4 Clad
44	165-31072	Variable-nozzle Actuator Air Duct Access	0.032	6061-T6
45	213-10005	Wing Center Section Fairing Aft Cover	0.040	2024-T4 Clad
46	165-317114	Anti-icing Access	0.040	2024-T4 Clad
47	165-31023	Fuel Vent Line Access	0.032	2024-T4 Clad
48	165-31021	Rear Fuselage Attachment Bolt Access	0.032	2024-T4 Clad
49	165-31020	Rear Fuselage Attachment Bolt Access	0.032	2024-T4 Clad
50	165-31751	Fire-fighting Access	0.064	2024-T4 Clad
51	165-31026	Thermocouple Connector Lead Access	0.040	7075-T6 Clad
52	165-31027	Engine Support Trunnion Access Dorsal Fin Stabilizer Sector Access	0.018	CRES
53	165-316126	Heat and Vent Empennage Anti-icing Line Access	0.032	2024-T4 Clad
54	181-23428	Vertical Stabilizer Access R.H.	0.064	7075-T6 Clad
55	165-23751	Rudder Trim Tab Electrical Disconnect Access	0.040	2024-T4 Clad
56	165-25514	Drag Chute Door Linkage Adjustment Access	0.051	2024-T4 Clad
57	165-31057	Battery Access	0.032	2024-T4 Clad
58	165-31060	Emergency Battery Access	0.032	2024-T4 Clad
59	140-14062	Remote Compass Transmitter Access	0.032	2024-T4 Clad
60	165-14059	Aileron Mechanism Access	0.051	7075-T6 Clad
61	151-14153	Trunnion Pin Access	0.020	CRES
62	165-14348	Gun Camera Access	0.064	7075-T6 Clad
63	205-31011	Fuselage Equipment Access	0.032	2024-T4 Clad
64	165-14268	Aileron Hydraulic Access	0.040	2024-T4 Clad
65	165-14285	Aileron Hydraulic Access	0.040	2024-T4 Clad
66	165-14260	Drop Tank Connection Access	0.040	2024-T4 Clad
67	165-14609	Aileron Hydraulic Line Access	0.040	7075-T6 Clad
68	165-14608	Aileron Seal Access	0.064	7075-T6 Clad
69	165-14462	Flap Actuator Access	0.032	2024-T4 Clad
70	151-18030	Flap Roller Access	0.025	2024-T4 Clad
71	140-18021	Flap Roller Access	0.025	2024-T4 Clad
72	165-14199	Pitot Tube Drain Access	0.020	CRES
73	165-10023	Booster Pump Drain Access Flow Control Valve Drain Access Fuel Tank Sump Drain	0.040	2024-T4 Clad
74	165-10017	Afterburner Pump Drain Access Hydraulic Accumulator Valve Access	0.040	2024-T4 Clad
75	165-10013	Hydraulic Access	0.040	2024-T4 Clad
76	165-10021	Hinge Access	0.040	2024-T4 Clad
77	165-10020	Fairing	0.032	2024-T4 Clad
78	205-10006	Main Fuel Pump Access	0.040	2024-T4 Clad
79	165-10005	Right Side Panel	0.040	2024-T4 Clad
80	177-31042	Single-point Refueling Equipment Access	0.064	2024-T4 Clad
81	177-31041	External Power Receptacle Access	0.064	2024-T4 Clad
82	165-31034	Fuel Tank Sump Drain Access	0.032	2024-T4 Clad

***Drawing numbers are for reference only, and are not to be used for ordering parts.**

Key to Figure 1-5A (Continued)

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leading edge to the wing trailing edge. The wing trailing edge was relocated in the original design of the F-86 wing, and the 25-percent plane on the present F-86K wing is actually an arbitrary reference plane which can only be located by given distances from the leading or trailing edge of the wing. In figure 1-6, the straight-line distance aft of the leading edge is given at the inboard and outboard trims.

Since wing stations zero is a theoretical plane inside the fuselage, a known location on the wing is necessary as a starting point when locating a wing station. In figure 1-6, the intersection of the 25-percent plane with the skin trim line at the wing tip has been selected as a point from which to measure.

Wing leading edge stations (Xw planes) are normal to the basic leading edge. Wing leading edge station "0" is in the fuselage, where a line drawn from wing station "0" and normal to the 25-percent plane intersects the leading edge plane. As with the wing stations, an external known point is needed from which to measure. The skin trim line at the tip leading edge has been selected as this point. (See figure 1-6.)

AILERON AND FLAP STATIONS. Because the aileron and flap stations are normal (at right angles) to their hinge centerline, they may be measured along their hinge centerline from the inboard skin trim lines. Flap stations are normal (at right angles) to their hinge centerlines. Station zero is where the flap hinge centerline, projected, would intersect fuselage buttock plane zero.

VERTICAL STABILIZER STATIONS. Vertical stabilizer stations are parallel to fuselage water planes, with stations "0" at water plane 24.75. In general, the ribs are canted stations normal to the hinge line (80-percent plane), and are designated by the station in which they intersect the hinge line. To find a station on the vertical stabilizer, construct a line on the stabilizer, perpendicular to the fuselage reference plane. Stations are normal to this line. In figure 1-6, the skin trim lines where the 80-percent plane crosses the lower edge of the radio antenna cover have been taken as a reference point from which to measure.

HORIZONTAL STABILIZER STATIONS. Horizontal stabilizer stations are parallel to fuselage buttock planes. In general, the ribs are canted stations normal to the 72-percent plane, and are designated by the station in which they intersect the 72-percent plane. To construct a line representing the 72-percent plane, take 72 percent of the straight-line distance (parallel to the fuselage buttock planes) of the stabilizer chord at two points. Draw a reference line spanwise through these points.

To locate stations along the reference line, construct a perpendicular line to fuselage buttock plane "0." (A straightedge placed along the aft outboard tips of the stabilizer will do.) Stations are normal to this line, and measured at the 72-percent plane. The skin trim line at the stabilizer tip, where crossed by the 72-percent plane, is given in figure 1-6 as a known reference point from which to measure.

CATEGORIES OF REPAIR CAPABILITIES.

Repairs may be divided into two categories: those which would require extensive disassembly of the airplane to gain access to the damaged area, and those for which the damage is readily accessible. Also, repairs may be categorized by the extent of damage, and by the materials available for the repair. The ability of an organization to repair an airplane will depend on the manpower, tools, and materials available. The repairs in this handbook are divided into the two categories. Category "A" repairs are minor (squadron or base shop) repairs; category "B" repairs are major (depot) repairs. It is assumed that at depot level both category "A" and "B" repairs would be performed. It is also assumed that a squadron or base shop, with adequate facilities and manpower would perform certain category "B" repairs.

TYPES OF REPAIR AND CLASSIFICATION OF DAMAGE.

The repair and damage in this handbook is broken down into four basic types: one-time flight damage, negligible damage, permanent repairs, and temporary repairs.

ONE-TIME FLIGHT DAMAGE.

One-time flight damage is damage that can be left as is or which requires only minor repairs to allow the airplane to be ferried to an overhaul base. Flight restrictions will be placed on the airplane as follows:

Maximum airspeed	300 knots
Maximum G-load	+3 G −1 G

A placard is placed in the cockpit that reads as follows:

WARNING

FLIGHT OF THIS AIRPLANE IS RESTRICTED TO A MAXIMUM AIRSPEED OF 300 KNOTS AND A MAXIMUM G-LOAD OF +3 "G" −1 "G."

MEASURING THE AIRPLANE

GENERAL

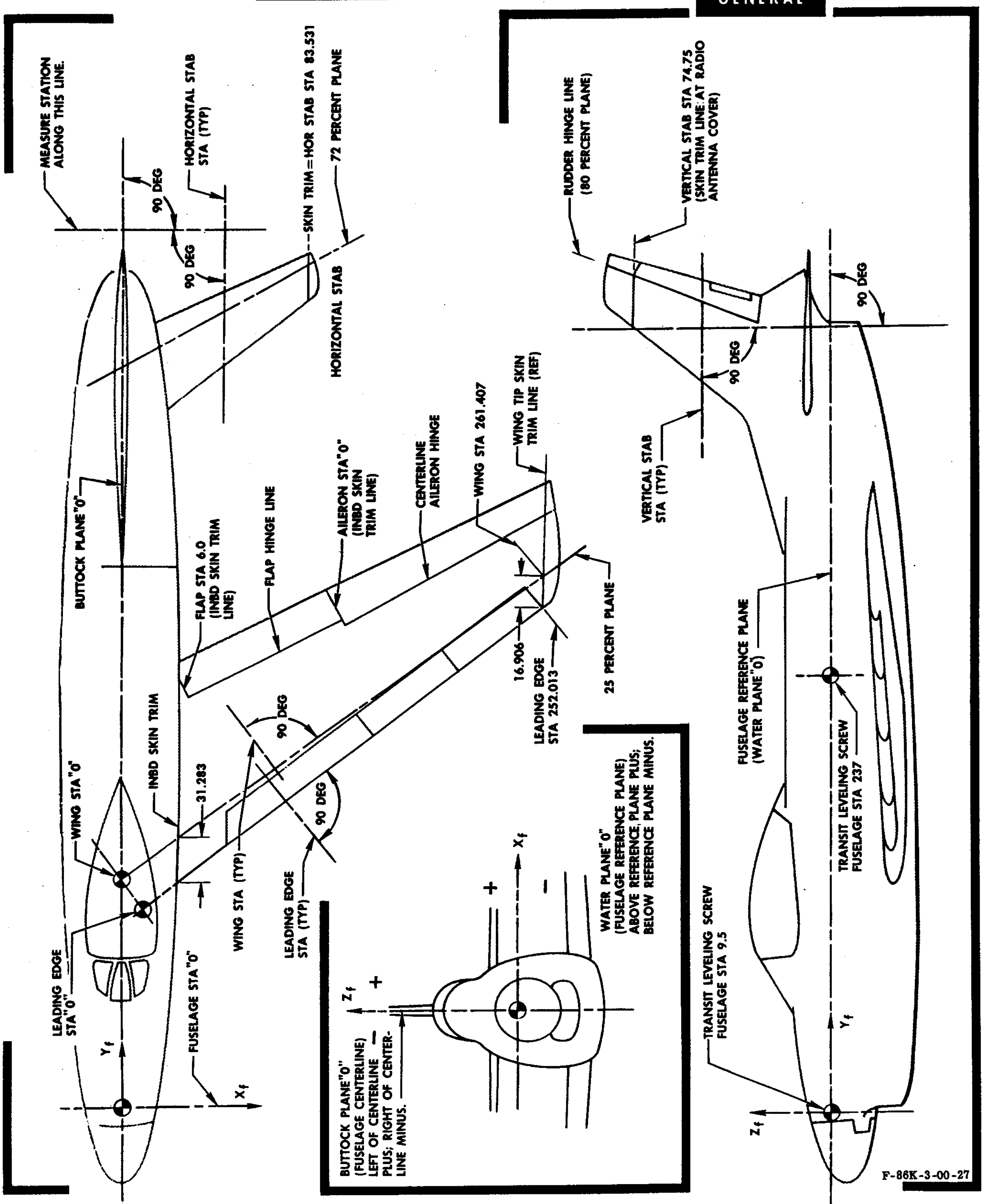
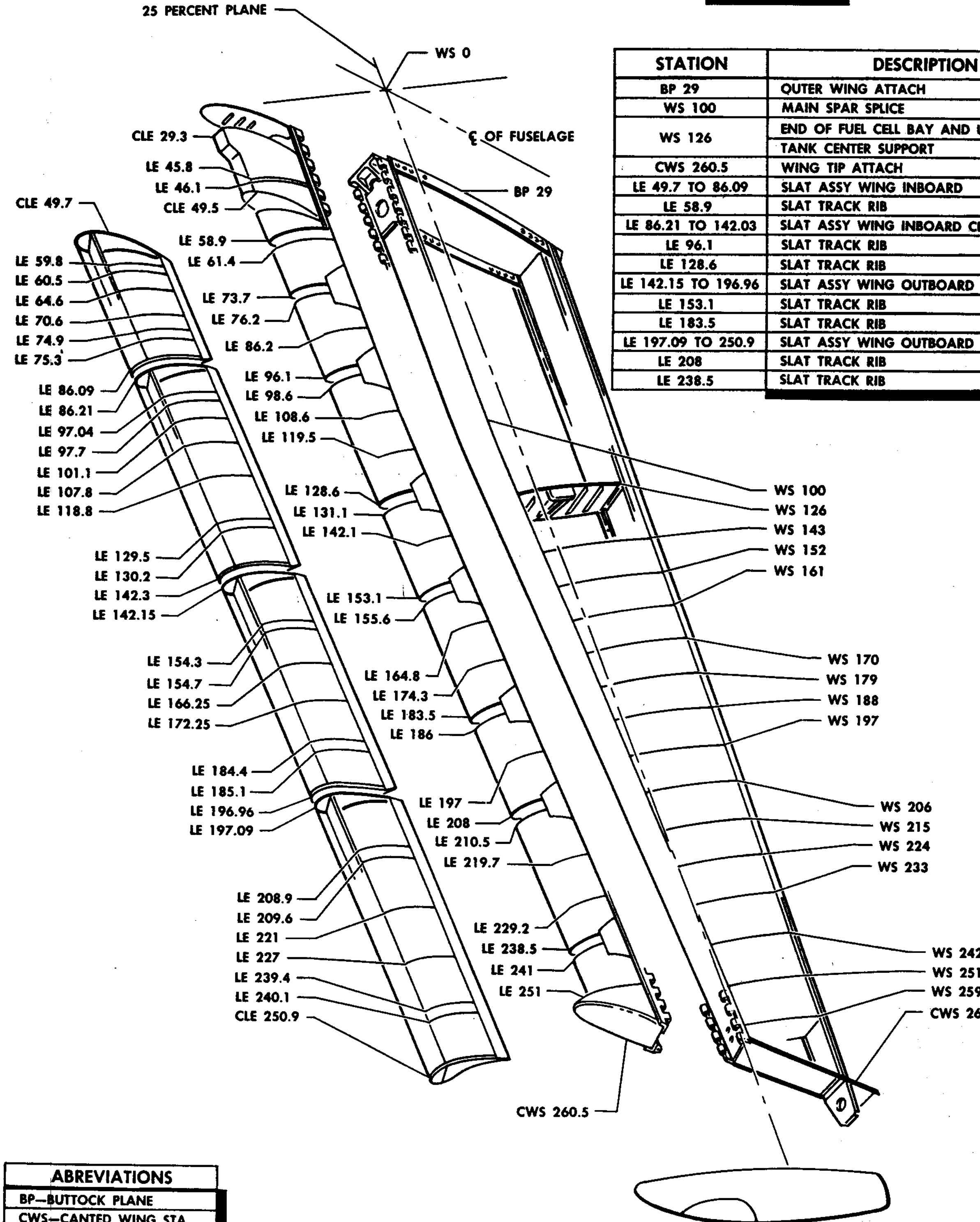


Figure 1-6. Locating Airplane Stations

WING STATIONS

GENERAL

STATION	DESCRIPTION
BP 29	OUTER WING ATTACH
WS 100	MAIN SPAR SPLICE
WS 126	END OF FUEL CELL BAY AND UNDER WING TANK CENTER SUPPORT
CWS 260.5	WING TIP ATTACH
LE 49.7 TO 86.09	SLAT ASSY WING INBOARD
LE 58.9	SLAT TRACK RIB
LE 86.21 TO 142.03	SLAT ASSY WING INBOARD CENTER
LE 96.1	SLAT TRACK RIB
LE 128.6	SLAT TRACK RIB
LE 142.15 TO 196.96	SLAT ASSY WING OUTBOARD CENTER
LE 153.1	SLAT TRACK RIB
LE 183.5	SLAT TRACK RIB
LE 197.09 TO 250.9	SLAT ASSY WING OUTBOARD
LE 208	SLAT TRACK RIB
LE 238.5	SLAT TRACK RIB



ABREVIATIONS
BP—BUTTOCK PLANE
CWS—CANTED WING STA
LE—LEADING EDGE
WS—WING STATION
CLE—CANTED LEADING EDGE
℄—CENTERLINE

NOTE Stations which are referenced in the description chart are those which have a particular function.

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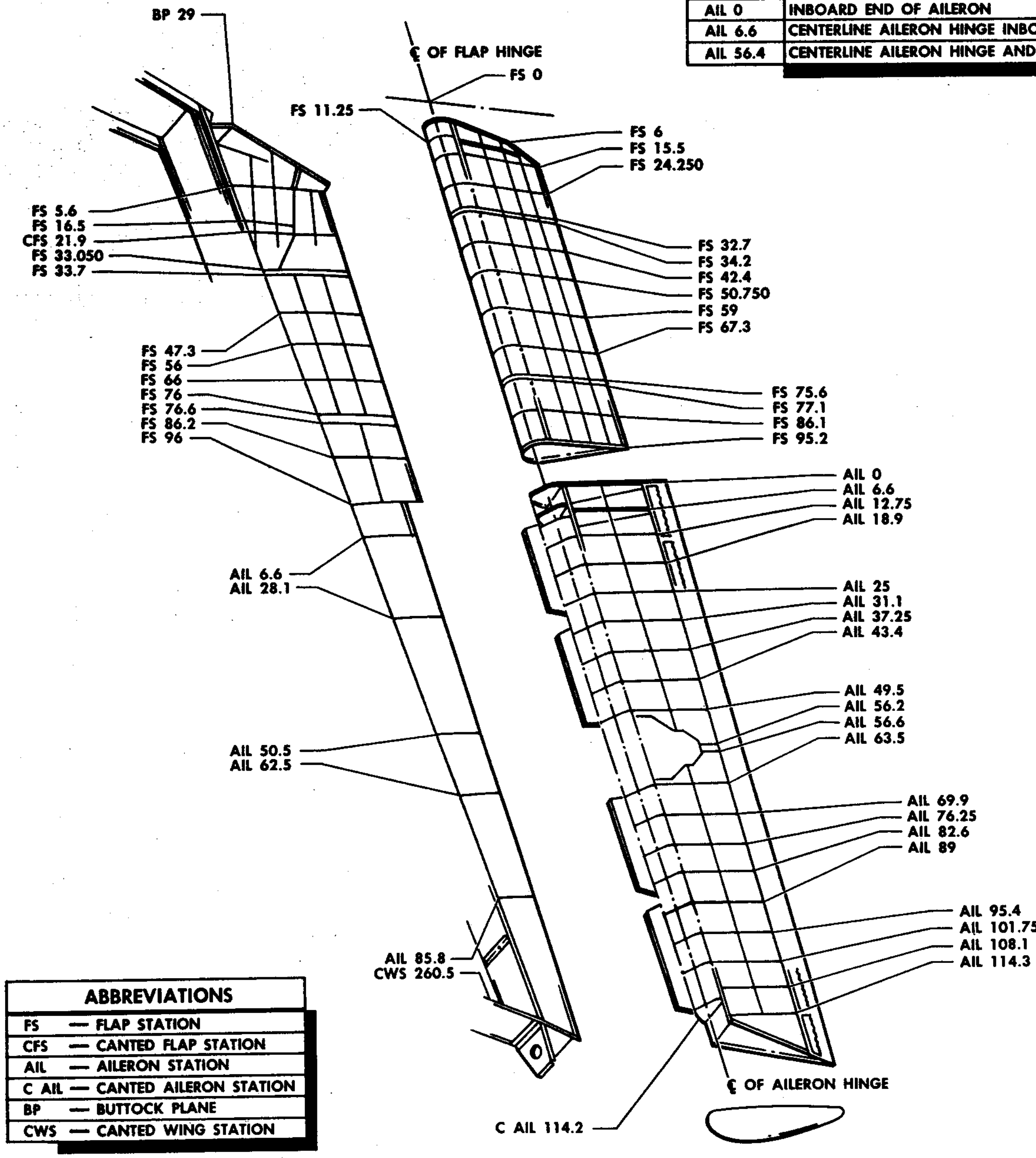
Figure 1-7. Airplane Stations—Wing (Sheet 1 of 2)

WING STATIONS

GENERAL

STATION	DESCRIPTION
FS 6.0	INBOARD FLAP RIB
FS 33.4	CENTERLINE OF FLAP TRACK
FS 50.8	CENTERLINE OF FLAP ACTUATOR
FS 76.3	CENTERLINE OF FLAP TRACK
AIL 0	INBOARD END OF AILERON
AIL 6.6	CENTERLINE AILERON HINGE INBOARD
AIL 56.4	CENTERLINE AILERON HINGE AND ACTUATOR



ABBREVIATIONS	
FS	— FLAP STATION
CFS	— CANTED FLAP STATION
AIL	— AILERON STATION
C AIL	— CANTED AILERON STATION
BP	— BUTTOCK PLANE
CWS	— CANTED WING STATION

NOTE
Stations which are referenced in the description chart are those which have a particular function.

F-86D-3-00-88

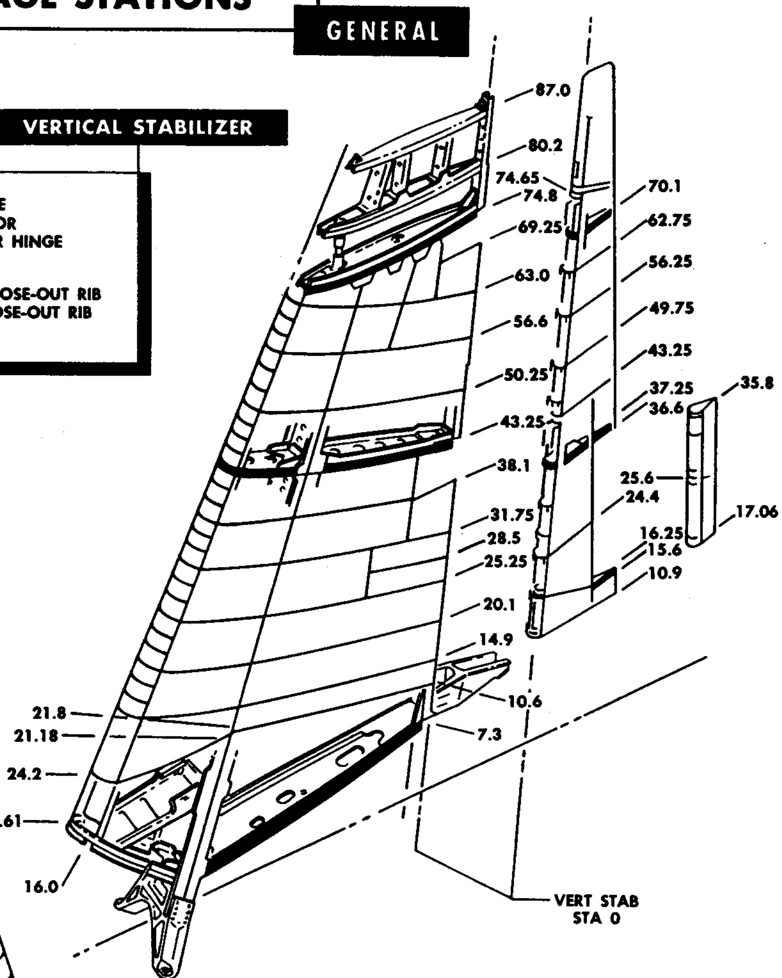
Figure 1-7. Airplane Stations—Wing (Sheet 2 of 2)

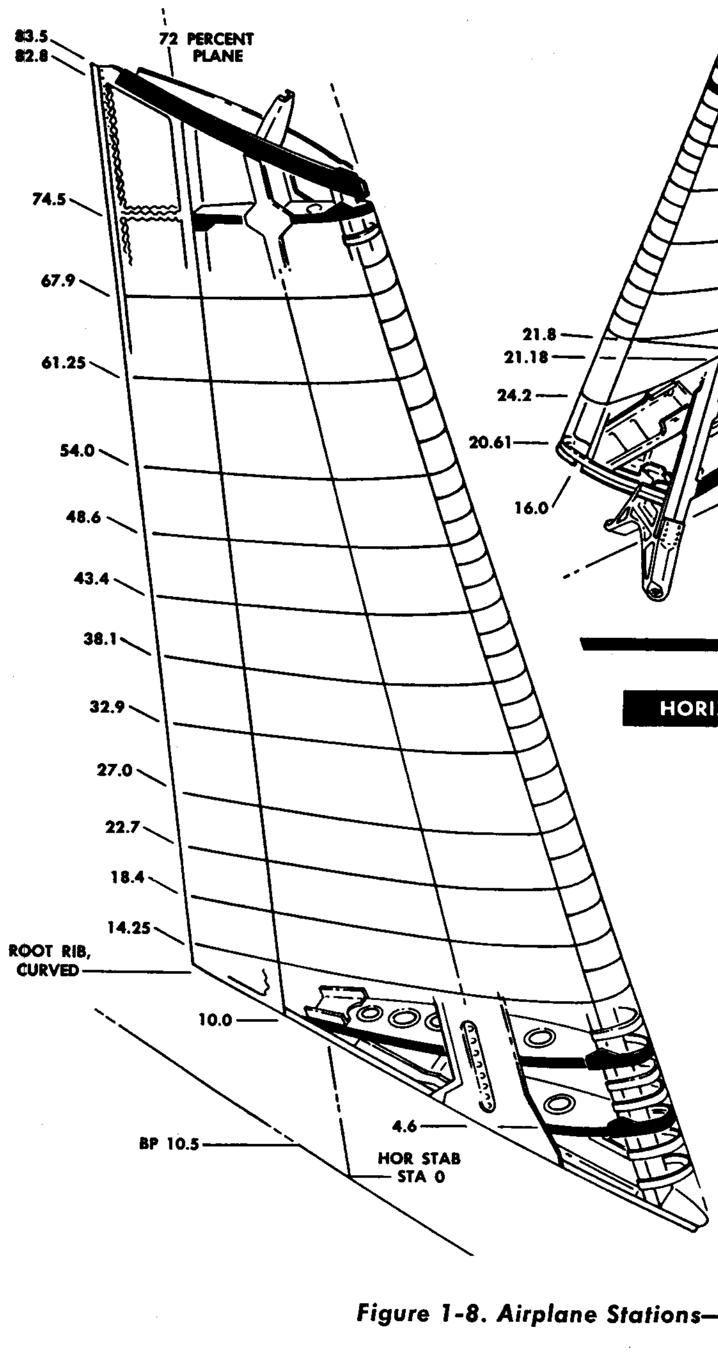
EMPENNAGE STATIONS

GENERAL

VERTICAL STABILIZER

STA	DESCRIPTION
	VERTICAL STABILIZER
7.3	LOWER RUDDER HINGE
28.5	RUDDER TAB ACTUATOR
43.1	INTERMEDIATE RUDDER HINGE
74.8	UPPER RUDDER HINGE
	RUDDER
16.3	TAB AREA—LOWER CLOSE-OUT RIB
36.6	TAB AREA—UPPER CLOSE-OUT RIB
74.7	RUDDER TIP ATTACH





HORIZONTAL STABILIZER

STA	DESCRIPTION
	ROOT RIB, CURVED
83.5	STABILIZER TIP ATTACH

NOTE Stations which are referenced in the description charts are those which have a particular function.

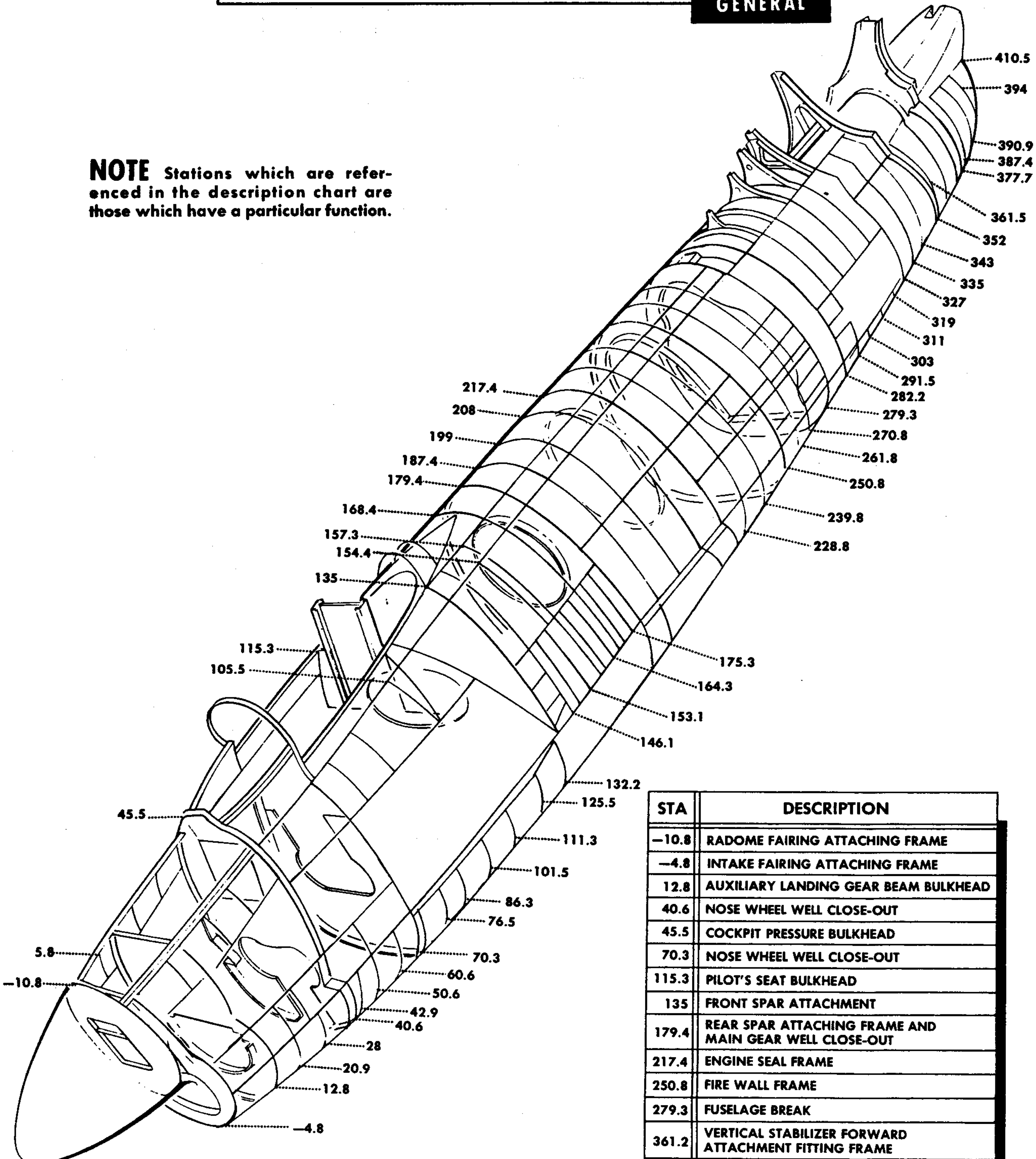
F-86D-3-00-56

Figure 1-8. Airplane Stations—Empennage

FUSELAGE STATIONS

GENERAL

NOTE Stations which are referenced in the description chart are those which have a particular function.



STA	DESCRIPTION
—10.8	RADOME FAIRING ATTACHING FRAME
—4.8	INTAKE FAIRING ATTACHING FRAME
12.8	AUXILIARY LANDING GEAR BEAM BULKHEAD
40.6	NOSE WHEEL WELL CLOSE-OUT
45.5	COCKPIT PRESSURE BULKHEAD
70.3	NOSE WHEEL WELL CLOSE-OUT
115.3	PILOT'S SEAT BULKHEAD
135	FRONT SPAR ATTACHMENT
179.4	REAR SPAR ATTACHING FRAME AND MAIN GEAR WELL CLOSE-OUT
217.4	ENGINE SEAL FRAME
250.8	FIRE WALL FRAME
279.3	FUSELAGE BREAK
361.2	VERTICAL STABILIZER FORWARD ATTACHMENT FITTING FRAME
377.7	VERTICAL STABILIZER ATTACHING FRAME AND HORIZONTAL STABILIZER SUPPORT FRAME

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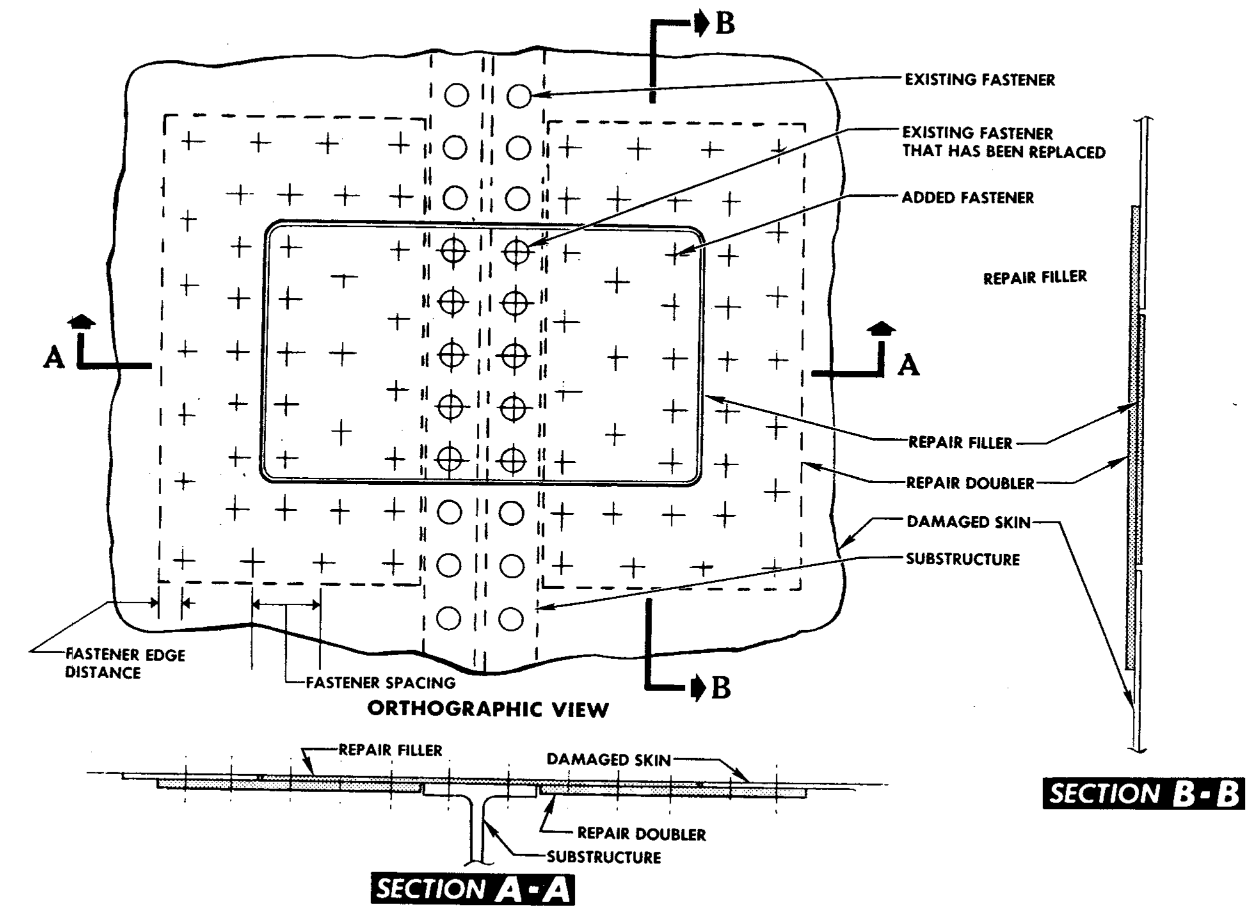
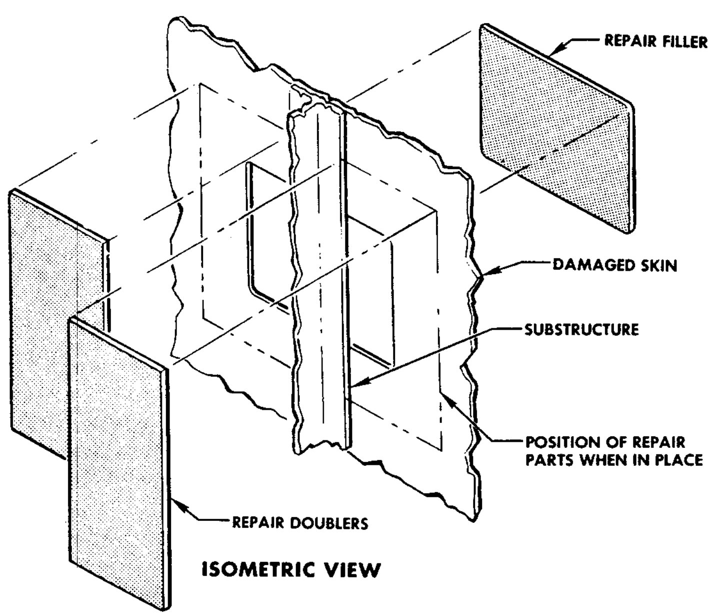
Figure 1-9. Airplane Stations—Fuselage

REPAIR DRAWING EXPLANATION





TYPICAL FASTENER SYMBOLS USED ON ALL REPAIR DRAWING

+ Indicates added fastener used to accomplish repair

⊕ Indicates an original fastener location. Fastener removed and replaced with an added fastener

○ Indicates an original fastener through surrounding skin and structure

Any additional types of fasteners required will be coded on the drawing.

Fastener size, types, spacing, and edge distance are called out on the orthographic view only.

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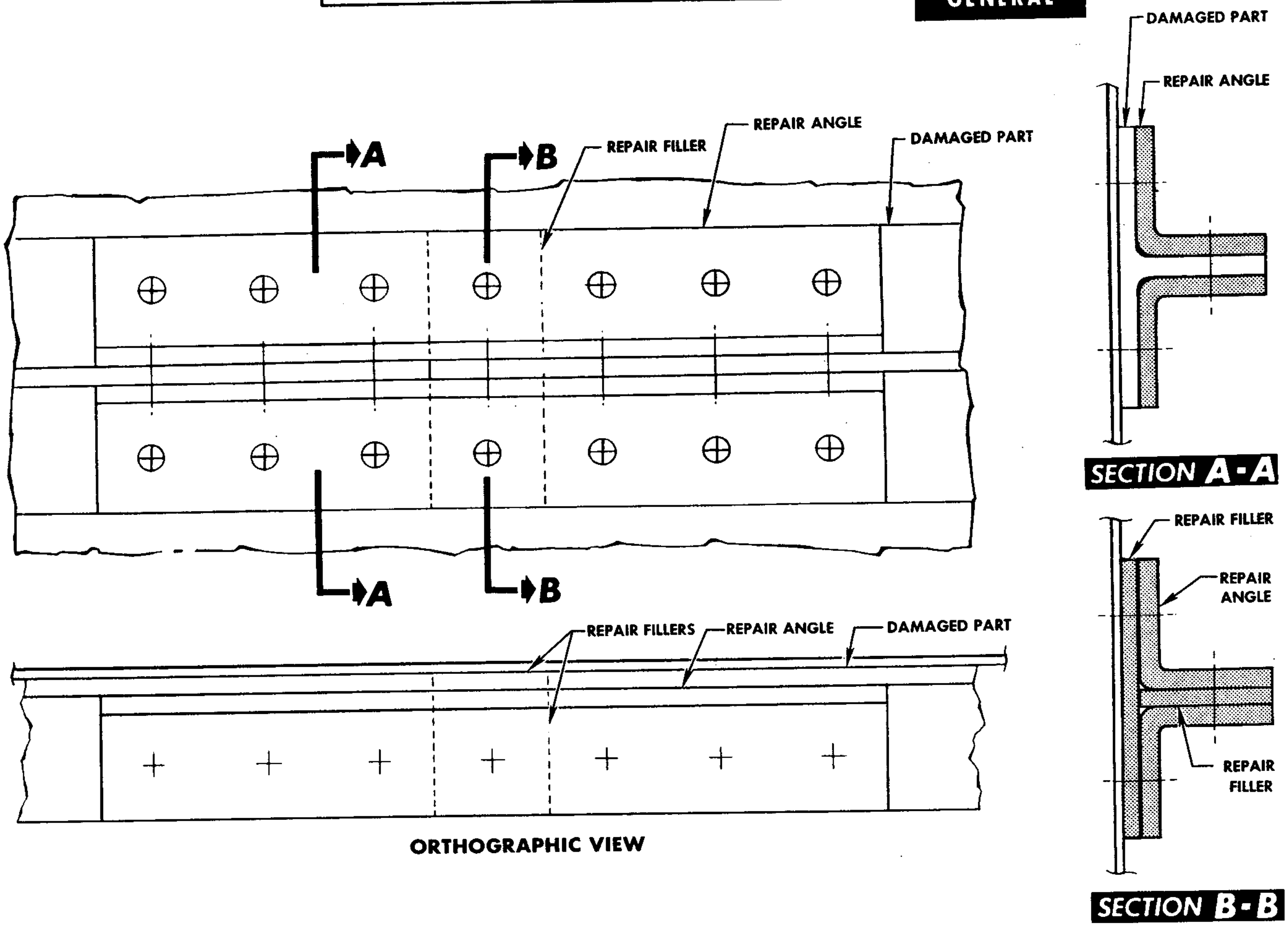
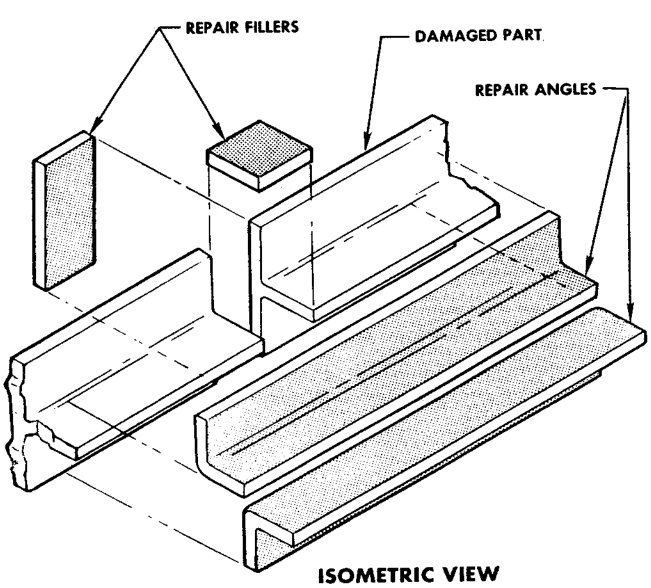
Figure 1-9A. Repair Drawing Explanation (Sheet 1 of 2)

REPAIR DRAWING EXPLANATION

GENERAL





Section views show *only* that which can be seen from the indicated section cut—nothing beyond. Section views would appear as a thin section of the part removed for viewing at the place indicated by the section lines.

Section arrows indicate the direction in which a person would appear to be looking when viewing the section cut.

The letters next to the section arrows indicate or label section view details.

Dotted lines indicate a hidden part or structure that cannot be seen from the side from which the part is being viewed.

Phantom lines are used either to indicate the position of the repair part when in place or as guide lines to show how repair parts are exploded from isometric view.

Shading is used for repair parts on the isometric and section views only.

Repair part material and gage are called out on the isometric view.

GEN-3-00-88

Figure 1-9A. Repair Drawing Explanation (Sheet 2 of 2)

Each section of the handbook contains a one-time flight diagram which indicates the area of the airplane that may be damaged but that will not prevent the airplane from being flown to a repair base. Repair to these areas is not required for ferry flight. One-time flight repairs are included in the handbook and will be used as indicated on the individual repair.

NEGLIGIBLE DAMAGE.

Negligible damage is that damage which can be permitted to exist as is, or which may be corrected by a simple procedure, without restricting flight. In most cases, a corrective action must be taken to keep the damage from spreading. Frequent inspection of areas with negligible and minor damage is necessary to ensure that the damage does not spread. Some examples of negligible damage are:

NEGLIGIBLE DAMAGE—DENTS.

Minor dents with no damage to structure which may be left as is, and large dents after being bumped back to mold line dimension, provided there are no sharp dents or wrinkles.

NEGLIGIBLE DAMAGE—SCRATCHES AND DENTS.

A damage which does not go through the protective coating of the material, or through the cladding on alclad sheet, is not considered a scratch. To determine whether the damage has gone through the cladding, thoroughly clean the surface with methyl ethyl ketone and apply a 10% solution of sodium hydroxide to the damage area. If the damage has gone through the cladding and into parent material, a black or dark brown discoloration will appear. This solution should not remain on the area for longer than two minutes because of its corrosive action. The solution must be thoroughly washed from the area with water.

Scratches or nicks are not considered negligible until after they have been reworked by blending or other prescribed methods. Scratches or nicks may reduce the cross sectional area of a material and produce localized stress concentration. This condition can lead to fatigue cracks and possible failure of the component. (See figure 1-10.)

Blending of scratches or nicks is the process of smoothing out the damage area. To blend properly, a fine grit (400 or finer) abrasive cloth or paper, or aluminum wool should be used. Do not use crocus cloth or steel wool since it tends to cause corrosion. Scratches or nicks should be smoothed out with the abrasive to remove all damage. The reworked area must be kept as small as possible. (See figure 1-11.)

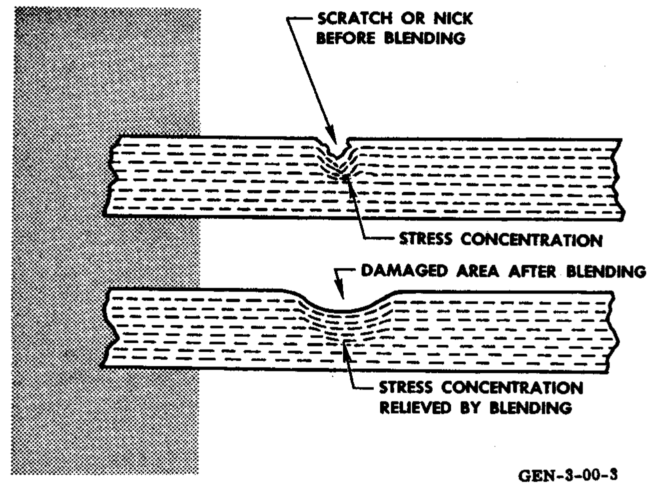


Figure 1-10. Stress Concentrations at Nicks and Scratches

In certain highly stressed areas, it is necessary to use a dye penetrant check after blending to reveal any cracks which may be undetected. (Refer to "Penetrant Method of Inspection.")

After blending, the damage area must be chemical film treated (refer to "Corrosion Rework by Chemical Film Treatments") and painted.

Limitations regarding the length and depth of scratches and nicks vary in different locations throughout the airplane. These limitations are shown on the illustrations of negligible damage for the various areas.

NEGLIGIBLE DAMAGE—CORROSION DAMAGE.

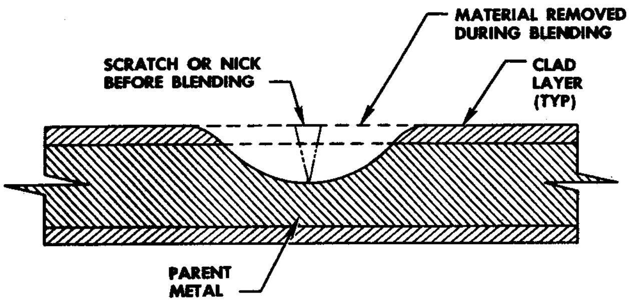
Corrosion damage which does not exceed the prescribed limits for scratches and nicks may be considered negligible if the corrosion is cleaned out and the area chemical film treated (refer to "Corrosion Rework by Chemical Film Treatments") and painted.

NEGLIGIBLE DAMAGE—CRACKS.

This type of damage usually originates at edges, holes, or points where concentrated loads are applied or abrupt changes occur in the cross-sectional area. Limitations regarding length of crack, distances from other damages, specific locations, etc, vary in different locations throughout the airplane. These limitations are shown on the illustrations of negligible damage for the various areas. All cracks will be stop-drilled at each end.

NEGLIGIBLE DAMAGE—HOLES.

Cleaned-up holes that do not reduce the cross-sectional area of a material enough to introduce prohibitive stress, or which do not interfere with the function of a compo-



NOTE Blending scratch or nick in machined bar or extrusion may be accomplished in same manner.

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Figure 1-11. Blending Scratches

nent (including pressurized areas and fueltight areas) may be considered negligible. Limitations regarding size of holes, distances from other damages, etc, vary in different locations throughout the airplane. These limitations are shown on the illustrations of negligible damage for the various areas.

PERMAMENT REPAIRS.

Permanent repairs are those which put the airplane, both structurally and aerodynamically, back to its original configuration. Permanent repairs may be made by one of the following methods:

1. Patching the damage. Repairing damage by patching is to completely encircle or bridge the damaged area of a component with splice material of the same type as the original. Holes and cracks which exceed the prescribed limitations for negligible damage in a given area may be repaired by this method. Filler plates may be used for bearing surfaces or for returning the part to its original contour when necessary.

2. Repairing damage by insertion. Damage repairable by insertion is that damage which can be repaired by splicing in a section of material to replace the damaged material. The section used for insertion should be identical in shape and type to the damaged part. The inserted material is fastened into place by a splice. The splice connection to the original structure provides for load transfer between the original structure and the inserted section.

3. Repair of damage by replacement of parts. The part is generally replaced when a repair cannot be made by practical means. When replacing a damaged component or part, care should be taken to avoid damage to adjacent or attaching structure.

TEMPORARY REPAIRS.

Temporary repairs are repairs that return the airplane to its original configuration structurally, but do not fully restore it aerodynamically. External (scab) patches, protruding head fasteners, etc, are temporary repairs. (Refer to "Aerodynamic Smoothness.") In spite of the undesirable effects of nonflush (temporary) repairs, they are sometimes necessary to make airplanes available for flight in the shortest possible time. They are *temporary repairs*, however, and they should be replaced with permanent (flush) repairs as soon as possible.

When the wings, vertical stabilizer, or control surfaces have been repaired in any manner which could possibly affect flight characteristics, a test flight should be made to determine what flight restrictions are necessary.

AERODYNAMIC SMOOTHNESS.

Modern airplane specifications require that the airplane exterior surfaces be of extremely smooth construction to obtain design performance. The structural repairman must keep this in mind when making repairs or changes. Figure 1-12 shows the areas that are most critical aerodynamically; however, smoothness of the entire airplane surface area is a critical requirement from the performance standpoint. The seriousness of this condition is proportional to the airflow disturbance created.

The prime considerations of aerodynamic smoothness are parasite drag (drag caused by skin friction and nonlifting surfaces of an airplane) and the aerodynamic load distribution on the surface. Any repair or change which increases parasite drag will reduce the top speed of the airplane. Also, combat range will be reduced, since more power, and thus more fuel, is required to maintain cruising speed.

Any change which disturbs the smooth flow of air over a critical surface will change the load on that surface, as well as increase the drag. This effect is greatly increased at transonic and supersonic speeds because of shock wave formation in these speed regions. Since, in most cases, a shock wave results in a radical change of load distribution and increased drag, a patch that will cause no difficulty (disturbance) at low speed may become critical when a shock wave is produced by this patch in the transonic and supersonic speed regions. If this flow change occurs on the wing, a wing-heavy condition proportional to the amount of disturbance will result. If this condition is on the vertical stabilizer, a

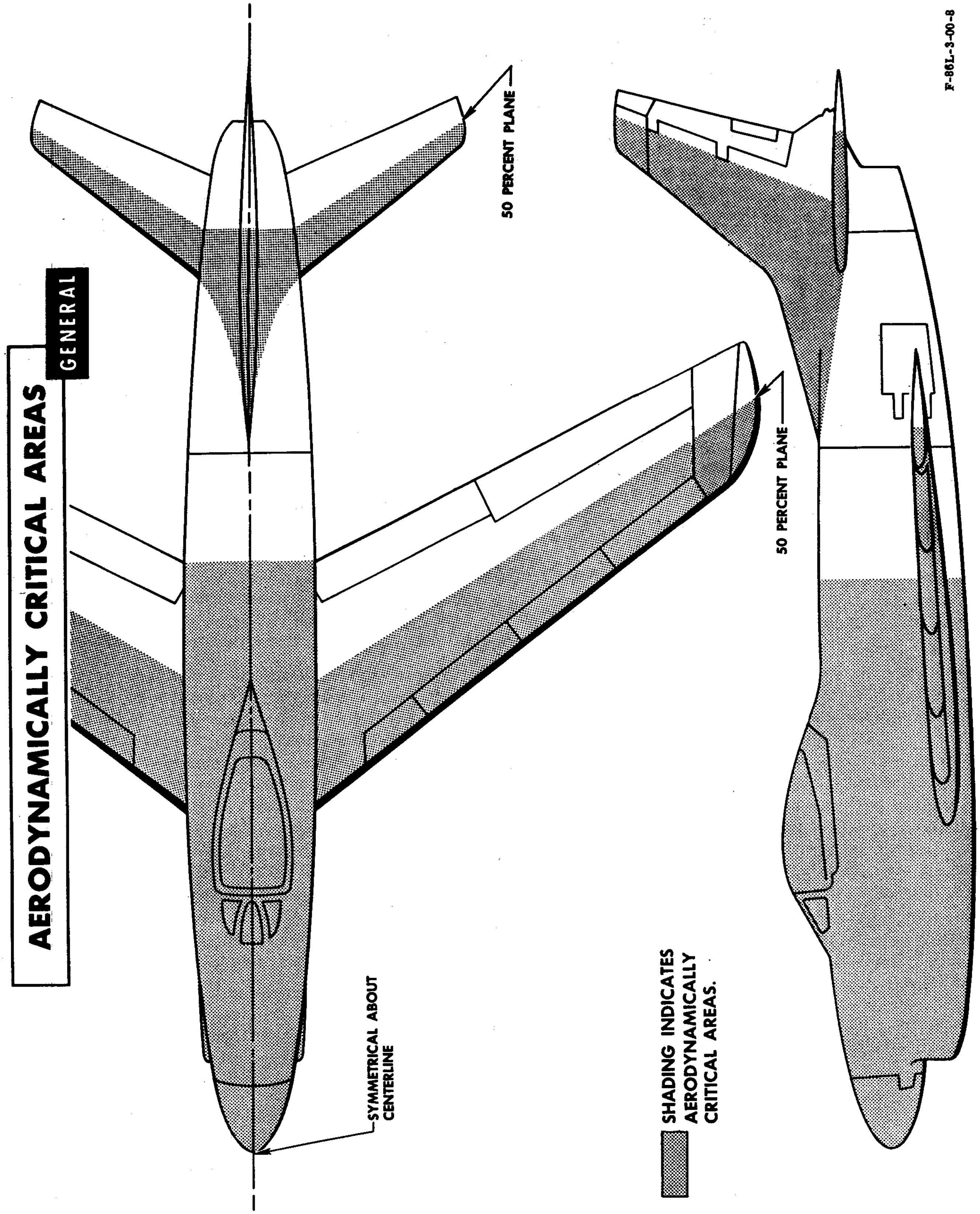

Figure 1-12. Aerodynamically Critical Areas

yawed flight condition will result. These conditions become increasingly serious as control effectiveness drops off at high Mach numbers. Any change in the airflow around the control surfaces is critical because control effectiveness, particularly at high Mach numbers, may be affected.

Another problem that may arise at the high speeds is buffeting. Buffeting can be caused by airflow separation around an abrupt change, such as a nonflush patch, in the mold line. Nonflush repairs are authorized as *temporary repairs* only. (Refer to "Temporary Repairs.")

CAUSES AND TYPES OF DAMAGE.

There are many causes and degrees of damage which may occur to an airplane. However, for purposes of description, some of the causes are:

1. Collision or impact damage. This type of damage varies from minor damage, such as a small hole or dent, to extensive damage such as torn, crushed, or burned skin and structural members, and misalignment of the airplane. Damage such as this can occur at any point on the airplane.
2. Stress damage. This type of damage generally consists of loosened, sheared, or popped rivets, wrinkled skin or webs, and cracked or deformed structural members. Damage such as this is caused by abnormal stresses imposed upon the members.
3. Fatigue damage. This type of damage generally consists of small cracks which are caused by vibration, oil cans, and variable loads imposed on skin, fittings, and load bearing members where fittings are attached. Damage of this type occurs more frequently as the total operation time of the airplane accumulates.
4. Corrosion damage. This type of damage may occur where dissimilar metals come in contact with each other, or where certain alloys or steel are exposed to moisture. Corrosion damage may be detected on aluminum alloys by the presence of white powdery spots or deposits, and pitting of the metal. Rust is a form of corrosion on steel surfaces.
5. Fire damage. This may or may not be the result of fire after collision or impact damage, landing accidents, or fire in flight.

CRASH HANDLING AND SHIPPING.

The purpose of this information is to guide personnel who handle crash damaged airplanes. It is the responsibility of the crash crews to make sure that the airplane is properly handled at the crash site. Every attempt must be made to keep crash damage to a minimum. A good knowledge of the airplane structure and the use of crash equipment will be an aid in airplane handling. It is recommended that crash handling equipment, of the type described in this handbook, be obtained and that personnel be trained in the techniques of using it.

All items suggested for handling damaged airplanes may be obtained through regular procurement sources. Tools and equipment which are to be fabricated locally are made from commercial materials.

EMERGENCY REMOVAL OF AIRPLANE FROM RUNWAY.

At times, it is necessary to remove a crashed airplane from a runway in the shortest possible time. Even when the operation is being performed under emergency conditions, every effort should be made to minimize handling damage of a reparable airplane. The emergency removal method shown in figure 1-12A should be used only when a runway must be cleared in the shortest possible time. In all other instances, methods which will not create additional damage should be employed. Towing an all-gear-up airplane with a cable installed as shown will add damage but is considered the least damaging method of attachment when an airplane is in this configuration.

LIFTING AIRPLANE WITH WEB SLING.

The web sling is used to lift airplanes that have made wheels-up landings. The sling (figure 1-13) may be locally fabricated from commercial materials. It is capable of lifting 25,000 pounds. The maximum takeoff weight of the F-86K Airplane, including external tanks, is about 20,430 pounds. A crane (mobile, 20-ton or equivalent) capable of lifting this load must be used.

The forward sling is placed under the belly of the airplane, forward of the wing. The strap should be far enough aft to clear the nose gear door. When the airplane is lifted off the ground, the gear should be dropped if possible. The aft sling is placed under the belly of the airplane, aft of the wing. The triangular links in the ends of the sling straps are put into the cable hooks. Both of the triangular links to which the cables are attached are placed in the hooks at each end of the spreader bar. Fuselage frames may be located by rivet patterns running vertically on the sides of the fuselage. The chain in the chain lock is adjusted so the lock is positioned about at the center of gravity. It may be necessary to move the lock forward or aft to raise the airplane evenly.

During the lifting operation, the airplane must be closely watched to see that it does not tip or swing into obstructions. Guide lines should be used to hold the airplane stable. The guide lines may be tied into the slot tracks on the wing or on other convenient places.

CAUTION

All personnel must stay clear of airplane while it is being lifted. Loose parts may fall, and injury could result.

When the airplane is high enough, the gear should be lowered, if possible. If the gear cannot be lowered,

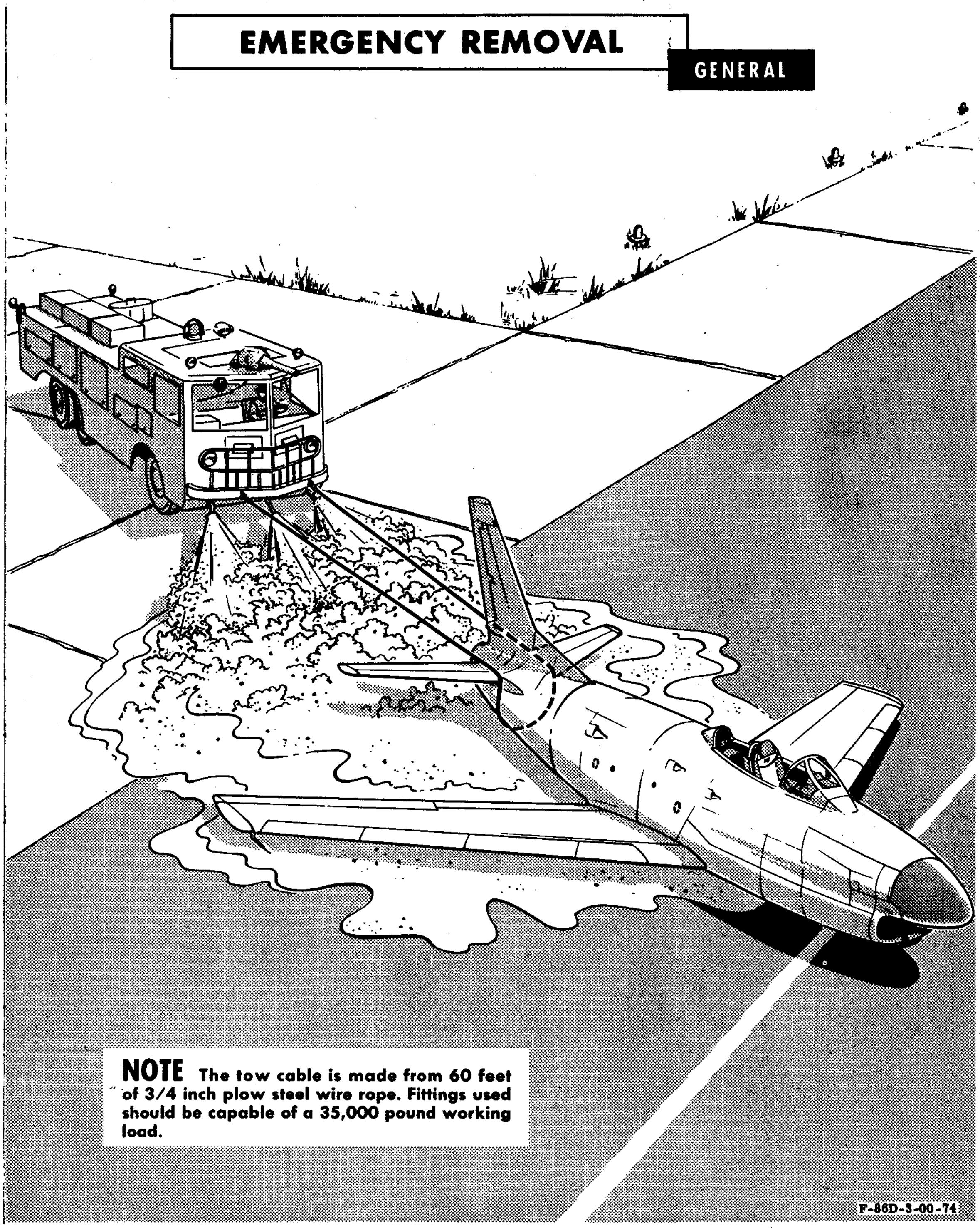

Figure 1-12A. Emergency Removal of Airplane From Runway

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DAMAGED WHEEL TOWING DOLLY

GENERAL

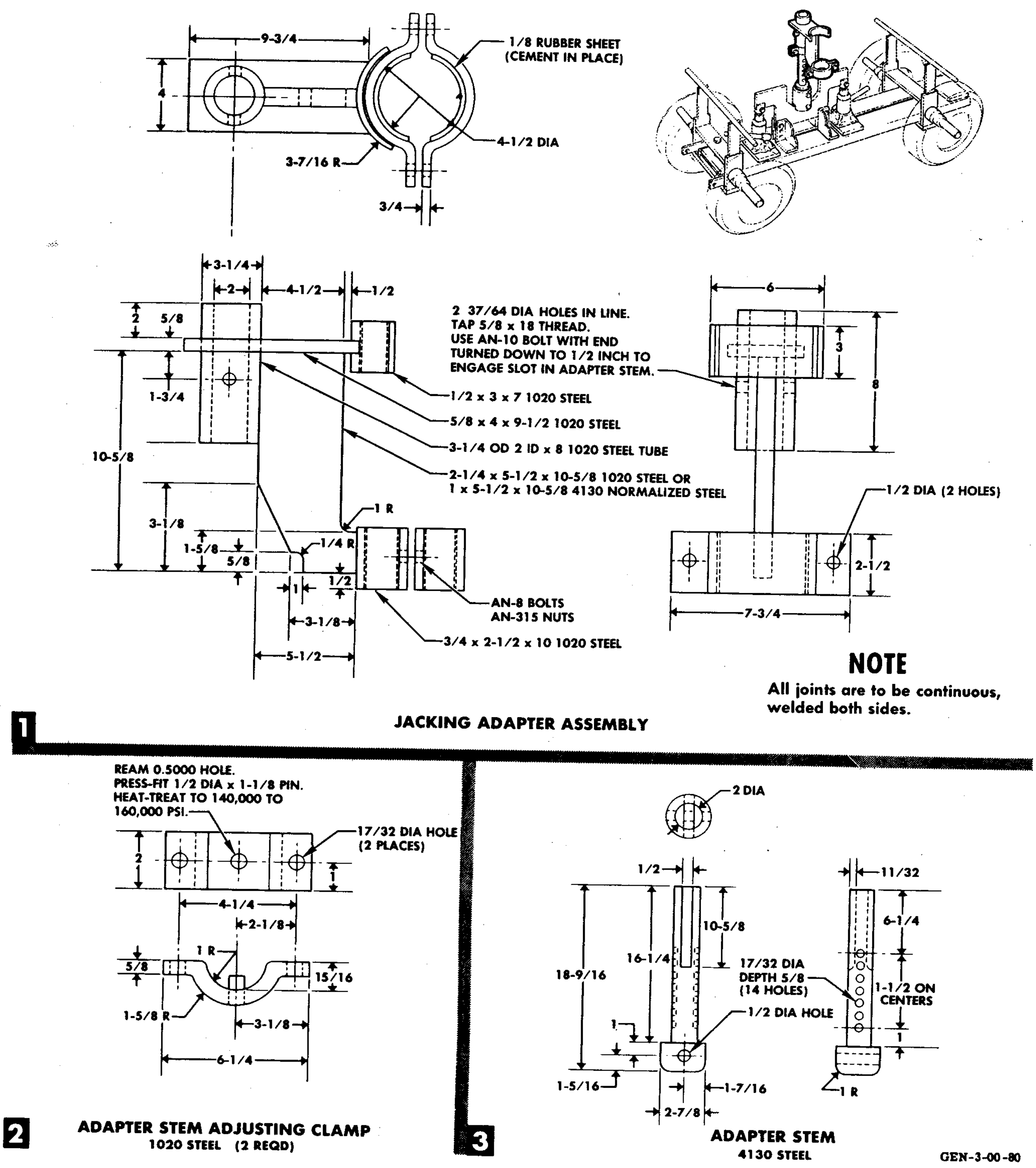


Figure 1-12B. Damaged Wheel Towing Dolly (Sheet 2 of 7)

DAMAGED WHEEL TOWING DOLLY

GENERAL

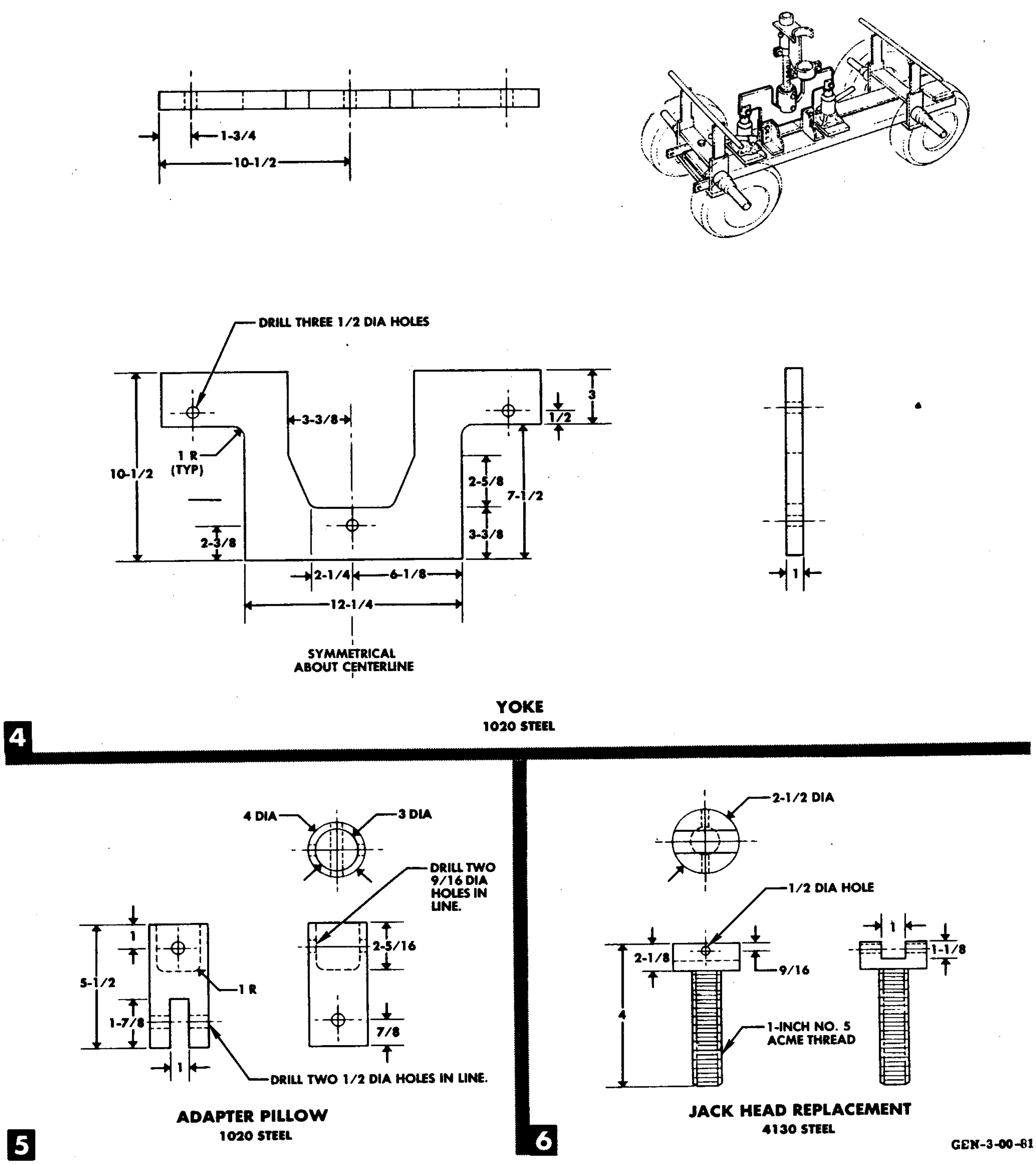
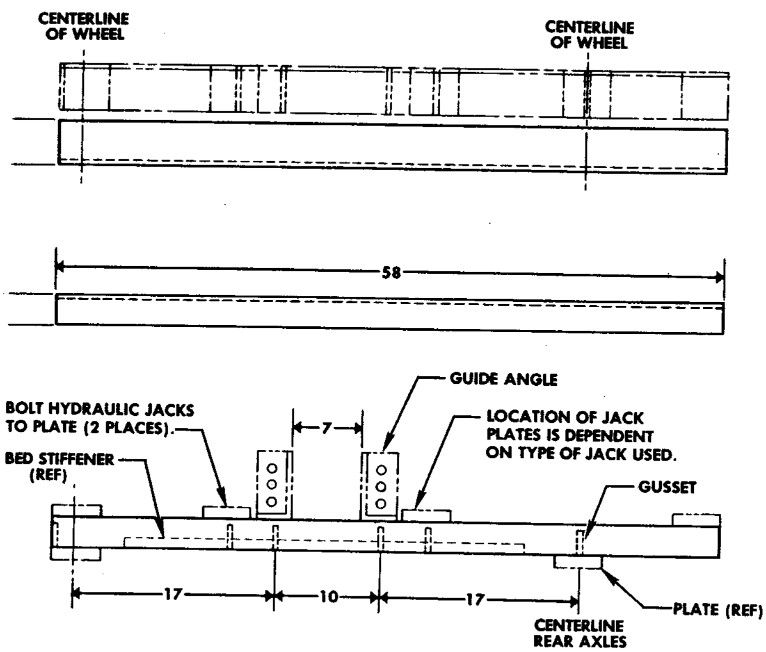
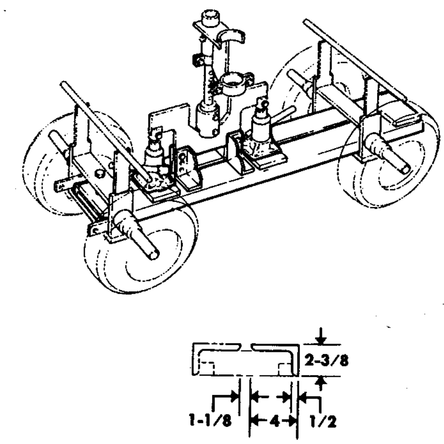


Figure 1-12B. Damaged Wheel Towing Dolly (Sheet 3 of 7)

DAMAGED WHEEL TOWING DOLLY

GENERAL

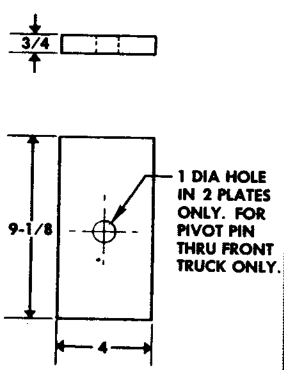




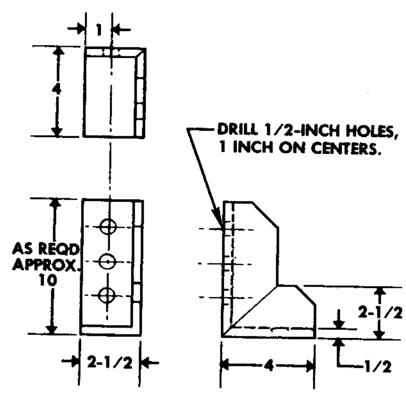
NOTE

All joints are to be continuous, welded both sides.

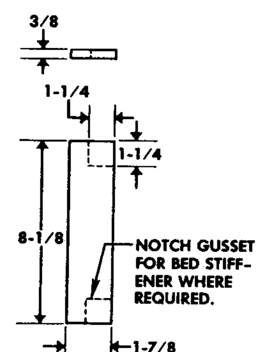
7 **BED ASSEMBLY**
STEEL ANGLE IRON



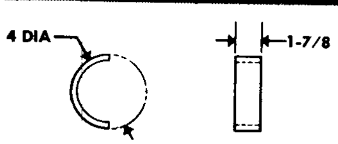
8 **PLATE**
1020 STEEL (6 REQD)



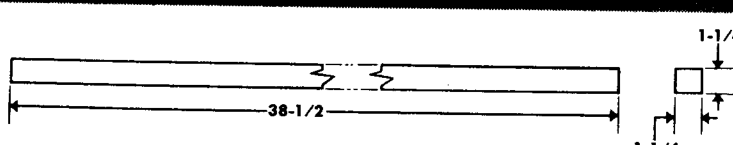
9 **GUIDE ANGLE**
STEEL ANGLE IRON (2 LH & 2 RH REQD)



10 **GUSSET**
1020 STEEL (6 REQD)



11 **FRONT TRUCK SUPPORT**
1020 STEEL (2 REQD)



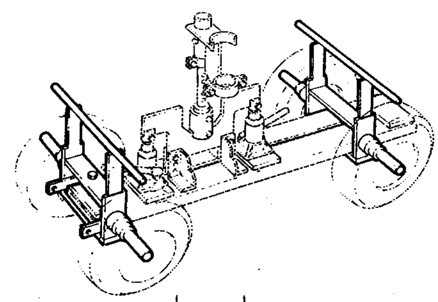
12 **BED STIFFENER**
1020 STEEL (2 REQD)

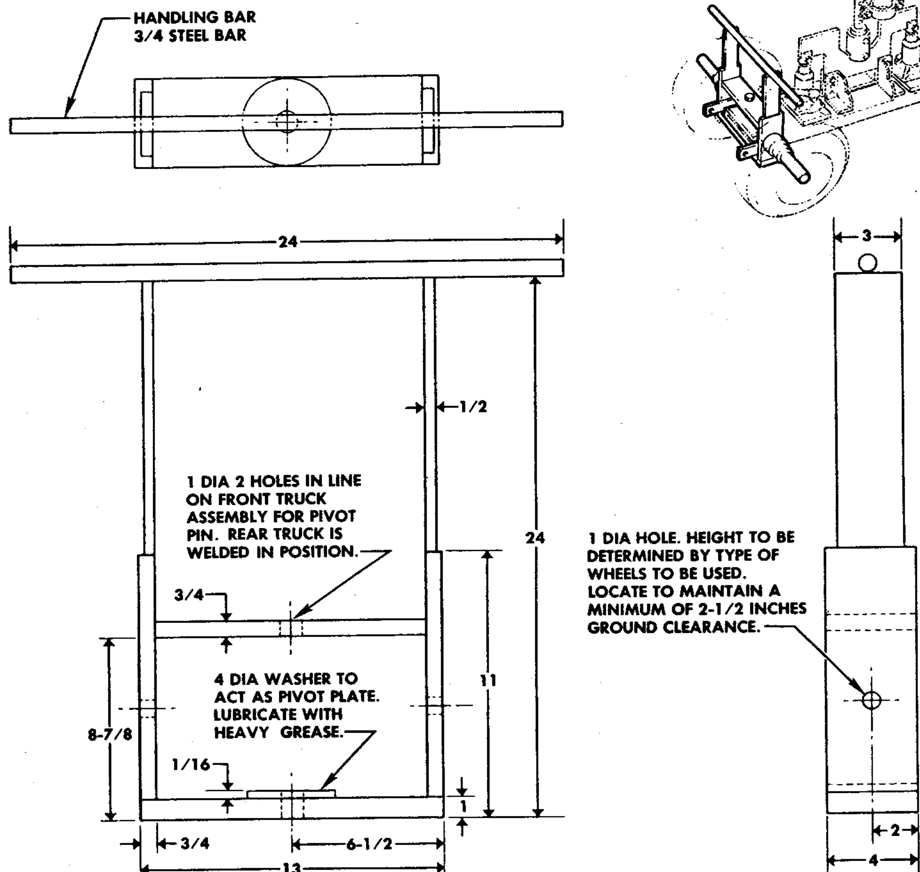
GEN-3-00-82

Figure 1-12B. Damaged Wheel Towing Dolly (Sheet 4 of 7)

DAMAGED WHEEL TOWING DOLLY

GENERAL



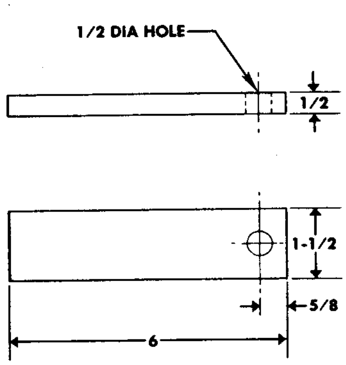


NOTE

All joints are to be continuous, welded both sides.

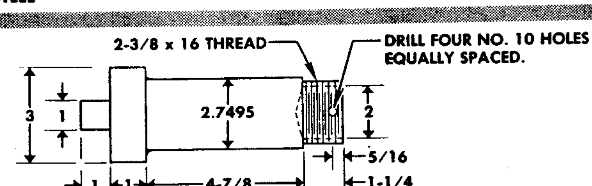
TRUCK ASSEMBLIES
1020 STEEL

13

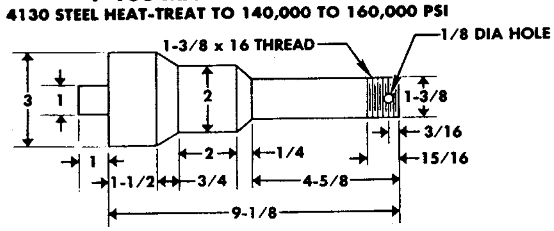


TOW BAR ATTACHMENT
1020 STEEL

14



F-100 MAIN GEAR AXLE
4130 STEEL HEAT-TREAT TO 140,000 TO 160,000 PSI



T-33 NOSE GEAR AXLE
4130 STEEL HEAT-TREAT TO 140,000 TO 160,000 PSI

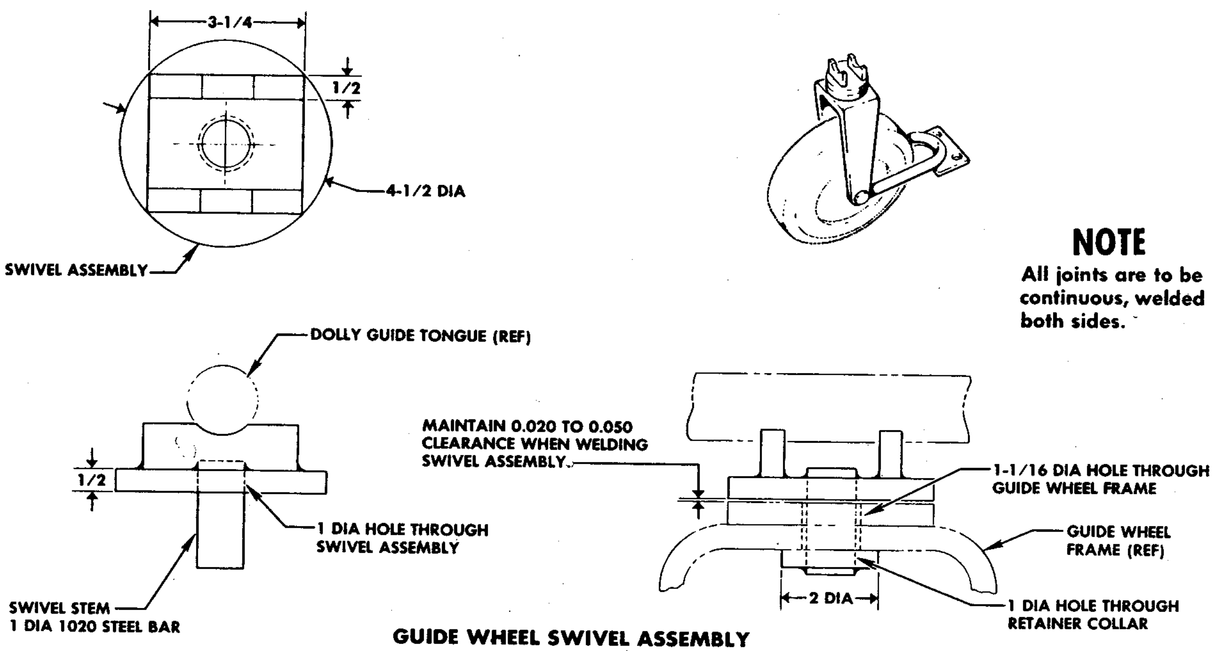
15

GEN-3-00-83

Figure 1-12B. Damaged Wheel Towing Dolly (Sheet 5 of 7)

DAMAGED WHEEL TOWING DOLLY

GENERAL



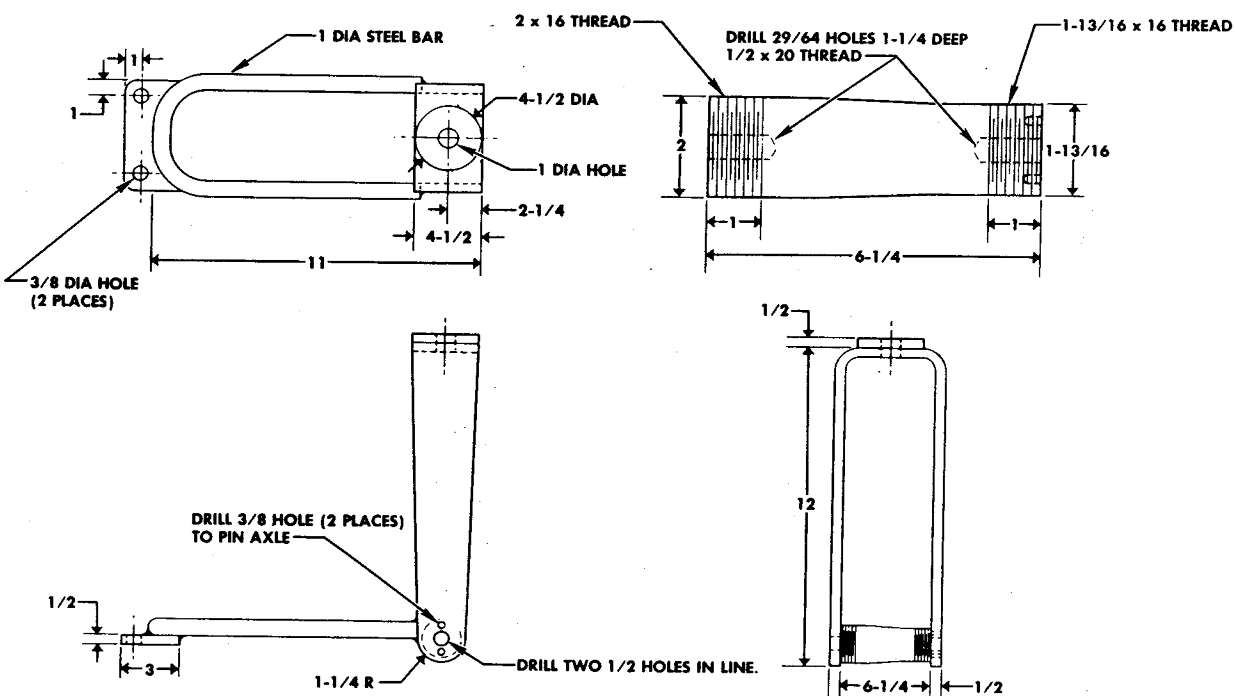
NOTE

All joints are to be continuous, welded both sides.

16

GUIDE WHEEL SWIVEL ASSEMBLY

1020 STEEL



17

GUIDE WHEEL ASSEMBLY

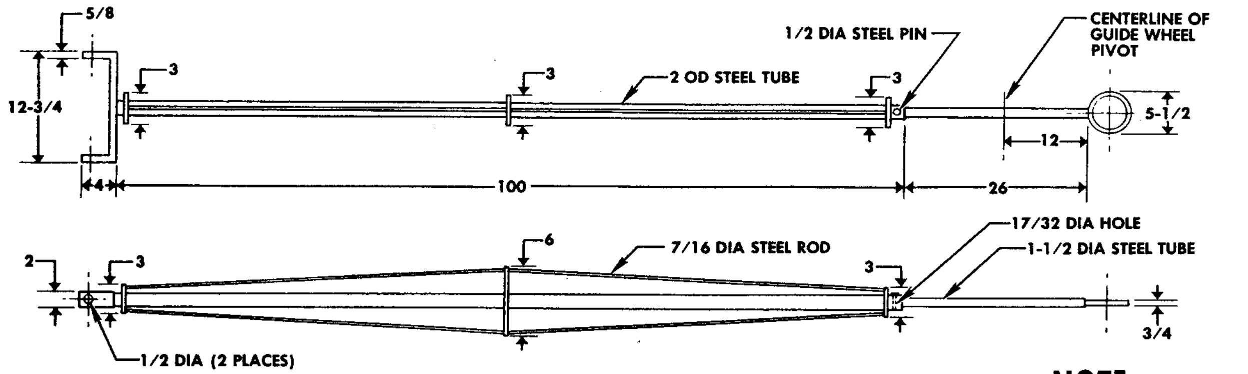
1020 STEEL

GEN-3-00-84

Figure 1-12B. Damaged Wheel Towing Dolly (Sheet 6 of 7)

DAMAGED WHEEL TOWING DOLLY

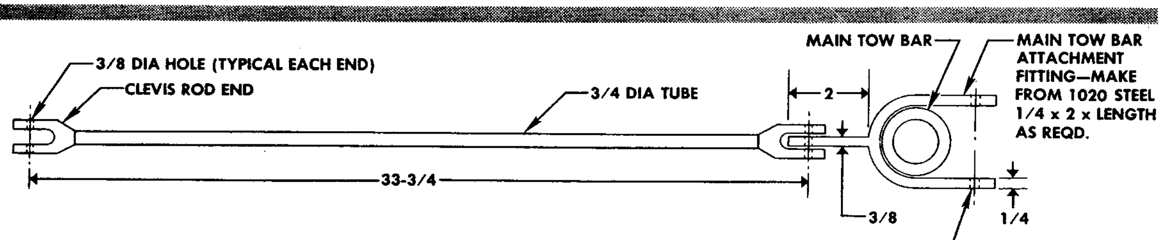
GENERAL



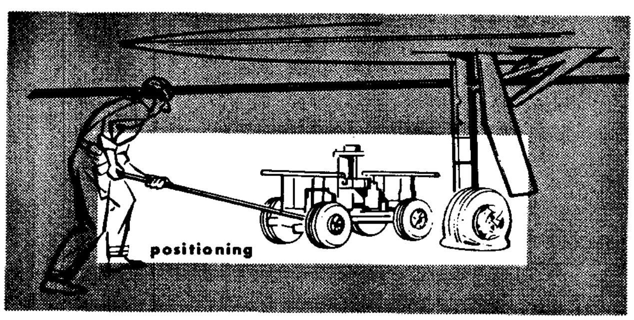
NOTE

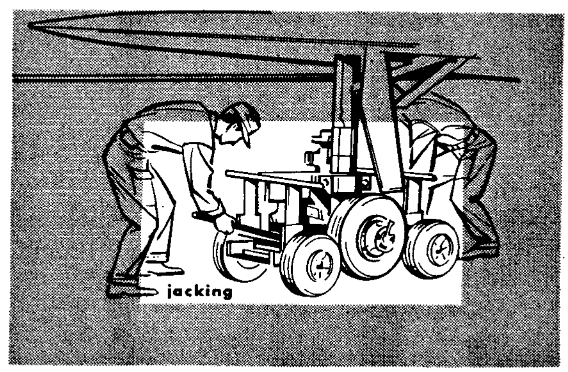
All joints are to be continuous, welded both sides.

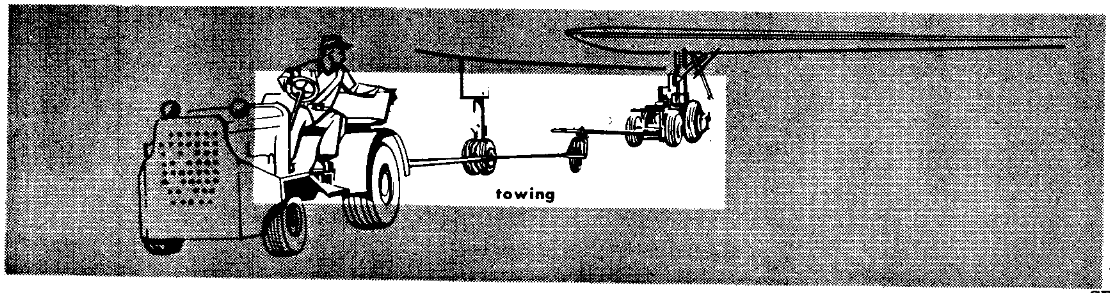
18 GUIDE WHEEL JOCKEY BAR



19 TOW BAR ASSEMBLY
1020 STEEL







GEN-3-00-85

Figure 1-12B. Damaged Wheel Towing Dolly (Sheet 7 of 7)

the airplane must be placed on a truck or suitable dolly for removal from the crash site.

LIFTING AIRPLANE WITH SLING.

See figure 1-14.

LIFTING AIRPLANE WITH PNEUMATIC LIFTING BAGS.

Airplanes that have made wheels-up landings on soft or swampy terrain may be lifted with pneumatic lifting bags (Part No. 44D5158, Type F-1, Specification No. 94-40683). This equipment may also be used for lifting belly-landed airplanes from runways in a minimum amount of time. The bags are similar in construction to bladder-type fuel cells. Each bag is capable of lifting a maximum weight of 24,000 pounds to a height of 6 feet. Operating pressure is provided by a gasoline-engine-driven blower, which supplies 5 psi pressure at a volume of 40 cubic feet per minute. Each bag is provided with a tarpaulin, which serves the dual purpose of protecting the bag during storage and transportation, and acting as a base upon which to set the bag during the lifting operation.

MOORING AIRPLANE.

The airplane must be secured to prevent its moving forward, backward, or to either side while being lifted. (See figure 1-15.) Mooring must be provided at the tail to prevent the airplane from nosing over when bags are inflated. Ropes are tied from the aft mooring point to ground stakes. The two ropes running forward and out are secured at one end to the wing mooring points and at the other end to ground stakes or heavy trucks.

If for some reason the regular mooring points cannot be used, the aft tie-down may be made with soft rope around the aft fuselage, forward of the horizontal stabilizer. Cable or wire must not be used. The wing mooring lines may be tied into the slat tracks. These are alternate methods of mooring only and should not be used unless it is impractical to use the regular mooring points.

Lines running forward must have enough slack to permit an upward motion of the airplane without tightening the lines. If available, block and tackle or chain falls should be used in the aft mooring lines. This provides a means of letting out the lines while the airplane is being lifted.

POSITIONING LIFTING BAGS.

In cases where the airplane is down in soft terrain, it may be necessary to dig out under the wings in order to get the bags in place. The tarpaulin in which the bag is wrapped is first spread out under the airplane and then the bag is positioned upon it.

Bags must be positioned with as much surface as possible in contact with the wing. The position of the bag must permit the gear to be dropped, or a dolly or truck to be rolled under the airplane after it is lifted. (See figure 1-16.) Before positioning the bag, check the underside of the wing for sharp or rough projections that might damage the bag. If any sharpness or roughness is found, the felt pad, provided in the lifting kit, should be placed between the bag and the wing to protect the surface of the bag.

LIFTING AIRPLANE.

To inflate the bags, the two outlet sleeves (stenciled with the word "OUTLET" directly below each sleeve) must be securely fastened. Two fabric straps with buckles are provided for securing each outlet.

Attach hoses securely to the inlet connection of the bag and the outlet connection of the blower. These connections are one-inch pipe-threaded fittings. The inlet connection of the bag has the word "INLET" stenciled directly above it.

CAUTION

Before starting blower, check mooring lines and be sure bags are located for greatest possible surface contact between bag and underside of wing.

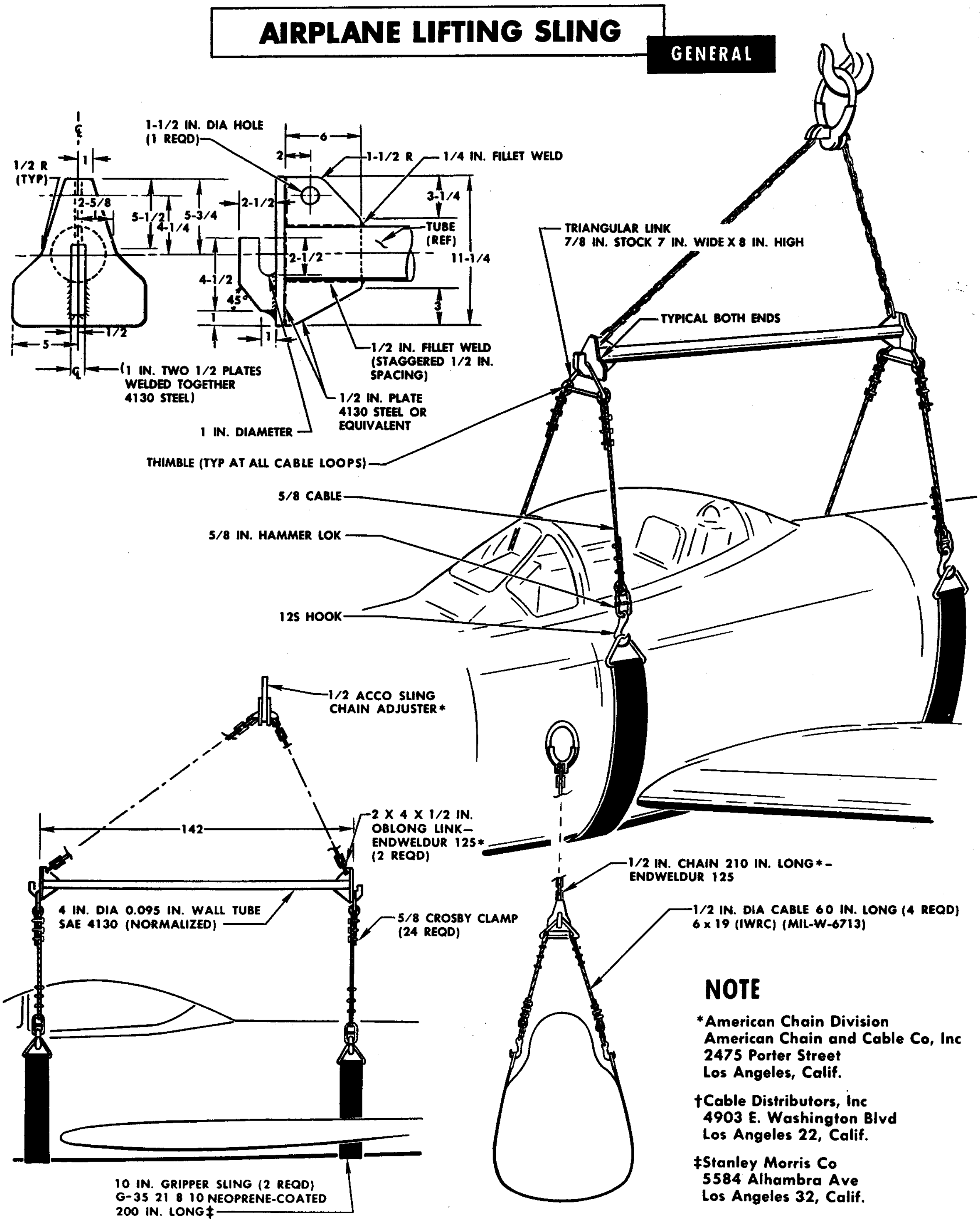
Bags should be inflated together unless the terrain is such that it would cause shifting of the airplane. As the bags are inflated, slack off on the mooring lines to permit the airplane to rise evenly. (See figure 1-17.)

CAUTION

Keep enough tension on the lines to prevent airplane from shifting.

When the airplane has reached sufficient height, it must be supported on its own gear, jacks, or crash dollies. Do not try to support the airplane on bags for any period of time. The bags do not have adequate pressure-holding qualities to permit them to be used as permanent supports.

With airplane safely supported, bags may be deflated by opening outlet sleeves and collapsing the bags. (Refer



NOTE

*American Chain Division
American Chain and Cable Co, Inc
2475 Porter Street
Los Angeles, Calif.

†Cable Distributors, Inc
4903 E. Washington Blvd
Los Angeles 22, Calif.

‡Stanley Morris Co
5584 Alhambra Ave
Los Angeles 32, Calif.

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Figure 1-13. Airplane Lifting Sling

LIFTING AIRPLANE WITH SLING

GENERAL

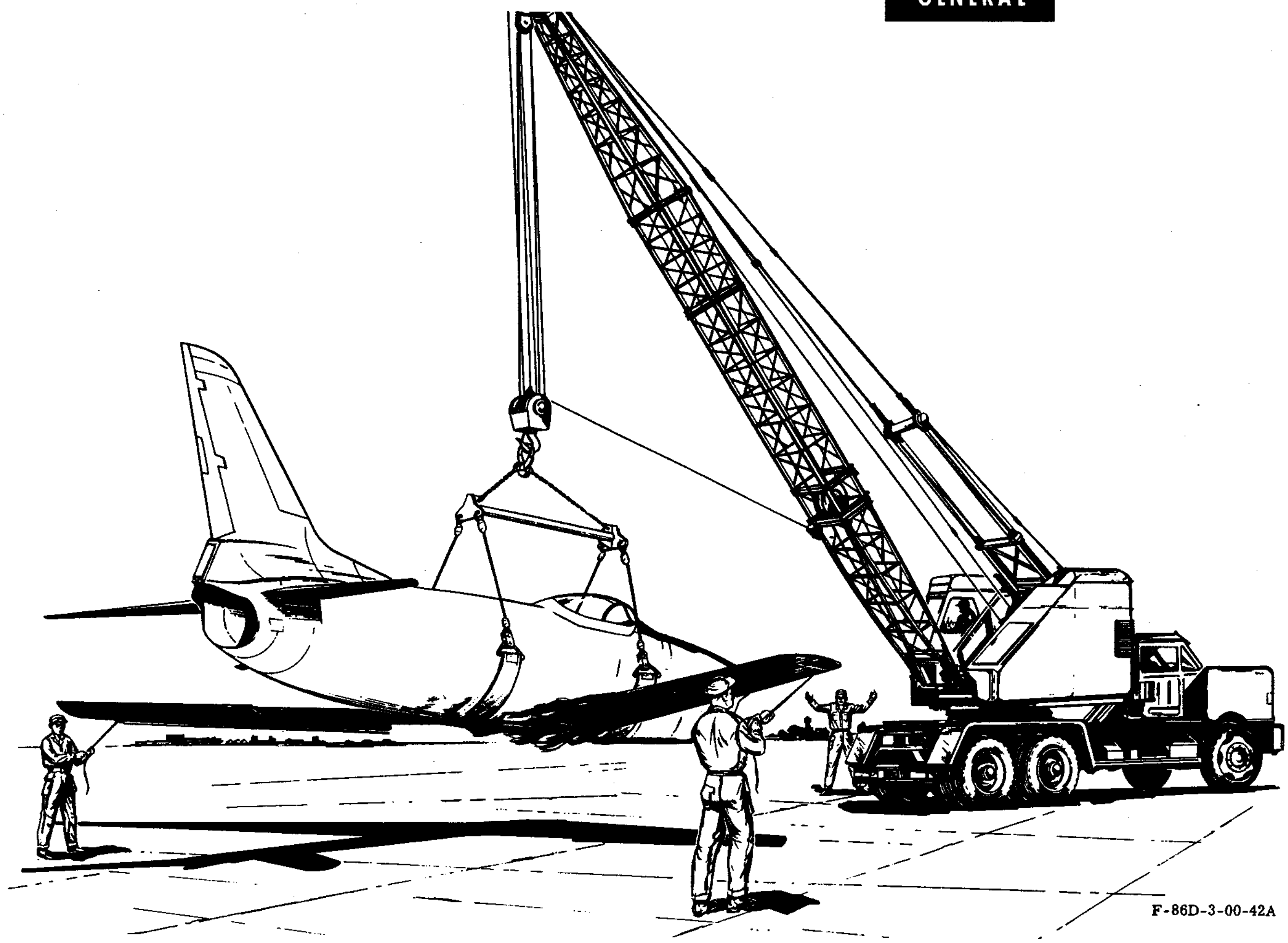

Figure 1-14. Lifting Airplane With Sling

to applicable Technical Order on pneumatic airplane-lifting bags for inspection and storage.)

REMOVING AIRPLANE FROM CRASH SITE.

When the airplane has been raised to sufficient height, an attempt should be made to lower the gear. If the gear is serviceable, the airplane may be towed from the crash site in the usual manner. (Refer to applicable Technical Order for towing procedures.) If the gear is damaged, it will be necessary to load the airplane on a truck or dolly.

To load the airplane on a truck, sand bags are used as cribbing. The sand bags are placed under the wing at the heavy structural section near the root. (See figure 1-18.) Care must be taken to place bags so that no airplane weight will be supported on the light structure of the wing leading or trailing edge. The airplane must be secured to the truck bed with rope or cable. Tie-down should be from the airplane mooring points if possible. If other securing points are used, care must be taken not to damage structure.

CAUTION

Wire, cable, chain, etc, must not be used where it will come in contact with airplane structure.

TRANSPORTING AIRPLANE AND COMPONENTS.

A damaged airplane that is to be transported by air, rail, or truck should be packed and handled in the same manner as new equipment. Proper crating and padding is essential. When possible, the airplane should

MOORING AIRPLANE

GENERAL

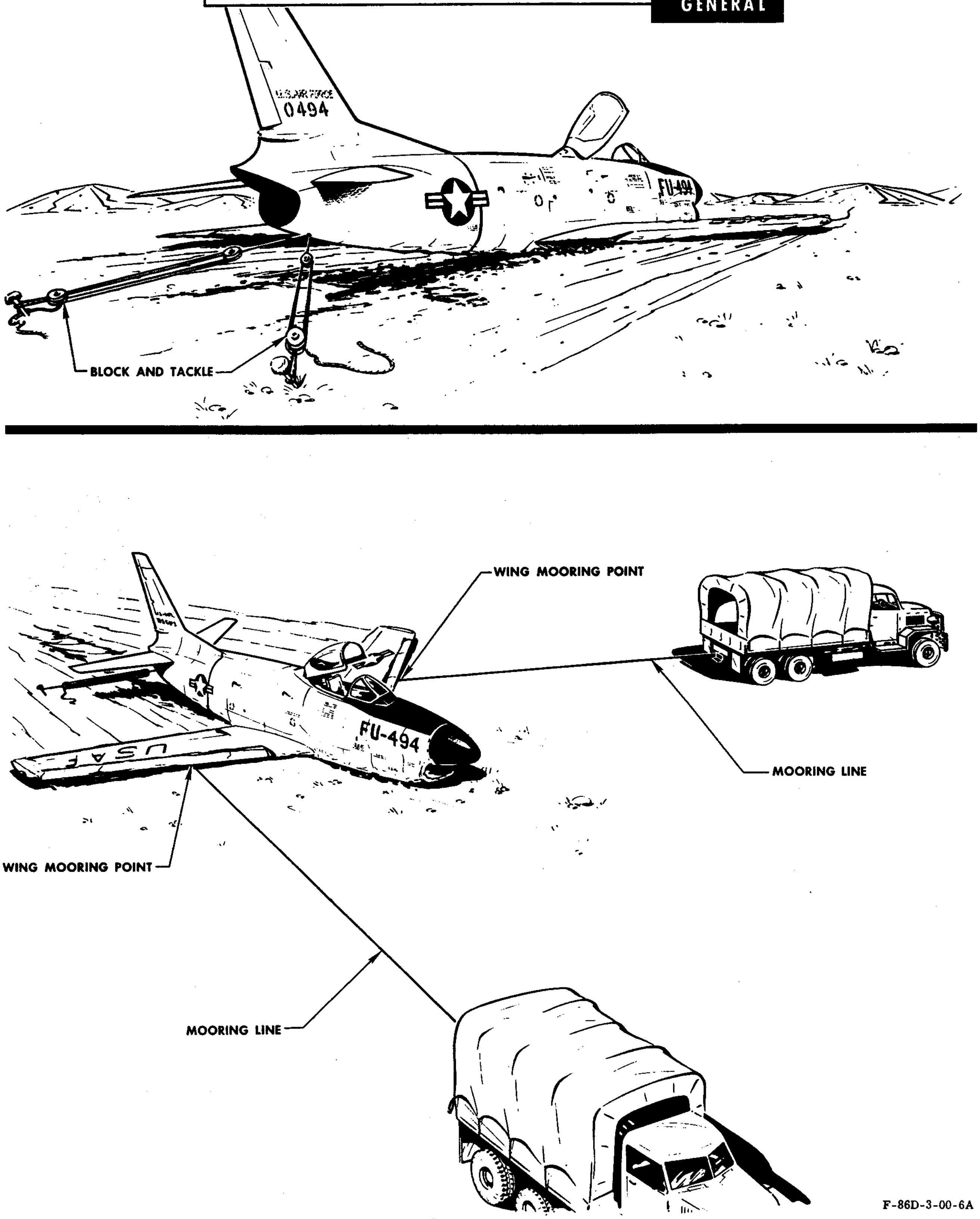

Figure 1-15. Mooring Airplane

LOCATING LIFTING BAGS

GENERAL

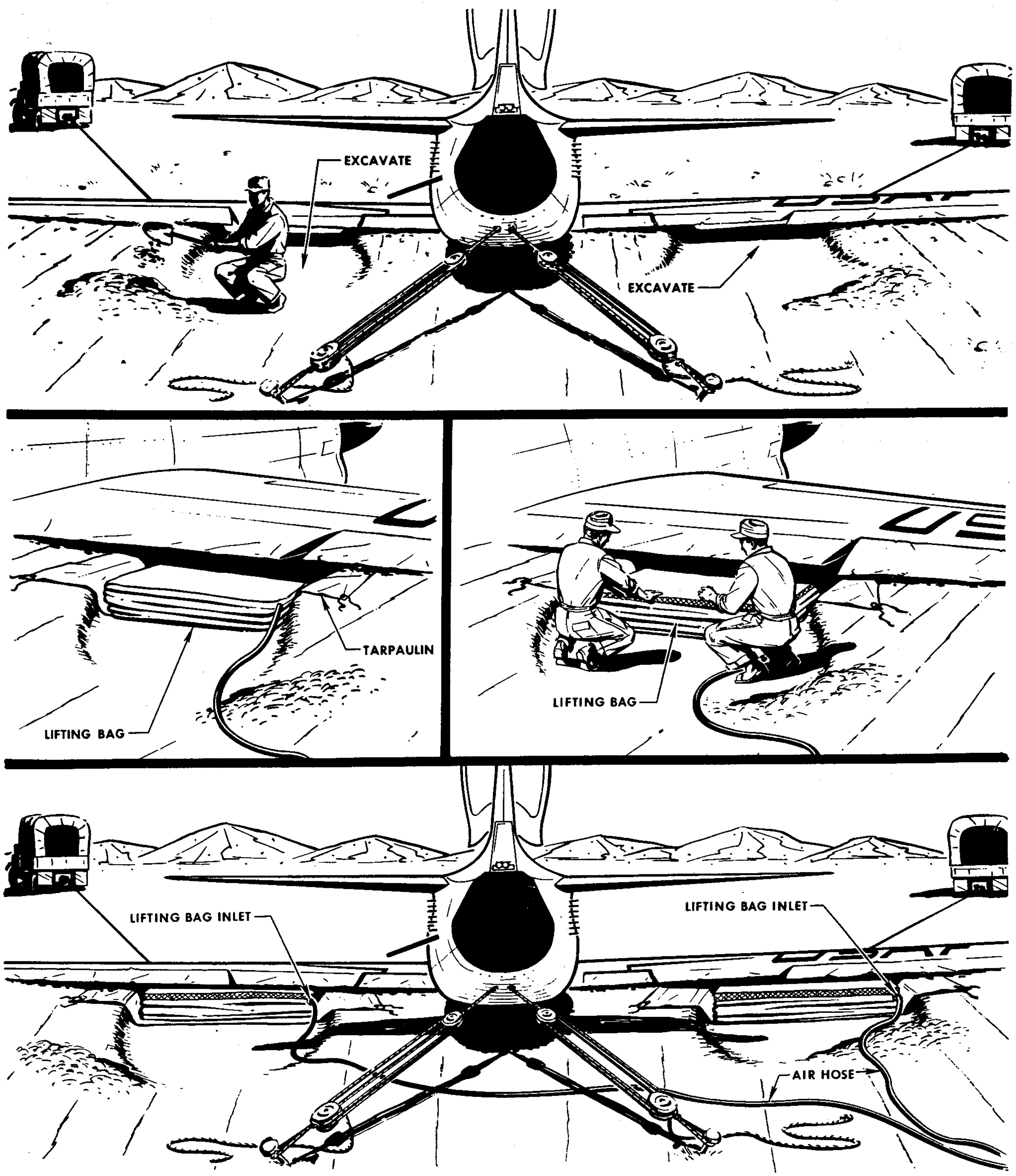

Figure 1-16. Locating Lifting Bags

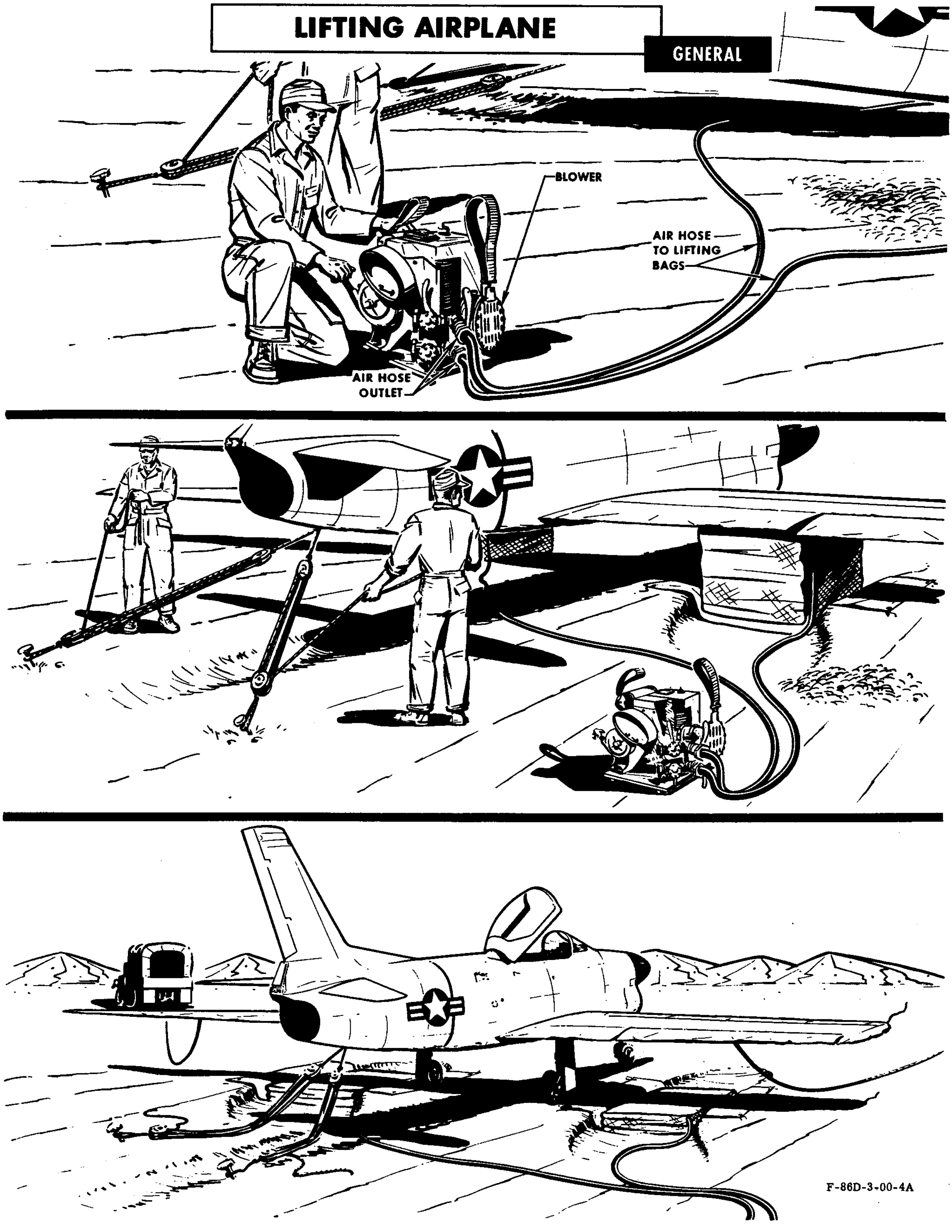

Figure 1-17. Lifting Airplane

LOADING AIRPLANE ON TRUCK

GENERAL

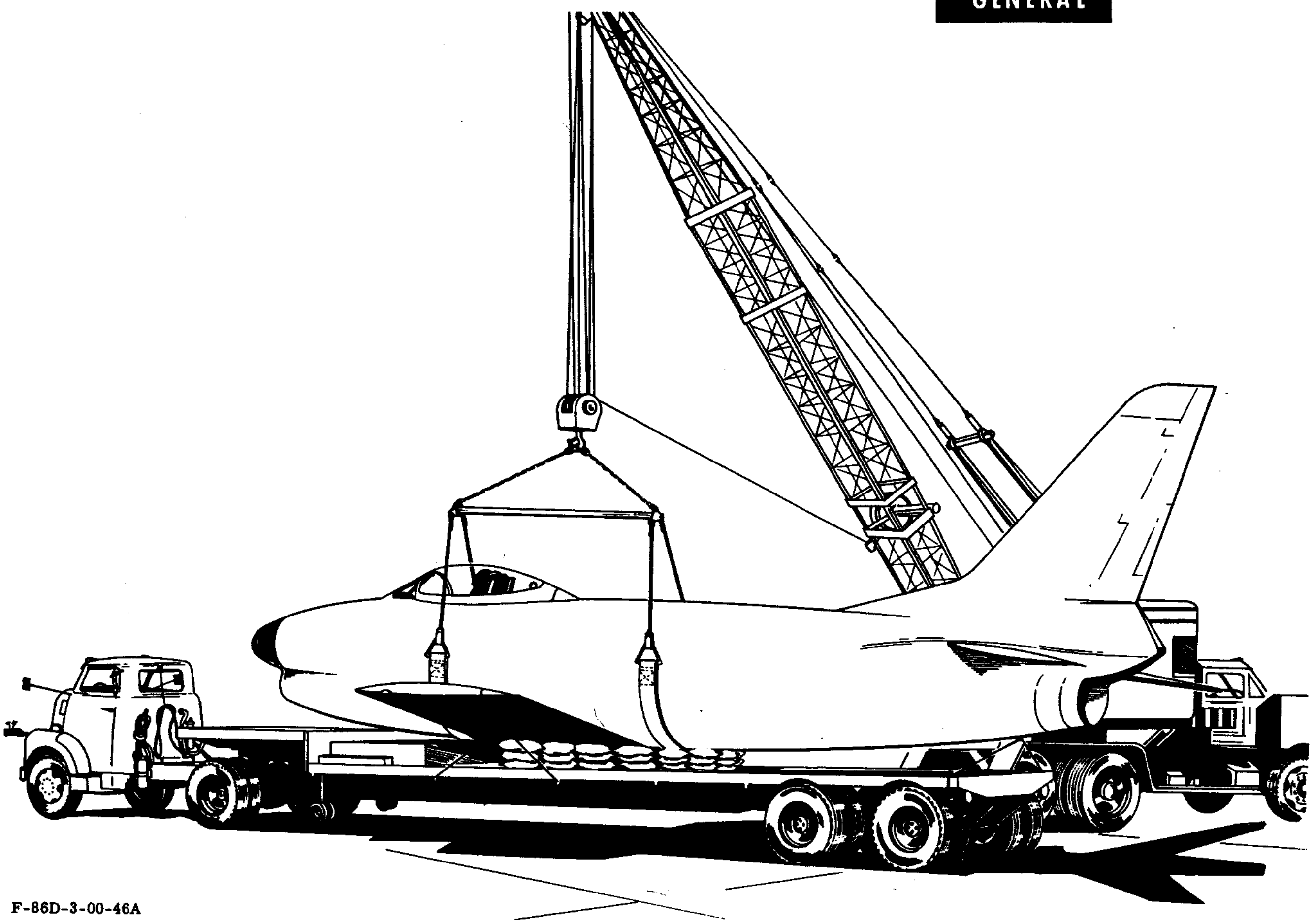

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Figure 1-18. Loading Airplane on Truck

be shipped by air. Rail or truck transportation is satisfactory when proper loading procedures are used.

Note

All airplanes are shipped with engines and all loose equipment removed. Fuel tanks must be empty and purged. The airplane and its equipment will be preserved in accordance with current directives.

An airplane shipped by rail will be subjected to high fore-and-aft loads. Adequate cradling and tie-down are necessary. By breaking the airplane down into its major components (fuselage, wing outer panels, vertical stabilizer, and horizontal stabilizer), each section may be crated and loaded. (See figures 1-19 through 1-23.) The shipping cradles are designed with heavy bases so that the components may be stored in them until work is to be done. Any part of the cradle coming in contact with the airplane structure must have one inch of padding. Movable surfaces, such as ailerons or rudder, should be secured so that they cannot move. All supports are placed at heavy structural members. Each component is secured within its own cradle, so that it cannot shift or slide from the supporting points.

The fuselage presents the greatest packing and shipping problem because of its bulk and weight. Packing it in two separate units is the easiest method of handling. The supporting cradles should be well padded and fit snugly. If the bottom of the fuselage is damaged, it may be necessary to change the supports to fit the situation. Much of the fore-and-aft load of the fuselage forward section is carried by the fuselage rear section attachment fittings. Care should be taken in the construction of the aft cradle support to ensure a good fit. Cables from the fore-and-aft jack-pad fittings carry some of the load. If the forward jack-pad fitting cannot be used, an alternate

WING SHIPPING CRADLE

GENERAL

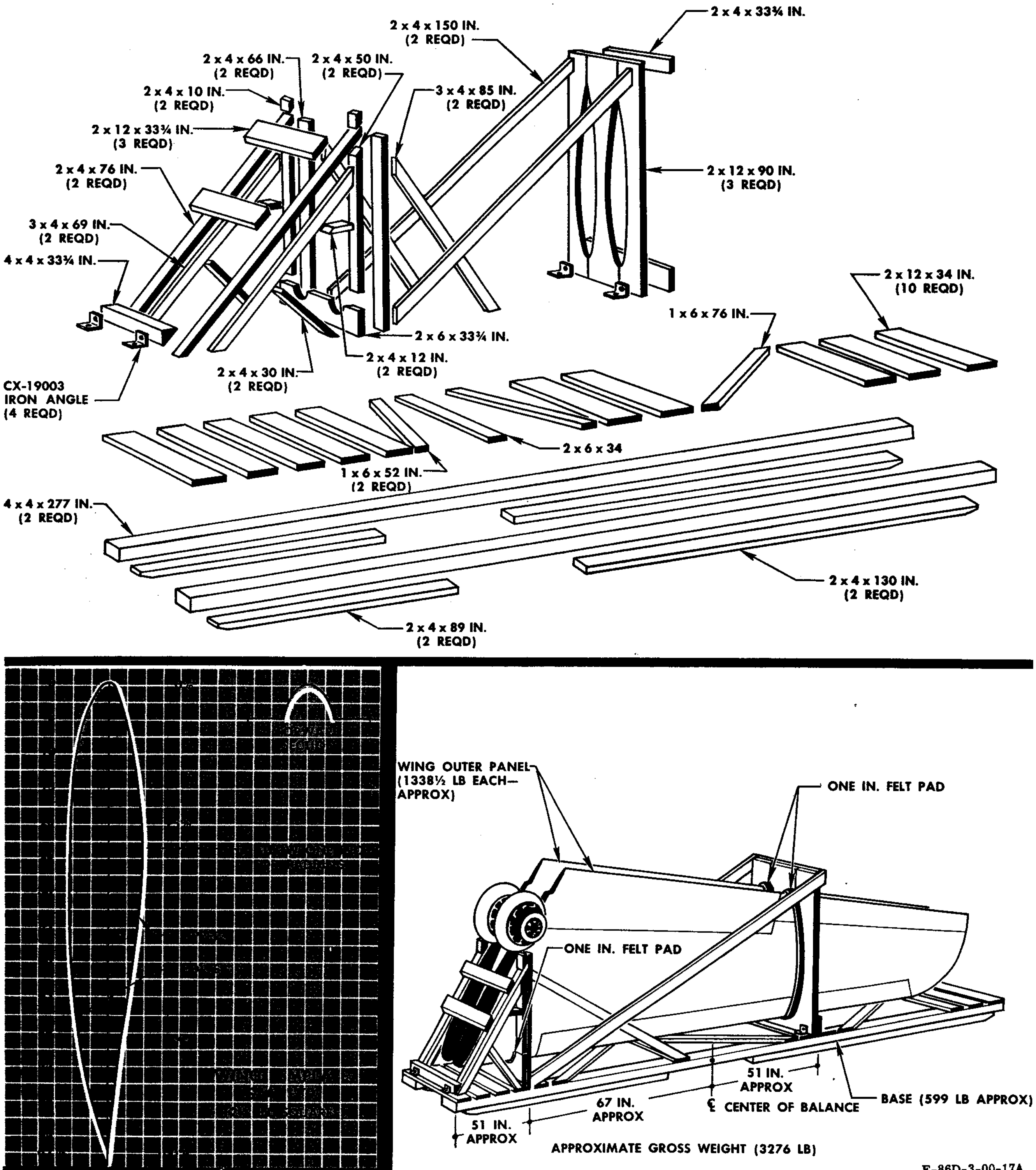


Figure 1-19. Wing Shipping Cradle

HORIZONTAL STABILIZER SHIPPING CRADLE

GENERAL

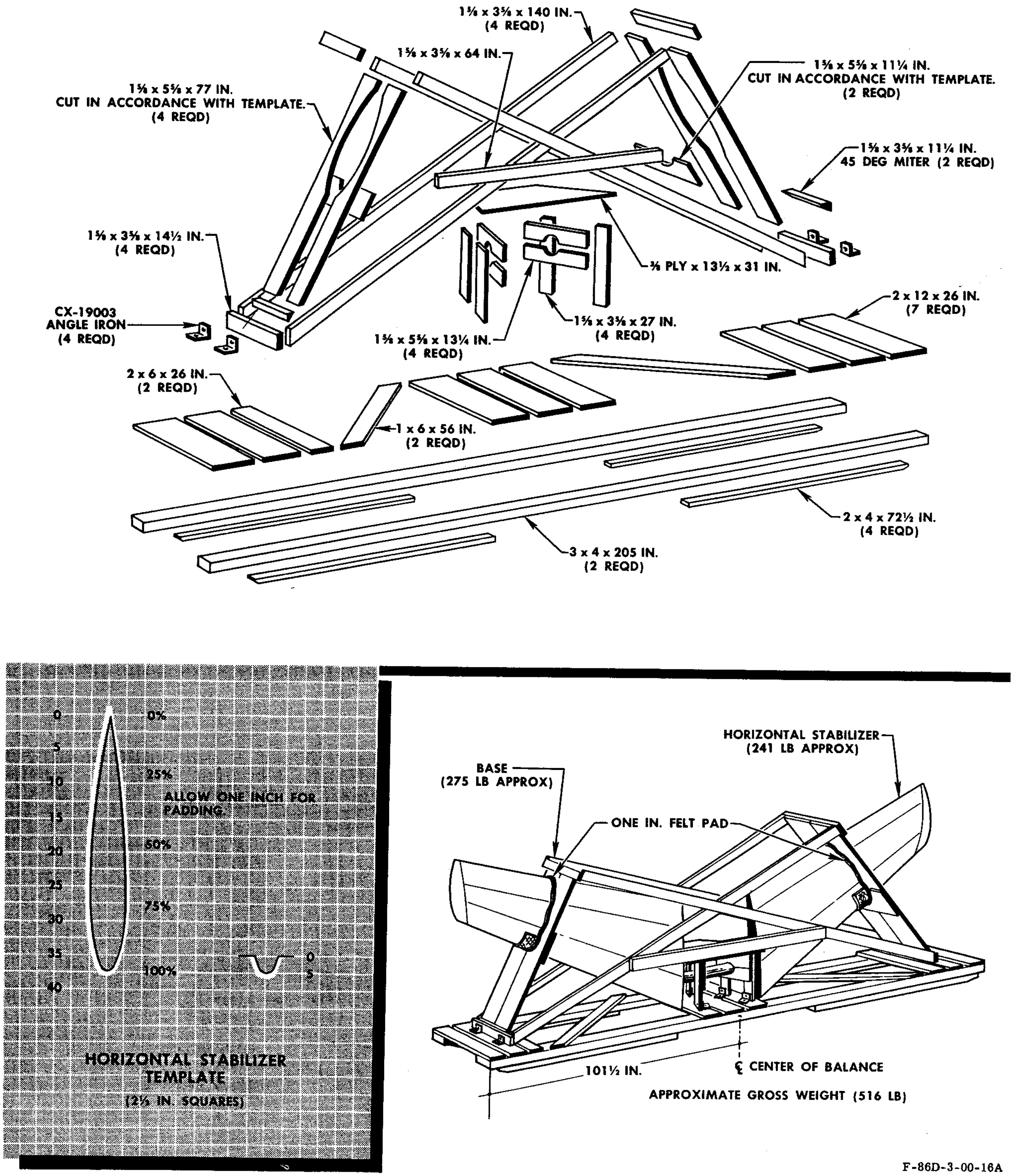
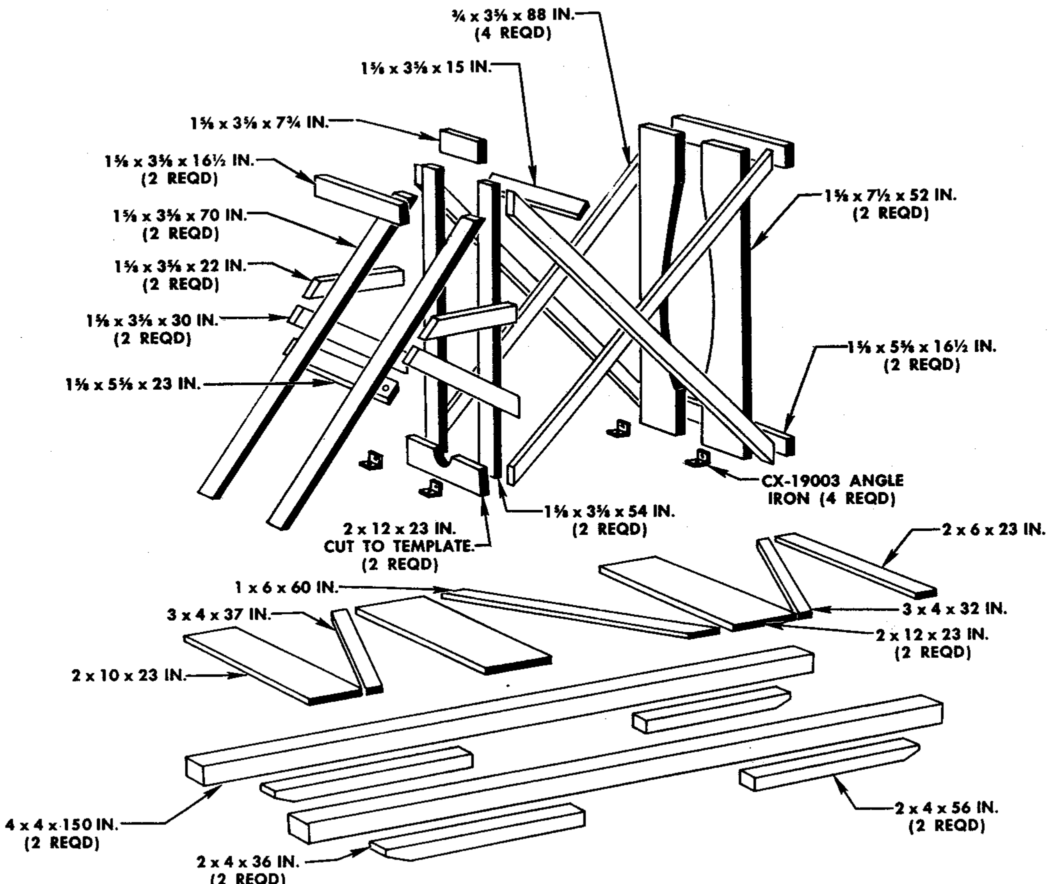
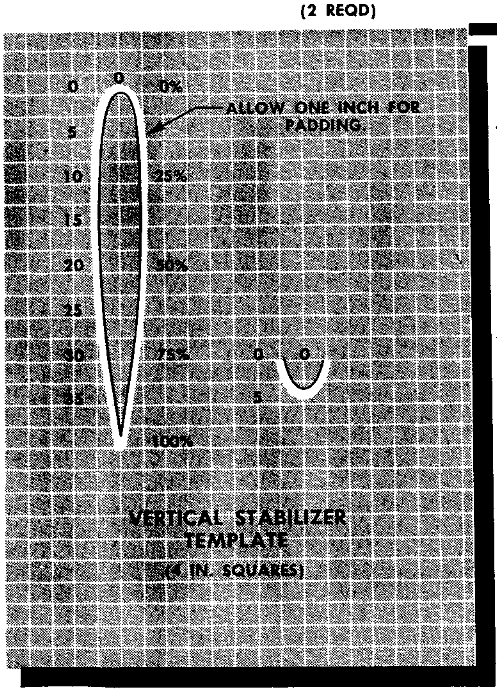


Figure 1-20. Horizontal Stabilizer Shipping Cradle

VERTICAL STABILIZER SHIPPING CRADLE

GENERAL





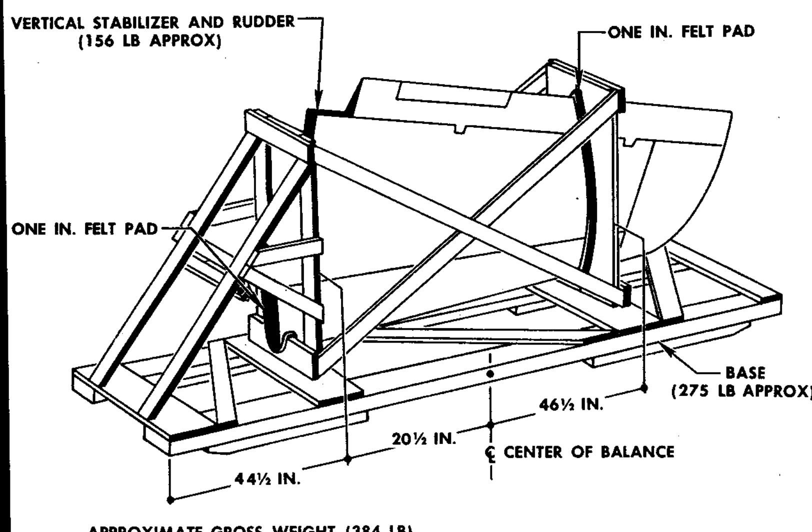


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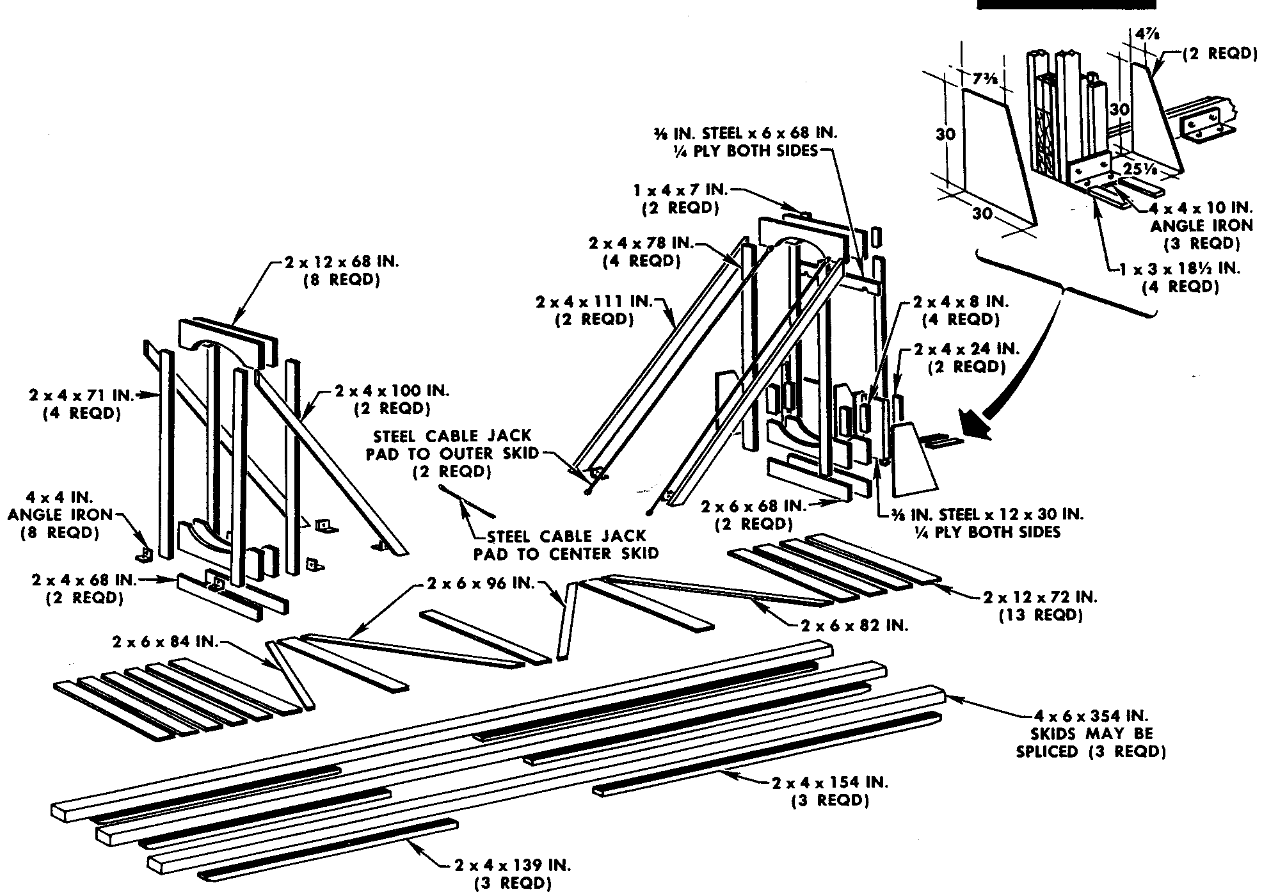
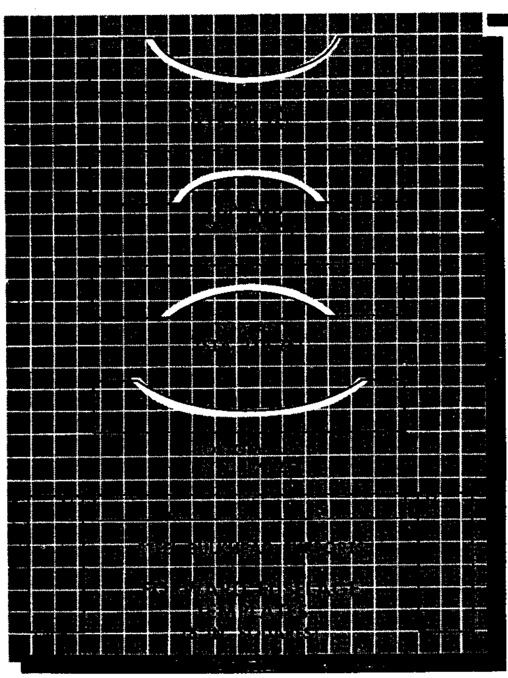
Figure 1-21. Vertical Stabilizer Shipping Cradle

FORWARD FUSELAGE SHIPPING CRADLE

GENERAL





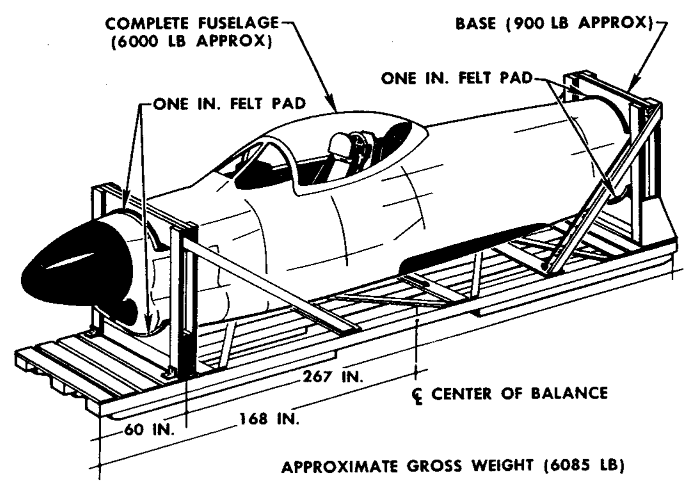


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Figure 1-22. Forward Fuselage Shipping Cradle

AFT FUSELAGE SHIPPING CRADLE

GENERAL

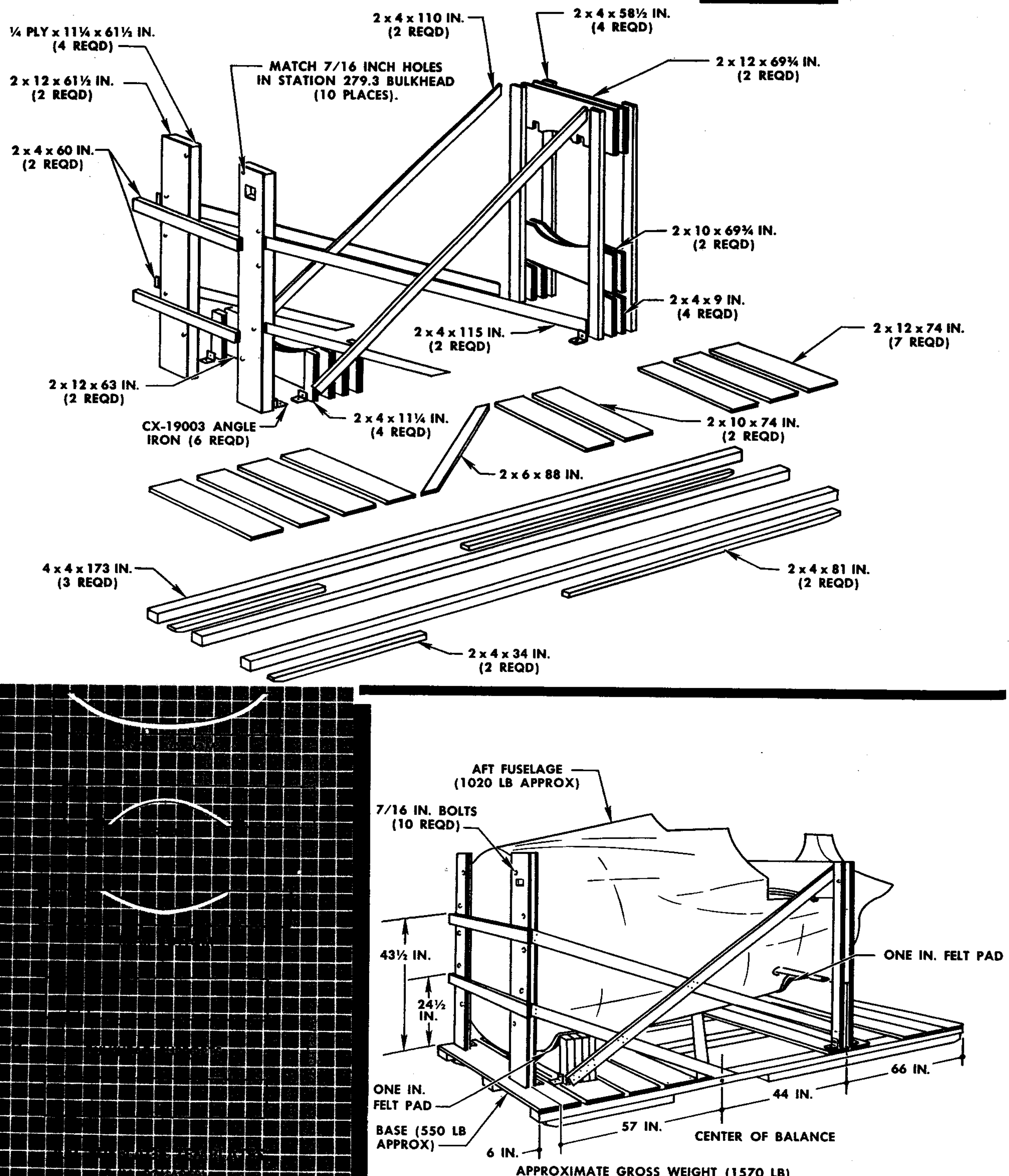
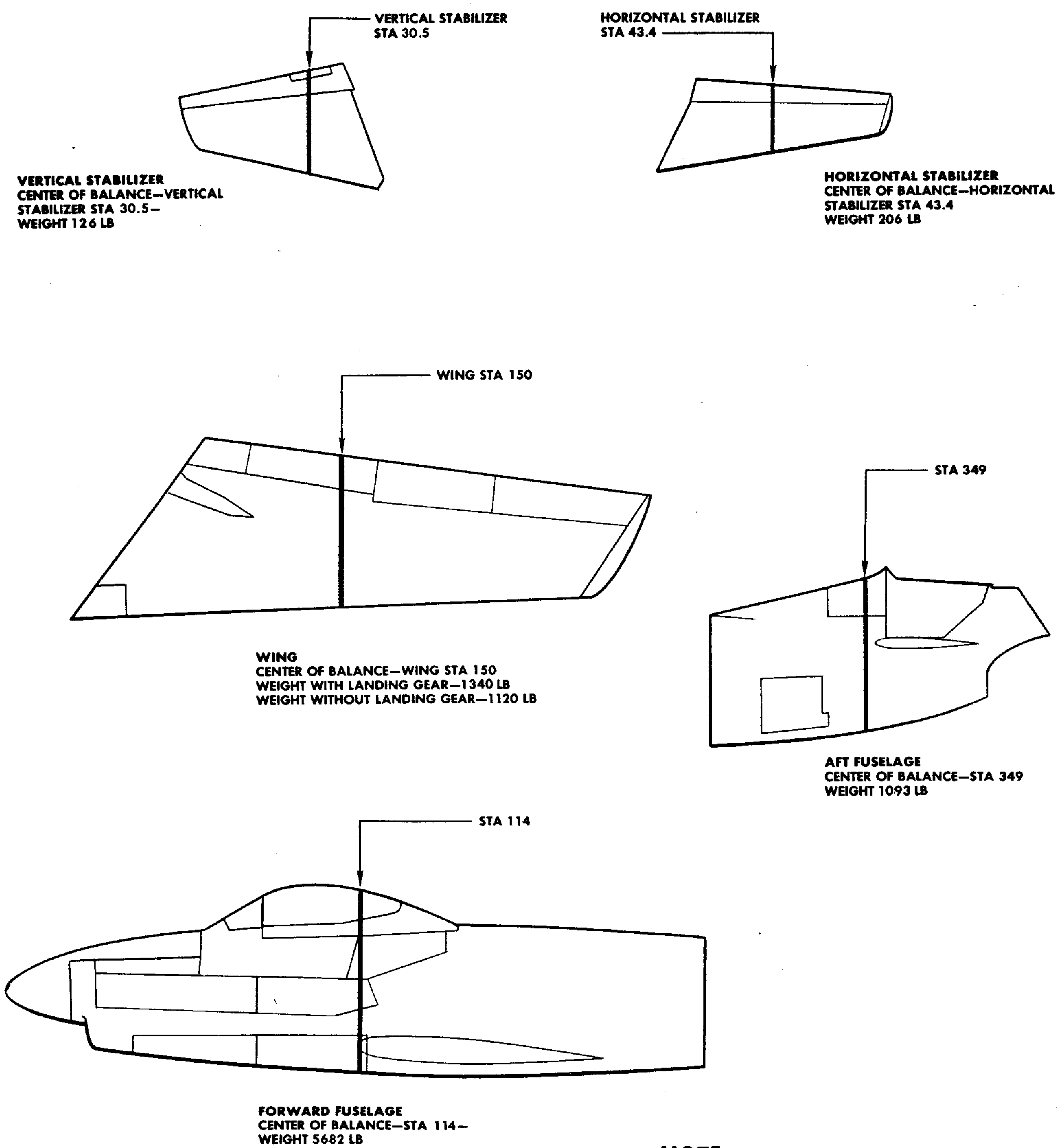


Figure 1-23. Aft Fuselage Shipping Cradle

WEIGHTS AND CENTER OF BALANCE

GENERAL



NOTE The above weights and center-of-balance figures are approximate, and may differ slightly on different airplanes of the same series.

F-86K-3-00-37

Figure 1-23A. Weight and Center of Balance of Airplane Components

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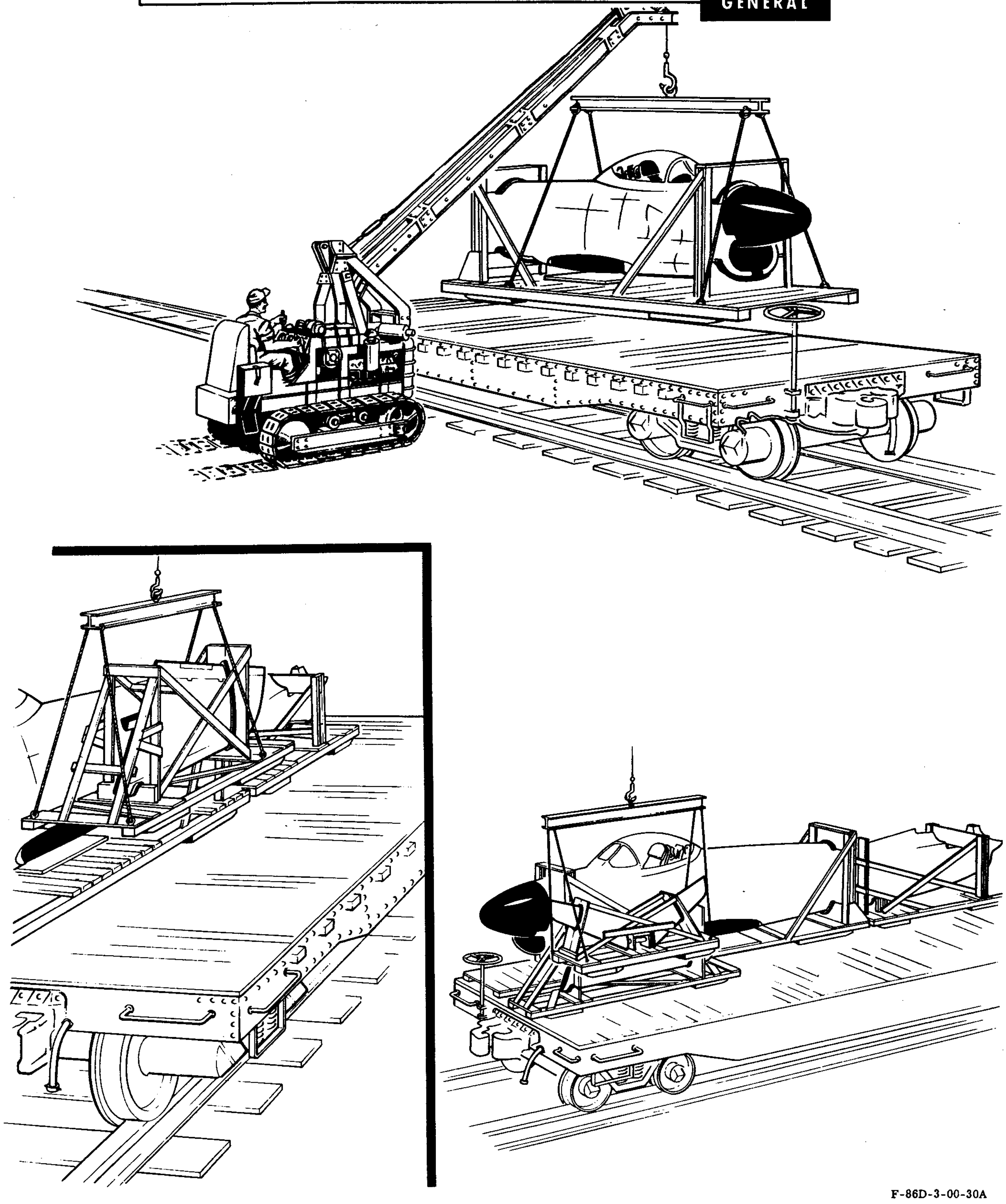
LOADING AIRPLANE ON FLATCAR

GENERAL



F-86D-3-00-30A

Figure 1-24. Loading Airplane on Flat Car

AIRPLANE LOADED ON FLATCAR

GENERAL

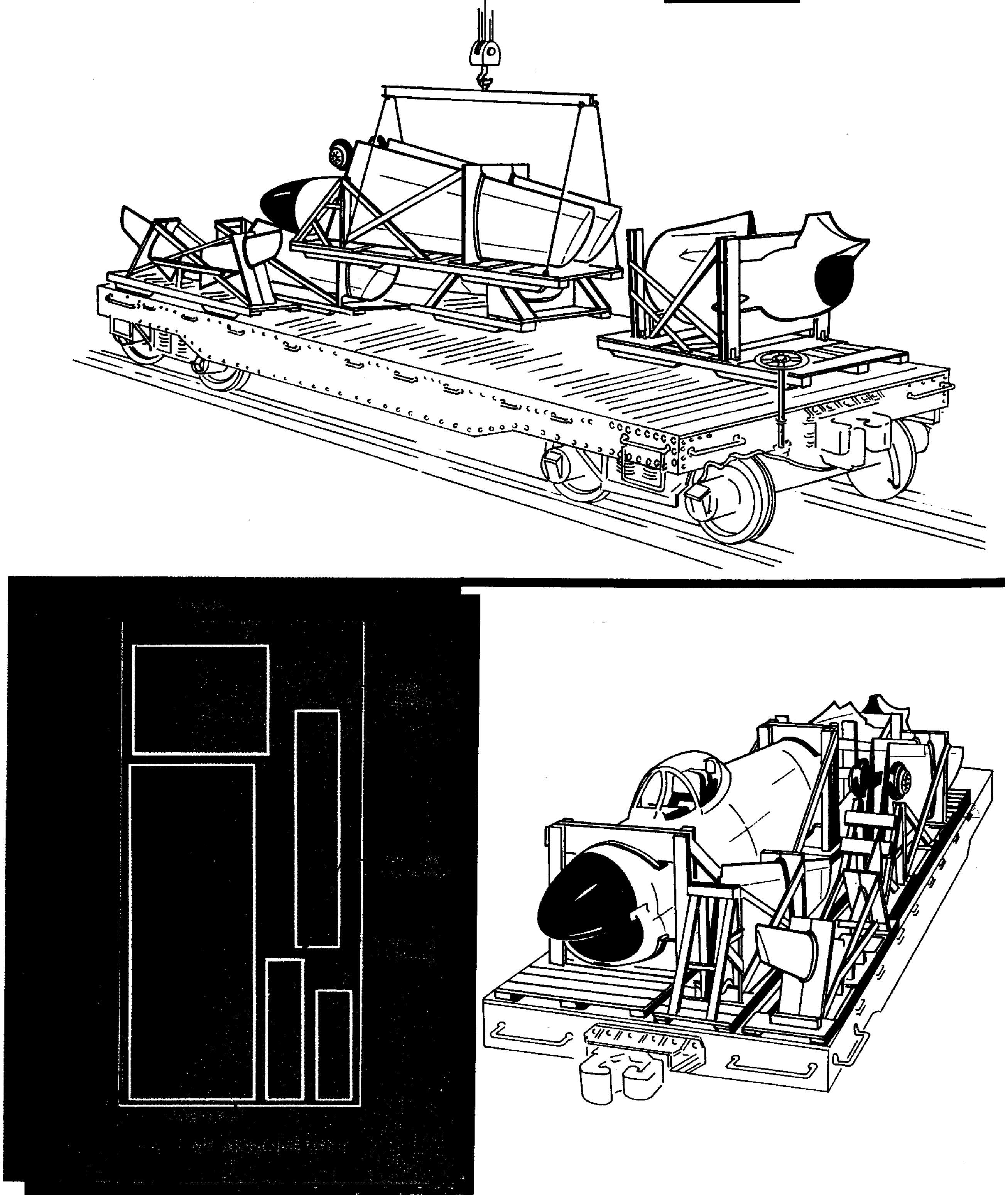


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Figure 1-25. Airplane Loaded on Flat Car strong point, such as the nose gear trunnion, should be selected for tie-down. Securing the fuselage with steel banding or cable that is not tied into some fixed point on the fuselage is undesirable. Load shifting will cause the band or cable to cut or chafe the airplane structure.

Any hoisting equipment capable of lifting the gross weights may be used. (See figure 1-24.) There are fork-lift slots on the base of each cradle. The individually packed components may be arranged on the railroad car in any convenient manner. (See figure 1-25.) The cradles are secured to the car with bolts (⅝-inch minimum) through the base and the car floor. One bolt for about every 5 feet of base skid is required. Bolts are equally spaced along the length of the skids. The end bolts should be about one foot from the skid end. When the cradle consists of three base skids, only the two outside skids need to be bolted.

DAMAGE EVALUATION AND INSPECTION CRITERIA.

FORCES ON AIRPLANE IN FLIGHT.

The five major forces working on an airplane in normal flight are:

- Lift—the force which supports the airplane in the air.
- Gravity—the downward pull of the earth, or the complete weight of the airplane.
- Thrust—the force which moves the airplane forward through the air.
- Drag—the resisting force which tends to hold the airplane back.
- Inertia—the characteristic of any physical body which tends to resist any change in speed or change in direction of motion from a straight line. (See figure 1-26.)

These forces act not only on the airplane as a whole, but may also be applied separately to individual parts of an airplane.

STRESSES AND STRAINS.

External forces acting on the airplane in flight set up stresses within the structure. Stresses are the intensity of the internal forces which are set up in a member to resist the external forces, and are measured in pounds per square inch. The intensity at any one point is the

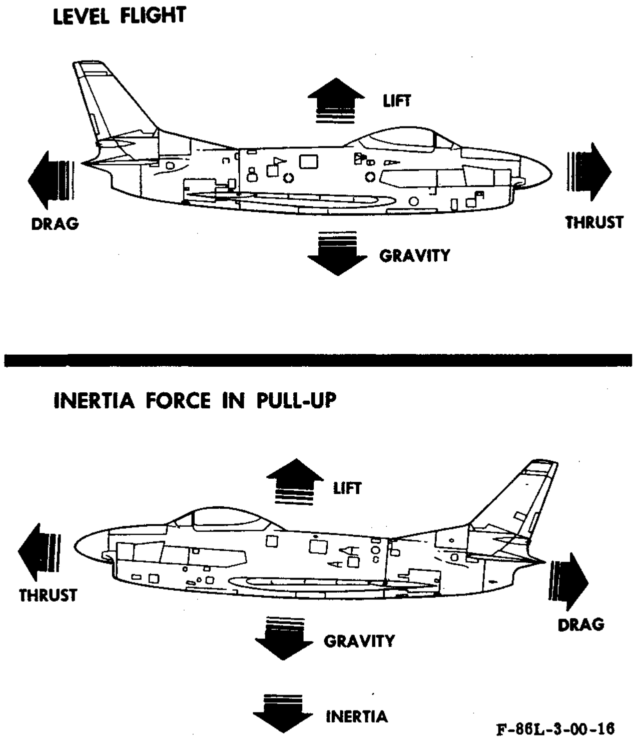


Figure 1-26. Forces in Flight

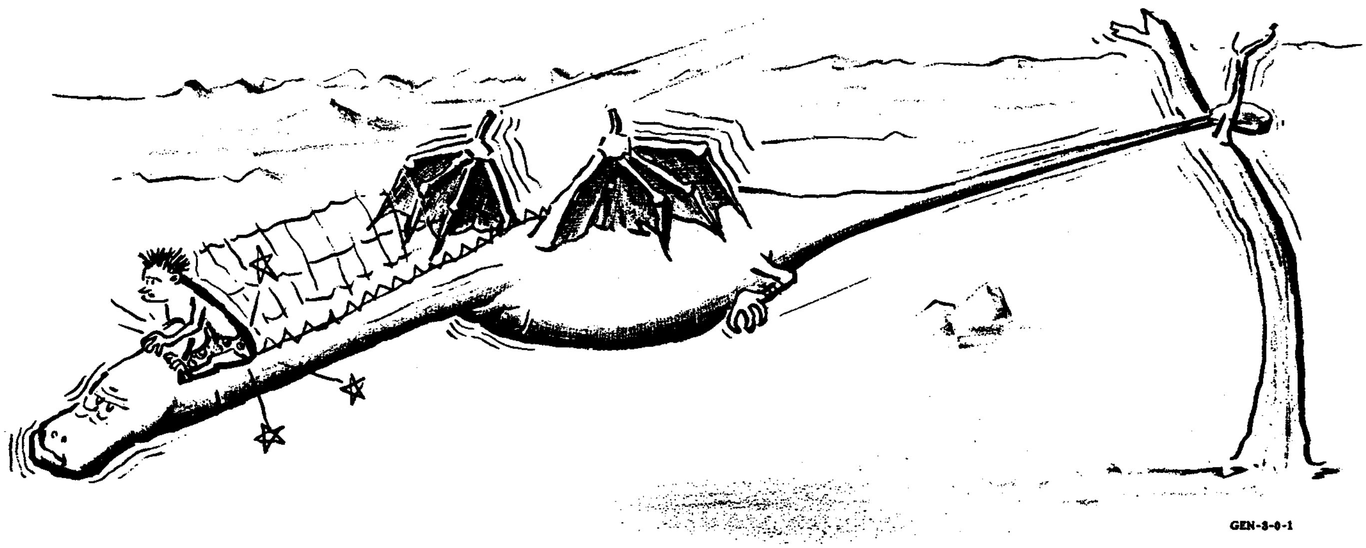
amount of the applied force acting at that point, divided by the cross-sectional area over which the force acts. Where the stress is uniform, the entire force may be divided by the entire cross-sectional area.

$$\left(\text{Stress} = \frac{\text{Applied force}}{\text{Cross-sectional area}} \right)$$

Strain is the deformation of a member resulting from the stress within it. Strain is measured as a change in length, thickness, or movement per unit length.

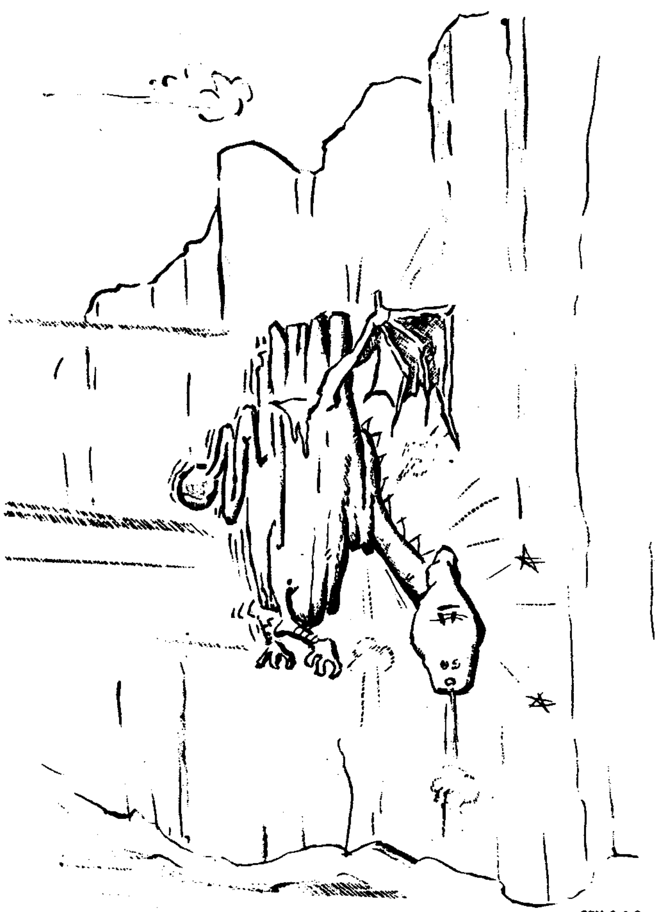
There are five types of stresses to be considered when a repair is made: tension, compression, shear, torsion, and bending.

Tension, compression, and shear are basic stresses, while torsion is a type of shear, and bending is a combination of tension and compression. Tension occurs when an applied force tends to stretch a member. Compression occurs when the force tends to shorten the member. Shear stress within a member results from a force tending to move or slide one portion of the member past an adjacent portion of the member. Torsion shear stress exists within a member when a torque or twisting moment acting upon it tends to turn or twist one portion of the member in relation to an adjacent portion in a



GEN-3-0-1

parallel plane. Bending stress results when a force or bending moment acting upon a member tends to bend one portion of the member so that it is no longer parallel to the adjacent portion. The resistance to bending is a combination of tension and compression, although in most airplane structures, shear is also present at the same time as bending.

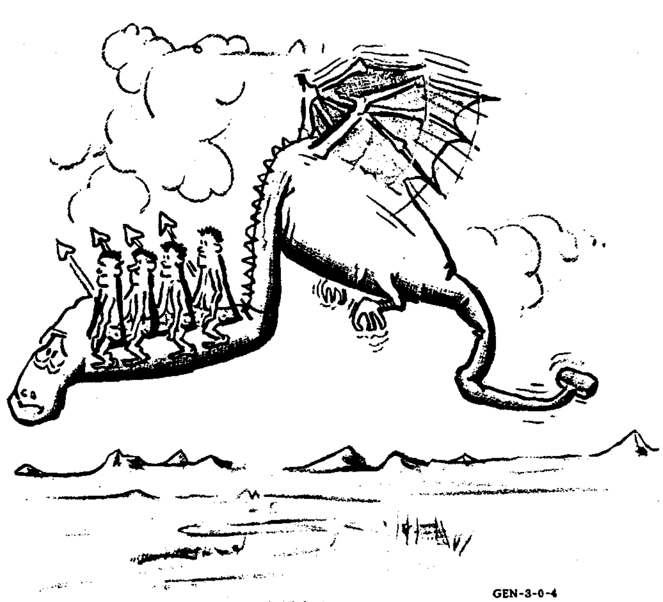


GEN-3-0-2

STRENGTH OF MEMBERS.

The strength of a member in tension is determined from its cross-sectional area and material only. Drilling a hole in the member decreases the cross-sectional area and reduces its ability to withstand tensile forces. Installation of a rivet or bolt in the hole will not materially affect the ability of the member to withstand tensile forces, since the river or bolt will not carry the tension loads across the hole.

The strength of a member in compression is determined from its cross-sectional area, material, and shape.



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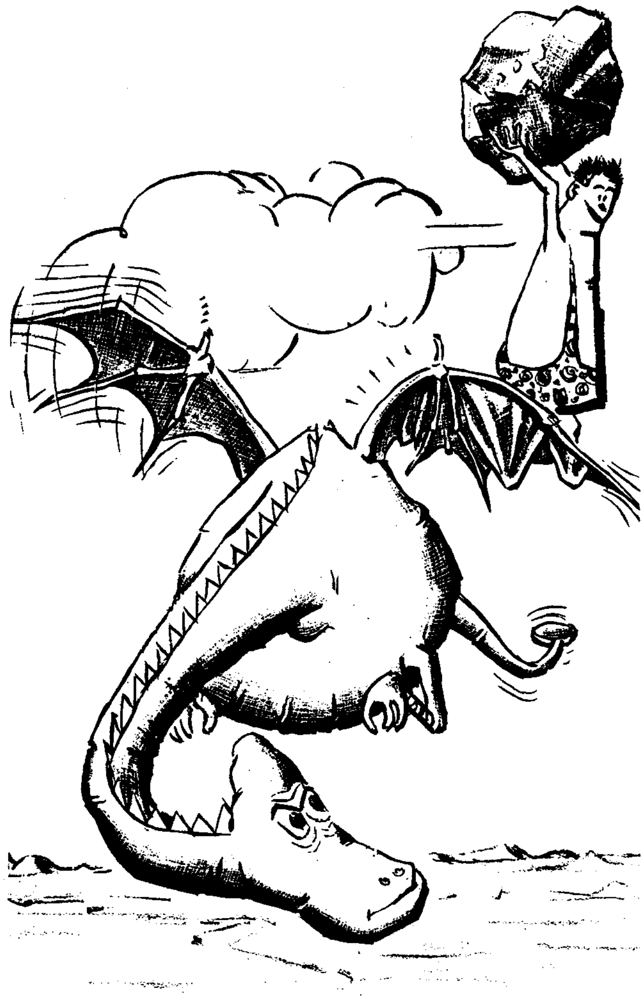


GEN-3-0-5

Drilling a hole in a member reduces its ability to withstand compressive loads. However, if a plug, such as a rivet or bolt of equivalent or stronger material, is fitted tightly into the drilled hole, the rivet or bolt will carry compressive loads across the hole.

The plugged member will carry about the same compression loads as it would have, had the hole not been drilled.

The strength of a member in shear is determined primarily from its cross-sectional area and material. Shape has less effect on shear strength if the member is supported properly to eliminate bending or buckling.

The strength of a member in torsion is determined to a large degree by its shape as well as its cross-sectional area and material.

The strength of a member in bending is greatly dependent upon the shape of the member, the cross-sectional area, and the material. Resistance to bending involves a combination of stresses.

The shape, cross-sectional area, and material used in the structural members of airplanes are usually selected to produce as strong and as light a structure as is possible within aerodynamic and production requirements. Any member, when repaired, should be returned as nearly as possible to its original shape and strength. Any loss of strength because of a change in shape must be made up by an increase in cross-sectional area.

EFFECT OF STRAIN IN A MEMBER.

When a force is applied to a member, stresses are set up within the member. These stresses resist the force but result in a strain or deformation of the member. Normally, when the force is removed, the member will return to its original shape. This is because of the elasticity of the member material. Figure 1-27 shows how stress resulting in strain affects a material. Material loaded to less than the stress corresponding to point "A" on the figure will have a strain shown by line OA. When the stress is removed, the strain will follow this line back to point "O." If a material is stressed until the proportional or elastic limit is exceeded (point "A"), when the stress is removed, the strain will diminish along a line parallel to OA starting at the highest point reached. The material will not return to its original shape because a certain amount of the strain or deformation will remain after the stress is removed. In this instance, it is said that a permanent set has been taken by the material. This does not necessarily mean failure. In most cases, the member will still be able to withstand reapplication of the same force without further yielding. A small, predetermined amount of permanent set is expected and permissible.

GEN-3-0-3

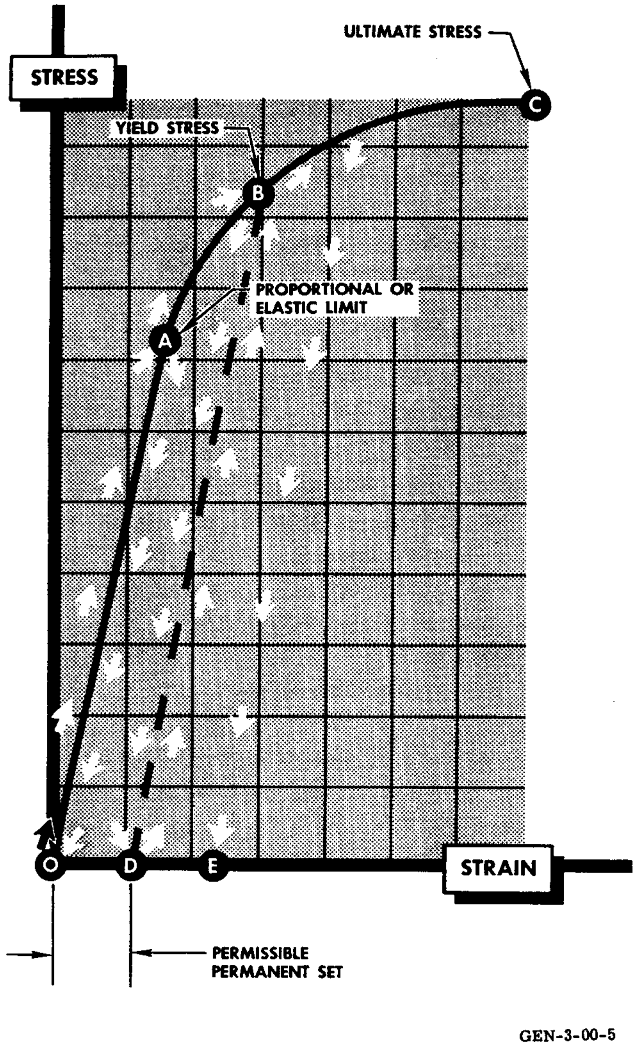


Figure 1-27. Stress-Strain Curve

The yield stress "B" is defined as that stress level, which, when removed, will leave a permanent set equal to the maximum permissible set, point "D." Upon reloading, the strain will follow the line DB, if "B" is not exceeded. Any stress higher than "B" will follow the line BC up to the value of stress imposed and then return along a new line to a permanent set "E," which is greater than permitted.

If the stress is allowed to reach point "C," the part will break.

LOCATION OF DAMAGE IN A MEMBER.

When a force which causes a member to bend is applied (figure 1-28), the bending stress causes a shortening or compressive stress to act upon one half of the beam and a stretching or tensile stress to act on the other half. These stresses act opposite one another on the two sides of the centerline (neutral axis) of the beam. Shear stresses occur along the member; they are greatest at the neutral axis and diminish to zero at the edges of a member. When there are bending stresses within a member, these stresses are greatest in the parts of the member most distant from its center. For this reason, ribs, spars, etc, are built with the greater part of their cross-sectional area at the outer edges. These reinforced edges are called flanges or caps. Because of the concentration of stresses within the flanges or caps, they can stand only a very limited amount of damage. Care should be exercised when choosing rivet sizes and locating holes in these flanges or caps. Holes drilled by the manufacturer are generally a reliable guide to use.

INVESTIGATING DAMAGE.

The primary structure of an airplane is designed to resist variable forces imposed upon it in operation. The structure must distribute these forces to the principal structural strength members of the wing and fuselage. When a member has been damaged, a complete and thorough inspection must be made. This inspection should include the damaged structural member and the adjacent or attaching members. It is possible that the damaging force might have been transmitted over the surrounding structure, causing secondary damage in areas other than the primary damage area. If the secondary damage is not discovered, forces distributed through the structure during normal airplane operation may cause this structure to fail. Careful investigation of all structure across which the forces must travel must be made, and parts must be checked for possible misalignment.

PRELIMINARY EXTERNAL INSPECTION.

A great deal may be learned about the condition of the internal structure of an airplane by a careful examination of the skin on the wings, stabilizers, and fuselage. Some indications might be buckle patterns on surface skin of stabilizers and along the sides, top, and bottom of fuselage. Loose, tipped, or sheared fasteners, and joggles or bulges in the skin at structural points or where heavy fittings are attached, indicate that a thorough inspection of the underneath structure should be made. Inspect fairings and other nonstructural parts for tears, cracks, buckles, and misalignment. Any unusual appearance of these parts is reason for a close inspection of the structures they cover.

Check also the fit of doors, covers, canopy, etc. Anything unusual about their fit or alignment may indicate a warped or sprung structure, and will be cause for inspection of that structure.

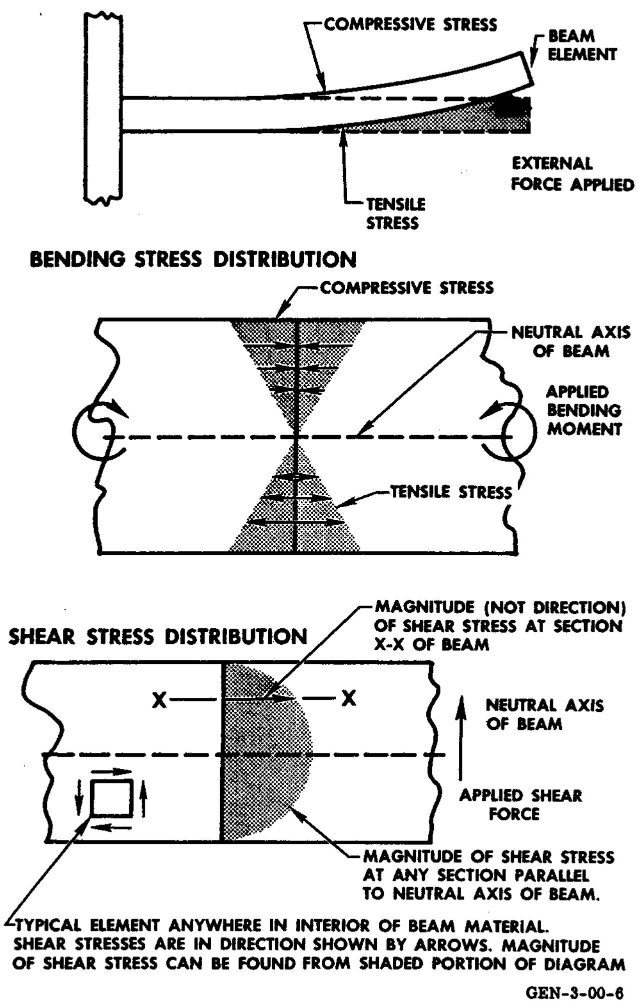


Figure 1-28. Typical Beam Elements

When possible, actuate control surfaces, flaps, speed brakes, etc. Observe these units closely throughout their travel. They should operate freely and without binding or chafing. In the zero or closed positions, check the units for proper alignment with adjacent members.

DETAILED VISUAL INSPECTION.

Carefully inspect all areas adjacent to the obvious damage, remove access panel and doors (figures 1-3 through 1-5) and inspect structure, forgings, and other machined parts for cracks and for evidence of having been moved. This can often be done by observing the paint around the edges, tipped bolt or rivet heads, or a slight space at the edge of faying surfaces. When possible, remove two bolts from a suspected fitting. Examine bolts for evidence of shearing or bending. Check bolt holes for elongation.

Inspect supporting structures for buckling, warpage, and joggles. Check for sheared, loose, or tipped fasteners. Alignment with adjacent members is also important. Using a straightedge, check known flat areas such as spar webs, frame webs, and bulkheads. Any deviation should be thoroughly investigated.

When an airplane has been damaged, or damage is suspected, a close examination is justified for all areas where major components are joined, or where heavy weights are supported. The principal areas of this nature, with their supporting structures, are as follows:

- Wing center section to outer wing panel
- Wing to fuselage attachment points
- Fuselage rear section attachment point
- Horizontal stabilizer attachment point
- Vertical stabilizer attachment point
- Rudder hinge
- Aileron and rudder balance weight attachment point
- Landing gear trunnion and braces
- Engine mount

Continue the inspection throughout the disassembly and repair of the airplane. During this time, indications of unsuspected damage are often revealed. When new parts being installed do not fit properly, find out why. It may be because of damage which has been overlooked.

After movable members have been installed, move them through their full range of travel as soon as possible. Check closely for freedom of movement and proper clearances and alignment. It is often helpful to install a control surface or other mechanism on a temporary basis while the structural repair is in progress. It will aid in the alignment of parts being repaired or replaced and may also reveal unnoticed damage.

INSPECTION TECHNIQUES.

IDENTIFICATION OF MATERIALS BY CHEMICAL TESTING.

It is often necessary to distinguish 7075 from the other aluminum alloys, and magnesium alloys from those of aluminum.

IDENTIFICATION OF 7075 ALUMINUM ALLOY BY CHEMICAL TEST. A chemical spot-test kit, containing the solutions and equipment which will aid in this type of inspection, can be made up. The formula for preparing the 7075 spot-test solution, with specification numbers of chemicals used, is as follows:

- 5 grams of cadmium sulphate (commercial)
- 5 milliliters of hydrochloric acid (Federal Specification O-A-86)
- 3 grams of sodium chloride (commercial)
- 100 milliliters of distilled water

Other materials and specification numbers are as follows:

- Chemical film solution (Specification MIL-C-5541)
- 20% solution chromic acid (Federal Specification O-C-303)
- Phosphoric acid cleaner (Specification MIL-C-5410, Type I)
- Silver nitrate crystals (commercial)
- Methyl ethyl ketone (Federal Specification TT-M-261)
- Nitric acid (Federal Specification O-A-88)

Most of the solutions are both poisonous and corrosive. Reasonable precautions should be taken in handling them. If any solution is spilled on the skin, immediately wash the area well with cold, running water. If the area feels irritated (stings or feels warm) after washing, report to the dispensary for treatment.

Because 7075 is an aluminum alloy which contains zinc, it is quickly and accurately identified by a simple chemical test. Because there is one percent zinc in the cladding of 7075, this test will work on either bare or clad material.

Remove paint, if present, from an area about the size of a dime. Clean area thoroughly with methyl ethyl ketone (Federal Specification TT-M-261). Remove surface film by lightly sanding with No. 320 grit abrasive cloth. To avoid contamination, use a fresh piece of abrasive cloth for each test.

Place one drop of 7075 spot test solution on the prepared surface. Allow to stand one minute; then rinse off the test solution with water and examine the spot. If the alloy is 7075, a dark gray deposit of cadmium will be seen. It is recommended that the sample pieces of 7075 and 2024 included in the kit be run with the test piece for comparison.

After the alloy is identified, it should be refinished as follows if material is to remain unpainted:

1. Remove any dark deposit with Bon Ami or very fine abrasive cloth.

2. Swab the area with phosphoric acid cleaner (Specification MIL-C-5410, Type I) and keep wet for 3 to 5 minutes.

3. Rinse thoroughly with water. Dry to avoid spotting.

After the alloy has been identified it should be refinished as follows if material is to be painted:

1. Clean area as outlined in the three preceding steps.

2. Swab cleaned area with chemical film solution (Specification MIL-C-5541) and keep wet for 3 to 5 minutes.

3. Rinse thoroughly with water and allow to dry. (Do not rub.)

4. Apply two coats of zinc-chromate primer and any colored finish coats required.

IDENTIFICATION OF MAGNESIUM ALLOYS BY CHEMICAL TEST. Magnesium alloy parts may be separated from those made of aluminum alloys by using the following spot-test procedure: Remove paint, if present, from an area about the size of a dime. Wipe area clean with methyl ethyl ketone (Federal Specification TT-M-261). If methyl ethyl ketone (MEK) is not available, lacquer thinner may be substituted.

Dissolve a few silver nitrate crystals in a small amount of distilled water. Place one or two drops of the silver nitrate solution on the test area. If the material is magnesium, the clear liquid will immediately turn black. If the material is an aluminum alloy, there will be no reaction. It is recommended that the operater check the aluminum and magnesium samples included in the test kit to familiarize himself with these reactions.

Silver nitrate in solution cannot be stored for long periods. However, if tests are to be made frequently, a small bottle of solution may be made up and used until it starts to darken or become cloudy.

The area tested must be thoroughly washed with water and treated as follows: If the material is an aluminum alloy, refinish as directed under "Identification of 7075 Aluminum Alloy by Chemical Test."

If material is a magnesium alloy:

1. Wash test area thoroughly with water.

2. Remove black stain with Bon Ami or fine abrasive paper.

FLUORESCENT AND NONFLUORESCENT PENETRANT ACTION

GENERAL

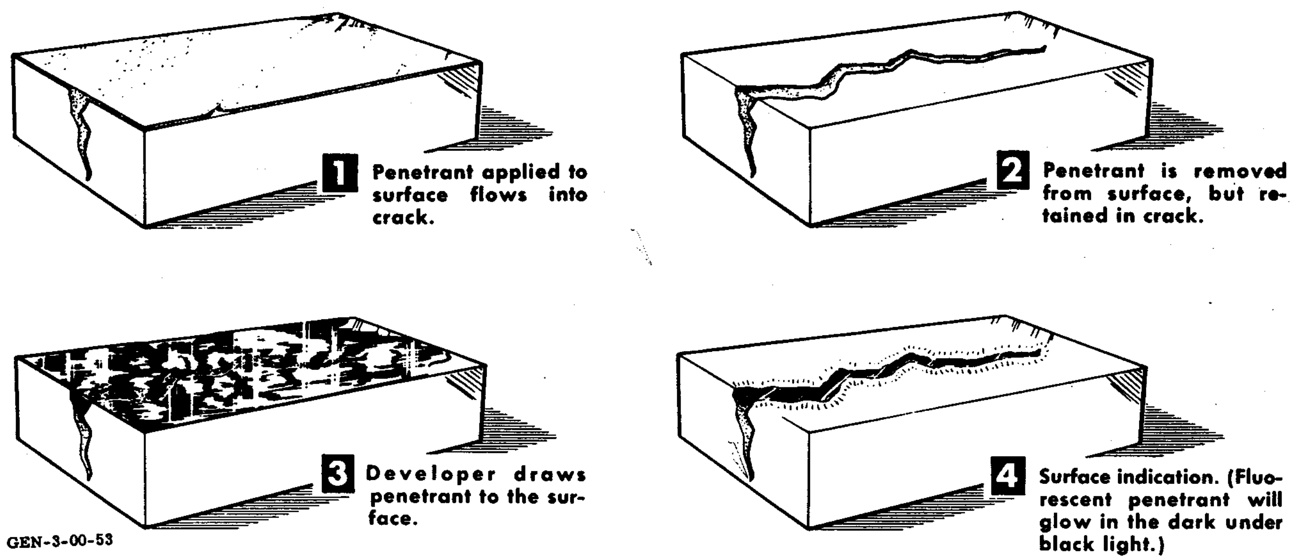


Figure 1-29. Fluorescent and Nonfluorescent Penetrant Action

3. Swab with 20 percent solution of chromic acid (Federal Specification O-C-303). Allow to stand 2 minutes.
4. Rinse with water and dry.
5. Apply one coat wash primer (Specification MIL-C-15328 or Specification MIL-C-8514).
6. Apply two coats of zinc-chromate primer (three coats on areas containing dissimilar metals).
7. Apply colored finish as required.

CHEMICAL TEST FOR DAMAGED CLADDING.

To determine whether the cladding on alclad aluminum alloy has been penetrated by scratches or nicks, thoroughly clean the surface with methyl ethyl ketone (Federal Specification TT-M-261) and apply a 10-percent solution of sodium hydroxide to the surface. If the damage has gone through the alclad coating, a black or dark brown discoloration will appear. Because of its corrosive action, the solution should not remain on the surface more than 2 minutes. After the test is completed, the area must be thoroughly washed with water.

PENETRANT INSPECTION METHOD.

Penetrant inspection materials are of two types, fluorescent, which fluoresces or glows strongly when exposed to black light (near ultraviolet), and nonfluorescent, which contrasts strongly with its background when examined under white light. Either type of penetrant inspection may be used when a directive does not state a specific type.

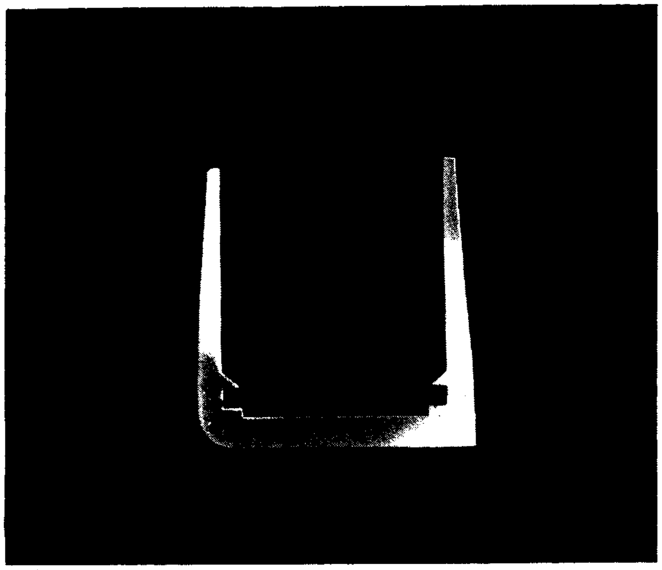
The penetrant method of inspection may be used for detection of surface defects or indications on nonabsorbent nonporous materials and parts which will not be harmed by chemical or physical reaction with the inspection materials. Typical examples of items which may be inspected are machined steel parts, aluminum castings, glazed ceramic and glass items, and certain plastic parts.

Parts to be inspected must be free of paint and thoroughly cleaned, using approved paint removers and cleaning solvents. Chemicals will be handled and stored in accordance with applicable Technical Orders.

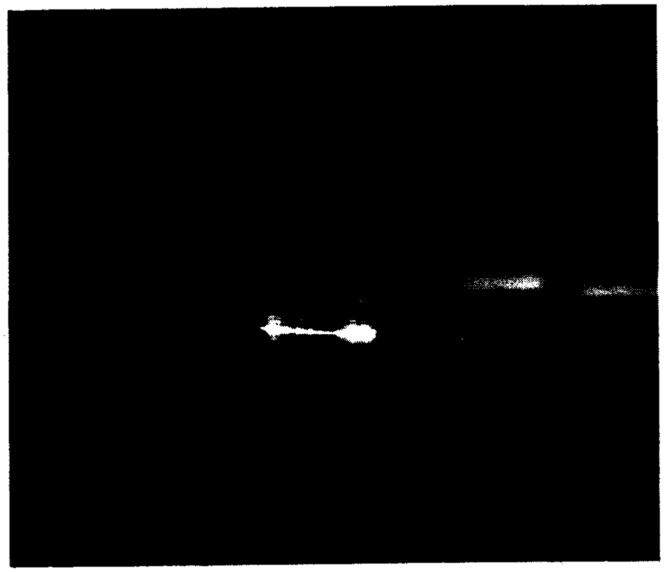
The surface to be inspected should be dry and free from dirt, scale, oil, or grease. Parts may be vapor-degreased or cleaned with solvent.

Apply dye penetrant by brush or spray and allow to stand for about 2 minutes. Re-cover the same area with additional penetrant and allow to stand for another 3 minutes. For extremely small flaws such as grinding checks, apply penetrant three times and allow 5 minutes penetration time after each application.

FLUORESCENT PENETRANT INDICATION OF CRACK



CROSS SECTION VIEW OF CRACKED CHANNEL



FLUORESCENT PENETRANT INDICATION OF SAME CRACK AS SEEN IN A MIRROR

GEN-3-00-54

Figure 1-30. Fluorescent Penetrant Indication of Cracks

Wipe off as much penetrant as possible with a clean, dry rag and follow with a rag impregnated with solvent. The surface should then be wiped dry with another clean rag. It is important to *thoroughly* remove all penetrant so as to avoid false indications. A cotton swab dipped in solvent is helpful in drying drilled holes, threads, re-entrant angles, etc. Do not soak parts by immersing them in cleaner, as this might weaken indications. Do not dry parts with strong air blast.

The developer must be kept thoroughly mixed while in use. Before applying it, shake bottle vigorously. Apply a thin, even coat of developer and observe part closely as developer dries. Blowing on the part gently with the mouth speeds the drying and is sometimes helpful in detecting small cracks. Make only one application of developer, as repeated applications tend to wash away small indications.

Cracks or voids will exude dye (figure 1-29) and cause a bright red indication. A red line indicates a crack, cold shut, or lap. Random red dots show pits or porosity. A series of red dots in a line indicates a very tight crack. The extent or volume of the discontinuity can be estimated by the width of the indication, or amount of spreading out. A diffused pink color shows that all of the penetrant was not thoroughly cleaned off before the developer was applied. If a very tight crack is suspected, allow several minutes for the indications to appear.

It is important to avoid contaminating the solvent and developer with the dye penetrant. This dye is oil-soluble and can be removed from the hand, etc, with ordinary solvents. All four solutions are chemically noncorrosive and can be left in contact with metals as long as desired. Keep all solutions tightly capped to minimize evaporation when not in use.

Procedure for fluorescent inspection is very similar to that for nonfluorescent, except that the black light inspection must be made in a darkened booth or hangar. Detailed instructions for use of the equipment and material may be obtained from the manufacturer. A field inspection kit should consist of the following, or their equivalent:

- Zyglo penetrant
- Zyglo dry developer powder ZP-2
- Zyglo developer ZP-3
- Black light—Magnaflux ZB-26

(Refer to index for sources of commercial products.)

PORTABLE X-RAY INSPECTION METHOD.

X-rays are electromagnetic vibrations similar to light,

PORTABLE X-RAY APPLICATIONS

GENERAL

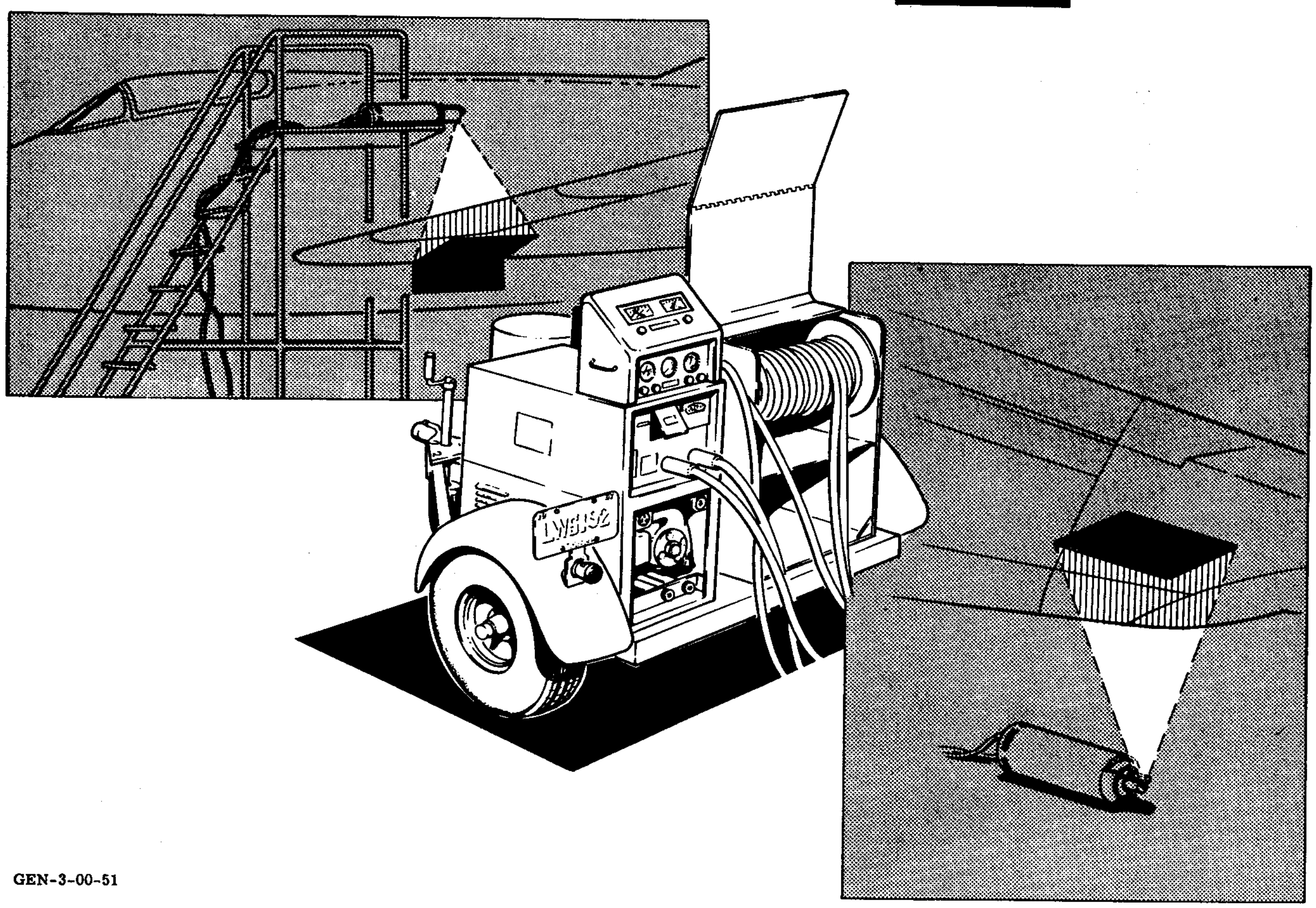


Figure 1-31. Portable X-ray Applications

but of a wave length short enough to pass, to a limited extent, through solid materials. X-rays also have the ability to expose photographic film while it is protected in a lightproof pack. Therefore, X-rays passing through material such as an aircraft part, are capable of producing a shadow picture on film. With proper exposure, slight changes in density of the material may be visible.

This method of inspection can be valuable in gaining information about the internal condition of materials. It does have limitations. Thorough training in methods and procedures in use of X-ray equipment is essential. To be able to understand what the X-ray reveals is also a skill which must be developed.

When inspecting airplanes which have been damaged by hard or unusual landings, or by exceeding established flight limits, X-ray can be a very valuable aid. It has also been widely used for periodic fatigue-checking of critical joints and fittings on airplanes which have accumulated a large number of flying hours.

X-rays will reveal cracks in hidden sheet metal parts such as ribs and spar webs. When exposures are taken with the X-ray beam axis parallel to the plane of mating surfaces, separation of those surfaces will be revealed. Enlarged bolt holes, and sheared or partially sheared fasteners may also be detected. Cracks in extrusions and heavy fittings can be seen when some portion of the surface of separation are parallel to the X-ray beam axis. Cracks cannot be seen when the X-ray beam is at an angle to the separated surfaces. (See figure 1-32.)

In X-ray inspection of assembled aircraft components, many factors must be considered. One of these factors will be how great and how confusing a mass of material must be penetrated along with the material in question.

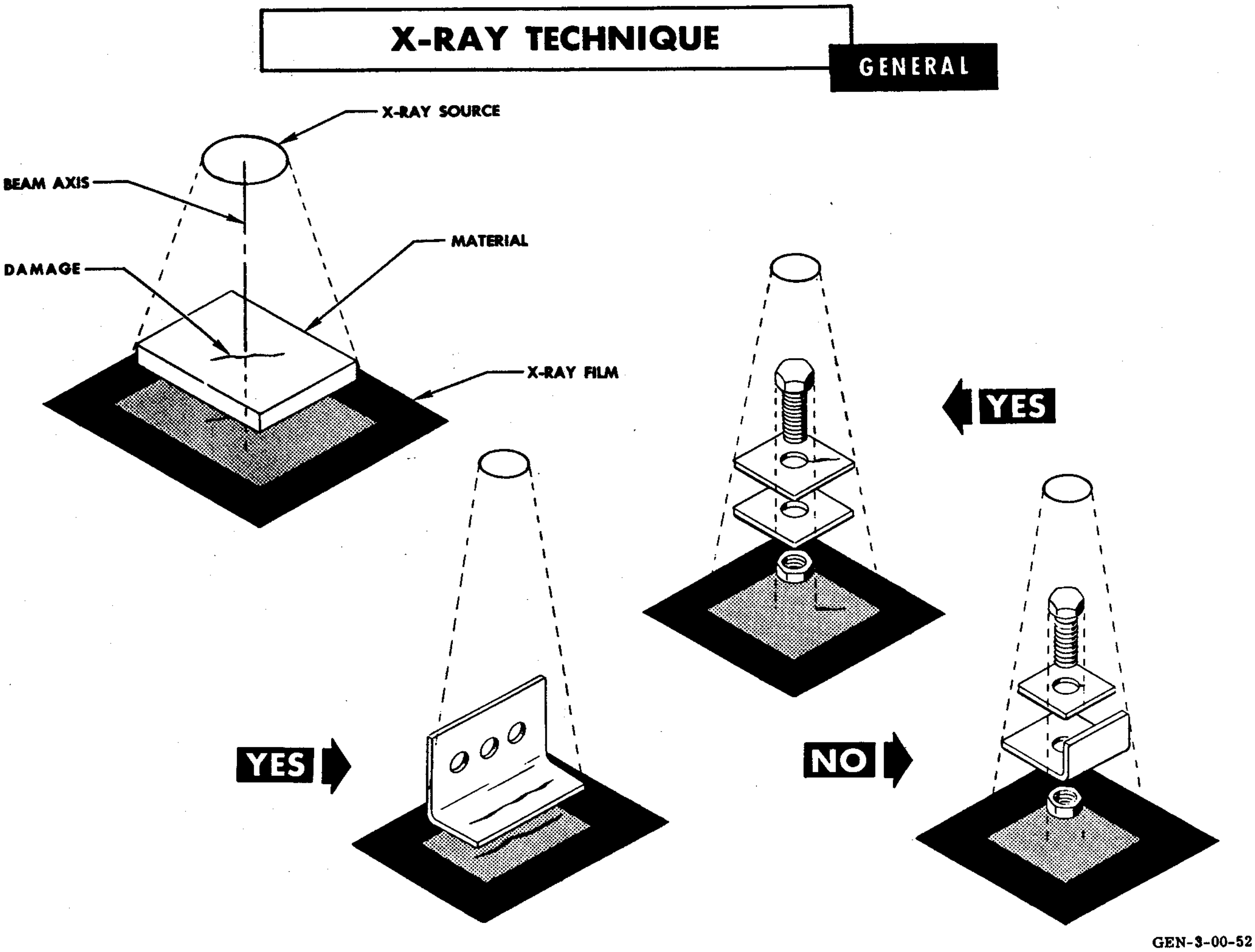


Figure 1-32. X-ray Technique

When the unwanted material is too thick, or would produce confusing patterns on the film, it makes interpretation difficult, if not impossible. Also to be considered is the presence of sealing compound, which can partially conceal cracks and may give indications similar to cracks where there are none. When there is any doubt, the sealing compound should be removed and another exposure taken. Liquids are another factor to consider. X-rays are harmless to all aircraft materials and fluids, including fuel. The transformer head is a sealed unit, and it may be used on a fueled airplane. However, when exposures are made through fuel or oil cells, the cells should be drained, because even a small amount of liquid tends to cloud the indications.

When a request for X-ray services from another base is being made and personnel making the request are not familiar with portable X-ray procedure, the exact parts to be inspected should be stated in the request. Personnel familiar with the airplane and X-ray possibilities will then be able to determine whether or not the trip would be of practical value.

PORTABLE X-RAY INSPECTIÔN METHOD SAFETY MEASURES. Safety of personnel is of extreme importance. A portable unit cannot have all the built-in protection that stationary units have. Splash radiation from the object being X-rayed and concrete floors must be considered. All safety information relative to the equipment in use should be obtained and used in establishing procedures. The area which must remain clear when X-ray equipment is being used may be found by using a Geiger counter or scintillator. This should be done by the radiological defense officer, and the findings should be approved by the medical officer. Personnel regularly using X-ray equipment should wear radiation-exposure badges. These badges, which are miniature film packs, measure the amount of radiation the wearer has received. To avoid injury from overexposure, the film should be developed and examined at regular intervals. The radiological defense officer or medical officer will have information on how to get these badges and what to do with them.

SKIN BUCKLING.

The mere presence of wrinkled or buckled skin is not positive evidence of an overloaded structure. It is not uncommon to find permanently buckled skin on an airplane which has never been overloaded. These buckles may appear on new airplanes because of manufacturing tolerances, or on others merely as evidence of age. In many examples of present day design, the vital importance of saving weight has led to types of structure in which the skin is designed to buckle, even to a large degree, under normal loading within the established flight limits of the airplane. Under perfect circumstances, these buckles disappear each time the loads are removed. It is, therefore, important to remember that buckled structure is not necessarily weakened structure. However, it is also important to remember that, although buckles themselves do not generally detract from the strength of the structure, their presence may be an external indication of trouble elsewhere. Unfortunately, since no hard and fast rules can be laid down, it must be left to experience and judgment to determine when an internal inspection should be made. For example, the sudden appearance of buckles after any one flight, where there were no buckles before, justifies an examination. Buckles that cross rows of rivets should be investigated. These are often a sign of tension failure in the rivets straddling the buckle, or a crippling failure in the flange of the internal member. Unusually severe buckles or sharp creases in the skin often lead to cracks after repeated flexing and, therefore, should be investigated.

Figures 1-33 and 1-34 show certain typical skin buckling patterns and a few of their common causes.

Figure 1-35 shows the resultant inertia loading when certain external loads are applied to various points on the airplanes. The initial loads shown are typical of those frequently occurring in airplane accidents or in high-G pullouts. Initial load or point of contact is represented by a broken arrow. The directions and magnitudes of the resultant inertia loadings are indicated by solid arrows within shaded areas.

When the load pattern charts are used as a guide in determining which areas should be more carefully inspected, it must be remembered that each illustration represents but one given load. In any given accident, there may be secondary loadings which would result in compound load patterns. An example of this might be when an airplane makes a hard two-wheel landing, runs off the runway during runout, and is spun around by contact with another object or because one wheel sinks into a soft surface.

The load pattern charts show only a few of the possible loading conditions. However, they do show how an external load applied to one area is transferred throughout the airframe. A careful analysis of the type of accident or unusual maneuver, and the probable resultant loadings, is of great importance in a thorough inspection.

AIRPLANE ALIGNMENT.

PRELIMINARY ALIGNMENT CHECK.

A preliminary field alignment check is shown in figure 1-36. The airplane need not be in level position. All measurements are taken with a tape measure. If tolerances are exceeded in this check, it is recommended that a major alignment check be given. The major alignment check is made with the airplane in a level attitude, supported on wing and fuselage jacks, with external stores removed, fuel tanks empty, and gear doors closed. The nose gear must be parallel to the centerline of the airplane, with strut fully extended, and the horizontal stabilizer must be in rigged zero position.

LEVELING AIRPLANE.

There are times when an airplane must be placed in a level attitude for repair reasons. The airplane must be jacked high enough to level the fuselage longitudinally with the nose gear completely extended and clear of the ground. Refer to "F-86K General Airplane," T. O. 1F-86K-2-1, for jacking and hoisting procedures.

Note

Personnel will not be permitted on the airplane while it is on jacks and the alignment check is in progress. All reference points must be reached from workstands.

Leveling may be done with a spirit level or a transit. When accurate leveling is required, the transit method of leveling is recommended.

SKIN BUCKLING

GENERAL

FORWARD FUSELAGE

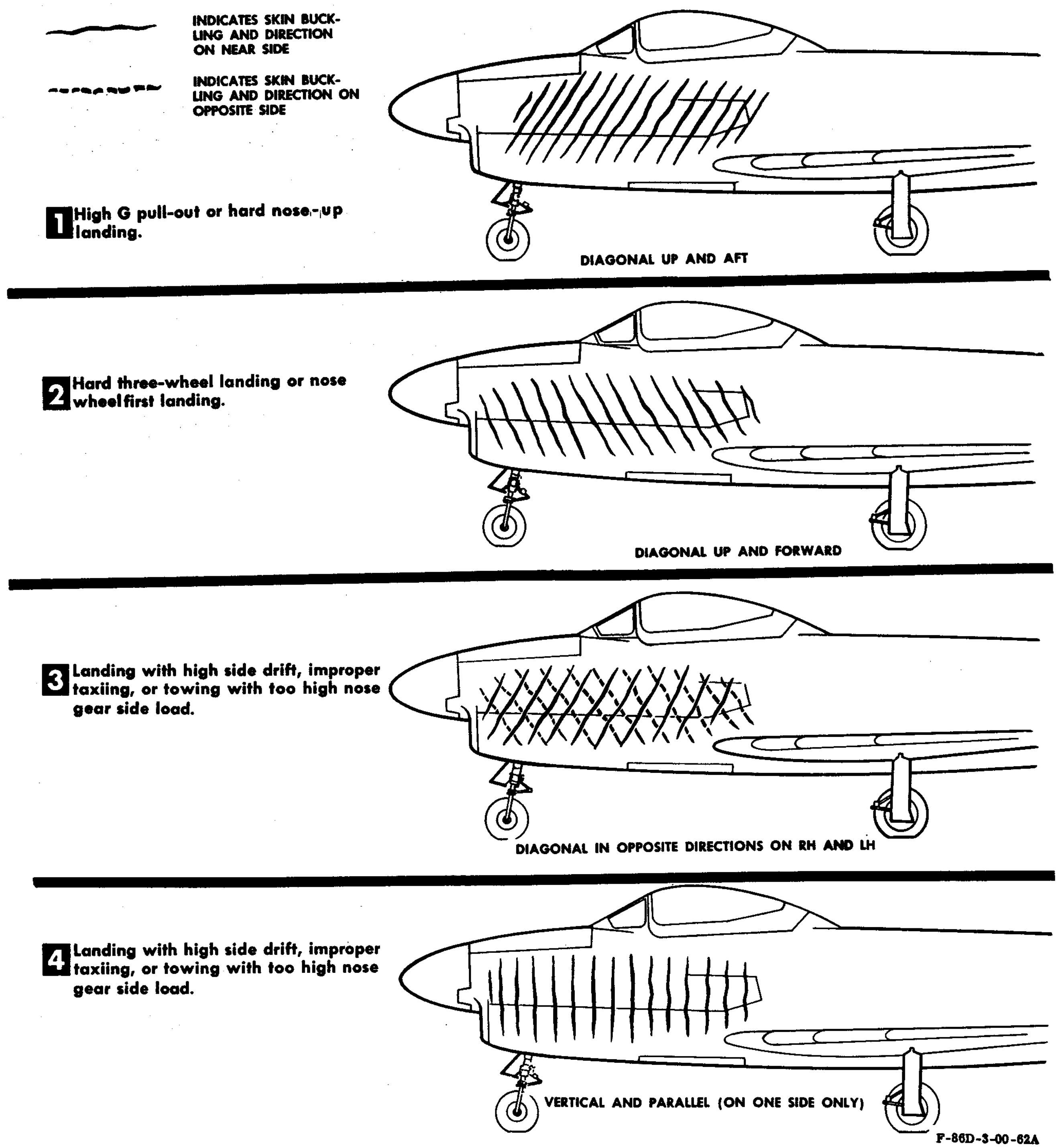


Figure 1-33. Skin Buckling Patterns—Forward Fuselage

SKIN BUCKLING

GENERAL

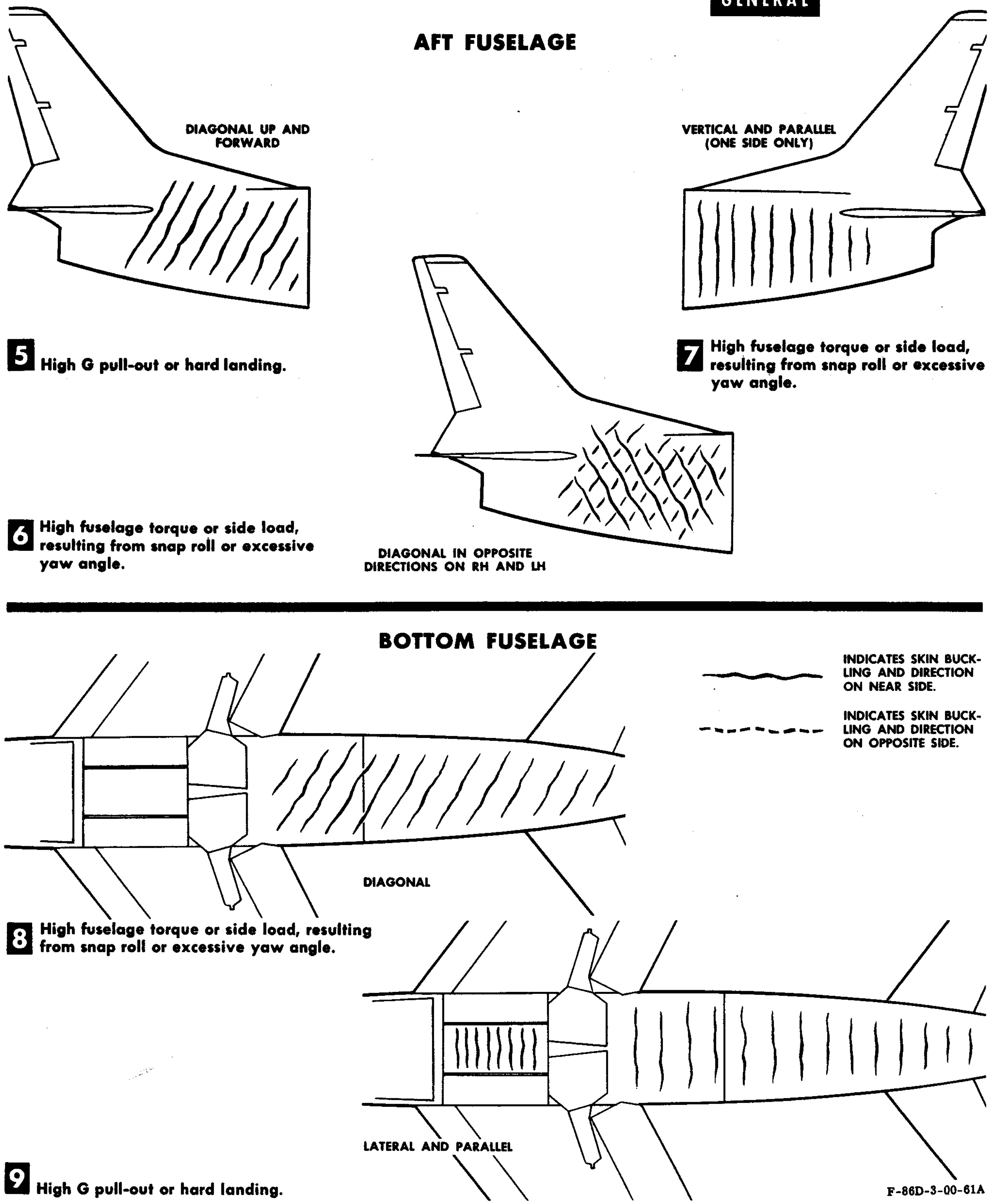


Figure 1-34. Skin Buckling Patterns—Aft Fuselage

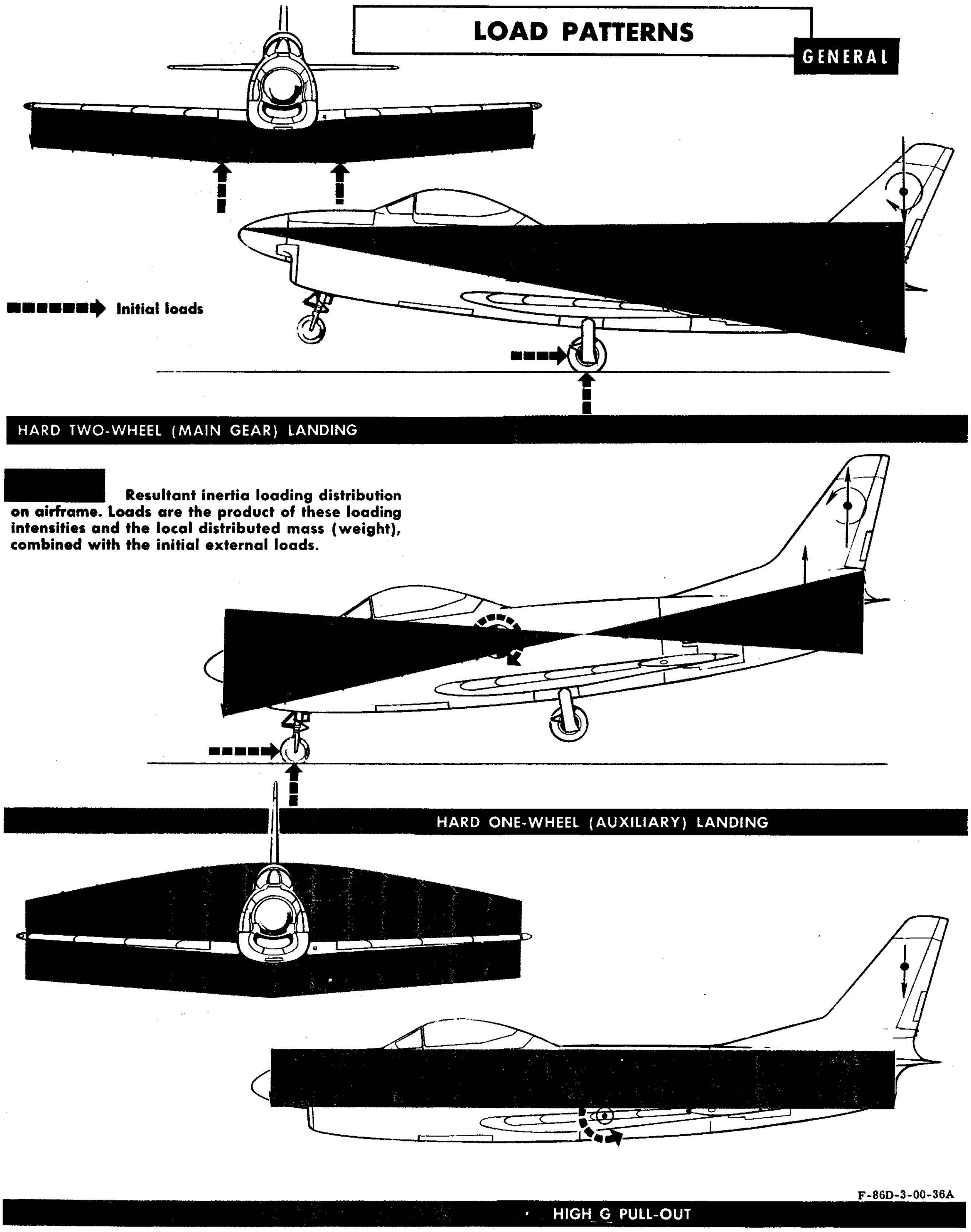


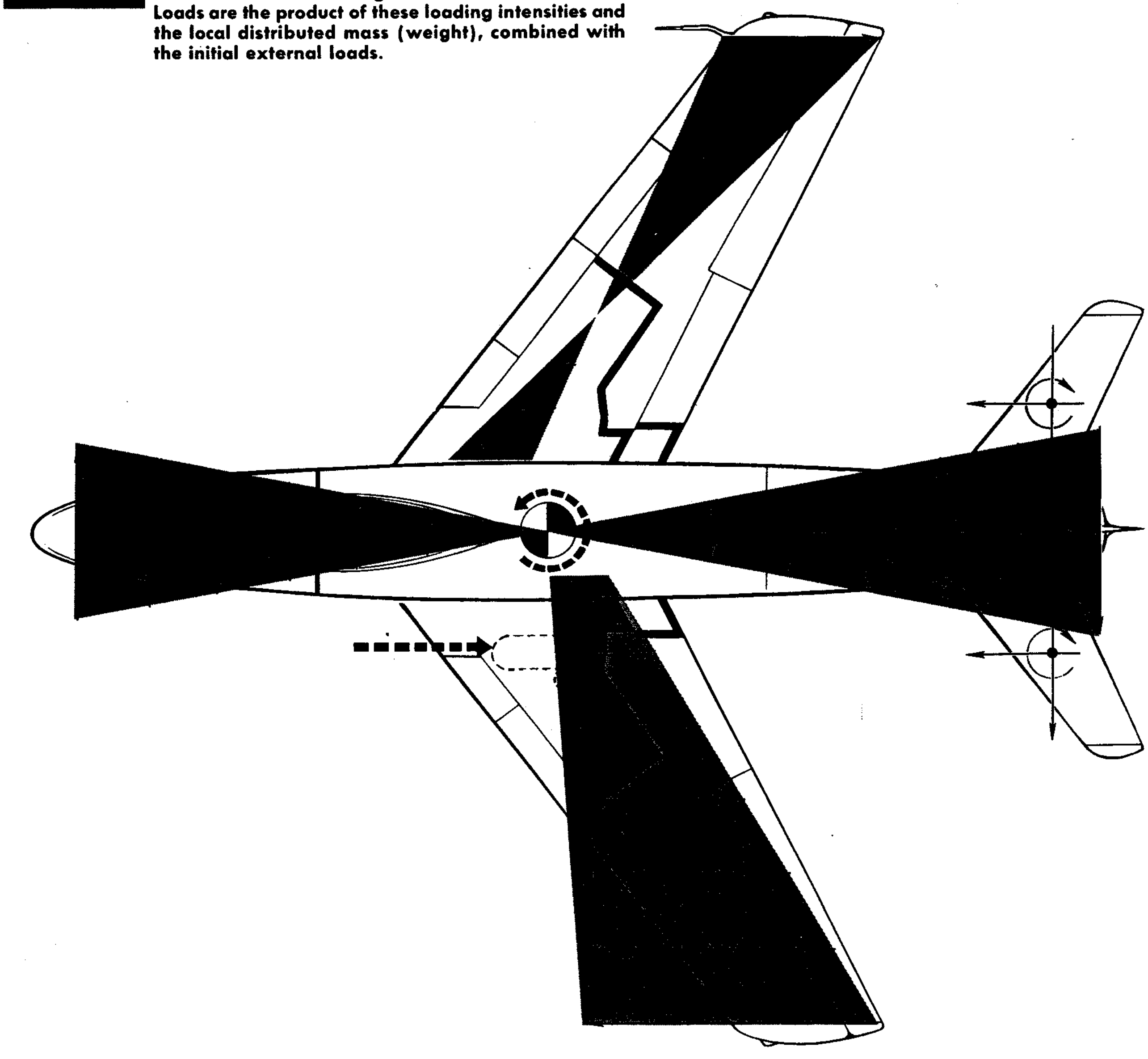
Figure 1-35. Load Patterns (Sheet 1 of 3)

LOAD PATTERNS

GENERAL

Initial loads

Resultant inertia loading distribution on airframe. Loads are the product of these loading intensities and the local distributed mass (weight), combined with the initial external loads.



SUDDEN STOP, LEFT WHEEL (RIGHT WHEEL OPPOSITE)

F-86D-3-00-37A

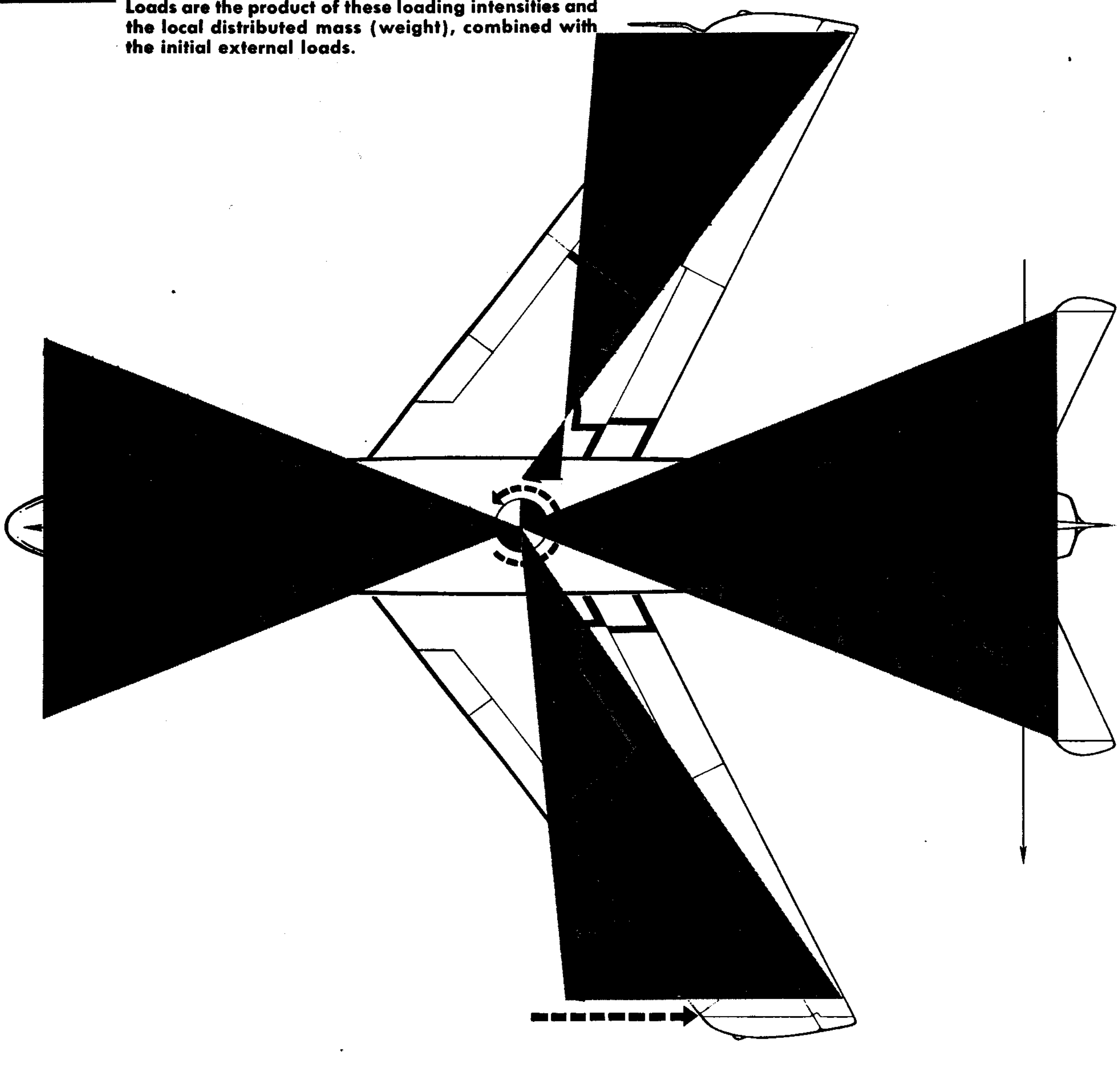
Figure 1-35. Load Patterns (Sheet 2 of 3)

LOAD PATTERNS

GENERAL

Initial loads

Resultant inertia loading distribution on airframe. Loads are the product of these loading intensities and the local distributed mass (weight), combined with the initial external loads.



LEFT WING HITS OBJECT (RIGHT WING OPPOSITE)

F-86D-3-00-38A

Figure 1-35. Load Patterns (Sheet 3 of 3)

LEVELING AIRPLANE WITH SPIRIT LEVEL. Lateral or transverse leveling points are on the cockpit longerons at the marked areas, just aft of the windshield. Two E2201 leveling lugs from the E1565-20 jacking, leveling, and mooring kit may be installed for bubble leveling. The lugs are installed at stations 193 and 211 on the left side of the fuselage after the plug screws are removed. Plumb bob attachment points are on the bottom of the fuselage at station 28.375 and 262.25 on right-hand buttock line 9.6. (See figure 1-37.)

TRANSIT LEVELING AIRPLANE. A surveyor's transit is used for accurate leveling of the airplane and for the subsequent alignment check. To obtain correct information, care must be exercised in leveling both the transit and the airplane. The transit must not be disturbed after it has been leveled for any phase of the check. The airplane must remain undisturbed throughout the alignment check.

For lateral leveling, set transit at a point forward and to the left of the nose. Lower telescope until a clear view can be seen under airplane. Drop scales from check points. Raise or lower wing jacks until readings on both scales are identical. (See figure 1-38.)

For longitudinal leveling, set transit on the left-hand side of the airplane, with telescope at approximately the same level as the longitudinal leveling points. Drop scales from center of leveling point screws. Level airplane by raising or lowering nose jack until readings on scales at both fore and aft leveling points are identical.

ALIGNMENT CHECK.

The airplane alignment data contained in figures 1-39 and 1-40 can be of considerable value in locating deformed structure after a hard landing or over-G maneuver. It should not, however, be considered a standard for determining structural integrity. In some instances, field checks indicate that an airplane is out of the tolerances presented, but experience shows that the airplane is aerodynamically acceptable because its flying qualities, performance, and handling characteristics meet established standards.

A thorough and searching inspection should be made of the airframe with particular attention given to fittings where heavy weight masses are carried. A sampling of fasteners may be removed to be examined for evidence of shear. Buckling of stressed skins, which did not exist before the hard landing or high-G maneuver, is cause for careful inspection of the substructure. Skin buckling in itself is not necessarily detrimental structurally if the buckles do not cross a row of rivets and have not loosened any rivets. When adequate inspection reveals the structure to be sound and functional checks of the controls and landing gear (after hard landings) are normal, a check flight should be made.

If the results of the structural inspection and flight test are satisfactory, the airplane is acceptable for flight status. If flight tests indicate the airplane is either laterally or directionally out of tolerances, a complete alignment check should be made and results of the alignment check and the flight test should be forwarded to the maintenance officer for engineering evaluation.

SYMMETRY CHECK. With the airplane supported on jacks and leveled, drop plumb bob from check points and mark locations on the floor, which is a reference plane in this case. The measurements are then taken from point to point with a tape. The horizontal stabilizer must be set at zero-degree incidence. This can be done with the rigging fixture. Dimensions must fall within tolerances shown in figures 1-39 and 1-40 and be symmetrical within one inch.

ELEVATION CHECK. To check elevation dimensions, the airplane must be level. External stores should be removed and gear doors should be closed. Set transit forward and to the left of the nose. (See figure 1-41.) The telescope must be low enough to have a clear, level sight under the airplane. Point "A" is the zero or reference dimension. Drop scale or steel tape from Point "A" and take reading. Drop scale or steel tape from all other check points and take readings. To obtain proper check dimensions, subtract "A" dimension from all other readings.

Note

For readings on the empennage, the horizontal stabilizer must be in rigged-zero position. The horizontal stabilizer is in rigged-zero position when the true distance, measured from the bottom of the 1/4-inch hole (forward attachment point for stabilizer rigging fixture) to the center of the small hole on the stabilizer leading edge, is 11 9/64 inches.

WING ALIGNMENT—PROCEDURE COMPLETE.

1. Locate wing station points 1 through 5, shown in figure 1-44, on lower side of front spar.

a. Locate wing station point 100 which is at the spar cap break. See locator view in figure 1-44.

b. Measure inboard and outboard along leading edge hinge from wing station point 100 to locate remaining points as shown in figure 1-44. (Wing station points are 1.5 inches aft of the forward edge of the Monahan hinge, as shown in Detail A of the referenced figure.)

2. Locate wing station point 10, which is on lower side of rear spar and toward outboard end.

a. Measure distance from wing point 5 to nearest chordwise row of rivets.

b. Trace this row of rivets to rear spar and transfer distance found in step a. to rear spar skin. (Wing station points along the rear spar are 0.84 inches forward of the skin mating line, as shown in detail B, figure 1-44.)

3. Locate wing station points 6, 7, 8, and 9. Follow same procedure as described for locating point 10, and locate points 6, 7, 8, and 9. They are located from points 1, 2, 3, and 4, respectively.

4. To set up a wing in alignment position, proceed as follows:

a. When wing it attached to an airplane, use jacks at wing and fuselage for positioning. When wing is not attached to an airplane, use four-post adjustable stands for positioning. The stands should be placed inboard of wing station points 1 and 6 and outboard of wing station points 5 and 10. Place stands close to these points but allow room for placing end of scale on points.

b. Set up an optical level in such a position that a scale dropped from each of the 10 wing station points can be sighted through the level.

c. Set up optical level at approximately 5 inches below wing station point 6.

d. Read distance on scale at wing station point 6. This distance will be the zero reference dimension, hereafter referred to as "X."

e. Adjust jack nearest to wing station point 1 so that reading on scale is exactly "X" + 2.04 inches.

f. Adjust jack nearest to wing station point 5 so that reading on scale is exactly "X" + 11.69 inches.

g. Recheck measurements from the three points given (6, 1, and 5), and readjust jacks as necessary to obtain measurements given in steps d., e., and f. When this is done, the wing is in the alignment position.

Note

Dimension "X" must remain exactly the same during the alignment check.

h. Using optical level and a scale, measure distances from remaining wing station points (2, 3, 4, 7, 8, 9, and 10). Enter measurements on chart similar to sample chart shown in figure 1-44.

5. Use in-service tolerances, when alignment figures have been determined, as follows:

a. Check that no wing station point varies more than 0.10 inch from computed dimension. The computed dimension is "X" + standard dimension.

Example from sample chart in figure 1-44:

The *standard dimension* for wing station point 2 is 4.53 inches. The "X" *dimension* is 5.08 inches. The *computed dimension* is 9.61 inches.

The *measured dimension* is 9.51 inches. The difference between the *computed dimension* and the *measured dimension* is −0.10, which is within the tolerance given.

b. Find the algebraic difference between wing station points 1 and 7, 2 and 6, 2 and 7, 2 and 8, 3 and 7, 3 and 8, 3 and 9, 4 and 8, 4 and 9, 4 and 10, 5 and 9, and 5 and 10. The difference between the points given must not be greater than 0.15 inch.

Example from sample chart in figure 1-44 (refer to line 5):

The algebraic difference between wing station point 3 (+0.05) and wing station point 7 (−0.03) is 0.08 inch, which is within the tolerance given.

6. Check aileron hinge brackets as follows:

a. Drop a scale from the centerline of the center hinge bracket. The reading should be "X" + 14.05 (±0.035) inches.

b. Install a serviceable aileron on wing to check inboard and outboard hinge brackets.

Note

A serviceable aileron is one that has been checked in an aileron alignment jig or one that has a serviceable tag.

WING ALIGNMENT—PROCEDURE SUMMARIZED.

1. Visually inspect wing for structural soundness.

2. Locate wing station points 1 through 10. (Refer to "Wing Alignment—Procedure Complete.")

3. Provide an alignment data chart similar to the one shown in figure 1-44.

4. Provide adequate alignment jacking provisions.

5. Set up optical level about 5 inches below wing station point 6.

6. Adjust jacks to obtain specified readings at wing station points 6, 1, and 5. (See figure 1-44.)

7. Check vertical distances from remaining points to line-of-sight plane. They should all be within 0.10 inch of the computed dimension.

8. Check algebraic differences between wing station points 1 and 7, 2 and 6, 2 and 8, 3 and 7, 3 and 8, 3 and 9, 4 and 8, 4 and 9, 4 and 10, 5 and 9, and 5 and 10. The difference between the points of each set must not exceed 0.15 inch.

9. Check vertical distance from centerline of aileron center hinge bracket to line-of-sight plane. It must be "X" + 14.05 (±0.035) inches.

VERTICAL STABILIZER ALIGNMENT.

To check the alignment of the vertical stabilizer, it is necessary to position the vertical stabilizer on a flat and level surface. Establish chord-plane line of vertical stabilizer station 7.312. Set up a transit aft of vertical stabilizer. The transit line of sight must be parallel and 6 inches from the established vertical stabilizer chord-plane line as shown in figure 1-45. Alignment check points are located at the vertical stabilizer hinge centerlines, and on the main and rear spars at stations 38.1 and 74.8. The main and rear spar alignment is determined by transit sight readings taken at alignment check points "A," "B," "D," and "E" at the vertical stabilizer mold line to the transit line of sight. When the transit line-of-sight reading is being taken, the scale must be held at 90 degrees to the transit line of sight. The transit line-of-sight reading plus the reference dimensions should equal 6 inches plus or minus the tolerance in the reference dimension chart. (See figure 1-45.) The maximum bow between attaching points and station 74.8 is 0.095 inch. The maximum variation between reference points "A" and "C" or "D" and "F" is 0.080 inch.

AIRPLANE REFERENCE DIMENSION CHECK.

Meaningful tolerances for reference dimensions are virtually impossible to state. They are design dimensions. Jig tolerances are held to a minimum, consistent with practical and economical production methods. However, an airframe is not an absolutely rigid structure. It is flexible and springy. It is capable of withstanding tremendous forces, but its members must deflect under the influence of these loads. Because of this flexibility, the normal loads imposed on the structure during flight and landings can cause minute shifting, or slipping, of the structural members. Each airplane, after considerable flying, will have settled into an individual pattern (most comfortable for it). Some dimensions may have been changed considerably from design dimensions and jig tolerances, but, under normal conditions, one should not interpret this to mean that damage has occurred. Many airplanes develop pronounced buckles or wrinkles in some portion of the airframe. This condition is generally caused by the shifting and settling of the structure.

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It is a normal and expected condition, provided there is no record of unusually severe loads in the history of the airplane. Tolerances can have value in determining whether an airframe component has been overstressed only if actual dimensions (measured after considerable flight time) are known, since these dimensions would be the true and normal ones for that component.

AFT FUSELAGE REFERENCE DIMENSIONS.

To check alignment of aft fuselage and empennage, support aft fuselage in 205226 dolly, or on jacks at two aft jack points (station 378) and forward jack point, station 291. (See figure 1-42.)

Note

The aft fuselage must be raised high enough so that a clear sight may be taken underneath with a transit.

Set up transit to one side, in line with the fuselage-break bulkhead and approximately midway up on the fuselage. To position aft fuselage, hold scale on face of upper and lower aft fuselage attachment fittings. Swing transit through its vertical axis and take readings on scales. Raise or lower aft end of fuselage until readings are identical. Lower transit so that a clear sight may be taken under the fuselage. Drop scales from center of lower aft fuselage attachment fittings. Take readings on scales. Raise or lower either aft jack until readings are identical. Reading taken on scale at lower aft fuselage attachment fitting is the zero or reference dimension. For proper dimensions, subtract this reading from other readings taken.

Note

For readings on the empennage, the horizontal stabilizer must be in rigged zero position. The horizontal stabilizer is in rigged zero position when the true distance, measured from the bottom of the 1/4-inch hole (forward attachment point of the stabilizer contour fixture to the center of the small hole on the stabilizer leading edge, is 11 9/64 inches.

When doubt exists as to the alignment of a spare aft fuselage, it is recommended that it be installed on the airplane on which it is to be used and the alignment checked in relation to the airplane. This check may be made with a transit or by direct measurement with a steel tape.

FORWARD FUSELAGE REFERENCE DIMENSIONS.

To level the forward fuselage, with wing and aft section removed, support fuselage on aft jack points and on an adjustable cradle or sling at the forward point (station 12.8).

CAUTION

The forward fuselage is extremely nose-heavy with all equipment installed. Refer to "F-86K General Airplane," T.O. 1F-86K-2-1, for jacking and hoisting procedures.

Locate transit behind and slightly below lower aft fuselage attachment fittings. With scales on the lower attachment fittings, adjust side jacks until readings are equal. Move transit to the left side of the fuselage and adjust a little below the longitudinal leveling points. With scales on longitudinal leveling points, adjust forward fuselage support until readings are equal.

Vertical dimensions of the forward fuselage reference points are taken from the aft wing attachment fittings. These will be zero or reference dimension. To obtain proper dimensions, subtract reference reading. (See figure 1-43.)

(Deleted)

FIRE DAMAGE INSPECTION.

CORROSIVE EFFECTS OF AIRCRAFT FIRE-EXTINGUISHING AGENTS AND METHODS OF REMOVAL.

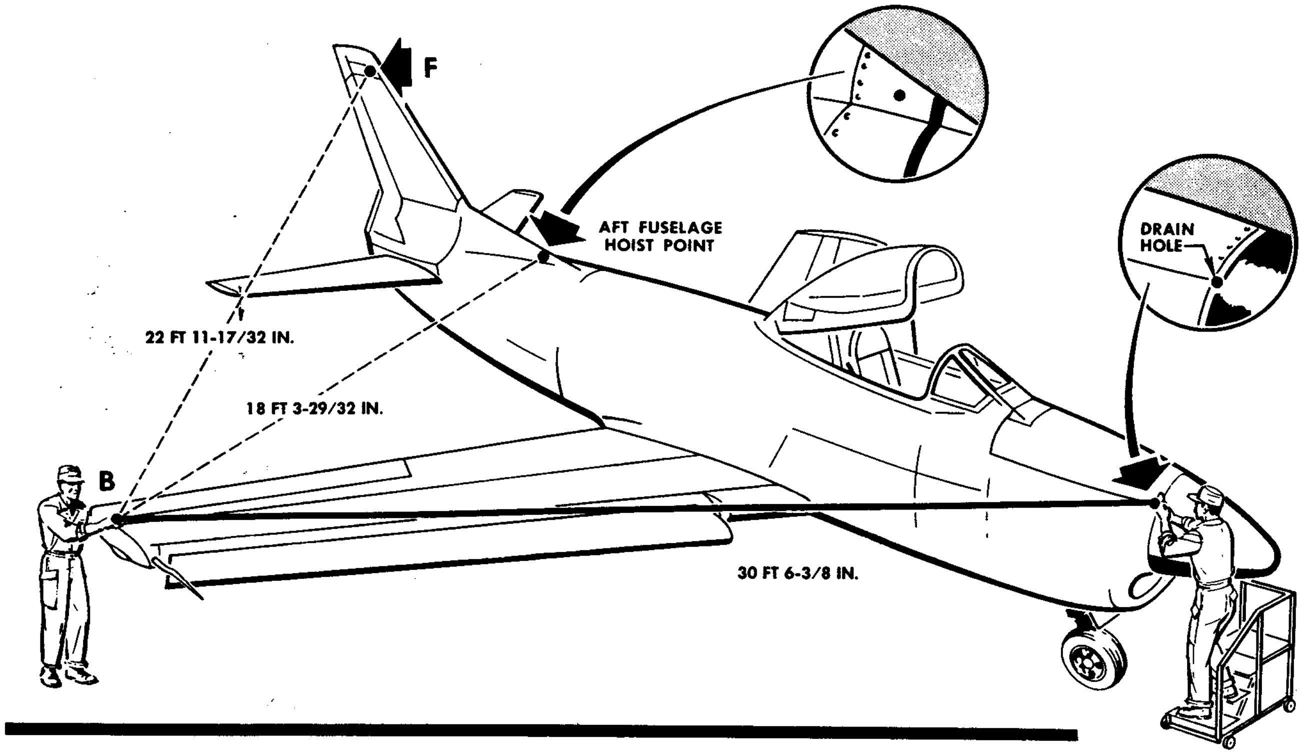
CORROSIVE EFFECTS AND REMOVAL OF DRY CHEMICAL POWDER. This type of extinguisher uses a specially prepared grade of sodium bicarbonate as the extinguishing agent. Heat causes the bicarbonate to decompose, releasing carbon dioxide gas and water vapor to smother the fire. A powdery residue of sodium carbonate (soda ash) will usually remain on and around the heat-affected area.

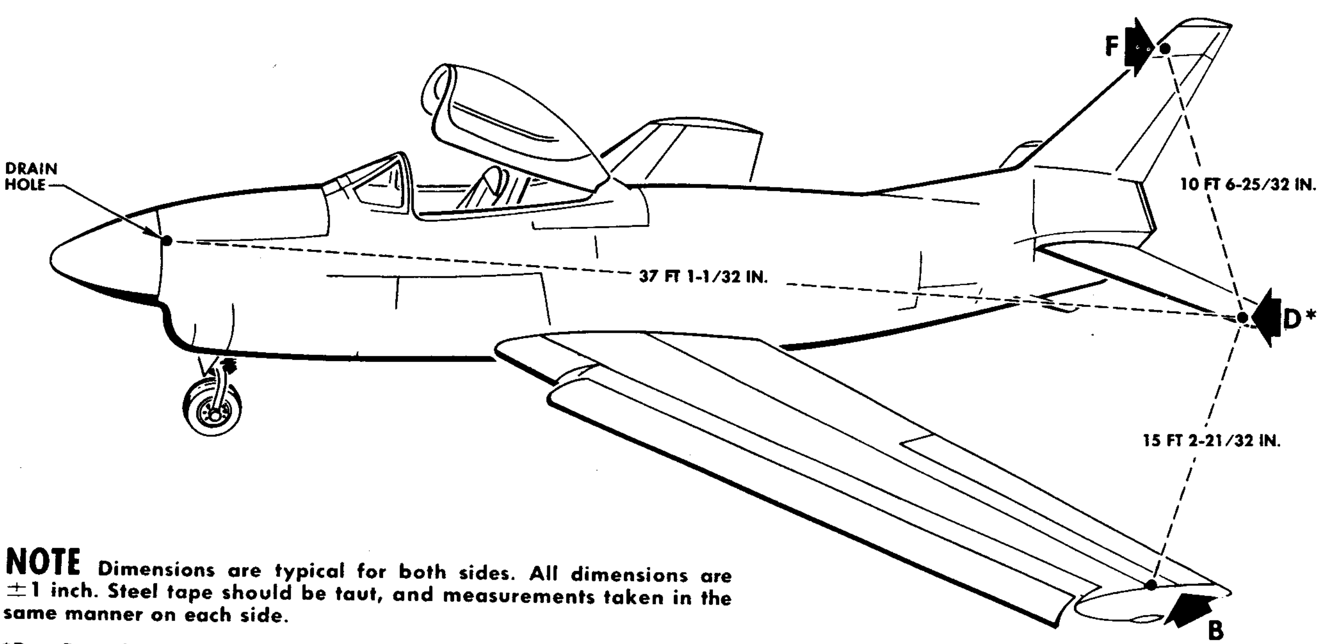
Dry sodium bicarbonate is nonabrasive and noncorrosive. In water solution, it will cause mild corrosion of most metals by either electrolytic or chemical means. However, its rate of corrosion is so slow that it can be cleaned up with little chance of damaging delicate parts. The decomposition product, sodium carbonate, will cause little damage if kept dry, but in solution with water it is strongly caustic and will rapidly attack many common aircraft materials. For this reason, when water is used to clean up after a fire, thorough rinsing is absolutely necessary to eliminate any pockets of strong carbonate solution from the airplane. Care should be taken to prevent sodium carbonate dust from entering the eyes, nose, or mouth during the following cleanup procedure.

In areas of the airplane which are free of electrical equipment, or where it is hermetically sealed, such as in wheel wells, blow any powder residue away with compressed air. Wash the area thoroughly with fresh

PRELIMINARY ALIGNMENT CHECK

GENERAL





NOTE Dimensions are typical for both sides. All dimensions are ±1 inch. Steel tape should be taut, and measurements taken in the same manner on each side.

*D to B reading is taken from bottom of stabilizer. Point D is typical top and bottom.

F-86K-3-00-25

Figure 1-36. Preliminary Alignment Field Check

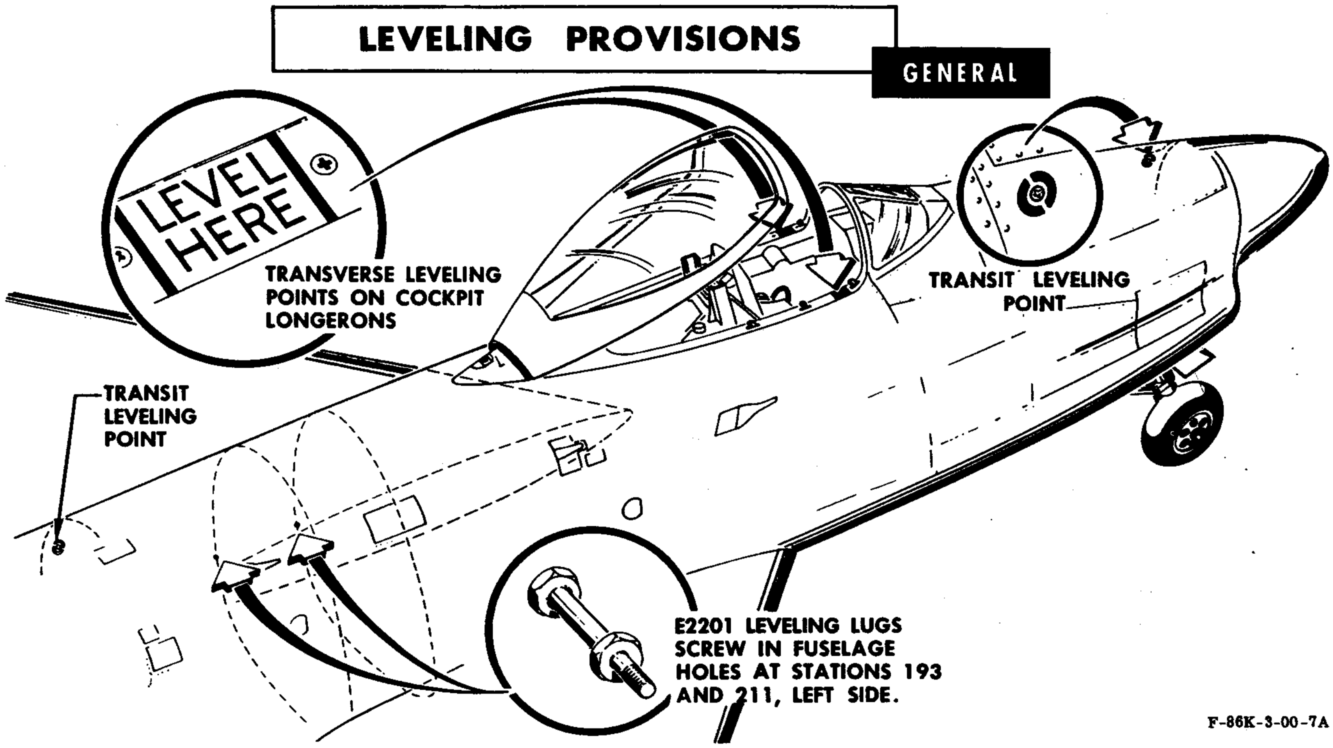


Figure 1-37. Leveling Provisions

water and then dry the area with clean rags and compressed air. When nonsealed electrical and electronic equipment is present, the decision to use water should be determined by how readily this equipment can be removed or dried. (Large bundles of wire will have to be loosened and blown dry.) If it is decided that water would be harmful to any of the airplane equipment, sodium carbonate can be removed satisfactorily by a combination of brushing, vacuum cleaning, and careful blowing with compressed air.

When the powdery residue sticks to hydraulic oil or grease, it should be removed with the solvent approved for removing the oil or grease alone.

CORROSIVE EFFECTS AND REMOVAL OF MECHANICAL FOAM. This fire-extinguishing agent is harmless to all materials not damageable by water alone. It is normally used on major fires that will damage the airplane extensively. The foam may be removed with a high-velocity jet of fresh water and scrubbing with a fibre brush. Dry airplane thoroughly with clean rags and compressed air. Remove all affected, nonsealed electrical and electronic components immediately. Dry and prepare them for overhaul in accordance with current directives.

CORROSIVE EFFECTS AND REMOVAL OF OTHER EXTINGUISHING AGENTS. Carbon dioxide and carbon tetrachloride evaporate rapidly and normally require no cleanup. Chlorobromomethane is highly corrosive. It evaporates rapidly, but if any of the substance is trapped in pockets, it must be cleaned out.

FIRE DAMAGE EVALUATION.

Three methods are used in checking airplane structures after a fire: visual inspection for buckles, canning, and primer discoloration; hardness testing of questionable parts with portable or stationary hardness tester; and tension testing of specimens taken from areas of doubtful values.

In visually inspecting an airplane, the search for buckles or canning is primarily concerned with the possibly weakened condition of primary internal structures. This is especially important when the fire has been in the wing area. It is possible that an area unaffected by the fire directly may have been bent enough to receive a permanent set.

Large (or thick) aluminum parts, such as forgings, are not as quickly affected by heat as are thinner and smaller components. However, when heat has been great enough

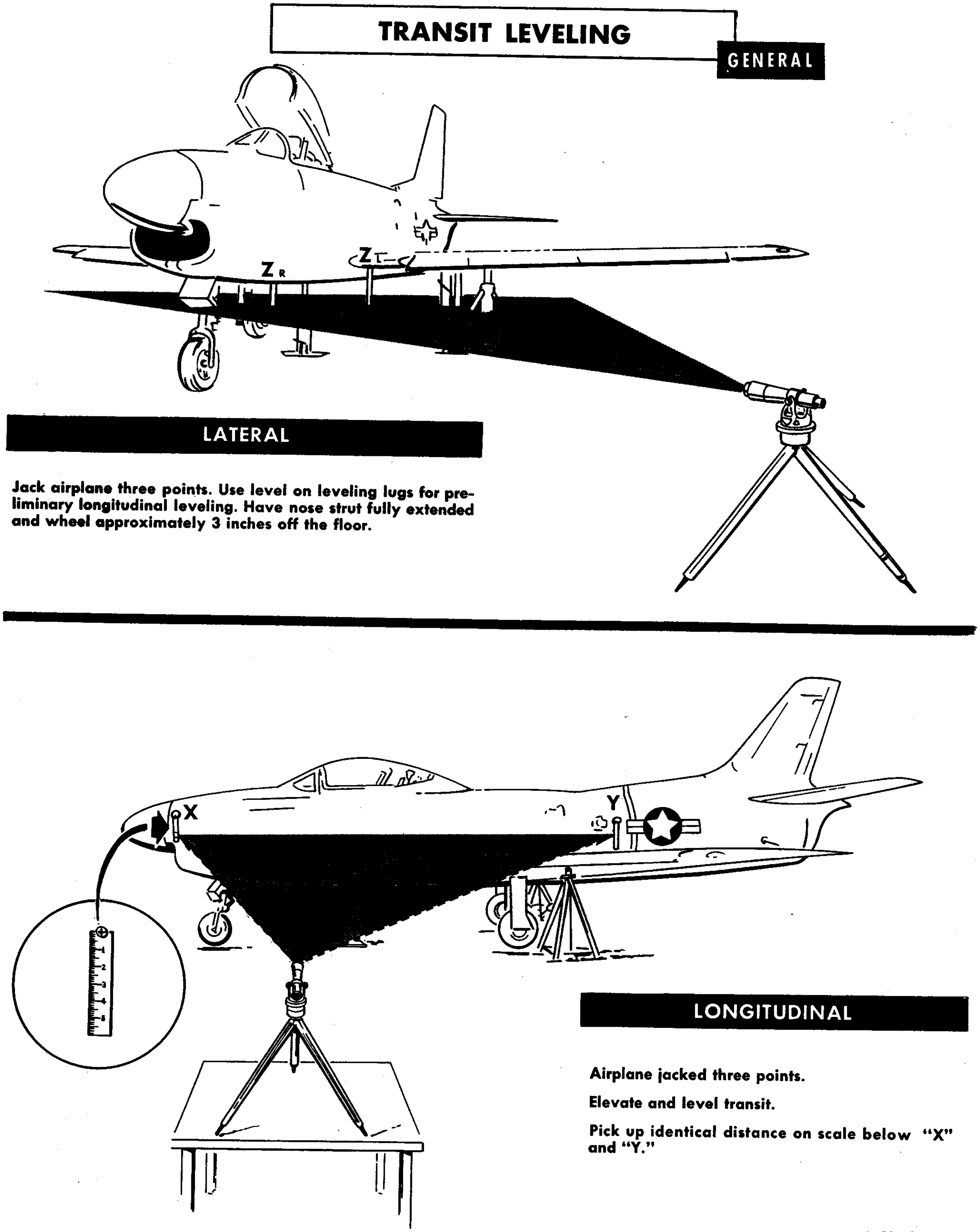


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Figure 1-38. Transit Leveling

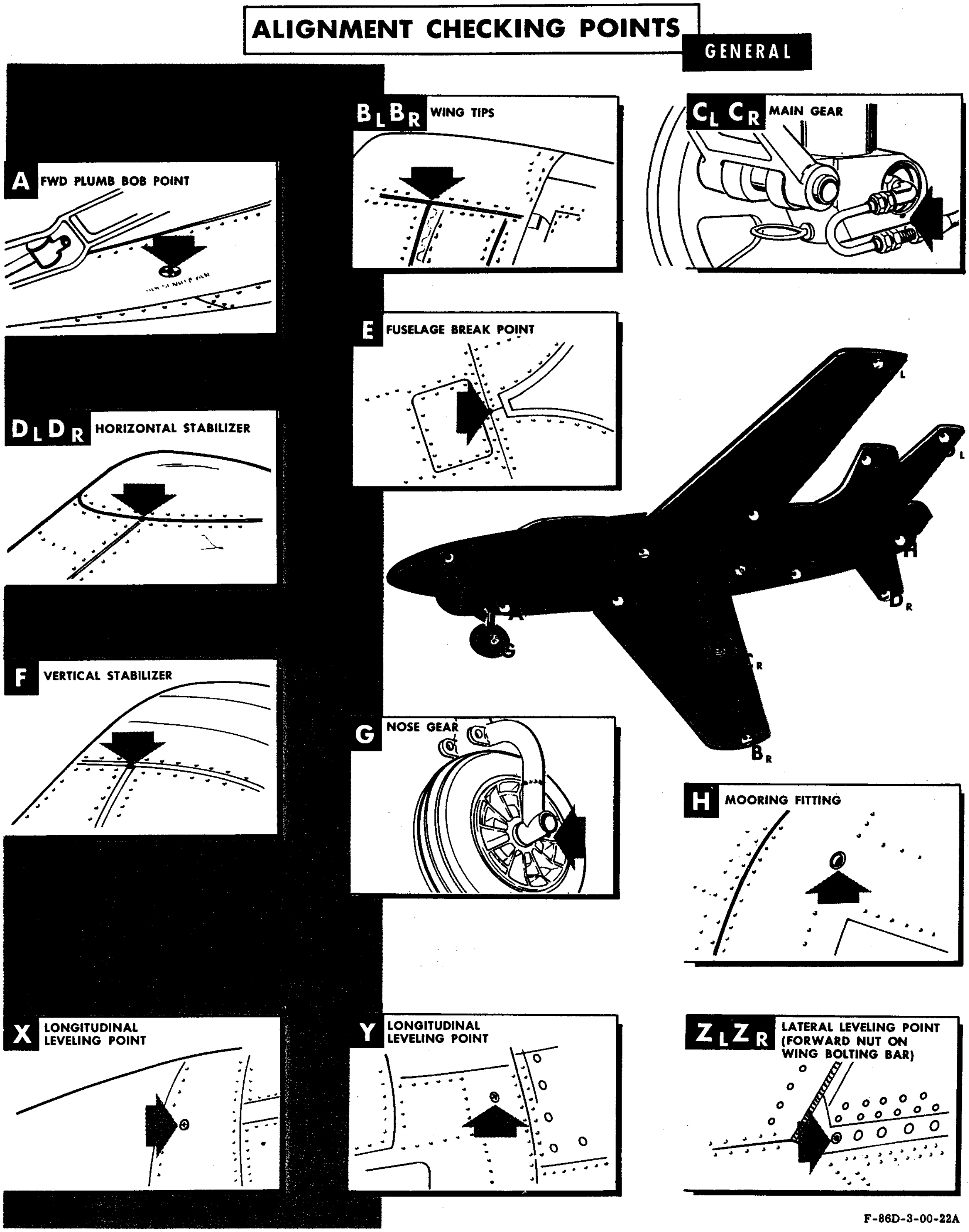
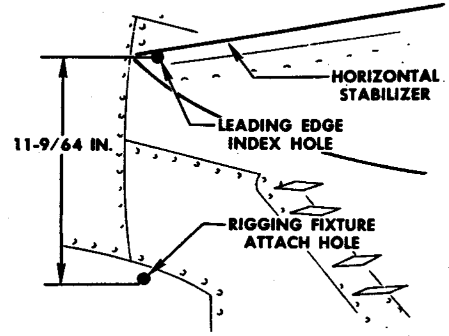


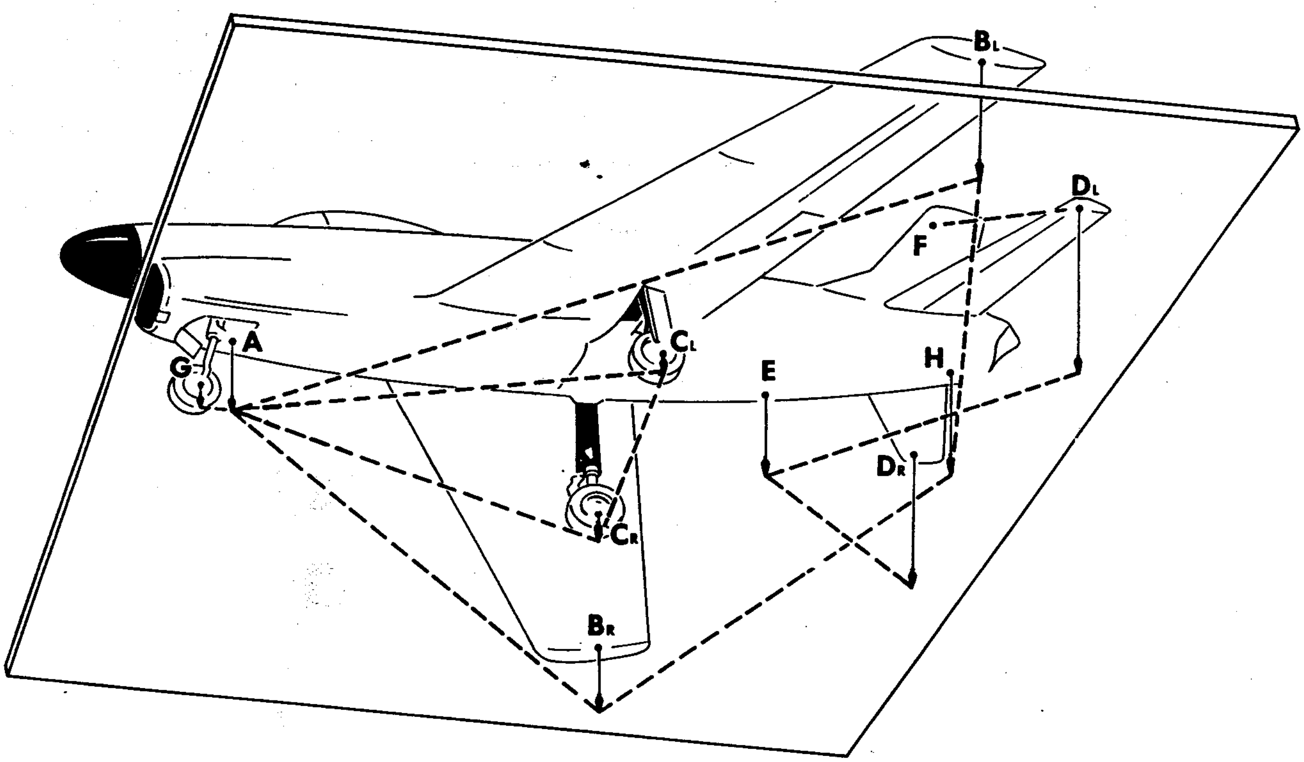
Figure 1-39. Alignment Check Points

SYMMETRY CHECK

GENERAL

NOTE Stabilizer to be at 0-degree incidence





dimensions

PROCEDURE:

Level airplane laterally and longitudinally.

Nose gear strut must be fully extended and nose wheel parallel with centerline of fuselage.

Drop plumb bobs from alignment check points and measure horizontal distances.

$A-B_L$ = 28 FT 10-9/16 (±1) IN.	C_L-C_R = 9 FT 9-1/8 (±1-3/8) IN.
$A-B_R$ = 27 FT 10-15/32 (±1) IN.	B_L-H = 19 FT 1-1/2 (±1) IN.
$A-C_L$ = 15 FT 7-15/16 (±1) IN.	B_R-H = 19 FT 1-1/2 (±1) IN.
$A-C_R$ = 15 FT 1-27/32 (±1) IN.	D_L-E = 14 FT 6-7/16 (±1) IN.
A-G = 1 FT 11-15/32 (±1/2) IN.	D_R-E = 14 FT 6-7/16 (±1) IN.
	D_L-F = 10 FT 6-3/4 (±3/8) IN.
	D_R-F = 10 FT 6-3/4 (±3/8) IN.

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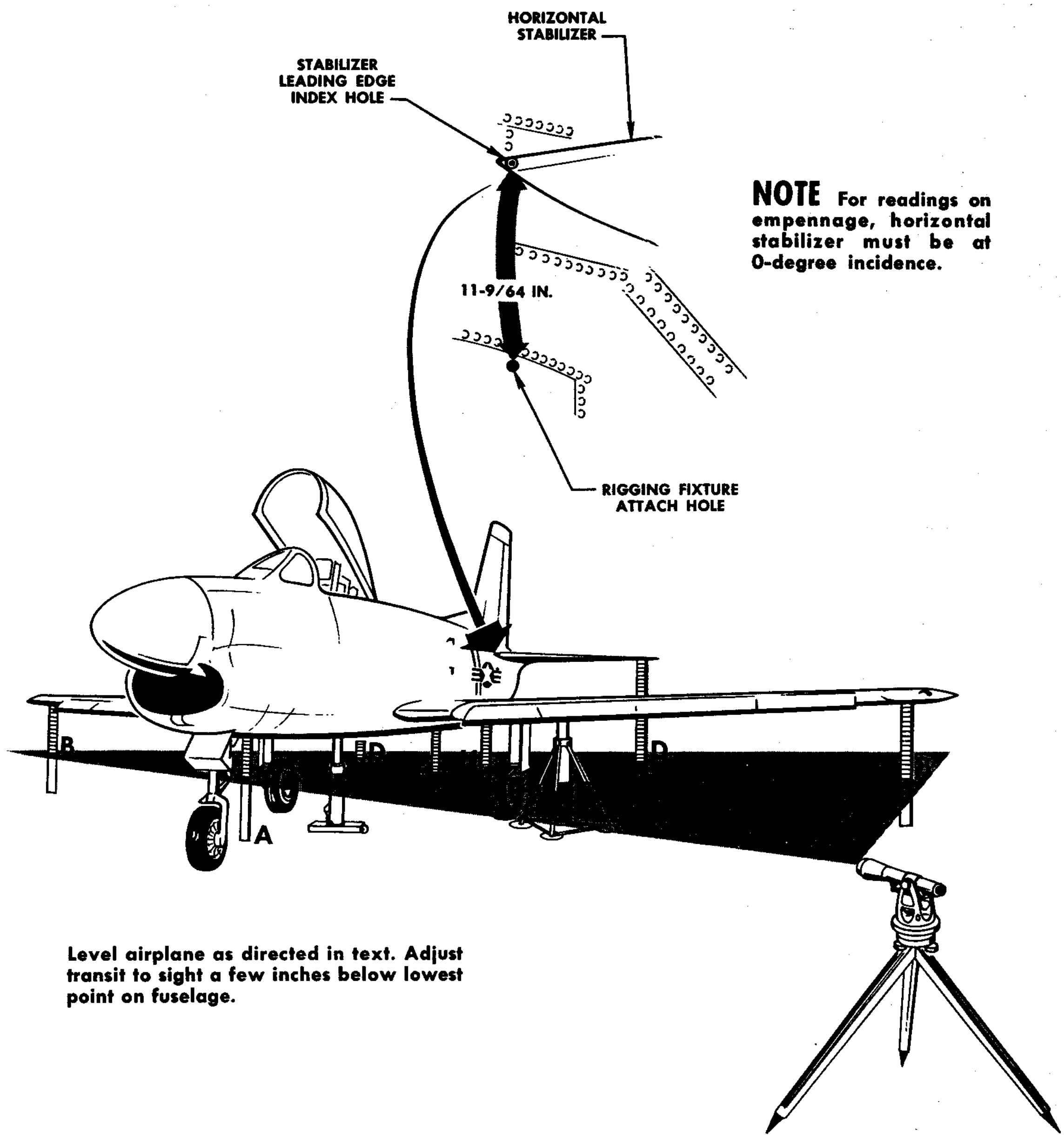
Figure 1-40. Symmetry Check

ELEVATION CHECK

GENERAL



NOTE For readings on empennage, horizontal stabilizer must be at 0-degree incidence.

Level airplane as directed in text. Adjust transit to sight a few inches below lowest point on fuselage.

dimensions

A =0 (ZERO DIMENSION)

H =1 FT 5-3/4 (±¾) IN.

B =1 FT 4-15/16 (±1⅞) IN.

E =0 FT 4-9/16 (±½) IN.

D =4 FT 4-1/4 (±1) IN.

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Figure 1-41. Elevation Check

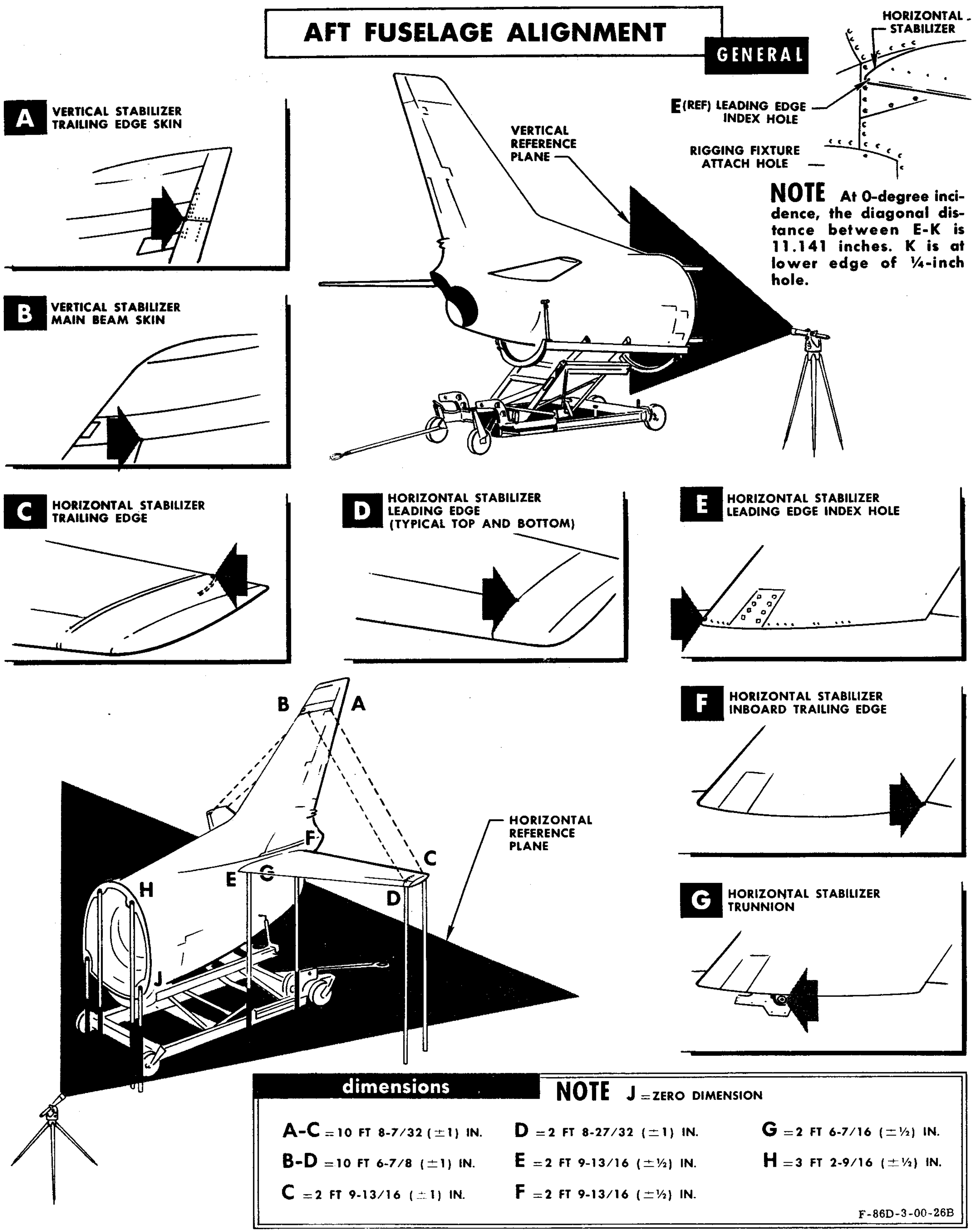
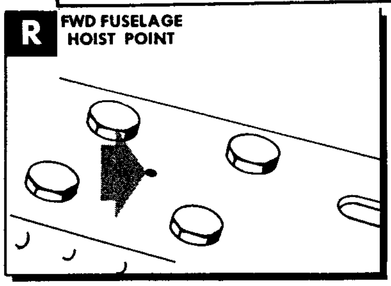


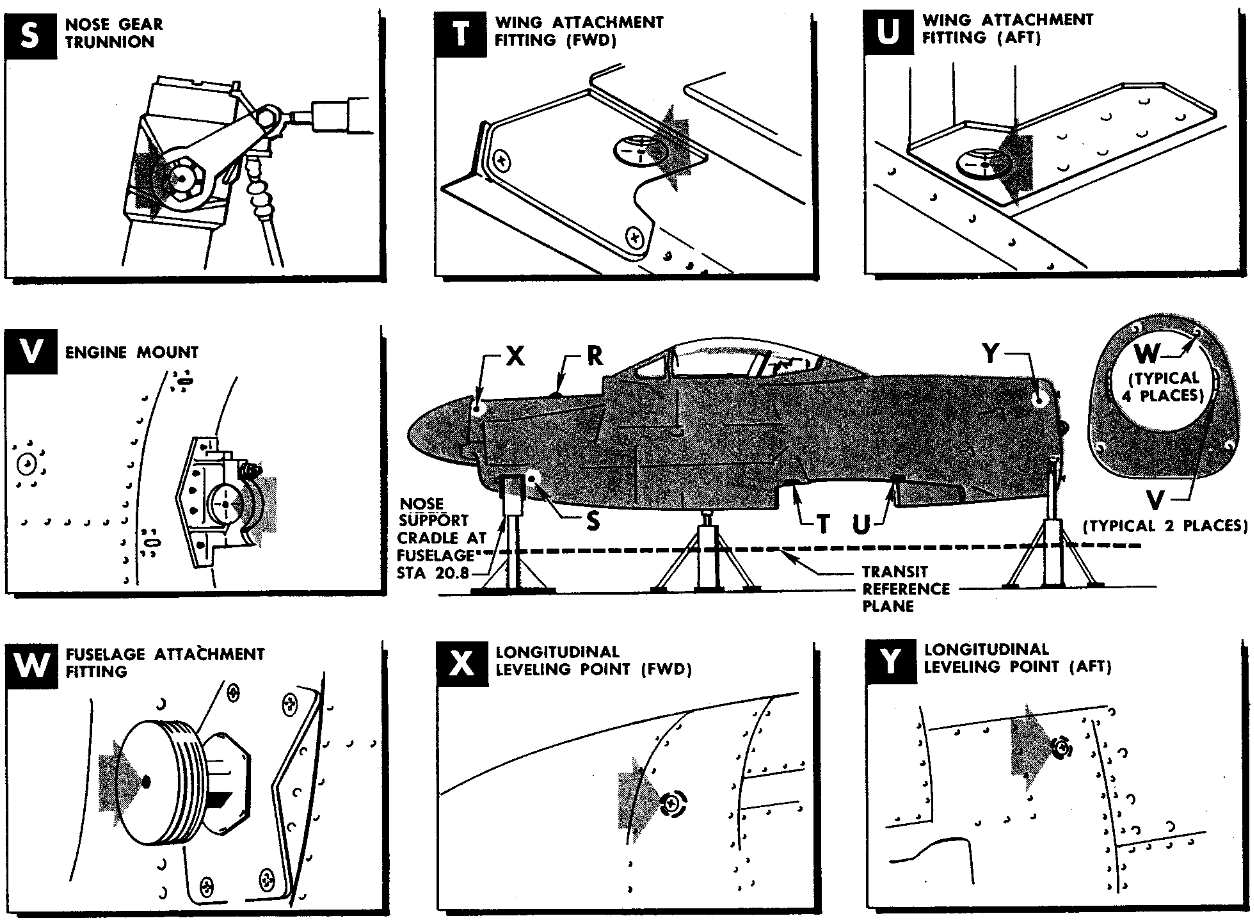
Figure 1-42. Aft Fuselage Reference Dimensions

FORWARD FUSELAGE REFERENCE DIMENSIONS

GENERAL



Level fuselage as directed in text. Transit is positioned to the rear of the fuselage first for lateral leveling, and on the left side for longitudinal leveling.



NOTE All dimensions are typical both sides except "X" and "Y" leveling points.

dimensions—inches

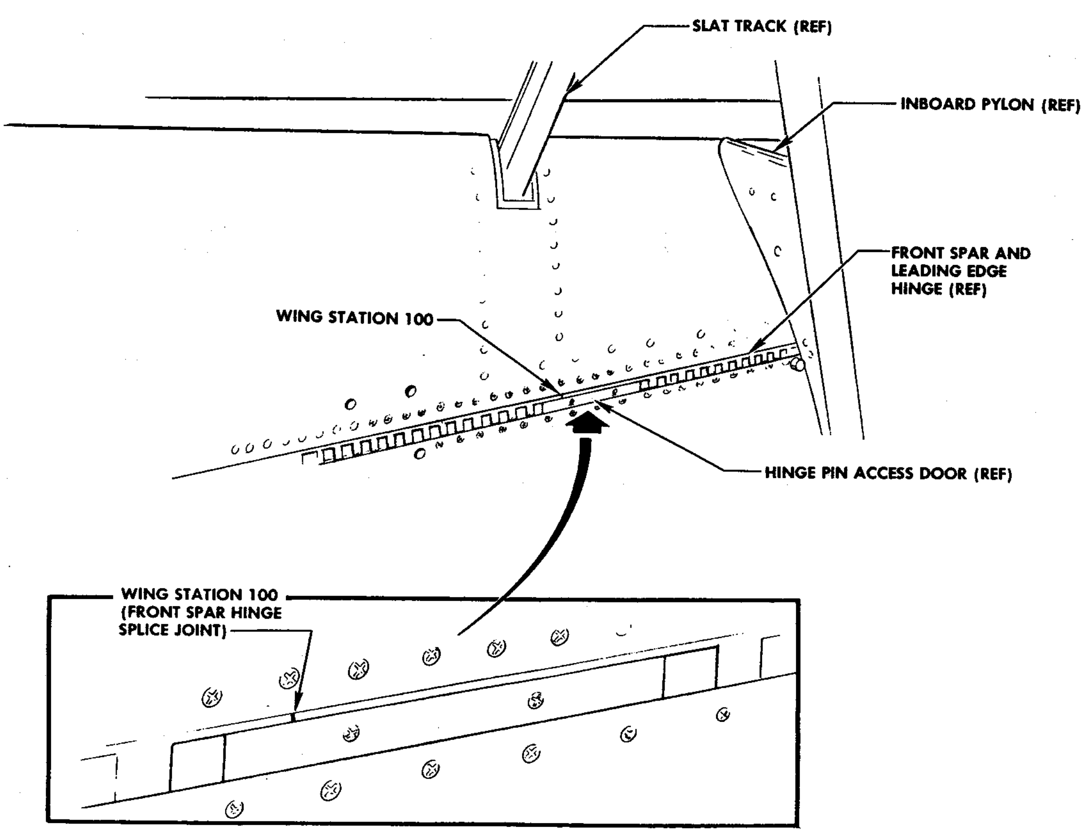
R —REFERENCE PLANE=36.834
S —REFERENCE PLANE=-10.274
T —REFERENCE PLANE=1.375
U —ZERO OR REFERENCE DIMENSION)
V —REFERENCE PLANE=25.250
W UPPER—REFERENCE PLANE=43.753
W LOWER—REFERENCE PLANE=5.183
X —REFERENCE PLANE=27.250
Y —REFERENCE PLANE=27.250

F-86D-3-00-25B

Figure 1-43. Forward Fuselage Reference Dimensions

WING ALIGNMENT

GENERAL



VIEW OF WING STATION 100, FRONT SPAR LOWER CAP, LEFT WING

SAMPLE CHART (TYP)											
LINE	WING STATION POINT	1	2	3	4	5	6	7	8	9	10
1	STANDARD DIMENSIONS	2.04	4.53	7.34	9.52	11.69	0.00	2.92	6.36	8.96	11.53
2	"X" DIMENSION	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08
3	COMPUTED DIMENSION ("X" DIMENSION PLUS STANDARD DIMENSION)	7.12	9.61	12.42	14.60	16.77	5.08	8.00	11.44	14.04	16.61
4	MEASURED DIMENSION	7.12	9.51	12.47	14.55	16.77	5.08	7.97	11.43	14.02	16.63
5	DIFFERENCE	0.00	−0.10	+0.05	−0.05	0.00	0.00	−0.03	−0.01	−0.02	+0.02

NOTE: Refer to "Wing Alignment" text.

F-86D-3-00-75

Figure 1-44. Wing Alignment (Sheet 1 of 2)

WING ALIGNMENT

GENERAL

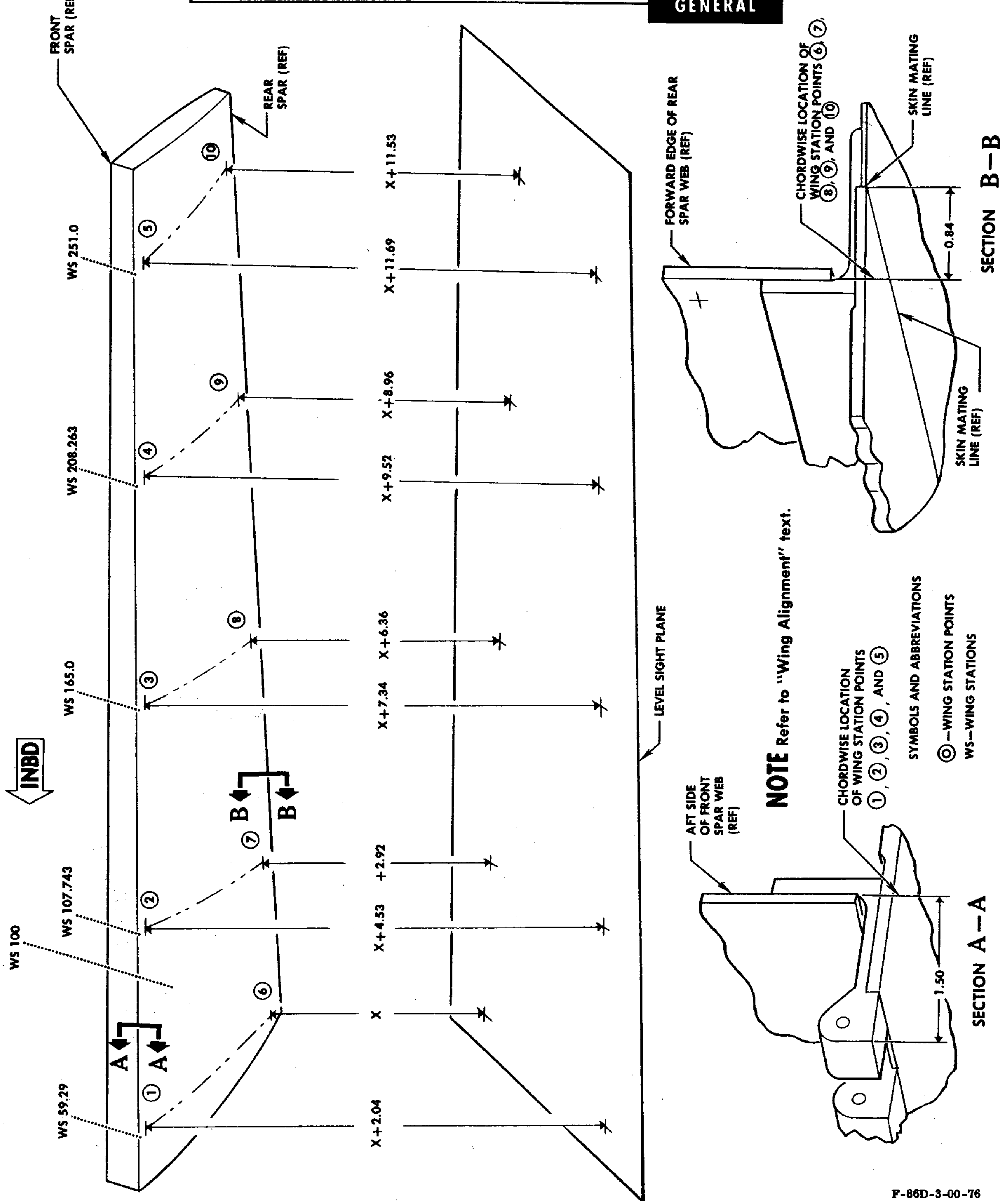


Figure 1-44. Wing Alignment (Sheet 2 of 2)

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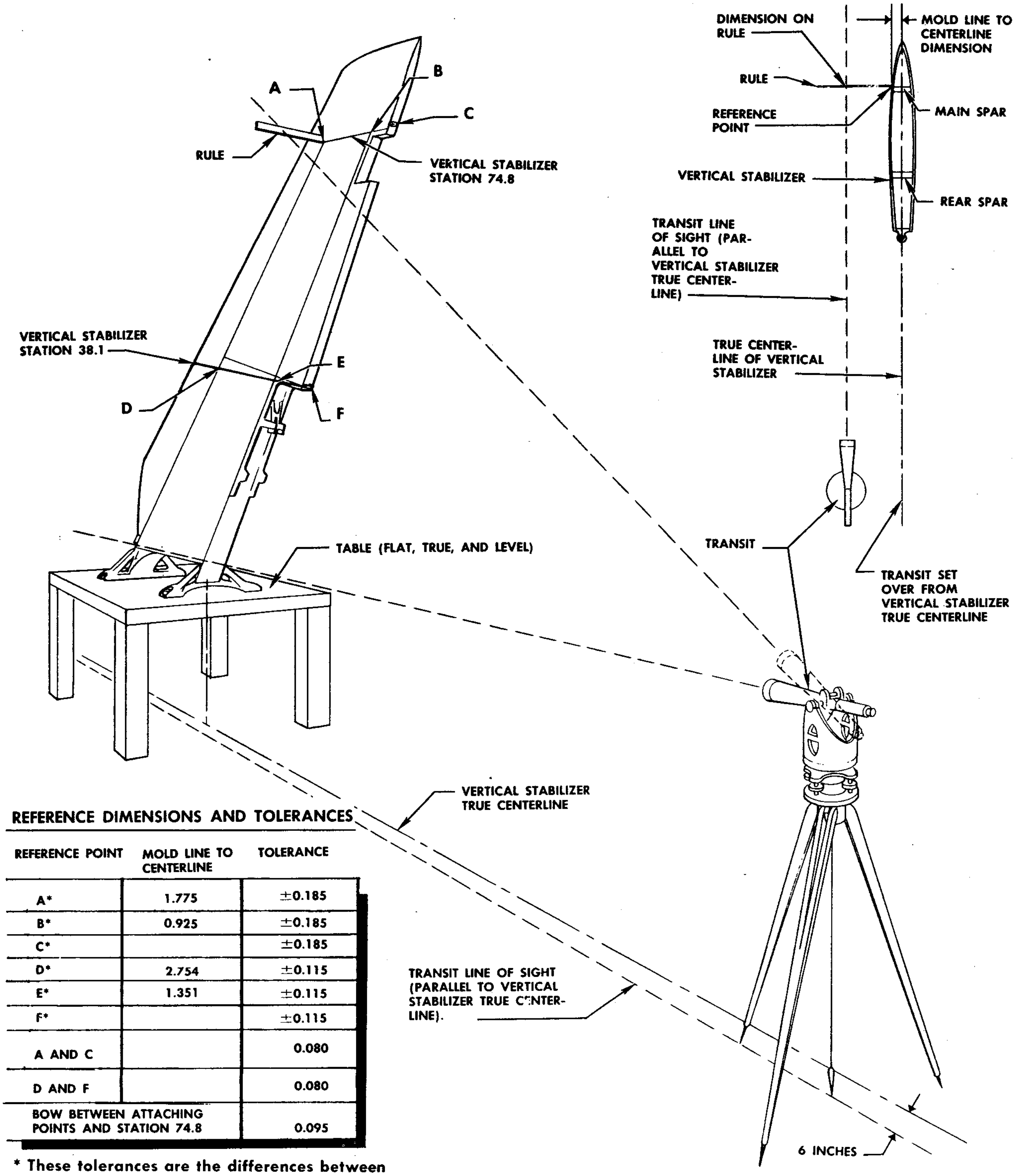
VERTICAL STABILIZER REFERENCE DIMENSIONS

GENERAL



REFERENCE DIMENSIONS AND TOLERANCES

REFERENCE POINT	MOLD LINE TO CENTERLINE	TOLERANCE
A*	1.775	±0.185
B*	0.925	±0.185
C*		±0.185
D*	2.754	±0.115
E*	1.351	±0.115
F*		±0.115
A AND C		0.080
D AND F		0.080
BOW BETWEEN ATTACHING POINTS AND STATION 74.8		0.095

* These tolerances are the differences between the true 90-degree centerline and the actual centerline of the vertical stabilizer.

F-86D-3-00-70

Figure 1-45. Vertical Stabilizer Alignment

HARDNESS TEST OF 7075-T6 WING FORGING

GENERAL

LOCATION	MATERIAL	* ROCKWELL HARDNESS
LH (NORMAL) RH (HEATED)	LARGE FORGING LARGE FORGING	B89 B86
LH (NORMAL) RH (HEADED)	MEDIUM FORGING MEDIUM FORGING	B89 B82
LH (NORMAL) RH (HEATED)	SMALL FORGING SMALL FORGING	B89 B59

*Using a Riehle portable hardness tester

GEN-3-00-9

Figure 1-46. Hardness Test 7075-T6 Wing Forgings

to injure sheet and extruded parts, all heavy fittings in the area should be removed and hardness tested. Similar parts from unaffected areas may be used for a comparison. Figure 1-46 shows the heat effect on three 7075-T6 forgings taken from a fire area and compared with similar parts from the opposite side of the airplane. Tests were made with a Riehle portable hardness tester.

It is often necessary to remove sample disks from sheet-metal parts in order to test them on a bench-type hardness tester. Disks for this purpose should be removed with a one-inch hole saw. If the part is to be retained in use, make repairs as directed in the applicable section of this handbook.

Access hole covers in the fire area are excellent samples for hardness sampling. They also provide an easily replaceable part for destructive testing.

When tension bars from sheet-metal parts are taken for laboratory testing, the blanks removed should measure 1 X 7 inches. However, pieces measuring 1 X 5 inches are acceptable. They should be cut with the long edges in line with the grain whenever possible. When parts or samples are sent to a laboratory for analysis, information about the type and duration of the fire should be included.

PRIMER DISCOLORATION EVALUATION.

Determining the extent of fire damage by zinc-chromate primer comparison can be reliable when used carefully. A clean sample of the primer known to be unaffected by heat is compared with chromate in the heated area. The sample should be from the same general area of the structure in question. The suspected area must be free of dirt, oil, and smoke.

Untinted chromate primer is a slightly greenish yellow. When exposed to about 300 degrees of heat for a few minutes, it turns a light tan color. Temperatures which discolor chromate primers will change the physical properties of 2024-T4 and 7075-T6. The 7075 which is already in the T6, or artificially aged, condition will be softened and weakened. The 2024-T4 will be artificially aged and hardened, until the temperature reaches 500 degrees; then, with increased heat, this metal also softens and weakens. (See figure 1-47.) When the temperature of 2024-T4 is raised to 300 to 500 degrees for a short period under uncontrolled conditions, as is the case in an airplane fire, the inherent corrosion-resisting properties are seriously affected.

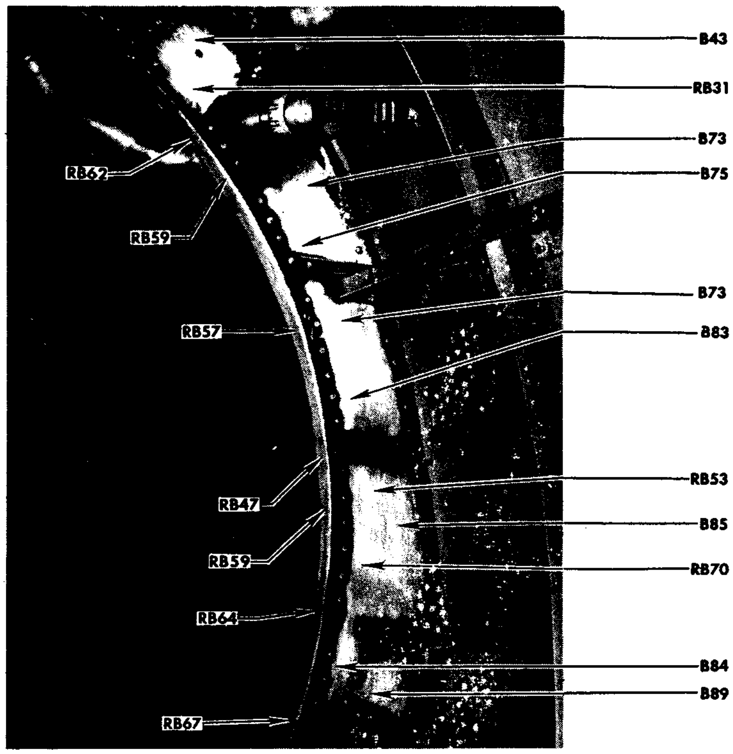
Both 2024-T4 and 7075-T6 are of questionable value and should be subjected to more accurate methods of testing when the slightest discoloration of the primer is evident.

Reliable limits of correlation between hardness tests and tensile tests have been established for 7075-T6, using hardness testers. Material which gives readings of 84 to 94 in the Rockwell "B" scale is normal. Material which falls below the minimum should be replaced, or specimens should be removed from the areas with the lowest Rockwell readings and sent to a laboratory for tension tests.

Hardness test readings are not accurate indications of heat damage on 2024-T4 because of the corrosion factor. A quick heating to 300 degrees may not raise the hardness number above normal, but will affect the corrosion resistance. Therefore, if chromate primer discoloration indicates heat has affected the material, it should be replaced or a specimen removed and sent to a laboratory for tension and corrosion-susceptibility tests.

TYPICAL HARDNESS TEST OF FIRE-DAMAGED FRAME

GENERAL



NOTE

"RB" values are Rockwell "B" scale.

"B" values are Barcol.

F-86K-3-00-36

Figure 1-47. Hardness Test of Fire-damaged Frame

If a decision is made to retain in use a section of 2024-T4 which has undergone slight mechanical change due to fire, every effort should be made to protect the metal. Painted areas should be stripped, treated with phosphoric cleaner, Iridite No. 14, and repainted. Surfaces not normally painted should be treated with phosphoric cleaner.

PORTABLE HARDNESS TESTING OF ALUMINUM ALLOYS.

Material to be tested must be free of paint and foreign material. Anodizing, which is hard, and cladding, which is soft, must be removed at the point of penetrator contact.

Portable hardness testers (figure 1-49) are of two types. The first grips the material like a clamp. The second is pressed onto the material from one side. The Riehle tester is of the first type; the Barcol and Ernst testers, the second. The Riehle portable hardness tester is supplied with a diamond penetrator and a 1/16-inch ball penetrator and reads in Rockwell "C," "A," "B," and "F" scales. The standard anvils (flat, "V," and convex) may be supplemented with special-purpose anvils of local manufacture. For use over flanges on relatively thin material, anvils up to 4-inches long have been successfully used. One-inch diameter, cold-rolled steel rod is a satisfactory material for anvils. Care must be exercised in machining to ensure that the face of the anvil will be perpendicular to the penetrator, and that the face of the anvil and shoulders on which it rests are parallel.

Three test blocks are supplied with the tester and should be used frequently to check the performance of the instrument. It is advisable to run a test on a hardness block between each series of tests, and at any time when hardness readings are not normal.

COLOR-HARDNESS-STRENGTH CORRELATIONS

GENERAL

SAMPLES FROM ONE FIRE-DAMAGED AIRPLANE

	ROCKWELL HARDNESS	PRIMER COLOR	ULTIMATE TENSILE STRENGTH	YIELD STRENGTH	ELONGATION PERCENT IN 2 INCHES
1	B38-40	BLACK	43,000 43,400	23,100 17,950	11 12
2	B38-40	BLACK	47,700 47,100	24,000 24,600	11 12
3	B52-56	BLACK	53,800 54,200	27,500 27,100	16.5 16
4	B-57	BLACK	54,000 54,300	27,500 28,600	14.5 15
5	B61-64	BROWN	56,100 56,500	41,700 43,300	6.5 7.5
6	B78-80 B68-72	TAN BROWN	64,500 61,600	51,600 47,700	6 6
7	B80-82	YELLOW (NORMAL)	74,800 74,100	63,400 65,400	13.5 12
Minimum values for 7075-T6 Federal Spec QQ-A-287			72,000	62,000	8

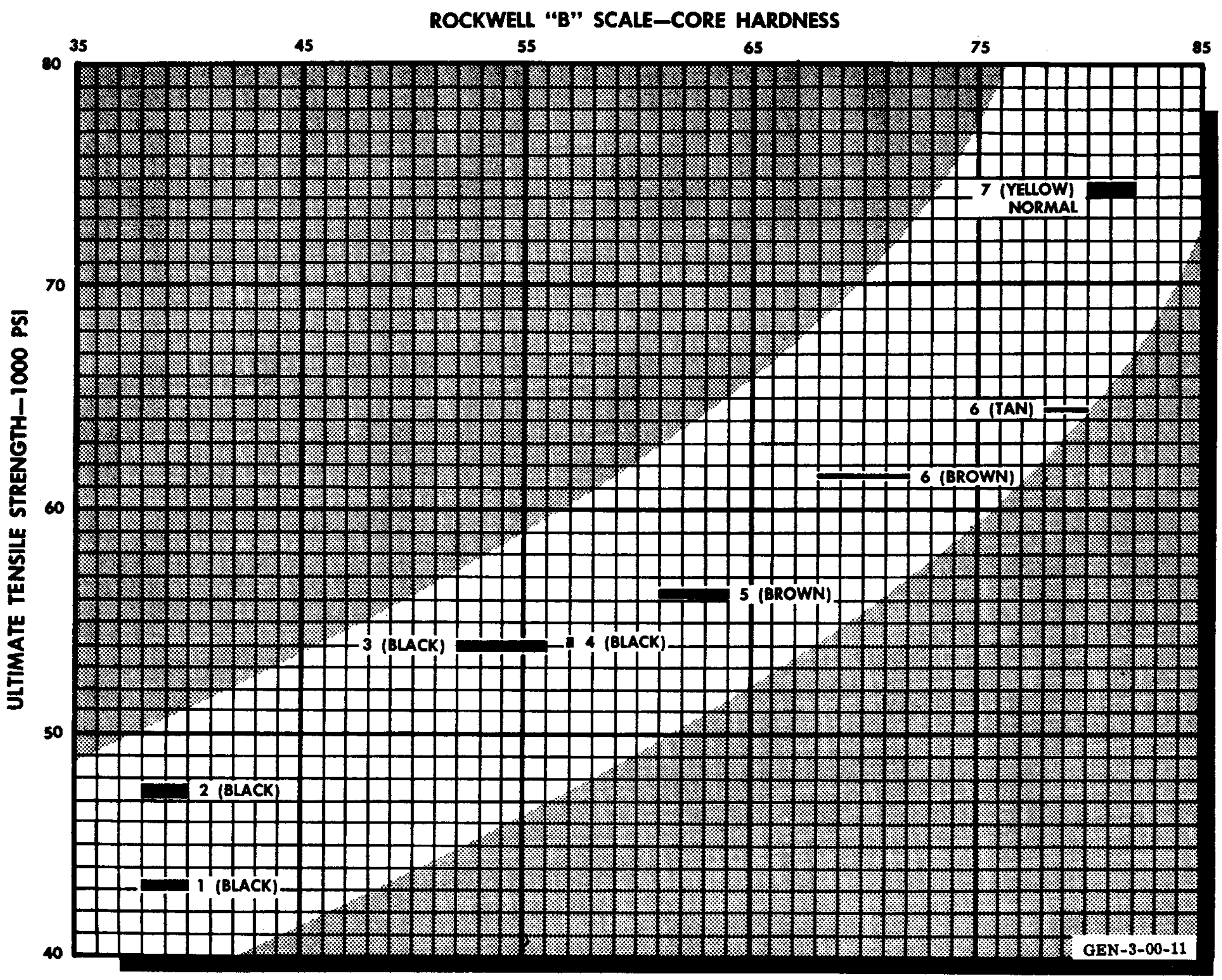


Figure 1-48. Color-Hardness-Strength Correlations—7075-T6

RIEHLE PORTABLE HARDNESS TESTER

GENERAL

1 Select penetrator to be used. Use diamond penetrator for hardened or heat-treated steel. Use ball penetrator for nonferrous materials, or materials softer than C-20.

2 Select proper anvil to suit nature of piece.

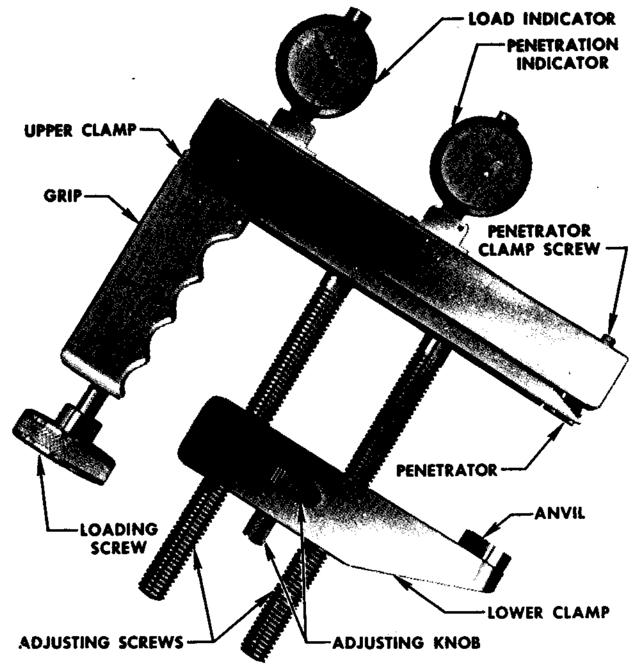
3 Make sure loading screw is backed off sufficiently so that penetrator does not project beyond upper clamp.

4 Clamp work firmly between upper clamp and anvil by means of adjusting knob on lower clamp. DO NOT FORCE.

5 Check zero setting of load indicator. Rotate bezel to bring pointer over small black dot for zero load.

6 Apply 10 kg minor load (pointer to SET) by means of loading screw.

Caution Hold instrument steady to avoid twisting motion of penetrator on the work.



7 Check zero setting of penetration indicator. Rotate bezel to bring pointer to 0 on the black scale.

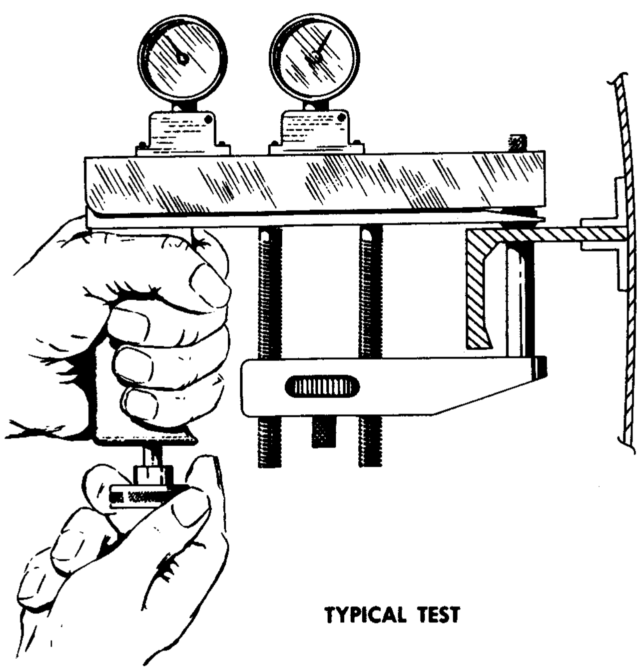
8 Apply major load [normally, "C" scale (150 kg) or "A" scale (60 kg) for diamond, or "B" scale (100 kg) for ball].

9 Take off major load—reduce to minor load (pointer back to SET).

10 Hardness is indicated on penetration indicator. Read black figures when using diamond penetrator. Read red figures when using ball penetrator.

11 Release load completely by backing off loading screw.

12 Turn adjusting knob to left to loosen lower clamp. For more detailed information covering the use, operation, and maintenance, refer to separate instruction folder supplied with this instrument.



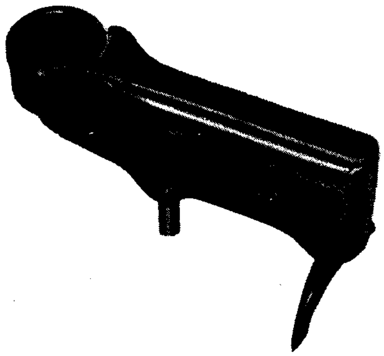
TYPICAL TEST

GEN-3-00-12

Figure 1-49. Portable Hardness Tester (Sheet 1 of 2)

PORTABLE HARDNESS TESTERS

GENERAL



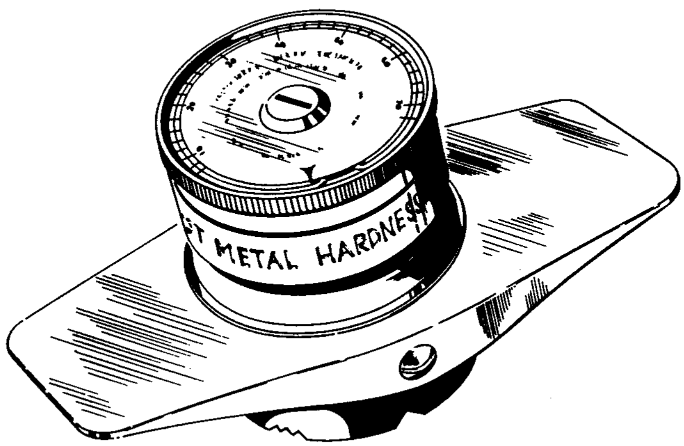
BARCOL PORTABLE HARDNESS COMPARATOR

Has hardened-steel penetrator.

Reads in Barcol impress or numbers.

Material must be solidly supported from behind. DO NOT ALLOW TESTER TO SLIDE ON MATERIAL.

ERNST PORTABLE HARDNESS TESTER



Has diamond-tipped penetrator.

Reads in Rockwell or Brinell scales.

Material must be solidly supported from behind. Press down with a steady, even force.

GEN-3-00-13

Figure 1-49. Portable Hardness Tester (Sheet 2 of 2)

The Barcol hardness comparator is a small, lightweight instrument, suitable for comparative checks within a given sheet of metal or on an object formed from one sheet of metal. It should be used in conjunction with a bench-type tester or with a Riehle tester or equivalent. Edge readings are taken with the Rockwell, and the same area is checked with the Barcol. The remainder of the sheet, or part, may be tested by using the lowest Barcol reading from the sample area as a minimum value.

The Barcol comparator is not recommended for reliable testing of 7075-T6, since the -T6 hardness value is in the upper range of the tester; however, it can be used to advantage in the inspection of 7075-T6 structure which is suspected of damage due to heat. Tests are taken of the part or sheet in question and, at the point of lowest Barcol reading, a one-inch disk is cut and tested on a bench-type tester. (Riehle or equivalent may be used if bench tester is not available.) The Barcol must be used carefully to avoid any bending of the fine steel penetrator. It must rest firmly on the material, and the pressure applied must be in line with the penetrator.

Frequent tests to ensure that the tester is reliable should be made on the test block provided.

The Ernst portable hardness tester is a small, versatile instrument which requires access to only one side of the material tested. It has a diamond-point penetrator and reads in Rockwell or Brinell scales, depending on the model. To ensure accurate readings, the handgrips must be pressed downward with a steady, even force until the fluid column has stopped moving. The final position of the fluid shows the hardness value directly on the scale.

As with other portable testers of this type, the material being tested must be very smooth and firmly backed up so there will be no tendency to sag under the load applied on the tester. The test block supplied with each tester should be used frequently to check the performance.

Figure 1-48 shows a tabular correlation of primer color, Rockwell hardness (clad removed), and ultimate tensile strength 7075-T6 samples taken from a fire-damaged airplane. It should be noted that tests were made on a relatively small number of specimens, and the limits on the scatter band shown are not necessarily those which could be found with a greater number of samples.

CORROSION.

Corrosion might be defined as the gradual chemical or electrochemical attack on a metal by atmosphere, moisture, and other agents. The types of corrosive attack most commonly encountered are: Ordinary corrosion, resulting in a uniform deterioration or pitting attack on the surface; intergranular corrosion, resulting in a grain boundary attack; and galvanic corrosion, resulting in the deterioration of the more active of two dissimilar metals in contact. Corrosion products from the deterioration of the more active metal will sometimes corrode the other dissimilar metal (for instance, magnesium and aluminum).

TYPES OF CORROSION.

ORDINARY CORROSION.

Ordinary corrosion may be recognized by a dulling or pitting of the surface accompanied by white powdery deposits on aluminum, and by a reddish rust coating on steel. Corrosion cannot always be detected by a visual examination alone, but may sometimes be discovered under paint where the paint flakes off under pressure.

INTERGRANULAR CORROSION.

Intergranular corrosion which may attack aluminum alloy is much more serious than ordinary corrosion. It normally progresses along the grain boundary of an alloy and cannot readily be recognized during a surface examination until actual failure of the material. This failure then shows up much as a crack might appear. Intergranular corrosion is actually a stress corrosion. It is caused by residual or "locked up" stresses within a material or applied (external) stresses in conjunction with a corrosion inducing agent. These residual or "locked-up" stresses within the material are sometimes the result of quenching after heat treating, too severe forming, etc. The structural strength of the material is gravely weakened by this type of attack.

GALVANIC CORROSION.

In the presence of moisture, when two different metals are in actual contact, an electric current flows from one to the other resulting in corrosive attack on one of the materials. This is similar to the action that takes place within a common storage battery. In galvanic corrosion, the more active of the two dissimilar metals serves as the anode, the moisture becomes the electrolyte, and the less active metal acts as the cathode. The weaker of the two metals suffers the corrosive attack.

When corrosion of any type is discovered, only sound judgment can determine whether or not the entire part should be replaced, the area reworked, or the corroded area cut out and a new section spliced in.

CORROSION REWORK.

Corroded areas on either painted or unpainted parts should be reworked as follows:

1. Remove all paint, or, if area is not painted, scrub free of any dirt, grease, etc.

2. Remove products of corrosion with a rag wet with solvent or water; or by using aluminum brightener, Specification MIL-C-5410. (Refer to "Corrosion Rework by Chemical Film Treatments.") If none of these methods are effective, Bon Ami, fine aluminum wool, or 400 or finer abrasive cloth or paper may be used. Do not use crocus cloth or steel wool because they tend to accelerate corrosion.

3. Clean the area thoroughly and treat with a chemical film. (Refer to "Corrosion Rework by Chemical Film Treatments.")

4. Apply proper protective coating.

CORROSION REWORK BY CHEMICAL FILM TREATMENTS.

Aluminum and aluminum alloys are chemical-film treated to prevent corrosion and to provide a base for paint and other protective coatings. Chemical film alone will not permanently protect the metal from corrosion. Two brush-on types of material are available, Iridite No. 14 or Alodine 1200 (Specification MIL-C-5541). Iridite No. 14 and Alodine 1200 films have the same properties and are interchangeable.

CORROSION REWORK BY IRIDITE NO. 14 CHEMICAL FILM TREATMENT. Materials used in the Iridite No. 14 treatment are as follows:

MATERIAL	SOURCE
Brush Iridite No. 14 with ARP No. 2 (wetting agent)	Allied Research Products, Inc
Toluol	Federal Spec TT-T-548
Cleaner	Spec MIL-C-5410, Type I

Refer to index for sources of commercial products.

1. Wipe area with toluol and dry with a clean, dry rag.

2. Apply Specification MIL-C-5410, Type I cleaner with a soft bristle brush or swab, keeping the surface wet for 5 to 10 minutes.

3. Rinse the surface with tap water to completely remove all cleaner. A water-break-free surface (no droplets) must be obtained. Repeat the cleaning process, if necessary, to obtain this condition.

4. Mix 6 ounces by weight of Iridite No. 14 and one fluid ounce of ARP No. 2 wetting agent with one gallon of water. Coat the cleaned surface with this solution, keeping it wet for 3 to 5 minutes; then allow to dry. Use rubber gloves while handling the solution.

5. Rinse with water but do not rub with rags or else the soft film will be damaged. If no color is visible, repeat Iridite application.

CORROSION REWORK BY ALODINE 1200 CHEMICAL FILM TREATMENT. Materials used in the Alodine 1200 treatment are as follows:

MATERIAL	SOURCE
Alodine 1200	American Chemical Paint Co
Nitric Acid	Federal Spec O-A-88
Toluol	Federal Spec TT-T-548
Cleaner	Spec MIL-C-5410, Type I

Refer to index for sources of commercial products.

1. Wipe area with toluol and dry with a clean, dry rag.

2. Apply Specification MIL-C-5410, Type I cleaner with a soft bristle brush or swab, keeping the surface wet for 5 to 10 minutes.

3. Rinse the surface with tap water to completely remove all cleaner. A water-break-free surface (no droplets) must be obtained. Repeat the cleaning process, if necessary, to obtain this condition.

4. Mix 3 ounces by weight of Alodine 1200 and 0.5 fluid ounces of nitric acid (Federal Specification O-A-88) with one gallon of water. Coat cleaned surface with this solution, keeping it wet from 3 to 5 minutes; then allow to dry. Use rubber gloves while handling the solution.

5. Rinse with water, but do not rub with rags, as soft film will be damaged. If no color is visible, repeat Alodine application.

CORROSION-PREVENTIVE MEASURES.

Ordinary corrosion can be prevented by a protective coating which may be applied to the surface of the material. Steel parts are plated or a rust-preventive compound is applied. Aluminum alloys are protected by the cladding, anodizing, and by paint-type coatings. Zinc-chromate primer is used extensively as a protective coating for aluminum parts.

A protective coating is generally not applied to corrosion-resistant steels except when necessary to provide insulation between dissimilar contacting surfaces.

Cables are treated with a suitable rust-preventive compound. Interior surfaces of steel tubes larger than ⅜-inch inside diameter, not carrying fluids and which are closed by fusion welding, brazing, or swaging are treated with a rust-preventive compound. Surfaces on which plating has been omitted because of close tolerances are protected with a film of some suitable organic rust-preventive compound.

Special care should be taken to prevent paint from being applied to working surfaces, oil holes, bearings etc. Rubber or synthetic rubber should not be painted, greased, or oiled. Intergranular corrosion can best be prevented by a good protective coating on the metal. Because this type of corrosion is caused by stresses in the metal in conjunction with a corrosion-inducing agent, the protective coating serves as a barrier between the metal and the corrosion-inducing agent.

Galvanic corrosion can be prevented by avoiding direct contact between dissimilar metals when possible. When such contact cannot be avoided, an insulation must be provided between the metals. This insulation might be paint coats or a corrosion barrier of some suitable gasketing material. The material, location, and use of part will determine method of insulation to be used.

A dissimilar metal contact is a contact between a surface metal of any one of the following groups and a surface metal of any other group.

DISSIMILAR METALS TABLE

GROUP I	GROUP II	GROUP III	GROUP IV
Magnesium and magnesium alloys	Aluminum, zinc, cadmium, and their alloys	Tin, iron, lead, and their alloys (except stainless steels)	Copper, silver, gold, platinum, nickel, chromium, cobalt, titanium, rhodium, and their alloys; stainless steels and graphite

PROTECTION OF CONTACTING SURFACES.

In order to provide proper protection, metal-contacting surfaces between metals in the same group in the table should receive one coat of zinc-chromate primer on each contacting surface. Metal-contacting surfaces between metals of different groups in the table should receive two coats of zinc-chromate primer (three coats on magnesium) on each contacting surface. Magnesium and magnesium alloys are especially susceptible to galvanic corrosion. Because paint coats alone do not provide sufficient protection against galvanic corrosion of magnesium in dissimilar metal contact, it is necessary to supplement the paint with other types of corrosion barriers. (Refer to "Corrosion Barriers.")

CORROSION BARRIERS.

CORROSION- AND ABRASION-RESISTANT PLASTIC COATING. This is a material which may serve both as a corrosion barrier and as an abrasion-resistant coating. The material may either be sprayed or brushed. The method used is determined by ease of application. The material is furnished in a kit consisting of two parts; a base material, and curing agent. The plastic material may be applied over metal pretreatments such as anodizing, chemical film treatment for steel, cadmium plating, and protective treatments for magnesium.

Note

Zinc-chromate primed surfaces must be stripped of the primer before the plastic material is applied.

MATERIAL	SOURCE
Coating—plastic, corrosion- and abrasion-resistant, Everlube 1329 (black), Everlube 1329A (aluminized)	Everlube Corp
Tape—vinyl No. 473	Minnesota Mining & Mfg Co
Naphtha	Federal Spec TT-N-95
Toluol	Federal Spec TT-T-548
Methyl isobutyl ketone	Federal Spec TT-M-268
Butyl Cellosolve	Commercial
Wash primer	Specification MIL-C-8514

Refer to index for sources of commercial products.

PREPARATION FOR APPLICATION OF CORROSION- AND ABRASION-RESISTANT PLASTIC COATING. All metal surfaces to which the coating is to be applied must have oil, grease, dirt, etc removed. Wipe surfaces with a cloth saturated in solvent and then wipe off solvent with a clean dry cloth. Spray one thin wet coat of wash primer onto the cleaned surface, and allow it to dry one to 4 hours before applying the plastic coating.

MIXING CORROSION- AND ABRASION-RESISTANT PLASTIC COATING. Immediately before use, the base material and the curing agent should be mixed together and thoroughly stirred. The mixed material has a pot life of about 4 hours. Therefore, only the amount which is to be used should be prepared. Generally, the properly mixed material is of the correct consistency for spray or brush application. If additional thinning is necessary, add a small amount (one to 5 percent) of the following mixture:

45 percent by volume—Methyl isobutyl ketone
5 percent by volume—Butyl Cellosolve
50 percent by volume—Toluol (Federal Spec TT-T-548)

APPLICATION OF CORROSION- AND ABRASION-RESISTANT PLASTIC COATING. The material may be applied by brushing or spraying successive coats, allowing an adequate drying time between coats to prevent sagging. Normally, two passes over the surface with a spray gun will provide a 0.003-inch thick film. A film 0.003 to 0.005 inch thick is adequate for abrasion and corrosion protection in most cases.

The applied material may be completely cured by air drying 7 days at room temperature, or by baking. Air-cured films will be dry to handle in 6 to 16 hours. Films which are to be baked must be allowed to air-dry at least one hour, then baked for 10 minutes at 250°F.

VINYL TAPE AS A CORROSION BARRIER. The use of vinyl tape No. 473 is recommended as a corrosion barrier between magnesium and other metals. Tape is to be used in addition to the paint coats required. Tape should not be used between press-fitted surfaces, nor as a corrosion barrier between dissimilar metals on mechanical, hydraulic, or electrical assemblies where the tape could cause faulty operation of the part. When one part is removable, the tape should be applied to the fixed member.

SURFACE PREPARATION FOR VINYL TAPE AS A CORROSION BARRIER. All sharp corners or edges of mating surfaces must be smooth to prevent cutting through the tape.

All operations on the mating surfaces, such as drilling, dimpling, chemical treating, etc, must be complete before the tape is applied. Immediately before application of tape, all mating surfaces must be carefully wiped with a clean cloth saturated in naphtha (Federal Specification TT-N-95) or other suitable solvent.

APPLICATION OF VINYL TAPE AS A CORROSION BARRIER. If magnesium is one of the dissimilar metals, the tape should be applied carefully to the magnesium surface. If this is not convenient, the tape may be applied to the other metal. The tape should be wide enough and long enough to extend 1/4 inch beyond all edges of the mating surfaces. (See figure 1-50.) The portion of the tape extending beyond the edges of the mating surfaces should be folded, as shown in details "A" and "D" of figure 1-50. On simple extrusions, the tape should be wide enough to cover the entire interior surface of the extrusion and extend 1/4-inch beyond the mating surfaces. On machined magnesium extrusions such as the trailing edge beam of the horizontal and vertical stabilizers, the tape must be applied to the extrusion and the attaching skins. Extreme precautions should be taken to see that all tape covering air vent and water drain holes is removed. The tape should be applied in one continuous length. If splicing the tape is necessary, the laps should be at least 1/4-inch wide but not more than 5/16-inch wide. Lapping of tape over any attaching hole must be avoided.

Before any fasteners are installed, the tape over the attaching holes should be pierced with a sharp awl or similar tool. During this operation, be careful not to tear the tape beyond the limits of the hole. When placing the parts into position for fastening or attaching, care should be taken to prevent damage to the tape. Corrosion protection is provided only if the tape is applied to form a continuous, unbroken film.

SEALING COMPOUND AS A CORROSION BARRIER. Sealing compound (PR-1221) as a corrosion barrier may be used where the use of vinyl tape is impracticable.

Note

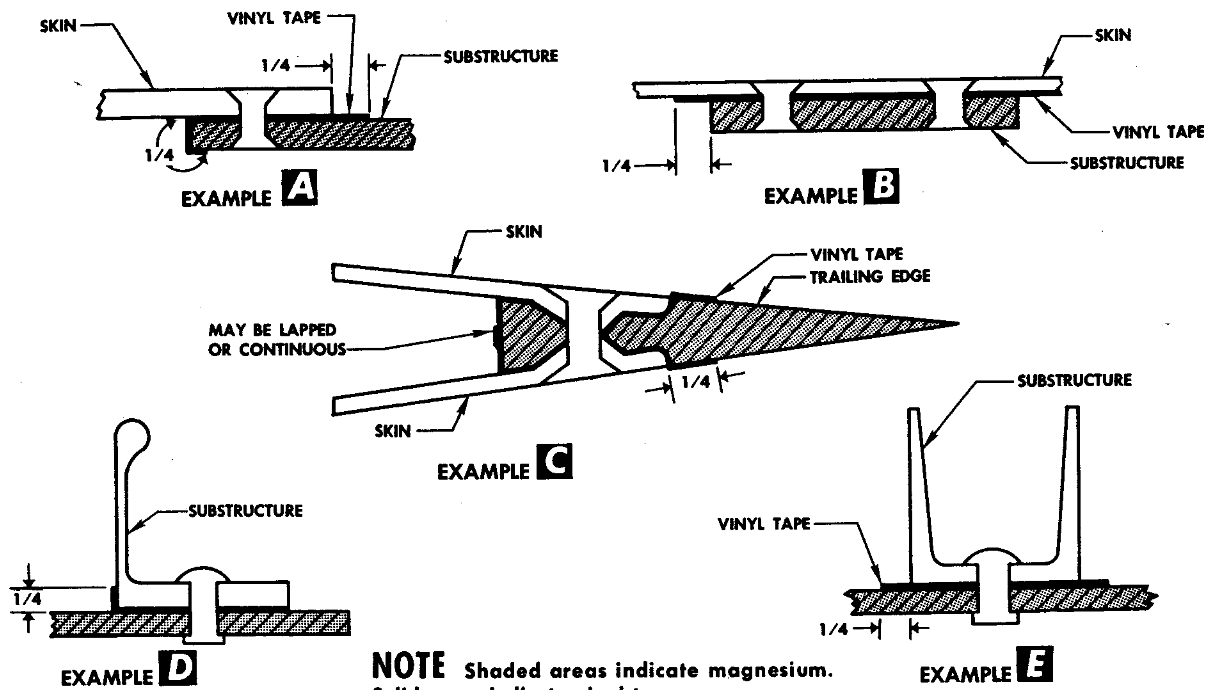
> Sealing compound should not be used as a corrosion barrier on movable control surfaces. Only tape should be used on such surfaces. When sealing compound is used as a corrosion barrier, it must be used in addition to the paint coats required.

Sealing compound should not be used between press-fitted surfaces, or on mechanical, hydraulic, or electrical assemblies where the sealing compound could cause faulty operation of the part.

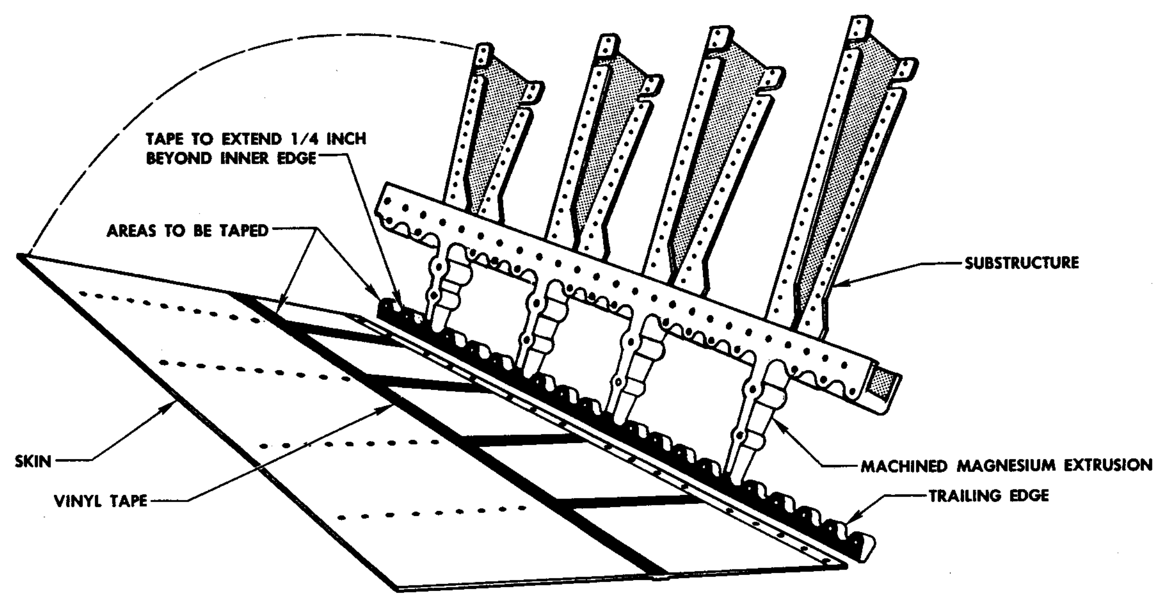
SURFACE PREPARATION FOR SEALING COMPOUND AS A CORROSION BARRIER. All sharp corners or edges of mating surfaces must be smooth to avoid damage to the film of sealing compound. All operations, such as drilling, dimpling, chemical treatments, etc, must be complete. Immediately before

VINYL TAPE CORROSION BARRIER

GENERAL



NOTE Shaded areas indicate magnesium. Solid areas indicate vinyl tape.



NOTE
Drain and vent holes not covered.

GEN-3-00-8

Figure 1-50. Corrosion

the sealing compound is applied, all mating surfaces must be carefully wiped with a clean cloth saturated in naphtha (Federal Specification TT-N-95) or other suitable solvent. In primed areas, primer adhesion must be tested by scraping it with the thumbnail. If the primer can be removed in this manner, the area to which the sealing compound is to be applied must be stripped.

APPLICATION OF SEALING COMPOUND AS A CORROSION BARRIER. Sealing compound may be applied with a brush, spatula, or special applicators. When attachment of the metals receiving the film of sealing compound is made by bolts, screws, or quick-disconnect fasteners, the sealing compound must be applied to the stationary part. The removable part, including fasteners, must be coated with petrolatum (Federal Specification VV-P-236) to prevent the sealing compound from sticking.

Immediately after the sealing compound is applied, assemble the part and let cure for 24 hours. Remove excess petrolatum from the exterior of the part with a cloth saturated in naphtha. After the sealing compound has cured, the part should be painted if required.

MATERIALS USED IN REPAIR.

ALUMINUM ALLOYS.

These are four basic aluminum alloy shapes used in the construction and repair of aircraft. These are extrusions or roll-formed sections, bar stock, sheet stock, and plate stock.

Sheet stock is available in various gages up to 0.250 inch in thickness. It may be obtained in both the clad and the bare state. Gages heavier than 0.250 are plate stock. Bar stock is a material from which parts may be machined. Shapes made from bar stock are generally not quite as strong as extruded shapes of the same alloy. Therefore, the cross-sectional area of a repair part machined from bar stock should be about 10 per cent greater than that of the original part to compensate for this lower strength factor. Extrusions are die-formed shapes that can be made to any specific cross-sectional area. (Refer to Section VIII.)

DESIGNATION AND PROPERTIES OF ALUMINUM ALLOYS.

The aluminum industry has changed the alloy designations for all wrought aluminum alloys. The new designation is a four digit number whose last two digits usually conform to the old standard alloy number. The letter "S" is eliminated in the new designations. For example, the designation for aluminum alloy formerly known as 75S is now 7075. The temper designations have not been changed. For example, material marked 7075-O is the same as material previously marked 75S-O. The basic temper designation is a letter. When the temper must be subdivided, a number follows the letter, for example: T4. The alloy number and the temper designation are separated by a dash, (2024-T4).

The general system of designation is as follows:

ALLOY DESIGNATIONS

FORMER DESIGNATION	ALLOY NO.	DESCRIPTION
2S	1100	Used where forming is severe—weldable—not heat-treatable—can be work hardened.
3S	3003	Forms nearly as well as 1100—weldable—not heat-treatable—can be work hardened.
52S	5052	More formable than 2024—less formable than 3003—weldable—not heat-treatable —can be work hardened.
61S	6061	Weldable and heat-treatable—may be spot-welded or seam-welded in heat-treated condition—may be fusion-welded if resultant annealed condition bordering weld is acceptable.
24S	2024	Heat-treatable—may be spot or seam welded in heat-treated condition, but not fusion welded. Can be formed in the heat-treated condition.
75S	7075	Heat-treatable—may be spot or seam welded in heat-treated condition, but not fusion welded—does not form as readily as 2024 in heat-treated condition.

ALUMINUM ALLOY TEMPER DESIGNATIONS

LETTER	INDICATES	DESCRIPTION
F	As fabricated	Applies to products that acquire some temper qualities in the shaping processes but are not later heat-treated or intentionally work hardened.

LETTER	INDICATES	DESCRIPTION
O	Annealed	Applies to the softest temper of wrought alloy products.
H	Strain Hardened	Applies to products that have their strength increased by work hardening. The "H" is always followed by a number of two or more digits which subdivides this temper designation. The first digit indicates specific combination of basic operations. The final digit or digits indicates the degree of hardness. **Subdivisions of "H" Temper** H1—Work hardened only. The number following this designation indicates the degree of work hardening. H2—Work hardened and then partially annealed. The number following this indicates the degree of work hardening remaining after partial annealing. H3—Work hardened and then stabilized. The number following this designation indicates the degree of work hardening remaining after having been work hardened a specific amount and then stabilized. **Breakdown of Hardness** ¼ hard indicated by 2 — ¾ hard indicated by 6 ½ hard indicated by 4 — Full hard indicated by 8 The digit "3" would indicate a degree of hardness between ¼ hard and ½ hard, etc.
W	The unstable condition following solution heat-treatment	This designation, because of natural aging, is specific only when the period of aging is indicated, for example 2024-W ½ hr, etc.
T	Treated to produce a stable temper (other)	This designation applies to alloys when treated thermally to produce stable tempers with or without supplementary strain hardening. The "T" is followed by a number of one or two digits which indicate a specific combination of operations.

Subdivisions of "T" Temper

T2—Annealed (applies to cast products only).

T3—Solution heat-treated and then cold-worked. This designation applies to products that are cold-worked after heat-treating chiefly to increase their strength; *however*, it also applies to alloy sheets as they come from the mill since the flattening process after heat-treating is recognized as cold-working, and does increase the strength of the material.

T4—Solution heat-treated and then naturally aged to a substantially stable condition. This designation applies when the alloy is not cold-worked in any manner after heat-treatment. When the user heat-treats an alloy, the flattening process does not follow. Therefore sheet stock received from the mill in the "T3" condition which is annealed and re-heat-treated by the user becomes "T4." Unless specifically noted, "T4" can be substituted for "T3."

T5—Artificially aged only. This designation applies to products that are artificially aged without prior solution heat-treatment.

T6—Solution heat-treated and then artificially aged. This designation applies to products that are not cold-worked after heat treatment and any flattening, even at the mill, is not recognized as cold-working.

T7—Solution heat-treated and then stabilized. This designation applies to products in which the temperature and time conditions for stabilizing are such that the aging is carried beyond that required to produce maximum strength and hardness in order to control growth and distortion resulting from casting or quenching strain.

LETTER	INDICATES	DESCRIPTION
		T8—Solution heat-treated, cold-worked, and then artificially aged. This designation applies when cold-working is done for improving strength and the flattening process at the mill is recognized as cold-working.
		T9—Solution heat-treated, artificially aged, and then cold-worked.
		T10—Artificially aged and then cold-worked.

TITANIUM.

This is a comparatively new metal which is highly resistant to corrosion and has much better strength-weight ratio than corrosion-resistant steel at temperatures up to 900°F. For this reason, it is used in various locations in the fuselage rear section of the F-86K Airplane. When titanium is substituted for the same thickness of corrosion-resistant steel, a weight saving of about 40 per cent is obtained. The embrittlement of titanium sheet is variable, being greatly affected by small amounts of nitrogen and oxygen absorbed into the surface when the temperature is raised above 1000°F. Aircraft manufacturers test each sheet as it is received from the rolling mill to be certain that it is sufficiently ductile to bend and to dimple so that it may be flush riveted.

Pure titanium (AMS 4900 and AMS 4901), and titanium alloy (AMS 4908) are dull silver-gray in color and look like stainless steel. Titanium can be identified in several ways. Touched on a grinding wheel, it gives off white traces ending in brilliant white bursts; moistened, it leaves gray-white marks when rubbed on glass. Most titanium airplane parts are identified by the word "TITANIUM" stamped or etched on the part.

DRILLING AND REAMING TITANIUM.

The important factor in drilling titanium, as in drilling other hard materials, is that sufficient power and pressure must be applied to keep the drill cutting until the hole is completed. If the drill is allowed to ride in the partially drilled hole, the area will work-harden and further drilling will be extremely difficult. High-speed drills of the type used for stainless steel (135-degree angle point) should be used, and they must be sharp and rigid. Recommended drill speeds for titanium are as follows:

Motor Speed (RPM)	Fractional Drill Size	Number Drill Size	Letter Drill Size
1000	3/32 through 3/16	13-40	
750	13/64 through 1/4	1-12	A-F
500	17/64 through 1/2		G-Z

When proper speed motor is not available, the next slowest speed motor should be used.

High-speed, spiral-fluted reamers may be used at cutting speeds at about half those recommended for drills.

Broken tools such as drills and taps can be loosened from titanium easier by submerging parts in a saturated solution of ferric ammonium sulfate or nitric acid, which does not appreciably affect titanium.

SCRATCHED TITANIUM.

Titanium is very notch-sensitive. All possible means of avoiding scratches should be taken. Scratches can lead to cracks and part failure. Long, deep scratches should be blended out. Fine sandpaper, or emery cloth of 120 grit or finer, may be used to blend out scratches.

ASSEMBLING TITANIUM.

Do not force or spring oversize parts or splices into place when assembling new titanium parts or repairing titanium parts in use. Work parts until they fit properly. Shim if necessary. Flanges that have been pulled up in a nested splice or to a mold line contour have stresses introduced which may result in cracks or rupture.

CUTTING TITANIUM.

Titanium is very susceptible to cracking if rough areas are present; therefore, all cut and trimmed edges must be filled free of burrs, grooves, scratches, and sharp corners before fabrication is started. Cutting of titanium is similar to that of stainless steel. It work-hardens readily if light pressures are applied and the cutting tool is allowed to ride. Grinding removes metal slowly and a poor surface finish wide heavy burring results. Titanium clogs and wears grinding wheels rapidly. Conventional saw equipment can be used; however, titanium is more apt than stainless steel to wear and clog saw blades.

WARNING

Fire precautions are necessary. Titanium burns similarly to magnesium and is explosive when suspended in air as dust particles.

FORMING AND HEAT-TREATING TITANIUM.

Forming of titanium sheet metal parts presents many difficulties because of its high yield strength, limited ductility, and material inconsistency. Its forming characteristics can be compared to those of ½ hard stainless steel, and heat is required for most forming operations. Forming should not be attempted without the proper forming equipment. Heat-controlled furnaces with controlled temperatures from 900°F (482°C) to a maximum of 1050°F (565°C) are recommended. At 1300°F (704°C) and above, a light greenish-gray deposit will form. If this condition occurs, the metal is assumed to have been overheated and should be discarded. All heat-formed titanium sheet metal parts must be stress-relieved after forming. This is done by placing them in a heat-controlled furnace at a controlled temperature of 900°F (482°C) to 1050°F (565°C) for a period of 30 to 90 minutes, and then air-cooling them at room temperature. This treatment is also useful for removing work-hardening between successive forming operations.

CAUTION

Do not attempt to form titanium parts by torch heating.

DIMPLING TITANIUM.

Titanium sheet must be hot dimpled. Either stationary or portable tools equipped with heated dies may be used. When both dies are heated, a controlled temperature of 750°F (±50°F) [398°C (±10°C)] must be held. When only one die is heated, the controlled temperature must be 800°F (+0°F, −50°F) [426°C (+0°C, −10°C)]. Torch heating of the area being dimpled is not satisfactory and is not to be used. It is important to clear out and burr holes before dimpling to prevent cracks.

CORROSION-RESISTANT STEEL.

Like titanium, corrosion-resistant steel is used in the fuselage rear section because of the high operating temperatures in this section. Its use is intended for applications requiring high heat-resistance values as well as high corrosion-resistance properties. Following are listed some of the most frequently used types of corrosion-resistant steels and their properties.

SPECIFICATION MIL-S-5059, COMPOSITION 301, ANNEALED AND ½ HARD.

This material is not to be heat-treated, fusion-welded, or brazed, but it may be spot-welded or seam-welded. In the annealed condition, it is nonmagnetic; in the ½-hard condition, it is only slightly magnetic. The annealed material forms very easily, but considerable difficulty will be encountered when forming the ½-hard material. Maximum service temperature is 700°F.

SPECIFICATION MIL-S-6721, COMPOSITION 301.

This material should be used only when it is not feasible to use Specification MIL-S-5059, or when the part requires fusion welding. Specification MIL-S-6721 forms very easily and is nonmagnetic. It cannot be heat-treated, but it can be spot-welded, seam-welded, fusion-welded, and silver-brazed. Specification MIL-S-6721, composition 301, should be used where temperatures are to exceed 700°F.

SPECIFICATION MIL-S-25043, 17-7 PH.

This type of material may be used where higher strength or better formability is required than can be obtained by using Specification MIL-S-5059, ½ hard. Whenever 17-7 PH material is used, it must be heat-treated after forming to 180,000-200,000 psi in accordance with Specification MIL-H-6875. The 17-7 PH can be spot-welded or seam-welded after heat-treating, or it can be fusion-welded before heat-treating, but it must not be silver- or copper-brazed. The 17-7 PH is magnetic with a maximum service temperature of 550°F.

CHROME MOLYBDENUM STEEL.

Chrome molybdenum steel is a low-alloy steel used in limited quantities in the construction and repair of aircraft.

Following are three of the most commonly used types of chrome molybdenum steel and their properties.

TYPE 4130.

This type of steel may be copper-brazed or fusion-welded, but not spot-welded or seam-welded. Type 4130 steel can also be silver-brazed if the part is not to be heat-treated. Type 4130 steel should not be surface-hardened, but can be heat-treated to 160,000-180,000 psi.

TYPE 4140.

This steel is very similar to Type 4130 steel. The one outstanding difference is that Type 4140 steel has a higher amount of carbon in its make-up. Type 4140 steel may be fusion-welded or copper-brazed, but not spot-welded, seam-welded, or silver-brazed. This material is not to be surface-hardened, but it can be heat-treated to 180,000-200,000 psi.

TYPE 4340.

This type of chrome molybdenum steel may be fusion-welded or copper-brazed, but not spot-welded, seam-welded, or silver-brazed. Type 4340 can not be surface-hardened, but can be heat-treated to 200,000-220,000 psi.

Selection of a low-alloy steel to meet repair requirements can be found in the following chart, using the thickness for full hardening and the strength range required. Type 4140 may be used in place of Type 4130, and Type 4340 may be used in place of either Type 4140 or Type 4130 steel.

THICKNESS FOR FULL HARDENING (IN.)	TENSILE STRENGTH REQD (PSI)				
	125,000 THRU 140,000	140,000 THRU 160,000	160,000 THRU 180,000	180,000 THRU 200,000	200,000 THRU 220,000
0.000 thru 0.250	4130	4130	4130	4130	4340
0.251 thru 0.500	4130	4130	4130	4140	4340
0.501 thru 0.750	4130	4130	4140	4140	4340
0.751 thru 1.000	4140	4140	4140	4140	4340
1.001 thru 1.250	4140	4140	4140	4340	4340
1.251 thru 1.500	4140	4340	4340	4340	4340
1.501 thru 3.000	4340	4340	4340	4340	4340
3.001 thru 3.500	4340	4340	4340	4340	—
3.501 thru 4.000	4340	4340	4340	—	—

HONEYCOMB SANDWICH PANELS.

Honeycomb sandwich panel construction is used in two basic types of airplane structure: that type of structure which must carry or transmit load (primary structure) such as speed brakes and that type which is used as fairing or streamlining (secondary structure). Construction of both types is generally the same, consisting of a core made of aluminum honeycomb and having sheet metal bonded (cemented) to each side. A very high-strength, light structure can be built up in this way. The structural or load-carrying type repair will require the replacement of damaged material so that the load can be transmitted through the repair. Minor damage may be considered nonstructural, and filling alone is all that is required. No load will be carried through this type of repair.

MATERIALS FOR REPAIR OF HONEYCOMB SANDWICH PANELS.

MATERIAL	SOURCE
Adhesive, EC-1469	Minnesota Mining and Manufacturing Co
Epoxy filler, Corefil 615	Bloomingdale Rubber Co
Curing Agent "U"	Shell Chemical Corp
Aerodynamic filler, PR-341 and PR-341 accelerator	Products Research Co
Toluene	Federal Spec TT-T-548
Methyl ethyl ketone (MEK)	Federal Spec TT-M-261
Sulphuric acid, specific gravity 1.84	Commercial
Sodium dichromate, technical grade	Commercial
Talc, white powder, technical grade	Commercial
Honeycomb core 8.0-½-20(5052)	Spec MIL-C-7438
Balsa wood	Spec MIL-S-7998
Sandpaper, 320 grit, wet or dry	Minnesota Mining and Manufacturing Co
Cellophane sheet	Commercial
Glass wool	Commercial
Naphtha	Federal Spec TT-M-95
Wash primer	Spec MIL-C-15328A
Zinc-chromate primer	Spec MIL-P-6889
Aluminized lacquer	Spec MIL-L-7178
Sealant injection gun	AF Stock No. 4940-345-1178
Clean, dry rags	Commercial
250-watt infrared heat lamp	Westinghouse

SURFACE PREPARATION FOR ADHESIVE BONDING.

The strength of the bond depends largely on the cleanness and proper preparation of the surfaces to be bonded. The importance of proper surface preparation can not be overemphasized.

METAL SURFACES. Prepare metal surfaces as follows:

1. Remove with toluene all dirt, grease, and other surface contamination. Apply the toluene to the bonding

surfaces with clean rags. Pour the toluene onto the rags or the surfaces to be cleaned. Do not dip rags into toluene container for this will contaminate the toluene. *Use only clean toluene in clean cans.* Do *not* permit toluene to air-dry on surfaces; wipe surface dry with clean, dry rags.

2. Lightly sand the bonding surfaces with clean 320-grit sandpaper and wipe all loose particles off with clean rags.

3. Apply the following acid cleaner to the bonding surfaces for 20 to 25 minutes at a solution temperature of at least 70°F. Apply cleaner either by immersing bonding surface in acid cleaner or by swabbing the cleaner on the bonding surface with glass wool.

ACID CLEANER

Sulphuric acid:	
specific gravity 1.84	55 parts by weight
Sodium dichromate	10 parts by weight
Water	80 parts by weight

4. Rinse thoroughly with water and check the surface for water break. If the water on the surface tends to form drops, repeat the cleaning and rinsing procedure until a water-break-free surface is obtained.

5. Dry the surfaces thoroughly. Do not heat over 150°F.

Note

When applying acid cleaner to vertical surfaces or areas near cracks or holes, add sufficient talc to the cleaner to form a thick paste which will not run or sag. *Do not permit the acid cleaner to run into areas that can not be flushed with water.*

CAUTION

Use rubber gloves and adequate eye protection when handling the acid cleaner.

HONEYCOMB CORE. If a vapor degreaser is available, suspend the core in the vapor zone until condensation ceases. Otherwise, flush it with clean toluene.

BALSA WOOD. Lightly sand the bonding surfaces with 320 grit sandpaper and wipe off all loose particles.

MACHINING HONEYCOMB CORE.

The honeycomb core must be cut to the desired thickness by sawing, milling, or other similar procedures, so that the core-to-face bond will be continuous over the entire bond area. The operations of cutting, forming, and shaping must not cause buckling or crippling of the cell walls. The core must be cut sufficiently oversize in length and width dimensions to allow a slight compression of the core cells next to the edges, and splice joints, and the ribbon direction must be parallel to that of the original part being repaired. The core must be machined without lubricants and kept free of all oil and other contaminants during the machining operation.

Note

When noncompressible materials such as metal, micarta, or wood, are being used as fillers to replace sections of honeycomb, the filler material should be trimmed to provide a clearance of between 0.003 and 0.006 inch between all surfaces to be bonded. This clearance is necessary to provide for a sufficient amount of adhesive.

SPLICING HONEYCOMB CORES.

After removing the damaged portion of the honeycomb core scuff, sand the old bond line, wipe the surfaces to be bonded with a clean rag soaked in toluene, and dry surface immediately with clean dry rags. Do not allow toluene to air-dry on surface. Do not use compressed air to hasten drying process. All contact edges of the replacement core must be coated with adhesive, and the section must be forced into place. Side pressure must be maintained until the bond has cured. This pressure must be enough to provide contact along the entire splice mating surfaces, but not great enough to cause excessive cell distortion to the core. Allowable core gaps are not to exceed 1/8 inch in width and six cells in length. The total number of gaps must not exceed 20 percent of the splice length. All gaps must be filled with adhesive.

MIXING ADHESIVE AND FILLER MATERIAL.

The adhesive and fillers used for repairs are two-part materials which begin to cure or harden as soon as the two components are mixed. Do not mix more material than can be used within the "pot life" of the mixture. The materials and their respective "pot life" at room temperature are as follows:

MATERIAL	HARDENER	POT LIFE
EC-1469 100 parts	Curing Agent "U" 40 parts	20-30 minutes
Corefil 615 Filler 100 parts	Curing Agent "U" 20 parts	20-30 minutes
PR-341 Filler 100 parts	PR-341 accelerator 10 parts	3-4 hours

Mix the hardener thoroughly into the adhesive or filler, using a spatula or putty knife. Observe the following precautions:

1. Mix it in small quantities—one quart or less.

2. Ventilate the mixing area and avoid breathing the vapors.

3. Keep curing agent "U" and adhesive off hands and clothing.

4. If curing agent "U" or mixed adhesive comes into direct contact with skin, wash affected area immediately with soap and water or with denatured alcohol.

NEGLIGIBLE DAMAGE.

Dents may exist if the depth of the dent in relation to its length is within the following limits:

LENGTH	DEPTH
½ to 1 inch	0.050
1 to 2 inches	0.075

Note

Check all dents for delamination. (Refer to "Delamination Test of Honeycomb Panels.") Refer to "Aerodynamic Skin Filler" for filling dents.

NONSTRUCTURAL REPAIRS.

The restrictions on nonstructural repairs are as follows: Minimum distance between damages is 12 inches and the maximum hole size is one inch in diameter. These restrictions must be firmly adhered to unless otherwise specified on the repair drawing.

Make nonstructural repairs as follows:

1. Cut out damaged skin and core using either a hole saw or router and template.
2. Fill area flush with freshly mixed Corefil 615 filler. Be sure to avoid trapping any air in cavity.
3. Remove all excess filler from surrounding area with methyl ethyl ketone (MEK) before it hardens.
4. Allow repair to cure for at least 4 hours at minimum temperature of 70°F. If temperature is below 70°F, place 250-watt heat lamp about 3 feet from repair. Do not allow temperature to exceed 180°F.
5. After repair has cured for required length of time, sand filler flush with adjacent skin areas, using 320-grit paper. Take care not to penetrate cladding.

STRUCTURAL REPAIRS.

The overlap requirements for skins or repair doublers when making a structural repair are as follows:

DAMAGE LENGTH	OVERLAP
Up to 2 inches	2 inches
2 to 4 inches	2½ inches
4 to 6 inches	2¾ inches
6 to 8 inches	3 inches

These overlap requirements must be used unless otherwise specified on the repair illustration.

Make structural repairs as follows:

1. Cut out damaged skin and core using either a hole saw or router and template.
2. Make replacement core from honeycomb core, balsa wood, or a drilled metal filler block (as specified on the repair figure) to fit exact area of removed core.
3. Trim and form replacement skins and doublers to match mold line of area being repaired.
4. Clean all surfaces to be bonded as specified in "Surface Preparation for Adhesive Bonding."
5. Apply coating of freshly mixed EC-1469 adhesive at least 1/32 of an inch thick on all surfaces to be bonded. Fill all gaps between replacement core and existing core with EC-1469 adhesive. Assemble as quickly as possible. If repair can not be completed within "pot life" of adhesive, clean off all of adhesive with toluene and repeat procedure.
6. Cover repair with cellophane and apply pressure of from one to 10 psi by dead weight load or clamping.
7. Cure for minimum of 4 hours at minimum temperature of 70°F. If temperature is below 70°F, place 250-watt heat lamp about 3 feet from repair area. Do not permit temperature to exceed 180°F during cure.
8. Remove pressure, and sand excess adhesive flush with surrounding skin with 320 grit paper. Take care not to penetrate cladding.

Note

All structural repairs *must* be allowed to age-cure for a period of 7 days before being returned to service.

DELAMINATION TEST OF HONEYCOMB PANELS.

When tapped with a coin, the suspected delaminated area will produce a dull tone if it is delaminated. If the area is not delaminated, a clear tone will result. There will be a slight difference in the tone produced by different filler materials, i.e. honeycomb, micarta, balsa wood, etc, but all will have a clear ringing tone when struck if they are properly bonded. If a change in tone is detected, the area should be carefully sounded and the boundaries of the delamination marked with a grease pencil. With a little practice, the operator can outline the delaminated area with a high degree of accuracy.

REPAIRING DELAMINATED HONEYCOMB.

1. Depending on size of delaminated area, drill two or more ⅛-inch diameter holes through delaminated skin near edge and at opposite sides of delaminated area.
2. Inject freshly mixed EC-1469 into core through the lowest ⅛-inch hole. Continue injecting adhesive until it flows from the highest hole.

3. Clean off excess adhesive with methyl ethyl ketone (MEK) and cover filler holes with cellophane.

4. Apply light pressure against skin to force it down into contact with core.

5. Cure under pressure for minimum of 4 hours at minimum temperature of 70°F. If temperature is below 70°F, place 250-watt heat lamp about 3 feet from repair area. Do not permit temperature to exceed 180°F during cure.

6. Remove pressure and sand excessive filler flush with surrounding area, using 320-grit paper. Take care not to penetrate cladding.

Note

All delamination repairs *must* be allowed to age-cure for a period of 7 days before being returned to service.

CONTROL SURFACE STATIC BALANCE.

By nature of the construction and location of their hinge points, movable control surfaces are tail-heavy until balanced. Lead weights, added to the leading edge in certain locations, provide this balance. Static balance is carefully considered in the design of an airplane to prevent flutter. When in flight, the wings of an airplane are deflected as the various loads are applied. This deflection of the wing is greatest at the tip and diminishes toward the root. As the wing is deflected upward, tail-heaviness in an unbalanced control surface will cause the control surface to move downward. Changing the flow of air over the wing in this manner would cause the wing to move upward even more. In the same way, if the wing is deflected downward, tail-heaviness would cause the control surface to move up, and tend to cause the wing to move down even further. A balanced control surface has enough weight added forward of the hinge line to offset the natural tail-heaviness of the surface. When a wing with a balanced surface is deflected upward or downward, the surface itself moves upward or downward in the same plane with the wing. (See figure 1-51.) After making repairs to a control surface, rebalancing may be necessary. This can be determined by testing the balance of the surface. (See figure 1-56.) Since the safety of the airplane is involved, it is most

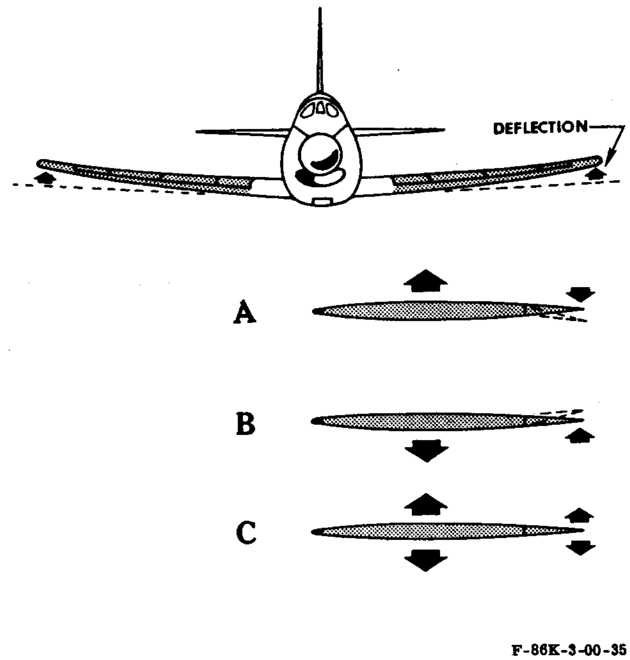


Figure 1-51. How Wing Deflection Affects Control Surface

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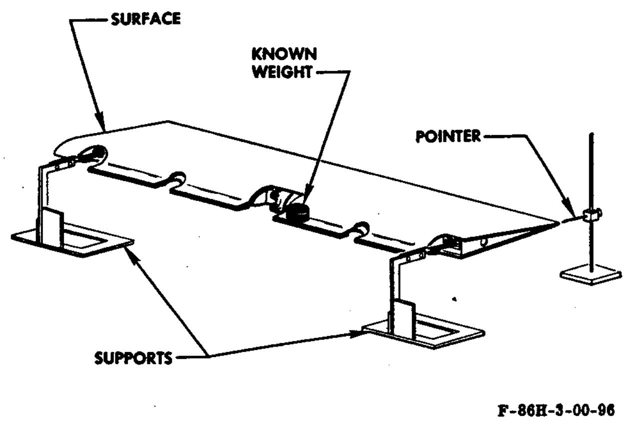


Figure 1-52. Static Underbalance

essential that the mass balancing of the ailerons and rudder must be maintained within the following tolerances:

SURFACE	TOLERANCE
Aileron	0 to 10 in. lb nose heavy
Rudder	3 in. lb tail heavy to 5 in. lb nose heavy

Note

All control surfaces must be complete with tab assembly attached before mass balance check is performed. Ailerons should be balanced with the seals on. The forward edge of the seal should be attached to the balance stand in a manner similar to that used to attach the seal to the wing. All dirt, grease, and moisture must be removed from the control surfaces.

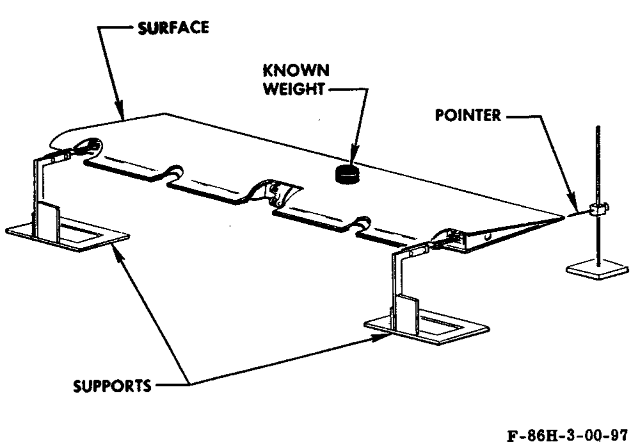


Figure 1-53. Static Overbalance

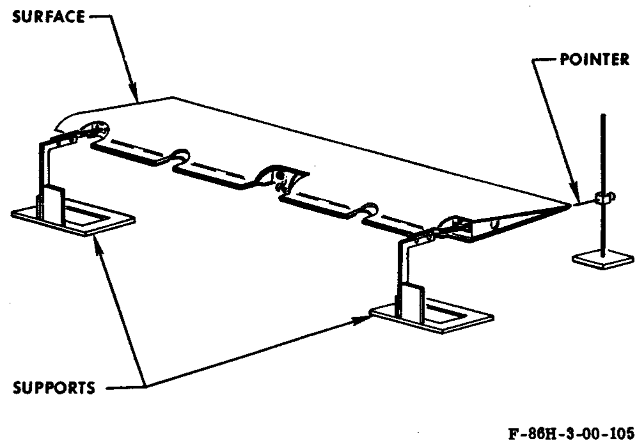


Figure 1-54. Complete Static Balance

The terms used in regard to static balance are defined as follows:

Moment—The tendency of a force (such as weight) to produce rotation about an axis (centerline of control surface hinge) because of its position with respect to the axis. For example, one pound of weight 10 inches, horizontally, from an axis produces 10 inch-pounds of moment (1 pound × 10 inches = 10 inch-pounds) about the axis.

Static Balance—the numerical value of the moment resulting from the weight of the surface about the hinge line (with surface horizontal). Balance is usually expressed in inch-pounds of moment.

Static Unbalance—Underbalance or Tail-heaviness—The moment that causes the trailing edge of a surface, which is suspended on its hinge points in a fixture, to rotate downward after the surface is placed at neutral. The center of gravity of the surface is aft of the hinge line. To balance an underbalanced surface at neutral, it would be necessary to place a quantity of weight forward of the hinge line which would bring the trailing edge up. (See figure 1-52.) The product of this weight and its measured distance from the hinge line is the moment in inch-pounds by which the surface is underbalanced.

Static Overbalance or Nose-heaviness—The moment that causes the leading edge of a surface, which is suspended on its hinge points in a fixture, to move downward from neutral. The center of gravity of the surface is forward of the hinge line. A quantity of weight placed on the surface aft of the hinge line would be required to balance an overbalanced surface at neutral. (See figure 1-53.) The surface would be overbalanced by the moment found when multiplying this weight by its measured distance from the hinge lines.

Complete Static Balance—The condition where the surface balances at neutral without having to place a weight anywhere on the surface. The center of gravity is on the hinge line. (See figure 1-54.)

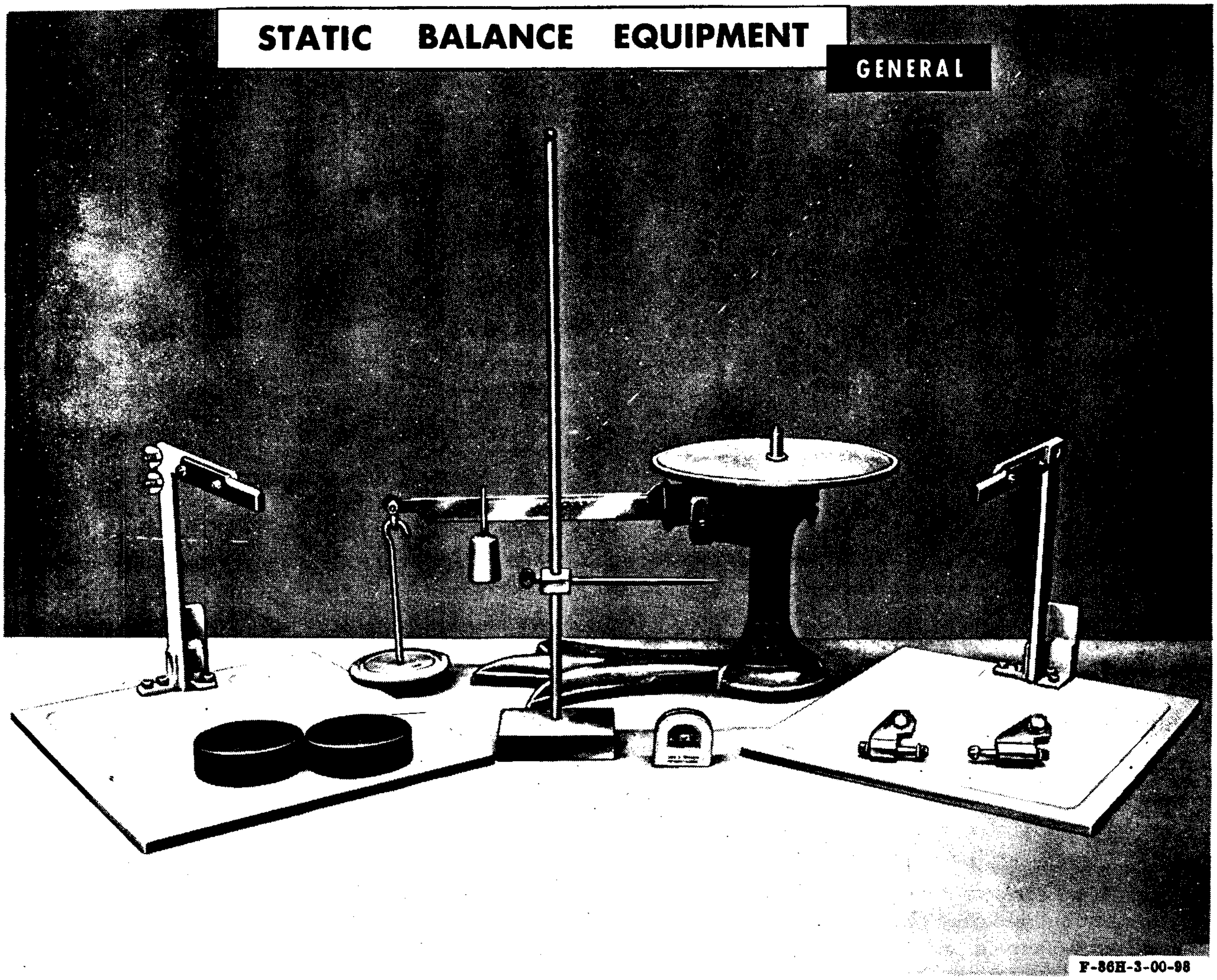


Figure 1-55. Static Balance Equipment

Statically Unstable Surface—A surface in which the center of gravity is above the hinge line. When an unstable surface is suspended on its hinge points in a fixture, it will rotate as far as the fixture will permit.

Statically Stable Surface—A surface in which the center of gravity is below the hinge line. When a stable surface is suspended on its hinge points in a fixture, it will assume a nose or tail down attitude in proportion to its overbalance or underbalance.

STATIC BALANCE EQUIPMENT.

See figure 1-55.

STATIC BALANCE CHECK.

Checking static balance is relatively simple and can be used at smaller bases. The equipment necessary to balance a surface is a set of support stands, a reference pointer, a beam scale and a reaction block or a weight of known value. The support stands must be arranged so that they are absolutely level. Mount the surface in the support stands and measure from center of hinge line to table to establish neutral. Set pointer at neutral. If surface trailing edge aligns with pointer, it is at neutral and in complete static balance. If the trailing edge of the surface does not align with the pointer, the moment of underbalance or overbalance may be found as follows:

To find overbalance moment, place reaction block on scale pan and adjust height of reaction block until tip is equal to neutral. Set scale and reaction block under leading edge of surface. (See figure 1-56.) The surface, being nose heavy, will bear on the scale. Balance scale beam and take scale reading. Measure distance from hinge line to point of contact of reaction block. This is the moment arm. The overbalance moment is equal to the scale reading minus weight of reaction block, times the measured distance (moment arm). If the overbalance moment falls within the tolerance established for the surface, it need not be rebalanced. For example: A control surface 0 to 10 inch-pounds overbalance.

1. Subtract weight of reaction block (one pound) from scale reading (2.5 pounds). The result is 1.5 pounds ($2.5 - 1.0 = 1.5$).

2. Multiply result from step 1 (1.5 pounds) by the moment arm (2 inches). The product, 3 inch-pounds ($2 \times 1.5 = 3$), is the overbalance moment.

The surface is within tolerance. Had the surface been out of tolerance, it would have been necessary to remove weight at the leading edge. Should a scale not be available, a weight of known value may be used. With the surface suspended on supports, place a weight on the surface and move it forward or aft until the trailing edge is neutral. The distance from the hinge line (moment arm), times the value of the weight will be the overbalance moment in inch-pounds.

Underbalance may be found in much the same manner as overbalance, except that the scale would be placed under the trailing edge, or the known weight would be used forward of the hinge line. (See figure 1-56.)

When checking balance of a surface, it is essential that the surface be supported so that it has the same freedom of movement and range of travel that it has on the airplane. The area should be free of air currents.

Note

Checking static balance while the surface is mounted on the airplane is not recommended.

When rebalancing, to compensate for a repair, balance weight should be added as nearly as possible at the station of repair.

When checking static balance, it is necessary to balance each control surface completely assembled. Suspend aileron panel on knife-edge supports using hinge link assemblies. To make use of knife-edge supports for the rudder panel, make a centering cone of metal or wood to fit opening in torque tube. Drill a hole through center of cone. The drilled hole should be the same size as the hole in the top hinge fitting. Get bolts the same size in diameter for the centering cone and the top hinge fitting. The bolts rest on the knife edge supports. (See figure 1-56, sheet 1 of 4.)

BALANCING FLIGHT CONTROL SURFACES.

The ailerons have lead weights in the leading edge. The ailerons are rebalanced by the addition or removal of lead washers. (See figure 1-56.) Balance weights are installed in the rudder hinges and rudder rebalancing is done by adding or removing to the hinge weight.

SEALS AND SEALANTS.

Many areas in an airplane must be sealed in order for the airplane to operate effectively and to provide comfort and safety for the pilot.

TYPES OF SEALANTS.

Two basic types of sealant used are curing and noncuring. The noncuring sealant is used exclusively in the integral fuel tank of the wing. (Refer to "Wing Group," Section II.) The curing sealants used vary in characteristics. Each sealant is chosen to do a specific job in the area to which it is applied.

To allow removal or replacement, parts such as castings, electrical equipment, hydraulic lines, bolts, etc, are sealed with rubber-type gaskets. Rubber seals, such as those used on doors, canopy, etc, should be replaced when deteriorated. Refer to Illustrated Parts Breakdown, T. O. 1F-86K-4 for nomenclature and part numbers.

SEALING PRESSURIZED AREAS.

The fuselage structure and seals in the pressurized cockpit section are designed to withstand a maximum pressure differential of about 10 psi. However, the cockpit pressure regulator will normally prevent the pressure differential from exceeding 5 psi maximum in operation. Should the pressure regulator fail, a cockpit air pressure dump valve limits maximum pressure differential in the cockpit to about 5.57 psi. Allowable leakage from the cockpit area is 55 cfm before repairs are necessary. (This includes the 5 cfm leakage through the cockpit pressure regulator when it is off for ground pressurization tests.) This must be considered when repairing any damage to the pressure seals in the cockpit section. Complete pressure-testing procedures, together with minimum pressure requirements and necessary precautionary measures, are outlined in "Fuel Systems and Utility Systems," T.O. 1F-86K-2-2. The pressure sealing should be done from the pressurized side of the surface being sealed. Sealing tapes must not be used between closely united surfaces, such as riveted structural components, in primary structure. Care should be taken to make sure that all areas are sealed before assembly operations make the area inaccessible.

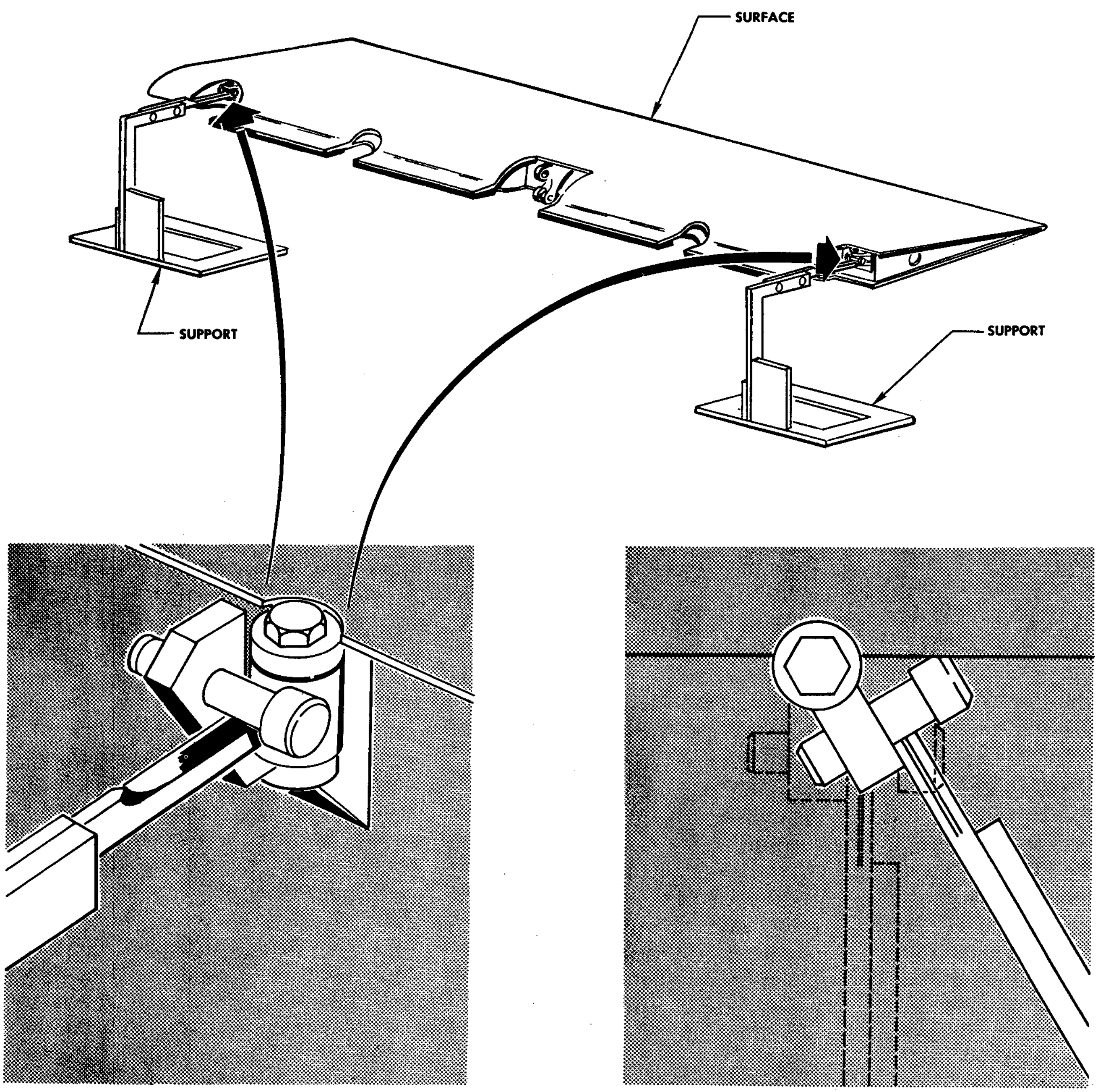
SEALING PRESSURIZED AREAS—COCKPIT PRESSURE-SEALING REPAIR PRECAUTIONS.

Before making any cabin repairs, all personnel concerned should be thoroughly acquainted with the following pressurization precautions:

1. With personnel inside, the cockpit must never be

STATIC BALANCE CHECK

GENERAL



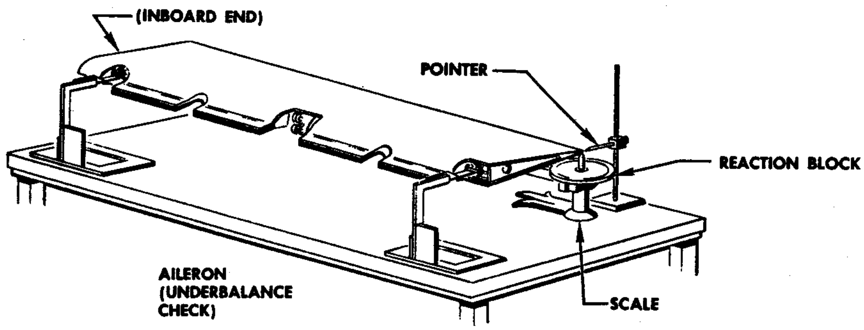
NOTE Knife-edge contacts surface only at hinge fitting.

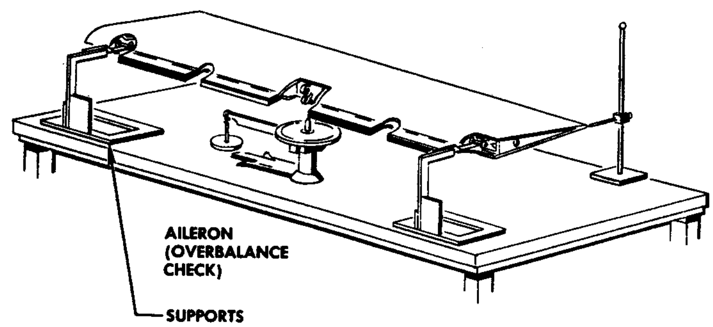
F-86H-3-00-100

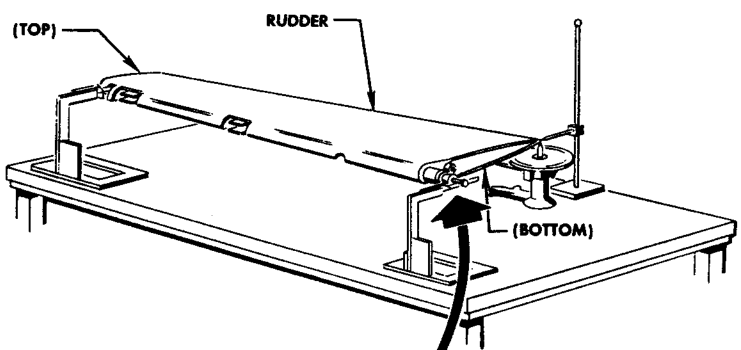
Figure 1-56. Static Balance Check (Sheet 1 of 4)

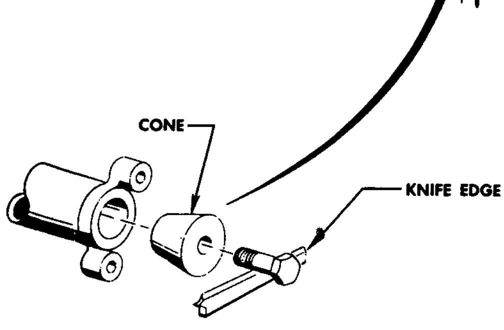
STATIC BALANCE CHECK

GENERAL









SURFACE	TOLERANCE
AILERON	0 TO 10 INCH-POUNDS NOSE-HEAVY
RUDDER	3 INCH-POUNDS TAIL-HEAVY TO 5 INCH-POUNDS NOSE-HEAVY.

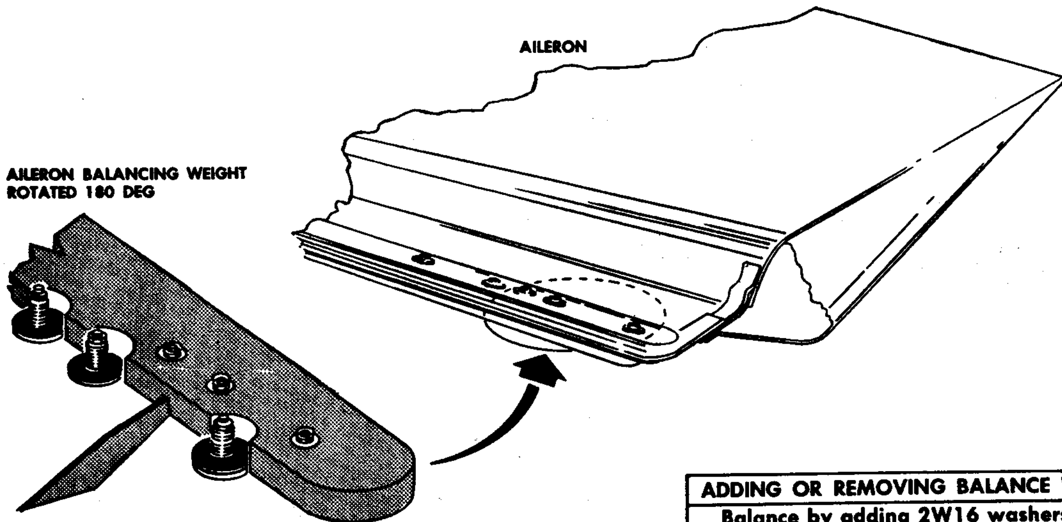
NOTE The area must be free of air currents. The surface must be free to move of its own inertia. Refer to index for rebalancing control surfaces.

F-86K-3-00-34

Figure 1-56. Static Balance Check (Sheet 2 of 4)

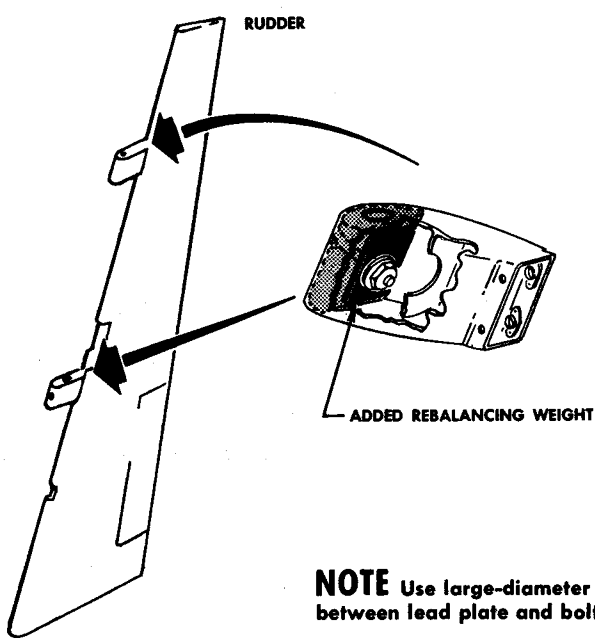
STATIC BALANCE WEIGHT PROVISIONS

GENERAL



ADDING OR REMOVING BALANCE WEIGHTS

Balance by adding 2W16 washers singly to each stud, working consecutively from outboard to inboard end, or by removing 2W16 washers singly from each stud, working consecutively from inboard to outboard end. For proper installation of nuts, vary grip by adding AN960D10 washers.



NOTE Use large-diameter steel washer between lead plate and bolthead.

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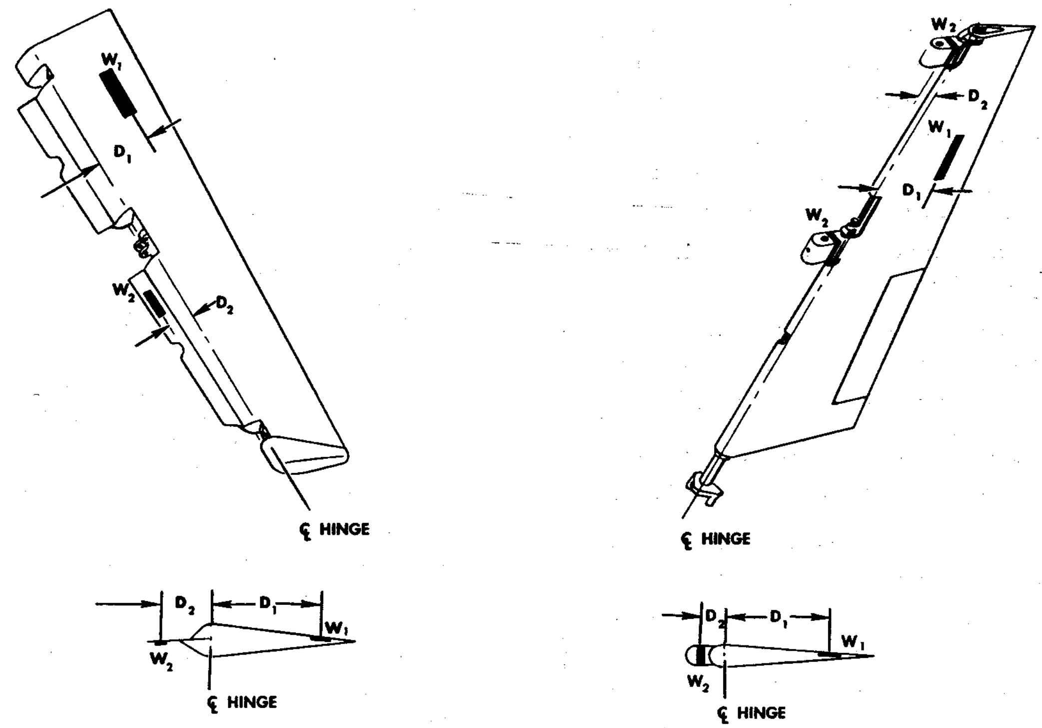
Figure 1-56. Static Balance Check (Sheet 3 of 4)

MATHEMATICAL BALANCE CHECK

GENERAL



D_1 represents the distance in inches from center of gravity of repair to hinge centerline

D_2 represents the distance in inches from center of gravity of rebalancing weight to hinge centerline.

W_1 represents the net weight of repair materials (gross weight of added repair materials minus the weight of damaged material removed).

W_2 represents the required weight necessary to rebalance control surface.

To determine the effect of the repair on the control surface, multiply W_1 (weight) by D_1 (distance).

Example:
W_1 = 1 pound
D_1 = 8 inches
The effect of repair on balance would be: 1 pound × 8 inches = 8 inch-pounds underbalance.

When the effect of a repair causes underbalance, use the following equation to determine the weight necessary to rebalance.

Example:
W_2 (weight necessary to balance effect of repair) $= \frac{W_1 \times D_1}{D_2}$

W_1 = 1 pound
D_1 = 8 inches
D_2 = 4 inches
$W_2 = \frac{\text{1 pound} \times \text{8 inches}}{\text{4 inches}} =$ 2 pounds required to balance control.

F-86K-3-00-33

Figure 1-56. Static Balance Check (Sheet 4 of 4)

pressurized to a higher pressure than has been previously established during the testing procedure with the cockpit empty.

2. It is recommended that only personnel who have been examined and approved by medical authority be allowed in the cockpit while it is under pressure.

3. It is essential that no one who has recently had a cold or has had his sinuses impaired in any way be allowed in the cockpit while it is under pressure.

4. An experienced operator must be present at the pressurization equipment control panel at all times while the cockpit is under pressure.

5. While the cockpit is under pressure, all personnel should stay clear of the canopy.

6. While the cockpit is being pressurized, pressure change should *never* exceed 1000 feet per minute altitude change, as indicated on a rate-of-climb indicator.

SEALING PRESSURIZED AREAS—DETECTING LEAKS WITH COCKPIT UNDER PRESSURE.

1. With the cockpit depressurized, let mechanic selected to do repair work enter.

2. Pressurize cockpit to required test pressure, or to maximum pressure attainable below required test pressure, using a rate of pressure increase not exceeding ½ psi per minute (a rate of descent of 1000 feet per minute on a vertical velocity indicator).

3. With cockpit pressurized, on outside of airplane locate leaks with a castile soap solution. Isolate leaks on inside by running a stethoscope or a piece of rubber tubing along seams in leakage area, listening for a change in sound when tube is passed over a leak.

4. Repair leaks until it is not possible to detect any change in sound when stethoscope or rubber tubing is passed over location, or until someone on outside indicates that leak has been stopped.

5. After repairs have been completed under pressure, depressurize cockpit at a rate of descent not to exceed 1000 feet per minute.

Air-tight seals are provided for all joggles, seams, butt and lap joints, holes, slots, rivets, etc, in the pressurized area.

SEALING PRESSURIZED AREAS—PRESSURE-SEALING MATERIALS.

MATERIAL	SOURCE
Naphtha	Specification MIL-N-15178
Toluol	Federal Spec TT-T-548
Sealing compound, general purpose	Specification MIL-S-7502, Class B-4
Pro-Seal 414, corrugation sealant	Coast Pro-Seal & Mfg Co
EC-612P	Minnesota Mining and Mfg Co
Cleaning compound, Deseal A or equivalent	Kelite Products, Inc
Coating, Vulcabond V-36	American Latex Products Corp
Coating, A56B	B. F. Goodrich Co
Tape, general purpose, pressure sensitive, Type II, Grade C	Specification JAN-P-127

(Refer to index for source of commercial products.)

SEALING PRESSURIZED AREAS—MIXING AND HANDLING OF SEALING COMPOUNDS, SPECIFICATION MIL-S-7502.

The base compound and accelerator should be mixed together in the proportions recommended by the manufacturer. It is important that the two parts be blended until the accelerator is uniformly distributed throughout the mixture. (There should be no evidence of streaks or discoloration.) A fillet made from sealant which is not mixed thoroughly will have areas which do not cure completely.

At room temperature (about 77°F), the sealing compound must be used within 3 hours total time after having been mixed with the accelerator or removed from cold storage. After addition of the accelerator, the sealing compound may be stored at 0°F to −10°F for 72 hours.

SEALING PRESSURIZED AREAS—CLEANING SURFACES TO BE SEALED.

The surface to which the sealant is to be applied must be absolutely clean. Remove all foreign material with air hose, vacuum cleaner, or clean, dry cloth. Moisten clean cloth with naphtha or solvent and wipe all surfaces to be sealed. Surface should be wiped dry before solvent evaporates. Always pour solvent onto cloth to prevent contamination of solvent supply. It is important that clean cloths be used. The surface is completely clean, when, after the surface is wiped, the cloth is not soiled.

Before applying sealing compound to any painted surface, check to see if paint is adhering to surface satisfactorily. If paint is removed easily when scratched with thumbnail, it is not satisfactory and should be removed before sealing compound is applied.

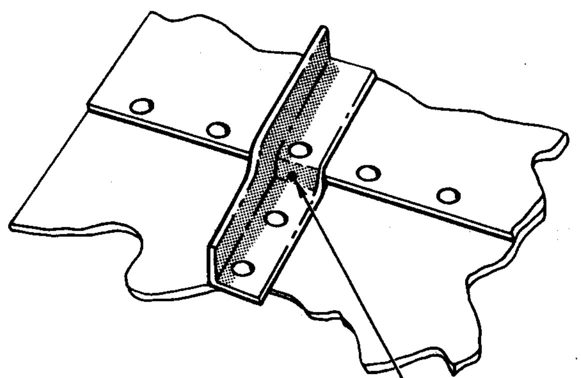


Figure 1-57. Sealing Joggle at Drilled Hole

Scrub paint to be removed with a cloth soaked with wash thinner (Federal Specification P-S-661). When paint is dissolved, clean with cloth wet with wash thinner or other suitable solvent. Wipe dry with clean cloth.

SEALING PRESSURIZED AREAS—
SEALING PROCEDURE.

Seal joggles first by forcing compound under the joggle from either side. If joggle is too small to seal from the side, it may be sealed by drilling a No. 40 hole in joggle as shown in figure 1-57. Apply compound through hole until it comes out from both sides of joggle.

CAUTION

When it is necessary to drill joggles, be sure necessary steps are taken to prevent damage to structure which is underneath the joggle.

Seal holes and slots up to 1/8 inch in diameter by filling them with sealing compound and building up a bead at least 1/8 inch high. (See figure 1-58.) Holes and slots greater than 1/8 inch in diameter, but not larger than 1/4 inch, are sealed by applying a layer of pressure-sensitive tape over the holes on the pressure side (tape to extend 1/2 inch beyond edge of hole in all directions) and then a layer of sealing compound which extends at least 1/8 inch beyond edge of the tape in all directions. Tape is used under the sealing compound to prevent pressure from causing the compound to be blown through the hole. Where pressure-sensitive tape cannot be used, fill hole completely with EC-612P sealing compound, forming a fillet on the pressure side. Then apply a layer of general purpose sealing compound over the EC-612P. (See figure 1-59.) Holes larger than 1/4 inch in diameter must be filled with a rivet, balsa wood plug, or a cap to reduce the size of the opening below 1/8 inch. Seal hole with layer of sealing compound which extends at least 1/4 inch beyond edge of hole in all directions.

Slats and joggles greater than 1/4 inch must be closed with sheet metal similar to that used in surrounding structure.

After all holes and joggles have been sealed, the seams and joints are sealed. With a pressure applicator or spatula, apply bead of sealing compound carefully along seams and joints so there are no bridges or gaps in the head.

Seal rivets and bolts as necessary. Brush a coat of Pro-Seal No. 414 or general purpose sealing compound on all bolts and rivets in pressurized area.

Note

General purpose sealing compound may be thinned to brush consistency by mixing one part toluol to two parts of sealing compound by volume.

CAUTION

Toluol and the solvent used in Pro-Seal No. 414 are highly inflammable and toxic. Safety precautions must be observed while using these materials to prevent fire. If used in a closed area, forced ventilation must be provided for personnel.

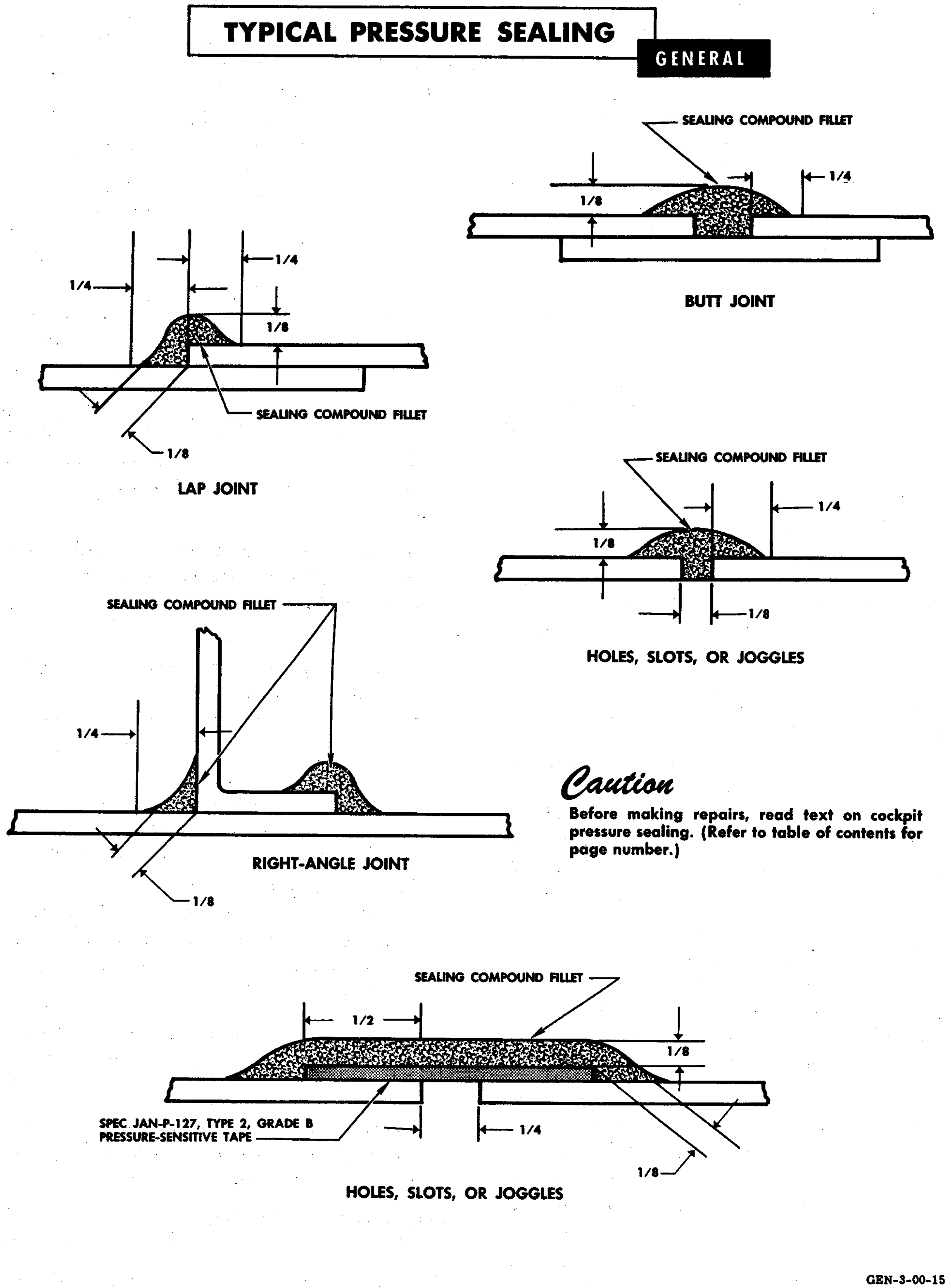
If it is necessary to apply sealant to any rubber parts, the rubber must first be cleaned with toluol.

Note

Toluol will remove B. F. Goodrich A-56B coating. If this coating is required, apply two brush coats of A-56B to exposed rubber.

Apply coating of Vulcabond V-36. When Vulcabond V-36 is no longer tacky, the sealant may be applied.

All equipment and any excess sealant used must be cleaned up within 3 hours after exposure to room temperature. Use naphtha, toluol, or Deseal A for cleaning.



Caution

Before making repairs, read text on cockpit pressure sealing. (Refer to table of contents for page number.)

Figure 1-58. Typical Pressure Sealing

FILLING HOLES

GENERAL

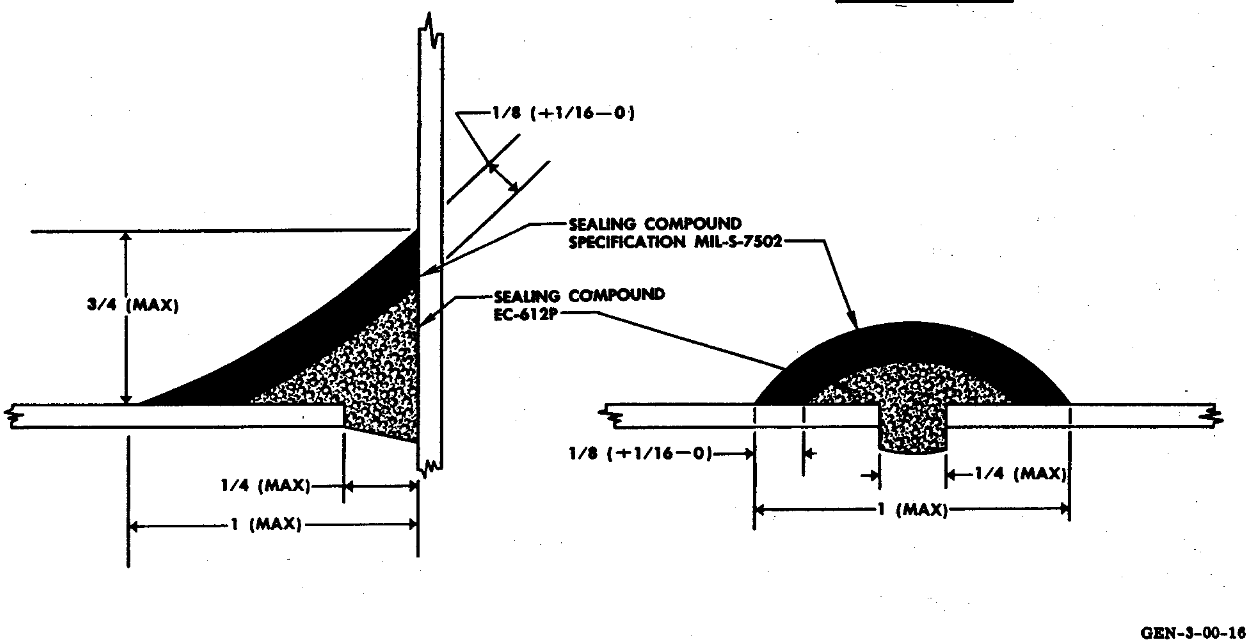


Figure 1-59. Filling Holes Where Tape Cannot Be Used

LIQUIDTIGHT SEALING.

There are some areas in the airplane where leakage of fluids such as hydraulic oil, fuel, water, etc, must be avoided, or controlled drainage provided. Since these areas are in different locations throughout the airplane, a wide range of operating temperatures exist between these various areas. For this reason, a sealant which may be used satisfactorily in one area may not be satisfactory in another. Liquidtight sealants are provided for three temperature ranges:

- Temperatures up to 250°F
- Temperatures from 225°F to 400°F
- Temperatures from 400°F to 500°F

All areas where liquidtight sealing is required must be completely sealed.

LIQUIDTIGHT SEALING—TEMPERATURES UP TO 250°F.

Use the same materials and procedures as outlined under "Sealing Pressurized Areas."

LIQUIDTIGHT SEALING—TEMPERATURES FROM 225°F TO 400°F.

This sealing process is used in areas where temperatures may be as high as 400°F in normal operation, with occasional temperatures up to 500°F for short periods.

LIQUIDTIGHT SEALING MATERIALS—TEMPERATURES FROM 225° TO 400°F.

MATERIAL	SOURCE
Solvent, cleaning	Federal Spec P-S-661
Pro-Seal high-temperature sealing compound No. 714	Coast Pro-Seal & Mfg Co
Pro-Seal catalyst No. 714A	Coast Pro-Seal & Mfg Co

(Refer to index for source of commercial products.)

MIXING AND HANDLING SEALING COMPOUND FOR LIQUIDTIGHT SEALS — TEMPERATURES FROM 225°F TO 400°F. Thoroughly mix 1½ parts catalyst (curing agent) by weight to each 100 parts of base compound by weight. After having been mixed, the sealant has a working life of from one to 2 hours in an open container when exposed to room temperature. It may be stored at 5°F for 2 weeks. If no low-temperature storage is available, it may be kept for 24 hours at room temperature if it is kept in a tightly closed container.

LIQUIDTIGHT SEALING PROCEDURES — TEMPERATURES FROM 225°F TO 400°F. Procedures for the use of this sealant are the same as those outlined under "Sealing of Pressurized Areas." However, balsa wood plugs may not be used for sealing at these temperatures.

LIQUIDTIGHT SEALING—TEMPERATURES FROM 400°F TO 500°F.

In areas where liquidtight sealing is to be used and the continuous operating temperatures may reach 500°F, the following sealing process is used.

LIQUIDTIGHT SEALING MATERIALS—TEMPERATURES FROM 400°F TO 500°F. Temperatures are as follows:

MATERIAL	SOURCE
High-temperature sealing compound, EC-1548	Minnesota Mining and Mfg Co
Sealing tape, unfused Teflon No. 547 (one-inch wide by 5 mils thick)	Minnesota Mining and Mfg Co
Coating compound, No. C-136	American Latex Products, Inc
Cement, No. EC-613B	Minnesota Mining and Mfg Co
Cleaning solvent	Federal Spec P-S-661

(Refer to index for source of commercial products.)

HANDLING SEALANT FOR LIQUIDTIGHT SEALS —TEMPERATURES FROM 400°F TO 500°F. Stir the high-temperature sealing compound thoroughly before use. If it appears caked or lumpy, it should be discarded. The compound cannot be thinned successfully with water or solvent of any kind. The container should be kept tightly covered when it is not being used. Freezing will damage the compound. The high-temperature sealing compound must not be disturbed while it is hardening during the 24 hours following application. It should not be applied until the job has progressed to a point where the compound may be allowed this undisturbed period. Hot water may be used to clean equipment.

SURFACE PREPARATION FOR LIQUIDTIGHT SEALS—TEMPERATURES FROM 400°F TO 500°F. Refer to "Sealing Pressurized Areas—Cleaning Surfaces to be Sealed."

SEALING PROCEDURE FOR LIQUIDTIGHT SEALS —TEMPERATURES FROM 400°F TO 500°F. For sealing of this nature, faying surfaces in riveted assemblies are sealed by a single thickness of sealing tape. To form a gasket for bolted assemblies, use 3 layers of sealing tape. The tape may be held in place during assembly with EC-613B cement. Apply tape while cement is wet. Sealing of holes, joggles, slots, etc, is done with high temperature sealing compound in the same manner as outlined under "Sealing Pressurized Areas—Sealing Procedures." However, balsa wood plugs are not to be used for sealing at these temperatures. Twenty-four hours after application of the high temperature sealant, apply 2 brush coats of Stabond C-136 coating. Allow 3 hours drying time between each coat.

Note

Do not allow this sealant to be subjected to sharp blows or movement during or after curing.

FUMETIGHT SEALING.

There are some areas in the airplane where excessive leakage of air, fumes, smoke, etc, may be dangerous. Therefore, these areas must be sealed. Since these areas are in different locations in the airplane, there is a wide range of temperatures between these areas during airplane operation. A sealant which may be used satisfactorily in one area may be unsatisfactory in another area.

Fumetight sealants are provided for three temperature ranges:

- Temperatures up to 250°F
- Temperatures from 250°F to 400°F
- Temperatures from 400°F to 500°F

FUMETIGHT SEALING—TEMPERATURES UP TO 250°F.

The same materials and procedures apply as outlined in "Sealing Pressurized Areas," except that for this particular sealing process only, small leaks, such as might be found at rivets, seams, and joints, need not be sealed.

FUMETIGHT SEALING—TEMPERATURES FROM 250°F TO 400°F.

This process is included for areas in which a fumetight seal is required and where temperatures normally range from 250°F to 400°F, but may at times reach a maximum of 500°F.

The same materials and procedures are used as those outlined under "Liquidtight Sealing — Temperatures From 225°F to 400°F."

FUMETIGHT SEALING—TEMPERATURES FROM 400°F TO 500°F.

Fumetight sealing in areas where normal operating temperatures exceed 400°F is done using same materials and procedures as outlined under "Liquidtight Sealing—Temperatures From 400°F to 500°F."

SEALING FAYING SURFACES.

Faying surfaces may be sealed using general purpose sealing compound (refer to "Sealing Pressurized Areas") or Pro-Seal 714 (refer to "Liquidtight Sealing —Temperatures From 225°F to 400°F"). The type of sealant used is determined by the normal operating temperature of the area to which it will be applied.

Fit components of structure to be sealed together and drill rivet and bolt holes as required. Disassemble components, clean thoroughly and check paint. (Refer to "Sealing Pressurized Areas.") Apply a smooth, even coat of the correct sealant, about 1/32-inch thick, to the faying surface area of one component, using either a spatula or pressure applicator. As soon as possible after application of the sealing compound, rivet or bolt the components of the structure together, squeezing out the excess compound.

EXTERIOR WATERTIGHT SEALING.

In some areas of the fuselage, it is necessary to protect against the possibility of moisture entering the interior compartments. The exterior watertight sealant is used at the windshield, canopy, electrical compartment, etc. It is applied to the exterior surfaces of aircraft structures.

MATERIALS FOR WATERTIGHT SEALING.

MATERIAL	SOURCE
Solvent, cleaning	Federal Spec P-S-661
Toluol	Federal Spec TT-T-548
Naphtha	Specification MIL-N-15178
Methyl ethyl ketone	Federal Spec TT-M-261
Sealing Compound PR-341	Products Research Co
Accelerator (Curing Agent) PR-341A	Products Research Co
Cleaning Compound LAR1634	Turco Products Co
Deseal A	Kelite Products, Inc

(Refer to index for source of commercial products.)

SURFACE PREPARATION FOR EXTERIOR WATERTIGHT SEALING.

Paint and primer coats must be removed from the area to be sealed using wash thinner and cloths or methyl ethyl ketone and a stiff bristle brush. Paint must be removed for a minimum of 1/2 inch on each side of skin gaps, and skin gaps must be thoroughly clean.

All surfaces to be sealed must be thoroughly cleaned. (Refer to "Sealing Pressurized Areas—Cleaning Surfaces to be Sealed.")

MIXING AND HANDLING SEALING COMPOUND FOR EXTERIOR WATERTIGHT SEALING.

Prepare the sealing compound for use by mixing 10 parts by weight of PR-341 base compound with one part by weight of PR-341A accelerator (curing agent). The materials should be mixed until no particles of accelerator are evident in the base compound.

At room temperature (about 77°F), the sealing compound must be used within 3 hours total time after having been mixed with the accelerator or removed from cold storage.

Note

After addition of the accelerator, the sealing compound may be stored at 0°F to −10°F for 72 hours.

SEALING PROCEDURE FOR EXTERIOR WATERTIGHT SEALING.

Apply masking tape to skin on each side of skin gap to be sealed leaving 1/16 (±1/32) inch of skin exposed on each side of gap.

Note

Tape should be applied immediately after cleaning the area with solvent. Do not allow fingers to touch cleaned surface as tape is applied.

Apply sealant with a pressure applicator or clean wooden spatula. Work sealant into, and along, seam. After seam has been sealed, remove excess compound and masking tape. Tape must be removed before compound starts to set. After removing tape, fair out edges of sealing compound. This may be done by moistening the finger with water and drawing the moistened finger along edge of compound. Clean up excessive compound and equipment within 4 hours, using methyl ethyl ketone, toluol, or Deseal A.

SELF-CONTOURING SEALING PADS.

Self-contouring sealing pads (figure 1-60) are applied to stationary structure at removable doors or between

SELF-CONTOURING SEALING PADS

GENERAL

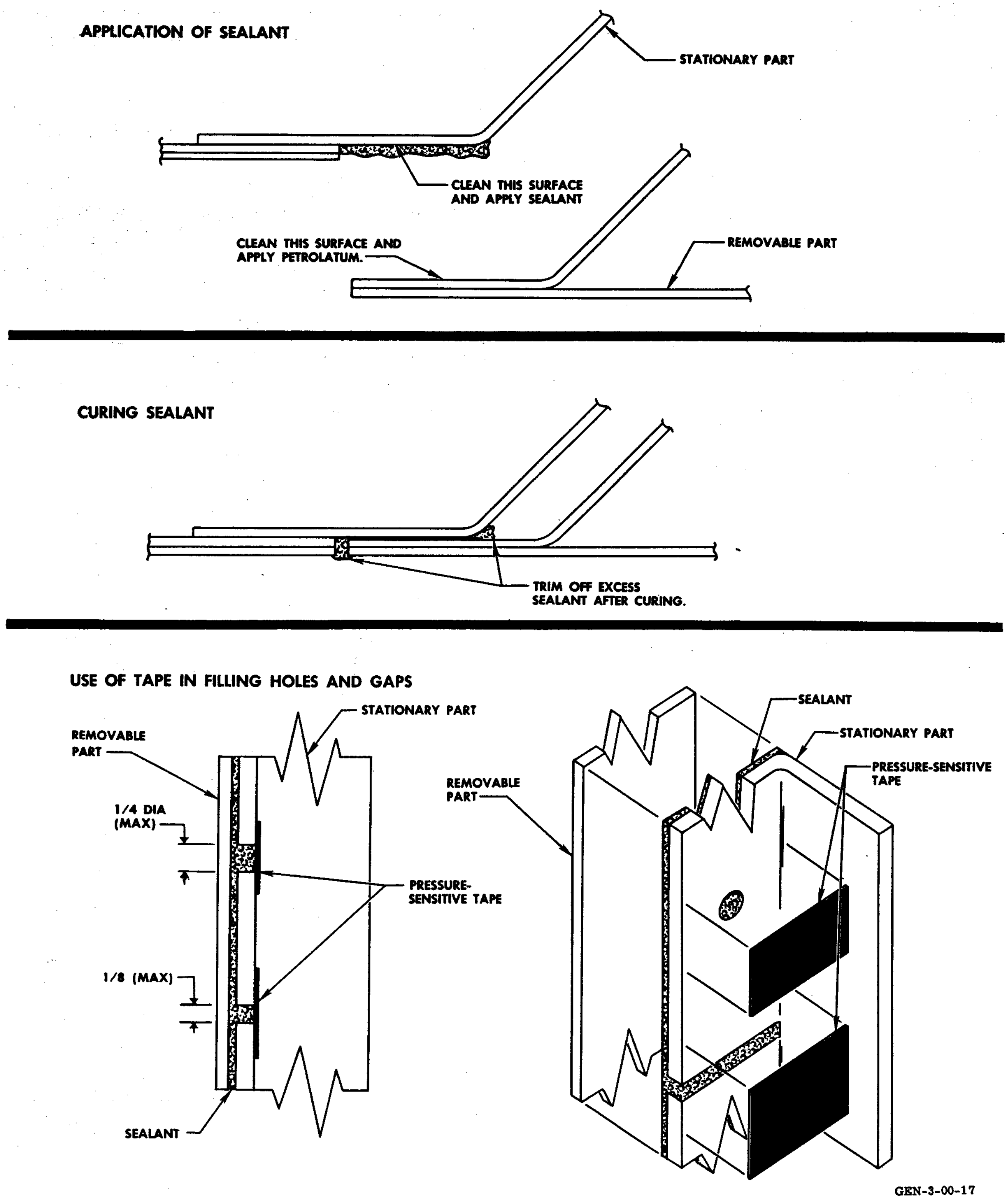


Figure 1-60. Self-contouring Sealing Pads

sections of a structure which may normally be separated.

The surface preparation, materials applicable, and mixing and handling methods covered under "Exterior Watertight Sealing" also apply to this process. The sealing procedure too, is the same, with the following exceptions:

1. The mixed sealant is applied to the cleaned stationary part of the assembly to be sealed.

2. Apply petrolatum (Federal Specification VV-P-236) to removable part, to screws, and quick-disconnect fasteners. This prevents the sealing compound from sticking to the removable part and fasteners.

3. Assemble parts being sealed and allow to remain in position for about 8 hours, or until the compound has cured.

4. After the sealant has cured, disassemble parts and trim off excess sealant with a sharp knife. Remove all traces of petrolatum with naphtha.

Note

Tooling holes and gaps may be backed up with general purpose pressure-sensitive tape (Specification JAN-P-127, Type II, Grade C). The tape must be removed after the sealant has cured.

GENERAL SHOP PRACTICES.

AERODYNAMIC SKIN FILLER.

Aerodynamic skin filler (PR341) is a two-part material: filler and accelerator. It is used extensively throughout the airplane for filling skin and door gaps, and at points of overlap on fairings. The cured material is silver-gray in color and feels like hard rubber. It may be sanded to blend with the surrounding surface and then painted over. Filling a depression of less than 0.050 inch in the skin is not satisfactory; the filler would be too thin and would not stay in place.

Aerodynamic skin filler may be used where screwheads have been recessed 0.015 inch or more below the surface of the skin. The filler is applied in the same manner as for skin surfaces. A screwdriver of the proper type should be inserted into the screw recess to keep out filler and to locate the screw for future removal.

AERODYNAMIC SKIN FILLER MATERIALS.

MATERIAL	SOURCE
PR341 filler	Products Research Co
Cleaner	Specification MIL-C-5410, Type I
Isopropyl alcohol	Commercial
Naphtha	Federal Spec TT-N-95
Wash primer	Specification MIL-C-15328A
Zinc chromate primer	Specification MIL-P-6889
Aluminized lacquer	Specification MIL-L-7178

Refer to index for source of commercial products.

MIXING AERODYNAMIC SKIN FILLER.

Mix the base compound and accelerator together in proportions recommended by the manufacturer. It is extremely important that complete mixing of the accelerator and filler be accomplished. At room temperature (about 77°F), the filler should be used within three hours after accelerator has been added. The accelerated filler may be stored at 0°F to −10°F for a period of 72 hours if stored immediately after mixing.

APPLYING AERODYNAMIC SKIN FILLER.

1. Remove all primers or organic paint finishes to a distance of 1 inch along each side of the area to be filled.

2. After surfaces are clean, wipe area to be filled with cleaner and brightener (Specification MIL-C-5410, Type I). Allow cleaner to remain on surface for 2 or 3 minutes, and then rinse it off with water. Water rinse may be followed by isopropyl alcohol rinse to speed drying. Allow all surfaces to dry thoroughly.

3. Force filler into damaged area with a knife or spatula. Smooth to desired contour by overfilling, and sanding down after material has cured.

4. The filler must be allowed a full 24 hours at room temperature to cure. Curing may be accelerated with heat lamps, but temperatures should not exceed 160°F.

5. After completion of cure, clean affected area with diluent naphtha (Federal Specification TT-N-95). Then finish with one coat of wash primer (Specification MIL-C-15328), one coat of zinc-chromate primer (Specification MIL-P-6889), and two coats of aluminized lacquer (Specification MIL-L-7178). Apply these according to Specification MIL-C-8507, Specification MIL-P-6808, and Specification MIL-M-5055, respectively.

SHEET METAL THICKNESS.

The services and aircraft industry have effected a new

STANDARD SHEET METAL THICKNESS

GENERAL

ALUMINUM AND MAGNESIUM		STEEL	
OLD STANDARD	NEW STANDARD	OLD STANDARD	NEW STANDARD
	0.006	0.010	0.010
	0.008	0.012	0.012
0.010	0.010	0.016	0.016
0.012	0.012	0.018	0.018
0.016	0.016	0.020	0.020
	0.018	0.025	0.025
0.020	0.020	0.028	0.028
	0.022	0.032	0.032
0.025	0.025	0.035	0.036
	0.028	0.036	0.036
0.032	0.032	0.040	0.040
	0.036	0.042*	0.040
0.040	0.040	0.045	0.045
	0.045	0.050	0.050
0.051	0.050	0.060	0.060
	0.056	0.063	0.063
0.064	0.063	0.065*	0.063
0.072	0.071	0.071	0.071
0.081	0.080	0.078	0.080
0.091	0.090	0.080	0.080
0.102	0.100	0.083*	0.080
	0.112	0.090	0.090
0.125	0.125	0.093*	0.090
	0.140	0.094*	0.090
0.156*	0.160	0.100	0.100
	0.180	0.109	0.112
0.188	0.190	0.112	0.112
	0.200	0.125	0.125
	0.244	0.156	0.160
		0.187	0.190
		0.188	0.190

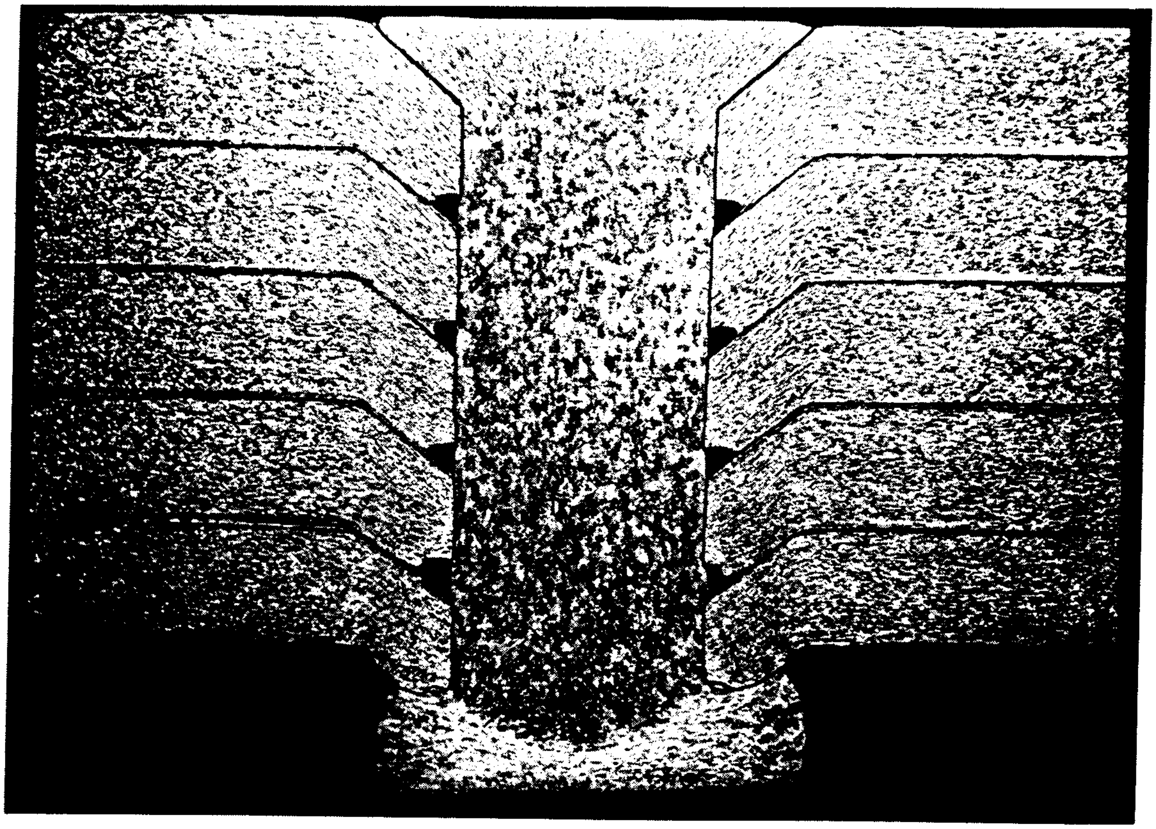
NOTE Reading across the chart, thicknesses may be used interchangeably except as noted. GEN-3-00-18

*Reading across the chart, the thicker material may be substitutea for the thinner material. Substitution of the thinner material for the heavier material must be approved by the structural repair officer.

Figure 1-61. Standard Sheet-metal Thickness

RAM COIN DIMPLES

GENERAL



GEN-3-00-26

Figure 1-62. Ram-coin Dimples Nested

thickness standard for aircraft sheet-metal materials. During the transition period from mill standard thicknesses and gage numbers to the new standard for all sheet metals, there will be many instances when the material call-out will specify a material not in stock. The table in figure 1-61 shows the old material thickness and the new one which has replaced it. Reading across the chart, the thicknesses, except those marked with an asterisk, may be used interchangeably. If a thickness is marked with an asterisk, the heavier of the two materials may be substituted for the lighter. The lighter material may be substituted for the heavier only on approval by the structural repair officer.

Examples:

Material call-out ....Steel, 4130, 0.040
Substitute ....Steel, 4130, 0.042
Material call-out ....Steel, 4130, 0.042
Substitute (on approval by the
structural repair officer) ....Steel, 4130, 0.040

The primary structural materials used in the construction of the major portion of the airplane are 2024-T and 7075-T in the clad state. 2024-T is a standard, general-purpose alloy. 7075-T is a high-strength aluminum which has physical properties that are, in certain applications, superior to 2024-T. It is used only where 2024-T is not suitable. It is more brittle than 2024-T and presents a greater problem in forming. These aluminum alloys, used in the primary structure, are heat-treatable and are in a treated condition as indicated by the "T." Materials used in making repairs and in replacement parts may be formed in the soft condition but must be heat-treated before being installed in the airplane.

RAM-COIN DIMPLING.

Ram-coin dimpling differs from all forms of radius dimpling in that the female die is fitted with a tube called a coining ram. The coining ram has a preset pressure which resists the downward pressure of the male die. It grips the lower side of the sheet close to the drilled hole and holds the material in closely against the pilot of the male die. The lower, outer edges are prevented from spreading out, thereby minimizing the chances of radial cracking. The upward pressure of the coining ram also forces the material into the radiuses of the dies, forming a dimple which closely matches the contours of the dies. Coin dimples nest (fit) closely into each other and into countersunk substructures. (See figure 1-62.)

WHY RAM-COIN DIMPLING IS USED.

All skin dimpling has been done by the ram-coin method. Dimpling of repair and replacement parts which are to nest into original dimples must be done with tooling which produces dimples of exactly the same contour and angle as the original. The strength of riveted joints in the repairs in this handbook presume the joints to be properly formed and mated and sound riveting practices employed. Dimples formed by radius dimpling have contours and angles which are different from those formed by the ram-coin method, therefore, they will not nest properly together. Figure 1-63 shows a sectional view of a riveted joint with a radius dimple nested into a ram-coin dimple. The mismatching is obvious. The misalignment caused by attempting to draw the oversized radius dimple into the smaller ram-coin dimple has caused a joggle in the rivet and the shop-formed point to be formed at one side.

Modified radius dimpling, into which ram-coin dimples will nest, may be used in substructures when space limitations do not permit the use of ram-coin tools. One radius dimple will not be nested into another radius dimple, and the top or outer skin will be ram-coin dimpled.

WHY RAM-COIN HEAT DIMPLING IS USED.

Dimpling with heated dies is necessary on 7075-T6 aluminum alloy, titanium, and titanium alloys in order to produce dependably sound dimples.

2024-T3 aluminum alloy can usually be successfully dimpled using cold dies for the smaller diameter head sizes. Heat should be applied to the dies when using the hand-tool equipment, and also, when dimpling for such fasteners as screws, dzus, or other types requiring a deep draw formation. It is also desirable to apply heat if excessive warpage of the part occurs.

Dimples are subject to three types of failures during fabrication; radial cracks, circumferential tension cracks, and internal shear cracks. (See figure 1-64.)

RADIUS DIMPLE NESTED INTO RAM COIN DIMPLE

GENERAL

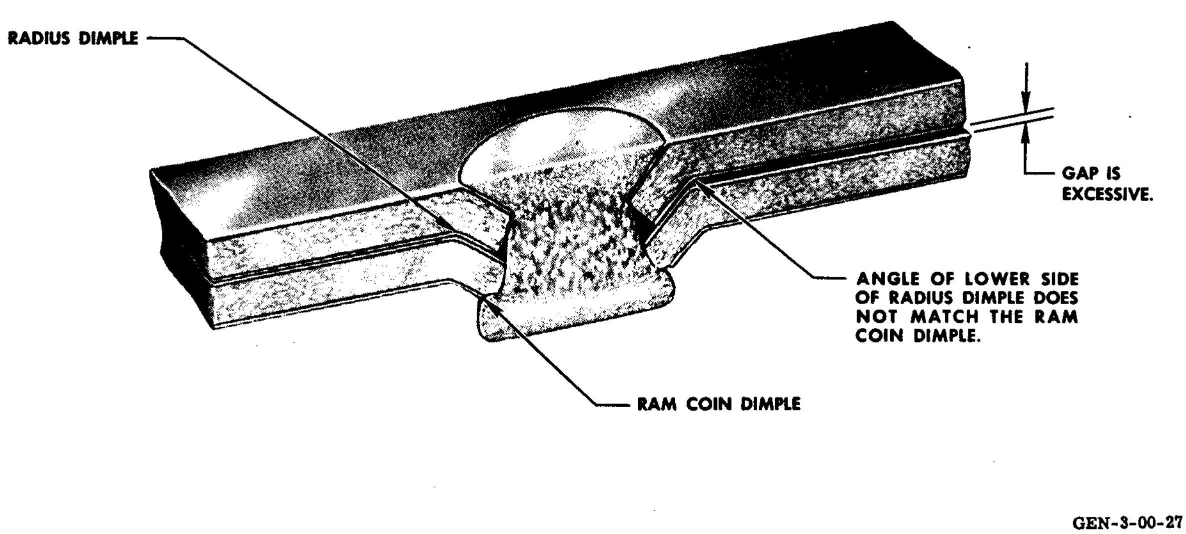


Figure 1-63. Radius Dimple Nested Into Ram-coin Dimple

DIMPLE DEFECTS

GENERAL

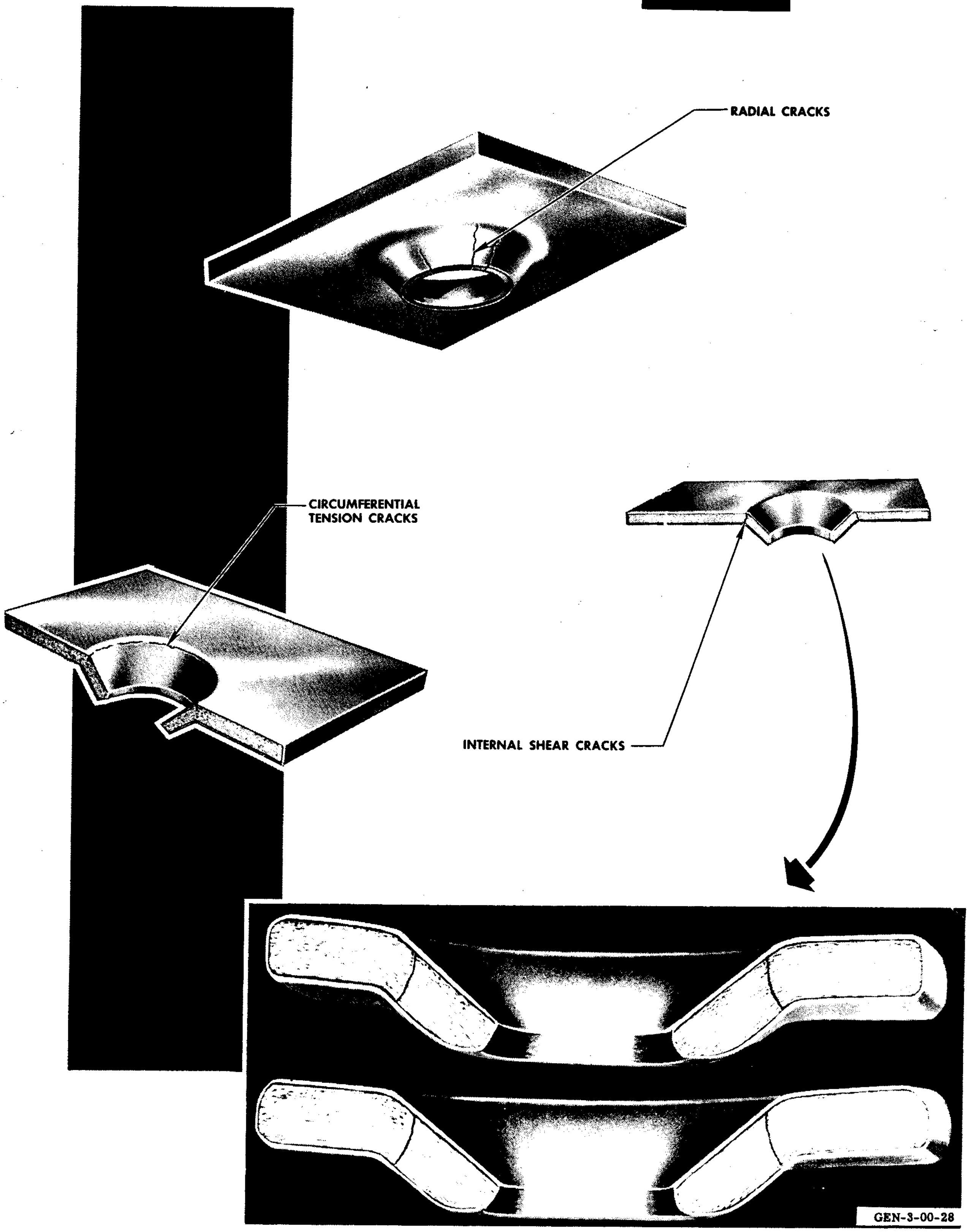


Figure 1-64. Dimple Defects

Radial cracks originate at the bottom edge of the hole and extend along its radius. They are easily detected by visual inspection.

Circumferential tension cracks originate at the bend and extend around the circumference of the dimple. They are similar to cracks in straight bends when insufficient bend radius has been used.

Internal shear cracks are most common in the heavier gages of 7075-T6 aluminum alloy. They occur within the structure of the metal and in the case of clad material cannot be detected by visual inspection. The clad covering in this case is not broken. Internal shear cracks are just below the bend radius of the dimple and actually occur during the first one third of the forming operation. Since this type of defect cannot be seen, proper machine setting and bend-test strip results must be relied upon for ensurance of sound dimples.

All the cracking conditions described result from attempts to form relatively brittle materials. The heat from controlled heating of the dies mildly anneals the material in the dimple area and, in conjunction with the coining action, permits the necessary deformation.

TRAINING RAM-COIN DIMPLE OPERATOR.

Before any person attempts to do ram-coin dimpling on an airplane part, he should be thoroughly familiar with the operation of the equipment. He should have had adequate practice on all the common materials and should be able to demonstrate satisfactory dimpling skill. The hand gun, which is likely to be used often in repair work, is more difficult to use than other types of equipment and extra time should be spent with it.

Close inspection of fabricated parts before assembly is necessary, but the principal ensurance of a sound dimple is a well-trained dimple operator.

RAM-COIN DIMPLING TOOLS.

A complete range of ram-coin dimpling tools for stationary and portable squeezers and for hand-gun dimpling is available.

Standard pneumatic-loaded dies are used for the majority of dimpling work on the stationary squeezers. A number of features are incorporated in the design of the dies. The face of the male and female dies are dished, the male concave and the female convex, at an angle of 2 degrees to allow for the normal springback of the material. Another feature of the male die is a 2-degree taper on the pilot to permit removal of material after the dimple has been formed. A high-temperature grease may be applied to the face of the

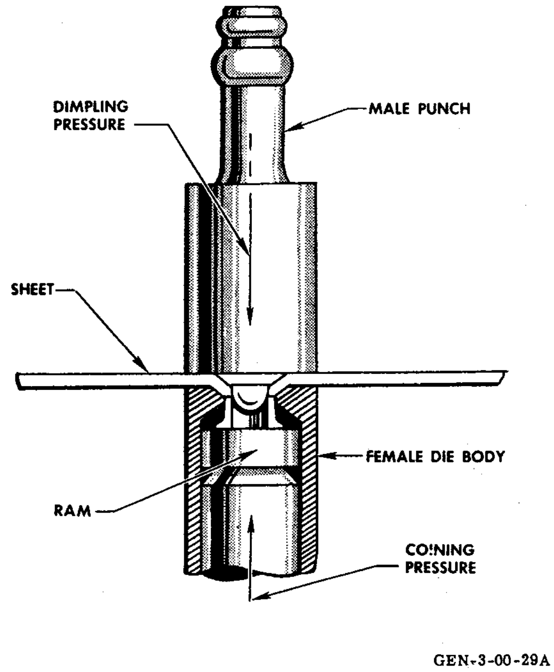


Figure 1-65. Ram-coin Dies

female die to help prevent pilot seizure. The female die is made up of four parts: the body, a two-piece coining ram, and a retainer spring. (See figure 1-65.) Dies for portable squeezers are similar to those used in the stationary squeezers—but the coining pressure is supplied by a spring instead of by air. Another type of die used in portable squeezers is rubber-loaded. The female die of this set has the rubber within the die itself. Rubber-loaded dies are restricted to cold dimpling. Pneumatic and spring-loaded dies may be used either hot or cold.

All dimpling equipment should be handled with care. Control boxes, heater elements, and cords are easily damaged by rough handling. The dies must never be allowed to contact each other in the squeezer. Always have a clean sheet of metal between them when checking adjustments. Be sure the dies are clean and that the coining ram is free to move before starting to dimple. Check the dies for cracks, nicks, or dents. Do not try to rework damaged dies.

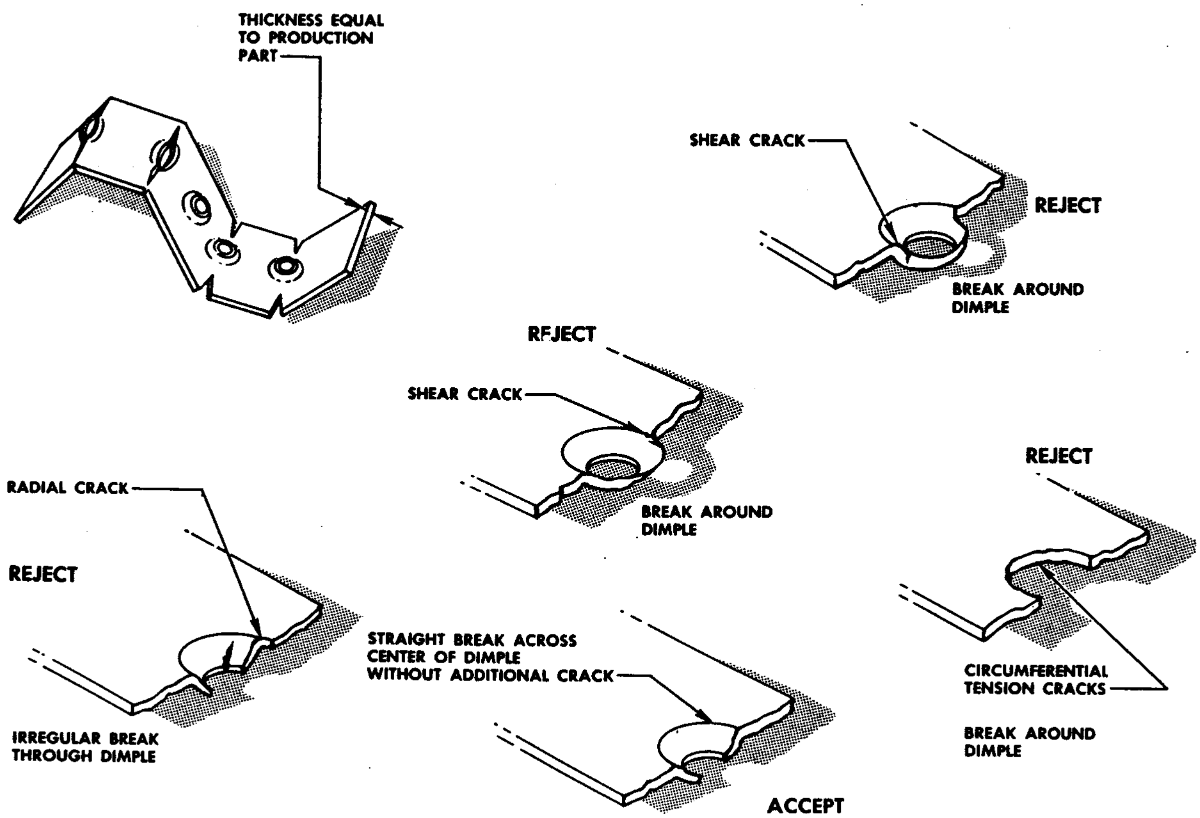
HOLE PREPARATION FOR RAM-COIN DIMPLES.

No particular hole preparation is necessary in the aluminum and steel alloys. A cleanly drilled hole is satisfactory.

Titanium and titanium alloys are more subject to

BEND TEST STRIPS

GENERAL



GEN-3-00-30

Figure 1-66. Bend-test Strips

cracking than other materials in common use, and require that extra precautions be taken from the initial shearing to forming, fitting, drilling, deburring, dimpling, and final riveting. Titanium must be drilled with properly sharpened drills, and then carefully deburred, removing as little material as possible. Handle this material carefully, as cracks may occur at the crest of the dimple if marks, scratches, or grooves are present on the surface of the material. It is recommended that all dimples in titanium material be deburred on the back or down side, and inspected for smoothness before assembly.

RAM-COIN DIMPLE BEND-TEST STRIPS.

A satisfactory bend test shall precede any dimpling of airplane parts made of 7075-T6 material. A strip the same thickness and temper as the sheet to be dimpled is selected and drilled to the proper pilot size for the dies to be used. (When possible to do so, make test strips from the same sheet from which the part will be made.) Preliminary adjustments are made on the equipment and a dimple is made in the test strip. The machine is readjusted as necessary until the dimple is satisfactory in appearance and fastener flushness.

A bend test is made by placing the strip in a vise across the center of the dimple, and bending it back and forth through the dimpled as well as the undimpled portion. Break at least two dimples in each direction. If a circumferential fracture is present, the break will usually follow the path of least resistance and break out a part of the dimple or the entire dimple. (See figure 1-66.) Bend tests for other materials are not required. However, the test strip should be used to obtain proper setup of the machine before dimpling of the airplane part is started. Critically examine the test dimples for appearance and flushness of sample fastener.

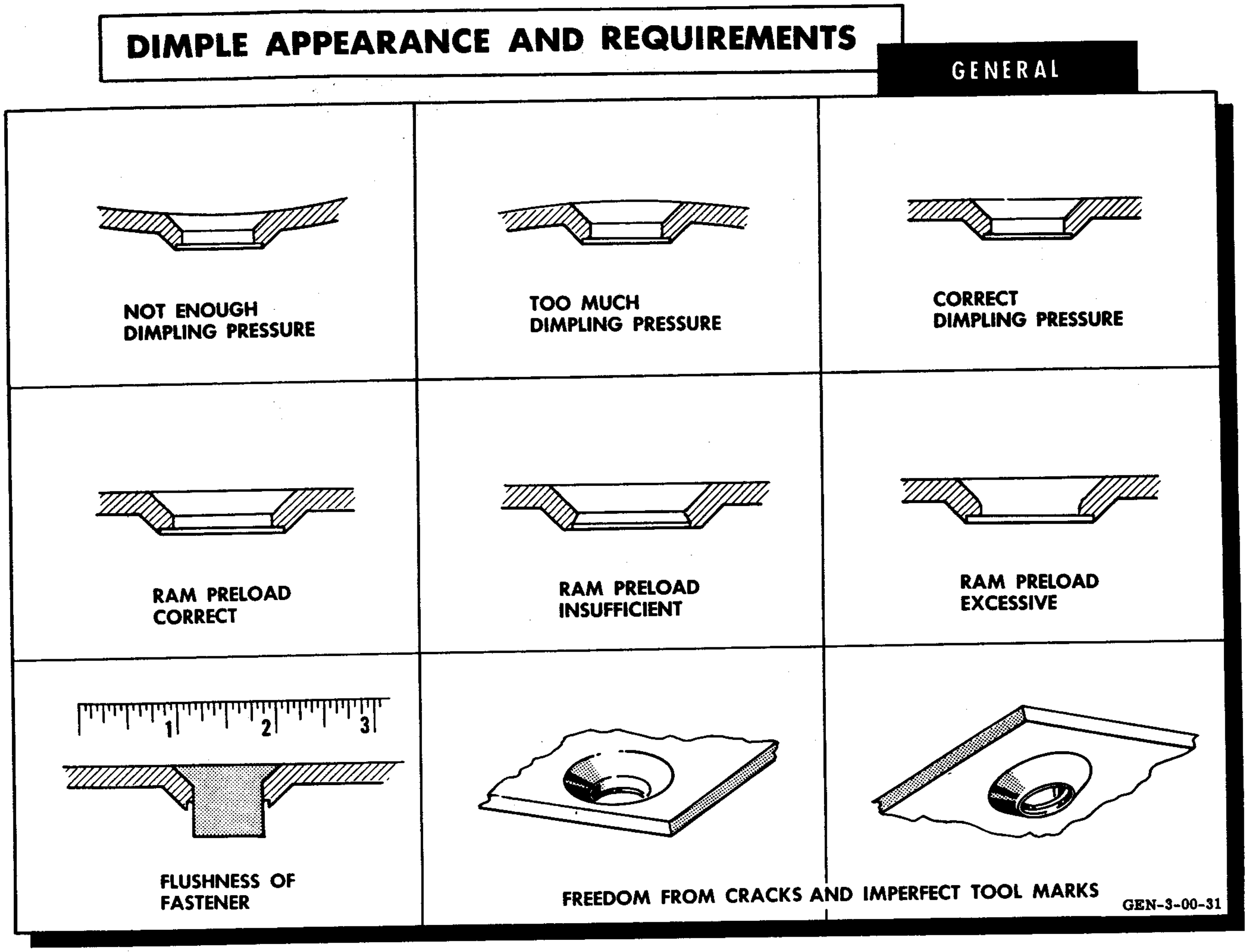


Figure 1-67. Dimple Appearance and Requirements

APPEARANCE AND REQUIREMENTS OF RAM-COIN DIMPLES.

There are four basic factors to be considered in determining ram-coin dimple quality:

1. Dimple formation and sharpness of break. Because of coining preload and dimpling pressure, a coin dimple may be formed with a sharp break from the sheet surface into the dimple. Definition should be checked with the corresponding fastener for flushness and to be certain that the correct size dies have been used.

2. Amount of coining. The coining ram preload pressure is the main factor in prevention of cracked dimples in aluminum alloy material. Too much preload will tend to extrude the coined area, and insufficient preload will not give the proper support to prevent cracking. Coining pressure is correct when there is a slight undercut of the flat on the bottom.

3. Sheet warpage. While it is practically impossible to completely eliminate sheet growth that results in warpage, it can be held to a minimum with correct dimpling and coining pressures. Because edge distance and hole layout pattern of the production part are different from those of the test strip, some pressure correction may be required on the production part.

4. Condition of the dimple. To determine whether it is free of cracks, the dimple should be carefully examined for any flaws that may result from damaged or dirty dies, accumulated chips, inferior material, cracked coining rams, or other causes. (See figure 1-67.)

COUNTERSINKING SUBSTITUTES FOR RAM-COIN DIMPLES.

When a dimple nests into a subcountersink, there shall be a gap between the mating parts to ensure complete bearing of the dimple into the countersink. This gap

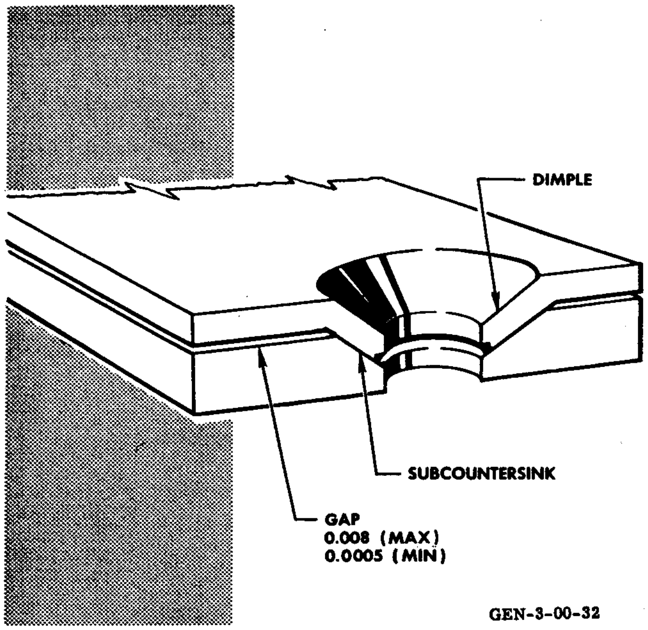


Figure 1-68. Dimple Into Subcountersink

shall be between a minimum of 0.0005 inch and a maximum of 0.008 inch. (See figure 1-68.)

FILLING DIMPLED HOLES.

See figure 1-69.

STOP-DRILLING.

See figure 1-70.

BOLTHEAD IDENTIFICATION.

Most of the structural bolts and screws used in the manufacture or fabrication of aircraft structures may be identified by the markings on the head of the bolt or screw. In addition, the manufacturer may also include his identification mark on the heads. Some of the most frequently used types of bolts and screws and their identifying head markings are shown in figure 1-89A.

BLIND FASTENERS.

HOLES FOR BLIND FASTENERS.

Hole sizes for blind fasteners are critical because of the amount of expansion built into the fastener. Holes to be dimpled for blind fasteners should be pilot drilled, dimpled, and redrilled to size. (See figure 1-71.) All holes should be checked with "go, no-go" gages before installing fasteners.

HANDLING AND STORAGE OF BLIND FASTENERS.

The protective film on blind explosive and pull rivets should never be removed. On explosive rivets this film is necessary for proper heating, firing, and expanding of the rivet. Prevent dirt or grit from contacting pull rivets. A clean, lubricated surface is necessary for proper stem installation and expansion.

Store explosive rivets in a cool, dry place, avoiding temperatures in excess of 100°F. Do not throw explosive rivets into trash containers. If rivets are not usable, place them in a wire basket and burn them.

Keep blind fasteners in boxes in which they are received, or in moistureproof containers properly labeled and giving all information that appears on the manufacturer's box.

INSTALLATION OF BLIND FASTENERS.

The following blind fasteners are covered in detail in the "Aircraft Structural Hardware" manual, AN01-1A-8: Cherry rivets, Huck rivets, Drill Lok-Rivets, Rivnuts, and explosive rivets.

In addition to the explosive rivets discussed in the referenced manual are the sealed (noiseless) and high-temperature explosive rivets. The sealed explosive rivets have a plug in the cavity containing the chemical charge. They are used mostly in honeycomb sandwich construction where the blast from the open-type rivet would damage the light expanded metal. High temperature explosive rivets are of both the open and closed types. They are made of nickel or nickel alloy and are used for joining stainless and titanium in areas where temperatures would be injurious to aluminum alloys.

WARNING

Sealed-type explosive rivets, like the non-sealed type, must not be driven where fuel or other inflammable vapors are likely to be present.

DEUTSCH DRIVE PIN BLIND RIVET.

This fastener consists of two parts, either a flush or protruding brazier, a head sleeve of corrosion-resistant steel, and a hardened steel pin. (See figure 1-72.) The pin is driven into the sleeve after the rivet is firmly seated in the drilled or reamed hole. The action of the pin pushing out the restricting walls of the sleeve forms the upset, beginning with a swelling action in the second sheet and progressing into a definite shop-formed head on the blind side.

The protruding ridge on top of the sleeve head locks the pin in the rivet. The final strokes of the hammer form the locking material into the area provided by the chamfer on the drive pin head. After the pin is seated in the head recess, a rotary action of the upsetting tool (hammer) smooths out the pin locking ring for improved flushness and locking action.

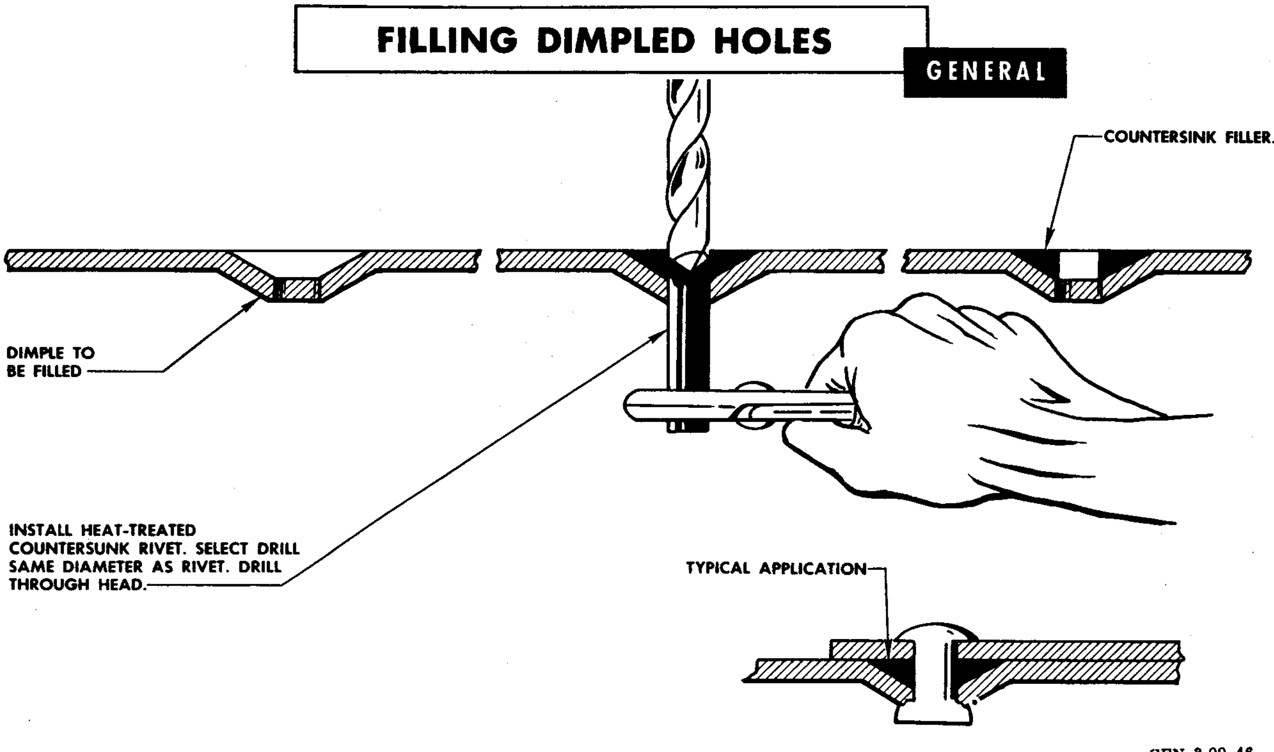


Figure 1-69. Filling Dimpled Holes

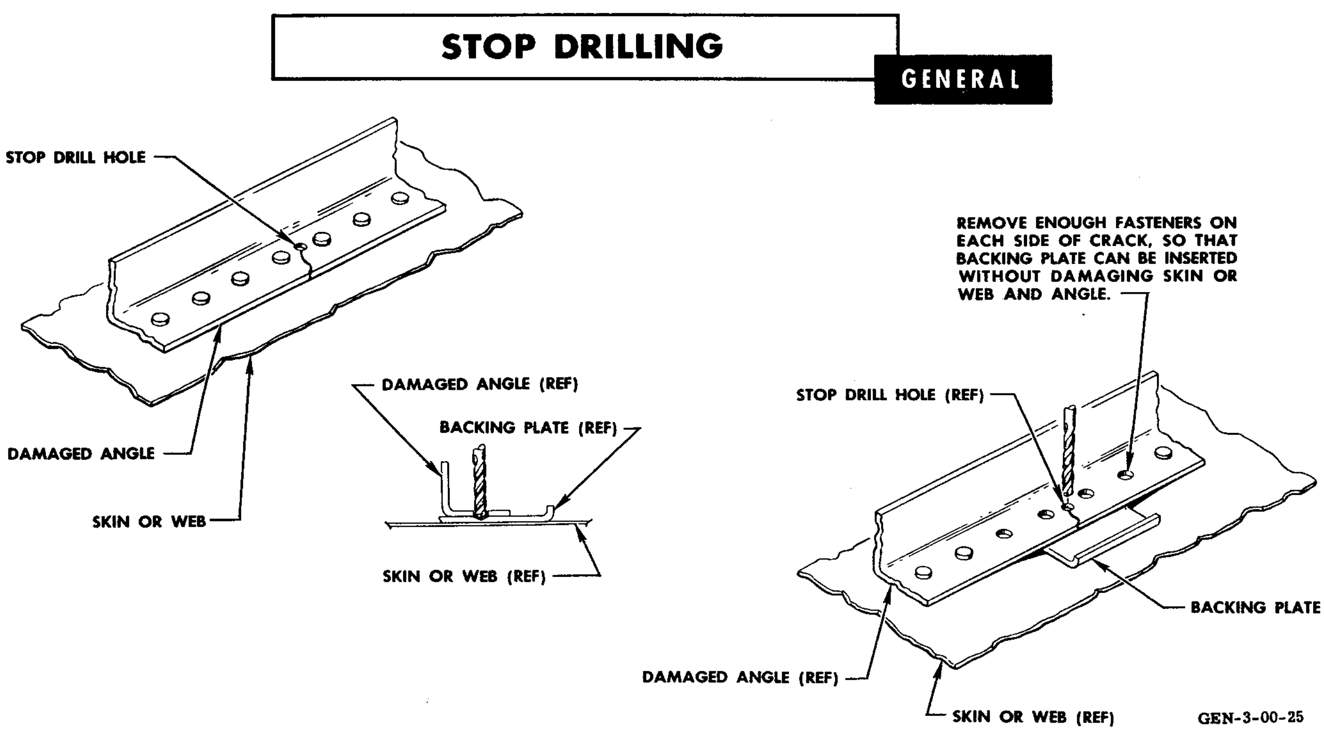


Figure 1-70. Stop-drilling

FASTENER, DIE, & PILOT DRILL SIZES

GENERAL

SIZE & TYPE OF FASTENER	CODE NUMBER ON MALE & FEMALE DIES	PILOT DRILL SIZE
FLUSH-DRIVEN RIVETS 3/32 100 DEG 1/8 100 DEG 5/32 100 DEG 3/16 100 DEG 1/4 100 DEG	AN426-3 3/32 AN426-4 1/8 AN426-5 5/32 AN426-6 3/16 AN426-8 1/4	NO. 40 (0.097-0.100) NO. 30 (0.1290-0.1305) NO. 21 (0.160-0.162) NO. 11 (0.192-0.194) "F" (0.256-0.261)
FLUSH PULL RIVETS (CHERRY) 1/8 (CR-162 OR AF462-4) 5/32 (CR-162 OR AF462-5) 3/16 (CR-162 OR AF462-6)	AN426-4 1/8 AN426-5 5/32 AN426-6 3/16	NO. 30 (0.1290-0.1305) NO. 21 (0.160-0.162) NO. 11 (0.192-0.194)
EXPLOSIVE RIVETS 1/8 (DR-134-100 OR AF458-4) 5/32 (DR-173-100 OR AF458-5 3/16 (DR-204-100 OR AF458-6	AN426-4 1/8 AN426-5 5/32 AN426-6 3/16	NO. 30 (0.1290-0.1305) NO. 21 (0.160-0.162) NO. 11 (0.192-0.194)
HI-SHEAR RIVETS 3/16 100 DEG 1/4 100 DEG 5/16 100 DEG	2R2 OR 2R7-6 3/16 2R2 OR 2R7-8 1/4 2R2 OR 2R7-10 5/16	NO. 17 (0.172-0.176) NO. 1 (0.227-0.231) 9/32 (0.2802-0.2852)
FLUSH DEUTSCH DRIVE PINS 3/16 1/4 5/16	2R2 OR 2R7-6 3/16 2R2 OR 2R7-8 1/4 2R2 OR 2R7-10 5/16	NO. 17 (0.172-0.176) NO. 1 (0.227-0.231) 9/32 (0.2802-0.2852)
FLUSH SCREWS NO. 8 100 DEG NO. 10 100 DEG 1/4 100 DEG 5/16 100 DEG	NAS204 NO. 8 OR AN509 NAS205 NO. 10 OR AN509 NAS206 1/4 OR AN509 NAS207 5/16 OR AN509	NO. 29 (0.135-0.139) NO. 24 (0.151-0.155) NO. 5 (0.2045-0.2085) 1/4 (0.249-0.254)
FLUSH JO-BOLTS 3/16 1/4 5/16	NAS205 NO. 10 OR AN509 NAS206 1/4 OR AN509 NAS207 5/16 OR AN509	NO. 24 (0.151-0.155) NO. 5 (0.2045-0.2085) 1/4 (0.249-0.254)
FLUSH DZUS 5/16 (STUD) 5/16 (SUPPORT) 13/32 (STUD) 13/32 (SUPPORT)	FA-5 STUD 3/8 × 120 DEG FA-5 SPRING 3/8 × 110 DEG FA-6 1/2 STUD 1/2 × 120 DEG FA-6 1/2 SPRING 1/2 × 110 DEG	3/8 (0.374-0.379) 3/8 (0.374-0.379) 1/2 (0.499-0.504) 1/2 (0.499-0.504)
UNITED CARR AIRLOC NO. 5 NO. 98265	TJ403-100-303-3 FEMALE TJ403-100-308-7 MALE	9/32 (0.280-0.285)

GEN-3-00-33

Figure 1-71. Fastener Die and Pilot Drill Sizes

The Deutsch "SP" (short pin) rivet is the same as a standard Deutsch rivet, except that the drive pin is 0.060-inch shorter. This type rivet is used in buried rivet application where clearance is restricted. "SP" rivets are available in 3/16-inch diameter and larger.

An "SP" rivet may be made by replacing the drive pin in a rivet of the correct grip length with a drive pin from a rivet one grip length shorter.

JO-BOLTS.

Jo-bolts (figure 1-74) are blind fasteners of relatively high shear strength. They are used in many areas of the airplane where the installation of standard fasteners is difficult or impractical. Special tools are required for Jo-bolt installation. A wide range of grip lengths is available. Close-tolerance, reamed holes are required for good installation. Three types of Jo-bolts are available: protruding (hex) head, 100-degree countersunk head, and millable head. The millable-head fastener has a protruding (hex) head with a 100-degree taper on its lower side. After installation in a countersunk hole, the protruding part of the head is milled off.

For installation and removal of Jo-bolts, see figures 1-74 and 1-75.

THREADED INSERTS.

HELI-COIL INSERTS.

Heli-Coil inserts are made of 18-8 stainless steel (AMS-7245) helically coiled wire. The wire has a diamond-shaped cross section which accommodates internal and external threads at the same time. When assembled in a Heli-Coil tapped hole, the insert becomes a permanent standard internal thread with a Class B tolerance. The same insert will produce other classes of fit depending upon tapped-hole dimensions.

Heli-Coil inserts are available in two types: plain non-self-locking and self-locking mid-grip. Both types of inserts are made with a tang which is a portion of the bottom coil. The tang is offset to provide a driving member. The insert has a notch adjacent to the tang; this provides a break-off point for removing the tang after installation.

If a mid-grip type insert is removed, the same type should be reinstalled.

The mid-grip insert is dyed red for identification and has a specially formed grip coil, or coils, in the center which have a gripping effect on the engaging screw. (See figure 1-76.) For detailed information on installation and removal, refer to "General—Installation of Heli-Coil Inserts," T.O. 44H1-1117. Although the mid-grip type insert is not covered in this Technical Order, the information is applicable for both types, except for some of the tools used. The mid-grip inserts require a different inserting and tang break-off tool than those used for plain inserts. The differences in basic tool numbers are noted in the table below.

NAME OF TOOL	BASIC TOOL NUMBERS Plain Insert	Mid-grip Insert
Prewinder inserting tool	528	3551
Prewinder inserting tool	535	3552
Tang break-off tool	1195	3580
Tang break-off tool	1196	3581

The size dash numbers are identical to those outlined in the Technical Order.

KEENSERT THREADED INSERTS.

The Keensert is an internally-externally threaded bushing, manufactured from Type 303 stainless steel. (See figure 1-76A.) The insert is positively locked against rotation by integral keys driven through the threads of the surrounding parent material; Keenserts are available in two types, the lightweight series and the heavy-duty series. The lightweight series, when installed in sand castings of 3056-T6 aluminum alloy, will not pull out at tension loads exceeding the ultimate tensile strength for fasteners manufactured in accordance with Specification MIL-B-6812 (125,000 to 140,000 psi heat-treat ranges). The heavy-duty series, when installed in Type 3056-T6 aluminum alloy sand castings, will not pull out at tension loads exceeding the ultimate tensile strength for threaded fasteners manufactured in accordance with Specification MIL-B-7838 (160,000 to 180,000 psi heat-treat ranges). Either insert, when installed in 2024-T42 aluminum alloy, will usually break the appropriate bolt before damaging the insert or the parent material.

Keenserts are also available either plain (nonlocking) or with a relieved and indented locking feature at the center of the insert. The indented locking feature produces a locking effect on an engaging threaded fastener that meets the torque requirements established by Specification MIL-N-25027. The locking-type inserts are treated with a dry, nongalling lubricant identified by its dark gray color. The letter "L" is omitted from the part number when the locking feature is not required. Both types of inserts are counterbored to prevent interference with the imperfect threads on the bolt. The length of engagement of the bolt into the insert is not considered critical (except for penetration of the locking feature). The additional wall thickness provided by the increased minor diameter of the external thread transmits the load the full length of the insert, regardless of the location of the end of the bolt within the insert.

ROSAN INSERTS.

Threaded inserts with the Rosan locking feature are available in several types. The type in most common use consists of an internally and externally threaded and externally serrated insert with a matching internally and externally serrated ring. Variations include plain holes, taper pipe threads, gasket seals, solid plugs, dowels, and studs. Design information for the internally threaded type is shown in figure 1-77. The insert is available either plain or with a slotted lower end for self-locking.

If a self-locking feature is used with an AN standard bolt, the insert shown in figure 1-77 should be specified, rather than the longer types which are illustrated in the Rosan catalog. The insert is counterbored, as shown by the "M" dimension, for No. 10 sizes and over to prevent interference with the imperfect threads on the bolt, and to allow the threaded area of the bolt to penetrate through the locking device by at least a portion of the first thread past the chamfer. The letter "L" is omitted from the part number when the self-locking feature is not required. The insert and ring are made of carbon steel; the ring is casehardened. However, if the tensile strength of the material into which the ring is to be inserted is 125,000 psi or above, the counterbore diameter, "C," shown for aluminum alloy in figure 1-71, must be increased by 0.015 inch. The material code "SB" in columns "H" and "J" indicates either C1117 or B1113 low-carbon steel for the insert and B1113 low-carbon steel for the ring. The code "SB" supersedes "SH." However, identical material will be furnished for either call-out.

LOCATING BLIND HOLES WITH HOLE FINDER.

The fastest and most accurate method of locating blind fastener holes is with the hole finder. They may be made of various materials and in special shapes and

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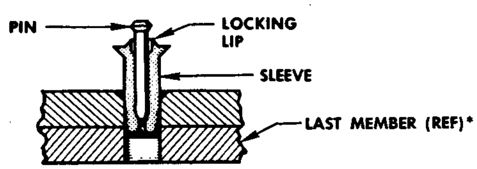
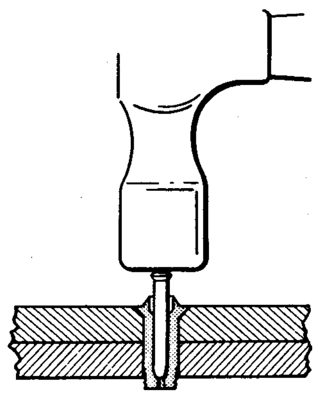
DEUTSCH RIVET INSTALLATION

GENERAL

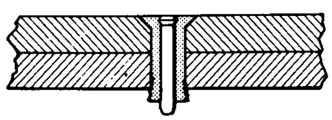


1 Select proper length rivet (refer to note) and place in hole.

FASTENER SIZE—INCH	MIN THICKNESS OF LAST MEMBER*
3/16	0.125
1/4	0.188
5/16	0.250



3 Rivets may be driven with air gun or hammer.



4 After pin has been seated in recess, smooth out the locking lip with a rotary or rolling action of the driving tool. If shaving is necessary for flushness, make certain that locking lip is not cut away to extent that lock is damaged or destroyed.

CODING FOR SELECTION OF PROPER FASTENERS

6950 designates flush head.
6951 designates protruding brazier head.
First letter indicates sleeve material.
S—Steel
First dash number indicates rivet diameter in 1/32nds.
Second dash number indicates nominal grip in 1/16ths.

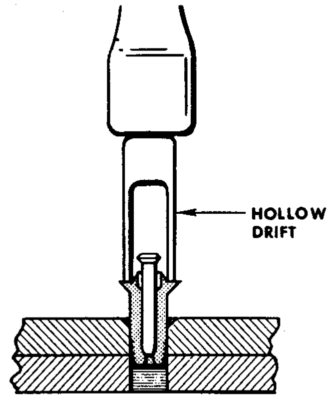
EXAMPLE:

6950-S-06-10 flush head—Cres—3/16 dia—5/8 nominal grip

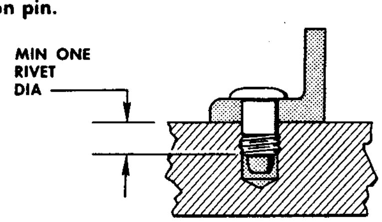
FINAL HOLE SIZES

RIVET SIZE	DIAMETER	REAM
3/16	0.1915	0.191-0.193
1/4	0.260	0.259-0.262
5/16	0.316	0.315-0.318
3/8	0.386	0.385-0.388

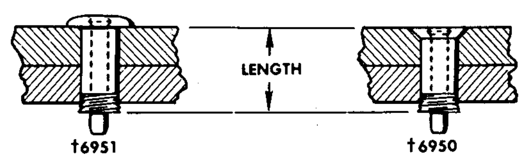
NOTE Total thickness of material being joined should be measured to determine correct length rivet to use. If measurement shows a borderline case between two different lengths, always use shorter length rivet. Dimpling tools for Hi-shear rivets may be used for Deutsch blind rivets.



2 Use a hollow drift that will clear locking lip. Do not drive Deutsch drive pin blind rivets into tight holes by hammering on pin.



NOTE When rivet is installed in a buried hole, at least one times the rivet diameter (including locking rings) must extend into the hole.



LENGTH AND GRIP RANGE CHART

DASH NO.	NOMINAL GRIP	GRIP RANGE	LENGTH 3/16 DIA	1/4 DIA	5/16 DIA	3/8 DIA
-3	3/16	0.166—0.227	0.233			
-4	1/4	0.227-0.290	0.295	0.315	0.329	
-5	5/16	0.290-0.353	0.357	0.379	0.391	
-6	3/8	0.353-0.415	0.420	0.437	0.453	0.468
-7	7/16	0.415-0.478	0.482	0.500	0.516	0.530
-8	1/2	0.478-0.540	0.545	0.562	0.578	0.593
-9	9/16	0.540-0.603	0.607	0.625	0.641	0.656
-10	5/8	0.603-0.665	0.670	0.687	0.703	0.718
-11	11/16	0.665-0.728	0.732	0.749	0.766	0.780
-12	3/4	0.728-0.790	0.795	0.817	0.828	0.843
-13	13/16	0.790-0.853	0.857	0.877	0.891	0.905
-14	7/8	0.853-0.915	0.920	0.940	0.953	0.968
-15	15/16	0.915-0.978	0.982	1.000	1.016	1.030
-16	1.	0.978-1.040	1.045	1.062	1.078	1.093

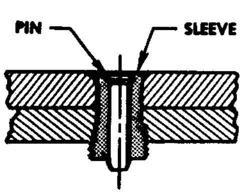
† The Deutsch Co. Refer to index for source of commercial products.

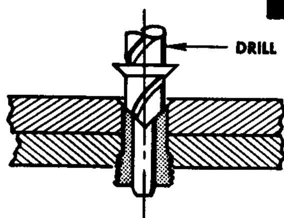
GEN-3-00-34

Figure 1-72. Installation of Deutsch Drive Pin Rivets

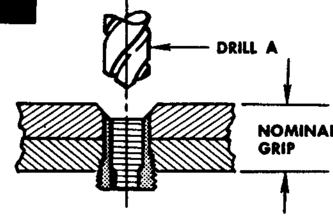
DEUTSCH RIVET REMOVAL

GENERAL

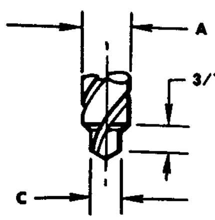


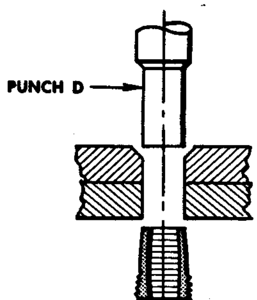


1 DRILL RIVET PIN HEAD OFF, USING DRILL SIZE A.



2 DRILL SLEEVE, USING DRILL SIZE A. DRILL TO NOMINAL GRIP DEPTH ONLY.





3 DRIVE REMAINDER OF SLEEVE THROUGH.

DEUTSCH RIVET DASH NO.	DRILL SIZE A	PIN SIZE C	PUNCH SIZE D
-06 (3/16)	NO. 21 (0.1590)	0.1215	5/32
-08 (1/4)	NO. 1 (0.2280)	0.1625	7/32
-010 (5/16)	9/32 (0.2812)	0.1975	1/4
-012 (3/8)	NO. 5 (0.3480)	0.2425	11/32
-16 (1/2)	15/32 (0.4687)	0.3235	7/16

PROCEDURE FOR REMOVAL WHERE RIVET DOES NOT EXTEND THROUGH MATERIAL

1 Drill out rivet pin about half the depth, using recommended drill size.

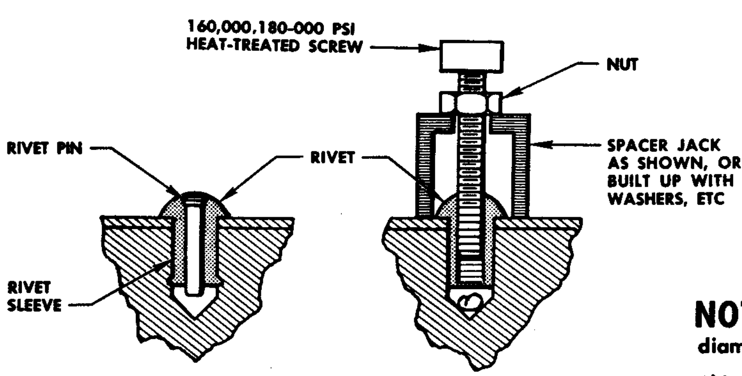
2 Tap sleeve, using recommended tap size.*

3 Drill out remainder of pin.

4 Insert Allen-head screw through spacer into tapped sleeve, and tighten nut.

5 Continue tightening nut until rivet sleeve is removed from work.

6 Hole is re-usable with same size rivet.



RIVET DIA (INCHES)	DRILL SIZE	SCREW AND TAP SIZE
3/16	29	8-32
1/4	19	10-32
5/16	3	1/4-28
3/8	I	5/16-24
7/16	Q	3/8-24
1/2	25/64	7/16-20

NOTE Use minimum of 1-1/2 times screw diameter thread engagement in rivet sleeve.

*If rivet sleeve rotates during tapping operation, use slightly larger drill for step 1, providing less cutting effort of tap.

GEN-3-00-35

Figure 1-73. Removal of Deutsch Drive Pin Rivets

JO-BOLT INSTALLATION

GENERAL

PART NO.	DIAMETER	DRILL SIZE	REAM DIA	COUNTERSINK
200	No. 10	No. 15 (0.180)	0.199-0.202	100 deg x 0.375 to 0.390
260	1/4	D (0.246)	0.260-0.263	100 deg x 0.495 to 0.510

CODING FOR SELECTION OF PROPER FASTENERS

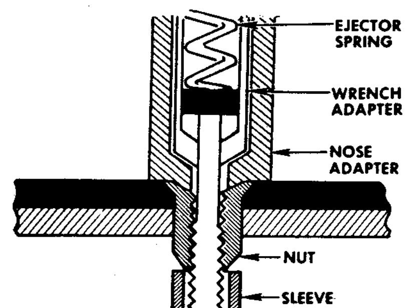
F indicates flush head.
P indicates protruding head.
260 indicates diameter in thousands.
Last dash number indicates nominal grip length in 1/16ths.
EXAMPLE: F260-4 flush head—0.260 dia—1/4 nominal grip

National Screw & Mfg Co of Calif.
Refer to index for source of commercial products.

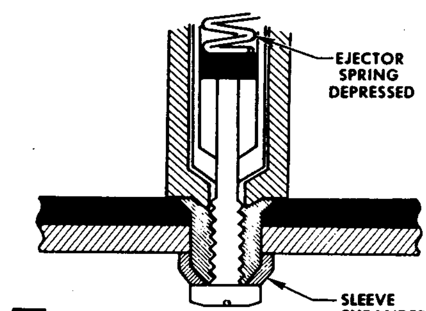
HEAD STYLE	STEM BREAK-OFF TOLERANCES				
	5/32	3/16	1/4	5/16	3/8
FLUSH	+0.010 −0.068	+0.000 −0.078	+0.000 −0.078	+0.000 −0.083	+0.000 −0.083
PROTRUDING	+0.078 +0.000	+0.093 +0.015	+0.115 +0.037	+0.130 +0.047	+0.142 +0.059

TABLE OF GRIP LENGTHS

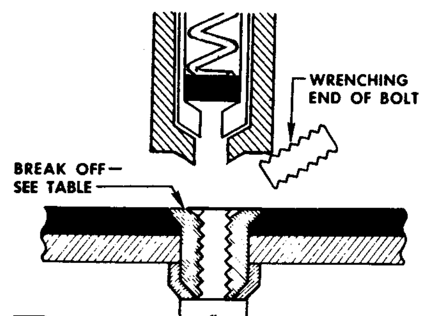
DASH NO.	2	3	4	5	6	7	8	9	10
GRIP LENGTH MIN	0.094	0.156	0.219	0.281	0.344	0.406	0.469	0.531	0.594
GRIP LENGTH MAX	0.156	0.219	0.281	0.344	0.406	0.469	0.531	0.594	0.656



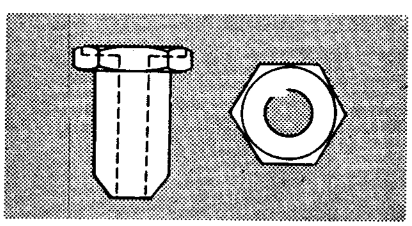
1 In Driving Position



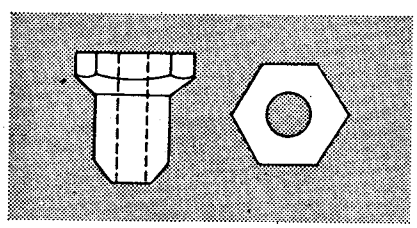
2 Installed



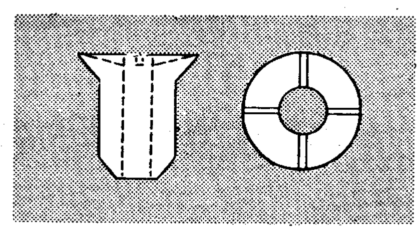
3 End of bolt broken off and ejected from tool



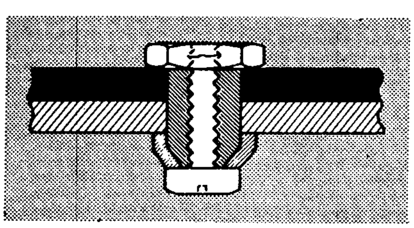
PROTRUDING HEAD



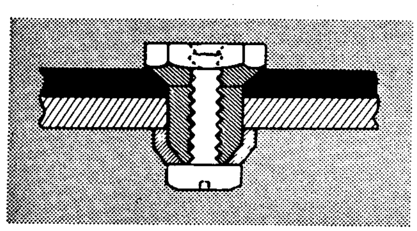
MILLABLE



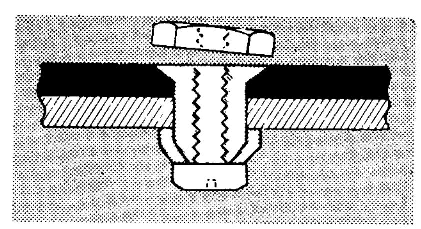
FLUSH HEAD



PROTRUDING HEAD INSTALLED



MILLABLE HEAD INSTALLED



HEAD MILLED

GEN-3-00-36

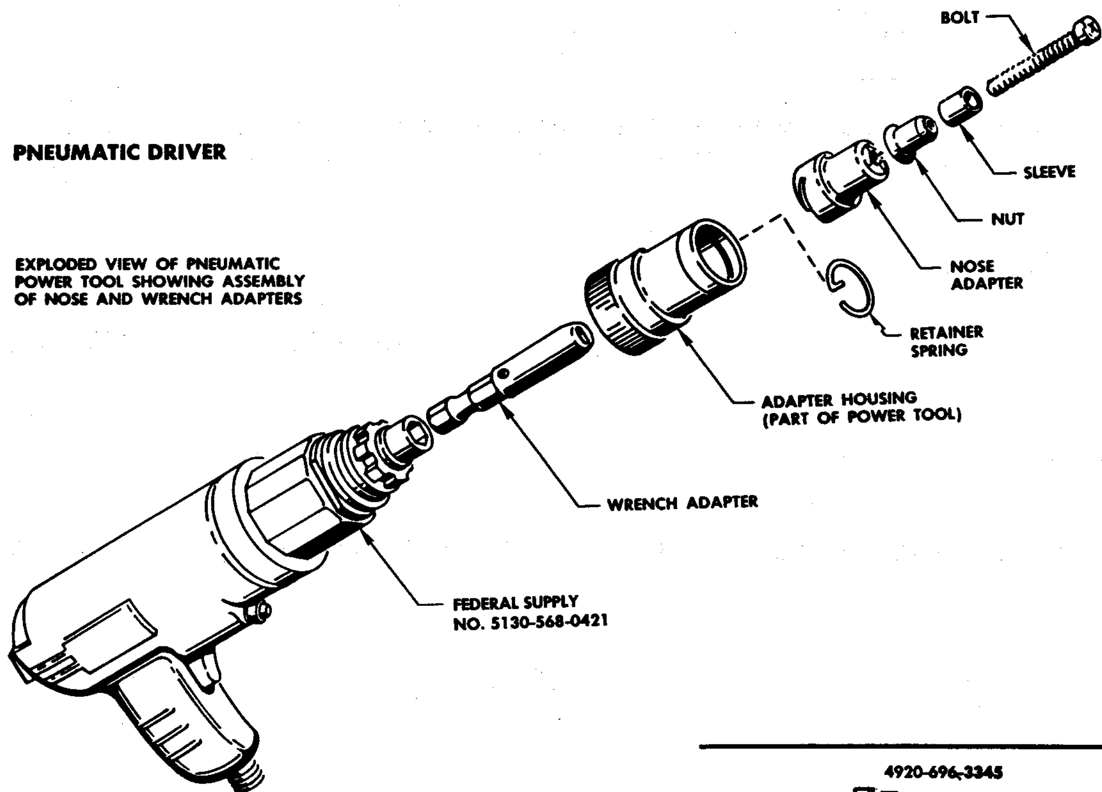
Figure 1-74. Installation of Jo-bolts (Sheet 1 of 3)

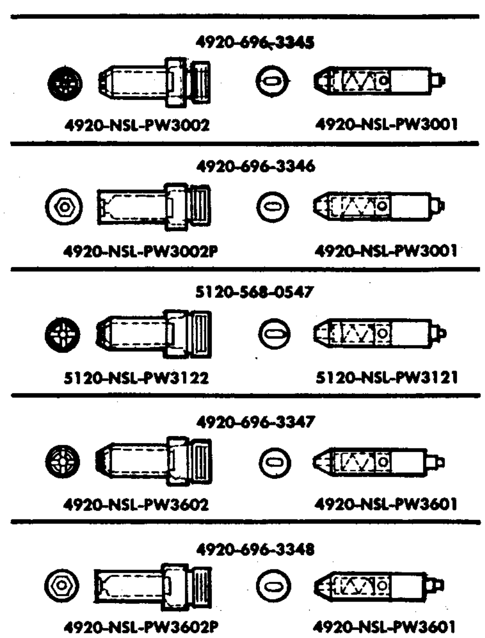
JO-BOLT INSTALLATION TOOLS

GENERAL

PNEUMATIC DRIVER

EXPLODED VIEW OF PNEUMATIC POWER TOOL SHOWING ASSEMBLY OF NOSE AND WRENCH ADAPTERS





THE LISTED ADAPTERS ARE USED WITH MODEL 302 PNEUMATIC DRIVER (FEDERAL SUPPLY NO. 5130-568-0421) TO DRIVE HIGH-STRENGTH, FLUSH, BLIND FASTENERS (JO-BOLTS).

FEDERAL SUPPLY NO.	ADAPTER ASSY. NO.	CONSISTS OF		USE ON JO BOLTS
		NOSE	WRENCH	
3345	4920-696-3345	4920-NSL-PW3002	4920-NSL-PW3001	F200 SERIES
3346	4920-696-3346	4920-NSL-PW3002P	4920-NSL-PW3001	P200 SERIES
9DLF-PW312	5120-568-0547	5120-NSL-PW3122	5120-NSL-PW3121	F312 SERIES
3347	4920-696-3347	4920-NSL-PW3602	4920-NSL-PW3601	F260 SERIES
3348	4920-696-3348	4920-NSL-PW3602P	4920-NSL-PW3601	P260 SERIES

GEN-3-00-74

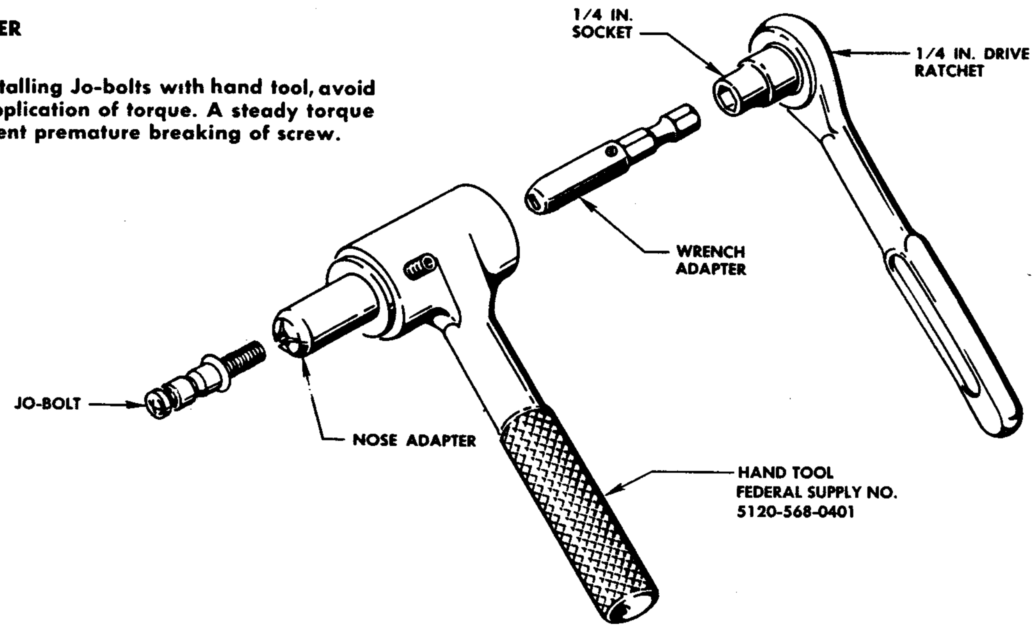
Figure 1-74. Installation of Jo-bolts (Sheet 2 of 3)

JO-BOLT INSTALLATION TOOLS

GENERAL

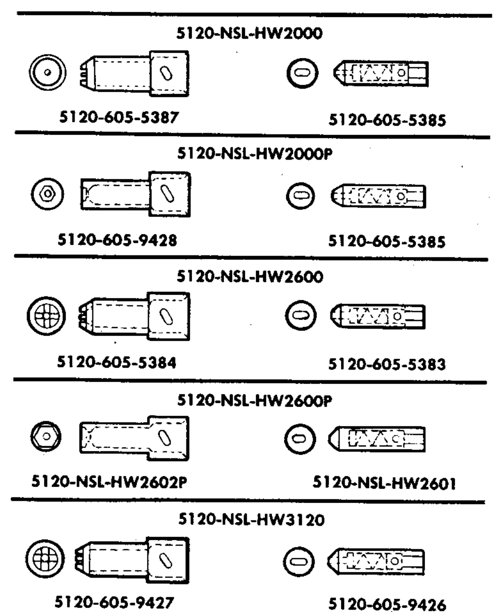
HAND DRIVER

When installing Jo-bolts with hand tool, avoid abrupt application of torque. A steady torque will prevent premature breaking of screw.



THE LISTED ADAPTERS ARE USED WITH RATCHET HAND TOOL (FEDERAL SUPPLY NO. 5120-568-0401) TO DRIVE HIGH-STRENGTH, FLUSH, BLIND FASTENERS (JO-BOLTS).

FEDERAL SUPPLY NO.	ADAPTER ASSY. NO.	CONSISTS OF NOSE	CONSISTS OF WRENCH	USE ON JO BOLTS
3340	5120-NSL-HW2000	5120-605-5387	5120-605-5385	P200 SERIES
3341	5120-NSL-HW2000P	5120-605-9428	5120-605-5385	F200 SERIES
3342	5120-NSL-HW2600	5120-605-5384	5120-605-5383	F260 SERIES
3343	5120-NSL-HW2600P	5120-NSL-HW2602P	5120-NSL-HW2601	P260 SERIES
3344	5120-NSL-HW3120	5120-605-9427	5120-605-9426	F312 SERIES



GEN-3-00-75

Figure 1-74. Installation of Jo-bolts (Sheet 3 of 3)

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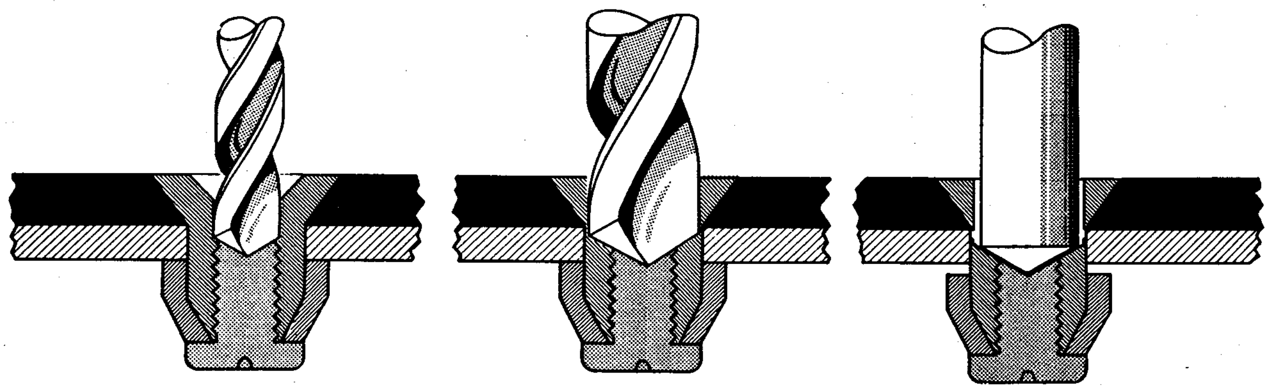
JO-BOLT REMOVAL

GENERAL

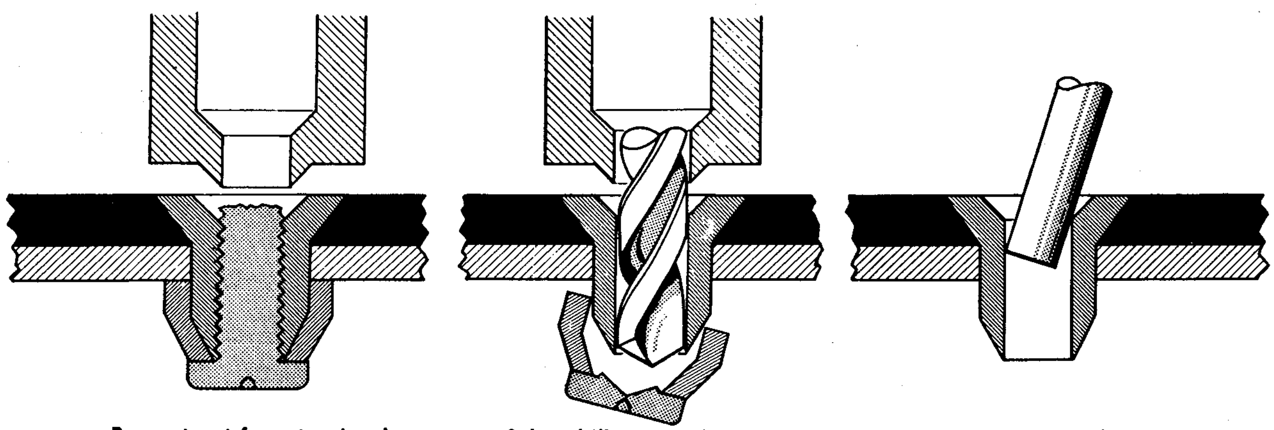


Select drill in accordance with Table I. Drill to below head-shank juncture.

Select drill in accordance with Table II. Drill to depth of pilot hole.

With hammer and nominal size punch, sever head and drive out shank and blind head.

REMOVAL WHEN BOLT TURNS IN HOLE WHILE DRILLING



Prevent nut from turning by engaging driving tool nose adapter. Hold nose adapter with hand tool handle or vise-grip pliers.

Select drill in accordance with Table I. Drill through shank, severing bolthead.

Pick nut out of hole with punch.

SELECT DRILL WITH 500 RPM MAXIMUM

	TABLE I	TABLE II
JO-BOLT SERIES	DRILL SIZE	DRILL SIZE
F- OR P-164	NO. 43 (0.089)	5/32 (0.1562)
F- OR P-200	NO. 35 (0.110)	12 (0.189)
F- OR P-260	NO. 24 (0.152)	D (0.246)
F- OR P-312	NO. 17 (0.173)	M (0.295)
F- OR P-375	NO. 5 (0.2055)	23/64 (0.3594)

GEN-3-00-38

Figure 1-75. Removal of Jo-bolts

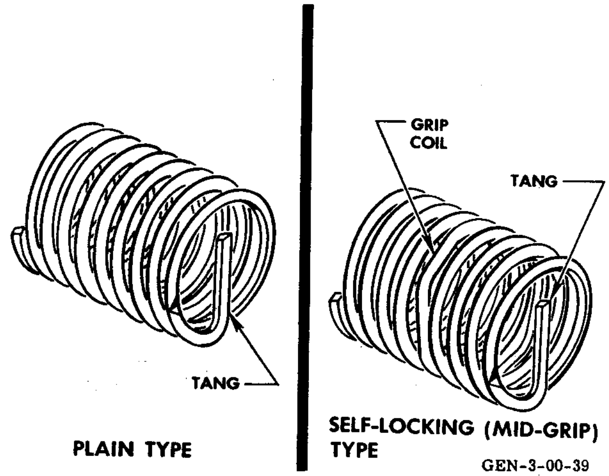


Figure 1-76. Heli-Coil Inserts

sizes when the conditions of the job do not permit the use of a hole finder such as is shown in figure 1-78. Although a temporary or one-time-use tool may be fabricated in a few minutes from any scrap of hardened aluminum alloy and a rivet of the desired size, it is urged that each sheet metal worker provide himself with a complete set of well made tools similar to the one shown in figure 1-78. A complete set will consist of a hole finder for each size sheet-metal fastener used, usually 3/32 inch through 5/16 inch.

When blind holes are being located with a hole finder, it is important that the material being marked or pilot-drilled does not move. It is usually advisable to fasten it to the understructure with two temporary fasteners and move them as necessary as the marking or drilling progresses.

LOCATING SKIN TRIM LINES.

LOCATING SKIN TRIM LINES WITH SKIN SCRIBE.

The skin scribe shown in figure 1-79 is made of any steel that is handy, but a material that will take and hold a good scribing edge will last longer and give the most satisfactory results.

This tool is equally useful for marking the "cut lines" of irregular- as well as straight-lined flush patches, cover plates, doors, etc. The turned-down tip on the lower strap is bent as sharply as possible; then the inside edge is rounded to about 1/4-inch radius. It should be polished so that it will slide smoothly along the inside edge of the cutout being matched. The scribe point on the upper strap is set 1/32 inch outside the inner edge of the guide to allow for the desired skin gap.

The edges of cutout to be matched should be filed or sanded smooth. The oversized filler sheet should be placed over the hole and held firmly in place while the scriber is drawn around it as illustrated in figure 1-79.

LOCATING SKIN TRIM LINES WITH MASKING TAPE.

Locating the trim lines for flush patch fillers, access covers, etc, when there is no access to the back side for marking, may be done with masking tape as shown in figure 1-79. This method is best when used on rectangular openings.

The cutout to be matched is filed or sanded smooth. The filler sheet is cut slightly oversize and formed to match mold line of repair area. Strips of masking tape are aligned along the edges of the opening to form a frame. The filler sheet is centered over the opening and taped down with tape of the same width as used underneath. Carefully align outer edges of outer or second tape with the first layer, and pull it tightly up over the filler. (Do not press tape into corners formed by edges of filler and base structure.) When thinner gages of filler material are used, the inner edge of the outer tape will closely match the edges of the cutout. When the filler material is thick, the outer tape will fall a little short of matching the edges of the cutout and, unless this is compensated for when marking, the filler will be too large for the opening. Unless otherwise specified, the skin gap is 1/32 (+1/32, −0) inch.

SPECIAL TOOLS.

SPAR RIVETING BAR.

See figure 1-83A.

MARKING OVERSIZE TRIM LINES.

The use of metal disks (figure 1-83B) can be of great assistance when marking or scribing oversize trim lines from a template, a pattern, or a form block. The usual procedure would be to set a pair of dividers to the required dimension, and then, keeping one leg of the dividers against the edge of the pattern, move the dividers around the edge of the pattern, marking the oversize trim. This procedure works well on a slightly curved line; however, on a sharp curve or radius, it is very difficult to get a correct dimension. Unless the dividers are held at 90 degrees to the edge of the pattern throughout the entire operation, the distance between the edge of the pattern and the scribe line will vary. Also, unless caution is used, both legs of the dividers may scratch the material being marked. By using a thin metal disk with a radius of the desired dimension, a true line can be obtained. Punch or manufacture a disk of about 0.050-inch sheet metal with a 1/16-inch hole in the exact center. Insert a scribe in the center hole, and using the scribe as an axis, roll the disk around the pattern. This will produce a scribe line that will be a constant dimension from either a straight or a sharply contoured pattern.

TRIMMING FASTENER HEADS.

When an outer skin has been repaired or replaced, all new flush rivets should be inspected for flushness. If some of the rivet heads protrude excessively, they should be milled with either an electric or pneumatic rivet mill to meet the flushness requirements shown in figure 1-83C. When the rivet hole sizes are not within the tolerances shown for standard rivets in figure 10-21, an oversized rivet should be used. However, if oversized rivets are not available, the next larger standard size must be used. Redimpling titanium for the next size larger rivet is *prohibited*. When using the next size larger rivet in titanium, the head must be trimmed to match the existing dimple.

Figure 1-83C shows the method of trimming the rivet head before installation.

When using aluminum rivets in aluminum skin, either method shown in figure 1-83C may be used.

HAND-FORMING.

FLANGES AND ANGLES.

When making repairs, it is often necessary to make a part when replacement parts are not available. Several different methods of hand-forming concave and convex flanges and angles are shown in figure 1-83D.

EXPLOSIVE RIVET FRICTION DETONATOR.

A friction detonating tool for installing explosive rivets, and which ensures proper time-temperature relationship and personnel safety, is commercially available. It consists of a high-speed pneumatic motor, a spring-loaded sleeve, and a specially treated micarta tip assembly.

The sleeve serves the dual purpose of centering the tool and preventing the rivet from turning. The tip assembly is rotated at high speed and creates the friction necessary to detonate the rivet. (See figure 1-80.) The friction detonator may be purchased from Sheridan Friction Products. Refer to index for sources of commercial products.

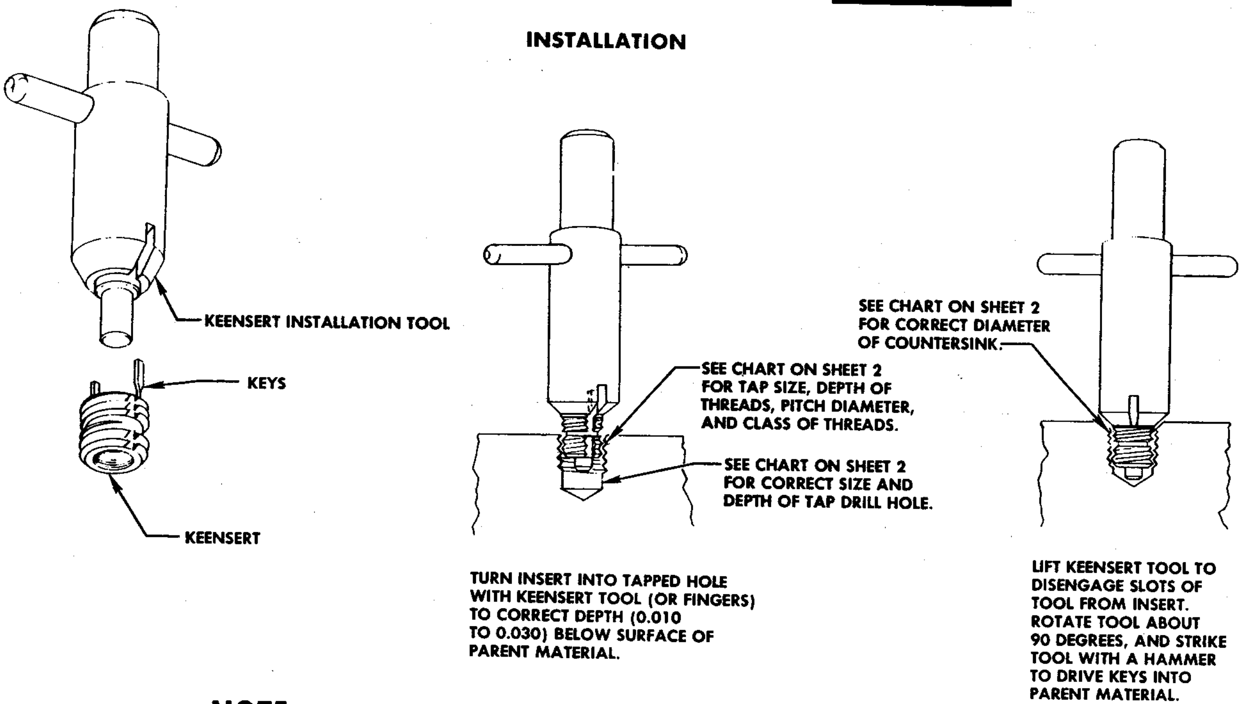
DETONATING TOOL NUMBER SP-301

Tip Size	Type	Part Number
1/8	Braz Hd	JJ650-130 detail 101-1
5/32	Braz Hd	JJ650-130 detail 101-2
3/16	Braz Hd	JJ650-130 detail 101-3

KEENSERT THREADED INSERTS

GENERAL

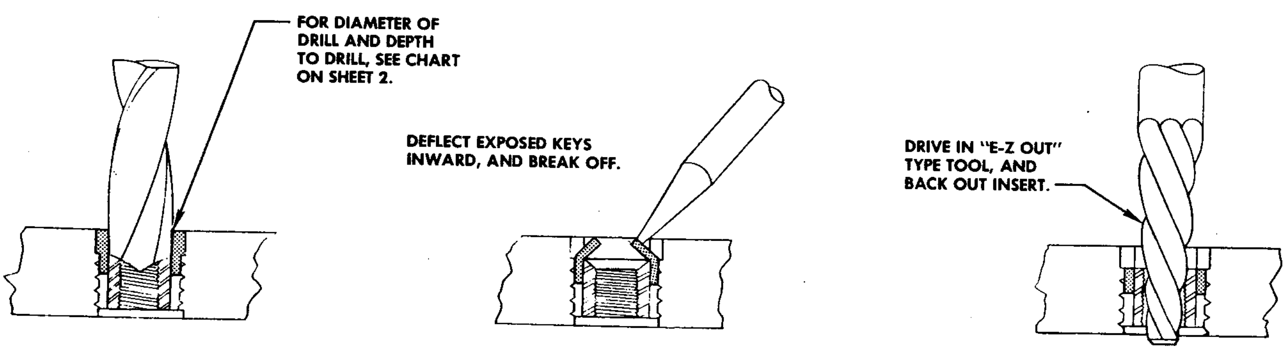
INSTALLATION



NOTE The tap drill used is larger than the standard tap drill, to clear the increased minor diameter of the external threads.

- The tolerance on the countersink is held to ±0.010 inch to automatically position insert 0.010 to 0.030 inch below the start of the first thread.
- If the proper Keensert tool is not available, the keys may be driven by a hammer.

REMOVAL



NOTE A new insert of the same size may be reinstalled in the original tapped hole if it is undamaged. The insert should be rotated sufficiently to eliminate the possibility of driving the keys into the original slots of the parent material.

GEN-3-00-66

Figure 1-76A. Keensert Threaded Inserts (Sheet 1 of 2)

KEENSERT THREADED INSERTS

GENERAL

INSERT INTERNAL THREAD	TAP DRILL SIZE		TAP DRILL DEPTH	COUNTERSINK DIA		EXTERNAL THREAD	
	LIGHT WEIGHT	HEAVY DUTY		LIGHT WEIGHT	HEAVY DUTY	LIGHT WEIGHT	HEAVY DUTY
# 4-40		#15 (0.1800)	13/32		0.220		# 12-24NC-3B
# 6-32		# 3 (0.2130)	13/32		0.254		1/4-20UNC-3B
# 8-32		I (0.2720)	15/32		0.323		5/16-18UNC-3B
#10-32	9/32	Q(0.3320)	15/32	0.320	0.385	5/16-18UNC-3B	3/8-16UNC-3B
1/4-28	11/32	X(0.3970)	19/32	0.380	0.447	3/8-16UNC-3B	7/16-14UNC-3B
5/16-24	Y(0.4040)	29/64	23/32	0.440	0.510	7/16-14UNC-3B	1/2-13UNC-3B
3/8-24	15/32	33/64	25/32	0.510	0.572	1/2-13UNC-3B	9/16-12UNC-3B
7/16-20		37/64	29/32		0.635		5/8-11UNC-3B

INSERT INTERNAL THREAD	FULL THREAD	EXTERNAL THREAD		KEENSERT NUMBER	
		LIGHT WEIGHT	HEAVY DUTY	LIGHT WEIGHT	HEAVY DUTY
# 4-40	9/32		0.1889 +0.0024 −0.0000		KNHL0440
# 6-32	9/32		0.2175 +0.0036 −0.0000		KNHL0632
# 8-32	11/32		0.2764 +0.0039 −0.0000		KNHL0832
# 10-32	11/32	0.2764 +0.0039 −0.0000	0.3344 +0.0043 −0.0000	KNL1032	KNHL1032
1/4-28	13/32	0.3344 +0.0043 −0.0000	0.3911 +0.0046 −0.0000	KNL428	KNHL428
5/16-24	1/2	0.3911 +0.0046 −0.0000	0.4500 +0.0048 −0.0000	KNL524	KNHL524
3/8-24	9/16	0.4500 +0.0048 −0.0000	0.5084 +0.0051 −0.0000	KNL624	KNHL624
7/16-20	11/16		0.5660 +0.0054 −0.0000		KNHL720

INSERT INTERNAL THREAD	KEENSERT TOOL NO.		INTERNAL THREAD SIZE	INTERNAL THREAD PITCH DIAMETER	SIZE OF DRILL FOR REMOVAL		DEPTH OF DRILL FOR REMOVAL	
	LIGHT WEIGHT	HEAVY DUTY			LIGHT WEIGHT	HEAVY DUTY	LIGHT WEIGHT	HEAVY DUTY
# 4-40		TH0440L	# 4-40NC-3B	0.0958 +0.0024 −0.0000		5/32		1/8
# 6-32		TH0632L	# 6-32NC-3B	0.1177 +0.0027 −0.0000		3/16		1/8
# 8-32		TH0832L	# 8-32NC-3B	0.1437 +0.0028 −0.0000		7/32		1/4
# 10-32	T1032L	TH1032L	# 10-32NF-3B	0.1697 +0.0029 −0.0000	7/32	9/32	1/4	1/4
1/4-28	T428L	TH428L	1/4-28UNF-3B	0.2268 +0.0032 −0.0000	9/32	11/32	1/4	1/4
5/16-24	T524L	TH524L	5/16-24UNF-3B	0.2854 +0.0036 −0.0000	11/32	13/32	1/4	1/4
3/8-24	T624L	TH624L	3/8-24UNF-3B	0.3479 +0.0037 −0.0000	11/32	15/32	1/4	1/4
7/16-20		TH720L	7/16-20UNF-3B	0.4050 +0.0041 −0.0000		17/32		5/16

GEN-3-00-65

Figure 1-76A. Keensert Threaded Inserts (Sheet 2 of 2)

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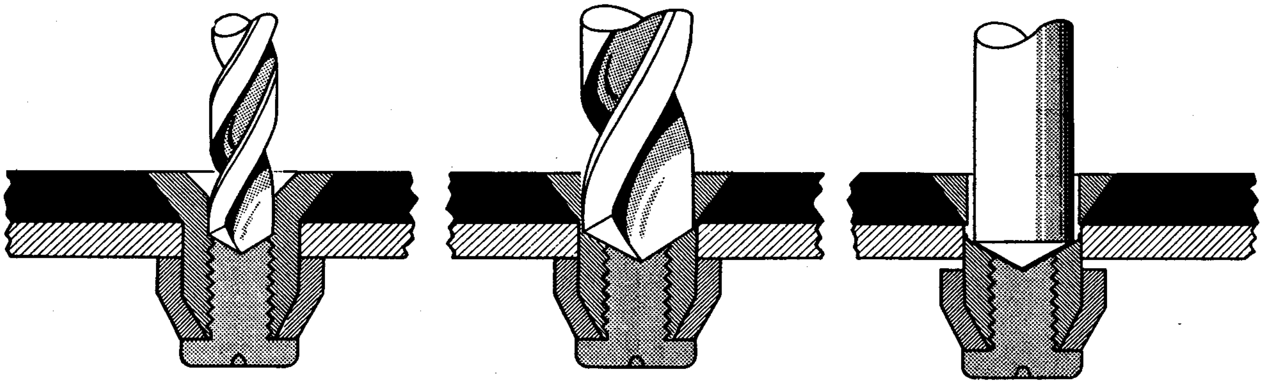
JO-BOLT REMOVAL

GENERAL

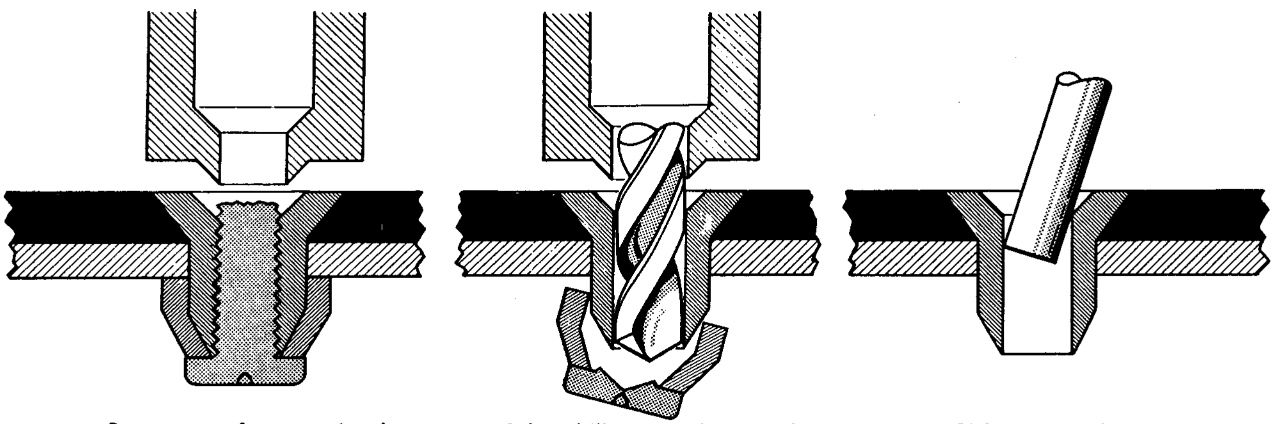


Select drill in accordance with Table I. Drill to below head-shank juncture.

Select drill in accordance with Table II. Drill to depth of pilot hole.

With hammer and nominal size punch, sever head and drive out shank and blind head.

REMOVAL WHEN BOLT TURNS IN HOLE WHILE DRILLING



Prevent nut from turning by engaging driving tool nose adapter. Hold nose adapter with hand tool handle or vise-grip pliers.

Select drill in accordance with Table I. Drill through shank, severing bolthead.

Pick nut out of hole with punch.

SELECT DRILL WITH 500 RPM MAXIMUM

	TABLE I	TABLE II
JO-BOLT SERIES	DRILL SIZE	DRILL SIZE
F- OR P-164	NO. 43 (0.089)	5/32 (0.1562)
F- OR P-200	NO. 35 (0.110)	12 (0.189)
F- OR P-260	NO. 24 (0.152)	D (0.246)
F- OR P-312	NO. 17 (0.173)	M (0.295)
F- OR P-375	NO. 5 (0.2055)	23/64 (0.3594)

GEN-3-00-38

Figure 1-75. Removal of Jo-bolts

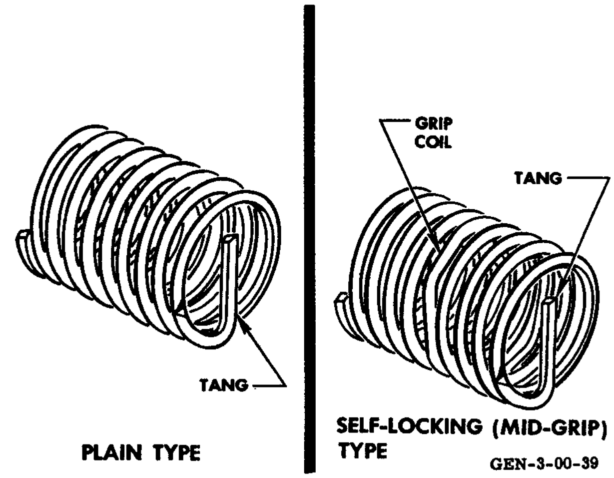


Figure 1-76. Heli-Coil Inserts

sizes when the conditions of the job do not permit the use of a hole finder such as is shown in figure 1-78. Although a temporary or one-time-use tool may be fabricated in a few minutes from any scrap of hardened aluminum alloy and a rivet of the desired size, it is urged that each sheet metal worker provide himself with a complete set of well made tools similar to the one shown in figure 1-78. A complete set will consist of a hole finder for each size sheet-metal fastener used, usually 3/32 inch through 5/16 inch.

When blind holes are being located with a hole finder, it is important that the material being marked or pilot-drilled does not move. It is usually advisable to fasten it to the understructure with two temporary fasteners and move them as necessary as the marking or drilling progresses.

LOCATING SKIN TRIM LINES.

LOCATING SKIN TRIM LINES WITH SKIN SCRIBE.

The skin scribe shown in figure 1-79 is made of any steel that is handy, but a material that will take and hold a good scribing edge will last longer and give the most satisfactory results.

This tool is equally useful for marking the "cut lines" of irregular- as well as straight-lined flush patches, cover plates, doors, etc. The turned-down tip on the lower strap is bent as sharply as possible; then the inside edge is rounded to about 1/4-inch radius. It should be polished so that it will slide smoothly along the inside edge of the cutout being matched. The scribe point on the upper strap is set 1/32 inch outside the inner edge of the guide to allow for the desired skin gap.

The edges of cutout to be matched should be filed or sanded smooth. The oversized filler sheet should be placed over the hole and held firmly in place while the scriber is drawn around it as illustrated in figure 1-79.

LOCATING SKIN TRIM LINES WITH MASKING TAPE.

Locating the trim lines for flush patch fillers, access covers, etc, when there is no access to the back side for marking, may be done with masking tape as shown in figure 1-79. This method is best when used on rectangular openings.

The cutout to be matched is filed or sanded smooth. The filler sheet is cut slightly oversize and formed to match mold line of repair area. Strips of masking tape are aligned along the edges of the opening to form a frame. The filler sheet is centered over the opening and taped down with tape of the same width as used underneath. Carefully align outer edges of outer or second tape with the first layer, and pull it tightly up over the filler. (Do not press tape into corners formed by edges of filler and base structure.) When thinner gages of filler material are used, the inner edge of the outer tape will closely match the edges of the cutout. When the filler material is thick, the outer tape will fall a little short of matching the edges of the cutout and, unless this is compensated for when marking, the filler will be too large for the opening. Unless otherwise specified, the skin gap is 1/32 (+1/32, −0) inch.

SPECIAL TOOLS.

EXPLOSIVE RIVET FRICTION DETONATOR.

A friction detonating tool for installing explosive rivets, and which ensures proper time-temperature relationship and personnel safety, is commercially available. It consists of a high-speed pneumatic motor, a spring-loaded sleeve, and a specially treated micarta tip assembly.

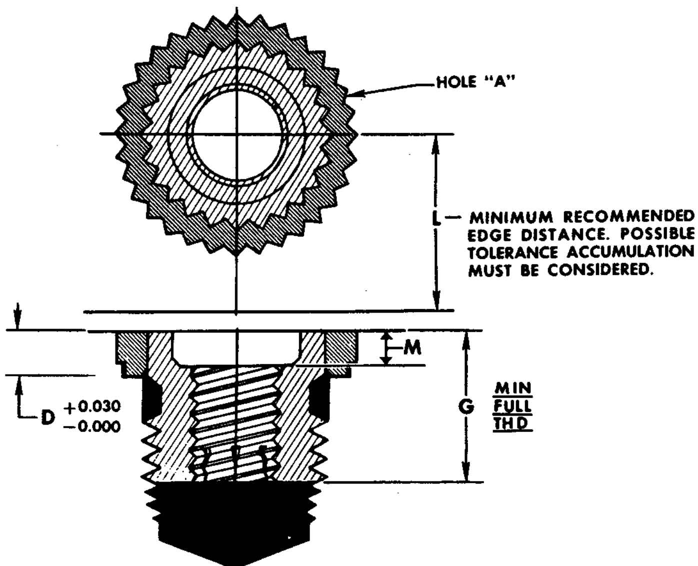
The sleeve serves the dual purpose of centering the tool and preventing the rivet from turning. The tip assembly is rotated at high speed and creates the friction necessary to detonate the rivet. (See figure 1-80.) The friction detonator may be purchased from Sheridan Friction Products. Refer to index for sources of commercial products.

DETONATING TOOL NUMBER SP-301

Tip Size	Type	Part Number
1/8	Braz Hd	JJ650-130 detail 101-1
5/32	Braz Hd	JJ650-130 detail 101-2
3/16	Braz Hd	JJ650-130 detail 101-3

ROSAN INSERTS

GENERAL



1 Drill hole shown in column "A" to depth shown in column "B."

2 Counterbore diameter shown in column "C" (+0.003, −0.000 inch), to depth shown in column "D." Fillet radius 0.010 to 0.020 inch. Counterbore to be concentric with thread pitch diameter within 0.006-inch total indicator reading.

3 Countersink 90 degrees to full diameter of counterbore.

4 Tap for thread size shown in column "K" to depth shown in column "G."

5 Select applicable insert from column "H." Install from 0.010 to 0.020 inch below the surface.

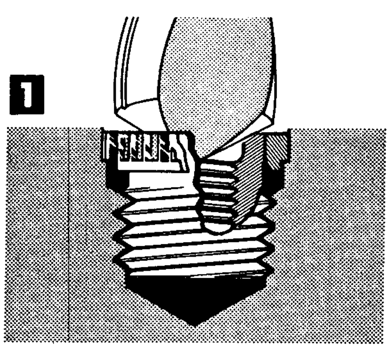
6 Select applicable lock ring from column "J." Install from flush to 0.010 inch below the surface.

CODE: Last dash number indicates length in 1/16ths. When locking feature is not required, omit letter "L" after part numbers. Example: RD206SB-8

INSERT INTERNAL THREAD	TAP DRILL A	DRILL DEPTH B	CBORE DIA C		CBORE DEPTH D	MIN FULL THD G	INSERT PART NUMBER H	LOCK RING PART NUMBER J	TAP THREAD K	MIN EDGE DISTANCE L	CBORE FOR AN BOLT M	REMOVAL DRILL X
			AL ALLOY	MAG								
4-40 NC-3B	25(0.149)	15/32	0.250	0.258	0.094	1/4	R102SB-4L	RL16SB-5	10-24 NC-3B	11/64	----------	11/64
6-32 NC-3B	16(0.177)	17/32	0.281	0.290	0.109	5/16	R103SB-5L	RL18SB-6	12-24 NC-3	13/64	----------	13/64
8-32 NC-3B	7(0.201)	9/16	0.328	0.337	0.109	3/8	R104SB-6L	RL21SB-6	1/4-20 UNC-3B	7/32	----------	15/64
10-32 NF-3B	F(0.257)	19/32	0.375	0.381	0.140	11/32	RD205SB-5.5L	RL24SB-7	5/16-18 UNC-3B	1/4	0.062	9/32
1/4-28-UNF-3B	5/16	21/32	0.438	0.448	0.156	13/32	RD206SB-6.5L	RL28SB-8	3/8-16 UNC-3B	5/16	0.080	11/32
5/16-24 UNF-3B	27/64	23/32	0.516	0.526	0.172	15/32	RAD207SB-7.5L	RL33SB-9	1/2-13 UNC-3B	3/8	0.095	27/64
3/8-24 UNF-3B	31/64	13/16	0.594	0.601	0.172	9/16	RD2098SB-9L	RL38SB-9	9/16-12 UNC-3B	7/16	0.100	31/64
7/16-20 UNF-3B	17/32	13/16	0.734	0.747	0.188	9/16	RD2089SB-9L	RL47SB-10	5/8-11 UNC-3B	1/2	0.100	19/32
1/2-20 UNF-3B	41/64	15/16	0.875	0.888	0.203	11/16	RD210SB-11L	RL56SB-11	3/4-10 UNC-3B	5/8	0.109	23/32

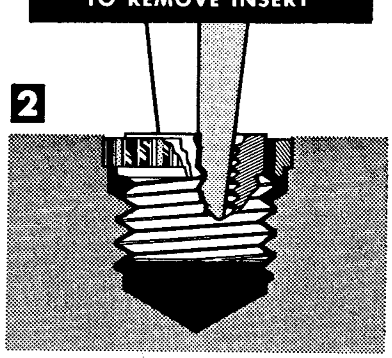
TO REMOVE INSERT

1



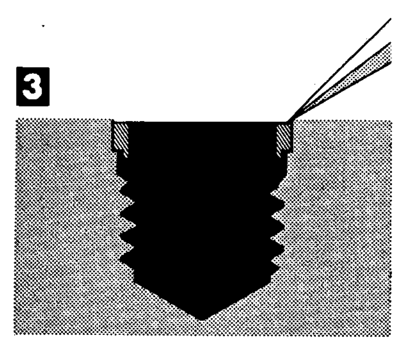
Drill out serrated collar of insert. Use drill same diameter as serrations. Drill to depth of lock ring only. Use drill at high speed. For correct drill sizes, see column "X" in table above.

2



Drive in square-type "ease-out" tool or similar square tool. Screw out insert.

3



If lock ring fails to come out as insert is unscrewed, collapse remaining portion of ring with punch.

GEN-3-00-40

Figure 1-77. Rosan Inserts (Sheet 1 of 2)

ROSAN INSERTS

GENERAL

NOTE Sequences of operation for the installation of Rosan inserts.

1 Tap drill

2 Counterbore

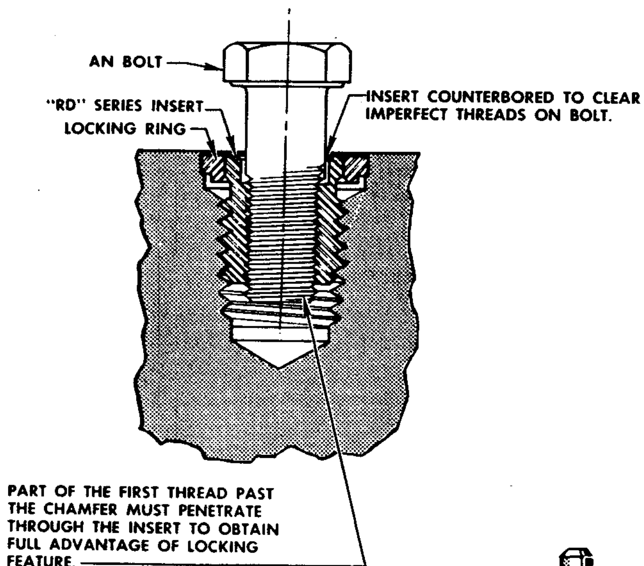
3 Countersink.

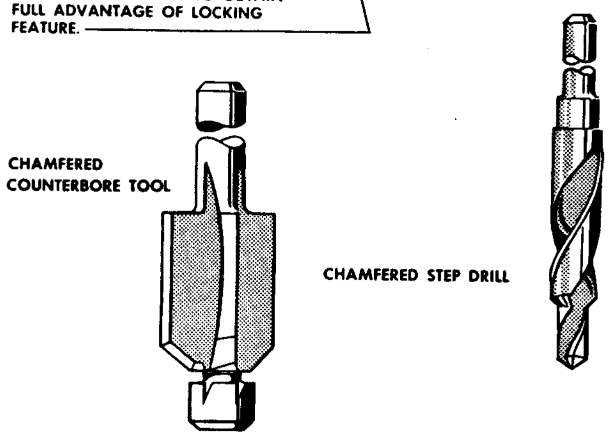
4 Tap

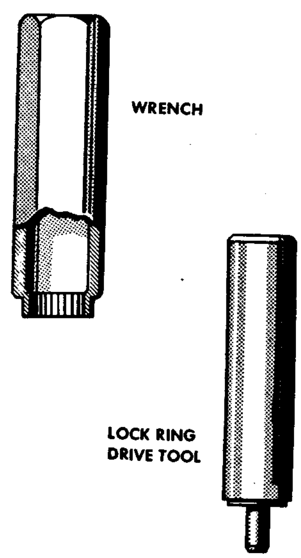
Operations 1, 2, and 3 can be combined into one operation by using a chamfered step drill.

Operations 2 and 3 can be combined into one operation by using a chamfered counterbore tool with pilot.

All operations may be accomplished with separate tools.

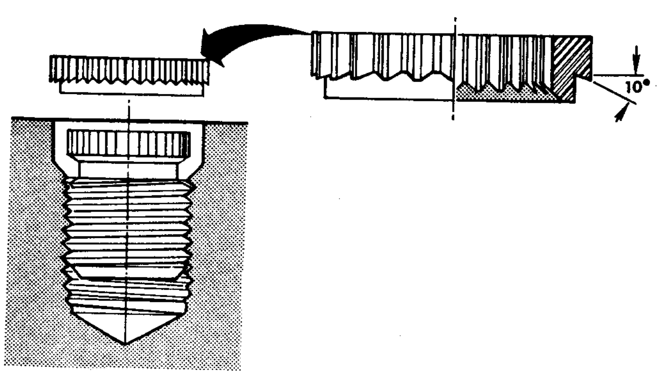






NOTE

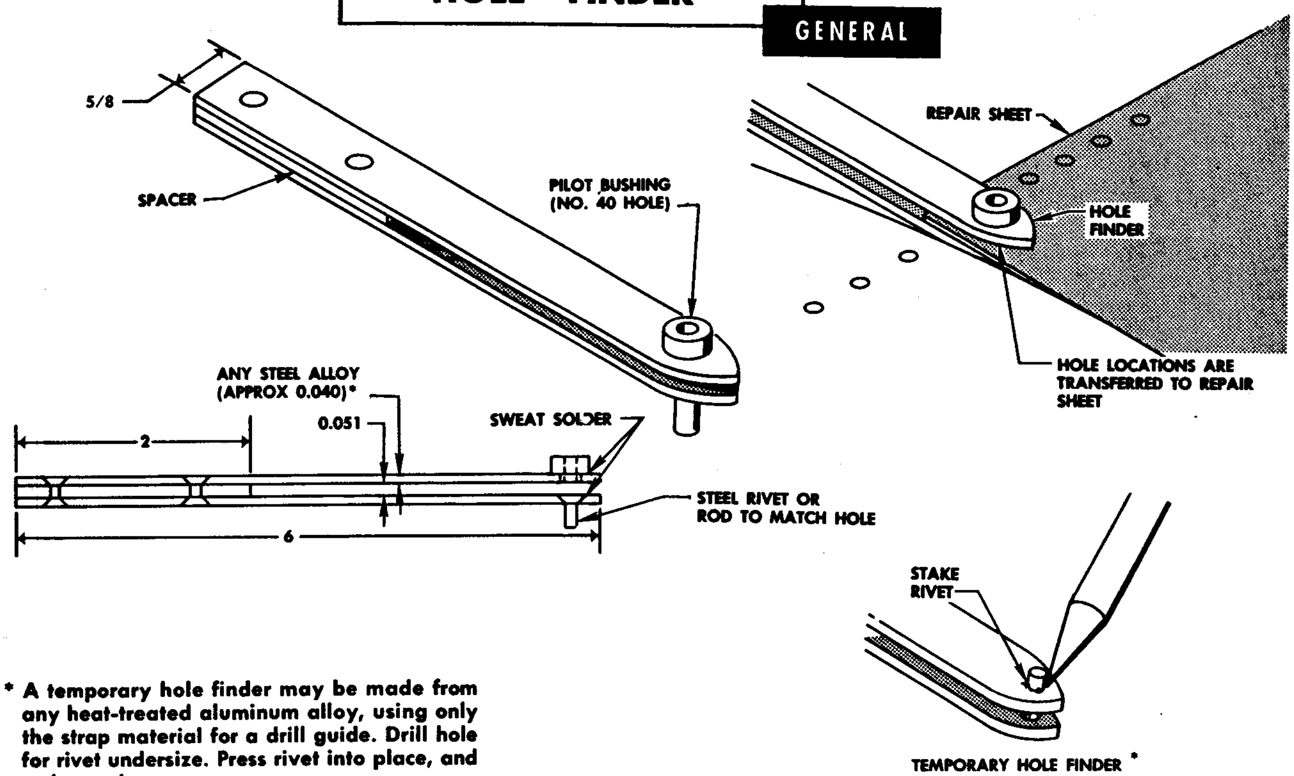
Lock ring is designed to broach its own way into parent material. Ring should be driven straight with flat tool.



GEN-3-00-41

Figure 1-77. Rosan Inserts (Sheet 2 of 2)

HOLE FINDER



* A temporary hole finder may be made from any heat-treated aluminum alloy, using only the strap material for a drill guide. Drill hole for rivet undersize. Press rivet into place, and stake as shown.

TWO METHODS WITH A SCALE

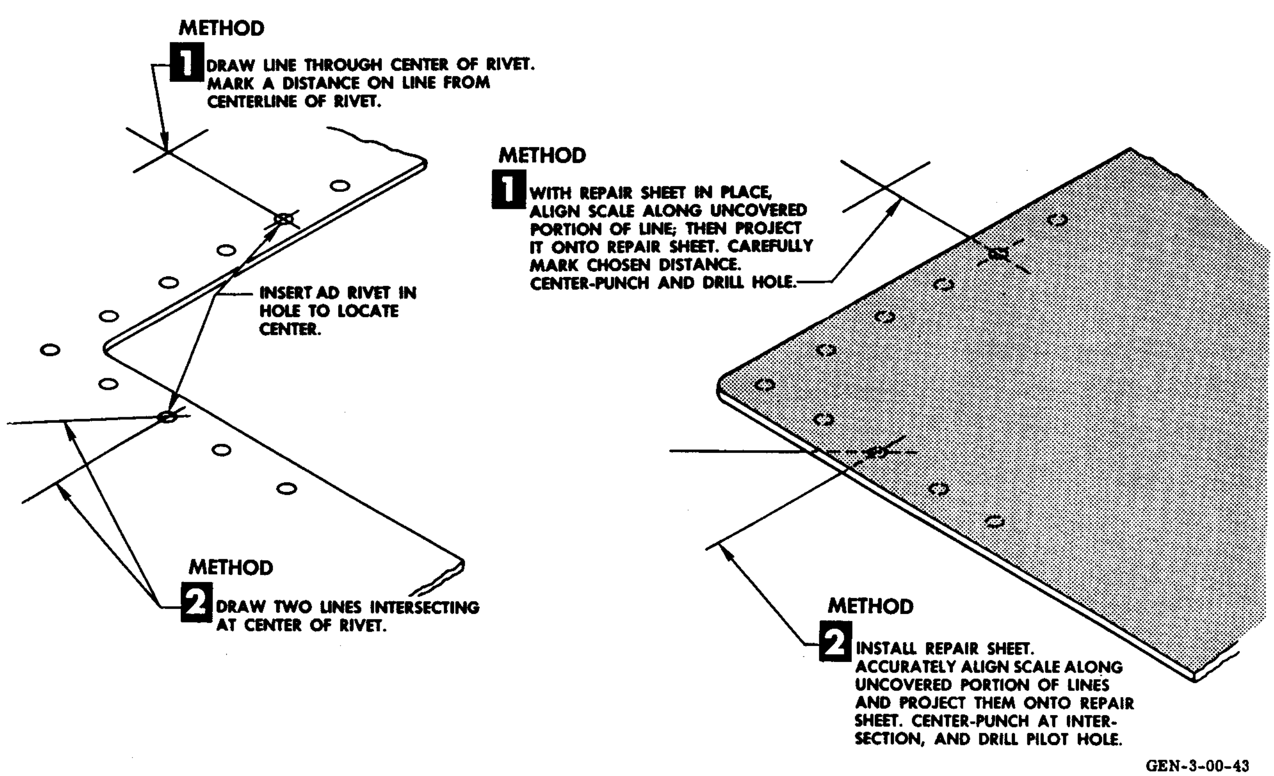
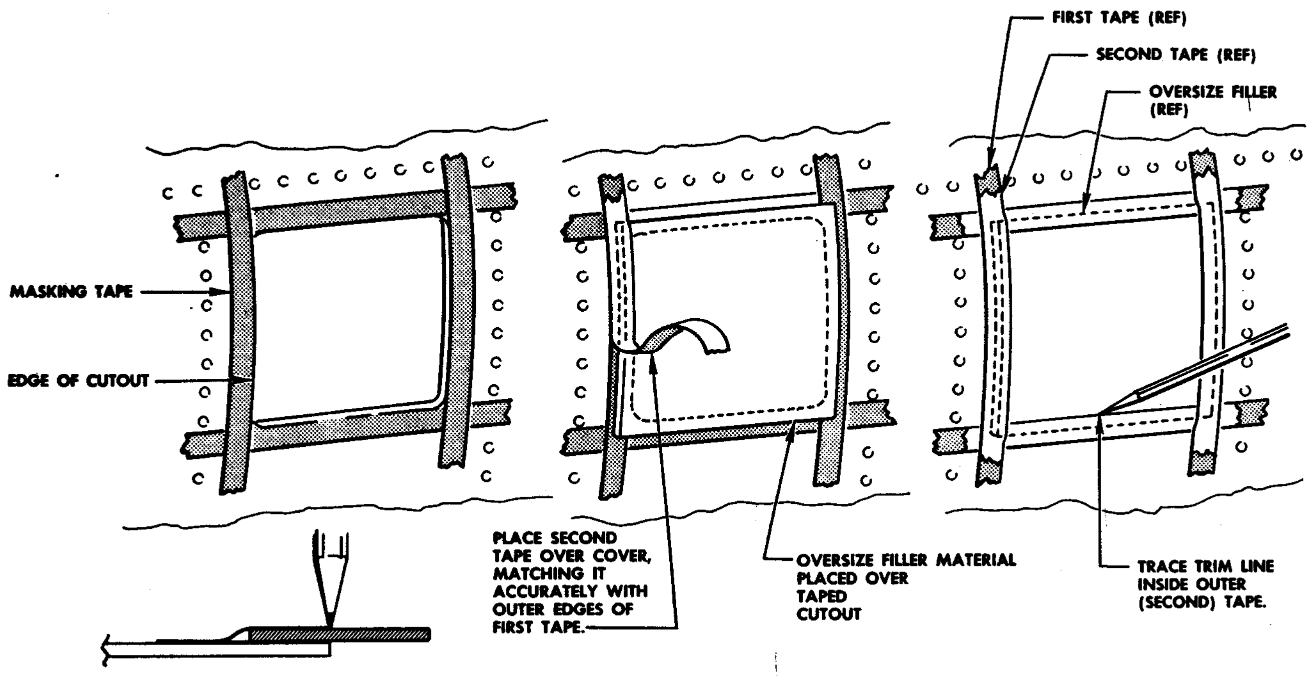


Figure 1-78. Locating Blind Holes

LOCATING TRIM LINES WITH MASKING TAPE

GENERAL



LOCATING TRIM LINES WITH SKIN SCRIBE

NOTE Trim out damaged area. Cut filler oversize. Place filler over cutout, and insert skin scribe. Hold filler firmly in place, and slide scribe around cutout.

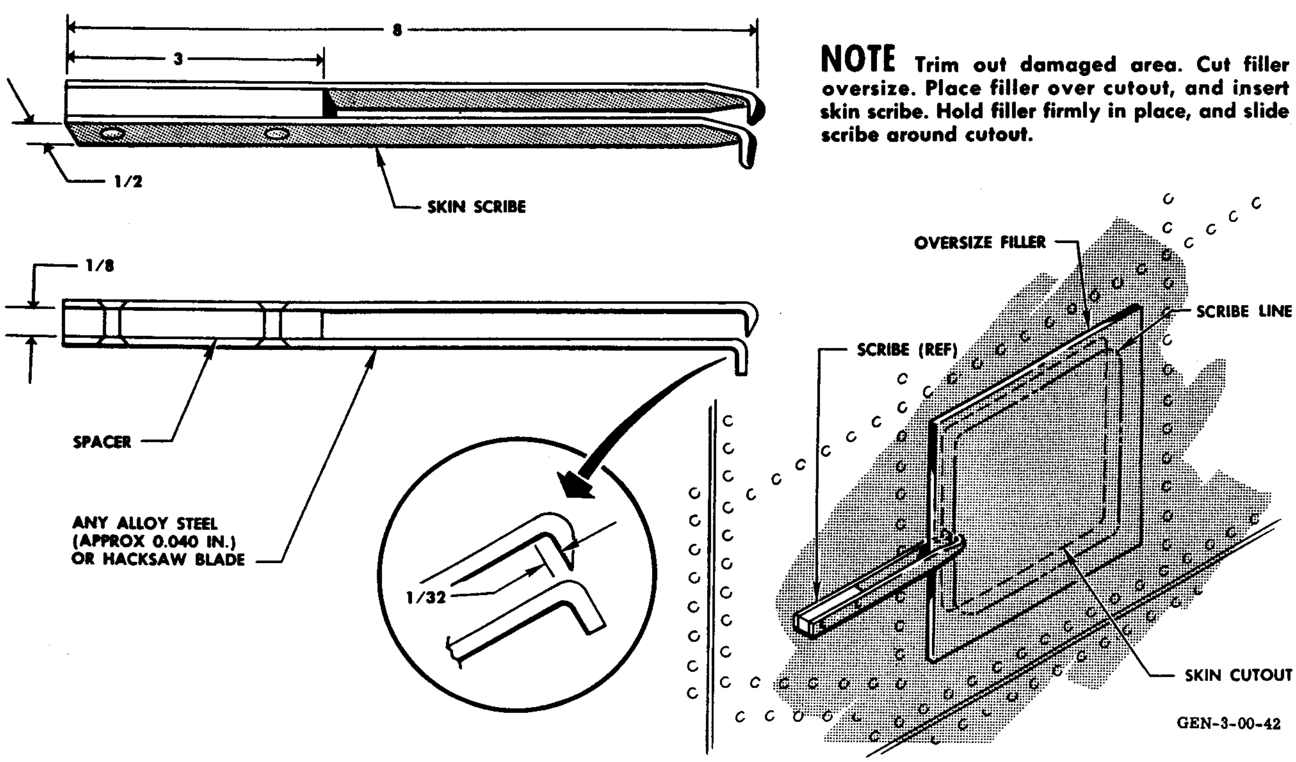
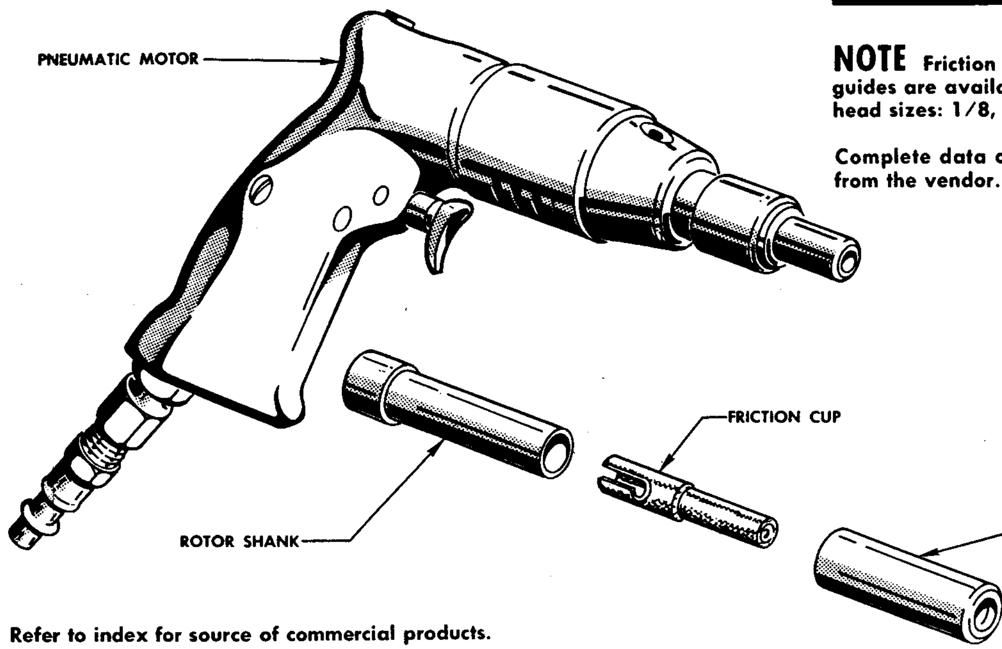


Figure 1-79. Locating Skin Trim Lines

FRICTION DETONATOR

GENERAL



NOTE Friction cups and locating pressure guides are available in the following brazier-head sizes: 1/8, 5/32, and 3/16 inch.

Complete data on this tool may be obtained from the vendor.

Refer to index for source of commercial products.

GEN-3-00-49

Figure 1-80. Explosive Rivet Friction Detonator

DRILL EXTENSION.

The drill extension tool, shown in figure 1-81, with a complete assortment of chucks, makes an extension drill of any standard length drill bit. It is relatively safer to use than a regular extension drill because the extension is rigid. It will not whip or bend, as a slim extension drill tends to do when not properly controlled. It is limited, however, to working through holes of ¼-inch diameter or larger.

DISPOSABLE-CARTRIDGE SEALANT GUN.

The disposable-cartridge sealant gun (figure 1-82) provides a simple and convenient method for injecting sealants, adhesives, etc, into prepared holes, and for laying external fillets in airtight or fluidtight sections of the airplane.

All components of the gun which come in contact with the sealant are made of polyethylene plastic and are of a disposable nature. They may be cleaned and reused, however, by stripping cured compound from plastic parts, since the compound adheres very poorly to this plastic after it has cured.

DRAW DIMPLING TOOL.

See figure 1-83.

CHIP CHASER.

See figure 1-84.

CUTTING HI-SHEAR RIVET COLLARS.

See figure 1-85.

CHARTS AND TABLES.

SETBACK.

See figure 1-86.

BEND ALLOWANCE.

See figure 1-87.

MINIMUM BEND RADII.

See figure 1-88.

TAP DRILL SIZES AND DECIMAL EQUIVALENTS.

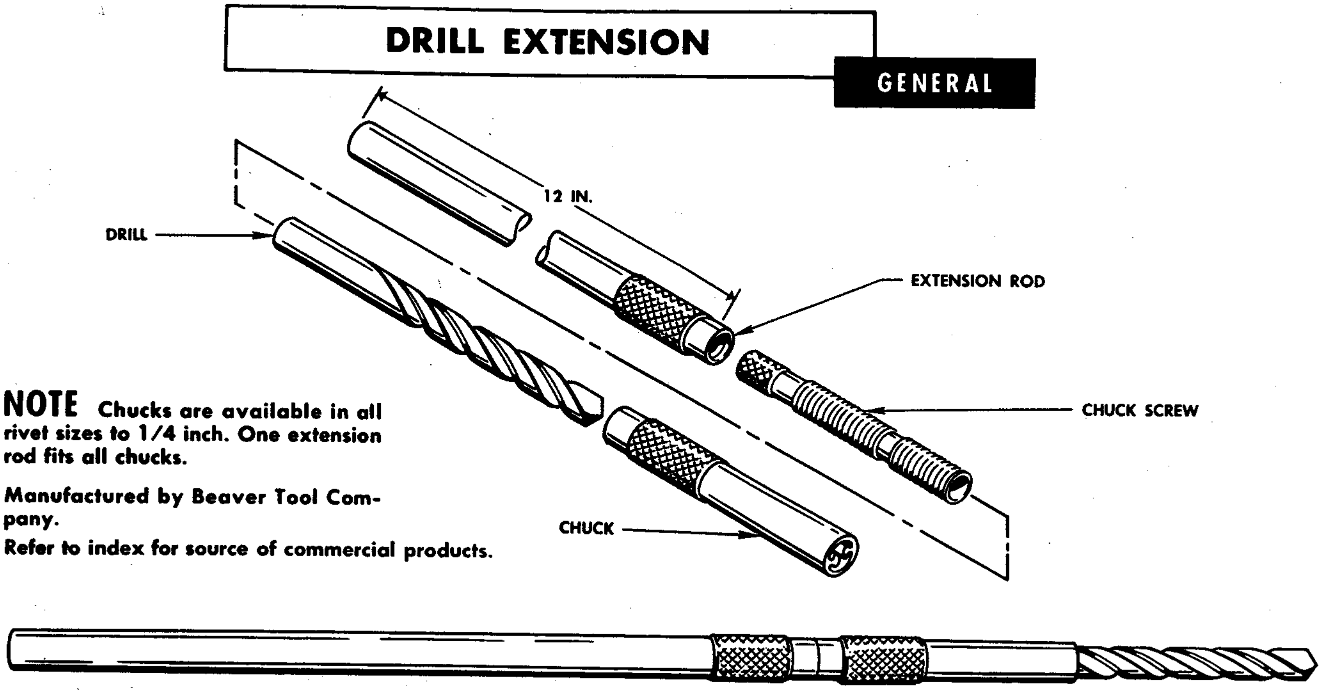
See figure 1-89.

TORQUE TABLE.

See figure 1-90.

CIRCUMFERENCE AND AREA CHART.

Using the circumference chart (figure 1-90A) the circumference of any circle may be found. This chart will



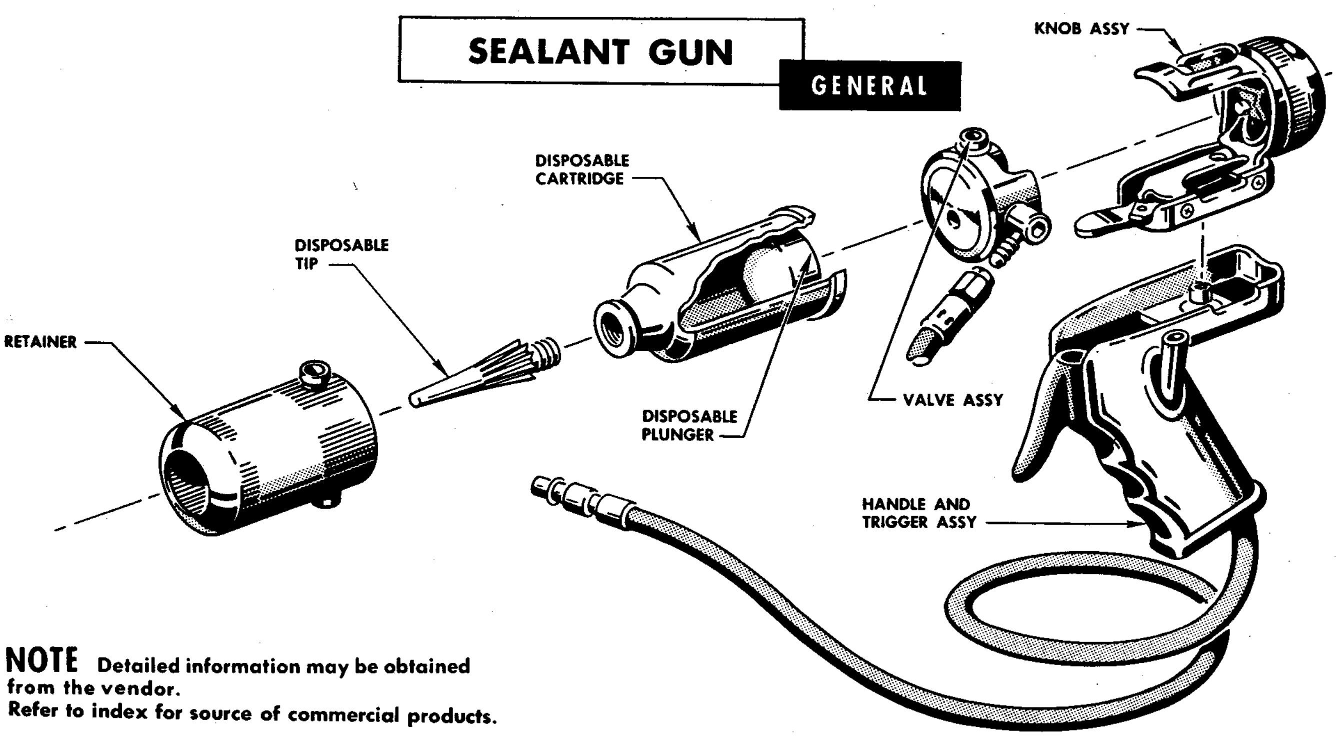
NOTE Chucks are available in all rivet sizes to 1/4 inch. One extension rod fits all chucks.

Manufactured by Beaver Tool Company.

Refer to index for source of commercial products.

GEN-3-00-48

Figure 1-81. Drill Extension



NOTE Detailed information may be obtained from the vendor.

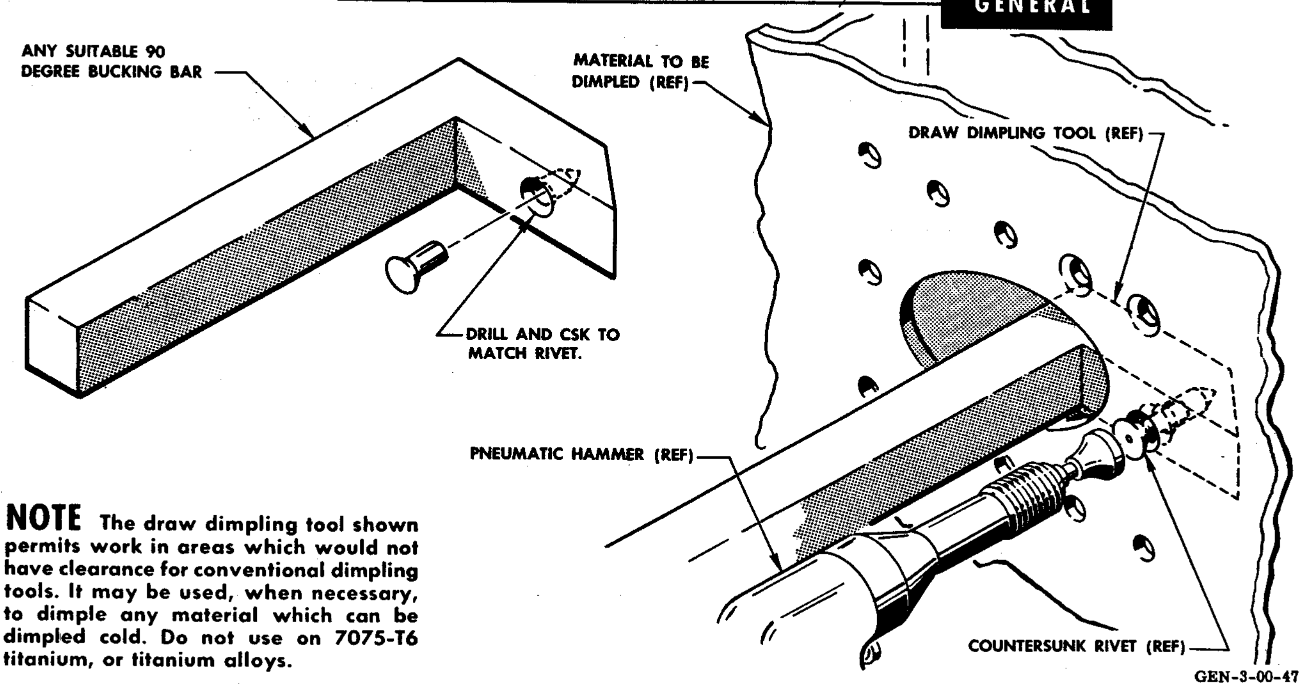
Refer to index for source of commercial products.

GEN-3-00-50

Figure 1-82. Disposable-cartridge Sealant Gun

DRAW DIMPLING TOOL

GENERAL



NOTE The draw dimpling tool shown permits work in areas which would not have clearance for conventional dimpling tools. It may be used, when necessary, to dimple any material which can be dimpled cold. Do not use on 7075-T6 titanium, or titanium alloys.

Figure 1-83. Draw Dimpling Tool

be of invaluable assistance to the repair man in helping to determine the exact size to cut material in making tubes or cylindrical parts. The chart is divided into two sections. One section has the circumference and areas of all fractions and decimals up to one-inch diameter. The other section has circumference and areas in graduations of one inch. By using both sections of the chart, the circumference of any circle can be determined. For example: To find the circumference of a 7½-inch diameter circle, the first step is to look up the circumference of a 7-inch diameter circle.

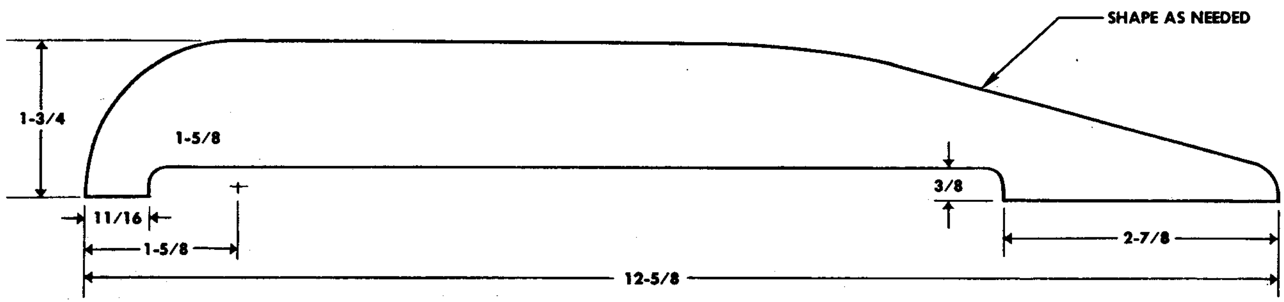
This dimension is 21.991. The second step is to look up the circumference for a ½-inch diameter circle. This dimension is 1.5708. By adding the two dimensions, 21.991 inches and 1.5708 inches, the circumference for a 7½-inch diameter circle is obtained (23.5618 inches). If an inside or outside dimension is required, subtract one material thickness from the diameter for an outside dimension and add one material thickness for an inside dimension.

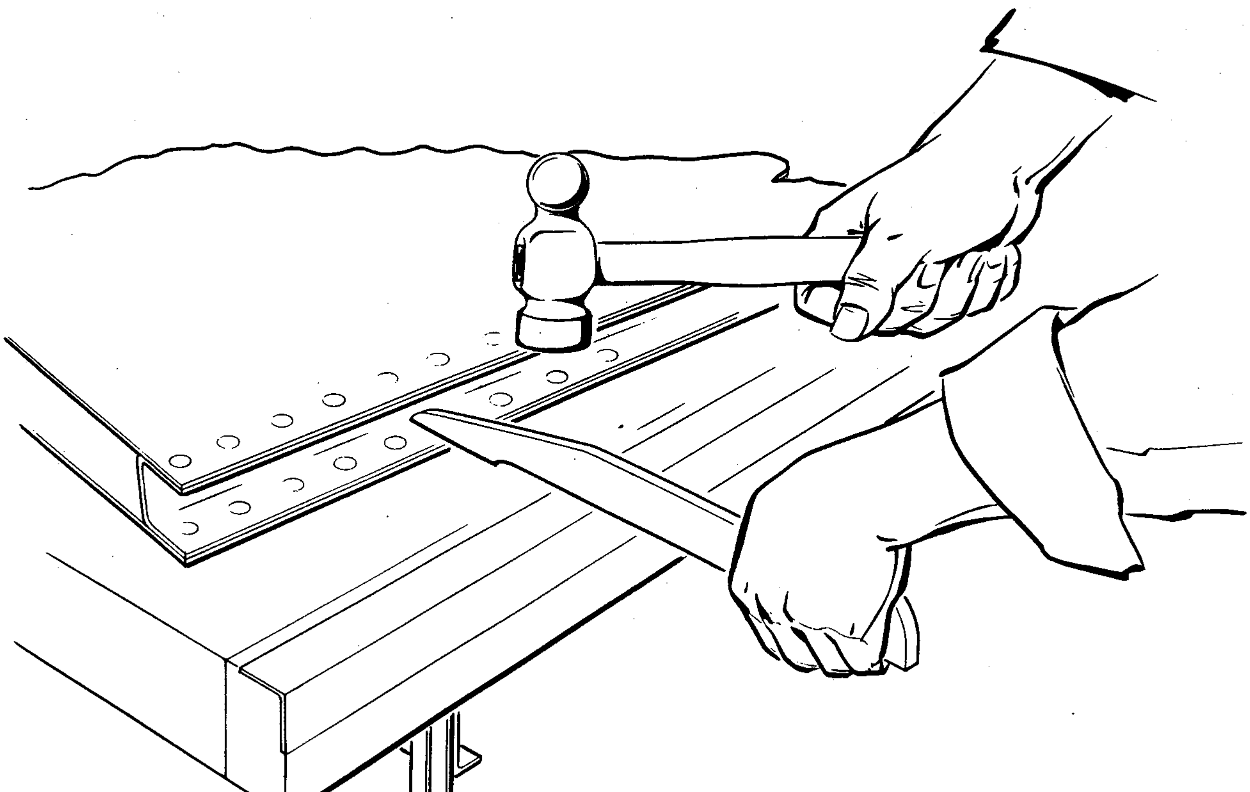
SHOP MATHEMATICS.

See figure 1-91.

SPAR RIVETING BAR

GENERAL





NOTE From 1/2-inch steel plate, fabricate spar riveting bar to dimensions shown.

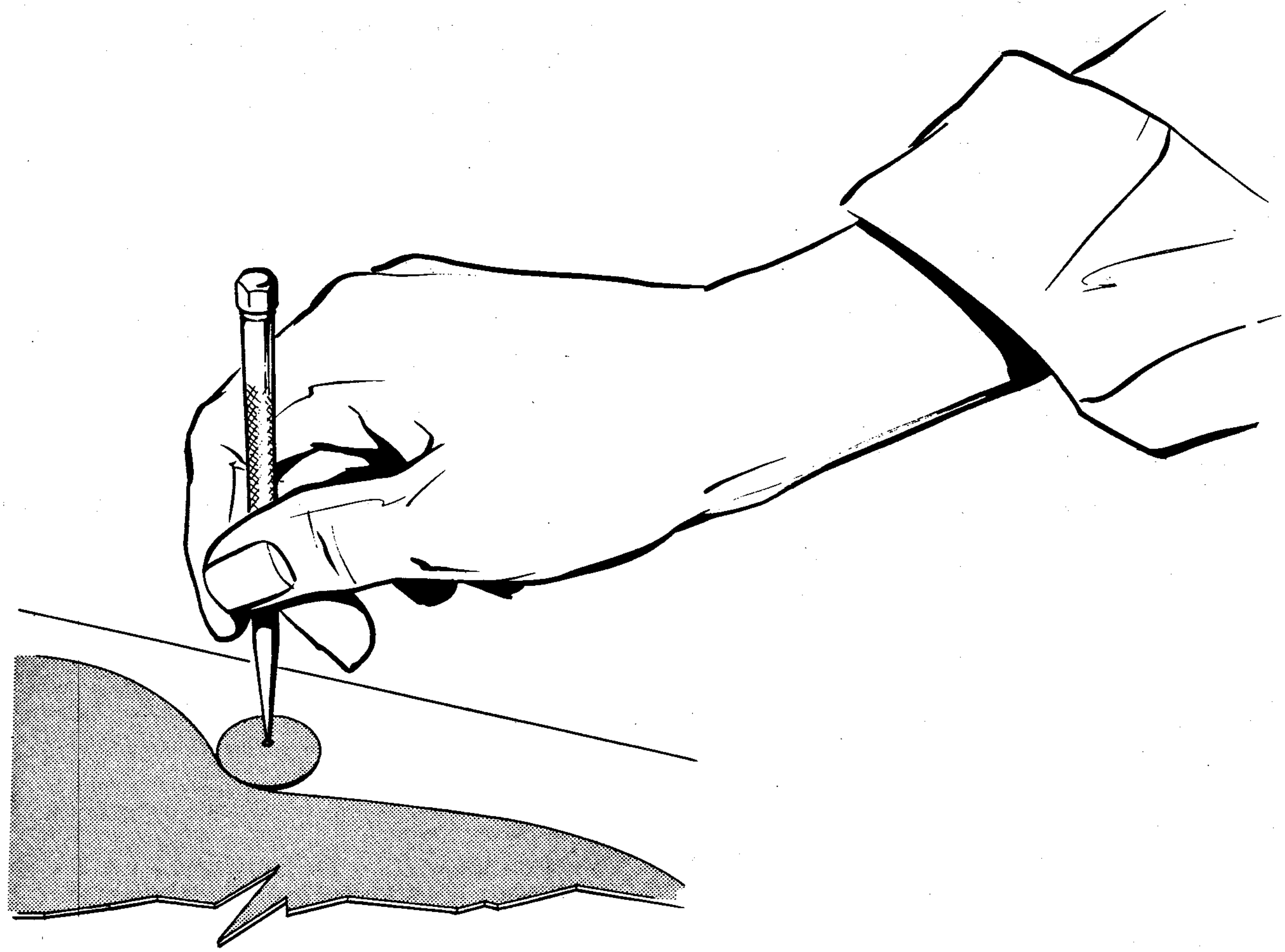
- Rivets that cannot be reached with the use of a rivet gun may be driven in the following manner: Hold one end of spar riveting bar by hand and place other end of spar riveting bar on a supported or backed-up rivet; then strike spar riveting bar with a steel hammer.

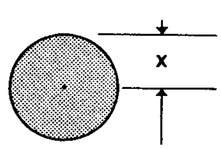
GEN-3-00-70

Figure 1-83A. Spar Riveting Bar

DISKS FOR OVERSIZE TRIM LINES

GENERAL





X=OVERSIZE DIMENSION REQUIRED

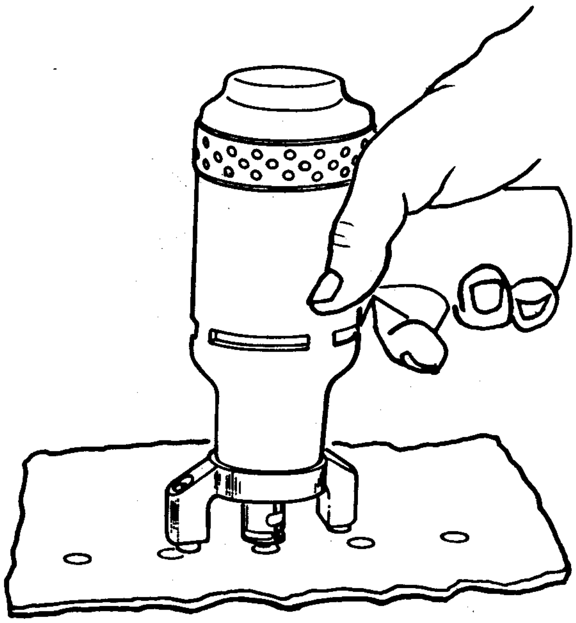
NOTE By keeping a number of sheet-metal disks in graduated sizes, as shown, the repair man has a quick and effective method of scribing oversize trim lines around irregular-shaped patterns. Locate a disk with radius of oversized dimension desired. Insert a scribe or pencil point in center hole, and roll disk around pattern, using scribe or pencil point as an axis upon which disk can rotate. (Refer to "Marking Oversize Trims" in text.)

GEN-3-00-71

Figure 1-83B. Marking Oversized Trims

SHAVING FASTENER HEADS

GENERAL



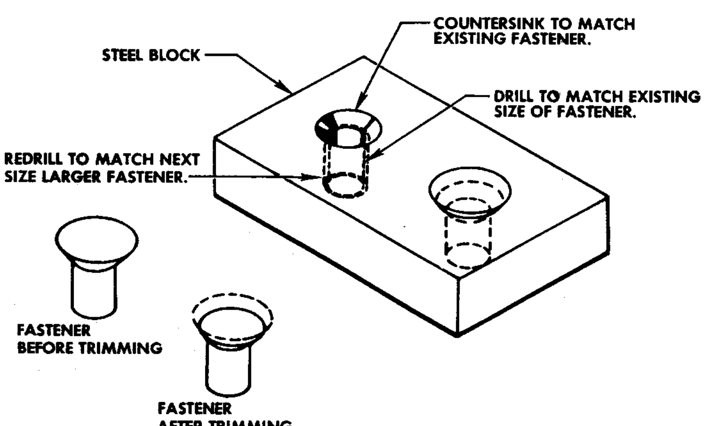
NOTE The fastener heads may be milled with either the electric or pneumatic rivet mill to meet the flushness requirements below. The surface of the sheet must not be damaged, and the fastener head must not be reduced more than 5 percent of the head diameter.

- Do not mill or shave the heads of Deutsch drive pin rivets or Jo-bolts.

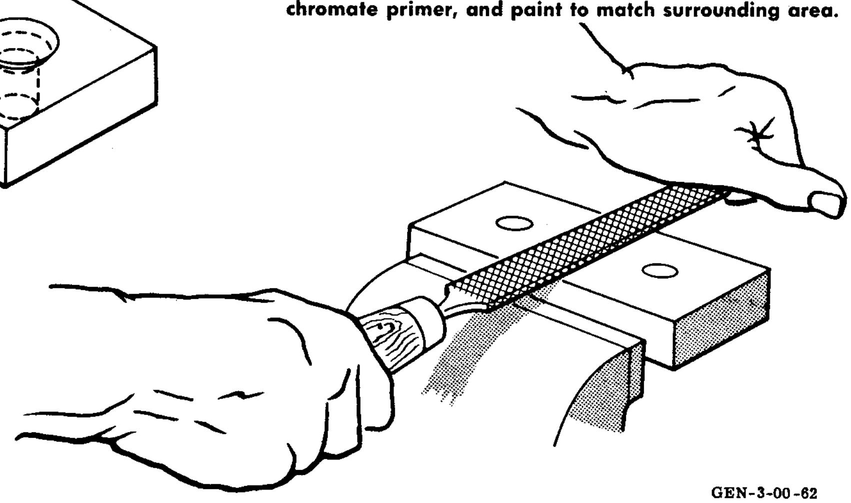
FLUSHNESS REQUIREMENTS		
	COUNTERSUNK HOLES	DIMPLED HOLES
BELOW SURFACE	0.002	0.002
ABOVE SURFACE	0.000	0.002

REDUCING FASTENER HEAD SIZE

In cases where a dimpled or countersunk hole has become enlarged, and it is not possible to redimple or countersink for the next size larger fastener, the following method may be used to trim the next size larger fastener head to match the existing dimples or countersinks.



1. Drill a hole in a steel block the same size as the existing fastener.
2. Countersink the drilled hole so that the existing size fastener head is flush with the surface of the steel block.
3. Redrill hole to next size larger fastener diameter.
4. Place the fastener to be used in the countersunk hole in the steel block, and file or grind off head flush with the surface of the block.
5. Install the fastener to be used in redrilled holes. After installation, coat head of fastener with two coats of zinc-chromate primer, and paint to match surrounding area.



NOTE This method is to be used only for the next size larger fastener.

GEN-3-00-62

Figure 1-83C. Trimming Fastener Heads

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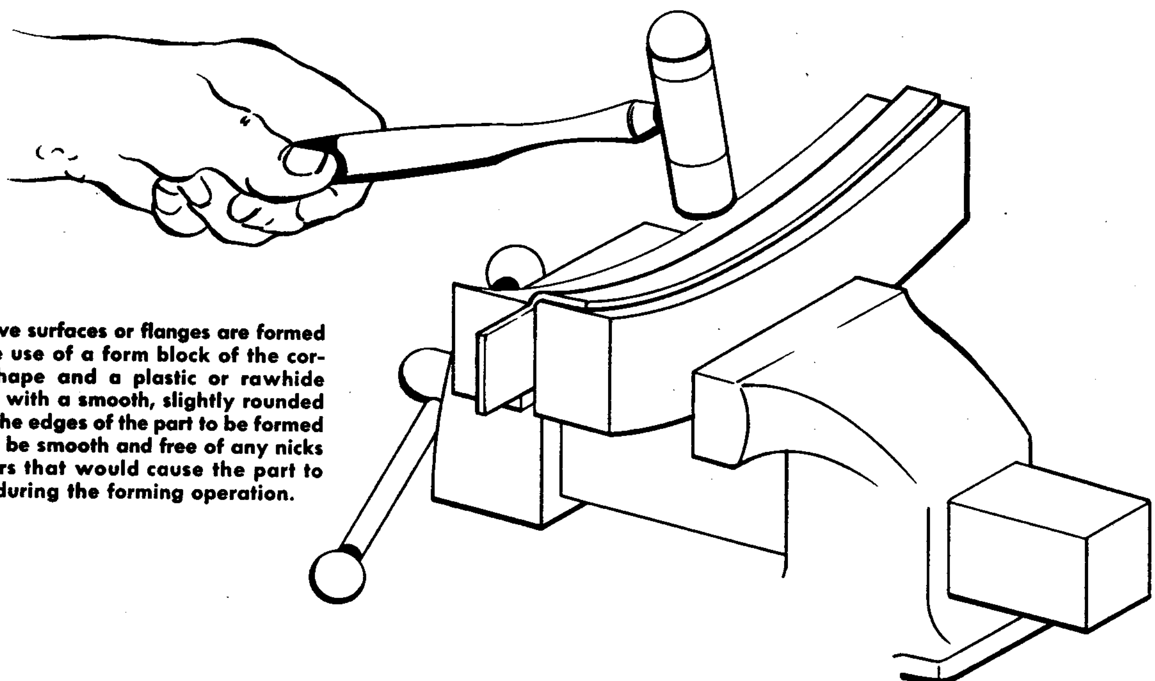
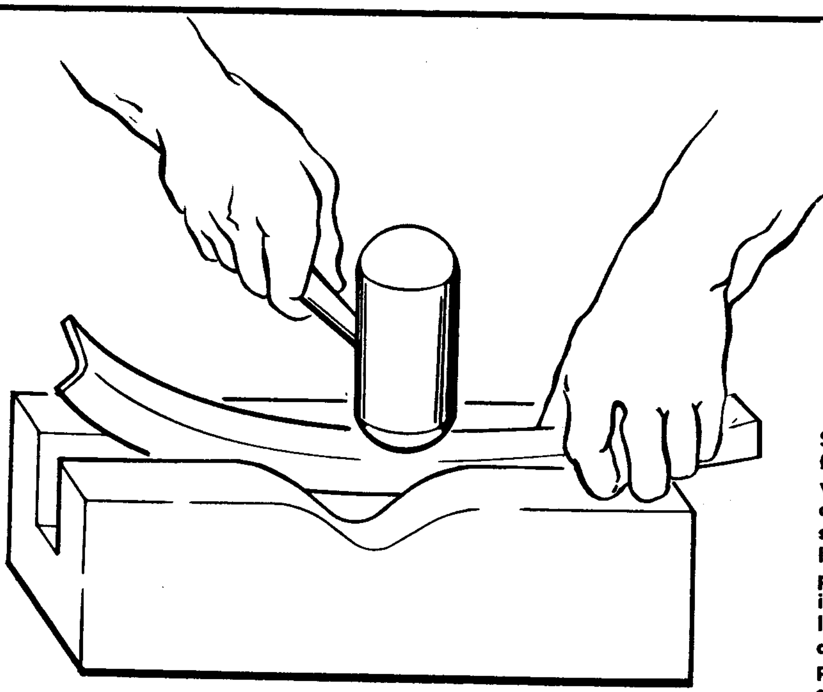
HAND-FORMING

GENERAL



Concave surfaces or flanges are formed by the use of a form block of the correct shape and a plastic or rawhide mallet with a smooth, slightly rounded face. The edges of the part to be formed should be smooth and free of any nicks or burrs that would cause the part to crack during the forming operation.



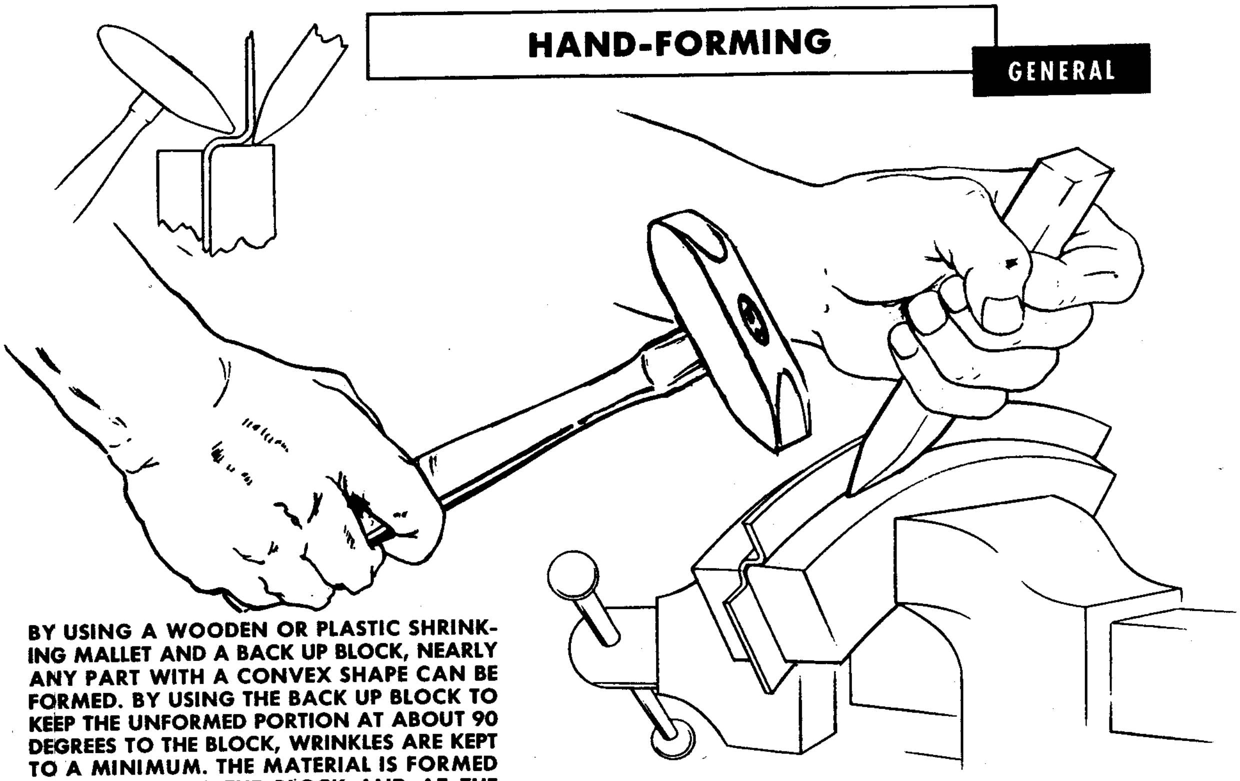
Sheet metal or extruded angles can be formed by hand with the use of a wooden block, slotted so that one leg of the angle will fit into it. The slot should be just wide enough so that the leg of the angle fits it snugly. This will prevent the angle from wrinkling as it is formed. To form the angle, tap it lightly with a plastic or rawhide mallet as it is moved along over the relieved portion of the block. Channels, "T's," and various other shapes can be formed in the same way by varying the size and number of slots cut into the block.

GEN-3-00-63

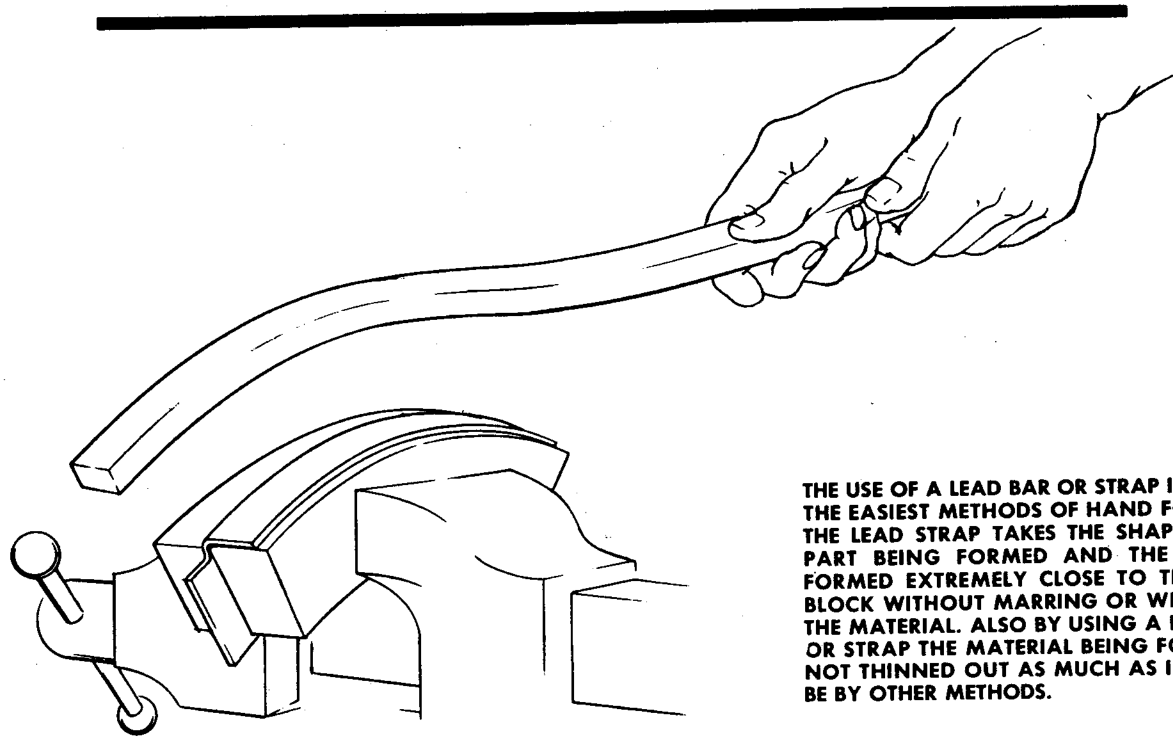
Figure 1-83D. Hand-forming (Sheet 1 of 2)

HAND-FORMING

GENERAL



BY USING A WOODEN OR PLASTIC SHRINKING MALLET AND A BACK UP BLOCK, NEARLY ANY PART WITH A CONVEX SHAPE CAN BE FORMED. BY USING THE BACK UP BLOCK TO KEEP THE UNFORMED PORTION AT ABOUT 90 DEGREES TO THE BLOCK, WRINKLES ARE KEPT TO A MINIMUM. THE MATERIAL IS FORMED DOWN AGAINST THE BLOCK AND AT THE SAME TIME AWAY FROM THE RADIUS OF THE FORM BLOCK.



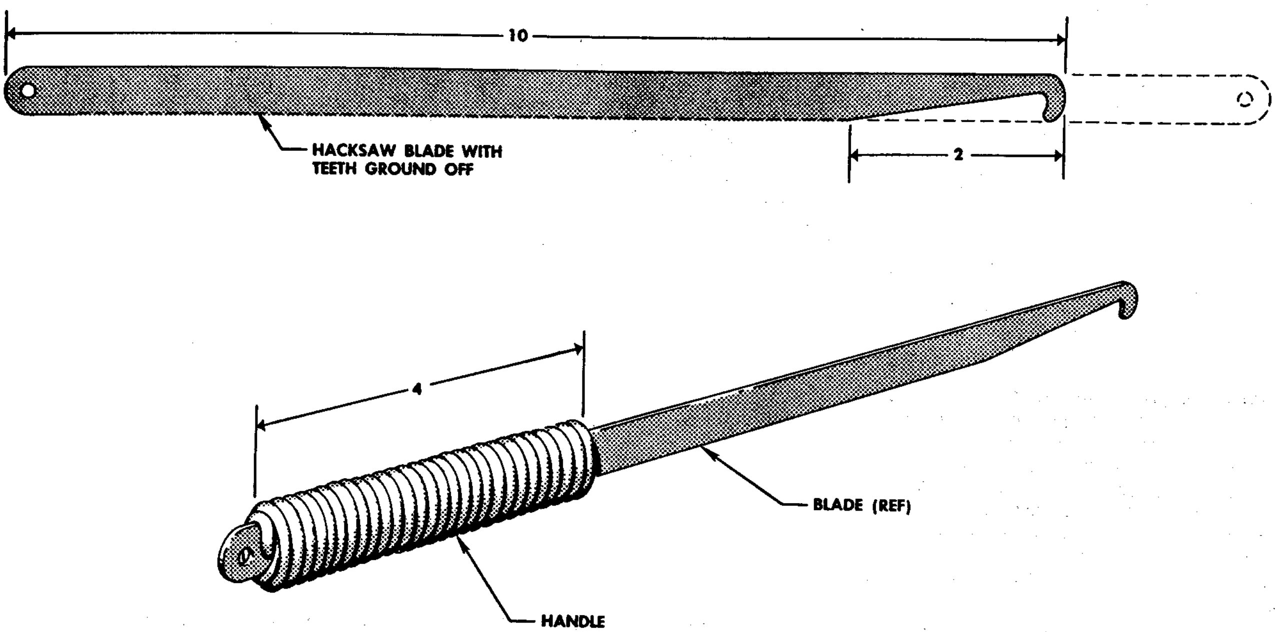
THE USE OF A LEAD BAR OR STRAP IS ONE OF THE EASIEST METHODS OF HAND FORMING. THE LEAD STRAP TAKES THE SHAPE OF THE PART BEING FORMED AND THE PART IS FORMED EXTREMELY CLOSE TO THE FORM BLOCK WITHOUT MARRING OR WRINKLING THE MATERIAL. ALSO BY USING A LEAD BAR OR STRAP THE MATERIAL BEING FORMED IS NOT THINNED OUT AS MUCH AS IT WOULD BE BY OTHER METHODS.

GEN-3-00-64

Figure 1-83D. Hand-forming (Sheet 2 of 2)

CHIP CHASER

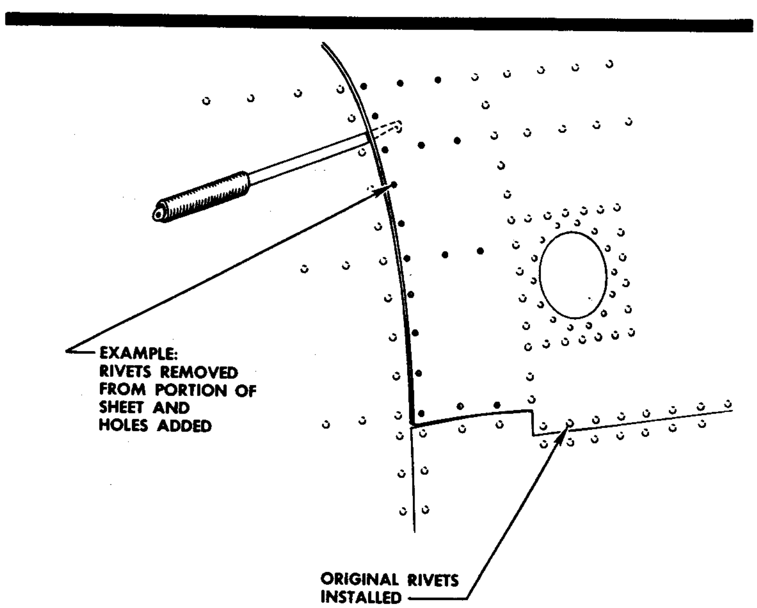
GENERAL



NOTE Any thin steel may be used; however, a springy material will give more satisfactory service.

Handle may be made of wood, phenolic, scrap Plexiglas, etc. Rivet or tape to blade.

Use chip chaser to remove drill chips, etc, from between assemblies which cannot be separated after cutting operations.



GEN-3-00-44

Figure 1-84. Chip Chaser

DRILLING SPOT WELDS

GENERAL

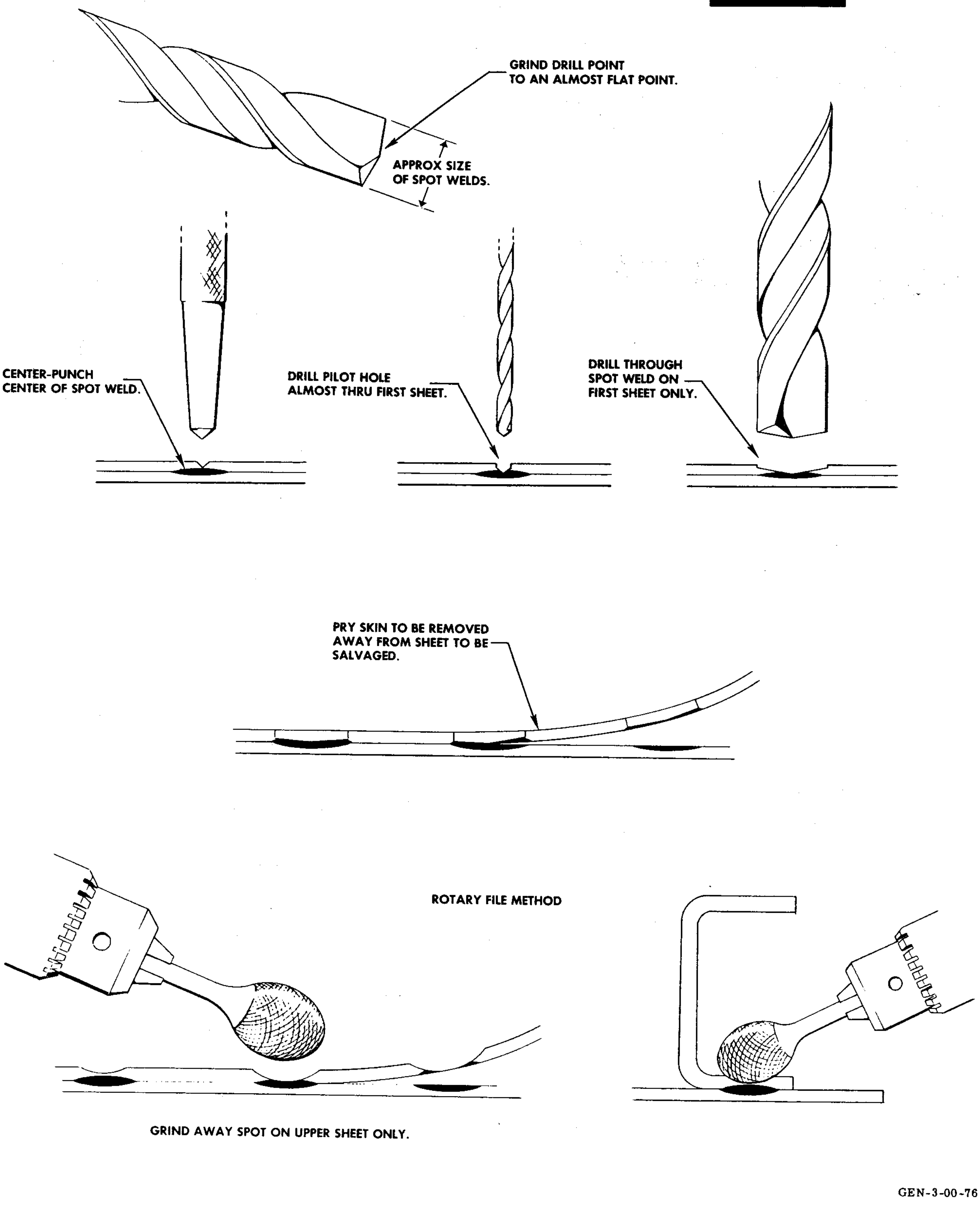


Figure 1-84A. Drilling or Grinding Spot Welds

FROZEN SCREW REMOVAL

GENERAL

When removing screws that are frozen in place, the tool shown below can be of great assistance. Insert the screwdriver tip into the frozen screw and apply firm pressure on the rivet gun; then pull the trigger. At the same time as the rivet gun is operated, apply pressure on the tool handle. As vibration loosens the screw, turn out the screw.

NOTE

Always be sure that the correct size screwdriver tip is being used. This tool may also be used to remove frozen bolts by substituting a standard 1/2-inch drive socket for the screwdriver adapter.

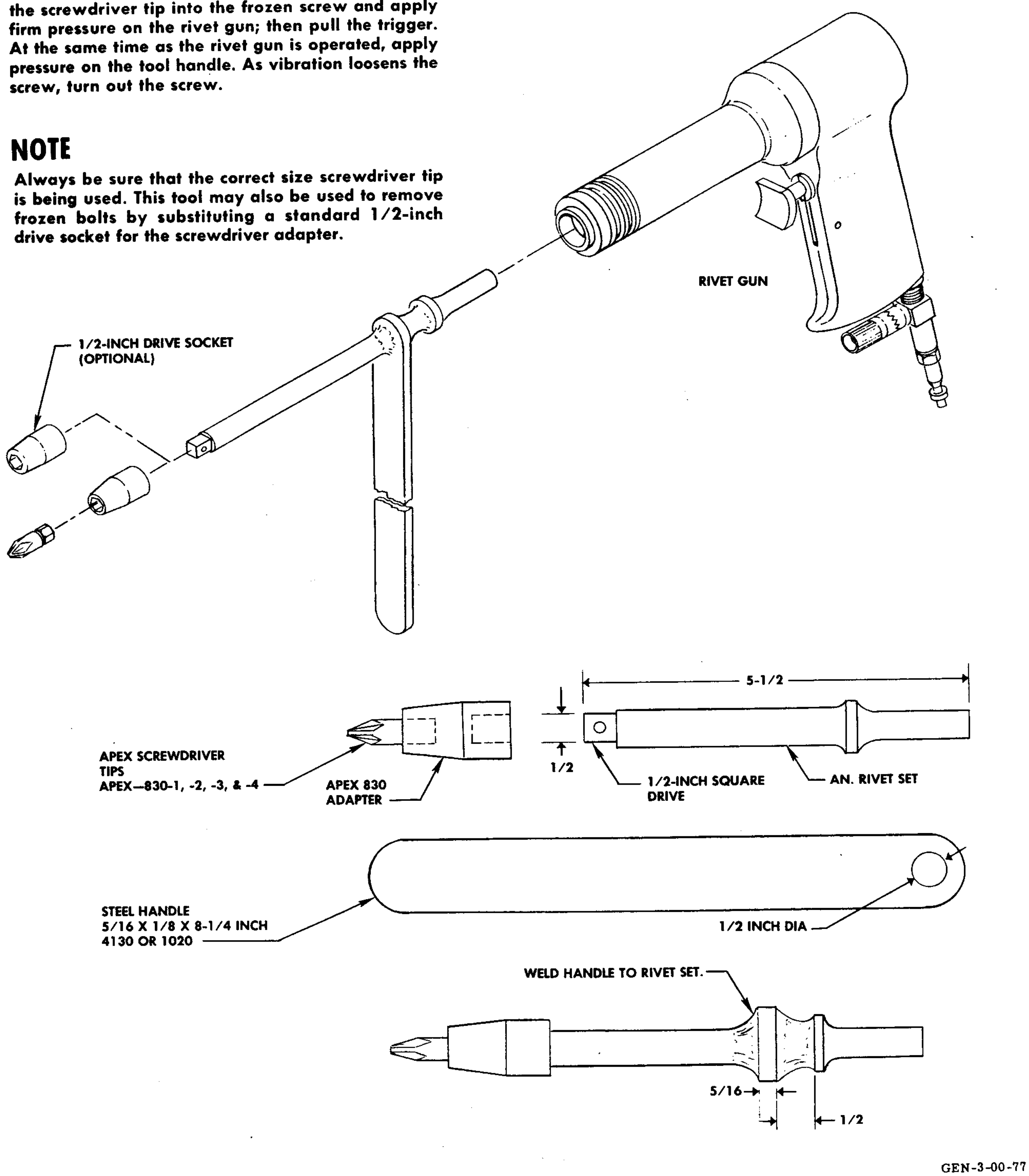
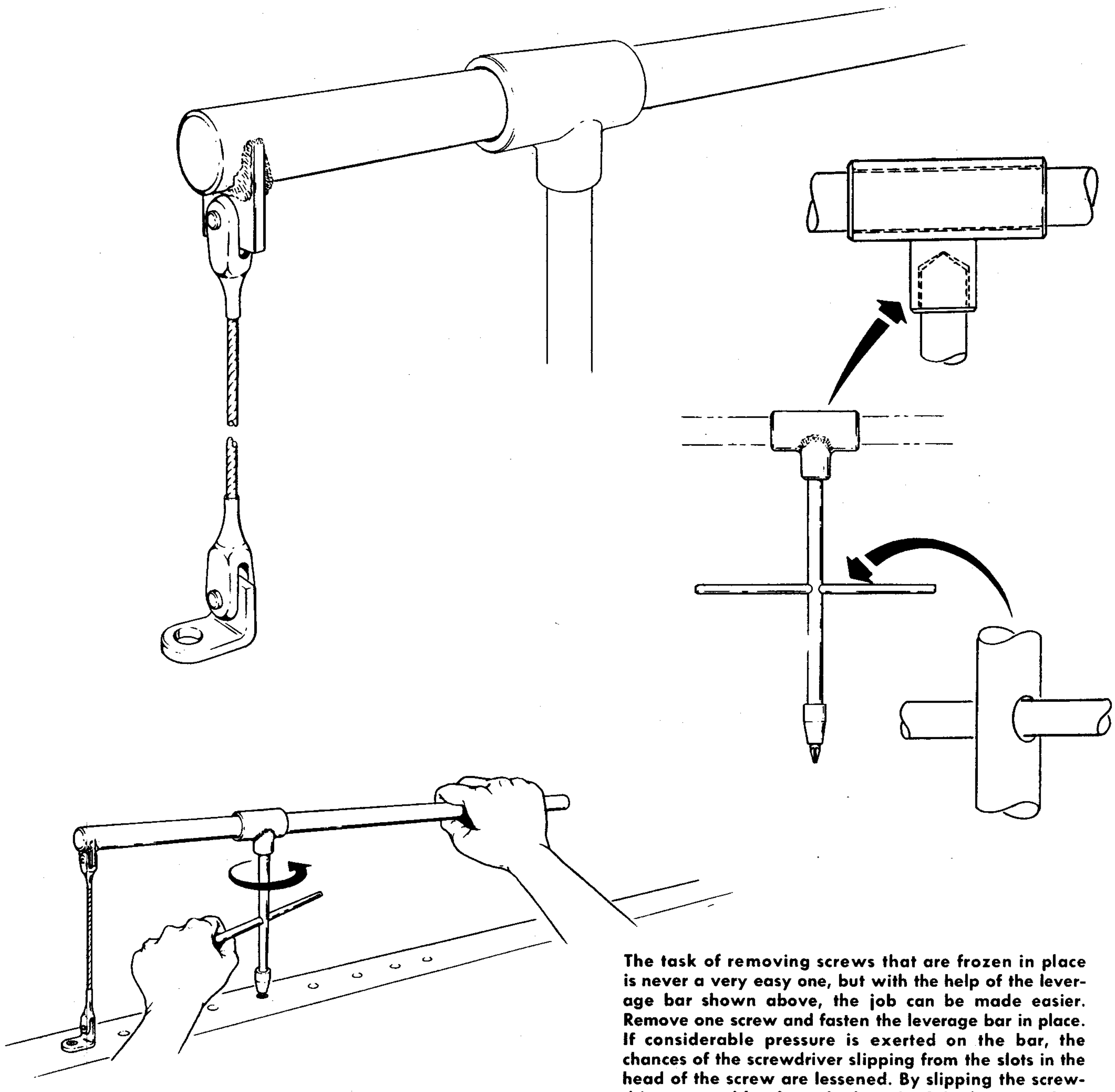


Figure 1-84B. Rivet Gun for Loosening Screws

SCREW EXTRACTOR

GENERAL



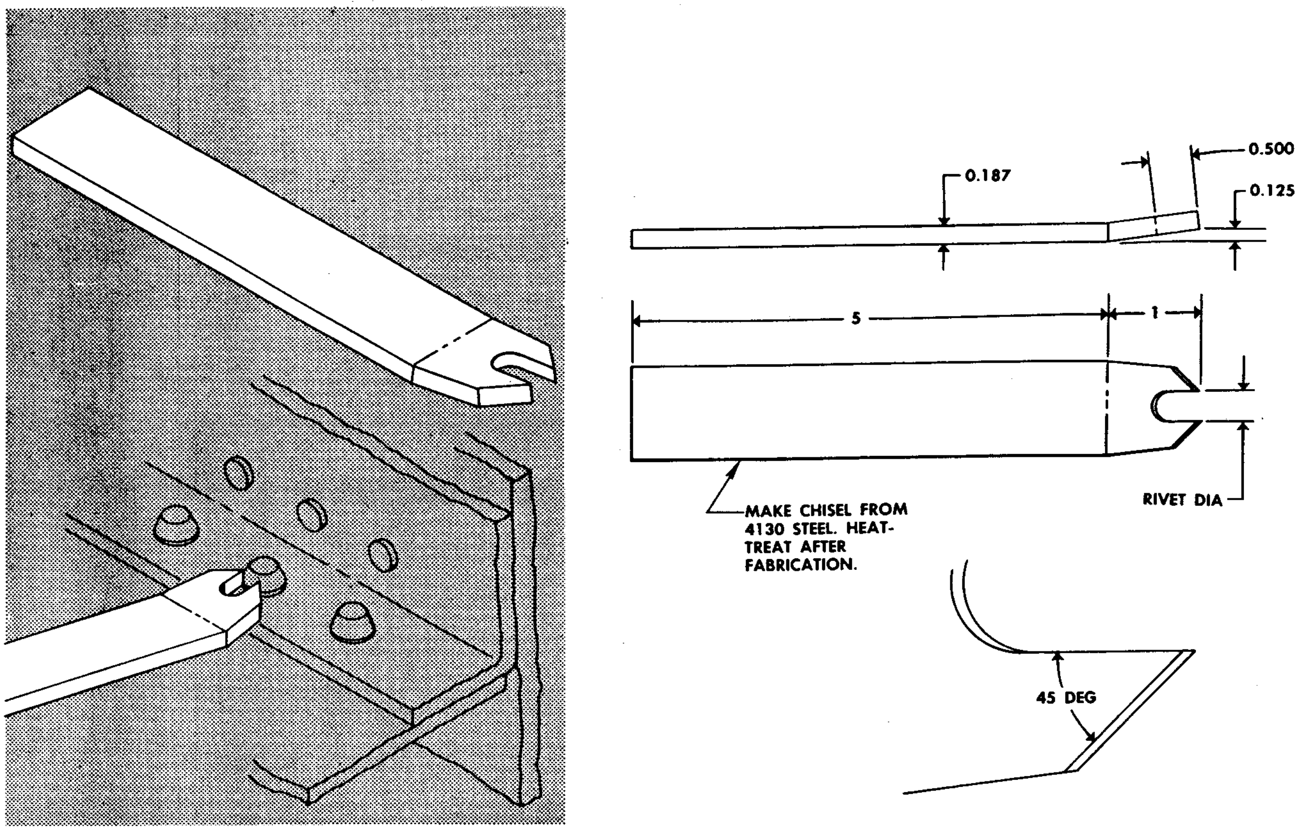
The task of removing screws that are frozen in place is never a very easy one, but with the help of the leverage bar shown above, the job can be made easier. Remove one screw and fasten the leverage bar in place. If considerable pressure is exerted on the bar, the chances of the screwdriver slipping from the slots in the head of the screw are lessened. By slipping the screwdriver assembly along the length of the leverage bar, several screws can be removed before the bar needs to be relocated.

GEN-3-00-78

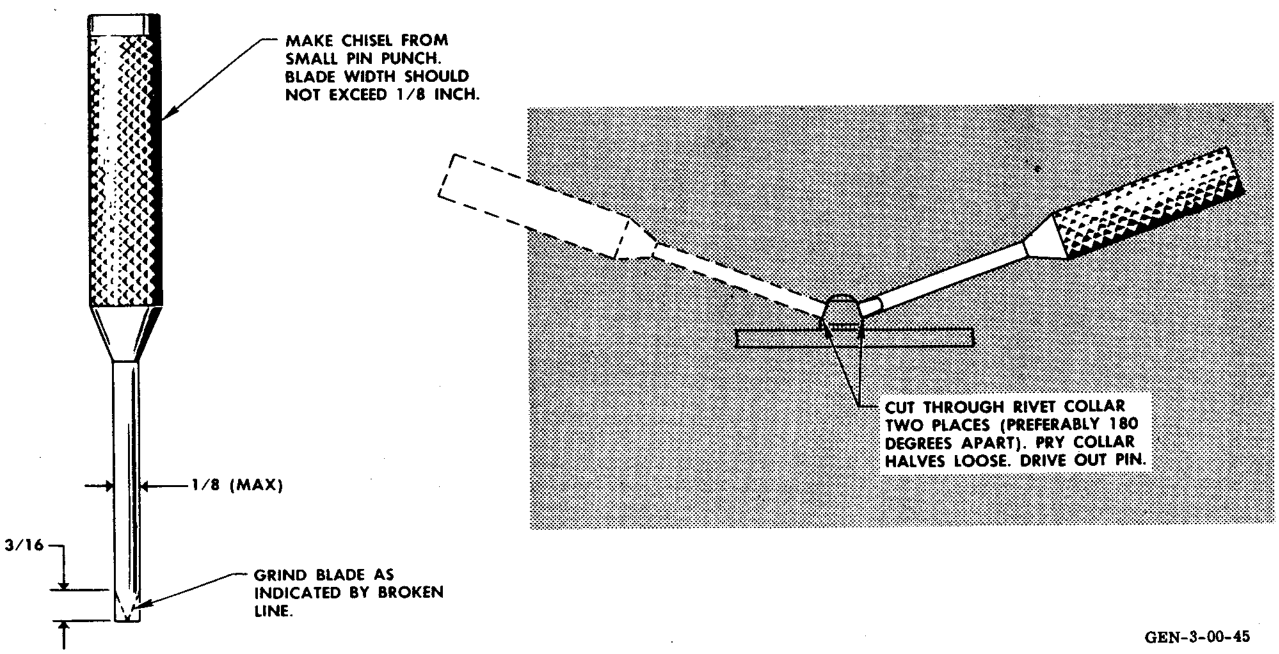
Figure 1-84C. Leverage Bar for Loosening Screws

FORKED CHISEL

GENERAL



NARROW-BLADE CHISEL



GEN-3-00-45

Figure 1-85. Cutting Hi-Shear Rivet Collars

ALUMINUM ALLOY DESIGNATIONS

GENERAL

WROUGHT ALUMINUM ALLOY DESIGNATIONS	
OLD DESIGNATION	NEW DESIGNATION
2S	1100
3S	3003
14S	2014
17S	2017
A17S	2117
24S	2024
52S	5052
56S	5056
61S	6061
75S	7075
79S	7079

TEMPER DESIGNATIONS

The temper designation system in effect since 31 December 1947 is being continued without change. The temper designation follows the alloy designation and is separated from it by a dash. Example: 3S-O is now 3003-O, Alclad 24S-T3 is Alclad 2024-T3, and 75-T6 is 7075-T6.

Alloy designations and temperature designations for aluminum alloy castings have not been changed.

NOTE

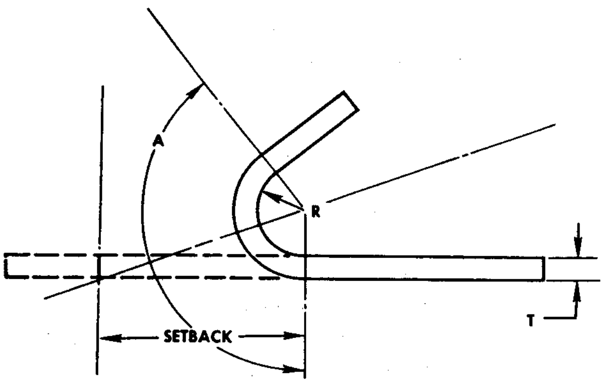
2024-T3 may be substituted for 2024-T4 for Repair, except as specified.

GEN-3-00-73

Figure 1-85A. Aluminum Alloy Designations

SETBACK CHART

GENERAL



Example:
Angle of bend (A) = 140 deg
Material thickness (T) = 0.064 in.
Radius (R) = 0.125 in.
K—from table = 2.7475

SETBACK = K × (T + R) =
2.7475 × (0.064 + 0.125) =
2.7475 × 0.189 = 0.509
SETBACK = 0.509 IN.

ANGLE DEGREE	K	ANGLE DEGREE	K	ANGLE DEGREE	K	ANGLE DEGREE	K	ANGLE DEGREE	K	ANGLE DEGREE	K
1	0.00873	31	0.27732	61	0.58905	91	1.0176	121	1.7675	151	3.8667
2	0.01745	32	0.28674	62	0.60086	92	1.0355	122	1.8040	152	4.0108
3	0.02618	33	0.29621	63	0.61208	93	1.0538	123	1.8418	153	4.1653
4	0.03493	34	0.30573	64	0.62487	94	1.0724	124	1.8807	154	4.3315
5	0.04366	35	0.31530	65	0.63707	95	1.0913	125	1.9210	155	4.5107
6	0.05241	36	0.32492	66	0.64941	96	1.1106	126	1.9626	156	4.7046
7	0.06116	37	0.33459	67	0.66188	97	1.1303	127	2.0057	157	4.9151
8	0.06993	38	0.34433	68	0.67451	98	1.1504	128	2.0503	158	5.1455
9	0.07870	39	0.35412	69	0.68728	99	1.1708	129	2.0965	159	5.3995
10	0.08749	40	0.36397	70	0.70021	100	1.1917	130	2.1445	160	5.6713
11	0.09629	41	0.37388	71	0.71329	101	1.2131	131	2.1943	161	5.9758
12	0.10510	42	0.38386	72	0.72654	102	1.2349	132	2.2460	162	6.3137
13	0.11393	43	0.39391	73	0.73996	103	1.2572	133	2.2998	163	6.6911
14	0.12278	44	0.40403	74	0.75355	104	1.2799	134	2.3558	164	7.1154
15	0.13165	45	0.41421	75	0.76733	105	1.3032	135	2.4142	165	7.5957
16	0.14054	46	0.42447	76	0.78128	106	1.3270	136	2.4751	166	8.1443
17	0.14945	47	0.43481	77	0.79543	107	1.3514	137	2.5386	167	8.7769
18	0.15838	48	0.44523	78	0.80978	108	1.3764	138	2.6051	168	9.5144
19	0.16734	49	0.45573	79	0.82434	109	1.4019	139	2.6746	169	10.385
20	0.17633	50	0.46631	80	0.83910	110	1.4281	140	2.7475	170	11.430
21	0.18534	51	0.47697	81	0.85408	111	1.4550	141	2.8239	171	12.706
22	0.19438	52	0.48773	82	0.86929	112	1.4826	142	2.9042	172	14.301
23	0.20345	53	0.49858	83	0.88472	113	1.5108	143	2.9887	173	16.350
24	0.21256	54	0.50952	84	0.90040	114	1.5399	144	3.0777	174	19.081
25	0.22169	55	0.52057	85	0.91633	115	1.5697	145	3.1716	175	22.904
26	0.23087	56	0.53171	86	0.93251	116	1.6003	146	3.2708	176	26.636
27	0.24008	57	0.54295	87	0.94896	117	1.6318	147	3.3759	177	38.188
28	0.24933	58	0.55431	88	0.96569	118	1.6643	148	3.4874	178	57.290
29	0.25862	59	0.56577	89	0.98270	119	1.6977	149	3.6059	179	114.590
30	0.26795	60	0.57735	90	1.00000	120	1.7320	150	3.7320	180	INFINITE

GEN-3-00-20

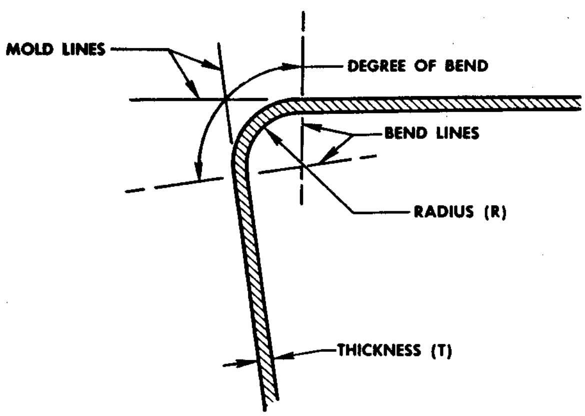
Figure 1-86. Setback Chart

BEND ALLOWANCE CHART

GENERAL

The empirical formula for finding the bend allowance of material required for a bend = (0.01743 × radius) × (0.0078 × thickness)

This equals the material required for one degree of bend.



1 Multiply the numbers in the table by the degrees of bend to determine the amount of material required for the bend.

Example:
95 deg bend, 1/8 in. radius, 0.040 in. material
0.00249 × 95 = 0.2365 in.

2 For bends larger than one inch radius, the amount of material required for the bend is calculated as the arc of a circle, the radius of which is taken to the center of the material.

Example:
90 deg bend, 1 in. radius, 0.064 in. material.
Radius to center of material = bend radius (1 in.) + 1/2 material thickness = 1 + 0.032 = 1.032 in.

$$\text{Circumference of arc} = \frac{2\ \pi\ R \times \text{degree of bend}}{360\ \text{(total degrees in circle)}}$$

BEND ALLOWANCE COEFFICIENTS FOR ALUMINUM ALLOYS, BASED ON ONE-DEGREE ANGLE

RADII	METAL THICKNESS											
	0.016	0.020	0.022	0.025	0.032	0.040	0.050	0.063	0.080	0.090	0.125	0.180
1/32	0.00067	0.00070	0.00072	0.00074	0.00079	0.00086	0.00094	0.00104	0.00117	0.00125	0.00154	0.00200
1/16	0.00121	0.00125	0.00126	0.00129	0.00135	0.00140	0.00149	0.00159	0.00171	0.00180	0.00209	0.00255
3/32	0.00176	0.00179	0.00180	0.00183	0.00188	0.00195	0.00203	0.00213	0.00226	0.00234	0.00263	0.00309
1/8	0.00230	0.00234	0.00235	0.00238	0.00243	0.00249	0.00258	0.00268	0.00281	0.00289	0.00317	0.00364
5/32	0.00285	0.00288	0.00290	0.00292	0.00297	0.00304	0.00312	0.00322	0.00335	0.00343	0.00372	0.00418
3/16	0.00339	0.00342	0.00344	0.00347	0.00352	0.00358	0.00367	0.00377	0.00390	0.00398	0.00426	0.00473
7/32	0.00394	0.00397	0.00398	0.00401	0.00406	0.00412	0.00421	0.00431	0.00444	0.00452	0.00481	0.00527
1/4	0.00448	0.00451	0.00454	0.00456	0.00461	0.00467	0.00476	0.00486	0.00499	0.00507	0.00535	0.00582
9/32	0.00503	0.00506	0.00507	0.00510	0.00515	0.00521	0.00530	0.00540	0.00553	0.00561	0.00590	0.00636
5/16	0.00557	0.00560	0.00562	0.00564	0.00570	0.00576	0.00584	0.00595	0.00608	0.00616	0.00644	0.00691
11/32	0.00612	0.00615	0.00616	0.00619	0.00624	0.00630	0.00639	0.00649	0.00662	0.00670	0.00699	0.00745
3/8	0.00666	0.00669	0.00671	0.00673	0.00679	0.00685	0.00693	0.00704	0.00717	0.00725	0.00753	0.00800
13/32	0.00721	0.00724	0.00725	0.00728	0.00733	0.00739	0.00748	0.00758	0.00771	0.00779	0.00808	0.00854
7/16	0.00775	0.00778	0.00780	0.00782	0.00787	0.00794	0.00802	0.00812	0.00826	0.00834	0.00862	0.00908
15/32	0.00829	0.00833	0.00834	0.00837	0.00842	0.00848	0.00857	0.00867	0.00880	0.00888	0.00917	0.00963
1/2	0.00884	0.00887	0.00889	0.00891	0.00896	0.00903	0.00911	0.00921	0.00935	0.00943	0.00971	0.01017
17/32	0.00938	0.00942	0.00943	0.00946	0.00951	0.00957	0.00966	0.00976	0.00989	0.00997	0.01025	0.01072
9/16	0.00993	0.00996	0.00998	0.01000	0.01005	0.01012	0.01020	0.01030	0.01043	0.01051	0.01080	0.01126
19/32	0.01047	0.01051	0.01052	0.01055	0.01058	0.01065	0.01073	0.01083	0.01098	0.01105	0.01133	0.01179
5/8	0.01102	0.01105	0.01107	0.01109	0.01114	0.01121	0.01129	0.01139	0.01152	0.01160	0.01189	0.01235
21/32	0.01156	0.01160	0.01161	0.01164	0.01170	0.01175	0.01183	0.01193	0.01207	0.01214	0.01245	0.01289
11/16	0.01211	0.01214	0.01216	0.01218	0.01223	0.01230	0.01238	0.01248	0.01261	0.01269	0.01298	0.01344
23/32	0.01265	0.01268	0.01269	0.01273	0.01276	0.01283	0.01291	0.01301	0.01316	0.01322	0.01351	0.01397
3/4	0.01320	0.01323	0.01324	0.01327	0.01332	0.01338	0.01347	0.01357	0.01370	0.01378	0.01407	0.01453
25/32	0.01374	0.01378	0.01379	0.01381	0.01386	0.01392	0.01401	0.01411	0.01425	0.01432	0.01461	0.01507
13/16	0.01429	0.01432	0.01433	0.01436	0.01441	0.01447	0.01456	0.01466	0.01479	0.01487	0.01516	0.01562
27/32	0.01483	0.01486	0.01487	0.01490	0.01494	0.01501	0.01509	0.01519	0.01534	0.01540	0.01569	0.01615
7/8	0.01538	0.01541	0.01542	0.01545	0.01550	0.01556	0.01565	0.01575	0.01588	0.01596	0.01625	0.01671
29/32	0.01592	0.01595	0.01596	0.01599	0.01604	0.01610	0.01619	0.01629	0.01643	0.01650	0.01679	0.01727
15/16	0.01646	0.01650	0.01651	0.01654	0.01659	0.01665	0.01674	0.01684	0.01697	0.01705	0.01734	0.01780
31/32	0.01701	0.01704	0.01705	0.01708	0.01712	0.01718	0.01727	0.01737	0.01752	0.01758	0.01787	0.01833
1	0.01755	0.01759	0.01760	0.01763	0.01768	0.01774	0.01783	0.01793	0.01806	0.01814	0.01843	0.01888

GEN-3-00-19

Figure 1-87. Bend Allowance Chart

MINIMUM BEND RADII TABLES

GENERAL

THICKNESS	ALUMINUM ALLOYS			
	2024-0	2024-T4	7075-0	7075-T6
0.020	1/32	1/16	1/16	1/8
0.025	1/16	1/16	1/16	1/8
0.032	1/16	3/32	1/16	1/8
0.040	1/16	3/32	1/16	3/16
0.050	1/16	1/8	3/32	1/4
0.063	3/32	5/32	3/32	5/16
0.071	1/8	7/32	5/32	3/8
0.080	1/8	1/4	3/16	7/16
0.090	1/8	9/32	1/4	1/2
0.100	5/32	11/32	5/16	9/16
0.125	3/16	7/16	11/32	3/4

THICKNESS	STEEL				TITANIUM‡	
	4130*		CORROSION-RESISTANT		PURE	ALLOY
	NORMALIZED	ANNEALED	ANNEALED	1/2 HARD	AMS—4900	AMS—4908
0.020	1/16	1/16	1/32	1/16	1/16	
0.025	1/16	1/16	1/32	1/16	3/32	3/32
0.032	1/8	1/16	1/32	1/16	1/8	1/8
0.036	1/8	3/32	1/16	1/8	1/8	1/8
0.040	1/8	3/32	1/16	1/8	1/8	1/8
0.050	1/8	3/32	1/16	1/8	5/32	5/32
0.063	1/8	3/32	1/16	1/8	3/16	3/16
0.080	5/32	3/32	3/32	3/16	9/32	9/32
0.090	3/16	3/32	3/32	3/16	5/16	5/16
0.112	1/4	1/8	1/8	1/4	13/32	13/32
0.125	1/4	1/8	1/8	1/4	7/16	7/16
0.190	3/8	3/16	3/16			
0.250	1/2	1/4	1/4			
OVER 0.250	2-1/2 T†	1-1/2 T†	2T†		3-1/2 T†	3-1/2 T†

*For normalized 4130 steel, bend radii equal to thickness may be obtained by heat forming. Material must be reheat-treated to normalized condition after forming.

†T = Material thickness

‡It is recommended that larger bend radii be used where possible. If forming difficulty is encountered, heat forming may be used. (Refer to index for titanium.)

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Figure 1-88. Minimum Bend Radii

TAP DRILLS AND DECIMAL EQUIVALENTS

GENERAL

TAP DRILL SIZES

NC Coarse Thread SCREW SIZE	NC Coarse Thread TAP DRILL	NF Fine Thread SCREW SIZE	NF Fine Thread TAP DRILL
7/16-14	U	7/16-20	25/64
1/2-13	27/64	1/2-20	29/64
9/16-12	31/64	9/16-18	33/64
5/8-11	17/32	5/8-18	37/64
11/16-11	19/32	11/16-11	5/8
3/4-10	21/32	3/4-16	11/16
13/16-10	23/32	7/8-14	13/16
7/8- 9	49/64	1 -14	15/16
15/16- 9	53/64	1-1/8-12	1-3/64
1 - 8	7/8	1-1/4-12	1-11/64
1-1/8- 7	63/64	1-1/2-12	1-27/64
1-1/4- 7	1-7/64		
1-1/2- 6	1-11/32		

MACHINE SCREW

SCREW SIZE	DRILLS FOR TAP	DRILLS FOR CLEARANCE
2 -56	No. 50	No. 43
3 -48	No. 47	No. 40
4 -40	No. 43	No. 32
6 -32	No. 36	No. 28
8 -32	No. 29	No. 19
10 -24	No. 25	No. 10
10 -32	No. 21	No. 10
12 -24	No. 16	7/32
1/4 -20	No. 7	1/4
1/4 -28	No. 3	1/4
5/16 -18	F	5/16
5/16 -24	I	5/16
3/8 -16	5/16	3/8
3/8 -24	Q	3/8

PIPE

DIAMETER OF TAP	DRILLS FOR TAP	DRILLS FOR CLEARANCE
1/8- 27	11/32	7/16
1/4- 18	7/16	7/16
3/8- 18	37/64	3/4
1/2- 14	23/32	7/8
3/4- 14	59/64	1-3/16
1 -11-1/2	1- 5/32	1-7/16
1-1/4-11-1/2	1- 1/2	1-3/4
1-1/2-11-1/2	1-47/64	2
2 -11-1/2	2- 7/32	2-1/2
2-1/2- 8	2- 5/8	3
3 - 8	3- 1/4	3-3/4
3-1/2- 8	3- 3/4	4-1/4
4 - 8	4- 1/4	4-3/4

DECIMAL EQUIVALENTS

NUMBER, LETTER, AND FRACTIONAL SIZE DRILLS

SIZE DRILL	DECI-MAL	SIZE DRILL	DECI-MAL	SIZE DRILL	DECI-MAL
80	0.0135	1/8	0.1250	21/64	0.3281
79	0.0145	30	0.1285	Q	0.3320
1/64	0.0156	29	0.1360	R	0.3390
78	0.0160	28	0.1405	11/32	0.3437
77	0.0180	9/64	0.1406	S	0.3480
76	0.0200	27	0.1440	T	0.3580
75	0.0210	26	0.1470	23/64	0.3594
74	0.0225	25	0.1495	U	0.3680
73	0.0240	24	0.1520	3/8	0.3750
72	0.0250	23	0.1540	V	0.3770
71	0.0260	5/32	0.1562	W	0.3860
70	0.0280	22	0.1570	25/64	0.3906
69	0.0292	21	0.1590	X	0.3970
68	0.0310	20	0.1610	Y	0.4040
1/32	0.0313	19	0.1660	13/32	0.4062
67	0.0320	18	0.1695	Z	0.4130
66	0.0330	11/64	0.1719	27/64	0.4219
65	0.0350	17	0.1730	7/16	0.4375
64	0.0360	16	0.1770	29/64	0.4531
63	0.0370	15	0.1800	15/32	0.4687
62	0.0380	14	0.1820	31/64	0.4843
61	0.0390	13	0.1850	1/2	0.5000
60	0.0400	3/16	0.1875	33/64	0.5156
59	0.0410	12	0.1890	17/32	0.5312
58	0.0420	11	0.1910	35/64	0.5469
57	0.0430	10	0.1935	9/16	0.5625
56	0.0465	9	0.1960	37/64	0.5781
3/64	0.0469	8	0.1990	19/32	0.5937
55	0.0520	7	0.2010	39/64	0.6094
54	0.0550	13/64	0.2031	5/8	0.6250
53	0.0595	6	0.2040	41/64	0.6406
1/16	0.0625	5	0.2055	21/32	0.6562
52	0.0635	4	0.2090	43/64	0.6719
51	0.0670	3	0.2130	11/16	0.6875
50	0.0700	1/32	0.2187	45/64	0.7031
49	0.0730	2	0.2210	23/32	0.7187
48	0.0760	1	0.2280	47/64	0.7344
5/64	0.0781	A	0.2340	3/4	0.7500
47	0.0785	15/64	0.2344	49/64	0.7656
46	0.0810	B	0.2380	25/32	0.7812
45	0.0820	C	0.2420	51/64	0.7969
44	0.0860	D	0.2460	13/16	0.8125
43	0.0890	1/4	0.2500	53/64	0.8281
42	0.0935	F	0.2570	27/32	0.8437
3/32	0.0937	G	0.2610	55/64	0.8594
41	0.0960	17/64	0.2656	7/8	0.8750
40	0.0980	H	0.2660	57/64	0.8906
39	0.0995	I	0.2720	29/32	0.9062
38	0.1015	J	0.2770	59/64	0.9219
37	0.0140	K	0.2811	15/16	0.9375
36	0.0165	9/32	0.2812	61/64	0.9531
7/64	0.1093	L	0.2900	31/32	0.9687
35	0.1100	M	0.2950	63/64	0.9844
34	0.1110	19/64	0.2968	1	1.000
33	0.1130	N	0.3020		
32	0.1160	5/16	0.3125		
31	0.1200	O	0.3160		
		P	0.3230		

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Figure 1-89. Tap Drill Sizes and Decimal Equivalents

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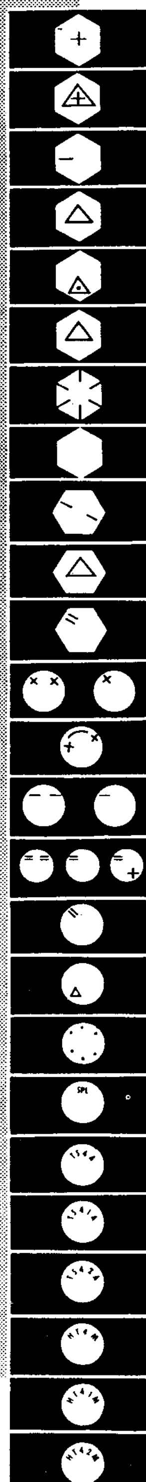
BOLT HEAD IDENIFICATION

GENERAL

NOTE The head slots have been left off the screw and boltheads for clarity.

The figure "1" after the figure indicating the diameter of both Hi-Torque and Torq-Set bolts indicates that the screw is 0.015 inch oversize, and the figure "2" after the figure indicating the diameter indicates that the bolt is 0.031 inch oversize.



STEEL ALLOY BOLT	125,000 TO 145,000 PSI
CLOSE-TOLERANCE STEEL ALLOY BOLT	125,000 TO 145,000 PSI
CORROSION-RESISTANT STEEL AN OR NAS BOLT	
CLOSE-TOLERANCE CORROSION-RESISTANT STEEL AN OR NAS BOLT (INACTIVE FOR NEW DESIGN)	
CLOSE-TOLERANCE ALUMINUM ALLOY BOLT	160,000 TO 180,000 PSI
CLOSE-TOLERANCE SHANK AND/OR HEAD HIGH-STRENGTH NAS BOLT	
CLOSE-TOLERANCE SHANK AND/OR HEAD (ROCKWELL HARDNESS C28-34)	130,000 PSI
STEEL ALLOY MEDIUM CARBON	
INDICATES THREADS HAVE BEEN ROLLED ON AFTER HEAT TREATMENT	
ALUMINUM ALLOY OR NAS BOLT (INACTIVE FOR NEW DESIGN)	
HIGH-STRENGTH BRONZE AN BOLT	85,000 PSI
STEEL AN OR NAS SCREWS	125,000 TO 145,000 PSI
FULL-STRENGTH STEEL AND SCREW	125,000 TO 145,000 PSI
CORROSION-RESISTANT STEEL AN SCREW	
HIGH-STRENGTH BRONZE NAS SCREW	85,000 PSI
STEEL LOCKING AN OR NAS SCREW	85,000 PSI
CLOSE-TOLERANCE NAS 333 SERIES	160,000 PSI
SELF-LOCKING AN OR NAS SCREWS	
SPECIAL SCREW WITH HEAD TOO SMALL TO STAMP COMPLETE NUMBER UPON IT	
1/4 DIA TORQ-SET SCREW	160,000 TO 180,000 PSI
1/4 DIA TORQ-SET SCREW (0.015 OVERSIZE)	160,000 TO 180,000 PSI
1/4 DIA TORQ-SET SCREW (0.031 OVERSIZE)	160,000 TO 180,000 PSI
1/4 DIA HI-TORQUE SCREW	160,000 TO 180,000 PSI
1/4 DIA HI-TORQUE SCREW (0.015 OVERSIZE)	160,000 TO 180,000 PSI
1/4 DIA HI-TORQUE SCREW (0.031 OVERSIZE)	160,000 TO 180,000 PSI

F-86K-3-00-41

Figure 1-89A. Bolthead Identification

TORQUE TABLE

GENERAL

The torque table is to be used as a guide in tightening nuts, bolts, and screws whenever specific torque values are not called out in maintenance procedures. Using the proper torque allows the structure to develop its designed strength and greatly reduces the possibility of failure due to fatigue. There are a few items you should be aware of when using this table:

1 To convert to foot-pounds, divide inch-pounds by 12.

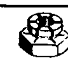
2 Threads must be free from grease or oil. Lubrication changes the torque value and will result in overtorquing.

3 When castellated nuts are used, tighten them to the lower torque limit. Then continue tightening until cotter pin hole is aligned with slots in nut. Do not back off nut to align hole.

4 When it is necessary to tighten from the bolthead, use the high side of the torque range. If necessary, the maximum allowable tightening torque may be used.

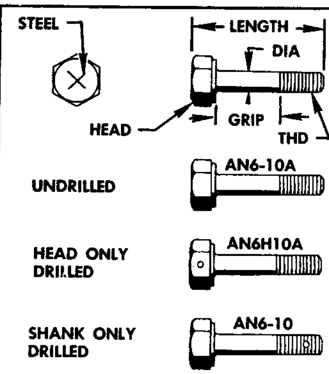
5 When corrosion-resistant steel bolts are used, they should be lubricated with an anti-seize compound. Corrosion-resistant steel bolts and nuts must be used together. Use shear nut torque values when tightening these bolts.

HEX NUTS

AN. NUMBER AND DESCRIPTION	STEEL CAD PLATED	STEEL CAD PLATED	CORR RESISTANT STEEL	STEEL CAD PLATED	CORR RESISTANT STEEL
AN363 REG HEIGHT 550°F MAX					
AN363C REG HEIGHT 800°F MAX					
AN364 THIN 250°F MAX					
AN365 REG HEIGHT 250°F MAX					
AN320 THIN 250°F MAX					
AN310 REG HEIGHT 250°F MAX					

BOLTS

BASIC NUMBER	DIAMETER	THREADS PER INCH
AN173	10*	32
174	1/4*	28
175	5/16	24
176	3/8	24
177	7/16	20
178	1/2	20
179	9/16	18
180	5/8	18
182	3/4	16
184	7/8	14
186	1	14



*BOLT SHANK SHOULD BE WITHOUT COTTER PIN HOLE WHEN USED WITH SELF-LOCKING NUTS.

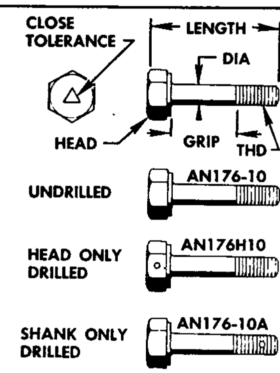
TORQUE VALUES IN INCH-POUNDS

STANDARD NUTS, BOLTS, AND SCREWS

WRENCH SIZE	BOLT, STUD, OR SCREW SIZE	TENSION-TYPE NUTS AN310 AND AN365	SHEAR-TYPE NUTS AN320 AND AN364
11/32	8-36	12 – 15	7 – 9
3/8	10-32	20 – 25	12 – 15
7/16	1/4-28	50 – 70	30 – 40
1/2	5/16-24	100 – 140	60 – 85
9/16	3/8-24	160 – 190	95 – 110
5/8	7/16-20	450 – 500	270 – 300
3/4	1/2-20	480 – 690	290 – 410
7/8	9/16-18	800 – 1000	480 – 600
15/16	5/8-18	1100 – 1300	660 – 780
1-1/16	3/4-16	2300 – 2500	1300 – 1500
1-1/4	7/8-14	2500 – 3000	1500 – 1800
1-7/16	1-14	3700 – 5500	2200 – 3300

CLOSE-TOLERANCE BOLTS

BASIC NUMBER	DIAMETER	THREADS PER INCH
AN3	10*	32
4	1/4*	28
5	5/16	24
6	3/8	24
7	7/16	20
8	1/2	20
9	9/16	18
10	5/8	18
12	3/4	16
14	7/8	14
16	1	14



*BOLT SHANK SHOULD BE WITHOUT COTTER PIN HOLE WHEN USED WITH SELF-LOCKING NUTS.

GEN-3-00-22

Figure 1-90. Torque Table

CIRCUMFERENCES AND AREAS

GENERAL

OF ONE INCH				INCHES OR FEET					
DIAMETER		CIRCUM.	AREA	DIAM.	CIRCUM.	AREA	DIAM.	CIRCUM.	AREA
FRACTION	DECIMAL								
1/64	0.015625	0.04909	0.00019	1	3.1416	0.7854	64	201.06	3216.99
1/32	0.03125	0.09818	0.00077	2	6.2832	3.1416	65	204.20	3318.31
3/64	0.046875	0.14726	0.00173	3	9.4248	7.0686	66	207.35	3421.19
1/16	0.0625	0.19635	0.00306	4	12.5664	12.5664	67	210.49	3525.65
5/64	0.078125	0.24545	0.00479	5	15.7080	19.635	68	213.63	3631.68
3/32	0.09375	0.29452	0.00690	6	18.850	28.274	69	216.77	3739.28
7/64	0.109375	0.34363	0.00939	7	21.991	38.485	70	219.91	3848.45
1/8	0.125	0.39270	0.01227	8	25.133	50.266	71	223.05	3959.19
9/64	0.140625	0.44181	0.01553	9	28.274	63.617	72	226.19	4071.50
5/32	0.15625	0.49087	0.01917	10	31.416	78.540	73	229.34	4185.39
11/64	0.171875	0.53999	0.02320	11	34.558	95.033	74	232.48	4300.84
3/16	0.1875	0.58905	0.02761	12	37.699	113.1	75	235.62	4417.86
13/64	0.203125	0.63817	0.03241	13	40.841	132.73	76	238.76	4536.46
7/32	0.21875	0.68722	0.03758	14	43.982	153.94	77	241.90	4656.63
15/64	0.234375	0.73635	0.04314	15	47.124	176.71	78	245.04	4778.36
1/4	0.25	0.78540	0.04909	16	50.265	201.06	79	248.19	4901.67
17/64	0.265625	0.83453	0.05542	17	53.407	226.98	80	251.33	5026.55
9/32	0.28125	0.88357	0.06213	18	56.549	254.47	81	254.47	5153.
19/64	0.296875	0.93271	0.06922	19	59.690	283.53	82	257.61	5281.02
5/16	0.3125	0.98175	0.07670	20	62.832	314.16	83	260.75	5410.61
21/64	0.328125	1.0309	0.08456	21	65.973	346.36	84	263.89	5541.77
11/32	0.34375	1.0799	0.09281	22	69.115	380.13	85	267.04	5674.50
23/64	0.359375	1.1291	0.10144	23	72.257	415.48	86	270.18	5808.80
3/8	0.375	1.1781	0.11045	24	75.398	452.39	87	273.32	5944.68
25/64	0.390625	1.2273	0.11984	25	78.540	490.87	88	276.46	6082.12
13/32	0.40625	1.2763	0.12962	26	81.681	530.93	89	279.60	6221.14
27/64	0.421875	1.3254	0.13979	27	84.823	572.56	90	282.74	6361.73
7/16	0.4375	1.3744	0.15033	28	87.965	615.75	91	285.88	6503.88
29/64	0.453125	1.4236	0.16126	29	91.106	660.52	92	289.03	6647.61
15/32	0.46875	1.4726	0.17257	30	94.248	706.86	93	292.17	6792.91
31/64	0.484375	1.5218	0.18427	31	97.389	754.77	94	295.31	6939.78
1/2	0.5	1.5708	0.19635	32	100.53	804.25	95	298.45	7088.22
33/64	0.515625	1.6199	0.20880	33	103.67	855.30	96	301.59	7238.23
17/32	0.53125	1.6690	0.22166	34	106.81	907.92	97	304.73	7389.81
35/64	0.546875	1.7181	0.23489	35	109.96	962.11	98	307.88	7542.96
9/16	0.5625	1.7671	0.24850	36	113.10	1017.88	99	311.02	7697.69
37/64	0.578125	1.8163	0.26248	37	116.24	1075.21	100	314.16	7853.98
19/32	0.59375	1.8653	0.27688	38	119.38	1134.11	101	317.30	8011.85
39/64	0.609375	1.9145	0.29164	39	122.52	1194.59	102	320.44	8171.28
5/8	0.625	1.9635	0.30680	40	125.66	1256.64	103	323.58	8332.29
41/64	0.640625	2.0127	0.32232	41	128.81	1320.25	104	326.73	8494.87
21/32	0.65625	2.0617	0.33824	42	131.95	1385.44	105	329.87	8659.01
43/64	0.671875	2.1108	0.35453	43	135.09	1452.20	106	333.01	8824.73
11/16	0.6875	2.1598	0.37122	44	138.23	1520.53	107	336.15	8992.02
45/64	0.703125	2.2090	0.38828	45	141.37	1590.43	108	339.29	9160.88
23/32	0.71875	2.2580	0.40574	46	144.51	1661.90	109	342.43	9331.32
47/64	0.734375	2.3072	0.42356	47	147.65	1734.94	110	345.58	9503.32
3/4	0.75	2.3562	0.44179	48	150.80	1809.56	111	348.72	9676.89
49/64	0.765625	2.4054	0.46038	49	153.94	1885.74	112	351.86	9852.03
25/32	0.78125	2.4544	0.47937	50	157.08	1963.50	113	355.	10028.75
51/64	0.796875	2.5036	0.49872	51	160.22	2042.82	114	358.14	10207.03
13/16	0.8125	2.5525	0.51849	52	163.36	2123.72	115	361.28	10386.89
53/64	0.828125	2.6017	0.53862	53	166.50	2206.18	116	364.42	10568.32
27/32	0.84375	2.6507	0.55914	54	169.65	2290.22	117	367.57	10751.32
55/64	0.859375	2.6999	0.58003	55	172.79	2375.83	118	370.71	10935.88
7/8	0.875	2.7489	0.60132	56	175.93	2463.01	119	373.85	11122.02
57/64	0.890625	2.7981	0.62298	57	179.07	2551.76	120	376.99	11309.73
29/32	0.90625	2.8471	0.64504	58	182.21	2642.08	121	380.13	11499.01
59/64	0.921875	2.8959	0.66748	59	185.35	2733.97	122	383.27	11689.87
15/16	0.9375	2.9452	0.69029	60	188.50	2827.43	123	386.42	11882.29
61/64	0.953125	2.9945	0.71349	61	191.64	2922.47	124	389.56	12076.28
31/32	0.96875	3.0434	0.73708	62	194.78	3019.07	125	392.70	12271.85
63/64	0.984375	3.0928	0.76097	63	197.92	3117.25	126	395.84	12468.98

Diameter multiplied by 3.1416 circumference. Circumference multiplied by 0.3183 diameter.
Square of the diameter multiplied by 0.7854 area.

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Figure 1-90A. Circumference Chart

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SHOP MATHEMATICS

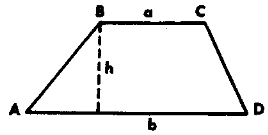
GENERAL

PLANE FIGURES

TRAPEZOID
(a parallel to b)

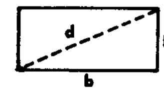
AREA $= \frac{(a+b)}{2} h$

(h is perpendicular to a and b)



RECTANGLE
AREA $= bh$

DIAGONAL $d = \sqrt{b^2 + h^2}$



CIRCLE
CIRCUMFERENCE $= \pi d$

$= 2\pi r$

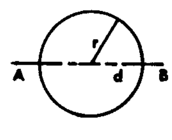
$\left(\pi = \frac{\text{circumference}}{\text{diameter}}\right)$

AREA $= \pi r^2$

$= \frac{\pi}{4} d^2$

$= 0.7854 d^2$

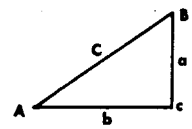
$\pi = 3.1416$



RIGHT TRIANGLE
AREA $= \frac{ba}{2}$

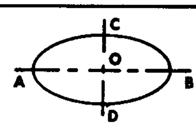
HYPOTENUSE $= c = \sqrt{a^2 + b^2}$

$A + B + C = 180$ degrees



ELLIPSE
AREA $= \pi (OA) \times (OC)$

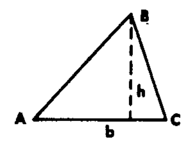
$= \frac{\pi}{4} (AB) \times (CD)$



ANY TRIANGLE
AREA $= \frac{bh}{2}$

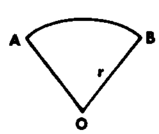
(h is perpendicular to b)

$A + B + C = 180$ degrees



SECTOR
AREA $= \frac{r(\text{arc } AB)}{2}$

$= \frac{\pi r^2 (\text{angle } AOB)}{360 \text{ degrees}}$

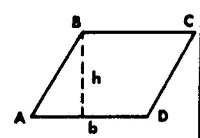


PARALLELOGRAM
(opposite sides parallel)

AREA $= bh$

(h is perpendicular to b)

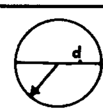
$A + B + C + D = 360$ degrees



SOLID FIGURES

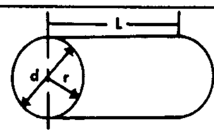
SPHERE
VOLUME $= \frac{4}{3} \pi r^3 = \pi \frac{d^3}{6}$

AREA $= 4\pi r^2 = \pi d^2$



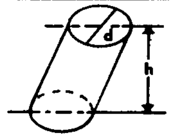
CYLINDER
VOLUME $= \pi r^2 L = 0.7854 d^2 L$

AREA OF CYLINDRICAL SURFACE $= \pi DL$



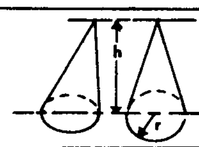
CYLINDER
VOLUME $=$ (area base) h

AREA OF CYLINDRICAL SURFACE $=$ (perimeter base) h



CONE
VOLUME (OF EITHER) $= \frac{1}{3} \pi r^2 h$

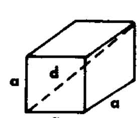
AREA (OF RIGHT CONE) $= \pi rs$



CUBE
VOLUME $= a^3$

DIAGONAL $= d = a\sqrt{3}$

TOTAL AREA $= 6a^2$

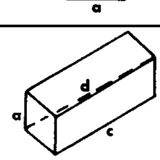


RECTANGULAR PRISM
VOLUME $=$ (area of end) C

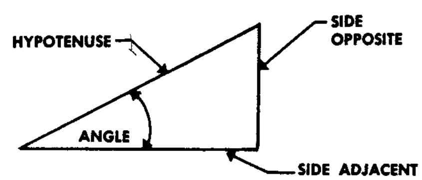
$= abc$

DIAGONAL $= d = \sqrt{a^2 + b^2 + c^2}$

TOTAL AREA $= 2(ab + bc + ca)$



FUNCTIONS OF ANGLES



SINE $= \frac{\text{Side Opposite}}{\text{Hypotenuse}}$ COSINE $= \frac{\text{Side Adjacent}}{\text{Hypotenuse}}$

TANGENT $= \frac{\text{Side Opposite}}{\text{Side Adjacent}}$ COTANGENT $= \frac{\text{Side Adjacent}}{\text{Side Opposite}}$

SECANT $= \frac{\text{Hypotenuse}}{\text{Side Adjacent}}$ COSECANT $= \frac{\text{Hypotenuse}}{\text{Side Opposite}}$

CONVERSION OF FRACTION TO DECIMAL

To convert fraction to decimal . . . .

Divide numerator (top) by denominator (bottom)

Example: ⅝

$$\begin{array}{r} 0.625 \\ 8\overline{)5.000} \\ 4\,8 \\ \hline 20 \\ 16 \\ \hline 40 \\ 40 \\ \hline 0 \end{array}$$

$\frac{5}{8} = 0.625$

GEN-3-00-24

Figure 1-91. Shop Mathematics

SECTION II

WING GROUP

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DESCRIPTION OF WING.

The wing is a full cantilever, swept-back wing of all-metal semimonocoque design. The wing is a two-spar structure of two outer panels and a center section. The primary bending and shear structure is the single-cell box sections. There are fuel cells in the wing center and outer panels. In the fuel cell bays, a double skin is used with stringers separating the inner and outer skin. On the wing outer panels, a single-skin structure is used outboard of station 126. The wing skins are tapered spanwise. All external skin riveting is dimpled or machine countersunk flush types.

The landing gear trunnion is attached directly to the rear spar at station 96, and with a side brace at station 112. The trunnion fitting transmits the landing gear loads to the wing.

LEADING EDGE AND SLATS.

The leading edge is a removable assembly attached to the front spar. A broached extrusion hinge joins the leading edge to the hinge section attached to front spar. The leading edge assembly is constructed with a double skin which forms ducts for surface anti-icing.

There are four leading edge slat sections on each wing. Each slat section is attached to slat tracks at two places. The slat tracks are bolted to the slats and run through rollers attached to leading edge structure. The slat sections are flexibly linked together to move in unison without binding.

The slat structure consists of a main spar, chordwise ribs, and a trailing edge strip. The slats are covered by aluminum alloy skin. The spar and leading edge of the slat form a duct to carry heated air for anti-icing the full span of the four slat sections. The top side of the slat is covered with a double skin. The inner skin is dimpled intermittently and the two skins are riveted together at the dimples. The double skin provides anti-icing for slat surfaces. The slat tracks are made from 4137 steel except the track at station 238.75 which is made from beryllium copper.

BOX SECTIONS.

The wing outer panel box section is formed by a front spar, rear spar, skin-stringer cover panels and intermediate ribs. The wing box section carries all bending and shear loads. The wing outer panels attach to a wing center box section. The center box section is formed by a front spar, rear spar, and double-skin upper and lower cover panels. The center box section attaches to the fuselage by four bolts through the corner attach fittings.

TRAILING EDGE.

The wing trailing edge assembly is secondary structure, fairing the wing outer panel box section to the ailerons and flaps. The trailing edge attaches to the rear spar and is not removable as a unit.

FLAPS.

The wing flaps are of all-metal stressed-skin construction, consisting of forward and aft spars, two longitudinal stringers top and bottom, and chordwise ribs. The skin and forward spar cap strips on early model flaps are 7075-T6 alclad sheet. On later models, the skins are 2024-T4. The stringers are 1S151 2024-T4 rolled stock. All ribs are press-formed from 2024-T4 alclad sheet. The trailing edge is magnesium alloy extrusion.

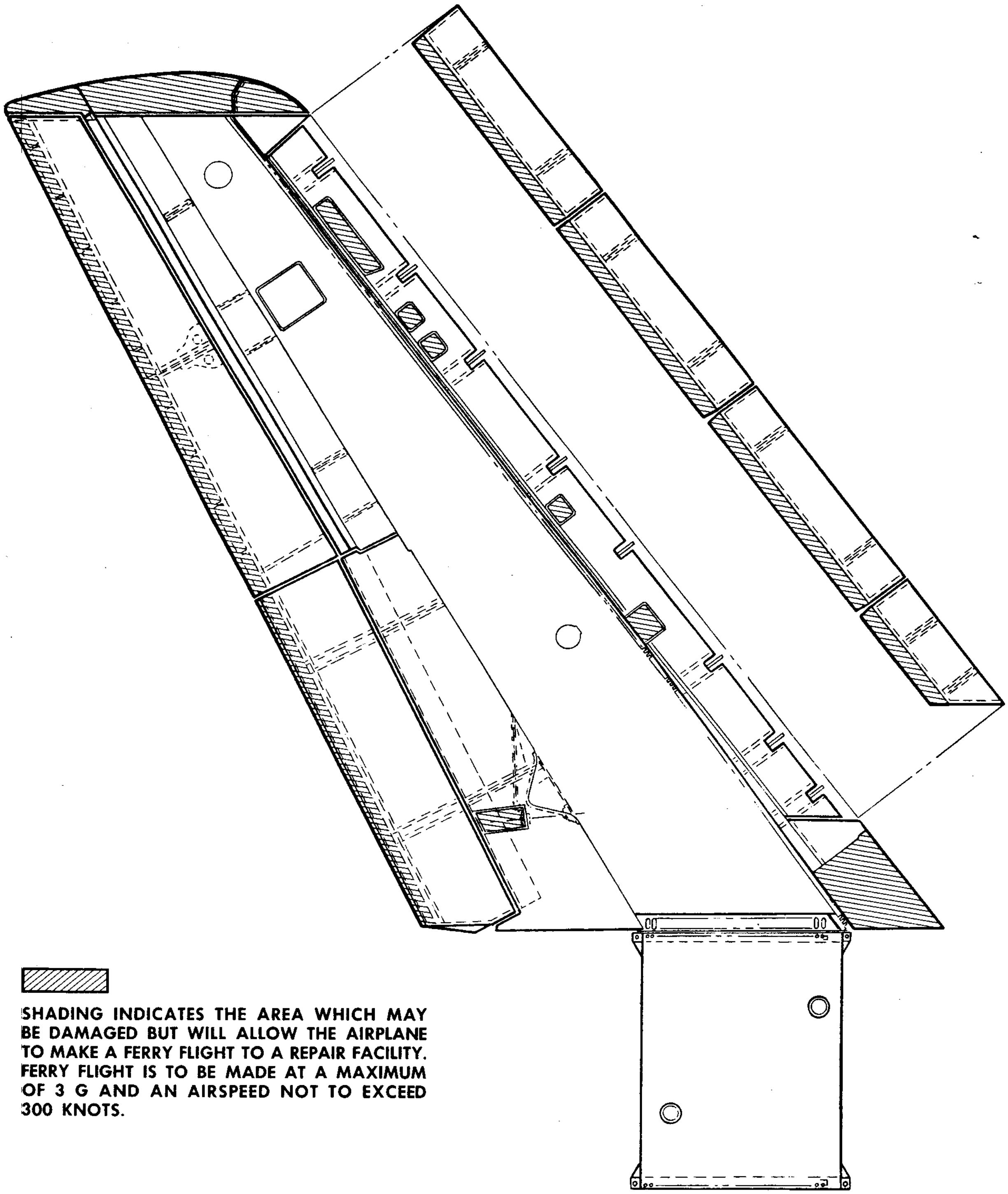
AILERONS.

The ailerons are all-metal, statically and dynamically balanced surfaces, attached to the wing by three anti-friction type bearings. An aerodynamic seal is provided at the leading edge by means of a fabric strip attached from the leading edge (paddle portion) of the aileron to the wing rear spar.

The aileron main spar has caps of 7075-T6 "T" extrusion, with an 0.032 7075-T6 alclad web. The trailing edge is magnesium alloy extrusion. Between the main spar and the trailing edge is a 1S3 2024-T4 stringer on the upper and lower surface. The center hinge fitting is a 2014-T6 aluminum die forging. The ribs forward and aft of the main spar (except the center hinge ribs) are press-formed from 2024-T4 alclad sheet. The center hinge ribs are 7075-T6 alclad sheet. All skins are 0.025 2024-T4 alclad sheet. The tip is 5052-S aluminum alloy sheet.

ONE-TIME FLIGHT

WING



SHADING INDICATES THE AREA WHICH MAY BE DAMAGED BUT WILL ALLOW THE AIRPLANE TO MAKE A FERRY FLIGHT TO A REPAIR FACILITY. FERRY FLIGHT IS TO BE MADE AT A MAXIMUM OF 3 G AND AN AIRSPEED NOT TO EXCEED 300 KNOTS.

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Figure 2-1. One-time Flight

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ONE-TIME FLIGHT.

The one-time flight diagram (figure 2-1) indicates areas of the wing which may be damaged but will permit restricted ferry flight to a repair facility.

REMOVAL OF WING OUTER PANEL LOWER COVER.

The greater portion of the wing box section, from wing station 126 outboard, is a closed-out area. Access to most of the interior of this section is attained only by the removal of the lower skin-stringer cover panel. The outer skin, stringers, and inner skin are a single assembly and may be removed from the box section as one unit. Before the cover can be removed, the following components must be removed as directed in the applicable handbook of the Maintenance Handbook series: wing center section, wing tip, leading edge, aileron, flap, outer wing fuel tank, and landing gear strut. It is possible to remove the cover without removing the landing gear strut. However, the fasteners attaching the inner skin angle to the rear spar will be more readily accessible with the strut removed. Remove the two aileron line access doors on the lower surface and the aileron mechanical access door on the upper surface. Remove aileron actuator cylinder and support.

To prevent distortion, the outer wing panel should be supported in a jig while the lower cover is being removed.

To remove skin-stringer cover assembly, proceed as follows (parts and procedures are identified in figure 2-2):

1. Remove all fasteners attaching either lower inner skin and stringers or lower outer skin to chord angle of rib at wing station 126. Access to this area is through the wing tank bay. Early model wings were made with explosive rivets and AN. bolts through the chord angle into the inner skin. All rivets and AN. bolts must be removed. Access to nuts and AN. bolts is through small holes inboard of rib. Later model wings have AN509 screws extending from the outer skin through the chord angle and Hi-Shear locator pins through the chord angle and into the stringers. Only the AN509 screws need be removed.

2. Remove AN426 AD3 rivets attaching lower trailing edge skin to lower skin in area around landing gear strap.

3. Remove seven NAS338 bolts attaching lower skin to landing gear trunnion fitting.

4. Remove four AN509 screws and two AD3 tack rivets attaching lower skin to jack fitting at wing station 106.7.

5. Remove Hi-Shear rivets, Deutsch blind rivets, and AN509 screws through trailing edge skin, lower skin, and rear spar cap from wing station 58 to wing station 96.

6. Remove riveting access door between wing stations 143 and 152 on front spar.

7. Through access hole, remove all pull rivets attaching inner skin and stringers to chord angles of ribs at wing stations 143 and 152.

8. From the outer surface, remove AN426 AD5 rivets attaching outer skin to clips in three places.

9. At wing stations 215 and 224, remove all AD or explosive rivets attaching skin and stringers to rib flanges, and skin to brackets and stiffeners on rear spar.

10. Remove AN426 AD5 rivets attaching aileron autopilot support to lower skin at wing station 217 (left wing only).

11. Remove explosive rivets attaching lower skin to angle between wing stations 206 and 215.

12. At canted wing station 260.4, remove AN426 AD4 rivets through lower skin and rib angle and AN426 AD5 rivets through lower skin and stringer-to-rib attachment clips.

13. Remove fasteners attaching lower skin to remaining intermediate ribs. Attachment rivets may be either explosive or pull rivets.

14. Remove all Hi-Shear rivets, Deutsch blind rivets, and bolts through lower inner skin attached angles and front and rear spars.

15. Remove all Deutsch blind rivets, Hi-Shear rivets, AD or DD rivets, Jo-bolts, and screws attaching lower skin to front and rear spar caps.

16. Remove lower skin-stringer cover assembly from wing structure. As skin is lifted, check to be sure that all attaching fasteners have been removed.

LEADING EDGE NEGLIGIBLE DAMAGE.

Leading edges and slats may have holes, dents, scratches, and cracks within the limits given in figure 2-5. Care must be taken not to exceed hole limitations in "D" duct area, because of hot-air leakage. Scratches must be held to a minimum. Scratches which penetrate the cladding on alclad sheet should be blended out. Dye penetrant check should be made on scratches to ensure that all damage has been removed. Minor dents may be left without repair. Deep or sharp-cornered dents must be considered major damage. Attempt may be made to bump large smooth dents back to mold line dimensions, provided no sharp edges or wrinkles are evident. All cracks must be stop-drilled and should be evaluated to determine cause. Dye penetrant check may be made after stop-drilling to see if crack extends beyond stop-drill holes.

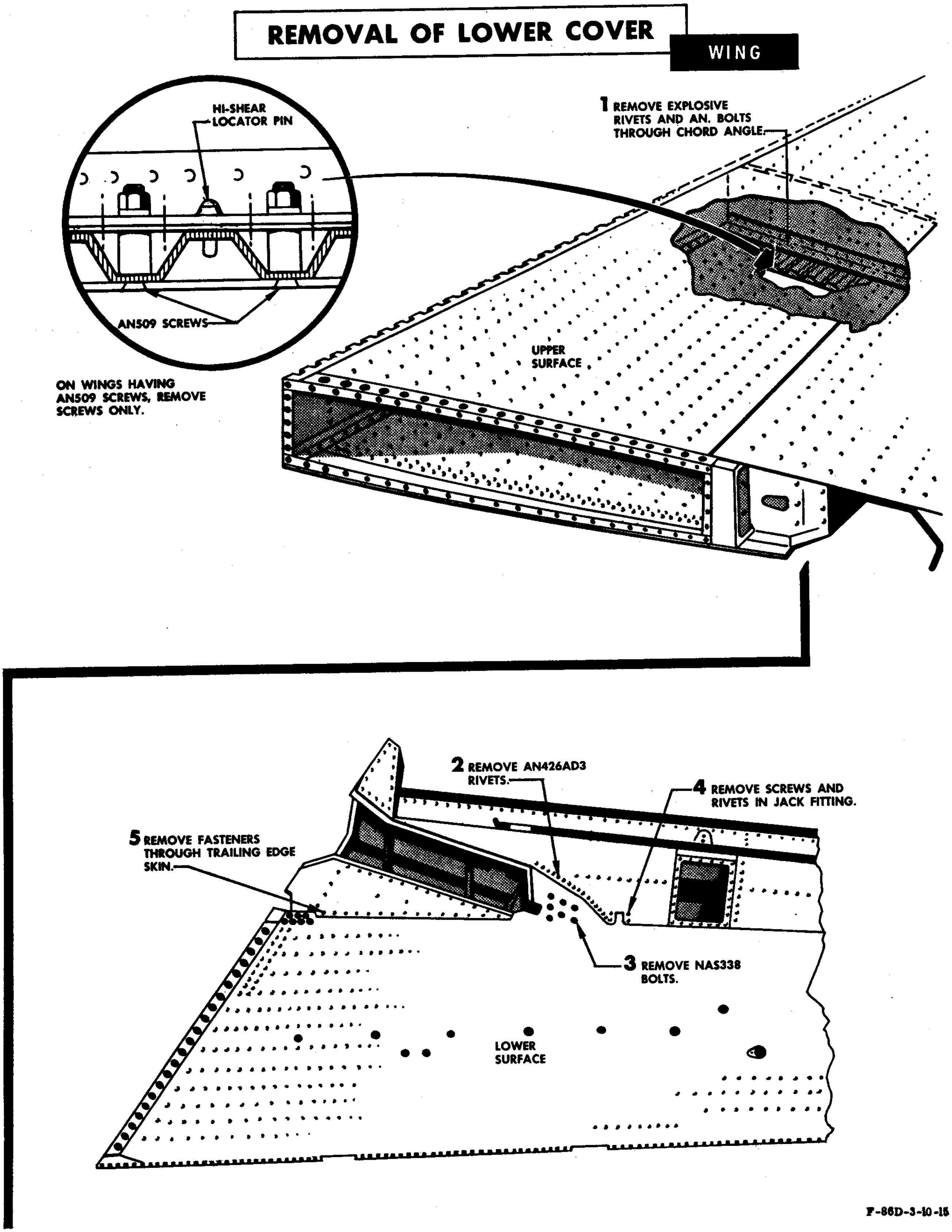

Figure 2-2. Removing Lower Cover of Wing Box Section (Sheet 1 of 5)

REMOVAL OF LOWER COVER

WING

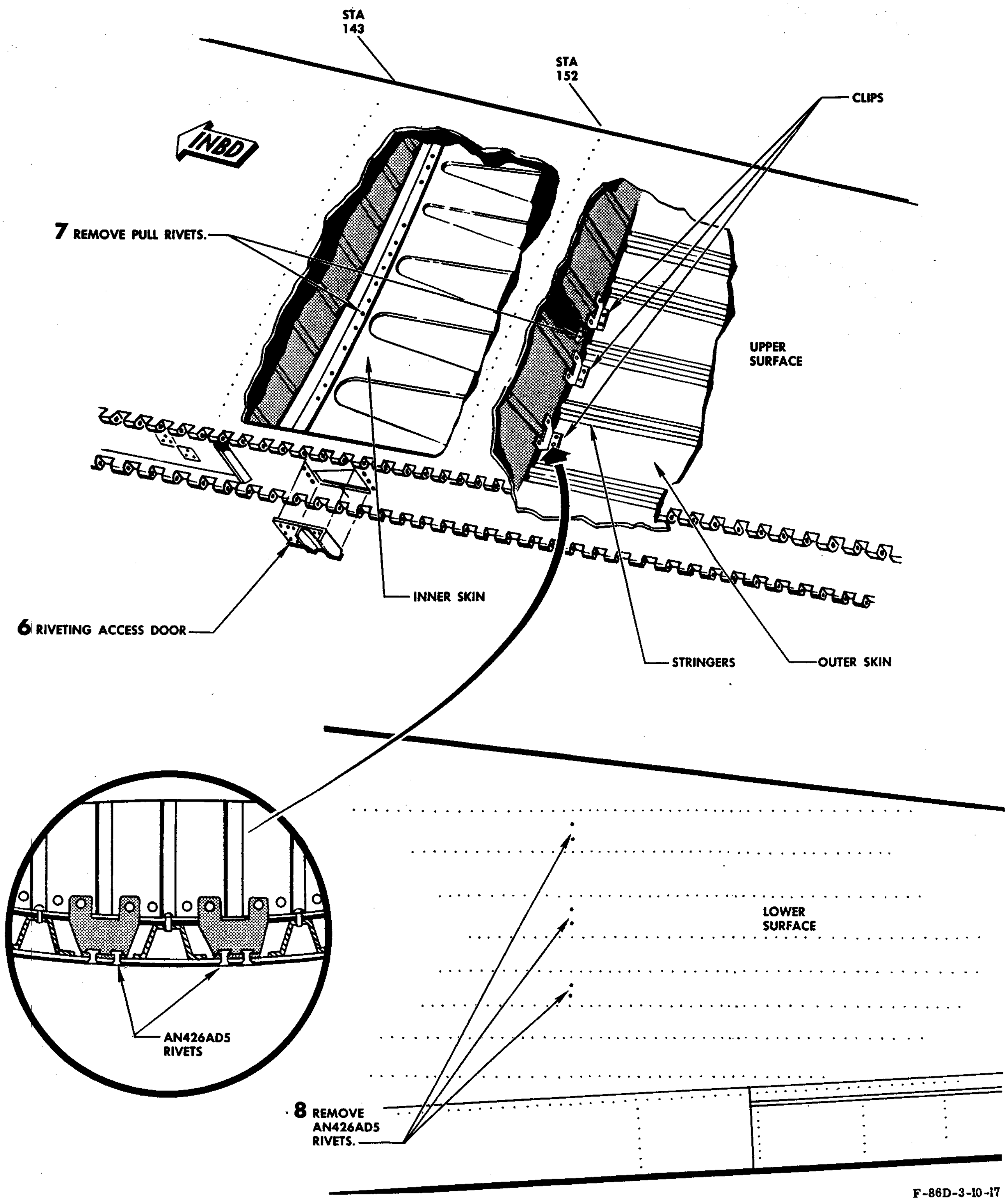

Figure 2-2. Removing Lower Cover of Wing Box Section (Sheet 2 of 5)

REMOVAL OF LOWER COVER

WING

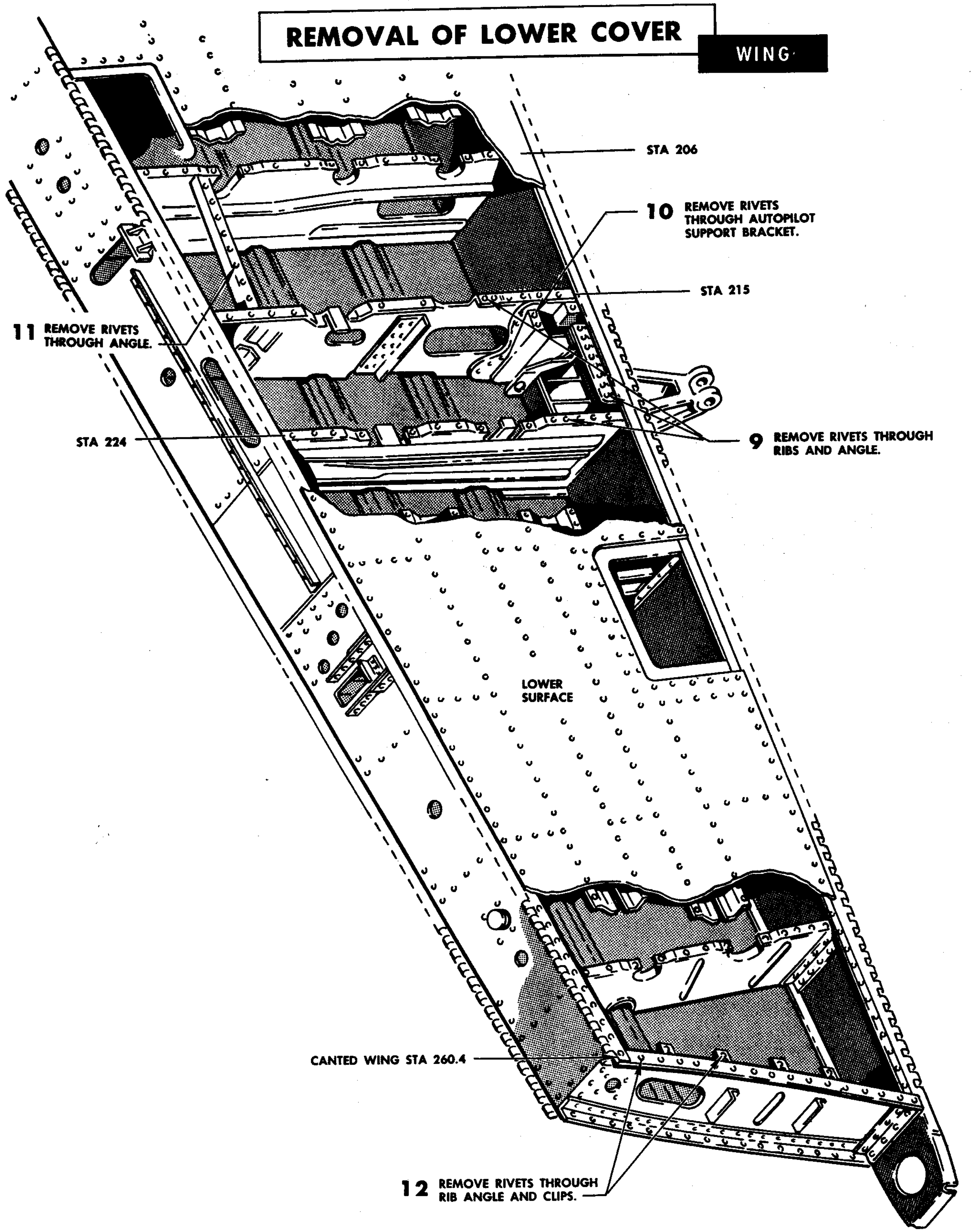

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Figure 2-2. Removing Lower Cover of Wing Box Section (Sheet 3 of 5)

REMOVAL OF LOWER COVER

WING

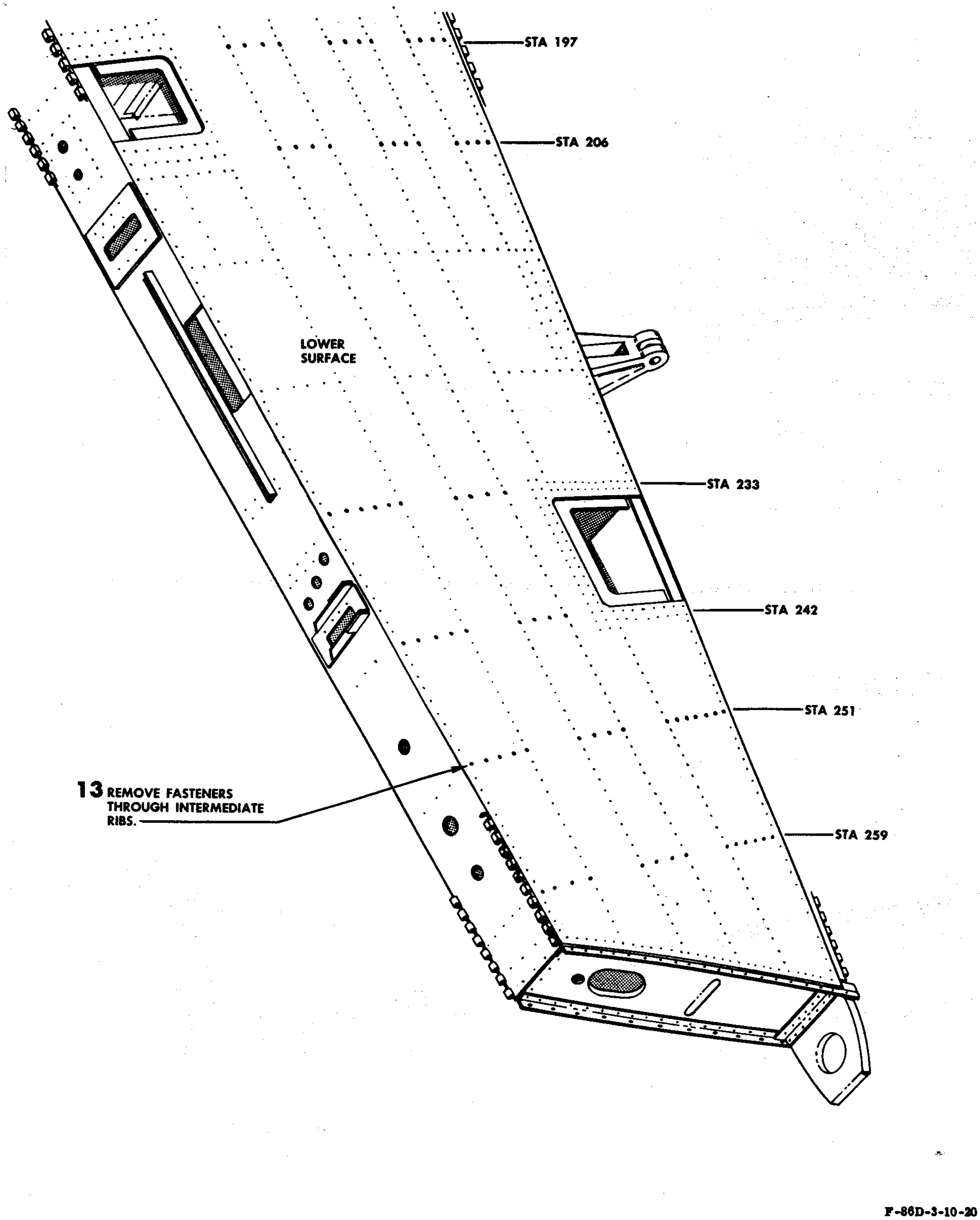
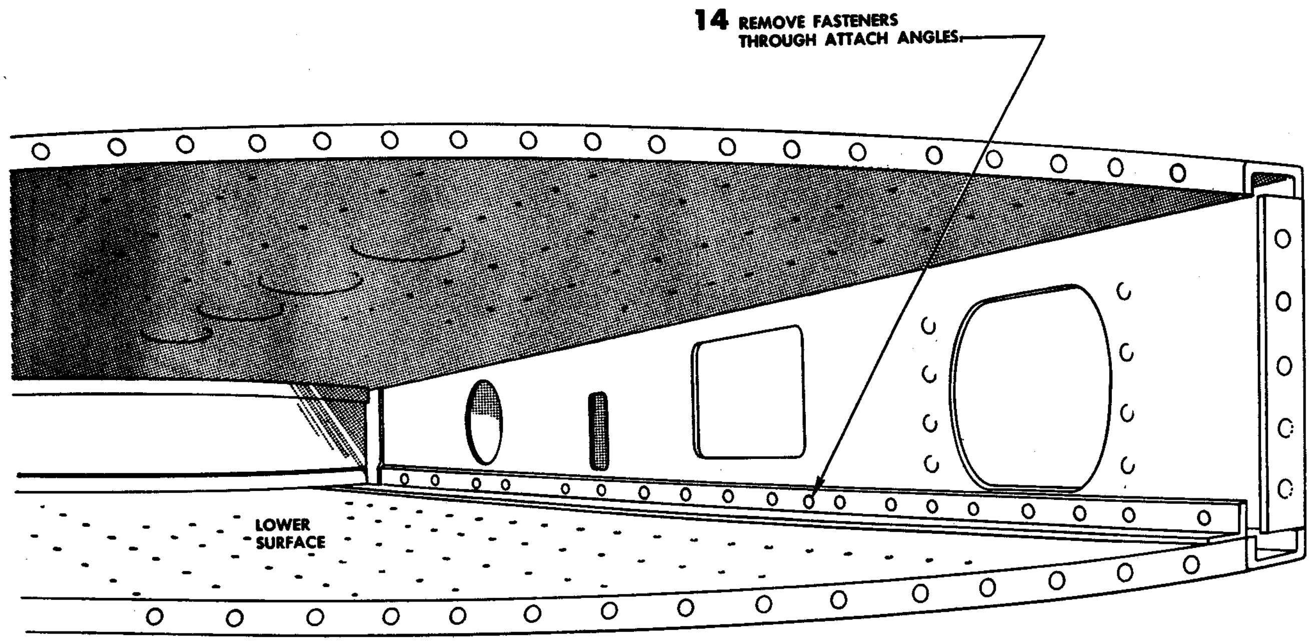


Figure 2-2. Removing Lower Cover of Wing Box Section (Sheet 4 of 5)

REMOVAL OF LOWER COVER

WING



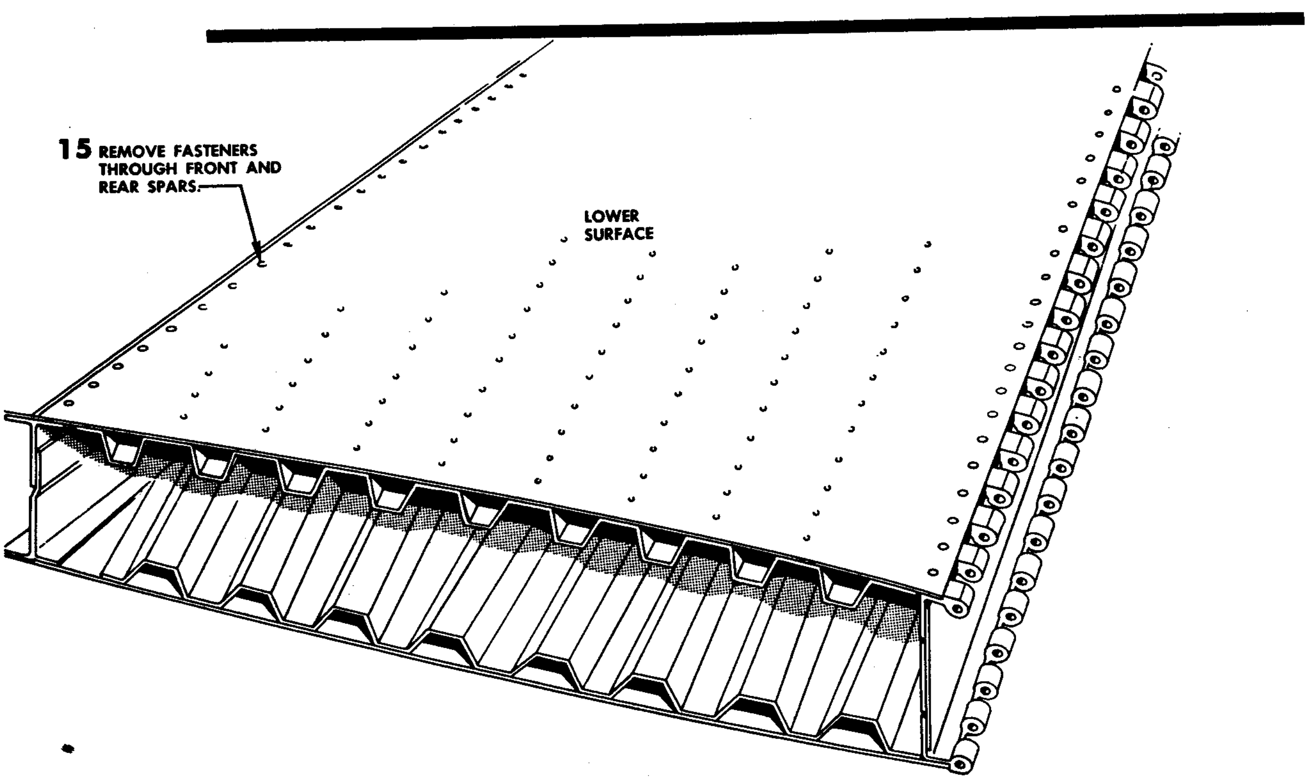


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Figure 2-2. Removing Lower Cover of Wing Box Section (Sheet 5 of 5)

SLAT TRAILING EDGE.

The slat trailing edge (figure 2-9) is an aluminum alloy extrusion and is considered to be secondary structure, aft of skin trim. Ferry flight may be made with damage in this area. Slats must be free and operate without binding before ferry flight is attempted. The clearance between the slat trailing edge and the under leading edge is very small; therefore, all rivets and repair members must be flush with the bottom surface of the extrusion.

LEADING EDGE ANTI-ICING DUCT.

Repairs to the anti-icing duct ("D" duct) must be adequate to ensure hot-air sealing. Figure 2-6 shows both temporary and permanent repairs. Both types of repair must be sealed with HT-23 high-temperature sealing compound. One-time flight may be made with damaged duct by disconnecting and plugging hot-air lines leading to the duct. Permanent repair will require the removal of the duct in the damaged area. When the duct is replaced, all edges must be sealed with HT-23 high-temperature sealing compound. (Refer to index for high-temperature sealing compound application.)

LEADING EDGE HINGE.

Broken hinge lugs on the leading edge (figure 2-7) may be replaced by using a section of scrap hinge or machining a section of hinge from aluminum bar stock, and adding strap repairs. Two broken lugs may be left unrepaired in any 8-inch length, provided they are separated by at least one good lug and are not within 4 inches of any slat track rib. One lug may be broken off within 4 inches of a slat track rib. In areas where lugs are broken, the area must be filed smooth and primed.

CENTER SECTION HINGE.

The center section fairing attachment hinges, both on the door and on the center section, may be repaired by replacing the damaged section. (See figure 2-21.) A new section of hinge may be machined from 7075-T6 bar stock or may be made from a section of scrap hinge. Every third lug may be missing from either hinge as long as the mating hinge has no missing lugs. Two adjacent lugs may be missing as long as there are at least three good lugs on either side and no lugs missing in the mating part. One lug may be missing on mating parts as long as there are at least two good lugs on either side. Areas where lugs are missing must be filed smooth and primed.

WING TIP NEGLIGIBLE DAMAGE.

Wing tips may have holes, scratches, cracks, and dents within the limitations given in figure 2-39. All cracks must be stop-drilled at each end. Attempt may be made to bump large dents back to mold line dimensions, provided there are no sharp edges or wrinkles.

WING SKIN ASSEMBLY NEGLIGIBLE DAMAGE.

Wing outer panel main skins may have holes, scratches, and dents within the limitations given in figure 2-11, sheet 3. No unrepaired cracks are permitted in the wing skins or stringers. All scratches which go through the cladding should be blended out and dye-penetrant checked for cracks.

WING SKIN AT AUXILIARY FUEL TANK PAD.

The holes in the lower wing skin just forward of the rear spar line at about station 138 mate with alignment studs for the auxiliary (drop) fuel tank. Cracks around holes, cracks across an area between holes, and elongated holes may be temporarily repaired. Clean out damage around each hole to a circular shape of ¾-inch diameter. Smooth up edges. (See figure 2-18, sheet 1.) Fabricate external patch plate. Locate and drill holes for screws at rear spar line as shown. Minimum edge distance for these holes is twice the diameter of the fastener. Locate and drill holes for blind fasteners forward of rear spar line. Minimum edge distance for these holes in 5/16 inch. Bevel and crimp edges of patch plate, and round off corners. Install patch plate with screws, using AN960 washers, AN365 nuts, and blind fasteners as shown. Locate and drill holes in patch plate to match tank pad.

To make a permanent repair, trim out damaged area midway between original fasteners at rear spar cap as shown in figure 2-18, sheet 2. Remove as many of original fasteners from skin at spar cap and stringer as necessary to make repair.

Note

This skin is quite thick. It may be difficult to insert repair parts unless enough fasteners are removed.

When cutting out damaged area, protect spar cap by slipping a thin sheet of steel between spar cap and skin. Make large-radius corners in cutout and smooth all edges. Fabricate repair doublers and filler of thickness and dimensions shown in figure 2-18, sheet 3. Locate and drill fastener holes. Pick up original fastener holes at spar cap and stringer. Fastener spacing may be 3/4 inch to one inch. Minimum edge distance for added fasteners is 3/8 inch. Slide repair doublers into place one at a time. Doubler No. 1 picks up the stringer, doubler No. 3 picks up the spar cap, and doubler No. 2 ties doubler No. 1 and doubler No. 3 together. Attach repair doublers with Hi-Shear rivets and screws in original holes at spar cap, Jo-bolts in original holes at stringer, and blind fasteners in added holes. Attach filler with Hi-Shear rivets and screws at spar cap and blind fasteners at doublers. Locate and drill stud holes to match tank pad.

WING TRAILING EDGE NEGLIGIBLE DAMAGE.

Wing trailing edge skins may have scratches and holes within the limitations given in figure 2-25.

FLAP AND AILERON NEGLIGIBLE DAMAGE.

Flaps and ailerons may have cracks, holes, dents, and scratches within the limitations given in figures 2-28 and 2-33. All cracks must be stop-drilled at both ends. Cracks in the skins which start from rivets must not exceed two adjacent rivets with skin cracks or must not have more than two rivets with skin cracks in any eight adjacent rivets. Cleaned-out holes must be smooth and have no sharp edges or corners. Dents must be smooth with no wrinkles. All deep scratches must be blended out.

HOLDING FIXTURE DIMENSIONS.

Figures 2-41 through 2-44 show the necessary dimensions for the construction of fixtures to hold the wing components while repairs are being made. These dimensions and attachment points are not intended for use in manufacturing jigs for building a complete assembly. They are intended only for manufacturing holding fixtures to maintain the proper attachment points and dimensions, and to ensure that the part being repaired will fit when reinstalled.

WING REPAIR INDEX

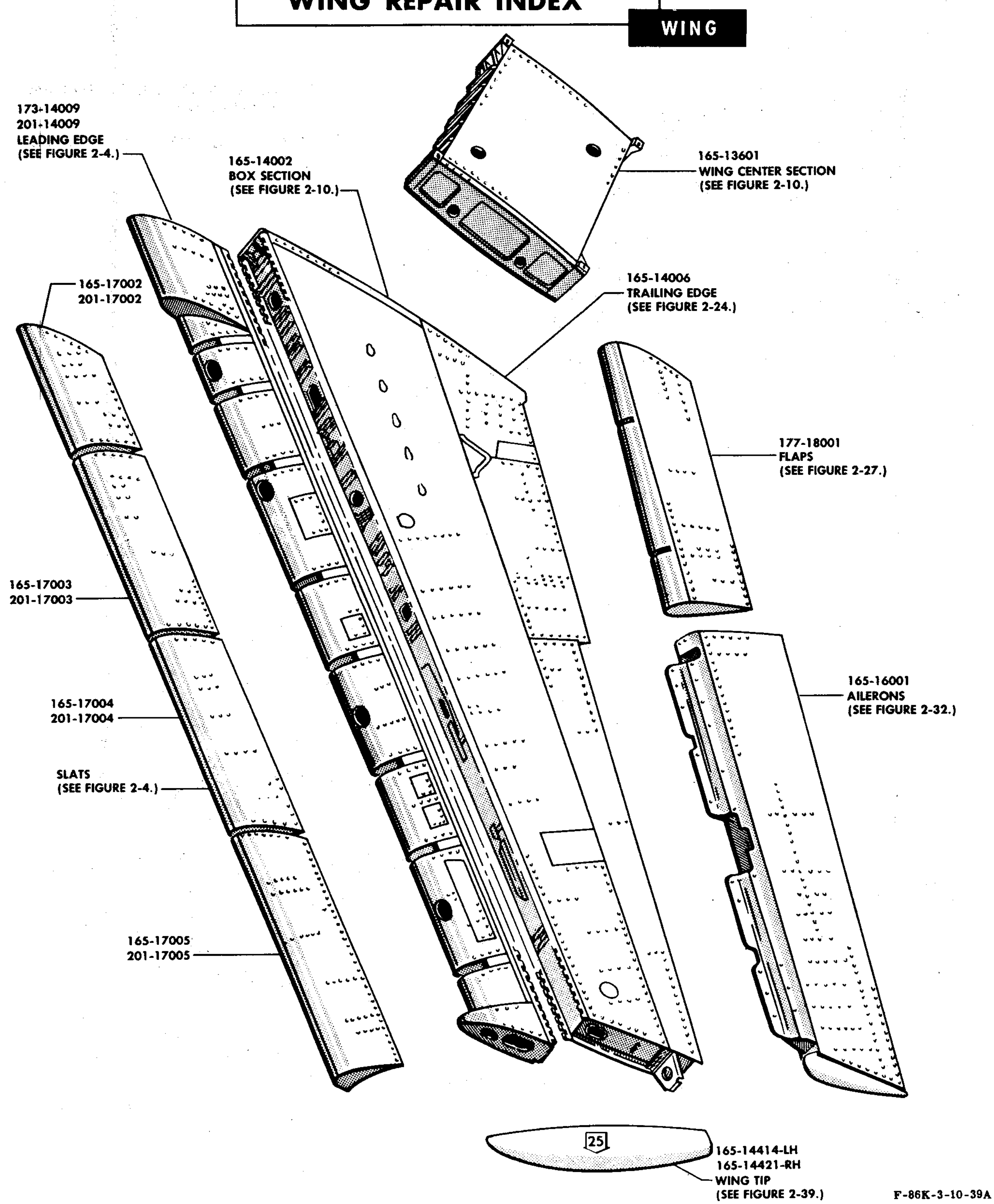
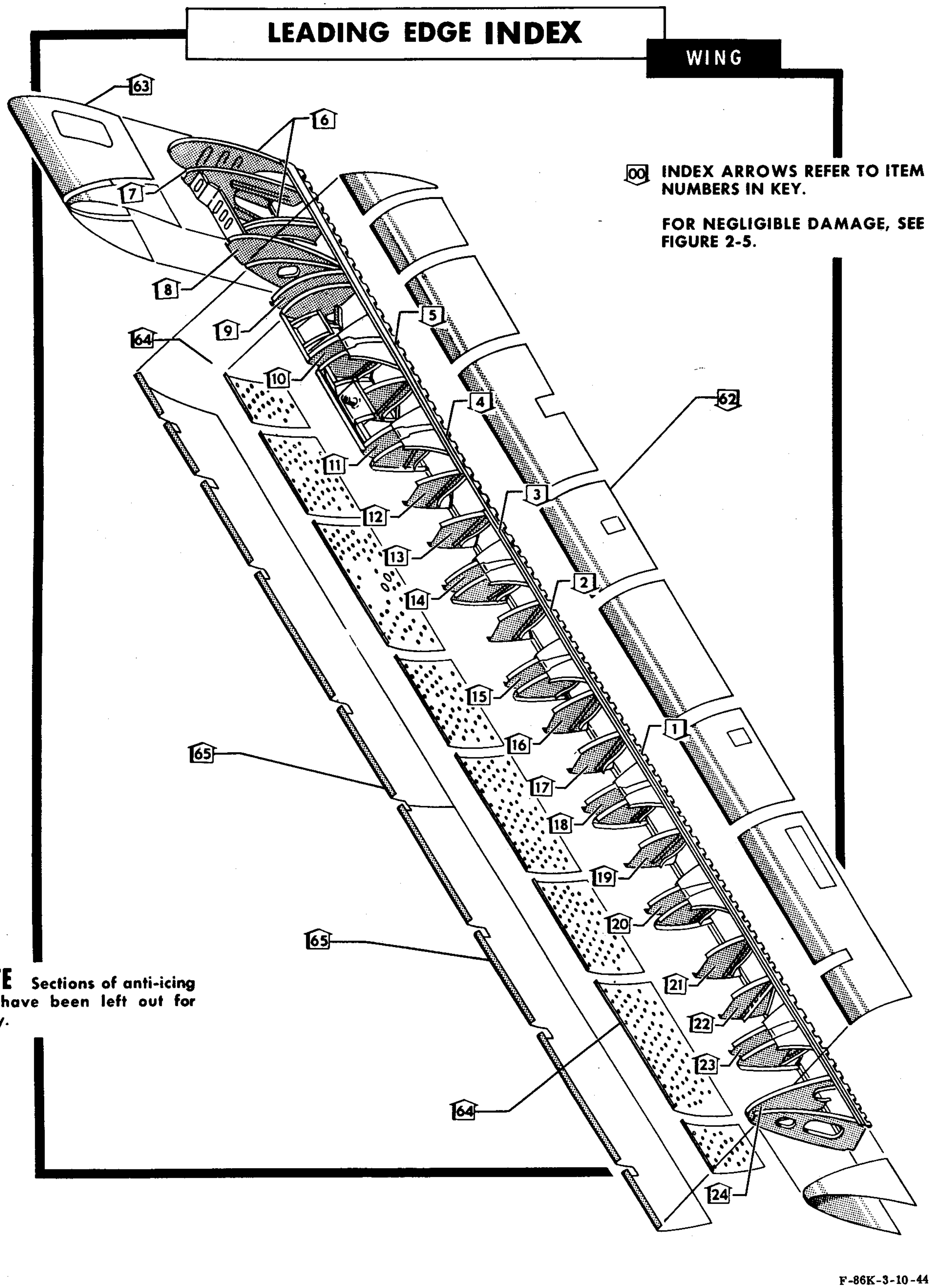


Figure 2-3. Wing Group Index



NOTE Sections of anti-icing duct have been left out for clarity.

Figure 2-4. Wing Leading Edge and Slat Indexes (Sheet 1 of 2)

SLAT INDEX

WING

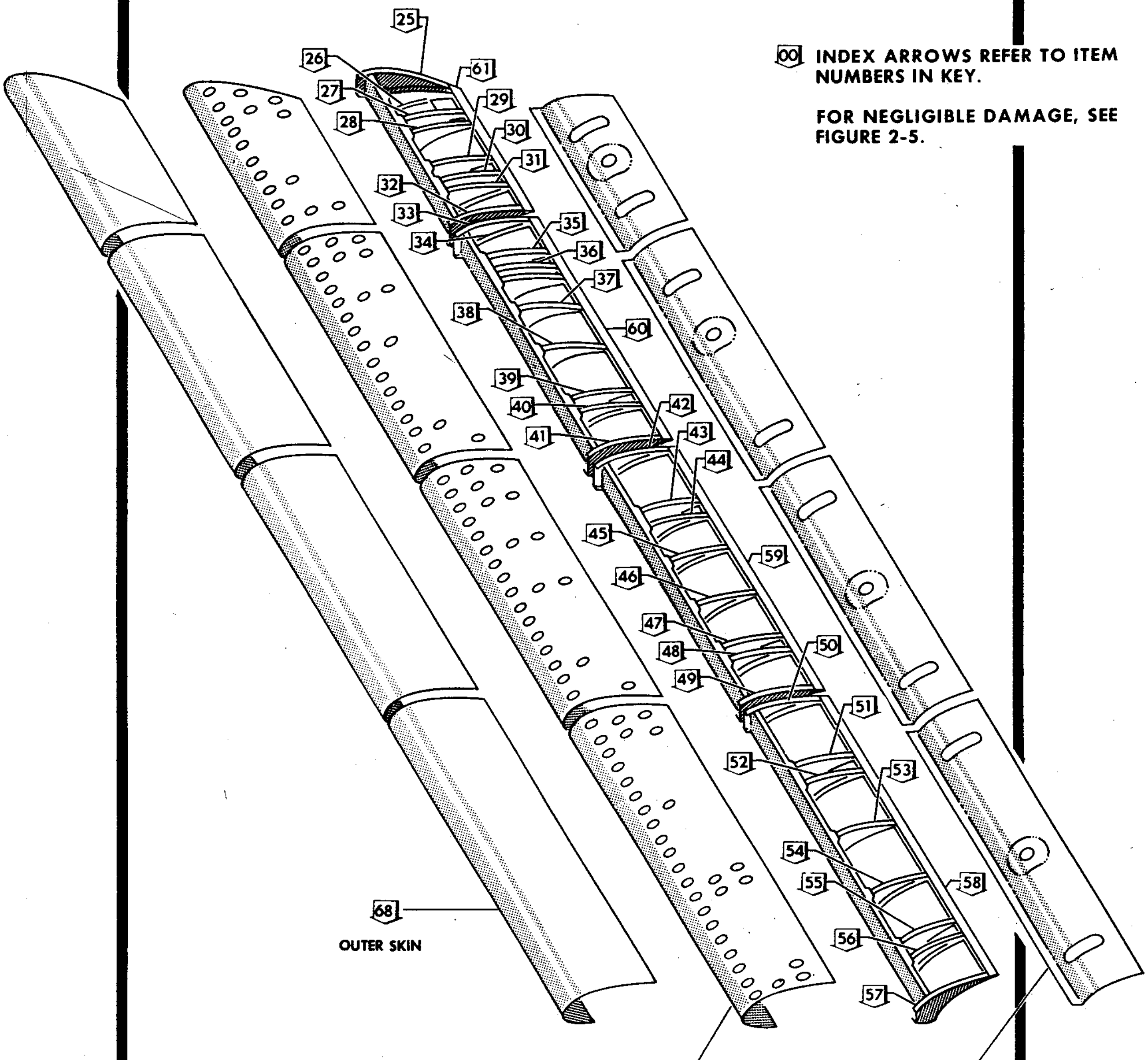


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Figure 2-4. Wing Leading Edge and Slat Indexes (Sheet 2 of 2)

ITEM NO.	DRAWING NO.*	DESCRIPTION	GAGE	MATERIAL	REPAIR FIGURE NO.†
1	165-14018	Joint—Leading Edge		7075-T6 Extr	2-7
2	165-14022	Angle—Leading Edge		7075-T6 Extr	
3	165-14016	Joint—Leading Edge		7075-T6 Extr	2-7
4	165-14020	Angle—Leading Edge		2024-T42 Extr	
5	165-14014	Joint—Leading Edge		7075-T6 Extr	2-7
6	165-14337	Rib	0.051	2024-T4 Clad	
7	190-14346	Rib	0.064	2024-T4 Clad	
8	165-14445	Rib	0.051	2024-T4 Clad	
9	165-14361	Rib	0.051	2024-T4 Clad	
10	165-14376	Rib	0.064	2024-T4 Clad	
11	165-14398	Rib	0.064	2024-T4 Clad	
12	173-14408	Rib	0.032	2024-T4 Clad	
13	165-14417	Rib	0.032	2024-T4 Clad	
14	165-14431	Rib	0.064	2024-T4 Clad	
15	165-14455	Rib	0.064	2024-T4 Clad	
16	165-14464	Rib	0.032	2024-T4 Clad	
17	165-14474	Rib	0.032	2024-T4 Clad	
18	165-14486	Rib	0.064	2024-T4 Clad	
19	165-14498	Rib	0.032	2024-T4 Clad	
20	165-14510	Rib	0.064	2024-T4 Clad	
21	165-14519	Rib	0.032	2024-T4 Clad	
22	165-14529	Rib	0.032	2024-T4 Clad	
23	165-14540	Rib	0.064	2024-T4 Clad	
24	165-14298	Edge Assy	0.040	2024-T4 Clad	
25	165-17002	Ribs	0.051	2024-T4 Clad	
26	165-17002	Ribs	0.051	2024-T4 Clad	
27	165-17002	Ribs	0.051	2024-T4 Clad	
28	165-17002	Ribs	0.051	2024-T4 Clad	
29	165-17002	Ribs	0.051	2024-T4 Clad	
30	165-17002	Ribs	0.051	2024-T4 Clad	
31	165-17002	Ribs	0.051	2024-T4 Clad	
32	165-17002	Ribs	0.051	2024-T4 Clad	
33	165-17003	Rib	0.020	CRES	
34	165-17003	Ribs	0.051	2024-T4 Clad	
35	165-17003	Ribs	0.051	2024-T4 Clad	
36	165-17003	Ribs	0.051	2024-T4 Clad	
37	165-17003	Ribs	0.051	2024-T4 Clad	
38	165-17003	Ribs	0.051	2024-T4 Clad	
39	165-17003	Ribs	0.051	2024-T4 Clad	
40	165-17003	Ribs	0.051	2024-T4 Clad	
41	165-17003	Rib	0.020	CRES	
42	165-17004	Rib	0.020	CRES	
43	165-17004	Ribs	0.051	2024-T4 Clad	
44	165-17004	Ribs	0.051	2024-T4 Clad	
45	165-17004	Ribs	0.051	2024-T4 Clad	
46	165-17004	Ribs	0.051	2024-T4 Clad	
47	165-17004	Ribs	0.051	2024-T4 Clad	
48	165-17004	Ribs	0.051	2024-T4 Clad	
49	165-17005	Rib	0.020	CRES	
50	165-17005	Ribs	0.051	2024-T4 Clad	
51	165-17005	Ribs	0.051	2024-T4 Clad	
52	165-17005	Ribs	0.051	2024-T4 Clad	
53	165-17005	Ribs	0.051	2024-T4 Clad	
54	165-17005	Ribs	0.051	2024-T4 Clad	
55	165-17005	Ribs	0.051	2024-T4 Clad	
56	165-17005	Ribs	0.051	2024-T4 Clad	
57	165-17005	Ribs	0.051	2024-T4 Clad	
58	165-17010	Trailing Edge		2024-T42 Extr	2-8, 2-9
59	165-17008	Trailing Edge		2024-T42 Extr	2-8, 2-9
60	165-17008	Trailing Edge		2024-T42 Extr	2-8, 2-9

*Drawing numbers are for reference only.
†For additional repairs, refer to Section X.

Key to Figure 2-4

ITEM NO.	DRAWING NO.*	DESCRIPTION	GAGE	MATERIAL	REPAIR FIGURE NO.†
61	165-17007	Trailing Edge		2024-T42 Extr	2-8, 2-9
62	165-14002	Upper Skin	0.040	2024-T4 Clad	
63	165-14002	Inboard Skin	0.040	2024-T4 Clad	
64	165-14002	Inner Skin	0.020	2024-T4 Clad	
65	165-14002	Outer Skin	0.040	2024-T4 Clad	
66	165-17002	Lower Skin	0.040	2024-T4 Clad	
67	165-17002	Inner Skin	0.020	2024-T4 Clad	
68	165-17002	Outer Skin	0.064	2024-T4 Clad	

Key to Figure 2-4 (Continued)

LEADING EDGE AND SLAT NEGLIGIBLE DAMAGE

WING

NOTE Shallow marks which do not penetrate the clad on alclad sheet are not considered scratches.

One bay may have no more than three scratches.

A scratch must not exceed 1/4 inch in width.

SCRATCHES

Scratches in this area may not exceed 20 percent of the total skin thickness.

Scratches in this area may not exceed 0.030 inch in depth and 3 inches in length chordwise or 0.030 inch in depth and 6 inches in length spanwise.

Scratches in the unshaded area may not exceed 0.005 inch in depth and 3 inches in length or 0.003 inch in depth if the length is over 3 inches.

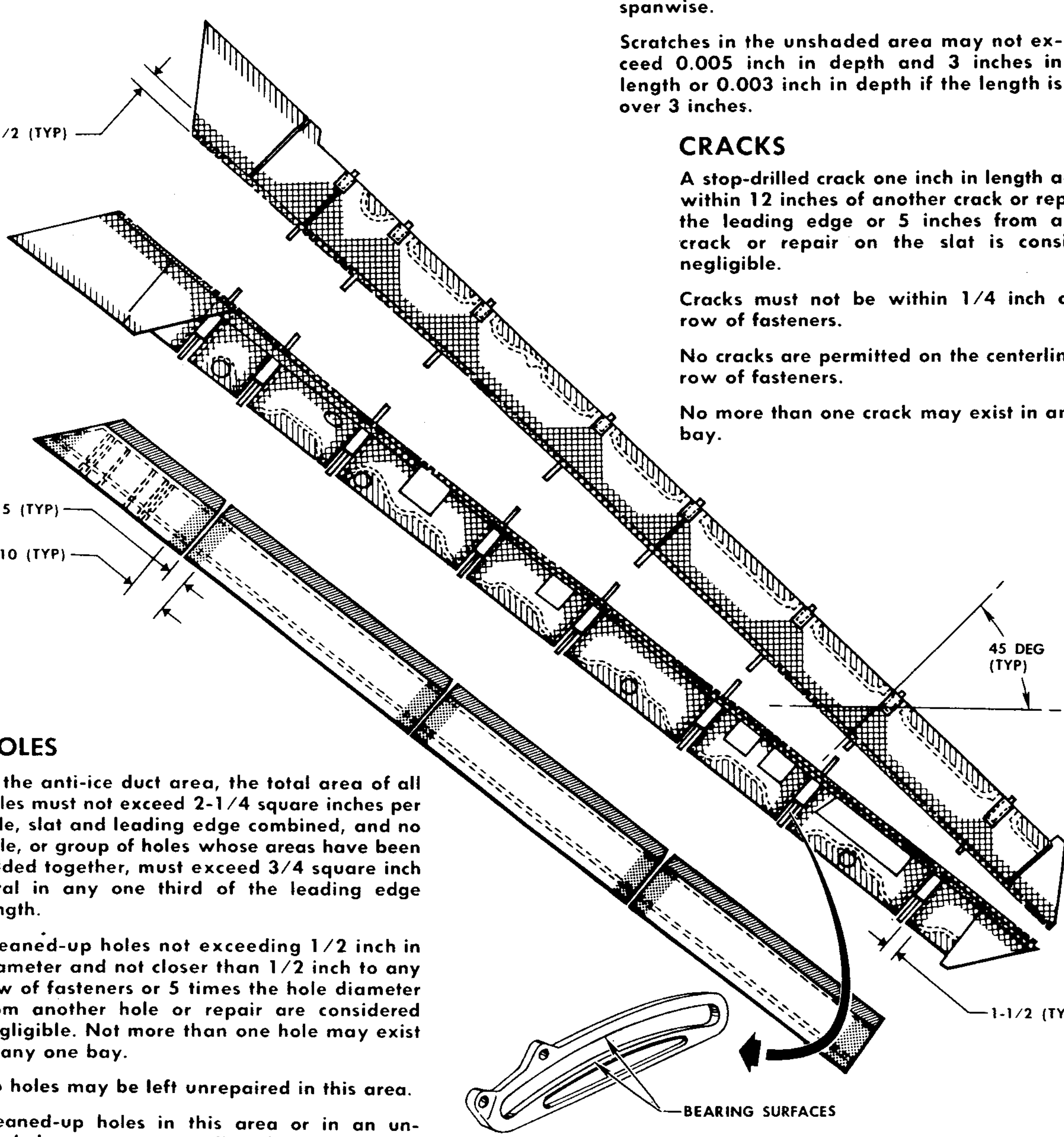
CRACKS

A stop-drilled crack one inch in length and not within 12 inches of another crack or repair on the leading edge or 5 inches from another crack or repair on the slat is considered negligible.

Cracks must not be within 1/4 inch of any row of fasteners.

No cracks are permitted on the centerline of a row of fasteners.

No more than one crack may exist in any one bay.



HOLES

In the anti-ice duct area, the total area of all holes must not exceed 2-1/4 square inches per side, slat and leading edge combined, and no hole, or group of holes whose areas have been added together, must exceed 3/4 square inch total in any one third of the leading edge length.

Cleaned-up holes not exceeding 1/2 inch in diameter and not closer than 1/2 inch to any row of fasteners or 5 times the hole diameter from another hole or repair are considered negligible. Not more than one hole may exist in any one bay.

No holes may be left unrepaired in this area.

Cleaned-up holes in this area or in an unshaded area not exceeding 3/4 inch in diameter and not closer than 1/2 inch to any row of fasteners or 5 times the hole diameter from another hole or repair are considered negligible. Not more than one hole may exist in any one bay.

SLAT TRACKS

A maximum wear depth of 0.005 inch is acceptable for the groove in bearing surfaces of slat tracks.

F-86K-3-10-42A

Figure 2-5. Wing Leading Edge and Slat Negligible Damage

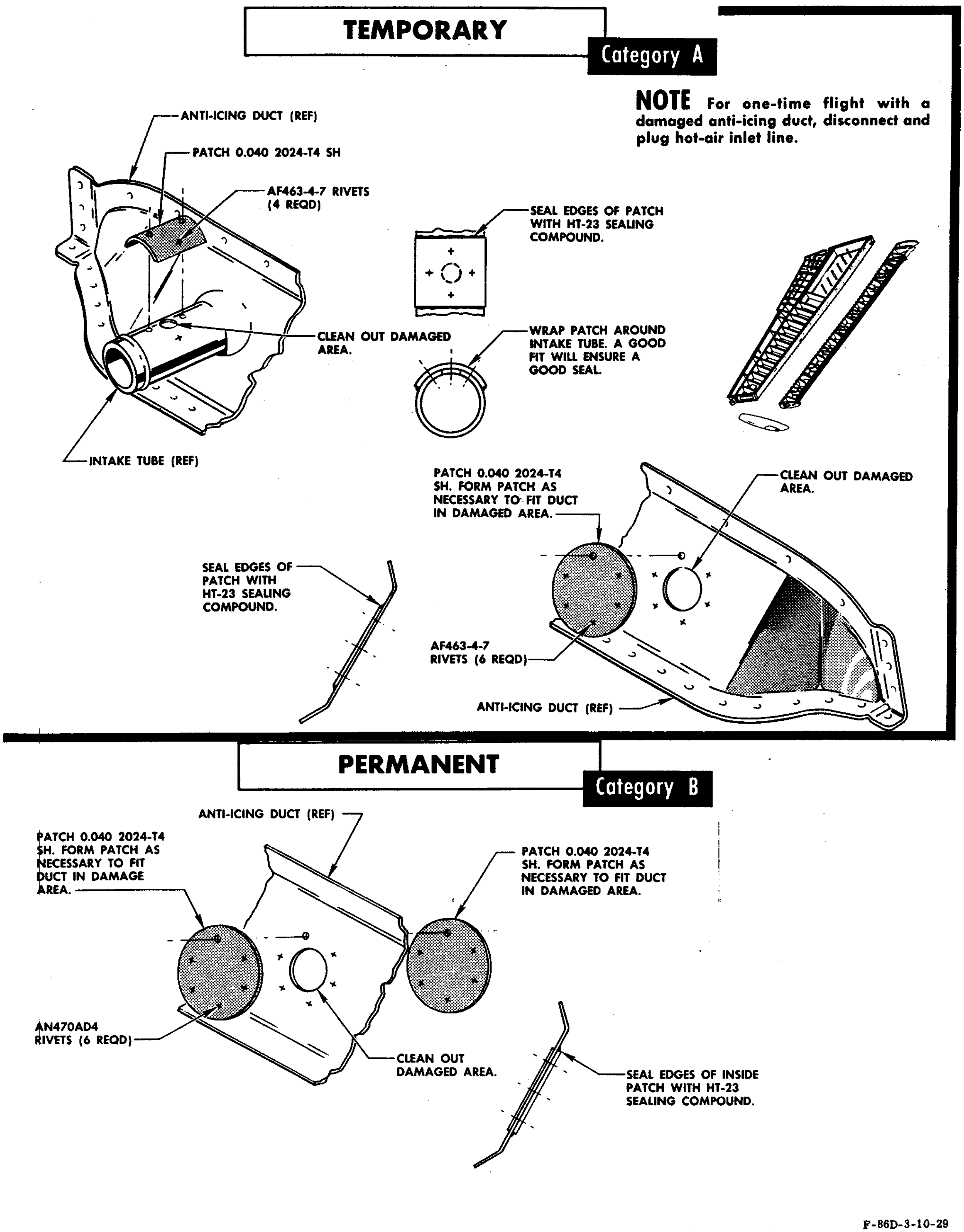


Figure 2-6. Wing Leading Edge Anti-icing Duct

PERMANENT

Category A

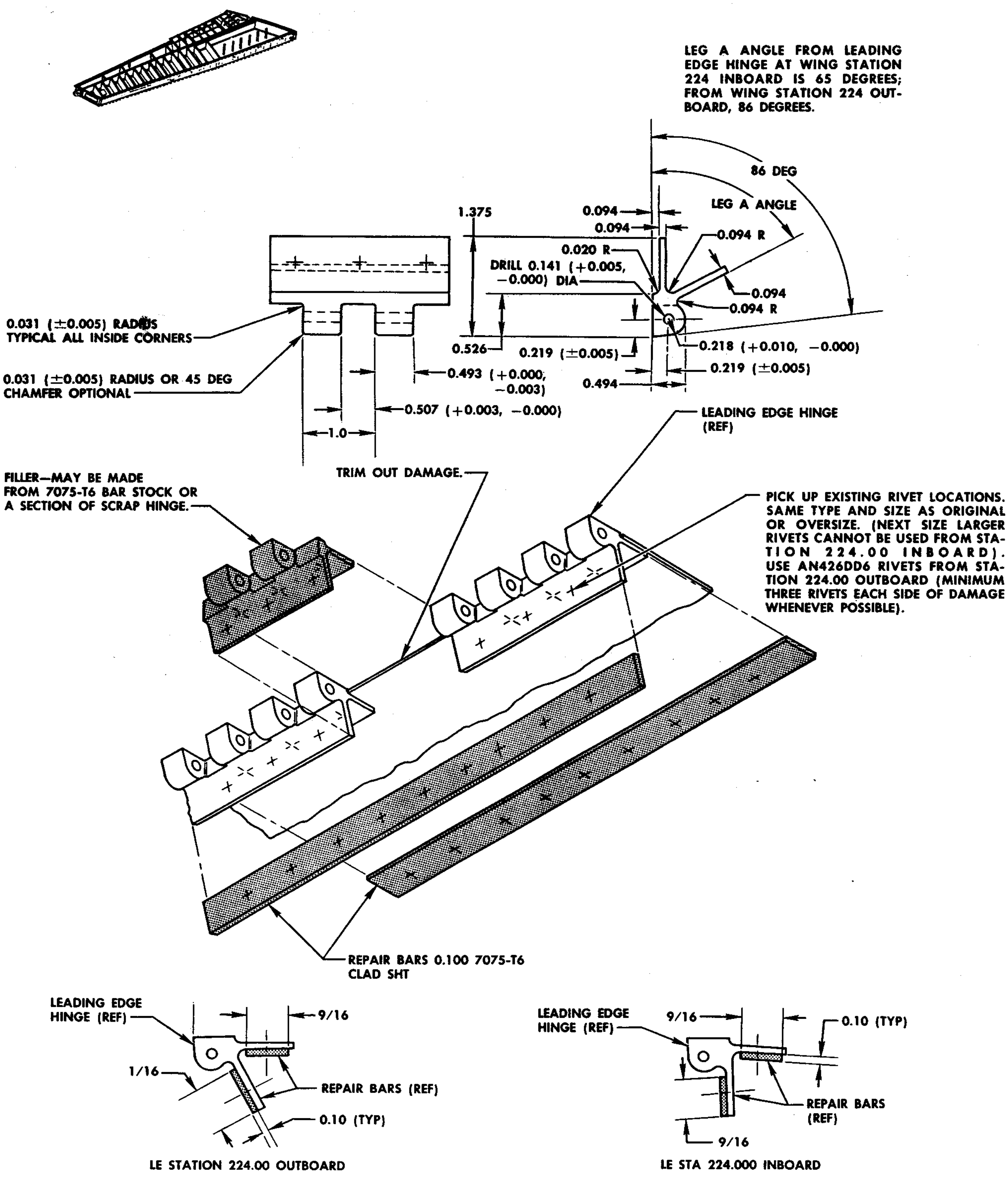
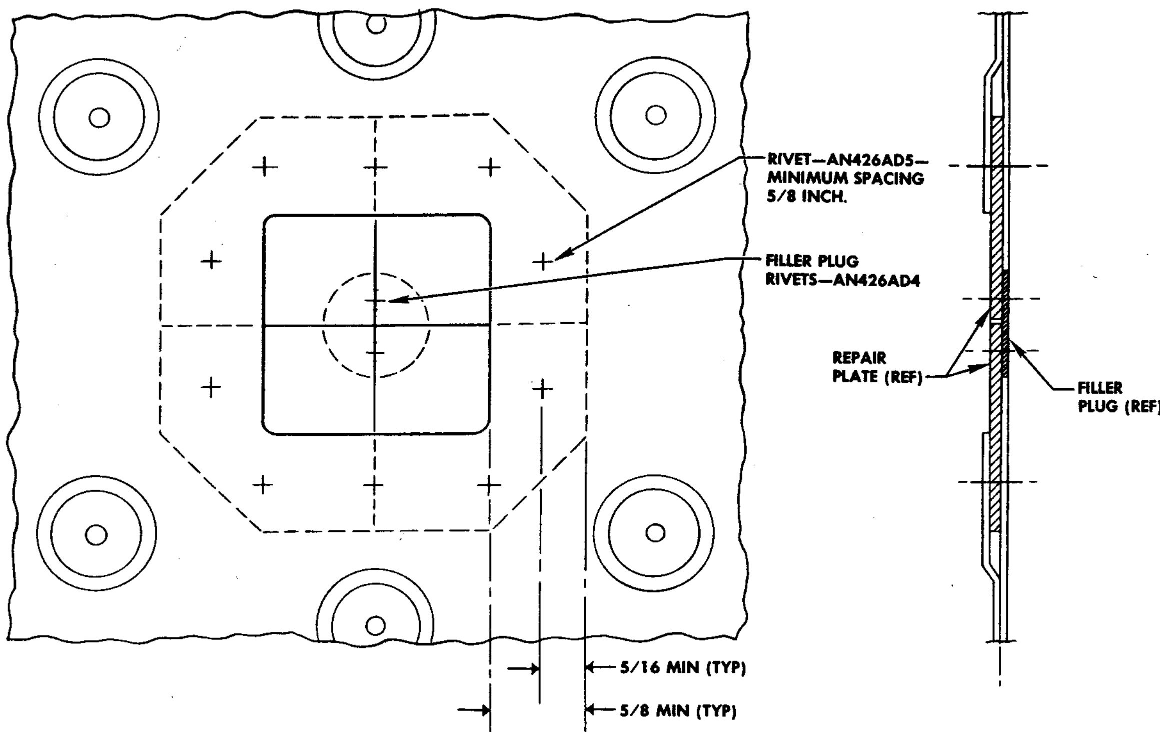
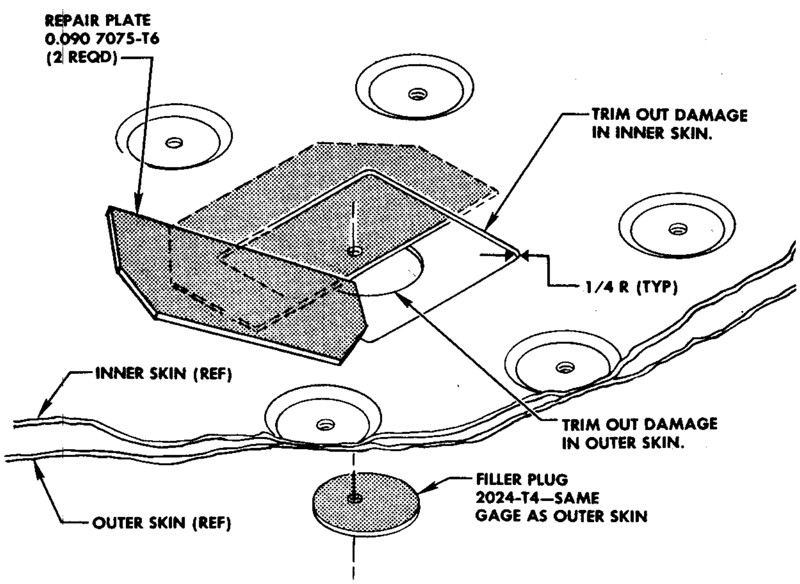


Figure 2-7. Wing Leading Edge Hinge

PERMANENT CATEGORY A

WING





NOTE

Remove rivets from dimples in area surrounding damage.

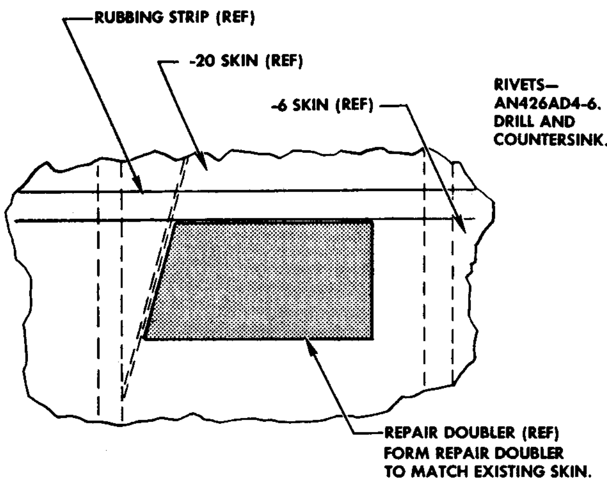
1. Trim out damage in outer and inner skins.
2. Cut hole in inner skin. Cut larger hole in outer skin.
3. Make repair plates and filler plug from material called out.
4. Slide repair plates in position through hole in inner skin.
5. Rivet repair plates and skins together with AN426AD5 rivets.
6. Rerivet skins together at dimples.
7. Fasten filler to repair plates with AN426-AD4 rivets.

F-86L-3-10-24

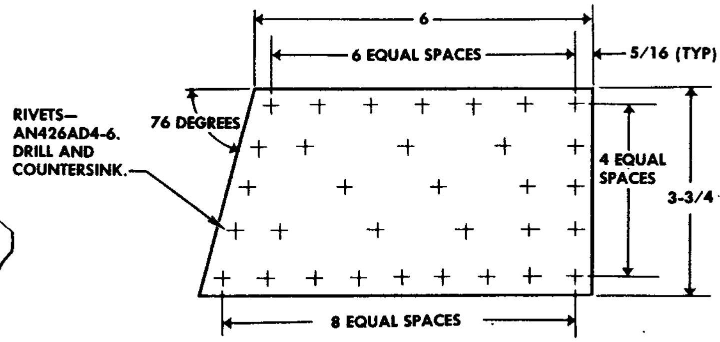
Figure 2-7A. Repair of Slat Double Skins

PERMANENT—CATEGORY A

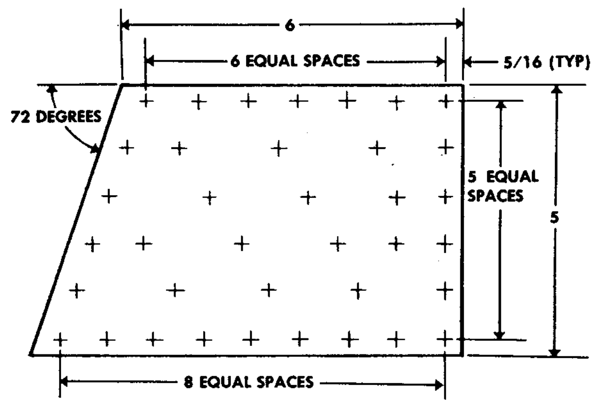
WING



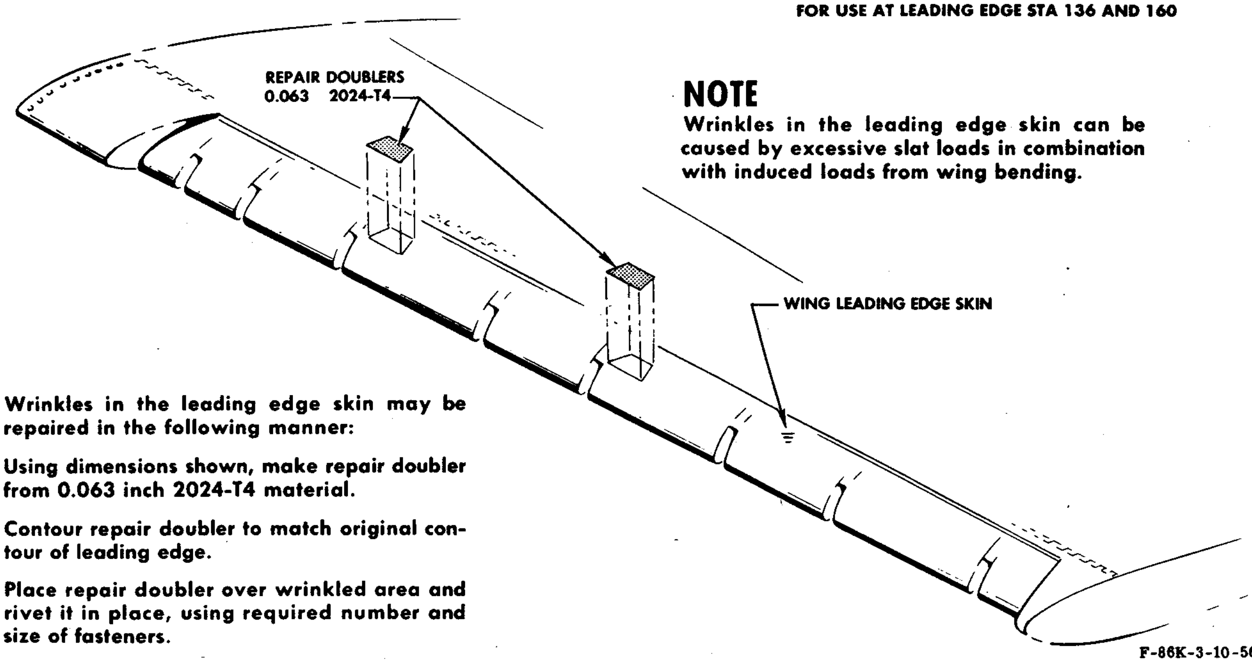
VIEW LOOKING DOWN ON UNDERSLAT LEADING EDGE SKIN



FOR USE AT LEADING EDGE STA 103



FOR USE AT LEADING EDGE STA 136 AND 160



NOTE

Wrinkles in the leading edge skin can be caused by excessive slat loads in combination with induced loads from wing bending.

Wrinkles in the leading edge skin may be repaired in the following manner:

1. Using dimensions shown, make repair doubler from 0.063 inch 2024-T4 material.
2. Contour repair doubler to match original contour of leading edge.
3. Place repair doubler over wrinkled area and rivet it in place, using required number and size of fasteners.

Figure 2-7B. Repair of Leading Edge Skin Wrinkles

ONE TIME FLIGHT

Category A

NOTE This repair is optional and may be used if desired. If damage exceeds 8 inches in length, repair is impractical. Ferry flight may be made as instructed in one-time flight. (Refer to index.)

Keep rivet layout accurate, as rivet holes will be used for future repair.

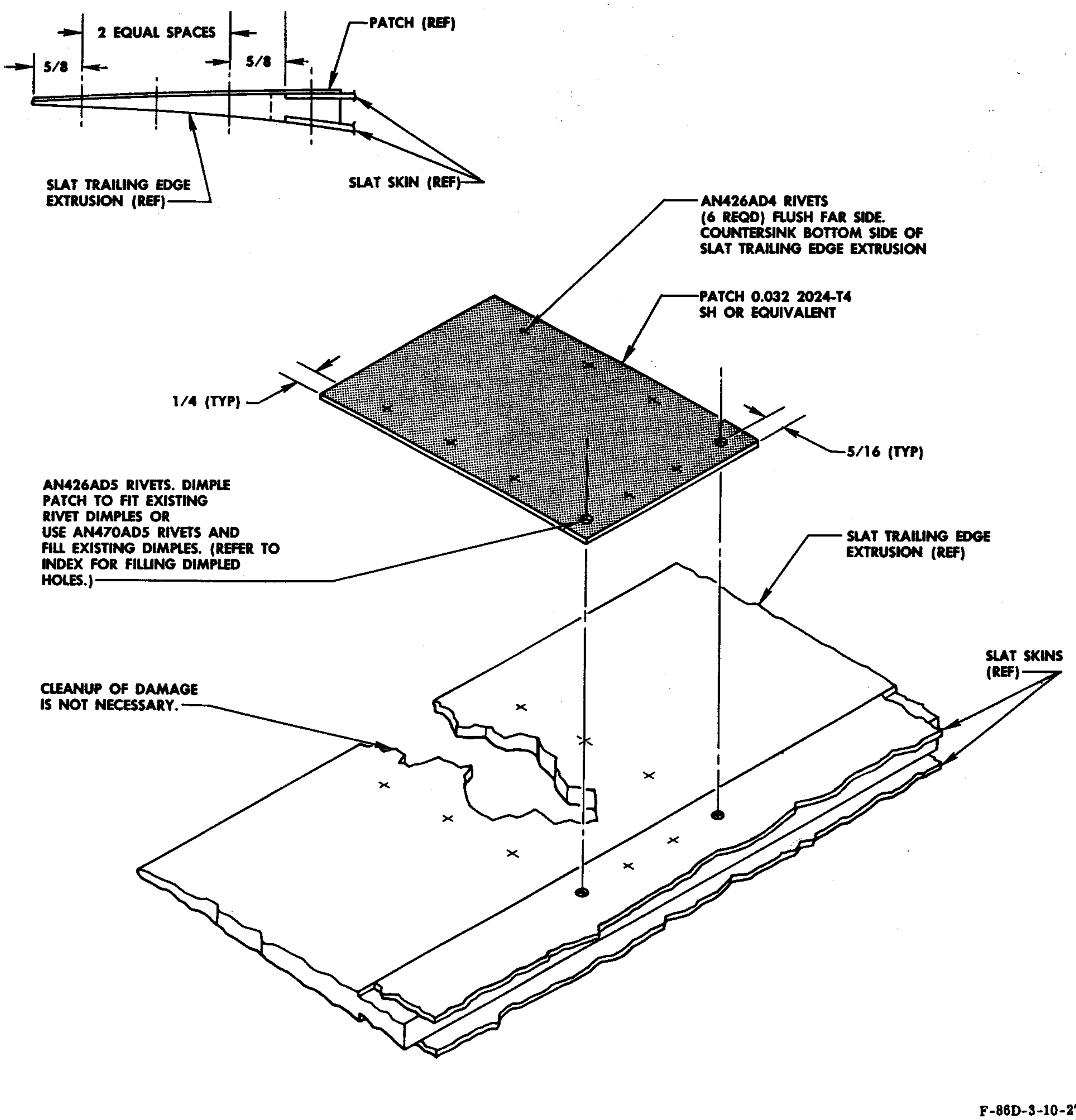


Figure 2-8. Wing Slat Trailing Edge One-time Flight Repair

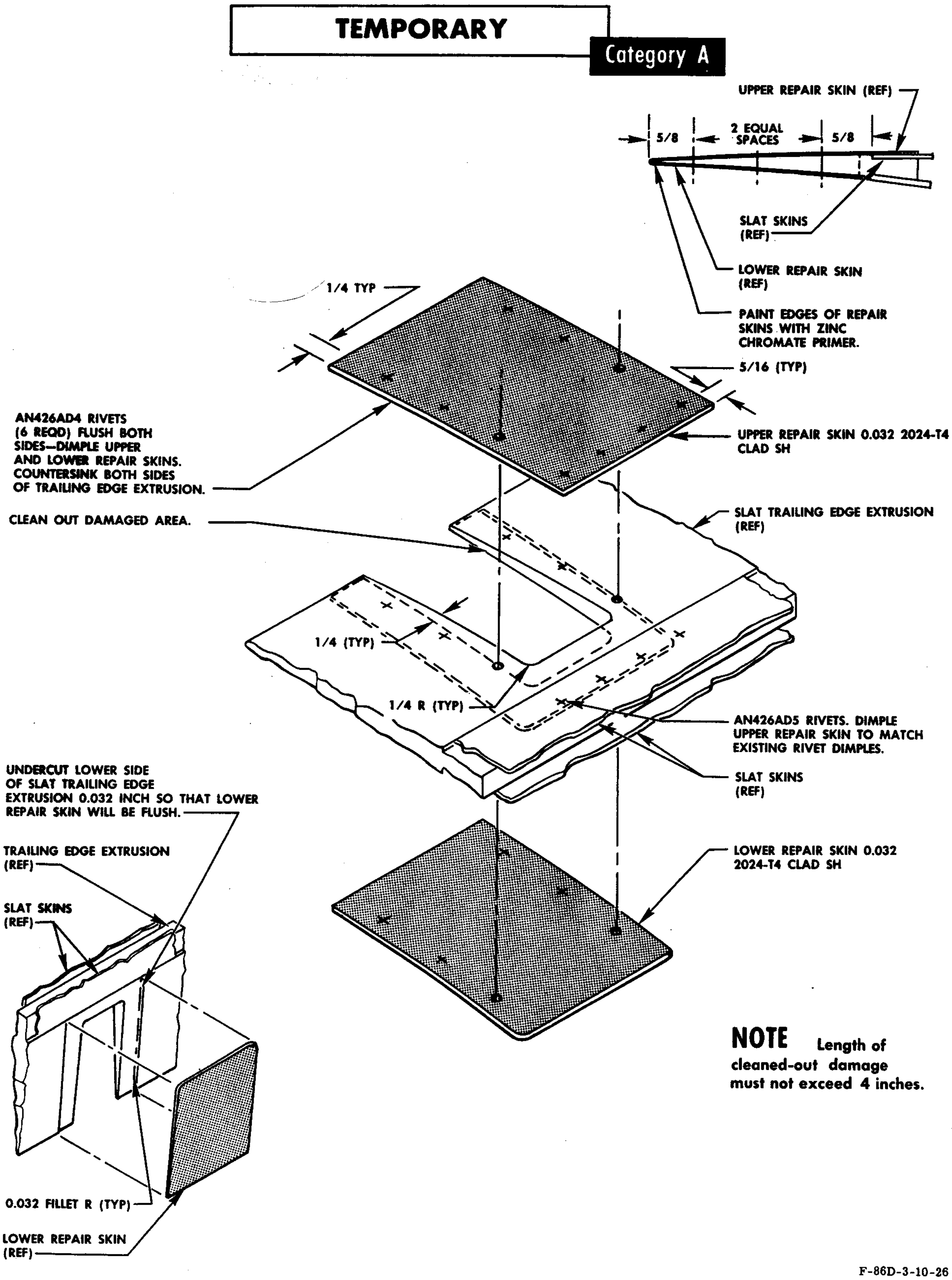
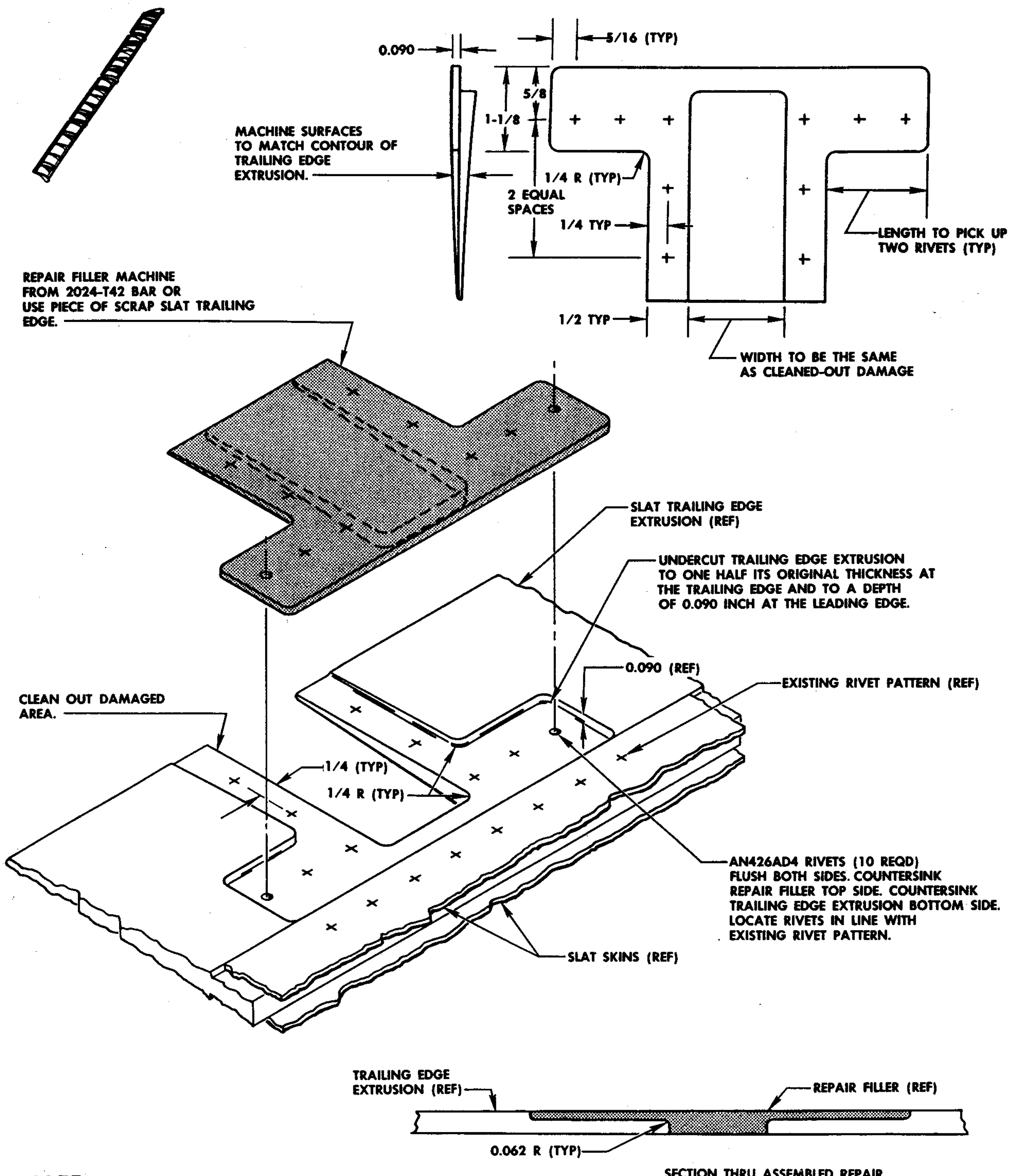


Figure 2-9. Wing Slat Trailing Edge (Sheet 1 of 2)

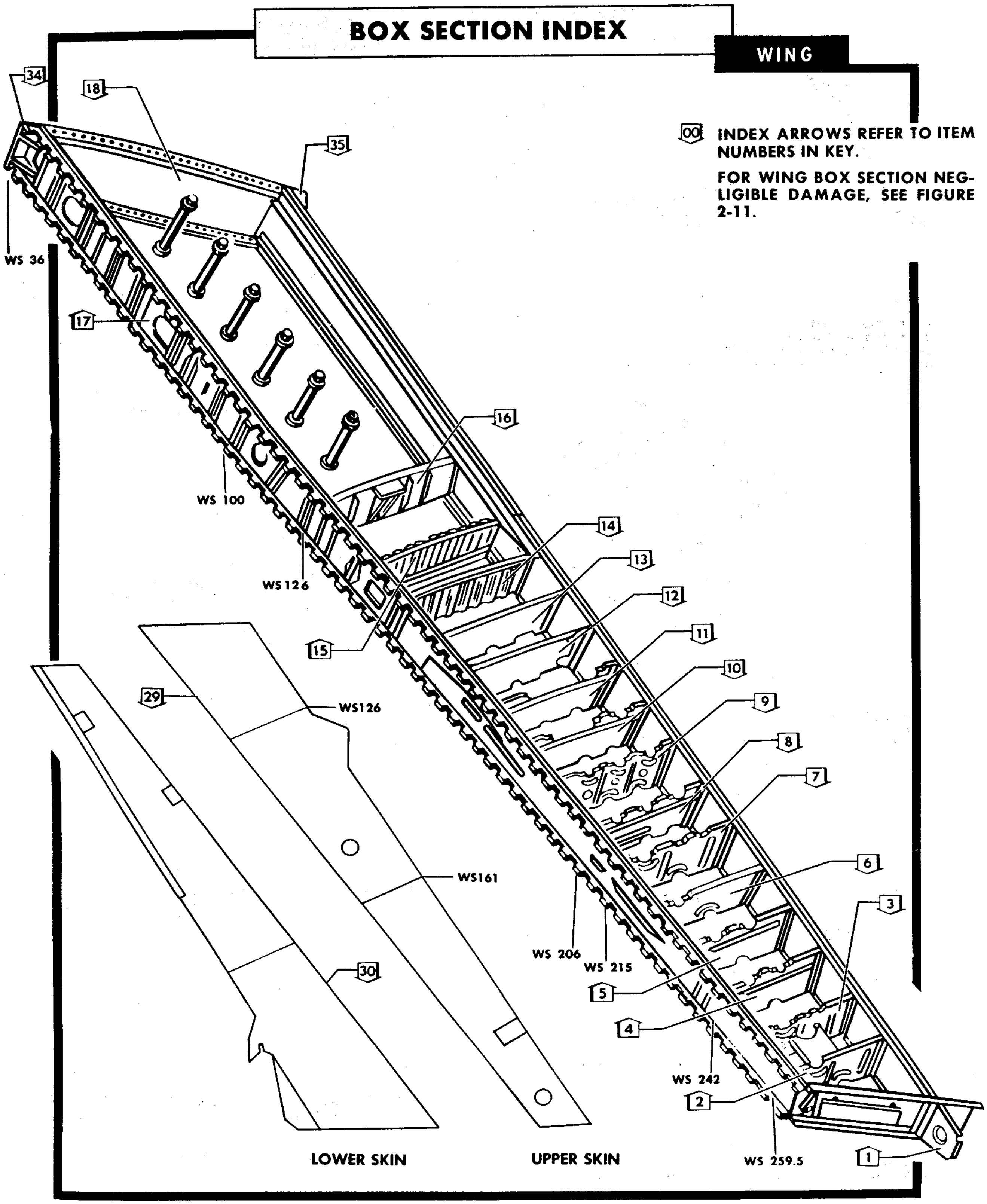
PERMANENT Category B



NOTE Length of cleaned-out damage must not exceed 4 inches.

F-86D-3-10-25

Figure 2-9. Wing Slat Trailing Edge (Sheet 2 of 2)



F-86K-3-10-49A

Figure 2-10. Wing Box Section and Wing Center Section Indexes (Sheet 1 of 2)

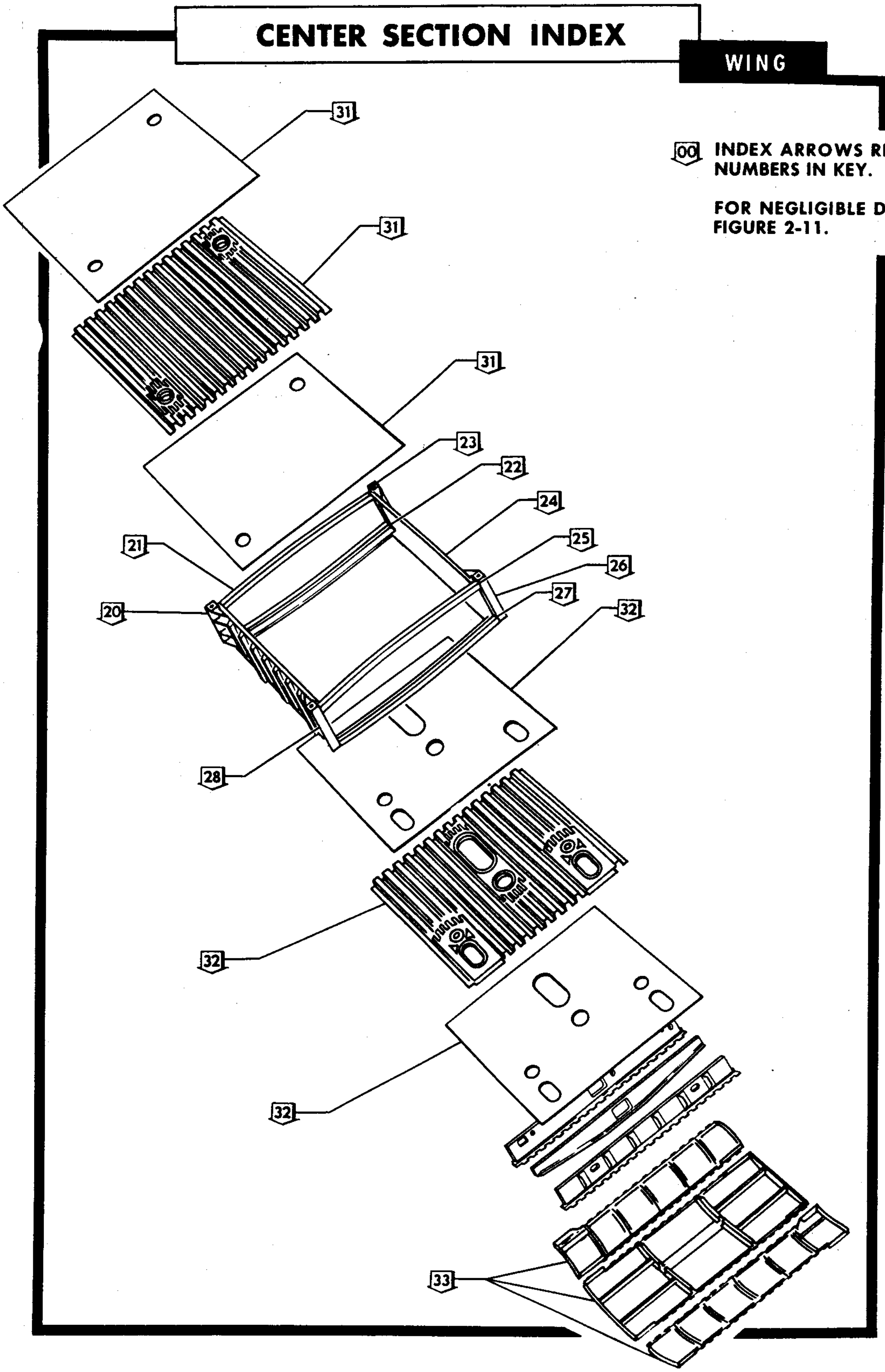


Figure 2-10. Wing Box Section and Wing Center Section Indexes (Sheet 2 of 2)

ITEM NO.	DRAWING NO.*	DESCRIPTION	GAGE	MATERIAL	REPAIR FIGURE NO.†
1	165-14411	Support Assy	0.010	Glass Fabric	
2	165-14559	Rib	0.032	2024-T4 Clad	2-14
3	165-14551	Rib	0.032	2024-T4 Clad	2-14
4	165-14542	Rib Assy	0.032	2024-T4 Clad	2-14
5	165-14533	Rib Assy	0.032	2024-T4 Clad	2-14
6	165-14524	Rib Assy	0.064	2024-T4 Clad	2-14
7	165-14515	Rib Assy	0.064	2024-T4 Clad	2-14
8	165-14506	Rib Assy	0.032	2024-T4 Clad	2-14
9	165-14497	Rib	0.032	2024-T4 Clad	2-14
10	165-14488	Rib Assy	0.032	2024-T4 Clad	2-14
11	165-14479	Rib Assy	0.032	2024-T4 Clad	2-14
12	165-14670	Rib Assy	0.032	2024-T4 Clad	2-14
13	151-14661	Rib Assy	0.032	2024-T4 Clad	2-14
14	151-14452	Rib Assy	0.025	7075-T6 Clad	2-15
15	151-14443	Rib Assy			2-15
16	165-14426	Rib Assy	0.091	7075-T6 Clad	
17	165-14003	Spar Assy	0.081	7075-T6 Clad	2-12, 2-13, 2-22, 2-22A
18	165-14076	Fitting Assy			
19	165-13003	Front Spar Assy	0.072	7075-T6	
20	152-13027	Fitting		7075-T6 Forging	
21	140-13029	Fitting	1	7075-T6 Bar	
22	165-13030	Fitting Assy		2024-T4 Forging	
23	152-13028	Fitting		2024-T4 Forging	
24	165-13005	Rear Spar Assy	0.064	7075-T6	
25	140-13029	Fitting Assy	1	7075-T6 Bar	
26	152-13028	Fitting		2024-T4	
27	165-13030	Fitting Assy		2024-T4	
28	152-13027	Fitting		7075-T6 Forging	
29	165-14100	Outer Skin		7075-T6 Clad	
		Stringers		7075-T6 Clad 2-15B	
		Inner Skin		7075-T6 Clad	
30	165-14101	Outer Skin		7075-T6 Clad	
		Stringers		7075-T6 Clad 2-15B	
		Inner Skin		7075-T6 Clad	
31	165-13001	Outer Skin		7075-T6 Plate	
		Stringers		7075-T6 Clad 2-15B	
		Inner Skin		7075-T6 Plate	
32	165-13001	Outer Skin		7075-T6 Plate	
		Stringers		7075-T6 Clad 2-15B	
		Inner Skin		7075-T6 Plate	
33	165-13002	Fairing Skins	0.040	2024-T4 Clad	
34	151-14047	Fitting		7075-T6 Forging	
35	172-14049	Fitting		7075-T6 Forging	

***Drawing numbers are for reference only.**
†For additional repairs, refer to Section X.

Key to Figure 2-10

WING SKIN NEGLIGIBLE DAMAGE

WING

HOLES

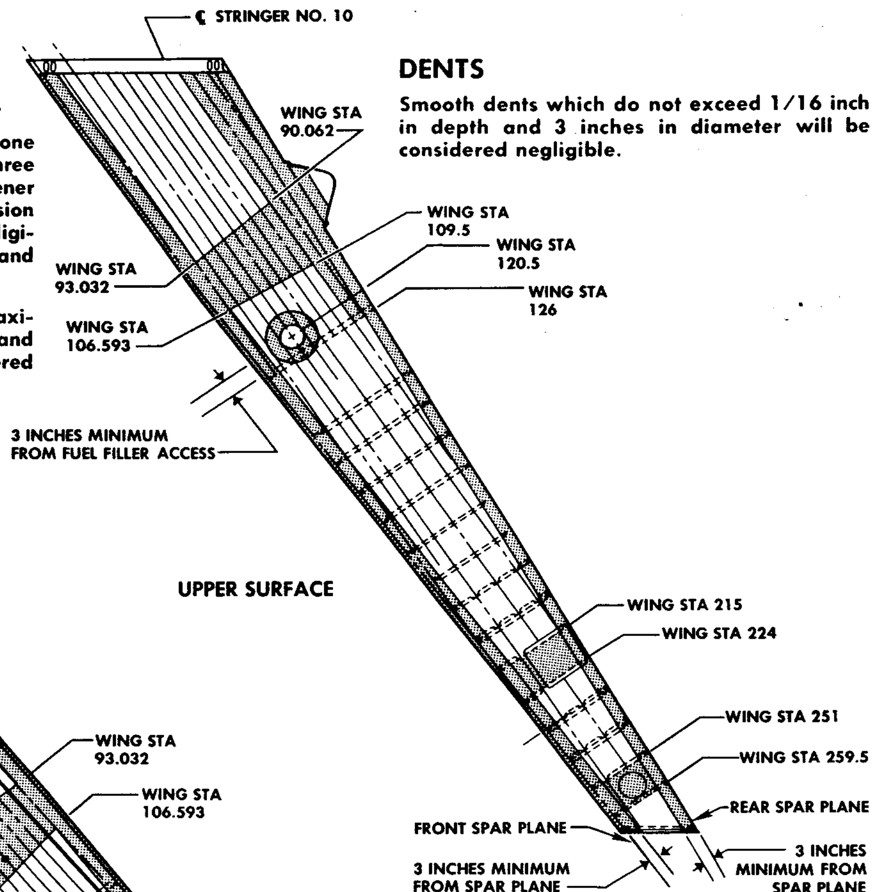
No holes are permitted in the shaded area.

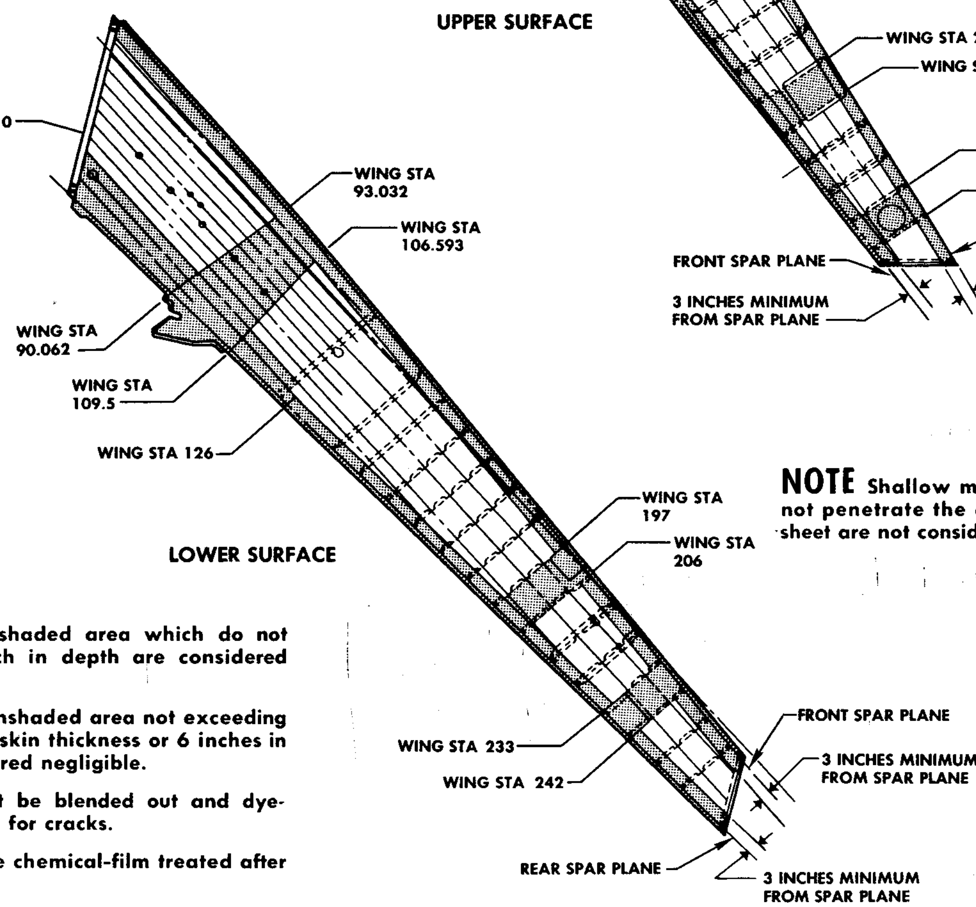
In the unshaded area, a cleaned-up hole one inch in diameter which is not closer than three times the fastener diameter from any fastener or 6 inches from any unpatched hole (tension post, fuel filler, etc) will be considered negligible (applies to upper and lower surfaces and inner and outer skins).

Cleaned-up holes in the stringers whose maximum diameter does not exceed 3/16 inch and does not fall in the radius will be considered negligible.

DENTS

Smooth dents which do not exceed 1/16 inch in depth and 3 inches in diameter will be considered negligible.





NOTE Shallow marks which do not penetrate the clad on alclad sheet are not considered scratches.

SCRATCHES

Scratches in the shaded area which do not exceed 0.004 inch in depth are considered negligible.

Scratches in the unshaded area not exceeding 25 percent of the skin thickness or 6 inches in length are considered negligible.

All scratches must be blended out and dye-penetrant checked for cracks.

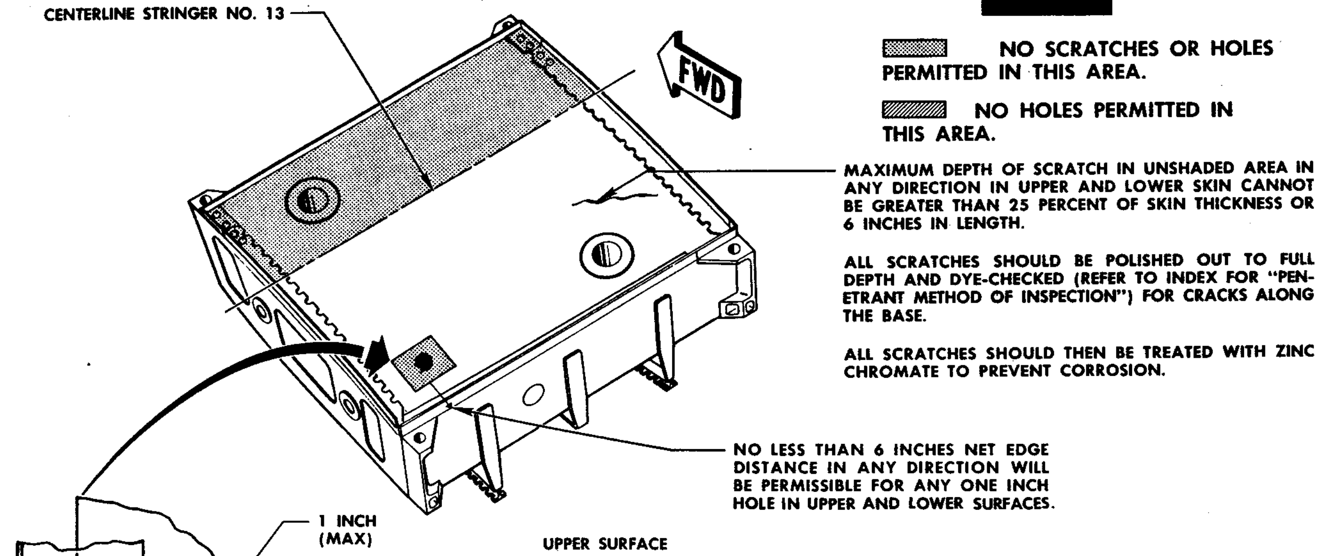
Surfaces should be chemical-film treated after blending.

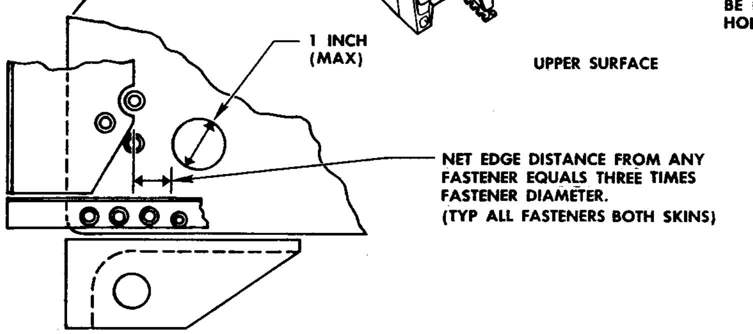
F-86D-3-10-41A

Figure 2-11. Wing Box Section Negligible Damage (Sheet 3 of 4)

CENTER SECTION NEGLIGIBLE DAMAGE

WING

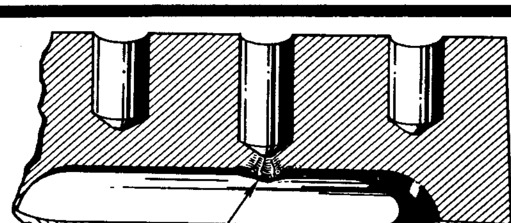




NOTE No scratch deeper than clad thickness (0.003 inch) may run over edge of skin at outer edges, at internal holes, or at any row of rivets.

Any damage to the front or rear spars, upper and lower, will not be considered negligible.

Every third lug may be missing from either hinge as long as the mating hinge has no missing lugs. Two adjacent lugs may be missing as long as there are at least three good lugs on either side and no lugs missing in the mating part. One lug may be missing on mating parts as long as there are at least two good lugs on either side. Areas where lugs are missing must be filed smooth and primed.



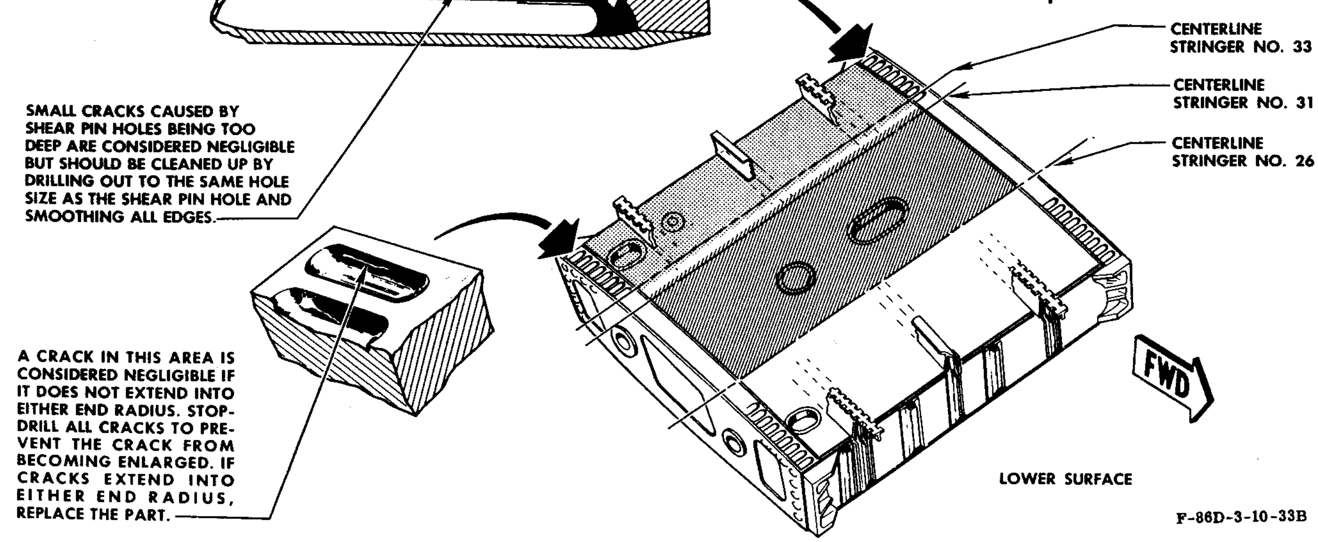
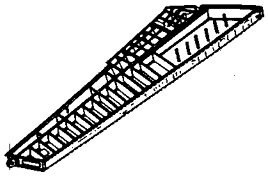


Figure 2-11. Wing Box Section Negligible Damage (Sheet 4 of 4)



PERMANENT

Category A

NOTE

This repair is limited to five adjacent lugs.

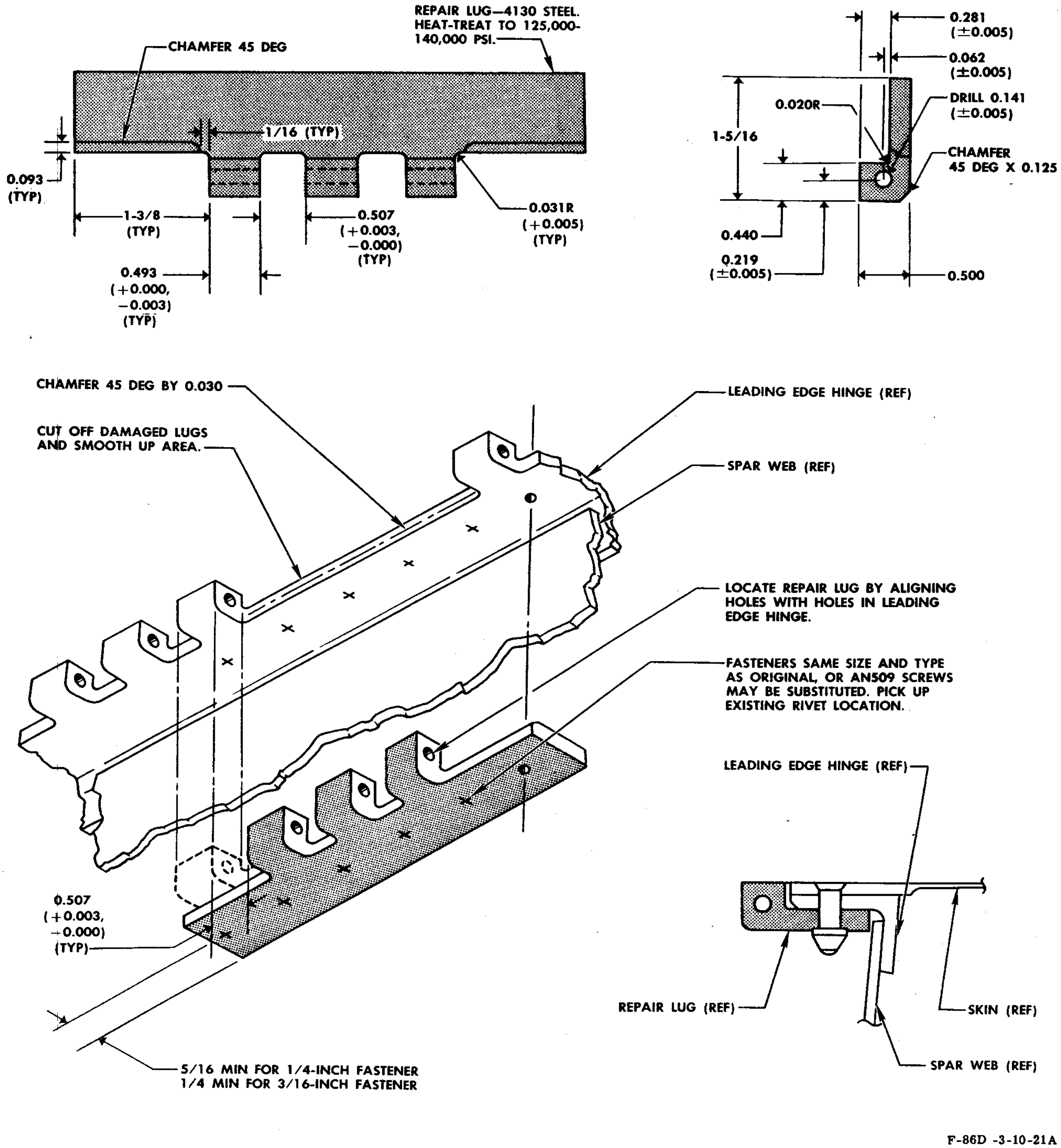
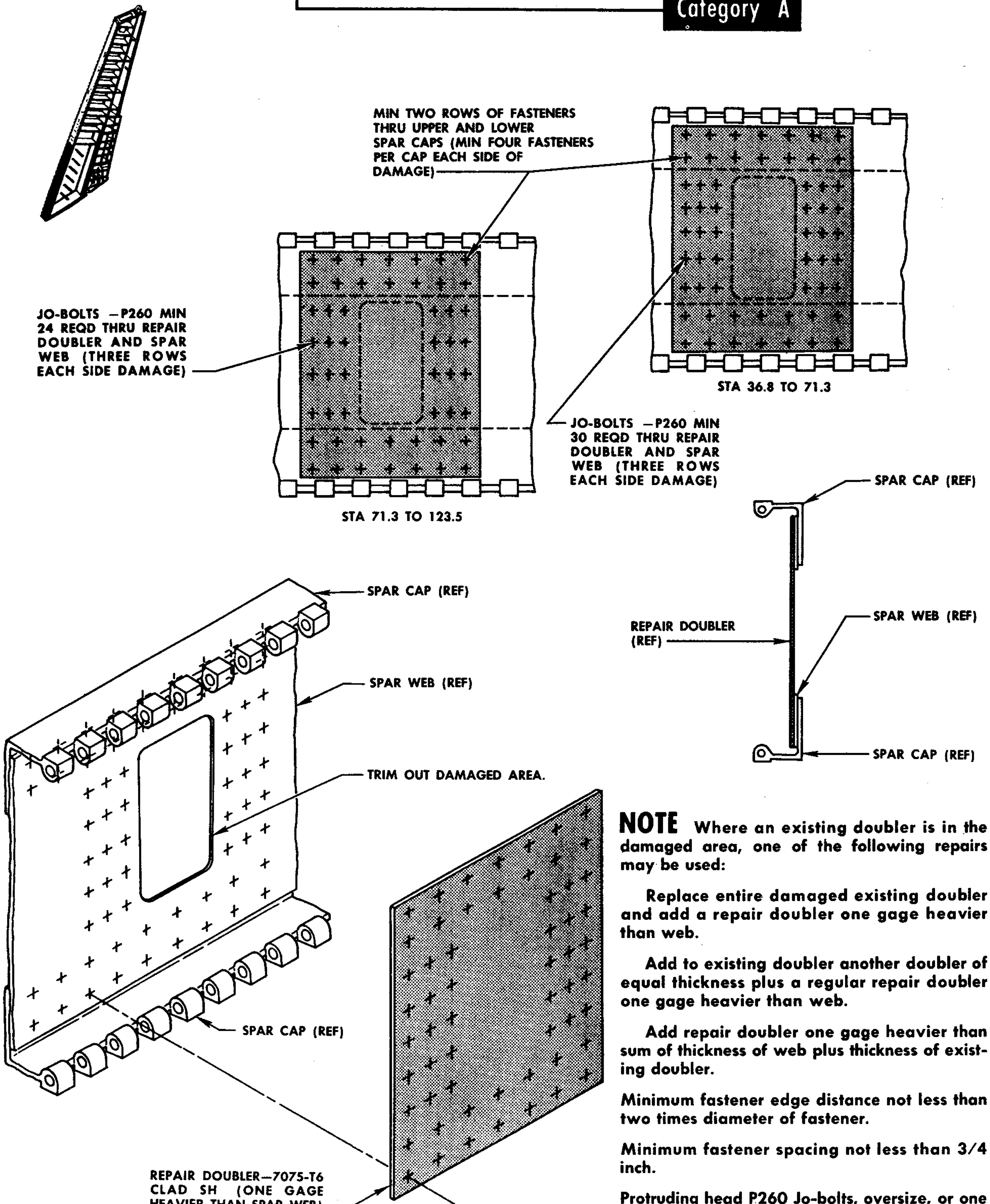


Figure 2-12. Front Spar Leading Edge Hinge

PERMANENT Category A



NOTE Where an existing doubler is in the damaged area, one of the following repairs may be used:

Replace entire damaged existing doubler and add a repair doubler one gage heavier than web.

Add to existing doubler another doubler of equal thickness plus a regular repair doubler one gage heavier than web.

Add repair doubler one gage heavier than sum of thickness of web plus thickness of existing doubler.

Minimum fastener edge distance not less than two times diameter of fastener.

Minimum fastener spacing not less than 3/4 inch.

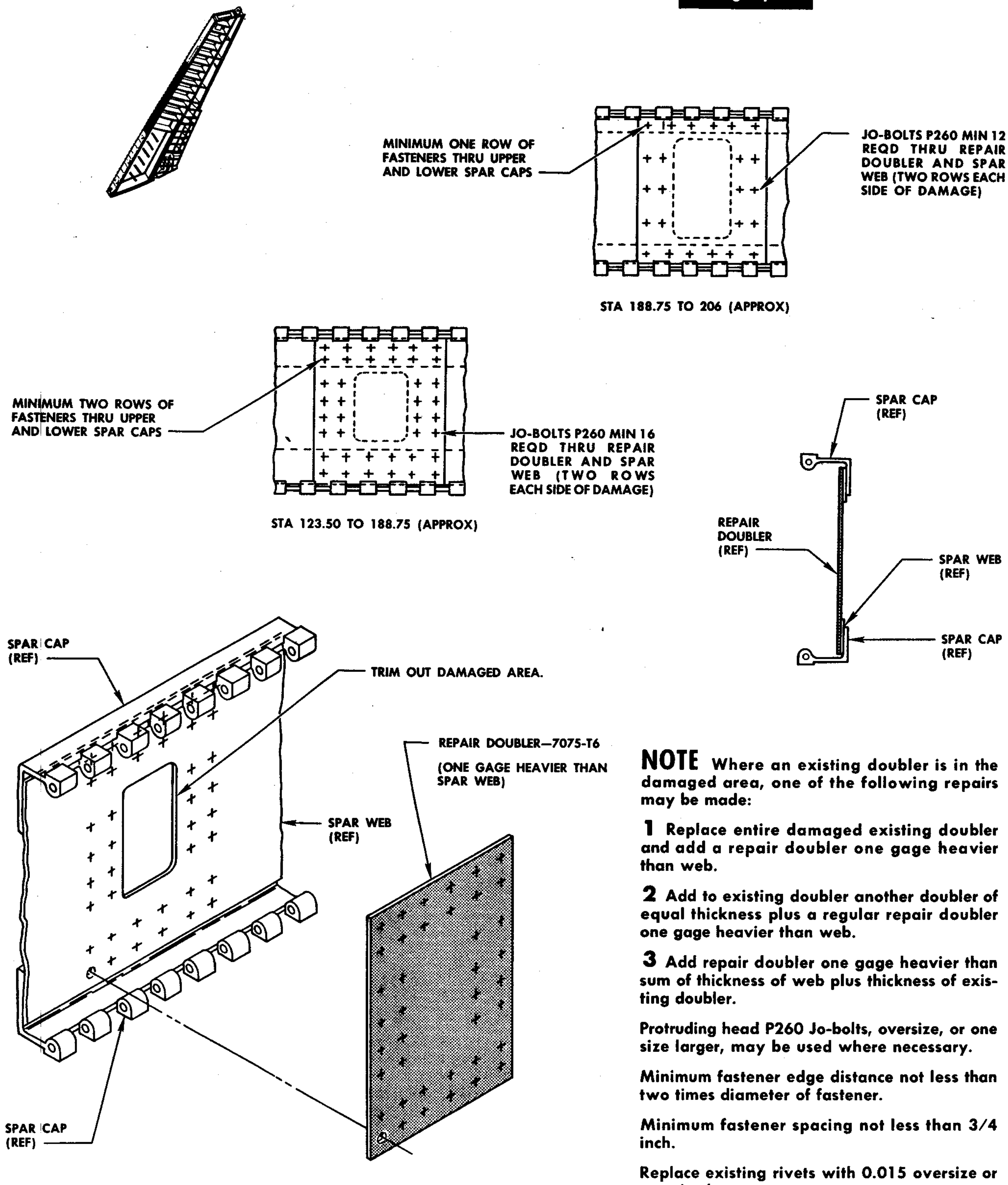
Protruding head P260 Jo-bolts, oversize, or one size larger, may be used where necessary.

Replace existing rivets with 0.015 oversize or one size larger as necessary. F-86D-3-10-63

Figure 2-13. Front Spar Web (Sheet 1 of 4)

PERMANENT

Category A



NOTE Where an existing doubler is in the damaged area, one of the following repairs may be made:

1 Replace entire damaged existing doubler and add a repair doubler one gage heavier than web.

2 Add to existing doubler another doubler of equal thickness plus a regular repair doubler one gage heavier than web.

3 Add repair doubler one gage heavier than sum of thickness of web plus thickness of existing doubler.

Protruding head P260 Jo-bolts, oversize, or one size larger, may be used where necessary.

Minimum fastener edge distance not less than two times diameter of fastener.

Minimum fastener spacing not less than 3/4 inch.

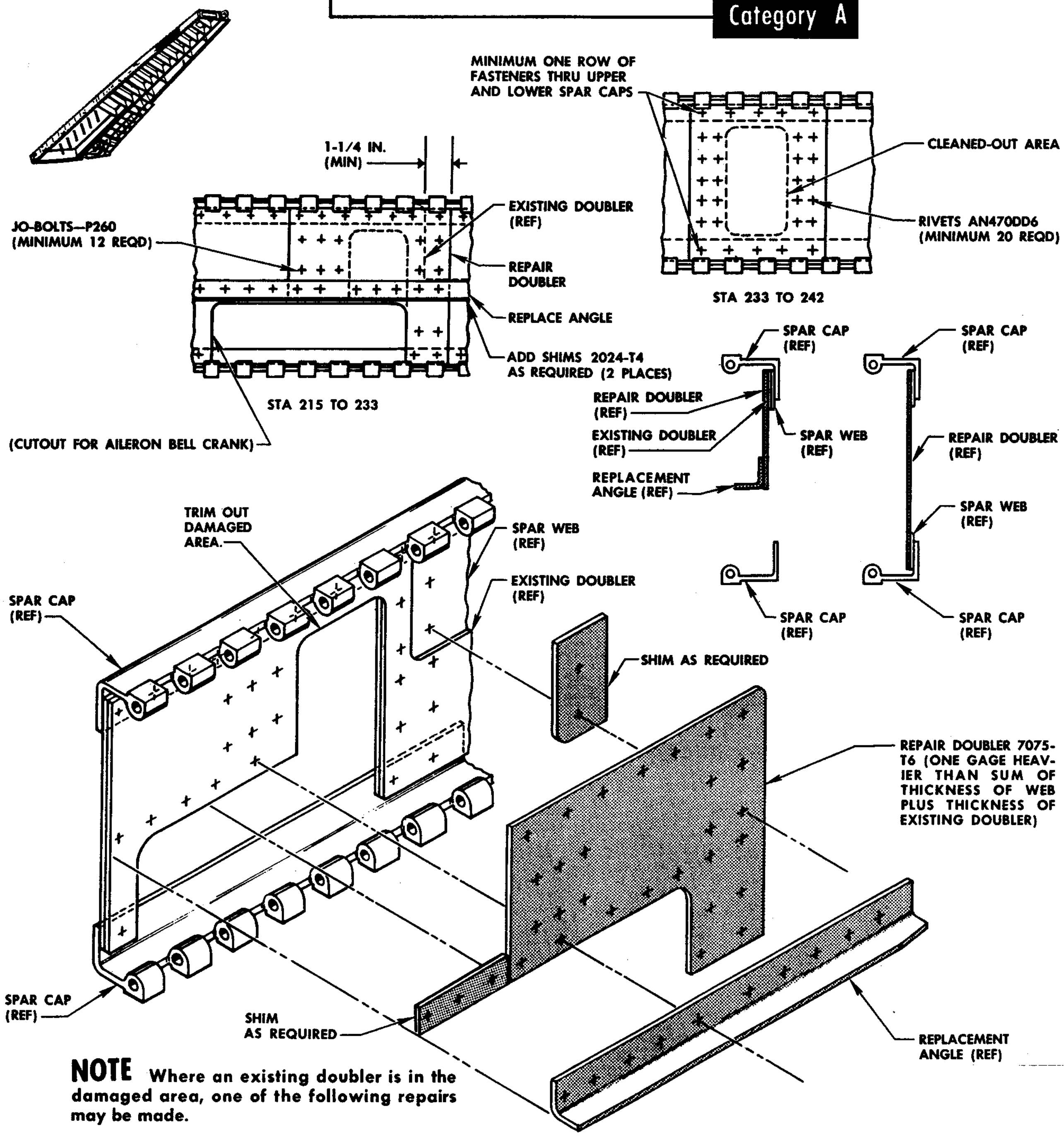
Replace existing rivets with 0.015 oversize or one size larger as necessary.

F-86D-3-10-64

Figure 2-13. Front Spar Web (Sheet 2 of 4)

PERMANENT

Category A



NOTE Where an existing doubler is in the damaged area, one of the following repairs may be made.

Replace entire damaged existing doubler and add a repair doubler one gage heavier than web.

Add to existing doubler another doubler of equal thickness plus a regular repair doubler one gage heavier than web.

Add a repair doubler which is one gage heavier than the sum of the thickness of web plus thickness of existing doubler.

Protruding head P260 Jo-bolts, oversize, or one size larger, may be used where necessary.

Minimum fastener edge distance not less than two times diameter of fastener.

Minimum fastener spacing not less than 3/4 inch.

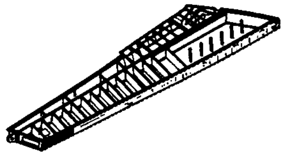
Replace existing rivets with 0.015 oversize or one size larger as necessary.

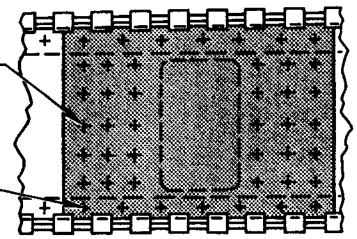
F-86D-3-10-65

Figure 2-13. Front Spar Web (Sheet 3 of 4)

PERMANENT

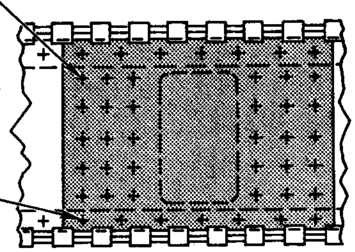
Category A



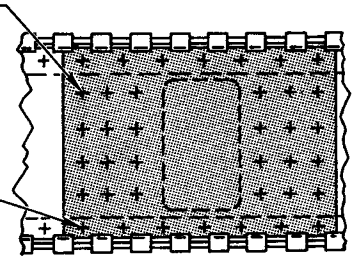


EXTENDED TIP REPAIR

THIS REPAIR TO BE USED FROM STATIONS 242 TO 262 ON AIRPLANES WHICH HAVE EXTENDED TIPS.



STA 242 TO 251



STA 251 TO STA 259.5

NOTE Where an existing doubler is in the damaged area, one of the following repairs may be made:

Replace entire damaged existing doubler and add a repair doubler one gage heavier than web.

Add to existing doubler another doubler of equal thickness plus a regular repair doubler one gage heavier than web.

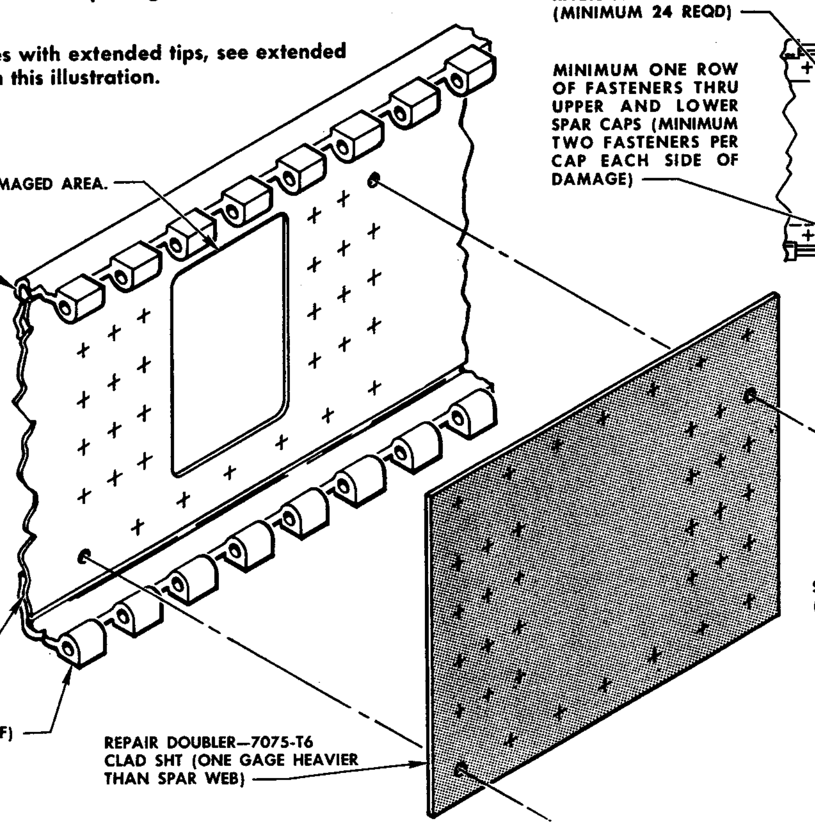
Add repair doubler one gage heavier than sum of thickness of web plus thickness of existing doubler.

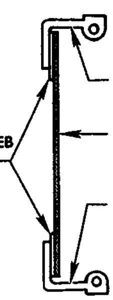
Replace existing rivets with 0.015, oversize, or next size larger, as necessary.

Minimum fastener edge distance not less than two times diameter of fastener.

Minimum fastener spacing not less than 3/4 inch.

For airplanes with extended tips, see extended tip repair on this illustration.





F-86D-3-10-66

Figure 2-13. Front Spar Web (Sheet 4 of 4)

PERMANENT

Category B

NOTE This type of repair is applicable to all intermediate ribs in the wing box section except corrugated ribs. Insert, repair doubler, and rivet layout may be altered to fit the damaged area.

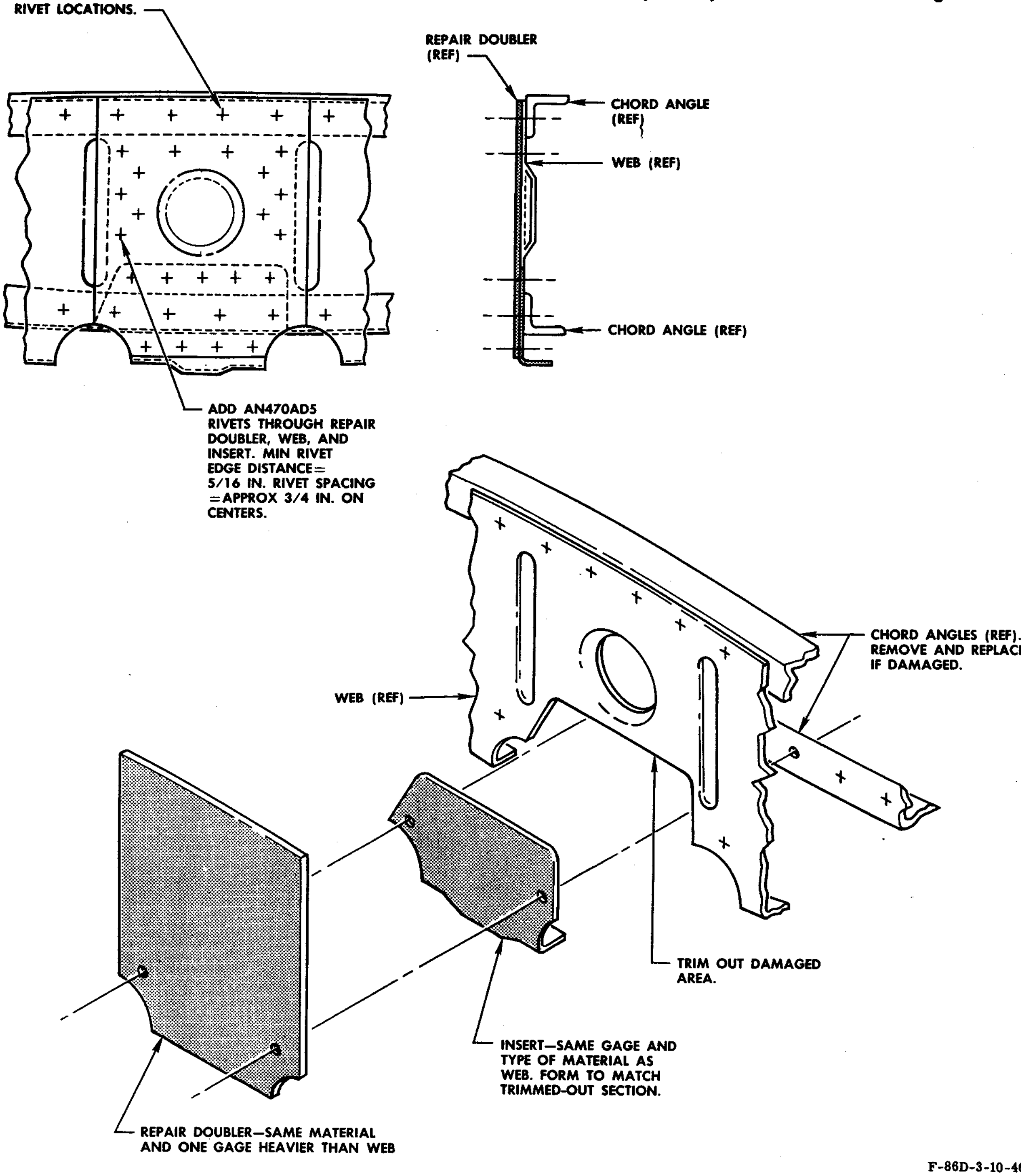
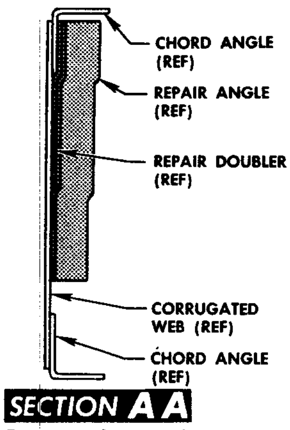


Figure 2-14. Box Section Intermediate Ribs



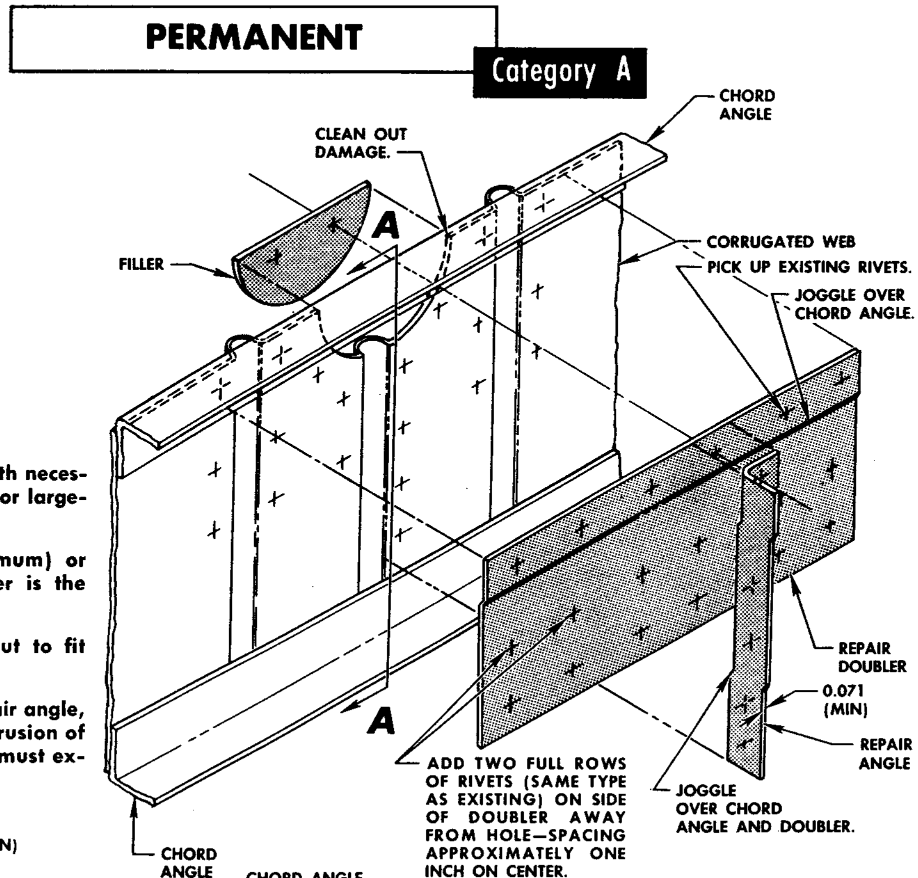
SECTION A A

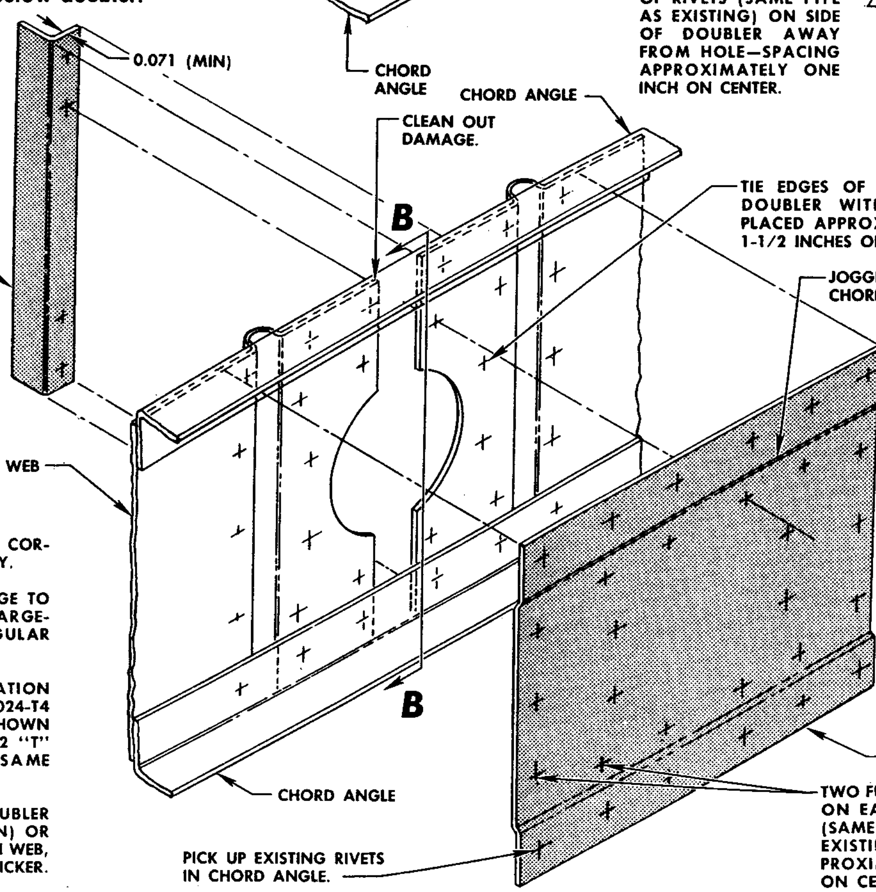
Remove damaged corrugation to depth necessary to clean out damage to circular or large-radius rectangular hole.

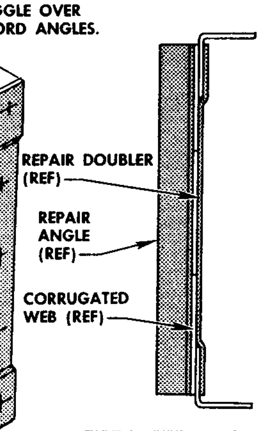
Add 2024-T4 doubler 0.050 (minimum) or 0.010 heavier than web, whichever is the thicker.

Add 0.040-inch filler of 2024-T4, cut to fit cleaned-out area.

Replace corrugation with 2024-T4 repair angle, as shown, or with 2024-T42 "T" extrusion of same thickness. Repair angle or "T" must extend two rivets below doubler.







SECTION B B

REMOVE DAMAGED CORRUGATION ENTIRELY.

CLEAN OUT DAMAGE TO CIRCULAR OR LARGE-RADIUS RECTANGULAR HOLE.

REPLACE CORRUGATION FULL DEPTH WITH 2024-T4 REPAIR ANGLE AS SHOWN OR WITH 2024-T42 "T" EXTRUSION OF SAME THICKNESS.

ADD REPAIR DOUBLER 2024-T4 0.071 (MIN) OR 0.010 HEAVIER THAN WEB, WHICHEVER IS THE THICKER.

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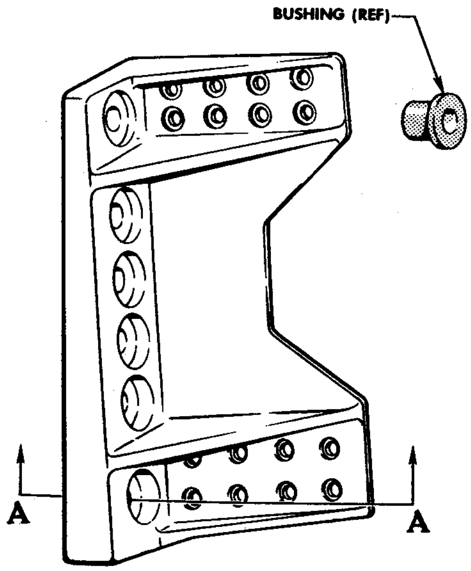
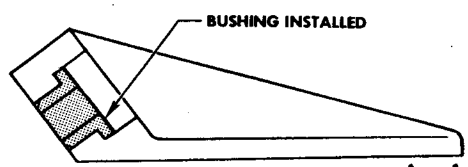
Figure 2-15. Box Section Corrugated Ribs

PERMANENT CATEGORY A

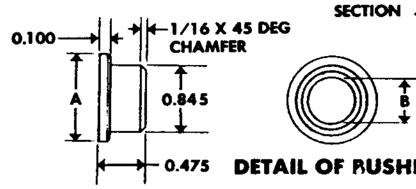
WING



FRONT SPAR ATTACH FITTING



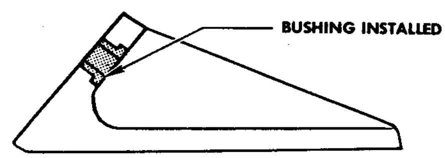
SECTION A–A



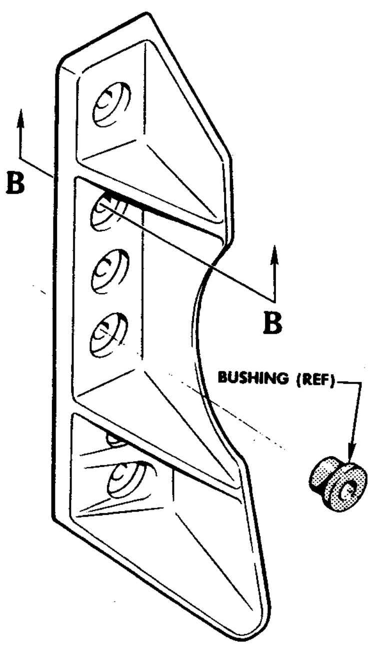
DETAIL OF BUSHING

BUSHING DIMENSIONS	A DIA (IN.)	B DIA (IN.)
-1	0.937	0.5100 (+0.001, −0.004)
-2	1.062	0.5715 (+0.001, −0.004)

NOTE Use -1 bushing in holes No. 2, 3, and 4; use -2 bushing in holes No. 1, 5, and 6.



SECTION B–B



REAR SPAR ATTACH FITTING

1. Hand-ream elongated holes to "true up" circumference.
2. Minimum diameter of the reamed holes is 0.578 inch for the 1/2-inch holes and 0.640 inch for the 9/16-inch holes.
3. Maximum diameter for the reamed holes in the front spar attach fitting is 0.8438 inch. For the rear spar attach fitting, the maximum diameter for reamed hole No. 1 is 0.782 inch; for reamed holes No. 2, 3, and 4, 0.8125 inch. If holes cannot be "trued up" within these limits, the fitting must be replaced.
4. Machine the outside diameter of the bushing so that the finished diameter (after plating) will be 0.0005 to 0.0010 inch over the diameter of the reamed hole.
5. Chamfer the end of the bushing 1/16 inch X 45 degrees, and cadmium plate it in accordance with Federal Specification QQ-P-416.
6. Press bushing into fitting from outboard side of fitting.

NOTE Holes in the wing spar attach fittings are numbered from top to bottom.

- Use -2 bushing in holes No. 1, 2, 3, and 4 of the rear spar attach fitting. No. 5 and 6 use barrel nuts. These holes (No. 5 and 6) cannot be repaired by this method.

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Figure 2-15A. Wing-to-Fuselage Attach Fitting Repair

PERMANENT

Category A

NOTE Length of repair = approximately 6 inches plus damage.

Refer to list of illustrations for page number of bend radii table.

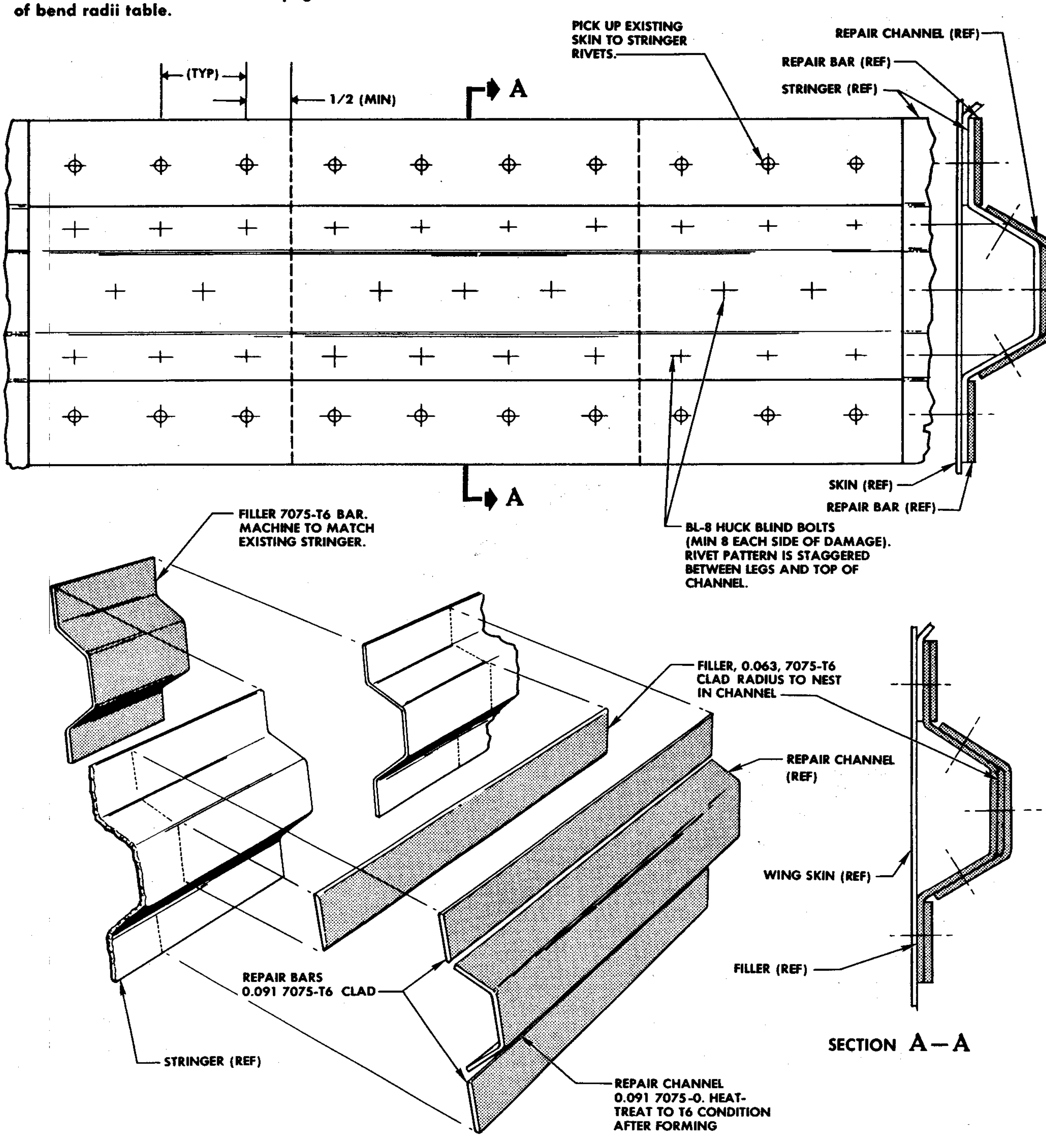


Figure 2-15B. Stringer Repair

PERMANENT

Category A

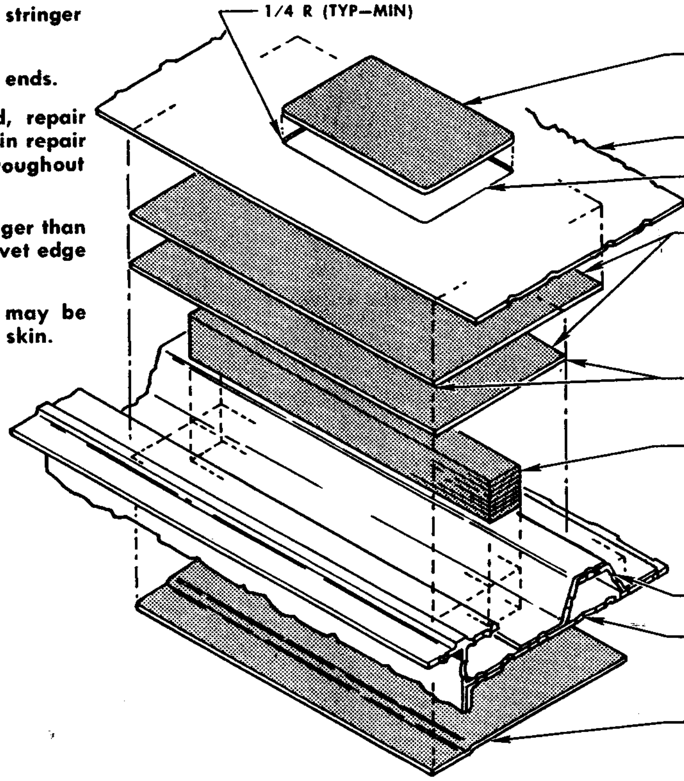
NOTE This repair may be used where outer skin is damaged and the inner skin and stringer is cracked.

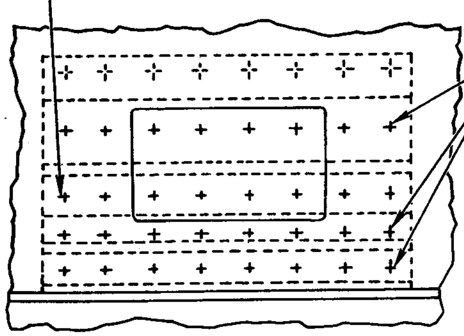
All cracks must be stop-drilled at both ends.

Where outer skin alone is damaged, repair may be made, using the two outer skin repair doublers only and F-200 Jo-bolts throughout the repair.

Make all repair members 5 inches longer than cleaned-up damage area. Minimum rivet edge distance = two times rivet diameter.

Edges of outer skin repair doublers may be chamfered if necessary to drive under skin.





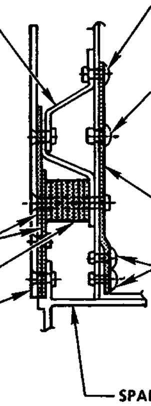


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Figure 2-16. Wing Outer Skin—Station 126 Inboard

PERMANENT

Category A

NOTE This repair is to be used only when inner skin is not damaged and when stringers are not broken. A cracked stringer may be repaired by stop-drilling the crack at both ends and installing the repair channel.

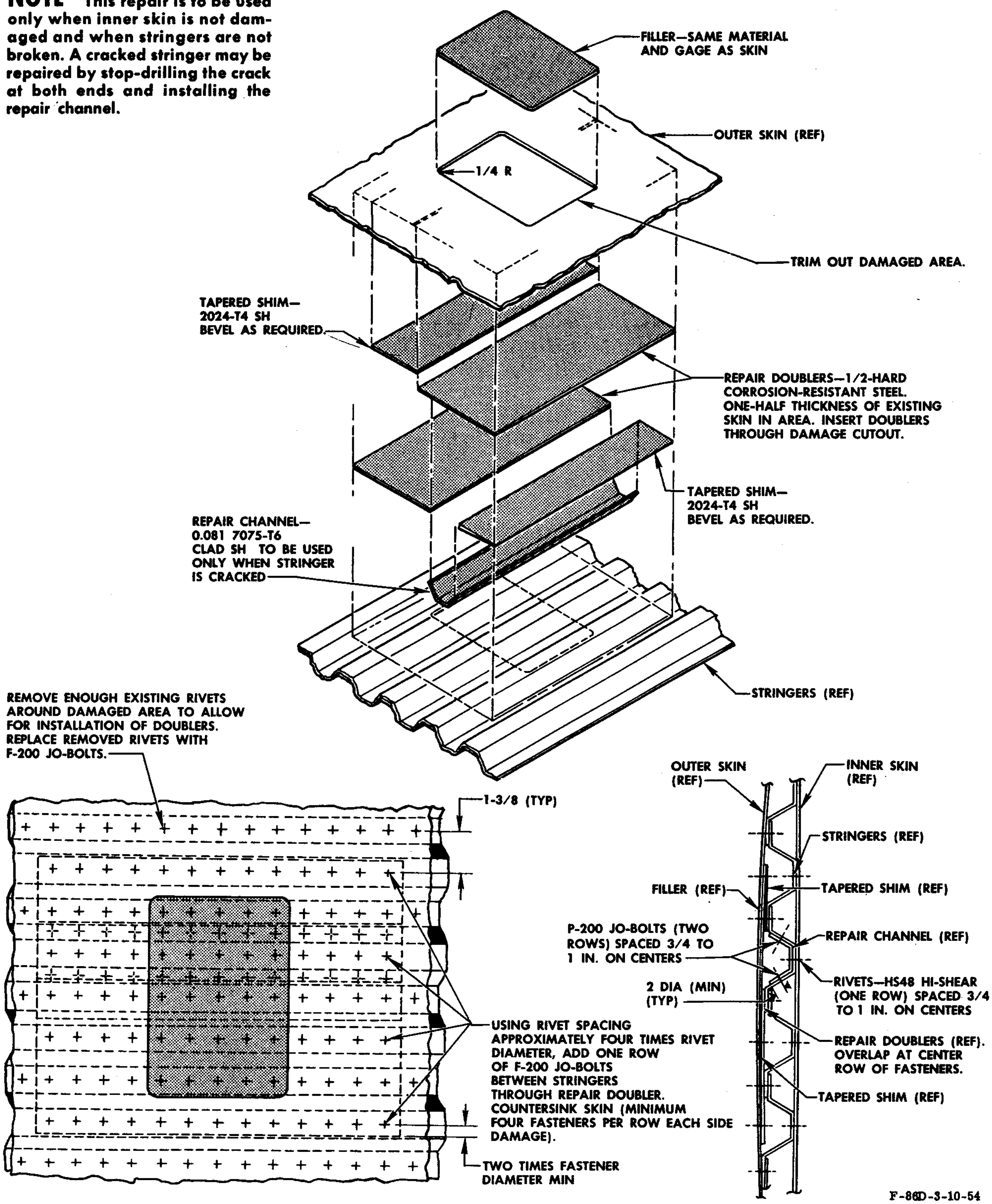
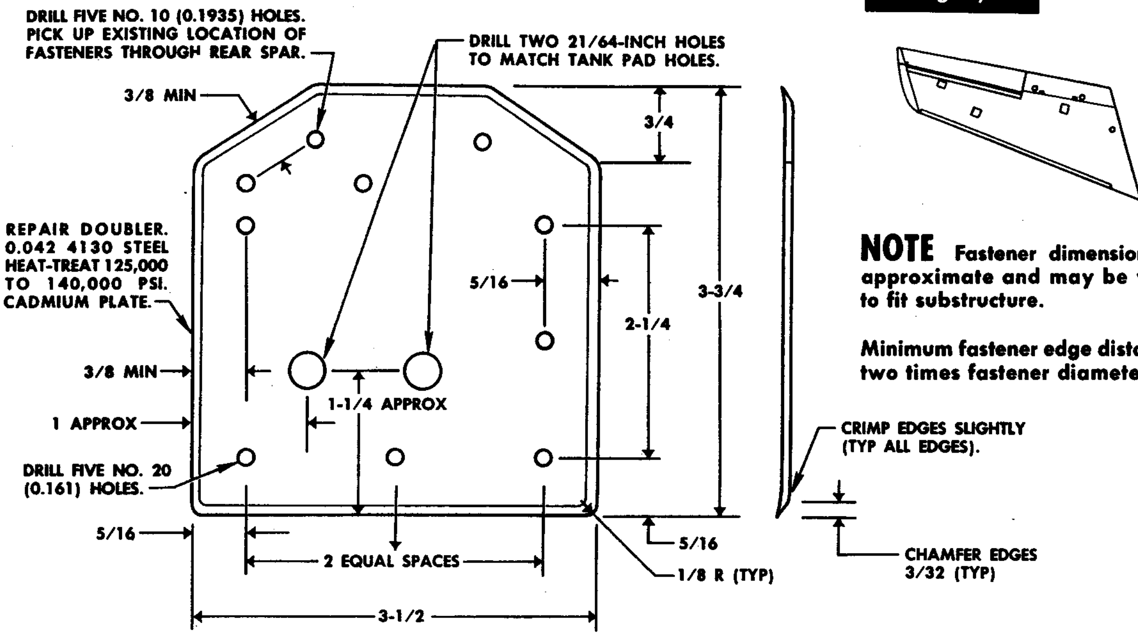


Figure 2-17. Wing Outer Skin, Stringer, and Inner Skin—Station 126 Inboard

TEMPORARY

Category A



NOTE Fastener dimensions are approximate and may be varied to fit substructure.

Minimum fastener edge distance = two times fastener diameter.

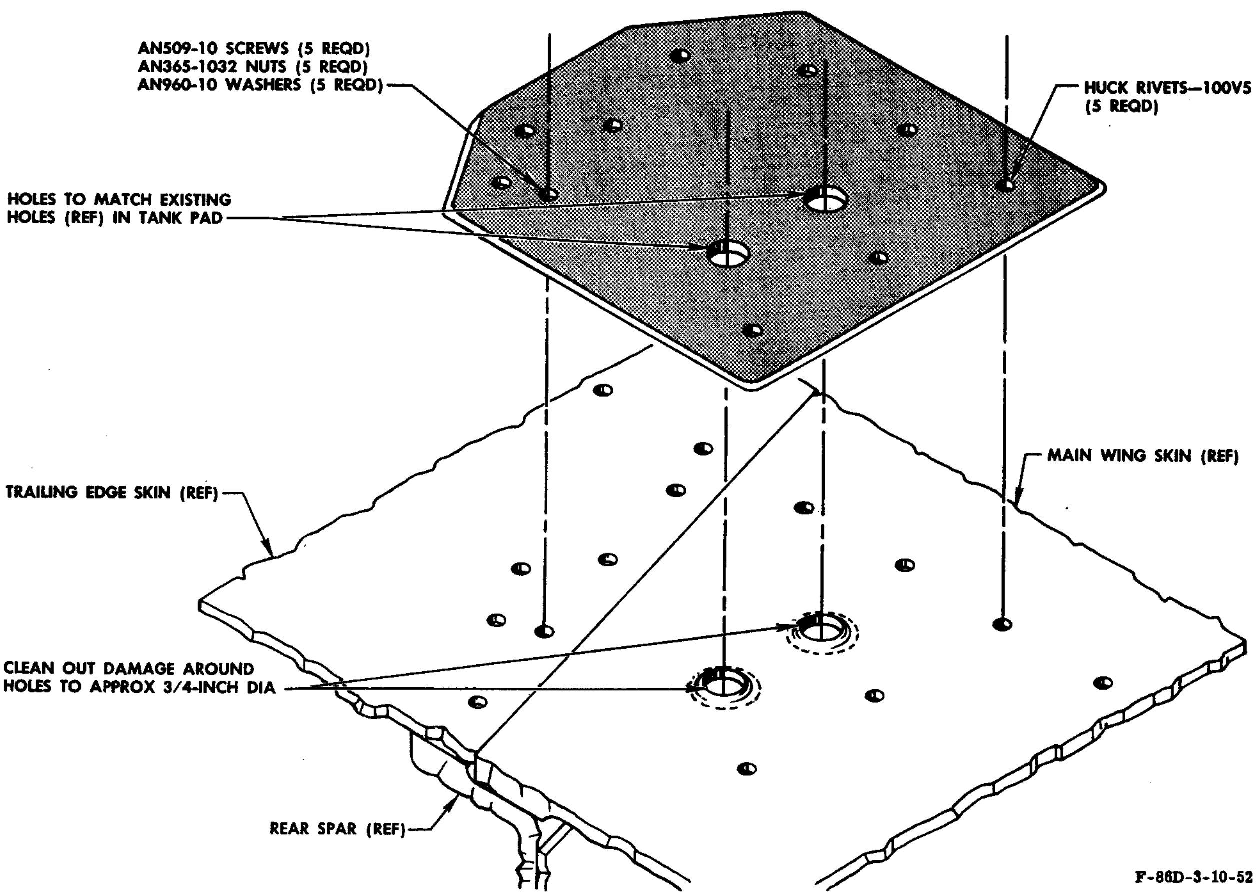
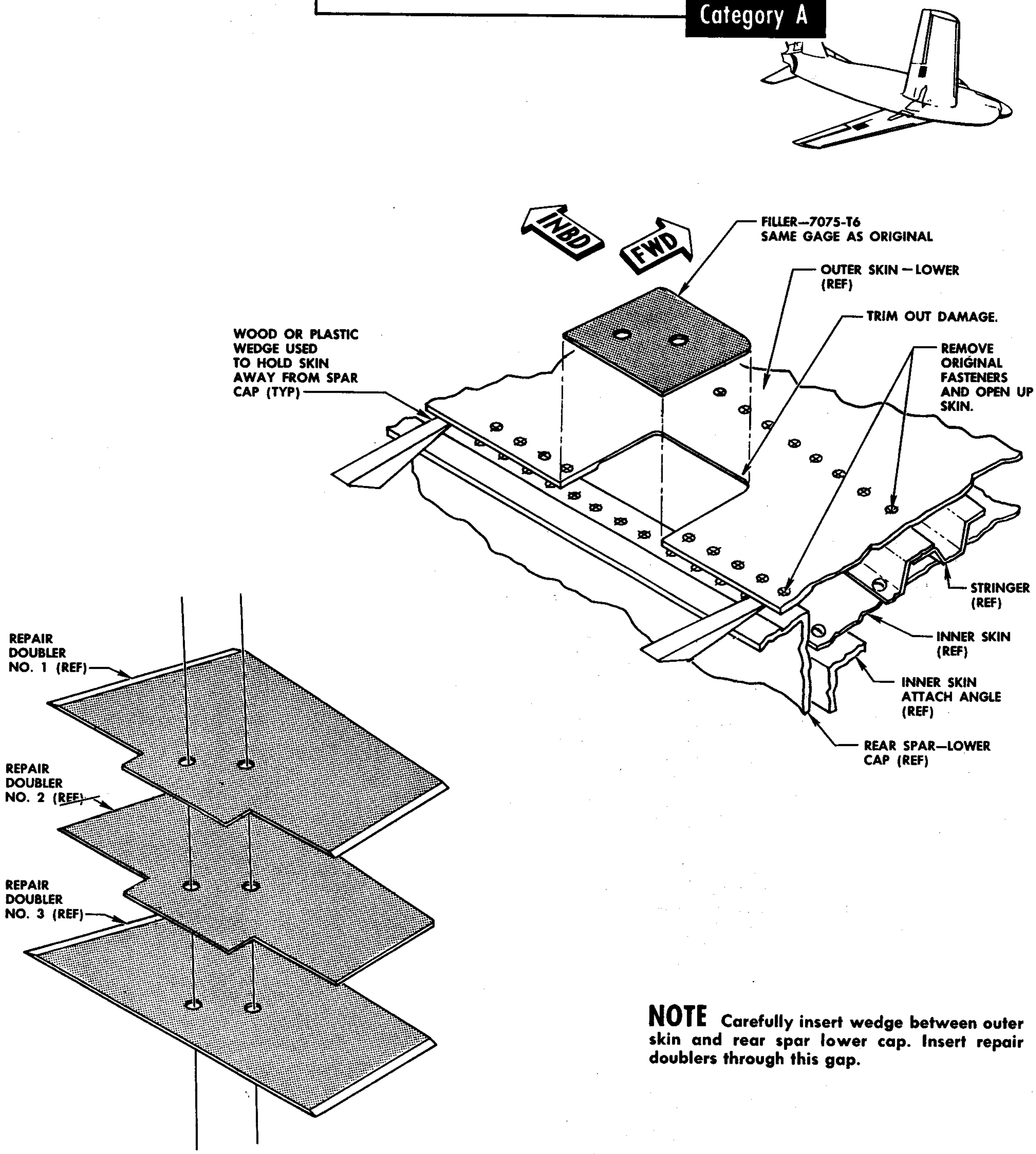


Figure 2-18. Wing Skin at Auxiliary Fuel Tank Pads (Sheet 1 of 3)

PERMANENT Category A



NOTE Carefully insert wedge between outer skin and rear spar lower cap. Insert repair doublers through this gap.

F-86D-3-10-67

Figure 2-18. Wing Skin at Auxiliary Fuel Tank Pads (Sheet 2 of 3)

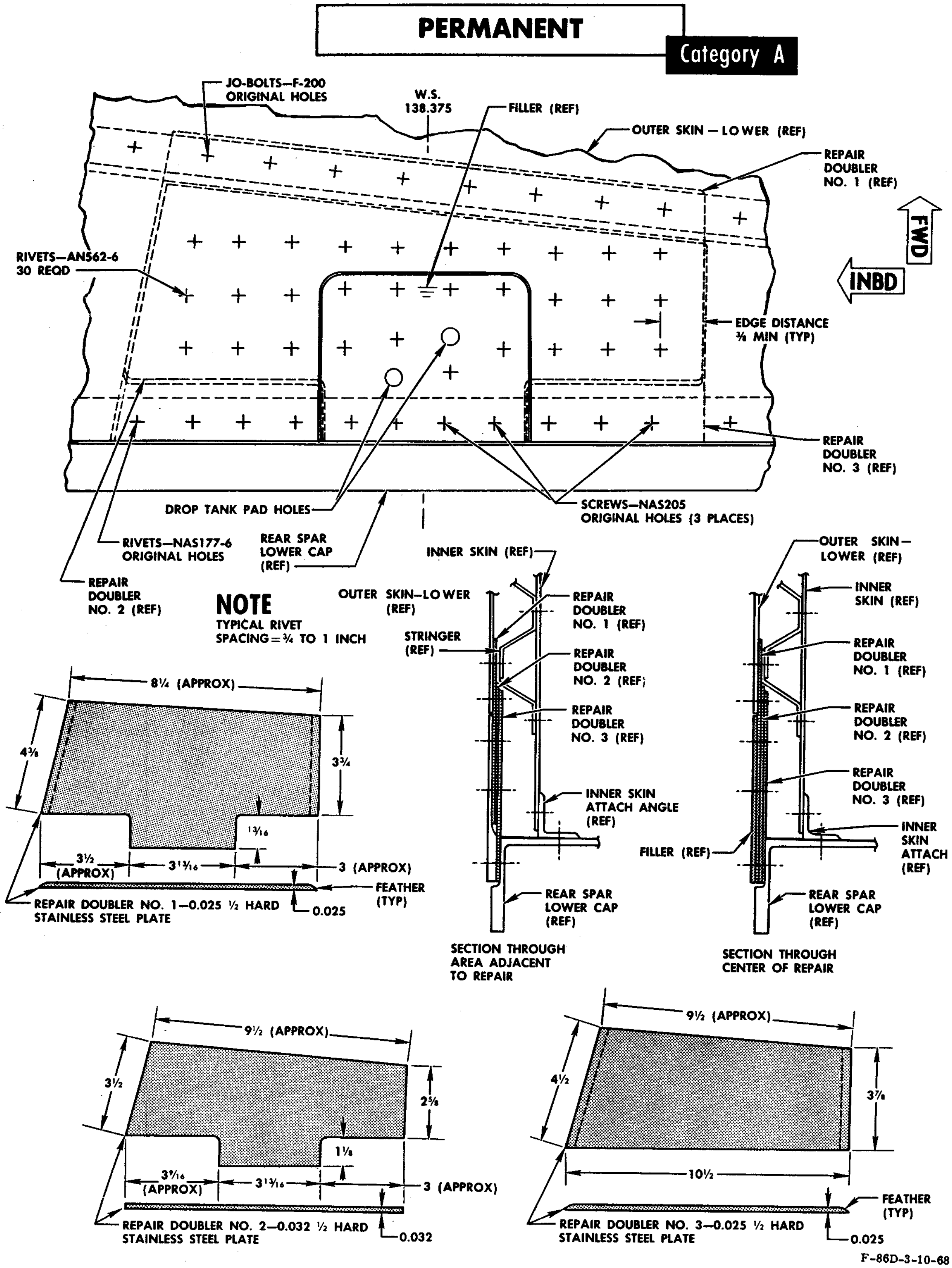
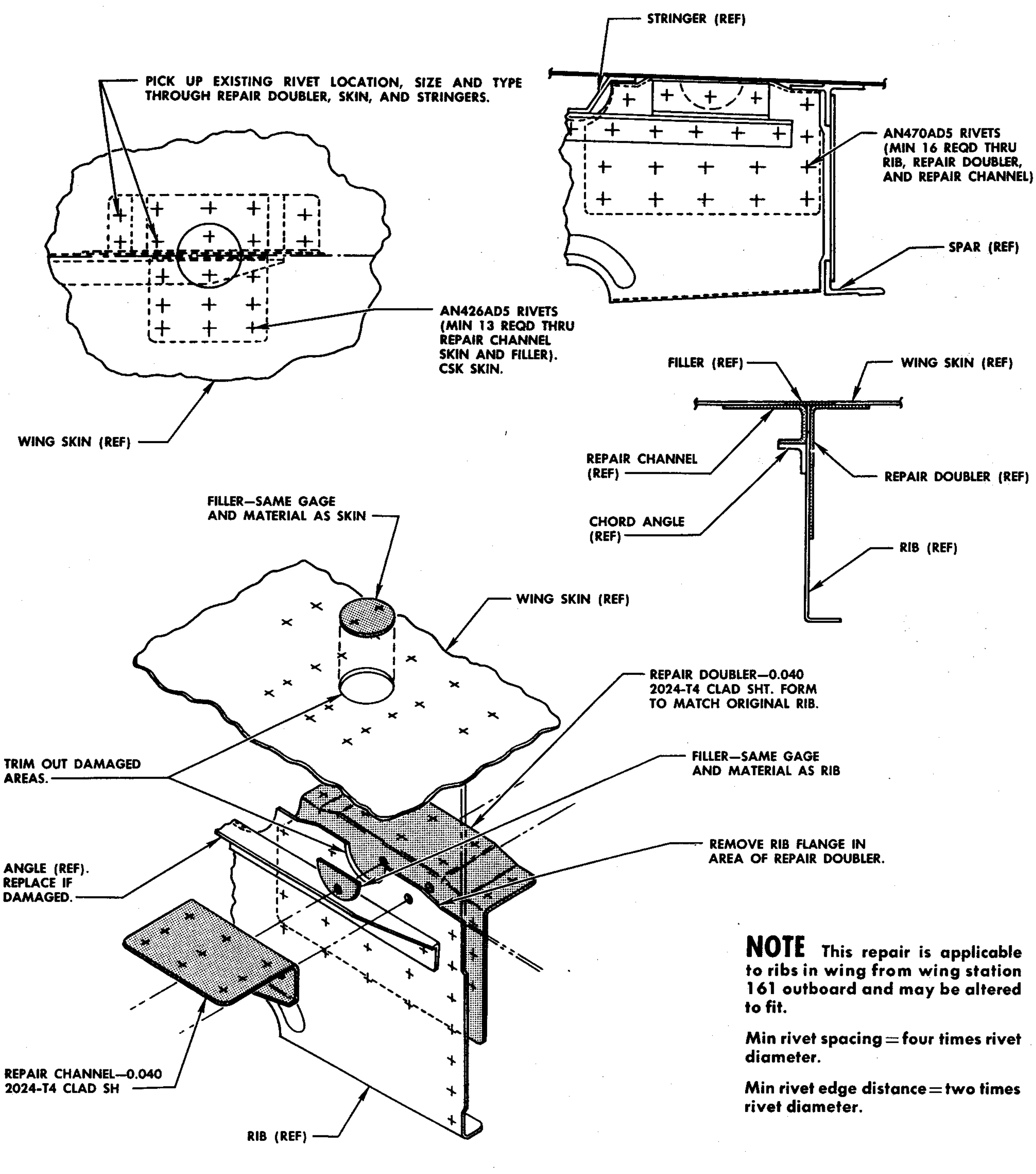


Figure 2-18. Wing Skin at Auxiliary Fuel Tank Pads (Sheet 3 of 3)

PERMANENT

Category B



NOTE This repair is applicable to ribs in wing from wing station 161 outboard and may be altered to fit.

Min rivet spacing = four times rivet diameter.

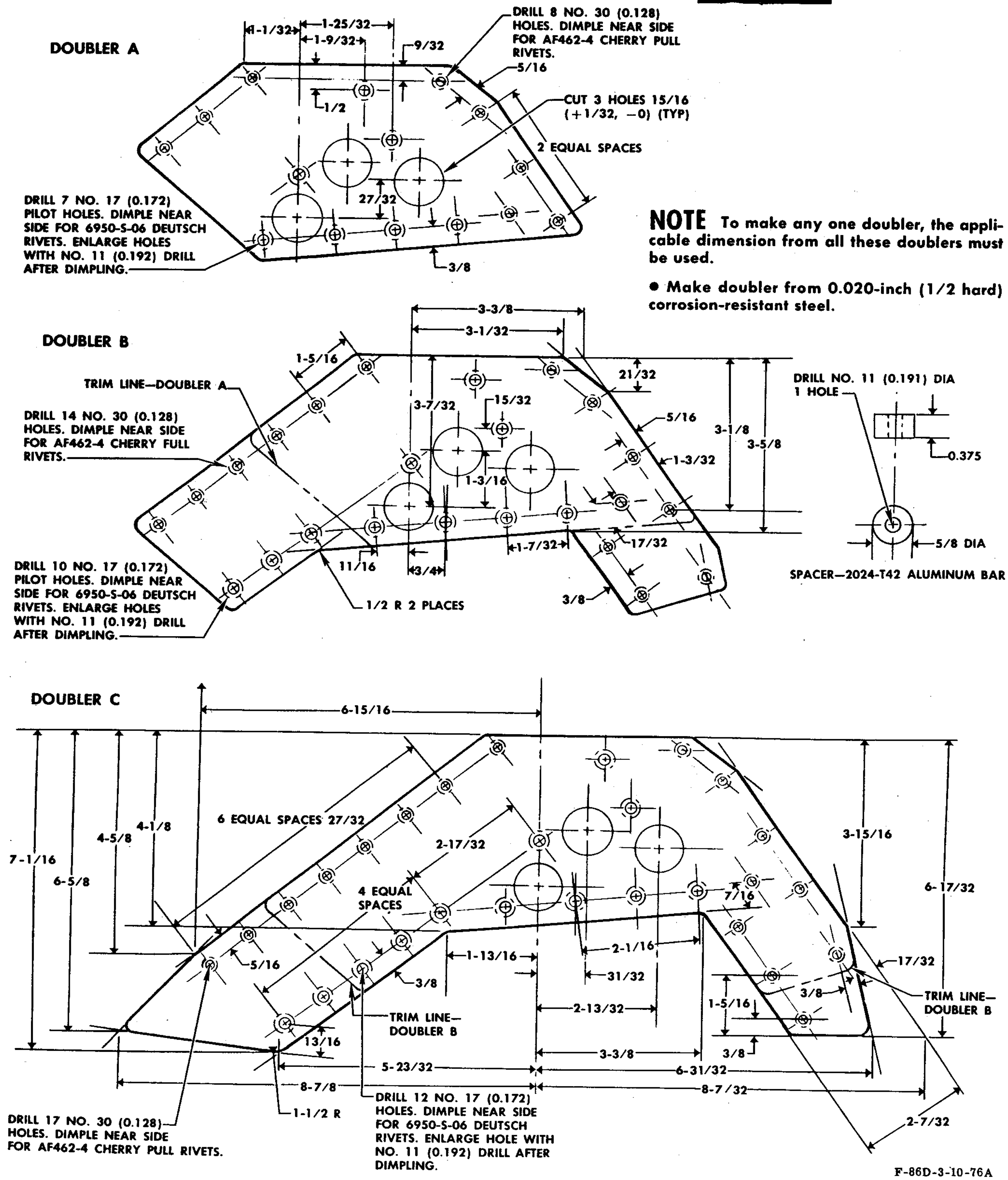
Min rivet edge distance = two times rivet diameter.

F-86D-3-10-58

Figure 2-19. Wing Skin and Rib Flange—Station 161 Outboard

PERMANENT

Category A



NOTE To make any one doubler, the applicable dimension from all these doublers must be used.

- Make doubler from 0.020-inch (1/2 hard) corrosion-resistant steel.

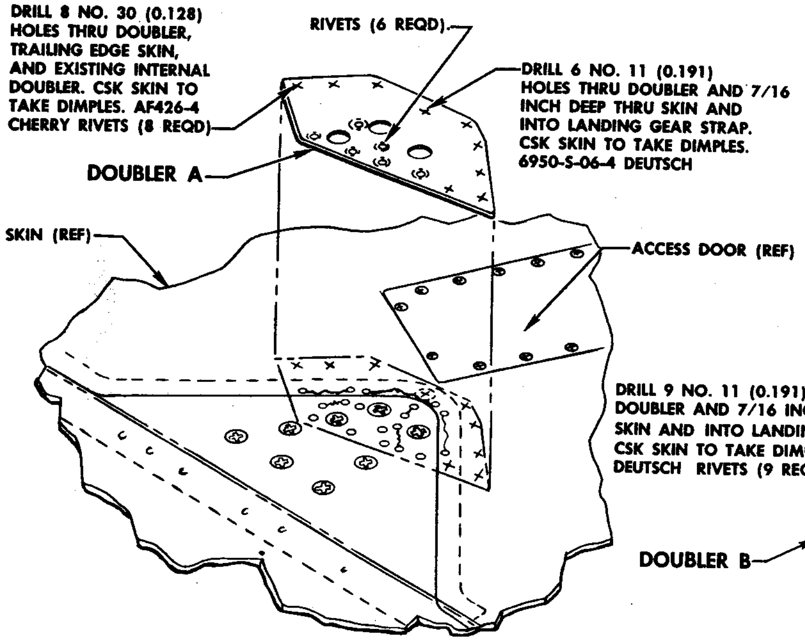
Figure 2-20. Wing Skin at Landing Gear Trunnion (Sheet 1 of 2)

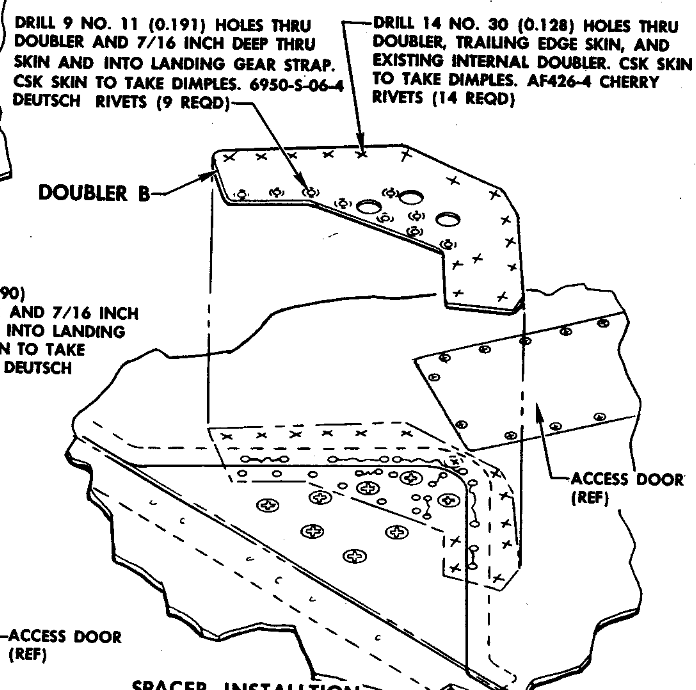
PERMANENT

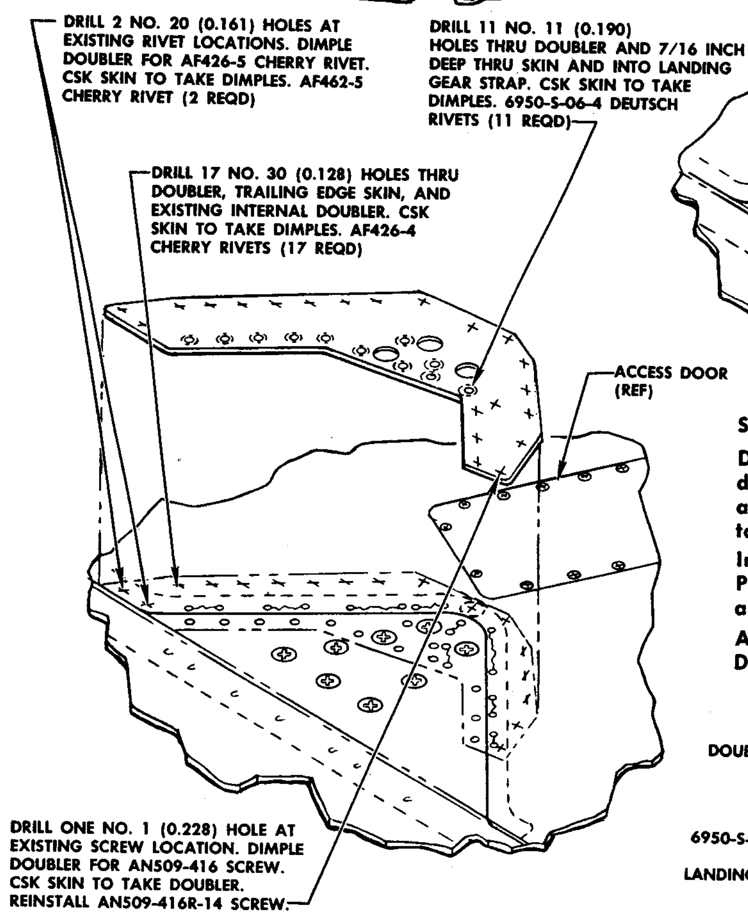
Category A

NOTE Select doubler which will overlap stop-drilled ends of cracks by a minimum of one inch.

- Locate doubler by centering 15/16-inch holes with flush screws in box skin.
- Care must be taken to control the depth of the drilled holes to prevent nicking the trunnion fitting below the skin.
- Stop-drill all cracks with No. 30 (0.128-inch) drill through skin only.
- Refer to index for installation of Deutsch rivets.







SPACER INSTALLTION

Drill one No. 11 (0.191-inch) hole through doubler, trailing edge skin, internal doubler, and wing box skin ledge. Countersink skin to take dimple.

Install spacer through access door opening. Place spacer between landing gear trunnion and wing box skin ledge.

Align spacer with hole in doubler and install Deutsch rivet.

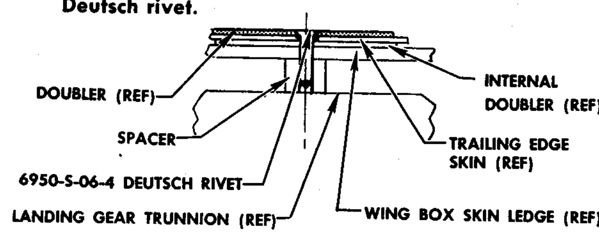


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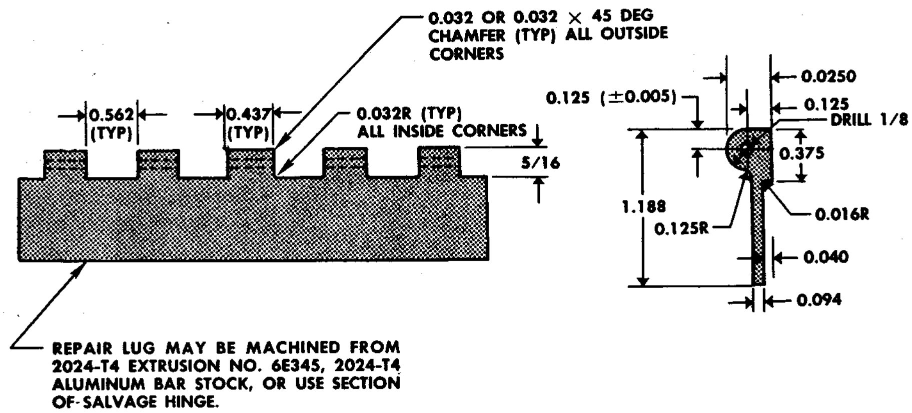
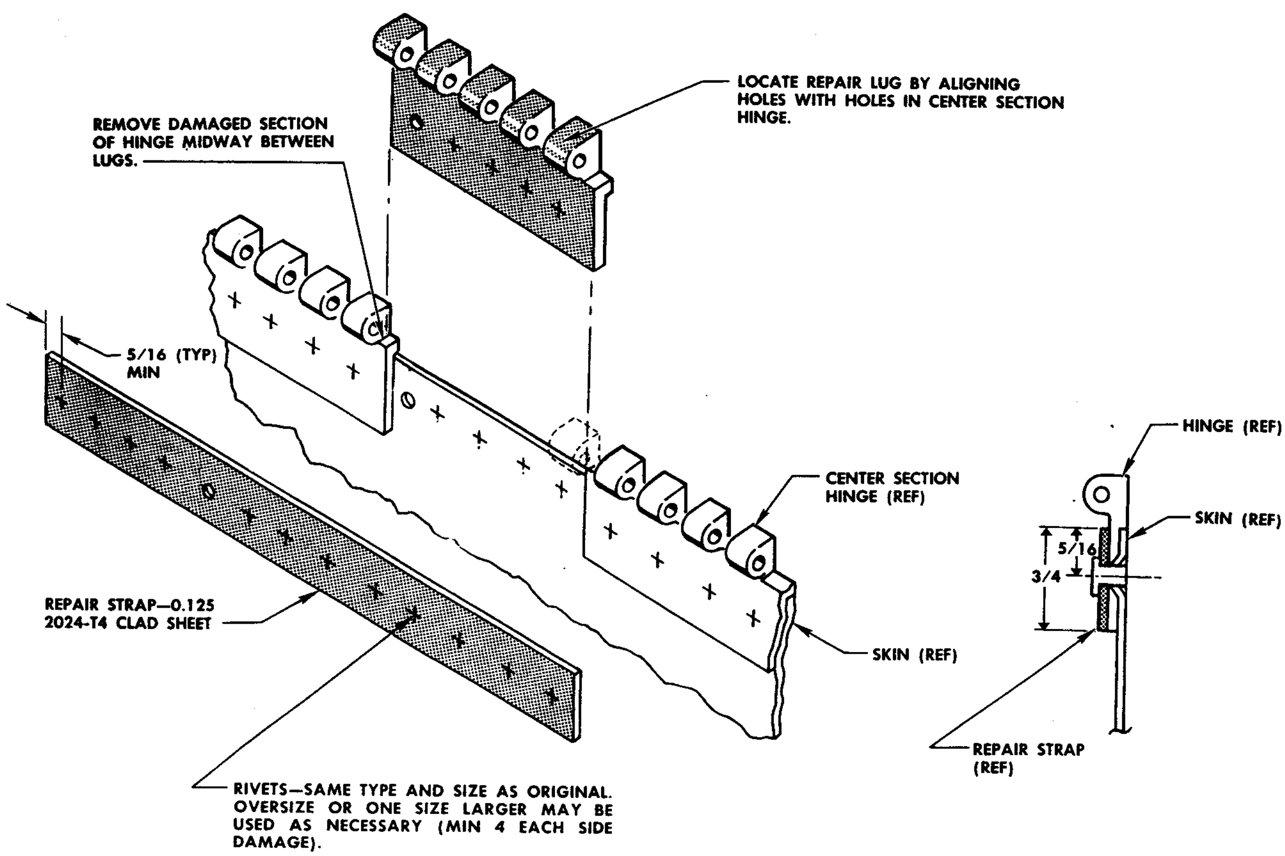
Figure 2-20. Wing Skin at Landing Gear Trunnion (Sheet 2 of 2)

PERMANENT

Category A





F-86D-3-10-51

Figure 2-21. Wing Center Section Hinge (Sheet 1 of 2)

PERMANENT Category A

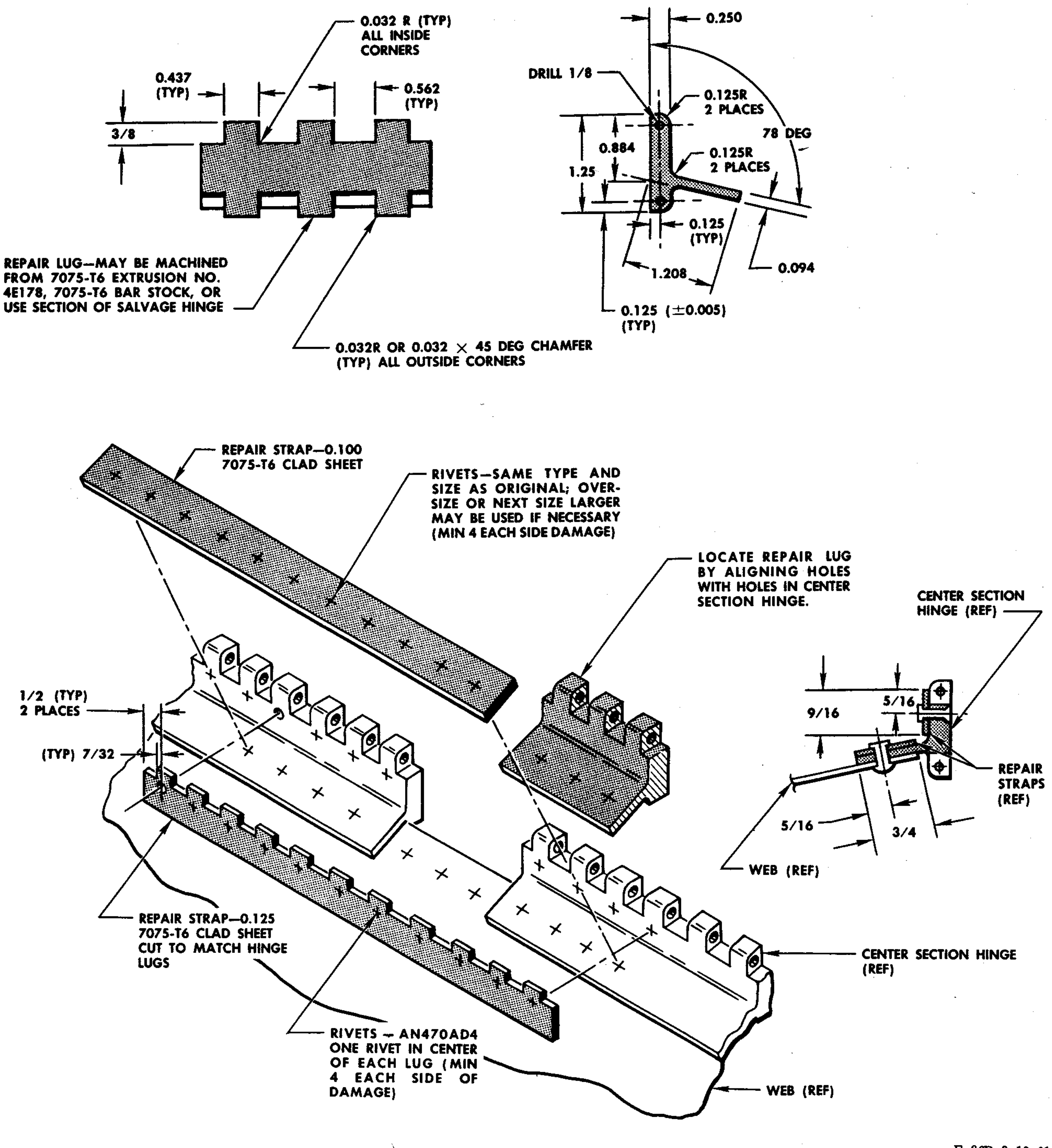
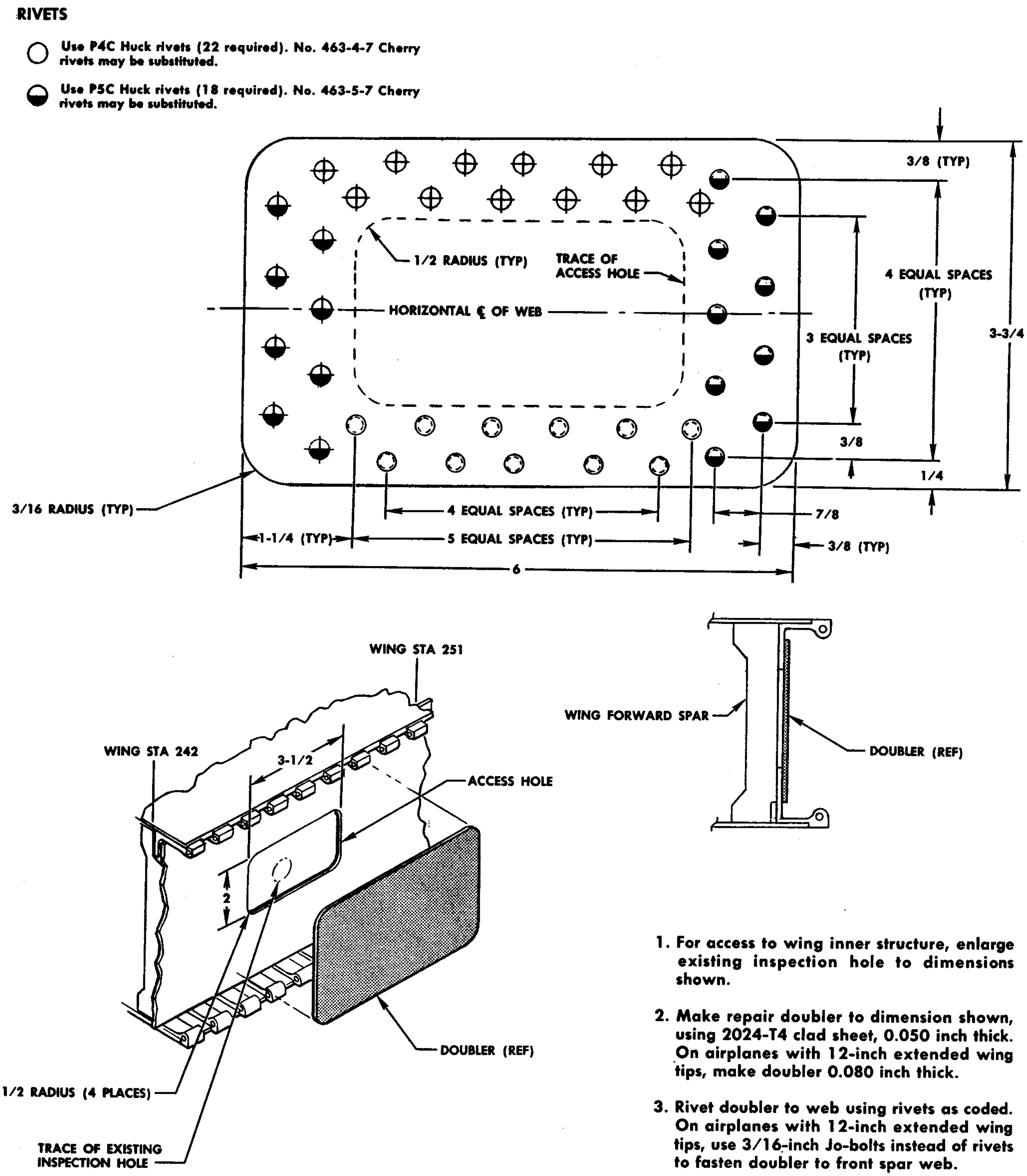


Figure 2-21. Wing Center Section Hinge (Sheet 2 of 2)

PERMANENT

Category A



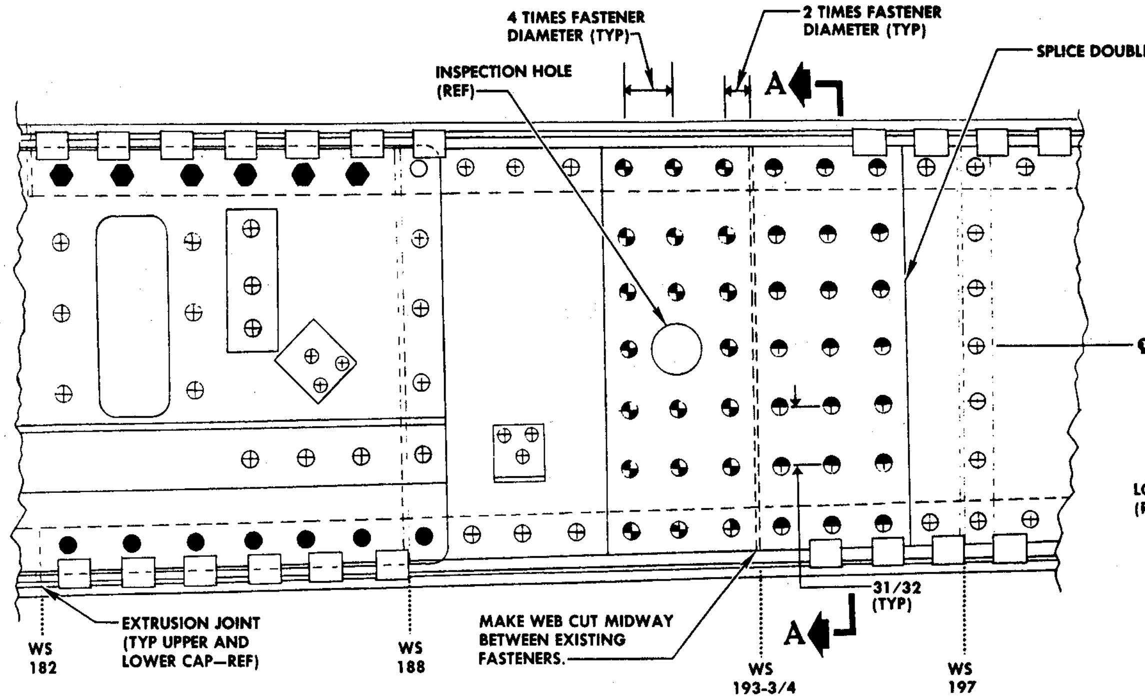
1. For access to wing inner structure, enlarge existing inspection hole to dimensions shown.
2. Make repair doubler to dimension shown, using 2024-T4 clad sheet, 0.050 inch thick. On airplanes with 12-inch extended wing tips, make doubler 0.080 inch thick.
3. Rivet doubler to web using rivets as coded. On airplanes with 12-inch extended wing tips, use 3/16-inch Jo-bolts instead of rivets to fasten doubler to front spar web.

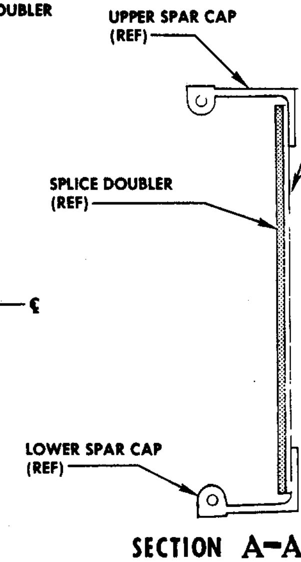
F-86D-3-10-80

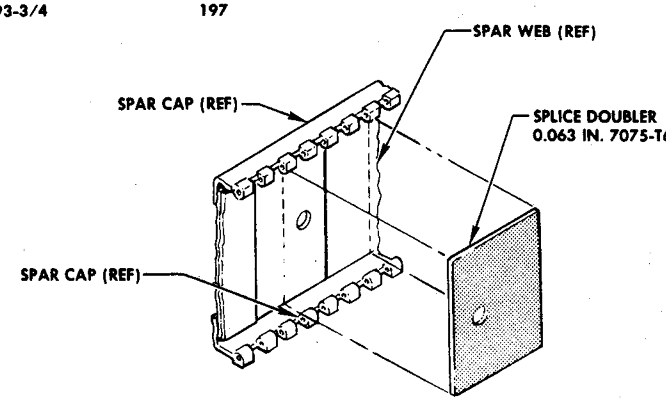
Figure 2-23. Access for Repairs Through Front Spar Web—Station 242 to 259

PERMANENT CATEGORY A

WING







In order to gain access to make a satisfactory skin repair outboard of station 188, the following procedure may be used to temporarily remove a section of the front spar:

1. Cut front spar web between fasteners at station 193-3/4.
2. Remove rivets through outer skin and spar caps from station 182 outboard.
3. Remove rivets through spar web and spar caps between stations 182 and 193-3/4.
4. Remove rivets through spar web and wing ribs outboard of station 193-3/4.
5. Remove outboard section of spar web and spar caps.

When repair has been completed, splice outer spar assembly as follows:

1. Fasten splice doubler to outer spar assembly with fasteners shown.
2. Reinstall outer spar section and replace rivets through skin and spar caps.
3. Install three rows of Jo-bolts through splice doubler and spar web.
4. Replace the 12 removed Hi-Shear rivets through spar cap and webs between stations 182 and 188 with fasteners of same diameter as the ones removed. Refer to "Fastener Code" chart for type of fasteners to be used.
5. Install three rows of Jo-bolts through splice doubler and spar web to complete repair.

FASTENER CODE

- ⊕ Replace with original-type fastener.
- Replace original fastener with P200 Jo-bolts.
- Replace original fastener with NAS178-6 Hi-Shear rivets.
- ● Replace original fastener with AN509 screws.
- ⬢ Replace original fasteners with AN3 and AN4 bolts.

F-86D-3-10-90

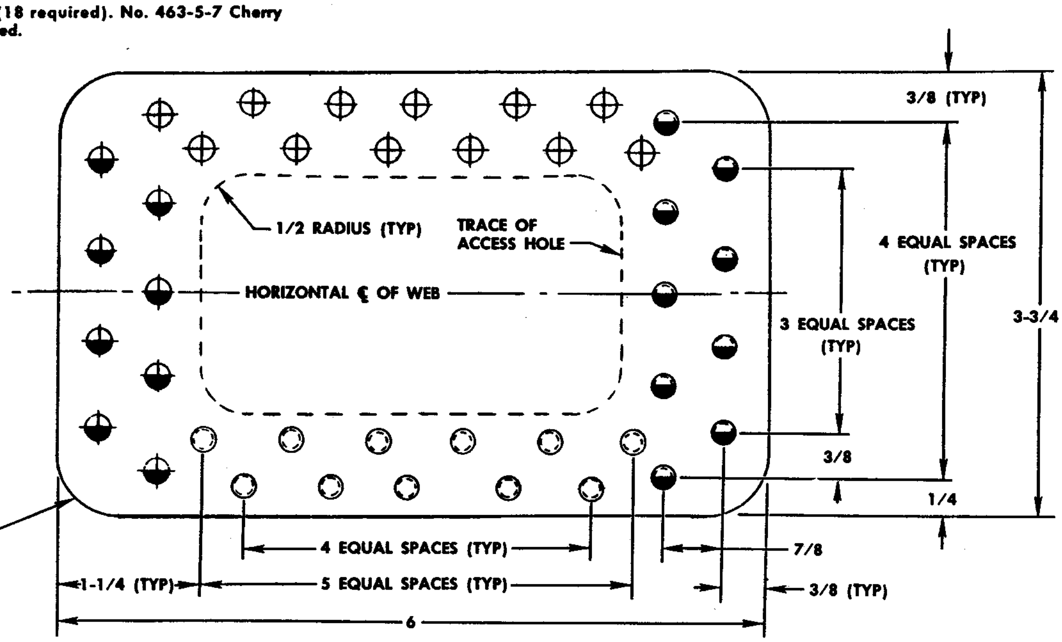
Figure 2-22A. Spar Splice at Station 193-3/4—Access for Skin Repair

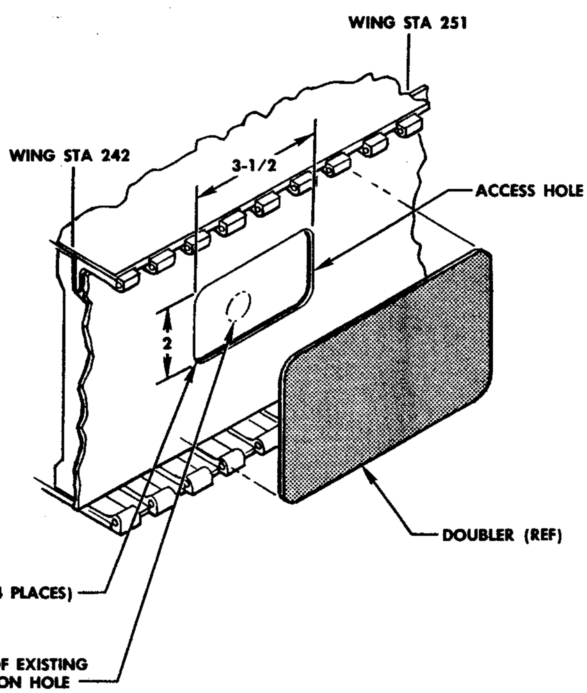
PERMANENT Category A

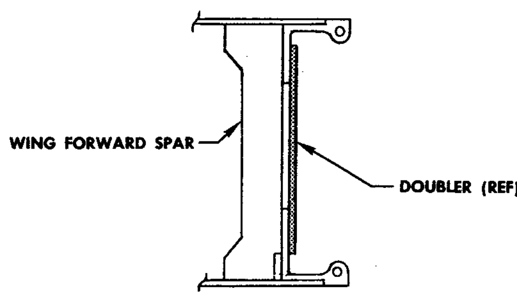
RIVETS

○ Use P4C Huck rivets (22 required). No. 463-4-7 Cherry rivets may be substituted.

◒ Use P5C Huck rivets (18 required). No. 463-5-7 Cherry rivets may be substituted.







1. For access to wing inner structure, enlarge existing inspection hole to dimensions shown.

2. Make repair doubler to dimension shown, using 2024-T4 clad sheet, 0.050 inch thick. On airplanes with 12-inch extended wing tips, make doubler 0.080 inch thick.

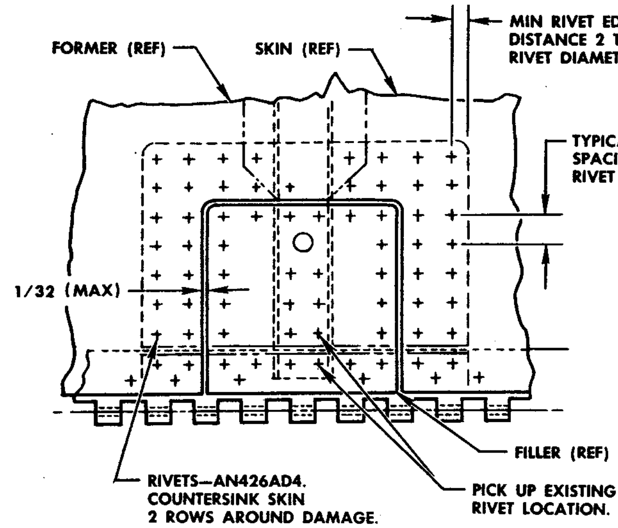
3. Rivet doubler to web using rivets as coded. On airplanes with 12-inch extended wing tips, use 3/16-inch Jo-bolts instead of rivets to fasten doubler to front spar web.

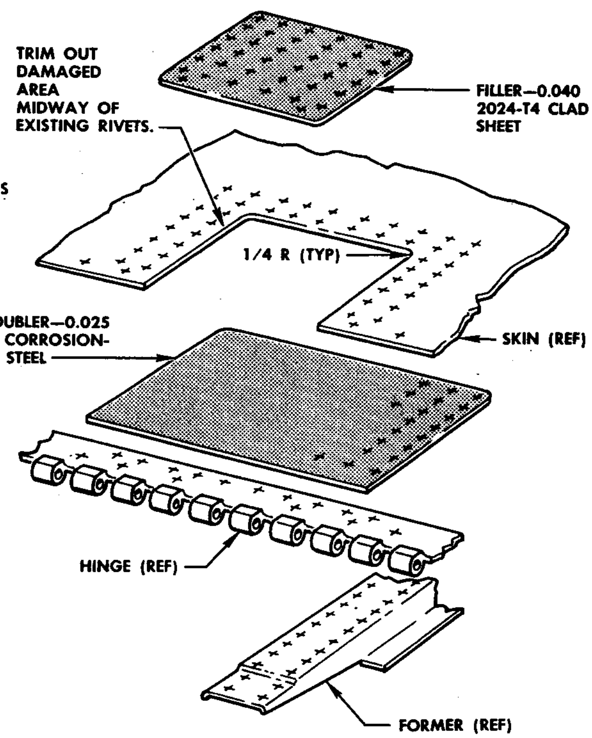
F-86D-3-10-80

Figure 2-23. Access for Repairs Through Front Spar Web—Station 242 to 259

PERMANENT

Category A

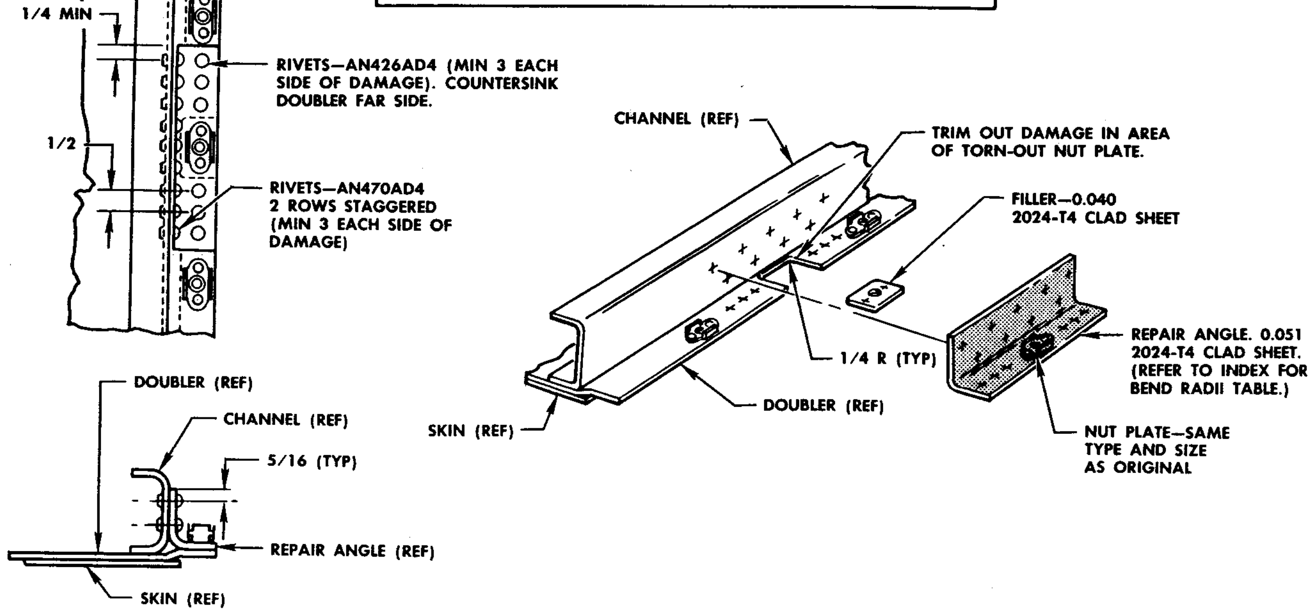




NOTE

Damaged formers should be replaced.

REPLACING DAMAGED NUT PLATE



F-86D-3-10-62

Figure 2-22. Wing Center Section Fairing (Sheet 2 of 2)

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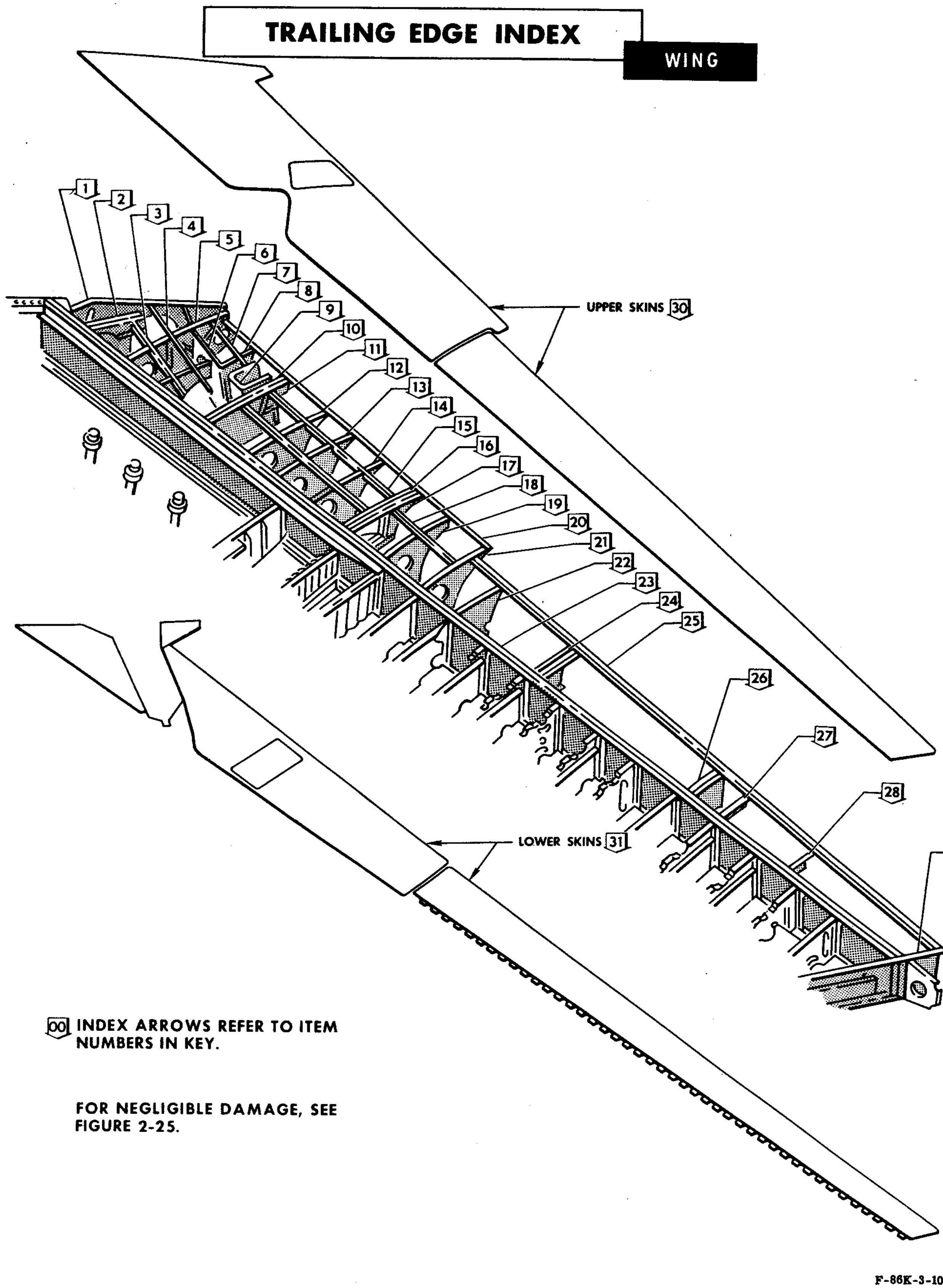


Figure 2-24. Wing Trailing Edge Index

ITEM NO.	DRAWING NO.*	DESCRIPTION	GAGE	MATERIAL	REPAIR FIGURE NO.†
1	165-14266	Rib Assy	0.040	2040-T4 Clad	
2	165-14067	Rib Assy	0.072	2024-T4 Clad	
3	165-14006	Stringer		2024-T42 Extr	
4	165-14006	Stringer		2024-T42 Extr	
5	165-14068	Rib Assy	0.040	2024-T4 Clad	
6	151-14065	Beam Assy	0.032	2024-T4 Clad	
7	165-14069	Rib Assy	0.040	2024-T4 Clad	
8	165-14006	Stringer		2024-T42	
9	165-14006	Doubler	0.064	2024-T4 Clad	
10	151-14635	Angle Assy			
11	151-14634	Angle Assy		2024-T42 Extr	
12	165-14070	Rib Assy	0.032	2024-T4 Clad	
13	165-14071	Rib Assy	0.032	2024-T4 Clad	
14	165-14072	Rib Assy	0.032	2024-T4 Clad	
15	165-14006	Stringer		2024-T42 Extr	
16	165-14177	Rib Assy	0.040	2024-T4 Clad	
17	165-14176	Rib Assy	0.040	2024-T4 Al Clad	
18	165-14006	Stringer		2024-T42 Extr	
19	165-14073	Rib Assy	0.032	2024-T4 Clad	
20	151-14152	Trailing Edge		Magnesium Extr	
21	165-14074	Rib Assy	0.032	2024-T4 Clad	
22	165-14607	Rib Assy	0.040	2024-T4 Clad	
23	165-14005	Spar Assy	0.032	7075-T6 Clad	
24	165-14628	Rib Assy	0.064	2024-T4 Clad	
25	165-14239	Trailing Edge		61S-T6 Extr	2-25
26	165-14652	Rib Assy	0.040	2024 Clad	
27	165-14662	Rib Assy	0.040	2024-T4 Clad	
28	165-14685	Rib Assy	0.064	2024-T4 Clad	
29	165-14560	Rib Assy	0.032	2024-T4 Clad	
30	165-14006	Upper Skin	0.032	2024-T4 Clad	
31	165-14006	Lower Skin	0.032	2024-T4 Clad	

***Drawing numbers are for reference only.**
†For additional repairs, refer to Section X.

Key to Figure 2-24

TRAILING EDGE NEGLIGIBLE DAMAGE

WING

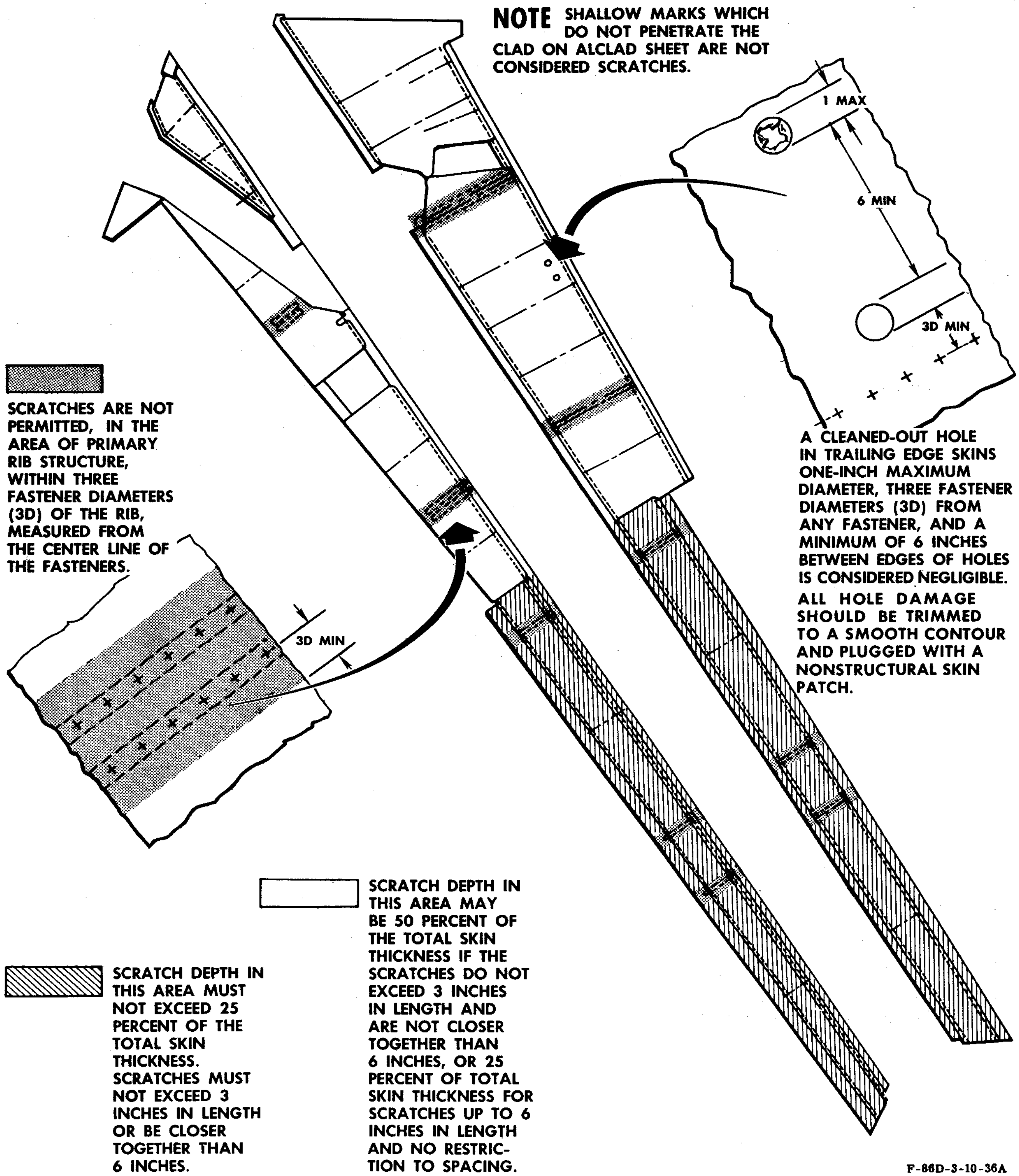
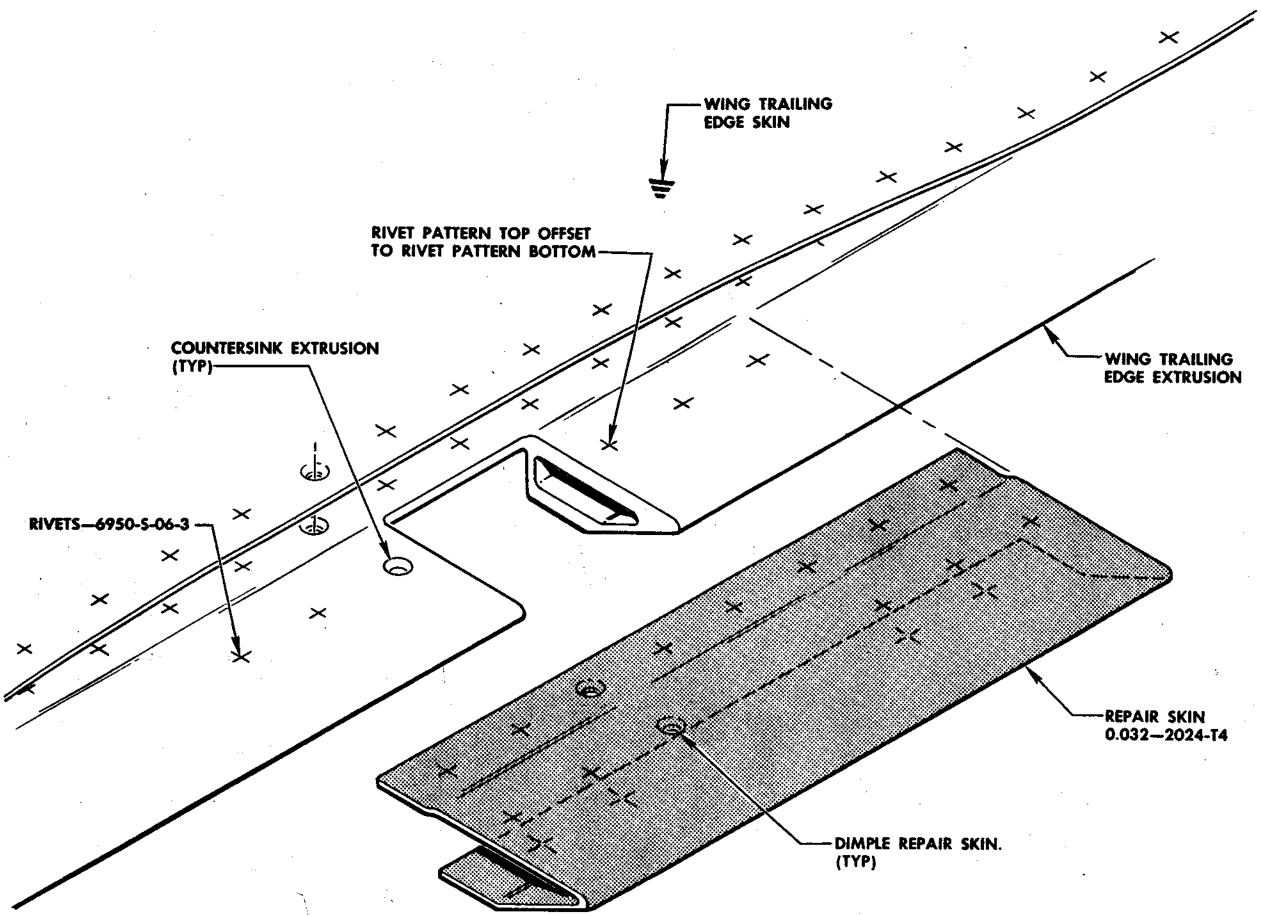
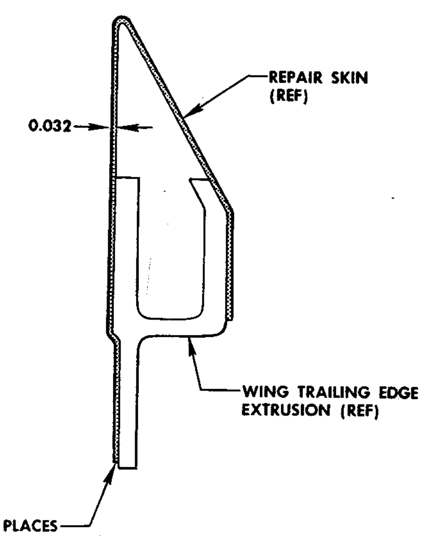


Figure 2-25. Wing Trailing Edge Negligible Damage

TEMPORARY Category A



WING STA 162.638 TO WING STA 260.491



Trim out damaged area.

Remove rivets necessary for repair.

Fabricate metal repair skin to fit wing trailing edge extrusion.

Attach metal repair skin to wing trailing edge extrusion with Deutsch drive pin rivets. Pick up existing rivets in wing trailing edge skin.

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Figure 2-26. Wing Trailing Edge Extrusion (Sheet 1 of 2)

PERMANENT

Category A

Remove rivets necessary to accomplish repair.

Trim out damage midway between existing skin rivets.

Fabricate bar filler machined to match interior of existing wing trailing edge extrusion.

Cut existing wing trailing edge extrusion to match bar filler.

Attach bar filler to wing trailing edge extrusion with flush rivets holding gap to 1/32 inch maximum.

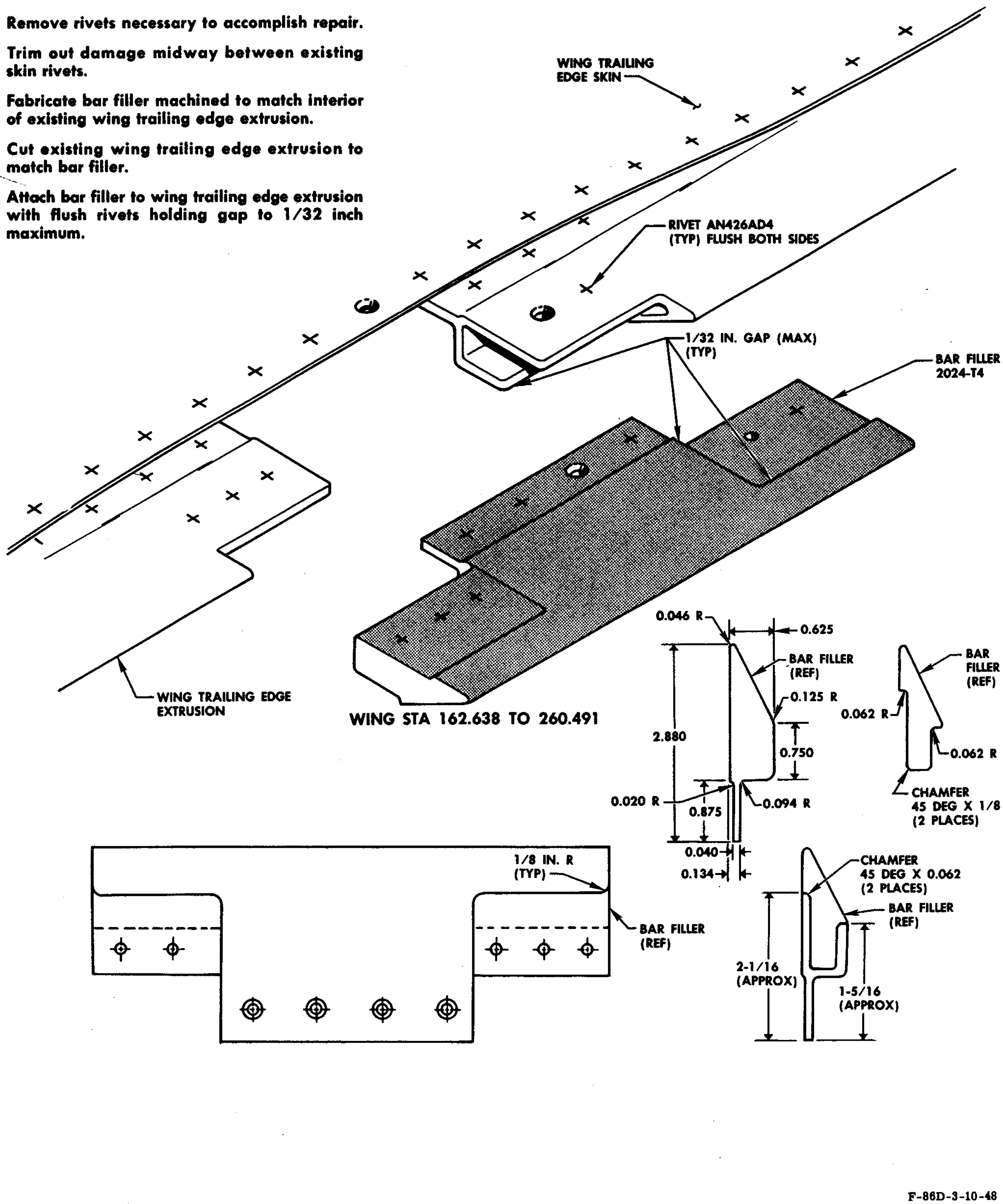


Figure 2-26. Wing Trailing Edge Extrusion (Sheet 2 of 2)

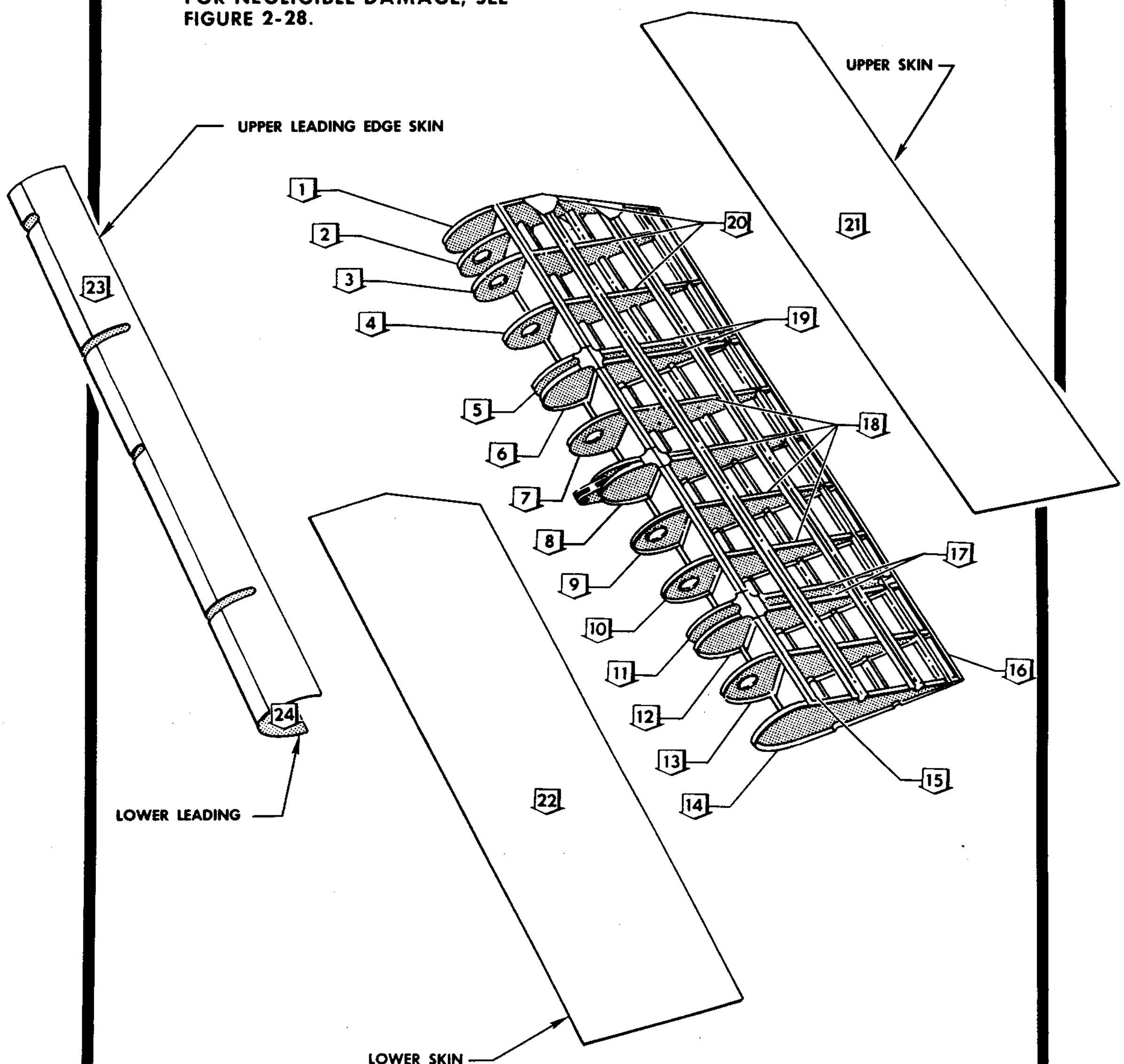
FLAP INDEX

WING

NOTE The original flap part number is 165-18001. The replacement and future procurement part number is 177-18001.

00 INDEX ARROWS REFER TO ITEM NUMBERS IN KEY.

FOR NEGLIGIBLE DAMAGE, SEE FIGURE 2-28.



F-86K-3-10-47

Figure 2-27. Wing Flap Index

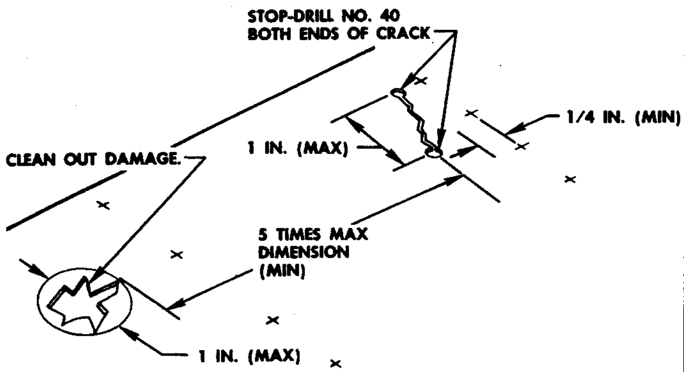
ITEM NO.	DRAWING NO.*	DESCRIPTION	GAGE	MATERIAL	REPAIR FIGURE NO.†
1	177-18001	Rib	0.032	2024-T4 Clad	
2	177-18001	Rib	0.020	2024-T4 Clad	
3	177-18001	Rib	0.020	2024-T4 Clad	
4	151-18001	Rib	0.025	2024-T4 Clad	
5	151-18032	Rib Assy	0.064	2024 Clad	
6	151-18034	Rib Assy	0.064	2024 Clad	
7	177-18011	Rib	0.025	2024-T4 Clad	
8	177-18010	Rib Assy	0.051	2040-T4 Clad	
9	177-18011	Rib	0.025	2024-T4 Clad	
10	177-18001	Rib	0.020	2024-T4 Clad	
11	151-18076	Rib Assy	0.032	2024-T4 Clad	
12	151-18077	Rib Assy	0.032	2024-T4 Clad	
13	177-18001	Rib	0.025	2024-T4 Clad	
14	177-18001	Rib	0.040	2024-T4 Clad	
15	140-18004	Spar Assy	0.025	2024-T4 Clad	2-29
16	151-18177	Flap Trailing Edge	0.032	2024-T4 Clad	2-30
17	151-18034	Rib Assy	0.064	2024-T4 Clad	
18	151-18177	Rib Assy	0.032	2024-T4 Clad	
19	151-18034	Rib Assy	0.064	2024-T4 Clad	
20	151-18177	Rib Assy	0.032	2024-T4 Clad	
21	165-18001	Upper Skin	0.020	7075-T6 Clad	
	177-18001		0.020	2024-T4 Clad	
22	165-18001	Lower Skin	0.020	7075-T6 Clad	
	177-18001		0.032	2024-T4 Clad	
23	165-18001	Leading	0.016	CRES	
	177-18001	Edge, Upper	0.016	CRES	
24	165-18001	Leading	0.020	2024-T4 Clad	
		Edge, Lower		7075-T6 Clad	
	177-18001		0.020	2024-T4 Clad	

***Drawing numbers are for reference only.**
†For additional repairs, refer to Section X.

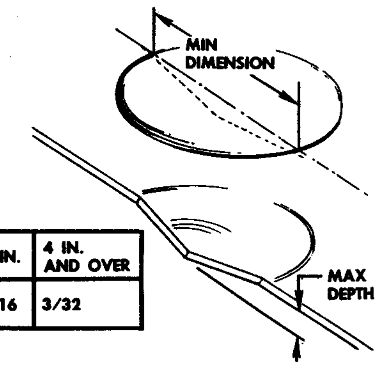
Key to Figure 2-27.

FLAP NEGLIGIBLE DAMAGE

WING

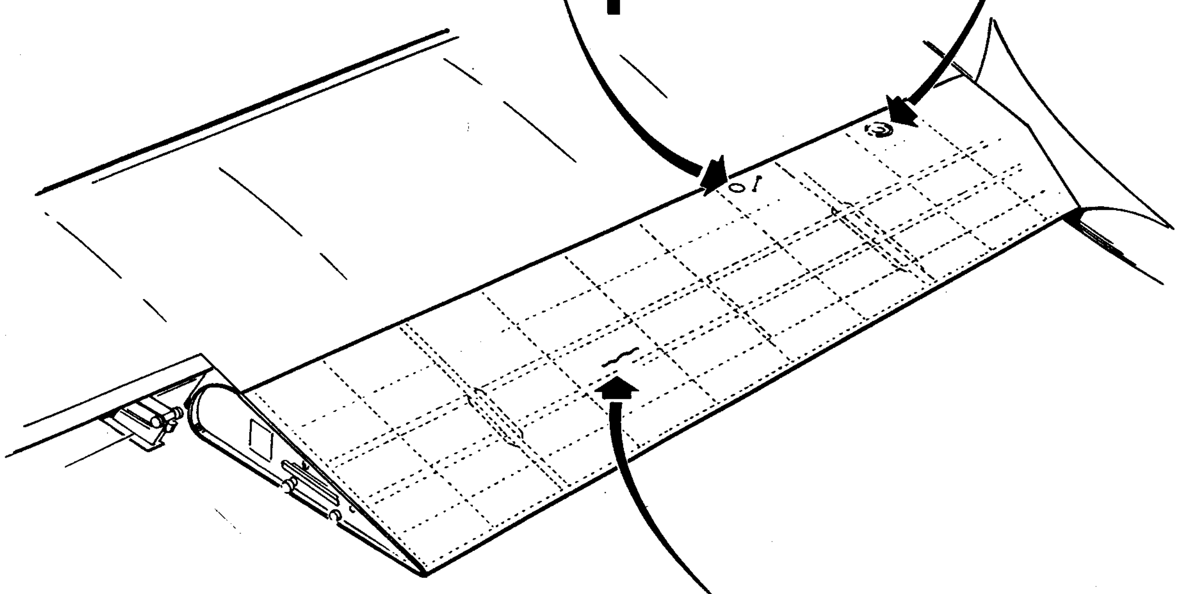


NOTE A cleaned-out hole or stop-drilled crack with a maximum dimension not exceeding one inch is considered negligible, provided it is a minimum of 1/4 inch from any fastener and the minimum distance between damages is five times the greatest dimension of the damages being considered.



MIN DIMENSION	1 IN.	2 IN.	4 IN. AND OVER
MAX DEPTH	1/32	1/16	3/32

Dents which do not exceed the dimensions given in the table are considered negligible.



NOTE Scratches or nicks are considered negligible under the following conditions:

Minimum of 1/4-inch distance exists between damage and edge of part, hole, fastener, or radius.

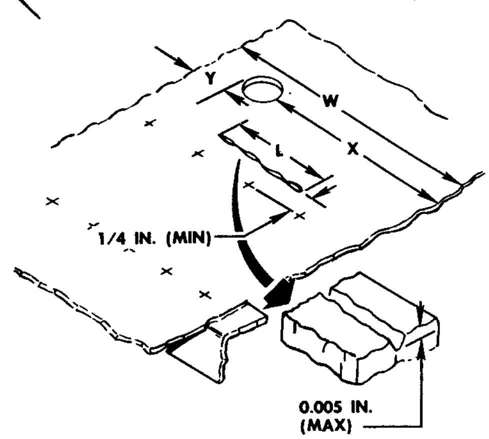
Depth of damage does not exceed 0.005 inch.

They are within limitations shown in table.

DEPTH OF DAMAGE	LENGTH OF DAMAGE
Between 0.003 and 0.005 in.	3 in. or one half the width of part minus original holes (whichever is smaller)
Up to 0.003 in.	Unlimited

X + Y = Width of part minus orginal hole.

Length of damage to be measured in same direction that width of part is measured.



F-86D-3-10-38

Figure 2-28. Wing Flap Negligible Damage

PERMANENT Category B

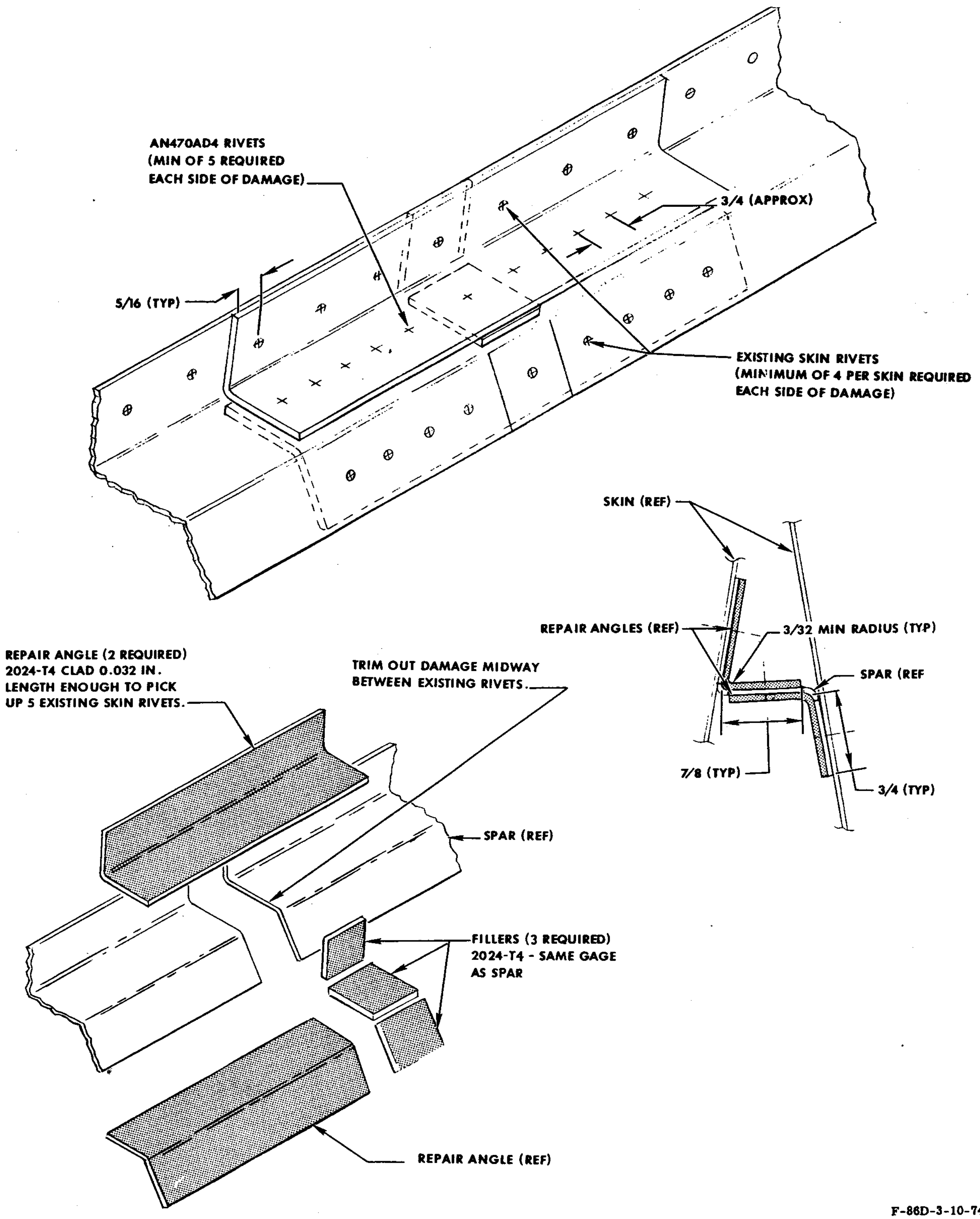


Figure 2-29. Wing Flap Rear Spar

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PERMANENT – CATEGORY A

WING

Trim out damage midway between existing skin fasteners.

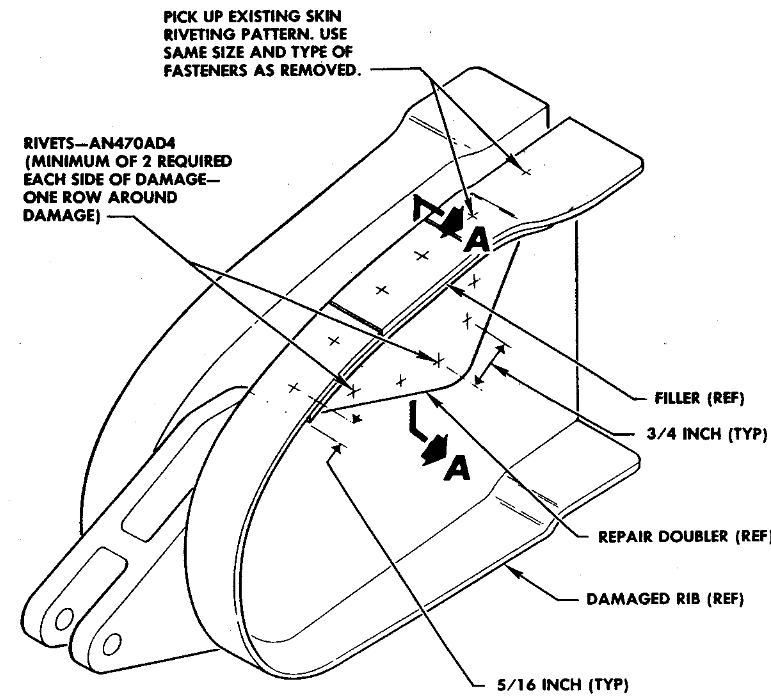
Smooth all edges and corners after trimming.

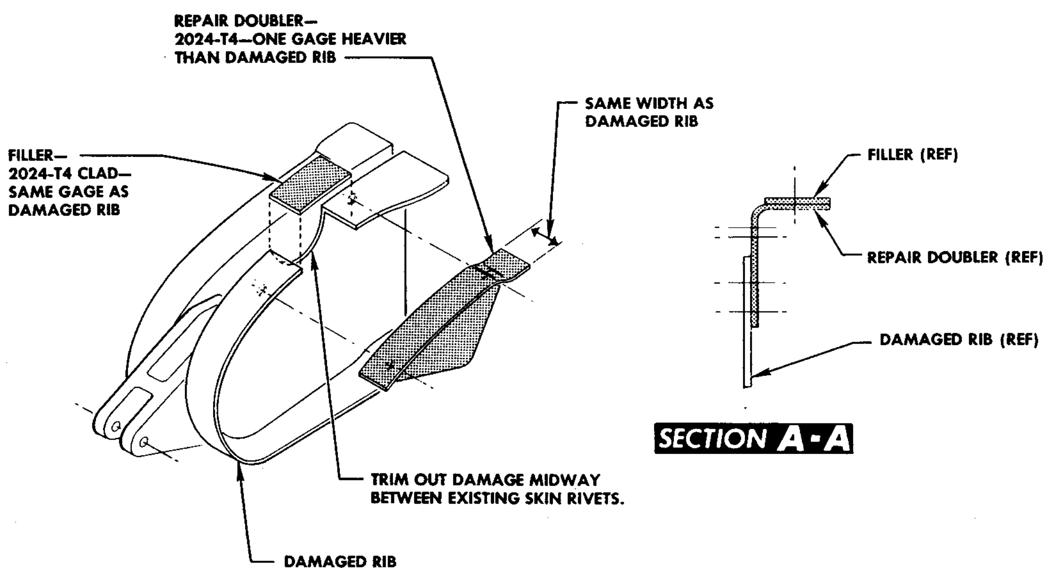
Make filler to match section of rib flange that has been removed.

Make repair doubler from 2024-O clad material. Heat-treat to the T4 condition after forming and joggling.

Fasten repair doubler and filler in place, using size and type of fasteners and spacing called out.

NOTE — The length of the repair doubler is about 4 inches plus the length of damage.





F-86D-3-10-101

Figure 2-29A. Flap Nose Rib Repair

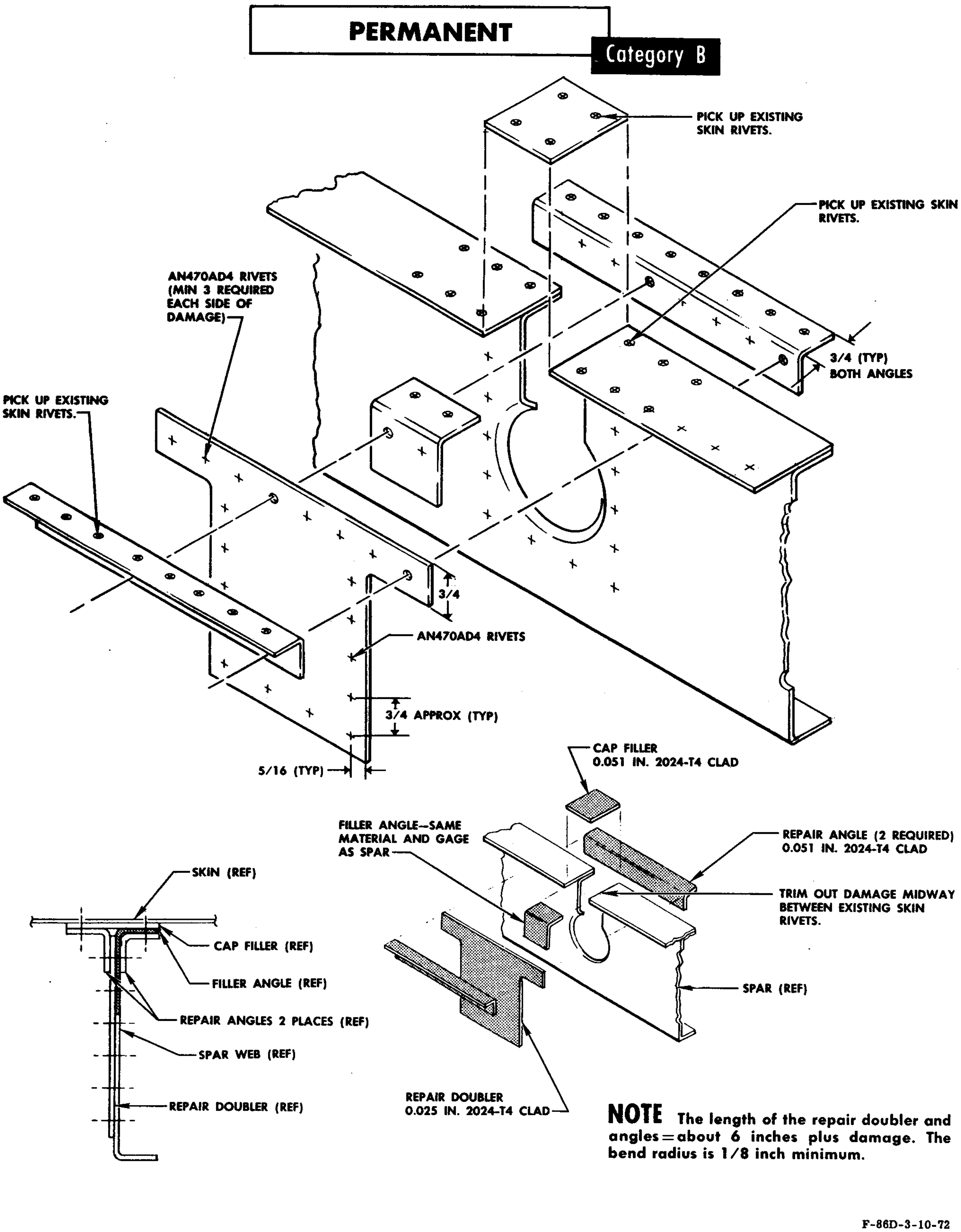
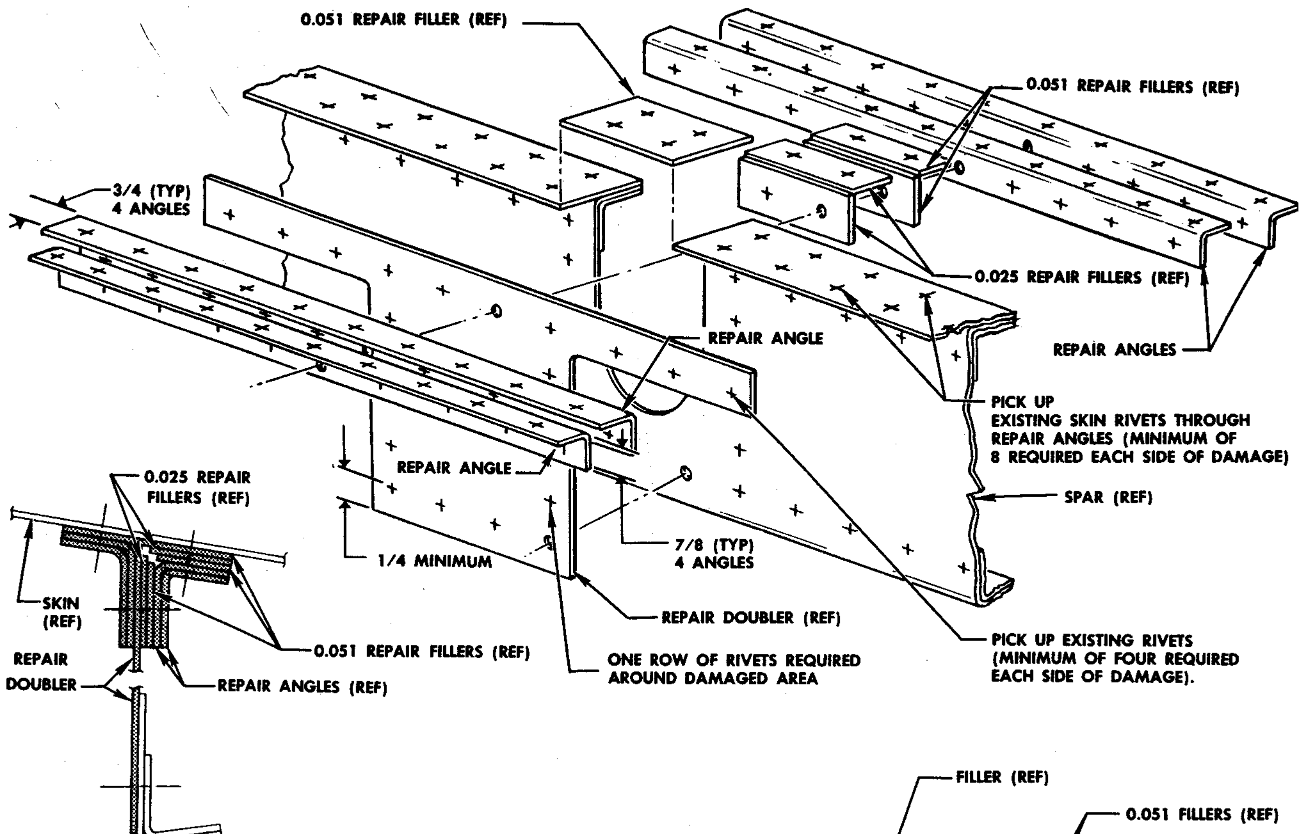


Figure 2-30. Wing Flap Front Spar (Sheet 1 of 2)

PERMANENT

Category B



1 Trim out damage midway between existing spar flange rivets.

2 Make repair doubler using 0.025-inch 2024-T4 clad sheet (one required).

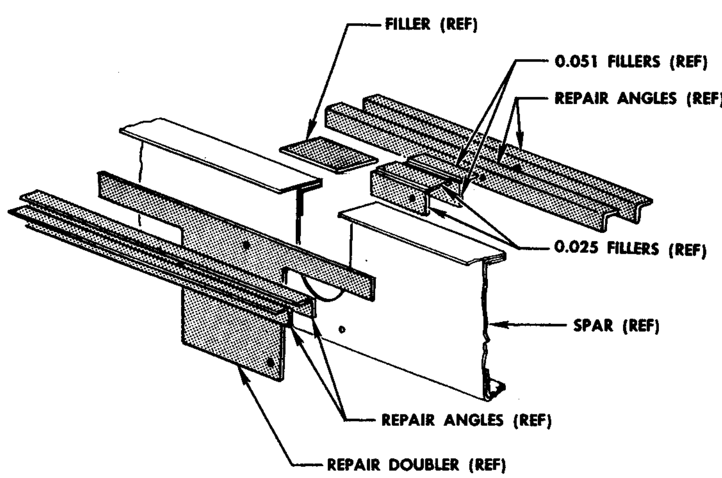
3 Make repair angles using 0.040-inch 2024-T4 clad sheet (four required).

4 Make repair fillers using 0.025-inch 2024-T4 clad sheet (two required).

5 Make repair fillers using 0.051-inch 2024-T4 clad sheet (three required).

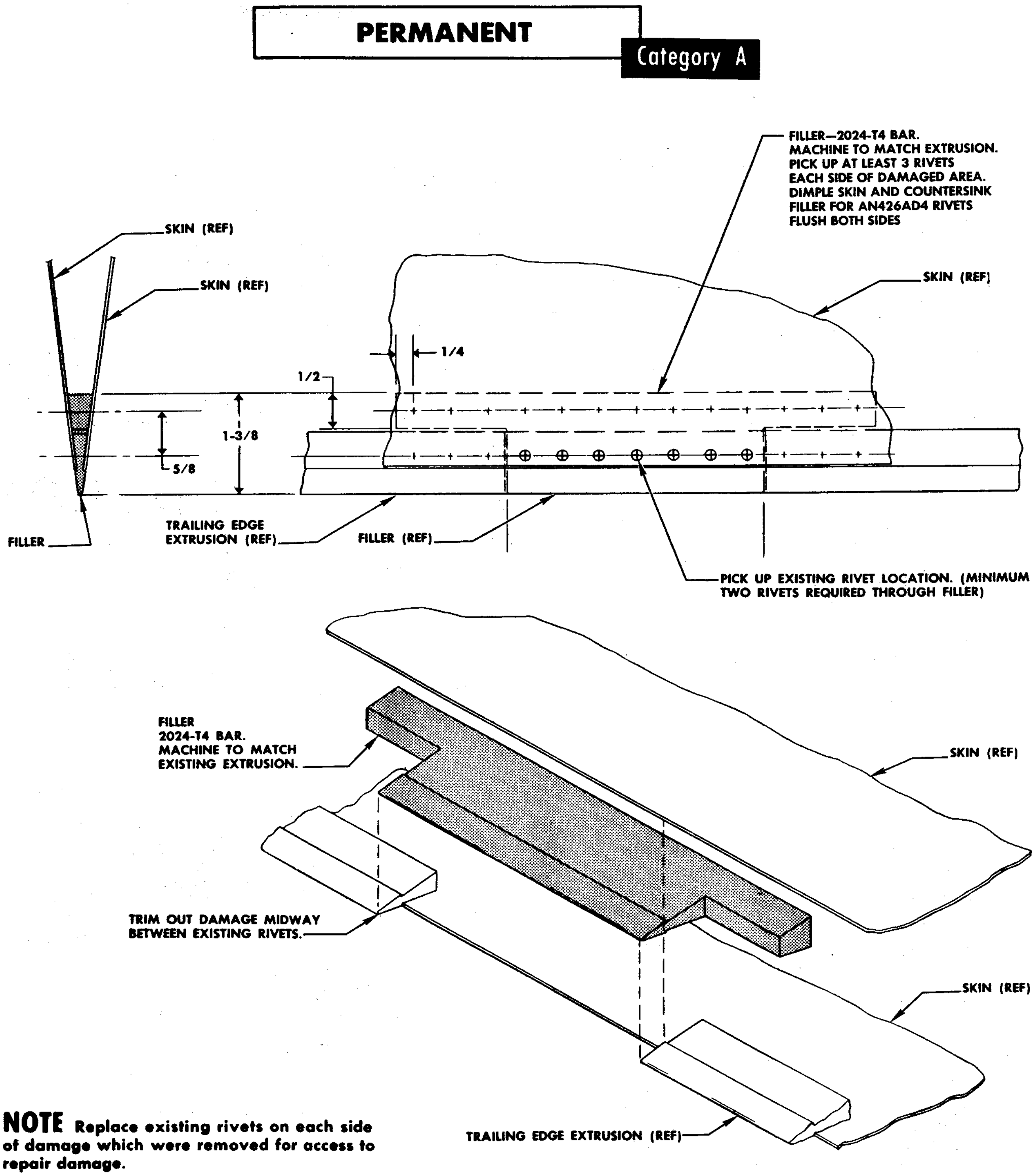
6 Assemble and install spar web rivets using AN470AD4 rivets. One row of rivets is required around the damaged area and a minimum of four rivets is required on each side of the damaged area.

7 Install existing skin rivets through repair angles (minimum of eight rivets required each side of damage).



F-86D-3-10-73

Figure 2-30. Wing Flap Front Spar (Sheet 2 of 2)



NOTE Replace existing rivets on each side of damage which were removed for access to repair damage.

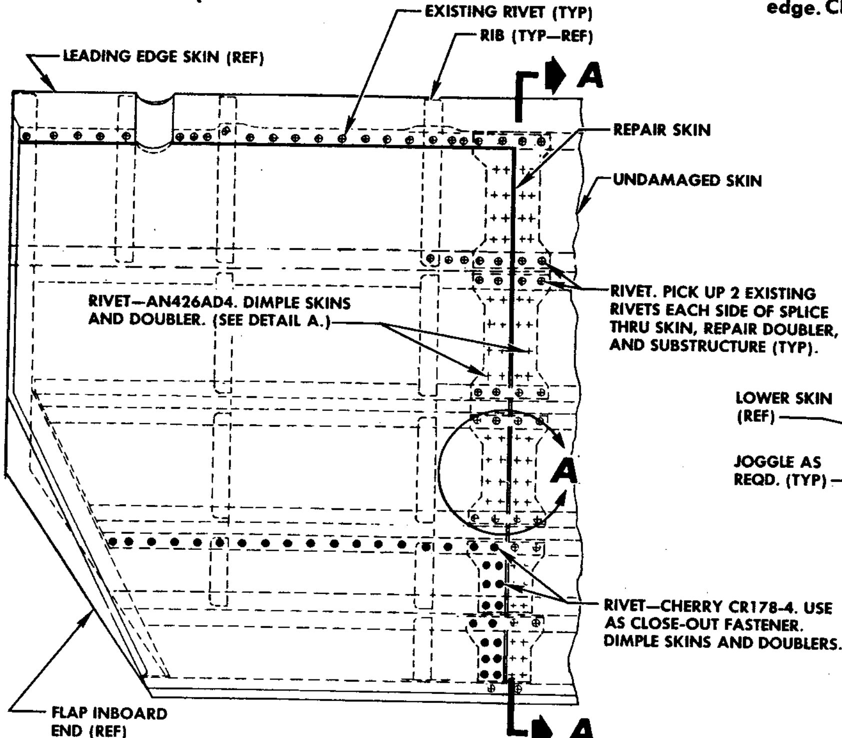
F-86D-3-10-92

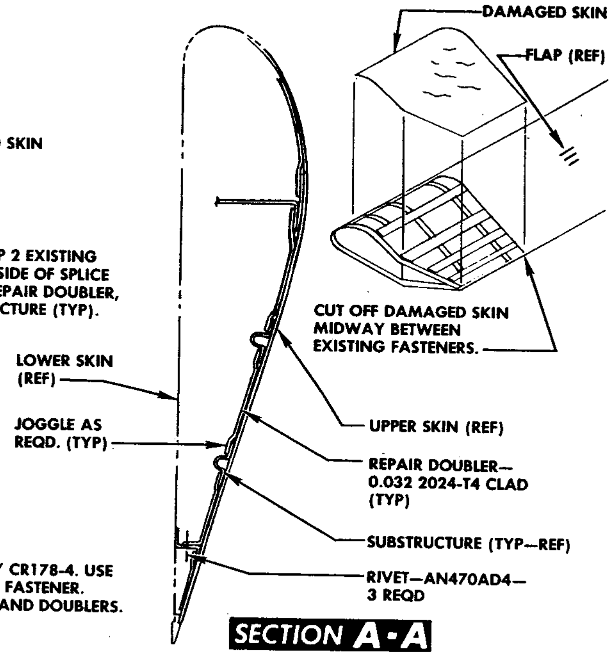
Figure 2-31. Wing Flap Trailing Edge

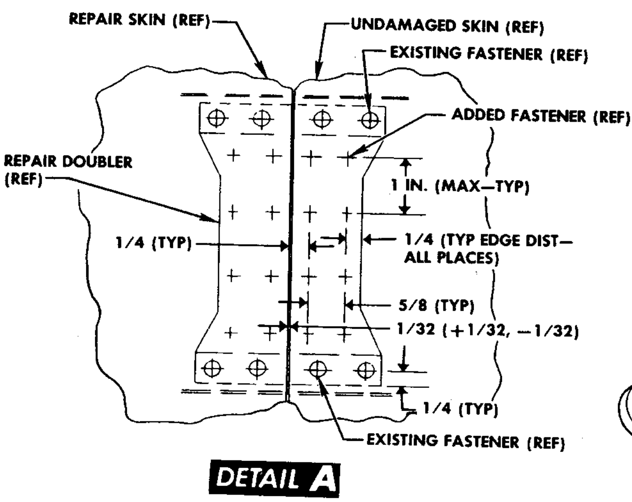
PERMANENT

CATEGORY A

1. Remove damaged skin section. (The inboard end is shown.) A splice can be used at either end, or two splices may be used to insert a middle section of skin.
2. Fabricate and install repair doublers. Dimple skin and doublers.
3. Shape repair skin to match removed skin section.
4. Transfer rivet holes from removed skin section to the repair skin with a transfer punch.
5. Pilot-drill repair skin.
6. Install repair skin, line-drill pilot hoes, and drill new holes through skin and repair doublers.
7. Dimple repair skin and repair doublers.
8. Install repair skin riveting from leading edge to trailing edge. Close out trailing edge with cherry rivets as shown.







TYPICAL RIVET DISTRIBUTION DATA FOR ALL DOUBLERS

F-86K-3-10-50

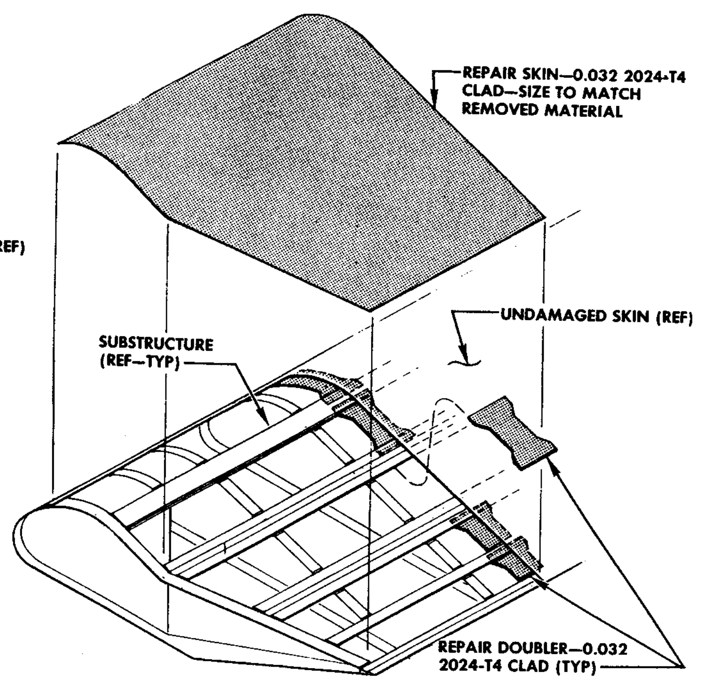


Figure 2-31A. Flap Skin Splice

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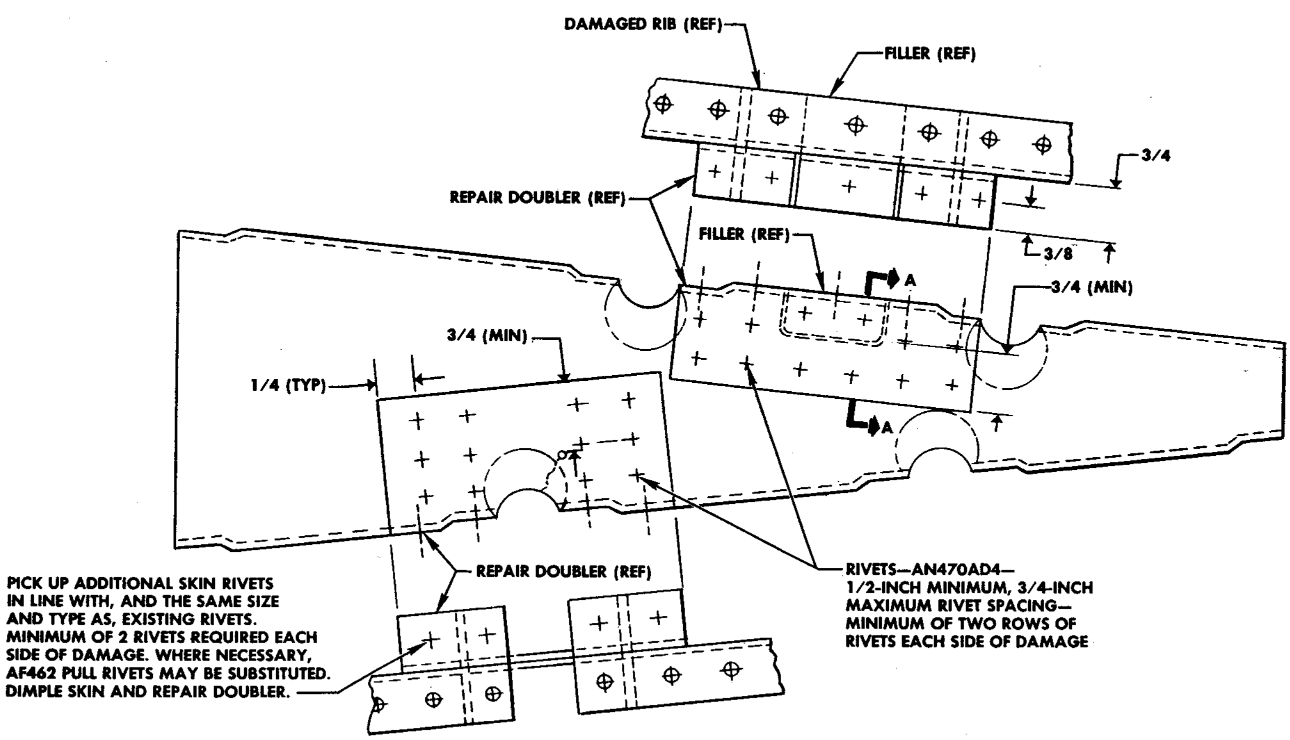
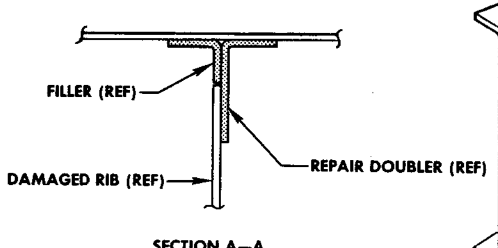
PERMANENT - CATEGORY A

WING



1. If damage requires a filler, trim out damage midway between existing fasteners. If damage is a crack, stop-drill it with a No. 30 (0.128-inch) drill.
2. Manufacture repair doubler from 2024-T4 material, one gage heavier than damaged part. If forming or a small radius is required, make repair doublers from 2024-O material, and heat-treat them.
3. Fasten repair doubler and filler (if required) in place, using size and type of fasteners and spacing called out.



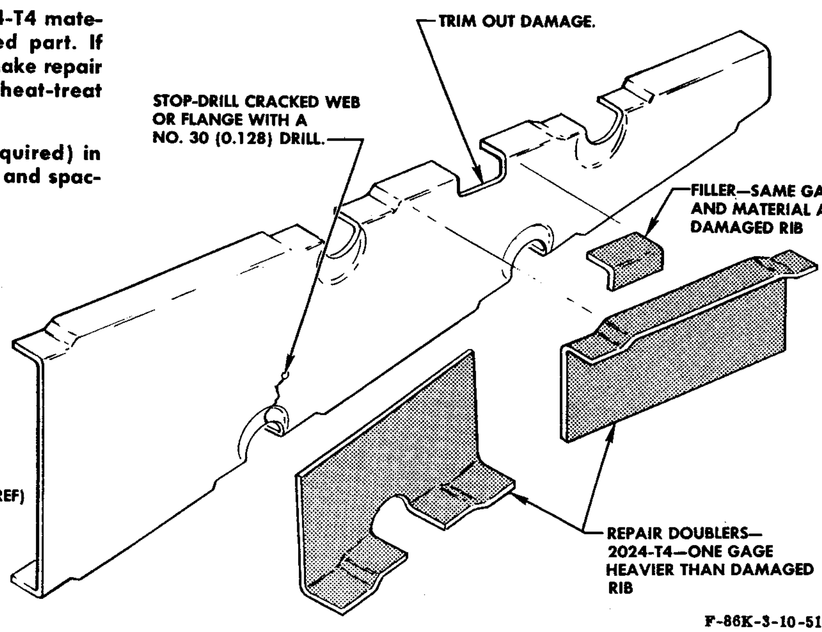
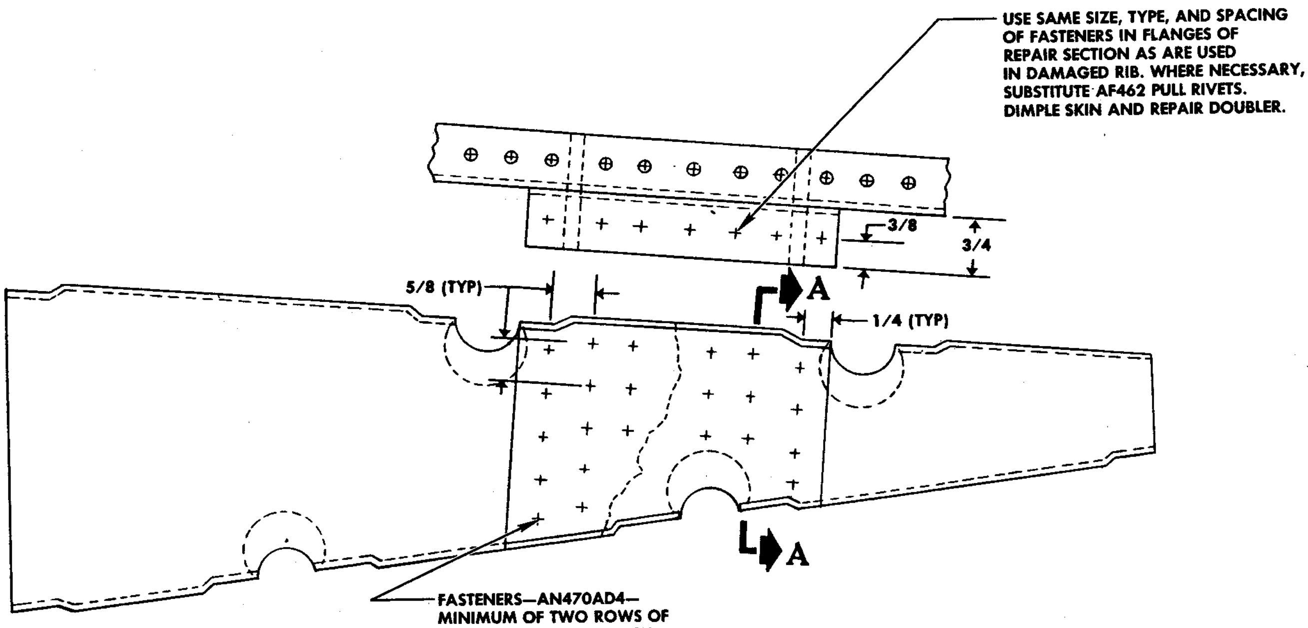


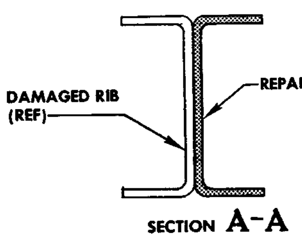
Figure 2-31C. Flap Air Load Rib Repair (Sheet 1 of 2)

PERMANENT – CATEGORY A

WING



1. Smooth edges of damage so that there are no sharp edges or corners where it might be possible for new cracks to start.
2. Manufacture a repair section by forming a new section, as shown, from same material and gage as damaged rib, or trim a section from a rib of the opposite "hand," large enough to accept required amount of fasteners.
3. Fasten repair section in place, using size and type of fasteners and spacing called out.



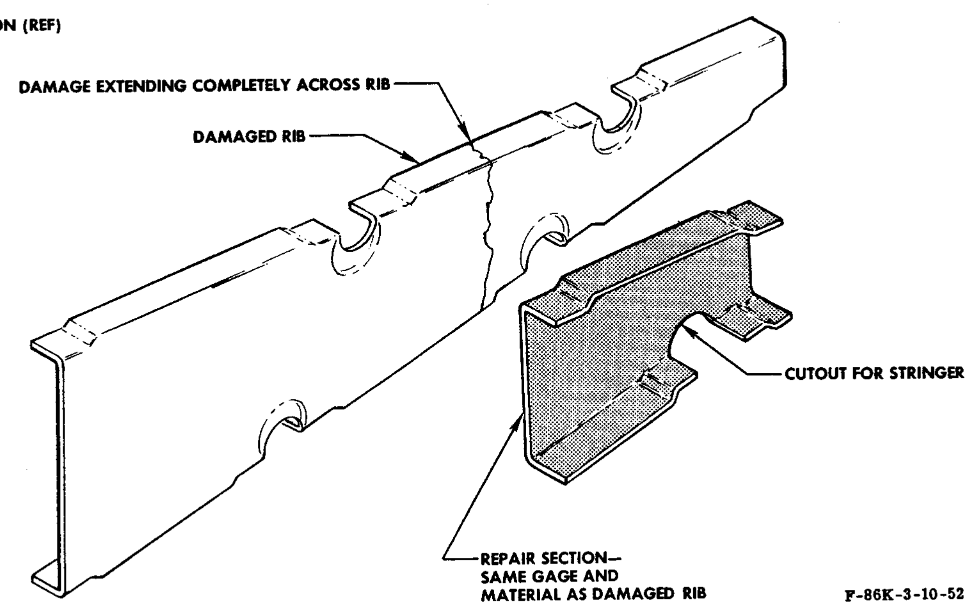


Figure 2-31C. Flap Air Load Rib Repair (Sheet 2 of 2)

PERMANENT CATEGORY A

WING

1 Trim out damage midway between existing skin rivets.
2 Smooth all edges and corners after trimming.
3 Make repair doubler, filler, and repair channel.
4 Fasten repair parts in place, using size and type of fasteners and spacing called out.

NOTE The length of the repair doubler is about 6 inches plus the length of damage.

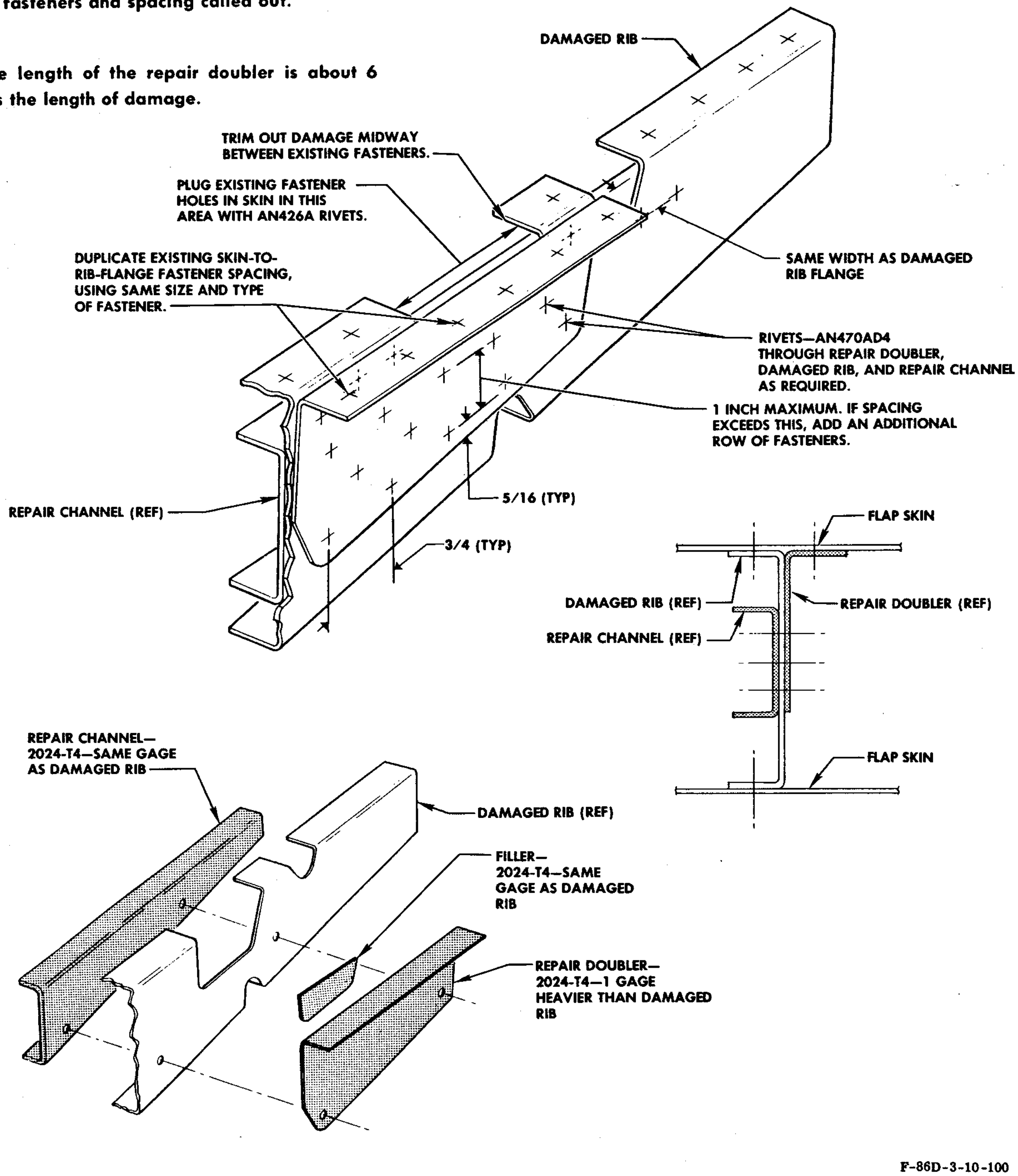


Figure 2-31D. Flap Trailing Edge Rib Repair

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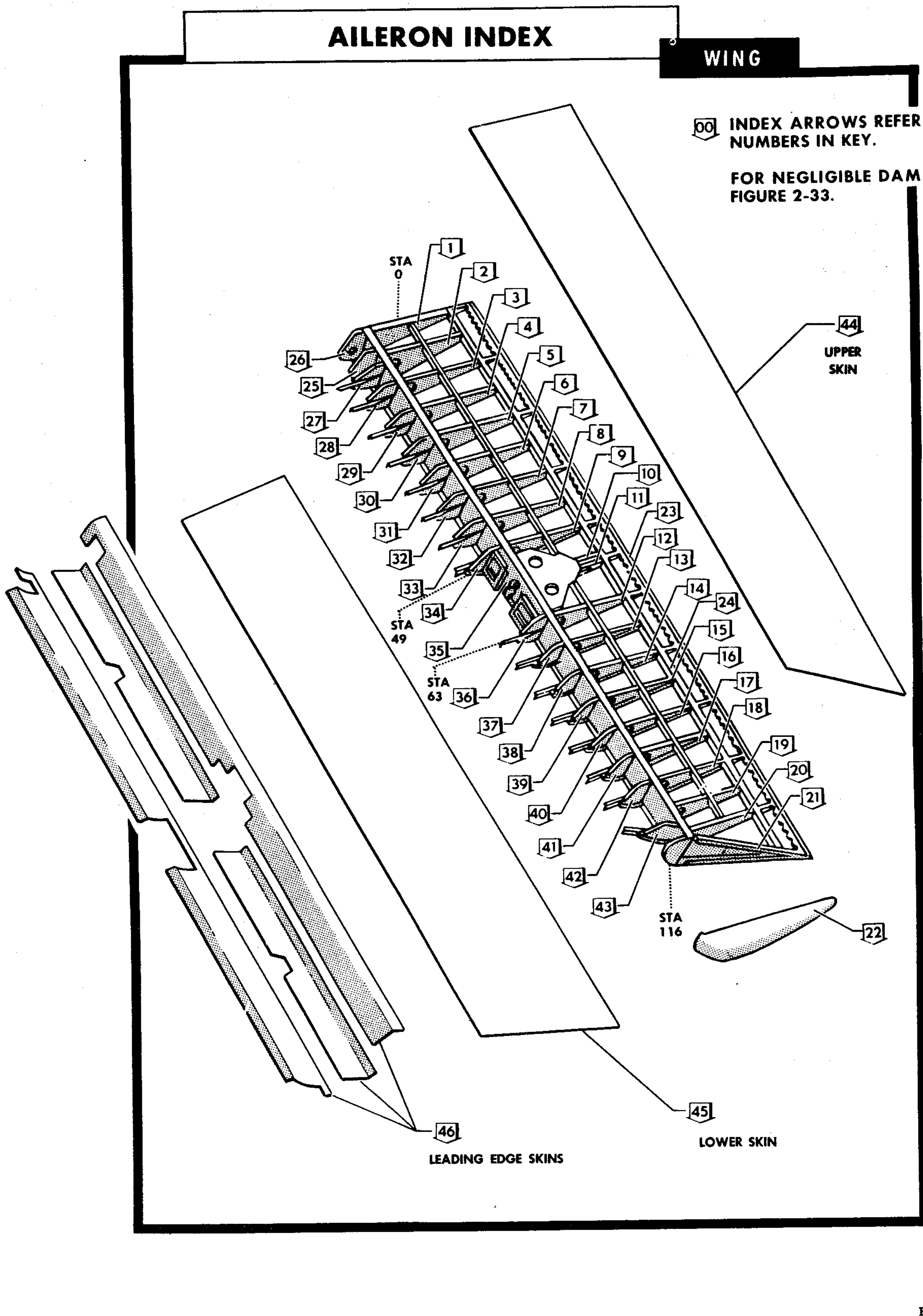


Figure 2-32. Aileron Index

ITEM NO.	DRAWING NO.*	DESCRIPTION	GAGE	MATERIAL	REPAIR FIGURE NO.†
1	165-16128	End Rib	0.040	2024-T4 Clad	2-36
2	165-16112	Rib	0.040	2024-T4 Clad	2-33
3	165-16141	Rib	0.025	2024-T4 Clad	2-36
4	165-16140	Rib	0.025	2024-T4 Clad	2-36
5	165-16139	Rib	0.025	2024-T4 Clad	2-36
6	165-16130	Rib	0.025	2024-T4 Clad	2-36
7	165-16126	Rib	0.025	2024-T4 Clad	2-36
8	165-16127	Rib	0.025	2024-T4 Clad	2-36
9	165-16119	Rib	0.025	2024-T4 Clad	2-36
10	165-16114	Rib	0.064	7075-T6 Clad	2-33
11	165-16115	Rib	0.064	7075-T6 Clad	2-33
12	165-16129	Rib	0.025	2024-T4 Clad	2-36
13	165-16131	Rib	0.025	2024-T4 Clad	2-36
14	165-16132	Rib	0.025	2024-T4 Clad	2-36
15	165-16133	Rib	0.025	2024-T4 Clad	2-36
16	165-16138	Rib	0.025	2024-T4 Clad	2-36
17	165-16135	Rib	0.025	2024-T4 Clad	2-36
18	165-16136	Rib	0.025	2024-T4 Clad	2-36
19	165-16137	Rib	0.025	2024-T4 Clad	2-36
20	165-16116	Rib	0.040	2024-T4 Clad	2-33
21	165-16117	Rib Assy	0.020	2024-T4 Clad	
22	165-16218	Tip Assy	0.032	5052-O	
23	165-16113	Edge		Magnesium Extr	2-37
24	165-16002	Stringer		2024-T4 Clad	
25	157-16008	Rib	0.032	2024 Clad	2-34
26	165-16413	Rib Assy	0.032	2024 Clad	2-34
27	165-16409	Rib Assy	0.025	2024-T4 Clad	2-34
28	165-16408	Rib Assy	0.025	2024-T4 Clad	2-34
29	165-16411	Rib Assy	0.025	2024-T4 Clad	2-34
30	165-16407	Rib Assy	0.025	2024-T4 Clad	2-34
31	165-16406	Rib Assy	0.075	2024-T4 Clad	2-34
32	165-16405	Rib Assy	0.025	2024-T4 Clad	2-34
33	165-16414	Rib Assy	0.025	2024-T4 Clad	2-34
34	165-16415	Rib Assy	0.025	2024-T4 Clad	2-34
35	165-16169	Fitting		2014-T6 Forging	
36	165-16402	Rib Assy	0.025	2024-T4 Clad	2-34
37	165-16412	Rib Assy	0.025	2024-T4 Clad	2-34
38	165-16416	Rib Assy	0.025	2024-T4 Clad	2-34
39	165-16417	Rib Assy	0.025	2024-T4 Clad	2-34
40	165-16418	Rib Assy	0.025	2024-T4 Clad	2-34
41	165-16419	Rib Assy	0.025	2024-T4 Clad	2-34
42	165-16420	Rib Assy	0.025	2024-T4 Clad	2-34
43	165-16401	Rib Assy	0.025	2024-T4 Clad	2-34
44	165-16002	Upper Skin	0.025	2024-T4 Clad	
45	165-16002	Lower Skin	0.025	2024-T4 Clad	
46	165-16002	Leading Edge Skins	0.020	2024-T4 Clad	

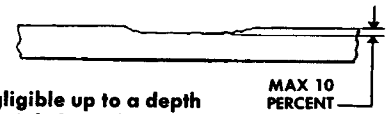
***Drawing numbers are for reference only.**
†For additional repairs, refer to Section X.

Key to Figure 2-32

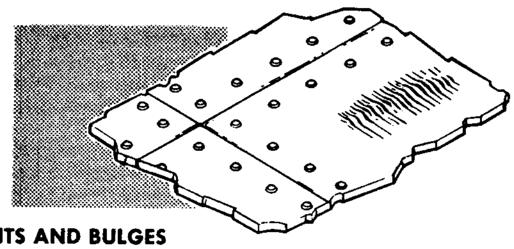
AILERON NEGLIGIBLE DAMAGE

WING

SCRATCHES, NICKS

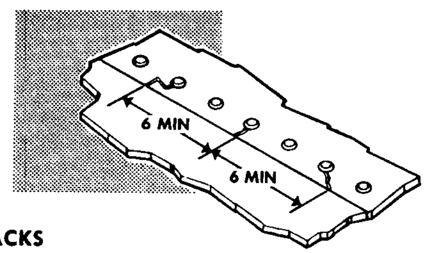


- Scratches or nicks are negligible up to a depth of 10 percent of the material. Smooth out all scratches and nicks.



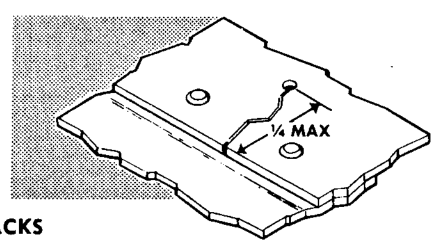
DENTS AND BULGES

- Dents to a depth of 3/32 inch are negligible if they show no evidence of cracks or internal damage.
- Bulges or depressions are negligible up to 1/16 inch in any 6-inch area.



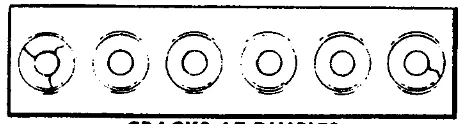
CRACKS

- Cracks from rivet hole to edge of skin are allowable to a maximum of one crack per bay and three per surface, if separated by a minimum of 6 inches.
- If practical, add rivet on each side of cracks.
- Where skin is attached to trailing edge at stations 59.5 to 63.5, only one cracked rivet hole is allowed per bay and one AN426B4 rivet must be added each side of crack.



CRACKS

Cracks in edge of skin are negligible to maximum of ¼-inch length, and three cracks per bay. Stop-drill cracks and add rivet each side of crack.



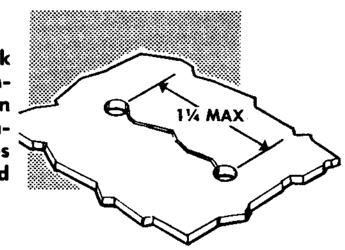
CRACKS AT DIMPLES

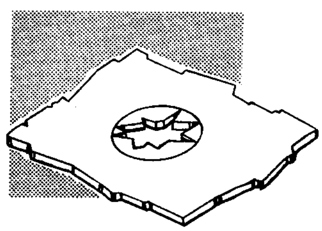
NEGLIGIBLE DAMAGE LIMITS AT DIMPLES

- One cracked dimple per five dimples, separated by four good dimples, is allowed.
- Maximum of three cracks per dimple is allowed.
- Cracks are not to extend beyond dimpled radius.
- Circumferential cracks are not considered as negligible damage.
- Blind brazier-head rivets, one size larger than original flush rivet, may be installed in oversize holes—maximum of one to a bay and four to a skin.

CRACKS

Stop-drill both ends of crack. Length of crack must not exceed one inch (maximum). Minimum distance of ¼ inch must exist between crack and edge of part, existing holes, fasteners, or radius. Minimum distance of five times length of crack must exist between crack and other damages.





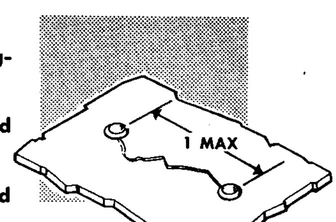
HOLES IN SKIN

Holes must be smoothed up so that no sharp corners or edges exist. Maximum diameter of a smoothed-up hole must not exceed one inch. Minimum distance of ½ inch must exist between the smoothed-up hole and the edge of part, existing holes, fasteners, or radius. Minimum distance of five times the diameter of a smoothed-up hole must exist between the hole and the other damages.

CRACKS

Cracks at rivets in groups are considered negligible under the following conditions:

- Not more than two rivets together weakened by skin crack.
- Not more than two rivets together weakened by skin crack in any eight rivets.
- Length of crack does not exceed 1¼ inch (maximum).



F-86K-3-10-40

Figure 2-33. Aileron Negligible Damage (Sheet 1 of 2)

AILERON NEGLIGIBLE DAMAGE

WING

STIFFENERS

- A maximum of two stiffeners per bay or six per surface may be used (attached at both ends to supporting structure).

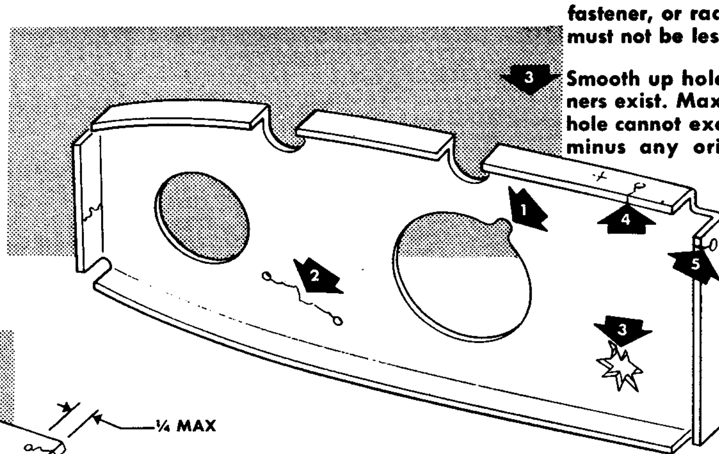
HINGE BRACKET LINK ASSEMBLIES AND CONTOUR WEIGHTS

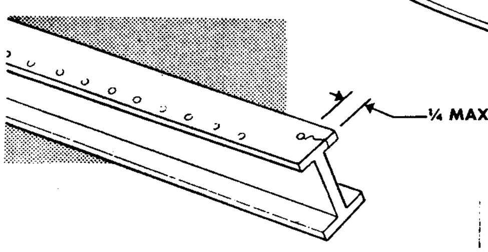
- Nicks and scratches smoothed out and not exceeding 1/32 inch in depth are permissible, provided no nicks or scratches occur at the rib attach points.

1 RIBS
Cracks in lightening holes not reaching radius of flange are negligible if stop-drilled or cleaned out—maximum of one crack per lightening hole and three cracks per surface.

2 Stop-drill both ends of crack. Maximum length of crack must not exceed 25 percent of width of part minus any original cutouts or net distance between original holes, whichever is the least. Minimum of ½-inch distance between the crack and the edge of the part, existing hole, fastener, or radius. Distance between damages must not be less than five times length of crack.

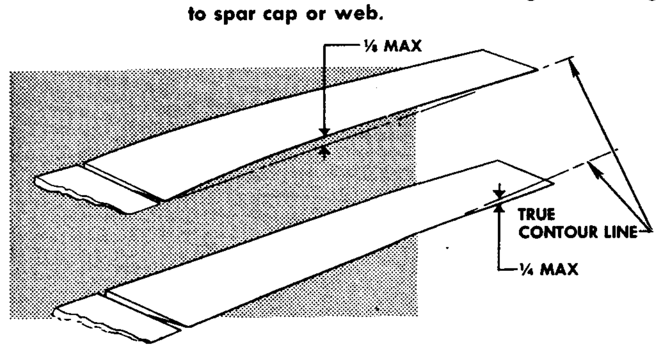
3 Smooth up hole so that no sharp edges or corners exist. Maximum diameter of smoothed-up hole cannot exceed 25 percent of width of part minus any original cutouts or net distance between original holes (which ever is the least). Minimum of ½-inch distance exists between the edge of smoothed-up hole and the edge of the part, existing hole, fastener, or radius. Distance between damages must not be less than five times diameter of smoothed-up hole.





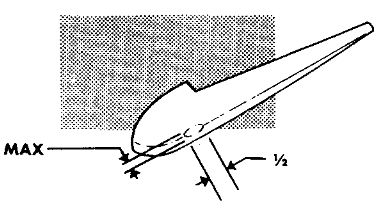
4 Cracks from the edge of the metal to rivet holes, when not more than ¼ inch long, are negligible to maximum of two cracks per rib—three cracked ribs per surface (ribs not adjacent). Add rivet each side of cracks.

5 Only one crack from the edge of the metal to a rivet hole is allowed in rib flanges attaching to spar cap or web.



SPARS

- Stop-drilled or cleaned-out cracks up to ¼-inch length from edge of metal end of spar spanwise—one crack per spar maximum—are considered negligible.
- 5/32-inch rivets may be installed in oversize rivet holes in spar flanges.



AILERON TIP

Dents in weld in centerline of top assembly to a maximum depth of ⅛ inch and to a length of ½ inch are considered negligible.

TRAILING EDGE

- Twist—With the aileron hinge line and trailing edge at inboard end on the true contour, the outboard end may vary by ¼-inch maximum.
- BOW—The trailing edge may vary from a straight line between inboard and outboard ends by ⅛ inch maximum.

F-86K-3-10-41

Figure 2-33. Aileron Negligible Damage (Sheet 2 of 2)

PERMANENT

Category B

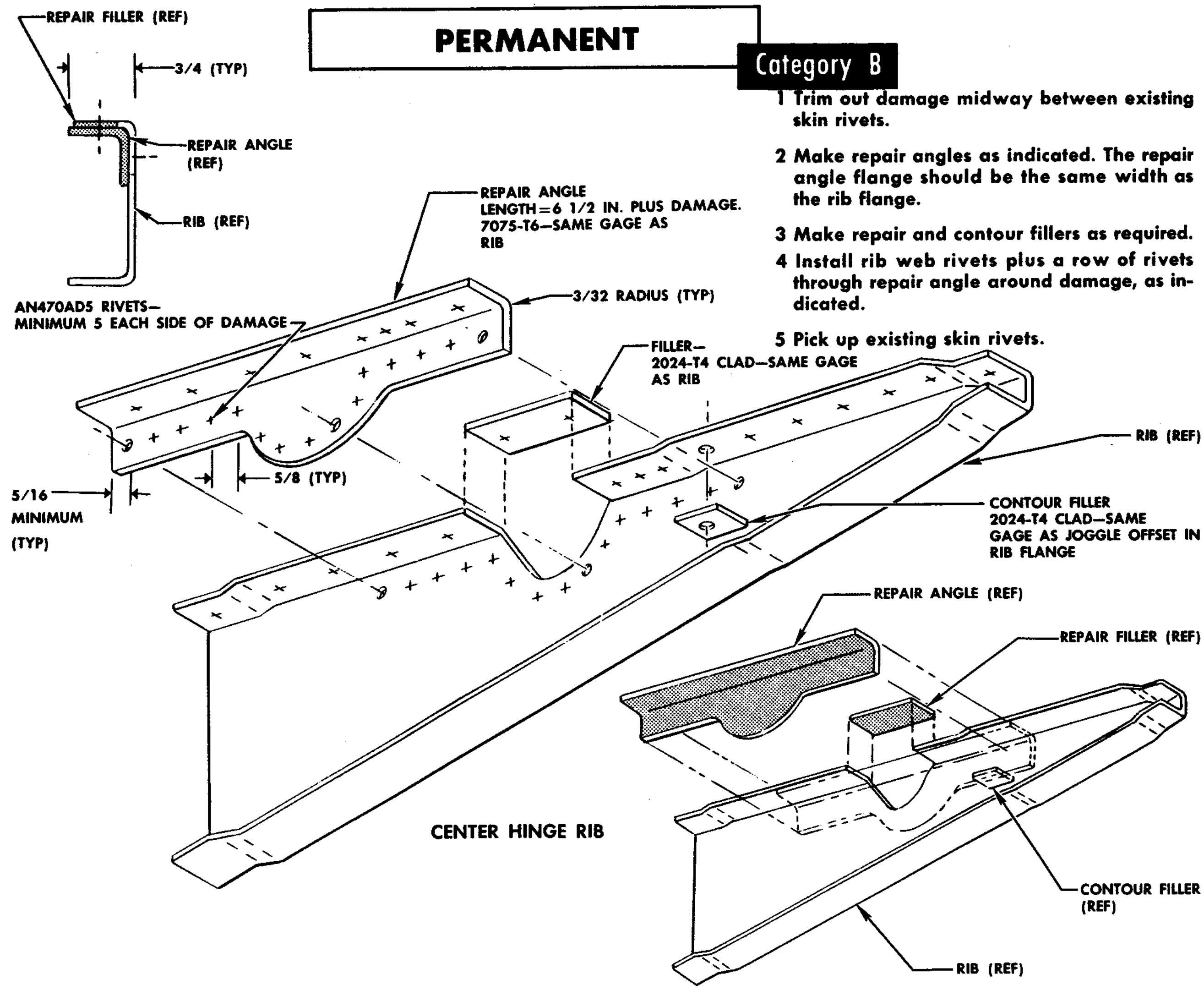
1 Trim out damage midway between existing skin rivets.

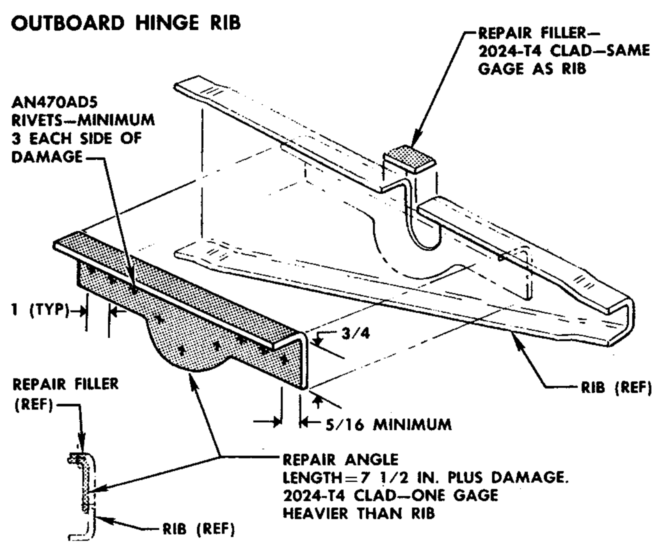
2 Make repair angles as indicated. The repair angle flange should be the same width as the rib flange.

3 Make repair and contour fillers as required.

4 Install rib web rivets plus a row of rivets through repair angle around damage, as indicated.

5 Pick up existing skin rivets.





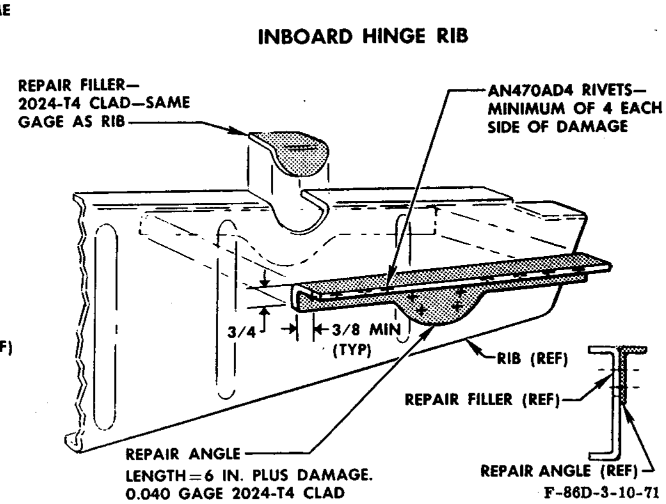
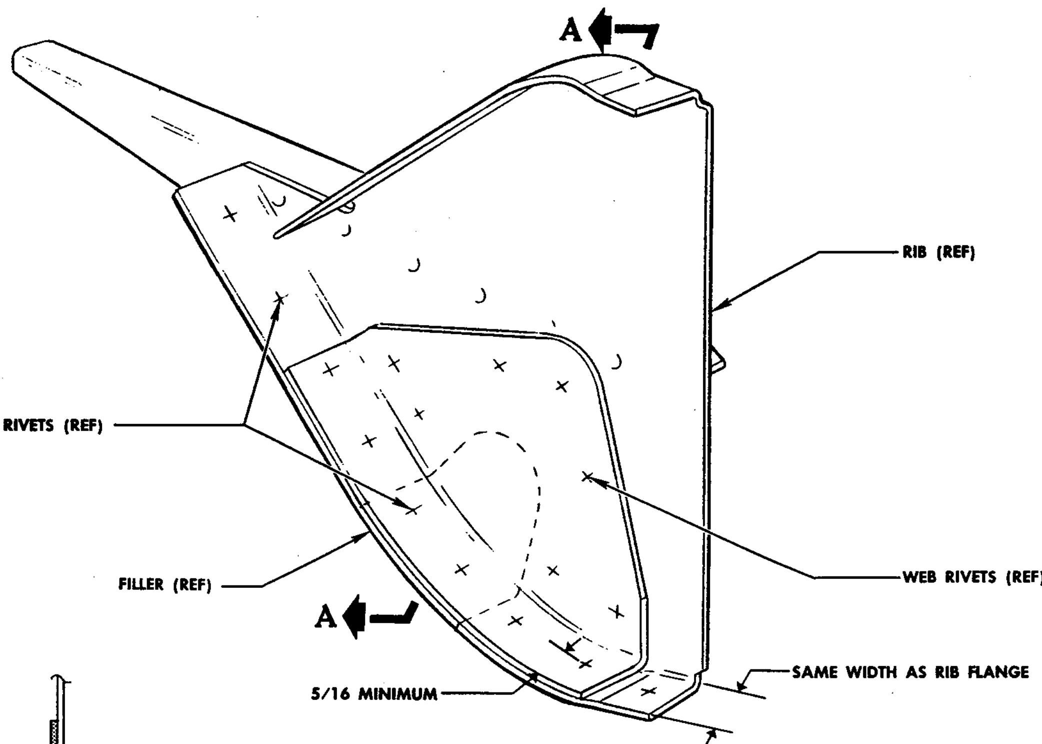
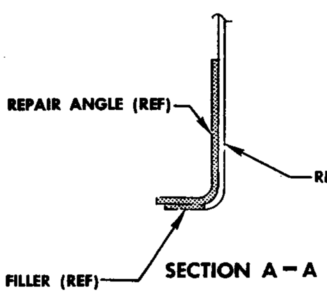
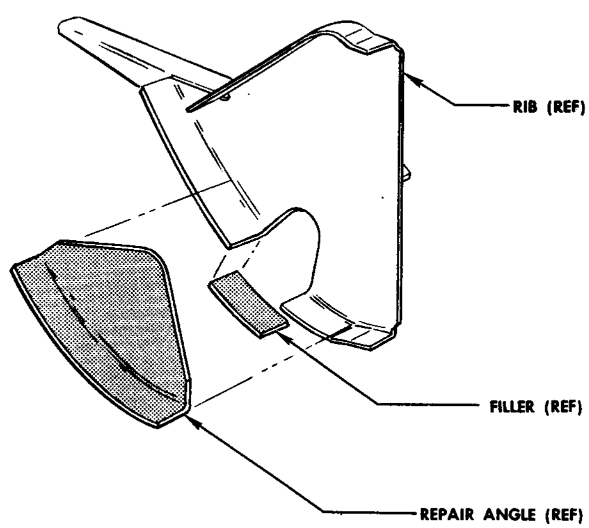


Figure 2-34. Aileron Hinge Ribs

PERMANENT Category B







NOTE Trim out damage midway between existing rivets.

Make repair angle one gage heavier than rib, using 2024-T4 clad. Length of repair angle = 3 inches plus length of damage.

Make filler same gage as rib, using 2024-T4 clad.

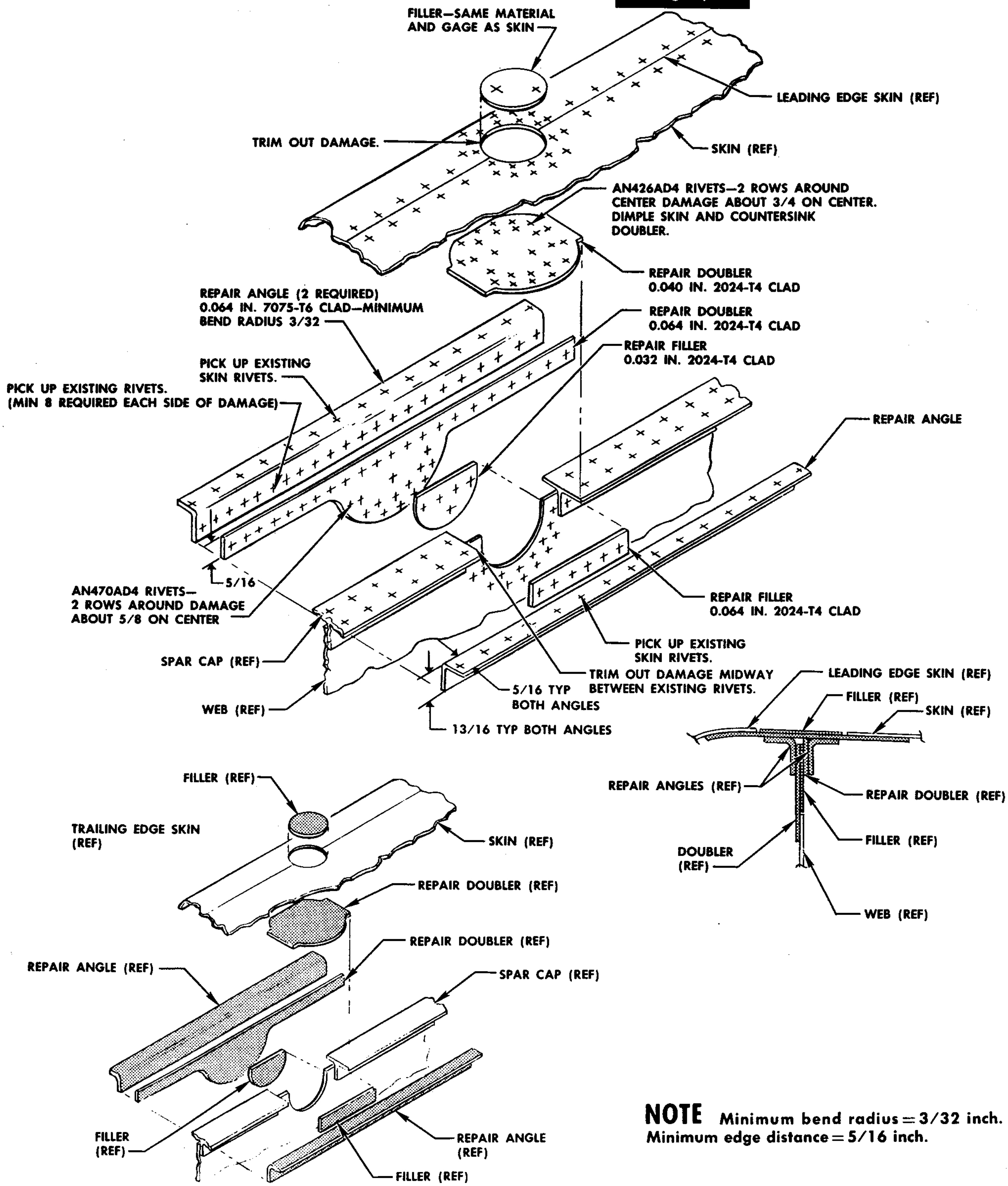
Pick up existing skin rivets. A minimum of two is required on each side of the damage.

Install AN470AD4 rivets through web. A minimum of three is required on each side of the damage.

Figure 2-35. Aileron Nose Ribs

PERMANENT

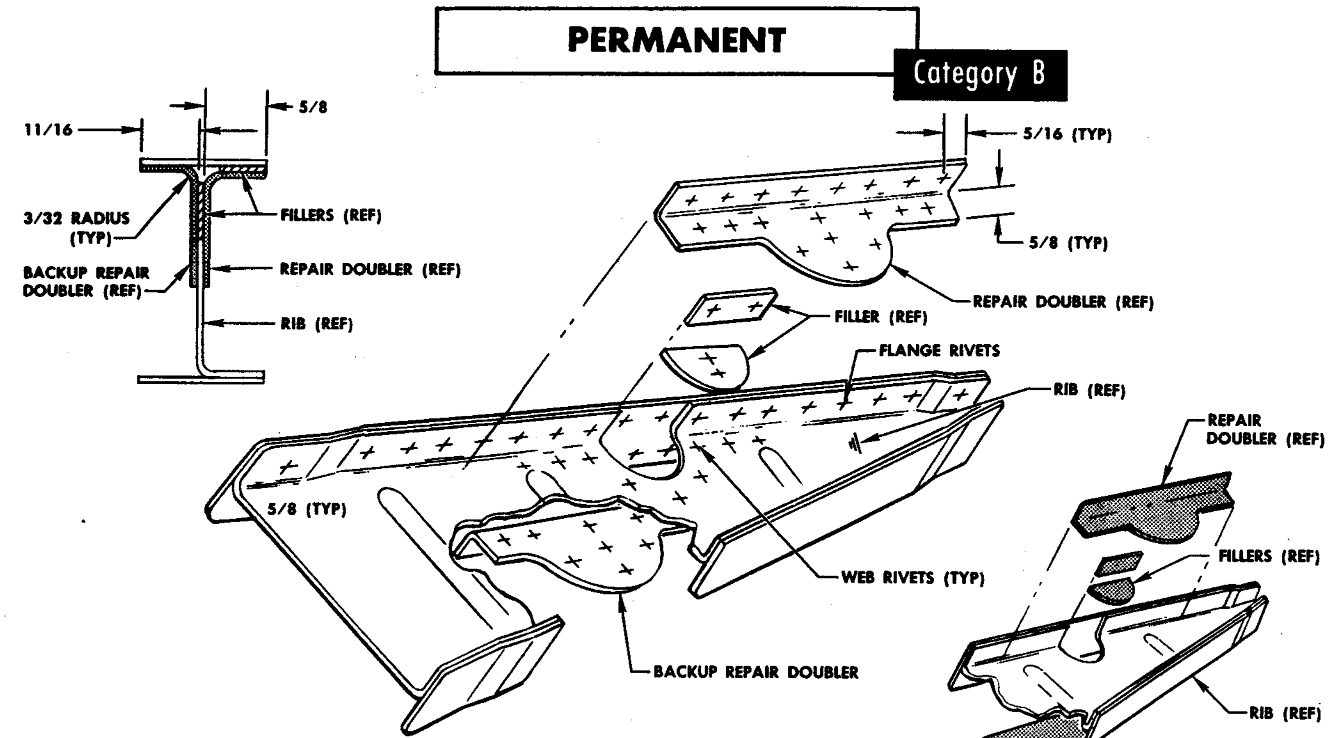
Category B

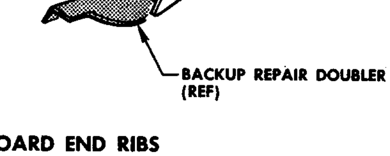


NOTE Minimum bend radius = 3/32 inch. Minimum edge distance = 5/16 inch.

F-86D-3-10-78

Figure 2-36. Aileron Spar Cap—Stations 0–49 and 63–116





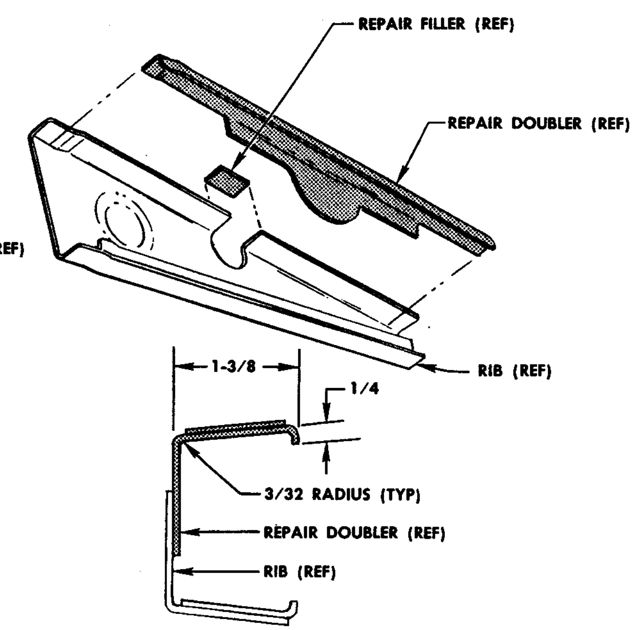
1 Trim out damaged area.

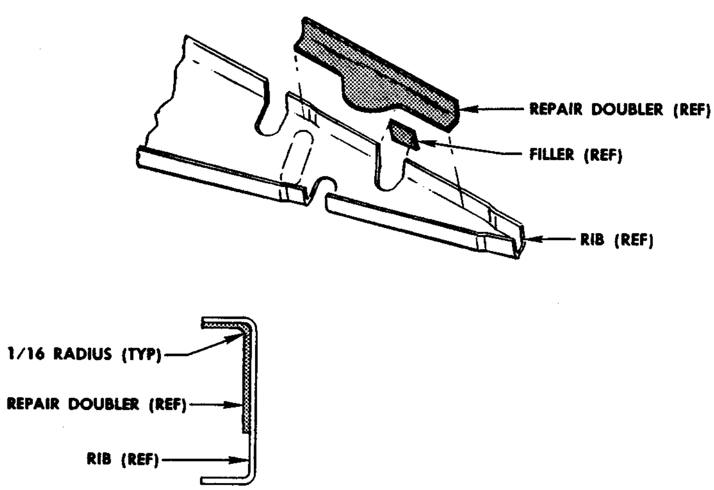
2 Make repair doubler and backup doublers as required, using 2024-T4 clad one gage heavier than rib. Make doubler 5 inches plus damage length.

3 Make repair fillers as necessary, using 2024-T4 clad, same gage as rib.

4 Install AN470AD4 web rivets (minimum of three each side of damage).

5 Pick up existing flange rivets.





AIR-LOAD RIBS

OUTBOARD END RIBS

F-86D-3-10-70

Figure 2-37. Aileron Air Load and End Ribs

PERMANENT

Category B

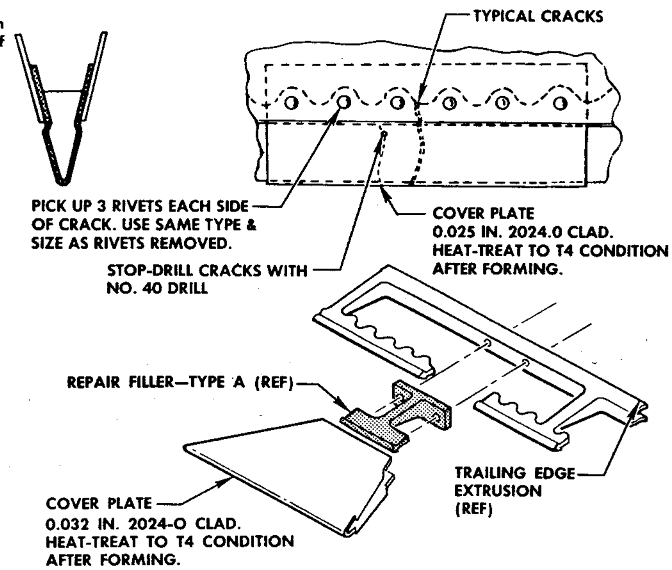
Damage to trailing edge not exceeding 3/16 inch in depth and 2 inches in length is considered negligible. To smooth up nicks and cracks, a maximum of 1/8 inch may be removed from the trailing edge for the entire length.

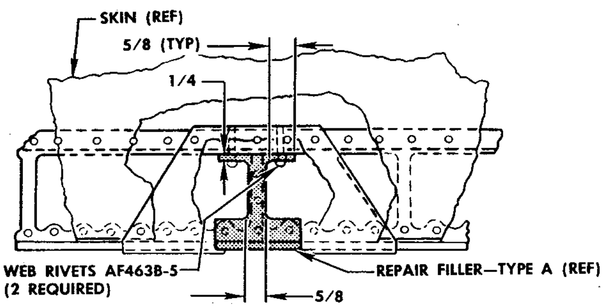
NOTES (1) A maximum of three repairs is allowed per trailing edge.

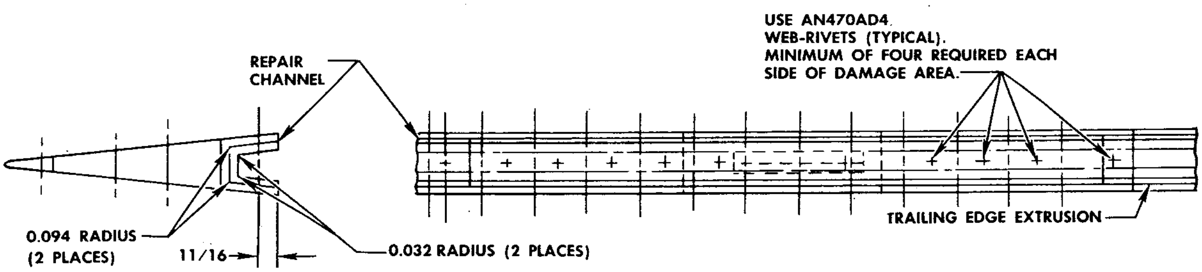
(2) One repair is allowed per bay.

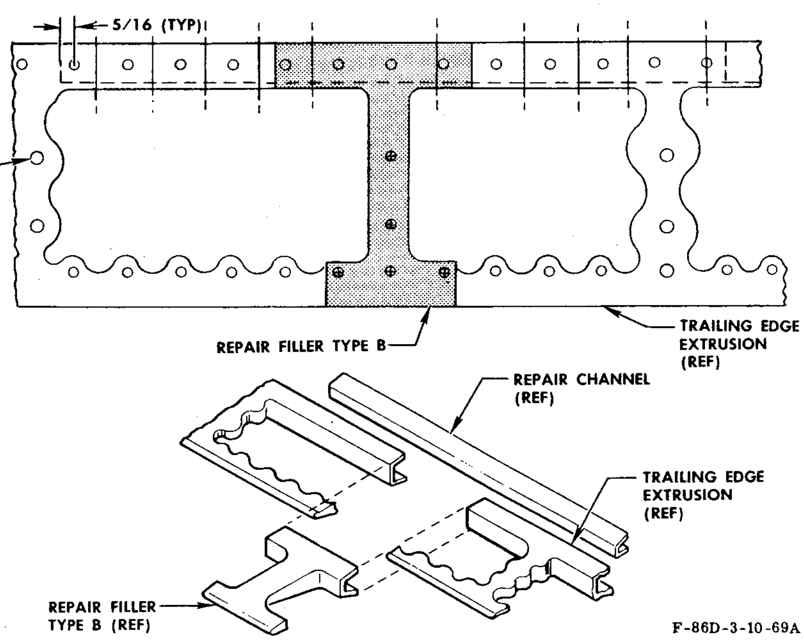
(3) Repairs must be 16 inches apart.

(4) Minimum edge distance = 5/16 inch.









1. Trim out damage midway between existing skin rivets.
2. Machine repair filler to match damaged area. Use Type A if the forward part of the extrusion is not damaged. Use Type B where forward structure of extrusion is damaged. Make filler of 2024-T4, cross section matching extrusion. Make repair channel from 2024-T4 to dimensions shown.
3. Drill web holes to install repair fillers. A repair channel is used with Type B repair filler.
4. Pick up existing skin rivets.

Figure 2-38. Aileron Trailing Edge Extrusion

TIP INDEX

WING

INDEX ARROWS REFER TO THE FIGURE NUMBERS OF THE DETAIL REPAIR ILLUSTRATIONS IN THIS SECTION.

FOR NEGLIGIBLE DAMAGE, SEE FIGURE 2-40.

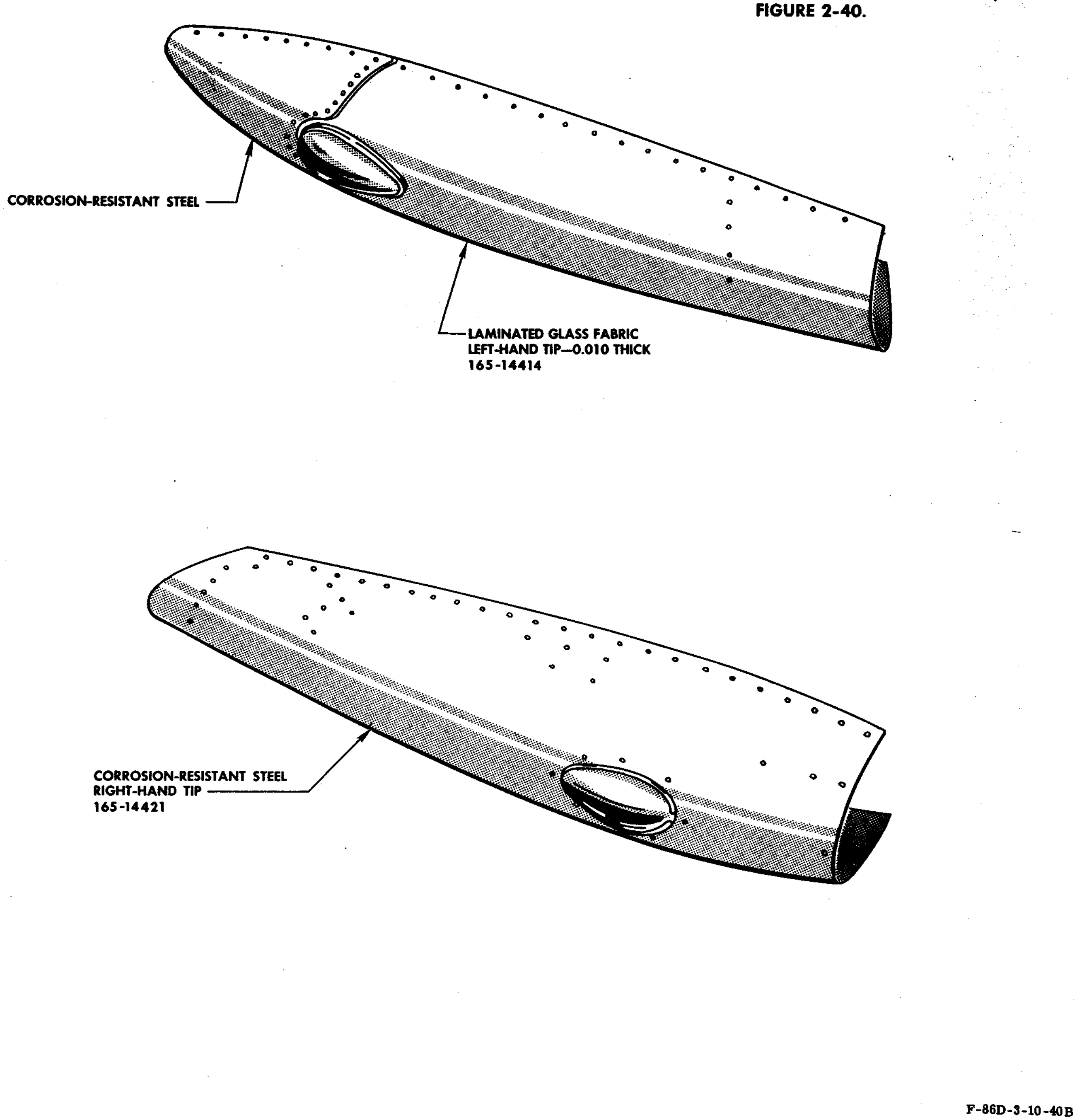
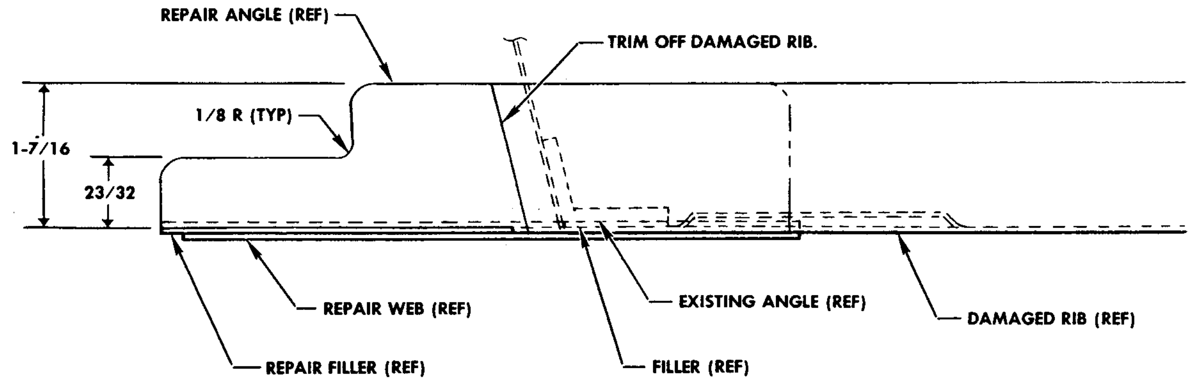
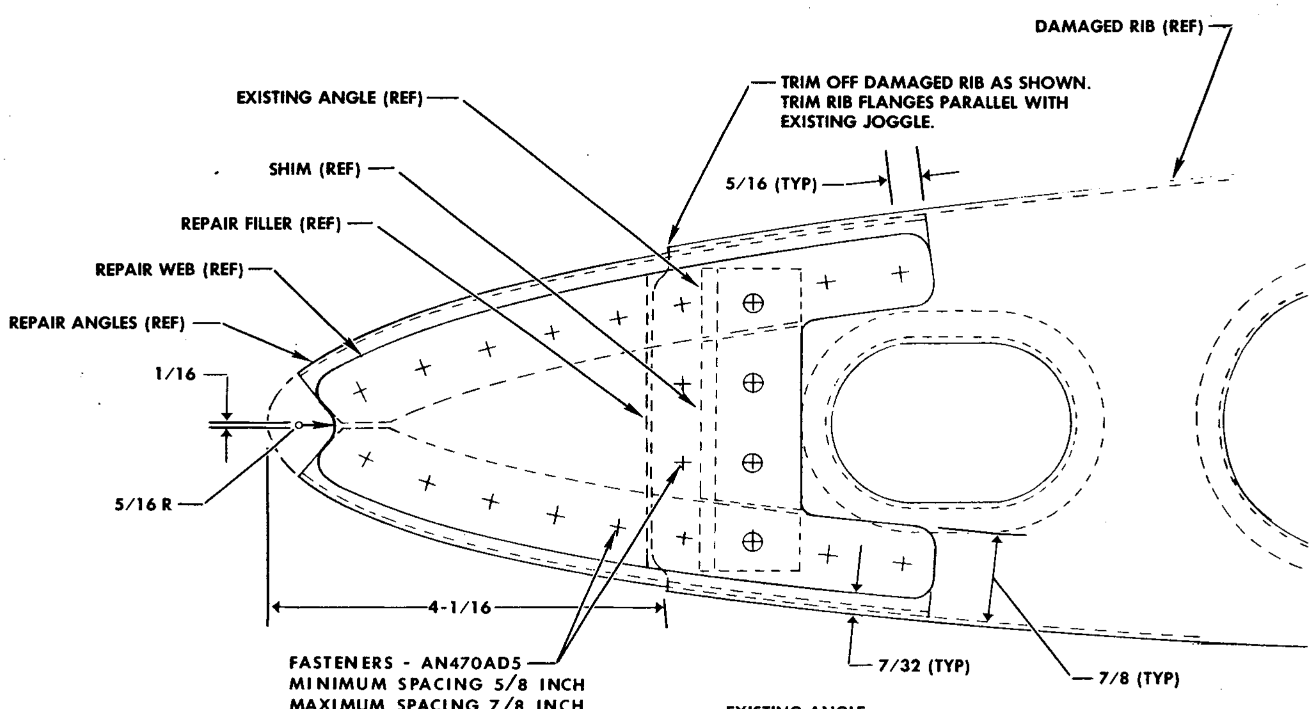


Figure 2-39. Wing Tip Index

PERMANENT—CATEGORY A

WING





1. Remove damaged area approximately as shown on illustration. Make trim on rib flanges so as to remove joggles. Make trim as close to joggle as possible.
2. Make repair web, repair filler, and shim from 2024-T4 material. Make repair angles from 2024-O material, using 1/8-inch bend radius. Heat-treat repair angles to T4 condition after forming.
3. Remove fasteners from existing angle and insert repair angles and repair filler between rib and angle.
4. Fasten all repair parts in place, using size and type of fastener and spacing called out.

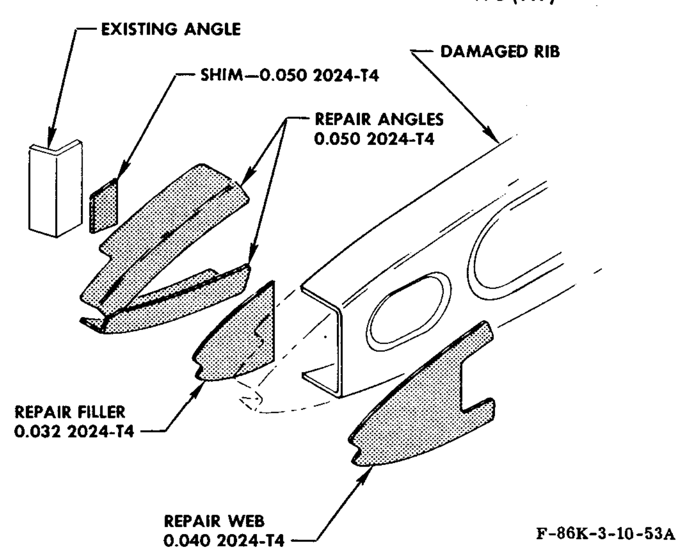


Figure 2-39A. Wing Tip Close-out Rib

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TIP NEGLIGIBLE DAMAGE

WING

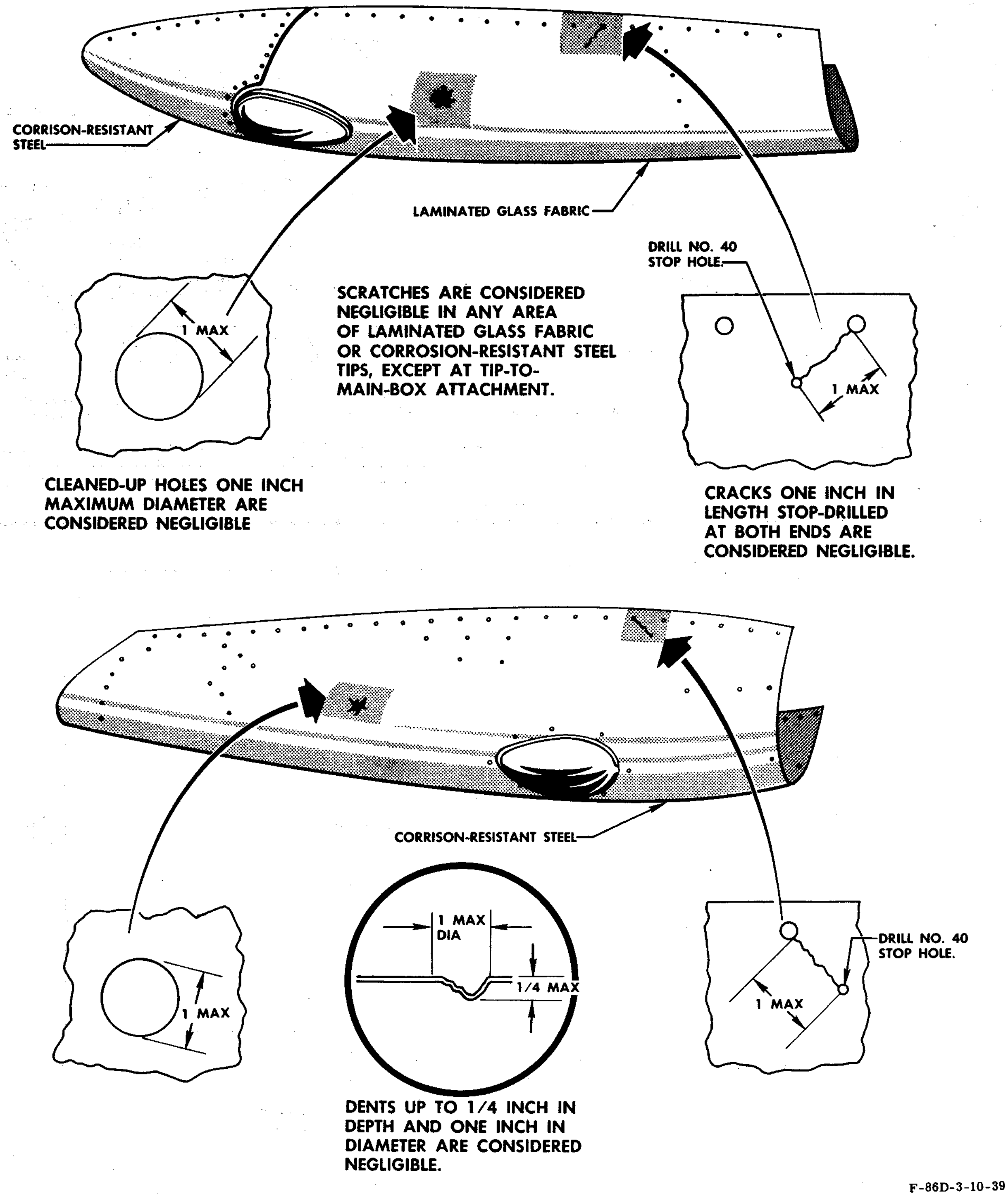


Figure 2-40. Wing Tip Negligible Damage

HOLDING FIXTURE DIMENSIONS

WING

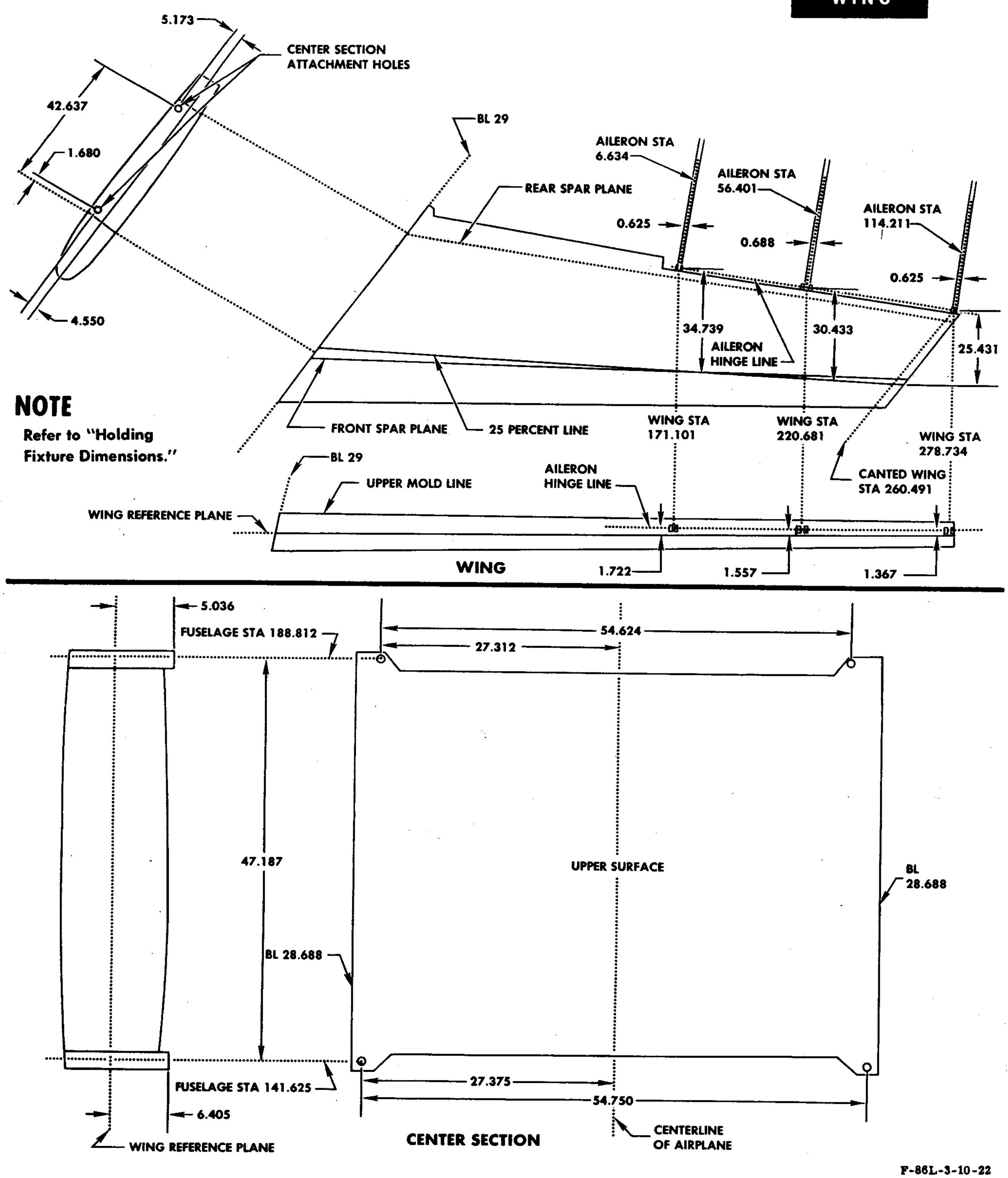
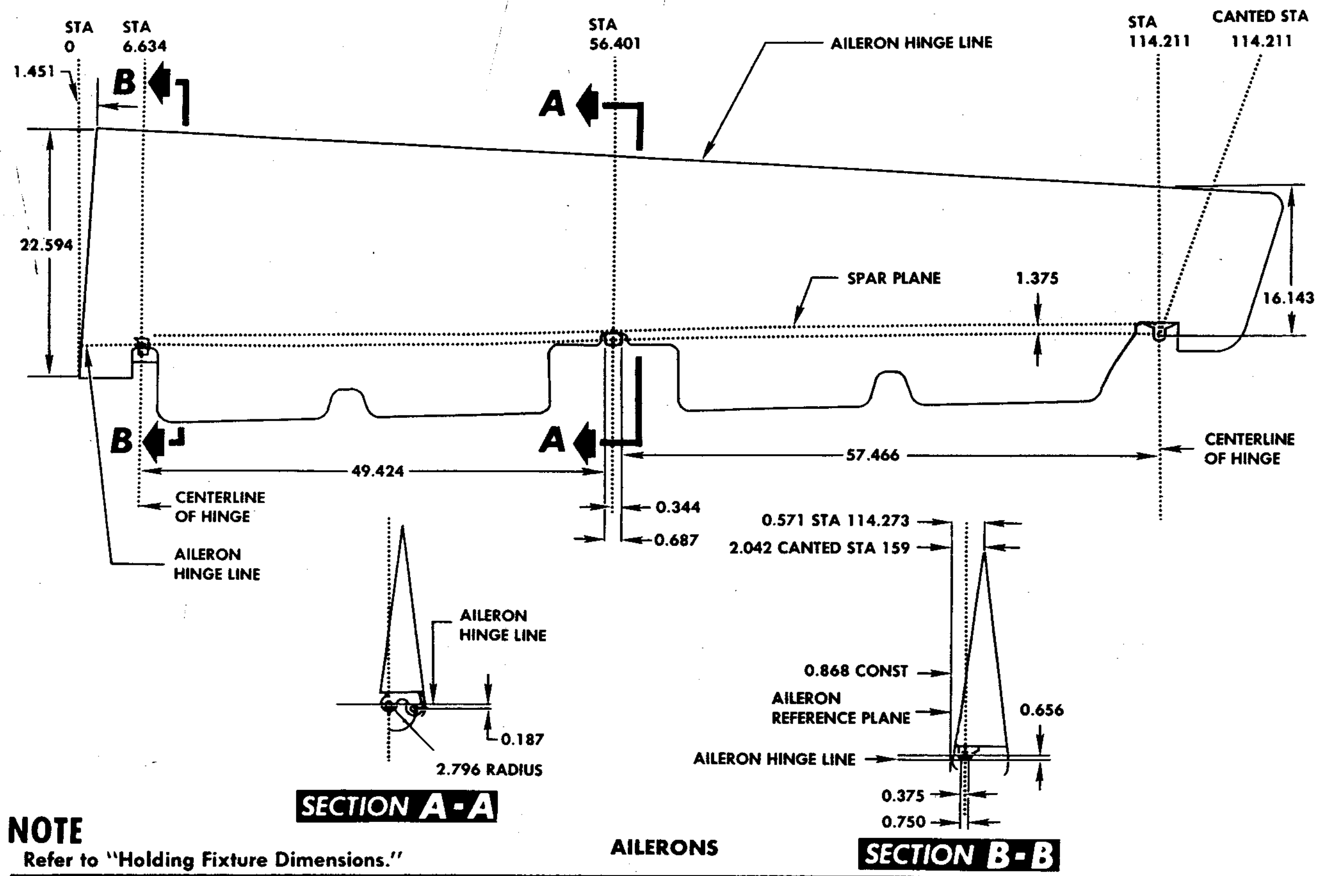


Figure 2-41. Holding Fixture Dimensions—Wing Box and Center Sections

HOLDING FIXTURE DIMENSIONS

WING



NOTE
Refer to "Holding Fixture Dimensions."

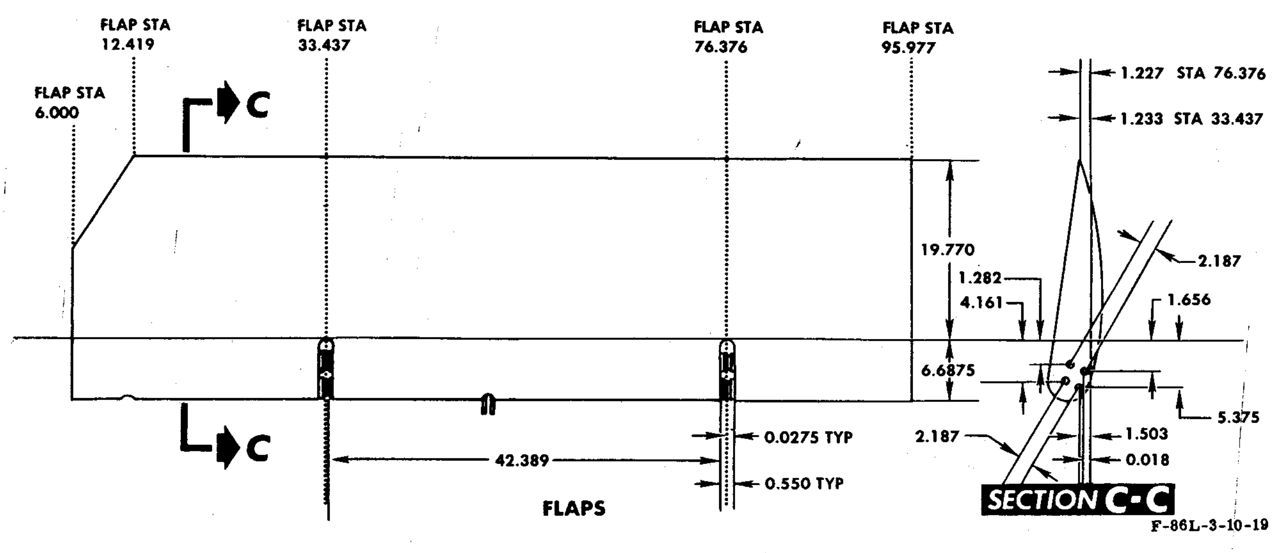
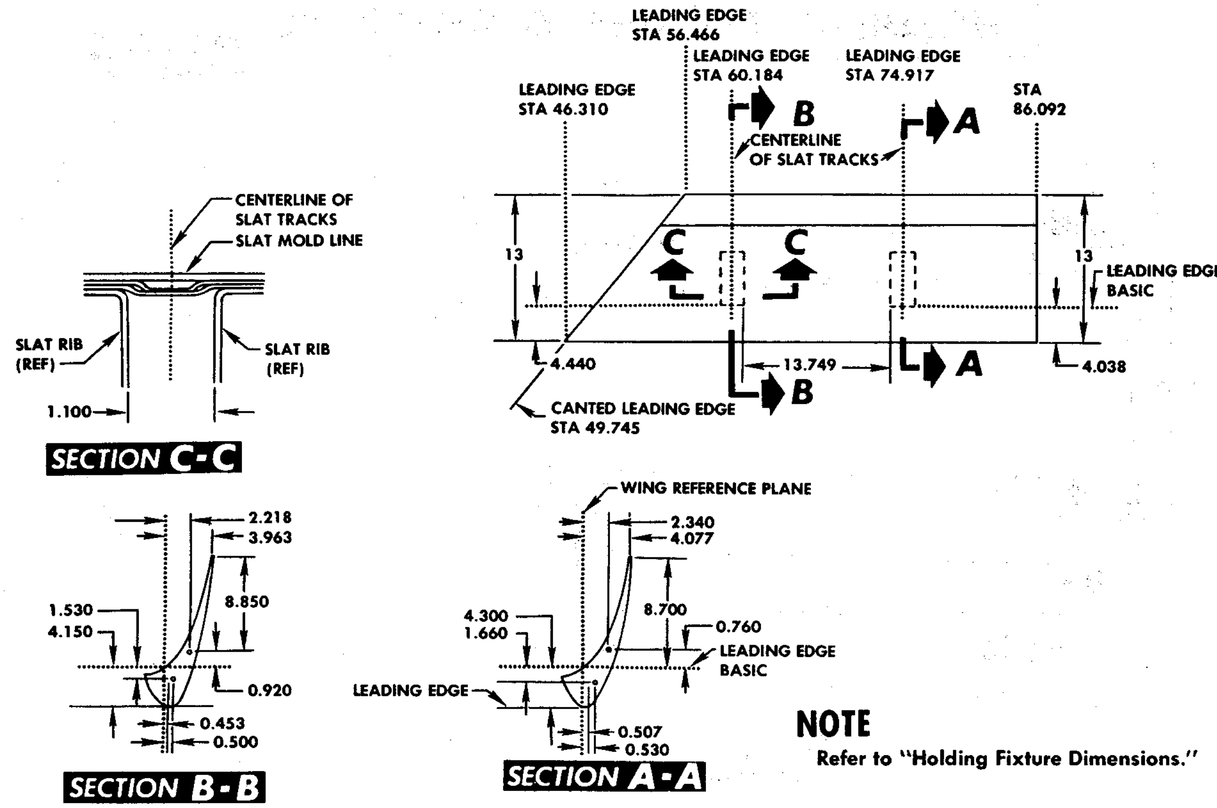


Figure 2-42. Holding Fixture Dimensions—Ailerons and Flaps

HOLDING FIXTURE DIMENSIONS

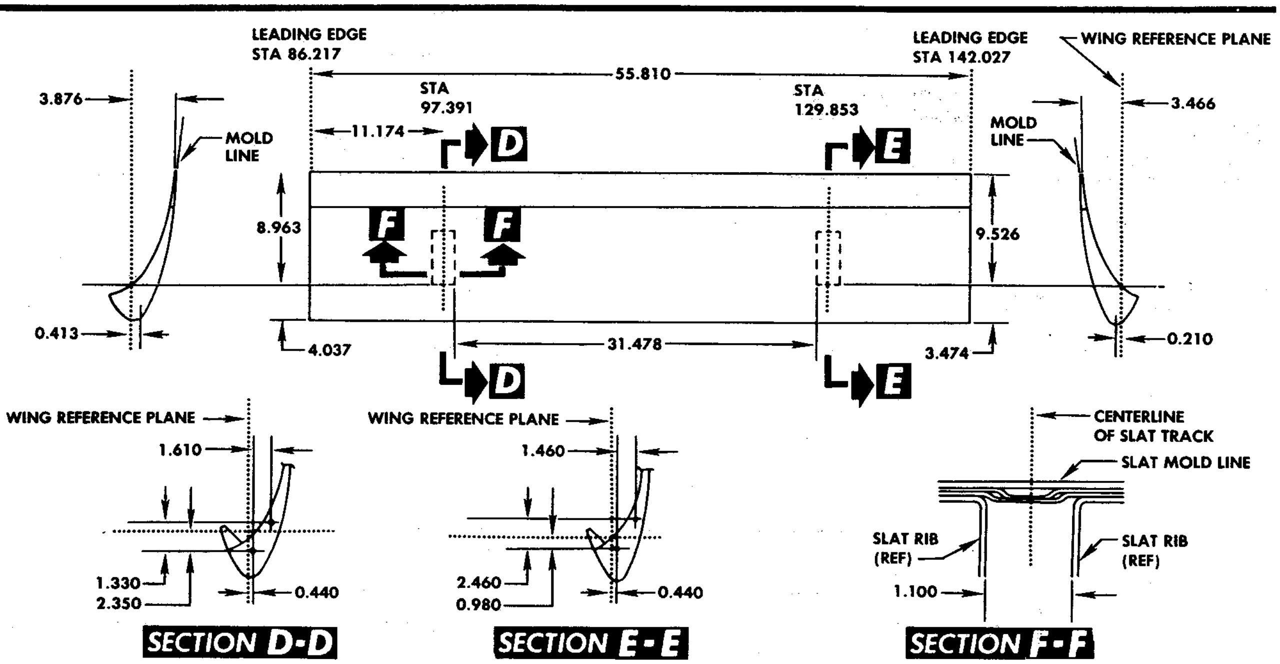
WING



SLAT—INBOARD

NOTE

Refer to "Holding Fixture Dimensions."



SLAT—INTERMEDIATE INBOARD

F-86L-3-10-21

Figure 2-43. Holding Fixture Dimensions—Slats—Inboard and Inboard Intermediate (Sheet 1 of 2)

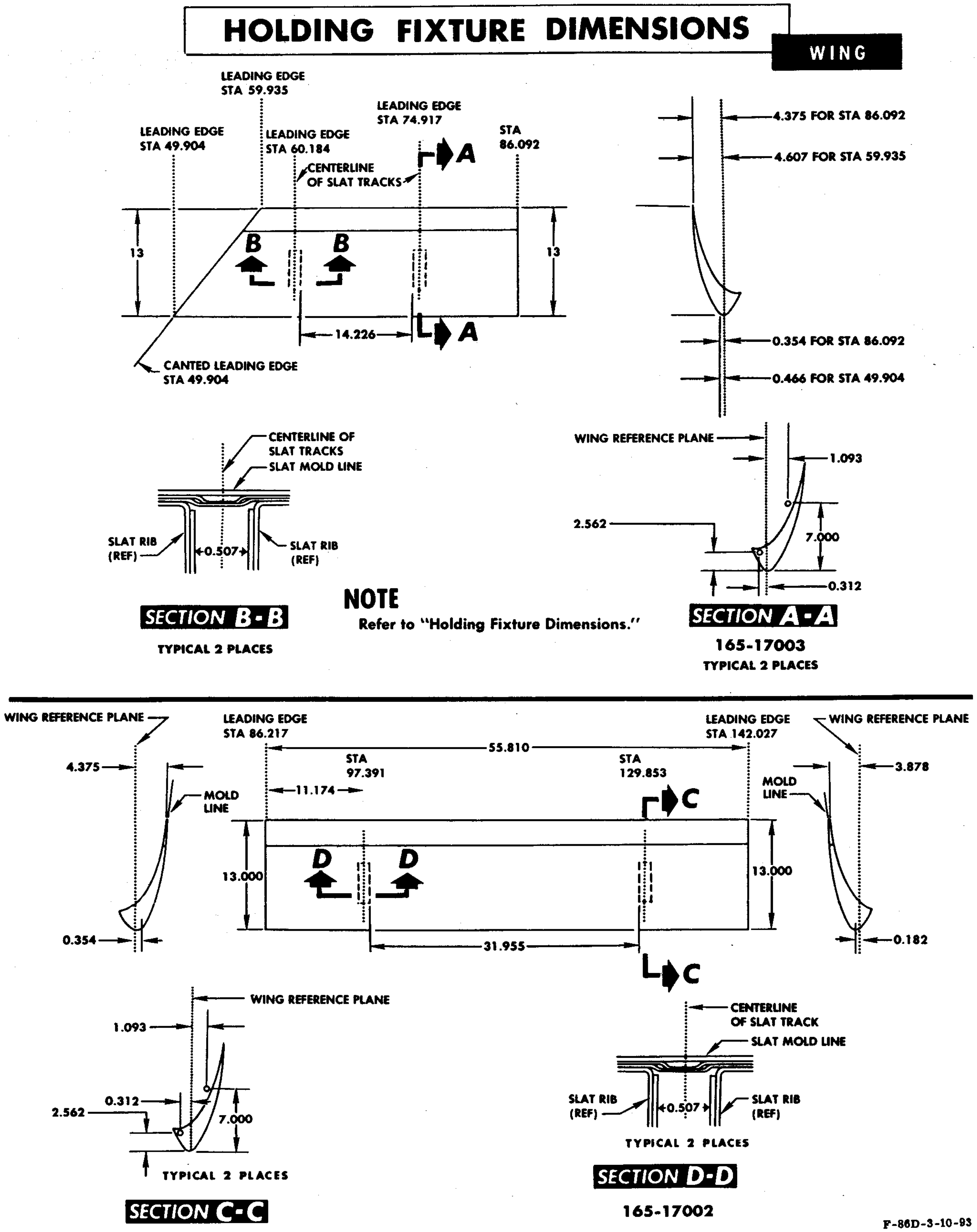


Figure 2-43. Holding Fixture Dimensions—Slats—Inboard and Inboard Intermediate (Sheet 2 of 2)

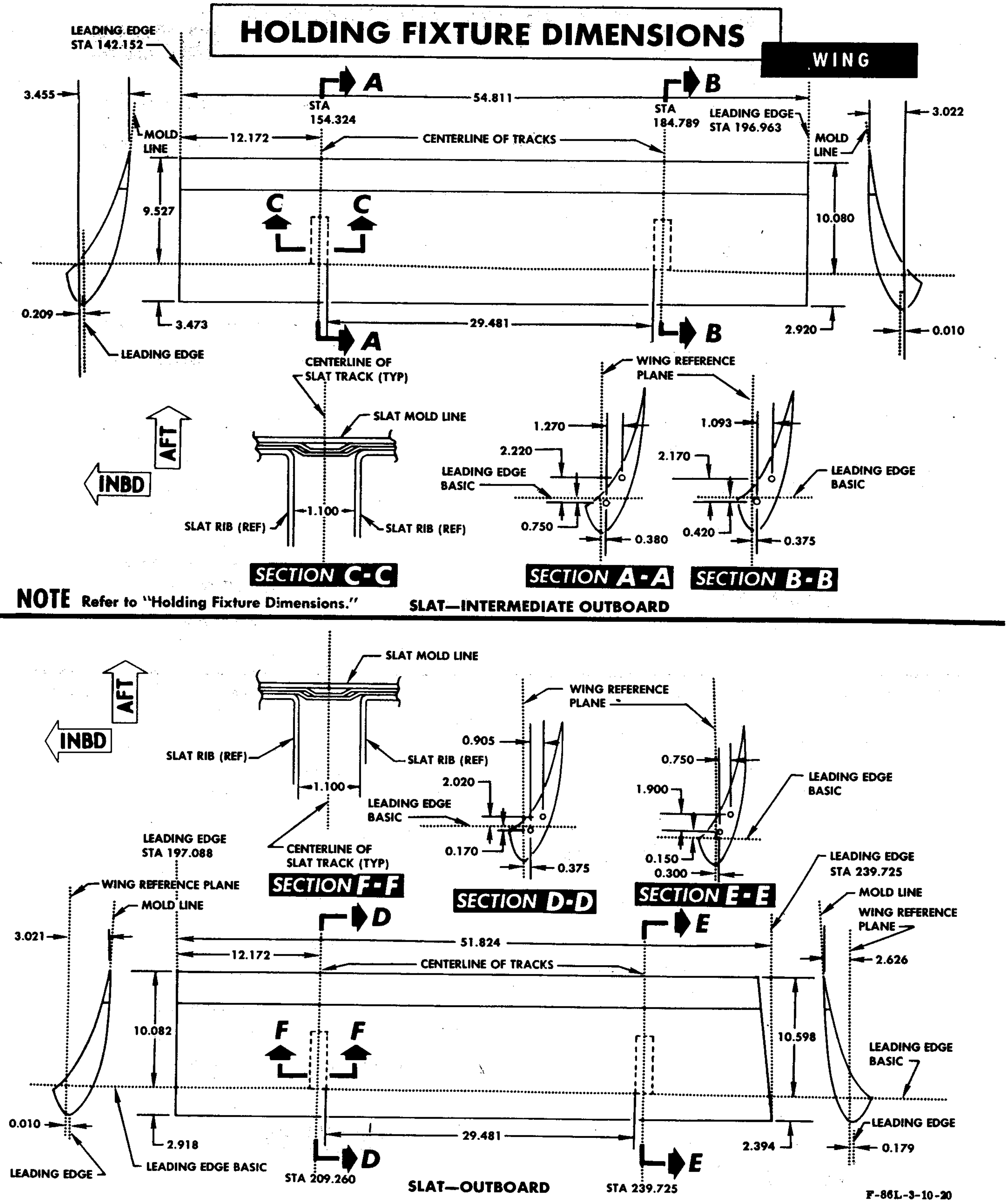


Figure 2-44. Holding Fixture Dimensions—Slats—Outboard and Outboard Intermediate (Sheet 1 of 2)

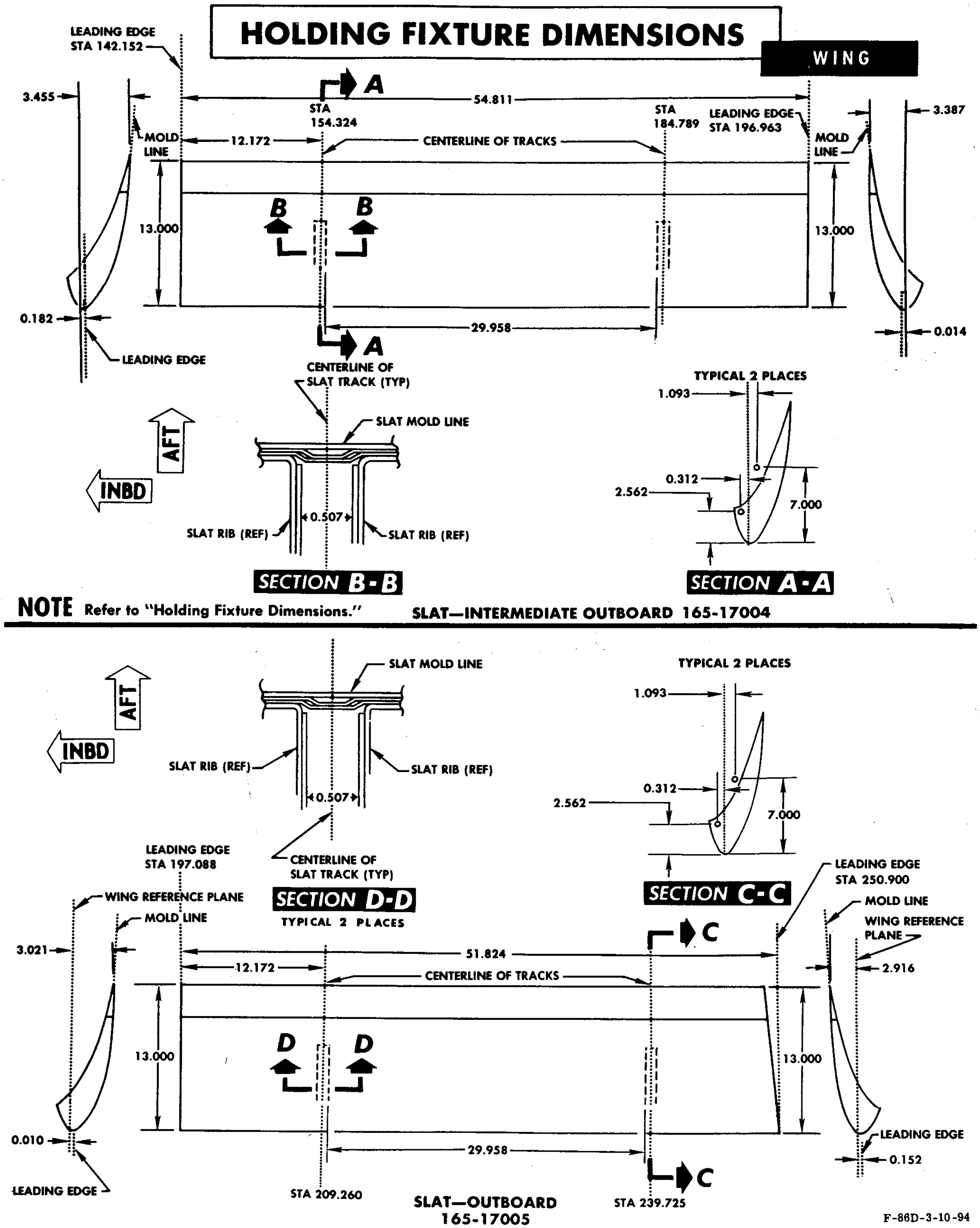


Figure 2-44. Holding Fixture Dimensions—Slats—Outboard and Outboard Intermediate (Sheet 2 of 2)

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SECTION III

EMPENNAGE GROUP

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DESCRIPTION OF EMPENNAGE 3-1
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HORIZONTAL STABILIZER TIP 3-3
HORIZONTAL AND VERTICAL STABILIZER LEADING EDGE SKINS 3-3
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DESCRIPTION OF EMPENNAGE.

HORIZONTAL STABILIZER.

The horizontal stabilizer is a one-piece, all-movable surface attached to the airplane by two pivot fittings at fuselage station 377.718 and water plane 8.375. The two pivot fittings are equidistant from the centerline of the airplane, at buttock plane 18.875. The surface is made up of a center section and two outer panels. The outer panels are swept back at an angle of 35 degrees at the 25-percent line. The angle of incidence of the surface may be controlled in flight by means of a hydraulically operated cylinder. The actuator is mounted on the deck of the fuselage and is tied to an arm projecting off the stabilizer center section at the centerline of the airplane.

The horizontal stabilizer is all metal. The center section is a steel tube which has been formed to shape and tied to the actuator, fuselage, and outer panel by means of steel fittings. The outer panel (outboard from the side of the fuselage) consists of two longitudinal spars, a trailing edge strip, and transverse ribs. The outer panel is covered with an all-metal skin, and forms a three-cell box section to resist torsion. The nose skin and leading edge spar form a duct to carry heated air the full span of the stabilizer. The area forward of the main spar is covered by two skins. The inner skin of the two is corrugated, providing a path for the heated air to flow aft. This flow of heated air makes this area resistant to icing. The inner and outer skins are riveted together at the corrugations.

The outer panel nose skin, leading edge beam, and ribs are fabricated from 2024-T4 alclad sheet. The main beam web, the aft skin, and the doublers along the main beam and in the inboard bay are made from 7075-T6 alclad sheet. The main beam spar caps are machined from 7075-T6 extrusion. The trailing edge is machined from a magnesium extrusion. The center section tube is made from a chrome molybdenum steel and the fittings in the center section are made from chrome molybdenum steel forgings or machined from steel bar.

VERTICAL TAIL SURFACES.

The vertical tail surfaces consist of a fixed stabilizer and a movable rudder which has an adjustable trim tab along the trailing edge for a part of the span. The surface is swept back at an agle of 35 degrees at the 25-percent line. The vertical stabilizer is fixed to the fuselage deck at fuselage station 361.21 and water plane 18.81 and is pinned to a frame at fuselage station 404.696 and water plane 30.75.

The vertical stabilizer is semimonocoque in design. It is all metal with the exception of a small strip of plastic in the tip. It has three longitudinal spars, the aft of which is cut away in two places for the rudder counterbalance weights. In these areas, intercostals have been added to replace the spar. It has transverse ribs between spars and is covered with an all-metal skin, forming a three-cell box section to resist torsion.

The nose skin and leading edge spar form a duct to carry heated air to the full span of the vertical stabilizer. The area forward of the main spar is covered by two skins. The inner skin of the two is corrugated, providing a path for the heated air to flow aft. This flow of heated air makes this area resistant to icing. The inner and outer skins are riveted together at the corrugations. The vertical stabilizer skin, leading edge spar, trailing edge spar, ribs, and intercostals are 2024-T4 alclad. The main spar web is 7075-T6 alclad sheet. The main spar caps, intermediate rudder hinge fitting, and the outboard rudder hinge fitting are machined from 7075-T6 extrusions. The lower rudder hinge attaching fitting is machined from 2024-T42 extrusions.

RUDDER.

The rudder is an all-metal structure except for the tip which is laminated glass fabric. It is attached to the stabilizer on three antifriction bearings. The rudder consists of a box section formed by the beam, the side skin, and the trailing edge extrusion. In the area of the tab, the box section is formed by the rear spar which is also the tab hinge. The beam is formed to fit inside the nose contour. The skins extend forward and wrap around the area of the intermediate hinge cutout. The box section is made continuous by the addition of channel doublers which also support the hinge fittings. The rudder has transverse ribs continuous from the nose to the trailing edge and spaced along the span.

The skin and ribs are fabricated from 2024-T4 alclad sheet. The beam and channel doublers are fabricated from 7075-T6 alclad sheet. The hinge fittings and counterbalance weights are 356-T6 aluminum alloy sand castings. The torque tube is machined from a 4140 steel die forging. The rudder horn is machined from 4130 steel plate. The trailing edge is a 2024-T42 extrusion.

Static and dynamic balance of the rudder is obtained by means of weights attached to the outboard and intermediate hinge fittings, forward of the hinge line. The all-metal trim tab has a single spar along its leading edge which also acts as the hinge to attach the tab to the rudder.

ONE-TIME FLIGHT.

One-time flight damage is damage which can be left "as is" or which requires only minor repairs to allow the airplane to be ferried to an overhaul base. Flight restrictions as to maximum airspeed and G will be placed on the airplane. Figure 3-1 shows one-time flight damage areas on the horizontal stabilizer, vertical stabilizer, and rudder.

REMOVAL OF HORIZONTAL AND VERTICAL STABILIZER SKINS.

Construction of the horizontal and vertical stabilizer makes it necessary to remove the outer skins if extensive repair is to be done to the internal structure. The double skin forward of the main spar is removable in two pieces. The outer skin may be removed first, then the inner skin.

HORIZONTAL STABILIZER.

Before horizontal stabilizer skins may be removed, the horizontal stabilizer tip must be removed for access to the tip rib. The removal procedures given in figure 3-2 are self-explanatory.

When the horizontal stabilizer skins are reinstalled, the leading edge skin must be assembled first. The same type and size fasteners as those removed must be used. This will make it necessary to remove or partially remove the aft skin to install the leading edge.

The assembly sequence for the horizontal stabilizer is as follows:

1. Completely assemble leading edge section, which includes outer skin, inner skin and leading edge formers, leading edge spar, and nose ribs.

Note

All double-skin area must have high-temperature sealing compound HT-23 applied between inner skin, root and tip ribs, doublers, and leading edge spar. (Refer to index for sealing.)

2. Assemble leading edge section to box section. Nose ribs are attached to the main spar with bolts through the main spar into nut plates on the nose ribs.
3. Install and rivet aft skin in place, starting at the main spar and working aft. Cherry rivets may be used only in locations where they were used on original assembly. Rivets through the trailing edge grid extend through both skins and are driven flush on both sides.

VERTICAL STABILIZER.

Before vertical stabilizer skins may be removed, the rudder, vertical stabilizer tip, and all removable access doors must be removed.

When the vertical stabilizer skins are reinstalled, the leading edge skins must be assembled first. The same type and size fasteners as those removed must be used. This makes it necessary to remove or partially remove the aft skins to install the leading edge.

The assembly sequence for the vertical stabilizer is as follows:

1. Completely assemble leading edge section, which

includes outer skin, inner skin and leading edge formers, leading edge spar, and nose ribs.

Note

All double-skin area shall have high-temperature sealing compound HT-23 applied between inner skin, root and tip ribs, doublers, and leading edge spar. (Refer to index for sealing.)

2. Assemble leading edge section to box section. The nose ribs are attached to the main spar with bolts through the main spar into nut plates on the nose ribs.
3. Install and rivet aft skins in place. Cherry rivets may be used only in the same locations as on original assembly.
4. Install rear spar upper and lower section. The rear spar is attached to the aft ribs with screws and bolts into nut plates in the aft ribs. Pick up rivets through aft skins and rear spar.

HORIZONTAL AND VERTICAL STABILIZER NEGLIGIBLE DAMAGE.

The horizontal and vertical stabilizer may have dents, cracks, scratches, and oil canning within the limitations given in figures 3-6 and 3-13. Dents must be smooth and have no sharp edges, wrinkles, or cracks. Cracks may exist in the horizontal stabilizer and rudder trailing edge extending aft from rivets to the edge of the skin, provided no more than three cracks exist per skin, and provided the cracks are separated by at least one

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rivet without a crack in the skin. Cracks in skin panels must not exceed ½ inch in length, and must be stop-drilled at each end. Horizontal stabilizer tips may have scratches up to 0.010 inch deep. Horizontal and vertical stabilizer skins may have oil cans, provided no cracks or loose rivets are adjacent to the canned area. No more than two cans are permitted per skin, and cans must not be in adjoining bays. Each can must be confined to one bay; that is, popping of the can must not extend across ribs or stringers and create a can in an adjacent bay.

HORIZONTAL STABILIZER TIP.

Because the horizontal stabilizer tips are made of weldable aluminum alloy, much of the repair may be done by welding. The damaged area may be cut out and new sections welded in, or regular skin-doubler repairs may be used. The edge repair (figure 3-11) may be used at a fastener or in between fasteners. It is optional as to whether the filler is welded into place or riveted as shown.

HORIZONTAL AND VERTICAL STABILIZER LEADING EDGE SKINS.

The double-skin area of the horizontal and vertical stabilizer leading edge may be repaired as shown in figure 3-19. For damage to both inner and outer skin, the temporary repairs shown in sheet 1 of figure 3-19 may be used as one-time flight repairs. The damaged area must be trimmed out and smoothed before the patch can be applied. A one-time ferry flight is restricted to a maximum of 300 knots and a maximum of +3 G and −1 G.

When a large area of the double skin has been damaged, a repair such as that shown in sheet 3 of figure 3-19 may be used. Remove damaged area by removing rivets holding skins and formers to leading edge and cutting out inner and outer skin midway between existing formers. Cut back over edge of leading edge spar ⅛ inch, leaving sufficient edge distance for existing rivets. To do this step, slide a thin sheet of steel in between inner skin and leading edge spar (to protect the spar) and rout out with a rotary file or other suitable tool. Cut and form inner skin patch, skin attach doublers, formers, spacers, outer skin patch, and outer skin doubler.

The repair is assembled as follows:

1. Fit all parts in place, and drill all holes. Disassemble parts and do all countersinking and dimpling.
2. Apply high-temperature sealing compound HT-23 to the leading edge spar, and place inner skin patch in position. (Refer to index for sealing.)
3. Apply high-temperature sealing compound HT-23 to the underside of the doublers and formers, and place them in position.
4. Place spacers in position.
5. Apply high-temperature sealing compound HT-23 to underside of outer skin doubler, and place it in position.
6. Place outer skin patch in position, and install rivets.

When there is extensive damage to the outer skin and the inner skin is intact, the repair may be made by using the outer skin doubler and picking up formers and splice spacers as necessary. The outer skin doubler may be made of one-half hard corrosion-resistant steel, 0.010 to 0.016 inch thick.

Note

Repair of the leading edge of the horizontal stabilizer is limited to:

- External patches inboard of 50 percent of the span must not exceed 150 square inches; outboard of 50 percent of the span, patches must not exceed 100 square inches.
- The total length of all leading edge repairs must not exceed 40 inches.

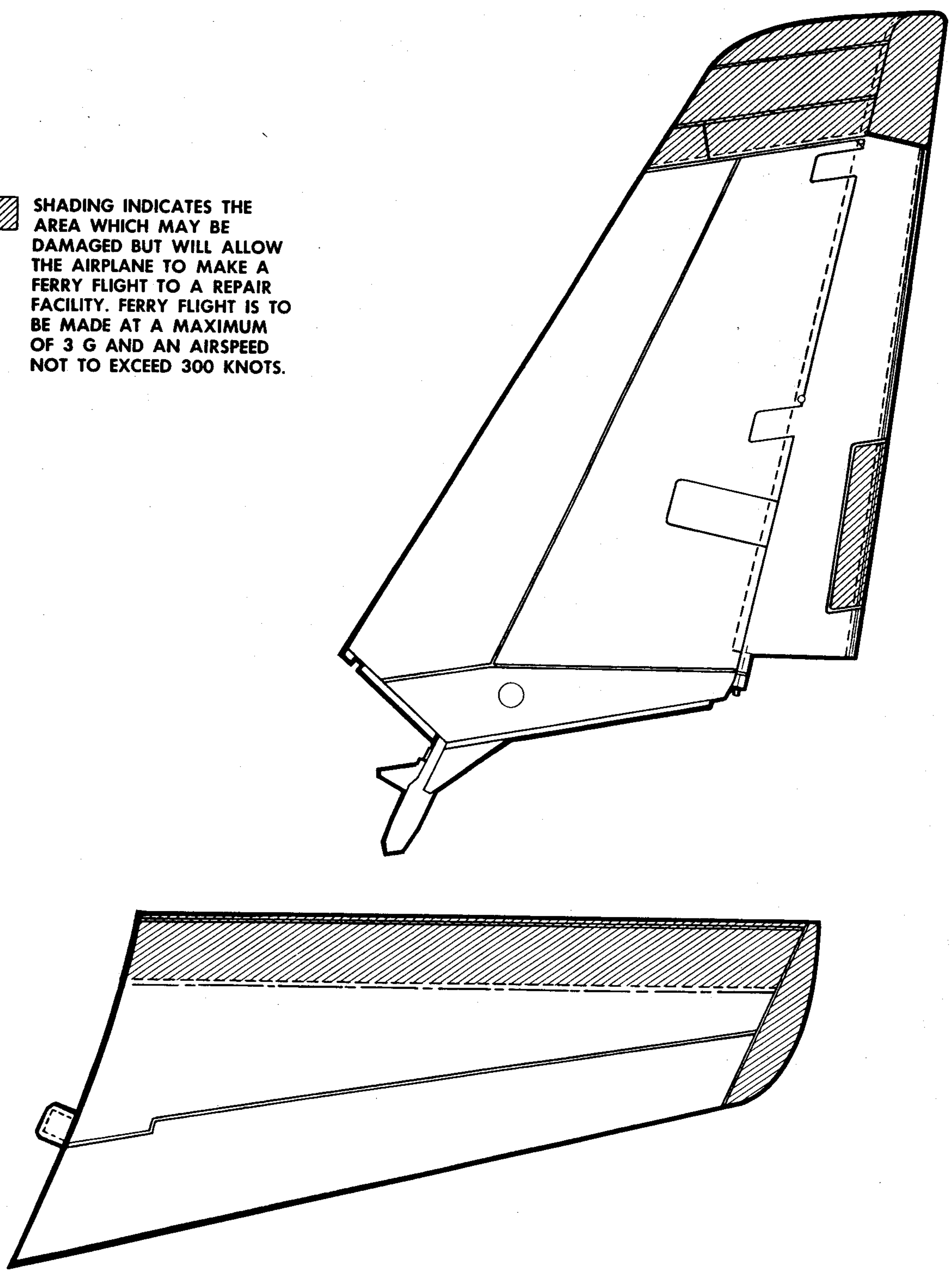
HOLDING FIXTURE DIMENSIONS.

Figure 3-25 shows the necessary dimensions for the construction of fixtures for holding the empennage components while repairs are being made. These dimensions and attachment points are not intended for use in manufacturing jigs for building a complete assembly. They are intended only for use in manufacturing holding fixtures to maintain the proper attachment points and dimensions and to ensure that the part being repaired will fit when reinstalled.

ONE-TIME FLIGHT

EMPENNAGE

SHADING INDICATES THE AREA WHICH MAY BE DAMAGED BUT WILL ALLOW THE AIRPLANE TO MAKE A FERRY FLIGHT TO A REPAIR FACILITY. FERRY FLIGHT IS TO BE MADE AT A MAXIMUM OF 3 G AND AN AIRSPEED NOT TO EXCEED 300 KNOTS.



F-86D-3-20-16

Figure 3-1. One-time Flight

REMOVAL OF HORIZONTAL STABILIZER SKINS

EMPENNAGE

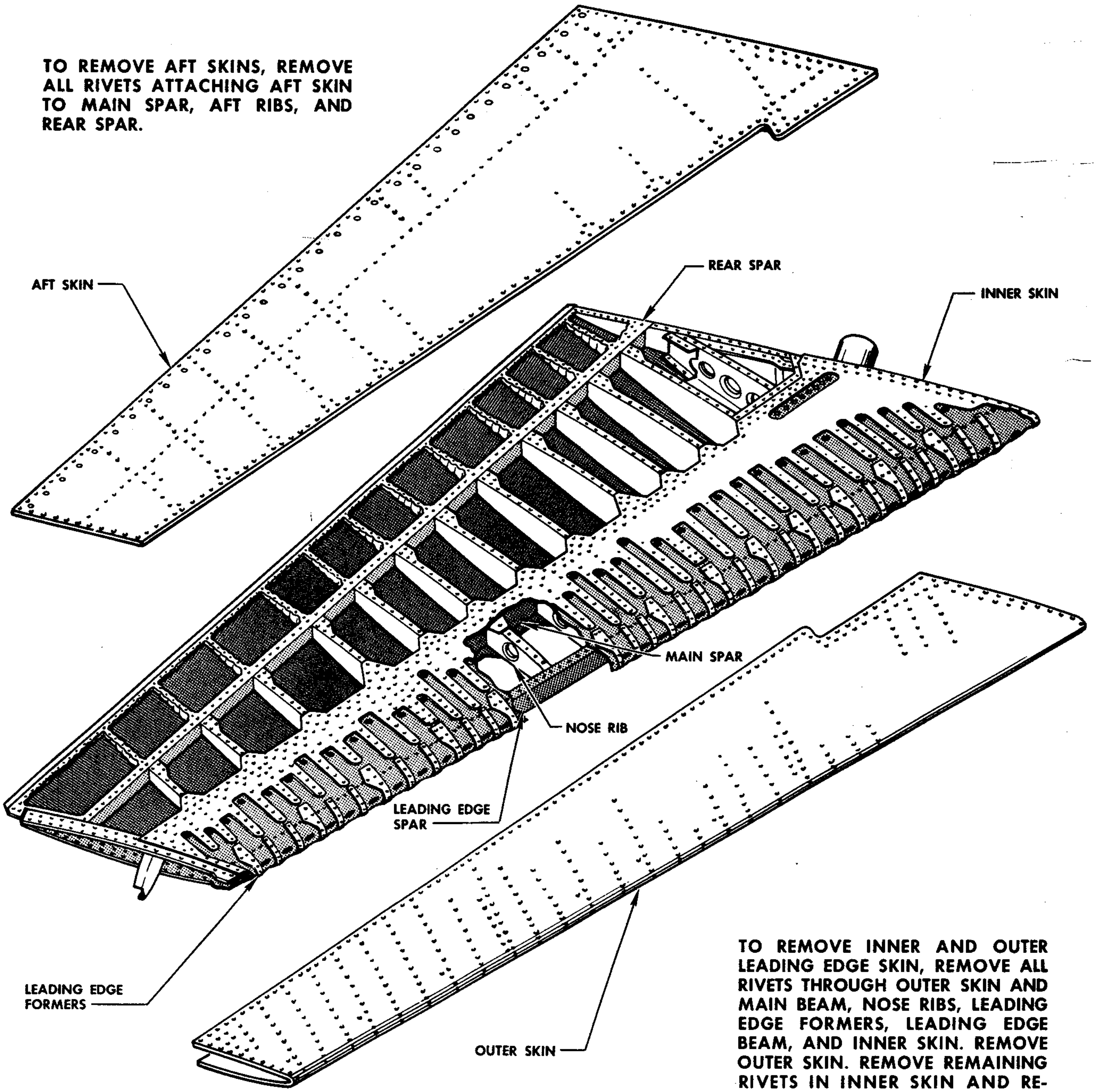
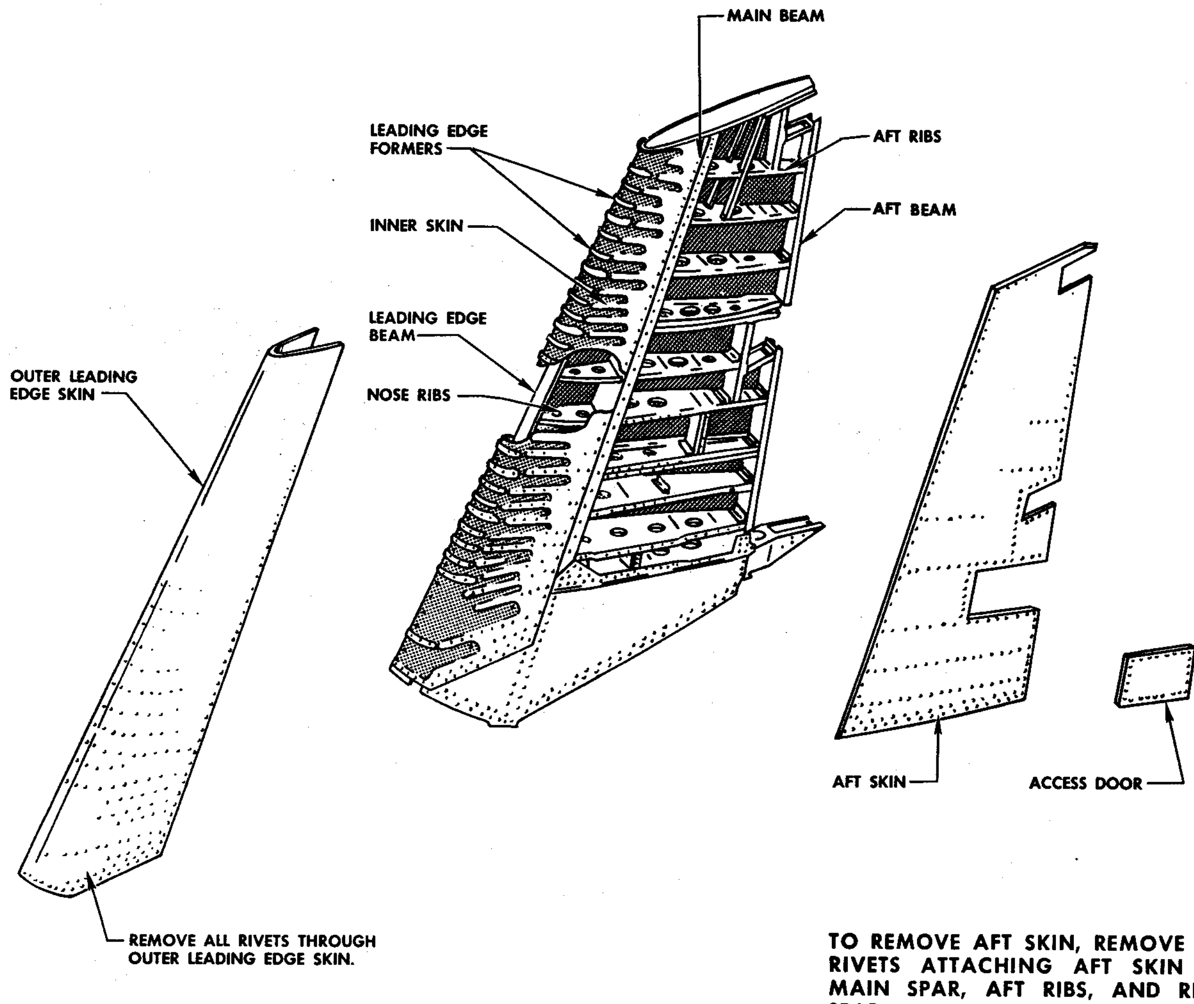


Figure 3-2. Removing Horizontal Stabilizer Skins

REMOVAL OF VERTICAL STABILIZER SKINS

EMPENNAGE

TO REMOVE INNER AND OUTER LEADING EDGE SKIN, REMOVE ALL RIVETS THROUGH OUTER SKIN AND MAIN SPAR, NOSE RIBS, LEADING EDGE FORMERS, LEADING EDGE SPAR, AND INNER SKIN. REMOVE OUTER SKIN. REMOVE REMAINING RIVETS IN INNER SKIN AND REMOVE INNER SKIN. LEADING EDGE FORMERS ARE REMOVED WITH INNER SKIN.



TO REMOVE AFT SKIN, REMOVE ALL RIVETS ATTACHING AFT SKIN TO MAIN SPAR, AFT RIBS, AND REAR SPAR.

F-86D-3-20-22

Figure 3-3. Removing Vertical Stabilizer Skins

REPAIR INDEX

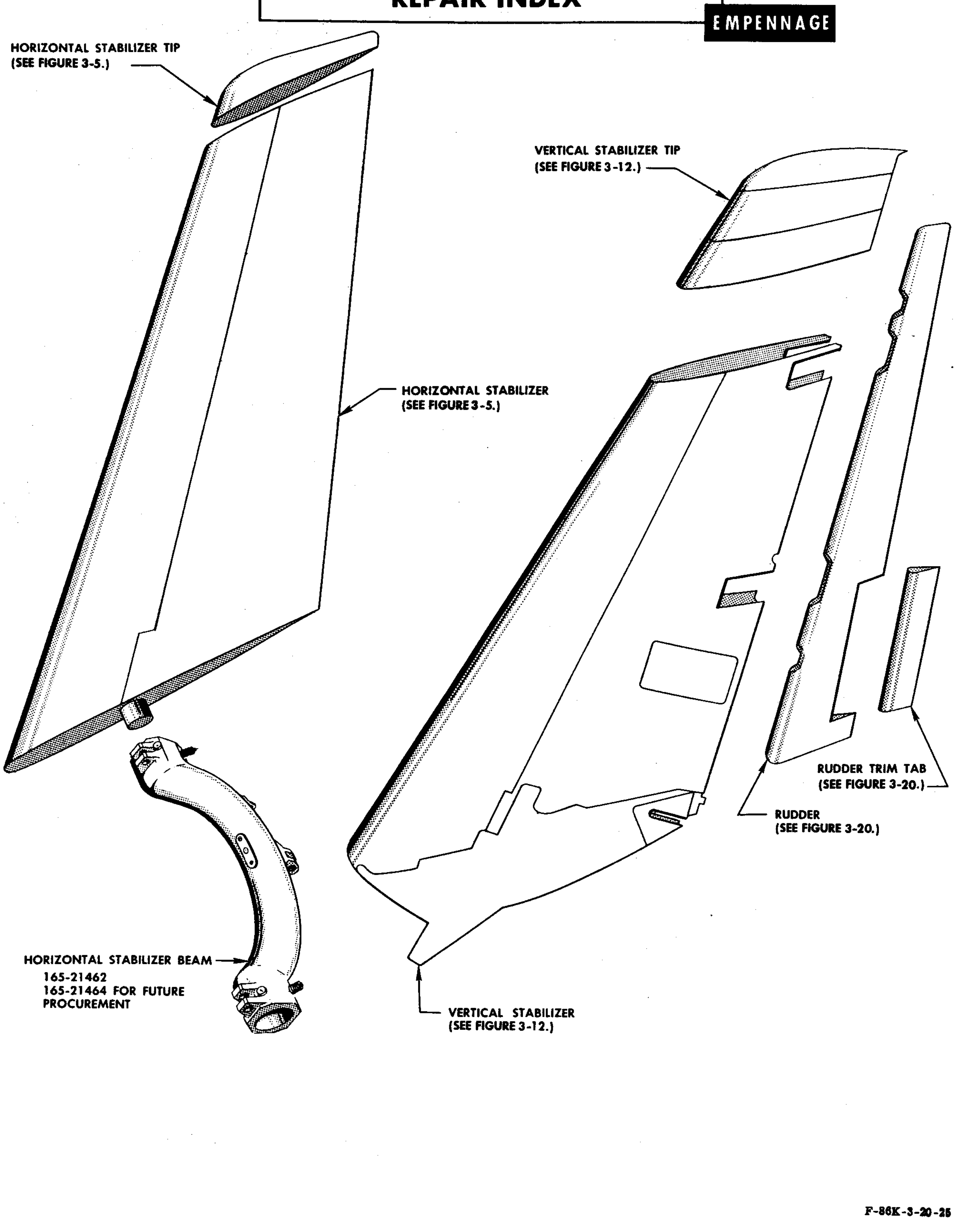


Figure 3-4. Empennage Group Index

HORIZONTAL STABILIZER INDEX

EMPENNAGE

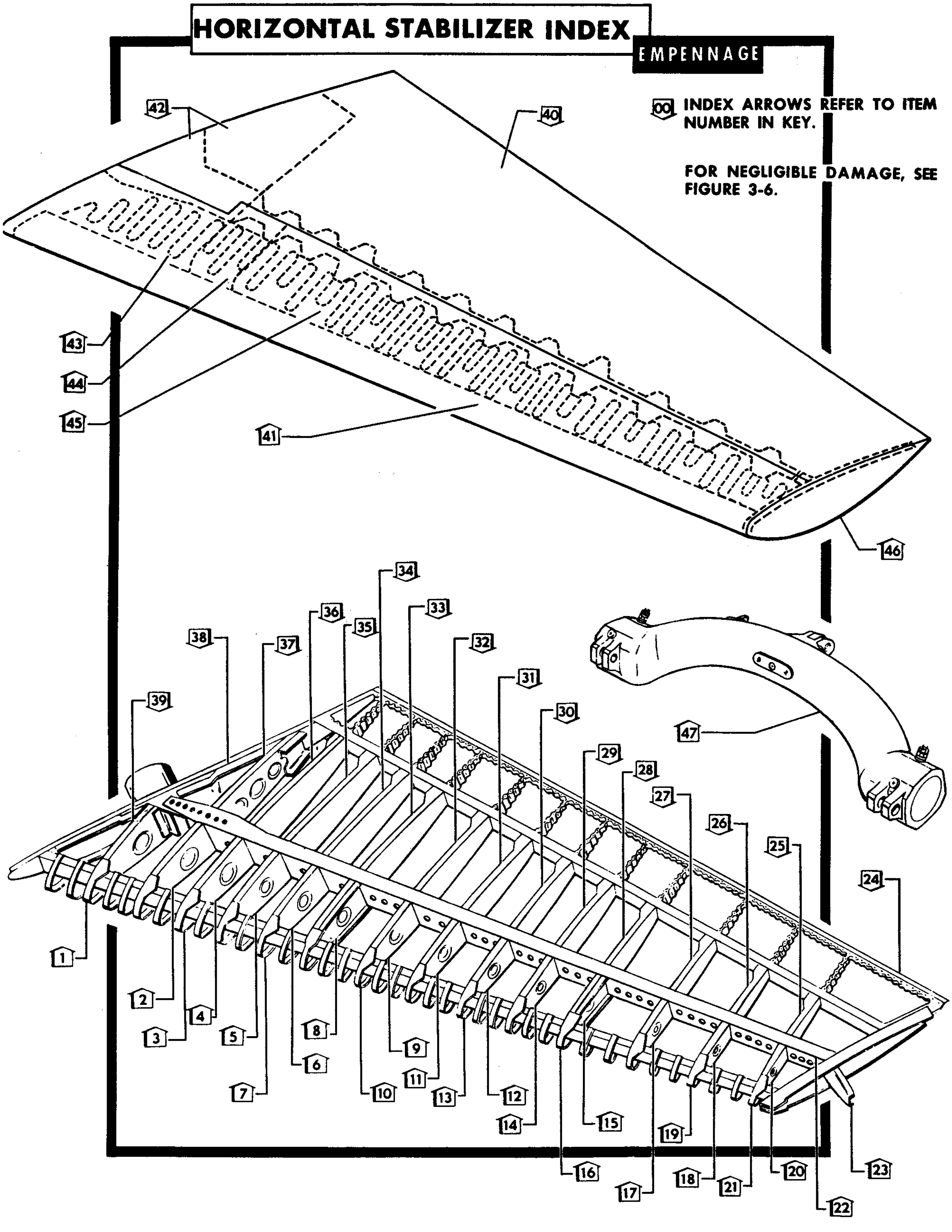


Figure 3-5. Horizontal Stabilizer Index

ITEM NO.	DRAWING NO.*	DESCRIPTION	GAGE	MATERIAL	REPAIR FIGURE NO.†
1	165-21115-3	Former	0.091	2024-T4 Clad	
2	165-21210	Rib	0.040	2024-T4 Clad	
3	165-21115-7	Former	0.091	2024-T4 Clad	
4	165-21214	Rib	0.040	2024-T4 Clad	
5	165-21218	Rib	0.040	2024-T4 Clad	
6	165-21222	Rib	0.032	2024-T4 Clad	
7	165-21115-11	Former	0.091	2024-T4 Clad	
8	165-21126-13	Former	0.091	5052-H34	
9	165-21232	Rib	0.032	2024-T4 Clad	
10	165-21115-13	Former	0.091	2024-T4 Clad	
11	165-21238	Rib	0.032	2024-T4 Clad	
12	165-21243	Rib	0.032	2024-T4 Clad	
13	165-21115-17	Former	0.091	2024-T4 Clad	
14	165-21248	Rib	0.032	2024-T4 Clad	
15	165-21254	Rib	0.032	2024-T4 Clad	
16	165-21116-5	Former	0.091	2024-T4 Clad	
17	165-21261	Rib	0.025	2024-T4 Clad	
18	165-21267	Rib	0.025	2024-T4 Clad	
19	165-21115-23	Former	0.091	2024-T4 Clad	
20	165-21274	Rib	0.025	2024-T4 Clad	
21	165-21303	Beam Assy	0.051	2024-T4 Clad	3-8
22	165-21301	Beam	0.125	7075-T6 Clad	3-9
23	165-21810	Intercostal	0.032	2024-T4 Clad	
24	165-21476	Beam		Mag Extr	3-10
25	165-21775	Rib	0.025	2024-T4 Clad	3-7
26	165-21768	Rib	0.025	2024-T4 Clad	3-7
27	165-21762	Rib	0.025	2024-T4 Clad	3-7
28	165-21755	Rib	0.040	2024-T4 Clad	3-7
29	165-21749	Rib	0.025	2024-T4 Clad	3-7
30	165-21744	Rib	0.025	2024-T4 Clad	3-7
31	165-21739	Rib	0.025	2024-T4 Clad	3-7
32	165-21733	Rib	0.025	2024-T4 Clad	3-7
33	165-21728	Rib	0.025	2024-T4 Clad	3-7
34	165-21723	Rib	0.025	2024-T4 Clad	3-7
35	165-21719	Rib	0.032	2024-T4 Clad	3-7
36	165-21715	Rib	0.064	2024-T4 Clad	3-7
37	165-21711	Rib	0.064	2024-T4 Clad	
38	165-21510	Rib	0.064	2024-T3 Clad	
39	165-21204	Rib	0.051	2024-T4 Clad	
40	165-21701	Skin	0.025	2024-T3 Clad	
41	165-21701	Inner Skin	0.020	2024-T4 Clad	
42	165-21701	Doublers	0.032	7075-T6 Clad	
43	165-21701	Milled Skin	0.040	2024-T3 Clad	
44	165-21701	Milled Skin	0.030	2024-T3 Clad	
45	165-21701	Milled Skin	0.020	2024-T3 Clad	
46	165-21701	Tip	0.040	5052-O Clad	3-11
47	165-21001	Beam	Tube	Chrome Molybdenum Steel	

***Drawing numbers are for reference only.**

†For additional repairs, refer to Section X.

Key to Figure 3-5

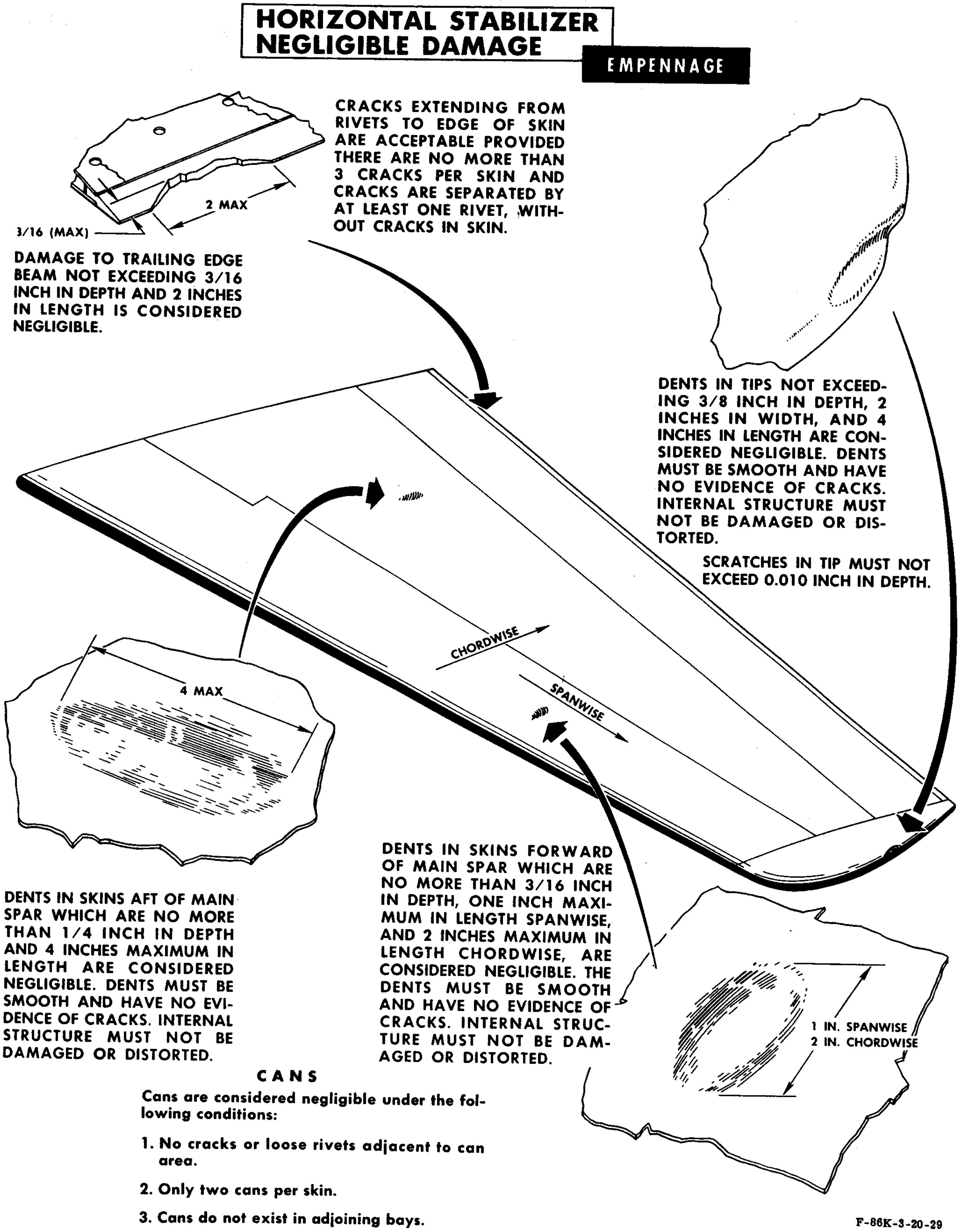
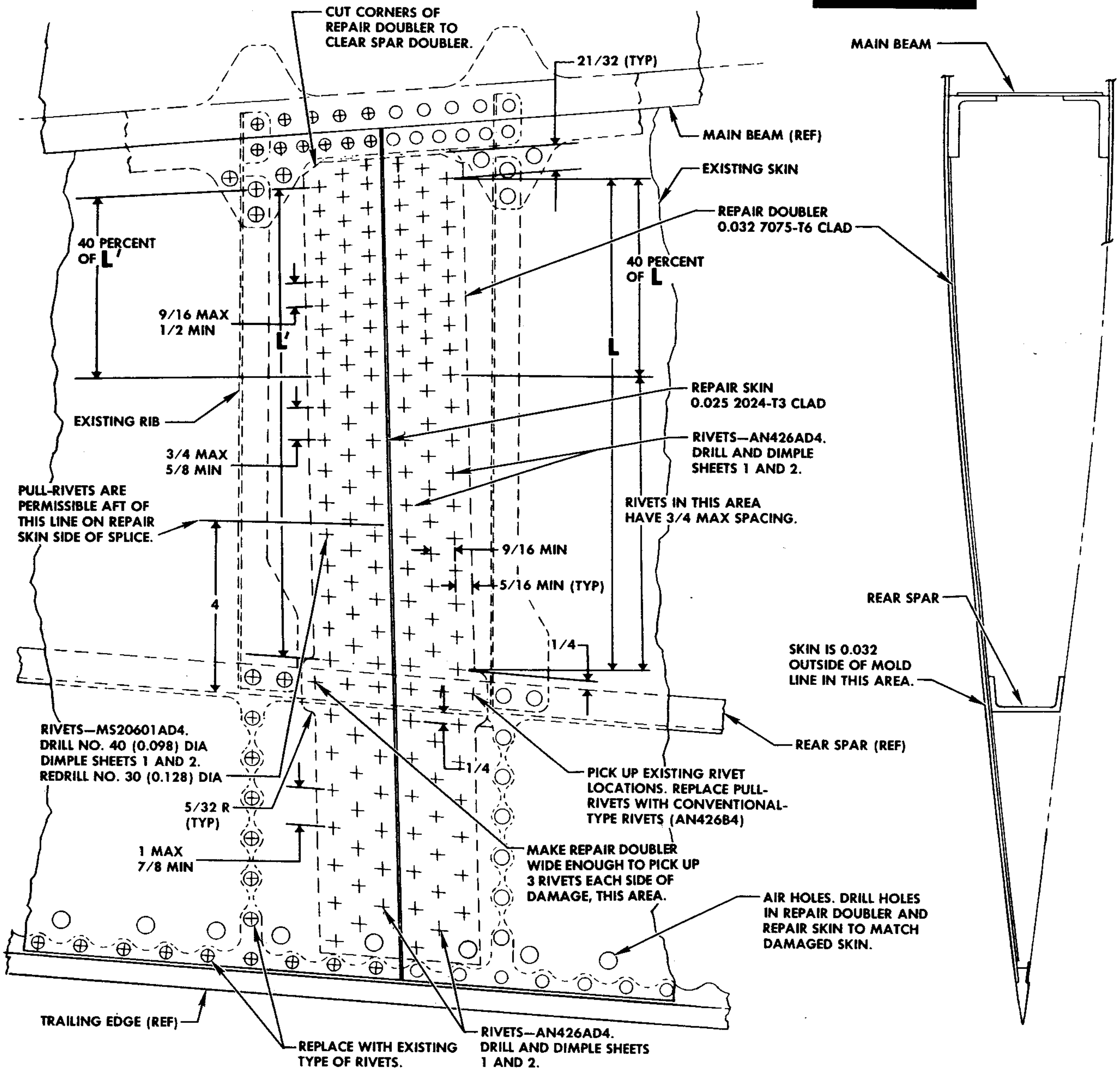


Figure 3-6. Horizontal Stabilizer Negligible Damage

PERMANENT — CATEGORY A

EMPENNAGE



1 Trim out damage midway between existing fasteners.
2 Smooth all edges and corners after trimming.
3 Make repair doubler and repair skin from materials called out on illustration.
4 Locate repair doubler in place and lay out and drill fastener pattern through existing skin and repair doubler.
5 Locate repair skin in place, and lay out and drill fastener pattern through repair skin and repair doubler. Pick up all existing fastener locations through repair skin.
6 Remove repair skin and repair doubler. Dimple all holes for required type of fastener.
7 Fasten all repair parts in place, using size and type of fasteners and spacing called out.

NOTE This repair is applicable outboard of station 14-1/4 and aft of the main beam. Two such repairs may be used to insert a section of skin.

- Remove enough trailing edge fasteners to allow bucking bar to be inserted for bucking rivets aft of rear spar.

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Figure 3-6A. Skin Splice—Horizontal Stabilizer

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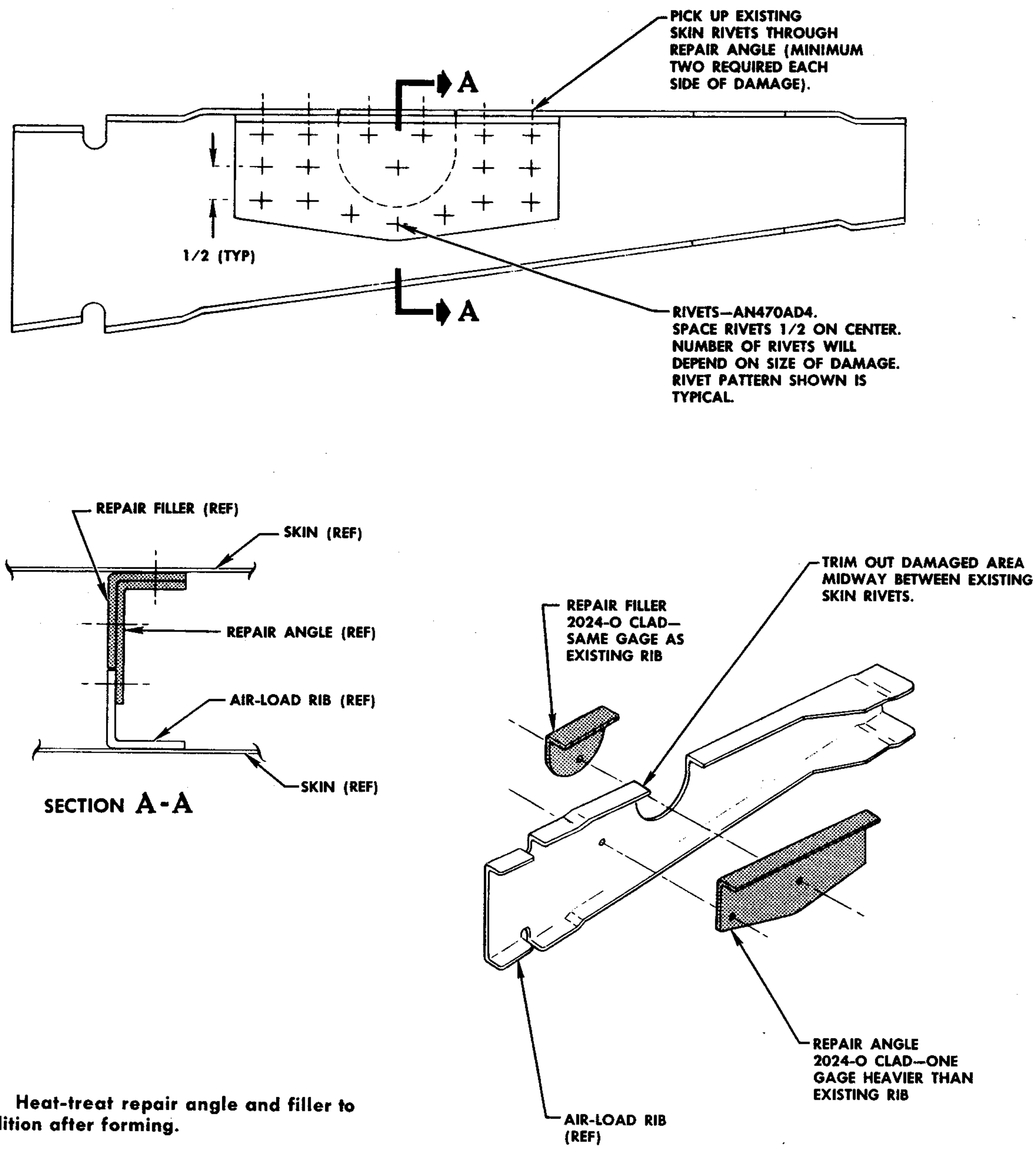
PERMANENT Category A



NOTE Heat-treat repair angle and filler to T4 condition after forming.

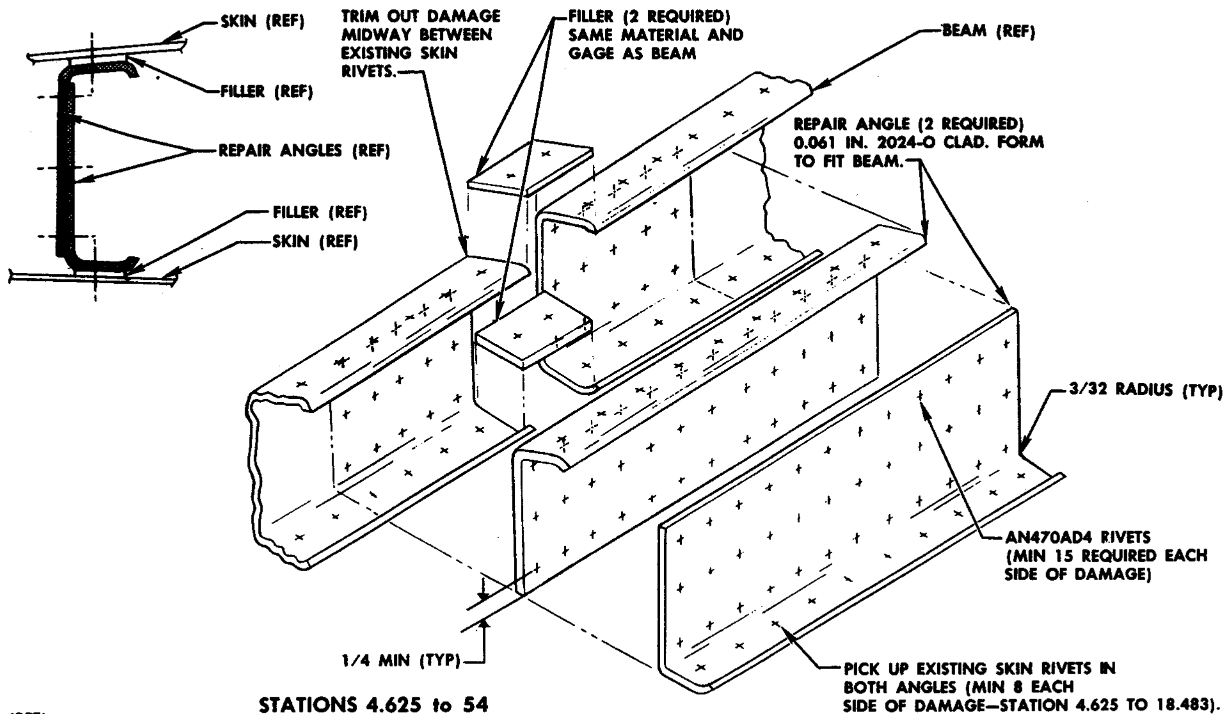
Refer to index for page number of minimum bend radii table.

F-86D-3-20-40

Figure 3-7. Horizontal Stabilizer Air Load Ribs

PERMANENT

Category B



NOTE Heat-treat repair members to T4 condition after forming.

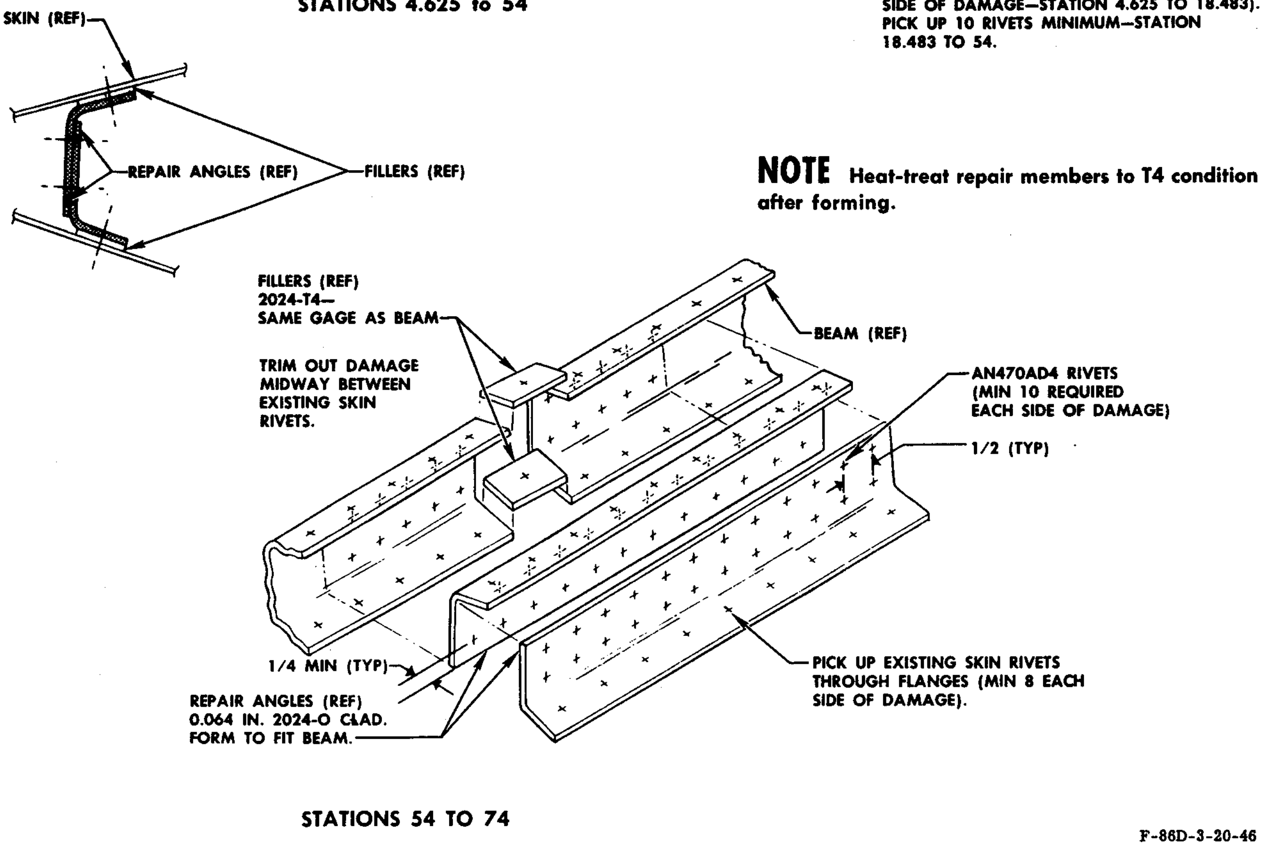
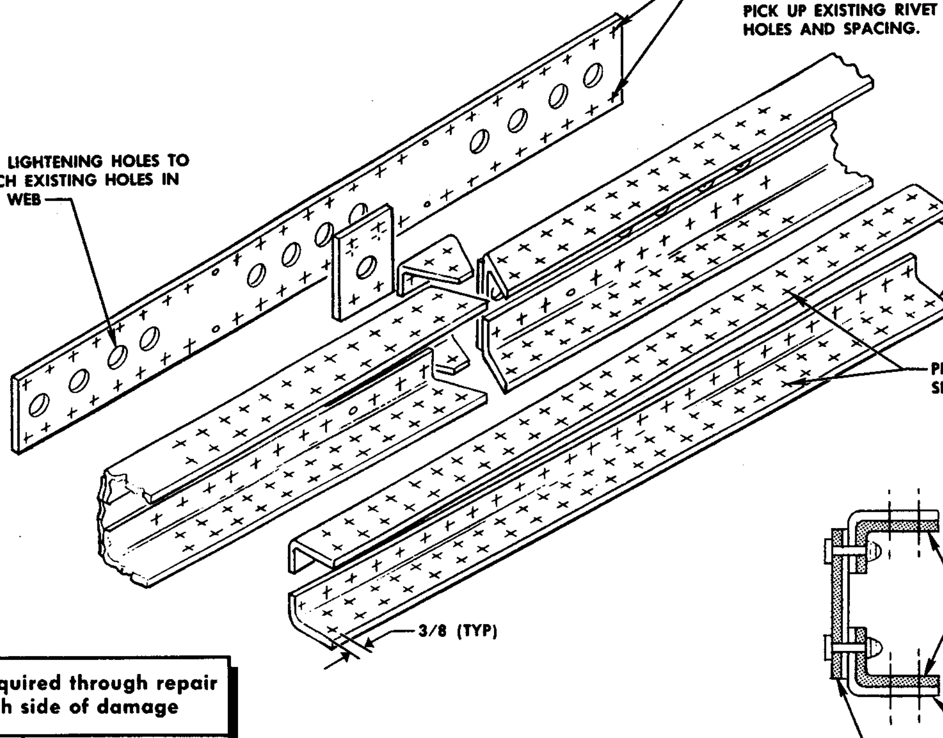
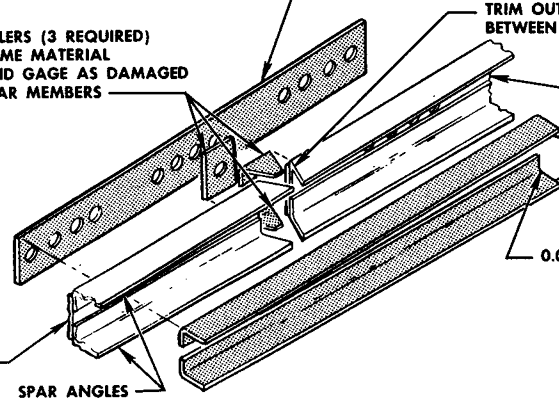


Figure 3-8. Horizontal Stabilizer Leading Edge Beam

PERMANENT Category B



Rivets required through repair plate each side of damage	
STATION	MINIMUM REQUIRED
43 TO 54	22
54 TO TIP	17



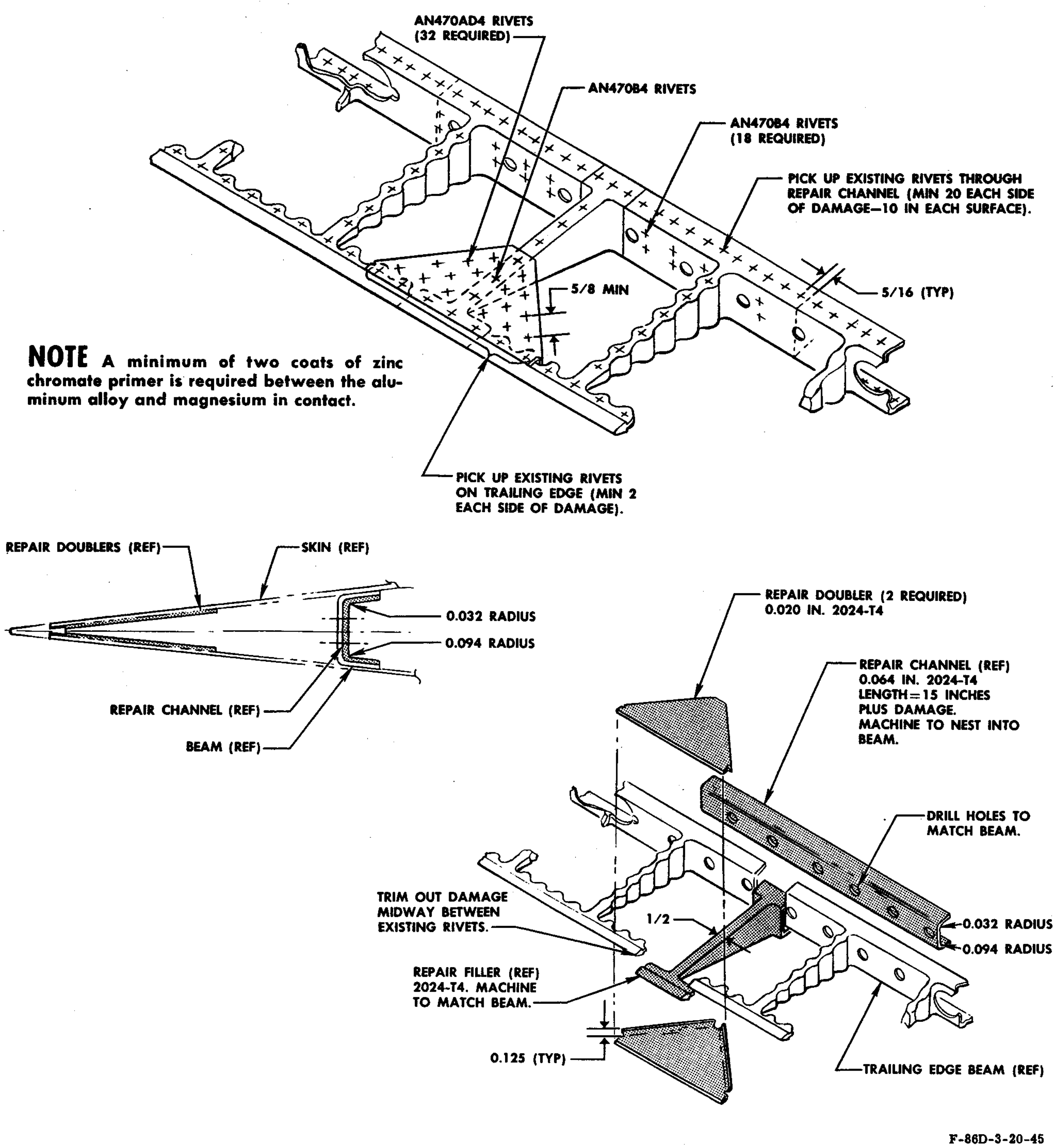
NOTE Length of repair angles and repair plate = about 20 inches plus length of damage.

F-86D-3-20-44

Figure 3-9. Horizontal Stabilizer Main Spar

PERMANENT

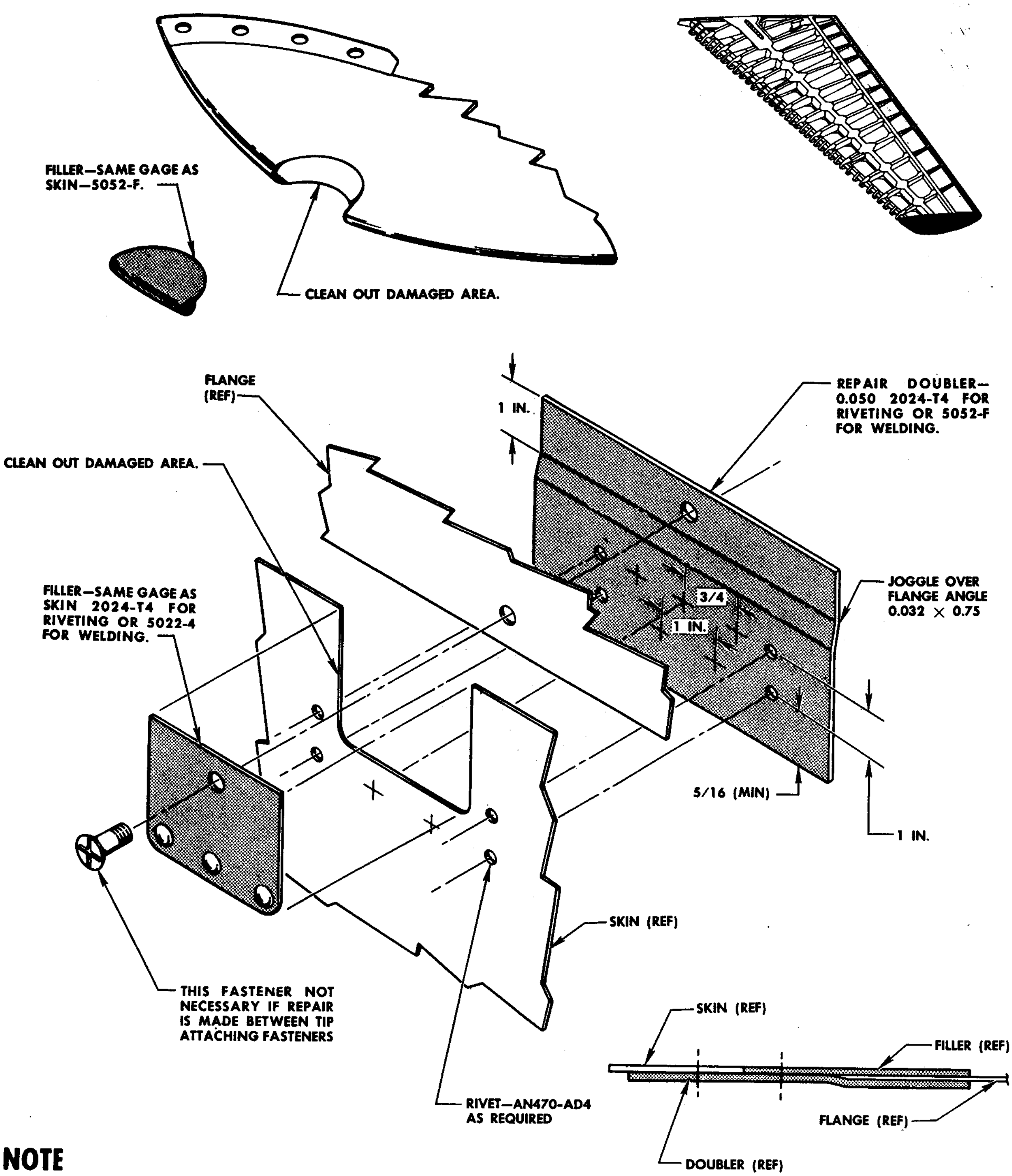
Category B



NOTE A minimum of two coats of zinc chromate primer is required between the aluminum alloy and magnesium in contact.

Figure 3-10. Horizontal Stabilizer Trailing Edge Beam

PERMANENT Category A



NOTE

Weld according to Navy Specification PW-2.
After welding, finish to provide smooth surface.

F-86D-3-20-21

Figure 3-11. Horizontal Stabilizer Tip Repair

VERTICAL STABILIZER INDEX

EMPENNAGE

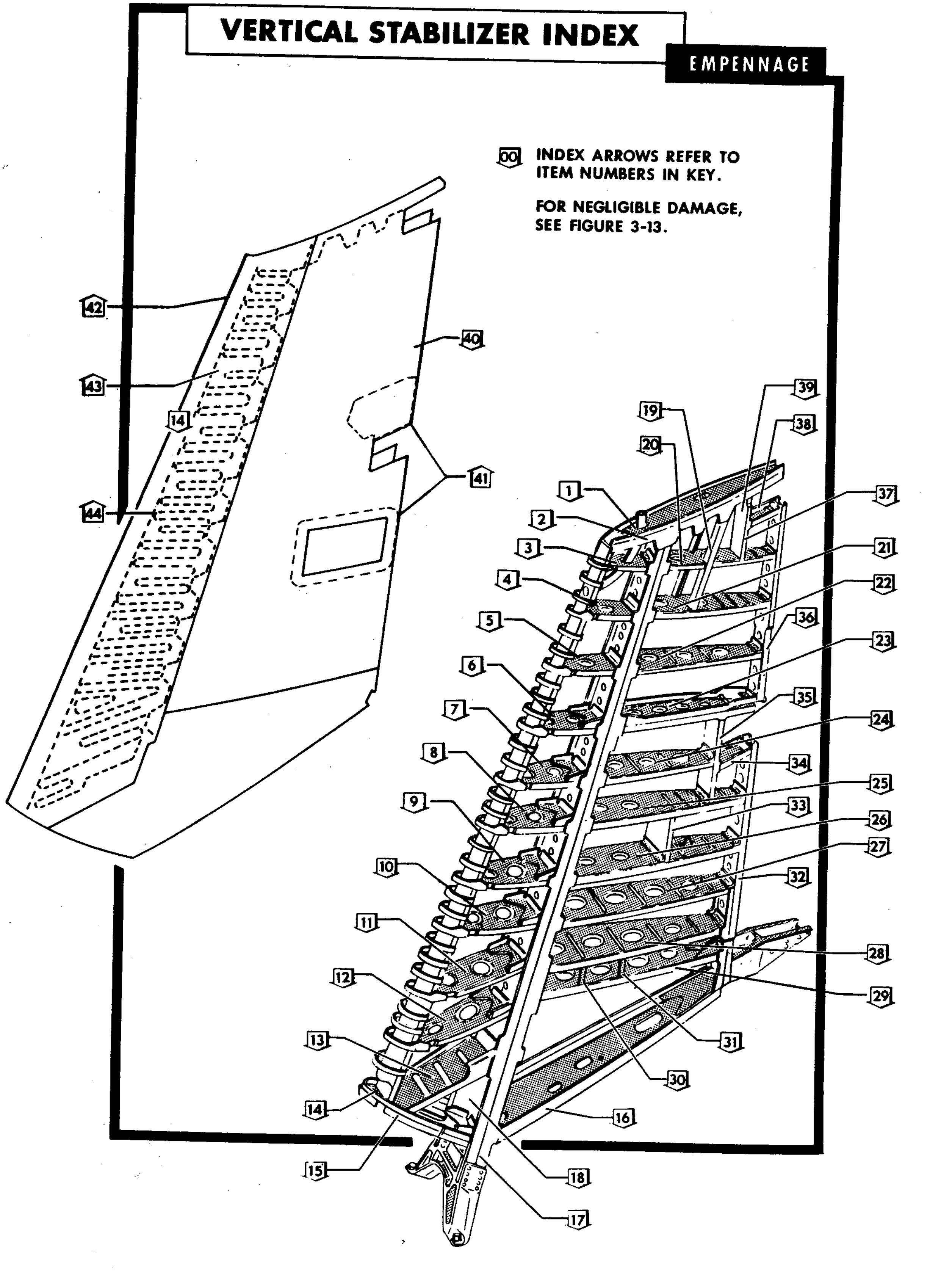


Figure 3-12. Vertical Stabilizer Index

ITEM NO.	DRAWING NO.*	DESCRIPTION	GAGE	MATERIAL	REPAIR FIGURE NO.†
1	165-23074	Rib	0.040	7075-T6 Clad	
2	165-23075	Doubler	0.040	2024-T4 Clad	
3	190-23063	Rib	0.025	2024-T4 Clad	3-14
4	190-23056	Rib	0.025	2024-T4 Clad	3-14
5	190-23050	Rib	0.025	2024-T4 Clad	3-14
6	190-23043	Rib	0.051	2024-T4 Clad	3-14
7	190-23037	Rib	0.032	2024-T4 Clad	3-14
8	190-23031	Rib	0.032	2024-T4 Clad	3-14
9	190-23025	Rib	0.032	2024-T4 Clad	3-14
10	190-23020	Rib	0.032	2024-T4 Clad	3-14
11	190-23014	Rib	0.032	2024-T42 Clad	3-14
12	165-23302	Beam	0.040	2024-T3 Clad	
13	190-23016	Rib	0.032	2024-T4 Clad	
14	165-23138	Doubler	0.025	2024-T4 Clad	
15	190-23008	Rib	0.064	2024-T4 Clad	
16	190-23007	Rib	0.051	2024-T3	
17	190-23402	Cap	0.750	7075-T6 Plate	
18	190-23302	Web	0.091	7075-T6 Clad	
19	165-23117	Stringer		2024-T42 Extr	
20	190-23064	Rib	0.025	2024-T4 Clad	3-15
21	190-23057	Rib	0.025	2024-T4 Clad	3-15
22	190-23051	Rib	0.025	2024-T4 Clad	3-15
23	190-23044	Rib	0.040	2024-T4 Clad	3-16
24	190-23038	Rib	0.032	2024-T4 Clad	3-15
25	190-23032	Rib	0.032	2024-T4 Clad	3-15
26	190-23026	Rib	0.032	2024-T4 Clad	3-15
27	190-23021	Rib	0.032	2024-T4 Clad	3-15
28	190-23015	Rib	0.032	2024-T4 Clad	3-15
29	190-23010	Rib	0.040	2024-T4 Clad	3-15
30	190-23359	Intercostal	0.032	2024-T4 Clad	
31	190-23360	Intercostal	0.040	2024-T4 Clad	
32	190-23303	Beam	0.040	2024-T4 Clad	
33	165-23110	Intercostal	0.040	2024-T4 Clad	
34	165-23038	Rib	0.040	2024-T4 Clad	
35	187-23332	Intercostal	0.051	2024-T4 Clad	
36	187-23307	Beam	0.040	2024-T4 Clad	
37	165-23112	Intercostal	0.051	2024-T4 Clad	
38	165-23069	Rib	0.032	2024-T4 Clad	
39	165-23073	Rib	0.040	2024-T4 Clad	
40	190-23001	Side Skin	0.025	2024-T3 Clad	3-17, 3-18
41	190-23001	Doublers	0.040	2024-T4 Clad	
42	190-23001	Aft Leading Edge Skin	0.040	2024-T3 Clad	3-19
43	190-23001	Fwd Leading Edge Skin	0.020	2024-T3 Clad	3-19
44	190-23001	Inner Skin	0.020	2024-T4 Clad	

***Drawing numbers are for reference only.**

†For additional repairs, refer to Section X.

Key to Figure 3-12

VERTICAL STABILIZER NEGLIGIBLE DAMAGE

EMPENNAGE

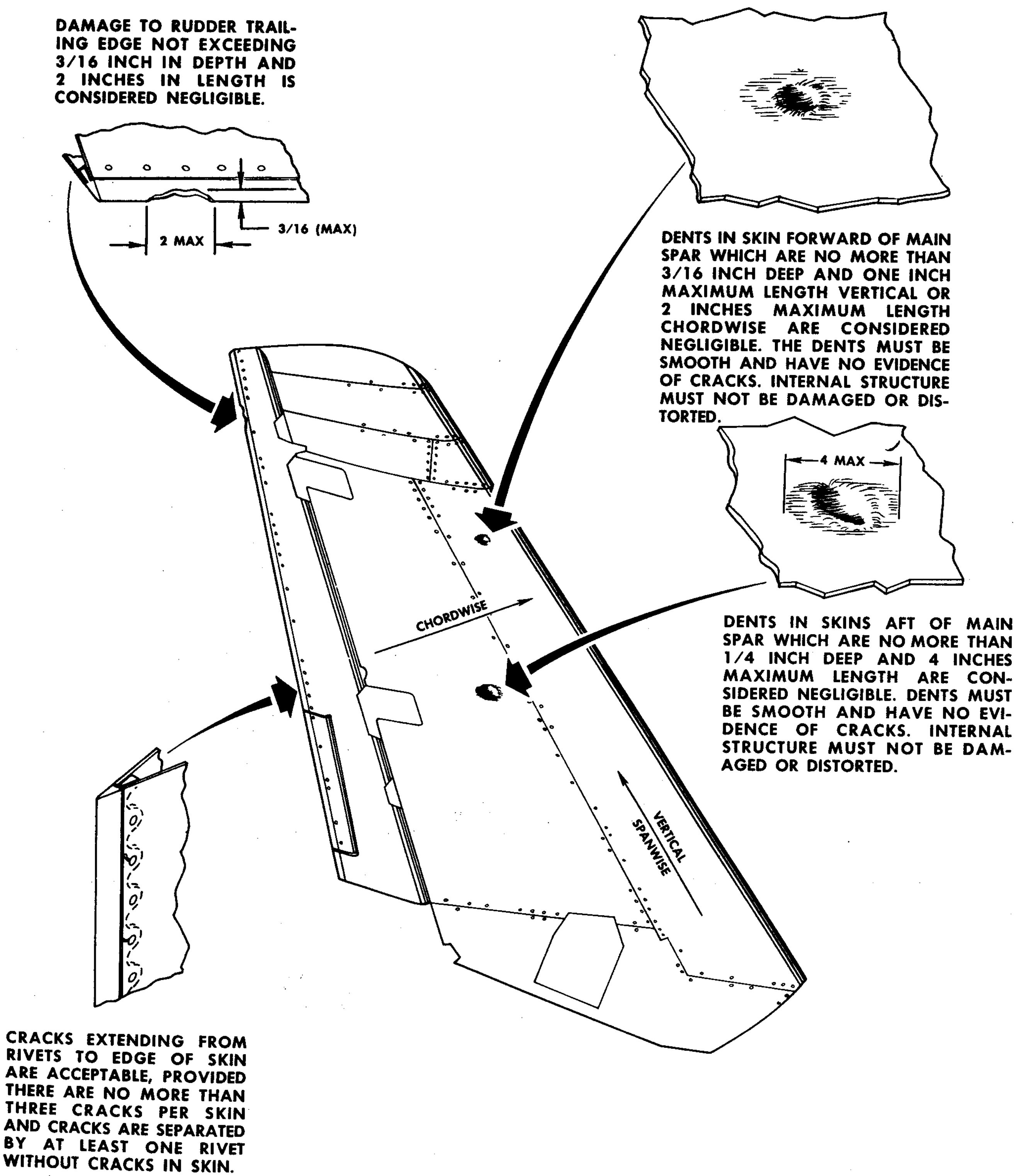
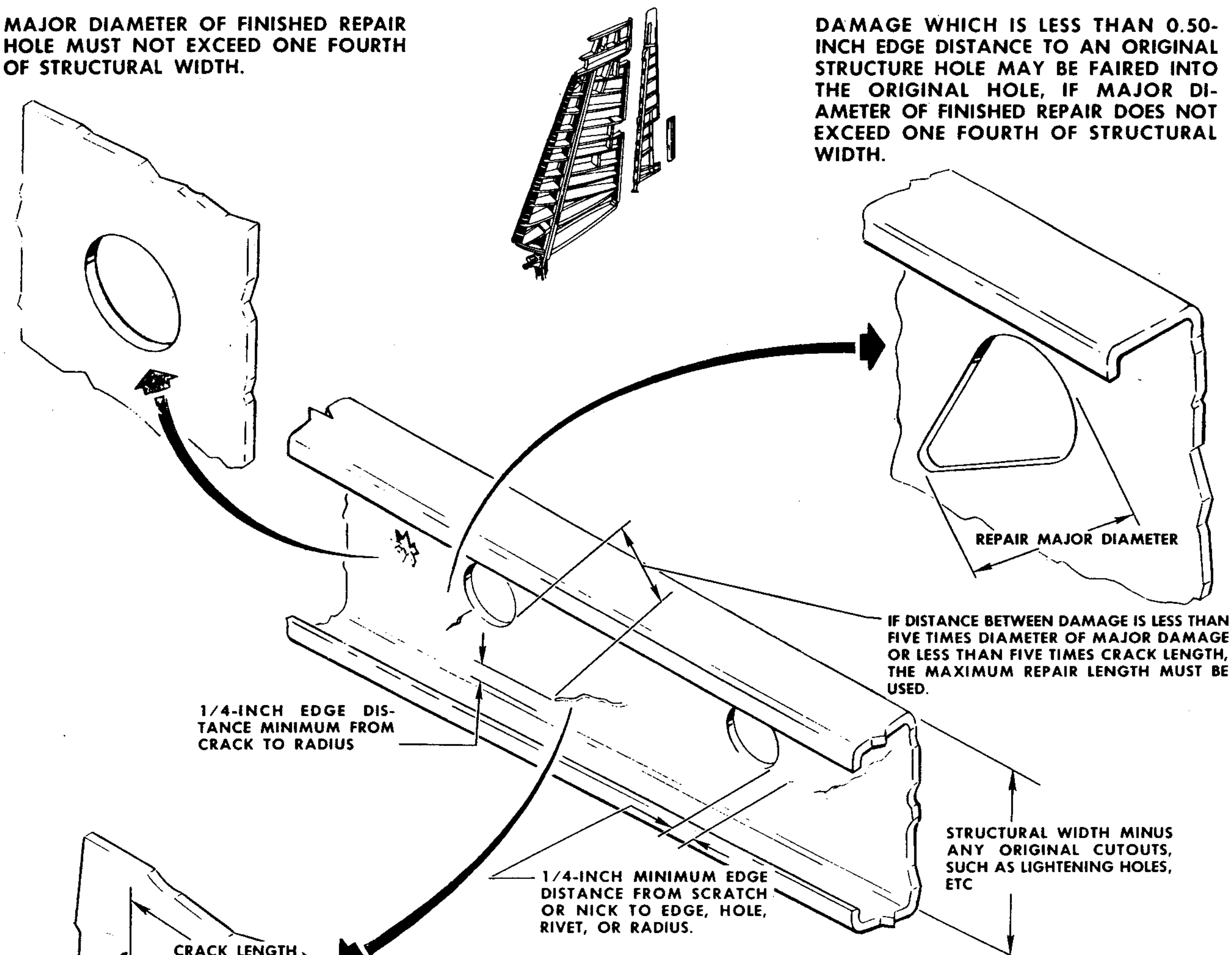
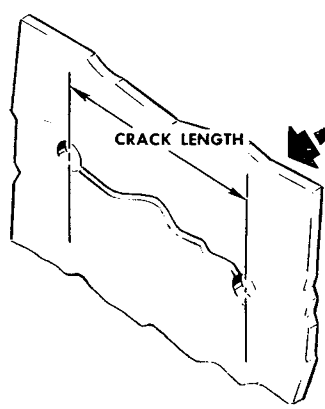


Figure 3-13. Vertical Stabilizer Negligible Damage (Sheet 1 of 2)

VERTICAL STABILIZER NEGLIGIBLE DAMAGE

EMPENNAGE





LENGTH OF CRACK BETWEEN STOP-DRILL HOLE CENTERS MUST NOT EXCEED ONE FOURTH OF STRUCTURAL WIDTH.

NICK & SCRATCH DAMAGE LIMITATION TABLE

LENGTH OF SCRATCH	DEPTH OF SCRATCH				
	RIBS			VERTICAL STABILIZER	
	ROOT	HINGE	AIR LOAD	LEADING EDGE BEAM	REAR BEAM
3.00 INCHES OR ONE HALF STRUCTURAL WIDTH	0.018	0.012	0.006	0.010	0.010
UNLIMITED. (REFER TO NOTE BELOW.)	0.012	0.010	0.004	0.008	0.008

NOTE Cross section loss in area due to damage from scratches and nicks must not exceed 1/4 of the cross section area of the structural width of the member at the point of damage.

No damage is considered negligible on the main beam of the vertical stabilizer.

F-86D-3-20-29A

Figure 3-13. Vertical Stabilizer Negligible Damage (Sheet 2 of 2)

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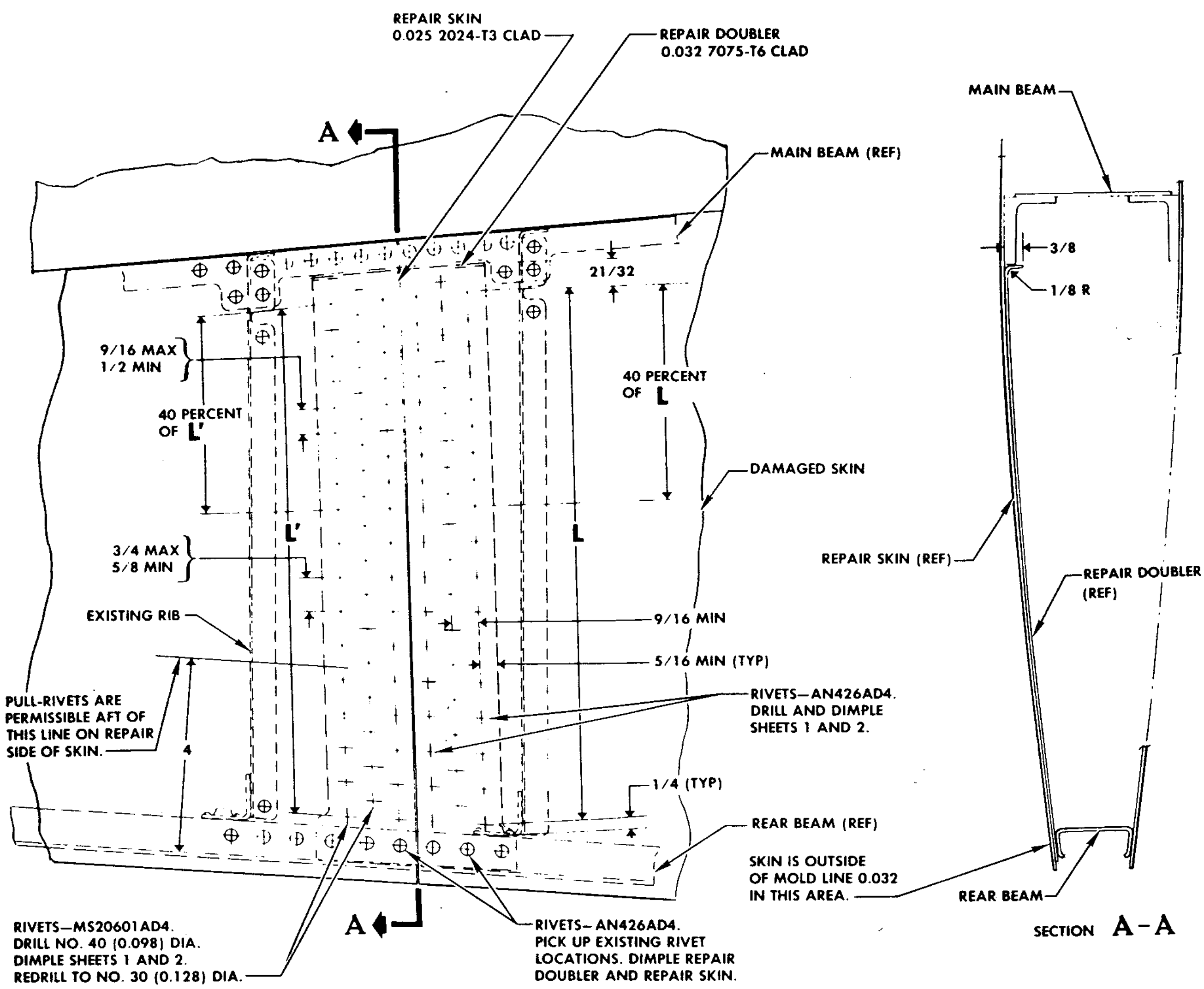
PERMANENT—CATEGORY A

EMPENNAGE



1 Trim out damage midway between existing fasteners.

2 Smooth all edges and corners after trimming.

3 Make repair doubler and repair skin from material called out on this illustration.

4 Locate repair doubler in place, and lay out and drill fastener pattern through existing skin and repair doubler.

5 Locate repair skin in place, and lay out and drill fastener pattern through repair skin and repair doubler. Pick up all existing fastener holes through repair skin.

6 Remove repair skin and repair doubler, and dimple for required type of fasteners.

7 Fasten all repair parts in place, using size and type of fasteners and spacing called out.

NOTE This repair is applicable only to the following rib bays between the main and rear beams: station 14.875 to 20.062, station 20.062 to 25.250, and station 50.250 to 56.625.

F-86K-3-20-33

Figure 3-13A. Skin Splice—Vertical Stabilizer

PERMANENT

Category B

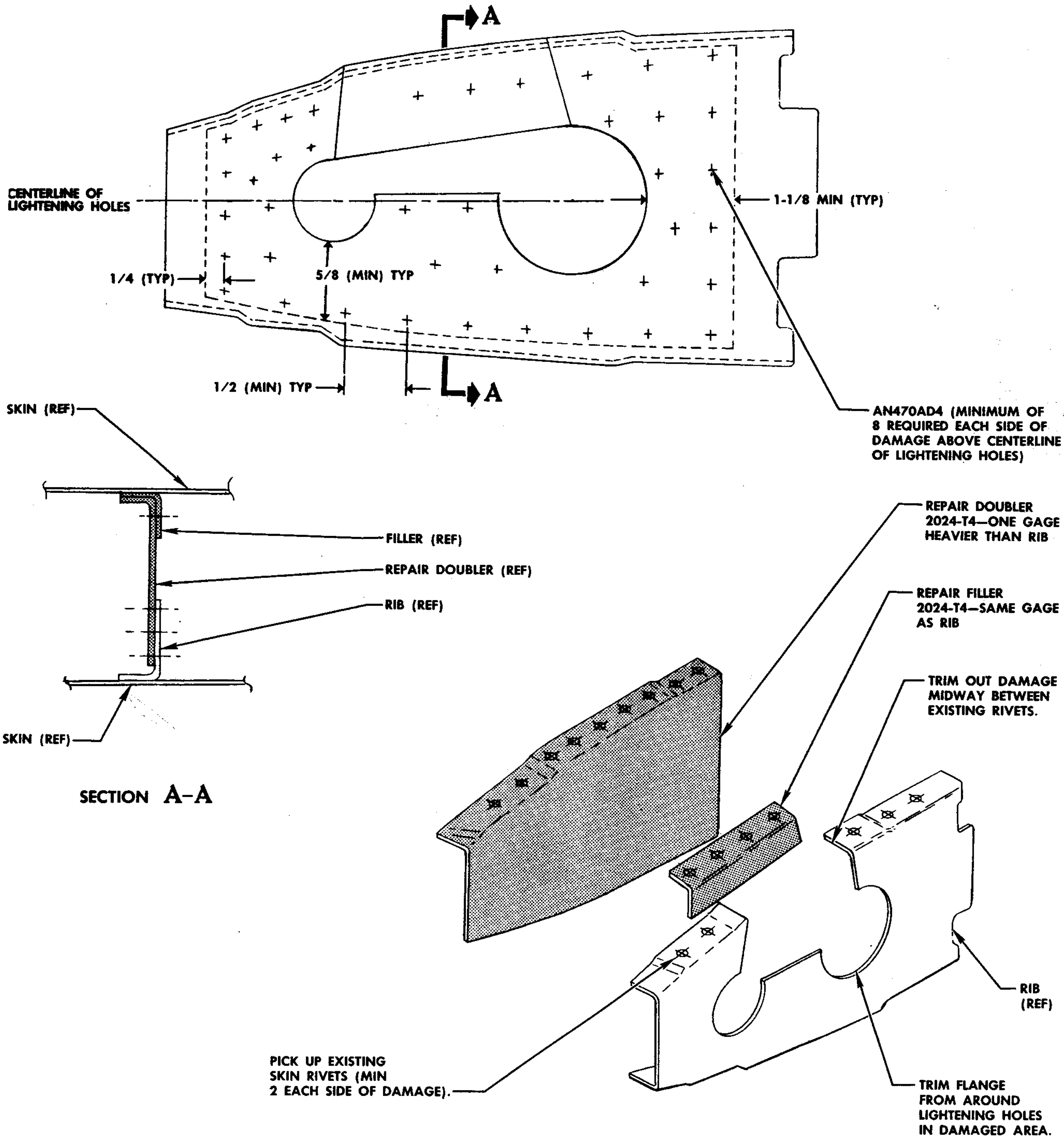
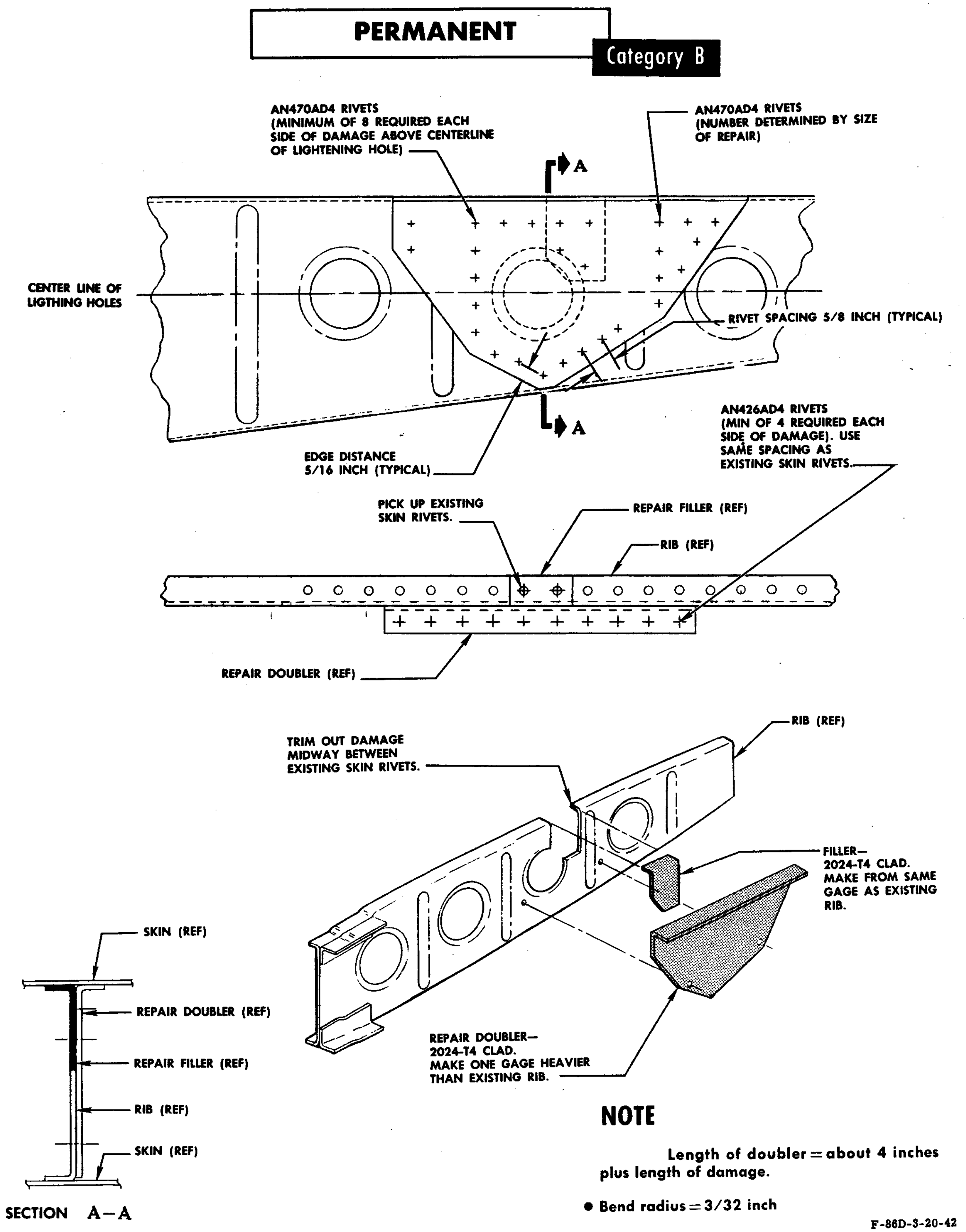


Figure 3-14. Vertical Stabilizer Nose Ribs



NOTE

Length of doubler = about 4 inches plus length of damage.

- Bend radius = 3/32 inch

Figure 3-15. Vertical Stabilizer Air Load Ribs

PERMANENT

Category B

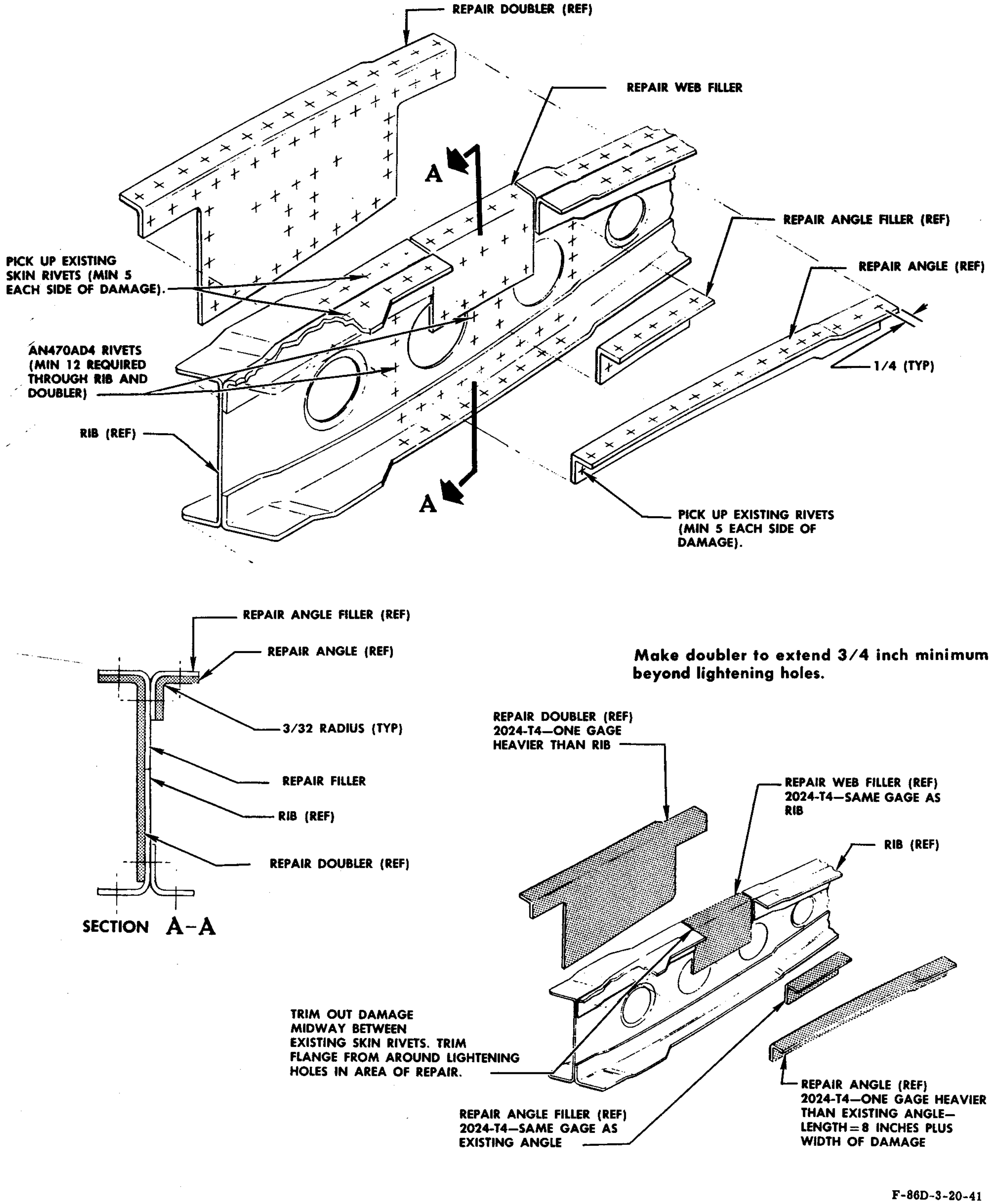
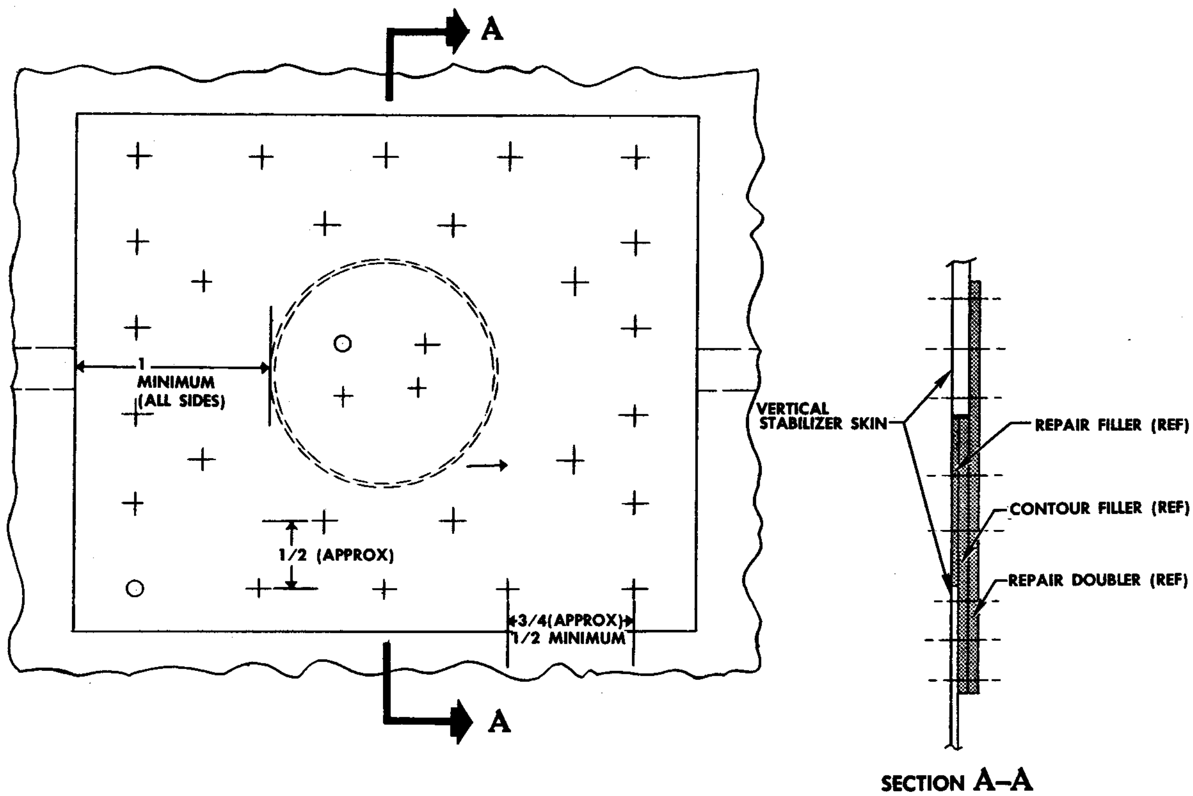
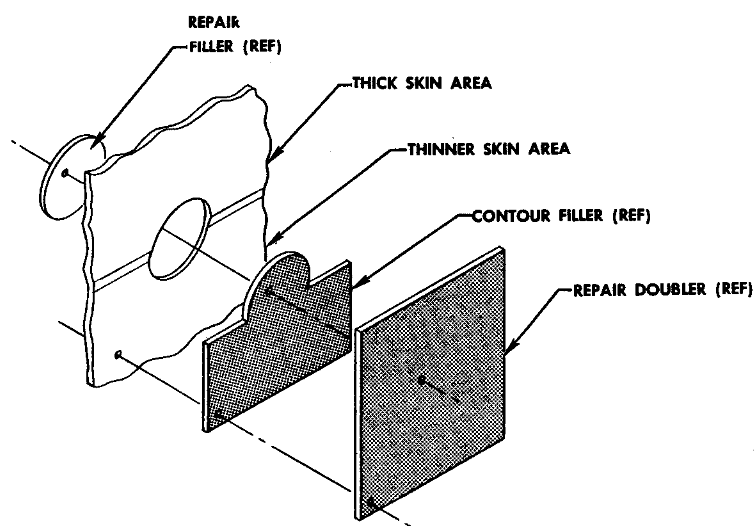


Figure 3-16. Vertical Stabilizer Intermediate Hinge Ribs

PERMANENT

Category A





1 Trim out damaged area.

2 Make repair filler using 2024-T4 clad, same gage as thinner skin section.

3 Make contour filler using 2024-T4 clad in gage to provide level surface for repair doubler.

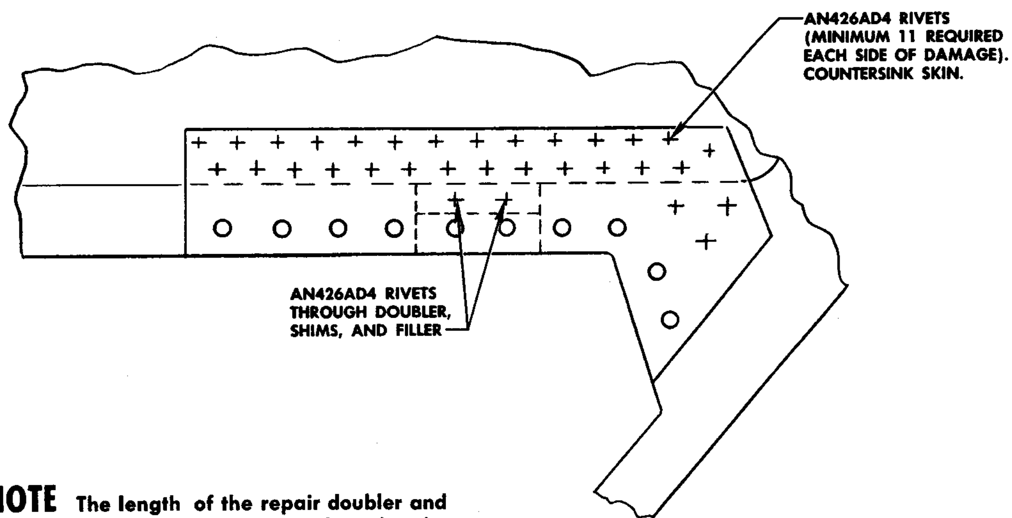
4 Make repair doubler using 2024-T4 clad one gage heavier than thicker skin area.

5 Dimple fillers and repair doubler. Rivet, using AN426AD4 rivets.

F-86D-3-20-39

Figure 3-17. Vertical Stabilizer Skin (Sheet 1 of 3)

PERMANENT Category A



NOTE The length of the repair doubler and shims should be about 9-1/2 inches plus the width of the damage.

- Remove existing nut plates from removed skin and install on doubler (minimum 4 each side of damage).

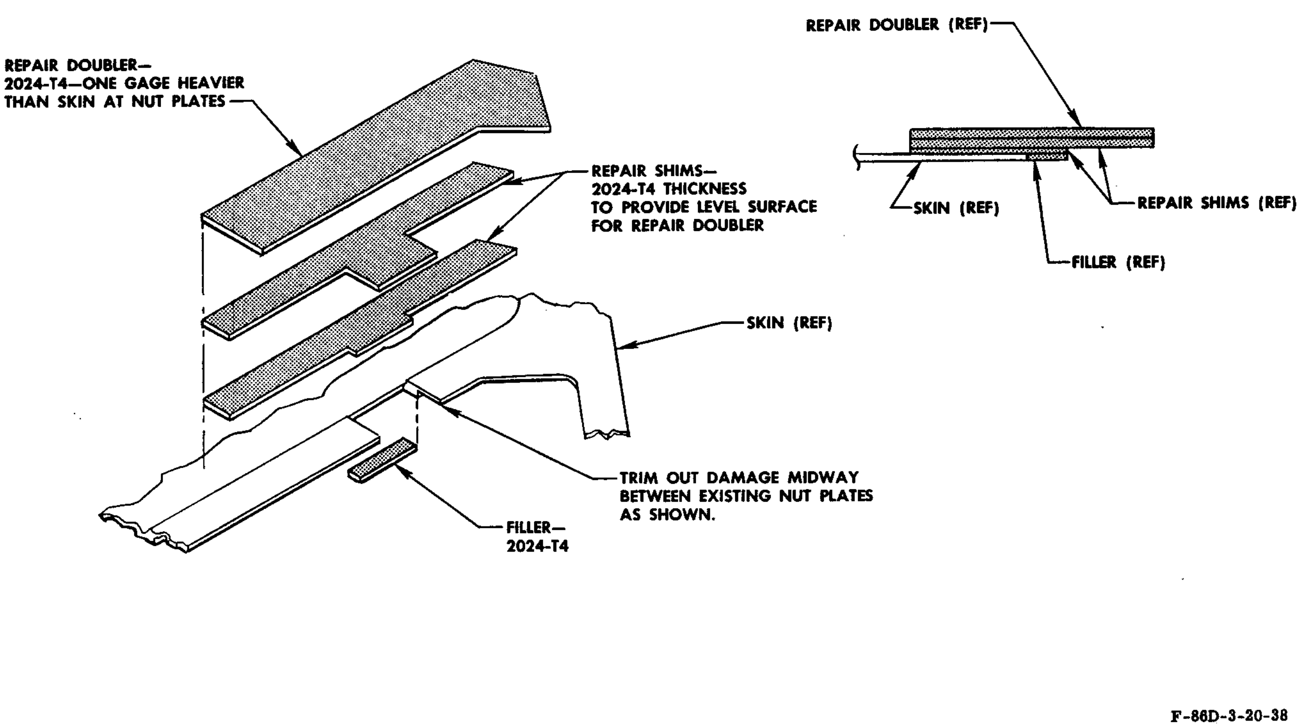
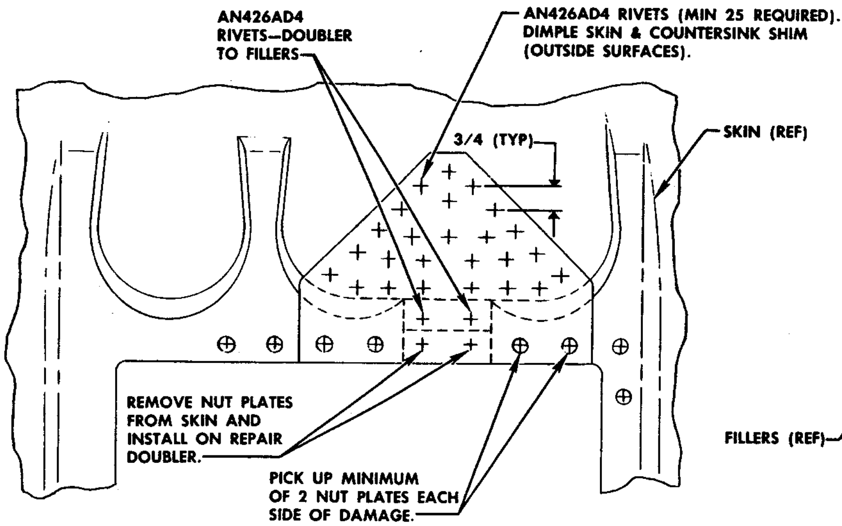
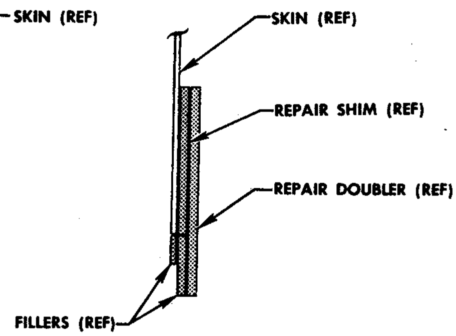


Figure 3-17. Vertical Stabilizer Skin (Sheet 2 of 3)

PERMANENT Category A

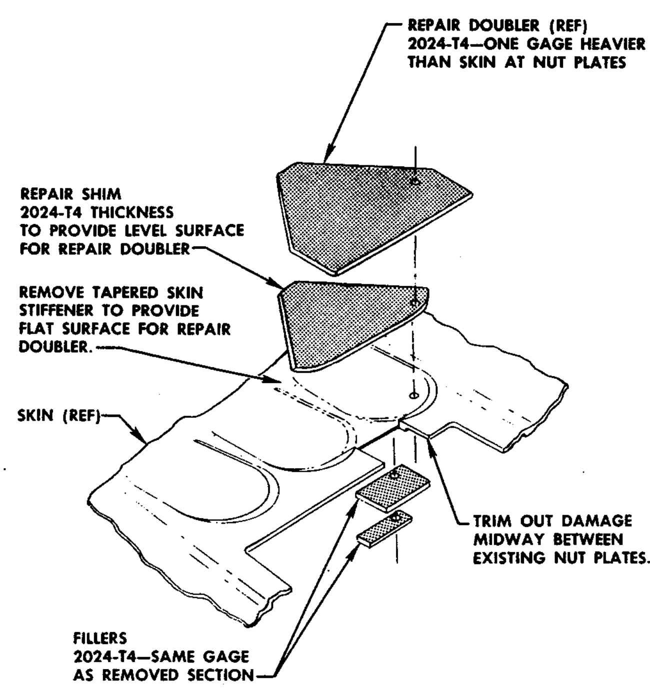




NOTE The repair is shown on the inner side of the skin.

Minimum edge distance = 1/4 inch.

Minimum spacing = 1/2 inch.



F-86D-3-20-37

Figure 3-17. Vertical Stabilizer Skin (Sheet 3 of 3)

PERMANENT

Category B

NOTE

Tack fillers to repair doubler with two AN426AD4 rivets.

- Use 2024-T4 clad for fillers and repair doublers.
- Minimum edge distance = 2 X rivet diameter.
- Minimum rivet spacing = 4 X rivet diameter.

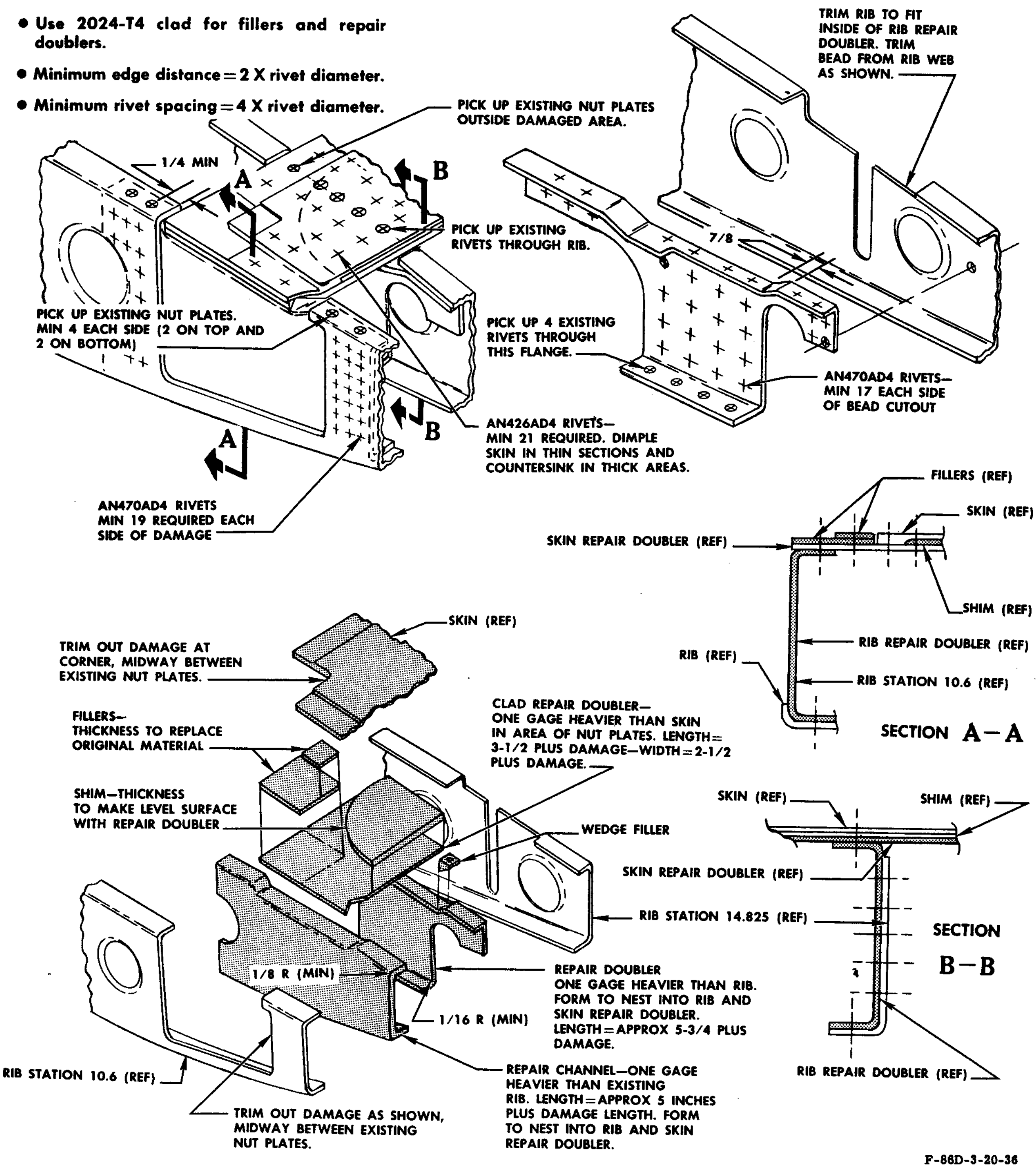


Figure 3-18. Vertical Stabilizer Skin and Rib Stations 10.6 to 14.9

PERMANENT Category A

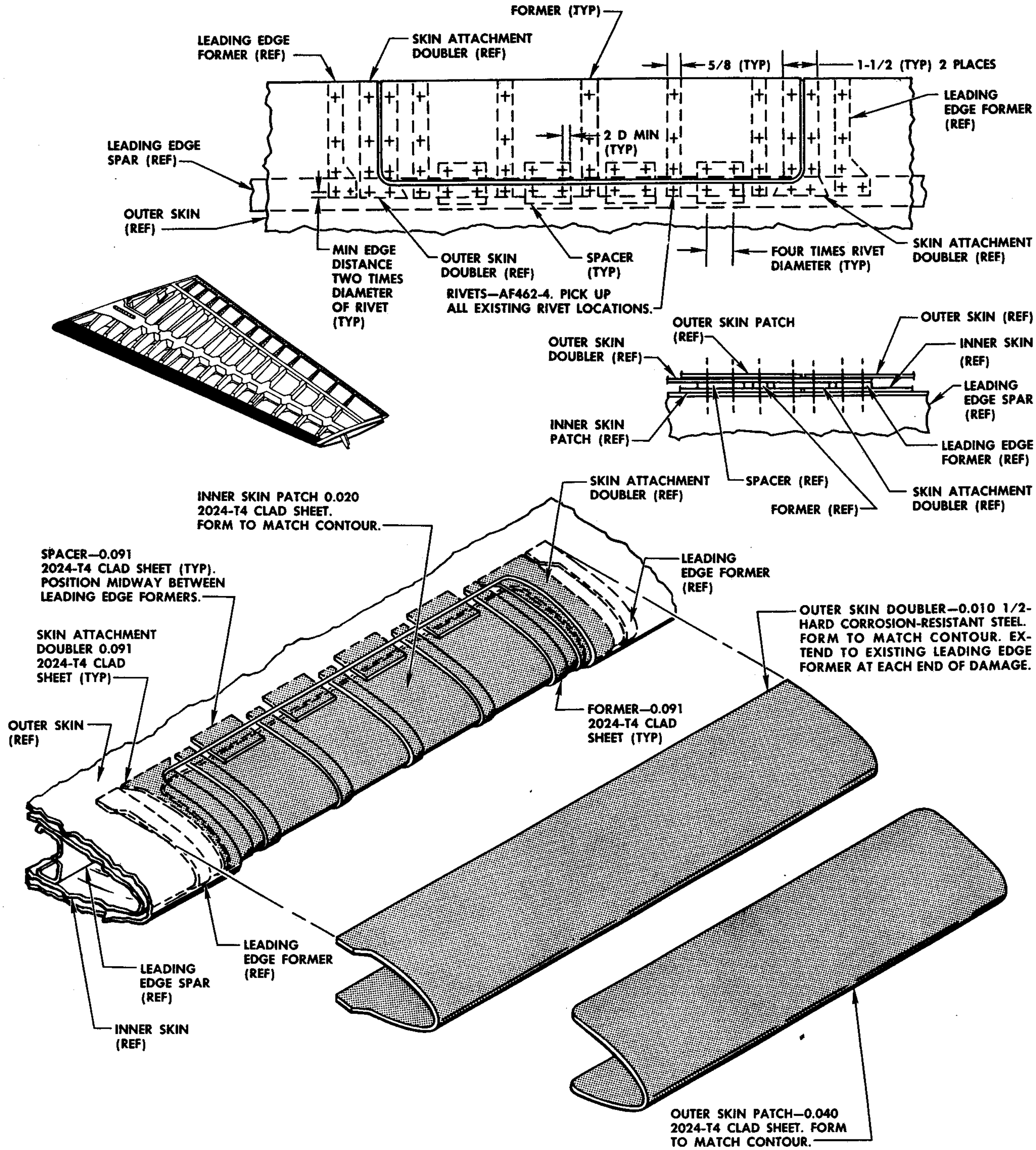


Figure 3-19. Vertical and Horizontal Stabilizer Leading Edge Skins (Sheet 3 of 3)

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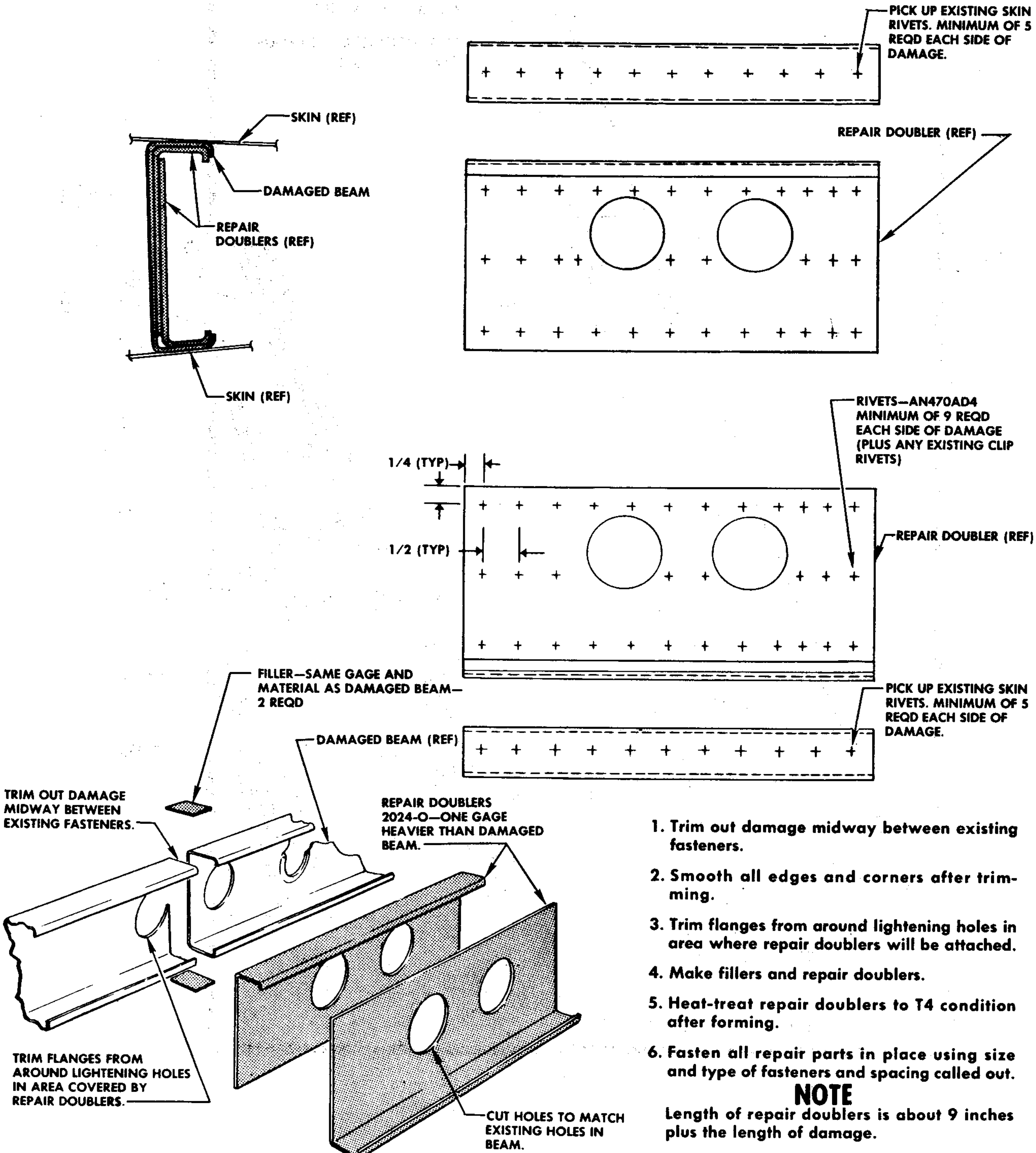
PERMANENT CATEGORY A

EMPENNAGE



1. Trim out damage midway between existing fasteners.
2. Smooth all edges and corners after trimming.
3. Trim flanges from around lightening holes in area where repair doublers will be attached.
4. Make fillers and repair doublers.
5. Heat-treat repair doublers to T4 condition after forming.
6. Fasten all repair parts in place using size and type of fasteners and spacing called out.

NOTE

Length of repair doublers is about 9 inches plus the length of damage.

- Minimum bend radius for repair doublers is 1/16 inch.

F-86K-3-20-30

Figure 3-19A. Vertical Stabilizer Close-out Beam—Stations 8-38 and 43-69

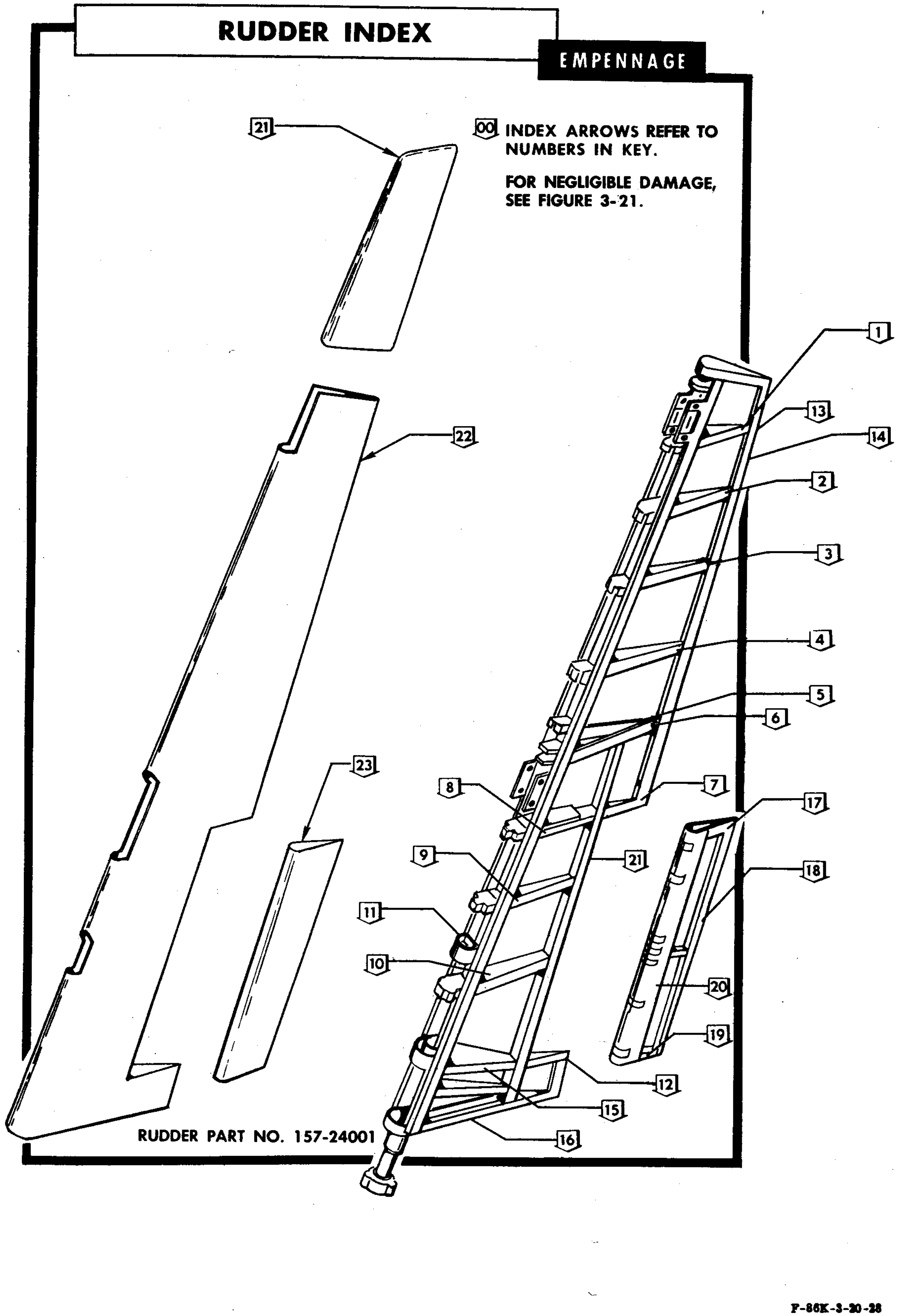


Figure 3-20. Rudder Index

ITEM NO.	DRAWING NO.*	DESCRIPTION	GAGE	MATERIAL	REPAIR FIGURE NO.†
1	157-24070	Rib	0.032	2024-T4 Clad	
2	157-24062	Rib	0.025	2024-T4 Clad	
3	157-24056	Rib	0.025	2024-T4 Clad	
4	157-24049	Rib	0.025	2024-T4 Clad	
5	157-24045	Rib	0.032	2024-T4 Clad	3-23
6	157-24043	Rib	0.032	2024-T4 Clad	
7	157-24036	Rib	0.032	2024-T4 Clad	
8	157-24037	Rib	0.032	2024-T4 Clad	
9	157-24030	Rib	0.032	2024-T4 Clad	
10	157-24024	Rib	0.032	2024-T4 Clad	
11	157-24026	Rib	0.032	2024-T4 Clad	3-23
12	157-24015	Rib	0.032	2024-T4 Clad	
13	157-24301	Cap Strip		7075-T6	
14	157-24120-13	Strip, TE		6061-T6 Extr	
15	157-24019	Rib	0.032	2024-T4 Clad	
16	157-24013	Rib	0.040	2024-T4 Clad	
17	157-24503	Rib	0.020	2024-T4 Clad	
18	157-24505	Block		2024-T42 Bar	
19	157-24502	Rib	0.020	2024-T4 Clad	
20	157-24506	Beam		2024-T42 Extr	
21	157-24302	Beam		2024-T42 Extr	
21	157-24001	Tip Assy	0.010	Glass Fabric	
22	157-24001	Side Skin	0.020	2024-T4 Clad	3-24
23	157-24001	Side Skin	0.020	2024-T4 Clad	3-24

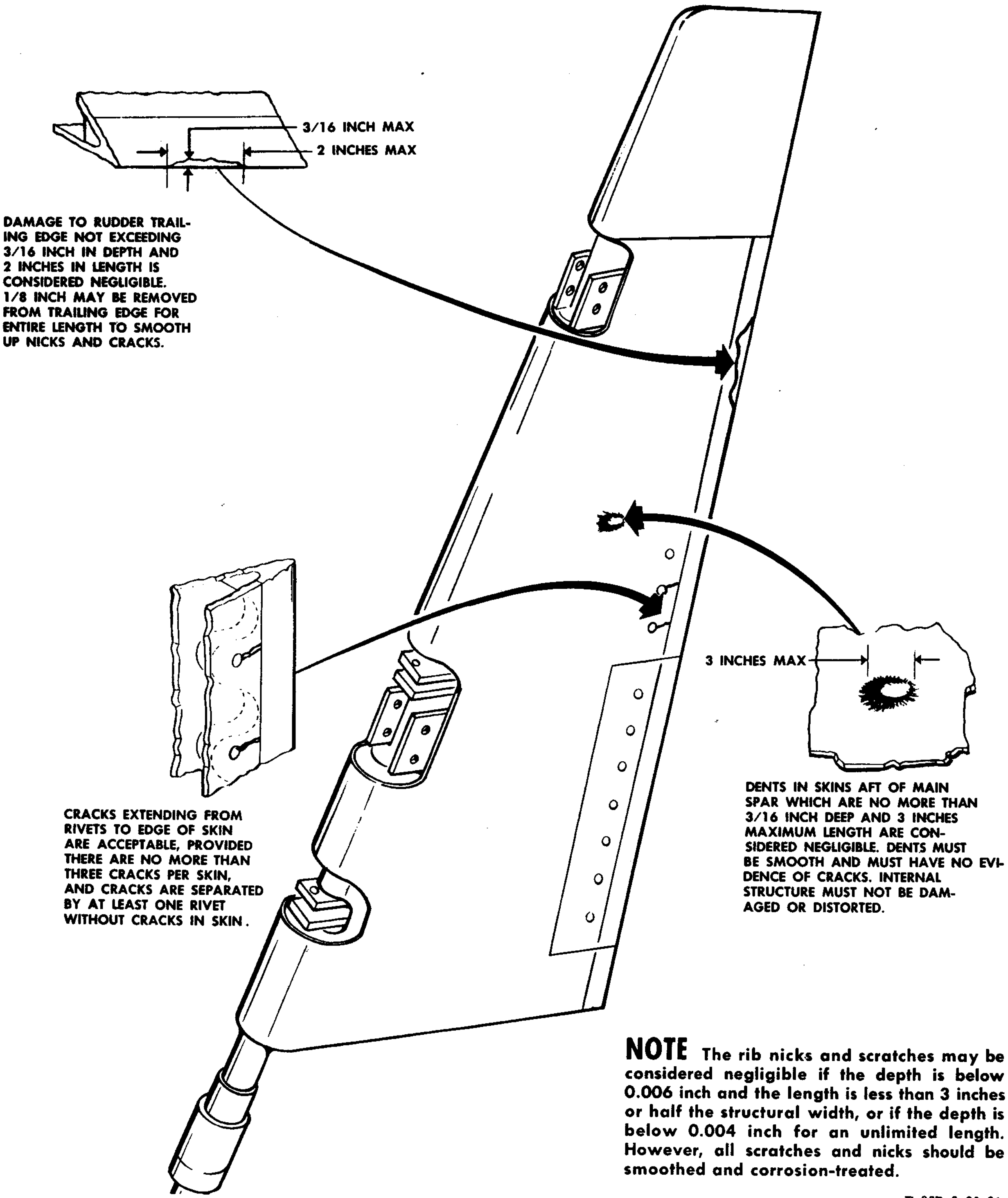
*Drawing numbers are for reference only.

†For additional repairs, refer to Section X.

Key to Figure 3-20

RUDDER NEGLIGIBLE DAMAGE

EMPENNAGE



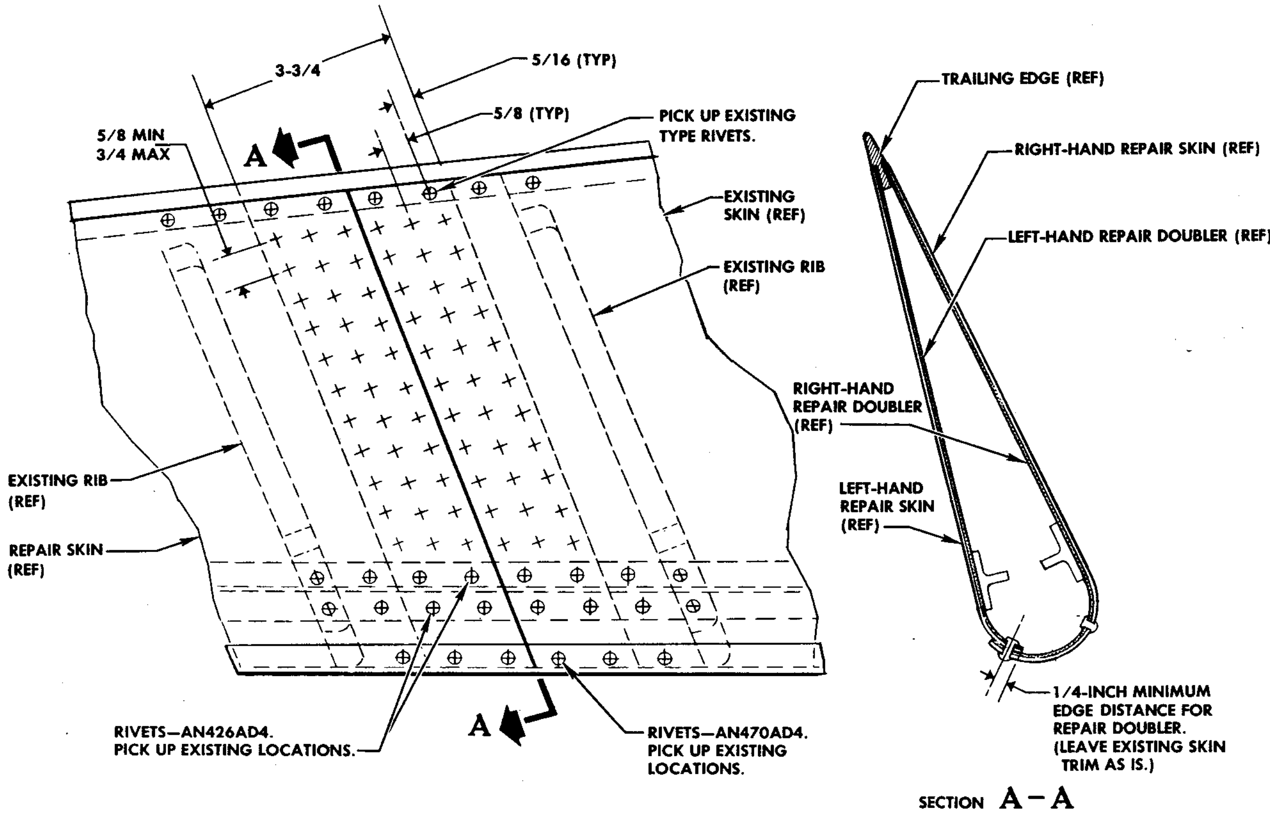
NOTE The rib nicks and scratches may be considered negligible if the depth is below 0.006 inch and the length is less than 3 inches or half the structural width, or if the depth is below 0.004 inch for an unlimited length. However, all scratches and nicks should be smoothed and corrosion-treated.

F-86D-3-20-31

Figure 3-21. Rudder Negligible Damage

PERMANENT CATEGORY A

EMPENNAGE



1. Trim out damage midway between existing fasteners.
2. Smooth all edges and corners after trimming.
3. Make repair doubler, and contour to match inside mold line of existing skin.
4. Place repair doubler in place, and lay out and drill for fasteners.
5. Place repair skin in place, and lay out and drill for fasteners.
6. Remove repair parts and dimple for fasteners. Also dimple existing skin.
7. Fasten all repair parts in place, using size and type of fasteners called out.

NOTE This repair is applicable to both sides of the rudder, but both sides cannot be repaired within the same rib bays.

- This repair is typical, and two such repairs may be used to insert a new section of skin.

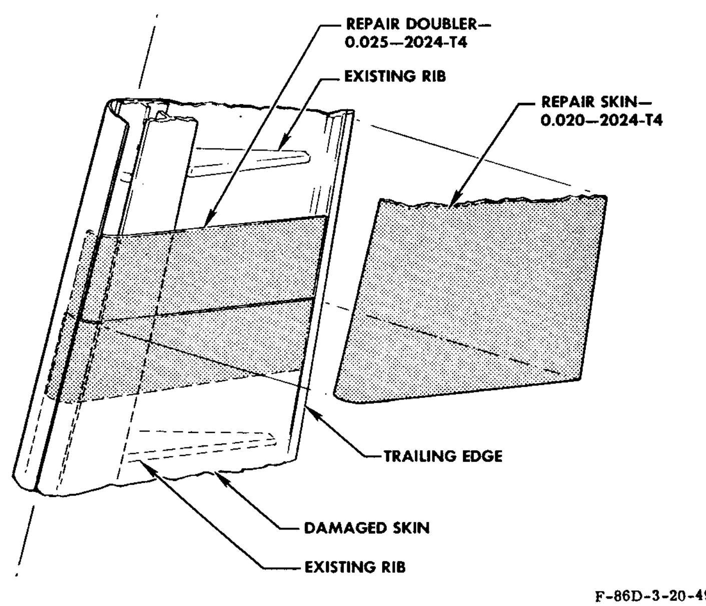


Figure 3-21A. Skin Splice—Rudder

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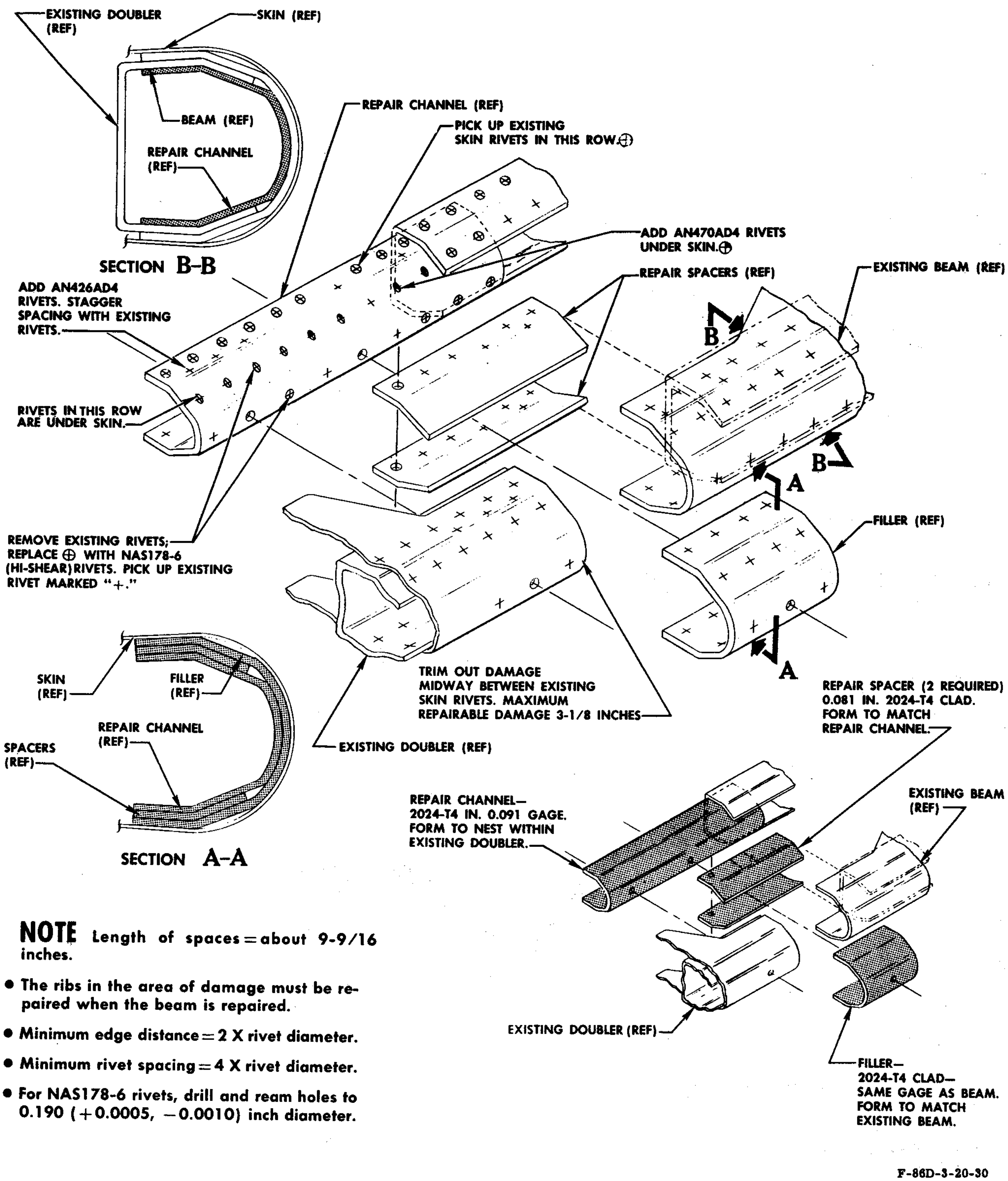
PERMANENT Category B

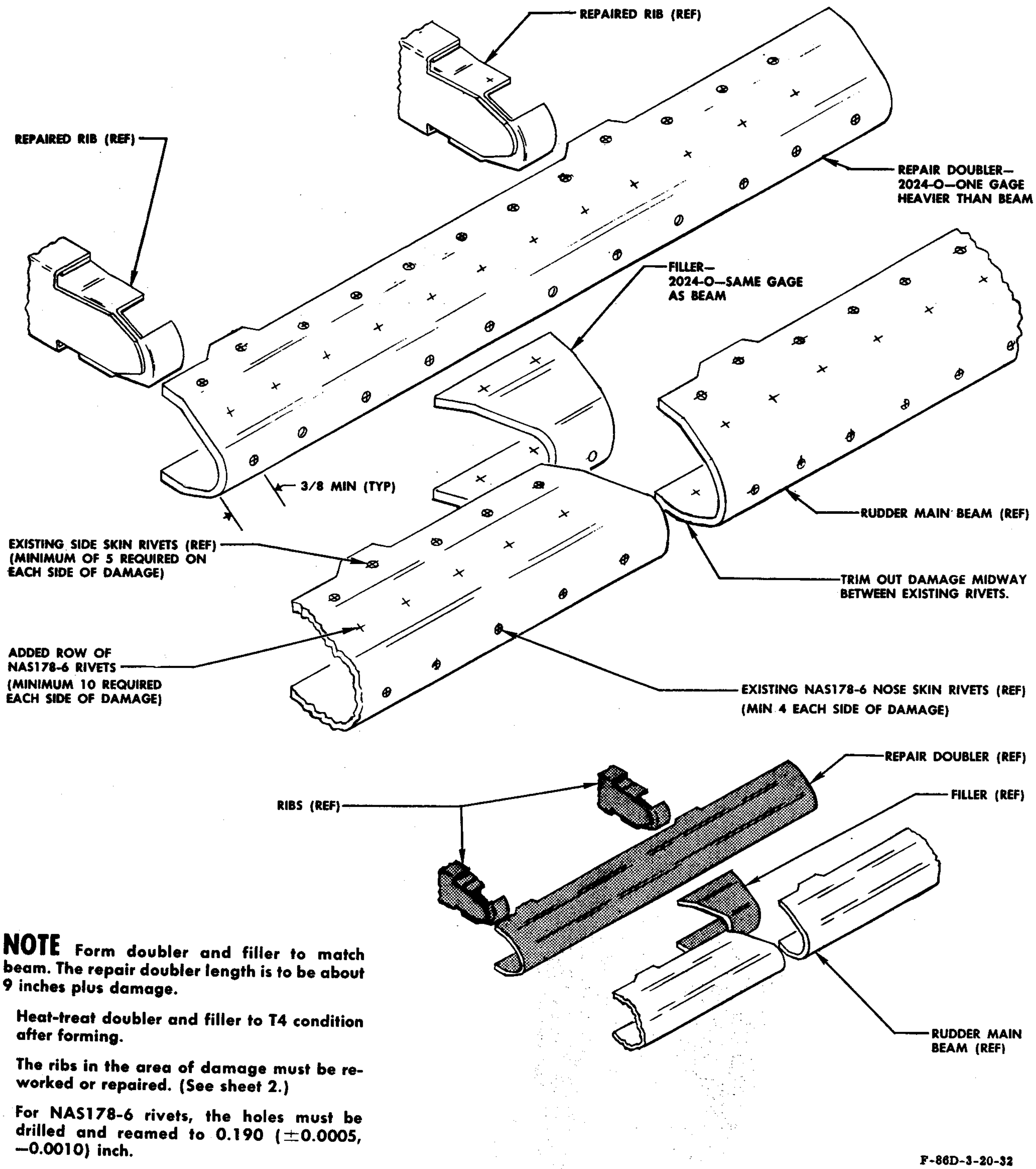


NOTE Length of spaces = about 9-9/16 inches.

- The ribs in the area of damage must be repaired when the beam is repaired.
- Minimum edge distance = 2 X rivet diameter.
- Minimum rivet spacing = 4 X rivet diameter.
- For NAS178-6 rivets, drill and ream holes to 0.190 (+0.0005, −0.0010) inch diameter.

Figure 3-22. Rudder Main Beam Station 32.187

PERMANENT Category B



NOTE Form doubler and filler to match beam. The repair doubler length is to be about 9 inches plus damage.

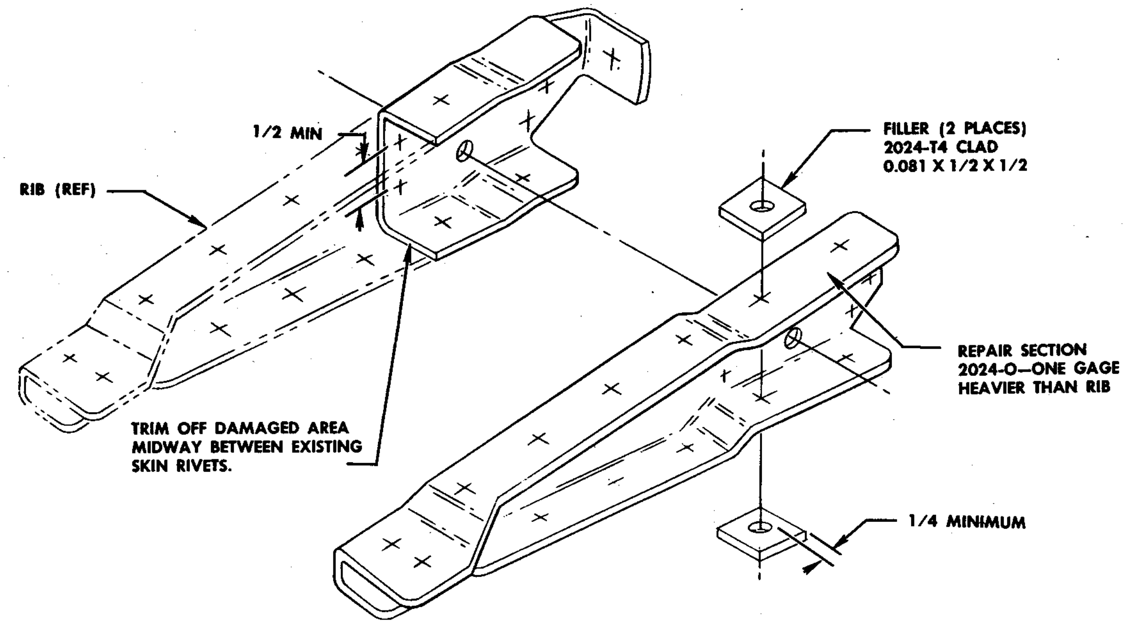
Heat-treat doubler and filler to T4 condition after forming.

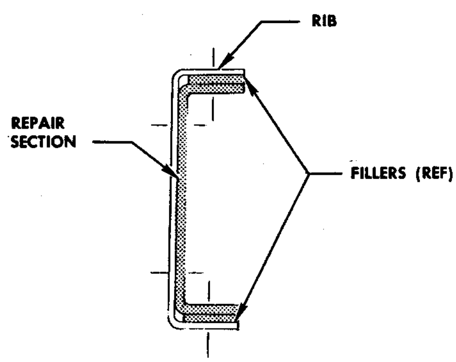
The ribs in the area of damage must be reworked or repaired. (See sheet 2.)

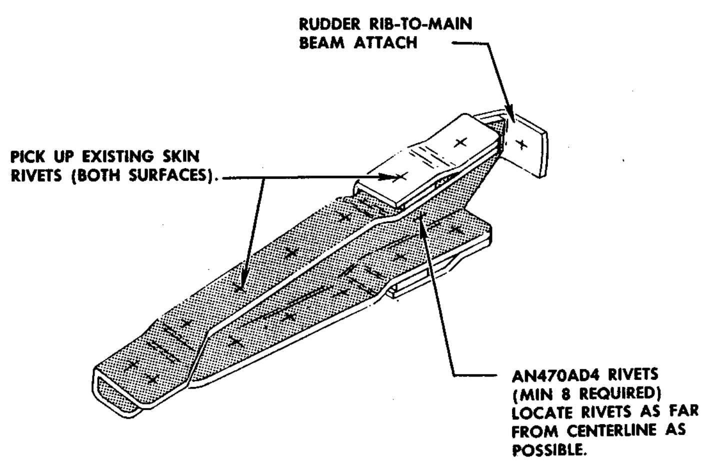
For NAS178-6 rivets, the holes must be drilled and reamed to 0.190 (±0.0005, −0.0010) inch.

Figure 3-23. Rudder Main Beam and Rib Repair (Sheet 1 of 2)

PERMANENT Category B







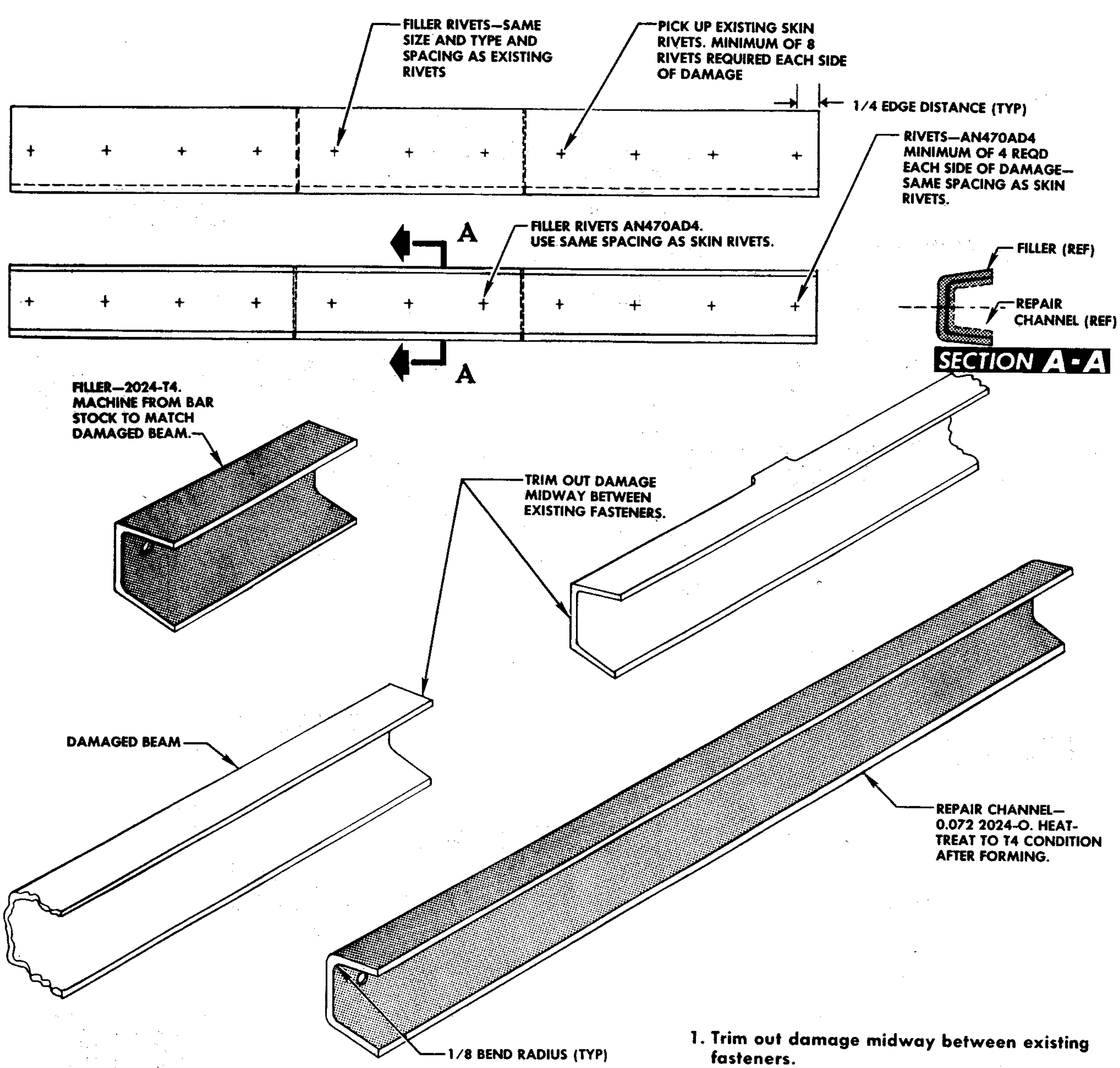
NOTE Heat-treat repair section to T4 condition after forming. Form repair to match rudder main beam. The repair section must lap existing rib by a minimum of two inches.

F-86D-3-20-33

Figure 3-23. Rudder Main Beam and Rib Repair (Sheet 2 of 2)

PERMANENT CATEGORY A

EMPENNAGE



1. Trim out damage midway between existing fasteners.
2. Smooth all edges and corners after trimming.
3. Matching filler to match existing beam.
4. Make repair channel to fit inside of damaged beam. Heat-treat to T4 condition.
5. Fasten all repair parts in place using size and type of fasteners and spacing called out.

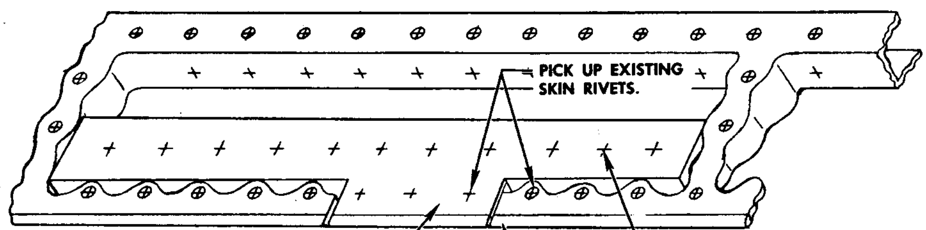
NOTE

Length of repair channel is about 8 inches plus the length of damage.

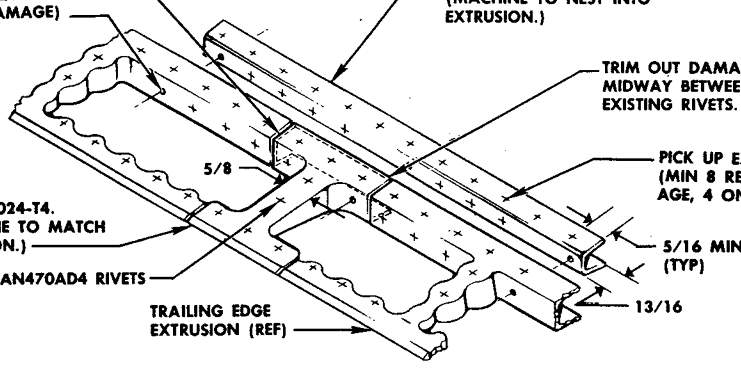
F-86K-3-20-31

Figure 3-23A. Rudder Rear Beam

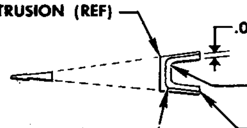
PERMANENT Category A



STATION 13 TO 75



STATION 32-70



F-86D-3-20-34

Figure 3-24. Rudder Trailing Edge

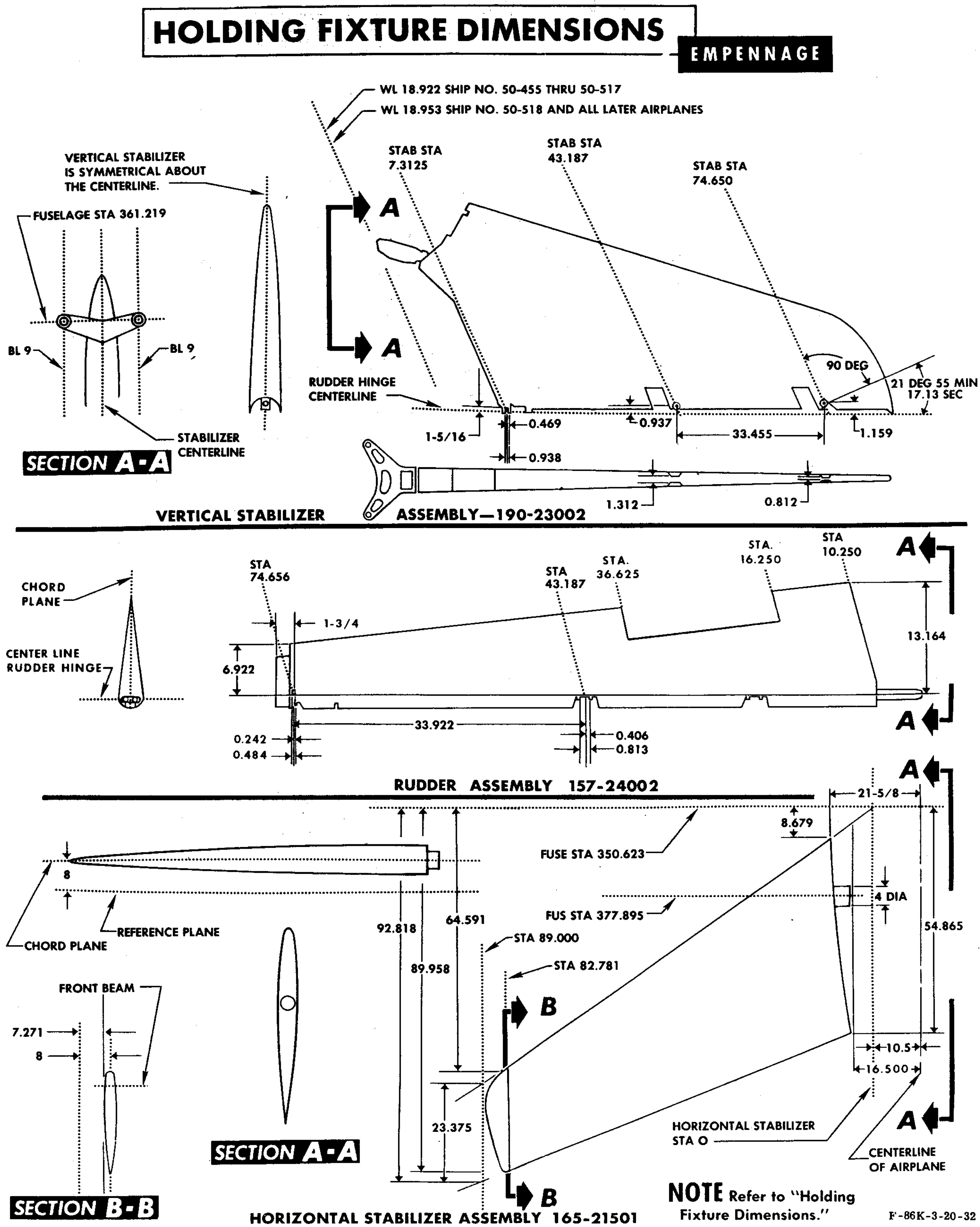


Figure 3-25. Holding Fixture Dimensions—Horizontal and Vertical Stabilizers and Rudder

SECTION IV

FUSELAGE GROUP

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DESCRIPTION OF FUSELAGE 4-1
FORWARD FUSELAGE SECTION (STATION −46 TO CANTED STATION 124.3) 4-1
INTERMEDIATE FUSELAGE SECTION (CANTED STATION 124.3 TO STATION 279.3 4-1
AFT FUSELAGE SECTION (STATION 279.3 AFT) 4-4
SKIN REPAIR 4-4
REPAIR OF LONGERON "T" SECTION 4-4
REPAIR OF LOWER LONGERON 4-4
FUEL CELL LINER 4-4
ENGINE AIR INTAKE DUCT 4-4A
CERAMIC COATING OF ASPIRATOR LINERS 4-4A
HOLDING FIXTURE DIMENSIONS 4-4A

DESCRIPTION OF FUSELAGE.

The fuselage is of semimonocoque construction. Four main longerons carry the bending loads and a stressed skin carries the shear load. Frames and bulkheads interconnect with the longerons and stringers to help carry the loads. The fuselage is made up of the forward section and the aft section. The forward section is made up of two major assemblies joined together at canted station 124.3. The aft section of the fuselage is made as one major assembly. The fuselage is divided into the three major assemblies (sections) for indexing: the forward fuselage section which extends from station −46 (the extreme leading edge of the radome) to canted station 124.3, the forward intermediate section which extends from canted station 124.3 to station 279.3, and the aft fuselage section which extends from station 279.3 aft to the rear of the fuselage. The field break point for engine removal, service, and inspection is located at station 279.3.

FORWARD FUSELAGE SECTION (STATION −46 TO CANTED STATION 124.3).

The forward fuselage section contains the radar, radio, and electronic equipment, and armament and ammunition. Also contained in the forward section is the cockpit (pressurized), the nose wheel well, and also the forward section of the engine air intake duct. The engine air intake duct makes it necessary to cut out all of the frames and bulkheads for the entire length of the forward fuselage. The side skin from station 4.75 to canted station 124.3 is partially cut out for access, and is replaced by an inner web, except between station 4.75 and 12.75. In this area, the remaining side skins below and above the access cutouts take all the shear load. From station 12.75 aft, the inner web ties to a horizontal shelf at the top and to the duct at the bottom. The duct, in turn, ties to the side skins by another horizontal shelf. Because the upper and lower skins are cut out for the access doors, cockpit, and nose wheel well, all torque loads are assumed to be taken by the cell formed by the nose gear beams, and by the engine air intake ducts. The duct is an integral part of the fuselage and assists in distributing the loads throughout the entire forward fuselage.

INTERMEDIATE FUSELAGE SECTION (CANTED STATION 124.3 TO STATION 279.3).

The intermediate fuselage contains the canopy actuating mechanism, oxygen supply, the forward and aft fuel cell bays, the engine fire wall, the aft fuselage attachment fittings and the wing-to-fuselage attachment fittings. The wing is attached to the fuselage by four tension bolts located at the intersection of the spars to the fuselage. To relieve the bulkhead at station 179 from working at the same stress as the wing top cover, the holes in the wing center section fitting at the rear spar

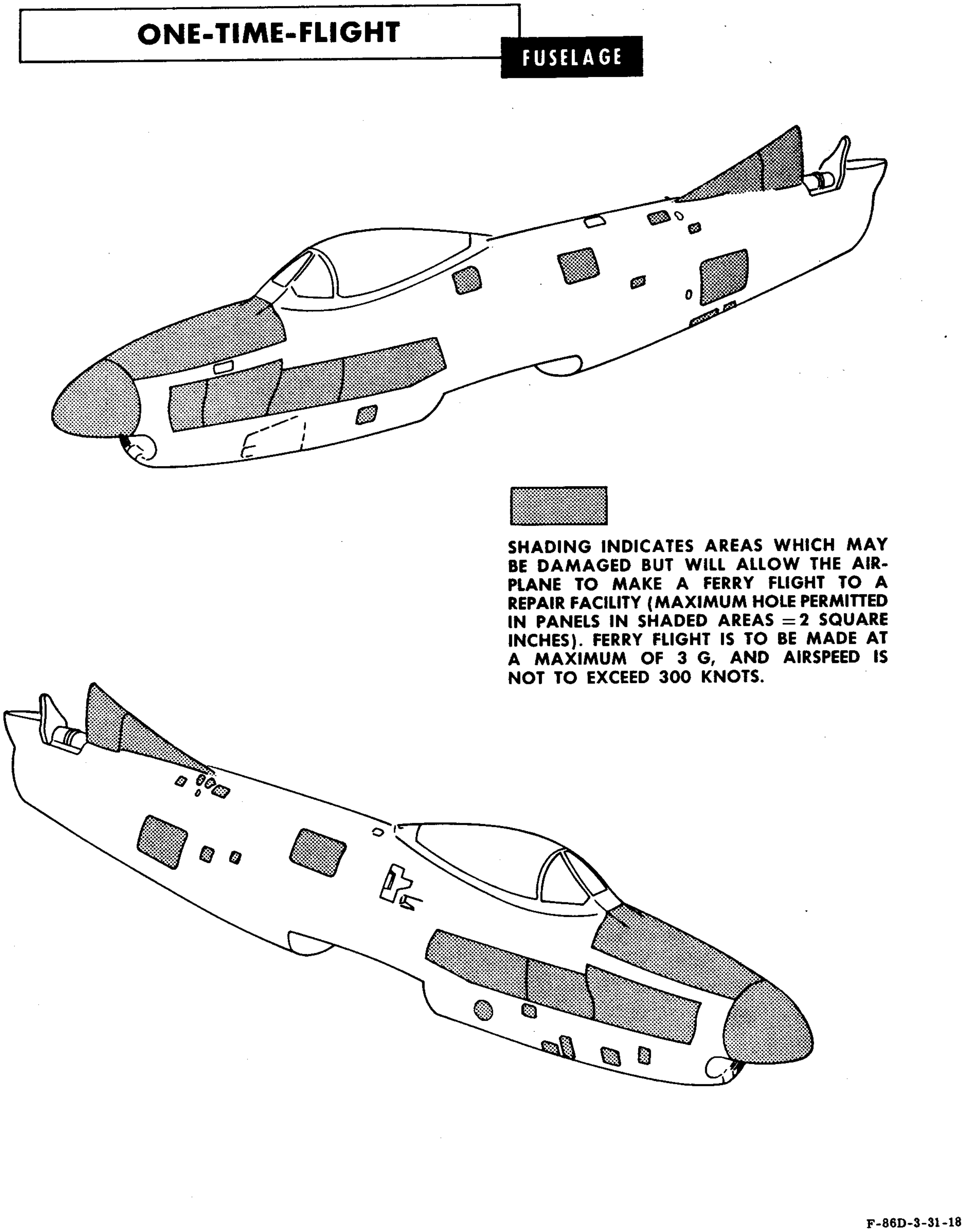

Figure 4-1. One-time Flight

FUSELAGE & DUCT SKIN DIAGRAM

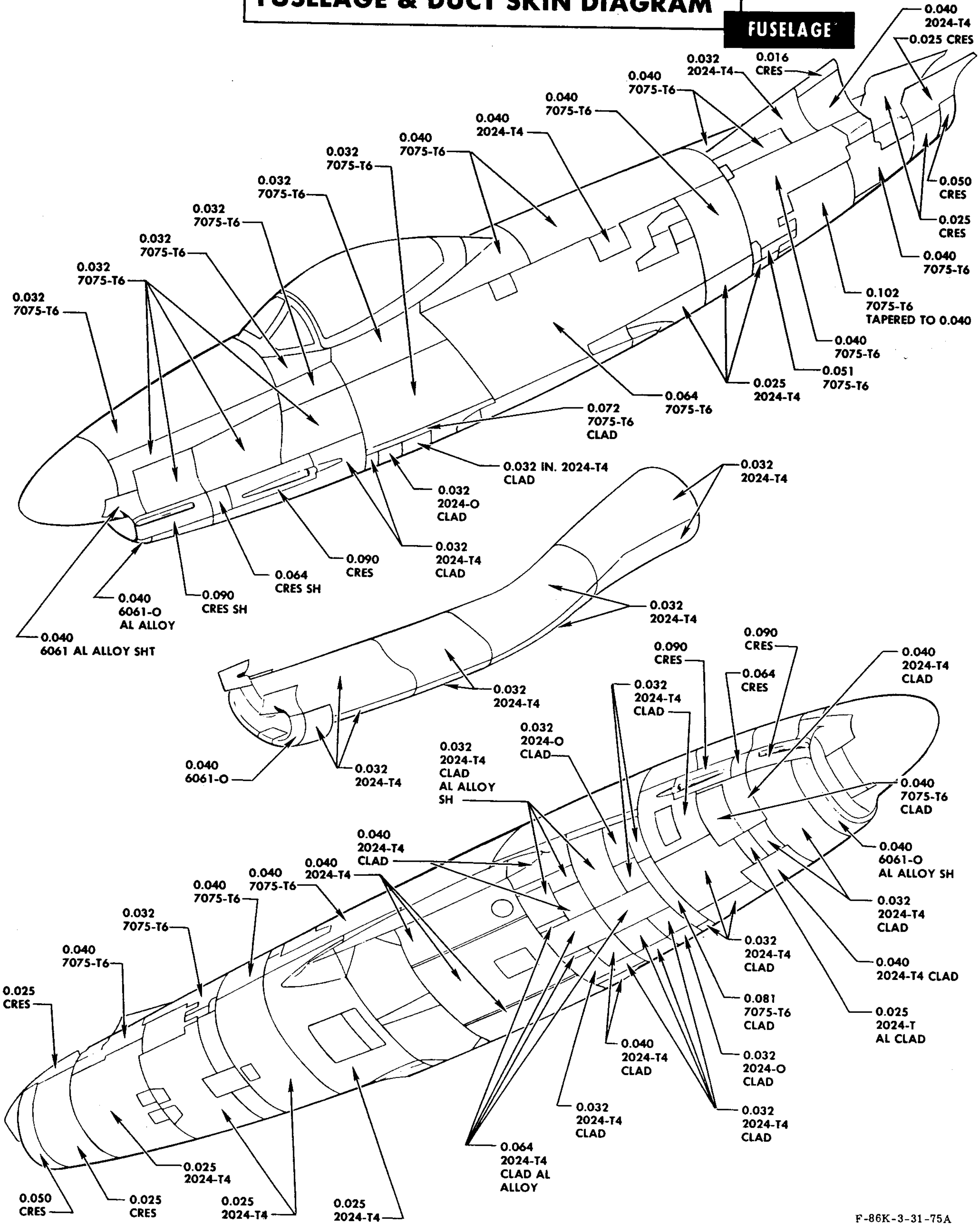

Figure 4-2. Fuselage Skin and Duct Diagram

are oversize. The transfer of side and drag loads from the wing to the fuselage is accomplished through the front spar fittings. Aft of the rear spar bulkhead, the fuselage is a closed box which extends through the forward intermediate and aft section. The four longerons are spliced at the aft section disconnect joint at station 279.3 by tension bolts. The shear loads are transmitted through the joint by shear pins in matching holes around the circumference of the two matching frames. The longerons in the intermediate section are 7075-T6 aluminum alloy extrusion, except for the two upper longerons between station 250 and 279 which are made from corrosion-resistant steel. All frames are of aluminum alloy with the exception of the fire wall frame at station 250 which is made of corrosion-resistant steel.

AFT FUSELAGE SECTION (STATION 279.3 AFT).

The aft fuselage contains the engine afterburner shroud, the speed brakes, and the drag chute. The aft section is designed to withstand the higher temperatures of engine operation. All longerons in this section are made of corrosion-resistant steel. The two frames that attach the tail assembly to the fuselage are of corrosion-resistant steel. All other frames are of aluminum alloy. All inner shrouds and the aspirator are fabricated of corrosion-resistant steel. Approximately 65 pounds of titanium, both pure and alloy, are used in the aft fuselage section. Titanium parts consist of frame webs, shroud sections, small panels, and doors.

The speed brakes are located on each side of the aft fuselage between station 302 and station 332. The speed brakes are operated by a hydraulic actuating cylinder.

Construction of the speed brakes may be of either aluminum sheet or aluminum honeycomb. All future replacement speed brakes will be of the aluminum honeycomb construction. For repairs to the aluminum honeycomb speed brakes, refer to "Structural Repair of Honeycomb Sandwich Panels" in Section I.

The aspiration assembly is considered a nonstructural fairing and does not contribute support to the fuselage or empennage structure. Its primary function is to provide satisfactory airframe cooling throughout the aft fuselage section. The aspirator is constructed of corrosion-resistant steel.

SKIN REPAIR.

The light skin repairs shown in figures 4-40, 4-41, and 4-42 are designed to be used on any section of the fuselage. These repairs are not restricted to any particular size or shape. They may be as large as it is practical to make.

When a large section of skin is damaged it is much more practical to replace the complete skin. When replacing a skin or making a partial skin repair, always replace the original fasteners with fasteners of the same size and type as the ones removed. Blind fasteners should be used only when it is not practical to replace the original type of fastener.

The fastener requirements are relatively simple to determine. Keeping the same spacing and type of fastener as in the nearest manufactured splice, double the rows of fasteners in the repair. For longitudinal repairs, use the nearest longitudinal manufactured splice (a longitudinal splice is approximately parallel with the direction of flight of the airplane). For transverse repairs, use the nearest transverse manufactured splice (a transverse splice crosses or runs into a longitudinal splice at approximately right angles). When installing the doubler behind the skin and picking up the required amount of fasteners in the doubler, those fasteners which fall outside of the normal pattern must be picked up by enlarging the doubler in that area as shown on the illustration.

REPAIR OF LONGERON "T" SECTION.

This repair, shown in figure 4-13, is designed for use in the field where equipment for forming the heavy repair materials is not readily available.

Because the repair parts are not formed, the repair can be accomplished without the use of heat-treat facilities.

REPAIR OF LOWER LONGERON.

This repair is designed for field use where facilities for forming heavy-gage, corrosion-resistant steel repair parts are not available.

The repair in figure 4-17 may be made entirely with 4130 chrome molybdenum steel straps. Fillers may be built up of separate pieces where the area to be filled is no greater in length than one fastener spacing. When the area to be filled is greater than one fastener spacing, a replacement section of longeron may be inserted. The 4130 chrome molybdenum steel straps should be cadmium-plated. Two coats of zinc chromate primer should be applied between the steel and aluminum structure.

FUEL CELL LINER.

Repairs to fuel cell liners within the limits shown in figure 4-24 may be entirely nonstructural as no load is carried through them. When repairing the larger holes, a clip is riveted on the back of the patch. A bead of fuel- and oil-resistant cement is laid under the patch, and the patch is inserted and turned into position. After it is centered over the cutout, another bead or fillet of cement is laid around the outer edges of the patch and over the rivet heads. This outer bead of cement holds the patch in place and provides a smooth surface which will not damage the fuel cell. When repairing small holes, the clip need not be used. The patch is cemented in the same manner and taped in position until the cement has hardened; then the tape is removed.

ENGINE AIR INTAKE DUCT.

Repairs to the engine air intake duct should be flush with the inside of the duct when installation of this type of repair is practical. Nonflush repairs may be installed when necessary. The total area of nonflush repairs should not exceed 3000 square inches. Material for nonflush repairs should meet minimum thickness requirements for countersinking and the edges should be chamfered 30 degrees. Cherry self-plugging type rivets are authorized for use in inaccessible areas of the engine air intake duct.

CERAMIC COATING OF ASPIRATOR LINERS.

Remove liner from aspirator and clean liner thoroughly with alcohol or carbon tetrachloride to remove all dirt and grease. Do not use leaded gasoline, kerosene, or any other substance that will leave a residue on the surface. Sandblast both sides of liner with a low-pressure, fine-grit (35- to 60-grit alumina garnet or silica) sandblast.

It is extremely important that the liner be kept clean and free of all dirt, grease, and fingerprints. Handle liner only with clean cotton gloves. The ceramic coating material should have a specific gravity of between 1.60 and 2.00. (Ordinary house paint has a specific gravity of about 1.70.) The consistency of the ceramic coating material can be adjusted by thinning it with water until a sample will run off a piece of test glass, leaving a translucent film. Before the ceramic coating material is applied, it should be strained through a 60-mesh (maximum) screen. The ceramic coating should be sprayed on the liner to a thickness of between 0.001 and 0.0035 inch. Use a De Vilbiss TGA gun with a No. 90 cap, F-tip and needle, and KS-502 suction feed cup or equivalent. Operate the spray equipment with a pressure of about 20 psi. Heat lamps may be used to hasten the drying process, but they are not essential. After the coating has dried, it is very easily damaged and should be handled with care. To prevent distortion, the liner should be hung in a fixture during the firing process. Fire the liner in a controlled-heat oven at a temperature of between 1650°F and 1700°F for 8 to 15 minutes. Remove liner from oven, and air-cool it.

HOLDING FIXTURE DIMENSIONS.

Figure 4-43 shows the necessary dimensions for construction of fixtures for holding the fuselage components while repairs are being made. The dimensions and attachment points shown are not intended for use in manufacturing jigs for building a complete assembly. They are intended only for use in manufacturing holding fixtures to maintain the proper attachment points and dimensions. The holding fixtures are made to hold the fuselage components in their original shape and will ensure a proper fit when the part being repaired is reinstalled.

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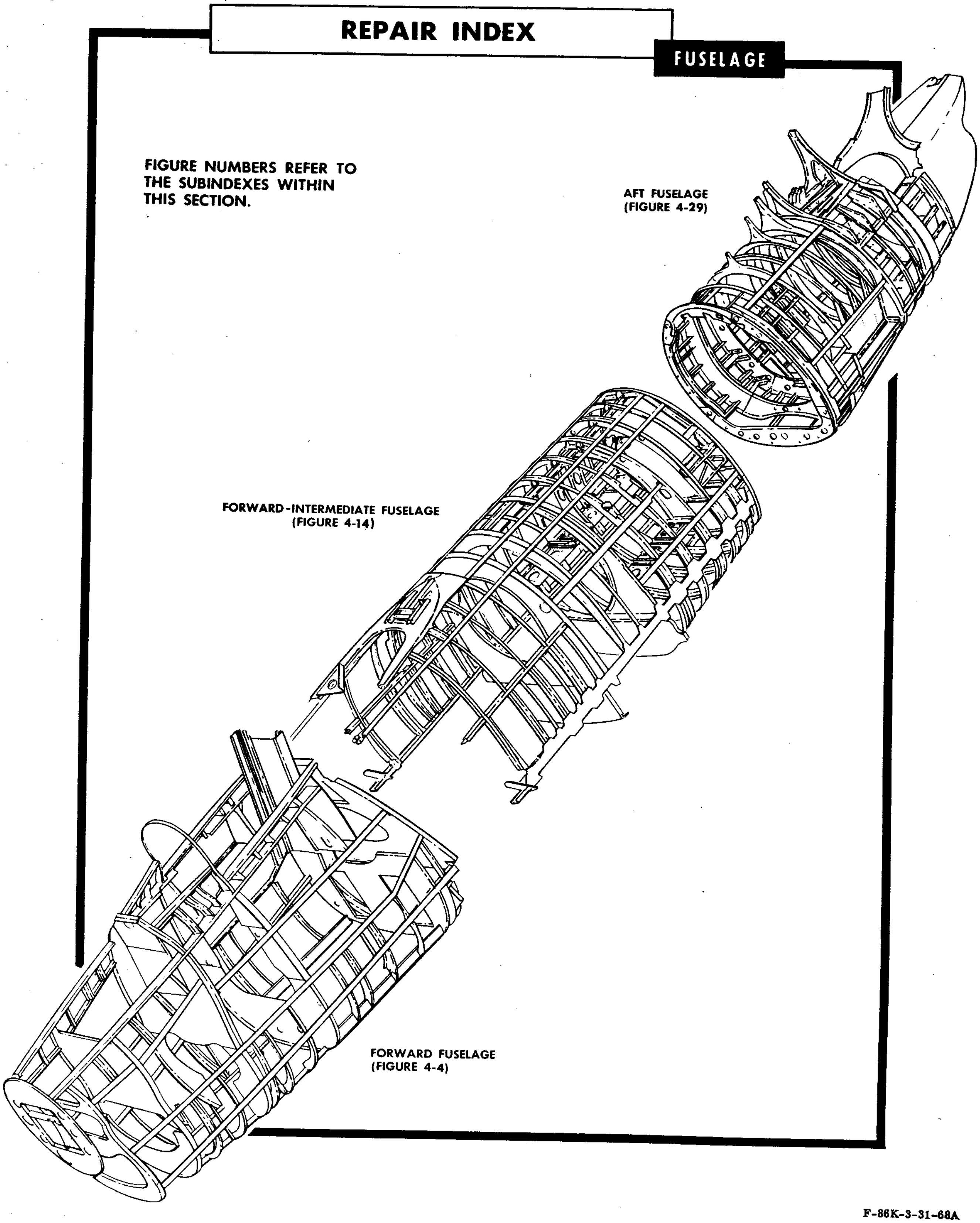

Figure 4-3. Fuselage Group Index

FORWARD SECTION—INDEX

FUSELAGE

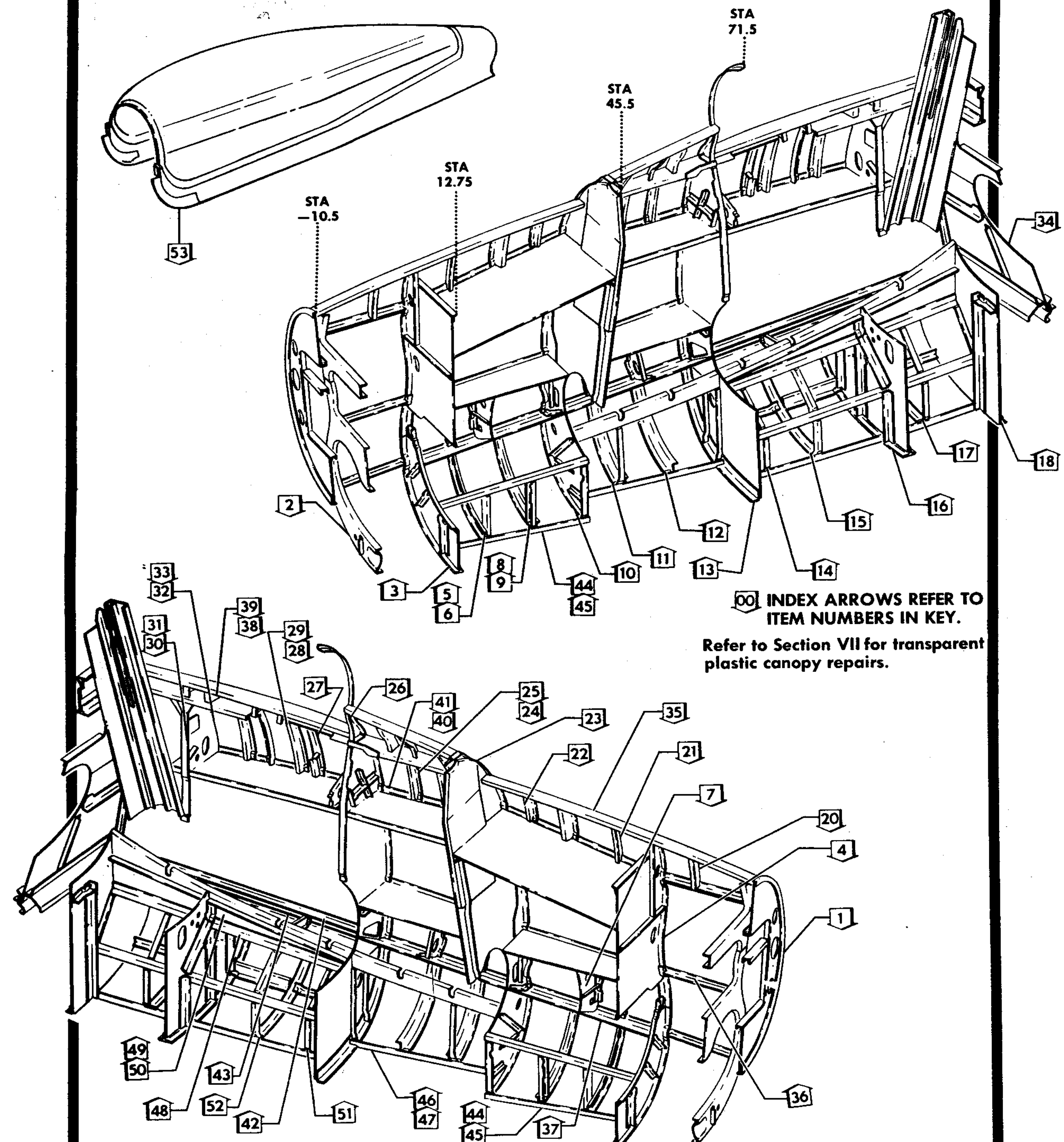

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Figure 4-4. Forward Section Index

ITEM NO.	DRAWING NO.*	DESCRIPTION	GAGE	MATERIAL	REPAIR FIGURE NO.†
1	207-31332-3	Web	0.032	2024-T4 Clad	4-6
	207-31332-5	Cap		7075-T6 Extr	
	207-31332-9, -11	Channel	0.040	2024-T4 Clad	
	207-31332-13	Channel	0.032	2024-T4 Clad	
	207-31332-15, -19	Angle	0.032	2024-T4 Clad	
	207-31332-17	Hat	0.040	2024-T4 Clad	
	207-31332-21	Angle	0.040	2024-T4 Clad	
	207-31332-57	Seal		Synthetic Rubber	
2	207-31139-3	Frame Assy	0.040	2024-T4 Clad	4-7
3	207-31128-3	Web	0.064	75S-T6 Clad	4-8
	207-31128-7	Angle		75S-T6 Extr	
	207-31128-31	Tee (Cap)		75S-T6 Extr	
4	207-31127-3	Web	0.032	7075-T6 Clad	4-8
	207-31127-5, -6	Tee	0.094	7075-T6 Extr	
	207-31127-13	Angle	0.063	7075-T6 Extr	
	207-31127-15	Angle	0.040	2024-T4 Clad	
	207-31127-17	Angle	0.040	2024-T4 Clad	
	207-31127-23	Angle	0.063	2024-T4 Clad	
	207-31127-29	Angle	0.063	2024-T4 Clad	
5	205-31232-3	Frame Assy		2024-T4 Extr	
	205-31232-7	Angle	0.072	2024-T4 Clad	
6	205-31233-3	Tee		2024-T4 Extr	
	205-31233-9	Tee		2024-T4 Extr	
	205-31233-15	Angle	0.072	2024-T4 Clad	
7	205-31234-1	Frame			
8	205-31238-3	Frame Assy	0.051	2024-T4 Clad	
	205-31238-5	Angle	0.051	2024-T4 Clad	
9	205-31235	Frame	0.051	2024-T4 Clad	
10	207-31130-3	Frame	0.064	2024-T4 Clad	
	207-31130-5	Tee	0.064	2024-T4 Extr	
11	207-31143-3, -4	Frame	0.064	2024-T4 Clad	
12	207-31144-3, -4	Frame	0.040	7075-T4 Clad	
13	205-31205-25, -45	Web	0.040	2024-T4 Clad	4-10
	205-31205-5, -41	Tee (Cap)		2024-T4 Extr	
14	205-31301-3, -4	Web	0.032	2024-T4 Clad	
	205-31301-7, -8	Stiffener	0.051	2024-T4 Clad	
	205-31301-15, -16	Cap	0.040	2024-T4 Clad	
	205-31301-25, -26	Cap	0.064	2024-T4 Clad	
15	205-31302-3, -4	Web	0.032	2024-T4 Clad	
	205-31302-7, -10	Angle	0.040	2024-T4 Clad	
	205-31302-21, -22	Angle	0.064	2024-T4 Clad	
16	205-31303-39	Web	0.032	2024-T4 Clad	
	205-31303-5, -6	Angle	0.064	2024-T4 Clad	
	205-31303-27	Tee		2024-T42 Extr	
	205-31303-29	Strip	0.032	2024-T4 Clad	
	205-31303-31	Doubler	0.032	2024-T4 Clad	
	205-31303-37	Angle	0.125	2024-T42 Al Extr	
	205-31303-55, -56	Angle		2024-T42 Al Extr	
17	205-31304-3, -4	Web	0.032	2024-T4 Clad	
	205-31304-5, -6	Angle	0.064	2024-T4 Clad	
	205-31304-7, -8	Angle	0.064	2024-T4 Clad	
18	205-31306-3	Web	0.032	2024-T4 Clad	
	205-31306-5, -6	Land	0.064	2024-T4 Clad	
	205-31306-7	Angle	0.040	2024-T4 Clad	
	205-31306-13	Angle	0.064	2024-T4 Clad	
	205-31306-15	Angle		2024-T42 Extr	
	205-31306-21	Angle		2024-T42 Extr	
	205-31306-23	Angle		2024-T42	

***Drawing numbers are for reference only.**

†For additional repairs, refer to Section X.

Key to Figure 4-4

ITEM NO.	DRAWING NO.*	DESCRIPTION	GAGE	MATERIAL	REPAIR FIGURE NO.†
20	165-31223-1, -2	Frame	0.040	7075-T6 Clad	4-9
21	165-31224-3, -4	Frame	0.040	7075-T6 Clad	4-9
22	165-31225-3, -4	Frame	0.064	7075-T6 Clad	
	165-31225-7, -8	Angle	0.064	7075-T6 Clad	
23	207-31129-3, -4	Web	0.032	7075-T6 Clad	
	207-31129-5	Angle	0.064	7075-T6 Clad	
	207-31129-11	Web	0.032	7075-T6 Clad	
	207-31129-13, -14	Angle	0.040	7075-T6 Clad	
	207-31129-29	Angle	0.064	7075-T6 Clad	
	207-31129-31	Angle	0.040	7075-T6 Clad	
	207-31129-59	Filler	0.032	2024-T4 Clad	
	207-31129-119, -121	Angle		7075-T6 Extr	
	207-31129-123, -125	Angle		7075-T6 Extr	
24	205-31239-3, -4	Web	0.072	2024-T4 Clad	
	205-31239-15, -16	Tee		2024-T4 Extr	
25	207-31136-3	Web	0.091	7075-T6 Clad	
	207-31136-4	Web	0.064	7075-T6 Clad	
	207-31136-5, -6	Tee		7075-T6 Extr	
	207-31136-7, -8	Angle		7075-T6 Extr	
26	165-31865-1, -2	Frame	0.064	7075-T6 Clad	
27	207-31281	Frame			
28	207-31282	Frame			
29	165-31340	Frame			
30	207-31269-3	Web	0.051	7075-T6 Clad	
	207-31269-11	Angle	0.064	7075-T6 Clad	
31	207-31149-3	Web	0.051	7075-T6 Clad	
	207-31149-13	Angle	0.064	7075-T6 Clad	
	207-31149-17	Tee		7075-T6 Extr	
32	207-31133-3	Frame	0.032	7075-T6 Clad	
	207-31133-9, -11	Angle		7075-T6 Extr	
	207-31133-13	Angle		7075-T6 Extr	
	207-31133-19, -20, -21, -22, -23, -24	Angle		7075-T6 Extr	
33	207-31134-3	Web	0.040	7075-T6 Clad	
	207-31134-11	Angle		7075-T6 Extr	
	207-31134-13	Web	0.032	7075-T6 Clad	
	207-31134-15	Channel	0.040	7075-T6 Clad	
	207-31134-17	Tee		7075-T6 Extr	
	207-31134-67	Tee	0.091	7075-T6 Clad	
34	207-31126-5, -6	Frame	0.072	7075-T6 Clad	
	207-31126-7	Beam	0.091	7075-T6 Clad	
	207-31126-9	Beam	0.102	7075-T6 Clad	
	207-31126-11	Support	0.064	2024-T4 Clad	
	207-31126-13	Angle	0.040	2024-T4 Clad	
	207-31126-17	Stiffener	0.072	7075-T6 Clad	
	207-31126-35, -36	Support	0.040	2024-T4 Clad	
	207-31126-37, -38	Stiffener		7075-T6 Extr	
	207-31126-43	Shim	0.032	2024-T4 Clad	
	207-31126-55	Web	0.040	7075-T6 Clad	
35	165-31120-3, -4	Longeron	0.064	7075-T6 Clad	4-5
36	207-31114-3, -4	Web	0.025	7075-T6 Clad	4-13
	207-31114-27, -28	Cap		7075-T6 Extr	
37	205-31230-3, -4	Tee		7075-T6 Extr	4-13
38	165-31122-3, -4	Longeron	0.072	7075-T6 Clad	
	165-31414-3	Longeron	0.064	7075-T6 Clad	
39	165-31121-3, -4	Longeron	0.072	7075-T6 Clad	
	165-31121-53, -54	Longeron	0.072	7075-T6 Clad	
40	207-31116-5	Web—Horiz	0.081	7075-T6 Clad	
	207-31116-7	Tee—Horiz		7075-T6 Extr	

***Drawing numbers are for reference only.**
†For additional repairs, refer to Section X.

Key to Figure 4-4 (Continued)

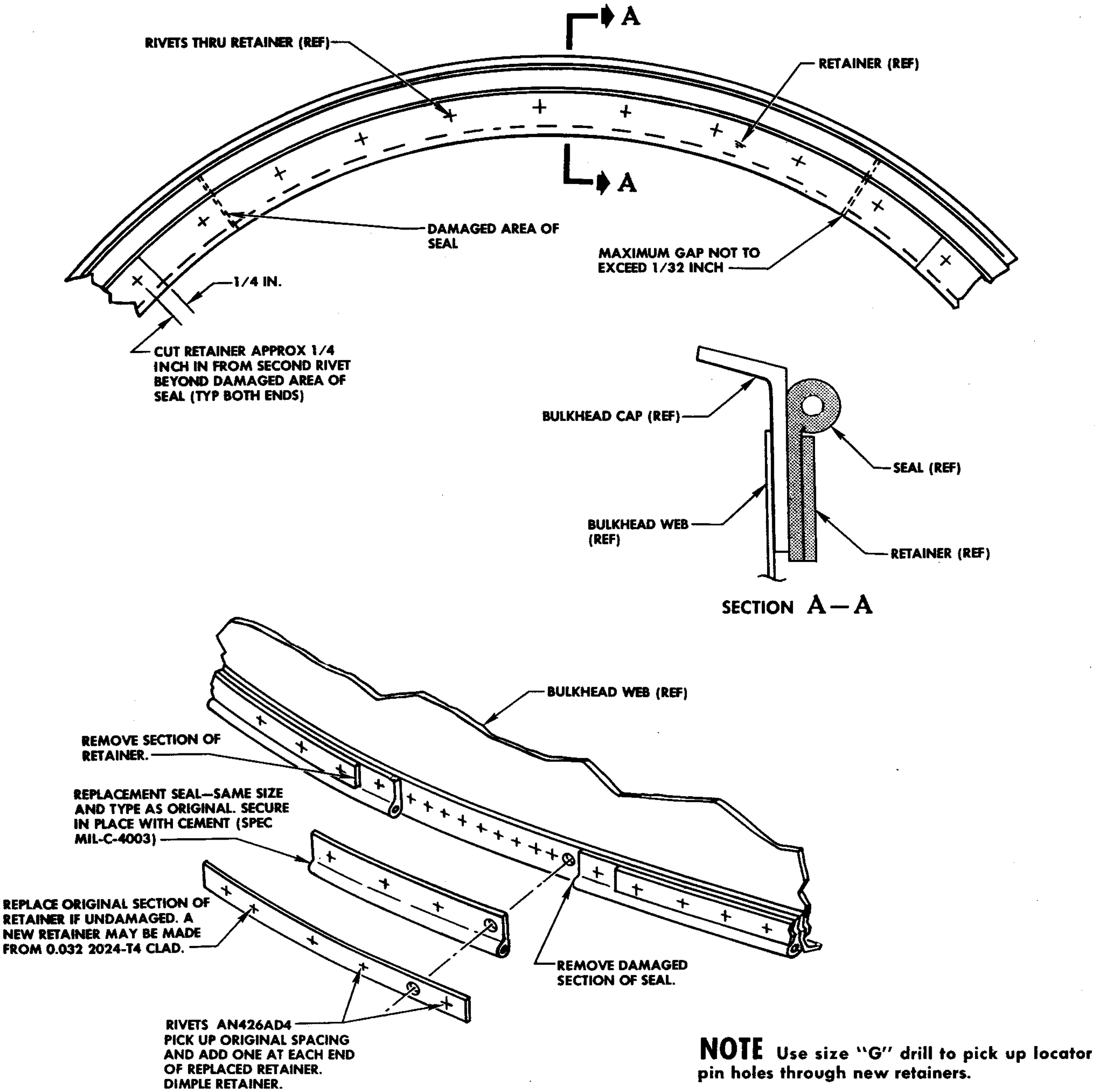
ITEM NO.	DRAWING NO.*	DESCRIPTION	GAGE	MATERIAL	REPAIR FIGURE NO.†
41	207-31203-3	Web—Horiz	0.040	7075-T6 Clad	
	207-31203-9	Tee—Horiz		7075-T6 Extr	
	207-31203-65	Web—Horiz	0.040	7075-T6 Clad	
42	205-31231-3, -4	Tee—Long		7075-T6 Extr	
	205-31231-5, -6	Angle—Long		7075-T6 Extr	
	205-31231-7	Strap		7075-T6 Clad	
43	205-31208-3, -5	Web—Horiz		2024-T4 Clad	
	205-31208-43, -44	Angle—Horiz		2024-T42 Extr	
	205-31208-47, -48	Angle—Horiz		2024-T42 Extr	
44	165-31109-3	Web	0.032	7075-T6 Clad	
	165-31109-5, -19	Angle		7075-T6 Extr	
45	165-31110-3	Web	0.051	7075-T6 Clad	
	165-31110-5	Angle		7075-T6 Extr	
46	165-31111-3	Web	0.032	7075-T6 Clad	
	165-31111-13	Angle	0.064	7075-T6 Clad	
47	165-31112-3, -35	Web	0.032	7075-T6 Clad	
	165-31112-7, -37	Angle	0.064	7075-T6 Clad	
48	205-31243-3	Web	0.032	2024-T4 Clad	
	205-31243-5	Angle		2024-T42 Extr	
	205-31243-7	Angle	0.091	2024-T4 Clad	
49	205-31244-3, -4	Web	0.032	2024-T4 Clad	
	205-31244-5, -6	Angle		2024-T42 Extr	
	205-31244-7, -8	Angle	0.091	2024-T4 Clad	
50	205-31245-23	Web	0.032	7075-T6 Clad	
	205-31245-7	Angle		7075-T6 Extr	
51	205-31310				
52	205-31312				
53	165-31802	Canopy Assy		4-5E, 4-5F‡	

***Drawing numbers are for reference only.**
†For additional repairs, refer to Section X.
‡Refer to Section VII for transparent plastic repairs.

Key to Figure 4-4 (Continued)

PERMANENT

Category A



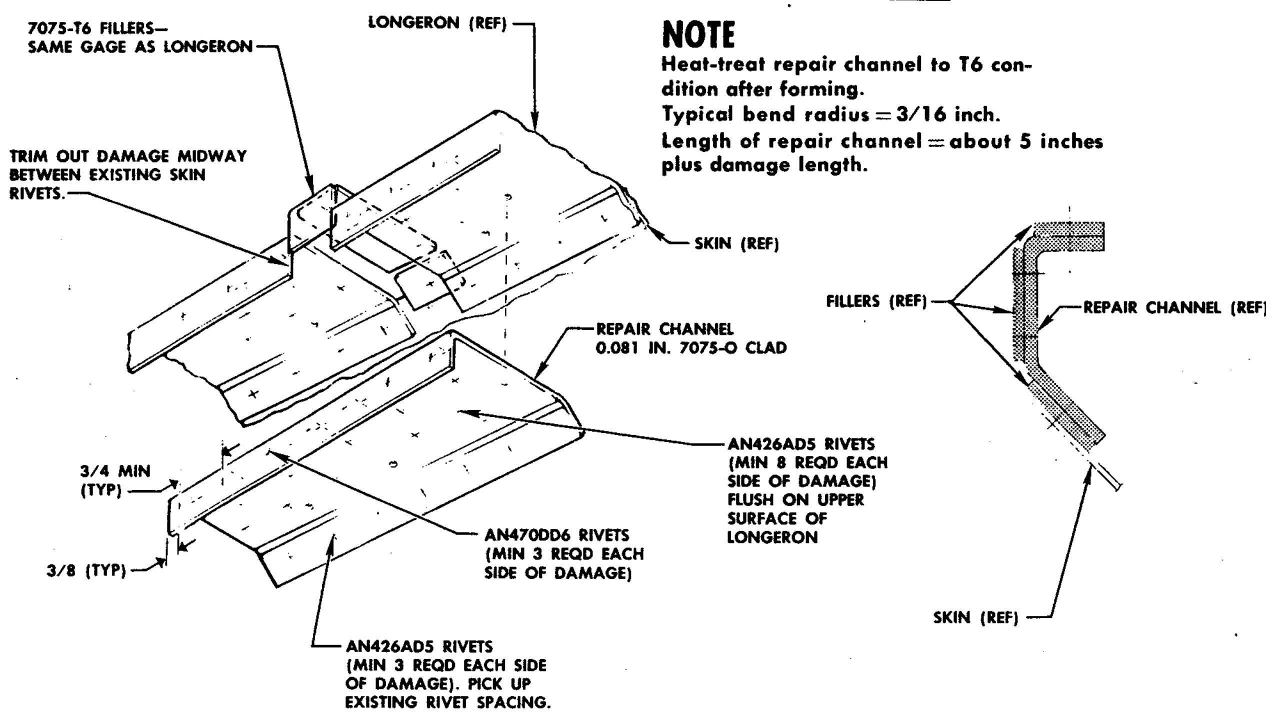
NOTE Use size "G" drill to pick up locator pin holes through new retainers.

F-86D-3-31-43

Figure 4-4A. Rubber Seal—Station —10.8

PERMANENT

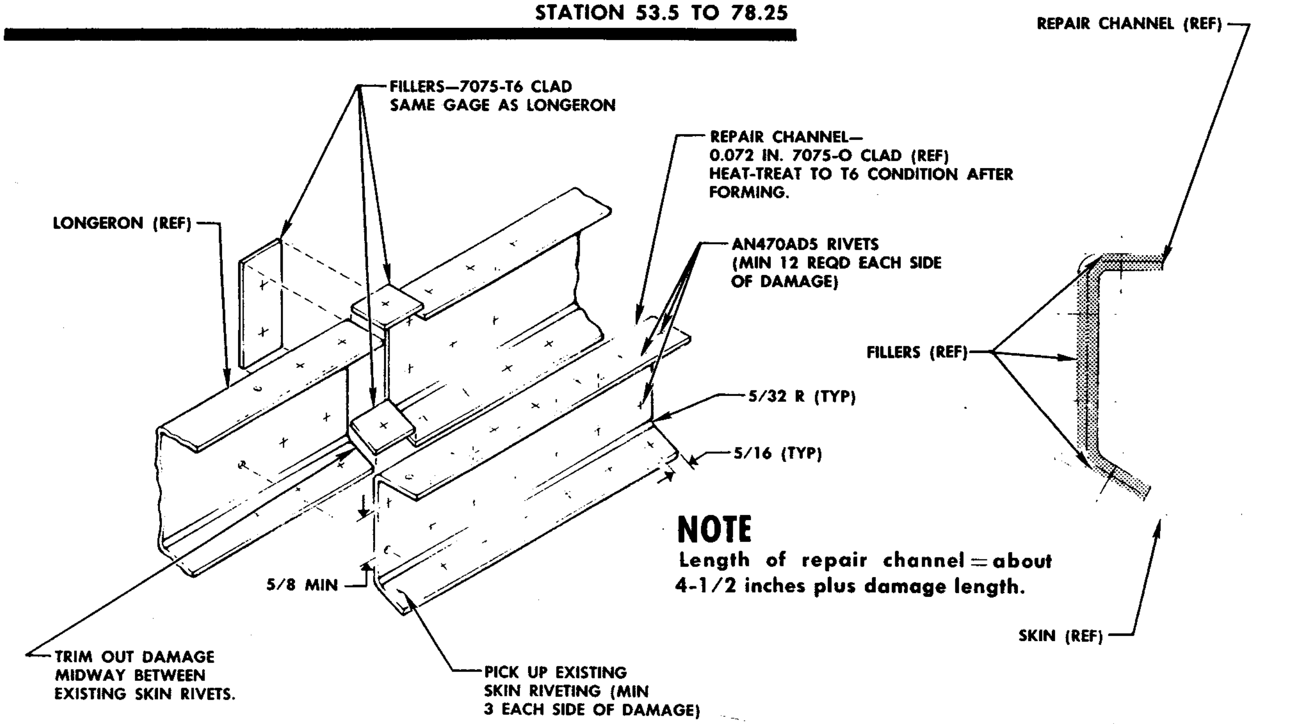
Category A



NOTE

Heat-treat repair channel to T6 condition after forming.
Typical bend radius = 3/16 inch.
Length of repair channel = about 5 inches plus damage length.

STATION 53.5 TO 78.25



NOTE

Length of repair channel = about 4-1/2 inches plus damage length.

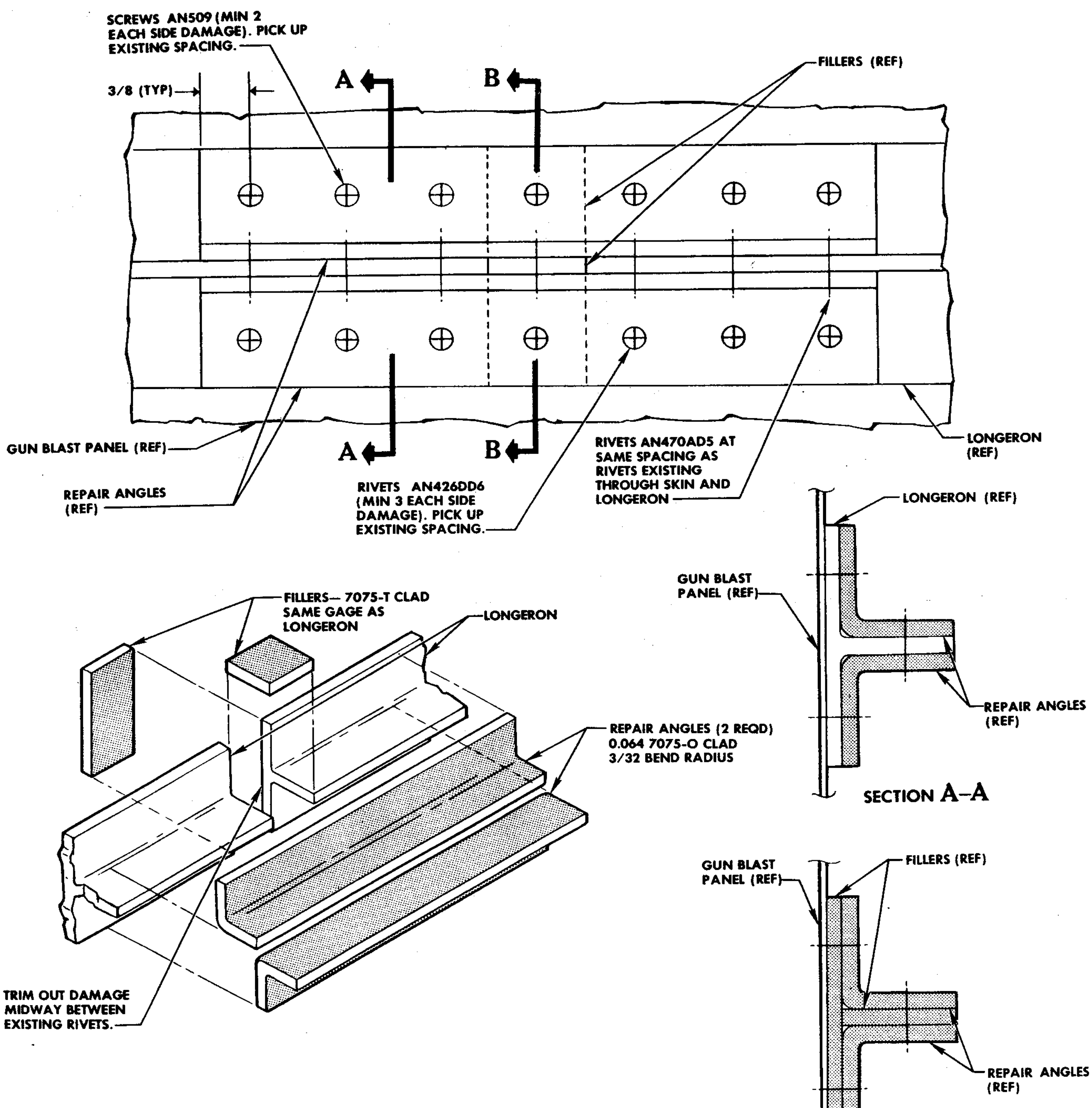
STATION 2.8 TO 53.5

F-86D-3-31-30

Figure 4-5. Upper Longeron Station 2.8 to 78.3

PERMANENT

FUSELAGE



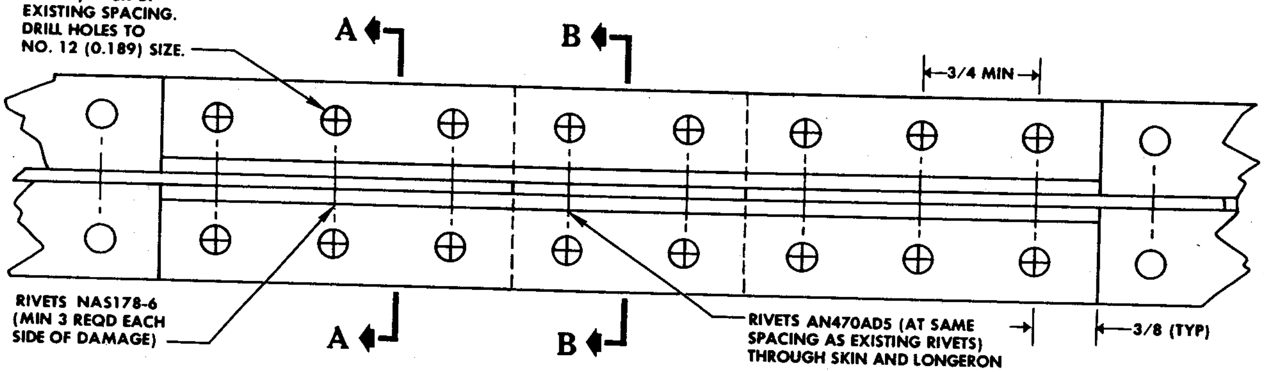
NOTE Heat-treat repair angles to T6 condition after forming. The length of the repair angles should be about 5 inches plus the damage length.

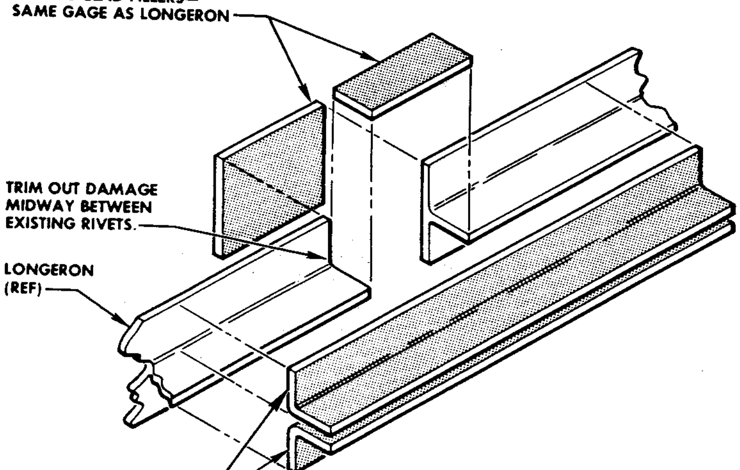
F-86D-3-31-44

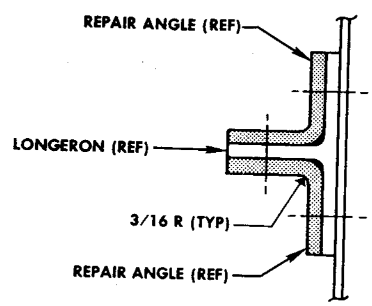
Figure 4-5A. Lower Longeron—Station 5.3 to 36

PERMANENT

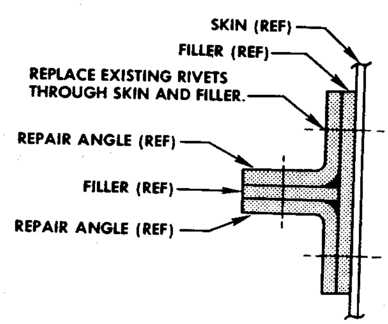
Category A







SECTION A—A



SECTION B—B

1. Trim out damage midway between existing fasteners.
2. Smooth all edges and corners after trimming.
3. Make repair angles and fillers.
4. Fasten all repair parts in place using size and type of fasteners and spacing called out.

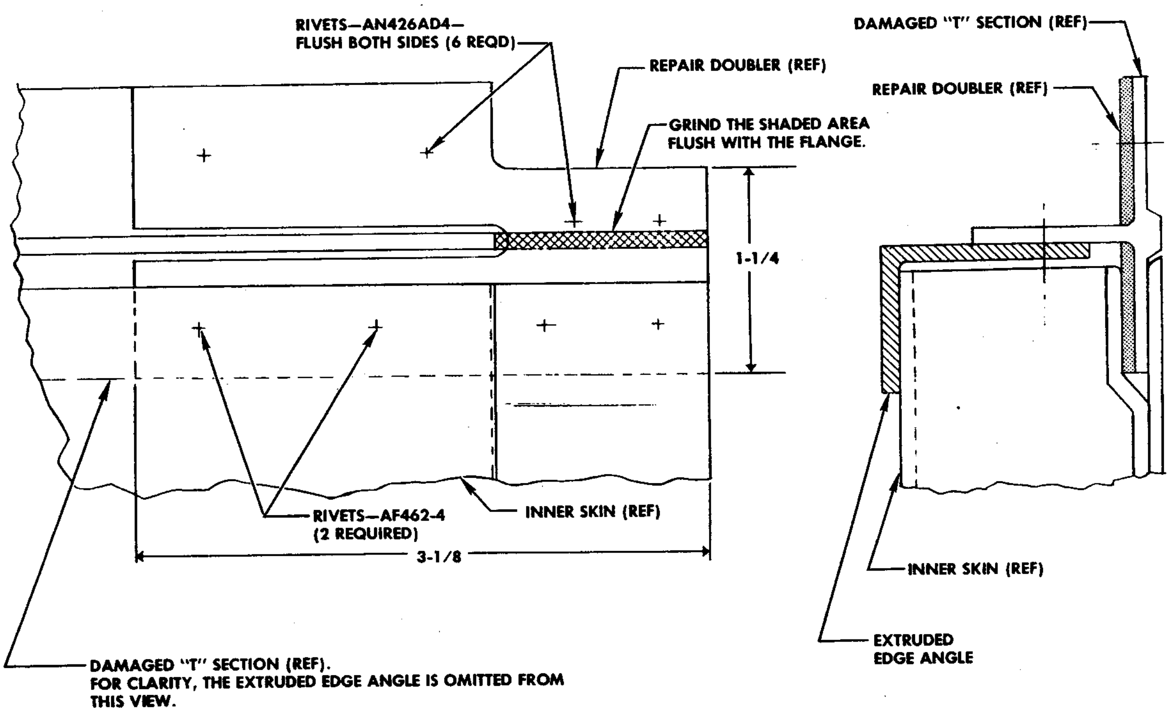
NOTE The length of the repair angles should be about 5 inches plus the damage length.

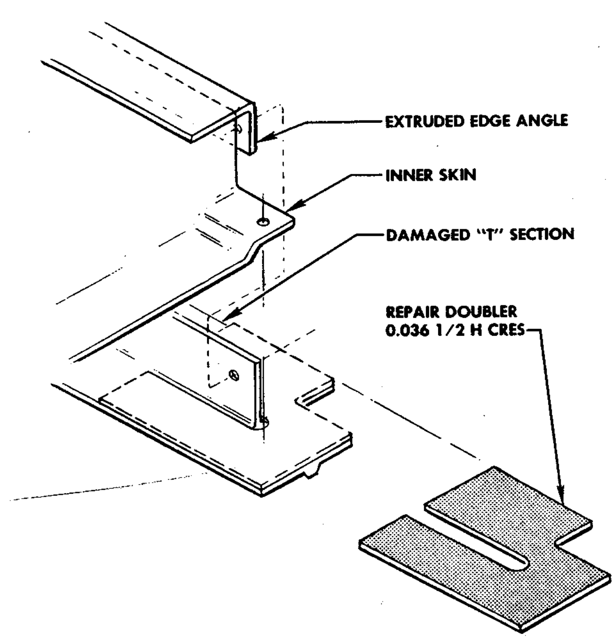
F-86D-3-31-37

Figure 4-5B. Lower Longeron—Station 36 to 96.8 and Upper "T" Stringer

PERMANENT CATEGORY A

FUSELAGE





Because of the many times the side equipment door is removed and reinstalled, the end of the "T" angle may become damaged. When damage occurs, the following repair may be used:

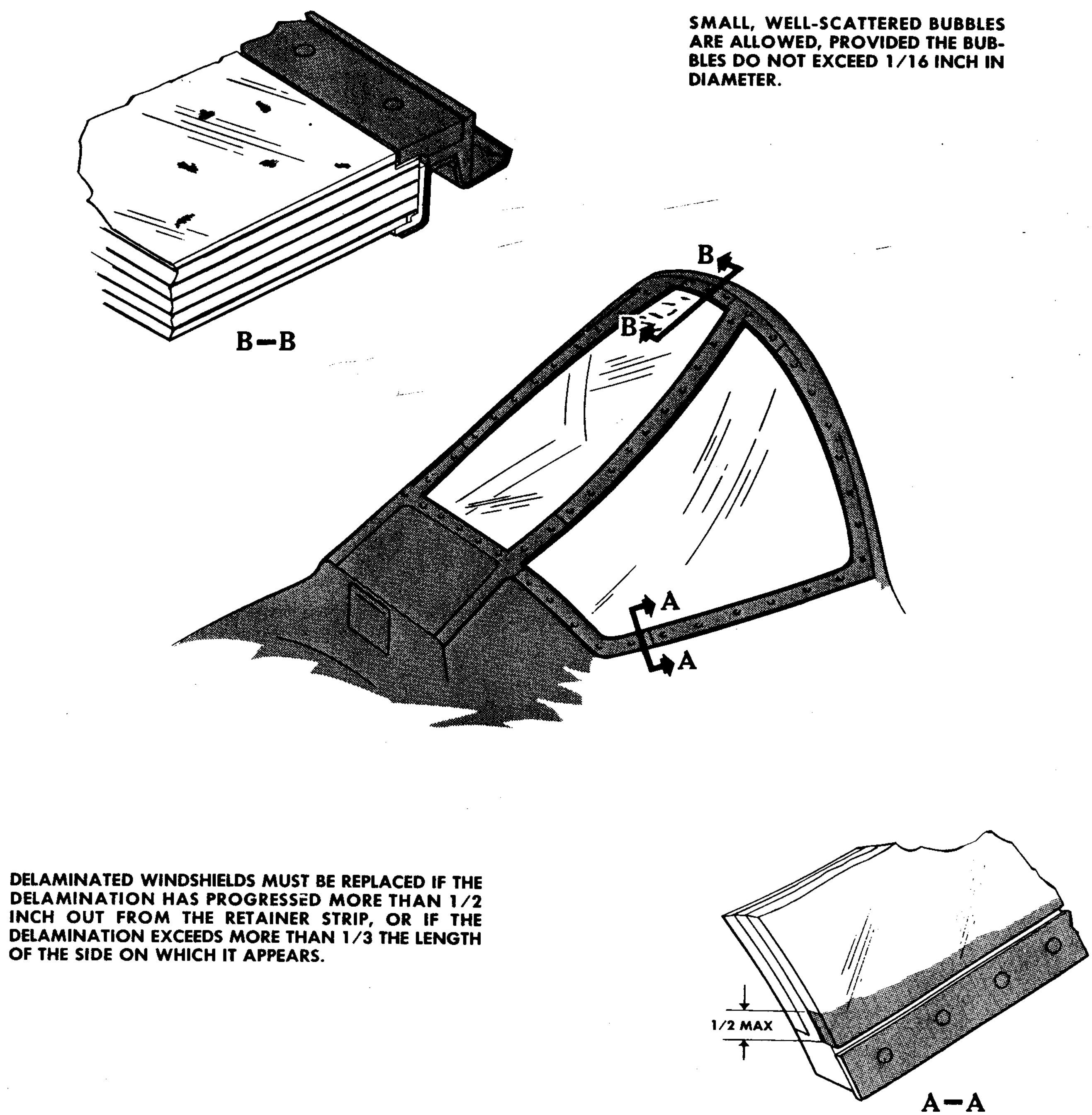
1 Stop-drill all cracks.
2 Grind the inside surface of the "T" flush.
3 Fabricate a repair doubler of 0.036 inch one-half hard corrosion-resistant steel to fit between the inner surface of the damaged "T" section and the inner skin.
4 Secure all repair parts in place, using size and type of fastener and spacing called out. Use existing rivet holes whenever possible.

F-86L-3-31-4

Figure 4-5C. Side Equipment Door Repair

WINDSHIELD NEGLIGIBLE DAMAGE

FUSELAGE



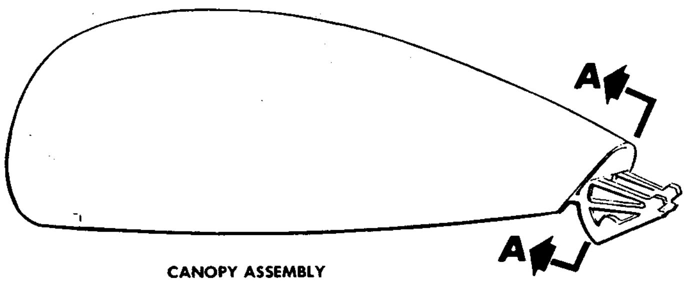
NOTE Refer to "Windshield Negligible Damage."

F-86D-3-31-42

Figure 4-5D. Windshield Negligible Damage

PERMANENT CATEGORY A

FUSELAGE



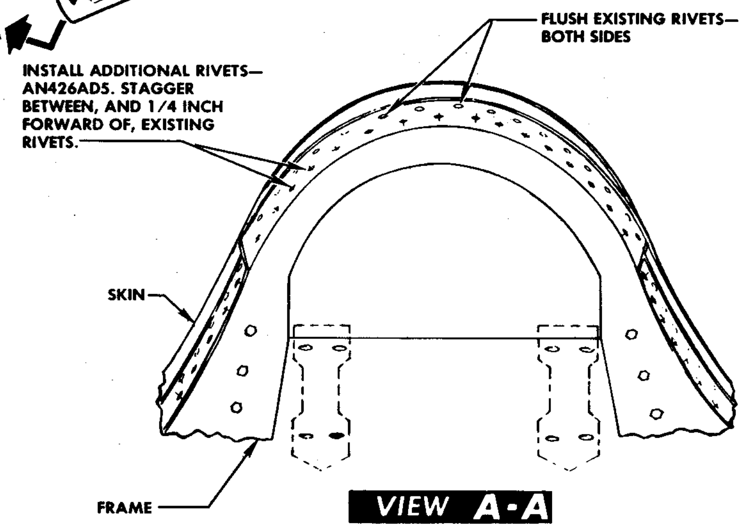
When the aft edge of the canopy frame skin is damaged during the operation of the canopy because of interference between the canopy and canopy fairing cover, modify the canopy and canopy fairing cover as follows:

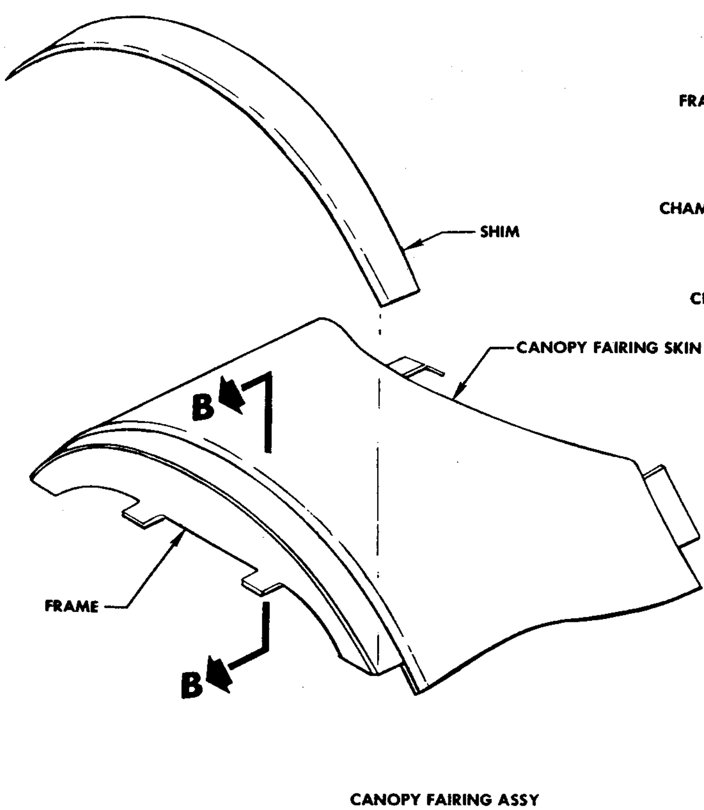
1 Double-flush the existing rivets in the aft canopy frame. Add one row of additional AN426AD5 rivets 1/4 inch forward of existing row of fasteners. Stagger the added row of fasteners between the existing fasteners.

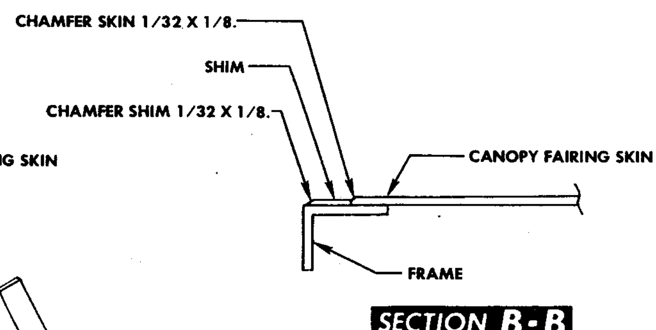
2 Chamfer canopy fairing skin, and shim 1/32 X 1/8 inch.

3 Trim off ends of shim where the mold line will not be affected.

4 Trim aft edge of canopy assembly skins to allow 1/8-inch gap between canopy assembly and canopy fairing assembly.





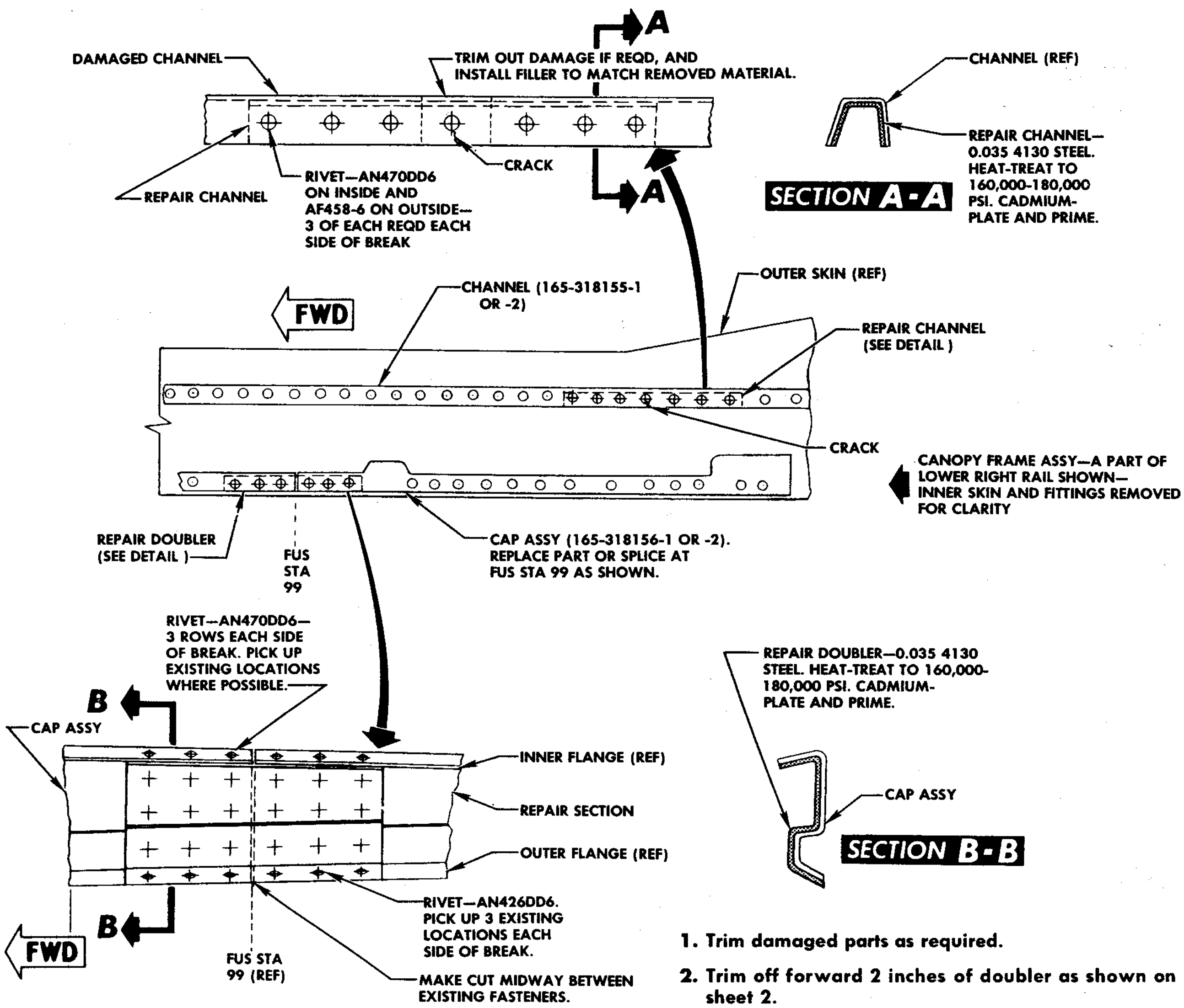


F-86D-3-31-55

Figure 4-5E. Canopy Fairing Repair

PERMANENT

Category B



1. Trim damaged parts as required.
2. Trim off forward 2 inches of doubler as shown on sheet 2.
3. Fabricate repair doublers and fillers as shown.
4. Heat-treat all steel parts to 160,000-180,000 psi.
5. Cadmium-plate and prime all steel parts.
6. Prime aluminum alloy fillers.
7. Install channel repair.
8. Install cap assembly repair.
9. Install inner skin repair.
10. Install doubler repair.

NOTE

This repair is designed for repairing canopy frame assembly lower rails when damaged in the vicinity of fuselage station 104 (left or right side).

Repairs for the channel and cap assemblies are shown on this sheet. The inner skin repair and necessary doubler rework is shown on sheet 2.

⊕ Existing fastener locations

+ Additional fasteners to be added

● Fastener coding noted where used

NOTE

It will be necessary to remove the outer skin to gain access for riveting the inner skin and doubler.

F-86K-3-31-80

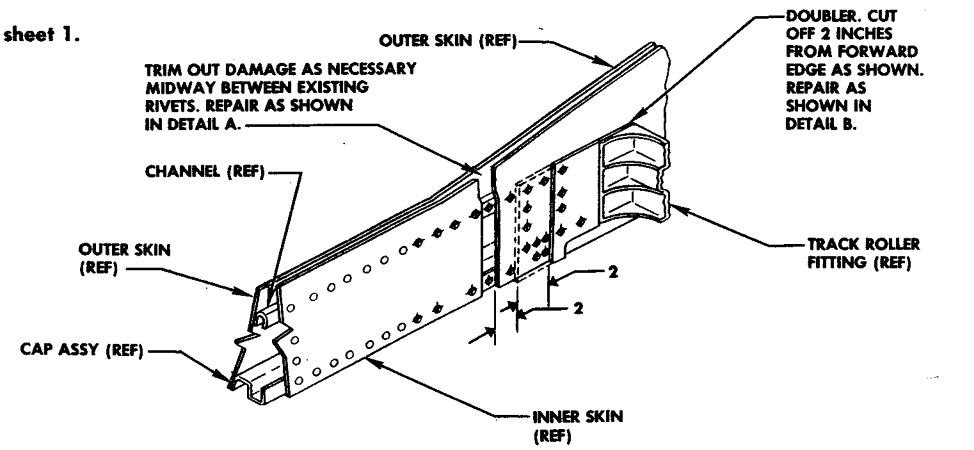
Figure 4-5F. Canopy Frame Repair—Lower Beam (Sheet 1 of 2)

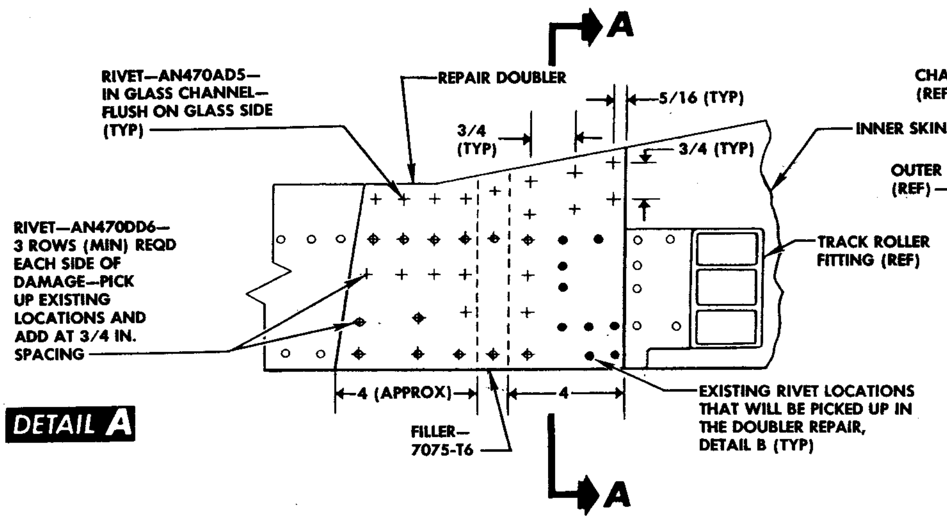
PERMANENT

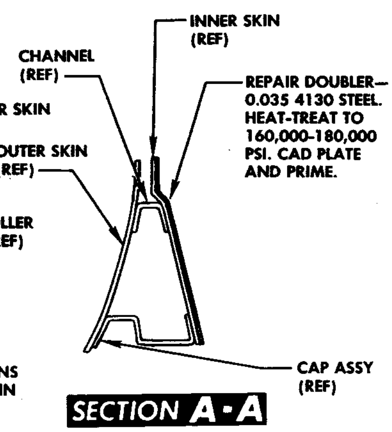
Category B

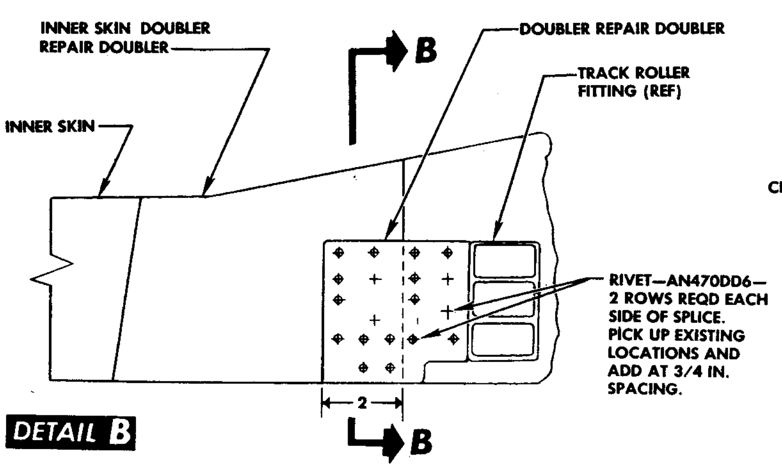
NOTE

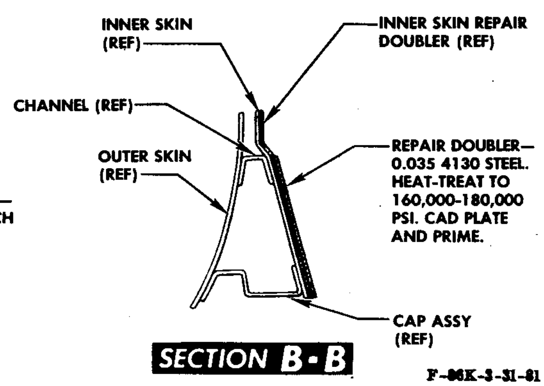
Refer to note and steps on sheet 1.









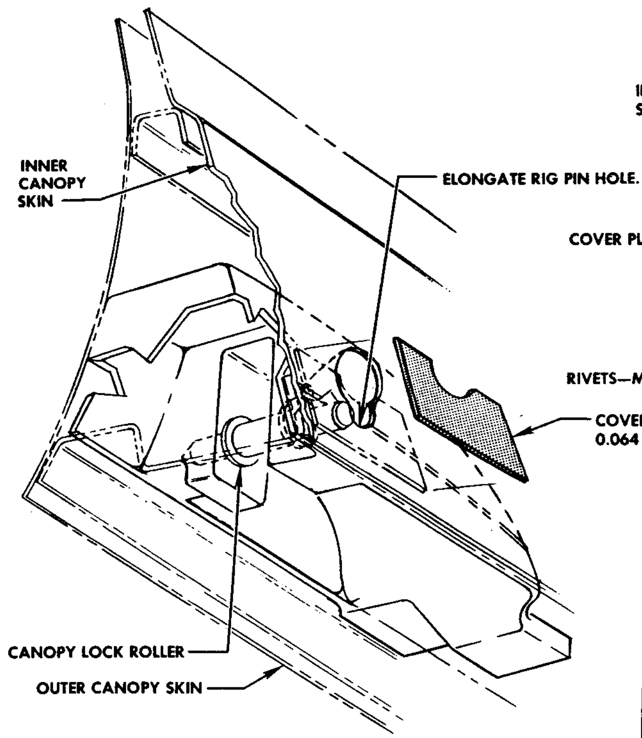


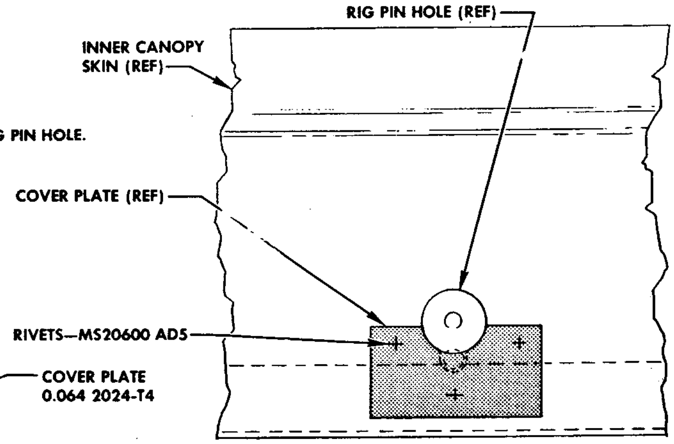
F-86K-3-31-81

Figure 4-5F. Canopy Frame Repair—Lower Beam (Sheet 2 of 2)

PERMANENT – CATEGORY A

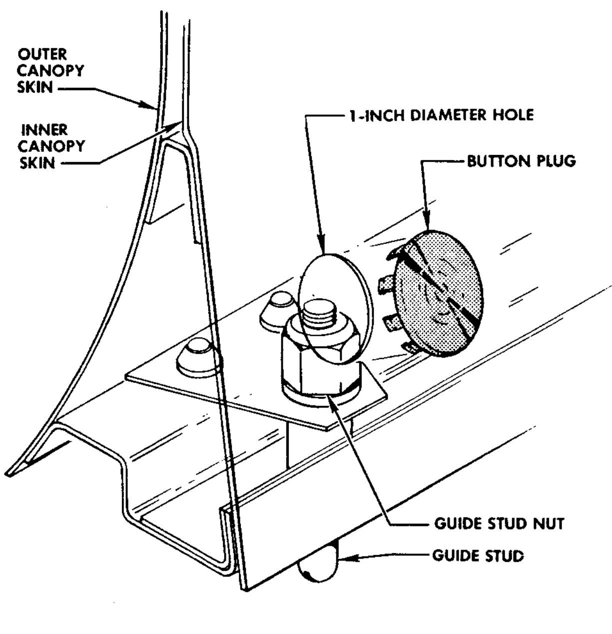
FUSELAGE

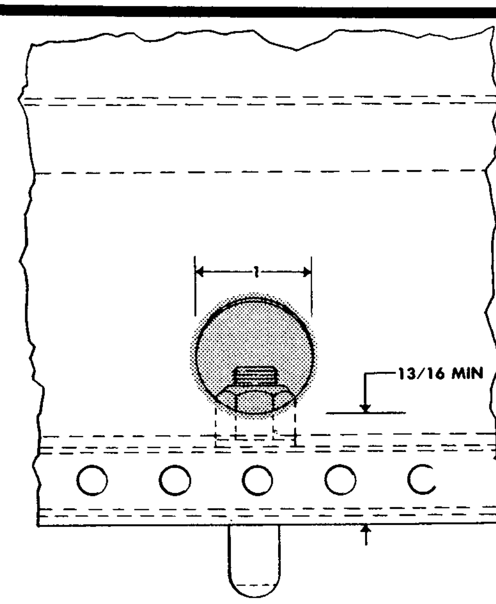




1 Elongate existing 3/4-inch rig pin hole on inner skin only as necessary to remove pin and canopy roller.
2 Install new canopy roller.
3 Fabricate a cover plate from 0.064 inch 2024-T4 material. Do not cover any portion of original rig pin hole.
4 Install cover plate with three MS20600AD5 rivets.

CANOPY LOCK ROLLER REPLACEMENT





1 Locate and cut one-inch diameter holes in inner canopy skin at stations 96.156 and 111.75. The one-inch holes must be a minimum of 13/16 inch above the lower edge of the inner skin.
2 Remove nut from guide stud through one-inch access hole.
3 Reinstall new guide stud, using one-inch hole for access to tighten guide stud nut.
4 Install button plug (Federal Stock No. 5340-290-4533 or equivalent) in one-inch diameter holes.
5 Apply sealing compound around edges of button plug.

CANOPY GUIDE STUD REPLACEMENT

F-86K-3-31-84

Figure 4-5G. Canopy Locking Rollers and Guide Stud Replacement

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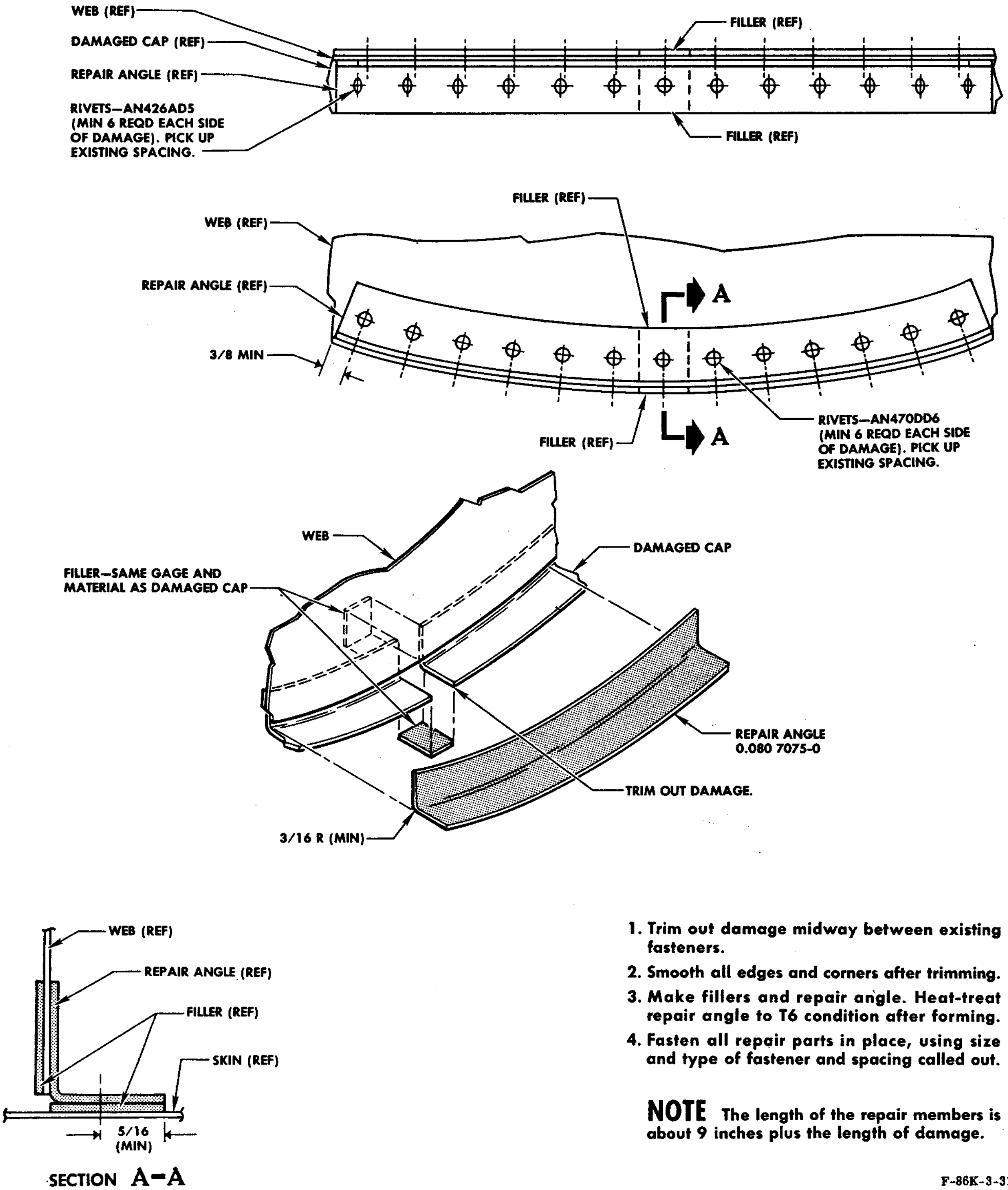
PERMANENT—CATEGORY A

FUSELAGE



1. Trim out damage midway between existing fasteners.
2. Smooth all edges and corners after trimming.
3. Make fillers and repair angle. Heat-treat repair angle to T6 condition after forming.
4. Fasten all repair parts in place, using size and type of fastener and spacing called out.

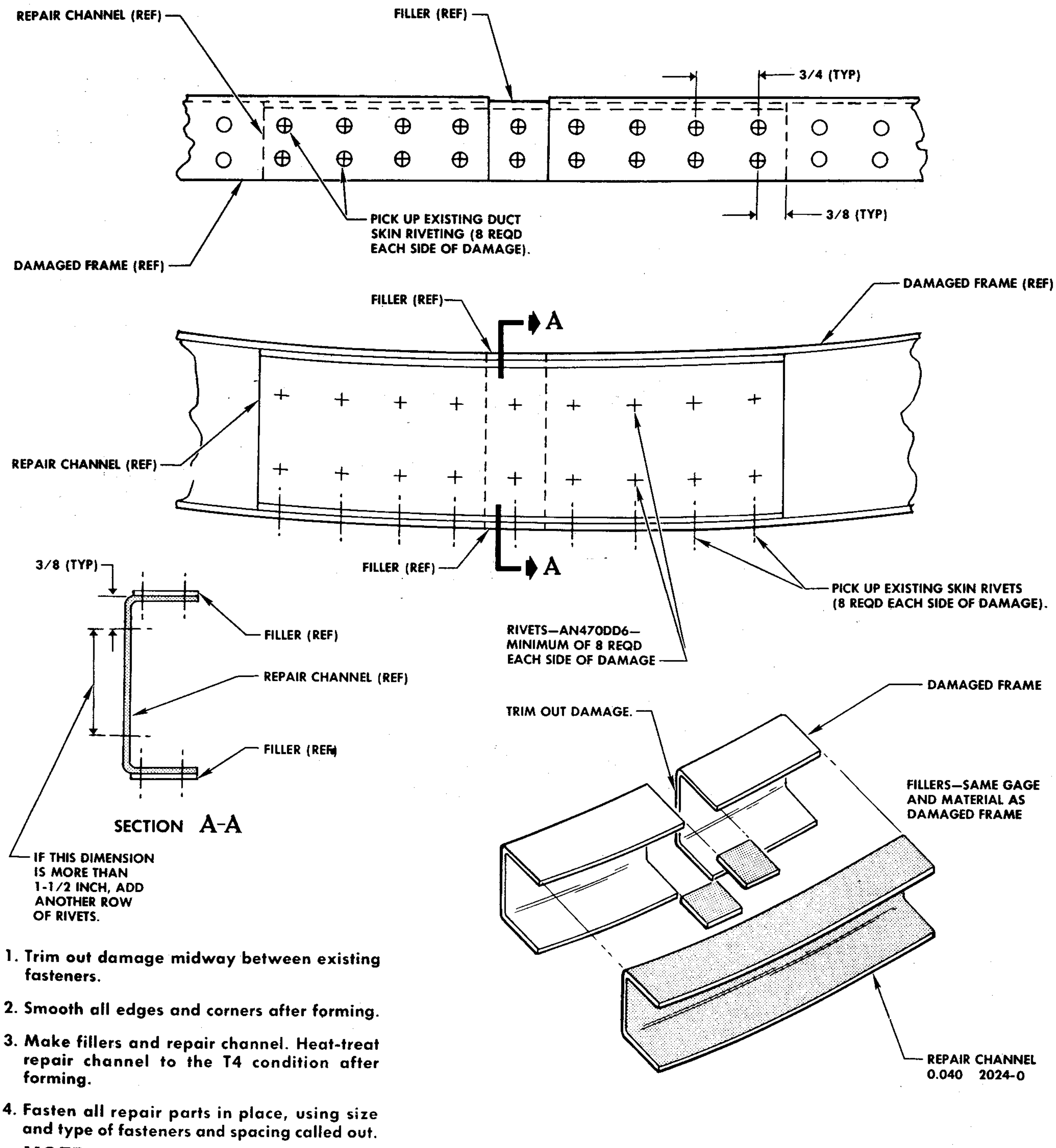
NOTE The length of the repair members is about 9 inches plus the length of damage.

F-86K-3-31-56A

Figure 4-6. Bulkhead Outer Cap—Station 10.8

PERMANENT—CATEGORY A

FUSELAGE



1. Trim out damage midway between existing fasteners.
2. Smooth all edges and corners after forming.
3. Make fillers and repair channel. Heat-treat repair channel to the T4 condition after forming.
4. Fasten all repair parts in place, using size and type of fasteners and spacing called out.

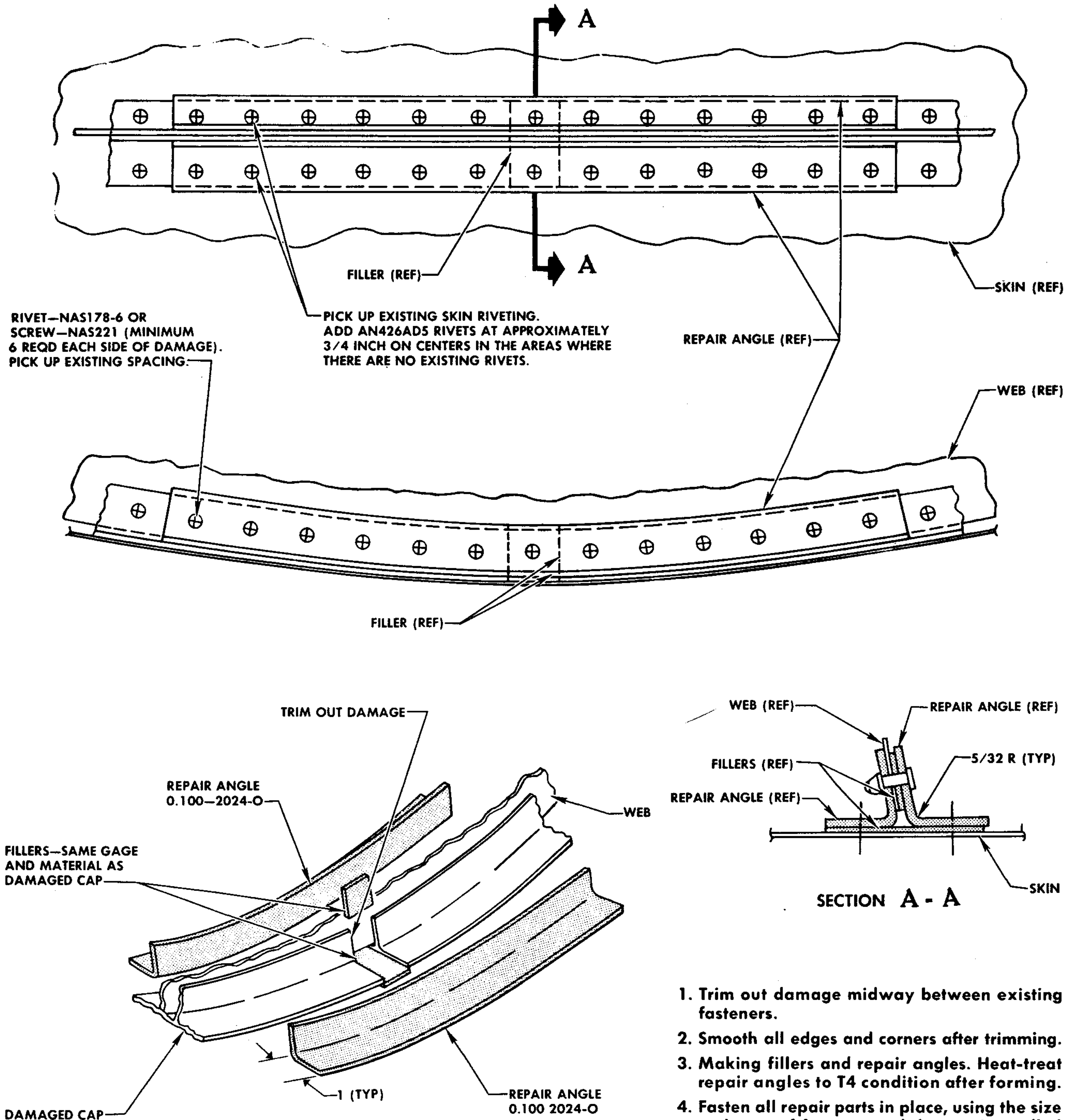
NOTE The length of the repair member is about 6 inches plus the length of the damage.

F-86K-3-31-57A

Figure 4-7. Frame—Station —4.75

PERMANENT CATEGORY A

FUSELAGE



1. Trim out damage midway between existing fasteners.
2. Smooth all edges and corners after trimming.
3. Making fillers and repair angles. Heat-treat repair angles to T4 condition after forming.
4. Fasten all repair parts in place, using the size and type of fastener and the spacing called out.

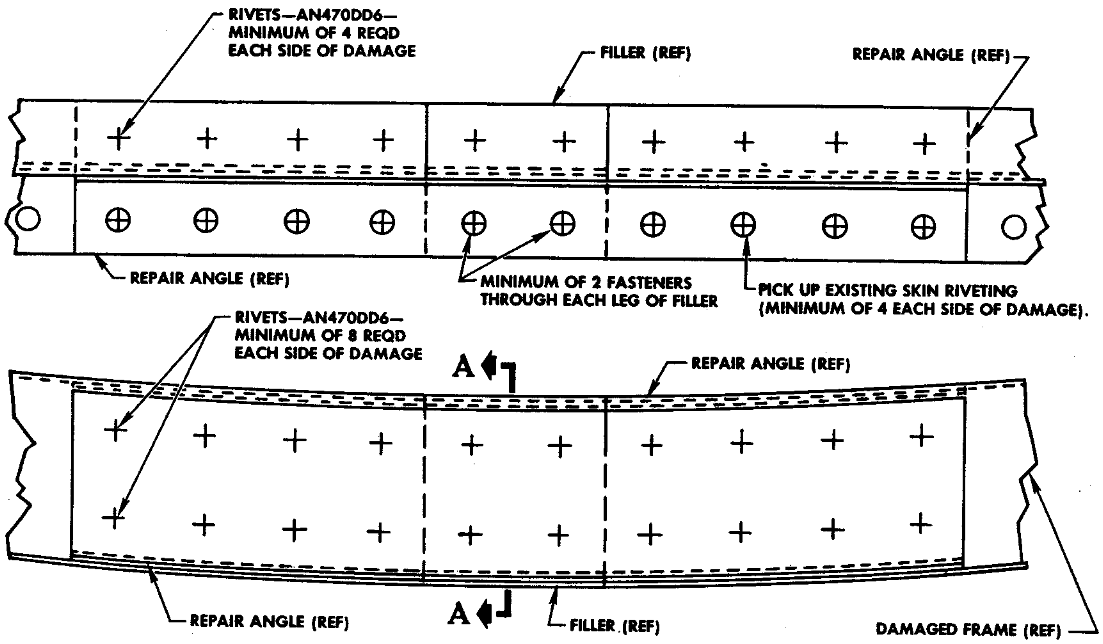
NOTE Length of repair members is about 10-1/2 inches plus the length of damage.

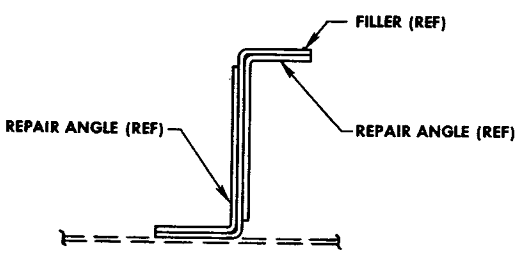
F-86K-3-31-58A

Figure 4-8. Bulkhead Outer Cap—Station 12.75

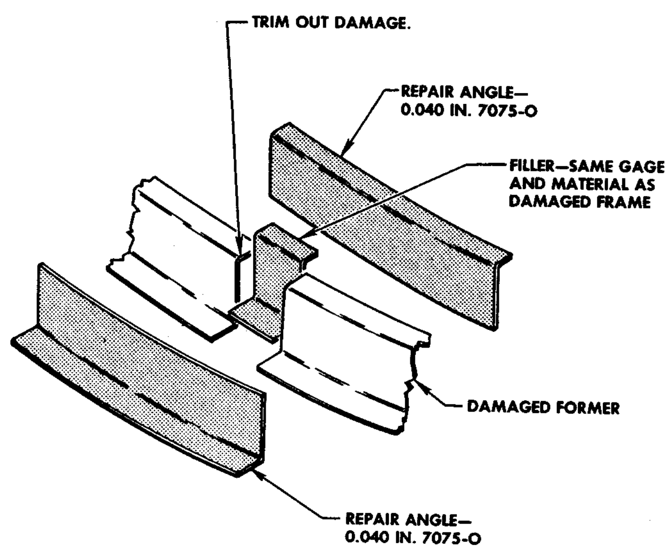
PERMANENT CATEGORY A

FUSELAGE





SECTION A-A



1. Trim out damage midway between existing fasteners.
2. Smooth all edges and corners after trimming.
3. Make fillers and repair angles. Heat-treat repair angles to T6 condition after forming.
4. Fasten all repair parts in place, using size and type fasteners and spacing called out.

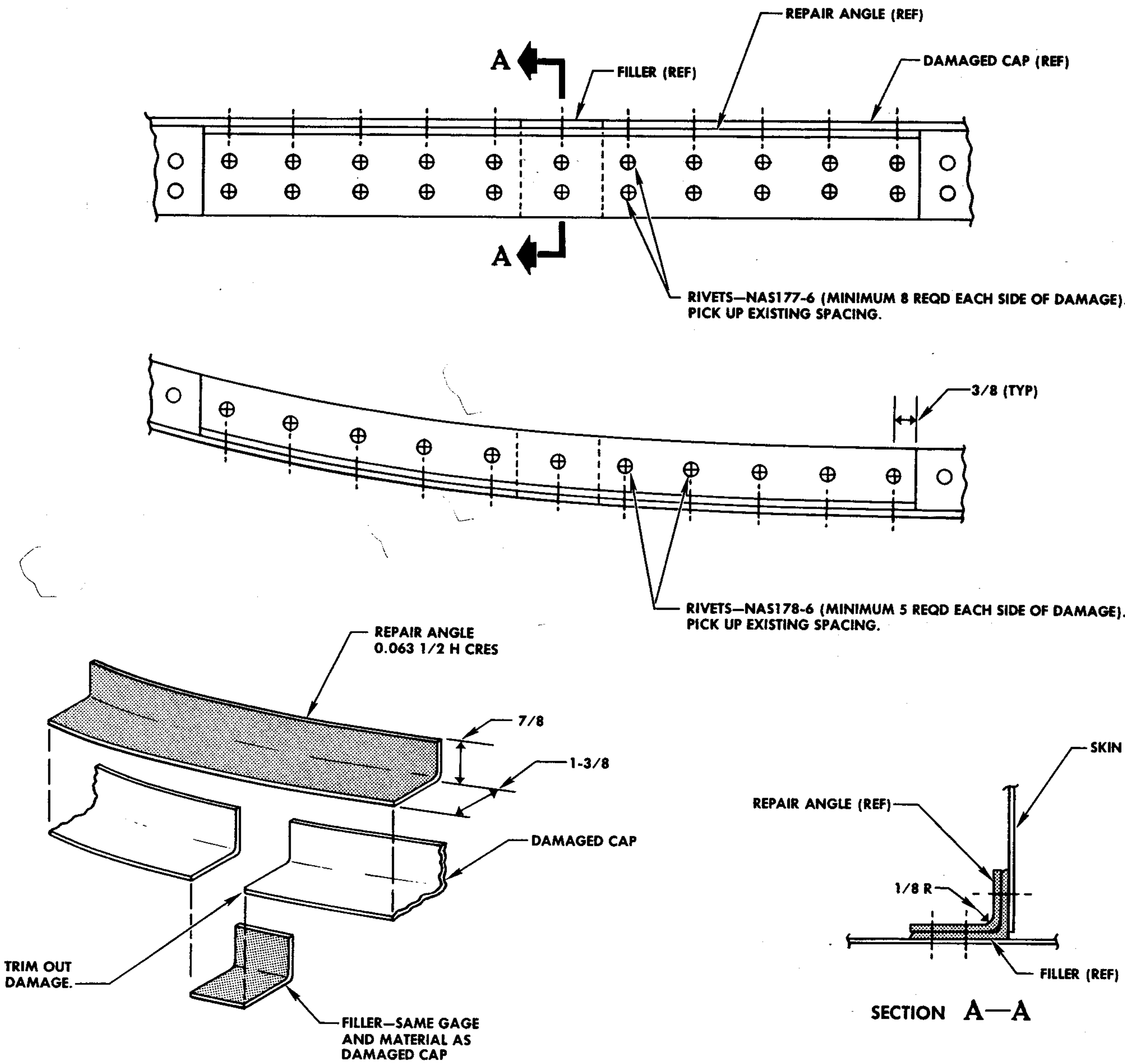
NOTE The length of the repair members is about 6 inches, plus the length of the damage.

F-86K-3-31-33A

Figure 4-9. Formers—Station 12.75 to 20.25

PERMANENT CATEGORY A

FUSELAGE



1. Trim out damage midway between existing fasteners.
2. Smooth all edges and corners after trimming.
3. Make filler and repair angle.
4. Fasten all parts in place, using size and type of fastener and spacing called out.

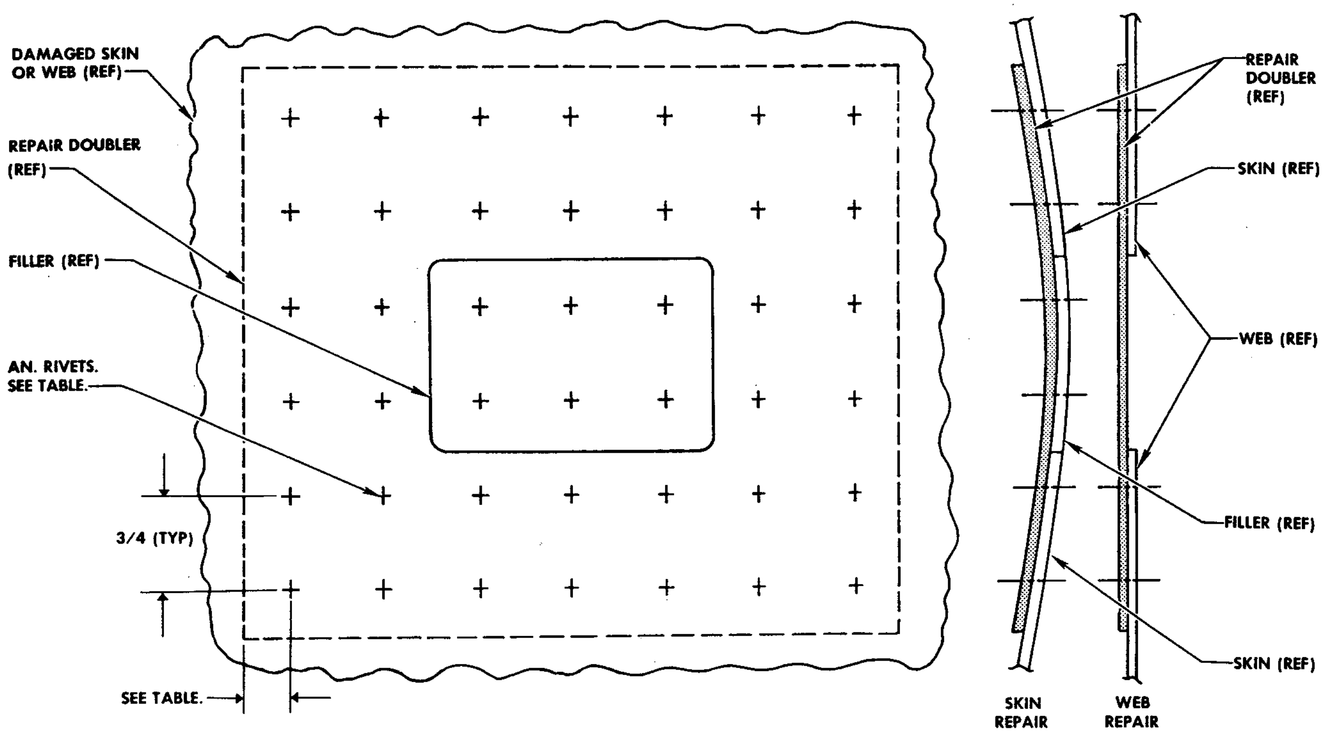
NOTE Length of repair members is about 8 plus the length of damage.

F-86K-3-31-76

Figure 4-10. Bulkhead Lower Outer Cap—Station 70.25

PERMANENT CATEGORY A

FUSELAGE



DOUBLER GAGE	RIVET SIZE	MIN EDGE DISTANCE
0.032	AN470AD5	5/16
0.040	AN470AD5	5/16
0.071	AN470DD6	3/8

1. Trim out damage midway between existing fasteners.
2. Smooth all edges and corners after trimming.
3. Make filler (if required) and repair doubler. Make repair doubler of 7075-T6 material one gage heavier than damaged skin or web. Repair doubler must pick up at least two rows of fasteners around damage.
4. Fasten all repair parts in place, using size and type of fastener and spacing called out.

NOTE AN426 rivets should be used on skin repairs where dimpling equipment is available.

- In areas where a large number of holes for wiring, heat, and vent tubes are located, this repair is not practical and the web should be replaced.

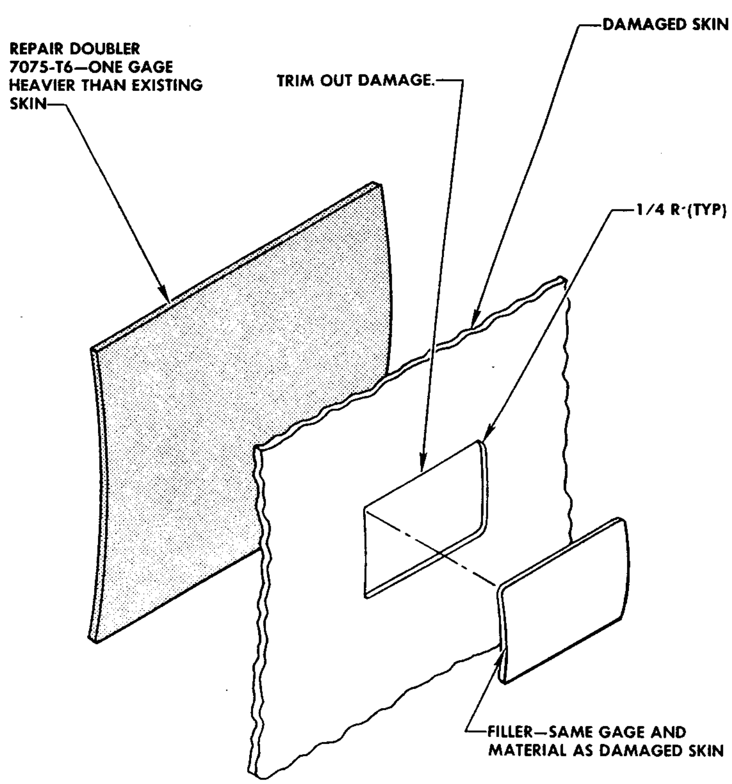
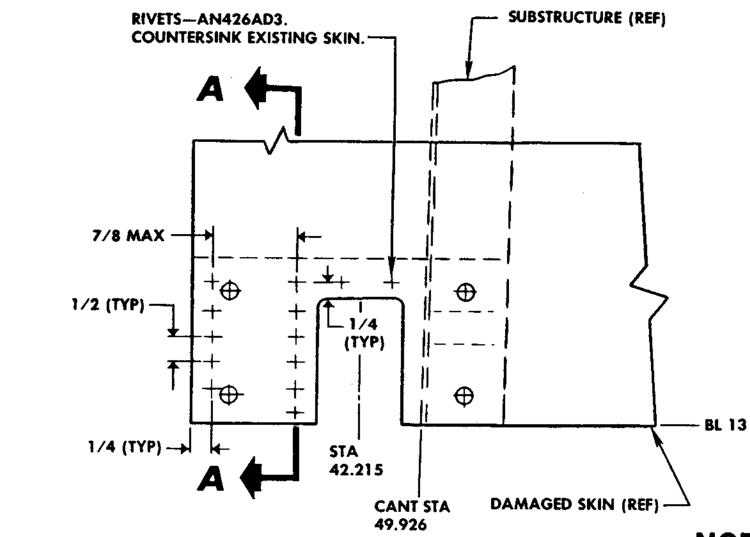


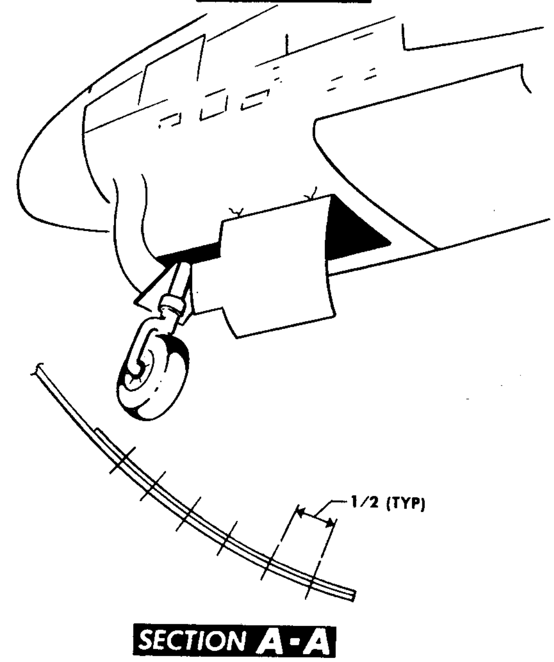
Figure 4-11. Web and Skin Repairs

PERMANENT-CATEGORY A

FUSELAGE



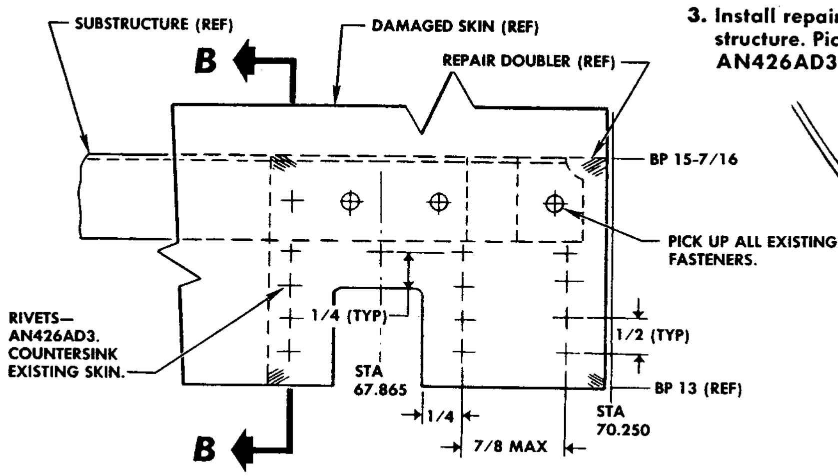
FORWARD HINGE SLOT



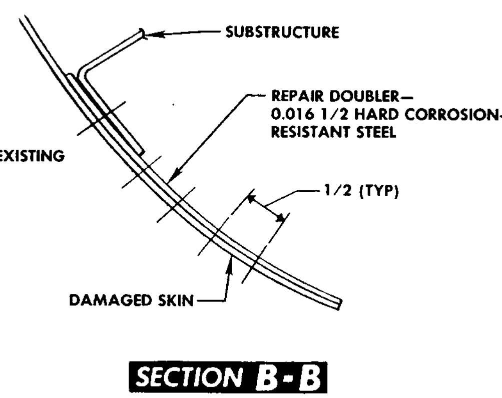
NOTE

This type of damage generally occurs when the landing gear doors are opened at high speed and the airplane is allowed to sideslip. This maneuver puts excessive air pressure on the auxiliary landing gear door and sometimes tears the door off.

1. Stop-drill all cracks, smooth all nicks and sharp edges, and file smooth all sharp corners.
2. Make repair doubler from 0.016-inch 1/2 hard corrosion-resistant steel. Form repair doublers to match original mold line.
3. Install repair doublers between damaged skin and substructure. Pick up all existing fasteners, adding sufficient AN426AD3 rivets to maintain required rivet pattern.



AFT HINGE SLOT



BP=BUTTOCK PLANE

F-86K-3-31-55A

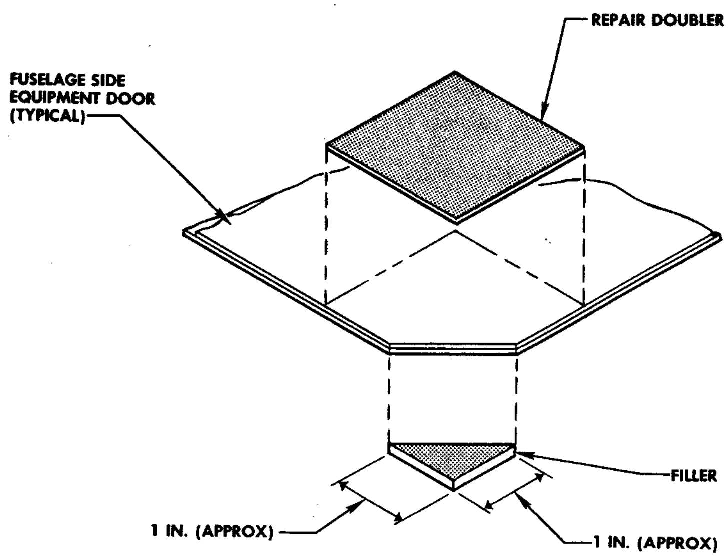
Figure 4-11A. Nose Gear Door Hinge Attach Points

PERMANENT

Category A

NOTE **This repair is typical for the left and right fuselage side equipment doors damaged on the forward and aft lower corners.**

- **Trim off damaged corner of skins as shown. Cut on 45-degree angle.**
- **Make repair filler, using 0.062-inch 2024-T4 clad material.**
- **Make repair doubler, using 0.025 corrosion-resistant steel about 1-3/4 inch square.**
- **Countersink filler on both sides. Dimple doubler to match and join, using three double-flushed AN426AD4 rivets.**
- **Attach repair doubler to equipment door, using nine double-flushed AN426AD4 rivets. Countersink inner skin about 0.015 inch. Dimple repair doubler to match. Countersink outer skin.**



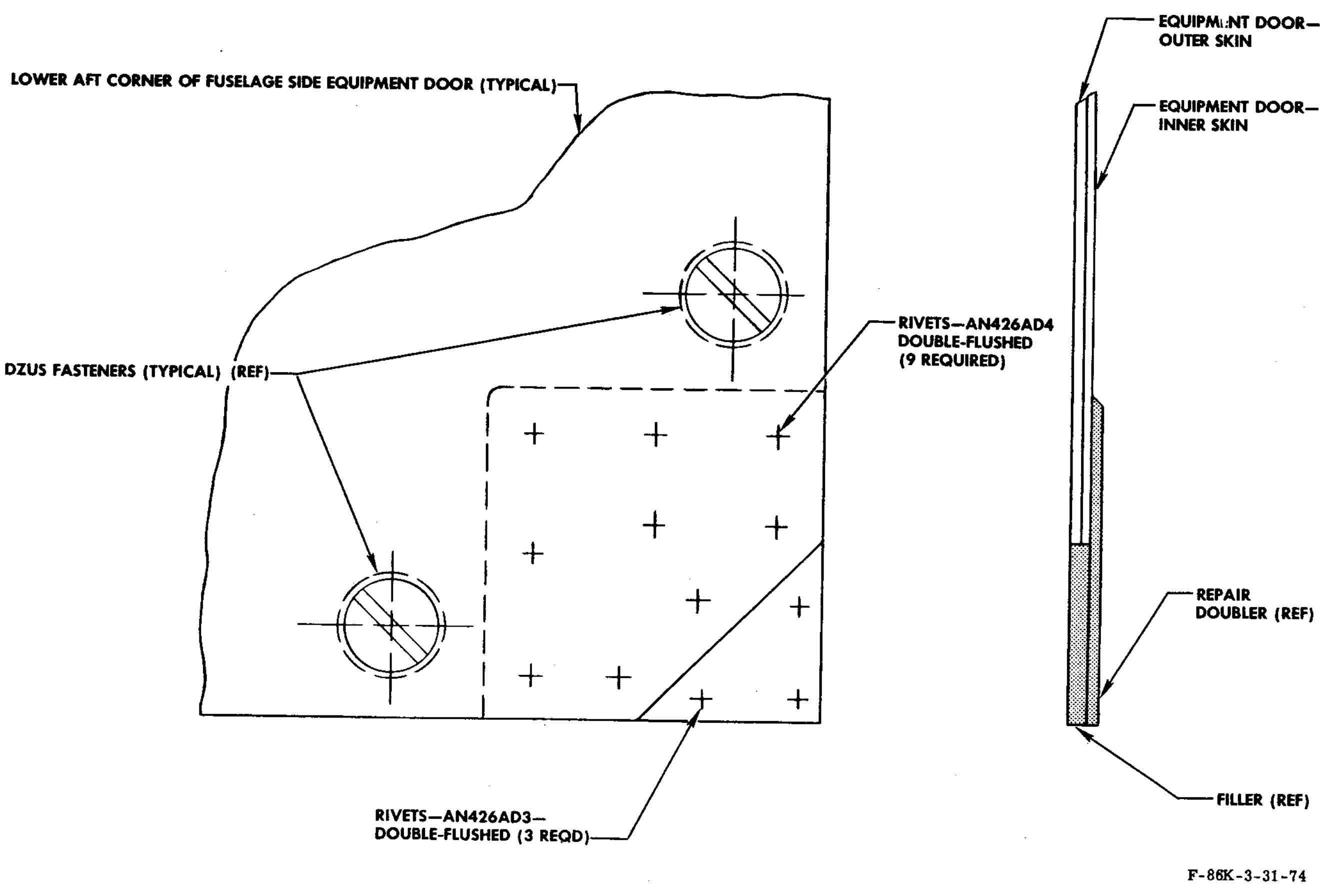
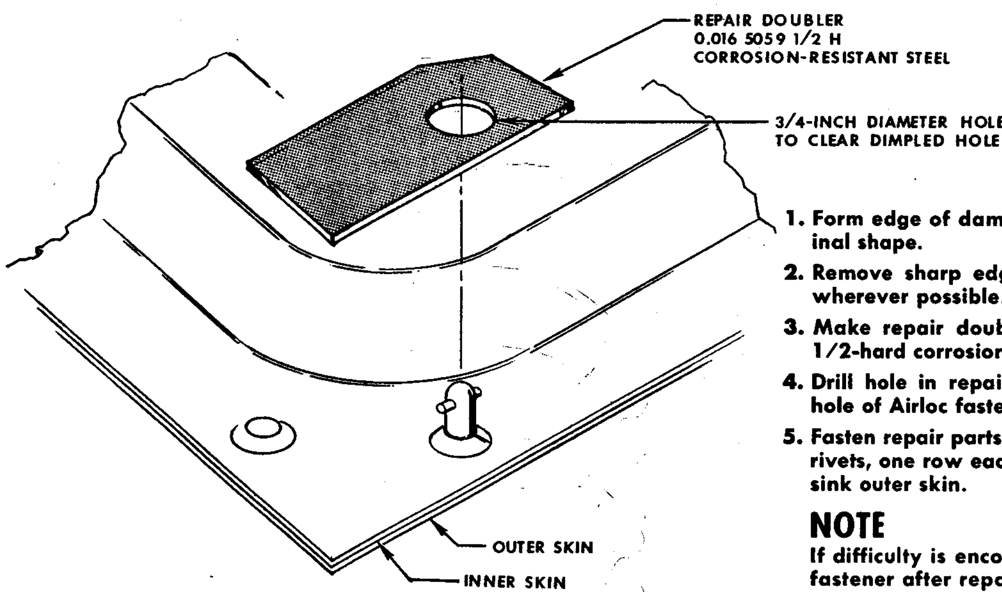


Figure 4-12. Repair of Equipment Access Doors

PERMANENT CATEGORY A

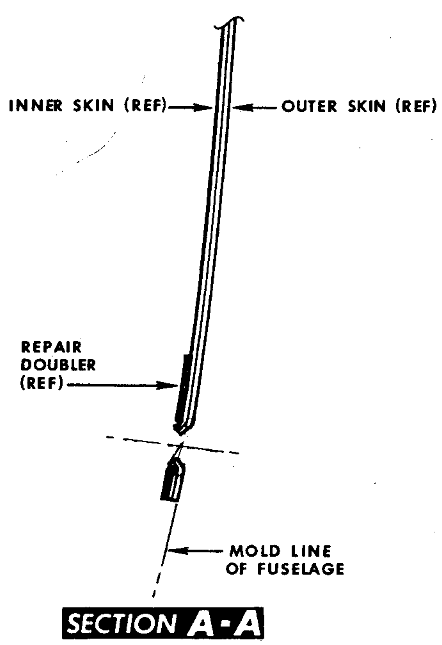
FUSELAGE



1. Form edge of damaged door back to its original shape.
2. Remove sharp edges from crack or damage wherever possible.
3. Make repair doubler from 0.016-inch 5059 1/2-hard corrosion-resistant steel.
4. Drill hole in repair doubler to clear dimpled hole of Airloc fastener.
5. Fasten repair parts in place, using AN426AD3 rivets, one row each side of damage. Countersink outer skin.

NOTE

If difficulty is encountered in engaging Airloc fastener after repair has been made, replace Airloc fastener with one the next size longer.



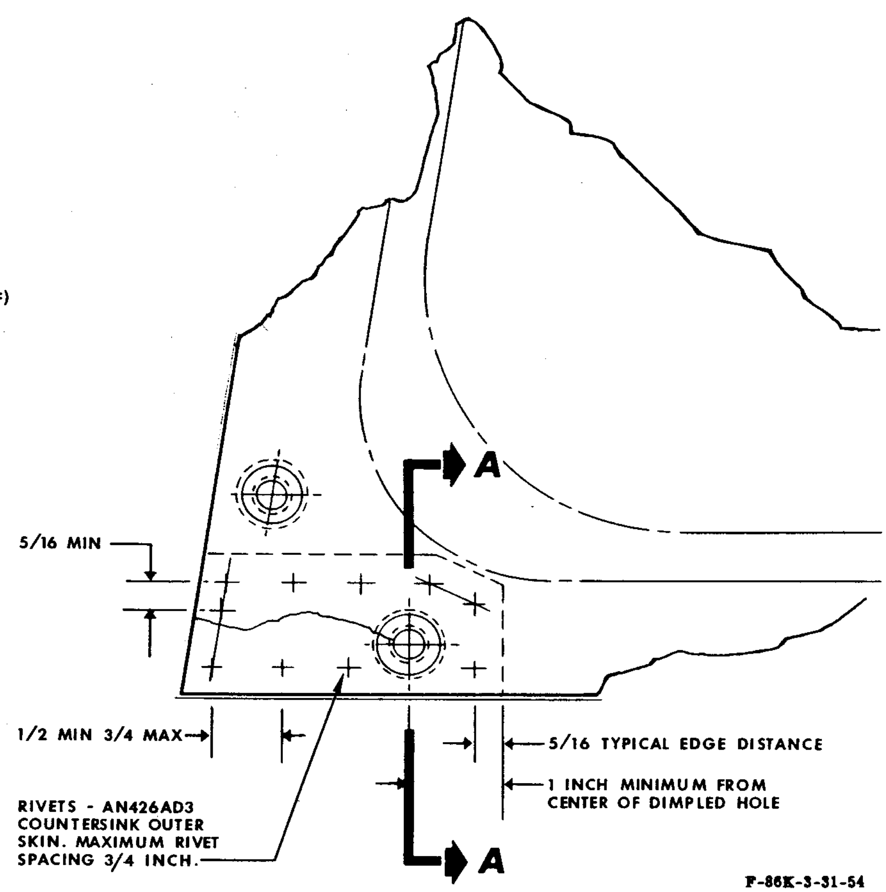
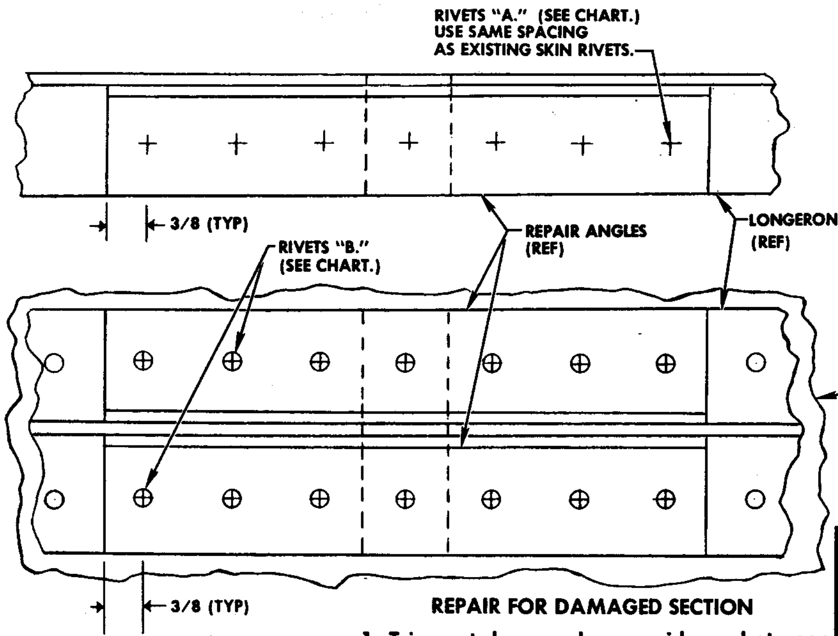


Figure 4-12A. Corner Repair—Removable Doors and Panels

PERMANENT—CATEGORY A

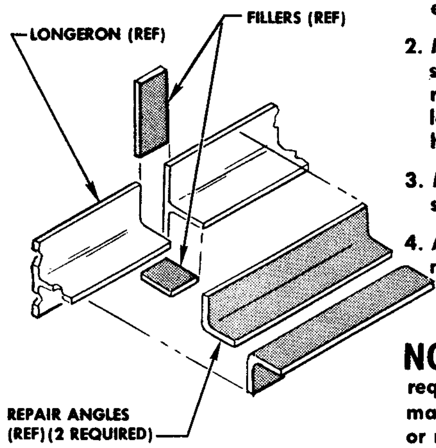
WING



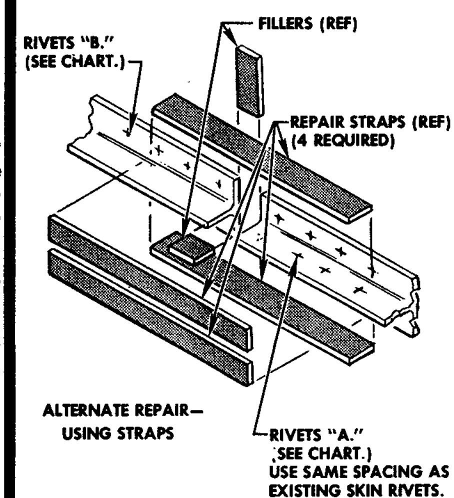
		RIVET CHART
A	AN470DD6	LOWER LONGERON—FWD OF STA 36
	NAS178-6	LOWER LONGERON—STA 36 TO 100 UPPER "T" STRINGER—STA 176 TO 279
B	AN426AD5	LOWER LONGERON—FWD OF STA 36
	NAS177-6	LOWER LONGERON—STA 36 TO 100 UPPER "T" STRINGER—STA 176 TO 279

REPAIR FOR DAMAGED SECTION

1. Trim out damaged area midway between existing rivets.
2. Make repair angles (as shown) or repair straps, using same material as longeron. The repair angles must be the same gage as the longeron; the repair straps must be one gage heavier than the longeron.
3. Make fillers using 7075-T6 clad material—same gage as damaged longeron section.
4. Assemble repair using rivet as shown (minimum of four required each side of damage).

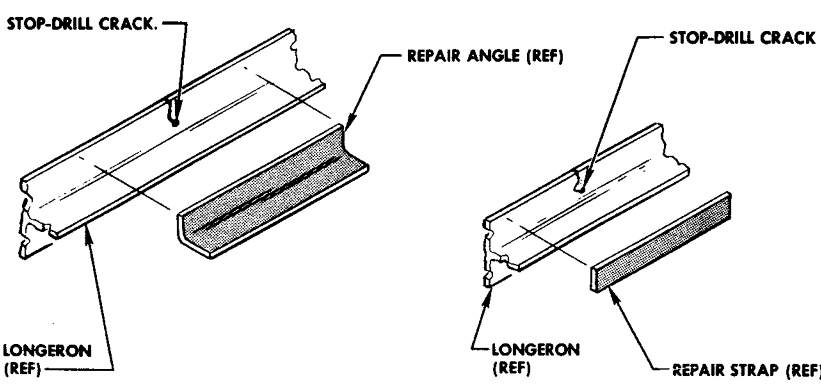


NOTE The repair for the damaged section requires fillers as shown. The repair may be made using repair angles (preferred method) or repair straps (alternate method).



REPAIR FOR CRACK (ONE SECTION OF LONGERON)

1. Stop-drill crack.
2. Make repair angle (preferred method) or repair strap, using same material as longeron section—one gage thicker.
3. Assemble, using AN426AD5 rivets through skin, longeron, and strap (four required each side of crack). When repair angle is used, install rivets on both legs of repair angle, using same pattern as is used on strap.
4. Install AN426DD6 rivets—one on each side of crack between existing rivet pattern.



F-86K-3-31-79

Figure 4-13. Longeron "T" Section

INTERMEDIATE INDEX

FUSELAGE

00 INDEX ARROWS REFER TO ITEM NUMBERS IN KEY.

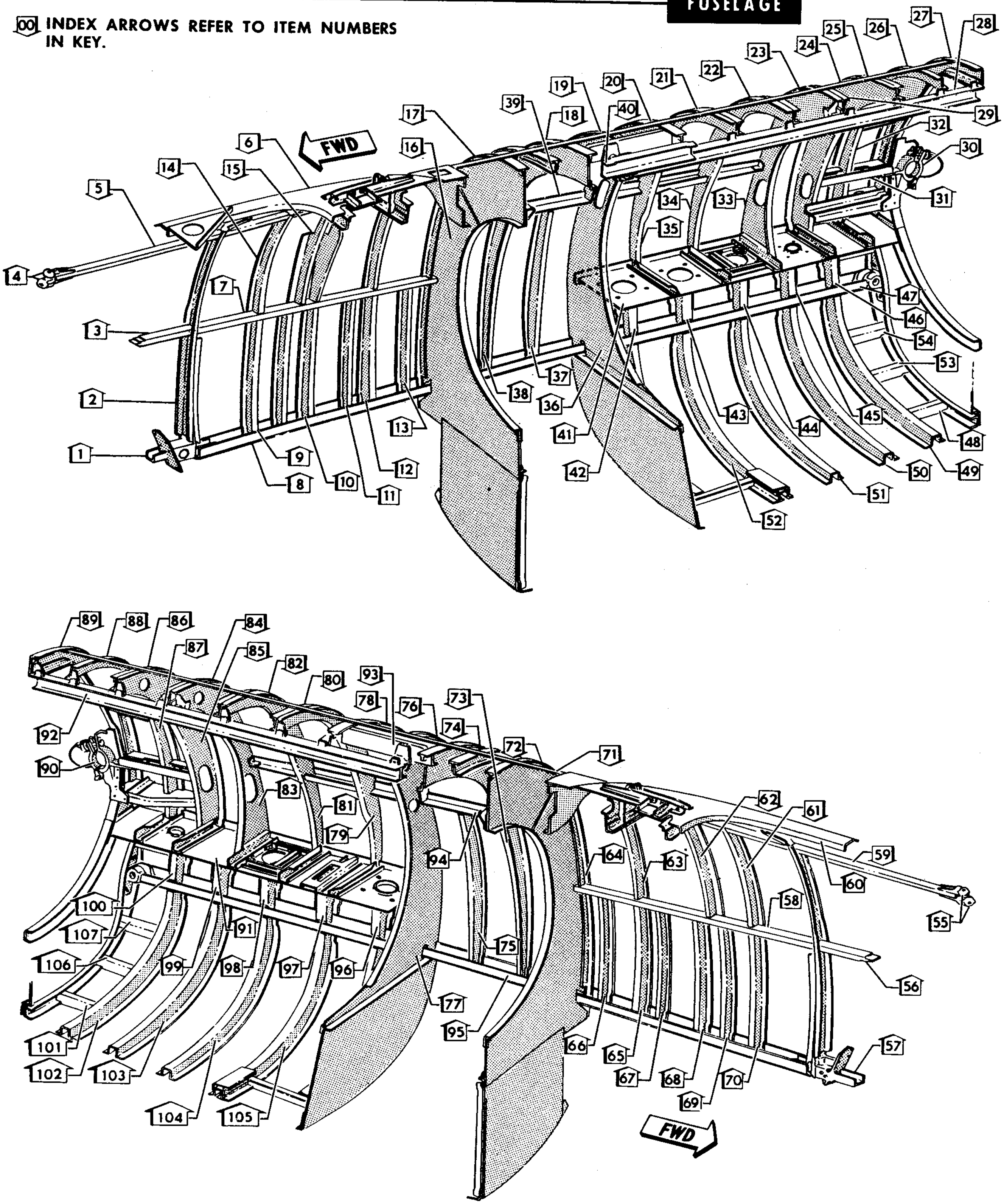


Figure 4-14. Intermediate Section Index

ITEM NO.	DRAWING NO.*	DESCRIPTION	GAGE	MATERIAL	REPAIR FIGURE NO.†
1	165-31465	Fitting		AST6 Forging	
2	165-31416	Frame	0.081	7075-T6 Clad	
3	165-31495-2	Longeron	0.081	7075-T6 Clad	4-16
4	165-31201	Fitting		14-ST6 Forging	
5	165-31409	Longeron		7075-T6 Extr	4-15
6	165-31414	Longeron	0.064	7075-T6 Clad	4-18
7	165-31411	Longeron	0.081	7075-T6 Clad	4-16
8	165-31413	Longeron		7075-T6 Extr	4-17
9	165-31420-3	Frame	0.064	7075-T6 Clad	
10	165-31407	Frame	0.072	7075-T6 Clad	
11	165-314146	Frame	0.081	7075-T6 Clad	
12	165-31425	Frame	0.064	7075-T6 Clad	
13	165-314147	Frame	0.081	7075-T6 Clad	
14	165-31417	Frame	0.064	7075-T6 Clad	
15	165-314101	Frame	0.064	7075-T6 Clad	
16	165-31429	Frame	0.125	7075-T6 Clad	4-19
17	165-31427	Frame	0.081	7075-T6 Clad	
18	165-31431	Frame	0.040	7075-T6 Clad	
19	165-31433	Frame	0.064	7075-T6 Clad	
20	165-31435	Frame	0.064	7075-T6 Clad	
21	165-31438	Frame	0.051	7075-T6 Clad	4-22
22	165-31442	Frame	0.051	7075-T6 Clad	4-23
23	165-31446	Frame	0.040	CRES	4-25
24	165-31475	"T"		7075-T6 Extr	
25	165-31450	Frame	0.064	7075-T6 Clad	4-23
26	165-31454	Frame	0.064	7075-T6 Clad	4-23
27	165-31458	Frame	0.080	CRES	4-26
28	165-31502	Rail		7075-T6 Extr	
29	165-31579	Frame	0.051	7075-T6 Clad	
30	165-31920	Fitting		14S-T6 Forging	
31	165-31588	Intercostal	0.064	2024-T4 Clad	
32	165-31577	Frame	0.064	7075-T6 Clad	
33	165-314111	Frame	0.040	CRES	
34	165-314110	Frame	0.064	7075-T6 Clad	
35	165-31576	Frame	0.064	7075-T6 Clad	
36	165-31501	Frame	0.016	CRES	4-19
37	165-31434	Frame	0.064	7075-T6 Clad	
38	165-31432	Frame	0.040	7075-T6 Clad	
39	165-31412	Longeron		7075-T6 Extr	4-21
40	165-31506	Support	0.125	7075-T6 Clad	
41	165-31474	Web	0.016	CRES	
42	165-31440	Frame	0.051	7075-T6 Clad	
43	165-31444	Frame	0.051	7075-T6 Clad	
44	165-31448	Frame	0.051	7075-T6 Clad	
45	165-31452	Frame	0.051	7075-T6 Clad	
46	165-31456	Frame	0.051	7075-T6 Clad	
47	165-31413	Longeron		7075-T6 Extr	4-17
48	165-31552	Intercostal	0.040	7075-T6 Clad	
49	165-31457	Frame	0.072	7075-T6 Clad	
50	165-31453	Frame	0.072	7075-T6 Clad	
51	165-31449	Frame	0.072	7075-T6 Clad	
52	165-31445	Frame	0.072	7075-T6 Clad	
53	165-31586	Intercostal	0.040	7075-T6 Clad	
54	165-31585	Intercostal	0.040	7075-T6 Clad	
55	165-31201	Fitting		14S-T6 Forging	
56	165-31495	Longeron	0.081	7075-T6 Clad	4-16
57	165-31465	Fitting		14S-T6 Forging	
58	165-31411	Longeron	0.081	7075-T6 Clad	4-16

***Drawing numbers are for reference only.**

†For additional repairs, refer to Section X.

Key to Figure 4-14

ITEM NO.	DRAWING NO.*	DESCRIPTION	GAGE	MATERIAL	REPAIR FIGURE NO.†
59	165-31409	Longeron		7075-T6 Extr	4-15
60	165-31414	Longeron	0.064	7075-T6 Clad	4-18
61	165-31419	Frame	0.064	7075-T6 Clad	
62	165-31422	Frame	0.064	7075-T6 Clad	
63	165-31425	Frame	0.064	7075-T6 Clad	
64	165-31428	Frame	0.016	CRES	4-19
65	165-31426	Frame	0.064	7075-T6 Clad	
66	165-314147	Frame	0.081	7075-T6 Clad	
67	165-314146	Frame	0.081	7075-T6 Clad	
68	165-31423	Frame	0.064	7075-T6 Clad	
69	165-314145	Frame	0.081	7075-T6 Clad	
70	165-31420	Frame	0.064	7075-T6 Clad	
71	165-31475	"T"		7075-T6 Extr	
72	165-31427	Frame	0.081	7075-T6 Clad	
73	165-31432	Frame	0.040	7075-T6 Clad	
74	165-31431	Frame	0.040	7075-T6 Clad	
75	165-31434	Frame	0.064	7075-T6 Clad	
76	165-31433	Frame	0.064	7075-T6 Clad	
77	165-31436	Frame	0.040	7075-T6 Clad	4-19
78	165-31435	Frame	0.064	7075-T6 Clad	
79	165-31439	Frame	0.064	7075-T6 Clad	
80	165-31438	Frame	0.051	7075-T6 Clad	4-22
81	165-314110	Frame	0.064	7075-T6 Clad	
82	165-31442	Frame	0.051	7075-T6 Clad	4-23
83	165-314111	Frame	0.040	CRES	
84	165-31446	Frame	0.040	CRES	4-25
85	165-31451	Frame	0.064	7075-T6 Clad	
86	165-31450	Frame	0.064	7075-T6 Clad	4-23
87	165-31455	Frme	0.064	7075-T6 Clad	
88	165-31454	Frame	0.064	7075-T6 Clad	4-23
89	165-31458	Frame	0.080	CRES	4-26
90	165-31920	Fitting		14S-T6 Forging	
91	165-31474	Web	0.015	CRES	
92	165-31502	Rail		7075-T6 Extr	
93	165-31506	Support	0.125	7075-T6 Clad	
94	165-31412	Longeron		7075-T6 Extr	4-21
95	165-31413	Longeron		7075-T6 Extr	4-17
96	165-31440	Frame	0.051	7075-T6 Clad	
97	165-31444	Frame	0.051	7075-T6 Clad	
98	165-31448	Frame	0.051	7075-T6 Clad	
99	165-21452	Frame	0.051	7075-T6 Clad	
100	165-31456	Frame	0.051	7075-T6 Clad	
101	165-31552	Intercostal	0.040	7075-T6 Clad	
102	165-31457	Frame	0.072	7075-T6 Clad	
103	165-31453	Frame	0.072	7075-T6 Clad	
104	165-31449	Frame	0.072	7075-T6 Clad	
105	165-31445	Frame	0.072	7075-T6 Clad	
106	165-31586	Intercostal	0.040	7075-T6 Clad	
107	165-31585	Intercostal	0.040	7075-T6 Clad	

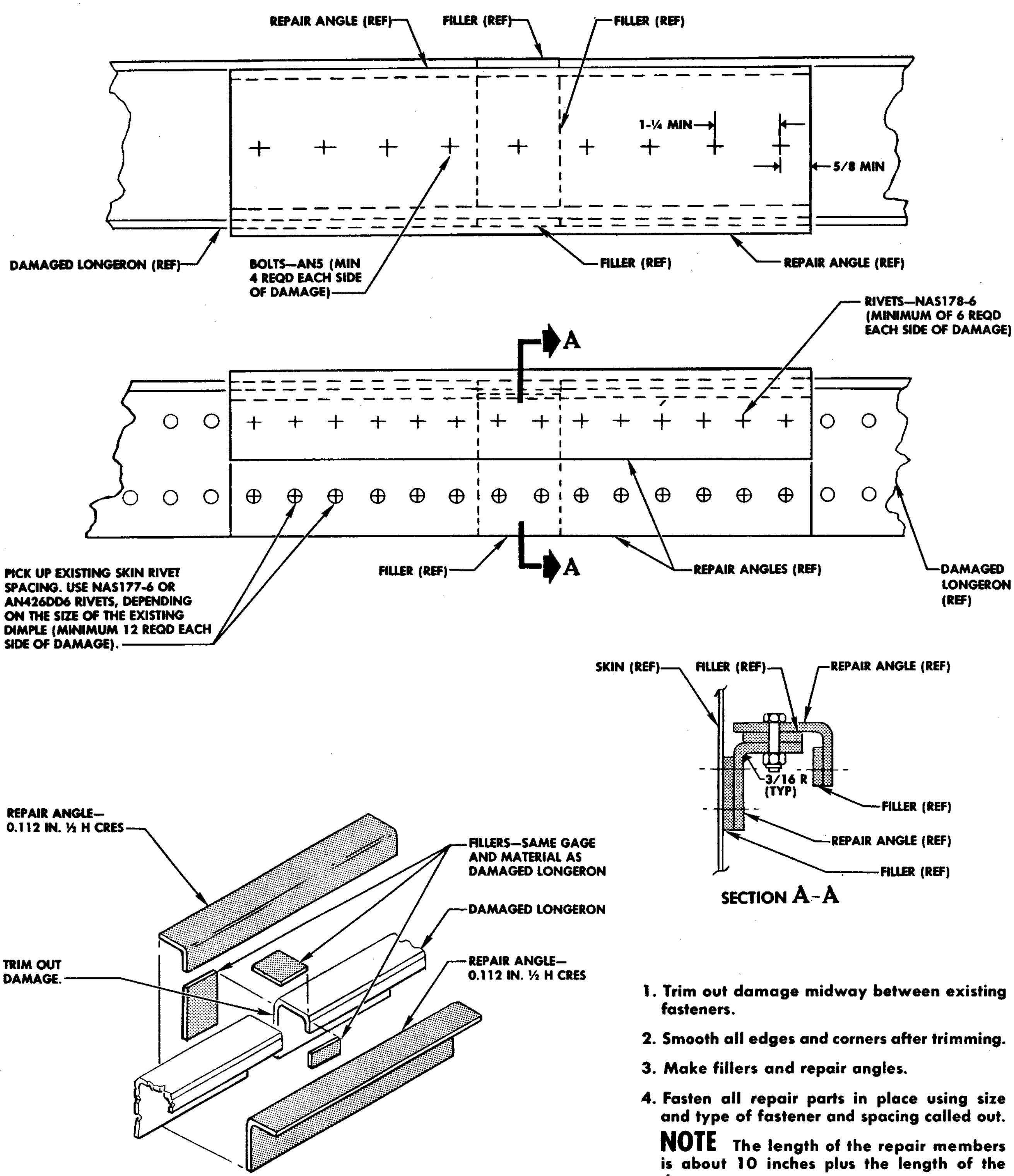
*Drawing numbers are for reference only.

†For additional repairs, refer to Section X.

Key to Figure 4-14 (Continued)

PERMANENT CATEGORY A

FUSELAGE



1. Trim out damage midway between existing fasteners.
2. Smooth all edges and corners after trimming.
3. Make fillers and repair angles.
4. Fasten all repair parts in place using size and type of fastener and spacing called out.

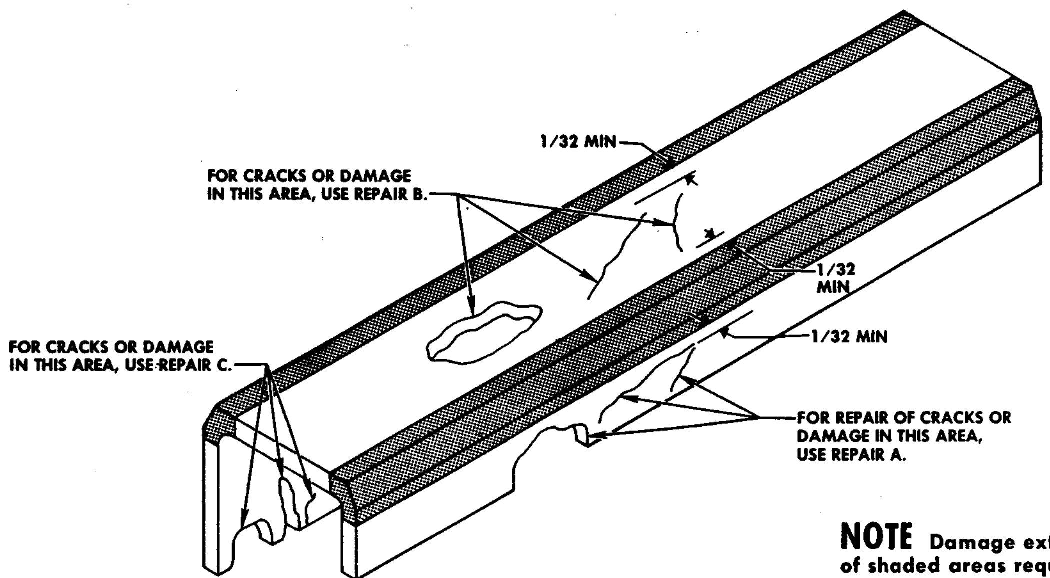
NOTE The length of the repair members is about 10 inches plus the length of the damage.

F-86K-3-31-46A

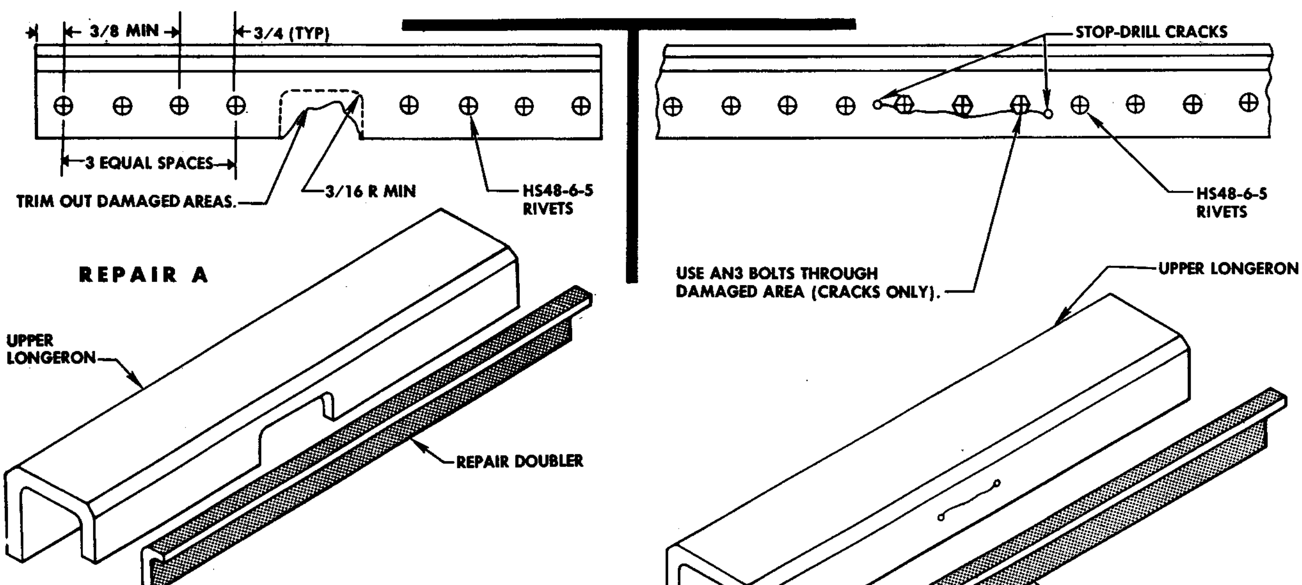
Figure 4-15. Upper Longeron—Station 126 to 245

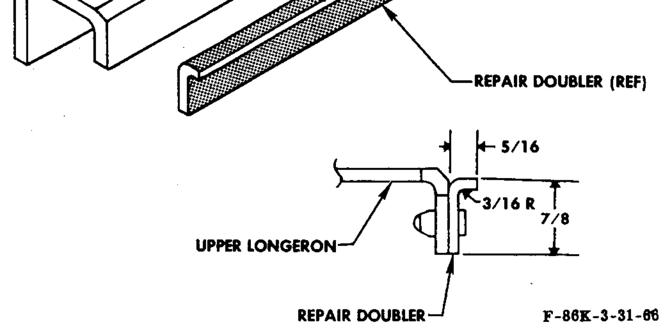
PERMANENT CATEGORY A

FUSELAGE



NOTE Damage extending within 1/32 inch of shaded areas requires repairs on adjacent surfaces.





1. Trim out damaged area or stop-drill crack.
2. Make repair doubler, using 0.091-inch, 1/2-hard corrosion-resistant steel (Specification MIL-S-5059).
3. Assemble, using HS48-6-5 Hi-Shear rivets (four required each side of damage).
4. On crack repairs, install AN3 bolts through damaged areas as shown (number determined by length of damage).

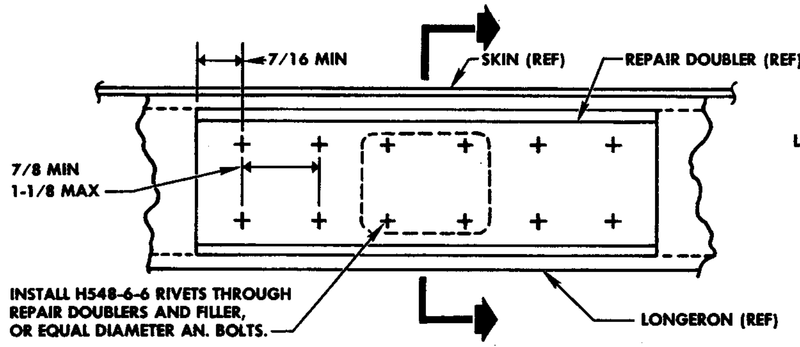
NOTE Filler is not required.

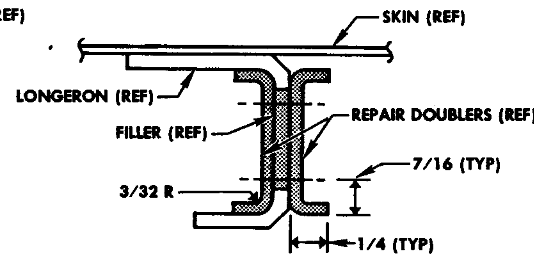
F-86K-3-31-66

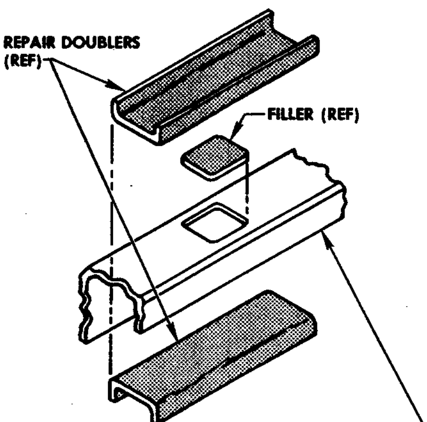
Figure 4-16. Upper Longeron—Station 134 to 245 (Sheet 1 of 2)

PERMANENT—CATEGORY A

FUSELAGE





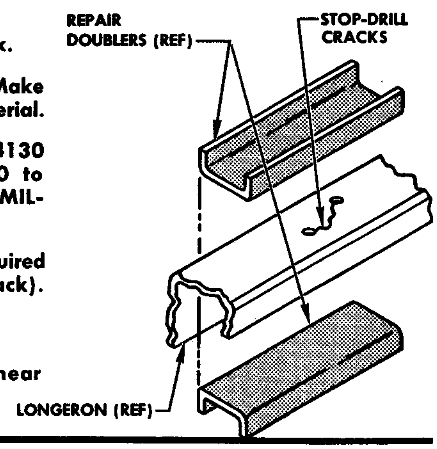


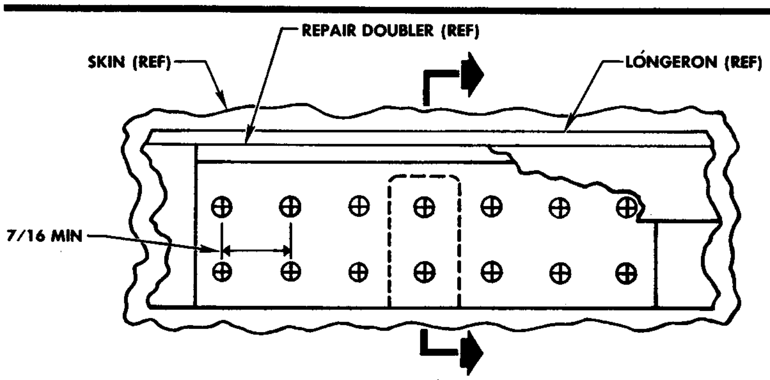
REPAIR B

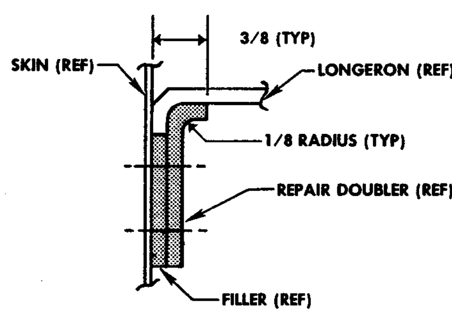
1. Trim out damage area, or stop-drill crack.
2. A filler is required for damaged areas. Make filler using 0.156-inch 7075-T6 clad material.
3. Make repair doubler using 0.091-inch 4130 steel, Cond A. (Normalize to 90,000 to 125,000 psi according to Specification MIL-H-6875.)
4. Assemble, using H548-6-6 rivets (four required each side of damage or stop-drilled crack).

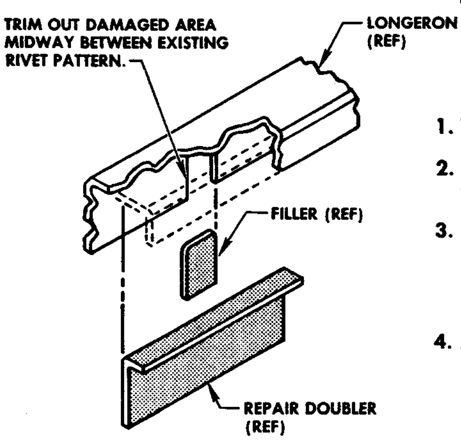
NOTE

AN bolts may be substituted for Hi-Shear rivets of equal diameter.



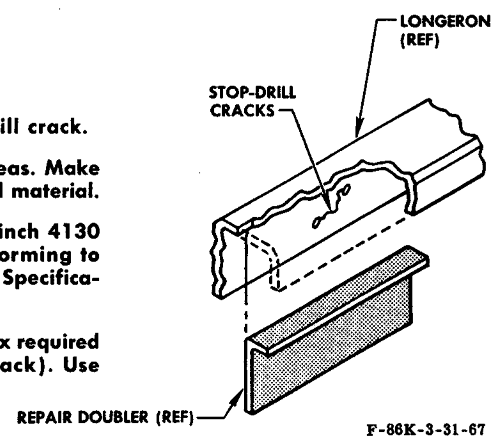






REPAIR C

1. Trim out damage area, or stop-drill crack.
2. A filler is required for damaged areas. Make filler using 0.156-inch 7075-T6 clad material.
3. Make repair doubler using 0.091-inch 4130 steel, Cond A. (Heat-treat after forming to 140,000-160,000 psi according to Specification MIL-H-6875.)
4. Assemble, using H548-6-7 rivets (six required each side of damaged area or crack). Use existing rivet pattern.



F-86K-3-31-67

Figure 4-16. Upper Longeron—Station 134 to 245 (Sheet 2 of 2)

PERMANENT REPAIR—LOWER LONGERON

Category B

NOTE Repairs shown are a combination of cracks in both legs. When crack is in one leg only, use one strap as applicable.

Ream-fit salvage screws and Hi-shear rivets.

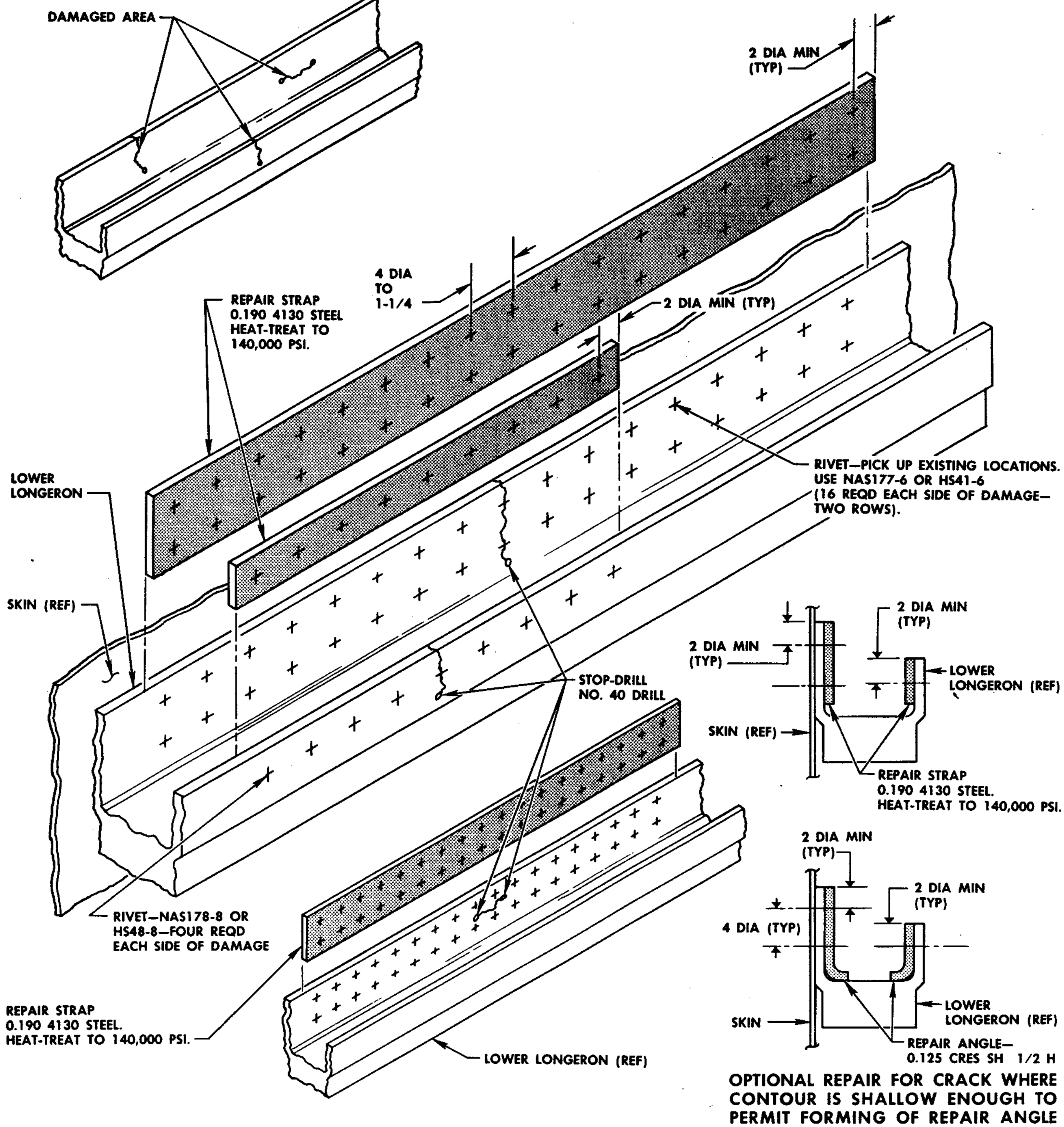


Figure 4-17. Lower Longeron—Station 135 to 157 and 208 to 279 (Sheet 1 of 2)

TEMPORARY Category B

NOTE

Length of repair members is approximately 12 inches plus damage.

Ream-fit bolts and Hi-shear rivets.

When the damage exceeds one rivet space, or when the existing structure interferes with the repair, a section of the extrusion may be removed and replaced with a new extrusion, using the rivet spacing called out in the repair for one rivet space damage as shown.

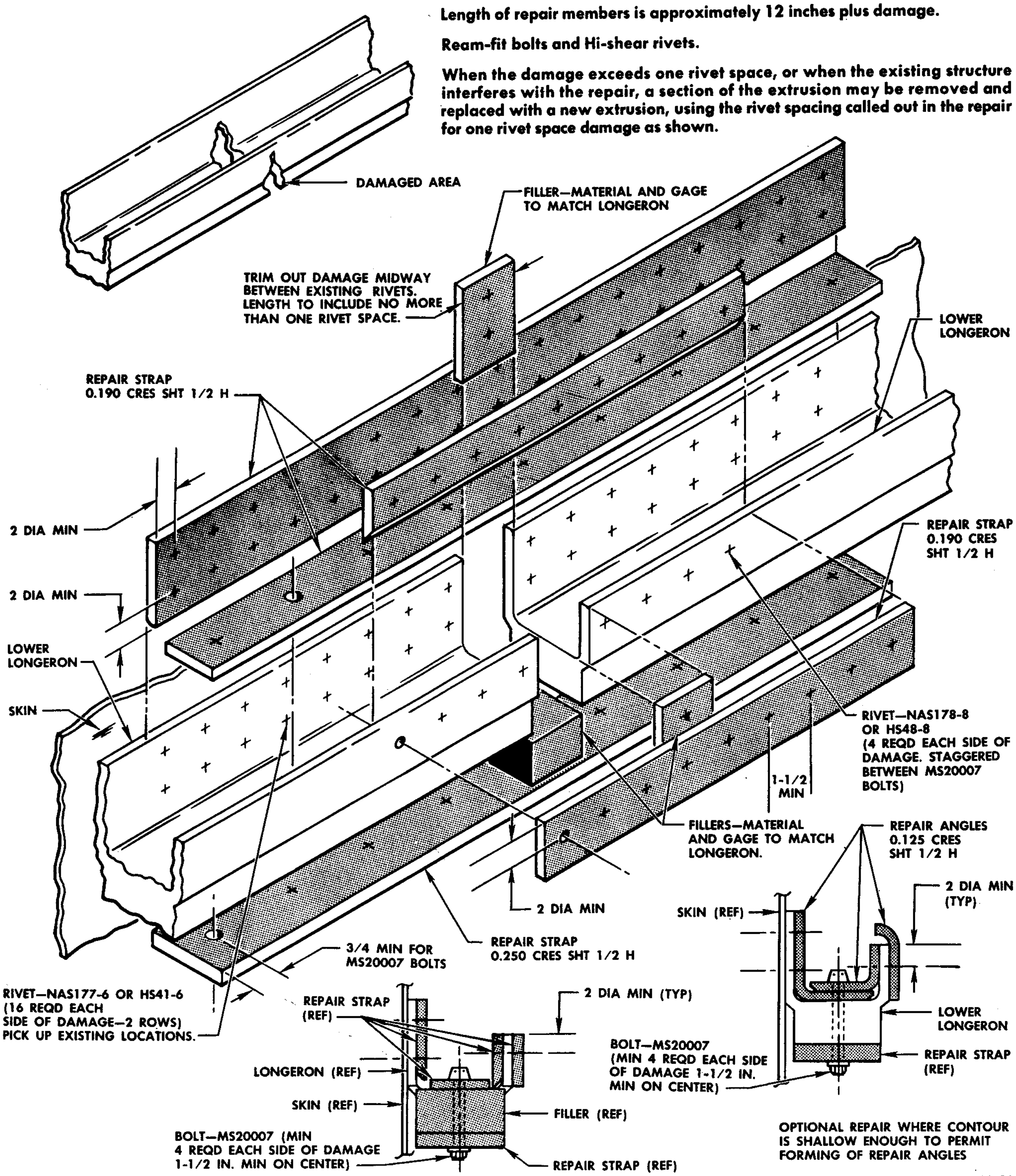
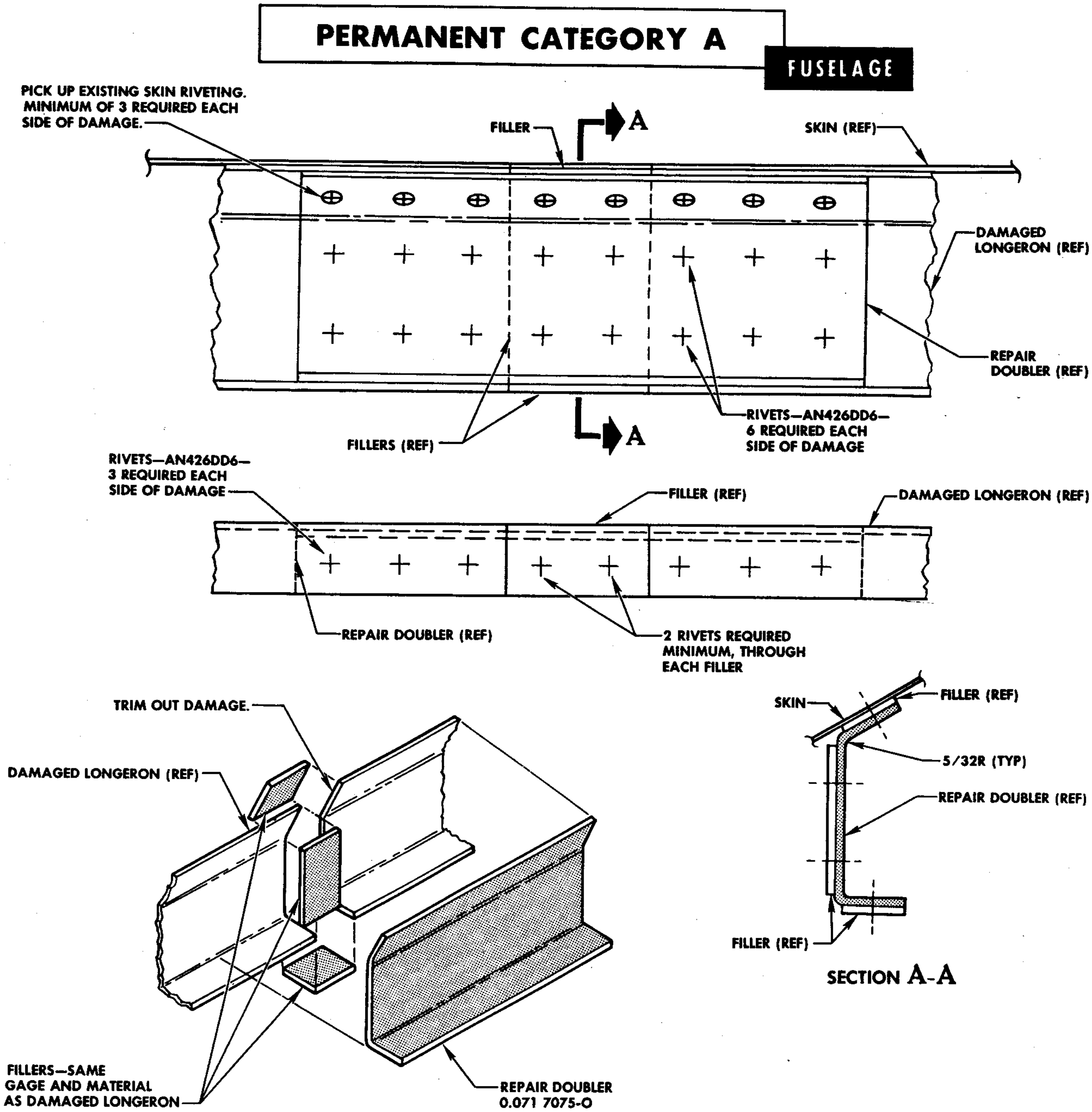


Figure 4-17. Lower Longeron—Station 135 to 157 and 208 to 279 (Sheet 2 of 2)



NOTE Length of repair members is about 6 inches plus the length of damage.

1. Trim out damage midway between existing fasteners.
2. Smooth all edges and corners after trimming.
3. Make fillers and repair doubler. Heat-treat repair doubler to T6.
4. Fasten all repair parts in place, using size and type of fasteners called out.

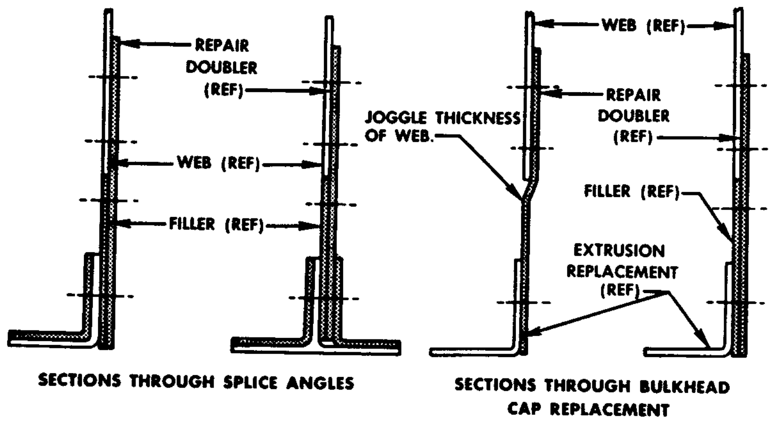
F-86K-3-31-45A

Figure 4-18. Deck Longeron—Station 126 to 140

PERMANENT

Category A

NOTE In case of lightening holes or holes for wiring, etc, make the doubler larger to pick up required number of rivets. (Refer to index.) Refer to "Typical Repair Application," for alternate methods of repairing formed and extruded shapes.



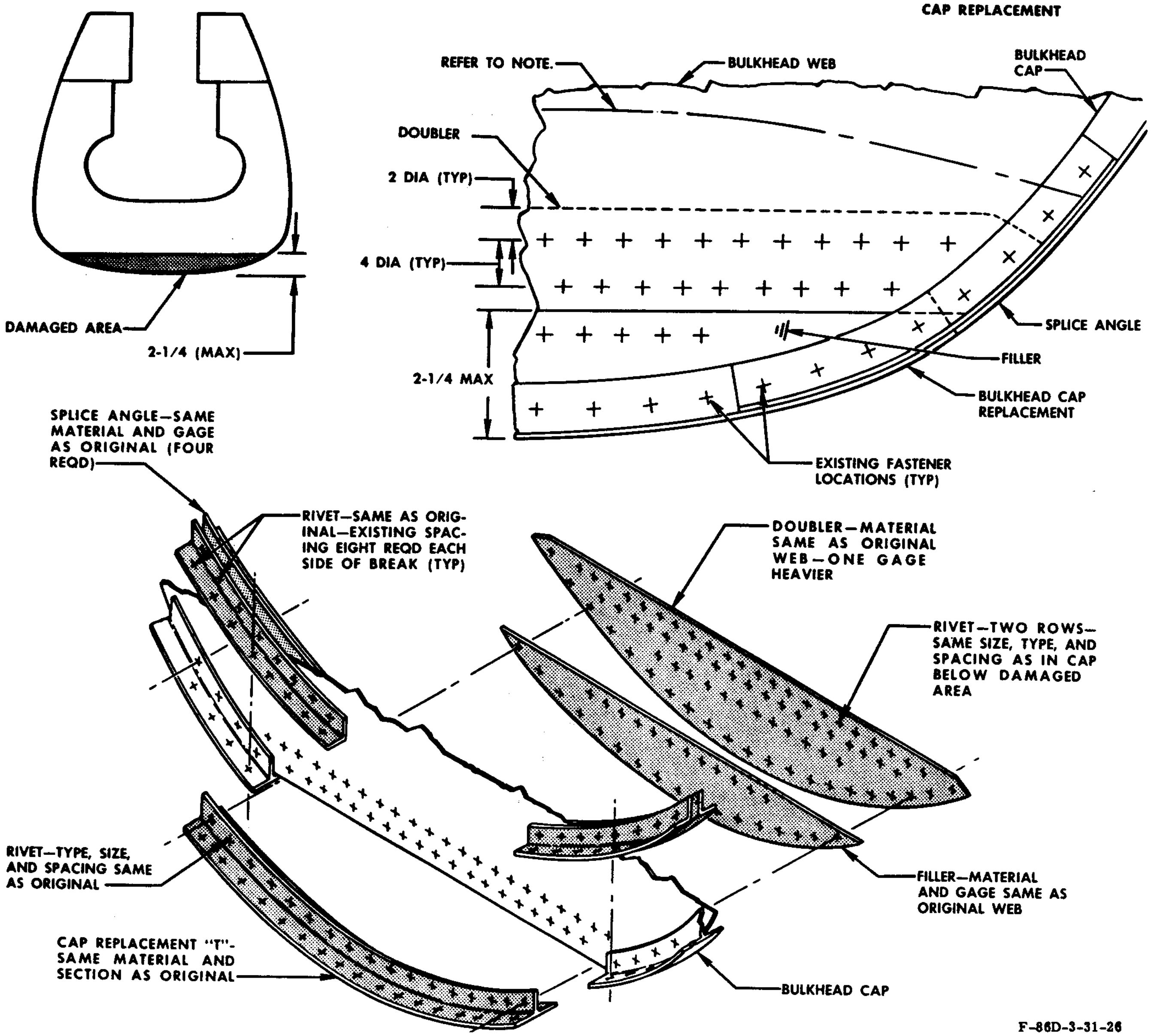


Figure 4-19. Bulkhead—Lower Fuselage

TEMPORARY Category A

NOTE Flush rivets should be used in temporary repairs when possible to do so.

*ALTERNATE RIVETS:

CR-562 MONEL CHERRY RIVETS OF SAME DIAMETER AS EXISTING RIVETS. CR-563 MONEL CHERRY RIVETS MAY BE USED IF THE FLUSH RIVET IS NOT AVAILABLE.

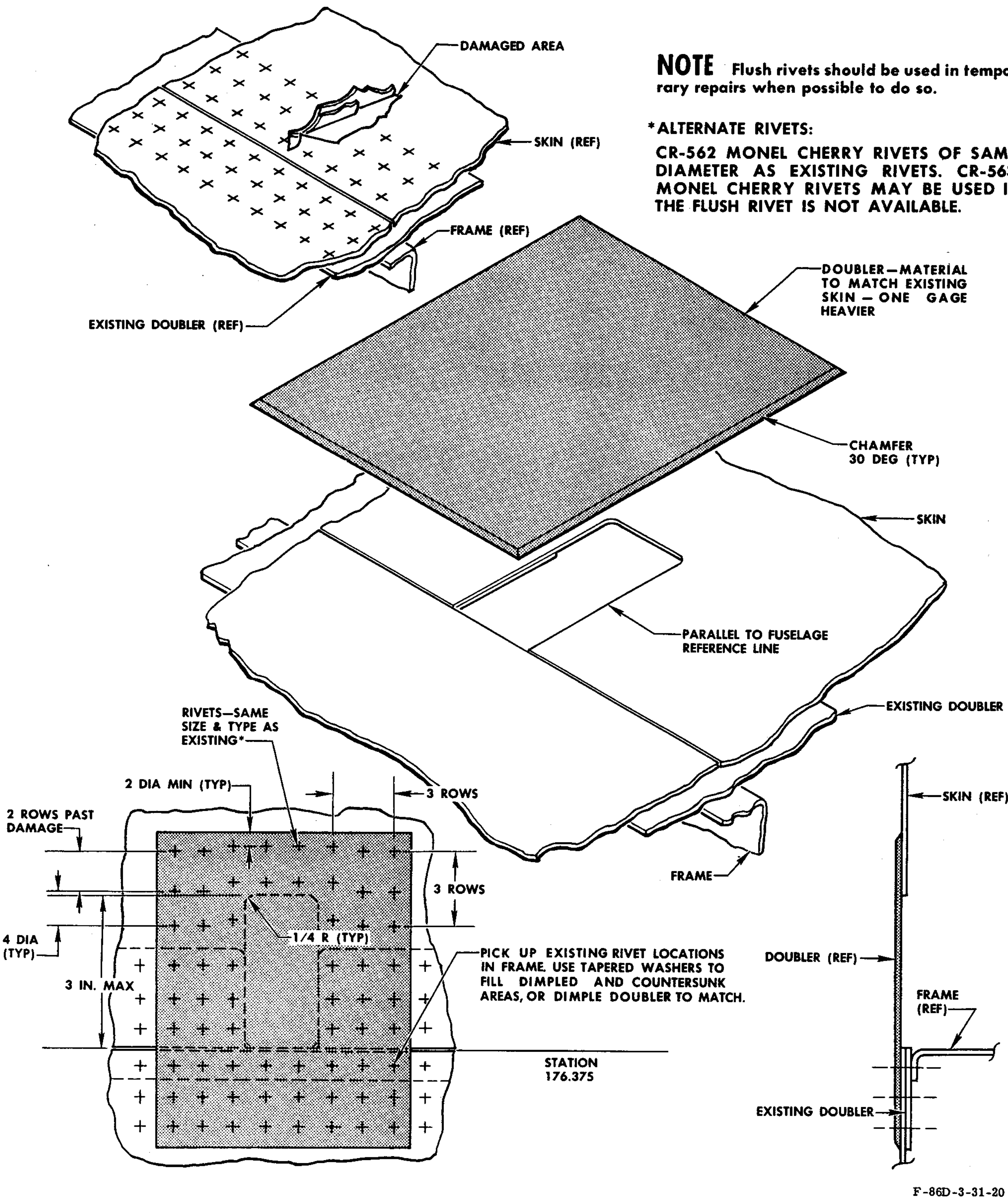


Figure 4-20. Tension Skin Repair (Sheet 1 of 2)

PERMANENT Category A

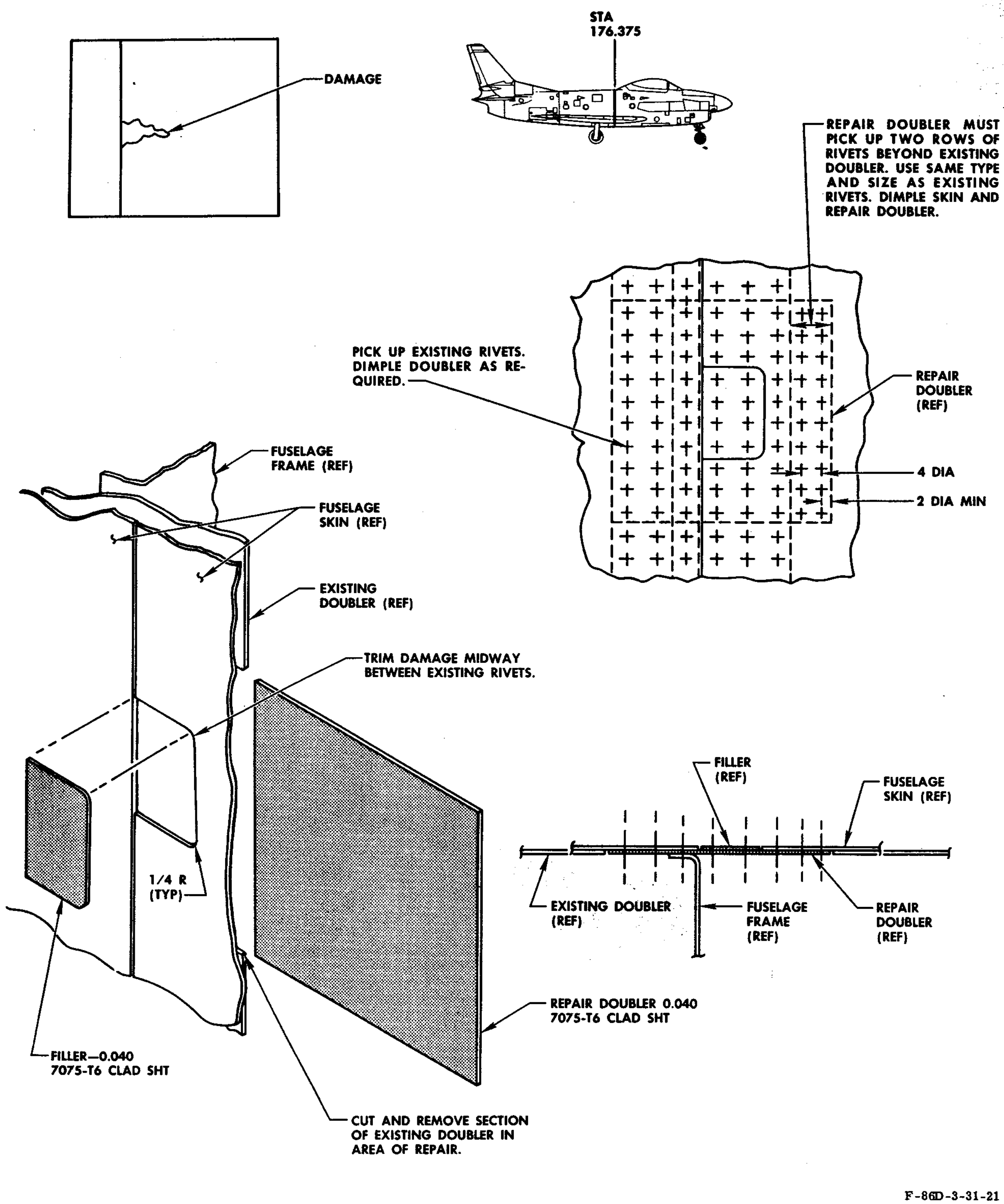


Figure 4-20. Tension Skin Repair (Sheet 2 of 2)

PERMANENT CATEGORY A

FUSELAGE

NOTE

For areas of airplane requiring tension repairs, refer to Typical Repair Index illustration in Section X. Install repair doubler with longest dimension parallel to fore-and-aft fuselage reference plane.

1 Trim out damage.

2 Smooth all edges and corners after trimming.

3 Make filler to match removed damaged area. Contour, if necessary, to match existing skin.

4 Make repair doubler, and contour, if necessary, to fit damaged area. The size of the repair doubler is determined by the damage cut out and the number of fasteners required.

5 Fasten repair doubler and filler in position, using size and type of fasteners and spacing called out.

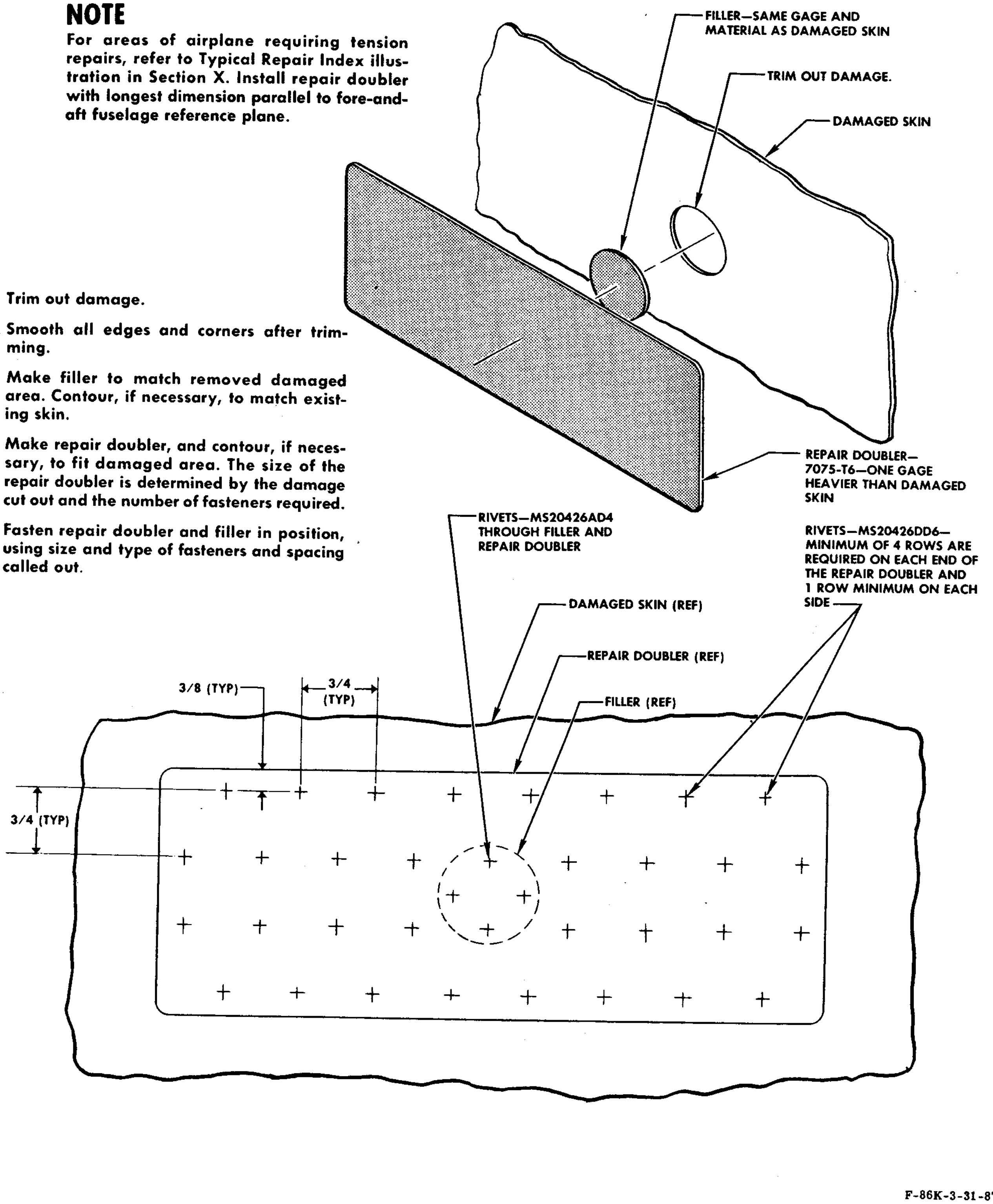
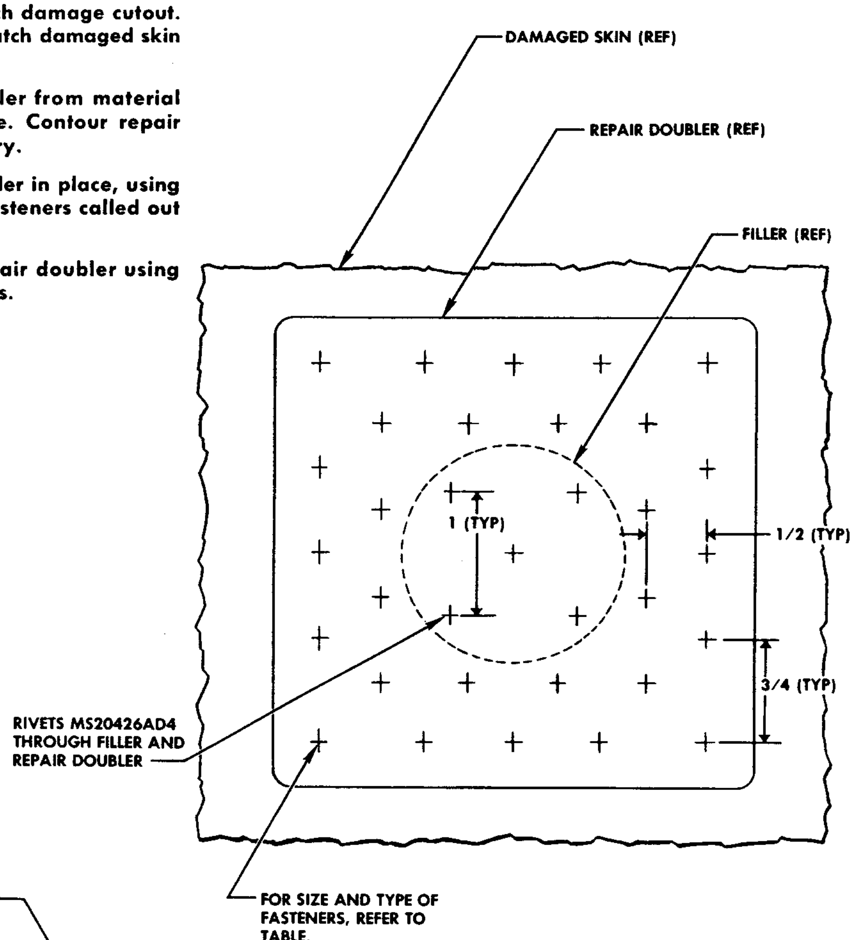


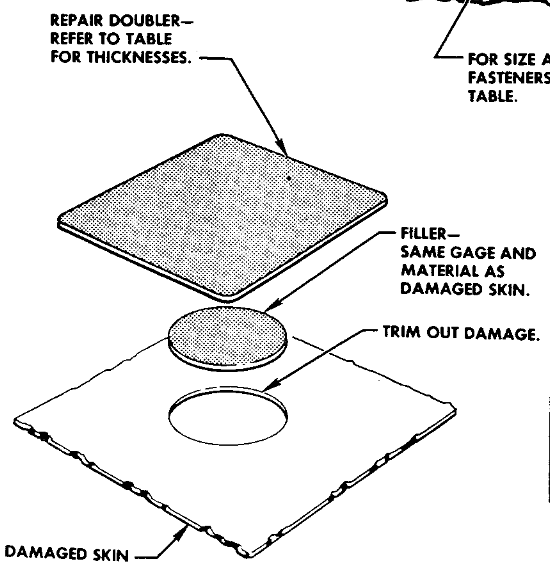
Figure 4-20A. Skin Repair—Tension

PERMANENT CATEGORY A

EMPENNAGE

1 Trim out damage and smooth all edges and corners.
2 Make filler to match damage cutout. Contour filler to match damaged skin if necessary.
3 Make repair doubler from material called out in table. Contour repair doubler if necessary.
4 Fasten repair doubler in place, using size and type of fasteners called out in table.
5 Fasten filler to repair doubler using MS20426AD4 rivets.





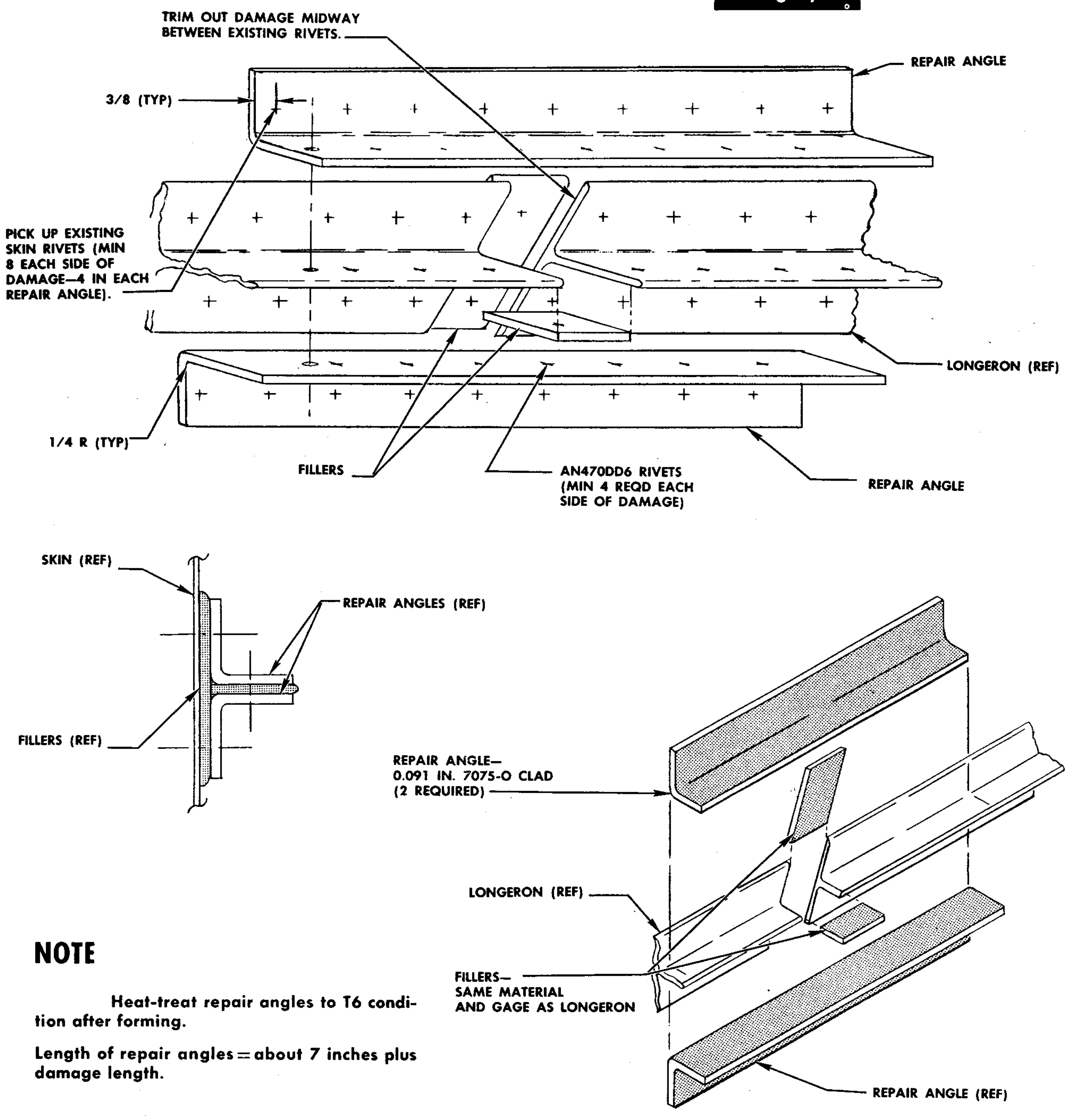
ORIGINAL SKIN THICKNESS	REPAIR DOUBLER THICKNESS	RIVETS
0.025 2024-T4	0.032 2024-T4	MS20426AD5
0.032 2024-T4	0.040 2024-T4	MS20426AD5
0.040 2024-T4	0.051 2024-T4	MS20426AD5
0.020 7075-T6	0.032 7075-T6	MS20426AD5
0.032 7075-T6	0.040 7075-T6	MS20426AD5
0.040 7075-T6	0.051 7075-T6	MS20426AD5
0.064 7075-T6	0.072 7075-T6	MS20426DD6
0.018 CRES	0.025 CRES	AN427M5
0.025 CRES	0.032 CRES	AN427M5
0.032 CRES	0.040 CRES	AN427M5

F-86K-3-31-86

Figure 4-20B. Skin Repair—Shear

PERMANENT

Category A



NOTE

Heat-treat repair angles to T6 condition after forming.

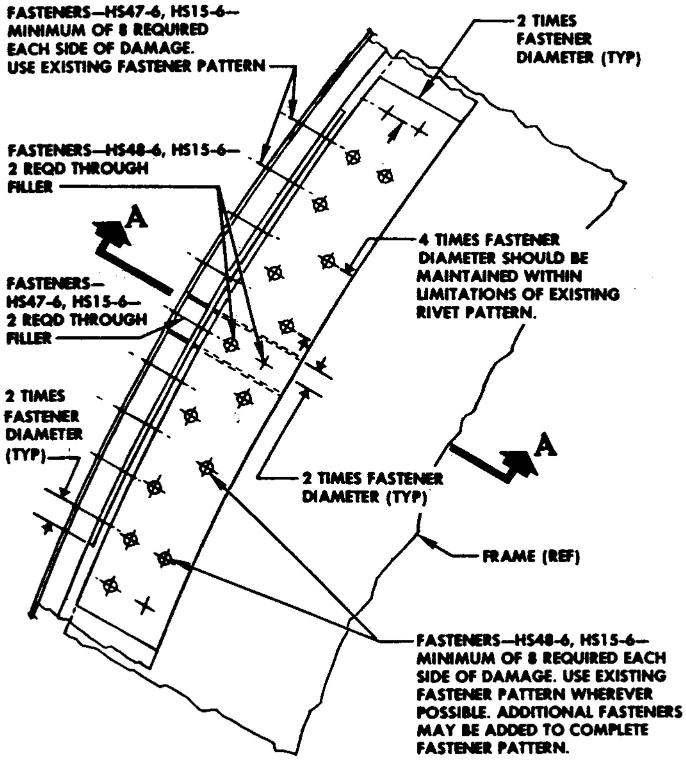
Length of repair angles = about 7 inches plus damage length.

F-86D-3-31-33

Figure 4-21. Intermediate Longeron—Station 187.4 to 250.8

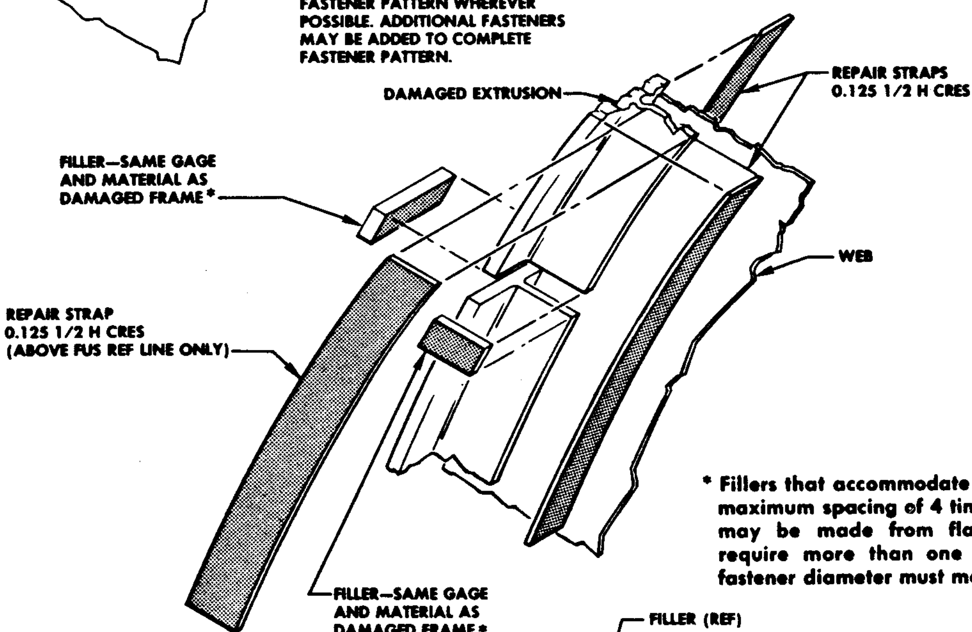
PERMANENT CATEGORY A

FUSELAGE

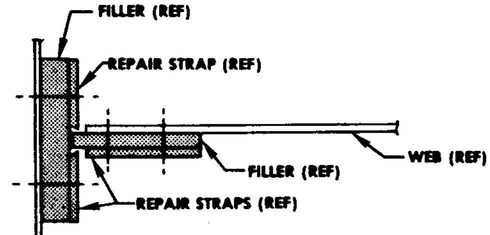


1. Trim out damage midway between existing fasteners.
2. Smooth all edges and corners after trimming.
3. Make repair straps and fillers. Chamfer repair straps to fit radius.
4. Fasten repair parts in place using size and type of fastener and spacing called out.

NOTE This repair is suitable for a repair of the outer extruded frame cap between the upper and lower longerons. The frame web flange of the extrusion can be repaired only between the fuselage reference line and the upper longeron. A repair below the fuselage reference line is impractical and, in this case, the entire extrusion should be replaced.



* Fillers that accommodate only one fastener at maximum spacing of 4 times fastener diameter may be made from flat stock. Fillers that require more than one fastener at 4 times fastener diameter must match the original part.

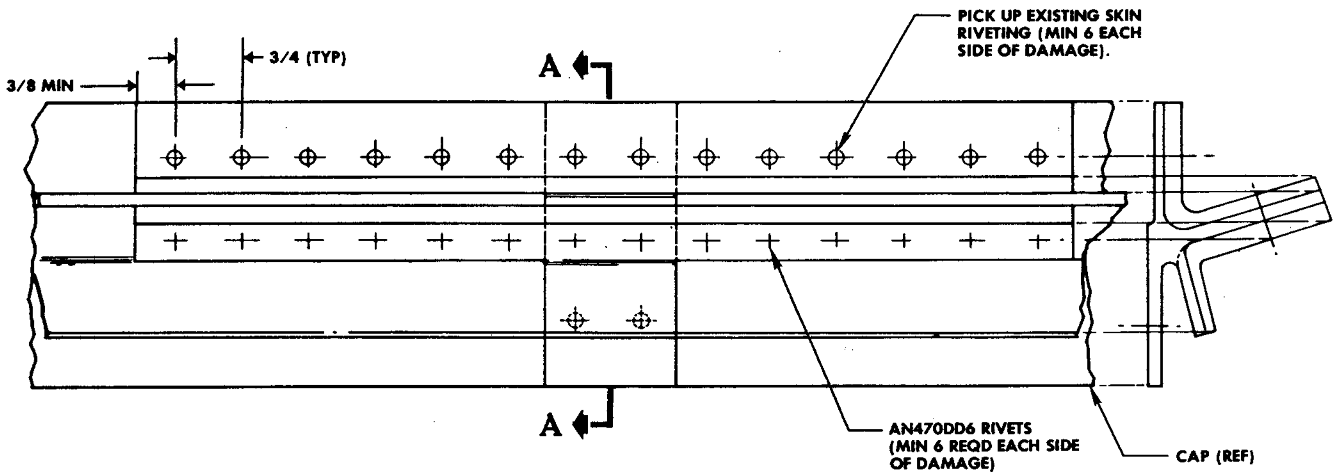


SECTION A-A

F-86D-3-31-62

Figure 4-21A. Frame Assembly—Station 187.406

PERMANENT Category A



NOTE The length of the repair member should be about 9 inches plus the damage length.

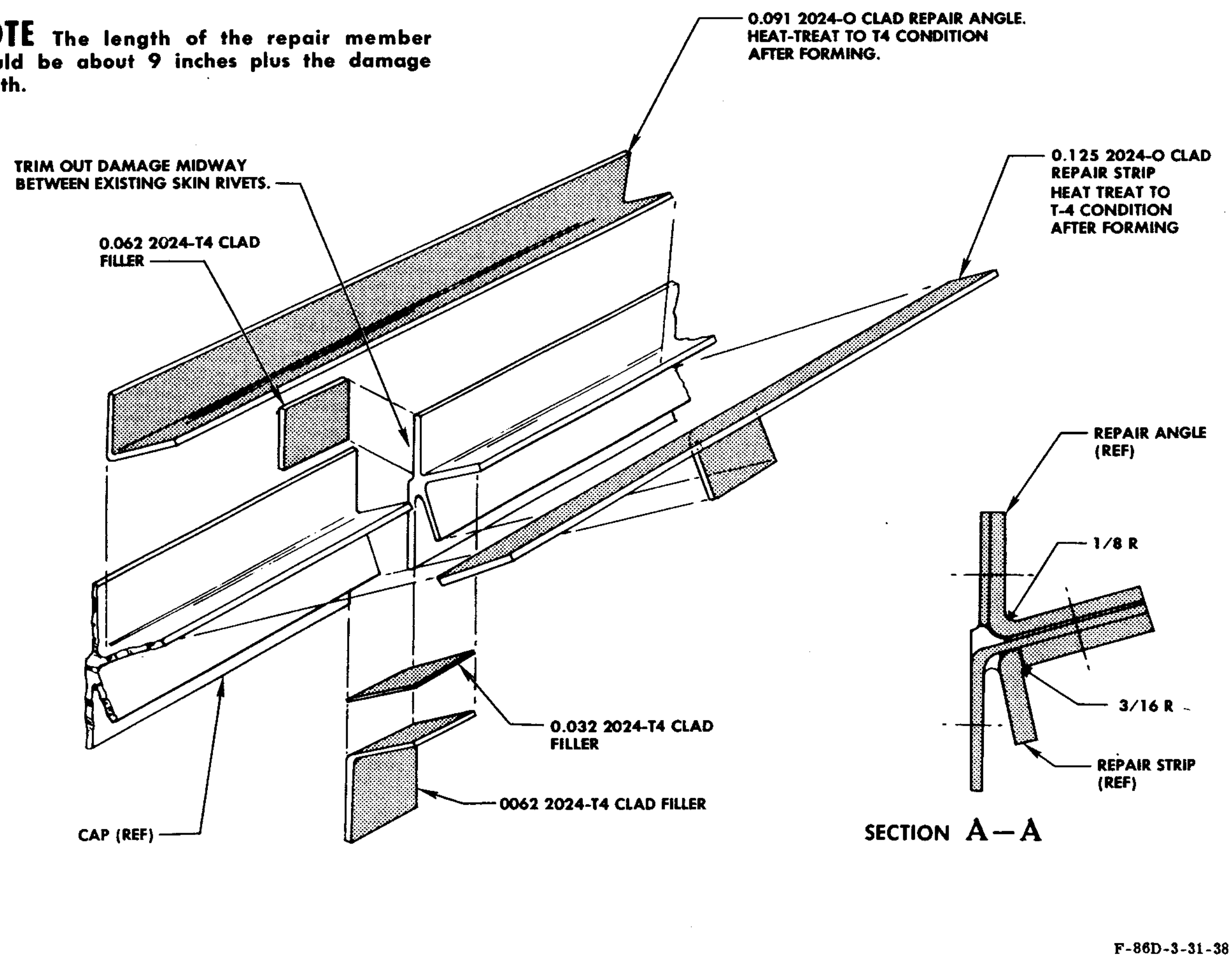
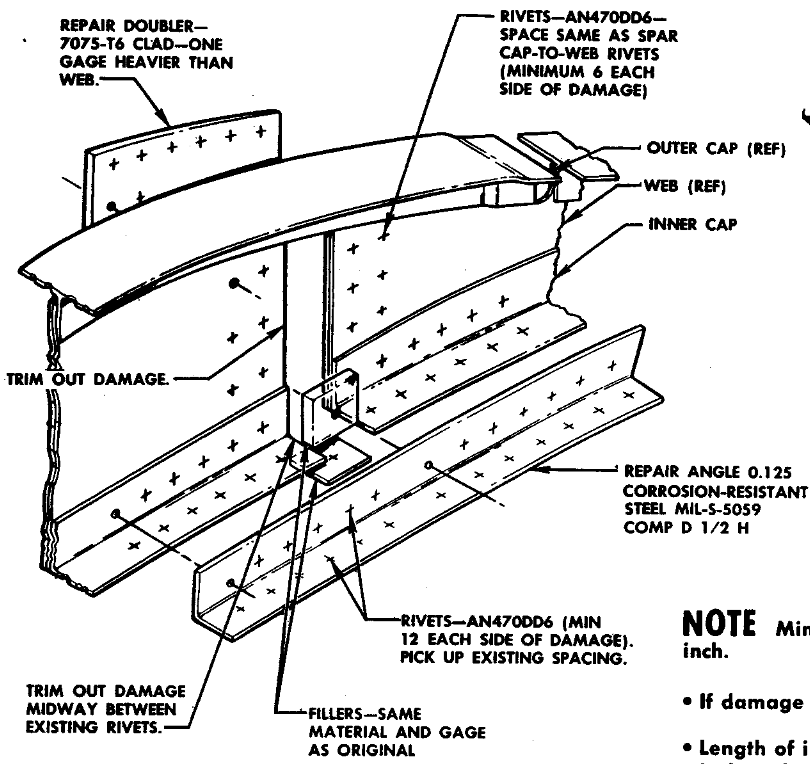
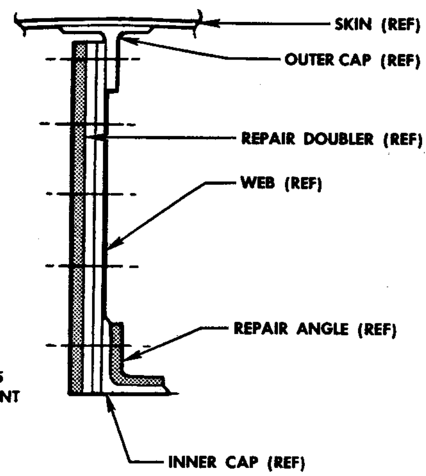


Figure 4-21B. Fuselage Reference Line Shelf—Outboard Cap

PERMANENT

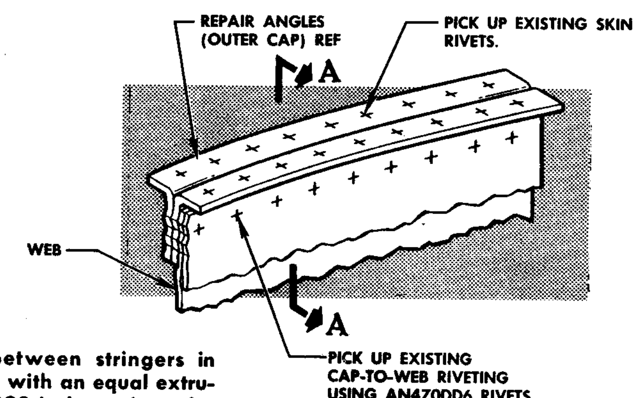
Category A

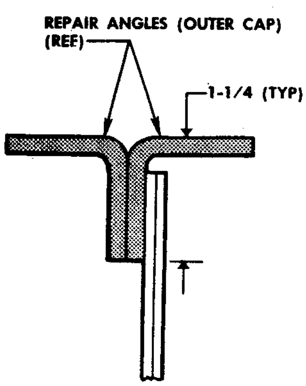




NOTE Minimum typical bend radius = 1/4 inch.

- If damage is extensive, replace entire web.
- Length of inner cap repair angle = about 9 inches plus damage length.





SECTION A-A

NOTE For damage between stringers in outer cap repair, replace with an equal extrusion or substitute two 0.090-inch repair angles of composition D, one-half hard corrosion-resistant steel (Specification MIL-S-5059).

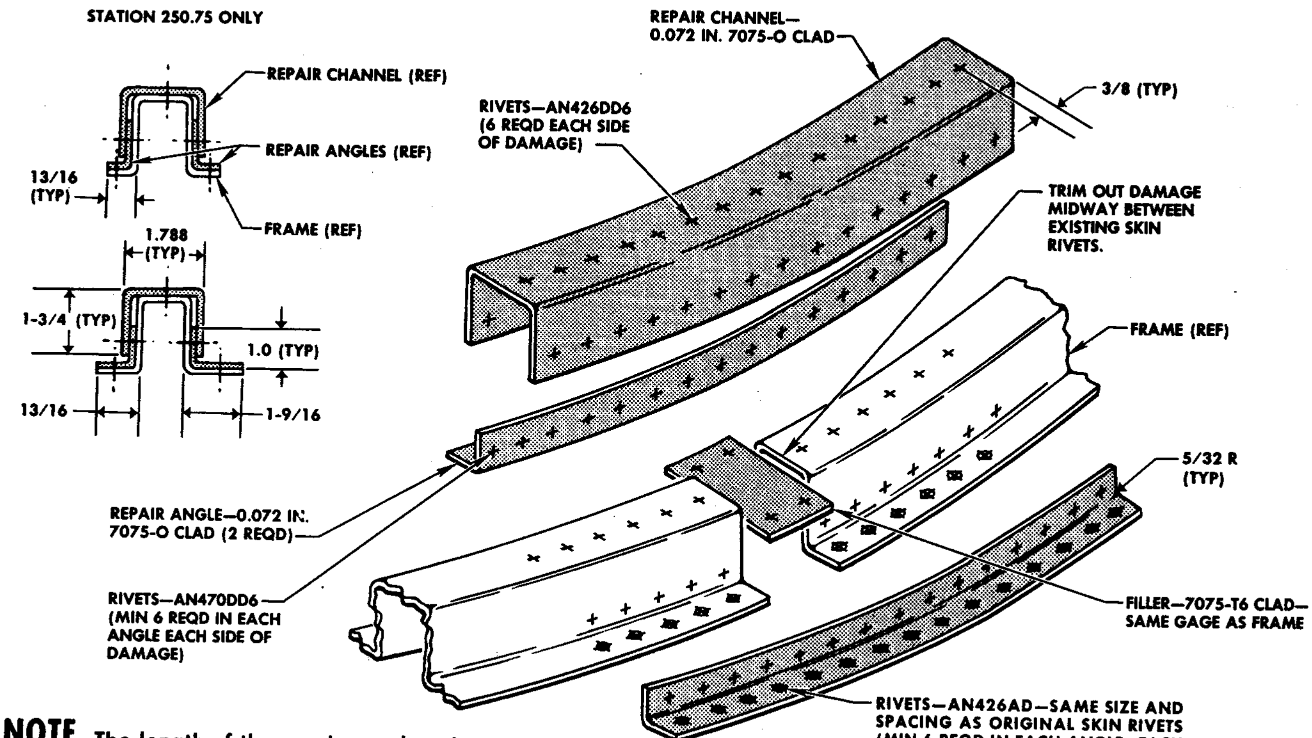
For damage between longeron and stringer, replace with an equal extrusion or substitute two 0.032-inch repair angles of composition D, one-half hard corrosion-resistant steel (Specification MIL-S-5059).

F-86D-3-31-32

Figure 4-22. Upper Frame—Station 217.4

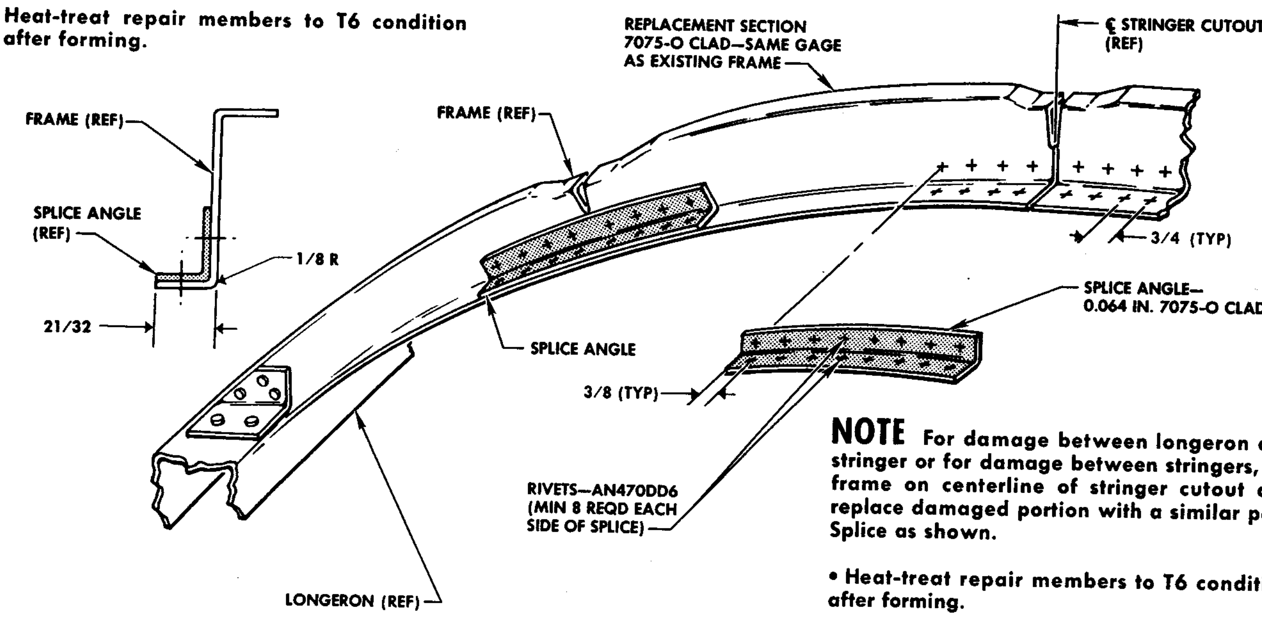
PERMANENT

Category A



NOTE The length of the repair members is about 12 inches plus damage length.

Heat-treat repair members to T6 condition after forming.



NOTE For damage between longeron and stringer or for damage between stringers, cut frame on centerline of stringer cutout and replace damaged portion with a similar part. Splice as shown.

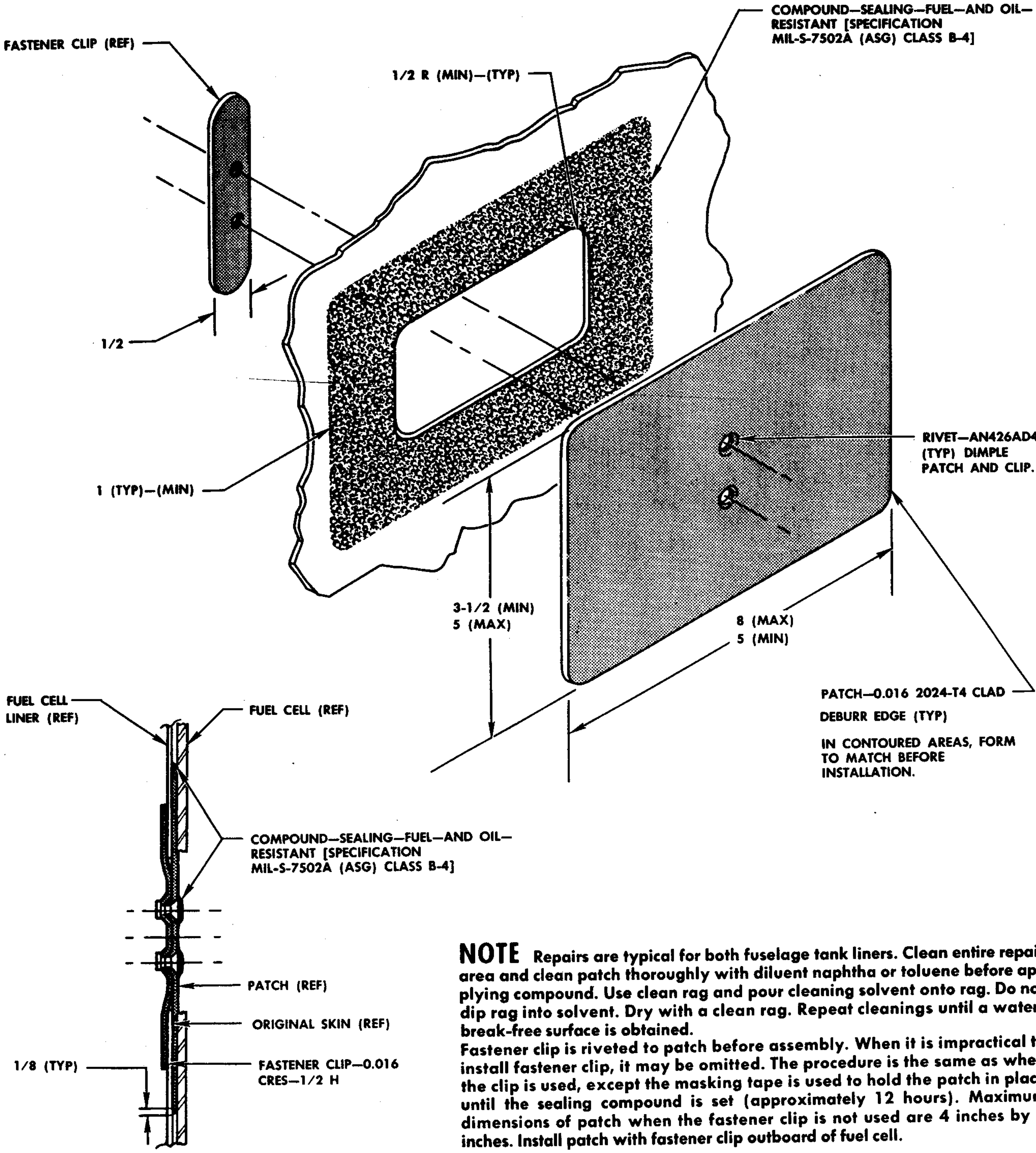
- Heat-treat repair members to T6 condition after forming.
- The length of the splice angles is about 6 inches.

F-86K-3-31-72

Figure 4-23. Frame Repair—Station 228.8 to 270.8

PERMANENT

Category A



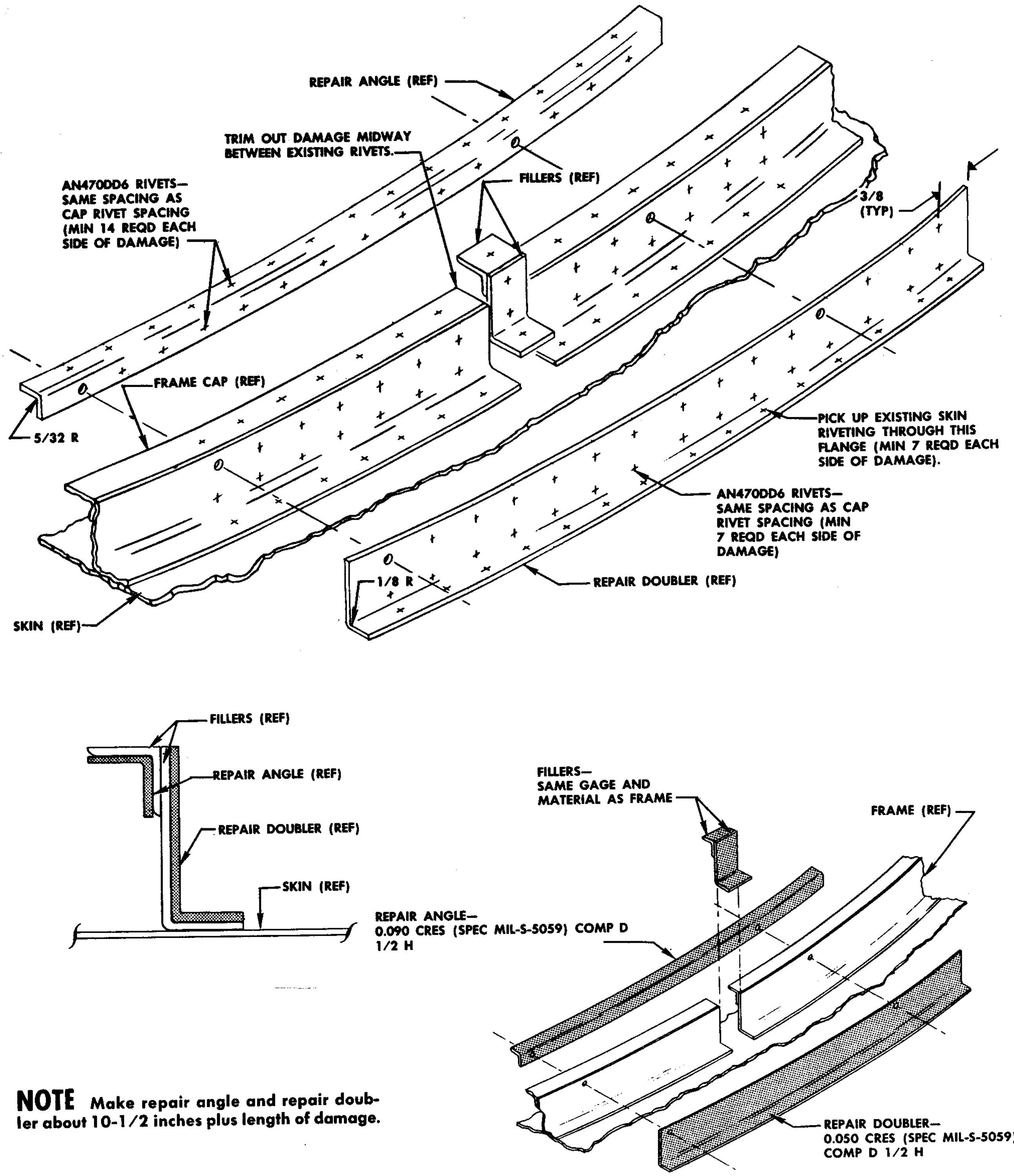
NOTE Repairs are typical for both fuselage tank liners. Clean entire repair area and clean patch thoroughly with diluent naphtha or toluene before applying compound. Use clean rag and pour cleaning solvent onto rag. Do not dip rag into solvent. Dry with a clean rag. Repeat cleanings until a water-break-free surface is obtained.
Fastener clip is riveted to patch before assembly. When it is impractical to install fastener clip, it may be omitted. The procedure is the same as when the clip is used, except the masking tape is used to hold the patch in place until the sealing compound is set (approximately 12 hours). Maximum dimensions of patch when the fastener clip is not used are 4 inches by 6 inches. Install patch with fastener clip outboard of fuel cell.

F-86D-3-31-16

Figure 4-24. Fuel Cell Liners

PERMANENT

Category A



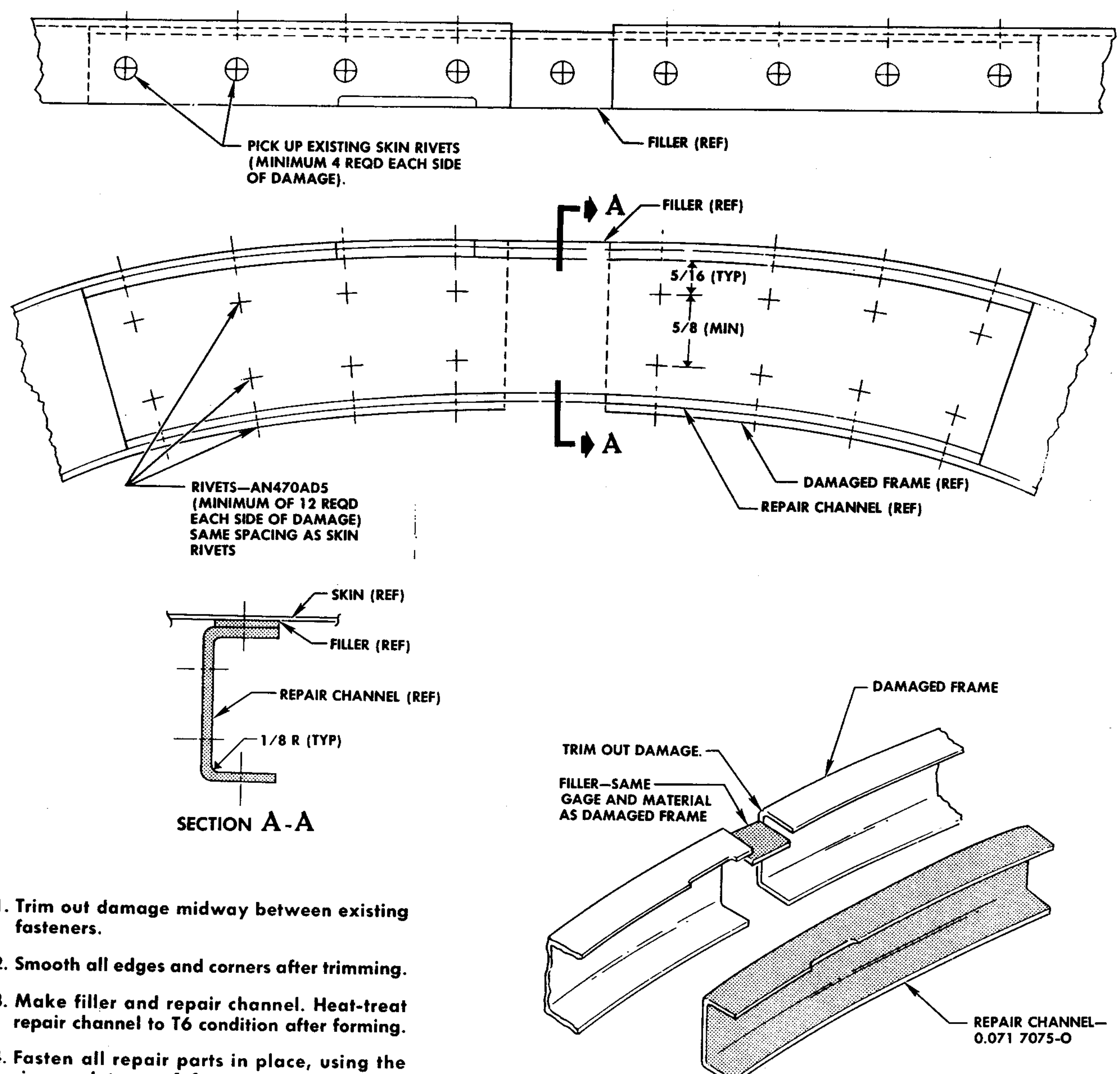
NOTE Make repair angle and repair doubler about 10-1/2 inches plus length of damage.

F-86D-3-31-28

Figure 4-25. Intermediate Frame—Station 270.8

PERMANENT—CATEGORY A

FUSELAGE



1. Trim out damage midway between existing fasteners.
2. Smooth all edges and corners after trimming.
3. Make filler and repair channel. Heat-treat repair channel to T6 condition after forming.
4. Fasten all repair parts in place, using the size and type of fasteners and spacing called out.

NOTE The length of repair members is about 8 inches plus the length of damage.

F-86K-3-31-20A

Figure 4-26. Frame—Station 279.3

DUCT INDEX

FUSELAGE

NOTE

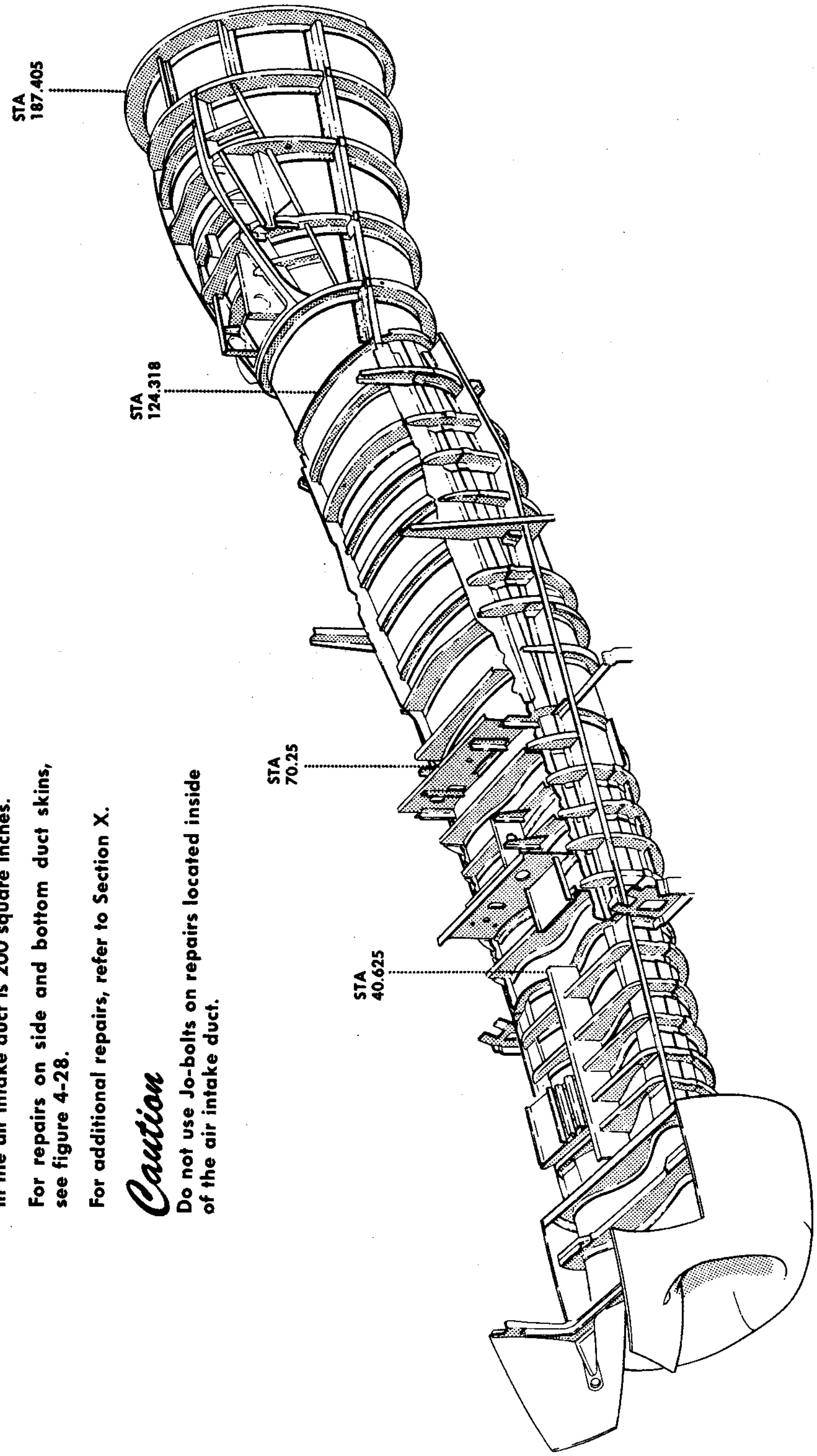
The total area of nonflush repairs allowable in the air intake duct is 200 square inches.

For repairs on side and bottom duct skins, see figure 4-28.

For additional repairs, refer to Section X.

Caution

Do not use Jo-bolts on repairs located inside of the air intake duct.

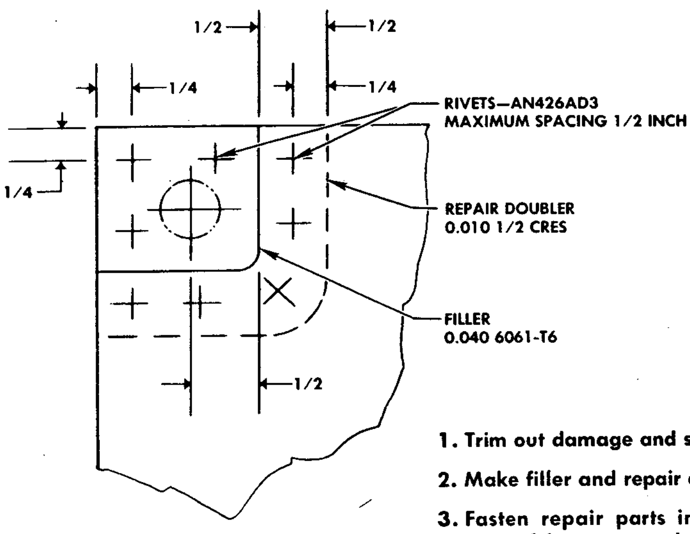


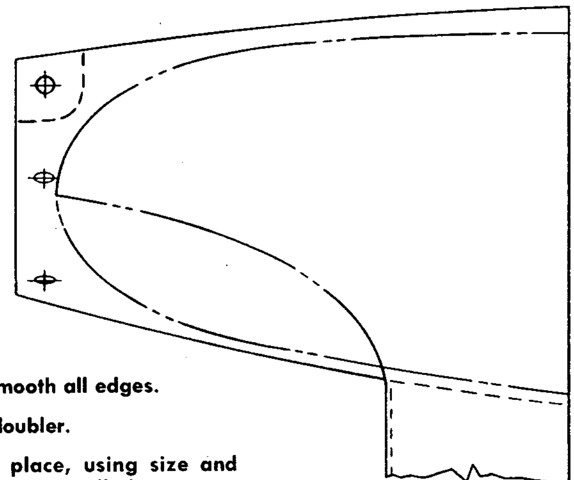
F-86K-3-31-78A

Figure 4-27. Air Intake Duct Index

PERMANENT CATEGORY A

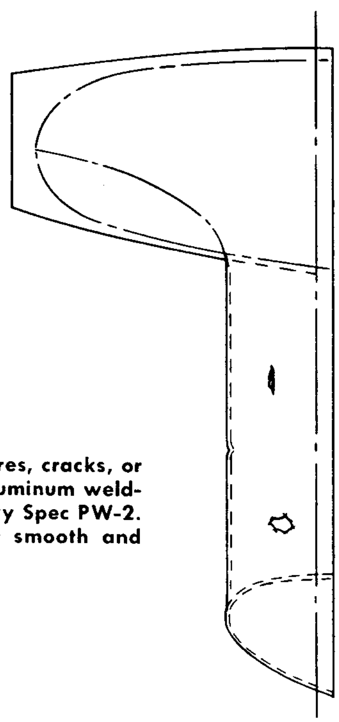
FUSELAGE

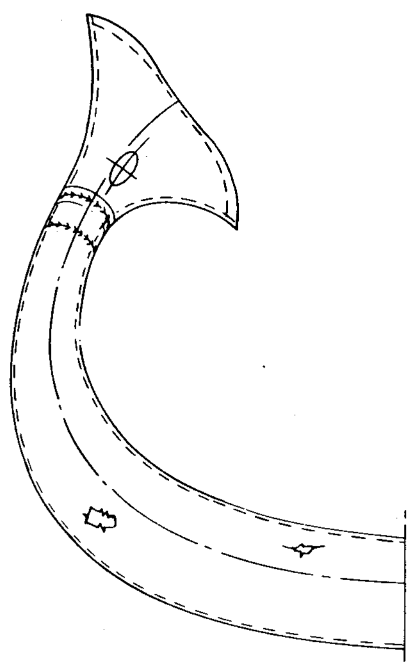




1. Trim out damage and smooth all edges.
2. Make filler and repair doubler.
3. Fasten repair parts in place, using size and type of fasteners and spacing called out.

RADOME ATTACH HOLES





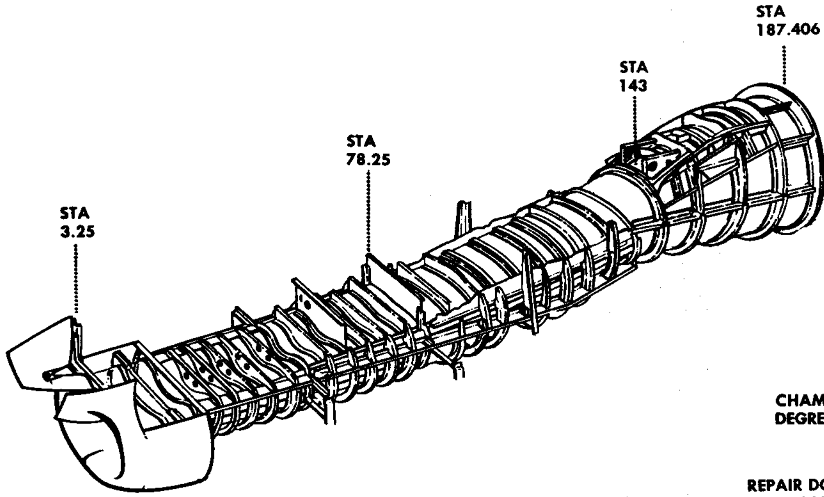
Heliarc-weld any small punctures, cracks, or deep dents in skins, with 43S aluminum welding rod in accordance with Navy Spec PW-2. Grind area surrounding repair smooth and flush.

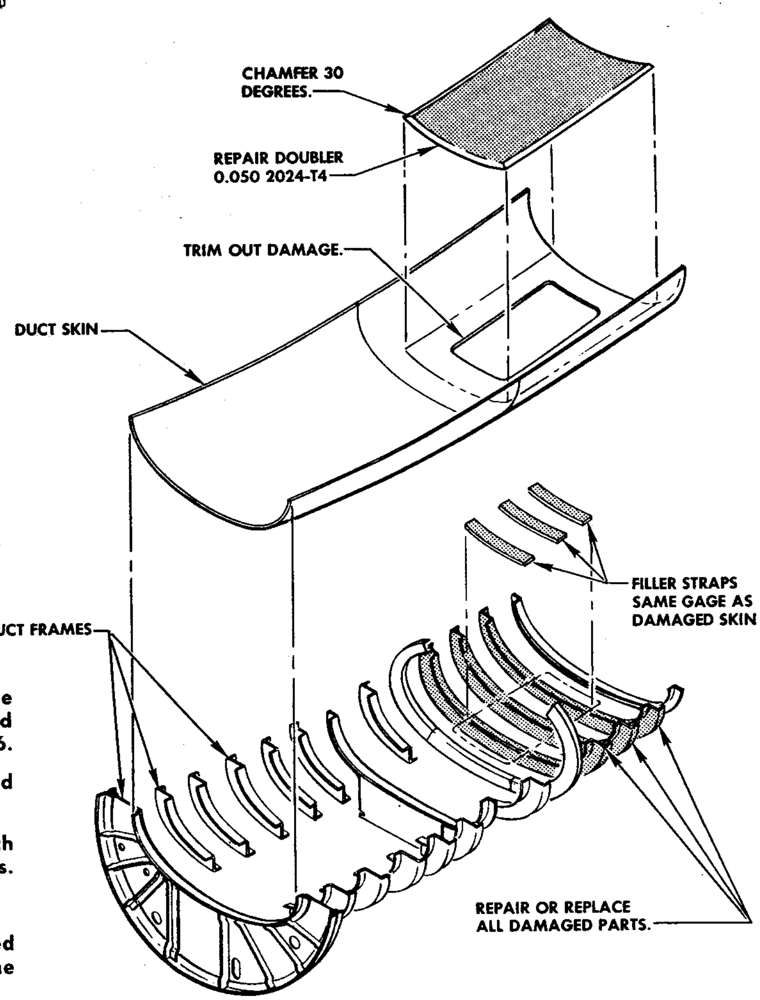
F-86D-3-31-57

Figure 4-27A. Air Intake Duct—Leading Edge Repairs

PERMANENT—CATEGORY A

FUSELAGE





NOTE This repair is applicable to any section of the duct except the bottom section between stations 82.5 and 134, and the side section between stations 104 and 136.

- The total area of all nonflush repairs must not exceed 300 square inches.
- All repair doublers are to be made from 0.050 inch 2024-T4 material and must be chamfered 30 degrees.
- All damaged structure must be repaired or replaced.
- Fillers must be used on the structure where the damaged skin has been removed. Fillers are to be of the same gage and material as the removed skin.
- Fastener requirements are two rows of AN426AD5 fasteners on all sides of the repair doubler. The existing fastener spacing through a stiffener or frame may be used as one row of fasteners. Pick up existing fasteners.
- The fastener spacing is 3/4 inch, with 3/8-inch edge distance.

Caution

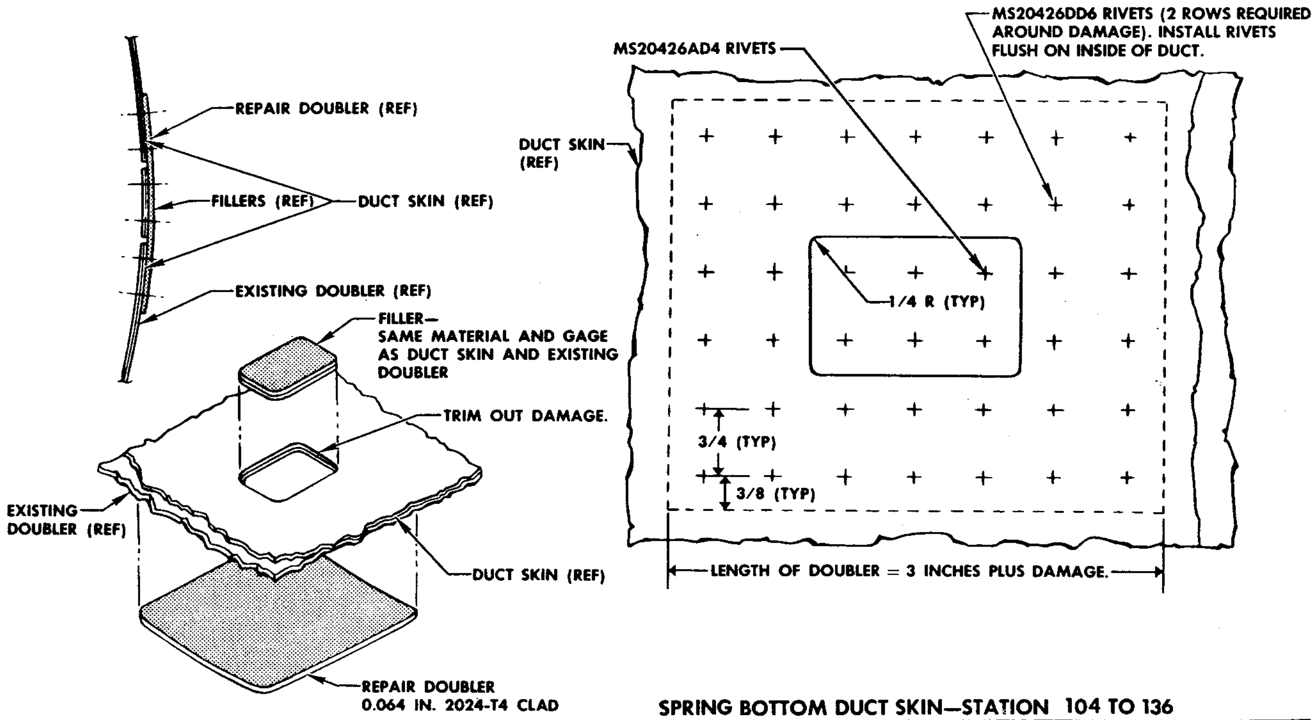
Do not use Jo-bolts on repairs located inside of the air intake duct.

F-86L-3-31-3A

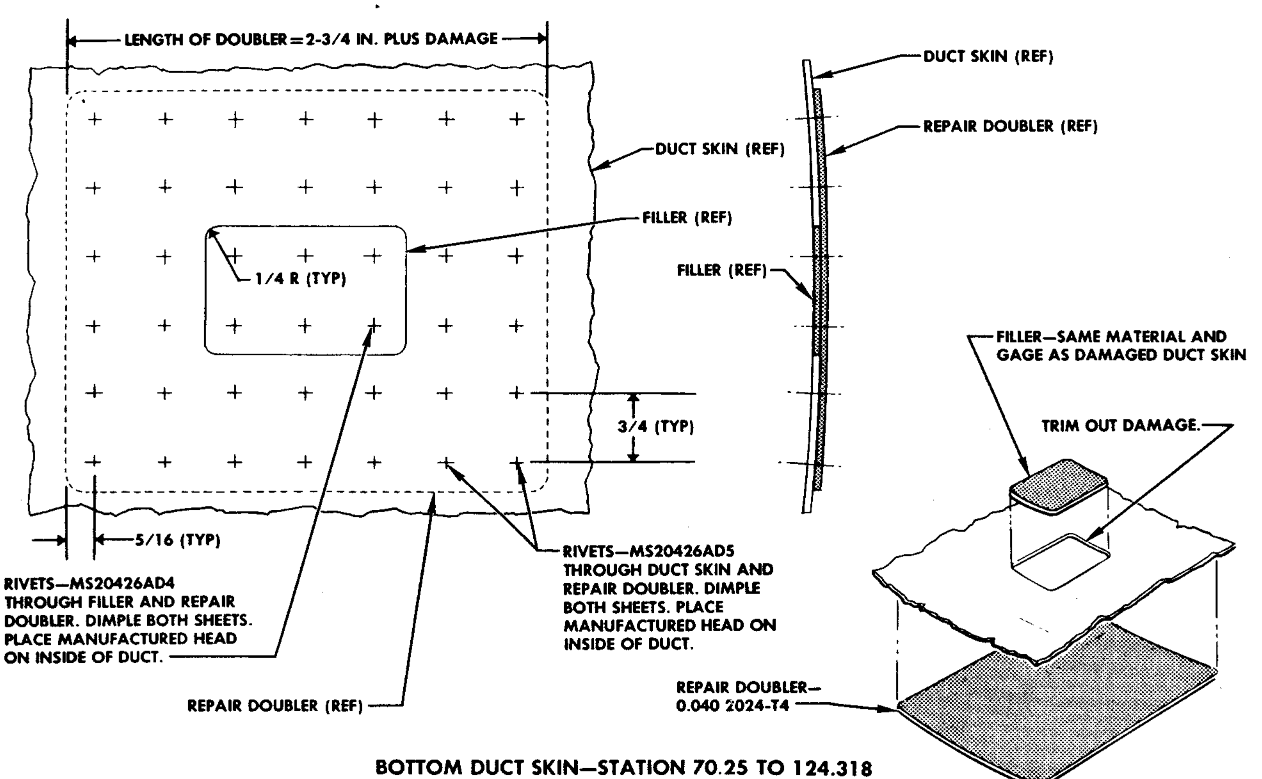
Figure 4-28. Duct Skin Repairs (Sheet 1 of 2)

PERMANENT—CATEGORY A

EMPENNAGE



SPRING BOTTOM DUCT SKIN—STATION 104 TO 136



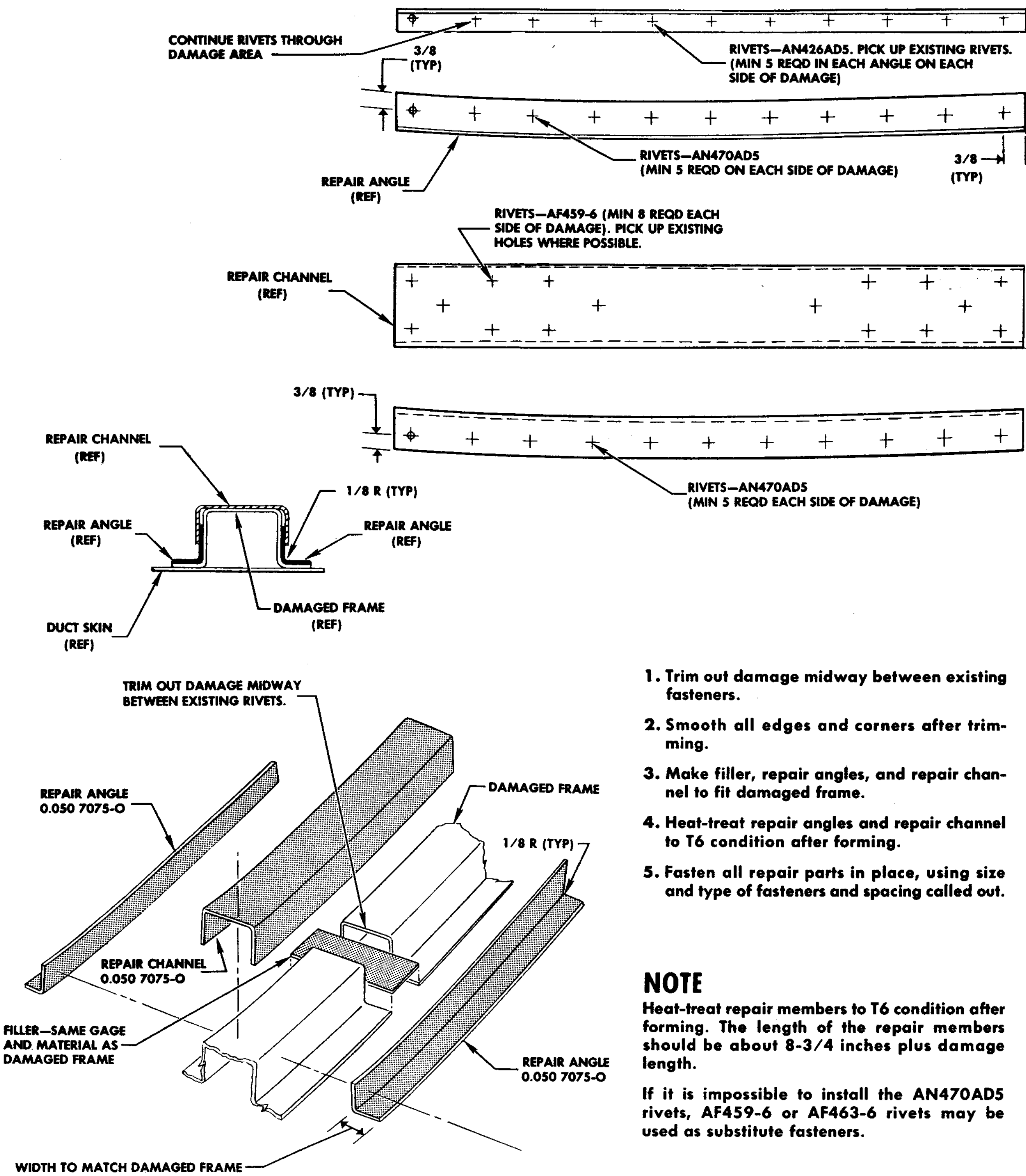
BOTTOM DUCT SKIN—STATION 70.25 TO 124.318

F-86K-3-31-85

Figure 4-28. Duct Skin Repairs (Sheet 2 of 2)

PERMANENT CATEGORY A

FUSELAGE



1. Trim out damage midway between existing fasteners.
2. Smooth all edges and corners after trimming.
3. Make filler, repair angles, and repair channel to fit damaged frame.
4. Heat-treat repair angles and repair channel to T6 condition after forming.
5. Fasten all repair parts in place, using size and type of fasteners and spacing called out.

NOTE

Heat-treat repair members to T6 condition after forming. The length of the repair members should be about 8-3/4 inches plus damage length.

If it is impossible to install the AN470AD5 rivets, AF459-6 or AF463-6 rivets may be used as substitute fasteners.

F-86L-3-31-8

Figure 4-28A. Duct Frame Repairs—Station 135 to Station 168.375

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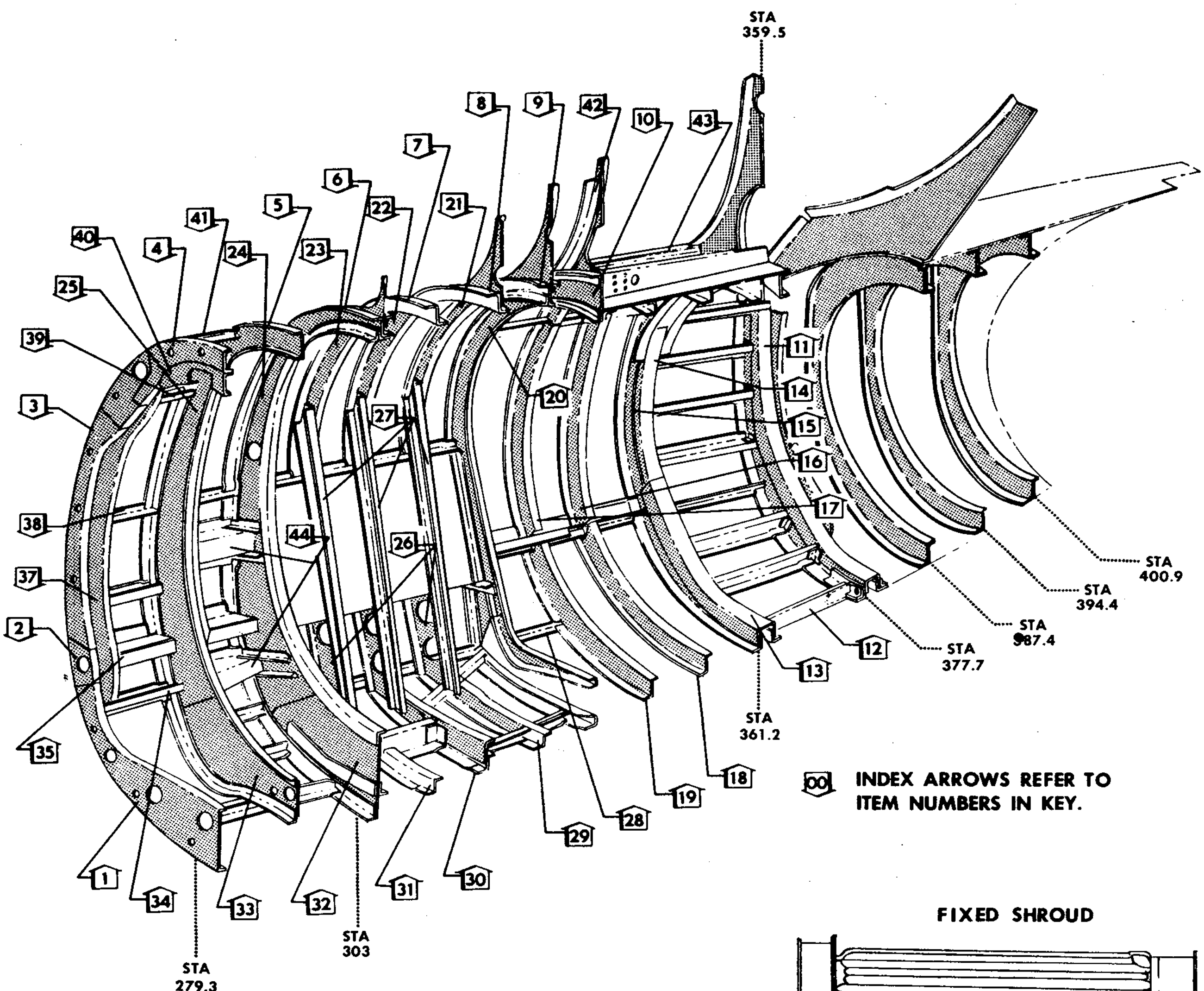
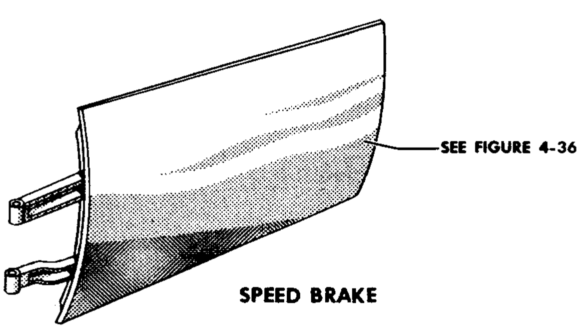
AFT SECTION INDEX

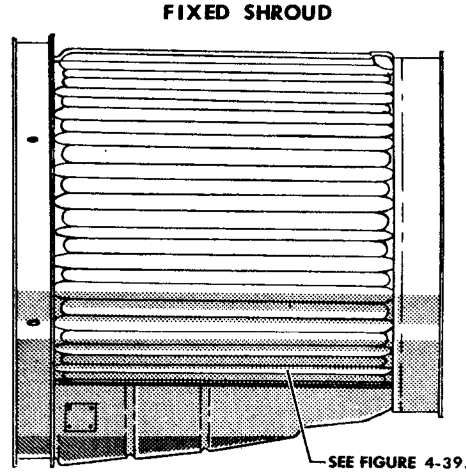
FUSELAGE



FIXED SHROUD



SPEED BRAKE



F-86K-3-31-70A

Figure 4-29. Aft Section Index

ITEM NO.	DRAWING NO.*	DESCRIPTION	GAGE	MATERIAL	REPAIR FIGURE NO.†
1	165-317126	Frame	0.051	7075-T6 Clad	
2	165-31724	Splice	0.064	7075-T6 Clad	
3	165-31709	Frame	0.064	7075-T6 Clad	
4	165-31723	Splice	0.064	7075-T6 Clad	
5	165-31741	Frame	0.051	7075-T6 Clad	4-31
6	165-31742	Frame	0.064	7075-T6 Clad	4-31
7	165-31743	Frame	0.040	7075-T6 Clad	4-32
8	165-31744	Frame	0.040	7075-T6 Clad	4-32
9	165-31745	Frame	0.040	7075-T6 Clad	4-32
10	165 & 190-317146	Frame	0.040	7075-T6 Clad	
11	165 & 190-316175	Frame	0.032	CRES	4-35
12	165-316167	Frame	0.090	CRES	
13	165-316170	Frame	0.063	CRES	4-34
14	165-316131	Frame	0.040	2024-T4 Clad	4-34
15	165-316122	Frame	0.051	2024-T4 Clad	4-34
16	165-317117	Frame	0.040	2024-T4 Clad	
17	165-317116	Frame	0.040	2024-T4 Clad	
18	165-317131	Frame	0.032	2024-T4 Clad	4-30
19	165-317130	Frame	0.032	2024-T4 Clad	4-30
20	165-317169	Frame	0.032	7075-T6 Clad	
21	165-31714	Frame	0.040	7075-T6 Clad	4-30
22	165-31313	Latch	0.051	2024-T4 Clad	4-30
23	165-31712	Frame	0.040	7075-T6 Clad	4-30
24	165-317167	Frame	0.032	7075-T6 Clad	
25	165-317166	Frame	0.032	7075-T6 Clad	
26	165-31715-29	Panel	0.032	7075-T6 Clad	4-30
27	165-31715-15	Channel	0.040	7075-T6 Clad	
28	165-31715-13	Angle	0.064	7075-T6 Clad	
29	165-31729	Frame	0.064	7075-T6 Clad	4-30
30	165-317134	Frame	0.064	7075-T6 Clad	4-30
31	165-317133	Frame	0.064	7075-T6 Clad	4-30
32	165-317107	Frame	0.032	7075-T6 Clad	
33	165-317106	Frame	0.032	7075-T6 Clad	
34	165-317139	Intercostal	0.051	7075-T6 Clad	
35	165-31778	Intercostal	0.064	7075-T6 Clad	
36	165-31777	Intercostal	0.064	7075-T6 Clad	
37	165-31721	Frame	0.064	7075-T6 Clad	
38	165-31710	Longeron	0.100	CRES	
39	165-31776	Intercostal	0.051	7075-T6 Clad	
40	165-31740	Frame	0.064	7075-T6 Clad	
41	165-31720	Longeron	0.071	CRES	
42	165-316134	Frame	0.032	CRES	4-31
43	165-316135	Frame	0.032	CRES	

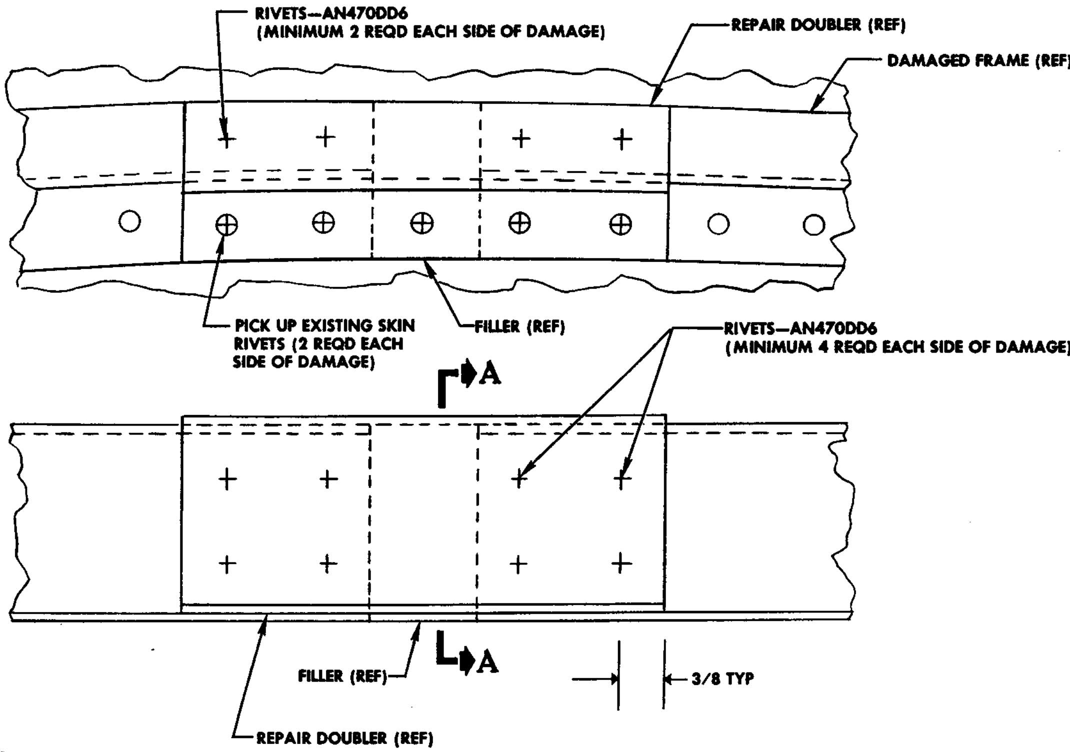
*Drawing numbers are for reference only.

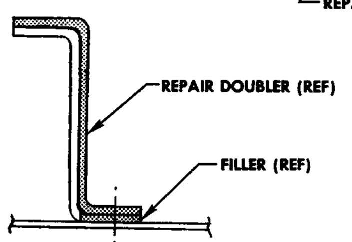
†For additional repairs, refer to Section X.

Key to Figure 4-29

PERMANENT CATEGORY A

FUSELAGE

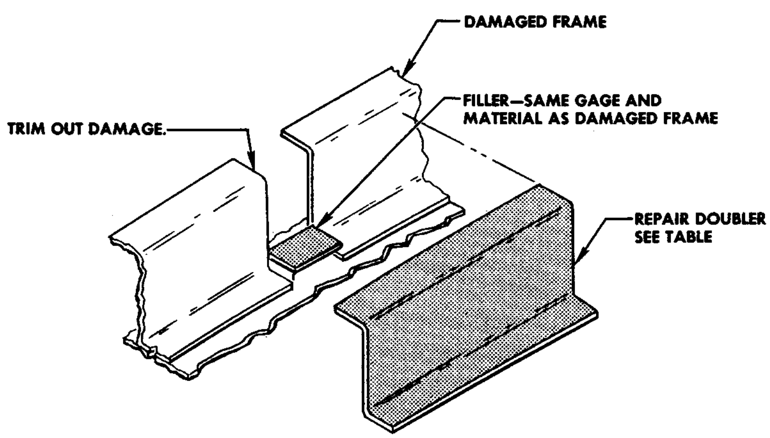




SECTION A-A

FRAMES	STATIONS	DOUBLER MATERIAL	BEND RADII
LOWER	343 352	0.040-2024-T4	3/32
LOWER SIDE	343 352	0.050-2024-T4	1/8
UPPER	319 327	*0.050 7075-O *(0.063 7075-O ON AIRPLANES AF50-518 AND SUBSEQUENT	3/32
SIDE	311 319 327	*0.050 7075-O	3/32

* HEAT TREAT TO T6 CONDITION AFTER FORMING



1. Trim out damage midway between existing fasteners.
2. Smooth all edges and corners after trimming.
3. Make fillers and repair doublers. Refer to chart for material, gage, and bend radius of repair doubler.
4. Fasten all parts in place, using size and type of fastener and spacing called out.

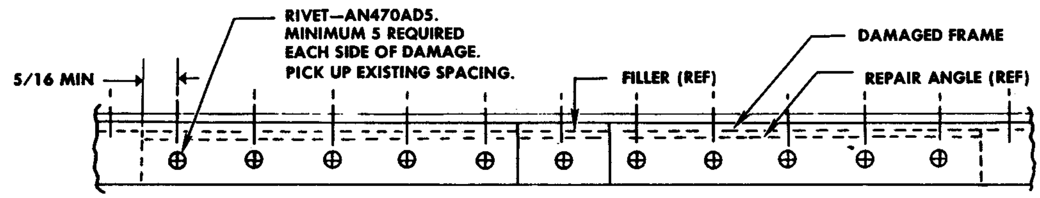
NOTE Length of repair members is about 3-1/2 inches plus the length of damage.

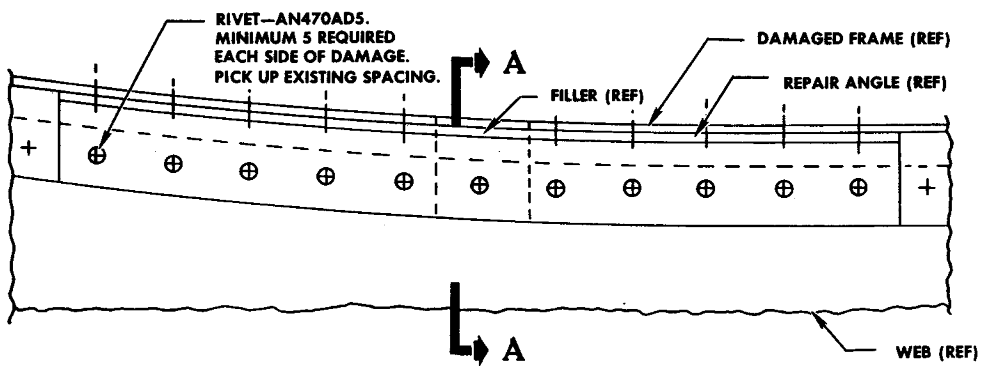
F-86K-3-31-21A

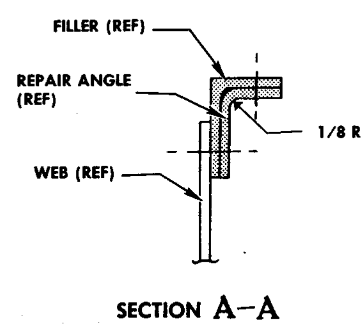
Figure 4-30. Frames—Upper, Lower, and Side

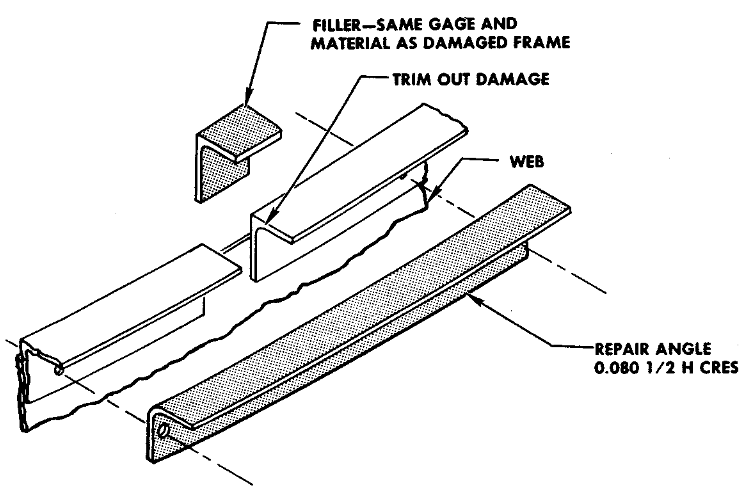
PERMANENT CATEGORY A

FUSELAGE









1. Trim out damage midway between existing fasteners.
2. Smooth all edges and corners after trimming.
3. Make filler angle and repair angle.
4. Fasten all parts in place, using size and type of fastener and spacing called out.

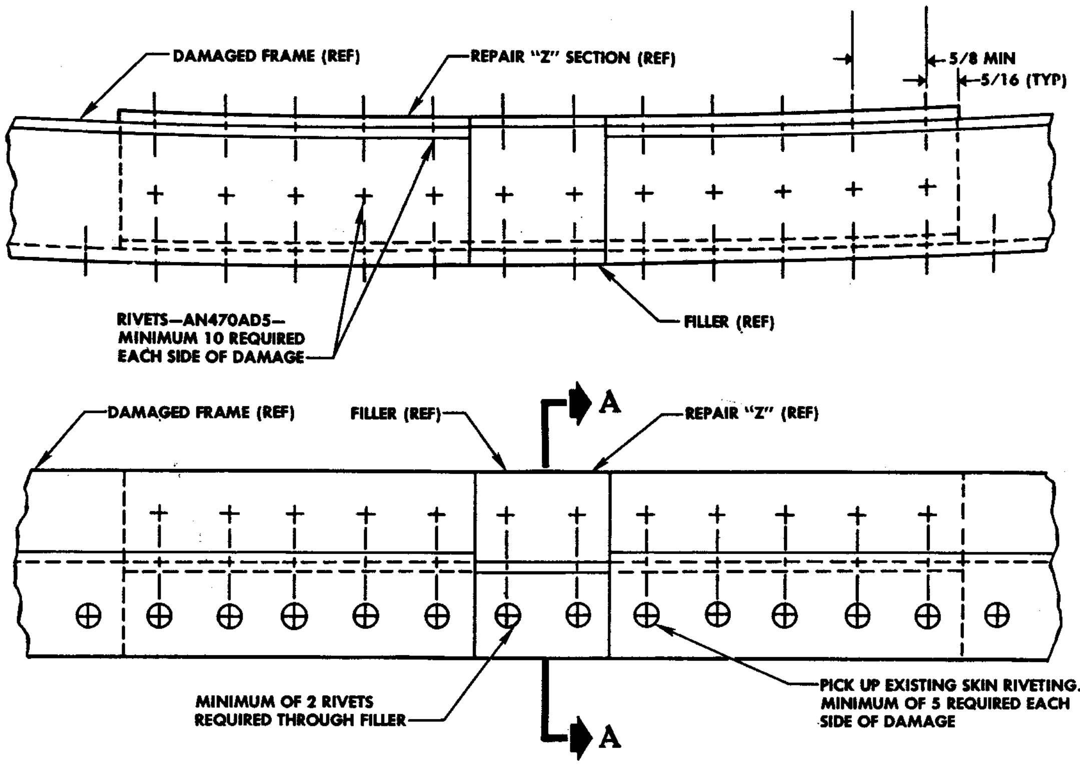
NOTE Length of repair angle is about 9 inches plus the length of damage. Repair is typical for both inner and outer caps.

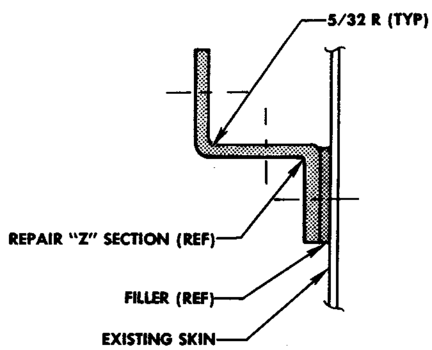
F-86K-3-31-22A

Figure 4-31. Frames—Stations 291.5, 303, and 335

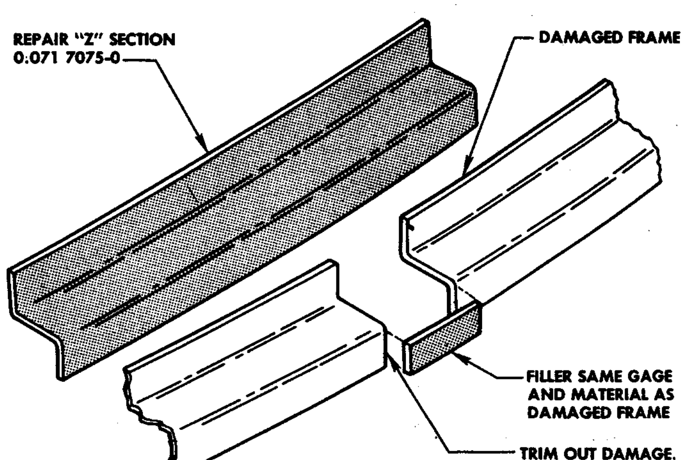
PERMANENT CATEGORY A

FUSELAGE





SECTION A-A



1. Trim out damage midway between existing fasteners.
2. Smooth all edges and corners after trimming.
3. Make filler and repair "Z" section. Heat-treat repair "Z" section to T6 condition after forming.
4. Fasten all repair parts in place, using size and type of fastener and spacing called out.

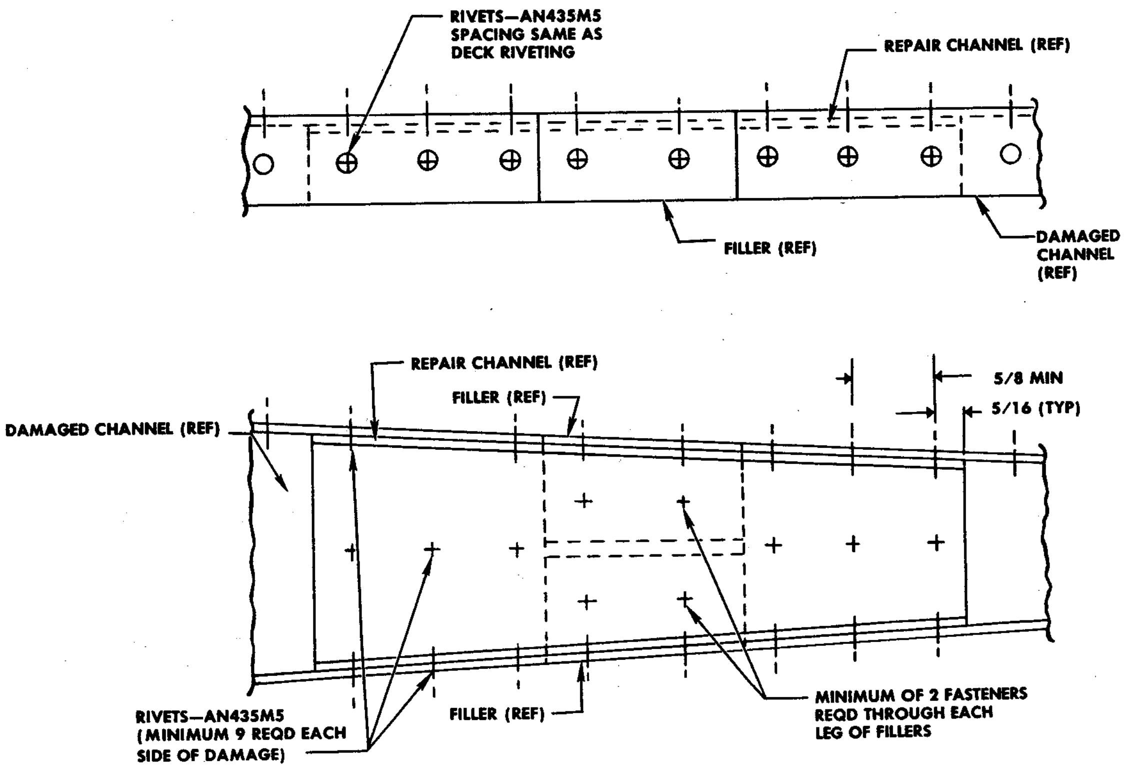
NOTE Length of repair "Z" section is about 6 inches plus the length of damage.

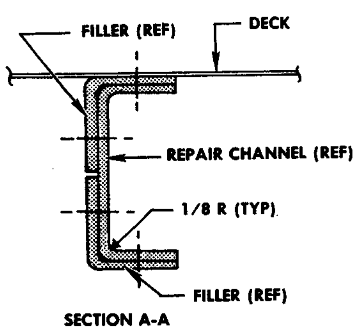
F-86K-3-31-24A

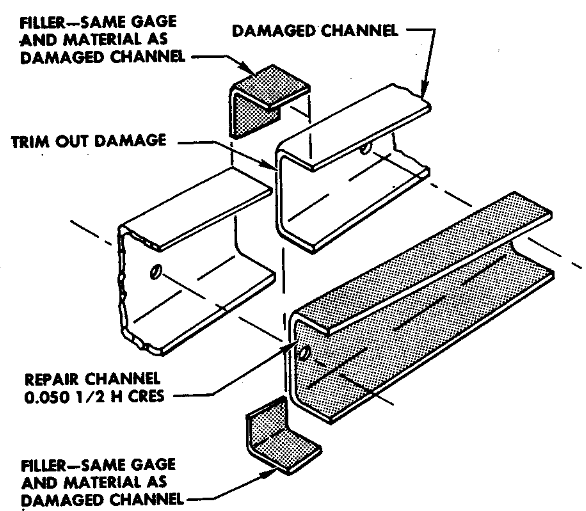
Figure 4-32. Lower Frames—Stations 311, 319, and 327

PERMANENT CATEGORY A

FUSELAGE







1. Trim out damage midway between existing fasteners.
2. Smooth all edges and corners after trimming.
3. Make fillers and repair channel.
4. Fasten all parts in place, using size and type of fasteners and spacing called out.

NOTE Length of repair members must be long enough to pick up 3 fasteners on each side of the damage.

F-86K-3-31-26A

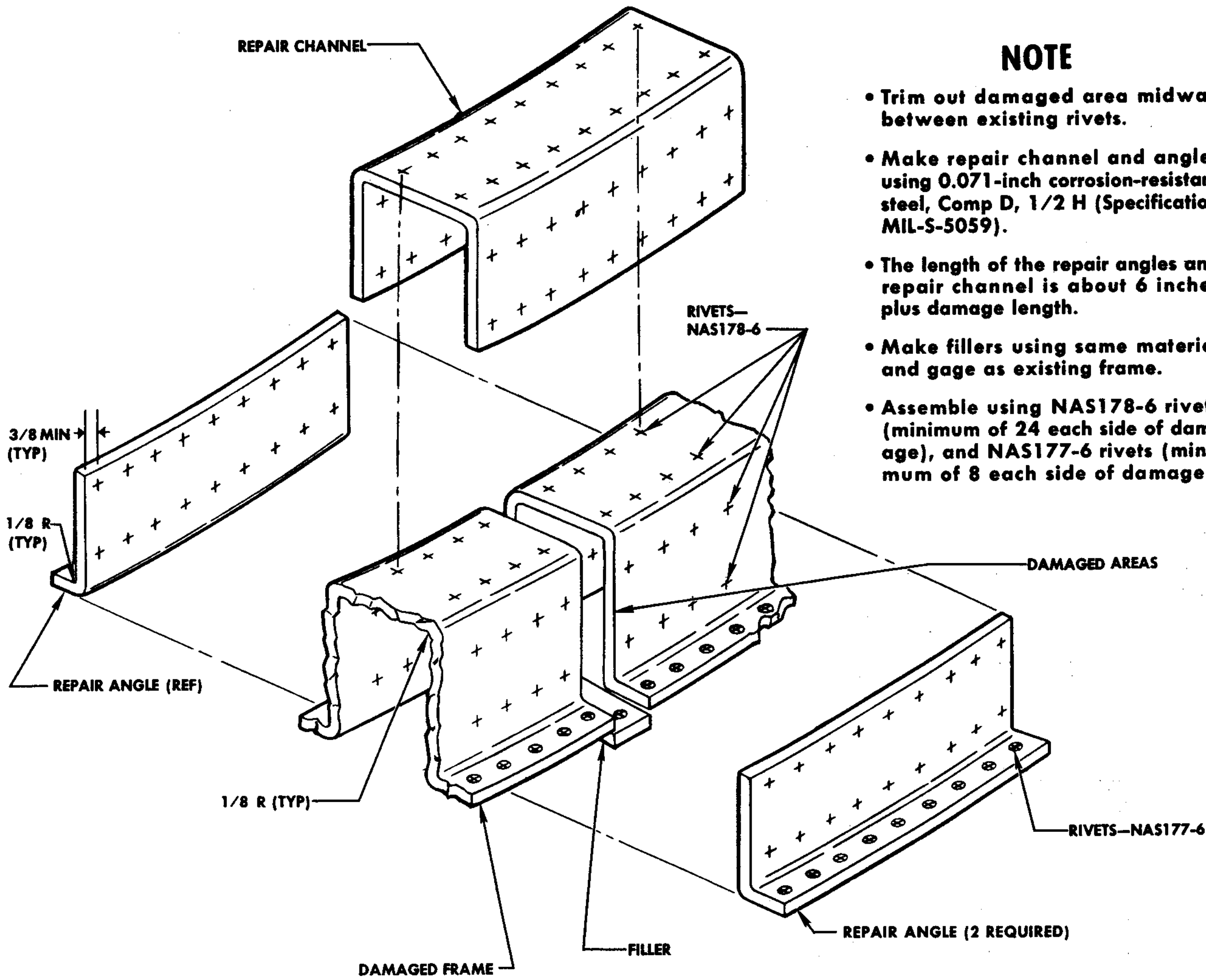
Figure 4-33. Channel—Station 335 to 352

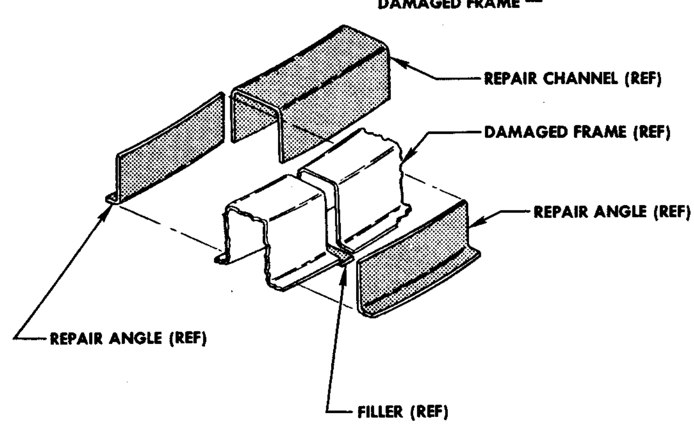
PERMANENT

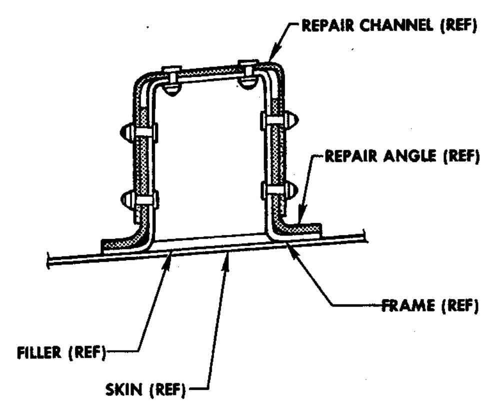
Category A

NOTE

- Trim out damaged area midway between existing rivets.
- Make repair channel and angles using 0.071-inch corrosion-resistant steel, Comp D, 1/2 H (Specification MIL-S-5059).
- The length of the repair angles and repair channel is about 6 inches plus damage length.
- Make fillers using same material and gage as existing frame.
- Assemble using NAS178-6 rivets (minimum of 24 each side of damage), and NAS177-6 rivets (minimum of 8 each side of damage).





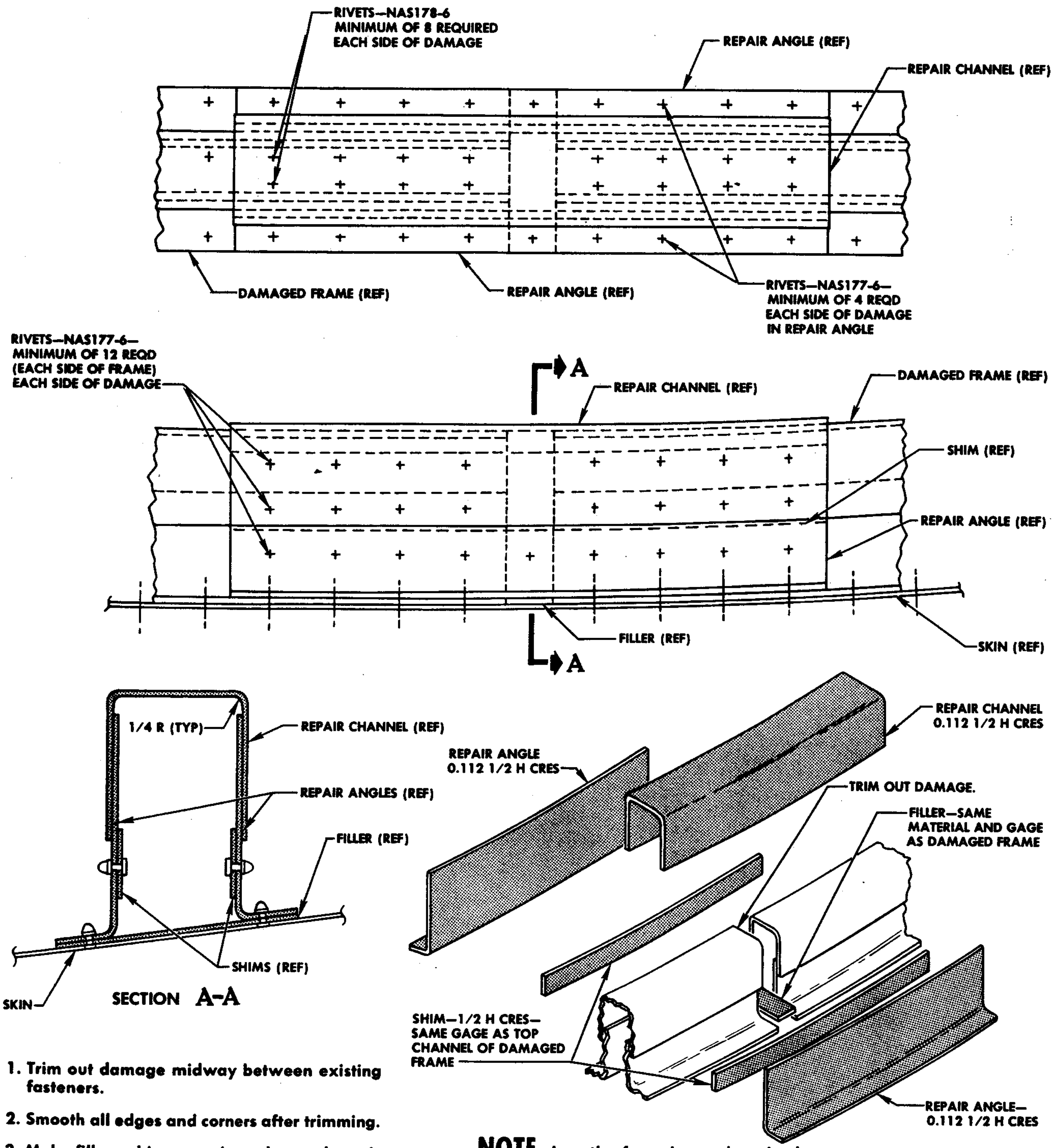


F-86K-3-31-71

Figure 4-34. Frame Repair—Station 361.2

PERMANENT—CATEGORY A

FUSELAGE



1. Trim out damage midway between existing fasteners.
2. Smooth all edges and corners after trimming.
3. Make fillers, shims, repair angles, and repair channel.
4. Fasten all repair parts in place, using size and type of fasteners and spacing called out.

NOTE Length of repair members is about 6 inches plus the length of damage.

• Jo-bolts may be substituted for Hi-Shear rivets in inaccessible areas.

F-86K-3-31-26A

Figure 4-35. Frame Repair—Station 377.7

PERMANENT

Category A

NOTE If damage is closer than specified overlap, extend doubler to the edge, keeping a minimum overlap of one inch.

New holes must be spaced at least 3/4 inch from any existing fastener in the honeycomb structure to avoid drilling into internal structural members.

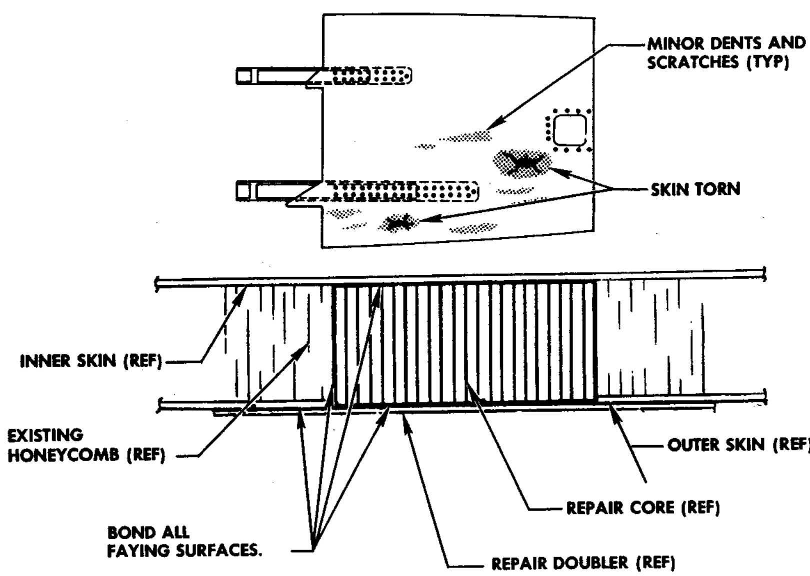
Refer to index for structural repair of honeycomb sandwich panels.

If scratches go through cladding, blend scratches and extend doubler 2 inches beyond scratches or to edge of skin.

This repair must receive elevated temperature cure.

(See sheet 2 for substitute repair core.) This repair is limited to damage to outer skin and core only.

All riveting must be accomplished before cure.



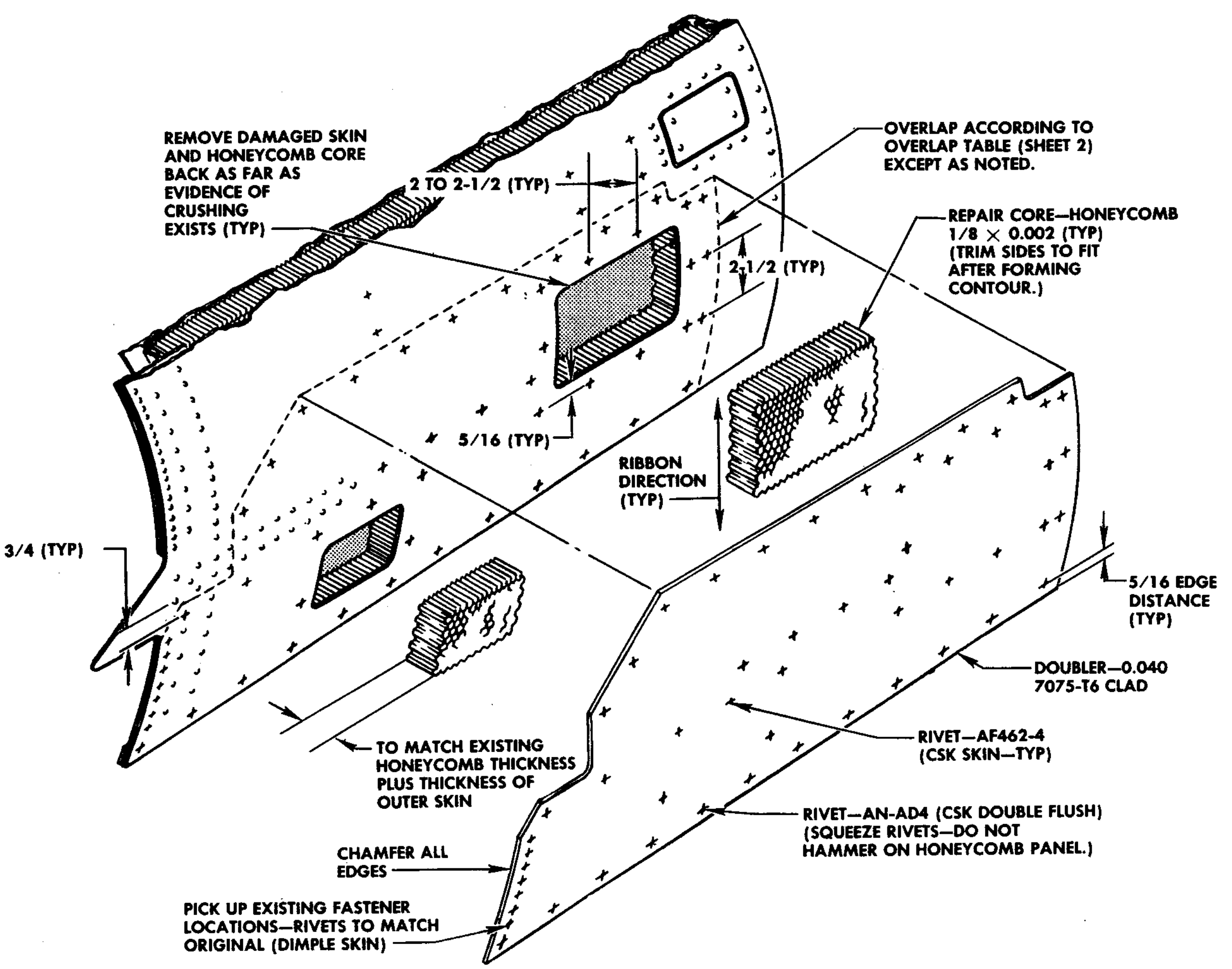
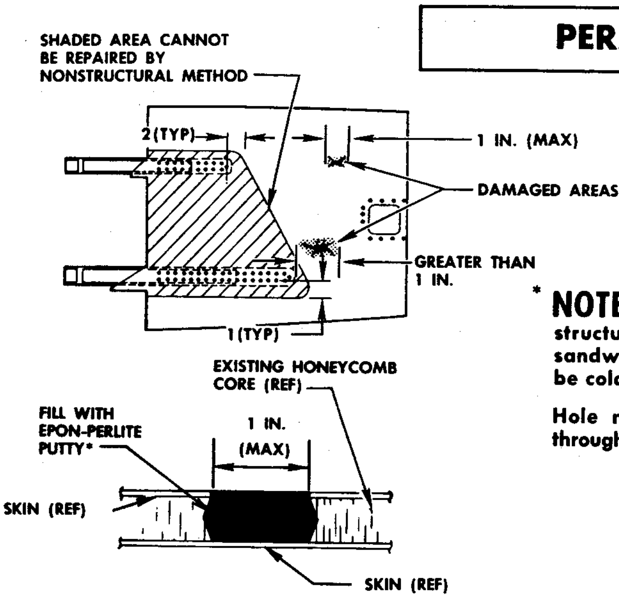
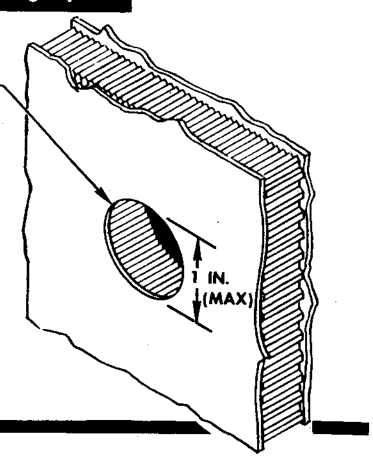


Figure 4-36. Speed Brake—Honeycomb (Sheet 1 of 4)

PERMANENT

Category A





* **NOTE** Refer to index for nonstructural repair of honeycomb sandwich panels. This repair may be cold-cured.

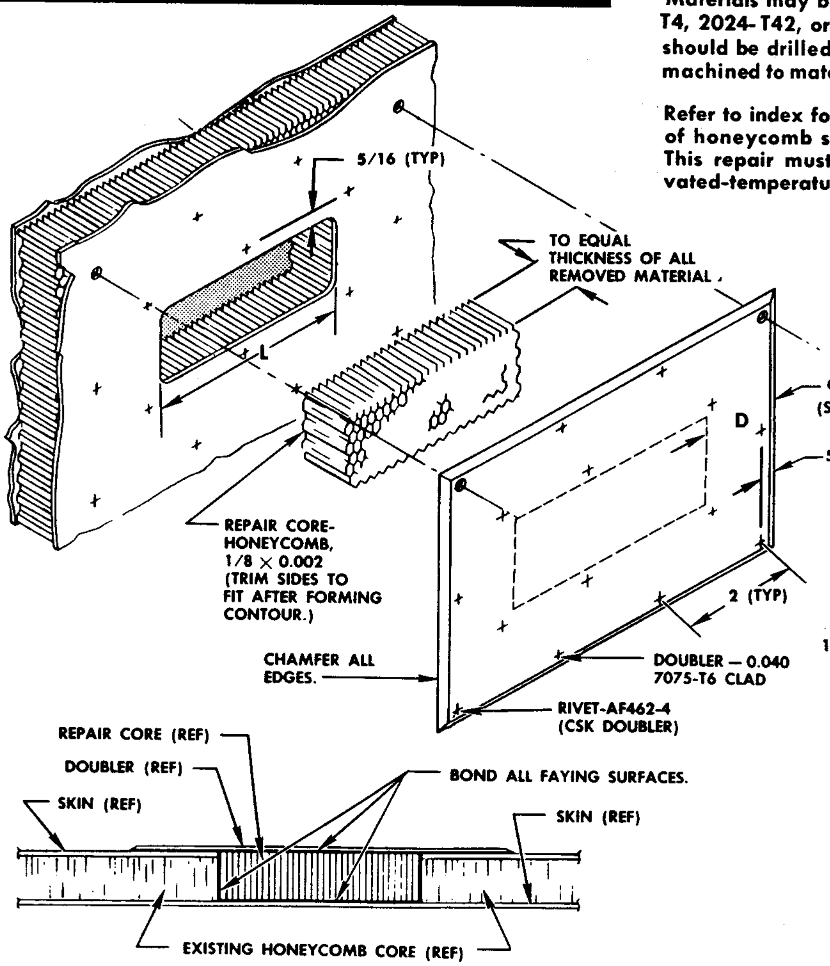
Hole may be in either skin or through both skins.

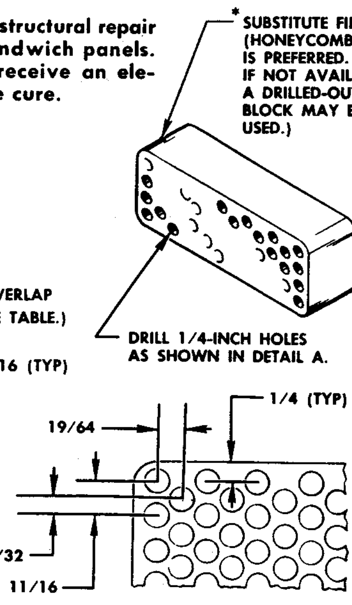
NONSTRUCTURAL REPAIR

NOTE Repair may be made on one or both surfaces.

*Materials may be 2014-T6, 2024-T4, 2024-T42, or 7075-T6. Holes should be drilled before block is machined to match contour of part.

Refer to index for structural repair of honeycomb sandwich panels. This repair must receive an elevated-temperature cure.





DETAIL **A**

OVERLAP TABLE				
HOLE "L" (LONGEST SIDE OF CUTOUT)	2 IN.	4 IN.	6 IN.	8 IN.
OVERLAP "D"	2 IN.	2-1/2 IN.	2-3/4 IN.	3 IN.

F-86D-3-31-11B

Figure 4-36. Speed Brake—Honeycomb (Sheet 2 of 4)

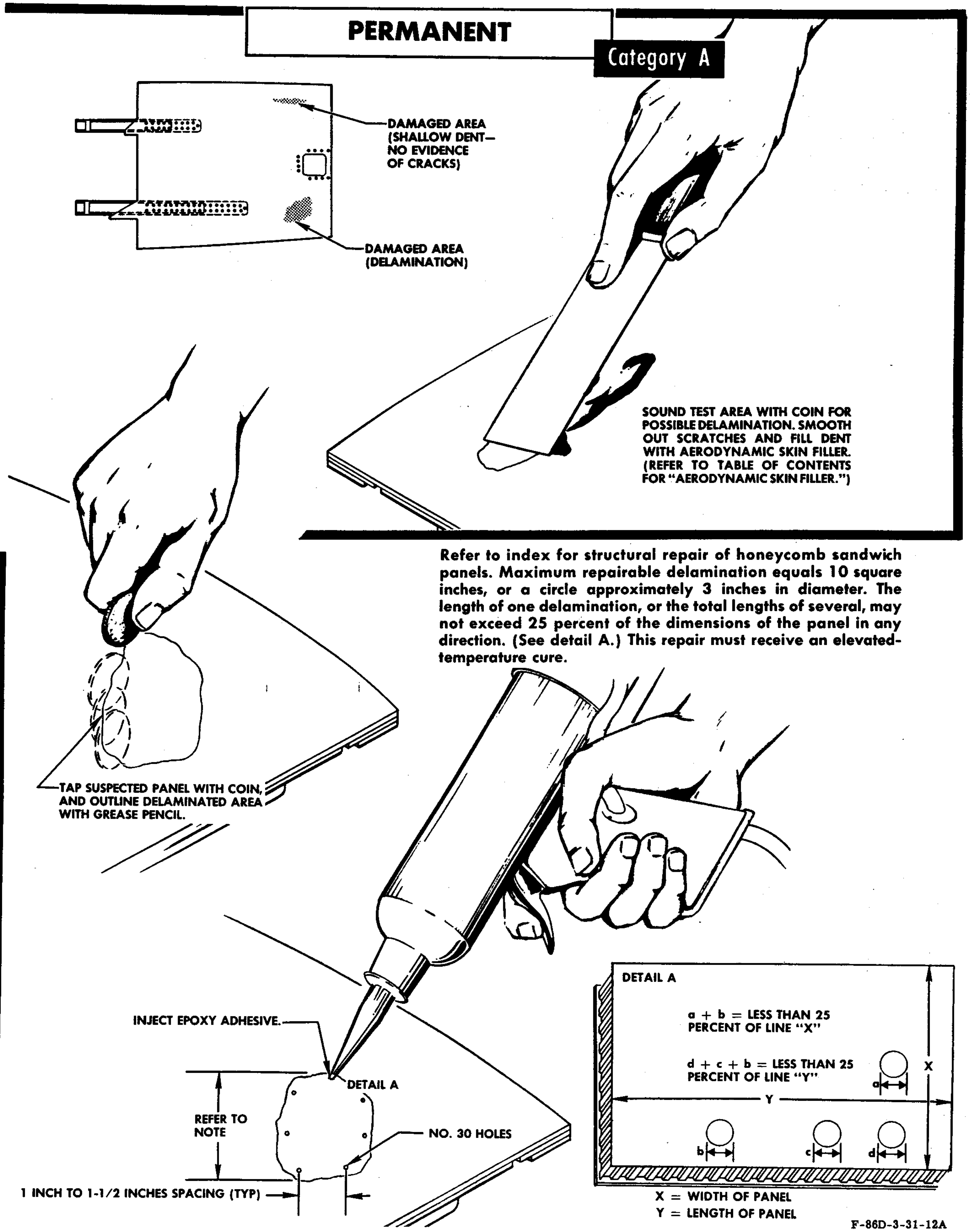
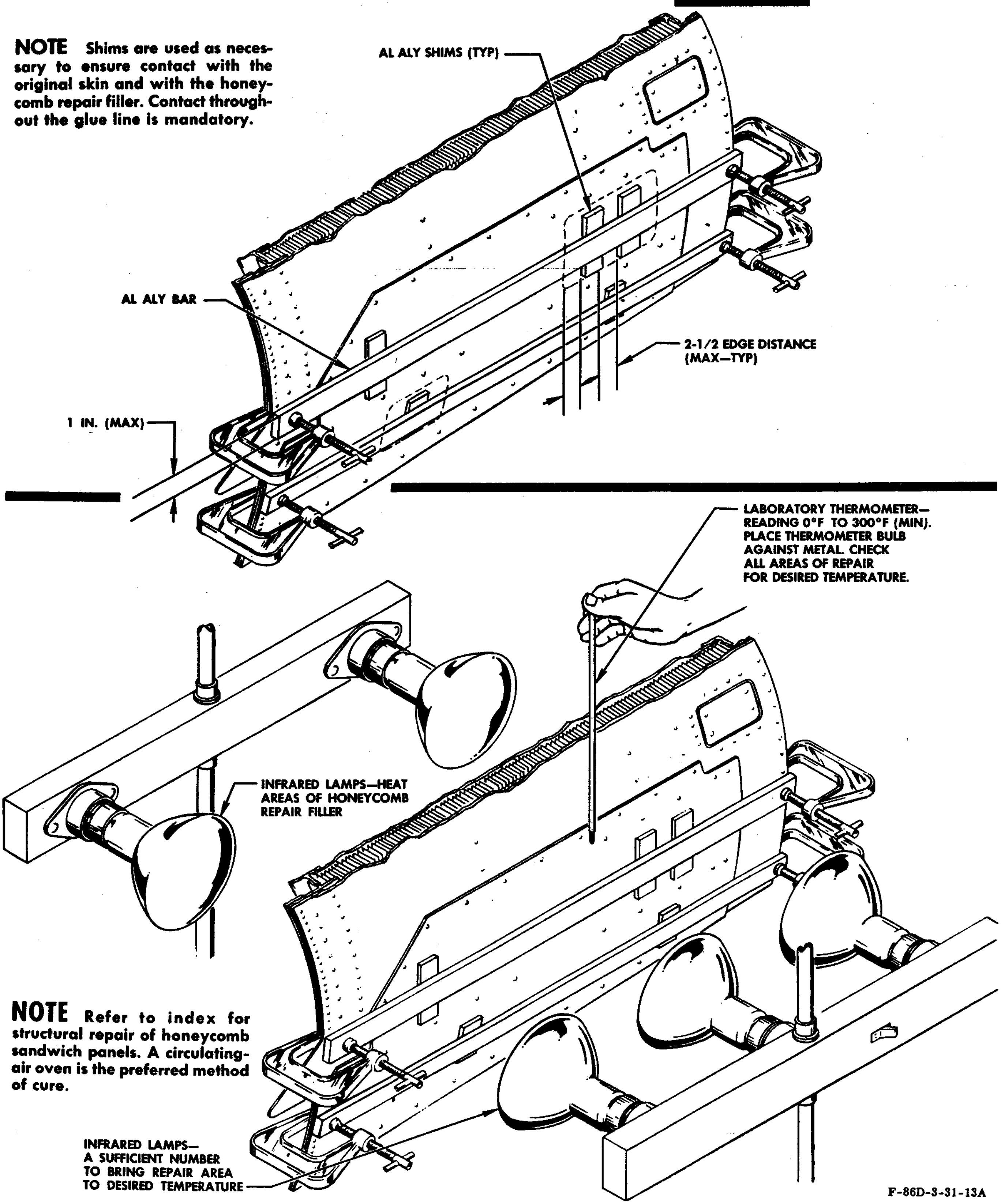


Figure 4-36. Speed Brake—Honeycomb (Sheet 3 of 4)

PERMANENT

Category A

NOTE Shims are used as necessary to ensure contact with the original skin and with the honeycomb repair filler. Contact throughout the glue line is mandatory.

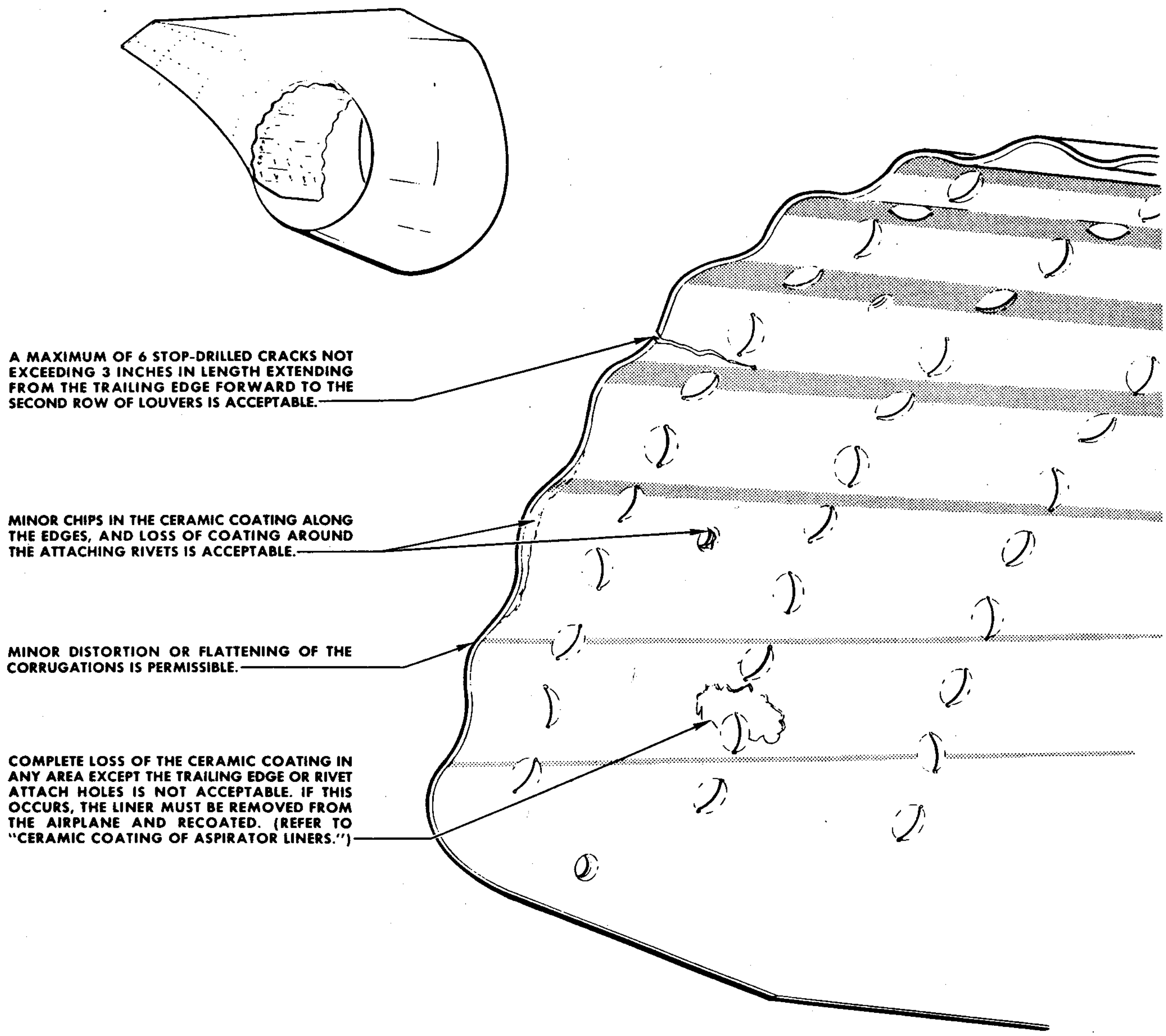


NOTE Refer to index for structural repair of honeycomb sandwich panels. A circulating-air oven is the preferred method of cure.

Figure 4-36. Speed Brake—Honeycomb (Sheet 4 of 4)

ASPIRATOR LINER NEGLIGIBLE DAMAGE

FUSELAGE



NOTE Aspirator liners that are cracked or have broken-out areas in the leading edge area should be replaced.

F-86D-3-31-56

Figure 4-36A. Negligible Damage Aspirator Liners

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PERMANENT Category A

NOTE Refer to index for page number of bend radii table.

- Monel Cherry rivets may be used in inaccessible areas.
- Monel rivets may be substituted for spot welds.
- When replacing whole frames, use 0.032-inch corrosion-resistant steel.

*Damage other than cracks must be cut out. The cracks may be stop-drilled at the ends, and the original material left in place. A repair doubler must be installed in either case.

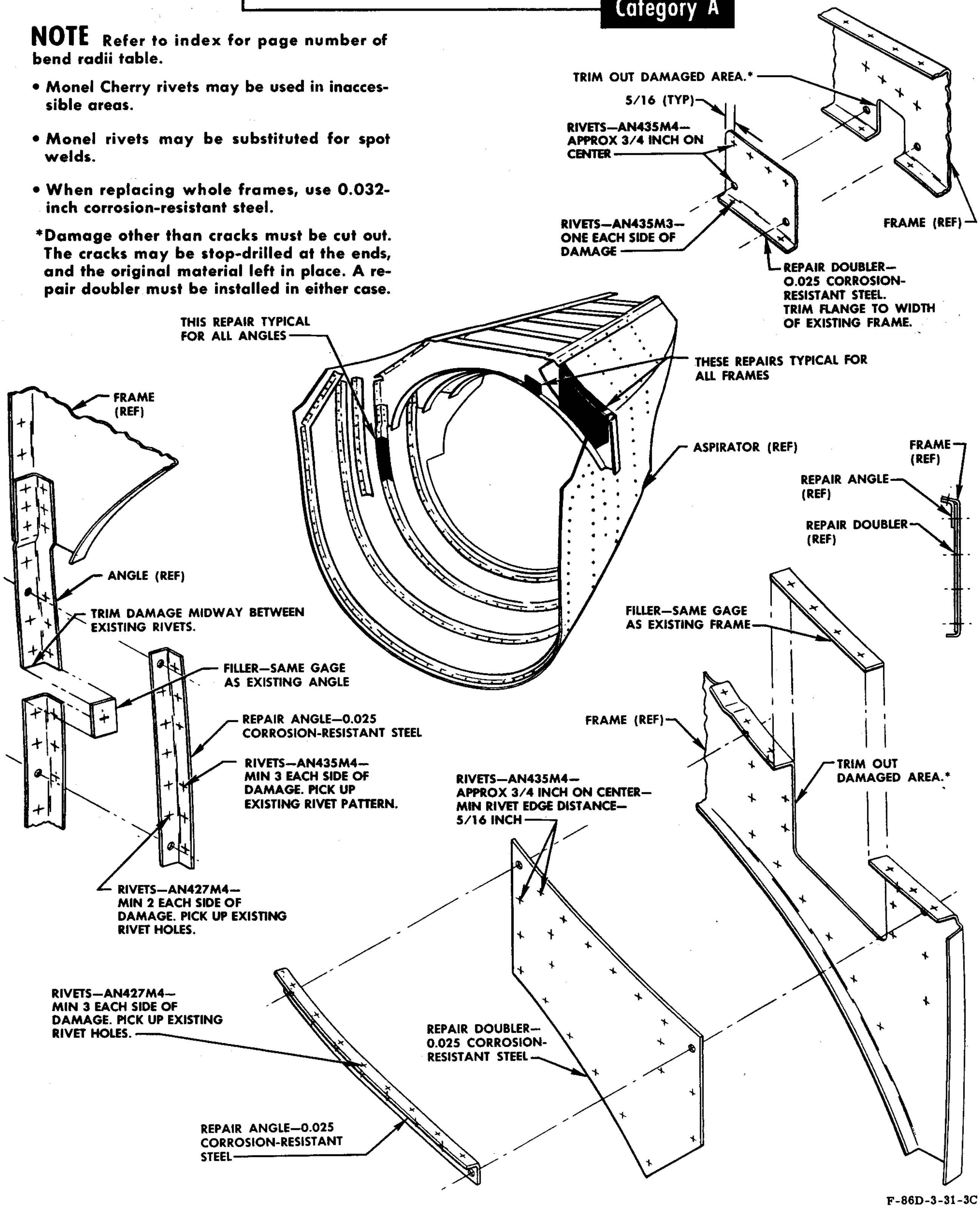
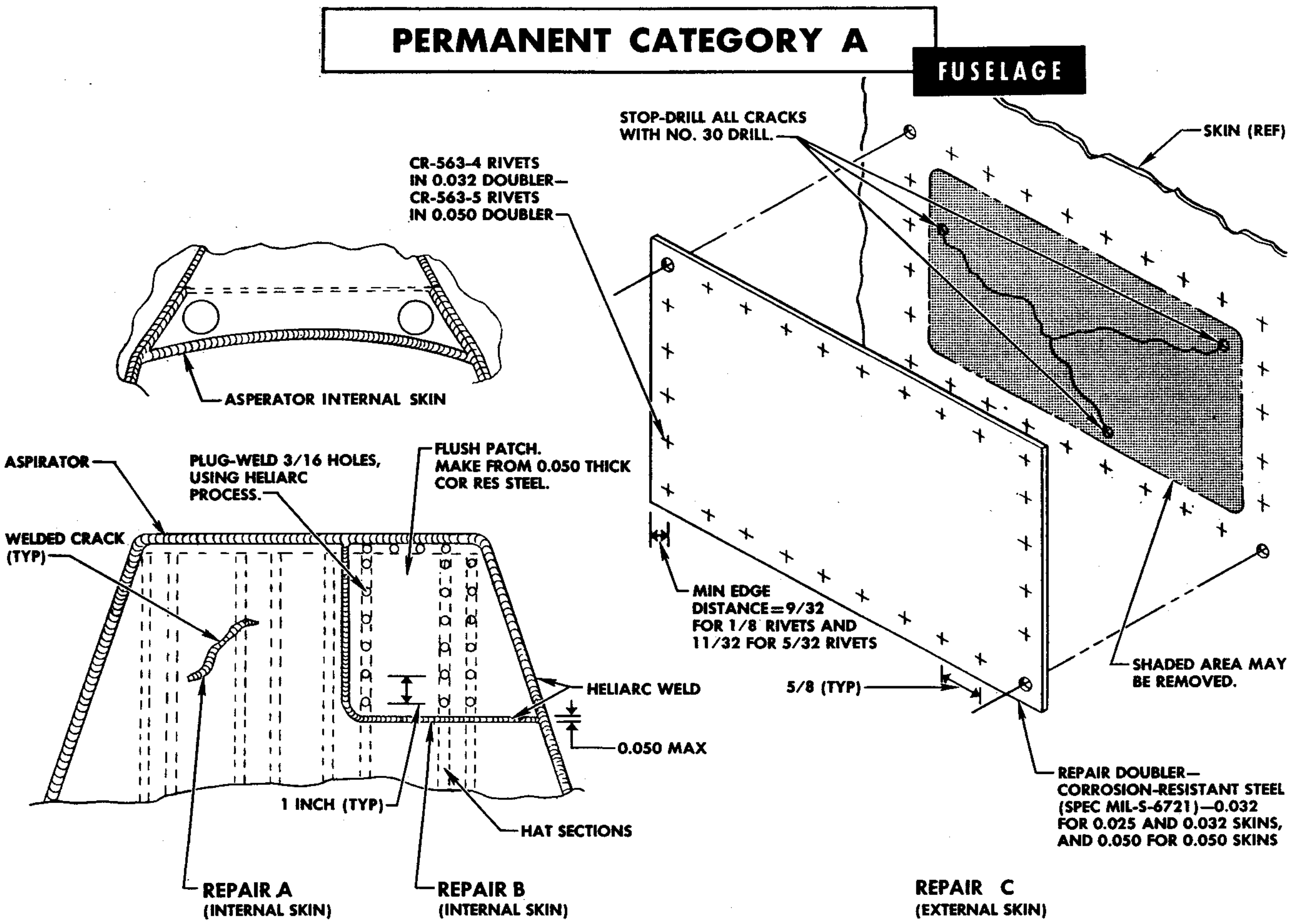


Figure 4-37. Aspirator Frame Repairs



EXTERNAL SKIN

1. Warpage in external skins producing buckles and ripples is allowed if the airplane trim is not affected. A deflection error not exceeding 5 degrees from the original contour of the vortex generator vanes is allowed.

2. For minor buckling and warpage of panels, apply an even heat not to exceed 1400°F to surfaces, and re-form to original contour.

3. For excessive buckling and warpage, relieve expanded metal by cutting. Apply an even heat not to exceed 1400°F to surfaces and re-form to original contour. Install doubler as shown in repair C.

4. Open cracks 3 inches in length or less should be repaired by welding or by applying doubler. Open cracks longer than 3 inches must be repaired by applying doubler.

5. Metallic arc or inert arc (Heliarc) welding is recommended for weld repair. Oxyacetylene welding is allowed on 0.035-inch or thinner metal.

6. Old weld areas may be repaired after proper cleaning. If the area cannot be rewelded, the weld area may be removed and the doubler applied as shown.

7. Pulled spot welds, which are free from other damage, may be drilled out and replaced with NAS508M, AN427M, CR-562, and CR-563 rivets.

INTERNAL SKIN

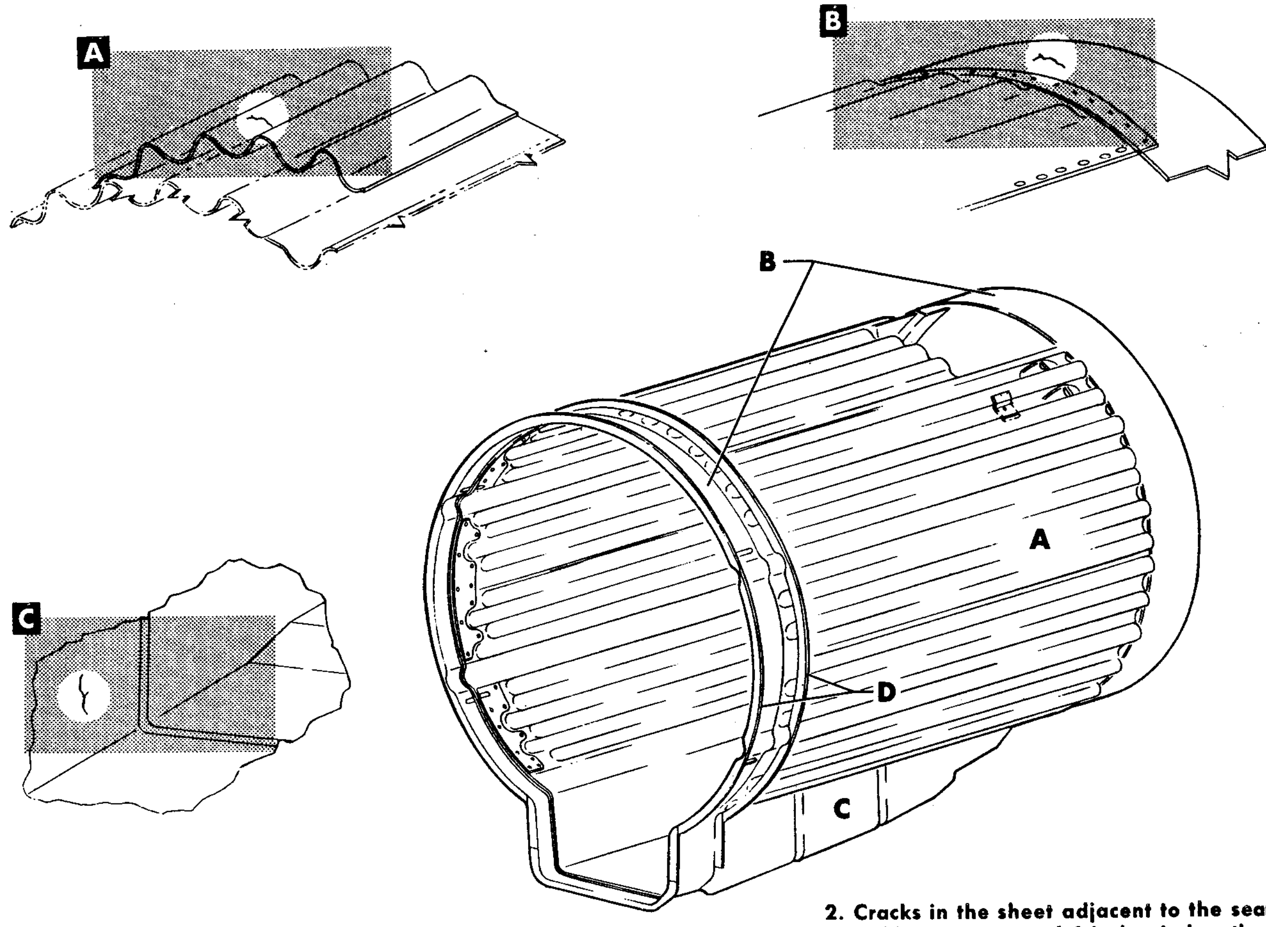
Repair all cracks as shown. Repair A is used for repair of simple cracks. They should be Heliarc welded. Repair B is used for an extended crack damage. Trim out damaged area and weld (Heliarc) in a flush patch. Remove damaged portion of skin seam-welded to internal hat section by grinding. Secure flush patch to structure by drilling 3/16-inch holes in patch and plug-weld as shown.

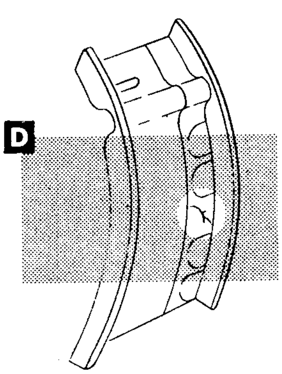
F-86K-3-31-73A

Figure 4-38. Aspirator Skin Repairs

PERMANENT

Category A





CRACKS IN AREA A

1. Cracks up to 2 inches in length may be repaired by stop-drilling with a No. 30 drill and installing a 0.016- or 0.020-inch corrosion-resistant steel doubler (Specification MIL-S-6721). The doublers are to be attached with a single row (minimum) of spot welds (3/8-inch overcenter and 5/16-inch edge distance) or NAS508M4 rivets (1/2-inch overcenter and 5/16-inch edge distance).
2. Cracks adjacent to the louvers are acceptable without repair (condition 1) if covered by doublers called out on shrouds changed by T. O. 1F-86D-202.

CRACKS IN AREA B

Cracks in area B which are covered by doublers on shrouds changed by T.O. 1F-86D-202 are acceptable under the following conditions:

1. All cracks are stop-drilled with a No. 30 drill.
2. Cracks in the sheet adjacent to the seam weld can not exceed 6 inches in length.
3. Cracks in 25 percent of the circumference are acceptable provided at least 6 inches of the circumference is undamaged between cracks.
4. Cracks which begin in area B and extend into area A may be repaired as outlined for area A.

CRACKS IN AREA C—BOTTOM PAN

1. No cracks or repairs in the bottom pan which permit fuel leakage into the aft fuselage are permitted.
2. Cracks elsewhere in the pan may be repaired as described for area A except 0.020-inch gage material is to be used.

CRACKS IN AREA D

1. Cracks in the forward angles up to one inch in length are acceptable after stop-drilling with a No. 30 drill. No cracks are permitted in the upstanding flanges without repair.

F-86D-3-31-31

Figure 4-39. Fixed Shroud Repair

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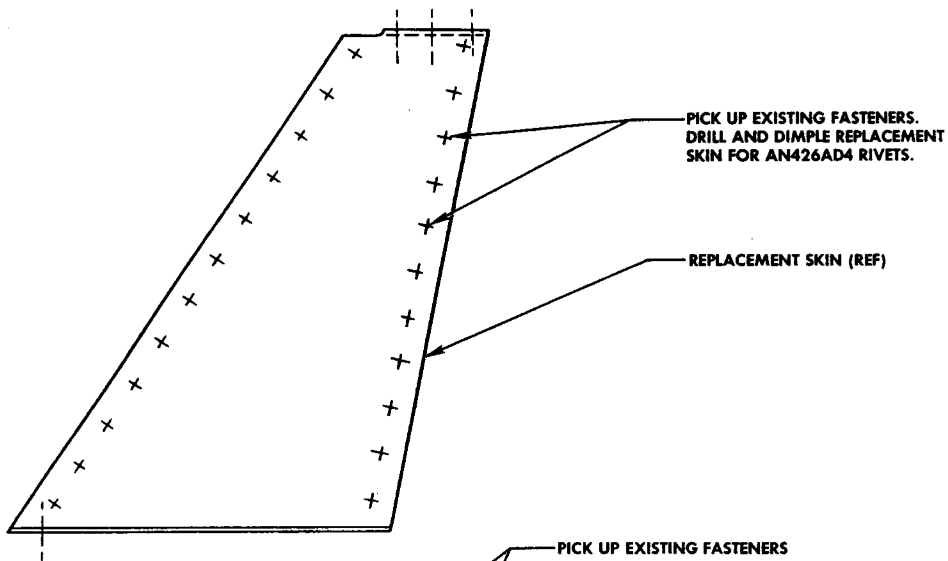
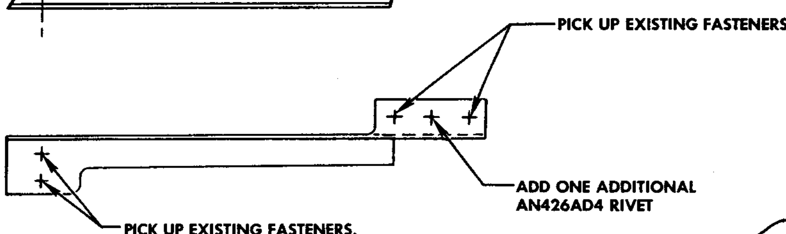
PERMANENT CATEGORY A

FUSELAGE





1. Remove damaged area by trimming damaged liner aft of 190-25125 frame at about fuselage station 425.750.
2. After trimming damaged liner, smooth all of its edges and corners.
3. Make replacement skin from 2024-T4 material.
4. Drill and dimple replacement skin to match existing fasteners through frames, angles, and skins.
5. Insert replacement skin under original liner.
6. Fasten replacement skin in place, using AN426AD4 rivets: 11 rivets through 190-25125 frame, 14 through 190-25124-2 frame and 190-25002-20 clip, and two through 190-25002-6 angle. Add one additional rivet through 190-25002-6 angle.

NOTE

This repair is applicable to either side of drag chute compartment.

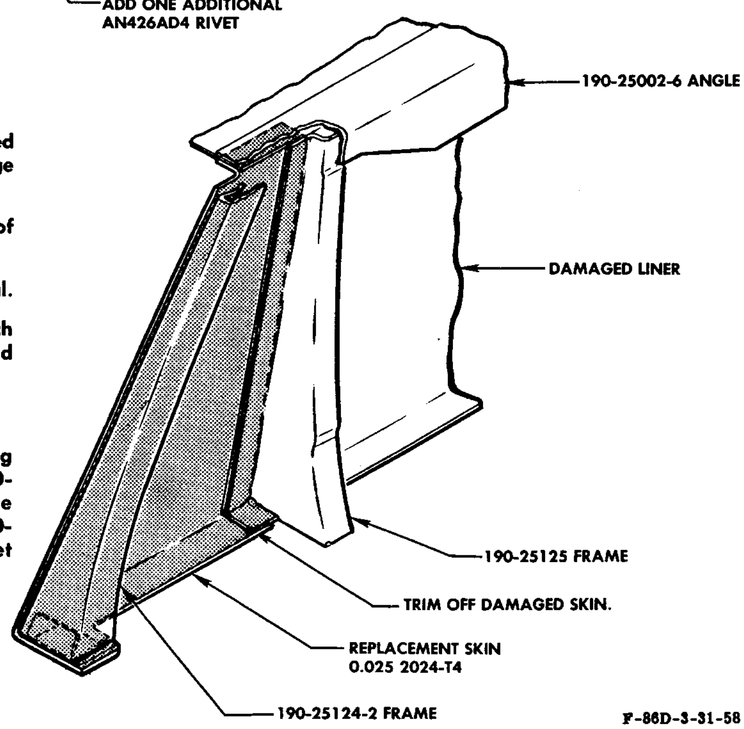


Figure 4-39B. Replacing Sections of Drag Chute Liner

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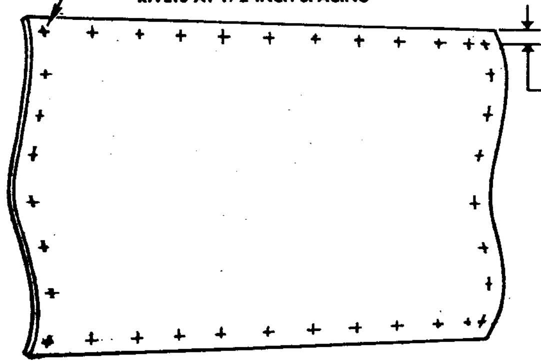
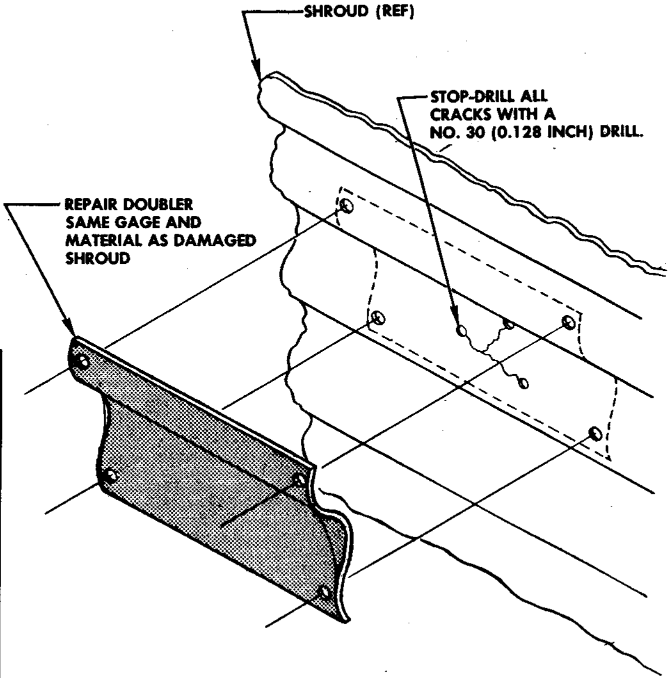
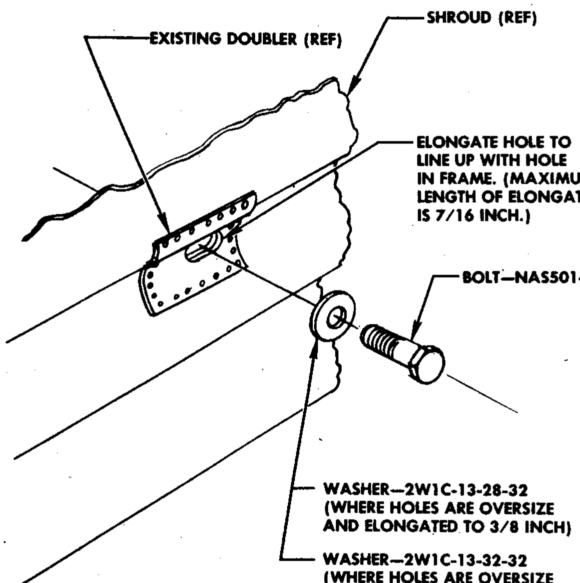
PERMANENT CATEGORY A

FUSELAGE





SHROUD ASSEMBLIES IN WHICH THE 5/16-INCH MOUNTING HOLES DO NOT LINE UP WITH THE CORRESPONDING HOLES IN THE FRAMES MAY BE REWORKED IN THIS MANNER.



1. Stop-drill all cracks with a No. 30 (0.128-inch) drill.
2. Manufacture repair doubler from same type and gage material as damaged shroud.
3. Form repair doubler to match corrugations of damaged shroud.
4. Fasten repair doubler in position with either spotwelds or rivets, using type, size, and spacing called out.

NOTE

Cracks up to 2 inches in length may be repaired as shown.

- No crack or repair which would allow fuel to leak into the aft fuselage is permitted in the bottom of the pan.
- Cracks elsewhere in the pan may be repaired as shown by using a 0.020-inch repair doubler.
- Engine-mounted shrouds may also be repaired in the same manner.

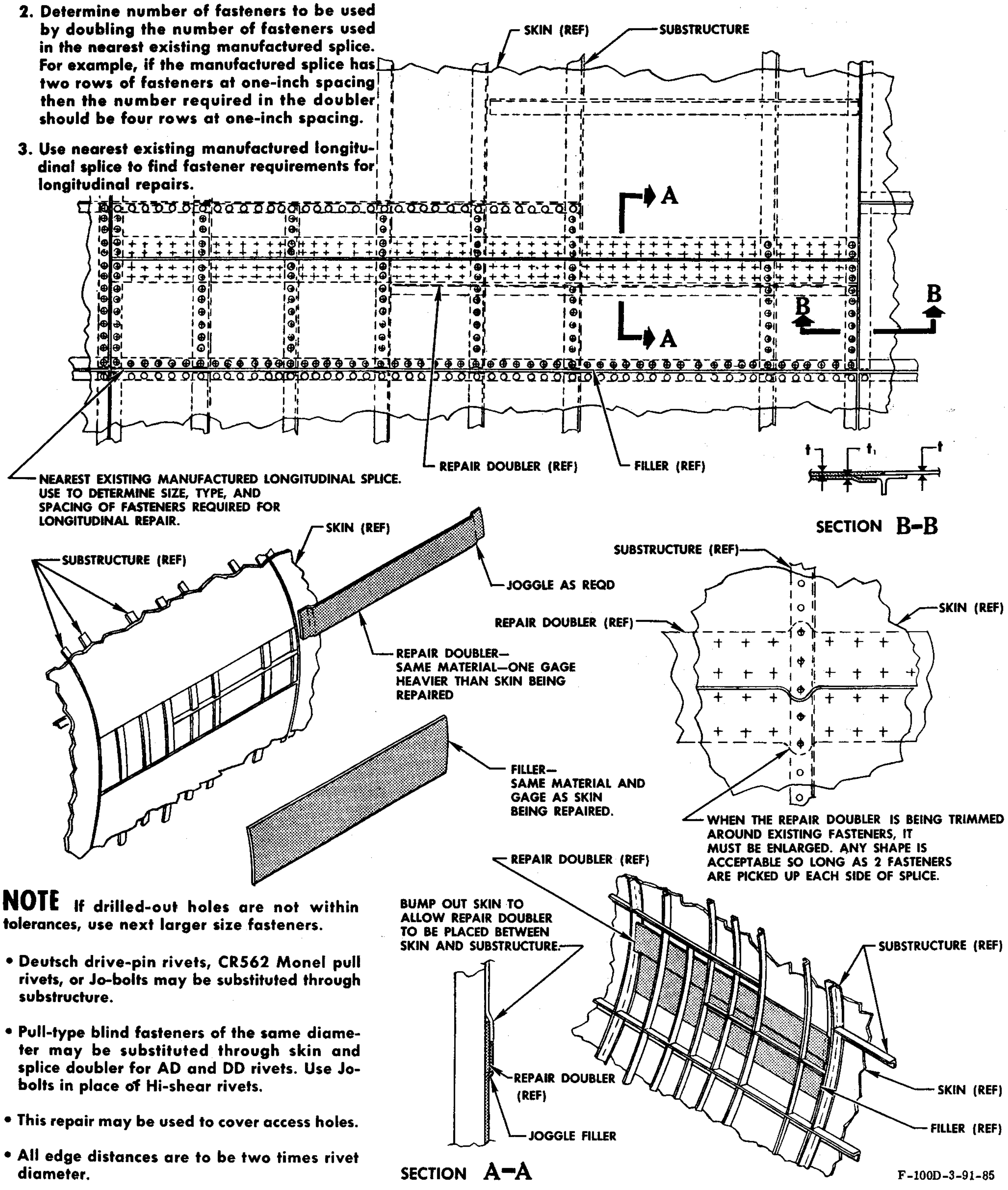
F-86K-3-31-82

Figure 4-39A. Aft Shroud Repair

PERMANENT—CATEGORY A

FUSELAGE

1. Trim out damage midway between existing fasteners.
2. Determine number of fasteners to be used by doubling the number of fasteners used in the nearest existing manufactured splice. For example, if the manufactured splice has two rows of fasteners at one-inch spacing then the number required in the doubler should be four rows at one-inch spacing.
3. Use nearest existing manufactured longitudinal splice to find fastener requirements for longitudinal repairs.



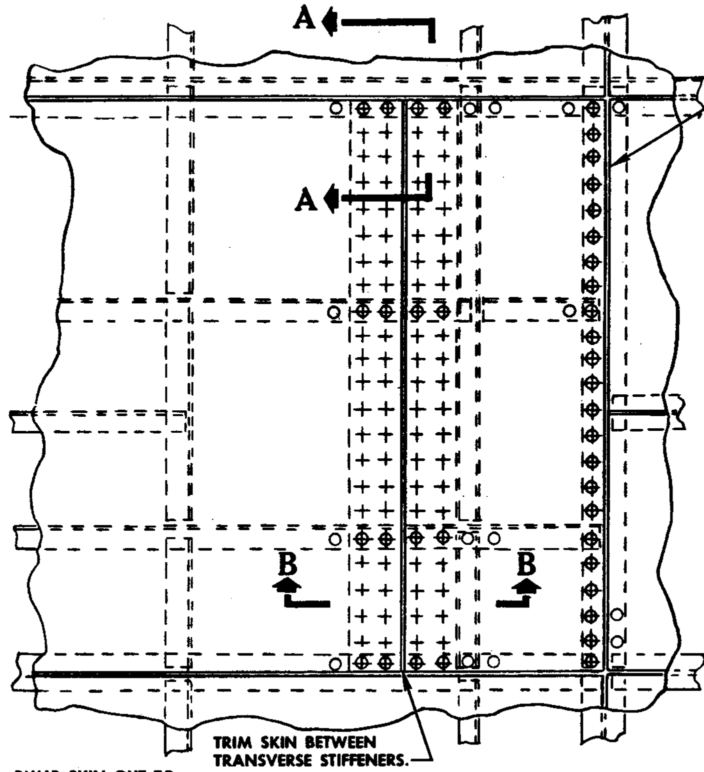
NOTE If drilled-out holes are not within tolerances, use next larger size fasteners.

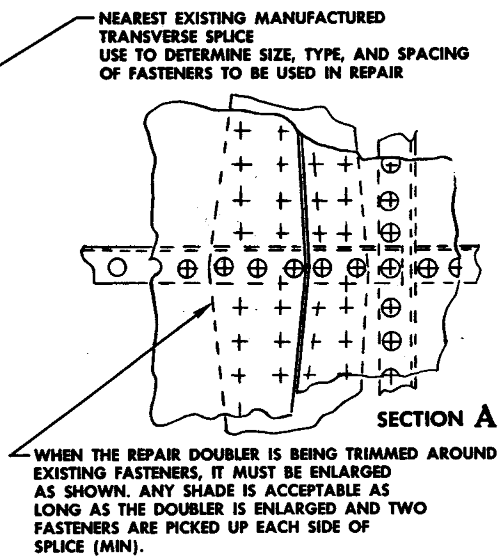
- Deutsch drive-pin rivets, CR562 Monel pull rivets, or Jo-bolts may be substituted through substructure.
- Pull-type blind fasteners of the same diameter may be substituted through skin and splice doubler for AD and DD rivets. Use Jo-bolts in place of Hi-shear rivets.
- This repair may be used to cover access holes.
- All edge distances are to be two times rivet diameter.

Figure 4-40. Skin Splice—Shear (Sheet 1 of 4)

PERMANENT—CATEGORY A

FUSELAGE

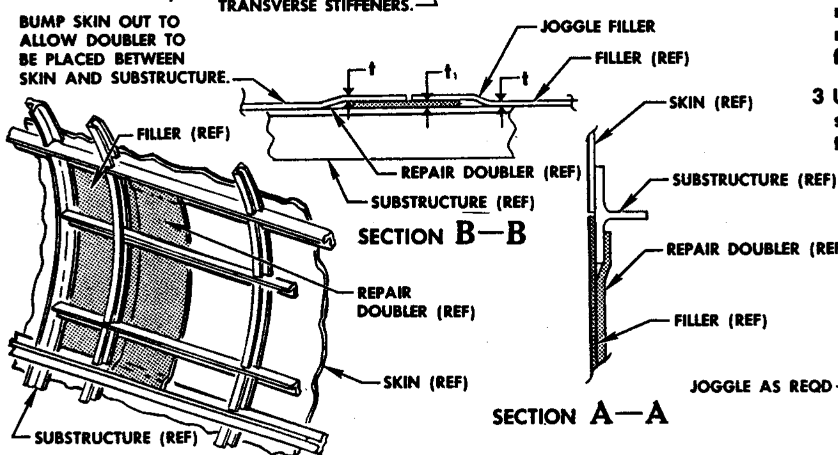


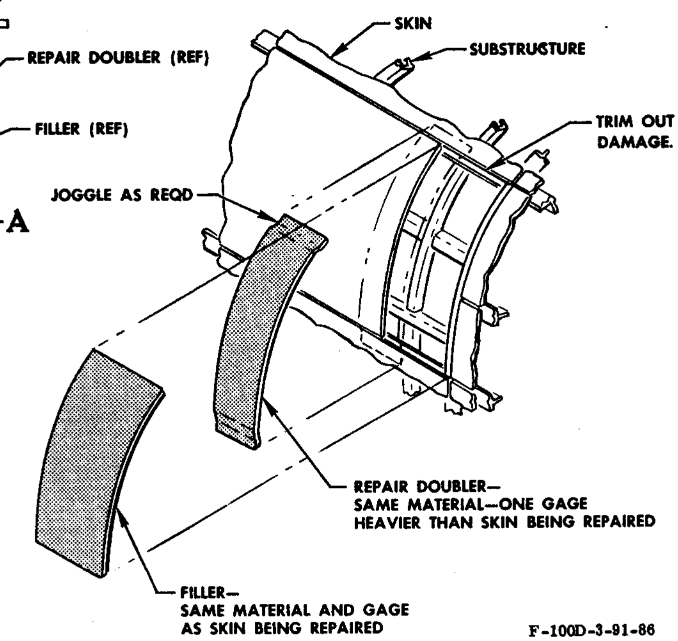


1 Trim out damage midway between existing fasteners.

2 Determine number of fasteners to be used by doubling number of fasteners used in nearest existing manufactured splice. For example, if the manufactured splice has two rows of fasteners at one-inch spacing, the number required for the doubler would be four rows of fasteners at one-inch spacing.

3 Use nearest existing manufactured transverse splice to find fastener requirements for transverse repairs.





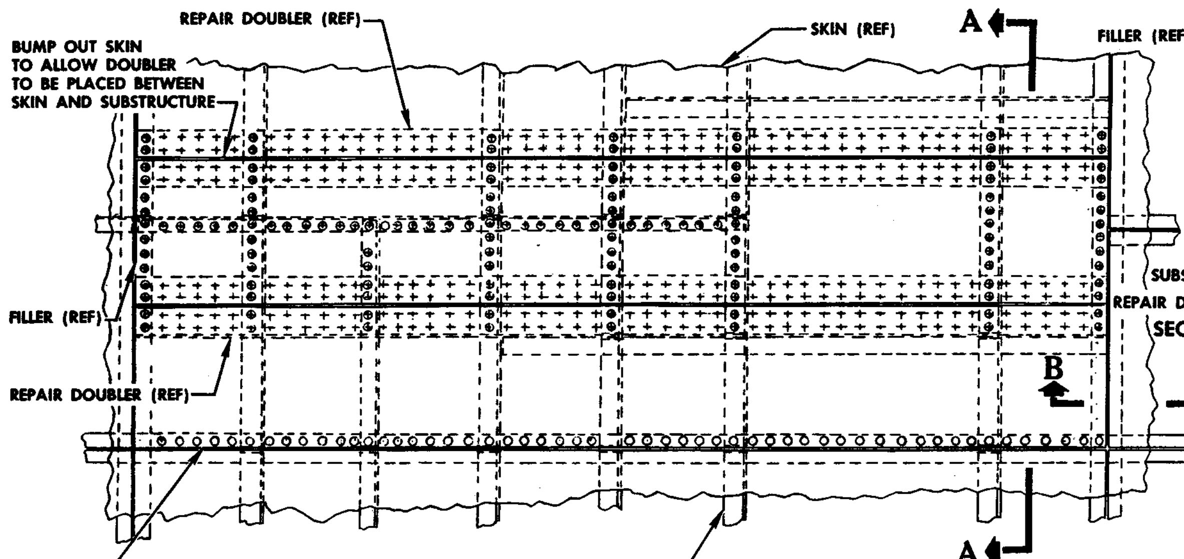
NOTE If drilled-out holes are not within tolerances, use next larger size fasteners.

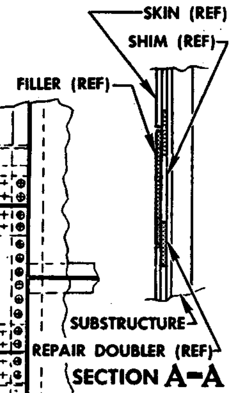
- Deutsch drive-pin rivets, CR562 Monel pull rivets, or Jo-bolts may be substituted through substructure.
- Pull-type blind fasteners of the same diameter may be substituted through skin and splice doubler for AD and DD rivets. Use Jo-bolts in place of Hi-shear rivets.
- This repair may be used to cover access holes.
- All edge distances are to be two times rivet diameter.

Figure 4-40. Skin Splice—Shear (Sheet 2 of 4)

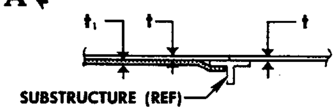
PERMANENT CATEGORY A

FUSELAGE

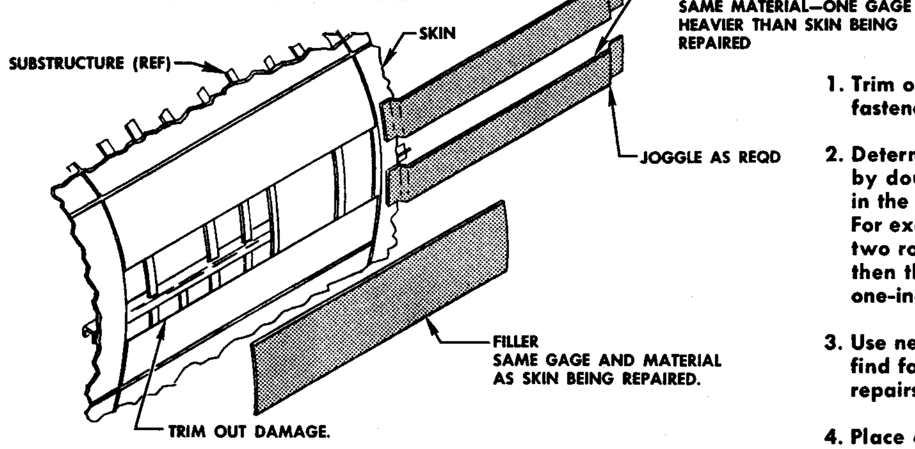




SECTION A-A



SECTION B-B



1. Trim out damage midway between existing fasteners.

2. Determine number of fasteners to be used by doubling the number of fasteners used in the nearest existing manufactured splice. For example, if the manufactured splice has two rows of fasteners at one-inch spacing, then the doubler would have four rows at one-inch spacing.

3. Use nearest existing manufactured splice to find fastener requirements for longitudinal repairs.

4. Place a shim on the substructure between doublers, where filler is away from substructure.

NOTE If drilled-out holes are not within tolerances, use next larger size fasteners.

- Deutsch drive-pin rivets, CR562 Monel pull rivets, or Jo-bolts may be substituted through substructure.
- Pull-type blind fasteners of the same diameter may be substituted through skin and splice doubler for AD and DD rivets. Use Jo-bolts in place of Hi-shear rivets.
- This repair may be used to cover access holes.
- All edge distances are to be two times rivet diameter.

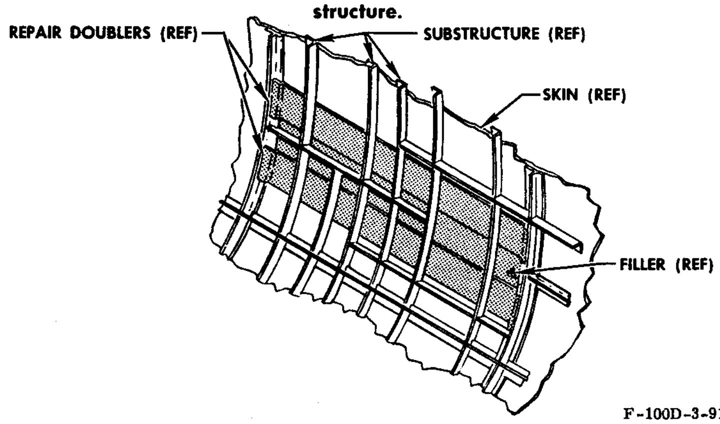


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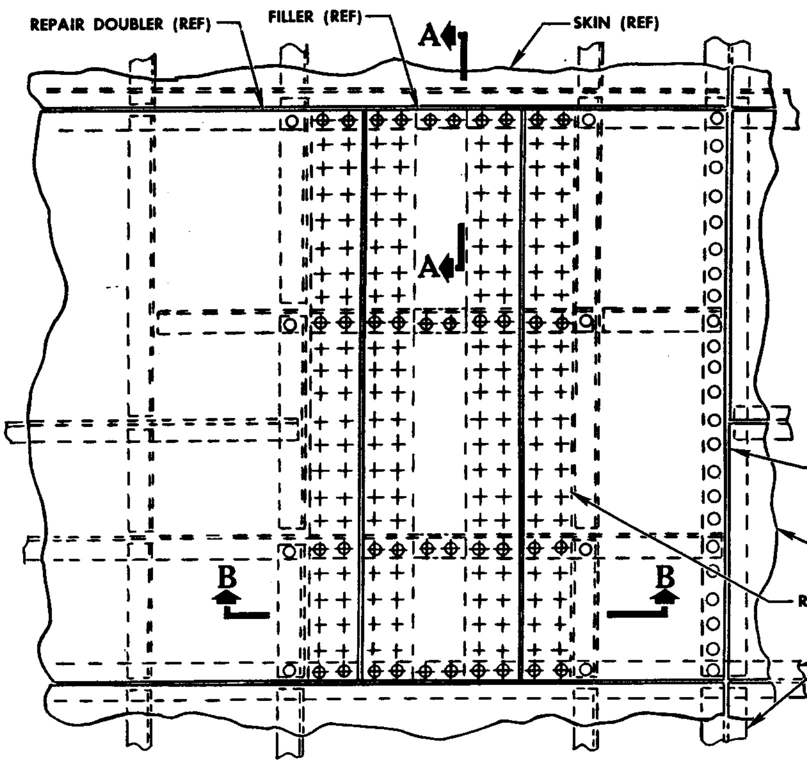
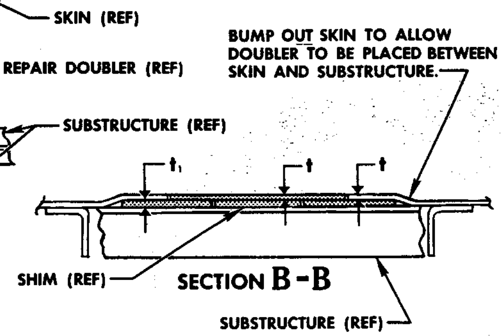
Figure 4-40. Skin Splice—Shear (Sheet 3 of 4)

PERMANENT—CATEGORY A

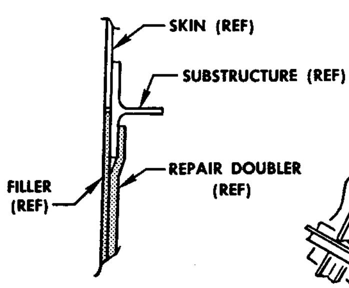
FUSELAGE



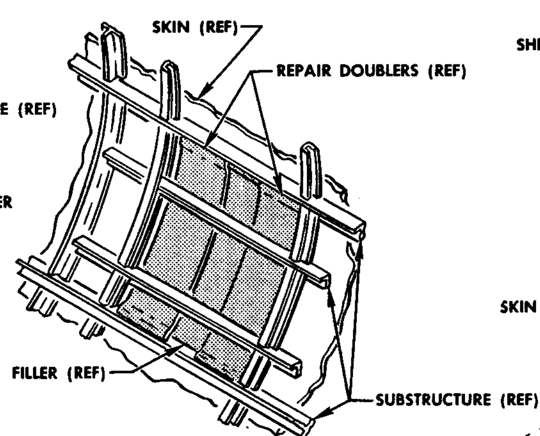
1. Trim out damage midway between existing fasteners.
2. Determine number of fasteners to be used by doubling number of fasteners used in nearest existing manufactured splice. For example, if the manufactured splice has two rows of fasteners at one-inch spacing, the number required in the doubler should be four rows at one-inch spacing.
3. Use nearest existing manufactured transverse splice to find requirements for transverse repairs.
4. Put a shim the same gage as doublers between doublers on substructure to take up gap between filler and substructure.



SECTION B-B

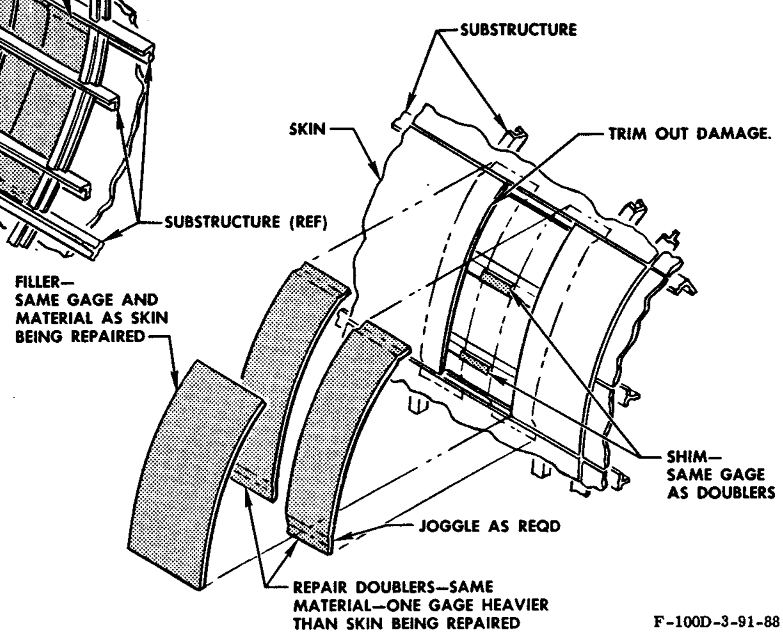


SECTION A-A



NOTE If drilled-out holes are not within tolerances, use next larger size fasteners.

- Deutsch drive-pin rivets, CR562 Monel pull rivets, or Jo-bolts may be substituted through substructure.
- Pull-type blind fasteners of the same diameter may be substituted through skin and splice doubler for AD and DD rivets. Use Jo-bolts in place of Hi-shear rivets.
- This repair may be used to cover access holes.
- All edge distances are to be two times rivet diameter.

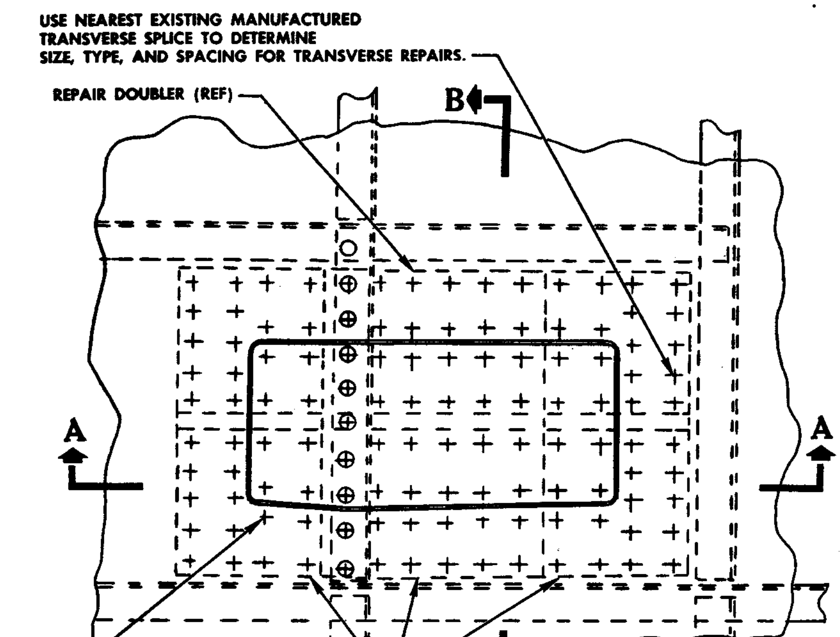


F-100D-3-91-88

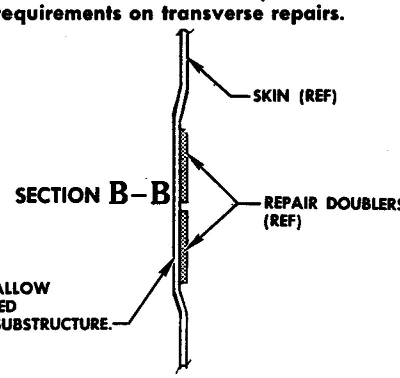
Figure 4-40. Skin Splice—Shear (Sheet 4 of 4)

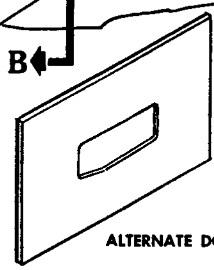
PERMANENT—CATEGORY A

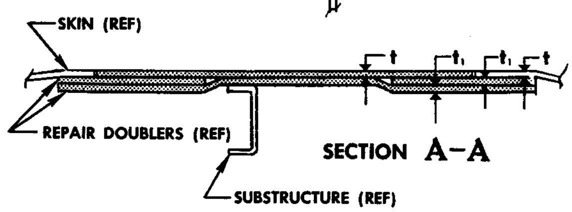
FUSELAGE

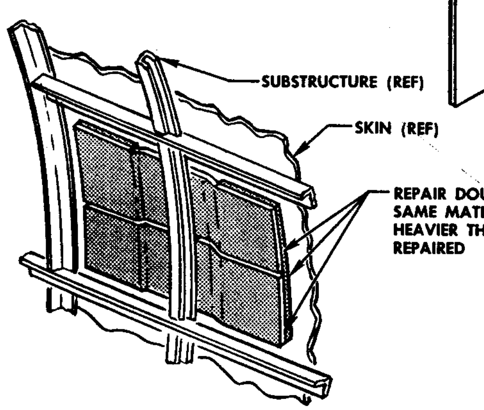


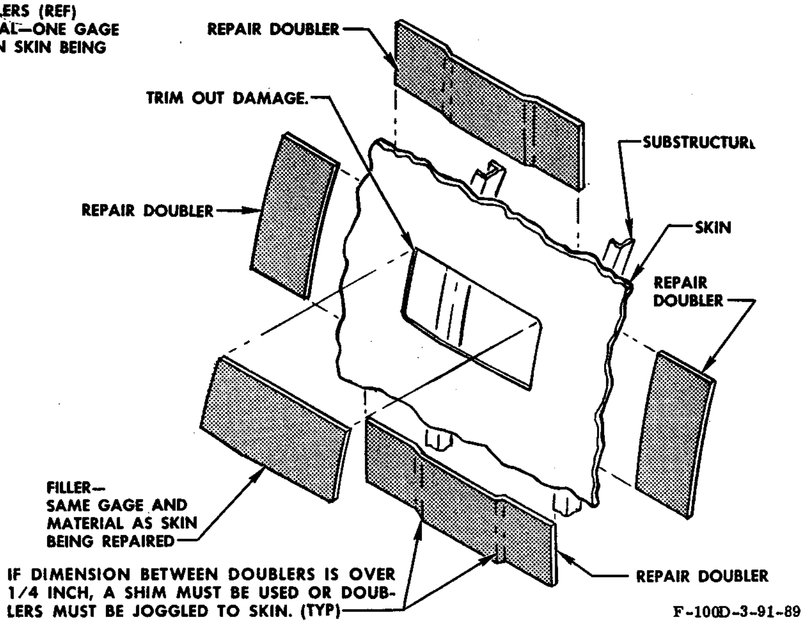
1. Trim out damage midway between existing fasteners.
2. Determine number of fasteners to be used by doubling number of fasteners used in nearest existing manufactured splice. For example, if the manufactured splice has two rows of fasteners at one-inch spacing, the number required for the doubler would be four rows at one-inch spacing.
3. Use nearest existing manufactured longitudinal splice to find fastener requirements for longitudinal repairs. Use nearest existing manufactured transverse splice for fastener requirements on transverse repairs.











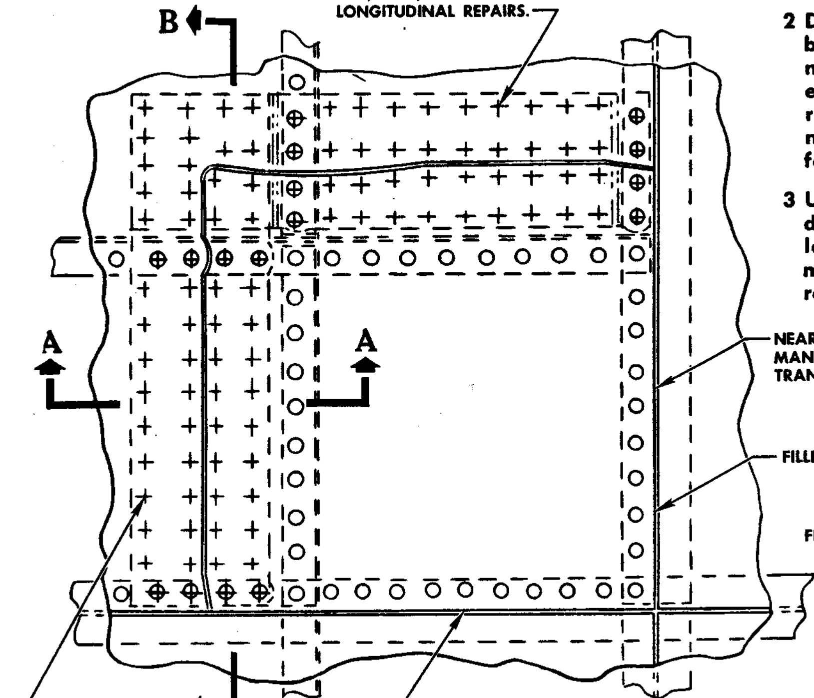
NOTE If drilled-out holes are not within tolerances, use next larger size fasteners.

- Deutsch drive-pin rivets, CR562 Monel pull rivets, or Jo-bolts may be substituted through substructure.
- Pull-type blind fasteners of the same diameter may be substituted through skin and splice doubler for AD and DD rivets. Use Jo-bolts in place of Hi-shear rivets.
- This repair may be used to cover access holes.
- All edge distances are to be two times rivet diameter.

Figure 4-41. Skin Center Repair

PERMANENT—CATEGORY A

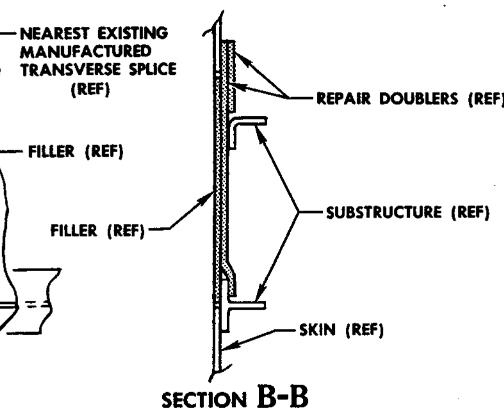
FUSELAGE

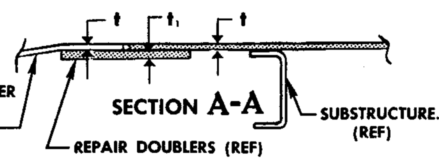


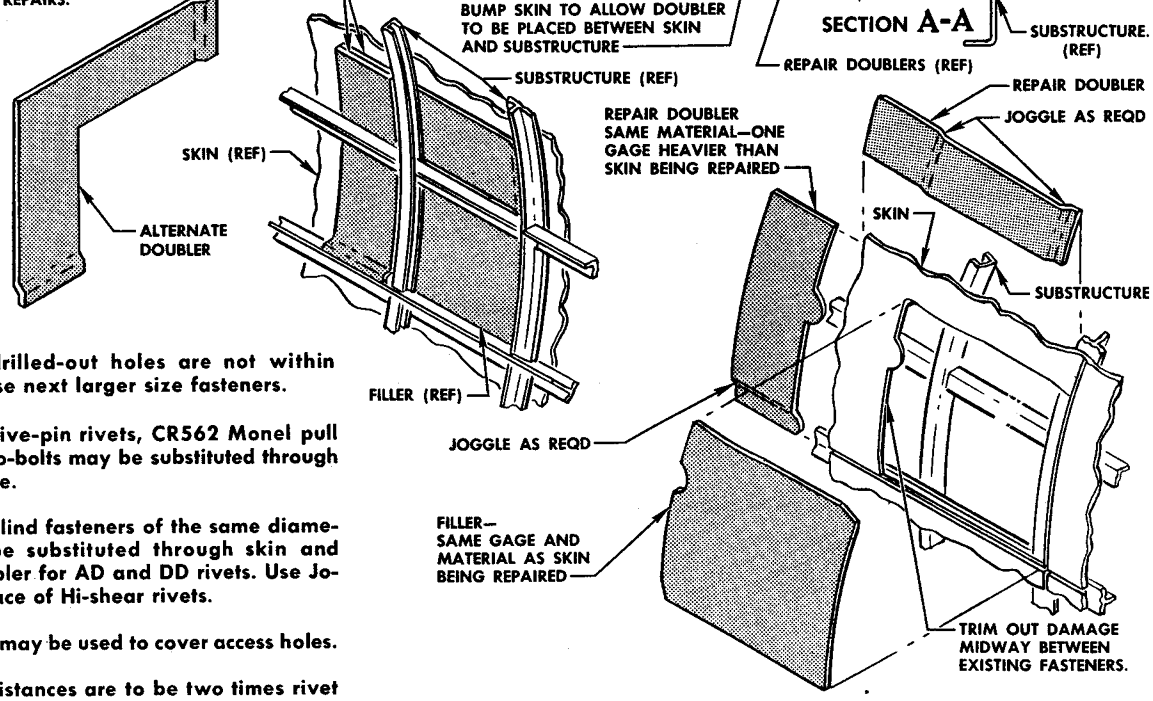
1 Trim out damage midway between existing fasteners.

2 Determine number of fasteners to be used by doubling number of fasteners used in nearest existing manufactured splice. For example, if manufactured splice has two rows of fasteners at one-inch spacing, the number required for the doubler would be four rows of fasteners at one-inch spacing.

3 Use nearest existing manufactured longitudinal splice to find fastener requirements for longitudinal repairs. Use nearest existing manufactured transverse splice for fastener requirements on transverse repairs.







NOTE If drilled-out holes are not within tolerances, use next larger size fasteners.

- Deutsch drive-pin rivets, CR562 Monel pull rivets, or Jo-bolts may be substituted through substructure.
- Pull-type blind fasteners of the same diameter may be substituted through skin and splice doubler for AD and DD rivets. Use Jo-bolts in place of Hi-shear rivets.
- This repair may be used to cover access holes.
- All edge distances are to be two times rivet diameter.

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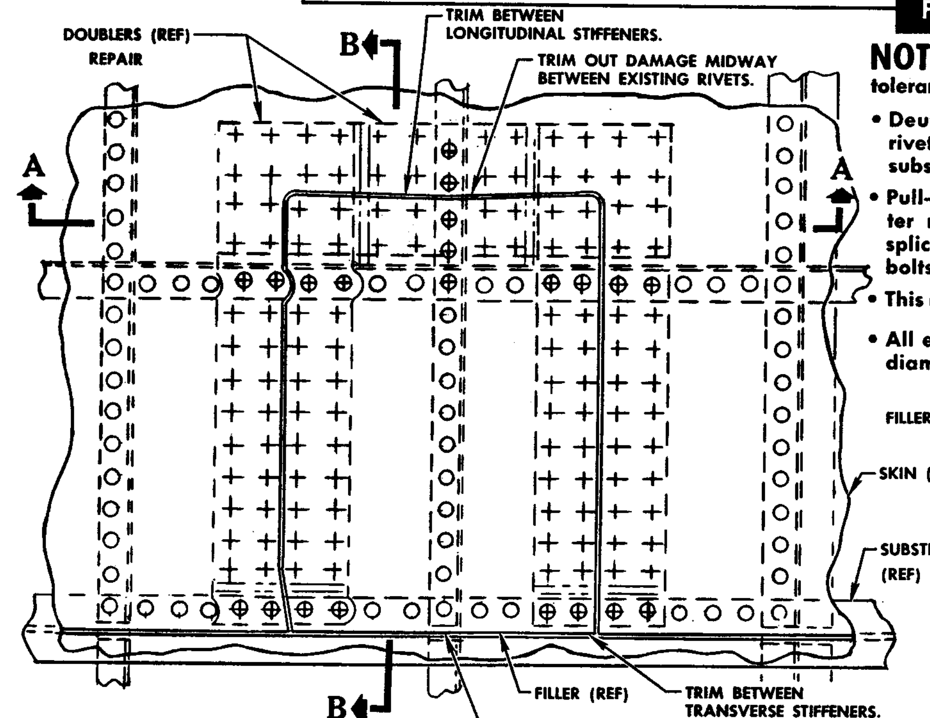
Figure 4-42. Skin End Repair (Sheet 1 of 3)

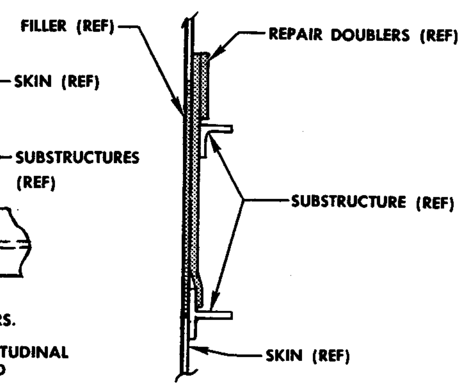
PERMANENT—CATEGORY A

FUSELAGE



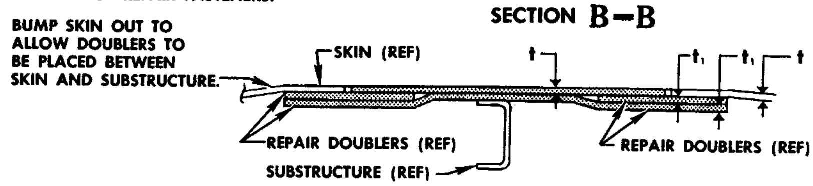
NOTE If drilled-out holes are not within tolerances, use next larger size fasteners.

- Deutsch drive-pin rivets, CR562 Monel pull rivets, or Jo-bolts may be substituted through substructure.
- Pull-type blind fasteners of the same diameter may be substituted through skin and splice doubler for AD and DD rivets. Use Jo-bolts in place of Hi-shear rivets.
- This repair may be used to cover access holes.
- All edge distances are to be two times rivet diameter.

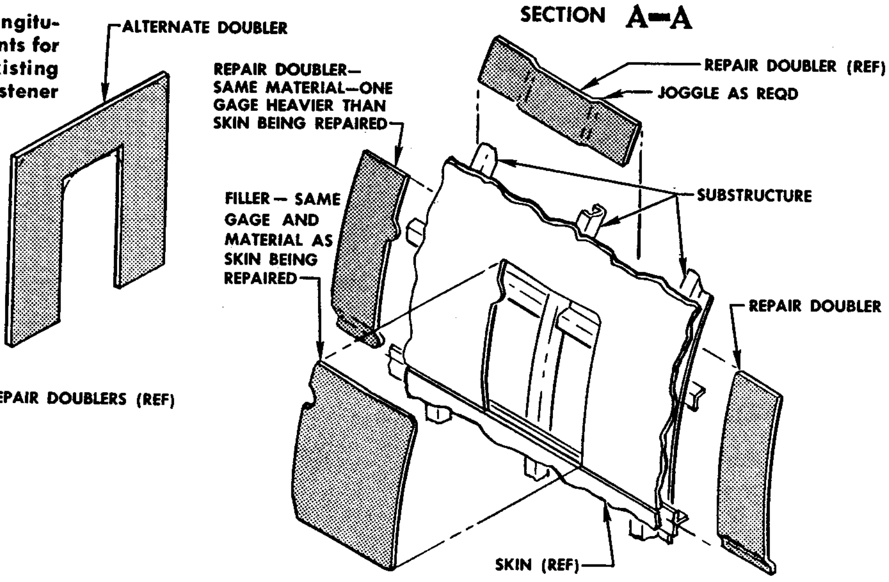


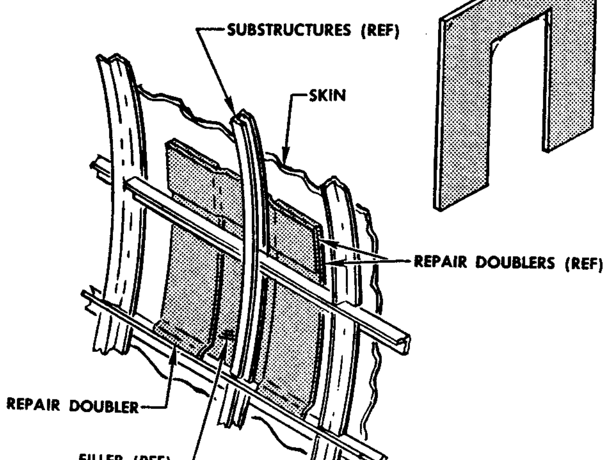
SECTION B—B

1. Trim out damage midway between existing fasteners.
2. Determine number of fasteners to be used by doubling number of fasteners used in nearest existing manufactured splice. For example, if the manufactured splice has two rows of fasteners at one-inch spacing, the number required for the doubler should be four rows of fasteners at one-inch spacing.
3. Use nearest existing manufactured longitudinal splice to find fastener requirements for longitudinal repairs. Use nearest existing manufactured transverse splice for fastener requirements on transverse repairs.



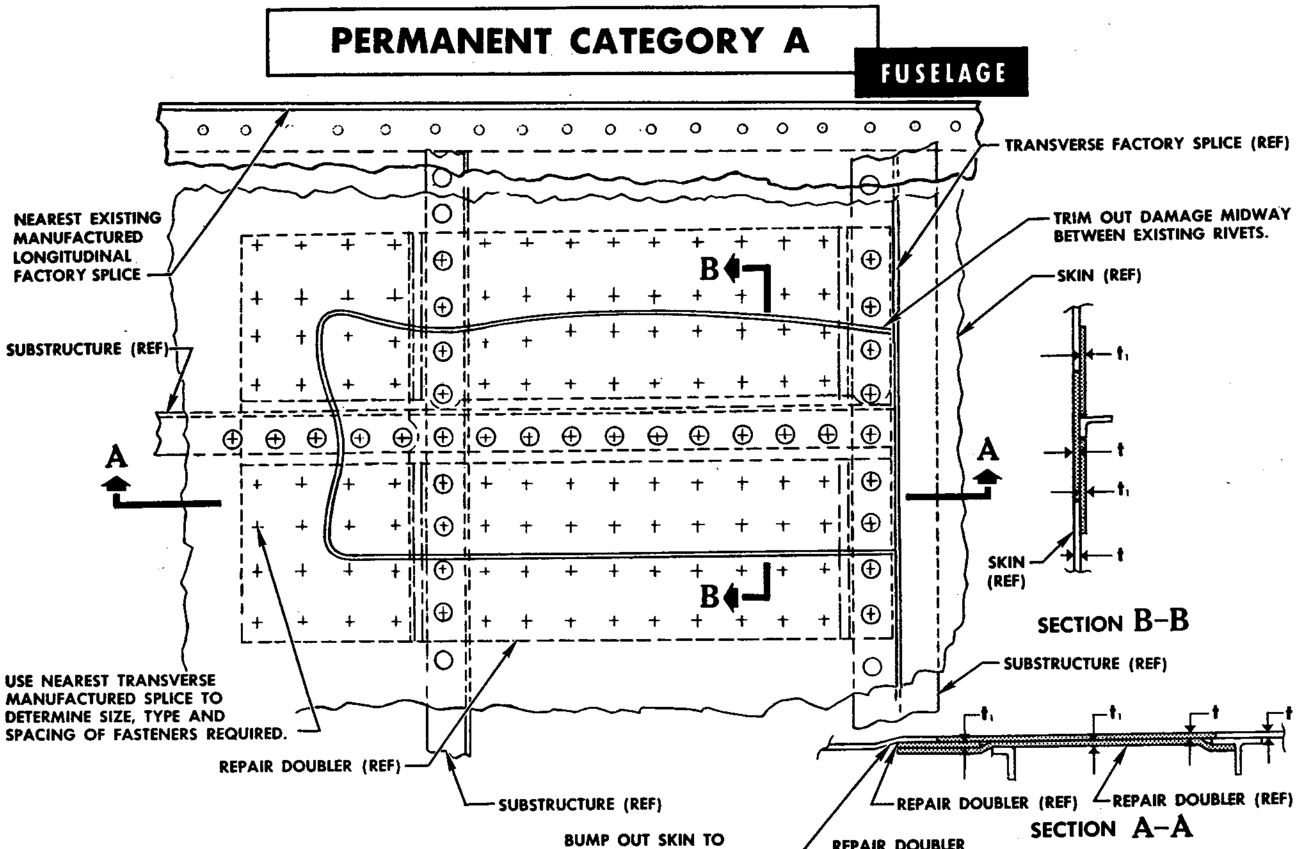
SECTION A—A





F-100D-3-91-91

Figure 4-42. Skin End Repair (Sheet 2 of 3)



NOTE If drilled-out holes are not within tolerances, use next larger size fasteners.

- Deutsch drive-pin rivets, CR562 Monel pull rivets, or Jo-bolts may be substituted through substructure.
- Pull-type blind fasteners of the same diameter may be substituted through skin and splice doubler for AD and DD rivets. Use Jo-bolts in place of Hi-shear rivets.
- This repair may be used to cover access holes.
- All edge distances are to be two times rivet diameter.

1 Trim out damage midway between existing rivets.

2 Determine number of fasteners to be used by doubling number of fasteners used in nearest existing manufactured splice. For example, if the manufactured splice has two rows of fasteners at one-inch spacing, the number required for the doubler would be four rows of fasteners at one-inch spacing.

3 Use nearest existing manufactured longitudinal splice to find fastener requirements for longitudinal repairs.
Use nearest existing manufactured transverse splice for fastener requirements on transverse repairs.

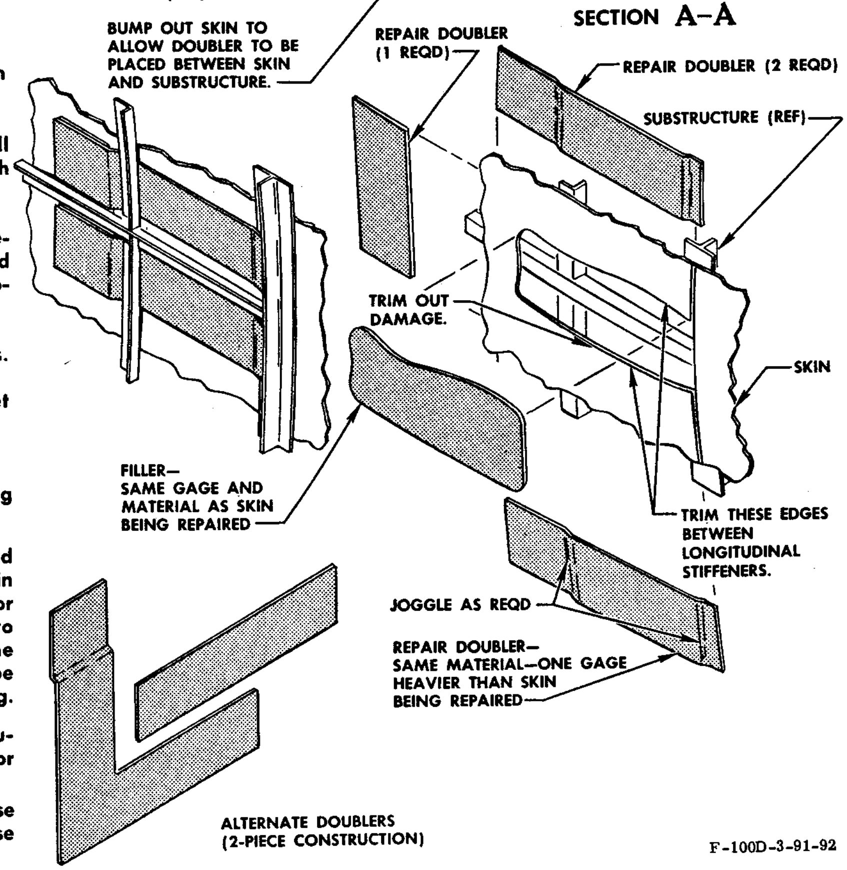
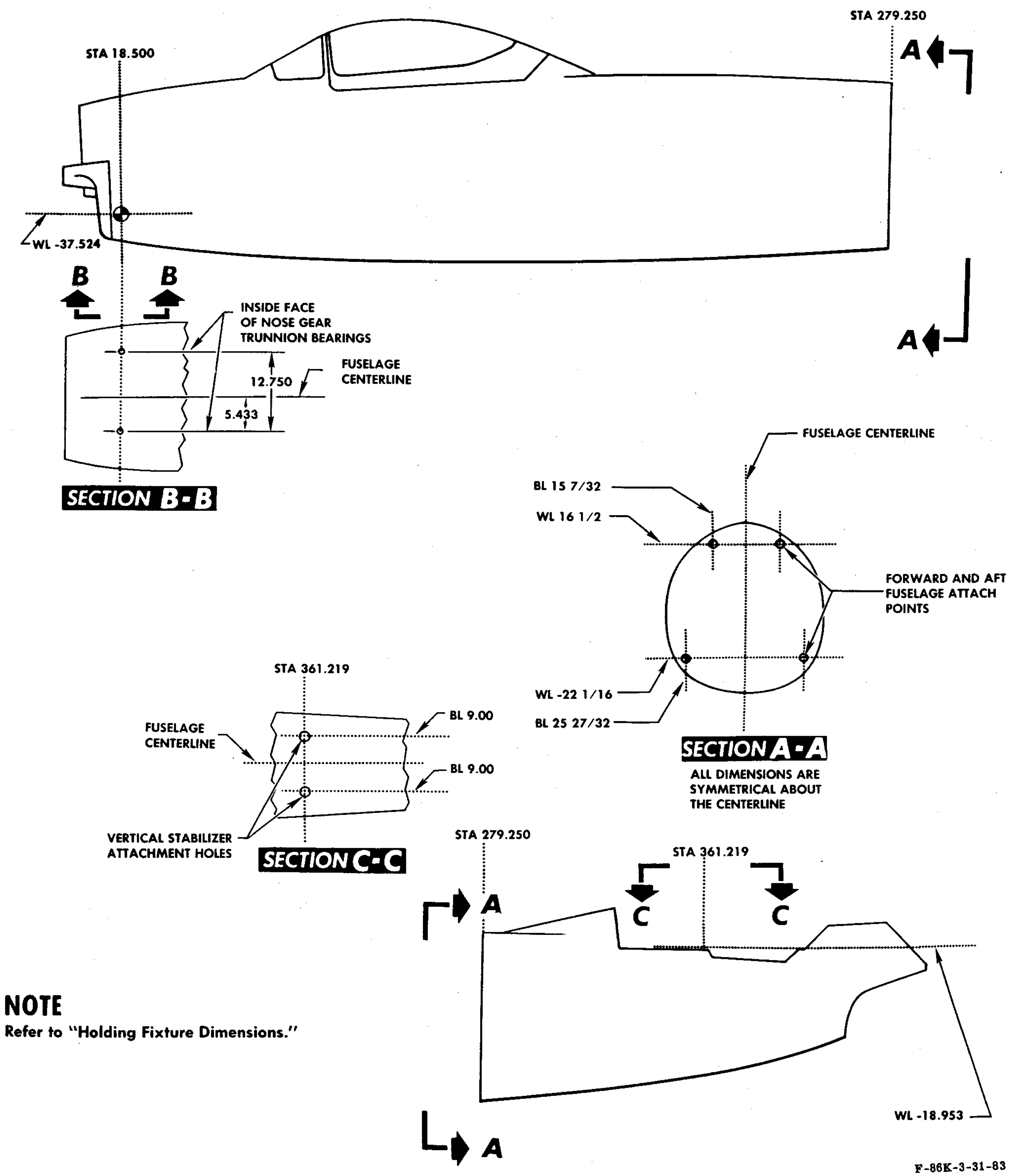


Figure 4-42. Skin End Repair (Sheet 3 of 3)

HOLDING FIXTURE DIMENSIONS

FUSELAGE



NOTE

Refer to "Holding Fixture Dimensions."

Figure 4-43. Holding Fixture Dimensions—Forward and Aft Fuselage

SECTION V

LANDING GEAR

Contents **Page**

DESCRIPTION OF LANDING GEAR....5-1
LANDING GEAR DOORS....5-1
NEGLIGIBLE DAMAGE....5-1
NEGLIGIBLE DAMAGE TO STRUTS....5-1
LANDING GEAR REPAIRS....5-1
STRUT REPAIRS....5-1
TRUNNION SUPPORT BUSHING REPLACEMENT....5-2
ELONGATED AND OVERSIZE BOLT HOLE REPAIRS....5-2
DOOR REPAIRS....5-2

DESCRIPTION OF LANDING GEAR.

The airplane has a tricycle-type landing gear, with two main gears and a nose gear. The landing gear uses air-oil shock struts, and cast magnesium alloy wheels, upon which are mounted extra-high-pressure tires. The brakes are mounted to the main landing gear strut axles. The nose gear is equipped with nose wheel steering. All the landing gear is fully retractable and is faired in by wheel well and shock strut doors. The landing gear system is electrically controlled and hydraulically operated.

A main landing gear air-oil shock strut is mounted to the landing gear trunnion which is attached in each wing to the rear spar.

The landing gear wheels are made of cast magnesium. The wheels are balanced at the time of manufacture, and will remain in balance as long as they are not damaged.

LANDING GEAR DOORS.

The main gear and auxiliary landing gear doors are of metal construction. The inner skins, channels, and outer skins are fabricated from 2024-T alclad sheet material. Spot-welding, seam welding, and riveting are the methods used in the construction of the doors. Most of the areas between the inner and outer skins are closed out.

The main gear strut door is attached by a hinge fitting to the lower wing structure, just outboard of the gear trunnion mount. The nose gear strut door is hinged to the structure on the forward end of the nose gear shock strut well. Damage to the fittings on the doors will be considered cause for replacement of the fitting.

NEGLIGIBLE DAMAGE.

NEGLIGIBLE DAMAGE TO STRUTS.

Because of the close tolerances and the highly stressed condition of the landing gear members, the repair of any damage more serious than small nicks (caused by flying rocks, contact with ground handling equipment, etc) is impractical.

Small nicks may be smoothed out with a riffle file, emery paper, or a burnishing tool. After damage has been removed, apply at least one coat of zinc-chromate primer (Specification MIL-P-6889) to the smoothed area. Small cracks may be detected by the application of a liberal coat of light oil to the part or area suspected. Thoroughly wipe away the oil and apply a coat of whiting (calcium carbonate, Specification JAN-C-293). Cracks will show by the appearance of oil on the whiting and are cause for replacement of the unit.

LANDING GEAR REPAIRS.

STRUT REPAIRS.

Corrosion of the up-latch assembly on the auxiliary landing gear may be treated without removing the up-latch from the airplane.

1. Remove the corrosion with 320 grit sandpaper.
2. Wipe the surface clean of foreign matter with Stoddard solvent (Federal Specification No. P-S-661).
3. Apply one coat of wash primer (Specification MIL-C-8514) to the reworked area.
4. Apply one coat of zinc-chromate primer (Specification MIL-P-6889).

5. Apply one coat of medium-green zinc-chromate primer (Specification MIL-L-6805).

Do not use chromic acid for removing corrosion from the up-latch, because the chromic acid cannot be thoroughly removed from the up-latch bearings.

TRUNNION SUPPORT BUSHING REPLACEMENT.

Main landing gear trunnion support bushings may be replaced as shown in figure 5-2 when the bushings become worn in excess of tolerances.

ELONGATED AND OVERSIZE BOLT HOLE REPAIRS.

Repair of elongated or oversize bolt holes in the nose landing gear trunnion, trunnion pin, trunnion bushing and retraction arm is shown in figure 5-3. The trunnion pin and retraction arm may be removed from the trunnion assembly for inspection. Do not attempt to remove the trunnion bushing for inspection. The bushing is pressed in to the trunnion assembly. The holes in the trunnion bushing may be checked with a small hole gage for oversize or elongation.

DOOR REPAIRS.

Repairs to the landing gear door skins are difficult, because most of the areas between the inner and outer skin are closed out. Repairs have been designed to be installed blind in this area. (Refer to index for typical repairs for structural doors.)

Figure 5-4 shows a repair to the landing gear door where the door hinge is installed to the gear door.

RENEWING LANDING GEAR DOOR SKINS.

Use following procedures for welding a new skin to original door frames of nose gear and main gear doors. (See figure 5-5.)

1. Remove original weld nuggets from frame to provide as smooth a faying surface as possible. Remove only amount of material necessary to provide a smooth surface.
2. Attach new skin to frame for welding, using existing rivet holes and additional holes as necessary.
3. Seam-weld outer faying surfaces.
   a. Place seam welds between, or adjacent to, the existing welds. Do not seam-weld over original welds.
   b. When edge distance permits, use double-row seam weld.
   c. When edge distance does not permit use of double-row seam weld, use a single seam weld and a double row of spot welds.
   d. When seam welding is not possible, use three rows of spot welds.

Note

In some instances, prior skin trim of doors will prohibit use of more than two rows of weld. In these cases, use one row of seam weld and one row of spot welds. If seam welding is impossible, use two rows of spot welds.

   e. Use ½-inch spacing for all spot welds.
   f. Spot-weld all inner faying surfaces which were originally spot-welded.
   g. Use 2-inch radius wheel electrode and certified setup schedule for all seam welds.
4. After completion of welding operations, install AN426AD4 rivets in all existing rivet holes. Flush both sides as required for mating surfaces of doors.

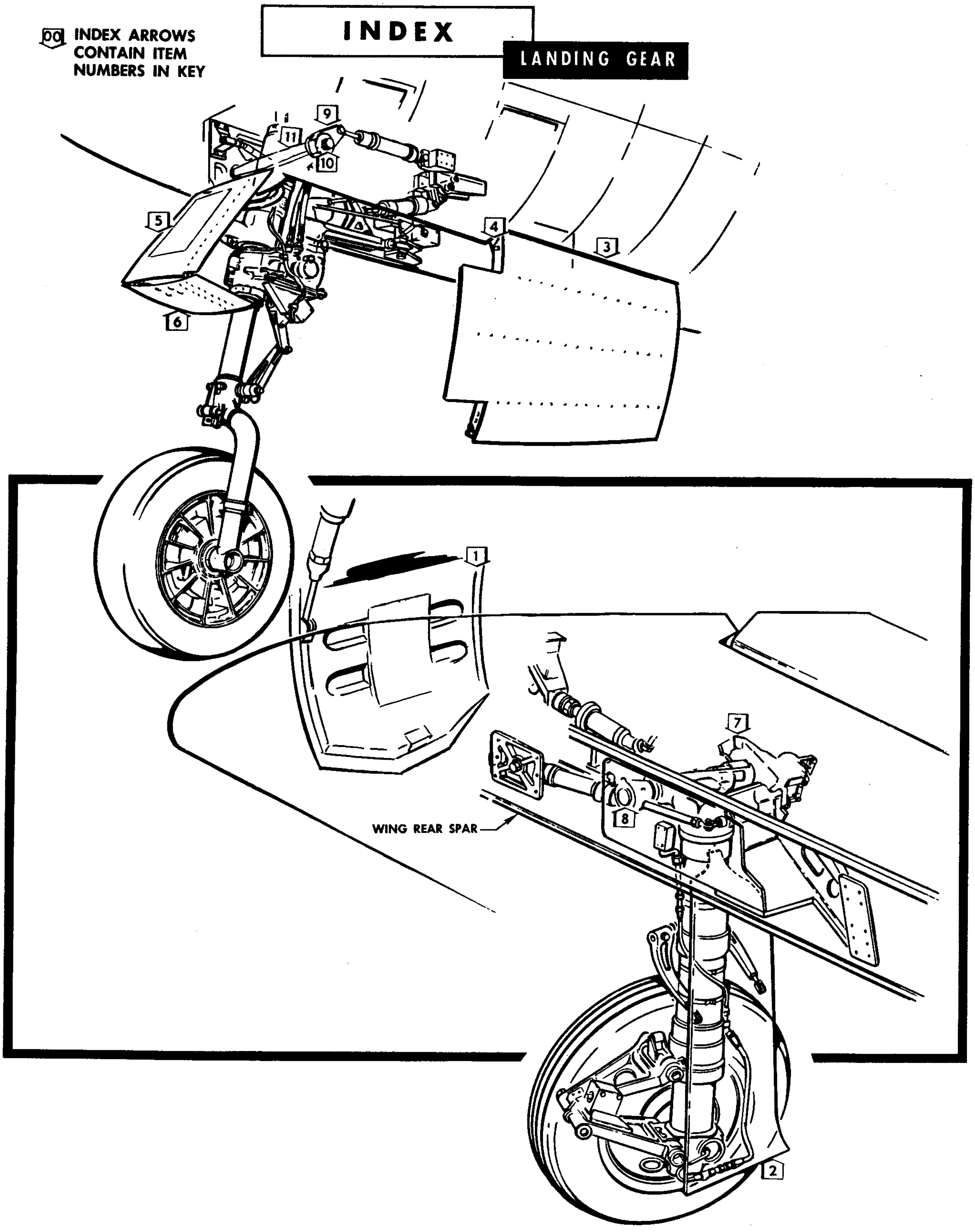


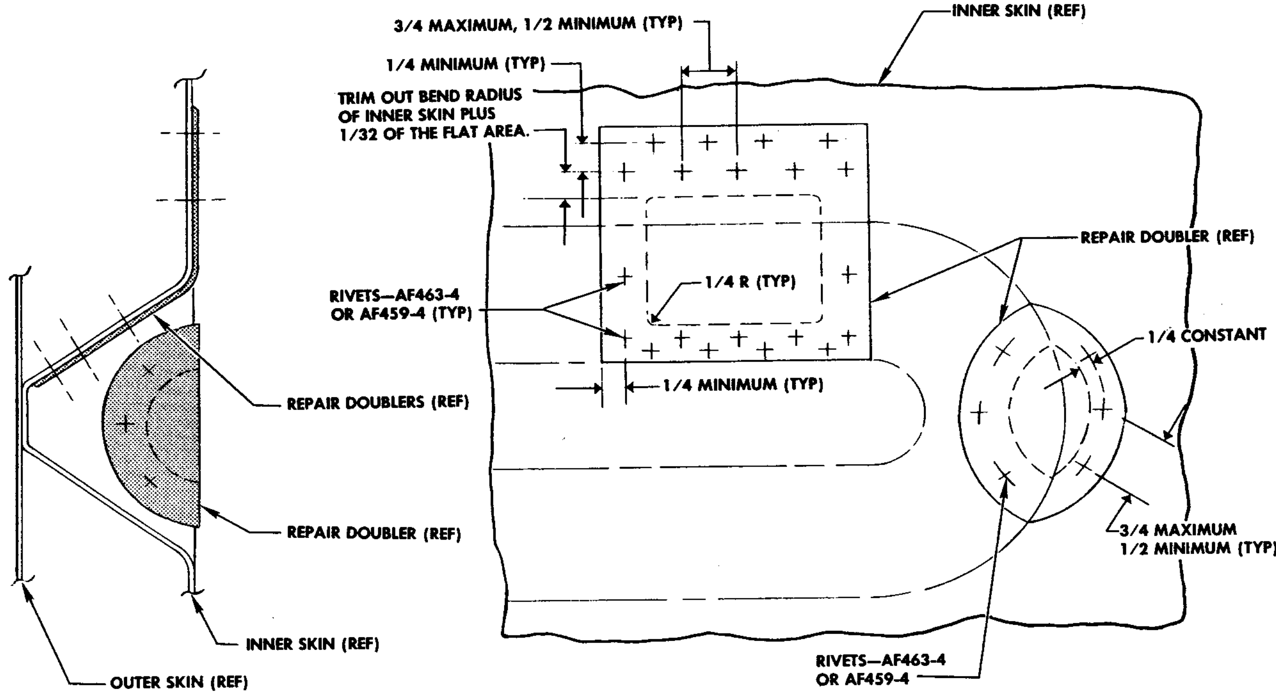
Figure 5-1. Landing Gear Index

ITEM NO.	DRAWING NO.*	DESCRIPTION	GAGE	MATERIAL	REPAIR FIGURE NO.†
1	207-33301	Main Gear Wheel Door Assembly			
2	140-33351	Main Gear Strut Door Assembly			
3	165-34370	Auxiliary Gear Wheel Door Assembly			5-4
4	165-34305-9	Channel	0.051	2024-O Sheet	5-4
5	165-34371	Forward Auxiliary Gear Strut Door Assembly			
6	165-34386	Aft Auxiliary Gear Strut Door Assembly			
7	151-33120	Main Landing Gear Trunnion Support Fitting			5-2
8	140-33124	Bushing		Steel Tube AMS 6283	5-2
9	165-34510	Arm		2014-T6 Al Alloy Die Forging	5-3
10	140-34125	Pin			5-3
11	151-34112	Trunnion		2014 Al Alloy Forging	5-3

*Drawings numbers are for reference only and are not to be used for ordering parts.
†For additional repairs, refer to Section X.

Key to Figure 5-1

PERMANENT CATEGORY A **LANDING GEAR**

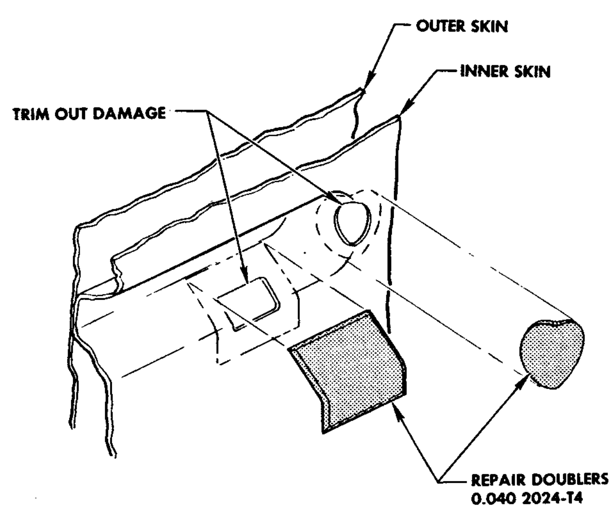


1 Trim out damage to a round or rectangular shape as shown.

2 Smooth all edges and corners.

3 Make repair doublers to match damaged skin. Repair doublers should be made from 2024-T4 material whenever possible. If compound curves or severe radii are required, use 2024-O material, and heat-treat it to T4 condition after forming.

4 Fasten repair doublers in place, using size and type of fasteners and spacing called out.



F-86D-3-33-6

Figure 5-1A. Waffle Repair Landing Gear Doors (Sheet 1 of 2)

PERMANENT CATEGORY A

LANDING GEAR

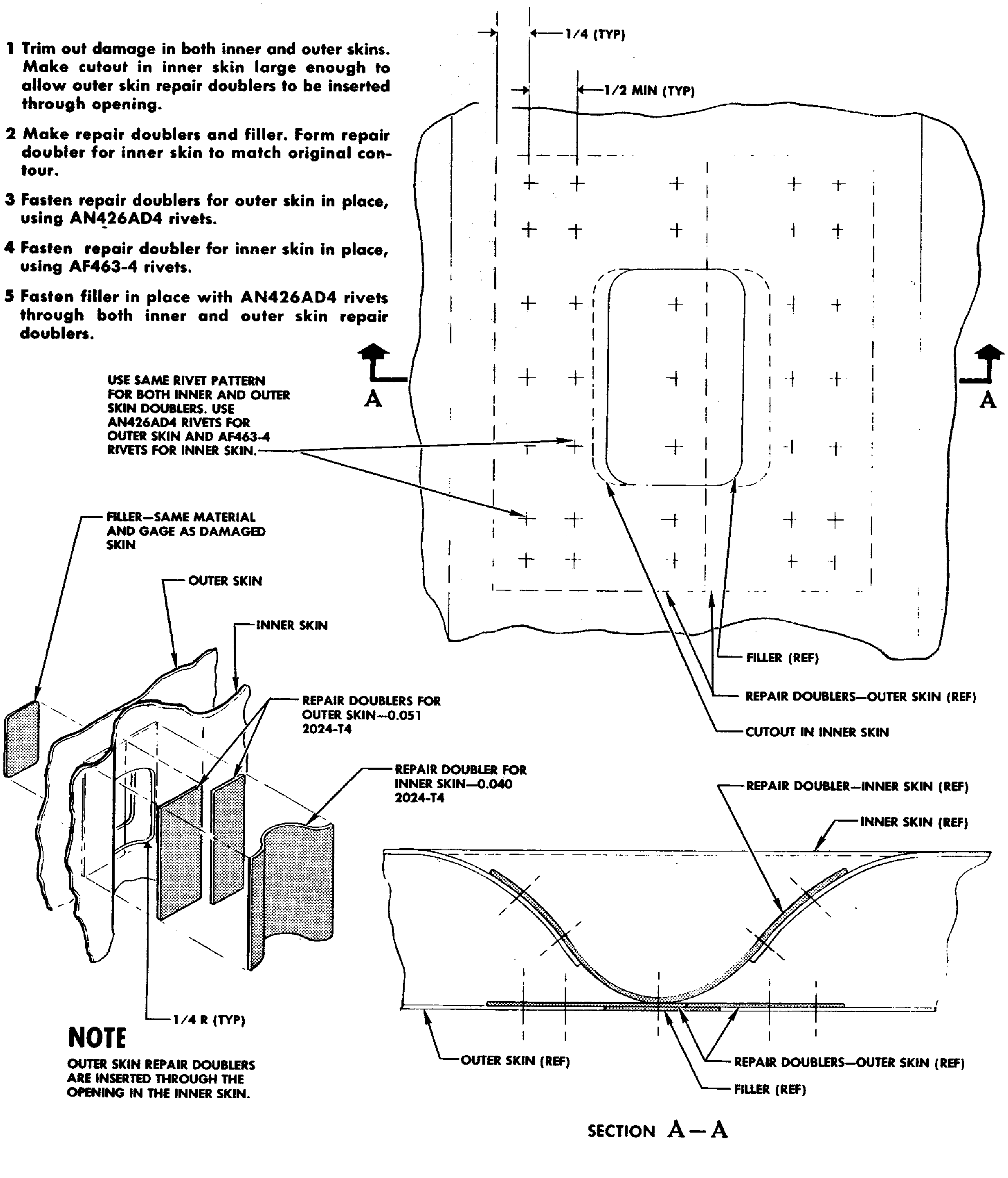
1 Trim out damage in both inner and outer skins. Make cutout in inner skin large enough to allow outer skin repair doublers to be inserted through opening.

2 Make repair doublers and filler. Form repair doubler for inner skin to match original contour.

3 Fasten repair doublers for outer skin in place, using AN426AD4 rivets.

4 Fasten repair doubler for inner skin in place, using AF463-4 rivets.

5 Fasten filler in place with AN426AD4 rivets through both inner and outer skin repair doublers.

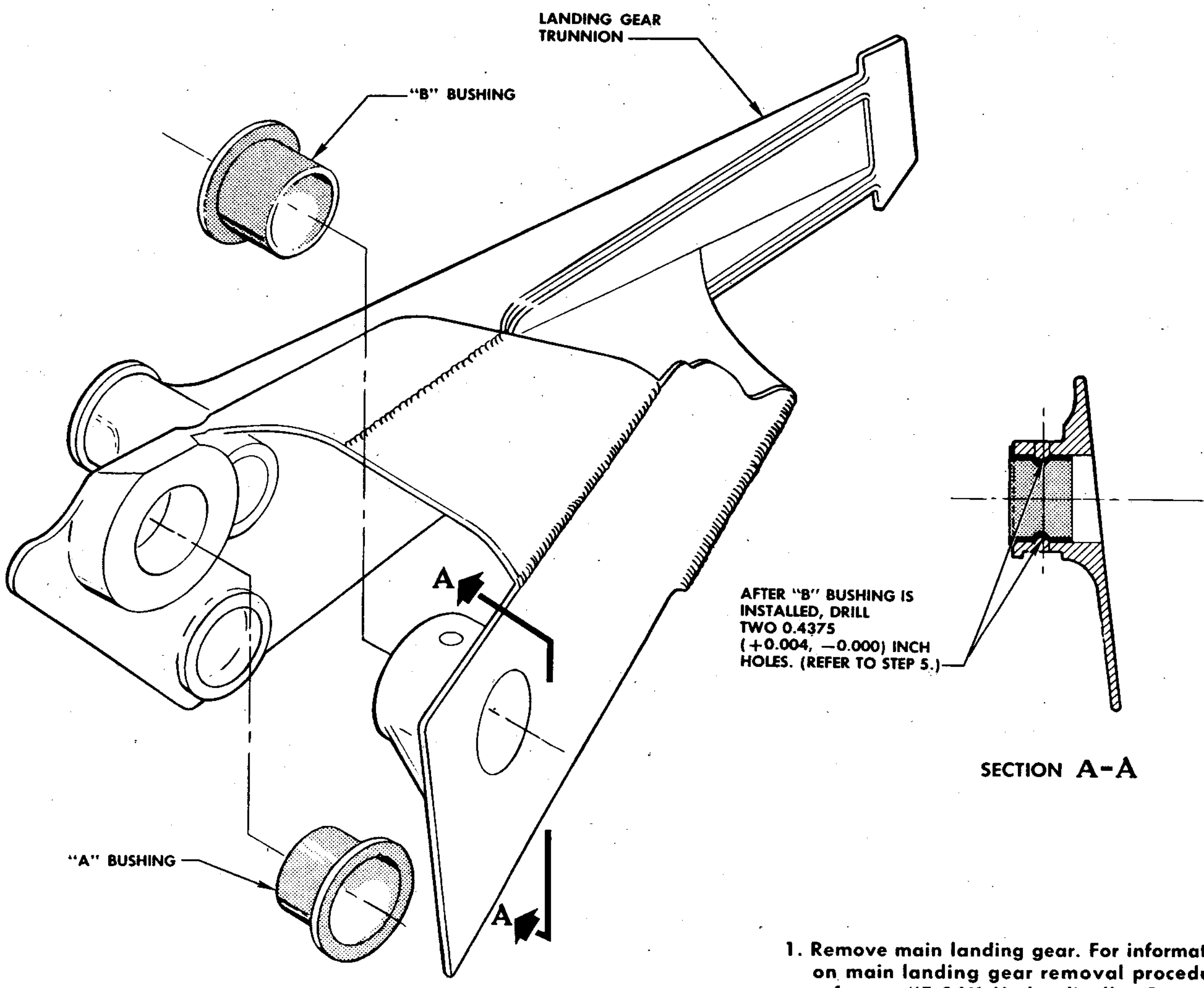


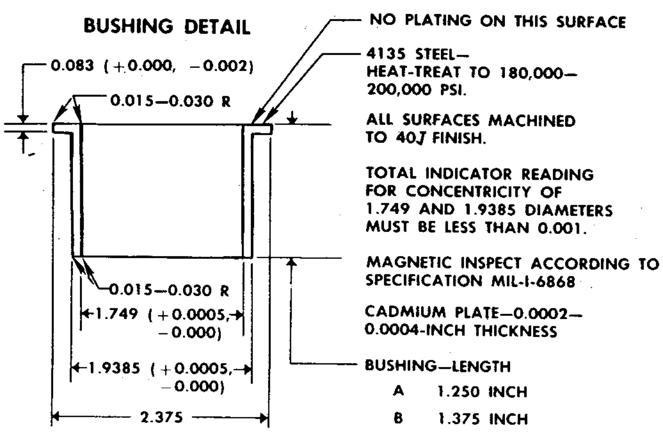
NOTE

OUTER SKIN REPAIR DOUBLERS ARE INSERTED THROUGH THE OPENING IN THE INNER SKIN.

Figure 5-1A. Waffle Repair Landing Gear Doors (Sheet 2 of 2)

PERMANENT Category B





1. Remove main landing gear. For information on main landing gear removal procedure, refer to "F-86K Hydraulically Operated Systems," T. O. 1F-86K-2-5.
2. Remove old bushings from landing gear trunnion.
3. Make new bushings.
4. Press the bushings into place in the landing gear trunnion. The longest bushing ("B") must be pressed into the bushing boss next to the rear spar.
5. Line-drill two 0.4375 (+0.004, −0.000) inch holes in bushing next to aft wing spar. The drilled holes are picked up from the bushing boss and must intersect the axis of the bushing within 0.003 inch of the intersection of the radius.
6. Line-ream bushings to 1.750-inch diameter and a 125√ finish. The bushing holes must be concentric and parallel.

F-86K-3-33-2

Figure 5-2. Main Landing Gear Trunnion Support Bushing

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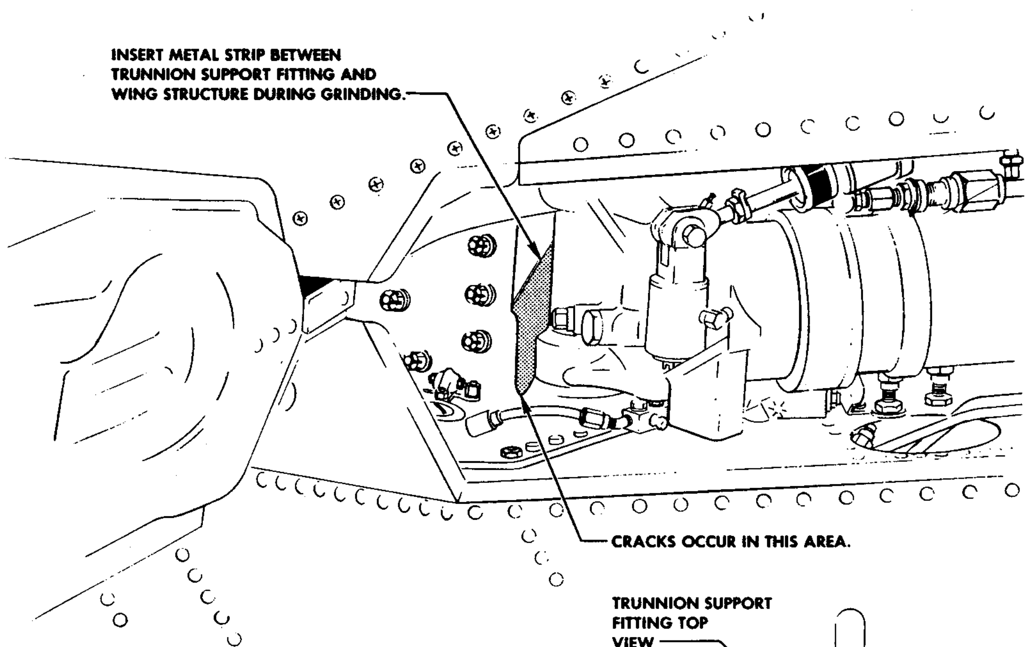
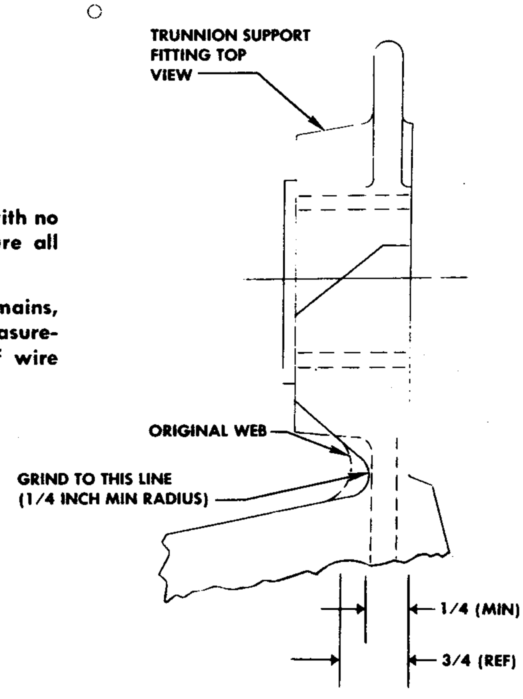
PERMANENT CATEGORY A LANDING GEAR



NOTE

Ground-out area must have a smooth, curved surface with no sharp edges or tool marks. Dye-check area to be sure all cracks have been removed.

The web may be removed until a width of 1/4 inch remains, measuring across the top of the support fitting. This measurement may be taken by inserting a hooked piece of wire between the wing structure and the trunnion support.

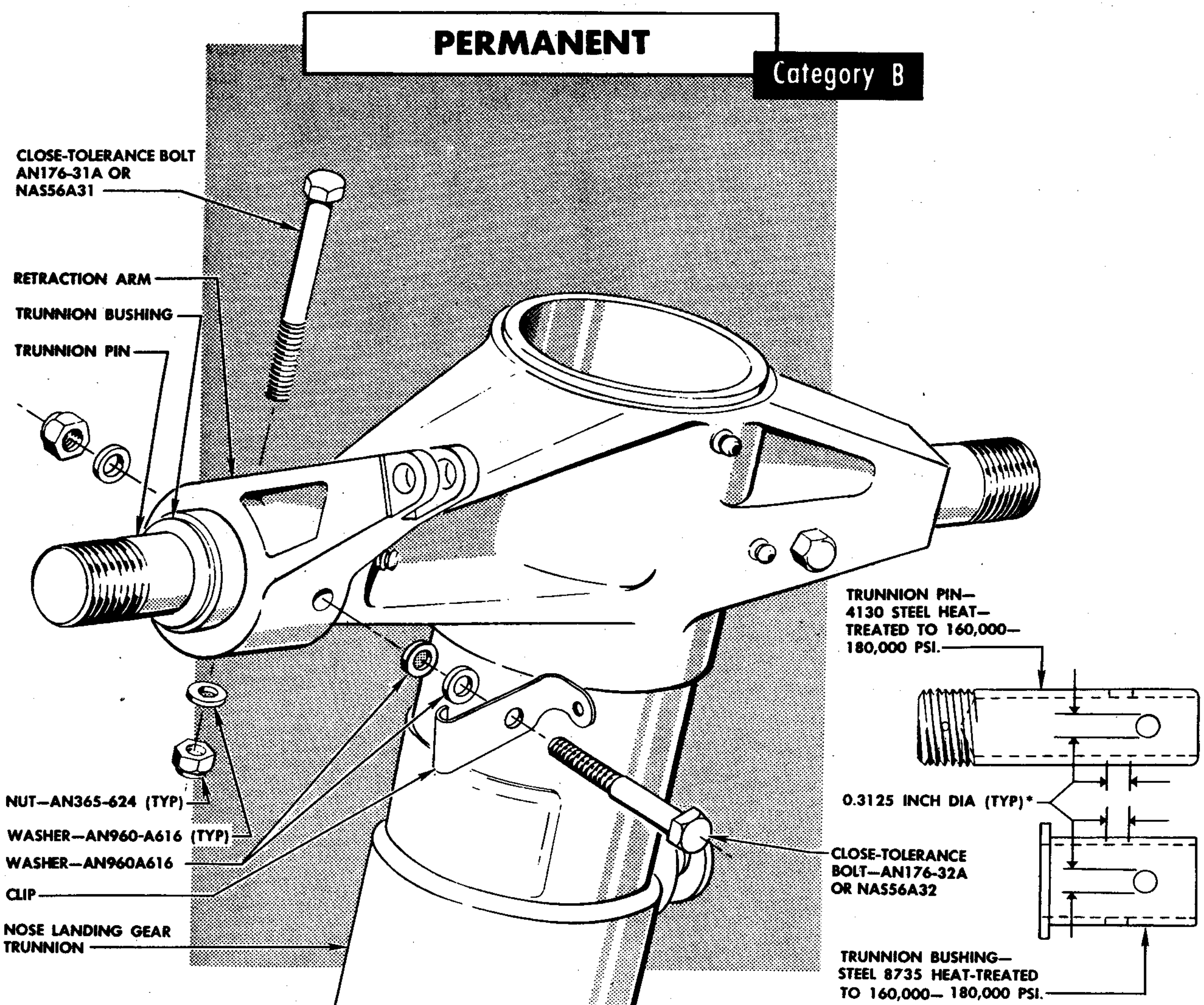


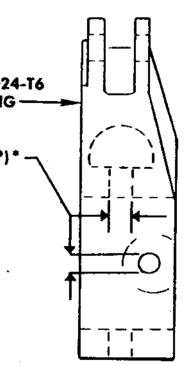
F-86A-3-33-8

Figure 5-2A. Rework of Trunnion Support Fitting

PERMANENT

Category B





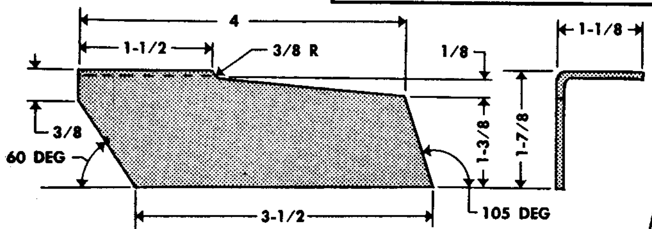
1. Refer to text.
2. Place retraction arm and trunnion pin into position on the nose gear trunnion and align the bolt holes.
3. Temporarily install the AN5-31A bolt and drill the other bolt hole and clip with a 23/64-inch drill.
4. Line-ream the drilled bolt hole and clip to 0.3735 (+0.0005, −0.000) inch diameter and install the AN176-32A or NAS56A32 close-tolerance bolt with AN960A616 washer and AN365-624 nut.
5. Remove AN5-31A bolt and drill bolt hole with a 23/64-inch drill.
6. Line ream bolt hole to 0.3735 (+0.0005, −0.000) inch diameter and install AN176-31A or NAS56A31 close-tolerance bolt with AN960-A616 washer and AN365-624 nut.

*Where any one bolt hole exceeds 0.3125 inch in the nose gear trunnion, trunnion bushing, trunnion pin, or retraction arm assembly, the bolt holes must be repaired.

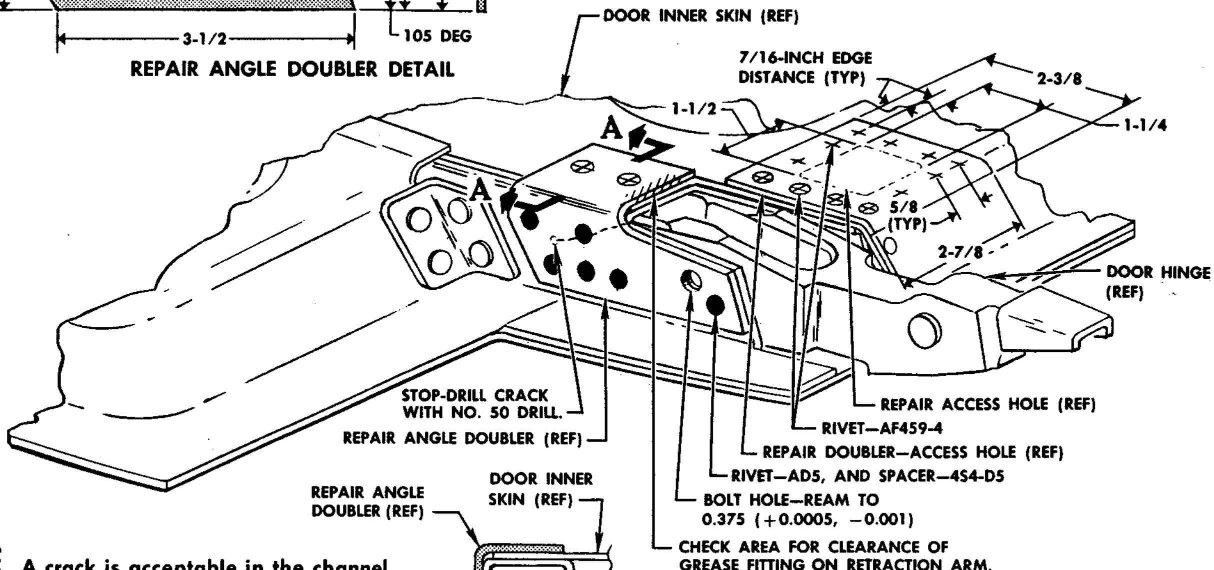
F-86K-3-33-1

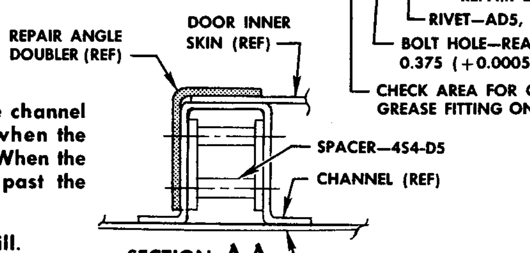
Figure 5-3. Nose Gear Trunnion and Retraction Arm Bolt Hole Repair

PERMANENT Category A



REPAIR ANGLE DOUBLER DETAIL

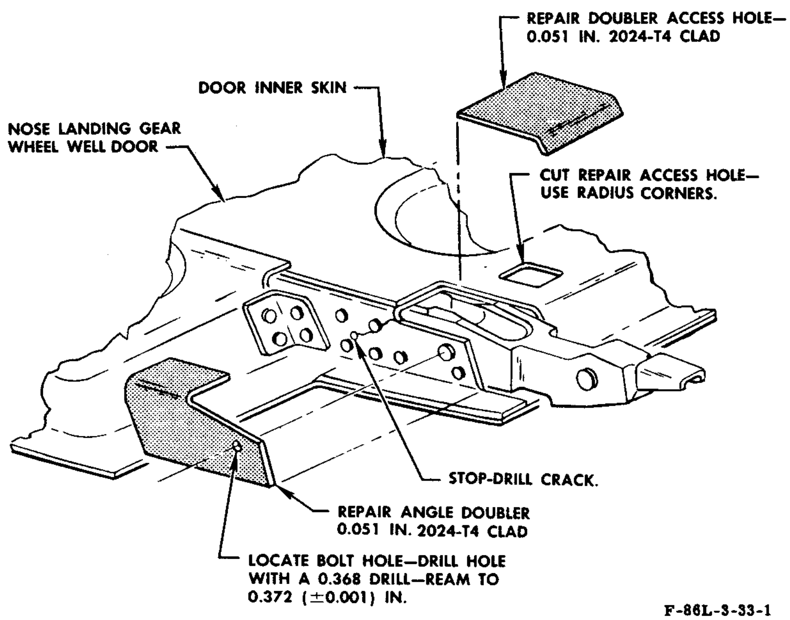




SECTION AA

NOTE A crack is acceptable in the channel and does not have to be repaired when the crack does not extend past the rivet. When the crack in the channel does extend past the rivet, the channel must be repaired.

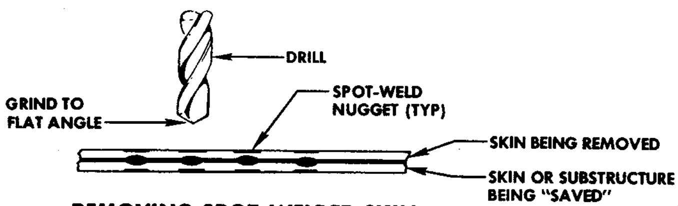
1. Stop-drill crack with a No. 50 drill.
2. Cut out a 1-1/4- by 1-1/2-inch repair access hole.
3. Remove the six AD5 and two AF459-4 rivets. Be sure to recover the 4S4-D5 spacers that were used with the AD5 rivet installation.
4. Make repair angle doubler. Locate bolt hole, drill with a 0.368 drill and then ream to 0.372 (±0.001) inch diameter.
5. Temporarily install and position repair angle doubler with an AN6-14A bolt.
6. Start repair angle doubler installation with the two AF459-4 rivets, and then reinstall 4S4-D5 spacers with AD5 rivets. The AD5 rivets can be bucked from repair access hole.
7. Remove AN6-14A bolt and ream bolt hole to 0.375 (+0.0005, −0.001) inch diameter.
8. Make repair doubler for repair access hole.
9. Install repair access hole repair doubler with AF459-4 rivets.
10. Make sure repair doubler clears grease fitting on door retraction arm.



F-86L-3-33-1

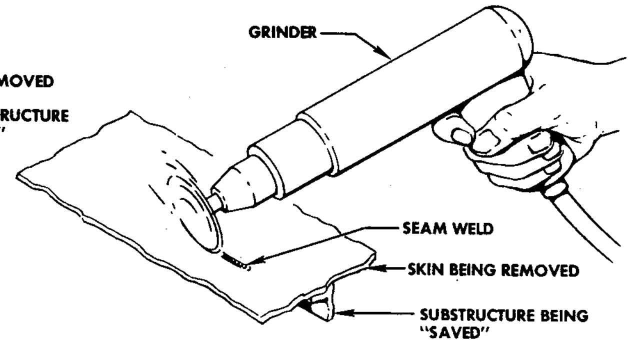
Figure 5-4. Landing Gear Door Hinge Attachment Repair

PERMANENT **CATEGORY B**



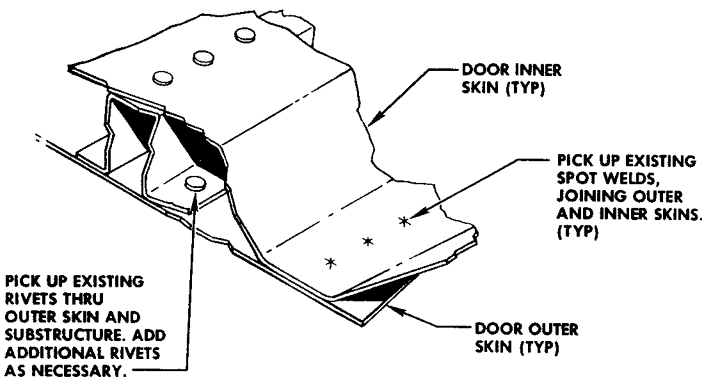
REMOVING SPOT-WELDED SKIN

1. Drill through skin being removed only.
2. Separate parts with a thin chisel.
3. Grind remaining nugget from parts which are to be re-used.

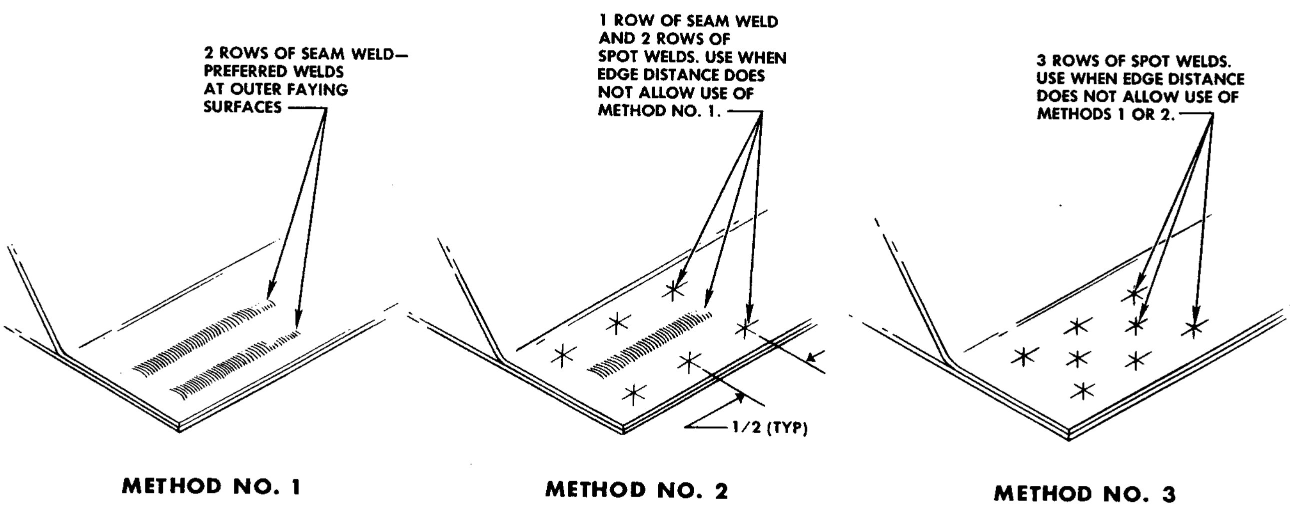


REMOVING SEAM-WELDED SKIN

1. Grind weld from skin being removed.
2. Separate parts with a thin chisel.
3. Grind remaining weld material from parts which are to be re-used.



NOTE Refer to text for additional information.



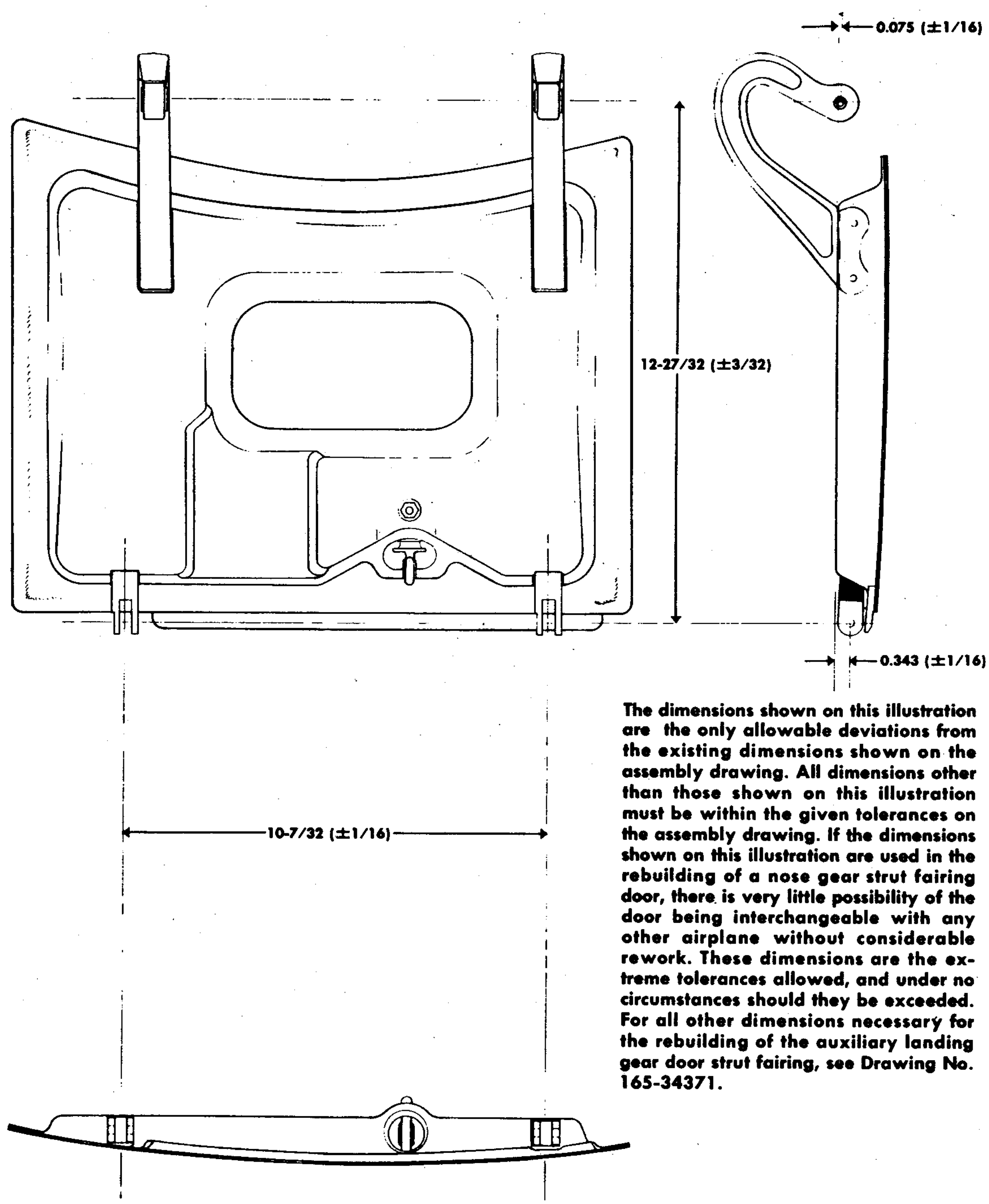
METHODS OF JOINING OUTER FAYING SURFACES

F-86A-3-33-7

Figure 5-5. Replacing Landing Gear Door Skins

PERMANENT CATEGORY A

LANDING GEAR



The dimensions shown on this illustration are the only allowable deviations from the existing dimensions shown on the assembly drawing. All dimensions other than those shown on this illustration must be within the given tolerances on the assembly drawing. If the dimensions shown on this illustration are used in the rebuilding of a nose gear strut fairing door, there is very little possibility of the door being interchangeable with any other airplane without considerable rework. These dimensions are the extreme tolerances allowed, and under no circumstances should they be exceeded. For all other dimensions necessary for the rebuilding of the auxiliary landing gear door strut fairing, see Drawing No. 165-34371.

F-86D-3-33-5

Figure 5-6. Tolerance for Nose Gear Strut Fairing Door

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SECTION VI

ENGINE

Contents

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GENERAL.

The North American Aviation F-86K airplane is powered by a single General Electric J47 series engine with an afterburner. This engine is an axial-flow, turbojet engine incorporating an afterburner and electronic engine controls. The engine accessories located at the front of the engine are covered by a sheet-metal fairing, formed to a streamlined shape.

A cooling duct is built into the accessory cover to aid in cooling the accessories by ducting ram air into the accessory cover. A fire seal is installed on the engine just forward of the burners or hot section of the engine. This seal is to separate the hot areas of the engine from the fuel area to aid in preventing fires.

A two-section stainless steel afterburner heat shroud is installed on the afterburner and tail-pipe assembly. This shroud helps to protect the fuselage structure from the high temperature of the tail pipe during afterburner operation.

The fuselage from station 187.407 aft, is designed to house the engine. The engine air intake duct is in the forward section of the fuselage and is considered as part of the fuselage. (Refer to Section IV.)

When making any repairs on or near the engine, care should be taken to keep dust, dirt, rivets, nuts, washers, or other foreign objects out of the engine.

CAUTION

Any such foreign matter in the engine must be removed to prevent engine failure.

Suitable plugs, caps, and other coverings should be used to protect all engine openings as soon as they are exposed. The use of blind rivets should be avoided when there is a chance of their getting into the air intake duct if they come out. A clean repair job is of the utmost importance. The repair man must make sure that all tools, equipment, metal filings, trimmings, hardware, and any material used to make the repair are removed from the air intake area.

REPAIRS.

AUXILIARY ACCESSORY COVER SKIN.

The accessory cover at the front of the engine may be repaired with flush-type skin-doubler repairs as shown in figures 6-2 and 6-3. If the damage to the accessory cover occurs at an internal stiffening member, the stiffener should be repaired by splicing. An aluminum alloy bar or a channel of one-half hard corrosion-resistant steel may be used for the splice member. After the stiffener is repaired, the skin may be repaired by using a two-piece doubler as shown. All repairs to the accessory cover skin must be sealed with high-temperature sealing compound HT-23. (Refer to "Seals and Sealants" in Section I.)

AFTERBURNER SHROUD REPAIRS.

Damage to the afterburner shroud may be repaired as shown in figures 6-6 and 6-7. Stiffeners may be repaired by welding a crack or break, or if damage is severe, by cutting out damage and welding in a filler. Either repair should be reinforced by welding in repair angles as shown in illustration. Dimensions for the length of repair angles are the same for all shapes of stiffeners. Repair angles should be placed on the stiffener as shown in the end views for the different shapes.

Skin repair should be made as shown with the repair parts formed to match the original contour.

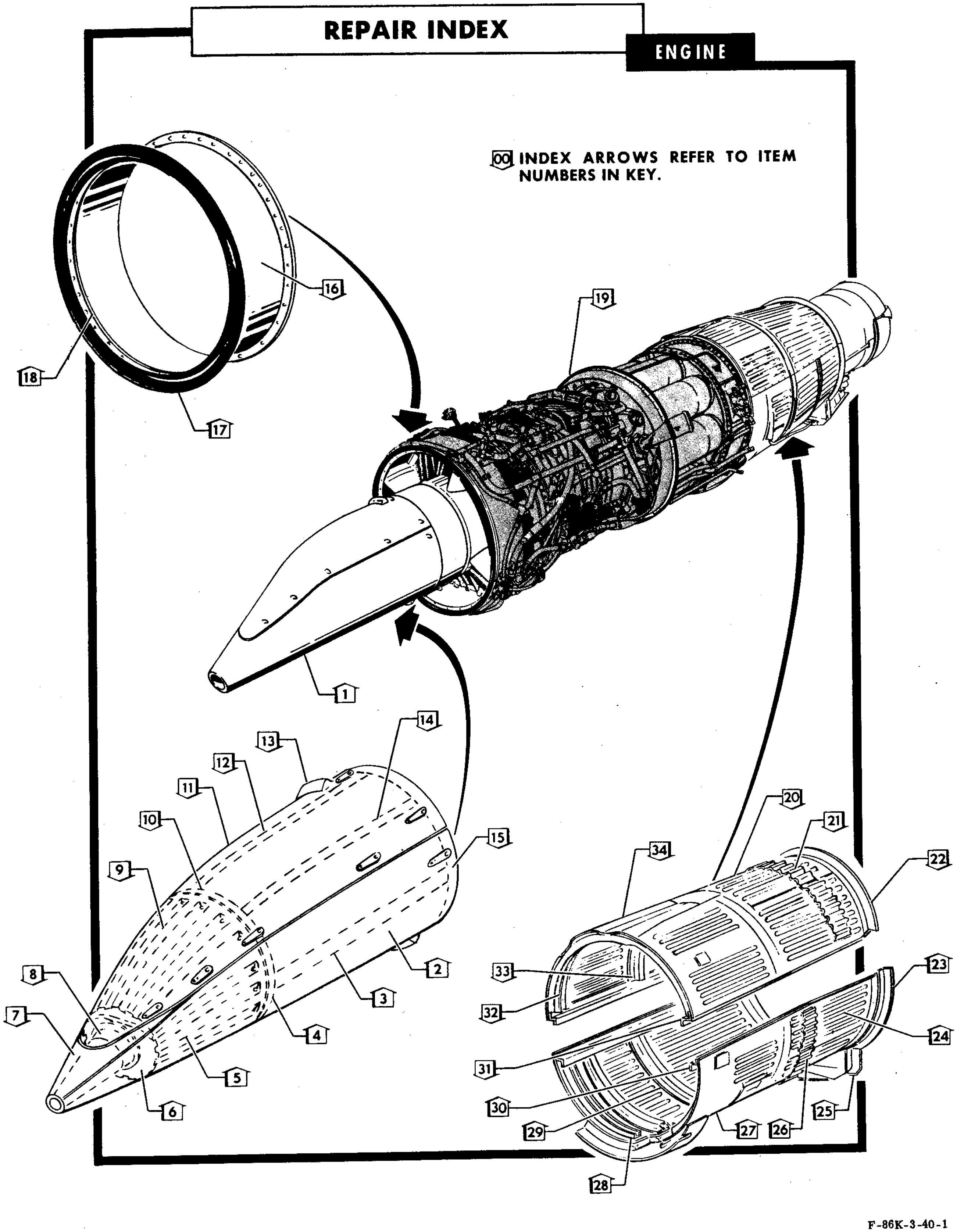


Figure 6-1. Engine Repair Index

ITEM NO.	DRAWING NO.*	DESCRIPTION	GAGE	MATERIAL	REPAIR FIGURE NO.†
1	207-42004	Eng—Cover Assy			
2	207-42004-3	Skin	0.040	6061-T6 Al Alloy Sh	6-2, 6-3
3	207-42004-27	Hat	0.040	2024-T4 Clad Sh	
4	207-42004-25	Stiffener	0.064	2024-T4 Clad Sh	
5	207-42004-61, -62, -63	Inner Skin	0.032	5052-O Al Alloy Sh	Replace
6	207-42004-23	Doubler	0.040	2024-T4 Clad Sh	
7	207-42004-5	Skin	0.040	6061-T6 Al Alloy Sh	6-2, 6-3
8	165-42099	Manifold Assy	0.035	6061-T4 Al Alloy Tube	Replace
9	207-42004-11, -13, -15, -17	Inner Skin	0.032	5052-O Al Alloy Sh	Replace
10	207-42004-67	Stiffener	0.064	2024-T4 Clad Sh	
11	207-42004-59	Skin	0.040	6061-T6 Al Alloy Sh	6-2, 6-3
12	207-42004-83, -53	Channel	0.032	2024-T4 Clad Sh	6-2, 6-3
13	207-42004-65	Louver	0.040	2024-T4 Clad Sh	Replace
14	207-42004-87, -85	Doubler	0.040	2024-T4 Clad Sh	Replace
15	207-42004-77	Doubler	0.032	2024-T4 Clad Sh	Replace
16	205-42005-3	Ring Assy	0.064	2024-T4 Clad Sh	
17	165-42089	Seal Assy		Synthetic Rubber and Art Upholstery Leather	6-4
18	165-42090	Retainer	0.015	CRES Sh	
19	165-42024-23	Fire Wall Seal	¾	Inconel Mesh and Asbestos Cloth	6-5
20	165-42141-75, -76, -77, -78	Skin	0.016	CRES Sh	6-7
21	165-42141-159, -160, -161, -162	Shield	0.016	CRES Sh	
22	165-42141-89	Angle	0.063	CRES Sh	6-7
23	165-42141-45, -46	Angle	0.063	CRES Sh	6-7
24	165-42141-7, -8, -9, -11	Skin	0.016	CRES Sh	6-7
25	165-42141-63	Angle	0.063	CRES Sh	6-7
26	165-42141-155, -156, -157, -158	Shield	0.016	CRES Sh	Replace
27	165-42141-5, -95, -201, -145	Skin	0.016	CRES Sh	6-7
28	165-42141-25, -26, -141, -142	Channel	0.016	CRES Sh	6-6

Key to Figure 6-1

ITEM NO.	DRAWING NO.*	DESCRIPTION	GAGE	MATERIAL	REPAIR FIGURE NO.†
29	165-42141-35, -147, -37, -129, -39	Hat	0.016	CRES Sh	6-6
30	165-42141-47, -48	Zee	0.025	CRES Sh	Replace
31	165-42141-91, -92	Zee	0.025	CRES Sh	Replace
32	165-42141-119	Channel	0.025	CRES Sh	6-6
33	165-42141-81, -83	Hat	0.016	CRES Sh	6-6
34	165-42141-71, -73	Skin	0.016	CRES Sh	6-7

***Drawing numbers are for reference only and are not to be used for ordering parts.**
†For additional repairs, refer to Section X.

Key to Figure 6-1 (Continued)

PERMANENT

Category A

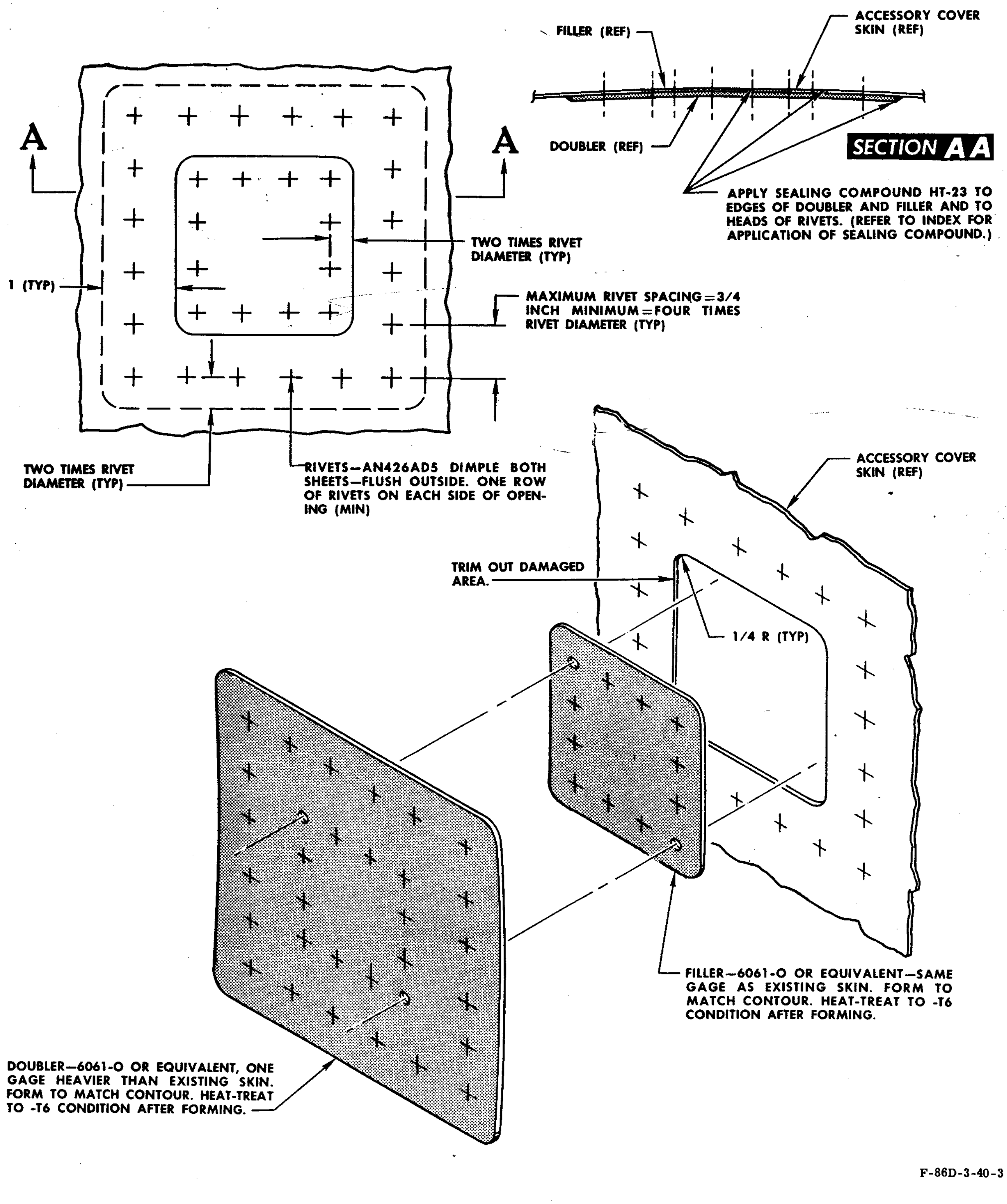


Figure 6-2. Auxiliary Accessory Cover Skin

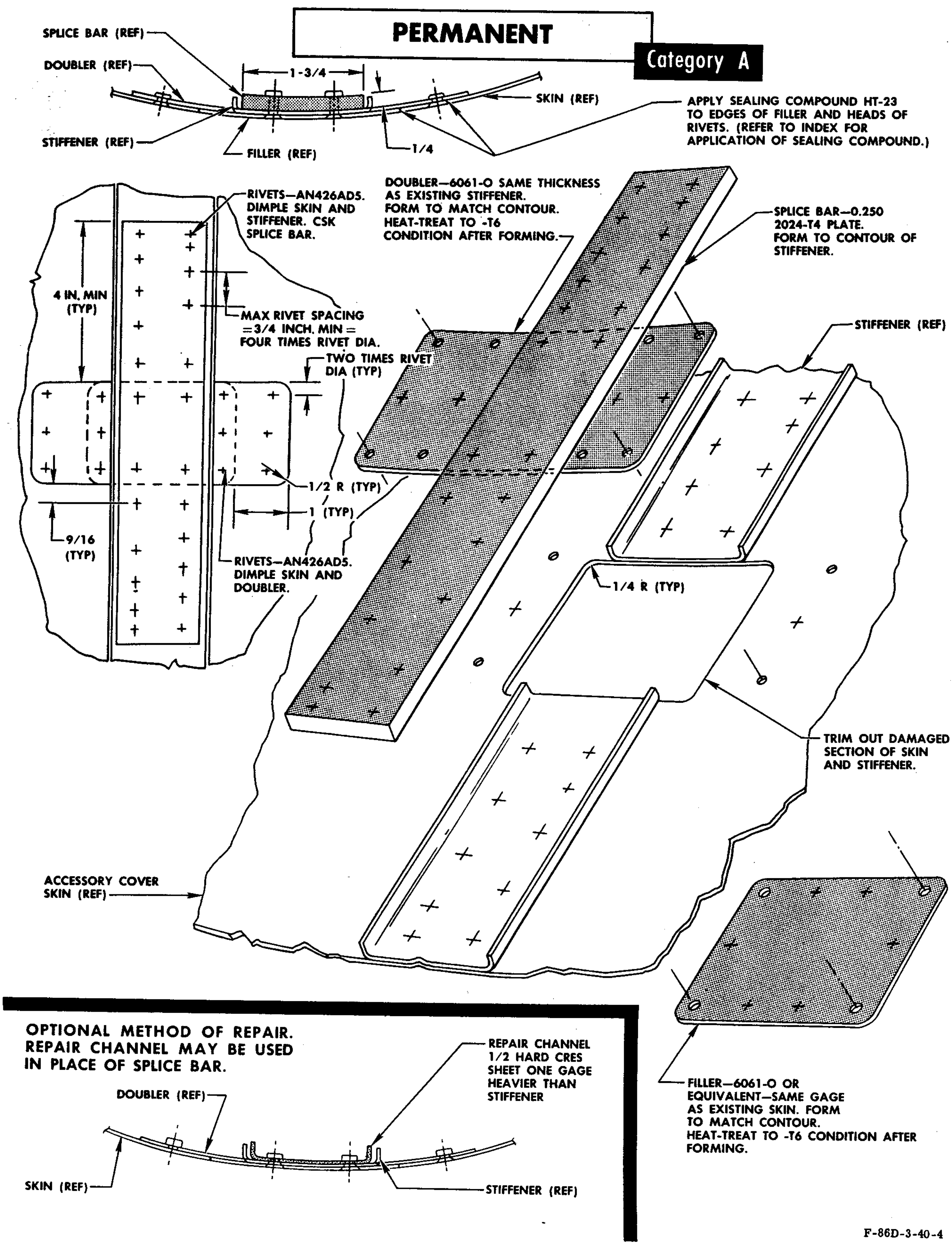
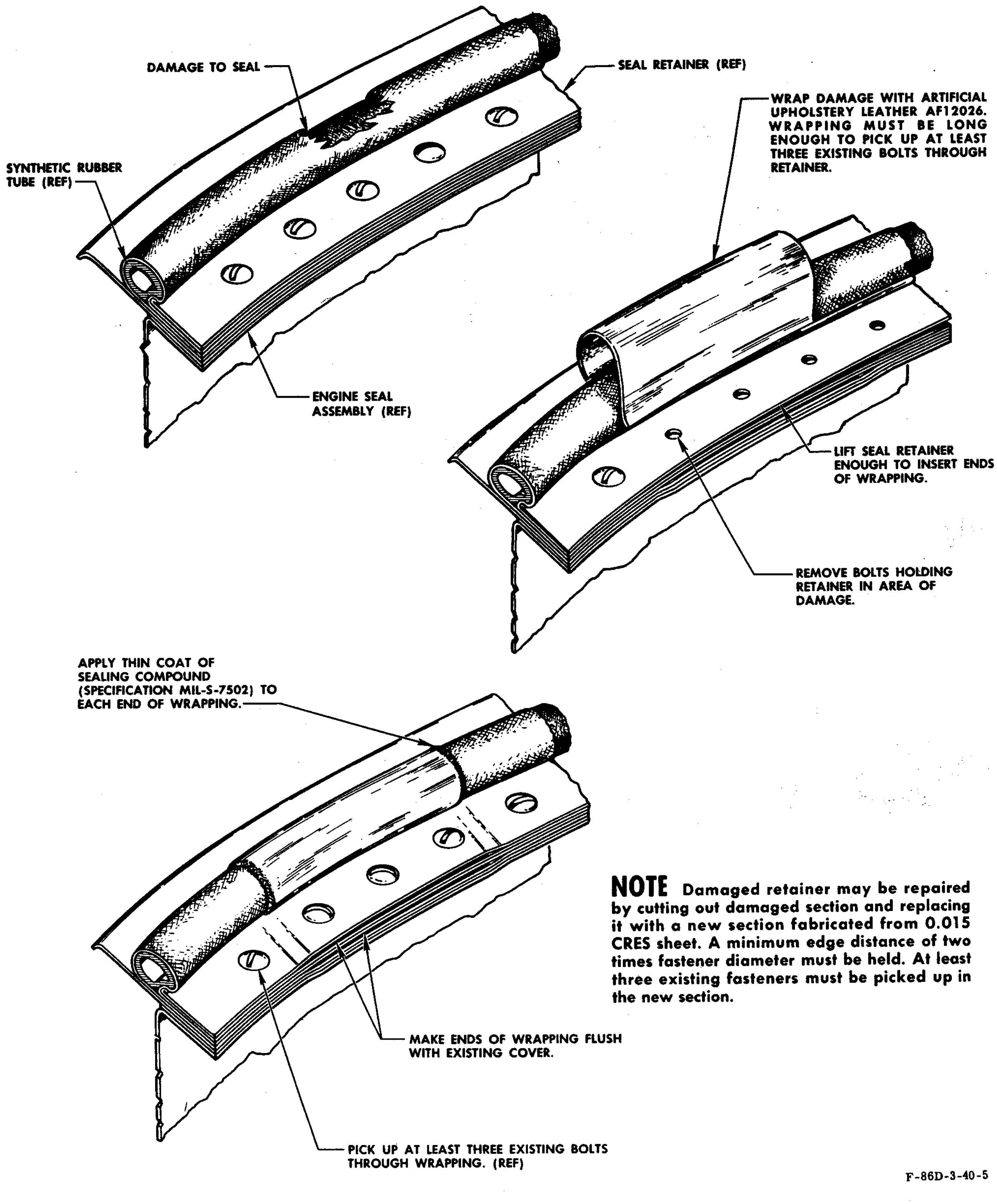


Figure 6-3. Auxiliary Accessory Cover Skin and Stiffener

PERMANENT

Category A



NOTE Damaged retainer may be repaired by cutting out damaged section and replacing it with a new section fabricated from 0.015 CRES sheet. A minimum edge distance of two times fastener diameter must be held. At least three existing fasteners must be picked up in the new section.

Figure 6-4. Engine Air Intake Duct Seal

PERMANENT

Category A

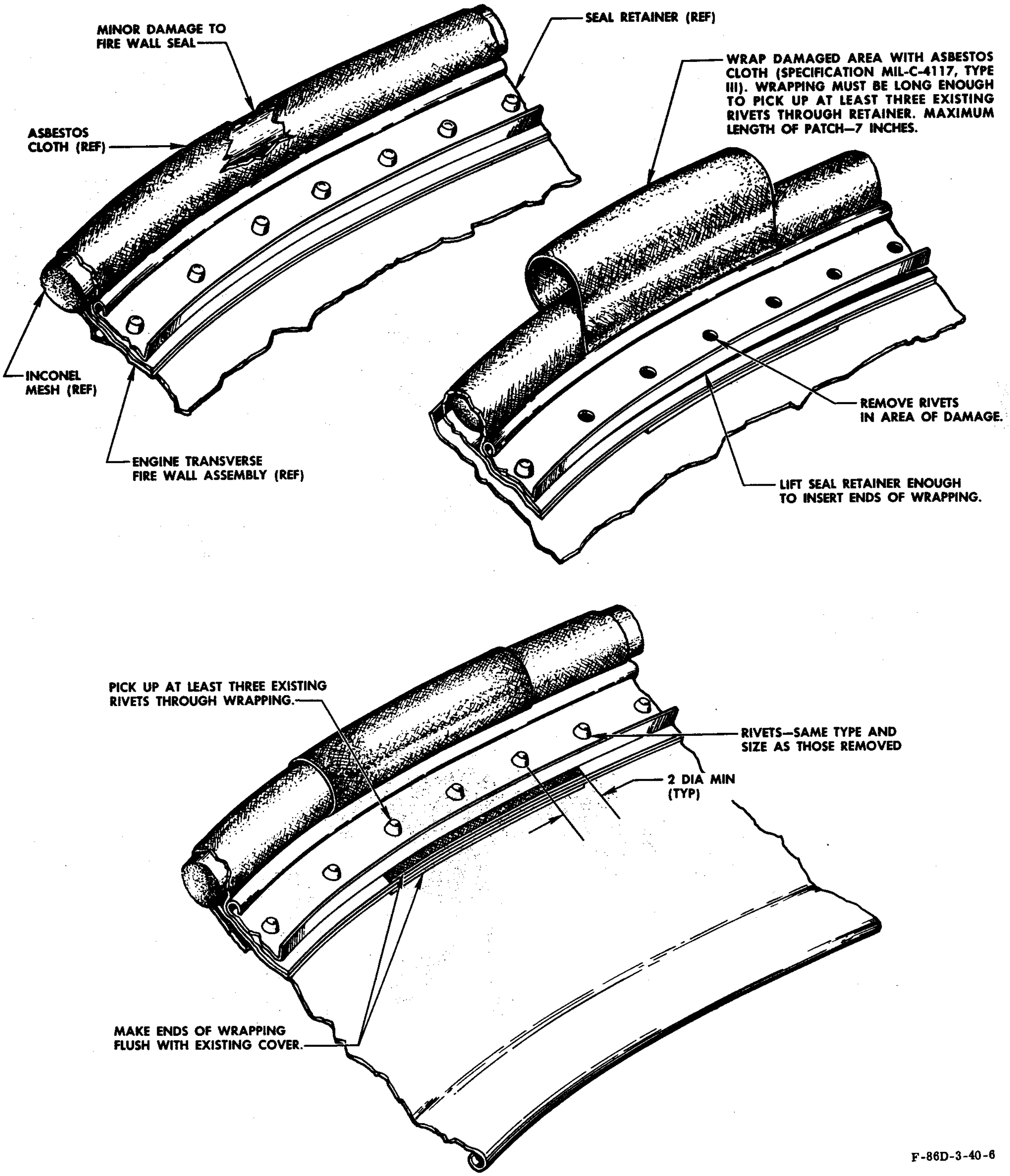
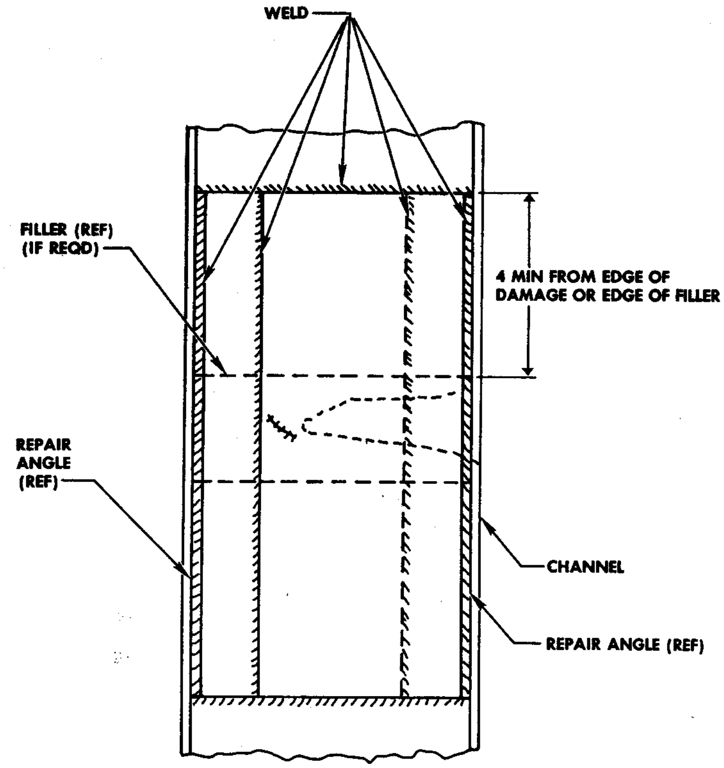
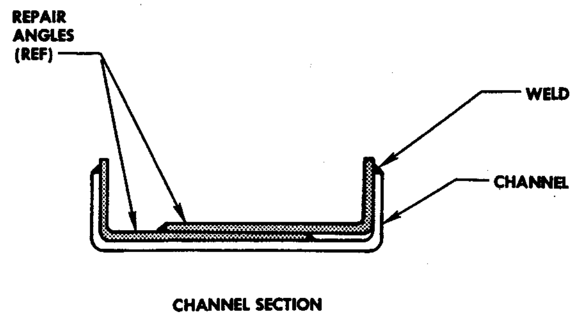


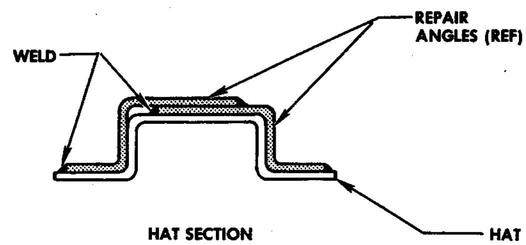
Figure 6-5. Engine Fire-wall Seal

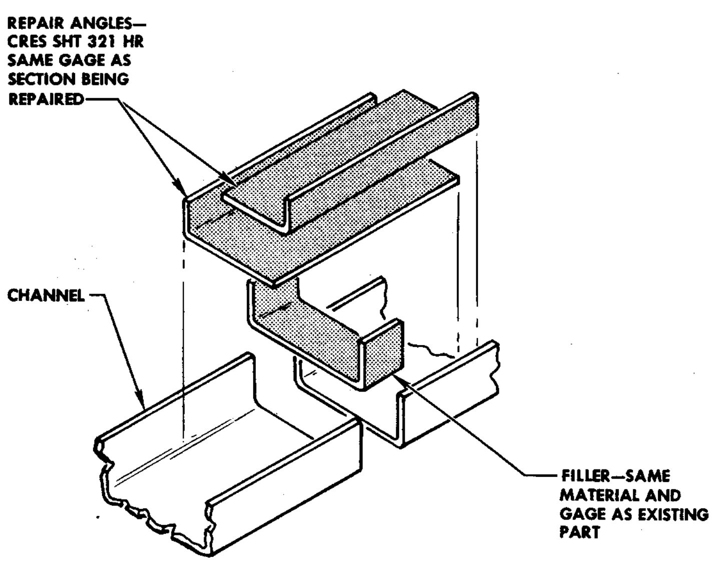
AFTERBURNER SHROUD

ENGINE SECTION









NOTE

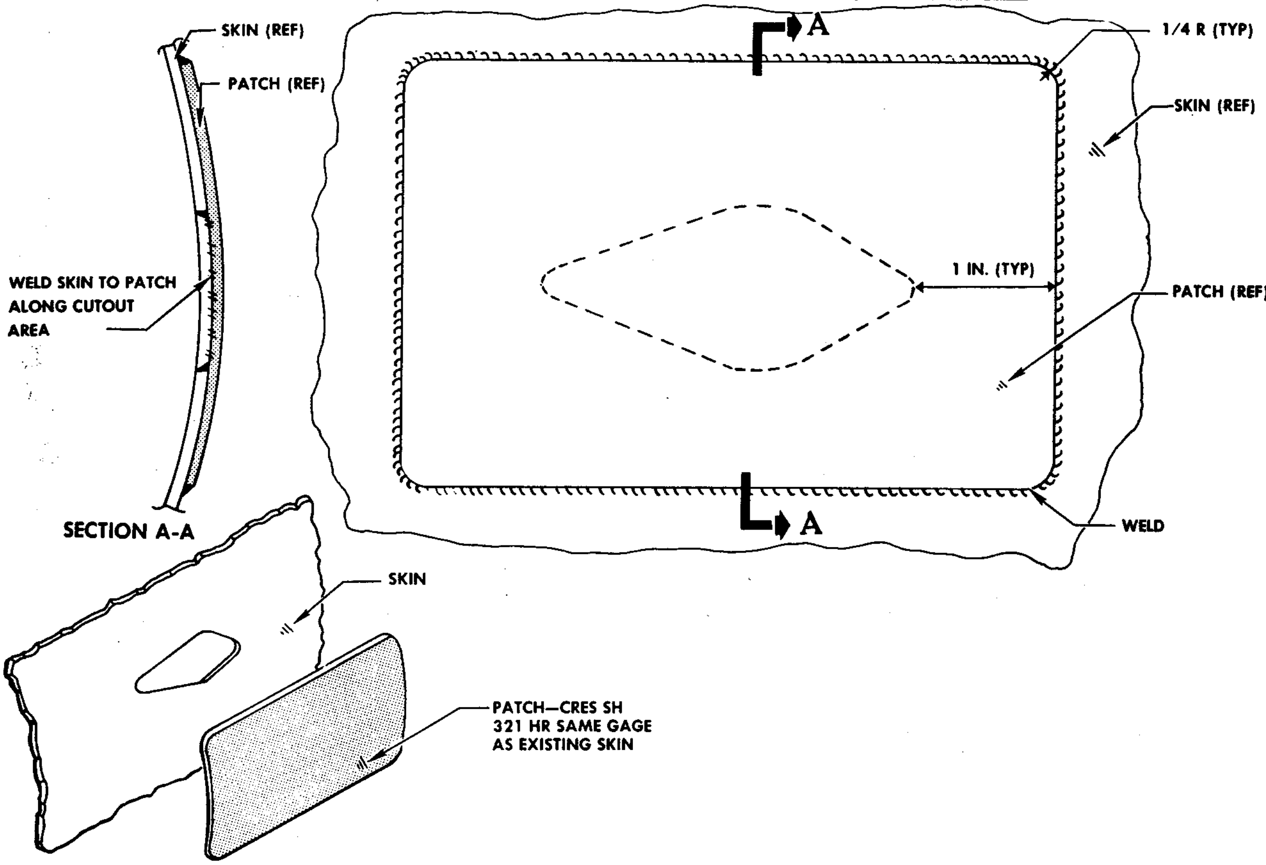
1. Smooth edges of damaged section and straighten so that repair sections are flush with damaged section.
2. Weld damaged area, or trim out damaged area, depending on how severe damage is.
3. Fabricate repair angles and filler (if required) as shown.
4. Weld repair angles in place.

F-86K-3-40-3

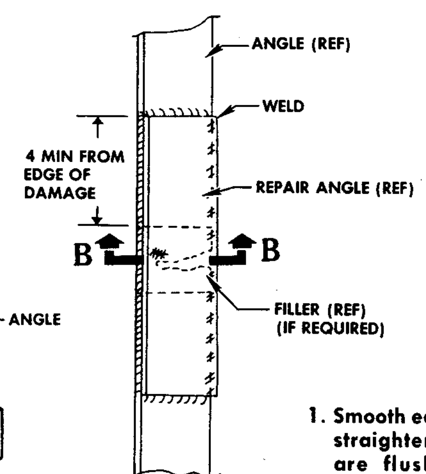
Figure 6-6. Afterburner Shroud—Channel and Hot Sections

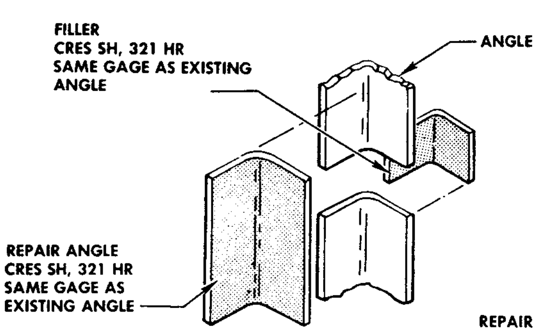
AFTERBURNER SHROUD

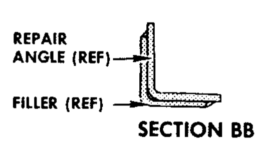
ENGINE



1. Trim out damaged area, using 1/4-inch minimum radius. Smooth and straighten edges.
2. Fabricate patch. Contour to fit damaged area.
3. Weld patch in place on skin.







1. Smooth edges of damage and straighten so repair sections are flush with damaged section.
2. Weld damaged area, or if damage is severe, trim out damaged area.
3. Fabricate repair angles and filler (if required).
4. Weld repair sections in place.

F-86K-3-40-2

Figure 6-7. Afterburner Shroud—Angle and Skin

SECTION VII

FABRICS AND PLASTICS

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GENERAL.

Fabric and plastic parts are used for aileron seals, radio and radar antenna covers, various shields and covers for electrical equipment, and for the cockpit canopy. Many of these items are small and should be replaced if damaged. Other parts may be repaired if the damage is not too great and is not in a critical area. These fabric and plastic parts are of three types: fabric, glass-fabric-reinforced plastic, and clear plastic.

FABRIC.

The aerodynamic seals, used only on the ailerons, are the only fabric parts used in the structure of F-86 Airplanes. These seals are attached to the leading edge of the ailerons and to the trailing edge structure of the wing. Removal and attachment instructions are contained in Handbooks of Maintenance Instructions, T.O. 1F-86K-2.

GLASS-FABRIC-REINFORCED PLASTIC.

Glass-fabric-reinforced plastic parts are made of layers of glass fabric which have been impregnated with chemical resins, molded to a particular contour, and cured to a hard consistency. Polyester resin, which is used in most cases, is a thermosetting (hardens when exposed to heat), low-pressure, laminating resin. When the resin is mixed with a catalyst according to the manufacturer's specification, and cured by heat or at room temperature, it gradually changes from thick syrupy liquid to a hard solid. The curing action is controlled by the type of catalyst used. The function of the glass fabric in glass-fabric-reinforced plastic is just as important as the function of the resin in providing good strength properties. When the glass fabric and resin are combined, a very strong, lightweight material is obtained which is resistant to water, weather, aging, and a variety of chemicals. This material also has desirable electrical properties so that it may be used as antenna covers, etc.

REPAIRING FABRIC AILERON SEALS.

Rips, tears, and chafed areas may be repaired by using fabric patches (Specification MIL-C-7020, Type II) cemented to the seal with general-purpose cement (Specification MIL-C-4003). The patches must be large enough to extend a minimum of ¾ inch in all directions beyond the damage. To repair seals, proceed as follows:

1. Remove all grease, dirt, oil, talc, etc, from surfaces to be jointed, by wiping with a cloth dampened with dry-cleaning solvent (Federal Specification P-S-661).

2. Brush one coat of cement on each surface to be joined. Allow cement to dry until it is tacky. Check for proper stage of tackiness by touching a knuckle to drying cement. (Do not use finger tip because it is likely to be oily or greasy.) When the cement appears to stick to the knuckle but does not come away with it, the cement is in the proper condition for bonding.

Note

If cement on areas to be bonded has dried tack-free before bond has been made, apply a second coat of cement to one of the surfaces to be joined. If this is impractical, the first coat may be reactivated by moistening the cement surface with methyl ethyl ketone (Federal Specification TT-M-261).

3. Press or roll both surfaces together. This eliminates any bubbles and ensures good adhesion. The bond should not be strained for 48 hours after assembly. The cement used in repairing the aileron seals is fast-drying and should not be allowed to stand in an open container. The solvents are flammable and the cement must be used with all proper precautions in order to prevent fires. If the cement becomes too thick for easy application, it may be thinned with methyl ethyl ketone (Federal Specification TT-M-261). The cement should not be thinned beyond its original consistency. To clean up tools, etc, after using cement, use a cloth dampened with methyl ethyl ketone. Do not use an excess of this solvent, but just enough to dampen cloth.

REPAIRING GLASS-FABRIC-REINFORCED PLASTIC.

The following procedures are recommended for satisfactory repair of panels of glass-fabric-reinforced plastic.

MATERIALS USED.

MATERIALS	SOURCE
Low-pressure laminating resin	Spec MIL-R-7575
Liquid catalyst (curing agent) methyl ethyl ketone peroxide (DDM)	Lucidol Div Novadel-Agene Corp Buffalo, N.Y.
Glass fabric, Type VIII	Spec MIL-F-9084
Rain-erosion-resistant coating material—primer (Bostik 1007)	B B Chemical Co Cambridge, Mass.
Top-coat base cement and accelerator	Spec MIL-C-7439
Cobalt naphthenate (6-percent)	Nuodex Corporation Elizabeth F, N.J.
Toluol	Fed. Spec TT-T-548
Cellophane	Commercial
Polyvinyl alcohol sheet (0.003- to 0.005-inch)	Commercial
Felt sheet (0.250-inch)	Commercial
Sandpaper (120-grit)	Commercial
Masking tape	Commercial
Scotch tape	Commercial

The following equipment is suggested to aid in making this repair. However, substitute equipment may be used as needed.

MATERIALS	SOURCE
Razor blades (single-edge)	Commercial
Infrared heat lamp 250-watt, 105- to 120-volt or equivalent	Commercial
Small spatula	Commercial
Paint brush ½- or one-inch width	Commercial
Rolling pin or equivalent	Commercial

PAINT SUBSTITUTION—GLASS-FABRIC WING TIPS.

If the painted surfaces on wing tips are found to be cracked or checked, the probable causes are the loss of resiliency in the paint, the vibrations of the wing tips in flight, or a combination of both of these. The finish most commonly used on glass-fabric wing tips is Specification MIL-L-7178 lacquer paint. It is the resin base of this lacquer that loses its resiliency and is then subject to cracking and checking shortly after application.

A substitute finish for Specification MIL-L-7178 lacquer is Specification MIL-E-7229, Type I, gloss enamel. This finish has a tendency to retain its resiliency longer and is not as readily subject to cracking or checking.

Glass-fabric wing tips may be left unpainted without harmful effects to the part; however, because of the appearance of the airplane, this may not be desirable.

REMOVING RAIN-EROSION-RESISTANT COATING.

If the area to be repaired is covered with a rain-erosion-resistant coating, the coating must be removed to a minimum of three inches around the damaged area. To remove coating, place a piece of ¼-inch-thick commercial felt over the area and fasten the felt in place securely with masking tape. Saturate felt with toluol and keep it saturated for 30 to 45 minutes. At the end of this time, the coating should come loose from the glass fabric easily. Fair in edges of coating with a cloth soaked in toluol, or with commercial sandpaper, 120-grit.

PREPARATION OF DAMAGED AREA.

Clean out damage to a rectangular shape large enough to remove any areas that have delaminated. The rectangular shape makes it easier to fit the repair layers of glass cloth. A sharp knife or razor blade may be used to cut the material. After the hole has been sized, the correct amount of overlap for the top layer may be determined. (See figure 7-1.) Carefully trim and peel top layer of cloth from overlap area. Be careful not to cut into next layer of cloth, and do not let layers separate outside damage area. This would result in an area which is structurally weaker than the surrounding area. Cut and peel each layer in stair-step fashion as shown in figure 7-1. A spatula is often helpful in lifting the layers and for separating the layers for removal.

MIXING LAMINATING RESIN.

The laminating resin must be mixed with the curing agent or catalyst according to manufacturer's instructions before use. After adding curing agent to resin, mix thoroughly for several minutes. Laminating resin should be mixed in small amounts, to minimize wastage, because the mixed resin has a pot life of only about 6 hours.

PREPARING "WET" LAYER.

Spread glass fabric on a sheet of cellophane on a flat surface. Saturate fabric with mixed resin, spreading it uniformly over surface with a spatula or other flat tool. Cover saturated fabric with another sheet of cellophane, and roll gently but firmly to force resin into fabric. This rolling action forces the excess resin out to the edge of the fabric. This impregnated fabric between sheets of cellophane may then be cut to the required size. To avoid contamination, the cellophane should remain in contact with the "wet" fabric until the layer is to be used.

PREPARING "DRY" LAYER.

The "dry" or precured layer is used as a backing layer. This layer should be contoured to match the part being repaired as near as possible. The preparation is the same as for a "wet" layer, except that it is not cut to size until after it is cured. To cure "dry" layer, lay fabric smoothly over a contouring block and expose it to heat from an infrared heat lamp, or equivalent, for one hour. The lamp should be held about 12 to 15 inches from the surface of the layer. The surface temperature should be 150°F to 200°F for at least one hour. After the layer has cooled, it should be relatively hard, if it is completely cured. The cellophane sheets should not be removed.

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FITTING REPLACEMENT CORE.

Cut out a core replacement to provide a tight fit. Be sure that core surfaces are flush with adjacent core, and that replacement is same thickness as original core. If the repair is in an area of sharp contour, it may be necessary to use several pieces of core to reproduce the same contour as the original surface. Do not remove fuzz from sawed edges of replacement core. These frayed surfaces are important aids in obtaining a strong secondary bond between the core and the inner layers of the faces.

CORE SUPPORTS.

When repairing honeycomb sandwich type construction, it is necessary to support the core while making the repair lay-up on one skin. When one skin is cured, it will support the core while the other side is repaired. There are many ways the core may be supported for this first phase of repair. One of the simplest and most accurate is the plaster "splash" method. To do this, stretch a piece of cellophane or polyvinyl alcohol sheet over an area about 4 times as large as the repair and as close to repair as possible. As much as possible, choose an area with the same contour as the repair area. Mix a large enough batch of plaster of Paris to coat an area of cellophane the size of the repair plus about one-inch overlap on all sides, and to a depth of 1/4 to 3/8 inch. When plaster is completely dry, remove it from cellophane, and trim core support to leave a male-type part which matches core surface. This plaster mold will support the replacement core after it is taped securely in place with a piece of cellophane between the plaster and the core plug. Trimming of the plaster may be done with a knife or a piece of coarse sandpaper (garnet No. 1/0 or No. 1/2).

REBUILDING DAMAGED AREA.

Where both faces and the core of a honeycomb type panel are damaged, a support for the core on the far side is required during the lay-up of the repair. The far face of the panel will provide this support normally, unless it has had to be removed. Brush a coat of the mixed resin on to the four sides of core plug and core cavity. Fit core plug carefully into place with a layer of cellophane next to core plug on far side. Put core support in place, and tape down securely. The cellophone sheet should be large enough to prevent leakage of the resin onto the adjacent layers of the panel and the core support. The cutout area to be rebuilt should be masked off with cellophane or masking tape. This masking should cover an area at least two inches wide around the entire cutout. Masking saves considerable time and trouble in the cleanup process after the repair has cured. Peel cellophane from one side of precut "dry" layer, and brush a thin coat of mixed resin onto exposed surface. Place layer in position on core, with resin-coated surface against core plug. Rub layer gently with a smooth tool to remove excess resin and to secure layer in place. Peel cellophane from one side of first precut "wet" layer and from "dry" layer already in place. Position layer as before and rub gently to remove excess resin and any trapped air bubbles. Repeat this procedure for all layers until repaired area has the same number of layers as original part.

When last layer is in place, remove outer cellophane from it and brush a thin coat of resin over outside layer. Cover the repair area with a sheet of polyvinyl alcohol sheet. Stretch this sheet as tightly as possible, without wrinkles, and secure it with cellophane or masking tape. Rub repair area gently with a smooth tool to remove excess resin and to work any air bubbles out of layers and onto masking. Too much rubbing should be avoided because it may reduce tne resin content of the fabric enough so that a poor bond results.

Laminated glass fabric without the honeycomb core is repaired about the same as the honeycomb type except a precured backing layer is used to support the repair layers. This backing layer should be formed to the same contour as the repair area. The repair consists of replacing the skin layers as required.

CURING THE LAY-UP.

Cure repair area with infrared heat lamp or equivalent. The lamp should be placed 12 to 15 inches from the surface to maintain a surface temperature of 150°F to 200°F. The curing time should be about one hour. If the repair is properly cured, the area should have a metallic ring when tapped with a coin. If a dull sound is produced, or if repair is soft to touch, continue curing until repair is hard to the touch and produces a metallic ring. After repair is cured, remove polyvinyl sheet and masking around repair. The complete repair may be sanded lightly to obtain good fairing and a smooth surface.

If heating equipment is not available, the repair may be cold-cured. A special resin mix is required for a cold or room-temperature cure. This special mix is made by adding 6-percent cobalt naphthenate to unmixed resin according to the manufacturer's instructions. Mix thoroughly, add curing agent, and then mix again for several minutes.

CAUTION

The cobalt naphthenate must be mixed into the resin before the curing agent is added. Contact of the undiluted cobalt naphthenate with the curing agent produces an explosive mixture.

The pot life of the mixed resin for a cold cure is about 10 to 15 minutes at about 70°F. This time varies with the temperature of the air. The higher the temperature, the less time it takes the resin to harden. At temperatures below about 60°F, the resin will not harden. For this reason, the room-temperature cure cannot be used below about 60°F. Curing time at about 70°F for this material is at least two hours or until the repair is hard to the touch and produces a metallic ring when tapped with a coin.

REFINISHING RAIN-EROSION COATING.

Surfaces coated with rain-erosion-resistant material are coated basically to protect them from rain impingement during high-speed flight. To satisfactorily protect the surface, the coating must be well bonded and free of all blemishes. Blemishes erode very rapidly, and poorly bonded areas blister under rain impact. Once the coating has become penetrated, water droplets along with the air stream tend to peel the coating away and expose the surface to extremely rapid erosion due to direct impact. Parts that have damage to more than 5 percent of the coating must be completely recoated. Parts with less than 5 percent of the coating damaged may have the coating patched without completely replacing the coating.

RECOATING—TOTAL AREA.

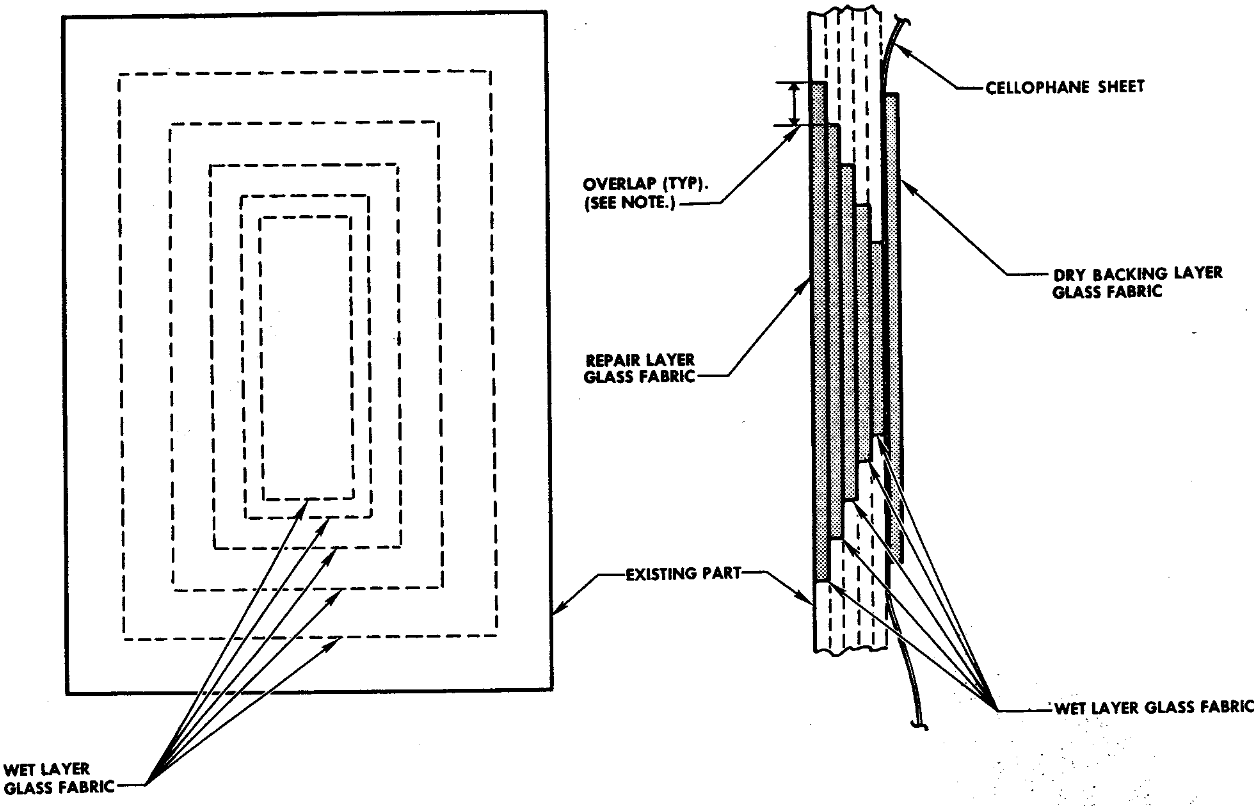
The coating must be applied to scuff-sanded surfaces which are free of pinholes and any surface irregularities. Following the initial scuff-sanding, any pinholes or defects must be filled with Tuf-on P-24A Filiplast filler or its equivalent. Filler material can be knifed or squeezed into the defect or sprayed after the filler has been thinned with toluene or xylene. When the filler has dried, the surface must be smoothed by sanding with either sandpaper or garnet paper. Use a grit no coarser than 1/0. Clean surface of all dust by using an air hose with clean, dry air or by wiping with a clean cloth dampened with toluene or a similar solvent. Spray surface with Bostik 1007 primer to a thickness of 0.001 to 0.002 inch. (Thin primer to brushing consistency with a 50-50 solution of toluene and xylene.) Two coats are normally enough. Allow about 10 minutes between coats. If the surface is not perfectly smooth after the primer has been applied, it should be sanded lightly with sandpaper or garnet paper with a grit no coarser than 4/0. After primer has been dried for at least 30 minutes, spray surface with top-coat material (Specification MIL-C-7439) which has been catalyzed to manufacturer's specifications. All materials must be used within 12 hours after catalization. The initial coats should be very light to prevent the primer being dissolved into the top-coat material. Spray in long, even passes, spraying from wet to dry surfaces. Two or three fast passes per coat are preferable to one slow pass because it gives a greater coat thickness with less chance of running or sagging. Under normal conditions, 10 to 15 minutes drying time between coats should be allowed. The finished thickness of the top coating should be from 0.007 to 0.009 inch. Any entrapped air bubbles can be replaced by spraying the surface gently with a mist coat of thinner, or a 50-50 mixture of toluene and methyl ethyl ketone. The finished coating must be dried for a minimum of 72 hours under interior conditions before installation. The finished coating must be free of pinholes, blisters, lumps, runs, sags, and any other surface irregularities. The cured coat can be cleaned with a mild detergent and water. No other solvents should be used. When desired, the coating may be polished with a carnuba-base *paste* wax. Liquid oils, polishes, and cleaners must not be used.

RECOATING—LESS THAN 5 PERCENT OF TOTAL AREA.

Mask off a rectangle which includes damaged area plus a perimeter of about ½ inch of nondamaged area. The masking should be at least 2 inches wide. With a sharp knife, carefully cut and remove rain-erosion coating inside of marked area, being careful not to cut glass laminate. Sand exposed area with sandpaper or garnet paper no coarser than 1/0. Extreme caution should be used so as not to loosen the edges of the adjacent coating. Fill all pinholes with Tuf-on P-24A Filiplast or equivalent, and sand smooth. Remove all dust and foreign matter by wiping area with a clean cloth dampened with toluene. Brush a coat of Bostik 1007 primer on prepared surface. Care should be used so that the primer barely contacts the edge of the adjacent surface. The presence of more than a slight amount of the primer against the coating will cause blistering and loss of adhesion. This will necessitate repeating the entire procedure. Air-dry Bostik 1007 primer for 2 hours before application of top coating. Brush on as many coats of catalyzed top coating as required to bring repaired surface slightly higher than masking tape around edge of repair. Allow at least 30 minutes drying time between each coat. After last coat has dried for 24 hours, remove masking tape and carefully feather edges of repair, using a clean cheesecloth slightly dampened with toluene. The excessive use of toluene will cause the repair to blister. Air-dry completed repair for at least 72 hours before installation.

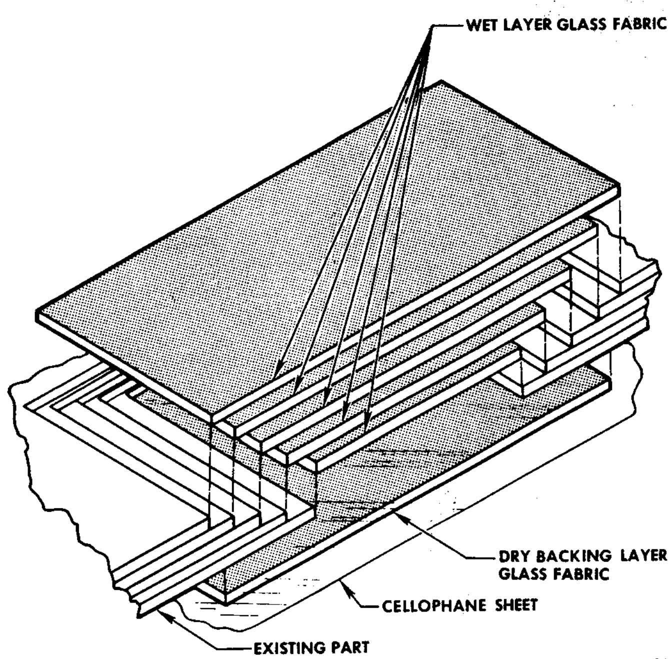
PERMANENT CATEGORY A

FABRICS AND PLASTICS



NOTE For a hole up to 2-1/2 by 4 inches, use 1/2-inch overlap; for a hole up to 5 by 8 inches, use 3/4-inch overlap; for a hole over 5 by 8 inches, use one-inch overlap.

1. Trim out damaged area in "stair-step" fashion, as shown. Be careful not to cut into layer below the one being removed.
2. Mix resin and prepare layers. (Refer to text.)
3. Install dry layer as shown.
4. Install wet layers.
5. Cover repair with polyvinyl alcohol sheet on both sides. Stretch tight and tape in place.
6. Cover repair area with felt pad taped down to apply pressure on repair area.
7. Cure repair and refinish area as prescribed in text.



F-86A-3-91-2

Figure 7-1. Glass-fabric Laminate Repair

RADOME DIMENSIONS

FABRICS AND PLASTICS

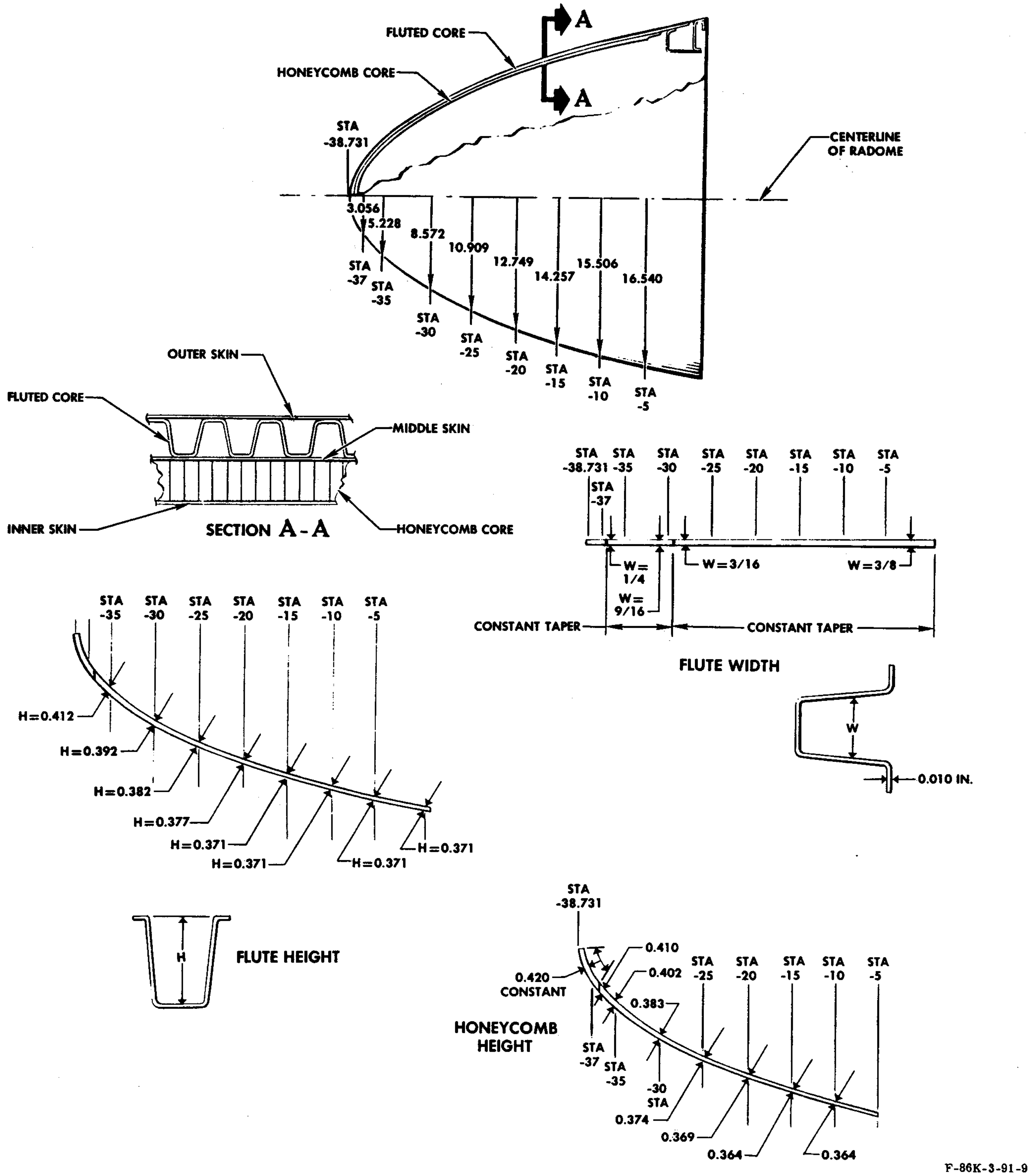


Figure 7-2. Radome Dimensions

STOCK NO.	NOMENCLATURE	CLASS	SOURCE
8030-506-403	Coating—Neoprene, Class I, Specification MIL-C-7439	8030	Local purchase
8030-NSL	Coating—Neoprene, Class II, Specification MIL-C-7439	8030	Local purchase
8030-223-5050	Putty—Tuf-on P-24, ½ pt can for laminated Fiberglass plastic repair	8030	AF stock
8040-281-1976	Primer—Bostic 1007	8040	AF stock
6810-281-2002	Toluene—Specification TT-T-548, one-gallon can	6810	AF stock
6810-598-6600	Xylene—Grade B, Specification TT-X-916, one-gallon can	6810	Local purchase
6810-281-2785	Methyl ethyl ketone—Specification TT-M-261, one-gallon can	6810	AF stock

RADOME REPAIR.

Because of the radar transmission requirements of the radome, all repairs must be an exact replacement of the damaged area, with no local structural "beef-ups" permitted. The result is an area of reduced mechanical strength; however, if instructions are followed and good workmanship is used, the repaired radome will be strong enough for service. Each skin thickness and each core height in the radome is the amount required for a balanced radome sandwich. Any change in these dimensions or in the materials used is likely to change the radar transmission quality of the radome. Because there is no way to know that a repaired radome is acceptable for radar transmission except by actual test, a repaired radome should be tested for one-way radar transmission quality before being returned to service. These repairs are concerned only with the radar transmission area of the radome. Repairs can be made to the manifold or the metal attachment ring according to structural requirements only.

NEGLIGIBLE DAMAGE.

Weathered or eroded rain-erosion coatings and minor surface blemishes on the outer layers of the skin may be considered as negligible damage. Fill blemishes and recoat part as described under "Refinishing Rain-erosion Coating."

REPAIRS.

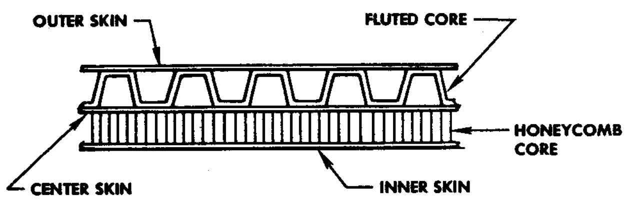
Damage extending through the inner or outer skin but not into the core may be repaired by replacing the damaged material. Loss of bond between the inner or outer skin and the core may be repaired by cutting out the area where the loss of bond has occurred and replacing the removed material. Both these repairs require the use of precured skin, if a large area is involved. If the damage is bond failure, the skin layers in the damaged area can be re-used. When damage to the skin itself occurs, a new section of precured skin must be molded and used. A complete "wet" lay-up over the open fluted core would result in the repair being corrugated. Severe damage is damage which extends through the inner skin and into the honeycomb core, or through the outer skin and into the fluted core. Repair of this damage includes replacing the damaged core as well as the damaged skin section. The replacement core must be the same height as the original. Flat pieces of honeycomb can be made to fit the contour of the radome if several small pieces are used. Lightly coat mating surfaces of skin and core with resin mixed to cure at room temperature. Hold replacement core tightly against skin with sandbags until resin has cured. The inner skin should then be rebuilt. No attempt should be made to repair damage extending through the center skin. (See figure 7-3.)

TRANSPARENT PLASTIC.

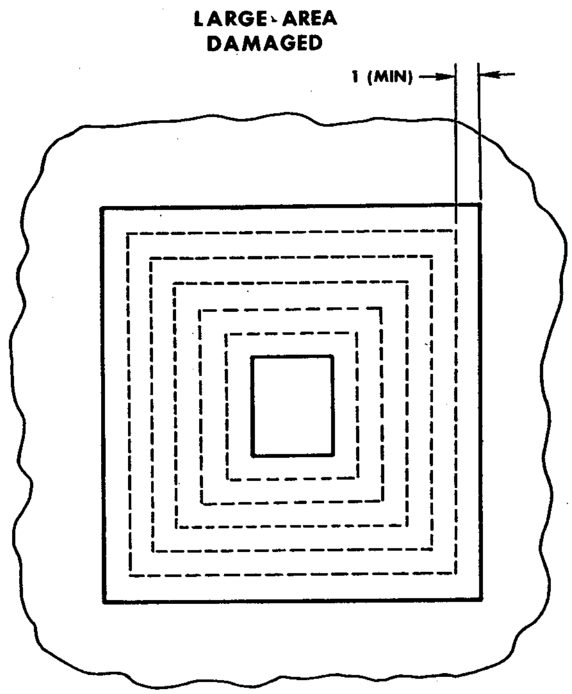
All repairs given for the transparent enclosure (canopy) are to be considered *temporary* and should be used under emergency conditions only. Two types of repairs are permissible: the transparent plastic plug repair, and the fabric overlay repair. Because of pressurization and thermal expansion problems, the transparent plastic plug repair is restricted to one inch in diameter and cannot be used in certain areas as shown in figure 7-4. No *structural* limits are placed on the fabric overlay repair. The limits for this type of repair will be determined by the using activity and will be based on operational visibility requirements.

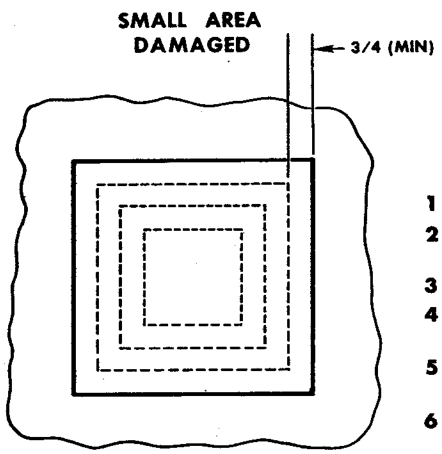
PERMANENT CATEGORY A

FABRICS AND PLASTICS



NOTE: The repairs shown apply to one skin and one core only. Damage extending through the center skin from either direction is not reparable.





1 Repairs apply to inner or outer cores.

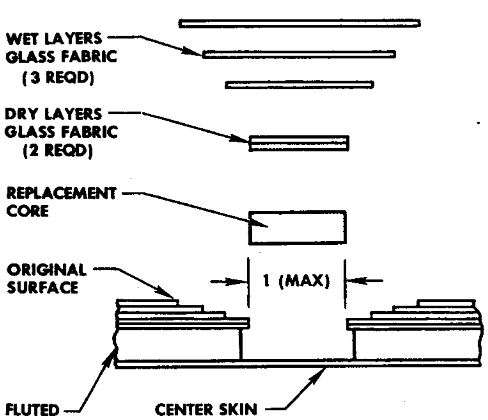
2 Trim out damage in stair-step fashion as shown.

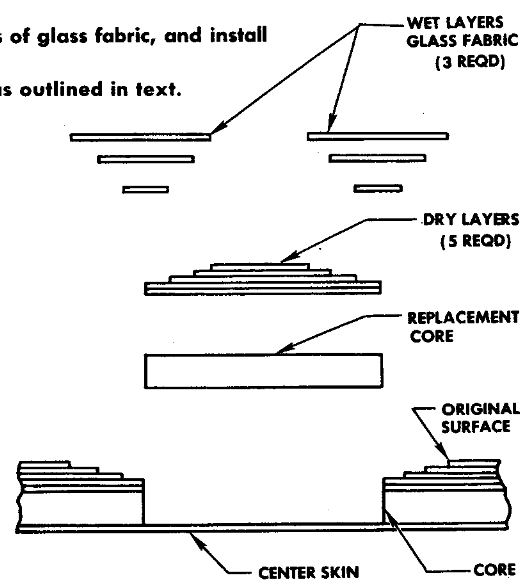
3 Trim replacement core to fit hole.

4 Prepare dry layers of glass fabric, and install next to core.

5 Prepare wet layers of glass fabric, and install as shown.

6 Cure repair area as outlined in text.





F-86K-3-91-8A

Figure 7-3. Radome Repair

NEGLIGIBLE DAMAGE.

Nicks, dents, scratches, etc, may be considered as negligible damage if they can be sanded out without removal of more than 10 percent of the material. The sanding and polishing of this material should be done by hand. Using power equipment may overheat and ruin the enclosure.

HAND-SANDING.

When sanding is required, the finest abrasive paper that will remove the scratch or other defect (no coarser than No. 320A) is used first. This is wrapped around a felt or felt-covered wooden block. The defective area is rubbed lightly, with water or 2 percent soap solution being used as a lubricant. Light pressure should be used, and the strokes should be circular. The initial sanding should be followed by a similar treatment using successively finer grades of abrasive paper. The plastic should be washed after each sanding operation. During each step, the deeper scratches left by the preceding grade of abrasive should be removed.

Note

Do not sand transparent plastics unless it is absolutely necessary. Hairline scratches of 0.001 inch maximum depth will be left "as is," provided optical requirements are maintained.

HAND-POLISHING.

The area to be polished must first be washed free of dirt and grit. Wash with a mild soap, rinse thoroughly, and dry carefully with a chamois. Polish with a soft, damp cloth, using a polish that meets the requirements of Specification MIL-C-18767. Rub vigorously with polish, but be careful not to rub too long in one place. Rub with a free circular motion over a fairly wide area.

CEMENTS.

The recommended cement for plastic material conforming to Specification MIL-P-6886 is Specification MIL-A-8576. Cement conforming to Specification MIL-A-8576 is a mixture of a polymerizable ingredient (monomer) and solvent. A catalyst is furnished as a separate ingredient and must be added to the cement before it is used in accordance with the cement manufacturer's instructions.

Before the catalyst is added, and if the container is kept tightly closed, the cement has a shelf life of at least one year. After the catalyst is added, and if the container is kept tightly closed, the following shelf lives will apply at the given temperature:

TEMPERATURE	SHELF LIFE
50°C (122°F)	20 hours
40°C (104°F)	3½ days
25°C (77°F)	45 days
5°C (41°F)	5 months

In use, the solvent will evaporate, causing the cement to thicken; if the shelf life given has not been exceeded, solvent (methylene chloride, Specification MIL-M-6998) may be added to keep the proportion of monomer to solvent correct. The specific gravity of the cement provides a quick method of checking the relative proportions of the two components. The following table gives the correct specific gravity ranges for given temperatures.

TEMPERATURE	SPECIFIC GRAVITY RANGE
20°C (68°F)	1.17 to 1.21
25°C (77°F)	1.16 to 1.20
30°C (86°F)	1.15 to 1.19
35°C (95°F)	1.14 to 1.18
40°C (104°F)	1.13 to 1.17

The specific gravity should be checked at least every 4 hours if the cement is used continuously, and more often if the 4-hour check shows an excessive change of composition. If the cement is not used continuously, check specific gravity before each use.

A high-grade storage-battery hydrometer is ordinarily satisfactory to determine specific gravity; however, since these are known to vary in their calibration, it is advisable to check them periodically against a fresh mixture or an unused batch of cement.

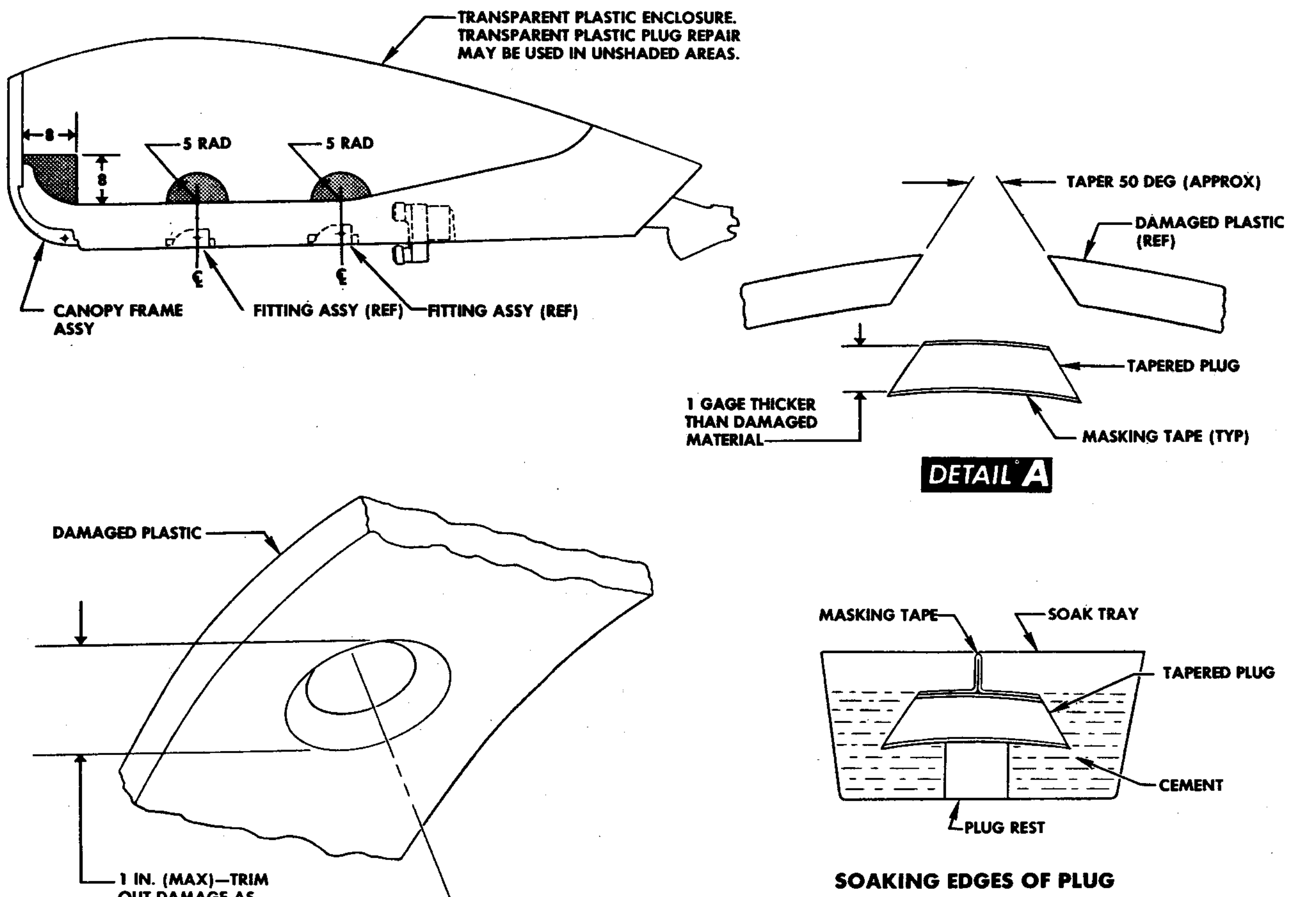
If, at the time of checking, the specific gravity of the cement is found to be too low, it should be adjusted by adding methylene chloride, conforming to Specification MIL-M-6998, to bring its specific gravity to the maximum end of the specified range. This adjustment requires tthe addition of methylene chloride to the extent of approximately 2.5 percent by volume of the cement per 0.01 unit of required correction of specific gravity. The cement should be thoroughly stirred, and the specific gravity should be rechecked.

WARNING

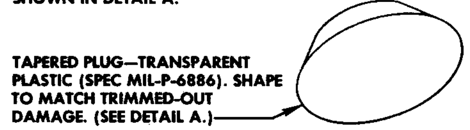
Methylene chloride is toxic if its vapors are inhaled over a period of time. Adequate ventilation must be provided for personnel working with this cement, taking into consideration that methylene chloride vapor is heavier than air.

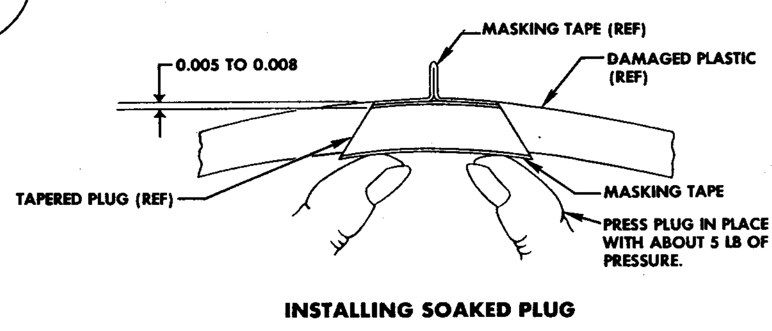
TEMPORARY

CATEGORY A



SOAKING EDGES OF PLUG





INSTALLING SOAKED PLUG

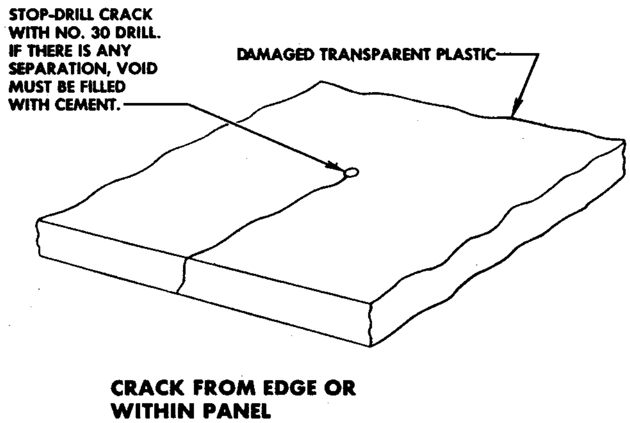
1. Trim out damage as shown.
2. Shape plug to match finished hole.
3. Soak plug until a soft cushion is formed on tapered edges. Protect other surfaces with an approved masking tape.
4. Press plug into hole as shown. Devise means of holding it in place for 24 hours.
5. Remove tape; then sand and polish repaired area.
6. Refer to "Transparent Plastic" for detailed instructions and repair materials.

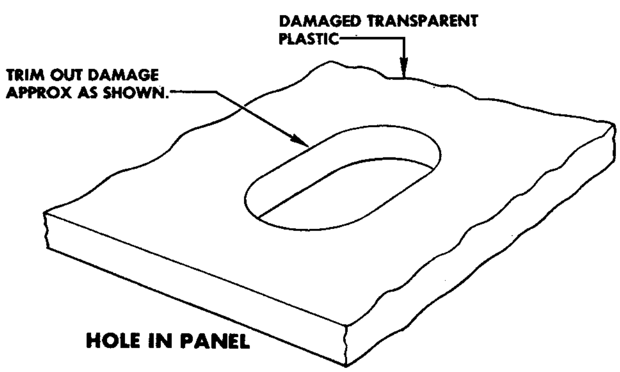
GEN-3-91-101

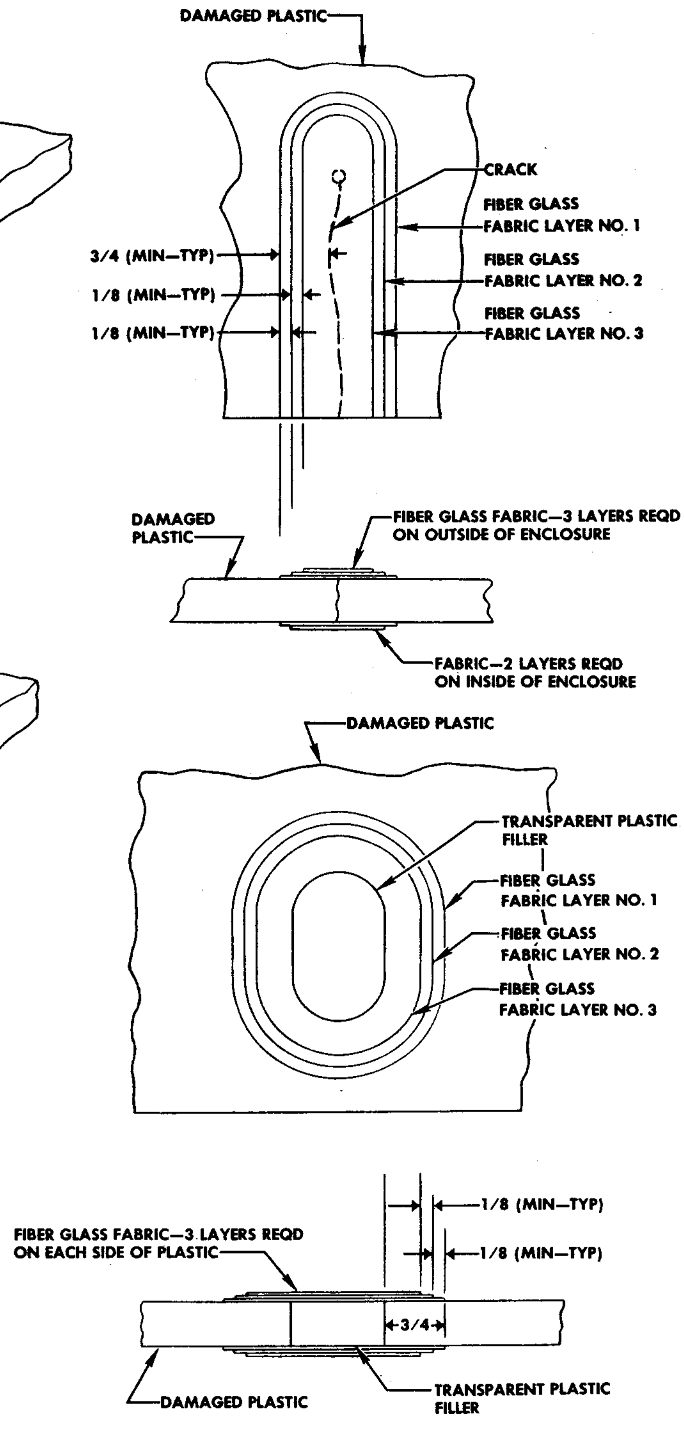
Figure 7-4. Temporary Repair of Canopy Plastic (Sheet 1 of 2)

TEMPORARY

Category A







1. Trim out damage, or stop-drill as shown.
2. Shape transparent plastic filler to match finished hole (if applicable).
3. Soak mating edges of filler until soft cushion is formed; then install in finished hole.
4. Soak prepared fabric in cement until soft.
5. Place fiber glass fabric layers over crack or filler as shown. Remove excess cement with scraper or with fingers.
6. Cover repair with cellophane to keep moisture out.
7. Cure as directed by cement manufacturer.
8. Remove cellophane and wet sand to obtain smoothness.
9. Refer to "Transparent Plastic" for detailed instructions and repair materials.

Figure 7-4. Temporary Repair of Canopy Plastic (Sheet 2 of 2)

METHYLENE CHLORIDE.

In emergencies when Specification MIL-A-8576 cement is not available, methylene chloride may be used. It is a more active solvent than cement, and shorter soak periods should be used. It is also more conducive to blushing or whitening of a joint.

TRANSPARENT PLUG REPAIR PROCEDURES.

The area to be repaired must first be cleaned with soap and water or with an approved cleaning polish. Trim out damaged area as shown in figure 7-4. Cut repair plug from a sheet of the next greater thickness of plastic (Specification MIL-P-6886). Shape plug to match tapered hole in enclosure. Hand-fit plug by scraping and sanding. Wash a 2-inch area around plug cavity with approved tape. (Refer to "Transparent Plastic Repair Materials" in this section.)

Mask a 2-inch area around plug cavity with approved tape. (Refer to "Transparent Plastic Repair Materials," in this section.)

When cementing transparent plastic (Specification MIL-P-6886), place transparent plastic plug in a soak tray. The tray should be made of material that will not be attacked by action of the cement. Place wire rods in the soak tray on which the plug or part to be cemented may rest; this will permit cement to contact all edges to be cemented. Pour applicable cement into tray until it is level with top of plastic plug. Do not soak top of plug patch; masking of this surface will be added protection from cement contacts. Leave plastic plug immersed in cement until surfaces to be cemented soften into a deep cushion. Accurate soaking time should be worked out for each cementing operation. Temperature should be 80°F to 90°F and a relatively low humidity. Do not attempt to cement transparent plastic assembly at temperatures below 65°F.

Immediately press plastic plug into cavity and wipe along its length applying about 5 psi pressure to remove trapped air. Do not press hard enough to produce "starving" or dispersion of cement. A hypodermic needle may be used to inject cement into the bond area to force out trapped air bubbles. Ten percent of the plug area may contain air bubbles; however, it is not desired. The plug can be held in place by means of contour blocks and airplane shock cord. Contour blocks may be removed in 24 hours. Allow approximately 72 hours before finishing plug surface.

Complete plug repair by sanding down excess of plug extending above transparent plastic assembly surface. Finish surface by sanding and polishing. (Refer to "Hand-sanding" and "Hand-polishing.")

FABRIC OVERLAY REPAIR.

The fabric overlay repair may be used for deep scratches, cracks, etc, and for holes over one inch in diameter. (See figure 7-4.)

Clean surface with approved cleaning compound. All grease must be removed. Do not touch cleaned surface with fingers.

Methyl-methacrylate resin (prebodied) is satisfactory for use in laminating Fiberglas and orlon fabric material or in applying a wet lay-up fabric patch on transparent plastics.

Note

Resin must be stored under refrigeration at temperatures not exceeding 40°F. Mix catalyst with methyl-methacrylate resin by stirring slowly to avoid whipping air into the resin. Catalyze resin in accordance with manufacturing instructions.

WARNING

Do not store catalyzed resin in an airtight container or an unvented refrigerator. Catalyze only enough resin for immediate use. If a promoter is recommended for use with catalyst, do not mix or store them directly together, as they are explosively reactive as a mixture.

Acrylic laminated fabric is supplied by Swedlow Plastic Company, Los Angeles, California, and Goodyear Aircraft Corporation, Akron, Ohio, in two different types, Type I and Type II acrylic impregnated fabrics. Type I impregnated fabric is recommended in preference to the stiffer Type II, where a very flexible and pliable lay-up is required (e.g., the lay-up of a laminate on a compound curvature). Procedure for applying a fabric overlay patch is as follows:

1. Prepare plastic surface to receive patch as previously outlined for transparent overlay patch repair.

2. Cut patches from acrylic laminate fabric the desired size (patches will overlap damaged area as shown in figure 7-4, and extend one inch into fabric edge attachment when damages are adjacent to edge attachment) and soak preimpregnated fabric patch in a bath of applicable cement for specific type of damaged plastic, from 10 to 20 minutes where a very flexible and pliable lay-up is required (compound curvatures).

Note

The excess cement may be removed when the fabric patch is removed from the cement container by use of the fingers or a scraper.

3. When very little flexibility of fabric patch is required, apply a brush coat of cement on patch and surface to receive patch.

4. Within one minute after application of brush coat of cement, place preimpregnated fabric patch in position.

5. Cover wet patch with cellophane to prevent moisture absorption, apply pressure, and cure as specified by cement manufacturer's instructions.

6. Remove cellophane; wet-sand patch to obtain smoothness.

TRANSPARENT PLASTIC REPAIR MATERIALS.

NOMENCLATURE	SPECIFICATION	AIR FORCE STOCK NO.	FEDERAL STOCK NO. OR COMMERCIAL SOURCE
Cement II (1 pt cans)	Spec MIL-A-8576		8040-266-0815
Chamois skins	Fed. Spec KK-L-167 Type A		8330-257-2492
Solvent-type cleaners			
Shell solvent TS. 1			Shell Petroleum Co
Shell solvent 360			
Aliphatic naphtha	Fed. Spec TT-N-95, Type II	8500-617900	
Cloth—polishing and waxing	Fed. Spec CCC-F-466		
27 in. wide	Type 3		
36 in. wide	Type 3		
Methylene chloride	Spec MIL-M-6998		
Polishes and cleaners	Spec MIL-C-18767		
Masking tapes			Minnesota Mining & Mfg Co
3MBD 221			
CFM 670			

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SECTION VIII

EXTRUSION CHARTS

Contents

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EXTRUSIONS AND ROLL-FORMED SECTIONS	8-1
IDENTIFICATION OF EXTRUSIONS AND ROLL-FORMED SECTIONS	8-1
EXTRUSION AND ROLL-FORMED SECTION SUBSTITUTES	8-1
EXTRUSION AND FORMED SECTION INDEX	8-1

EXTRUSIONS AND ROLL-FORMED SECTIONS.

Extrusions are die-formed shapes that can be made to any specific cross-sectional area. The material, in a plastic or soft state, is forced through the die by very high pressure. The material takes the form of the die and becomes solid in that shape. The extrusion process makes possible the quantity production of many unusually shaped sections which are found in aircraft. It also has the advantage of considerable weight reduction.

Extrusions may be made of many different types of material, both metal and plastic. The F-86K Airplane makes extensive use of extrusions made of aluminum alloy (2024 and 7075) and magnesium. When replacing extrusion in an airplane, be sure that the material of the replacement part is the same as that of the original.

Roll-formed sections differ from the extrusions in that the roll-formed sections have a uniform thickness and they are limited as to the number of shapes that can be made.

Like extrusions, roll-formed sections are made of many different types of materials. Replacement parts in the airplane must be of the same material as that of the original part.

IDENTIFICATION OF EXTRUSIONS AND ROLL-FORMED SECTIONS.

Extrusions are identified by a die or shape number. Identification numbers may be either those of the contractor or an Alcoa die number. Those numbers with the identification letter "E" in them are contractor numbers.

Roll-formed sections are identified by contractor number.

EXTRUSION AND ROLL-FORMED SECTION SUBSTITUTES.

Sheet-metal substitutes may be made for some of the less complicated extruded or roll-formed shapes. In making substitutes for either extrusion or roll-formed sections, it is important that the same material be used in the substitute as was in the original part, unless otherwise noted on the extrusion chart. Bend radii must not be less than that used in standard sheet-metal practices. (Refer to index for bend radii table.) Either annealed or heat-treated material may be used. Annealed material is recommended if the material is over 0.064 inch thick. Heat-treat 2024-O to T4 condition and 7075-O to a T6 condition after forming.

If the shape of the extrusion is such that a sheet-metal substitution cannot be made, the shape may be machined from bar stock. The bar stock used must be of the same material and heat-treat as that of the original extrusion.

EXTRUSION AND FORMED SECTION INDEX

EXTRUSIONS—FIGURE 8-1.

NAA DIE NO.	SHEET NO.	NAA DIE NO.	SHEET NO.
1E29	1	1E100	1
1E45	1	1E110	1
1E48	1	1E122	1
1E87	1	1E128	2
1E88	3	1E129	1

NAA DIE NO.	SHEET NO.
1E132	1
1E141	1
1E168	1
1E178	6
1E180	3
1E191	1
1E214	1
1E269	2
1E282	6
1E286	3
2E111	6
2E123	7
4E13	9
4E84	9
4E85	10
4E117	9
4E118	10
4E120	10
4E148	9
4E156	8
4E157	8
4E166	10
4E178	10
5E29	7
5E90	5
5E111	5
6E141	4
6E296	7
6E296	6
6E345	7
12E5	5

ALCOA DIE NO.	SHEET NO.
77B	1
78A	1
78C	1
78F	1
78J	1
78K	1
78M	1
78U	1
472	1
734-2	1
734JJ	1
3660	9
6494	1
11636	1
11899	1
12883	1
13642	2
13829	9
13891	9

ALCOA DIE NO.	SHEET NO.
14044	1
14263	1
14654	1
16074	3
16869	1
22882	1
22885	1
22897	9
23854	8
24750	9
27760	1
27903	1
27918	1
27936	1
29034	1
29146	1
29244	2
30663	1
30796	1
31153	2
31154	1
31277	1
31475	1
32862	4
32900	3
32977	7
34880	1
42616	1
43360	10
43416	1
43515	9
44259	1
44271	10
44281	9
44544	10
44584	6
44847	2
51777	9
52057	10
52093	3
59309	
62098	4
AND 10133-0701	1
AND 10133-0702	1
AND 10134-0702	1
AND 10134-1204	1
AND 10134-1205	1
AND 10134-1404	1
AND 10134-1601	1
AND 10136-2004	9
AND 10137-1202	7
AND 10137-1703	9
AND 10137-2007	9
DC—760	5
M—1387	5

ROLL-FORMED SECTIONS—FIGURE 8-1.

SECTION NO.	SHEET NO.	SECTION NO.	SHEET NO.
1S3	11	1S151	11
1S4-2	11	1S155	10
1S4-3	11	1S166	11
1S77	11	1S202-7	11
1S91	11	1S203-5	11
		1S205-064	10

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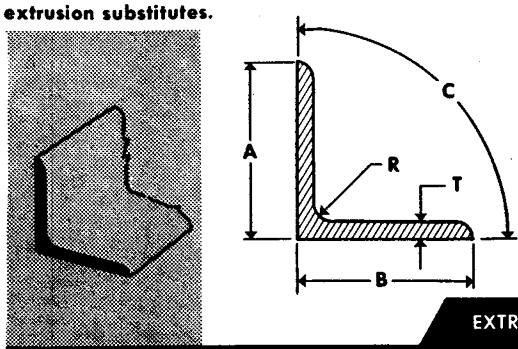
EXTRUSIONS & SUBSTITUTES

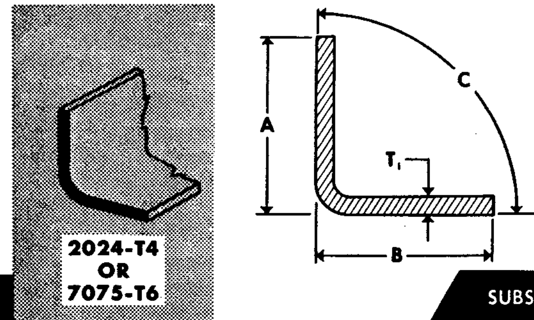
EXTRUSION CHARTS

NOTE

Refer to index for text on extrusion substitutes.



EXTRUSION



SUBSTITUTE

EXTRUSION NO.		DIMENSIONS						
ALCOA NO.	NAA NO.	A	B	C		R	T	T_1
77B		1.000	1.000	90°		0.125	0.125	*
78A		1.250	1.250	90°		0.125	0.188	*
78C		0.750	.750	90°		0.125	0.094	*
78F		1.000	1.000	90°		0.094	0.074	0.081
78J		1.000	1.000	90°		0.062	0.062	0.072
78K		0.750	0.750	90°		0.125	0.063	0.072
78M		1.000	1.000	90°		0.125	0.188	0.250
78U		1.125	1.125	90°		0.188	0.125	*
472		0.750	0.750	90°		0.015	0.062	0.072
734-2		1.250	1.625	90°		0.125	0.125	0.156
734JJ	1E110	0.750	1.000	90°		0.063	1.125	0.156
6494		1.125	1.750	90°		0.125	0.064	0.072
11636		1.000	1.500	90°		0.094	0.094	0.102
11899		0.500	1.000	90°		0.063	0.063	0.072
12883		0.625	0.750	90°		0.063	0.051	0.056
14044		0.750	1.000	90°		0.125	0.094	0.102
14263		1.000	1.750	90°		0.094	0.094	0.102
14654	1E100	0.625	0.813	90°		0.094	0.078	0.094
16869	1E87	0.750	0.875	90°		0.063	0.125	*
22882		0.875	1.375	90°		0.125	0.125	*
22885		0.750	1.000	90°		0.063	0.063	0.072
27760		1.125	2.625	92°		0.125	0.125	0.156
27903	1E29	1.125	1.375	90°		0.188	0.125	*
27918		1.250	1.500	90°		0.125	0.094	0.102
27936		1.750	2.250	86°		0.094	0.156	0.188
29034	1E48	1.000	1.000	96°		0.094	0.125	*
29146	1E45	1.625	2.000	90°		0.094	0.125	*
30663		1.000	2.250	90°		0.094	0.093	0.102
30796	1E122	1.000	0.125	90°		0.125	0.125	*
31154	1E129	0.875	1.000	90°		0.063	0.125	0.156
31277	1E132	1.000	1.500	72°		0.094	0.094	*
31475	1E141	1.625	1.625	92°45′		0.125	0.125	0.156
34880		0.875	0.875	90°		0.125	0.093	0.102
42616	1E168	1.750	1.750	84°		0.094	0.156	0.188
43416	1E191	0.938	1.312	73°30′		1.250	0.156	0.188
44259	1E214	1.000	2.000	90°		0.188	0.062	0.072
AND10133-0701		0.875	0.875	90°		0.094	0.063	0.072
AND10133-0702		0.875	0.875	90°		0.094	0.094	0.102
AND10134-0702		0.750	0.875	90°		0.125	0.063	0.072
AND10134-1204		1.000	1.250	90°		0.125	0.063	0.072
AND10134-1205		1.000	1.250	90°		0.125	0.094	0.102
AND10134-1404		1.000	1.500	90°		0.156	0.125	0.156
AND10134-1601		1.000	1.750	90°		0.156	0.125	0.156

* NO SUBSTITUTE

F-100D-3-91-84

Figure 8-1. Extrusion Charts (Sheet 1 of 11)

EXTRUSIONS & SUBSTITUTES

EXTRUSION CHARTS

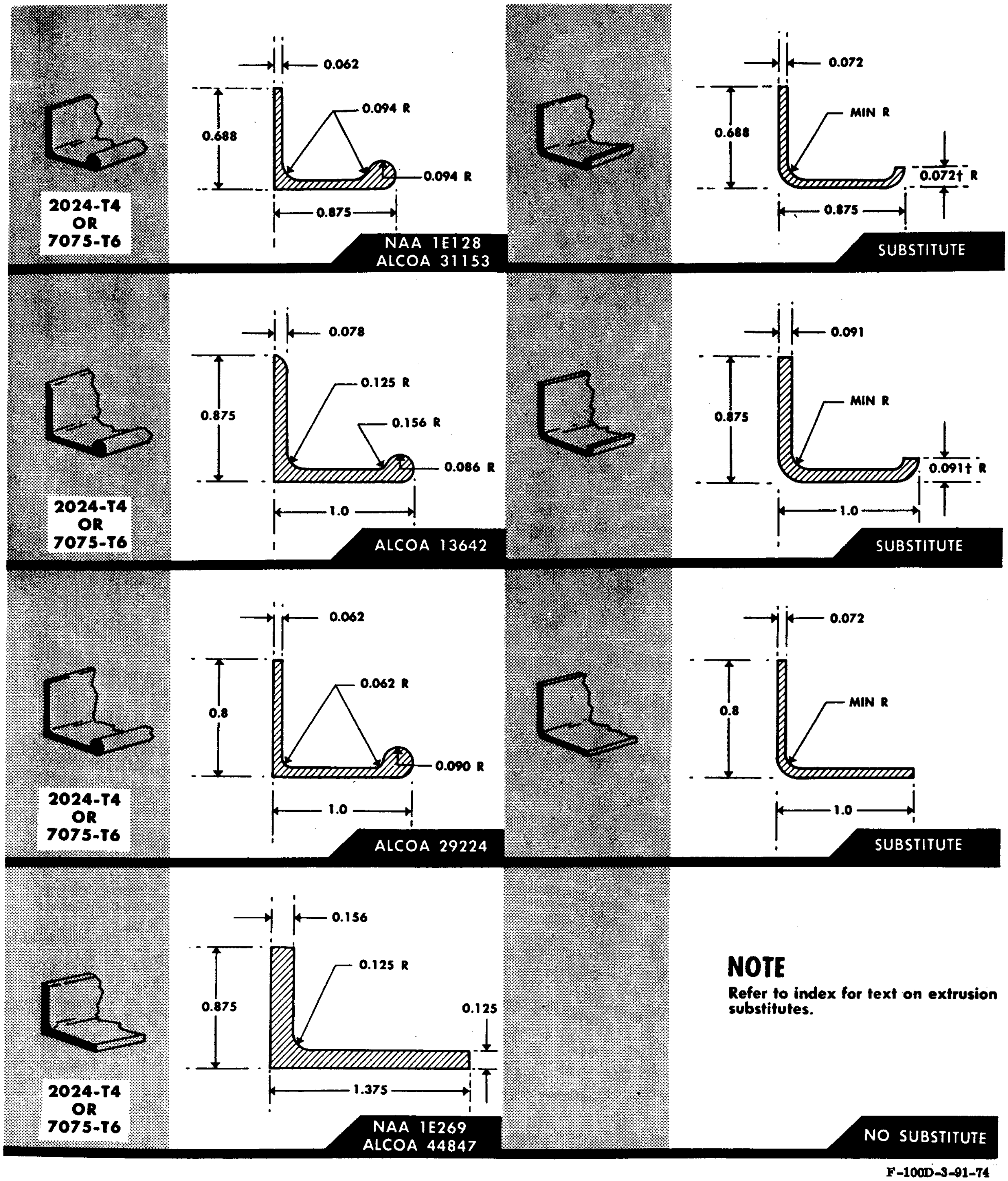
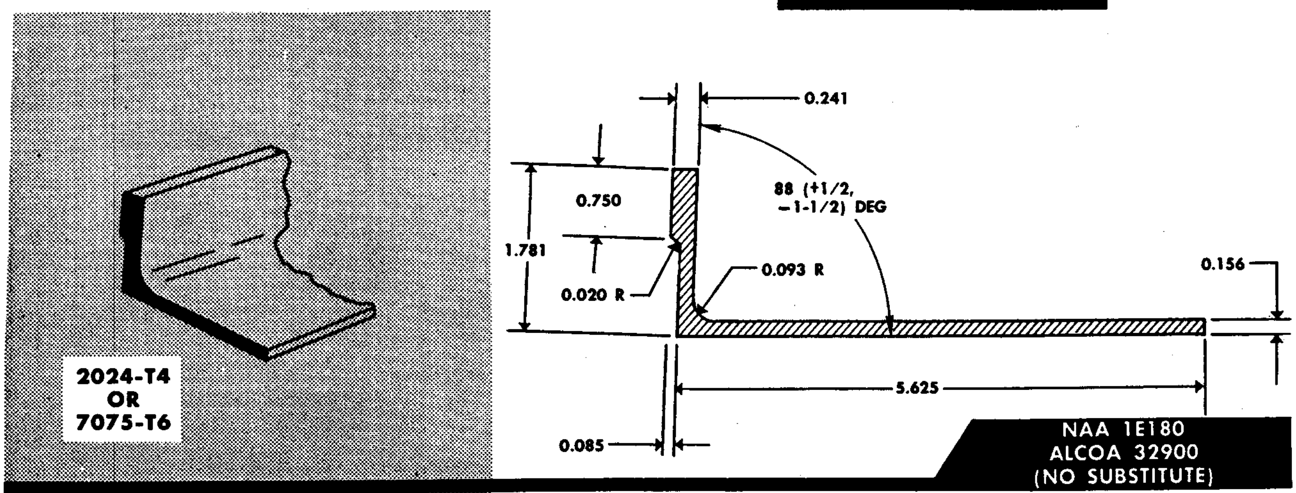
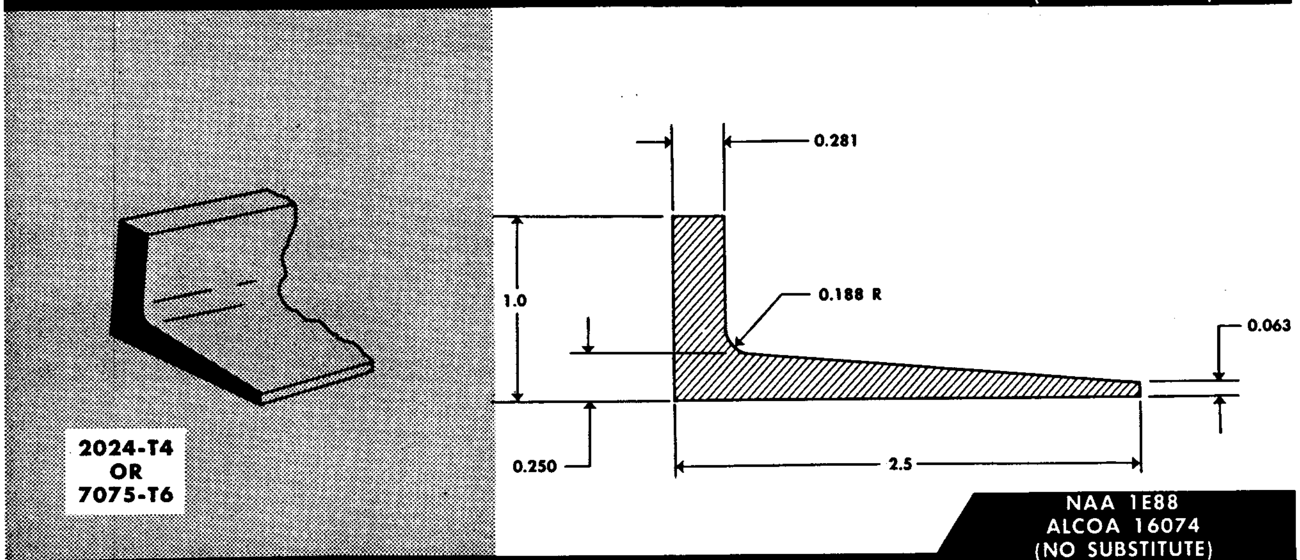


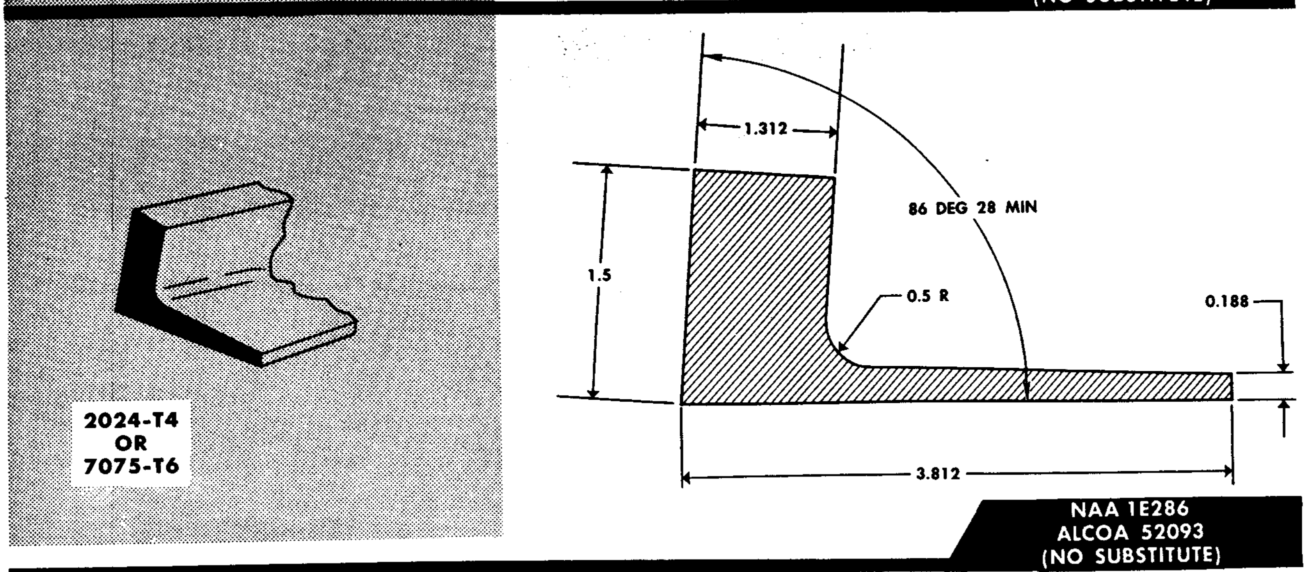
Figure 8-1. Extrusion Charts (Sheet 2 of 11)

EXTRUSION CHART

EXTRUSION CHARTS





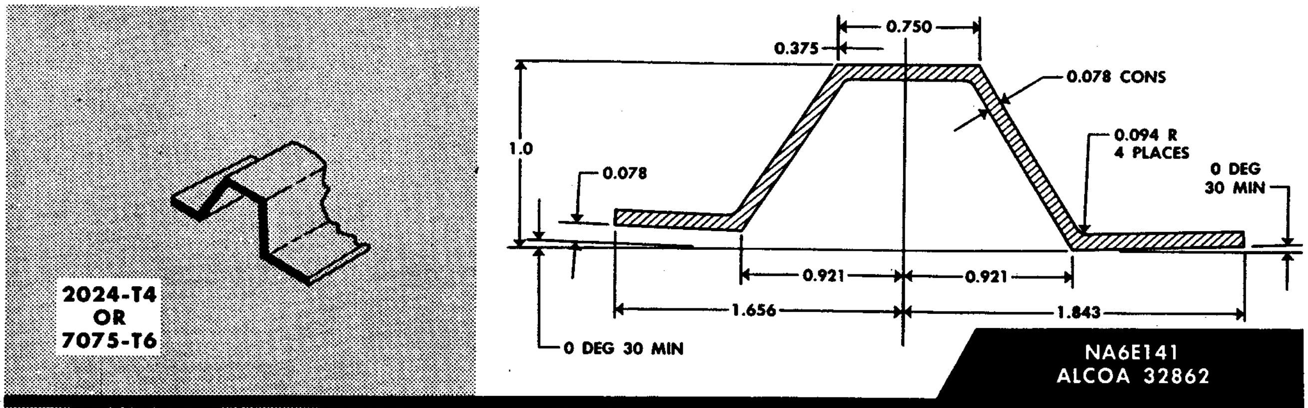


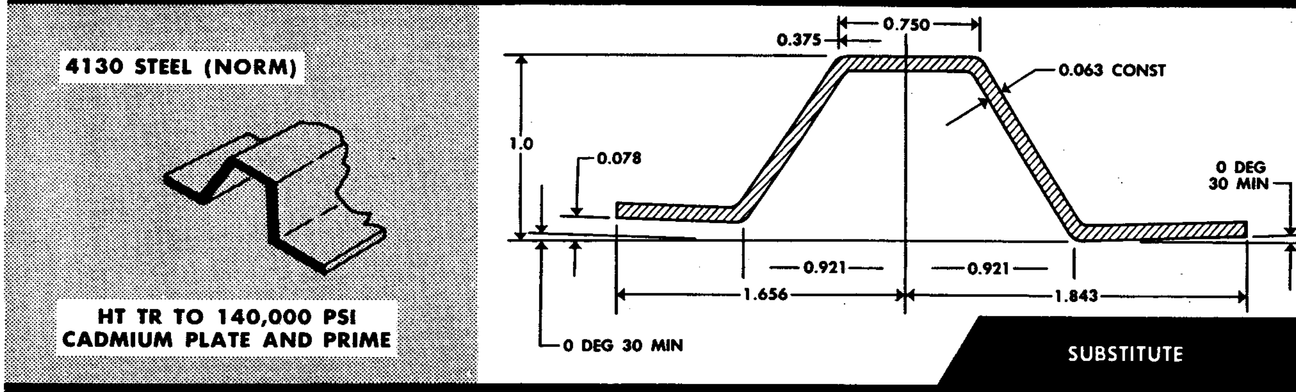
F-100D-3-91-75

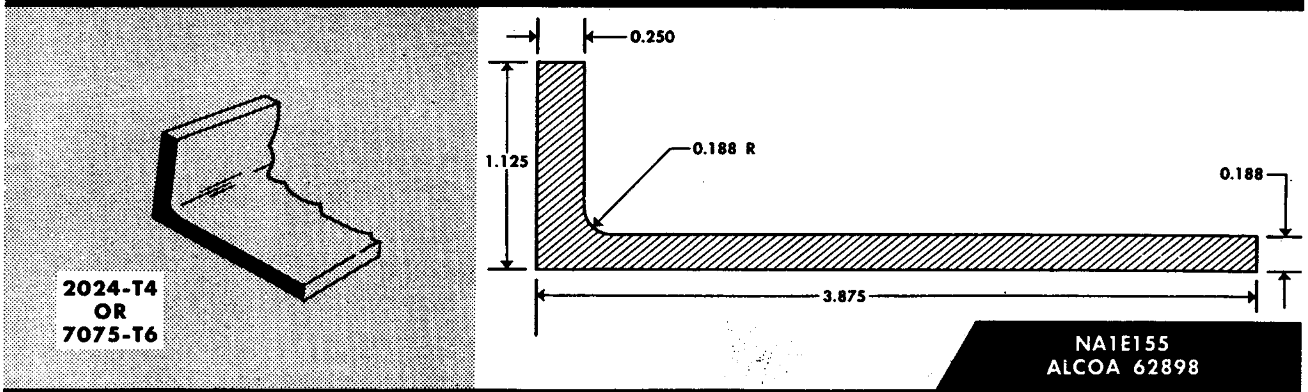
Figure 8-1. Extrusion Charts (Sheet 3 of 11)

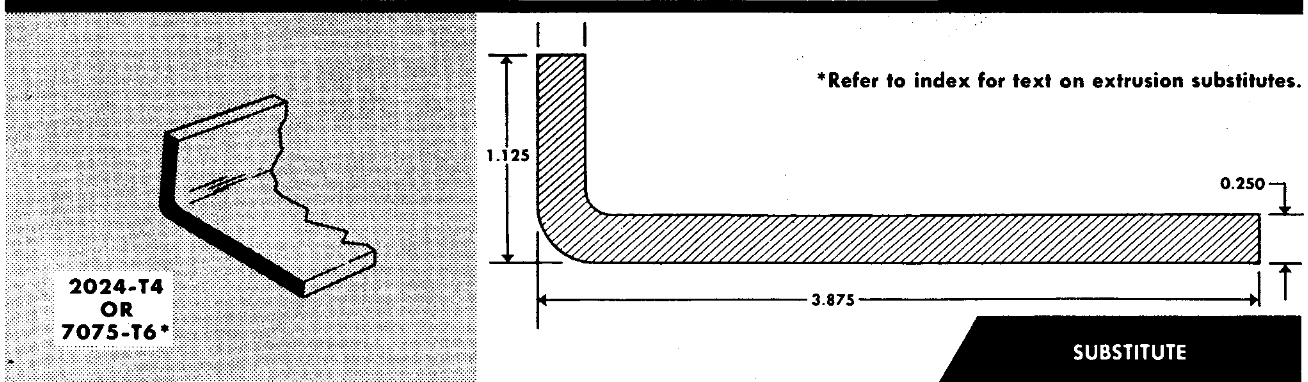
EXTRUSIONS & SUBSTITUTES

EXTRUSION CHARTS







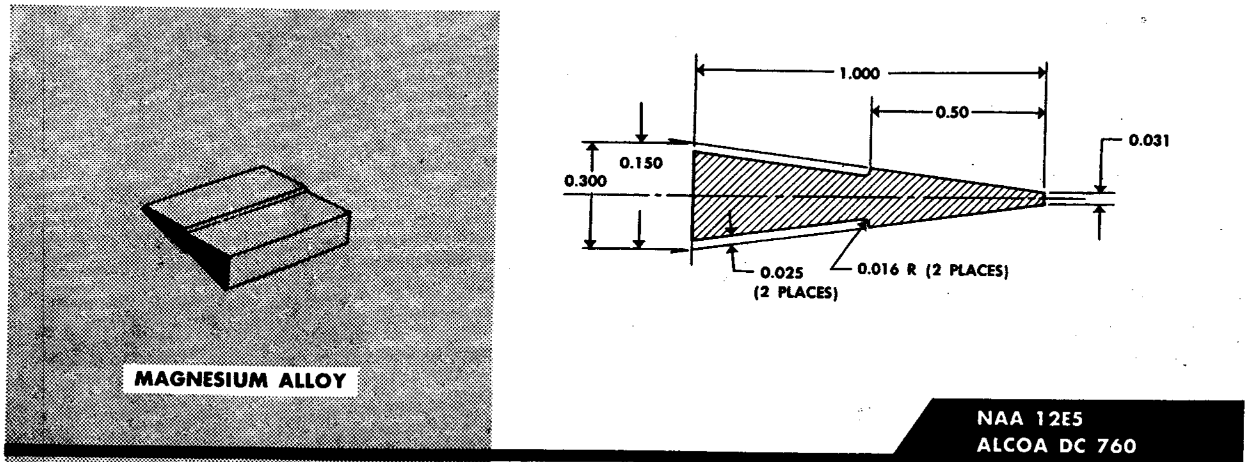


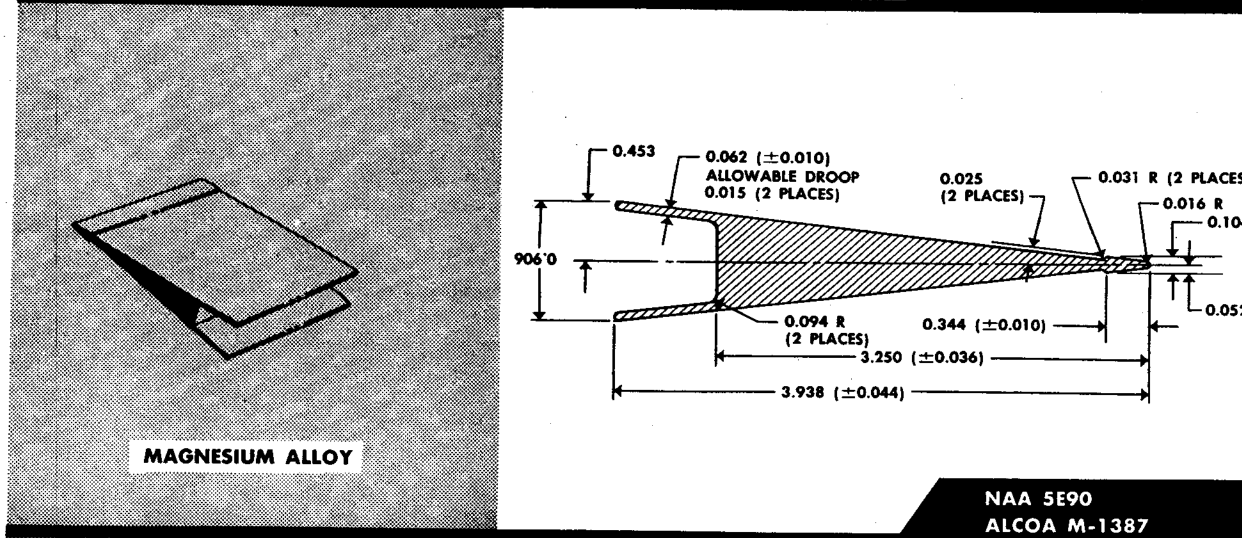
F-100D-3-91-76

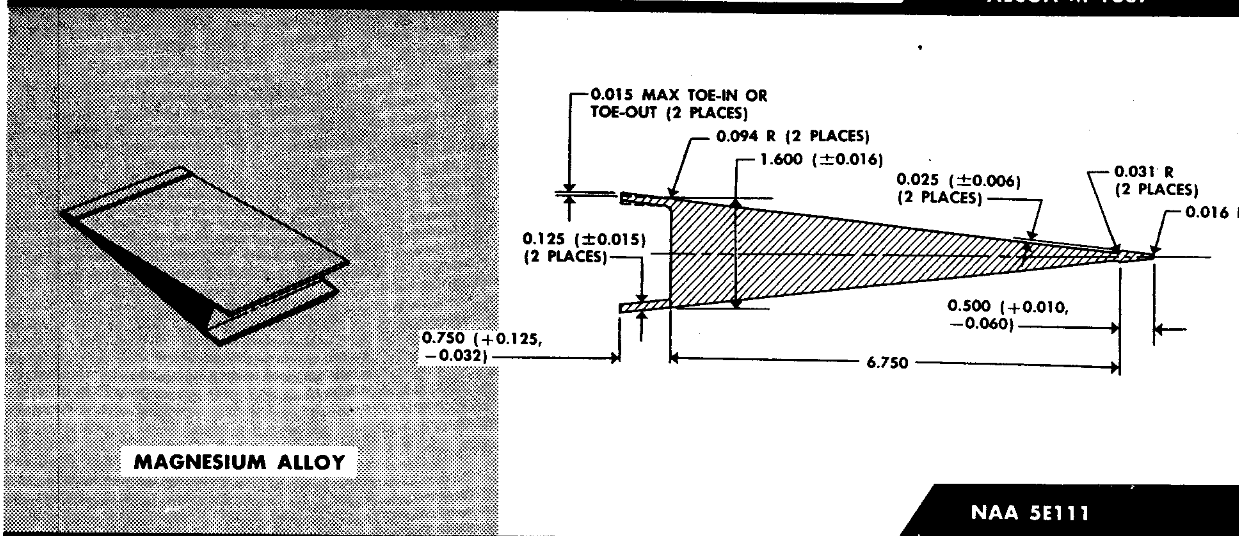
Figure 8-1. Extrusion Charts (Sheet 4 of 11)

EXTRUSIONS

EXTRUSION CHARTS





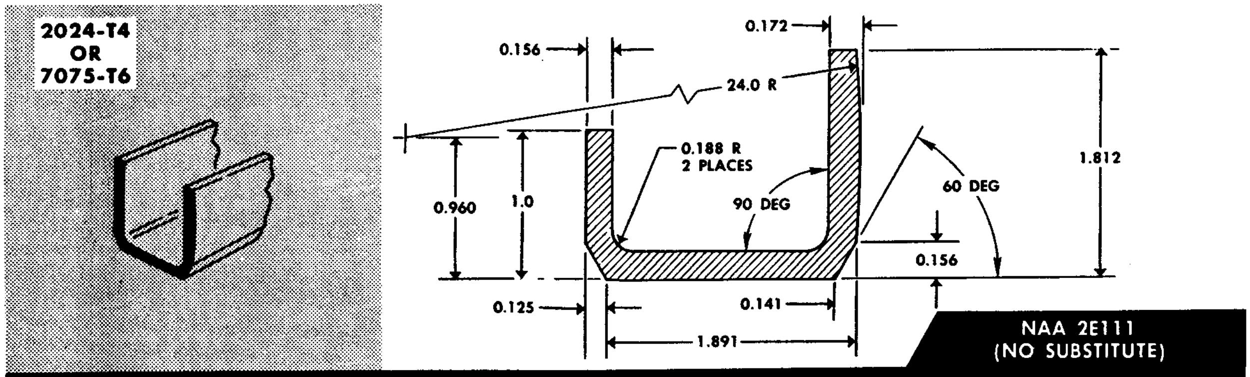


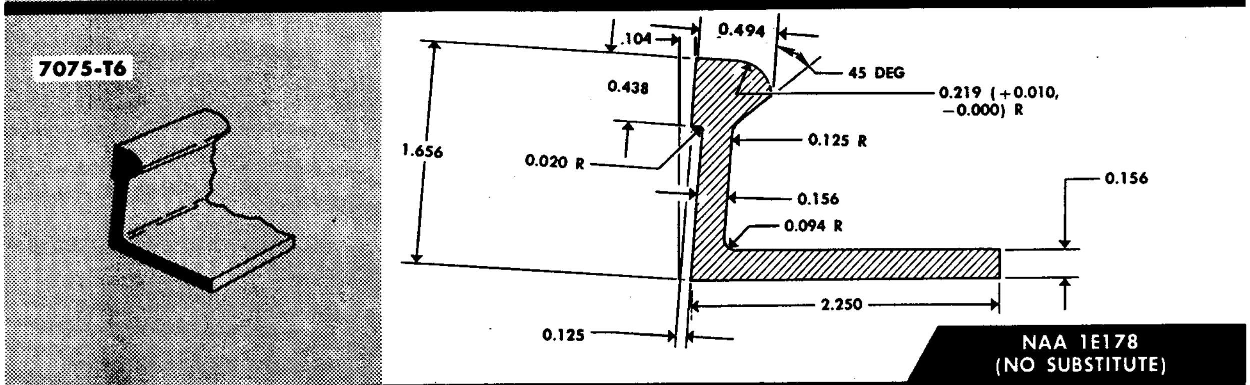
F-100D-3-91-77

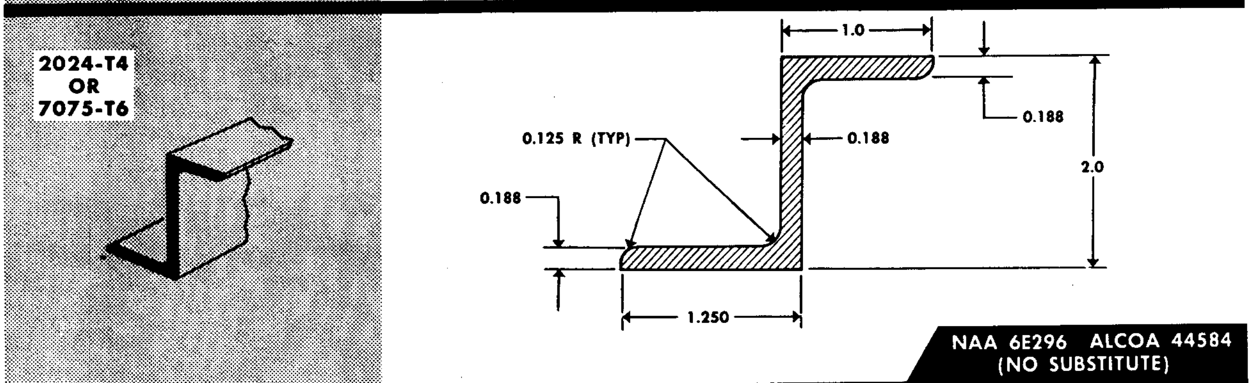
Figure 8-1. Extrusion Charts (Sheet 5 of 11)

EXTRUSIONS

EXTRUSION CHARTS







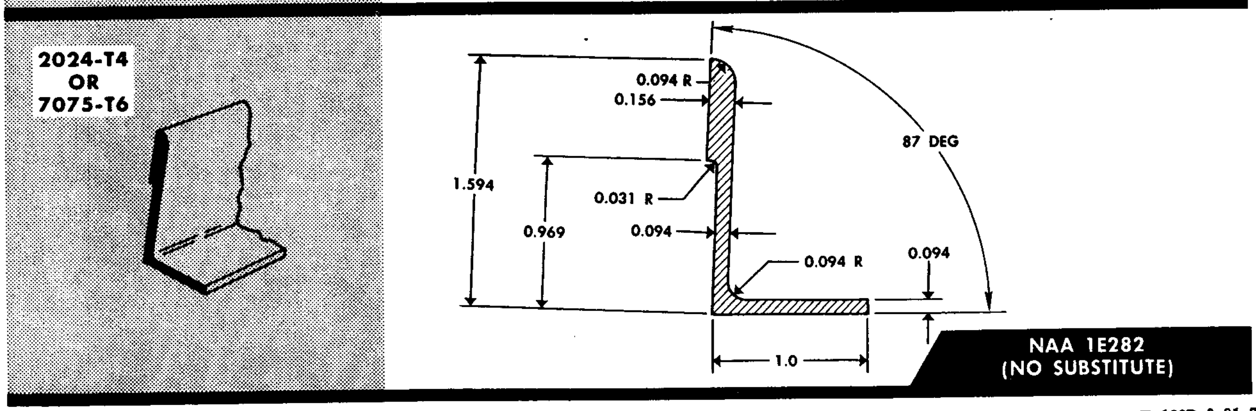


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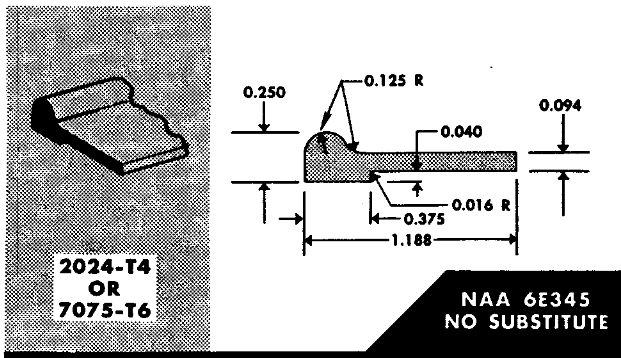
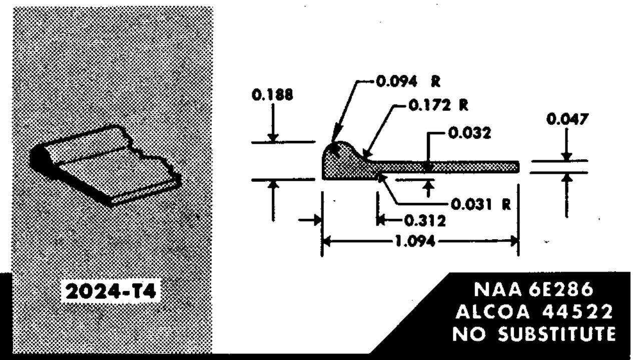
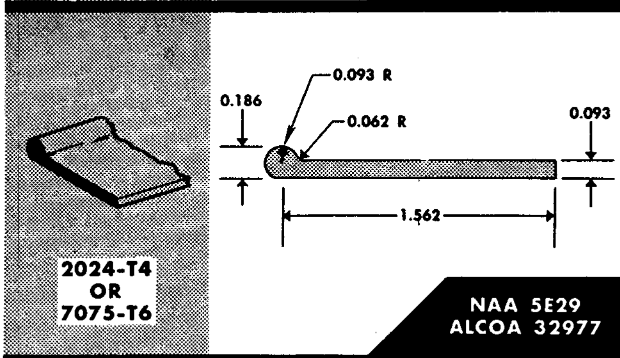
Figure 8-1. Extrusion Charts (Sheet 6 of 11)

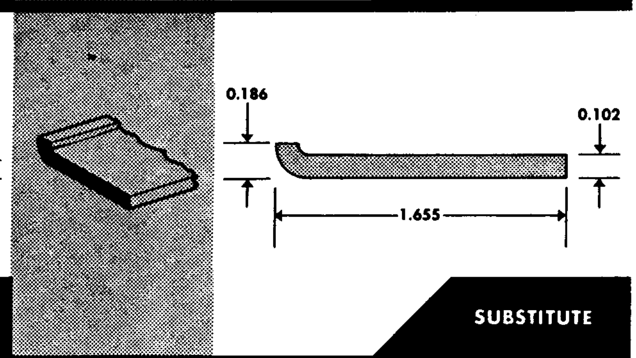
EXTRUSIONS & SUBSTITUTES

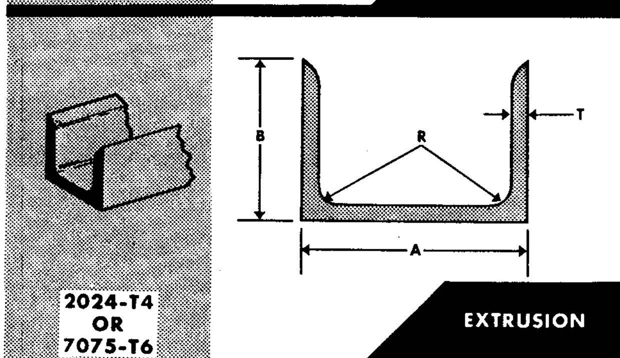
EXTRUSION CHARTS

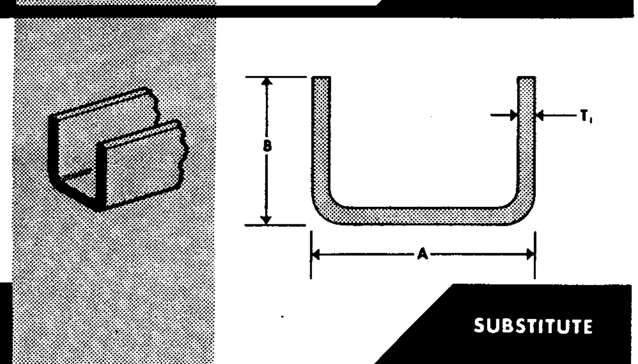












EXTRUSION NO.		DIMENSIONS					
ALCOA NO.	NAA NO.	A	B	T	T_1	R	
59309	2E123	1.062	0.875	0.125		0.094	NO SUBSTITUTE
AND10137-1202		1.250	0.875	0.094	0.102	0.125	SUBSTITUTE

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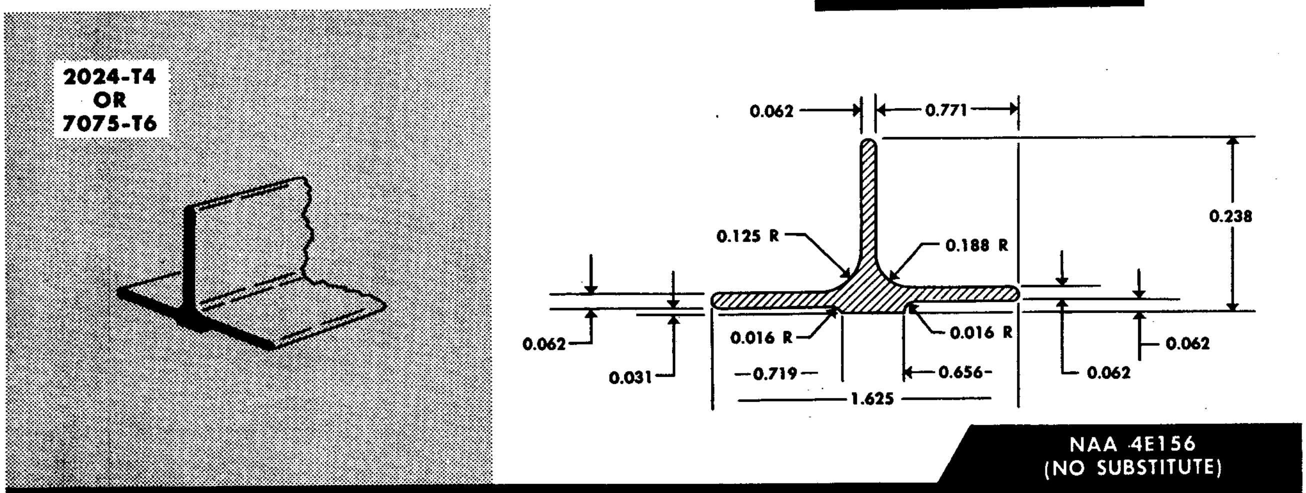
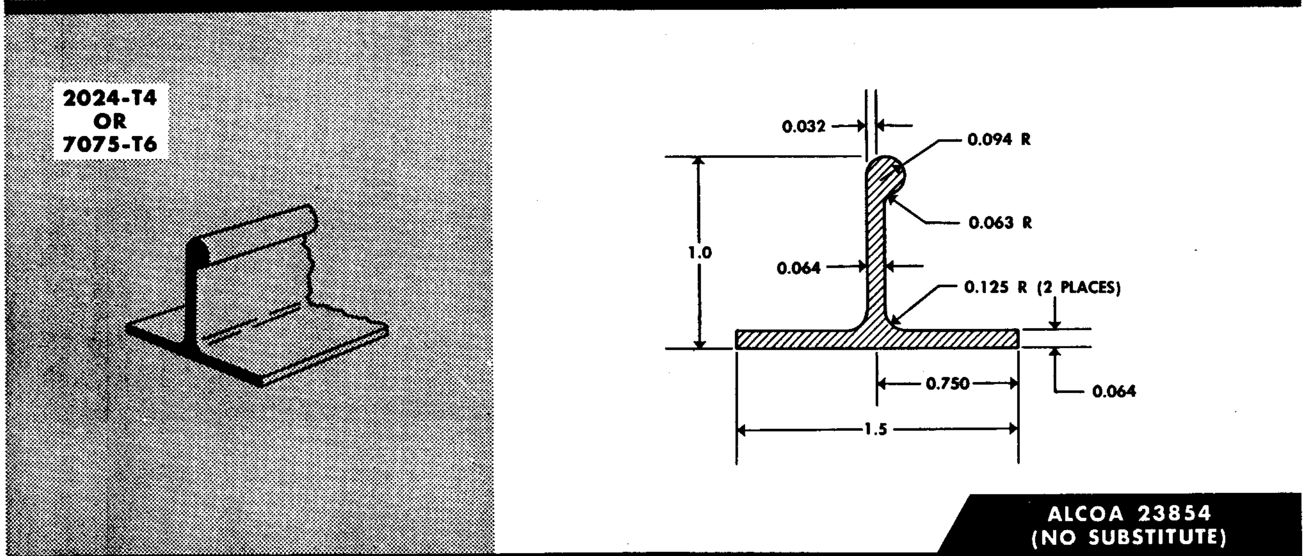
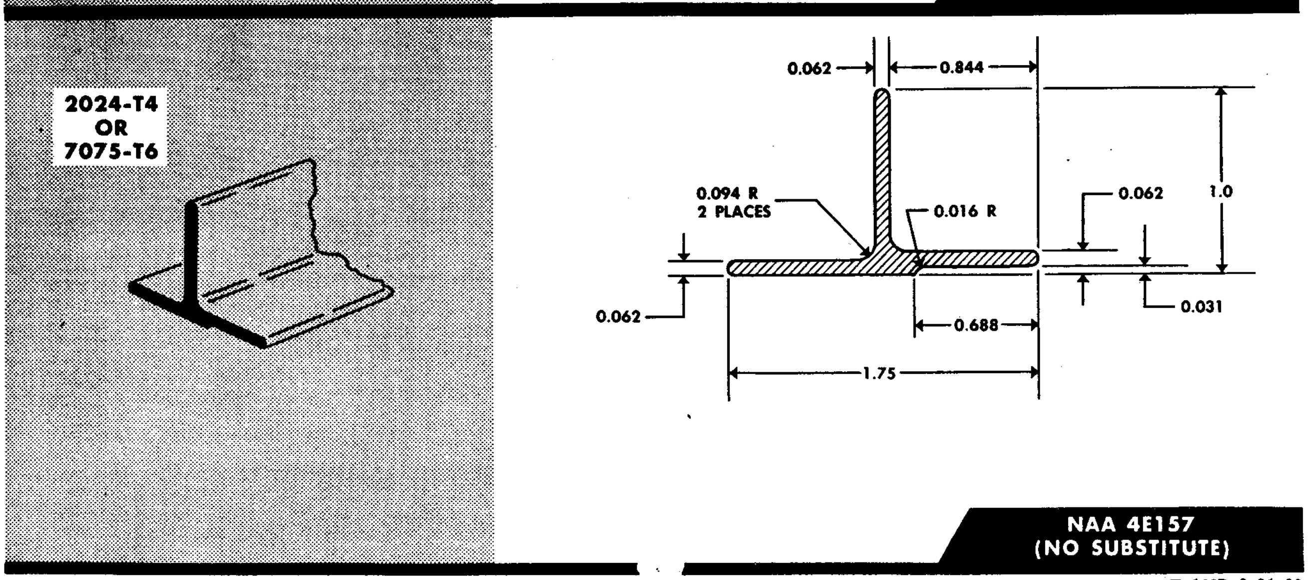
Figure 8-1. Extrusion Charts (Sheet 7 of 11)

EXTRUSIONS

EXTRUSION CHARTS





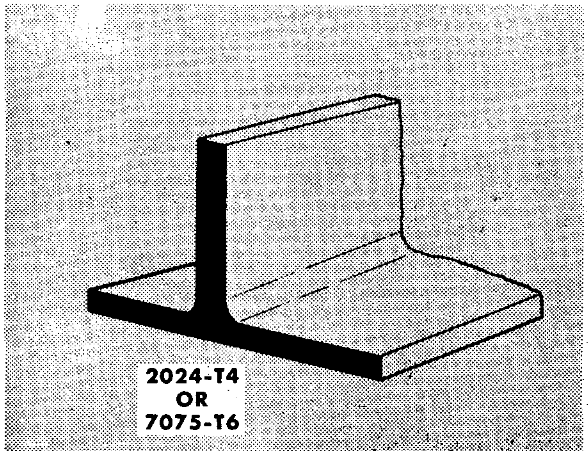


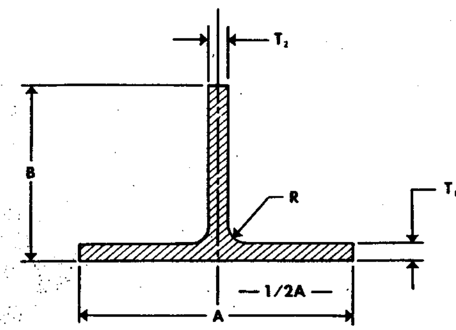
F-100D-3-91-80

Figure 8-1. Extrusion Charts (Sheet 8 of 11)

EXTRUSIONS

EXTRUSION CHARTS





EXTRUSIONS (NO SUBSTITUTE)		DIMENSIONS				
ALCOA NO.	NAA NO.	A	B	R	T_1	T_2
1 3660		1.500	1.000	0.063	0.094	0.094
2 13829		1.625	1.750	0.094	0.085	0.085
3 13891		2.000	1.000	0.125	0.094	0.090
4 22897		1.500	0.750	0.062	0.062	0.062
5 24750	4E13	1.500	2.125	0.156	0.125	0.125
6 43515	4E84	2.000	3.375	0.188	0.344	0.125
7 44281	4E117	1.750	1.000	0.094	0.062	0.062
8 51777	4E148	1.562	1.000	0.094	0.062	0.062
9 AND10136-1703		1.875	1.000	0.125	0.125	0.125
10 AND10136-2004		2.000	1.250	0.125	0.078	0.078
11 AND10136-2007		2.000	1.750	0.125	0.094	0.094

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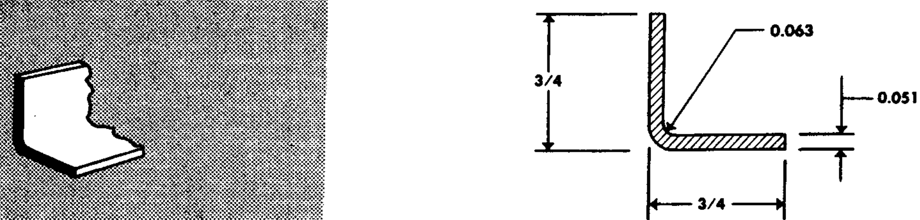
Figure 8-1. Extrusion Charts (Sheet 9 of 11)

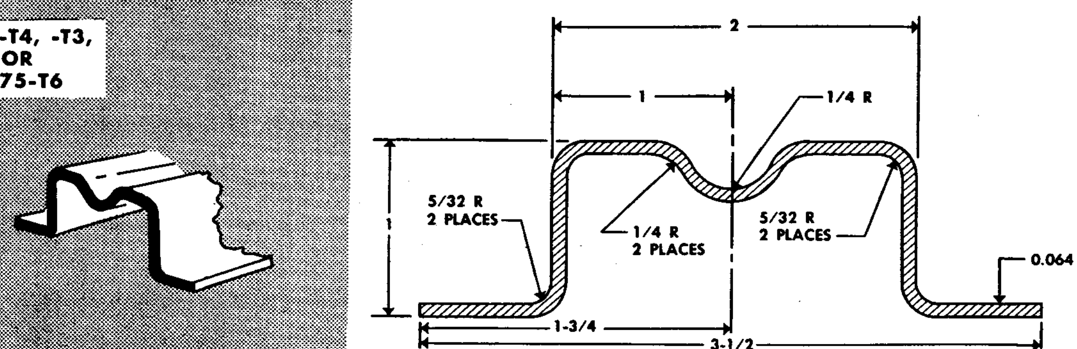
ROLL-FORMED SECTIONS

2024-T4



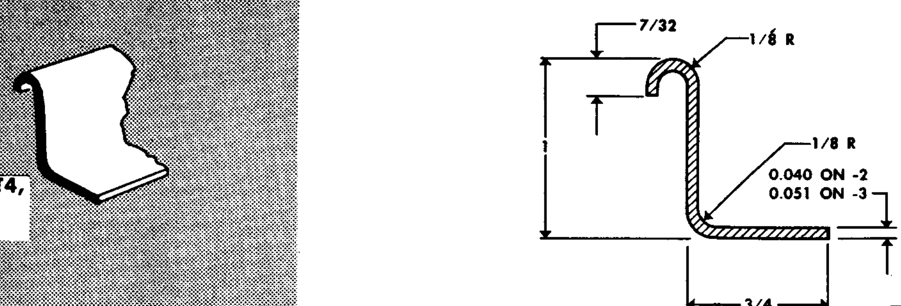
1S155

2024-T4, -T3, OR 7075-T6



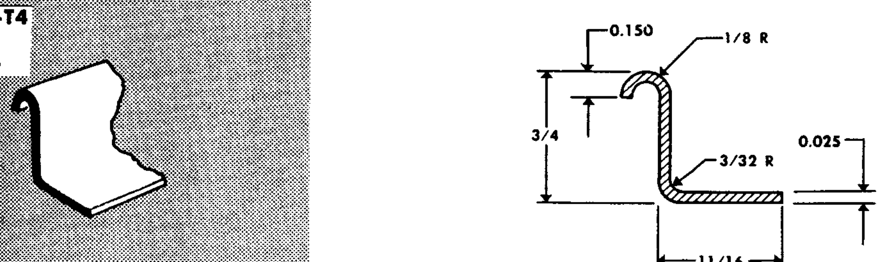
1S205-064

2024-T3, -T4, OR 7075-T6



1S3

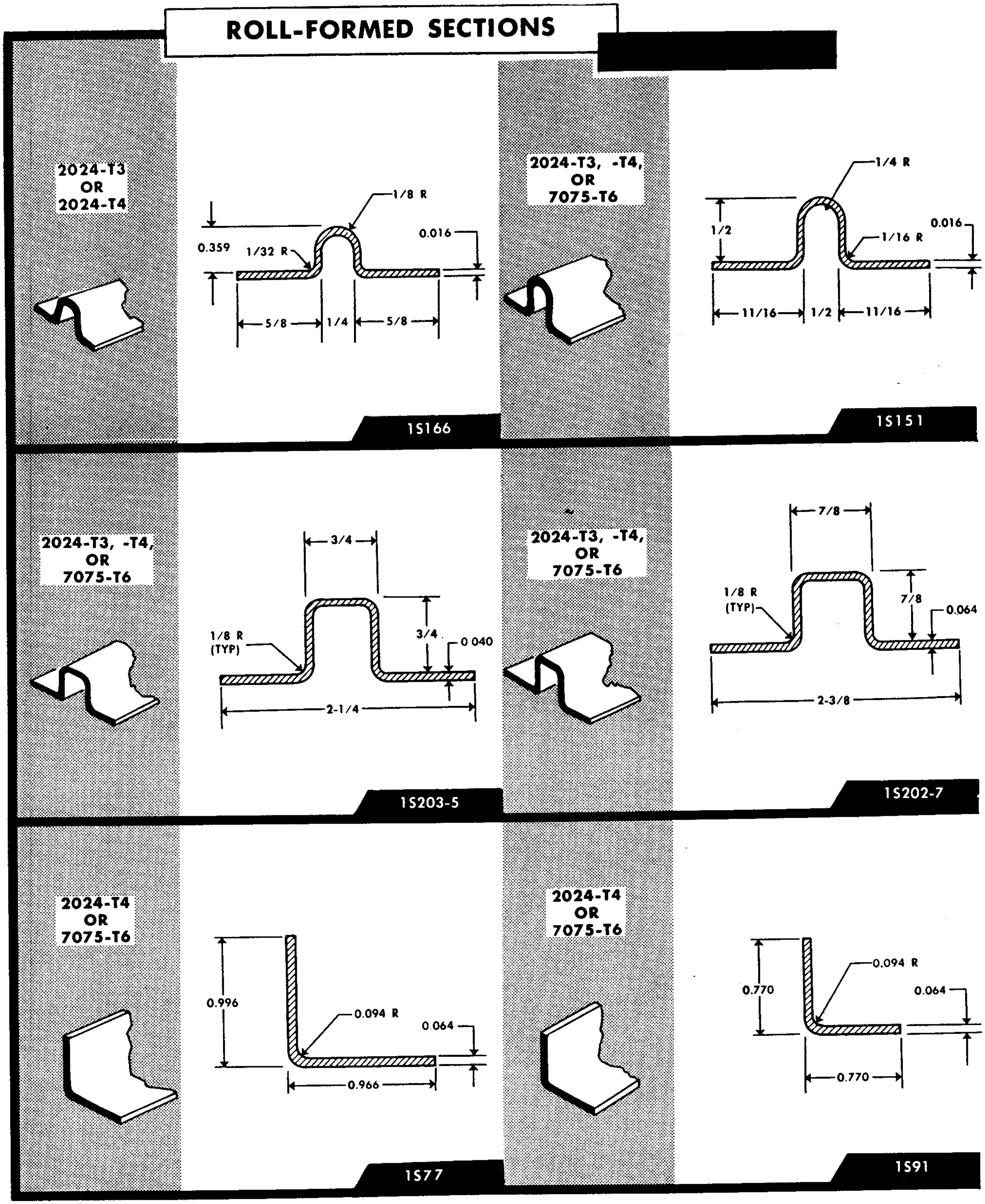
2024-T3, -T4 OR 7075-T6



F-100D-3-91-82A

1S4-2 1S4-3

Figure 8-1. Extrusion Charts (Sheet 10 of 11)



F-100D-3-91-83A

Figure 8-1. Extrusion Charts (Sheet 11 of 11)

SECTION IX

GEAR-UP LANDING DAMAGE

Contents **Page**

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REPAIRING FUSELAGE FORWARD SECTION 9-2
REPAIRING NOSE-GEAR-UP LANDING DAMAGE TO FUSELAGE FORWARD SECTION 9-2
REPAIRING SHEARED-NOSE-GEAR LANDING DAMAGE TO FUSELAGE FORWARD SECTION 9-2
REPAIRING ALL-GEAR-UP LANDING DAMAGE TO FUSELAGE FORWARD SECTION 9-2
REPAIRING ONE-MAIN-GEAR-UP LANDING DAMAGE TO FUSELAGE FORWARD SECTION 9-3
REPAIRING BOTH-MAIN-GEAR-UP LANDING DAMAGE TO FUSELAGE FORWARD SECTION 9-3
REPAIRING FUSELAGE AFT SECTION 9-3
REPAIRING MAIN-GEAR-UP LANDING DAMAGE TO FUSELAGE AFT SECTION 9-3
REPAIRING ALL-GEAR-UP LANDING DAMAGE TO FUSELAGE AFT SECTION 9-4
REPAIRING ONE-MAIN-GEAR-UP LANDING DAMAGE TO FUSELAGE AFT SECTION 9-4
REPAIRING WING ASSEMBLY 9-4
REPAIRING ALL-GEAR-UP LANDING DAMAGE TO WING ASSEMBLY 9-4
REPAIRING MAIN-GEAR-UP LANDING DAMAGE TO WING ASSEMBLY 9-4
REPAIRING ONE-MAIN-GEAR-UP LANDING DAMAGE TO WING ASSEMBLY 9-4

GENERAL.

This section covers the normal or expected damage involved in four conditions of gear-up landings. These are nose-gear-up, one-main-gear-up, both-main-gear-up, and all-gear-up landing. Also included is damage resulting from shearing the nose gear. The gear is assumed to have been down and locked and to have been sheared off during landing.

Areas of expected damage from each landing condition are shown in the illustrations by shading. The bottom crosshatched areas are where the principal damage occurs. The lighter shading above may have a lesser degree of damage (bending, buckling, etc).

It is important that each damaged bulkhead or frame be inspected over its entire length. Even when bottom damage is slight, a momentary vertical impact may shear or loosen rivets at any point along the member. Particular attention should be given inspection of the entire airplane during and after structural disassembly. Conditions under which the airplane landed should be carefully considered and kept in mind during the inspection. (Refer to Damage Evaluation and Inspection Criteria in Section I.)

DAMAGE AND REPAIR INDEXES.

Applicable repairs to damaged members are indexed in the illustrations on the shaded views representing damage. Both the section number and the illustration number are shown in small rectangular "boxes." Two, or even three, repairs may be referenced as applicable to a part. This allows the repair man to select the repair that best fits the need. Repairs in Section X are referenced wherever they apply. However, repairs designed especially for a part are often more desirable when tooling, time, etc, permit their fabrication. Typical repairs (in Section X), are likely to be heavier, cover larger areas, and include more fasteners than a specific repair. This is necessary because the typical repair has to be strong enough for the most heavily loaded part on which it may be used.

When the damage extends beyond limits considered normal for the landing condition (not shown in illustrations), applicable repairs should be selected from the repair indexes in this handbook.

PART NUMBERS AND SPLICING INDEXES.

Illustrations of substructures, similar to those showing the damaged parts and repairs, are used to reference part numbers and splice points. These part numbers should be used as a guide only. When parts are to be ordered from stock, the "F-86K Illustrated Parts Breakdown," T.O. 1F-86K-4, or the US Air Force Supply Catalog, S-01M-F86, should be used. When parts to be manufactured are to be ordered, the part numbers should be selected from blueprints or microfilm. The part numbers referenced in the illustrations may have been superseded because of airplane modifications. However, they will be a valuable aid in locating the current number. Before a part is ordered by an assembly number, the extent or size of the assembly should be determined. It may be more practical to locally manufacture the part or parts needed than to try to install the larger assembly. Exploded-view illustrations which show part numbers also indicate the point where members are spliced. The assembly is exploded (separated) at normal production splices or at recommended points, for cutting and splicing-in sections of new members. The "cut" locations shown are not the only points where splices may be made. They are the most convenient locations when the extent of damage permits their use.

REPAIRING FUSELAGE FORWARD SECTION.

REPAIRING NOSE-GEAR-UP LANDING DAMAGE TO FUSELAGE FORWARD SECTION.

The fuselage forward section is damaged, to some extent, by any wheels-up landing. In case of a nose-gear-up landing, the damage can be expected to extend from the leading edge fairing back to the aft wheel well close-out bulkhead. The vertical extent of wear-off and buckling is confined to the lower frames, bulkheads, and nose gear trunnion beams, if the forward fuselage contacts the runway lightly. If contact with the runway is harder, the nose gear trunnion beams are forced upward, damaging the lower intake duct frames and skins.

The air intake duct fairing assembly is replaced as a unit. Also, the upper splice angles at canted station 4.75 are replaced. The lower fairing section is joined to the fuselage at the production splice point. Bottom frames and bulkheads are repaired or replaced. The extent of damage will probably indicate replacement, if parts are available.

The nose gear trunnion beams must be replaced, and the lower duct frames and skins, when damaged, must be replaced or repaired.

The forward section of the lower longerons may be damaged, requiring replacement. There is a production splice point just forward of the wheel well close-out bulkhead (station 40.625). Slight bends in the longerons aft of the splice may be straightened if the straightened member is free of cracks. When this cannot be done, a section of longeron must be spliced in. For splicing, a point midway between the frames should be selected.

While nose-gear-up landing damage usually ends at station 70.25, the force aft from that bulkhead may damage the rocket compartment close-out channels enough to require their replacement.

A jig must be provided for the installation of the nose gear trunnion beam assembly. This is the only jig required in the rebuilding of the lower fuselage forward of station 279.3. Necessary locating points for other replacement members can be found by measurement.

REPAIRING SHEARED-NOSE-GEAR LANDING DAMAGE TO FUSELAGE FORWARD SECTION.

The damage from a sheared-nose-gear landing is similar to that from a nose-gear-up landing; however, the loose gear is usually driven up through the air intake duct. This requires replacement of the entire duct assembly forward of station 70.25. Fuselage skin panels in the forward section are usually replaced. Panels which receive minor damage (cracks, small holes, etc) may be repaired. The illustrations showing skins give the material, heat treatment, and thickness; however, as in the case of the part numbers, they should not be relied on as replacement materials. Applicable blueprints or microfilm should be consulted for the proper panel material for the particular airplane. (A list of applicable airplane serial numbers is included on the blueprint or microfilm.) If blueprints or microfilm for the part are not available, a material test should be made on the part, and its thickness should be measured with a micrometer.

REPAIRING ALL-GEAR-UP LANDING DAMAGE TO FUSELAGE FORWARD SECTION.

All-gear-up landing damage to the forward fuselage is similar to that caused by nose-gear-up landings; however, it extends the entire length of the forward fuselage. The forward air duct section is less likely to be damaged; however, damage does occur when the airplane is landed in a nose-down attitude. The air intake duct fairing, all bottom frames, lower bulkheads, lower stringers and channels, lower skins, and covers require replacement or repair.

Replacement of a section of the aft mating frame, station 279.3, requires the use of a fuselage mating jig. The four attachment points and shear pins must be accurately located.

REPAIRING ONE-MAIN-GEAR-UP LANDING DAMAGE TO FUSELAGE FORWARD SECTION.

Forward fuselage damage resulting from a one-main-gear-up landing is usually slight if the landing is otherwise normal. Main landing gear doors are damaged to an extent requiring replacement. There may be minor skin damage near the aft end on the low side of the fuselage if there is gravel or other loose material on the landing area.

REPAIRING BOTH-MAIN-GEAR-UP LANDING DAMAGE TO FUSELAGE FORWARD SECTION.

Normally, landings made on the nose gear only damage the lower frames from about station 250 back to and including the aft mating frame. All frames affected, except the aft mating frame, are more easily replaced than repaired. The bottom section of the aft mating frame should be replaced. A mating jig is required for positioning the shear pins.

Skin panels are usually replaced except in cases of small hole or crack damage. They may be spliced, however, if it is considered more practical.

REPAIRING FUSELAGE AFT SECTION.

The aft fuselage is damaged in all types of gear-up landings except nose-gear-up landings. The most extensive damage is from a both-main-gear-up landing. Damage from an all-gear-up landing is similar but does not extend so far aft. One-main-gear-up landings are the least damaging to this section of the fuselage.

REPAIRING MAIN-GEAR-UP LANDING DAMAGE TO FUSELAGE AFT SECTION.

When the airplane is landed with only the nose gear down, the aft fuselage becomes a huge tail skid. All frames are worn off and otherwise damaged, from the forward mating frame (station 279.25) aft to the aspirator. The speed brakes take some of the load on their lower aft corners and give it to the hinge wells. The hinge wells are forced upward, usually cracking along the radius of their upper skin attachment flanges.

It is necessary to remove the upper hinge well in order to repair it. The lower well may be repaired in place.

If speed brake hinge wells are warped or buckled, it is necessary to replace them. Accurate alignment of the hinge pin holes in the new parts is extremely difficult. It is recommended that half the old part be retained, whenever the condition of the part is such that it can be used, for hinge pinhole alignment. Assemble new half of hinge well in place, and install speed brake in closed position. Install hinge pins through old hinge well section. Check outside speed brake fit for proper skin gap clearance and for smooth mating with fuselage mold line (contour). When satisfactory fit is obtained, hold speed brake in place, remove one hinge pin, and line drill hinge pinhole in new hinge well section, using nominal drill size. The lower frames of the aft fuselage may be replaced, or the lower sections may be spliced in. A fuselage mating jig is required for proper alignment of the forward mating frame (station 279.25). The four aft fuselage attachment bolts and shear pinholes must be picked up.

All lower frame sections in the aft fuselage may be replaced back to station 359.9. The two aft frames (stations 359.9 and 378.7) are made of heavy corrosion-resistant steel hat sections formed to a relatively small radius. Fabrication of parts for adequate repairs or splices on these members requires the manufacture of dies for press-forming the parts. Therefore, it is considered more practical to replace the entire frames. Negligible damage to the two aft frames includes minor cracks, bent flanges, and deviation from the fuselage mold line by not more than 0.064 inch. Cracks should be stop-drilled with a No. 40 drill. Bent flanges may be straightened, and shims up to 0.064 inch may be added between frames and skin to meet mold line requirements. Skin panels on the fuselage aft section are single-curved from the forward end back to station 335. The panels may be entirely replaced, or the bottom sections may be spliced in as necessary.

The lower skin panel from station 335 back to the aspirator is compound-curved. If a new formed panel is not available for installation, narrow flat sections may be spliced in. A maximum of three sections should be used to replace the damaged area. The longitudinal shear skin splice shown in figure 4-41 is used for making this repair.

When the fuselage aft section is severely damaged back of the speed brake close-out frame (station 335), replacing the section is more practical than trying to repair it. Assembly 165-316111 is fastened to the frame at station 335 with two rows of rivets. The longerons and stringers are bolted together at this point, and the drag chute fitting bolts to the top of the frame. With this number of jig-located points to connect together, alignment of the new part is ensured without the use of a jig. After fore-and-aft members are securely bolted, the skin panels are line-drilled and riveted, with rivets equal to those removed.

REPAIRING ALL-GEAR-UP LANDING DAMAGE TO FUSELAGE AFT SECTION.

All-gear-up landing damage is similar to that produced by main-gear-up landings. The speed brakes and speed brake hinge wells are damaged. Bottom skins and frames are damaged from the forward mating frame (station 279.25) back to station 352. Since the damage aft of station 335 is likely to be light, repair rather than replacement of this section is indicated. Replacement of repair of frame sections, speed brake hinge wells, and skins is as described under "Repairing Main-gear-up Landing Damage to Fuselage Aft Section."

REPAIRING ONE-MAIN-GEAR UP LANDING DAMAGE TO FUSELAGE AFT SECTION.

The speed brake door on the gear-up side is damaged and also its attaching hinge wells. Slight skin damage on this side is possible in the area of the forward mating frame if the landing is on other than a clean, smooth surface. (Refer to "Repairing Main-gear-up to Fuselage Aft Section" for repair or replacement of speed brake hinge wells.)

REPAIRING WING ASSEMBLY.

Three types of wheels-up landings affect the wing assembly. They are all-gear-up, main-gear-up, and one-main-gear-up landings. In any of the gear-up damage conditions, the wing is not considered to be economically repairable if a landing gear assembly tears loose, damaging the spar.

REPAIRING ALL-GEAR-UP LANDING DAMAGE TO WING ASSEMBLY.

In all-gear-up landings, most of the weight of the airplane is concentrated on the wing center section. Auxiliary fuel tanks (if installed) take the initial load and aid considerably in minimizing airframe damage. Fairing assemblies and beams on the lower side of the wing center section are crushed and worn down, requiring replacement. To replace them requires separation of the wing center section from the outer panels and removal of the center section fuel cell. Skin around the auxiliary tank pad holes is damaged and may be repaired as shown in figure 2-18. The two middle wing slats are usually warped. Alignment of the slats is critical; therefore, replacement rather than repair is indicated. Flaps and ailerons are damaged beyond economical repair.

REPAIRING MAIN-GEAR-UP LANDING DAMAGE TO WING ASSEMBLY.

In main-gear-up (nose-gear-down) landings, the principal wing damage is at the tips. Wing tips, lower skins, and spars are worn down and otherwise damaged in this area. Wing rips are replaced. Skins are patched, or new outer ends may be spliced on. The spliced-on section should not be longer than 3 feet. These repairs may be made without the use of jigs. An adequate wing jig is necessary, however, any time a complete skin panel is removed, even though the same panel is to be replaced.

New spar sections about 18 inches long may be spliced on, at the outer spar ends. The length of the new section is limited because of attachment problems encountered farther inboard. The only jig required for this repair is a serviceable aileron for aligning the outboard aileron hinge.

Flaps and ailerons are usually damaged to an extent requiring replacement.

REPAIRING ONE-MAIN-GEAR-UP LANDING DAMAGE TO WING ASSEMBLY.

When the airplane is landed with one-main-gear-up, damage to the wing on the low side is likely to be extensive. The principal damage is from about wing station 200 outboard. Rebuilding the wing when it is damaged to this extent requires a jig similar to that used in manufacture. Whether the wing is to be rebuilt or not depends on the exact condition of each wing in question.

NOSE GEAR UP

GEAR-UP LANDING

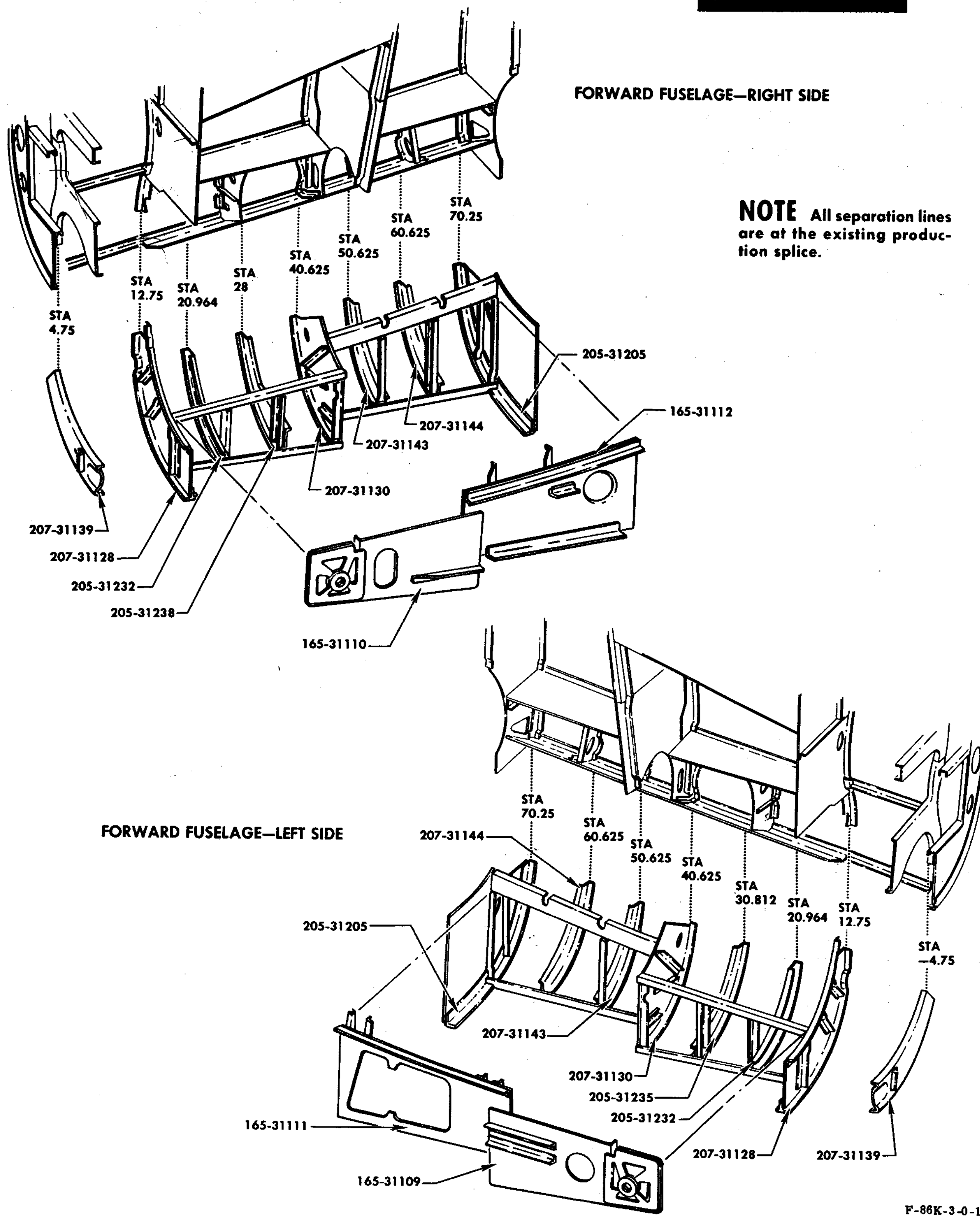


Figure 9-1. Nose-gear-up Landing (Sheet 1 of 4)

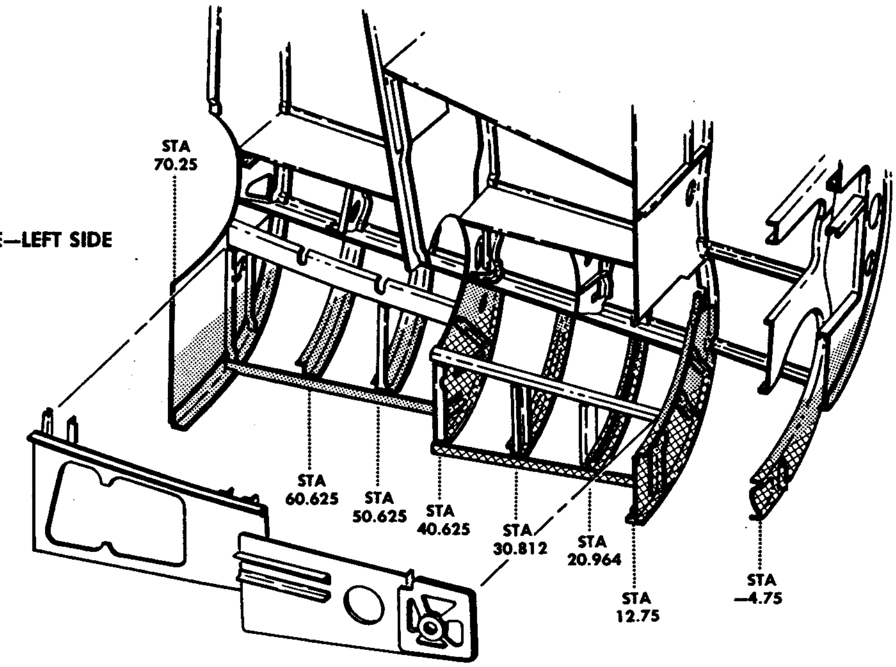
NOSE GEAR UP

GEAR-UP LANDING

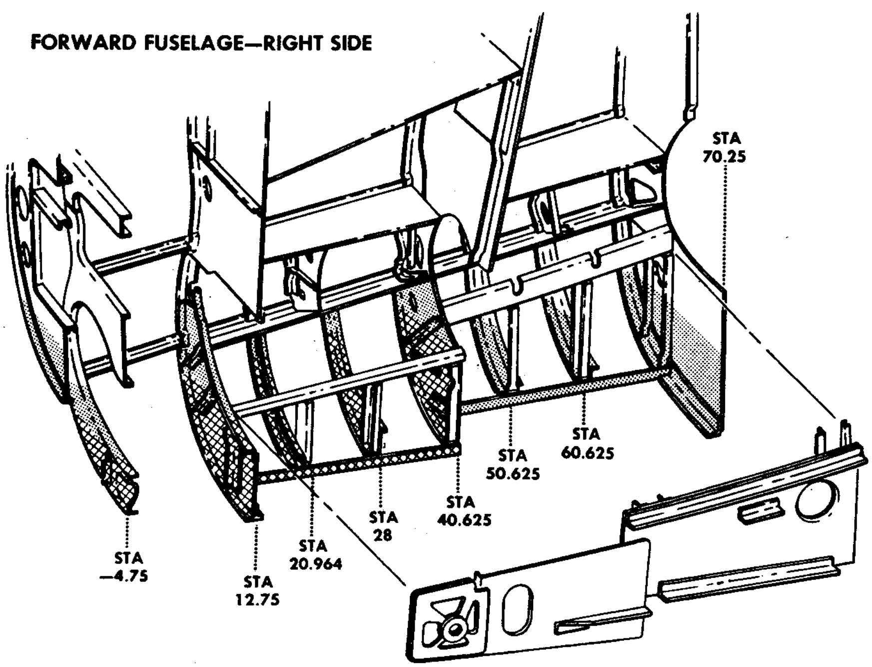
AREAS OF NORMAL DAMAGE

AREAS WHICH SUFFER MINOR DAMAGE

FORWARD FUSELAGE—LEFT SIDE



FORWARD FUSELAGE—RIGHT SIDE



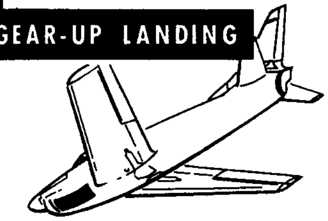
NOTE Refer to index for skin repair and repairs to structural and nonstructural doors.

F-86K-3-0-2

Figure 9-1. Nose-gear-up Landing (Sheet 2 of 4)

NOSE GEAR UP

GEAR-UP LANDING



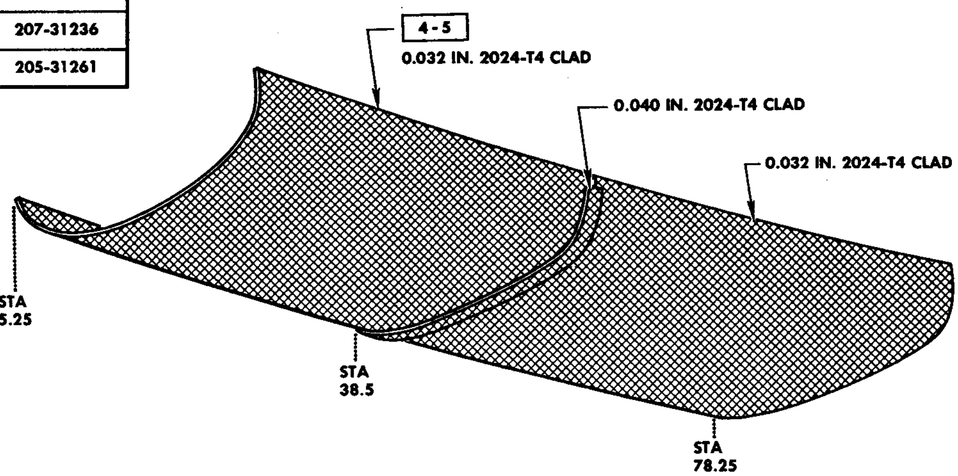
DUCT FRAME PART NUMBERS		
STA NO.	LOWER FRAME	SIDE FRAME
12.75	207-31128	NONE
16.875	207-31156 LH 207-31157 RH	NONE
20.964	165-31211 LH 165-31212 RH	NONE
25.875	165-31161 LH 165-31162 RH	NONE
30.812	207-31215 LH 207-31216 RH	NONE
35.75	165-31166 LH 165-31167 RH	NONE
40.625	207-31169	NONE
45.625	165-31171	165-31233
50.625	165-31154	165-31173
55.625	165-31175	165-31234
60.625	165-31177	165-31235
65.625	207-31183	207-31236
70.25	205-31258	205-31261

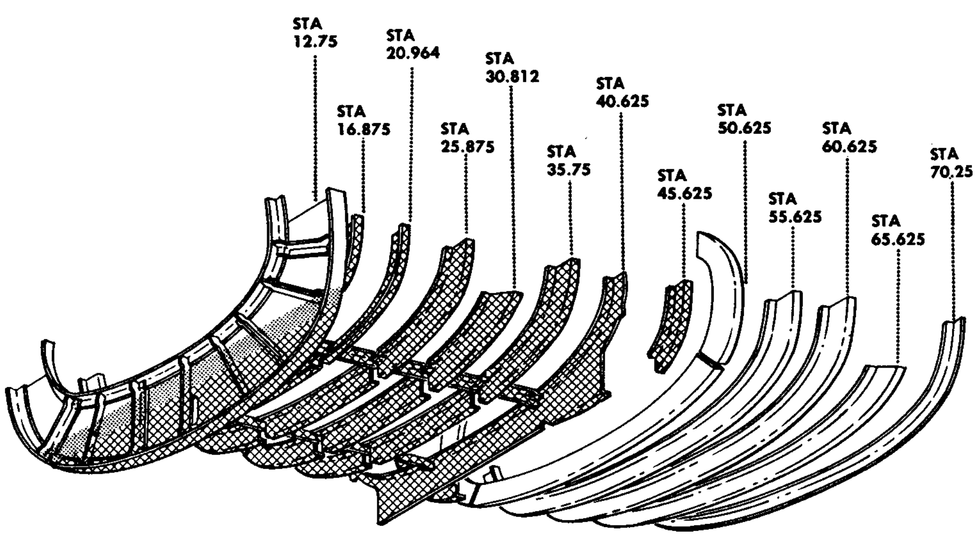
NOTE The part numbers shown are intended to be used as a guide. For actual requisitioning, consult applicable microfilm, parts catalog, or blueprints.

0-00 REPAIR SECTION AND FIGURE NUMBER

AREAS WHICH USUALLY SUFFER MINOR DAMAGE

AREAS OF NORMAL DAMAGE



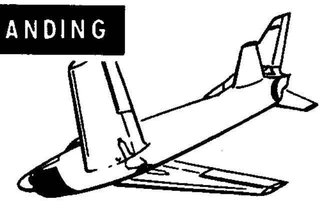


F-86K-3-0-3

Figure 9-1. Nose-gear-up Landing (Sheet 3 of 4)

NOSE GEAR UP

GEAR-UP LANDING



NOTE Refer to index for shear skin repairs and splices, and repairs to structural and non-structural doors.

Part numbers shown are intended to be used as a guide. For actual requisitioning, consult applicable microfilm, parts catalog, or blueprints.

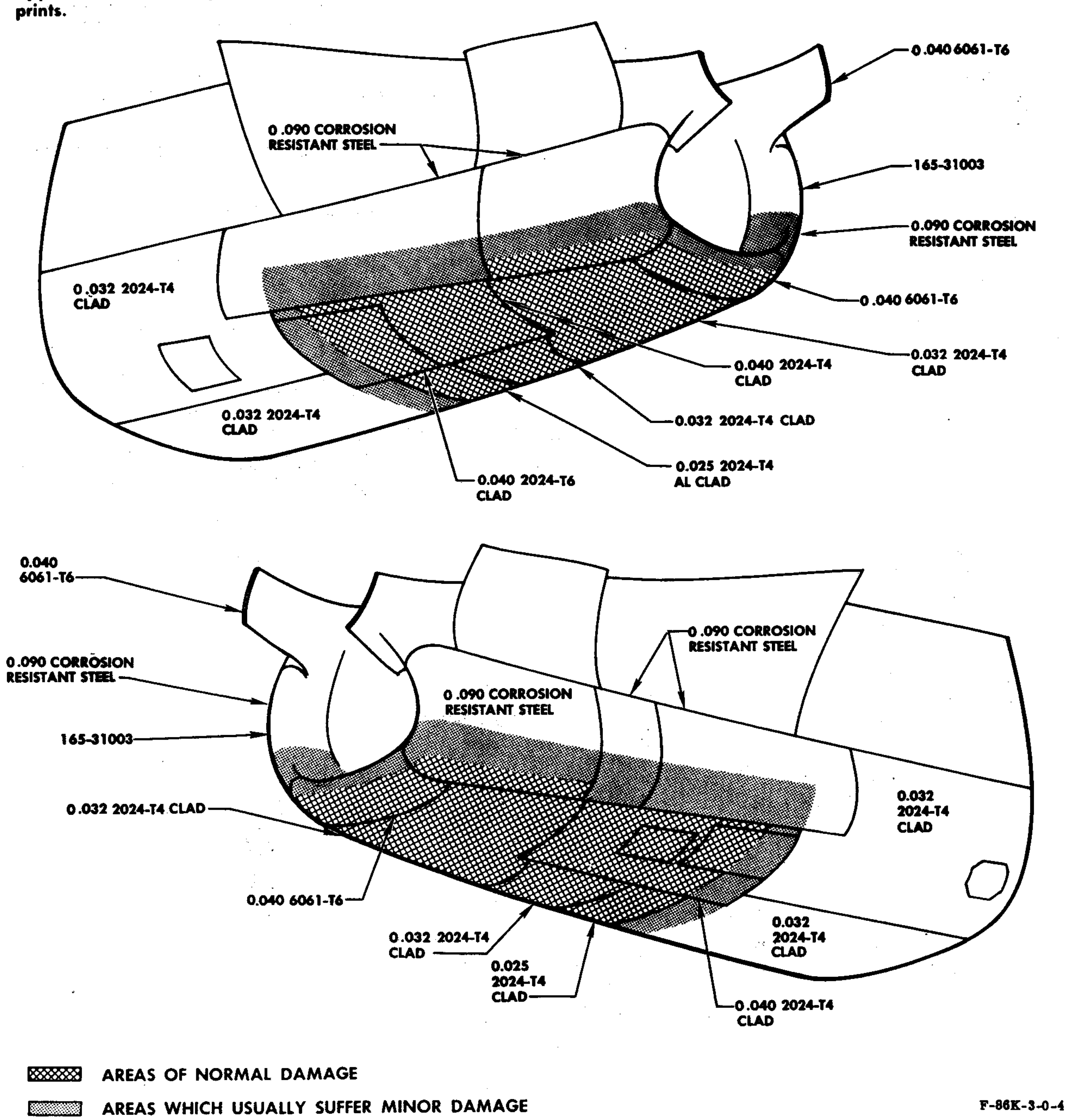
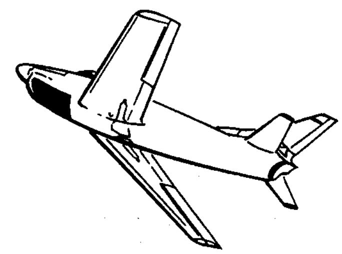


Figure 9-1. Nose-gear-up Landing (Sheet 4 of 4)

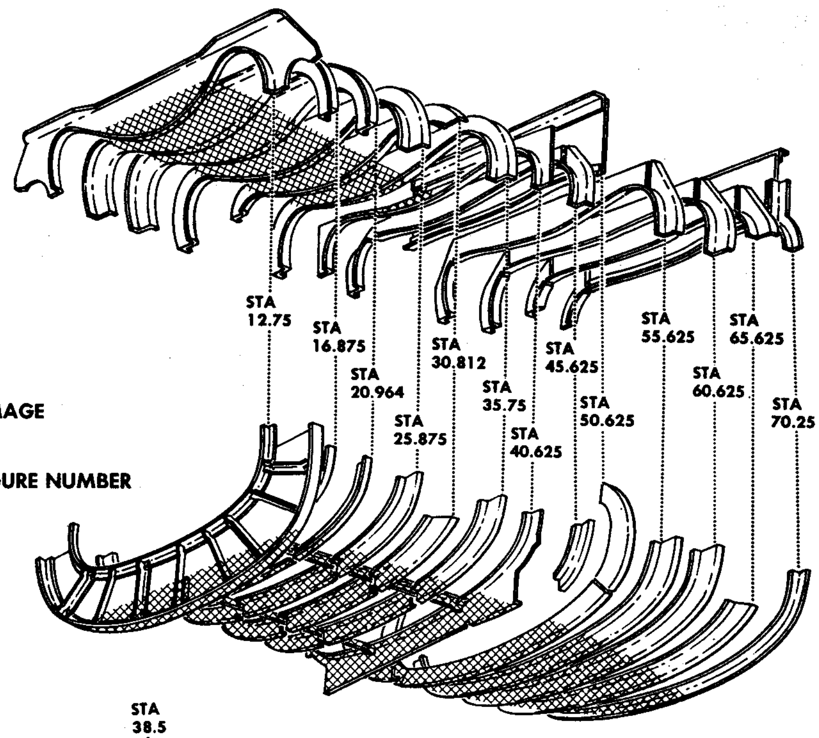
SHEARED NOSE GEAR

GEAR-UP LANDING

DUCT FRAME PART NUMBERS					
STA NO.	LOWER FRAME		SIDE FRAME	UPPER FRAME	
12.75	207-31128			207-31153	
16.875	207-31156 LH	207-31157 RH		207-31155	
20.464	165-31211 LH	165-31212 RH		165-31158 LH	165-31159 RH
25.875	165-31161 LH	165-31162 RH		165-31160 LH	165-31213 RH
30.812	207-31215 LH	207-31216 RH		207-31163 LH	165-31164 RH
35.75	165-31166 LH	165-31167 RH		165-31165 LH	165-31214 RH
40.625	207-31169			207-31168	
45.625	165-31171		165-31233	207-31170	
50.625	165-31154		165-31173	165-31172	
55.625	165-31175		165-31234	165-31174	
60.625	165-31177		165-31235	165-31176	
65.625	207-31183		207-31236	165-31178	
70.25	205-31258		205-31261	165-31180	

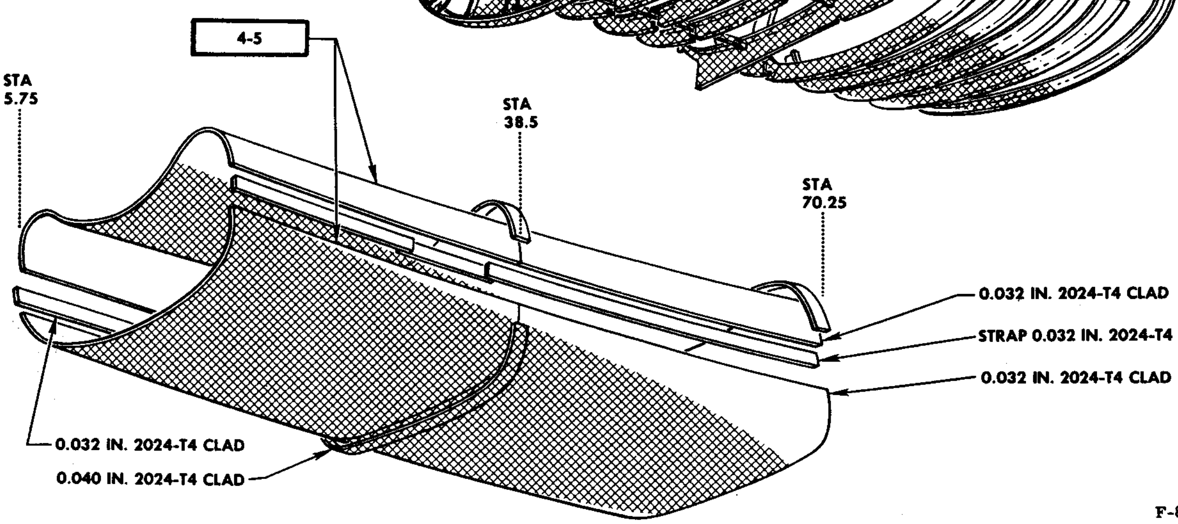


NOTE The part numbers shown are intended to be used as a guide. For actual requisitioning, consult applicable microfilm, parts catalog, or blueprints.



AREAS OF NORMAL DAMAGE

0-0 REPAIR SECTION AND FIGURE NUMBER

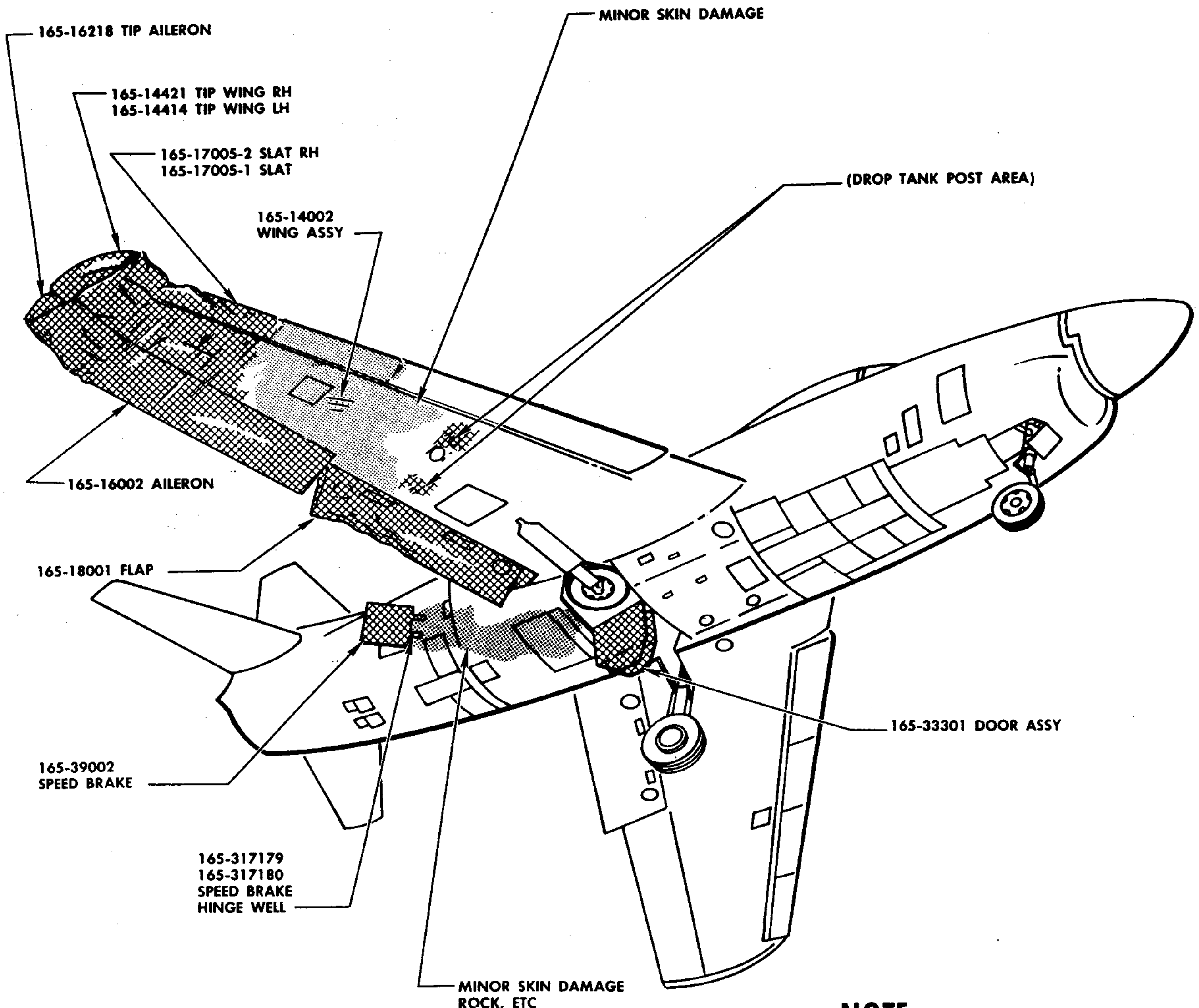


F-86K-3-0-5

Figure 9-2. Sheared Nose Gear

ONE MAIN GEAR UP

GEAR-UP LANDING



NOTE For applicable repairs, refer to index.

Part numbers shown are intended to be used as a guide. For actual requisitioning, consult applicable microfilm, parts catalog, or blueprints.

AREAS OF NORMAL DAMAGE
AREAS WHICH USUALLY SUFFER MINOR DAMAGE

F-86K-3-0-6

Figure 9-3. One-main-gear-up Landing

MAIN GEAR UP

GEAR-UP LANDING

NOTE For applicable repair, refer to index. Part numbers shown are intended to be used as a guide. For actual requisitioning, consult applicable microfilm, parts catalog, or blueprints.

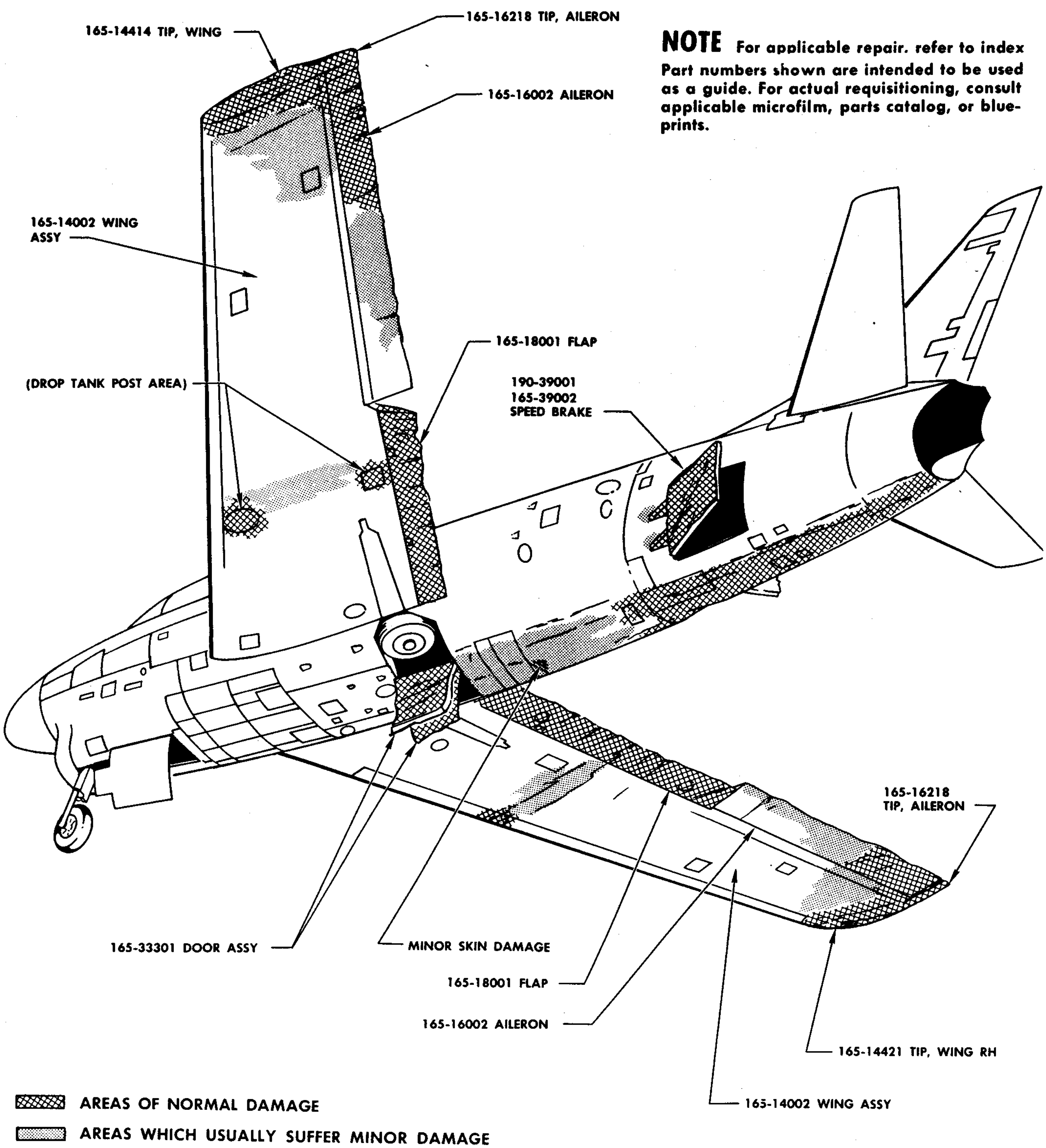
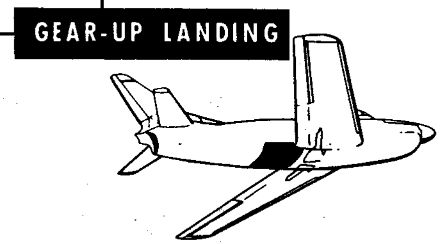
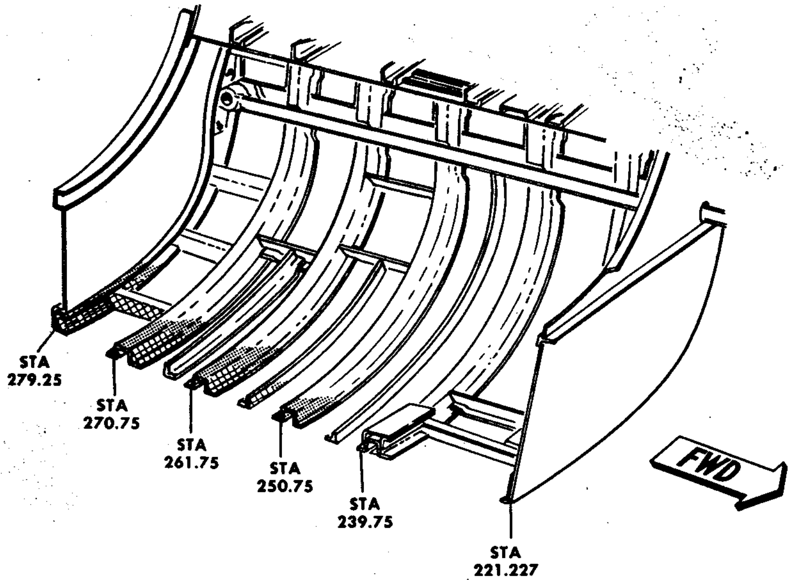


Figure 9-4. Both-main-gear-up Landing (Sheet 1 of 5)

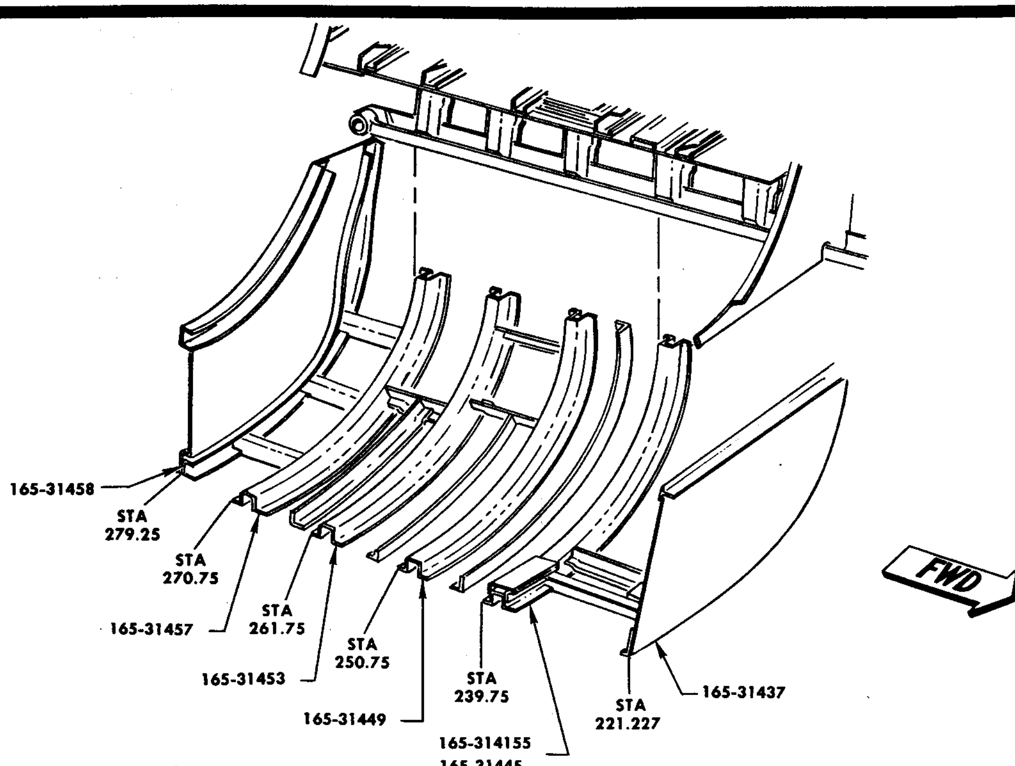
MAIN GEAR UP





AREAS OF NORMAL DAMAGE
AREAS WHICH SUFFER MINOR DAMAGE

NOTE Refer to index for skin repairs and repairs to structural and nonstructural doors.



NOTE Part numbers shown are intended to be used as a guide. For actual requisitioning, consult applicable microfilm, parts catalogue, or blueprints.

F-86K-3-0-8

Figure 9-4. Both-main-gear-up Landing (Sheet 2 of 5)

MAIN GEAR UP

GEAR-UP LANDING

NOTE Refer to index for shear skin repairs and splices, and repairs to structural and non-structural doors.

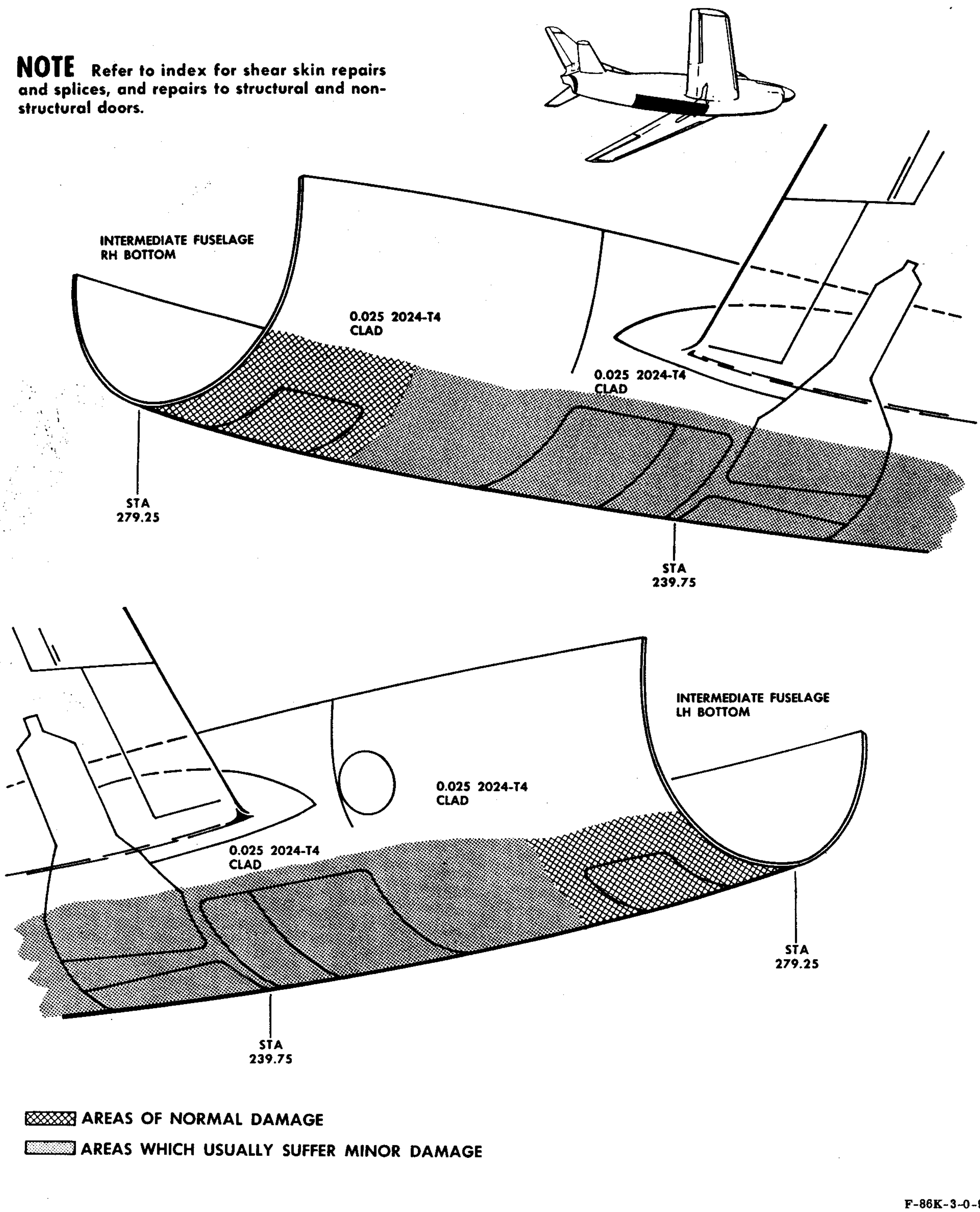
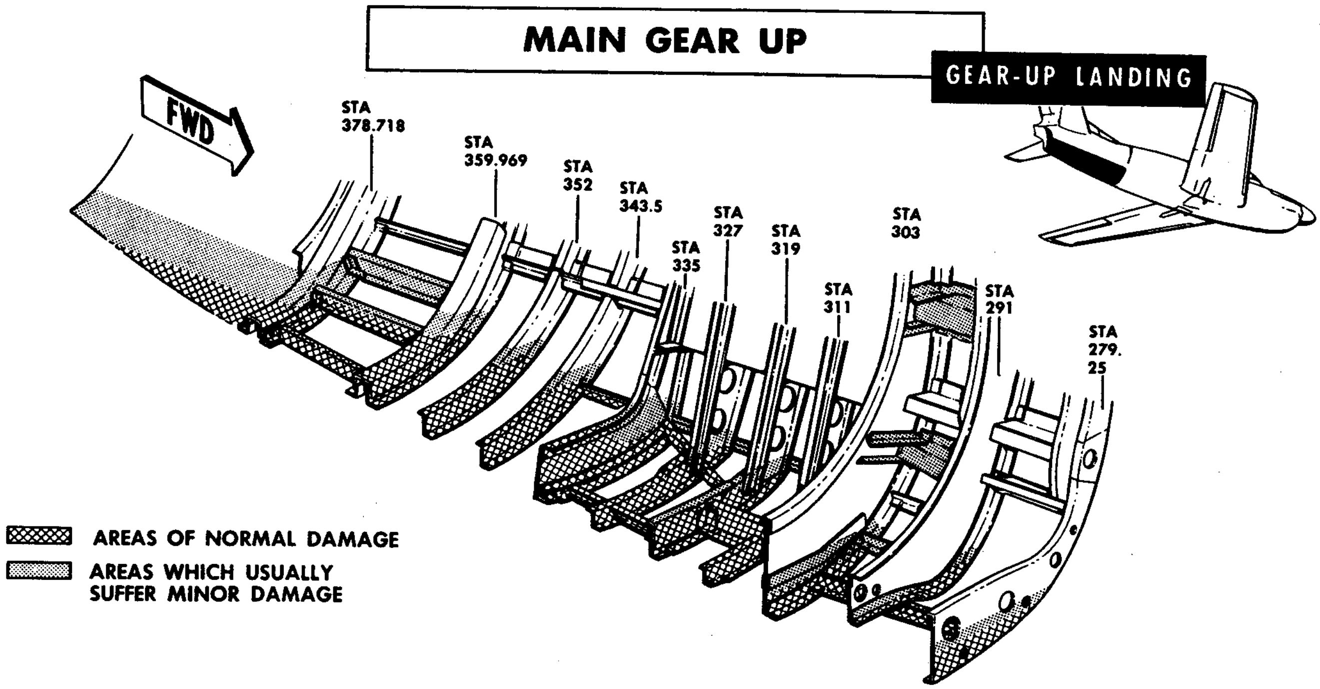


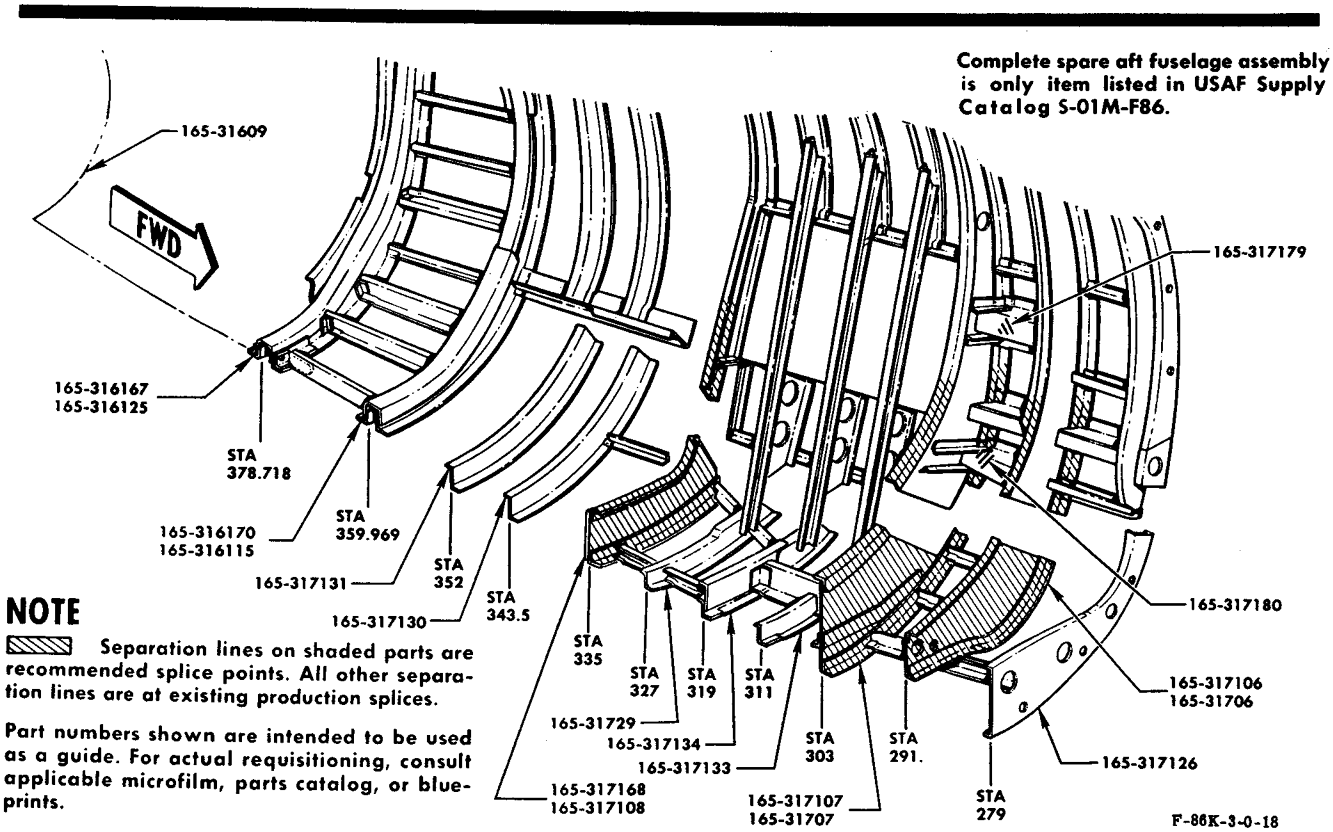
Figure 9-4. Both-main-gear-up Landing (Sheet 3 of 5)



NOTE Refer to index for skin repairs and repairs to structural and nonstructural doors.

DAMAGE MAY OCCUR AT THESE POINTS BECAUSE OF STRAIN TRANSFERRED FROM SPEED BRAKE. BOTTOM CORNER OF SPEED BRAKE (190-39002) WILL USUALLY BE GROUND OFF AND REQUIRE REPLACEMENT.

Complete spare aft fuselage assembly is only item listed in USAF Supply Catalog S-01M-F86.

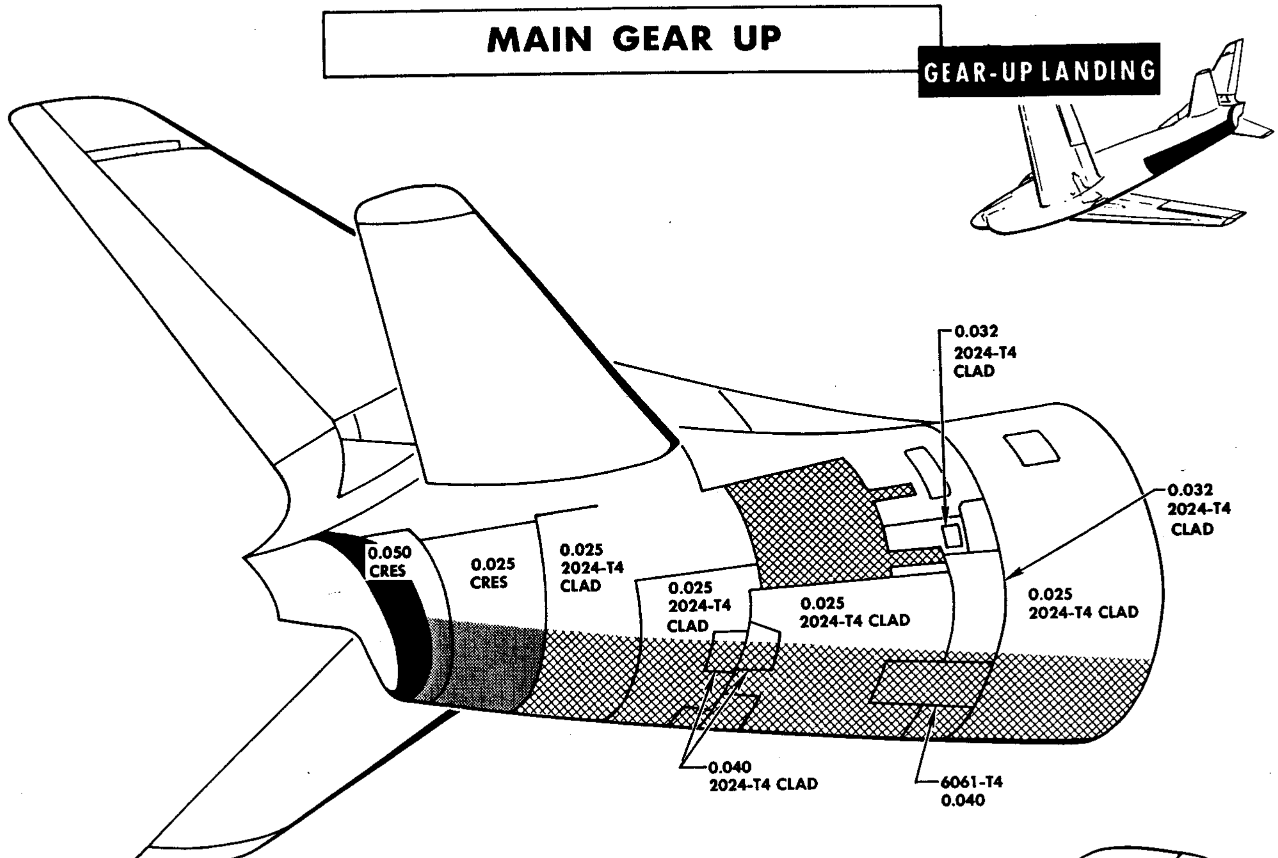


NOTE

Separation lines on shaded parts are recommended splice points. All other separation lines are at existing production splices.

Part numbers shown are intended to be used as a guide. For actual requisitioning, consult applicable microfilm, parts catalog, or blueprints.

Figure 9-4. Both-main-gear-up Landing (Sheet 4 of 5)



NOTE Refer to index for shear skin repairs and splices, and for repairs to structural and nonstructural doors.

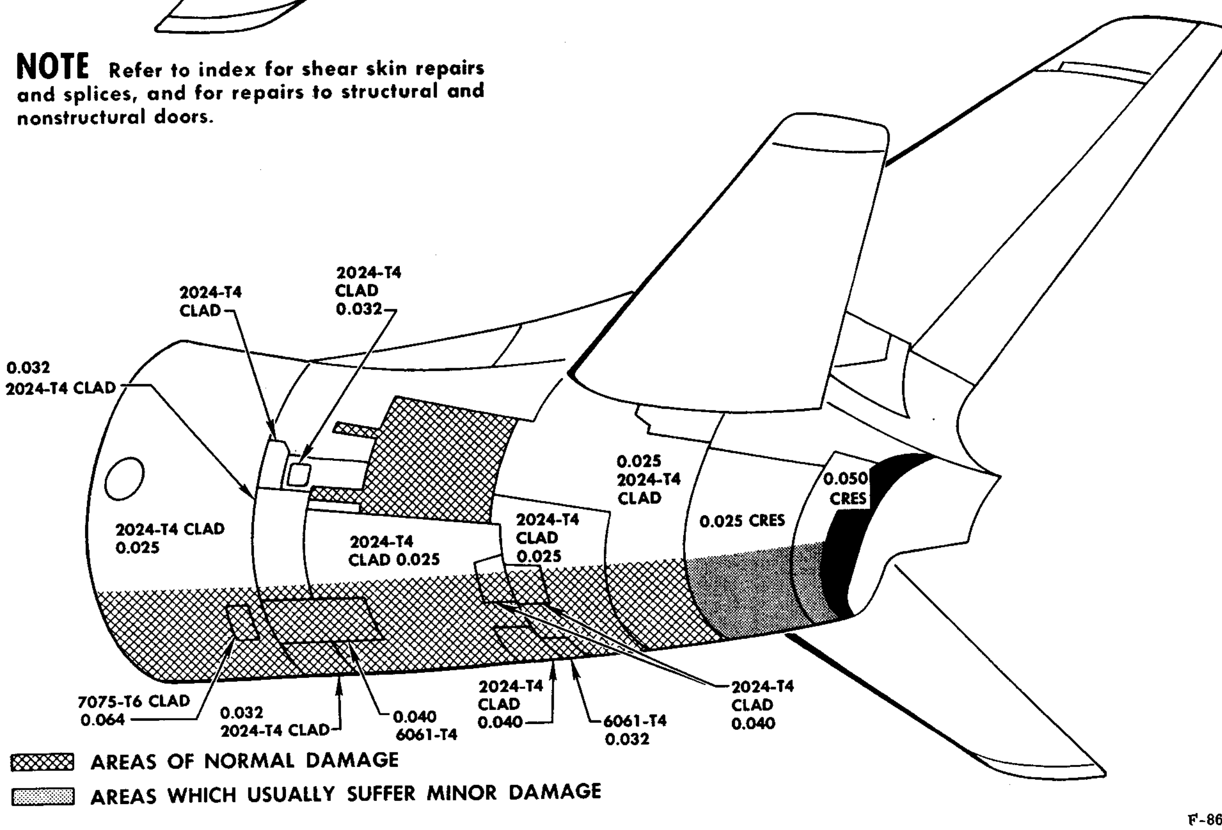
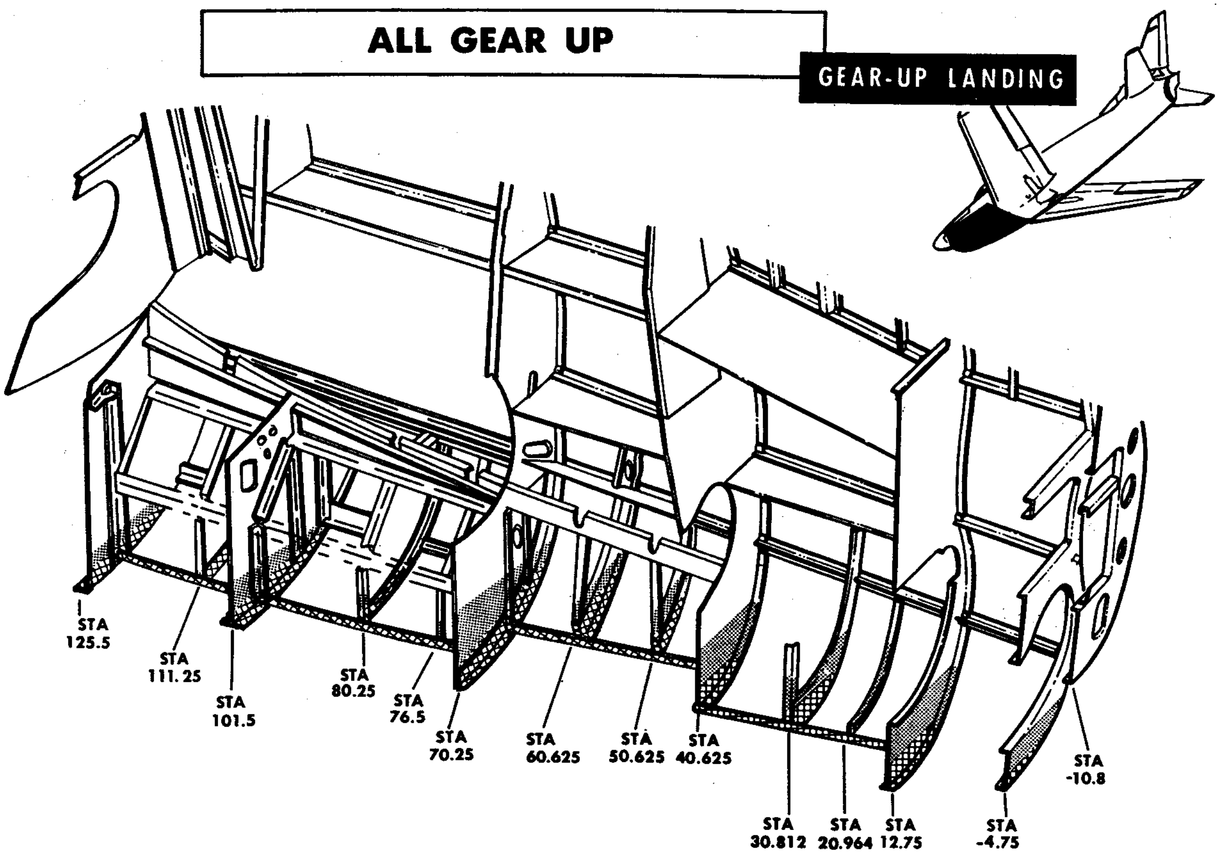


Figure 9-4. Both-main-gear-up Landing (Sheet 5 of 5)



NOTE Refer to index for skin repairs and repairs to structural and nonstructural doors.

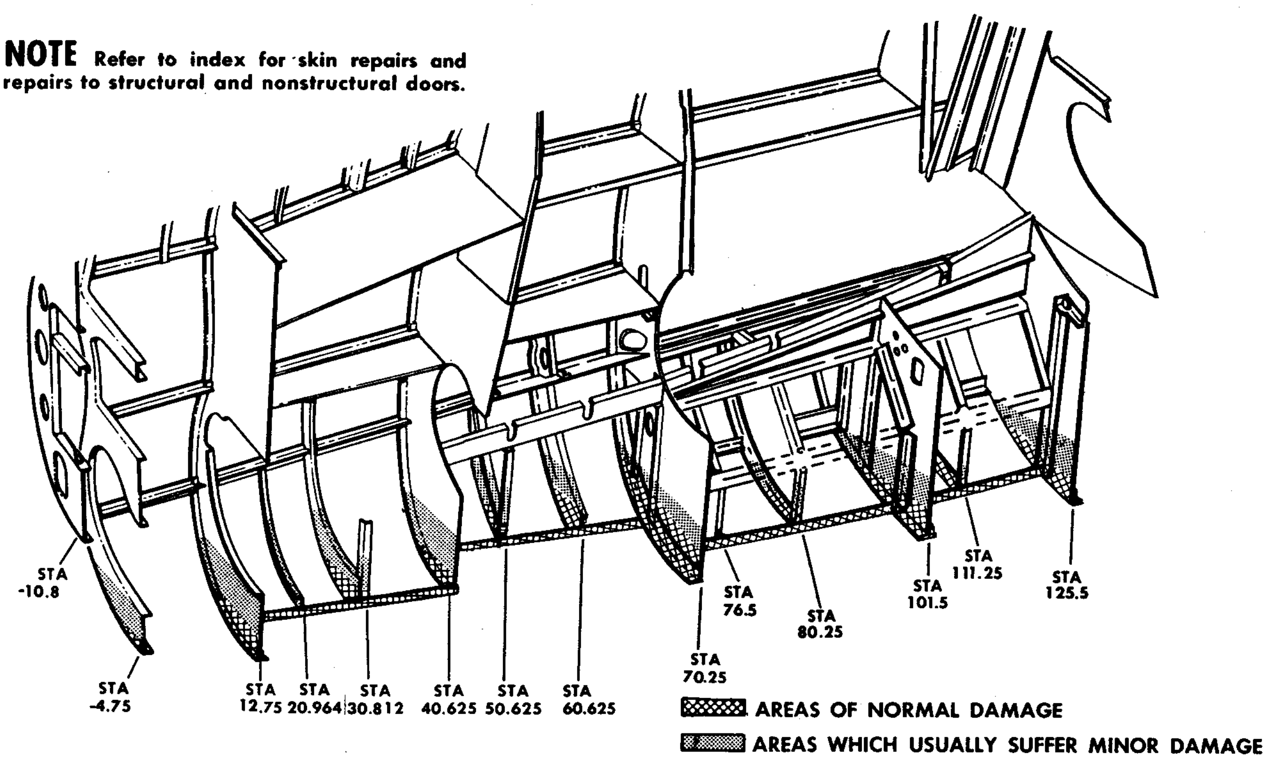
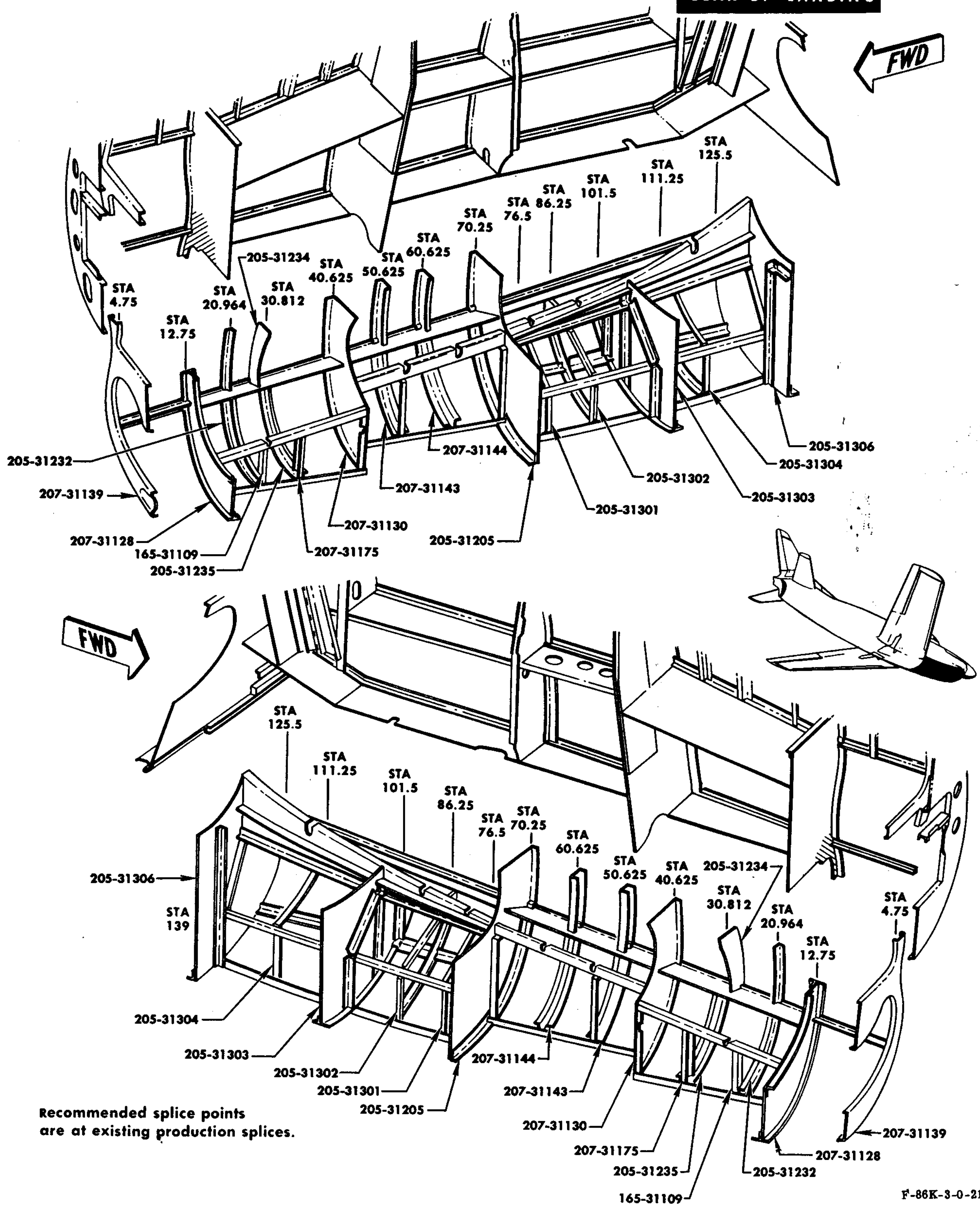


Figure 9-5. All-gear-up Landing (Sheet 1 of 9)

ALL GEAR UP



Recommended splice points are at existing production splices.

F-86K-3-0-21

Figure 9-5. All-gear-up Landing (Sheet 2 of 9)

ALL GEAR UP

GEAR-UP LANDING

NOTE Refer to index for shear skin repairs and splices, and repairs to structural and non-structural doors.

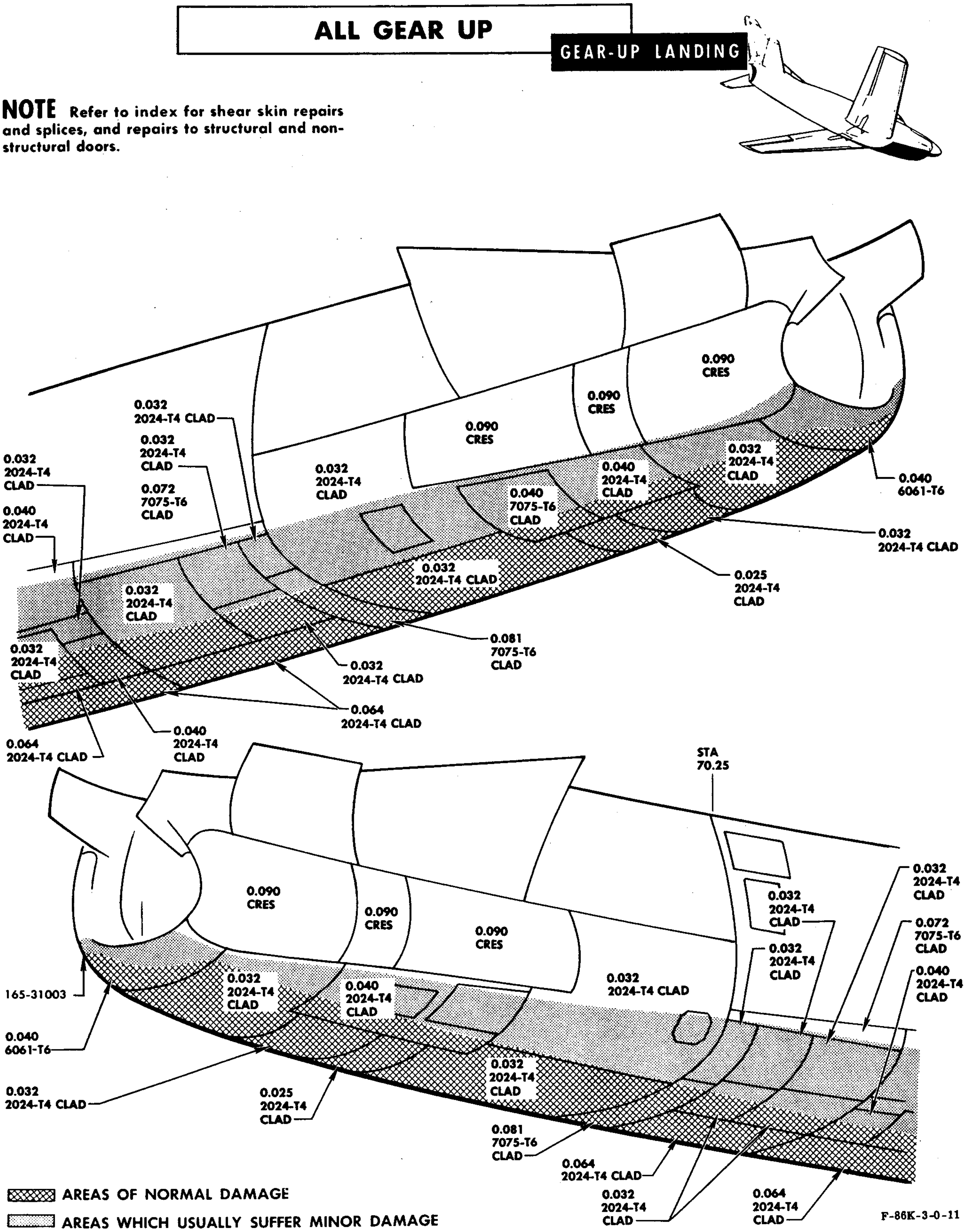
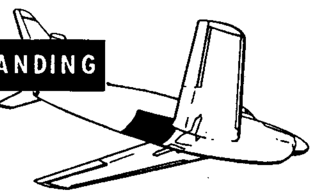
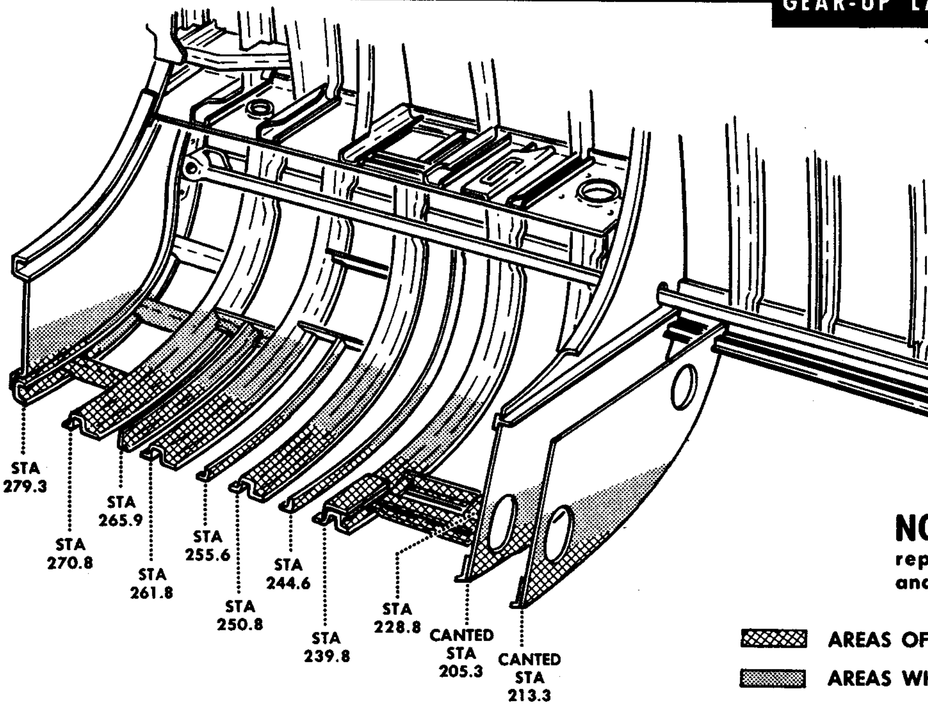


Figure 9-5. All-gear-up Landing (Sheet 3 of 9)

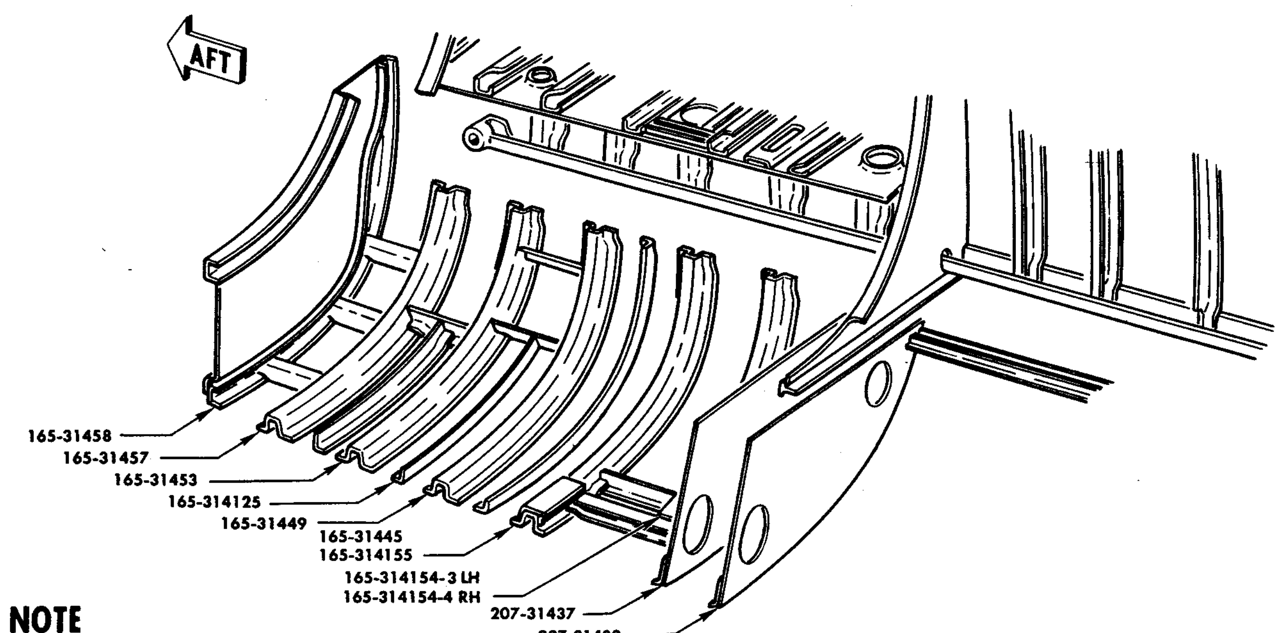
ALL GEAR UP





NOTE Refer to index for skin repairs and repairs to structural and nonstructural doors.

- AREAS OF NORMAL DAMAGE
- AREAS WHICH SUFFER MINOR DAMAGE



NOTE

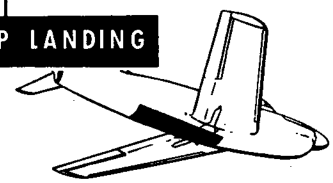
Part numbers shown are intended to be used as a guide. For actual requisitioning, consult applicable microfilm, parts catalog, or blueprints.

F-86K-3-0-12

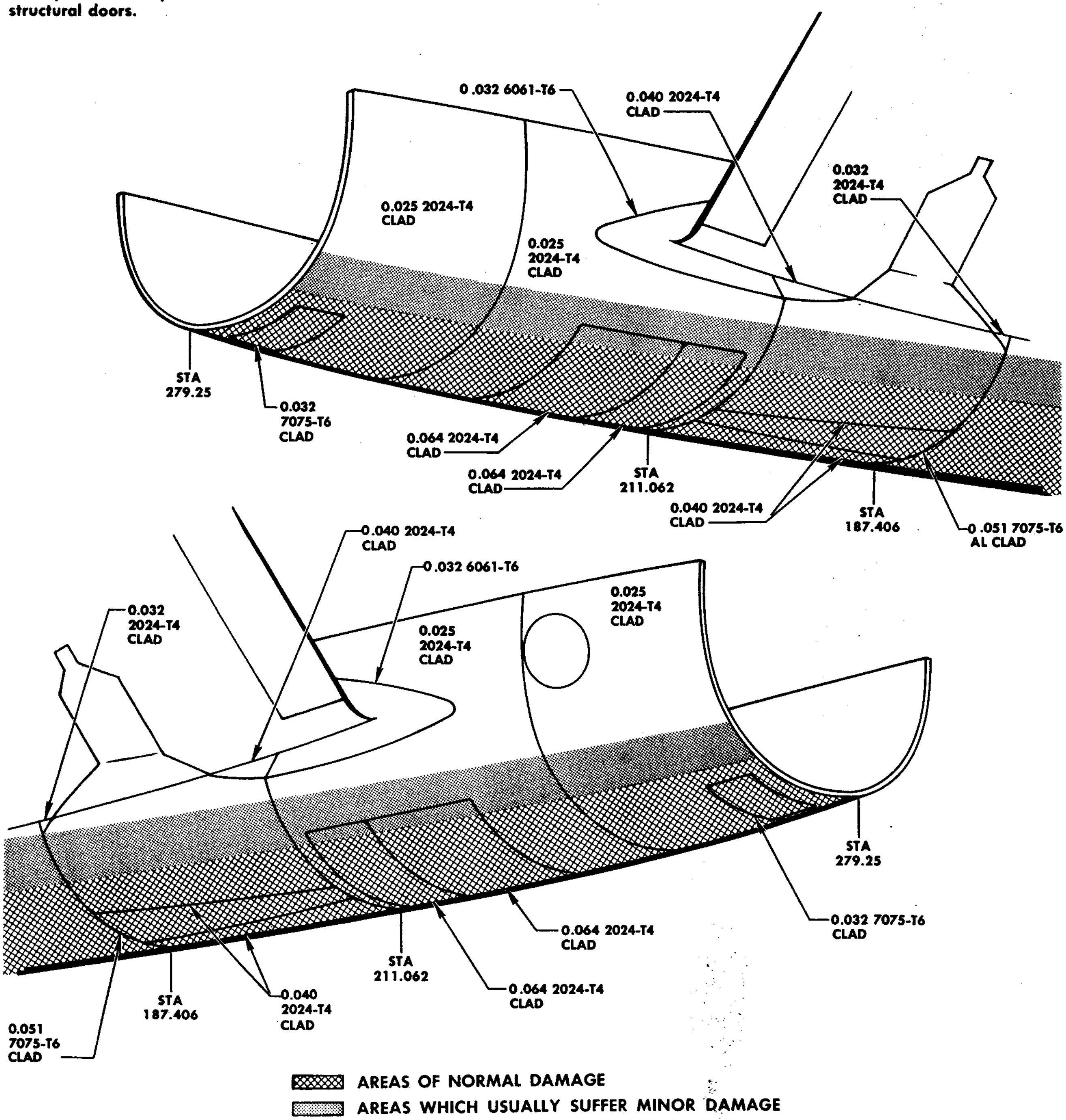
Figure 9-5. All-gear-up Landing (Sheet 4 of 9)

ALL GEAR UP

GEAR-UP LANDING



NOTE Refer to index for shear skin repairs and splices and repairs to structural and non-structural doors.

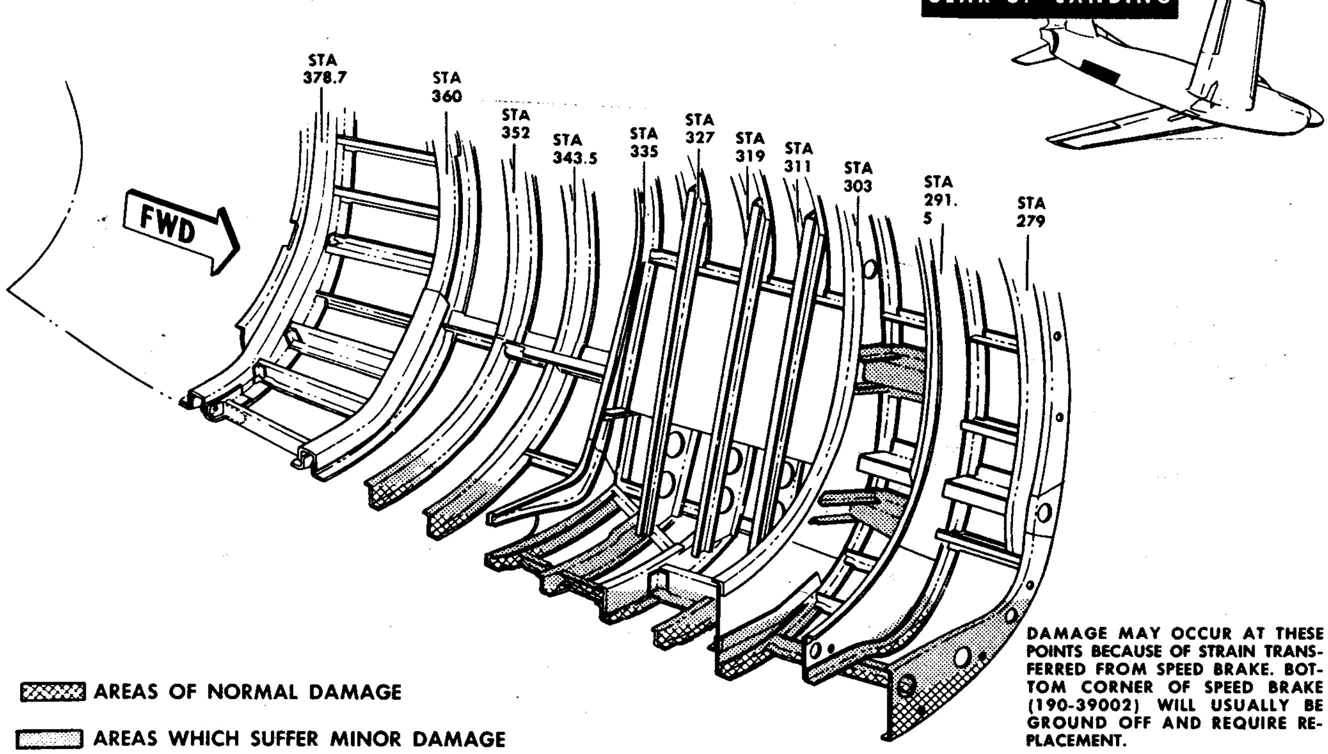


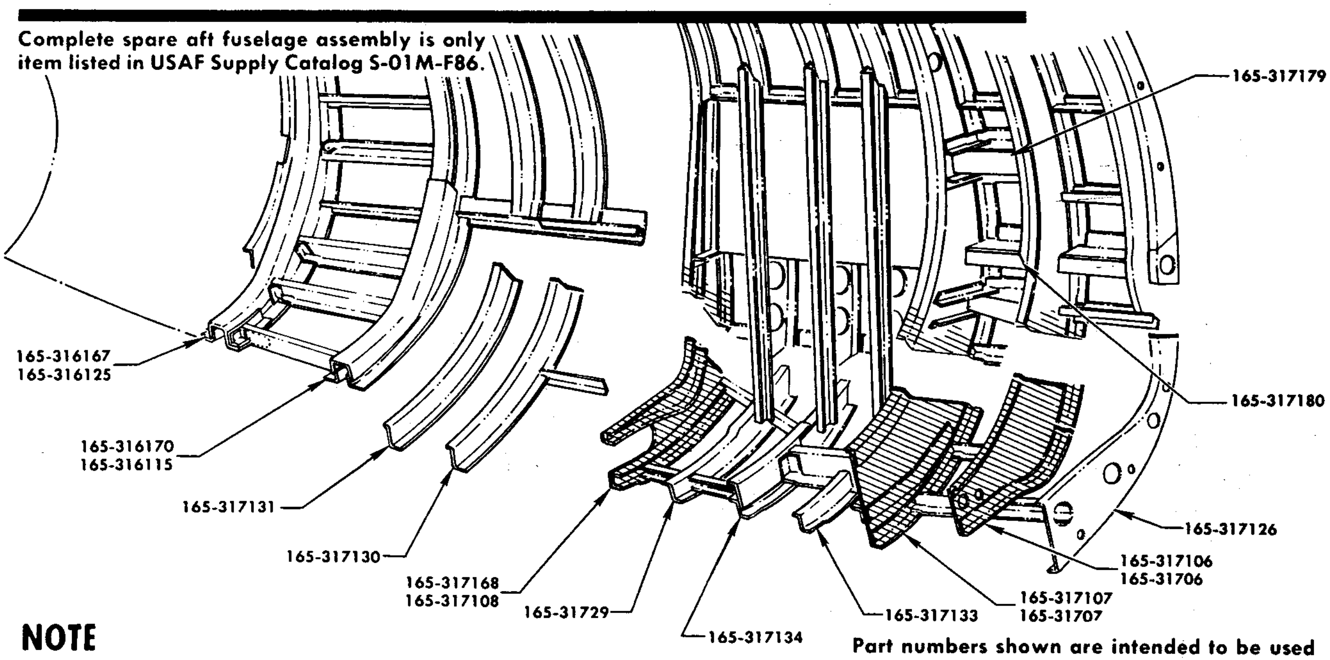
F-86K-3-0-13

Figure 9-5. All-gear-up Landing (Sheet 5 of 9)

ALL GEAR UP

GEAR-UP LANDING





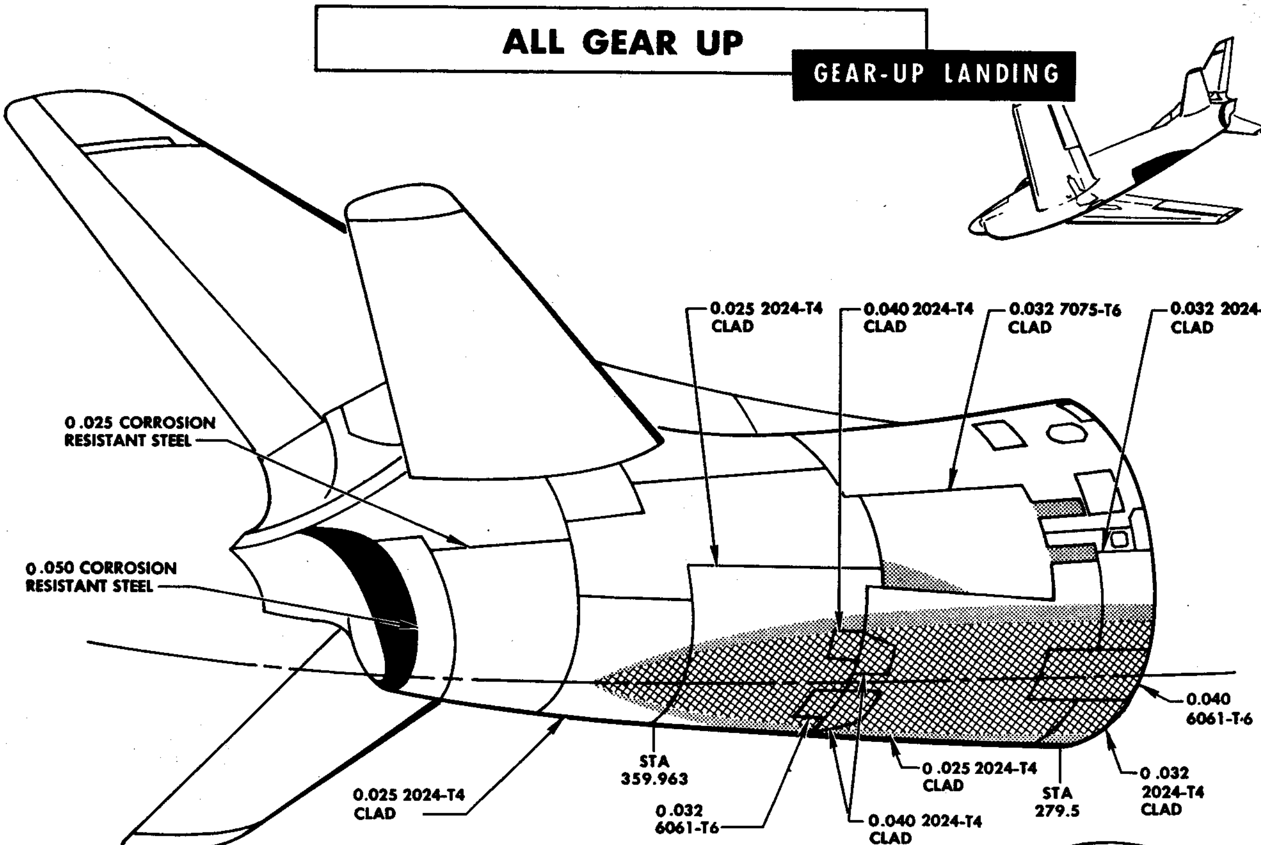
NOTE

Separation lines on shaded parts are recommended splice points. All other separation lines are at existing production splices.

Part numbers shown are intended to be used as a guide. For actual requisitioning, consult applicable microfilm, parts catalog, or blueprints.

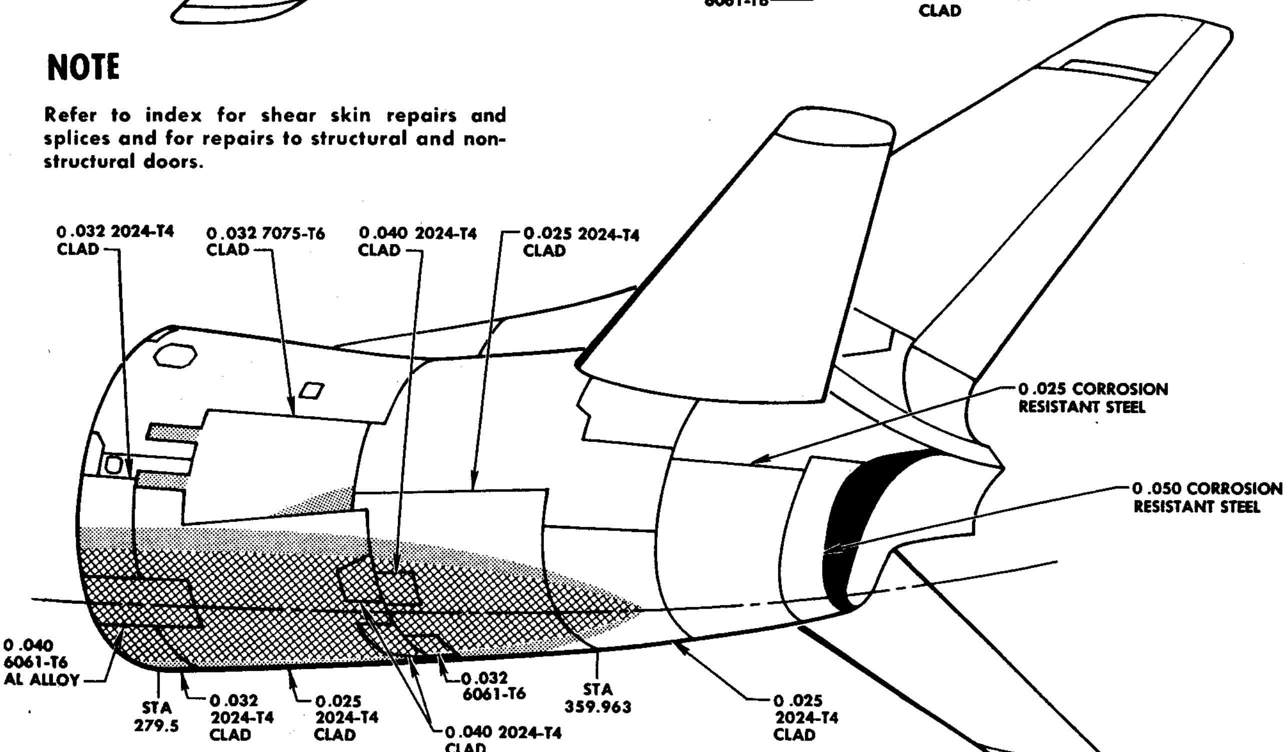
F-86K-3-0-20

Figure 9-5. All-gear-up Landing (Sheet 6 of 9)



NOTE

Refer to index for shear skin repairs and splices and for repairs to structural and non-structural doors.



AREAS OF NORMAL DAMAGE

AREAS WHICH USUALLY SUFFER MINOR DAMAGE

F-86K-3-0-15

Figure 9-5. All-gear-up Landing (Sheet 7 of 9)

ALL GEAR UP

GEAR-UP LANDING

NOTE For applicable repair, refer to index.

Part numbers shown are intended to be used as a guide. For actual requisitioning, consult applicable microfilm, parts catalog, or blueprints.

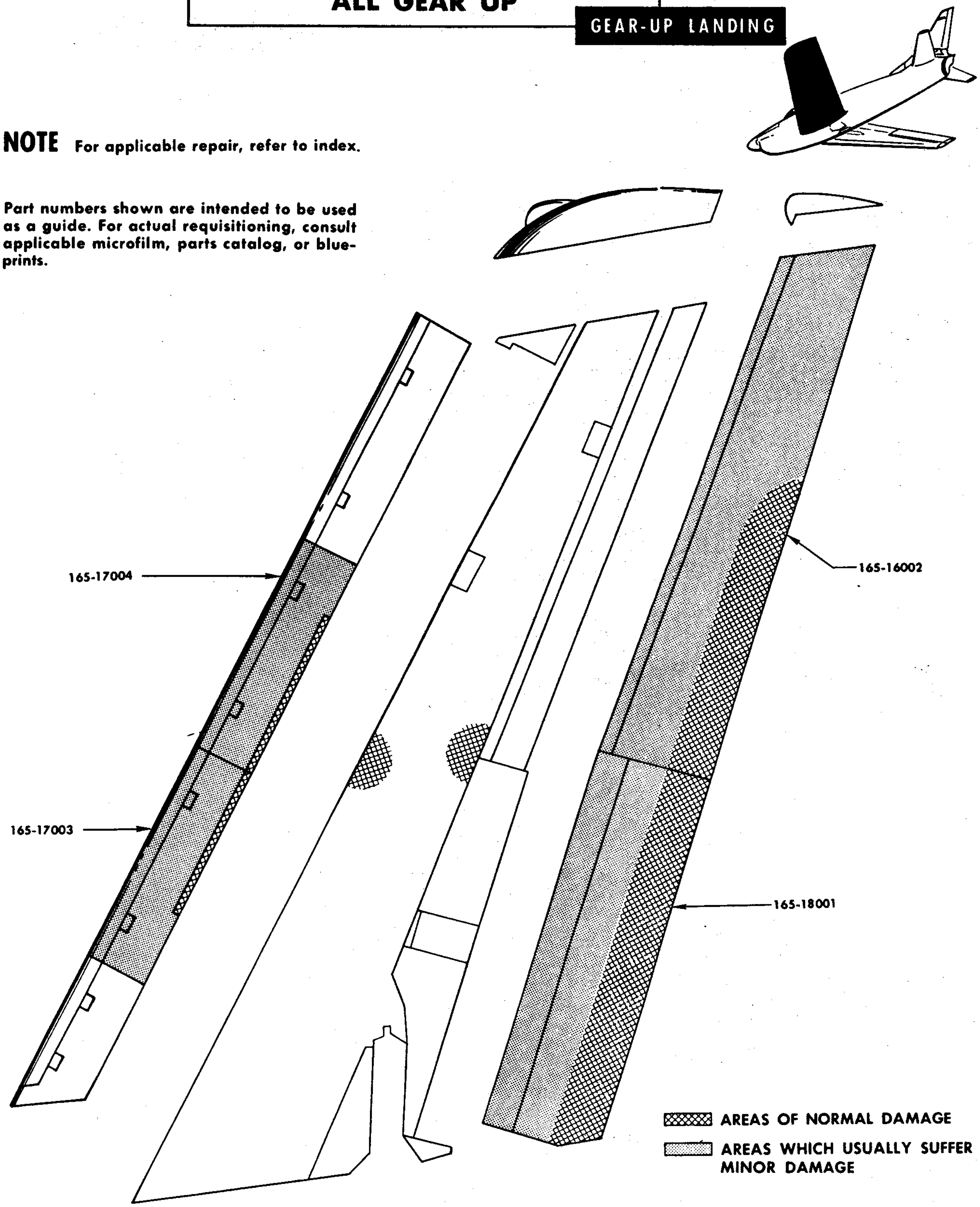


Figure 9-5. All-gear-up Landing (Sheet 8 of 9)

ALL GEAR UP

GEAR-UP LANDING

NOTE Refer to index for shear skin repairs and splices and repairs to structural and non-structural doors.

Part numbers shown are intended to be used as a guide. For actual requisitioning, consult applicable microfilm, parts catalog, or blueprints.

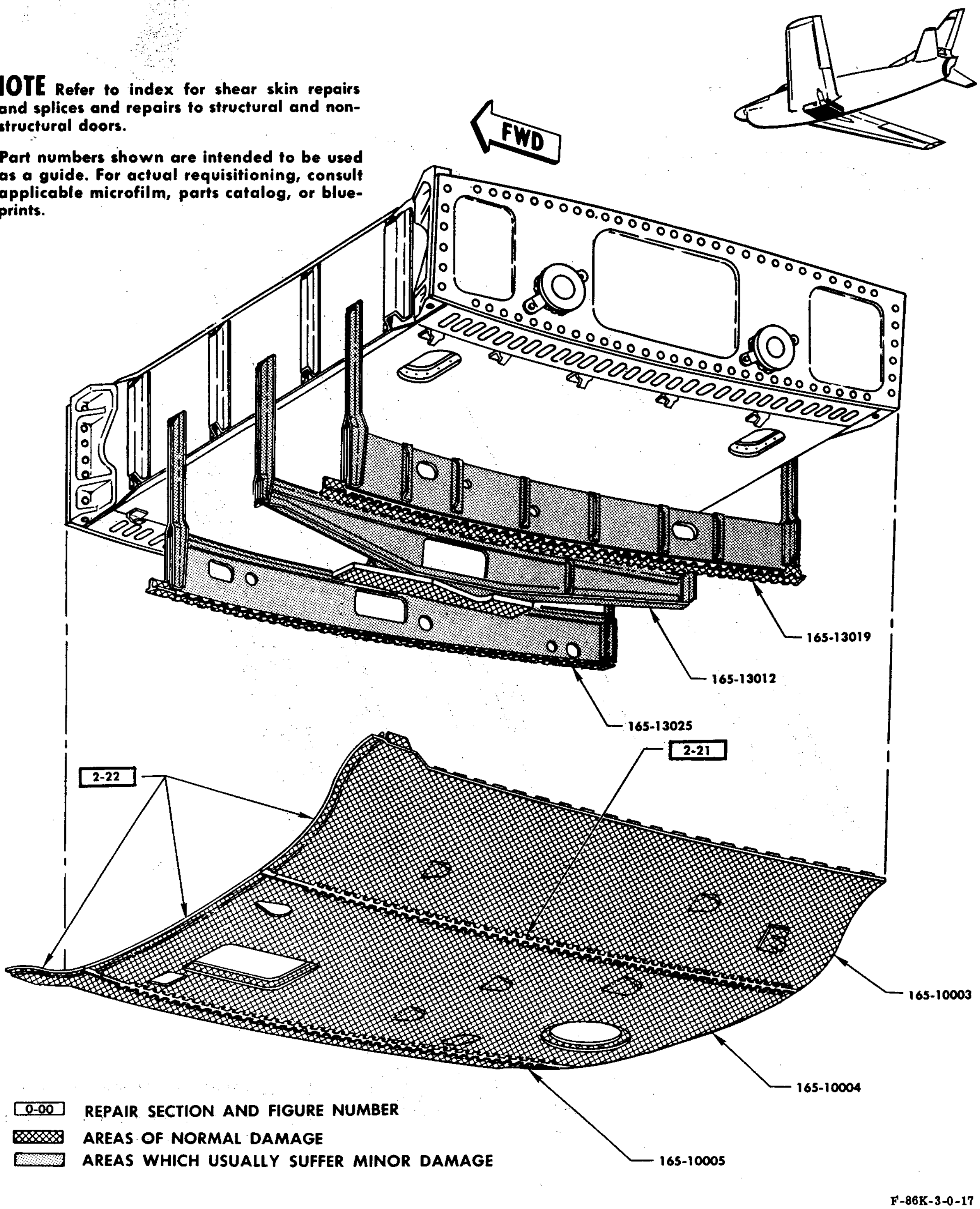


Figure 9-5. All-gear-up Landing (Sheet 9 of 9)

FUSELAGE BOTTOM COVERS AND DOORS

GEAR-UP LANDING

NOTE Refer to index for shear skin repairs and splices, and repairs to structural and non-structural doors.

Part numbers shown are intended to be used as a guide. For actual requisitioning, consult applicable microfilm, parts catalog, or blueprints.

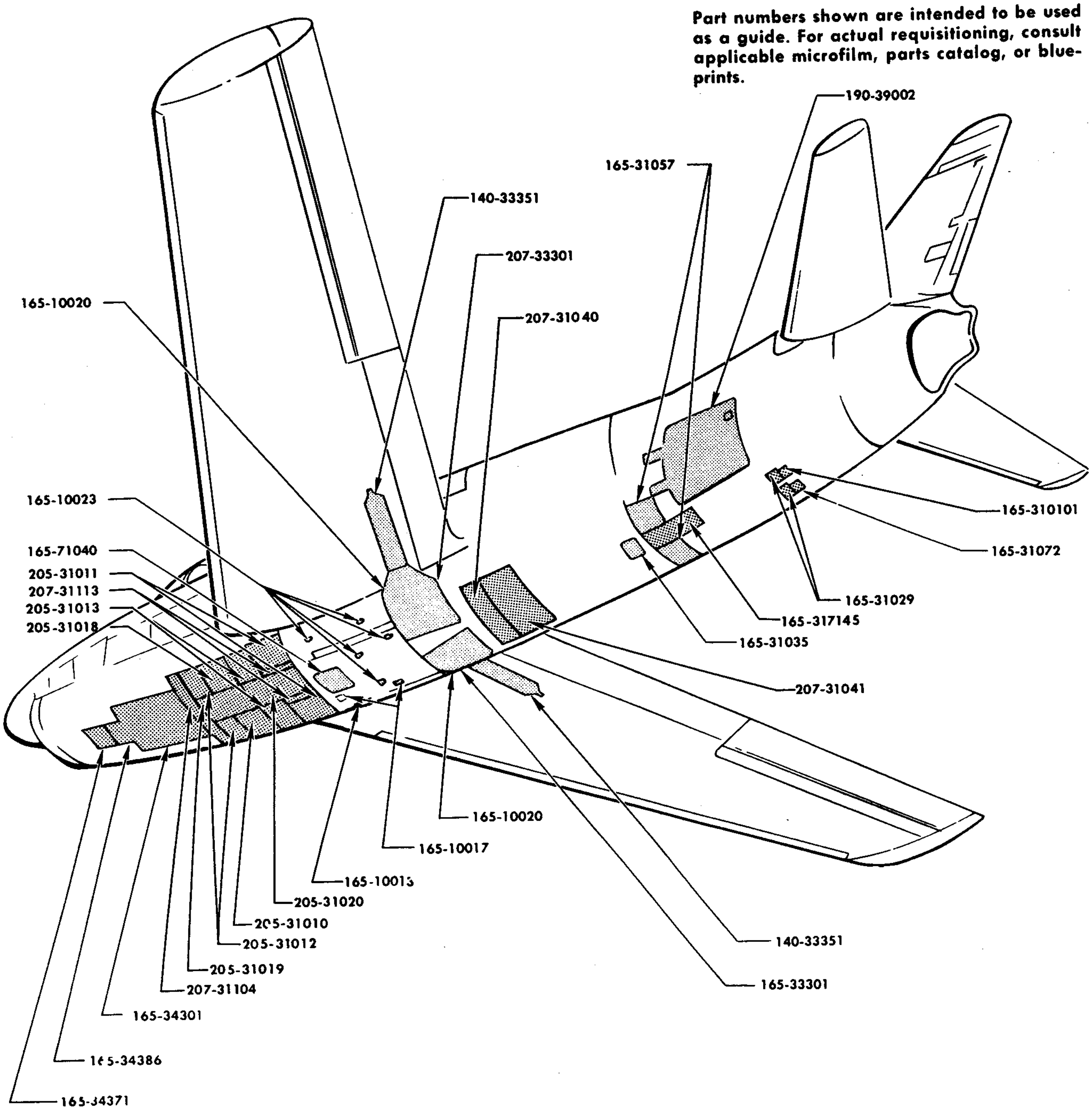


Figure 9-6. Fuselage Bottom Covers and Doors

SECTION X

TYPICAL REPAIRS

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TYPICAL REPAIR INDEX 10-1
SELECTION OF TYPICAL REPAIRS....10-1
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GENERAL.

Typical repairs are designed for the widest possible applications. The aim in designing repairs for areas considered to be primary structure is to rebuild the material. This is necessary because the typical repair has to be strong enough for the most heavily loaded part on which it may be used. Repairs for areas considered to be secondary structure are somewhat lighter, since the known loading in those areas is lighter. Repairs for secondary structure are skin repairs only. All substructure is to be considered as *primary structure* for repair purposes. Secondary structure repairs are noted as such in their titles. Nonstructural door repairs are also secondary structure repairs. All other repairs in this section are applicable to primary structures. Typical repair indexes show certain covers and doors as secondary structure. These covers and doors are nonstructural. However, the load-carrying ability of a structure must be continuous, so that, when a nonstructural door is installed, the load paths are transferred to the framework around the door and/or to the compartment which it covers.

TYPICAL REPAIR INDEX.

The typical repair index contains the necessary information for selection of a typical repair. All outer skins are designated as primary or secondary structure. Primary structure skins are coded as to how they are loaded; that is, whether they are loaded in shear or tension, or in combined shear and tension. This repair index gives the *type* of repair required for each area only. It permits selection of the most suitable repair within the type.

The index applies to the skins only, not to the structures underneath them. For repair purposes, all formed and extruded shapes are considered to be tension-loaded. Use tension riveting tables when calculating rivet requirements. All internal webs are considered to be loaded in shear. Use shear riveting tables when calculating requirements for web repairs. Tension repairs used in this section are actually extra-strong shear repairs. The number of rivets required for "l" (cutout dimensions) is the same, regardless of the direction of tension. A 4-inch opening would have an equal number of rivets along each of its sides. This eliminates the need for determining the directions of the tension loads.

Typical repairs may be used whenever they meet the shape and material requirements, as long as they are applied to areas as previously specified. There are no repairs in this section for tapered or sculptured skins. The following paragraphs discuss selecting the repair and fastener table, and also fastener distribution. Refer to "Developing a Typical Repair" for an itemized list of the various factors which must be considered when planning and working-up a typical repair. It provides a convenient reference to the problems involved, and supplies the answers or refers to data which contains the answers.

SELECTION OF TYPICAL REPAIRS.

Typical repairs may be selected in two ways. The repair index keys in each section list the figure numbers of certain typical repairs that apply to the listed part. All possible applications, however, are too numerous to index. The second method of selecting a typical repair is by reference to the alphabetical index.

The repair titles are actually a brief description of the repair. For example: To repair a hole near a frame in a fuselage skin panel, find the damaged area on the fuselage primary and secondary structure diagram. This diagram indicates that the damaged area is primary structure. On the fuselage shear and tension diagram, the damage is shown to be in a shear area. Because the damage is near a frame, refer to the alphabetical index under "Typical Repairs" and select "Skin Repair Adjacent to Substructure—Shear." Each of the three sheets of this figure shows a different method of dealing with the problem. Select the method which best fits your needs. A brief study of the repair titles, listed in the index under "Typical Repairs," familiarizes the repairman with the many types of repairs he can make by using the information in this section.

SELECTING FASTENER TABLE.

Fastener tables, listed in the alphabetical index, are titled according to the type of fastener and the shape of its head; the material or materials for which calculations were made; and how the repair is loaded (shear or tension).

The type of fastener chosen for a repair should be the one that best fits the need. In skin and web repairs, it is best to match the type and size of fastener that is in general use in the area. When it is necessary to use blind fasteners, they should be of the same size and head type as the original fasteners in the surrounding area.

Protruding head fasteners must be used to repair extruded or formed shapes, except where external skins are picked up in the fastener pattern.

Because of the space available for overlap of repair parts, several calculations may be necessary to determine the suitable fastener. Minimum (or greater) fastener edge distance spacing must be observed to obtain the required strength in the repair.

FASTENER DISTRIBUTION PATTERNS.

The fastener distribution patterns (figure 10-3) show how fastener patterns are developed for the more common types of repairs. Fastener layout determines the size and shape of the repair doubler.

The first three sheets of figure 10-3 deal with problems in skin and web repairs; the fourth sheet, with problems in repairing extruded and roll-formed shapes. In both cases, the problems are about the same. Whenever there is a break or gap in a piece of metal, it must be joined together with another piece of metal (a repair doubler). The repair doubler must be fastened to the broken material with a given number of fasteners. The required number, as found in the fastener tables, is the number that is required for *each side* of the break.

In skin and web repairs, the trimmed-out damage is usually rectangular or circular in shape. The rectangle has two directions of break, at 90 degrees to each other. Each direction is treated separately and the required fasteners are distributed on opposite sides of that particular direction of break.

The circle is considered to have but one break, its circumference. Fasteners are distributed evenly around the cutout.

A crack in sheet metal may have one or two directions, depending on the path the crack has taken. When it is a generally straight line, it is measured as a straight line and the required fasteners are distributed on each side of the break. When the path of the crack deviates from a generally straight line, it is considered to have two directions of break and is treated as a rectangular repair. The area of skin inside the rivet pattern actually becomes the "filler" material and may be tacked to the repair doubler with small structural rivets, as a filler would be.

The only skin and web repair which does *not* require the specified number of fasteners on each side of the break is the overlap splice. In this repair, the fasteners required for the break are distributed within the overlap area.

In extruded and roll-formed shape repairs, the length of the break may vary from a partial damage to one flange to a complete separation of the part. In all cases, fastener calculations are made for each surface of the shape affected by the break. Fasteners required for each surface are distributed in that surface on each side of the break. Fasteners may be added in any surface to obtain a uniform fastener pattern.

(Deleted)

MIXING INSTRUCTIONS FOR CEMENT.

Select curing agent desired. Curing agent A and CH-1 hardener are slow-acting materials, whereas DTA is a fast-acting material. Add six parts by weight of curing agent to 100 parts by weight of adhesive. Stir ingredients until they are thoroughly blended. Do not thin mixture during blending process. After the curing agent has been added, the pot life is about 30 minutes for the DTA and about 3 hours for the curing agent A and CH-1 hardener.

CAUTION

Poisonous fumes are given off during the blending process. To minimize the danger of the fumes, the following precautions should be observed:

- Add curing agent slowly.
- Mix in small quantities.
- Mix only in well-ventilated areas.
- Do not inhale vapors.
- Keep curing agent off hands and clothing.

SURFACE PREPARATION FOR BONDING.

The strength of the bond depends to a great degree on the cleanness of the bonding surfaces. The importance of thorough and careful cleaning cannot be overemphasized. Remove all dirt, grease, and foreign matter from bonding surfaces with diluent naphtha. Apply cleaner (Specification MIL-C-5410, Type II) at package consistency with a clean swab or brush to surfaces to be cleaned. Allow it to remain in contact with the surface from one to 2 minutes. (On assemblies, every effort should be made to prevent the cleaner from entering the seams or faying surfaces.) Scrub surfaces lightly and rinse thoroughly with clean water. Examine surface for water break. If the water on surface tends to stand in beads or drops, repeat cleaning process until a surface free of water break is obtained. Dry surface thoroughly before applying adhesive. Do not used a compressed-air hose to accelerate drying. Sometimes the compressed air has condensed liquids which would tend to contaminate the cleaned area, causing the need for the complete cleaning operation to be repeated.

CORE MACHINING.

The core must be cut to the desired thickness by sawing or milling or other similar methods so that the core-to-face bonds of the parts will be continuous over 100 percent of the bonding surfaces. The operation of sizing must not cause buckling of the cell walls. The core should be cut enough oversize (1/16 inch to 1/8 inch) in length and width dimensions to allow a slight compression of the core cells next to the edges and splice joints, but deformation of the cells must not extend back more than one row of cells. The ribbon direction must run parallel to the original part being repaired. The core must be machined dry, without lubricants of any kind. It must be kept free from oil or any other substance that would contaminate the core. If the core does become contaminated, it would be discarded, because it is virtually impossible to ever get a contaminated core clean enough to use. When noncompressible materials, such as micarta, wood, or metal, are being used as fillers to replace honeycomb, fillers should be trimmed to allow from 0.003- to 0.006-inch gap between the fillers and the honeycomb being repaired. This provides for an ample amount of adhesive to bond the honeycomb to the filler.

CORE SPLICING.

Remove the damaged core in the area where the repair is to be made, and scuff-sand the old bond line. Wipe all surfaces to be bonded with a clean rag soaked in toluol and dry immediately with clean, dry rags. If the solvent is allowed to air-dry, the surface is *not clean.* The solvent must be wiped dry from the liquid state. Repeat cleaning procedure with toluol several times, each time wiping dry with clean rags. Keep solvent clean by pouring solvent on rags. Do not hold rag against mouth of inverted container; this could cause all of the solvent in the container to become contaminated. Do not use compressed air to hasten the drying process. All contact edges of the prefit core must be coated with cement and then forced into position. Side pressure must be maintained until the bond has cured. This pressure must be enough to provide contact with all of the splice mating surfaces, but not enough to cause excessive cell distortion. The allowable core gap is 1/8 inch in width and not more than six cells in length. The total number of gaps must not exceed 20 percent of length of the splice, and all gaps must be filled with adhesive.

APPLYING CEMENT.

The cement may be applied with a spatula or putty knife, or any other suitable implement. It should be applied in a continuous film over both bonding surfaces, whenever possible, although it is not necessary that both surfaces are coated with cement. The cement should be applied heavily enough so that it fills all depressions and voids. The cement should not be thinned and should be applied as soon as possible after the curing agent has been added. As soon as possible after the cement has been applied, the surfaces should be joined together to avoid any chance of contamination. Nothing is gained by leaving the coated surfaces exposed to the air. If the cement has started to set before the surfaces are joined together, clean surfaces of old cement and recoat with freshly mixed cement.

CORE-TO-FACE BONDING.

When core-to-face bonds are made, the cement must be spread in a uniform layer. The glue line must be from 1/64 inch to 1/32 inch thick over the entire surface.

ROOM-TEMPERATURE CURE.

Clamp bonding surfaces together. Clamping pressure must be maintained until the cement has set enough to prevent damage to the bond from handling. The time will vary with the temperature and curing agent selected, but a minimum of 16 hours should be allowed. Contact pressure is ample to ensure a good bond. Pressure must be applied, however, *throughout* the entire repair area. When clamps are used, care must be taken to avoid crushing the core material. Where thick glue lines are used, care must be taken that air is not trapped in the glue line. Parts cured at room temperature should not be stressed for 24 hours when DTA is used, or for one week when using curing agent A or CH-1. Place strips of cellophane sheet under all clamps and blocks used for applying pressure to the repair. Adhesive that is squeezed out under pressure will not bond to this material.

The excess hardened cement may be removed from the repair by carefully lifting it with a knife and lightly sanding the surface, as necessary.

ELEVATED-TEMPERATURE CURE.

Elevated temperature curing of the bond materials increases the strength of the joint by a ratio of 3 to 1. Refer to the notes on each repair for instructions as to the type of cure required. Unless otherwise stated, the elevated temperature may be used to hasten the return of the part to service. Use curing agent A or CH-1 hardener for elevated temperature cures, as shown in the following tables:

SOURCE	TEMPERATURE	TIME (Minimum)
Circulating-air oven	160°F to 175°F	3 hours
Infrared reflector*	160°F to 175°F	3 hours
250-watt Westinghouse or equivalent	230°F to 250°F	75 minutes

*If it is difficult to bring the repair area to the desired temperature, heat absorption may be increased considerably by blacking the repair surface. A blacking material which will not burn off or bake on the aluminum is required. Black lacquer paste, thinned to a brushing consistency, meets these requirements. It is easily removed with lacquer thinner, toluol, or mineral spirits. If lacquer paste is not available, a good substitute can be made from any dry black pigment and a nondrying oil, such as mineral oil or castor oil. Mix to a paste consistency and thin with mineral spirits for brushing.

CLEANING UP.

Remove excess adhesive with wiping rags dampened with toluol. This must be done as soon as possible after the adhesive is applied so as not to let it set. Clean all tools and equipment with toluol immediately after use.

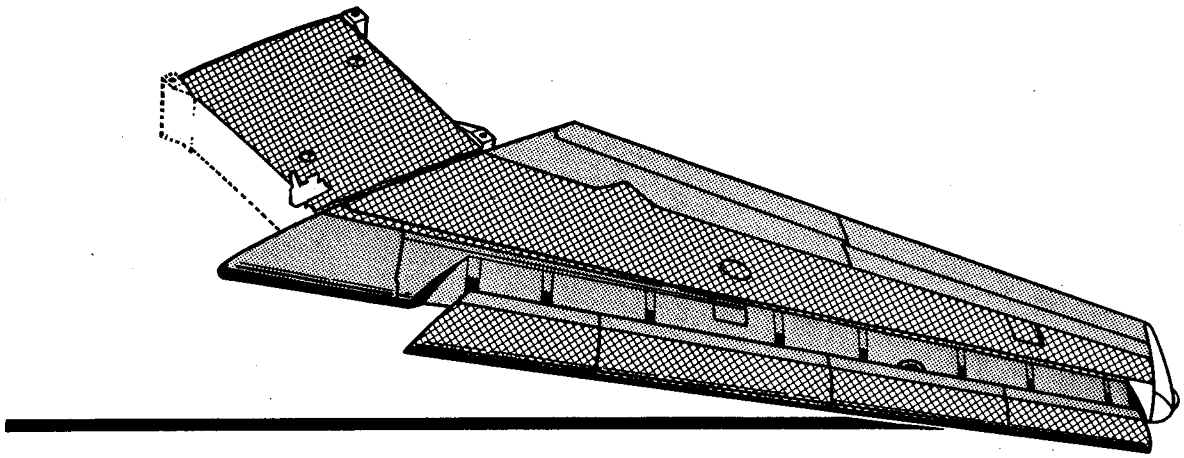
NONSTRUCTURAL REPAIRS TO HONEYCOMB SANDWICH PANELS.

Epoxy adhesive may be used as a filler to replace damaged honeycomb where the damage to a particular part is considered negligible and it is not necessary to transfer loads through the repair. Before putting the filler in the damaged area, place strips of a commercial cellophane tape across the damage, and then take a sharp knife or razor blade and trim the tape away from over the damage. This leaves the area around the damage completely masked off and eliminates any chance of the adhesive getting on to the skins surrounding the damage. Care should be used to make sure that all of the cells in the damaged area are packed with epoxy adhesive filler. If, after the repair has cured, there is any variation between the filler and the mold line, aerodynamic skin filler may be used to restore the original mold line.

WING

TYPICAL REPAIR

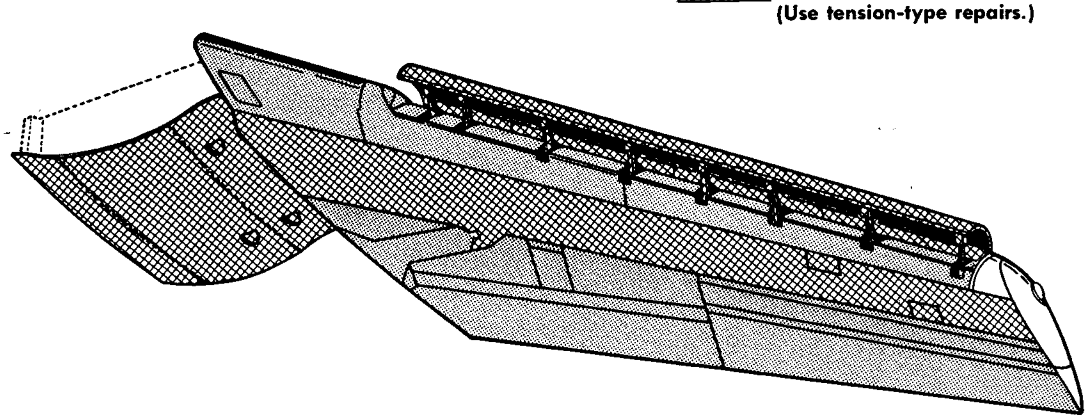
WING UPPER SURFACE



PRIMARY STRUCTURE LOADED IN SHEAR
(Use shear-type repairs.)

SECONDARY STRUCTURE
(Use secondary structure repairs.)

PRIMARY STRUCTURE LOADED IN COMBINED SHEAR AND TENSION
(Use tension-type repairs.)



WING LOWER SURFACE

F-86K-3-91-5

Figure 10-1. Typical Repair Index (Sheet 1 of 3)

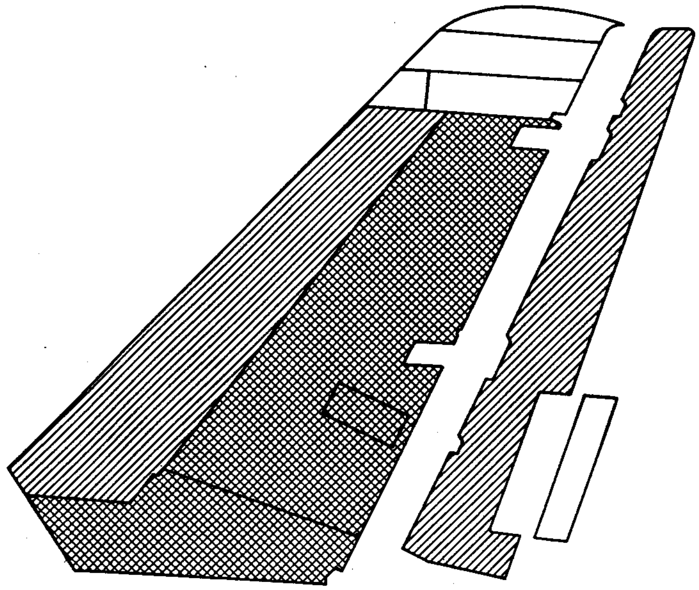
EMPENNAGE

TYPICAL REPAIR

SECONDARY STRUCTURE
(Use secondary structure repairs.)

PRIMARY STRUCTURE LOADED IN SHEAR
(Use shear-type repairs.)

PRIMARY STRUCTURE LOADED IN COMBINED SHEAR AND TENSION
(Use tension-type repairs.)



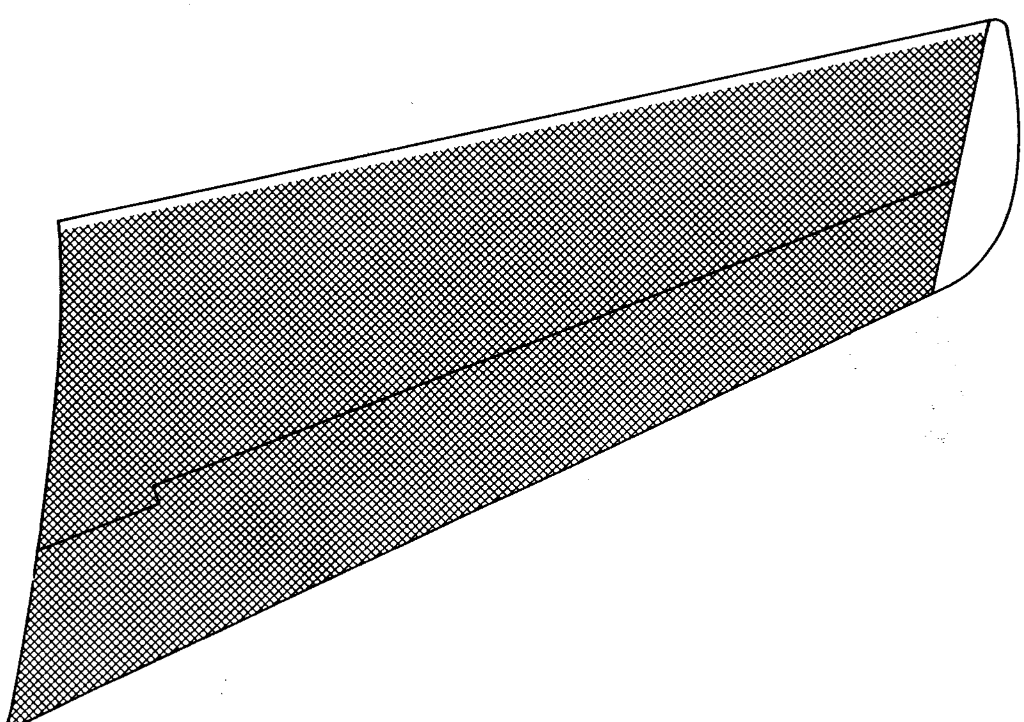


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Figure 10-1. Typical Repair Index (Sheet 2 of 3)

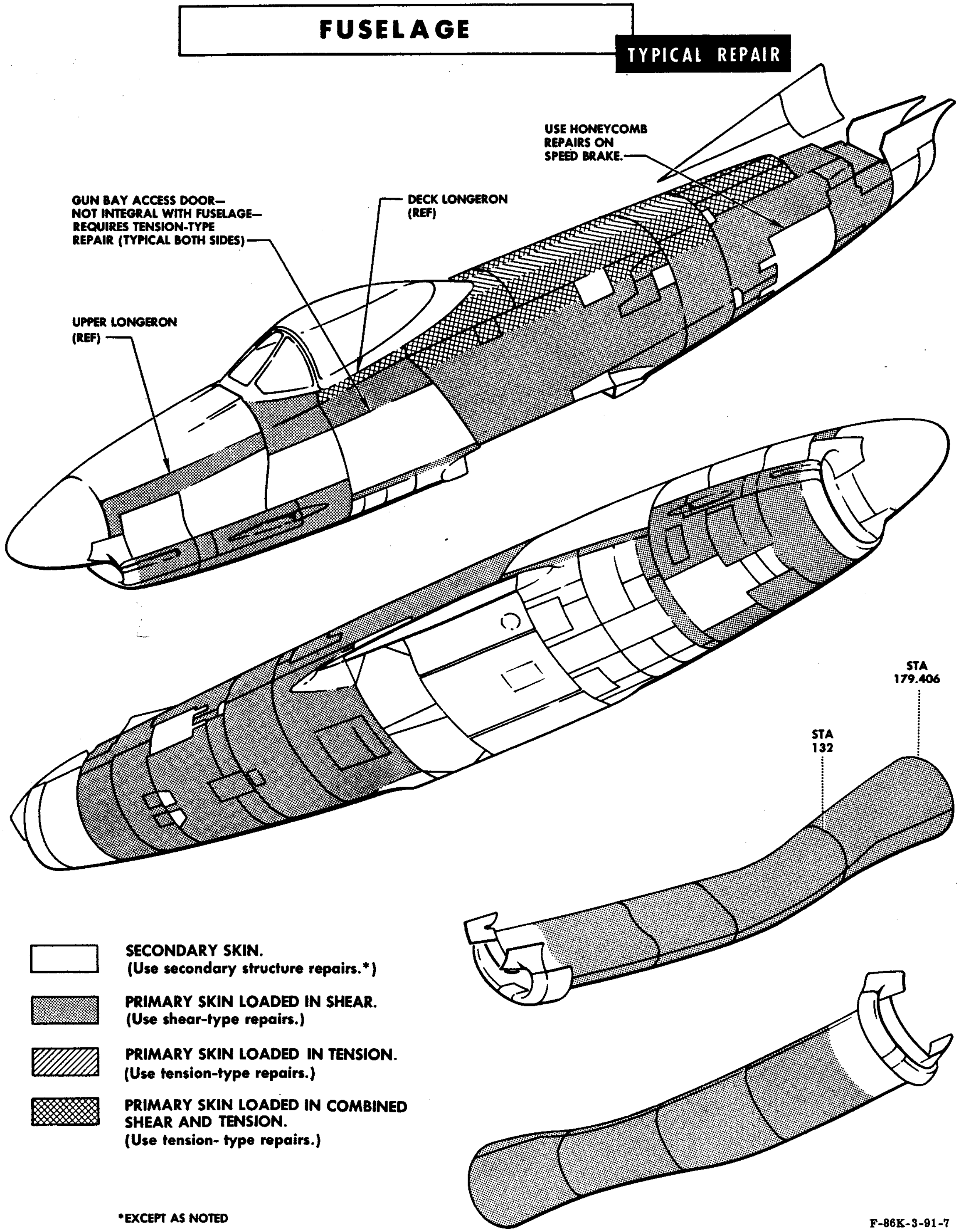
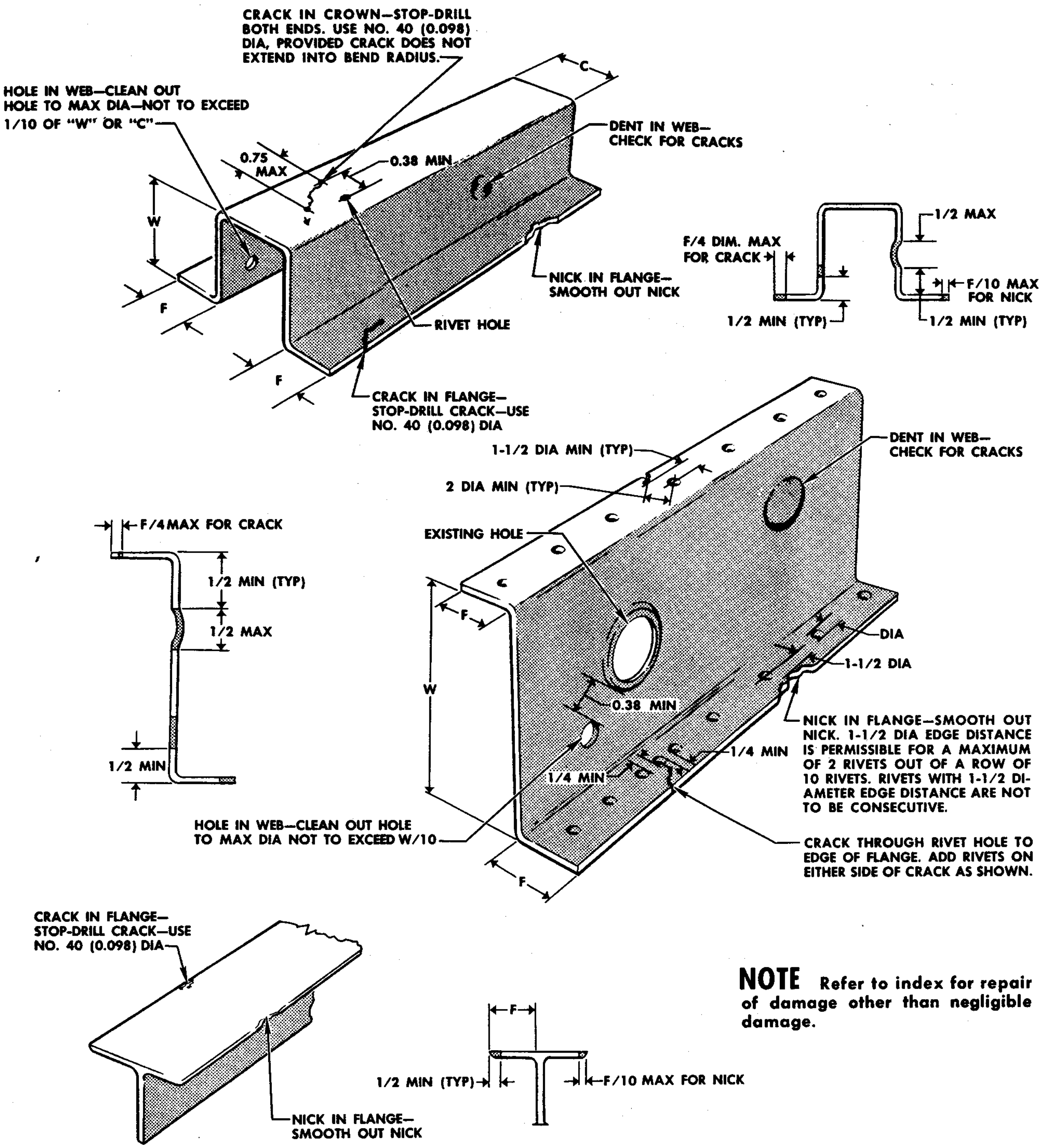


Figure 10-1. Typical Repair Index (Sheet 3 of 3)

NEGLIGIBLE DAMAGE SHAPES AND EXTRUSIONS

TYPICAL REPAIR



NOTE Refer to index for repair of damage other than negligible damage.

Figure 10-2. Negligible Damage—Sheet-metal Shapes and Extrusions

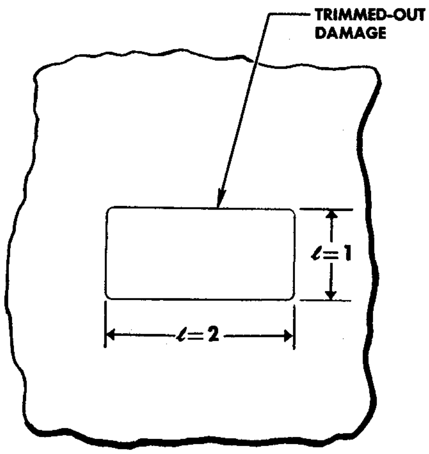
DEVELOPING A TYPICAL REPAIR.

The following items, listed in the left column as problems, are factors which must be considered when a typical repair is made. The right column contains either the solution or reference to where the solution will be found.

PROBLEMS	SOLUTIONS
1. Identify damaged material.	Refer to: Material column in the repair index keys. The "Fuselage and Duct Skin Diagram," Section IV. "Identification of Materials By Chemical Testing," Section I.
2. Identify material thickness ("t" on repair figure).	Refer to: Material "Gage" column in the repair index keys. "Fuselage and Duct Skin Diagram," Section IV (Thickness of material should be verified by physical measurement).
3. Determine whether damaged material is in a primary or secondary structure area.	Typical Repair Index.
4. Determine whether damaged material is loaded in shear or in tension.	Typical Repair Index.
5. Selecting appropriate repair.	Select a repair that satisfies conditions in problems 3 and 4.
6. Selecting appropriate fastener table.	Select table which satisfies conditions in problems 1 and 4. (Blind fasteners should not be used when other-type fasteners can be installed.)
7. Determining (from fastener tables) number of fasteners required.	The required number of fasteners for a given "l" dimension is found where the material thickness line crosses the selected rivet column, under the given "l" dimension. To compute for a dimension not shown, add requirements for smaller dimensions which *are* shown. Example: For an "l" of 7 inches, add requirements for 4-, 2-, and one-inch dimensions.
8. Determining minimum fastener edge distance ("a" dimension on repair figures).	Minimum fastener edge distance = two times fastener diameter measured from center of fastener.
9. Determining minimum and maximum fastener spacing ("b" dimension on repair figure).	Minimum fastener spacing = 4 times the fastener diameter. Maximum spacing = $1\frac{1}{2}$ inches. Spacing is measured from the centers of the fasteners.
10. Determine fastener distribution in skin and web repairs.	See figure 10-3, sheet 1, 2, and 3. (The referenced figure shows fastener distribution patterns in one-piece doubler repairs. Fastener distribution for split doublers and special situations are noted on the repair figure.)
11. Determining fastener distribution in extruded- and formed-shape repairs.	See figure 10-3, sheet 4. (A roll-formed "Z" section is used in the fastener distribution examples. These examples, however, apply to all roll-formed and extruded shapes for which repairs have been designed. Special fastener problems are noted on the repair figure.)

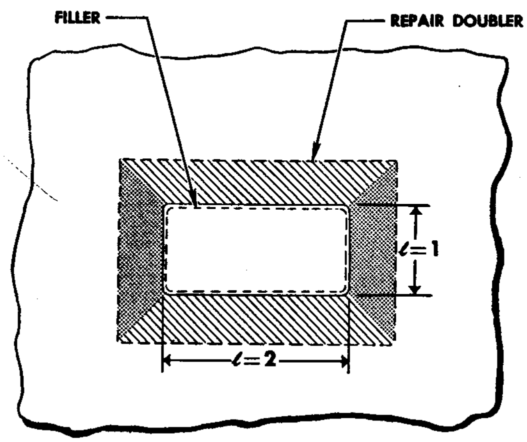
SKIN AND WEB

TYPICAL REPAIR



RECTANGULAR HOLE

A rectangular hole has two "ℓ" dimensions. If one-inch side shown requires five fasteners, use five fasteners on each side of one-inch opening. If two-inch side requires ten fasteners, use ten fasteners on each side of two-inch opening.



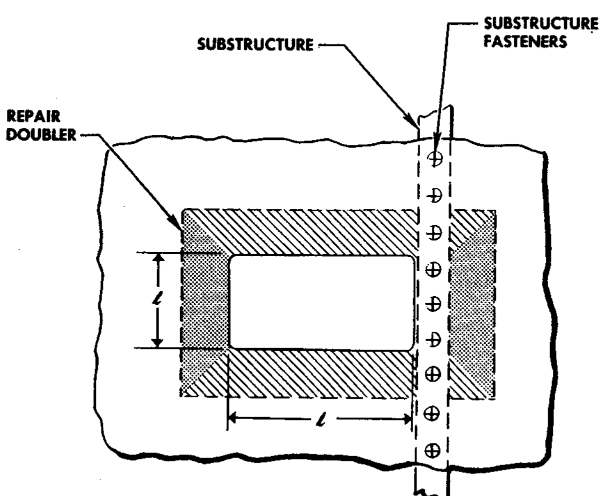
NORMAL FASTENER DISTRIBUTION

- FASTENERS FOR 1 IN. SIDES.
- FASTENERS FOR 2 IN. SIDES.

Divide area around hole as shown. Lay out fasteners in an approximately even pattern around hole. Watch minimum edge distance and minimum and maximum spacing.

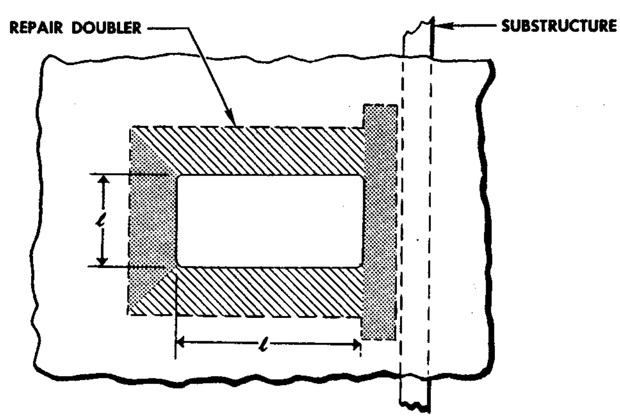
The fastener pattern will determine size of repair doubler. Fasteners in filler may be the smallest structural-type rivet available.

See alternate fastener and doubler patterns "A" and "B."



ALTERNATE DOUBLER AND FASTENER PATTERN A

This pattern is used when existing substructure fasteners are not counted in the number required for the repair.



ALTERNATE DOUBLER AND FASTENER PATTERN B

This pattern may be used when substructure or fittings restrict doubler width on one side of the repair.

RECTANGULAR REPAIR

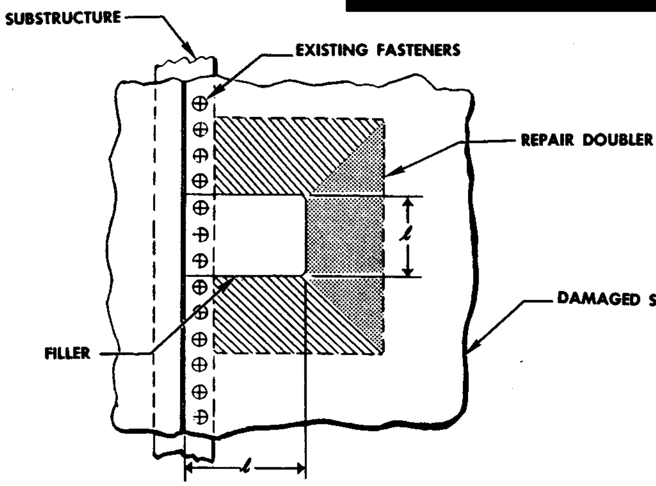
Gen-3-91-85

Figure 10-3. Fastener Distribution Patterns (Sheet 1 of 4)

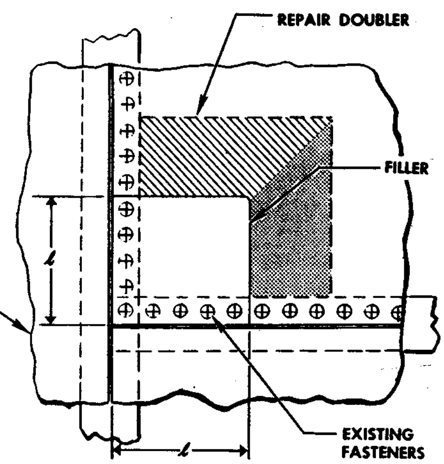
SKIN AND WEB

TYPICAL REPAIR

VARIATIONS OF THE RECTANGULAR REPAIR



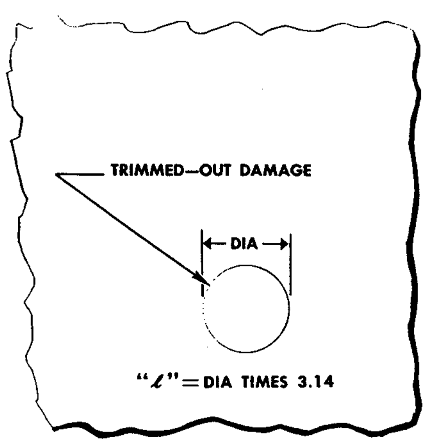
SKIN END REPAIR



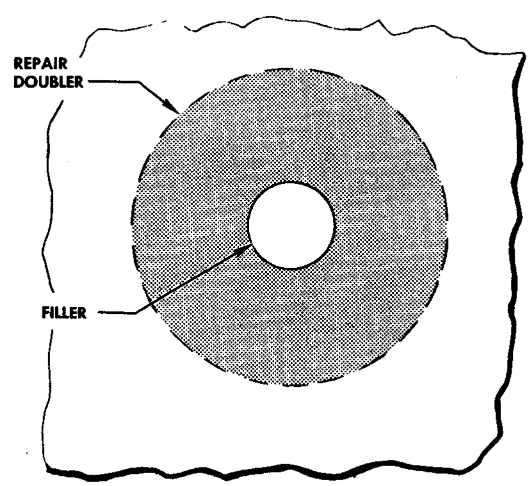
SKIN END REPAIR—CORNER

Repairs to skin end are treated the same as rectangular repairs shown on sheet No. 1, except that skin attaching fasteners through the substructure are not counted in the fasteners required for the repair.

CIRCULAR REPAIR



A circular cutout has one "ℓ" dimension, which is the circumference of the hole. To find "ℓ," multiply the diameter by pi. (3.14)



Distribute fasteners required evenly around hole in shaded area (repair doubler).

Watch minimum edge distance and spacing. Fasteners in filler may be the smallest structural-type rivet available.

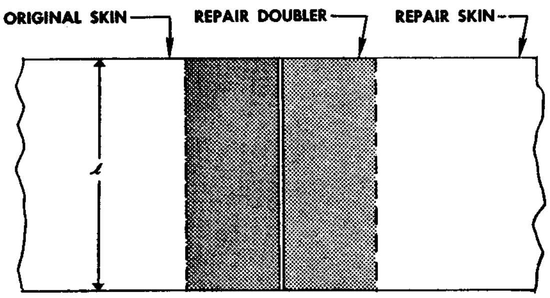
Gen-3-91-86

Figure 10-3. Fastener Distribution Patterns (Sheet 2 of 4)

SKIN AND WEB

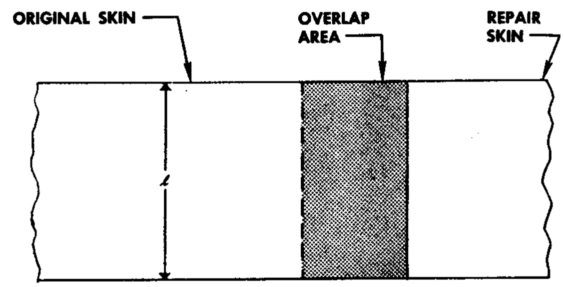
TYPICAL REPAIR

SPLICES



FLUSH SPLICE

Distribute the number of fasteners required for "ℓ" evenly on each side of the splice. (If "ℓ" requires 24 fasteners, use 24 fasteners on each side of the splice.)

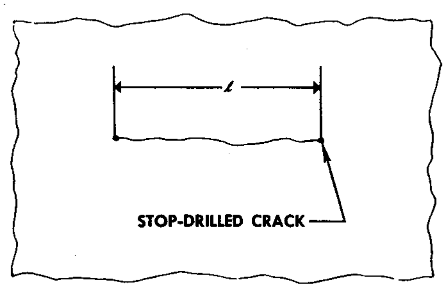


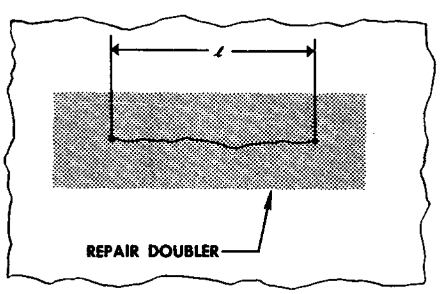
OVERLAP SKIN AND WEB SPLICE

Required fasteners for "ℓ" are distributed evenly in the overlap area.

CRACKS

GENERALLY STRAIGHT CRACK

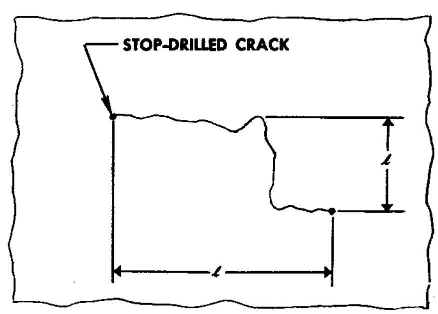


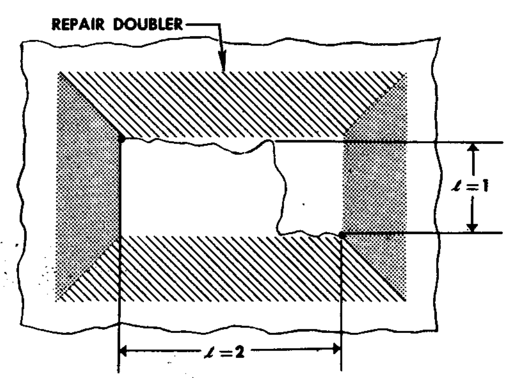


A crack which runs in a generally straight line can be considered to have one "ℓ" dimension.

If six rivets are required for "ℓ," distribute six rivets evenly through the doubler on each side of the crack.

IRREGULAR CRACK





A crack which deviates from a generally straight line should be treated as a rectangle with two "ℓ" dimensions.

Distribute rivets as shown and described for a rectangular repair.

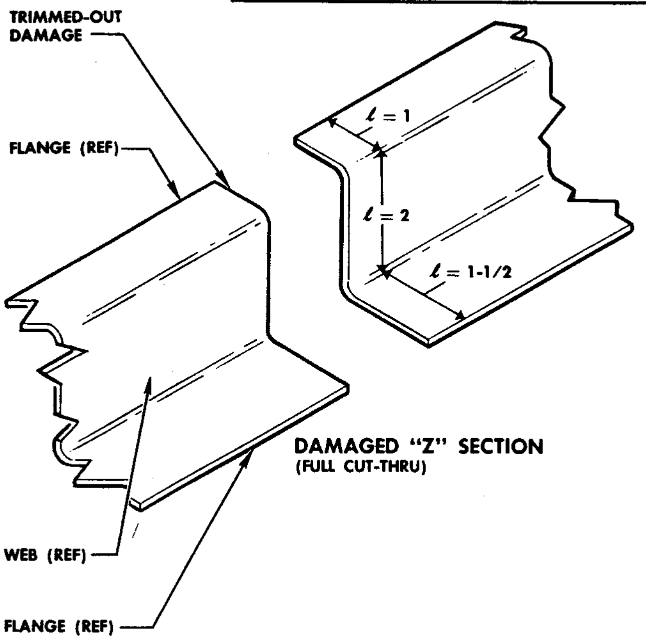
Use smallest structural-type rivets available to hold down irregular edges.

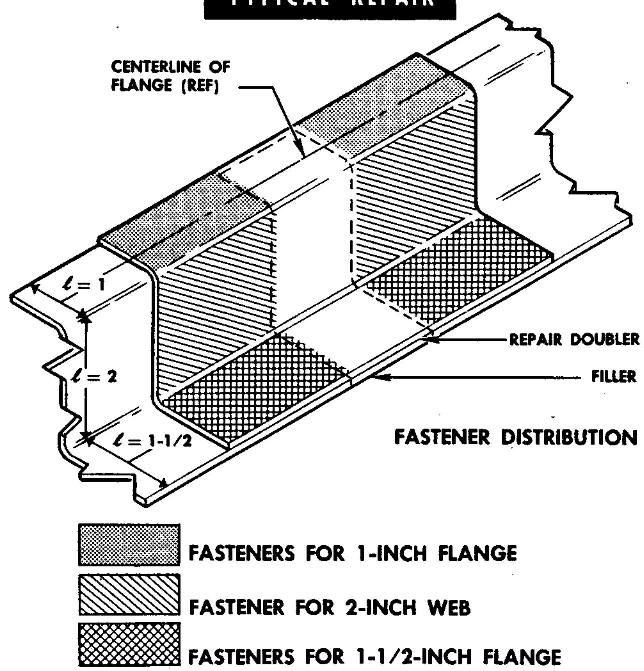
Gen-3-91-87

Figure 10-3. Fastener Distribution Patterns (Sheet 3 of 4)

EXTRUDED AND FORMED SHAPES

TYPICAL REPAIR





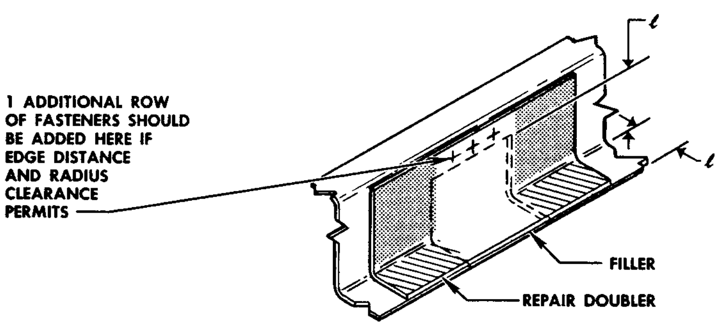
Each "ℓ" dimension shown is considered separately. If four fasteners are required for the one-inch flange, use four fasteners on each side of the one-inch opening. Repeat the calculations for the 2-inch web and the 1-1/2-inch flange. Distribute the fasteners as shown.

The fastener pattern should be similar on each side of the break.

When a flange has one row of fasteners, that row should be approximately on the centerline of the flange.

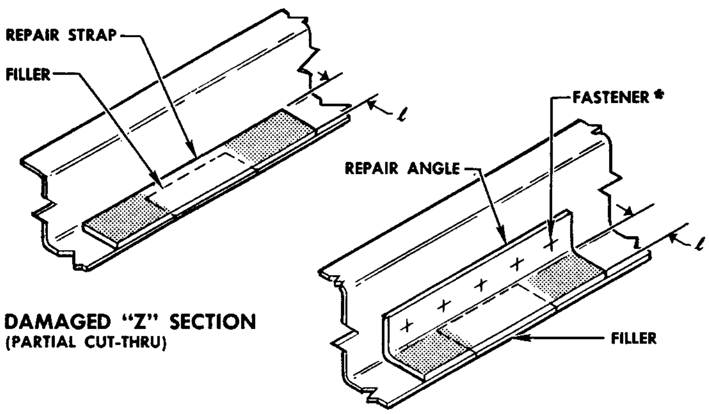
Observe minimum edge distance and minimum and maximum spacing.

Fasteners in the filler may be the smallest structural-type rivet available unless the filler is attached to a skin or web. In this case, fasteners should match those used in the repair.



NOTE

The examples of fastener distribution shown apply to all other shapes for which typical repairs have been designed. Special fastener problems are noted on the repair figure.



* When an angle is used in repairing a partial flange damage, the fasteners attaching the repair angle to the undamaged portion of the shape are the same as those used in the remainder of the repair. The number required is determined by the length of the repair angle. Fastener spacing may be a maximum of 1-1/2 inches.

Gen-3-91-88

Figure 10-3. Fastener Distribution Patterns (Sheet 4 of 4)

FASTENER TABLES

TYPICAL REPAIR

TABLE NO. 1

COUNTERSUNK			$\ell=$	FASTENERS REQUIRED																															
				1/2 INCH								1 INCH								2 INCHES								4 INCHES							
MATL	t	DOUBLER MATL	t_1*	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10
2024-T4	0.032	2024-T4	0.040	5								10								21								41							
	0.040		0.050	6	4							12	8							24	15							47	29						
	0.050		0.063	7	5	3			3			14	9	6			5			28	17	12			9			56	34	24			18		
	0.063		0.071	9	6	4	3		3	2		18	11	8	5		5	4		35	21	15	9		9	8		70	42	29	17		18	15	
	0.071		0.080		6	4	3		3	2	2		12	8	5		5	4	4		23	16	9		9	7	7		46	32	18		18	14	13
	0.080		0.090		7	5	3		3	2	2		13	9	5		5	4	3		25	17	10		9	7	6		50	35	20		18	14	12
	0.090		0.100			5	3	2	3	2	2			10	6	4	5	4	3			19	11	7	9	7	6			38	21	14	18	14	11
	0.100		0.125			5	3	2	3	2	2			11	6	4	5	4	3			21	12	8	9	7	6			41	23	15	17	14	11
	0.125		0.160				4	2	2	2	2				7	4	4	4	3				13	8	8	7	6				26	16	16	14	11
2024-T4	0.160	2024-T4	0.180				4	3	3	2					8	5	5	3	3				16	10	9	7	6				32	19	18	13	11

TABLE NO. 2

DIMPLED			$\ell=$	FASTENERS REQUIRED																															
				1/2 INCH					†			1 INCH					†			2 INCHES					†			4 INCHES					†		
MATL	t	DOUBLER MATL	t_1*	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10
2024-T4	0.020	2024-T4	0.025	3	2							6	4							11	8							22	15						
	0.025		0.032	3	2	2						6	4	3						12	8	6						24	16	12					
	0.032		0.040	4	3	2	2					7	5	4	3					14	9	7	5					28	18	13	10				
	0.040		0.050	5	3	2	2	2				9	5	4	3	3				17	10	7	5	6				33	20	15	10	11			
	0.050		0.063		3	2	2	2	2				6	5	3	3	3				12	9	6	5	6				24	17	11	9	11		
	0.063		0.071			3		2	2	2				6		3	3	3				11		5	6	5				21		9	11	9	
	0.071		0.080					2		1	1					3		3	2					5		5	4					9		9	8
	0.080		0.090					2		1	1					3		2	2					5		4	4					10		8	7
2024-T4	0.090	2024-T4	0.100					2								3								5								10			

NOTE Refer to "Developing a Typical Repair" before using this table.

*The doubler thickness (t_1) applies to the skin and web repairs only. Obtain doubler thickness for shapes from typical repair.

† Dimple t and subcountersink t_1.

GEN-3-91-15A

Figure 10-4. Fastener Tables—Conventional and Hi-Shear, Flush, 2024-T4, Tension

FASTENER TABLES

TYPICAL REPAIR

TABLE NO. 1

COUNTERSUNK			$\angle =$	FASTENERS REQUIRED																															
				1/2 INCH								1 INCH								2 INCHES								4 INCHES							
MATL	t	DOUBLER MATL	t_1*	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10
2024-T4	0.032	2024-T4	0.040	4								7								13								25							
↑	0.040	↑	0.050	4	3							7	5							15	9							29	18						
	0.050		0.063	5	3	2			2			9	6	4			3			17	11	8			6			34	21	15			11		
	0.063		0.071	6	4	3	2		2	2		11	7	5	3		3	3		22	13	9	6		6	5		43	26	18	11		11	9	
	0.071		0.080		4	3	2		2	2	1		7	5	3		3	3	2		14	10	6		6	5	4		28	20	11		11	9	8
	0.080		0.090		4	3	2		2	2	1		8	6	3		3	3	2		15	11	6		6	5	4		30	21	12		11	9	7
	0.090		0.100			3	2	2	2	1	1			6	4	3	3	2	2			12	7	5	6	4	4			23	13	9	11	8	7
	0.100		0.125			4	2	2	2	2	1			7	4	3	3	3	2			13	7	5	5	5	4			25	14	9	10	9	7
↓	0.125	↓	0.160				2	2	2	1	1				4	3	3	2	2				8	5	5	4	4				16	10	10	8	7
2024-T4	0.160	2024-T4	0.190				3	2	2	1	1				5	3	3	2	2				10	6	6	4	4				19	12	11	8	7

TABLE NO. 2

DIMPLED			$\angle =$	FASTENERS REQUIRED																															
				1/2 INCH					†			1 INCH					†			2 INCHES					†			4 INCHES					†		
MATL	t	DOUBLER MATL	t_1*	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10
2024-T4	0.020	2024-T4	0.025	2	2							4	3							7	5							13	10						
↑	0.025	↑	0.032	2	2	1						4	3	2						8	5	4						15	10	8					
	0.032		0.040	3	2	1	1					5	3	2	2					9	6	4	3					17	11	8	6				
	0.040		0.050	3	2	2	1	1				5	3	3	2	2				10	6	5	3	4				20	12	9	6	7			
	0.050		0.063		2	2	1	1	1				4	3	2	2	2				8	5	4	3	4				15	10	7	6	7		
	0.063		0.071			2		1	1	1				4		2	2	2				7		3	4	3				13		6	7	6	
	0.071		0.080					1		1	1					2		2	2					3		3	3					6		6	5
↓	0.080	↓	0.090					1		1	1					2		2	2					3		3	3					6		5	5
2024-T4	0.090	2024-T4	0.100					1								2								4								7			

NOTE Refer to "Developing a Typical Repair" before using this table.

*The doubler thickness (t_1) applies to the skin and web repairs only. Obtain doubler thickness for shapes from typical repair.

† Dimple t and subcountersink t_1.

GEN-3-91-16A

Figure 10-5. Fastener Tables—Conventional and Hi-Shear, Flush, 2024-T4, Shear

FASTENER TABLES

TYPICAL REPAIR

TABLE NO. 1

COUNTERSUNK			$\ell=$	FASTENERS REQUIRED 1/2 INCH								1 INCH								2 INCHES								4 INCHES							
MATL	t	DOUBLER MATL	t_1*	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10
7075-T6	0.032	7075-T6	0.040	7								14								27								53							
	0.040		0.050	8	5							16	10							31	20							62	39						
	0.050		0.063	10	6	4			3			19	12	8			5			37	23	16			10			74	45	32			19		
	0.063		0.071	11	7	5	3		3	2		22	13	9	6		5	4		44	27	19	11		10	8		88	53	37	22		19	15	
	0.071		0.080		8	5	3		3	2	2		15	10	6		5	4	3		29	20	12		9	8	7		58	40	23		18	15	13
	0.080		0.090		8	6	3		3	2	2		16	11	6		5	4	3		31	22	13		9	7	6		62	43	25		17	14	12
	0.090		0.100			6	4	3	2	2	2			12	7	5	4	4	3			24	13	9	9	7	6			47	26	17	17	14	12
	0.100		0.125			7	4	3	2	2	2			13	7	5	4	4	3			26	15	9	8	7	6			51	29	18	15	14	12
	0.125		0.160				5	3	3	2	2				9	5	5	3	3				17	10	9	6	6				33	20	18	12	11
7075-T6	0.160	7075-T6	0.190				5	3	3	2	2				10	6	6	4	3				20	12	11	7	5				40	23	22	13	10

TABLE NO. 2

DIMPLED			$\ell=$	FASTENERS REQUIRED 1/2 INCH					†			1 INCH					†			2 INCHES					†			4 INCHES					†		
MATL	t	DOUBLER MATL	t_1*	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10
7075-T6	0.020	7075-T6	0.025	4	3							7	5							14	10							28	20						
	0.025		0.032	4	3	2						8	5	4						16	11	8						32	21	16					
	0.032		0.040	5	3	2	2					10	6	4	3					19	12	8	6					37	23	16	12				
	0.040		0.050	6	4	3	2	2				11	7	5	3	3				22	14	9	6	5				44	27	17	12	10			
	0.050		0.063	7	4	3	2	2	2			14	8	5	4	3	4			27	16	10	7	5	7			53	32	20	14	9	13		
	0.063		0.071			3		2	2	2				6		3	3	3				12		5	6	5				23		10	12	10	
	0.071		0.080					2		2	1					3		3	2					5		5	4					10		10	9
7075-T6	0.080	7075-T6	0.090					2		2	1					3		3	2					6		5	4					11		10	8

NOTE Refer to "Developing a Typical Repair" before using this table.

*The doubler thickness (t_1) applies to the skin and web repairs only. Obtain doubler thickness for shapes from typical repair.

† Dimple t and subcountersink t_1.

GEN-3-91-17A

Figure 10-6. Fastener Tables—Conventional and Hi-Shear, Flush, 7075-T6, Tension

FASTENER TABLES

TYPICAL REPAIR

TABLE NO. 1

COUNTERSUNK			ℓ= ⬍	FASTENERS REQUIRED 1/2 INCH								1 INCH								2 INCHES								4 INCHES							
MATL	t	DOUBLER MATL	t_1*	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10
7075-T6	0.032	7075-T6	0.040	4								8								16								32							
↑	0.040	↑	0.050	5	3							10	6							19	12							37	23						
	0.050		0.063	6	4	3			2			11	7	5			3			22	14	10			6			44	27	19			12		
	0.063		0.071	7	4	3	2		2	2		13	8	6	4		3	3		27	16	11	7		6	5		53	31	22	13		11	9	
	0.071		0.080		5	3	2		2	2	1		9	6	4		3	3	2		17	12	7		6	5	4		34	24	14		11	9	8
	0.080		0.090		5	4	2		2	2	1		10	7	4		3	3	2		19	13	8		6	5	4		37	26	15		11	9	7
	0.090		0.100			4	2	2	2	2	1			7	4	3	3	3	2			14	8	6	5	5	4			28	16	11	10	9	7
	0.100		0.125			4	3	2	2	1	1			8	5	3	3	2	2			15	9	6	5	4	4			31	17	11	9	8	7
↓	0.125	↓	0.160				3	2	2	1	1				5	3	3	2	2				10	6	6	4	4				20	12	11	7	7
7075-T6	0.160	7075-T6	0.190				3	2	2	1	1				6	4	4	2	2				12	7	7	4	3				24	14	13	8	6

TABLE NO. 2

DIMPLED			ℓ= ⬍	FASTENERS REQUIRED 1/2 INCH					†			1 INCH					†			2 INCHES					†			4 INCHES					†		
MATL	t	DOUBLER MATL	t_1*	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10	AD3	AD4	AD5	DD6	DD8	NAS177-6	NAS177-8	NAS177-10
7075-T6	0.020	7075-T6	0.025	3	2							5	3							9	6							17	12						
↑	0.025	↑	0.032	3	2	2						5	4	3						10	7	5						19	13	10					
	0.032		0.040	3	2	2	1					6	4	3	2					11	7	5	4					22	14	10	8				
	0.040		0.050	4	2	2	1	1				7	4	3	2	2				13	8	6	4	3				26	16	11	8	6			
	0.050		0.063	4	3	2	1	1	1			8	5	3	2	2	2			16	10	6	4	3	4			32	19	12	8	6	8		
	0.063		0.071			2		1	1	1				4		2	2	2				7		3	4	3				14		6	7	6	
↓	0.071	↓	0.080					1		1	1					2		2	2					3		3	3					6		6	5
7075-T6	0.160	7075-T6	0.090					1		1	1					2		2	2					4		3	3					7		6	5

NOTE Refer to "Developing a Typical Repair" before using this table.

*The doubler thickness (t_1) applies to the skin and web repairs only. Obtain doubler thickness for shapes from typical repair.

† Dimple t and subcountersink t_1.

GEN-3-91-18A

Figure 10-7. Fastener Tables—Conventional and Hi-Shear, Flush, 7075-T6, Shear

FASTENER TABLES

TYPICAL REPAIR

TABLE NO. 1

SINGLE SHEAR			ℓ =	FASTENERS REQUIRED 1/2 INCH					1 INCH					2 INCHES					4 INCHES				
MATL	t	DOUBLER MATL	t_1*	AD3	AD4	AD5	DD6	DD8	AD3	AD4	AD5	DD6	DD8	AD3	AD4	AD5	DD6	DD8	AD3	AD4	AD5	DD6	DD8
2024-T4	0.020	2024-T4	0.025	4					7					14					27				
	0.025		0.032	4	3				7	5				14	10				27	20			
	0.032		0.040	5	3	2			9	5	4			17	10	8			33	20	16		
	0.040		0.050	6	3	2	2		11	6	4	4		21	12	8	7		42	24	16	14	
	0.050		0.063	7	4	3	2	2	14	8	5	4	3	27	15	10	7	5	53	30	20	14	10
	0.063		0.071		5	4	2	2		10	7	4	3		20	13	7	6		39	26	14	10
	0.071		0.080		6	4	2	2		11	8	4	3		22	15	8	6		44	29	15	10
	0.080		0.090			5	3	2			9	5	3			16	9	6			32	17	10
	0.090		0.100				3	2				5	3				10	6				19	11
2024-T4	0.100	2024-T4	0.125					2					3					6					12
DOUBLE SHEAR																							
2024-T4	0.032	2024-T4	0.025	4					7					14					27				
	0.040		0.032	4	3				7	5				14	10				27	20			
	0.050		0.040	4	3	2			7	5	4			14	10	8			28	20	16		
	0.063		0.050	5	3	3			9	6	5			18	11	9			35	21	17		
	0.071		0.063		3	3	2			6	5	4			12	9	7			23	17	14	
	0.080		0.071		4	3	2			7	5	4			13	9	7			25	17	14	
	0.090		0.080			3	2	2			5	4	3			10	7	6			19	14	10
	0.100		0.090			3	2	2			6	4	3			11	7	6			21	14	10
	0.125		0.100				2	2				4	3				7	6				14	10
2024-T4	0.160	2024-T4	0.125				2	2				4	3				8	6				16	10

TABLE NO. 2

SINGLE SHEAR			ℓ =	FASTENERS REQUIRED 1/2 INCH					1 INCH					2 INCHES					4 INCHES				
MATL	t	DOUBLER MATL	t_1*	AD3	AD4	AD5	DD6	DD8	AD3	AD4	AD5	DD6	DD8	AD3	AD4	AD5	DD6	DD8	AD3	AD4	AD5	DD6	DD8
7075-T6	0.020	7075-T6	0.025	4					8					15					29				
	0.025		0.032	5	3				9	6				18	11				35	21			
	0.032		0.040	6	4	3			11	7	5			22	13	9			43	25	17		
	0.040		0.050	7	4	3	2		14	8	6	3		28	16	11	6		55	31	21	11	
	0.050		0.063	9	5	4	2	2	18	10	7	4	3	35	20	13	7	5	70	39	26	14	9
	0.063		0.071		7	4	2	2		13	8	4	3		25	16	8	5		49	32	16	10
	0.071		0.080		7	5	3	2		14	9	5	3		28	18	9	6		55	36	19	11
	0.080		0.090			6	3	2			10	6	3			21	11	6			41	21	12
	0.090		0.100					2					4					7					13
7075-T6	0.100	7075-T6	0.125					2					4					8					15
DOUBLE SHEAR																							
7075-T6	0.025	7075-T6	0.020	3	2				6	4				12	8				24	16			
	0.032		0.025	4	3	2			7	5	4			14	9	7			27	18	13		
	0.040		0.032	4	3	2			8	5	4			16	10	8			31	20	15		
	0.050		0.040	5	3	2	2		10	6	4	3		19	12	8	6		37	23	16	11	
	0.063		0.050	6	4	3	2		11	7	5	3		22	14	9	6		44	27	18	11	
	0.071		0.063		4	3	2	2		8	5	3	3		15	10	6	5		29	20	11	9
	0.080		0.071		4	3	2	2		8	6	3	3		16	11	6	5		31	22	12	9
	0.090		0.080		5	3	2	2		9	6	4	3		18	12	7	5		35	24	13	9
	0.100		0.090			4	2	2			7	4	3			13	7	5			26	14	9
	0.125		0.100			4	2	2			8	4	3			16	8	5			31	16	10
7075-T6	0.160	7075-T6	0.125					2					3					6					11

NOTE Refer to "Developing a Typical Repair" before using this table.

*The doubler thickness (t_1) applies to the skin and web repairs only. Obtain doubler thickness for shapes from typical repair.

GEN-3-91-19A

Figure 10-8. Fastener Tables—Conventional, Protruding-head, 2024-T4 and 7075-T6, Tension

FASTENER TABLES

TYPICAL REPAIR

TABLE NO. 1				FASTENERS REQUIRED																			
SINGLE SHEAR			ℓ= ▶	1/2 INCH					1 INCH					2 INCHES					4 INCHES				
MATL	t	DOUBLER MATL	t_1*	AD3	AD4	AD5	DD6	DD8	AD3	AD4	AD5	DD6	DD8	AD3	AD4	AD5	DD6	DD8	AD3	AD4	AD5	DD6	DD8
2024-T4	0.020	2024-T4	0.025	2					4					8					16				
	0.025		0.032	3	2				5	3				9	6				17	12			
	0.032		0.040	3	2	2			5	3	3			10	6	5			20	12	10		
	0.040		0.050	4	2	2	2		7	4	3	3		13	7	5	5		26	14	10	8	
	0.050		0.063	4	3	2	2	1	8	5	3	3	2	16	9	6	5	3	32	18	12	8	6
	0.063		0.071		3	2	2	1		6	4	3	2		12	8	5	4		24	16	9	7
	0.071		0.080		4	3	2	1		7	5	3	2		14	9	5	4		27	18	9	7
	0.080		0.090			3	2	1			5	3	2			10	5	4			20	10	7
	0.090		0.100				2	1				3	2				6	4				12	7
2024-T4	0.100	2024-T4	0.125					1					2					4					7
DOUBLE SHEAR																							
2024-T4	0.032	2024-T4	0.025	2					4					8					16				
	0.040		0.032	2	2				4	3				8	6				16	12			
	0.050		0.040	3	2	2			5	3	3			9	6	5			17	12	10		
	0.063		0.050	3	2	2			6	4	3			11	7	5			22	13	10		
	0.071		0.063		2	2	2			4	3	3			7	5	5			14	10	9	
	0.080		0.071		2	2	2			4	3	3			8	6	5			15	11	9	
	0.090		0.080			2	2	1			3	3	2			6	5	4			12	9	7
	0.100		0.090			2	2	1			4	3	2			7	5	4			13	9	7
	0.125		0.100				2	1				3	2				5	4				9	7
2024-T4	0.160	2024-T4	0.125				2	1				3	2				5	4				10	7

TABLE NO. 2				FASTENERS REQUIRED																			
SINGLE SHEAR			ℓ= ▶	1/2 INCH					1 INCH					2 INCHES					4 INCHES				
MATL	t	DOUBLER MATL	t_1*	AD3	AD4	AD5	DD6	DD8	AD3	AD4	AD5	DD6	DD8	AD3	AD4	AD5	DD6	DD8	AD3	AD4	AD5	DD6	DD8
7075-T6	0.020	7075-T6	0.025	3					5					9					18				
	0.025		0.032	3	2				6	4				11	7				21	13			
	0.032		0.040	4	2	2			7	4	3			13	8	6			26	15	11		
	0.040		0.050	5	3	2	1		9	5	4	2		17	10	7	4		33	19	13	7	
	0.050		0.063	6	3	2	1	1	11	6	4	2	2	21	12	8	4	3	42	24	16	8	5
	0.063		0.071		4	3	2	1		8	5	3	2		15	10	5	3		29	19	10	6
	0.071		0.080		5	3	2	1		9	6	3	2		17	11	6	4		33	22	11	7
	0.080		0.090			3	2	1			6	4	2			12	7	4			24	13	7
	0.090		0.100					1					2					4					8
7075-T6	0.100	7075-T6	0.125					2					3					5					9
DOUBLE SHEAR																							
7075-T6	0.025	7075-T6	0.020	2	2				4	3				8	5				15	10			
	0.032		0.025	2	2	1			4	3	2			8	6	4			16	11	8		
	0.040		0.032	3	2	2			5	3	3			10	6	5			18	12	9		
	0.050		0.040	3	2	2	1		6	4	3	2		11	7	5	4		22	14	10	7	
	0.063		0.050	4	2	2	1		7	4	3	2		13	8	6	4		26	16	11	7	
	0.071		0.063		3	2	1	1		5	3	2	2		9	6	4	3		17	12	7	5
	0.080		0.071		3	2	1	1		5	4	2	2		10	7	4	3		19	13	7	5
	0.090		0.080		3	2	1	1		6	4	2	2		11	7	4	3		21	14	8	5
	0.100		0.090			2	1	1			4	2	2			8	4	3			15	8	5
	0.125		0.100			3	2	1			5	3	2			10	5	3			19	10	6
7075-T6	0.160	7075-T6	0.125					1					2					4					7

NOTE Refer to "Developing a Typical Repair" before using this table.

*The doubler thickness (t_1) applies to the skin and web repairs only. Obtain doubler thickness for shapes from typical repair.

GEN-3-91-20A

Figure 10-9. Fastener Tables—Conventional, Protruding-head, 2024-T4 and 7075-T6, Shear

FASTENER TABLES

TYPICAL REPAIR

TABLE NO. 1		FASTENERS REQUIRED																			
SINGLE SHEAR	ℓ= ▶	1/2 INCH					1 INCH					2 INCHES					4 INCHES				
MATL	t	AD3	AD4	AD5	DD6	DD8	AD3	AD4	AD5	DD6	DD8	AD3	AD4	AD5	DD6	DD8	AD3	AD4	AD5	DD6	DD8
2024-T4	0.040	6	4	3	2		11	7	5	3		23	13	9	6		45	25	17	12	
	0.051	7	4	3	2	2	15	8	6	3	3	29	16	11	6	5	57	32	21	12	9
	0.062	9	5	4	2	2	18	10	7	4	3	35	20	13	7	5	69	39	25	13	9
	0.064		5	4	2	2		10	7	4	3		20	13	7	5		40	26	14	9
	0.078			4		2			8		3			16		5			32		9
	0.094					2					3					6					11
	0.100					2					3					6					12
2024-T4	0.125					2					4					8					15
DOUBLE SHEAR																					
2024-T4	0.040	4	3	2			7	5	4			13	9	7			25	17	14		
	0.051	4	3	2			8	5	4			15	10	7			30	19	14		
	0.062	5	3	2	2		9	6	4	3		18	11	8	6		35	21	15	12	
	0.064	5	3	2	2		9	6	4	3		18	11	8	6		36	22	15	12	
	0.078	6	4	3	2	2	11	7	5	3	3	22	13	9	6	5	44	25	17	12	9
	0.094		4	3	2	2		8	5	3	3		15	10	6	5		30	20	12	9
	0.100		4	3	2	2		8	6	3	3		16	11	6	5		31	21	12	9
	0.125		5	4	2	2		10	7	4	3		20	13	7	5		39	26	13	9
2024-T4	0.156			4	2	2			8	4	3			16	8	5			32	16	9

TABLE NO. 2		FASTENERS REQUIRED																			
SINGLE SHEAR	ℓ= ▶	1/2 INCH					1 INCH					2 INCHES					4 INCHES				
MATL	t	AD3	AD4	AD5	DD6	DD8	AD3	AD4	AD5	DD6	DD8	AD3	AD4	AD5	DD6	DD8	AD3	AD4	AD5	DD6	DD8
7075-T6	0.040		5	3	2			9	6	4			17	12	7			34	23	13	
	0.051		6	4	2	2		11	7	4	3		22	14	8	5		43	28	15	10
	0.062		7	5	3	2		13	9	5	3		26	17	9	5		52	34	17	10
	0.064		7	5	3	2		14	9	5	3		27	18	9	5		53	35	18	10
	0.078			6	3	2			11	6	3			21	11	6			42	22	12
	0.094					2					4					8					15
7075-T6	0.100					2					4					8					16
DOUBLE SHEAR																					
7075-T6	0.040	5	3	2	2		9	6	4	4		17	11	8	7		33	21	16	13	
	0.051	5	4	3	2	2	10	7	5	4	3	20	13	9	7	5	40	25	18	13	10
	0.062	6	4	3	2	2	12	7	5	4	3	23	14	10	7	5	46	28	20	13	10
	0.064	6	4	3	2	2	12	8	5	4	3	24	15	10	7	5	48	29	20	13	10
	0.078		5	3	2	2		9	6	4	3		17	12	7	5		33	23	13	10
	0.094		5	4	2	2		10	7	4	3		20	13	7	5		39	26	14	10
	0.100		6	4	2	2		11	7	4	3		21	14	8	5		42	28	15	10
	0.125			5	3	2			9	5	3			17	9	6			34	17	11
	0.156			6	3	2			11	6	3			21	11	6			42	22	12
7075-T6	0.188					2					4					8					15

NOTE Refer to "Developing a Typical Repair" before using this table.

GEN-3-91-21A

Figure 10-10. Fastener Tables—Conventional, Protruding-head, Extrusions, Tension

FASTENER TABLES

TYPICAL REPAIR

TABLE NO. 1

SINGLE SHEAR—BRAZIER HEAD

1/2 HARD CRES			$\ell =$ ▶	1/2 IN.			1 IN.			2 IN.			4 IN.		
MATL	t	DOUBLER MATL	t_1*	AT4	AT5	AT6	AT4	AT5	AT6	AT4	AT5	AT6	AT4	AT5	AT6
CRES	0.010	CRES	0.016	4	3	3	7	6	5	14	11	9	27	22	18
↑	0.016	↑	0.020	4	3	3	7	6	5	14	11	9	27	22	18
	0.020		0.025	4	3	3	7	6	5	14	11	9	27	22	18
	0.025		0.032	4	3	3	7	6	5	14	11	9	27	22	18
	0.032		0.036	4	3	3	8	6	5	16	11	9	31	22	18
	0.036		0.040	5	3	3	9	6	5	17	12	9	34	23	18
	0.040		0.045	5	4	3	10	7	5	19	13	9	38	26	18
	0.045		0.050	6	4	3	11	7	5	21	14	10	42	28	20
	0.050		0.063	6	4	3	12	8	6	24	16	11	47	31	22
	0.063		0.071	8	5	4	15	10	7	30	19	14	59	38	27
↓	0.071	↓	0.080		6	4		11	8		22	15		43	30
CRES	0.080	CRES	0.090		6	5		13	9		25	17		49	34

TABLE NO. 3

SINGLE SHEAR—FLUSH HEAD (COUNTERSUNK)

1/2 HARD CRES			$\ell =$ ▶	1/2		1 IN.		2 IN.		4 IN.	
MATL	t	DOUBLER MATL	t_1*	BF6		BF6		BF6		BF6	
CRES	0.063	CRES	0.071	6		11		22		44	
↑	0.071	↑	0.080	6		12		23		46	
	0.080		0.090	7		13		25		49	
	0.090		0.100	7		14		27		53	
	0.100		0.125	8		15		29		57	
↓	0.125	↓	0.160	9		17		34		67	
CRES	0.160	CRES	0.190	10		20		40		80	

TABLE NO. 2

DOUBLE SHEAR—BRAZIER HEAD

1/2 HARD CRES			$\ell =$ ▶	1/2 IN.			1 IN.			2 IN.			4 IN.		
MATL	t	DOUBLER MATL	t_1*	AT4	AT5	AT6	AT4	AT5	AT6	AT4	AT5	AT6	AT4	AT5	AT6
CRES	0.020	CRES	0.025	4			7			13			25		
↑	0.025	↑	0.032	3	3		6	5		12	10		24	20	
	0.032		0.036	3	3	2	6	5	4	12	10	8	24	19	16
	0.036		0.040	3	3	2	6	5	4	12	10	8	24	19	16
	0.040		0.045	3	3	2	6	5	4	12	10	8	24	19	16
	0.045		0.050	4	3	2	7	5	4	13	10	8	25	19	16
	0.050		0.063	4	3	2	7	5	4	14	10	8	27	20	16
	0.063		0.071	4	3	3	8	6	5	16	11	9	31	22	17
	0.071		0.080	5	3	3	9	6	5	17	12	9	34	24	18
↓	0.080	↓	0.090	5	4	3	10	7	5	19	13	10	38	26	19
CRES	0.090	CRES	0.100	6	4	3	11	7	6	21	14	11	42	28	21

TABLE NO. 4

SINGLE SHEAR—BRAZIER HEAD (BLIND MONEL RIVETS)

1/2 HARD CRES			$\ell =$ ▶	1/2 IN.			1 IN.			2 IN.			4 IN.		
MATL	t	DOUBLER MATL	t_1*	1/8	5/32	3/16	1/8	5/32	3/16	1/8	5/32	3/16	1/8	5/32	3/16
CRES	0.020	CRES	0.025	4			8			16			32		
↑	0.025	↑	0.032	5	4		9	7		17	14		33	27	
	0.032		0.040	5	4	3	9	7	6	18	14	11	36	27	22
	0.040		0.050	6	4	3	11	8	6	21	15	12	41	30	23
↓	0.050	↓	0.063	6	5	4	13	9	7	25	17	13	49	34	26
CRES	0.063	CRES	0.071		5	4		10	8		20	15		39	29

NOTE Refer to "Developing a Typical Repair" before using this table.

- "AT" designates NAS508M rivets;
- "BF" designates AN427M rivets.

*The doubler thickness (t_1) applies to the skin and web repairs only. Obtain doubler thickness for shapes from typical repair.

GEN-3-91-22A

Figure 10-11. Fastener Tables—Flush, Protruding-head and Blind, ½ Hard CRES, Tension

FASTENER TABLES

TYPICAL REPAIR

TABLE NO. 1

COUNTERSUNK				RIVETS REQUIRED											
			ℓ =	1/2 INCH			1 INCH			2 INCHES			4 INCHES		
MATL	t	DOUBLER MATL	t_1*	AF462-4	AF462-5	AF462-6	AF462-4	AF462-5	AF462-6	AF462-4	AF462-5	AF462-6	AF462-4	AF462-5	AF462-6
2024-T4	0.032	2024-T4	0.040												
	0.040		0.050	7			13			25			50		
	0.050		0.063	6	6		12	11		24	21		48	42	
	0.063		0.071	6	5	11	12	10	21	24	19	42	48	38	
2024-T4	0.071	2024-T4	0.080	6	5	5	12	10	10	24	19	19	48	38	38
DIMPLED															
2024-T4	0.025	2024-T4	0.032	4	3		8	7		15	12		29	25	
	0.032		0.040	4	3	3	8	6	5	16	12	10	31	23	20
	0.040		0.050	5	3	3	9	6	5	17	12	10	34	23	19
	0.050		0.063	5	4	3	10	7	5	20	13	10	40	26	20
	0.063		0.071		4	3		8	6		16	12		32	24
	0.071		0.080			4			7			13			26
2024-T4	0.080	2024-T4	0.090			4			7			14			28

NOTE Refer to "Developing a Typical Repair" before using this table.

*The doubler thickness (t_1) applies to the skin and web repairs only. Obtain doubler thickness for shapes from typical repair.

TABLE NO. 2

COUNTERSUNK				RIVETS REQUIRED											
			ℓ =	1/2 INCH			1 INCH			2 INCHES			4 INCHES		
MATL	t	DOUBLER MATL	t_1*	AF462-4	AF462-5	AF462-6	AF462-4	AF462-5	AF462-6	AF462-4	AF462-5	AF462-6	AF462-4	AF462-5	AF462-6
7075-T6	0.032	7075-T6	0.040												
	0.040		0.050	9			17			33			66		
	0.050		0.063	8	7		15	14		30	28		60	55	
	0.063		0.071	8	6	13	15	12	26	30	24	52	59	48	
7075-T6	0.071	7075-T6	0.080	8	6	6	15	12	12	30	24	24	60	47	48
DIMPLED															
7075-T6	0.025	7075-T6	0.032	5	4		10	8		19	16		38	32	
	0.032		0.040	5	4	4	10	8	7	20	15	13	40	30	25
	0.040		0.050	6	4	4	12	8	7	23	16	13	45	31	25
	0.050		0.063	7	5	4	13	9	7	26	18	14	52	35	27
	0.063		0.071		5	4		10	8		20	15		40	30
	0.071		0.080			4			9			17			33
7075-T6	0.080	7075-T6	0.090			5			9			18			35

TABLE NO. 3

CR-562 MONEL RIVETS COUNTERSUNK				RIVETS REQUIRED											
			ℓ =	1/2 INCH			1 INCH			2 INCHES			4 INCHES		
MATL	t	DOUBLER MATL	t_1*	CR562-4	CR562-5	CR562-6	CR562-4	CR562-5	CR562-6	CR562-4	CR562-5	CR562-6	CR562-4	CR562-5	CR562-6
7075-T6	0.040	7075-T6	0.050	5			10			19			38		
	0.050		0.063	5	4		10	8		20	16		39	31	
	0.063		0.071	5	4	4	10	8	7	20	16	13	40	32	26
	0.071		0.080	6	4	4	11	8	7	21	16	13	42	32	26
	0.080		0.090	6	5	4	11	9	7	22	17	14	44	33	27
	0.090		0.100	6	5	4	12	9	7	24	17	14	47	34	27
	0.100		0.125	7	5	4	13	9	7	25	19	14	50	37	28
7075-T6	0.125	7075-T6	0.160	7	5	4	14	10	8	28	20	16	56	40	31

GEN-3-91-23A

Figure 10-12. Fastener Tables—Cherry, Flush, 2024-T4 and 7075-T6, Tension

FASTENER TABLES

TYPICAL REPAIR

TABLE NO. 1

COUNTERSUNK				RIVETS REQUIRED											
			ℓ=	1/2 INCH			1 INCH			2 INCHES			4 INCHES		
MATL	t	DOUBLER MATL	t_1*	AF462-4	AF462-5	AF462-6	AF462-4	AF462-5	AF462-6	AF462-4	AF462-5	AF462-6	AF462-4	AF462-5	AF462-6
2024-T4	0.040	2024-T4	0.050	4			8			15			30		
	0.050		0.063	4	4		7	7		14	13		28	25	
	0.063		0.071	4	3	7	8	6	13	15	12	26	29	23	51
2024-T4	0.071	2024-T4	0.080	4	3	3	8	6	6	15	12	12	29	23	23
DIMPLED															
2024-T4	0.025	2024-T4	0.032	3	2		5	4		9	8		18	15	
	0.032		0.040	3	2	2	5	4	3	10	7	6	19	14	12
	0.040		0.050	3	2	2	6	4	3	11	7	6	21	14	12
	0.050		0.063	3	2	2	6	4	4	12	8	7	24	16	12
	0.063		0.071		3	2		5	4		10	8		20	15
	0.071		0.080			2			4			8			16
2024-T4	0.080	2024-T4	0.090			3			5			9			18

NOTE Refer to "Developing a Typical Repair" before using this table.

*The doubler thickness (t_1) applies to the skin and web repairs only. Obtain doubler thickness for shapes from typical repair.

TABLE NO. 2

COUNTERSUNK				RIVETS REQUIRED											
			ℓ=	1/2 INCH			1 INCH			2 INCHES			4 INCHES		
MATL	t	DOUBLER MATL	t_1*	AF462-4	AF462-5	AF462-6	AF462-4	AF462-5	AF462-6	AF462-4	AF462-5	AF462-6	AF462-4	AF462-5	AF462-6
7075-T6	0.032	7075-T6	0.040												
	0.040		0.050	5			10			20			39		
	0.050		0.063	5	5		9	9		18	17		36	33	
	0.063		0.071	5	4	8	9	8	16	18	15	31	35	29	62
7075-T6	0.071	7075-T6	0.080	5	4	4	9	7	8	18	14	15	36	28	29
DIMPLED															
7075-T6	0.025	7075-T6	0.032	3	3		6	5		12	10		23	19	
	0.032		0.040	3	3	2	6	5	4	12	9	8	24	18	15
	0.040		0.050	4	3	2	7	5	4	14	10	8	27	19	15
	0.050		0.063	4	3	2	8	6	4	16	11	8	31	21	16
	0.063		0.071		3	3		6	5		12	9		24	18
	0.071		0.080			3			5			10			20
7075-T6	0.080	7075-T6	0.090			3			6			11			21

TABLE NO. 3

COUNTERSUNK				RIVETS REQUIRED											
			ℓ=	1/2 INCH			1 INCH			2 INCHES			4 INCHES		
MATL	t	DOUBLER MATL	t_1*	CR562-4	CR562-5	CR562-6	CR562-4	CR562-5	CR562-6	CR562-4	CR562-5	CR562-6	CR562-4	CR562-5	CR562-6
7075-T6	0.040	7075-T6	0.050	3			6			12			22		
	0.050		0.063	3	3		6	5		12	9		24	18	
	0.063		0.071	3	3	2	6	5	4	12	10	8	24	19	15
	0.071		0.080	4	3	2	7	5	4	13	10	8	25	19	16
	0.080		0.090	4	3	2	7	5	4	14	10	8	27	20	16
	0.090		0.100	4	3	3	7	6	5	14	11	9	28	21	16
	0.100		0.125	4	3	3	8	6	5	15	11	9	30	22	17
7075-T6	0.125	7075-T6	0.160	5	3	3	9	6	5	17	12	10	33	24	19

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Figure 10-13. Fastener Tables—Cherry, Flush, 2024-T4 and 7075-T6, Shear

FASTENER TABLES

TYPICAL REPAIR

TABLE NO. 1

AMS 4901 TITANIUM SINGLE SHEAR				FASTENERS REQUIRED																															
				AN. AND NAS SERIES BOLTS†																HI-SHEAR RIVETS‡															
			ℓ= ➧	1/2 INCH				1 INCH				2 INCHES				4 INCHES				1/2 INCH				1 INCH				2 INCHES				4 INCHES			
MATL	t	DOUBLER MATL	t_1*	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8
AMS4901	0.036	AMS4901	0.040	2	1	1	1	3	2	2	2	6	4	4	3	11	8	7	6	2	2	1	1	3	3	2	2	6	5	4	4	11	10	8	7
	0.040		0.045	2	1	1	1	3	2	2	2	6	4	4	3	11	8	7	6	2	2	1	1	3	3	2	2	6	5	4	4	11	10	8	7
	0.045		0.050	2	1	1	1	3	2	2	2	6	4	4	3	11	8	7	6	2	1	1	1	3	2	2	2	6	4	4	4	11	8	8	7
	0.050		0.056	2	1	1	1	3	2	2	2	6	4	4	3	11	8	7	6	2	1	1	1	3	2	2	2	6	4	4	4	11	8	8	7
	0.056		0.063	2	1	1	1	3	2	2	2	6	4	4	3	11	8	7	6	2	1	1	1	3	2	2	2	6	4	4	4	11	8	7	7
	0.063		0.071	2	1	1	1	3	2	2	2	6	4	4	3	11	8	7	6	2	1	1	1	3	2	2	2	6	4	4	4	11	8	7	7
	0.071		0.080	2	1	1	1	3	2	2	2	6	4	4	3	11	8	7	6	2	1	1	1	3	2	2	2	6	4	4	3	11	8	7	6
	0.080		0.090		1	1	1		2	2	2		4	4	3		8	7	6		1	1	1		2	2	2		4	4	3		8	7	6
	0.090		0.100		1	1	1		2	2	2		4	4	3		8	7	6		1	1	1		2	2	2		4	4	3		8	7	6
	0.100		0.112		1	1	1		2	2	2		4	4	3		8	7	6		2	1	1		3	2	2		5	4	3		9	7	6
	0.112		0.125			1	1			2	2			4	3			7	6			1	1			2	2			4	3			7	6
	0.125		0.140			1	1			2	2			4	3				6			1	1			2	2			4	3			7	6
AMS4901	0.140	AMS4901	0.160				1				2				3				6				1				2				3				6
DOUBLE SHEAR																																			
AMS4901	0.080	AMS4901	0.090	2				3				6				11				2				3				6				11			
	0.090		0.100	2				3				6				11				2				3				6				11			
	0.100		0.112	2				3				6				11				2				3				6				11			
	0.112		0.125	2	1			3	2			6	4			11	8			2	1			3	2			6	4			11	8		
	0.125		0.140	2	1			3	2			6	4			11	8			2	1			3	2			6	4			11	8		
	0.140		0.160	2	1	1		3	2	2		6	4	4		11	8	7		2	1	1		3	2	2		6	4	4		11	8	7	
	0.160		0.180		1	1	1		2	2	2		4	4	3		8	7	6		1	1	1		2	2	2		4	4	3		8	7	6
AMS4901	0.180	AMS4901	0.190		1	1	1		2	2	2		4	4	3		8	7	6		1	1	1		2	2	2		4	4	3		8	7	6

NOTE Refer to "Developing a Typical Repair" before using this table.

*The doubler thickness (t_1) applies to the skin and web repairs only. Obtain doubler thickness for shapes from typical repair.

† 125,000 psi bolts (3/16 inch—AN3 and NAS221, 1/4 inch—AN3 and NAS222, 5/16 inch—AN5 and NAS223, 3/8 inch—AN6 and NAS224)

‡ 125,000 psi protruding head Hi-shear rivets (NAS177, NAS178, NAA2R3, NAA2R7, and NAA2R6)

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Figure 10-14. Fastener Tables—Hi-Shear Rivets and Bolts, Protruding-head, Titanium, Tension (Sheet 1 of 2)

FASTENER TABLES

TYPICAL REPAIR

TABLE NO. 2

FASTENERS REQUIRED

NAS, MS & 5B—24 SERIES BOLTS †

AMS4908 TITANIUM				1/2 INCH				1 INCH				2 INCHES				4 INCHES			
SINGLE SHEAR			ℓ = ➧																
MATL	t	DOUBLER	t_1 *	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8
AMS4908	0.036	AMS4908	0.040	2	1	1	1	3	2	2	2	5	4	3	3	10	8	6	5
	0.040		0.045	2	1	1	1	3	2	2	2	5	4	3	3	10	8	6	5
	0.045		0.050	2	1	1	1	3	2	2	2	5	4	3	3	10	8	6	5
	0.050		0.063	2	1	1	1	3	2	2	2	5	4	3	3	10	8	6	6
	0.063		0.071	2	1	1	1	3	2	2	2	6	4	3	3	12	8	6	5
	0.071		0.080		1	1	1		2	2	2		4	3	3		8	6	5
	0.080		0.090			1	1			2	2			3	3			6	5
	0.090		0.100			1	1			2	2			3	3			6	5
	0.100		0.112				1				2				3				5
AMS4908	0.112	AMS4908	0.125				1				2				3				6
DOUBLE SHEAR																			
AMS4908	0.071	AMS4908	0.080	2				3				5				10			
	0.080		0.090	2	1			3	2			5	4			10	8		
	0.090		0.100	2	1			3	2			5	4			10	8		
	0.100		0.112	2	1	1		3	2	2		5	4	3		10	8	6	
	0.112		0.125		1	1			2	2			4	3			8	6	
	0.125		0.140		1	1	1		2	2	2		4	3	3		8	6	5
	0.140		0.160		1	1	1		2	2	2		4	3	3		8	6	5
	0.160		0.180			1	1			2	2			3	3			6	5
AMS4908	0.180	AMS4908	0.190			1	1			2	2			3	3			6	5

HIGH-STRENGTH HI-SHEAR RIVETS ‡

AMS4908 TITANIUM				1/2 INCH				1 INCH				2 INCHES				4 INCHES			
SINGLE SHEAR			ℓ = ➧																
MATL	t	DOUBLER	t_1 *	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8
AMS4908	0.036	AMS4908	0.040	2	2	1	1	3	3	2	2	5	5	4	3	10	9	7	6
	0.040		0.045	2	2	1	1	3	3	2	2	5	5	4	3	10	9	7	6
	0.045		0.050	2	1	1	1	3	2	2	2	5	4	4	3	10	8	7	6
	0.050		0.063	2	1	1	1	3	2	2	2	5	4	4	3	10	8	7	6
	0.063		0.071	2	1	1	1	3	2	2	2	6	4	3	3	12	8	6	6
	0.071		0.080		1	1	1		2	2	2		4	3	3		8	6	5
	0.080		0.090			1	1			2	2			3	3			6	5
	0.090		0.100			1	1			2	2			3	3			6	5
	0.100		0.112				1				2				3				5
AMS4908	0.112	AMS4908	0.125				1				2				3				6
DOUBLE SHEAR																			
AMS4908	0.071	AMS4908	0.080	2				3				5				10			
	0.080		0.090	2	1			3	2			5	4			10	8		
	0.090		0.100	2	1			3	2			5	4			10			
	0.100		0.112	2	1	1		3	2	2		5	4	3		10	8	6	
	0.112		0.125		1	1			2	2			4	3			8	6	
	0.125		0.140		1	1	1		2	2	2		4	3	3		8	6	5
	0.140		0.160		1	1	1		2	2	2		4	3	3		8	6	5
	0.160		0.180			1	1			2	2			3	3			6	5
AMS4908	0.180	AMS4908	0.190			1	1			2	2			3	3			6	5

NOTE Refer to "Developing a Typical Repair" before using this table.

- Use EWB18 Series bolts for 5B-24 (HT TR 180,000 psi).
- Use EB Series nuts for full tensile strength.
- Refer to index for source of commercial products.

* The doubler thickness (t_1) applies to the skin and web repairs only. Obtain doubler thickness for shapes from typical repair.

† 160,000 psi bolts (1/4-inch—NAS144 and MS20004; 5/16-inch—NAS145 and MS20005; 3/8-inch—NAS146 and MS20006)

‡ 160,000 psi protruding-head Hi-Shear rivets (HS47, HS48, HS10, HS38P, HS39P, HS51P, and HS52P)

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Figure 10-14. Fastener Tables—Hi-Shear Rivets and Bolts, Protruding-head, Titanium, Tension (Sheet 2 of 2)

FASTENER TABLES

TYPICAL REPAIR

TABLE NO. 1

AMS4901 TITANIUM				AN. AND NAS SERIES BOLTS†																HI-SHEAR RIVETS‡															
SINGLE SHEAR			ℓ=➡	1/2 INCH				1 INCH				2 INCHES				4 INCHES				1/2 INCH				1 INCH				2 INCHES				4 INCHES			
MATL	t	DOUBLER	t_1*	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8
AMS4901	0.036	AMS4901	0.040	1	1	1	1	2	2	1	1	3	3	2	2	6	5	4	3	1	1	1	1	2	2	1	1	3	3	2	2	6	5	4	4
	0.040		0.045	1	1	1	1	2	2	1	1	3	3	2	2	6	5	4	3	1	1	1	1	2	2	1	1	3	3	2	2	6	5	4	4
	0.045		0.050	1	1	1	1	2	2	1	1	3	3	2	2	6	5	4	3	1	1	1	1	2	2	1	1	3	3	2	2	6	5	4	4
	0.050		0.056	1	1	1	1	2	2	1	1	3	3	2	2	6	5	4	3	1	1	1	1	2	2	1	1	3	3	2	2	6	5	4	4
	0.056		0.063	1	1	1	1	2	2	1	1	3	3	2	2	6	5	4	3	1	1	1	1	2	2	1	1	3	3	2	2	6	5	4	4
	0.063		0.071	1	1	1	1	2	2	1	1	3	3	2	2	6	5	4	3	1	1	1	1	2	2	1	1	3	3	2	2	6	5	4	4
	0.071		0.080	1	1	1	1	2	2	1	1	3	3	2	2	6	5	4	3	1	1	1	1	2	2	1	1	3	3	2	2	6	5	4	3
	0.080		0.090		1	1	1		2	1	1		3	2	2		5	4	3		1	1	1		2	1	1		3	2	2		5	4	3
	0.090		0.100		1	1	1		2	1	1		3	2	2		5	4	3		1	1	1		2	1	1		3	2	2		5	4	3
	0.100		0.112		1	1	1		2	1	1		3	2	2		5	4	3		1	1	1		2	1	1		3	2	2		5	4	3
	0.112		0.125			1	1			1	1			2	2			4	3			1	1			1	1			2	2			4	3
	0.125		0.140			1	1			1	1			2	2			4	3			1	1			1	1			2	2			4	3
AMS4901	0.140	AMS4901	0.160				1				1				2				3				1				1				2				3
DOUBLE SHEAR																																			
AMS4901	0.080	AMS4901	0.090	1				2				3				6				1				2				3				6			
	0.090		0.100	1				2				3				6				1				2				3				6			
	0.100		0.112	1				2				3				6				1				2				3				6			
	0.112		0.125	1	1			2	2			3	3			6	5			1	1			2	2			3	3			6	5		
	0.125		0.140	1	1			2	2			3	3			6	5			1	1			2	2			3	3			6	5		
	0.140		0.160	1	1	1		2	2	1		3	3	2		6	5	4		1	1	1		2	2	1		3	3	2		6	5	4	
	0.160		0.180		1	1	1		2	1	1		3	2	2		5	4	3		1	1	1		2	1	1		3	2	2		5	4	3
AMS4901	0.180	AMS4901	0.190		1	1	1		2	1	1		3	2	2		5	4	3		1	1	1		2	1	1		3	2	2		5	4	3

NOTE Refer to "Developing a Typical Repair" before using this table.

*The doubler thickness (t_1) applies to the skin and web repairs only. Obtain doubler thickness for shapes from typical repair.

† 125,000 psi bolts (3/16 inch—AN3 and NAS221, 1/4 inch—AN3 and NAS222, 5/16 inch—AN5 and NAS223, 3/8 inch—AN6 and NAS224)

‡ 125,000 psi protruding head Hi-shear rivets (NAS177, NAS178, NAA2R3, NAA2R7, and NAA2R6)

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Figure 10-15. Fastener Tables—Hi-Shear Rivets and Bolts, Protruding-head, Titanium, Shear (Sheet 1 of 2)

FASTENER TABLES

TYPICAL REPAIR

TABLE NO. 2

NAS, MS, & 5B-24 SERIES BOLTS†

AMS4908 TITANIUM				1/2 INCH				1 INCH				2 INCHES				4 INCHES			
SINGLE SHEAR			ℓ=→	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8
MATL	t	DOUBLER	t₁*																
AMS4908	0.036	AMS4908	0.040	1	1	1	1	2	2	2	2	4	3	3	2	7	6	5	4
	0.040		0.045	1	1	1	1	2	2	2	2	4	3	3	2	7	6	5	4
	0.045		0.050	1	1	1	1	2	2	2	2	4	3	3	2	7	6	5	4
	0.050		0.063	1	1	1	1	2	2	2	2	4	3	3	2	7	6	5	4
	0.063		0.070	1	1	1	1	2	2	2	2	4	3	3	2	8	6	5	4
	0.071		0.080		1	1	1		2	2	2		3	3	2		6	5	4
	0.080		0.090			1	1			2	2			3	2			5	4
	0.090		0.100			1	1			2	2			3	2			5	4
	0.100		0.112				1				2				2				4
AMS4908	0.112	AMS4908	0.125				1				2				2				4
DOUBLE SHEAR																			
AMS4908	0.071	AMS4908	0.080	1				2				4				7			
	0.080		0.090	1	1			2	2			4	3			7	6		
	0.090		0.100	1	1			2	2			4	3			7	6		
	0.100		0.112	1	1	1		2	2	2		4	3	3		7	6	5	
	0.112		0.125		1	1			2	2			3	3			6	5	
	0.125		0.140		1	1	1		2	2	2		3	3	2		6	5	4
	0.140		0.160		1	1	1		2	2	2		3	3	2		6	5	4
	0.160		0.180			1	1			2	2			3	2			5	4
AMS4908	0.180	AMS4908	0.190			1	1			2	2			3	2			5	4

HIGH-STRENGTH HI-SHEAR RIVETS‡

AMS4908 TITANIUM				1/2 INCH				1 INCH				2 INCHES				4 INCHES			
SINGLE SHEAR			ℓ=→	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8
MATL	t	DOUBLER	t₁*																
AMS4908	0.036	AMS4908	0.040	1	1	1	1	2	2	2	2	4	4	3	3	7	7	5	5
	0.040		0.045	1	1	1	1	2	2	2	2	4	4	3	3	7	7	5	5
	0.045		0.050	1	1	1	1	2	2	2	2	4	3	3	3	7	6	5	5
	0.050		0.063	1	1	1	1	2	2	2	2	4	3	3	3	7	6	5	5
	0.063		0.070	1	1	1	1	2	2	2	2	4	3	3	3	8	6	5	5
	0.071		0.080		1	1	1		2	2	2		3	3	2		6	5	4
	0.080		0.090			1	1			2	2			3	2			5	4
	0.090		0.100			1	1			2	2			3	2			5	4
	0.100		0.112				1				2				2				4
AMS4908	0.112	AMS4908	0.125				1				2				2				4
DOUBLE SHEAR																			
AMS4908	0.071	AMS4908	0.080	1				2				4				7			
	0.080		0.090	1	1			2	2			4	3			7	6		
	0.090		0.100	1	1			2	2			4	3			7	6		
	0.100		0.112	1	1	1		2	2	2		4	3	3		7	6	5	
	0.112		0.125		1	1			2	2			3	3			6	5	
	0.125		0.140		1	1	1		2	2	2		3	3	2		6	5	4
	0.140		0.160		1	1	1		2	2	2		3	3	2		6	5	4
	0.160		0.180			1	1			2	2			3	2			5	4
AMS4908	0.180	AMS4908	0.190			1	1			2	2			3	2			5	4

NOTE Refer to "Developing a Typical Repair" before using this table.

- Use EB Series nuts for full tensile strength.
- Use EWB18 Series bolts for 5B-24. (Heat-treat to 180,000 psi.)
- Refer to index for source of commercial products.

*The doubler thickness (t_1) applies to the skin and web repairs only. Obtain doubler thickness for shapes from typical repair.

†160,000 PSI bolts (1/4 inch—NAS144 and MS20004, 5/16 inch—NAS145 and MS20005, 3/8 inch—NAS146 and MS20006)

‡160,000 psi protruding head Hi-shear rivets (HS47, HS48, HS10, HS38P, HS39P, HS51P, and HS52)

GEN-3-91-29A

Figure 10-15. Fastener Tables—Hi-Shear Rivets and Bolts, Protruding-head, Titanium, Shear (Sheet 2 of 2)

FASTENER TABLES

TYPICAL REPAIR

TABLE NO. 1

TENSION			ℓ=	FASTENERS REQUIRED - PROTRUDING HEAD: 1/2 INCH				1 INCH				2 INCHES				4 INCHES			
MATL	t	DOUBLER MATL	t_1*	NAS178-6 AN3	NAS178-8 AN4	NAS178-10 AN5	NAS178-12 AN6	NAS178-6 AN3	NAS178-8 AN4	NAS178-10 AN5	NAS178-12 AN6	NAS178-6 AN3	NAS178-8 AN4	NAS178-10 AN5	NAS178-12 AN6	NAS178-6 AN3	NAS178-8 AN4	NAS178-10 AN5	NAS178-12 AN6
2024-T4	0.040	2024-T4	0.050	2				4				7				14			
	0.050		0.063	2	2			4	3			7	6			14	11		
	0.063		0.071	2	2	2		4	3	3		7	6	5		14	11	9	
	0.071		0.080	2	2	2	1	4	3	3	2	7	6	5	4	14	11	9	7
	0.080		0.090	2	2	2	1	4	3	3	2	7	6	5	4	14	11	9	7
	0.090		0.100	2	2	2	1	4	3	3	2	7	6	5	4	14	11	9	7
	0.100		0.112	2	2	2	1	4	3	3	2	7	6	5	4	14	11	9	7
	0.112		0.125	2	2	2	1	4	3	3	2	7	6	5	4	14	11	9	7
	0.125		0.140		2	2	1		3	3	2		6	5	4		11	9	7
	0.140		0.160			2	1			3	2			5	4			9	7
	0.160		0.180			2	1			3	2			5	4			9	7
2024-T4	0.180	2024-T4	0.190				1				2				4				7

TABLE NO. 2

SHEAR			ℓ=	FASTENERS REQUIRED - PROTRUDING HEAD: 1/2 INCH				1 INCH				2 INCHES				4 INCHES			
MATL	t	DOUBLER MATL	t_1*	NAS178-6 AN3	NAS178-8 AN4	NAS178-10 AN5	NAS178-12 AN6	NAS178-6 AN3	NAS178-8 AN4	NAS178-10 AN5	NAS178-12 AN6	NAS178-6 AN3	NAS178-8 AN4	NAS178-10 AN5	NAS178-12 AN6	NAS178-6 AN3	NAS178-8 AN4	NAS178-10 AN5	NAS178-12 AN6
2024-T4	0.040	2024-T4	0.050	2				3				5				9			
	0.050		0.063	2	1			3	2			5	4			9	7		
	0.063		0.071	2	1	1		3	2	2		5	4	3		9	7	6	
	0.071		0.080	2	1	1	1	3	2	2	2	5	4	3	3	9	7	6	5
	0.080		0.090	2	1	1	1	3	2	2	2	5	4	3	3	9	7	6	5
	0.090		0.100	2	1	1	1	3	2	2	2	5	4	3	3	9	7	6	5
	0.100		0.112	2	1	1	1	3	2	2	2	5	4	3	3	9	7	6	5
	0.112		0.125	2	1	1	1	3	2	2	2	5	4	3	3	9	7	6	5
	0.125		0.140		1	1	1		2	2	2		4	3	3		7	6	5
	0.140		0.160			1	1			2	2			3	3			6	5
	0.160		0.180			1	1			2	2			3	3			6	5
2024-T4	0.180	2024-T4	0.190				1				2				3				5

NOTE Refer to "Developing a Typical Repair" before using this table.

*The doubler thickness (t_1) applies to the skin and web repairs only. Obtain doubler thickness for shapes from typical repair.

GEN-3-91-30A

Figure 10-16. Fastener Tables—Hi-Shear and AN Bolts, Protruding-head, Shear and Tension (Sheet 1 of 2)

FASTENER TABLES

TYPICAL REPAIR

TABLE NO. 3

TENSION			ℓ =	FASTENERS REQUIRED — PROTRUDING HEAD															
				1/2 INCH				1 INCH				2 INCHES				4 INCHES			
MATL	t	DOUBLER MATL	t_1*	NAS178-6 AN3	NAS178-8 AN4	NAS178-10 AN5	NAS178-12 AN6	NAS178-6 AN3	NAS178-8 AN4	NAS178-10 AN5	NAS178-12 AN6	NAS178-6 AN3	NAS178-8 AN4	NAS178-10 AN5	NAS178-12 AN6	NAS178-6 AN3	NAS178-8 AN4	NAS178-10 AN5	NAS178-12 AN6
7075-T6	0.040	7075-T6	0.045	2				3				6				12			
	0.045		0.050	2				3				6				12			
	0.050		0.056	2	2			3	3			6	5			12	9		
	0.056		0.063	2	2			3	3			6	5			12	9		
	0.063		0.071	2	2	1		3	3	2		6	5	4		12	9	7	
	0.071		0.080	2	2	1	1	3	3	2	2	6	5	4	3	12	9	7	6
	0.080		0.090		2	1	1		3	2	2		5	4	3		9	7	6
	0.090		0.100		2	1	1		3	2	2		5	4	3		9	7	6
	0.100		0.112		2	1	1		3	2	2		5	4	3		9	7	6
	0.112		0.125			1	1			2	2			4	3			7	6
	0.125		0.140			1	1			2	2			4	3			7	6
7075-T6	0.140	7075-T6	0.160				1				2				3				6

TABLE NO. 4

SHEAR			ℓ =	FASTENERS REQUIRED — PROTRUDING HEAD															
				1/2 INCH				1 INCH				2 INCHES				4 INCHES			
MATL	t	DOUBLER MATL	t_1*	NAS178-6 AN3	NAS178-8 AN4	NAS178-10 AN5	NAS178-12 AN6	NAS178-6 AN3	NAS178-8 AN4	NAS178-10 AN5	NAS178-12 AN6	NAS178-6 AN3	NAS178-8 AN4	NAS178-10 AN5	NAS178-12 AN6	NAS178-6 AN3	NAS178-8 AN4	NAS178-10 AN5	NAS178-12 AN6
7075-T6	0.040	7075-T6	0.045	1				2				4				7			
	0.045		0.050	1				2				4				7			
	0.050		0.056	1	1			2	2			4	3			7	5		
	0.056		0.063	1	1			2	2			4	3			7	5		
	0.063		0.071	1	1	1		2	2	1		4	3	2		7	5	4	
	0.071		0.080	1	1	1	1	2	2	1	1	4	3	2	2	7	5	4	4
	0.080		0.090		1	1	1		2	1	1		3	2	2		5	4	4
	0.090		0.100		1	1	1		2	1	1		3	2	2		5	4	4
	0.100		0.112		1	1	1		2	1	1		3	2	2		5	4	4
	0.112		0.125			1	1			1	1			2	2			4	4
	0.125		0.140			1	1			1	1			2	2			4	4
7075-T6	0.140	7075-T6	0.160				1				1				2				4

NOTE Refer to "Developing a Typical Repair" before using this table.

*The doubler thickness (t_1) applies to the skin and web repairs only. Obtain doubler thickness for shapes from typical repair.

GEN-3-91-31A

Figure 10-16. Fastener Tables—Hi-Shear and AN Bolts, Protruding-head, Shear and Tension (Sheet 2 of 2)

FASTENER TABLES

TYPICAL REPAIR

TABLE NO. 1

TENSION			ℓ =	FASTENERS REQUIRED—HUCK LOCK BOLTS 1/2 INCH				1 INCH				2 INCHES				4 INCHES			
MATL	t	DOUBLER MATL	t_1*	OS-8	OS-10	OS-12	BL-8	OS-8	OS-10	OS-12	BL-8	OS-8	OS-10	OS-12	BL-8	OS-8	OS-10	OS-12	BL-8
7075-T6	0.040	7075-T6	0.050	2				4				8				15			
	0.050		0.063	2	2		2	3	3		3	6	5		5	12	10		9
	0.063		0.071	2	2	1	2	4	3	2	3	7	5	4	5	13	10	8	9
	0.071		0.080	2	2	1	2	4	3	2	3	7	5	4	5	13	10	8	9
	0.080		0.090	2	2	1	2	4	3	2	3	7	5	4	5	14	10	8	10
	0.090		0.100	2	2	1	2	4	3	2	3	8	6	4	5	15	11	8	10
	0.100		0.125		2	2	2		3	3	3		6	5	5		11	9	10
	0.125		0.160			2	2			3	3			5	6			10	11
7075-T6	0.160	7075-T6	0.190				2				3				6				12

TABLE NO. 2

SHEAR			ℓ =	FASTENERS REQUIRED—HUCK LOCK BOLTS 1/2 INCH				1 INCH				2 INCHES				4 INCHES			
MATL	t	DOUBLER MATL	t_1*	OS-8	OS-10	OS-12	BL-8	OS-8	OS-10	OS-12	BL-8	OS-8	OS-10	OS-12	BL-8	OS-8	OS-10	OS-12	BL-8
7075-T6	0.040	7075-T6	0.050	2				3				5				9			
	0.050		0.063	1	1		1	2	2		2	4	3		3	7	6		5
	0.063		0.071	1	1	1	1	2	2	2	2	4	3	3	3	8	6	5	6
	0.071		0.080	1	1	1	1	2	2	2	2	4	3	3	3	8	6	5	6
	0.080		0.090	2	1	1	1	3	2	2	2	5	3	3	3	9	6	5	6
	0.090		0.100	2	1	1	1	3	2	2	2	5	4	3	3	9	7	5	6
	0.100		0.125		1	1	1		2	2	2		4	3	3		7	5	6
	0.125		0.160			1	1			2	2			3	4			6	7
7075-T6	0.160	7075-T6	0.190				1				2				4				7

NOTE Refer to "Developing a Typical Repair" before using this table.

*The doubler thickness (t_1) applies to the skin and web repairs only. Obtain doubler thickness for shapes from typical repair.

GEN-3-91-32A

Figure 10-17. Fastener Tables—Huck Lock Bolt, 7075-T6, Shear and Tension

FASTENER TABLES

TYPICAL REPAIR

TABLE NO. 1

				FASTENERS REQUIRED																							
				PROTRUDING				COUNTERSUNK																DIMPLED			
			ℓ= ➧	1/2	1	2	4	1/2 INCH				1 INCH				2 INCHES				4 INCHES				1/2	1	2	4
MATL	t	DOUBLER MATL	t_1*	P164	P164	P164	P164	F164	F200	F260	F312	F164	F200	F260	F312	F164	F200	F260	F312	F164	F200	F260	F312	F164	F164	F164	F164
2024-T4	0.025	2024-T4	0.032	3	5	9	18																	3	5	10	20
	0.032		0.040	3	5	9	18																	3	5	10	20
	0.040		0.050	3	5	9	18																	3	5	10	20
	0.050		0.063	3	5	9	18	3				5				10				20				3	5	10	19
	0.063		0.071	3	5	10	19	3	3			6	5			11	9			21	18			3	5	10	20
	0.071		0.080	3	5	10	19	3	3			6	5			11	10			21	19			3	5	10	20
	0.080		0.090	3	5	10	19	3	3			6	5			11	9			21	18						
	0.090		0.100	3	5	10	19	3	3	2		6	5	4		11	9	7		21	18	14					
	0.100		0.125	3	5	10	19	3	3	2	2	6	5	4	3	11	9	7	6	21	17	14	12				
	0.125		0.160	3	5	10	19	3	3	2	2	6	5	4	3	11	9	7	6	21	17	14	12				
	0.160		0.190	3	6	12	23	3	3	2	2	6	5	4	3	12	9	7	6	23	18	13	12				
	0.190		0.250	4	7	14	27	4	3	2	2	7	5	4	3	14	10	7	6	27	19	14	12				
	0.250		0.375						3	2	2		7	4	4		13	8	7		25	16	14				
2024-T4	0.375	2024-T4	0.500							3	3			6	5			11	9			21	17				

NOTE Refer to "Developing a Typical Repair" before using this table.

*The doubler thickness (t_1) applies to the skin and web repairs only. Obtain doubler thickness for shapes from typical repair.

GEN-3-91-33A

Figure 10-18. Fastener Tables—Jo-bolt, Flush, and Protruding-head, 2024-T4, Tension

FASTENER TABLES

TYPICAL REPAIR

TABLE NO. 1

				FASTENERS REQUIRED																							
				PROTRUDING				COUNTERSUNK																DIMPLED			
			ℓ =	1/2	1	2	4	1/2 INCH				1 INCH				2 INCHES				4 INCHES				1/2	1	2	4
MATL	t	DOUBLER MATL	t₁*	P164	P164	P164	P164	F164	F200	F260	F312	F164	F200	F260	F312	F164	F200	F260	F312	F164	F200	F260	F312	F164	F164	F164	F164
2024-T4	0.025	2024-T4	0.032	2	3	6	11																	2	3	6	12
↑	0.032	↑	0.040	2	3	6	11																	2	3	6	12
	0.040		0.050	2	3	6	11																	2	3	6	12
	0.050		0.063	2	3	6	11	2				3				6				12				2	3	6	12
	0.063		0.071	2	3	6	12	2	2			4	3			7	6			13	11			2	4	7	13
	0.071		0.080	2	3	6	12	2	2			4	3			7	6			13	12			2	4	7	13
	0.080		0.090	2	3	6	12	2	2			4	3			7	6			13	11						
	0.090		0.100	2	3	6	12	2	2	2		4	3	3		7	6	5		13	11	9					
	0.100		0.125	2	3	6	12	2	2	2	1	4	3	3	2	7	6	5	4	13	11	9	8				
	0.125		0.160	2	3	6	12	2	2	2	1	4	3	3	2	7	6	5	4	13	11	9	8				
	0.160		0.190	2	4	7	14	2	2	1	1	4	3	2	2	7	6	4	4	14	11	8	8				
	0.190		0.250	3	5	9	17	3	2	1	1	5	3	2	2	9	6	4	4	17	12	8	8				
↓	0.250	↓	0.375						2	2	1		4	3	3		8	5	5		16	10	9				
2024-T4	0.375	2024-T4	0.500							2	2			4	3			7	6			14	11				

NOTE Refer to "Developing a Typical Repair" before using this table.

*The doubler thickness (t_1) applies to the skin and web repairs only. Obtain doubler thickness for shapes from typical repair.

GEN-3-91-34A

Figure 10-19. Fastener Tables—Jo-bolt, Flush and Protruding-head, 2024-T4, Shear

FASTENER TABLES

TYPICAL REPAIR

TABLE NO. 1

TENSION			ℓ =	FASTENERS REQUIRED — PROTRUDING HEAD															
				1/2 INCH				1 INCH				2 INCHES				4 INCHES			
MATL	t	DOUBLER MATL	t_1*	P164	P200	P260	P312	P164	P200	P260	P312	P164	P200	P260	P312	P164	P200	P260	P312
7075-T6	0.025	7075-T6	0.032	2	2	2	2	4	4	3	3	8	7	5	5	16	13	10	9
	0.032		0.040	2	2	2	2	4	4	3	3	8	7	5	5	16	13	10	9
	0.040		0.050	2	2	2	2	4	4	3	3	8	7	5	5	16	13	10	9
	0.050		0.063	2	2	2	2	4	4	3	3	8	7	5	5	16	13	10	9
	0.063		0.071	2	2	2	2	4	4	3	3	8	7	5	5	16	13	10	9
	0.071		0.080	2	2	2	2	4	4	3	3	8	7	5	5	16	13	10	9
	0.080		0.090	2	2	2	2	4	4	3	3	8	7	5	5	16	13	10	9
	0.090		0.100	3	2	2	2	5	4	3	3	9	7	5	5	17	13	10	9
	0.100		0.125	3	2	2	2	5	4	3	2	9	7	5	4	18	13	10	8
	0.125		0.160	3	2	2	2	6	4	3	3	11	8	5	5	22	15	10	9
	0.160		0.190		3	2	2		5	3	3		10	6	5		19	12	9
	0.190		0.250		3	2	2		6	4	3		11	7	5		22	14	10
	0.250		0.375			3	2			5	3			9	6			17	12
7075-T6	0.375	7075-T6	0.500			3	3			6	5			12	9			24	17

TABLE NO. 2

TENSION			ℓ =	FASTENERS REQUIRED — COUNTERSUNK																FASTENERS REQUIRED — DIMPLED															
				1/2 INCH				1 INCH				2 INCHES				4 INCHES				1/2 INCH				1 INCH				2 INCHES				4 INCHES			
MATL	t	DOUBLER MATL	t_1*	F164	F200	F260	F312	F164	F200	F260	F312	F164	F200	F260	F312	F164	F200	F260	F312	F164	F200	F260	F312	F164	F200	F260	F312	F164	F200	F260	F312	F164	F200	F260	F312
7075-T6	0.025	7075-T6	0.032																	3	2	2	1	5	4	3	2	9	7	5	4	18	13	10	8
	0.032		0.040																	3	2	2	1	5	4	3	2	10	8	5	4	20	15	10	8
	0.040		0.050																	3	3	2	2	6	5	3	3	11	9	6	5	21	17	11	9
	0.050		0.063	3				6				12				24				3	3	2	2	6	5	4	3	12	9	7	5	23	18	13	10
	0.063		0.071	3	3			6	5			12	10			24	19			3	3	2	2	6	5	4	3	12	10	7	6	24	19	14	11
	0.071		0.080	3	3			6	5			12	10			24	19			4		2	2	7		4	3	13		7	6	25		14	11
	0.080		0.090	3	3			6	5			12	10			24	19					2	2			4	3			8	6			15	12
	0.090		0.100	3	3	2		6	5	4		12	10	8		24	19	15				2	2			4	3			8	6			15	12
	0.100		0.125	3	3	2	2	6	5	4	4	12	10	8	7	24	19	15	13																
	0.125		0.160	3	3	2	2	6	5	4	4	12	10	8	7	24	19	15	13																
	0.160		0.190	4	3	2	2	8	5	4	4	15	10	8	7	29	20	15	13																
	0.190		0.250	5	3	2	2	9	6	4	4	17	12	8	7	34	23	15	13																
	0.250		0.375	6	4	3	2	11	8	5	4	22	15	9	7	33	29	18	13																
7075-T6	0.375	7075-T6	0.500	9	6	3	3	17	11	6	5	33	22	12	9	66	43	24	18																

NOTE Refer to "Developing a Typical Repair" before using this table.

*The doubler thickness (t_1) applies to the skin and web repairs only. Obtain doubler thickness for shapes from typical repair.

Gen-3-91-35A

Figure 10-20. Fastener Tables—Jo-bolt, Flush and Protruding-head, 7075-T6, Tension

FASTENER TABLES

TYPICAL REPAIR

NOTE Refer to "Developing a Typical Repair" before using this table.

*The doubler thickness (t_1) applies to the skin and web repairs only. Obtain doubler thickness for shapes from typical repair.

TABLE NO. 1

SHEAR			ℓ= ➧	FASTENERS REQUIRED — PROTRUDING HEAD															
				1/2 INCH				1 INCH				2 INCHES				4 INCHES			
MATL	t	DOUBLER MATL	t_1*	P164	P200	P260	P312	P164	P200	P260	P312	P164	P200	P260	P312	P164	P200	P260	P312
7075-T6	0.025	7075-T6	0.032	2	1	1		3	2	2		5	4	3		10	8	6	
	0.032		0.040	2	1	1	1	3	2	2	2	5	4	3	3	10	8	6	5
	0.040		0.050	2	1	1	1	3	2	2	2	5	4	3	3	10	8	6	5
	0.050		0.063	2	1	1	1	3	2	2	2	5	4	3	3	10	8	6	5
	0.063		0.071	2	1	1	1	3	2	2	2	5	4	3	3	10	8	6	5
	0.071		0.080	2	1	1	1	3	2	2	2	5	4	3	3	10	8	6	5
	0.080		0.090	2	1	1	1	3	2	2	2	5	4	3	3	10	8	6	5
	0.090		0.100	2	1	1	1	3	2	2	2	5	4	3	3	10	8	6	5
	0.100		0.125	2	1	1	1	3	2	2	2	6	4	3	3	11	8	6	5
	0.125		0.160	2	2	1	1	4	3	2	2	7	5	3	3	13	9	6	5
	0.160		0.190		2	1	1		3	2	2		6	4	3		12	7	5
	0.190		0.250		2	1	1		4	2	2		7	4	3		13	8	6
	0.250		0.375			2	1			3	2			5	4			10	8
7075-T6	0.375	7075-T6	0.500			2	2			4	3			8	5			15	10

TABLE NO. 2

SHEAR			ℓ= ➧	FASTENERS REQUIRED — COUNTERSUNK															
				1/2 INCH				1 INCH				2 INCHES				4 INCHES			
MATL	t	DOUBLER MATL	t_1*	F164	F200	F260	F312	F164	F200	F260	F312	F164	F200	F260	F312	F164	F200	F260	F312
7075-T6	0.025	7075-T6	0.032																
	0.032		0.040																
	0.040		0.050																
	0.050		0.063	2				4				7				14			
	0.063		0.071	2	2			4	3			7	6			14	12		
	0.071		0.080	2	2			4	3			7	6			14	12		
	0.080		0.090	2	2			4	3			7	6			14	12		
	0.090		0.100	2	2	2		4	3	3		7	6	5		14	12	9	
	0.100		0.125	2	2	2	1	4	3	3	2	7	6	5	4	14	12	9	8
	0.125		0.160	2	2	2	1	4	3	3	2	7	6	5	4	14	12	9	8
	0.160		0.190	3	2	2	1	5	3	3	2	9	6	5	4	17	12	9	8
	0.190		0.250	3	2	2	1	5	4	3	2	10	7	5	4	20	14	9	8
	0.250		0.375		3	2	1		5	3	2		9	6	4		17	11	8
7075-T6	0.375	7075-T6	0.500			2	2			4	3			8	6			15	11

SHEAR			ℓ= ➧	FASTENERS REQUIRED — DIMPLED															
				1/2 INCH				1 INCH				2 INCHES				4 INCHES			
MATL	t	DOUBLER MATL	t_1*	F164	F200	F260	F312	F164	F200	F260	F312	F164	F200	F260	F312	F164*	F200*	F260	F312
7075-T6	0.025	7075-T6	0.032	2	1	1	1	3	2	2	2	6	4	3	3	11	8	6	5
	0.032		0.040	2	2	1	1	3	3	2	2	6	5	3	3	12	9	6	5
	0.040		0.050	2	2	1	1	4	3	2	2	7	5	4	3	13	10	7	6
	0.050		0.063	2	2	1	1	4	3	2	2	7	6	4	3	14	11	8	6
	0.063		0.071	2	2	1	1	4	3	2	2	8	6	4	4	15	11	8	7
	0.071		0.080	2		2	1	4		3	2	8		5	4	15		9	7
	0.080		0.090			2	1			3	2			5	4			9	7
	0.090		0.100			2	1			3	2			5	4			9	7
	0.100		0.125																
	0.125		0.160																
	0.160		0.190																
	0.190		0.250																
	0.250		0.375																
7075-T6	0.375	7075-T6	0.500																

GEN-3-91-36A

Figure 10-21. Fastener Tables—Jo-bolt, Flush and Protruding-head, 7075-T6, Shear

RIVET HOLE SIZES

TYPICAL REPAIR

FASTENER SIZE	HOLE SIZE: CONVENTIONAL RIVET	BLIND FASTENERS, FINAL HOLE SIZE: EXPLOSIVE (DUPONT)	PULL, CHERRY & OLYMPIC: STANDARD RIVET	PULL, CHERRY & OLYMPIC: OVERSIZE RIVET	PULL, HUCK: BL SERIES BLIND LOCK BOLT	PULL, HUCK: OS & OSR SERIES RIVET	JO-BOLT	DRIVE PIN RIVET (DEUTSCH): PILOT-DRILL BEFORE DIMPLING	DRIVE PIN RIVET (DEUTSCH): FINAL HOLE SIZE
3/32	0.097-0.100 (NO. 40)								
1/8	0.1290-0.1305 (NO. 30)	0.135-0.139 (NO. 29)	0.128-0.132 (NO. 30)	0.137-0.141 (NO. 29)				0.097-0.100 (NO. 40)	0.1255-0.1265
5/32	0.160-0.162 (NO. 21)	0.172-0.176 (NO. 17)	0.160-0.164 (NO. 20)	0.177-0.181 (NO. 16)			0.164-0.166	0.128-0.132 (NO. 30)	0.1565-0.1575
3/16	0.192-0.194 (NO. 11)	0.203-0.207 (NO. 6)	0.192-0.196 (NO. 10)	0.206-0.210 (NO. 5)			0.199-0.202	0.172-0.176 (NO. 17)	0.191-0.193
1/4	0.256-0.261 (F)		0.256-0.261 (F)		0.260-0.265 (G)	0.271-0.276 (I)	0.260-0.263	0.227-0.231 (NO. 1)	0.259-0.262
3/8							0.312-0.315	0.2802-0.2852 (9/32)	0.315-0.318
							0.375-0.379		0.385-0.388

Holes after dimpling must not exceed the nominal drill size by more than 15 percent.

Holes to be dimpled for explosive and pull fasteners must be pilot-drilled using nominal drill size given for conventional rivets, dimpled, and redrilled to size.

If the hole size exceeds the limits given for the standard rivet but is within the limits given for the oversize rivet, use the oversize rivet.

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Figure 10-22. Rivet Hole Sizes

CONVENTIONAL RIVET TYPES AND APPLICATIONS

TYPICAL REPAIR

	RIVET MATERIAL	AL ALLOY 2117-T4 (1)	AL ALLOY 2024-T4 (2)	AL ALLOY 5056-F (1)	AL 1100-F (1) (3)	MILD STEEL CAD-PLATED (1) (5)	MONEL (1)
IDENTIFICATION	HEAD MARKINGS	DIMPLE	RAISED DOUBLE DASH	RAISED CROSS	PLAIN	RECESSED TRIANGLE	DIMPLES / PLAIN
	UNIVERSAL HEAD	AN470AD	AN470DD	AN470B	AN470A		NAS508M
	ROUND HEAD					AN435	
	FLUSH HEAD	AN426AD	AN426DD	AN426B	AN426A	AN427	AN427M
	MAXIMUM TEMPERATURE	200°F	200°F	200°F		550°F	1000°F
	SIZES	3/32, 1/8, & 5/32 DIA	3/16 DIA & OVER			5/16 DIA MAX	3/16 DIA MAX
APPLICATION	AL ALLOY TO AL ALLOY	PREFERRED	PREFERRED	PERMISSIBLE BUT UNDESIRABLE	(3)	PROHIBITED	PROHIBITED
	AL ALLOY TO CAD PLATED STEEL	(4)	(4)	PROHIBITED	PROHIBITED	PREFERRED (5)	PERMISSIBLE BUT UNDESIRABLE
	AL ALLOY TO CRE STEEL						
	AL ALLOY TO TITANIUM						
	CAD PLATED STEEL TO CAD PLATED STEEL	PERMISSIBLE BUT UNDESIRABLE	PERMISSIBLE BUT UNDESIRABLE				
	CAD PLATED STEEL TO CRE STEEL						
	CAD PLATED STEEL TO TITANIUM						
	CRE STEEL TO CRE STEEL	PROHIBITED	PROHIBITED	PROHIBITED	PROHIBITED	PROHIBITED	PREFERRED
	CRE STEEL TO TITANIUM						
	TITANIUM TO TITANIUM						
	MAGNESIUM ALLOY TO AL ALLOY	PROHIBITED	PROHIBITED	PREFERRED	PROHIBITED	PROHIBITED	PROHIBITED
	MAGNESIUM ALLOY TO CAD PLATED STEEL						
	MAGNESIUM ALLOY TO MAGNESIUM ALLOY						
	SOFT MATERIAL	ACCEPTABLE	PROHIBITED	PERMISSIBLE BUT UNDESIRABLE	PREFERRED	PROHIBITED	PROHIBITED

(1) Use rivets in "as received" condition.

(2) Rivets should be reheat-treated and refrigerated before using, in accordance with Specification MIL-H-6088.

(3) May be used for welding, where extra softness is required, or for plugging holes.

(4) May be used for weight saving or strength.

(5) Not recommended for structural applications.

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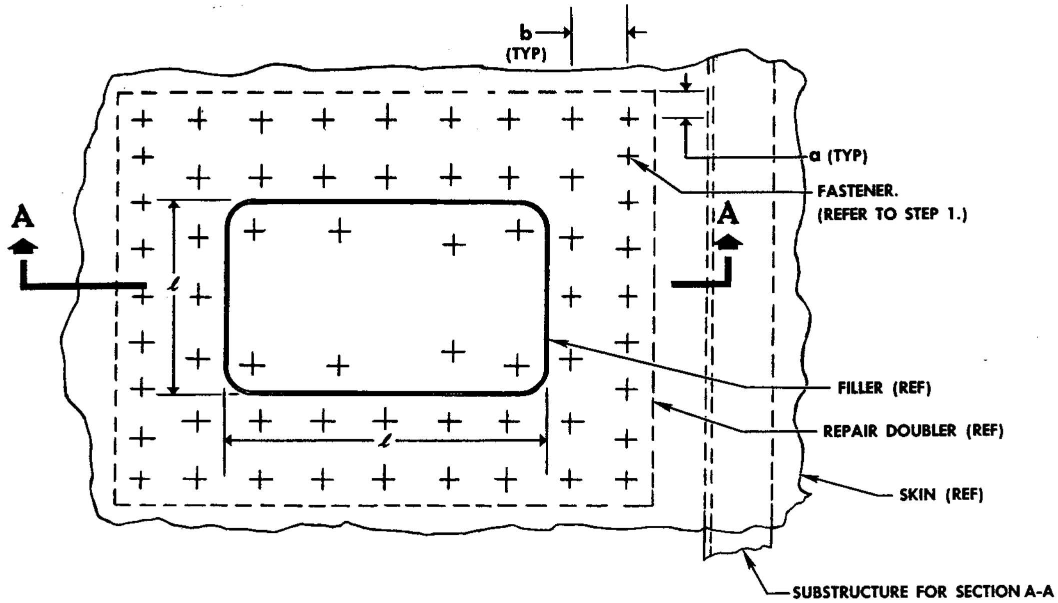
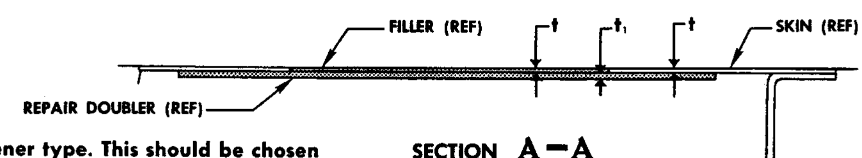
Figure 10-23. Conventional-type Rivets and Applications

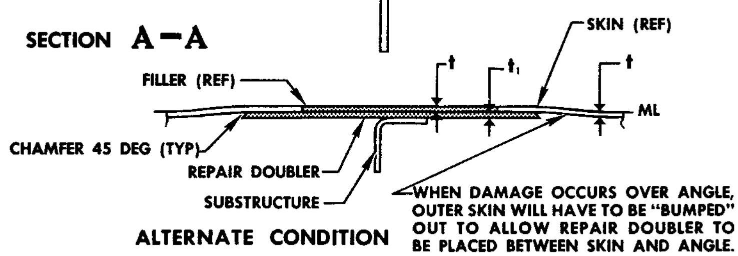
SKIN REPAIR - SHEAR

TYPICAL REPAIR





SECTION A—A



ALTERNATE CONDITION

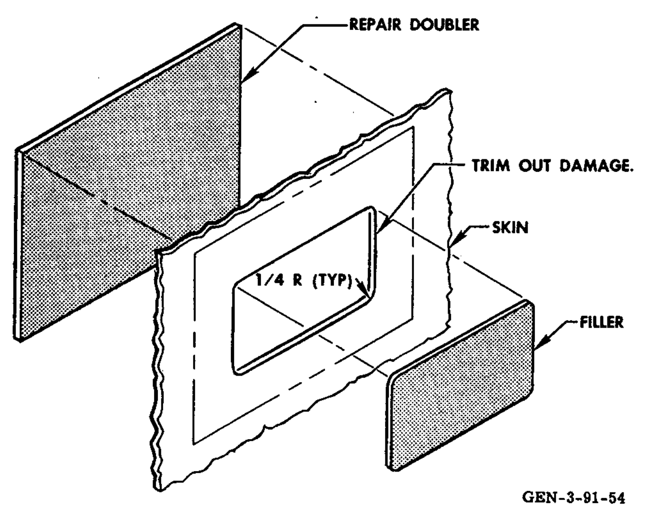
1. Select fastener type. This should be chosen on the basis of the material being repaired, the ease of installation, the blind area problems, and the tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated for each "ℓ" dimension.
4. Use doubler material and thickness given in rivet table.†
5. Distribute rivets as shown in examples in "Rivet Table Instructions."

*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot-dimpling tools are not available, brazier-head rivets may be used for temporary attachment of parts. (Replace with flush rivets as soon as possible.)

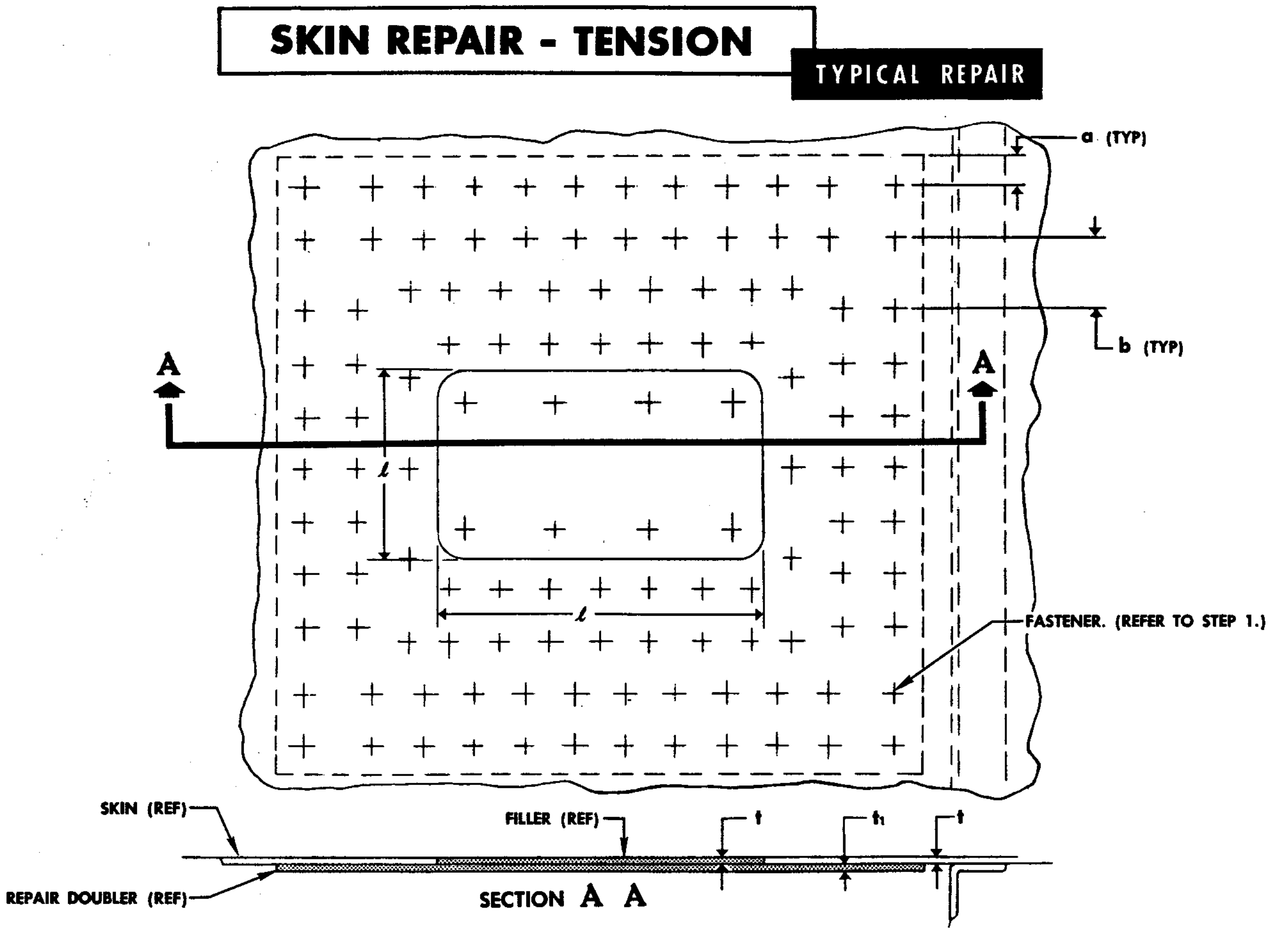
†One-half hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

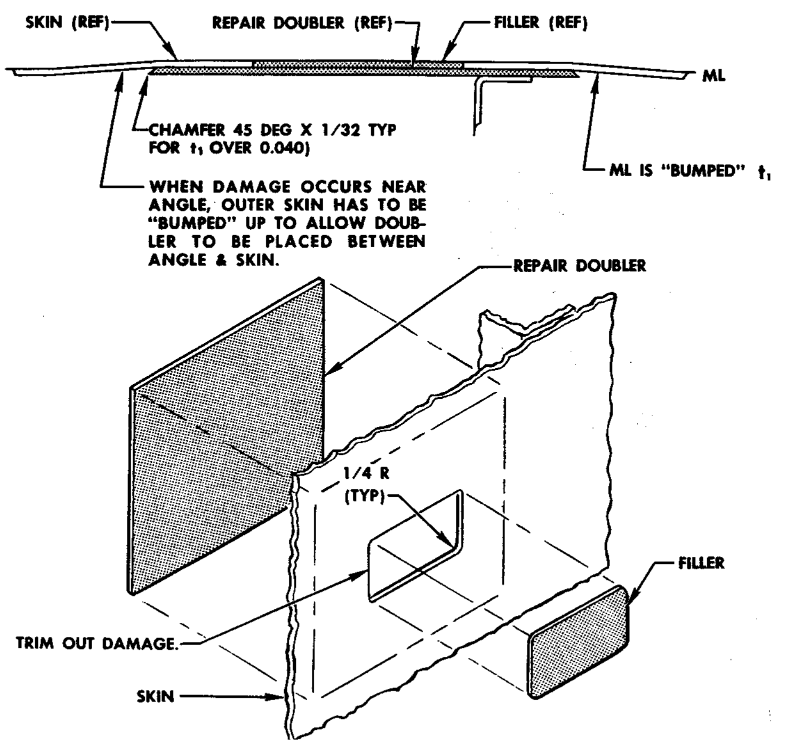
One-half hard corrosion-resistant steel doublers may be substituted for aluminum alloy doublers in making skin repairs. Use material one-half the thickness given for aluminum alloy.



GEN-3-91-54

Figure 10-24. Skin Repair—Shear





1. Select fastener type. This should be chosen on the basis of the material being repaired, the ease of installation, the blind area problems, and the tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated for each "ℓ" dimension.
4. Use doubler material and thickness given in rivet table.†
5. Distribute rivets as shown in examples in "Rivet Table Instructions."

*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot-dimpling tools are not available, brazier-head rivets may be used for temporary attachment of parts. (Replace with flush rivets as soon as possible.)

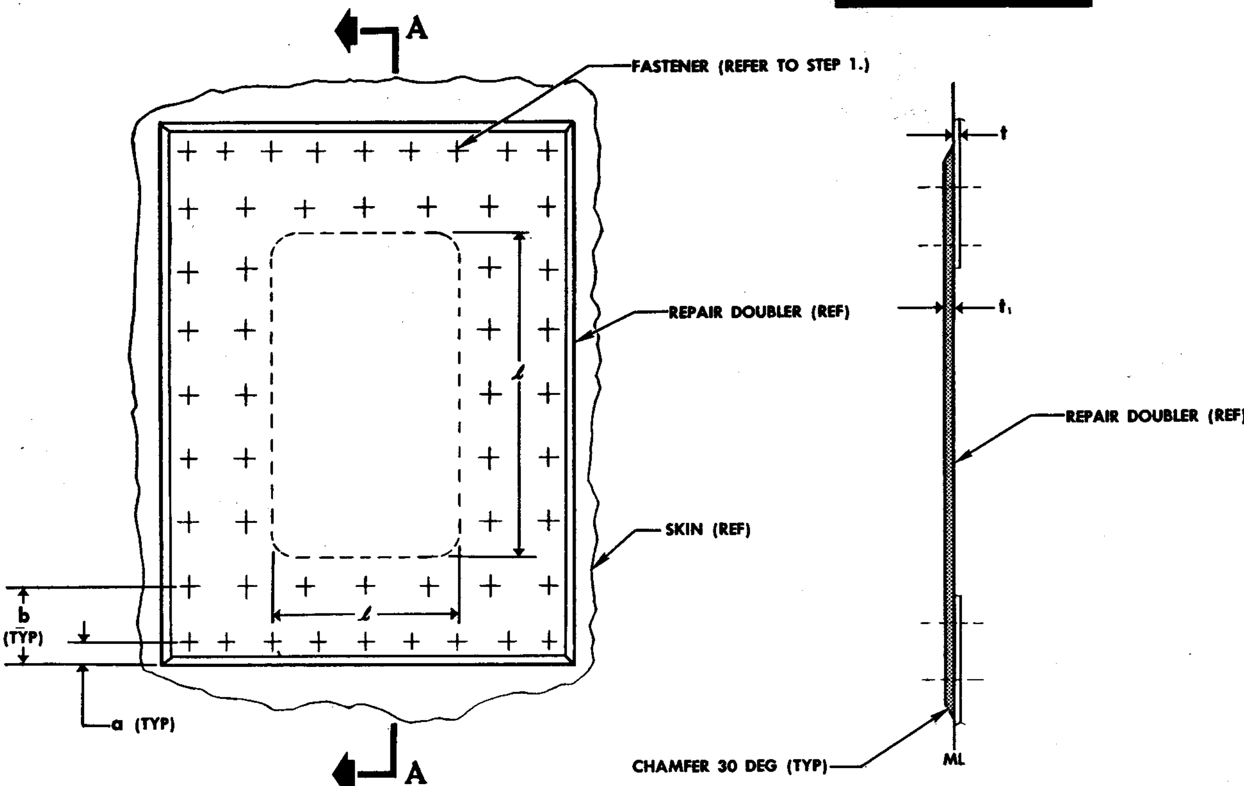
†One-half hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

One-half hard corrosion-resistant steel doublers may be substituted for aluminum alloy doublers in making skin repairs. Use material one-half the thickness given for aluminum alloy. GEN-3-91-53

Figure 10-25. Skin Repair—Tension

SKIN REPAIR—SHEAR AND TENSION

TYPICAL REPAIR



SECTION A–A

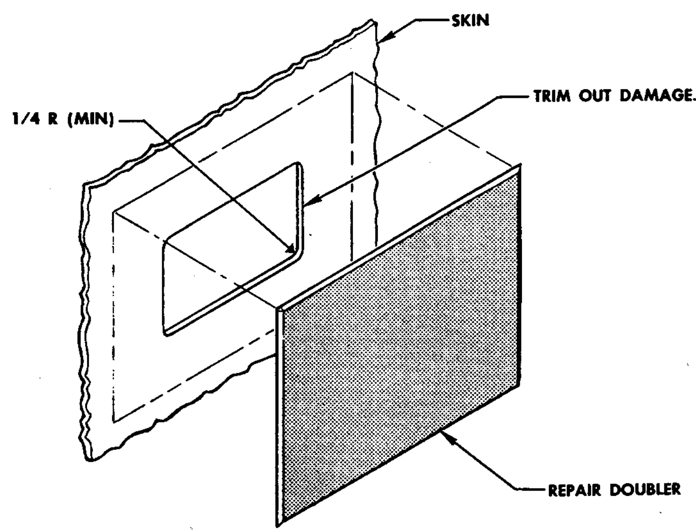
1. Select fastener type. Make selection on the basis of material being repaired, ease of installation, blind area problems, and tools available for use.*

2. Refer to rivet tables. Select applicable table.

3. Determine size of fastener and number required, as indicated for each "ℓ" dimension.

4. Use doubler material and thickness given in rivet table.†

5. Distribute rivets as shown in examples in "Rivet Table Instructions."



*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot dimpling tools are not available, brazier-head rivets may be used for temporary attachment of parts. (Replace with flush rivets as soon as possible.)

†1/2 hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

1/2 hard corrosion-resistant steel doublers may be substituted for aluminum alloy doublers in making skin repairs. Use material half the thickness given for aluminum alloy.

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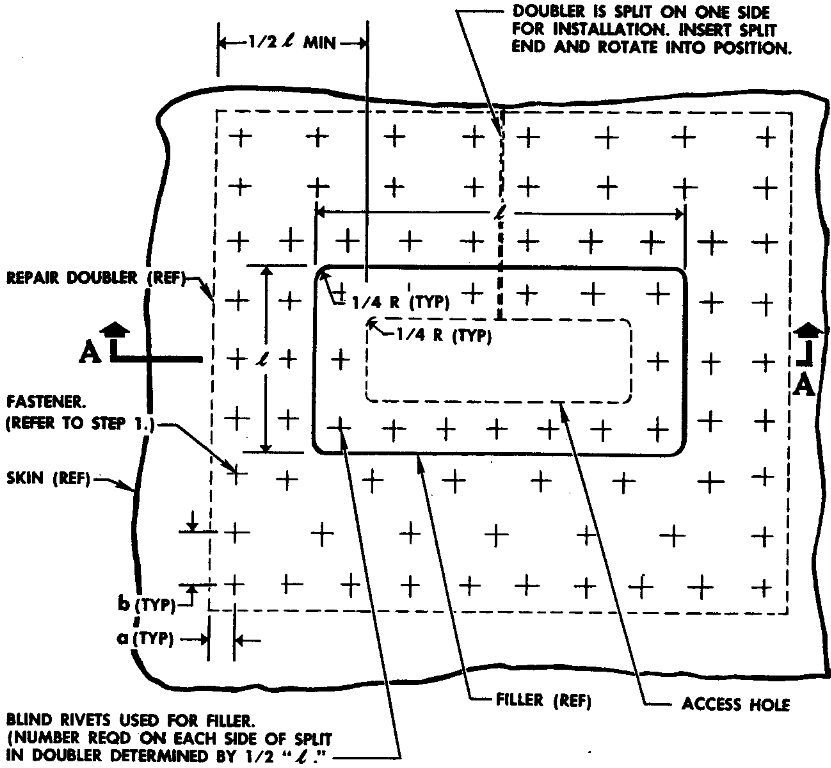
Figure 10-26. Skin Repair—Shear and Tension, Temporary

SKIN REPAIR - BLIND

TYPICAL REPAIR



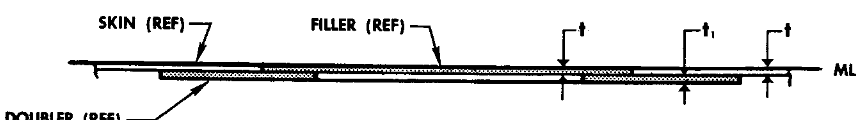
1. Select fastener type. This should be chosen on the basis of the material being repaired, the ease of installation, the blind area problems, and the tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated for each "ℓ" dimension.
4. Use doubler material and thickness given in rivet table.†
5. Distribute rivets as shown in examples in "Rivet Table Instructions."

*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot-dimpling tools are not available, brazier-head rivets may be used for temporary attachment of parts. (Replace with flush rivets as soon as possible.)

†One-half hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

One-half hard corrosion-resistant steel doublers may be substituted for aluminum alloy doublers in making skin repairs. Use material one-half the thickness given for aluminum alloy.



SECTION A A

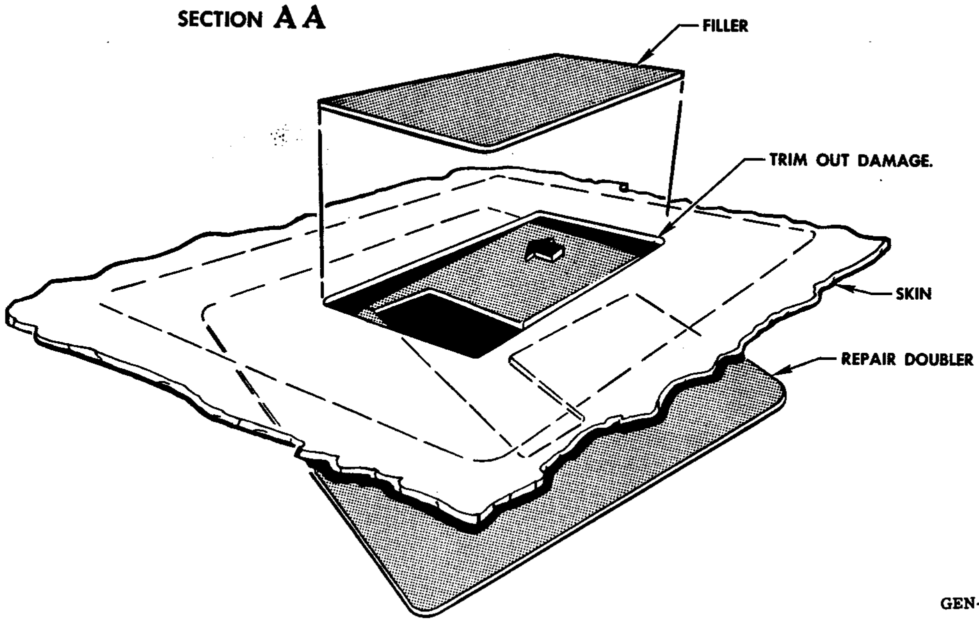
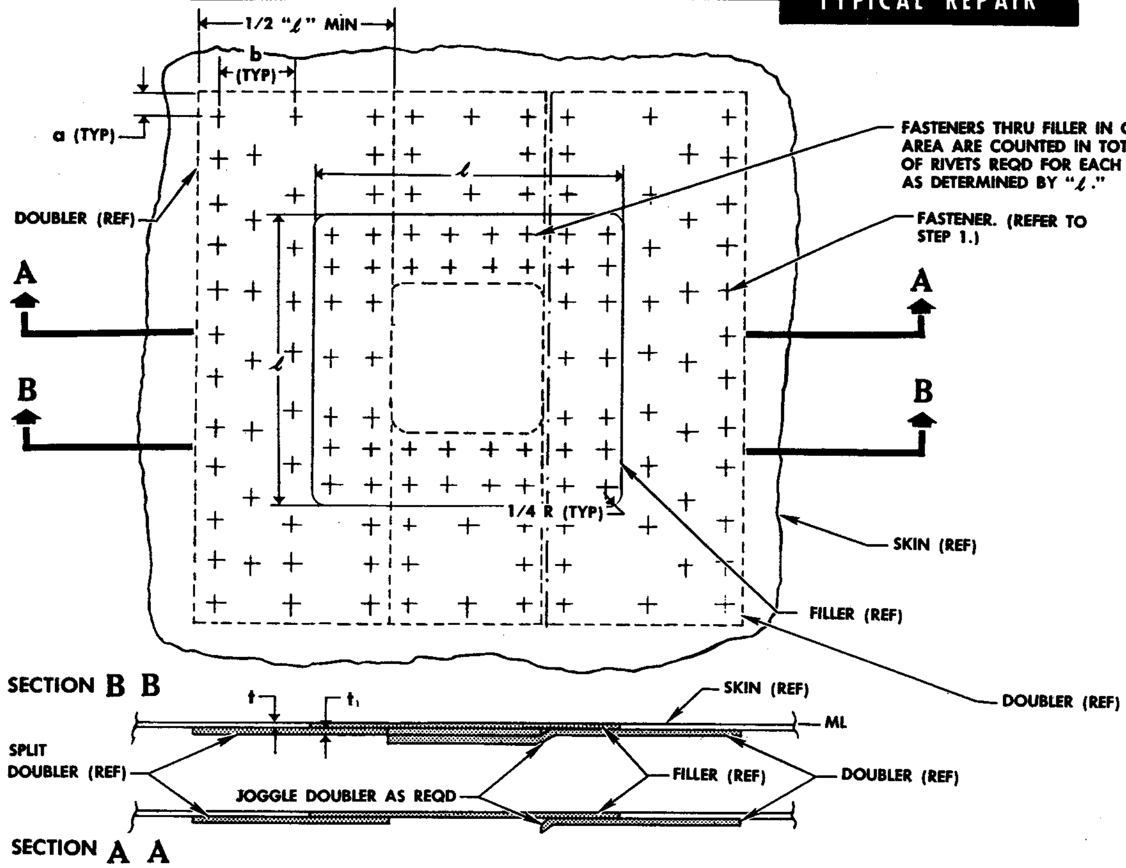
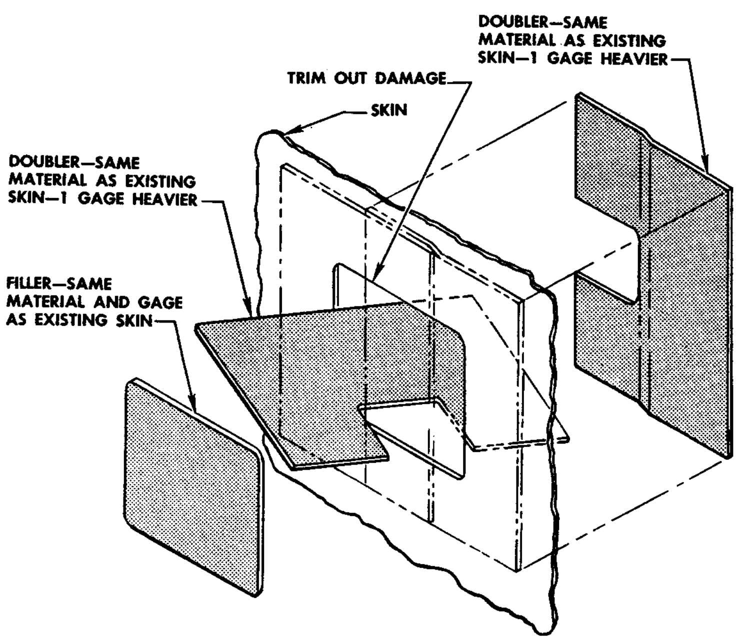


Figure 10-27. Skin Repair—Blind (Sheet 1 of 3)

SKIN REPAIR—BLIND

TYPICAL REPAIR





1. Select fastener type. This should be chosen on the basis of the material being repaired, the ease of installation, the blind area problems, and the tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated, for each "ℓ" dimension.
4. Use doubler material and thickness given in rivet table.†
5. Distribute rivets as shown in examples in "Rivet Table Instructions."

*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot-dimpling tools are not available, brazier-head rivets may be used for temporary attachment of parts. (Replace with flush rivets as soon as possible.)

†One-half hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

One-half hard corrosion-resistant steel doublers may be substituted for aluminum alloy doublers in making skin repairs. Use material one-half the thickness given for aluminum alloy.

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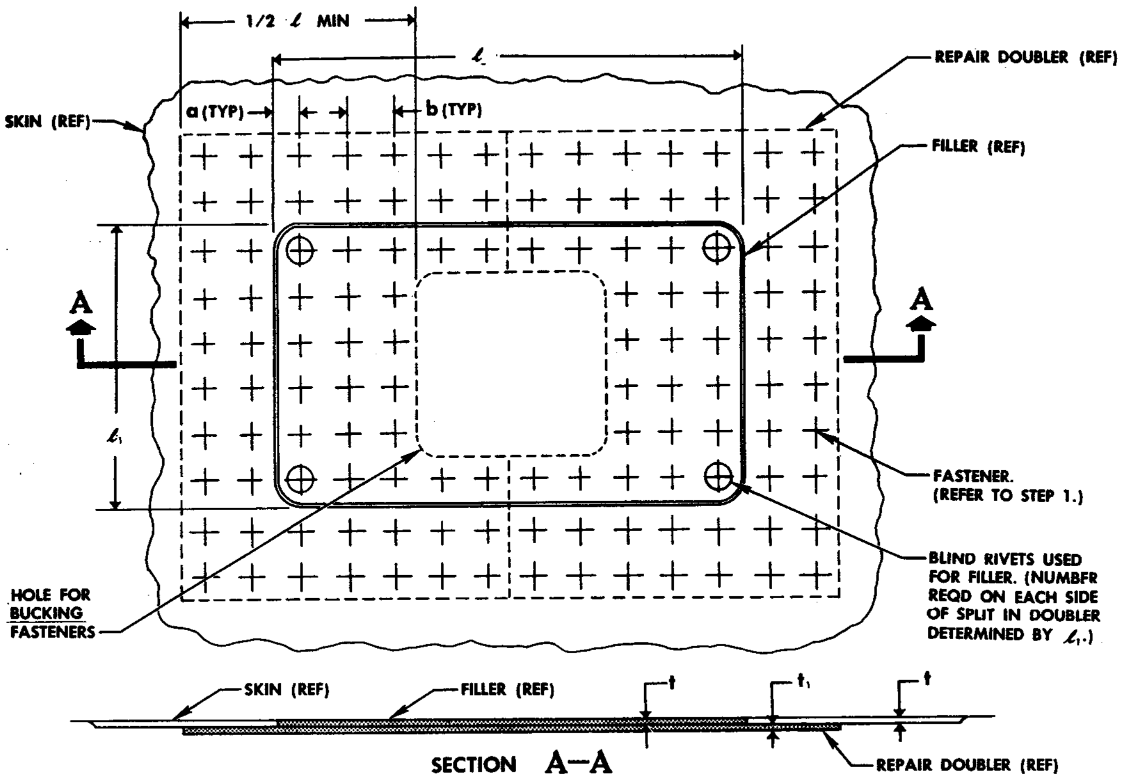
Figure 10-27. Skin Repair—Blind (Sheet 2 of 3)

SKIN REPAIR - BLIND

TYPICAL REPAIR



1. Select fastener type. This should be chosen on the basis of the material being repaired, the ease of installation, the blind area problems, and the tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated for each "ℓ" dimension.
4. Use doubler material and thickness given in rivet table.†
5. Distribute rivets as shown in examples in "Rivet Table Instructions."

*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot-dimpling tools are not available, brazier-head rivets may be used for temporary attachment of parts. (Replace with flush rivets as soon as possible.)

†One-half hard corrosion-resistant steel sheet may ed substituted for titanium, both pure and alloy, unless otherwise noted.

One-half hard corrosion-resistant steel doublers may be substituted for aluminum alloy doublers in making skin repairs. Use material one-half the thickness given for aluminum alloy.

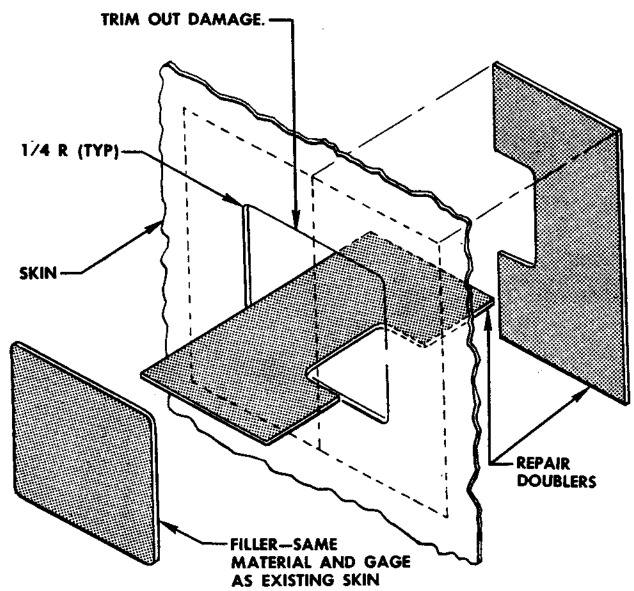


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Figure 10-27. Skin Repair—Blind (Sheet 3 of 3)

SECONDARY STRUCTURE—BLIND

TYPICAL REPAIR

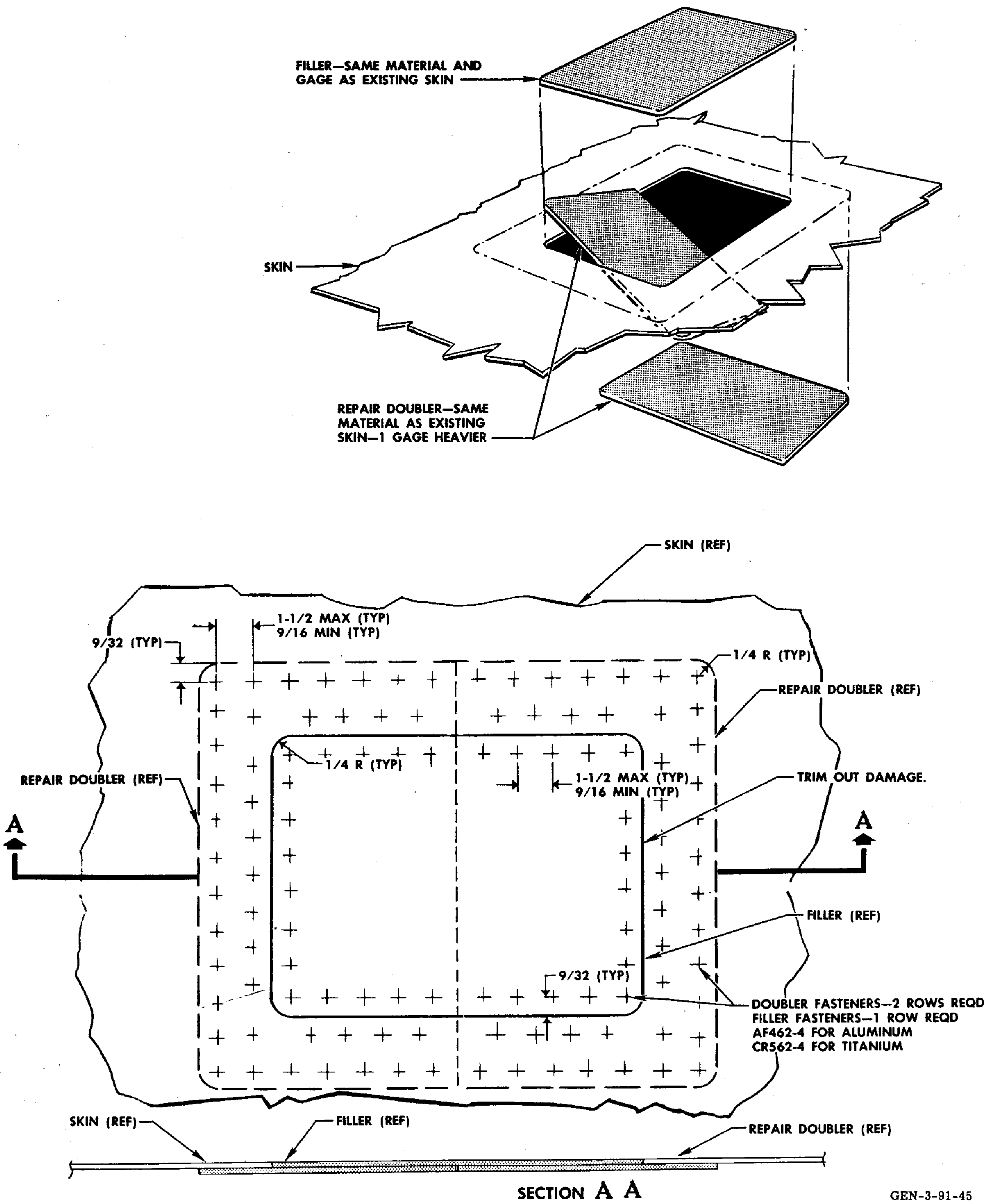


Figure 10-28. Skin Repair—Blind, Secondary Structure (Sheet 1 of 4)

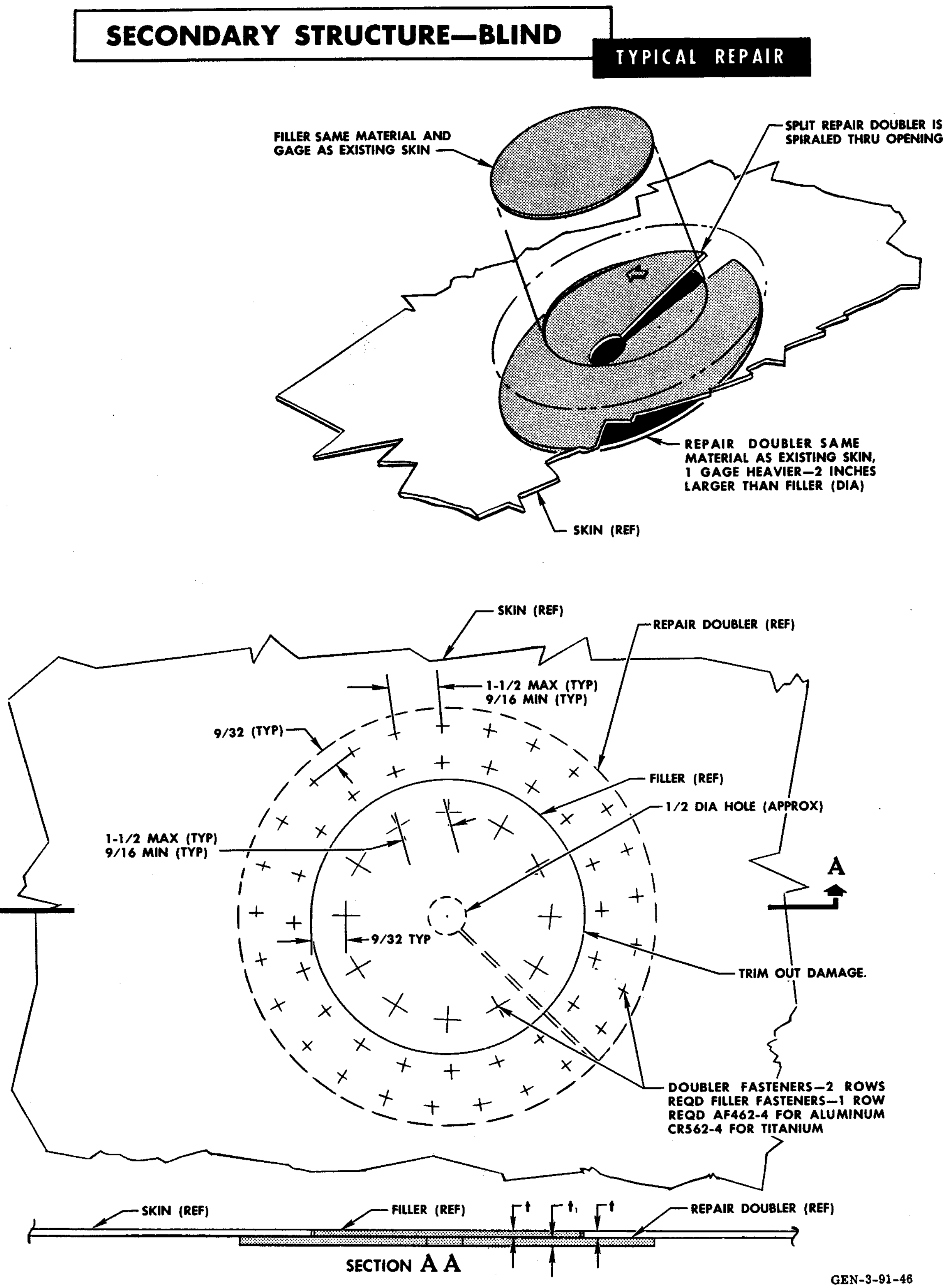


Figure 10-28. Skin Repair—Blind, Secondary Structure (Sheet 2 of 4)

SECONDARY STRUCTURE - BLIND

TYPICAL REPAIR

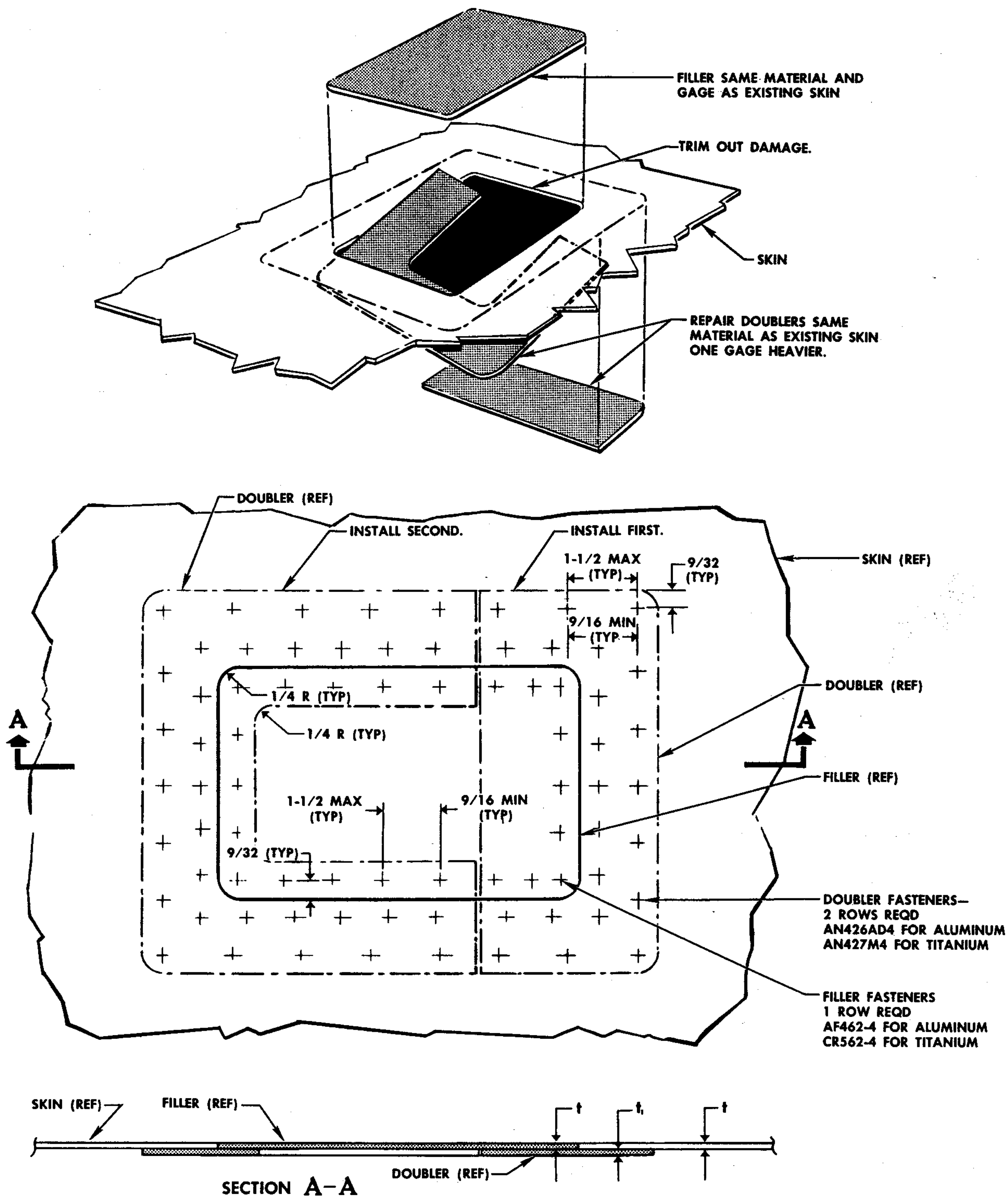


Figure 10-28. Skin Repair—Blind, Secondary Structure (Sheet 3 of 4)

SECONDARY STRUCTURE—BLIND

TYPICAL REPAIR

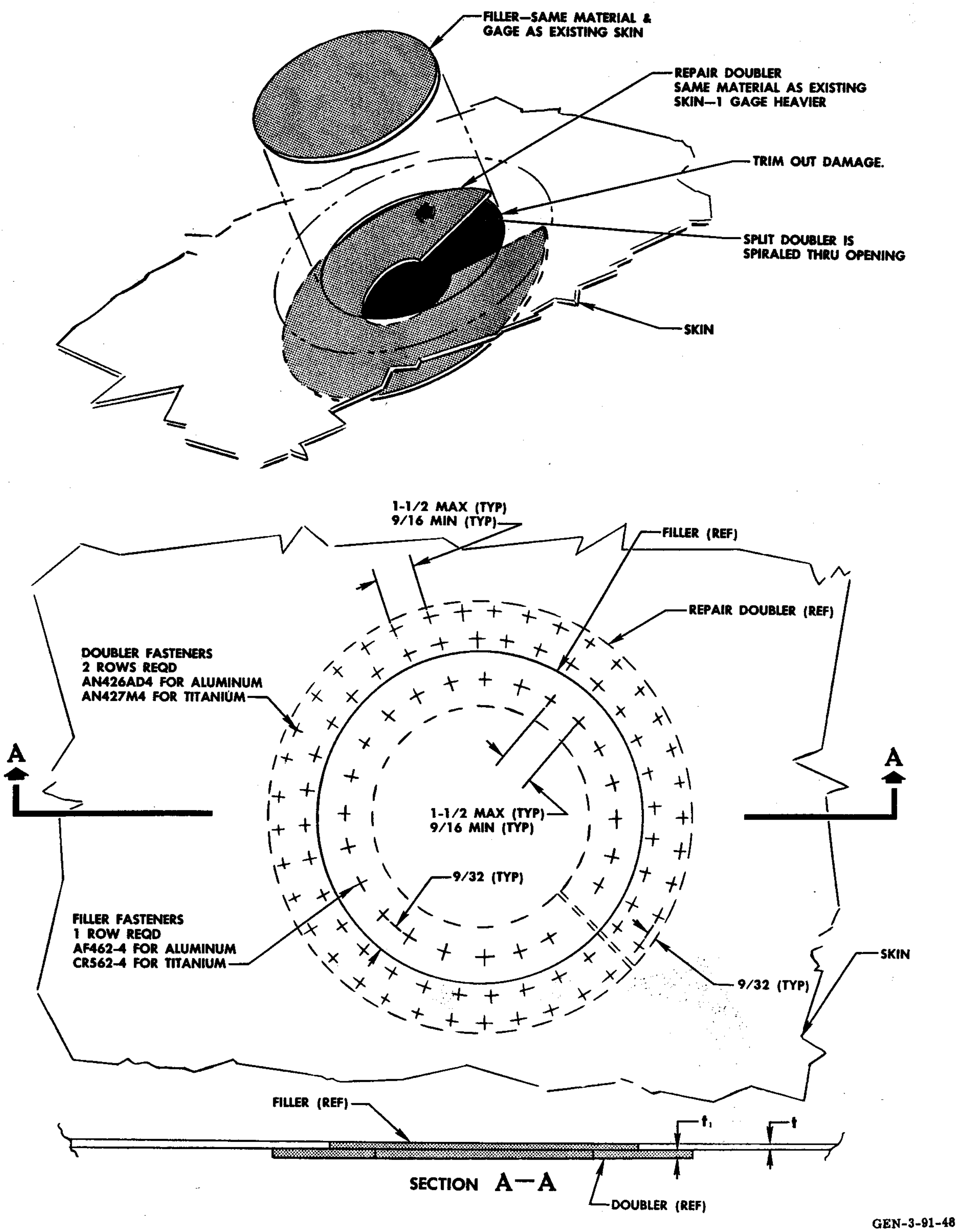
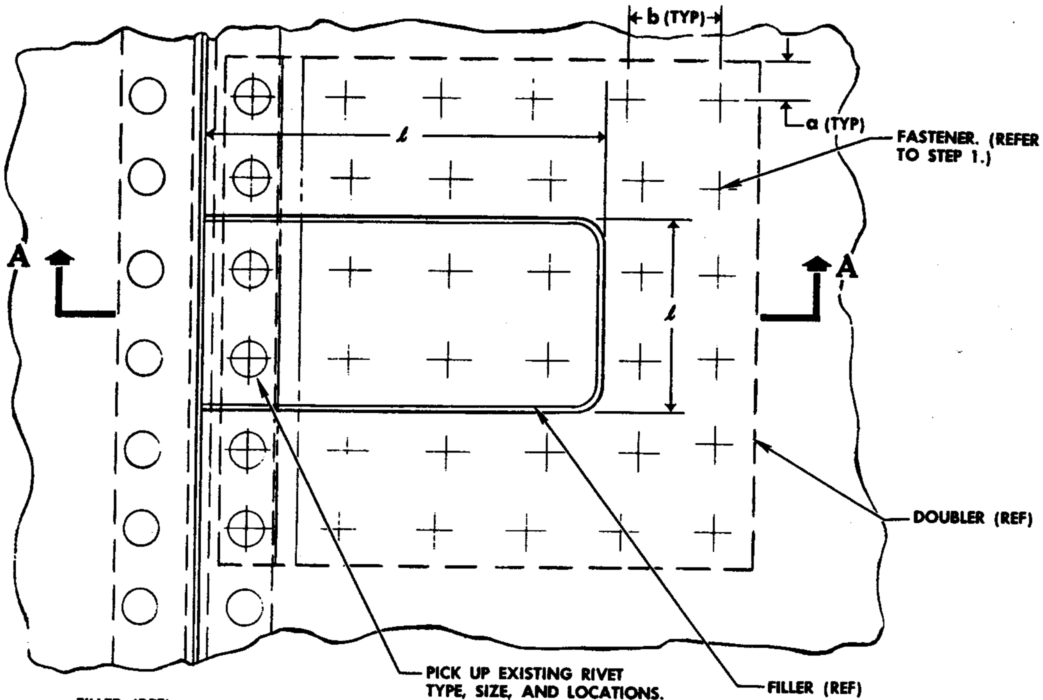
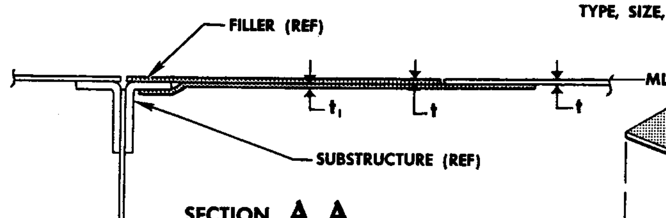


Figure 10-28. Skin Repair—Blind, Secondary Structure (Sheet 4 of 4)

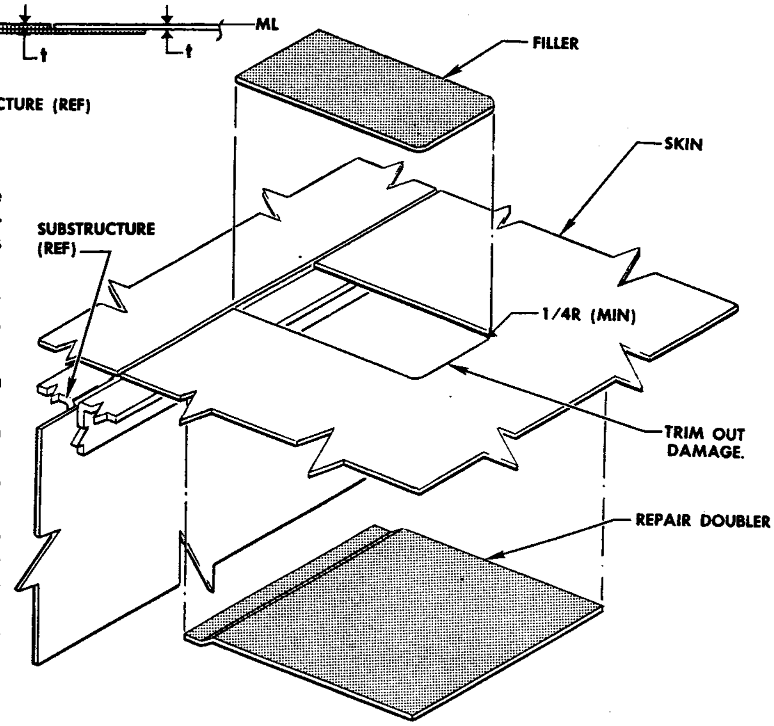
SKIN END REPAIR—SHEAR

TYPICAL REPAIR





SECTION A A



1. Select fastener type. Make selection on the basis of material being repaired, ease of installation, blind area problems, and tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated for each "ℓ" dimension.
4. Use doubler material and thickness given in rivet table.†
5. Distribute rivets as shown in examples in "Rivet Table Instructions."

*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot dimpling tools are not available, brazier-head rivets may be used for temporary attachment of parts. (Replace with flush rivets as soon as possible.)

†1/2 hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

1/2 hard corrosion-resistant steel doublers may be substituted for aluminum alloy doublers in making skin repairs.

Use material half the thickness given for aluminum alloy.

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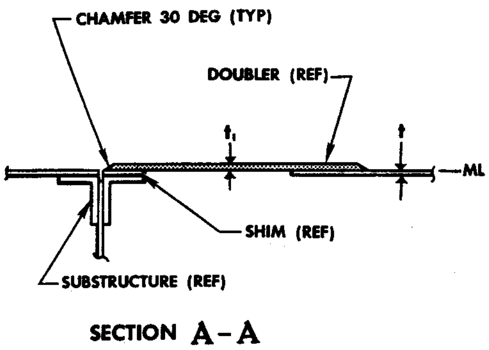
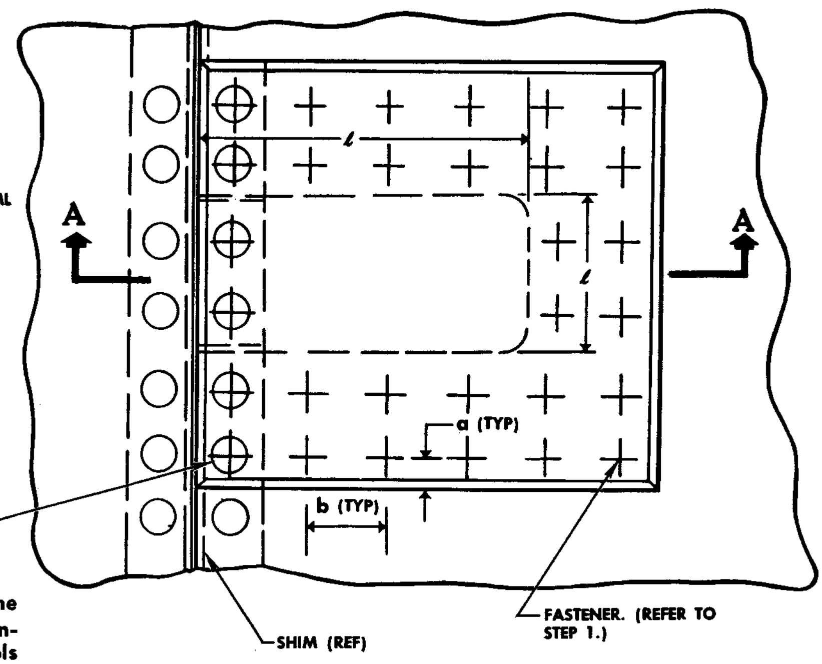
Figure 10-29. Skin End Repair—Shear

SKIN END REPAIR—SHEAR

TYPICAL REPAIR





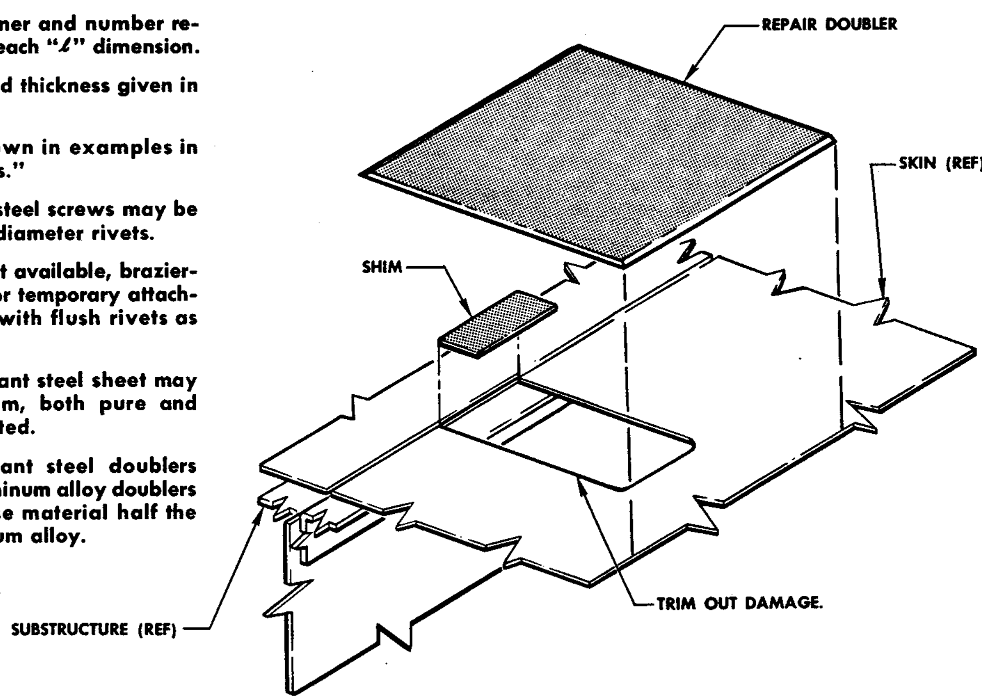
1. Select fastener type. Make selection on the basis of material being repaired, ease of installation, blind area problems, and tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated for each "ℓ" dimension.
4. Use doubler material and thickness given in rivet table.†
5. Distribute rivets as shown in examples in "Rivet Table Instructions."

*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot dimpling tools are not available, brazier-head rivets may be used for temporary attachments of parts. (Replace with flush rivets as soon as possible.)

†1/2 hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

1/2 hard corrosion-resistant steel doublers may be substituted for aluminum alloy doublers in making skin repairs. Use material half the thickness given for aluminum alloy.

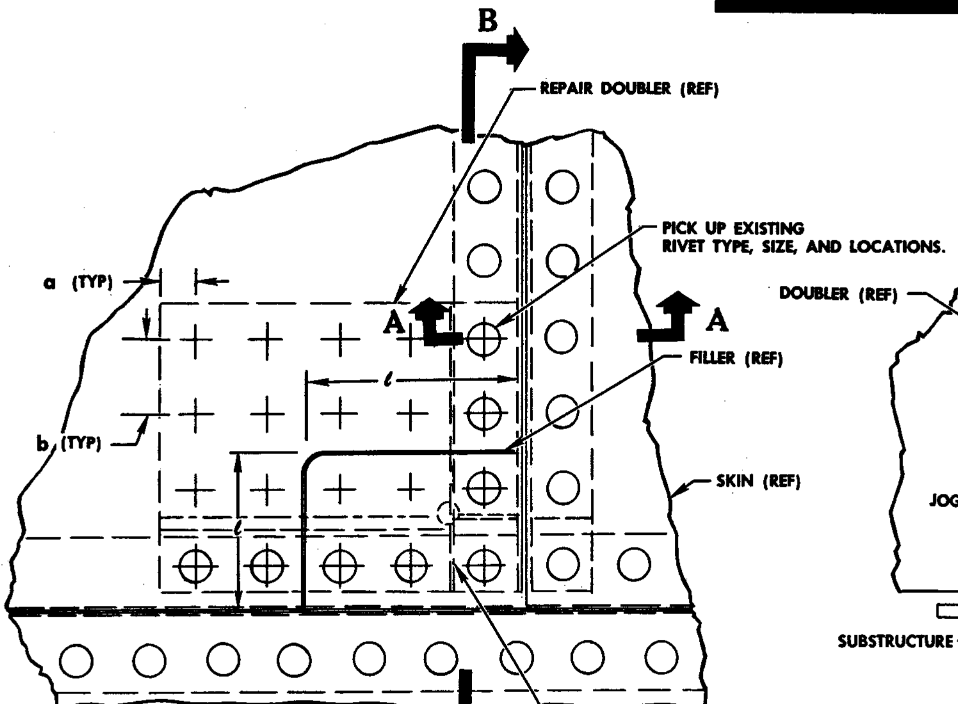


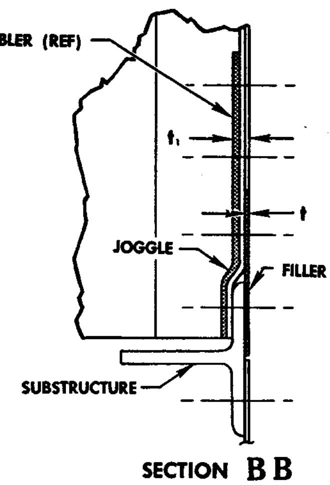
GEN-3-91-41

Figure 10-30. Skin End Repair—Shear, Temporary

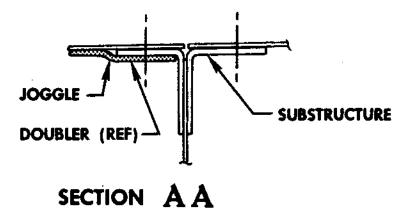
SKIN END REPAIR

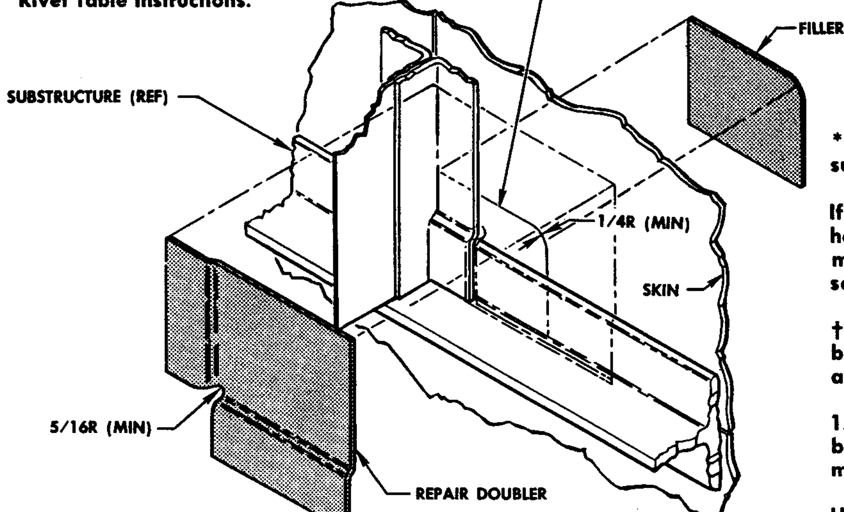
TYPICAL REPAIR





1. Select fastener type. Make selection on the basis of material being repaired, ease of installation, blind area problems, and tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated for each "ℓ" dimension.
4. Use doubler material and thickness given in rivet table.†
5. Distribute rivets as shown in examples in "Rivet Table Instructions."





*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot dimpling tools are not available, brazier-head rivets may be used for temporary attachment of parts. (Replace with flush rivets as soon as possible.)

†1/2 hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

1/2 hard corrosion-resistant steel doublers may be substituted for aluminum alloy doublers in making skin repairs.

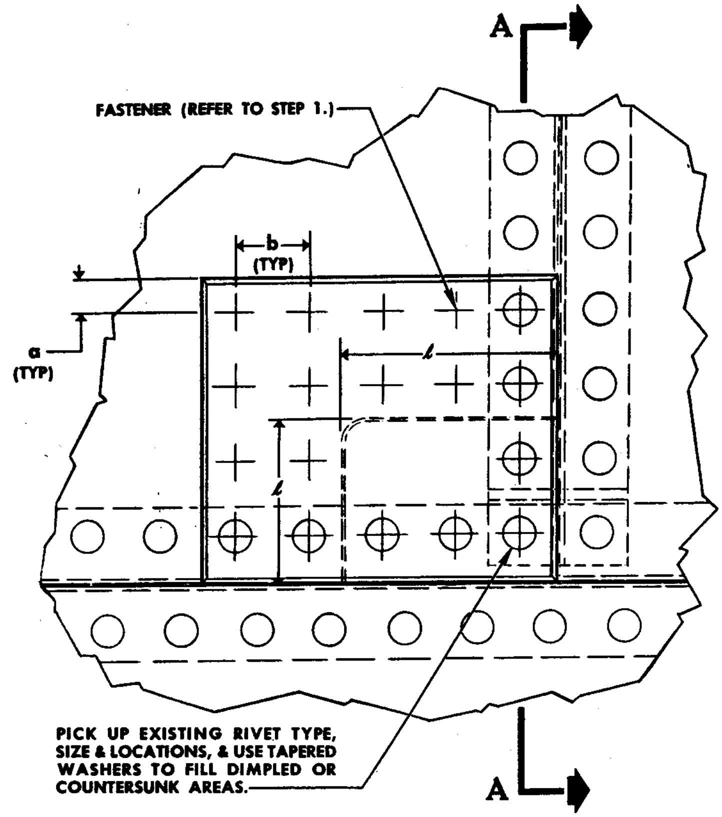
Use material half the thickness given for aluminum alloy.

GEN-3-91-44

Figure 10-31. Skin End Repair—Corner, Shear

SKIN END REPAIR—SHEAR

TYPICAL REPAIR



1. Select fastener type. Make selection on the basis of material being repaired, ease of installation, blind area problems, and tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated for each "ℓ" dimension.
4. Use doubler material and thickness given in rivet table.†
5. Distribute rivets as shown in examples in "Rivet Table Instructions."

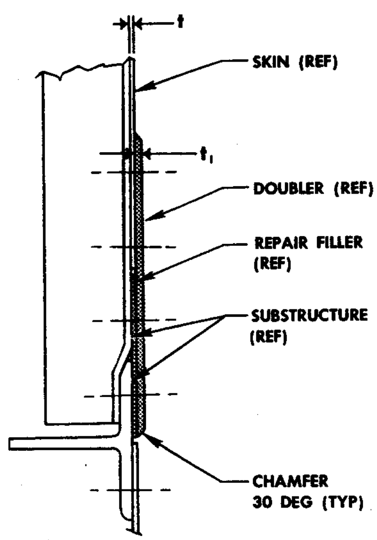
*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot dimpling tools are not available, brazier-head rivets may be used for temporary attachment of parts. (Replace with flush rivets as soon as possible.)

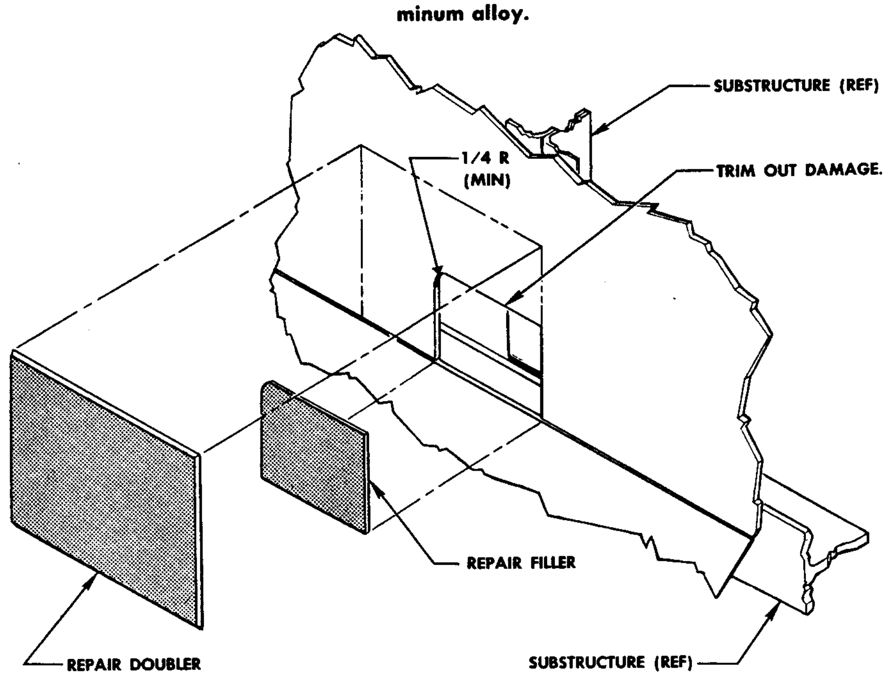
†1/2 hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

1/2 hard corrosion-resistant steel doublers may be substituted for aluminum alloy doublers in making skin repairs.

Use material half the thickness given for aluminum alloy.



SECTION A–A

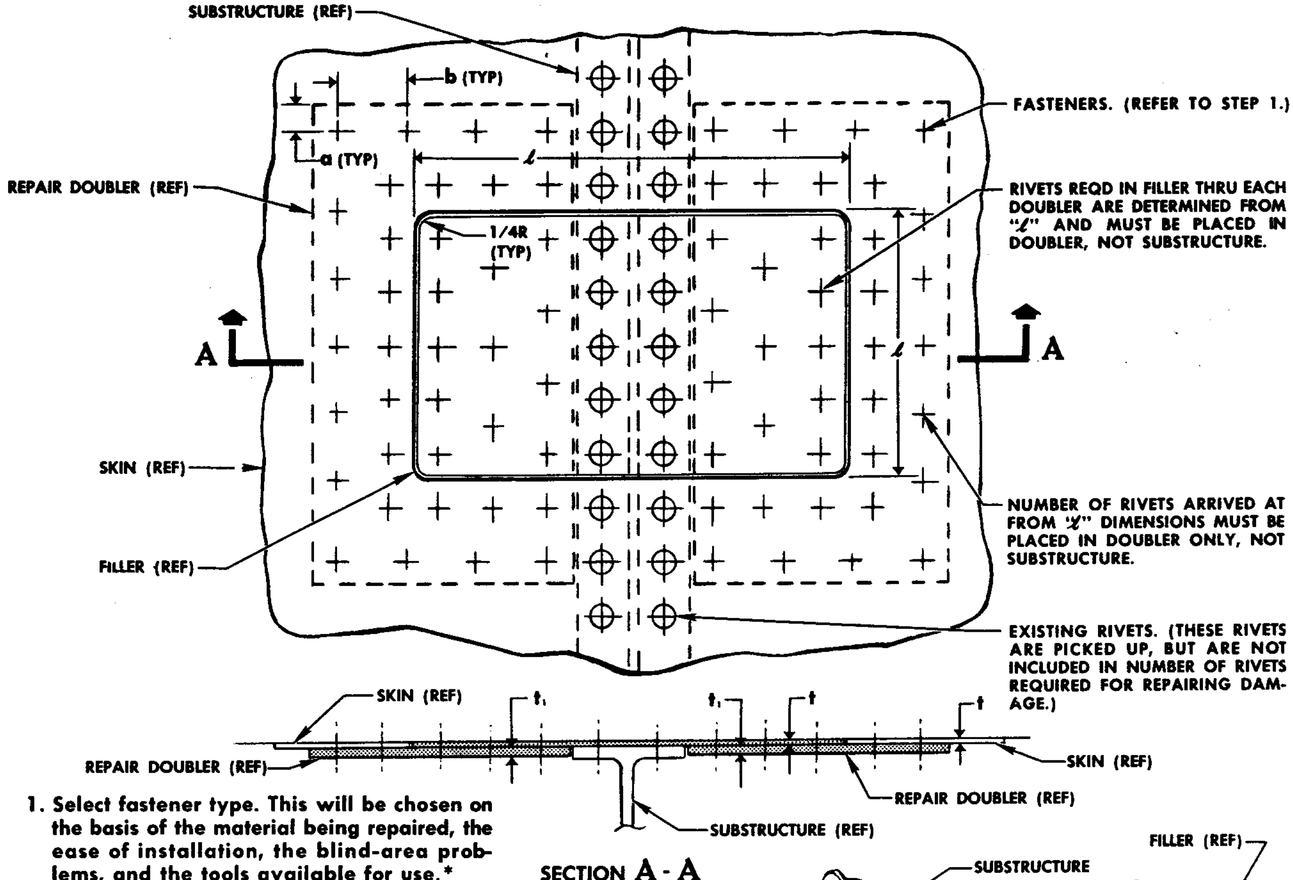


GEN-3-91-43

Figure 10-32. Skin End Repair—Corner, Shear, Temporary

SKIN OVER SUBSTRUCTURE - SHEAR AND TENSION

TYPICAL REPAIR



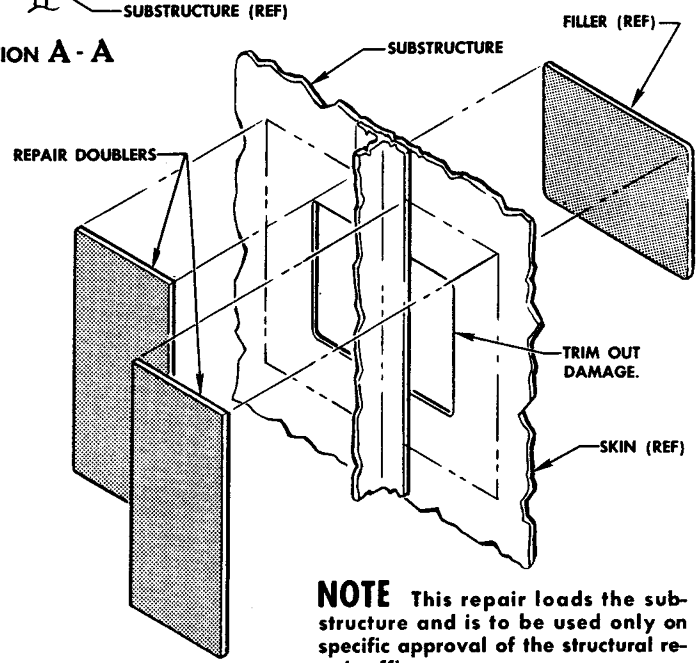
1. Select fastener type. This will be chosen on the basis of the material being repaired, the ease of installation, the blind-area problems, and the tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated for each "ℓ" dimension.
4. Use doubler material and thickness given in rivet table.†
5. Distribute rivets as shown in examples in "Rivet Table Instructions."

*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot-dimpling tools are not available, brazier-head rivets may be used for temporary attachment of parts. Replace with flush rivets as soon as possible.

†One-half hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

One-half hard corrosion-resistant steel doublers may be substituted for aluminum alloy doublers in making skin repairs. Use material half the thickness given tor aluminum alloy.



NOTE This repair loads the substructure and is to be used only on specific approval of the structural repair officer.

GEN-3-91-38

Figure 10-33. Skin Over Substructure Repair—Shear and Tension (Sheet 1 of 3)

SKIN OVER SUBSTRUCTURE - SHEAR AND TENSION

TYPICAL REPAIR

USE OF THIS REPAIR MUST BE APPROVED BY STRUCTURAL REPAIR OFFICER.

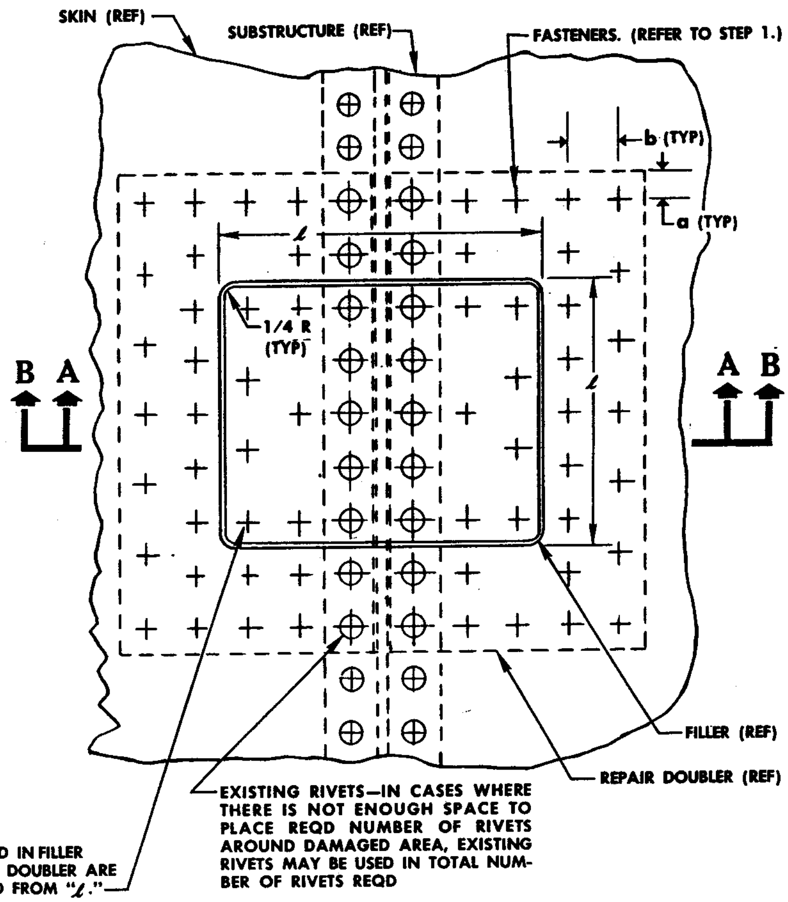
1. Select fastener type. This should be chosen on the basis of the material being repaired, the ease of installation, the blind area problems, and the tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated for each "ℓ" dimension.
4. Use doubler material and thickness given in rivet table.†
5. Distribute rivets as shown in examples in "Rivet Table Instructions."

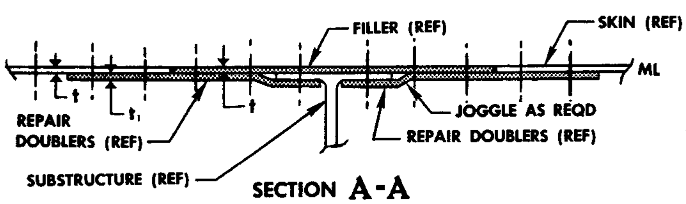
*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

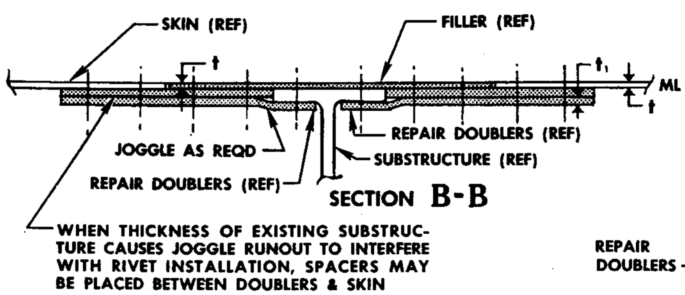
If hot-dimpling tools are not available, brazier-head rivets may be used for temporary attachment of parts. (Replace with flush rivets as soon as possible.)

†One-half hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

One-half hard corrosion-resistant steel doublers may be substituted for aluminum alloy doublers in making skin repairs. Use material one-half the thickness given for aluminum alloy.







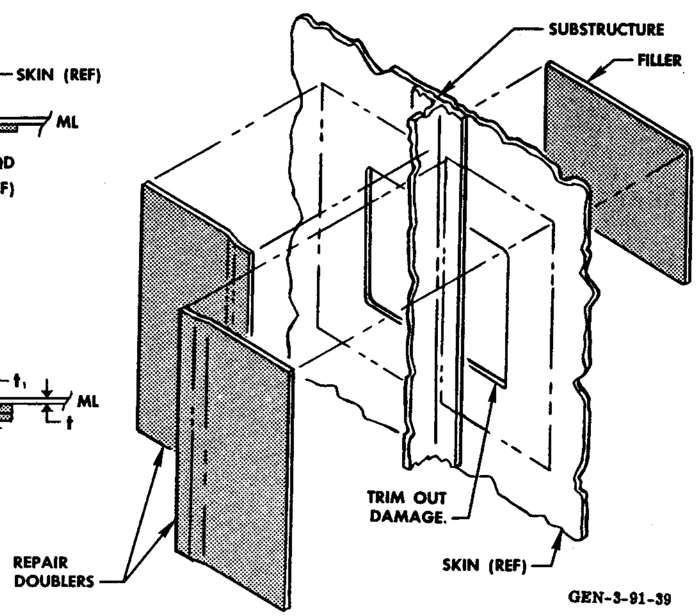
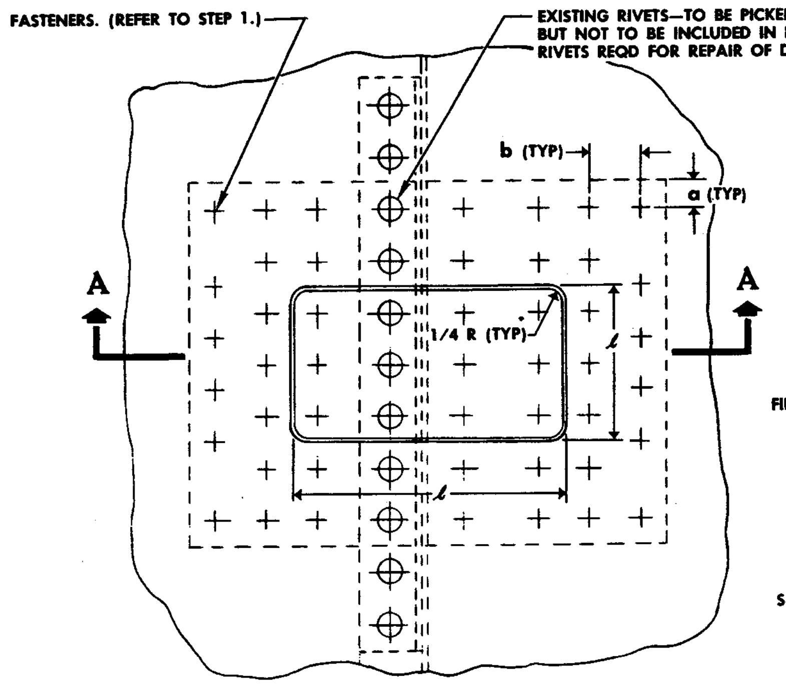
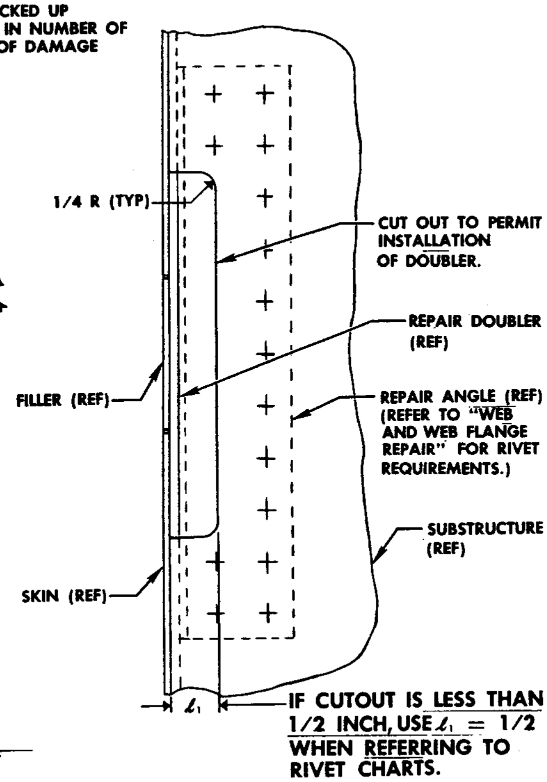


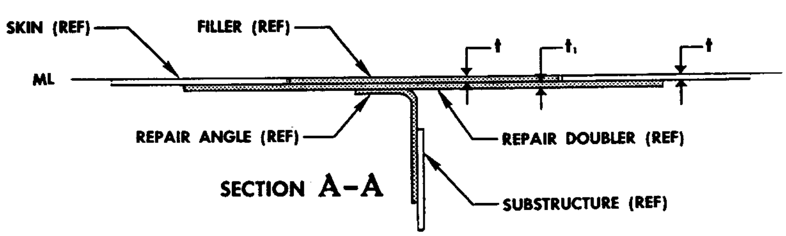
Figure 10-33. Skin Over Substructure Repair—Shear and Tension (Sheet 2 of 3)

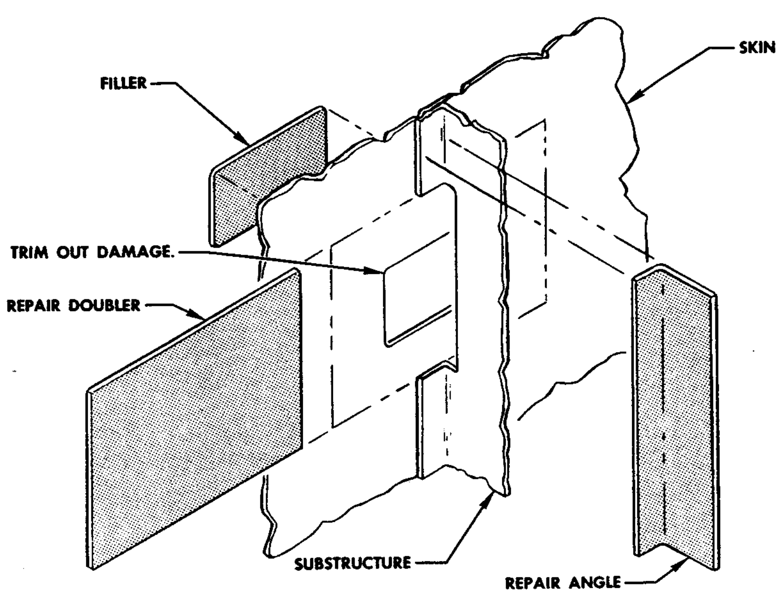
SKIN OVER SUBSTRUCTURE - SHEAR AND TENSION

TYPICAL REPAIR









1. Select fastener type. This should be chosen on the basis of the material being repaired, the ease of installation, the blind area problems, and the tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated for each "ℓ" dimension.
4. Use doubler material and thickness given in rivet table.†
5. Distribute rivets as shown in examples in "Rivet Table Instructions."

*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot-dimpling tools are not available, brazier-head rivets may be used for temporary attachment of parts. Replace with flush rivet as soon as possible.

†One-half hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

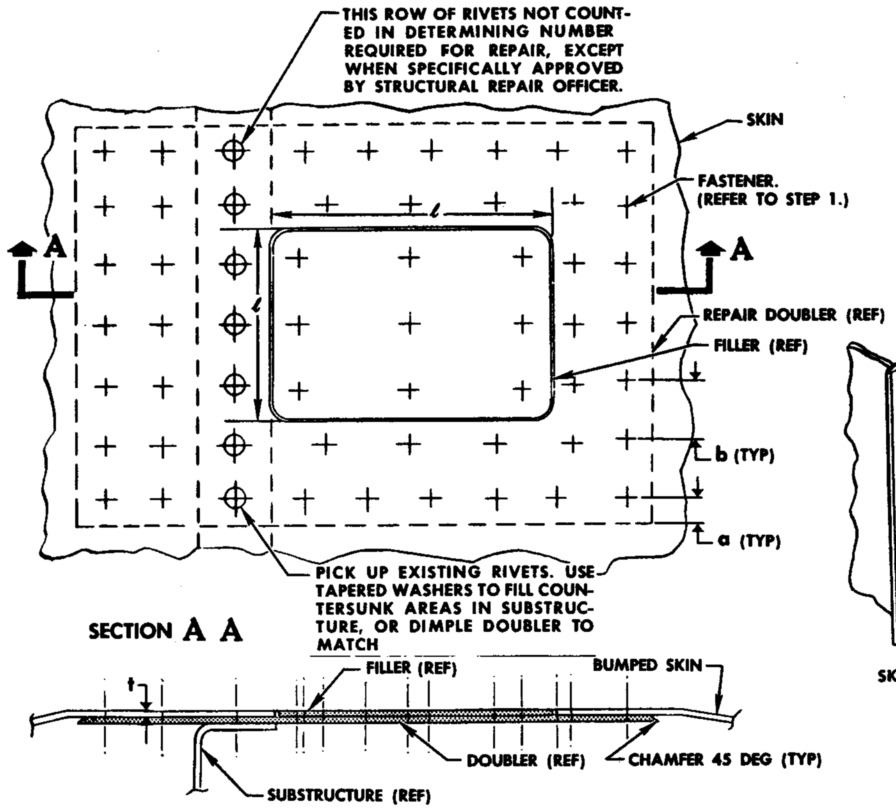
One-half hard corrosion-resistant steel doublers may be substituted for aluminum alloy doublers in making skin repairs. Use material one-half the thickness given for aluminum alloy.

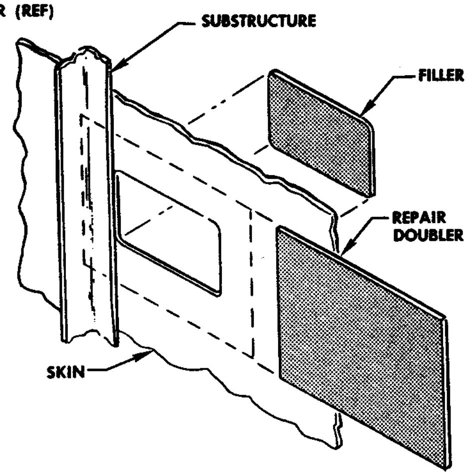
GEN-3-91-40

Figure 10-33. Skin Over Substructure Repair—Shear and Tension (Sheet 3 of 3)

SKIN AT SUBSTRUCTURE - SHEAR

TYPICAL REPAIR





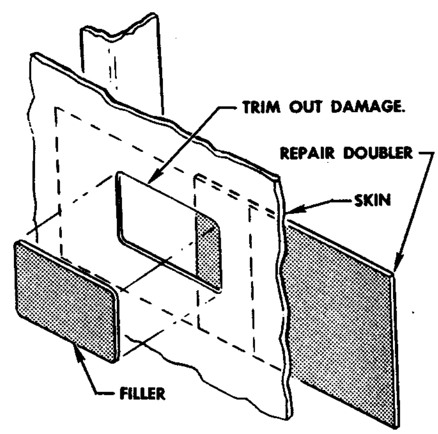
1. Select fastener type. This should be chosen on the basis of the material being repaired, the ease of installation, the blind area problems, and the tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated for each "ℓ" dimension.
4. Use doubler material and thickness given in rivet table.†
5. Distribute rivets as shown in examples in "Rivet Table Instructions."

*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot-dimpling tools are not available, brazier-head rivets may be used for temporary attachment of parts. (Replace with flush rivets as soon as possible.)

†One-half hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

One-half hard corrosion-resistant steel doublers may be substituted for aluminum alloy doublers in making skin repairs. Use material one half the thickness given for aluminum alloy.



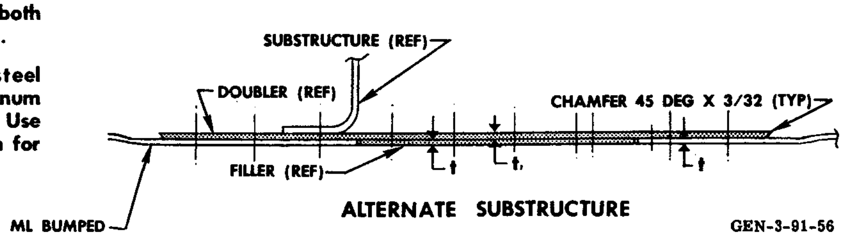
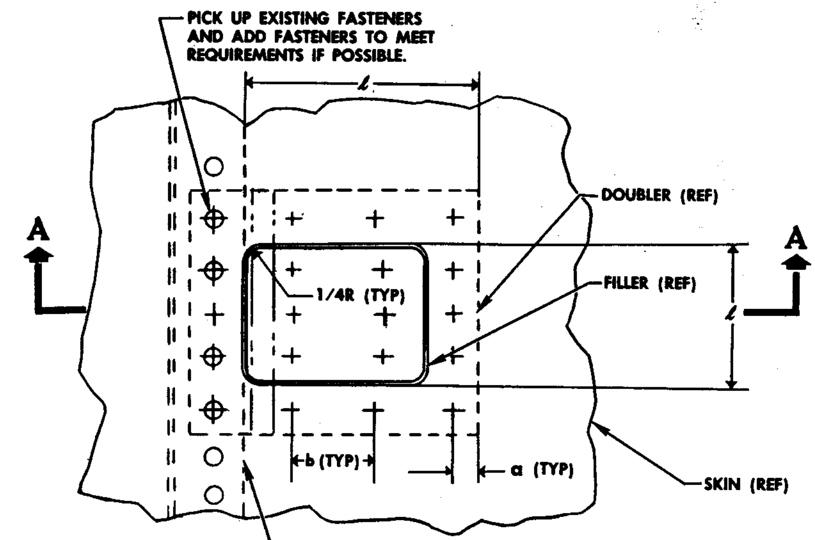


Figure 10-34. Skin Repair Adjacent to Substructure—Shear (Sheet 1 of 2)

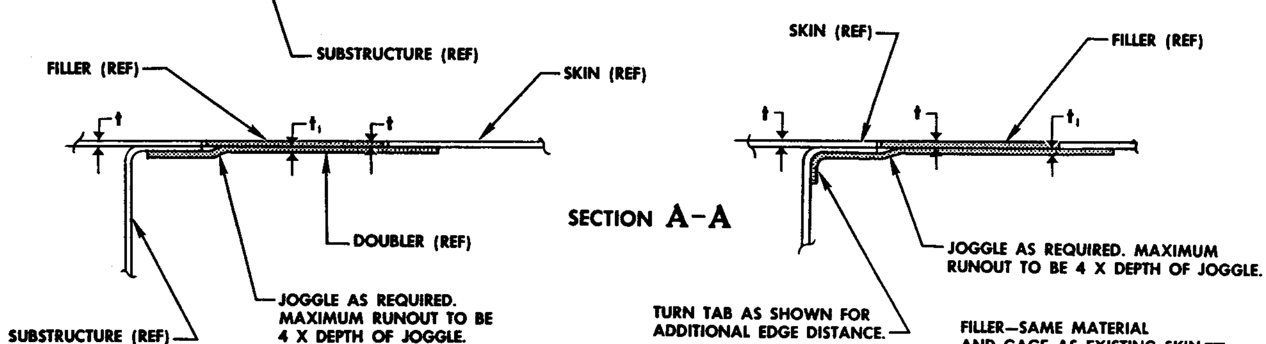
SKIN AT SUBSTRUCTURE —SHEAR

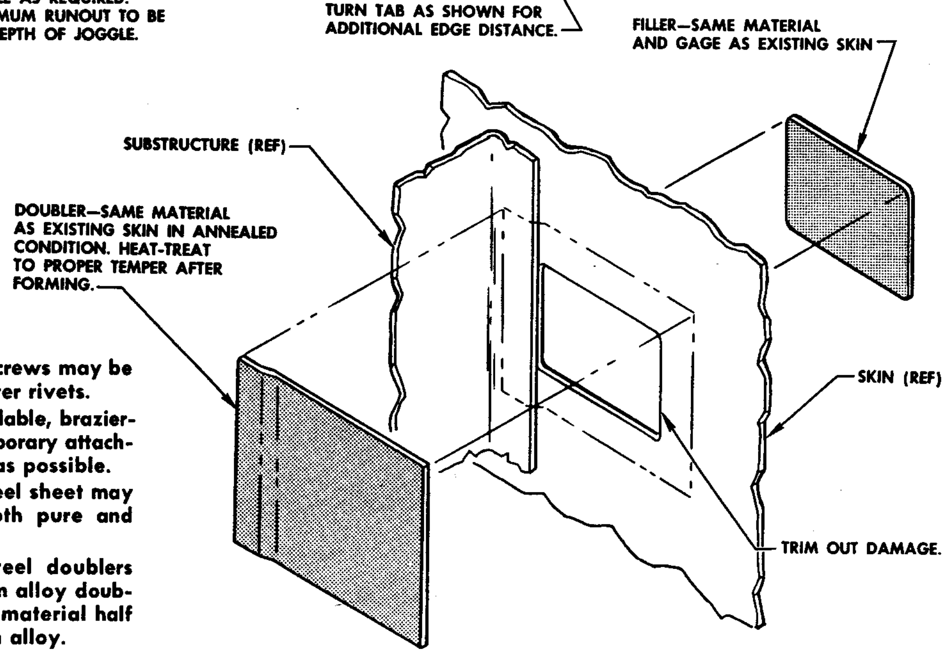
TYPICAL REPAIR



USE OF THESE REPAIRS MUST BE APPROVED BY STRUCTURAL REPAIR OFFICER.

1. Select fastener type. Make selection on the basis of material being repaired, ease of installation, blind area problems, and tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated for each "ℓ" dimension.
4. Use doubler material and thickness given in rivet table.†
5. Distribute rivets as shown in examples in "Rivet Table Instructions."





*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

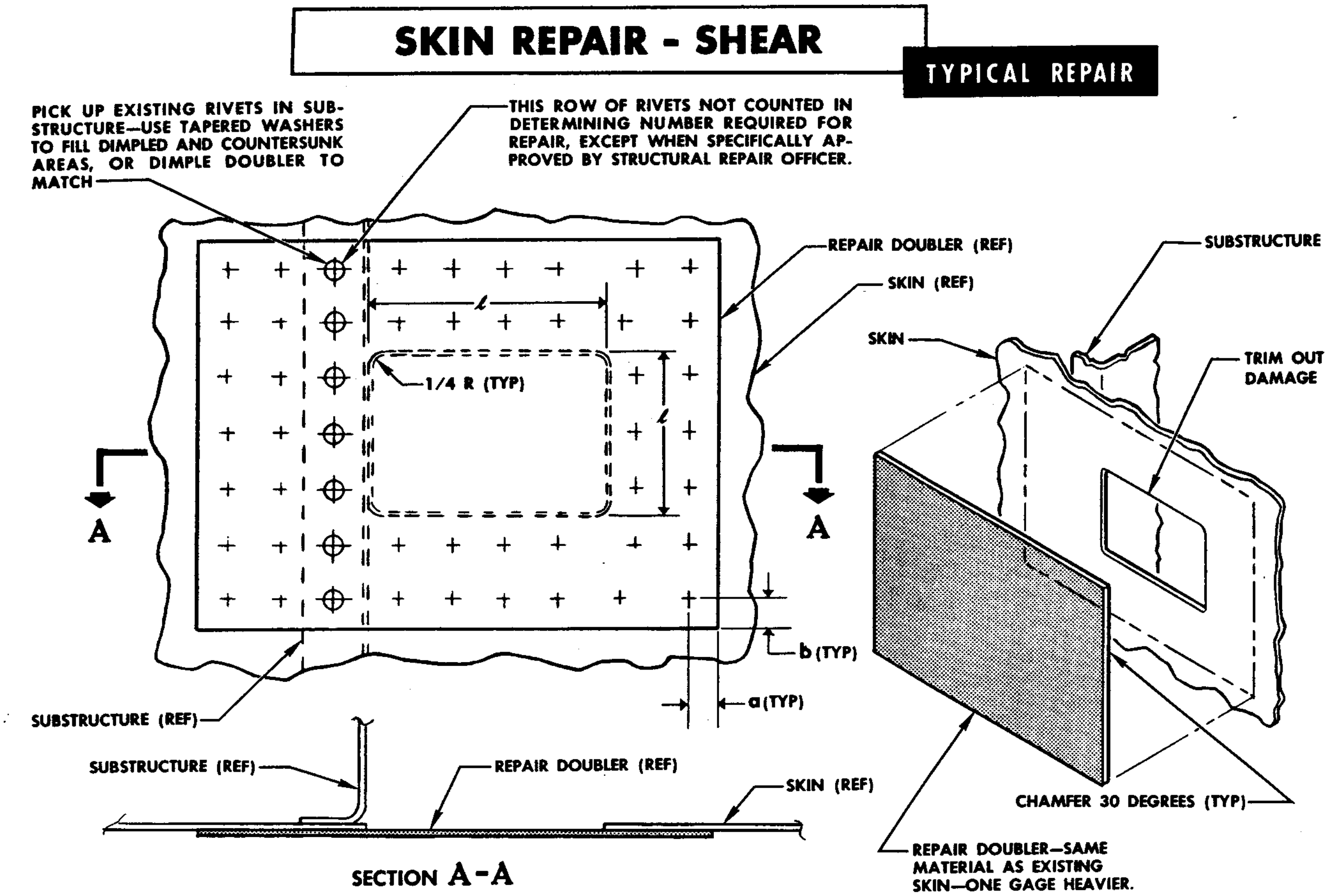
If hot dimpling tools are not available, brazier-head rivets may be used for temporary attachment of parts. Replace as soon as possible.

†1/2 hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

1/2 hard corrosion-resistant steel doublers may be substituted for aluminum alloy doublers in making skin repairs. Use material half the thickness given for aluminum alloy.

GEN-3-91-58

Figure 10-34. Skin Repair Adjacent to Substructure—Shear (Sheet 2 of 2)



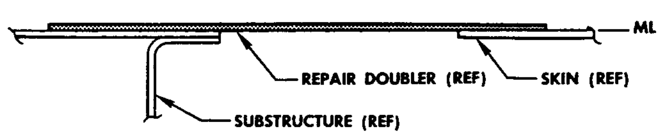
1. Select fastener type. This should be chosen on the basis of the material being repaired, the ease of installation, the blind area problems, and the tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated for each "ℓ" dimension.
4. Use doubler material and thickness given in rivet table.†
5. Distribute rivets as shown in examples in "Rivet Table Instructions."

*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot-dimpling tools are not available, brazier-head rivets may be used for temporary attachment of parts. (Replace with flush rivets as soon as possible.)

†One-half hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

One-half hard corrosion-resistant steel doublers may be substituted for aluminum alloy doublers in making skin repairs. Use material one-half the thickness given for aluminum alloy.



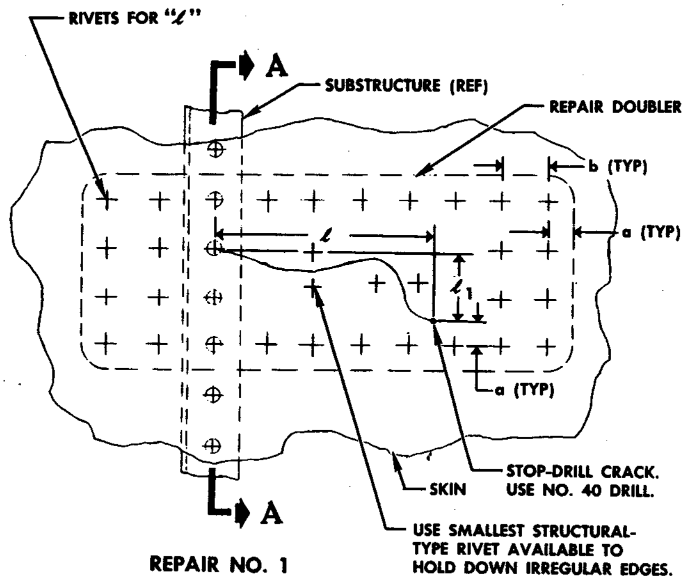
ALTERNATE CONDITION

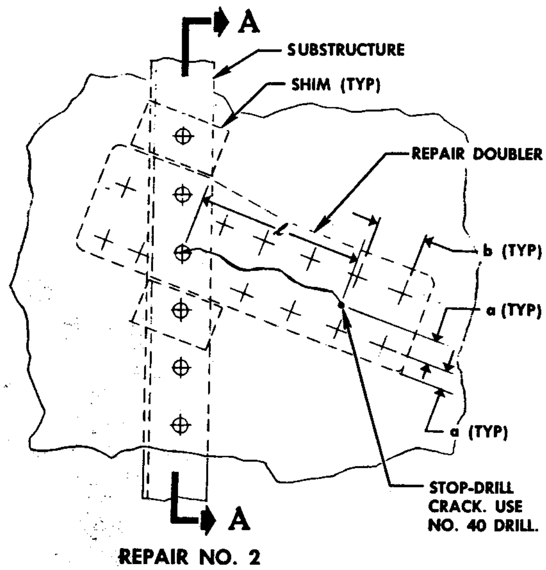
GEN-3-91-55

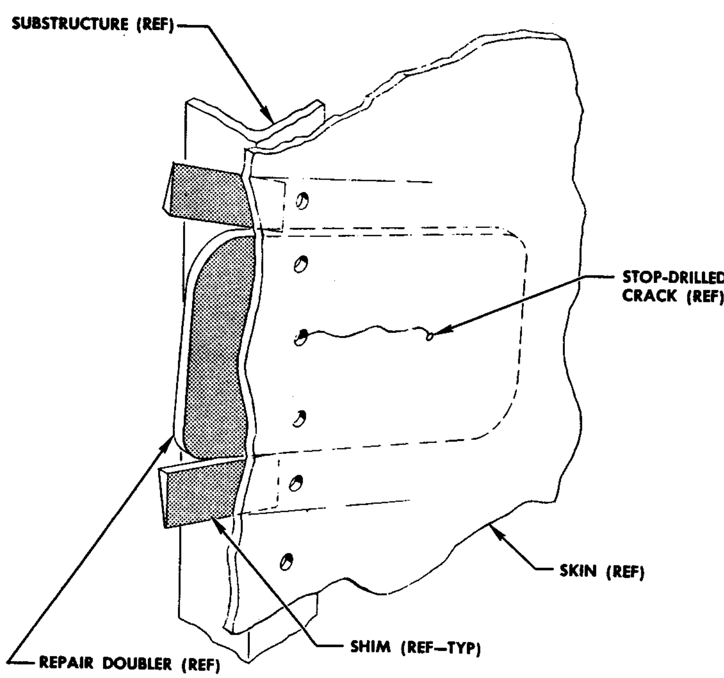
Figure 10-35. Skin Repair Adjacent to Substructure—Shear Temporary

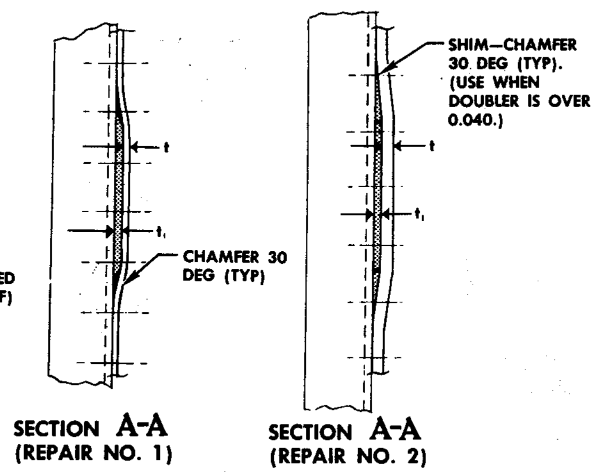
SKIN AND WEB

TYPICAL REPAIR









NOTE The doubler may be installed on the outside for a temporary repair. If the outside doubler is countersunk, it must meet the minimum countersink thickness requirements. (Refer to "Minimum Requirements.")

- Refer to "Aerodynamic Smoothness" before using nonflush repair on outer skins.

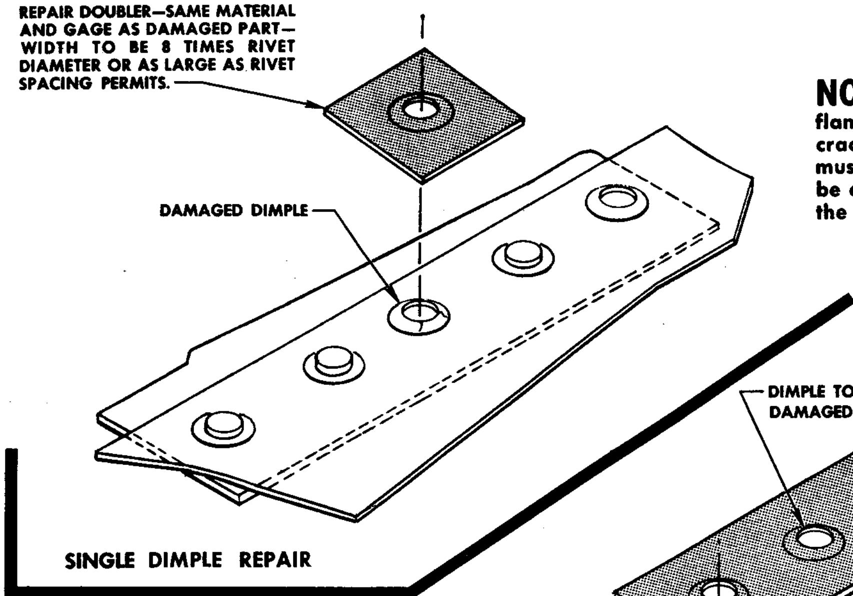
1. Stop-drill end of crack.
2. Select desired rivets. They should be the same as those in the surrounding area.
3. Refer to rivet tables. Select applicable table.
4. Determine number of rivets required for each "ℓ" dimension.
5. Distribute rivets approximately as shown. When the crack deviates from a generally straight line, it should be treated as a rectangle with two "ℓ" dimensions.
6. When doubler material is 0.040 inch or less, chamfer edges as shown in repair No. 1. When the doubler material is over 0.040 inch, shims should be used, as shown in repair No. 2.

GEN-3-91-81

Figure 10-36. Cracked Skin and Web Repair

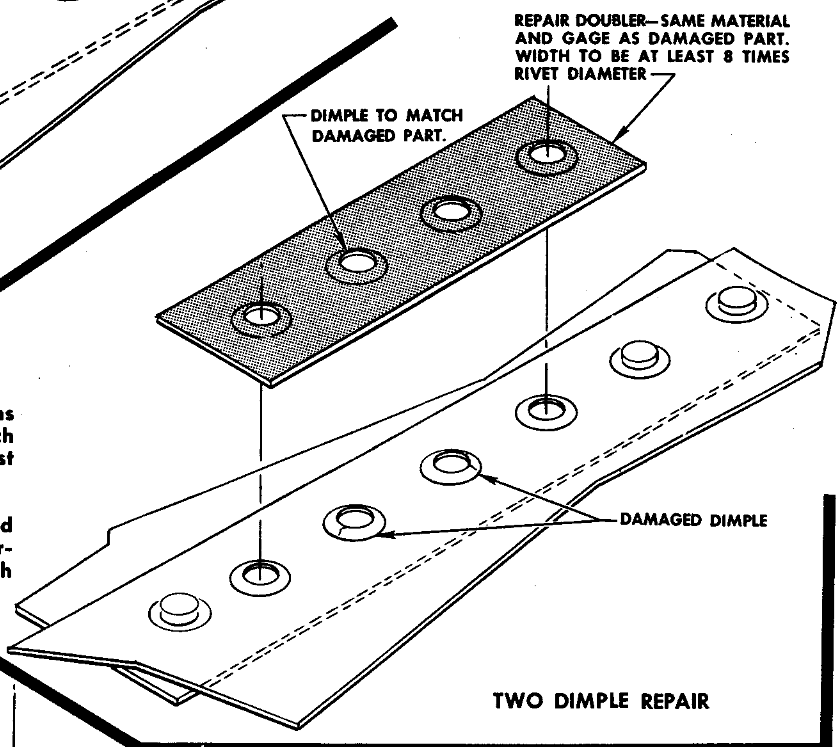
CRACKED DIMPLE 2024-T6

TYPICAL REPAIR



NOTE Use to repair a single dimple in rib flange or inner skin when not more than two cracks exist. The cracks must be radial and must not extend into the flat area. There must be at least six good dimples on each side of the cracked dimple.

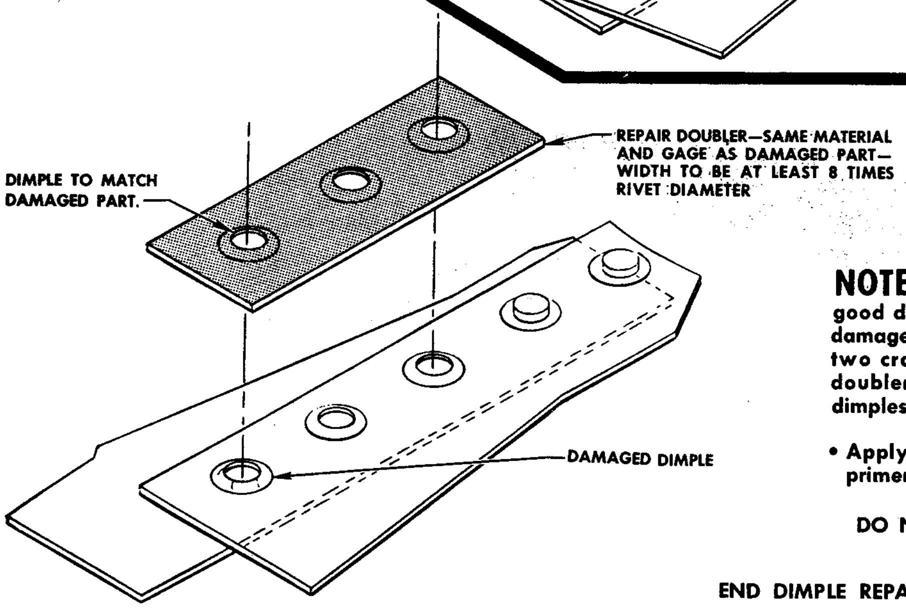
DO NOT STOP-DRILL CRACKS



NOTE Use when the following conditions exist: Less than six good dimples exist on each side of damage; more than two cracks exist per dimple; or adjacent dimples are cracked.

- The repair doubler must pick up one good dimple at each end. If fastener spacing permits, add one AD3 rivet between each dimple.

DO NOT STOP-DRILL CRACKS



NOTE Use when less than six good dimples exist on each side of damage or when there are more than two cracks per dimple. The repair doubler must pick up two good dimples.

- Apply two coats of zinc chromate primer to adjacent surfaces.

DO NOT STOP-DRILL CRACKS

END DIMPLE REPAIR

GEN-3-91-64

Figure 10-37. Cracked Dimple Repair 2024-T4

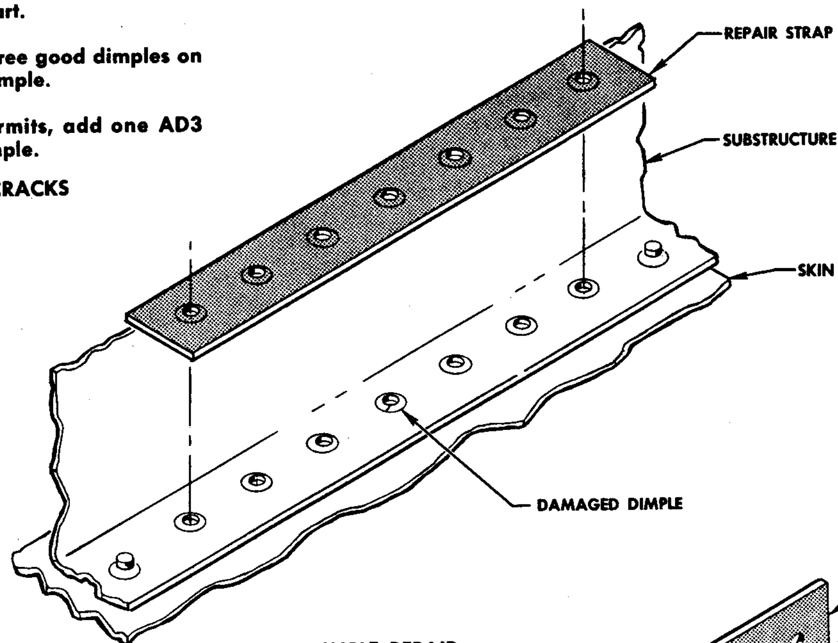
CRACKED DIMPLE 7075-T6

TYPICAL REPAIR

NOTE Use when cracks are radial and do not extend into flat area beyond dimple.

1. Fabricate dimpled strap of same material and gage as original part.
2. Install strap. Pick up three good dimples on each side of cracked dimple.
3. If fastener spacing permits, add one AD3 rivet between each dimple.

DO NOT STOP-DRILL CRACKS



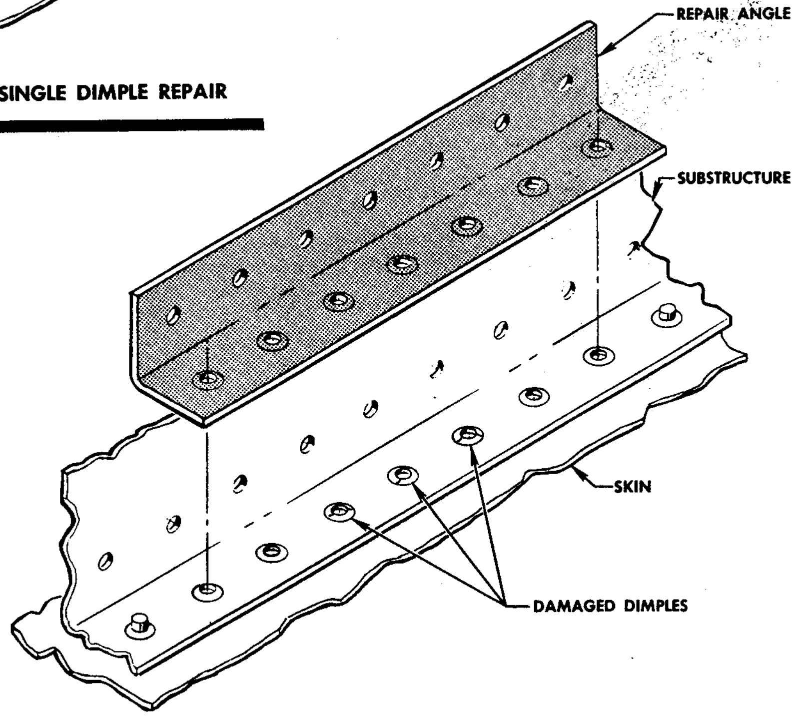
SINGLE DIMPLE REPAIR

NOTE Use when less than half of the dimples in a flange are damaged. Cracks must not extend into flat area.

1. Fabricate angle from same material, gage, and dimensions as original part.
2. Drill at least seven holes in web for AN470AD4 rivets. (Use same pitch as in flange.)
3. Pick up two good dimples on each side of cracked dimples, and attach with existing size rivets.

Apply two coats of zinc chromate primer to adjacent surfaces.

DO NOT STOP-DRILL CRACKS



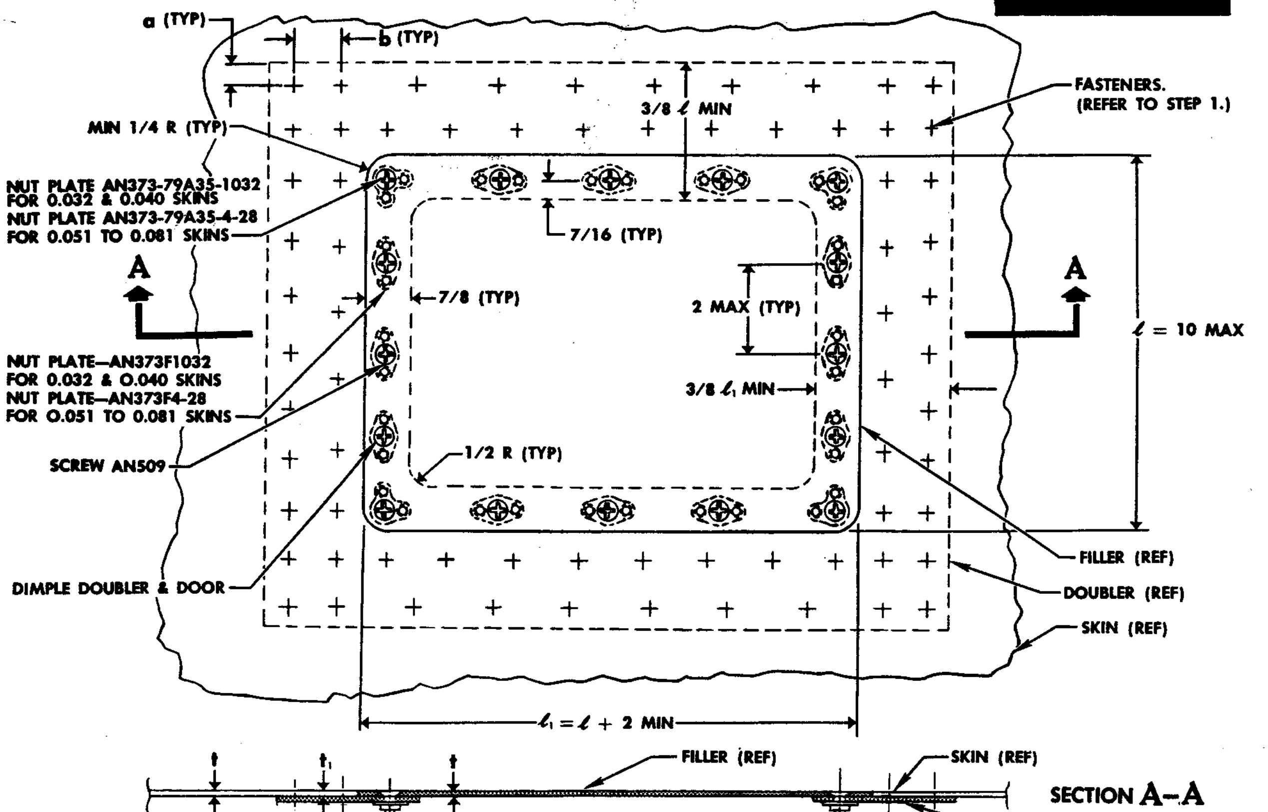
ADJACENT DIMPLE REPAIR

GEN-3-91-65

Figure 10-38. Cracked Dimple Repair—7075-T6

STRUCTURAL DOOR - SHEAR AND TENSION

TYPICAL REPAIR



1. Select fastener type. This should be chosen on the basis of the material being repaired, the ease of installation, the blind area problems, and the tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated for each "ℓ" dimension.
4. Use doubler material and thickness given in rivet table.†
5. Distribute rivets as shown in examples in "Rivet Table Instructions."

*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot-dimpling tools are not available, brazier-head rivets may be used for temporary attachment of parts. (Replace with flush rivets as soon as possible.)

†One-half hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

One-half hard corrosion-resistant steel doublers may be substituted for aluminum alloy doublers in making skin repairs. Use material one-half the thickness given for aluminum alloy.

NOTE This repair applies to 0.032- through 0.081-inch skins.

• For both "ℓ" and "ℓ₁" dimensions, refer to "ℓ" column in rivet tables.

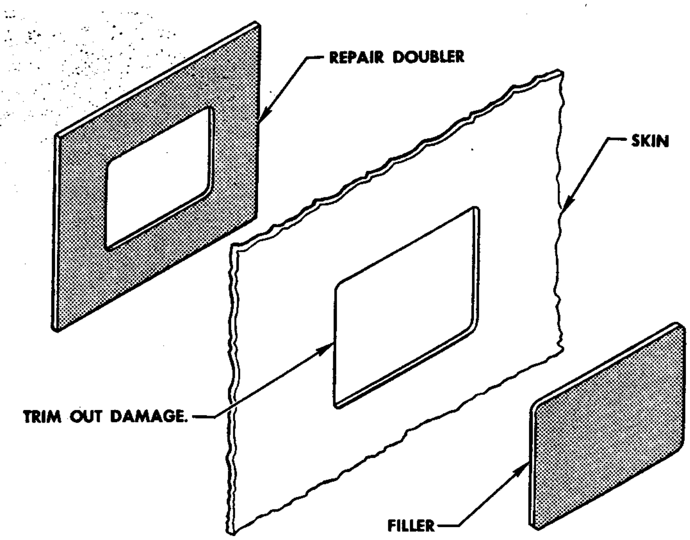


Figure 10-39. Access Door Installation—Structural, Shear and Tension

CRACKS—SHAPES AND EXTRUSIONS

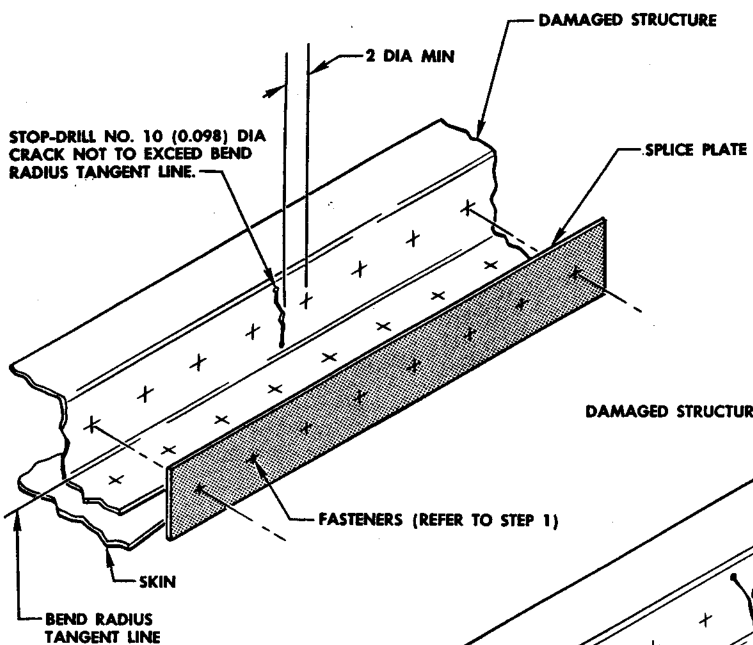
TYPICAL REPAIR

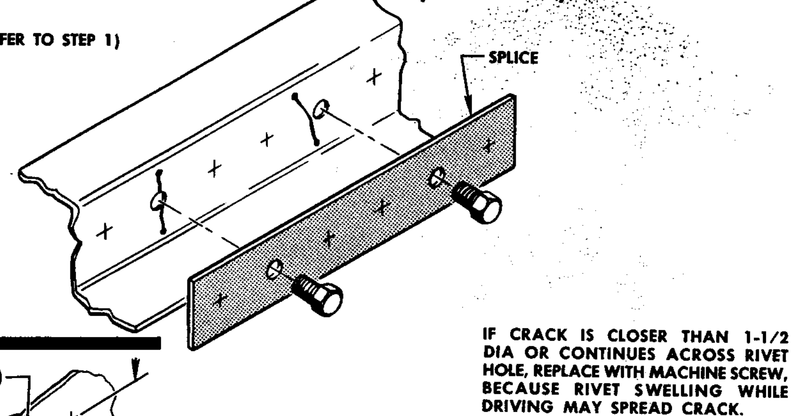
1. Select fastener type. This should be chosen on the basis of the material being repaired, the ease of installation, the blind area problems, and the tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated, for each "ℓ" dimension.
4. Use doubler material and thickness given in rivet table.†
5. Distribute rivets as shown in examples in "Rivet Table Instructions."

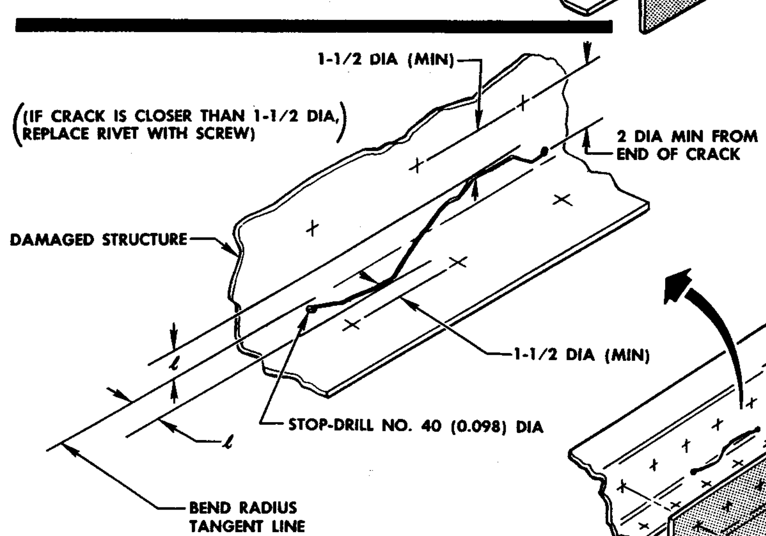
*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

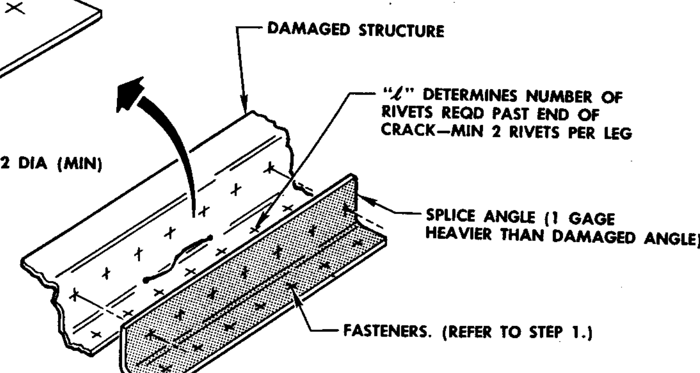
If hot-dimpling tools are not available, brazier-head rivets may be used for temporary attachment of parts. Replace with flush rivets as soon as possible.

†One-half hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.









GEN-3-91-61

Figure 10-40. Sheet-metal Shapes and Extrusions—Crack Repairs (Sheet 1 of 2)

CRACKS—SHAPES AND EXTRUSIONS

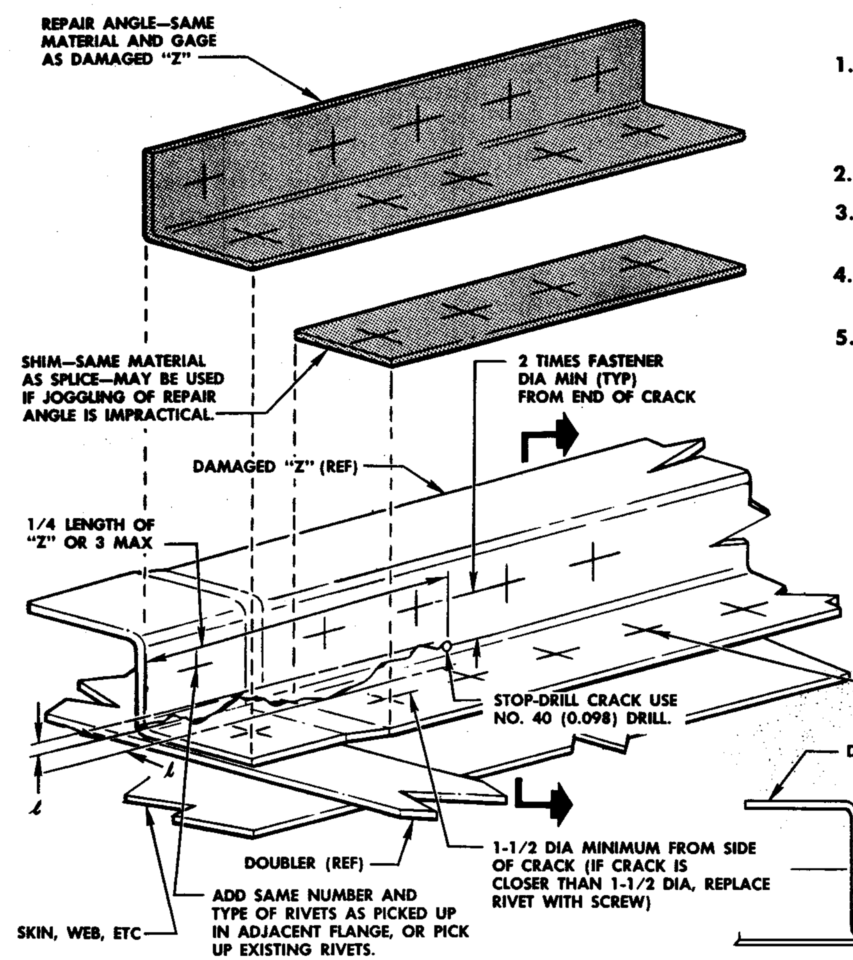
TYPICAL REPAIR

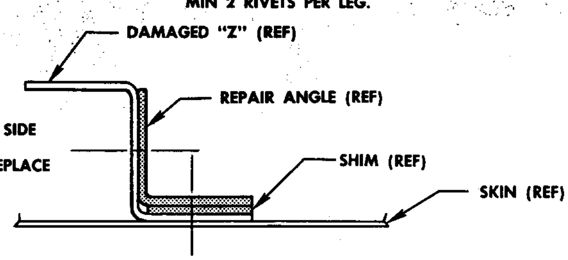
1. Select fastener type. This should be chosen on the basis of the material being repaired, the ease of installation, the blind area problems, and the tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated for each " " dimension.
4. Use doubler material and thickness given in rivet table.†
5. Distribute rivets as shown in examples in "Rivet Table Instructions."

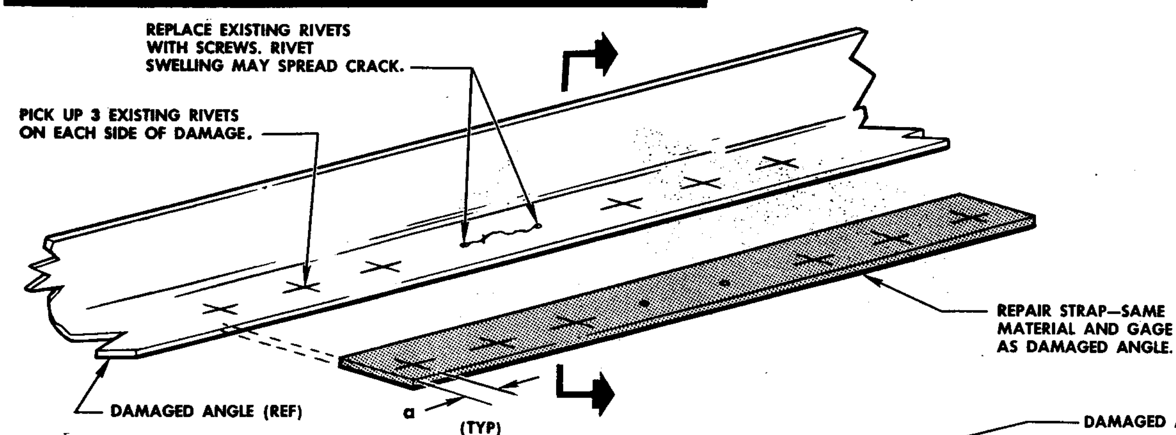
*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot-dimpling tools are not available, brazier-head rivets may be used for temporary attachment of parts. Replace with flush rivets as soon as possible.

One-half hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.







NOTE When "ℓ" dimensions is less than 1/2-inch, use "1/2-inch" column in rivet table.

*Refer to "Rivet Table Instructions" for number and type of rivets.

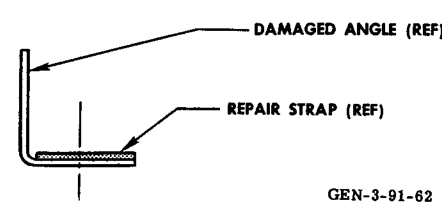


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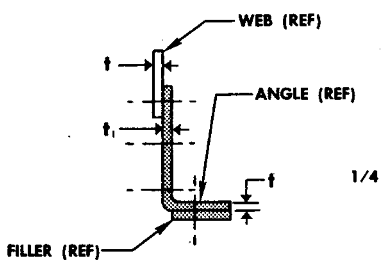
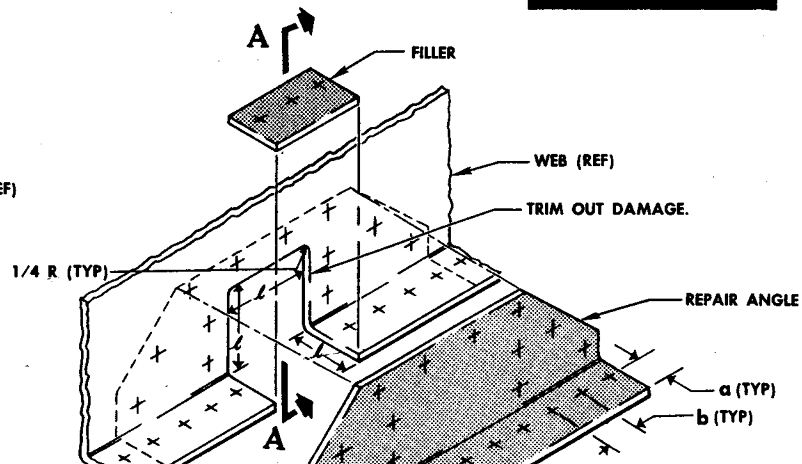
Figure 10-40. Sheet-metal Shapes and Extrusions—Crack Repairs (Sheet 2 of 2)

WEB AND FLANGE

TYPICAL REPAIR



SECTION A-A



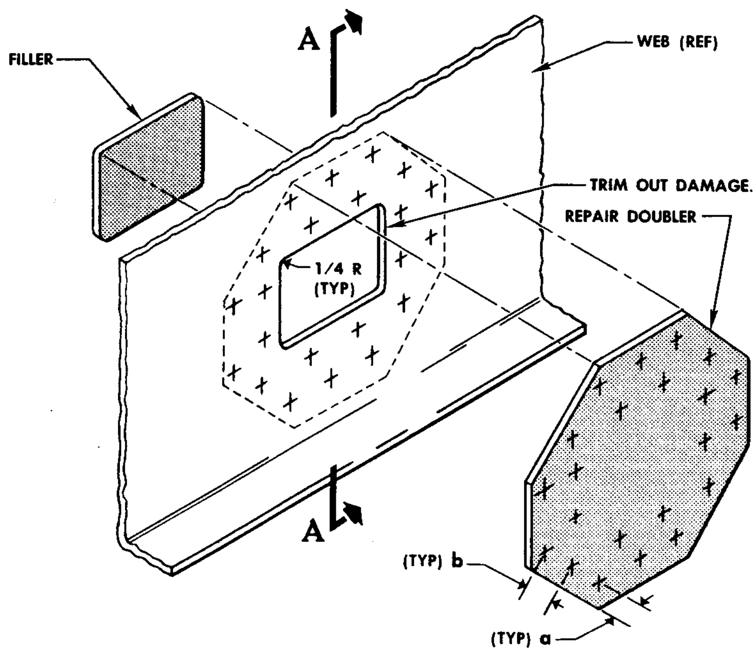
1. Select fastener type. This should be chosen on the basis of the material being repaired, the ease of installation, the blind area problems, and the tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated for each "ℓ" dimension.
4. Use doubler material and thickness given in rivet table.†
5. Distribute rivets as shown in examples in "Rivet Table Instructions."

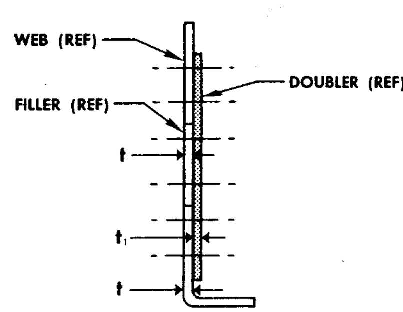
*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot-dimpling tools are not available, brazier-head rivets may be used for temporary attachment of parts. Replace with flush rivets as soon as possible.

†One-half hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

One-half hard corrosion-resistant steel doublers may be substituted for aluminum alloy doublers in making skin repairs. Use material one-half the thickness given for aluminum alloy.





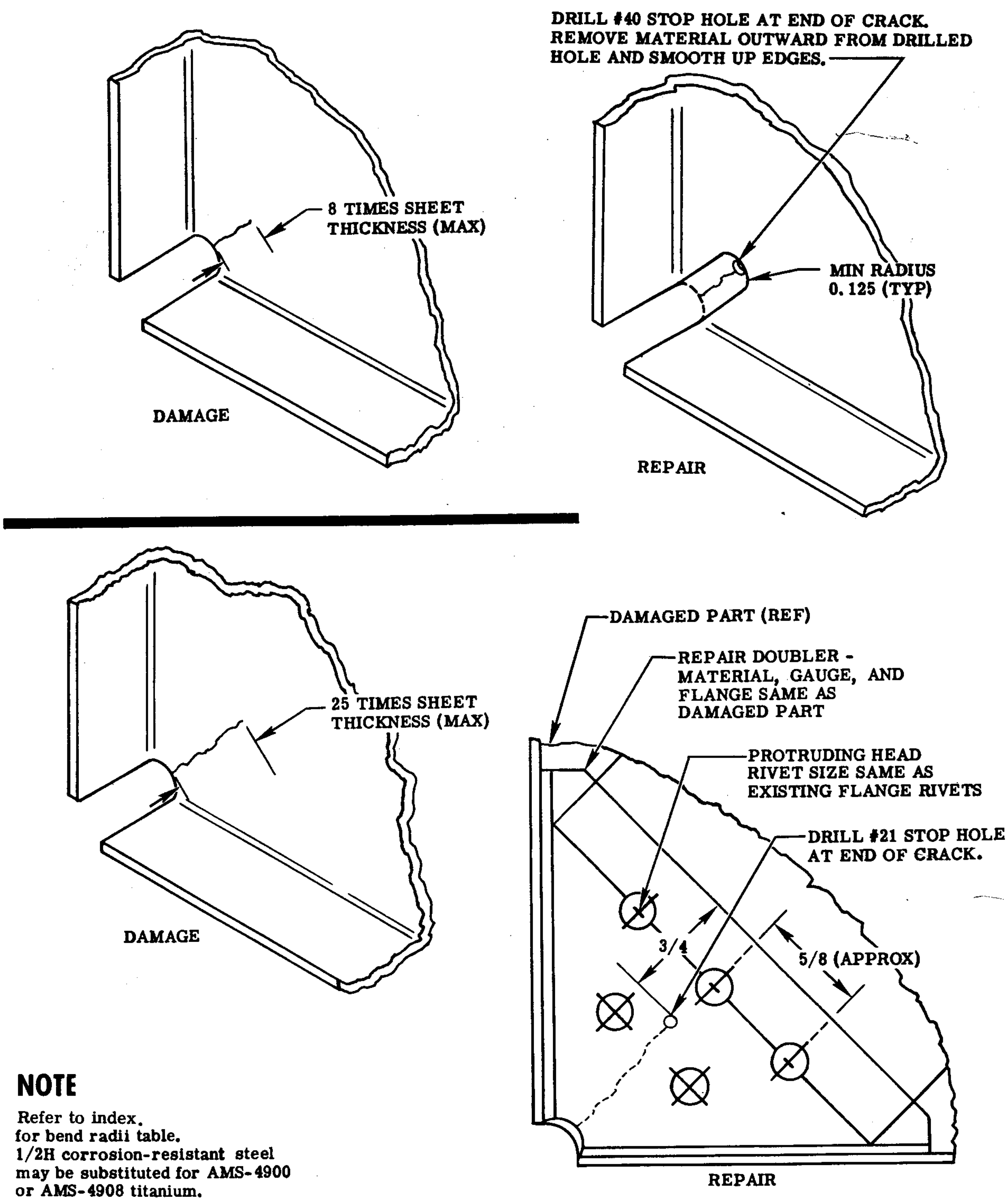
SECTION A-A

GEN-3-91-63

Figure 10-41. Web and Web Flange Repair

DOUBLE FORMED FLANGES

TYPICAL REPAIR



NOTE

Refer to index.
for bend radii table.
1/2H corrosion-resistant steel may be substituted for AMS-4900 or AMS-4908 titanium.

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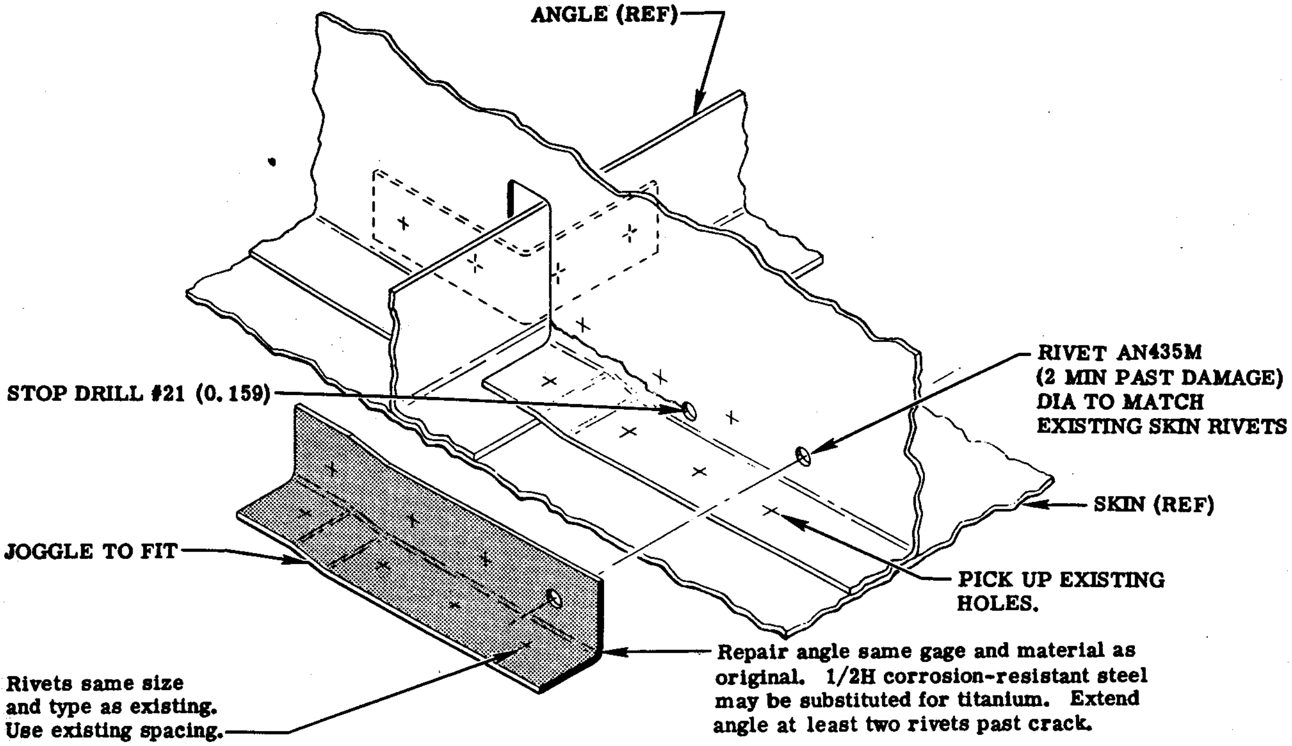
Figure 10-42. Double-formed Flange Repairs

FORMED-FLANGE CRACKS

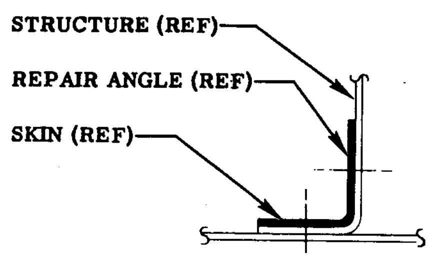
TYPICAL REPAIR



NOTE

Repair applicable to 0.063 material and under.

Refer to list of illustrations for bend radii table.
Min rivet edge distance = 2 times rivet diameter.



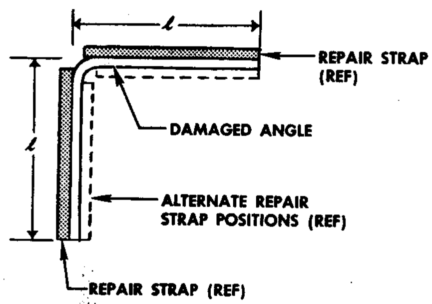
GEN-3-91-70

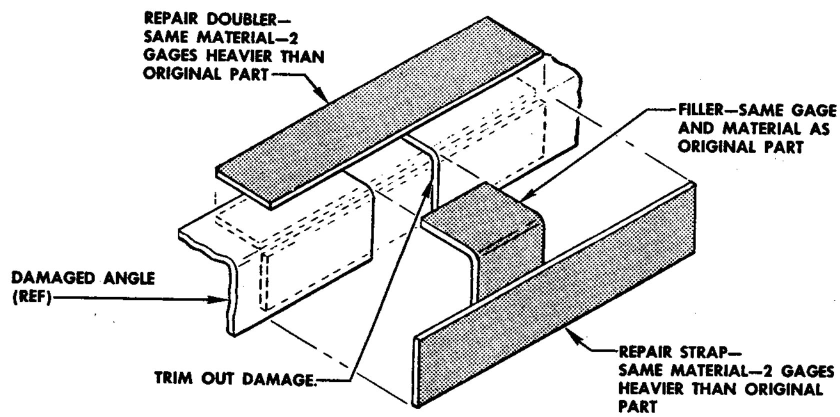
Figure 10-43. Formed Flange Crack Repairs

ANGLES

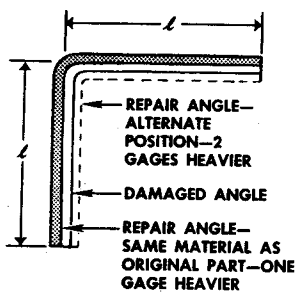
TYPICAL

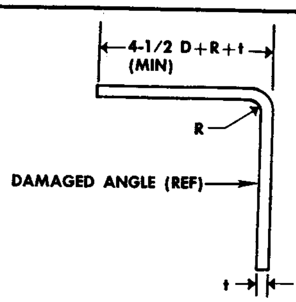
STRAP METHOD





NESTED ANGLE METHOD

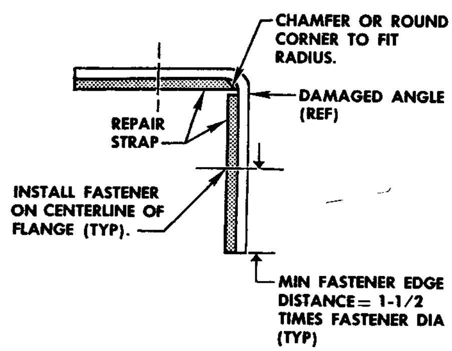




This repair cannot be used if the flange is less than 4-1/2 times the fastener diameter (selected or existing) plus the bend radius plus the material thickness.

Example—
Material (t) = 0.050 in. 7075-T6
Radius (R) = 1/4 (0.250) in.
Fastener (D) = 5/32 (0.156) in.

	0.156 (D)
TIMES	4.5
	0.702
PLUS	0.250 (R)
PLUS	0.050 (t)
	1.002=MIN FLANGE WIDTH



NOTE Do not use these repairs if leg length exceeds 50 times the original material thickness.

• These typical repairs apply to repair material up to and including 0.100-inch gage.

• The repair angles should nest. If not, they must have a minimum annealed bend radius for aluminum alloys, and an annealed or normalized condition for steel. (Refer to "Minimum Bend Radii" tables.) Heat-treat after forming.

• A filler of the same material and gage must be added if the filler is large enough for one rivet. The rivets must be of the same type and follow the same rivet pattern in the filler as in the repair.

1. Select fastener type. This will be chosen on the basis of the material being repaired, the ease of installation, the blind area problems, and the tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated for each "ℓ" dimension.
4. Use doubler material and thickness shown.
5. Distribute rivets as shown in examples in "Rivet Table Instructions."

*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot-dimpling tools are not available, brazier-head rivets may be used for temporary attachment of skins. Replace with flush rivets as soon as possible.

†One-half hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

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Figure 10-44. Formed Angle Repairs (Sheet 1 of 2)

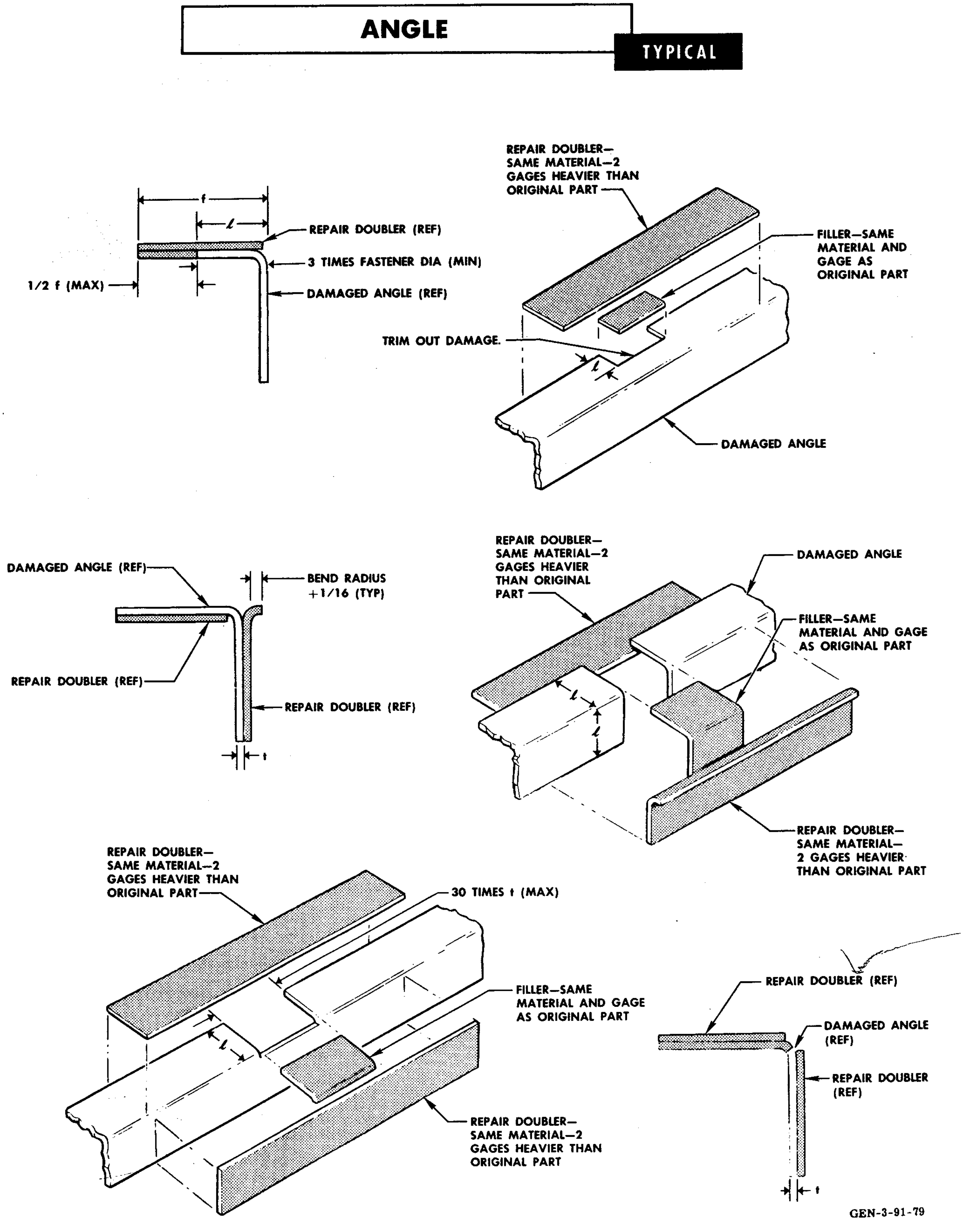
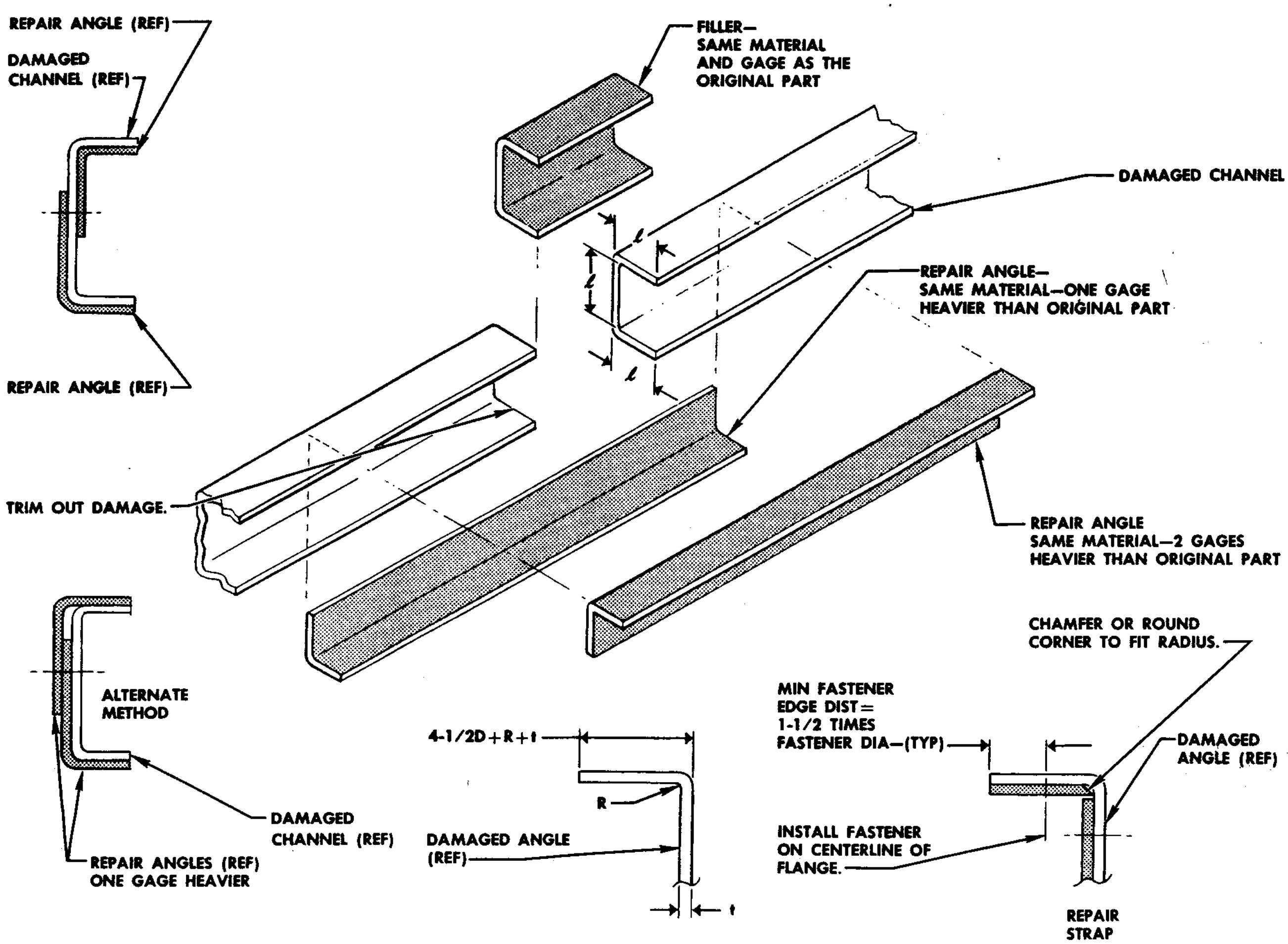


Figure 10-44. Formed Angle Repairs (Sheet 2 of 2)

CHANNEL

TYPICAL REPAIR



NOTE Do not use these repairs if minimum edge distance cannot be maintained.

- The repair angles should nest. If they do not, they must have a minimum annealed bend radius for aluminum alloys, and an annealed or normalized condition for steel. (Refer to "Minimum Bend Radii" tables.) Heat-treat after forming.
- A filler of the same material and gage must be added if the filler is large enough for one rivet. The rivets must be the same type and follow the same rivet pattern in the filler as in the repair.
- These typical repairs apply to repair material up to and including 0.090-inch gage.
- Minimum channel height = 5D + 2R + 2t. (Calculate the same as shown for flange.)

This repair cannot be used if the flange is less than 4-1/2 times the fastener (selected or existing) plus the bend radius, plus the material thickness.

EXAMPLE—

MATERIAL (t) = 0.050 IN. 7075-T6
RADIUS (R) = 1/4 (0.250) IN.
FASTENER (D) = 5/32 (0.156) IN.

	0.156	(D)
TIMES	4.5	
	0.702	
PLUS	0.250	(R)
PLUS	0.050	(t)
	1.002	= MIN FLANGE WIDTH

1. Select fastener type. This will be chosen on the basis of the material being repaired, the ease of installation, the blind area problems, and the tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated, for each "ℓ" dimension.
4. Use doubler materials and thickness shown.
5. Distribute rivets as shown in examples in "Rivet Table Instructions."

*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot-dimpling tools are not available, brazier-head rivets may be used for temporary attachment of skins. Replace with flush rivets as soon as possible.

†One-half hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

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Figure 10-45. Formed Channel Repairs (Sheet 1 of 2)

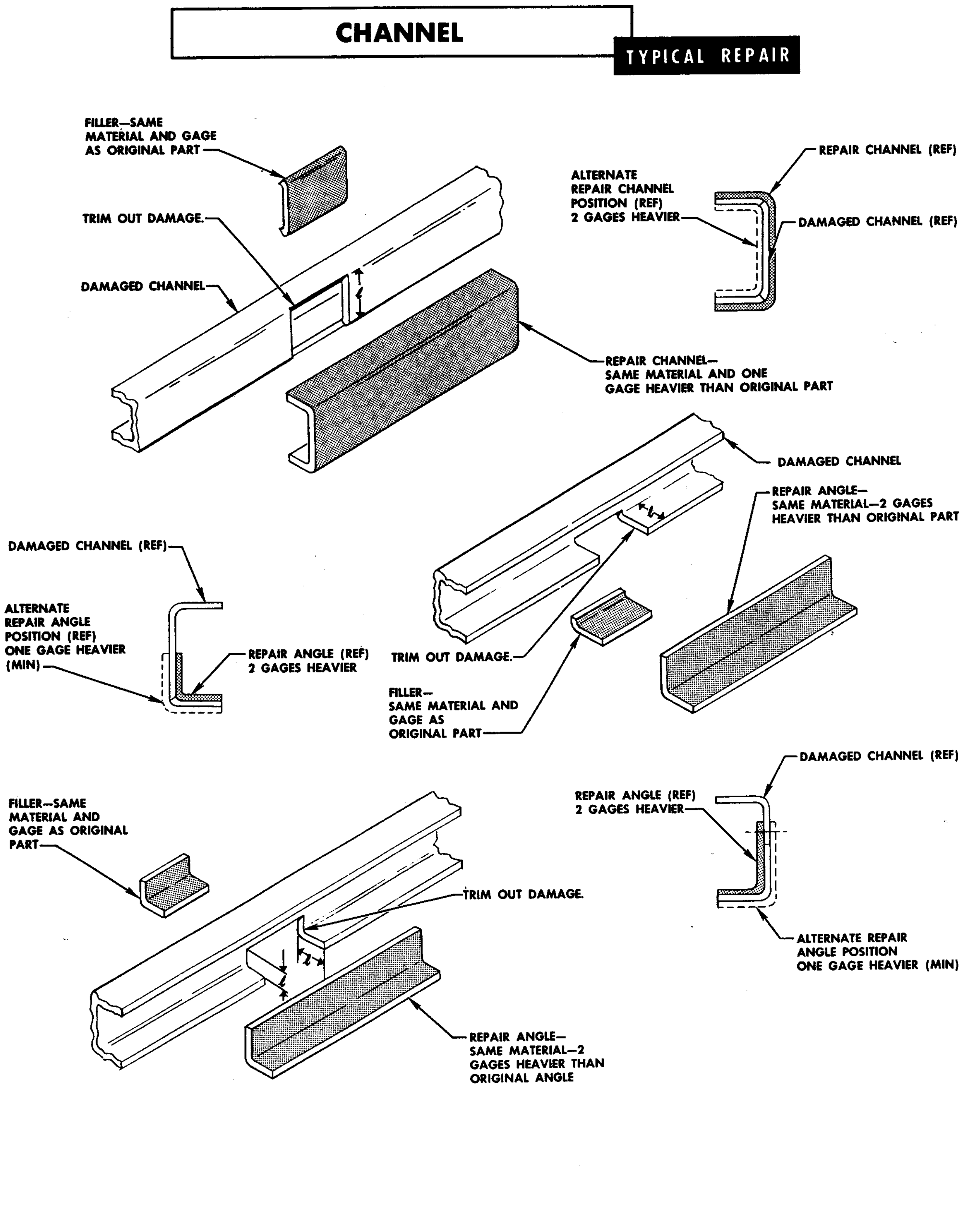
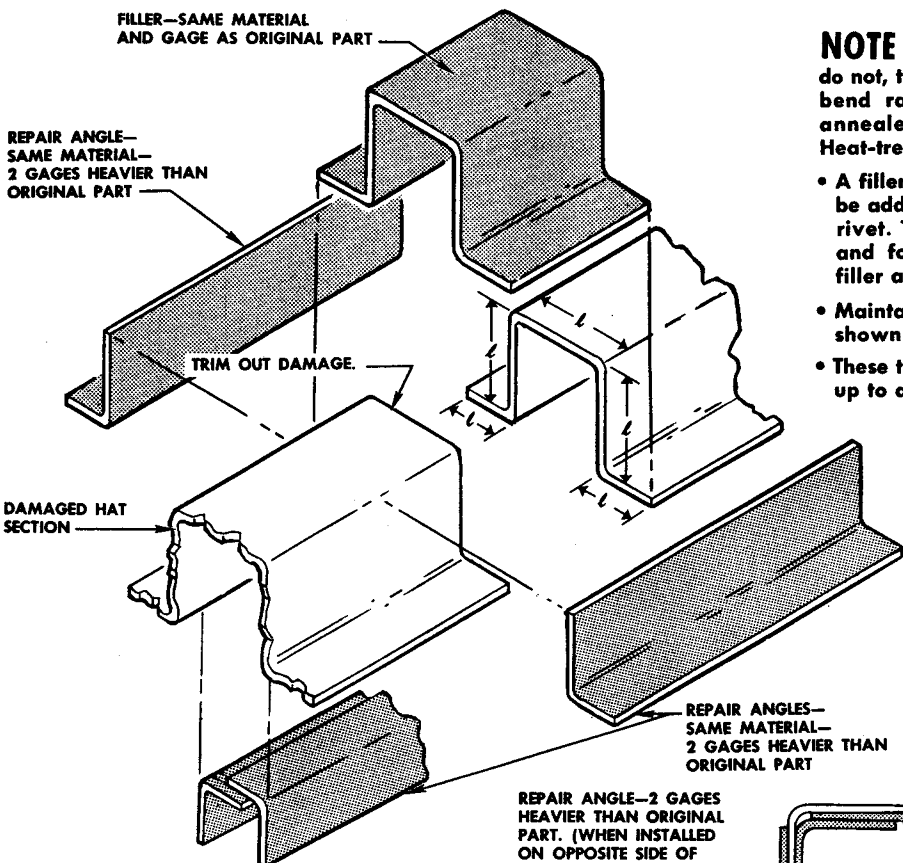


Figure 10-45. Formed Channel Repairs (Sheet 2 of 2)

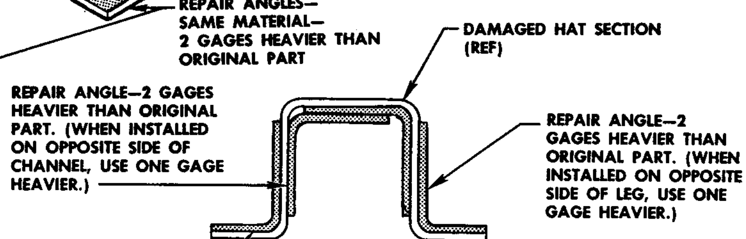
HAT SECTIONS

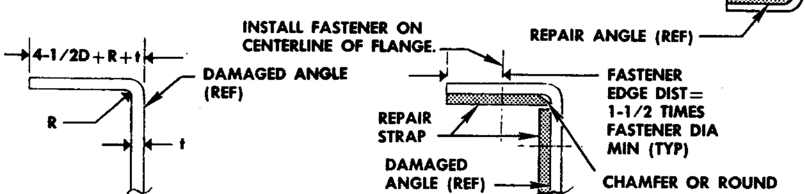
TYPICAL REPAIR



NOTE The repair angles should nest. If they do not, they must have a minimum annealed bend radius for aluminum alloys, and an annealed or normalized condition for steel. Heat-treat after forming.

- A filler of the same material and gage must be added if the filler is large enough for one rivet. The rivets must be of the same type and follow the same rivet pattern in the filler as in the repair.
- Maintain rivet spacing and edge distance as shown in "Rivet Table Instructions."
- These typical repairs apply to repair material up to and including 0.090-inch gage.





This repair cannot be used if the flange is less than 4-1/2 times the fastener diameter (selected or existing) plus the bend radius, plus the material thickness.

EXAMPLE—

MATERIAL (t) = 0.050 IN. 7075-T6

RADIUS (R) = 1/4 (0.250) IN.

FASTENER (D) = 5/32 (0.156) IN.

	0.156 (D)
TIMES	4.5
	0.702
PLUS	0.250 (R)
PLUS	0.050 (t)
	1.002 = MIN FLANGE WIDTH

1 Select fastener type. This will be chosen on the basis of the material being repaired, the ease of installation, the blind area problems, and the tools available for use.*

2 Refer to rivet tables. Select applicable table.

3 Determine size of fastener and number required, as indicated for each "ℓ" dimension.

4 Use doubler material and thickness shown.

5 Distribute rivets as shown in examples in "Rivet Table Instructions."

*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot-dimpling tools are not available, brazier-head rivets may be used for temporary attachment of skin. Replace with flush rivets as soon as possible.

†One-half hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

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Figure 10-46. Formed Hat Section Repairs (Sheet 1 of 2)

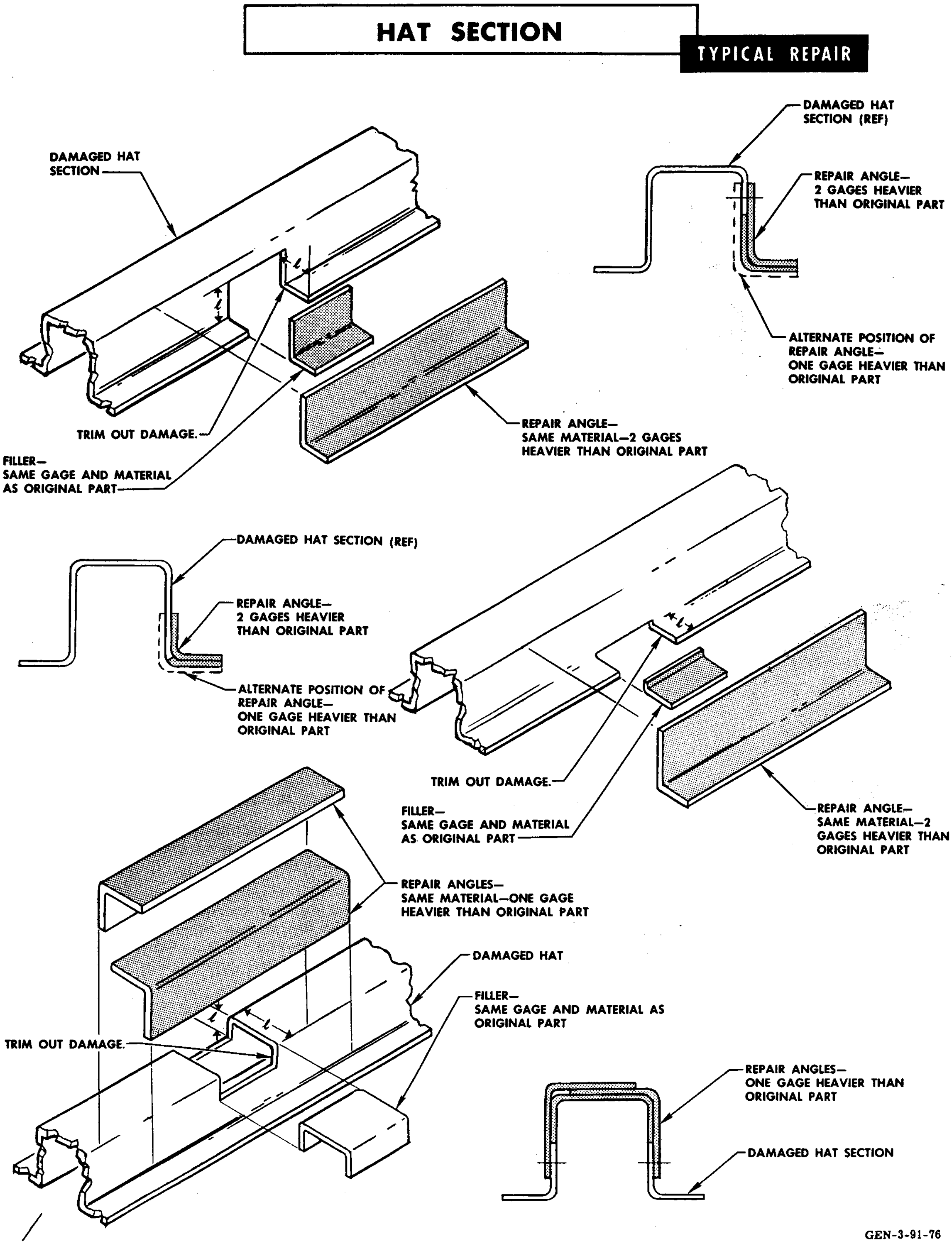
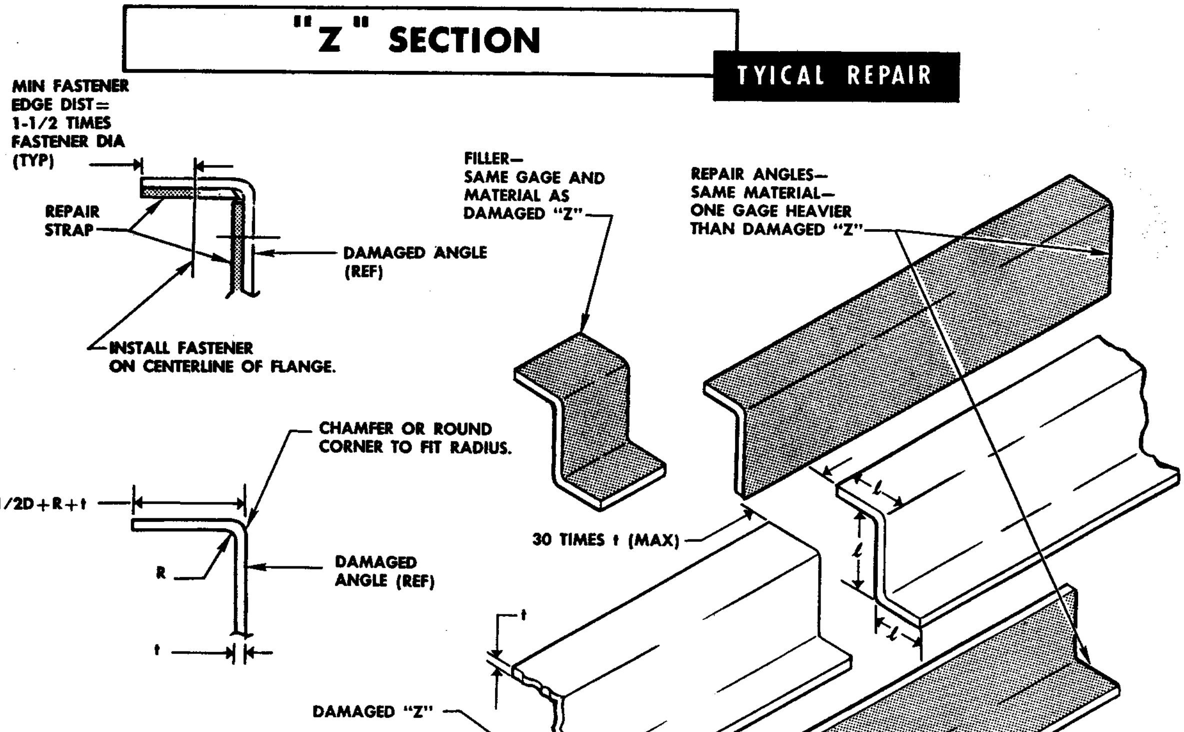


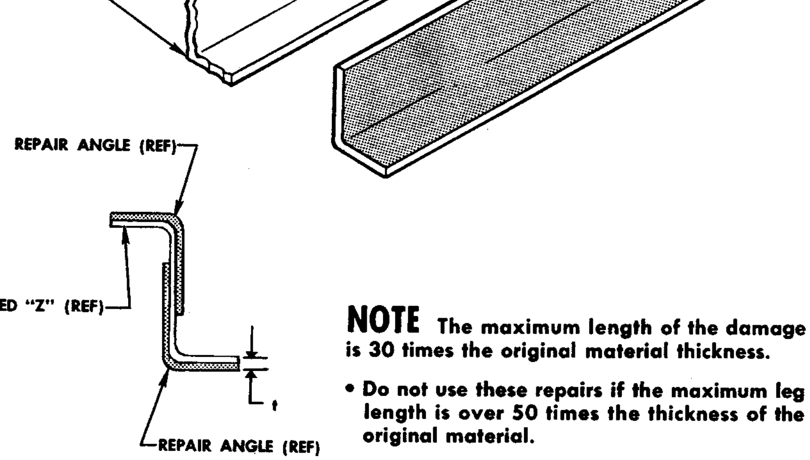
Figure 10-46. Formed Hat Section Repairs (Sheet 2 of 2)



This repair cannot be used if the flange is less than 4-1/2 times the fastener diameter (selected or existing) plus the bend radius, plus the material thickness.

EXAMPLE—
MATERIAL (t)=0.050 IN. 7075-T6
RADIUS (R)=1/4 (0.250) IN.
FASTENER (D)=5/32 (0.156) IN.

	0.156 (D)
TIMES	4.5
	0.702
PLUS	0.250 (R)
PLUS	0.050 (t)
	1.002=MIN FLANGE WIDTH



1 Select fastener type. This will be chosen on the basis of the material being repaired, the ease of installation, the blind area problems, and the tools available for use.*

2 Refer to rivet tables. Select applicable table.

3 Determine size of fastener and number required, as indicated for each "ℓ" dimension.

4 Use doubler material and thickness shown.

5 Distribute rivets as shown in examples in "Rivet Table Instructions."

*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot-dimpling tools are not available, brazier-head rivets may be used for temporary attachment of skins. Replace with flush rivets as soon as possible.

†One-half hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

NOTE The maximum length of the damage is 30 times the original material thickness.

- Do not use these repairs if the maximum leg length is over 50 times the thickness of the original material.
- The repair angles should nest. If they do not, they must have a minimum annealed bend radius for aluminum alloys, and an annealed or normalized condition for steel. (Refer to "Minimum Bend Radii" tables.) Heat-treat after forming.
- A filler of the same material and gage must be added if the filler is large enough for one rivet. The rivets must be of the same type and follow the same rivet pattern in the filler as in the repair.
- Minimum "Z" HEIGHT=5D+2R+2t. (Calculate the same as shown for flange.)
- These typical repairs apply to repair material up to and including 0.090-inch gage, with the exception of strap repairs which may go up to and include 0.100-inch gage.

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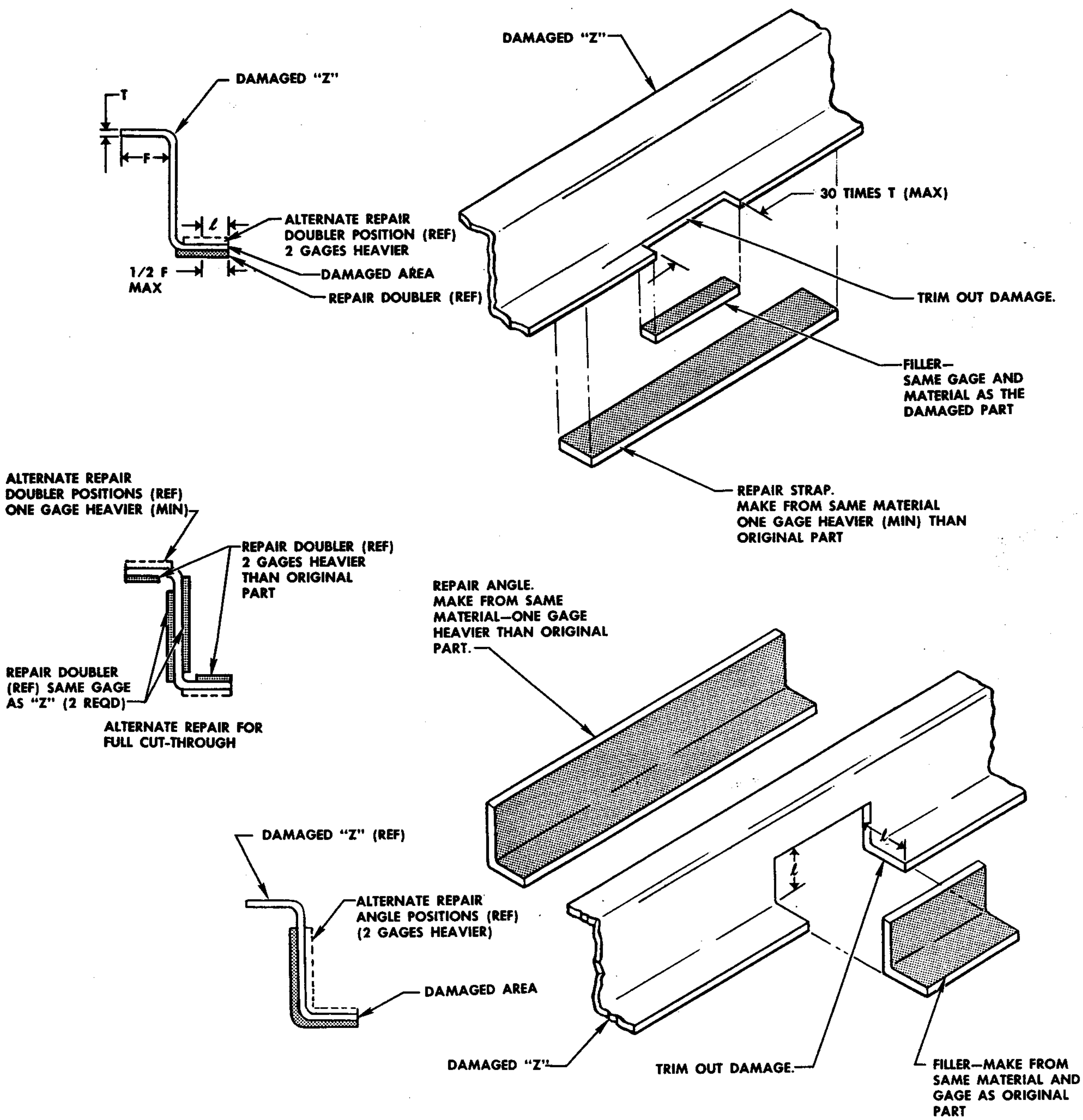
Figure 10-47. Formed "Z" Section Repairs (Sheet 1 of 2)

"Z" SECTION

TYPICAL REPAIR



NOTE

Refer to instructions and notes on sheet 1.

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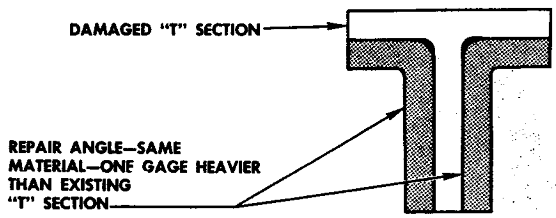
Figure 10-47. Formed "Z" Section Repairs (Sheet 2 of 2)

EXTRUDED & FORMED "T" SECTION

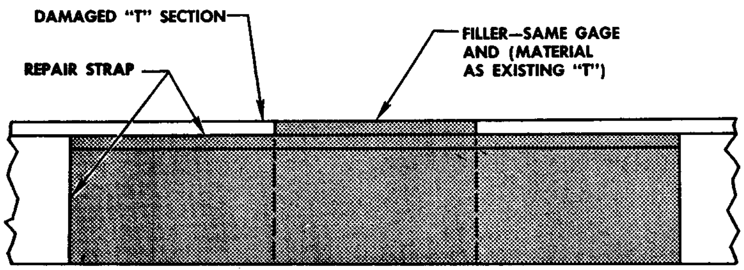
TYPICAL REPAIR

NOTE The repair angles must nest or have a minimum bend radius.

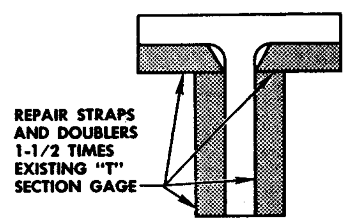
- The required thickness may be built up of two pieces.



PREFERRED METHOD OF REPAIR



SAMPLE REPAIR APPLICATION



ALTERNATE METHOD

1. Select fastener type. This will be chosen on the basis of the material being repaired, the ease of installation, the blind area problems, and the tools available for use.*
2. Refer to rivet tables. Select applicable table.
3. Determine size of fastener and number required, as indicated for each "ℓ" dimension.
4. Use doubler material and thickness shown.
5. Distribute rivets as shown in examples in "Rivet Table Instructions."

*AN509-10 and NAS221 steel screws may be substituted for 3/16-inch diameter rivets.

If hot-dimpling tools are not available, brazier-head rivets may be used for the temporary attachment of the skins. Replace with flush rivets as soon as possible.

†One-half hard corrosion-resistant steel sheet may be substituted for titanium, both pure and alloy, unless otherwise noted.

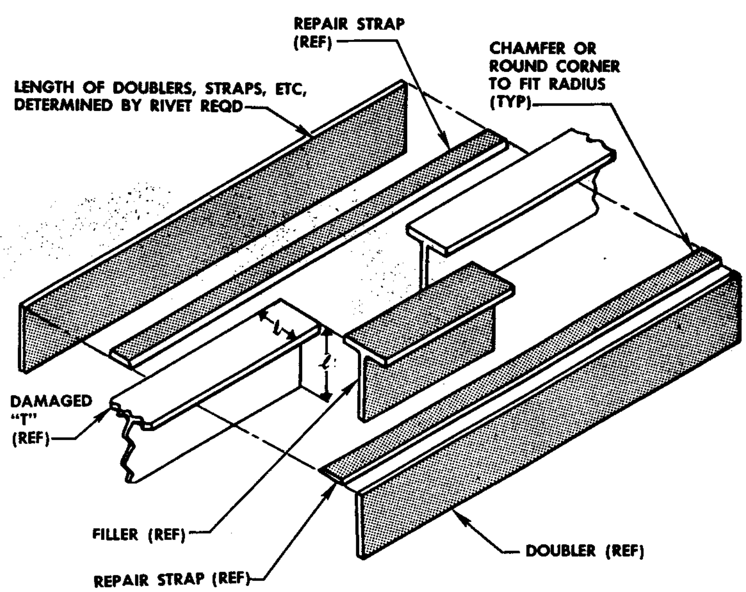


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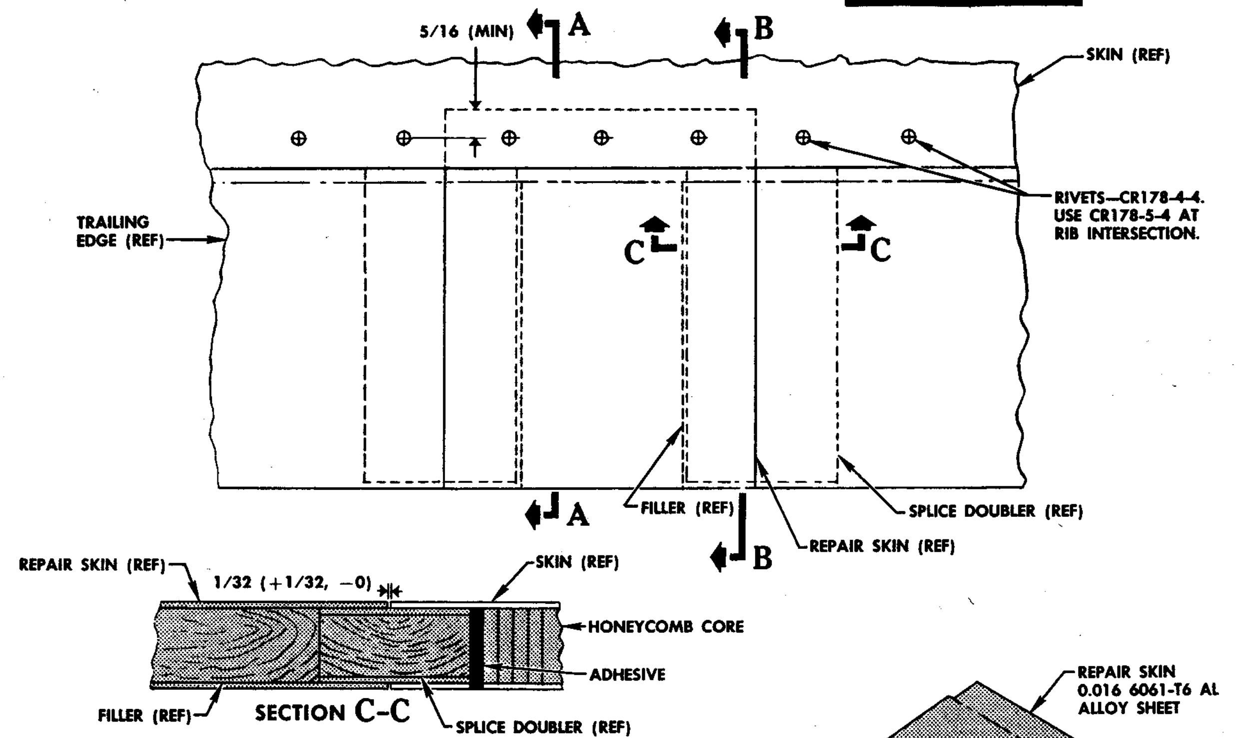
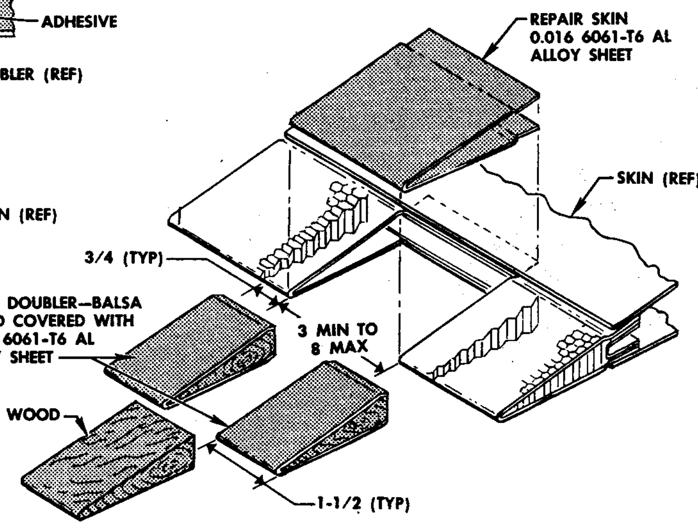
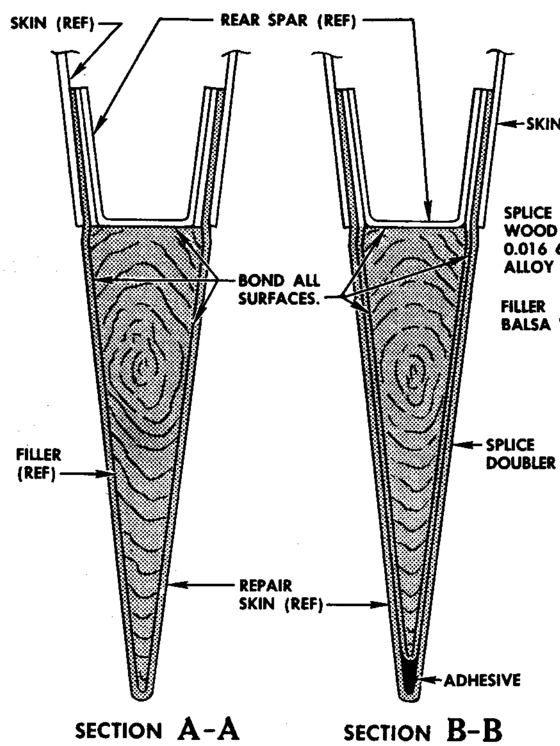
Figure 10-48. Formed and Extruded "T" Section Repairs

HONEYCOMB TRAILING EDGE

TYPICAL REPAIR







1. Trim out damaged area.
2. Trim out honeycomb core to make room for splice doubler.
3. Fabricate splice doubler and filler. Use balsa wood (Specification MIL-S-7998).
4. Fabricate repair skin. 2024-T4 clad sheet may be substituted for 6061-T6.
5. Apply plenty of adhesive and assemble repair parts.
6. Rivet repair skin in place.
7. Clean off excess adhesive.

NOTE For additional information, refer to "Wing Tip Trailing Edge Honeycomb Repair," in text.

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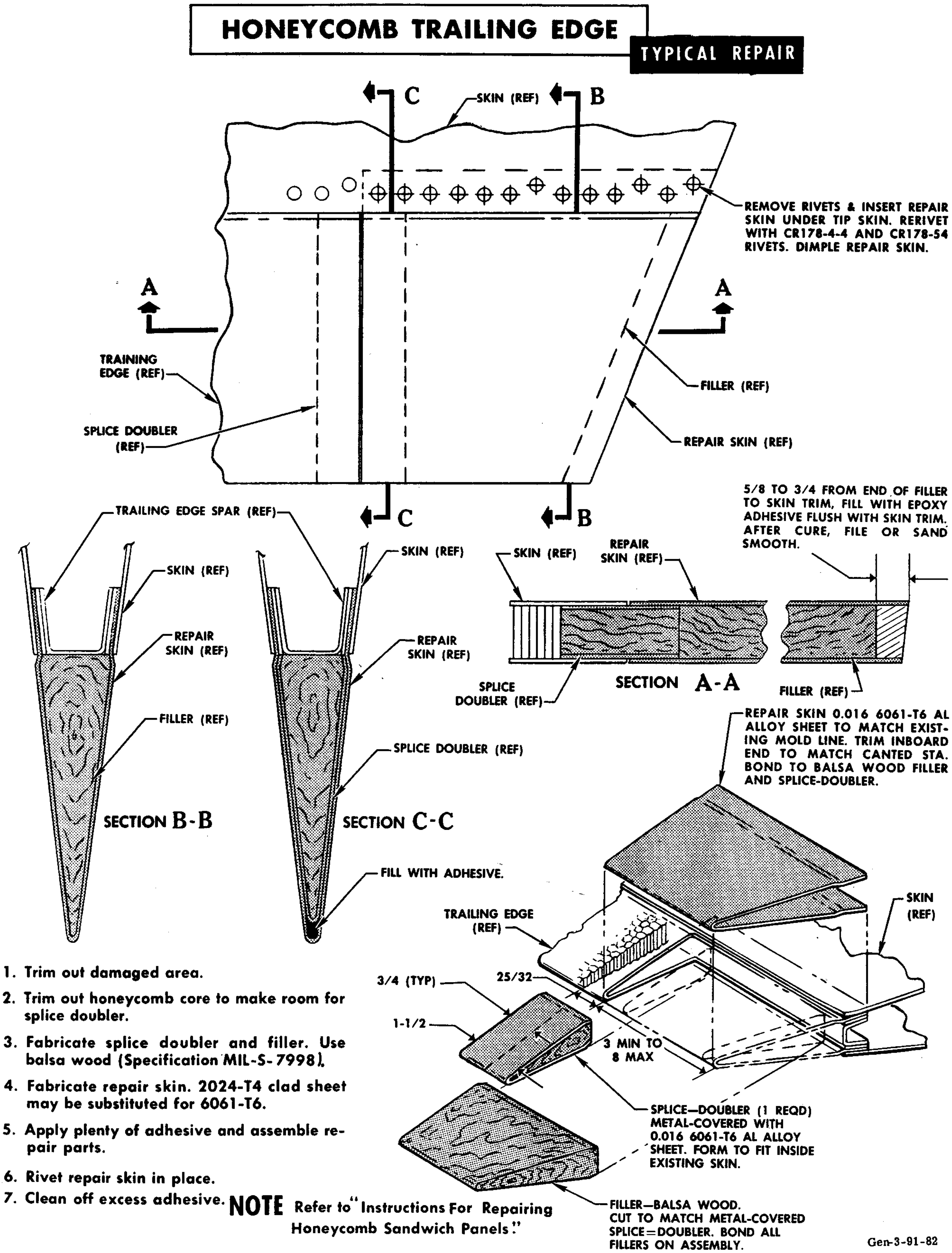
Figure 10-49. Honeycomb Trailing Edge (Sheet 1 of 3)



1. Trim out damaged area.
2. Trim out honeycomb core to make room for splice doubler.
3. Fabricate splice doubler and filler. Use balsa wood (Specification MIL-S-7998).
4. Fabricate repair skin. 2024-T4 clad sheet may be substituted for 6061-T6.
5. Apply plenty of adhesive and assemble repair parts.
6. Rivet repair skin in place.
7. Clean off excess adhesive.

NOTE Refer to "Instructions For Repairing Honeycomb Sandwich Panels."

Figure 10-49. Honeycomb Trailing Edge (Sheet 2 of 3)

HONEYCOMB TRAILING EDGE

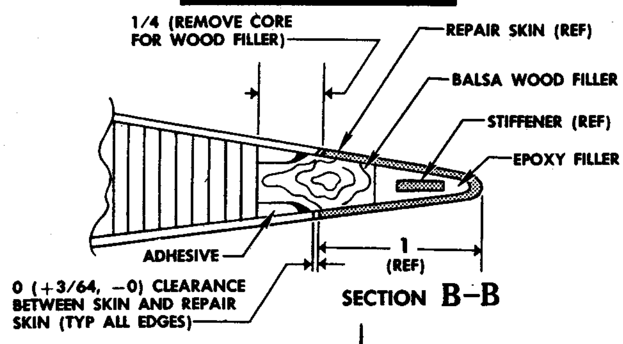
TYPICAL REPAIR

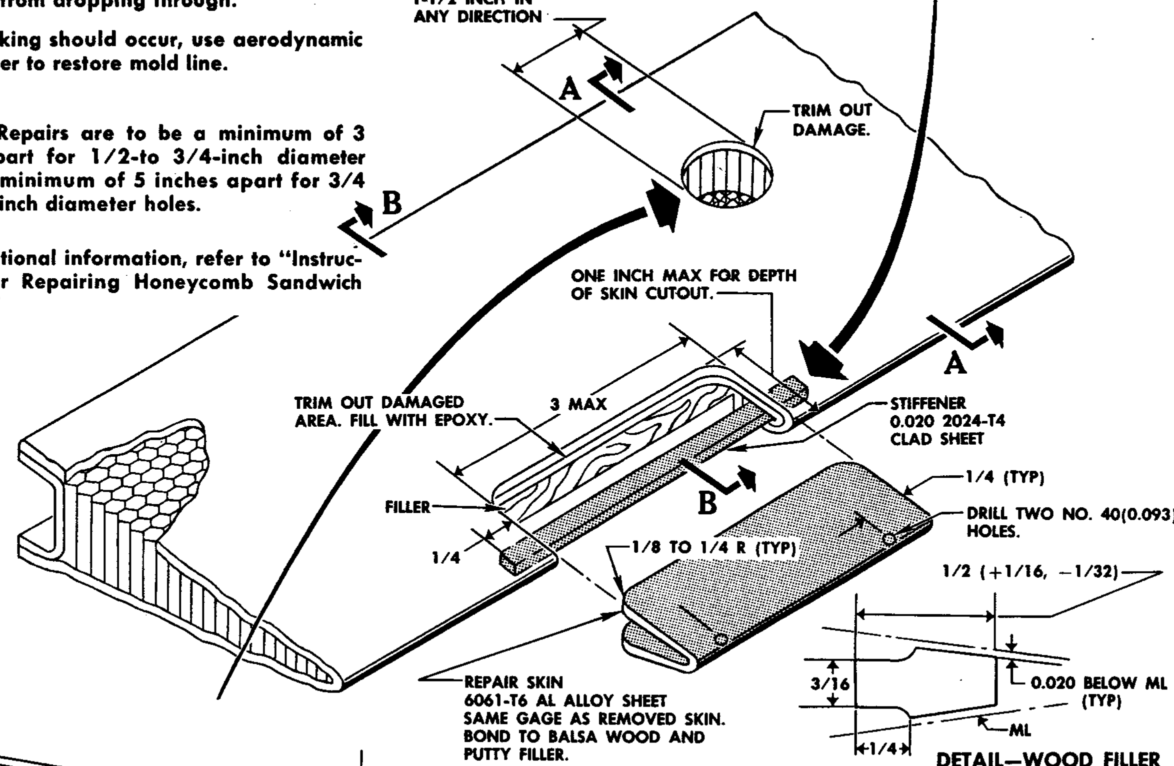
HOLE DAMAGE

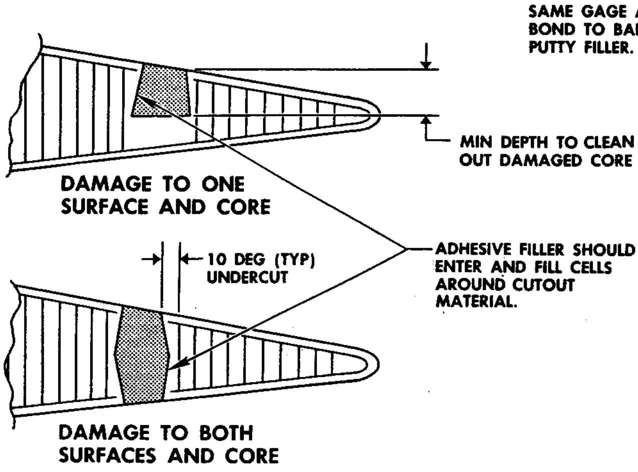
1. Trim out damage to smallest area possible.
2. Undercut core as shown in Section A-A. (Undercut may be made by crushing the core to the desired angle with a screwdriver or some other blunt instrument.) After crushing, puncture adjacent cells to permit epoxy adhesive to enter.
3. Fill hole with epoxy adhesive. If the hole is completely through the part being repaired, tape a piece of cellophane over the hole in the lower surface to prevent the epoxy adhesive from dropping through.
4. If shrinking should occur, use aerodynamic skin filler to restore mold line.

NOTE Repairs are to be a minimum of 3 inches apart for 1/2-to 3/4-inch diameter holes—a minimum of 5 inches apart for 3/4 to 1-1/2-inch diameter holes.

- For additional information, refer to "Instructions for Repairing Honeycomb Sandwich Panels."







TRAILING EDGE DAMAGE

1. Trim out damaged area.
2. Trim out honeycomb to make room for filler.
3. Make filler from balsa wood (Specification MIL-S-7998). Make repair skin from 6061-T6 or 2024-T4 material. Make stiffener from 2024-T4 material.
4. Bond wood filler in place and insert aluminum stiffener in position.
5. Fill damaged area with epoxy adhesive, place repair skin in position, and clamp securely until the bond has cured.
6. Fill any depressions with aerodynamic skin filler.

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Figure 10-49. Honeycomb Trailing Edge (Sheet 3 of 3)

Appendix I
REPAIR MATERIALS

REPAIR MATERIAL LIST

STOCK DESCRIPTION	GAGE	COMMERCIAL DESIGNATION	SPECIFICATION
		ALUMINUM	
Sheet	0.016	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Sheet	0.020	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Sheet	0.025	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Sheet	0.032	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Sheet	0.040	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Sheet	0.050	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Sheet	0.063	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Sheet	0.071	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Sheet	0.080	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Sheet	0.090	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Sheet	0.100	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Sheet	0.125	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Sheet	0.156	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Sheet	0.188	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Sheet	0.250	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Plate	0.375	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Plate	0.500	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Plate	0.625	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Plate	0.750	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Plate	1.000	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Plate	1.250	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362

STOCK DESCRIPTION	GAGE	COMMERCIAL DESIGNATION	SPECIFICATION
Plate	1.500	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Plate	1.750	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Plate	2.000	2024-T4 clad or 2024-O clad	Federal Spec QQ-A-362
Sheet	0.016	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Sheet	0.020	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Sheet	0.025	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Sheet	0.032	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Sheet	0.040	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Sheet	0.050	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Sheet	0.063	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Sheet	0.071	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Sheet	0.080	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Sheet	0.090	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Sheet	0.100	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Sheet	0.125	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Sheet	0.156	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Sheet	0.188	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Sheet	0.250	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Plate	0.375	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Plate	0.500	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Plate	0.625	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Plate	0.750	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Plate	1.000	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Plate	1.250	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Plate	1.500	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287

STOCK DESCRIPTION	GAGE	COMMERCIAL DESIGNATION	SPECIFICATION
Plate	1.750	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
Plate	2.000	7075-O clad or 7075-T6 clad	Federal Spec QQ-A-287
		MAGNESIUM ALLOY	
Magnesium alloy	0.020	Magnesium alloy	Federal Spec QQ-M-31
Magnesium alloy	0.025	Magnesium alloy	Federal Spec QQ-M-31
Magnesium alloy	0.032	Magnesium alloy	Federal Spec QQ-M-31
Magnesium alloy	0.040	Magnesium alloy	Federal Spec QQ-M-31
Magnesium alloy	0.050	Magnesium alloy	Federal Spec QQ-M-31
Magnesium alloy	0.063	Magnesium alloy	Federal Spec QQ-M-31
Magnesium alloy	0.071	Magnesium alloy	Federal Spec QQ-M-31
Magnesium alloy	0.080	Magnesium alloy	Federal Spec QQ-M-31
Magnesium alloy	0.090	Magnesium alloy	Federal Spec QQ-M-31
Magnesium alloy	0.100	Magnesium alloy	Federal Spec QQ-M-31
Magnesium alloy	0.125	Magnesium alloy	Federal Spec QQ-M-31
Magnesium alloy	0.190	Magnesium alloy	Federal Spec QQ-M-31
Magnesium alloy	0.250	Magnesium alloy	Federal Spec QQ-M-31
		STEEL	
Sheet	0.010	½ hard (CRES)	Spec MIL-S-5059
Sheet	0.012	½ hard (CRES)	Spec MIL-S-5059
Sheet	0.016	½ hard (CRES)	Spec MIL-S-5059
Sheet	0.018	½ hard (CRES)	Spec MIL-S-5059
Sheet	0.020	½ hard (CRES)	Spec MIL-S-5059
Sheet	0.024	½ hard (CRES)	Spec MIL-S-5059
Sheet	0.025	½ hard (CRES)	Spec MIL-S-5059
Sheet	0.030	½ hard (CRES)	Spec MIL-S-5059
Sheet	0.032	½ hard (CRES)	Spec MIL-S-5059
Sheet	0.035	½ hard (CRES)	Spec MIL-S-5059
Sheet	0.036	½ hard (CRES)	Spec MIL-S-5059
Sheet	0.040	½ hard (CRES)	Spec MIL-S-5059
Sheet	0.045	½ hard (CRES)	Spec MIL-S-5059
Sheet	0.050	½ hard (CRES)	Spec MIL-S-5059
Sheet	0.063	½ hard (CRES)	Spec MIL-S-5059
Sheet	0.080	½ hard (CRES)	Spec MIL-S-5059
Sheet	0.090	½ hard (CRES)	Spec MIL-S-5059
Sheet	0.125	½ hard (CRES)	Spec MIL-S-5059
Sheet	0.160	½ hard (CRES)	Spec MIL-S-5059
Sheet	0.190	½ hard (CRES)	Spec MIL-S-5059
Sheet	0.250	½ hard (CRES)	Spec MIL-S-5059
Plate	0.312	½ hard (CRES)	Spec MIL-S-5059
Plate	0.375	½ hard (CRES)	Spec MIL-S-5059
Plate	0.500	½ hard (CRES)	Spec MIL-S-5059
Plate	0.625	½ hard (CRES)	Spec MIL-S-5059
Plate	0.750	½ hard (CRES)	Spec MIL-S-5059

MATERIAL	STOCK NO.	SPECIFICATION	REMARKS
		FINISHES	
Alodine 1200		Spec MIL-C-5541	Used as a corrosion preventive and also as a prepaint surface treatment of aluminum alloys.
Iridite 14		Spec MIL-C-5541	Identical to Alodine 1200.
Lacquer, aluminized		Spec MIL-L-7178	Exterior finish.
Lacquer, medium green		Spec MIL-L-6805	Interior finish.
Primer, rain-erosion-resistant coating material (Bostic 1007)		Commercial	Used as a protective coating for fiberglass structure.
Primer, wash		MIL-C-8514	Used as a primer pretreatment coating on metal surfaces before painting.
Primer, zinc-chromate		Spec MIL-P-8585A	Primer coating used over wash primer or on clean metal surfaces of all types.
		MISCELLANEOUS	
Balsa wood		MIL-S-7998	Used in aluminum honeycomb repair.
Black light, Magnaflux ZB-26		Commercial	Used for locating and determining size of cracks in metal.
Butyl Cellosolve		Commercial	Used in corrosion- and abrasion-resistant coating.
Cadmium sulphate		Commercial	Used in chemical identification of metals.
Calcium carbonate		Spec JAN-C-293	Used to detect cracks in metal surfaces.
Cellophane sheet		Commercial	Used in aluminum honeycomb repair.
Chamois skin	8330-257-2492	Fed. Spec KK-L-167	Used to clean transparent plastic.
Cloth, polishing		Fed. Spec CCC-F-466	General-purpose cleaning cloth.
Cobalt naphthenate (6 percent)		Commercial	Used in making glass-fabric repairs.
Curing agent U		Commercial	Used in aluminum honeycomb repair.
Felt sheet 0.250-inch		Commercial	Used in making glass fabric repairs.
Glass fabric, Type VIII		Spec MIL-F-9084	Used in making glass fabric repairs.
Glass wool		Commercial	Used in aluminum honeycomb repair.
Honeycomb core, aluminum, ⅛ × 0.002 inch		Spec MIL-C-7438	Used as core material when making aluminum honeycomb repairs.
Petrolatum		Fed. Spec VV-P-236	Used to prevent sealing compound from sticking to screws and removable fasteners.
Plastic, transparent		Spec MIL-P-5425	Used to make repairs on transparent plastic canopies.

MATERIAL	STOCK NO.	SPECIFICATION	REMARKS
Polyvinyl alcohol sheet, 0.003 to 0.005 inch		Commercial	Used in making glass-fabric repairs.
Sealing tape, unfused Teflon No. 547		Commercial	Used for liquidtight sealing in areas where temperature is between 400°F and 500°F.
Silver nitrate crystals		Commercial	Used in chemical identification of metals.
Sodium chloride		Commercial	Used in chemical identification of metals.
Talc, white powder, technical grade		Commercial	Used in aluminum honeycomb repair.
Tape, general-purpose, pressure-sensitive, Type II, Grade III		Fed. Spec PPP-T-60	Used as backup, to prevent pressure from forcing sealants through openings in structure being sealed.
Tape, Vinyl No. 473		Commercial	Used as a corrosion barrier between magnesium and other metals.
Zyglo developer ZP-3		Commercial	Used to detect cracks in metal surfaces.
Zyglo dry developer powder ZR-2		Commercial	Used to detect cracks in metal surfaces.
Zyglo penetrant		Commercial	Used to detect cracks in metal surfaces.

SOURCES OF COMMERCIAL PRODUCTS

PRODUCT	SOURCE
Accelerator, PR-341A	Products Research Corp Los Angeles, Calif.
Adhesive epoxy base, Bondmaster 611	Rubber and Asbestos Corp Bloomfield, N. J.
Adhesive, epoxy base, Epon VIII	Shell Chemical Corp New York, N. Y.
Bolt, EWB-18 Series	Standard Pressed Steel Co Jenkintown, Pa.
Bolt, North American Aviation specification	Voi-Shan Manufacturing Co, Inc Culver City, Calif. Briles Manufacturing Co El Segundo, Calif.
Catalyst, DDM	Lucidol Division Novadel-Agene Corp Buffalo, N. Y.
Cement, EC-613B	Minnesota Mining and Mfg Co St. Paul, Minn.

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PRODUCT	SOURCE
Chemical film, Alodine 1200	American Chemical Paint Co Ambler, Pa.
Chemical film, Iridite 14	Allied Research Products, Inc Baltimore, Md.
Chuck, drill extension	Beaver Tool Company New York City, N. Y.
Cleaning compound, LAR 1634	Turco Products, Inc Los Angeles, Calif.
Cleaning compound, Deseal A	Kelite Products, Inc Los Angeles, Calif.
Coating compound, fuel- and oil-resistant, Stabond C-136	American Latex Products Corp Los Angeles, Calif.
Coating, Vulcabond V-36	American Latex Products Corp Los Angeles, Calif.
Coating, A56B	B. F. Goodrich Co Akron, Ohio
Coating, plastic, abrasion- & corrosion-resistant Everlube 1329, Everlube 1329A	Everlube Corp North Hollywood, Calif.
Curing agent, epoxy adhesive, CH-1 hardener	Rubber and Asbestos Corp Bloomfield, N. J.
Curing agent, epoxy adhesive, diethylamino propylamine	Shell Chemical Corp New York, N. Y.
Curing agent, epoxy adhesive, diethylene triamine (DTA)	Carbide and Carbon Chemicals Corp Division of Union Carbide and Carbon New York, N. Y.
Detonator, friction, explosive rivet	Sheridan Products, Inc Inglewood 3, Calif.
Developer, dry powder, Zyglo (ZP-2)	Magnaflux Corp Chicago, Ill.
Developer, Zyglo (ZP-3)	Magnaflux Corp Chicago, Ill.
Drill extension, "Little Beaver"	Beaver Tool Co New York, N. Y.
Fastener, quick-acting, structural	Camloc Fastener Corp Paramus, N. J.
Filler, aerodynamic skin filler PR-341	Products Research Corp Los Angeles, Calif.
Filler, epoxy adhesive, concrete aggregate	Panacalite Pacific, Inc Los Angeles, Calif.
Filler, epoxy adhesive, Perlite No. 1	Paramount Perlite Co Paramount, Calif.
Insert, threaded, Heli-Coil	Heli-Coil Corp Danbury, Conn.
Insert, threaded, Rosan	Rosan, Inc Newport Beach, Calif.
Jo-bolt	National Screw Manufacturing Co of Calif. Los Angeles, Calif.
Light, black, inspection, Magnaflux ZB-26	Magnaflux Corp Chicago, Ill.
Nut, EB series	Elastic Stop Nut Corp of America Union, N. J.

PRODUCT	SOURCE
Penetrant, inspection, Zyglo	Magnaflux Corp Chicago, Ill.
Rivet, Cherry	Townsend Co, Cherry Rivet Div Santa Ana, Calif.
Rivet, Deutsch drive pin	Huck Manufacturing Co Detroit 7, Mich.
Rivet, explosive	E. I. Dupont De Nemours and Co (Inc) Explosives Department Wilmington 98, Del.
Rivet, Hi-Shear	Hi-Shear Rivet Tool Co Los Angeles 45, Calif.
Rivet, Huck	Huck Manufacturing Co Detroit 7, Mich.
Rivet, Olympic	Olympic Screw and Rivet Corp Downey, Calif.
Screw, Hi-Shear	Hi-Shear Rivet Tool Co Los Angeles 45, Calif.
Screw, Phillips head	American Phillips Recess American Screw Co Willimantic, Conn.
Screw, Reed & Prince	Reed & Prince Mfg Co Worcester, Mass.
Screw, Torq-Set	American Screw Co Willimantic, Conn.
Sealant gun, disposable-cartridge	Pyles Industries, Inc Detroit 2, Mich.
Sealing compound, PR-341	Products Research Corp Los Angeles, Calif.
Sealing compound, high-temperature HT-23	American Latex Products Corp Hawthorne, Calif.
Sealing compound, high-temperature EC-1548	Minnesota Mining and Mfg Co St. Paul, Minn.
Sealing compound, general-purpose	Coast Pro-Seal & Mfg Co Los Angeles, Calif. Minnesota Mining and Mfg Co St. Paul, Minn. Products Research Corp Los Angeles, Calif.
Sealing compound, Pro-Seal 414	Coast Pro-Seal & Mfg Co Los Angeles, Calif.
Sealing compound, EC-612P	Minnesota Mining and Mfg Co St. Paul, Minn.
Sealing compound, Pro-Seal 714	Coast Pro-Seal & Mfg Co Los Angeles, Calif.
Sealing compound, Pro-Seal 714A	Coast Pro-Seal & Mfg Co Los Angeles, Calif.
Sealing tape, unfused Teflon 547	Minnesota Mining and Mfg Co St. Paul, Minn.
Tape, general-purpose, pressure-sensitive	Industrial Tape Corp New Brunswick, N. J.
Tape, general-purpose, pressure-sealing	Bauer & Black Division Kendall Co Chicago, Ill.

PRODUCT	SOURCE
Tester, hardness, portable, Barcol	Barber-Colman Co Rockford, Ill.
Tester, hardness, portable, Ernst	Newage International, Inc New York 17, N. Y.
Tester, hardness, portable, Riehle	Riehle Testing Machine Div American Machine & Metals, Inc East Moline, Ill.
Tool, Jo-bolt driving	Lok-Fast Inc Torrance, Calif.

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APPENDIX II

GLOSSARY OF AIRPLANE AND AIRPLANE REPAIR TERMS

INTRODUCTION.

The definitions in this glossary correspond to the meanings of words and phrases as used in this manual. Nontechnical explanations are used whenever possible.

DEFINITIONS.

abrasion. Wearing away by friction, scratching.

abrasive. A substance used for grinding, polishing, etc, as emery paper.

aerodynamic. **1.** Designed for favorable reaction when moved through the air. **2.** The result from the reaction of the moving object to the forces in the surrounding air, as in aerodynamic drag or performance.

aft. Toward the rear or tail.—**aft of.** Behind.

airfoil. A surface or body designed to obtain a reaction from the air through which it moves.

airframe. The total airplane structure, including the framework (substructure) and skins.

air load. The aerodynamic load or force imposed upon a moving airfoil or other object.

air-load rib. A rib which derives its principal loads from aerodynamic forces.

annealing. A process by which metals are stress-relieved and softened. This is done by carefully controlled heating and cooling (quenching).

anodize. An electrochemical treatment of bare aluminum alloys resulting in a corrosion-resistant surface. Anodized surfaces also offer an excellent bond for primer and paint.

axis. A straight line used as a reference for orienting a part, or about which a part could bend, twist, or rotate.

baffle. A plate or wall, as around an engine or in a tank, the purpose of which is to direct or retard the flow of a liquid or gas.

bead. **1.** A pressed or rolled-in molding in sheet metal used for stiffening. **2.** The fused area in fusion welding. **3.** A narrow strip of sealant laid over or along a seam.

beam. The principal structural members running from root to tip in the stabilizers and rudder and from inboard to outboard in the ailerons and flaps. (Corresponding members in the wing are called spars.)

beam cap. The beam edge member to which the control surface skins are attached.

bend allowance. The flat pattern dimension that must be allowed for each bend in sheet-metal layout.

blind hole. A hole which does not pass through the material.

blind repair. A repair that can be made with access to but one side of the damage. Blind rivets or other fasteners that can be installed from one side are necessary for close-out.

blind rivet. A rivet that is installed from one side—pull rivet, drive-pin rivet, etc.

bolting angle. An angle provided for bolting one assembly to another.

bolting bar. A heavy bar-like member provided for bolting one assembly to another.

brake, *n.* A tool used for bending sheet metal.—*v.* to bend.

braze. To join metal with a hard solder, usually a copper alloy.

bulkhead. A solid or closed frame in the fuselage such as at each end of the pressurized compartment.

burring. The removal of sharp edges which result from cutting, drilling, and punching sheet metal.

cantilever. A beam or other member supported at one end only.

centerline. A line running along the longitudinal center of an object. In the fuselage, it is the theoretical line dividing the left and right sides.

chamfer. The diagonal surface formed when a corner is removed. External patches are chamfered to blend the patch with the skin to reduce drag.

channel. A three-sided (generally U-shaped) member. It may be formed, machined, or extruded.

chord. A straight line between the leading and trailing edges of an airfoil section.

chordwise. In the direction of the chord of an airfoil. See **chord.**

clad. A general term applied to aluminum alloy sheet metal coated with pure aluminum.

close-out. Installation of the final panel, skin, or cover. This operation is often accomplished to some extent by the use of blind fasteners.

doubler. An added thickness of material, usually at the edge of a sheet. See **repair doubler.**

drag. The resistance produced by a body when moved through the air. An airplane is designed to produce the least possible drag. Any object added outside its mold line (skin) will increase the drag.

empennage. The group of fixed and movable control surfaces at the aft end of the airplane.

extrusion. A metal shape formed by forcing the material in a softened condition through a die.

fair. To streamline a *part* of an airplane, especially for reducing wind resistance or drag.

fairing. A nonstructural part of an airplane designed to blend with the surrounding structure to minimize drag.

fastener. A general term given to attaching hardware, such as bolts, screws, rivets, quick-acting fasteners, etc.

fatigue. The weakening of material caused by the repeated loading or bending movements applied to it.

faying surface. The surface area where one sheet of metal (or other material) overlaps another.

fillet. A concave area formed where two surfaces meet, or a member added to produce a concave area at a joint.

flutter. A vibrating movement of a wing or control surface caused by aerodynamic forces.

frame. Lateral members in the fuselage which support the skin and longitudinal members.

grid. A plate lightened by a pattern of holes, usually used for strength and/or stiffness inside the skin.

hat section. An extruded or formed shape, the cross section of which resembles that of a hat.

joggle. An offset or step in a sheet-metal part, usually used to fit against parts in different planes.

land. **1.** The surface on, or against, which an object rests, as a door land. **2.** In milled-skin construction, a thickened area where other members are attached, as a *rib land*, a *spar land*, etc.

longeron. A fore-and-aft member of the framing of an airplane fuselage, usually continuous across a number of points of support.

magnaflux. A patented method of inspecting steel parts for cracks or flaws. The part is first magnetized, then immersed in a solution of iron oxide and kerosene, thus making flaws visible to the naked eye.

manufactured splice. A skin splice made during the manufacture of the airplane.

mold line. The outside surface of an airplane. External patches are said to be "outside the mold line."

nonstructural. A nonload-carrying member, but subjected to air loads when used as an external part.

plane. A real or imaginary surface of infinite length and width, but having zero thickness.

prime. To apply the base or *primer* coats of finish in paints, lacquers, etc.

primer. A material used for the base coat (under the finish coat) of paint, lacquer, etc.

repair doubler. The added thickness of sheet or plate material that carries the loads across a hole or crack.

rib. A generally chordwise member of an airfoil which gives shape to the component. In addition, it usually carries structural loads.

spanwise. Across the ribs of an airfoil.

spar. A principal spanwise member of the structural framework of the wing.

spar cap. The upper and lower edge members of a spar. The skins are usually attached to this member.

specific gravity. The ratio of a weight or mass of a given volume to that of an equal volume of another substance. Water at 4°C is often used as a standard.

spotface. The removing of a small amount of the surface material around a hole providing a flat surface for a fastener head.

spring-back. The amount or degree that metal will return when the bending forces are released. Spring-back must be taken into consideration when making form blocks or making bends on a power brake.

static. At rest, without motion, influenced by no force other than its own weight.

statically balanced surface. A control surface that is in balance about its hinge axis when not subjected to aerodynamic forces.

strain. A condition in the material of a part expressed as the amount of dimensional distortion of the material (stretching, squeezing, etc) caused by the amount of stress being carried by the material. The higher the stress, the higher the strain.

stress. An internal condition of the material of a part, which is dependent upon the intensity of the load being carried by the part at that instant. Stress is always accompanied by strain. See **strain.**

stressed skin. A skin that works with the inner structure in carrying airframe loads.

stringer. Stiffening members usually runing longitudinally in the fuselage and spanwise in the wing used to reinforce thin sheets and also to resist bending and shear loads.

substructure. A general term for any structure behind a skin or web.

tension. The effect of loads acting on a part that tend to pull it apart or lengthen the part.

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