

TECHNICAL MANUAL

**STRUCTURAL REPAIR
ORGANIZATIONAL AND INTERMEDIATE**

GENERAL INFORMATION

**FMS SERIES
F-15SA
AIRCRAFT**

The Boeing Company

FA8634-12-C-2651

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CHANGE 5 - 1 OCTOBER 2020**

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Dates of issue for original and changed pages:

Revision.....	1	1 Sep 16	Change.....	2	1 Nov 18	Change.....	4	1 Apr 20	Change.....	5	1 Oct 20
Change.....	1	1 Sep 17	Change.....	3	15 Apr 19						

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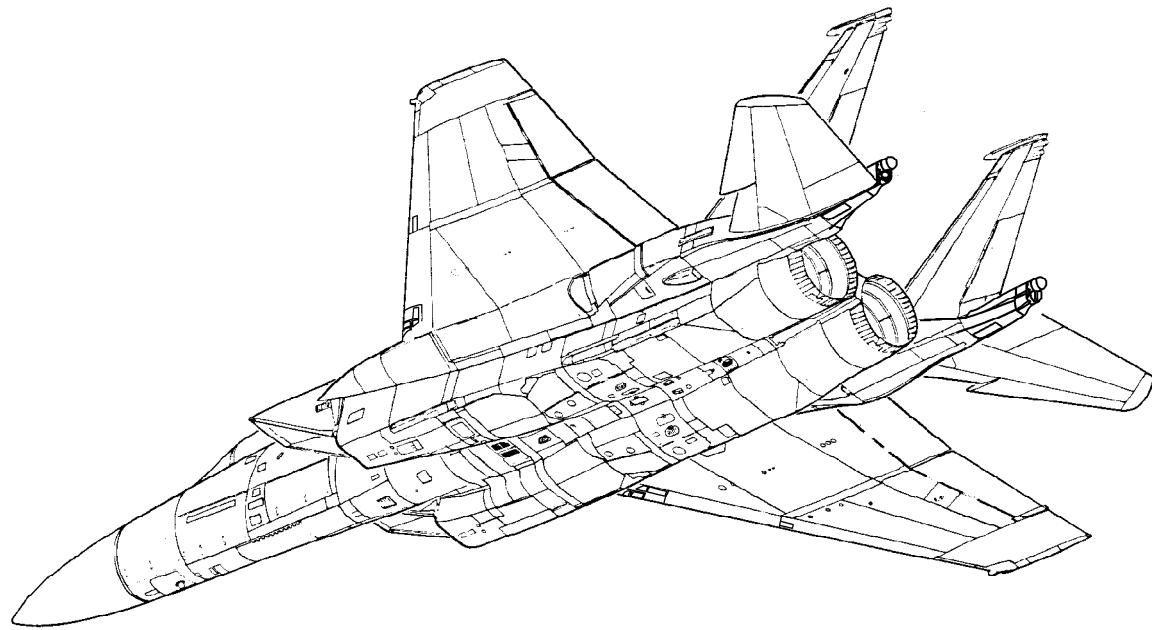
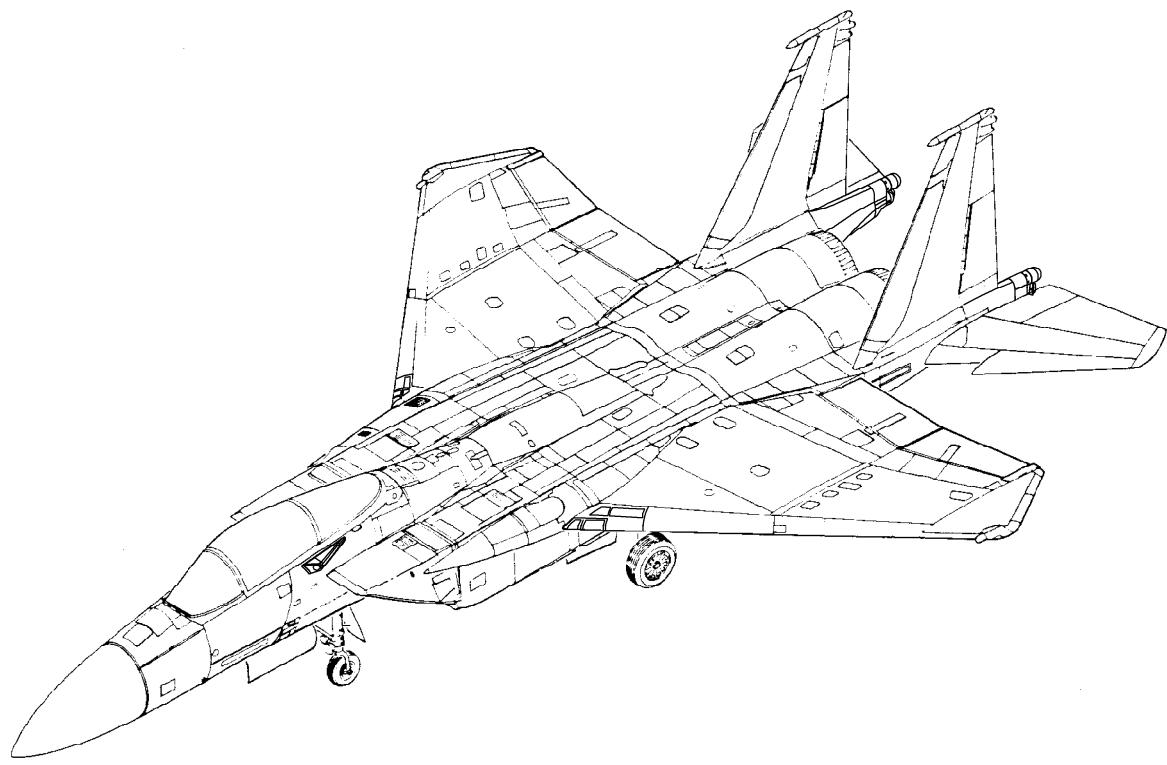
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F-15SA Aircraft

INTRODUCTION

PURPOSE AND SCOPE.

This manual is one of a series providing structural repair instructions to personnel at all maintenance levels. CSTO SR1F-15SA-3-1 through CSTO SR1F-15SA-3-5 manuals cover organizational and intermediate maintenance structural repair. CSTO SR1F-15SA-3-6 manual covers depot maintenance structural repair. CSTO SR1F-15SA-3-8 manual covers organizational, intermediate, and depot maintenance wear and rework tolerances for mechanical linkages. Information common to all maintenance levels is included in CSTO SR1F-15SA-3-1 through CSTO SR1F-15SA-3-8 and should be used by depot personnel.

CSTO SR1F-15SA-3-1, GENERAL INFORMATION.

Manual contains information common to more than one area of the aircraft or information required for procedures involving the complete aircraft. Common information includes fastener installation, shop practices, repair materials and special tools, and general aircraft information. An example of a procedure involving the complete aircraft is the aircraft detailed visual inspection, which is contained in the damage evaluation section. The general content of this manual is:

- Section I - General Information
- Section II - Damage Evaluation
- Section III - Shop Practices
- Section IV - Support of Structure
- Section V - Crash Handling and Shipping
- Section VI - Repair Materials and Special Tools
- Section VII - One-Time Ferry Flight

CSTO SR1F-15SA-3-2-1 AND CSTO SR1F-15SA-3-2-2 FIXED STRUCTURE.

Manual contains information on part numbers, type of material and thickness, negligible damage, repair and replacement of fixed structure. Fixed structure is considered to be those parts joined by permanent type fasteners in a production splice. Fixed structure includes riveted skins, longerons, stringers, keels, floors, webs, spars, ribs, and intercostals. Repairs in this manual are those which must be made with the part installed on the aircraft or replaced at intermediate or depot maintenance.

The general content of this manual is in two volumes:

CSTO SR1F-15SA-3-2-1

Section I - General Information

Section II - Wing

Section III - Forward Fuselage

Section IV - Center Fuselage (12-0001 THRU 12-0024; ALSO 93-0852 THRU 93-0923)

CSTO SR1F-15SA-3-2-2

Section IV - Center Fuselage (12-1025 AND UP)

Section V - Aft Fuselage

CSTO SR1F-15SA-3-3, DOORS, COVERS, AND REMOVABLE PANELS.

Manual contains information on type of material and thickness, negligible damage, repairs, and replacement. Coverage includes numbered and unnumbered doors and covers, single skin and reinforced single skin doors, double skin doors, and latch type doors. Fastener information includes all associated hardware, such as washers, shims, gang channels, and plate nuts. General content of this manual is:

Section I - General Information

Section II - Wing

Section III - Forward Fuselage

Section IV - Center Fuselage

Section V - Aft Fuselage

Section VI - Landing Gear

CSTO SR1F-15SA-3-4, CONTROL SURFACES AND REMOVABLE STRUCTURAL COMPONENTS.

Manual contains information on negligible damage, repairs, replacement of skins and structure, and trimming and drilling instructions for installation of the component on the aircraft. With the exception of trimming and drilling, the repair procedures specified may be done at organizational maintenance. The general content of this manual is:

Section I - General Information

Section II - Wing Group

Section III - Empennage

Section IV - Fuselage Group

Section V - Landing Gear

Section VI - Engine Supporting Structure

CSTO SR1F-15SA-3-5, TYPICAL REPAIRS, REPAIR OF SPECIAL STRUCTURE, AND SEALING.

Manual contains repairs applicable to more than one area of the aircraft. The information includes patch and

CSTO SR1F-15SA-3-1

insertion repairs of various structural members, webs, skins, angles and sheet metal equivalents, repairs to aluminum and glass fiber honeycomb, and plastic laminate structure. In most cases, the typical repairs must be adapted to fit the specific damage, using the specified rivet types, sizes, spacing, and edge distance, and the type and gage of repair materials. Exceptions to typical repairs are those contained in the special structure and radome sections. Standard repair parts and materials from a repair kit may be used for most of repairable damage. Sealing, when applicable to repairs, is contained in this manual. The general content of this manual is:

Section I - General Information
Section II - Typical Repairs
Section III - Extrusions and Equivalents
Section IV - Special Structure
Section V - Radome
Section VI - Sealing
Section VII - Wing Integral Fuel Tank Sealing
Section VIII - Damage Due to Landing Gear Failure

CSTO SR1F-15SA-3-6, DEPOT LEVEL REPAIR.

Manual contains the structure repair procedures that are done at depot maintenance. The general content of this manual is:

Section I - General Information
Section II - Wing
Section III - Empennage
Section IV - Forward Fuselage
Section V - Center Fuselage
Section VI - Aft Fuselage
Section VII - Landing Gear
Section VIII - Engine Support Structure
Section IX - Typical Repairs
Section X - Repair Materials and Special Tools

CSTO SR1F-15SA-3-8, REPAIR INSTRUCTIONS WITH WEAR AND REWORK TOLERANCES FOR MECHANICAL LINKAGES.

Manual contains information for organizational, intermediate, and depot maintenance personnel to inspect and decide, and correct excessive wear or damage to aircraft mechanical linkages which are outside the scope of the -2 aircraft maintenance manuals and other volumes of the structural repair series. The general content of this manual is:

Section I - General Information
Section II - Wing
Section III - Forward Fuselage

Section IV - Center Fuselage
Section V - Aft Fuselage
Section VI - Landing Gear

IMPROVEMENT REPORTS.

Recommendations for improvements to prescribed requirements and procedures will be submitted by AFTO Form 22, Technical Order System Publication Improvement Report, in accordance with TO 00-5-19. Complete forms shall be forwarded to AFLCMC/WWQL, 2725 C Street, Wright-Patterson AFB, OH 45433-7424.

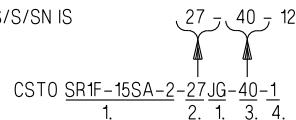
SYSTEM/SUBSYSTEM/SUBJECT NUMBER (S/S/SN) REFERENCES.

The S/S/SN references (for example, 27-40-12) contained in this manual, pertain to specific material contained in job guide program manuals. The TO number of the manual containing the referenced material is obtained as below.

- a. When an S/S/SN is not preceded by a prefix, the referenced material is always contained in a 5 x 8 inch job guide manual.

FOR EXAMPLE,

REFERENCES S/S/SN IS



1. These portions of the TO number are always the same.

2. This portion of the TO number is the first two digits of the S/S/SN.

3. This portion of the TO number is the second two digits of the S/S/SN. Note that the last two digits of the S/S/SN do not relate to TO number.

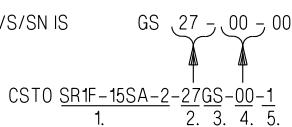
4. This is the volume number of the job guide manual. When a job guide manual is multivolume, refer to table of contents in volume one to determine the number of the volume containing the referenced S/S/SN.

- b. When an S/S/SN is preceded by a prefix, the referenced material is contained in a job guide

program manual other than a 5 x 8 inch job guide manual.

FOR EXAMPLE,

REFERENCES S/S/SN IS



1. This portion of the TO number is always the same.

2. This portion of the TO number is the first two digits of the S/S/SN.

3. This portion of the TO number indicates the manual type and precedes the S/S/SN. The prefix will be one of the below:

GV - Refers to a General Vehicle manual.

GS - Refers to a General Systems manual.

WD - Refers to a Wiring Diagram manual.

SD - Refers to a Schematic Diagram manual.

4. This portion of the TO number is the second two digits of the S/S/SN. Note that the last two digits of the S/S/SN do not relate to the TO number.

5. This is the volume number of the manual.
When a manual is multivolume, referenced S/S/SN

is indicated on title page of the volume in which it is contained.

c. Refer to CSTO SR1F-15SA-2-00GV-00-1 for a detailed explanation of the job guide program manual numbering system.

RECORD OF APPLICABLE COUNTRY STANDARD TIME COMPLIANCE TECHNICAL ORDERS (CSTCTO)/TIME COMPLIANCE TECHNICAL ORDERS (TCTO).

The record of applicable country standard time compliance technical orders/time compliance technical orders is a list of all CSTCTO/TCTO which affect the technical content (text or illustration) of this manual. Only current CSTCTO/TCTO are listed. A CSTCTO/TCTO is deleted from the list when any of the below occurs:

- a. The equipment configuration to which the CSTCTO/TCTO is applicable is no longer covered in the publication.
- b. The CSTCTO/TCTO is rescinded.
- c. The CSTCTO/TCTO is superseded or replaced.

Record of Applicable Country Standard Time Compliance Technical Orders/Time Compliance Technical Orders

CSTCTO/TCTO No.	Title	CSTCTO/TCTO Date
SR1F-15SF-6092	Modification of F-15S Aircraft to Incorporate Radar Upgrade, Electronic Warfare Upgrade, Flight Control Upgrade, Structural Upgrades and Center and Aft Fuselage Rewire	TBD

CONVENTIONS AND LEGENDS.

The text and illustrations in the manuals are arranged to supplement one another. The text in each sub-section references applicable figure numbers of the following illustrations. Where required, reference is also made to illustrations in other sections or other manuals in the structural repair series. While using the manuals, adjectives such as left, right, inboard, outboard, forward, aft, upper, lower, clockwise, or counterclockwise refer to the aircraft as viewed from the rear, on the

centerline, looking forward. Dimensions, material gages, and distances are given in inches, unless otherwise noted.

ILLUSTRATION LEGEND. Various symbols are used on illustrations to specify requirements for the repair/replacement of parts. A legend explaining the symbols used is shown in the illustration titled Illustration Legend.

CSTO SR1F-15SA-3-1

ILLUSTRATION TABLE LEGEND. The illustration table reflects the disposition of a part in the column titled RPR REF (Repair Reference). A legend explaining the usage of this column is shown in the illustration titled Illustration Table Legend.

APPLICABILITY NOTATIONS.

Data applicable to specific aircraft within a series are identified by aircraft serial numbers. Data applicable to an assembly that is serialized is identified to that assemblies serial number.

a. Assembly serial numbers are used for components that can be interchanged between aircraft. The following example shows the breakdown for assembly serial number A24-0013.

A - Manufacture code letter	93-0869
24 - Assembly designator	93-0870
0013 - Serial number	93-0871

The illustration titled Assembly Serial Number Plate Location shows location of assembly serial number plates.

b. When aircraft serial number applicability is given and the applicability is followed by the words AND UP, the aircraft through the last serial number are included in the chart below.

Block Number	F-15SA Serial Number	Block Number	F-15SA Serial Number
Block 54	93-0852	Block 55	93-0862
	93-0853		93-0863
	93-0854		93-0864
	93-0855		93-0865
	93-0856		93-0866
	93-0857		93-0867
	93-0858		93-0868
	93-0859		93-0869
	93-0860		93-0870
	93-0861		93-0871
		Block 56	93-0872
			93-0873
			93-0874
			93-0875
			93-0876
			93-0877
			93-0878
			93-0879
			93-0880
			93-0881
			93-0882
			93-0883
			93-0984
			93-0885
			93-0886

Block Number	F-15SA Serial Number	Block Number	F-15SA Serial Number
	93-0887	Block 59	93-0912
Block 57	93-0888		93-0913
	93-0889		93-0914
	93-0890		93-0915
	93-0891		93-0916
	93-0892		93-0917
	93-0893		93-0918
	93-0894		93-0919
	93-0895		93-0920
	93-0896		93-0921
	93-0897		93-0922
	93-0898		93-0923
	93-0899	Block 74	12-1001
Block 58	93-0900		12-1002
	93-0901		12-1003
	93-0902		12-1004
	93-0903	Block 75	12-1005
	93-0904		12-1006
	93-0905		12-1007
	93-0906		12-1008
	93-0907	Block 76	12-1009
	93-0908		12-1010
	93-0909		12-1011
	93-0910		12-1012
	93-0911	Block 77	12-1013

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Block Number	F-15SA Serial Number	Block Number	F-15SA Serial Number
	12-1014		12-1039
	12-1015		12-1040
	12-1016		12-1041
	12-1017		12-1042
	12-1018		12-1043
	12-1019		12-1044
	12-1020		12-1045
	12-1021		12-1046
	12-1022		12-1047
	12-1023		12-1048
	12-1024		12-1049
Block 78	12-1025		12-1050
	12-1026		12-1051
	12-1027		12-1052
	12-1028		12-1053
	12-1029		12-1054
	12-1030		12-1055
	12-1031		12-1056
	12-1032		12-1057
	12-1033		12-1058
	12-1034		12-1059
	12-1035		12-1060
	12-1036		12-1061
Block 79	12-1037		12-1062
	12-1038		12-1063

Block Number	F-15SA Serial Number	Block Number	F-15SA Serial Number
	12-1064		12-1075
	12-1065		12-1076
	12-1066		12-1077
	12-1067		12-1078
	12-1068		12-1079
	12-1069		12-1080
	12-1070		12-1081
	12-1071		12-1082
	12-1072		12-1083
	12-1073		12-1084
	12-1074		

REPAIR PROCEDURE SYMBOLS

	A. EXISTING PART.
	B. REPAIR PART.
	C. REPAIR PART IN CROSS SECTION.
	D. SHADING INDICATES AN AREA TO BE SEALED.
	E. PARTS SHOWN ARE INDICATED AS: (1) THE PART IS INVOLVED IN THE REPAIR PROCEDURE. (2) THE PART IS A REFERENCE PART WHICH IS SHOWN TO CLARIFY THE ILLUSTRATION.

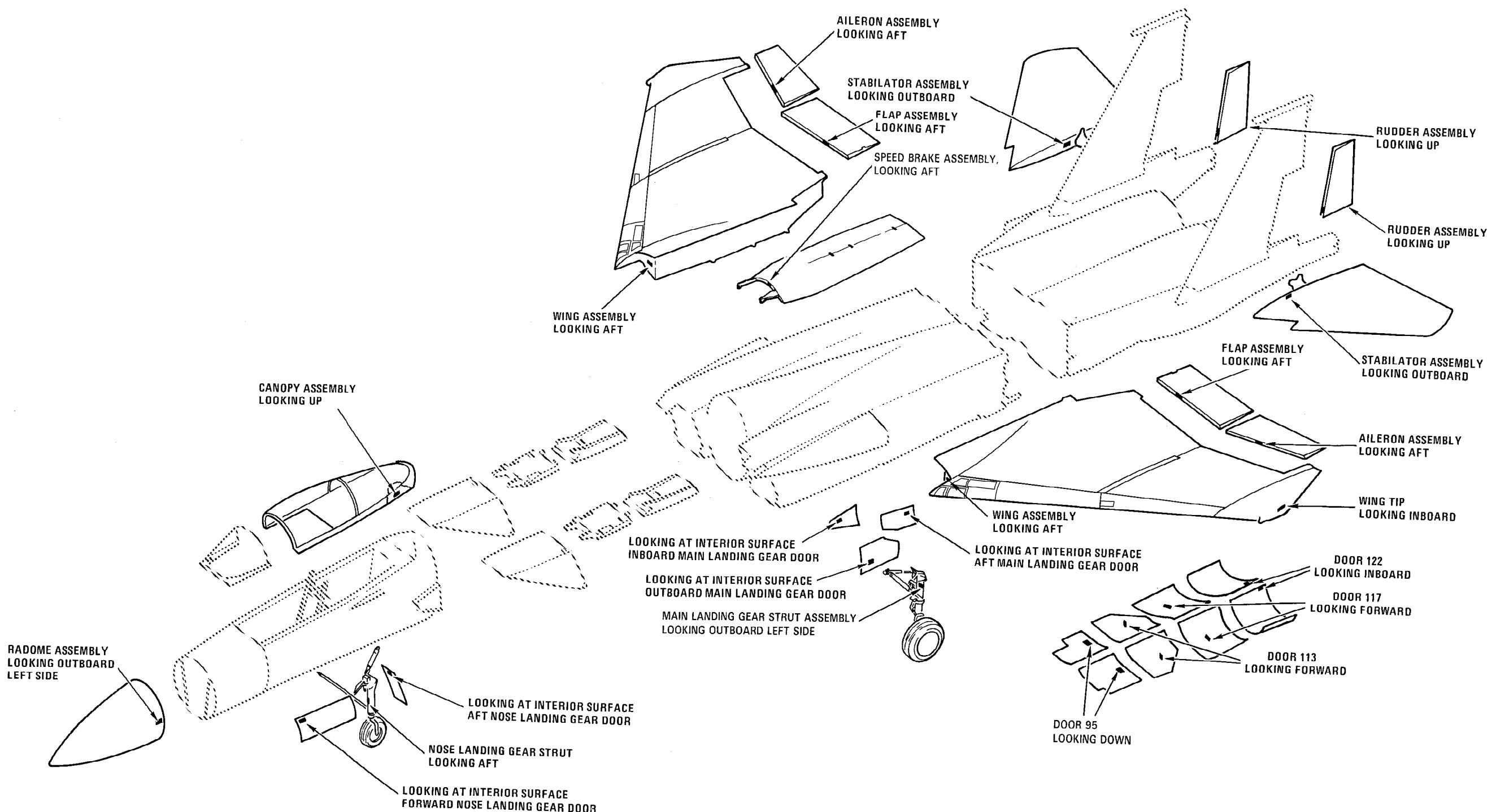
INSTALLATION PROCEDURE SYMBOLS

	F. INDICATES EXISTING HOLES WHICH DO NOT REQUIRE DRILLING OR REAMING.
	G. INDICATES THE POSITION OF A HOLE WHICH MUST BE DRILLED.
	H. INDICATES THE POSITION OF A HOLE WHICH HAS BEEN PILOT DRILLED BUT WHICH MUST BE ENLARGED TO THE PROPER DIAMETER.
	J. WITHIN THE SHADED AREA, ALL HOLES ARE THE SAME DIAMETER AND ALL FASTENERS ARE THE SAME TYPE AND SIZE.
	K. THE DASHED LINE INDICATES THE EDGE OF A PART WHICH MUST BE TRIMMED UPON INSTALLATION.

	RPR REF	
	2-2	INDICATES FIGURE NUMBER OF SPECIFIC REPAIR.
	TYP	REFERENCE CSTO SR1F-15SA-3-5. REFER TO APPLICABLE REPAIR PARAGRAPH IN CSTO SR1F-15SA-3-2, CSTO SR1F-15SA-3-3, OR CSTO SR1F-15SA-3-4 FOR LIMITATIONS AND AREA OF APPLICATION OF TYPICAL REPAIR.
	REPL	REPLACE PART. REFER TO APPLICABLE REPLACEMENT PARAGRAPH IN CSTO SR1F-15SA-3-2, CSTO SR1F-15SA-3-3, OR CSTO SR1F-15SA-3-4 FOR PROCEDURES.
	DEP	REPAIR AT DEPOT MAINTENANCE LEVEL ONLY. REPAIR CONTAINED IN CSTO SR1F-15SA-3-6.

Illustration Table Legend

CSTO SR1F-15SA-3-1



SAN301-1-32-001

Assembly Serial Number Plate Location

HOW TO USE THE MANUALS.

Refer to illustration titled How to Use the Manuals. Use of the manuals may be divided into the below procedures:

- a. Investigation of damage
- b. Location of repair index
- c. Classification of damage
- d. Classification of repair
- e. Repair procedures
- f. Use of repair procedures.

INVESTIGATION OF DAMAGE. Classify the damage as repairable or requiring replacement of parts. Refer to paragraph 1-38 for definitions. If the part number is painted over or illegible, refer to the paragraph below for location of information.

LOCATION OF REPAIR INDEX. To locate the repair index that contains the part number, gage, and type of material of the damaged part, one of the procedures below may be used.

- a. Name of part is known:
 1. See figure 1-1 to decide applicable manual.
 2. Use the alphabetical index or table of contents of the applicable manual to locate the page containing the required information.
- b. Name or number of part is not known:
 1. See figure 1-1 to determine the applicable manual.
 2. Figure 1-1 of the applicable manual lists the figure number of the illustration which contains the major assembly of the damaged part.
 3. The illustration which contains the major assembly refers to the repair index containing detailed information on the damaged part.
 - c. If the part number is known, the name of its major group may be determined from the following part number example and group number list. Use the alphabetical index, table of contents, or figure 1-1 of the applicable manual to locate the required information.

Part number example: 68A112689

68 - Prefix

A - Type designation

11 - Group number

2689 - Serial number

Group Number	Group Name
11	WING
17	AILERON
18	TRAILING EDGE FLAPS
21	HORIZONTAL STABILATOR
23	VERTICAL STABILIZER
24	RUDDER
30	NOSE SECTION
31	FORWARD FUSELAGE
32	CENTER FUSELAGE
33	AFT FUSELAGE
35	CANOPY AND WINDSHIELD
36	SPEED BRAKE
41	MAIN LANDING GEAR
45	NOSE LANDING GEAR
48	ARRESTING GEAR
50	ENGINE MOUNTS
73	ARMAMENT INSTALLATION

Group Number	Group Name
81	COCKPIT/CABIN INSTRUMENTA- TION
83	ENVIRONMENTAL CONTROL

CLASSIFICATION OF DAMAGE. Damage is classified as repairable or as requiring replacement of the part. Refer to paragraph 1-38 for definition of terms. If doubt exists as to which classification is applicable, the part shall be replaced.

CLASSIFICATION OF REPAIR. Refer to paragraphs 1-33 thru 1-51 for repair categories, classifications, and types. Repairs shall meet the stress intensity requirements of the part. Refer to the applicable section of each manual for the stress intensity requirements of a specific part.

REPAIR PROCEDURES. When there is a specific repair to a part, that repair is shown with the part. Typical repairs which may be adapted to meet the requirements are described in CSTO SR1F-15SA-3-5.

USE OF REPAIR PROCEDURES. Repair information is contained in both text and illustrations. The text should be read first, since it describes negligible damage, repairs, and replacement. Illustrations and charts list the gage, material, and specific repair of the damaged part.

RELATED PUBLICATIONS.

The structural repair manuals are supplemented by TO 1-1A-1, General Manual for Structural Repair, and is included in the list of related publications below, also used to supplement structural repair manuals with specific information as defined by the abbreviated publication titles. For a complete list of publication titles, refer to CSTO SR1F-15SA-01, List of Applicable Publications.

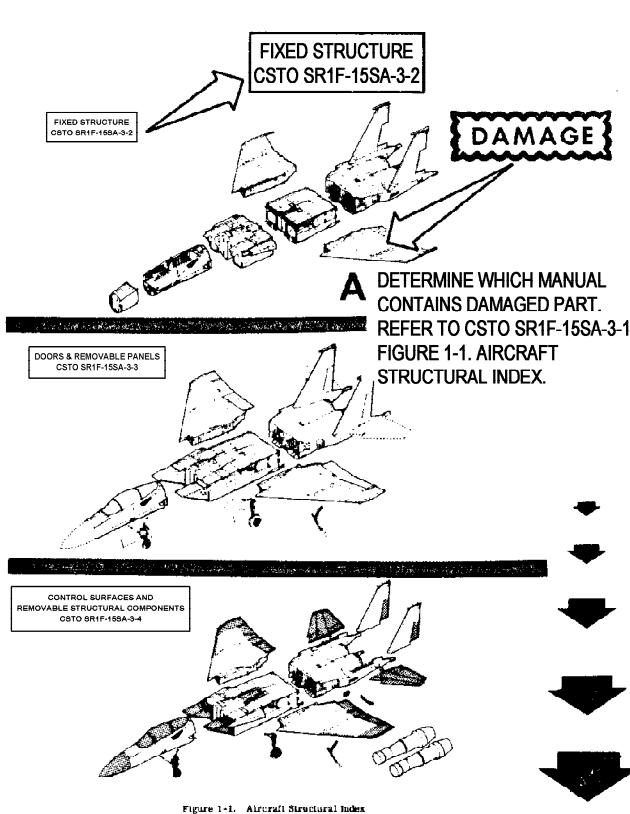


Figure 1-1. Aircraft Structure

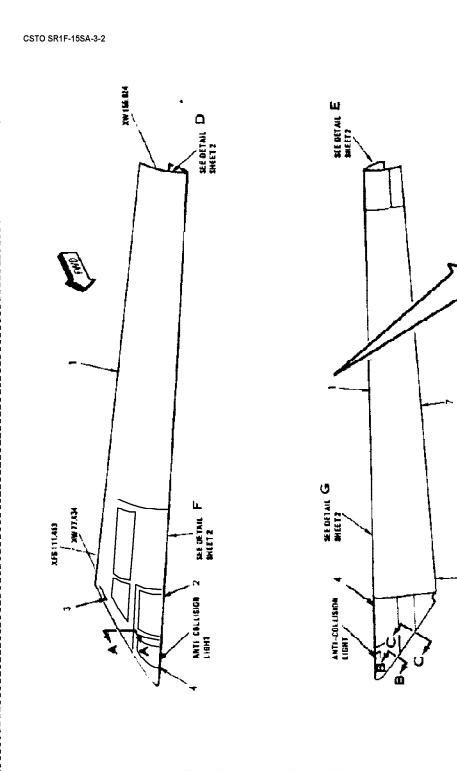


Figure 2-3. Inboard Leading Edge S-

**DETERMINE WHICH MANUAL
CONTAINS DAMAGED PART.
REFER TO CSTO SR1F-15SA-3-1
FIGURE 1-1. AIRCRAFT
STRUCTURAL INDEX.**

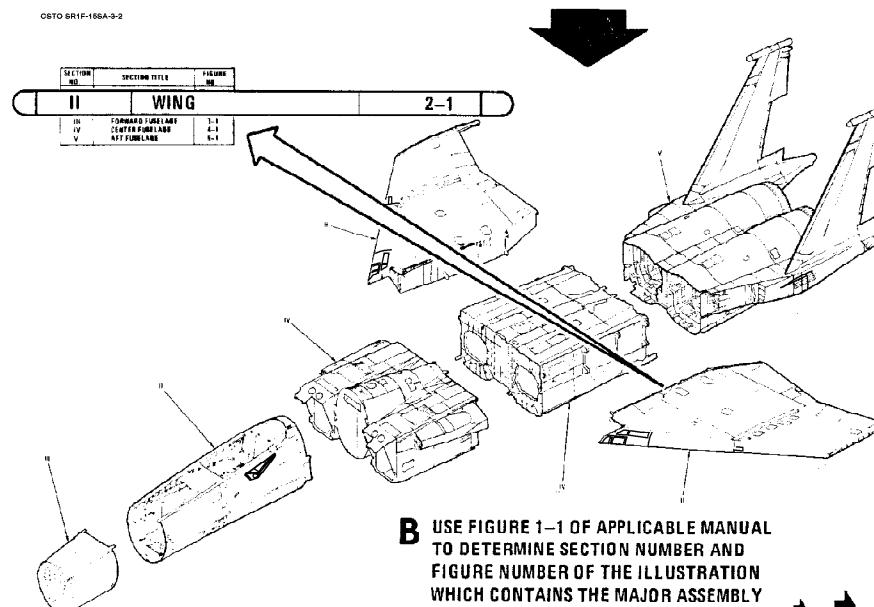


Figure 1. *Scanning*

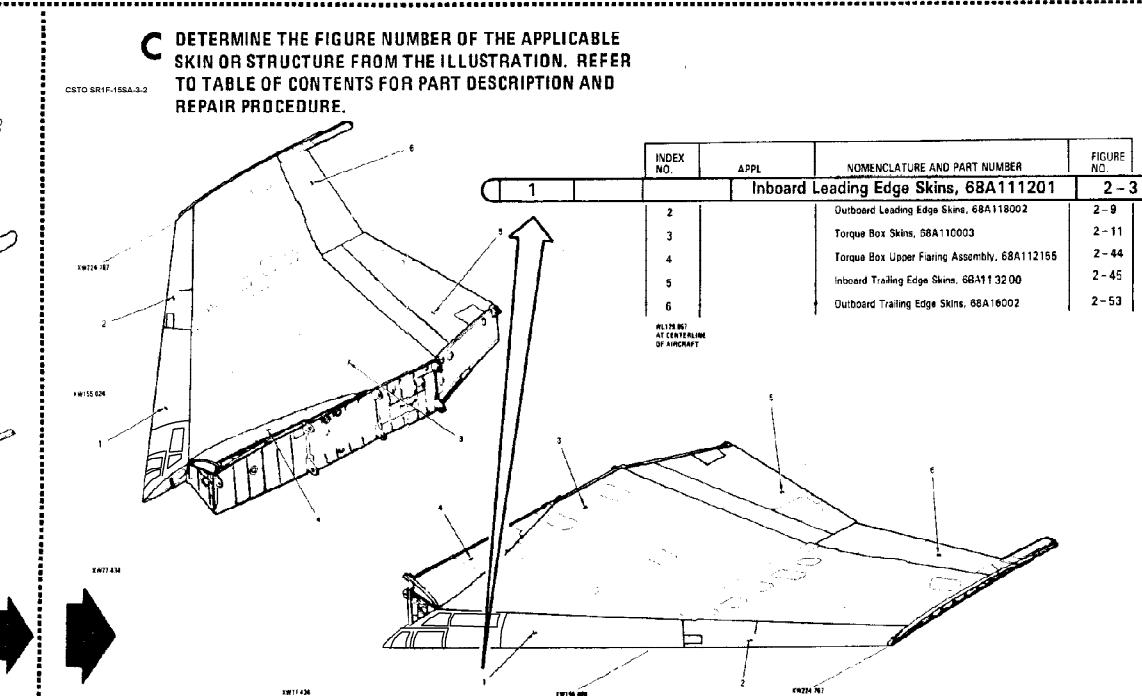
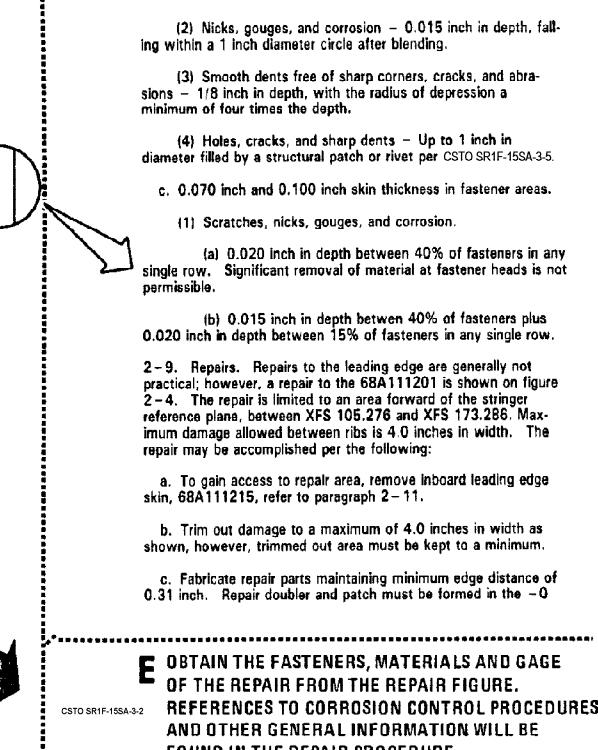


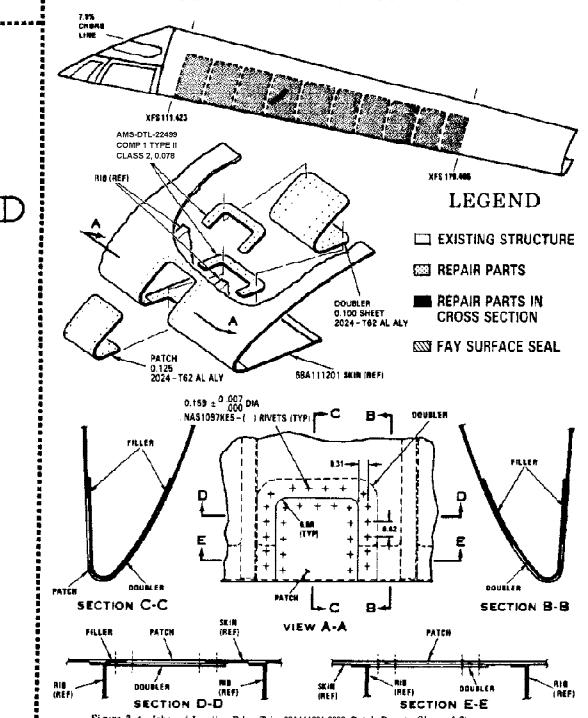
Figure 2-1. ★ 2010 Index

C DETERMINE THE FIGURE NUMBER OF THE APPLICABLE SKIN OR STRUCTURE FROM THE ILLUSTRATION. REFER TO TABLE OF CONTENTS FOR PART DESCRIPTION AND REPAIR PROCEDURE.

INDEX NO.	APPL	NOMENCLATURE AND PART NUMBER	FIGURE NO.
1	Inboard	Leading Edge Skins, 68A111201	2-3
2		Outboard Leading Edge Skins, 68A118002	2-9
3		Torque Box Skins, 68A110003	2-11
4		Torque Box Upper Flange Assembly, 68A112155	2-44
5		Inboard Trailing Edge Skins, 68A113200	2-45
6		Outboard Trailing Edge Skins, 68A16C002	2-53



E OBTAIN THE FASTENERS, MATERIALS AND GAGE
OF THE REPAIR FROM THE REPAIR FIGURE.
REFERENCES TO CORROSION CONTROL PROCEDURES
AND OTHER GENERAL INFORMATION WILL BE
FOUND IN THE REPAIR PROCEDURE.



CSTO SR1F-15SA-3-1

TO Number	Title
	FLIGHT MANUAL
SR1F-15SA-1	Flight Manual
	MAINTENANCE MANUALS
SR1F-15-101	Maintenance Instructions - F-15 Service Usage Recorder Program Data Collecting and Reporting
SR1F-15SA-2-00GV-00-1	Aircraft Description and Maintenance Orientation
SR1F-15SA-2-00WD-10-1	Wiring Diagrams
SR1F-15SA-2-00WD-20-1	Wiring Repair - General Wiring and Repair Procedures
SR1F-15SA-2-00WD-30-1	Wiring Repair - Reference Designation Index
SR1F-15SA-2-00WD-40-1	Wiring Repair - Cockpit Cable Assembly Data
SR1F-15SA-2-00WD-50-1	Wiring Repair - Forward Fuselage Cable Assembly Data
SR1F-15SA-2-00WD-60-1	Wiring Repair - Center, Aft Fuselage and Wing Cable Assembly Data
SR1F-15SA-2-00WD-70-1	Wiring Repair - Pylon and Miscellaneous Cable Assembly Data
SR1F-15SA-2-00WD-80-1	Wiring Repair - Retrofit Cable Assembly Data
SR1F-15SA-2-00WD-90-1	Wiring Repair - Panel Assembly Data
SR1F-15SA-2-05JG-00-1; -2; -3	Aircraft - General Maintenance
SR1F-15SA-2-05JG-10-1	Aircraft - Safety and Protective Devices
SR1F-15SA-2-05JG-30-1	Aircraft - Emergency Procedures
SR1F-15SA-2-07JG-00-1	Aircraft - Lifting and Jacking
SR1F-15SA-2-08JG-00-1	Aircraft - Leveling
SR1F-15SA-2-09JG-00-1	Aircraft - Towing
SR1F-15SA-2-10JG-00-1	Aircraft - Parking and Mooring
SR1F-15SA-2-12JG-10-1; -2	Servicing - Replenishing and Depleting
SR1F-15SA-2-12JG-11-1	Servicing - Special Occurrence
SR1F-15SA-2-12JG-20-1	Servicing - Aircraft Cleaning

TO Number	Title
SR1F-15SA-2-21GS-00-1	Air Conditioning System
SR1F-15SA-2-21JG-00-1	Air Conditioning System - General
SR1F-15SA-2-21JG-21-1	Air Conditioning System - Distribution
SR1F-15SA-2-21JG-30-1	Air Conditioning System - Pressurization Control - Cabin
SR1F-15SA-2-21JG-31-1	Air Conditioning System - Pressurization Control - Canopy Seal
SR1F-15SA-2-22JG-11-1; -2	Auto Flight System
SR1F-15SA-2-23JG-24-1; -2	Communication System - VHF/UHF and Audio Signal
SR1F-15SA-2-26JG-10-1	Fire Protection System - Detection - Engine Bays
SR1F-15SA-2-27JG-11-1; -2	Flight Control System - Lateral Control
SR1F-15SA-2-27JG-21-1; -2	Flight Control System - Directional Control
SR1F-15SA-2-27JG-41-1; -2	Flight Control System - Longitudinal Control
SR1F-15SA-2-27JG-50-1	Flight Control System - Flaps
SR1F-15SA-2-27JG-60-1	Flight Control System - Speed Brake
SR1F-15SA-2-28GS-00-1	Fuel System
SR1F-15SA-2-28JG-00-1; -2; -3; -4	Fuel System - General
SR1F-15SA-2-28JG-10-1	Fuel System - Storage - Fuselage Tank NO. 1
SR1F-15SA-2-28JG-12-1	Fuel System - Storage - Right Auxiliary Fuselage Tank
SR1F-15SA-2-28JG-13-1	Fuel System - Storage - Fuselage Tank NO. 2
SR1F-15SA-2-28JG-14-1	Fuel System - Storage - Fuselage Tanks NO. 3A and NO. 3B
SR1F-15SA-2-28JG-15-1	Fuel System - Storage - Internal and External Wing Tanks
SR1F-15SA-2-28JG-21-1; -2	Fuel System - Distribution - Internal Transfer
SR1F-15SA-2-28JG-22-1	Fuel System - Distribution - External Transfer
SR1F-15SA-2-28JG-23-1; -2	Fuel System - Distribution - Aerial Refueling
SR1F-15SA-2-28JG-24-1	Fuel System - Distribution - Ground Refueling and Defueling

CSTO SR1F-15SA-3-1

TO Number	Title
SR1F-15SA-2-28JG-40-1	Fuel System - Indicating - Quantity and Low Level Warning
SR1F-15SA-2-29JG-00-1	Hydraulic Power System - General
SR1F-15SA-2-29JG-10-1; -2	Hydraulic Power System - Power Control
SR1F-15SA-2-29JG-11-1; -2; -3	Hydraulic Power System - Utility
SR1F-15SA-2-29JG-30-1	Hydraulic Power System - Indicating
SR1F-15SA-2-30JG-40-1	Ice and Rain Protection System - Windshield
SR1F-15SA-2-31JG-71-1	Indicating/Recording Systems - Video Recorder and Map System (VRAMS)
SR1F-15SA-2-32JG-00-1	Landing Gear System - General
SR1F-15SA-2-32JG-10-1; -2; -3	Landing Gear System - Main Landing Gear and Doors
SR1F-15SA-2-32JG-20-1; -2	Landing Gear System - Nose Landing Gear and Doors
SR1F-15SA-2-32JG-30-1; -2; -3	Landing Gear System - Extension and Retraction
SR1F-15SA-2-32JG-40-1; -2; -3	Landing Gear System - Wheel Brake and Skid Control
SR1F-15SA-2-32JG-60-1	Landing Gear System - Position and Warning
SR1F-15SA-2-32JG-90-1; -2	Landing Gear System - Arresting Hook
SR1F-15SA-2-33JG-10-1	Lighting System - Flight Compartment
SR1F-15SA-2-33JG-40-1	Lighting System - Exterior
SR1F-15SA-2-34JG-11-1; -2	Navigation System - Flight Environment Data
SR1F-15SA-2-34JG-30-1	Navigation System - Instrument Landing
SR1F-15SA-2-34JG-42-1	Navigation System - Navigational Pod
SR1F-15SA-2-34JG-50-1	Navigation System - AN/APX-119 IFF Transponder
SR1F-15SA-2-34JG-51-1	Navigation System - TACAN
SR1F-15SA-2-34JG-59-1	Navigation System - AN/APX-114 Air-To-Air IFF Interrogator
SR1F-15SA-2-35JG-11-1	Oxygen System - Crew (MSOGS)
SR1F-15SA-2-71GS-03-1	General Systems - Power Plant System - F110-GE-129C/E Engine

TO Number	Title
SR1F-15SA-2-71JG-00-2	Power Plant System - General - F110-GE-129E Engine
SR1F-15SA-2-71JG-03-1	Power Plant System - Engine Removal and Installation - F110-GE-129E Engine
SR1F-15SA-2-71JG-21-1	Power Plant System - Engine Mounts - F110-GE-129E Engine
SR1F-15SA-2-71JG-60-1; -2; -3	Power Plant System - Air Intakes
SR1F-15SA-2-73JG-31-1	Engine Fuel System - Indicating -F110-GE-129E Engine
SR1F-15SA-2-77JG-11-1	Engine Indicating System - Power -F110-GE-129E Engine
SR1F-15SA-2-77JG-21-1	Engine Indicating System - Temperature -F110-GE-129E Engine
SR1F-15SA-2-77JG-31-1	Engine Indicating System - Analyzers -F110-GE-129E Engine
SR1F-15SA-2-80JG-10-1	Engine Starting System - Hydraulic
SR1F-15SA-2-83JG-00-1	Accessory Gearbox System - General
SR1F-15SA-2-94JG-10-1	Weapons System - Weapons Release
SR1F-15SA-2-94JG-31-1; -2; -3	Weapons System - Weapons Suspension - Missiles
SR1F-15SA-2-94JG-32-1; -2; -3; -4; -5	Weapons System - Weapons Suspension - Bombs
SR1F-15SA-2-94JG-50-1; -2; -3	Weapons System - Gun
SR1F-15SA-2-94JG-78-1; -2; -3	Weapons System - Radar Set AN/APG-63(V)3
SR1F-15SA-2-95JG-11-1; -2	Crew Escape and Safety System - Ejection Seat
SR1F-15SA-2-95JG-21-1; -2; -3; -4; -5	Crew Escape and Safety System - Canopy
SR1F-15SA-2-99JG-16-1	Electronic Warfare System
STRUCTURAL REPAIR MANUALS	
SR1F-15SA-3-1	General Information
SR1F-15SA-3-2-1; -2	Fixed Structure
SR1F-15SA-3-3	Doors, Covers, and Removable Panels

CSTO SR1F-15SA-3-1

TO Number	Title
SR1F-15SA-3-4	Control Surfaces and Removable Structural Components
SR1F-15SA-3-5	Typical Repairs, Repair of Special Structure and Sealing
SR1F-15SA-3-6	Depot
SR1F-15SA-3-8	Repair Instructions With Wear and Rework Tolerances for Mechanical Linkages
■ SR1F-15SA-39-1; -2	Aircraft Battle Damage Repair
	PARTS BREAKDOWN MANUALS
SR1F-15SA-4-1	Airframe
SR1F-15SA-4-2	Mechanisms, Controls, Armament, and Egress Systems
SR1F-15SA-4-3	Hydraulic and Environmental Control Systems
SR1F-15SA-4-4	Instruments, Electrical, and Electronic Systems
SR1F-15SA-4-5	Fuel System, Engine, and Related Systems
SR1F-15SA-4-6	Aerospace Ground Equipment
SR1F-15SA-4-7	Index
	CORROSION CONTROL MANUALS
1-1-691	Cleaning and Corrosion Prevention and Control, Aerospace and Non-Aerospace Equipment
SR1F-15SA-23	System Peculiar Corrosion Control
	WEIGHT AND LOADING DATA
1-1B-50	Weight and Balance
SR1F-15SA-5	Basic Weight Checklist and Loading Data
	INSPECTION MANUALS
SR1F-15SA-6	Inspection and Maintenance Requirements Manual
SR1F-15SA-36	Nondestructive Inspection

TO Number	Title
SA2J-F110-CD-1	Interactive Electronic Technical Manual - (IETM) Intermediate/Depot Level - F110-GE-129C/E Turbofan Engine
33B-1-1	Nondestructive Inspection Methods
33B-1-11	Nondestructive Inspection - Intermediate and Depot level Turbofan Engine, Model F101-102, F118-100, F110-129 (General Electric)
	STORAGE MANUAL
00-20-5	Aircraft, Drone, Aircrew Training Devices, Engines and Air-Launched Missile Inspections, Flight Reports and Supporting Maintenance Documents Records
SR1F-15SA-17	Aircraft Storage Manual
	INTERMEDIATE/OVERHAUL MANUALS
33D-1-131	Instructions with Parts List - Miscellaneous Depot Overhaul Frames Alignment Checks
4S1-120-3	Depot Overhaul Instructions - Left and Right Main Retractable Landing Gear, P/N 68A412501
4S2-89-3	Depot Overhaul Instructions - Nose Retractable Landing Gear, P/N 68A452500-2003 and 68A452600-1005
6J14-2-34-3	Intermediate/Depot Overhaul Instructions with Illustrated Parts Breakdown - Removable Auxiliary External Aircraft Fuel Tank, P/N 68A550600, and 315J500-1 Cable Assembly; Electrical External Fuel Tank Adapter, P/N 68A768217-17AA
SR6J14-5-17-3-2	Overhaul And Structural Repair - Aircraft Fuel Tank, P/N 68A250001-1065 and 68A250001-1067
8D10-6-1-103	Intermediate Overhaul Instructions with Illustrated Parts Breakdown - Aircraft Navigation Lights, P/N S2036LA-1, S2036RA-1, S2036-LC, S2036-RC, 30-0461-1, -1AMR, -2, -2AMR, -5R, -6R, -5A, -6A, 30-0462-1, 30-0764-5, -5A, -6, -6A, 30-0774-3, and 30-1501-1; Aircraft Floodlights, P/N 30-0714-3, -5, 30-0716-1, 30-1829-1 and -2
	GENERAL MANUALS
00-5-19	Security Assistance Technical Order Program - SATOP
00-25-223	Integrated Pressure Systems and Components (Portable and Installed)
1-1-3	Inspection and Repair of Aircraft Integral Tanks and Fuel Cells

CSTO SR1F-15SA-3-1

TO Number	Title
1-1-8	Application and Removal of Organic Coatings
1-1A-1	Engineering Handbook Series for Aircraft Repair - General Manual for Structural Repair
1-1A-8	Engineering Manual Series - Aircraft and Missile Repair - Structural Hardware
1-1A-9	Engineering Series for Aircraft Repair - Aerospace Metals - General Data and Usage Factors
34G1-10-6-1	Operation, Service Instructions with Illustrated Parts Breakdown - Hand Operated Tube Bender Kit, P/N 12A0104-1
36C3-5-5-1	Operation - Type MB-1A; Crane - Salvage Aircraft
44B-1-2	General Maintenance Instructions - Airframe Antifriction Bearings
42E1-1-1	Organizational, Intermediate, and Depot Maintenance - Aviation Hose and Tube Manual

SECTION I

GENERAL INFORMATION

1-1. AIRCRAFT DESCRIPTION. See figure 1-1.

1-2. The F-15SA aircraft is a high-mounted swept back wing, twin tailed aircraft. It is powered by two General Electric turbofan engines. Fuel tanks are located in the center fuselage and wing.

Fuselage-mounted conformal fuel tanks (CFT) supplement internal fuel. The engine air intakes are side mounted with variable intake ramps. A fairing on the right side of the center fuselage provides for an internally mounted 20 MM gun and on the left side an inflight refueling receptacle.

1-3. MAJOR STRUCTURAL GROUPS. See figure 1-2.

1-4. The main structural groups are the wing group, empennage, fuselage group, landing gear, and engine supporting structure.

1-5. WING GROUP. The wing group includes the torque box, inboard and outboard leading edge, inboard and outboard trailing edge, flap, aileron, and wing tip.

1-6. EMPENNAGE. The empennage includes the horizontal stabilator and the rudder.

1-7. FUSELAGE GROUP. The fuselage is divided into three sections; forward, center, and aft. The forward fuselage has the nose barrel, main structural assembly, radome, windshield, and canopy. The center fuselage is made up of the forward and aft main structural assembly, variable inlet, variable ramp, and speed brake. The aft fuselage is made up of the center body main structural assembly, side panels, keel assembly, and vertical stabilizers.

1-8. LANDING GEAR. The landing gear is made up of the tricycle landing gear (including doors) and arresting hook. The main landing gears are contained in the center fuselage and the nose landing gear is in the forward fuselage.

1-9. ENGINE SUPPORTING STRUCTURE. The engine supporting structure (engine mounts) are considered in this section. The engine doors are part of the aft fuselage structure.

1-10. PRINCIPAL DIMENSIONS. See figure 1-3.

1-11. The principal aircraft dimensions are shown in figure 1-3.

1-12. CONTOUR SMOOTHNESS. See figure 1-4.

WARNING

Damage or repairs which disturb the smooth flow of air over the critical areas of the wing will reduce lift of the wing. This may cause only a slight wing heavy condition or it could affect takeoff and landing pattern speeds. It could also cause buffeting at high speeds. Changes to airflow around critical areas of control surfaces may affect controls effectiveness.

Damage and/or repairs that change the contour or roughen the surface will cause a reduction in performance of the aircraft. In aerodynamically critical areas, every effort shall be made to maintain original contour and smoothness requirements or performance of the aircraft will be seriously affected. Contour smoothness requirements shall be met without application of aerodynamic fairing compound unless otherwise stated.

NOTE

Repairs using aerodynamic fairing compound on mold line surfaces have limiting conditions for engine air inlet areas, and surface temperatures per CSTO SR1F-15SA-3-5.

1-13. Dimensions given for the aircraft contour smoothness requirements shall be maintained so that established aerodynamic and flight characteristics are maintained. Because of repair or replacement of specific items, exceptions to the contour smoothness requirements may exist. See

CSTO SR1F-15SA-3-1

table I for exceptions. When exceptions are listed, the reference manual shall apply. When mismatch requirements are exceeded, refer to CSTO SR1F-15SA-3-5 for repairs.

1-14. FASTENER FLUSHNESS. Fasteners shall be flush with mold line surface within the limits given in figure 1-4. Milling of rivet heads is permissible when required to meet limits, provided they do not protrude beyond the protruded dimensions in the following chart. A maximum of 35 percent of aluminum solid rivets, in a row or pattern, are acceptable to a flushness tolerance of +0.005 inch to -0.001 inch.

Rivet Size	Protruded Dimension In Inches (Before Shaving)
3/32	0.010
1/8	0.010
5/32	0.010
3/16	0.010
1/4	0.015
5/16	0.020
3/8	0.020

1-15. GAP TOLERANCES. See figure 1-4. Dimensions given for butt joint gaps are the maximum allowable; minimum shall be 0.010 unless other dimensions are specified. Refer to paragraph 1-13 for exceptions to contour smoothness.

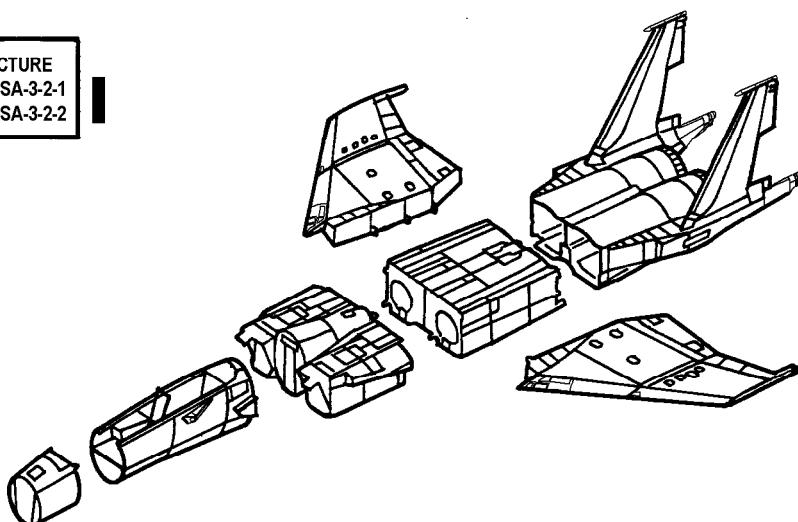
a. Contour. Except for items specified in table II, maximum exterior contour deviations in Zones I and II shall not exceed +0.020 -0.040 inch and in Zone III +0.030 -0.050 inch. Contour deviations in Zones IV, V, and VI shall not exceed +0.030 -0.030 inch. See table III.

b. Surface Waviness. Surface waviness shall be measured in water line and buttock line planes only

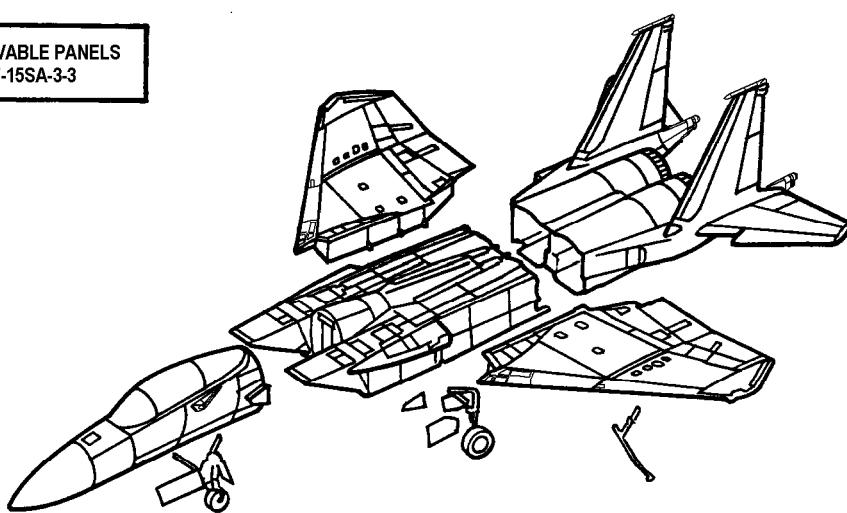
and shall not exceed 0.015 inch from peak to valley in a 6.00 inch span, except for the following:

1. Nacelle moldline skins, 68A327180, 68A327227, and 68A327168; the avionics doors 68A313904, 68A313906, 68A313908, 68A313910, and 68A312925; the landing gear doors 68A411600, 68A411650, 68A413400, 68A413450, 68A413500 and 68A413550; the engine access doors 68A334002 and 68A334003; and the sides of the center fuselage between FS 415.00 and FS 626.90 shall not exceed 0.030 inch from peak to valley in a 6.00 inch span.
2. Box assembly, lower, forward, leading edge, vertical stabilizer, HF-antenna, 68A230610 and 68A230710, surface waviness shall not exceed 0.040 peak to valley in a 6.00 span.
3. Aft fuselage skins 68A332043 and 68A332050 shall not exceed 0.030 inch from peak to valley in a 4.00 inch span.
4. Wing lower inboard skins 68A112110 and 68A112111 shall not exceed 0.020 from peak to valley in a 4.00 inch span measured chordwise up to 50 percent maximum of the panels between integral stiffeners along any buttock line; or shall not exceed 0.030 from peak to valley in a 4.00 inch span measured chordwise up to 25 percent maximum of the panels between integral stiffeners.
5. Zone V shall not exceed 0.020 inch from peak to valley in a 6.00 inch span.
6. Zone VI shall not exceed 0.030 inch from peak to valley in a 6.00 inch span.
- c. Surfaces of composite assemblies containing any or all of the following surface conditions are acceptable provided no condition exceeds 0.015 inches from peak to valley in a 6.0 inch moldline span.
 1. Resin ridges, filament crossovers or raised filaments.
 2. Gaps between filaments.
 3. Ply drop-offs permitted by the applicable Engineering drawing.

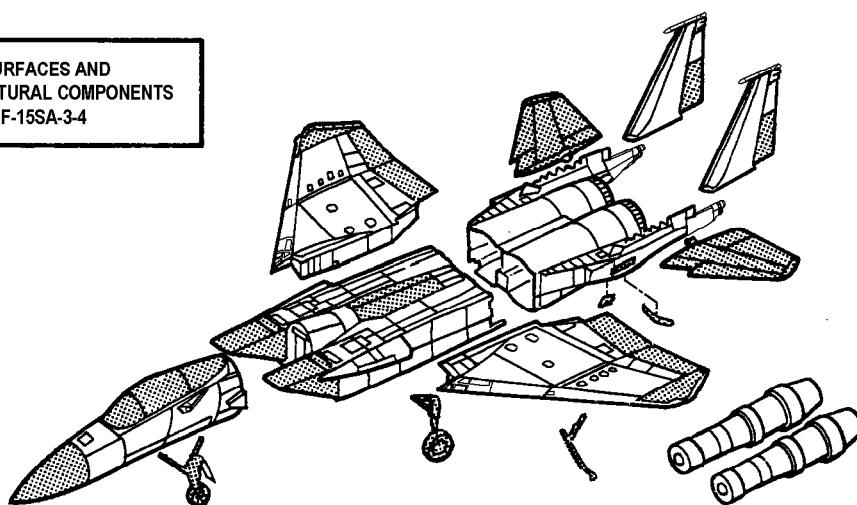
FIXED STRUCTURE
CSTO SR1F-15SA-3-2-1
CSTO SR1F-15SA-3-2-2



DOORS & REMOVABLE PANELS
CSTO SR1F-15SA-3-3



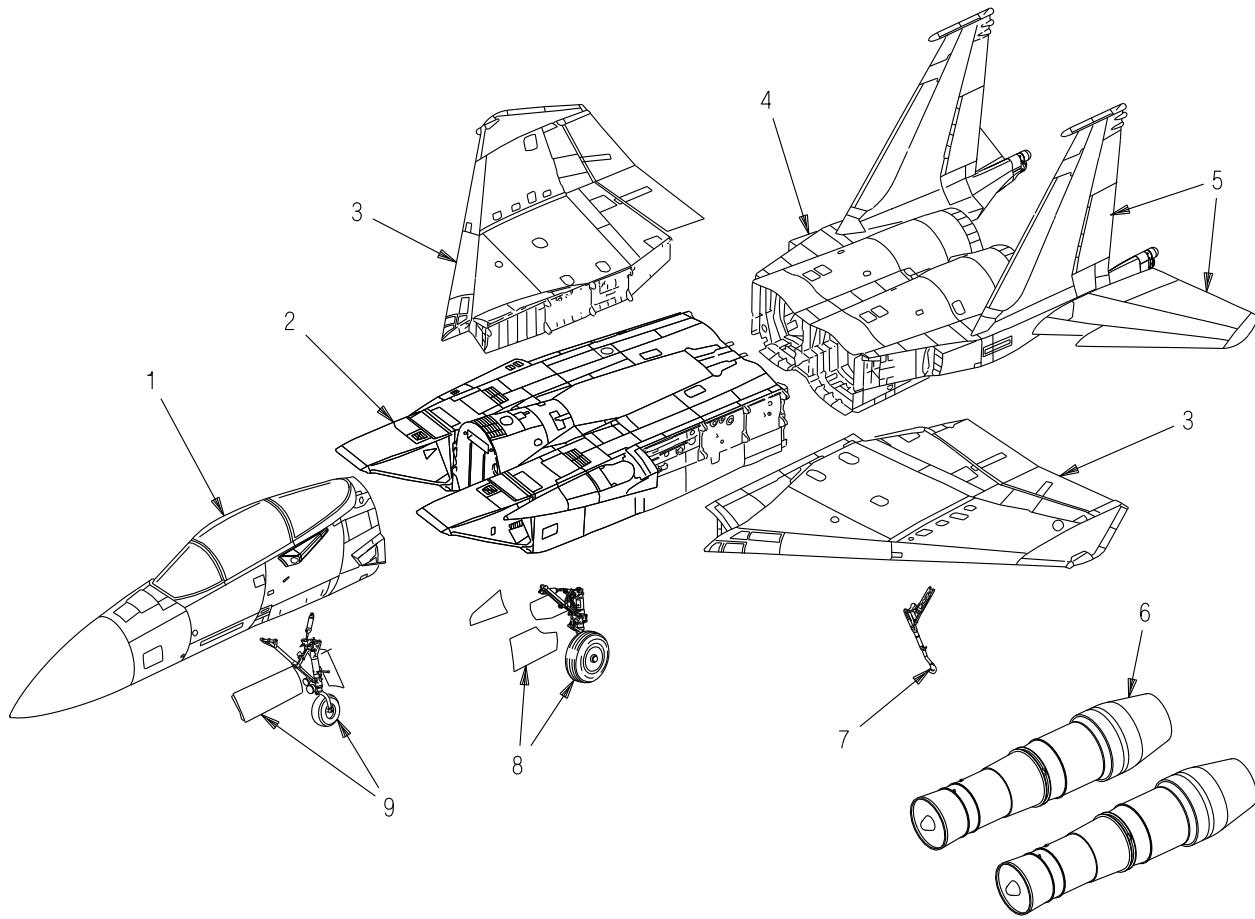
CONTROL SURFACES AND
REMOVABLE STRUCTURAL COMPONENTS
CSTO SR1F-15SA-3-4



SAN301-1-1-002

Figure 1-1. Aircraft Structural Index

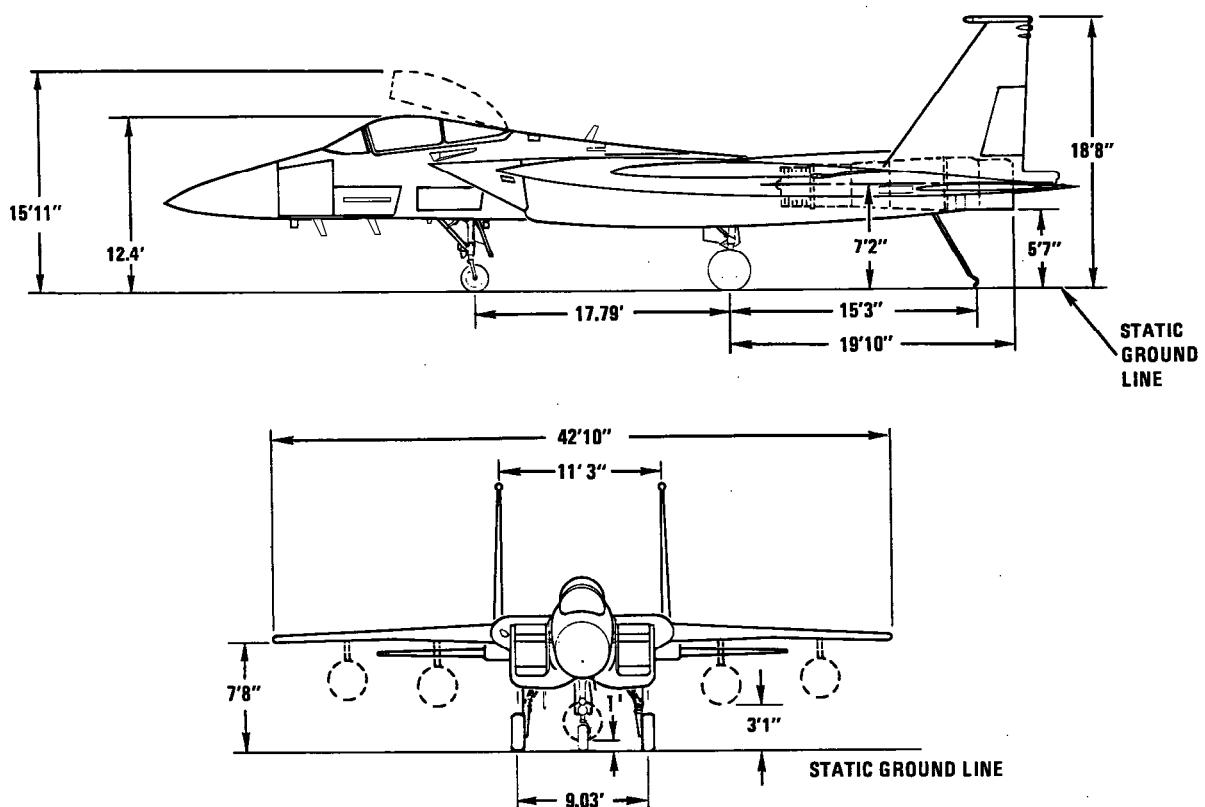
CSTO SR1F-15SA-3-1



INDEX NO.	TITLE
1	FORWARD FUSELAGE
2	CENTER FUSELAGE
3	WING
4	AFT FUSELAGE
5	EMPENNAGE
6	ENGINE SUPPORTING STRUCTURE
7	ARRESTING GEAR
8	MAIN LANDING GEAR
9	NOSE LANDING GEAR

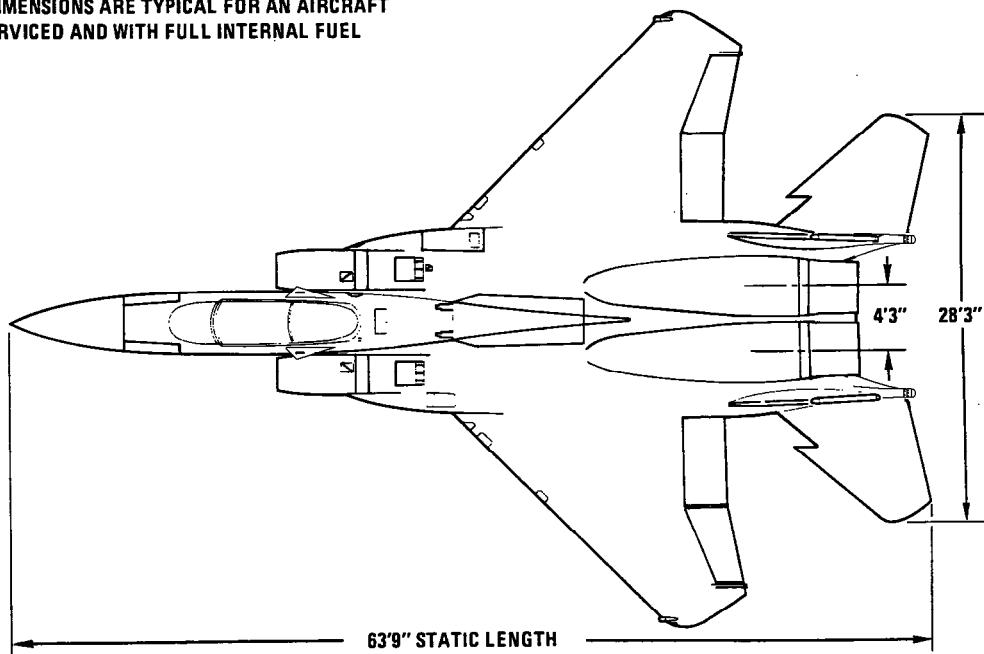
SAN301-1-2-001

Figure 1-2. Major Structural Components



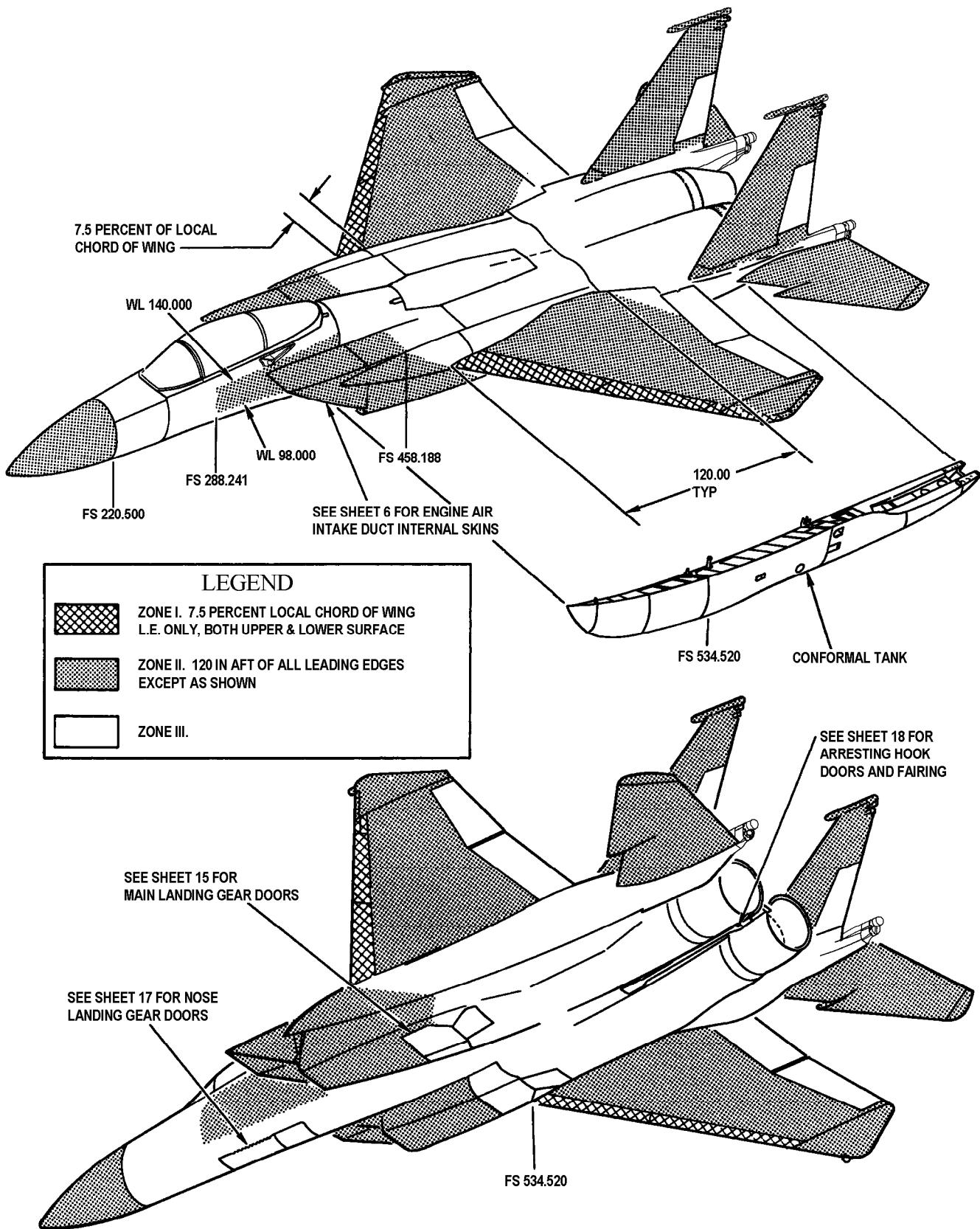
LEGEND

HEIGHT DIMENSIONS ARE TYPICAL FOR AN AIRCRAFT
FULLY SERVICED AND WITH FULL INTERNAL FUEL



SAN301-1-3-002

Figure 1-3. Principal Dimensions



SAN301-1-4-002

Figure 1-4. Contour Smoothness Requirements (Sheet 1 of 19)

TABLE I

EXCEPTIONS TO CONTOUR SMOOTHNESS REQUIREMENTS		
ITEM	PART NUMBER	REFERENCE
FORWARD FUSELAGE DOORS 3L/R	68A312925	CSTO SR1F-15SA-3-3
DOORS 6L/R	68A313904	CSTO SR1F-15SA-3-3
DOORS 10L/R	68A313906	CSTO SR1F-15SA-3-3
RADOME	68A313908	CSTO SR1F-15SA-3-3
WINDSHIELD FAIRING	68A313910	CSTO SR1F-15SA-3-4
STEP, AFT	68A315101	CSTO SR1F-15SA-3-4
STEP, FWD	68A350907	CSTO SR1F-15SA-3-3
	68A311210	CSTO SR1F-15SA-3-4
	68A311211	CSTO SR1F-15SA-3-4
CENTER FUSELAGE MLG DOORS, OUTBD  MLG DOORS, OUTBD  MLG DOORS, INBD  MLG DOORS, INBD  DOORS 86L/R	68A413400 68A413450 68A413500 68A413550 68A325591	CSTO SR1F-15SA-3-3 CSTO SR1F-15SA-3-3 CSTO SR1F-15SA-3-3 CSTO SR1F-15SA-3-3 CSTO SR1F-15SA-3-3
AFT FUSELAGE DOOR 96R DOORS 95L/R DOOR 122L PANEL STRUCTURE  PANEL STRUCTURE  PANEL STRUCTURE  PANEL STRUCTURE 	68A334101 68A334104 68A334004 68A336200 68A336201 68A336202 68A336228 68A336229	CSTO SR1F-15SA-3-3 CSTO SR1F-15SA-3-3 CSTO SR1F-15SA-3-3 CSTO SR1F-15SA-3-2-2 CSTO SR1F-15SA-3-2-2 CSTO SR1F-15SA-3-2-2 CSTO SR1F-15SA-3-2-2 CSTO SR1F-15SA-3-2-2
VERTICAL STABILIZER DOOR 145L/R	68A230075	CSTO SR1F-15SA-3-3
WING COVERS L/R	68A118272	CSTO SR1F-15SA-3-3

TABLE II

TOLERANCES FOR CONTOUR SMOOTHNESS IN AERODYNAMIC ZONES I, II, AND III					
ITEM NO.	ITEM	ZONES (SEE SHEET 1)			ZONES (SEE SHEET 1)
		I	II	III	
1	 FLUSH ALUMINUM RIVETS (MACHINE COUNTERSUNK).	+0.002 -0.001	+0.002 -0.001	+0.002 -0.001	
2	FLUSH RIVETS OTHER THAN ALUMINUM OR SPOTWELDS.	N/A	±0.005	±0.005	
3	QUICK RELEASE FASTENERS (MACHINE COUNTERSUNK).	N/A	±0.005	±0.005	
4	  FLUSH FASTENERS OTHER THAN ITEMS 1, 2, AND 3.	+0.006 -0.004	+0.006 -0.004	+0.006 -0.004	
5	MAXIMUM MISMATCH AT PERMANENT BUTT JOINTS, EXCEPT AS NOTED OTHERWISE.	 FORWARD AFT PARALLEL	0.005 0.010 1	0.015 0.020 0.030	0.020 0.030 0.030
6	MAXIMUM MISMATCH AT REMOVABLE PANELS, MAJOR JOINTS, SPLICES, MECHANICAL DOORS, LATCHES, HINGE HALVES, AND EXTERNAL HANDLES EXCEPT AS NOTED OTHERWISE.	FORWARD AFT PARALLEL	0.010 0.015 1	0.030 0.030 0.030	0.040 0.040 0.040
7	 MAXIMUM AND MINIMUM GAP AT BUTT JOINTS (SEE SHEETS ON GAPS).				
8	SURFACE FINISH (RHR MICRO-INCH BEFORE PAINTING) OR BETTER.	125	125	125	

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Figure 1-4. Contour Smoothness Requirements (Sheet 2)

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TABLE II CONT.

TOLERANCES FOR CONTOUR SMOOTHNESS IN AERODYNAMIC ZONES I, II, AND III					
ITEM NO.	ITEM	ZONES (SEE SHEET 1)			
		I	II	III	
9	MAXIMUM MISMATCH FOR ANTENNA AND NAVIGATION LIGHT.	FORWARD AFT PARALLEL	0.020 0.025 0.025	0.030 0.030 0.030	0.035 0.035 0.035
10	MAXIMUM MISMATCH FOR WINDSHIELD AND CANOPY TRANSPARENCIES.	FORWARD AFT	N/A N/A	N/A N/A	0.020 0.120
11	MAXIMUM MIXMATCH AT INTERCHANGEABLE LAUNCHER ASSEMBLY MOLD LINE TO ADJACENT STRUCTURAL MOLD LINE.	FORWARD AFT PARALLEL	N/A N/A N/A	0.200 0.200 0.200	0.200 0.200 0.200
12	MAXIMUM MISMATCH FOR LATCHES ON DOORS 3L/R, 6L/R, AND 10L/R WHEN THE LATCH IS OUTSIDE OF THE MOLD LINE SKIN.	FORWARD AFT PARALLEL	N/A N/A N/A	0.030 0.030 0.030	0.040 0.040 0.040
	WHEN LATCH IS INSIDE MOLD LINE SKIN.	FORWARD AFT PARALLEL	N/A N/A N/A	0.050 0.050 0.050	0.050 0.050 0.050
13	MAXIMUM MISMATCH PERMITTED BETWEEN SECONDARY HEAT EXCHANGER EXHAUST LOUVER FS 416.00 TO FS 428.000, AND ADJACENT STRUCTURE, IS +0.150-0.150.	FORWARD AFT PARALLEL	N/A N/A N/A	N/A N/A N/A	N/A N/A N/A
14	7 MAXIMUM MISMATCH FOR ANTI-COLLISION LIGHT.	FORWARD AFT PARALLEL	0.060 0.060 0.060	N/A N/A N/A	N/A N/A N/A
15	MAXIMUM EXTERIOR CONTOUR DEVIATIONS SHALL NOT EXCEED +0.030 OR -0.050 FROM CONTRACTOR SUPPLIED OR APPROVED CONTROL TOOL FOR FORWARD BOX ASSEMBLY P/N 68A210066 AND AFT BOX ASSEMBLY P/N 68B210001.	FORWARD AFT PARALLEL	N/A N/A N/A	N/A N/A N/A	N/A N/A N/A
16	MAXIMUM MISMATCH BETWEEN 68A315101 RADOME ASSEMBLY AND 68A312003 NOSE BARREL FS 207.650, SEE SHEET 14.	FORWARD AFT	N/A N/A	0.050 0.060	N/A N/A
1 PARALLEL MISMATCH FACING INBOARD SHALL BE TREATED AS AN AFT MISMATCH. PARALLEL MISMATCH FACING OUTBOARD SHALL BE TREATED AS A FORWARD MISMATCH. 2 A MAXIMUM OF 35 PERCENT OF ALUMINUM RIVETS, IN A ROW OR PATTERN, ARE ACCEPTABLE TO A FLUSHNESS TOLERANCE OF +0.005 TO -0.001. 3 EIGHT RUDDER SERVOACTUATOR COUNTERSUNK HEAD ATTACH BOLTS FLUSHNESS REQUIREMENT IS +0.006 -0.060. INSPECT FOR SUB-FLUSH CONDITION (27-21-10). 4 SEE SHEET 4 FOR ZONE III TOLERANCE EXCEPTIONS. 5 ZONE II AND III FLUSHNESS TOLERANCE FOR A MAXIMUM OF 10 PERCENT OF TAPER-LOK FASTENERS IN ANY ONE PANEL IS +0.010 TO -0.004. 6 WHEN MINIMUM GAP IS NOT SPECIFIED, GAP IS 0.010. 7 AFTER INSTALLATION, EDGE GAP TO BE FILLED WITH AERODYNAMIC FILLER/SEALER PER CSTO SR1F-15SA-3-5. 8 ZONE II AND III FLUSHNESS TOLERANCE FOR EXTERNALLY MOUNTED ANTENNA FASTENERS AND ANTENNA RADOME FASTENERS ARE +0.006 TO -0.015. 9 12-1001 THRU 12-1028; ALSO 93-0852 THRU 93-0923. 10 12-1029 AND UP. 11 93-0852 THRU 93-0923. 12 12-1001 AND UP.					

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Figure 1-4. Contour Smoothness Requirements (Sheet 3)

ZONE III TOLERANCE EXCEPTIONS

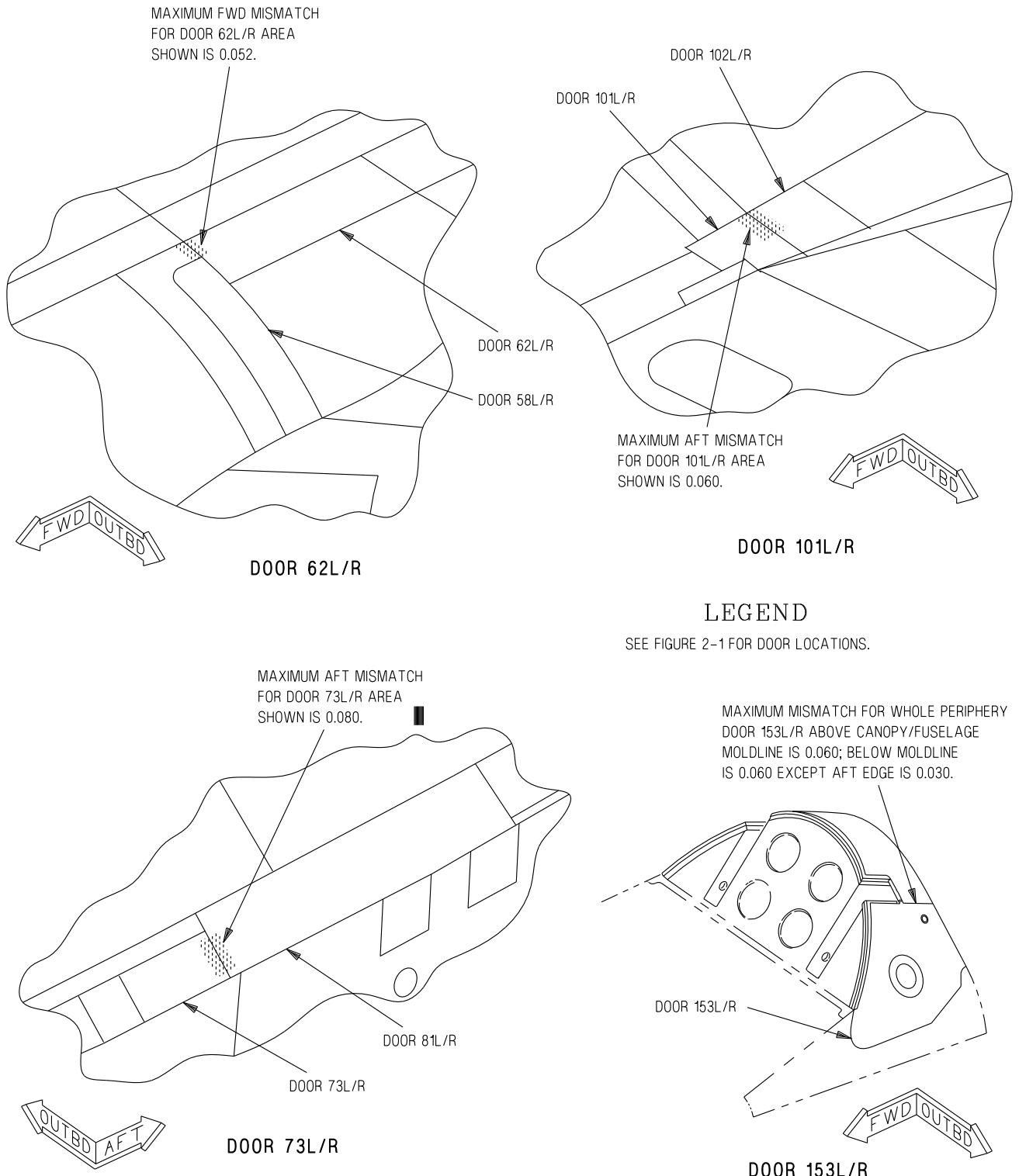
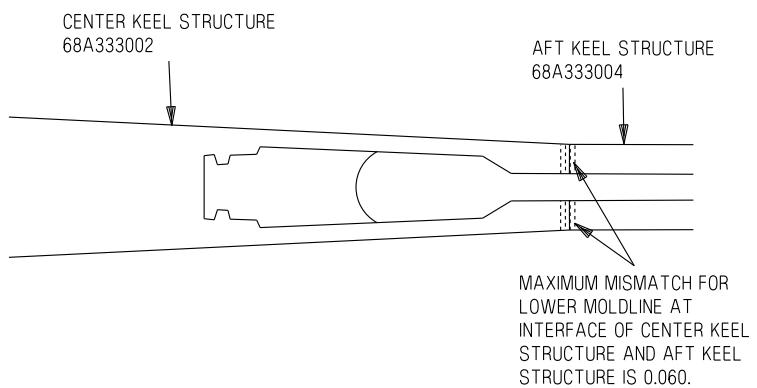


Figure 1-4. Contour Smoothness Requirements (Sheet 4)

ZONE III TOLERANCE EXCEPTIONS



KEEL ASSEMBLY, AFT FUSELAGE

SAN301-1-8-001

Figure 1-4. Contour Smoothness Requirements (Sheet 5)

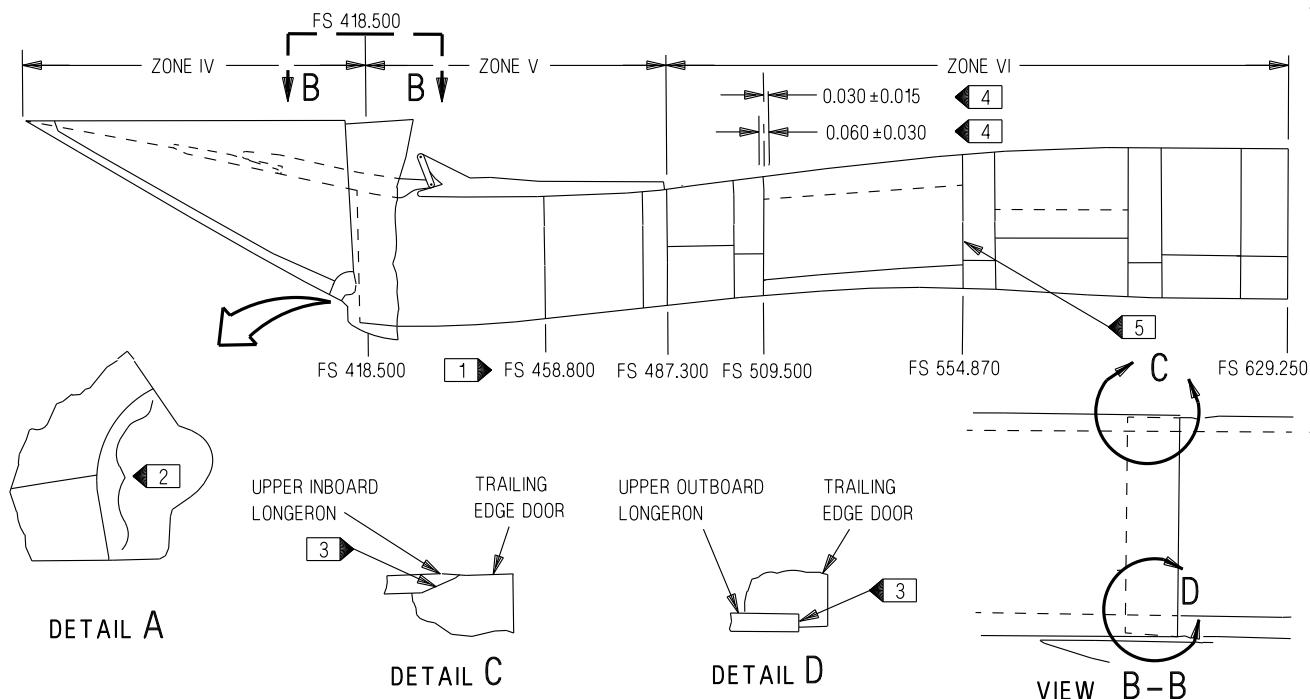
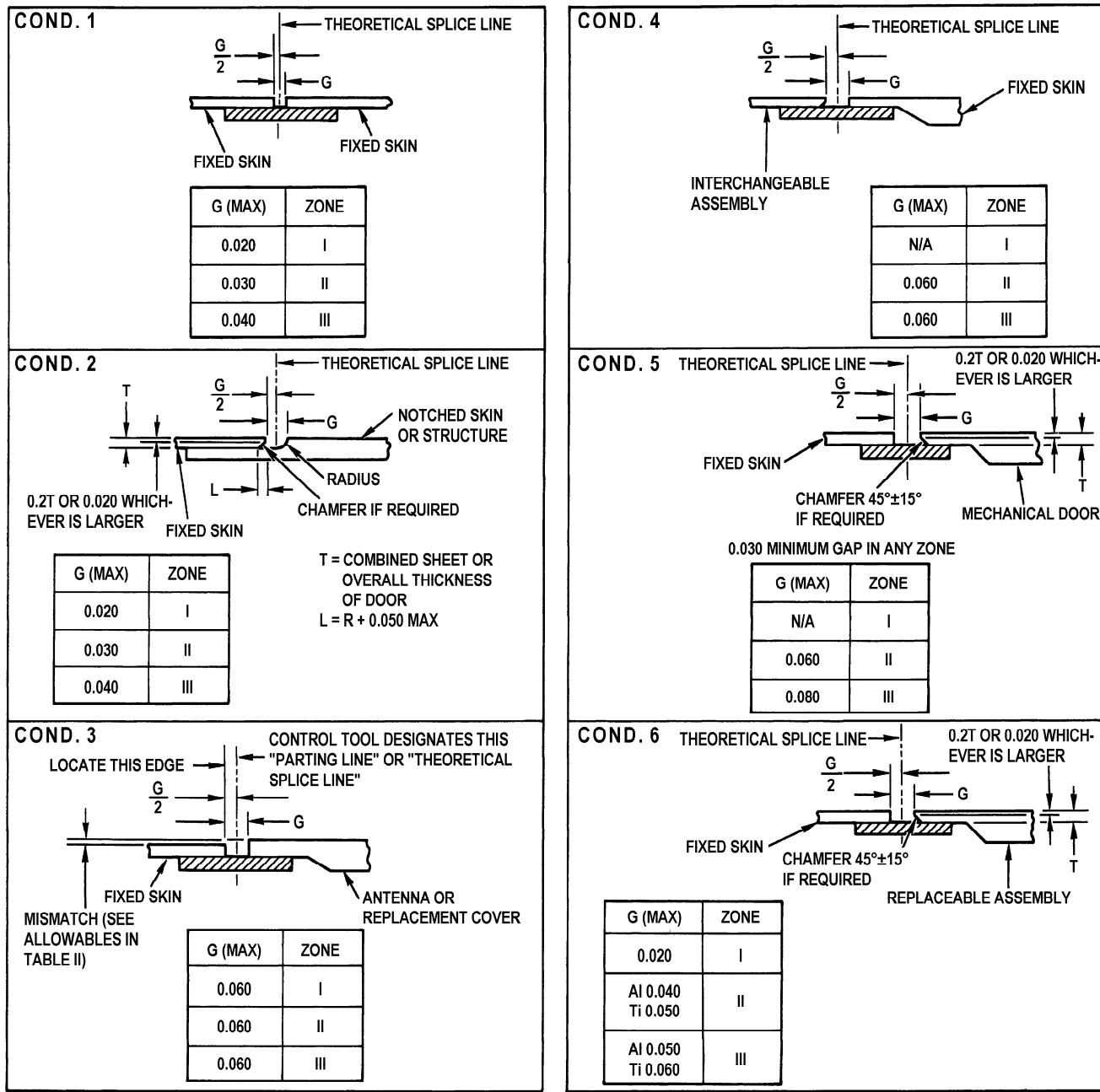
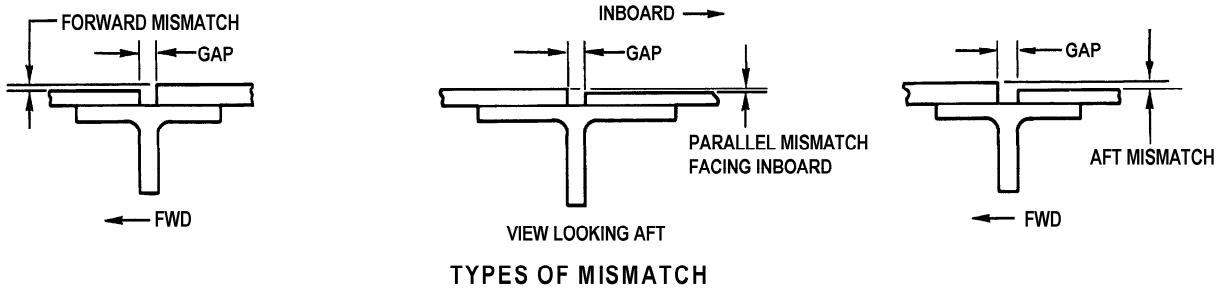


TABLE III

ITEM NO.	ITEM	ZONES		
		IV	V	VI
1	7 ► FLUSH ALUMINUM RIVETS (MACHINE COUNTERSUNK). FOR RIVET ROW/PATTERN TOLERANCE, SEE TABLE II.	+0.002 -0.000	+0.002 -0.000	+0.002 -0.000
2	FLUSH RIVETS OTHER THAN ALUMINUM.	±0.005	±0.005	±0.005
3	MAXIMUM MISMATCH AT PERMANENT BUTT JOINTS EXCEPT AS NOTED OTHERWISE.	FWD AFT PARALLEL	0.005 0.010 0.010	0.010 0.015 0.020
4	6 ► MAXIMUM GAP AT BUTT JOINTS; MINIMUM GAP PER TABLE II.	0.030	0.040	0.060
5	SURFACE FINISH (RMS MICRO-INCH BEFORE PAINTING).	125	125	125
6	WAVINESS- THE MAXIMUM VARIATION FROM A 6 INCH SPLINED LINE. CONTOUR SHALL BE SMOOTH AND FAIRED.	0.015	0.020	0.030
7	FLATNESS- APPLICABLE RAMP SURFACES SHALL BE FLAT WITHIN 0.060.	N/A	N/A	N/A
8	MOLD LINE DEVIATION- MAXIMUM DEVIATION FROM MOLD LINE. CONTOUR SHALL BE SMOOTH AND FAIRED. NO ABRUPT CHANGES IN MOLD LINE CONTOUR ARE PERMISSIBLE. AERODYNAMIC FILLER MATERIAL SHALL NOT BE USED.	±0.030	±0.030	±0.030
<p>1 ► MAXIMUM 0.060 BUTT GAP WHOLE PERIPHERY FS 458.800. 2 ► 68A327143 OR 68A327144 COVER, MAXIMUM ALLOWABLE GAP IS 0.040. 3 ► MAXIMUM PARALLEL MISMATCH BETWEEN AFT END OF UPPER INBOARD OR OUTBOARD LONGERON AND UPPER TRAILING EDGE DOOR OF VARIABLE INLET AFTER RIGGING OF DOOR IS 0.060. 4 ► TYPICAL FOR DUCT SKIN GAP AT FS 509.500 WHOLE PERIPHERY. 5 ► MINIMUM 0.005 GAP REQUIRED THIS SPLICE JOINT ONLY. PRELOAD OF DUCT SKIN TO REDUCE GAP NOT ALLOWED. 6 ► WHEN MINIMUM GAP IS NOT SPECIFIED GAP IS 0.010. 7 ► A MAXIMUM OF 35 PERCENT OF ALUMINUM RIVETS, IN A ROW OR PATTERN, ARE ACCEPTABLE TO A FLUSHNESS TOLERANCE OF +0.005 TO -0.001.</p>				

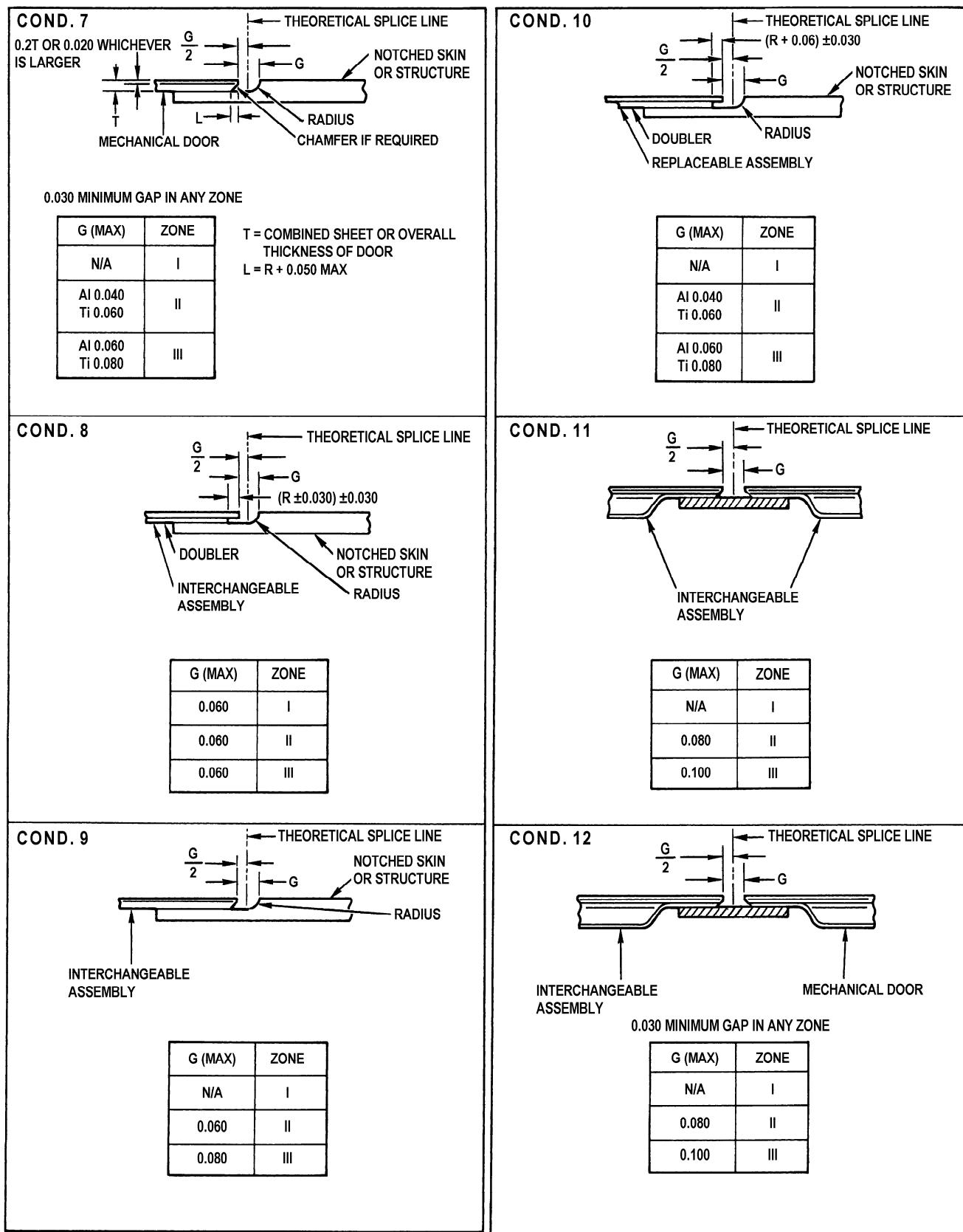
SAN301-1-9-002

Figure 1-4. Contour Smoothness Requirements (Sheet 6)



SAN301-1-10-001

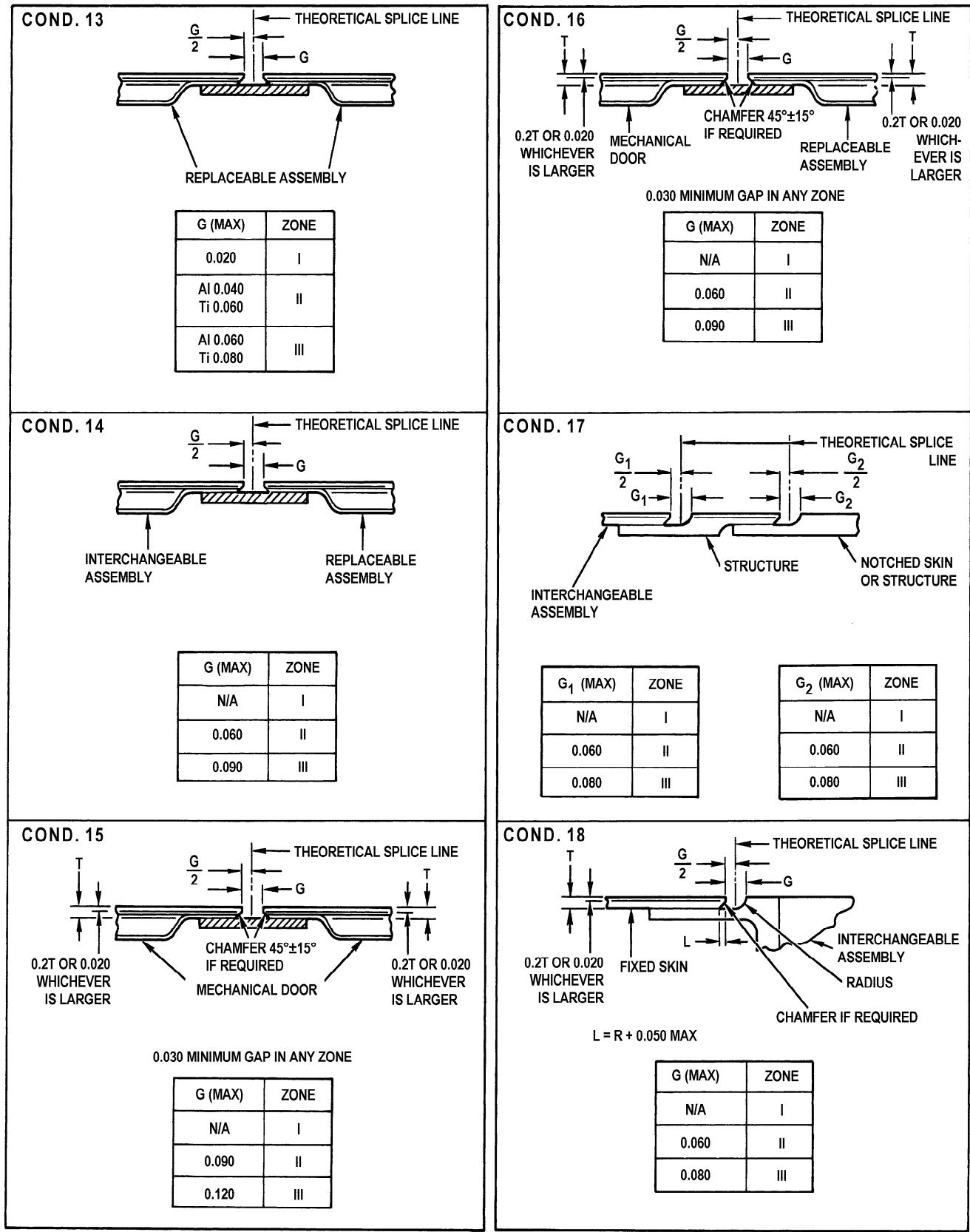
Figure 1-4. Contour Smoothness Requirements (Sheet 7)



SAN301-1-11-002

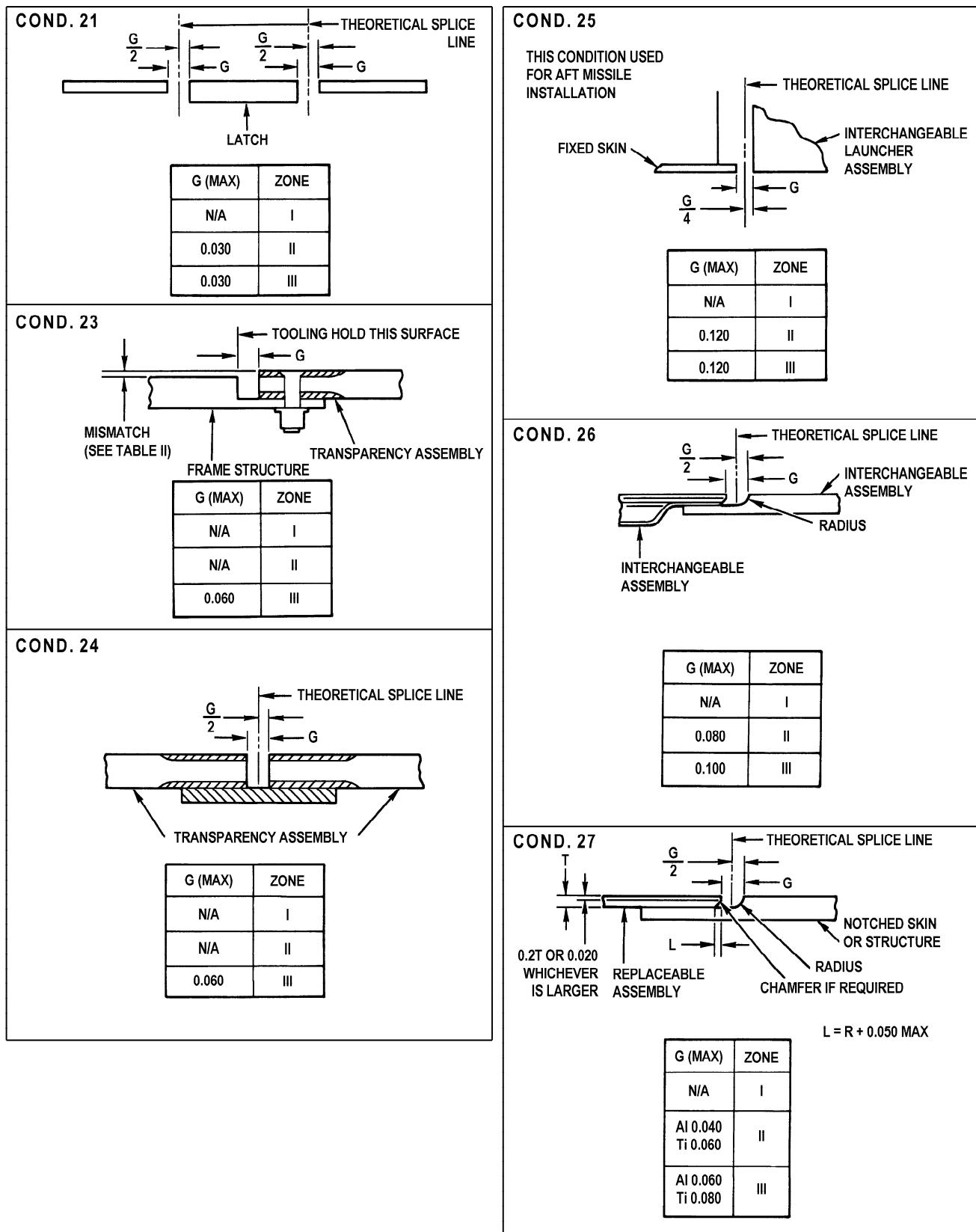
Figure 1-4. Contour Smoothness Requirements (Sheet 8)

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SAN301-1-12-002

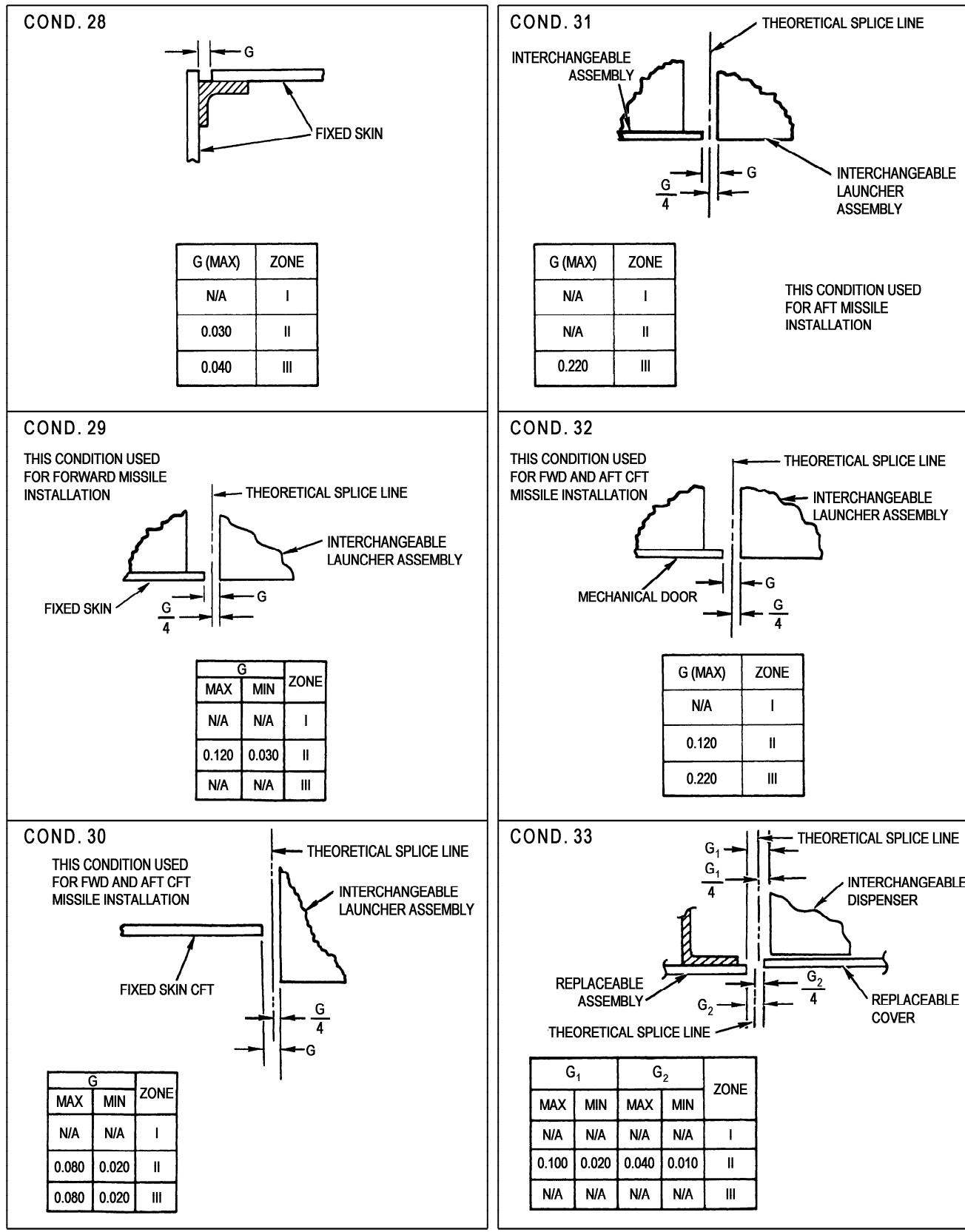
Figure 1-4. Contour Smoothness Requirements (Sheet 9)



SAN301-1-13-002

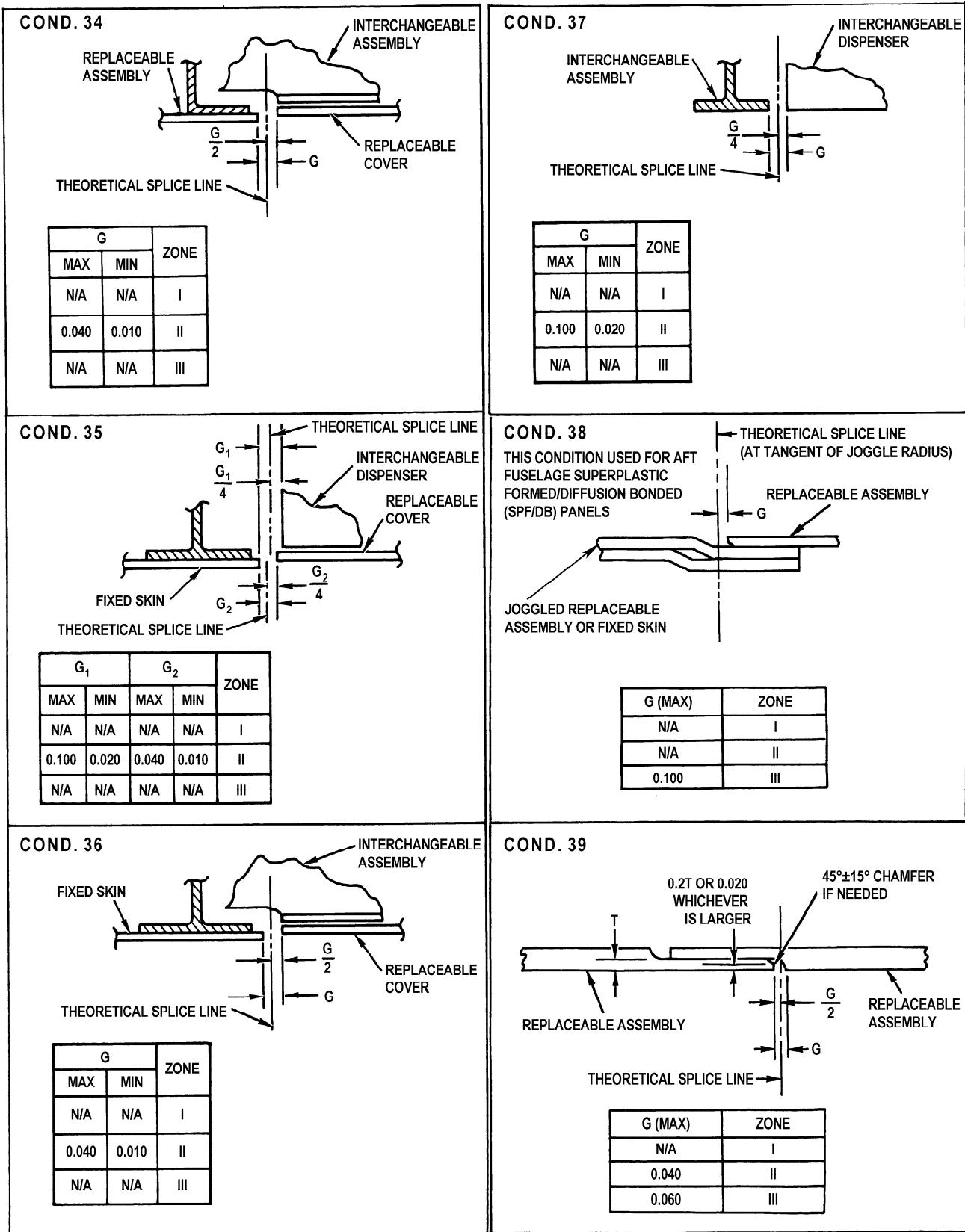
Figure 1-4. Contour Smoothness Requirements (Sheet 10)

CSTO SR1F-15SA-3-1



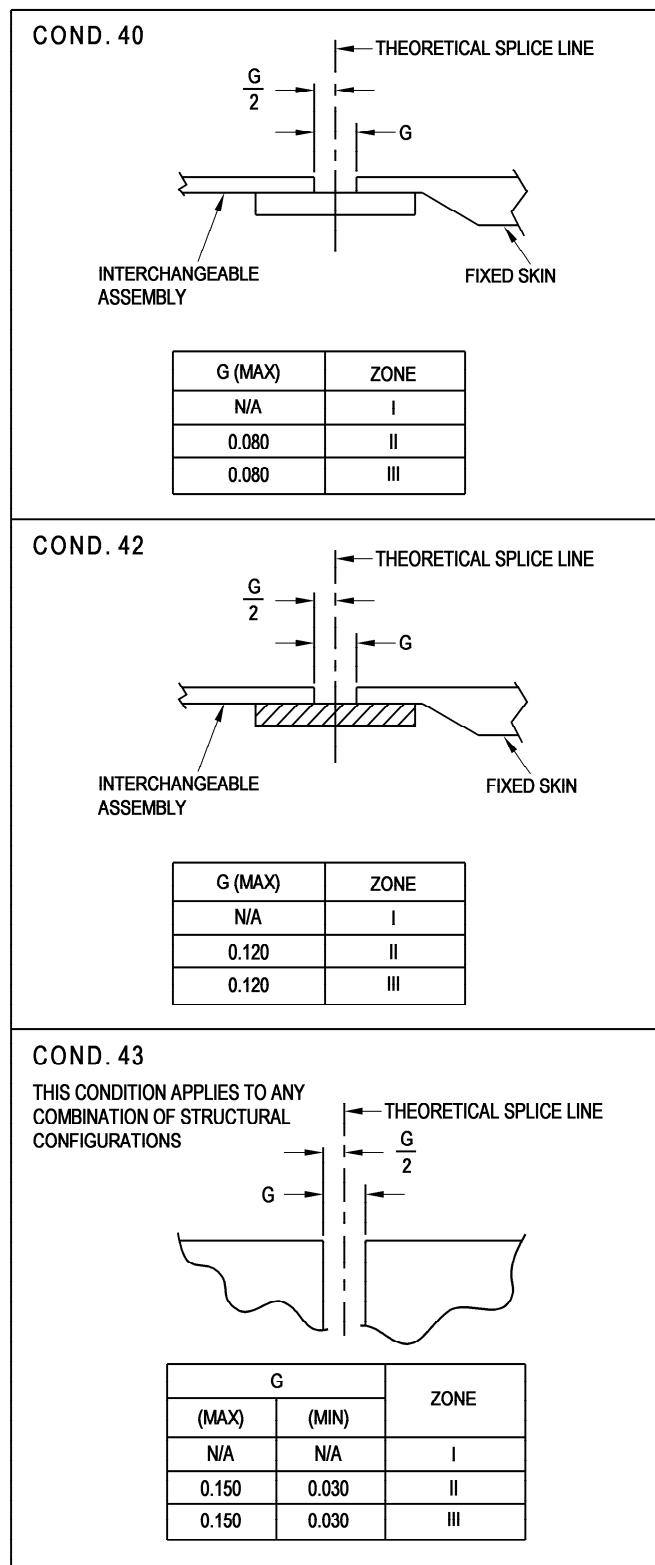
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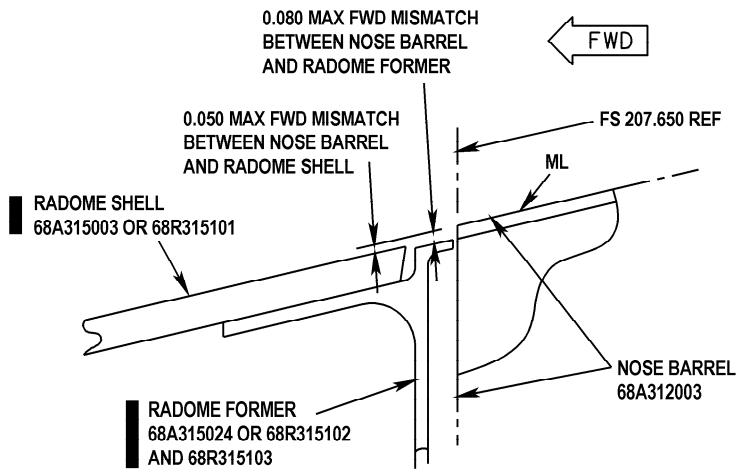
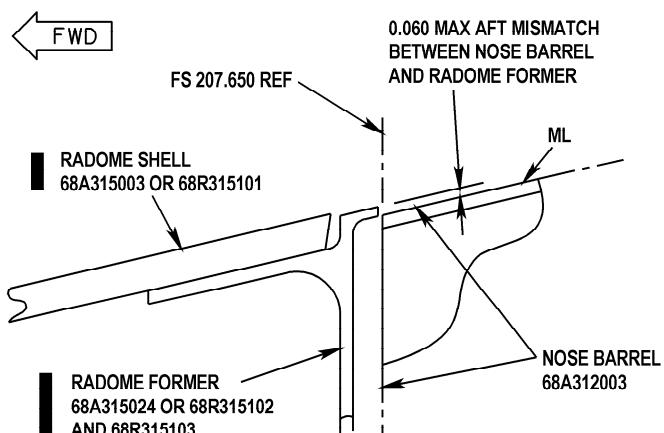
Figure 1-4. Contour Smoothness Requirements (Sheet 11)



SAN301-1-15-002

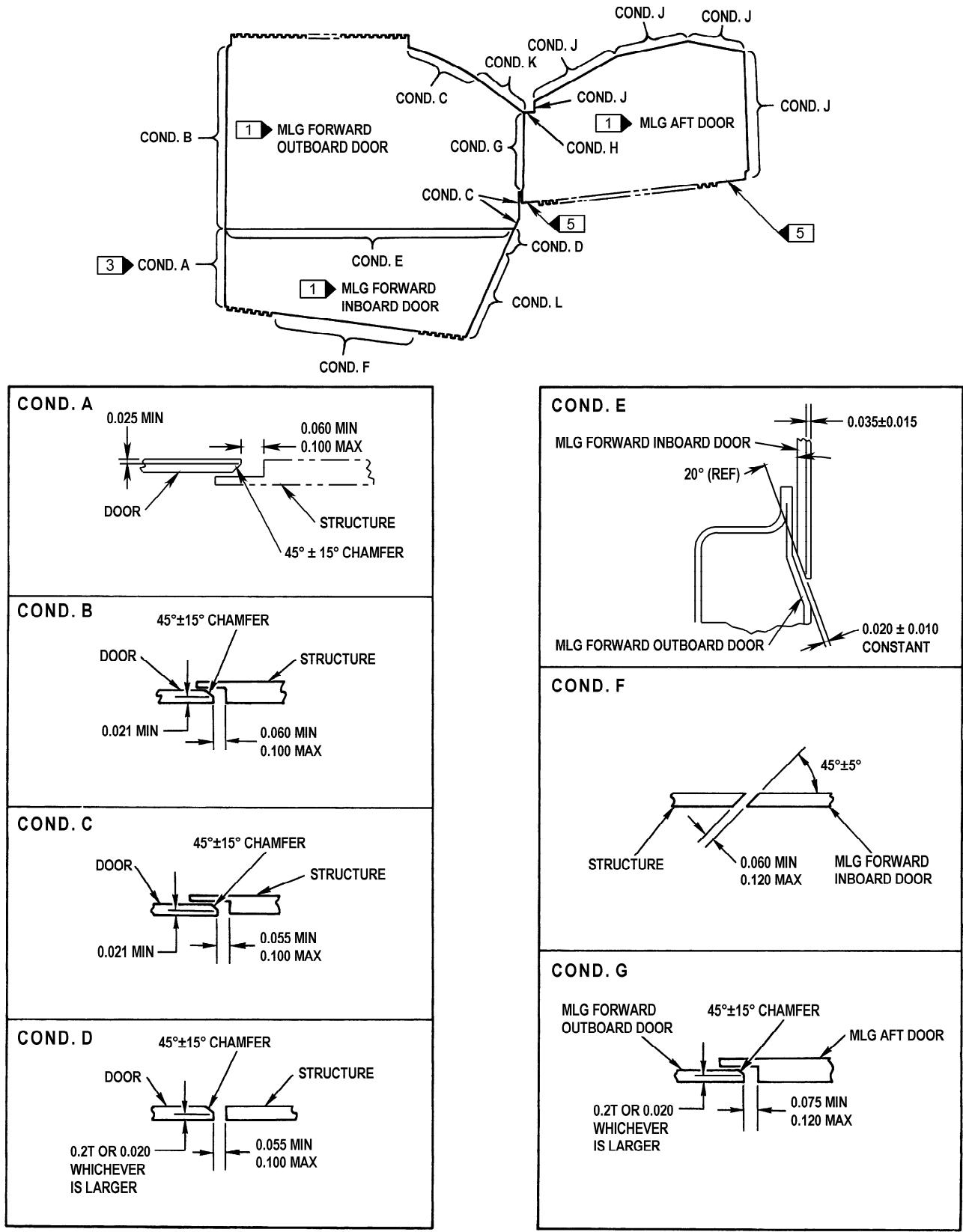
Figure 1-4. Contour Smoothness Requirements (Sheet 12)

**Figure 1-4. Contour Smoothness Requirements (Sheet 13)**

**FWD MISMATCH****AFT MISMATCH****RADOME TO NOSE BARREL MISMATCH ALLOWANCES**

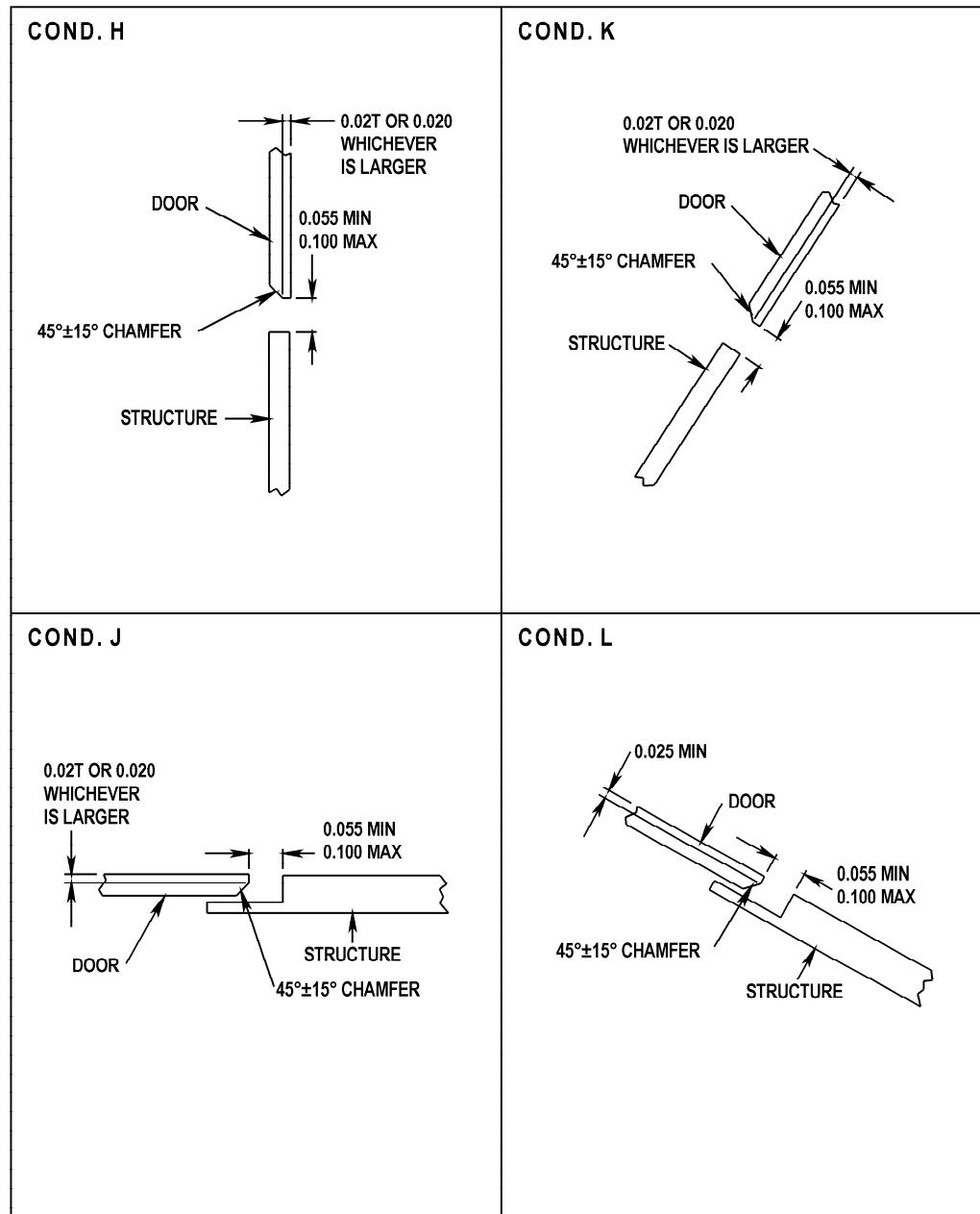
SAN301-1-36-002

Figure 1-4. Contour Smoothness Requirements (Sheet 14)

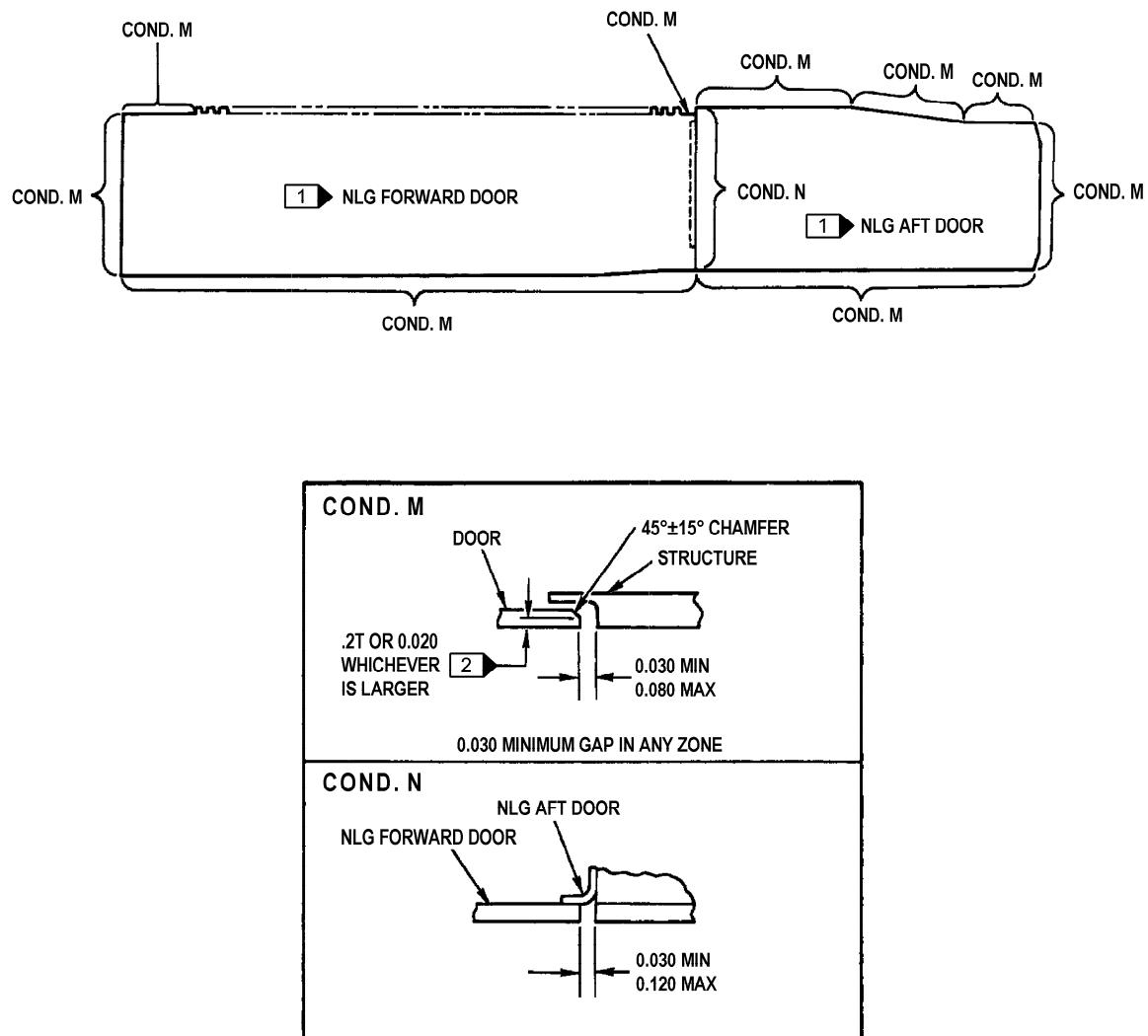


SAN301-1-17-002

Figure 1-4. Contour Smoothness Requirements (Sheet 15)

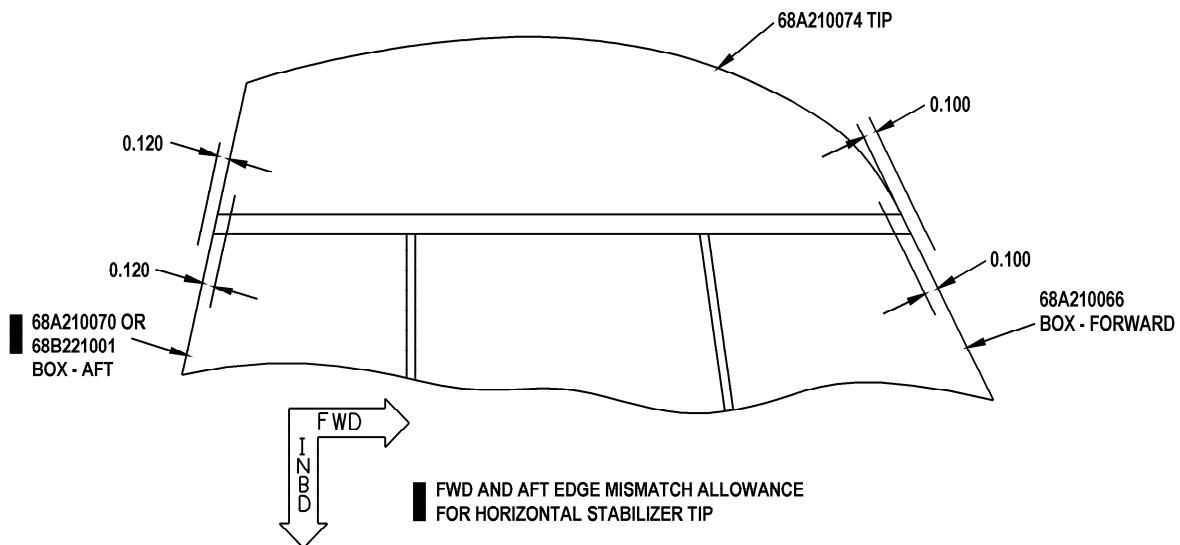
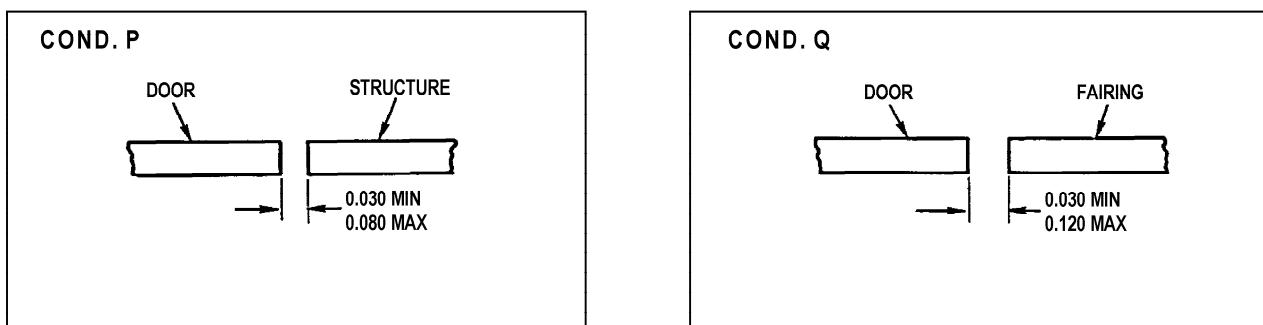
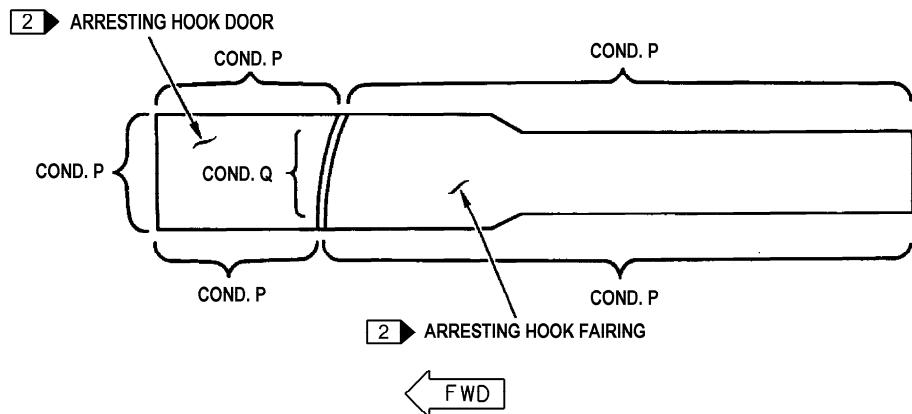
**Figure 1-4. Contour Smoothness Requirements (Sheet 16)**

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SAN301-1-18-002

Figure 1-4. Contour Smoothness Requirements (Sheet 17)



SAN301-1-19-002

Figure 1-4. Contour Smoothness Requirements (Sheet 18)

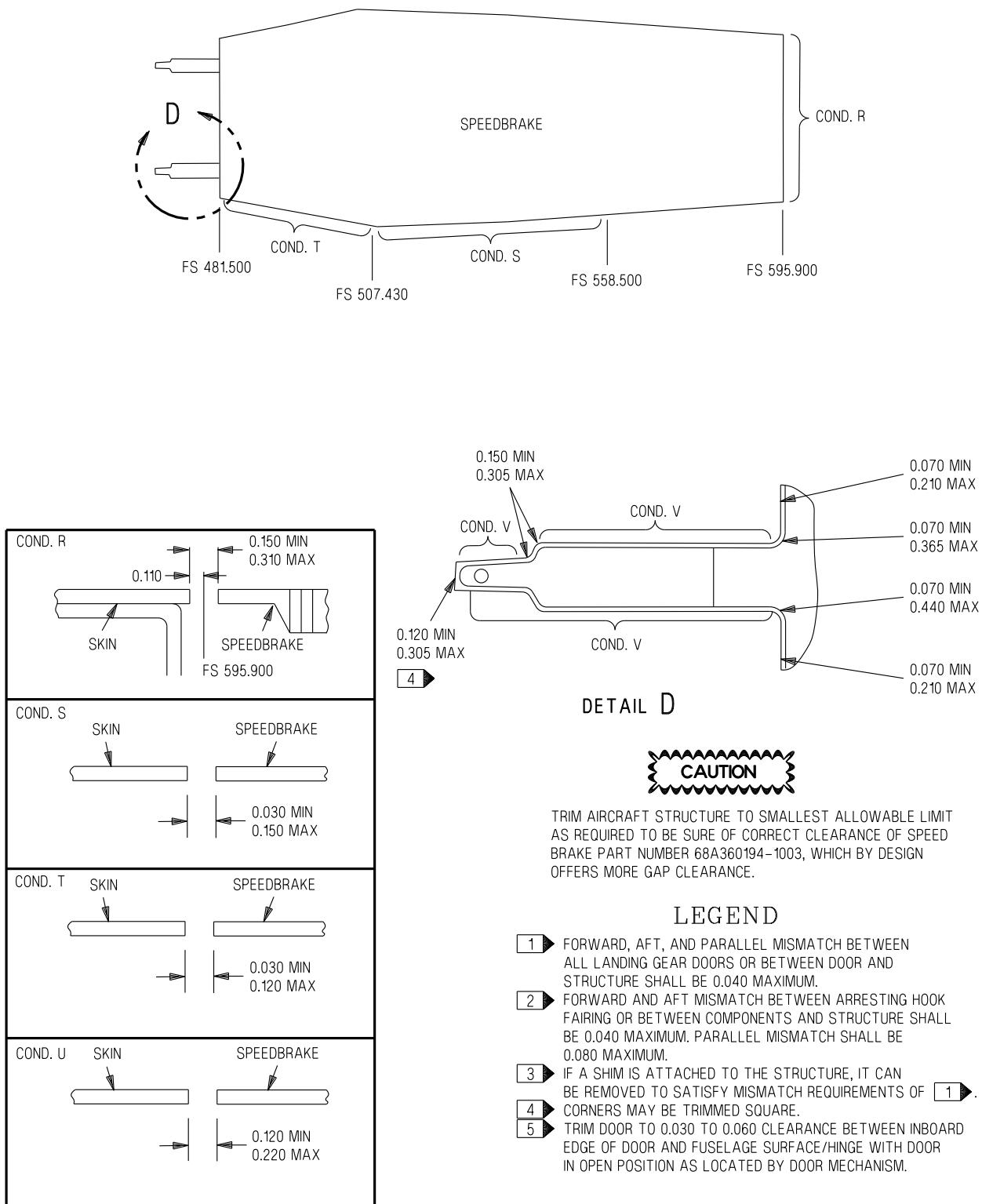


Figure 1-4. Contour Smoothness Requirements (Sheet 19)

1-16. MATERIALS AND SPECIFICATIONS.

1-17. The main materials used in the aircraft are aluminum alloy, alclad, corrosion-resistant steel, and titanium. Structural parts are also Ion Vapor Deposition (IVD) aluminum coated to prevent corrosion during exposure to temperatures up to 925 degrees Fahrenheit. The aft fuselage uses superplastic formed/diffusion bonded titanium structure for the upper panels, center keel, and forward engine doors. The 68A413550 main landing gear inboard and 68A413450 outboard doors are aluminum alloy, high speed machined structures. The 68A413500 main landing gear inboard and 68A413400 outboard doors are of superplastic formed/diffusion bonded titanium structure. The horizontal stabilator outboard leading edge box is made up of machined ribs and stiffeners and a three piece aluminum machined assembly with an upper machined surface, a lower machined surface, and a leading edge. The main torque box is composed of titanium spars, boron epoxy laminate skins, and aluminum honeycomb core. The rudder has graphite epoxy laminate composite ribs and a boron epoxy laminate composite skin. The radome assembly is a glass fiber wound shell with aluminum alloy frames. The following diagrams list the specifications for the various materials. The IVD coated materials are listed in a separate diagram following all other materials and specifications.

ALCLAD - SHEET AND PLATE

Material	Specification	
2024-T3	AMS-QQ-A-250/5	
2024-T351	AMS-QQ-A-250/5	
2024-T361	AMS-QQ-A-250/5	
2024-T42	AMS-QQ-A-250/5	MMS 1413
2024-T62	AMS-QQ-A-250/5	
2024-T62 (Clad One Side)	AMS-QQ-A-250/5	
ALCLAD - SHEET AND PLATE (CONT)		
2024-T781	AMS-QQ-A-250/5	
2024-T72	AMS-QQ-A-250/5	
2024-T81	AMS-QQ-A-250/5	
2024-T81 (Clad One Side)	AMS-QQ-A-250/5	
2024-T851	AMS-QQ-A-250/5	
2024-T861	AMS-QQ-A-250/5	
6951-T62 4045 Clad Both Sides	AMS-B-20148 Class 6	
6951-T62 4343 Clad Both Sides	AMS-B-20148 Class 4	
7075-T6	AMS 4049	
7075-T6 (Clad One Side)	AMS-QQ-A-250/18	
7075-T6 (Strong Clad)	ASTM B209	
7075-T651 (Clad One Side)	AMS-QQ-A-250/18	
7075-T651 (Strong Clad)	ASTM B209	
7075-T76 (Strong Clad)	ASTM B209	
7075-T76 (Clad One Side)	MMS 1413	

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ALCLAD - SHEET AND PLATE (CONT)

Material	Specification
7075-T76	AMS 4049

1 2024-T81 is interchangeable with and can be used in place of 2024-T861 sheet stock in all applications.

ALUMINUM ALLOY - BAR AND ROD

Material	Specification
2024-T851	AMS-QQ-A-225/6
7075-T7351	AMS-QQ-A-225/9
7075-T73511	AMS-QQ-A-200/11

ALUMINUM ALLOY - CASTING

Material	Specification
A356-T6 Perm Mold	ASTM B108
A356-T61 Perm Mold	ASTM B108
A356-T61 Soln Ht Tr and Artf Aged	AMS-A-21180
A357-T6	AMS-A-21180
201.1-T7 Soln Ht Tr and Overaged	AMS 4229

308	ASTM B686
C355-T6	AMS-A-21180
C355-T61	AMS-A-21180
2024-T3511	AMS-QQ-A-200/3

ALUMINUM ALLOY - CASTING (CONT)

Material	Specification
2024-T62	AMS-QQ-A-200/3

ALUMINUM ALLOY - EXTRUDED SHAPES

Material	Specification
2024-T8511	AMS-QQ-A-200/3
2024-T8611	AMS-QQ-A-200/3
6061-T6511	AMS-QQ-A-200/8
7075-T6	AMS-QQ-A-200/11

ALUMINUM ALLOY - CASTING

7075-T6511	AMS-QQ-A-200/11
7075-T73	AMS-QQ-A-200/11
7075-T73510	AMS-QQ-A-200/11
7075-T73511	AMS-QQ-A-200/11-T73511
7075-T76	AMS-QQ-A-200/11

ALUMINUM ALLOY - FORGING

Material	Specification
2219-T6	AMS-QQ-A-367
7050-T73652	MMS 146
7075-T411	MMS 1303
7075-T73	AMS-QQ-A-367

ALUMINUM ALLOY - FORGING (CONT)

Material	Specification
7075-T76511	AMS-QQ-AQ-200/15
7075-T7352	AMS-QQ-A-367
7075-T73652	MMS 1304
7075-T73652 Premium Quality	MMS 1304
7175-T74	MMS 1304
7175-T7452 Premium Strength	MMS 1304

ALUMINUM ALLOY - PRESSING

Material	Specification
7075-T73	AMS-QQ-A-367

ALUMINUM ALLOY - SHEET AND PLATE

Material	Specification
1100-H14	ASTM B209
1100-H18	ASTM B209
2024-T3	AMS-QQ-A-250/4
2024-T361	AMS-QQ-A-250/4
2024-T62	AMS-QQ-A-250/4
2024-T72	AMS-QQ-A-250/4 MMS-1412
2024-T81	AMS-QQ-A-250/4
2024-T851	AMS-QQ-A-250/4

ALUMINUM ALLOY - SHEET AND PLATE (CONT)

Material	Specification
2024-T851 Special Quality	MMS 149
2124-T8511	MMS 149
2219-T62	AMS-QQ-A-250/30
2219-T81	AMS-QQ-A-250/30
5052-H32	AMS-QQ-A-250/8
1 ➔ 2024-T861	AMS-QQ-A-250/4

2124-T351 Special Quality	MMS 149
2124-T851 Special Quality	MMS 149
5052-H34	AMS-QQ-A-250/8
6061-T4	AMS 4026
6061-T6	AMS 4027
6061-T62	AMS 4025
6061-T651	ASTM B209
7075-T6	AMS-QQ-A-250/12
7075-T651	AMS-QQ-A-250/12
7075-T73	AMS-QQ-A-250/12
7075-T7351	MMS 159

1 ➔ 2024-T81 is interchangeable with and can be used in place of 2024-T861 sheet stock in all applications.

CSTO SR1F-15SA-3-1**ALUMINUM ALLOY - SHEET AND PLATE (CONT)**

Material	Specification
7075-T73511	AMS-QQ-A-250/12
7075-T76	AMS 4315

ALUMINUM ALLOY - TUBE

Material	Specification
2024-T3	AMS-WW-T-700/3
2024-T81	AMS-WW-T-700/3
5052-0	AMS-WW-T-700/4
6061-0	AMS-WW-T-700/6
6061-T6	AMS-WW-T-700/6
6061-T6	AMS 4083

COPPER ALLOY - BAR AND ROD

Material	Specification
Aluminum Bronze	AMS 4640
Beryllium Copper COND A COND H COND HT	ASTM B197

COPPER ALLOY - SHEET

Material	Specification
Beryllium Copper COND H	ASTM B197

COPPER ALLOY - WIRE

Material	Specification
Round (Soft)	A-A-59551

CORK AND RUBBER - SHEET

Material	Specification
Cork and Rubber	AMS-C-6183

CORROSION-RESISTANT STEEL - BAR AND ROD

Material	Specification
A-286	AMS 5737
303Se COND A	ASTM A582
321 COND A	AMS-QQ-S-763
15-5PH COND H1025	AMS 5659
17-4PH COND H1025	AMS 5604

CORROSION-RESISTANT STEEL - CASTING

Material	Specification
17-4PH	AMS 5343

CORROSION-RESISTANT STEEL - EXTRUSION

Material	Specification
15-5PH COND H1025	AMS 5659

CORROSION-RESISTANT STEEL - SCREEN

Material	Specification
302	Commercial
304	Commercial

CORROSION-RESISTANT STEEL - FORGING

Material	Specification
PH13-8Mo COND H1000	AMS 5629
17-4PH COND H1025	AMS 5643

CORROSION-RESISTANT STEEL - WIRE

Material	Specification
17-7PH	AMS 5678
302 Steel Wire	ASTM A313 Spring Temper
304	ASTM-E-437

CORROSION-RESISTANT STEEL - SHEET AND PLATE

Material	Specification
301 Anl	AMS 5901
301 1/4 Hard	AMS 5517
301 1/2 Hard	AMS 5518
301 3/4 Hard	AMS 5902
301 Full Hard	AMS 5516
302 Anl	AMS 5901
Composition 316	AMS 5524, AMS 5907
Class 316	AMS-QQ-S-763
321 Anl	AMS 5510
15-5PH COND H1025	AMS 5862
17-7PH COND C	AMS 5529
PH15-7Mo COND HT1050	AMS 5520

HONEYCOMB CORE MATERIAL

Material	Specification
5056-H39 Al Aly	MMS 704, Type I
5056-H39 Al Aly	MMS 704, Type II
5056-H39 Al Aly	MMS 714
Plastic, Nylon Base	AMS-C-81986

LEAD - SHEET AND PLATE

Material	Specification
Lead Pig	QQ-L-171, Grade B
AZ91C COND T6	ASTM B199

MAGNESIUM ALLOY

Material	Specification
AZ91C COND T6	ASTM B199

NICKEL ALLOY - SHEET

Material	Specification
Inconel 625	AMS 5599

PLASTICS

Material	Specification
6/6 Nylon Sheet, (Natural)	L-P-410
FEP	ASTM D3368
Fiberglass Reinforced	MIL-P-25421
GSC	MIL-I-24768
Intermittently Supported	MIL-P-8045, Class 1 Type I, Type II
Thermoplastic, Polyester	MIL-M-24519, Type GPT-30
TFE, Teflon	AMS 3652, AMS 3656, AMS 3660, AMS 3667
Polyurethane Foam, Dark Blue	MIL-B-83054, Type IV
Polyurethane Foam, Light Blue	MIL-B-83054, Type V
Insulation Board, Thermal Polyurethane	ASTM C591, Type 1, Grade 2, Class 1
Acrylic Finish A	MIL-P-8184
Acrylic, Stretched	MIL-P-25690
Phenolic	MIL-I-24768, Type FBE, FBM or FBG
	ASTM D709, Type PBG

PLASTICS (CONT)

Material	Specification
Graphite Epoxy Prepreg	MMS 548, Type III
FEP Tubing	ASTM D2116

RUBBER - EXTRUSION

Material	Specification
Silicone Class III Grade 50 and 60 or Class IIB Grade 60	A-A-59588
Synthetic, General Purpose	AMS 3220

RUBBER - MOLDED

Material	Specification
Silicone Grade 50	A-A-59588

RUBBER - SHEET

Material	Specification
Silicone Sponge Medium	ASTM D1056, Grade M
Silicone	MCS-5901.13
Chloroprene Class II, Grade 40	MIL-R-6855
Chloroprene Sponge Type II, Grade A COND Soft	ASTM D6576
Buna N Class 1, Grade 40	MIL-R-6855

SHIM STOCK

Material	Specification
302 CRES	AMS-DTL-22499, Compsn 1, Type I, Class 1 or 2
5052 Al Aly	AMS-DTL-22499, Compsn 3, Type 1, Class 1 or 2

STEEL ALLOY - SHEET AND PLATE (CONT)

Material	Specification
1020	Commercial Cadmium Plate Case Hdn
1095	AMS 5121
4130	AMS 6345
4340	AMS 6359

STEEL ALLOY - BAR AND ROD

Material	Specification
4340 Premium Quality	AMS 6414
4340 COND C	AMS 6415 AMS 6484
4130	AMS S6758
D6AC	AMS 6431 AMS 6439
300M Premium Quality	AMS 6419

STEEL ALLOY - WIRE

Material	Specification
1090	ASTM A228
300 M	AMS 6419

TITANIUM - BAR AND ROD

Material	Specification
6Al-4V-Anl	AMS 6931
6Al-6V-2Sn Anl	AMS 6936

STEEL ALLOY - FORGING

Material	Specification
D6AC	AMS 6431 AMS 6439
300 M Premium Quality	AMS 6419
4340	AMS 6414

TITANIUM - EXTRUDED SHAPES

Material	Specification
6Al-4V Anl	MIL-T-81556
6Al-6V-2Sn Anl	MIL-T-81556
6Al-6V-2Sn Anl Skin Free	MMS 1202

STEEL ALLOY - SHEET AND PLATE

Material	Specification
Steel Low Alloy Extra High Strength	MMS 202

TITANIUM - FORGING

Material	Specification
6Al-4V-Anl	AMS 6931
6Al-6V-2Sn Anl	AMS 6936
6Al-6V-2Sn	AMS 6935

TITANIUM - SHEET AND PLATE

Material	Specification
Unalloyed Anl	AMS-T-9046
6Al-4V Anl	AMS 4911
6Al-4V ELI Anl	AMS 4907
6Al-6V-2Sn	MMS 1203
6Al-4V	AMS 6930

TITANIUM - SEAMLESS TUBING

Material	Specification
3Al-2.5V	MMS 1205

IVD - COATED MATERIAL

Material	Specification
Aluminum Alloy Plate 2124-T851	MMS 149
Steel Alloy Bar 4330	AMS 6411
4340	AMS 6414

1-18. HIGH TEMPERATURE AREAS. See figure 1-5.

1-19. High temperature areas of the aircraft are areas in which temperature exceeds 250 degrees Fahrenheit. To use correct materials, fasteners, adhesives, and processes when making repairs, the temperature of the area being repaired should be considered. When materials, fasteners, adhesives or processes are specified in a repair in other manuals, it shall take precedence over the temperature considerations on this figure. If doubt exists as to which temperature area a repair is located or if a repair will be made in more than one area, use the higher temperature to select materials, fasteners, adhesives, and processes.

1-20. COMPONENT WEIGHTS. See table 1-1.

1-21. The component weights are given in table 1-1. Considerations will have to be given to the fact that many Engineering Change Proposals and/or Time Compliance Technical Orders may have been incorporated in the field which are not in the representative block weighing. Also one block weighing would not give the exact weight of any component from the first to the last. Because of the possible variations, weights in table 1-1 are considered to have a ± 10 percent variation.

Table 1-1. Component Weights

Component (Excluding All Fuel)	Weight Pounds
Radome	196
Forward Fuselage	6104
Windshield	102
Canopy	285
Nose Landing Gear	265
Variable Inlet Ramp	180
Second Position Ramp	6
Third Position Ramp	41
Diffuser Ramp	70

Table 1-1. Component Weights (CONT)

Component (Excluding All Fuel)	Weight Pounds
Speed Brake	136
Center Fuselage	1 ▶ 8678
Centerline Pylon	2 ▶ 316
Inboard Pylon	2 ▶ 371
Outboard Pylon	107
Main Landing Gear	587
Wing (Excluding Following Items A and B)	1959
A. Aileron	42
B. Flap	60
Aft Fuselage	3846
Horizontal Stabilator	333
Vertical Stabilizer	3 ▶ 307
Rudder	22
Engine	3995
Wing Tip	53
Ejection Seat and Installation	91
Arresting Hook	120
<p>1 ▶ Excluding speed brake and variable inlet. 2 ▶ Includes 90 pound bomb rack. 3 ▶ Excluding rudder.</p>	

1-22. DEFINITION OF REFERENCE LINES.

See figure 1-6.

1-23. To give the location of bulkheads, ribs, spars, or other structure, certain reference lines or stations have been established for the aircraft. These lines represent an end view of a plane cutting the aircraft at a specific location. The numbers given to the reference line represent the distance in inches from a selected point. The main reference lines or stations are buttock lines, fuselage stations, and water lines.

1-24. **BUTTOCK LINES (BL).** Buttock lines indicate vertical lines parallel to the longitudinal centerline of the aircraft. Buttock line zero (BL 0.00) indicates the centerline of the aircraft. Left and right butt lines are measured from this line.

1-25. **LEFT BUTTOCK LINES (LBL).** Lines to the left of BL 0.000.

1-26. **RIGHT BUTTOCK LINES (RBL).** Lines to the right of BL 0.000.

1-27. **FUSELAGE STATIONS (FS).** Fuselage station lines indicate longitudinal positions of vertical lines

CSTO SR1F-15SA-3-1

that are 90 degrees to BL 0.000. The forward tip of the radome is at FS 116.290 and FS lines are measured in inches aft of this point.

1-28. **WATER LINES (WL).** Water lines indicate horizontal lines parallel to the ground line. The floor of the crew station is at WL 118.000 when the aircraft is in a level position.

1-29. **WING BUTTOCK LINES (XW).** Wing buttock lines are a continuation of the fuselage buttock lines.

1-30. **WING STATION LINES (YW).** Wing station lines indicate lines that are 90 degrees to the wing buttock lines. The forward wing to fuselage attach point is at YW 104.150.

1-31. **WING LEADING EDGE STATION LINES (XFS).** Wing leading edge station lines indicate lines perpendicular to the 7.5 percent cord line. See detail A, figure 1-6.

1-32. **HORIZONTAL STABILATOR STATION LINES (SS).** Horizontal stabilator station lines indicate lines that are parallel to fuselage buttock lines. The horizontal stabilator spindle is at SS 0.000 and the lines are measured outboard of that point.

1-33. CATEGORIES OF REPAIR CAPABILITIES.

1-34. Structural repairs have been divided into three major classes; organizational, intermediate, and depot. The repairs in CSTO SR1F-15SA-3-1 through CSTO SR1F-15SA-3-5 are limited to those which can be made at organizational and intermediate maintenance. Depot repairs are contained in CSTO SR1F-15SA-3-6. Wear and rework tolerances for mechanical linkages are contained in CSTO SR1F-15SA-3-8. CSTO SR1F-15SA-3-8 provides repair instructions for all maintenance levels.

1-35. **ORGANIZATIONAL MAINTENANCE REPAIRS.** Examples of organizational maintenance repairs are:

- a. Touch-up painting of nicks, scratches, countersunk holes, trimmed edges, and small parts.
- b. Replacement of fasteners if extensive painting is not required.
- c. Removal of sheet metal dents if extensive painting is not required.

d. Windshield and canopy glass maintenance (cleaning, waxing of shallow scratches).

- e. Visual damage inspection.
- f. Replacement of parts where drilling or trimming is not required.

1-36. **INTERMEDIATE MAINTENANCE REPAIRS.** Examples of intermediate maintenance repairs are:

- a. Stripping and refinishing of parts, such as ailerons, flaps, and access doors.
- b. Hardness testing.
- c. Replacement of parts requiring trimming and drilling.
- d. Sheet metal repairs including manufacture of small metal forms, forming and heat treating of repair parts, dimpling, welding or machining which can be done with light job shop type equipment.

e. Repairs to honeycomb, glass fiber, and plastic structure that is cracked, dented, crushed, delaminated or punctured.

1-37. **DEPOT REPAIRS.** Examples of depot repairs are:

- a. Repairs which require design by an aeronautical structure engineer.
- b. Major rebuilding and manufacture of structural assemblies.
- c. When repair parts are large and require major forming and production type machining operations.
- d. When replacement of structural parts require the use of production type jigs and fixtures.

1-38. CLASSIFICATION OF DAMAGE.

1-39. Structural damage has been divided into four classes: negligible damage, repairable damage, damage requiring replacement of parts, and combat area damage. Repairable damage has further been subdivided into patch repairs and insertion repairs.

1-40. **NEGLIGIBLE DAMAGE.** Damage that may be permitted to exist as is or corrected by simple repair methods, such as blending a scratch or bumping out a dent is considered negligible.

Damage which affects safety of flight or places flight restrictions on the aircraft shall not be classed as negligible. Refer to the specific structural group repair section in which the damaged part falls for negligible damage limits. If doubt exists as to whether damage is negligible or repairable, classify it as repairable.

1-41. REPAIRABLE DAMAGE. Damage which exceeds negligible damage limits but which is not large enough to require replacement is classified repairable. Repairable damage is divided into two types: damage repairable by patching and damage repairable by insertion.

1-42. Damage Repairable by Patching. Small areas of damage affecting only the center of a skin panel, a bulkhead web or the leg of an angle may be repaired by patching.

1-43. Damage Repairable by Insertion. When damage to a skin panel is extensive or affects the edges of a skin panel, it may be repaired by insertion. Repairs made by splicing in a new section of a bulkhead or a long section of a longeron or stringer are also classified as insertion type repairs.

1-44. DAMAGE REQUIRING REPLACEMENT OF PARTS. This type of damage includes damage to parts too small for practical repair, parts, such as forgings, castings, pressings or heat treated fittings, and damage so great that an economical repair is impossible. When items, such as small parts, castings, forgings are damaged beyond negligible damage limits, they should be replaced.

1-45. COMBAT AREA DAMAGE. Damage to the aircraft from enemy action. Refer to Section VII and CSTO SR1F-15SA-39-().

1-46. TYPES OF REPAIR.

1-47. There are four types of repair: permanent, temporary, one-time flight, and combat. The type of repair made will depend on the materials, tools,

amount of time available, and the maintenance level. Temporary and one-time flight repairs will generally be made only at organizational and field maintenance when it is impractical to do a permanent repair.

1-48. PERMANENT REPAIR. A permanent repair makes the strength of the repaired structure equal to or greater than its original strength and also satisfies aerodynamic, thermal, and interchangeability requirements.

1-49. TEMPORARY REPAIR. A temporary repair restores the load carrying ability of the structure but is not aerodynamically smooth or able to satisfy interchangeability requirements. This repair should be replaced by a permanent type as soon as practical.

NOTE

Stop drilling is considered as temporary and a permanent repair should be accomplished at the earliest possible date.

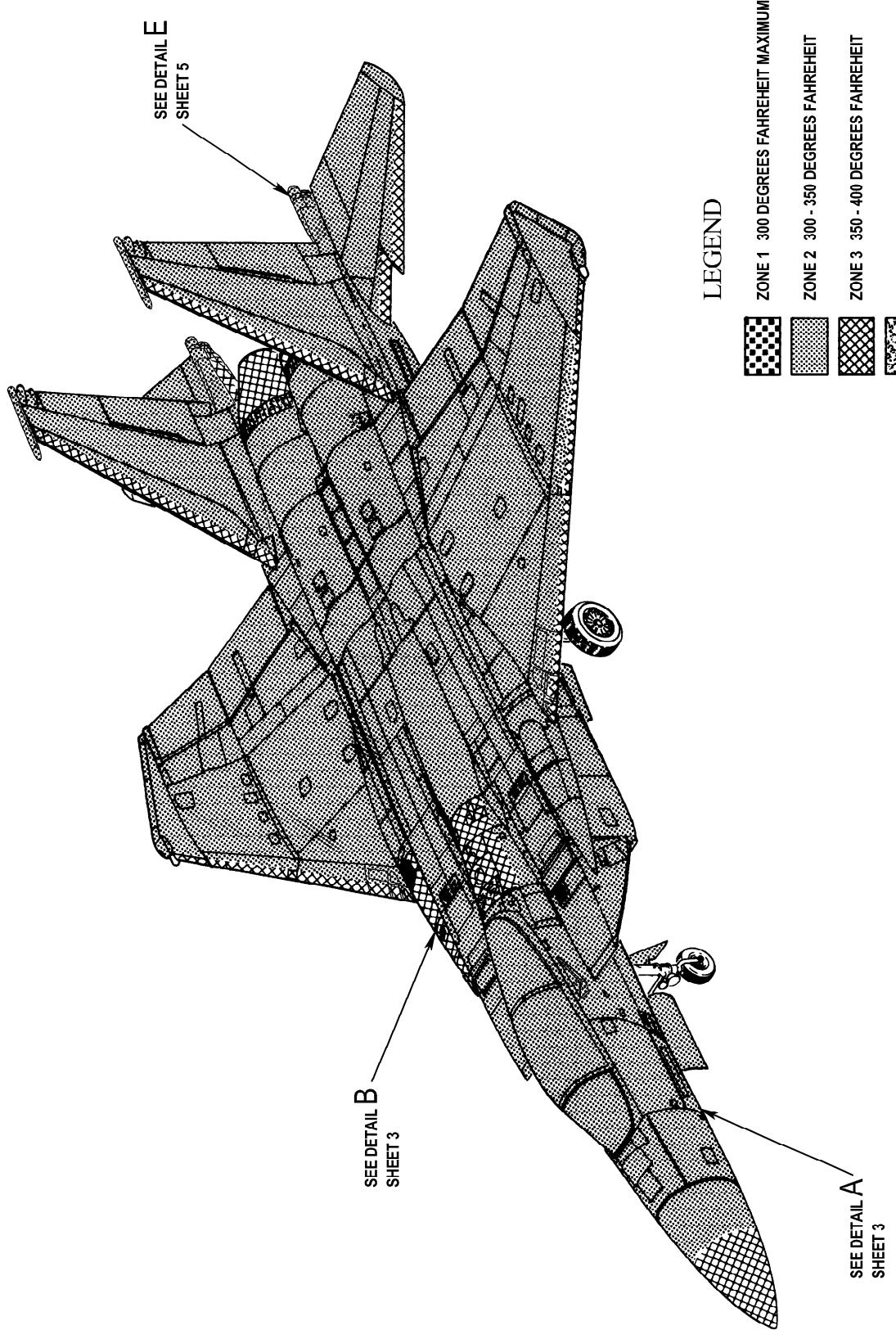
1-50. ONE-TIME FLIGHT (FERRY) REPAIR.

WARNING

The aircraft cockpit should be placarded to limit the performance of the aircraft because further damage could occur.

The one-time flight repair restores a limited load carrying ability to the damaged structure in order to fly the aircraft to a facility for a permanent repair.

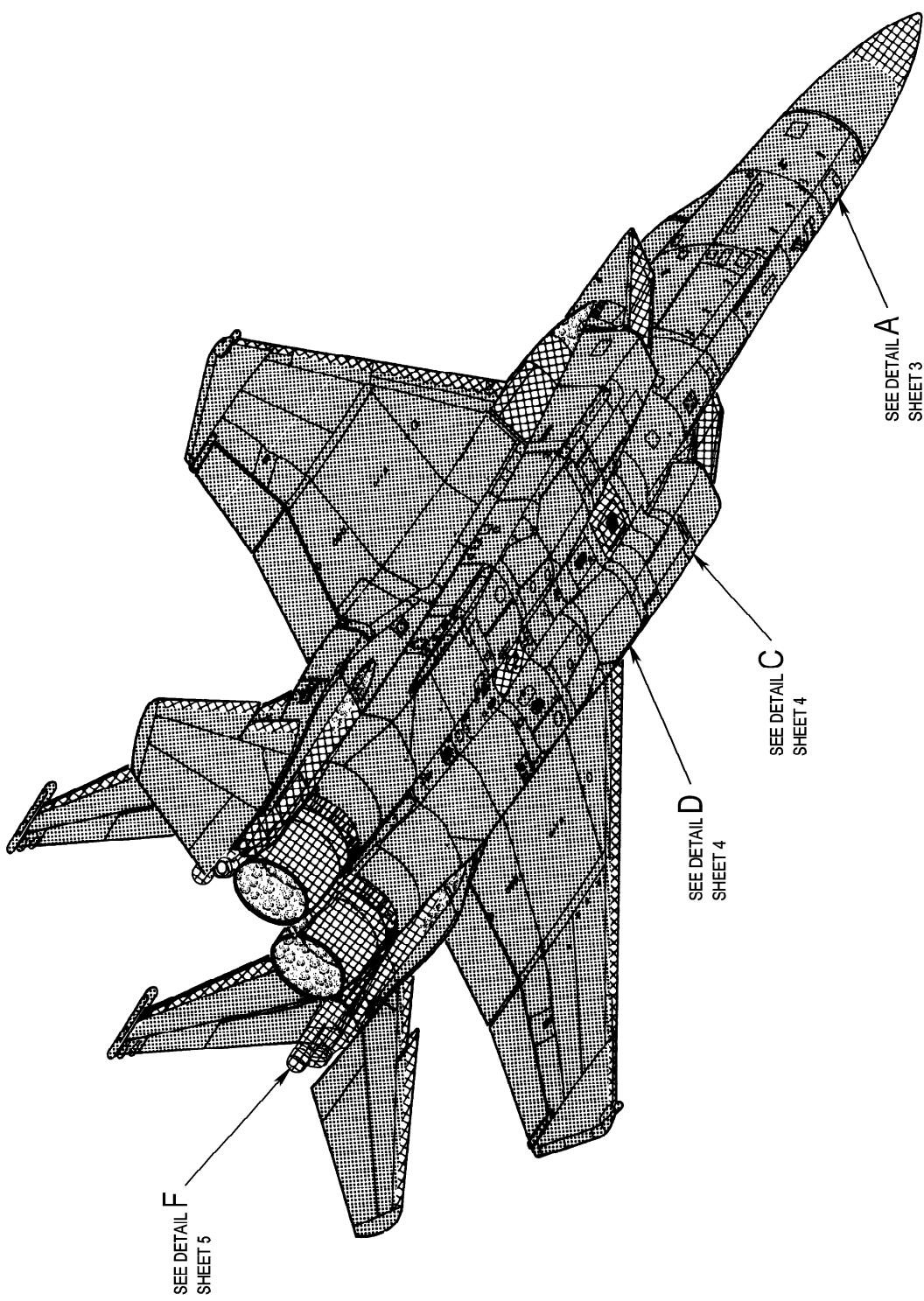
1-51. COMBAT REPAIR. A repair which can be used to quickly return battle damaged aircraft to operational status. Refer to CSTO SR1F-15SA-39-().



TEMPERATURES SHOWN ARE THE MAXIMUM TO WHICH
THE AREAS ARE SUBJECTED. ACTUAL TEMPERATURE
VARIANCES DO NOT EXACTLY FOLLOW THE LINES SHOWN
BUT THE AREAS ARE DEFINED FOR EASE OF LOCATION.

SAN301-1-21-002

Figure 1-5. High Temperature Area Diagram (Sheet 1 of 5)



SAN301-1-22-001

Figure 1-5. High Temperature Area Diagram (Sheet 2)

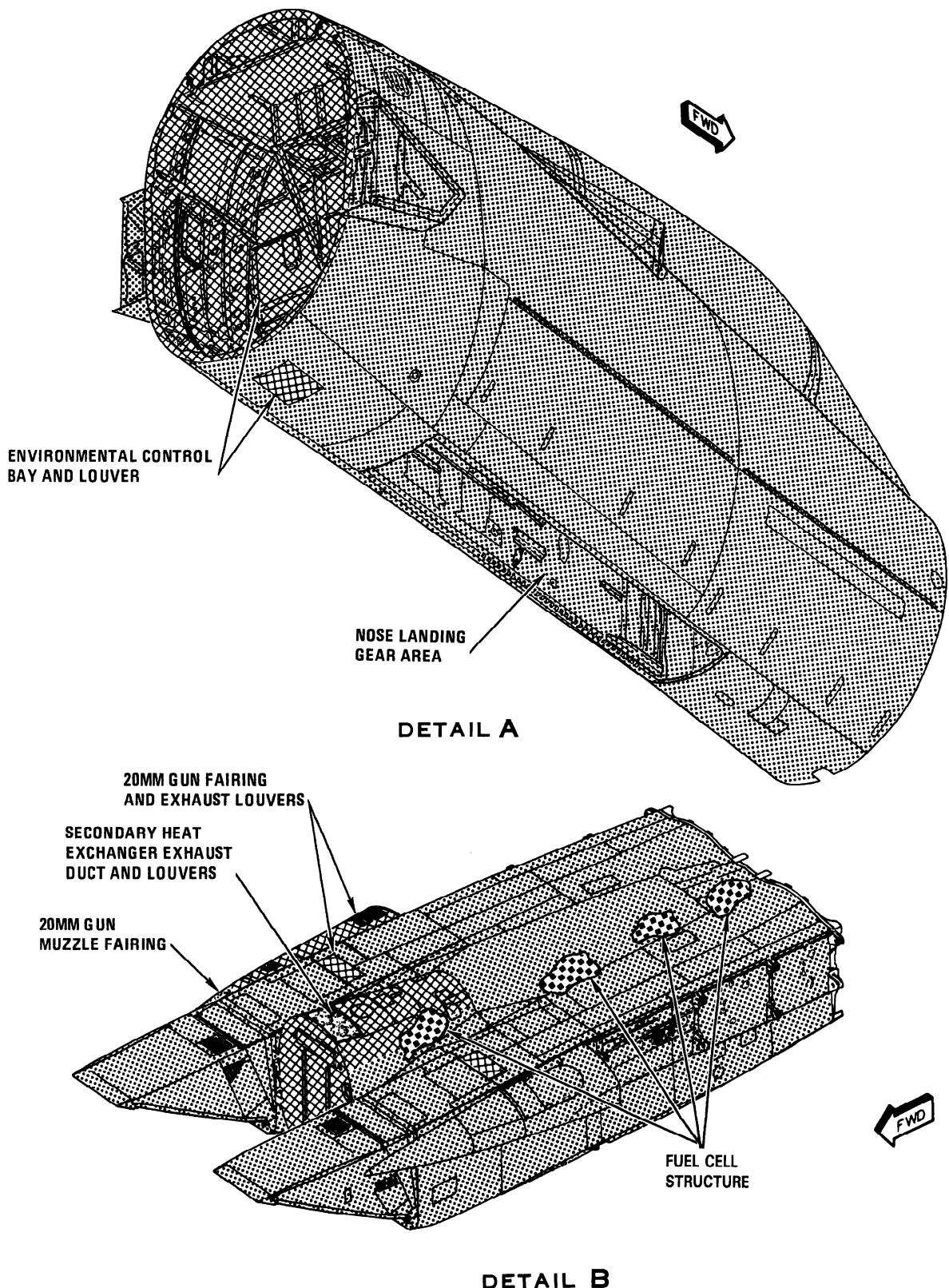
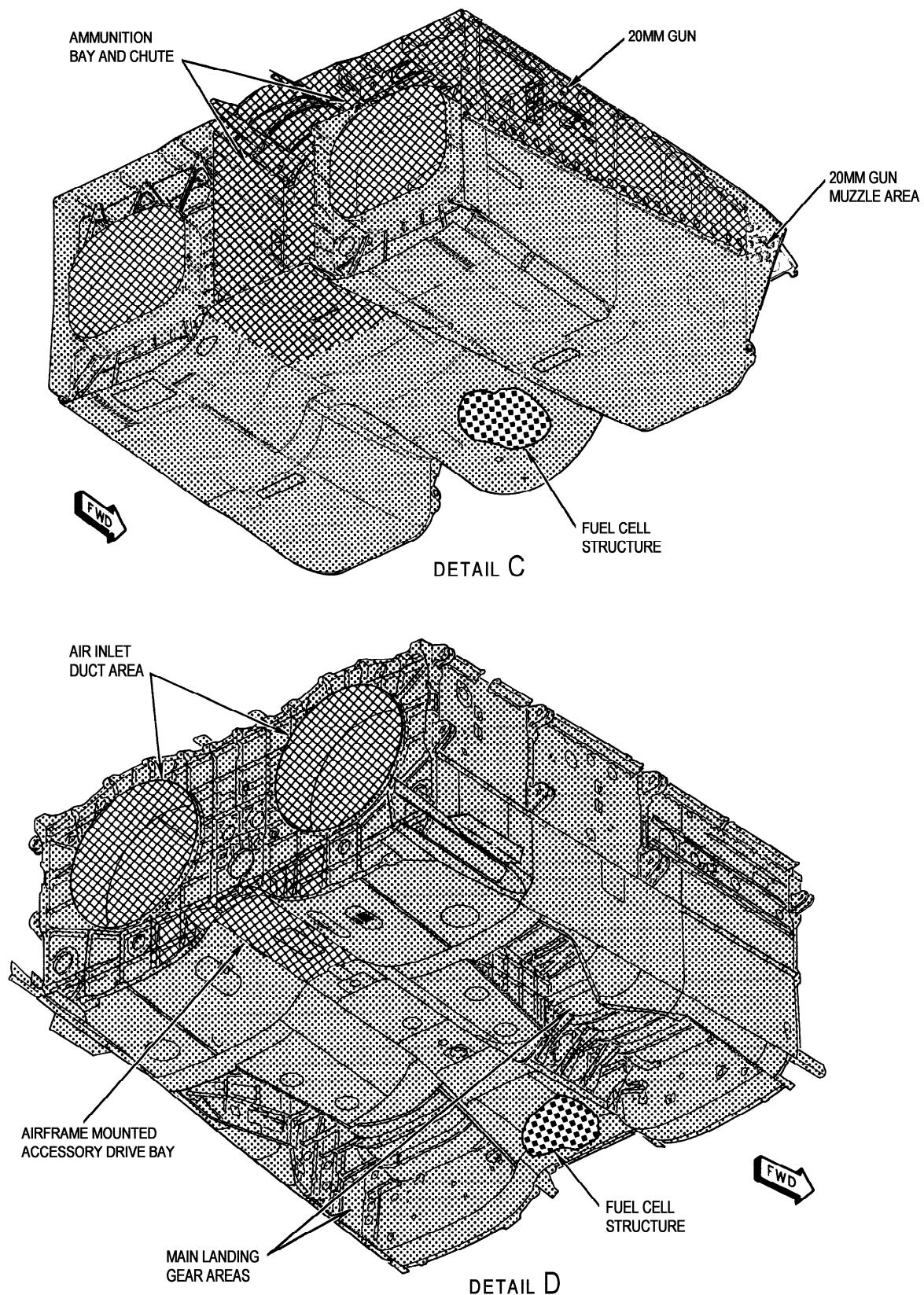


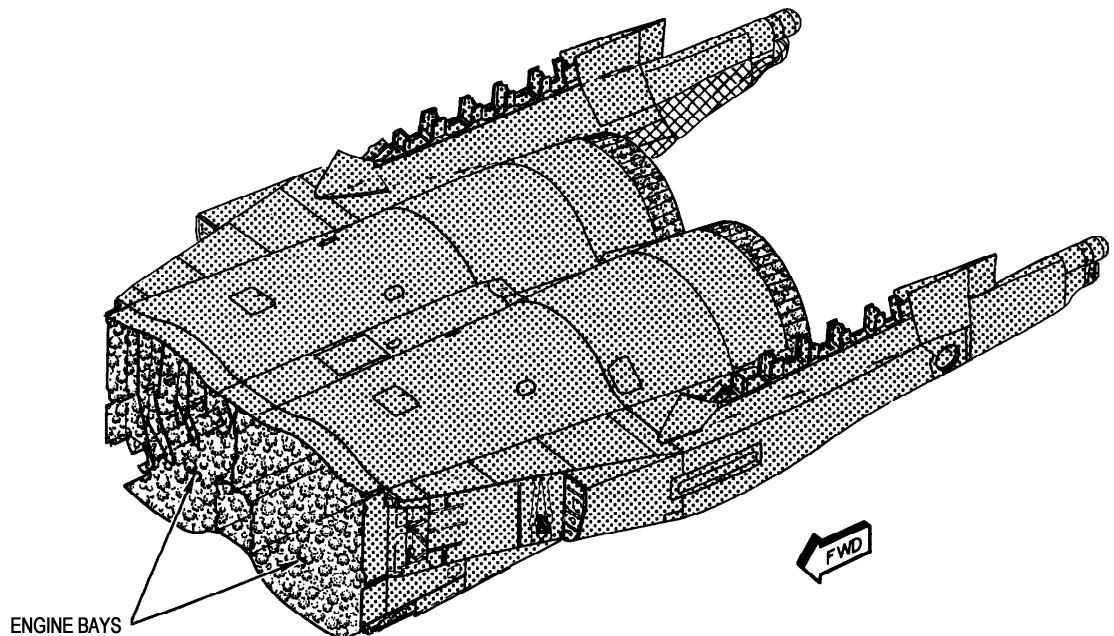
Figure 1-5. High Temperature Area Diagram (Sheet 3)

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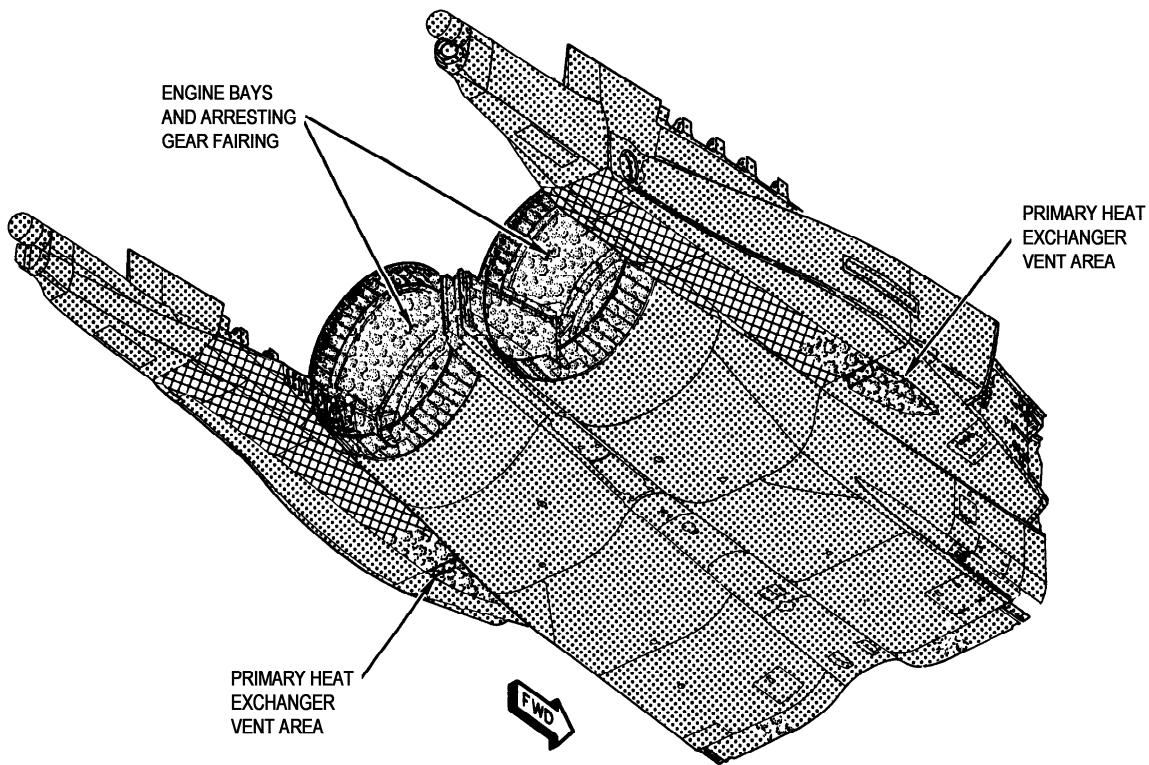


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Figure 1-5. High Temperature Area Diagram (Sheet 4)



DETAIL E



DETAIL F

SAN301-1-25-001

Figure 1-5. High Temperature Area Diagram (Sheet 5)

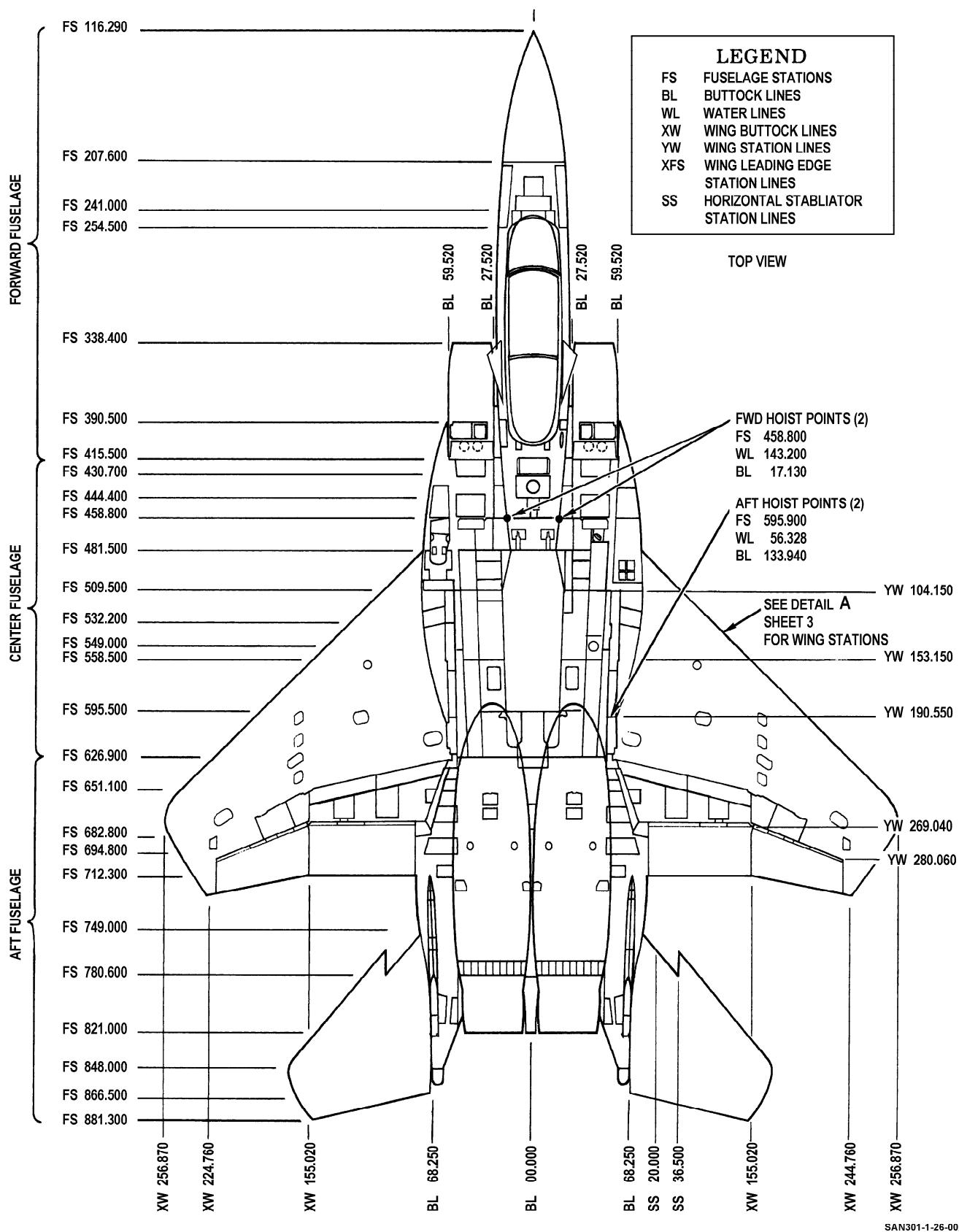


Figure 1-6. Station Diagram (Sheet 1 of 3)

CSTO SR1F-15SA-3-1

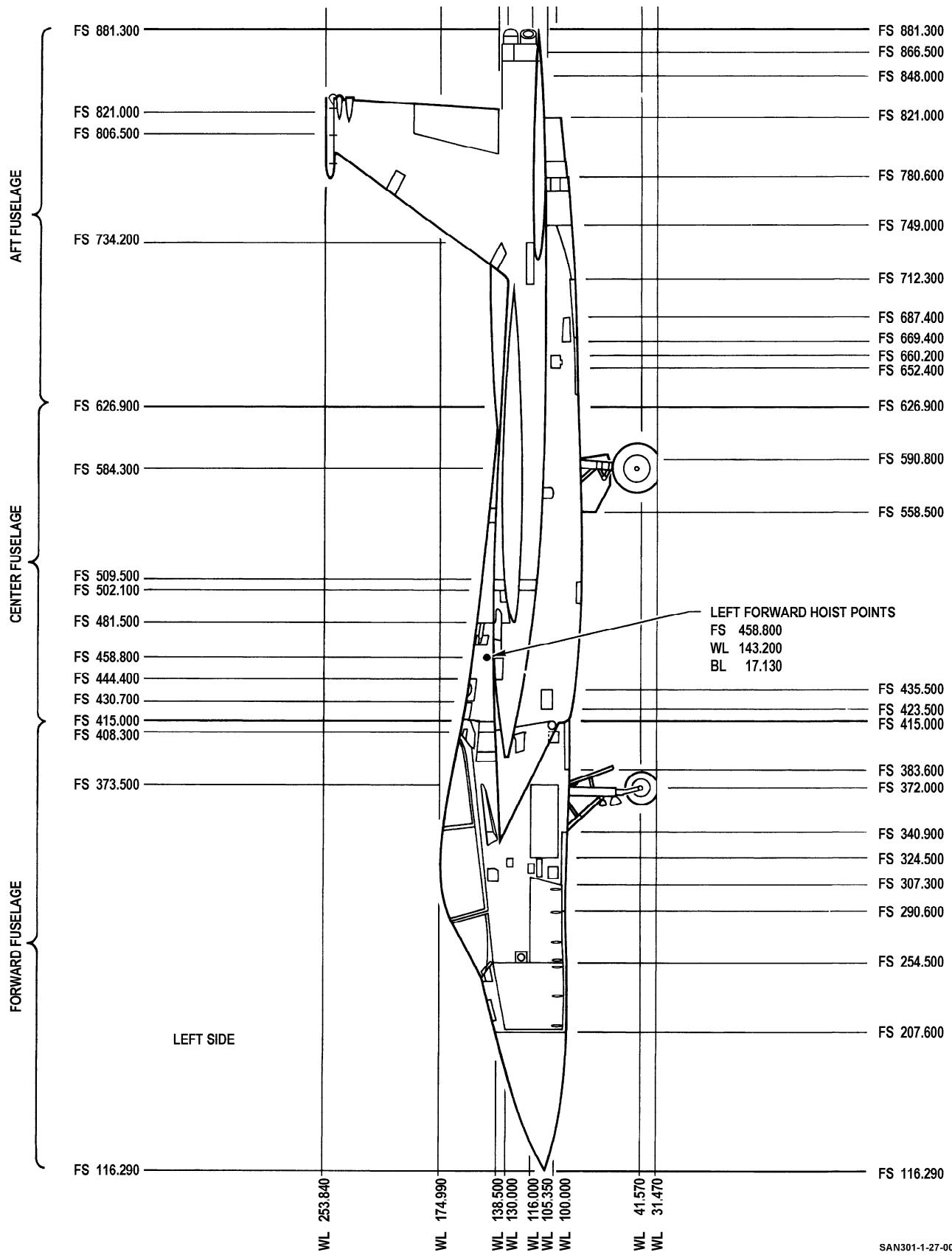
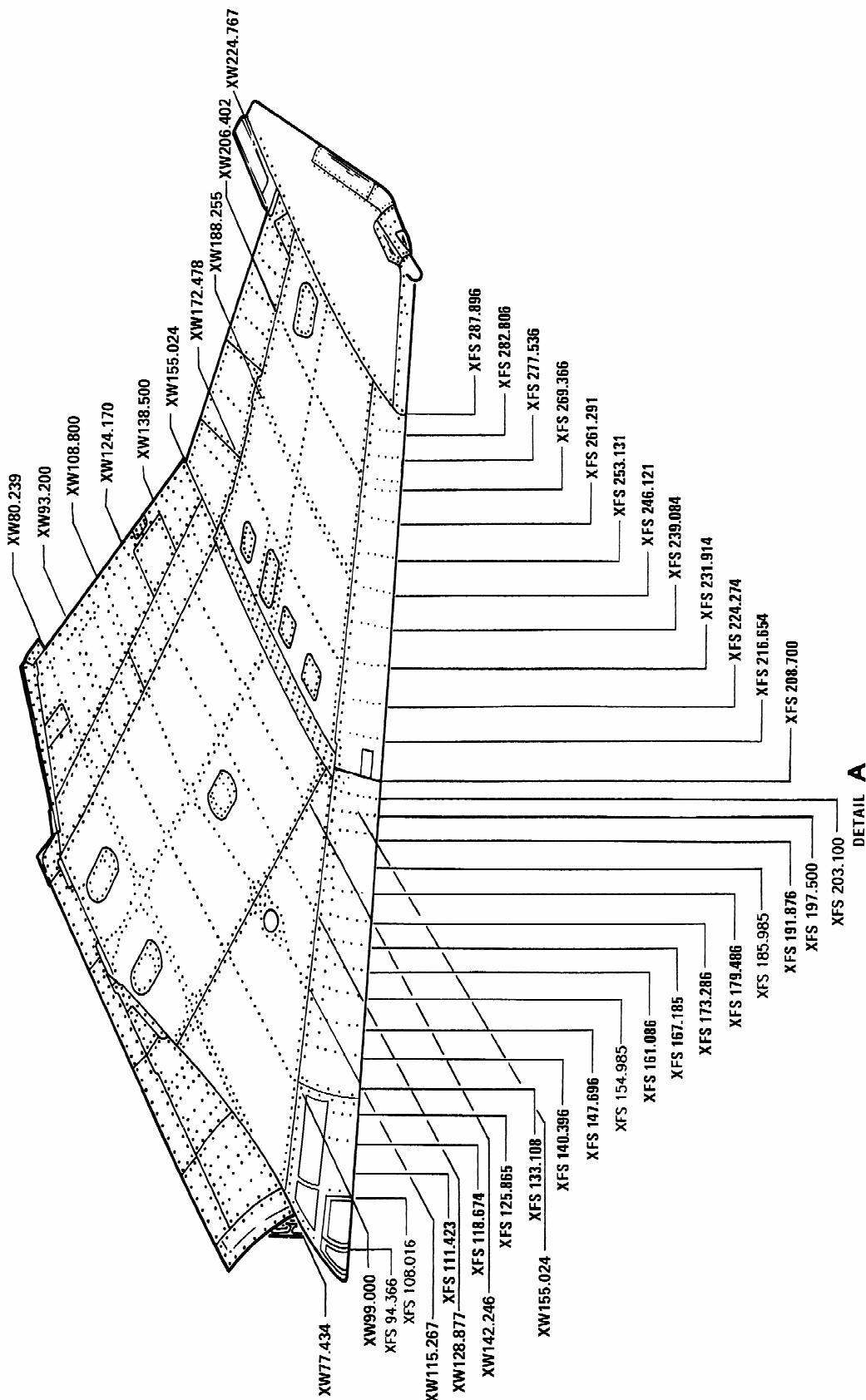


Figure 1-6. Station Diagram (Sheet 2)



SAN301-1-28-002

Figure 1-6. Station Diagram (Sheet 3)

SECTION II

DAMAGE EVALUATION

2-1. DESCRIPTION.

2-2. Information contained in this section outlines the areas and types of inspection required to locate and evaluate structural damage to aircraft and external stores. For damage limits, repairs, and/or replacement of damaged parts, refer to the applicable CSTO SR1F-15SA-3-() series manual in which the aircraft part is shown or

CSTO SR16W6-25-2 or CSTO SR16W6-25-2-11, as applicable, for inboard, outboard, and centerline pylons. To do some of the various inspections, exterior access doors and panels will require removal. When conformal fuel tanks (CFT) are installed, CFT access doors and panels, and/or CFT may require removal. For location of the access doors and panels, refer to paragraph 2-3. A visual inspection is the most common form of inspection used to locate damage. For a preliminary visual inspection, refer to paragraph 2-5. For a detailed visual inspection, refer to paragraph 2-7.

2-3. ACCESS FOR INSPECTION. See figure 2-1.

2-4. To evaluate and determine the amount of structural damage, open and/or remove external and/or internal access doors, panels, and covers. For location of aircraft external access doors, panels, and covers, see figure 2-1. For location of CFT access doors, refer to CSTO SR6J14-5-17-3-2. For location of 600 gallon fuel tank access doors, refer to TO 6J14-2-34-3. For location of inboard, outboard, and centerline pylon access doors, refer to CSTO SR16W6-25-2 or CSTO SR16W6-25-2-11, as applicable. Each of the inspections will refer to the applicable figure or manual for external access doors, panels, and covers.

2-5. PRELIMINARY VISUAL INSPECTION. See figure 2-2.

2-6. Do visual inspection of the exterior surfaces of the aircraft, nose and main landing gears, and variable air inlet duct skins and ramps for obvious damage, for example cuts, scratches, dents, holes, cracks, buckles, delamination, distortion, loose or missing fasteners, and fuel leaks. When damage to an area is large a more detailed visual inspection is required. For external access doors, see figure 2-1.

2-7. **DETAILED VISUAL INSPECTION.** See figure 2-3.

2-8. To evaluate and determine the amount of structural damage, a detailed visual inspection of damaged areas shall be done. The following paragraphs describe areas covered in a detailed visual inspection. When a detailed visual inspection for structural damage is done, a corrosion inspection should also be done. For external access doors, see figure 2-1.

2-9. **CRITICAL POINTS.** For damage to doors, inspect critical points, for example hinges, for misalignment and cracked, broken, and missing tangs. Inspect door latches for correct rigging, binding, and deformed or broken hooks. Inspect door fasteners and holes for deformation and elongation. On damaged skin panels, inspect supporting structure for cracks and deformation. Inspect landing gear support structure for cracks, deformation, and misalignment.

2-10. **FASTENERS.** Thoroughly inspect riveted and bolted joints in damaged area for loose, sheared or tilted heads. If the head of a bolt is tilted or loose, remove the bolt and inspect for deformation of bolt and elongation of hole. Inspect the complete row or pattern of fasteners. On painted surfaces rivet tilt can be detected by looking for cracks in the paint around rivet.

2-11. **CRACKS, DENTS, AND GOUGES.** Inspect for dents which appear as hollows or depressions in the skins and panels. Dents can also be detected by shadowing effects on the skins. Gouges will appear as scraped areas on painted and/or unpainted surfaces where metal is removed. Cracks in aluminum forgings, castings, and extrusions can usually be visually detected, but suspected areas should be fluorescent penetrant inspected per TO 33B-1-1 or CSTO SR1F-15SA-36, as applicable.

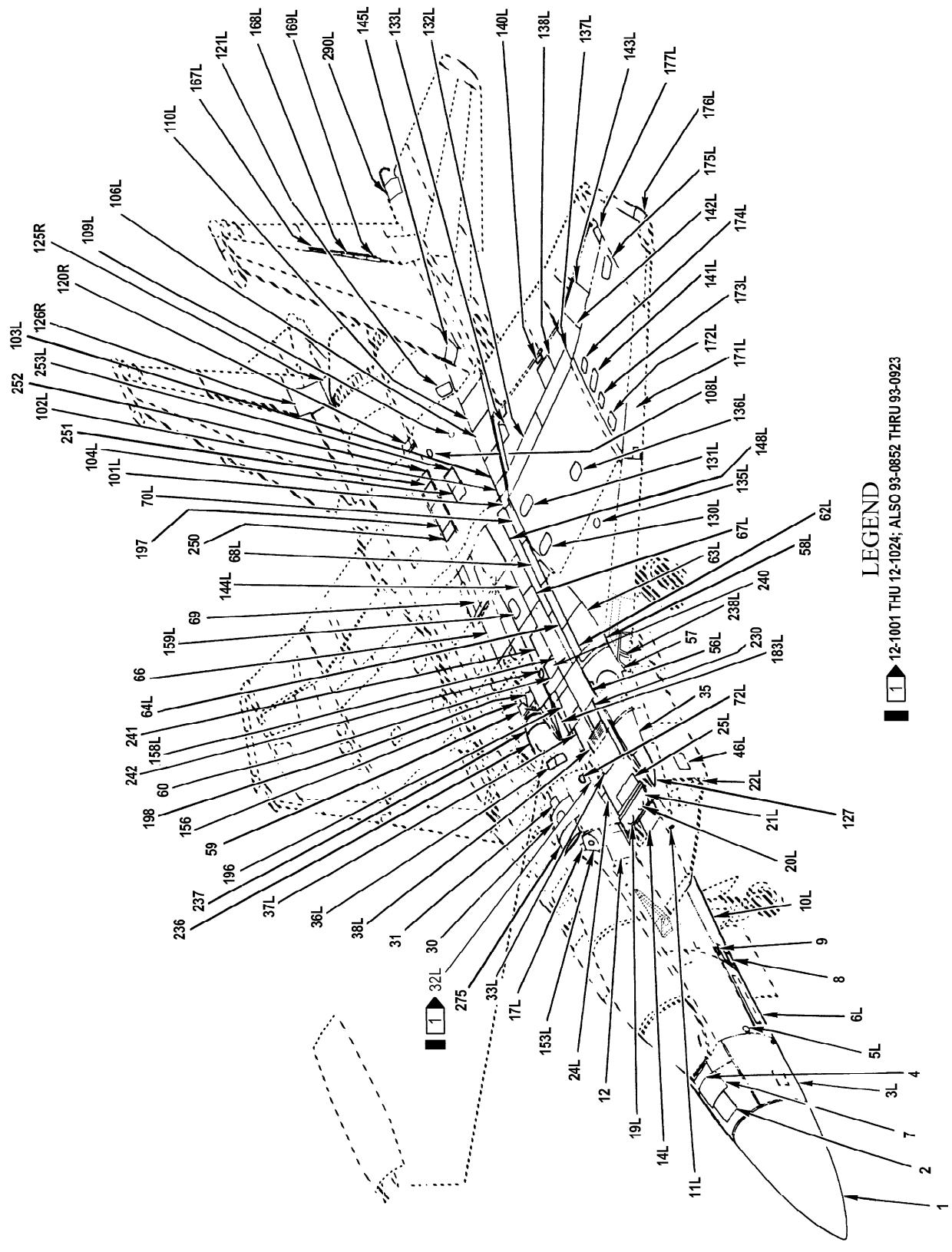
2-12. **DELAMINATIONS, DISBONDS, AND VOIDS.** Visually inspect boron and graphite composites, aluminum, titanium, and reinforced plastic skins over honeycomb core sandwich assemblies for delaminations, disbonds, and voids. Delamination in boron and graphite composites and reinforced plastic, caused by impact damage, will appear as

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white or light colored areas and may be loose around the edge of damage. Disbonds and voids may appear as slight blisters or waviness in skin surface. Relatively large disbonds and voids in aluminum and titanium skin to honeycomb core may be detected by lightly tapping skin with a coin or blunt instrument. Damaged areas will give off a dull or dead sound, where undamaged areas will have a clear metallic sound. Areas of suspected damage in boron and graphite composites, and aluminum and titanium assemblies should be ultrasonic inspected. For ultrasonic inspection of

skin to core bonds and laminates when bonded to core, refer to CSTO SR1F-15SA-36.

2-13. CORROSION. Inspect the inside surface of skin panels and supporting structure. Inspect pockets and corners where moisture may collect. Corrosion can be recognized by white deposits or spots. In some cases, corrosion can be detected by dulling and in severe cases by pitting or blistering of the metal. For corrosion control information, refer to CSTO SR1F-15SA-23.



SAN301-02-1-002

Figure 2-1. Access Openings External (Sheet 1 of 4)

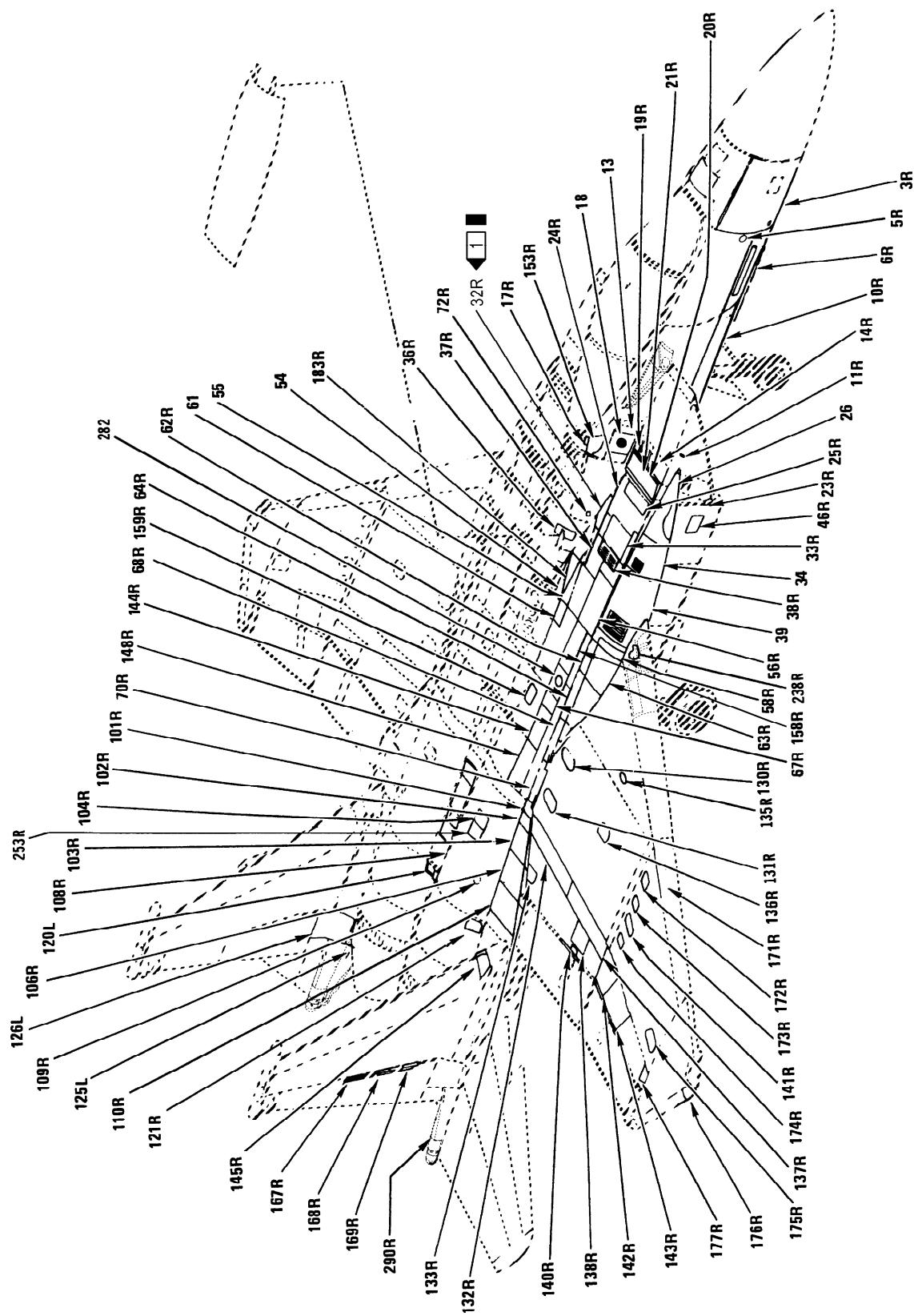
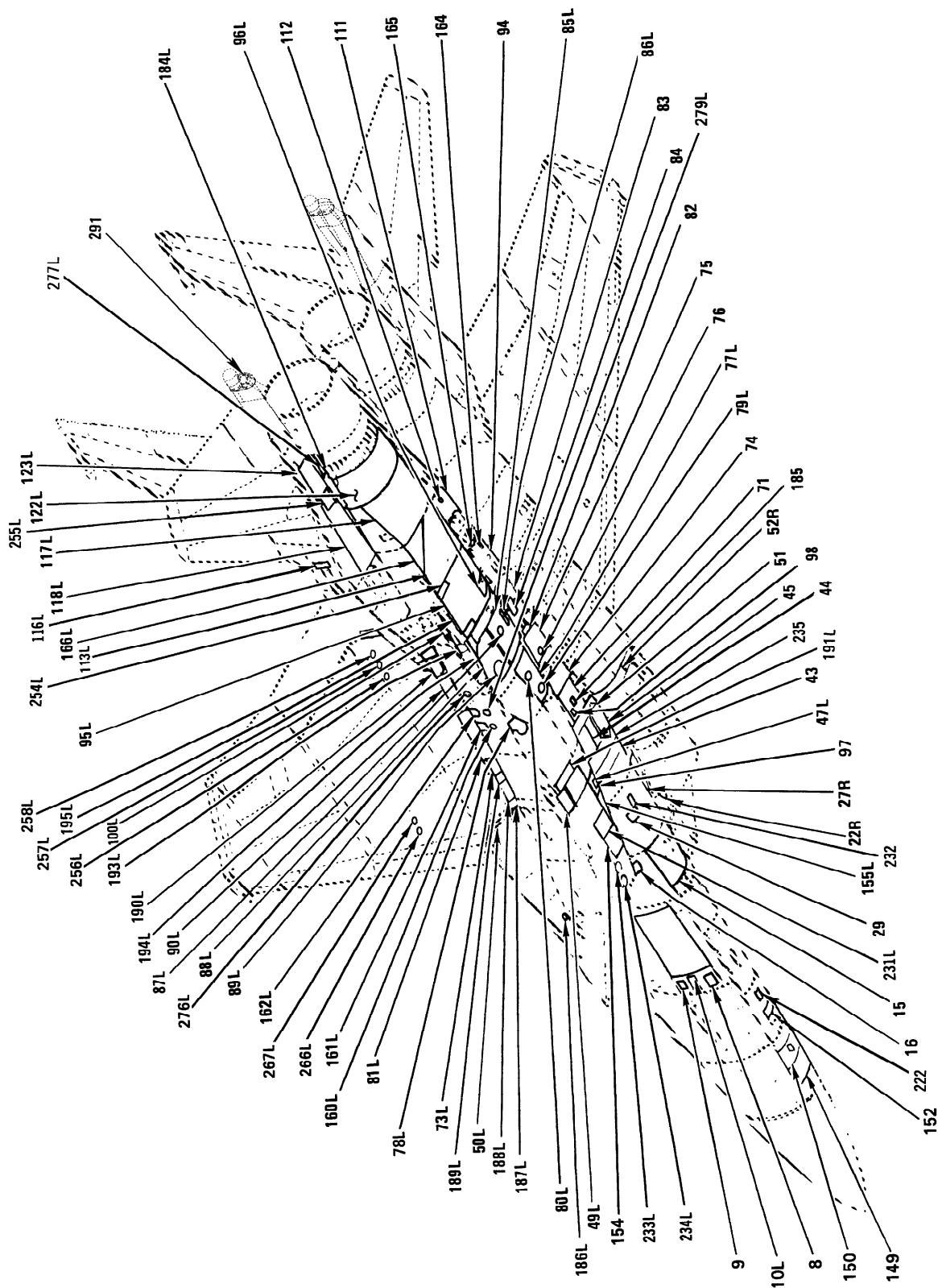


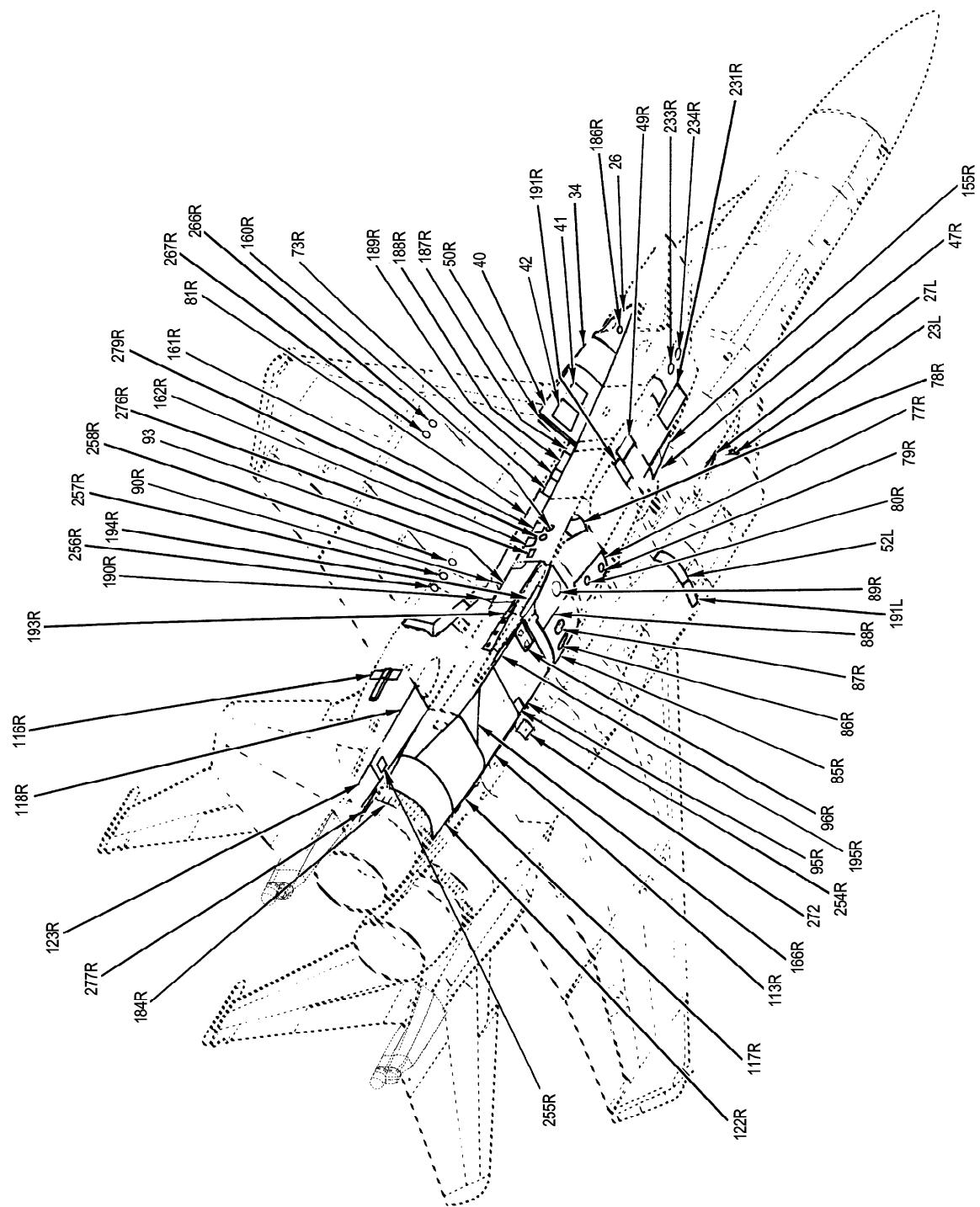
Figure 2-1. Access Openings External (Sheet 2)

SAN301-02-2-002



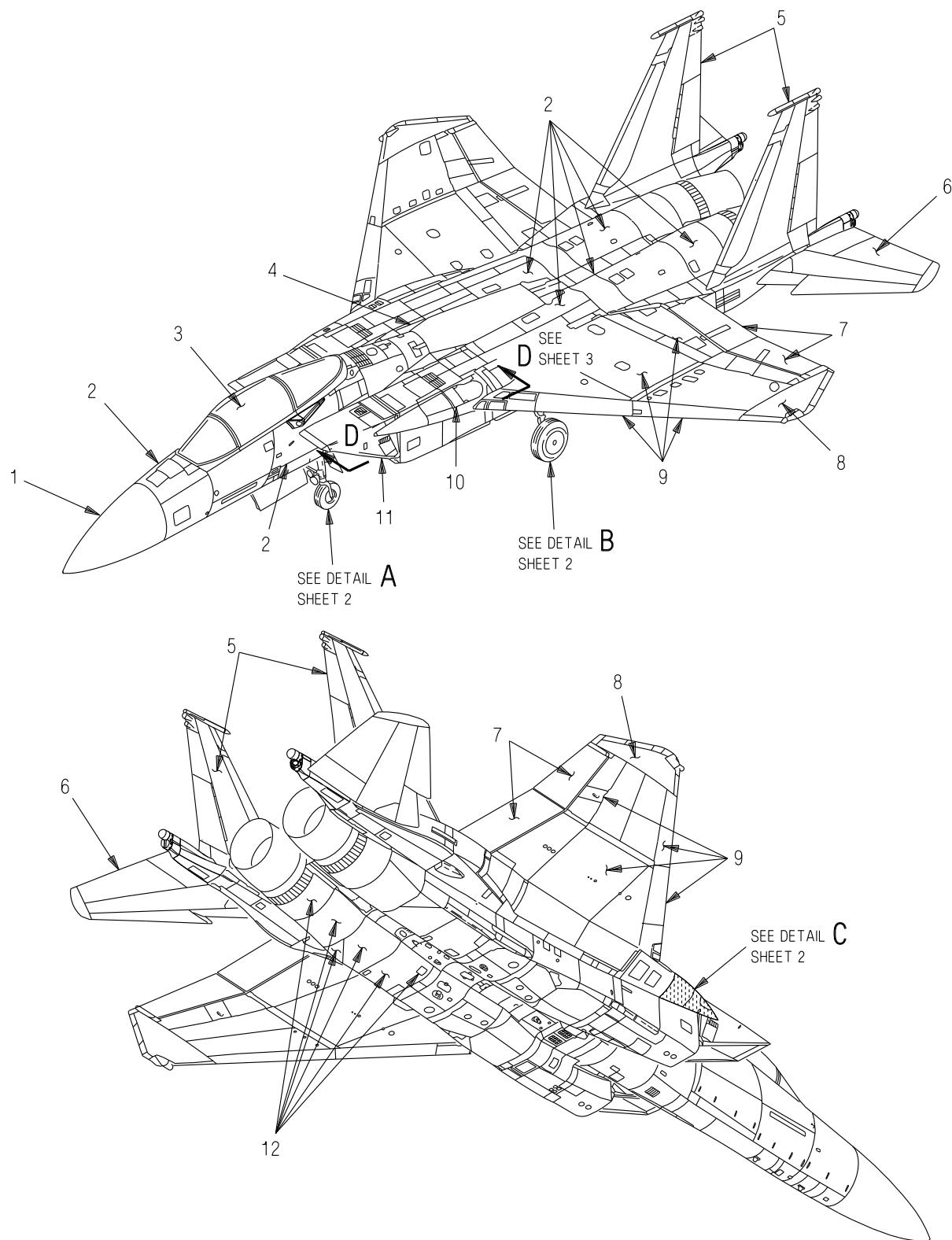
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Figure 2-1. Access Openings External (Sheet 3)



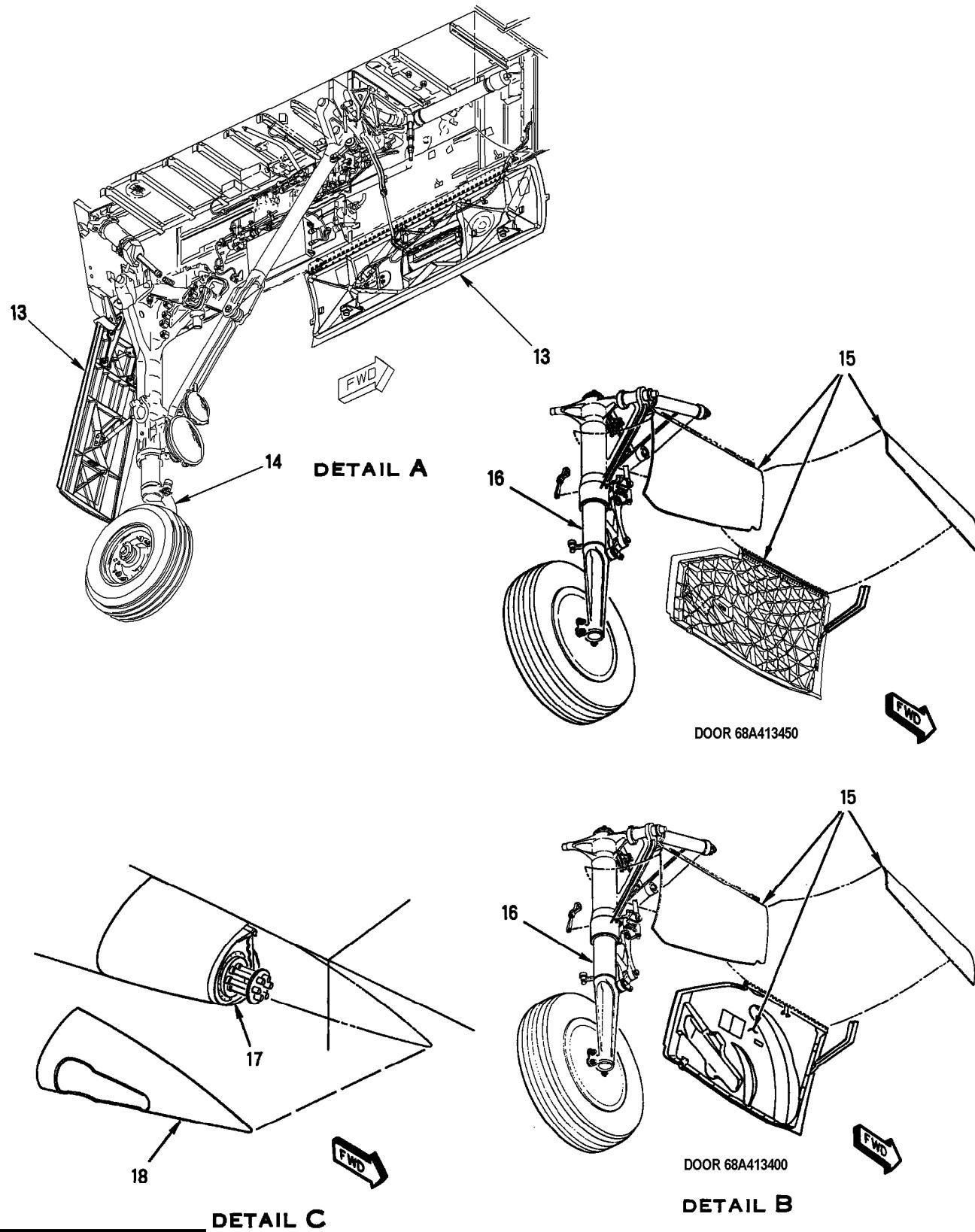
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Figure 2-1. Access Openings External (Sheet 4)



SAN301-02-5-001

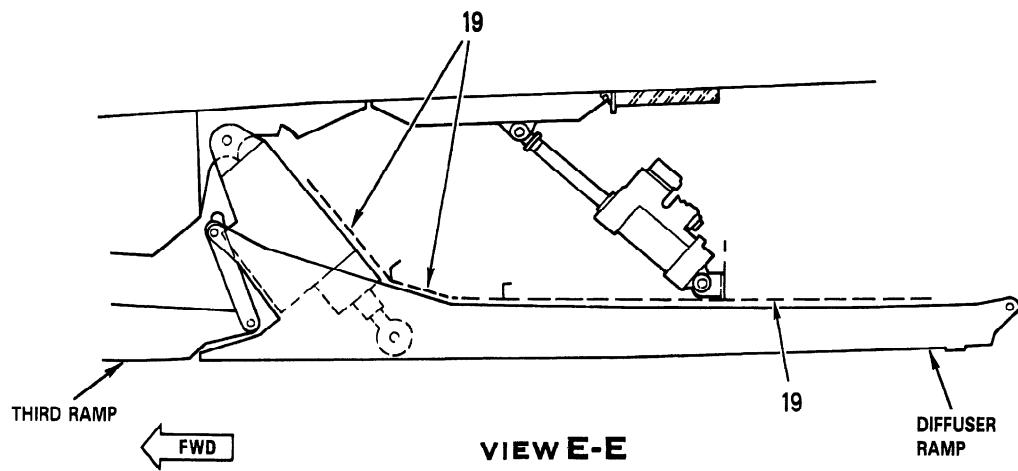
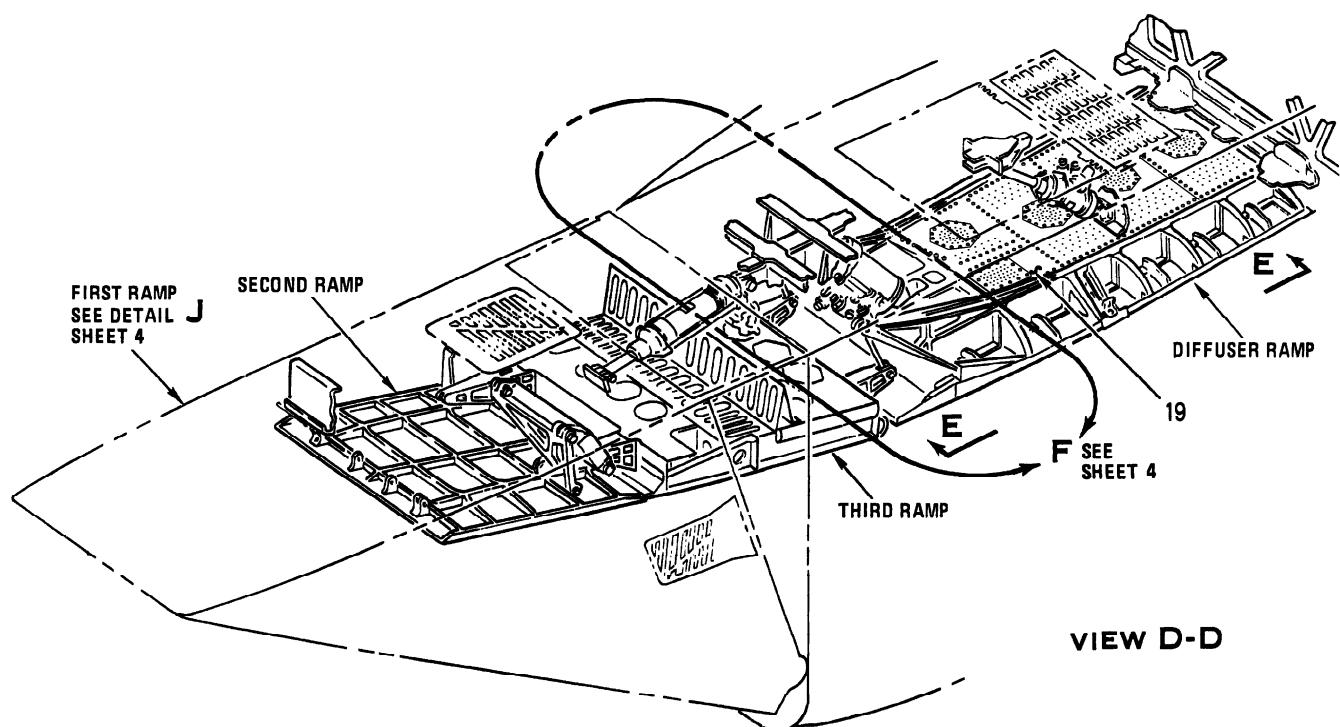
Figure 2-2. Preliminary Visual Inspection (Sheet 1 of 5)



MAJOR CHANGE

SAN301-02-6-002

Figure 2-2. Preliminary Visual Inspection (Sheet 2)



SAN301-02-7-001

Figure 2-2. Preliminary Visual Inspection (Sheet 3)

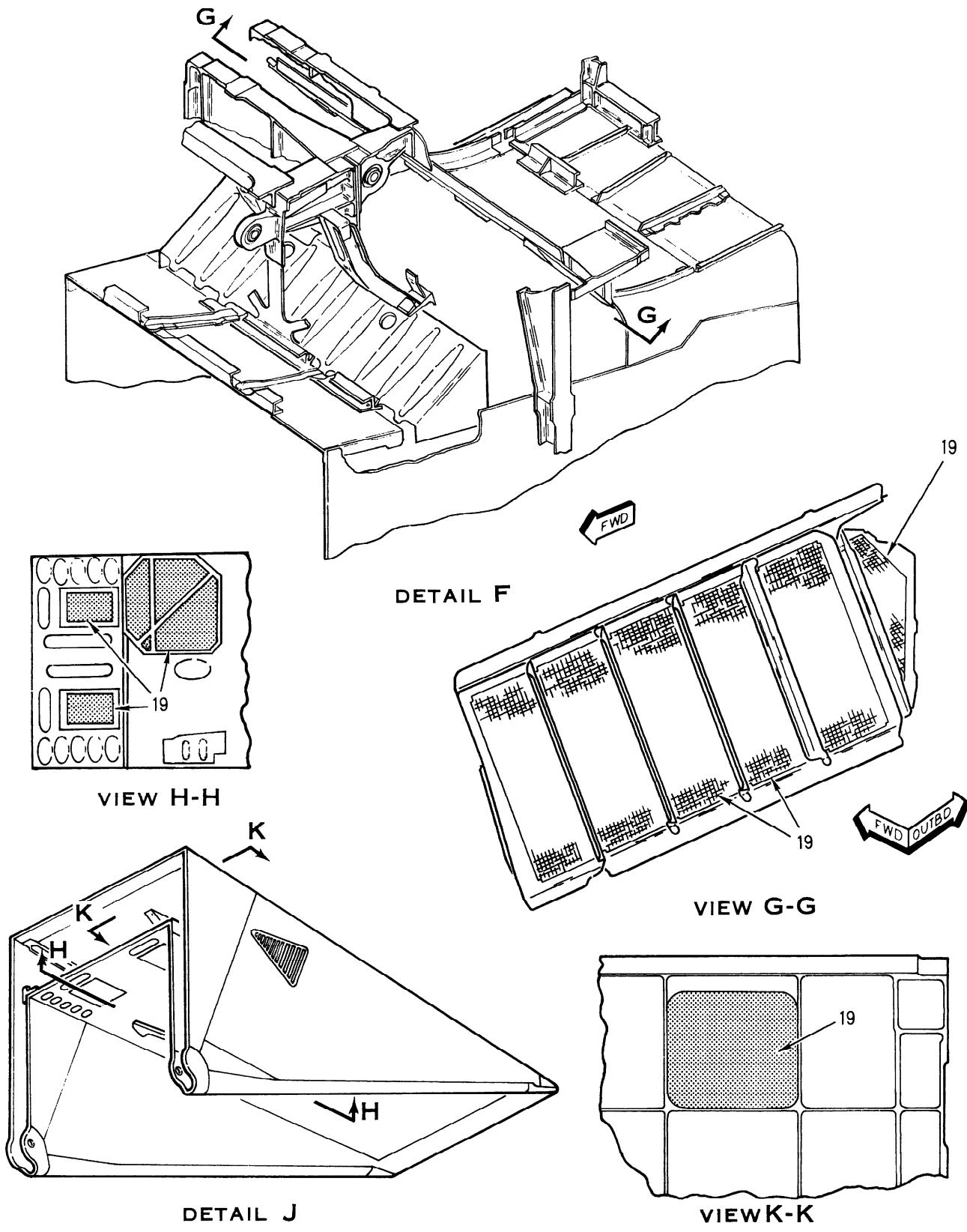
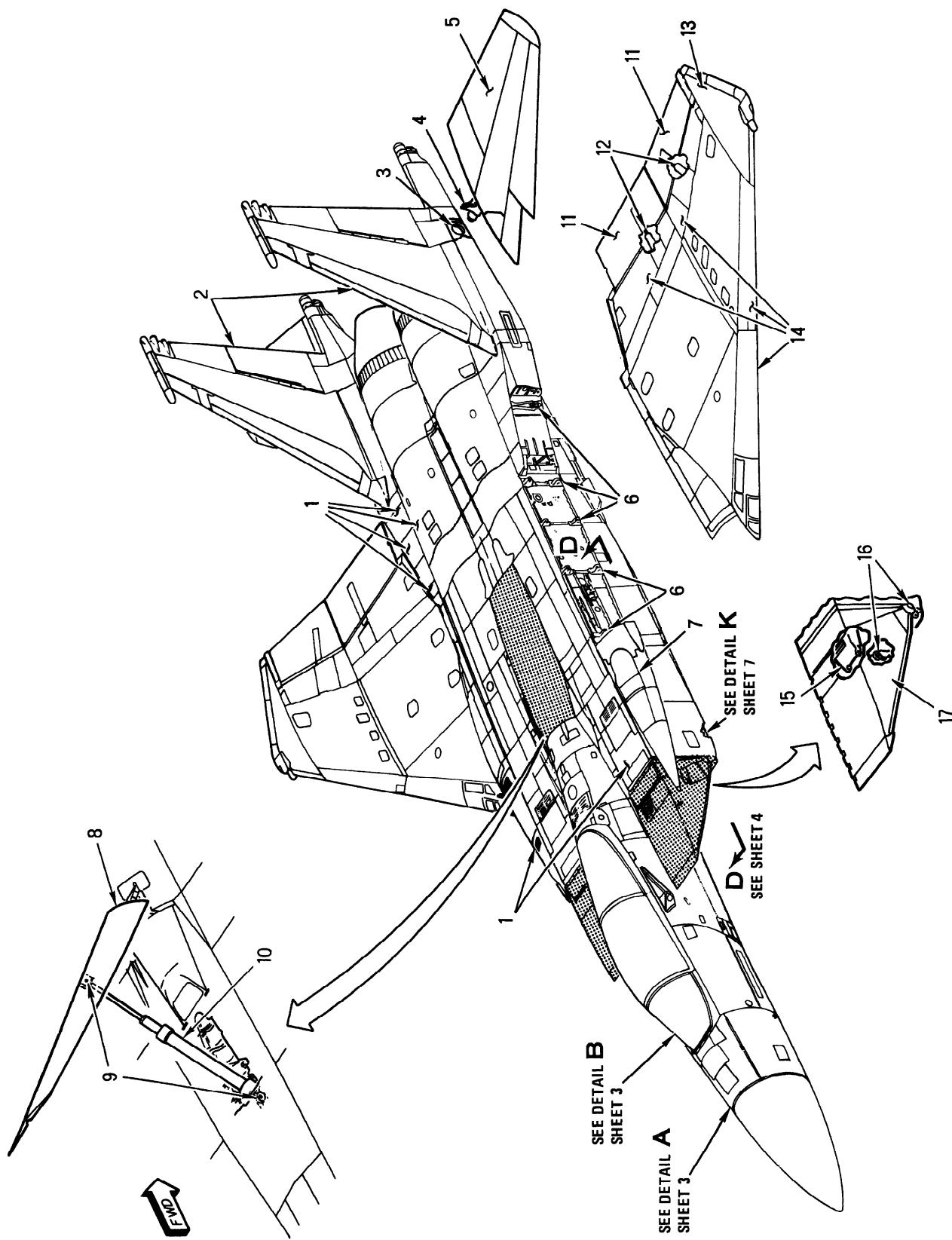


Figure 2-2. Preliminary Visual Inspection (Sheet 4)

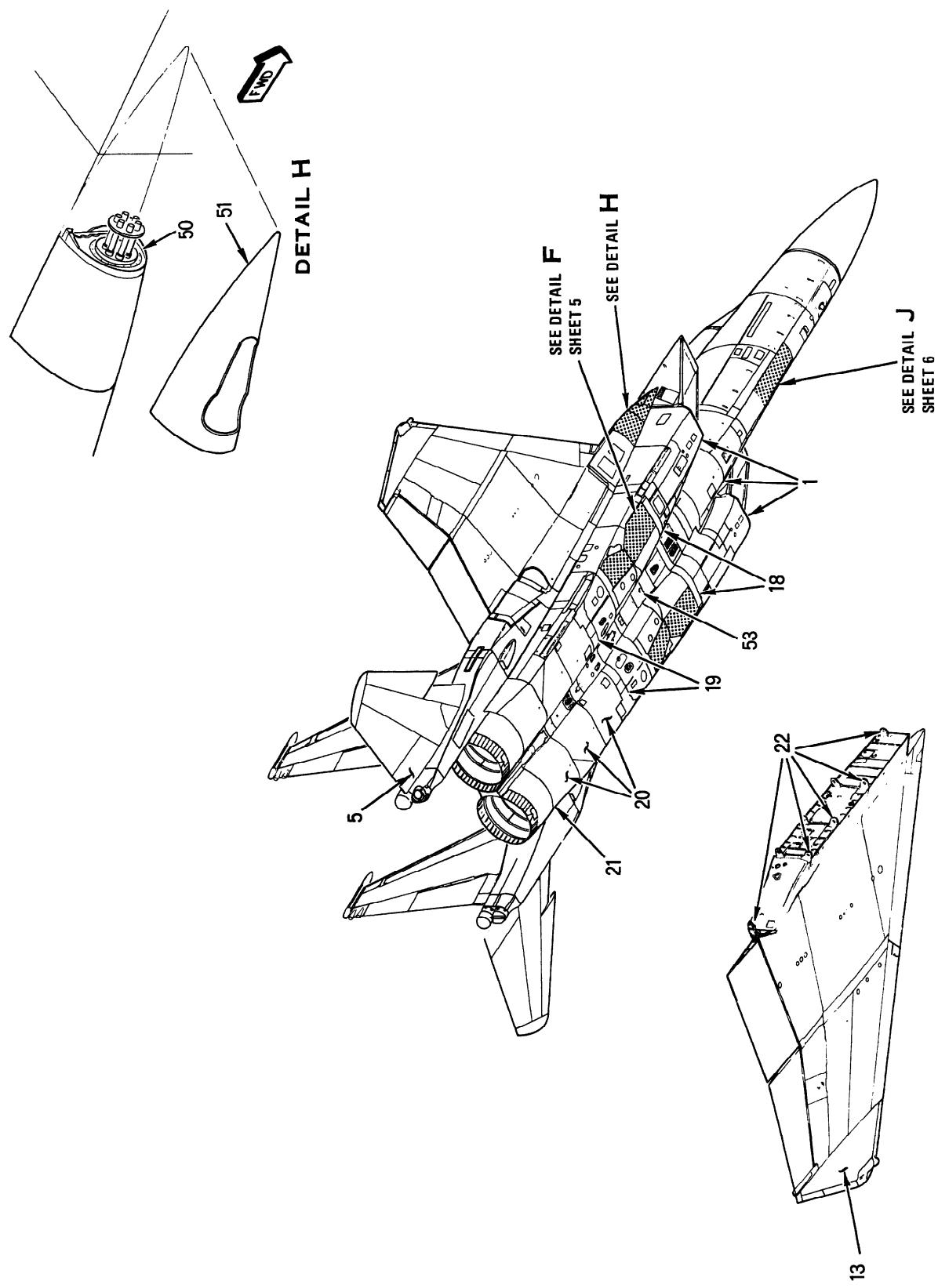
IDX NO.	NOMENCLATURE	TYPE OF DAMAGE
1	Radome.	Cuts, blisters, delamination, loose fibers.
2	Fuselage skins, doors, panels, and fairings.	Buckles, wrinkles, cracks, broken hinge tangs, loose or missing fasteners.
3	Windshield and canopy.	Cracks, distortion, scratches, loose or missing fasteners.
4	Speed brake.	Buckles, cracks, loose or missing fasteners.
5	Vertical stabilizer and rudder.	Buckles, cracks, delamination, loose or missing fasteners.
6	Horizontal stabilizer.	Buckles, cracks, delamination, loose or missing fasteners.
7	Flaps and ailerons.	Buckles, cracks, delamination, broken hinge tangs, loose or missing fasteners.
8	Wing tips.	Buckles, cracks, delamination, loose or missing fasteners.
9	Wing torque box skins, leading edge skins, and trailing edge skins.	Buckles, cracks, fuel leaks, loose or missing fasteners.
10	Aerial refueling receptacle fairing.	Dents, buckles, cracks, loose or missing fasteners.
11	Variable air intake skins.	Buckles, cracks, delamination, loose or missing fasteners.
12	Engine access doors 95L/R, 96L/R, 113L/R, 117L/R, 122L/R, and 166L/R.	Buckles, cracks, and loose or missing fasteners.
13	Nose landing gear doors and mechanism.	Buckles, cracks, loose or missing fasteners, cracked hinge tangs, worn hinge pin holes, and loose bearings.
14	Nose landing gear and jury brace downlock springs.	Looseness and distortion, cracked or broken jury brace downlock springs, loose axle nut.
15	Main landing gear doors and mechanism.	Buckles, cracks, loose or missing fasteners, cracked hinge tangs, worn hinge pin holes, and loose bearings.
16	Main landing gear and jury brace downlock springs.	Looseness and distortion, cracked or broken jury brace downlock springs, loose axle nuts, bearings for radial free play.
17	Gun seal assembly.	Cracks, worn spots, loose or missing fasteners.
18	Muzzle fairing, door 26.	Dents, cracks, loose or missing fasteners.
19	1 Screens.	Cracks.
1	For inspection procedure, refer to CSTO SR1F-15SA-3-4, screens.	

Figure 2-2. Preliminary Visual Inspection (Sheet 5)



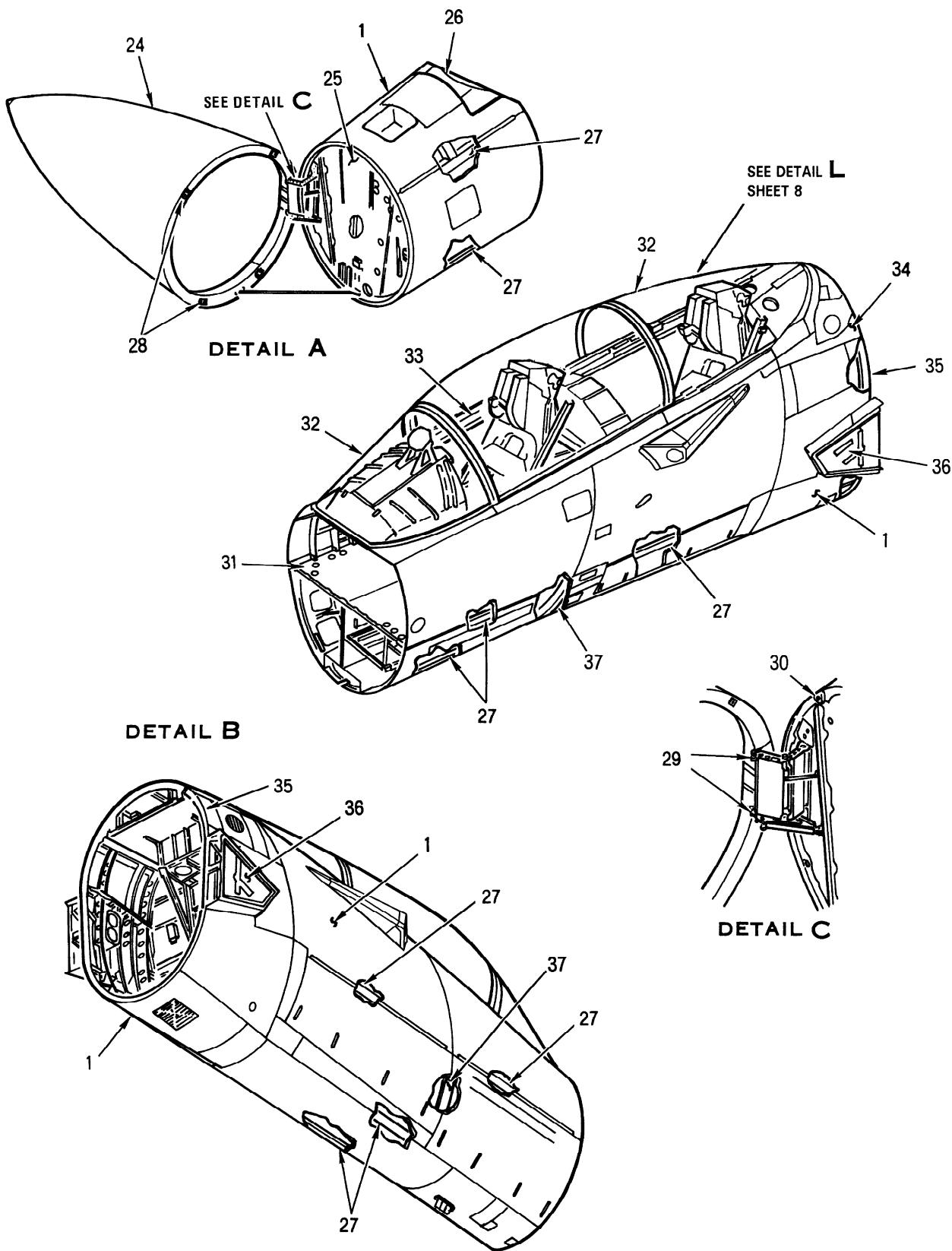
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Figure 2-3. Detailed Visual Inspection (Sheet 1 of 11)



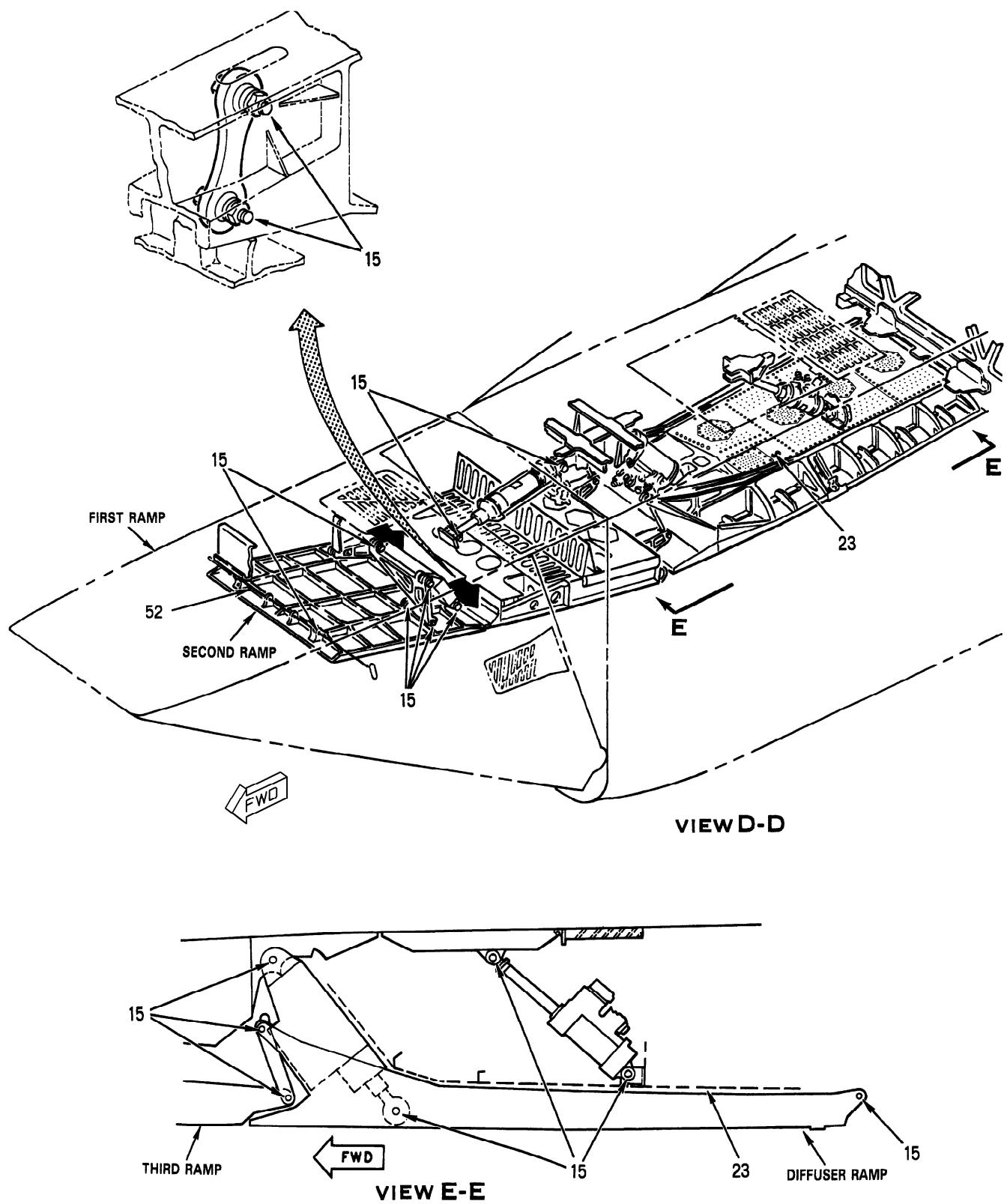
SAN301-02-10-001

Figure 2-3. Detailed Visual Inspection (Sheet 2)



SAN301-02-11-001

Figure 2-3. Detailed Visual Inspection (Sheet 3)



SAN301-02-12-001

Figure 2-3. Detailed Visual Inspection (Sheet 4)

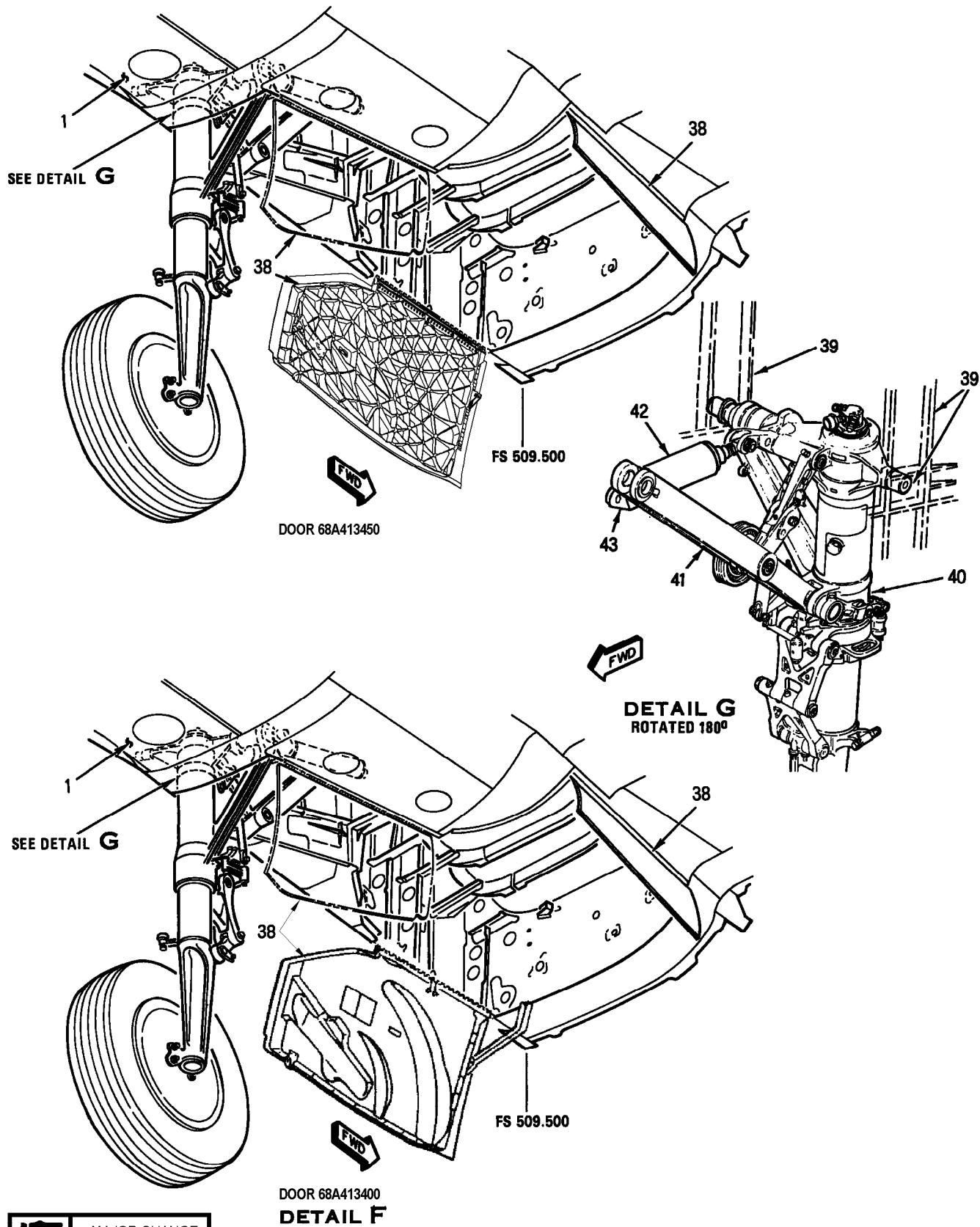
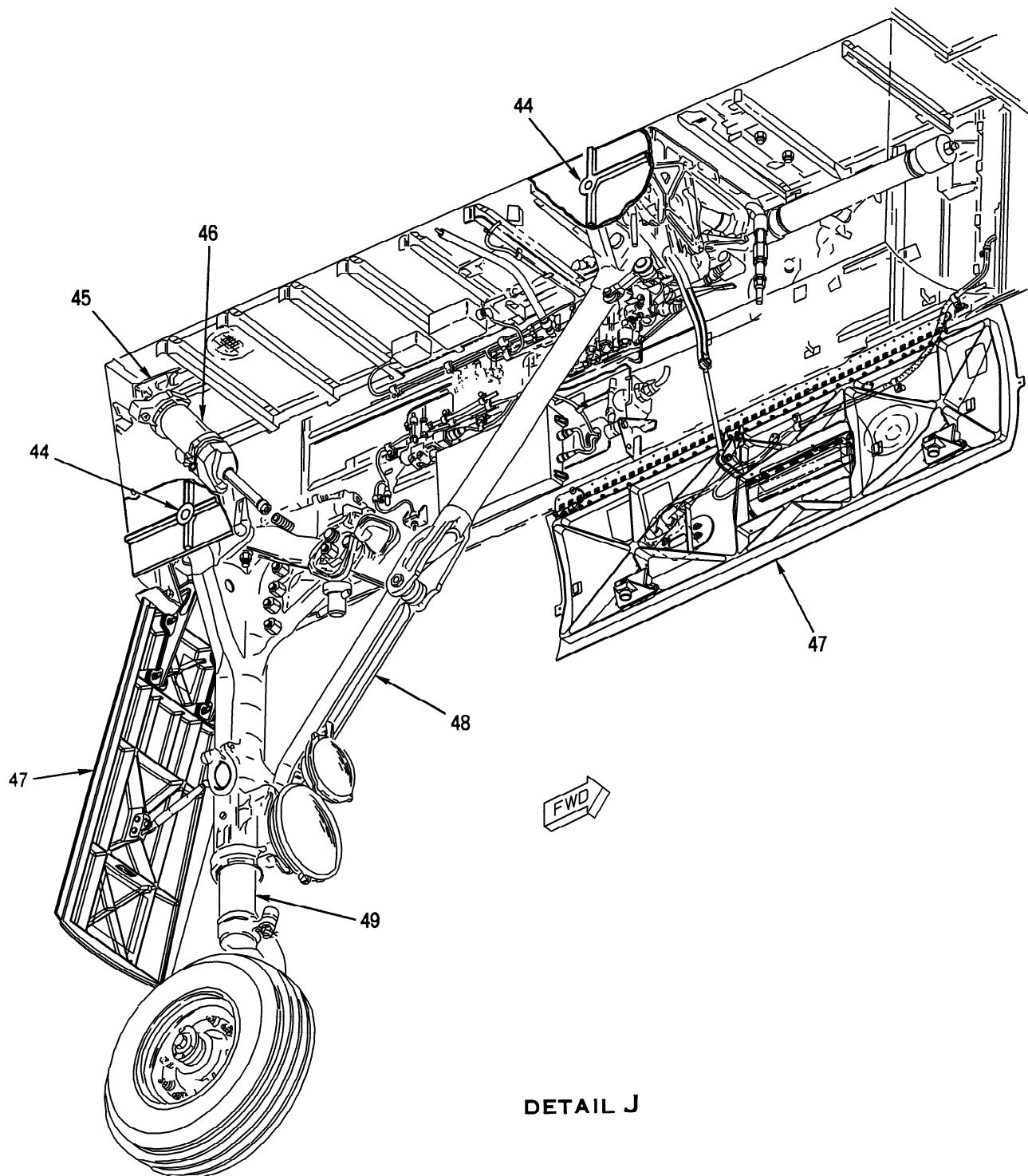
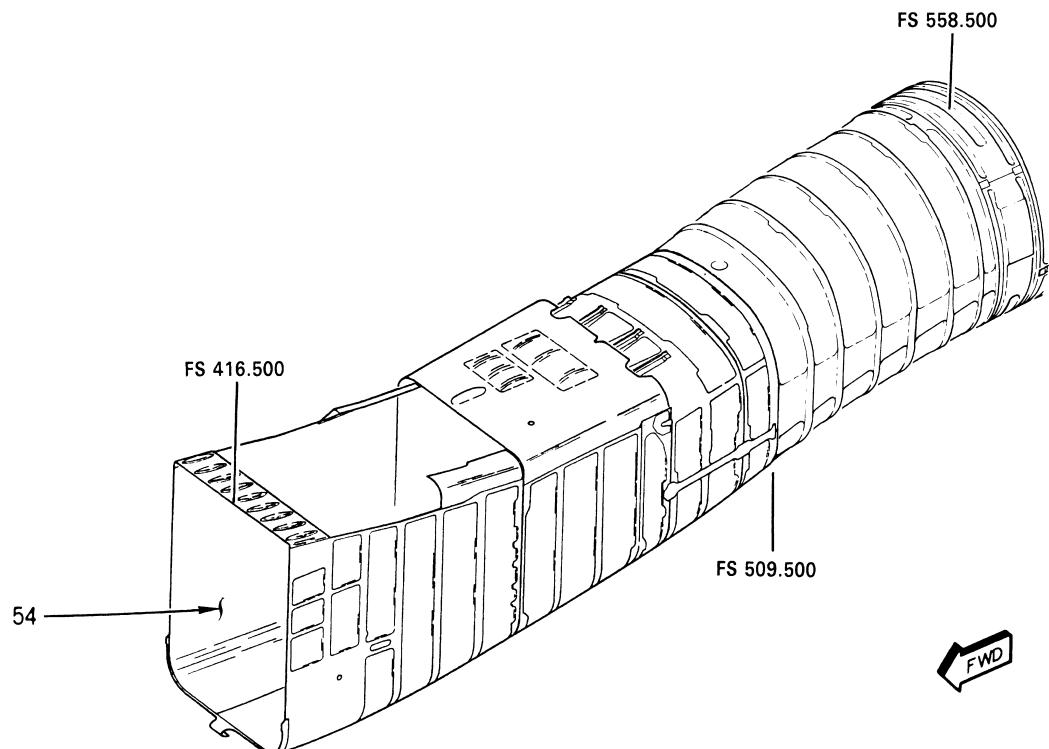


Figure 2-3. Detailed Visual Inspection (Sheet 5)



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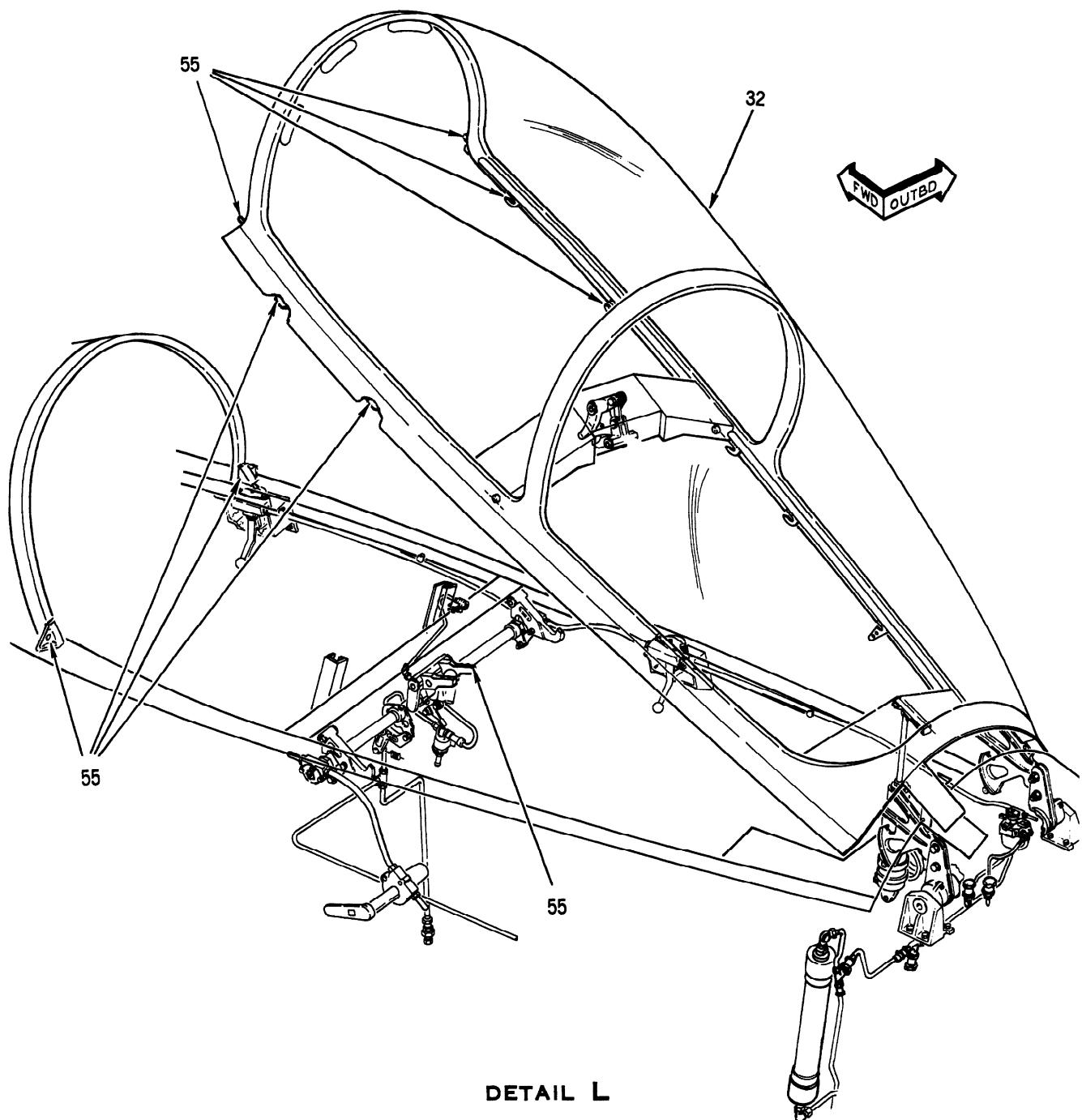
Figure 2-3. Detailed Visual Inspection (Sheet 6)



DETAIL K

Figure 2-3. Detailed Visual Inspection (Sheet 7)

SAN301-02-15-001



SAN301-02-16-001

Figure 2-3. Detailed Visual Inspection (Sheet 8)

IDX NO.	NOMENCLATURE	TYPE OF DAMAGE
1	Fuselage skins, doors, panels, and fairings.	Buckles, cracks, wrinkles, dents, scratches, broken hinge tangs, binding of door latches, loose, tilted or missing fasteners.
2	Vertical stabilizer skins, doors, and panels.	Buckles, cracks, delamination, voids, loose or missing fasteners.
3	Horizontal stabilator spindle bearing support bushings and bearings.	Cracks, distortion, evidence of wear, galling, and protrusion of bearing from support.
4	Horizontal stabilator spindle fitting and connecting link.	Cracks, distortion, loose or missing fasteners.
5	Horizontal stabilator skins.	Cracks, delamination, voids, loose or missing fasteners.
6	Fuselage bulkheads at wing attach points.	Cracks, distortion, loose or missing fasteners.
7	Aerial refueling receptacle fairing.	Cracks, buckles, holes, dents, loose or missing fasteners.
8	Speed brake.	Buckles, cracks, delamination, loose or missing fasteners.
9	Actuator attach fittings.	Cracks, distortion, loose or missing fasteners.
10	Actuator.	Cracks, distortion.
11	Flaps, ailerons.	Buckles, cracks, delamination, voids, broken or missing hinge tangs, loose or missing fasteners.
12	Actuator attach fittings.	Cracks, distortion, loose or missing fasteners.
13	Wing tips.	Buckles, cracks, delamination, broken lens, loose or missing fasteners.
14	Leading and trailing edge skins. Doors forward of aileron.	Buckles, cracks, dents, loose or missing fasteners.
15	Second and third ramp and diffuser moving joints.	Cracks, distortion, loose or missing fasteners.
16	Formers.	Cracks, distortion, loose or missing fasteners.
17	First ramp inner and outer skins.	Buckles, cracks, delamination, loose or missing fasteners.
18	Inboard longeron splice at FS 509.500.	Buckles, cracks, loose or missing fasteners.
19	Fuselage splice skins.	Buckles, cracks, loose or missing fasteners.
20	Engine access doors 95L/R, 113L/R, and 117L/R.	Buckles, cracks, loose or missing fasteners.
21	Drop out links.	Cracks, distortion, loose or missing fasteners, bolts for bending and wear, bushings for damage or wear.

Figure 2-3. Detailed Visual Inspection (Sheet 9)

IDX NO.	NOMENCLATURE	TYPE OF DAMAGE
22	Spars, wing to fuselage attach points.	Cracks, distortion, loose or missing fasteners, damaged pins, bushings, and washers.
23	Skins and screens.	Cracks, holes, buckles, loose or missing fasteners.
24	Radome shell.	Delamination, loose fibers, loose or missing fasteners.
25	Bulkhead.	Buckles, cracks, loose or missing fasteners.
26	Anti-ice diffuser.	Cracks, corrosion.
27	Longerons.	Cracks, distortion, loose or missing fasteners.
28	Support fittings.	Cracks, deformation, loose, tilted or missing fasteners.
29	Hinge fittings.	Cracks, deformation, loose, tilted or missing fasteners.
30	Lock bolts.	Deformation and stripped threads.
31	Crew station floor.	Cracks, buckles, corrosion, loose or missing fasteners.
32	Windshield and canopy.	Cracks, distortion, loose or missing fasteners.
33	Canopy sills.	Cracks, loose or missing fasteners.
34	Longerons.	Cracks, buckles, loose or missing fasteners.
35	Splice Ring, FS 415.000.	Cracks, distortion, loose, tilted or missing fasteners.
36	Air inlet diverters.	Cracks, corrosion, evidence of wear, loose or missing fasteners.
37	Bulkhead, CFS 307.330.	Cracks, buckles, loose or missing fasteners.
38	Main landing gear doors and mechanism.	Cracks, buckles, loose or missing fasteners, cracked hinge tangs, worn hinge pin holes, and loose bearings.
39	Main landing gear support fittings and pins.	Cracks, distortion, loose or missing fasteners.
40	Main landing gears.	Cracks, distortion, and loose axle nuts.
41	Drag braces and downlock springs.	Cracks, distortion, loose or missing fasteners. Cracked or broken downlock springs.
42	Actuators.	Cracks, distortion, loose or deformed attach fasteners.
43	Actuator and drag brace support fittings.	Cracks, distortion, loose or missing fasteners.
44	Nose landing gear strut and drag brace support fittings.	Cracks, buckles, loose or missing fasteners.
45	Bulkhead, CFS 377.700, and actuator support fitting.	Buckles, cracks, loose or missing fasteners.
46	Actuator.	Cracks, distortion, loose or missing attach fasteners.
47	Nose landing gear doors and mechanism.	Buckles, cracks, loose or missing fasteners, cracked hinge tangs, worn hinge pin holes, and loose bearings.

Figure 2-3. Detailed Visual Inspection (Sheet 10)

CSTO SR1F-15SA-3-1

IDX NO.	NOMENCLATURE	TYPE OF DAMAGE
48	Drag brace and down lock springs.	Cracks, distortion, loose or missing fasteners. Cracked or broken downlock springs.
49	Nose landing gear.	Cracks, distortion, loose axle nut.
50	Gun seal assembly.	Cracks, worn spots, loose or missing fasteners.
51	Muzzle fairing, door 26.	Dents, cracks, loose or missing fasteners.
52	Second ramp forward hinge pin.	Fretting, cracked or broken pin.
53	Pylon support, FS 558.500.	Cracks.
54	Air intake duct skins.	Cracks, buckles, loose or missing fasteners.
55	Canopy index retainers, pins, latches, corner castings, and hooks.	Cracks, distortion, wear, corrosion.

Figure 2-3. Detailed Visual Inspection (Sheet 11)

2-14. SPECIAL INSPECTIONS.

2-15. After the occurrence of a specific or unusual condition, a special inspection shall be done to detect structural damage. The following lists the condition and paragraph that describes the inspection. Except for step i., the inspections are done as specified in CSTO SR1F-15SA-6.

NOTE

Any munition downloaded to aid aircraft over-G inspection will be appropriately tagged, returned to munitions personnel for inspection in accordance with applicable munitions technical orders.

- a. Excessive G aircraft without overload warning system, refer to paragraph 2-16.
- b. Overload warning aircraft, refer to paragraph 2-22.
- c. Hard landing, refer to paragraph 2-24.
- d. Engine stall, refer to paragraph 2-25.
- e. Spin, refer to paragraph 2-26.
- f. Excessive airspeed, refer to paragraph 2-27.
- g. Canopy jettison, refer to paragraph 2-28.
- h. Pylons and fuel tanks jettison, refer to paragraph 2-29.
- i. Heat, refer to paragraph 2-30.

2-16. EXCESSIVE G INSPECTION OF AIRCRAFT WITHOUT OVERLOAD WARNING SYSTEM. An excessive G aircraft inspection is required when the aircraft has exceeded the G load factor limits of the aircraft by acceleration and/or weight which includes symmetrical and unsymmetrical maneuvers, as specified in CSTO SR1F-15SA-6. The inspection is divided into five separate detail inspections. The letter symbol Nz appearing in the following text is defined as acceleration in the vertical axis.

a. Excessive G aircraft inspection after exceeding positive Nz weight load factor. Refer to paragraph 2-17.

b. Excessive G aircraft inspection after exceeding negative Nz weight load factor. Refer to paragraph 2-18.

c. Excessive G aircraft inspection after exceeding positive load factor of 9.9g. Refer to paragraph 2-19.

d. Excessive G aircraft inspection after exceeding negative load factor of 3.0g without conformal fuel tank installed, and 2.0g with conformal fuel tank installed. Refer to paragraph 2-20.

e. Excessive G aircraft inspection after exceeding positive load factor of 9.0g or negative load factor of 3.0g with external stores and/or CFT external stores installed. Refer to paragraph 2-21.

2-17. Excessive G Aircraft Inspection After Exceeding Positive Nz Weight Load Factor.

See figure 2-4.

NOTE

Make sure aft inboard upper torque box skin is inspected for depressions.

The inspection is a visual inspection of critical structural items and requires removal of certain external access doors for two of the inspections, these being the wing carry through bulkheads on center fuselage and the inboard and outboard rear spar. When installed, the inspection also includes a visual inspection of the CFT. For aircraft external access doors, see figure 2-1. The remaining inspections are visual inspections of the external surfaces of inboard torque box skins. The conformal fuel tank must be removed for the inboard lower skin inspection. The aft inboard upper torque box skins 68A112223, are also inspected for depressions. See detail E of the figure. Report depression depths of 0.040 to 0.064 in areas 5A and 5B and depression depths in excess of 0.020 in areas 5C and 5D to AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH for tracking. Inspect the skins using a 12 to 18 inch straightedge and blade type feeler gage as follows:

NOTE

Inspect each aircraft in the same configuration, that is, full internal fuel, no external wing stores, and in a controlled environment, as a hangar, to provide constant readings.

- a. Place the straightedge on the skin parallel to the internal stiffeners and spars; measure depth of depressions from the highest skin point to the lowest skin point.
- b. Inspect skins in area 5A, between the main spar and the first two ribs outboard of door 136L/R. Depression depths of 0.065, or greater, require an engineering disposition from AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH.
- c. Inspect skins in area 5B, between internal stiffeners, in the bay directly aft of door 136L/R and forward of the rear spar. Depression depths of 0.065, or greater, require an engineering disposition from AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH.
- d. Inspect skins in area 5C, particularly at the first two internal stiffeners forward of the main spar and outboard of door 136L/R. A depression of up to 0.020, between ribs, is acceptable. Depression depths greater than 0.020 require an engineering disposition from AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH.
- e. Inspect skins in area 5D over the main spar, between XW 124.170 and XW 138.500 ribs, and over the rear spar, between XW 108.800 and XW 124.170 ribs. A depression of up to 0.020 over 7.00 length is acceptable. Depression depths greater than 0.020 require an engineering disposition from AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH.
- f. When skin depression allowables are exceeded, internal structure should be inspected for distortion or breaks. Refer to CSTO SR1F-15SA-36, wing, inboard torque box, internal structure, distortion or breaks.

2-18. Excessive G Aircraft Inspection After Exceeding Negative Nz Weight Load Factor. See figure 2-5. The inspection is a visual inspection of exterior surface of inboard and outboard torque box skins and interior surface of inboard torque box aft skin through door 136L/R. For aircraft external access doors, see figure 2-1.

2-19. Excessive G Aircraft Inspection After Exceeding Positive 9.9g. See figure 2-6.

NOTE

Be sure aft inboard upper torque box skin is inspected for depressions.

The inspection is a visual inspection of critical structural and linkage items and requires removal of external access doors, removal of engines, and forward LAU-106() missile launchers and navigation and targeting pod adapters. When conformal fuel tanks (CFT) are installed, forward and aft LAU-106() missile launchers require removal. The inspection is a visual inspection of CFT exterior skins, aerodynamic peripheral seals, selected areas of CFT internal skins, and mounting fittings in the CFT and aircraft fuselage. Removal of the CFT is required for the inspection. The inspection also covers the external surfaces of various access doors and skins. For aircraft external access doors, see figure 2-1. This inspection requires the 68A112223 aft inboard upper torque box wing skin to be inspected for depressions. Refer to paragraph 2-17 for inspection data.

2-20. Excessive G Aircraft Inspection After Exceeding Negative 3.0g Without CFT Installed; 2.0g With CFT Installed. See figure 2-7. The inspection is a visual inspection of the external surface of various external access doors and the center fuselage upper outboard longeron between FS 494.700 and FS 502.000 on the right side and FS 481.500 and FS 509.500 on the left side, which requires removal of access door 56L/R. When CFT are installed on the aircraft and have more than 1/2 maximum CFT fuel at the time when more than negative 3.0g occurs, a visual inspection of the CFT external surfaces and the attach fittings is required. The CFT must be removed for this inspection. The inspection per paragraph 2-18 is also required. For aircraft external access doors, see figure 2-1.

2-21. Excessive G Aircraft Inspection After Exceeding Positive Load Factor of 9.0g or Negative Load Factor of 3.0g; With External Stores Installed. See figure 2-8. An excessive G inspection of the installed external stores is required when the aircraft, configured as specified in CSTO SR1F-15SA-6, has exceeded either the positive load factor of 9.0g or negative load factor of 3.0g. The inspection is a visual inspection of critical structural items of the centerline, and inboard, pylons, 600 gallon fuel tank, BRU-47/A bomb rack, ADU-407/A or ADU-552/A launcher adapters and LAU-114A/A or LAU-128() missile launchers, and mating surfaces of CFT and aircraft structure. The pylons do not have to be removed or the mating aircraft structure inspected unless the pylons were loaded with an external fuel tank that was greater than 1/2 full or air-to-ground weapons, greater than 2,000 pounds, were installed when the load factor was exceeded. An excessive G inspection of the CFT installed external stores is required. This inspection is a visual inspection of the critical structural items of CFT inboard and outboard pylons. The bomb racks do not have to be removed unless the following criteria is exceeded: for the outboard pylons an external store greater than 700 pounds; inboard forward and aft greater than 1500 pounds, and the inboard center greater than 2200 pounds, at the time when the load factor was exceeded. When any inspection reveals structural damage to the CFT or to the aircraft, an excessive G aircraft inspection per paragraphs 2-19 and 2-20 shall be done on the CFT or the aircraft, respectively. For aircraft external access doors, see figure 2-1. For 600 gallon fuel tank access doors, refer to TO 6J14-2-34-3. For centerline and inboard pylon access doors, refer to CSTO SR16W6-25-2 or CSTO SR16W6-25-2-11, as applicable. If required, remove the items below:

- a. External fuel tanks (05-00-15).
- b. SUU-60() Centerline pylon (94-32-51).
- c. SUU-59() Inboard pylons (94-32-50).
- d. SUU-90/A Outboard pylons (94-32-52).
- e. LAU-106() Missile launchers (94-31-20).
- f. LAU-128() Missile launchers (94-31-27).
- g. ADU-552/A Launcher adapters (94-31-28).
- h. BRU-47/A Bomb rack (CFT) (94-32-40).

- i. BRU-47/A Bomb rack (Pylon) (94-32-39).

2-22. Positive and Negative Overload Warning Aircraft Inspections. See figures 2-9 and 2-10. Inspections per figure 2-9, which include wing skin depression inspections in paragraph 2-23, are required after positive overload or per figure 2-10 after negative overload on aircraft equipped with the overload warning system (OWS). The inspections are visual inspections, except a nondestructive inspection (NDI) per CSTO SR1F-15SA-36 may be required, as noted. Inspection of CFT equipped aircraft with external stores is required when the OWS indicates a severity code of 1 to 5. The true aircraft g is obtained from the advanced display core processor (ADCP). If this is greater than 9.0g, the CFT and pylon inspection per paragraphs 2-19 and 2-21 shall be done. If greater than a negative 3.0g, the CFT and pylon inspection is per paragraphs 2-20 and 2-21. Some access doors and/or equipment may require to be opened and/or removed to do inspections. For aircraft external access doors, see figure 2-1, and for supplemental technical order information refer to Introduction, Related Publications.

NOTE

As specified in CSTO SR1F-15SA-6, for aircraft with an inoperative overload warning system, refer to paragraph 2-15, step a., for inspection requirements.

2-23. Wing Inboard Torque Box Upper Skin, 68A112223, Depression Inspections. See figure 2-9. The inspections are visual inspections of the torque box upper skins, 68A112223, for depressions. See details B and C. Report depression depths of 0.040 to 0.064 in areas 5A and 5B and depression depths in excess of 0.020 in areas 5C and 5D to AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH for tracking. Depressions found in areas other than 5A, 5B, 5C or 5D shall be reported to AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH before the next flight. Inspect the skins using a 12 to 18 inch straightedge and blade type feeler gage as follows:

NOTE

Inspect each aircraft in the same configuration; that is, full internal fuel, no external wing stores, and in a controlled environment, for example a hangar, to provide constant readings.

- a. Put the straightedge on the skin parallel to the internal stiffeners and spars; measure depth of depressions from the highest skin point to the lowest skin point.
- b. Inspect skins in area 5A, between the main spar and the first two ribs outboard of door 136L/R. Depression depths of 0.065, or greater, require an engineering disposition from AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH.
- c. Inspect skins in area 5B, between internal stiffeners, in the bay directly aft of door 136L/R and forward of the rear spar. Depression depths of 0.065, or greater, require an engineering disposition from AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH.
- d. Inspect skins in area 5C, particularly at the first two internal stiffeners forward of the main spar and outboard of door 136L/R. A depression of up to 0.020, between ribs, is acceptable. Depression depths greater than 0.020 require an engineering disposition from AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH.
- e. Inspect skins in area 5D over the main spar, between XW 124.170 and XW 138.500 ribs, and over the rear spar, between XW 108.800 and XW 124.170 ribs. A depression of up to 0.020 over 7.00 inch length is acceptable. Depression depths greater than 0.020 require an engineering disposition from AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH.
- f. When skin depression allowables are exceeded, internal structure should be inspected for distortion or breaks. Refer to CSTO SR1F-15SA-36.

2-24. HARD LANDING INSPECTION. See figure 2-11. The inspection is primarily a visual inspection of critical aircraft structural items that can be

inspected with a minimum amount of aircraft disassembly. In general, sheet metal structure should be visually inspected for buckles and cracks. Fastener patterns should be inspected for tilted, loose or missing fasteners. Castings, forgings, and extrusions should be inspected for cracks and distortion. For engine inspection requirements, see figure 2-11. For external access doors, see figure 2-1.

2-25. ENGINE STALL INSPECTION. See figure 2-12. The inspection is a visual inspection of critical structural items in the air inlet duct, variable ramps, air inlet diverters, ECS bay skins, and inboard and outboard engine mount fittings and structure. Engine removal is not required. View accessible areas with aid of inspection mirror and flashlight. The inspection items are a function of calibrated airspeed as defined on figure 2-12, sheets 6 and 7. For external access doors, see figure 2-1.

2-26. SPIN INSPECTION. See figure 2-13. The inspection is primarily a visual inspection of structural, electrical items, and number one fuel cell structure and skins resulting from an uncontrolled spin. Electrical equipment indexed will require a functional inspection for correct operation. Inspection of CFT equipped aircraft is required when spin occurs with more than 1/2 maximum CFT fuel. This inspection is primarily a visual inspection of the outboard and lower CFT moldline skins for bulges, wrinkles, and missing fasteners. CFT removal is not required for the inspection. For external access doors, see figure 2-1.

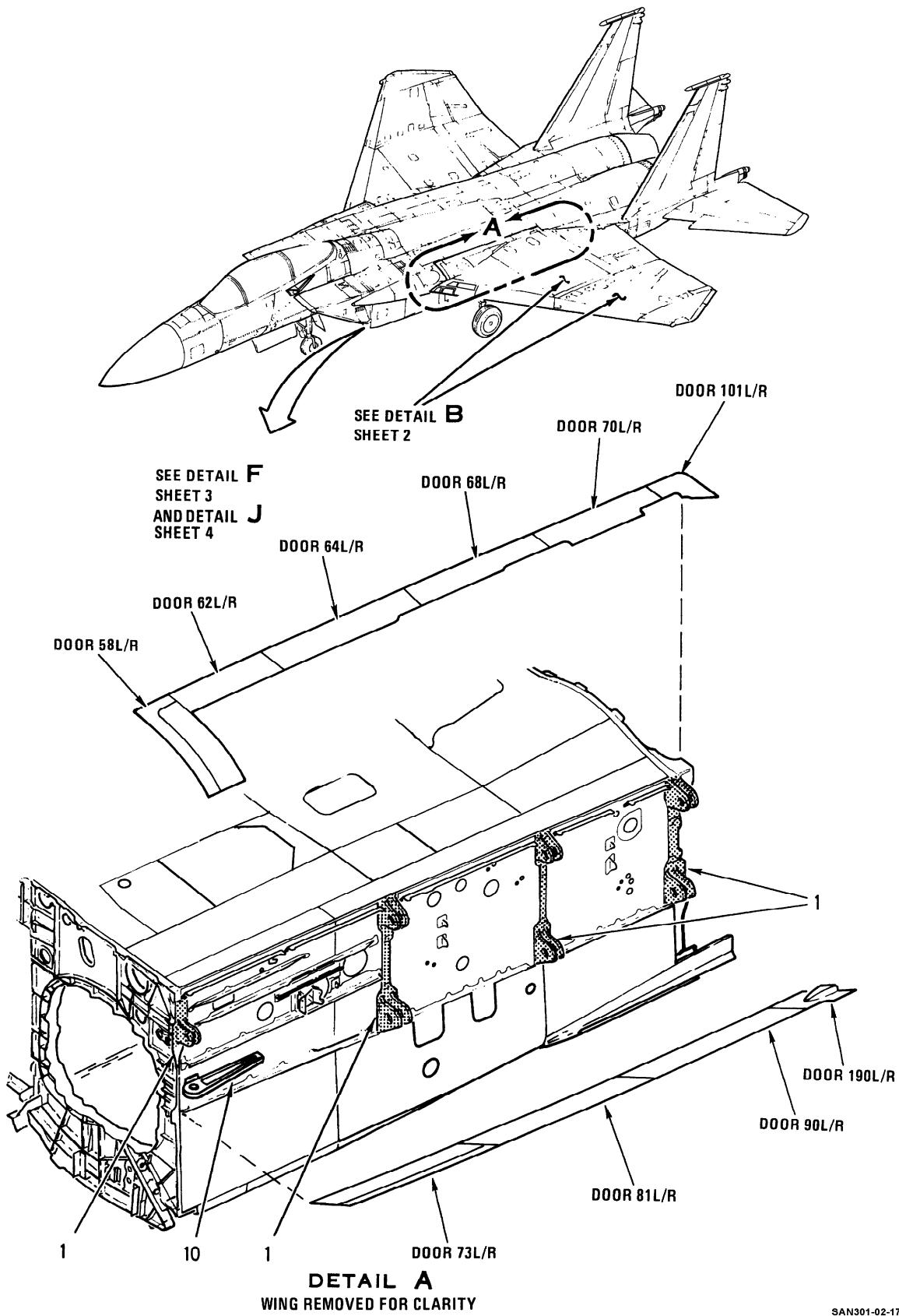
2-27. EXCESSIVE AIRSPEED INSPECTION. See figure 2-14. The inspection is a visual inspection of critical structural items in the air inlet duct, variable ramp components, and control surfaces. Inspection of CFT is required when CAS exceeds 700 knots. CFT removal is not required for inspection. For external access doors, see figure 2-1.

2-28. CANOPY JETTISON INSPECTION. See figure 2-15. The inspection is a visual inspection of critical structural and linkage items that can be inspected with a minimum amount of aircraft and component disassembly. Inspect the structural items for cracks and loose or missing fasteners. Inspect bellcranks and torque tube for cracks, distortion, and loose or missing fasteners. Inspect canopy remover mechanism for cracks and distortion. For external access doors, see figure 2-1.

2-29. PYLONS AND FUEL TANKS JETTISON

INSPECTION. See figure 2-16. Do a visual inspection of the centerline and inboard pylons aft pivot hook for damage to the bearing surface after jettison of fuel tanks. Do a visual inspection of the fuselage centerline and inboard wing aft pivot hooks

for damage to the bearing surface after jettison of centerline and/or inboard pylons. For damage limits, repairs, and/or replacement of damaged hooks, refer to CSTO SR1F-15SA-3-8 and CSTO SR16W6-25-2 or CSTO SR16W6-25-2-11, as applicable. ■



SAN301-02-17-001

Figure 2-4. Excessive G Aircraft Inspection After Exceeding Positive N_z Weight Load Factor
(Sheet 1 of 6)

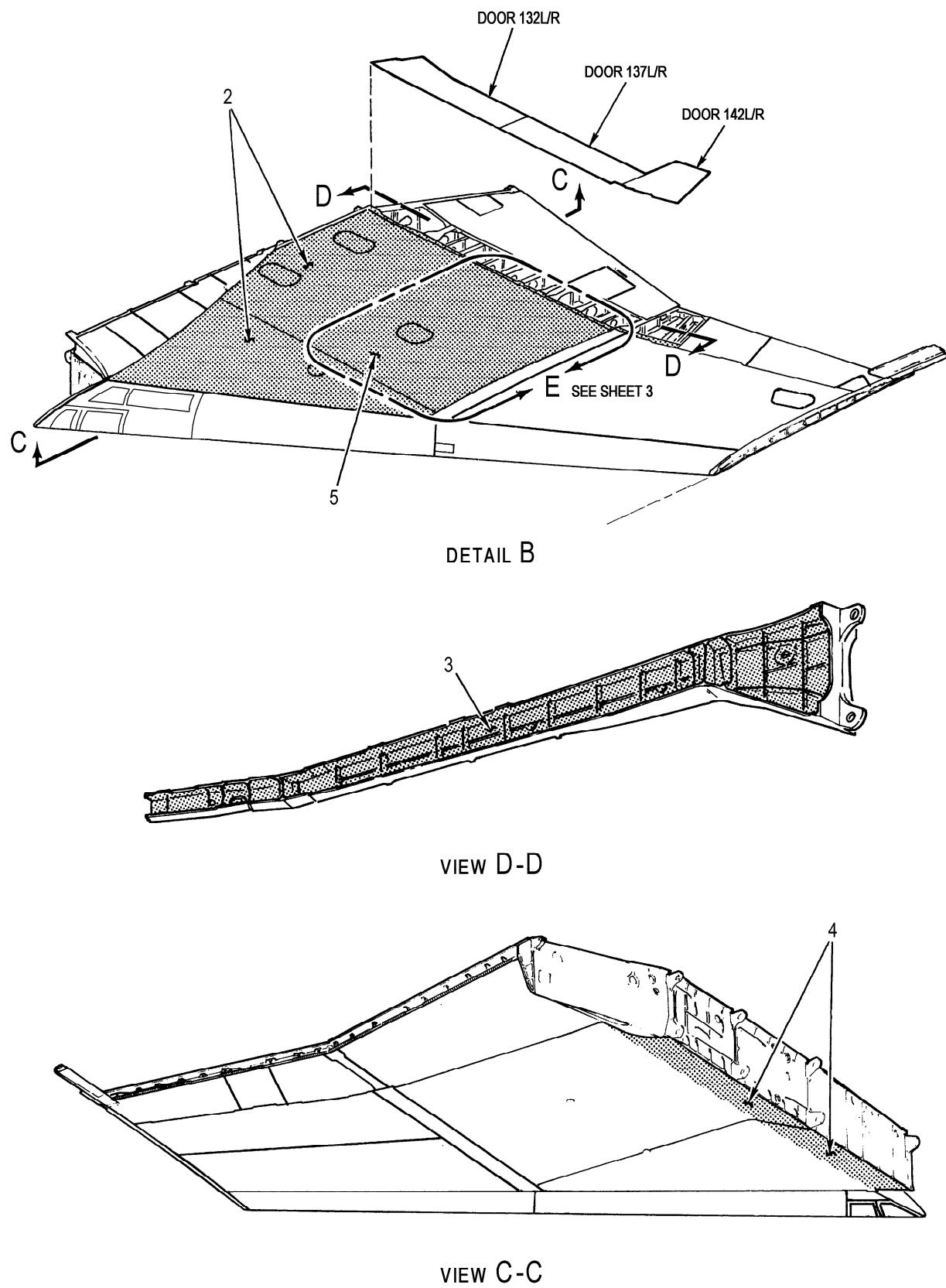
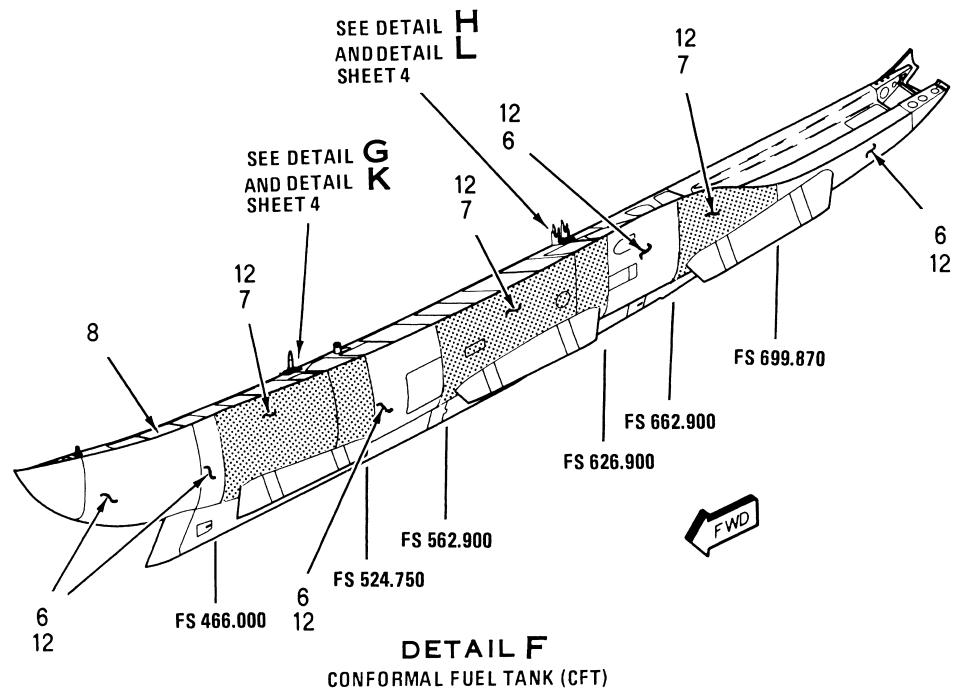
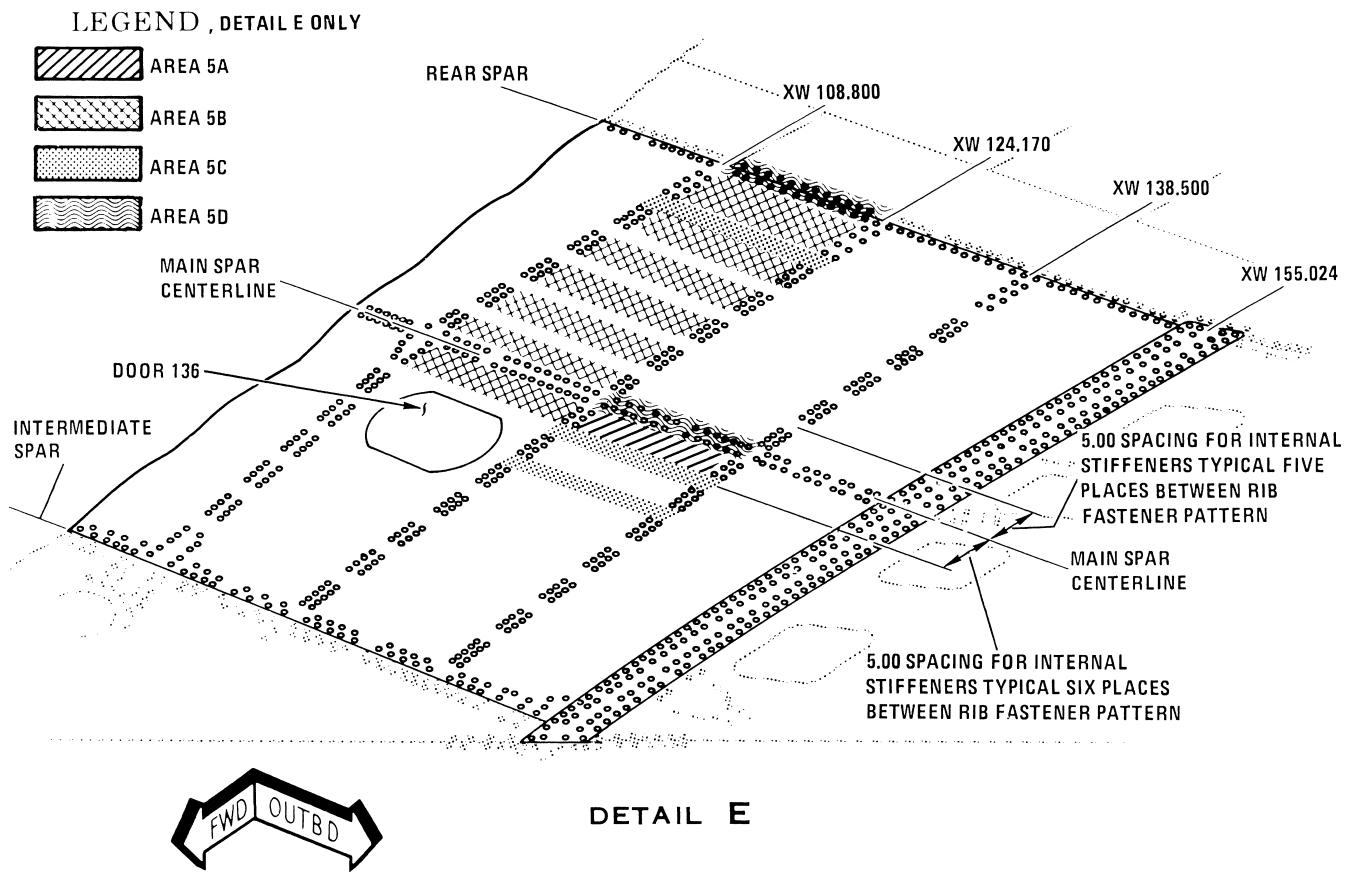


Figure 2-4. Excessive G Aircraft Inspection After Exceeding Positive Nz Weight Load Factor (Sheet 2)

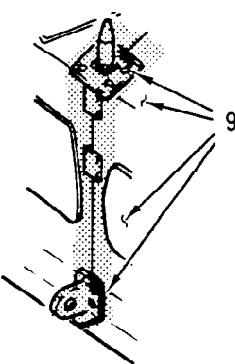
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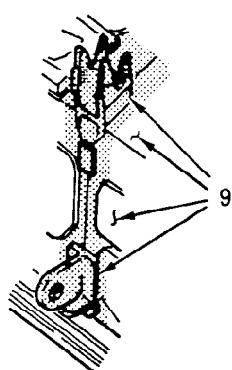


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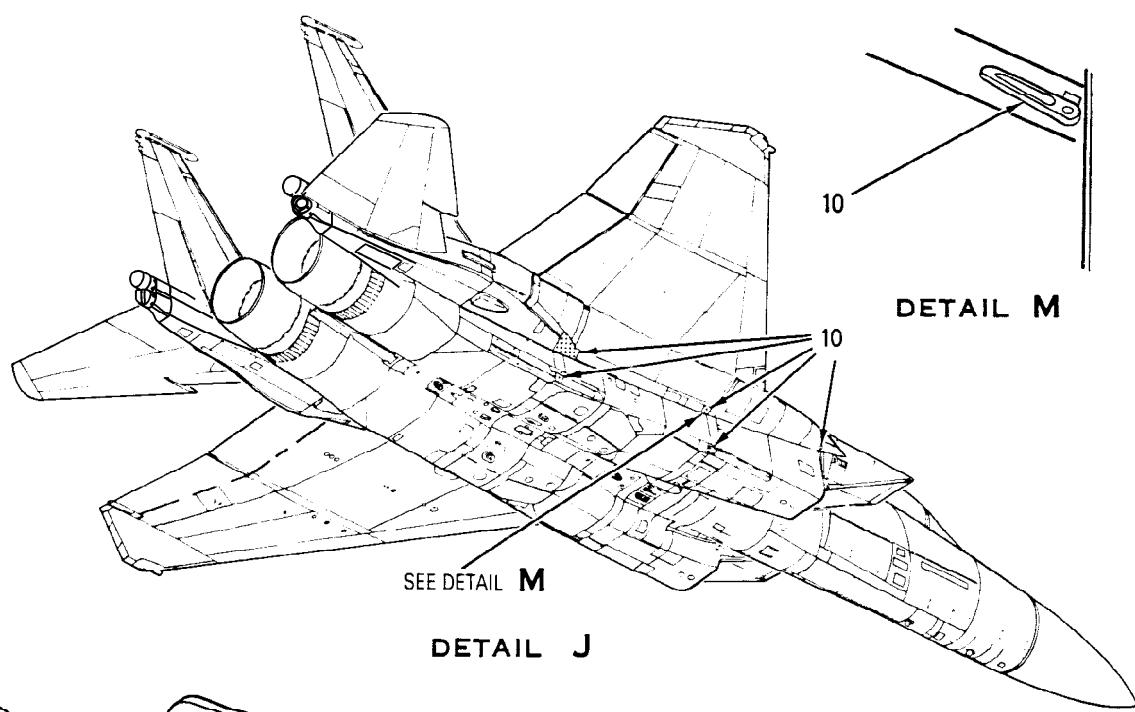
Figure 2-4. Excessive G Aircraft Inspection After Exceeding Positive Nz Weight Load Factor (Sheet 3)



DETAIL G

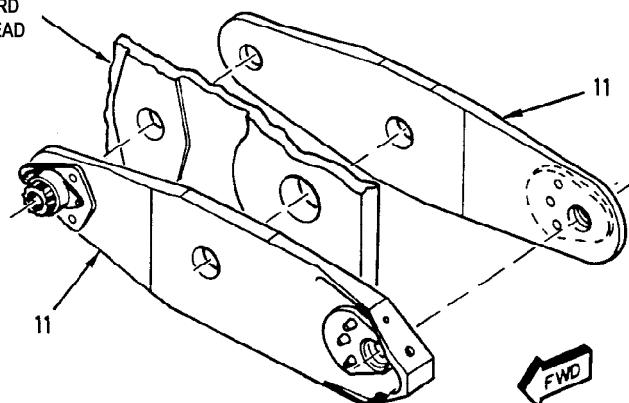


DETAIL H



DETAIL J

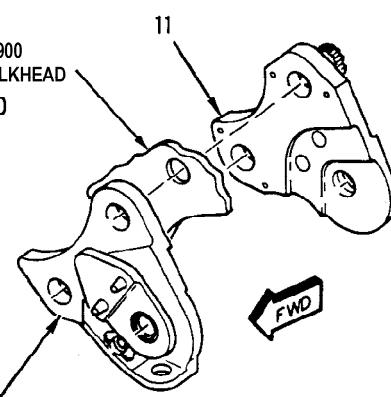
FS 609.500
FORWARD
BULKHEAD
10



FORWARD CFT ATTACH FITTINGS

DETAIL K

FS 629.900
AFT BULKHEAD
10



AFT CFT ATTACH FITTINGS

DETAIL L

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Figure 2-4. Excessive G Aircraft Inspection After Exceeding Positive N_z Weight Load Factor (Sheet 4)

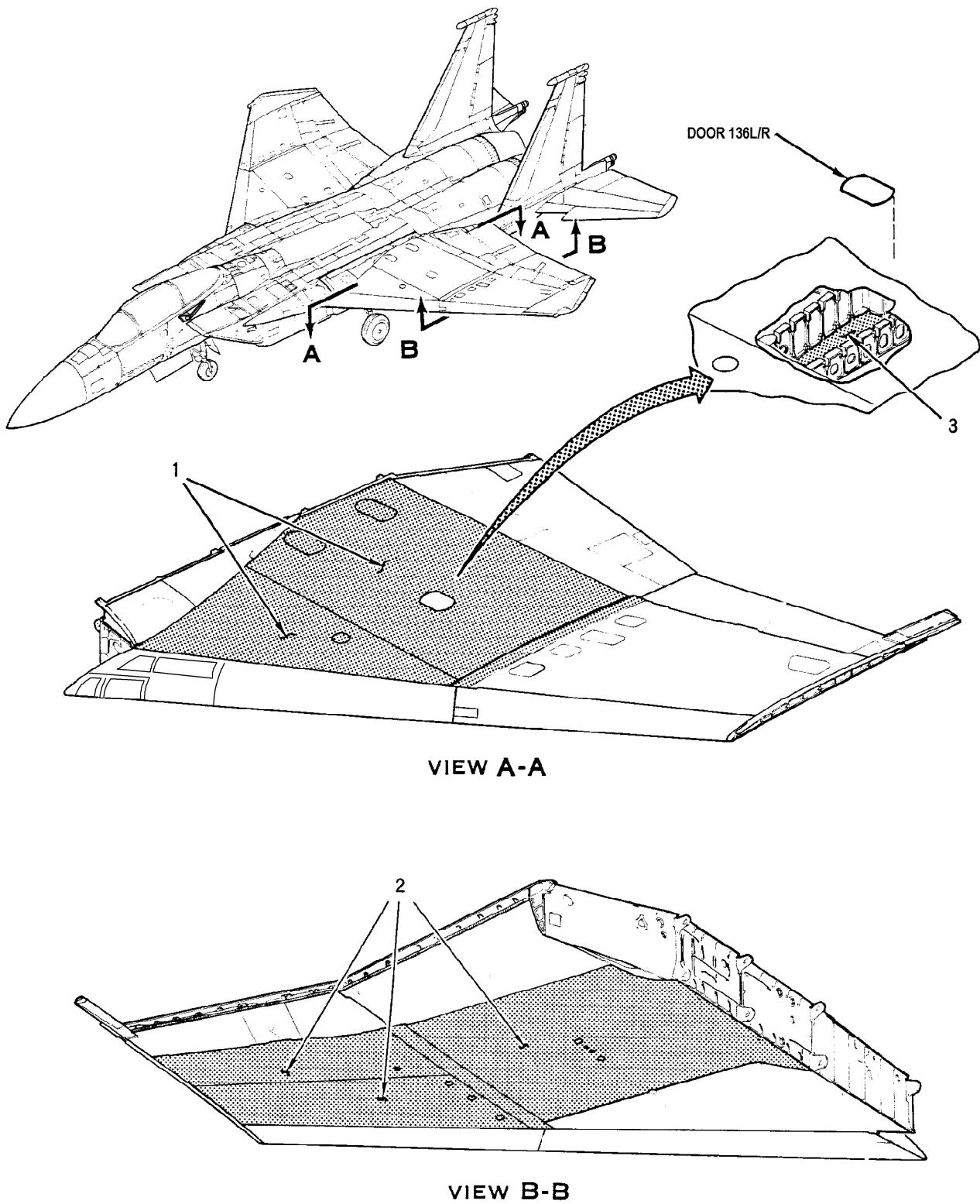
CSTO SR1F-15SA-3-1

IDX NO.	ITEM	ACCESS	TYPE OF DAMAGE
1	Wing carry-through bulkheads: 68A324152 68A324138 68A324140 68A324142.	Upper surface: Doors 58L/R, 62L/R, 64L/R, 68L/R, 70L/R, and 101L/R. Lower surface: 73L/R, 81L/R, 90L/R, and 190L/R.	Buckles, cracks, distortion, evidence of overload, loose or missing fasteners.
2	Exterior surface of inboard torque box forward and aft upper skins: 68A112108 1 → 68A122108 68A112223 1 → 68A122223.		Cracks in internal stiffener runout areas.
3	Inboard and outboard rear spars and upper caps and webs: 68A112107 1 → 68A122107 68A115101 1 → 68A125101.	Doors 132L/R, 137L/R, and 142L/R.	Buckles, cracks or yielded upper flanges and webs.
4	Exterior surface of inboard torque box forward and aft lower skins shoulder area: 68A112110 68A112111.	Remove CFT (05-00-30).	Buckles, cracks, separation of skin and fasteners, loose, tilted or missing fasteners.
5	Exterior surface of inboard torque box skins: 68A112223 1 → 68A122223.		Depressions in the skins between internal stiffeners and ribs, at internal stiffeners, main and rear spars.
6	Exterior surface of conformal fuel tank (CFT) skins.		Buckles, cracks, distortion, loose or missing fasteners.
7	Exterior surface of CFT skins between upper outboard longeron and lower inboard longeron from FS 466.000 through FS 524.750, FS 562.900 through FS 626.900, and FS 662.900 through FS 699.870.		Buckles, cracks, distortion, and loose or missing fasteners.
8	Aerodynamic peripheral seals.		Cuts, tears, loose or missing sections.
9	CFT mounting fittings. Upper and inboard mold line skins at FS 509.500 and FS 626.900.	Remove CFT (05-00-30).	Buckles, cracks, distortion, and loose or missing fasteners.
10	Fuselage CFT mounting fittings.	Remove CFT (05-00-30).	Buckles, cracks, distortion, and loose or missing fasteners.

**Figure 2-4. Excessive G Aircraft Inspection After Exceeding Positive Nz Weight Load Factor
(Sheet 5)**

IDX NO.	ITEM	ACCESS	TYPE OF DAMAGE
11	Aircraft/CFT attach kit parts.	Remove CFT (05-00-30).	Buckles, cracks, and distortion.
12	Exterior surface of CFT and around bomb racks.		Fuel leaks.
1 → Preferred part.			■

**Figure 2-4. Excessive G Aircraft Inspection After Exceeding Positive Nz Weight Load Factor
(Sheet 6)**



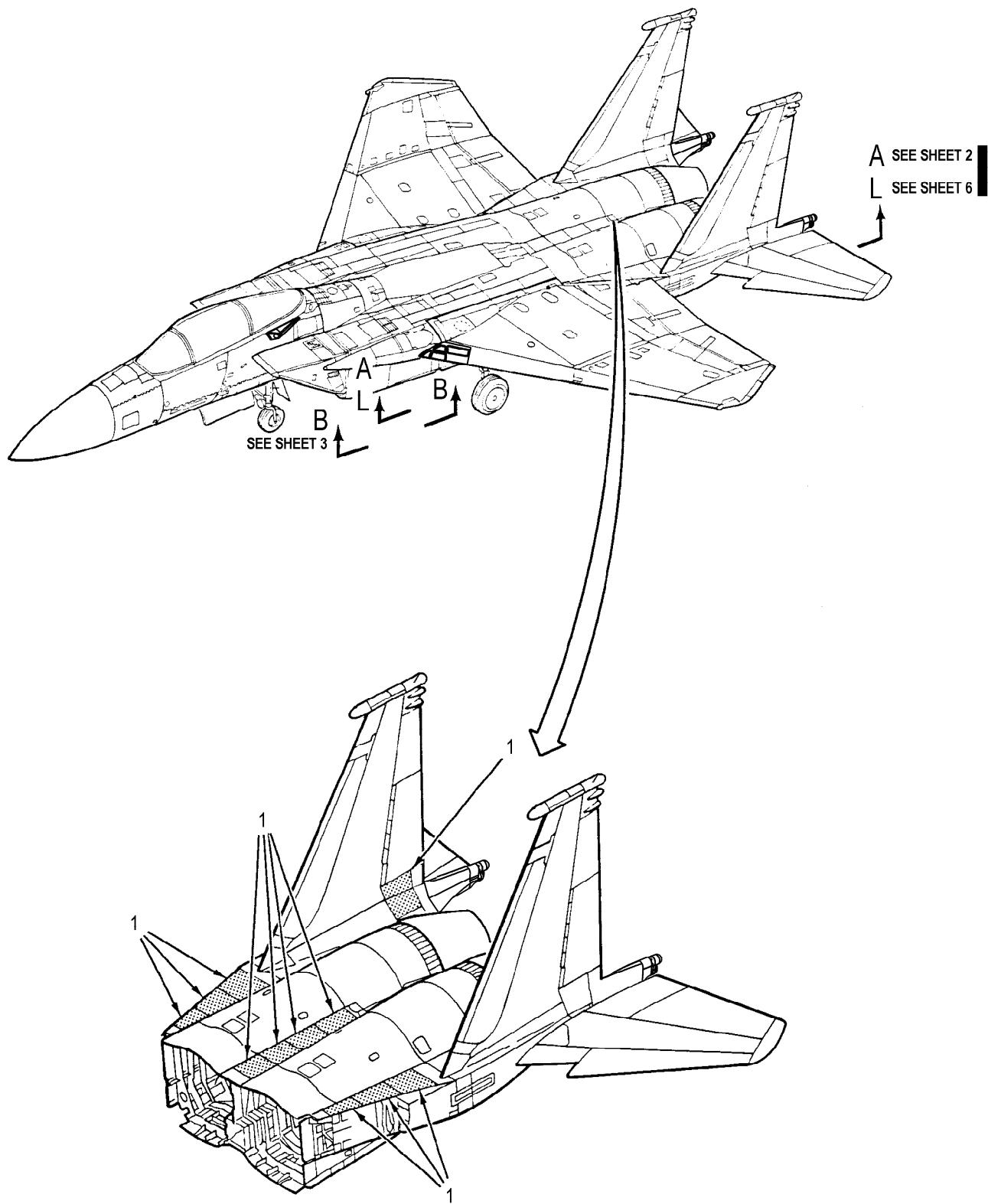
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Figure 2-5. Excessive G Aircraft Inspection After Exceeding Negative Nz Weight Load Factor
(Sheet 1 of 2)

IDX NO.	ITEM	ACCESS	TYPE OF DAMAGE
1	Inboard torque box upper forward and aft skins exterior surfaces: 68A112108  68A122108 68A112223  68A122223.		Cracks in stiffener runout areas.
2	Inboard torque box lower aft skin and outboard torque box lower forward and aft skins exterior surfaces: 68A112111 68A115113  68A125113 68A115114  68A125114.	Remove CFT (05-00-30).	Cracks in stiffener runout areas.
3	Inboard torque box lower aft skin, 68A112111, interior surfaces, and stiffeners.	Door 136L/R.	Cracks in stiffener runout areas.
 Preferred part.			

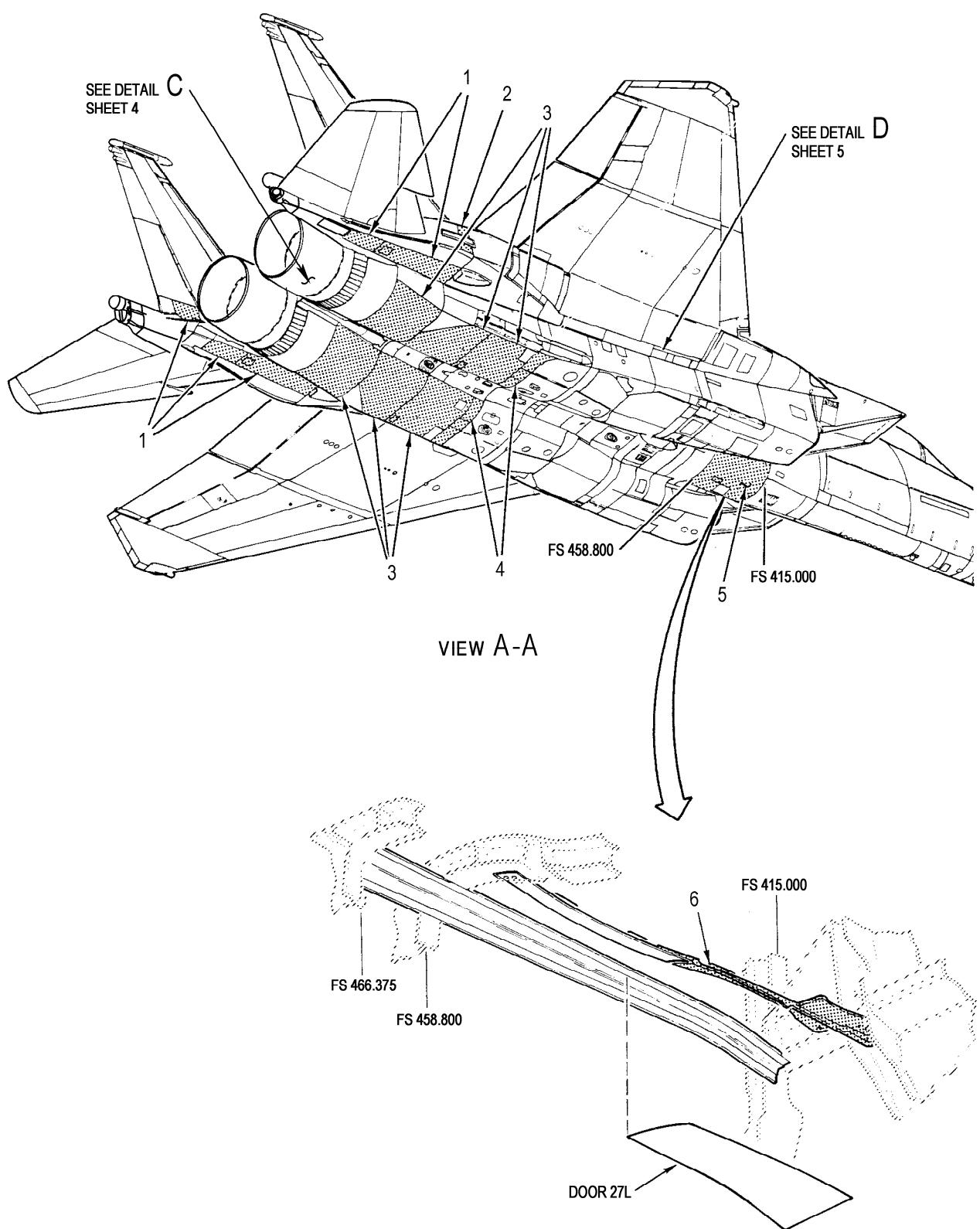
Figure 2-5. Excessive G Aircraft Inspection After Exceeding Negative Nz Weight Load Factor (Sheet 2)

CSTO SR1F-15SA-3-1



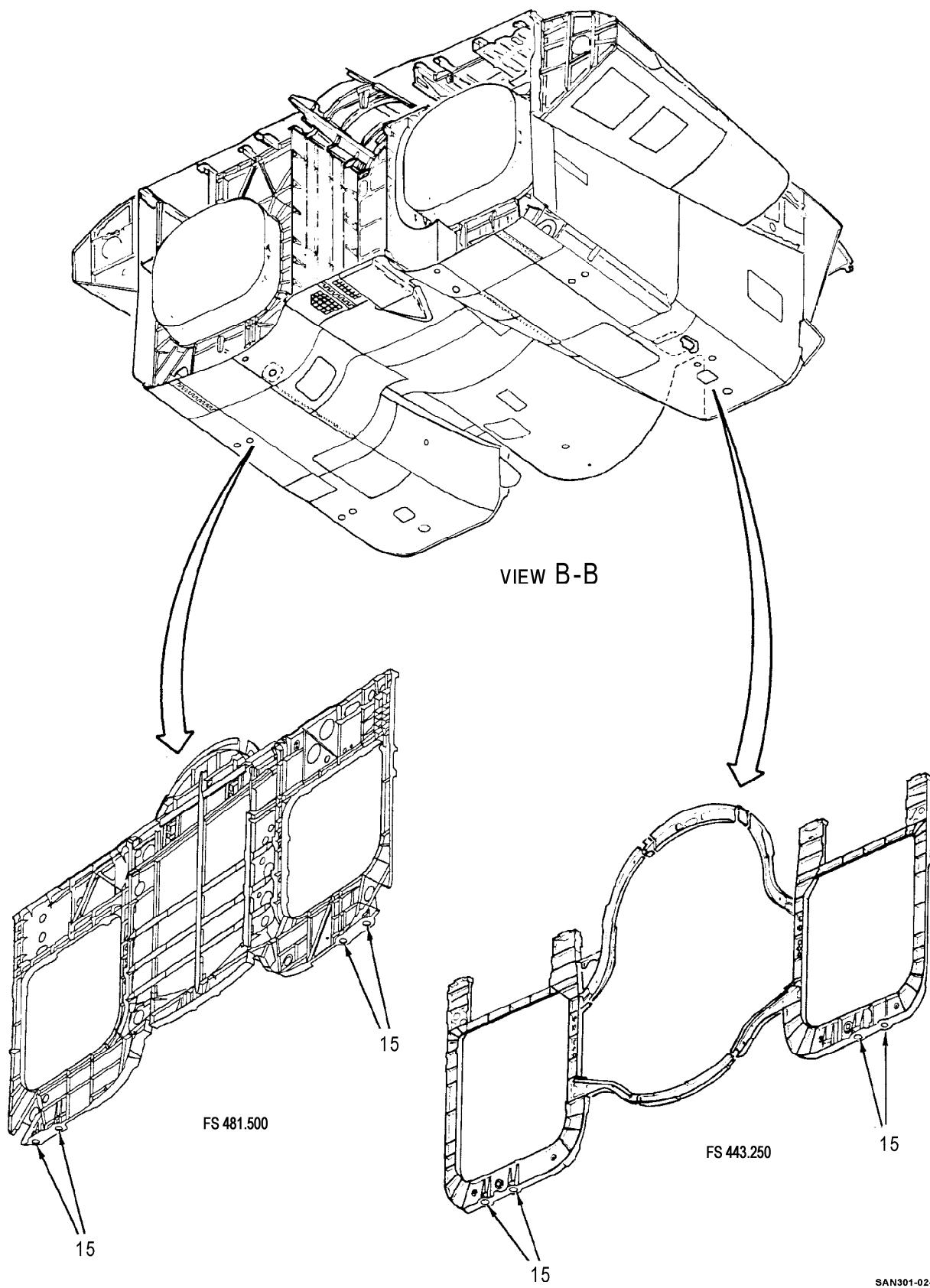
SAN301-02-22-002

Figure 2-6. Excessive G Aircraft Inspection After Exceeding Positive 9.9g (Sheet 1 of 8)



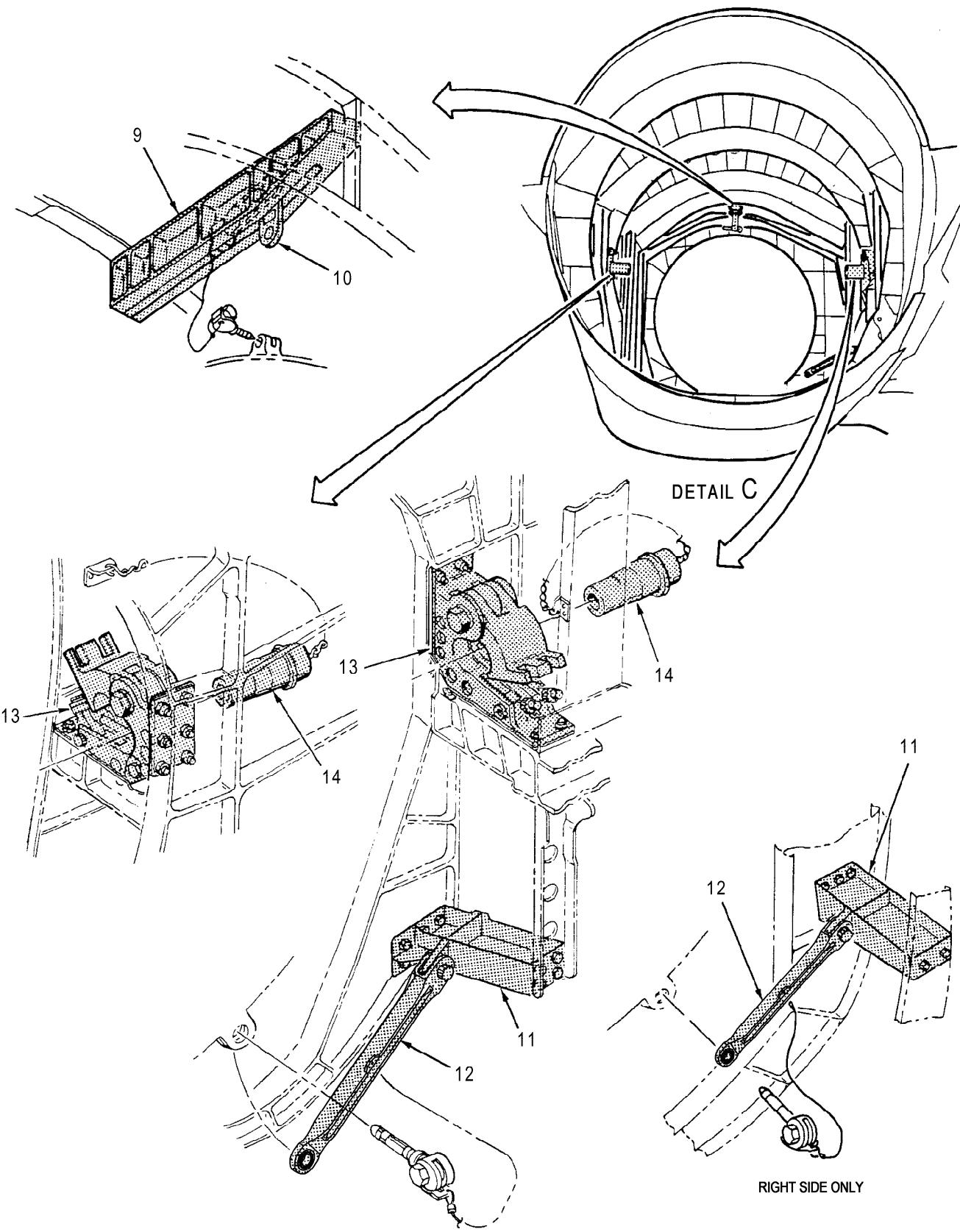
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Figure 2-6. Excessive G Aircraft Inspection After Exceeding Positive 9.9g (Sheet 2)



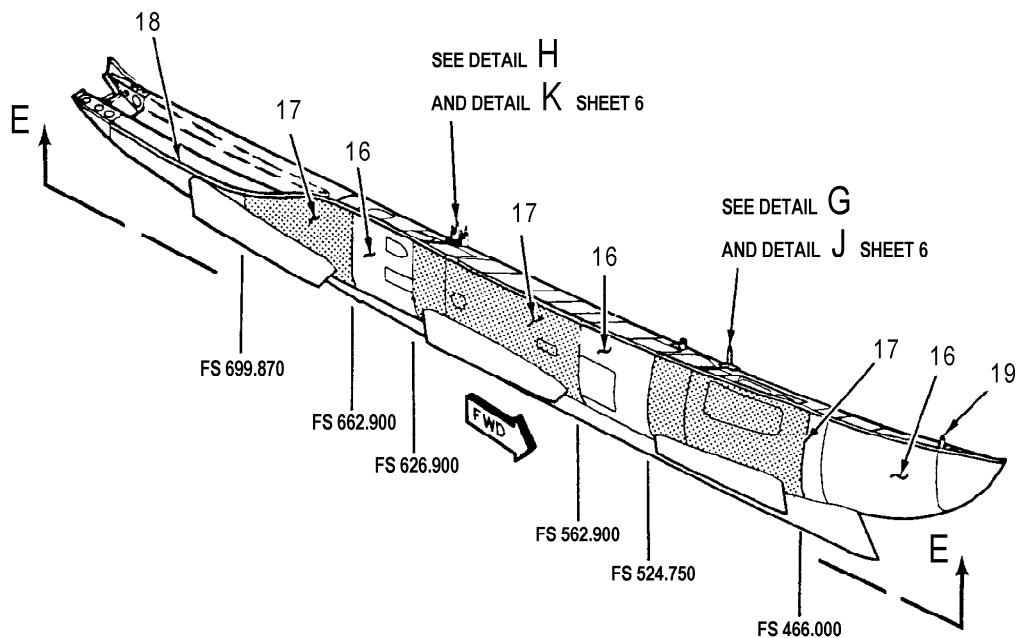
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Figure 2-6. Excessive G Aircraft Inspection After Exceeding Positive 9.9g (Sheet 3)



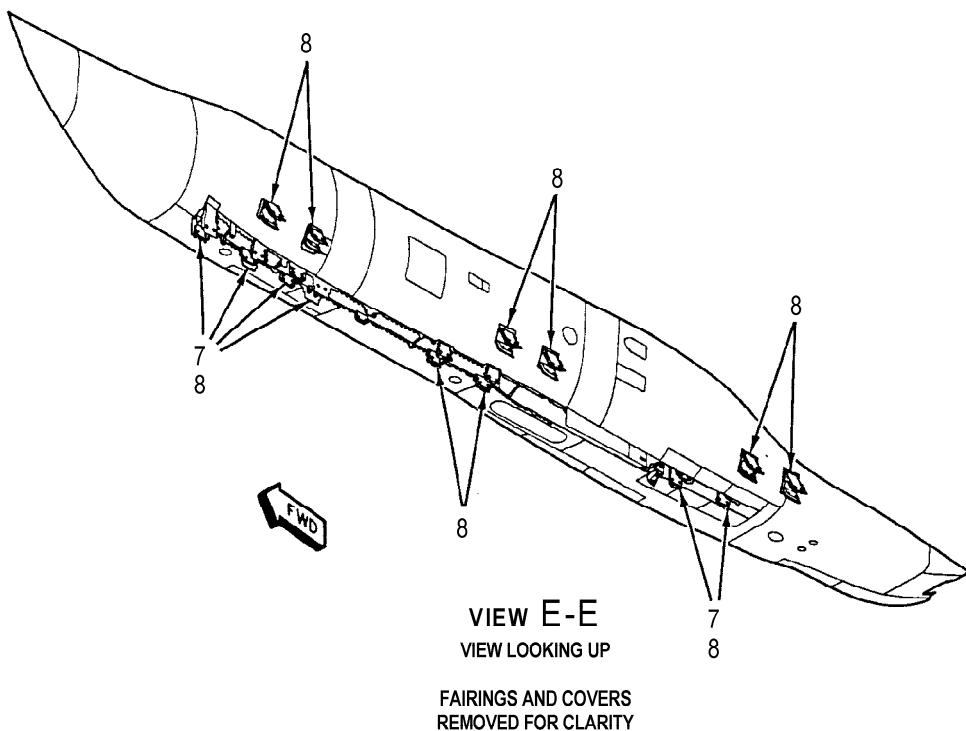
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Figure 2-6. Excessive G Aircraft Inspection After Exceeding Positive 9.9g (Sheet 4)



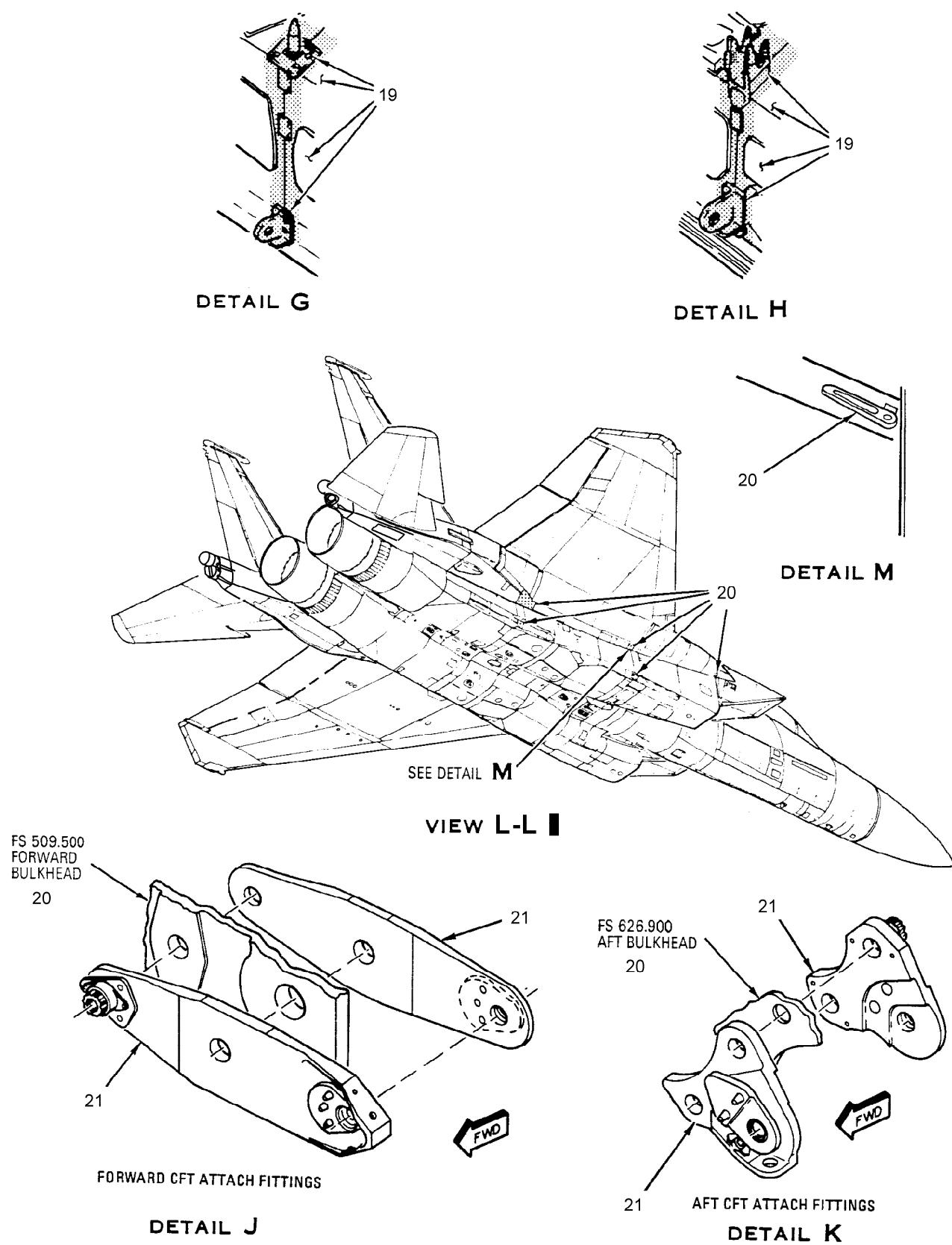
DETAIL D

■ CONFORMAL FUEL TANK (CFT), 68A250001 AND 68G250001
RIGHT SIDE SHOWN, LEFT SIDE OPPOSITE



SAN301-02-24-002

Figure 2-6. Excessive G Aircraft Inspection After Exceeding Positive 9.9g (Sheet 5)



SAN301-02-25-002

Figure 2-6. Excessive G Aircraft Inspection After Exceeding Positive 9.9g (Sheet 6)

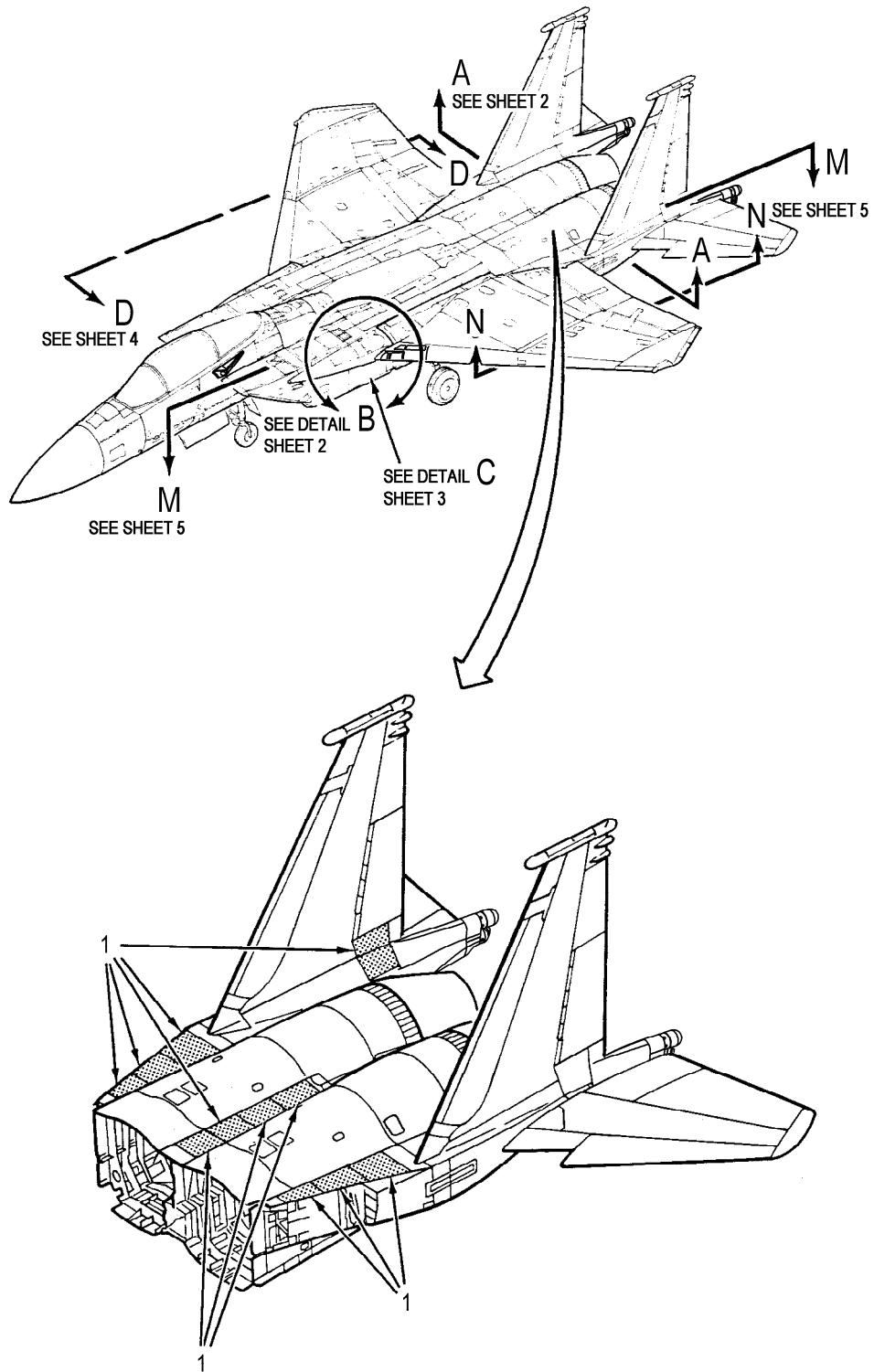
CSTO SR1F-15SA-3-1

IDX NO.	ITEM	ACCESS	TYPE OF DAMAGE
1	Fasteners in doors 103L/R, 106L/R, 110L/R, 118L/R, 123L/R, 126L/R, 197, 250, 251, 252, and 255.	Removal of doors not required.	Loose or damaged.
2	Fasteners in door 116R.	Removal of door not required.	Loose or damaged.
3	Doors 95L/R, 113L/R, and 117L/R exterior and interior surfaces.	Inspect with index no. 9 thru 14.	Cracks in skins. Buckled formers.
4	Aft fuselage lower splice skin exterior surface at FS 629.900: 68A335001.		Cracks and permanent buckles.
5	Center fuselage lower centerline skin and keel longerons between FS 415.000 and FS 458.000 exterior surfaces: 4 → 68A321056 5 → 68A346502 4 → 68A321095 5 → 68A342302.		Cracks and permanent buckles, especially in longeron area.
6	Center fuselage lower inboard diverter support between FS 415.000 and FS 440.000: 4 → 68A321150 5 → 68A342290.	Door 27L/R.	Buckles and cracks.
7	CFT forward and aft LAU-106() missile launchers: 68A733001.	Launchers removed (94-31-20).	Loose, sheared, and missing fasteners. Buckled walls.
8	CFT external stores stations. CFT missile launcher mounting fittings, forward and aft missiles.	Inspect with index no. 7.	Bearing failure in fitting bosses.
9	1 → Forward engine mount bracket: 68A336220.	Remove engines (71-03-10).	Cracks in mount bracket and supporting structure. Fasteners for looseness and deformation.
10	1 → Forward engine mount link: 68A500071.	Remove engines (71-03-10) and link from mount (71-21-12).	Cracks.
11	1 → Side load mount bracket: 68A500073 68A500075.	Remove engines (71-03-10).	Cracks in mount bracket and supporting structure. Fasteners for looseness and deformation.

Figure 2-6. Excessive G Aircraft Inspection After Exceeding Positive 9.9g (Sheet 7)

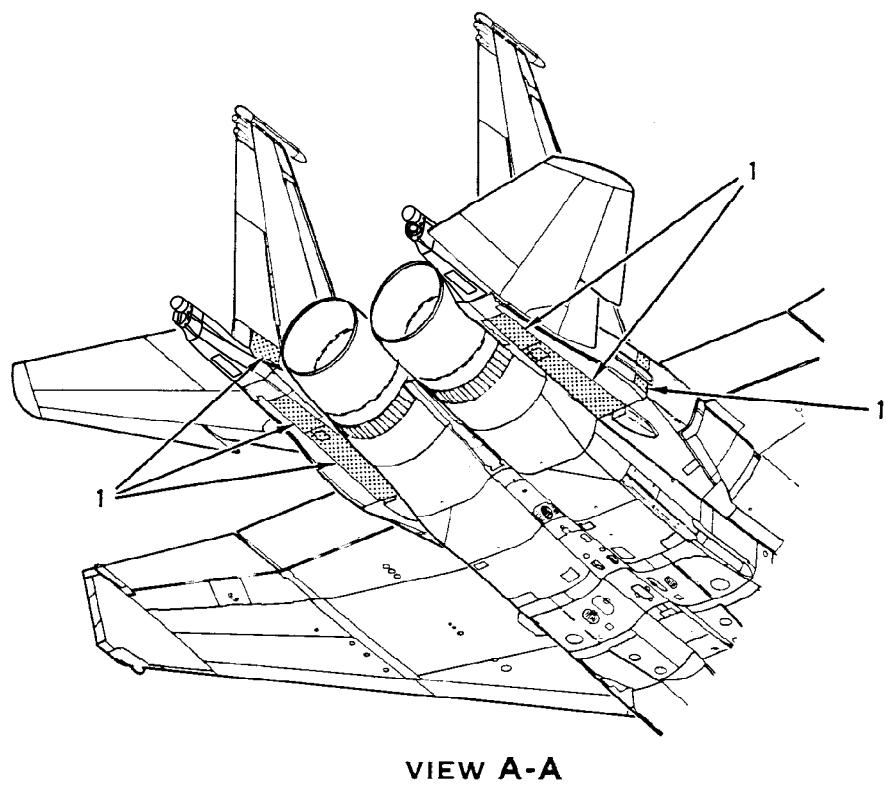
IDX NO.	ITEM	ACCESS	TYPE OF DAMAGE
12	1 Side load mount link: 68A500076.	Remove engines (71-03-10) and links from mounts (71-21-10).	Cracks.
13	1 Main inboard and outboard mounts: 68A500070.	Remove engines (71-03-10).	Cracks in mounts and supporting structure. Fasteners for looseness and deformation.
14	1 Engine mount to engine adapters: 68A500006.	Remove engines (71-03-10).	Cracks.
15	3 Fuselage Navigation and Targeting pod adapter mounting locations at FS 443.250 and FS 481.500.	2 Remove adapters (34-42-10 and 94-79-18).	Buckles or cracks in bulk- heads or skins. Fasteners for looseness and deformation. Bushing wear, galling or cracks.
16	Exterior surface of conformal fuel tank (CFT) skins.		Buckles, cracks, distortion, and loose or missing fasten- ers. Fuel leaks.
17	Exterior surface of CFT skins between upper outboard longeron and lower inboard longeron from FS 466.000 through FS 524.750, FS 562.900 through FS 626.900, and FS 662.900 through FS 699.870.		Cracks in mount bracket and supporting structure, fasten- ers for looseness and defor- mation.
18	Aerodynamic peripheral seals.		Cuts, tears, loose or missing sections.
19	CFT mounting fittings, upper and inboard mold line skins at FS 509.500 and FS 626.900.	Remove CFT (05-00-30).	Buckles, cracks, distortion, and loose or missing fasten- ers.
20	Fuselage CFT mounting fittings.	Remove CFT (05-00-30).	Buckles, cracks, distortion, and loose or missing fasten- ers.
21	Aircraft/CFT attach kit parts.	Remove CFT (05-00-30).	Buckles, cracks, distortion.
	1 Inspect index no. 3 with this inspection. 2 Inspection required only when pod adapters were installed. 3 If Navigation and/or Targeting pods were installed during over G condition, refer to CSTO SR1F-15SA-6, Special Inspection After Specific Occurrence, Fire Control System (System 74000). 4 12-1001 THRU 12-1024; ALSO 93-0852 THRU 93-0923. 5 12-1025 AND UP.		

Figure 2-6. Excessive G Aircraft Inspection After Exceeding Positive 9.9g (Sheet 8)

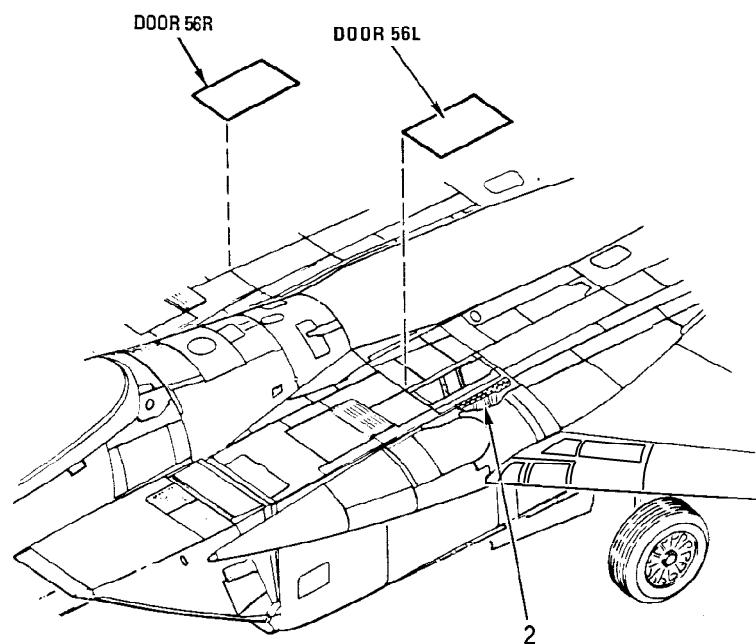


SAN301-02-28-001

Figure 2-7. Excessive G Aircraft Inspection After Exceeding Negative 3.0g Without CFT Installed; 2.0g With CFT Installed (Sheet 1 of 7)



VIEW A-A

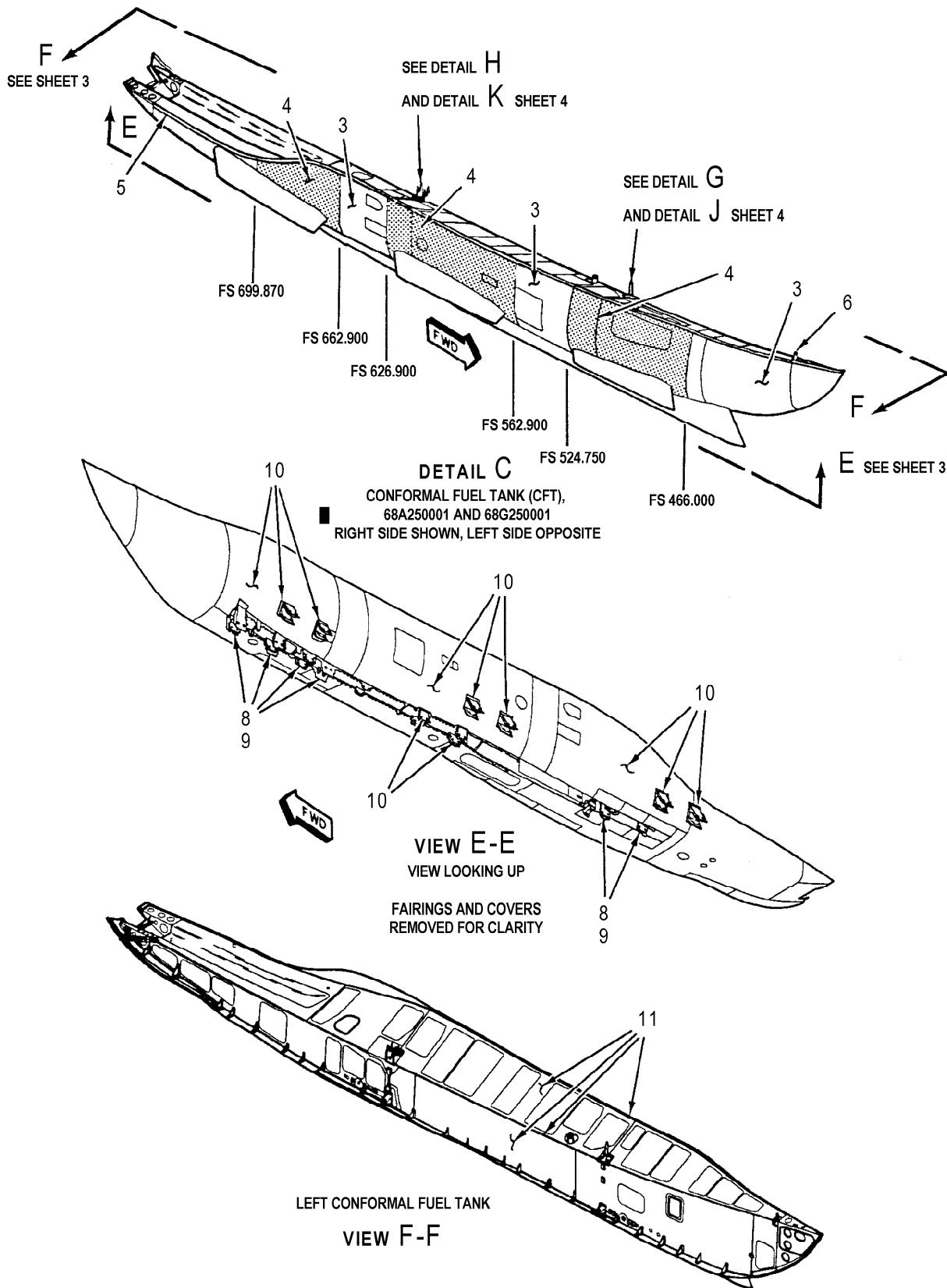


DETAIL B

SAN301-02-29-001

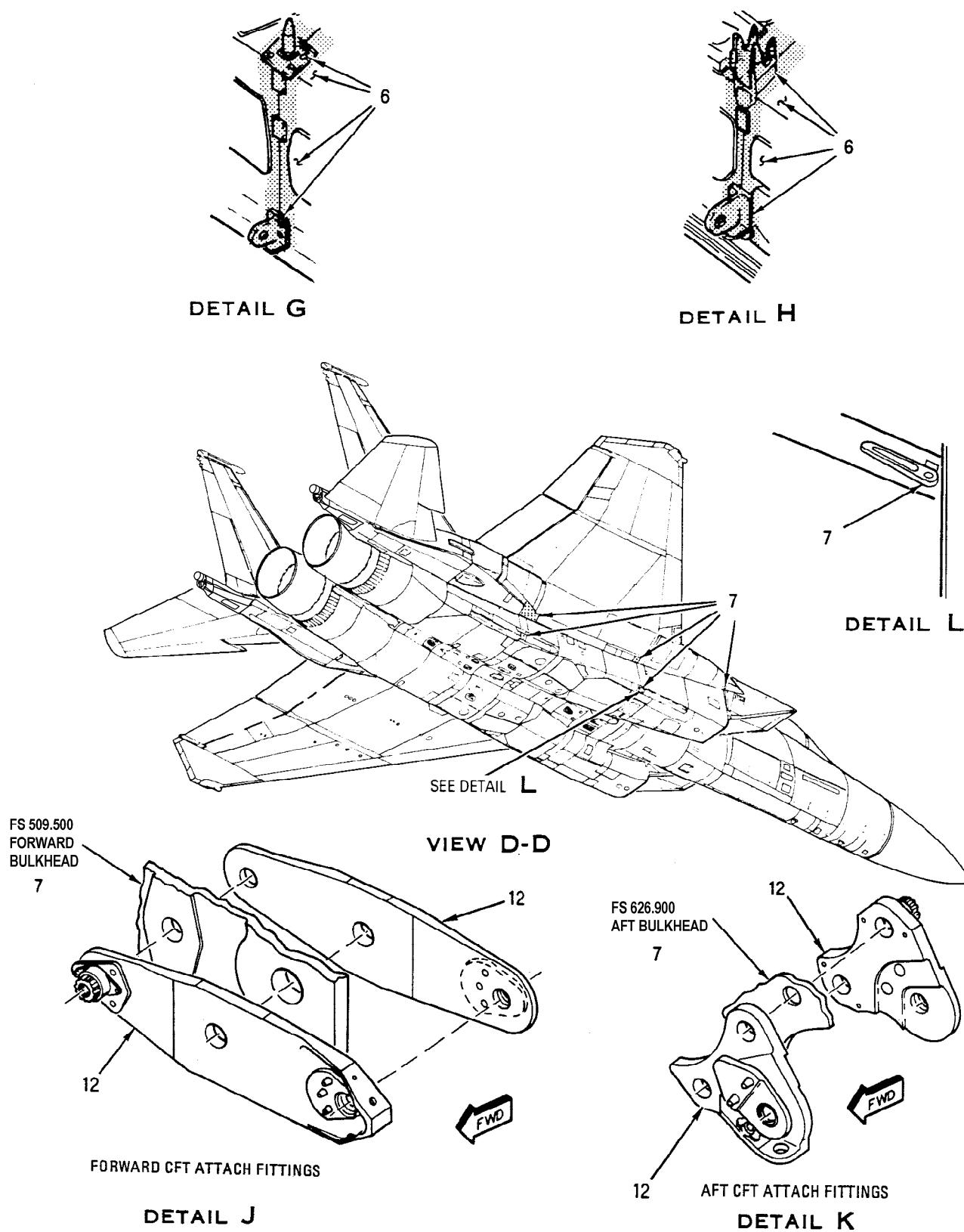
Figure 2-7. Excessive G Aircraft Inspection After Exceeding Negative 3.0g Without CFT Installed; 2.0g With CFT Installed (Sheet 2)

CSTO SR1F-15SA-3-1



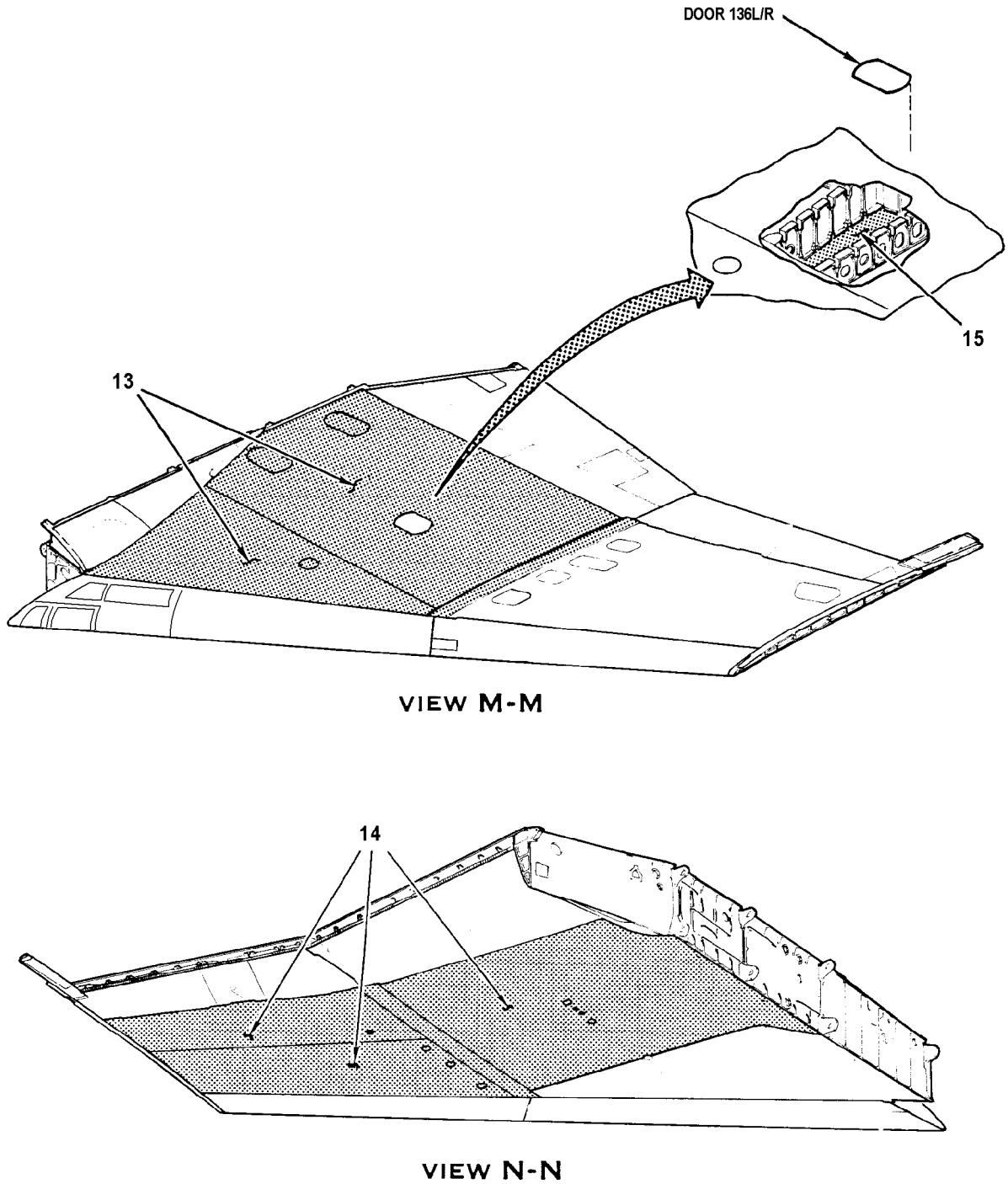
SAN301-02-30-002

Figure 2-7. Excessive G Aircraft Inspection After Exceeding Negative 3.0g Without CFT Installed; 2.0g With CFT Installed (Sheet 3)



SAN301-02-31-002

Figure 2-7. Excessive G Aircraft Inspection After Exceeding Negative 3.0g Without CFT Installed; 2.0g With CFT Installed (Sheet 4)



SAN301-02-32-002

Figure 2-7. Excessive G Aircraft Inspection After Exceeding Negative 3.0g Without CFT Installed; 2.0g With CFT Installed (Sheet 5)

IDX NO.	ITEM	ACCESS	TYPE OF DAMAGE
1	Fasteners in doors 103L/R, 106L/R, 110L/R, 116R, 118L/R, 123L/R, 126L/R, 197, 250, 251, and 252.	Removal of doors not required.	Loose or damaged.
2	Upper outboard longeron fasteners between FS 481.500 and FS 509.500, FS 494.700 and FS 502.100.	Doors 56L/R.	Loose, missing, and/or failed.
3	Exterior surface of conformal fuel tank (CFT) skins.		Buckles, cracks, distortion, and loose or missing fasteners. Fuel leaks.
4	Exterior surface of CFT skins between upper outboard longeron and lower inboard longeron from FS 466.000 through FS 524.750, FS 562.900 through FS 626.900, and FS 662.900 through FS 699.870.		Buckles, cracks, distortion, and loose or missing fasteners. Fuel leaks.
5	Aerodynamic peripheral seals.		Cuts, tears, and loose or missing sections.
6	CFT mounting fittings. Upper and inboard mold line skins at FS 509.500 and FS 626.900.	Remove CFT (05-00-30).	Buckles, cracks, distortion, and loose or missing fasteners.
7	Fuselage CFT mounting fittings.	Remove CFT (05-00-30).	Buckles, cracks, distortion, and loose or missing fasteners.
8	CFT forward and aft LAU-106() missile launchers: 68A733001.	Launchers removed (94-31-20).	Loose, sheared, missing fasteners. Buckled walls.
9	CFT external stores stations. CFT missile launcher mounting fittings, forward and aft missiles.	Inspect with index 8.	Bearing failure in fitting bosses.
10	Exterior surface of CFT and around bomb racks.		Fuel leaks.
11	Upper inboard and outboard longerons, upper and inboard skins.	Remove CFT (05-00-30).	Buckles, cracks, distortion, and loose or missing fasteners.
12	Aircraft/CFT attach kit parts.	Remove CFT (05-00-30).	Buckles, cracks, distortion.
13	Inboard torque box upper forward and aft skins exterior surfaces: 68A112108 1 → 68A122108 68A112223 1 → 68A122223.		Cracks in stiffener runout areas.

Figure 2-7. Excessive G Aircraft Inspection After Exceeding Negative 3.0g Without CFT Installed; 2.0g With CFT Installed (Sheet 6)

CSTO SR1F-15SA-3-1

IDX NO.	ITEM	ACCESS	TYPE OF DAMAGE
14	Inboard torque box lower aft skin and outboard torque box lower forward skin and outboard torque box aft skin exterior surfaces: 68A112111 and 68A115113  68A125113 68A115114  68A125014.	Remove CFT (05-00-30).	Cracks in stiffener runout areas.
15	Inboard torque box lower aft skin, 68A112111, interior surfaces, and stiffeners.	Door 136L/R.	Cracks in stiffener runout areas.
 Preferred part.			

Figure 2-7. Excessive G Aircraft Inspection After Exceeding Negative 3.0g Without CFT Installed; 2.0g With CFT Installed (Sheet 7)

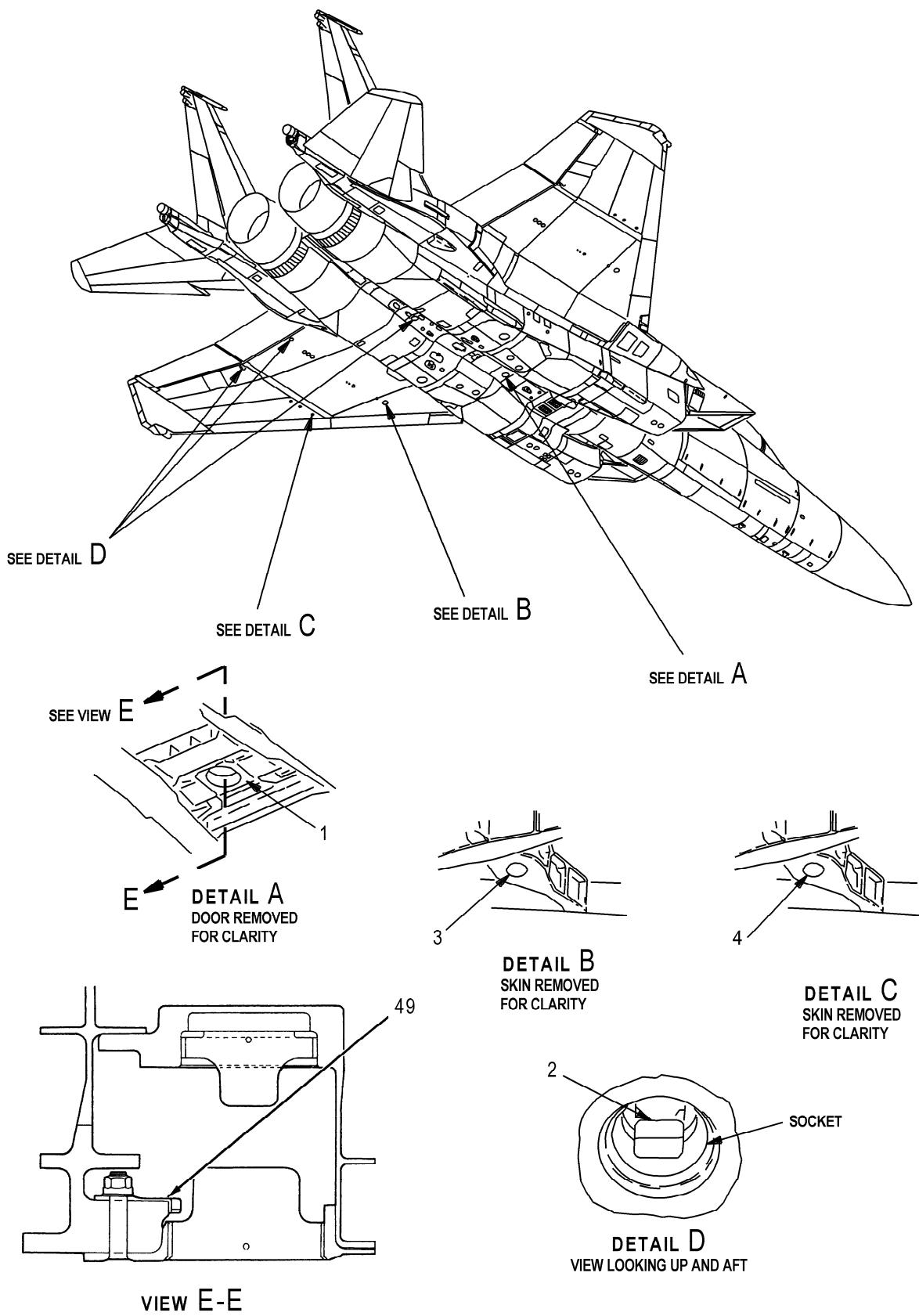
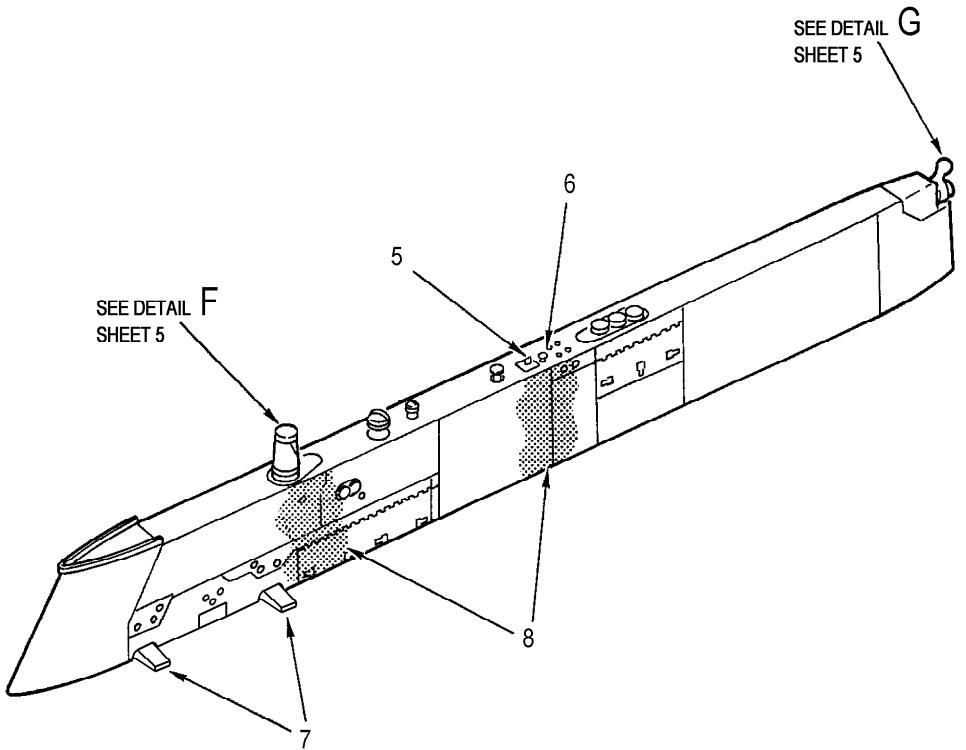
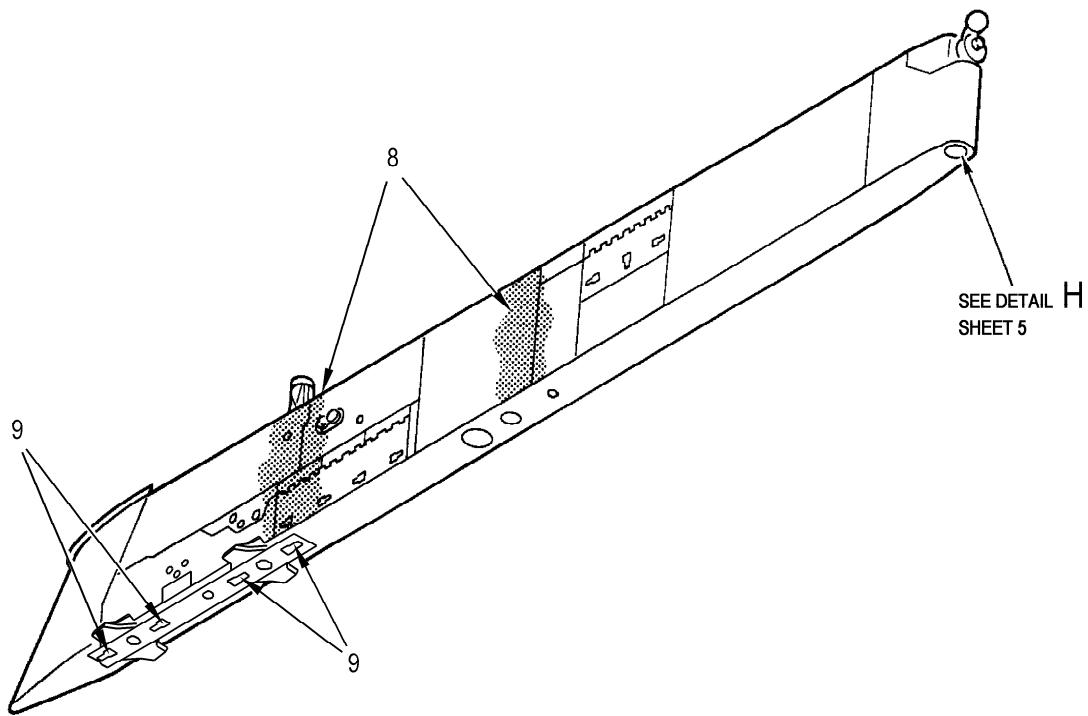


Figure 2-8. Excessive G Aircraft Inspection After Exceeding Positive Load Factor of 9.0g or Negative Load Factor of 3.0g; With External Stores Installed (Sheet 1 of 17)

SAN301-02-33-002

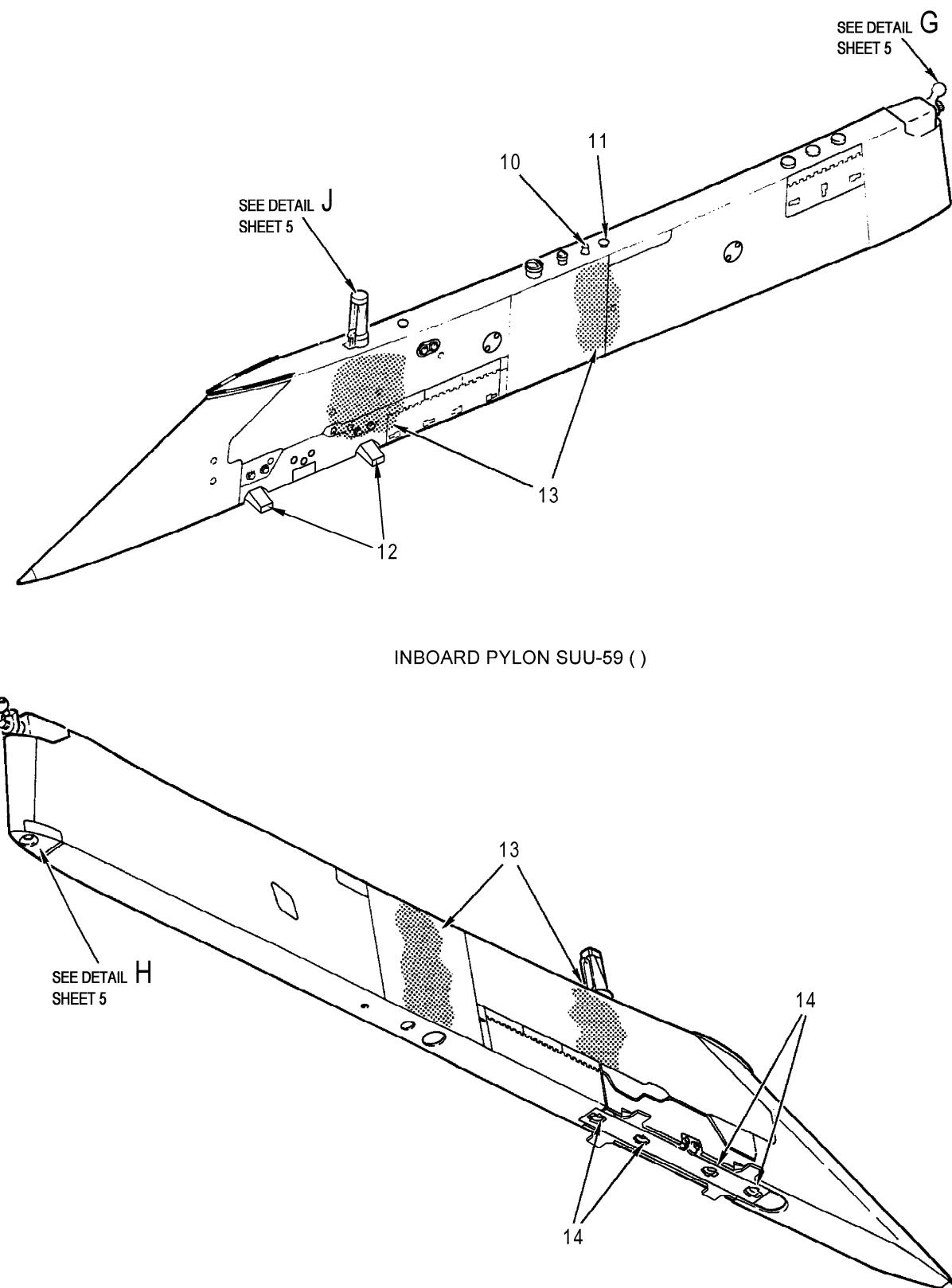


CENTERLINE PYLON SUU-60 ()



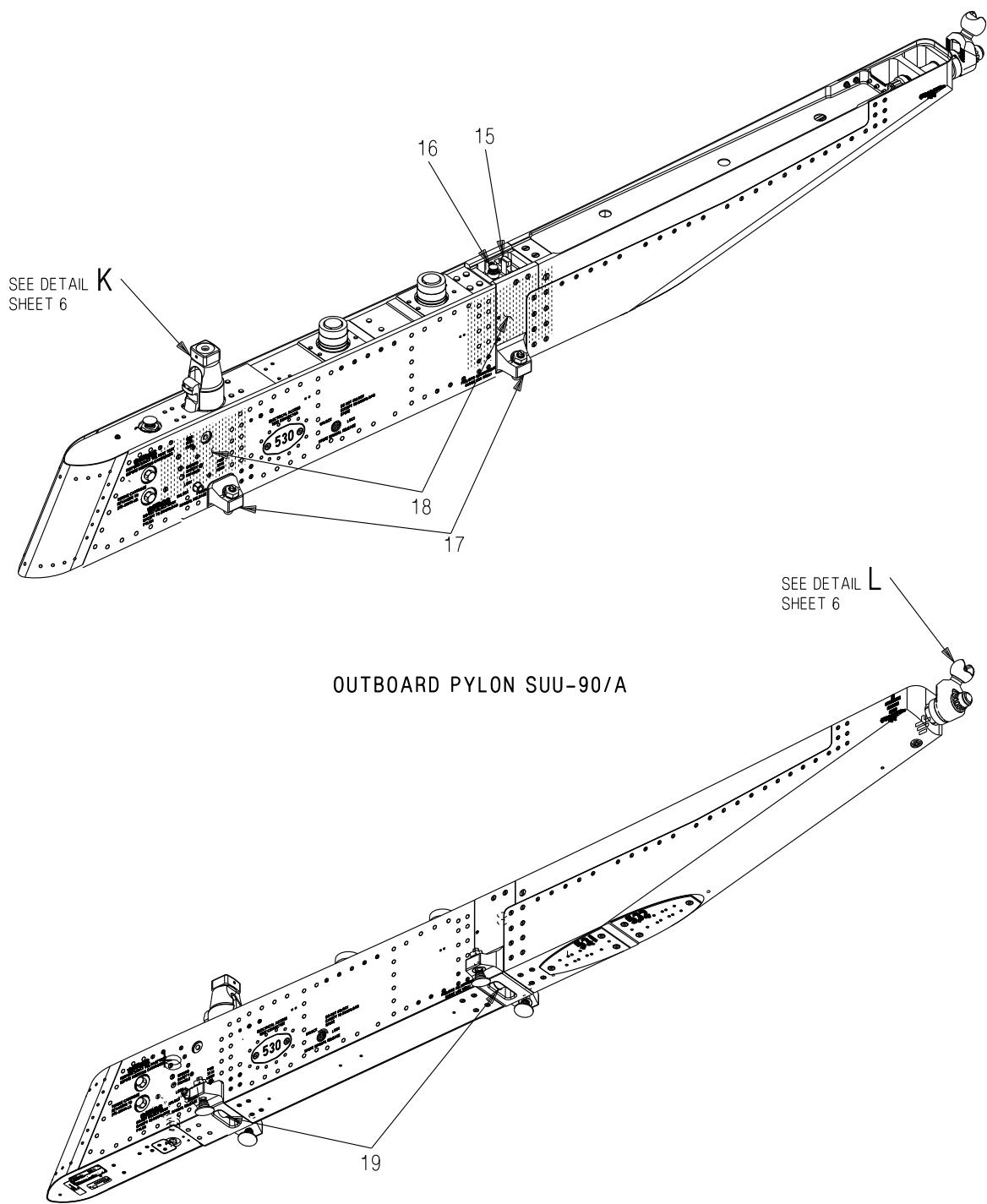
SAN301-02-34-001

Figure 2-8. Excessive G Aircraft Inspection After Exceeding Positive Load Factor of 9.0g or Negative Load Factor of 3.0g; With External Stores Installed (Sheet 2)



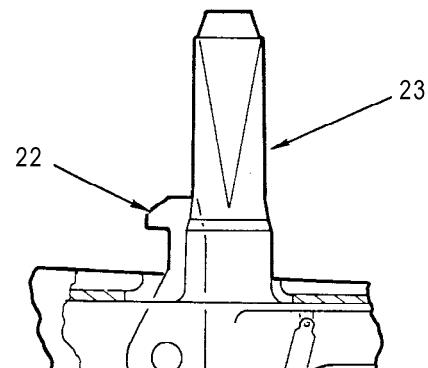
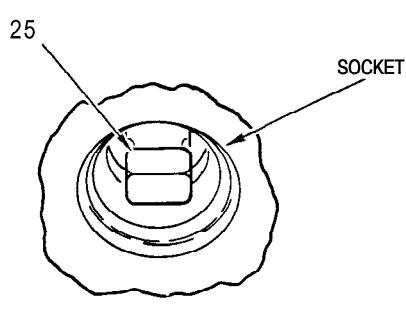
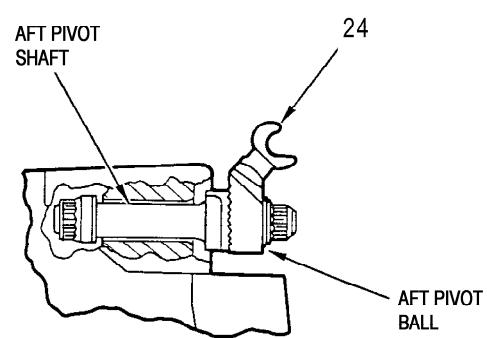
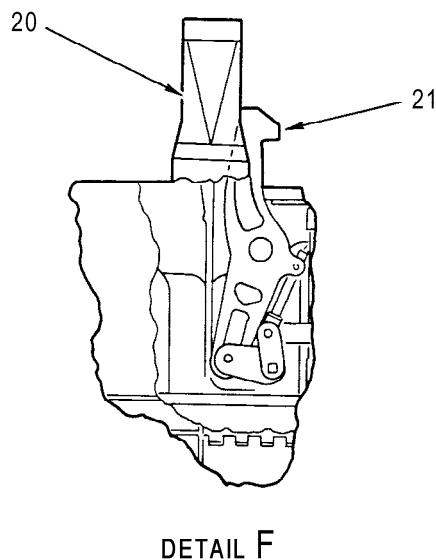
SAN301-02-35-001

Figure 2-8. Excessive G Aircraft Inspection After Exceeding Positive Load Factor of 9.0g or Negative Load Factor of 3.0g; With External Stores Installed (Sheet 3)



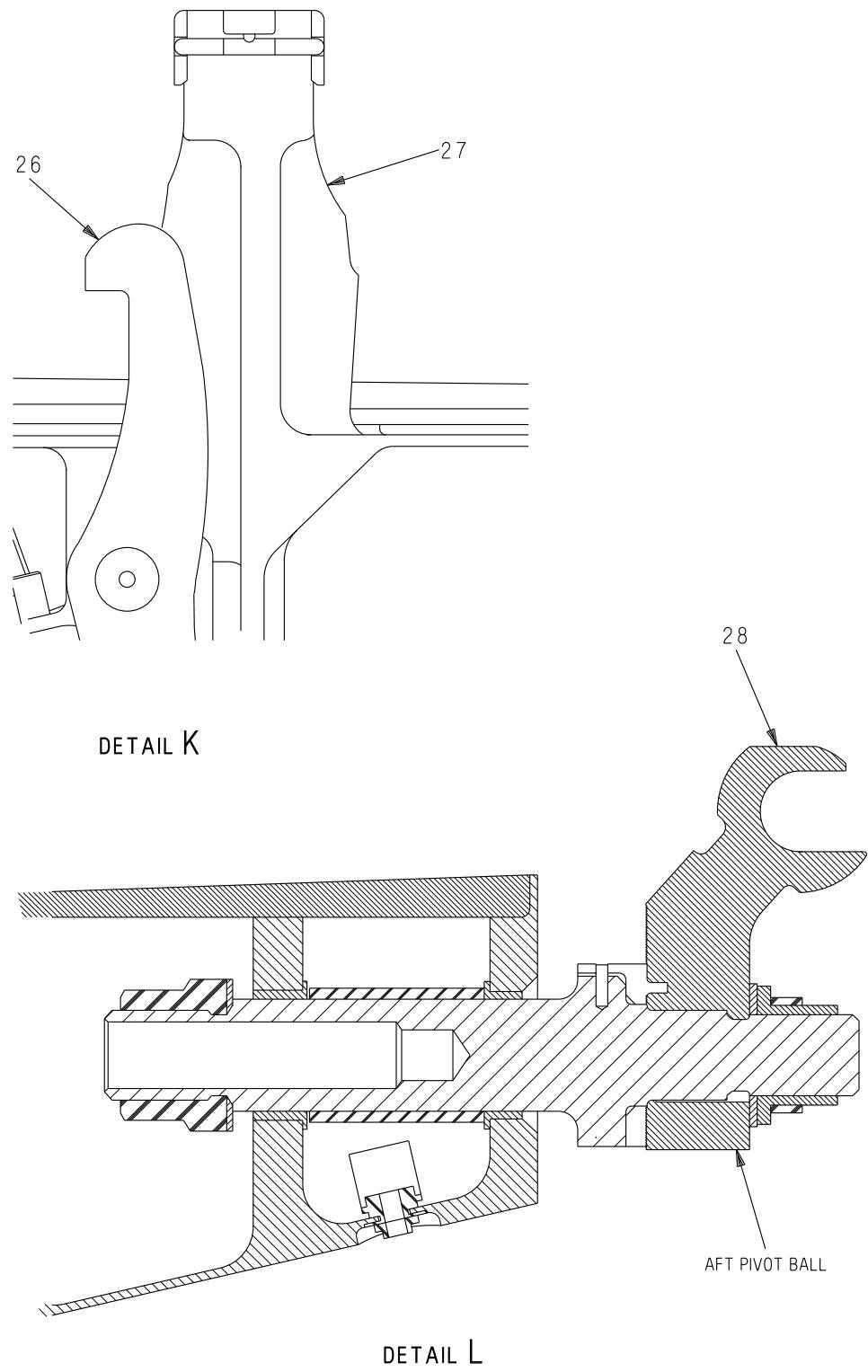
SAN301-02-105-001

Figure 2-8. Excessive G Aircraft Inspection After Exceeding Positive Load Factor of 9.0g or Negative Load Factor of 3.0g; With External Stores Installed (Sheet 4)



SAN301-02-36-001

Figure 2-8. Excessive G Aircraft Inspection After Exceeding Positive Load Factor of 9.0g or Negative Load Factor of 3.0g; With External Stores Installed (Sheet 5)



SAN301-02-106-001

Figure 2-8. Excessive G Aircraft Inspection After Exceeding Positive Load Factor of 9.0g or Negative Load Factor of 3.0g; With External Stores Installed (Sheet 6)

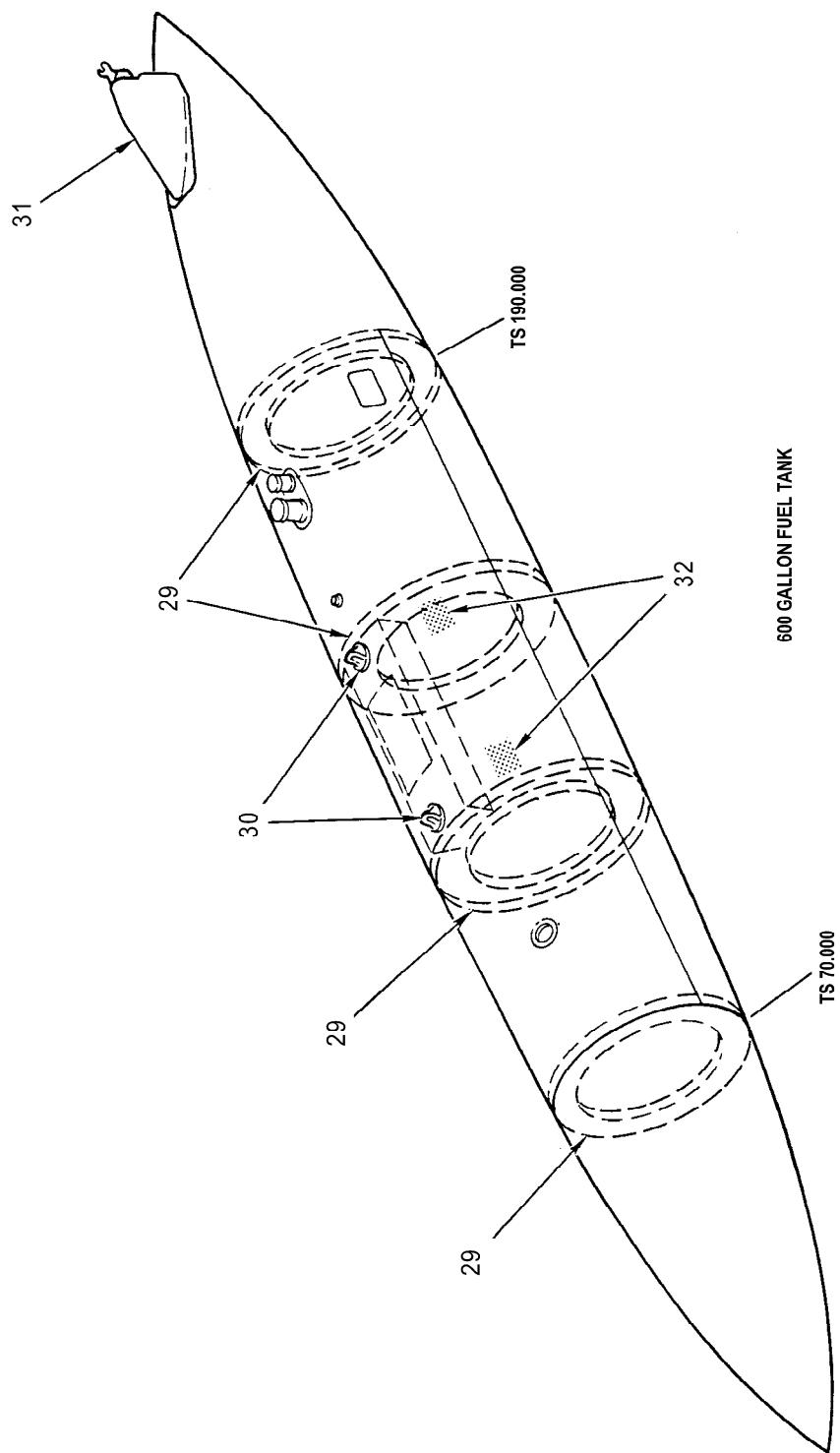
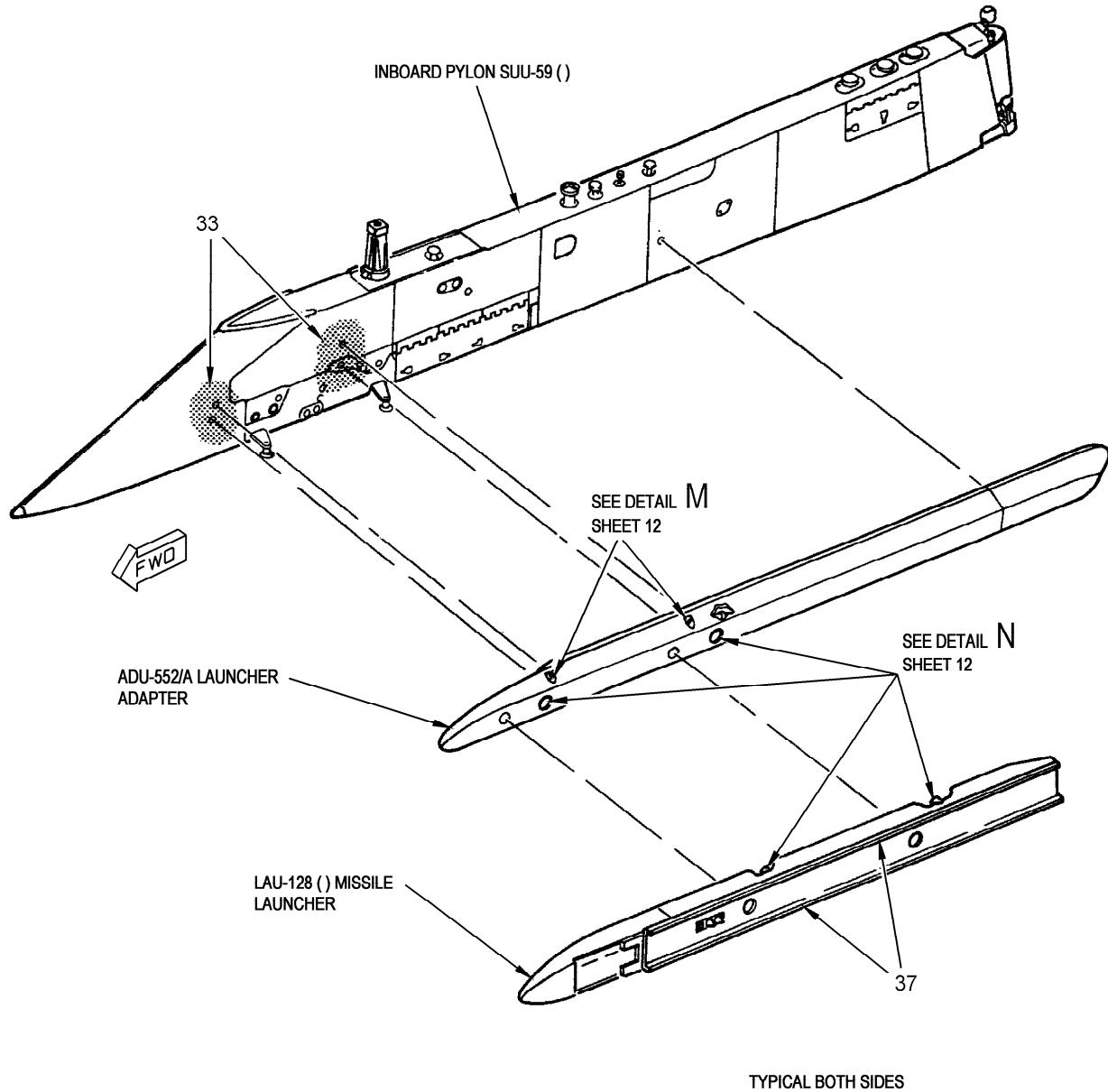


Figure 2-8. Excessive G Aircraft Inspection After Exceeding Positive Load Factor of 9.0g or Negative Load Factor of 3.0g; With External Stores Installed (Sheet 7)

SAN301-02-37-002



SAN301-02-38-001

Figure 2-8. Excessive G Aircraft Inspection After Exceeding Positive Load Factor of 9.0g or Negative Load Factor of 3.0g; With External Stores Installed (Sheet 8)

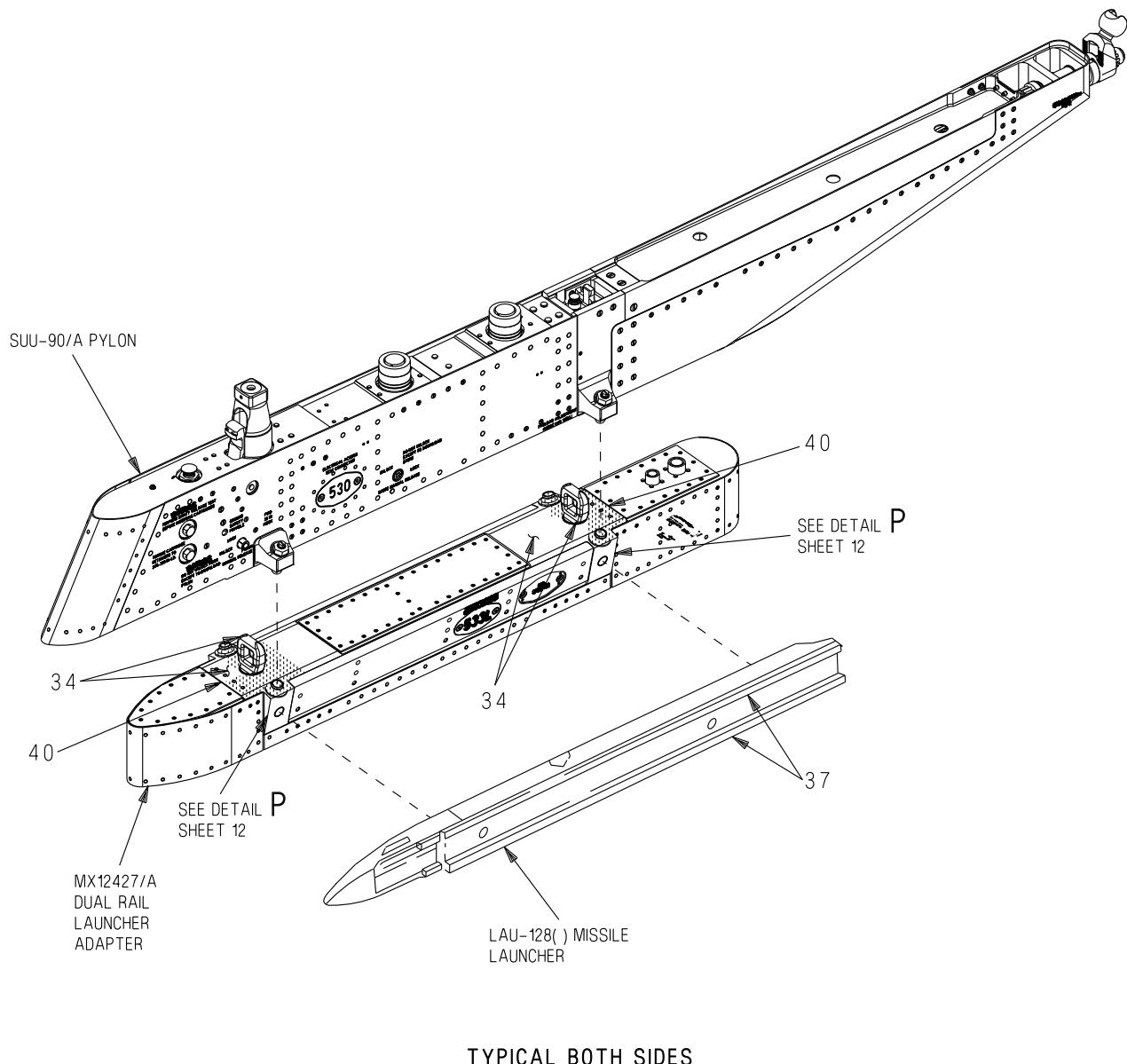


Figure 2-8. Excessive G Aircraft Inspection After Exceeding Positive Load Factor of 9.0g or Negative Load Factor of 3.0g; With External Stores Installed (Sheet 9)

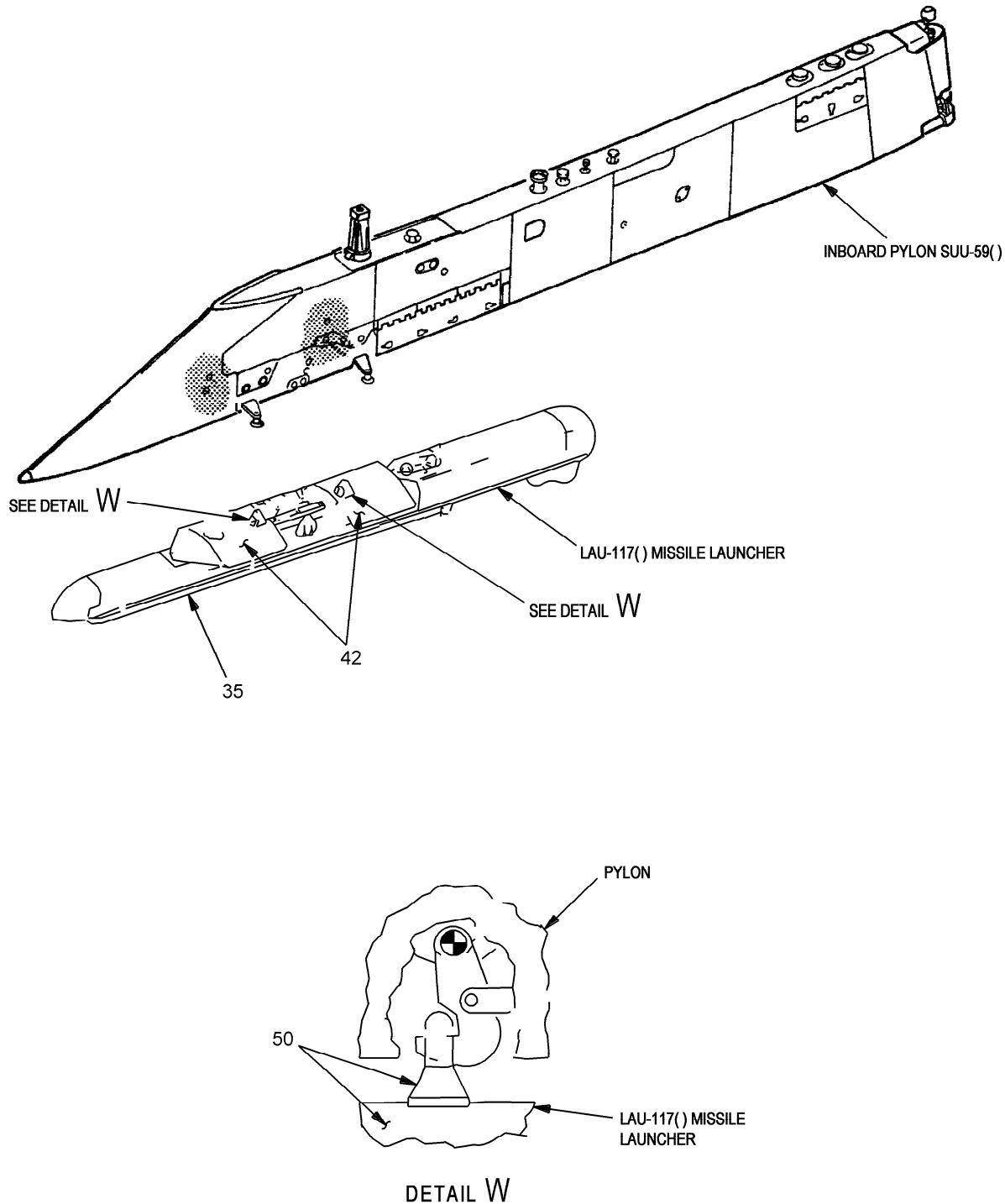


Figure 2-8. Excessive G Aircraft Inspection After Exceeding Positive Load Factor of 9.0g or Negative Load Factor of 3.0g; With External Stores Installed (Sheet 10)

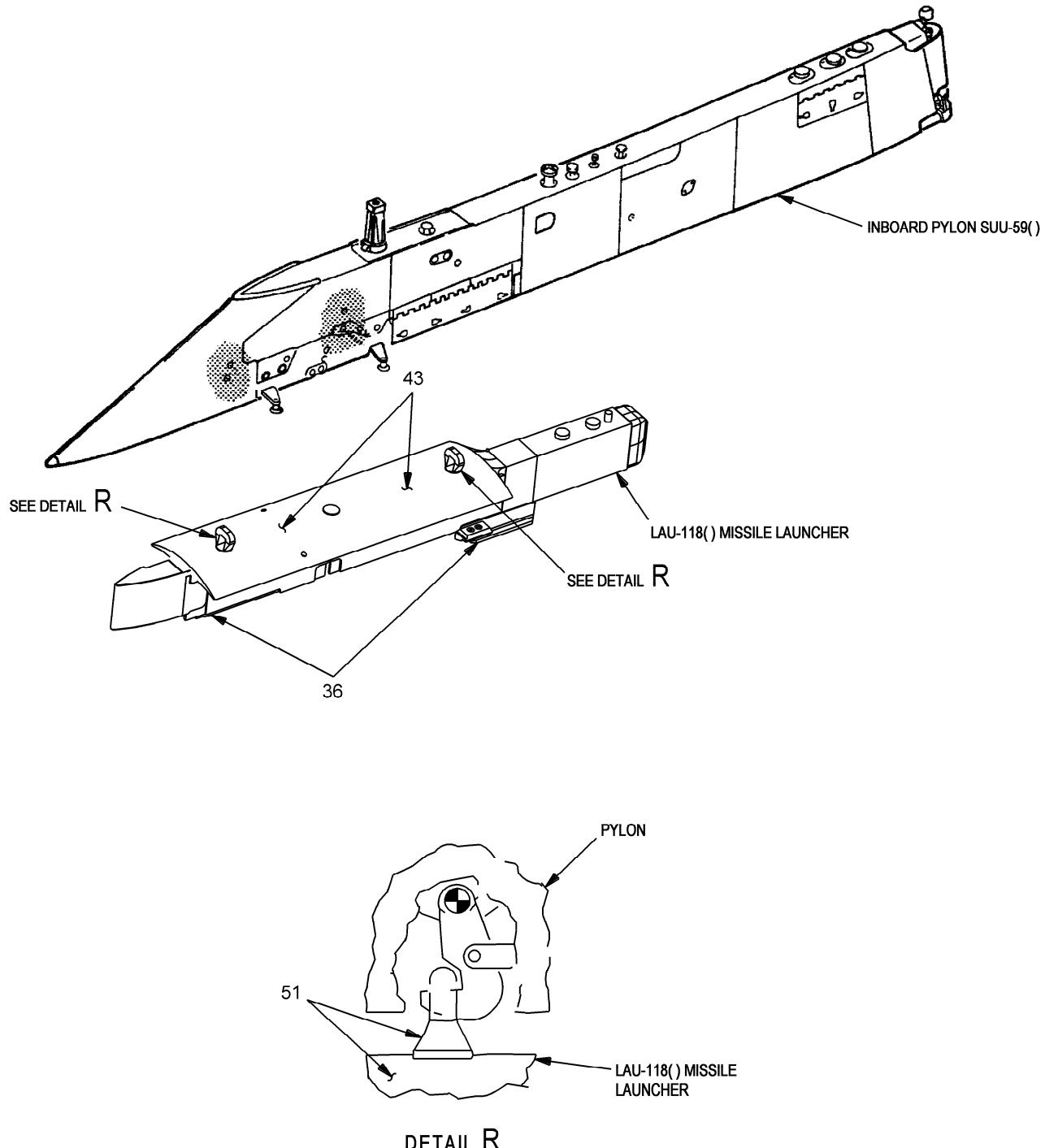
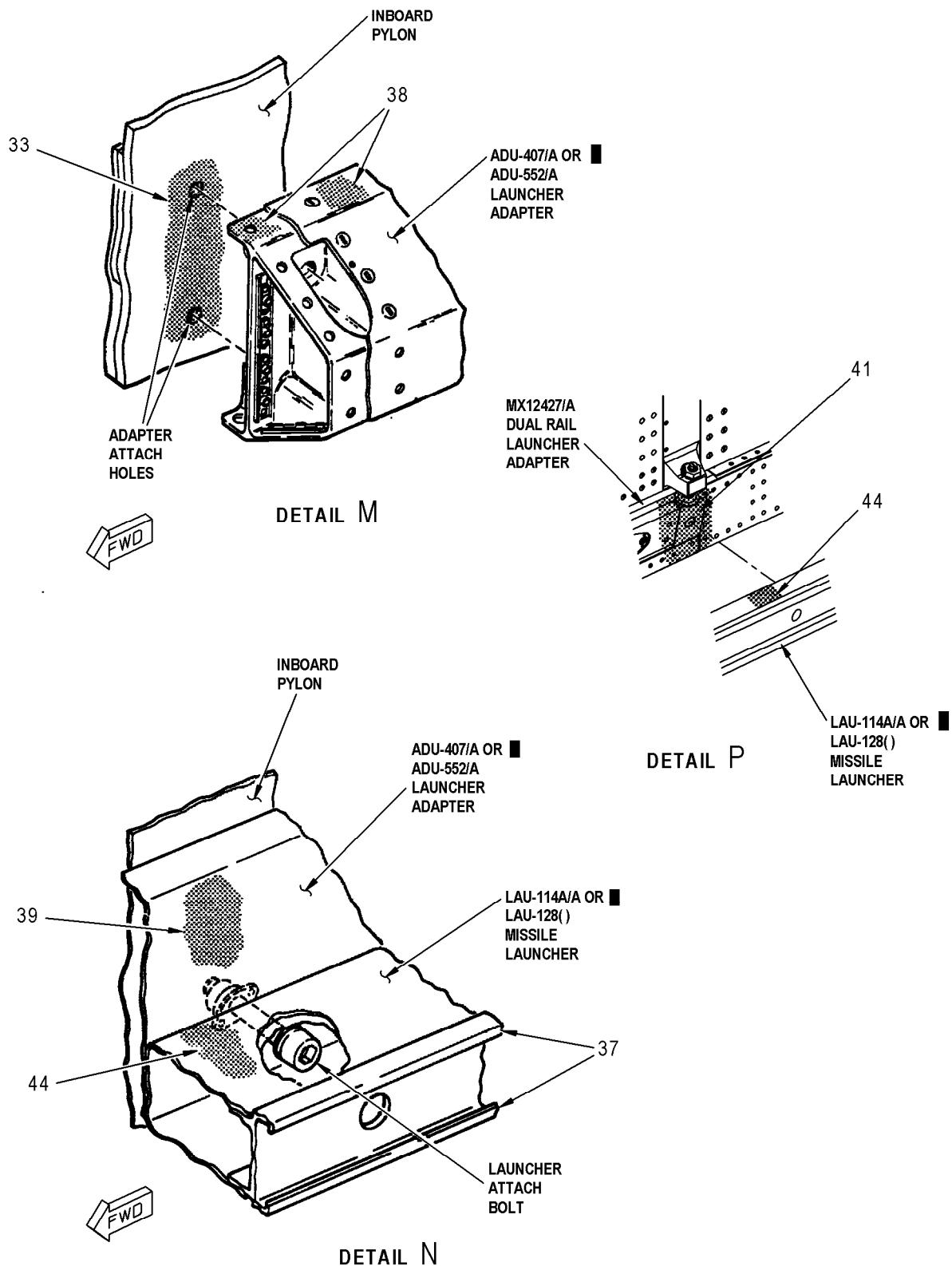
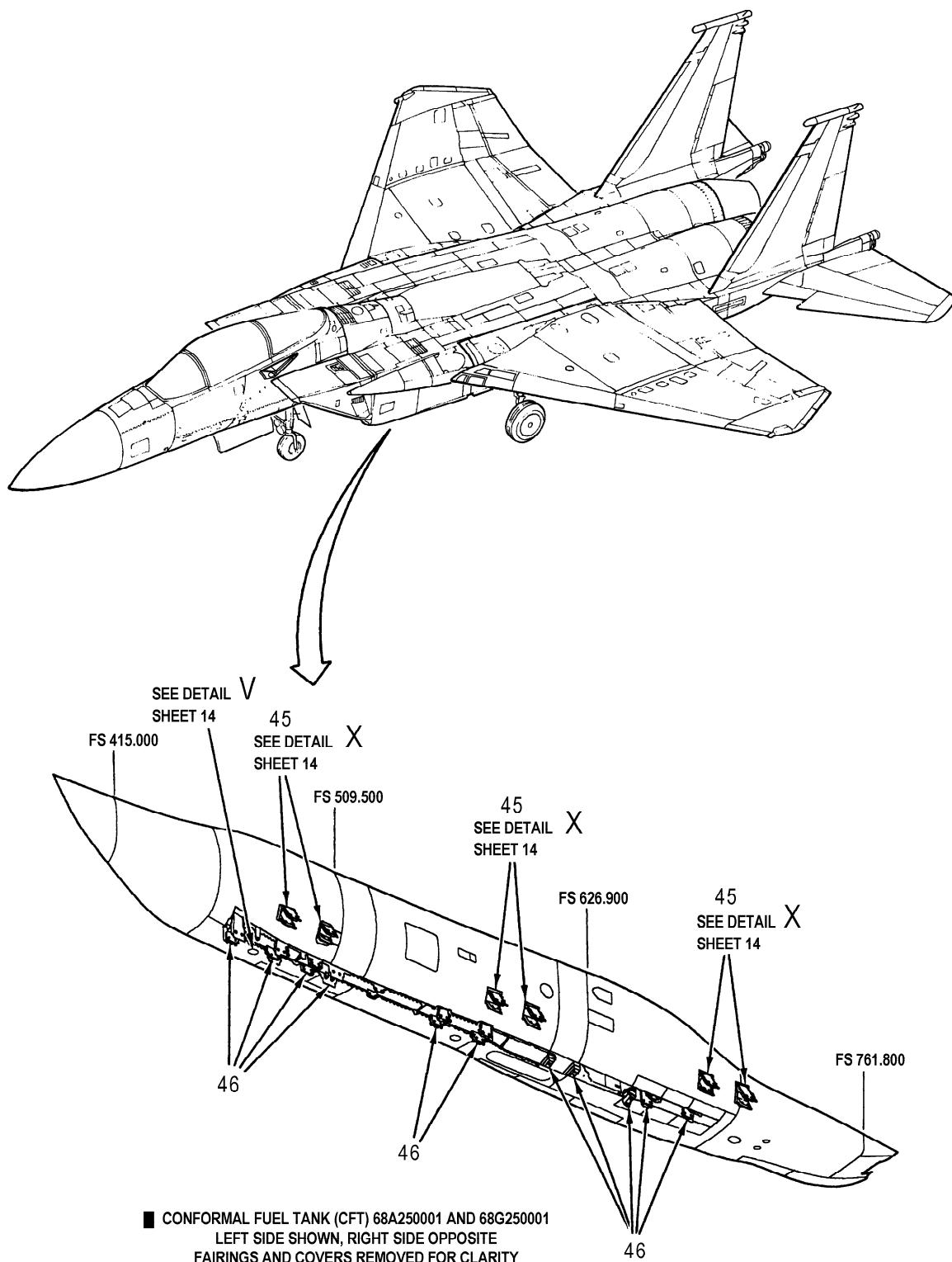


Figure 2-8. Excessive G Aircraft Inspection After Exceeding Positive Load Factor of 9.0g or Negative Load Factor of 3.0g; With External Stores Installed (Sheet 11)



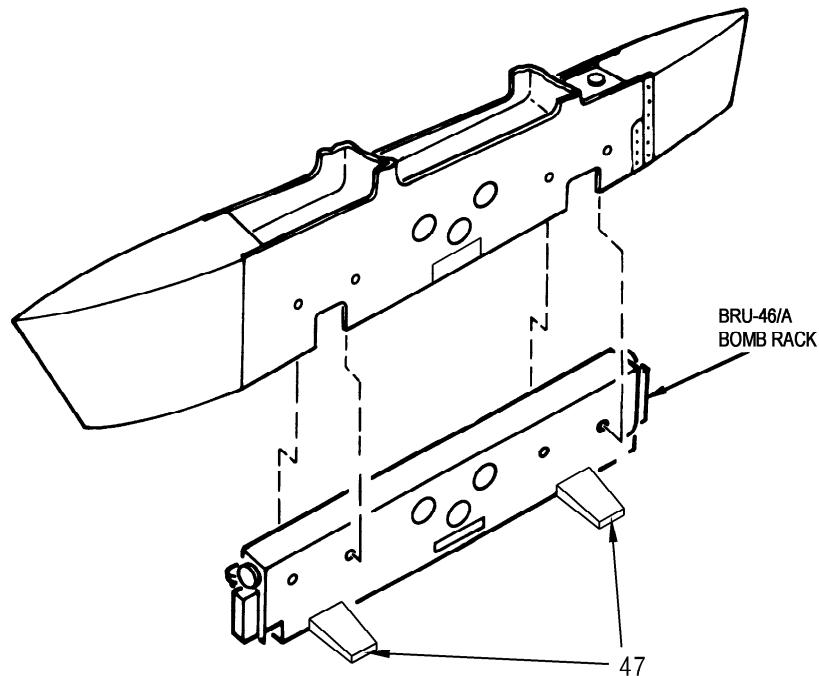
SAN301-02-39-002

Figure 2-8. Excessive G Aircraft Inspection After Exceeding Positive Load Factor of 9.0g or Negative Load Factor of 3.0g; With External Stores Installed (Sheet 12)

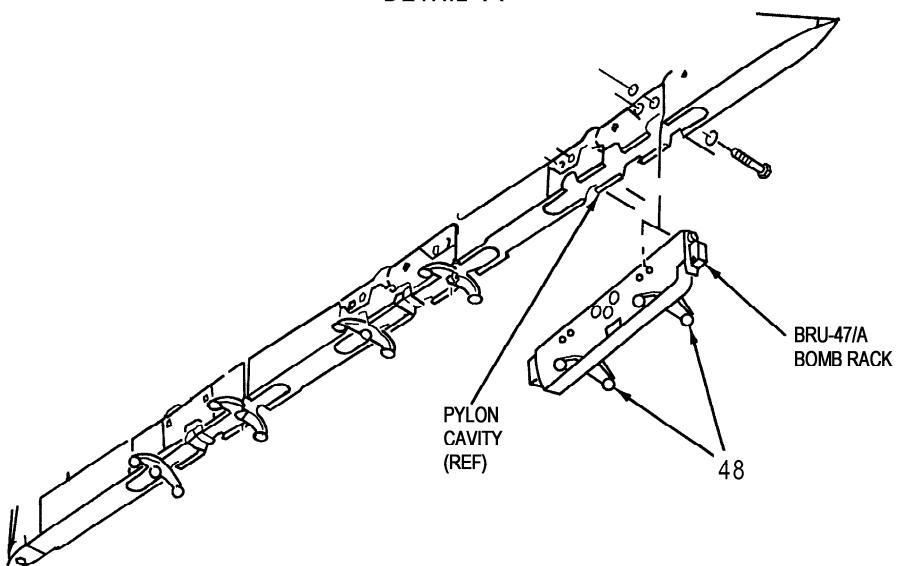


SAN301-02-40-002

Figure 2-8. Excessive G Aircraft Inspection After Exceeding Positive Load Factor of 9.0g or Negative Load Factor of 3.0g; With External Stores Installed (Sheet 13)



DETAIL X



DETAIL V

SAN301-02-41-001

Figure 2-8. Excessive G Aircraft Inspection After Exceeding Positive Load Factor of 9.0g or Negative Load Factor of 3.0g; With External Stores Installed (Sheet 14)

IDX NO.	ITEM	ACCESS	TYPE OF DAMAGE
1	Support, centerline pylon swaybrace post.	Remove pylon (94-32-51).	Cracks, distortion, galling or wear.
2	Hook, jettison pivot.	Remove pylons (94-32-50).	Cracks and/or distortion.
3	Support, inboard pylon swaybrace post.	Remove pylon (94-32-50).	Cracks and/or distortion.
4	Support, outboard pylon swaybrace post.	Remove pylon (94-32-52).	Cracks and/or distortion.
5	Fitting, yaw restraint.	Remove pylon (94-32-51).	Cracks and/or distortion.
6	Post, preload.	Remove pylon (94-32-51).	Cracks and/or evidence of overload.
7	Fittings, swaybrace pad, swaybrace pad retainer.	Stores removed.	Cracks and/or distortion.
8	Skins, pylon.		Buckles, cracks, and distortion. Loose, sheared or missing fasteners, in area of swaybrace post and yaw restraint fitting.
9	Hooks, stores suspension.	Stores removed.	Cracks and/or distortion.
10	Fitting, yaw restraint.	Remove pylon (94-32-50).	Cracks and/or distortion.
11	Post, preload.	Remove pylon (94-32-50).	Cracks and/or evidence of overload.
12	Fittings, swaybrace pad, swaybrace pad retainer.	Stores removed.	Cracks and/or distortion.
13	Skins, pylon.		Buckles, cracks, and distortion. Loose, sheared or missing fasteners, in area of swaybrace post and yaw restraint fitting.
14	Hooks, stores suspension.	Stores removed.	Cracks and/or distortion.
15	Fitting, yaw restraint.	Remove pylon (94-32-52).	Cracks and/or distortion.
16	Post, preload.	Remove pylon (94-32-52).	Cracks and/or evidence of overload.
17	Fittings, swaybrace pad, swaybrace pad retainer.	Stores removed.	Cracks and/or distortion.

Figure 2-8. Excessive G Aircraft Inspection After Exceeding Positive Load Factor of 9.0g or Negative Load Factor of 3.0g; With External Stores Installed (Sheet 15)

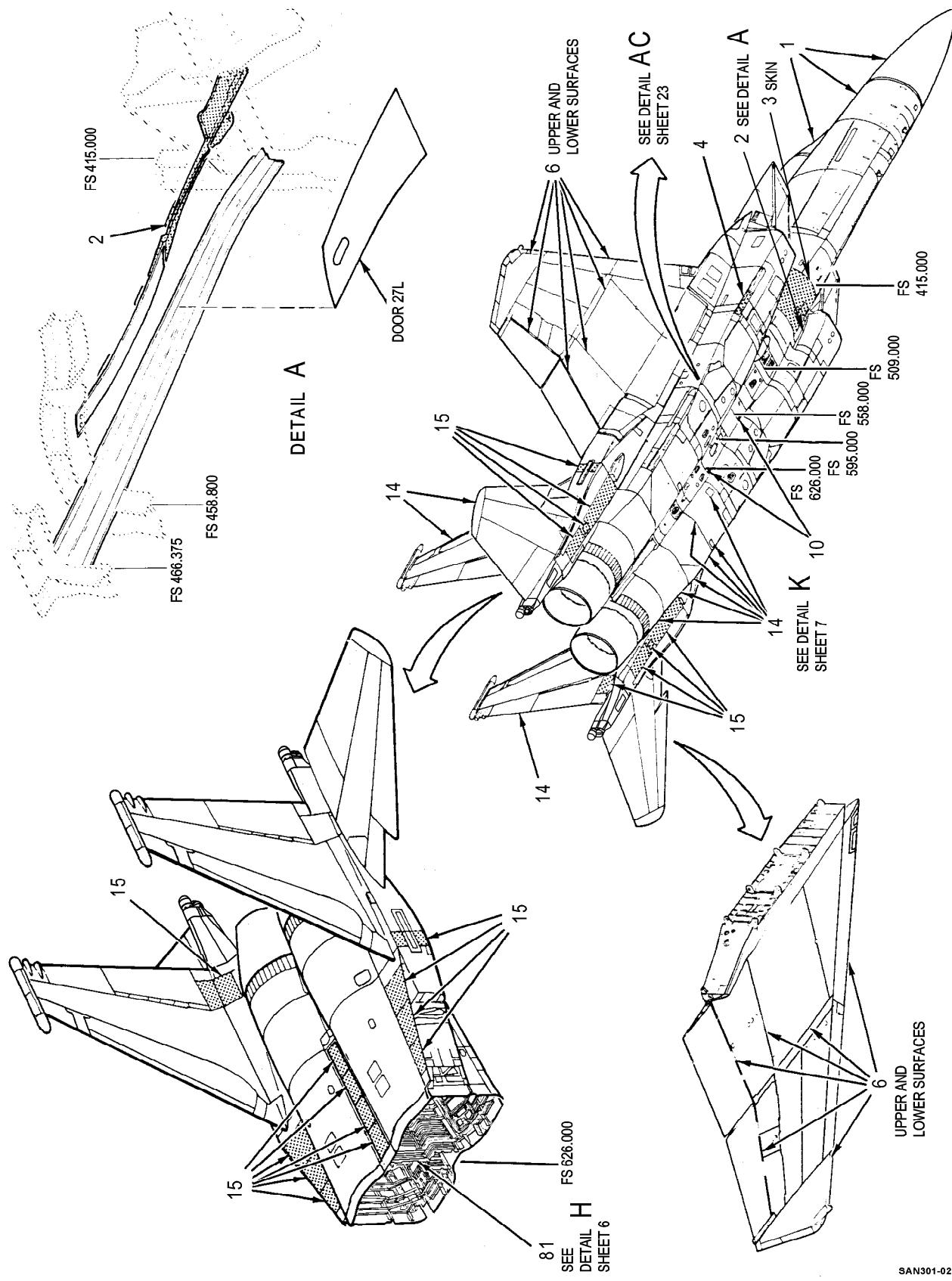
CSTO SR1F-15SA-3-1

IDX NO.	ITEM	ACCESS	TYPE OF DAMAGE
18	Skins, pylon.		Buckles, cracks, and distortion. Loose, sheared or missing fasteners, in area of swaybrace post and yaw restraint fitting.
19	Hooks, stores suspension.	Stores removed.	Cracks and/or distortion.
20	Post, centerline pylon swaybrace.	Remove pylon (94-32-51).	Evidence of galling and/or cracks.
21	Hook, centerline pylon.	Remove pylon (94-32-51).	Cracks and/or distortion.
22	Hook, inboard pylon.	Remove pylon (94-32-50).	Cracks and/or distortion.
23	Post, inboard pylon swaybrace.	Remove pylon (94-32-50).	Evidence of galling and/or cracks.
24	Ball, pylon aft pivot.	Remove pylon (94-32-50 and 94-32-51).	Cracks and/or distortion.
25	Hook, jettison pivot.	Stores removed.	Cracks and/or distortion.
26	Hook, outboard pylon.	Remove pylon (94-32-52).	Cracks and/or distortion.
27	Post, outboard pylon swaybrace.	Remove pylon (94-32-52).	Evidence of galling and/or cracks.
28	Ball, pylon aft pivot.	Remove pylon (94-32-52).	Cracks and/or distortion.
29	Skins, exterior surfaces at attach points with rings between TS 70.00 and TS 190.00.		Buckles and cracks around welds and/or fasteners.
30	Lugs, suspension.	Remove fuel tank (05-00-15).	Cracks and/or distortion.
31	Ball, fuel tank aft pivot.	Remove fuel tank (05-00-15).	Cracks and/or distortion.
32	Skin, external surfaces in areas mating pylon swaybrace pads.	Remove fuel tank (05-00-15).	Dents in skin.
33	1 Skins, pylon, areas mating ADU-552/A launcher adapter.	Remove launcher adapter (94-31-28).	Dents, buckles or cracks.
34	1 Skins, pylon, areas mating MX12427/A dual rail launcher adapter.	Remove launcher adapter (94-31-29).	Dents, buckles or cracks.
35	Rails, LAU-117() missile launcher.	Missiles removed.	Cracks and/or distortion.
36	Rails, LAU-118() missile launcher.	Missiles removed.	Cracks and/or distortion.
37	Rails, LAU-114A/A or LAU-128() missile launcher.	Missiles removed.	Cracks and/or distortion.

Figure 2-8. Excessive G Aircraft Inspection After Exceeding Positive Load Factor of 9.0g or Negative Load Factor of 3.0g; With External Stores Installed (Sheet 16)

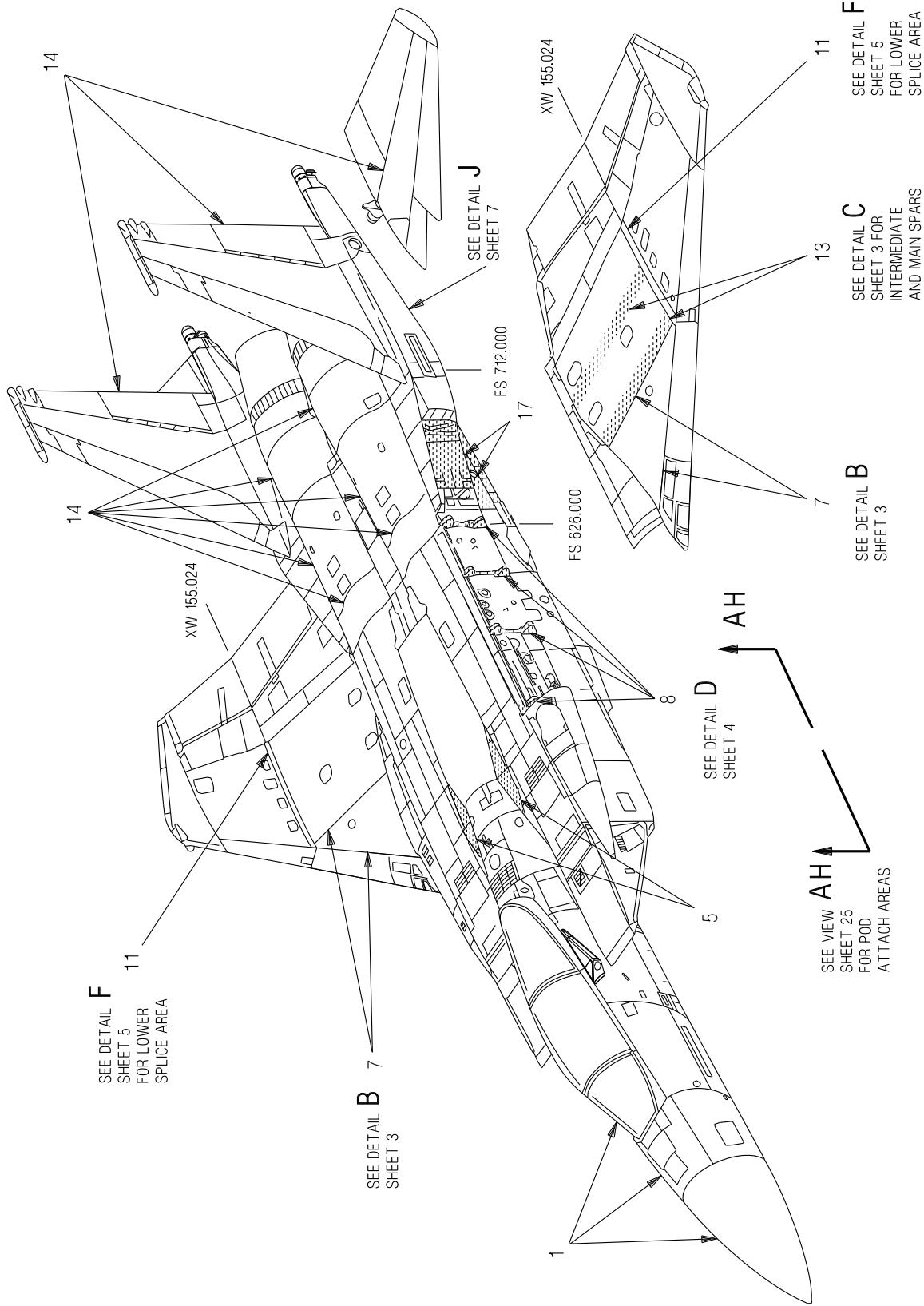
IDX NO.	ITEM	ACCESS	TYPE OF DAMAGE
38	Supports, ADU-407/A or ADU-552/A launcher adapter.	Remove launcher adapter (94-31-28).	Cracks and/or distortion.
39	Cover, ADU-552/A launcher adapter.	Remove missile launcher (94-31-28).	Buckles, cracks, and distortion.
40	Supports, MX12427/A dual rail launcher adapter.	Remove launcher adapter (94-31-29)	Cracks and/or distortion.
41	Cover, MX12427/A dual rail launcher adapter.	Remove launcher adapter (94-31-29).	Buckles, cracks and distortion.
42	Cover, LAU-117() missile launcher.	Remove missile launcher (94-32-31).	Buckles, cracks, and distortion.
43	Cover, LAU-118() missile launcher.	Remove missile launcher (94-32-53).	Buckles, cracks, and distortion.
44	Cover, LAU-114A/A or LAU-128() missile launcher.	Remove missile launcher (94-31-27).	Buckles, cracks, and distortion.
45	CFT forward, center, and aft BRU-46/A bomb racks.	Bomb racks removed (94-32-38).	Cracks and distortion in fittings. sheared fasteners, bearing failure.
46	CFT forward, center and aft BRU-47/A bomb racks.	Bomb racks removed (94-32-40).	Cracks and distortion in fittings. sheared fasteners, bearing failure.
47	BRU-46/A fittings, swaybrace pads, and swaybrace pad retainer.	Stores removed.	Cracks and/or distortion.
48	BRU-47/A fittings, swaybrace pads, and swaybrace pad retainer.	Stores removed.	Cracks and/or distortion.
49	FS 558.5 bulkhead, centerline pylon hook bearing pad, and lower bulkhead.		Cracks, galling, excessive wear. Loose, sheared or missing fasteners.
50	Supports LAU-117() missile launcher.	Remove missile launcher (94-32-31).	Buckles, cracks, and distortion.
51	Supports LAU-118() missile launcher.	Remove missile launcher (94-32-53).	Buckles, cracks, and distortion.
1 → Inspection required only when adapter and missile launcher was installed.			

Figure 2-8. Excessive G Aircraft Inspection After Exceeding Positive Load Factor of 9.0g or Negative Load Factor of 3.0g; With External Stores Installed (Sheet 17)



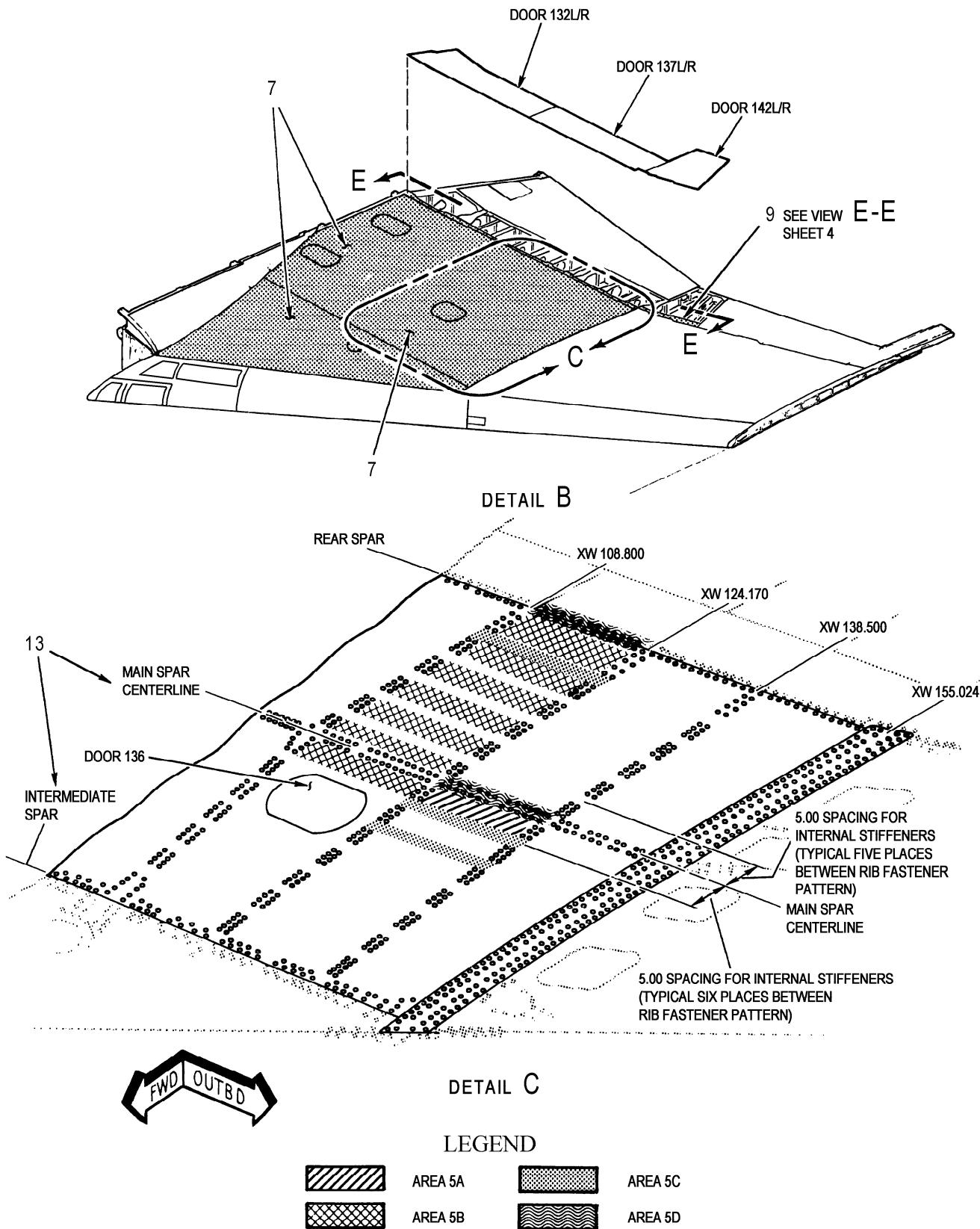
SAN301-02-42-001

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 1 of 36)



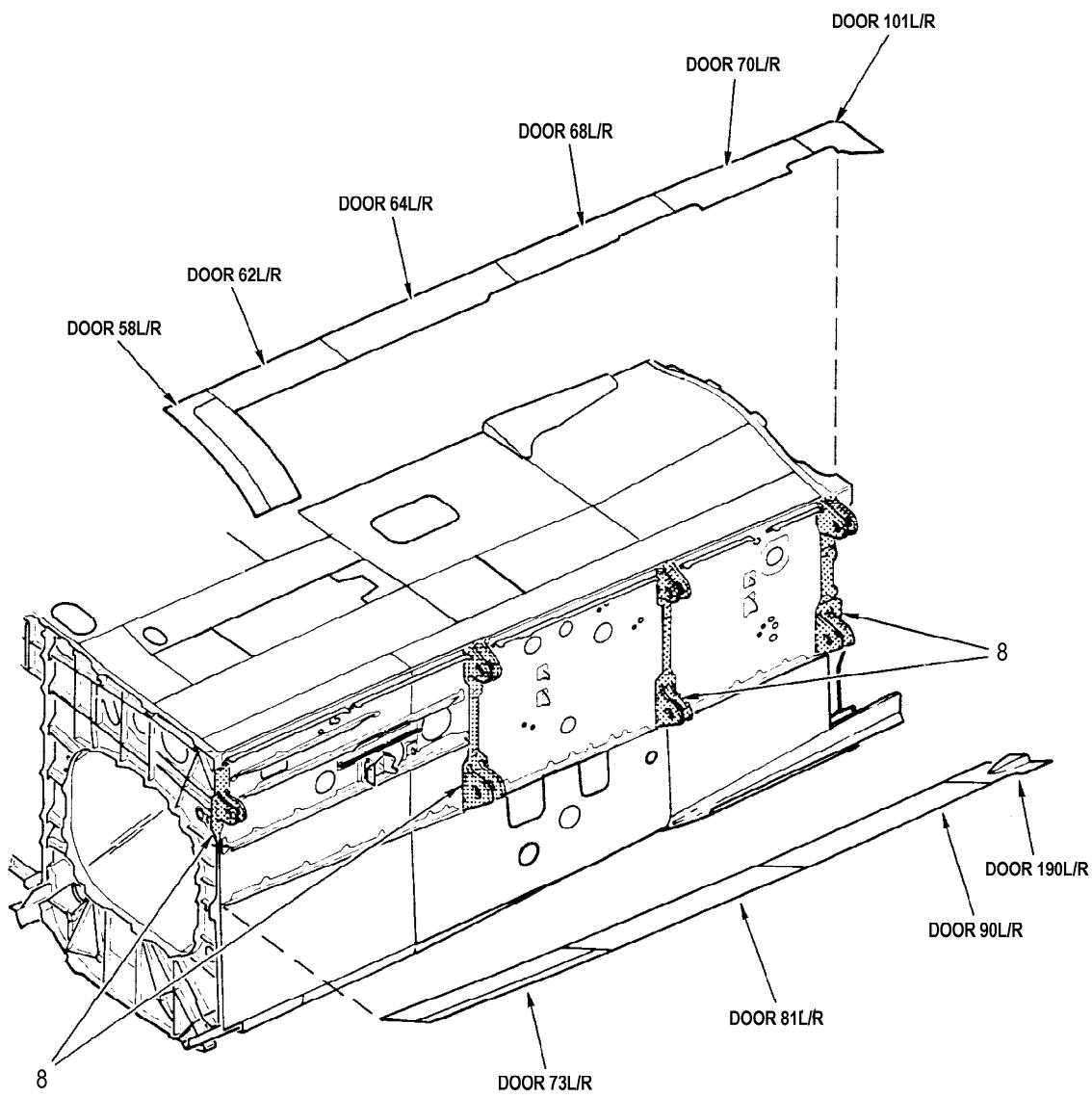
SAN301-02-43-001

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 2)

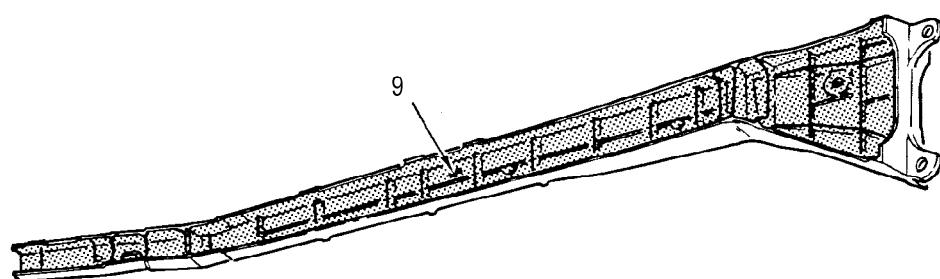


SAN301-02-44-001

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 3)



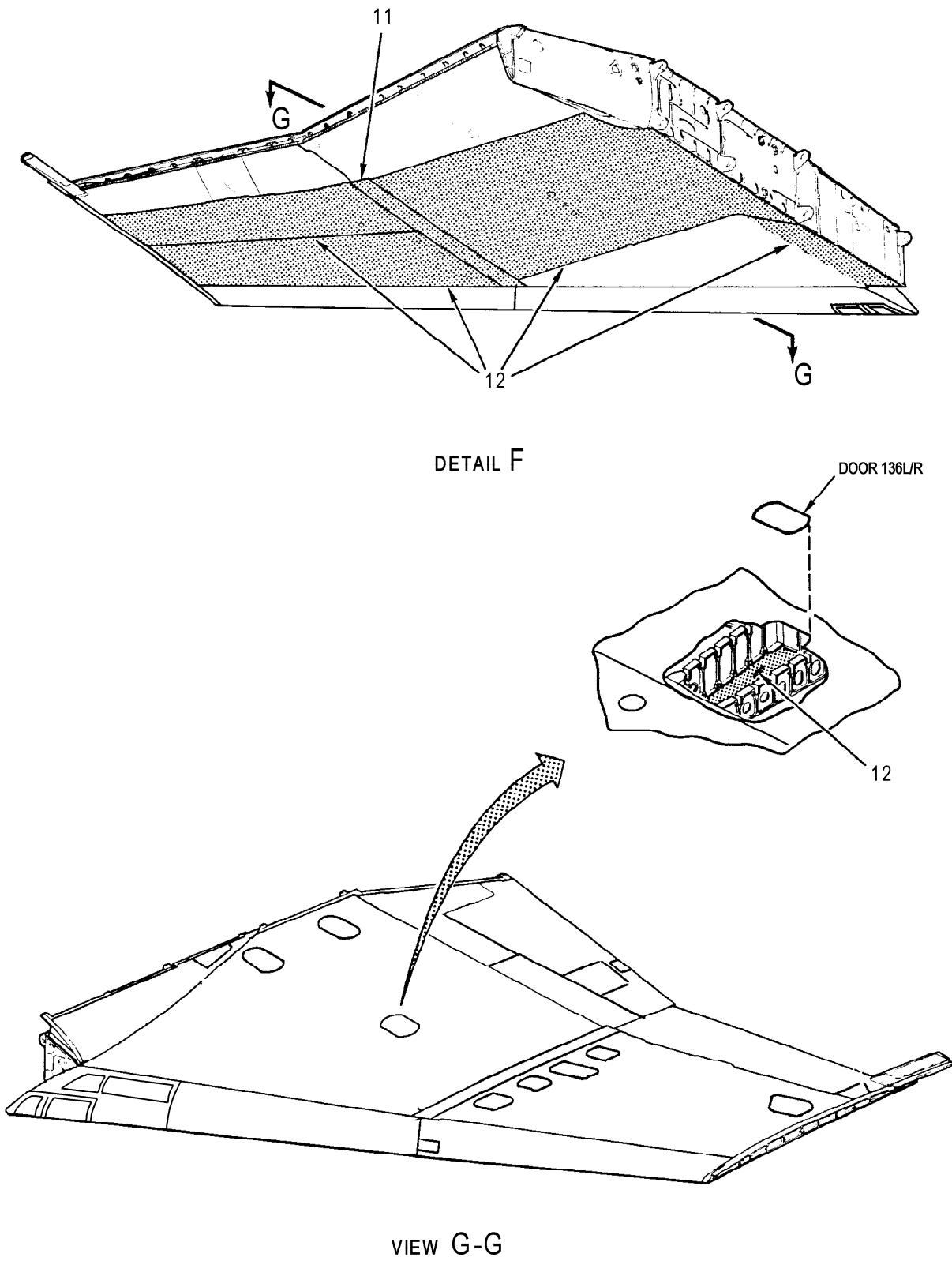
DETAIL D
WING REMOVED FOR CLARITY



VIEW E-E

SAN301-02-45-002

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 4)



SAN301-02-46-001

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 5)

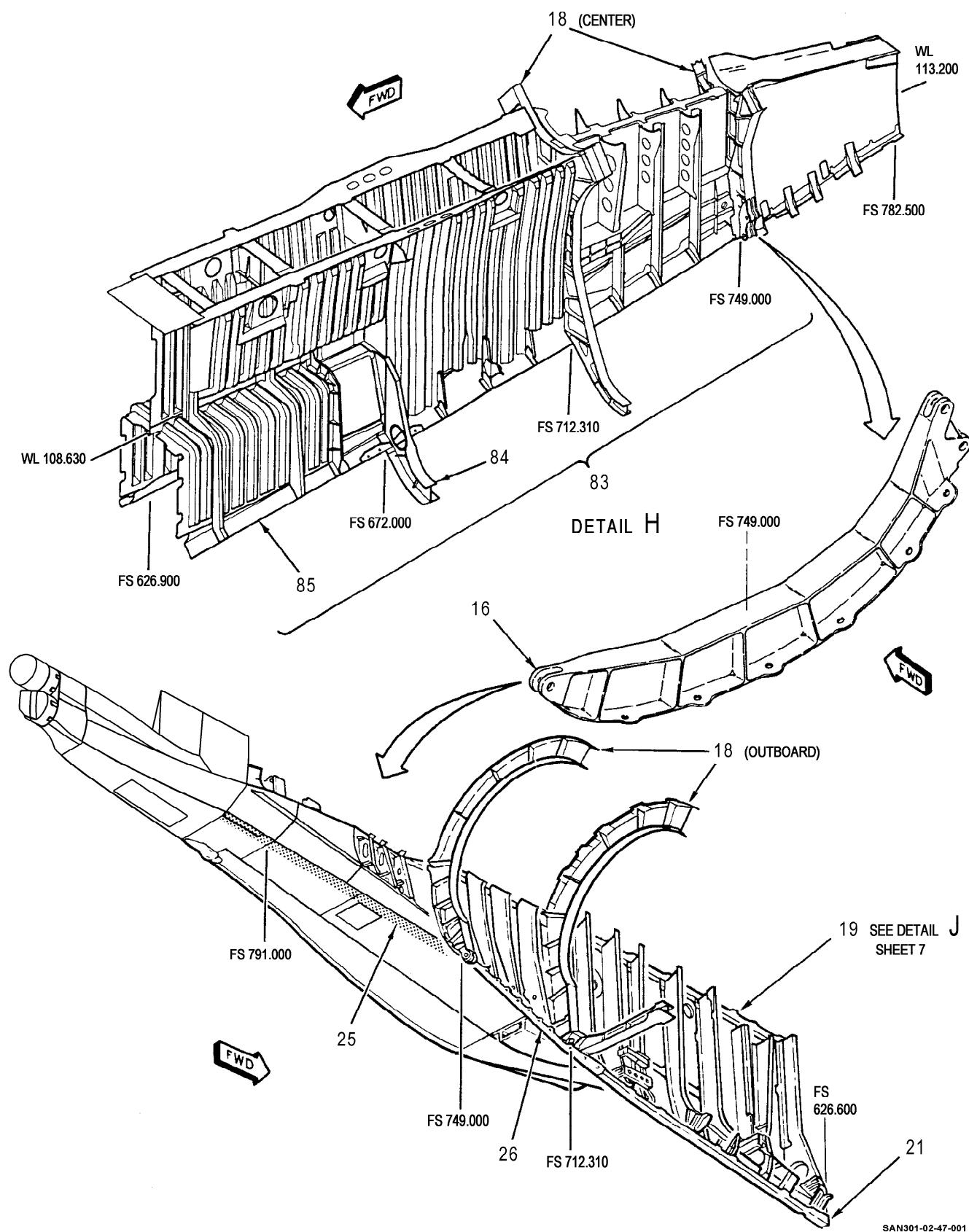


Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 6)

CSTO SR1F-15SA-3-1

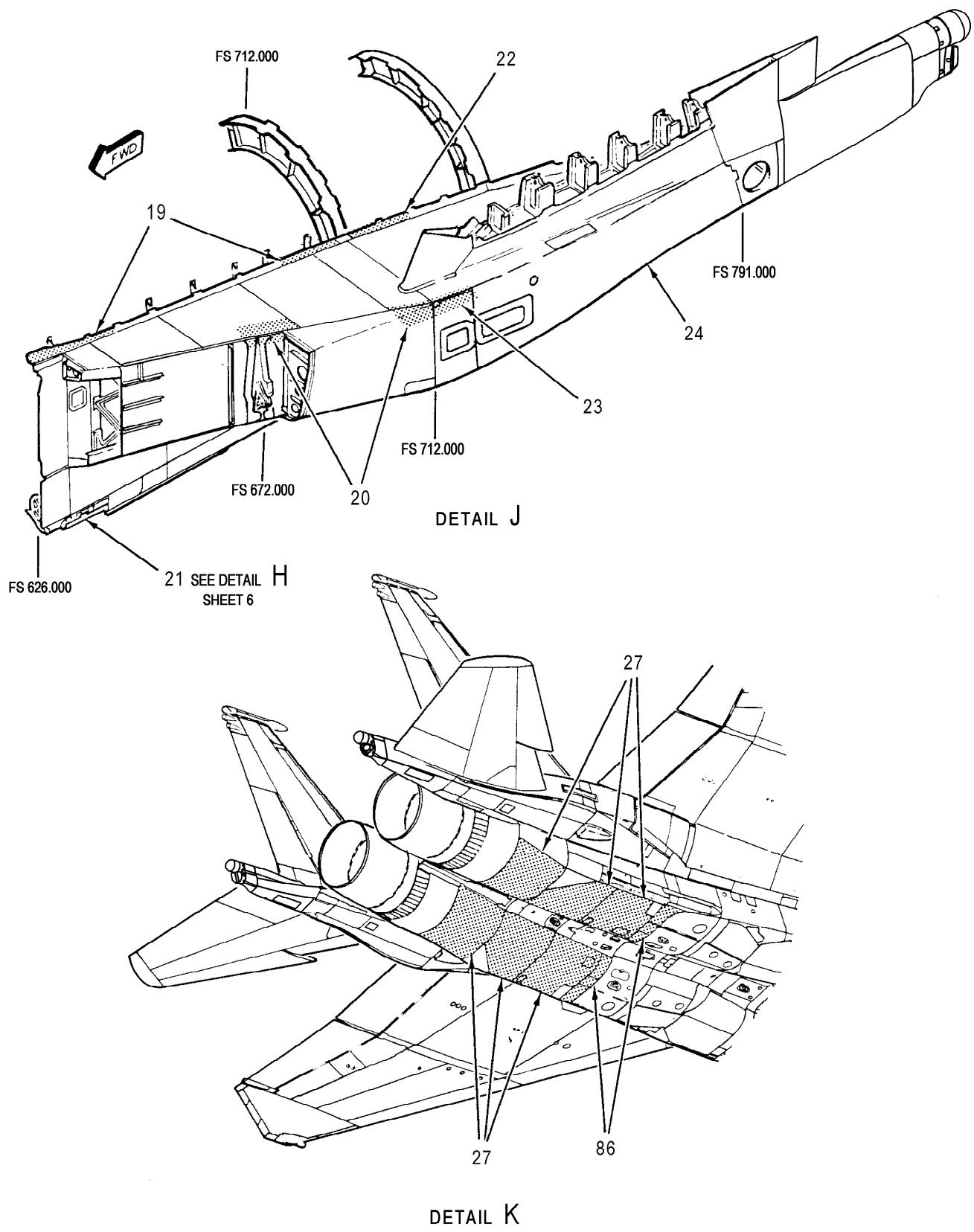


Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 7)

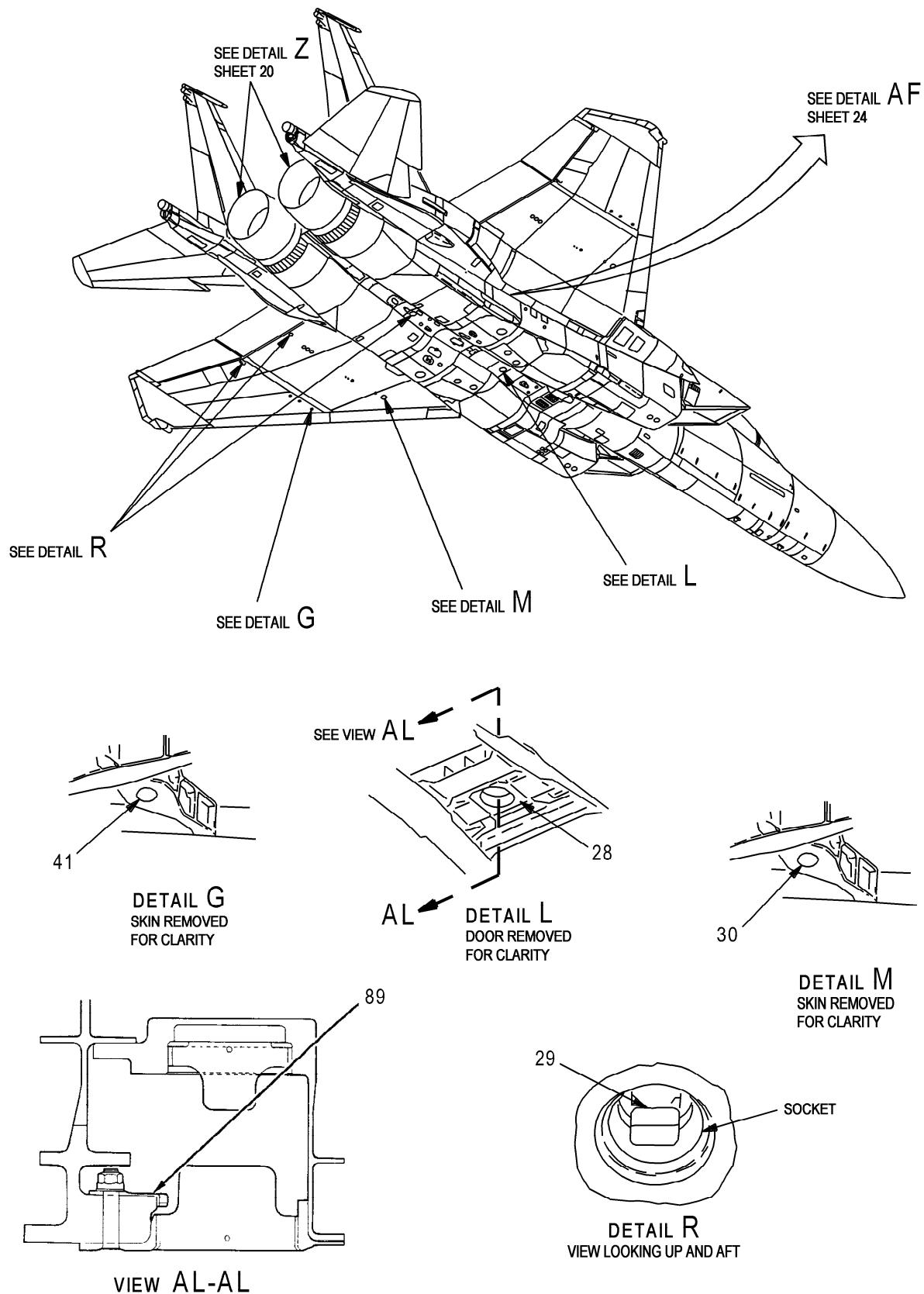
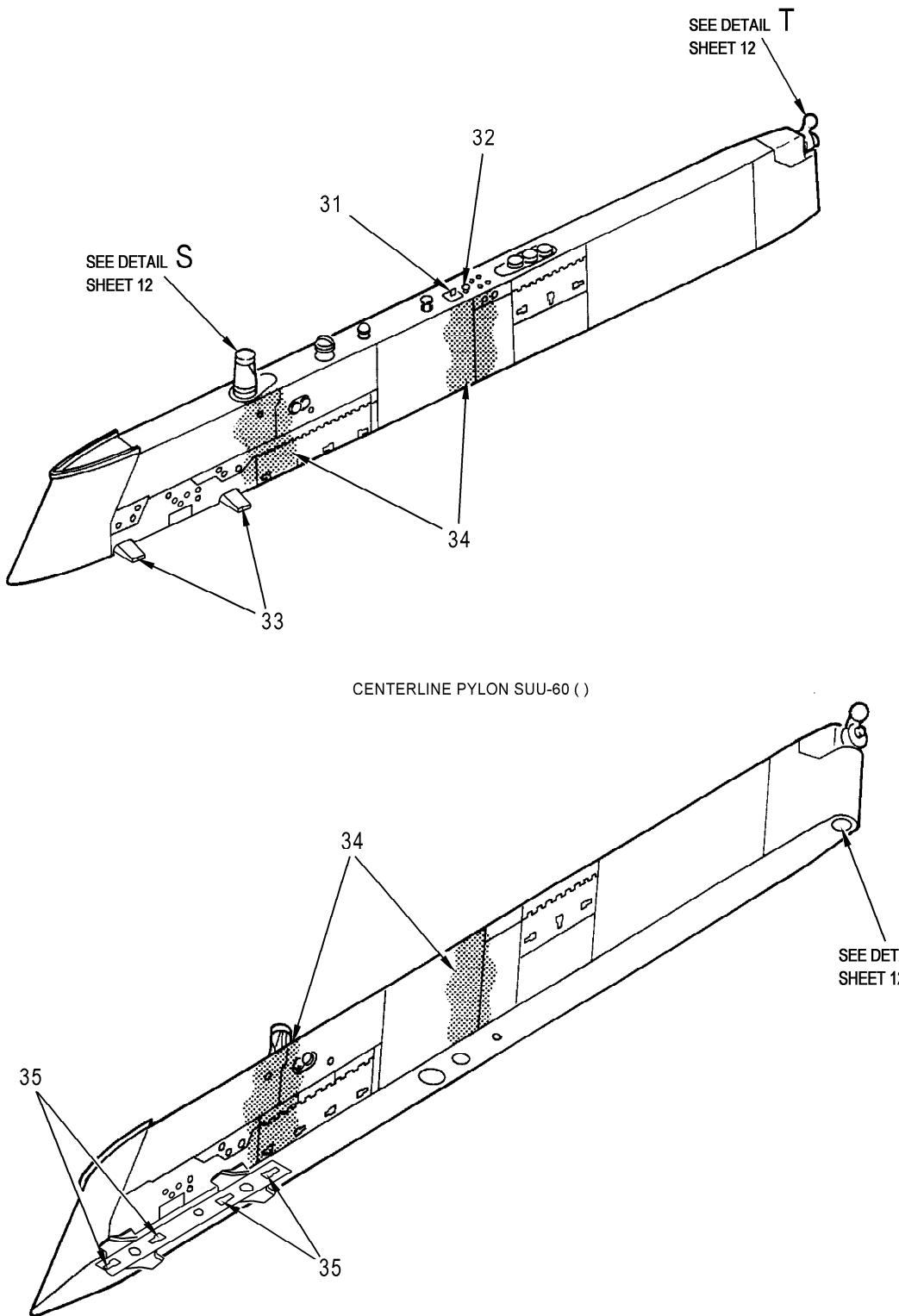


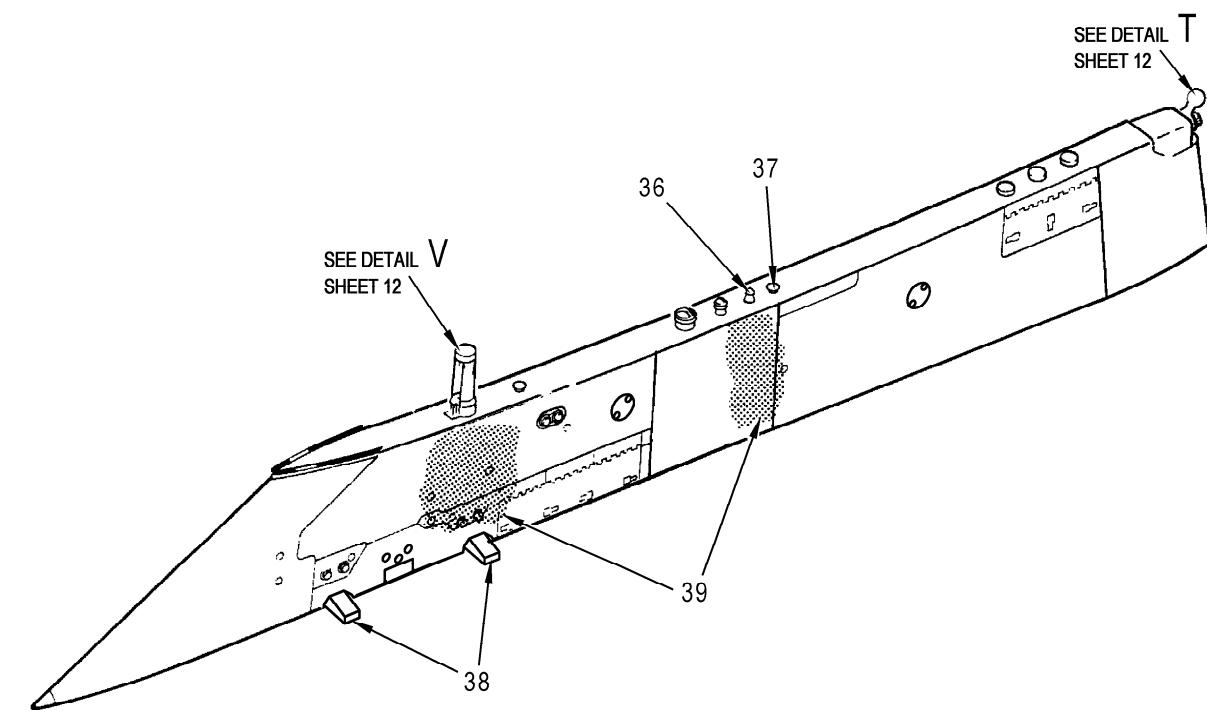
Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 8)

SAN301-02-49-001

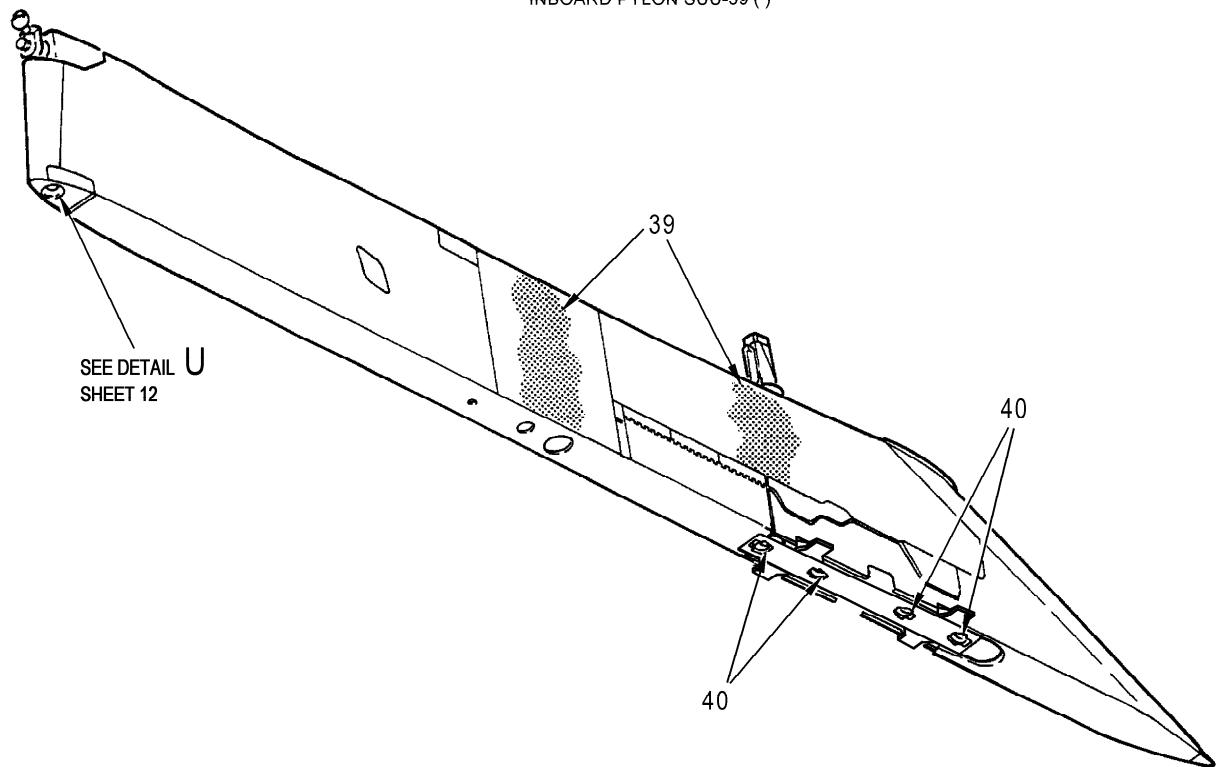


SAN301-02-50-001

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 9)



INBOARD PYLON SUU-59 ()



SAN301-02-51-001

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 10)

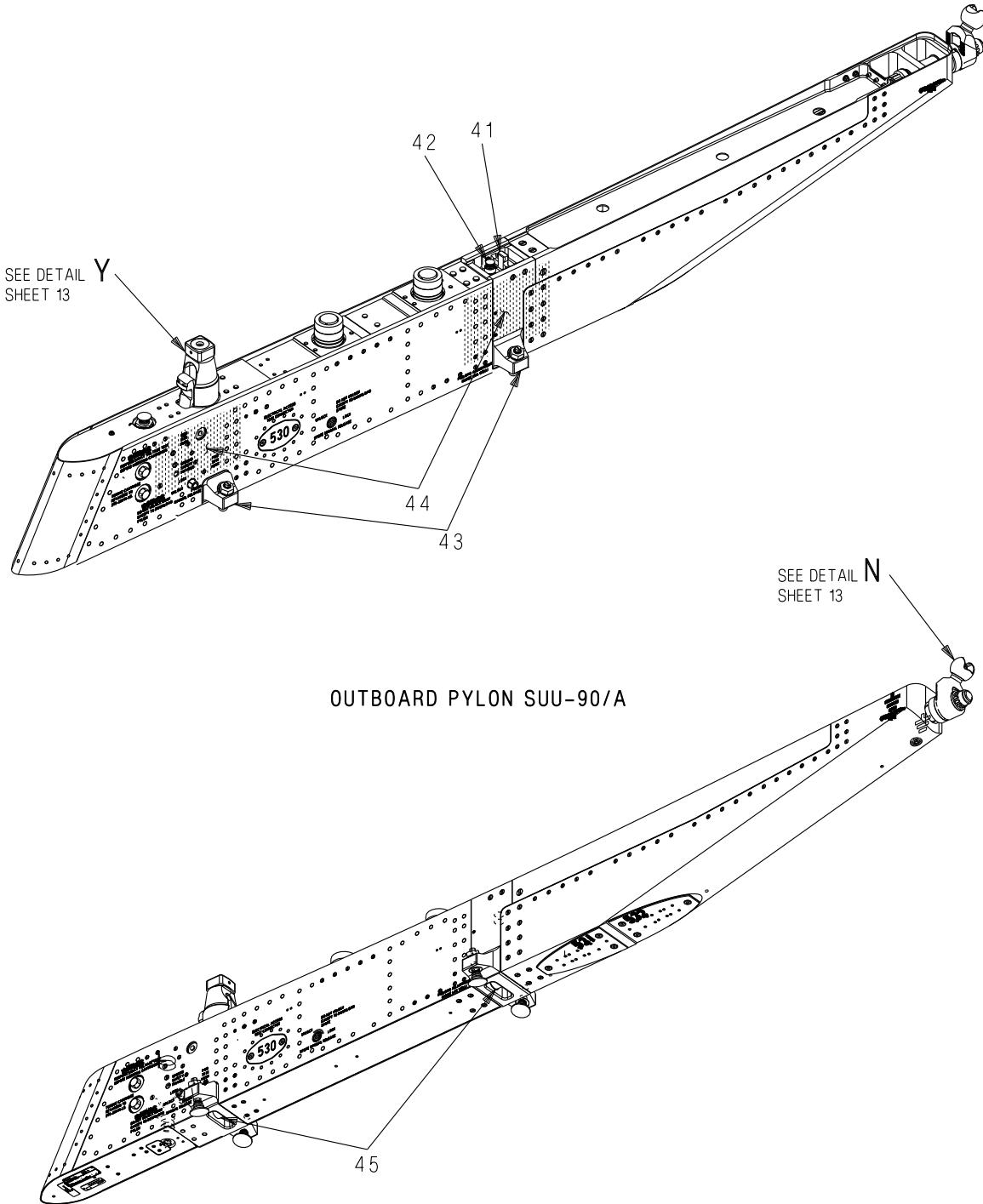
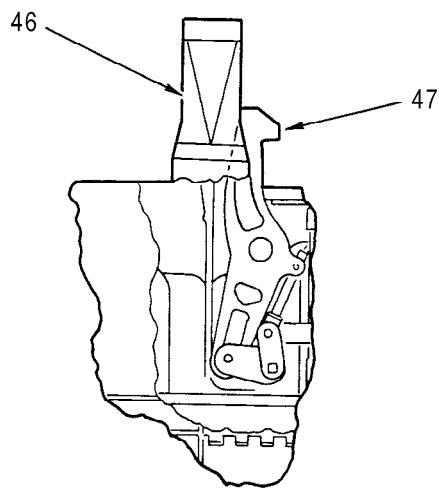
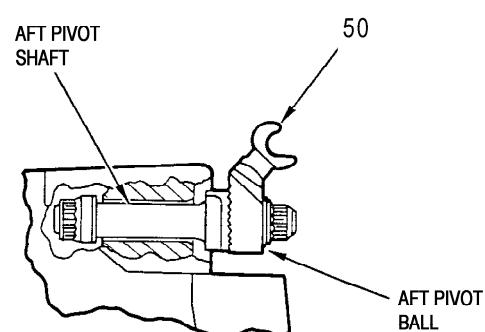
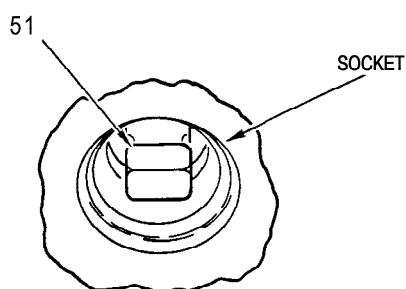
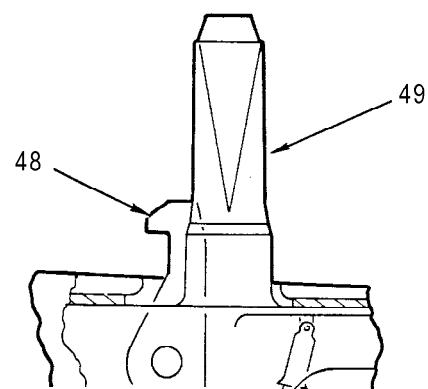


Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 11)



DETAIL S

DETAIL T
TYPICALDETAIL U
VIEW LOOKING UP AND AFT

DETAIL V

SAN301-02-52-001

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 12)

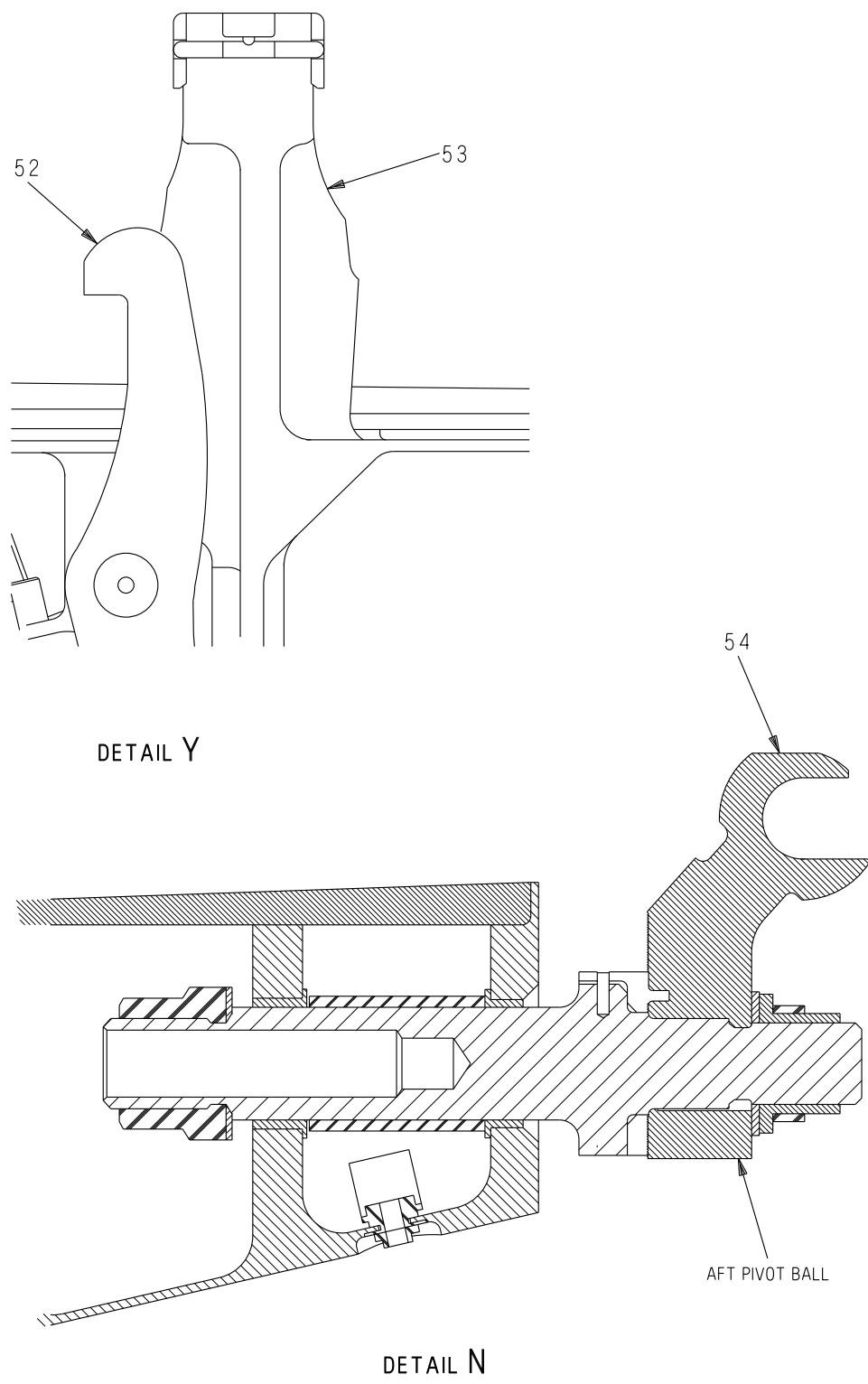
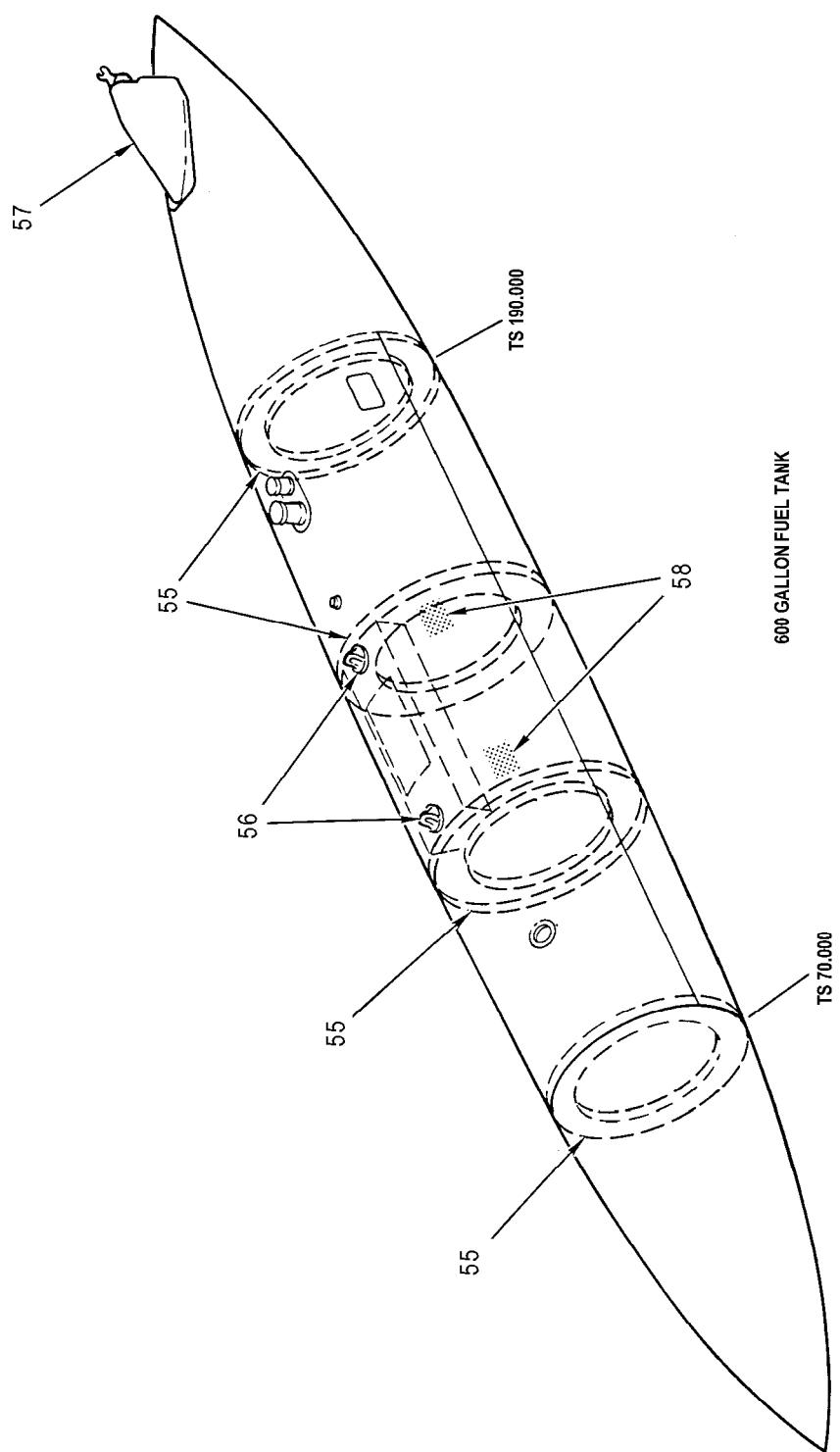
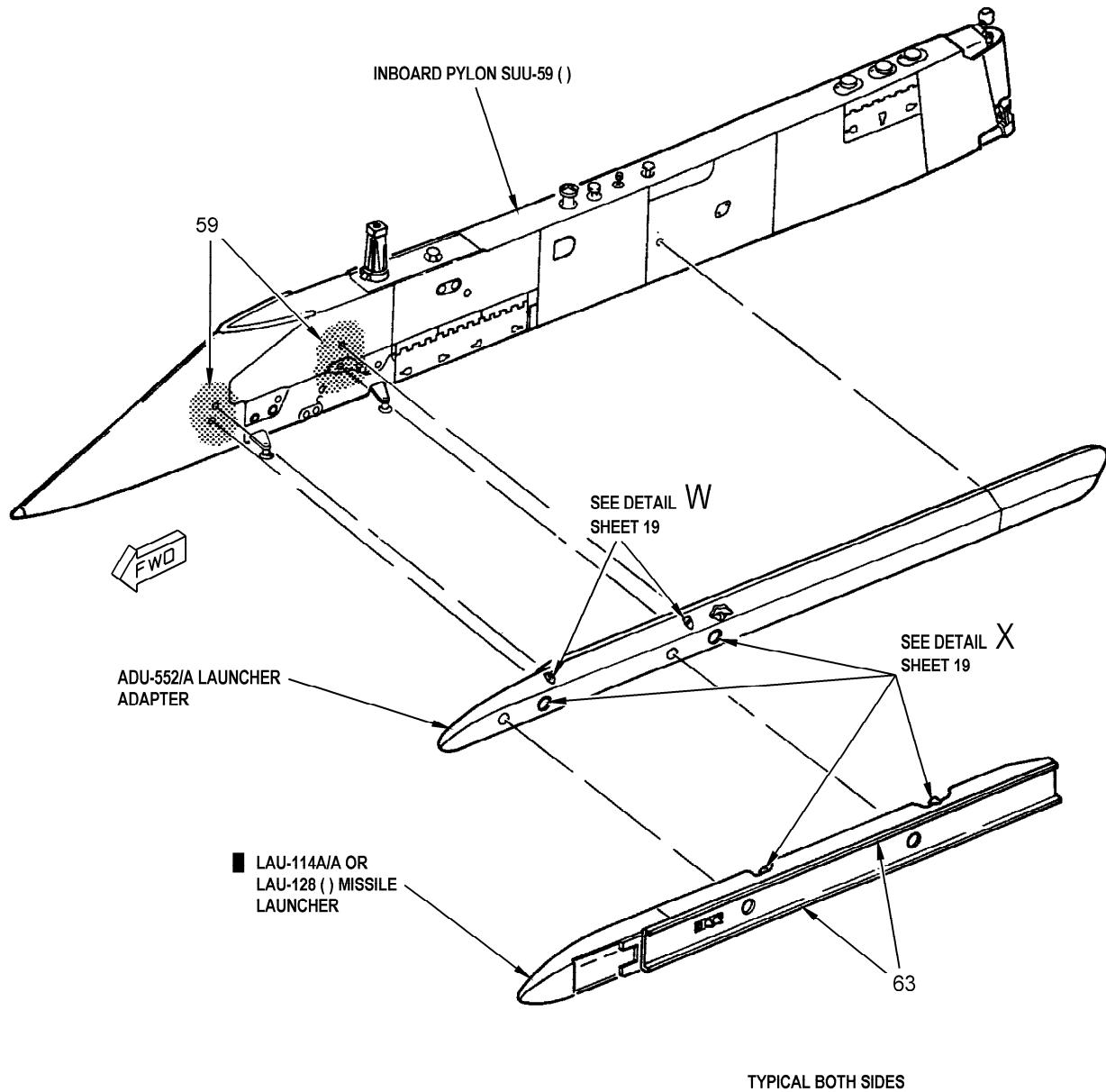


Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 13)



SAN301-02-53-002

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 14)



SAN301-02-54-002

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 15)

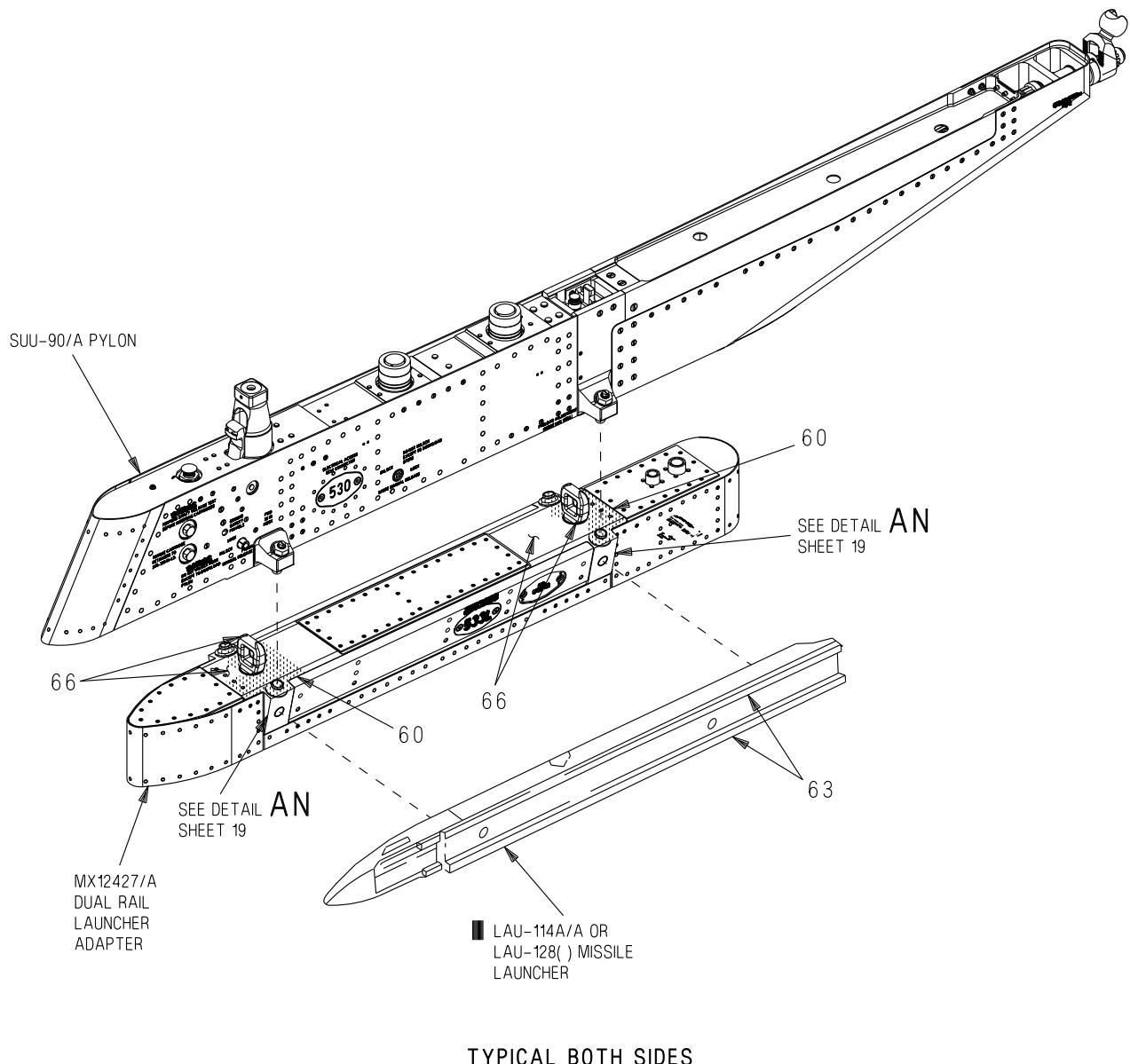


Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 16)

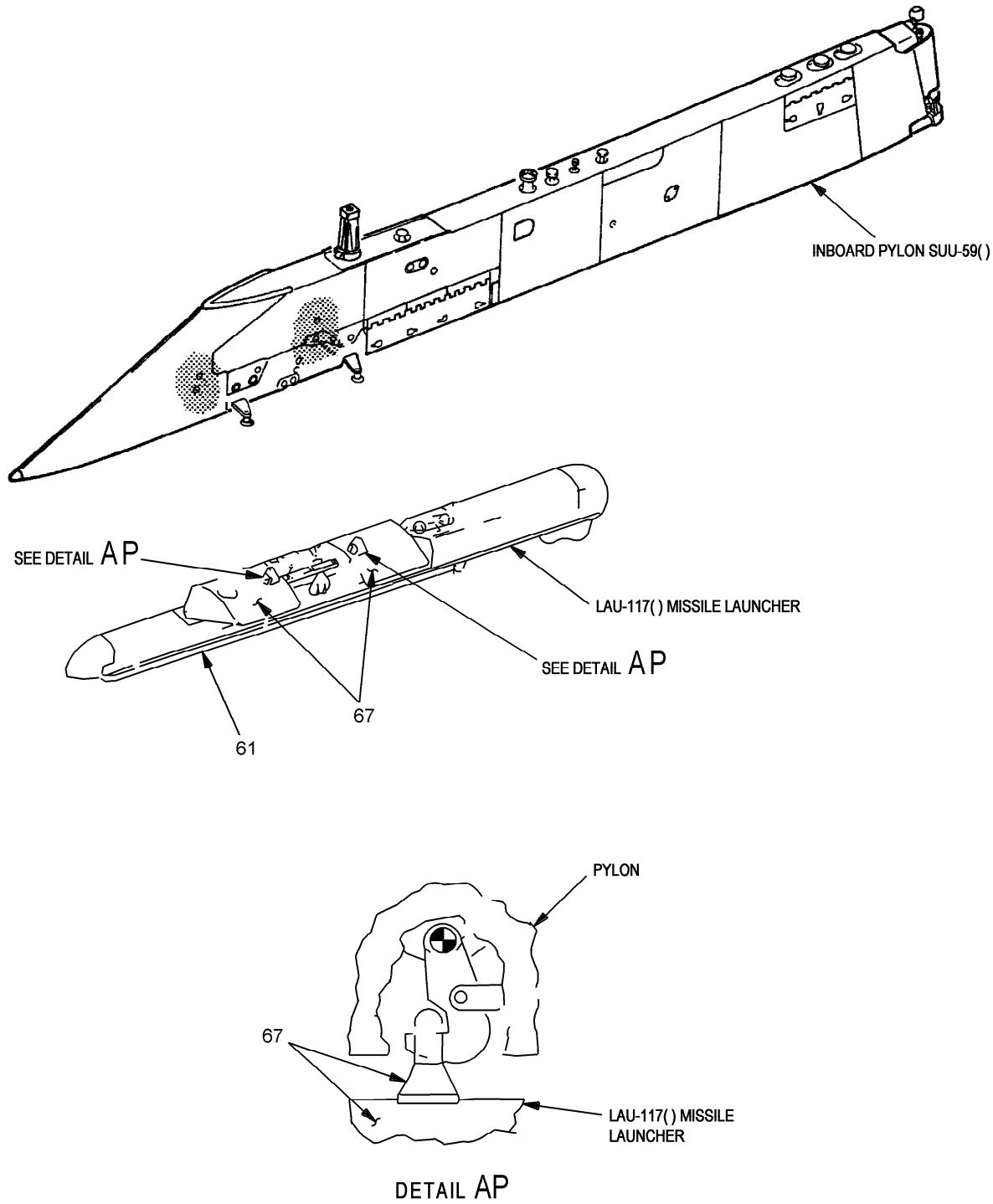


Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 17)

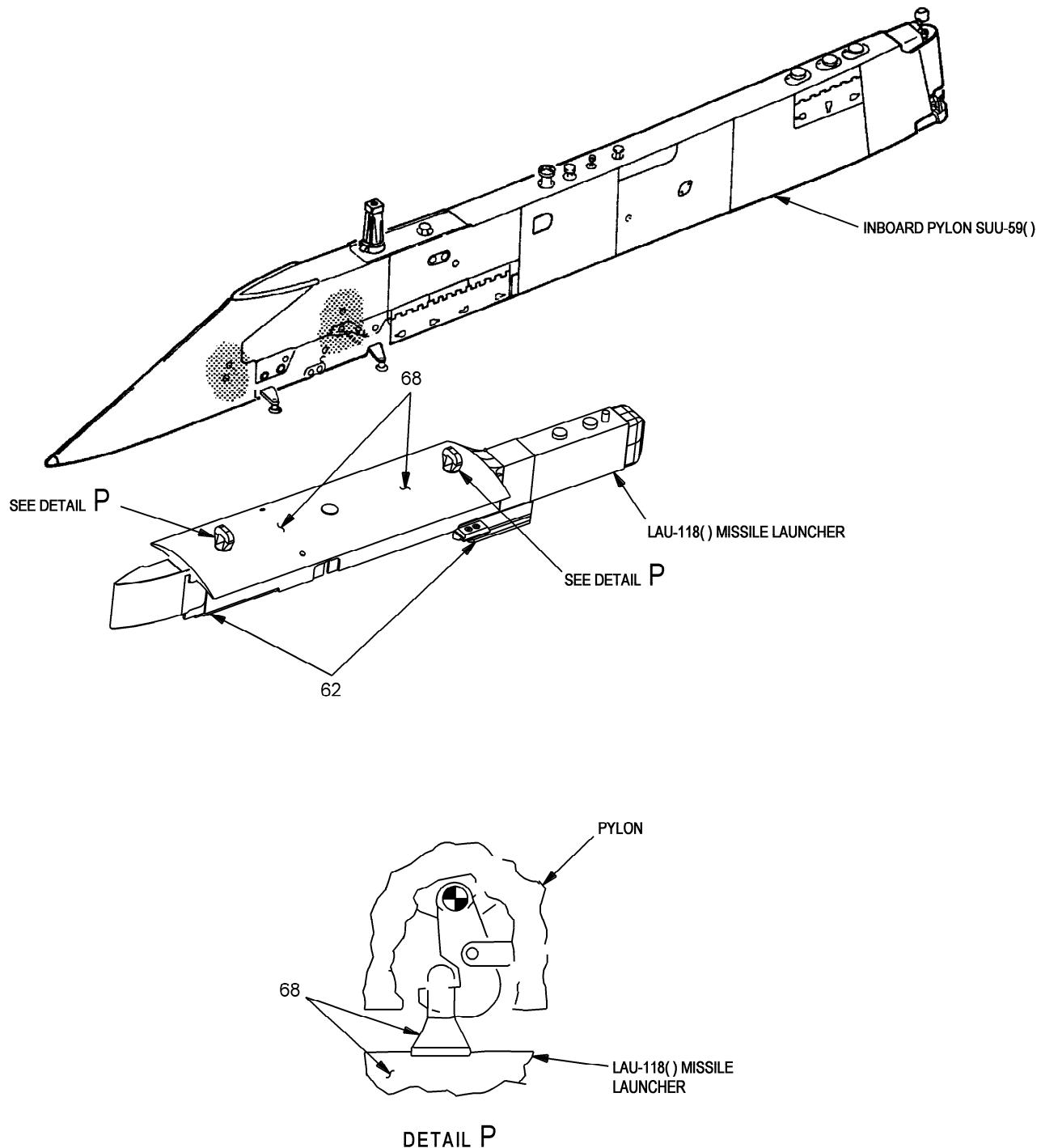
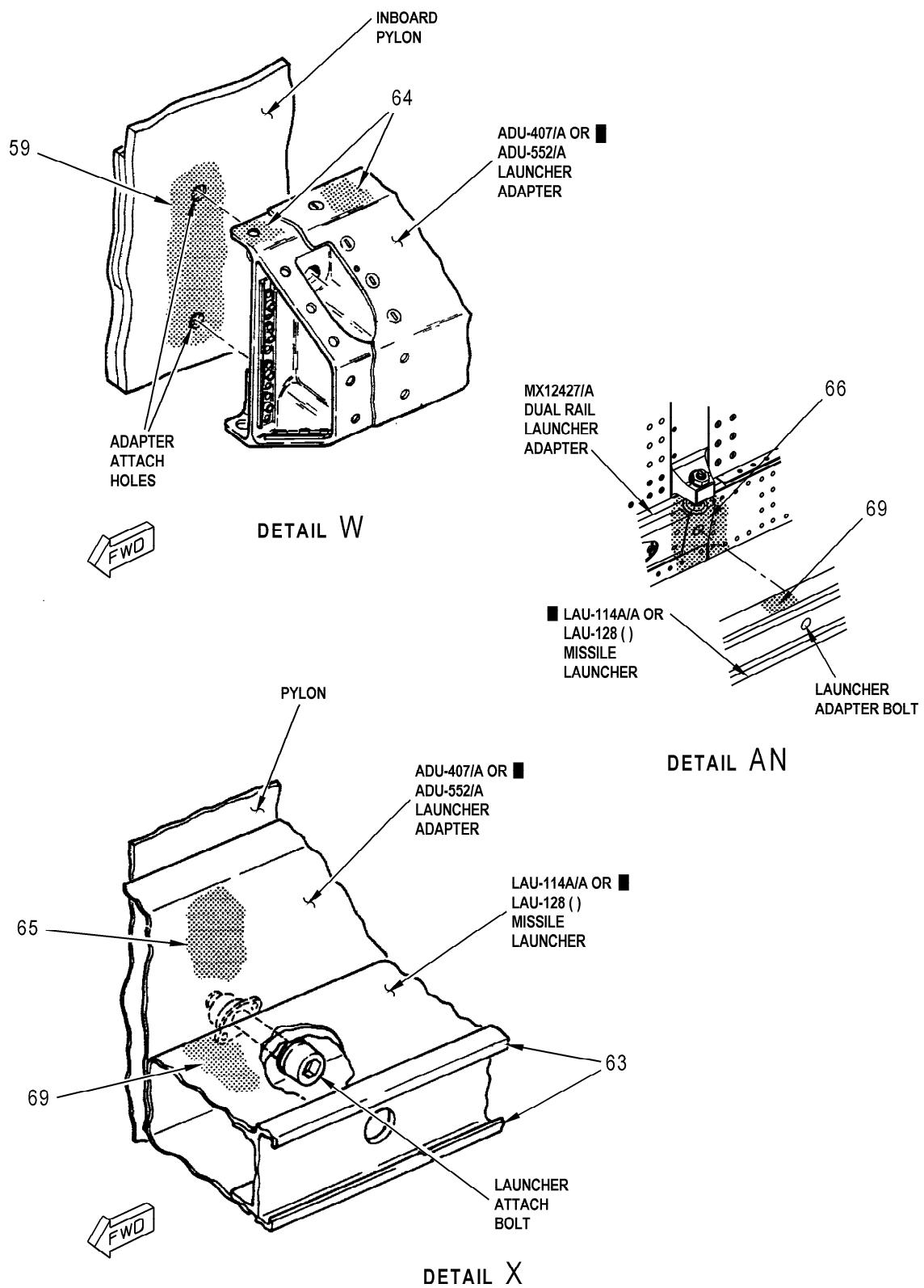


Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 18)



SAN301-02-55-002

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 19)

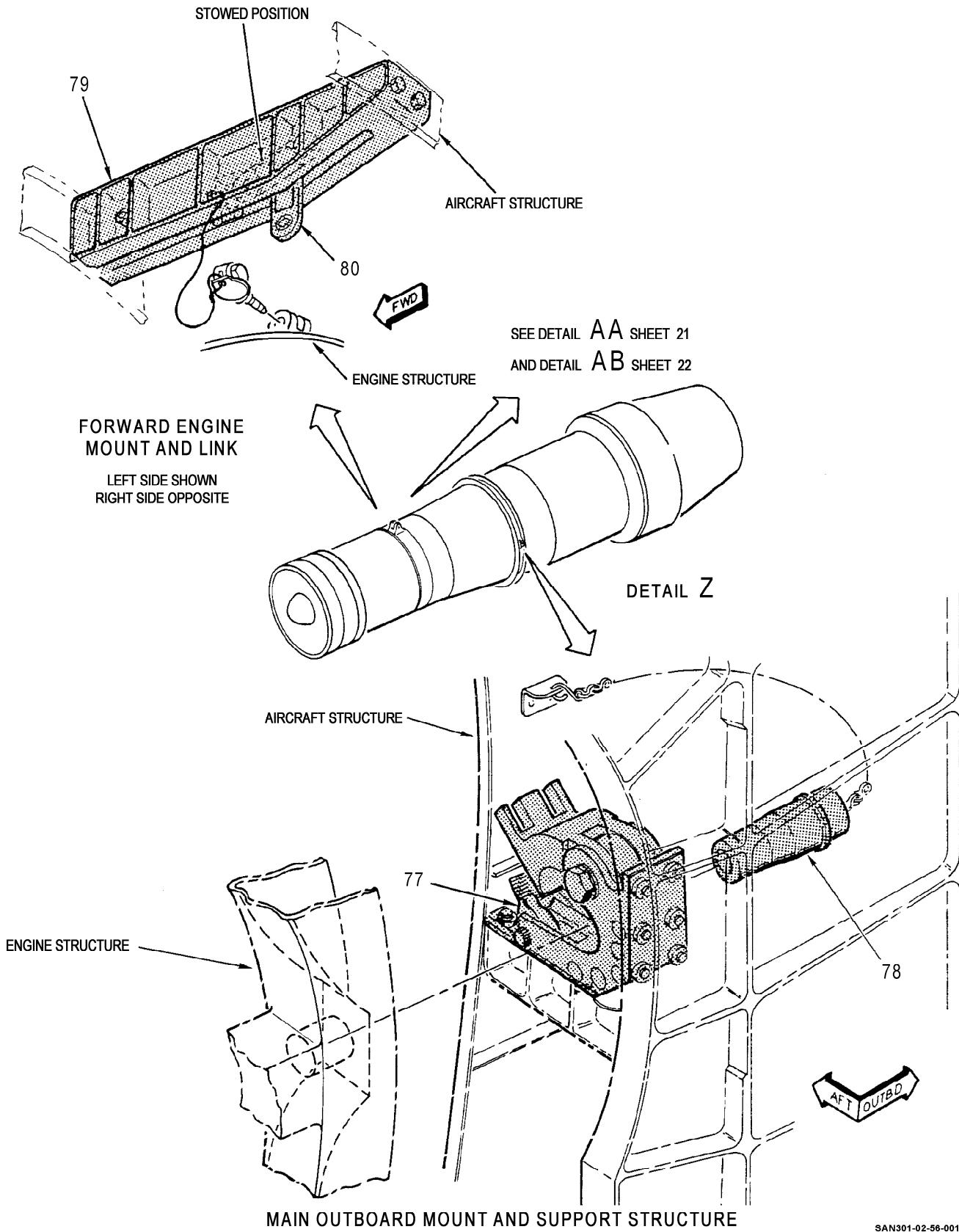
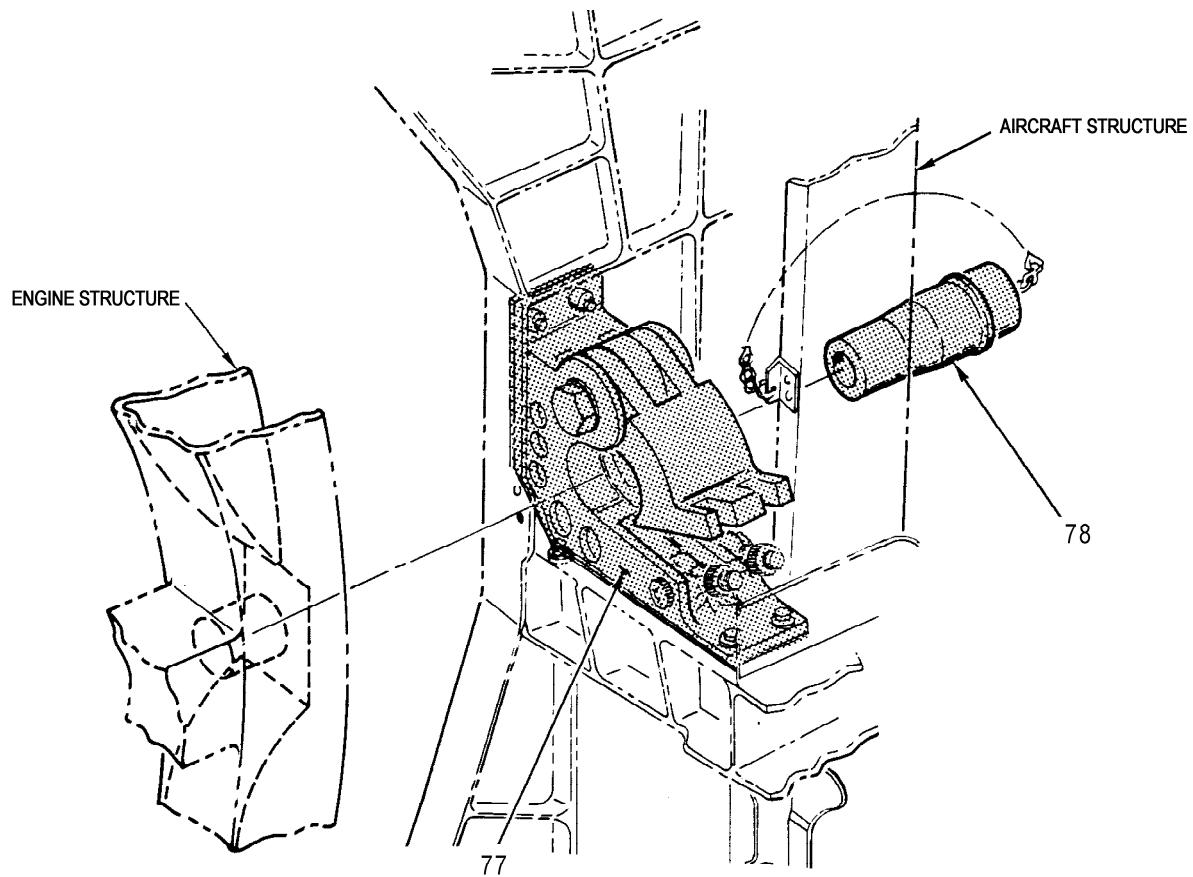


Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 20)



MAIN INBOARD MOUNT
AND SUPPORT STRUCTURE

DETAIL AA

SAN301-02-57-001

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 21)

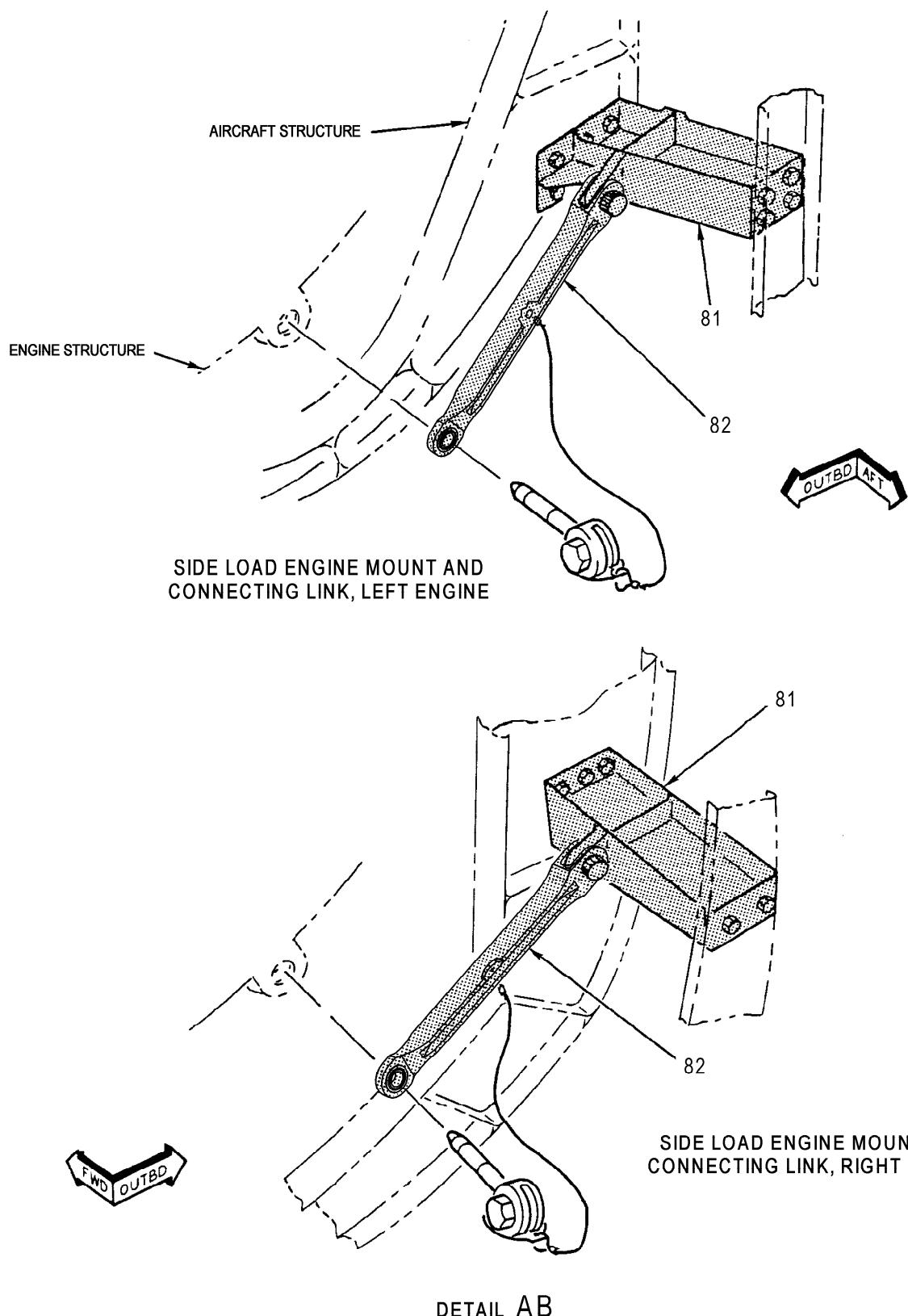
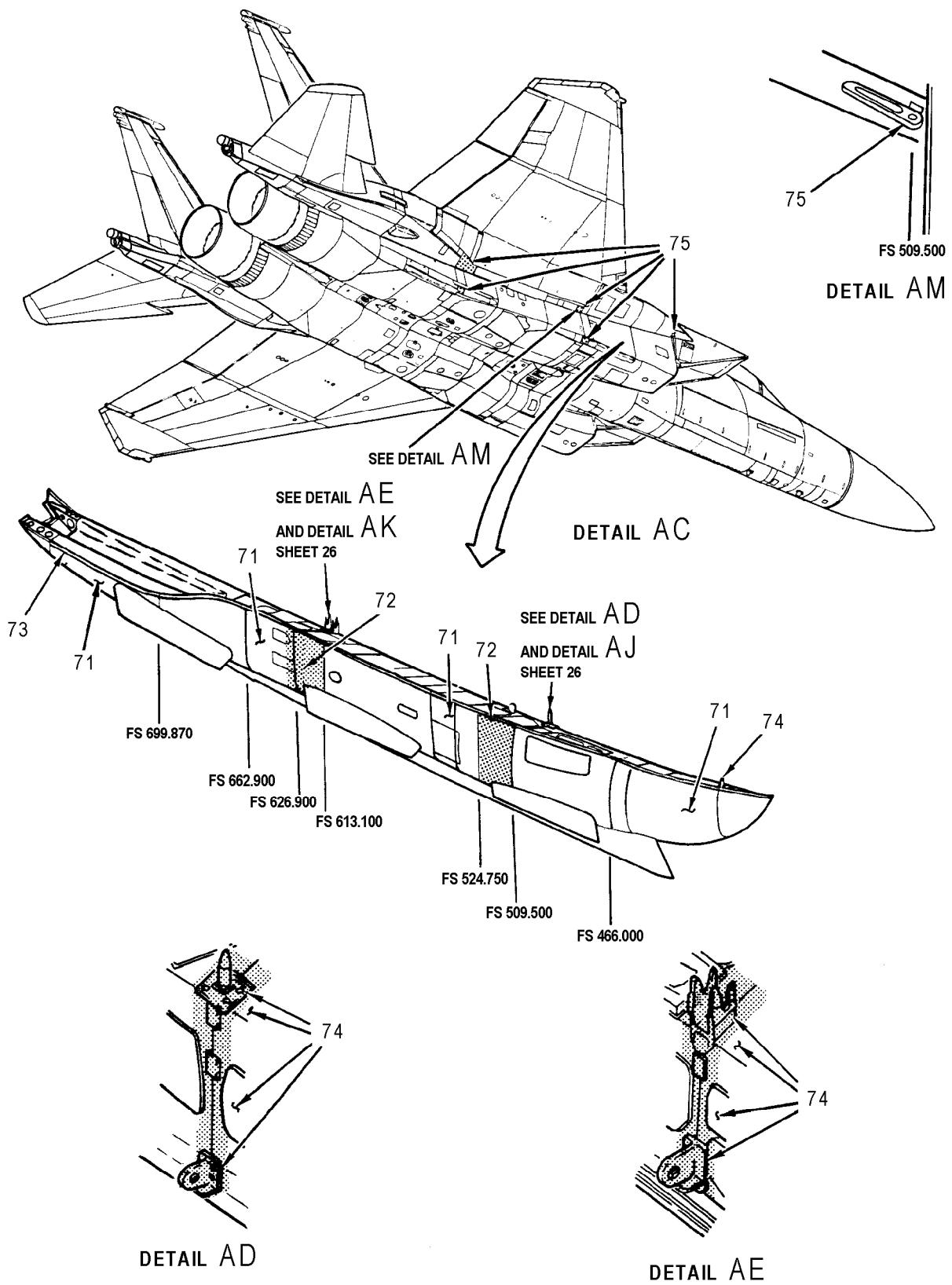


Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 22)

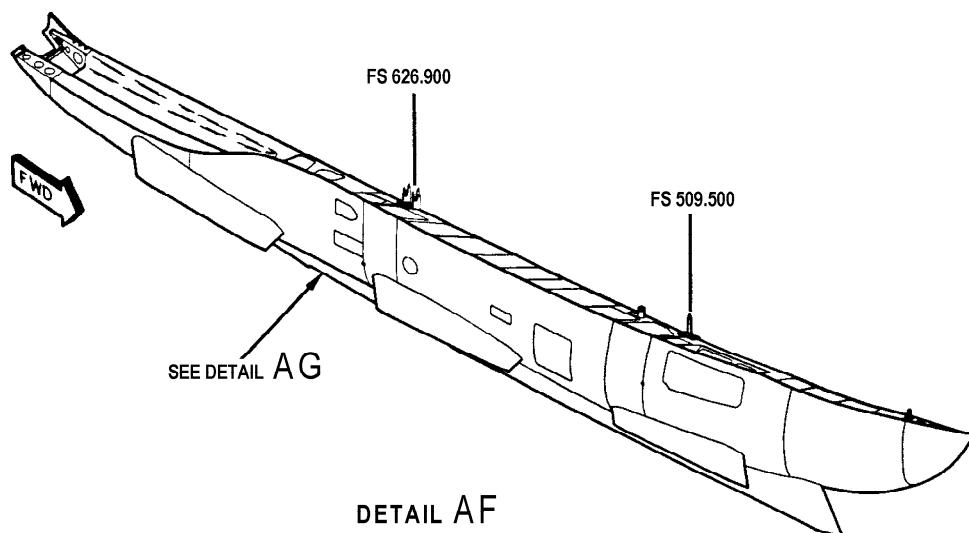
SAN301-02-58-001

CSTO SR1F-15SA-3-1

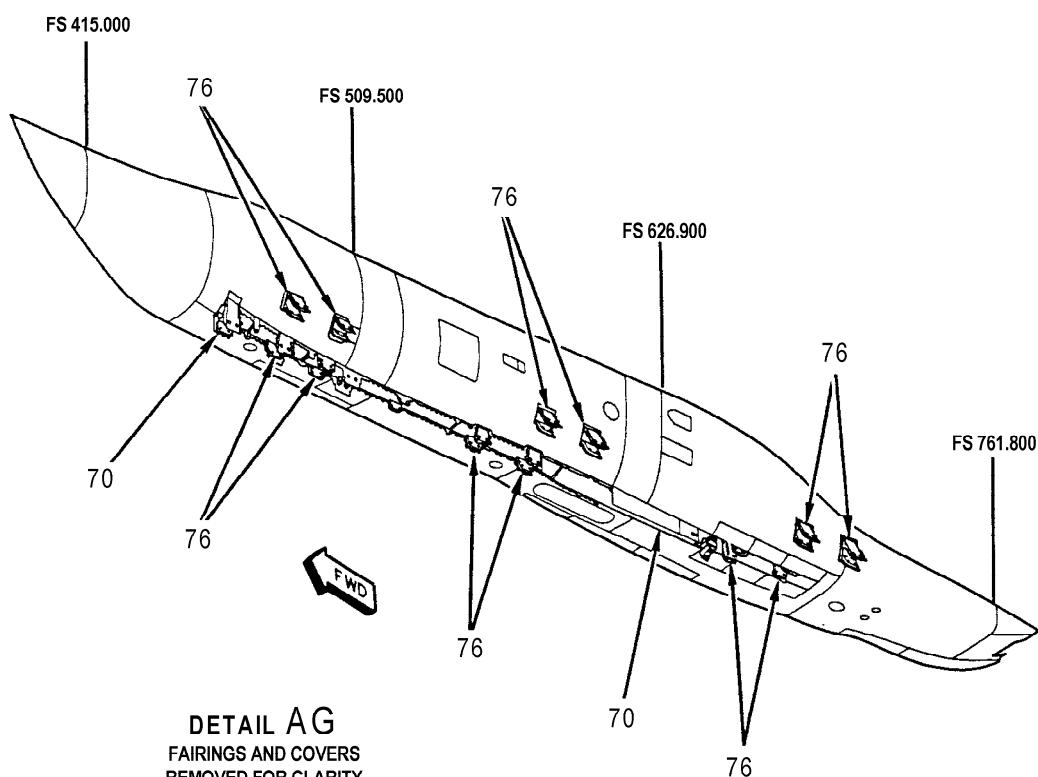


SAN301-02-59-002

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 23)



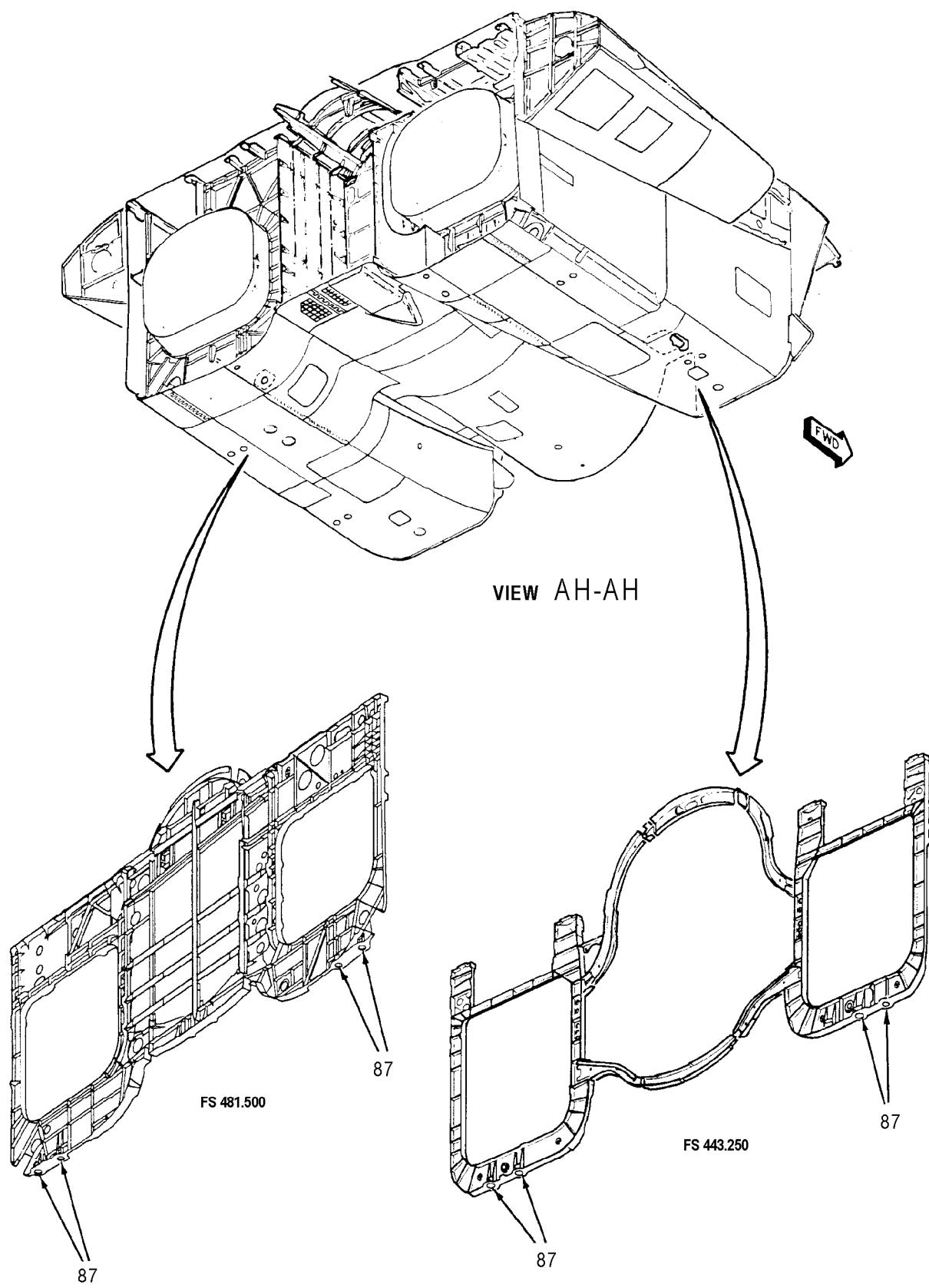
DETAIL AF
■ CONFORMAL FUEL TANK (CFT) 68A250001 AND 68G250001
RIGHT SIDE SHOWN, LEFT SIDE OPPOSITE



DETAIL AG
FAIRINGS AND COVERS
REMOVED FOR CLARITY

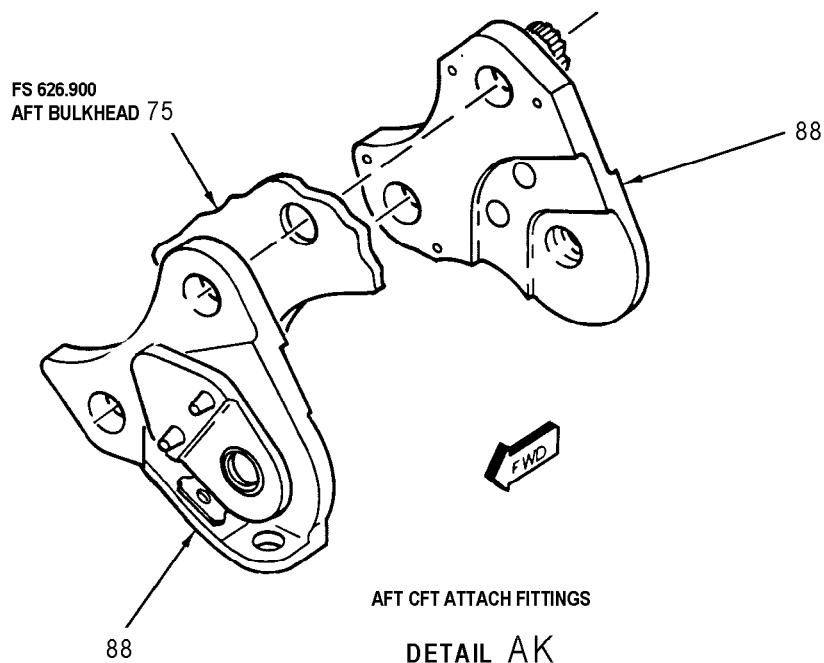
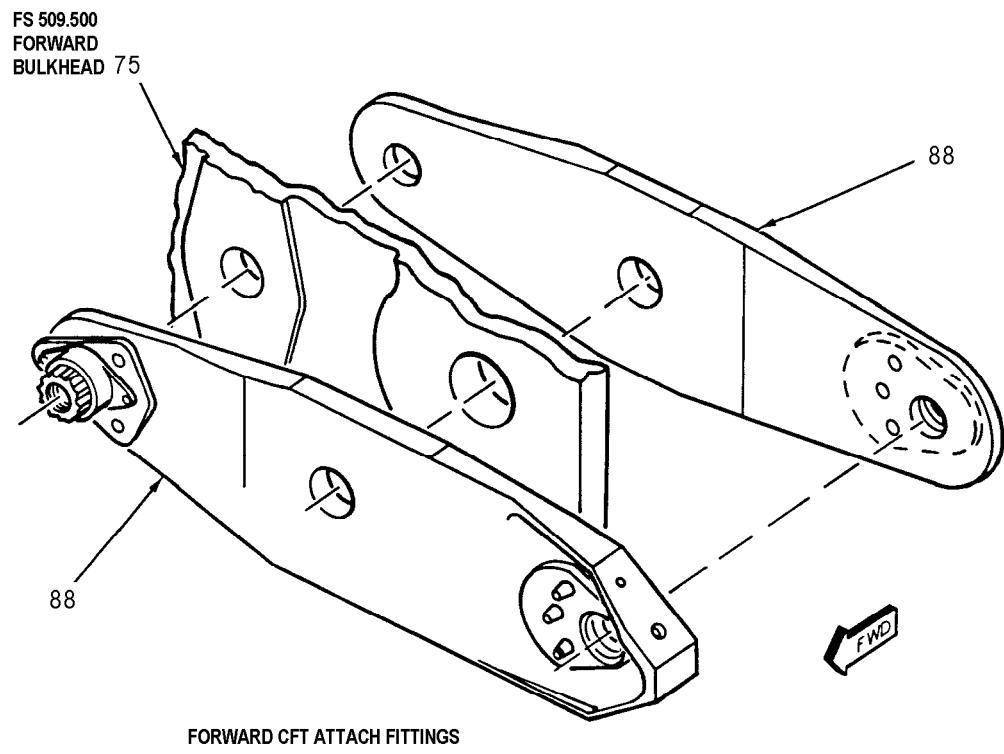
SAN301-02-60-002

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 24)



SAN301-02-61-002

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 25)



SAN301-02-62-002

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 26)

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IDX NO.	CATEGORY	SEVERITY CODE	ITEM	ACCESS	TYPE OF DAMAGE
1	Fuselage	1 thru 5	Radome. Forward fuselage. Windshield and canopy.		External surface for cuts, blisters, delamination, loose fibers. External surfaces of skins, doors, panels and fairings for buckles, wrinkles, cracks, broken hinge tangs, and loose or missing fasteners. Cracks, distortion, scratches, and loose or missing fasteners.
2	Fuselage	1 thru 5	Center fuselage lower inboard diverter support between FS 415.000 and FS 440.000: 4 → 68A321150 5 → 68A342290.	Door 27L/R.	Buckles and cracks.
3	Fuselage	3 thru 5	Lower inboard longeron, forward center fuselage between FS 415.000 to FS 509.000: 4 → 68A321095 5 → 68A343302.	Door 43, 44, 45, 235, and cover, 4 → 68A321510 or 5 → 68A347571.	Skin, 4 → 68A321056 or 5 → 68A346502, and longeron between FS 415.000 and FS 458.000 external surfaces for cracks and buckles; also FS 502.000 longeron splice area for cracks, buckles, and loose or missing fasteners in mating structure.
4	Fuselage	3 thru 5	Lower longeron, forward center fuselage between FS 416.000 to FS 502.000: 4 → 68A321026 5 → 68A342240.	LAU-106() forward missile launcher removed (94-31-20) or CFT, 68A250001 and 68G250001, door 568 opened.	Buckles, cracks, distortion, and loose or missing fasteners in skin and mating structure between FS 490.000 and FS 502.000.

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 27)

IDX NO.	CATEGORY	SEVERITY CODE	ITEM	ACCESS	TYPE OF DAMAGE
5	Fuselage	1 thru 5	Upper inboard longeron, forward fuselage at FS 415.000: 4 ➔ 68A321024 5 ➔ 68A342210.	Door 15, 12L/R, 275 (Secondary HX Exhaust).	FS 415.000 upper in-board longeron forward to center fuselage attach bolts (4 places), replace splice bolts and hardware at L/R upper longeron splices. Reinstall with 68A310510 radius blocks per 68A310010.
6	Wing	1 thru 5	External upper and lower surfaces of wing.		Flaps, ailerons, and tips for buckles, cracks, delamination, broken hinge tangs, loose or missing fasteners; torque box, leading edge and trailing edge skins for buckles, cracks, fuel leaks, and loose or missing fasteners.
7	Wing	2 thru 5	Inboard torque box upper skins and external surfaces: 68A122108 68A122223 and external surfaces.		Cracks in internal stiffener runout areas and skin, 68A122223, for depressions per CSTO SR1F-15SA-36. For depression inspection requirements, refer to paragraph 2-23.
8	Wing	3 thru 5	Wing carry-through bulkheads and lugs: 68A324103 68A324109 68A324115 68A324150.	Upper surface: Doors 58L/R, 62L/R, 64L/R, 68L/R, 70L/R, and 101L/R. Lower surface: Remove CFT (05-00-30), doors 73L/R, 81L/R, 90L/R, and 190L/R.	Buckles, cracks, distortion, evidence of overload, loose or missing fasteners.
9	Wing	3 thru 5	Rear spars, inboard and outboard: 68A112107 10 ➔ 68A122107 68A115101 10 ➔ 68A125101.	Doors 132L/R, 137L/R, and 142L/R.	Buckles, cracks or distorted upper flanges and webs.

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 28)

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IDX NO.	CATEGORY	SEVERITY CODE	ITEM	ACCESS	TYPE OF DAMAGE
10	Fuselage, Mass Items	3 thru 5	Longeron, keel, 68A324507, aft center fuselage, FS 509.000 to FS 626.000.		Buckles, cracks, distortion, and loose or missing fasteners in skin and mating structure at FS 509.000, FS 558.000, FS 595.000 and FS 626.000 areas.
11	Wing	4 and 5	XW 155.024 wing splice.		Buckles, cracks, distortion, and loose or missing fasteners in upper and lower skins at splice.
12	Wing	4 and 5	Inboard and outboard torque box, lower skins: 68A112110 68A112111 68A115113 68A125113 68A115114 68A125114.	Door 136L/R.	Buckles, cracks, separation of skin and fasteners, loose, tilted or missing fasteners on the external surfaces along shoulder area; cracks in stiffener runout areas (external surfaces); cracks in stiffener run- out areas (internal sur- faces thru door 136L/R).
13	Wing	4 and 5	Intermediate spar, inboard torque box: 68A112103 68A122103.		Nondestructive inspection per CSTO SR1F-15SA-36 is required if the wing skin above spar is buckled 0.020 or more or if main or rear spar is buckled.
			Main spar, inboard torque box: 68A112105 68A122105.		Nondestructive inspection per CSTO SR1F-15SA-36 is required if the wing skin above spar is buckled 0.020 or more or if rear spar is buckled.
14	Tail (L/R)	1 thru 5	External surfaces of aft fuselage, including vertical stabilizers and rudders, horizontal stabilator, and en- gine access doors.	Engine access doors: refer to index no. 27 and index no. 84.	Skins, doors, panels and fairings for buckles, wrinkles, cracks, broken hinge tangs, and loose or missing fasteners.

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 29)

IDX NO.	CATEGORY	SEVERITY CODE	ITEM	ACCESS	TYPE OF DAMAGE
15	Tail (L/R), Mass Items	1 thru 5	Doors 103L/R, 106L/R, 110L/R, 116L/R, 118L/R, 123L/R, 126L/R, 197, 250, 251, 252, and 255.	3 ► Remove CFT for doors 118L/R and 123L/R.	Loose or damaged fasteners.
16	Tail (L/R)	3 thru 5	Removable link, FS 749.000, 68A335010.	Inspect with index no. 81.	Buckles, cracks, distortion, and loose or missing installation bolts.
17	Tail (L/R), Mass Items	3 thru 5	Aft fuselage forward side panel assembly FS 626.000 to FS 712.000.		Shear beam webs for cracks, distortion, buckles, and loose or missing fasteners.
18	Tail (L/R), Mass Items	3 thru 5	Bulkheads: FS 749.000 - out-board: 68A332006 FS 749.000 - center: 68A333361 FS 712.310 - out-board: 68A332002 FS 712.310 - center: 68A333008.	Inspect with index no. 81.	Engine bay accessible areas for buckles, cracks, distortion, and loose or missing fasteners.
19	Tail (L/R), Mass Items	3 thru 5	Upper outboard longeron, FS 626.900 to FS 712.310: 68A331017.		Buckles, cracks, distortion, and loose or missing fasteners in skin and mating parts around splice areas FS 626.000 and FS 712.000.
20	Tail (L/R), Mass Items	3 thru 5	Stringer 10, FS 643.000 to FS 712.310: 68A331016.		Buckles, cracks, distortion, and loose or missing fasteners in skin and mating structure at FS 672.000 and FS 712.000.
21	Tail (L/R), Mass Items	3 thru 5	Lower longeron, FS 626.900 to FS 712.310: 8 ► 68A331020 9 ► 68A331187.	Remove engines (71-03-10).	Buckles, cracks, loose or missing fasteners, and distortion in engine bay area.

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 30)

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IDX NO.	CATEGORY	SEVERITY CODE	ITEM	ACCESS	TYPE OF DAMAGE
22	Tail (L/R)	3 thru 5	Upper outboard longeron, FS 712.310 to FS 791.650: 68A332048.		Buckles, cracks, loose or missing fasteners, and distortion at FS 712.000 splice in skin.
23	Tail (L/R)	3 thru 5	Stringer 10, FS 712.310 to FS 772.500: 68A332052.		Buckles, cracks, loose or missing fasteners, and distortion at FS 712.000 splice in skin and mating structure.
24	Tail (L/R)	3 thru 5	Stringer 12, FS 712.310 to FS 799.648: 68A332057.		Buckles, cracks, loose or missing fasteners, and distortion in skin and mating structure.
25	Tail (L/R)	3 thru 5	Stringer 6, FS 712.310 to FS 791.650: 68A332038.		Buckles, cracks, loose or missing fasteners, and distortion in skin and mating structure, FS 749.000 to FS 791.000 areas.
26	Tail (L/R)	3 thru 5	Lower longeron, FS 702.900 to FS 749.000: 68A332029.	Remove engines (71-03-10).	Buckles, cracks, loose or missing fasteners, and distortion in engine bay area.
27	Tail (L/R), Mass Items	3 thru 5	Engine bay doors 95L/R, 113L/R, and 117L/R.	Inspect with index no. 14.	External and internal surfaces of skins for cracks and formers on doors 113L/R and 117L/R for buckles.
28	Pylons and attach areas	2 thru 5	Support, centerline pylon swaybrace post.	Remove pylon (94-32-51).	Cracks and/or distortion.
29	Pylons and attach areas	2 thru 5	Hook, pylon jettison.	Remove pylon (94-32-50, (94-32-51, and (94-32-52).	Cracks and/or distortion.
30	Pylons and attach areas	2 thru 5	Support, inboard pylon swaybrace post.	Remove pylon (94-32-50).	Cracks and/or distortion.
31	Pylons and attach areas	2 thru 5	Fitting, yaw restraint.	Pylon removed.	Cracks and/or distortion.
32	Pylons and attach areas	2 thru 5	Post, preload.	Pylon removed.	Cracks and/or evidence of overload.

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 31)

IDX NO.	CATEGORY	SEVERITY CODE	ITEM	ACCESS	TYPE OF DAMAGE
33	Pylons and attach areas	2 thru 5	Fittings, swaybrace pad, and retainer.	Stores removed.	Cracks and/or distortion.
34	Pylons and attach areas	1 thru 5	Skins, pylon.		Buckles, cracks, and distortion. Loose, sheared or missing fasteners, in area of swaybrace post and yaw restraint fitting.
35	Pylons and attach areas	2 thru 5	Hooks, stores suspension.	Stores removed.	Cracks and/or distortion.
36	Pylons and attach areas	2 thru 5	Fitting, yaw restraint.	Pylon removed.	Cracks and/or distortion.
37	Pylons and attach areas	2 thru 5	Post, preload.	Pylon removed.	Cracks and/or evidence of overload.
38	Pylons and attach areas	2 thru 5	Fittings, swaybrace pad, and retainer.	Stores removed.	Cracks and/or distortion.
39	Pylons and attach areas	1 thru 5	Skins, pylon.		Buckles, cracks, and distortion. Loose, sheared or missing fasteners in area of swaybrace post and yaw restraint fitting.
40	Pylons and attach areas	2 thru 5	Hooks, stores suspension.	Stores removed.	Cracks and/or distortion.
41	Pylons and attach areas	2 thru 5	Fitting, yaw restraint.	Pylon removed.	Cracks and/or distortion.
42	Pylons and attach areas	2 thru 5	Post, preload.	Pylon removed.	Cracks and/or evidence of overload.
43	Pylons and attach areas	2 thru 5	Fittings, swaybrace pad, and retainer.	Stores removed.	Cracks and/or distortion.
44	Pylons and attach areas	1 thru 5	Skins, pylon.		Buckles, cracks, and distortion. Loose, sheared or missing fasteners, in area of swaybrace post and yaw restraint fitting.
45	Pylons and attach areas	2 thru 5	Hooks, stores suspension.	Stores removed.	Cracks and/or distortion.
46	Pylons and attach areas	2 thru 5	Post, centerline pylon swaybrace.	Remove pylon (94-32-51).	Evidence of galling and/or cracks.

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 32)

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IDX NO.	CATEGORY	SEVERITY CODE	ITEM	ACCESS	TYPE OF DAMAGE
47	Pylons and attach areas	2 thru 5	Hook, centerline pylon.	Remove pylon (94-32-51).	Cracks and/or distortion.
48	Pylons and attach areas	2 thru 5	Hook, inboard pylon.	Remove pylon (94-32-50).	Cracks and/or distortion.
49	Pylons and attach areas	2 thru 5	Post, inboard pylon swaybrace.	Remove pylon (94-32-50).	Evidence of galling and/or cracks.
50	Pylons and attach areas	2 thru 5	Ball, pylon aft pivot.	Remove pylon (94-32-50).	Cracks and/or distortion.
51	Pylons and attach areas	2 thru 5	Hook, jettison pivot.	Stores removed.	Cracks and/or distortion.
52	Pylons and attach areas	2 thru 5	Hook, outboard pylon.	Remove pylon (94-32-52).	Cracks and/or distortion.
53	Pylons and attach areas	2 thru 5	Post, outboard pylon swaybrace.	Remove pylon (94-32-52).	Evidence of galling and/or cracks.
54	Pylons and attach areas	2 thru 5	Ball, pylon aft pivot.	Remove pylon (94-32-52).	Cracks and/or distortion.
55	Pylons and attach areas	1 thru 5	Skins, external surfaces at attach points with rings between TS 70.00 and TS 190.00.		Buckles and cracks around welds and/or fasteners.
56	Pylons and attach areas	2 thru 5	Lugs, suspension.	Remove fuel tank (05-00-15).	Cracks and/or distortion.
57	Pylons and attach areas	2 thru 5	Ball, fuel tank aft pivot.	Remove fuel tank (05-00-15).	Cracks and/or distortion.
58	Pylons and attach areas	2 thru 5	Skin, external surfaces in areas mating pylon swaybrace pads.	Remove fuel tank (05-00-15).	Dents in skin.
59	Pylons and attach areas	1 thru 5	2 Skins, pylon, areas mating ADU-407/A or ADU-552/A launcher adapter.	Remove launcher adapter (94-31-28).	Dents, buckles or cracks.
60	Pylons and attach areas	1 thru 5	2 Skins, pylon, areas mating MX12427/A dual rail launcher adapter.	Remove launcher adapter (94-31-29).	Dents, buckles or cracks.
61	Pylons and attach areas	2 thru 5	Rails, LAU-117() missile launcher.	Missiles removed.	Cracks and/or distortion.

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 33)

IDX NO.	CATEGORY	SEVERITY CODE	ITEM	ACCESS	TYPE OF DAMAGE
62	Pylons and attach areas	2 thru 5	Rails, LAU-118() missile launcher.	Missiles removed.	Cracks and/or distortion.
63	Pylons and attach areas	2 thru 5	Rails, LAU-114A/A or LAU-128() missile launcher.	Missiles removed.	Cracks and/or distortion.
64	Pylons and attach areas	2 thru 5	Supports, ADU-407/A or ADU-552/A launcher adapter.	Remove launcher adapter (94-31-28).	Cracks and/or distortion.
65	Pylons and attach areas	1 thru 5	Cover, ADU-407/A or ADU-552/A launcher adapter.	Remove missile launcher (94-31-27).	Buckles, cracks, and distortion.
66	Pylons and attach areas	1 thru 5	Skins, pylon, areas mating MX12427/A dual rail adapter.	Remove launcher adapter (94-31-29).	Buckles, cracks and distortion.
67	Pylons and attach areas	1 thru 5	Skins, pylon, mating areas LAU-117() missile launcher.	Remove missile launcher (94-32-31).	Buckles, cracks, and distortion.
68	Pylons and attach areas	1 thru 5	Skins, pylon, areas mating LAU-118() missile launcher.	Remove missile launcher (94-32-53).	Buckles, cracks, and distortion.
69	Pylons and attach areas	1 thru 5	Cover, LAU-114A/A or LAU-128() missile launcher.	Remove missile launcher (94-31-27).	Buckles, cracks, and distortion.
70	Mass items	2 thru 5	CFT forward and aft LAU-106() missile launcher: 68A733001.	Launchers removed (94-31-20).	Loose, sheared and missing fasteners. Buckled walls.
71	CFT, Mass items	1 thru 5	Exterior surface of conformal fuel tank (CFT) skins.		Buckles, cracks, distortion, and loose or missing fasteners. Fuel leaks.
72	CFT, Mass items	1 thru 5	Exterior surface of CFT skins between upper outboard longeron and lower inboard longeron from FS 509.500 thru FS 524.750 and FS 613.100 thru FS 626.900.		Buckles, cracks, distortion, and loose or missing fasteners, fuel leaks.
73	CFT, Mass items	1 thru 5	Aerodynamic peripheral seals.		Cuts, tears, and loose or missing sections.

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 34)

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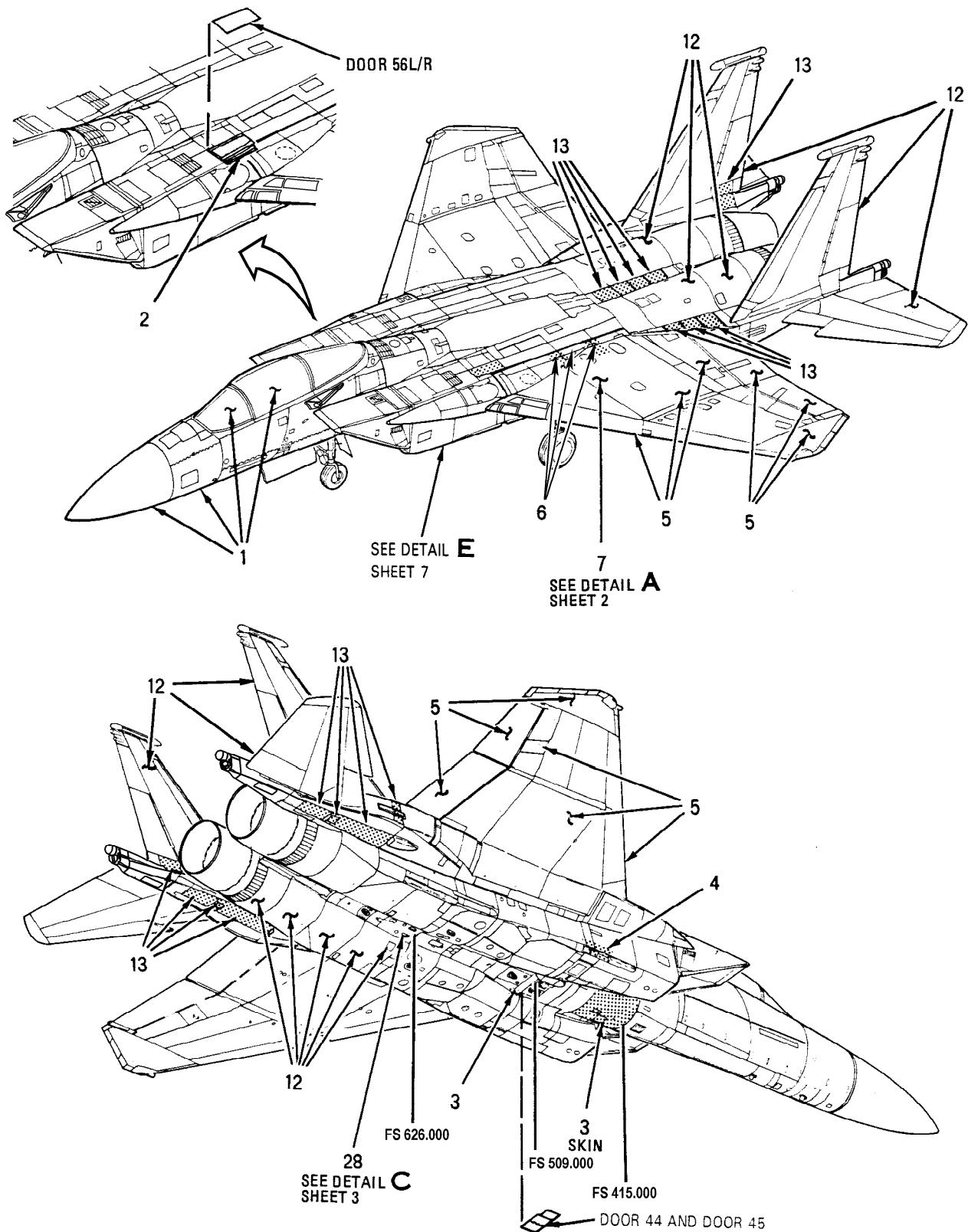
IDX NO.	CATEGORY	SEVERITY CODE	ITEM	ACCESS	TYPE OF DAMAGE
74	CFT, Mass items	2 thru 5	CFT mounting fittings. Upper and inboard mold line skins at FS 509.500 and FS 626.900.	Remove CFT (05-00-30).	Buckles, cracks, distortion, and loose or missing fasteners, fuel leaks.
75	CFT, Mass items	2 thru 5	Fuselage CFT mounting fittings.	Remove CFT (05-00-30).	Buckles, cracks, distortion, and loose or missing fasteners.
76	Mass items	1 thru 5	CFT external stores stations.	Inspect with index no. 56.	Buckles and cracks. Fuel leaks.
77	Mass items	2 thru 5	Main engine mount assembly and eyebolts: 68A500070.	Remove engines (71-03-10).	Cracks in mounts and supporting structure. Fasteners for looseness and deformation.
78	Mass items	2 thru 5	Engine mount adapter thrust pin.	Remove engines (71-03-10).	Cracks.
79	Mass items	2 thru 5	Engine mount forward bracket: 68A336220.	Remove engines (71-03-10).	Cracks in mount bracket and supporting structure. Fasteners for looseness and deformation.
80	Mass items	2 thru 5	Forward engine mount connecting link: 68A500071.	Remove engines (71-03-10) and link from mounts (71-21-12).	Cracks.
81	Mass items	2 thru 5	Engine mount side load bracket: 68A500075-left side, 68A500073-right side.	Remove engines (71-03-10).	Cracks in mount bracket and supporting structure. Fasteners for looseness and deformation.
82	Mass items	2 thru 5	Engine mount side load link: 68A500076.	Remove engines (71-03-10) and link from mounts (71-21-10).	Cracks.
83	Tail (L/R), Mass items	2 thru 5	Aft fuselage keel assembly.	Remove engines (71-03-10).	Buckles, cracks, distortion, and loose or missing fasteners.

Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 35)

IDX NO.	CATEGORY	SEVERITY CODE	ITEM	ACCESS	TYPE OF DAMAGE
84	Tail (L/R), Mass items	2 thru 5	Keel former, FS 672.680: 68A333077.	Inspect with index no. 14, engine access doors.	If the engine access doors are buckled (index no. 14), detailed visual inspection for buckles, cracks, distortion, and loose or missing fasteners.
85	Tail (L/R), Mass items	2 thru 5	Lower keel longeron, FS 626.000 to FS 749.000.	Remove engines (71-03-10).	Buckles, cracks, loose or missing fasteners, and distortion in keel area.
86	Tail (L/R), Mass items	1 thru 5	Aft fuselage lower splice skin, FS 629.000: 68A335001.		External surface of skins for cracks and permanent buckles.
87	Mass items	2 thru 5	Fuselage Navigation and Targeting pod adapter mounting locations at FS 443.250 and FS 481.500.	1 Remove adapters (34-42-10 and 94-79-18).	Buckles or cracks in bulkheads or skins. Fasteners for looseness and deformation. Bushing bosses for distortion, wear, galling or cracks.
88	CFT, Mass items	2 thru 5	Aircraft/CFT attach kit parts.	Remove CFT (05-00-30).	Buckles, cracks, and distortion.
89	Pylons and attach areas	2 thru 5	FS 558.500 bulkhead centerline pylon hook bearing pad and lower bulkhead.	Inspect with index no. 28.	Cracks, galling, excessive wear. Loose, sheared or missing fasteners.
<p>1 Inspection required only when pod adapters were installed. 2 Inspection required only when adapter and missile launcher was installed. 3 Remove CFT only when severity code is 2 thru 5. Refer to index no. 88. 4 12-1001 THRU 12-1024; ALSO 93-0852 THRU 93-0923. 5 12-1025 AND UP. 6 12-1001 THRU 12-1055; ALSO 93-0852 THRU 93-0872. 7 12-1056 AND UP; ALSO 93-0872 THRU 93-0923. 8 12-1001 THRU 12-1039; ALSO 93-0852 THRU 93-0923. 9 12-1038 AND UP. 10 Preferred part.</p>					

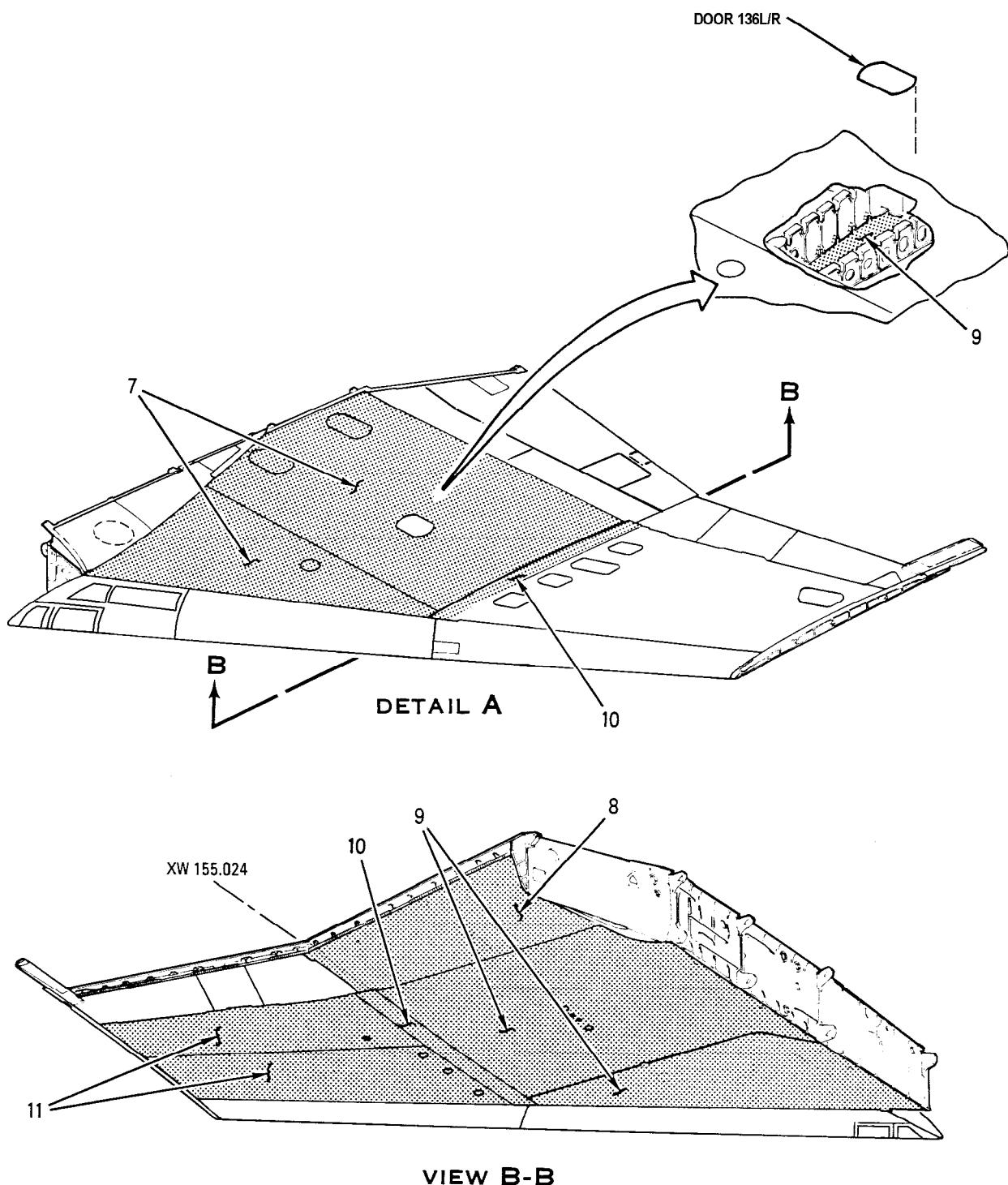
Figure 2-9. Positive Overload Warning Aircraft Inspections (Sheet 36)

CSTO SR1F-15SA-3-1



SAN301-02-63-002

Figure 2-10. Negative Overload Warning Aircraft Inspections (Sheet 1 of 15)



SAN301-02-64-002

Figure 2-10. Negative Overload Warning Aircraft Inspections (Sheet 2)

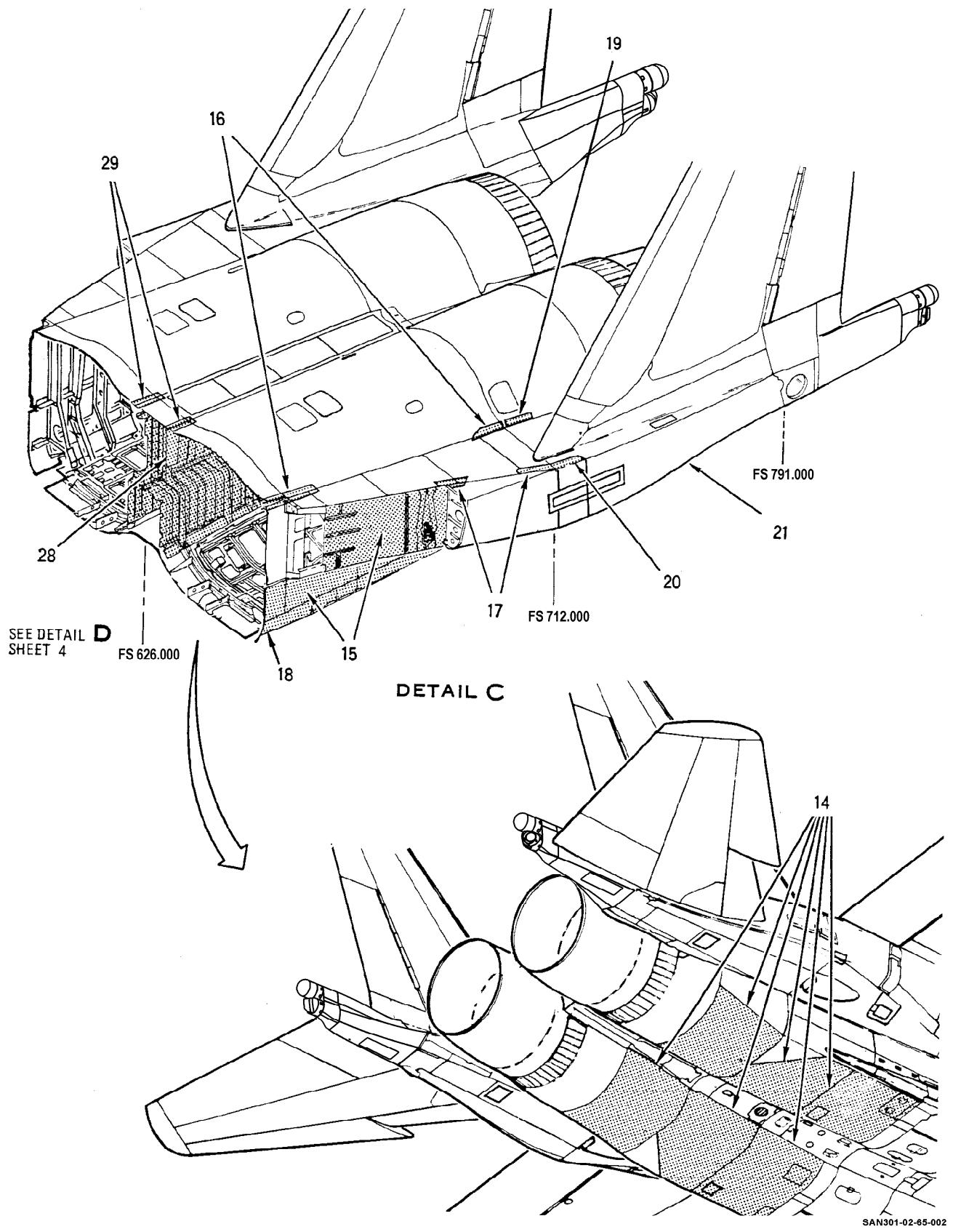


Figure 2-10. Negative Overload Warning Aircraft Inspections (Sheet 3)

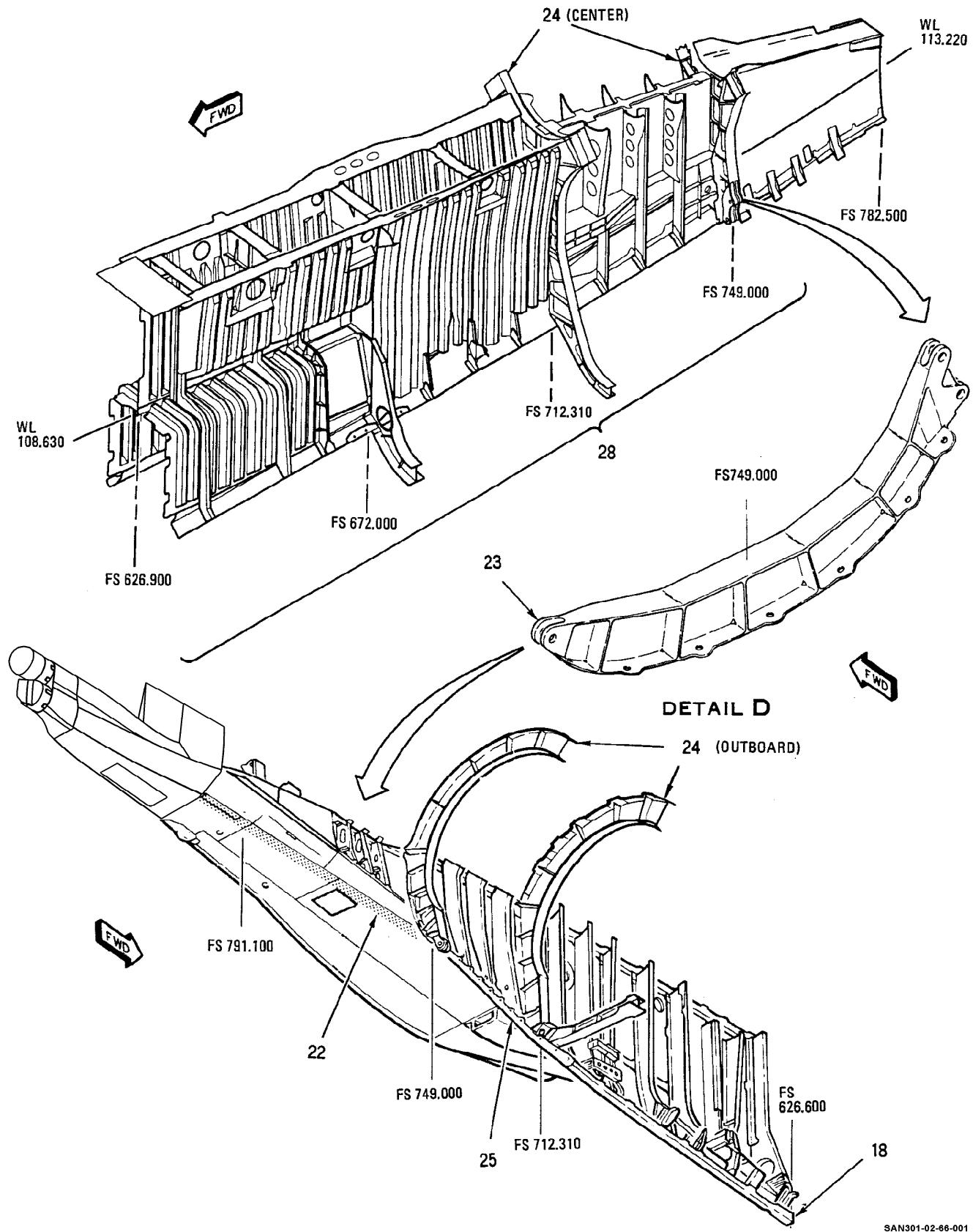
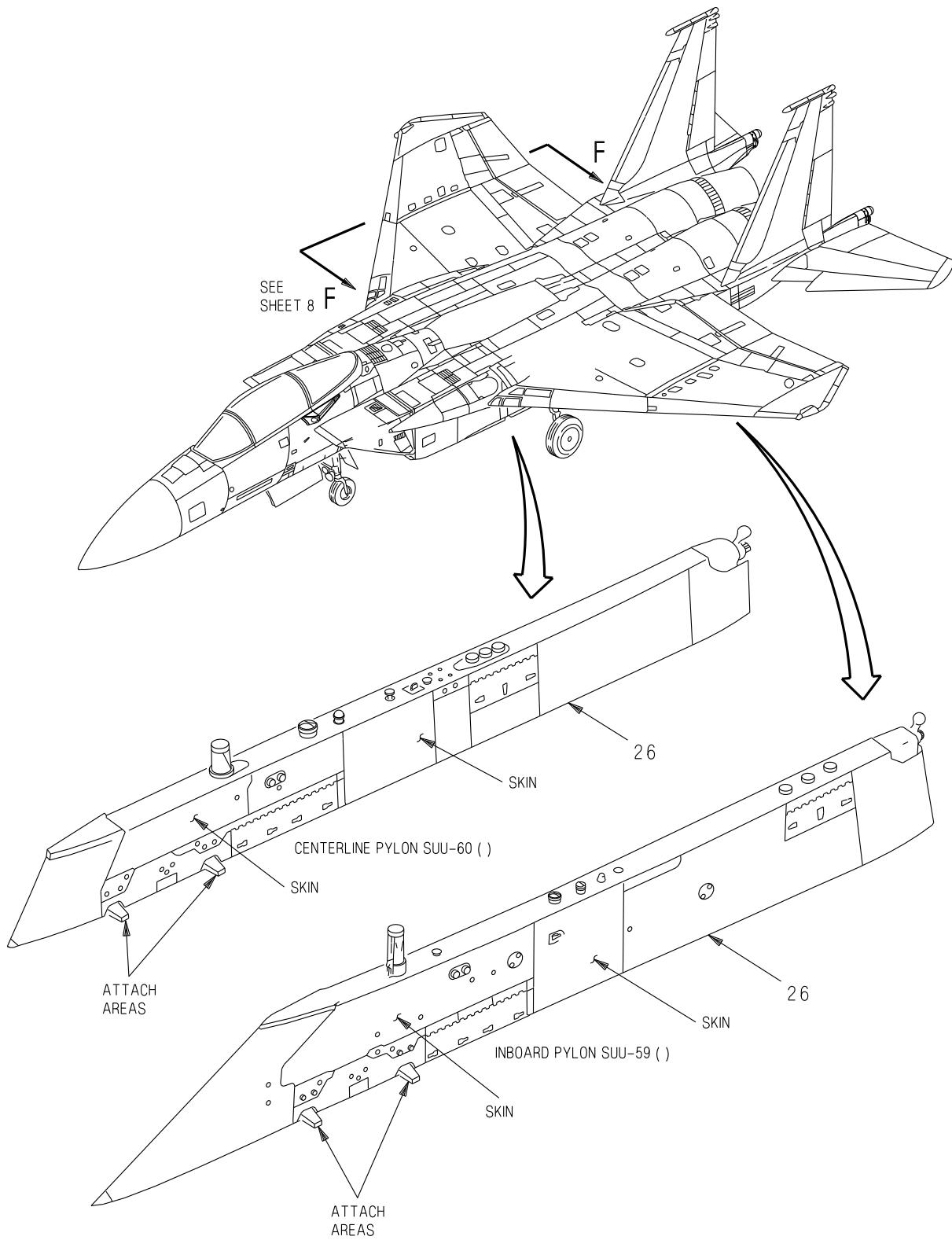
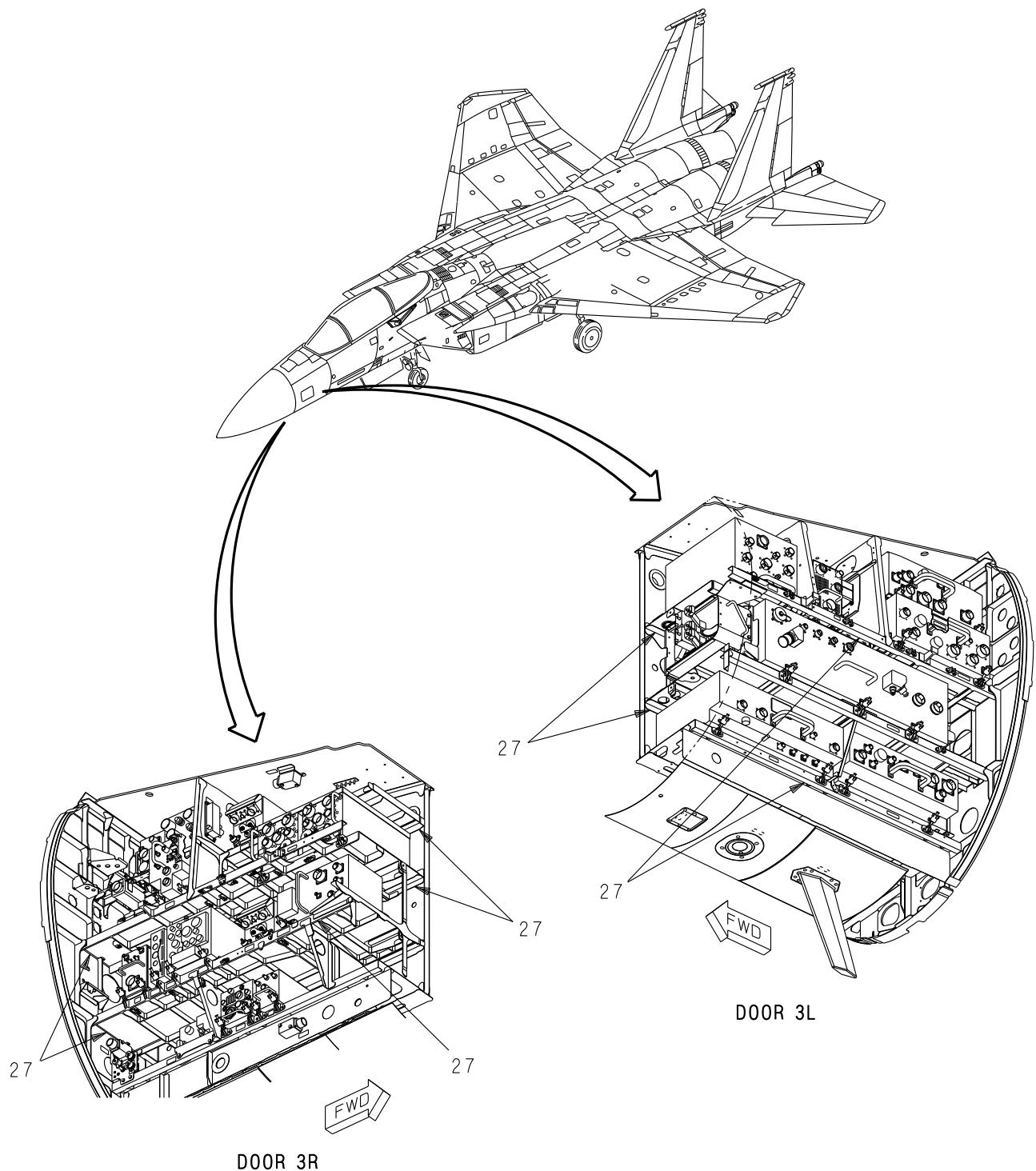


Figure 2-10. Negative Overload Warning Aircraft Inspections (Sheet 4)



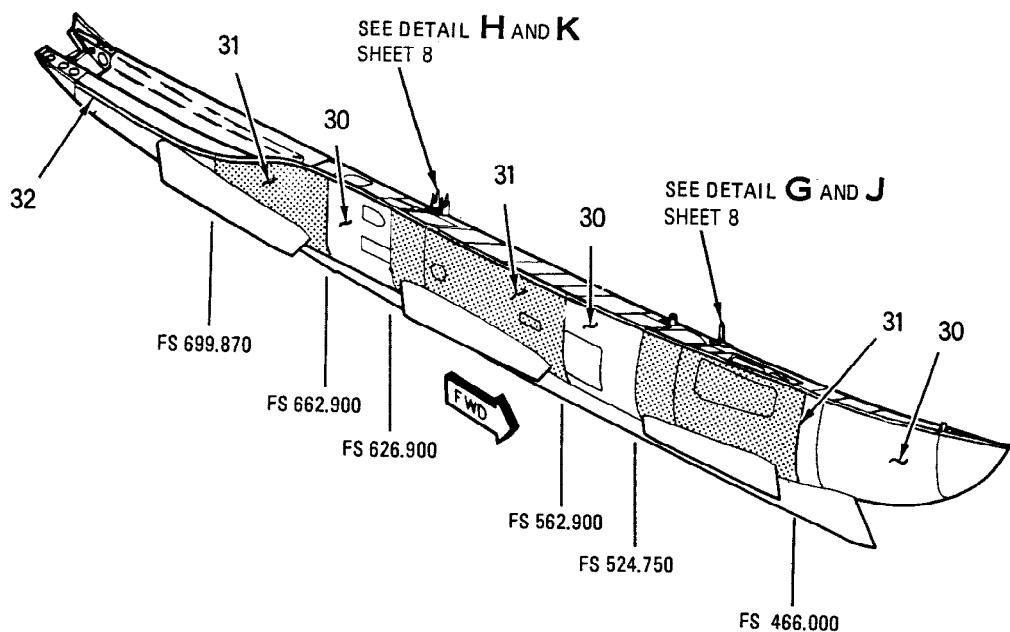
SAN301-02-67-001

Figure 2-10. Negative Overload Warning Aircraft Inspections (Sheet 5)



SAN301-02-68-001

Figure 2-10. Negative Overload Warning Aircraft Inspections (Sheet 6)



DETAIL E

■ CONFORMAL FUEL TANK (CFT) 68A250001 AND 68G250001
RIGHT SIDE SHOWN, LEFT SIDE OPPOSITE

SAN301-02-69-002

Figure 2-10. Negative Overload Warning Aircraft Inspections (Sheet 7)

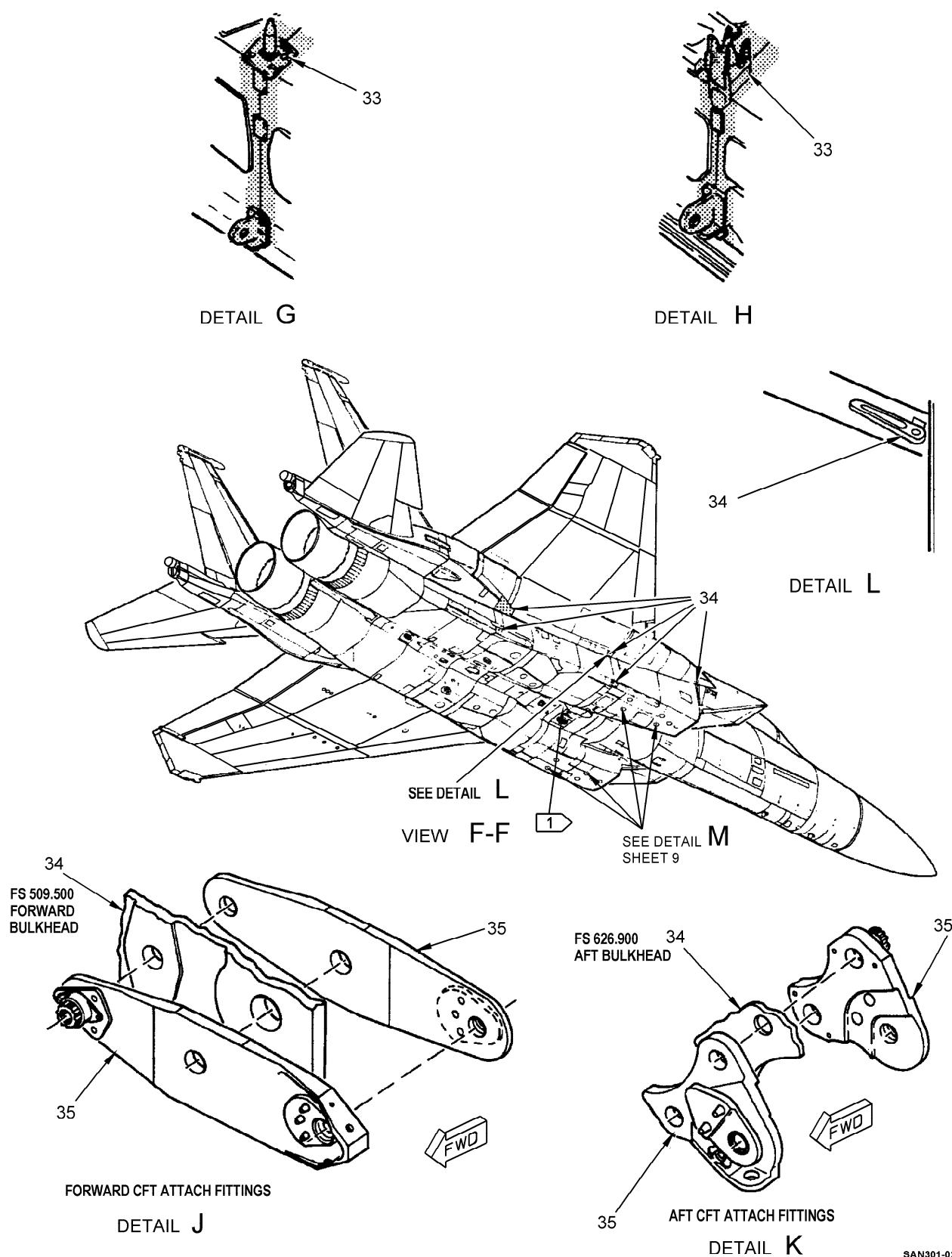
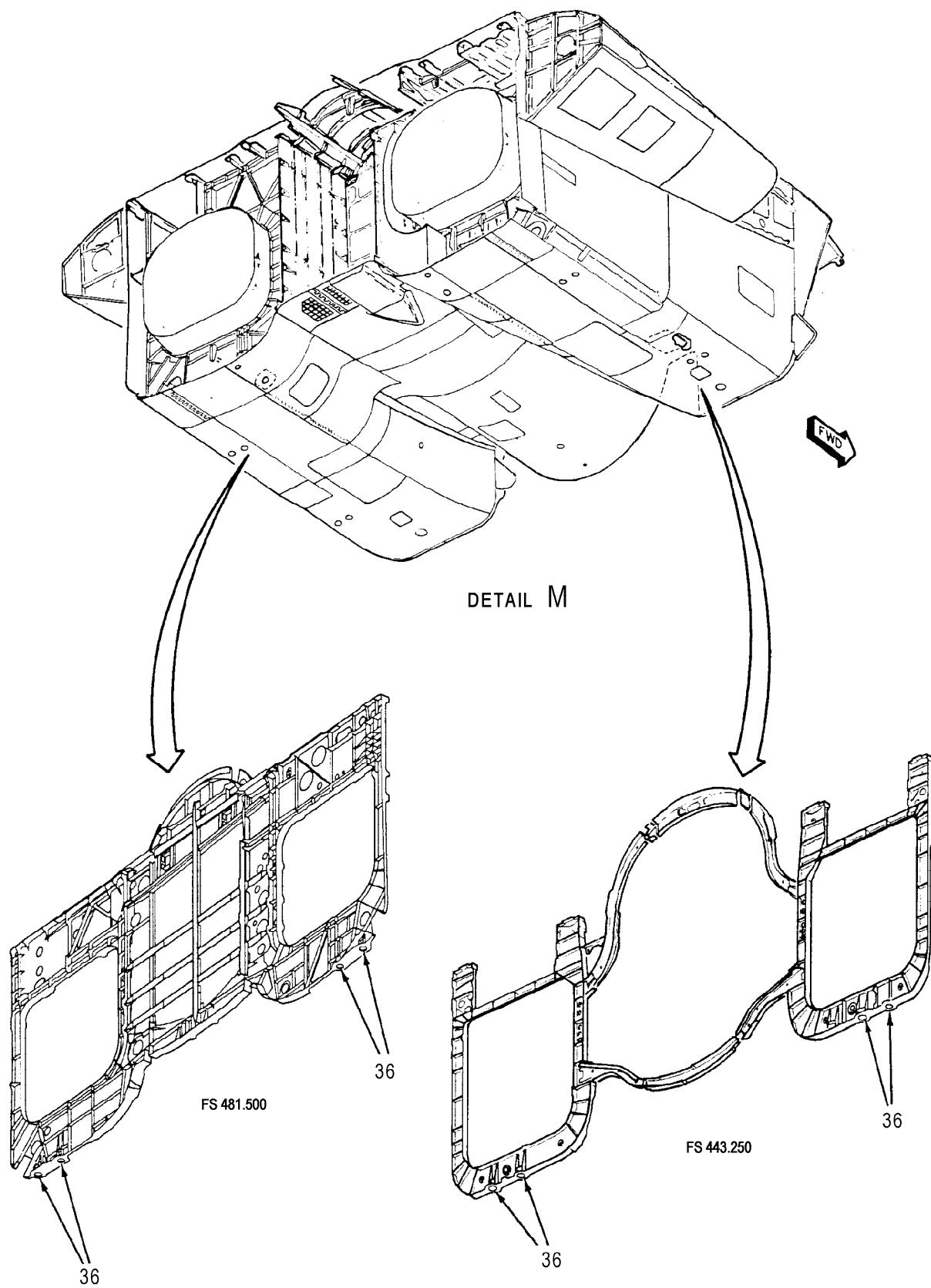


Figure 2-10. Negative Overload Warning Aircraft Inspections (Sheet 8)

SAN301-02-70-002



SAN301-02-115-001

Figure 2-10. Negative Overload Warning Aircraft Inspections (Sheet 9)

IDX NO.	CATEGORY	SEVERITY CODE	ITEM	ACCESS	TYPE OF DAMAGE
1	Fuselage	1 thru 5	Radome. Forward fuselage. Windshield and canopy.		External surface for cuts, blisters, delamination, loose fibers. External surfaces of skins, doors, panels and fairings for buckles, wrinkles, cracks, broken hinge tangs, and loose or missing fasteners. Cracks, distortion, scratches, and loose or missing fasteners.
2	Fuselage	3 thru 5	Upper outboard longeron, FS 415.000 to FS 509.000: 10 → 68A321025 11 → 68A342210.	Door 56L/R.	Buckles, cracks, and loose or missing fasteners at FS 490.000 to FS 509.000 areas.
3	Fuselage	3 thru 5	Lower inboard longeron, forward center fuselage, FS 415.000 to FS 509.500: 10 → 68A321095 11 → 68A342302. Lower mold line skin, forward center fuselage, FS 415.000 to FS 558.500: 10 → 68A321056 11 → 68A346502.	Door 44 and 45.	Skin, 10 → 68A321056, 11 → 68A346502, and longeron between FS 415.000 and FS 458.000 external surfaces for cracks and buckles; also FS 502.000 longeron splice area for cracks, buckles, and loose or missing fasteners in mating structure.
4	Fuselage	3 thru 5	Lower longeron, forward center fuselage, FS 416.000 to FS 502.000: 10 → 68A321026 11 → 68A342240.	LAU-106() missile launcher removed (94-31-20) or CFT, 68A250001 and 68G250001 door 568 opened.	Buckles, cracks, distortion and loose or missing fasteners in skin and mating structure between FS 490.000 and FS 502.000.

Figure 2-10. Negative Overload Warning Aircraft Inspections (Sheet 10)

CSTO SR1F-15SA-3-1

IDX NO.	CATEGORY	SEVERITY CODE	ITEM	ACCESS	TYPE OF DAMAGE
5	Wing	1 thru 5	External upper and lower surfaces of wing.		Flaps, ailerons, and tips for buckles, cracks, delamination, broken hinge tangs, loose or missing fasteners; torque box, leading edge and trailing edge skins for buckles, cracks, fuel leaks, and loose or missing fasteners.
6	Wing	2 thru 5	Inboard torque box main spar and intermediate spar: 68A112105 12 ➔ 68A122105 68A112103 12 ➔ 68A122103.	Door 64L/R, 68L/R, and 70L/R.	Nondestructive inspection by eddy current per CSTO SR1F-15SA-36 for cracks in spar upper flange by wing attach lug. If cracks are indicated, inspect by X-Ray per CSTO SR1F-15SA-36.
7	Wing	3 thru 5	Inboard torque box upper skins and external surfaces: 4 ➔ 68A112108 5 ➔ 68A122108 4 ➔ 68A112223 5 ➔ 68A122223.		Cracks in internal stiffener runout areas.
8	Wing	3 thru 5	Inboard trailing edge, lower skins: 68A123135.		Buckles and loose or missing fasteners.
9	Wing	3 thru 5	Inboard torque box lower skins: 68A112110 68A112111.	Door 136L/R.	External and internal surfaces for cracks in internal stiffener runout areas.
10	Wing	4 and 5	XW 155.024 wing splice.		Buckles, cracks, and loose or missing fasteners in upper and lower skins at splice.
11	Wing	5	Outboard torque box lower skins: 4 ➔ 68A115113 5 ➔ 68A125113 4 ➔ 68A115114 5 ➔ 68A125114.		External surfaces for cracks in internal stiffener runout areas.

Figure 2-10. Negative Overload Warning Aircraft Inspections (Sheet 11)

IDX NO.	CATEGORY	SEVERITY CODE	ITEM	ACCESS	TYPE OF DAMAGE
12	Tail (L/R), Mass items	1 thru 5	External surfaces of aft fuselage, including vertical stabilizers, horizontal stabilators, and rudders, and engine access doors.	Engine access doors, refer to index no. 14.	Skins, doors, panels and fairings for buckles, wrinkles, cracks, broken hinge tangs, and loose or missing fasteners.
13	Tail (L/R), Mass items	1 thru 5	Doors 103L/R, 106L/R, 110L/R, 116L/R, 118L/R, 123L/R, 126L/R, 197, 250, 251, 252, and 255.	1 Remove CFT for doors 118L/R, 123L/R, and 255L/R.	Loose or damaged fasteners.
14	Tail (L/R), Mass items	3 thru 5	Engine bay doors 95L/R, 113L/R, and 117L/R.	Inspect with index no. 12, engine access doors.	External and internal surfaces of door skins for cracks and formers on doors 113L/R and 117L/R for buckles.
15	Tail (L/R), Mass items	3 thru 5	Aft fuselage forward side panel assembly, FS 626.000 to FS 712.000.		Shear beam webs for cracks, distortion, buckles, and loose or missing fasteners.
16	Tail (L/R), Mass items	3 thru 5	Upper outboard longeron, FS 626.900 to FS 712.31: 68A331017.		Buckles, cracks, distortion, and loose or missing fasteners in skin and mating structure around splice areas FS 626.000 and FS 712.000.
17	Tail (L/R), Mass items	3 thru 5	Stringer 10, FS 643.000 to FS 712.310: 68A331016.		Buckles, cracks, distortion, and loose or missing fasteners in skin and mating structure at FS 672.000 and FS 712.000.
18	Tail (L/R), Mass items	3 thru 5	Lower longeron, FS 626.000 to FS 712.000: 8 68A331020 9 68A331187.	Remove engines (71-03-10).	Buckles, cracks, loose or missing fasteners, and distortion in engine bay area.
19	Tail (L/R), Mass items	3 thru 5	Upper outboard longeron, FS 712.000 to FS 791.000: 68A332048.		Buckles, cracks, loose or missing fasteners, and distortion in skin and mating structure at FS 712.000 splice.

Figure 2-10. Negative Overload Warning Aircraft Inspections (Sheet 12)

CSTO SR1F-15SA-3-1

IDX NO.	CATEGORY	SEVERITY CODE	ITEM	ACCESS	TYPE OF DAMAGE
20	Tail (L/R), Mass items	3 thru 5	Stringer 10, FS 712.000 to FS 772.000: 68A332052.		Buckles, cracks, loose or missing fasteners, and distortion in skin and mating structure at FS 712.000 splice.
21	Tail (L/R), Mass items	3 thru 5	Stringer 12, FS 712.000 to FS 791.000: 68A332057.		Buckles, cracks, loose or missing fasteners, and distortion in skin and mating structure.
22	Tail (L/R), Mass items	3 thru 5	Stringer 6, FS 712.000 to FS 791.000: 68A332038 78A332538.		Buckles, cracks, loose or missing fasteners, and distortion in skin and mating structure, FS 749.000 to FS 791.000 areas.
23	Tail (L/R), Mass items	3 thru 5	Removable link, FS 749.000: 68A335010.	Inspect with index no. 18.	Buckles, cracks, distortion, and loose or missing installation bolts.
24	Tail (L/R), Mass items	3 thru 5	Bulkheads: FS 749.000 - out-board: 68A332006 12 68A332506. FS 749.000 - center: 68A333361. FS 712.000 - out-board: 68A332002. FS 712.000 - center: 68A333008.	Inspect with index no. 18.	Engine bay accessible areas for buckles, cracks, distortion and loose or missing fasteners.
25	Tail (L/R), Mass items	3 thru 5	Lower longeron, FS 712.000 to FS 749.000: 68A332029.	Inspect with index no. 18.	Buckles, cracks, loose or missing fasteners, and distortion in engine bay area.
26	Pylons and attach areas	1 thru 5	External surfaces of pylons and attachments.		Buckles, cracks, loose or missing fasteners, and misalignment in pylon skin and structure.
27	Mass items	2 thru 5	Nose barrel equipment shelves (L/R).	Door 3L/R.	Buckles, cracks, distortion, loose and missing fasteners, and equipment for security.

Figure 2-10. Negative Overload Warning Aircraft Inspections (Sheet 13)

IDX NO.	CATEGORY	SEVERITY CODE	ITEM	ACCESS	TYPE OF DAMAGE
28	Tail (L/R), Mass items	3 thru 5	Aft fuselage keel assembly.	Inspect with index no. 18.	Buckles, cracks, distortion, and loose or missing fasteners, FS 626.000 to FS 749.000.
29	Tail (L/R), Mass items	1 thru 5	Upper inboard longeron, FS 626.000 to FS 712.000: 68A333045.		Buckles, cracks, distortion, and loose or missing fasteners in skin and mating structure, FS 626.000 to FS 640.000.
30	CFT, Mass items	1 thru 5	Exterior surface of conformal fuel tank (CFT) skins.		Buckles, cracks, distortion, and loose or missing fasteners.
31	CFT, Mass items	1 thru 5	Exterior surface of CFT skins between upper outboard longeron and lower inboard longeron from FS 466.000 thru FS 524.750, FS 562.900 thru FS 626.900, and FS 662.900 thru FS 699.870.		Buckles, cracks, distortion, and loose or missing fasteners.
32	CFT, Mass items	1 thru 5	Aerodynamic peripheral seals.		Cuts, tears, and loose or missing sections.
33	CFT, Mass items	2 thru 5	CFT mounting fittings. Upper and inboard mold line skins at FS 509.500 and FS 626.900.	Remove CFT (05-00-30).	Buckles, cracks, distortion, and loose or missing fasteners.
34	CFT, Mass items	2 thru 5	Fuselage CFT mounting fittings.	Remove CFT (05-00-30).	Buckles, cracks, distortion and loose or missing fasteners.
35	CFT, Mass items	2 thru 5	Aircraft/CFT attach kit parts.	Remove CFT (05-00-30).	Buckles, cracks, and distortion.
36	Mass items	2 thru 5	Fuselage Navigation and Targeting pod adapter mounting locations at FS 443.250 and FS 481.500.	2 → 3 Remove adapters (34-42-10), (94-79-18).	Buckles or cracks in bulkheads or skins. Fasteners for looseness and deformation. Bushing bosses for distortion, wear, galling or cracks.

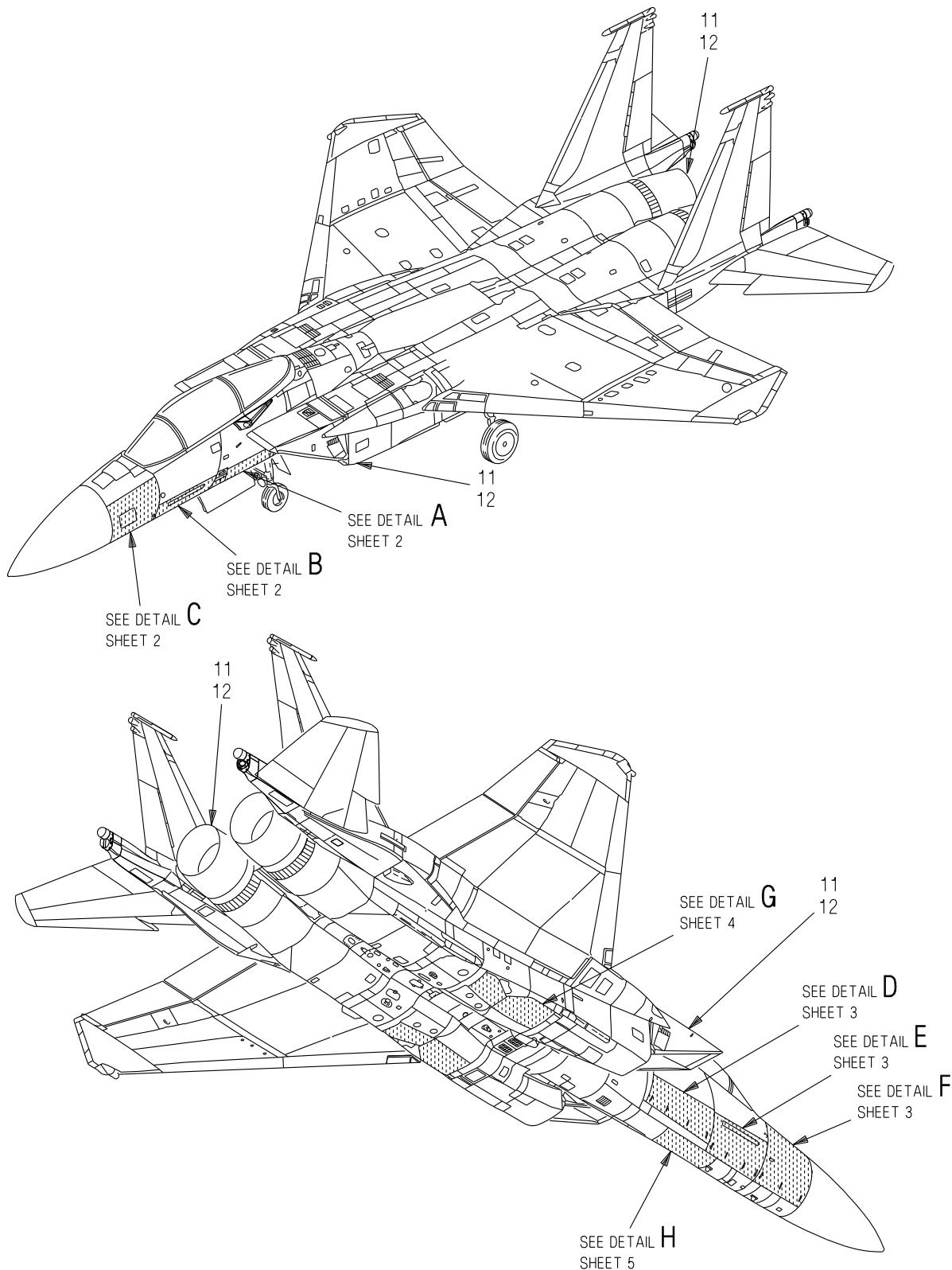
1 ➔ Remove CFT only when severity code is 2 thru 5. Refer to index no. 33, 34, and 35.

Figure 2-10. Negative Overload Warning Aircraft Inspections (Sheet 14)

CSTO SR1F-15SA-3-1

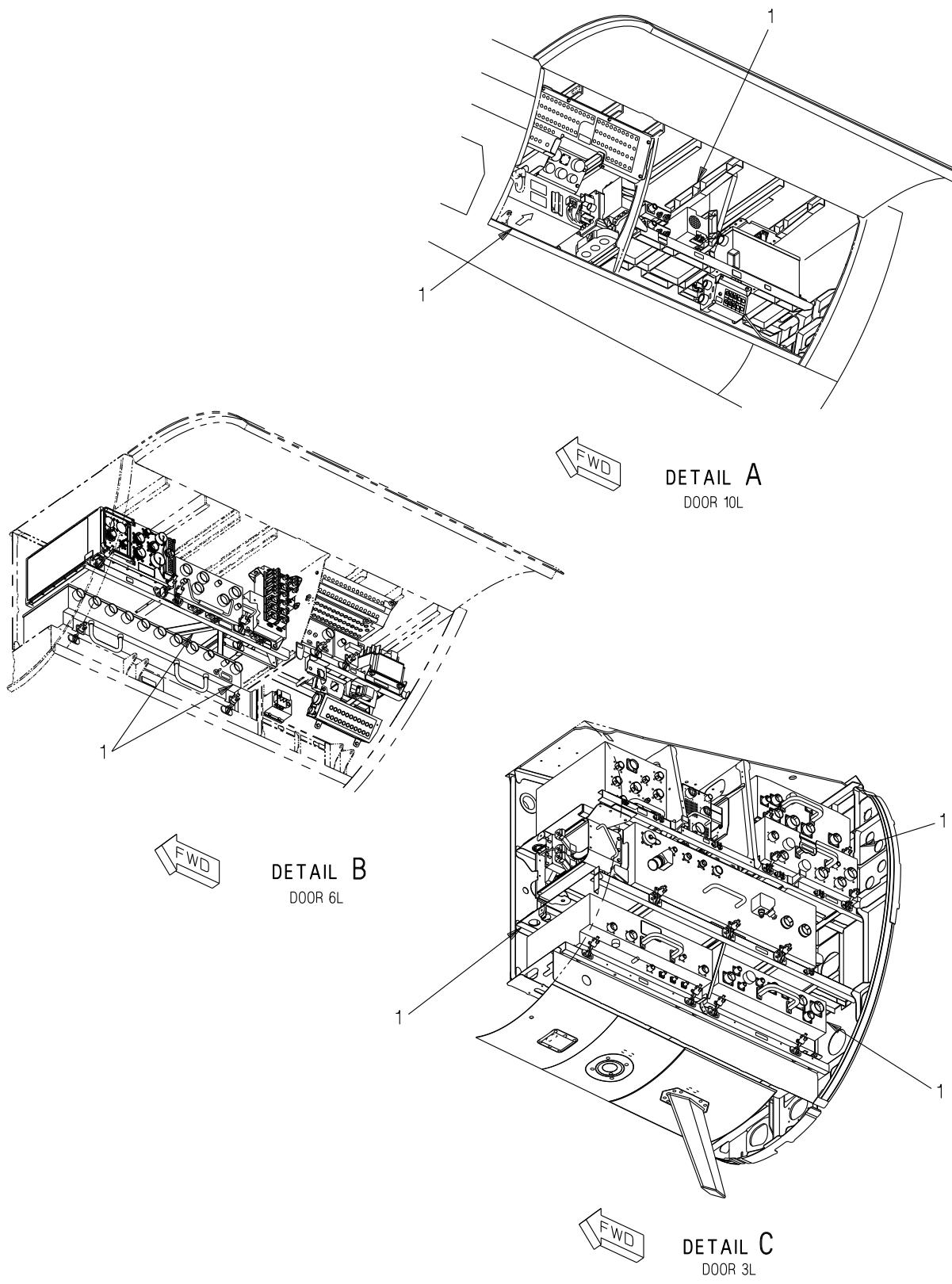
IDX NO.	CATEGORY	SEVERITY CODE	ITEM	ACCESS	TYPE OF DAMAGE
		2	► Inspection required only when pylons were installed.		
		3	► If Navigation and/or Targeting pods were installed during over G condition of 2 or greater, refer to CSTO SR1F-15SA-6, Special Inspection After Specific Occurrence, Fire Control (system 74000).		
		4	► 12-1001 THRU 12-1055; ALSO 93-0852 THRU 93-0906.		
		5	► 12-1056 AND UP; ALSO 93-0907 THRU 93-0923.		
		6	► 12-1001 THRU 12-1039; ALSO 93-0852 THRU 93-0923.		
		7	► 12-1040 AND UP.		
		8	► 12-1001 THRU 12-1032; ALSO 93-0852 THRU 93-0923.		
		9	► 12-1033 AND UP.		
		10	► 12-1001 THRU 12-1024; ALSO 93-0852 THRU 93-0923.		
		11	► 12-1025 AND UP.		
		12	► Preferred part.		

Figure 2-10. Negative Overload Warning Aircraft Inspections (Sheet 15)



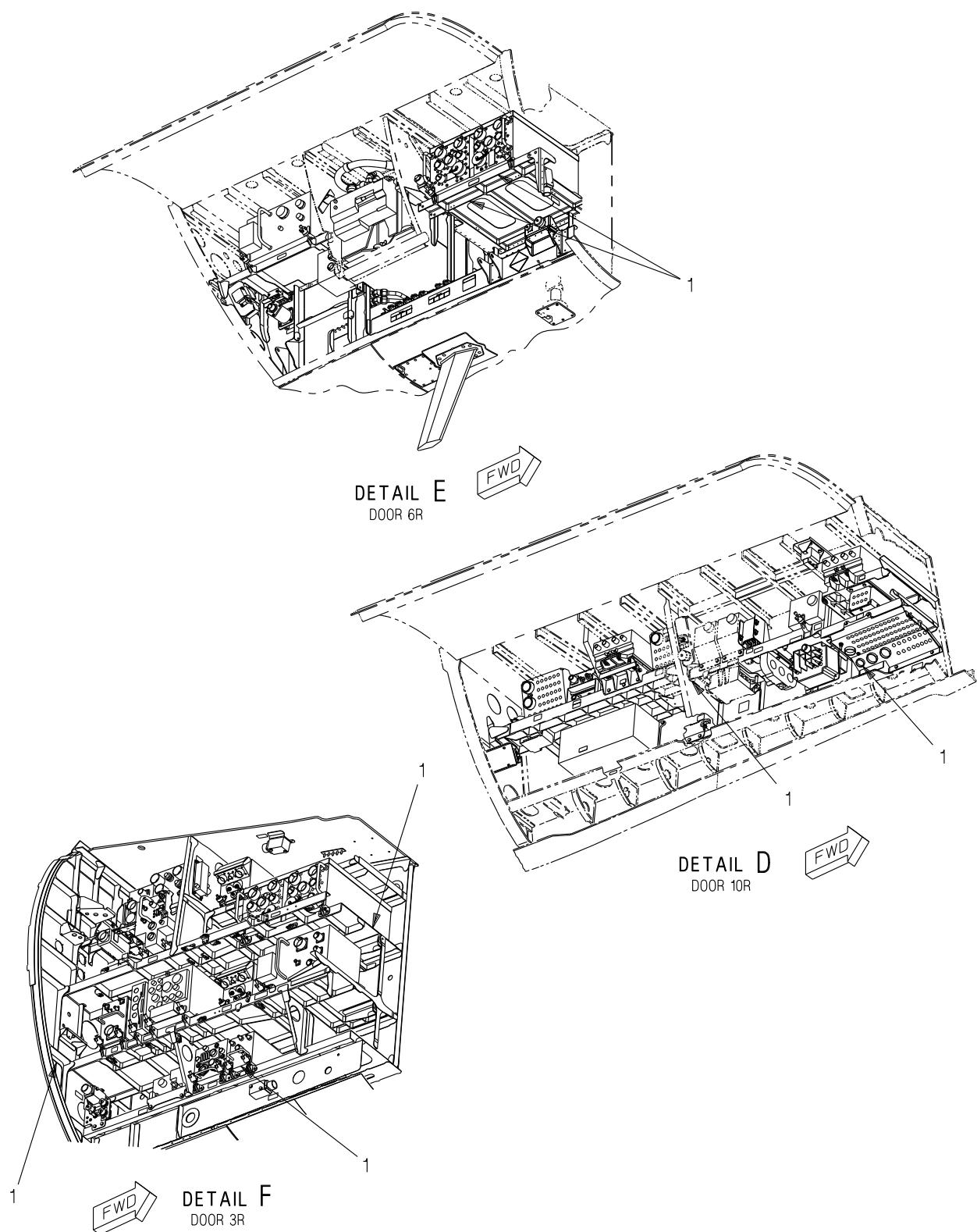
SAN301-02-71-001

Figure 2-11. Hard Landing Inspection (Sheet 1 of 6)



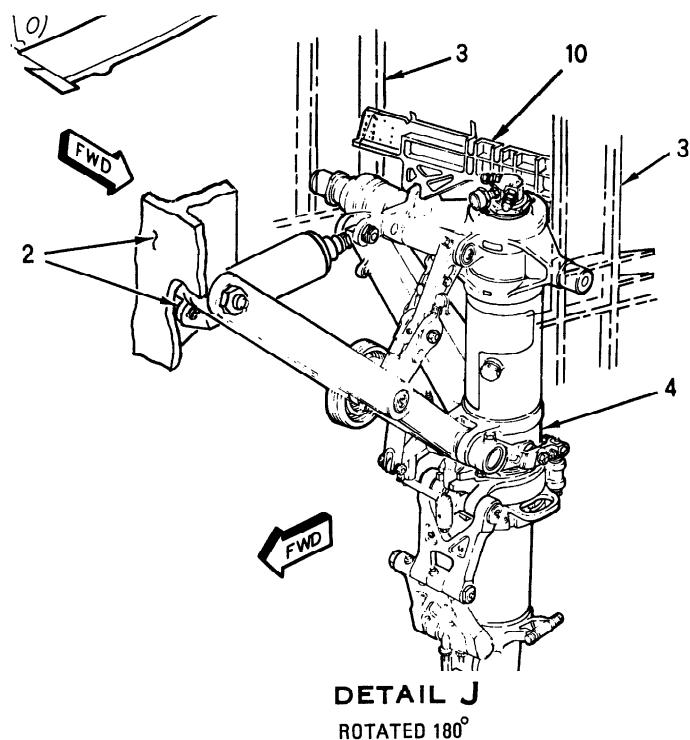
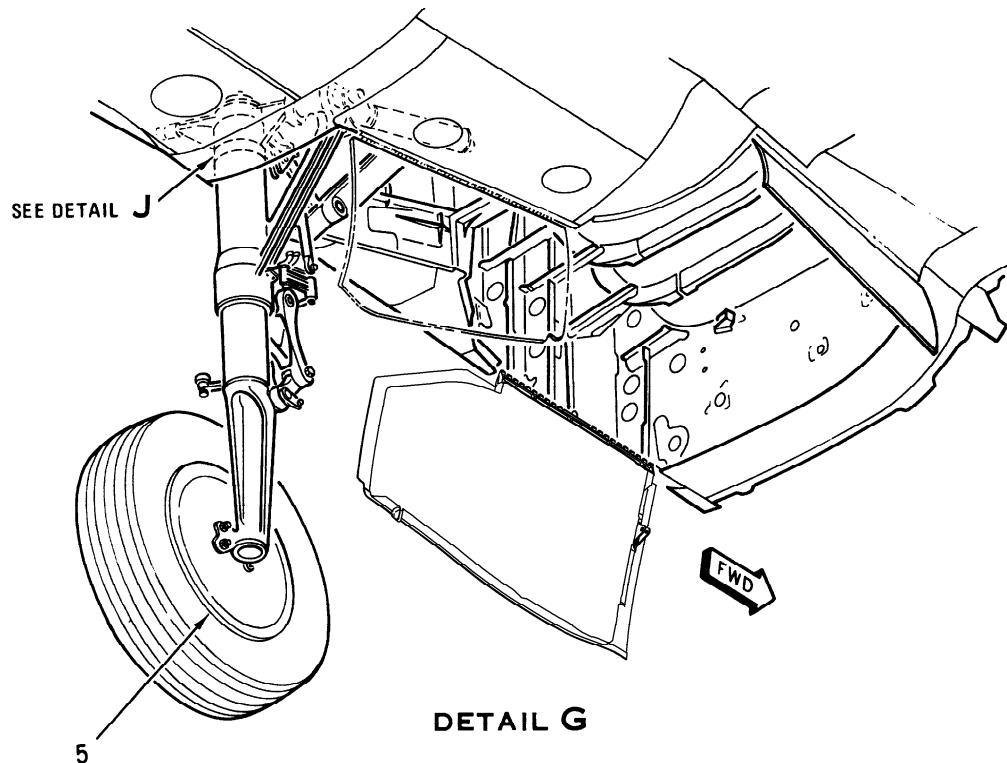
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Figure 2-11. Hard Landing Inspection (Sheet 2)



SAN301-02-73-001

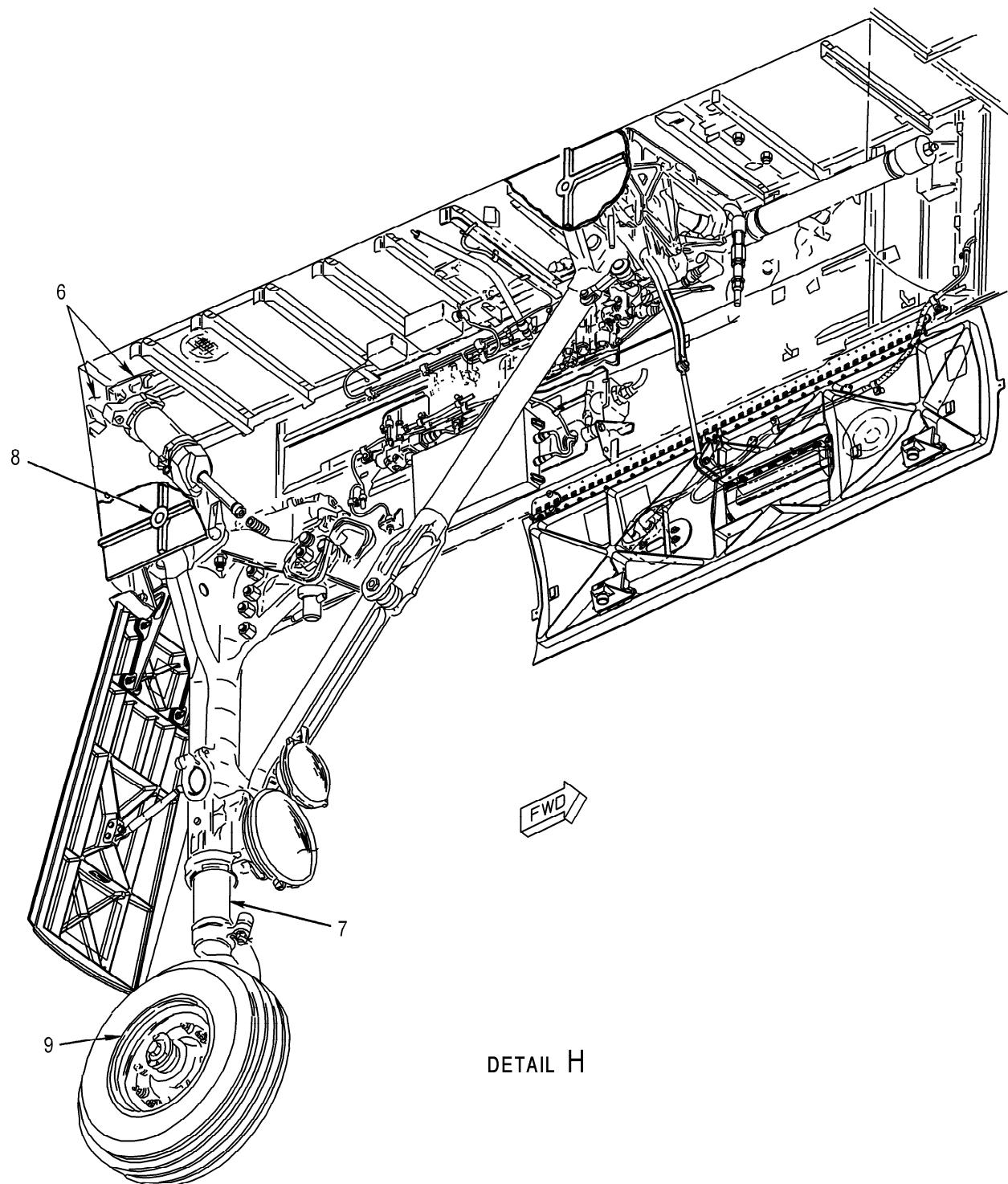
Figure 2-11. Hard Landing Inspection (Sheet 3)



MAJOR CHANGE

SAN301-02-74-002

Figure 2-11. Hard Landing Inspection (Sheet 4)



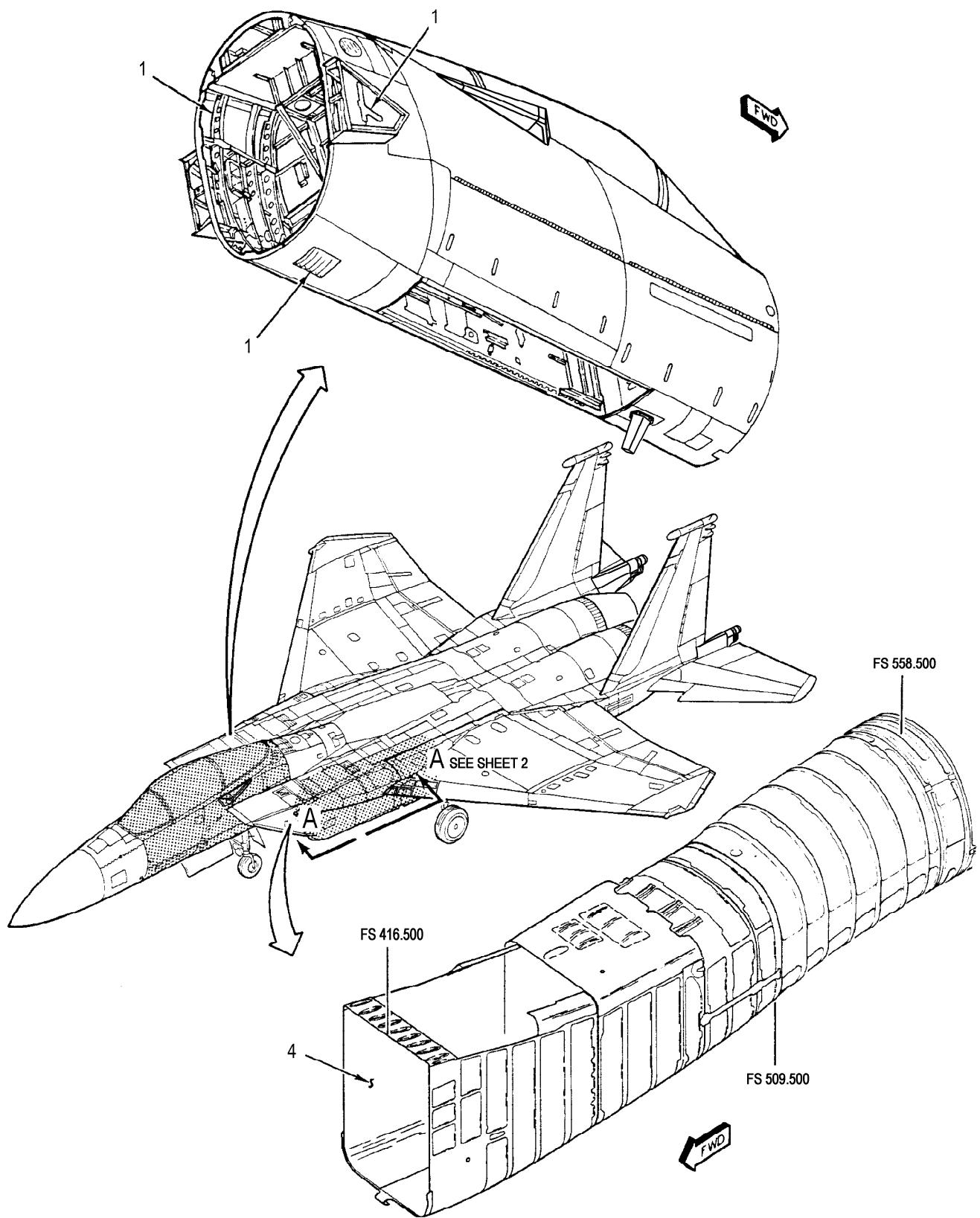
SAN301-02-75-001

Figure 2-11. Hard Landing Inspection (Sheet 5)

CSTO SR1F-15SA-3-1

IDX NO.	NOMENCLATURE	TYPE OF INSPECTION	TYPE OF DAMAGE
1	Electrical equipment and racks.	Visual.	Buckles, cracks, security of equipment, loose or missing fasteners.
2	Drag brace and actuator support fittings and all bearings.	Visual.	Cracks, distortion, loose, tilted, sheared or missing fasteners.
3	Strut support fittings and all bearings.	Visual.	Cracks, distortion, loose, tilted, sheared or missing fasteners.
4	Strut assemblies.	Visual.	Distortion, loose joints, loose, sheared or missing fasteners.
5	Wheels.	Visual.	Cracks, flat spots.
6	Bulkhead, CFS 377.700.	Visual.	Cracks, distortion, loose, tilted, sheared or missing fasteners.
7	Strut assembly.	Visual.	Distortion, loose joints, loose, sheared or missing fasteners.
8	Strut support fittings.	Visual.	Cracks, distortion, loose, tilted, sheared or missing fasteners.
9	Nose wheel.	Visual.	Cracks, flat spots.
10	Main landing gear side brace fitting and side load bearing seats.	Visual.	Cracks, distortion, loose, tilted, sheared or missing fasteners.
11	Both engine inlet and exhaust areas.	Visual.	 Bent, curled, bowed blades.
12	Both engine compressor rotors.	Freedom of rotation.	 Binding, abnormal noise.
 Refer to CSTO SR1F-15SA-2-71GS-03-1.			

Figure 2-11. Hard Landing Inspection (Sheet 6)



SAN301-02-76-001

Figure 2-12. Engine Stall Inspection (Sheet 1 of 7)

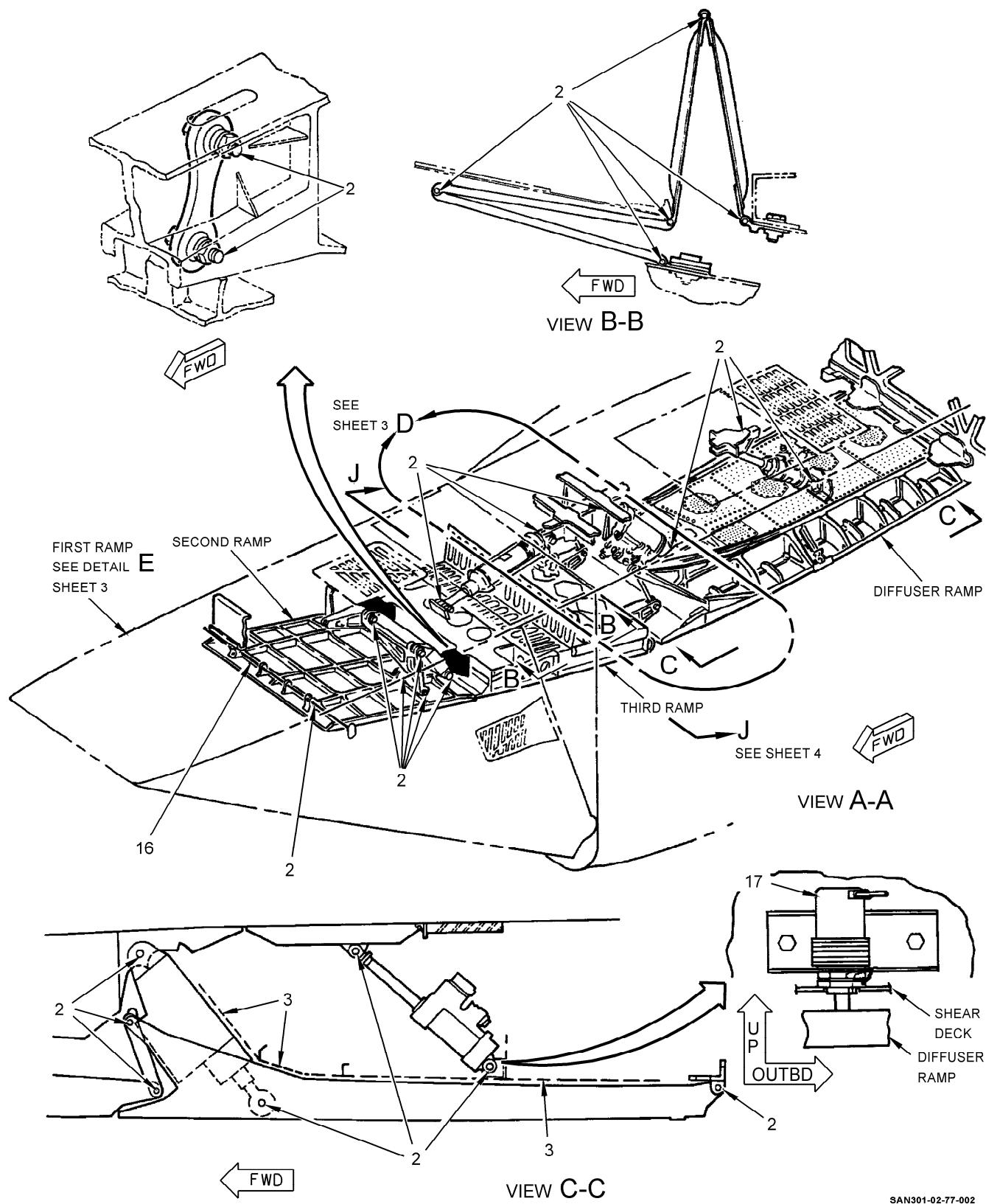


Figure 2-12. Engine Stall Inspection (Sheet 2)

SAN301-02-77-002

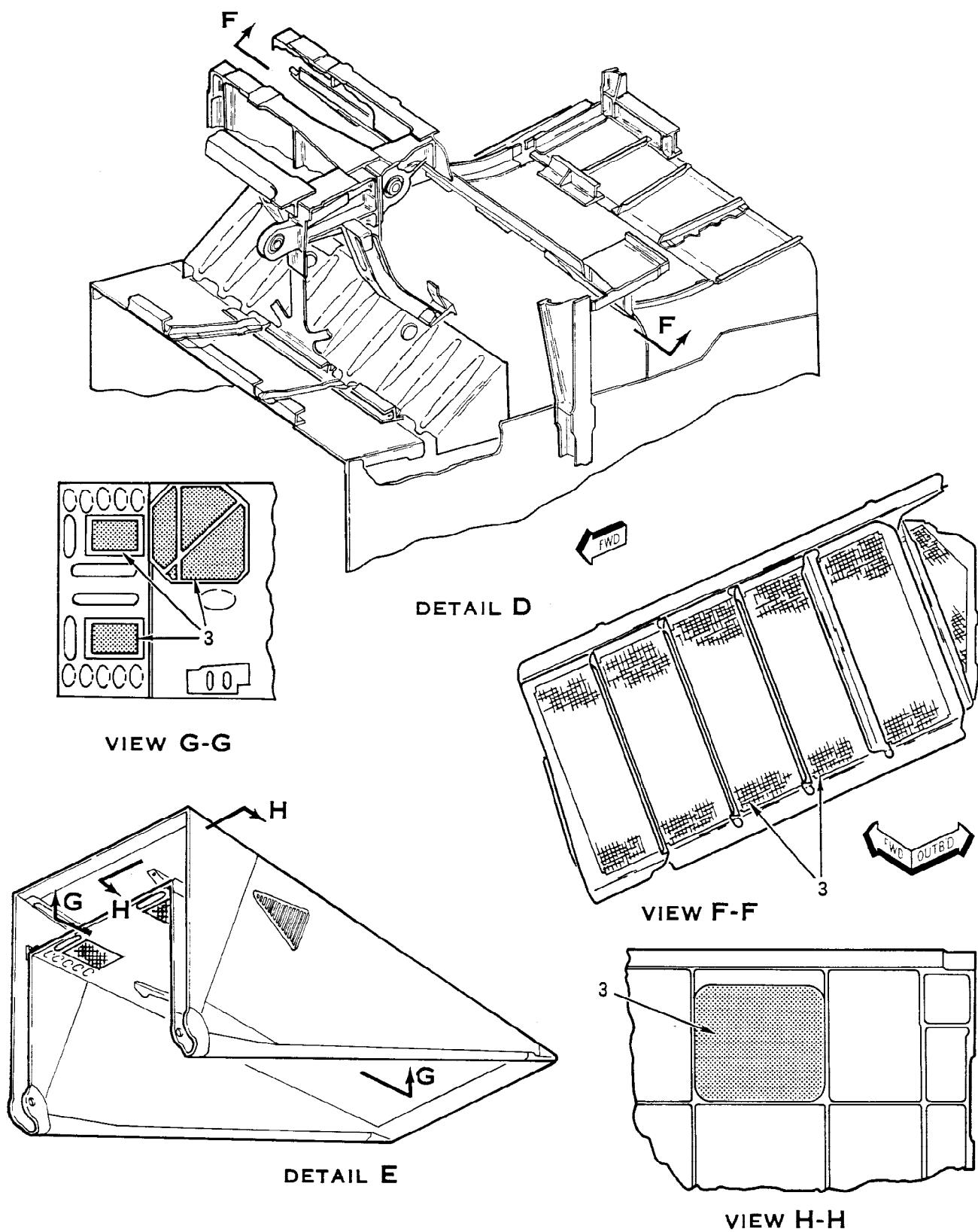
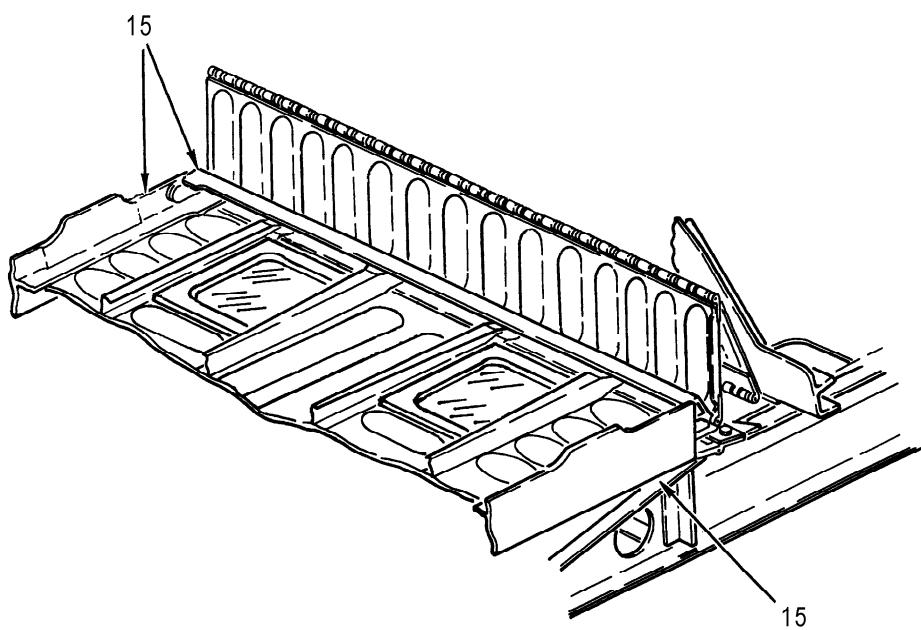


Figure 2-12. Engine Stall Inspection (Sheet 3)

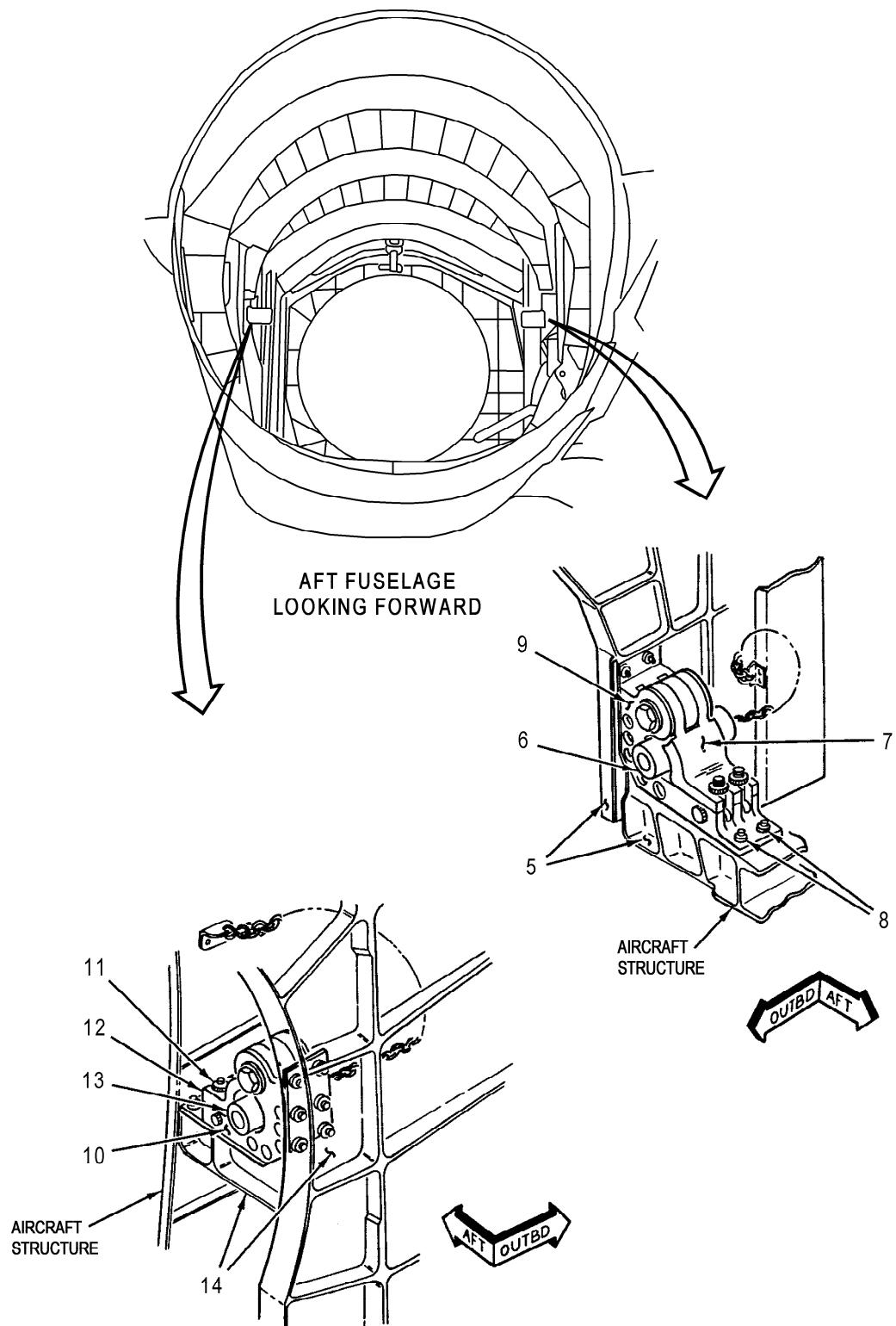
SAN301-02-78-001



DETAIL J-J
DOOR 21 OPEN, FIRST RAMP
IN FULL DOWN POSITION

SAN301-02-80-001

Figure 2-12. Engine Stall Inspection (Sheet 4)



SAN301-02-79-001

Figure 2-12. Engine Stall Inspection (Sheet 5)

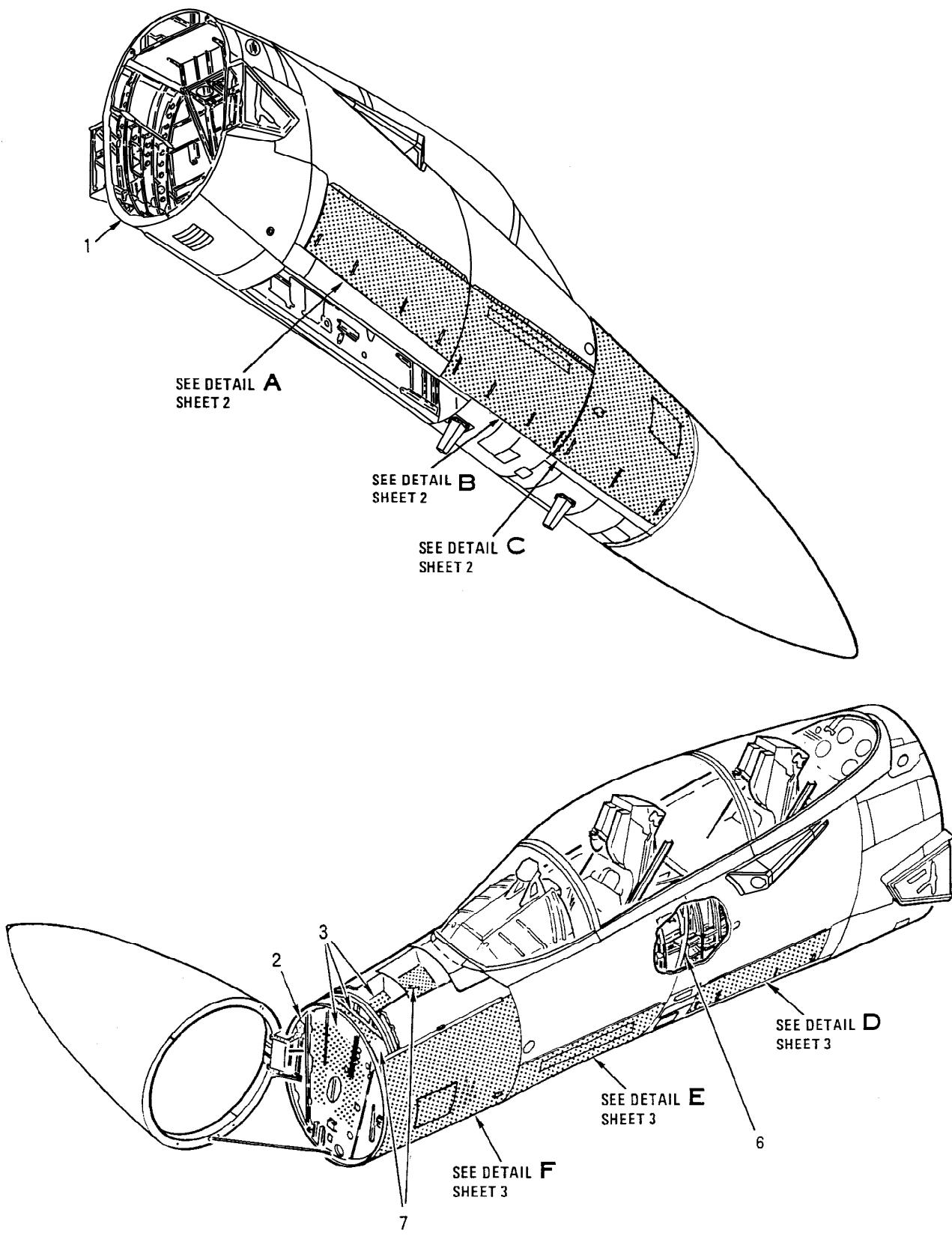
IDX NO.	NOMENCLATURE	TYPE OF INSPECTION	TYPE OF DAMAGE
1	Air inlet diverters, skins, and structure.	5 → Visual.	Cracks, buckles, loose or missing fasteners.
2	Second and third ramps and diffuser moving joints and actuator supports.	3 → Visual.	Cracks, distortion, loose or missing fasteners.
3	Skins and screens.	1 → 5 → Visual.	Cracks, holes, buckles, loose or missing fasteners.
4	Air intake duct skins.	5 → Visual.	Cracks, buckles, holes, loose or missing fasteners.
5	Inboard mount support structure.	2 → Visual.	Cracks, loose, sheared or missing fasteners.
6	Mount adapter.	2 → Visual.	Cracks, distortion.
7	Mount cap.	2 → Visual.	Cracks, distortion.
8	Bolts.	2 → Visual.	Cracks, distortion, stripped threads.
9	Inboard mount body.	2 → Visual.	Cracks, distortion, loose, sheared or missing fasteners.
10	Outboard mount body.	2 → Visual.	Cracks, distortion, loose, sheared or missing fasteners.
11	Bolts.	2 → Visual.	Cracks, distortion, stripped threads.
12	Mount cap.	2 → Visual.	Cracks, distortion.
13	Mount adapter.	2 → Visual.	Cracks, distortion.
14	Outboard mount support structure.	2 → Visual.	Cracks, loose, sheared or missing fasteners.
15	Hinge: 68A327158 Stringers: 68A327127 7 → 68A327128 8 → 68A327617.	5 → Visual.	Cracks, distortions, and missing hinge tangs.
16	Second ramp forward hinge pin.	3 → Visual.	Cuts, nicks, signs of galling and bending.
17	Diffuser ramp limit switch.	3 → Visual. 4 → Functional.	Visually for obvious damage, functionally for correct operation.

1 → For inspection procedure, refer to CSTO SR1F-15SA-3-4.
 2 → Inspect only after stalls with airspeed in excess of 700 KCAS. Engine removal is not required.
 3 → Inspect only after stalls with airspeed in excess of 600 KCAS.

Figure 2-12. Engine Stall Inspection (Sheet 6)

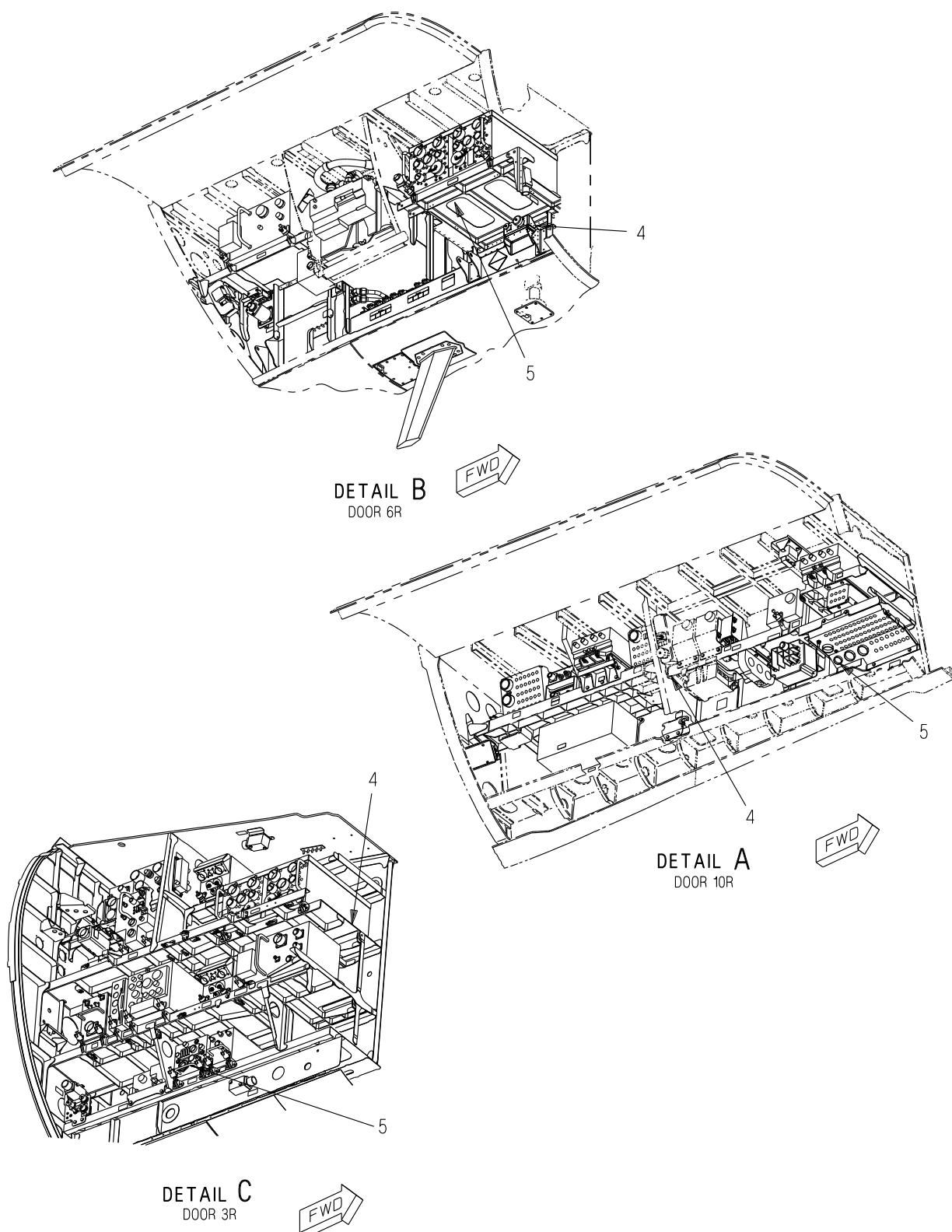
IDX NO.	NOMENCLATURE	TYPE OF INSPECTION	TYPE OF DAMAGE
4	For functional inspection refer to operational checkout, engine air induction systems (71-60-10).		
5	Inspect after any stall, regardless of airspeed, or any stall occurring on ground run-up or trim.		
6	For stalls with airspeed below 500 KCAS, visually inspect the air inlet diverters through the intake only, and inspect the skins externally. For stalls with airspeed in excess of 500 KCAS, remove ramp 1, door 12, and door 18 to gain access to the internal structure.		
7	12-1001 THRU 12-1024; ALSO 93-0852 THRU 93-0923.		
8	12-1025 AND UP.		

Figure 2-12. Engine Stall Inspection (Sheet 7)



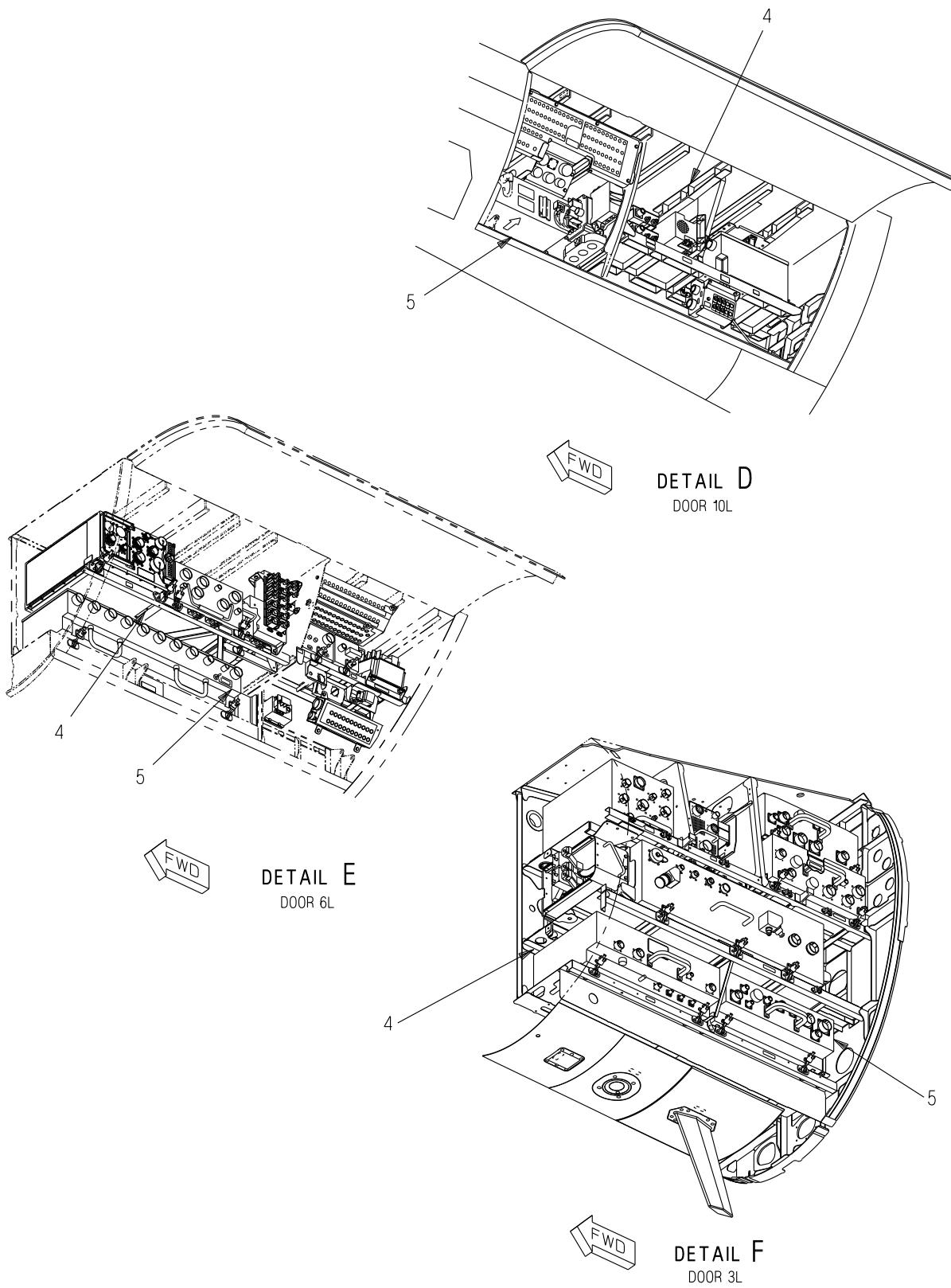
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Figure 2-13. Spin Inspection (Sheet 1 of 8)



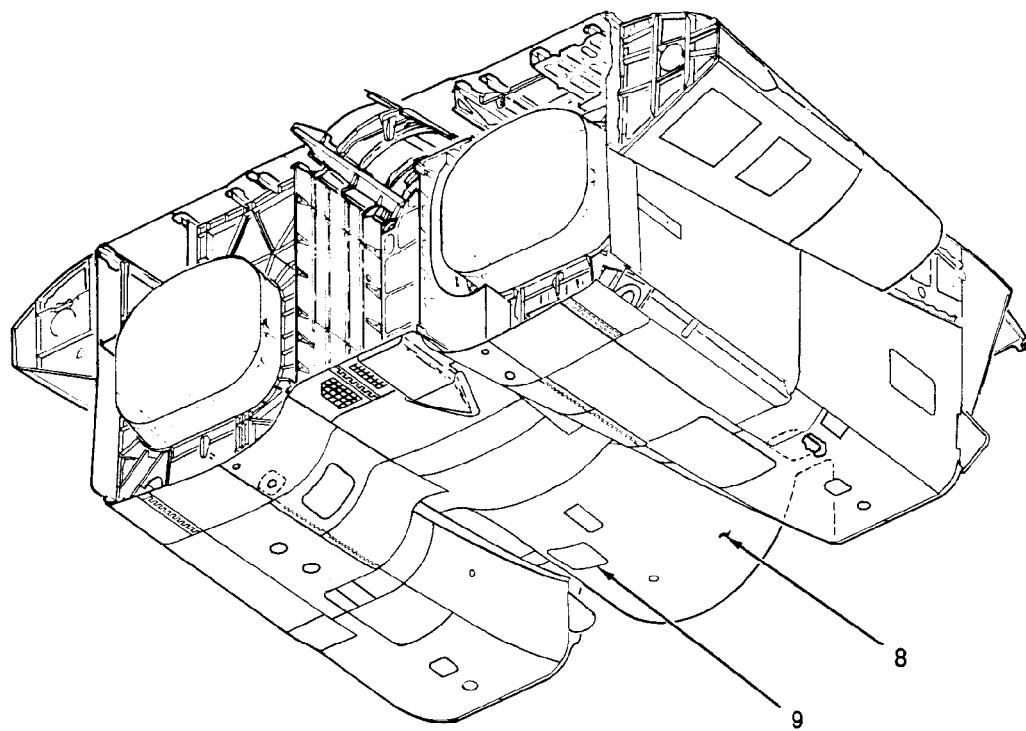
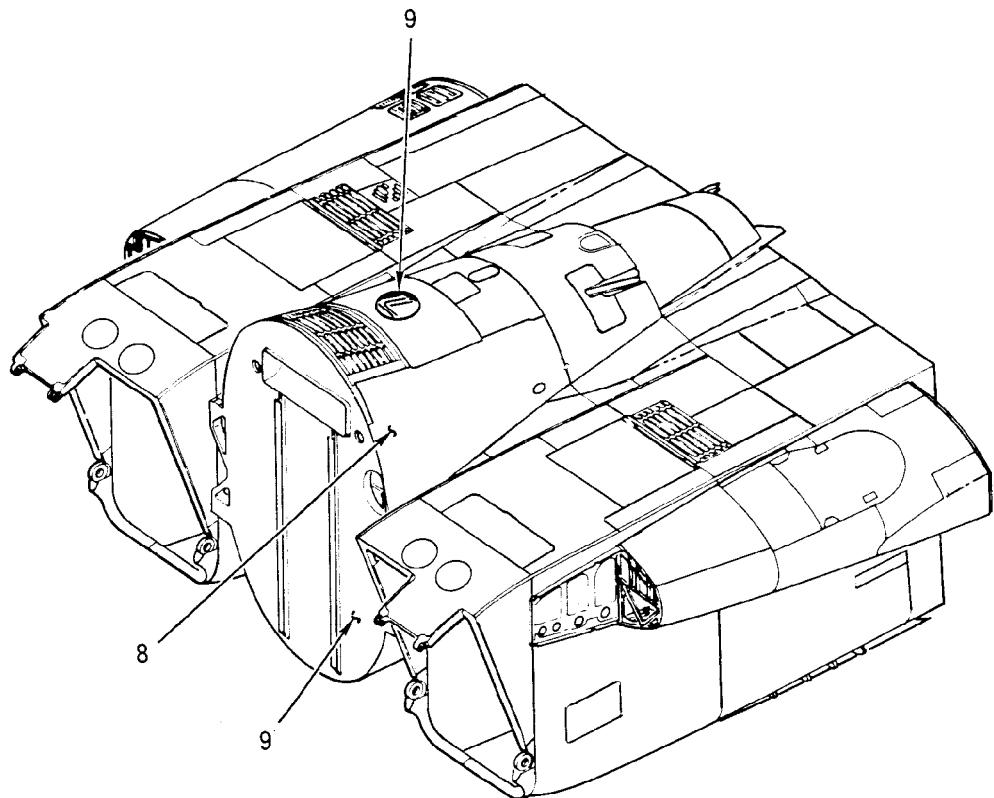
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Figure 2-13. Spin Inspection (Sheet 2)



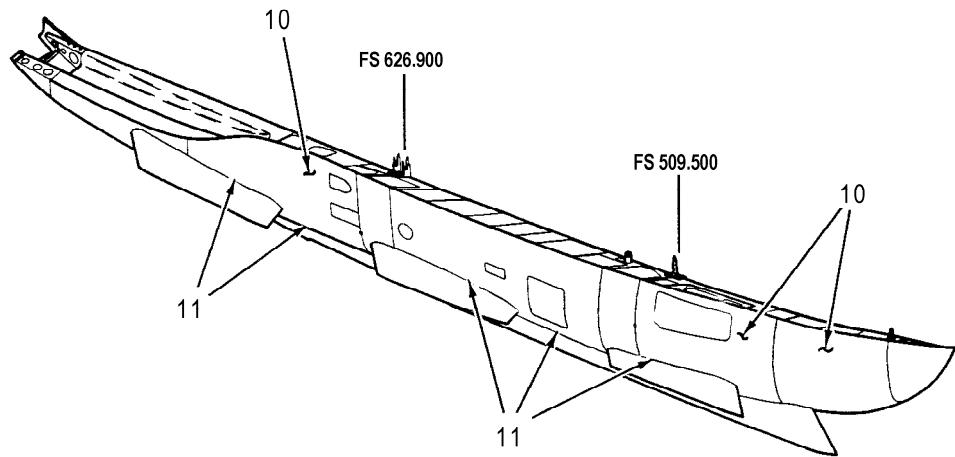
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Figure 2-13. Spin Inspection (Sheet 3)

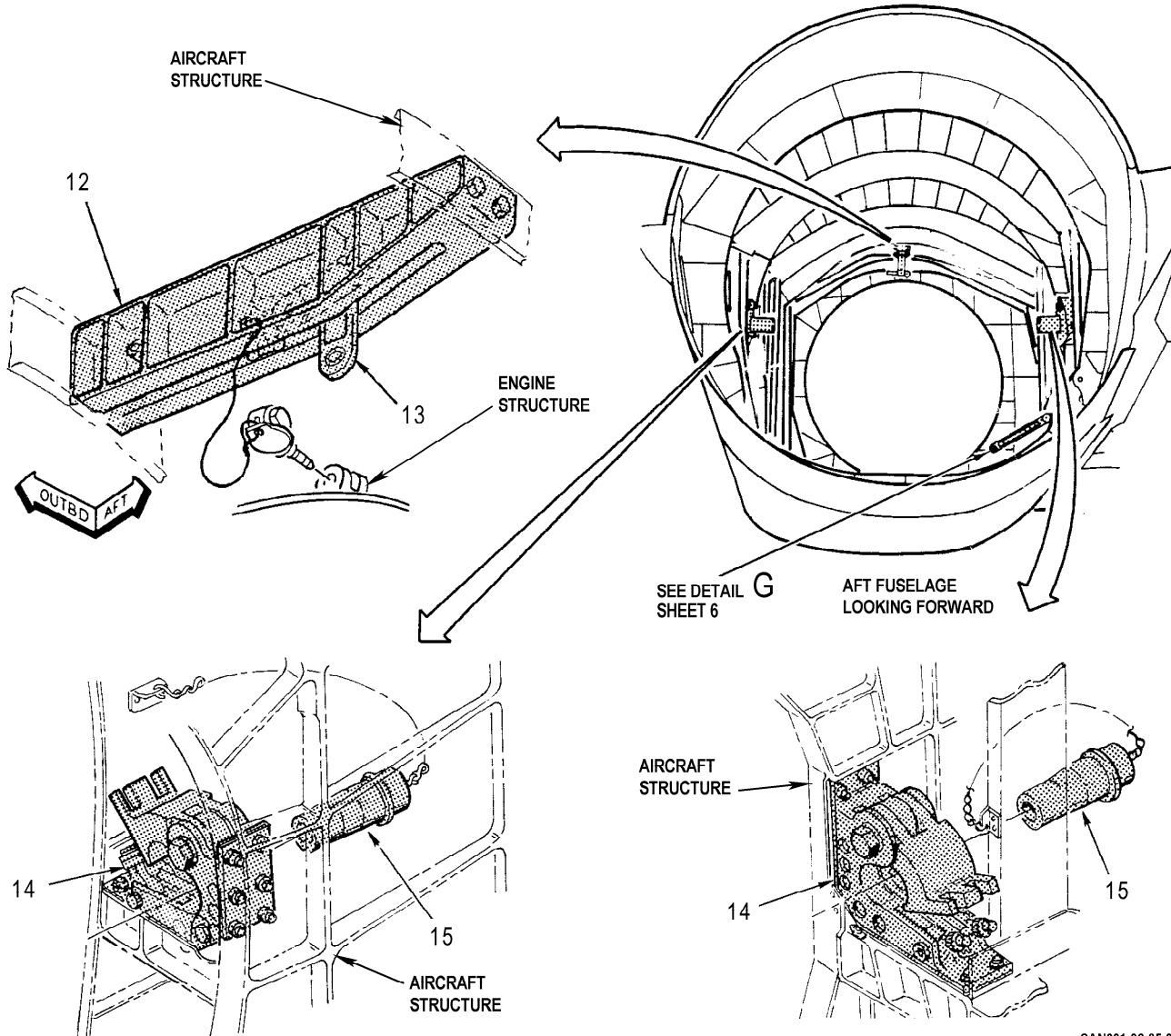


SAN301-02-84-002

Figure 2-13. Spin Inspection (Sheet 4)



■ CONFORMAL FUEL TANK (CFT), 68A250001 AND 68G250001
RIGHT SIDE SHOWN, LEFT SIDE OPPOSITE



SAN301-02-85-002

Figure 2-13. Spin Inspection (Sheet 5)

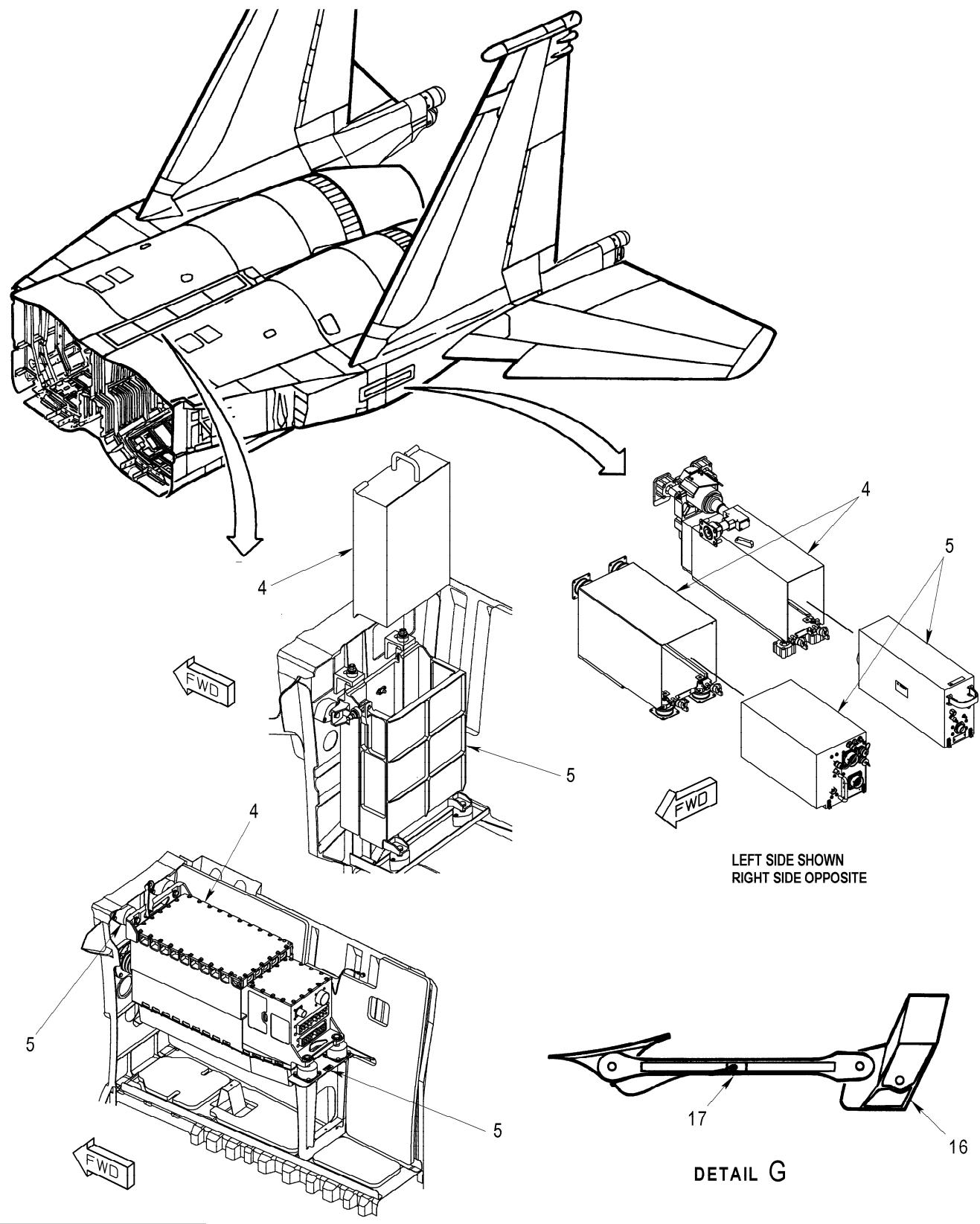


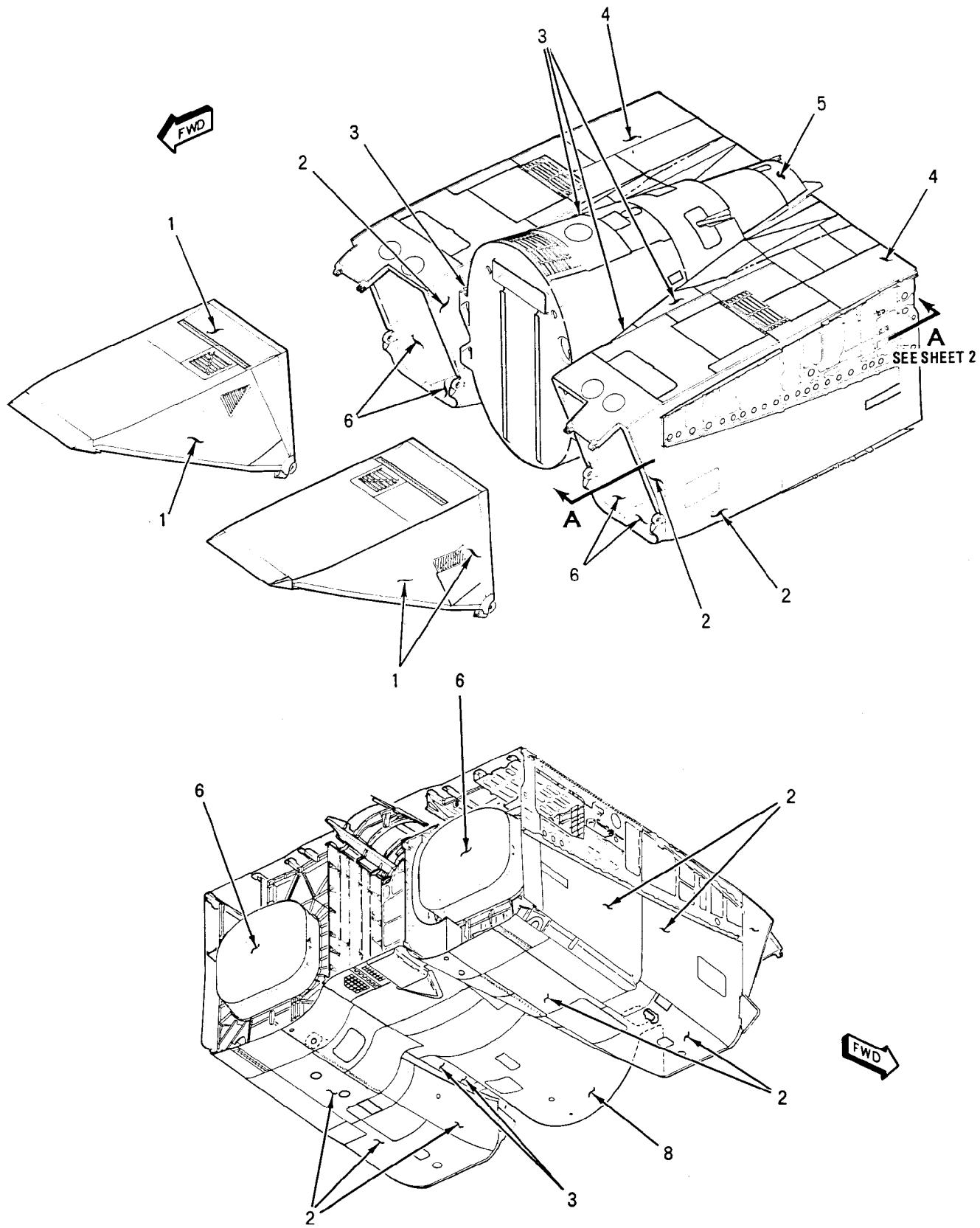
Figure 2-13. Spin Inspection (Sheet 6)

IDX NO.	NOMENCLATURE	TYPE OF INSPECTION	TYPE OF DAMAGE
1	Forward to center fuselage splice ring, match angles, and longerons.	Visual.	Buckles, cracks, distortion, loose or missing fasteners.
2	Bulkhead, FS 208.900.	Visual.	Buckles, cracks, loose, distorted or missing fasteners.
3	Ballast.	Visual.	Distortion, loose, distorted or missing fasteners.
4	Electrical racks and shelves.	Visual.	Buckles, cracks, dents, damaged bolts, shock mounts and alignment pins, loose or missing fasteners.
5	Electrical equipment.	Visual, Functional.	Visually for obvious damage and functionally for correct operation.
6	Bulkhead, CFS 307.330.	Visual.	Cracks, buckles, and distortion.
7	Nose barrel upper deck.	Visual.	Buckles, cracks, loose or missing fasteners.
8	Skins and fuel cell structure.	Visual.	Cracks, buckles, distortion of cell liners, and fuel leaks.
9	Bulkhead, FS 415.000 and number 1 fuel tank structure.	Visual.	Buckles, cracks, bulges caused by excess fuel pressure.
10	Exterior surface of conformal fuel tank (CFT) skins.	Visual.	Buckles, cracks, distortion, and loose or missing fasteners. Fuel leaks.
11	Exterior surface of CFT and around bomb racks.	Visual.	Fuel leaks.
12	Forward engine mount bracket, 68A336220.	Remove engines (71-03-10).	Cracks in mount bracket and supporting structure. Fasteners for looseness and deformation.
13	Forward engine mount link: 68A500071.	Remove engines (71-03-10) and link from mount (71-21-12).	Cracks.
14	Main inboard and outboard mounts: 68A500070.	Remove engines (71-03-10).	Cracks in mounts supporting structure. Fasteners for looseness and deformation.
15	Engine mount to engine adapters: 68A500079.	Remove engines (71-03-10).	Cracks.

Figure 2-13. Spin Inspection (Sheet 7)

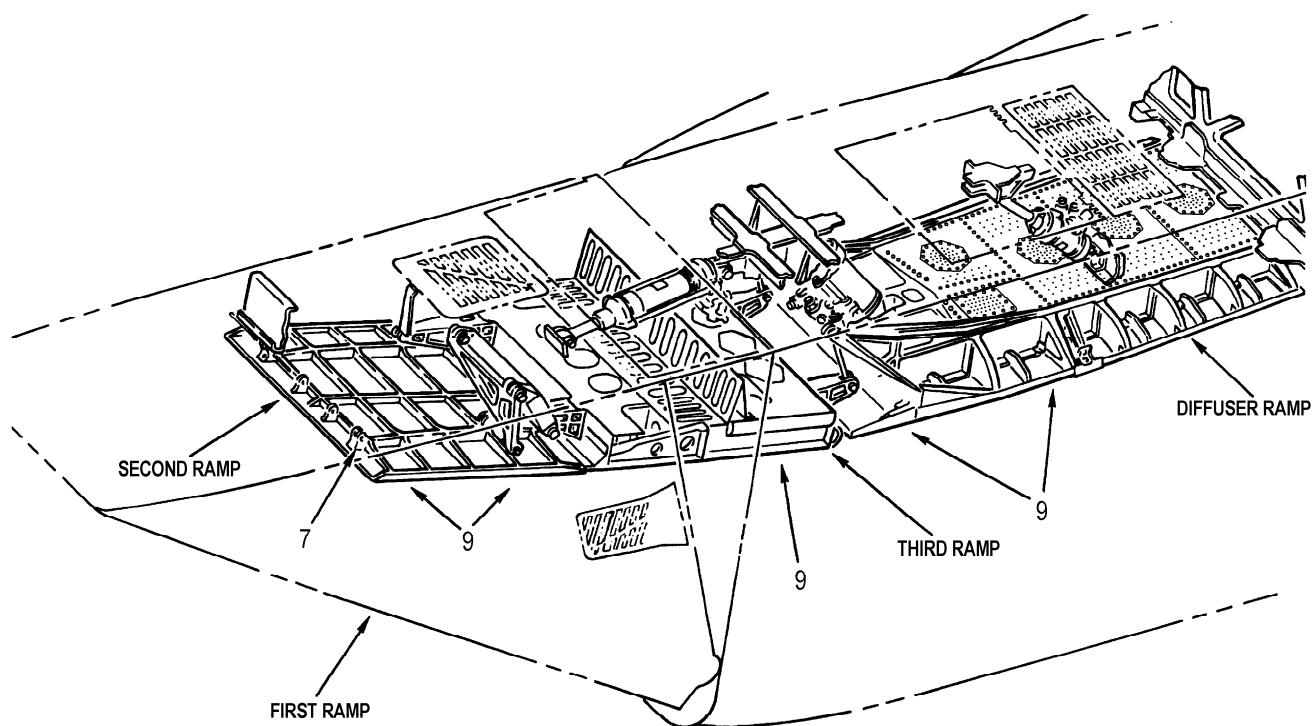
IDX NO.	NOMENCLATURE	TYPE OF INSPECTION	TYPE OF DAMAGE
16	Engine mount side load bracket: 1 → 68A500075 2 → 68A500073.	Remove engines (71-03-10).	Cracks in mount bracket and supporting structure. Fasteners for looseness and deformation.
17	Engine mount side load link: 68A500076.	Remove engines (71-03-10) and link from mount (71-21-10).	Cracks.
1 → Left side. 2 → Right side.			

Figure 2-13. Spin Inspection (Sheet 8)

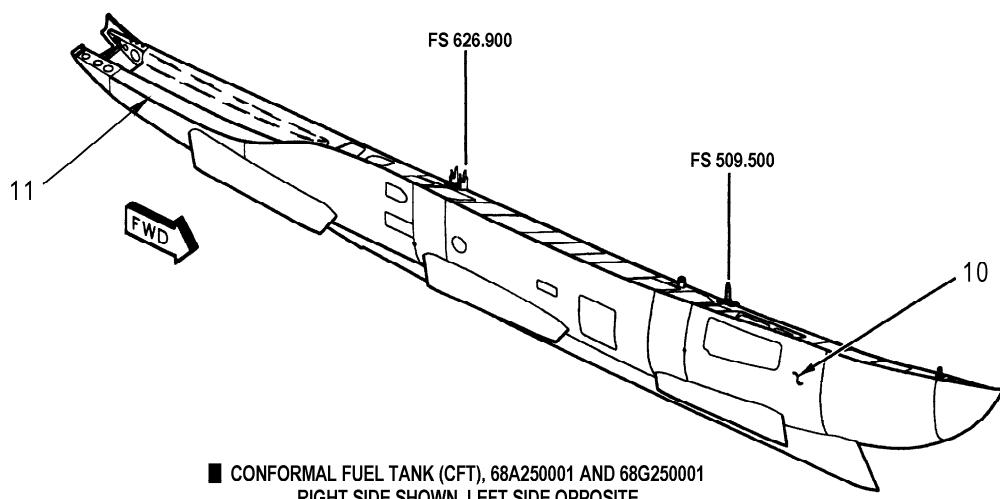


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Figure 2-14. Excessive Airspeed Inspection (Sheet 1 of 3)



VIEW A-A



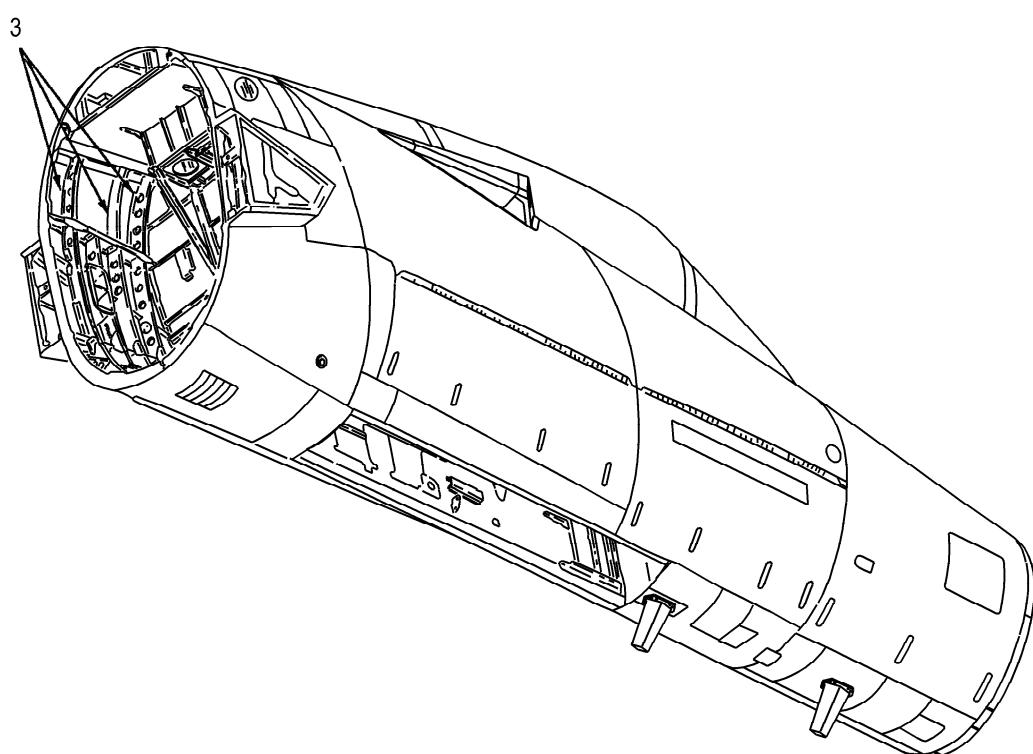
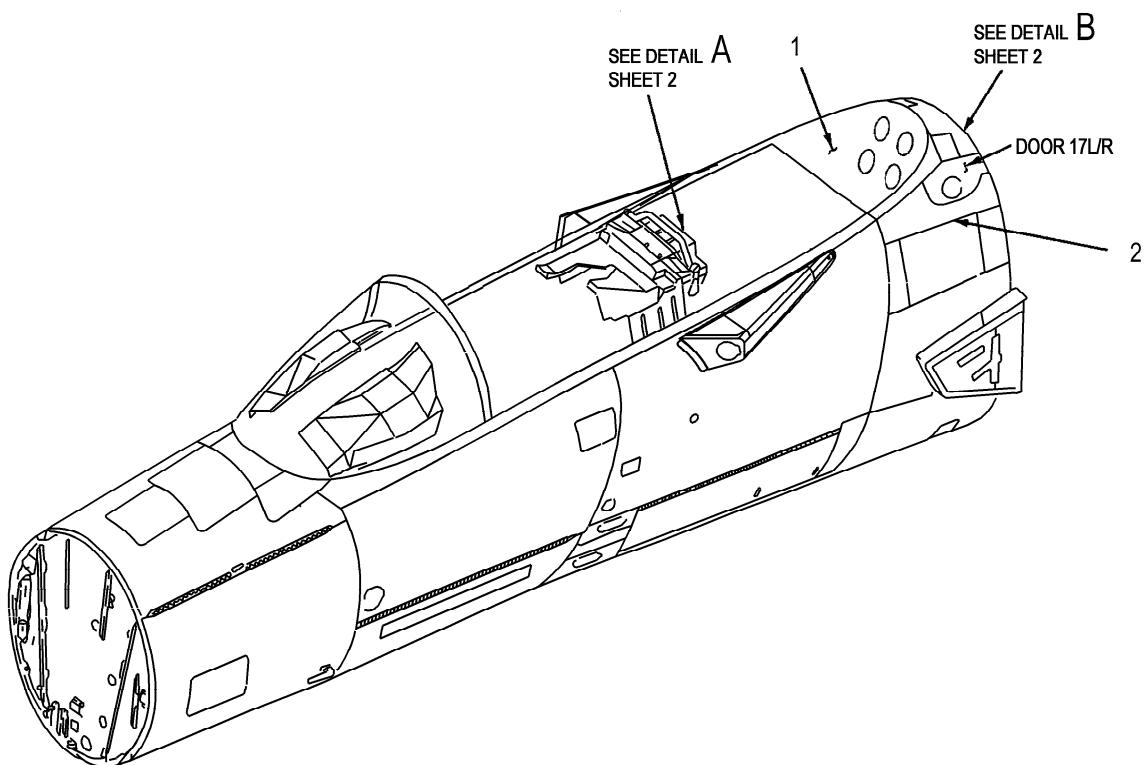
■ CONFORMAL FUEL TANK (CFT), 68A250001 AND 68G250001
RIGHT SIDE SHOWN, LEFT SIDE OPPOSITE

SAN301-02-88-002

Figure 2-14. Excessive Airspeed Inspection (Sheet 2)

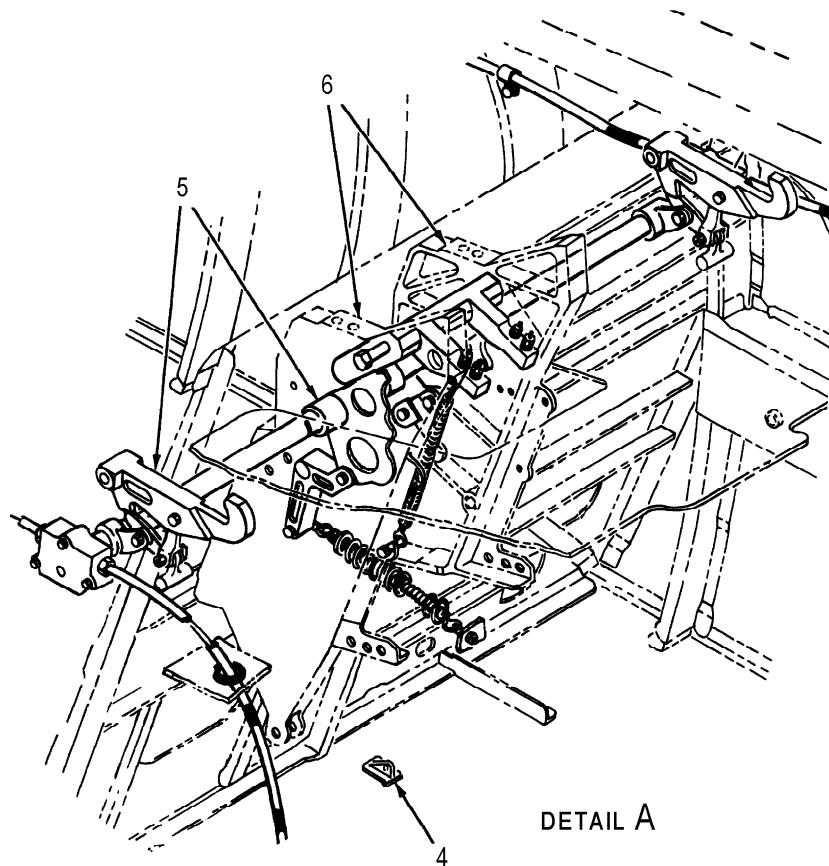
IDX NO.	NOMENCLATURE	TYPE OF INSPECTION	TYPE OF DAMAGE
1	First ramp inner and outer skins.	Visual.	Cracks, loose or missing fasteners.
2	Forward air duct outer skins.	Visual.	Cracks, loose or missing fasteners.
3	Diverter skins.	Visual.	Cracks, loose or missing fasteners.
4	Fuselage skins.	Visual.	Cracks, buckles, loose or missing fasteners.
5	Speed brake.	Visual.	Cracks, loose or missing fasteners.
6	Forward air duct inner skins and screens.	Visual.	Cracks in duct walls and flat areas, loose or missing fasteners.
7	Second ramp leading edge, hinge pins and mating lugs.	Visual.	Cracks, distortion, worn hinge pins and elongated holes.
8	Fuselage lower skin.	Visual.	Buckles, cracks, loose or missing fasteners.
9	Second and third ramp, and diffuser skins.	Visual.	Buckles, cracks, loose or missing fasteners.
10	Exterior surface of conformal fuel tank (CFT) skins.	Visual.	Buckles, cracks, distortion, loose or missing fasteners. Fuel leaks.
11	Aerodynamic peripheral seals.	Visual.	Cuts, tears and loose or missing sections.

Figure 2-14. Excessive Airspeed Inspection (Sheet 3)

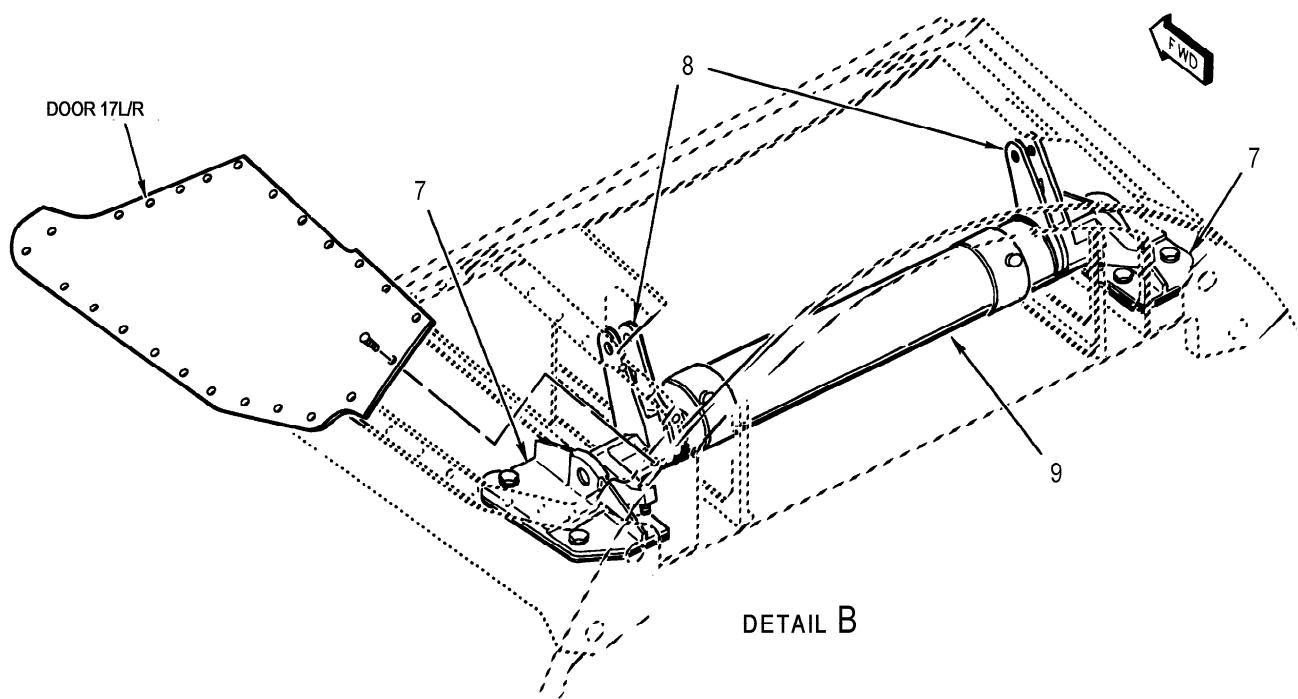


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Figure 2-15. Canopy Jettison Inspection (Sheet 1 of 3)



DETAIL A



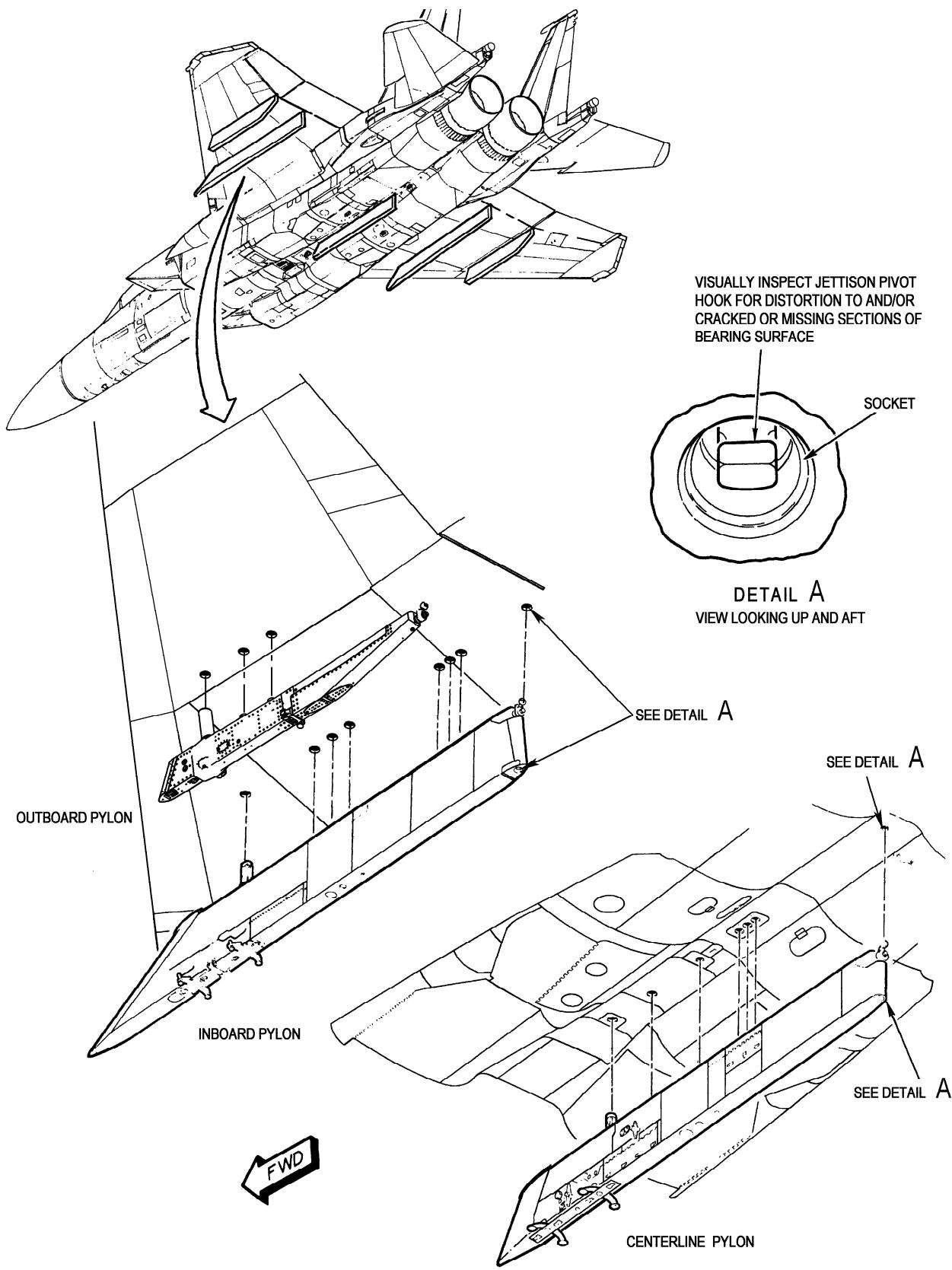
DETAIL B

SAN301-02-90-001

Figure 2-15. Canopy Jettison Inspection (Sheet 2)

IDX NO.	NOMENCLATURE	TYPE OF DAMAGE
1	Canopy closure fairing deck.	Cracks, loose or missing fasteners.
2	Longerons.	Cracks, loose or missing fasteners.
3	Frames, FS 309.250 through FS 408.340.	Cracks, loose or missing fasteners.
4	Canopy remover support.	Distortion, cracks, loose or missing fasteners.
5	Canopy locking mechanism.	Distortion, cracks.
6	Latch mechanism support.	Cracks, loose or missing fasteners.
7	Canopy hinge support fittings.	Cracks, loose or missing fasteners.
8	Canopy hinge bellcranks.	Cracks, distortion, loose, sheared or missing fasteners.
9	Torque tube.	Distortion, cracks.

Figure 2-15. Canopy Jettison Inspection (Sheet 3)



SAN301-02-91-001

Figure 2-16. Pylons and Fuel Tanks Jettison Inspection

2-30. HEAT INSPECTION. Visually inspect painted surfaces for discoloration, peeling or blistering. The severity of paint discoloration is dependent on temperature and duration of exposure. When exposed to heated air for a duration of 12 minutes, M85285-1-02Q-17925 white aliphatic polyurethane enamel begins to disolor at about 500 degrees Fahrenheit, turning to approximately a light tan shade. Higher temperatures produce darker shades of brown and the paint turns black around 900 degrees Fahrenheit. When M85285-1-02Q-36251 or M85285-1-02Q-16473 gray aliphatic polyurethane enamel is exposed to heated air for 12 minutes, tinges of brown appear at about 500 degrees Fahrenheit. Darker shades of brown are produced at higher temperatures and peeling begins around 800 degrees Fahrenheit. M23377-1C-002G blue-green epoxy primer undergoes an almost imperceptible change after a 12-minute exposure at 600 degrees Fahrenheit, when it starts to show a slight brownish discoloration. At 800 degrees Fahrenheit the primer turns a darker brown. Heat damage to unpainted titanium alloy is not significant until temperatures in excess of 1000 degrees Fahrenheit are reached. Given sufficient time above 1000 degrees Fahrenheit, oxygen may diffuse into the titanium and form a brittle layer called alpha case. The discoloration obtained by exposing 6Al-4V titanium alloy to high temperature air for 5 minutes are as follows:

Air Temperature (degrees Fahrenheit)	Discoloration
700	No effect
800	Light straw
900	Golden straw
1000	Bluish purple with gold
1100	Sky blue
1200	Light blue turning light tan
1300	Light to medium brown
1400	Medium brown

NOTE

The discoloration tints above were from hot air, and at a given temperature, the tints will be affected by length of exposure and composition of the surrounding gaseous environment.

For a 5 minute thermal exposure, temperatures in excess of 1200 degrees Fahrenheit are required to begin the formation of alpha case. Thus, alpha case formation would not be expected after an incident lasting up to 5 minutes, unless tan or brownish tints were produced. If these colors are not present, and no structural deformation exists, the heat damage is not significant. For incidents involving other periods of time or for incidents involving other titanium alloys (commercially pure titanium, Ti 6Al-6V-2Sn, and so forth), refer to AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH for assessment of possible degradation and possible salvage of suspect parts. Aluminum parts suspected of being heat damaged should be eddy current inspected for variations in their electrical conductivity values which are related to parts tensile strength. For eddy current inspection and conductivity values of aluminum alloys, refer to CSTO SR1F-15SA-36. When practical, aluminum parts exhibiting conductivity values greater than or less than those contained in CSTO SR1F-15SA-36, should also be hardness tested per paragraph 2-32.

2-31. Engine Bay Doors 113L/R Discoloration as a Result of Heat Inspection. See figure 2-17. Inspect door for discoloration.

- a. Discoloration which has not progressed to light blue, medium brown or flat gray in color may be continued in service as is.
- b. If the discoloration of the titanium is light blue to medium brown in color and has its normal gloss, it may continue in service.

NOTE

Alpha case is distinguished by a very thin layer of dull, flaky, brittle material. The thickness of alpha case depends on the temperature reached and the length of time the temperature was maintained.

- c. If the discoloration of the titanium is light blue to medium brown in color and has lost its normal

gloss or flat gray, use a Grade AA or finer grit abrasive mat as called out in TO 1-1-691, table 5-1, to remove any alpha case that may exist until the metal regains its normal gloss.

d. If polishing is required to remove alpha case, do eddy current inspection per CSTO SR1F-15SA-36 to detect any cracks that may exist around the fastener holes. If cracks exist, contact AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH for further instructions.

2-32. HARDNESS TESTING. See figure 2-18.

Hardness testing is used to determine the ability of a metal to resist penetration. The test results are usually directly related to tensile and yield strength of the metal involved. An exception would be case hardness. The test consists of pressing a hardened steel ball or a diamond point into a flat surface of the metal being tested. The hardened steel ball and the diamond point are known as indicators or penetrators. This impression made on the metal by the indicator or penetrator is related to the tensile strength of the metal. Through this relationship, it is possible to get an indication whether the strength characteristics of the material have been seriously affected. This relationship, however, is only an approximation and should not be used as a final judgement as to whether the strength characteristics of the material are satisfactory. When practical, a combination of eddy current inspection, followed by hardness testing, should be done to get a more accurate evaluation of the amount of damage. For eddy current inspection, refer to CSTO SR1F-15SA-36. If doubt still exists as to the strength of the material, and it is practical, a sample of the damaged material should be sent to a laboratory for analysis. Contact AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH for disposition instructions. Be sure that the sample selected is of the size and shape that can easily be used in a tensile strength testing machine. Rockwell hardness readings for aluminum alloy and alclad stocks are given in table 2-1 through 2-6. Parts manufactured from steel alloy are forged or

machined, and then heat treated. For material specifications, refer to the manual covering the part in detail. For Rockwell hardness values, refer to TO 1-1A-9. Hardness testers shall be calibrated and operated in accordance with the manufacturer's instructions.

- a. Remove finish from surface to be tested at the point of indicator or penetrator contact. A surface that has been anodized is harder than the actual base material, thus requiring removal of the anodize coating in order to get a true reading. A surface that has been clad is softer than the actual base material, thus requiring removal of cladding in order to get a true reading. Remove scratches and surface variations that may affect the reading.
- b. Calibrate the tester in accordance with manufacturer's instructions.
- c. Operating the hardness tester in accordance with manufacturer's instructions, take readings, starting at center of damaged area and work outward until minimum acceptable readings are obtained. See tables 2-1 through 2-6 for minimum acceptable values.
- d. Take a reading on structure that has not been damaged for comparison.

2-33. Main Landing Gear Brake Flange Hardness Test. See figure 2-19. When a hardness test is

required for the brake flange, use the Model MRBR Newage Hardness Tester, Newage Industries, Inc., Willow Grove Industrial Park, PA, or equivalent, and do the procedure below:

- a. Calibrate tester in accordance with manufacturer's instructions.
- b. Inspect flange for correct hardness value on the brake attach side, see view A-A. Acceptable reading is Rockwell C53 to C55.
- c. A reading below Rockwell C53 requires removal and replacement of the strut (32-10-12).

Table 2-1. Rockwell Hardness and Conductivity Readings, Sheet and Plate

Material	Specification	Condition	Rockwell Value
1100 Al Aly	ASTM-B209	0	H50 MAX
		F	Not Applicable
		H14	H70 MIN
2024 Al Aly	AMS-QQ-A-250/4	T3, T351	B69 to B83
		T361	B74 MIN
		1 T42	B62 to B78
		2 T42	B62 to B78
		1 T62	B68 to B82
		2 T62	B72 to B83
		1 T72	B64 to B76
		T81, T851	B74.5 to B83.5
		T861	B83 to B90
2024 Alclad	AMS-QQ-A-250/5	T3, T351, T42	B54 to B76
		T361	B58 MIN
		T62	7 B60 to B78
		1 T62	8 B68 to B82
		2 T62	8 B72 to B83
		T72	B56 to B76
		T81, T851	B64 MIN
		T81	8 B74.5 to B83.5
		T861	B72 MIN
2124 Al Aly	MMS-149	T351	B69 to B83
		T851	B74.5 to B83.5
2219 Al Aly	AMS-QQ-A-250/30	T31	B70 MIN
		T81	B75 MIN

Table 2-1. Rockwell Hardness and Conductivity Readings, Sheet and Plate (CONT)

Material	Specification	Condition	Rockwell Value
5052 Al Aly	AMS-QQ-A-250/8	H32	H86 MIN
		H34	H95 MIN
6061 Al Aly	AMS-4026M	T4	E60 MIN
	AMS-4027N, AMS-4025L, ASTM-B209	T6, T62, T651	B47 to B72
7075 Al Aly	AMS-QQ-A-250/12	T6, T651	B85 to B94
		T73	B78 MIN
7075 Al Aly	MMS-152	T351	B78 MIN
		T651	B83 MIN
7075 Al Aly	MMS-159	T7351	B78 MIN
7075 Al Aly	AMS-QQ-A-200/11	T7351	B78 MIN
7075 Al Aly	AMS-4315	T76, T7651	B83 MIN
7075 Alclad	AMS-4049L	3 → T6, T651	B85 to B94
		3 → T76	B83 MIN
		4 → T6, T651	B78 to B90
		4 → T76	B78 to B90
		5 → T6, T651	B76 to B90
		5 → T76	B76 to B90
		6 → T6, T651	B73 to B90
7075 Alclad	AMS-QQ-A-250/18	T6, T651	7 → 15T 86 to 90
			8 → B85 to B94
7075 Alclad	ASTM-B209	T6, T651	B85 to B94
		T76	B83 MIN
7079 Al Aly	AMS-QQ-A-250/17	T651	B81 to B93

1 → 0.080 thick and under.

2 → 0.081 thick and over.

3 → 0.036 thick and under.

Table 2-1. Rockwell Hardness and Conductivity Readings, Sheet and Plate (CONT)

Material	Specification	Condition	Rockwell Value
	<p>4 ► 0.037 thick thru 0.050 thick.</p> <p>5 ► 0.051 thick thru 0.070 thick.</p> <p>6 ► 0.071 thick and over.</p> <p>7 ► Alclad side.</p> <p>8 ► Bare side.</p>		

Table 2-2. Rockwell Hardness and Conductivity Readings, Extrusions

Material	Specification	Condition	Rockwell Value
2014 Al Aly	ASTM-B221	T6, T6511	B81 to B90
2014 Al Aly	AMS-QQ-A-200/2	T6511	B81 to B90
2024 Al Aly	AMS-QQ-A-200/3	T3511 T42 T62 T8511	B69 to B83 B62 to B78 B72 to B83 B74.5 to B83.5
5456 Al Aly	AMS-QQ-A-200/7	0 H11	B42 MAX B22 MIN
6061 Al Aly	AMS-QQ-A-200/8	T42 T62, T6511	E60 MIN B47 to B72
6061 Al Aly	ASTM-B221	T6	B47 to B72
7075 Al Aly	AMS-QQ-A-200/11	T6, T6511 T73, T73510 1 ► T73511 2 ► T73511 T76, T76511	B85 to B94 B78 MIN B78 MIN B78 MIN B83 MIN
7075 Al Aly	AMS-QQ-A-200/15	T76311	B85 to B94
7079 Al Aly	AMS-QQ-A-200/12	T6511	B81 to B93
7178 Al Aly	AMS-QQ-A-200/13	T6, T651	B86 MIN
		1 ► 1.49 thick and under. 2 ► 1.50 thick and over.	

CSTO SR1F-15SA-3-1**Table 2-3. Rockwell Hardness and Conductivity Readings, Bar and Rod**

Material	Specification	Condition	Rockwell Value
2014 Al Aly	AMS-QQ-A-200/2	T6511	B81 to B90
2024 Al Aly	AMS-QQ-A-200/3	T3511	B69 to B83
		T42	B62 to B78
		T62	B72 to B83
		T8511	B74.5 to B83.5
2024 Al Aly	AMS-QQ-A-225/6	T351	B69 to B83
		T4, T42	B62 to B78
		T6, T62	B72 to B83
		T851	B74.5 to B83.5
5456 Al Aly	AMS-QQ-A-200/7	0	B42 MAX
		H11	B22 MIN
6061 Al Aly	AMS-QQ-A-200/8	T42	E60 MIN
		T62, T6511	B47 to B72
6061 Al Aly	AMS-4116	T42	E60 MIN
	AMS-4117	T6, T62, T651	B47 to B72
7075 Al Aly	AMS-QQ-A-200/11	T6511	B85 to B94
		T7351	B78 MIN
7075 Al Aly	AMS-QQ-A-225/9	T6	B87
		T651	B85 to B94
		T73	B82
		T7351	B78 MIN
7079 Al Aly	AMS-QQ-A-200/12	T6511	B81 to B93
7178 Al Aly	AMS-QQ-A-200/13	T6, T651	B86 MIN

Table 2-4. Rockwell Hardness and Conductivity Readings, Castings

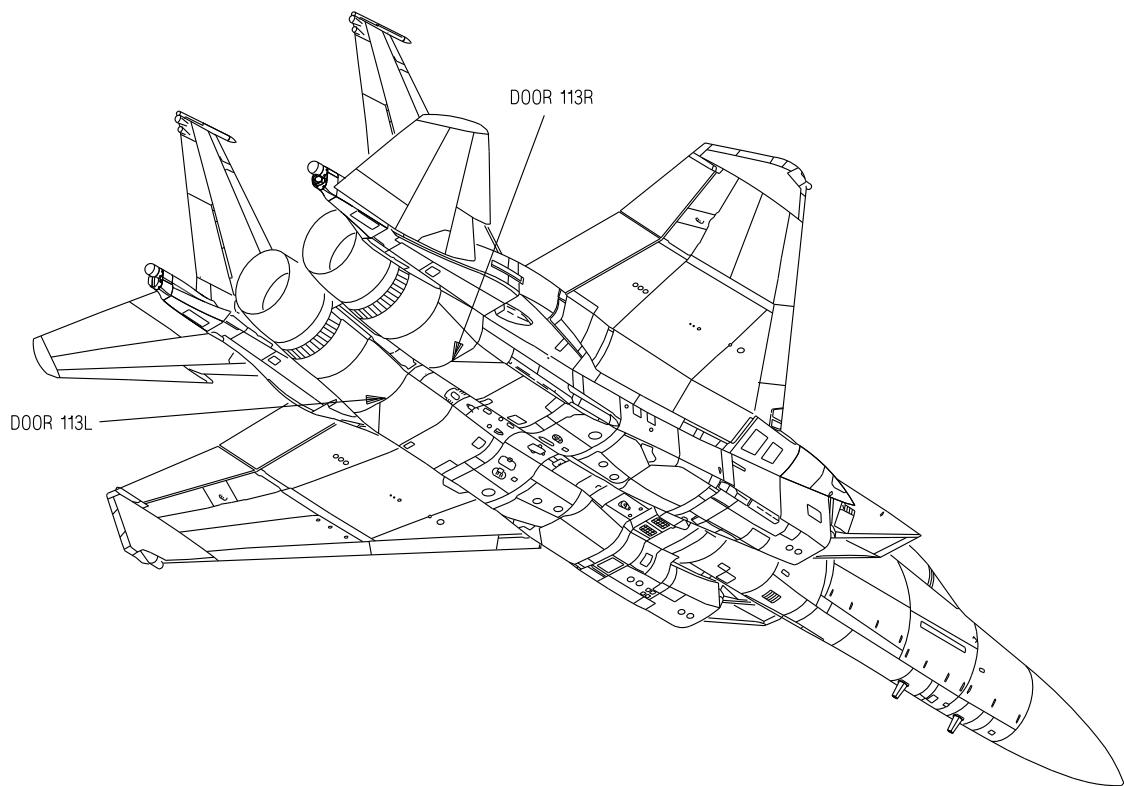
Material	Specification	Condition	Rockwell Value
C355 Al Aly	AMS-A-21180 Class 12	T61	1 ➔ 75-110 (AMS4215)
356 Al Aly	AMS-4260 Investment	T6	B27 to B60
	ASTM-B108 Comp. 8	T6	E72.5 to E93
Permanent Mold	ASTM-B26 Comp. 3 Sand	T6	E72.5 to E93
	ASTM-B26 Sand	T6	E72.5 to E93
A356 Al Aly	AMS-A-21180 Class 10	T61	E84 to E94
A357 Al Aly	AMS-A-21180 Class 10	T6	E84 to E94
1 ➔ Brinell Hardness 10MM Ball 500K6.			

Table 2-5. Rockwell Hardness and Conductivity Readings, forgings

Material	Specification	Condition	Rockwell Value
2014 Al Aly	AMS-QQ-A-367	T6, T652	B81 to B90
2219 Al Aly	AMS-QQ-A-367	T6	B72 to B80
2219 Al Aly	MMS-134	T852	B75 Min
6061 Al Aly	AMS-QQ-A-367	T6, T652	B47 to B72
7050 Al Aly	MMS-146	T73652	R _B 81.5 MIN
7075 Al Aly	MMS-1303	T411	B78 MIN
7075 Al Aly	AMS-QQ-A-367	T6, T652	B85 to B94
		T73	B78 MIN
		T736, T73652	B85 MIN
7075 Al Aly	MMS-1304	T73652	B85 MIN
7175 Al Aly	MMS-1304	T73652	B85 MIN
7175 Al Aly	MMS-1304	T736	B85 MIN

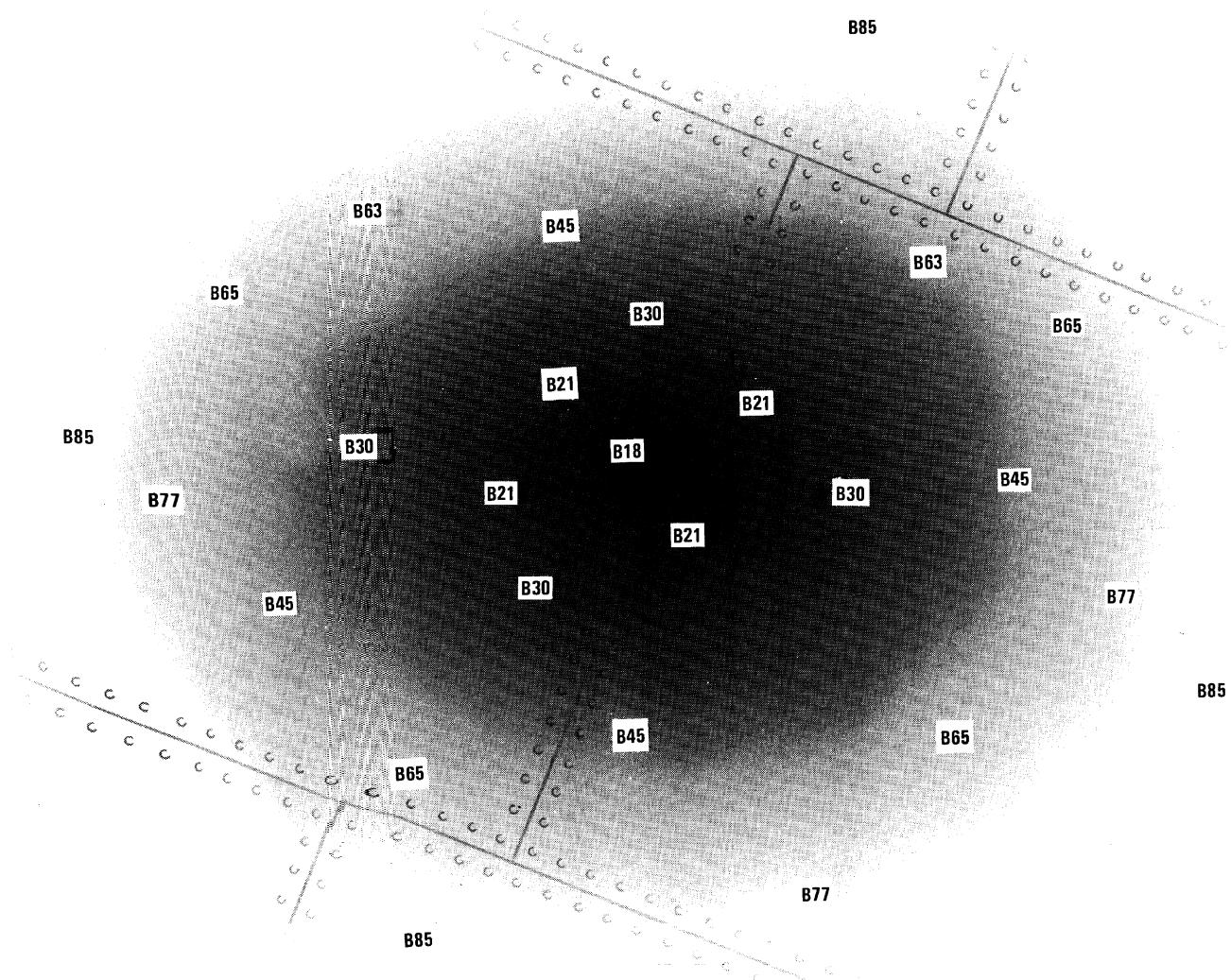
CSTO SR1F-15SA-3-1**Table 2-6. Rockwell Hardness and Conductivity Readings, Pressing**

Material	Specification	Condition	Rockwell Value
7075 Al Aly	AMS-QQ-A-367	T73	B78

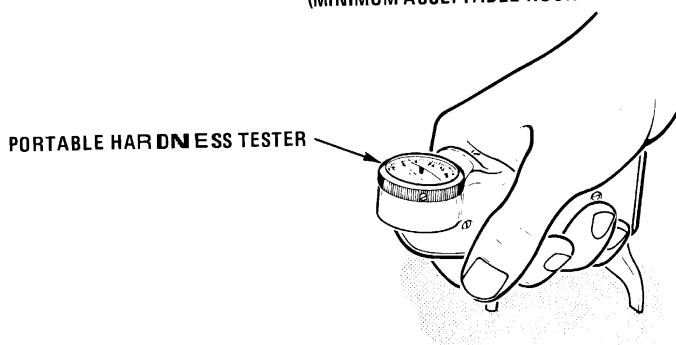


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Figure 2-17. Engine Bay Doors 113L/R Discoloration as a Result of Heat Inspection

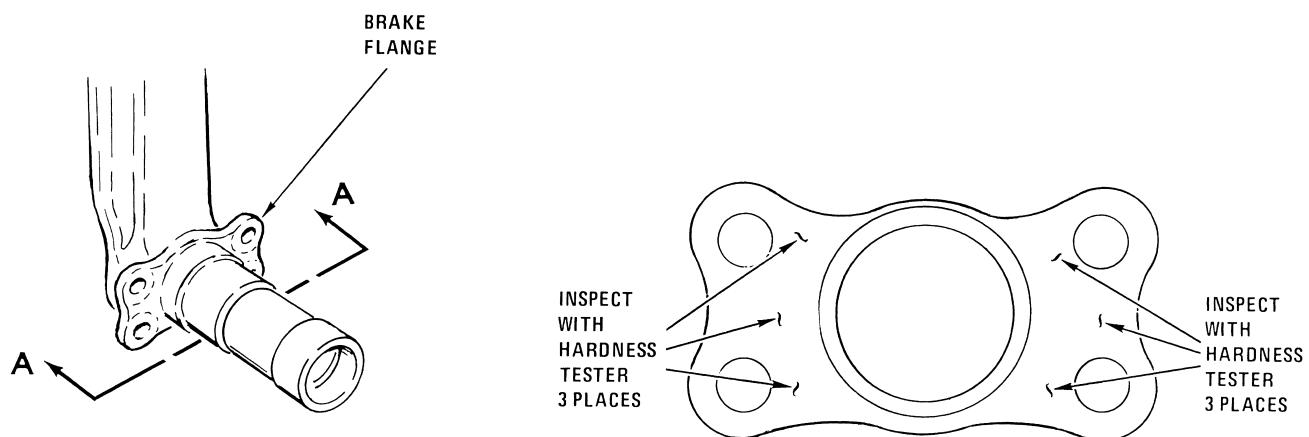


7075-T6 ALUMINUM ALLOY SKIN PANEL
(MINIMUM ACCEPTABLE ROCKWELL READING IS B85)



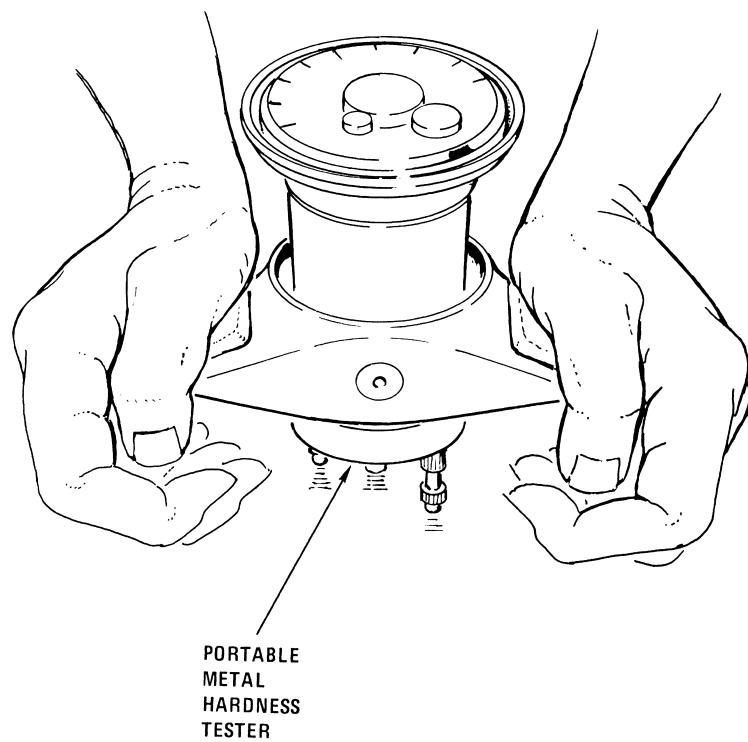
SAN301-02-93-001

Figure 2-18. Hardness Testing



VIEW A-A

MINIMUM ACCEPTABLE
ROCKWELL READING IS C53



SAN301-02-94-001

Figure 2-19. Main Landing Gear Brake Flange Hardness Test

2-34. **AIRCRAFT ALIGNMENT.** See figure 2-20.

2-35. The primary purpose of the alignment check is to be sure of correct aerodynamic performance of the aircraft and should not be used as criteria for finding damage. Alignment of aircraft is done to get overall and symmetrical dimensions of the aircraft about its centerline. The inspection may, however, indicate the need for a more thorough inspection of detail parts for possible structural damage. For major components, alignment check will be done by boresight. Contact AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH for procedures.

2-36. **SPECIAL TOOLS.**

Tape measure

2-37. **TEST EQUIPMENT.** Apply and/or remove electrical and hydraulic power and cooling air.

- a. Power source, external electrical (05-00-05).
- b. Power source, external hydraulic (05-00-07).
- c. Air source, external cooling (05-00-08).

2-38. **PROCEDURE.**

WARNING

To prevent possible death or injury to personnel and damage to aircraft, safety devices required during ground and maintenance operations shall be installed.

- a. Make sure safety devices required during ground operation are installed (05-00-01).
- b. Install safety devices used during maintenance in the following locations:
 1. Canopy external jettison thermal battery (05-10-11).
 2. Internal CANOPY-EMERG JETT handle (05-10-11).
 3. Nose and main landing gear doors (05-10-05).

- c. Connect ground intercommunications (05-00-09).
- d. Level aircraft (08-00-01).
- e. Apply external ground cooling air (05-00-08).
- f. Apply external electrical power (05-00-05).
- g. Apply external hydraulic power (05-00-07).
- h. Position horizontal stabilator in neutral position as follows. See detail A and section B-B:

NOTE

GND PWR control panel switches are manually set and electromagnetically held. If external power is interrupted, switches must be reset to ON.

1. Set controls/switches on GND PWR control panel to designated positions.

Control/Switch	Position
SWITCH 1	B - ON
SWITCH 2	AUTO
SWITCH 3	AUTO
SWITCH 4	AUTO
ADCP/AIU1	AUTO

WARNING

To prevent personal injury, keep hands out of scissor area of control surfaces. Maintain concise communications between cockpit and aft fuselage.

2. Using TRIM switch on control stick, position horizontal stabilator until its lower mold line surface is 2.15 ± 0.03 above lower mold line surface of aft fuselage at FS 772.040. See detail A and section B-B.
- i. Measure aircraft dimension D, left and right sides, using a tape measure, and record dimensions.

- j. Reset controls/switches on GND PWR control panel as follows:

Control/Switch	Position
SWITCH 1	AUTO
SWITCH 2	AUTO
SWITCH 3	AUTO
SWITCH 4	AUTO
ADCP/AIU1	AUTO

- k. Remove external hydraulic power (05-00-07).
l. Remove external electrical power (05-00-05).
m. Remove external ground cooling air (05-00-08).
n. Remove ground intercommunications (05-00-09).



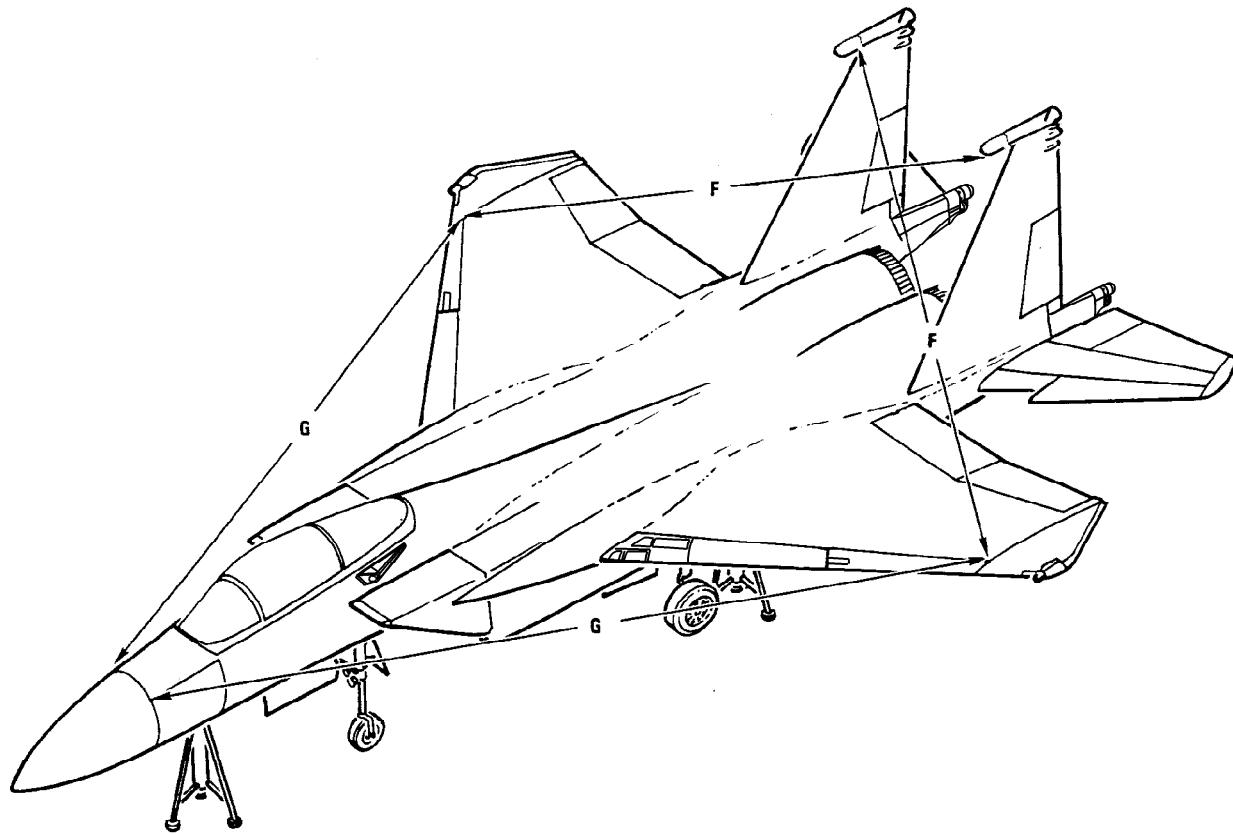
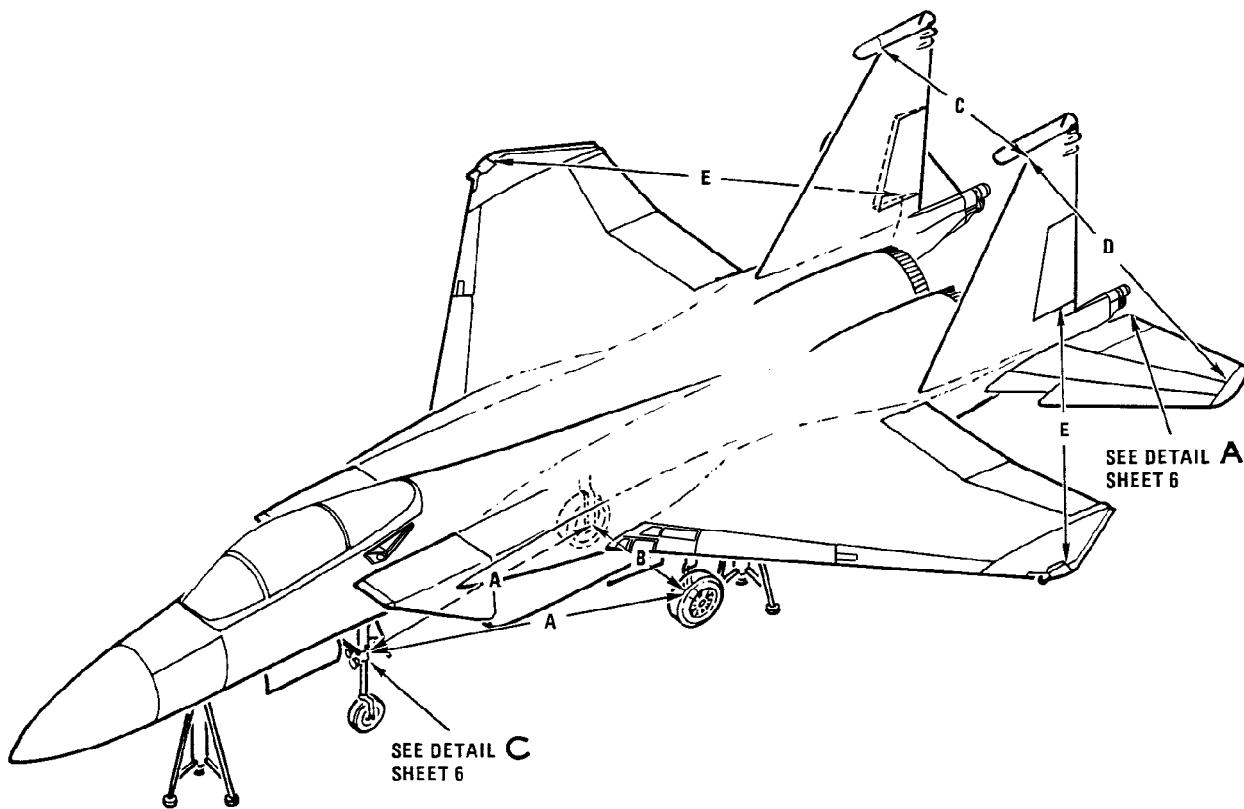
Do not change link adjustment when disconnecting link from NLG aft door or damage to door and structure may result.

- o. Disconnect link from NLG aft door by removing cotter pin, nut, bolt, washers, bushing, and bearing from link attach point. See detail C.



Make sure door does not contact structure or damage to door or structure may result.

- p. Swing NLG door aft. Measure aircraft dimension A, left and right, using a tape measure, and record dimensions.
q. Reconnect link to NLG aft door with bolt, washers, and bushing. Install nut and tighten; safety with cotter pin. See detail C.
r. Measure remaining aircraft dimensions, using a tape measure, and record dimensions.
s. Compare dimensions recorded in steps i., p., and r. with dimensions listed in chart on sheet 7. If dimensions exceed allowable tolerance, a more thorough inspection of detail components should be done to determine the cause of defect, and contact AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH.
t. Lower the aircraft (07-00-01).



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Figure 2-20. Aircraft Alignment Diagram (Sheet 1 of 7)

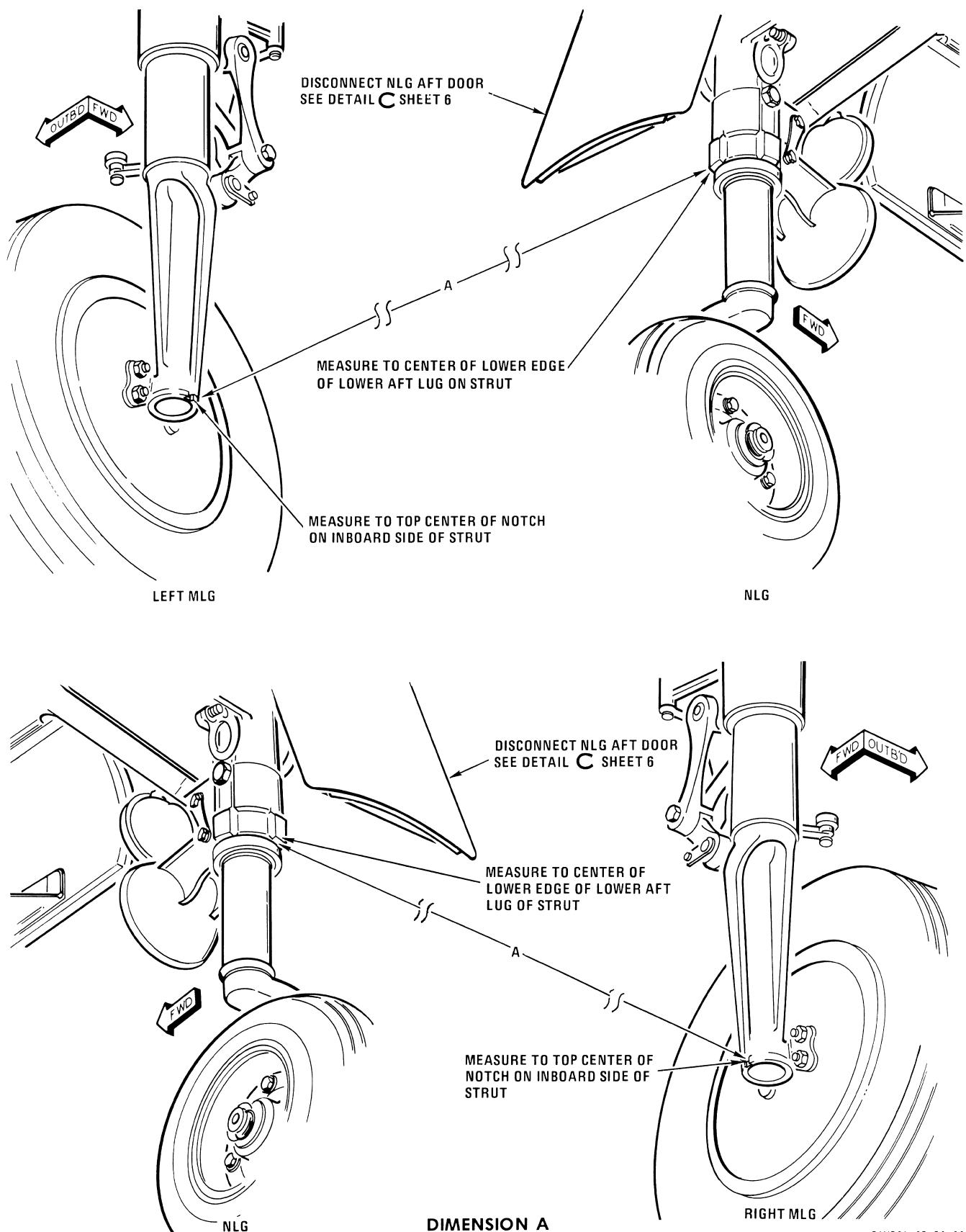
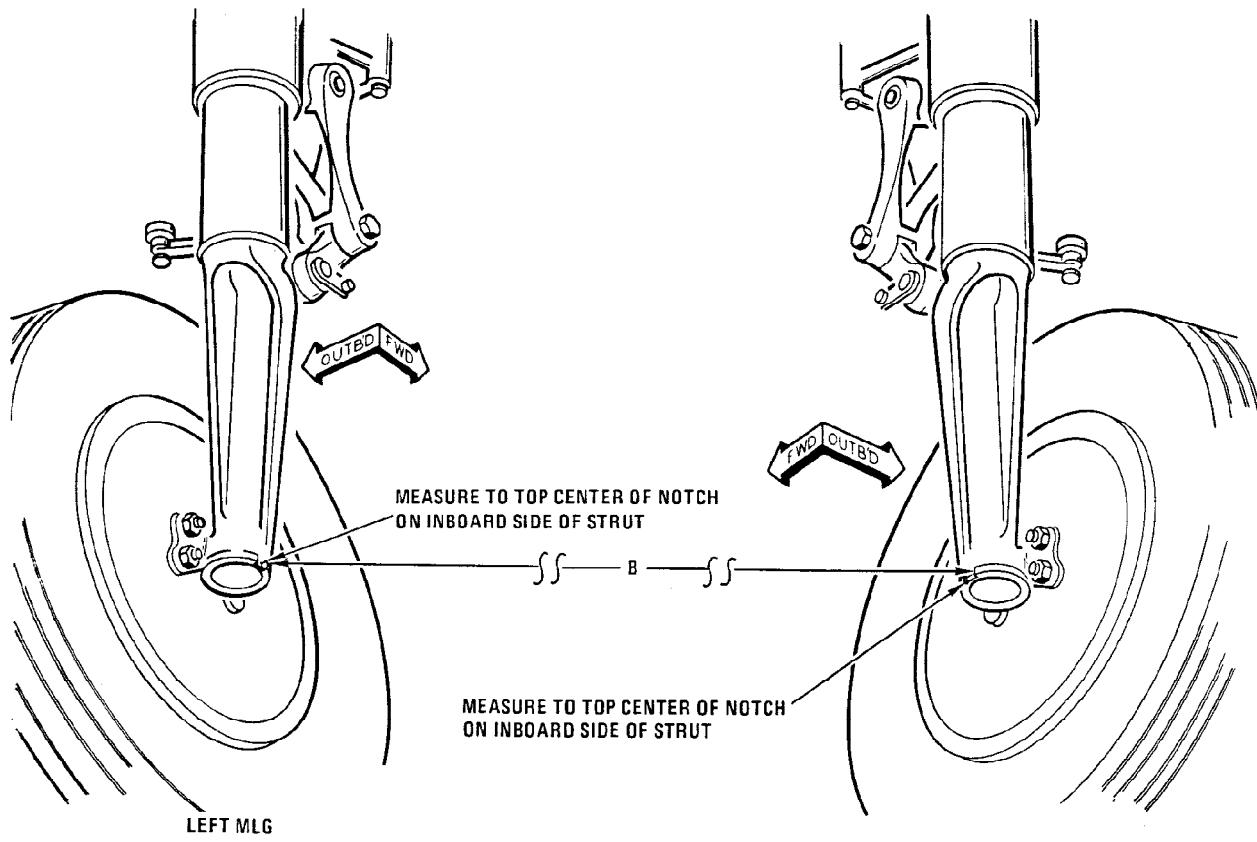
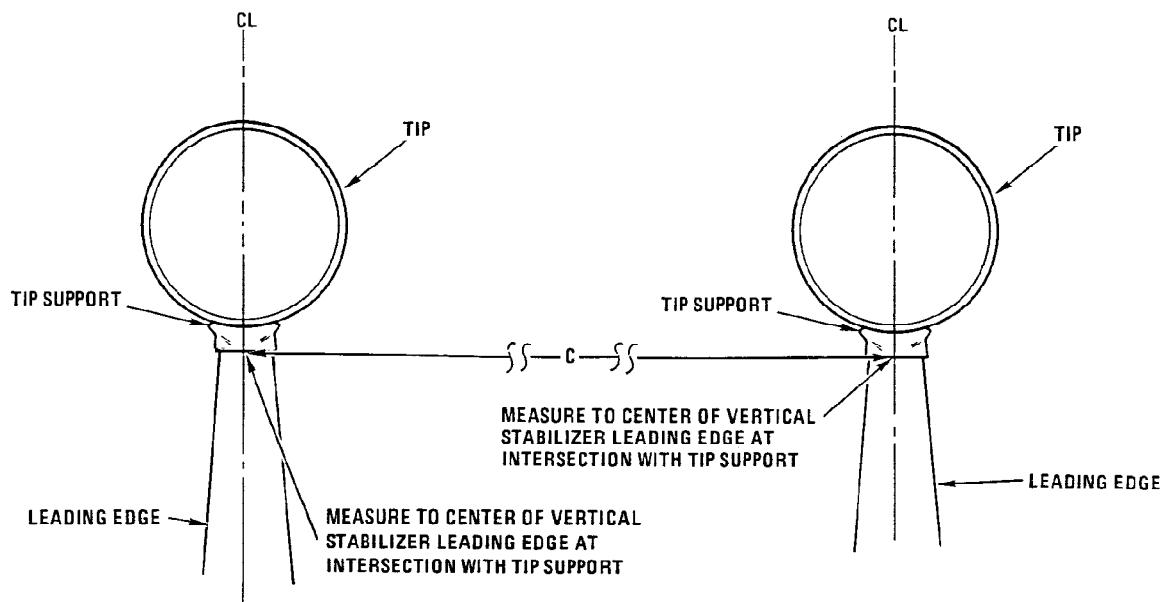


Figure 2-20. Aircraft Alignment Diagram (Sheet 2)



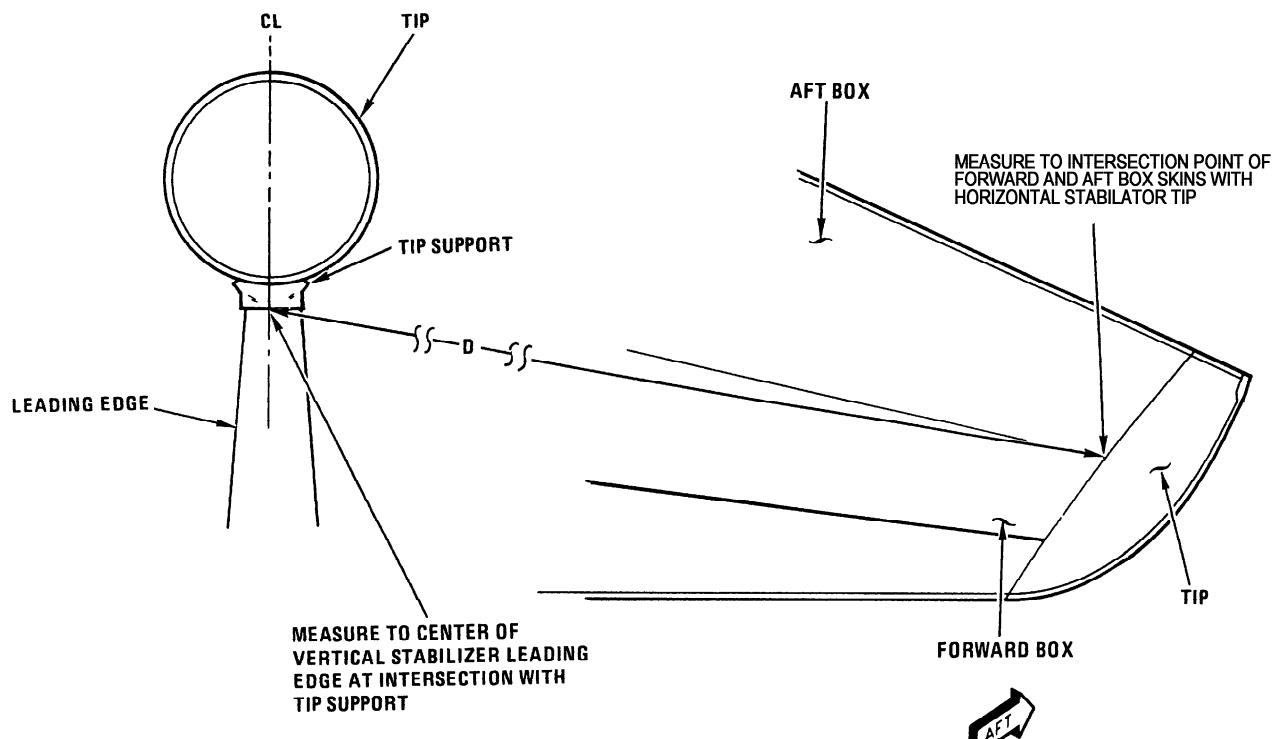
DIMENSION B



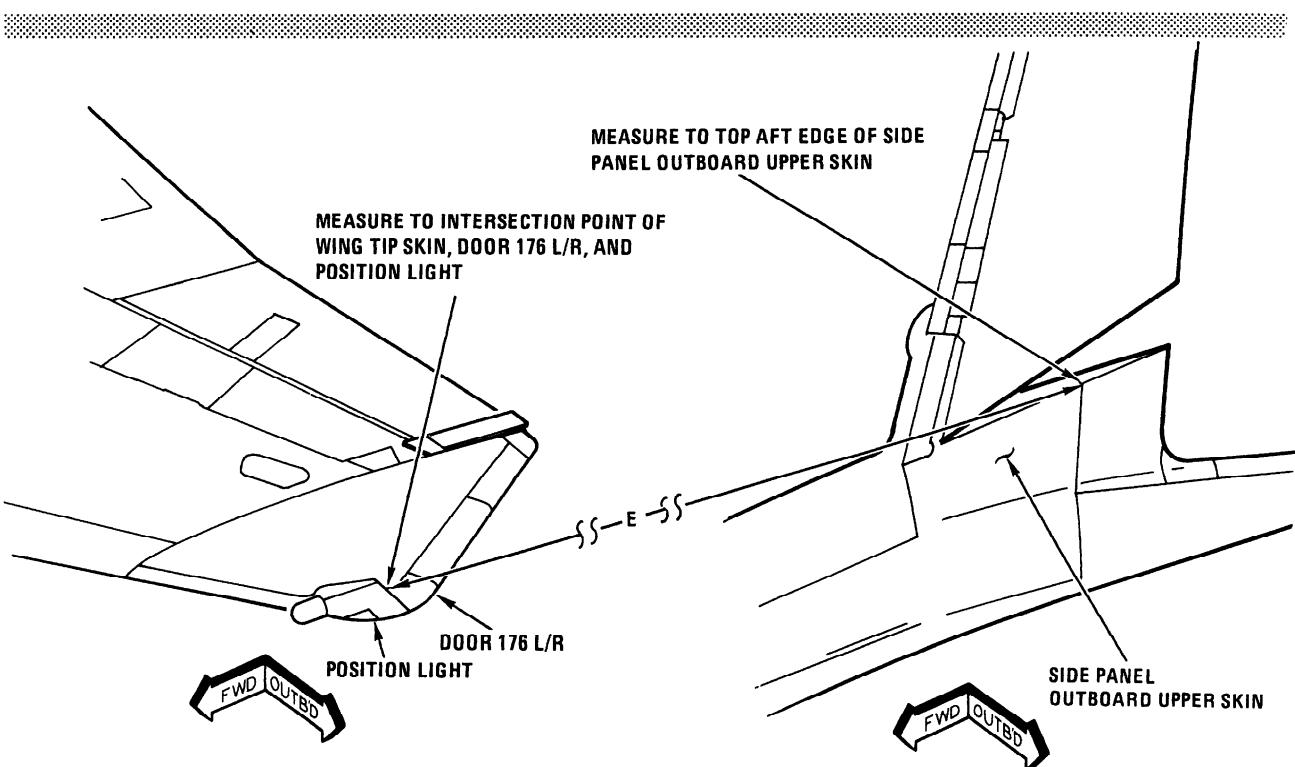
DIMENSION C

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Figure 2-20. Aircraft Alignment Diagram (Sheet 3)



DIMENSION D



DIMENSION E

SAN301-02-98-001

Figure 2-20. Aircraft Alignment Diagram (Sheet 4)

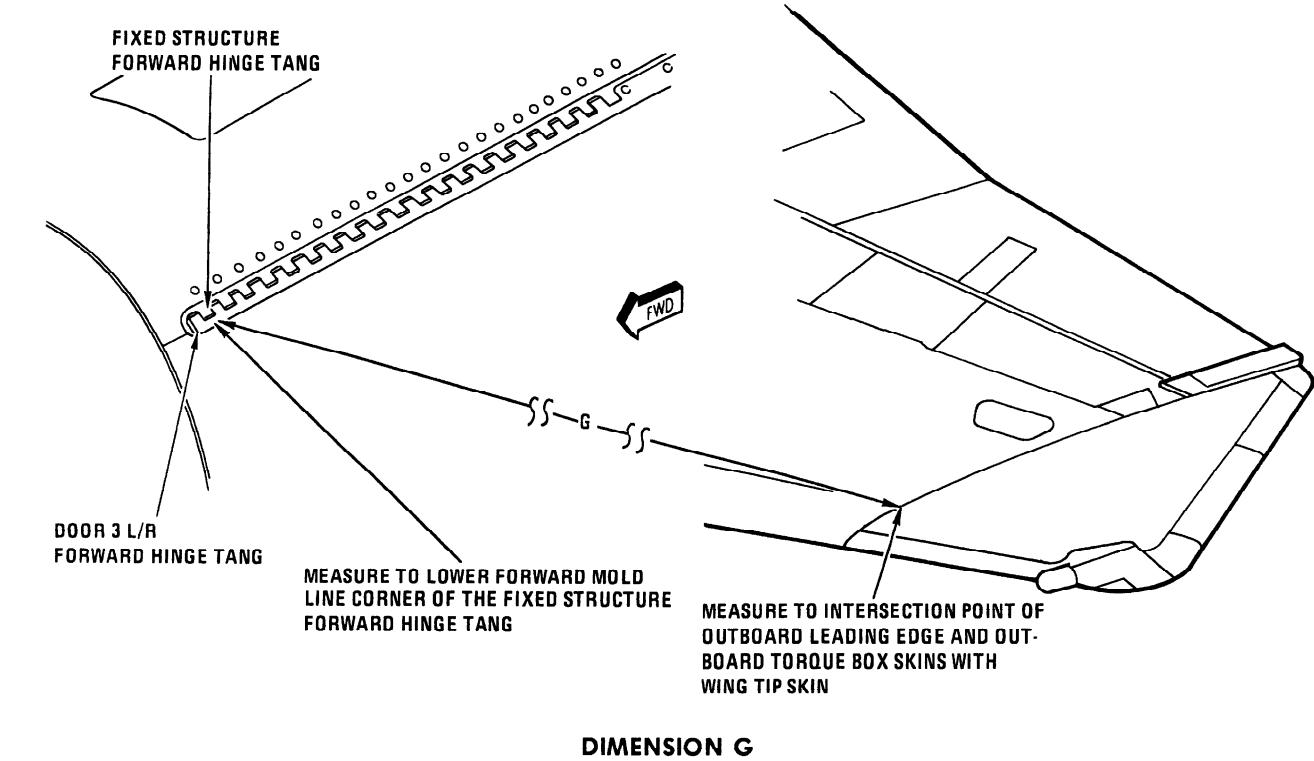
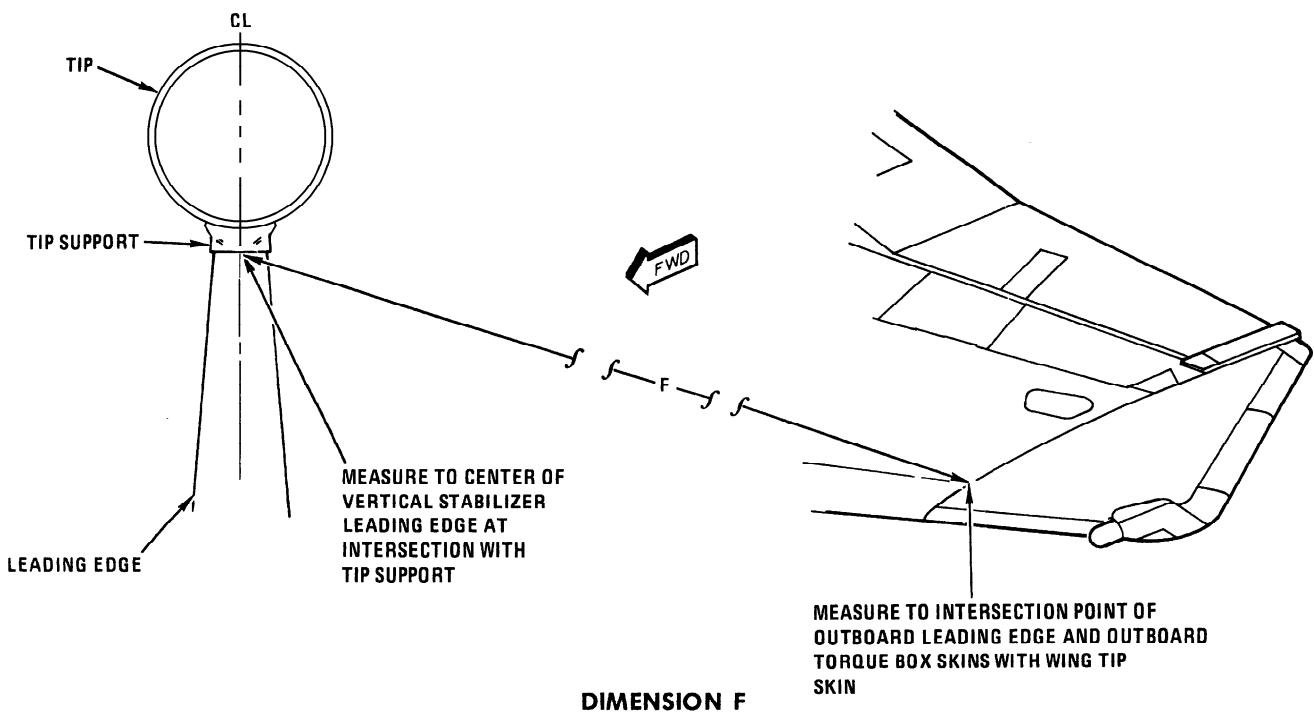


Figure 2-20. Aircraft Alignment Diagram (Sheet 5)

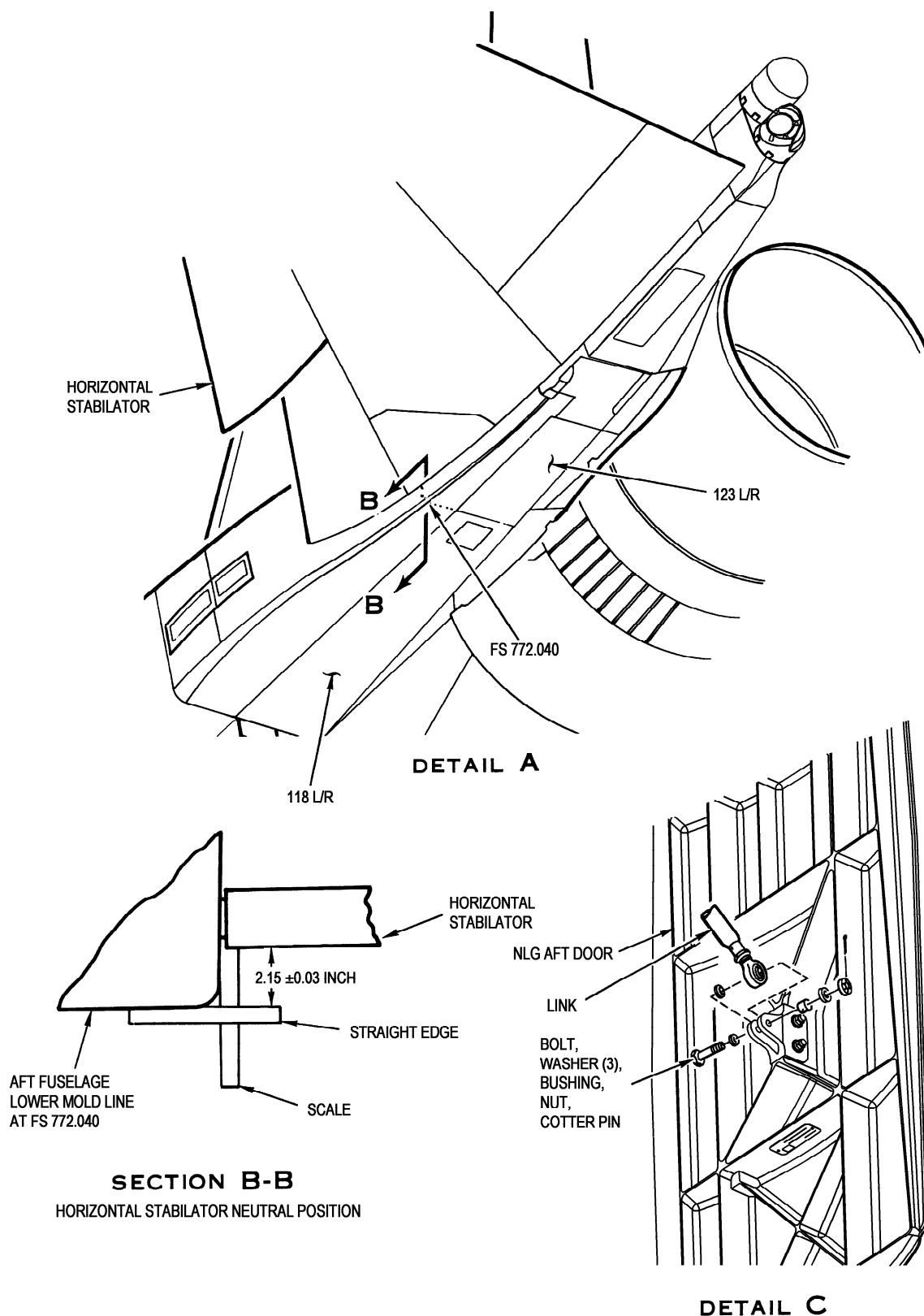


Figure 2-20. Aircraft Alignment Diagram (Sheet 6)

Ref Ltr	Appl	Dim. for Aircraft		Dim. Tol. Between Left and Right Sides of Aircraft		Dim. Tol. Between Aircraft	
		Inches	Feet and Inches	Inches	Inches	Inches	Inches
A		220.227	18' 4-1/2"	2.00	2.00	± 2.00	± 2.00
B		93.26	7' 9-1/4"	1		± 1.00	± 1.00
C		135.90	11' 3-7/8"	1		± 1.00	± 1.00
D		173.047	14' 5-1/16"	1.00	1.00	± 1.50	± 1.50
E		234.24	19' 6-1/4"	1.00	1.00	± 1.50	± 1.50
F		353.728	29' 5-3/4"	1.00	1.00	± 1.50	± 1.50
G		477.849	39' 9-7/8"	1.00	1.00	± 1.50	± 1.50

1 ► Dimension tolerance between measuring points is 1.00 inch.

Figure 2-20. Aircraft Alignment Diagram (Sheet 7)

SECTION III

SHOP PRACTICES

3-1. DESCRIPTION.

3-2. This section covers methods of fabricating repair parts using general shop practices. It includes sheet metal forming, working titanium alloys, locating blind holes and trim lines, types of fasteners used, and information on titanium tubing and fittings.

3-3. **MARKING MATERIALS.** The following materials or equivalents shall be used when marking reference lines for flat pattern development or locating fastener hole patterns.



Graphite lead pencils shall not be used to mark any bare metal. The graphite lead will cause etch corrosion or carbonization of the area marked.

Refer to section VI for procurement sources of the materials.

Ink, drawing, 1448, black
 Ink, drawing, 1448, silver
 Ink, drawing, 1448, white
 Ink, GK-6646-R, purple
 Ink, stamp pad, F-100, black, silver
 Ink, stamp pad, 127 1/2, Master Marker
 Ink, opaque quick drying
 Ink, drawing, Marco S-1141
 Ink, Superior Spartan opaque, black
 Ink, Superior Spartan opaque, white
 Ink, stamp pad, 73X, black
 Marker, 673-T, black
 Marker, 665-T, red
 Pencil, No. 2125, blue
 Pencil, No. 2436, red
 Dye, bearing blueing, Hi-Spot Blue, Number 107, (Dykem)
 Dye, aerosol 6001, blue
 Dye, aerosol, 603, blue

Only the materials below shall be used on anodized aluminum.

Marker, 673-T, black

Marker, 665-T, red
 Pencil, No. 2125, blue
 Pencil, No. 2436, red

3-4. SHEET METAL FORMING.

3-5. Forming is an operation that produces curves, flanges or other irregular shapes in material by stretching or compressing material in specific areas. The amount of stretching or compressing depends on material thickness and temper.

3-6. **FORMING REQUIREMENTS.** Requirements for forming are listed below:

- a. Sheet metal temper requirements.
 - 1. Fully annealed material can be formed easier and with a smaller bend radius than other temper conditions.
 - 2. Replacement and repair parts should be formed using same bend radius as part being replaced. If bend radius cannot be determined, select bend radius from chart on figure 3-1.
 - 3. Complexity of part being formed determines temper of material used.
 - (a) Parts with straight or almost straight bends, shallow joggles, single flanged lightening holes or single uniform curvature should be formed in the heat treated condition. This eliminates straightening or line up to remove warp or twist.
 - (b) Aluminum alloy parts with beads, curved bend lines, deep joggles, return flange lightening holes, embossed areas or large bends and bend radii should be formed in the "O" or annealed condition; or if made of steel, in the annealed condition. Parts formed from 2024 or 7075 in the "O" or annealed condition require heat treating before aircraft installation.
- b. Equipment requirements.
 - 1. Brake and press surfaces should be free from nicks, gouges, and dirt.
 - 2. Mallet and form block surfaces should be free from imbedded foreign objects.

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c. Formed parts require inspection due to material creep and deformation that happens during forming process. See figure 3-2 for acceptable conditions and tolerances.

3-7. USE OF UNDIMENSIONED DRAWINGS.

Undimensioned drawings provide a means of establishing fully coordinated and accurate full-scale views for engineering and tooling purposes. The drawings can be accurately reproduced on material for use in manufacturing and inspection of the part. Reproduction may be made photographically by contact. The reproduction may be made from accurate, full scale prints on sensitized paper, stock for form blocks, templates or material from which the part is to be made. Undimensioned drawings may be used for parts described below:

- Individual sheet metal parts that require a template or flat pattern development.
- Sheet metal assemblies which are primarily in the same plane and follow a lofted contour, such as ribs, bulkheads, frames, or when development of parts requires many cuts for development of tooling templates.
- Closely related sheet metal parts which are not assembled together and stocked as a unit, but are finally assembled on common contour or station line at a later assembly, such as wing ribs at adjacent station lines or several sections of one rib on one station line.

3-8. TECHNICAL FORMING TERMS.

Some terms normally used in the development of flat pattern layout are defined as listed below:

Leg	The longer part of a formed angle.
Flange	The shorter part of a formed angle. If each is the same length, each is known as a leg.
Bend tangent line	The line at which the metal starts to bend.
Bend allowance (BA)	The amount of material consumed in making the bend.

Radius (R) The radius of the bend, which is always the inside of the metal being formed.

Bend line (BL) A guide line used in aligning the material when put into the forming tool.

Thickness (T) Thickness of material.

3-9. FLAT PATTERN DEVELOPMENT. Fabrication of aircraft parts is done by the forming of flat stock. Before a part is formed, a flat pattern is required to show how much material is required in the bend areas, to what point the sheet must be inserted into the forming tool or to indicate the bend lines. Flat pattern development of sheet metal parts and the terminology commonly associated with this type of layout is outlined below.

3-10. Bend Allowance. See figure 3-3. Aluminum alloy and sheet steel require a definite length of material to make a bend, depending on the thickness of the material and the bend radius used. To determine the amount of material required to make a bend, the bend allowance per degree is multiplied by the number of degrees in the bend. Bend allowances can be computed by using the bend allowance chart shown in figure. This chart gives the amount of material required for each degree of bend, when material thickness and bend radius are known.

3-11. Bend Tangent Adjustment. See figure 3-4. This adjustment is computed by multiplying the sum of bend radius plus material thickness by a factor K. The K factor is taken from figure 3-4.

3-12. Layout Application. See figure 3-5 for an example of the steps required to layout a flat pattern of a part.

3-13. Bend Lines. After the flat pattern has been cut to shape with the bend tangent lines indicated, bend lines, marked on the part, are required to indicate where the edge of the forming tool must be aligned on the part in order to make the bend. Do not use a scribe to mark bend lines on the part for this will cause the metal to crack when bent. Use a pencil or similar tool per paragraph 3-3. Bend lines

are located differently for the cornice brake and hand forming blocks as opposed to the V-brake per the below:

NOTE

The radius of the V-brake die, the cornice brake jaw or the hand forming blocks must be the same as the bend radius of the flat pattern.

- a. Locating bend lines for parts formed with cornice brake or hand forming blocks. See figure 3-6.
- 1. Bend line is located at a distance equal to bend radius away from one bend tangent line, depending on direction in which part is to be bent.
- 2. Angle of bend has no bearing on location of bend line.
- 3. Line up bend line with nose of brake jaw or form block by eye or by using a combination square.
- b. For parts formed on the V-brake, bend line is midway between bend tangent lines, and is lined up at the center of brake anvil and upper die.

3-14. FORMING PROCESSES. There are two types of forming processes: hand forming and machine forming.

3-15. Hand Forming. Parts with straight line bends, curved flanges, some extrusions, and joggles can be hand formed.

3-16. Straight Line Bends. See figure 3-7. Parts with short straight line bends can be formed using wooden or metal form blocks which have one rounded edge to give the correct bend radius. Form straight line bends as listed below:

- a. Layout and trim part per paragraphs 3-9 through 3-13.
- b. Clamp part firmly between form blocks.

NOTE

If a large amount of sheet extends past edge of form block, use hand pressure to prevent the metal from springing back when striking sheet.

- c. Strike sheet lightly with a plastic, rubber or rawhide mallet starting at one end and working back and forth along edge.
- d. Continue process until sheet is bent to required angle.
- e. Remove flange irregularities by holding a piece of hardwood edgewise against bend and striking wood with hard blows.
- f. Make short flange bends using a piece of hardwood and a mallet for the whole bend.

3-17. Curved Flanges. Curved flange parts have concave or convex mold lines. Concave flanges are formed by stretching and convex flanges by compressing the metal. These parts are formed using hardwood or metal form blocks. Listed below are requirements for form blocks, material preparation, and forming of concave and convex surfaces.

- a. Requirements for form blocks. See figure 3-7 and 3-8.
 - 1. Form blocks are made in pairs and are shaped to conform to true dimensions and contour of finished part.
 - 2. Edges of form blocks are rounded to provide correct bend radius.
 - 3. Edges are undercut about 5 degrees to allow for metal spring back.
 - 4. Alignment pins can be used to align blocks and hold part in place.
 - 5. To fabricate form blocks when only mold line dimensions are known. See figure 3-8.
- b. Material preparation. See figure 3-7.
 - 1. Layout part per paragraphs 3-9 through 3-13.
 - 2. Trim part to size, leaving approximately 0.250 excess trim on flange to be formed.
 - 3. Drill and deburr holes for alignment pins.
 - 4. File or sand edges to remove nicks.

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NOTE

To prevent strain on form blocks and to keep material from slipping, material should be clamped as close as possible to area being formed.

5. Clamp material in a vise.
- 3-18. Forming Concave Surfaces. See figure 3-9.
 - a. Starting at each end of part, strike part with a plastic or rawhide mallet and work toward center of part.
 - b. Continue striking material until flange is gradually worked down flush with form block.
 - c. Trim excess flange material and file or sand edge to remove nicks.
 - d. Inspect part for accuracy. See figure 3-7.

3-19. Forming Convex Surfaces. See figure 3-10.

- a. Method A.

NOTE

A backup or wedge block should be used when forming convex surfaces to lessen possibility of buckling, splitting or cracking material.

1. Starting at center of part and working toward each end, strike part at approximately a 45 degree angle with a wooden or plastic mallet.
 2. Gradually work flange down flush with form block.
 3. Trim excess flange material.
 4. File or sand edge to remove nicks.
 5. Inspect part for accuracy. See figure 3-7.
- b. Method B.

NOTE

A lead bar or strap will conform to shape of part being formed and lessen the possibility of marring, wrinkling or thinning material.

1. Strike material with lead bar or strap.
2. Gradually work flange down flush with form block.
3. Trim excess flange material.
4. File or sand edge to remove nicks.
5. Inspect part for accuracy. See figure 3-7.

3-20. Extrusions. Extruded angles and tees can be formed with curves, but not bent sharply. Extrusions are hand formed using a V-block, mallet, and pattern. Use steps listed below to form extrusions. See figure 3-11.

- a. Make an accurate paper or plywood pattern of part to be formed.
- b. Position extrusion on V-block.

NOTE

Material should be formed with a minimum number of blows to lessen possibility of work-hardening.

- c. Strike the material with light blows directly over the V cutout in the block.

NOTE

Material should be worked uniformly. Working one area too great will create distortion in other areas.

- d. Continue process, moving material back and forth on block and spreading blows evenly along flange.
- e. Periodically check accuracy of formed material against pattern until forming process is complete.

3-21. Joggles. A joggle is an offset formed on a part to provide clearance for a mating part. Hand formed joggles are formed using joggle blocks and joggle clips.

a. Joggle Blocks. See figure 3-12. Joggle blocks can be made of hardwood, aluminum alloy or steel. Hardwood is satisfactory for limited use. Aluminum alloy blocks are preferred if blocks are to be used several times. Use steps listed below to form joggles with joggle blocks.

1. Make joggle blocks. See figure for dimensions.
2. Check accuracy of joggle blocks with a piece of scrap material that is same thickness as material to be formed.
3. Check surface of joggle blocks for foreign objects.
4. Form joggle. See figure 3-13.

b. Joggle Clips. See figure 3-14. Joggle clips can be used to form joggles in small parts or parts having a short width joggle. Joggle clips should be made from material as hard or harder than material to be formed and should be one gage thicker than required depth of finished joggle. Use steps listed below to form joggles using joggle clips. See figure 3-14.

1. Determine slot width for joggle clip and cut slot.
2. Round off edges and file or sand joggle clip smooth.
3. Lay out joggle bend lines on part to be formed.
4. Form joggle on a piece of scrap material that is same gage of material to be formed and check accuracy of joggle.

NOTE

To prevent scratching material during forming operation, vise jaws should be machined smooth or covered with a soft metal, such as brass.

5. Insert joggle clip and material to be formed in a vise. As vise jaws squeeze part, flatten bulge on flange with a rawhide or plastic mallet.
6. After forming, inspect joggle for cracks and accuracy.

3-22. **Machine Forming.** Two types of machine formers are cornice brakes and slip roll formers.

3-23. Cornice Brakes. Cornice brakes are the most accurate method of making straight line bends on sheet metal. Joggles can also be formed on a cornice brake.

a. Straight Line Bends. Straight line bends can be formed on a cornice brake using the steps listed below. See figures 3-8 and 3-15.

NOTE

Before bending material requiring an accurate bend radius and definite flange length, cornice brake setting should be checked with a piece of scrap the same gage as material to be bent.

1. Position sheet to be bent on the brake so that bend line is directly under the edge of the upper jaw or clamping bar. See figure 3-6.
2. Pull down clamping bar handle to hold sheet in place with clamping bar. See figure 3-15.
3. Set stop for correct angle or amount of bend.
4. Raise bending leaf until it strikes the stop to make the bend.
5. Move next bend line under clamping bar and repeat steps 1. through 4. if more than one bend is required.

b. Joggles. Joggles can be brake formed using the steps listed below. See figure 3-13.

1. Lay out boundary lines where bends are to be made. See figure 3-12.
2. Insert sheet in the brake and bend the sheet up 20 to 30 degrees. See figure 3-13.
3. Release brake and remove part.
4. Turn part over and clamp in brake at second bend line.
5. Bend part up to correct the height of joggle.
6. Remove part from brake and inspect joggle for correct dimensions and clearance.

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3-24. Slip Roll Former. See figure 3-16.

- a. The slip roll former is used to form sheet metal into cylinders, cones or other curved surfaces with straight line elements.
- b. It has two end frames and three solid steel rolls mounted between them.
- c. Adjustment screws on each frame adjust the drive rolls to the sheet thickness of material being formed.
- d. Additional adjustment screws adjust the rear roll to bend radius of material to be formed.
- e. On most slip rolling machines, the top drive roll can be released on one end to allow sheet metal removal without distortion.
- f. The rear and lower front rolls are grooved on one end for forming wires or parts with wired edges on the outside of the curve.

CAUTION

Before inserting material into the rolls, inspect the surface of the rolls for dirt, nicks or gouges to prevent damage of part being formed.

- g. Some metals may require forming process to be done by passing metal through rolls several times using progressive settings on roll.

ALUMINUM						
MATERIAL THICKNESS	5052-0 2024-0 6061-0	5052-H34 6061-T6	2024-T3 2024-T4 2024-T351	2024-T81 2024-T851	7075-0 7178-0	7075-T6 7178-T6
0.012	0.03	0.06	0.06	0.06	0.03	0.06
0.016	0.03	0.06	0.06	0.09	0.03	0.06
0.020	0.03	0.06	0.06	0.13	0.06	0.09
0.025	0.06	0.09	0.09	0.16	0.06	0.13
0.032	0.06	0.13	0.13	0.19	0.06	0.16
0.036						
0.040	0.06	0.13	0.13	0.25	0.09	0.22
0.045						
0.050	0.09	0.16	0.16	0.31	0.13	0.25
0.056						
0.063	0.13	0.22	0.22	0.38	0.13	0.31
0.071	0.13	0.25	0.25	0.44	0.16	0.38
0.080	0.13	0.28	0.28	0.50	0.19	0.41
0.090	0.13	0.31	0.36	0.56	0.19	0.47
0.100	0.16	0.38	0.41	0.63	0.22	0.56
0.112						
0.125	0.19	0.44	0.50	0.88	0.28	0.69
0.140						
0.160	0.25	0.56	0.66	1.00	0.38	0.88
0.180						
0.190	0.31	0.75	0.81	1.31	0.44	1.13
0.200						
0.224						
0.250	0.50	1.00	1.13	2.00	0.63	1.50
0.313	0.63	1.25	1.50		0.81	2.00
0.375	0.75	1.50	1.88		1.00	2.50
0.500	1.00	2.00	2.50		1.50	3.25

Figure 3-1. Minimum Bend Radius Chart (Sheet 1 of 2)

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MATERIAL THICKNESS	STEEL				ALLOY	
	STAINLESS			17-7PH		4130 8830 4135 1010 4340 1020 1095
	301	301	301	COND A ANNEALED (RUBBER OR DIE FORMED)	COND TH 1050 (BRAKE- FORMED ONLY)	
	ANNEALED	1/4H	1/2H			
						(ANL-NORM)
0.012	0.03	0.06	0.06	0.03	0.13	0.03
0.016	0.03	0.06	0.06	0.03	0.13	0.03
0.020	0.03	0.06	0.06	0.06	0.16	0.06
0.025	0.03	0.06	0.09	0.06	0.16	0.06
0.032	0.03	0.06	0.09	0.06	0.25	0.06
0.036	0.06	0.09	0.13	0.09	0.25	0.09
0.040	0.06	0.09	0.13	0.09	0.31	0.09
0.045	0.06	0.09	0.13	0.08	0.34	0.09
0.050	0.06	0.13	0.16	0.13	0.38	0.13
0.056	0.06	0.13	0.19	0.13	0.47	0.13
0.063	0.06	0.13	0.19	0.13	0.50	0.13
0.071	0.09	0.16	0.22	0.16	0.56	0.16
0.080	0.09	0.16	0.25	0.16	0.63	0.16
0.090	0.09	0.19	0.31	0.19	0.75	0.19
0.100	0.13	0.22	0.31	0.22		0.22
0.112	0.13	0.22	0.34	0.22		0.22
0.125	0.13	0.25	0.38	0.25		0.25
0.140	0.16	0.28	0.44	0.28		0.28
0.160	0.16	0.31	0.50	0.34		0.31
0.180	0.19	0.38	0.56	0.38		0.38
0.190	0.19	0.38	0.63	0.38		0.38
0.200	0.22	0.41	0.63			0.41
0.224	0.22	0.44	0.69			0.44
0.250	0.25	0.50	0.75			0.50
0.313	0.31					0.63
0.375	0.38					0.75
0.500	0.50					1.00

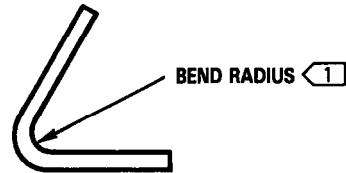
TITANIUM		
MATERIAL THICKNESS	ROOM TEMP.	HOT
0.012	0.06	0.02
0.016	0.09	0.03
0.020	0.13	0.04
0.025	0.13	0.05
0.032	0.16	0.06
0.036	0.19	0.07
0.040	0.22	0.08
0.045	0.25	0.09
0.050	0.25	0.10
0.056	0.31	0.11
0.063	0.33	0.13
0.071	0.38	0.18
0.080	0.44	0.20
0.090	0.50	0.22
0.100	0.56	0.25
0.112	0.63	0.28
0.125	0.72	0.31
0.140	0.88	0.42
0.160	1.00	0.48
0.180	1.13	0.54
0.190	1.25	0.57
0.200		
0.224		
0.250		
0.313		
0.375		
0.500		

LEGEND

TOLERANCES FOR FORMED PARTS:

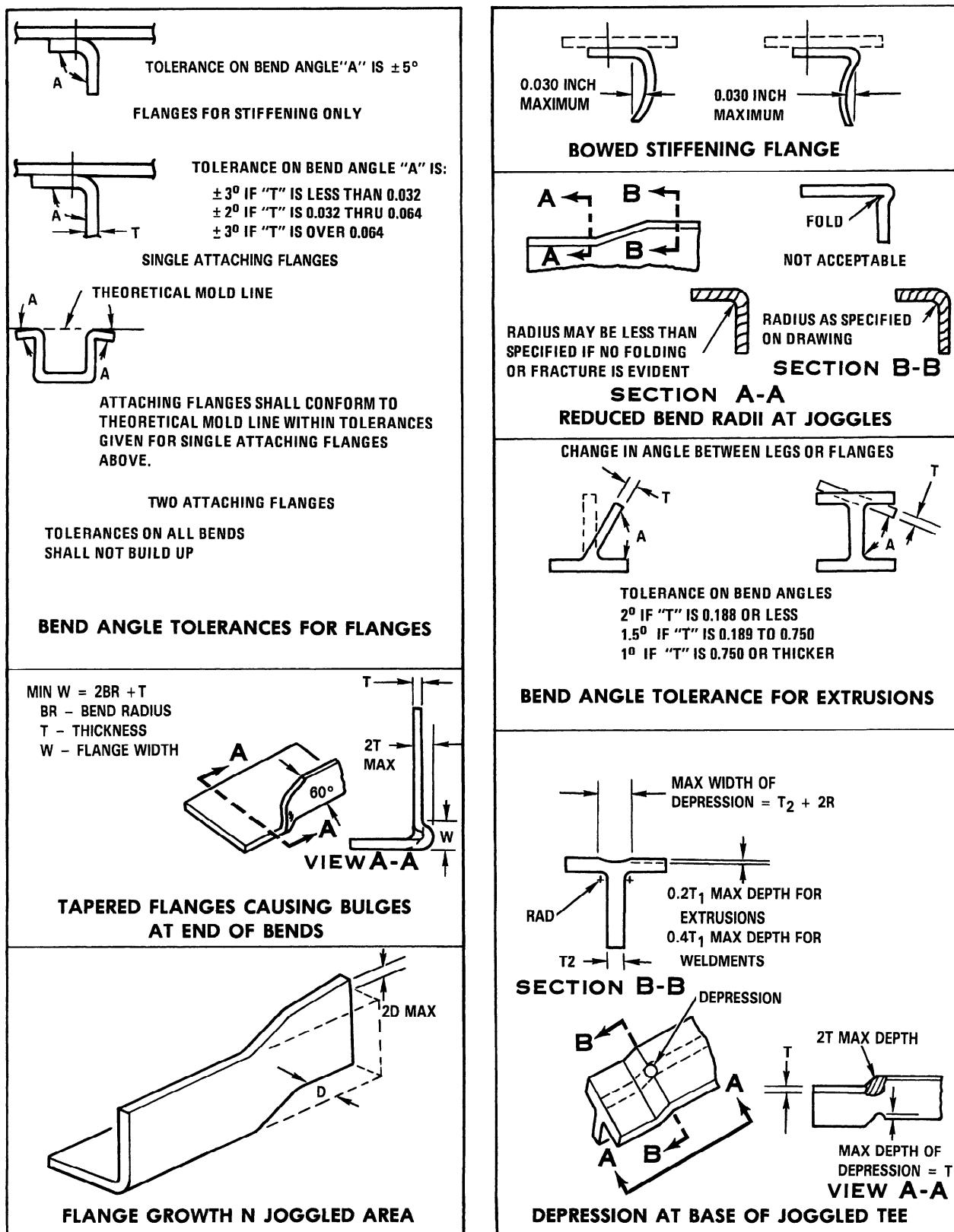
1 BEND RADII ARE MEASURED TO THE INSIDE SURFACE OF THE BEND.

BEND RADIUS	TOLERANCE
0.03 TO 0.06	+.03 -.00
0.07 TO 0.25	±.03
0.26 TO 0.50	±.06
0.51 TO 1.00	±.09
1.01 TO 2.00	±.13
2.01 TO 3.00	±.18
3.01 TO 5.00	±.25



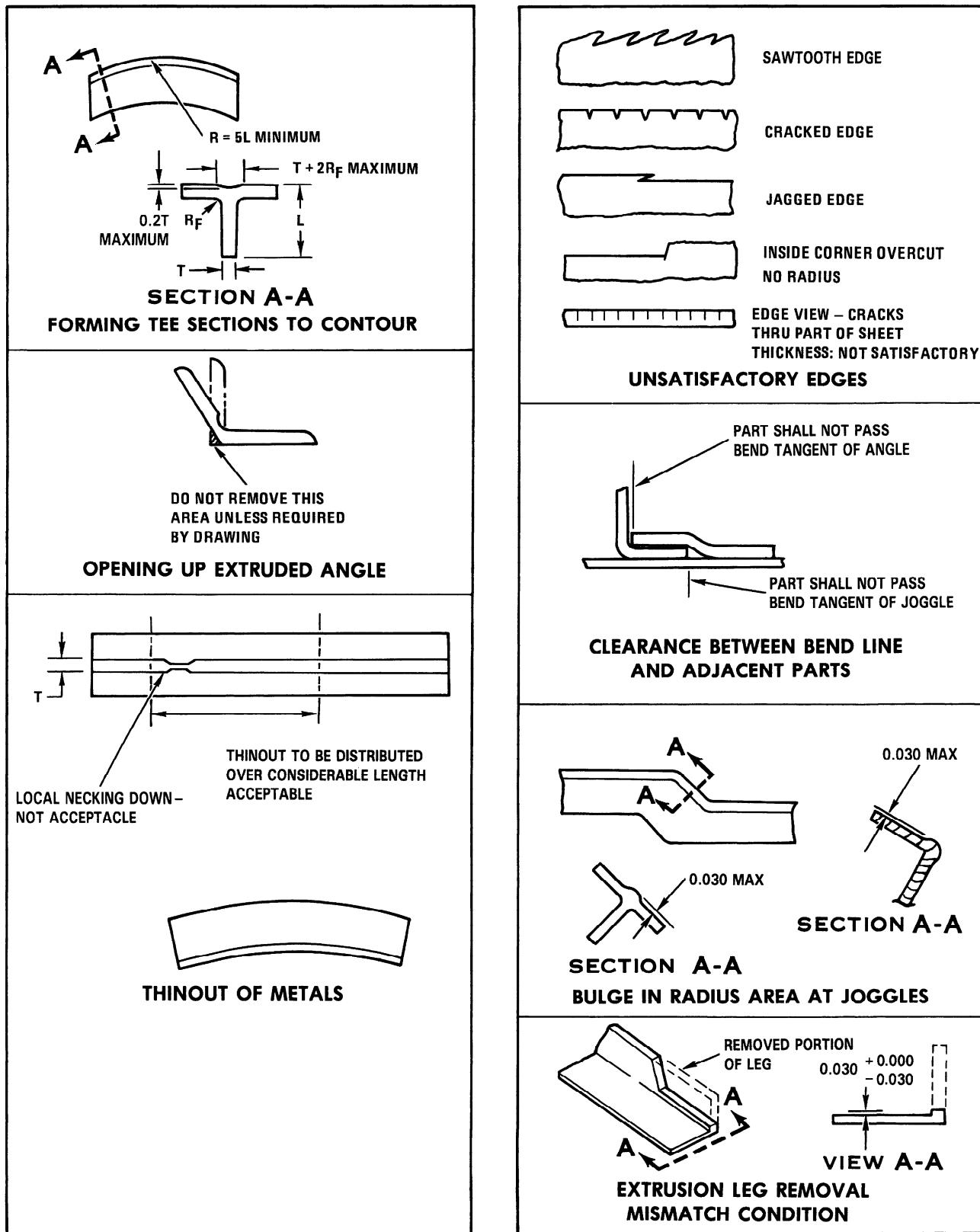
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Figure 3-1. Minimum Bend Radius Chart (Sheet 2)



SAN301-03-3-002

Figure 3-2. Sheet Metal Inspection Requirements (Sheet 1 of 2)



SAN301-03-4-002

Figure 3-2. Sheet Metal Inspection Requirements (Sheet 2)

BEND ALLOWANCE PER DEGREE OF BEND

BEND RADIUS	MATERIAL THICKNESS (INCHES)											
	0.020	0.025	0.032	0.040	0.050	0.063	0.071	0.080	0.090	0.100	0.125	0.190
1/32	0.00070	0.00074	0.00079	0.00085	0.00093	0.00104	0.00110	0.00117	0.00125	0.00132	0.00154	0.00202
1/16	0.00125	0.00129	0.00134	0.00140	0.00148	0.00158	0.00164	0.00171	0.00180	0.00187	0.00209	0.00256
3/32	0.00179	0.00183	0.00188	0.00195	0.00202	0.00212	0.00219	0.00226	0.00233	0.00242	0.00263	0.00312
1/8	0.00233	0.00237	0.00243	0.00249	0.00257	0.00267	0.00273	0.00282	0.00288	0.00296	0.00315	0.00366
5/32	0.00288	0.00292	0.00297	0.00303	0.00311	0.00321	0.00327	0.00334	0.00342	0.00350	0.00370	0.00420
3/16	0.00342	0.00347	0.00352	0.00358	0.00366	0.00375	0.00382	0.00389	0.00397	0.00404	0.00424	0.00475
7/32	0.00397	0.00401	0.00406	0.00412	0.00420	0.00430	0.00436	0.00443	0.00451	0.00459	0.00479	0.00529
1/4	0.00451	0.00455	0.00461	0.00467	0.00475	0.00484	0.00491	0.00498	0.00505	0.00513	0.00533	0.00583
9/32	0.00506	0.00510	0.00515	0.00521	0.00529	0.00539	0.00545	0.00552	0.00560	0.00568	0.00588	0.00638
5/16	0.00560	0.00564	0.00570	0.00576	0.00584	0.00593	0.00599	0.00606	0.00614	0.00622	0.00642	0.00692
11/32	0.00615	0.00619	0.00624	0.00630	0.00638	0.00647	0.00654	0.00661	0.00669	0.00676	0.00697	0.00747
3/8	0.00669	0.00673	0.00679	0.00685	0.00693	0.00702	0.00708	0.00715	0.00723	0.00731	0.00751	0.00774
13/32	0.00724	0.00728	0.00733	0.00739	0.00748	0.00756	0.00763	0.00770	0.00777	0.00785	0.00806	0.00856
7/16	0.00778	0.00782	0.00788	0.00794	0.00802	0.00811	0.00817	0.00824	0.00832	0.00840	0.00840	0.00910
15/32	0.00833	0.00837	0.00842	0.00848	0.00856	0.00865	0.00871	0.00878	0.00886	0.00894	0.00914	0.00964
1/2	0.00887	0.00891	0.00896	0.00903	0.00910	0.00919	0.00926	0.00933	0.00941	0.00948	0.00969	0.01019
17/32	0.00941	0.00945	0.00951	0.00957	0.00965	0.00974	0.00980	0.00987	0.00995	0.01003	0.01023	0.01073
9/16	0.00996	0.01000	0.01005	0.01012	0.01019	0.01028	0.01034	0.01042	0.01049	0.01057	0.01078	0.01127
19/32	0.01050	0.01054	0.01060	0.01066	0.01074	0.01083	0.01089	0.01096	0.01104	0.01112	0.01132	0.01182
5/8	0.01105	0.01109	0.01114	0.01121	0.01128	0.01137	0.01143	0.01150	0.01158	0.01166	0.01187	0.01236
21/32	0.01159	0.01163	0.01169	0.01175	0.01183	0.01191	0.01198	0.01205	0.01213	0.01220	0.01241	0.01291
11/16	0.01214	0.01218	0.01223	0.01230	0.01238	0.01248	0.01258	0.01261	0.01269	0.01281	0.01298	0.01351
23/32	0.01268	0.01273	0.01276	0.01283	0.01291	0.01301	0.01310	0.01316	0.01322	0.01333	0.01351	0.01403
3/4	0.01323	0.01327	0.01332	0.01338	0.01347	0.01357	0.01363	0.01370	0.01378	0.01385	0.01407	0.01455
25/32	0.01378	0.01381	0.01386	0.01392	0.01401	0.01411	0.01415	0.01425	0.01432	0.01437	0.01461	0.01508
13/16	0.01432	0.01436	0.01441	0.01447	0.01456	0.01466	0.01471	0.01479	0.01487	0.01493	0.01516	0.01564
27/32	0.01486	0.01490	0.01494	0.01501	0.01509	0.01519	0.01520	0.01534	0.01540	0.01542	0.01569	0.01612
7/8	0.01541	0.01545	0.01550	0.01556	0.01565	0.01575	0.01582	0.01588	0.01596	0.01619	0.01625	0.01682
29/32	0.01595	0.01599	0.01604	0.01610	0.01619	0.01629	0.01639	0.01643	0.01650	0.01664	0.01679	0.01734
15/16	0.01650	0.01654	0.01659	0.01665	0.01674	0.01684	0.01693	0.01697	0.01705	0.01716	0.01734	0.01786
31/32	0.01704	0.01708	0.01712	0.01718	0.01727	0.01737	0.01746	0.01752	0.01758	0.01769	0.01787	0.01839
1	0.01759	0.01763	0.01768	0.01774	0.01783	0.01793	0.01798	0.01806	0.01814	0.01821	0.01843	0.02191

EXAMPLE

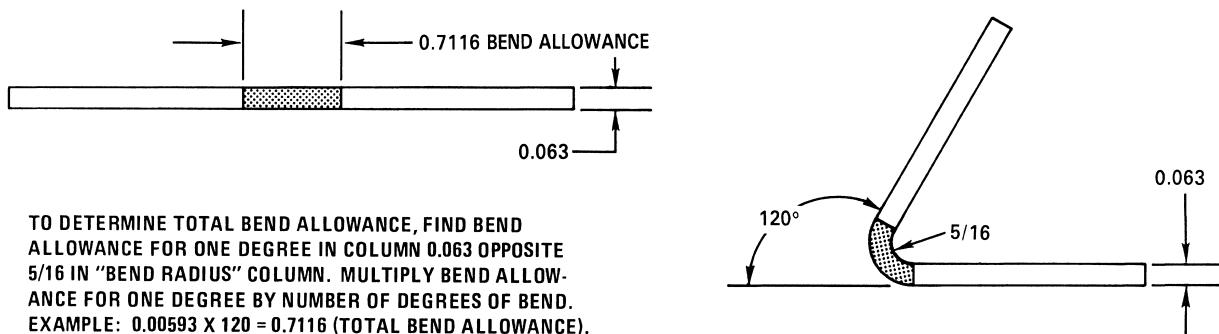


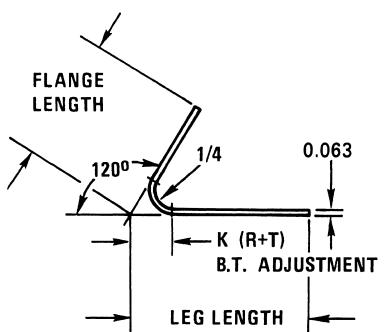
Figure 3-3. Bend Allowance Chart

SAN301-03-5-001

CSTO SR1F-15SA-3-1

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	0.58904	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	1.0727	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	2.14455	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	0.22169	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	0.57737	90	1.00000	120	1.7320	150	3.7320	180	INFINITE

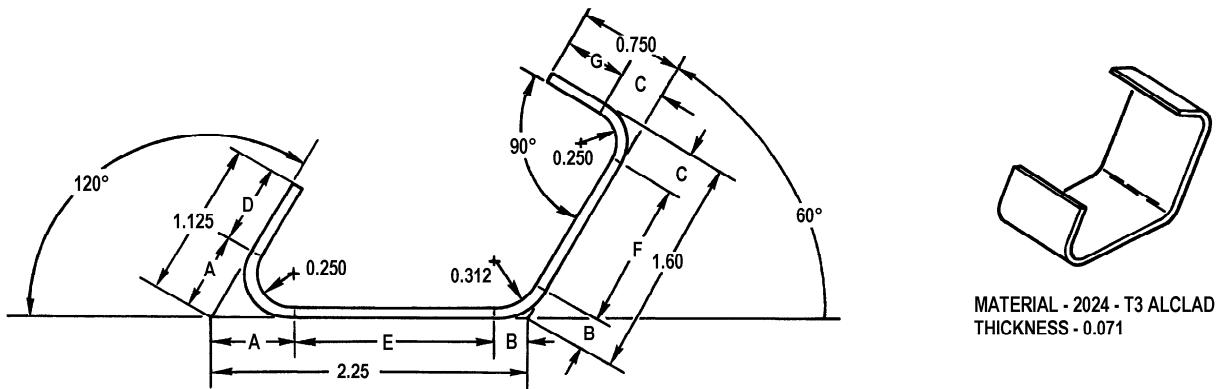
EXAMPLE



ANGLE OF BEND —————— 120 DEGREES
MATERIAL THICKNESS (T) —————— 0.063
BEND RADIUS (R) —————— 0.250
K FROM TABLE —————— 1.7320
BEND TANGENT ADJUSTMENT
 = K (R+T)
 = 1.7320 (0.250 + 0.063)
 = 1.7320 X 0.313
 = 0.542 INCH

SAN301-03-6-001

Figure 3-4. Bend Tangent Adjustment Chart



STEP 1 DETERMINE BEND TANGENT ADJUSTMENT (BTA)

ADJUSTMENT CALCULATIONS

$$\text{ADJUSTMENT} = "K" \text{ VALUE} \times \text{BEND RADIUS (R)} + \text{MATERIAL THICKNESS (T)} \text{ (SEE FIGURE 3-4 FOR "K" VALUE)}$$

$$\text{BTA AT A} = K(R + T)$$

$$\text{BTA AT A} = 1.7320(0.250 + 0.071)$$

$$\text{BTA AT A} = 1.7320 \times 0.321$$

$$\text{BTA AT A} = 0.556$$

$$\text{BTA AT B} = K(R + T)$$

$$\text{BTA AT B} = 0.5773(0.312 + 0.071)$$

$$\text{BTA AT B} = 0.5773 \times 0.383$$

$$\text{BTA AT B} = 0.221$$

$$\text{BTA AT C} = K(R + T)$$

$$\text{BTA AT C} = 1(0.250 + 0.071)$$

$$\text{BTA AT C} = 1 \times 0.321$$

$$\text{BTA AT C} = 0.321$$

STEP 2 DETERMINE FLAT AREAS

FLAT AREA CALCULATIONS

$$\text{FLAT AREA} = \text{MLM} - \text{BEND TANGENT ADJUSTMENT}$$

$$\text{FLAT D} = \text{MLM} - A$$

$$\text{FLAT D} = 1.125 - 0.556$$

$$\text{FLAT D} = 0.569$$

$$\text{FLAT E} = \text{MLM} - A - B$$

$$\text{FLAT E} = 2.250 - 0.556 - 0.221$$

$$\text{FLAT E} = 1.473$$

$$\text{FLAT F} = \text{MLM} - B - C$$

$$\text{FLAT F} = 1.600 - 0.221 - 0.321$$

$$\text{FLAT F} = 1.058$$

$$\text{FLAT G} = \text{MLM} - C$$

$$\text{FLAT G} = 0.750 - 0.321$$

$$\text{FLAT G} = 0.429$$

STEP 3 DETERMINE BEND ALLOWANCE

BEND ALLOWANCE CALCULATIONS

$$\text{BEND ALLOWANCE (BA)} = \text{NUMBER OF DEGREES IN BEND} \times \text{BEND ALLOWANCE PER DEGREE} \\ (\text{SEE FIGURE 3-3 FOR BEND ALLOWANCE PER DEGREE})$$

$$\text{BA FOR } 120^\circ \text{ BEND} = 120 \text{ (BA PER DEGREE)}$$

$$\text{BA FOR } 120^\circ \text{ BEND} = 120 \times 0.00491$$

$$\text{BA FOR } 120^\circ \text{ BEND} = 0.589$$

$$\text{BA FOR } 60^\circ \text{ BEND} = 60 \text{ (BA PER DEGREE)}$$

$$\text{BA FOR } 60^\circ \text{ BEND} = 60 \times 0.00599$$

$$\text{BA FOR } 60^\circ \text{ BEND} = 0.359$$

$$\text{BA FOR } 90^\circ \text{ BEND} = 90 \text{ (BA PER DEGREE)}$$

$$\text{BA FOR } 90^\circ \text{ BEND} = 90 \times 0.00491$$

$$\text{BA FOR } 90^\circ \text{ BEND} = 0.442$$

STEP 4 LAYOUT

0.569	0.589	1.473	0.359	1.058	0.442	0.429
FLAT "D"	BA 120°	FLAT "E"	BA 60°	FLAT "F"	BA 90°	FLAT "G"

SAN301-03-7-002

Figure 3-5. Layout Development

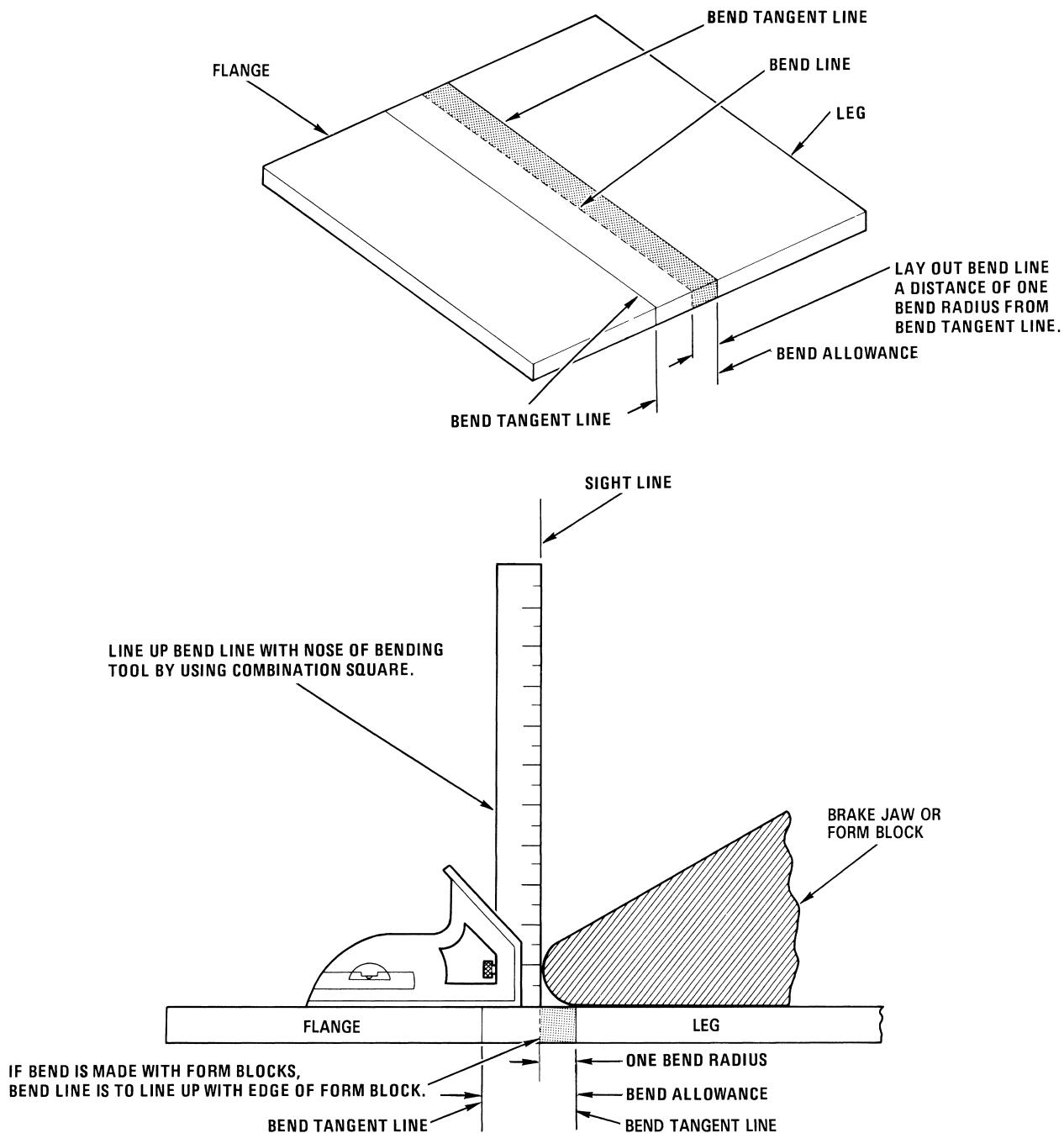


Figure 3-6. Use of Bend Lines - Cornice Brake and Form Blocks

SAN301-03-8-001

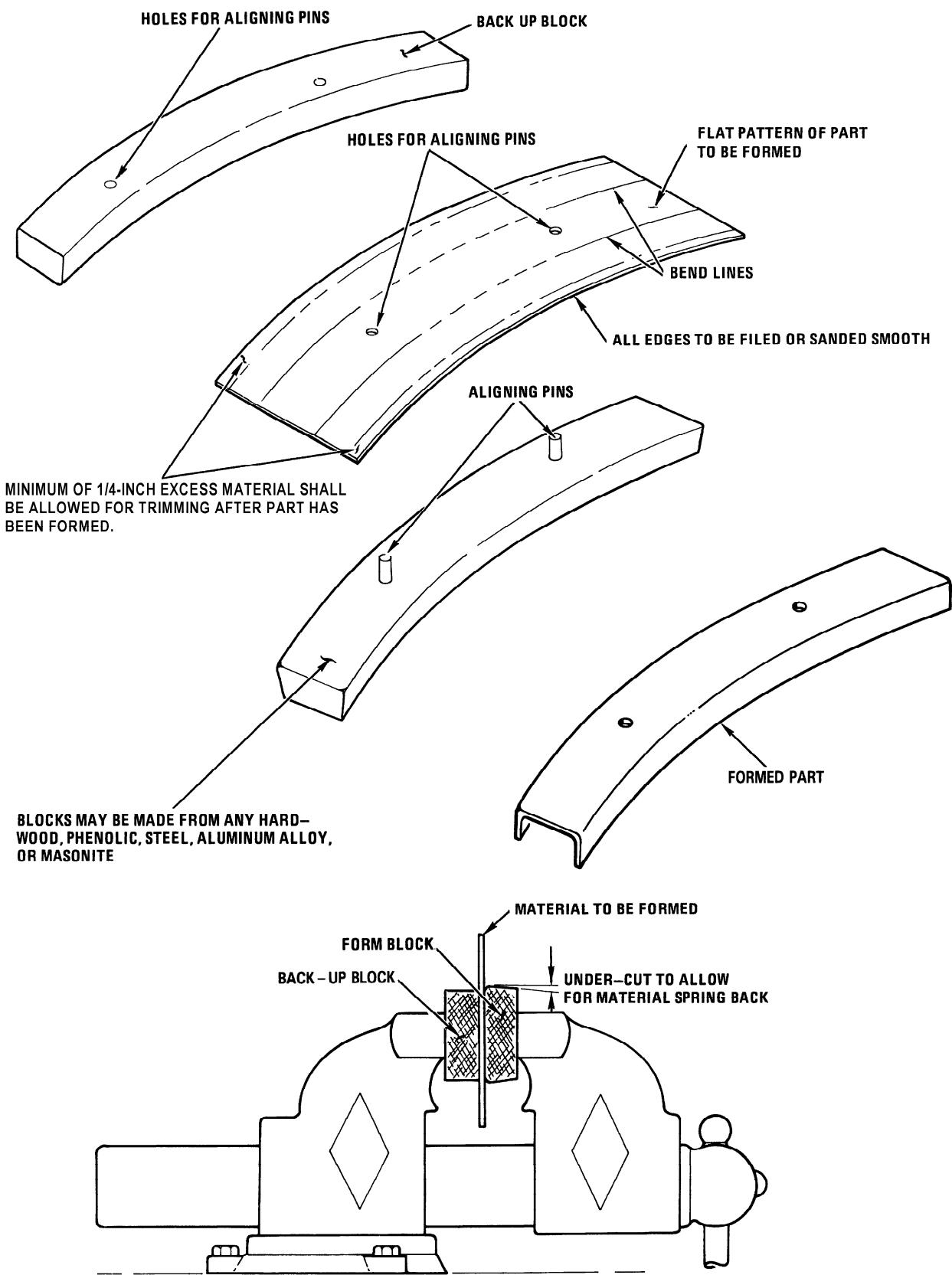


Figure 3-7. Material and Form Block Alignment

SAN301-03-9-002

CSTO SR1F-15SA-3-1

THE CHART ILLUSTRATES THE ALLOWANCE TO BE MADE FROM THE MOLD LINE TO THE THEORETICAL EDGE OF THE FORM BLOCK OR THE EDGE OF THE UPPER JAW ON THE CORNICE BRAKE.

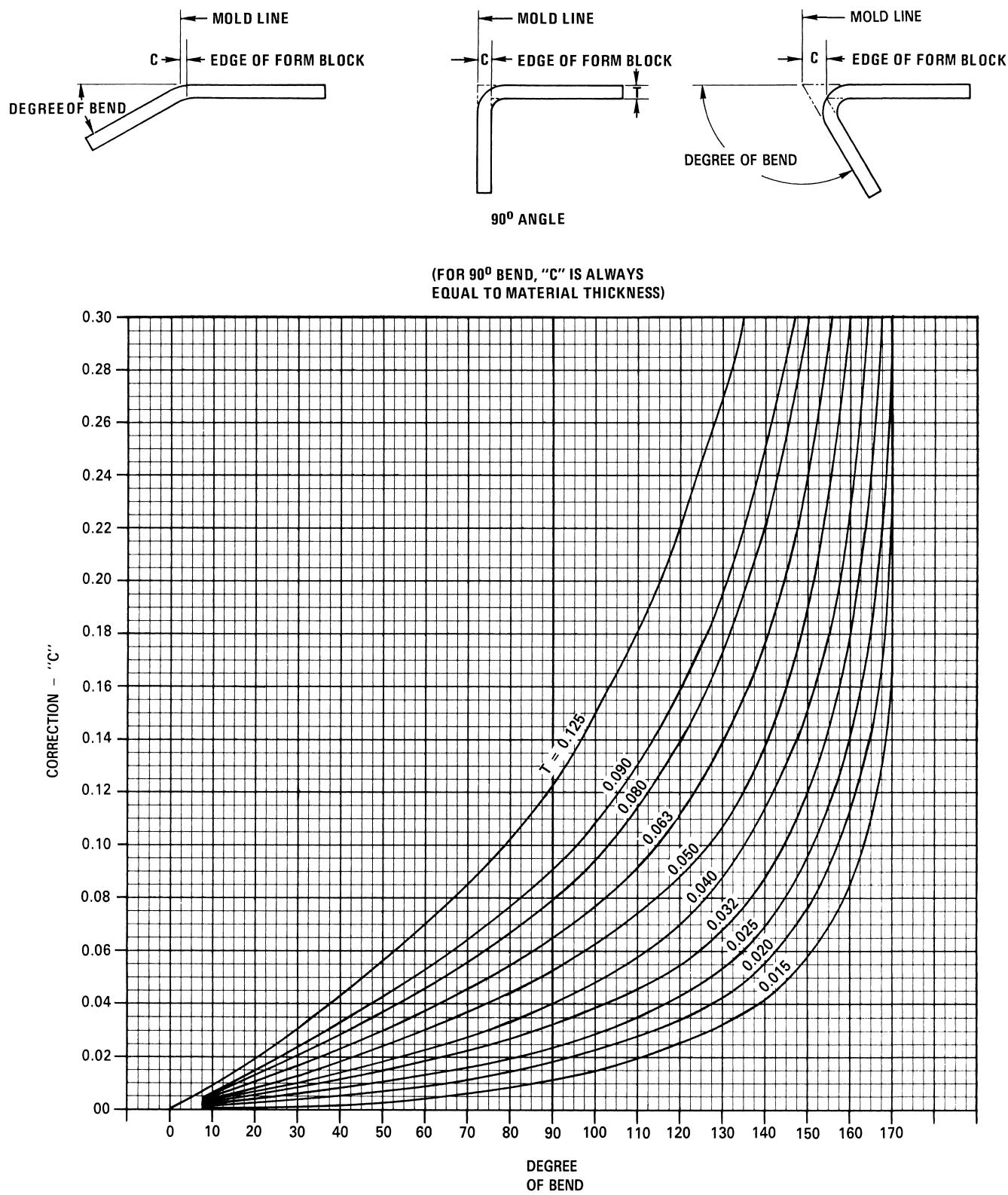


Figure 3-8. Form Block and Cornice Brake Correction Chart

SAN301-03-10-001

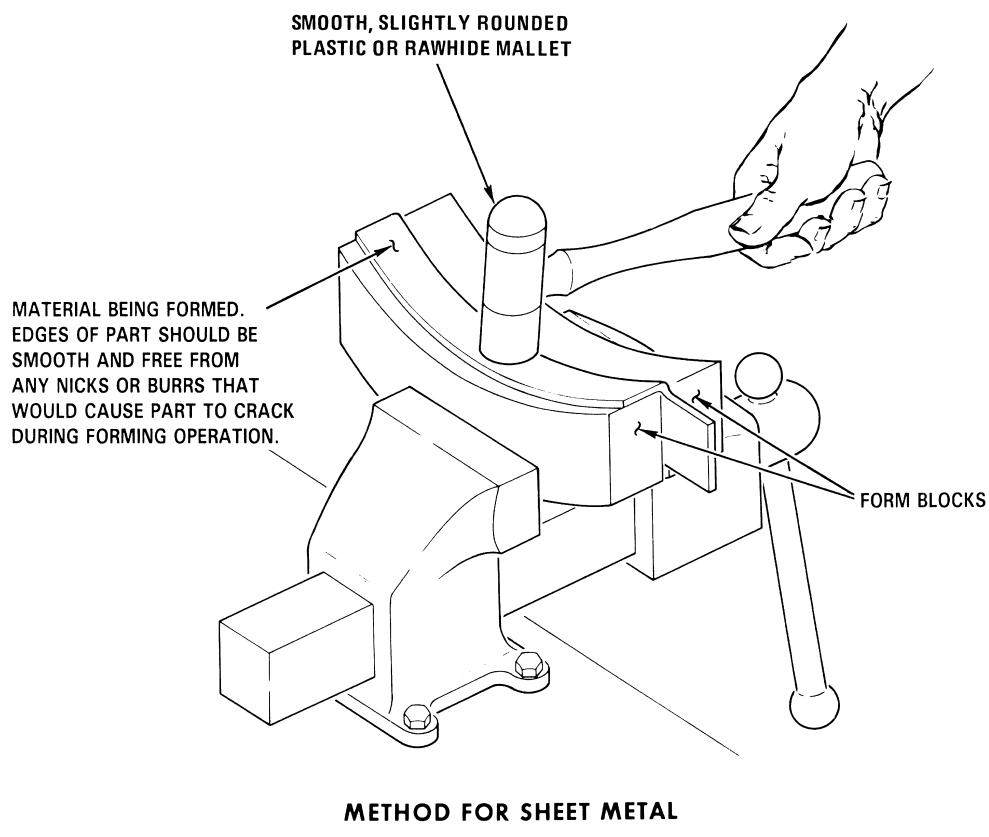


Figure 3-9. Hand Forming Concave Surfaces

SAN301-03-11-001

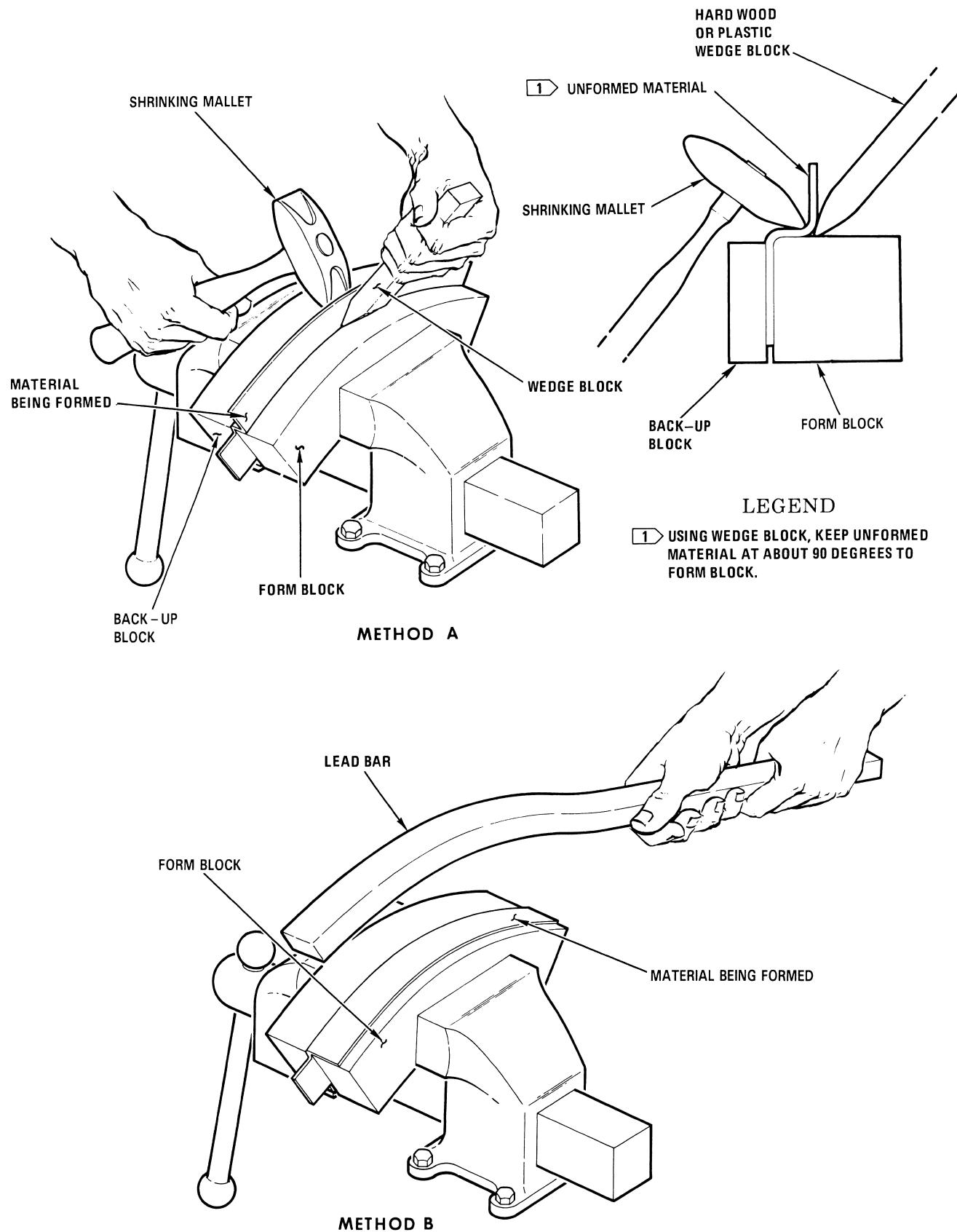


Figure 3-10. Hand Forming Convex Surfaces

SAN301-03-12-001

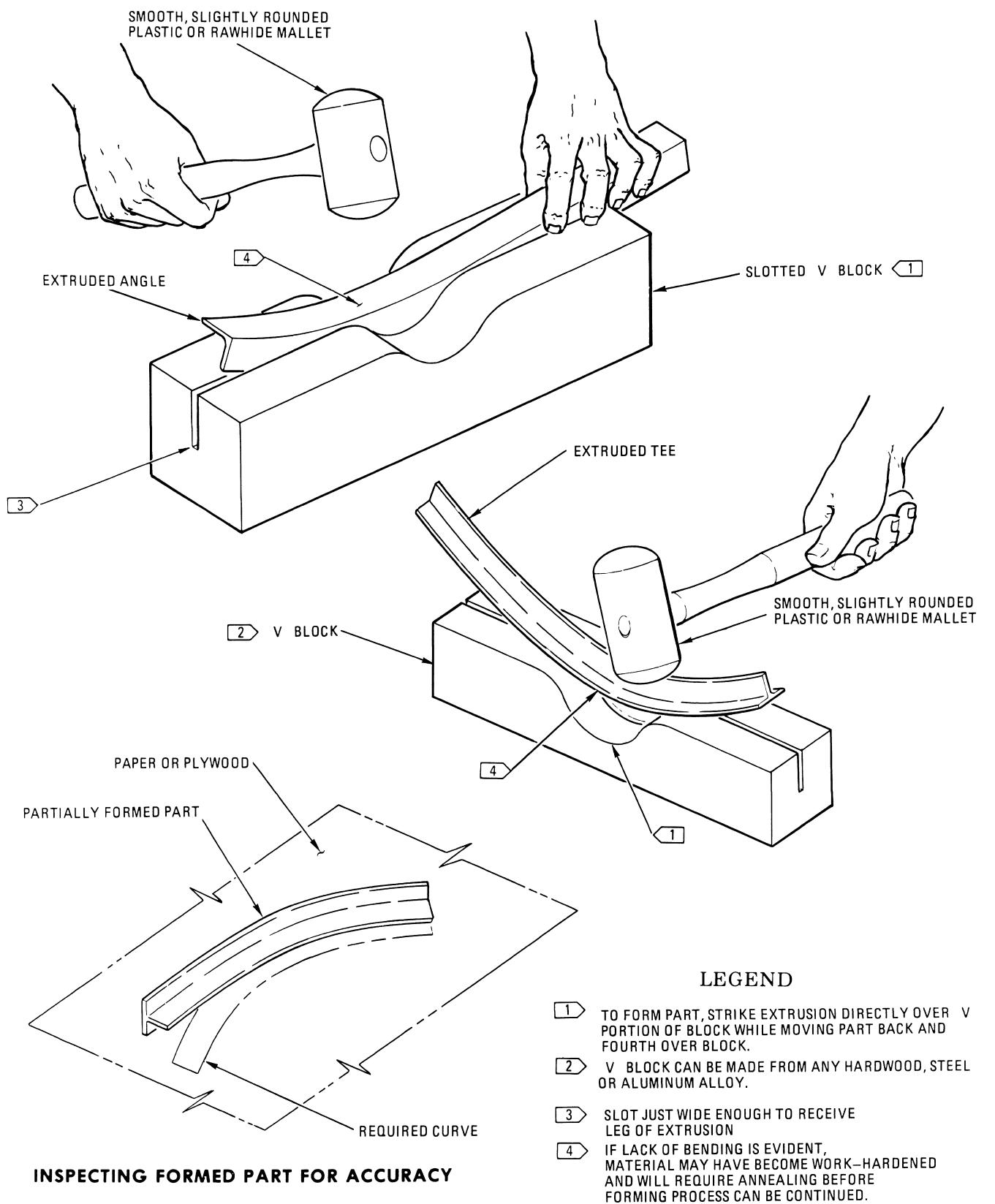
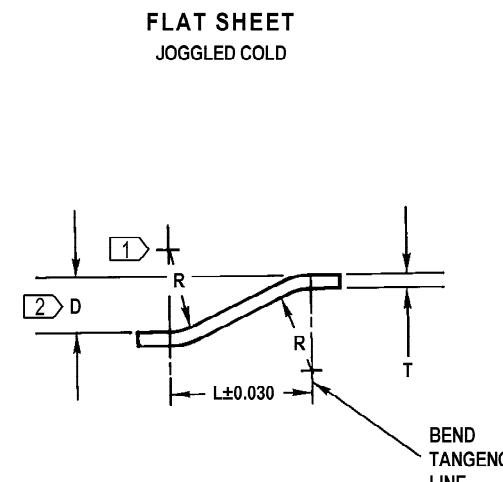


Figure 3-11. Hand Forming Extruded Parts

CSTO SR1F-15SA-3-1

DEPTH OF OFFSET "D"	JOGGLE LENGTH "L"														
	WHEN SHEET THICKNESS "T" IS:														
	UP THRU 0.022	0.023 THRU 0.027	0.028 THRU 0.035	0.036 THRU 0.044	0.045 THRU 0.054	0.055 THRU 0.068	0.069 THRU 0.075	0.076 THRU 0.084	0.085 THRU 0.097	0.098 THRU 0.113	0.114 THRU 0.139	0.140 THRU 0.172	0.173 THRU 0.219	0.220 THRU 0.262	
UP THRU 0.022	A B	A B	A B	A B	A B	A B	A B	A B	A B	A B	A B	A B	A B	A B	A B
0.023 THRU 0.027	0.14 0.17	0.16 0.18	0.17 0.19	0.19 0.19	0.19 0.22	0.21 0.24	0.24 0.27	0.24 0.27	0.24 0.27	0.24 0.27	0.24 0.27	0.24 0.27	0.24 0.27	0.24 0.27	0.24 0.27
0.028 THRU 0.035	0.15 0.18	0.17 0.19	0.19 0.20	0.20 0.20	0.20 0.24	0.22 0.26	0.25 0.28	0.26 0.29	0.27 0.31	0.29 0.33	0.30 0.35	0.32 0.38	0.35 0.42	0.37 0.44	0.37 0.44
0.036 THRU 0.044	0.17 0.20	0.20 0.22	0.22 0.23	0.22 0.26	0.24 0.28	0.27 0.30	0.28 0.32	0.30 0.34	0.31 0.36	0.33 0.38	0.36 0.42	0.40 0.46	0.45 0.50	0.49 0.55	0.49 0.51
0.045 THRU 0.054	0.20 0.21	0.21 0.23	0.24 0.25	0.24 0.28	0.26 0.31	0.29 0.33	0.31 0.35	0.33 0.37	0.34 0.39	0.37 0.41	0.39 0.46	0.44 0.50	0.49 0.56	0.54 0.61	0.54 0.61
0.055 THRU 0.068	0.21 0.24	0.24 0.25	0.25 0.27	0.25 0.30	0.28 0.33	0.32 0.36	0.34 0.38	0.35 0.40	0.37 0.43	0.40 0.45	0.43 0.47	0.51 0.55	0.54 0.61	0.58 0.68	0.58 0.68
0.069 THRU 0.075	0.22 0.25	0.25 0.26	0.26 0.28	0.26 0.32	0.29 0.34	0.33 0.38	0.35 0.41	0.37 0.42	0.39 0.45	0.43 0.47	0.45 0.53	0.50 0.59	0.57 0.65	0.62 0.72	0.62 0.72
0.076 THRU 0.084	0.22 0.26	0.26 0.29	0.27 0.29	0.27 0.33	0.30 0.36	0.33 0.39	0.34 0.40	0.37 0.42	0.38 0.44	0.41 0.47	0.44 0.50	0.56 0.62	0.60 0.69	0.66 0.77	0.66 0.77
0.085 THRU 0.097	0.23 0.26	0.27 0.29	0.29 0.30	0.30 0.30	0.35 0.31	0.38 0.36	0.41 0.38	0.44 0.40	0.47 0.42	0.50 0.46	0.52 0.48	0.59 0.55	0.65 0.63	0.72 0.69	0.80 0.80
0.098 THRU 0.113	0.23 0.27	0.27 0.30	0.31 0.34	0.31 0.36	0.32 0.39	0.37 0.43	0.39 0.46	0.42 0.49	0.44 0.52	0.48 0.55	0.51 0.62	0.58 0.69	0.66 0.75	0.72 0.85	0.72 0.85
0.114 THRU 0.139	0.24 0.28	0.29 0.32	0.33 0.36	0.33 0.39	0.37 0.42	0.40 0.47	0.43 0.50	0.45 0.53	0.48 0.56	0.51 0.59	0.55 0.68	0.63 0.75	0.71 0.82	0.79 0.94	0.79 0.94
0.140 THRU 0.172	0.24 0.30	0.30 0.34	0.35 0.38	0.35 0.45	0.39 0.46	0.46 0.51	0.47 0.55	0.51 0.58	0.53 0.62	0.57 0.65	0.62 0.74	0.69 0.82	0.79 0.91	0.87 1.03	0.87 1.03
0.173 THRU 0.219	0.24 0.30	0.31 0.35	0.36 0.40	0.36 0.47	0.41 0.51	0.48 0.54	0.52 0.59	0.53 0.62	0.56 0.66	0.61 0.70	0.66 0.80	0.71 0.89	0.85 0.99	0.94 0.99	0.94 1.12
0.220 THRU 0.262	0.24 0.30	0.31 0.37	0.37 0.43	0.38 0.51	0.44 0.56	0.53 0.62	0.57 0.68	0.60 0.69	0.64 0.74	0.70 0.79	0.76 0.90	0.84 1.01	0.96 1.12	1.07 1.29	1.07 1.29

FLAT SHEET
JOGGED COLD

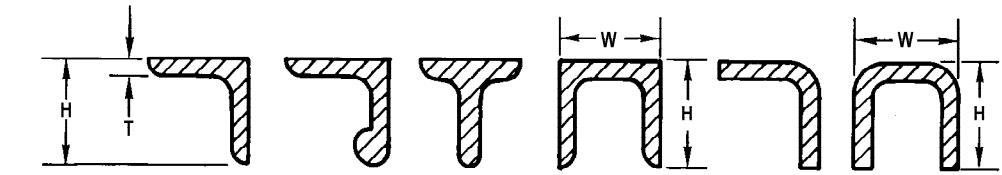
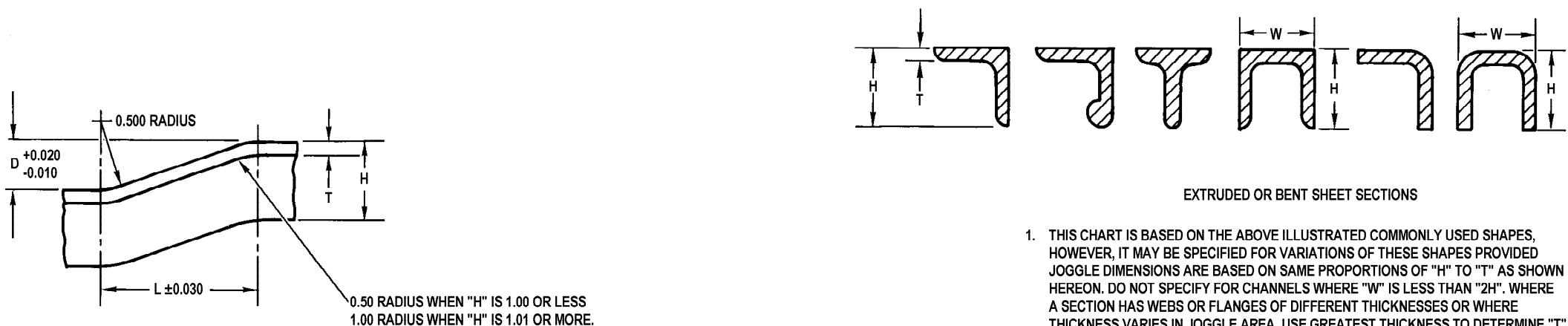


MATERIAL ◀ 1	USE COLUMN
2024-0	A
2024-T3	A
2024-T361	B
2024-T81	B
6061-0	A
6061-T6	A
7075-0	A
7075-T6, 7075-T76	B
7178-0	A
7178-T6	B
TITANIUM	B
STAINLESS STEEL HARD	B
STAINLESS STEEL ANNEALED	A
ALLOY STEEL ANNEALED	A
MAGNESIUM	B
INCONEL	B

LEGEND

- [1] FOR "R" DIMENSION SEE CHART FOR BRAKE FORMED SHEET.
[2] TOLERANCE FOR DEPTH OFFSET "D" IN FLAT SHEET IS:
D ±0.030 FOR SHEET THICKNESS OF 0.068 OR LESS.
D ±0.020 FOR SHEET THICKNESS OF 0.069 OR GREATER.

DEPTH OF OFFSET "D"	5 > JOGGLE LENGTH "L"														
	WHEN SHEET THICKNESS "T" IS:														
	UP THRU 0.022	0.023 THRU 0.027	0.028 THRU 0.035	0.036 THRU 0.044	0.045 THRU 0.054	0.055 THRU 0.068	0.069 THRU 0.075	0.076 THRU 0.084	0.085 THRU 0.097	0.098 THRU 0.114	0.114 THRU 0.139	0.140 THRU 0.172	0.173 THRU 0.219	0.220 THRU 0.262	
UP THRU 0.022	0.12 0.13	0.15 0.15	0.15 0.15	0.15 0.18	0.18 0.20	0.19 0.22	0.20 0.23	0.21 0.26	0.23 0.27	0.24 0.29	0.26 0.34	0.27 0.34	0.31 0.38	0.34 0.41	0.34 0.38
0.023 THRU 0.027	0.14 0.15	0.16 0.16	0.16 0.17	0.17 0.18	0.18 0.19	0.19 0.22	0.20 0.23	0.21 0.26	0.22 0.27	0.24 0.28	0.26 0.30	0.27 0.31	0.34 0.41	0.38 0.41	0.38 0.41
0.028 THRU 0.035	0.15 0.17	0.18 0.18	0.18 0.20	0.20 0.20	0.21 0.24	0.24 0.25	0.25 0.27	0.26 0.28	0.28 0.30	0.30 0.33	0.33 0.37	0.37 0.42	0.42 0.46	0.46 0.51	0.46 0.46
0.036 THRU 0.044															

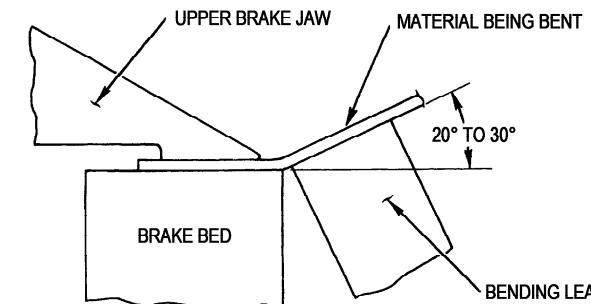


EXTRUDED OR BENT SHEET SECTIONS

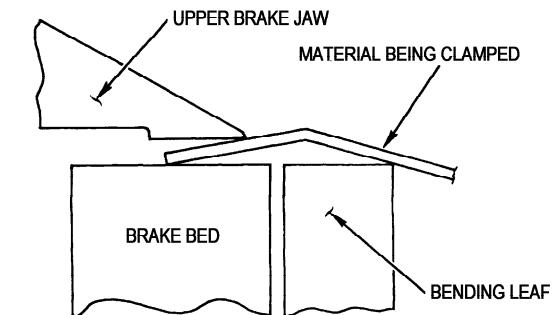
1. THIS CHART IS BASED ON THE ABOVE ILLUSTRATED COMMONLY USED SHAPES, HOWEVER, IT MAY BE SPECIFIED FOR VARIATIONS OF THESE SHAPES PROVIDED JOGGLE DIMENSIONS ARE BASED ON SAME PROPORTIONS OF "H" TO "T" AS SHOWN HEREIN. DO NOT SPECIFY FOR CHANNELS WHERE "W" IS LESS THAN "2H". WHERE A SECTION HAS WEBS OR FLANGES OF DIFFERENT THICKNESSES OR WHERE THICKNESS VARIES IN JOGGLE AREA, USE GREATEST THICKNESS TO DETERMINE "T".
2. THIS CHART IS BASED ON THE ABOVE ILLUSTRATED COMMONLY USED SHAPES, HOWEVER, 6M51 MAY BE SPECIFIED FOR VARIATIONS OF THESE SHAPES PROVIDED THE JOGGLE DIMENSIONS ARE BASED ON THE SAME PROPORTIONS OF "H" TO "T" AS SHOWN HEREIN.
3. USE JOGGLE LENGTH DIMENSIONS IN COLUMN "A" FOR ALL "O" CONDITION ALUMINUM, ANNEALED STEEL, STAINLESS STEEL AND HOT FORMED TITANIUM.
4. USE JOGGLE LENGTH DIMENSIONS IN COLUMN "B" FOR ALL "T" OR "H" CONDITION (HOT FORMED) ALUMINUM.
5. JOGGLES IN STRAIGHT SECTIONS OF PARTS MADE FROM EXTRUDED OR PREFORMED SHEET STOCK ARE JOGGLED WITH STANDARD Dies. PARTS WITH MULTIPLE JOGGLES REQUIRE A MINIMUM OF 3 INCHES BETWEEN JOGGLES FOR DIE GRIP.
6. FOR STOCK THICKNESSES BELOW THE MINIMUMS SHOWN, USE JOGGLE LENGTH DIMENSIONS GIVEN IN THE 0.040 - 0.078 AND 0.079 - 0.125 COLUMNS, AS APPLICABLE.

JOGGLE DEPTH "D" IS	A		B		A		B		A		B		A		B		A		B		A		B		A		B													
	UP THRU 1.00		UP THRU 1.00		1.01 - 1.50		1.01 - 1.50		1.51 - 2.00		1.51 - 2.00		2.01 - 2.50		2.01 - 2.50		2.51 - 3.00		2.51 - 3.00		3.01 - 4.00		3.01 - 4.00		4.01 - 5.00		4.01 - 5.00													
	"H" IS	"T" IS	.040 - .078	.040 - .125	.040 - .078	.040 - .125	.040 - .063 - .102	.040 - .063 - .102	.040 - .063 - .103	.040 - .063 - .103	.040 - .063 - .103	.040 - .063 - .103	.040 - .063 - .126 - .250	.040 - .063 - .126 - .250	.040 - .063 - .126 - .250	.040 - .063 - .126 - .250	.040 - .079 - .188	.040 - .079 - .188	.040 - .079 - .188	.040 - .079 - .188	.040 - .079 - .188	.040 - .079 - .188	.050 - .079 - .188	.050 - .079 - .188	.050 - .079 - .188	.050 - .079 - .188	.050 - .079 - .200	.050 - .079 - .200	.050 - .079 - .200	.050 - .079 - .200	.062 - .125	.062 - .125	.062 - .125	.062 - .125						
UP THRU .027	0.20	0.20	0.25	0.26	0.23	0.23	0.30	0.30	0.30	0.27	0.26	0.26	0.32	0.30	0.30	0.29	0.28	0.28	0.35	0.31	0.30	0.30	0.30	0.30	0.30	0.30	0.32	0.32	0.30	0.35	0.33	0.32	0.30	0.33	0.31	0.30	0.36	0.34	0.32	
.028 - .044	0.22	0.22	0.33	0.33	0.26	0.26	0.36	0.39	0.39	0.30	0.29	0.28	0.46	0.41	0.39	0.32	0.31	0.30	0.52	0.41	0.39	0.34	0.33	0.32	0.52	0.42	0.41	0.37	0.35	0.32	0.53	0.45	0.42	0.39	0.36	0.33	0.54	0.46	0.43	
.045 - .054	0.25	0.24	0.38	0.38	0.30	0.29	0.49	0.44	0.44	0.34	0.33	0.30	0.60	0.50	0.45	0.36	0.34	0.32	0.69	0.50	0.48	0.39	0.36	0.34	0.69	0.51	0.49	0.43	0.39	0.35	0.69	0.58	0.50	0.46	0.41	0.36	0.69	0.60	0.55	
.055 - .068	0.28	0.26	0.43	0.41	0.34	0.33	0.32	0.58	0.52	0.49	0.38	0.37	0.33	0.73	0.59	0.51	0.41	0.38	0.35	0.84	0.59	0.52	0.45	0.40	0.36	0.84	0.62	0.56	0.49	0.44	0.38	0.84	0.70	0.59	0.53	0.47	0.40	0.85	0.73	0.66
.069 - .075	0.32	0.28	0.47	0.43	0.39	0.37	0.35	0.63	0.56	0.52	0.42	0.41	0.36	0.80	0.64	0.55	0.46	0.42	0.38	0.92	0.65	0.57	0.52	0.45	0.39	0.92	0.68	0.61	0.56	0.49	0.42	0.92	0.77	0.64	0.60	0.53	0.45	0.93	0.80	0.72
.076 - .084	0.36	0.30	0.51	0.45	0.44	0.41	0.38	0.70	0.62	0.56	0.47	0.45	0.40	0.89	0.70	0.60	0.53	0.47	0.42	1.03	0.71	0.61	0.59	0.51	0.43	1.03	0.74	0.66	0.63	0.55	0.47	1.03	0.85	0.70	0.67	0.59	0.51	1.03	0.89	0.79
.085 - .097	0.40	0.32	0.57	0.50	0.49	0.44	0.41	0.79	0.69	0.61	0.53	0.49	0.44	1.01	0.80	0.67	0.61	0.53	0.46	1.18	0.81	0.68	0.58	0.49	1.18	0.84	0.75	0.73	0.63	0.53	1.18	0.96	0.80	0.78	0.68	0.58	1.18	1.01	0.90	
.098 - .113	0.45	0.36	0.65	0.55	0.57	0.51	0.45	0.90	0.78	0.68	0.62	0.57	0.51	1.16	0.90	0.75	0.71	0.62	0.54	1.36	0.91	0.75	0.79	0.68	0.57	1.36	0.96	0.84	0.85	0.73	0.62	1.36	1.10	0.91	0.90	0.79	0.68	1.36	1.16	1.03
.114 - .139	0.56	0.42	0.77	0.64	0.70	0.63	0.56	1.08	0.93	0.79	0.76	0.70	0.63	1.41	1.08	0.88	0.87	0.76	0.66	1.65	1.10	0.89	0.97	0.83	0.70	1.65	1.15	0.99	1.04	0.90	0.76	1.65	1.33	1.09	1.11	0.97	0.83	1.66	1.41	1.24
.140 - .172	0.69	0.52	0.93	0.76	0.86	0.77	0.69	1.31	1.13	0.94	0.95	0.86	0.77	1.73	1.33	1.06	1.08	0.95	0.82	2.03	1.34	1.06	1.20	1.03	0.86	2.03	1.41	1.20	1.29	1.12	0.95	2.03	1.67	1.32	1.38	1.20	1.03	2.04	1.73	1.50
.173 - .219	0.88	0.66	1.15	0.91	1.10	0.99	0.88	1.64	1.40	1.14	1.20	1.10	0.99	2.16	1.65	1.31	1.37	1.20	1.04	2.56	1.67	1.31	1.53	1.10	2.56	1.75	1.48	1.64	1.42	1.20	2.56	2.04	1.64	1.75	1.53	1.31	2.56	2.16	1.89	
.220 - .262	1.05	0.79	1.36	1.06	1.31	1.18	1.05	1.93	1.64	1.34	1.44	1.31	1.18	2.58	1.95	1.54	1.64	1.44	1.24																					

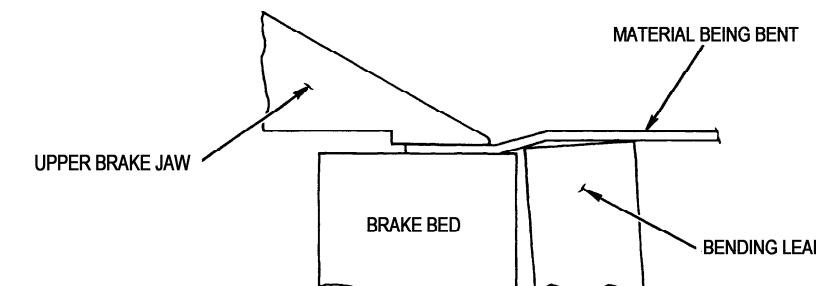
CSTO SR1F-15SA-3-1



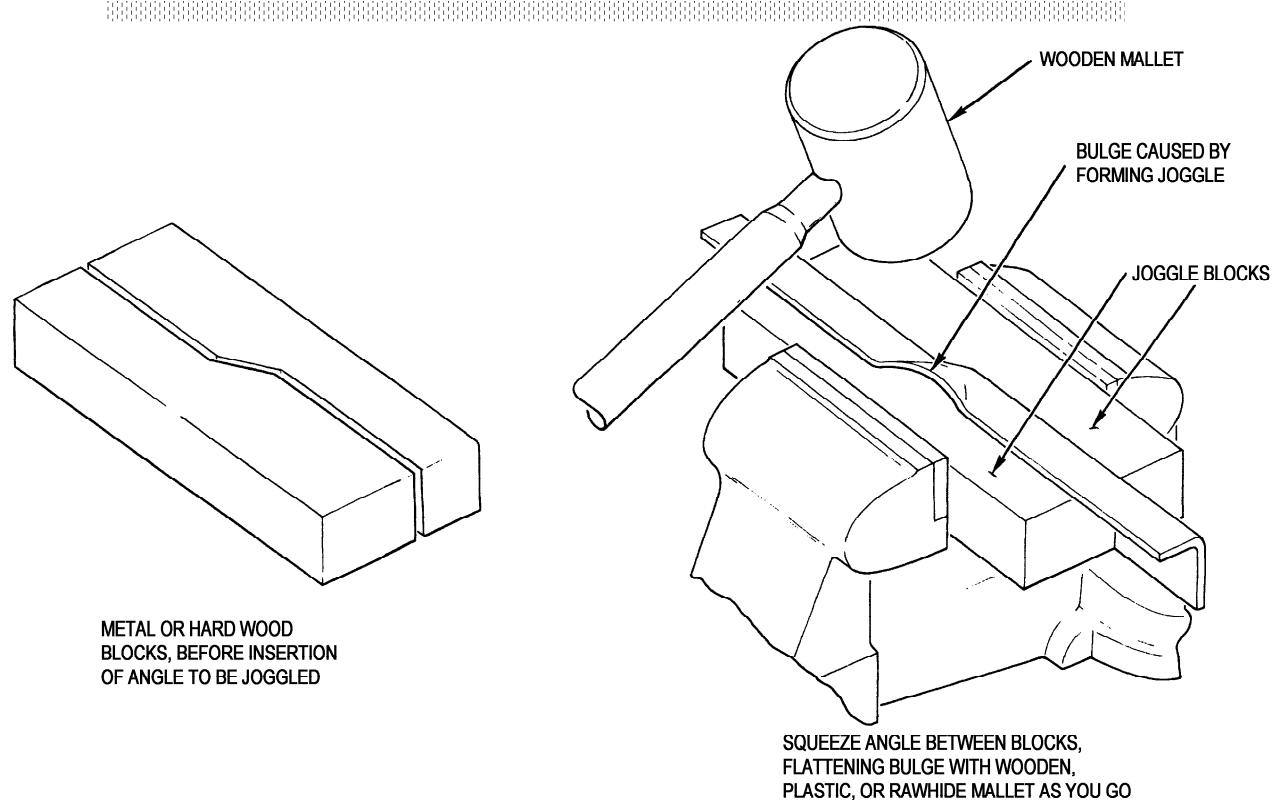
STEP 1. CLAMP MATERIAL IN BRAKE AND BEND UP 20 TO 30 DEGREES.



STEP 2. TURN MATERIAL OVER AND CLAMP IN BRAKE.



STEP 3. RAISE BENDING LEAF OF BRAKE UNTIL CORRECT OFFSET IS PRODUCED.
BRAKE METHOD (SHEET STOCK)



JOGGLE BLOCK METHOD

SAN301-03-16-001

Figure 3-13. Forming Joggles Using Brake or Joggle Blocks

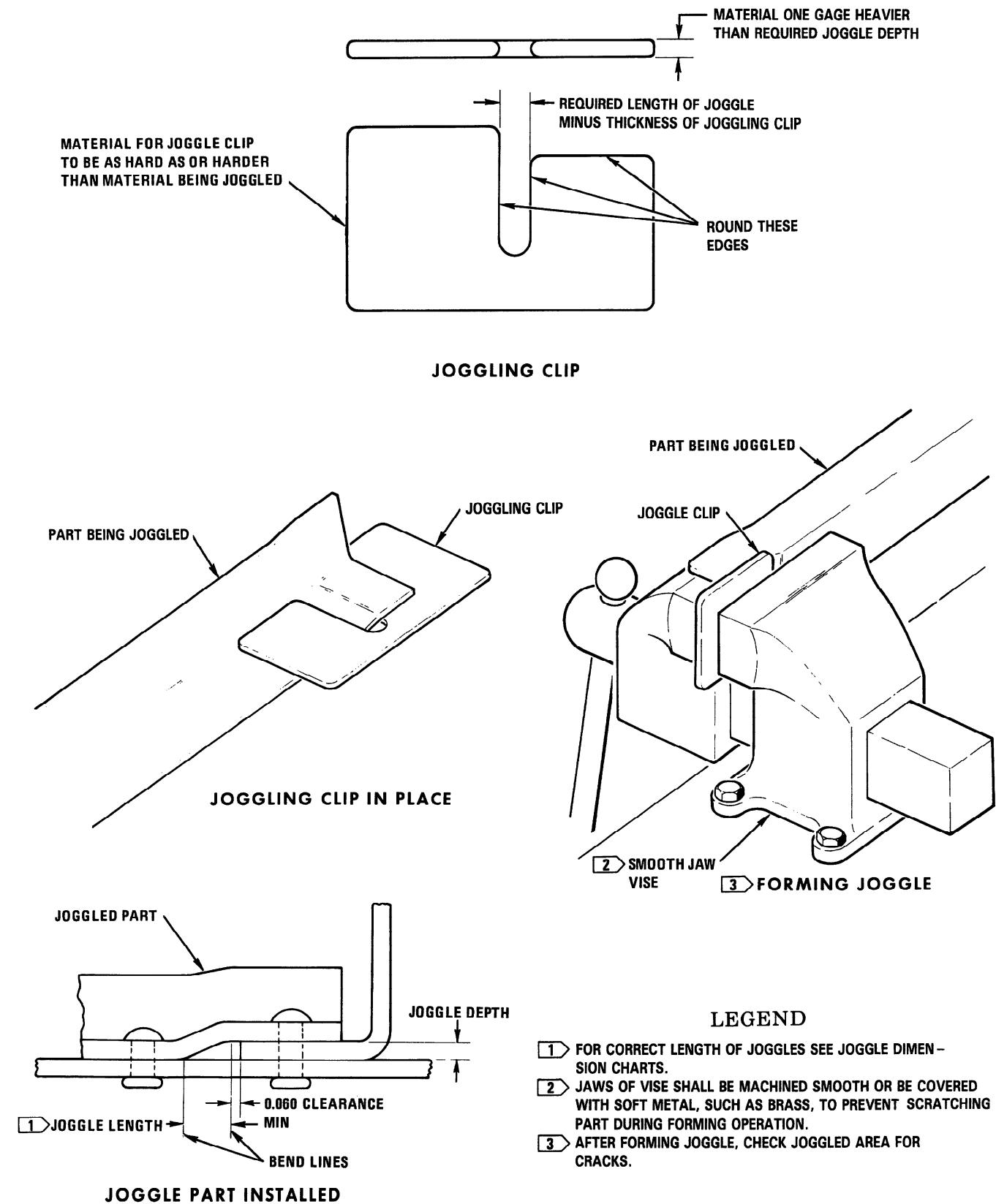
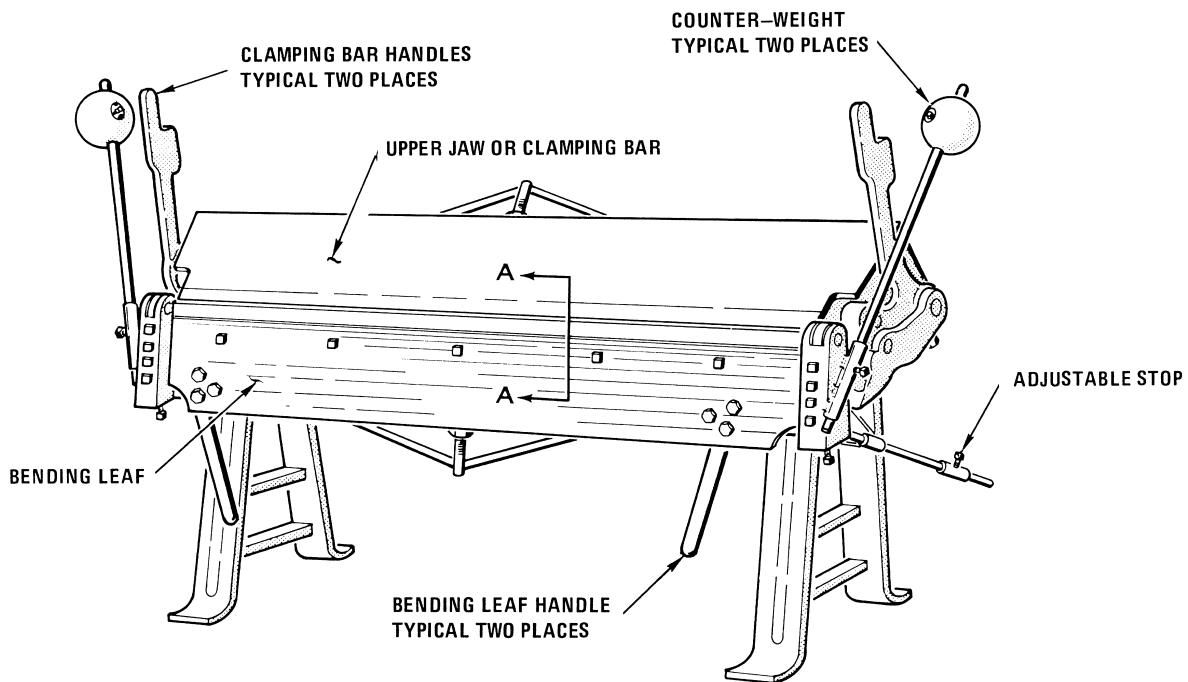
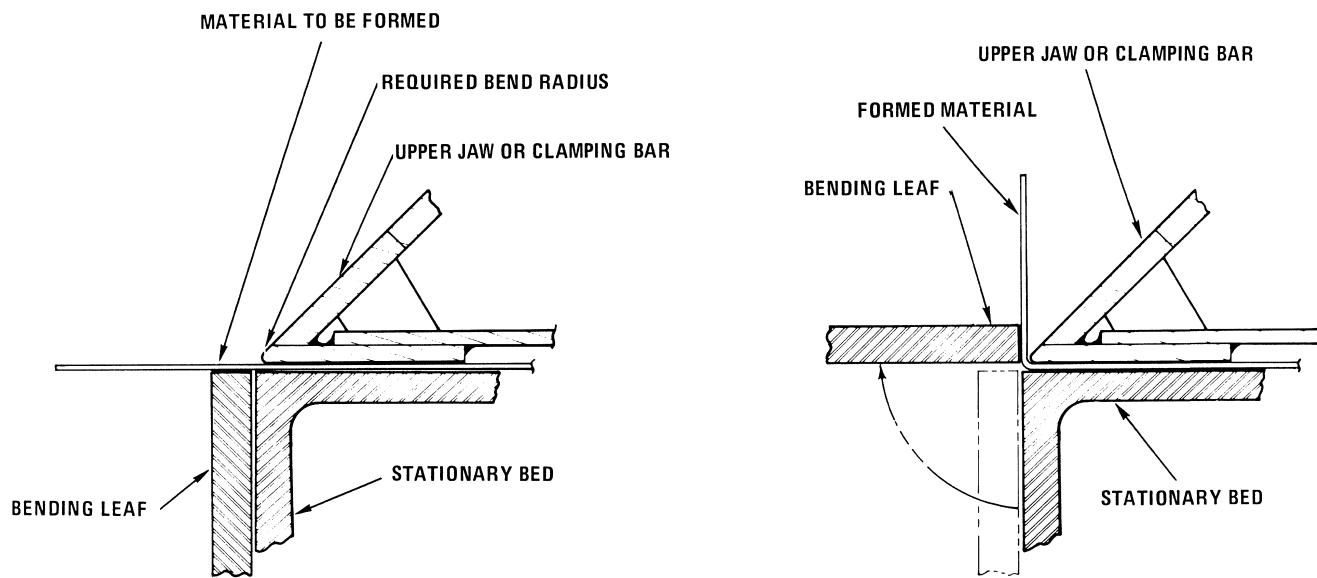


Figure 3-14. Forming Joggles Using Joggling Clips

SAN301-03-17-002



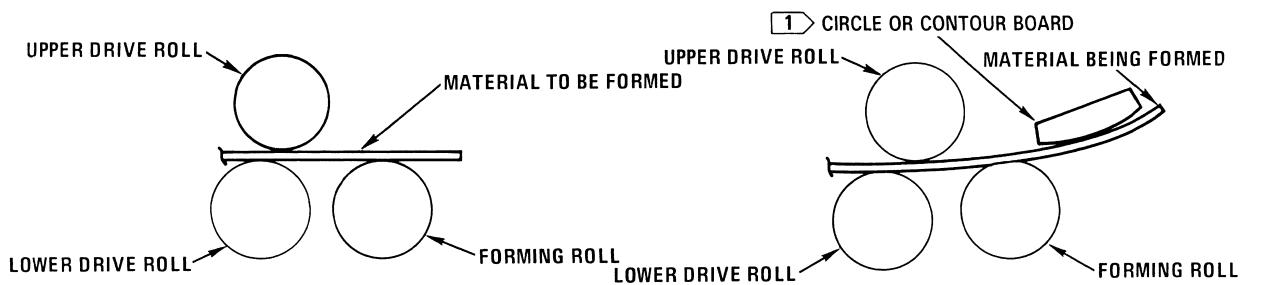
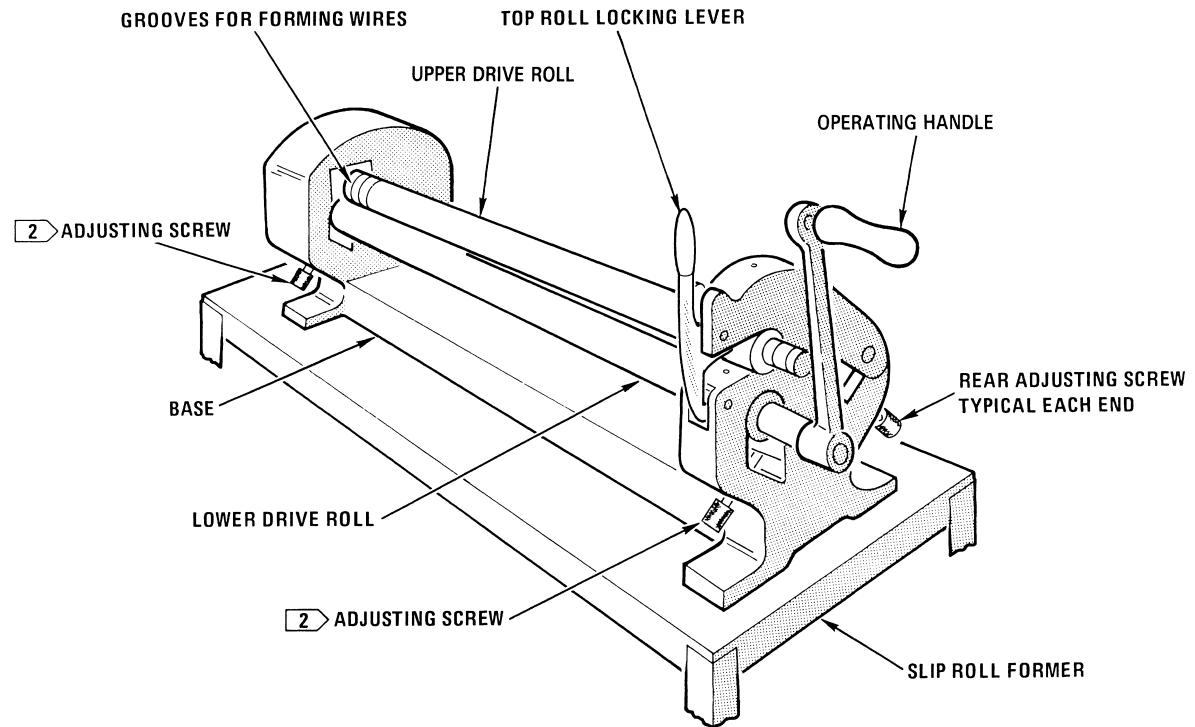
BENDING OPERATION



SECTION A-A

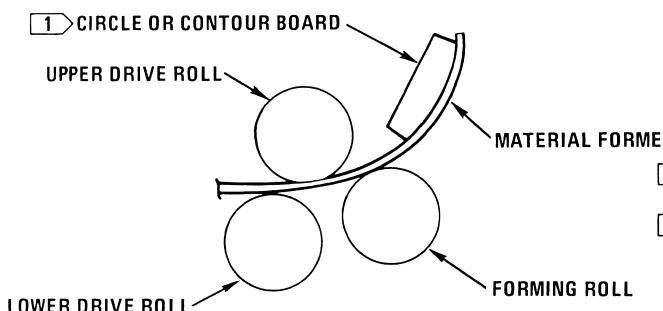
SAN301-03-18-001

Figure 3-15. Cornice Brake Operations



STEP 1. ADJUST THE ROLL AND INSERT MATERIAL TO BE FORMED.

STEP 2. TURN REAR ADJUSTING SCREWS TO RAISE THE FORMING ROLL AND PASS THE MATERIAL THROUGH THE ROLL.



LEGEND

- [1] CIRCLE OR CONTOUR BOARD SHOULD HAVE RADIUS EQUAL TO REQUIRED RADIUS OF FORMED PART.
- [2] TAPERED SHAPES CAN BE FORMED BY TIGHTENING ADJUSTING SCREW ON ONE END OF ROLLS AND LOOSENING SCREW ON OTHER END.

STEP 3. READJUST FORMING ROLL TO GIVE REQUIRED CURVE AND PASS MATERIAL THROUGH THE ROLLS.

SAN301-03-19-001

Figure 3-16. Slip Roll Operation

3-25. WORKING TITANIUM ALLOY.

3-26. Titanium alloy is a relatively lightweight, corrosion resistant structural metal. Because of its physical properties, special techniques are required when working titanium.

3-27. **CUTTING AND GRINDING.** Cutting tools for titanium machining operations shall be sharp and properly ground. Titanium machining operations require a positive, uniform feed. The cutting tool shall not be allowed to dwell or ride in the cut. The low thermal conductivity of titanium inhibits dissipation of heat, so cutting speed is a critical factor in titanium machining operations. Cutting fluids shall be used to cool the work area, to increase tool life, improve surface finish, minimize galling and seizing, and to reduce residual stresses in the part. The recommended cutting fluid is cleaning compound, Dascool 2003A. Titanium is susceptible to cracking if rough areas are present. Therefore, all cut and trimmed edges must be filed free of burrs, grooves, scratches, and sharp corners before forming or assembly is started.

WARNING

A fire danger exists when grinding titanium. Titanium dust can be easily ignited when dry. The precautionary measures below shall be taken.

Cleaning compound, Dascool 2003A (cutting fluid) is a flammable liquid and vapor. May cause eye, skin, and respiratory irritation. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

Precautionary measures:

- a. Sufficient cutting fluid shall be used to rapidly quench sparks during grinding operations.
- b. External surfaces of machines shall be kept cleaned of titanium dust.
- c. Titanium dust shall not be allowed to accumulate in the work area.

d. Open flame or spark producing operations shall not be allowed in area containing titanium dust or chips.

e. Dry extinguishing powder shall be readily available in the area in which the grinding is being done, and shall be used to extinguish titanium fires.

Titanium shall be ground only with machines equipped with controllable speed and coolant flow regulator. Use silicon carbide wheels to grind titanium. Wheels shall be kept sharp by redressing to prevent load up and the discoloration, smearing or glazing of the metal surface.

NOTE

Peripheral speed (S.F.M.) may be determined using the following formula:
$$(.26) \times \text{grinding wheel diameter} \times \text{tool R.P.M.} = (\text{S.F.M.})$$

Surface grinding shall be done with a J grade wheel at 2500 S.F.M. with a minimum work speed of 40 feet per minute. Rough grinding shall remove a maximum of 0.001 inch per pass. Finish grinding shall consist of three passes removing 0.0005 inch per pass plus a minimum of two passes removing 0.00025 inch per pass. Edge grinding shall be done with an N grade wheel at 3000 S.F.M. with a minimum work speed of 40 feet per minute. Rough grinding shall remove a maximum of 0.001 inch per pass. Finish grinding shall consist of a minimum of four passes removing 0.0005 inch per pass. A yellow to golden straw discoloration is normal when grinding titanium and is acceptable. A blue or bluish purple with gold discoloration indicates an overheat condition. If the blue or bluish purple with gold discoloration cannot be removed with solvent, wipe, DS-108F, the part shall be replaced.

3-28. **DRILLING AND REAMING.** See figure 3-17. Standard high speed steel drills will do satisfactorily in drilling titanium if the drills are sharp, sufficient force is applied, and a low speed motor is used. A dull drill, or if the drill is allowed to ride in a partially drilled hole, will cause an overheat condition and make further drilling extremely difficult. If an overheat condition occurs, indicated by a blue or bluish purple with gold discoloration cannot be removed with solvent, wipe, DS-108F, the part shall be replaced. It is recommended that carbide or 8-percent cobalt drills, reamers or countersinks be used when working titanium. See figure for drill shapes and speeds to be used for drilling titanium.

Drills and reamers shall be rotating when withdrawn from the hole to prevent scoring the sides of the hole. Reamers shall be used at one-half the drill speed.

3-29. FORMING OF TITANIUM. Forming of titanium falls into three classes:

- a. Moderate cold forming with no stress relief
- b. Severe cold forming stress relief
- c. Elevated temperature forming (built in stress relief)

3-30. Cold Forming. Dimpled sheets, parts with bends less than 15 degrees, roll formed or bent parts with radii greater than 15 times the thickness of the metal, and parts lined up with less than one percent permanent set do not require stress relieving or annealing.

3-31. Hot Processing. If titanium is formed more severely than indicated in paragraph 3-30, one or more of the heat processes below must be used.

- a. Forming (initial or final) in heated tools such as creep form blocks or from pre-heated sheet.
- b. Bulk stress relieving in a furnace after forming.
- c. Annealing after a partial forming operation to remove the effects of work hardening and thereby aid finish forming. All of these operations, by relieving internal strains, counteract the tendency to crack or to creep back toward the original shape of the sheet. For all three operations, the parts must be cleaned and covered with a protective coating to prevent oxidation when the parts are heated. When

all operations are completed, the parts are pickle cleaned. The requirements for furnaces are the same for all three operations.

3-32. Elevated Temperature Forming. The forming of titanium at elevated temperatures is advantageous because it is possible to produce smaller bend radii, less spring back, and increased elongation. The paragraphs below cover the requirements and procedures for forming titanium and titanium alloy material at elevated temperatures.

3-33. Dies and Joggle Blocks. In order to get the desired shape, dies and joggle blocks may be used. Requirements of paragraph 3-21 will apply, except only steel or ferrous metals will be used. Joggle blocks, dies, and bend radius bars used in bending titanium shall not be allowed to become coated or covered with any form of iron oxide in the form of rust or heavy scale. A light, tightly adhering film or discoloration on ferrous material shall not be considered as harmful.

3-34. Stress Relieving and Annealing. Parts must be stress relieved if either cold forming is more severe than allowed in paragraph 3-30 or the hot forming temperatures fall above those specified in tables 3-1 and 3-2. Stress relieving shall be done within 24 hours after the final forming operation and before the part is installed on the aircraft. Annealing is used on parts which are formed to several different steps. This annealing process restores the metal to its softest and most workable condition allowing the forming operation to continue without damage to the material. Stress relieving is used on finished formed parts to remove any internal stresses in the metal caused by the forming operation.

Table 3-1. Stress Relief

Material Specification	Material	Temperature Degree Fahrenheit	Time At Temperature	Cooling Rate
MIL-T-9046, Type II, Composition B, Annealed	Unalloyed Titanium	950 to 1000	1/2 to 1 hour	Air cool to room temperature
MIL-T-9046, Type III, Composition C, Annealed	Ti-6Al-4V	1075 to 1125	1 to 2 hours	Air cool to room temperature
		1150 to 1300	1/2 to 1 hour	

CSTO SR1F-15SA-3-1**Table 3-1. Stress Relief (CONT)**

Material Specification	Material	Temperature Degree Fahrenheit	Time At Temperature	Cooling Rate
MIL-T-9047, Type I, Composition A	Unalloyed Titanium	950 to 1000	1/2 to 1 hour	Air cool to room temperature
MIL-T-9047, Type III, Composition C, Annealed	Ti-6Al-6V-2Sn	1075 to 1125	1/2 to 2 hours	Air cool to room temperature
AMS4928	Ti-6Al-4V	1075 to 1125	1 to 2 hours	Air cool to room temperature
		1150 to 1300	1/2 to 1 hour	
MMS1203	Ti-6Al-6V-2Sn	1075 to 1125	1/2 to 2 hours	Air cool to room temperature

Table 3-2. Annealing

Material Specification	Material	Temperature Degree Fahrenheit	Time At Cooling Rate	Temperature
MIL-T-9046, Type I, Composition B, Annealed	Unalloyed Titanium	1000 to 1300	Air cool to room temperature	1/2 to 1 hour
MIL-T-9046, Type III, Composition C, Annealed	Ti-6Al-4V (Sheet, Plate up to 5/8-inch thick)	1300 to 1450	Air cool to room temperature	1 to 2 hours
MIL-T-9047, Type I, Composition A	Unalloyed	1000 to 1300	Air cool to room temperature	1/2 to 1 hour
MIL-T-9047, Type III, Composition C, Annealed	Ti-6Al-6V-2Sn	1300 to 1450	Furnace cool to 1000 degrees Fahrenheit max at a rate not greater than 300 degrees Fahrenheit per hour. Air cool to room temperature	1 to 2 hours
AMS4928	Ti-6Al-4V	1300 to 1450	Air cool to room temperature	1 to 2 hours

Table 3-2. Annealing (CONT)

Material Specification	Material	Temperature Degree Fahrenheit	Temperature	Time At Cooling Rate
MMS1203	Ti-6Al-6V-2Sn	1300 to 1450	1 to 2 hours	Furnace cool to 1000 degrees Fahrenheit max at a rate not greater than 300 degrees Fahrenheit per hour. Air cool to room temperature

3-35. **Cleaning and Oxidation Protection.** Before the parts are placed in hot dies or the furnace they must be protected by an anti-oxidant coating. This protective coating aids final cleaning and reduces the metal loss due to surface scaling. Clean the surface with solvent or vapor degrease to remove all oil, grease, identification marking, oxides, fingerprints, and other surface contamination. Spray the surface with one coat of Turco No. 4367 and allow to dry for 10 minutes before handling. The coating shall be a smooth continuous film and reasonably free of surface irregularities.

WARNING

Forced or compressed air shall not be blown in a direct stream on titanium because of possibility of sparking. This sparking is caused by minute particles of dirt striking the surface at a high velocity.

3-36. **Heating.** Furnaces shall be electrically heated, or shall be muffle type if fuel fired, to prevent direct contact between the titanium and any products of combustion. The use of any controlled atmosphere containing carbon or hydrogen, or any compound thereof, is prohibited. Any furnace used shall be capable of maintaining a uniform temperature within ± 25 degrees Fahrenheit of the required temperature. When the parts are heated they shall be supported in the furnace by clean, dry firebrick or other ceramic material, or by some ferrous material, provided supports are free from iron oxide in the form of rust or heavy scale. A light, tightly adhering film or discoloration on ferrous materials shall not be considered as harmful. The forming temperature range for furnace

heating and the maximum time at that temperature shall be as shown in table 3-3. Heating temperatures shall be kept as low as possible, depending on the amount of forming required, since an excessively high temperature will cause surface scaling and contamination. The time limits for the various temperatures shown in the table may be cumulatively proportioned. For example: A part made of AMS4901 material has been heated to 900 degrees Fahrenheit for 4 hours and then it is desired to heat it to a higher temperature for final forming. Since only 1 hour 20 minutes of the permitted time at the 800 to 1150 degrees Fahrenheit range was used, 7 hours and 40 minutes of the exposure time remains. Therefore, it would be permissible to heat to a temperature from 800 to 1150 degrees Fahrenheit for 7 hours and 40 minutes. The time at temperature shall be the total accumulative time the part is in the furnace. After forming, allow the part to air cool before doing the final stress relieving.

Table 3-3. Forming Temperature and Time Limits

Material	Condition	Forming Temperature Degrees Fahrenheit	Total Accumulated Time At Temperature
Unalloyed Ti	Annealed	950 to 1200	4 Hours
Ti-6Al-4V	Annealed	1200 to 1425	4 Hours
Ti-6Al-6V-2Sn	Annealed	1 → 1200 to 1350	4 Hours

1 → A beta stabilization heat treatment shall be done on all parts which are air cooled from the forming temperature. The beta stabilization is an after operation to forming and shall be made up of heating to 1050 to 1150 degrees Fahrenheit, holding at temperature for 1 to 2 hours followed by an air cool to room temperature. The beta stabilization treatment is not required when parts are furnace cooled to below 900 degrees Fahrenheit from the forming temperature.

WARNING

The acids in the pickling solution will cause serious injury if not handled properly. Wear acid resistant gloves, protective face shield, and approved protective clothing. If acid contacts the skin or eyes, flush the affected area immediately with water. Report to the medical facility if the eyes are affected or the skin is burned.

3-37. **Cleaning of Completed Parts.** During the annealing and stress relieving operation a certain amount of scale and contamination will form on the surface of the titanium part. This scale and contamination can be removed after the part has been cleaned with an alkaline cleaner by one of two processes depending on the temperature at which the surface scale was formed. If the scale was formed at a temperature below 1000 degrees Fahrenheit, it can be removed by soaking the part up to 10 minutes in a nitric-hydrofluoric pickle solution at a temperature of 130 to 140 degrees Fahrenheit. This nitric-hydrofluoric pickle solution is made up of:

Nitric acid

Nitric acid (40 degrees Be')	27 to 32 percent by volume
Hydrofluoric acid (70 percent)	1.6 to 2.5 percent by volume
Tap water	remainder by volume

WARNING

Scale removing compound, Turco 4316L, causes eye and skin burns. May be fatal if inhaled, absorbed through skin or swallowed. May cause eye, skin, and respiratory irritation. Do not breathe dust (vapor, mist, gas). Do not get in eyes, on skin or on clothing. Use only with adequate ventilation. Keep container closed. Wash thoroughly after handling.

If scale was formed at a temperature above 1000 degrees Fahrenheit, it can be removed by soaking the part for a 1/2-hour in a Turco 4316L solution followed by a 2 to 5 minute immersion in the nitric-hydrofluoric preserve solution at a temperature of 130 to 140 degrees Fahrenheit.

The Turco 4316L solution is made up of:

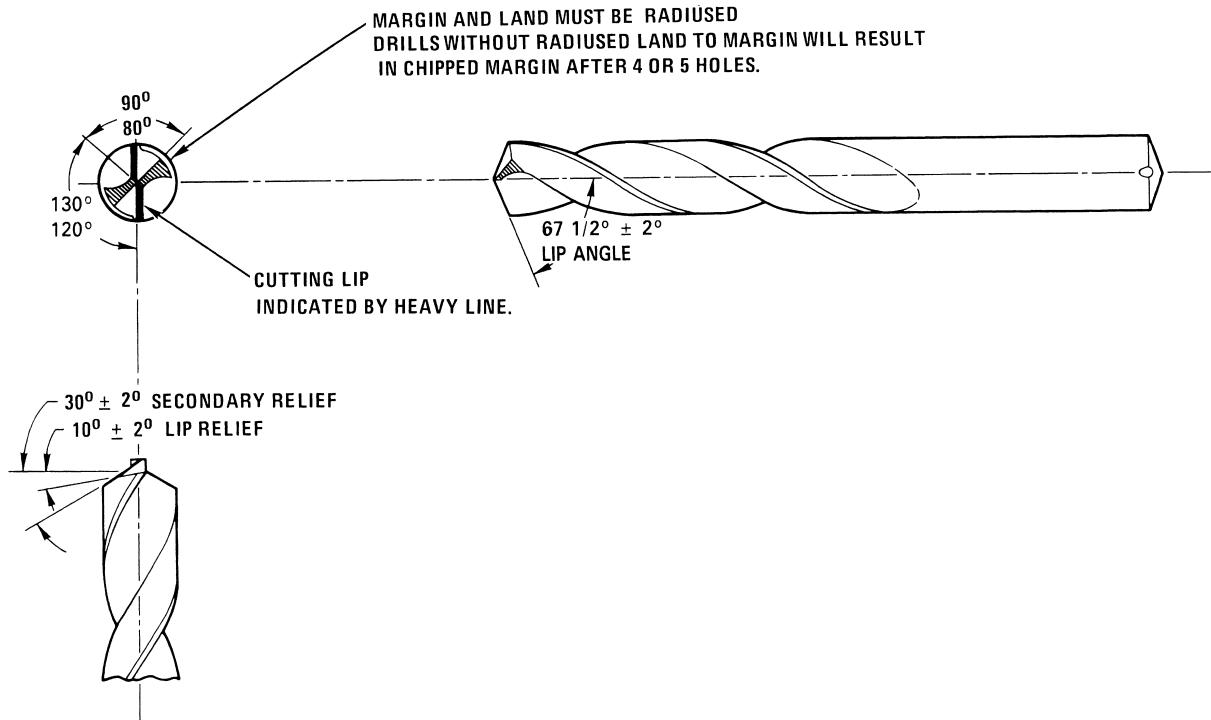
Turco 4316L	6.4 to 8.3 pounds
Tap water	1 gallon

Removal of the surface scale and contamination may be aided by scrubbing the surface with a wire brush and reimmersing.

After the parts have been cleaned by using one of

the solutions, give the parts a final rinse in cold running water and dry.

3-38. **Inspection.** When any of the limits of cold forming, stress relieving or heating are exceeded, a fluorescent penetrant inspection shall be done on the part. Refer to TO 33B-1-1.



DRILL SPEEDS		
DRILL SIZE	HAND DRILL RPM	MACHINE DRILL RPM
NO. 60 TO NO. 40	2000	
NO. 39 TO NO. 30	1000	750
NO. 29 TO NO. 21	1000	600
NO. 20 TO NO. 10	750	500
NO. 9 TO E	500	300
F TO 5/16	250	300
0 TO 3/8	250	200
V TO 1/2		150

LEGEND

- 1 → HAND DRILLING OF HOLES
LARGER THAN 0.1875 INCH DIAMETER
IS NOT RECOMMENDED WITHOUT
DRILLING AIDS.

SAN301-03-20-001

Figure 3-17. Drills for Titanium

3-39. SHOP PROCEDURES.

3-40. General requirements to accomplish any repair or replacement of structure are to pick up existing hole pattern and establish trim lines. The paragraphs below will outline the procedures to use during these operations.

3-41. **LOCATING BLIND HOLES.** See figure 3-18. There are four methods of locating blind holes. The hole finder, measuring and scaling, and blind hole transfer punch method which are shown in figure and the flat part hole transfer method is in paragraph 3-45. As a general guide, parts that are relatively flat, such as replacement skins and one piece doors, can most accurately have the holes located using a hole finder, blind hole transfer punches or the part hole transfer method. Parts that are more rigid, such as extruded shapes, parts with compound curved surfaces, and built-up assemblies can have the holes most accurately located by using the measuring and scaling method. A more detailed explanation of each method is outlined in paragraphs below.

3-42. **Hole Finder Method.** See figure 3-18. The hole finder may be made of various material and of special shapes and sizes to fit a particular job. 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 recommended that when a large number of holes are to be drilled, a prefabricated tool or one made of steel with a steel drill bushing be used. Locating blind holes in a part using the hole finder method may be done as listed below:

- a. Place the new part in position.
- b. Install fasteners in all existing full size holes. If the part has no holes or has only pilot holes (undersize holes), tape the part in place.
- c. Using the hole finder, inspect the location of all existing pilot holes in relation to the existing holes in the structure before bringing them up to their final size.
- d. Remove part from structure and drill several holes to size.
- e. Reinstall part with temporary fasteners. Locate and pilot drill remaining holes.



Be careful when bringing holes up to their final size to eliminate the hole being drilled off center. Several intermediate size drills should be used before the hole is brought up to its final size. Visual inspections of hole alignment should be made as the drilling progresses.

- f. Remove part from structure and drill holes to final size.
- g. Deburr holes.

3-43. **Measuring and Scaling Method.** See figure 3-18. With the measuring and scaling method, blind holes are located by either measuring a predetermined amount along a line passing through the center of the existing hole, or by locating the intersecting point of two lines passing through the center of the hole. Locating blind holes in a part using the measuring and scaling method may be done as listed below:

- a. Draw a line through the center of the existing hole in the structure and mark off a measured distance on the line from the centerline of the hole, or draw two lines intersecting at the center of the hole.
- b. Place the new part in position.
- c. Install fasteners in all existing full size holes. If the part has no holes or has only pilot holes (undersize holes) tape the part in place.
- d. Inspect the location of all existing pilot holes in relation to the existing holes in the structure by placing a scale or straight edge along the uncovered part of the line and project the lines on the new portion. Mark the measured distance along the projected line or extend the two lines until they intersect. If there are no full size holes in the part, adjust the new part so that as many of the pilot holes as possible are located in the center of the existing holes in the structure.
- e. On parts that have no holes, place a scale or straightedge along the uncovered portion of the lines of several holes and project the lines

on the new part. Mark the measured distance along the projected line or extend the two lines until they intersect.

- f. Center punch the intersection mark and pilot drill holes.
- g. Remove part from structure and drill holes to size.
- h. Reinstall part with temporary fasteners. Locate and pilot drill remaining holes.



Be careful when bringing holes up to their final size to eliminate the hole being drilled off center. Several intermediate size drills should be used before the hole is brought up to its final size. Visual inspections of hole alignment should be made as the drilling progresses.

- i. Remove part from structure and drill holes to final size.
- j. Deburr holes.

3-44. Blind Hole Transfer Punches. See figure 3-18. Blind hole transfer punches provide an accurate method of locating blind holes in a part. Locating blind holes in a part using the blind hole transfer punch method may be done as listed below:

- a. Determine hole sizes in part.
- b. Select applicable size blind hole transfer punch from table on figure.
- c. Insert transfer punches in selected holes.
- d. Place new part in position, lightly tap part over each transfer punch.



Be careful when bringing holes up to their final size to eliminate the hole being drilled off center. Several intermediate size drills should be used before the hole is brought up to its final size. Visual inspections of hole alignment should be made as the drilling progresses.

- e. Remove part from structure and drill holes to final size.
- f. Deburr holes.

3-45. Flat Part Hole Transfer Method. With the flat part hole transfer method, the part being replaced may be used as a template to locate new holes on the new part if the part is relatively flat and has no stiffeners or other structure that would interfere with nesting the parts together. The fastener holes in the old part must also be within tolerance to use this method.

- a. Nest the new and old parts together. Be sure that the new part is located properly on the old part. Clamp the parts together.
- b. Drill several holes to size using drill bushings inserted into holes in old part. Enlarge holes to final size.
- c. Trial fit new part to make sure holes and part are located properly.
- d. Repeat step a. using full size holes to establish correct alignment.
- e. Drill remainder of holes per step b.

3-46. TRIMMING. See figure 3-19. Excess material on repairs and/or spares requires trimming. Two methods of locating trim lines are shown in figure. Either the skin scribe or the tape method may be used to accurately locate trim lines for oversize cover plates, skin panels, doors, and so forth. The skin scribe method is equally useful for making the trim lines of irregular as well as straight lined flush patches, cover plates, skin panels, and doors. The tape method is best used on rectangular or straight edge openings. Regardless of the method used in trimming the parts, consideration must always be given as to mismatch and gap between parts. Refer to section I of this manual for the contour

smoothness requirements. A more detailed explanation of each method is outlined in the paragraphs below.

3-47. Skin Scribe Method. See figure 3-19. The skin scribe may be 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. The turned down tip on the lower strap is bent as sharply as possible and rounded to about a 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 edge is located even with inner edge of the guide to allow for minimum allowable gap. Locating trim lines for parts using the skin scribe method may be done as listed below:

- a. File the edges of the opening to be matched and the edges of the oversize part to remove all burrs.
- b. Put the oversize part over the opening and align any existing holes in the part with their mating holes in the structure. Install fasteners in several existing full size holes. If the part contains only pilot holes (undersize holes) or no holes, tape or hold the part firmly in place.
- c. Loosen one untrimmed edge and insert the skin scribe.
- d. Move the scribe back and forth along the edge of the opening until a visible scribe line is produced on the top surface of the oversize part.
- e. Secure the fasteners or tape along the marked edge and proceed to the next edge. Repeat this procedure for each untrimmed edge.
- f. Remove part and trim edges.

3-48. Tape Method. See figure 3-19. Locating trim lines for oversize parts, where there is no access to the back side for marking, may be done with masking tape as listed below:

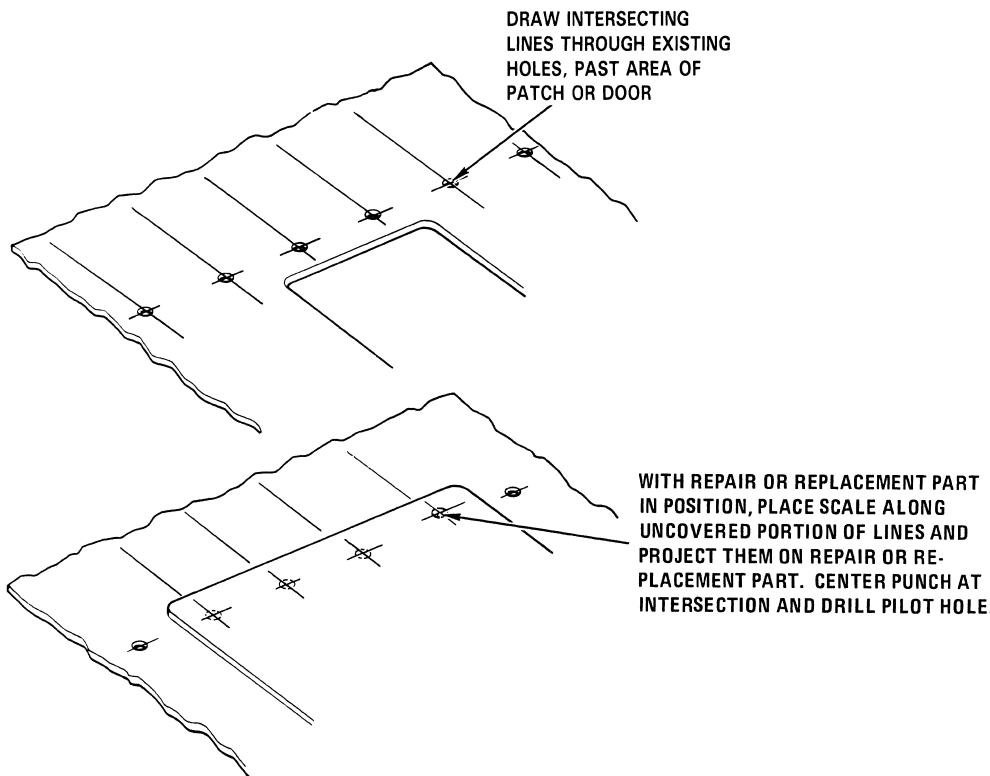
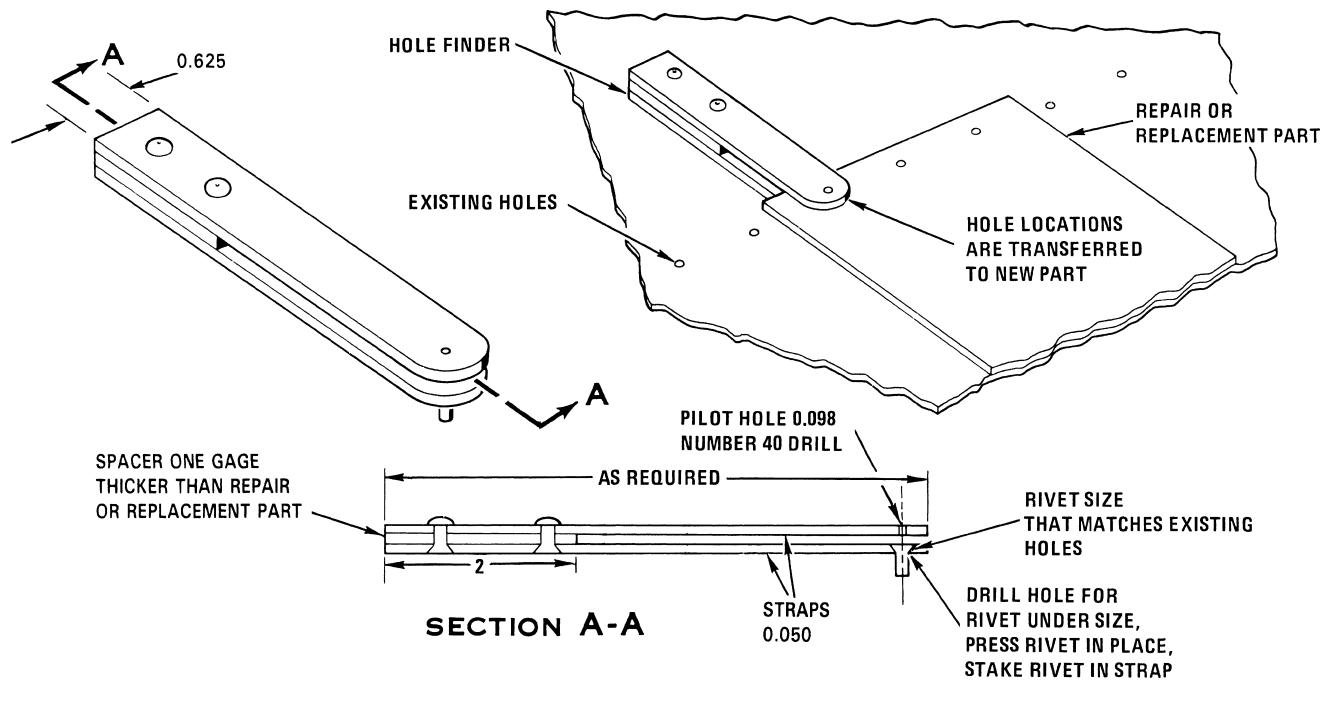
- a. File the edges of the opening to be matched and the edges of the oversize part to remove all burrs.
- b. Align strips of masking tape along the edges of the opening to form a frame.
- c. Put the oversize part over the opening and align any existing holes in the part with their mating holes in the structure. Install fasteners in as many of the full size holes as possible. If the part contains only pilot holes (undersize holes) or no holes, tape or hold the part in place.
- d. Carefully align the outer edge of a second strip of tape with the outer edge of the first strip of tape and pull it tightly up over the oversize edge of the part.

NOTE

When the replacement part is thick, the inner edge of the second tape will fall a little short of matching the edges of the cutout causing the new part to be a little large. Compensation for this mismatch can be made when marking the edges.

- e. Mark the inside edge of the second tape.
- f. Remove part and trim edges.

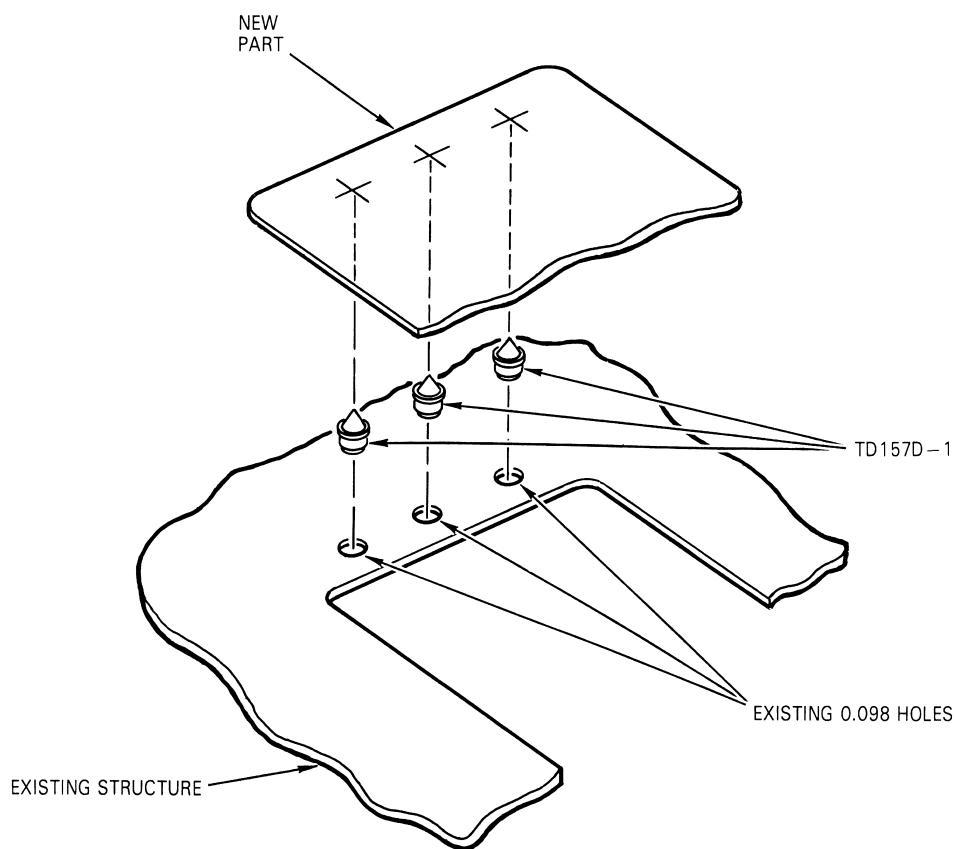
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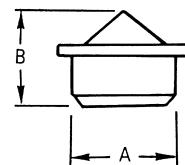
MEASURING AND SCALING METHOD

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Figure 3-18. Locating Blind Holes (Sheet 1 of 2)



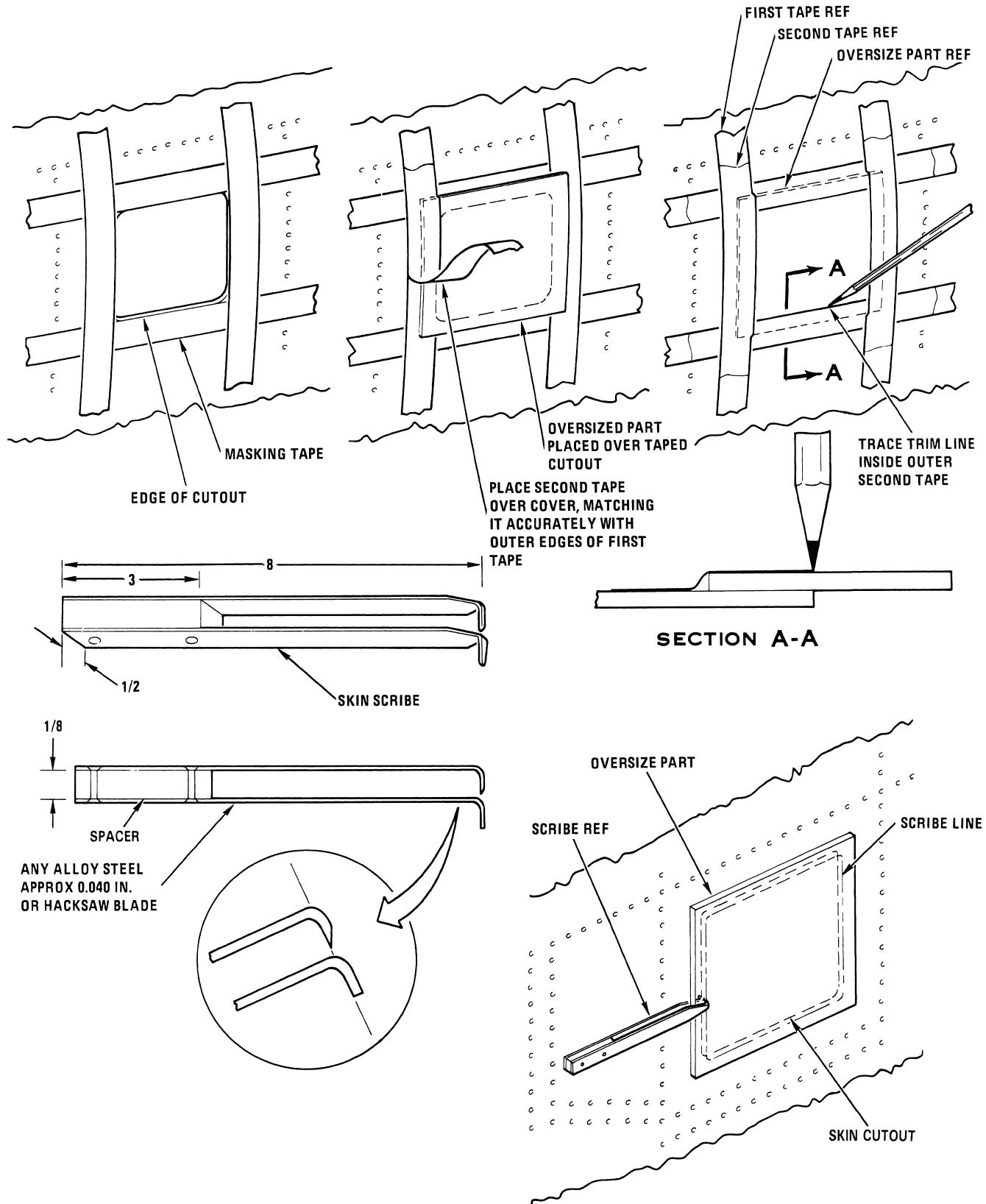
TOOL NO.	A	B
TD157D-1	0.096	0.315
TD157D-2	0.1265	0.315
TD157D-3	0.157	0.315
TD157D-4	0.1915	0.315
TD157D-5	0.250	0.315
TD157D-6	0.312	0.315
TD157D-19	0.496	0.563
TD157D-23	0.165	0.315



BLIND HOLE TRANSFER PUNCH METHOD

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Figure 3-18. Locating Blind Holes (Sheet 2)



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Figure 3-19. Locating Trim Lines

3-49. FASTENERS.

3-50. Fasteners are used to join parts together. The fasteners may be of several types: solid one piece rivets, pin and collar, blind fasteners, and threaded fasteners. Solid fasteners have a manufactured head on one end and, when the rivet is inserted through the parts being joined, the shank end is mushroomed to form a second head. Pin and collar fasteners have a head at one end and locking grooves around the other end. The collar is swaged on to the locking grooves of the pin giving a locking and clamping affect. Blind fasteners are used when access to only one side of the work is possible. The blind fasteners are locked into position by expanding their shank and forming a friction lock. Threaded fasteners are held in place by nuts or by gang channel and are used for high strength and when ease of disassembly is required. All fasteners shall be installed in accordance with the approved practices outlined in this manual. When installing fasteners, only the approved equipment shall be used.

3-51. **SOLID RIVETS.** Solid or one piece rivets are the most common type fastener used in the assembly of the aircraft. When driven, the shank swells to fill the fastener hole and a flat collar shop head is formed. Solid rivets are available in either the protruding or flush 100 degree countersunk head styles. When making a repair it is important to select the correct rivet to maintain structural integrity.

3-52. **Identification.** See figure 3-20. Each rivet can be identified with respect to head style, type of material from which the rivet is made, and its size. Markings on the head of the rivet indicate the type of material from which the rivet is made. Figure shows the style of rivet head with its basic code number for corresponding materials, its material code, and its identifying head markings. The size of the rivet is measured in 1/32-inch increments for the diameter and 1/16-inch increments for the length.

3-53. Requirements.

a. The minimum permissible space between rivets shall be three rivet diameters for protruding head rivets and three and one half rivet diameters for flush head rivets.

b. When driving corrosion-resistant steel or Monel rivets, the hole size shall be kept to the minimum size for the diameter rivet to be installed.

c. When rivets are installed on a sloping surface, the shop head will be formed on the sloping surface, except no rivet will be installed when the sloping surface is greater than the limits below:

Rivet Diameter	Maximum Degree of Angle
3/32	30
1/8	20
5/32	20
3/16	15
1/4	10
5/16	5

d. Hole sizes for solid rivets are:

Rivet Diameter	Hole Diameter
1/16	0.067 to 0.071
3/32	0.098 to 0.106
1/8	0.128 to 0.134
5/32	0.159 to 0.166
3/16	0.191 to 0.198
1/4	0.257 to 0.262
5/16	0.323 to 0.330
3/8	0.386 to 0.393

e. Oversize holes shall be corrected by the use of one size larger rivet with the below restrictions:

1. No more than 10 percent of the rivets in the pattern shall be affected.
2. Minimum required edge distance and sufficient head clearance for the larger rivet shall be obtainable.
3. The hole shall not have a dimension exceeding the maximum allowable diameter for the next larger size rivet.

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4. See table 3-4 for allowable sheet thickness.

Table 3-4. Minimum Sheet Thickness for Use of Next Diameter Fastener

Fastener	Diameter/ Sheet Thickness	Diameter/ Sheet Thickness	Diameter/ Sheet Thickness	Diameter/ Sheet Thickness
B/P Dia.	3/32	1/8	5/32	3/16
O/S Dia.	1/6	5/32	3/16	7/32
MS20426	0.063	0.080	0.100	0.120
NAS1097 NAS1200	0.050	0.063	0.071	-
ST3M455 ST3M758	-	-	0.071	-
NAS2706 ST3M427 ST3M509	-	0.063	0.071	-
NAS2106 ST3M760	-	-	0.120	-
NAS1674	-	-	0.090	-
NAS1670 NAS1672	-	-	0.110	-
3M1235	-	0.080	0.100	-
NAS1724 ST3M781	-	-	0.071	-

f. When sealing is required, rivets shall be assembled with the specified sealant material.

g. To determine the rivet length, add to the thickness of the material through which the rivet must pass, 1-1/2 times the rivet diameter.

h. The shop formed, or bucked, rivet head shall be equal to one and one half times the rivet diameter and the head height shall be equal to one half the rivet diameter.

3-54. Removal.



Be careful not to enlarge rivet hole when drilling out rivet.

- a. Drill out rivet from the manufactured head side.
- b. Center punch rivet head before drilling. For thin material, back up rivet bucked head side before center punching to avoid damaging surrounding metal.
- c. Select drill one size smaller than rivet shank.
- d. Set drill on center punch mark on head of rivet and rotate the drill bit by hand a few revolutions to start a cutting spot on the rivet head.
- e. Drill rivet to the depth of the rivet head.
- f. If rivet head does not come loose, insert a drift punch into the hole and twist slightly to either side until head comes off or shear the head with a sharp chisel.
- g. Drive rivet shank out with a drift punch slightly smaller than the rivet shank. On thin metal, support the thin sheet while driving out the rivet shank.



Be careful not to elongate or damage the dimple or countersunk hole.

- h. If rivet shank is exceptionally tight, drill the shank about two thirds of the way through the

thickness of the material, then drive out the remainder of the rivet shank.

3-55. Installation.

- a. Parts to be joined shall be secured firmly into position to prevent slipping during the riveting operations.
- b. Select correct size rivet for thickness of material to be joined.
- c. Select rivet set for type rivet to be installed.
- d. Install rivet using one of the methods below:
1. Pneumatic. Pneumatic rivet guns used with a separate bucking bar is the most common and most satisfactory method of riveting. These guns are provided with interchangeable rivet sets in numerous sizes and shapes to fit the type and location of the rivet. The correct set is inserted in the gun and applied to the head of the rivet. Pressure is applied in a series of rapid strokes and the shank end is upset against the bucking bar. The gun and bucking bar must be held at right angles to the work at all times, and sufficient pressure exerted to keep the tool from jumping off the rivet. Excessive pressure should be avoided because it may result in dented surfaces.
2. Squeeze Riveters. Squeeze riveters and their use are limited and can be used only over the edge of sheets. The two types of riveters, hand and pneumatic, are basically the same, the difference being in the actuating power. One jaw of the squeezer is stationary and is placed against the manufactured head, while the movable jaw upsets the shank. However, during some operations it may be required to reverse the sets, placing the manufactured head set on the movable jaw.
3. Hand Riveting. Hand riveting should be done only when power riveting is impossible because of lack of facilities or inaccessibility to the work area. Hand riveting is generally done by driving from the head end and bucking the shank, or by driving from the shank end and bucking the head with a rivet set attached to a bucking bar. A 12 to 16 ounce ballpeen hammer is heavy enough to drive most rivets. The bucking bar and rivet

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set must be held square to the work. For best results, use as few hammer strokes as possible.

- e. Inspect rivet after installation per paragraph 3-56.

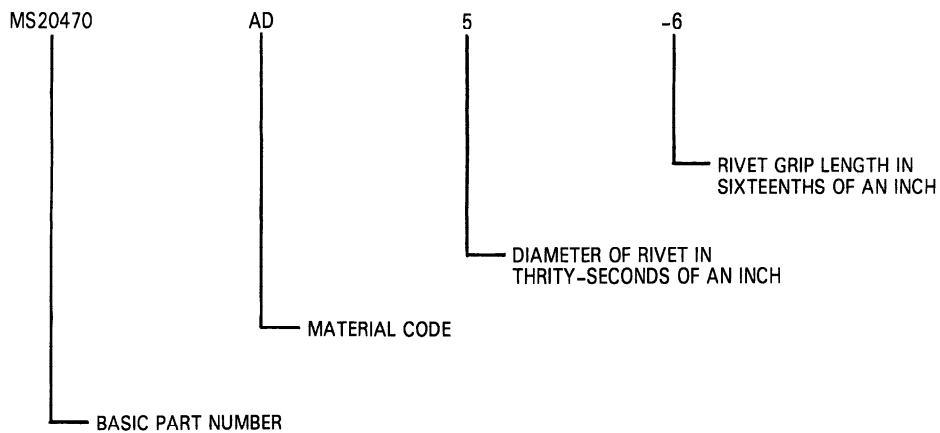
3-56. **Inspection.** See figure 3-21. The manufactured head and shop head shall be inspected for correct installation. See figure for acceptable limits for installed rivets. Also inspect the parts being joined for correct clamp up after riveting.

RIVET STYLE	BASIC NUMBER	MATERIAL	MATERIAL CODE	HEAD MARKING	TEMPERATURE LIMITATION
100 DEGREE COUNTER SINK	3M268	5056 ALUMINUM ALLOY	B	(+) RAISED CROSS	250°
		2117 ALUMINUM ALLOY	AD	(○) DIMPLE	250°
	MS20426	5056 ALUMINUM ALLOY	B	(+) RAISED CROSS	250°
		2117 ALUMINUM ALLOY	AD	(○) DIMPLE	250°
		7050 ALUMINUM ALLOY	E	(◎) RAISED RING	250°
		45Cb TITANIUM COLUMBIAN ALLOY	T	(◇) DIAMOND INDENTED	600°
		STEEL HIGH TEMPERATURE CORROSION RESISTANT	A-286	(○) ONE RAISED TEAT	1200°
	NAS1200	MONEL	M	(○○) TWO RAISED OR RECESSED MARKS	800°
100 DEGREE FLUSH SHEAR HEAD	NAS1097	5056 ALUMINUM ALLOY	B	(+) RAISED CROSS	250°
		2117 ALUMINUM ALLOY	AD	(○) DIMPLE	250°
		7050 ALUMINUM ALLOY	KE	(◎) RAISED CIRCLE	250°
		45Cb TITANIUM COLUMBIAN ALLOY	T	(◇) DIAMOND IDENTED	600°
	MS20470	5056 ALUMINUM ALLOY	B	(+) RAISED CROSS	250°
		2117 ALUMINUM ALLOY	AD	(○) DIMPLE	250°
		7050 ALUMINUM ALLOY	E	(◎) RAISED RING	250°
		45Cb TITANIUM COLUMBIAN ALLOY	U	(◇) RAISED DIAMOND	600°
		MONEL	M	(○○) TWO DIMPLES	900°

Figure 3-20. Solid Fastener Identification (Sheet 1 of 2)

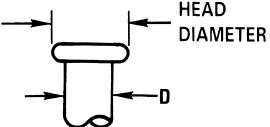
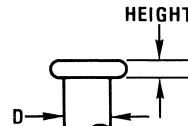
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RIVET STYLE	BASIC NUMBER	MATERIAL	MATERIAL CODE	HEAD MARKING	TEMPERATURE LIMITATION
UNIVERSAL HEAD	NAS1198	STEEL HIGH TEMPERATURE CORROSION-RESISTANT	A-286	ONE RAISED TEAT	1200°



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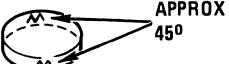
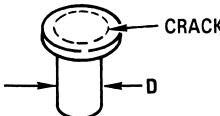
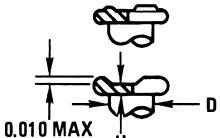
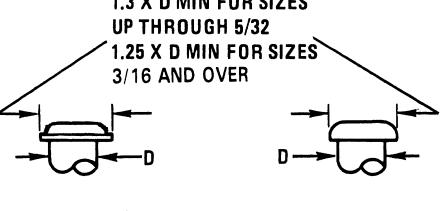
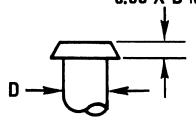
Figure 3-20. Solid Fastener Identification (Sheet 2)

CONDITION	ACCEPTANCE LIMIT					
DRIVEN HEAD DIAMETER	RIVET SIZE	DIAMETER MAX 1.66D	DIAMETER MIN 1.3D	RIVET SIZE	DIAMETER MAX 1.66D	DIAMETER MIN 1.25D
	1/16	0.103	0.081	3/16	0.312	0.235
	3/32	0.156	0.122	1/4	0.423	0.312
	1/8	0.203	0.163	5/16	0.515	0.390
	5/32	0.264	0.203	3/8	0.625	0.470
DRIVEN HEAD HEIGHT	RIVET SIZE	HEIGHT MAX 0.66D	HEIGHT MIN 0.4D	RIVET SIZE	HEIGHT MAX 0.66D	HEIGHT MIN 0.4D
	1/16	0.041	0.025	3/16	0.125	0.075
	3/32	0.062	0.038	1/4	0.172	0.100
	1/8	0.078	0.050	5/16	0.203	0.125
	5/32	0.109	0.062	3/8	0.250	0.150
BEVELED DRIVEN HEAD	<p>A. THE AVERAGE OF THE MINIMUM AND THE MAXIMUM HEAD HEIGHTS SHALL NOT BE LESS THAN 0.4 X D.</p> <p>B. THE MINIMUM HEAD HEIGHT AT ANY POINT SHALL BE 0.25 X D. THE MAXIMUM 0.75 X D.</p>					
OFFSET DRIVEN HEAD	THE HEAD MAY BE TANGENT TO THE SHANK EXCEPT THAT NO PORTION OF THE HOLE, THE DEBURRED SURFACE OR THE BELLMOUTH OF THE DIMPLE SHALL BE VISIBLE.					
STEPPED DRIVEN HEAD	<p>A. MINIMUM THICKNESS SHALL BE 0.4 X D.</p> <p>B. HEAD IS ACCEPTABLE WITH HIGH PART REMOVED.</p>					
BELL DRIVEN HEAD	RIVET IS INCOMPLETELY DRIVEN AND DOES NOT FILL HOLE. MUST BE REDRIVEN OR REPLACED.					
CONCENTRIC RINGED (OR CUT) MANUFACTURED HEAD	<p>A. IF DIAMETER OF IMPRESSION IS LARGER THAN 1.4 X D, DEPTH IS NOT CAUSE FOR REJECTION.</p> <p>B. EXCEPT IN CASE AS STATED IN (A) ABOVE, DEPTH OF IMPRESSION SHALL NOT EXCEED 0.25H.</p> <p>C. THIS CONDITION, IF OCCURRING MORE THAN OCCASIONALLY, MAY BE CAUSE FOR REJECTION, REGARDLESS OF SEVERITY OF IMPRESSION.</p> <p>D. CUT HEADS WHEREIN ONLY A PORTION OF A CIRCULAR IMPRESSION APPEARS, SHALL ALSO BE GOVERNED BY (A) THRU (C) ABOVE.</p> <p>E. NOT ACCEPTABLE ON FLUSH HEAD RIVETS.</p>					
CRACKED UNIVERSAL HEAD	<p>A. ACCEPTABLE CRACKS ARE APPROXIMATELY RADIAL (VIEWING TOP OF HEAD) NO CRACK SHALL ENTER INTO AN AREA CIRCUMSCRIBED BY A 1.4D CIRCLE.</p> <p>B. TWO OR MORE CRACKS SHALL NOT INTERSECT. THIS FORMS A POTENTIAL CAUSE FOR A PORTION OF THE HEAD TO CHIP OFF.</p> <p>C. FIVE OR MORE CRACKS ARE NOT ACCEPTABLE.</p> <p>D. CRACKS SHALL NOT EXCEED 0.125D IN DEPTH AND 0.063D IN WIDTH.</p>					

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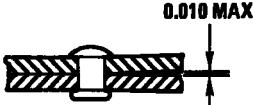
Figure 3-21. Solid Fastener Inspection (Sheet 1 of 4)

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CONDITION	ACCEPTANCE LIMIT																				
 PARALLEL DIAGONAL CRACKS – DRIVEN HEAD	THIS CONDITION IS OFTEN INDICATIVE OF A PARTIAL SHEAR CONDITION ACROSS THE WHOLE HEAD. RIVET IS NOT ACCEPTABLE.																				
 DIAGONAL CRACKS – DRIVEN HEAD	A. ACCEPTABLE CRACKS ARE APPROXIMATELY RADIAL (VIEWING TOP OF HEAD). NO CRACK SHALL EXTEND INTO AN AREA WITH A DIAMETER LESS THAN 1.1D. B. TWO OR MORE CRACKS SHALL NOT INTERSECT. THIS IS A POTENTIAL CAUSE FOR A PORTION OF THE HEAD TO CHIP OFF. C. FIVE OR MORE CRACKS ARE NOT ACCEPTABLE.																				
 PUNCH RING – DRIVEN HEAD	A. PUNCH RINGS EVEN WITH OR ABOVE THE SURFACE OF THE RIVET ARE ACCEPTABLE. B. PUNCH RINGS BELOW THE SURFACE OF THE HEAD FLAT ARE ACCEPTABLE PROVIDED THE DEPTH DOES NOT EXCEED 0.010 AND MINIMUM H IS 0.4 X D.																				
 CONICAL DRIVEN HEAD	ACCEPTABLE AS SHOWN PROVIDED DRIVEN HEAD HEIGHT CONDITIONS ARE MET.																				
 FLATTENED MANUFACTURED HEAD	<table border="1"> <thead> <tr> <th>RIVET SIZE</th> <th>MINIMUM HEIGHT</th> <th>RIVET SIZE</th> <th>MINIMUM HEIGHT</th> </tr> </thead> <tbody> <tr> <td>1/16</td> <td>0.021</td> <td>3/16</td> <td>0.062</td> </tr> <tr> <td>3/32</td> <td>0.031</td> <td>1/4</td> <td>0.083</td> </tr> <tr> <td>1/8</td> <td>0.041</td> <td>5/16</td> <td>0.104</td> </tr> <tr> <td>5/32</td> <td>0.052</td> <td>3/8</td> <td>0.125</td> </tr> </tbody> </table>	RIVET SIZE	MINIMUM HEIGHT	RIVET SIZE	MINIMUM HEIGHT	1/16	0.021	3/16	0.062	3/32	0.031	1/4	0.083	1/8	0.041	5/16	0.104	5/32	0.052	3/8	0.125
RIVET SIZE	MINIMUM HEIGHT	RIVET SIZE	MINIMUM HEIGHT																		
1/16	0.021	3/16	0.062																		
3/32	0.031	1/4	0.083																		
1/8	0.041	5/16	0.104																		
5/32	0.052	3/8	0.125																		
 MISSHAPEN DRIVEN HEAD	ACCEPTABLE IF LIMITS OF MINIMUM HEAD DIAMETER AND MINIMUM HEAD HEIGHT ARE MET.																				
 TILTED MANUFACTURED HEAD	A. UNACCEPTABLE IF 0.002 FEELER CAN BE INSERTED TO SHANK. RESTRIKE TO CORRECT. B. NO TILT ACCEPTABLE ON PRESSURE RETAINING ASSEMBLIES.																				

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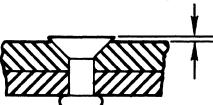
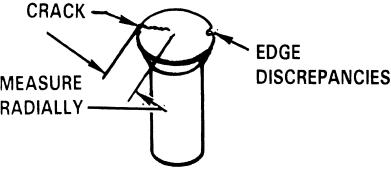
Figure 3-21. Solid Fastener Inspection (Sheet 2)

CONDITION.	ACCEPTANCE LIMIT
	MAY BE CAUSE FOR REJECTION OF THE ASSEMBLY.
CUTS OR DINGS IN SHEET CAUSED BY RIVET SET OR BUCKING BAR	
	MAY BE CAUSE FOR REJECTION.
CUTS OR DINGS IN SHEET CAUSED BY RIVETING EQUIPMENT OR SHAVING EQUIPMENT.	
	PROTRUDING HEAD TYPE RIVETS MAY HAVE DRIVEN HEAD FORMED INTO DIMPLE OR COUNTERSINK. ACCEPTABILITY LIMITS FOR THE DRIVEN HEAD SHALL BE THE SAME AS FOR THE EQUIVALENT MANUFACTURED HEAD (COUNTERSINK TYPE).
ALUMINUM ALLOY RIVETS ONLY DRIVEN HEAD REVERSED	
	A. GAP BETWEEN JOINED SHEETS IS ACCEPTABLE PROVIDED IT IS NOT GREATER THAN 0.008. B. NO GAP PERMISSIBLE ON PRESSURE RETAINING ASSEMBLIES.
GAP BETWEEN SHEETS	
	A GAP OF 0.002 IS ACCEPTABLE FOR A MAXIMUM OF 40 PERCENT OF THE OUTER PERIPHERY (CIRCUMFERENCE) OF THE HEAD OF STRUCTURAL RIVETS. EXCESS PRIMER OR SEALANT MAY BE REMOVED FROM THE HEAD PERIPHERY (CIRCUMFERENCE) FOR THIS INSPECTION. TOUCH UP REMOVED PRIMER OR SEALANT AS REQUIRED. RIVETS ARE UNACCEPTABLE ONLY IF A 0.003 FEELER GAGE CAN BE INSERTED TO THE RIVET SHANK.
NOT ACCEPTABLE	
	NOTES: 1. FLAT EDGES OR ROUNDED EDGES ON RIVET HEAD CREATE A CONDITION WHICH RESEMBLES THE ABOVE; HOWEVER, IF THE RIVET HEAD IS TIGHT AND THE OPENING DOES NOT EXTEND TO SHANK, RIVET IS ACCEPTABLE. 2. THESE LIMITS APPLY TO BOTH MACHINE COUNTERSUNK AND DIMPLED JOINTS.
ACCEPTABLE PARTIALLY OPEN COUNTERSINK	
	RIVET IS ACCEPTABLE PROVIDED NO PART OF HEAD FALLS BELOW FLUSH, MAXIMUM H DOES NOT EXCEED LIMITS OF MANUFACTURED HEAD PROTRUSION, AND DIFFERENTIAL BETWEEN HIGH AND LOW PORTION DOES NOT EXCEED 0.010.
0.000 MAX BELOW FLUSH MACHINE COUNTERSUNK TILTED FLUSH RIVET	
	RIVET IS ACCEPTABLE PROVIDED NO PART OF HEAD FALLS MORE THAN 0.004 BELOW FLUSH, MAXIMUM H DOES NOT EXCEED LIMITS OF MANUFACTURED HEAD PROTRUSION AND DIFFERENTIAL BETWEEN HIGH AND LOW PORTION DOES NOT EXCEED 0.010.
0.004 MAX BELOW FLUSH DIMPLE TILTED FLUSH RIVET	

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Figure 3-21. Solid Fastener Inspection (Sheet 3)

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CONDITION	ACCEPTANCE LIMIT
 MANUFACTURED HEAD RECESION DIMPLED TOP SHEET	RIVET IS NOT ACCEPTABLE IF HEAD FLAT IS MORE THAN 0.004 BELOW SHEET SURFACE (WHERE TOP SHEET IS DIMPLED).
 MANUFACTURED HEAD RECESION COUNTERSUNK TOP SHEET	RIVET IS NOT ACCEPTABLE IF ANY PART OF THE HEAD FLAT IS BELOW SURFACE UNLESS SPECIFICALLY NOTED OTHERWISE ON THE AIRPLANE CONTOUR SMOOTHNESS DRAWING (WHERE TOP SHEET IS COUNTERSUNK).
 MANUFACTURED HEAD PROTRUSION	RIVET IS NOT ACCEPTABLE IF HEAD PROTRUDES MORE THAN 0.004 (H). A MAXIMUM OF 0.006 MAY BE SHAVED FROM A PROTRUDING HEAD TO MEET THIS REQUIREMENT.
 CRACK IN FLUSH RIVET HEAD NAS1097 FASTENERS	ACCEPT: <ol style="list-style-type: none"> 1. MAXIMUM OF ONE RADIAL CRACK WITH A LENGTH NOT EXCEEDING ONE FIFTH (20%) OF THE HEAD DIAMETER. 2. NO CIRCUMFERENTIAL CRACKS ARE PERMITTED. 3. UNLIMITED EDGE DISCREPANCIES PER RIVET AS LONG AS NO DISCREPANCY EXCEEDS ONE TENTH (10%) OF ONE RIVET HEAD DIAMETER. 4. NO MORE THAN 10% OF THE RIVETS OF ANY GIVEN PANEL MAY HAVE CRACKED RIVET HEADS PER CRITERIA 1 ABOVE.

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Figure 3-21. Solid Fastener Inspection (Sheet 4)

3-57. **LOCKBOLTS.** Lockbolts are made up of a grooved pin and a tubular collar which is swaged into the grooves of the Lockbolt pin. The Lockbolts are available in protruding head and 100 degree flush head styles. Two types of Lockbolts are used: stump type driven with standard riveting equipment except for the special sets used for swaging the collars; and pull gun type has a pulling stem which breaks off as the pulling gun pulls the Lockbolt through the material and swages the collar into the locking grooves of the Lockbolt. Lockbolts are available in aluminum alloy, corrosion-resistant steel, and titanium alloy materials. Refer to section VI for oversized repair fastener.

3-58. **Identification.** See figure 3-22. Lockbolts are identified by a basic part number which represents

the type of Lockbolt, nominal diameter and grip length. See figure for basic part numbers and types of Lockbolts. The Lockbolt diameter is measured in increments of 1/32-inch increments, and the grip length is the maximum material thickness the Lockbolt will allow measured in 1/16-inch increments. Thus a NAS2605V05 would be protruding head titanium Lockbolt, the nominal diameter would be 5/32-inch and the maximum grip length would be 5/16-inch. The collars which are swaged into the grooves of the Lockbolts are identified by a basic part number and a dash number which corresponds to the nominal diameter of the Lockbolts. See figure for collar part numbers. Collars are also identified by a color code for different types of materials, see table 3-5.

Table 3-5. Lockbolt Collars

Collar Number	Material	Color	Maximum Temperature
NAS1080MG() NAS1080MK()	Monel	Black	1200 degrees Fahrenheit
NAS1080UG() NAS1080UK()	Steel Alloy A286	Black	900 degrees Fahrenheit
NAS1080AG() NAS1080AT()	Alum Alloy 2219	Violet	425 degrees Fahrenheit

3-59. Requirements.

a. Lockbolt edge distance is measured from the centerline of the Lockbolt to the nearest edge of the part. The recommended minimum edge distance for flush and protruding head Lockbolts is two times the nominal diameter plus 0.060 inch, except where specified differently in a repair procedure or when replacing existing Lockbolts.

b. Spacing for Lockbolts is measured between the centerline of adjacent Lockbolts. The minimum

spacing between protruding head Lockbolts shall not be less than three and one half times the nominal Lockbolt diameter. The minimum spacing between flush head Lockbolts shall not be less than four times the nominal diameter of the flush Lockbolts.

c. For hole sizes for titanium Lockbolts, see table 3-6. For hole sizes for aluminum alloy Lockbolts, see table 3-7.

d. For Lockbolt grip length, see table 3-8.

Table 3-6. Hole Sizes for Titanium Lockbolts

Lockbolt Size	Class I Fit	Class II Fit
5/32	0.1628 to 0.165	0.1635 to 0.1657
3/16	0.1888 to 0.191	0.1895 to 0.1917
1/4	0.2488 to 0.251	0.2495 to 0.2517
5/16	0.3113 to 0.3135	0.3120 to 0.3142
3/8	0.3738 to 0.376	0.3745 to 0.3767

Table 3-7. Hole Sizes for Aluminum Alloy Lockbolts

Lockbolt Size	Class II Fit	Class III Fit
5/32	0.1635 to 0.1657	0.166 to 0.172
3/16	0.1895 to 0.1917	0.191 to 0.197
1/4	0.2495 to 0.2517	0.250 to 0.256
5/16	0.312 to 0.3142	0.312 to 0.319
3/8	0.3745 to 0.3767	0.375 to 0.382

Table 3-8. Lockbolt Grip Length

Dash No.	Grip Length	Material Thickness	
		Shear Head	Tension Head
1	0.062	0.020 to 0.062	0.031 to 0.094
2	0.125	0.063 to 0.125	0.095 to 0.156
3	0.188	0.126 to 0.188	0.157 to 0.219
4	0.250	0.189 to 0.25	0.220 to 0.281
5	0.312	0.251 to 0.312	0.282 to 0.344
6	0.375	0.313 to 0.375	0.345 to 0.406
7	0.438	0.376 to 0.438	0.407 to 0.469
8	0.500	0.439 to 0.50	0.470 to 0.531
9	0.562	0.501 to 0.562	0.532 to 0.594
10	0.625	0.563 to 0.625	0.595 to 0.656

Table 3-8. Lockbolt Grip Length (CONT)

Dash No.	Grip Length	Material Thickness	
		Shear Head	Tension Head
11	0.688	0.626 to 0.688	0.657 to 0.719
12	0.750	0.689 to 0.750	0.720 to 0.781
13	0.812	0.751 to 0.812	0.782 to 0.844
14	0.875	0.813 to 0.875	0.845 to 0.906
15	0.938	0.876 to 0.938	0.907 to 0.969
16	1.000	0.939 to 1.000	0.970 to 1.031
17	1.062	1.001 to 1.062	1.032 to 1.094
18	1.125	1.063 to 1.125	1.095 to 1.156
19	1.188	1.126 to 1.188	1.157 to 1.219
20	1.250	1.189 to 1.250	1.220 to 1.281
21	1.312	1.251 to 1.312	1.282 to 1.344
22	1.375	1.313 to 1.375	1.345 to 1.406
23	1.438	1.376 to 1.438	1.407 to 1.469
24	1.500	1.439 to 1.500	1.470 to 1.531
25	1.562	1.501 to 1.562	1.532 to 1.594
26	1.625	1.563 to 1.625	1.595 to 1.656
27	1.688	1.626 to 1.688	1.657 to 1.719
28	1.750	1.689 to 1.750	1.720 to 1.781
29	1.812	1.751 to 1.812	1.782 to 1.844
30	1.875	1.813 to 1.875	1.845 to 1.906
31	1.938	1.876 to 1.938	1.907 to 1.969
32	2.000	1.939 to 2.000	1.970 to 2.031

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3-60. **Removal.** Lockbolts may be removed by splitting the collar axially with a Lockbolt collar splitter or by splitting collar with a chisel. A special hollow end mill in a drill motor may also be used to remove the collars. After the collar is removed, drive out the Lockbolt with a punch. When removing Lockbolts in thin material, back up the structure to prevent damage before driving out the Lockbolt.

3-61. **Installation.** See figure 3-23.

- a. Parts to be joined shall be secured firmly into position before installing the Lockbolts.
- b. Lockbolt holes should be reamed to the final hole size per table 3-6 and 3-7.
- c. Select the correct diameter and length Lockbolt for thickness of material to be joined.
- d. Lockbolt grip length may be adjusted using a Lockbolt one length longer or shorter or by installing washers under the collar as listed below:
 1. The total washer thickness shall be 0.032 inch.
 2. The maximum number of washers used shall be one, except when 0.016 inch thick washers are used, then two washers may be used.

NOTE

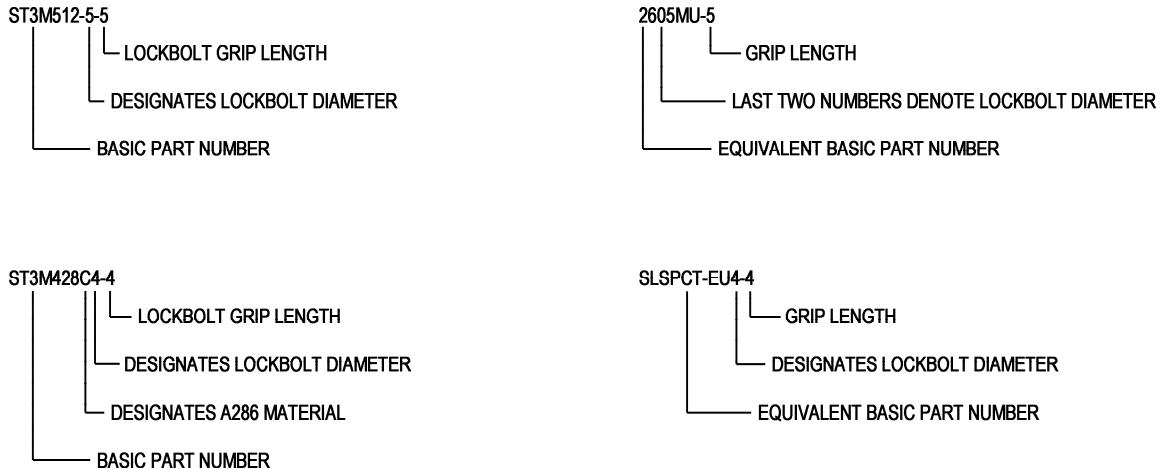
When the collar material is corrosion-resistant steel and the structure on which the washer will seat is aluminum, use aluminum washers.

3. Use only corrosion-resistant steel washers

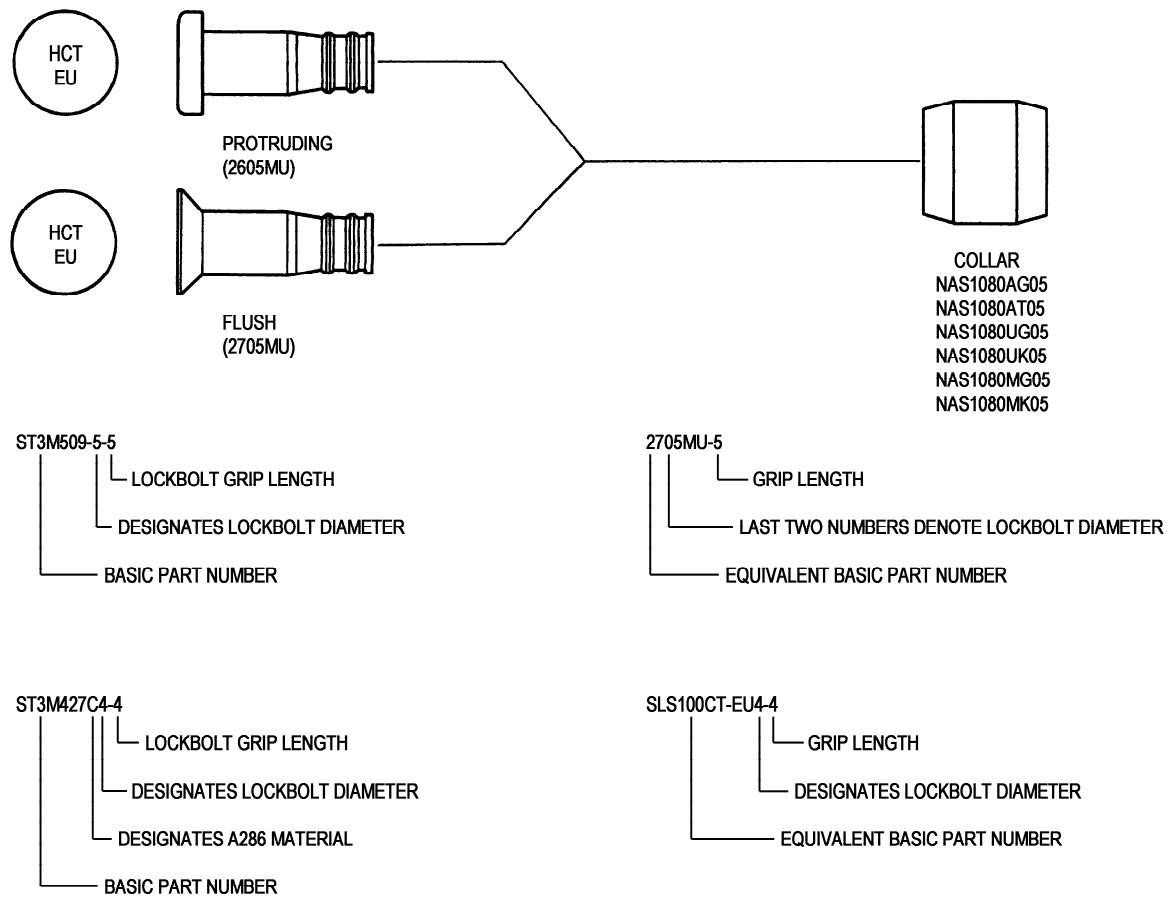
on Lockbolts with corrosion-resistant steel or Monel collars.

- e. Install stump type Lockbolts by using a special Lockbolt collar set in a rivet gun and bucking bar. The set is placed on the collar and the bucking bar placed against the head of the Lockbolt and the collar is swaged to the locking grooves of the Lockbolt.
- f. Installing pull type Lockbolts is a continuous operation using a pulling gun. The Lockbolt is installed in the hole and a collar placed on the grooved end of the Lockbolt. The pulling gun is installed on the grooved end of the Lockbolt. The gun is actuated and the Lockbolt is drawn into the hole and the collar is swaged on to the locking grooves of the Lockbolt by the anvil of the gun. The continuous buildup of pressure by the gun automatically breaks the Lockbolt at the break neck grooves.
- g. After installing pull type Lockbolts, apply corrosion preventive compound to the stem break off area of the Lockbolt. Refer to CSTO SR1F-15SA-23.

3-62. **Inspection.** Lockbolt heads and collars will be inspected for looseness and gap. All Lockbolts found to be loose will be removed and replaced. Gaps under head of either protruding or flush head Lockbolts which will allow the insertion of a 0.005 inch feeler gage to the shank of the Lockbolts are not acceptable. Gaps which will allow the insertion of an 0.004 inch feeler gage are acceptable provided no more than 40 percent of the head circumference has a gap. The Lockbolt collars will be visually inspected for being completely swaged on the Lockbolt. See figure 3-24 for acceptance standards for collars.



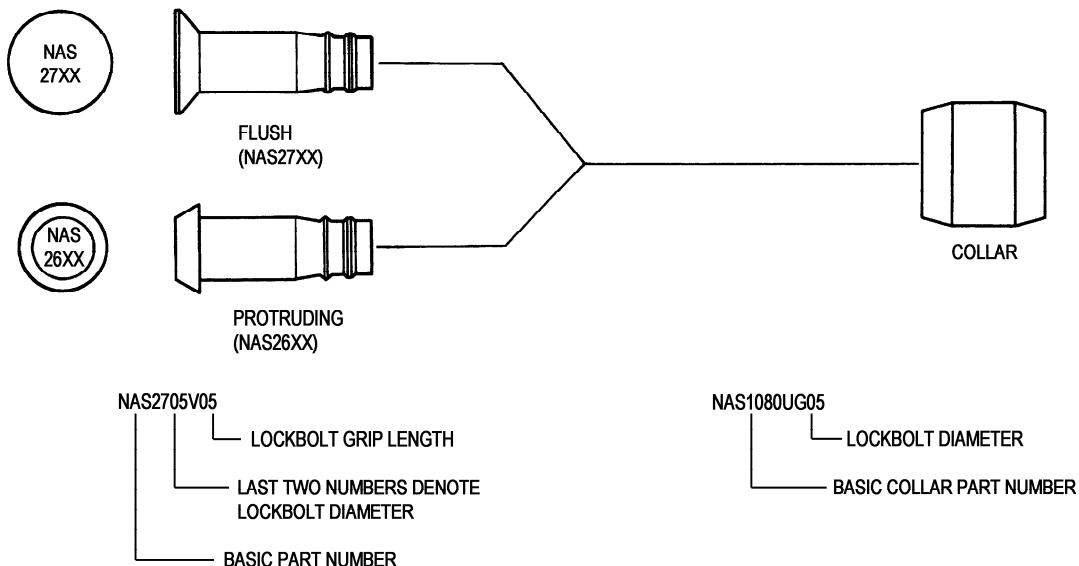
CORROSION RESISTANT STEEL LOCKBOLTS



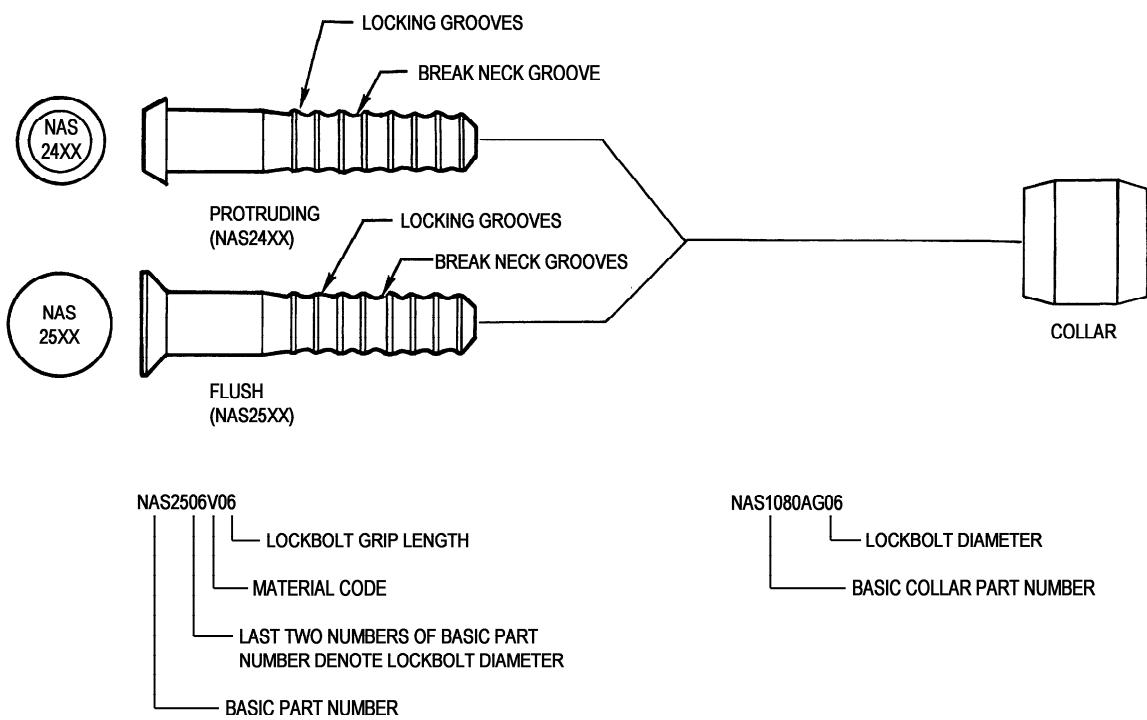
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Figure 3-22. Lockbolt Identification (Sheet 1 of 2)

TITANIUM LOCKBOLTS
STUMP TYPE

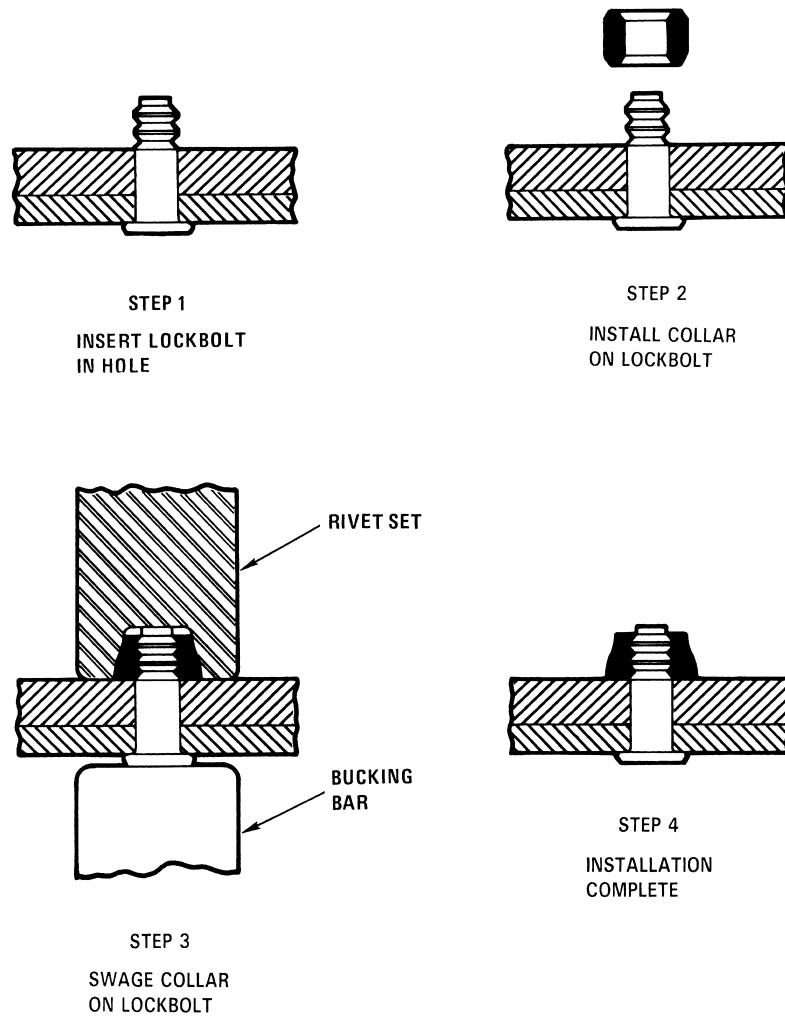


TITANIUM PULL TYPE

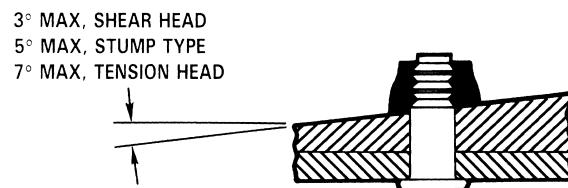


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Figure 3-22. Lockbolt Identification (Sheet 2)



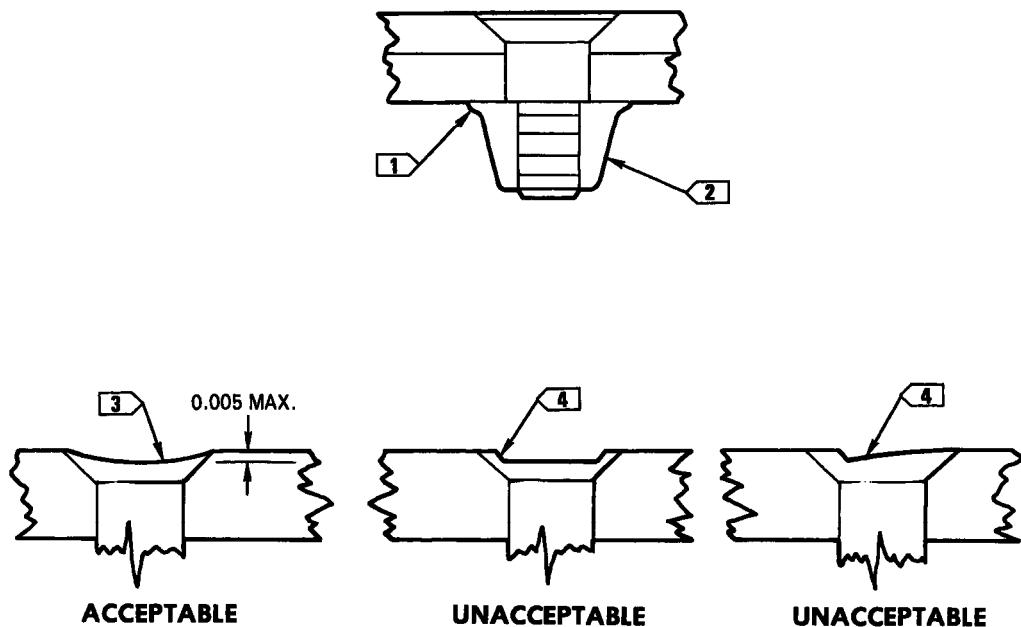
INSTALLATION OF LOCK BOLTS



INSTALLING LOCKBOLT COLLAR ON SLOPING SURFACE

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Figure 3-23. Lockbolt Installation

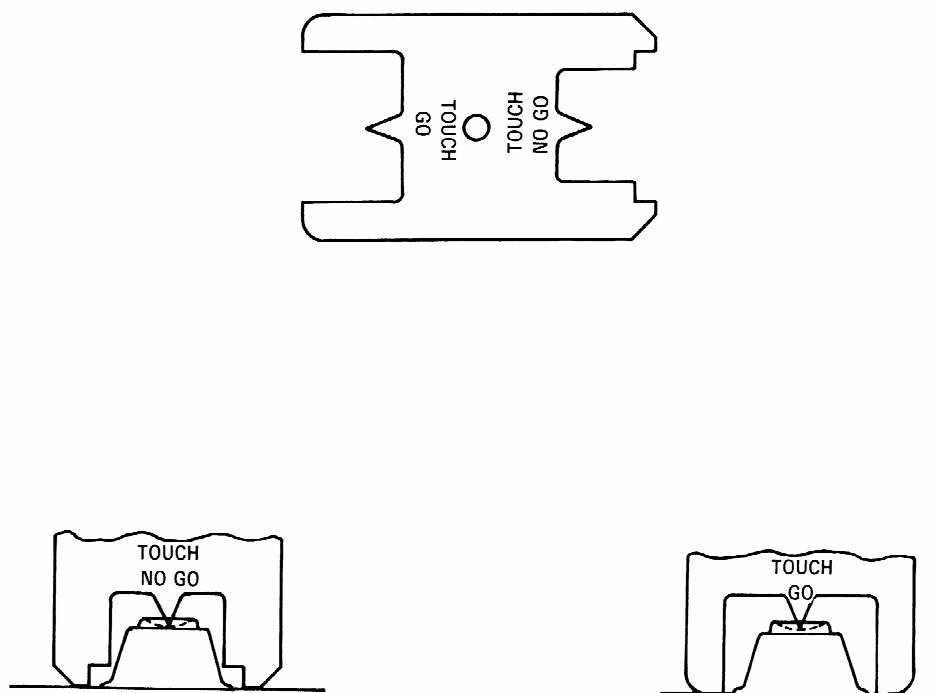


LEGEND

- 1 SWAGING OF COLLARS MAY PRODUCE A PAD OF EXCESS MATERIAL AT THE BOTTOM OF THE COLLAR, ON SLOPED SURFACES THE PAD WILL EXIST ON ONE SIDE ONLY AND THIS CONDITION IS ACCEPTABLE.
- 2 LOCALIZED ABSENCE OF IDENTIFICATION DYES ON SWAGED COLLARS IS ACCEPTABLE.
- 3 HEAD DISHING THAT IS SMOOTH AND UNIFORM IS ACCEPTABLE PROVIDED IT DOES NOT EXCEED 0.005 INCH DEPTH.
- 4 HEAD DISHING THAT SHOWS A DISTINCT RING CAUSED BY AN ABRUPT STEP IN THE HEAD IS NOT ACCEPTABLE.

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Figure 3-24. Lockbolt Collar Acceptance (Sheet 1 of 3)



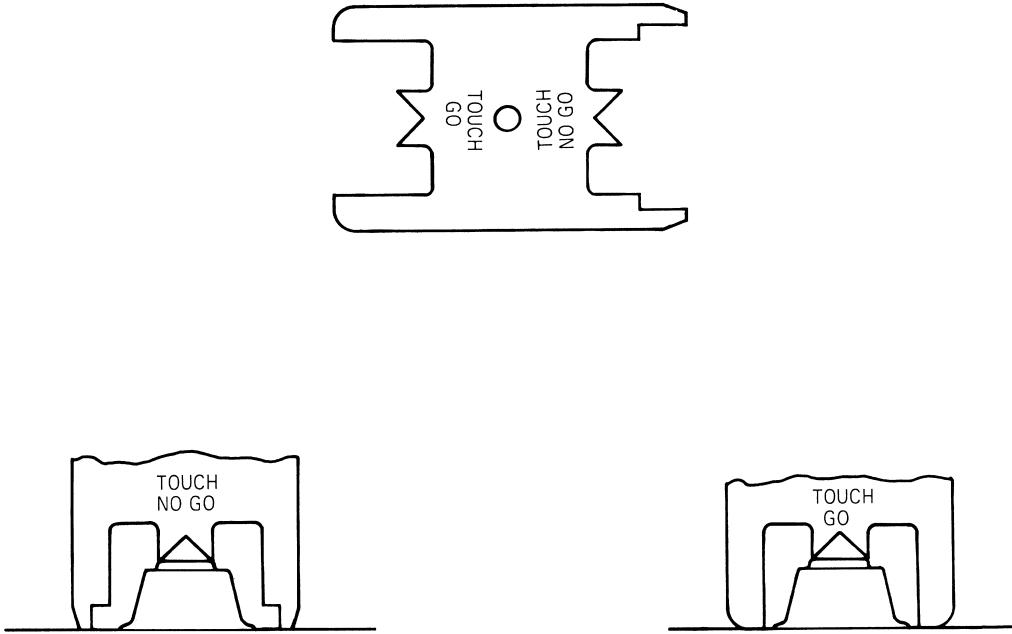
GAGE NUMBER	PIN DIAMETER
HG75-8	0.164
HG75-1	0.187
HG75-2	0.250
HG75-3	0.312
HG75-4	0.375

STUMP TYPE INSPECTION PROCEDURE

1. WITH TOUCH-NO-GO END DOWN, IF POINTS TOUCH THE PIN,
PIN IS TOO LONG AND SHALL BE REPLACED.
2. IF STEP TOUCHES COLLAR, COLLAR IS NOT COMPLETELY
SWAGED. REPLACE PIN AND COLLAR.
3. WITH TOUCH-GO END DOWN, IF POINTS DO NOT TOUCH PIN,
PIN IS TOO SHORT AND SHALL BE REPLACED.

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Figure 3-24. Lockbolt Collar Acceptance (Sheet 2)



GAGE NUMBER	PIN DIAMETER
HG85-12	0.164
HG85-10	0.187
HG85-2	0.250
HG76-1	0.187
HG76-2	0.250

**PULL TYPE
INSPECTION PROCEDURE**

1. WITH TOUCH-NO-GO END DOWN, IF POINTS TOUCH THE PIN, PIN IS TOO LONG AND SHALL BE REPLACED.
2. IF STEP TOUCHES COLLAR, COLLAR IS NOT COMPLETELY SWAGED. REPLACE PIN AND COLLAR.
3. WITH TOUCH-GO END DOWN, IF POINTS DO NOT TOUCH PIN, PIN IS TOO SHORT AND SHALL BE REPLACED.

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Figure 3-24. Lockbolt Collar Acceptance (Sheet 3)

3-63. HI-LOKS. Hi-Loks are primarily a threaded fastener which combine the best features of a rivet and bolt, and is made up of a threaded pin and collar. The Hi-Lok consistently maintains the same preload as the other fasteners in the same joint. The fasteners are available in either flush or protruding head styles; at installation, protruding head styles may require one ST4M146 washer under the head. The threaded end of the Hi-Lok contains a hexagon shaped recess which engages a hex allen wrench which prevents rotation of the Hi-Lok while the collar is being installed. The collar is designed with a wrenching device that separates at the torque off groove when a predetermined torque is applied. The design removes any torque inspection after installation. Refer to section VI for oversized repair fasteners.

3-64. Identification. See figure 3-25. Hi-Loks are identified by a standard code number which represents the type, the style of Hi-Lok, nominal diameter and the grip range. See figure for breakdown of the code number. Diameter of

Hi-Loks is in 1/32-inch increments, and grip length is in 1/16-inch increments. Hi-Loks are available in titanium, and corrosion-resistant steel (CRES), see table 3-9. Titanium alloy Hi-Loks are used on applications where temperatures are below 600 degrees Fahrenheit. CRES Hi-Loks are used on applications where temperatures range from 600 to 1200 degrees Fahrenheit. Hi-Lok Collars are identified by material by a color code as listed below:

2024-T6	Orange
A286	Black

The Hi-Lok Collar, ST3M608N or ST3M573C is a self-aligning collar and must be used with self-aligning washer ST3M683-(). This washer collar combination will accommodate a maximum of 8 degrees of misalignment.

Table 3-9. Hi-Lok Fastener

Hi-Lok Number	Material	Type Head
1 ► ST3M758D()-()	CRES A286	Flush Shear
1 ► ST3M758T()-()	Titanium	Flush Shear
1 ► ST3M759C()-()	CRES A286	Protruding Shear
1 ► ST3M759V()-()	Titanium	Protruding Shear
1 ► ST3M760D()-()	CRES A286	Flush Tension
1 ► ST3M760T()-()	Titanium	Flush Tension
1 ► ST3M761C()-()	CRES A286	Protruding Tension
1 ► ST3M761V()-()	Titanium	Protruding Tension
1 ► ST3M758D()-()	CRES Ph13-8Mo	Flush Shear
1 ► ST3M759C()-()	CRES Ph13-8Mo	Protruding Shear
2 ► ST3M758D()-()	CRES Ph13-8Mo	Flush Shear
2 ► ST3M758T()-()	Titanium	Flush Shear
2 ► ST3M759C()-()	CRES Ph13-8Mo	Protruding Shear

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Table 3-9. Hi-Lok Fastener (CONT)

Hi-Lok Number	Material	Type Head
2 ► ST3M759V()-()	Titanium	Protruding Shear
2 ► ST3M760D()-()	CRES Ph13-8Mo	Flush Tension
2 ► ST3M760T()-()	Titanium	Flush Tension
2 ► ST3M761C()-()	CRES Ph13-8Mo	Protruding Tension
2 ► ST3M761V()-()	Titanium	Protruding Tension
<p>1 ► Head is marked with part number, size, and manufacturer's letters; hs, H, or no letter indicates Hi-Shear, VS indicates Voi-Shan, and SPS indicates Standard Pressed Steel.</p> <p>2 ► Head is marked with prefix, part number, material symbol, and manufacturer's identification, as required by size. See NAS1347.</p>		

3-65. Requirements.

- a. Minimum edge distance for flush and protruding head Hi-Loks is two times the diameter of the Hi-Lok being installed plus 0.050 inch, or where specified differently in a repair procedure or when replacing existing Hi-Loks.
- b. Spacing for Hi-Loks is measured between the centerlines of the adjacent Hi-Loks. The minimum spacing as listed below shall be used except when specified differently in a specific repair procedure or when replacing existing Hi-Loks.
 - 1. The minimum spacing between protruding head Hi-Loks shall not be less than three and one half times the nominal diameter of the Hi-Lok.

2. The minimum spacing between flush head Hi-Loks shall not be less than four times the nominal diameter of the Hi-Lok.

- c. For Hi-Lok hole sizes, see table 3-10.
 - 1. Class one hole sizes should be selected where not more than three Hi-Loks are used in a group and where relative movement of the joined parts is undesirable.
 - 2. Class two hole sizes should be selected where Hi-Loks are used in groups of four or more or in patterns of less than four where moderate installation clearances are desirable and some movement is allowable.
- d. For Hi-Lok grip length, see table 3-11.

Table 3-10. Hi-Lok Hole Sizes

Hi-Lok Diameter	Hole Size	
	Class I	Class II
5/32 (08)	0.1635 +0.0015 -0.0007	0.1635 +0.0025 -0.0000
3/16 (3)	0.1895 +0.0015 -0.0007	0.1895 +0.0025 -0.0000
1/4 (4)	0.2495 +0.0015 -0.0007	0.2495 +0.0025 -0.0000
5/16 (5)	0.3120 +0.0015 -0.0007	0.3120 +0.0020 -0.0000
3/8 (6)	0.3745 +0.0015 -0.0007	0.3745 +0.0020 -0.0000

Table 3-11. Hi-Lok Grip Length

Dash No.	Grip Length	Material Thickness
2	0.125	0.063 to 0.125
3	0.188	0.126 to 0.188
4	0.250	0.189 to 0.250
5	0.312	0.251 to 0.312
6	0.375	0.313 to 0.375
7	0.438	0.376 to 0.438
8	0.500	0.439 to 0.500
9	0.562	0.501 to 0.562
10	0.625	0.563 to 0.625
11	0.688	0.626 to 0.688
12	0.750	0.689 to 0.750
13	0.812	0.751 to 0.812
14	0.875	0.813 to 0.875
15	0.938	0.876 to 0.938
16	1.000	0.939 to 1.000
17	1.062	1.001 to 1.062
18	1.125	1.063 to 1.125
19	1.188	1.126 to 1.188
20	1.250	1.189 to 1.250
21	1.312	1.251 to 1.312
22	1.375	1.313 to 1.375
23	1.438	1.376 to 1.438
24	1.500	1.439 to 1.500
25	1.562	1.501 to 1.562
26	1.625	1.563 to 1.625

Table 3-11. Hi-Lok Grip Length (CONT)

Dash No.	Grip Length	Material Thickness
27	1.688	1.626 to 1.688
28	1.750	1.689 to 1.750
29	1.812	1.751 to 1.812
30	1.875	1.813 to 1.875
31	1.938	1.876 to 1.938
32	2.000	1.939 to 2.000
33	2.062	2.001 to 2.062
34	2.125	2.063 to 2.125
35	2.188	2.126 to 2.188
36	2.250	2.189 to 2.250
37	2.312	2.251 to 2.312
38	2.375	2.313 to 2.375

3-66. Removal. See figure 3-26. Hi-Lok fasteners with ST3M526C()M collars may be removed by holding the pin with an allen wrench and turning the collar with SWT15-5 removal tool. All other Hi-Lok fasteners may be removed by holding the pin with an allen wrench and turning the collar with pliers. Undamaged pins may be reused but any collar that has been removed shall be scrapped. Pins installed in interference holes shall be driven out with a plastic mallet or by driving with a light rivet gun.

3-67. Installation Preparation. See figure 3-26.

- a. Parts to be joined shall be secured firmly into position.
 - 1. Relieve interference between head to shank fillet radius of protruding head Hi-Loks, and edges of holes per figure 3-26.
 - b. Install Hi-Lok in hole and inspect head for correct seating.
 - c. When installing Hi-Loks in interference fit holes, the pin must be driven through the hole until the head is seated before installing the
- collar. Pins may be driven by tapping the head with a plastic mallet or by driving with a light rivet gun.
- d. Check pin protrusion through hole per figure 3-26.
 - e. Washers may be used under the Hi-Lok collar to meet the pin protrusion limits per the below:
1. Use NAS620C series washers through 1/4-inch diameter, and NAS1149CN616R series washers with 5/16 diameter and up pins.
 2. The maximum total washer thickness shall be 0.032 inch and maximum number of washers used shall be one, except when 0.016 washers are used, then two may be used.
 3. Only corrosion resistant steel (CRES) washers shall be used on Hi-Loks with CRES collars, except when collar is CRES, and structure the washer will contact is aluminum, use aluminum washers.

4. Only aluminum washers (NAS1149DN332J) shall be used on pins with aluminum collars.

3-68. **Installation.** See figure 3-26.

3-69. Materials.

Cloth, cheesecloth, CCC-C-440 TY1 CL1
Solvent, wipe, DS-108F
Primer, MIL-S-22473, grade N or T, form R
Sealing compound, ASTM D5363 TYAN0121

3-70. Procedure.

a. Fastener and collar assembly.

1. Hi-Lok fastener using aluminum collar may be installed through wet sealing compound (fay sealing per CSTO SR1F-15SA-3-5), and need not be removed from fastener threads if the collar is installed while the sealing compound is wet.
2. Hi-Lok fastener using CRES collar retained with sealing compound.

WARNING

Solvent is a flammable liquid and vapor. May cause eye, skin, and respiratory irritation. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

- (a) Using clean cheesecloth cloth dampened with solvent, wipe fastener threads clean after installation through hole.

WARNING

Primer is a flammable liquid and vapor. Harmful if swallowed. May cause eye and skin irritation. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

- (b) Using brush, dip or spray method, apply primer to collar threads only. Allow

primer to air dry 15 to 30 minutes at room temperature.

WARNING

Sealing compound may cause skin irritation. Avoid contact with skin and clothing. Wash thoroughly after handling.

NOTE

The primer applied to the collar per step (b) is acceptable for collar installation per below step (c) for up to 30 days. After 30 days, collar must be reprimed before installation.

- (c) Apply sealing compound to fastener threads, and install primed collar immediately per below steps b. through d. Refer to CSTO SR1F-15SA-3-5 for preparation and application.
- b. Start collar and Hi-Lok threads a minimum of three quarters of a turn by hand.
- c. After collar has been started, power tools or hand tools can be used to install collar.
- d. Proper torque is achieved when the wrenching device twists off the collar.

NOTE

If fastener, and collar are moved with respect to each other 15 minutes after installation, disassemble, and repeat step a.2.(c).

- e. Allow retaining compound to cure at room temperature for a minimum of 12 hours when collar was primed with grade N primer; cure 2 hours when grade T primer was used.

3-71. **Inspection.** Final acceptance of Hi-Lok pin protrusion will be as shown in figure 3-26 step 5. and the below conditions:

- a. No gap is permitted at the shank of the pin.
- b. Preferred Method:
 1. Loose Hi-Loks that can be moved axially or rotated with the fingers are not acceptable and must be replaced.

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c. Optional method:

1. Insert allen wrench into end of Hi-Lok pin. Grasp the wrench between one finger and thumb approximately 1/2-inch from fastener centerline. If fastener can be rotated with torque applied in this manner, fastener is not acceptable and must be replaced.

2. In panels of thin skin-crushed honeycomb combination, Hi-Lok fasteners that can be rotated with fingers or allen wrench are acceptable providing the axial movement does not exceed 0.005.

d. Gaps under the Hi-Lok head which allow the insertion of a 0.004 inch feeler gage are acceptable provided no more than 40 percent of the circumference has a gap. Replace Hi-Loks if a 0.005 inch feeler gage can be inserted to the shank.

e. No collar shall have wrench marks or cuts showing evidence of being reinstalled or retightened after installation.

3-72. HI-TIGUES. The Hi-Tigue fastener is a threaded pin secured by a collar. The pin-shanks are provided with a circumferential bead or ball section adjacent to the threaded area. Inserting the fastener into a prepared hole causes the circumferential bead to exert high pressure on the wall of the hole. This high pressure provides a burnishing effect to smooth minute tool marks and other surface imperfections and also work hardens the hole surface. This results in a layer of stronger

metal at the surface of the hole as well as an improved hole surface finish that enhances fatigue resistance. The threaded end of the pin has a hex recess to accommodate an allen wrench used to prevent rotation when the collar is installed. Hi-Tigue pins are used in combination with steel or aluminum collars, or with self aligning steel or aluminum collars with self aligning stainless steel bases or steel washers.

3-73. Identification. See figure 3-25. Hi-tigues are identified by a standard code number that represents the type, the style of Hi-Tigue, nominal diameter and the grip range. See figure for the breakdown of the code number. The diameter of Hi-Tigues is in 1/32 of an inch and the grip length is in 1/16 of an inch. Hi-Tigues are available in titanium alloy and corrosion resistant steel, see table 3-12. Titanium alloy Hi-Tigues are used on applications where temperatures are below 600 degrees Fahrenheit. Corrosion resistant steel Hi-Tigues are used on applications where temperatures range from 600 to 1200 degrees Fahrenheit. Hi-Tigues utilize standard Hi-Lok collars. The Hi-Lok collars are identified by material color code as below:

2024-T6	Orange
A286	Black

The SW2000 Hi-Lok collar is a self-aligning collar and must be used with a washer. This washer collar combination will accommodate a maximum of 8 degrees of misalignment.

Table 3-12. Hi-Tigue Fasteners

Hi-Lok Number	Material	Type Head	1st oversize	2nd oversize
HLT 50	CRES	Protruding Shear	HLT 150	HLT 250
ST3M759C()-()	CRES PH13-8MO	Protruding Shear	ST3M814-()-()	ST3M811-()-()
HLT 51	CRES	Flush Shear	HLT 151	HLT 251
ST3M456C()-()	CRES PH13-8MO	Flush Shear	ST3M812-()-()	ST3M809-()-()
HLT 52	CRES	Protruding Tension	HLT 152	HLT 252
ST3M761C()-()	CRES PH13-8MO	Protruding Tension	ST3M814-()-()	ST3M811-()-()
HLT 53	CRES	Flush Tension	HLT 153	HLT 253

Table 3-12. Hi-Tigue Fasteners (CONT)

Hi-Lok Number	Material	Type Head	1st oversize	2nd oversize
ST3M760C()-()	CRES PH13-8MO	Flush Tension	ST3M813-()-()	ST3M810-()-()
HLT 10	Ti	Protruding Shear	HLT 110	HLT 210
ST3M759V()-()	Ti 6AL-4V	Protruding Shear	ST3M501-()-()	ST3M507-()-()
HLT 11	Ti	Flush Shear	HLT 111	HLT 211
ST3M415V()-()	Ti 6AL-4V	Flush Shear	ST3M812-()-()	ST3M809-()-()
HLT 12	Ti	Protruding Tension	HLT 112	HLT 212
ST3M420V()-()	Ti 6AL-4V	Protruding Tension	ST3M814-()-()	ST3M811-()-()
HLT 13	Ti	Flush Tension	HLT 113	HLT 213
ST3M419V()-()	Ti 6AL-4V	Flush Tension	ST3M813-()-()	ST3M810-()-()

3-74. Requirements.

- a. Minimum edge distance for flush and protruding head Hi-Tigues is two times the diameter of the Hi-Tigue being installed plus 0.050, or where specified differently in a repair procedure or when replacing existing Hi-Tigues.
- b. Spacing for Hi-Tigues are measured between the centerlines of the adjacent Hi-Tigues. The minimum spacing will be used except when specified differently in a specific repair procedure, or when replacing existing Hi-Tigues.

1. The minimum spacing between protruding head Hi-Tigues shall not be less than three and one half times the nominal diameter of the Hi-Tigue.

2. The minimum spacing between flush head Hi-Tigues will not be less than four times the nominal diameter of the Hi-Tigue.

c. For Hi-Tigue hole sizes, see table 3-13.

Table 3-13. Hi-Tigue Hole Sizes

Hi-Tigue Nominal Diameter	Nominal Hole Diameter	1st Oversize	2nd Oversize
3/16	0.1850 to 0.1880	0.1981 to 0.2011	0.2137 to 0.2167
1/4	0.2450 to 0.2480	0.2606 to 0.2636	0.2762 to 0.2792
5/16	0.3075 to 0.3105	0.3231 to 0.3261	0.3387 to 0.3417
3/8	0.3700 to 0.3730	0.3856 to 0.3886	0.4012 to 0.4042

3-75. Removal. See figure 3-26. Hi-Tigue fasteners with ST3M526C()M collars may be removed by holding the pin with an allen wrench and turning the collar with pliers. Pins may be driven out with a plastic mallet.

Hi-Tigue fasteners may be removed by holding the pin with an allen wrench and turning the collar with pliers. Pins may be driven out with a plastic mallet.

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3-76. **Installation.** See figure 3-26 and table 3-13. The preparation of holes for Hi-Tigue fasteners and the installation of the fasteners require very close tolerances and very precise procedures to fully utilize the fatigue life improvement feature of the fastener. Table 3-13 provides hole size dimensions for basic size, first and second oversize fasteners.

3-77. Materials.

Alcohol, Cetyl, NDC00527-0610-16



Failure to observe the requirements below will result in improperly installed Hi-Tigue fasteners and could cause structural damage.

- a. Layout hole locations with respect to edge distance and fastener spacing specified for the specific repair procedure. Spot locations of each hole using a center punch and a light blow of a hammer.
- b. Determine hole size for particular size and type of fastener to be installed per dimensional requirements of table 3-13.
- c. Select appropriate drill motor, speed, and feed for drilling holes.
- d. Before producing holes in structure and repair members, demonstrate satisfactory performance of the drill-ream methods and tooling for each repair fastener diameter and grip length as below:
 1. Select test material of the same composition as the structure and thickness equal or greater than the fastener grip length.
 2. Prepare a sufficient number of holes to make any adjustments required to produce a satisfactory hole in the test material.
- e. Assemble and clamp all repair members in place without sealing compound.
- f. Predrill pilot holes (number 30 drill size) through all mating surfaces. Drill final holes using pilot holes as a guide. Observe the steps below for all holes.

1. Drill at right angle to the surface. Holes must be perpendicular within two degrees to the surface. If possible use a drill jig.
2. Hold drill motor as steady as possible to be sure of an acceptable hole.
3. Keep aluminum buildup off drills to prevent oversized holes. Lubricating the drill bit with cetyl alcohol will aid in preventing aluminum buildup. Frequent wiping or cleaning of drill bit may also be required.
4. Deburr exit side of drilled hole, as required, with a file type deburring tool that deburrs only the surface and does not penetrate the hole.
5. Disassemble all repair members and detail parts. Brush away all chips produced by drilling operations with a clean cloth.
6. Visually inspect all hole surfaces for scoring and roughness (125 RHR maximum).
7. Insert pin into prepared hole using applicable sealing compound to coat shank and shoulders as required. Fully seat the pin by squeezer or equivalent method before installing the collar. The collar shall not be used to pull the pin into the hole. When a squeezer is not used and the thickness of the back sheet is less than 0.190. Satisfactory support, such as a bucking bar, shall be used as the pin is being installed. Push the pin in along the centerline of hole to prevent damage to the wall of the hole. A NAS1149F washer may be used, if required, under a steel collar and a NAS1149D washer may be used under an aluminum collar for adjusting thread protrusion to within requirements. Washer may be radiused locally on one edge where a structural interference prevents full seating. When the angle formed between the base of a standard collar and structure is 2 to 8 degrees, install a self-aligning washer/base.
8. Hi-Tigue fasteners may be installed through wet sealant and the sealant material does not have to be removed from the Hi-Tigue threads if the collar is installed while the sealant is wet.
9. Start collar and Hi-Tigue threads a minimum of three quarters of a turn by hand.

m. Start collar by hand. Power or hand tools can be used to finish installation of collar.

n. Proper torque is achieved when the wrenching device twists off the collar.

■ 3-78. **Inspection.** Final acceptance of Hi-Tigue pin protrusion will be as shown in figure 3-27, step 5., and the conditions below:

a. No gap is permitted at the shank of the pin.

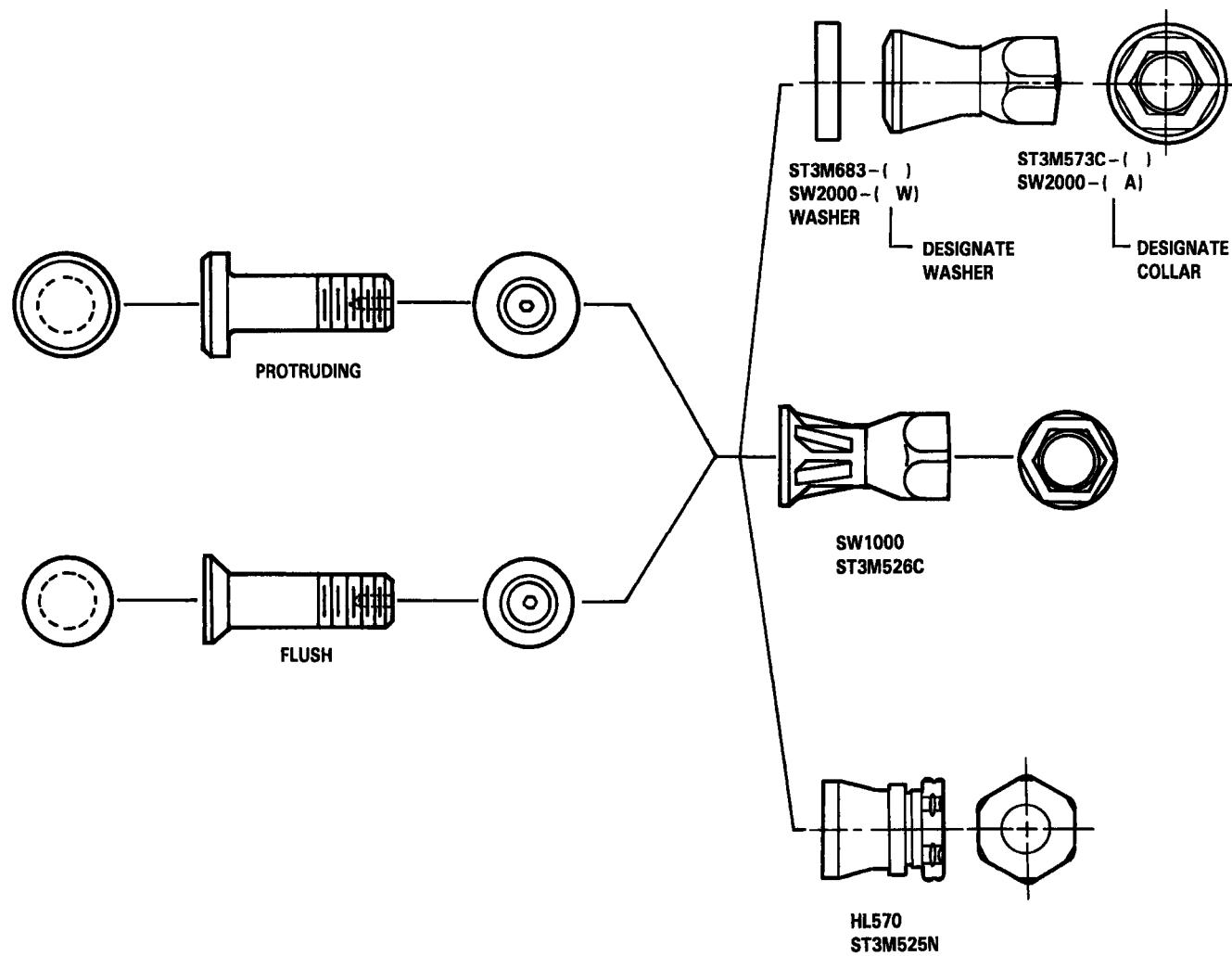
1. Loose Hi-Tigues that can be moved axially or rotated with the fingers are not acceptable and must be replaced.

b. Optional method: Insert allen wrench into end of Hi-Tigue pin. Grasp the wrench between one finger and thumb, approximately 0.500 from fastener centerline. If fastener can be rotated with torque applied in this way, fastener is not acceptable and must be replaced.

c. Gaps under the Hi-Tigue head that allow the insertion of a 0.004 feeler gage are acceptable, provided no more than 40 percent of the circumference has a gap. Replace Hi-Tigues if a 0.005 feeler gage can be inserted to the shank.

d. No collar shall have wrench marks or cuts showing evidence of being reinstalled or retightened after installation.

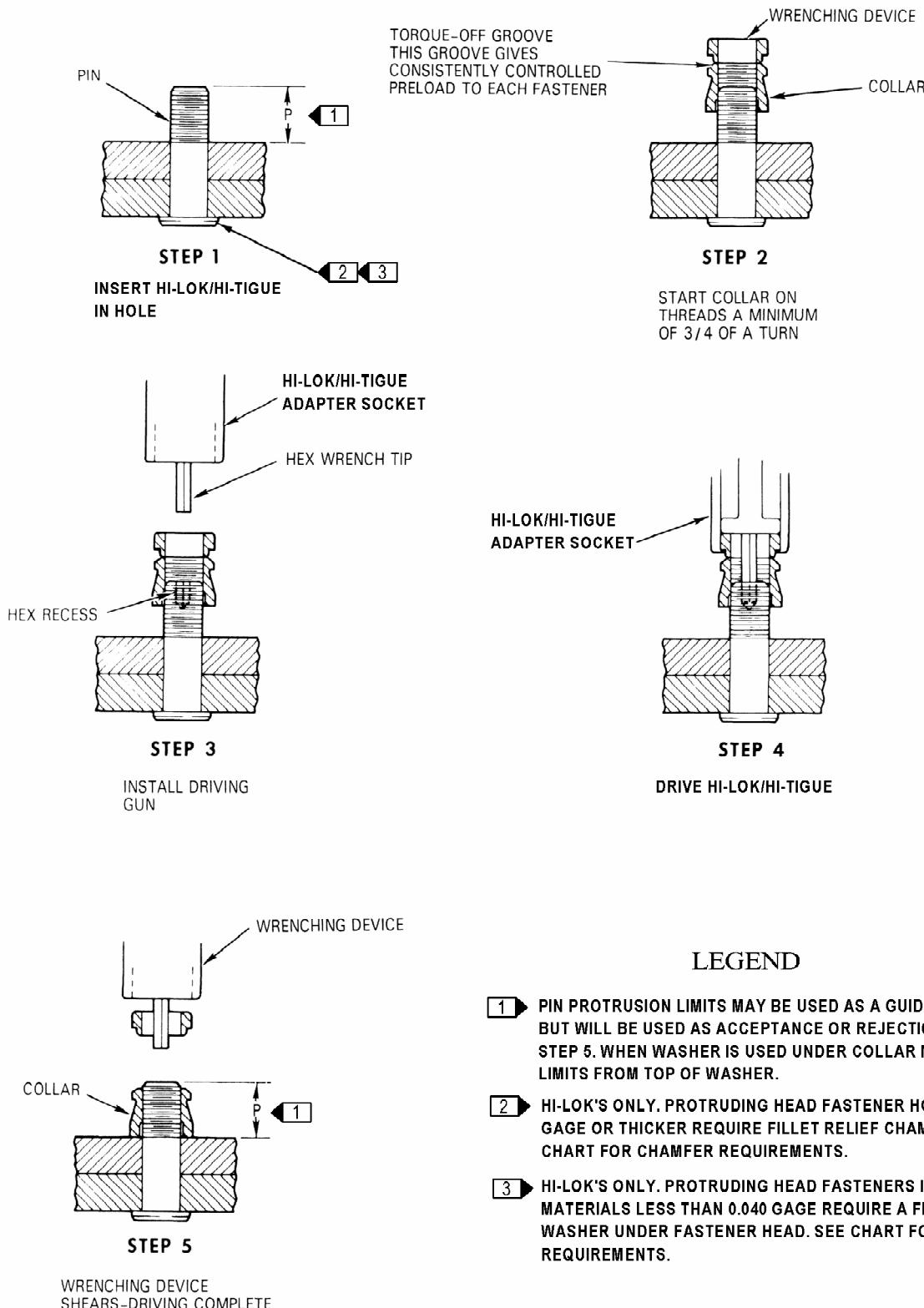
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HI-LOK/HI-TIGUE PIN				HI-LOK/HI-TIGUE COLLAR		
ST3M579	V	3	-10	ST3M526C	^{.08MA} _{.5MA}	
HL 10	V	6	-10	SW1000	DIAMETER FOR HI-LOK PIN	
HLT 50	V	5	-10		BASIC PART NUMBER	
					GRIP LENGTH	
					DIAMETER OF HI-LOK/HI-TIGUE	
					MATERIAL CODE	
					BASIC PART NUMBER	

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Figure 3-25. Hi-Lok/Hi-Tigue Pin and Collar Identification



SAN301-03-37-002

Figure 3-26. Hi-Lok/Hi-Tigue Installation and Removal (Sheet 1 of 3)

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PIN PROTRUSION LIMITS HI-LOK AND HI-TIGUE			
FASTENER SIZE	1/16 STANDARD GRIP LENGTH		
	MINIMUM P	MAXIMUM P	
-5 5/32	0.302	0.384	
-6 3/16	0.315	0.397	
-8 1/4	0.385	0.467	
-10 5/16	0.490	0.572	
-12 3/8	0.535	0.617	

FILLET RELIEF CHAMFER FOR PROTRUDING HEAD HI-LOK	
NOMINAL HOLE SIZE (INCHES)	RELIEF CHAMFER A
5/32	0.015 TO 0.025
3/16	0.015 TO 0.025
1/4	0.015 TO 0.025
5/16	0.020 TO 0.030
3/8	0.020 TO 0.030

ABOVE CHAMFERS ARE APPLICABLE FOR BOTH COMPOSITE AND METAL STRUCTURES.

FILLET RELIEF WASHERS FOR PROTRUDING HEAD HI-LOKS			
HI-LOK NOMINAL DIAMETER (INCHES)	HI-LOK DIAMETER DASH NUMBER	1 ➤ ALUMINUM WASHER PART NUMBER	2 ➤ TITANIUM WASHER PART NUMBER
5/32	-5	ST4M146-5D	ST4M146-5V
3/16	-6	ST4M146-6D	ST4M146-6V
1/4	-8	ST4M146-8D	ST4M146-8V
5/16	-10	ST4M146-10D	ST4M146-10V
3/8	-12	ST4M146-12D	ST4M146-12V

NOTES: 1 ➤ THE 0.020 THICK ALUMINUM WASHERS SHALL BE USED ONLY AGAINST ALUMINUM ALLOY MATERIALS.

2 ➤ THE 0.020 THICK TITANIUM WASHERS SHALL BE USED ONLY AGAINST TITANIUM, STAINLESS STEEL(CRES) ALLOYS, AND COMPOSITE MATERIALS.

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Figure 3-26. Hi-Lok/Hi-Tigue Installation and Removal (Sheet 2)

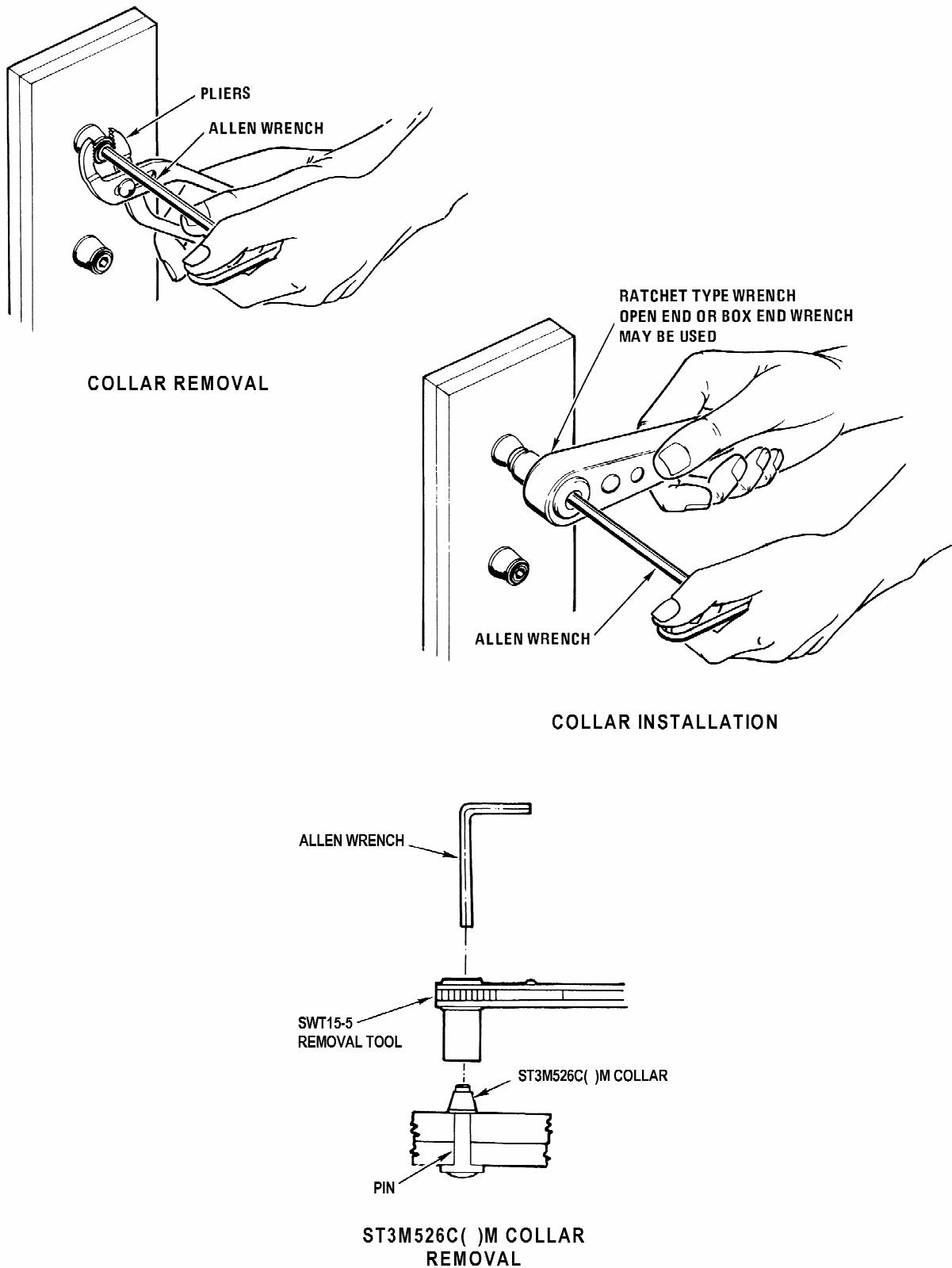
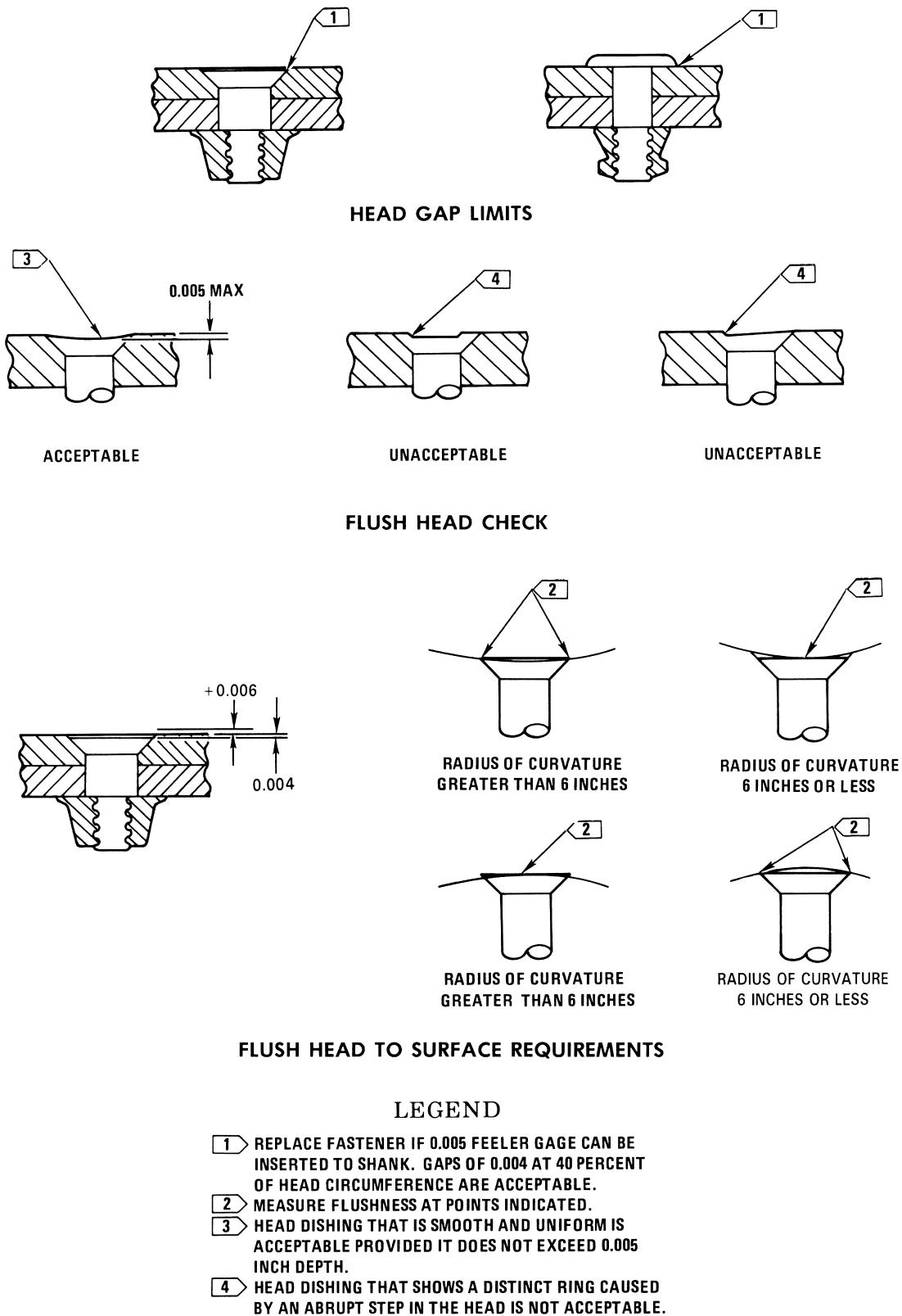


Figure 3-26. Hi-Lok/Hi-Tigue Installation and Removal (Sheet 3)

SAN301-03-39-001



SAN301-03-40-001

Figure 3-27. Hi-Lok/Hi-Tigue Inspection

3-79. OLYMPIC-LOK RIVETS (NAS1398/NAS1399 TYPE A) and WIREDRAWN RIVETS (NAS1398/NAS1399 TYPE AB).

Olympic-Lok and Wiredrawn rivets are used in areas where access to one side of the work area is impossible to reach. These rivets are used in non-structural applications. Wiredrawn rivets (Type AB) have a driving anvil manufactured on each rivet to omit wear on the installation head of the pulling gun. The driving anvil pops off during rivet installation and is considered FOD once the rivet is installed. After installation, Olympic-Lok (Type A) and Wiredrawn (Type AB) rivets are identical.

3-80. Identification. See figure 3-28. Olympic-Lok and Wiredrawn rivets are identified by a basic part number which represent the style, material, nominal diameter, and grip range of the rivets. See figure for breakdown of part number. The rivets are available in flush or protruding head styles.

3-81. Requirements.

- Select the correct pulling head to conform to the diameter of the rivet to be installed. The same pulling head is used to install either flush or protruding head rivets.
- Olympic-Lok and Wiredrawn rivets will install and function properly where the blind head is formed against a dimpled sheet.
- For rivet hole sizes, see table 3-14.
- The recommended minimum edge distance is two times the rivet diameter plus 0.060 inch.
- The recommended minimum spacing between protruding head rivets is three and one half times the rivet diameter. The minimum spacing between flush head rivets shall not be less than four times the rivet diameter.

Table 3-14. Olympic-Lok Hole Sizes

Rivet Diameter	Hole Size		Drill Size
	Minimum	Maximum	
1/8	0.129	0.132	30
5/32	0.160	0.164	21
3/16	0.192	0.196	11
1/4	0.256	0.261	F

f. For correct rivet length corresponding to the material thickness, use the below:

Rivet Length		
Dash Length	Material Thickness	
	Minimum	Maximum
1	1 →	0.062
2	0.063	0.125
3	0.126	0.187
4	0.188	0.250
5	0.251	0.312
6	0.313	0.375

Rivet Length	Dash Length	Material Thickness	
		Minimum	Maximum
7		0.376	0.437
8		0.438	0.500
9		0.501	0.562
10		0.563	0.625
11		0.626	0.687
12		0.688	0.750
13		0.751	0.812

Rivet Length Dash Length	Material Thickness	
	Minimum	Maximum
14	0.813	0.875
15	0.876	0.938
16	0.939	1.000

NOTE

 Minimum material thickness must always be greater than the head height of flush rivets.

- g. The maximum angled surface against which the formed head may be installed is 7 degrees.

3-82. Removal.

- a. Use a small pointed punch to knock the spindle out of the rivet. Center the punch in the middle of the rivet head and give it one or two firm blows with a hammer. The spindle should then fall out through the blind side of the work.
- b. Before drilling, pry out the locking ring normally remaining in the rivet head with a scribe or some other pointed tool. If the ring is not removed, it has a tendency to spin on the drill as the head is drilled out.
- c. Drill a hole slightly smaller than the rivet shank to a depth just past the thickness of the rivet shank. Flush heads will usually fall out and protruding heads will have to be carefully knocked off with a punch.
- d. Punch the remaining shank out carefully so as not to enlarge the hole.

3-83. Installation.

- a. Parts to be joined shall be secured firmly into position.
- b. Measure material thickness and select correct length rivet from paragraph 3-81. When measuring, where the bottom sheet is dimpled, the height of the dimple must be included in the measurement.

c. Insert the rivet sleeve into the prepared hole by hand or the rivet may first be inserted into the pulling head and then the gun can be used as a guide for inserting the rivet into the hole.

d. Use hand or power gun to install rivets.

1. Hand gun. When using hand gun, hold handle rigid and straight in line with axis of the rivet. Pressing down with force will not allow the rivet and gun to align themselves and may result in a premature (low) break of the rivet spindle or excessive gap under the rivet head. Actuate the rivet gun by bringing together the levers on the gun. The rivet will form and the spindle will break approximately flush with the head of the rivet. Release the handles and the pulling head will eject the pulling portion of the spindle.
2. Power gun. When using power gun to install rivets, follow same basic procedure as for hand gun. Hold power gun in correct position and pull trigger. The spindle will be pulled, fractured and ejected. Tooling between Olympic-Lok (Type A) and Wiredrawn (Type AB) is not compatible unless specified by the tool manufacturer.

e. Inspect installed rivets per paragraph 3-84.

3-84. Inspection. See figure 3-29 for acceptance or rejection of installed rivets. If blind side of rivet is visible, the expanded shank part shall be visually inspected. The plugged end of the spindle shall extend into the rivet shank forming the shop head. The shop head shall be pulled up tight against the material. Inspect rivet head for correct fracture of the spindle (stem) and lockring insertion. See figure 3-30 for spindle and lockring flushness limits.

3-85. BLIND FASTENER SUBSTITUTION REQUIREMENTS FOR CONVENTIONAL RIVETS.

The blind fasteners have an inherently lower level of reliability than most conventional aircraft fasteners, particularly when the blind side of the installed fastener cannot be inspected. For this reason, they shall only be used when absolutely required and more specifically, their use shall be consistent with the requirements in paragraph 3-86.

3-86. **Requirements.** Blind fasteners may be substituted for conventional aircraft fasteners per the requirements below:

- a. Blind fasteners shall be used in nonstructural applications only when access to one of the working sides of the assembly is impossible, or the cost and effort to gain access for installation of conventional aircraft fasteners is not practical. Examples of nonstructural application are: attaching tank liners, rubber seals, name plates, anchor nuts, and gang channels.
- b. Blind fasteners shall be used in structural applications only where lack of access prevents the use of conventional aircraft fasteners. In structural applications considerable effort is justified to enable the use of conventional nonblind fasteners.
- c. Blind fasteners shall not be used for primary tension applications.

d. In installations where blind side of the work is visible, though not accessible, the blind head shall be visually inspected and replaced if not properly seated and/or formed.

e. Blind fasteners shall not be used in any of the below applications.

1. Areas requiring a fluid tight seam.
2. Control systems, operating devices or mechanisms.
3. Primary structure fittings.
4. Any item or assembly that must be periodically removed.

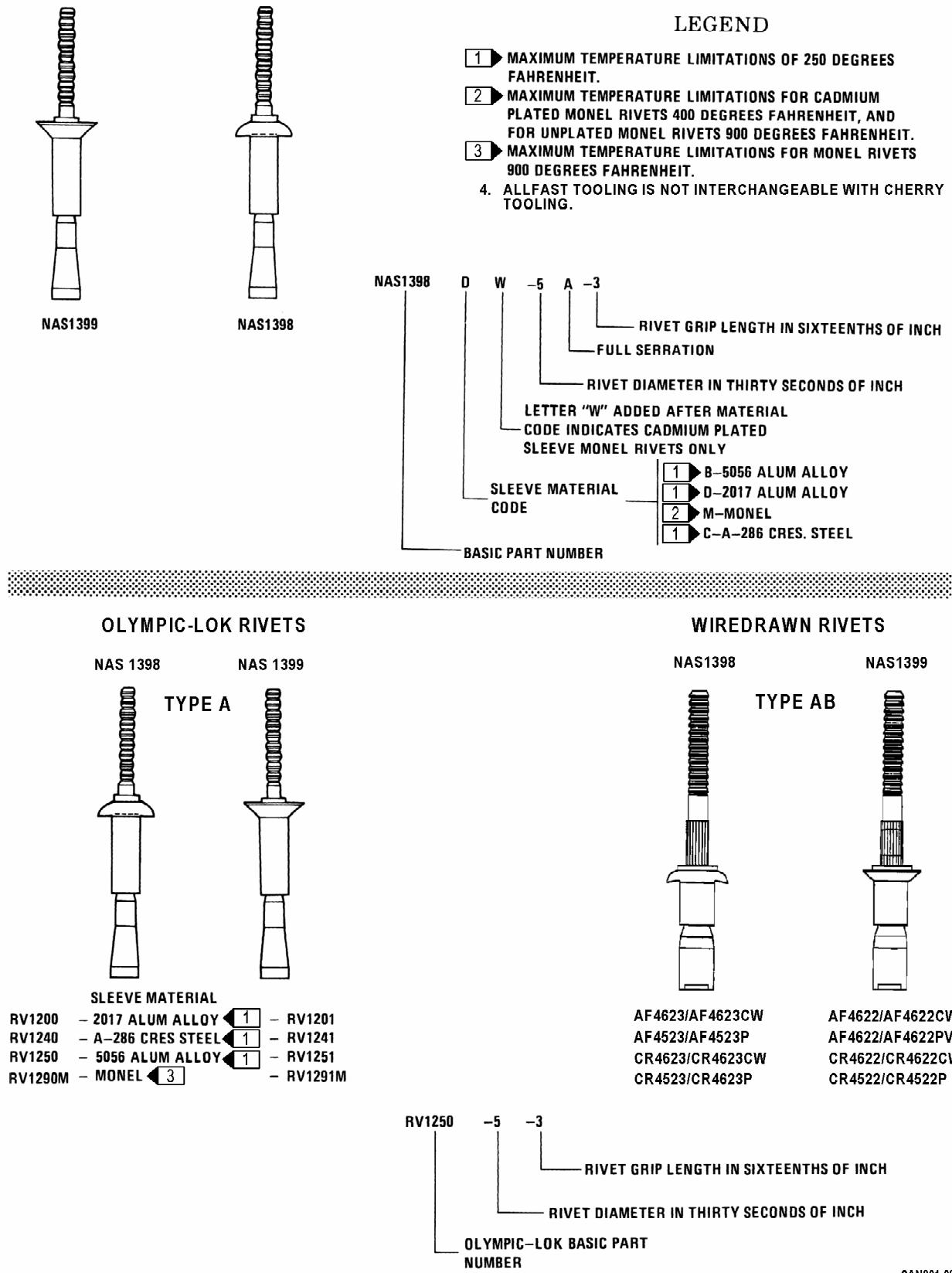


Figure 3-28. Olympic-Lok and Wiredrawn Blind Fastener Identification

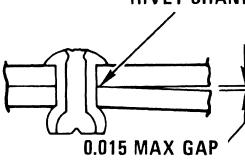
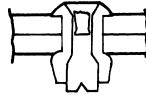
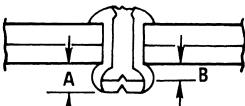
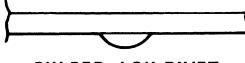
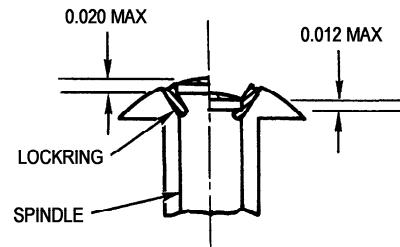
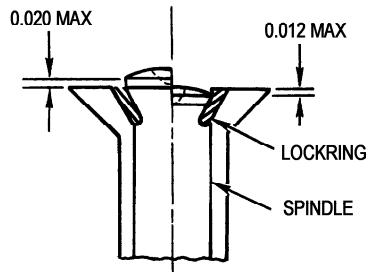
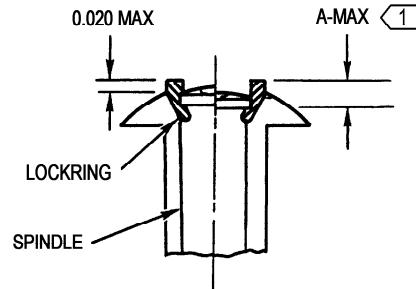
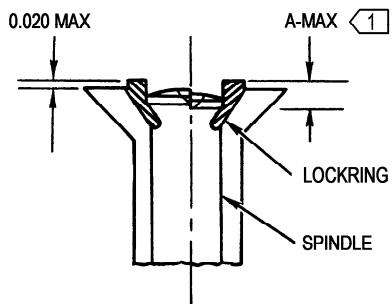
CONDITION	ACCEPTABILITY LIMITS	CONDITION	ACCEPTABILITY LIMITS															
NO GAP AT RIVET SHANK 	ACCEPTABLE WITHIN LIMITS SHOWN	LOCKING RING MISSING AFTER PREMATURE BREAK 	NOT ACCEPTABLE. RIVETS NOT PROPERLY LUBRICATED OR LUBRICATION DRIED OUT. SPINDLE DIRTY, UNDERSIZE HOLE. HOLES SLANTED OR MISALIGNED, RIVET GRIP LENGTH TOO SHORT. PULLING HEAD NOT FAR ENOUGH DOWN ON SPINDLE. PULLING HEAD CROOKED.															
MINIMUM PROTRUSION OF SLEEVE AND SPINDLE.  PROTRUSION NAS1398, 1399	ACCEPTABLE IF A OR B EXCEEDS THESE VALUES. <table border="1"> <thead> <tr> <th>DIA</th> <th>"A" MIN</th> <th>"B" MIN</th> </tr> </thead> <tbody> <tr> <td>1/8"</td> <td>0.070</td> <td>0.040</td> </tr> <tr> <td>5/32"</td> <td>0.075</td> <td>0.045</td> </tr> <tr> <td>3/16"</td> <td>0.085</td> <td>0.050</td> </tr> <tr> <td>1/4"</td> <td>0.100</td> <td>0.055</td> </tr> </tbody> </table>	DIA	"A" MIN	"B" MIN	1/8"	0.070	0.040	5/32"	0.075	0.045	3/16"	0.085	0.050	1/4"	0.100	0.055	INSERT FEELER GAGE HERE  0.004 MAX	A. GAPS UNDER THE HEAD, WHICH PERMIT INSERTION OF A 0.004 FEELER GAGE TO THE SHANK ARE NOT ACCEPTABLE. GAPS WHICH WILL PERMIT INSERTION OF A 0.003 FEELER GAGE ARE ACCEPTABLE PROVIDED NO MORE THAN 40% OF THE CIRCUMFERENCE HAS A GAP. B. ACCEPTABLE IF PORTION OF HEAD IS SEATED AND CLEARANCE ON OPPOSITE SIDE DOES NOT EXCEED THAT SHOWN. IF GAP EXCEEDS LIMITS SHOWN, REMOVE RIVET AND CLEAN HOLE AND SURFACE CAREFULLY.
DIA	"A" MIN	"B" MIN																
1/8"	0.070	0.040																
5/32"	0.075	0.045																
3/16"	0.085	0.050																
1/4"	0.100	0.055																
BULBED-LOK RIVET IN MINIMUM GRIP 	ACCEPTABLE WHETHER THE BULB COVERS THE SPINDLE UNIFORMLY OR NOT.	SPACE UNDER HEAD 	0.004 MAX DIMPLE OR COUNTERSINK NOT ACCEPTABLE IF RECESION EXCEEDS 0.004" AS SHOWN.															
BULBED-LOK RIVET IN MAXIMUM GRIP 	ACCEPTABLE AS SHOWN.	COUNTERSINK OR DIMPLE TOO DEEP 	NOT ACCEPTABLE IF PROTRUSION EXCEEDS 0.010.															
ACCEPTABLE APPEARING VISIBLE HEAD  STRUCTURALLY INADEQUATE BLIND HEAD  TOO SHORT GRIP LENGTH	NOT ACCEPTABLE. RIVET GRIP LENGTH TOO SHORT FOR MATERIAL THICKNESS.	FLUSH HEAD PROTRUDING ABOVE MATERIAL 	0.010 MAX CLOSER LIMITS SHALL APPLY IF SPECIFIED ON DRAWING.															
		SHANK SPLIT 	NOT ACCEPTABLE.															
		RIVET SPINDLE PULLS THRU OR BREAKS HIGH 	NOT ACCEPTABLE IF SPINDLE HEIGHT EXCEEDS THE LIMITS OF FIGURE 3-30. CAUSE: RIVET INSTALLED IN OVERSIZE HOLE. RIVET LENGTH TOO LONG. MALADJUSTED RIVET GUN.															

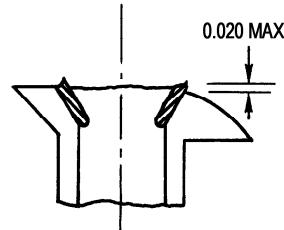
Figure 3-29. Olympic-Lok and Wiredrawn Blind Fastener Inspection



SPINDLE LIMITS



RIVET SIZE	-4 DIA.	-5 DIA.	-6 DIA.	-8 DIA.
A MAX	0.015	0.020	0.025	0.030



A SLIGHT LOCKRING "FLASH" CAUSED BY THE PRESSURES NECESSARY TO DRIVE THE LOCKRING IS ACCEPTABLE WITHIN THE LIMIT SHOWN.

LOCKRING LIMIT

LEGEND

- ① LOCKRING SHOULD NEVER BE HIGHER THAN 0.020 FROM TOP OF RIVET HEAD WHEN SPINDLE IS ABOVE RIVET HEAD. IF SPINDLE IS FLUSH OR BELOW FLUSH WITH RIVET HEAD, LOCKRING SHOULD NEVER BE MORE THAN "A" HIGHER THAN SPINDLE.

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Figure 3-30. Blind Fastener Spindle and Locking Flushness Limits

3-87. JO-BOLTS. Jo-Bolt fasteners are used on difficult riveting jobs where access to one side of the work is impossible. The Jo-Bolt consists of three parts: an aluminum alloy or steel nut, a threaded alloy steel screw, and a corrosion-resistant steel sleeve which are factory preassembled. As the Jo-Bolt is installed the screw is turned while the nut is held causing the sleeve to expand over the end of the nut, forming the blind head and clamping against the material. When driving is complete, the bolt wrenching end breaks off from flush to below the head. The head styles available for Jo-Bolts are the hexagon protruding head, the 100 degree flush head, and the 100 degree flush millable head. Refer to section VI for oversized repair fasteners. Tapered shank blind fasteners are also used. Removal and installation of tapered shank blind fasteners requires special tools and certified personnel.

3-88. Identification. See figure 3-31. Jo-Bolts are identified by a basic part number which represents the type and style of Jo-Bolt, nominal diameter and the grip range. See figure for breakdown of Jo-Bolt basic part number and for the nominal diameter of the different sizes of Jo-Bolts and the grip range for the grip length dash numbers.

3-89. Requirements.

a. Minimum edge distance for flush or protruding head Jo-Bolts is two times the nominal diameter plus 0.060 inch or as specified differently on a repair procedure or when replacing existing Jo-Bolts.

b. Minimum spacing between protruding head Jo-Bolts shall not be less than three and one half times the nominal diameter. Spacing between flush and millable head Jo-Bolts shall not be less than four times the Jo-Bolt diameter.

c. Hole sizes for Jo-Bolts are listed below:

Jo-Bolt Diameter	Hole Size	
	Minimum	Maximum
5/32	0.1645	0.1675
3/16	0.1990	0.2020
1/4	0.2600	0.2630
5/16	0.3120	0.3150

Jo-Bolt Diameter	Minimum	Hole Size Maximum
3/8	0.3750	0.3780

d. The maximum angled surface against which the Jo-Bolt sleeve may be formed is 7 degrees, except for 3/8 diameter Jo-Bolts, the maximum angled surface is 4 degrees.

e. Holes for Jo-Bolts should be drilled under size and then brought up to final size by reaming.

3-90. Removal. See figure 3-32.

- a. Select a drill motor that does not turn over 500 rpm for drilling out Jo-Bolts.
- b. Select drills for size Jo-Bolt to be drilled out from the below list:

Jo-Bolt	Pilot Drill	Shank Drill
5/32	40	23
3/16	30	12
1/4	21	D
5/16	17	M
3/8	5	23/64

c. To remove Jo-Bolts that are tight and do not rotate, select a pilot drill from step b. for size of Jo-Bolts to be removed, and drill a pilot hole just below the head and shank juncture. Use a shank drill from shank drill column in step b. for same size Jo-Bolt and drill Jo-Bolt to depth of pilot drill hole. Using a hammer and nominal size punch, sever head of Jo-Bolt and drive out shank and blind head.

d. To remove Jo-Bolts that are loose and rotate, select a pilot drill from step b. for size Jo-Bolt to be removed. Prevent Jo-Bolts from turning by using a drill bushing having dogs to engage the head slots for flush Jo-Bolts and a wrench for hexagon head Jo-Bolts. Drill completely through shank of Jo-Bolt severing the bolt head. Remove the remaining nut out of the hole with a punch.

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■ 13-91. Installation. See figure 3-33.

- a. Secure materials to be joined firmly into position.
- b. Measure the thickness of the materials using a Jo-Bolt hook gage, and select a Jo-Bolt having the correct grip range for thickness of material being joined. See figure for Jo-Bolt grip range diagram.
- c. Insert Jo-Bolt in the hole. Jo-Bolts should be easily pushed into a properly prepared hole. In no case shall a Jo-Bolt be driven forcibly into the hole. A very light tap fit is allowable in aluminum alloy parts but not in steel parts.
- d. Install Jo-Bolt using either hand tools or pneumatic gun. Select the correct nose and wrench adapter for the size Jo-Bolt to be installed and secure them in either the hand tool or pneumatic gun. Pneumatic gun and hand tools, nose and wrench adapters, are not interchangeable.
- e. Place the nose adapter of the driving tool over the stem portion of the Jo-Bolt so the nose adapter engages the head of the Jo-Bolt.



Failure to hold the driving tool perpendicular against the Jo-Bolt and to the surface of the work may result in premature stem breakoff before the Jo-Bolt is tight.

- f. Holding driving tool perpendicular against Jo-Bolt and to work surface, as power is applied, the stem of the Jo-Bolt is turned while the nut is held. The sleeve, compressed between stem head and tapered end of the nut, is drawn over the end of the nut and is expanded forming the blind head against the inner surface of the part.
- g. When the sleeve is drawn up tight, the stem is snapped off and ejected completing the driving operation.

- h. Millable head Jo-Bolts shall be inspected before they are shaved. The millable Jo-Bolt may be shaved flush with the material surface using a standard rivet shaver equipped with a carbide cutter. For best results, use a shaver that turns at least 10,000 rpm.

3-92. Inspection. See figure 3-34.

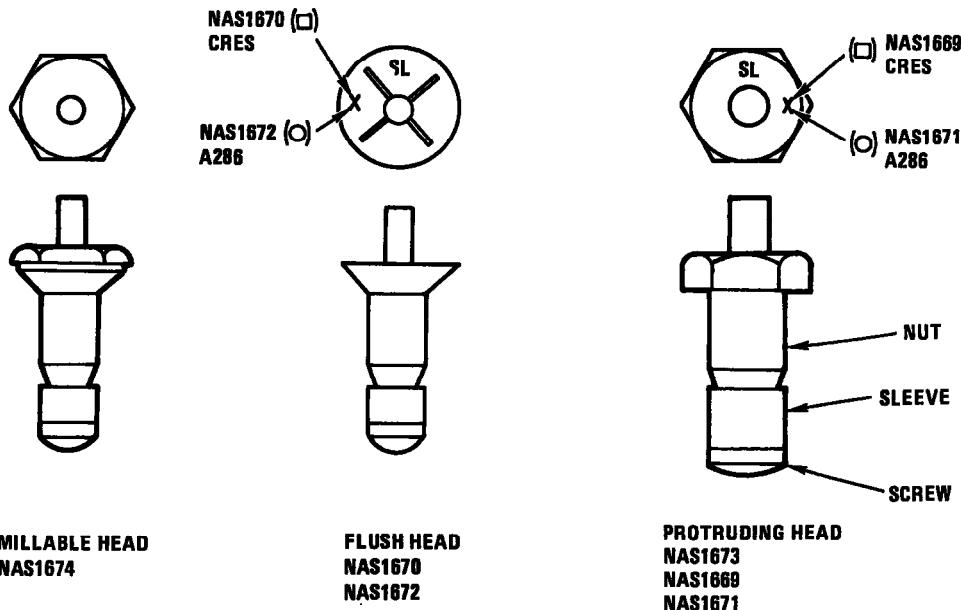
- a. In areas where the Jo-Bolt blind head can be seen after installation, they shall be visually inspected.
- b. Jo-Bolt stem breakoff shall be within the limits shown in figure. The Jo-Bolt will be replaced if the stem is not within these limits.
- c. Jo-Bolts shall be individually checked for looseness as listed below:

NOTE

Torque will be applied in a counterclockwise direction only. The Jo-Bolt resistance to the torque values must be met whether tested on wet or cured sealant, except 5/32-inch Jo-Bolts are required to withstand only 2 inch-pounds maximum torque. If the Jo-Bolt turns when the light torque is applied, it shall be removed and replaced.

1. Using the driving tool nose adapter with a torque wrench, the Jo-Bolt shall be capable of withstanding the below torque requirements:

Jo-Bolt Diameter	Torque Limits Inch-Pounds
5/32	4
3/16	6
1/4	10
5/16	20
3/8	30



NAS1673 **-4 DL** **6**
 BASIC PART NUMBER
 JO-BOLT DIAMETER
 (SEE CHART I)
 GRIP LENGTH OF JO-BOLT
 (SEE CHART II)

CHART II

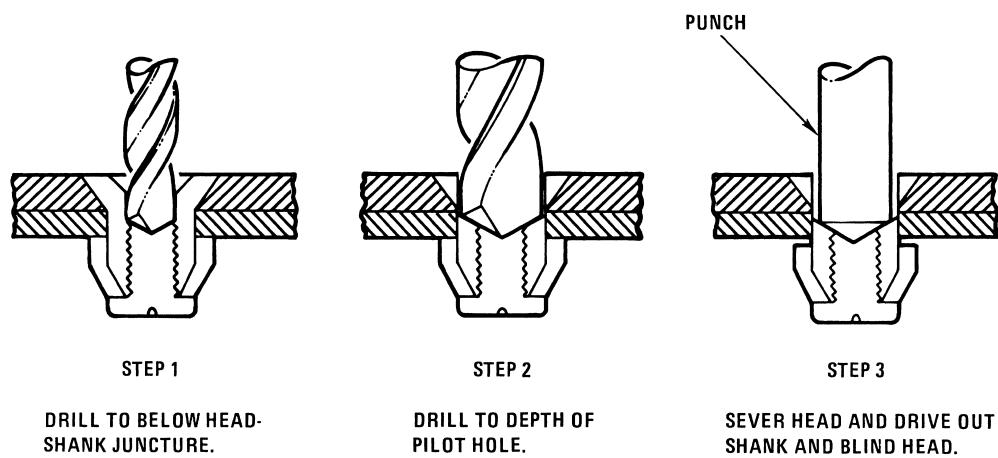
CHART I

JO-BOLT DIAMETER DASH NUMBER	JO-BOLT NOMINAL DIAMETER
-08DL	0.165
-3DL	0.199
-4DL	0.260
-5DL	0.312
-6DL	0.375

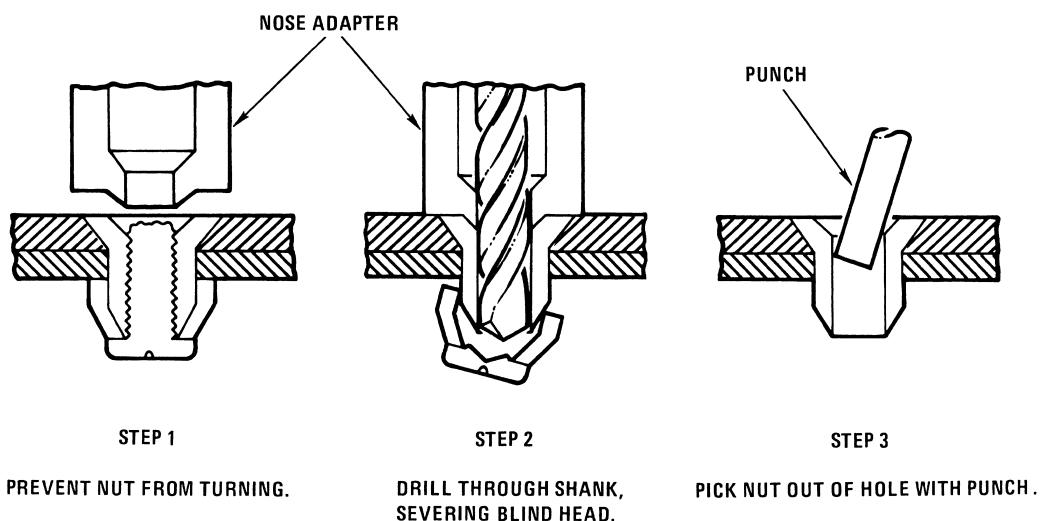
FASTENER LENGTH DASH NUMBER	GRIP LENGTH RANGE
1	0.031 - 0.093
2	0.094 - 0.156
3	0.157 - 0.219
4	0.220 - 0.281
5	0.282 - 0.344
6	0.345 - 0.406
7	0.407 - 0.469
8	0.470 - 0.531
9	0.532 - 0.594
10	0.595 - 0.656
11	0.657 - 0.719
12	0.720 - 0.781
13	0.782 - 0.844
14	0.845 - 0.906
15	0.907 - 0.969
16	0.970 - 1.031

Figure 3-31. Jo-Bolt Identification

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REMOVAL WHEN JO-BOLT IS CLAMPED UP TIGHT



REMOVAL WHEN JO-BOLT TURNS IN HOLE WHEN DRILLING

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Figure 3-32. Jo-Bolt Removal

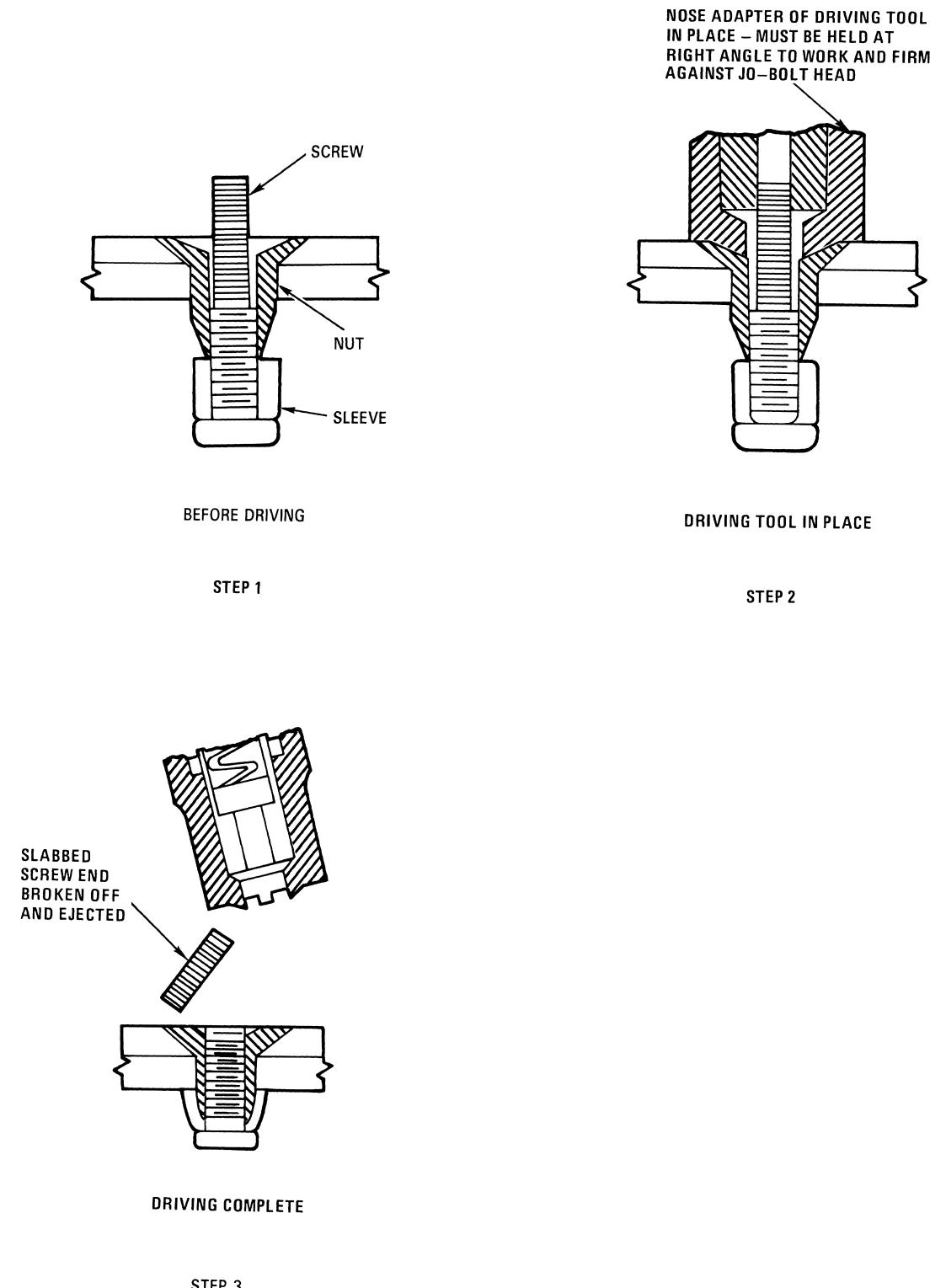
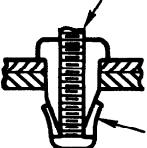
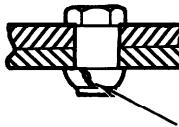
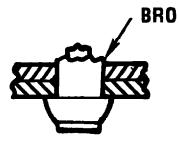
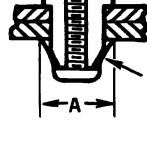


Figure 3-33. Jo-Bolt Installation

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CSTO SR1F-15SA-3-1

CONDITION	PROBABLE CAUSE	CONDITION	PROBABLE CAUSE
 STEM BREAK OFF HIGH SLEEVE NOT PULLED UP TO MATERIAL	GRIP LENGTH OF FASTENER TOO LONG. DISPOSITION: REJECT	 SPLIT SLEEVE	POOR SLEEVE MATERIAL OR SLEEVES SCRATCHED OR NICKED. DISPOSITION: REJECT
 STEM BREAK OFF LOW OR WITHIN STEM BREAK OFF REQUIREMENTS 4 SLEEVE NOT PULLED UP TO MATERIAL	PREMATURE STEM BREAK-OFF RESULTING FROM DIRTY OR IMPROPERLY LUBRICATED FASTENER. DISPOSITION: REJECT	 VOID 1	DISPOSITION: ACCEPTABLE WHEN PRODUCED BY A DIMENSIONALLY ACCEPTABLE FASTENER INSTALLED WITHIN SPECIFIED FLUSHNESS LIMITS. NOTE: THIS VOID WILL NOT BE CONCENTRIC WHEN THE FASTENERS ARE INSTALLED ON A CONTOURED SURFACE.
 LOW STEM BREAK OFF	GRIP LENGTH OF FASTENER TOO SHORT. DISPOSITION: REJECT	 INTERNAL SCREW HEAD PULLED OFF	FAULTY FASTENER. DISPOSITION: REJECT
 BUCKLED SLEEVE	FAULTY FASTENER, SLEEVES TOO SOFT. DISPOSITION: REJECT	 NUT HEAD BROKEN OFF	FAULTY FASTENER DISPOSITION: REJECT
 FLARED SLEEVE	FAULTY FASTENER, SLEEVES TOO SOFT. DISPOSITION: REJECT IF DIMENSION A EXCEEDS THE FOLLOWING: 6/32 - 0.244 5/16 - 0.427 3/16 - 0.300 3/8 - 0.516 1/4 - 0.384		

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Figure 3-34. Jo-Bolt Inspection (Sheet 1 of 3)

JO-BOLT SIZE	JO-BOLT	A	GAGE NO.									
-08 5/32	1670-08L PLT110-5	+0.020 -0.068	4F5	1672-08L PLT120-5	+0.082 -0.006	A4F5LS	1669-08L PLT210-5	+0.000 +0.088	3P6	1671-08L PLT220-5	+0.000 +0.088	A3P5
-3 3/16	1670-3L PLT110-6	+0.015 -0.073	4F6	1672-3L PLT120-6	+0.072 -0.016	A4F6LS	1669-3L PLT210-6	+0.010 +0.098	3P6	1671-3L PLT220-6	+0.015 +0.103	A3P6
-4 1/4	1670-4L PLT110-8	+0.010 -0.078	4F8	1672-4L PLT120-8	+0.072 -0.026	A4F8LS	1669-4L PLT210-8	+0.047 +0.135	3P8	1671-4L PLT220-8	+0.032 +0.130	A3P8
-5 5/16	1670-5L PLT110-10	+0.010 -0.083	4F10	1672-5L PLT120-10	+0.072 -0.031	A4F10LS	1669-5L PLT210-10	+0.043 +0.146	3P10	1671-5L PLT220-10	+0.027 +0.130	A3P10
-6 3/8	1670-6L PLT110-12	+0.010 -0.093	4F12	1672-6L PLT120-12	+0.072 -0.031	A4F12LS	1669-6L PLT210-12	+0.049 +0.152		1671-6L PLT220-12	+0.027 +0.130	A3P12

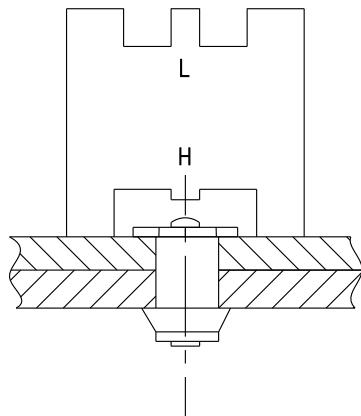
JO-BOLT SIZE	JO-BOLT	A	GAGE NO.	JO-BOLT	A	GAGE NO.
-08 5/32	1673-08L PLT230-5	+0.000 +0.088	3P5	1674-08L PLT130-5	+0.000 +0.088	3P5
-3 3/16	1673-3L PLT230-6	+0.015 +0.103	3P6	1674-3L PLT130-6	+0.010 +0.098	3P6
-4 1/4	1673-4L PLT230-8	+0.047 +0.135	3P8	1674-4L PLT130-8	+0.010 +0.098	3P6

LEGEND

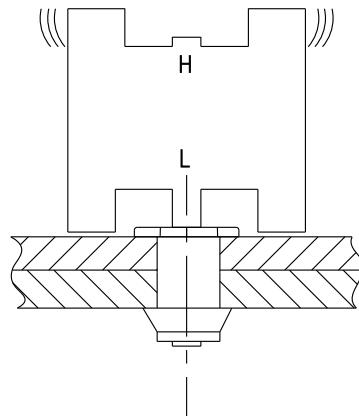
- 1 PROTRUDING HEAD AND FLUSH HEAD FASTENERS HAVING A GAP UNDER ONE SIDE OF THE HEAD WHICH WILL PERMIT INSERTION OF A 0.005 FEELER GAGE TO THE SHANK SHALL BE REJECTED. GAPS WHICH WILL PERMIT INSERTION OF A 0.004 FEELER GAGE ARE ACCEPTABLE PROVIDED NO MORE THAN 40 PERCENT OF THE CIRCUMFERENCE HAS A GAP.
- 2 MEASURED FROM SKIN SURFACE.
- 3 MEASURED FROM TOP OF HEAD OR NUT.
- 4 IF BLIND SIDE OF BOLT IS NOT VISIBLE (WITHOUT DISASSEMBLY, BORESCOPE, ETC.), USE BREAKOFF GAGE ACCEPTANCE CRITERIA. A MIRROR MAY BE USED TO VIEW BLIND SIDE OF BOLT IF ACCESS IS ALLOWED.

Figure 3-34. Jo-Bolt Inspection (Sheet 2)

USE OF INSPECTION GAGES



HIGH BREAK-OFF
CHECK GAGE MUST NOT ROCK



LOW BREAK-OFF
CHECK GAGE MUST ROCK

NOTES:

1. GAGES SHOWN ON PROTRUDING HEAD BLIND BOLT BUT METHOD IS THE SAME FOR FLUSH HEAD BLIND BOLT.
2. TO CHECK HIGH BREAK-OFF STEM, LEGS OF GAGE MUST STRADDLE BOTH SIDES OF SCREW, AND NOT ROCK.
3. TO CHECK LOW BREAK-OFF OF STEM, LEGS OF GAGE MUST STRADDLE BOTH SIDES OF SCREW, AND BE ABLE TO ROCK.



MAJOR CHANGE

SAN301-03-127-003

Figure 3-34. Jo-Bolt Inspection (Sheet 3)

3-93. **TAPER-LOKS.** See figures 3-35 thru 3-52. The Taper-Lok fastener, standard and sealant injection, consists of a close tolerance tapered pin installed in a smaller precision tapered hole and held in place with a mating nut. The interference fit provides greatly increased joint fatigue life. Taper-Loks are used only where fatigue benefits are essential and each Taper-Lok must be closely controlled to realize these full benefits. To be sure of control, personnel should become thoroughly familiar with Taper-Lok group numbering system, grip length selection, preparation of precision tapered holes, and proper installation of the tapered pin. The sealant injection Taper-Lok and standard Taper-Lok are the same, except for the sealing capabilities of the sealant injection Taper-Lok. Removal and installation of Taper-Loks requires special tools and certified personnel. Refer to section VI for oversize repair Taper-Lok information.

3-94. Special Tools.

Adapter, Coolant

IE12-201-3, 5/32 and 3/16

IE12-201-6, 1/4 to 3/8

IE12-201-7, 7/16

Bolt, Tapered, Slave

TLD501-05-6, 5/32 Deep, Group 1

TLD501-3-8, 3/16 Deep, Group 1

TLD501-3-11, 3/16 Deep, Group 2

TLD501-4-10, 1/4 Deep, Group 1

TLD501-4-14, 1/4 Deep, Group 2

TLD501-5-11, 5/16 Deep, Group 1

TLD501-5-14, 5/16 Deep, Group 2

TLD501-6-9, 3/8 Deep, Group 1

Cage Assembly, Countersink

TLA4901-24, 5/32 and 3/16

TLA4901-38, 1/4 to 3/8

TLA4903-38, 7/16

C-clamp, 6 inch minimum

Countersinks

T.F.I.M.25.0067-101, 5/32 100°, Group 1

T.F.I.M.25.0067-102, 3/16 100°, Group 1

T.F.I.M.25.0067-104, 1/4 100°, Group 1

T.F.I.M.25.0067-105, 5/16 100°, Group 1

T.F.I.M.25.0067-107, 7/16 100°, Group 1

T.F.I.M.25.0067-201, 5/32 100°, Group 2

T.F.I.M.25.0067-202, 3/16 100°, Group 2

T.F.I.M.25.0067-204, 1/4 100°, Group 2

T.F.I.M.25.0067-205, 5/16 100°, Group 2

T.F.I.M.25.0067-207, 7/16 100°, Group 2

T.F.I.M.25.0067-301, 5/32 100°, Group 3
 T.F.I.M.25.0067-302, 3/16 100°, Group 3
 T.F.I.M.25.0067-304, 1/4 100°, Group 3
 T.F.I.M.25.0067-305, 5/16 100°, Group 3
 T.F.I.M.25.0067-307, 7/16 100°, Group 3
 T.F.I.M.25.0067-401, 5/32 100°, Group 4
 T.F.I.M.25.0067-402, 3/16 100°, Group 4
 T.F.I.M.25.0067-404, 1/4 100°, Group 4
 T.F.I.M.25.0067-405, 5/16 100°, Group 4
 T.F.I.M.25.0067-407, 7/16 100°, Group 4

Gage, Bearing Pin

TD216K4-301, 5/32, Group 1 and 2

TD216K4-302, 3/16, Group 1 and 2

TD216K4-402, 3/16, Group 2

TD216K4-404, 1/4, Group 1 and 2

TD216K4-405, 5/16, Group 1 and 2

TD216K4-406, 3/8, Group 1 and 2

TD216K4-407, 7/16, Group 1 and 2

Gage, Countersink

100°-1, 5/32 and 3/16

100°-2, 1/4 and 5/16

100°-3, 3/8 and 7/16

Gage, Protrusion

TD216J4-1, 5/32

TD216J4-2, 3/16

TD216J4-4, 1/4

TD216J4-5, 5/16

TD216J4-6, 3/8

TD216J4-7, 7/16

TD5001B-1E, 5/32

TD5001C-1E, 3/16 to 7/16

Gage, Protrusion Pin

TLG5190-1-05, 5/32, Group 1

TLG5190-1-3, 3/16, Group 1

TLG5190-1-4, 1/4, Group 1

TLG5190-1-5, 5/16, Group 1

TLG5190-1-6, 3/8, Group 1

TLG5190-1-7, 7/16, Group 1

TLG5190-2-05, 5/32, Group 2

TLG5190-2-3, 3/16, Group 2

TLG5190-2-4, 1/4, Group 2

TLG5190-2-5, 5/16, Group 2

TLG5190-2-6, 3/8, Group 2

TLG5190-2-7, 7/16, Group 2

TLG5190-3-05, 5/32, Group 3

TLG5190-3-3, 3/16, Group 3

TLG5190-3-4, 1/4, Group 3

TLG5190-3-5, 5/16, Group 3

TLG5190-3-6, 3/8, Group 3

TLG5190-3-7, 7/16, Group 3

TLG5190-4-3, 3/16, Group 4

TLG5190-4-4, 1/4, Group 4	T.F.I.M.25.0052-306, 3/8 Protruding Head, Group 3
TLG5190-4-5, 5/16, Group 4	T.F.I.M.25.0052-404, 1/4 Protruding Head, Group 4
TLG5190-4-6, 3/8, Group 4	T.F.I.M.25.0059-101, 5/32 Flush Head Drill and Countersink, Group 1
TLG5191-1-3, 3/16, Group 1	T.F.I.M.25.0059-102, 3/16 Flush Head Drill and Countersink, Group 1
TLG5191-1-5, 5/16, Group 1	T.F.I.M.25.0059-104, 1/4 Flush Head Drill and Countersink, Group 1
TLG5191-2-3, 3/16, Group 2	T.F.I.M.25.0059-105, 5/16 Flush Head Drill and Countersink, Group 1
TLG5191-2-5, 5/16, Group 2	T.F.I.M.25.0059-107, 7/16 Flush Head Drill and Countersink, Group 1
TLG5191-3-3, 3/16, Group 3	T.F.I.M.25.0059-201, 5/32 Flush Head Drill and Countersink, Group 2
TLG5191-3-5, 5/16, Group 3	T.F.I.M.25.0059-202, 3/16 Flush Head Drill and Countersink, Group 2
TLG5191-4-3, 3/16, Group 4	T.F.I.M.25.0059-204, 1/4 Flush Head Drill and Countersink, Group 2
TLG5191-4-5, 5/16, Group 4	T.F.I.M.25.0059-205, 5/16 Flush Head Drill and Countersink, Group 2
Gage, Protrusion Thread	Reamers
TD216E5-05, 5/32	T.F.I.M.25.0051-102, 3/16 Flush Head, Group 1
TD216E5-3, 3/16	T.F.I.M.25.0051-104, 1/4 Flush Head, Group 1
TD216E5-4, 1/4	T.F.I.M.25.0051-105, 5/16 Flush Head, Group 1
TD216E5-5, 5/16	T.F.I.M.25.0051-202, 3/16 Flush Head, Group 2
TD216E5-6 3/8	T.F.I.M.25.0051-204, 1/4 Flush Head, Group 2
TD216E5-7, 7/16	T.F.I.M.25.0051-205, 5/16 Flush Head, Group 2
	T.F.I.M.25.0051-207, 7/16 Flush Head, Group 2
	T.F.I.M.25.0051-301, 5/32 Flush Head, Group 3
	T.F.I.M.25.0051-302, 3/16 Flush Head, Group 3
	T.F.I.M.25.0051-304, 1/4 Flush Head, Group 3
	T.F.I.M.25.0051-305, 5/16 Flush Head, Group 3
	T.F.I.M.25.0051-307, 7/16 Flush Head, Group 3
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	T.F.I.M.25.0051-404, 1/4 Flush Head, Group 4
	T.F.I.M.25.0051-405, 5/16 Flush Head, Group 4
	T.F.I.M.25.0052-102, 3/16 Protruding Head, Group 1
	T.F.I.M.25.0052-104, 1/4 Protruding Head, Group 1
	T.F.I.M.25.0052-105, 5/16 Protruding Head, Group 1
	T.F.I.M.25.0052-106, 3/8 Protruding Head, Group 1
	T.F.I.M.25.0052-202, 3/16 Protruding Head, Group 2
	T.F.I.M.25.0052-204, 1/4 Protruding Head, Group 2
	T.F.I.M.25.0052-205, 5/16 Protruding Head, Group 2
	T.F.I.M.25.0052-206, 3/8 Protruding Head, Group 2
	T.F.I.M.25.0052-302, 3/16 Protruding Head, Group 3
	T.F.I.M.25.0052-304, 1/4 Protruding Head, Group 3
	T.F.I.M.25.0052-305, 5/16 Protruding Head, Group 3
	Socket, 7/8 to 1 inch, or equivalent bushing Slide, Hammer Assembly
	TD5006A-1E-101, 1/4 to 7/16
	TD5006A-1E-102, 5/32 and 3/16

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Tool, Knockout
TLA4150-05, 5/32
TLA4150-3, 3/16
TLA4150-4, 1/4
TLA4150-5, 5/16
TLA4150-6, 3/8
TLA4150-7, 7/16

3-95. Materials.

Alcohol, Cetyl, NDC00527-0610-16
Block, sponge rubber
Cloth, cheesecloth, CCC-C-440 TY1CL1
Coolant, Isopar M
Bearing dye, Dykem, Hi-Spot Blue, Number 107
(Nondrying)
Scuff pad, 0.010 inch thick titanium or aluminum
Sealing compound, AMS 3277 TY1 CLA-1/2
Solvent, cleaning compound, MIL-PRF-680 TY2

3-96. **Identification.** Taper-Loks are divided into groups according to nominal fastener diameter and grip length. The minimum diameter of shank end reflects the group into which the Taper-Lok will fall. For Taper-Lok part number and fastener head markings, see figure 3-35. Taper-Lok nuts and self aligning washers used with Taper-Lok bolts are identified by a standard part number. See figure 3-35 for part number. For Taper-Lok fastener grip lengths, see figure 3-36. To produce the correct tapered hole for Taper-Lok fasteners a drill reamer is used to drill the hole. To determine drill reamer size to use, the Taper-Lok fastener group and nominal diameter are used. See figures 3-40 through 3-46 for drill reamer part numbers. The hand reamers used for hole cleanup or enlarging to next group size also use the Taper-Lok group and nominal diameter to select correct size reamer. See figure 3-47.

3-97. Requirements.

- a. Parts shall be clamped, temporarily bolted or held tightly together to minimize separation during drilling, taper reaming, hand reaming or inspection of parts.
- b. Taper-Lok fasteners may be increased to first oversize without engineering approval, however, second oversize requires engineering approval.
- c. Taper-Lok fasteners are supplied lubricated and shall be kept in original container until used.

d. Taper-Lok fastener holes shall be round, smooth, and free of chips, longitudinal scratches, rifling or other imperfections.

e. Taper-Loks will be torqued to the limits in figure 3-50.

3-98. **Removal.** See figure 3-37. Remove Taper-Lok as follows:

NOTE

Do not reuse removed nut washer assembly.

- a. Remove Taper-Lok nut.
- b. The Taper-Lok fastener removal can be by a knockout tool or C-clamp.
 1. Knockout tool.
 - (a) Install knockout tool on threaded end of Taper-Lok.



Do not use rivet gun to remove fasteners when specified in procedures to avoid damaging skin or structure. If there is a possibility of the hammer or rivet gun slipping off the knockout tool, protect the surrounding skin or structure.

- (b) Using a hammer or rivet gun, tap knockout tool to relieve interference between Taper-Lok and hole and remove Taper-Lok.
2. C-clamp.



Care shall be taken to place C-clamp pads directly over center of fastener and a scuff pad is required between socket and skin or structure, or damage to fastener threads and skin or structure may result.

- (a) Press out Taper-Lok fastener using C-clamp and socket combination and centered directly over the fastener. Put a

scuff pad between the socket and skin or structure to prevent socket impressions on skin or structure.

- c. The removed nut shall be scrapped. The removed pin can be salvaged, if it is undamaged, and can be lubricated.

3-99. Alternate Removal. Use alternate procedure only when other procedures cannot be used.

Remove Taper-Lok as follows:



Use care during drilling and/or tapping operations to prevent damage to wing skin and spar.

- a. Remove Taper-Lok nut.
- b. Using a drill guide, centered on Taper-Lok head, and securely attached to skin, drill and tap Taper-Lok head with a thread size which will fit into the Taper-Lok without damaging tapered hole.
- c. Fabricate a puller using a high strength bolt with thread size of hole tapped in Taper-Lok, a socket large enough to clear the Taper-Lok head and washer.
- d. Remove Taper-Lok from hole using puller.
- e. Removed Taper-Lok and nut shall be scrapped.

3-100. Bearing Pin Check (Blue Pin). See figures 3-48 and 3-49. Blue pin check all Taper-Lok fastener holes as follows:

- a. Select applicable slide hammer assembly. See figure 3-49.

NOTE

Make sure check pin is free from surface defects, chafed areas, nicks, scratches or buildup of material.

- b. Select applicable check pin.

- c. Apply a thin, uniform coat of bearing dye to shank of check pin with a pad of cheesecloth or a sponge rubber block.

WARNING

Solvent, cleaning compound, may cause eye, skin, and respiratory irritation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Use with adequate ventilation. Avoid contact with eyes, skin and clothing. Wash thoroughly after handling.

- d. Clean fastener hole with cheesecloth dampened with solvent.

NOTE

Do not insert check pin into fastener hole without checking to verify that hole is clean.

- e. Insert check pin into fastener hole.
- f. Tap pin into fastener hole until pin is seated.
- g. Remove excess bearing dye outside fastener hole.

NOTE

Do not rotate pin during removal because pin interpretation results may be false.

- h. Remove check pin from fastener hole using slide hammer.
- i. Check bearing pattern on check pin for acceptance. See figure 3-49 for acceptance patterns.
- j. If pattern is unacceptable, hand ream hole using applicable hand reamers, while continually monitoring Taper-Lok protrusion and countersink depth.
- k. When bearing check is complete, clean bearing dye from hole using cheesecloth dampened with solvent.

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3-101. **Hole Preparation Criteria.** See figures 3-38 thru 3-47. Drilling of holes or minor hole cleanup can be done by power or hand reaming as follows:

- a. Hand reaming.
 1. For minor hole cleanup, use applicable straight flute reamer. For major hole cleanup or hand reaming a hole oversize, alternately use straight flute reamer and spiral flute reamer.
 2. Select the correct size hand reamer and install in applicable T-handle. See figure 3-46 for hand reamers.



The six fluted straight reamer has limited chip clearance and must be removed from hole and cleaned frequently during reaming operation.

3. Insert reamer in hole and hand ream.
 4. During insertion and removal of reamer from hole, keep reamer turning at all times.
 5. When using hand reamer to increase countersink depth, apply a liberal coating of cetyl alcohol lubricant, or a thick solution of cetyl alcohol dissolved in solvent to flutes of reamer to prevent an oversize hole condition after using reamer to increase countersink depth.
- b. Power reaming.
1. Completely remove any rifling from hole with a hand reamer before using applicable power reamer to increase hole size for an oversize fastener.
 2. Assemble reamer countersink with microstop countersink and drill motor.

NOTE

A complete checkout of microstop countersink drilling technique and test hole acceptance is required before any rework on aircraft structure.

3. Drill a minimum of two test holes in a panel of the same material as on aircraft to set

depth of microstop countersink and to verify test hole acceptance.

4. Place base of tool firmly against structure and align drill reamer with hole.



Because of the low RPM and increased power, excess torque is transferred to drill motor because the drill reamer is cutting on all sides and bottom.

5. Using Isopar M spray mist coolant while drilling, maintain a firm grip on the drill motor and apply a constant pressure until reamer countersink has bottomed out. Insert alignment pins. See figure 3-38.
6. Hand reaming may be required to clean up hole to satisfy acceptance criteria.

WARNING

Solvent, cleaning compound, may cause eye, skin, and respiratory irritation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Use with adequate ventilation. Avoid contact with eyes, skin and clothing. Wash thoroughly after handling.

- c. Clean finished hole with cheesecloth dampened with solvent.
- d. Do bearing pin check on completed holes. Refer to paragraph 3-100.
- e. Install Taper-Lok. Refer to paragraph 3-102.

3-102. **Installation.** See figure 3-37. Install Taper-Lok as listed below:



Slave bolts shall be clean and lubricated before installation to prevent damage to tapered hole.

- a. Align and secure parts by installing slave bolts, as required, in tapered holes. For correct slave bolts, see figure 3-39.



Solvent, cleaning compound, may cause eye, skin, and respiratory irritation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Use with adequate ventilation. Avoid contact with eyes, skin and clothing. Wash thoroughly after handling.

- b. Clean fastener hole with cheesecloth dampened with solvent.
- c. Visually inspect fastener hole for damage. If damage exists, refer to paragraph 3-100 for rework.

NOTE

Salvaged Taper-Loks shall be lubricated before installation.

- d. Install standard or sealant injection Taper-Lok.
- 1. Standard Taper-Lok.
 - (a) Insert Taper-Lok in hole and seat Taper-Lok with firm thumb pressure or use C-clamp as shown on figure 3-37.
- e. If Taper-Lok is to be installed wet with sealant, do the below:

WARNING

Sealing compound, may cause eye, skin, and respiratory irritation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Use with adequate ventilation. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

- 1. Sealant injection Taper-Lok.
 - (a) Measure depth to sealant channel in hole.
 - (b) Make sure correct sealant injection fastener is installed.
 - (c) Align index marks on head of Taper-Lok with sealant channel.
 - (d) Seat sealant injection Taper-Lok with firm thumb pressure or use C-clamp as shown on figure 3-37.
- f. Inspect Taper-Lok head protrusion. See figure 3-51 for requirements.
- 1. Standard Taper-Lok.
 - (a) Remove Taper-Lok from hole.
 - (b) Dip threaded end of Taper-Lok to one half of the shank in sealant.
 - (c) Install Taper-Lok in hole.
- 2. Sealant injection Taper-Lok.
 - (a) Apply sealant to countersink surface or the protruding shank of sealant injection Taper-Lok after inserting Taper-Lok in hole.
 - g. Install Taper-Lok washer and nut.
 - h. Torque nut using socket and torque value as shown on figure 3-50.
 - i. Remove excess sealant, as required, using cheesecloth dampened with solvent.

- j. Check thread protrusion to be sure correct grip length Taper-Lok has been installed. See figure 3-51 for limits.
- k. Visually inspect installed nut for cracks and replace and retorque any damaged nut. See figure 3-50 for torque value.
- l. Examine Taper-Lok head and nut to verify they are fully seated. Gaps under Taper-Lok head or nut which will allow insertion of a 0.0015 inch feeler gage to shank are unacceptable.
- m. Check Taper-Lok flushness. See figure 3-52 for flushness requirements.

3-103. **Oversize Hole Criteria.** When a Taper-Lok is removed from a hole, the hole may gage slightly oversize. This is caused by plastic deformation of material around hole because of high interference fit of the Taper-Lok. Acceptance of a hole, which gages oversize or the need for rework of hole, is based on the information below.



The oversize hole condition permitted is not acceptable if an oversize hole is reworked for an oversize Taper-Lok.

The oversize is acceptable for reinstallation of removed Taper-Lok or a new Taper-Lok of the same size, if protrusion of Taper-Lok is within limits specified in figure 3-51. If hole is oversize to the extent that Taper-Lok protrusion is less than limits in figure, the hole must be reworked for an oversize Taper-Lok.

3-104. **TAPERED SHANK BLIND FASTENERS.** See figures 3-53 and 3-54. Tapered shank blind fasteners have the same shank and flush head dimensions as Taper-Lok fasteners and are installed in holes prepared to the same specifications.

3-105. **Special Tools.** Special tools used for Taper-Lok hole preparation are also used to prepare holes for tapered shank blind fasteners. For Taper-Lok special tools, refer to paragraph 3-94. The following special tools are used for tapered shank blind fasteners but not with Taper-Lok fasteners.

- Adapter, Nose
HW2002, 3/16
HW2602, 1/4
HW3122, 5/16
HW3752, 3/8
- Adapter, Wrench
HW2001, 3/16
HW2601, 1/4
HW3121, 5/16
HW3751, 3/8
- Gun, Rivet
Jiffy Model 300, or equivalent

- Ratchet Handle
HW202

- Set, Driving
TD154R3-2, 3/16
TD154R3-3, 1/4
TD154R3-4, 5/16
TD154R3-5, 3/8

3-106. Materials.

- Alcohol, Cetyl, NDC00527-0610-16
- Block, sponge rubber
- Cloth, cheesecloth, CCC-C-440 TY1CL1
- Coolant, Isopar M
- Dykem, Hi-Spot Blue, Number 107 (Non-drying)
- Scuff pad, 0.010 titanium or aluminum
- Sealing compound, ASTM D5363 TYAN0121
- Solvent, cleaning compound, MIL-PRF-680 TY2

3-107. **Identification.** See figure 3-53 for tapered shank blind fastener identification.

3-108. **Requirements.** Tapered shank blind fasteners are installed in holes prepared to the same specifications as Taper-Loks. Refer to paragraphs 3-97, 3-100, 3-101, and 3-103.

3-109. Removal.

WARNING

Drill and reaming operations create airborne particles which can be hazardous to the eyes. Eye protection must be worn at all times.

- a. Drill out core bolt using Jo-bolt type removal tool. Refer to paragraph 3-90.

- b. Drill and tap nut component with a thread size which will fit into the nut without damaging tapered hole.
- c. Fabricate a puller using a high strength bolt of thread size tapered in nut, a socket large enough to clear the nut, and a washer.
- d. Extract the nut of the tapered shank fastener from hole using puller.

3-110. Installation.



Tapered shank blind fasteners are supplied lubricated and shall be kept in original container until used.

- a. After fastener holes have been inspected and accepted, separate the parts for any specified processing.
- b. Reassemble parts by installing tapered alignment pin, as required, to align fastener holes.

WARNING

Solvent, cleaning compound, may cause eye, skin, and respiratory irritation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Use with adequate ventilation. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

- c. Clean fastener holes, as required, with cheesecloth dampened with solvent.
- d. Insert fastener in hole and seat with firm thumb pressure.
- e. Inspect fastener head protrusion. See figure 3-51 for gage and protrusion limits. Correct any discrepancies.

WARNING

Sealing compound, may cause skin irritation. Avoid contact with skin and clothing. Wash thoroughly after handling.

- f. Remove fastener from hole. Unscrew the core bolt to expose a minimum of four threads between core bolt head and sleeve. Apply enough sealing compound to wet the exposed threads.



Do not solvent clean or use sealing compound on core bolt and sleeve.

- g. Reseat the core bolt head against the sleeve and insert fastener in hole.
- h. Use rivet gun and a driving set to seat fastener. The correct driving set will clear the core bolt and drive against the head of the nut.

NOTE

Fastener installation must be completed before curing of sealing compound. Curing of sealing compound may occur within one hour after application.

- i. After seating fastener, form the blind head using Jo-Bolt type installation tools. Refer to paragraph 3-91.
- j. Verify that core bolt breaks off within limits. See figure 3-54.

WARNING

Milling operations are dangerous to the eyes. Eye protection is required.

- k. Use a rivet shaver to mill the protruding core bolt to within limits specified for contour smoothness.

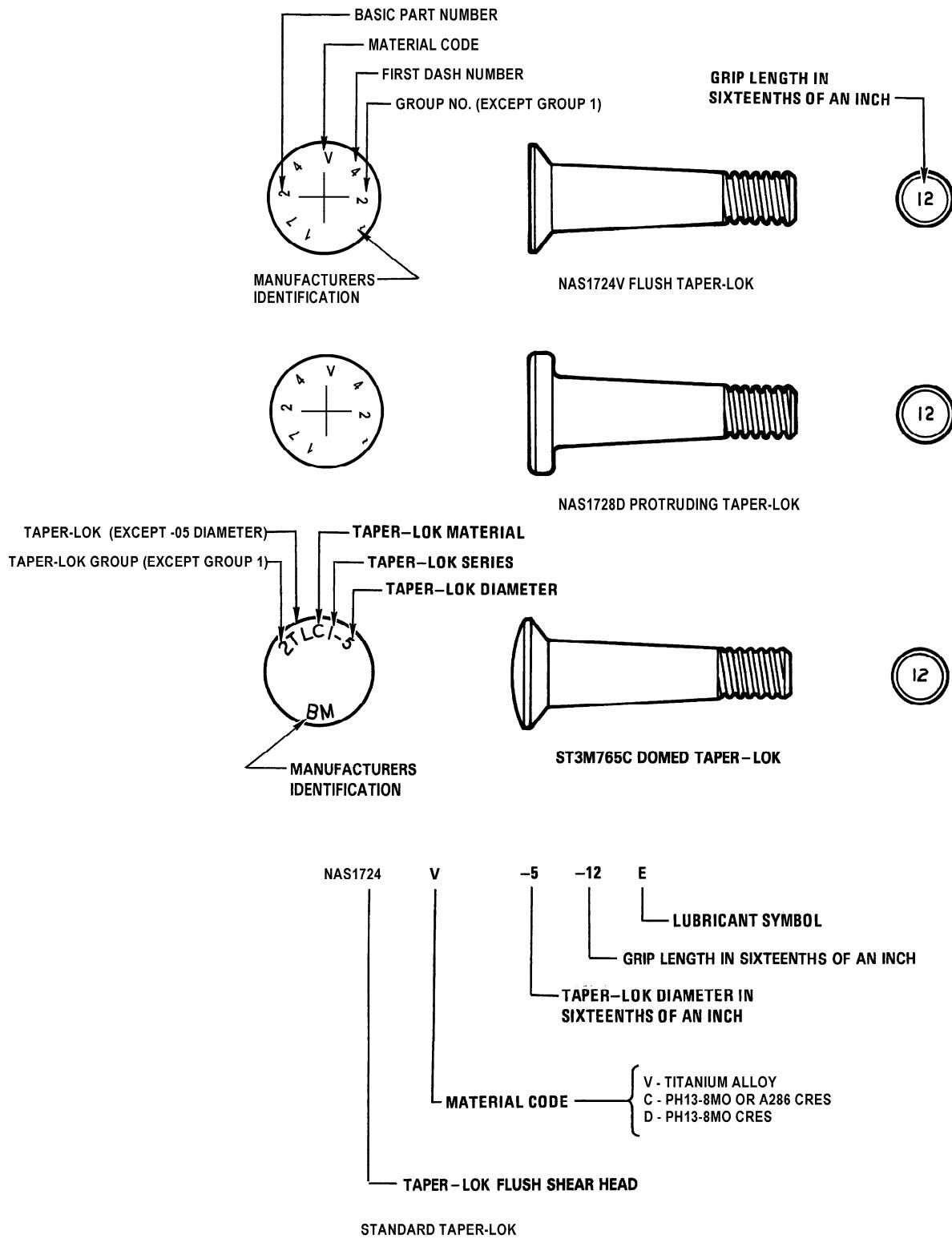
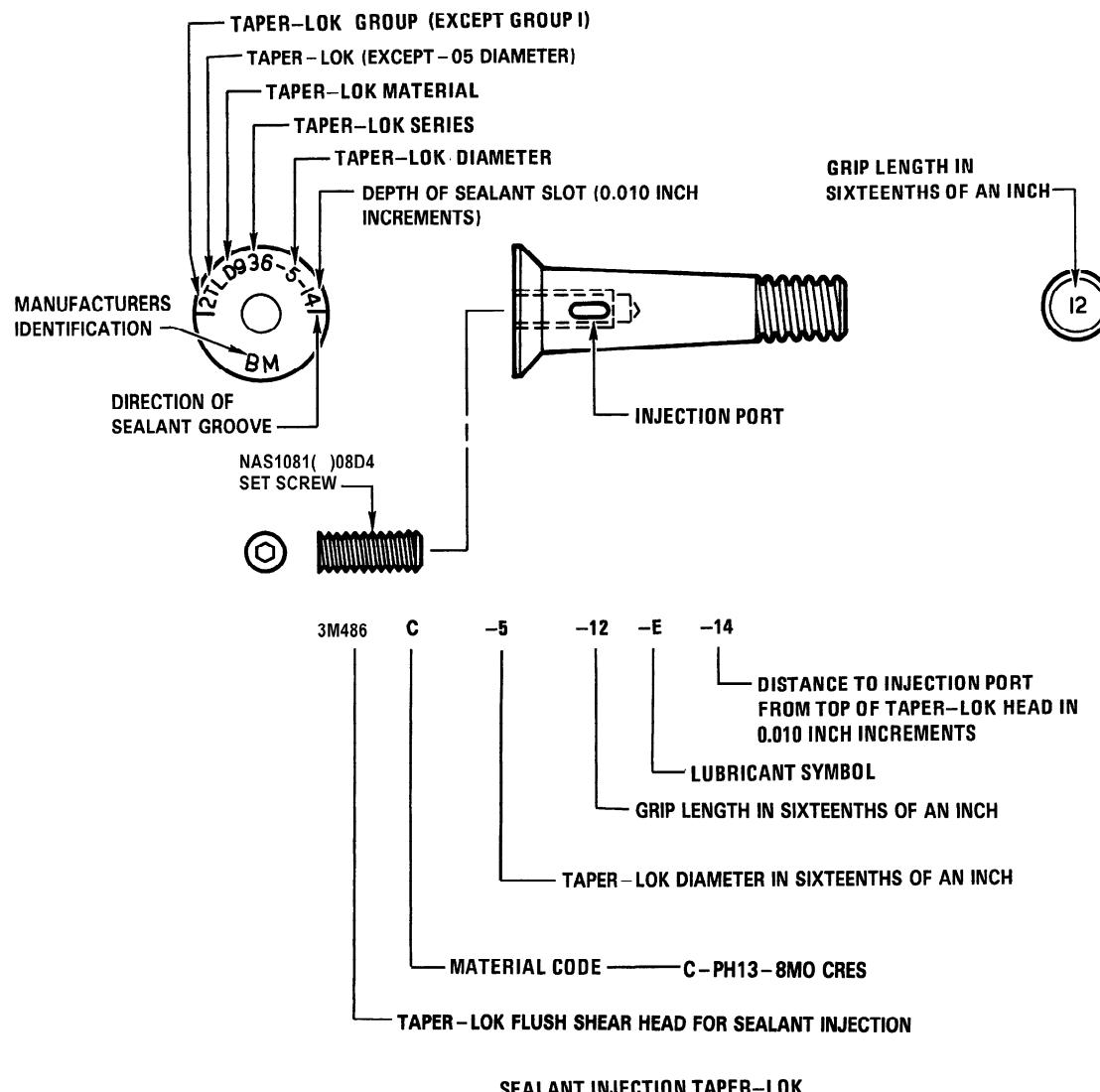
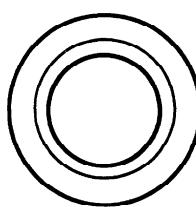


Figure 3-35. Taper-Lok Fastener, Nut, and Washer Identification (Sheet 1 of 4)



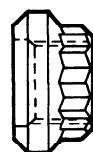
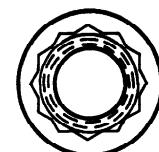
ST3M469C
—5 MA
DESIGNATE WASHER
WASHER DIAMETER
BASIC PART NUMBER



MA
DESIGNATE WASHER
WASHER DIAMETER
BASIC PART NUMBER



ST3M468C
—5 M
DESIGNATE NUT
NUT DIAMETER
BASIC PART NUMBER

**SELF-ALIGNING WASHER****TAPER-LOK NUT**

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Figure 3-35. Taper-Lok Fastener, Nut, and Washer Identification (Sheet 2)

CSTO SR1F-15SA-3-1

STANDARD TAPER-LOK PINS				1ST OVERSIZE PINS				2ND OVERSIZE PINS				
FASTENER STYLE	GROUP NO.	PART NO.	NOM DIA	MATL	FASTENER STYLE	PART NO.	MATL	FASTENER STYLE	PART NO.	MATL		
FLUSH SHEAR HEAD	1	NAS1724V	05	5/32	Ti	08	Ti	08	NAS1724V	3		
			3	3/16		3	3	3		3		
	2		4	1/4		4	4	4	ST3M350V (TLV130)	4	Ti	
			5	5/16		5	5	5		5		
			6	3/8		6	6	6		6		
			7	7/16		7	7	7		7		
			05	5/32		08	08	3				
PROTRUDING SHEAR HEAD	1	NAS1728V	3	3/16	Ti	08	Ti	08	NAS1728V	3		
			4	1/4		3	3	3		3		
	2		5	5/16		5	5	5		4		
			6	3/8		6	6	6		5		
			7	7/16		7	7	7		6		
			05	5/32		08	08	7				
			3	3/16		3	3	3		7		
FLUSH TENSION HEAD	1	ST3M429V (TLV300L)	4	1/4	Ti	08	Ti	08	NAS1728D	3		
			5	5/16		3	3	3		3		
	2		6	3/8		5	5	5		4		
			7	7/16		6	6	6		5		
			3	3/16		7	7	7		6		
			4	1/4		3	3	3		7		
			5	5/16		4	4	4		7		
FLUSH SHEAR HEAD FOR SEALANT INJECTION	2	ST3M429C (TLC300L)	6	3/8	A286 CRES	08	Ti	08	ST3M585V (TLV330L)	3		
			7	7/16		3	3	3		4		
	2		5	5/16		4	4	4		5		
			6	3/8		5	5	5		6		
			7	7/16		6	6	6		7		
			3	3/16		7	7	7		7		
			4	1/4		3	3	3		7		
DOMED TENSION HEAD	2	ST3M765C (TLC879)	5	5/16	A286 CRES	08	Ti	08	TLD966	5		
			6	3/8		3	3	3		6		
	2		7	7/16		4	4	4		7		
			8	1 1/2		5	5	5		8		
			9	9/16		6	6	6		9		
			10	5/8		7	7	7		10		
			3	3/16		8	8	8		8		
FLUSH SHEAR HEAD	3	ST3M530C (TLD939)	7	7/16	PH13-8MO CRES	08	Ti	08	ST3M549C (TLD969)	7		
			8	1 1/2		3	3	3		8		
	3		9	9/16		4	4	4		9		
			10	5/8		5	5	5		10		
			3	3/16		6	6	6		7		
			4	1/4		7	7	7		7		
			5	5/16		8	8	8		8		

SAN301-03-51-001

Figure 3-35. Taper-Lok Fastener, Nut, and Washer Identification (Sheet 3)

TAPER-LOK NUTS

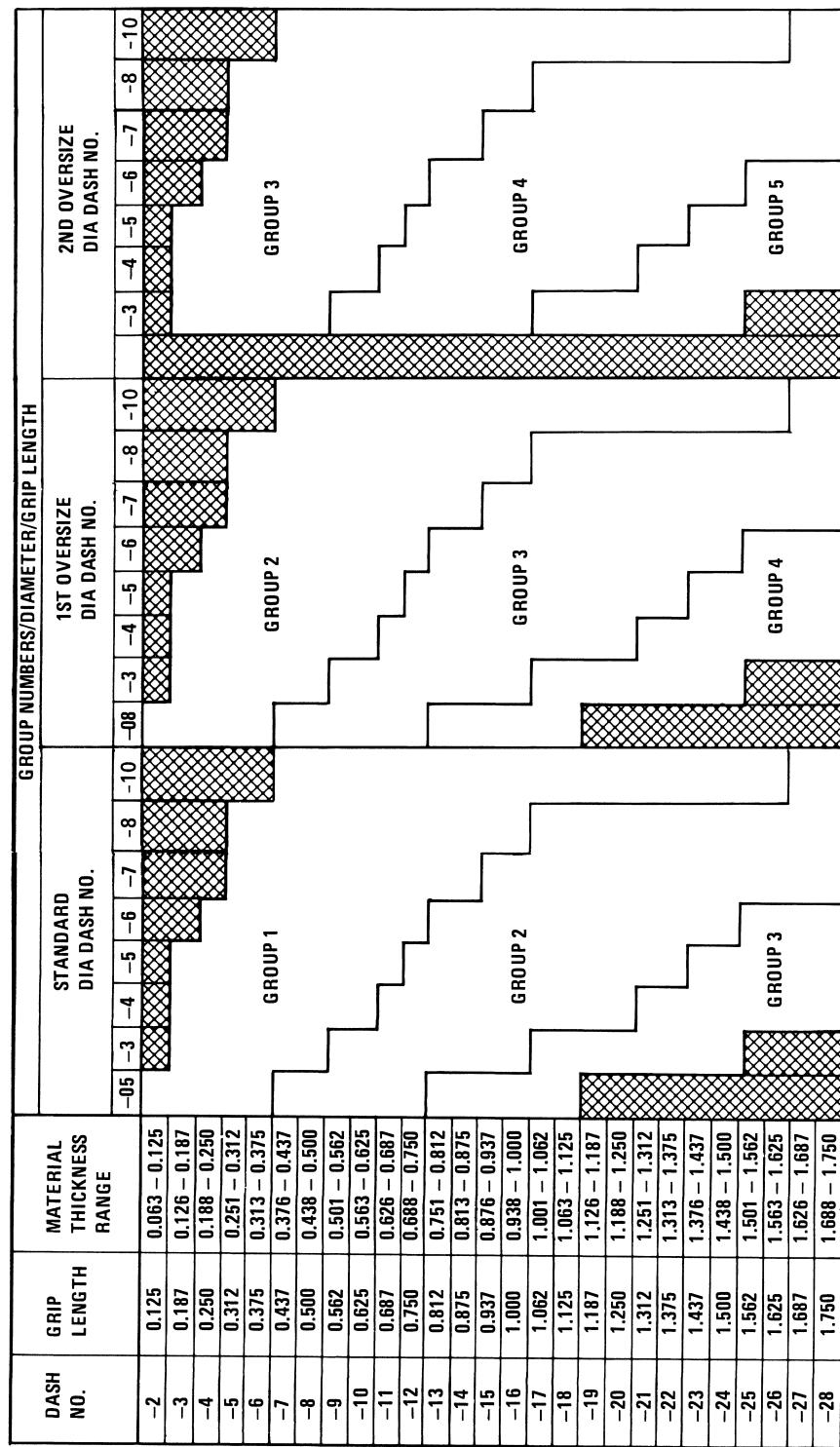
FASTENER STYLE	PART NO.	NOM PIN DIA	MATL
12 POINT NUT	ST3M426C (TLN1002CD3)	05M 3M 4M 5M 6M 7M 8M 9M 10M	5/32 3/16 1/4 5/16 3/8 7/16 1/2 9/16 5/8
SELF ALIGNING NUT	ST3M468C (TLN1023CD3)	05M 3M 4M 5M 6M 7M	5/32 3/16 1/4 5/16 3/8 7/16
SELF ALIGNING WASHER	ST3M469C (TLN1023CD3L)	05MA 3MA 4MA 5MA 6MA 7MA	5/32 3/16 1/4 5/16 3/8 7/16

LEGEND

1. WHEN A SECOND OVERTAPE-LOK PIN IS USED AND THE SHANK DIAMETER EXTENDS BEYOND THE MATERIAL TO BE JOINED, A WASHER MUST BE USED UNDER THE NUT TO PRECLUDE INTERFERENCE BETWEEN THE SHANK DIAMETER AND THE NUT COUNTER-BORE.
2. USE NAS1081()08D4 SET SCREW IN THE THREADED HEAD OF THE TAPER-LOK.

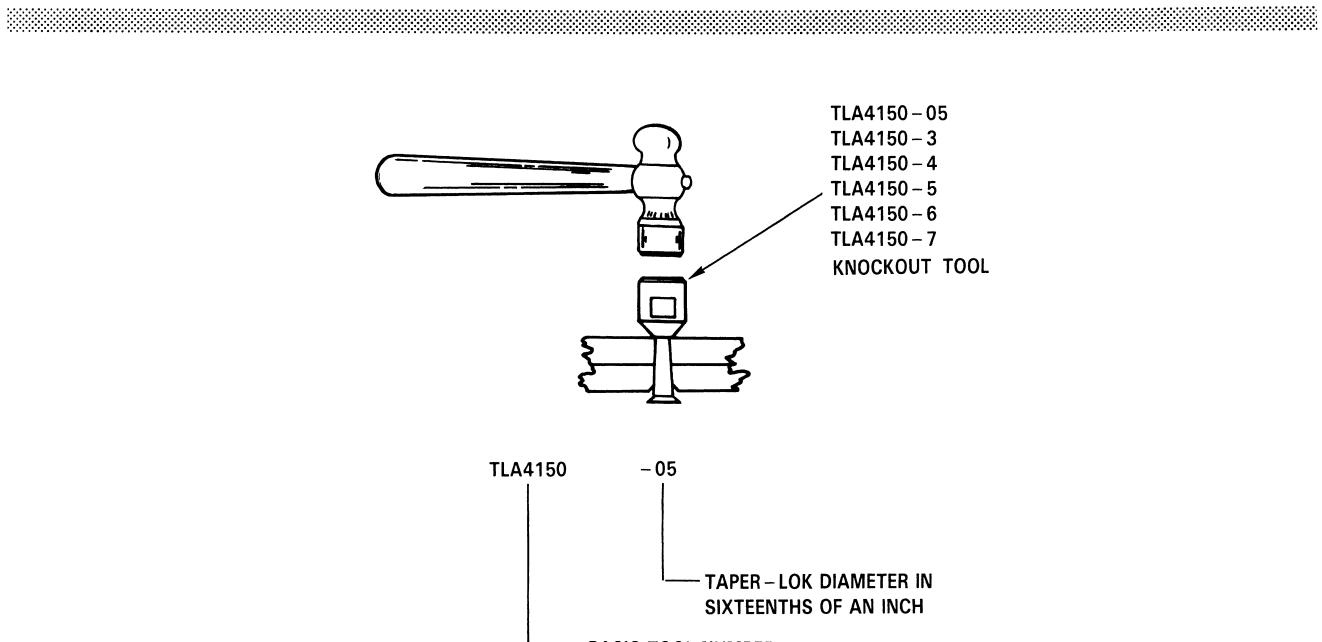
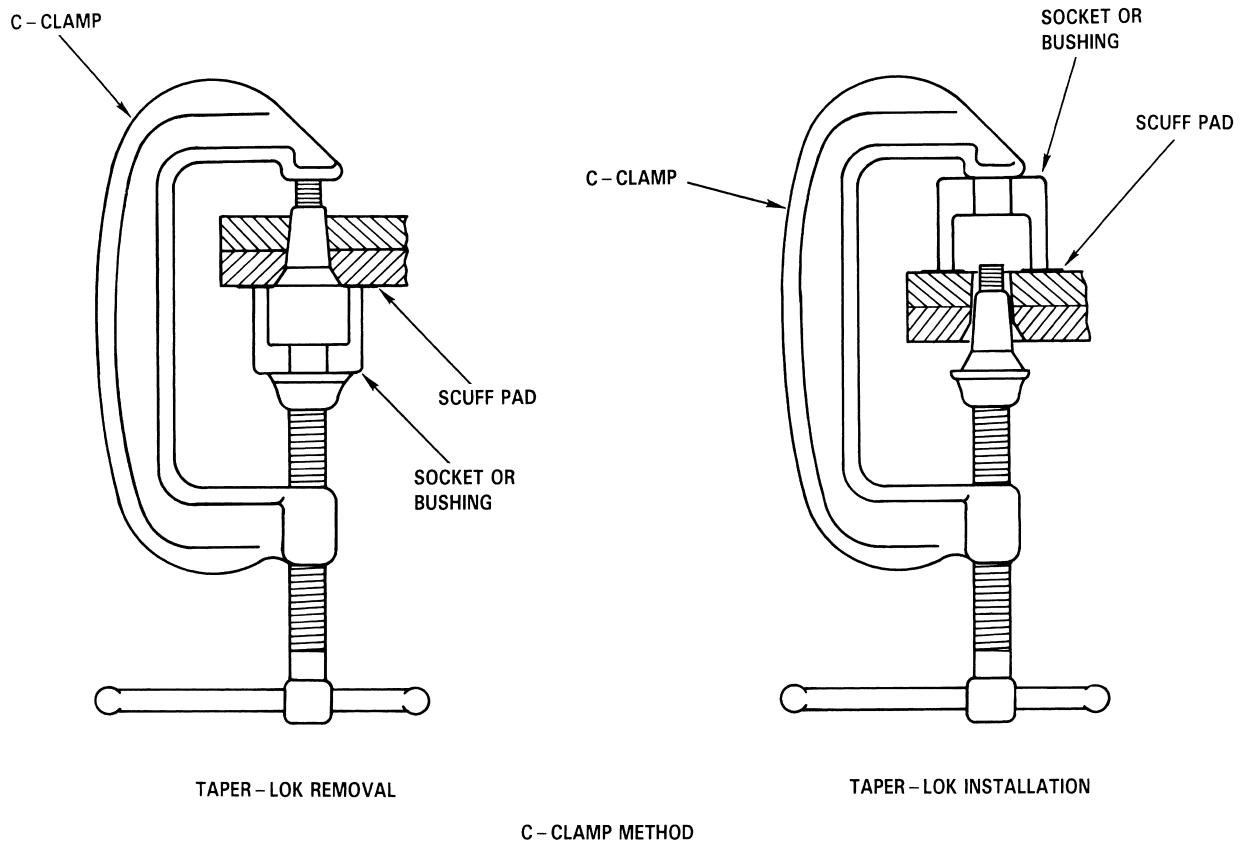
SAN301-03-52-001

Figure 3-35. Taper-Lok Fastener, Nut, and Washer Identification (Sheet 4)



SAN301-03-53-001

Figure 3-36. Taper-Lok Pin Grip Lengths



KNOCKOUT TOOL METHOD

SAN301-03-54-001

Figure 3-37. Taper-Lok Removal and Installation

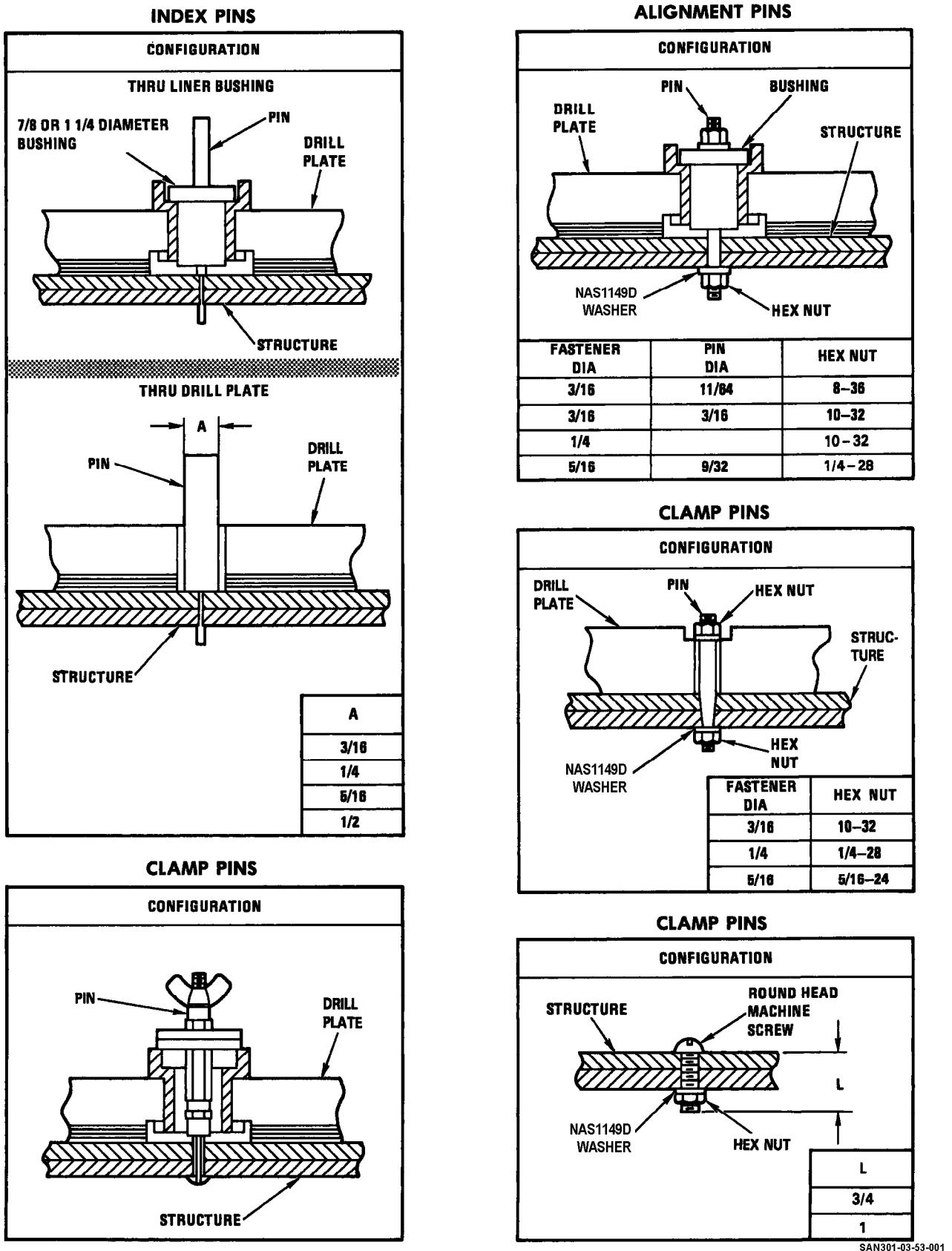


Figure 3-38. Taper-Lok Index Clamp and Alignment Pins for Straight Holes

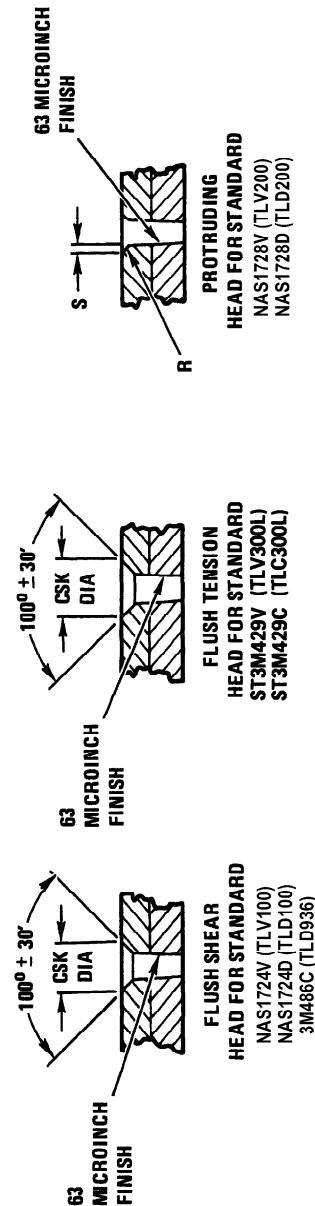
SLAVE BOLTS-STRUCTURE ONLY				ALIGNMENT PIN-TOOLS AND STRUCTURE			
CONFIGURATION				CONFIGURATION			
<p>PROTRUDING HEAD HOLE</p> <p>FLUSH HEAD HOLE</p>				<p>BUSHING</p> <p>PIN</p> <p>DRILL PLATE</p> <p>STRUCTURE</p> <p>HEX NUT</p> <p>NAS1149D WASHER</p>			
NOM DIA	GROUP	PIN NO.	HEX NUT	NOM DIA	GROUP	HEX NUT	BUSHING
5/32	1	TLD501-05-6	8-36	5/32	1	8-36	7/8 O.D.
	2				2		
3/16	1	TLD501-3-8	10-32	3/16	1	10-32	
	2	TLD501-3-11	10-32		2	10-32	
1/4	1	TLD501-4-10	1/4-28	1/4	1	1/4-28	
	2	TLD501-4-14	1/4-28		2	1/4-28	
5/16	1	TLD501-5-11	5/16-24	5/16	1	5/16-24	1 1/4 O.D.
	2	TLD501-5-14	5/16-24		2	5/16-24	
3/8	1	TLD501-6-9	3/8-24	3/8	1		
	2				2		
7/16	1			7/16	1		
	2				2		

SAN301-03-56-002

Figure 3-39. Taper-Lok Slave Bolts and Alignment Pins for Tapered Holes

CSTO SR1F-15SA-3-1

MATERIAL THICKNESS RANGE	FASTENER STYLE	STANDARD		1ST OVERSIZE		2ND OVERSIZE		SPACEMATIC REAM EQUIPMENT	FREE HAND REAM EQUIPMENT
		REAMER TOOL T. F. I. M. NUMBER	CSK DIA	REAMER TOOL T. F. I. M. NUMBER	CSK DIA	TOOL T. F. I. M. NUMBER	CSK DIA		
0.063	FLUSH SHEAR HEAD							R +0.010 -0.000	\$ ±0.005
0.375	PROTRUDING HEAD								
AL ALY	0.376	FLUSH SHEAR HEAD		FLUSH TENSION HEAD		PROTRUDING HEAD		MODEL 1600 STROKE 1-1/2 RPM 230 FEED 24 SEC./IN.	
	0.625								
	0.063	FLUSH SHEAR HEAD	0.256 0.266	25.0059-201	0.265 0.275	USE STANDARD 3/16 DIAMETER FOR 2ND OVERRSIZE HOLES		MODE: 1600 STROKE 1-1/2 RPM 1600 FEED 10 SEC./IN.	
	0.375	FLUSH TENSION HEAD							
AL ALY	0.376	PROTRUDING HEAD							
	0.625	PROTRUDING HEAD							



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Figure 3-40. Taper-Lok 5/32 Taper Ream Equipment

MATERIAL THICKNESS RANGE	FASTENER STYLE	STANDARD		1ST OVERSIZE		2ND OVERSIZE		SPACEMATIC REAM EQUIPMENT	FREE HAND REAM EQUIPMENT
		REAMER TOOL T.F.I.M. NUMBER	CSK DIA	REAMER TOOL T.F.I.M. NUMBER	CSK DIA	R +0.010 -0.000	S ±0.005		
Ti OR Ti/AL ALY	FLUSH SHEAR HEAD	25.0051-102	0.303 0.311	25.0059-202	0.313 0.322	25.0051-302	0.323 0.332	RPM 250 IE12-201-3 MICRO STOP CAGE 1/4 CHUCK	LEGEND 1. USE ISOPARM SPRAY MIST COOLANT FOR REAMING OPERATIONS.
	PROTRUDING HEAD	25.0052-102		25.0052-202		25.0052-302			
	FLUSH TENSION HEAD	25.0051-202	0.313 0.322	25.0051-302	0.323 0.332	25.0051-402	0.334 0.343		
	PROTRUDING HEAD	25.0059-102		25.0059-202		25.0059-302			
	FLUSH SHEAR HEAD	25.0059-102	0.311	25.0059-202	0.313	25.0059-302	0.323		
	PROTRUDING HEAD	25.0059-102	0.384 0.393	25.0059-202	0.395 0.403	25.0059-302	0.405 0.413		
AL ALY	FLUSH SHEAR HEAD	25.0051-102	0.311	25.0051-202	0.322	25.0051-302	0.332	RPM 3000 IE12-201-3 MICRO STOP CAGE 1/4 CHUCK	LEGEND 1. USE ISOPARM SPRAY MIST COOLANT FOR REAMING OPERATIONS.
	PROTRUDING HEAD	25.0051-202		25.0051-302		25.0051-402			
	FLUSH TENSION HEAD	25.0051-302		25.0051-402		25.0051-502			
	PROTRUDING HEAD	25.0051-302		25.0051-402		25.0051-502			
	FLUSH SHEAR HEAD	25.0051-402		25.0051-502		25.0051-602			
	PROTRUDING HEAD	25.0051-502		25.0051-602		25.0051-702			

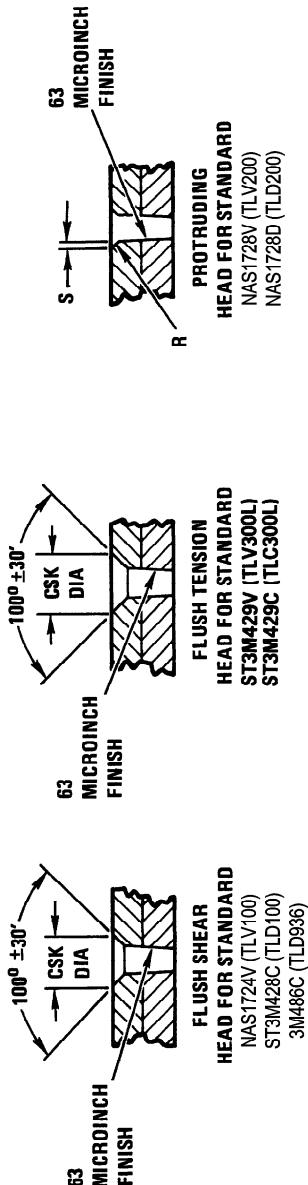


Figure 3-41. Taper-Lok 3/16 Taper Ream Equipment

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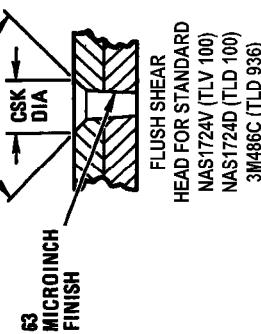
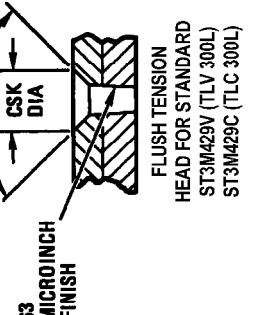
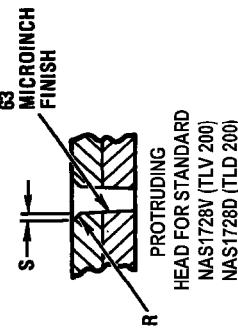
MATERIAL THICKNESS RANGE	FASTENER STYLE	STANDARD REAMER TOOL T.F.I.M. NUMBER	1ST OVERSIZE	2ND OVERSIZE	REAMER TOOL T.F.I.M. NUMBER	CSK DIA	S ± 0.005	SPACEMATIC REAM EQUIPMENT	POSITIVE FEED REAM EQUIPMENT	FREE HAND REAM EQUIPMENT
			R ± 0.010	S ± 0.000						
0.126	FLUSH SHEAR HEAD	25.0051-104	0.399	25.0051-204	0.412	25.0051-304	0.425			
	FLUSH TENSION HEAD	0.406	0.419							
0.625	PROTRUDING HEAD	25.0052-104		25.0052-204		25.0052-304		0.020	0.025	
	FLUSH SHEAR HEAD	25.0051-204	0.412	25.0051-304	0.431	25.0051-404	0.436			
0.626	FLUSH TENSION HEAD	0.419								
0.875	PROTRUDING HEAD	25.0052-204		25.0052-304		25.0052-404		0.020	0.025	
	FLUSH SHEAR HEAD	25.0051-104	0.399	25.0051-204	0.412	25.0051-304	0.425			
	FLUSH TENSION HEAD	0.406								
0.126	PROTRUDING HEAD									
0.625	FLUSH SHEAR HEAD	25.0059-204	0.412	25.0051-304	0.431	25.0051-404	0.436			
	FLUSH TENSION HEAD	0.419								
0.626	PROTRUDING HEAD									
0.875	AL ALY									

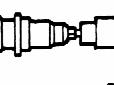
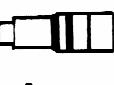
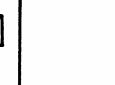
Figure 3-42. Taper-Lok 1/4 Taper Ream Equipment

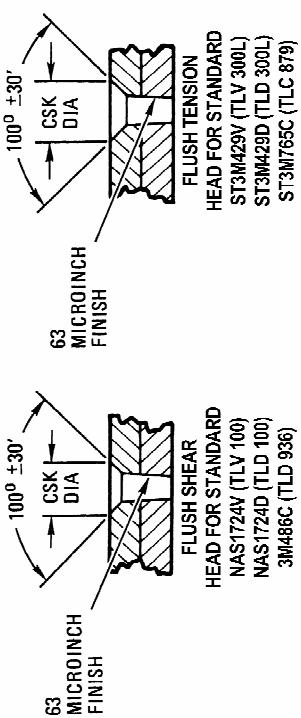
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LEGEND

1. USE ISOPARM SPRAY MIST COOLANT FOR REAMING OPERATIONS.



MATL	THICKNESS RANGE	FASTENER STYLE	STANDARD REAMER TOOL T.F.I.M. NUMBER	CSK DIA	REAMER TOOL T.F.I.M. NUMBER	2ND OVERSIZE R	S ±0.005	SPACEMATIC REAM EQUIPMENT	POSITIVE FEED REAM EQUIPMENT	FREE HAND REAM EQUIPMENT
Ti OR TV AL ALY	0.126	FLUSH SHEAR HEAD	25.0051-105	0.480 0.488	25.0051-205 0.502	0.494 0.516	25.0051-305 0.516	0.508 0.516		
		FLUSH TENSION HEAD	25.0051-105	0.640 0.647	25.0051-205 0.661	0.655 0.675	25.0051-305 0.675	0.659 0.675		
		PROTRUDING HEAD	25.0052-105		25.0052-205		25.0052-305			
	0.687	FLUSH SHEAR HEAD	25.0051-205	0.494 0.502	25.0051-305 0.516	0.508 0.516	25.0051-405 0.516	0.521 0.530		
		FLUSH TENSION HEAD	25.0051-205	0.655 0.661	25.0051-305 0.675	0.669 0.675	25.0051-405 0.675	0.683 0.690		
		PROTRUDING HEAD								
0.937	0.126	FLUSH SHEAR HEAD	25.0059-105	0.480 0.488	25.0059-215 0.502	0.494 0.502	25.0051-305 0.516	0.508 0.516		
		FLUSH TENSION HEAD								
		PROTRUDING HEAD								
	0.687	FLUSH SHEAR HEAD	25.0059-105	0.480 0.488	25.0059-215 0.502	0.494 0.502	25.0051-305 0.516	0.508 0.516		
		FLUSH TENSION HEAD								
		PROTRUDING HEAD								
AL ALY	0.688	FLUSH SHEAR HEAD	25.0059-205	0.494 0.502	25.0051-315 0.516	0.508 0.516	25.0051-405 0.516	0.521 0.530		
		FLUSH TENSION HEAD								
		PROTRUDING HEAD								
	0.937	FLUSH SHEAR HEAD	25.0092-205				25.0066-305			
		FLUSH TENSION HEAD								
		PROTRUDING HEAD								



LEGEND
1. USE ISOPARM SPRAY MIST COOLANT FOR REAMING OPERATIONS.

LEGEND

FLUSH SHEAR HEAD FOR STANDARD
ST3M423V (TLV 300)
ST3M429D (TLD 300)
ST3M765C (TLC 879)

PROTRUDING HEAD FOR STANDARD
NAS1724V (TLV 200)
NAS1724D (TLD 200)
3M486C (TLD 936)

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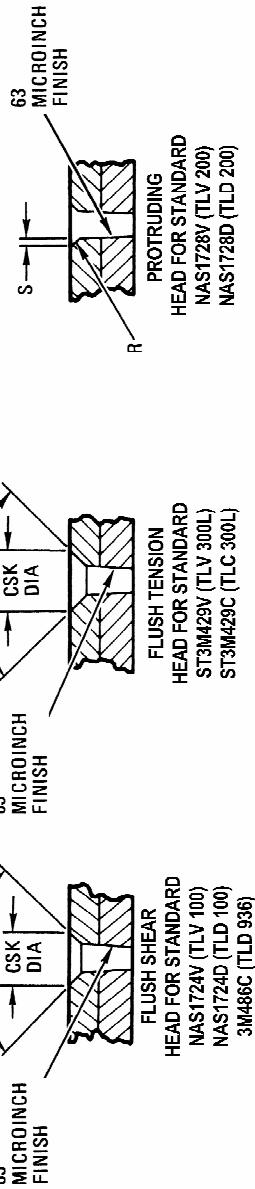
Figure 3-43. Taper-Lok 5/16 Taper Ream Equipment

CSTO SR1F-15SA-3-1

MATL	MATL THICKNESS RANGE	FASTENER STYLE	STANDARD REAMER TOOL T.F.I.M. NUMBER	1ST OVERSIZE REAMER TOOL T.F.I.M. NUMBER	2ND OVERSIZE REAMER TOOL T.F.I.M. NUMBER	CSK DIA	CSK DIA	R	S ± 0.005	SPACEMATIC REAM EQUIPMENT	POSITIVE FEED REAM EQUIPMENT	FREE HAND REAM EQUIPMENT
Ti OR Ti AL ALY	0.188	FLUSH SHEAR HEAD										
	0.750	PROTRUDING HEAD	25.0052-106	25.0052-206	25.0052-306			0.025	0.030			
		FLUSH SHEAR HEAD										
		FLUSH TENSION HEAD										
		PROTRUDING HEAD										
		FLUSH SHEAR HEAD										
		FLUSH TENSION HEAD										
		PROTRUDING HEAD										
		FLUSH SHEAR HEAD										
		FLUSH TENSION HEAD										
		PROTRUDING HEAD										
		FLUSH SHEAR HEAD										
		FLUSH TENSION HEAD										
		PROTRUDING HEAD										
AL ALY												

LEGEND

1. USE ISOPAR M SPRAY MIST COOLANT FOR REAMING OPERATIONS.



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Figure 3-44. Taper-Lok 3/8 Taper Ream Equipment

MATL Ti OR Ti/ AL ALY	THICKNESS RANGE	FASTENER STYLE	STANDARD REAMER TOOL T.F.I.M. NUMBER	CSK TOOL DIA	REAMER TOOL T.F.I.M. NUMBER	CSK DIA	2ND OVERSIZE R $+0.010$ -0.000	S ± 0.005	SPACEMATIC REAM EQUIPMENT	POSITIVE FEED REAM EQUIPMENT	FREE HAND REAM EQUIPMENT
		FLUSH SHEAR HEAD									
		FLUSH TENSION HEAD									
		PROTRUDING HEAD									
		FLUSH SHEAR HEAD									
		FLUSH TENSION HEAD									
		PROTRUDING HEAD									
0.251		FLUSH SHEAR HEAD	25.0059-107	0.693 0.698	25.0051-207	0.711 0.716	25.0051-307	0.729 0.734			
0.875		FLUSH TENSION HEAD									
		PROTRUDING HEAD									
		FLUSH SHEAR HEAD									
		FLUSH TENSION HEAD									
		PROTRUDING HEAD									

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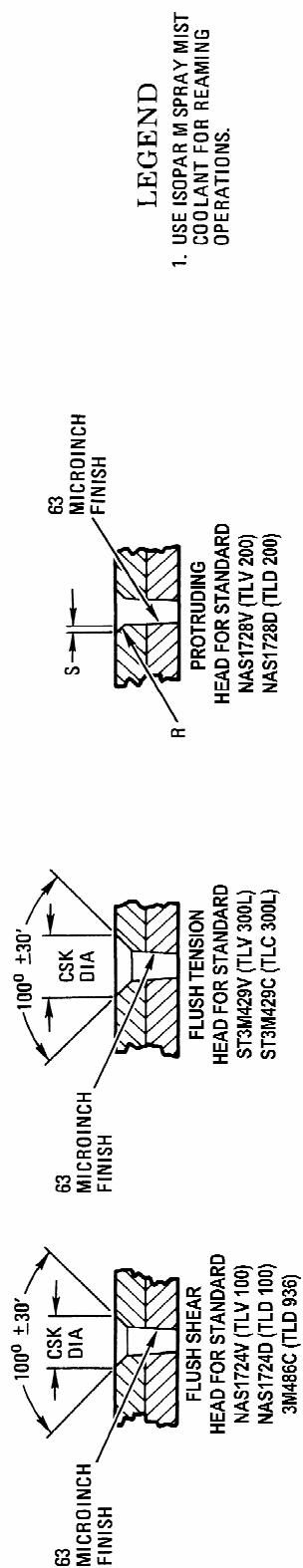


Figure 3-45. Taper-Lok 7/16 Taper Ream Equipment

DRILLS
ALUMINUM STRUCTURE
DRILLS HAVE BRIGHT FINISH

TYPE	CONFIGURATION	APPLICATION	T.F.I.M. NO.
B		GENERAL PURPOSE DEPTH LESS THAN 2-1/2 TIMES DIAMETER	25.0202
D		OVERALL LENGTH GREATER THAN TYPE B REQUIRED	25.0204
E		DEPTH GREATER THAN 2-1/2 TIMES DIAMETER	25.0205
F		DEPTH GREATER THAN 2-1/2 TIMES DIAMETER FLUTE LENGTH. GREATER THAN TYPE E REQUIRED	25.0206

DRILLS
TITANIUM STRUCTURE
DRILLS HAVE BLACK OXIDE FINISH

TYPE	CONFIGURATION	APPLICATION	T.F.I.M. NO.
Y		IN BLANK PARTS NO PILOT HOLE EXISTS	25.0217
X		ENLARGING HOLES OR DRILLING BLANK PARTS	25.0216
W		DRILLING BLANK PARTS OVERALL LENGTH GREATER THAN TYPE Y	25.0215
V		DRILLING BLANK PARTS OVERALL LENGTH GREATER THAN TYPE Y	25.0214
U		ENLARGING HOLES OR DRILLING BLANK PARTS OVERALL LENGTH GREATER THAN TYPE X	25.0213

TAPERED REAMER AND COUNTERSINK
ALUMINUM AND TITANIUM STRUCTURE

CONFIGURATION	APPLICATION	T.F.I.M. NO.
	TAPER REAMING AND COUNTERSINKING HOLES FOR FLUSH HEAD TAPER-LOK FASTENERS THRU PREDRILLED HOLES	25.0051

CONFIGURATION	APPLICATION	T.F.I.M. NO.
	TAPER REAMING HOLES FOR PROTRUDING HEAD TAPER- LOK FASTENERS THRU PREDRILLED HOLES	25.0052

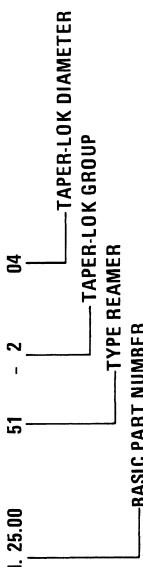


Figure 3-46. Taper-Lok Drills and Reamers

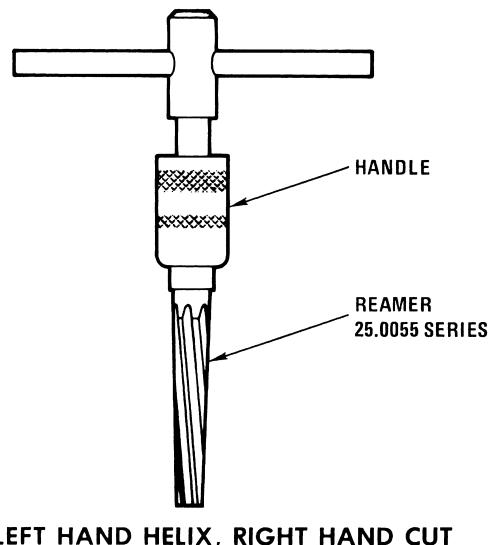
HAND REAMER

T.F.I.M. 25.00 55 - 2 04

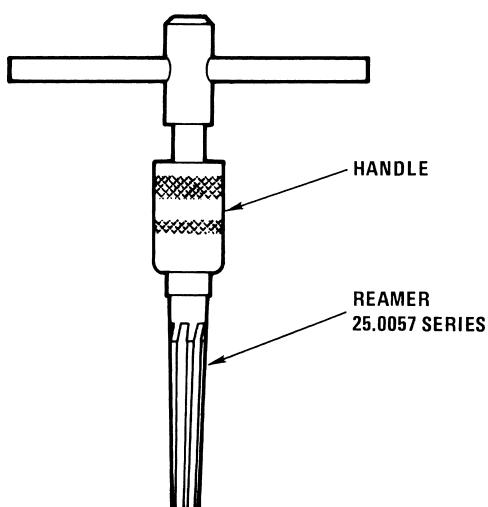
BASIC PART NUMBER

LEGEND

1. COAT HAND REAMERS WITH CETYL ALCOHOL PRIOR TO REAMING.



NOM DIA	GROUP	REAMER T.F.I.M. NO.	HANDLE	APPLICATION
5/32	1,2	25.0055-201	GGGW680	FOR MAJOR REPAIRS, ALTERNATE WITH 25.0057 SERIES HAND REAMERS
	3,4	25.0055-401		
3/16	1,2	25.0055-202		
	3,4	25.0055-402		
1/4	1,2	25.0055-204		
	3,4	25.0055-404		
5/16	1,2	25.0055-205		
	3,4	25.0055-405		
3/8	1,2	25.0055-206	TD483G-1	
	3,4	25.0055-406		
7/16	1,2	25.0055-207		
	3,4	25.0055-407		

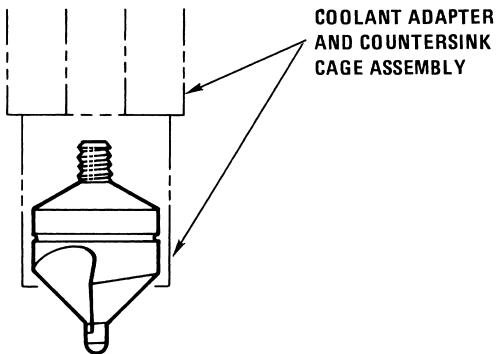


NOM DIA	GROUP	REAMER T.F.I.M. NO.	HANDLE	APPLICATION
5/32	1,2	25.0057-201	GGGW680	FOR MINOR CLEANUP ONLY
	3,4	25.0057-401		
3/16	1,2	25.0057-202		
	3,4	25.0057-402		
1/4	1,2	25.0057-204		
	3,4	25.0057-404		
5/16	1,2	25.0057-205		
	3,4	25.0057-405		
3/8	1,2	25.0057-206	TD483G-1	
	3,4	25.0057-406		
7/16	1,2	25.0057-207		
	3,4	25.0057-407		

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Figure 3-47. Taper-Lok Hand Reamers and Countersinks (Sheet 1 of 2)

COUNTERSINK



2 FLUTE

NOM DIA	GROUP	COUNTERSINK T.F.I.M. NO.	COOLANT ADAPTER AND COUNTERSINK CAGE ASSEMBLY NO.	APPLICATION
5/32	1	25.0067-101	1E12-201-3 AND TLA4901-24	FOR CLEANUP OR INCREASING DEPTH OF COUNTERSINK SURFACE
	2	25.0067-201		
	3	25.0067-301		
	4	25.0067-401		
3/16	1	25.0067-102	1E12-201-3 AND TLA4901-24	FOR CLEANUP OR INCREASING DEPTH OF COUNTERSINK SURFACE
	2	25.0067-202		
	3	25.0067-302		
	4	25.0067-402		
1/4	1	25.0067-104	1E12-201-6 AND TLA4901-38	FOR CLEANUP OR INCREASING DEPTH OF COUNTERSINK SURFACE
	2	25.0067-204		
	3	25.0067-304		
	4	25.0067-404		
5/16	1	25.0067-105	1E12-201-6 AND TLA4901-38	FOR CLEANUP OR INCREASING DEPTH OF COUNTERSINK SURFACE
	2	25.0067-205		
	3	25.0067-305		
	4	25.0067-405		
3/8	1	25.0067-106	1E12-201-7 AND TLA4903-38	FOR CLEANUP OR INCREASING DEPTH OF COUNTERSINK SURFACE
	2	25.0067-206		
	3	25.0067-306		
	4	25.0067-406		
7/16	1	25.0067-107	1E12-201-7 AND TLA4903-38	FOR CLEANUP OR INCREASING DEPTH OF COUNTERSINK SURFACE
	2	25.0067-207		
	3	25.0067-307		
	4	25.0067-407		

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Figure 3-47. Taper-Lok Hand Reamers and Countersinks (Sheet 2)

NOM DIA	MATERIAL THICKNESS RANGE	STANDARD TAPER-LOK					
		CSK GAGE		PROTRUSION INSPECTION PIN		PROTRUSION GAGE	BLUE PIN GAGE
		FLUSH SHEAR HEAD	FLUSH TENSION HEAD	FLUSH SHEAR AND PROTRUDING HEAD	FLUSH TENSION HEAD		
5/32	0.063 ↓ 0.375	100° -1		TLG5190-1-05		TD216 J4-1	TD216 K4-301
	0.376 ↓ 0.625	100° -1		TLG5190-2-05		TD216 J4-1	TD216 K4-301
3/16	0.126 ↓ 0.500	100° -1	100° -2	TLG5190-1-3	TLG5191-1-3	TD216 J4-2	TD216 K4-302
	0.501 ↓ 0.750	100° -1	100° -2	TLG5190-2-3	TLG5191-2-3	TD216 J4-2	TD216 K4-302
1/4	0.126 ↓ 0.625	100° -2		TLG5190-1-4	TLG5191-1-4	TD216 J4-4	TD216 K4-404
	0.626 ↓ 0.875	100° -2		TLG5190-2-4	TLG5191-2-4	TD216 J4-4	TD216 K4-404
5/16	0.126 ↓ 0.687	100° -2	100° -3	TLG5190-1-5	TLG5191-1-5	TD216 J4-5	TD216 K4-405
	0.688 ↓ 0.937	100° -2	100° -3	TLG5190-2-5	TLG5191-2-5	TD216 J4-5	TD216 K4-405
3/8	0.188 ↓ 0.750	100° -3		TLG5190-1-6		TD216 J4-6	TD216 K4-406
	0.751 ↓ 1.000	100° -3		TLG5190-2-6		TD216 J4-6	TD216 K4-406
7/16	0.251 ↓ 0.875	100° -3		TLG5190-1-7		TD216 J4-7	TD216 K4-407

Figure 3-48. Taper-Lok Hole Gage Selection (Sheet 1 of 3)

CSTO SR1F-15SA-3-1

NOM DIA	MATERIAL THICKNESS RANGE	1ST OVERTSIZE					
		CSK GAGE		PROTRUSION INSPECTION PIN		PROTRUSION GAGE	BLUE PIN GAGE
		FLUSH SHEAR HEAD	FLUSH TENSION HEAD	FLUSH SHEAR AND PROTRUDING HEAD	FLUSH TENSION HEAD		
5/32	0.063 ↓ 0.375	100 ⁰ -1		TLG5190-2-05		TD216 J4-1	TD216 K4-301
	0.376 ↓ 0.625	100 ⁰ -1		TLG5190-3-05		TD216 J4-1	TD216 K4-301
3/16	0.126 ↓ 0.500	100 ⁰ -1	100 ⁰ -2	TLG5190-2-3	TLG5191-2-3	TD216 J4-2	TD216 K4-302
	0.501 ↓ 0.750	100 ⁰ -1	100 ⁰ -2	TLG5190-3-3	TLG5191-3-3	TD216 J4-2	TD216 K4-302
1/4	0.126 ↓ 0.625	100 ⁰ -2		TLG5190-2-4	TLG5191-2-4	TD216 J4-4	TD216 K4-404
	0.626 ↓ 0.875	100 ⁰ -2		TLG5190-3-4	TLG5191-3-4	TD216 J4-4	TD216 K4-404
5/16	0.126 ↓ 0.687	100 ⁰ -2	100 ⁰ -3	TLG5190-2-5	TLG5191-2-5	TD216 J4-5	TD216 K4-405
	0.688 ↓ 0.937	100 ⁰ -2	100 ⁰ -3	TLG5190-3-5	TLG5191-3-5	TD216 J4-5	TD216 K4-405
3/8	0.188 ↓ 0.750	100 ⁰ -3		TLG5190-2-6		TD216 J4-6	TD216 K4-406
	0.751 ↓ 1.000	100 ⁰ -3		TLG5190-3-6		TD216 J4-6	TD216 K4-406
7/16	0.251 ↓ 0.875	100 ⁰ -3		TLG5190-2-7		TD216 J4-7	TD216 K4-407

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Figure 3-48. Taper-Lok Hole Gage Selection (Sheet 2)

NOM DIA	MATERIAL THICKNESS RANGE	2ND OVERSIZE					
		CSK GAGE		PROTRUSION INSPECTION PIN		PROTRUSION GAGE	BLUE PIN GAGE
		FLUSH SHEAR HEAD	FLUSH TENSION HEAD	FLUSH SHEAR AND PROTRUDING HEAD	FLUSH TENSION HEAD		
5/32	0.063 ↓ 0.375	100 ⁰ -1		TLG5190-1-3		TD216 J4-1	TD216 K4-301
	0.376 ↓ 0.625	100 ⁰ -1		TLG5190-2-3		TD216 J4-1	TD216 K4-301
3/16	0.126 ↓ 0.500	100 ⁰ -1	100 ⁰ -2	TLG5190-3-3	TLG5191-3-3	TD216 J4-2	TD216 K4-302
	0.501 ↓ 0.750	100 ⁰ -1	100 ⁰ -2	TLG5190-4-3	TLG5191-4-3	TD216 J4-2	TD216 K4-402
1/4	0.126 ↓ 0.625	100 ⁰ -2		TLG5190-3-4	TLG5191-3-4	TD216 J4-4	TD216 K4-404
	0.626 ↓ 0.875	100 ⁰ -2		TLG5190-4-4	TLG5191-4-4	TD216 J4-4	TD216 K4-404
5/16	0.126 ↓ 0.687	100 ⁰ -2	100 ⁰ -3	TLG5190-3-5	TLG5191-3-5	TD216 J4-5	TD216 K4-405
	0.688 ↓ 0.937	100 ⁰ -2	100 ⁰ -3	TLG5190-4-5	TLG5191-4-5	TD216 J4-5	TD216 K4-405
3/8	0.188 ↓ 0.750	100 ⁰ -3		TLG5190-3-6		TD216 J4-6	TD216 K4-406
	0.751 ↓ 1.000	100 ⁰ -3		TLG5190-4-6		TD216 J4-6	TD216 K4-406
7/16	0.251 ↓ 0.875	100 ⁰ -3		TLG5190-3-7		TD216 J4-7	TD216 K4-407

Figure 3-48. Taper-Lok Hole Gage Selection (Sheet 3)

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<p>STEP 1 CSK/R AND S CHECK</p> <p>CHECK R AND S DIMENSIONS VISUALLY FOR DEPTH CONTROL</p>	<p>STEP 2 BLUE PIN BEARING CHECK</p> <p>THICKNESS OF ONE MEMBER</p>	<p>STEP 3 PROTRUSION CHECK</p> <p>TD216J4 PROTRUSION GAGE</p> <p>GO/ON-GO INDICATION</p> <p>PROCEDURE</p> <p>A. APPLY A THIN COAT OF BLUE DYE TO THE SHANK OF THE BLUE PIN GAGE. B. INSERT THE BLUE PIN GAGE INTO THE HOLE UNTIL THE GAGE IS SEADED. GENTLY TAP AND THEN APPLY ONE TO THREE SOLID STROKES WITH HAMMER ASSEMBLY AS SHOWN. C. REMOVE THE BLUE PIN GAGE FROM THE HOLE AND CHECK THE BLUE PIN GAGE.</p> <p>HAMMER ASSEMBLY TD50006A - 1E - 101 STEEL SLIDE HANDLE 1/4 DIA TAPER - LOK AND UP - 102 ALUM SLIDE HANDLE 3/16 DIA TAPER - LOK AND SMALLER</p> <p>100° CSK GAGE</p> <p>CSK DIA INDICATION</p> <p>SEE APPLICABLE CSK DIA</p> <p>TD216K4 BLUE PIN GAGE</p> <p>COUNTERSUNK HOLE</p>
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Figure 3-49. Taper-Lok Hole Gaging Procedure (Sheet 1 of 2)

STEP 2 LEGEND

1. **B = BEARING; NB = NONBEARING.**
2. IN DETERMINING PERCENT BEARING, EACH MEMBER MUST BE CONSIDERED SEPARATELY.
3. A SHADED AREA COMPLETELY AROUND THE CHECK PIN WOULD INDICATE A BELL-SHAPED OR GALLED HOLE. THIS CONDITION IS UNACCEPTABLE IF BEARING IS LESS THAN 80 PERCENT IN ANY MEMBER. A SHADED AREA ON ONE SIDE OF THE CHECK PIN WOULD INDICATE AN ELONGATED HOLE. THIS CONDITION IS UNACCEPTABLE IF BEARING IS LESS THAN 80 PERCENT IN ANY MEMBER OR THE HOLE IS ELONGATED COMPLETELY THROUGH A MEMBER.
4. THE BLUE BEARING DYE IS APPLIED TO THE CHECK PIN IN THE LONGITUDINAL DIRECTION. NON-BEARING AREAS ARE CHARACTERIZED BY RETENTION OF THE DYE PATTERN IN THE LONGITUDINAL DIRECTION. BEARING AREAS ARE CHARACTERIZED BY THE DYE BEING CHANGED FROM A LONGITUDINAL TO CIRCUMFERENTIAL PATTERN.
- 5** PARALLEL RINGS AROUND THE SHANK WHICH EXTEND OVER THE ENTIRE BEARING AREA INDICATE PROPER BEARING. BEARING OF 80 TO 100 PERCENT IN EACH MEMBER IS ACCEPTABLE. IN THIN MEMBERS, BEARING MAY BE GENERATED ON THE PIN IN A SOLID PATTERN RATHER THAN IN PARALLEL RINGS.
- 6** RIFLING, SPIRAL MARKINGS, REDUCES THE BEARING AREA. RIFLING IS UNACCEPTABLE WHEN THE BEARING AREA IS LESS THAN 90 PERCENT IN ANY MEMBER.
- 7** A LONG SHARP, NO BEARING, AREA MAY INDICATE A GOUGE, SCRATCH, OR STEP IN THE HOLE. THIS IS UNACCEPTABLE IF THE CONDITION CAN BE FELT WHILE USING A POINTED, NON-METALLIC INSTRUMENT TO EXAMINE THE HOLE.

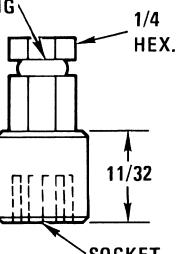
NOTE

FOR ALTERNATIVE METHOD OF MEASURING USE DIAL INDICATOR AND MACHINIST SCALE, USE REQUIRED DIMENSIONS SHOWN ON CHART, FIGURE 3-51.

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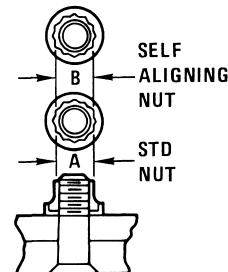
Figure 3-49. Taper-Lok Hole Gaging Procedure (Sheet 2)

TABLE I
12 POINT SOCKETS

CONFIGURATION		SOCKET SIZE
	1/4 HEX.	7/32
		1/4
		9/32
		5/16

SOCKET SIZES

PIN DIA	SOCKET SIZE	
	A	B
5/32	7/32	7/32
3/16	7/32	1/4
1/4	9/32	5/16
5/16	3/8	3/8
3/8	7/16	7/16
7/16	1/2	1/2



1 TABLE 2

GRIP LENGTH DASH NO.	GRIP LENGTH	INSTALLATION TORQUE VALUE / FASTENER DIA/GRIP LENGTH (INCH LBS)					
		5/32	3/16	1/4	5/16	3/8	7/16
-2	0.125						
-3	0.187	20	25	65			
-4	0.250	+10	+10	+20	150		
-5	0.312	-0	-0	-0	+20		
-6	0.375		30		-0		
-7	0.437		+10	70	160		
-8	0.500		-0	+20	+20		
-9	0.562		25	-0	-0		
-10	0.625	+10			160		
-11	0.687	-0			+20		
-12	0.750		40		-0		
-13	0.812		+10		180		
-14	0.875		-0		+20		
-15	0.937				-0		
-16	1.000				300		
-17	1.062				+50		
-18	1.125				-0		
-19	1.187						
-20	1.250						
-21	1.312						
-22	1.375						
-23	1.437						
-24	1.500						
-25	1.562						
-26	1.625						
-27	1.687						
-28	1.750						

1 TABLE 3

FASTENER NOM DIA	MAX SEATING TORQUE (INCH-LBS)
5/32	35
3/16	65
1/4	125
5/16	260
3/8	300
7/16	350

CAUTION
DO NOT EXCEED TORQUE RATING PER TABLE 3.

LEGEND

1 IF TABLE 2 TORQUE VALUES DO NOT SEAT FASTENER HEAD, USE HAND TORQUE WRENCH TO SEAT FASTENER PER TABLE 3. AFTER FASTENER IS SEALED, PER TABLE 3, LOSEN THE NUT AND RE-TORQUE PER TABLE 2.

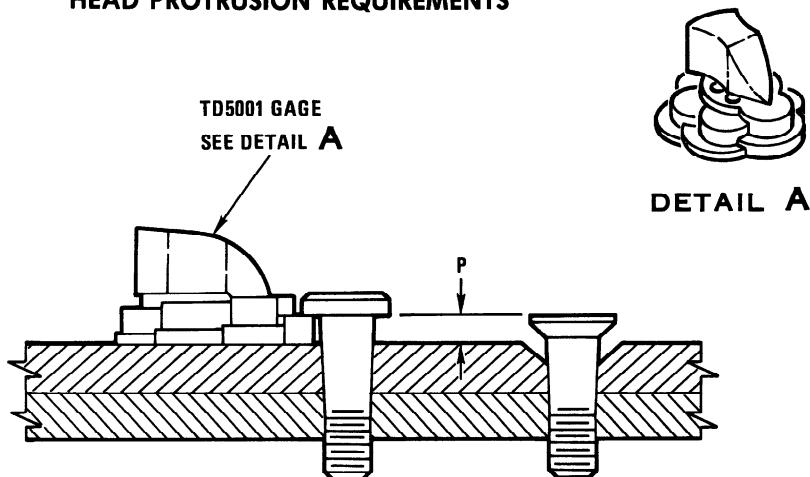
CAUTION

THE MAXIMUM TORQUE VALUES FOR TLC300L 3/16 AND 1/4 FASTENERS SHALL NOT EXCEED THOSE SHOWN IN TABLE 2.

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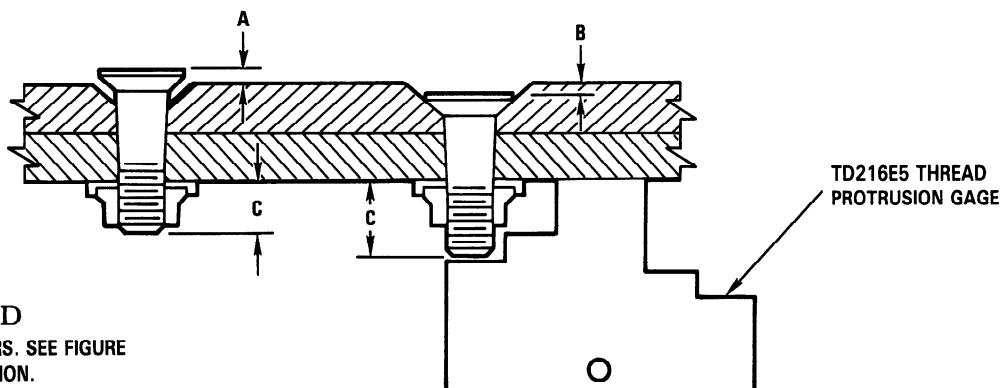
Figure 3-50. Taper-Lok Sockets and Torque Values

HEAD PROTRUSION REQUIREMENTS



PIN DIA	P	GAGE NO.
5/32	0.110 0.206	TD5001B-1E
1/2	0.194 0.365	
5/8	0.223 0.422	
3/16	0.120 0.221	
1/4	0.134 0.250	TD5001C-1E
5/16	0.149 0.278	
3/8	0.163 0.307	
7/16	0.178 0.336	

THREAD PROTRUSION REQUIREMENTS



LEGEND

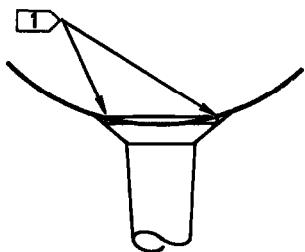
- 1 SHEAR HEAD FASTENERS. SEE FIGURE 3-35 FOR IDENTIFICATION.
- 2 TENSION HEAD FASTENERS. SEE FIGURE 3-35 FOR IDENTIFICATION.

PIN DIA	A	B	C ①			SHEAR HEAD THREAD PROTRUSION GAGE NO.	C ②	TENSION HEAD THREAD PROTRUSION GAGE NO.
			STANDARD	1ST OVERRSIZE	2ND OVERRSIZE			
5/32	+0.006	-0.004	0.250 0.337	0.250 0.337		TD216E5-05		
3/16	+0.006	-0.004	0.270 0.356	0.270 0.356	0.322 0.409	TD216E5-3	0.333 0.420	TD216E5-3A
1/4	+0.006	-0.004	0.322 0.409	0.322 0.409	0.371 0.458	TD216E5-4	0.396 0.483	TD216E5-4A
5/16	+0.006	-0.004	0.371 0.457	0.371 0.457	0.396 0.483	TD216E5-5	0.474 0.561	TD216E5-5A
3/8	+0.006	-0.004	0.396 0.483	0.396 0.483	0.443 0.530	TD216E5-6	0.552 0.639	TD216E5-6A
7/16	+0.000	-0.010	0.443 0.530	0.443 0.530	0.475 0.562	TD216E5-7	0.615 0.702	TD216E5-7A

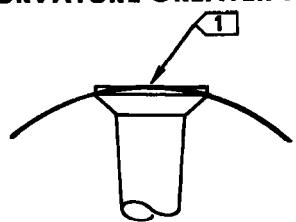
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Figure 3-51. Taper-Lok Head and Thread Check Data

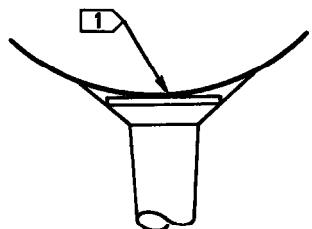
FLUSHNESS REQUIREMENTS



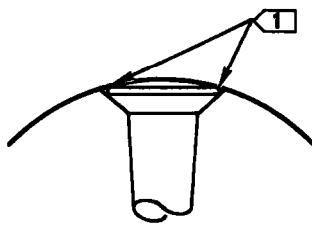
RADIUS OF CURVATURE GREATER THAN 6 INCHES



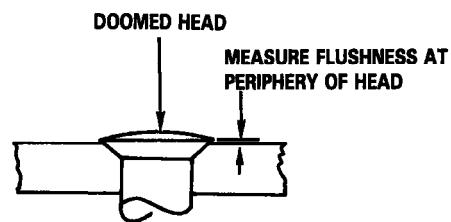
RADIUS OF CURVATURE GREATER THAN 6 INCHES



RADIUS OF CURVATURE 6 INCHES OR LESS



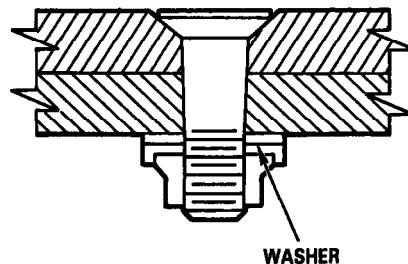
RADIUS OF CURVATURE 6 INCHES OR LESS



LEGEND

MEASURE FLUSHNESS AT POINTS INDICATED.

USE OF WASHERS



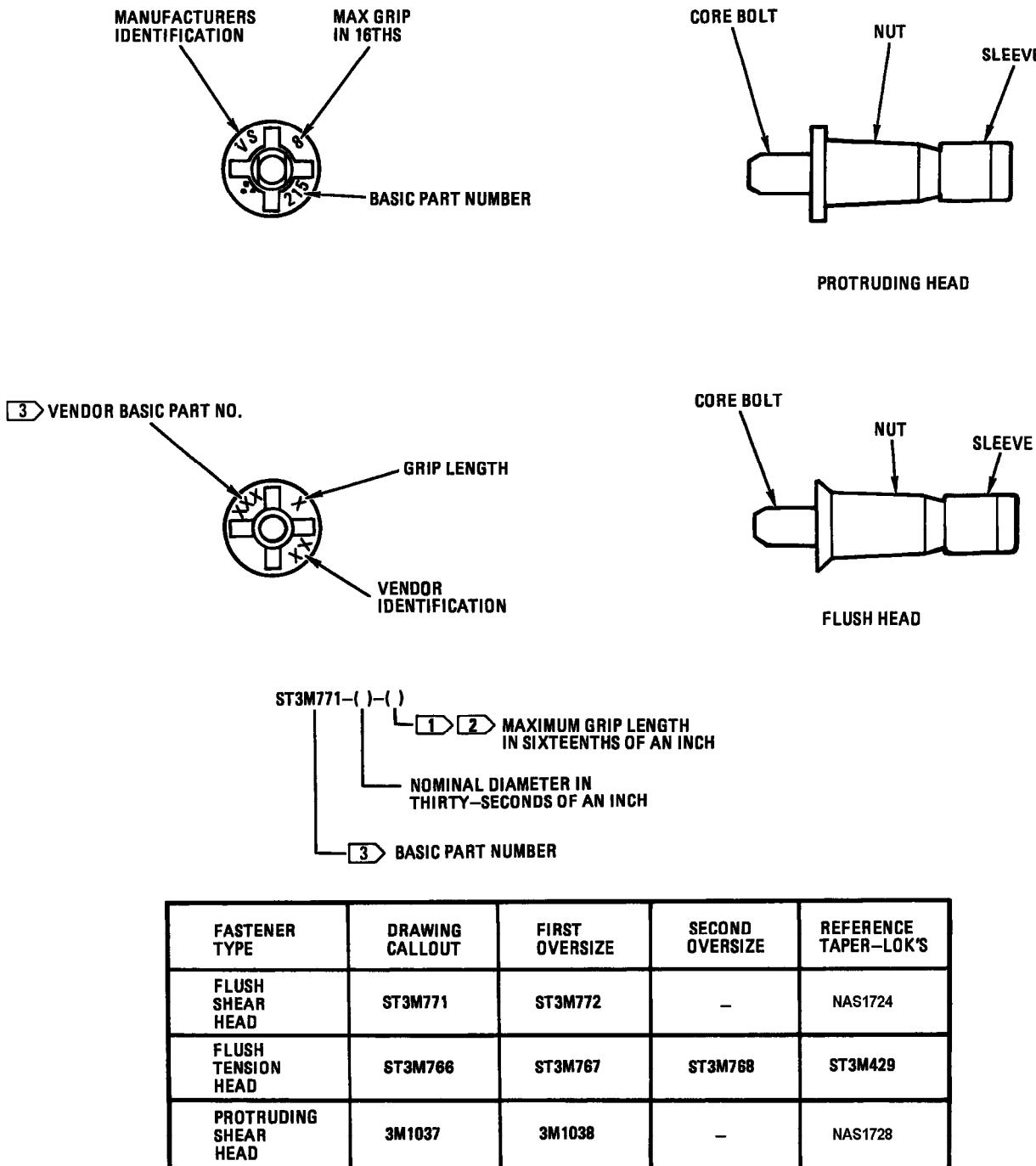
PIN DIA	WASHER PART NO.
5/32	4M36-01062
3/16	4M36-01067
1/4	4M36-02092
5/16	4M36-02093
3/8	4M36-03055
7/16	4M36-03058

LEGEND

1. THE ABOVE WASHERS ARE TO BE USED WHEN A GRIP LENGTH CHANGE IS REQUIRED BETWEEN GROUP 1 AND GROUP 2 FASTENERS.
2. THE WASHER IS TO BE USED WITH A MINIMUM GRIP LENGTH GROUP 2 FASTENER IN A GROUP 2 HOLE WHEN MATERIAL THICKNESS IS EQUIVALENT TO THE MAXIMUM GRIP LENGTH GROUP 1 FASTENER.

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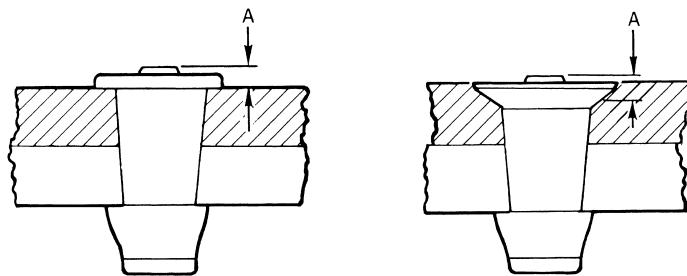
Figure 3-52. Taper-Lok Flushness Requirements and Washer Usage

**LEGEND**

- 1 DO NOT USE JO-BOLT GRIP GAGES FOR THESE FASTENERS.
USE GRIP GAGES FOR TAPER-LOKS.
- 2 GROUP NUMBERS FOR THE VARIOUS DIAMETERS AND
GRIP LENGTHS ARE THE SAME AS THOSE SPECIFIED
FOR TAPER-LOK FASTENERS.
- 3 SEE STANDARD PART DRAWING FOR VENDOR MARKING.

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Figure 3-53. Tapered Shank Blind Fastener Identification



FASTENER PART NO.	A	MONOGRAM INC. GAGE NO.	LOK-FAST INC. GAGE NO.
ST3M771-6 ST3M766-6	+ 0.072 - 0.016	MGFA 6	A4F6LS
ST3M771-8 ST3M766-8	+ 0.072 - 0.026	MGFA 8	A4F8LS
ST3M771-10 ST3M766-10	+ 0.072 - 0.031	MGFA 10	A4F10LS
ST3M771-12 ST3M766-12	+ 0.072 - 0.031	MGFA 10	A4F12LS
3M1037-6 3M1038-6	+ 0.103 + 0.015	MGPA 6	A3P6
3M1037-8 3M1038-8	+ 0.130 + 0.032	MGPA 8	A3P8
3M1037-10 3M1038-10	+ 0.130 + 0.027	MGPA 10	A3P10
3M1037-12 3M1038-12	+ 0.130 + 0.027	MGPA 10	A3P12

LEGEND

1. PLUS (+) INDICATES PROTRUSION ABOVE SKIN SURFACE.
MINUS (-) INDICATES PROTRUSION BELOW SKIN SURFACE.

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Figure 3-54. Tapered Shank Blind Fastener Core Bolt Break-Off Limits

3-111. MILSON FASTENERS. The Milson fastener is a quick release fastener used primarily on structural access doors. Milson fasteners are made up of a sleeve bolt, retaining ring, and a receptacle. The sleeve bolt is retained in the door or panel with the retaining ring which expands over the sleeve bolt. The receptacle is mounted in a permanent position on the structure and accommodates the sleeve bolt. The Milson fastener allows freedom in transferring structural loads directly through access panels. Gaps up to 0.125 inch can be closed with this fastener and hole misalignments up to 0.040 inch still allows fastener installation.

3-112. Tools and Equipment.

Tool, NST120-5 retainer ring installation, Standard Pressed Steel (56878)

Tool, NST120-6 sleeve bolt installation and removal, Standard Pressed Steel (56878)

3-113. Identification. See figure 3-55. Sleeve bolts, retaining rings, shims, and receptacles which make up the Milson fastener assembly can be identified by standard part numbers as shown in figure. The sleeve bolts are available in either flush or protruding head styles. Shims are used in certain installations as the housing for the retaining ring. They are installed either on the inside of the panel or door, or on top of the door or panel sill. The shims are available in different styles to mate the styles of receptacles. Retaining rings are distinguished in size by the number of nodes on the rings. The -4 and -5 rings have seven nodes and the -6 ring has eight nodes. Receptacles are available in sealing and non-sealing styles. The sealing receptacle has a O-ring located around the base of the receptacle which seals against the door or panel when closed. For corner installations, a corner receptacle is used for ease of installation.

3-114. Panel and Substructure Hole Installation Procedures.

See figure 3-56.

a. Installation procedure one.

1. Panel or door installation.

- (a) Drill or ream hole in panel or door for sleeve bolt.
- (b) For flush type Milson fasteners, countersink panel or door for sleeve bolt to seat flush with the moldline of the panel or door.

- (c) Insert sleeve bolt in the hole and install retaining ring on sleeve bolt. Refer to paragraph 3-115 for retaining ring installation procedure.

2. Substructure Installation.

- (a) Drill or ream hole in substructure for size sleeve bolt to be installed.
- (b) Counterbore surface of substructure hole to dimension shown in figure 3-56.
- (c) Locate and drill receptacle rivet holes.
- (d) Countersink rivet holes to allow rivet heads to seat flush within +0.004 –0.001 inch.
- (e) Install receptacle to substructure.

b. Installation procedure two.

1. Panel or door installation.

- (a) Drill or ream hole in panel or door for sleeve bolt.
- (b) For flush type Milson fasteners, countersink the hole in the panel or door to seat sleeve bolt flush with moldline of the panel or door.
- (c) Counterbore the sleeve bolt hole on the sill side of the panel or door to the diameter and depth shown in figure 3-56.
- (d) Locate and drill rivet holes for shim.
- (e) Countersink shim rivet holes on the outside of the panel or door.
- (f) Locate shim in place and countersink rivet holes in shim. The shim must be in place since the countersink will protrude through the shim into the panel or door.

- (g) Insert sleeve bolt into hole in panel or door.

- (h) Install retaining ring on sleeve bolt per paragraph 3-115.

- (i) Hold the sleeve bolt in the full in position and slide the retaining ring flush to the bottom of the counterbore.

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- (j) Install shim with rivets per figure.
2. Substructure installation.
 - (a) Drill or ream hole in substructure for size sleeve bolt to be installed.
 - (b) Locate and drill rivet holes for receptacle.
 - (c) Countersink rivet holes on top side of substructure to allow heads of rivets to seat flush within $+0.004 -0.001$ of sill.
 - (d) Install receptacle to substructure.
- c. Installation procedure three.
 1. Panel or door installation.
 - (a) Drill or ream hole in panel or door for size sleeve bolt to be installed.
 - (b) For flush type Milson fasteners, countersink panel or door for the sleeve bolt to seat flush with mold line of panel or door.
 - (c) Counterbore the sleeve bolt hole on the sill side of the panel or door to the diameter and depth shown in figure 3-56.
 - (d) Insert sleeve bolt into hole in the panel or door and install retaining ring on sleeve bolt per paragraph 3-115.
 2. Substructure installation.
 - (a) Drill or ream hole in substructure for size sleeve bolt to be installed.
 - (b) Locate and drill rivet holes for receptacle.
 - (c) Countersink rivet holes on top side of substructure to allow head of rivets to seat flush within $+0.004 -0.001$ inch of sill.
 - (d) Install receptacle to substructure.
- d. Installation procedure four.
 1. Panel or door installation.
 - (a) Drill or ream hole in panel or door for size sleeve bolt to be installed.
- (b) For flush type Milson fastener, countersink panel or door for the sleeve bolt to seat flush with mold line of the panel or door.
 - (c) Counterbore the sleeve bolt hole on the sill side of the panel to the diameter and depth shown in figure 3-56.
 - (d) Insert sleeve bolt into hole in the panel or door and install retaining ring on sleeve bolt per paragraph 3-115.
2. Substructure installation.
 - (a) Drill or ream hole in substructure for size sleeve bolt to be installed.
 - (b) Counterbore the sill side of the panel or door to the diameter and depth as shown in figure 3-56.
 - (c) Locate and drill rivet holes for receptacle.
 - (d) Countersink rivet holes on top side of substructure to allow head of rivets to seat flush within $+0.004 -0.001$ inch of sill.
 - (e) Install receptacle to substructure.
- e. Installation procedure five.
 1. Panel or door installation.
 - (a) Drill or ream hole in panel or door for size sleeve bolt to be installed.
 - (b) For flush type Milson fastener, countersink panel or door for the sleeve bolt to seat flush with moldline of the panel or door.
 - (c) Locate and drill rivet holes for shim.
 - (d) Countersink shim rivet holes on outside of panel or door.
 - (e) Insert sleeve bolt into the hole in the panel or door and install the retaining ring on the sleeve bolt per paragraph 3-115.
 - (f) Hold sleeve bolt in the full in position and slide the retaining ring flush with the door.

- (g) Install shim on panel or door with rivet per figure 3-56.
2. Substructure installation.
- (a) Drill or ream hole in substructure for size sleeve bolt to be installed.
 - (b) Counterbore the sill side of the panel or door to the diameter and depth shown.
 - (c) Locate and drill rivet holes for receptacle.
 - (d) Countersink rivet holes on top side of substructure to allow head of rivet to seat flush within +0.004 –0.001 inch of sill.
 - (e) Install receptacle to substructure.
- f. Installation procedure six.
1. Panel or door installation.
 - (a) Drill or ream hole in panel or door for size sleeve bolt to be installed.
 - (b) For flush type Milson fasteners, countersink panel or door for the sleeve bolt to seat flush with mold line of the panel or door.
 - (c) Insert sleeve bolt into the hole in the panel or door and install the retaining ring on the sleeve bolt per paragraph 3-115.
 2. Substructure installation.
 - (a) Drill or ream hole in substructure for size sleeve bolt to be installed.
 - (b) Locate and drill rivet holes for shim and receptacle.
 - (c) Countersink rivet holes in shim.
 - (d) Install shim and receptacle to substructure as shown.

3-115. Retaining Ring Installation. The retaining ring holds the sleeve bolt in the panel when the sleeve bolt is pulled to the full out position. Retaining rings are grooved on both sides and may be positioned in either direction on the sleeve bolt.

The procedures below shall be used to install retaining rings:

- a. Installing retaining rings with NST120-5 retaining ring tool. See figure 3-57.

NOTE

Do not use retaining rings not preloaded on the NST120-5 tools.

1. Select correct size NST120-5 installation tool Milson fastener to be installed from the below:

Sleeve Bolt Diameter	Installation Tool Color Code
-4	YELLOW
-5	BLUE
-6	RED

2. Select correct size retaining ring, per figure 3-55, and install ring onto NST120-5 tool.
3. Position the tapered shank end of the NST120-5 tool into the end of the sleeve bolt.
4. Using the thumb and index finger, slide a retaining ring over the end of the tool on the sleeve bolt.
- b. Replacing retaining rings under a shim.
 1. Remove sleeve bolt per paragraph 3-116.
 2. Use a pointed scribe or similar tool to probe the damaged ring from under the shim. Remove the correct size retaining ring from the NST120-5 tool. See step a., substep 1. and substep 2.
 3. Using the fingers, carefully feed the retaining ring under the shim into the counterbore recess. A limited amount of ring expansion may be necessary to install the ring. See figure 3-57 for expansion limits.

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NOTE

Do not force a sleeve bolt through an installed retaining ring without using the NST120 tool.

4. Reinstall sleeve bolt with NST120-6 tool into the hole to the fully engaged position.
5. Remove the NST120-6 tool from the sleeve bolt.
6. Inspect retaining ring for correct operation.
- c. Inspection of retaining ring installation.
 1. Inspect door or panel installation for proper sleeve bolt - retaining ring operation, by moving the sleeve bolt back and out in the panel to be sure the retaining ring is free to move and not bound in the counterbore recess.
 2. Remove and replace all bent or over expanded retaining rings.

3-116. Removal.

- See figure 3-57.
- a. Position sleeve bolt to the full in position.
 - b. Install the correct size NST120-6 removal tool on sleeve bolt. The removal tool dash number is the same as the Milson fastener diameter dash number.
 - c. Push the sleeve bolt back through the retaining ring and panel with the fingers and remove.

3-117. Installation.

- a. Install NST120-6 removal tool on sleeve bolt.
- b. Insert sleeve bolt through panel and retaining ring.
- c. Remove NST120-6 removal tool from sleeve bolt.

3-118. Torque Requirements. Milson fasteners may be torqued by either hand torque tools or by power screwdrivers with preset torque limits. Milson fasteners shall not be overtorqued to meet moldline flushness requirements. A minimum of three complete turns is required for correct engagement of Milson fasteners into the receptacle. Milson fasteners shall be torqued to the limits below:

Milson Diameter	Torque Limits Inch-Pounds
-4	20 to 30
-5	40 to 50
-6	90 to 110

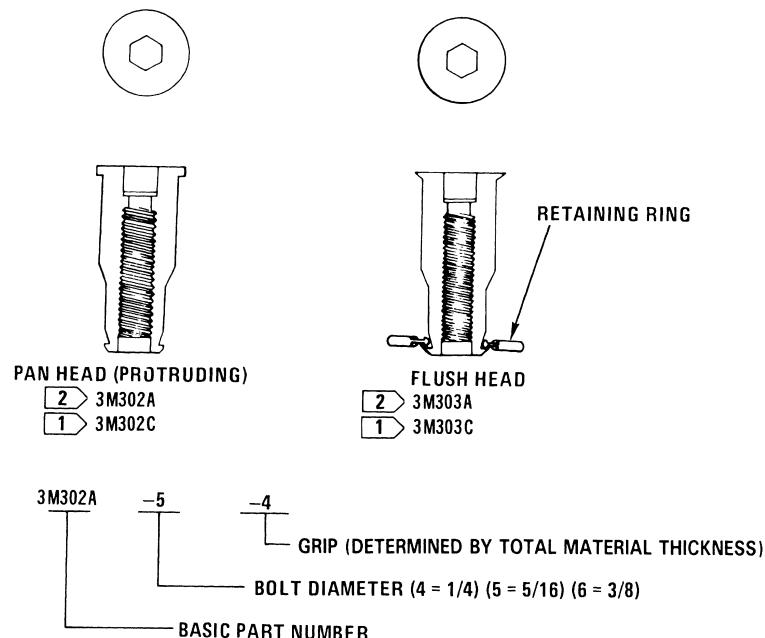
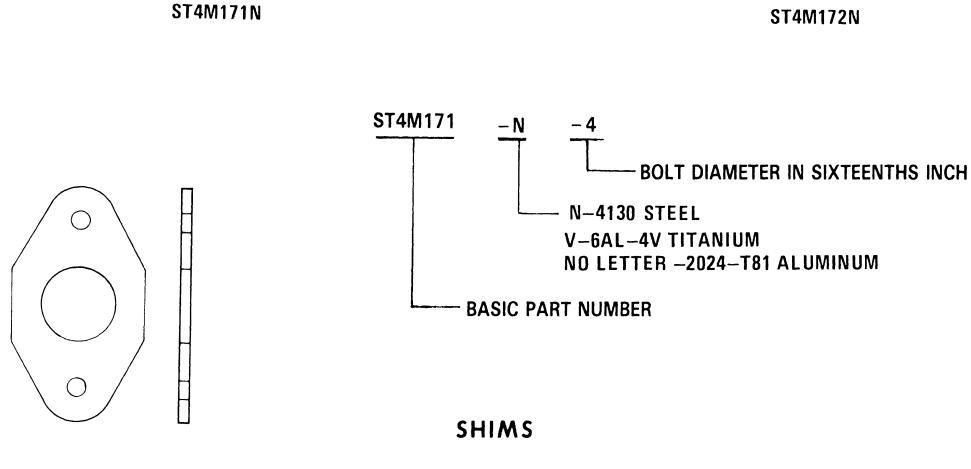
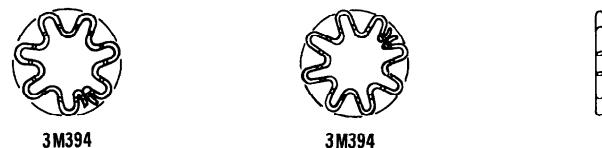
**SLEEVE BOLTS**

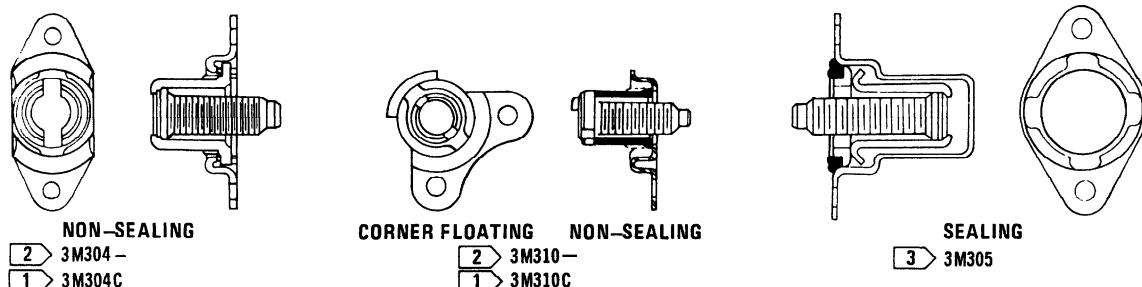
Figure 3-55. Milson Sleeve Bolt, Shims, Retaining Rings and Receptacles Identification
(Sheet 1 of 2)

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3M394 - 4
 └── SLEEVE BOLT DIAMETER DASH NUMBER
 └── BASIC PART NUMBER

RETAINING RINGS



3M304 - 4 - 8 - 1
 └── STUD PROTRUSION
 └── BARREL HEIGHT
 └── SLEEVE BOLT DIAMETER
 └── BASIC PART NUMBER

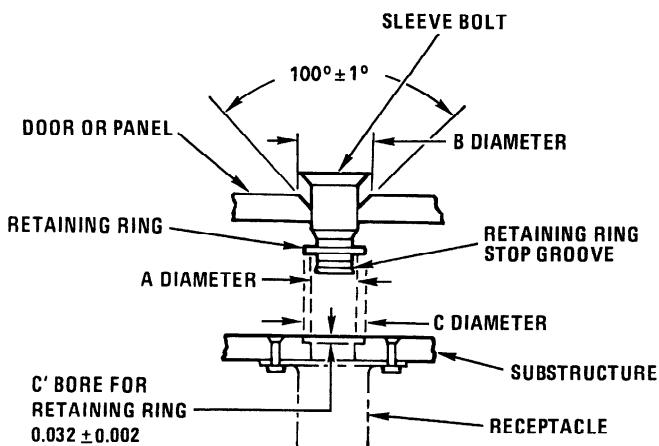
RECEPTACLES

LEGEND

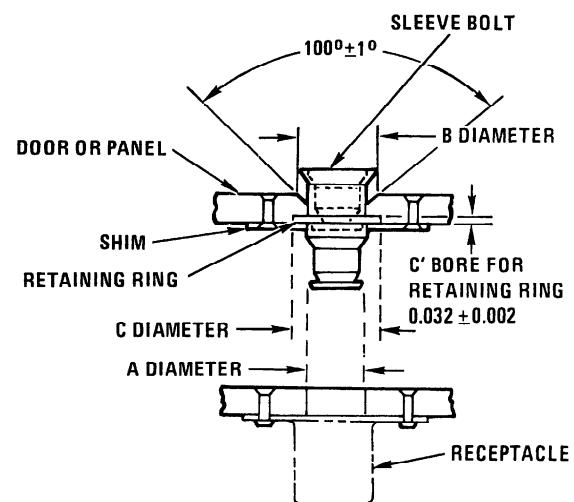
- 1 RECEPTACLE MADE FROM A286 CORROSION RESISTANT STEEL WITH A MAXIMUM TEMPERATURE LIMITATION OF 700 DEGREE FAHRENHEIT.
- 2 RECEPTACLE MADE FROM STEEL ALLOY WITH A MAXIMUM TEMPERATURE LIMITATION OF 450 DEGREE FAHRENHEIT.
- 3 RECEPTACLE MADE FROM STEEL ALLOY WITH A MAXIMUM TEMPERATURE LIMITATION OF 260 DEGREE FAHRENHEIT.

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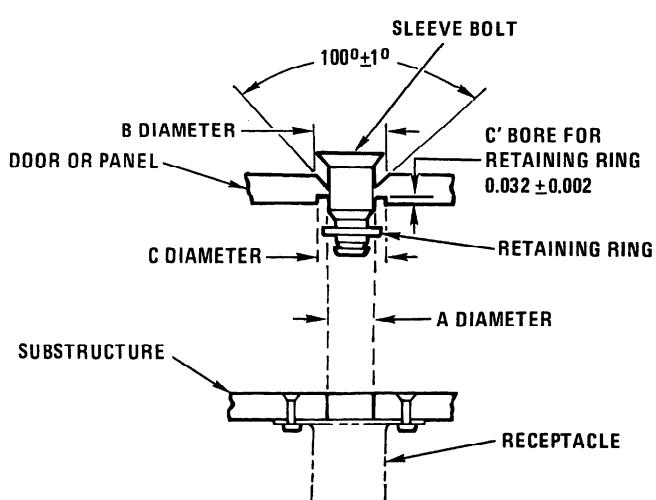
Figure 3-55. Milson Sleeve Bolt, Shims, Retaining Rings and Receptacles Identification
 (Sheet 2)



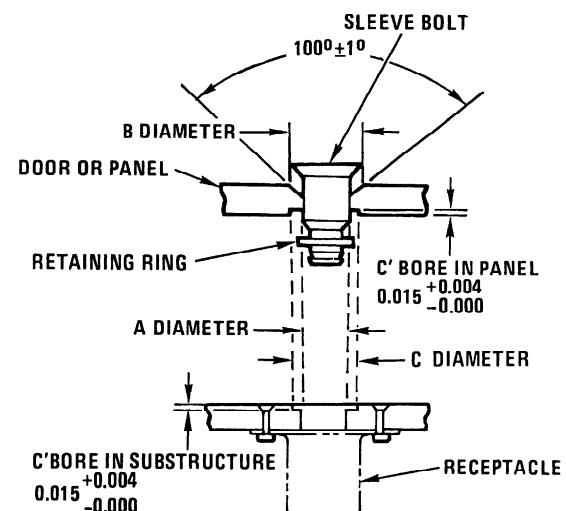
INSTALLATION PROCEDURE I



INSTALLATION PROCEDURE II

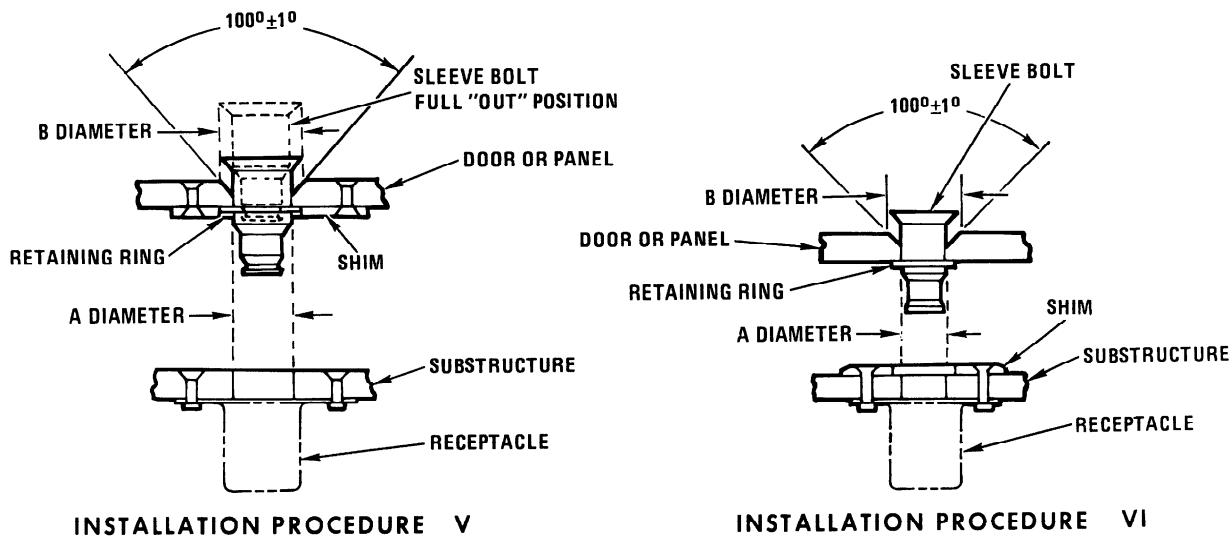


INSTALLATION PROCEDURE III



INSTALLATION PROCEDURE IV

Figure 3-56. Milson Fastener Panel and Substructure Hole Fabrication Procedures
(Sheet 1 of 2)



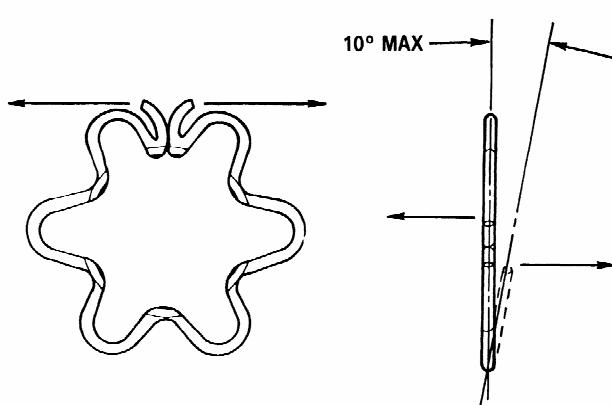
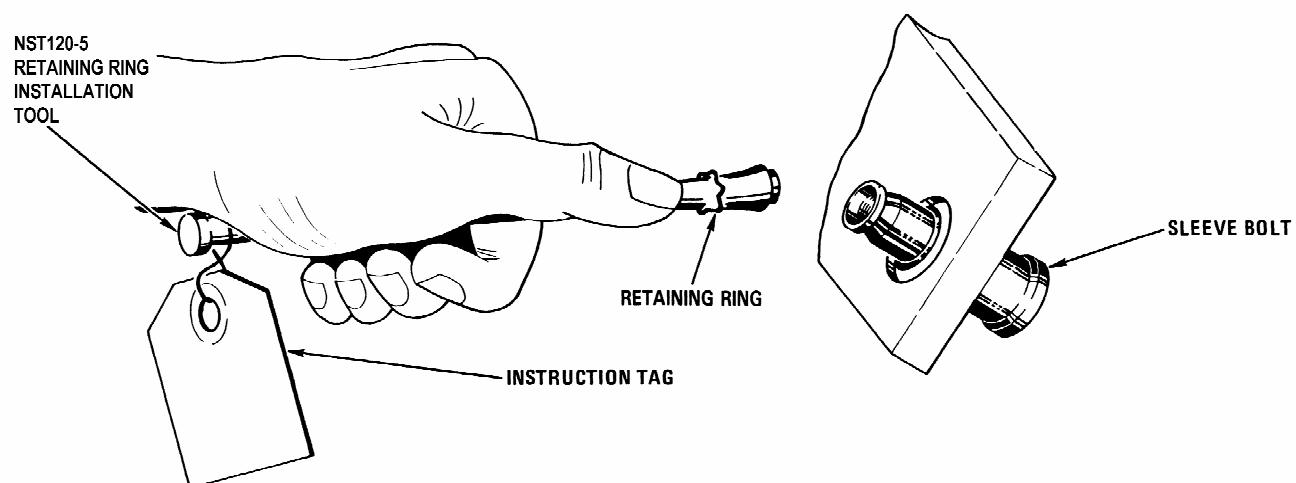
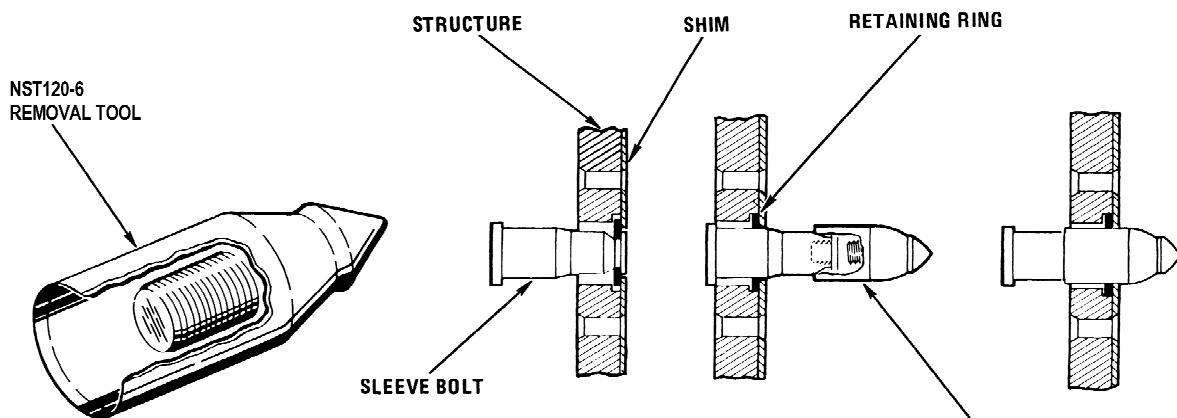
INSTALLATION PROCEDURE V

INSTALLATION PROCEDURE VI

MILSON DIAMETER	HOLE SIZE (A)	COUNTERSINK DIAMETER (B)	COUNTERBORE DIAMETER (C)
-4	$0.252^{+0.007}_{-0.000}$	$0.345^{+0.010}_{-0.000}$	0.450 ± 0.010
-5	$0.314^{+0.007}_{-0.000}$	$0.428^{+0.010}_{-0.000}$	0.537 ± 0.010
-6	$0.377^{+0.007}_{-0.000}$	$0.507^{+0.010}_{-0.000}$	0.625 ± 0.010

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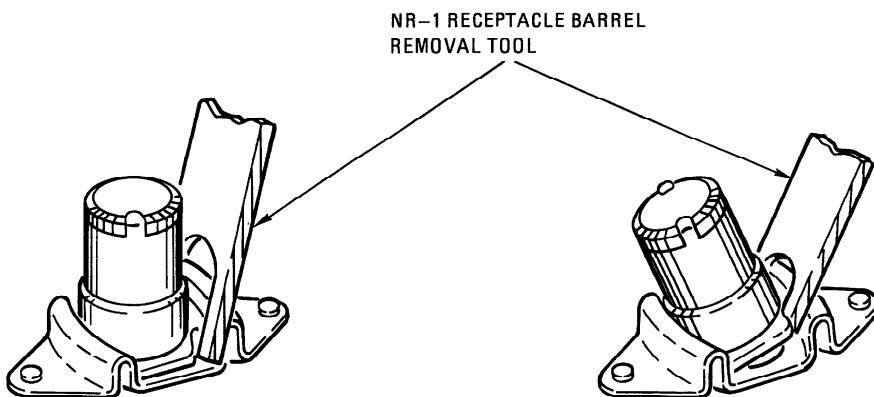
Figure 3-56. Milson Fastener Panel and Substructure Hole Fabrication Procedures
(Sheet 2)



RETAINING RING EXPANSION

SAN301-03-80-001

Figure 3-57. Milson Fastener and Retaining Ring Installation and Removal

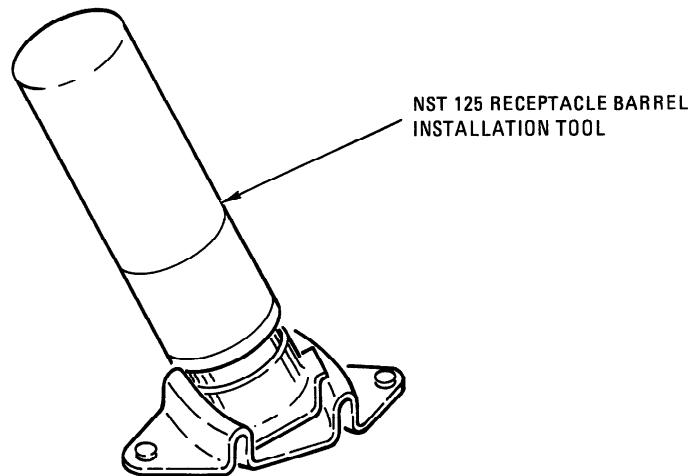


INSERT REMOVAL TOOL, WITH DOWNWARD PRESSURE, BETWEEN RECEPTACLE BARREL ASSEMBLY AND SHELL AS SHOWN. LEAN AGAINST BARREL ASSEMBLY TO INSURE ENGAGEMENT.

MAINTAIN DOWNWARD PRESSURE. BARREL ASSEMBLY WILL SNAP OUT EASILY WITH A SIMPLE PRYING MOTION.

RECEPTACLE BARREL REMOVAL

FASTENER DIAMETER	REMOVAL TOOL	INSTALLATION TOOL
0.3125	NR-1	NST 125-5
0.375	NR-3	NST 125-6
0.250	NR-2	NST-4



INSTALL NEW BARREL ASSEMBLY BY INSERTING THE BARREL ASSEMBLY INTO AN NST125 TOOL, ENGAGE ONE LUG IN RECEPTACLE RETAINER AND ROCK TOOL UNTIL BARREL ASSEMBLY SNAPS INTO PLACE.

RECEPTACLE BARREL INSTALLATION

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Figure 3-58. Barrel Assembly Replacement

3-119. TRI-MIL FASTENING SYSTEM. See figure 3-59 and table 3-15. The Tri-Mil fastening system may be used as a replacement for Milson fasteners. The Tri-Mil system includes a stud nut and retaining assembly which are used with existing Milson receptacles installed in aircraft. Sheet gap closure and hole misalignment capabilities of the Milson fastener are maintained with Tri-Mil system.

3-120. Special Tools.

Hand tool, CA17201-T10 or equivalent
Right angle hex key, 0.188

3-121. Installation Procedure.

- a. Open access cover by disengaging existing Milson fasteners.
- b. Remove and dispose of Milson sleeve bolts and retaining rings.
- c. Select Tri-Mil replacement stud from table 3-15.

- d. Insert Tri-Mil stud into fastener hole in access cover left open by removal of Milson sleeve bolt. See figure 3-59.
- e. Align internal tabs of retaining ring with open slots at end of stud nut. Slide retaining ring to end of these slots.
- f. Engage external hex of retaining ring with hand tool.
- g. Engage 0.188 hex key into mating recess in head of stud nut.
- h. While holding stud nut stationary with hex key, rotate retaining ring using hand tool, through transverse slots into long slots in stud nut.
- i. Reinstall access cover by engaging existing Milson receptacles with Tri-Mil stud nuts.

Table 3-15. Milson Sleeve Bolt to Tri-Mil Stud Interchangeability

Milson Sleeve Bolt		Tri-Mil Stud Nut
Alloy Steel	A286 CRES	A286 CRES
3M303A6W3	3M303C6W3	CA17202-3HS
3M303A6W4	3M303C6W4	CA17202-4HS
3M303A6W5	3M303C6W5	CA17202-5HS
3M303A6W6	3M303C6W6	CA17202-6HS
3M303A6W7	3M303C6W7	CA17202-7HS
3M303A6W8	3M303C6W8	CA17202-8HS
3M303A6W9	3M303C6W9	CA17202-9HS
3M303A6W10	3M303C6W10	CA17202-10HS
3M303A6W11	3M303C6W11	CA17202-11HS
3M303A6W12	3M303C6W12	CA17202-12HS
3M303A6W13	3M303C6W13	CA17202-13HS

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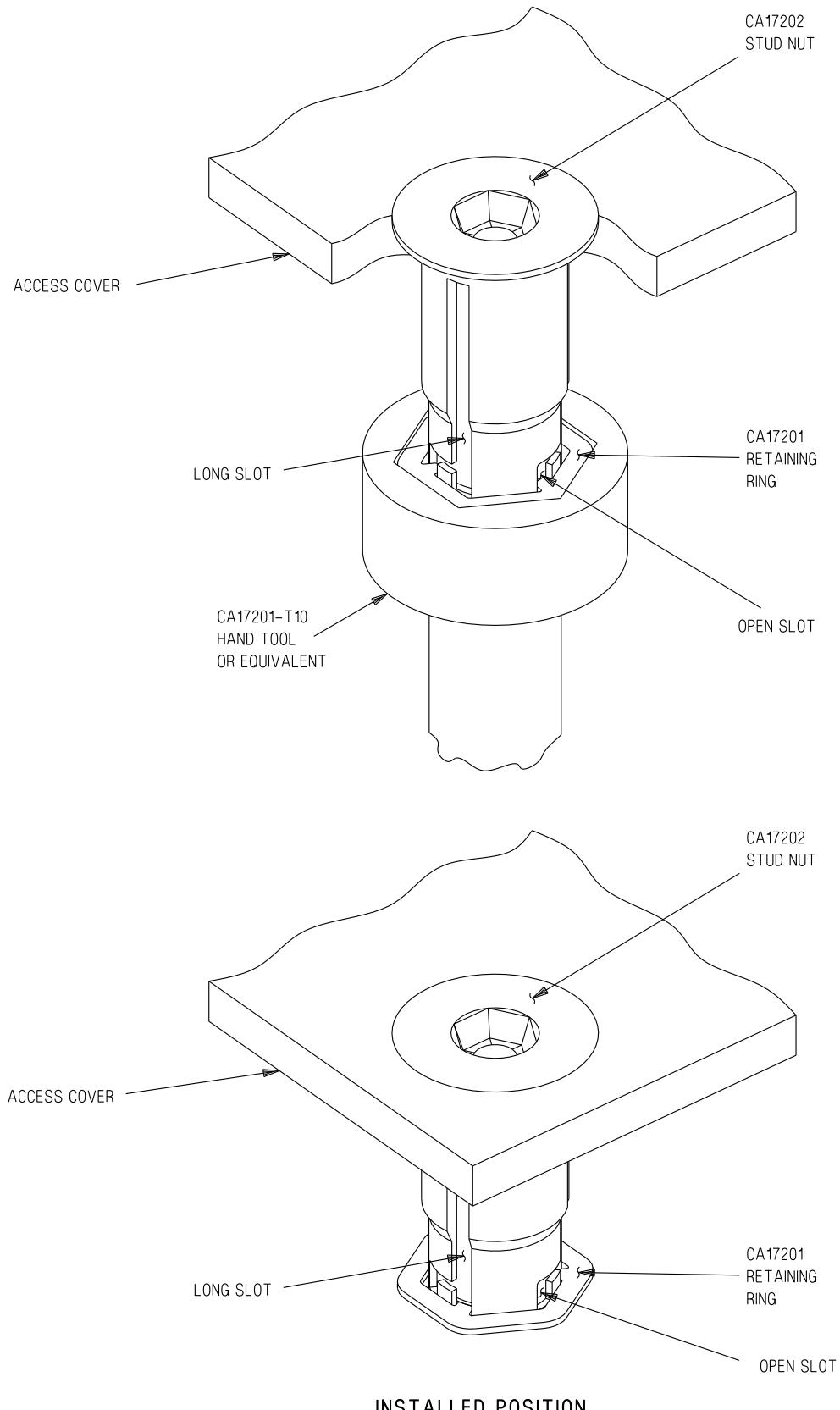


Figure 3-59. Tri-Mil Fastening System

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3-122. RADIAL-LOK FASTENERS. See figure 3-60. The ability of the Radial-Lok to expand (0.002 to 0.006) uniformly throughout the entire length of the hole greatly increases the fatigue life of the fastener and guarantees structural integrity under severe cyclic loading conditions in both aluminum and composite structures.

- a. Because of the Radial-Loks hole filling ability, it is ideal for lightning strike applications in composite materials. Additionally, high clamp up loads are reached without damage to composite materials by the formation of a large blind side swage, which distributes the loading over a large bearing area.
- b. Because the Radial-Lok has a 0.100 grip accommodation, it is possible to install it in a wider range of composite or aluminum material stack-ups, while maintaining designated strength requirements.

3-123. Identification. See figure 3-60. The two types of Radial-Lok fasteners both have separate part numbers.

3-124. Requirements.

- a. To determine grip length, measure the material thickness with an RLS-1A grip gage as shown in figure 3-60.
 - 1. Insert gage into hole, draw gage back until hook contacts the blind sheet. Move the slide (GSS-01) towards the skin surface until it straddles both sides of the prepared hole.
 - 2. This procedure ensures that the gage is perpendicular to the skin surface, producing accurate grip registration on the RLS-1A gage.
 - 3. Once that is done, remove gage and read where the slide coincides with the numbers on the gage.
- b. In those applications where a tapered sheet condition exists on the blind side, the grip length must be determined by the depth at the centerline of the hole as illustrated. See sheet 6 of figure 3-60.

3-125. Installation Tooling. See figure 3-60. This section describes the installation tooling and accessories required to correctly install Radial-Lok blind bolts and make sure they perform correctly.

a. The Radial-Lok blind fastener uses standard NAS1675 tooling at standard air pressure levels. No secondary hydraulic units are required. Limited access tooling is available.

b. The tooling, when used with the correct "Nose Adapters" and "Wrench Adapters", will satisfactorily install all basic Radial-Lok fastener configurations in the 3/16 thru 3/8-inch body diameters.

c. The basic configurations of installation tools and their accessories are described below:

1. The Driver - Pneumatic power motor.
2. The Nose Adapter - The nose adapter connects to the power motor housing. Its function is to engage the drive nut and prevent rotation of the fastener body.
3. The Wrench Adapter - The wrench adapter is enclosed by the nose adapter and connects directly to the power source. Its function is to apply driving force to the fastener wrenching end and eject it after break-off.

3-126. Installation. See figure 3-60.

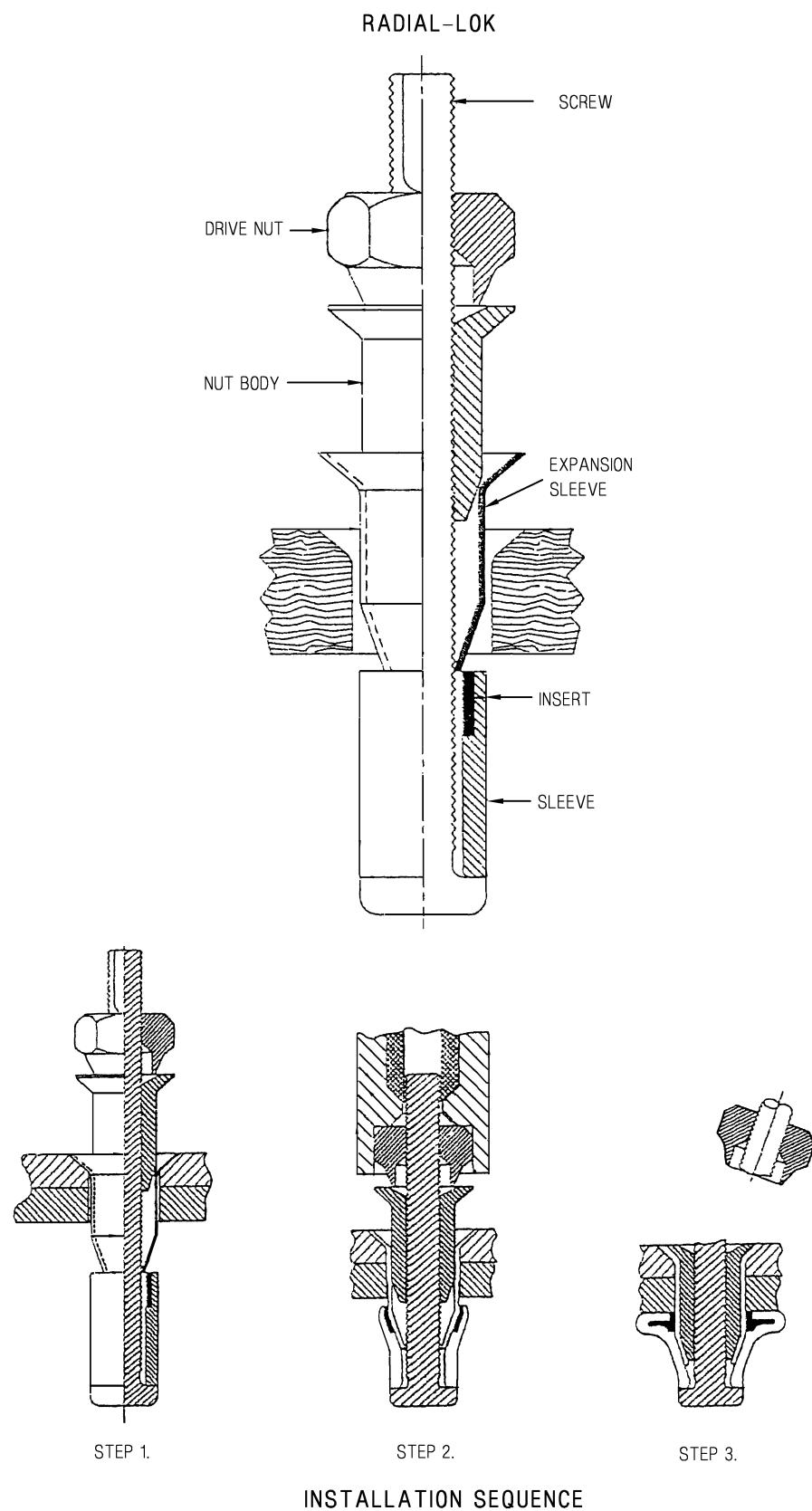
- a. The Radial-Lok fastener is first inserted into the prepared clearance fit hole. See sheet 6. for hole preparation information. The installation tool is placed over the screw, at the same time engaging the wrench flats and the drive nut. See step 1. on sheet 1.
- b. Torque is applied to the screw, while the drive nut is held stationary. The screw continues to advance through the center of the fastener, forcing the nut body into the expansion sleeve, causing uniform radial expansion throughout the length of the hole. See step 2. on sheet 1.
- c. Once the nut body is fully seated in the expansion sleeve, initial blind head formation is started. Continued tightening removes the sheet gap, clamps the sheets tightly together, and forms the large blind head required for composite materials.
- d. When the blind side sleeve forms tight against the structure, the screw will fracture at the break groove. The tool is pulled away, and the pin tail drive nut assembly is disposed of. See step 3. on sheet 1.

CSTO SR1F-15SA-3-1

3-127. **Inspection After Installation.** See figure 3-60.

a. The break-off location of the screw in the head of the nut is a positive indication that the fastener has been correctly installed, as long as the correct grip length has been used. See Table VII on sheet 7.

b. Table VIII on sheet 7 lists the acceptable screw break-off limits for a correctly installed fastener. Screw break-off beyond specification limits is an indication of incorrect installation. To be sure of correct performance, it is extremely important to inspect the grip very carefully before installing the fastener.

**Figure 3-60. Radial-Lok Fastener Installation (Sheet 1 of 7)**

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LOW PROFILE PROTRUDING HEAD
SERIES MRL 3210

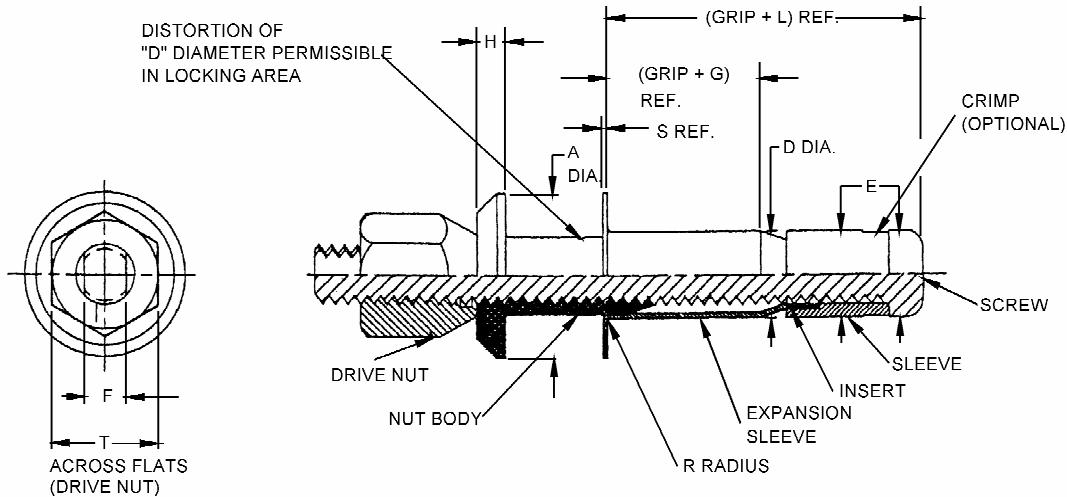


TABLE I

BASIC DIA. DASH NO.	A DIA. REF.	D DIA. REF.	E DIA. MAX	F WRFNCH FLATS	G RFF	H RFF	L RFF	R RADIUS MAX.	S RFF	T ACROSS FLATS	MIN. AVAIL. CRIP	MAX. AVAIL. GRIP
-6	0.406	0.197	0.1905	0.113 0.108	0.075	0.070 0.063	0.650	0.040	0.011	0.375	-100	-500
-7	0.406	0.226	0.2275	0.121 0.116	0.075	0.070 0.063	0.650	0.040	0.011	0.375	-100	-500
-8	0.531	0.258	0.2595	0.135 0.130	0.075	0.085 0.078	0.700	0.045	0.014	0.375	200	-1000
-9	0.531	0.280	0.2895	0.152 0.147	0.075	0.085 0.078	0.750	0.046	0.014	0.500	-200	-1000
-10	0.625	0.310	0.3110	0.152 0.117	0.090	0.105 0.098	0.800	0.050	0.017	0.600	-200	-1000
-11	0.625	0.342	0.3433	0.185 0.180	0.090	0.105 0.098	0.850	0.050	0.017	0.500	-200	-1000
-12	0.750	0.373	0.3740	0.185 0.180	0.100	0.125 0.118	1.000	0.050	0.017	0.500	-200	-1000

TABLE II

2ND (GRIP) DASH NO.	CRIP RANGE	
	MIN. GRIP	MAX. CRIP
-100	0.050	0.125
-200	0.126	0.225
-300	0.226	0.325
-400	0.326	0.425
-500	0.426	0.525
-600	0.526	0.625
700	0.626	0.725
800	0.726	0.825
900	0.826	0.925
-1000	0.926	1.025

TABLE III

BASIC PART NO.	COMPONENT	MATERIAL	HEAT IRLAI	FINISH	LUBRICATION
MRL 3210	NUT	6-AL-4V TITANIUM PER AMS-T-9047 STA OR AMS 4928 OR AMS 4967.	PER AMS-I-81200 TO 95 KSI SHEAR STRENGTH MIN. MAX. HYDROGFN (25 PPM).	KALCARD CONVERSION COATING ANN-RO 1012.	DRY FILM LUBE PLR I HL CHMLICAL REQUIREMENTS OF MIL L 46101, TYPE I. PARAFFIN WAX AND/OR CETYL ALCOHOL USED AS REQUIRED FOR PERFORMANCE.
	SCRFW	A-286 AMS 5732. AMS 5/31 OR AMS 5/37.	TO 175 KSI TENSILE MIN.	PASSIVAL PLR 00-P-35, KAL CARD CONVERSION COATING ANN-RD 1013 (OPTIONAL).	
	SLEEVE	304 STAINLESS STEEL PER AMS 5639 FULLY ANNEALED	AS REQUIRED FOR PERFORMANCE		
	EXPANSION SLEEVE	A-286 PER AMS 5732. AMS 5731 OR AMS 5737.			
	INSERT	ACQ-L AL PER FED-AL SPECIFICATION ASTM D4181.	NONE.		
	DRIVLNUT	MILD STEEL	COLOR GREY.		

NOTES:

- PROCUREMENT SPECIFICATION: MRL 1000
- EXAMPLE OF PART NUMBER:
MRL 3210 (-8-200)
- DESIGNS CRIP (TABLE II)
- DESIGNS BASIC DIAFTER (TABLE I)
- DESIGNS SPECIAL FINISH CODE (SEE MRL 1001)
- DESIGNS BASIC PART NUMBER
- LOCKING FEATURE CONSISTS OF THREE INDENTATIONS LOCATED 120° APART ON THE PERIPHERY OF THE NUT COMPONENT.
- SEE MRL 1003 FOR INSTALLATION AND INSPECTION INFORMATION.
- CONCENTRICITY OF NUT HEAD TO "D" DIAFTER SHALL BE WITHIN 0.010 T.I.R.

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Figure 3-60. Radial-Lok Fastener Installation (Sheet 2)

**100 FLUSH TENSION HEAD
SERIES MRL 3212**

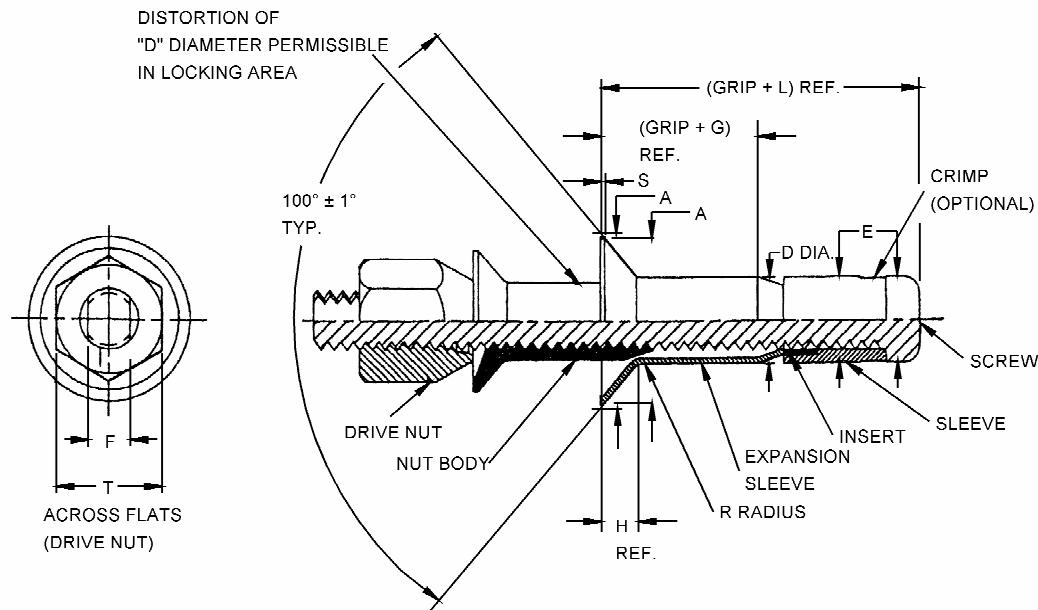


TABLE IV

BASIC DIA. DASH NO.	A DIA. DIA.	A' DIA. MIN.	D DIA. REF.	E DIA. MAX.	F WRENCH FLATS	G RFF	H RFF	L REF.	R RADIUS	S RFF	T ACROSS FLATS	MIN. AVAIL. GRIP	MAX. AVAIL. GRIP
-6	0.385 0.378	0.342	0.197	0.1965	0.113 0.108	0.076	0.077	0.650	0.030	0.010	0.375	-200	-500
-7	0.416 0.409	0.373	0.226	0.2275	0.121 0.118	0.075	0.077	0.650	0.030	0.015	0.375	-200	-500
-8	0.50/ 0.499	0.463	0.258	0.2595	0.135 0.130	0.075	0.104	0.700	0.030	0.015	0.375	-200	-1000
-9	0.530 0.530	0.494	0.288	0.2895	0.152 0.141	0.075	0.104	0.750	0.030	0.015	0.500	-200	-1000
-10	0.635 0.626	0.577	0.310	0.3110	0.152 0.147	0.090	0.136	0.800	0.040	0.015	0.500	-300	-1000
-11	0.666 0.657	0.608	0.342	0.3433	0.185 0.180	0.090	0.136	0.850	0.040	0.015	0.500	-300	-1000
-12	0.762 0.752	0.696	0.373	0.3740	0.185 0.180	0.100	0.162	1.000	0.040	0.015	0.500	-300	-1000

TABLE V

2ND (GRIP) DASH NO.	GRIP RANGE	
	MIN. GRIP	MAX. GRIP
200	0.126	0.225
-300	0.226	0.325
-400	0.326	0.425
500	0.426	0.525
-600	0.526	0.625
-700	0.626	0.725
800	0.726	0.825
-900	0.826	0.925
-1000	0.926	1.025

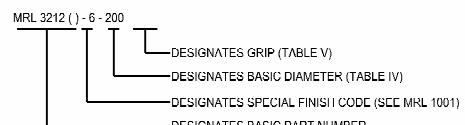
TABLE VI

BASIC PART NO.	COMPONENT	MATERIAL	HEAT TREAT	FINISH	LUBRICATION
MRL 3212	NUT	6-4V TITANIUM PFR AMS-T-9047 STA OR AMS 4928 OR AMS 4987.	PER AMS-II-81200 TO 95 KSI CLEAR STRENGTH MIN. MAX. HYDROGFN 125 PPM.	KALCARD CONVERSION COATING ANN-RO 1012.	DRY FILM LUBE PER THE CHEMICAL REQUIREMENTS OF MLL-16101.1.YPL 1. PARAFFIN WAX, AND/OR CETYL ALCOHOL USED AS REQUIRED FOR PERFORMANCE.
	SCRFW	A-286 AMS 5/32. AMS 5731 OR AMS 5737.	10 1/5 KSI TFNSII F MIL	PASSIVATE PER 00-P-35, KAL GARD CONVERSION COATING ANN-RO 1013 (OPTIONAL).	
	SLLLVL	301 STAINLESS STEEL PLR AMS 5639 FUJI Y ANNFAI FD.	AS RLQUIRLO	FOR PERFORMANCE	
	EXPANSION SLEEVE	A-266 PER AMS 5732. AMS 5731 OR AMS 5737.	FOR PERFORMANCE	NONE	
	INSRT	ACIAL PLATE MATERIAL SPECIFICATION ASTM D4181.		COLOR GREY.	
	DRIV/NUT	MILD STEEL			

NOTES:

1. PROCUREMENT SPECIFICATION: MRL 1000

2. EXAMPLE OF PART NUMBER:



3. LOCKING FEATURE CONSISTS OF THREE INDENTATIONS LOCATED 120° APART ON THE PERIPHERY OF THE NUT COMPONENT.

4. SFF MRL 1003 FOR INSTALLATION AND INSPECTION INFORMATION.

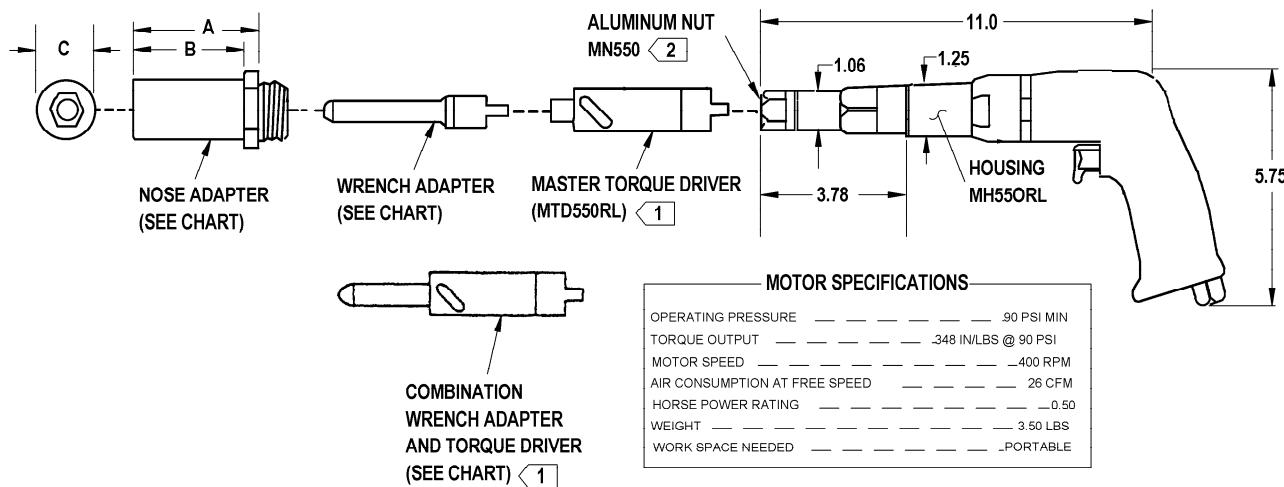
5. CONCENTRICITY OF NUT HEAD TO "D" DIAMETER SHALL BE WITHIN 0.010 T.I.R.

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Figure 3-60. Radial-Lok Fastener Installation (Sheet 3)

INSTALLATION TOOLING

PNEUMATIC PISTOL



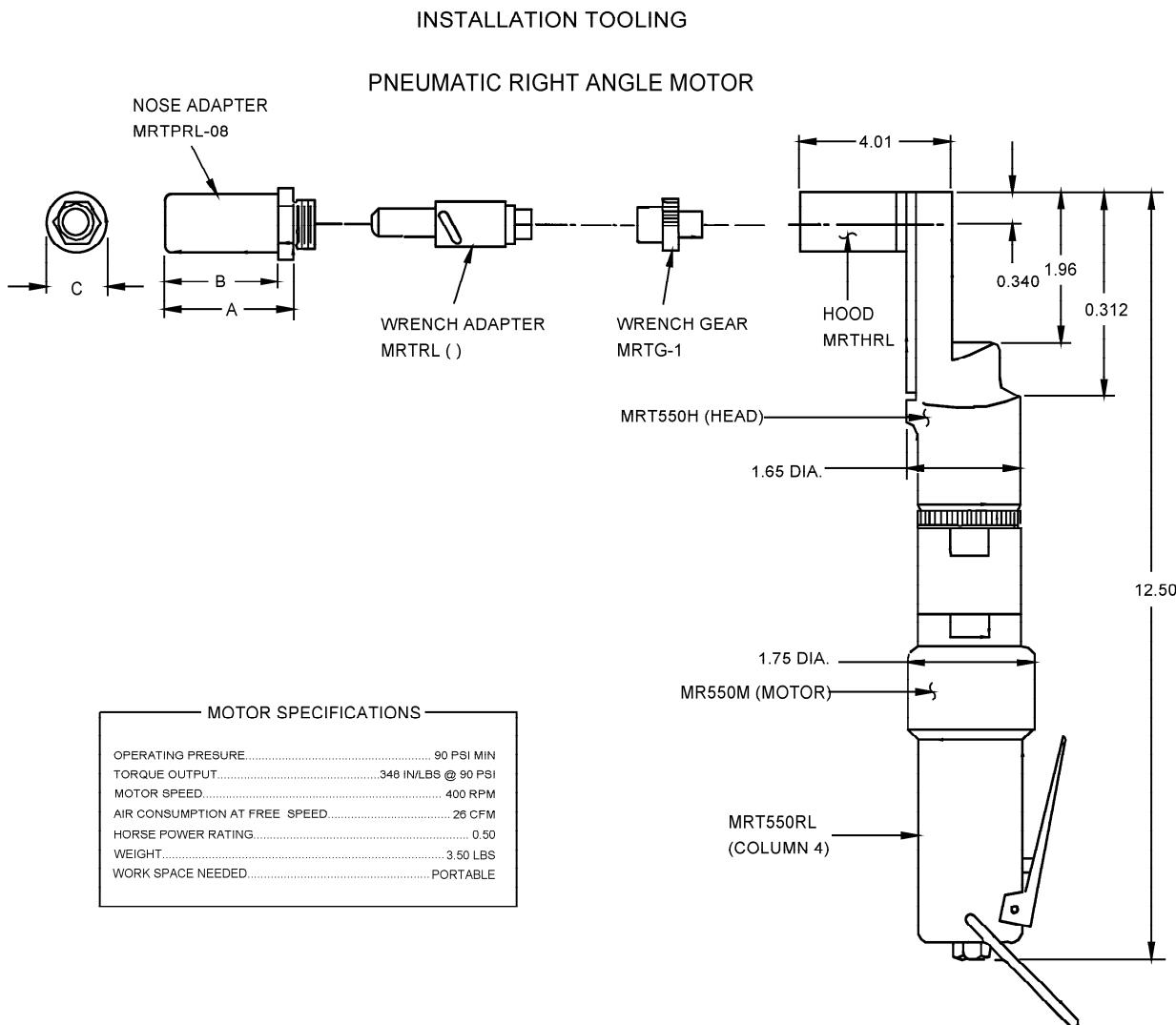
1	2	3	4	5	6	7	8	9
BASIC DIA.	TYPICAL RADIAL-LOK FASTENER PART NUMBERS	COMPLETE MOTOR ASSEMBLY	PNEUMATIC MOTOR	NOSE ADAPTER (HOLDS NUT)	WRENCH ADAPTER (TURNS SCREW)	A REF.	B REF.	C REF.
3/16	MRL3210	MP550RL-6AA	MP550RL	MPPBF-08	MPBF-06	1.80	1.70	0.560
7/32		MP550RL-7AA			MPBF-07			
1/4		MP550RL-8AA			MPBF-08			
9/32		MP550RL-10AA		MPP-12	MPTRL-10 1	1.48	1.36	0.750
5/16		MP550R-12AA			MPTR-12 1			
11/32								
3/8								

NOTES:

- 1 COMBINATION WRENCH ADAPTER & TORQUE DRIVER - REQUIRES REMOVAL OF MASTER TORQUE DRIVER (MTD550RL) SUPPLIED WITH THE TOOL.
- 2 LARGER MALE THREAD ON NOSE ADAPTERS - REQUIRES REMOVAL OF ALUMINUM NUT (MN550) SUPPLIED WITH TOOL

Figure 3-60. Radial-Lok Fastener Installation (Sheet 4)

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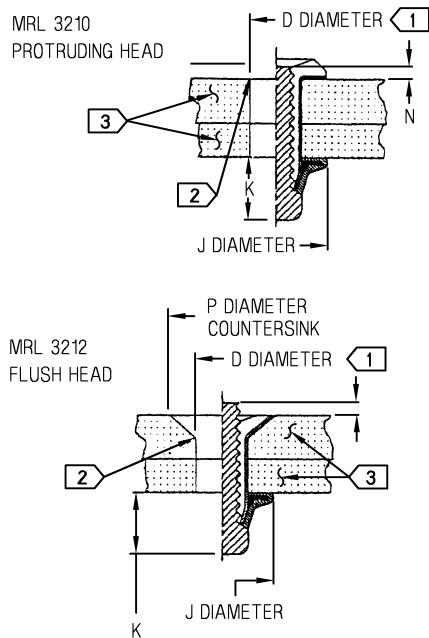


1	2	3	4	5	6	7	8	9
BASIC DIA	TYPICAL RADIAL-LOK FASTENER PART NUMBERS	COMPLETE MOTOR ASSEMBLY	PNEUMATIC MOTOR ASSEMBLY	NOSE ADAPTER (HOLDS NUT)	WRENCH ADAPTER (TURNS SCREW)	A REF.	B REF.	C REF.
3/16	MRL3210 MRL3212	MRT55ORL-6AA MRT55ORL-7AA MRT55ORL-8AA	MRT55ORL	MRTPRL-08	MRTRL-06	0.900	0.770	0.560
7/32					MRTRL-07			
1/4					MRTRL-08			
9/32 5/16 11/32 3/8		FOR INSTALLATION INFORMATION, CONTACT MONOGRAM.						

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Figure 3-60. Radial-Lok Fastener Installation (Sheet 5)

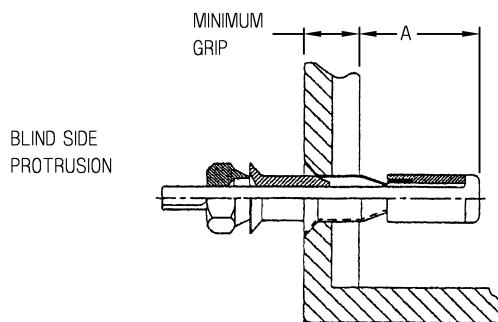
INSTALLATION INFORMATION
HOLE PREPARATION & INSTALLED DIMENSIONS



DASH DASH NUMBER	D.DIAMETER RECOMMENDED HOLE SIZE	100° CSK P. DIA.	J DIA. MIN.	K REF.	N ⁴ SCREW BREAK-OFF LIMITS	
					PROT.	FLUSH
-6	0.199-0.202	0.378-0.385	0.290	0.450	+0.275 +0.075	+0.185 -0.015
-7	0.228-0.231	0.409-0.416	0.340	0.500	+0.275 +0.075	+0.185 -0.015
-8	0.260-0.263	0.499-0.507	0.400	0.500	+0.295 +0.095	+0.185 -0.015
-9	0.290-0.293	0.530-0.538	0.430	0.500	+0.295 +0.095	+0.185 -0.015
-10	0.312-0.315	0.626-0.635	0.460	0.550	+0.315 +0.115	+0.185 -0.015
-11	0.344-0.347	0.657-0.666	0.490	0.625	+0.315 +0.115	+0.185 -0.015
-12	0.375-0.378	0.752-0.762	0.520	0.625	+0.335 +0.135	+0.185 -0.015

NOTES:

- [1] HOLES SHOULD BE STRAIGHT AND PERPENDICULAR TO SURFACE.
HOLES SHOULD BE REASONABLY ROUND AND FREE FROM DELAMINATON.
- [2] EDGE OF HOLES MUST BE GIVEN A CHAMFER GREATER THAN FASTENER RADIUS.
- [3] SHEETS SHOULD BE FIRMLY CLAMPED TOGETHER DURING DRILLING AND GRIP SELECTION.
- [4] SCREW BREAK-OFF LIMITS ARE MEASURED FROM SKIN SURFACE ON PROTRUDING HEAD FASTENERS ONLY. FLUSH STYLE FASTENERS ARE MEASURED FROM THE HEAD OF THE FASTENER.



NOMINAL DIAMETER	A BLIND SIDE PROTRUSION IN MINIMUM GRIP
3/16	0.750
7/32	0.800
1/4	0.800
9/32	0.850
5/16	0.900
11/32	0.950
3/8	1.125

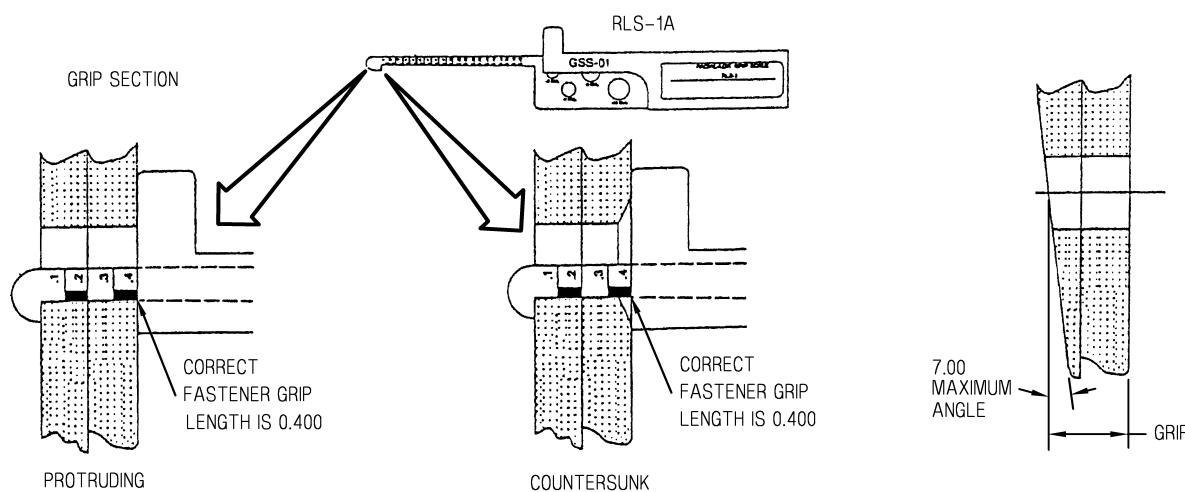
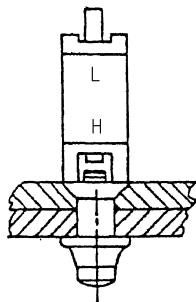


Figure 3-60. Radial-Lok Fastener Installation (Sheet 6)

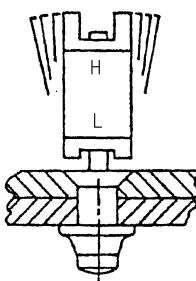
SAN301-03-88-001

INSPECTION

FLUSH HEAD



HIGH BREAK-OFF CHECK - GAGE MUST NOT ROCK



LOW BREAK-OFF CHECK - GAGE MUST ROCK

BLIND BOLT

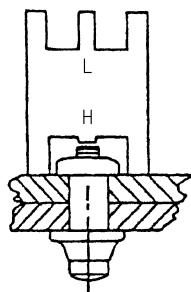
INSPECTION AFTER INSTALLATION

TABLE VII

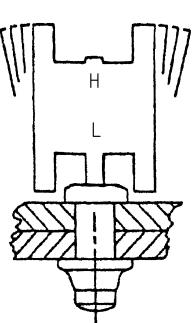
SCREW BREAK-OFF GAGES

FASTENER DIA.	FLUSH HEAD BARREL GAGE	PROTRUDING HEAD LEAF GAGE
-6	MGFRL-6	MGPRL-6
-7	MGFRL-7	MGPRL-7
-8	MGFRL-8	MGPRL-8
-9	MGFRL-9	MGPRL-9
-10	MGFRL-10	MGPRL-10
-11	MGFRL-11	MGPRL-11
-12	MGFRL-12	MGPRL-12

PROTRUDING HEAD



HIGH BREAK-OFF CHECK - GAGE MUST NOT ROCK



LOW BREAK-OFF CHECK - GAGE MUST ROCK

TABLE VIII

SCREW BREAK-OFF LIMITS

FASTENER DIA.	PROTRUDING HEAD	FLUSH HEAD
-6	+0.275 +0.075	+0.185 -0.015
-7	+0.275 +0.075	+0.185 -0.015
-8	+0.295 +0.095	+0.185 -0.015
-9	+0.295 +0.095	+0.185 -0.015
-10	+0.315 +0.115	+0.185 -0.015
-11	+0.315 +0.115	+0.185 -0.015
-12	+0.335 +0.135	+0.185 -0.015

Figure 3-60. Radial-Lok Fastener Installation (Sheet 7)

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3-128. **AIRLOC FASTENERS.** Airloc fastener assemblies are made up of a stud, cross pin, and a receptacle. The fasteners are available in three head styles, flush head, round head, and wing head. The cross pin hole in the stud is reamed for a press fit of the cross pin. The receptacle is made of high carbon, heat treated steel and is available in floating and non-floating types.

3-129. **Identification.** See figure 3-61. The Airloc stud, cross pin, and receptacle are identified by separate part numbers. For breakdown of each part number see figure.

3-130. Requirements.

a. To determine the grip length of the stud for non-floating type receptacles, measure the thickness of the material through which the stud passes in 0.001 of an inch and add 0.010 inch. Take the nearest 0.010 inch above this total to find the correct grip length.

b. To determine stud for use with floating type receptacle, add 0.040 inch to the total material thickness, in thousandths, through which the stud passes. Take the nearest 0.010 inch above this total to find the correct grip length.

c. Removed stud and cross pin shall not be reused.

3-131. **Removal.** To remove Airloc studs, press the cross pin out with Airloc pliers and remove stud.

3-132. Installation.

- a. Drill hole and dimple or countersink material for flush Airloc installation. See figure 3-62 for types of Airloc installation.
- b. Select correct length stud for type installation required, see figure 3-61. Refer to paragraph 3-130 for determining stud length.
- c. Insert stud through outer sheet and press new cross pin into stud with Airloc pliers.

3-133. THREADED FASTENERS.

3-134. Threaded fasteners are used for parts that must be removed and reinstalled at frequent intervals. The fasteners have a formed head at one end and threads on the other end. The threaded

fasteners are installed by securing the threaded portion directly into the part being installed or into a nut or threaded receptacle. The fasteners are available in either flush or protruding head styles.

3-135. **BOLTS.** Bolts are available with Hi-Torque recess or hexagon head styles. Steel bolts are preferred in most corrosion compatibility with the structure and the temperature requirements. Bolts used in frequently removed doors, panels or parts should use gang channel or floating plate nuts to prevent binding of fasteners due to misalignment of mating holes and to make sure of interchangeability of the parts.

3-136. **Identification.** Structural bolts can be identified as to type, tolerance, and sometimes the nominal diameter by the head markings. Refer to TO 1-1A-8 for breakdown of bolt part numbers.



Be careful to make sure that the oversize shank is not interfering with the nut counterbore.

3-137. **Installation.** Where location of the head of the bolt is not specified, the bolt shall be, where practical, located in a way that the head is positioned up, forward or inboard. Where an oversize bolt engages the blueprint gang channel and/or plate nut, a spacer may be required between the nut and the structure because the counterbore in these type of nuts may not be large enough to accept the oversize shank of the repair bolt. The spacer shall be a NAS463 shim, 4M49 shim or custom shim made from SRP 1002 repair stock 0.063 thick (nominal). For aluminum structure, use aluminum spacer. For steel or titanium structure, use stainless steel or titanium spacer. For installation procedure for bolts refer to TO 1-1A-8.

3-138. **SCREWS.** Flush screws are used to secure doors and panels on the exterior surface of the aircraft. Ion Vapor Deposited (IVD) aluminum coated screws provide improved corrosion protection in exterior surfaces. Screws are also used to install components, brackets, and angles where access to install rivets is limited. Structure screws are close tolerance and require a precision drilled hole to maintain stress integrity. Screws are available with Hi-Torque, frearson or phillips driving recess.

3-139. **Identification.** Screws can be identified by the head markings as to type materials, tolerance, and in some cases the nominal diameter, refer to TO 1-1A-8. For conversions of threaded fastener part numbers, refer to section VI. See figures 3-63 and 3-64 for ST3M454 or ST3M733 and ST3M455 or 3M927 fastener identification.

3-140. **Installation.** For installation procedure for screws, refer to TO 1-1A-8.

3-141. **TORQUE REQUIREMENT.** Bolts and screws shall be tightened sufficiently so they are snugged up tight against the part or component being installed. Final tightening shall be done with a torque wrench to the specified torque value for the size bolt or screw being installed. The torque applied shall not be great enough to cause bending or warping of parts or components into position. Bolts and screws shall never be lubricated before they are installed, since this would greatly affect the torque reading.

3-142. **Bolt Torque Values.** When necessary because of accessibility, the torque wrench may be applied to the bolt head. When bolts are torqued by the head, the bolts shall be torqued to the highest specified torque limits. Over-torquing bolts installed in clinch nuts may cause the nut to rotate. When no specified torque values are called out, bolt shall be torqued to the below values in inch-pounds.

Bolt Size	Tension Application		Shear Application	
	Min	Max	Min	Max
10-32	20	25	12	15
1/4-28	50	70	30	40
5/16-24	100	140	60	85
3/8-24	160	190	95	110
7/16-20	450	500	270	300

Bolt Size	Tension Application		Shear Application	
	Min	Max	Min	Max
1/2-20	480	690	290	410
9/16-18	800	1000	480	600
5/8-18	1100	1300	660	780

3-143. **Screw Torque Values.** Screws shall not be installed at a higher torque value than specified to get it within flushness requirements. Power screwdrivers with preset torque limits may be used to install screws in doors and panels. The screw shall be started into the nut or receptacle by hand before a power tool is used to install the screw. Over-torquing screws installed in clinch nuts may cause nut to rotate. When no specific torque values are called out, screws used to install doors and removable panels will be torqued to the limits below:

Screw Size	Torque (Inch-Pounds)
10-32	15 to 35
1/4-28	40 to 60
5/16-24	65 to 95
3/8-24	85 to 125
7/16-20	125 to 175
1/2-20	190 to 270
9/16-18	250 to 350
5/8-18	375 to 475



Bolts or screws having threads or head recesses with obvious wear or damage, shall be scrapped and replaced, or damage to gang channels and plate nuts will result.

NOTE

Due to tolerance build up during manufacturing and assembly, a non-blueprint specified nut element may have been installed. A nut element of the same type as called out on the blueprint but with a counterbore of 0.125 greater or less than the nut element specified on the drawing may have been used. To be sure proper fastener protrusion is maintained when replacing a nut element, a grip length inspection of the replacement nut element should be done.

3-144. INSPECTION. All bolts and screws shall be installed perpendicular to the surface on which the head will bear. Bolts or screws having threads or head recesses with obvious wear or damage, shall be scrapped and replaced. A bolt or screw shall not be installed into a self-locking nut if the bolt or screw can be installed on a nut by hand far enough to permit the end of the bolt or screw to protrude through the nut. The threaded portion of the bolts or screws shall extend through the nuts or receptacles within the limits below.

3-145. To make installation acceptable, a nut element of the same type with a counterbore ± 0.125 specified in CSTO SR1F-15SA-4-1 may be used. Shims up to 0.125 may be added or removed from under the nut element or gang channel to maintain proper permissible fastener protrusion.

Bolt or Screw Size	Minimum Thread Protrusion
#4, #6, #8	0.060
10-32, 1/4	0.060
5/16, 3/8	0.070
7/16, 1/2	0.080

Bolt or Screw Size	Minimum Thread Protrusion
9/16, 5/8	0.090
3/4	0.120
7/8	0.140
1.0, 1-1/8, 1-1/4	0.170

3-146. NUTS. Nuts are used to secure parts or components when they are installed. Types of nuts available are self-locking, castellated, channel nut, clinch nut, plate nuts, and barrel nuts. Nuts are available in different materials for use in different temperature ranges. All nuts shall be installed so rotation or misalignment of the nut cannot occur during tightening of the bolt or screw. Various types of spacers, washers, and shims are used with nuts, refer to paragraph 6-13.

NOTE

Due to tolerance build up during manufacturing and assembly, a non-blueprint specified nut element may have been installed. A nut element of the same type as called out on the blueprint but with a counterbore of 0.125 greater or less than the nut element specified on the drawing may have been used. To be sure proper fastener protrusion is maintained when replacing a nut element, a grip length inspection of the replacement nut element should be done.

3-147. Self-Locking Nuts. Self-Locking nuts have the safetying features included in the construction or as an internal part and no auxiliary means of safetying. Two types of self-locking nuts used are the all metal nuts and metal nuts with non-metallic inserts.

3-148. Metal Nuts. The all metal self-locking nuts are constructed with the threads in the locking insert out of phase with the load carrying section, or with a saw cut top portion with a pinched-in head. The locking action of the nut depends on the resiliency of the metal when the locking portion and load carrying portions are engaged by a bolt or screw.

3-149. Non-Metallic Insert Nuts. Non-metallic insert self-locking nuts are constructed with an unthreaded, non-metallic, locking insert on top of the load carrying section or with a plug inserted in one of the side faces of the nut. The non-metallic insert has a smaller inside diameter than the nut, therefore, when a screw or bolt is inserted, contact is forced between the insert and the screw or bolt threads causing the locking action.

3-150. Castellated Nuts. Castellated nuts have slots on the top portion of the nut and require an external means of safetying the nut on a bolt. The castellated nuts are installed on bolts which have a hole drilled in the shank of the bolt and a cotter pin installed through the slot in the nut and hole in the bolt. Castellated nuts are used on linkage where the movement of the linkage would cause a self-locking nut to loosen.

3-151. Clinch Nuts. A clinch nut is a threaded, piloted nut that is inserted into a drilled or punched close tolerance hole, and is clinched or staked in place to prevent rotation. The nut can be used in open or blind locations and is suitable for high speed assembly. It is often used with sheet metal difficult to weld, with parts where tapping is not feasible or with partially assembled units. Types include square, hex, round, floating, and other proprietary body styles. Available in most standard nut sizes, it is supplied in steel, brass, stainless steel, and aluminum.

3-152. Identification. Part number identification is shown on figure 3-65.

3-153. Installation. See figure 3-66.

- a. Drill or punch installation holes to tolerance indicated in table II on sheet 1.
- b. Determine the thickness of the part that will receive the clinch nut and select the appropriate shank length from table III on sheet 1.
- c. Install clinch nuts with punch and dolly sets that press the nut shank into the base material while forming the shank end to secure the part. Control the load applied during this operation so that no cracks, dents or irregularities are produced in the part. Acceptance limits for installed clinch nuts are shown in table V on sheet 2.

d. The completed installation shall be capable of withstanding the torque requirements of table IV on sheet 2 without loosening.

e. After installation of clinch nut, the bolt shall turn freely up to the locking feature.

3-154. Removal. Clinch nuts may be removed by drilling out from the swaged end. Use a drill slightly smaller than the nut shank and drill just past the swaged head. The shank may then be pushed out with a small tool which will not damage the sheet metal.

3-155. GANG CHANNELS. Gang channels are a series of equally spaced, self-locking nuts retained in a channel. They are attached to the structure by rivets. For maintenance purposes, they may be considered as two types; gang channel assemblies with removable nuts and retainers, and a channel with permanently installed nuts.

3-156. Gang Channel Assemblies with Removable Nuts. Gang Channel Assemblies of this type are made up of a U-shaped channel, self-locking nuts, and retaining clips.

3-157. Identification. Part number identification of gang channel assemblies is shown in figure 3-67. Part number identification of the removable self-locking nut is shown in figure 3-68. The basic McDonnell Standard number of the self-locking nut indicates type, temperature limitation, size, material, and counterbore depth. The nuts authorized for replacement have the counterbore depth code number on the ear of the nut.

3-158. Nut Replacement. See table 6-12 for part number listing of gang channel nuts and table 6-13 for part number listing of gang channel retaining clips.



Do not use self-locking nuts without code number on ear of nut, as stripped nuts and binding of screws will result.

- a. Squeeze ends of retaining clip and remove clip and nut from channel.
- b. Insert replacement nut in channel.
- c. Squeeze ends of clip and insert in slots in flanges of channel.

3-159. Gang Channel Assembly Repair and Replacement.

Repair. See figure 3-69. Repair by splicing a section of the gang channel assembly is done by cutting a gang channel section of the correct length from standard gang channel assembly stock. The standard stock sections are supplied in lengths of approximately 72 inches. See table 6-10 for part number listing of gang channel stock.

- a. If splicing a section, cut damaged channel allowing enough space after last good nut to maintain nut spacing.
- b. Drill out fasteners which secure damaged channel section or entire channel to structure.



Do not use gang channel assemblies which contain self-locking nuts without code number on ear of nut, as stripped nuts and binding of screws will result.

- c. Cut repair or replacement section from standard stock size gang channel. Allow enough space after last nut to maintain nut spacing when splicing to undamaged section.

NOTE

A minimum of two rivets shall be used in attaching any gang channel section to the aircraft structure.

- d. Rivet replacement section to structure.
- e. If a repair splice is being made, rivet undamaged section to structure, as required.
- f. ForceTec retainers are also authorized substitutes. See figure 3-79 for installation information.

3-160. Gang Channels with Permanently Installed Nuts.

This type of gang channel has the channel flanges bent over to retain the nut. The nuts are not stocked separately as a replacement part.

3-161. Repair by Nut Replacement.

- a. Obtain standard stock gang channel. See table 6-14 for part number listing of standard gang channel stock.



Care must be taken in removing nuts or damage to channel will result.

- b. Spread flanges of spare gang channel and remove nuts.
- c. Spread flanges of gang channel containing damaged nut, and remove nut.
- d. Install replacement nut.
- e. Close flanges of channel to hold nut in place.

3-162. Gang Channel Repair and Replacement.

Repair by splicing a section of the gang channel is done by cutting a gang channel section of the correct length from standard gang channel stock. See table 6-14 for part number listing of standard gang channel stock.

- a. If splicing a section, cut damaged channel allowing enough space after last good nut to maintain nut spacing.
- b. Drill out fasteners which secure damaged channel section or entire channel to structure.



Do not use gang channel assemblies which contain self-locking nuts without code number on ear of nut, as stripped nuts and binding of screws will result.

- c. Cut repair or replacement section from standard stock size gang channel. Allow enough space after last nut to maintain nut spacing when splicing to undamaged section.

NOTE

A minimum of two rivets shall be used in attaching any gang channel section to the aircraft structure.

- d. Rivet replacement section to structure.
- e. If a repair splice is being made, rivet undamaged section to structure, as required.

3-163. Plate Nuts. Plate nut assemblies are made up of a nut and a plate retainer that is riveted to the structure. The self-aligning or floating type plate nut uses a retaining clip or the plate is formed to hold the nut element but still allow a controlled amount of movement. Depending on the application, the nut is either self-locking or non self-locking. Four basic types are used. One lug type, the attaching rivets are on the same end of the retaining plate. Two lug types, the attaching rivets are on each end of the retaining plate. Corner type, the retaining plate is formed to allow a corner installation. Right angle type, the retaining plate is formed so that the nut element is at right angles to the structure. For identification, removal, and installation, refer to TO 1-1A-8.

3-164. Barrel Nuts. Barrel nut assemblies are made up of a self-locking nut, a half round cradle, and a spring steel retainer. Barrel nuts are used on installations where access is limited and high tensile strength is necessary. The round installation hole and the half round cradle provides for alignment of the bolt and nut. For identification, removal, and installation, refer to TO 1-1A-8.

3-165. THREADED INSERTS.

3-166. Threaded inserts are used in the original design of aircraft accessories and all types of mechanical equipment to protect and strengthen tapped threads in light metals, particularly in locations which require frequent assembly and disassembly. Inserts are used to restore damaged or stripped threads and also are used to repair solid bushings which have become worn or damaged.

3-167. HELICAL COIL. Helical coil screw inserts are made of helically coiled wire with a diamond-shaped cross section which accommodates internal and external threads at the same time. Each insert is made with a tang which is a portion of the bottom coil that has been offset to provide a simple driving member. This tang is removed with a breakoff tool after the insert has been installed. Helical coil screw lock inserts have one or more polygonal shaped coils near the center of the insert to act as a self-locking feature to hold screws or bolts in place.

3-168. Tools and Equipment. See figure 3-71 for tool dash number requirements.

Tool, installation, PN 7551-()
 Tool, breakoff, automatic, PN 3695-()
 Tool, extracting, PN 1227-()

3-169. Identification. See figure 3-70. Each helical coil insert can be identified by a standard part number. This part number consists of a basic code number and a two part dash number. The basic code number MS21209 identifies the part as a helical coil screw lock insert. The letter represents the type of internal thread. The first dash number represents the size of thread and the second dash number represents the true length of the insert plus a half a turn of the threads. For sizes up through number 10-32, the number represents the numbered thread size. For sizes 1/4-inch and larger, the number represents the internal thread size of the insert in 1/16-inch increments. The letter portion of the dash number designates the actual length of the insert when it is installed plus a half turn of the threads. This letter represents a different length for each size of insert and must be taken from the diagram shown in figure. For determining the length of the insert, the diagram gives the size of the insert and two nominal lengths under the columns headed -15 and -20. An example of an insert part number is MS21209F5. This would represent a screw lock insert with an internal thread size of 5/16-24 and an installed nominal length of 0.469. Before the insert is installed it can be identified as having two grip coils and 5 1/2 free coils. For quick identification, MS21209 inserts are dyed red.

3-170. Hole Preparation. Since the structural integrity and close fit of the installed insert are directly affected by the tapped hole preparation, careful drilling and tapping of the hole is important. Figure 3-71 gives the correct hole sizes and helical coil inserts. Drill and countersink the holes to the dimensions shown in the table. Countersink the hole to the diameter shown and remove all chips and other foreign particles from the hole. Tap the hole, using the applicable helical coil tap, to the specified depth. Finish tapping may be preceded by a roughing tap of the same thread size, when necessary. Roughing taps are available for thread sizes 7/16-inch and larger only. The spiral point, two flute taps are recommended for tapping stud or other hard materials for thread sizes smaller than 7/16-inch. These taps have greater strength and better cutting action in steel. However, the limited chip space may necessitate more frequent removal of the tap to clean chips out of blind holes. After the hole has been tapped, remove all chips and foreign particles from the tapped holes and inspect the hole for proper dimensions. If the insert is installed in aluminum or magnesium alloy, apply a

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thin coat of paint of the type specified for the part to the tapped hole threads before installing the insert. If zinc chromate primer is specified for the part, apply zinc chromate primer to the tapped hole threads.

3-171. **Installation.** See figure 3-71. Select the correct installation tool from the diagram. Pull back the handle of the tool until the cutaway chamber is cleared of the material. Place the insert in the chamber with the tang toward the threaded end of the sleeve. Push the handle forward so the mandrel slots engage the insert tang. Turn the handle clockwise permitting the insert to engage in the prewinder sleeve and advance until the mandrel tip is exposed about 1/32-inch through the end of the prewinder sleeve. This is done without the use of any forward pressure. Locate the tool over the tapped hole and turn the handle clockwise until the insert disengages from the prewinder tool. Slide the prewinder sleeve back toward the handle and turn the insert mandrel until the insert is 1-1/2 turns below the top of the tapped hole. Never turn the mandrel counterclockwise. If the insert is turned too far through the prewinder sleeve, it should be turned all the way through and reinserted to turn to correct depth.

3-172. **Removal.** Select the correct size extraction tool from the diagram given in figure 3-71. Place the extraction tool blade into the hole so one side of the blade is one fourth of a turn from the end of the insert. Strike the head of the extraction tool lightly with a hammer. Bearing down hard on the handle, turn the handle slowly counterclockwise, firmly maintaining pressure as the insert backs out. Correct removal of the insert will not damage the threads in the tapped hole. Never reuse an insert after it has been removed from a hole.

3-173. MIL-DTL-83454 TERMINAL GROUND STUD.

3-174. The MIL-DTL-83454 ground stud assembly is made of two pieces, a headed and threaded stud, and a ductile, electrically conductive outer sleeve. The sleeve shoulder, or head, serves as a positioning stop, standoff and electrical contact surface. The stud threads and pulling stem protrude from the shoulder of the sleeve. The grounding stud is installed from one side of the workpiece.

Installation is done with conventional pulling tools. On installation, the grounding stud is inserted in drilled hole and an axial load is applied to the stem

and reacted against the washer face of the sleeve. The sleeve is displaced radially by the expander boss, inducing an interference fit and electrical contact in the structure. The section of the outer sleeve, which protrudes from the backside of the workpiece before driving, is expanded outwardly into a bulb. This bulbing clamps the workpiece which bears tension loading of the installed stud. The pull-stem is configured to separate at that predetermined axial load required to install the fastener correctly for best mechanical and electrical capabilities.

3-175. TOOLS AND EQUIPMENT.

RV30GB, Olympic Pneumatic-Hydraulic Blind Rivet Gun

RV911-10, Olympic Straight Pulling Head

RV981-10, Olympic Double Offset Pulling Head

3-176. INSTALLATION. See figure 3-72.

- a. Remove any abnormal contamination from installation area.
- b. Drill or finish drill hole 0.3125 to 0.3165 in diameter.
- c. As soon as possible after final hole is drilled, install the bare stud (no sealants or lubricants).
- d. Select the applicable pulling head.
- e. Insert the end of the pulling head over the stud spindle and press firmly against the structure.

NOTE

When the gun is actuated, the action of the stud being pulled will automatically help to bring the gun and pulling head into correct alignment with the stud axis; however, the operator should align the gun as accurately as possible.

- f. Activate tool by pulling trigger on the pneumatic gun and maintain pressure against structure until the spindle breaks.

3-177. REMOVAL.

- a. Hit stud with several sharp hammer blows; this will punch stud out, leaving sleeve shoulder assembly.

b. Drill out sleeve shoulder assembly using a drill slightly smaller than the stud shank. The remaining material should be carefully picked

out of hole. If the hole has not been damaged, a new stud may be installed.

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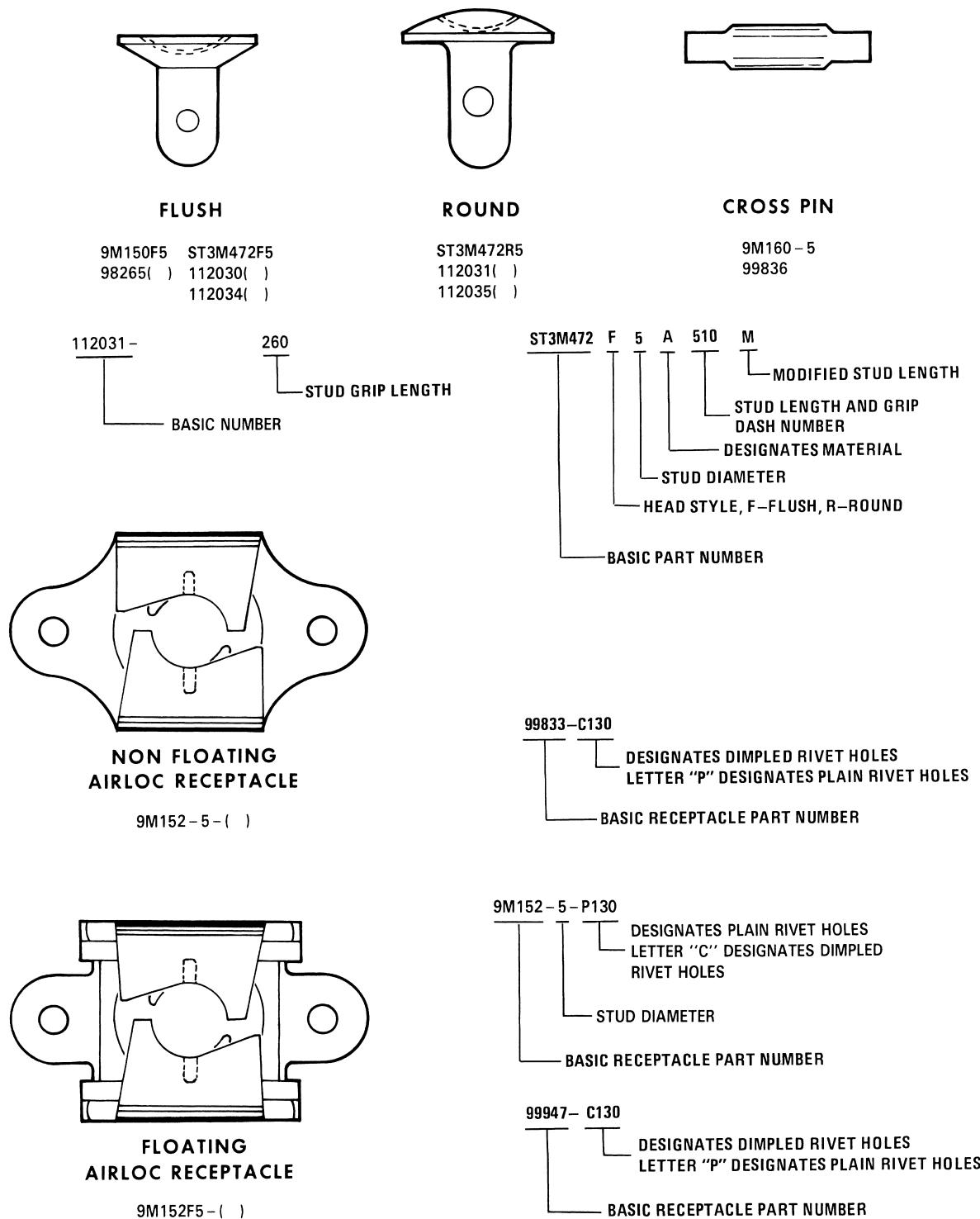
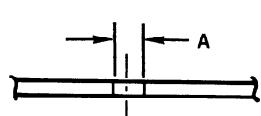
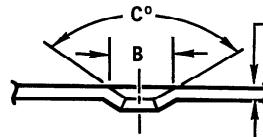


Figure 3-61. Airloc Stud and Receptacle Identification

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DRILL OR PUNCH

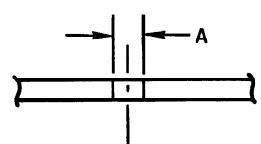


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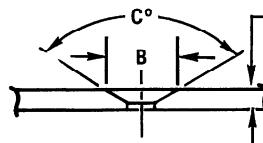


INSTALL CROSS-PIN

STUD SIZE	STUD NUMBER REFERENCE	$A^{+0.007}_{-0.001}$	B	C°	H	CROSS-PIN REFERENCE
5	112030	0.281	0.625	120	0.100	99836
5	ST3M472	0.281	0.625	120	0.100	9M160
5	98265	0.281	0.625	120	0.100	99836
5	9M150	0.281	0.625	120	0.100	9M160



DRILL OR PUNCH

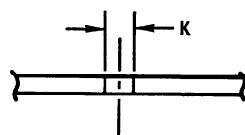


MACHINE COUNTERSINK



INSTALL CROSS-PIN

STUD SIZE	STUD NUMBER REFERENCE	$A^{+0.007}_{-0.001}$	B	C°	H	CROSS-PIN REFERENCE
5	112030	0.281	0.625	120	0.100	99836
5	ST3M472	0.281	0.625	120	0.100	9M160
5	98265	0.281	0.625	120	0.100	99836
5	9M150	0.281	0.625	120	0.100	9M160



DRILL OR PUNCH



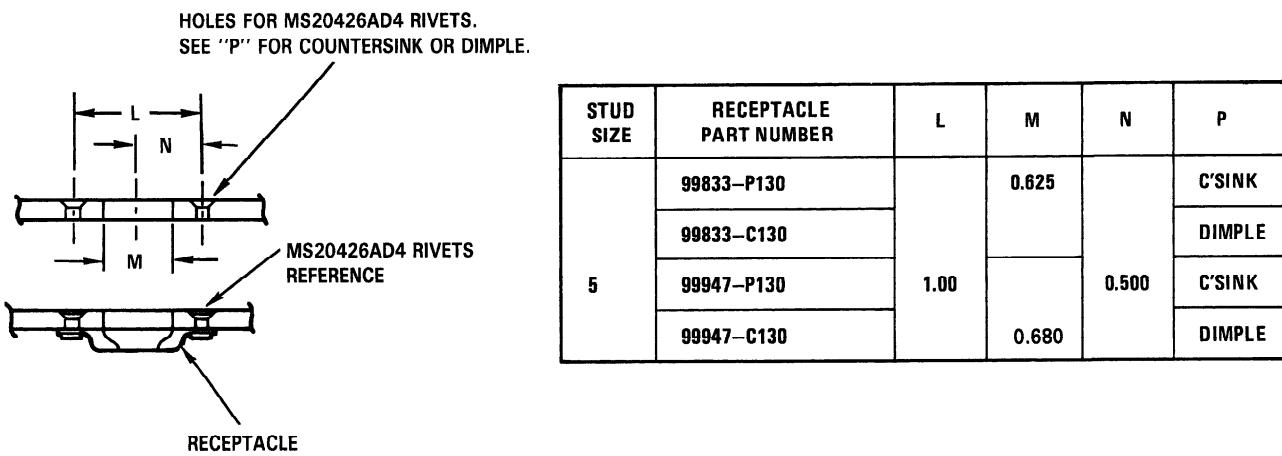
INSTALL CROSS-PIN

STUD SIZE	STUD NUMBER REFERENCE	K	CROSS-PIN REFERENCE
	ROUND HEAD		
5	112031	0.318	99836
5	ST3M472	0.318	9M160

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Figure 3-62. Airloc Stud and Receptacle Installation (Sheet 1 of 2)

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Figure 3-62. Airloc Stud and Receptacle Installation (Sheet 2)

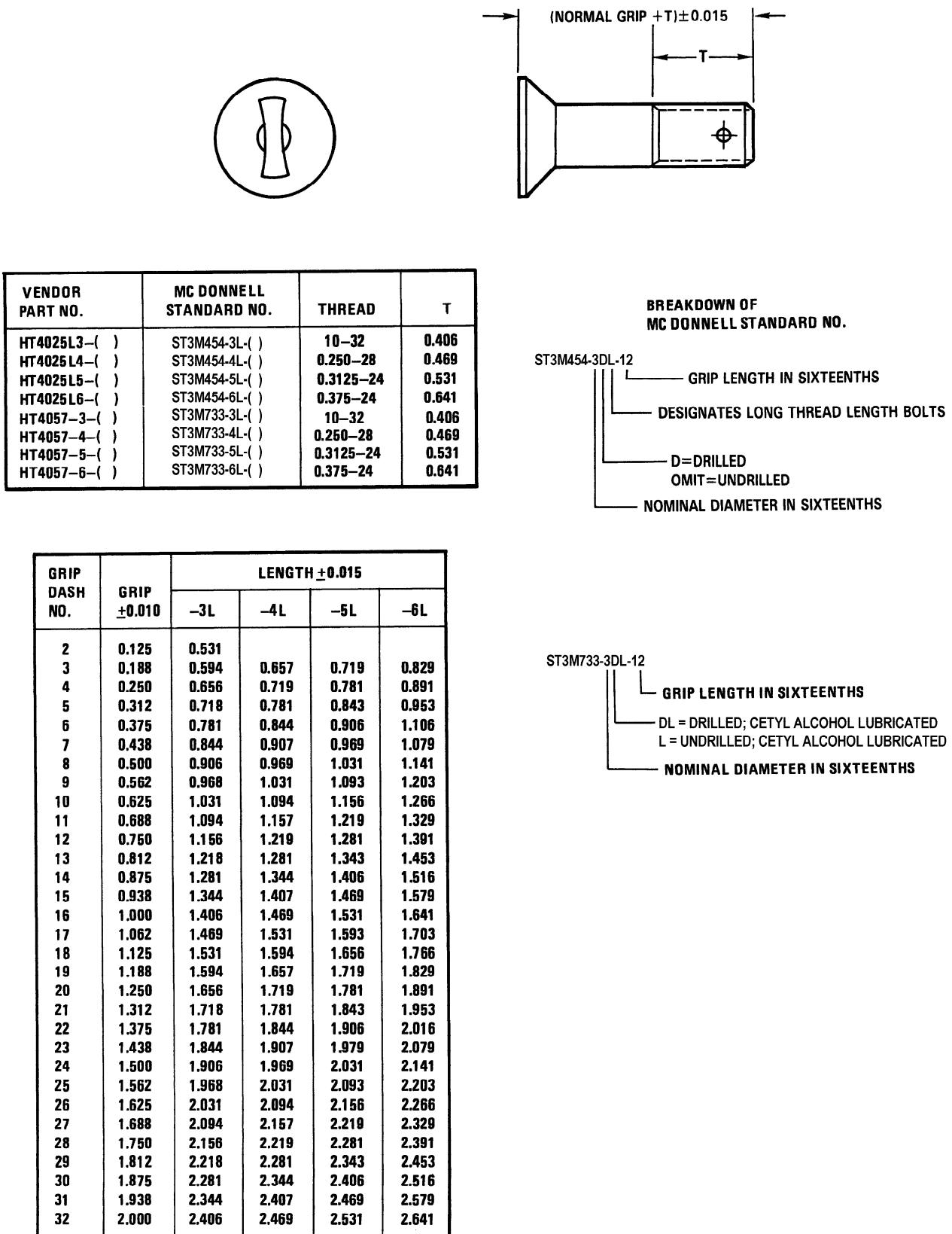
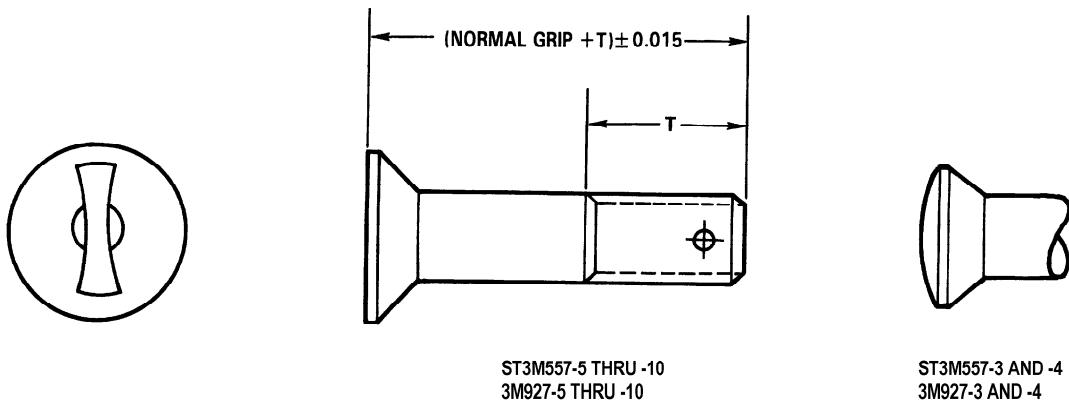


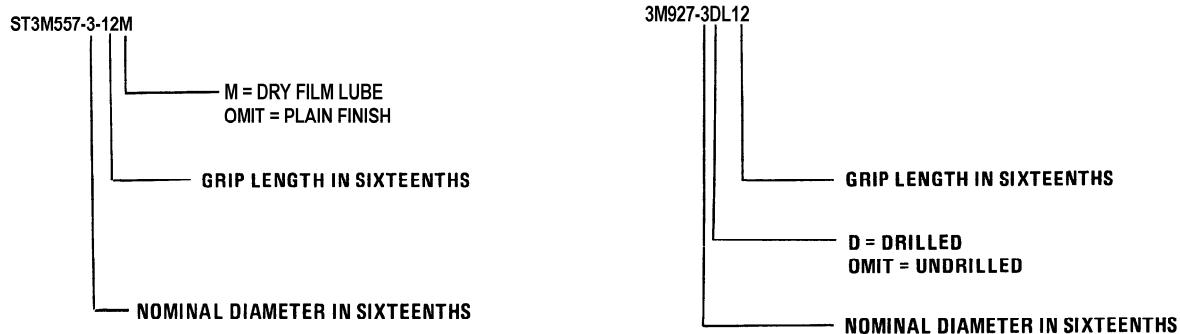
Figure 3-63. ST3M454 and ST3M733 Fastener Identification

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VENDOR PART NO.	MCDONNELL STANDARD NO.	THREAD	T
HT4027-3-()	ST3M557-3-()	0.1900-32	0.406
HT4027-4-()	ST3M557-4-()	0.2500-28	0.469
HT4027-5-()	ST3M557-5-()	0.3125-24	0.531
HT4027-6-()	ST3M557-6-()	0.3750-24	0.641
HT4027-7-()	ST3M557-7-()	0.4375-20	0.656
HT4027-8-()	ST3M557-8-()	0.5000-20	0.781
HT4027-9-()	ST3M557-9-()	0.5625-18	0.906
HT4027-10-()	ST3M557-10-()	0.6250-18	0.953
HT4069-3-()	3M927-3L-()	0.1900-32	0.406
HT4069-4-()	3M927-4L-()	0.2500-28	0.469
HT4069-5-()	3M927-5L-()	0.3125-24	0.531
HT4069-6-()	3M927-6L-()	0.3750-24	0.641
HT4069-7-()	3M927-7L-()	0.4375-20	0.656
HT4069-8-()	3M927-8L-()	0.5000-20	0.781
HT4069-9-()	3M927-9L-()	0.5625-18	0.906
HT4069-10-()	3M927-10L-()	0.6250-18	0.953

BREAKDOWN OF
MCDONNELL STANDARD NO



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Figure 3-64. ST3M557 and 3M927 Fastener Identification (Sheet 1 of 2)

GRIP DASH NO	GRIP ± 0.010	LENGTH ± 0.015							
		3L	4L	5L	6L	7L	8L	9L	10L
2	0.125	0.531	0.594	0.657	0.767				
3	0.188	0.594	0.657	0.719	0.829	0.843	0.969	1.094	1.141
4	0.250	0.656	0.719	0.781	0.891	0.905	1.031	1.15-	1.203
5	0.312	0.718	0.781	0.843	0.953	0.968	1.093	1.218	1.265
6	0.375	0.781	0.844	0.906	1.016	1.031	1.156	1.281	1.328
7	0.438	0.844	0.907	0.969	1.079	1.094	1.219	1.344	1.391
8	0.500	0.906	0.969	1.031	1.141	1.156	1.281	1.406	1.453
9	0.562	0.968	1.031	1.093	1.203	1.218	1.343	1.468	1.515
10	0.625	1.031	1.094	1.156	1.266	1.281	1.406	1.531	1.578
11	0.688	1.094	1.157	1.219	1.329	1.344	1.469	1.594	1.641
12	0.750	1.156	1.219	1.281	1.391	1.406	1.531	1.666	1.703
13	0.812	1.218	1.281	1.343	1.453	1.468	1.593	1.718	1.765
14	0.875	1.281	1.344	1.406	1.516	1.531	1.656	1.781	1.828
15	0.938	1.344	1.407	1.469	1.579	1.594	1.719	1.844	1.891
16	1.000	1.406	1.469	1.531	1.641	1.656	1.781	1.906	1.953
17	1.062	1.469	1.531	1.593	1.703	1.718	1.843	1.968	2.015
18	1.125	1.531	1.594	1.656	1.766	1.781	1.906	2.031	2.078
19	1.188	1.594	1.657	1.719	1.829	1.844	1.969	2.094	2.141
20	1.250	1.656	1.719	1.781	1.891	1.906	2.031	2.156	2.203
21	1.312	1.718	1.781	1.843	1.963	1.968	2.093	2.218	2.265
22	1.375	1.781	1.844	1.906	2.016	2.031	2.156	2.281	2.328
23	1.438	1.844	1.907	1.969	2.079	2.094	2.219	2.344	2.391
24	1.500	1.906	1.969	2.031	2.141	2.156	2.281	2.406	2.453
25	1.562	1.968	2.031	2.093	2.203	2.218	2.343	2.468	2.515
26	1.625	2.031	2.094	2.156	2.266	2.281	2.406	2.531	2.578
27	1.688	2.094	2.157	2.219	2.329	2.344	2.469	2.594	2.641
28	1.750	2.156	2.219	2.281	2.391	2.406	2.531	2.666	2.703
29	1.812	2.218	2.281	2.343	2.453	2.468	2.593	2.718	2.765
30	1.875	2.281	2.344	2.406	2.516	2.531	2.656	2.781	2.828
31	1.938	2.344	2.407	2.469	2.579	2.594	2.719	2.844	2.891
32	2.000	2.406	2.469	2.531	2.641	2.656	2.781	2.906	2.953

Figure 3-64. ST3M455 and 3M927 Fastener Identification (Sheet 2)

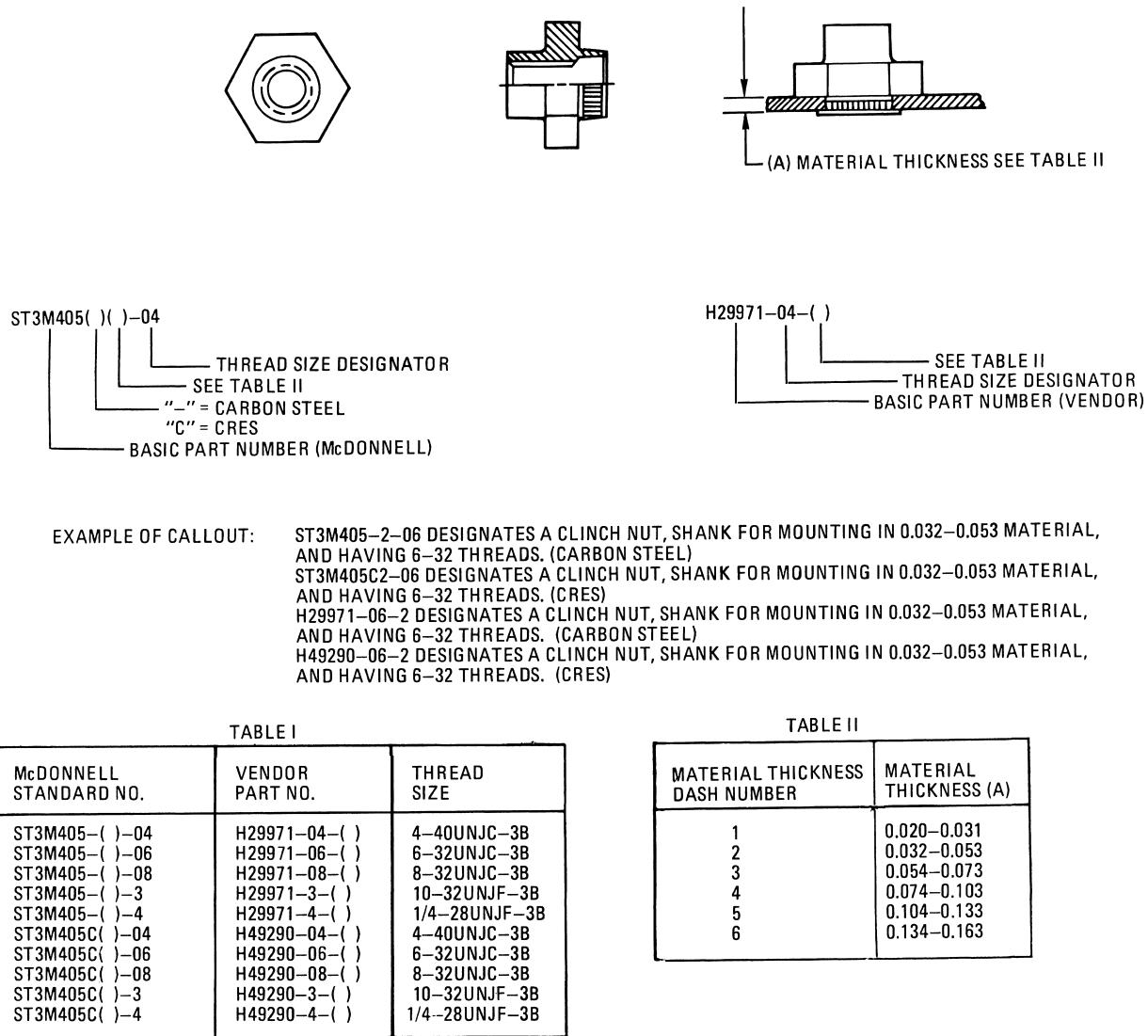


Figure 3-65. Clinch Nut Identification

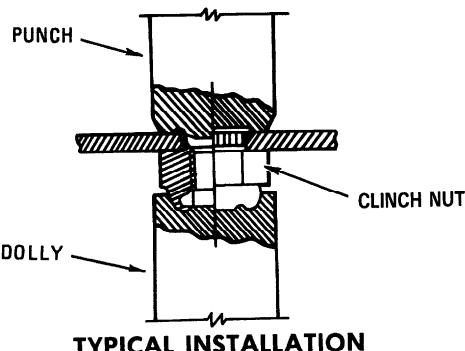
**TYPICAL INSTALLATION**

TABLE I – TOOLS FOR USE WHEN INSTALLING CLINCH.NUTS

CLINCH NUT PART NO	PUNCH VENDORS DESIGNATION	DOLLY VENDORS DESIGNATION	TOOL DIA ±0.015
ST3M405-()-04 ST3M405C()-04	TD484G3-1DET1	TD484G3-1DET2	0.438
ST3M405-()-06 ST3M405C()-06	TD484G3-2DET1	TD484G3-2DET2	0.438
ST3M405-()-08 ST3M405C()-08	TD484G3-3DET1	TD484G3-3DET2	0.500
ST3M405-()-3 ST3M405C()-3	TD484G3-4DET1	TD484G3-4DET2	0.500
ST3M405-()-4 ST3M405C()-4	TD484G3-5DET1	TD484G3-5DET2	0.563

NOTE: SEE TABLE III FOR FIRST DASH NUMBER ().

TABLE II – HOLE SIZE FOR CLINCH NUT INSTALLATION

CLINCH NUT PART NUMBER	HOLE SIZE	MINIMUM COUNTERBORE DIAMETER FOR FLUSH MOUNTING
ST3M405-()-04 (4-40 THD) ST3M405C()-04	0.184 to 0.186	0.501
ST3M405-()-06 (6-32 THD) ST3M405C()-06	0.217 to 0.219	0.501
ST3M405-()-08 (8-32 THD) ST3M405C()-08	0.263 to 0.266	0.563
ST3M405-()-3 (10-32 THD) ST3M405C()-3	0.263 to 0.266	0.563
ST3M405-()-4 (1/4-28 THD) ST3M405C()-4	0.352 to 0.355	0.626

NOTE: SEE TABLE III FOR FIRST DASH NUMBER ().

TABLE III – SELECTION OF CLINCH NUT SHANK LENGTH

CLINCH NUT PART FIRST () DASH NUMBER	MATERIAL THICKNESS	SHANK LENGTH
1	0.020 to 0.031	0.063±0.006
2	0.032 to 0.053	0.085±0.006
3	0.054 to 0.073	0.105±0.006
4	0.074 to 0.103	0.135±0.006
5	0.104 to 0.133	0.165±0.006
6	0.134 to 0.163	0.195±0.006

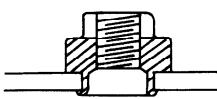
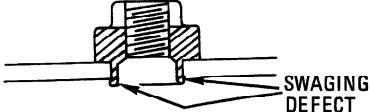
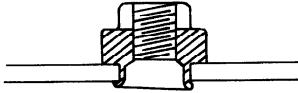
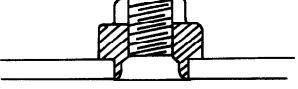
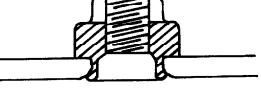
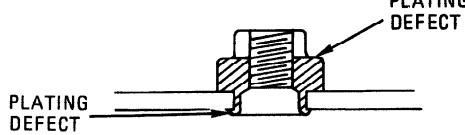
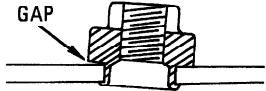
SAN301-03-97-002

Figure 3-66. Clinch Nut Installation (Sheet 1 of 2)

TABLE IV – TORQUE REQUIREMENTS OF INSTALLED CLINCH NUT

CLINCH NUT PART SECOND DASH NUMBER	MINIMUM TORQUE-OUT COMPLETED INSTALLATION (INCH LBS)
04 (4–40 THD)	20
06 (6–32 THD)	30
08 (8–32 THD)	45
3 (10–32 THD)	60
4 (1/4–28 THD)	100

TABLE V – ACCEPTANCE LIMITS FOR INSTALLED CLINCH NUTS

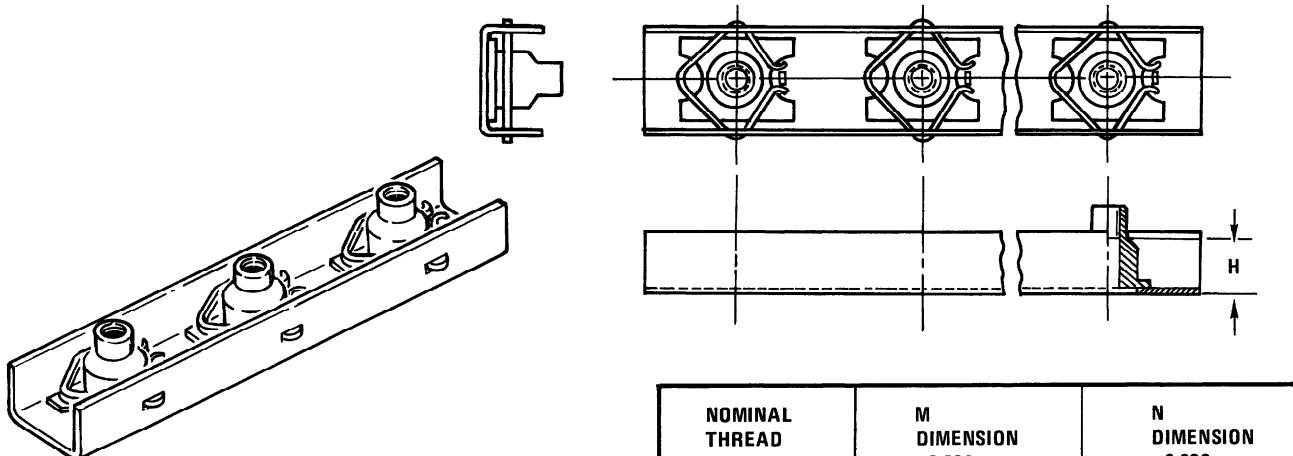
TYPE OF DEFECT	ACCEPT OR REJECT	COMMENTS
	ACCEPT	SATISFACTORY INSTALLATION. CLINCH NUT IS COMPLETELY SWAGED. NO EVIDENCE OF LOOSENESS OR DAMAGE TO PARTS ATTACHED.
	REJECT	INCOMPLETE SWAGE, CLINCH NUT LOOSE. CAN BE MOVED AXIALLY OR WOBLED WITH LIGHT PRESSURE. MAY BE ACCEPTABLE AFTER RESWAGING.
	REJECT	TOOL OUT OF LINE, NUT NOT SWAGED FOR ENTIRE CIRCUMFERENCE. MAY BE RESUBMITTED AFTER REWORKING.
	REJECT	SHANK TOO SHORT. SELECT PROPER SHANK LENGTH PER TABLE III.
	REJECT	EXCESSIVE DEFORMATION OF BASE PART. THIS IS A RESULT OF APPLICATION OF EXCESSIVE LOAD DURING THE SWAGING OPERATION.
	REJECT	CRACKS, EITHER RADIALLY OR CIRCUMFERENTIALLY ON FORMED PART OF NUT.
	ACCEPT	PEELING OR CRACKING OF PLATING ACCEPTABLE PROVIDING UNDERLYING BARE MATERIAL UNAFFECTED.
	REJECT	IMPROPER SEATING OF NUT SUCH THAT 0.002 FEELER GAGE CAN BE INSERTED TO THE SHANK. MAY BE ACCEPTABLE AFTER RESWAGING.

LEGEND

 MCDONNELL AIRCRAFT COMPANY (76301).

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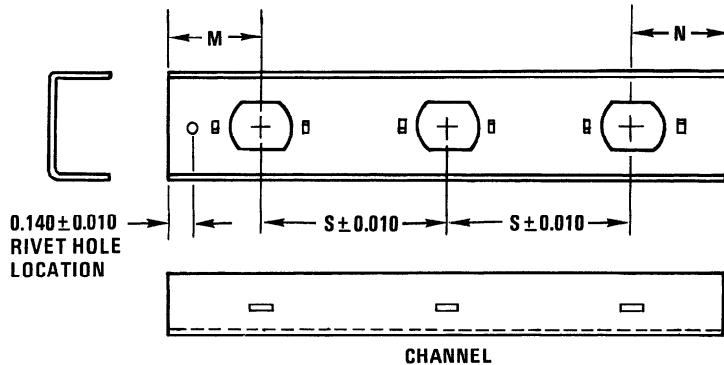
Figure 3-66. Clinch Nut Installation (Sheet 2)



VENDOR G18421 (4) L(2)(1)(3) ASSEMBLY
EXAMPLE: G18421JL1-3-20

MCDONNELL STANDARD 3M46 (1) (4) (3) A (5) - (2)
EXAMPLE: 3M463N10A57-1

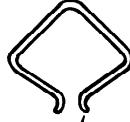
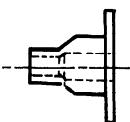
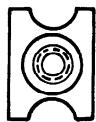
NOMINAL THREAD DIAMETER	M DIMENSION +0.030 -0.000	N DIMENSION +0.030 -0.000
3	0.350	0.590
4	0.400	0.640
5	0.450	0.720



VENDOR NO.	MCDONNELL STANDARD NO	THREAD OF NUT	NUT ELEMENT	CLIP
G18421L()-3	3M463C	0.190-32	G18421L()-3	9421A-0
G18421L()-4	3M464C	0.250-28	G18421L()-4	9421A-04
G18421L()-5	3M465C	0.3125-24	G18421L()-5	9421-05
G18421JL()-3	3M463N	0.190-32	G18421L()-3	9421A-0
G18421JL()-4	3M464N	0.250-28	G18421L()-4	9421A-04
G18421JL()-5	3M465N	0.3125-24	G18421L()-5	9421-05



G18421L NUT (SEE FIGURE 3-66)



LEGEND

- 1 NORMAL THREAD DIAMETER OF NUTS (1/16 THS).
- 2 DEPTH OF COUNTERBORE IN ASSEMBLED NUTS. DIMENSION "H" (1/16 THS).
- 3 SPACING OF NUTS IN CHANNEL. DIMENSION "S" (1/8 THS).
- 4 LETTERS "J" OR "N" DESIGNATES ALUMINUM CHANNEL, LETTER "C" OR NO LETTER DESIGNATES CRES CHANNEL.
- 5 DESIGNATES NUMBER OF NUTS IN SIX FOOT LENGTH.

9421-(1)W CLIP

MATERIAL IS CORROSION
RESISTANT STEEL

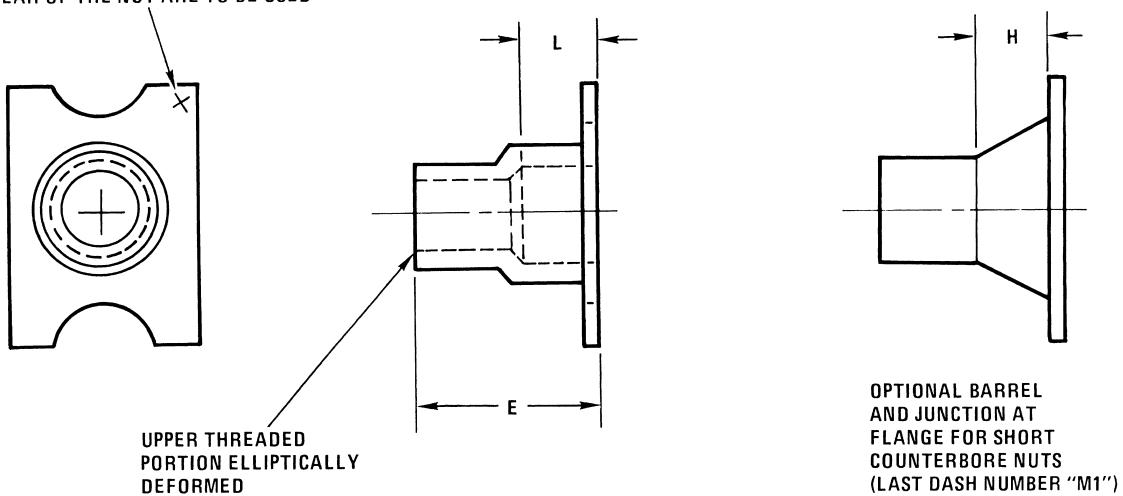
SAN301-03-99-002

Figure 3-67. Gang Channel Identification G18421L

CSTO SR1F-15SA-3-1

CAUTION

ONLY THOSE SELF-LOCKING NUTS WITH A COUNTERBORE DEPTH CODE NUMERAL ON THE EAR OF THE NUT ARE TO BE USED



VENDOR PART NO.	MCDONNELL STANDARD NO.	THREAD	E MAX	H	L MIN
G18421L1-3	ST3M445C3M1		0.184	0.052	0.041
G18421L2-3	ST3M445C3M2		0.263	—	0.100
G18421L4-3	ST3M445C3M4		0.388	—	0.225
G18421L6-3	ST3M445C3M6		0.522	—	0.350
G18421L1-4	ST3M445C4M1		0.246	0.056	0.036
G18421L2-4	ST3M445C4M2		0.305	—	0.100
G18421L1-4	ST3M445C4M4		0.430	—	0.225
G18421L6-4	ST3M445C4M6		0.559	—	0.350
G18421L1-5	ST3M445C5M1		0.287	0.051	0.036
G18421L2-5	ST3M445C5M2		0.344	—	0.100
G18421L4-5	ST3M445C5M4		0.480	—	0.225
G18421L6-5	ST3M445C5M6		0.605	—	0.350

BREAKDOWN OF MCDONNELL STANDARD NO.

ST3M445-C-3M-1

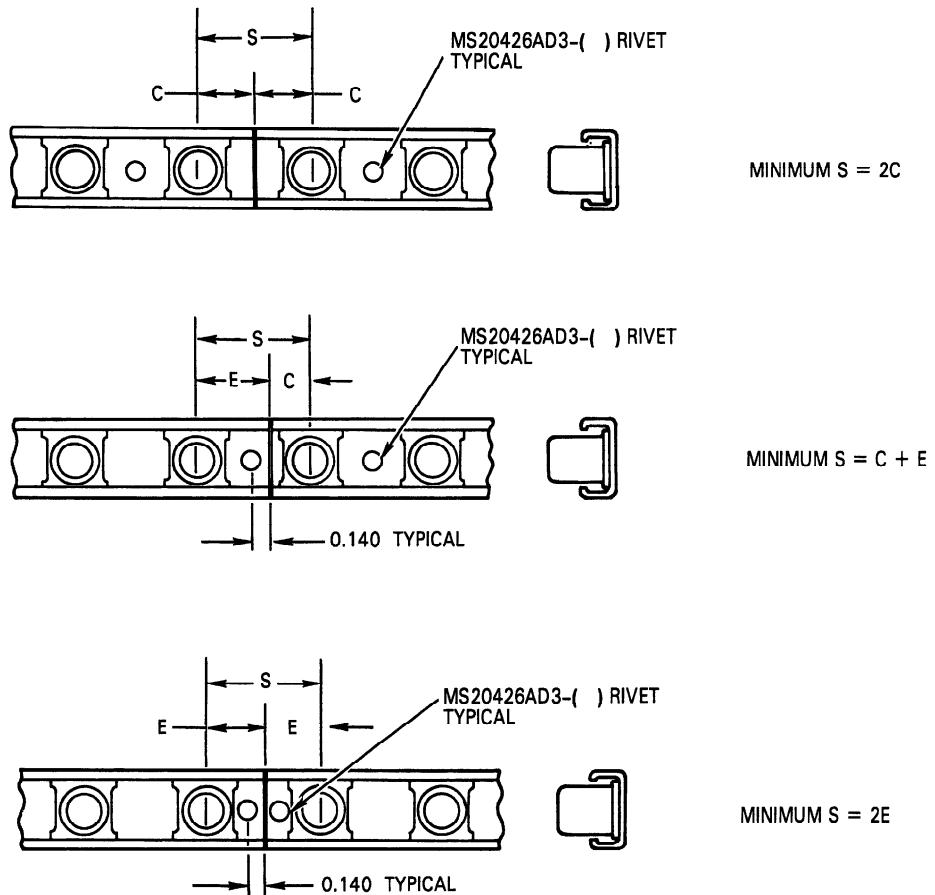
COUNTERBORE DEPTH "L" PER TABLE

SIZE PER TABLE

C = CRES (STAINLESS STEEL)
A = ALLOY STEEL

Figure 3-68. Gang Channel Nut Self-Locking Identification ST3M445

SAN301-03-100-001



VENDOR PART NUMBER	VENDOR PART NUMBER	MCDONNELL PART NUMBER	THREAD SIZE OF NUT	END DIMENSIONS	
				$C \pm 0.030$	$E \pm 0.000$
G49760-3-()()	G10851-3-()()	ST3M723C1M()()	10-32	0.340	0.590
G49760-4-()()	G10851-4-()()	ST3M724C1M()()	1/4-28	0.390	0.640
G49760-5-()()	G10851-5-()()	ST3M719C3M()()	5/16-24	0.450	0.720
G49760-6-()()	G10851-6-()()	ST3M776C1()()	3/8-24	0.520	0.760
G49461-3-()()	G10851J3-()()	ST2M723N1()()	10-32	0.340	0.590
G49461-4-()()	G10851J4-()()	ST3M724N1()()	1/4-28	0.390	0.640
G49461-5-()()	G10851J5-()()	ST3M776C1()()	5/16-24	0.450	0.720
G49461-6-()()	G10851J6-()()	ST3M775C1()()	3/8-24	0.520	0.760
RMG15B2-02-()	G19179-3-2-()	ST3M442-3A2	10-32	0.350	0.590
RMG15B4-02-()	G19179-3-4-()	ST3M442-3A4	10-32	0.350	0.590
RMG15B6-02-()	G19179-3-6-()	ST3M442-3A6	10-32	0.350	0.590
RMG15B2-048-()	G19179-4-2-()	ST3M442-4A2	1/4-28	0.400	0.640
RMG15B4-048-()	G19179-4-4-()	ST3M442-4A4	1/4-28	0.400	0.640
RMG15B6-048-()	G19179-4-6-()	ST3M442-4A6	1/4-28	0.400	0.640

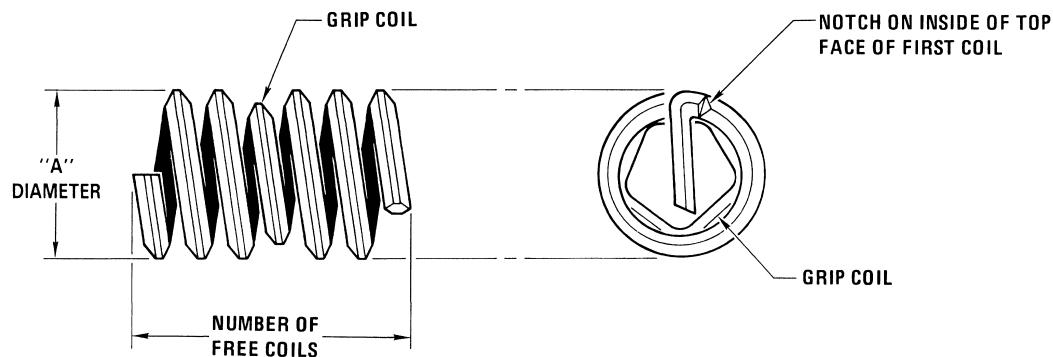
SAN301-03-101-002

Figure 3-69. Gang Channel Repair (Sheet 1 of 2)

VENDOR PART NUMBER	VENDOR PART NUMBER	MCDONNELL PART NUMBER	THREAD SIZE OF NUT	END DIMENSIONS	
				C ± 0.030 0.000	E ± 0.030 0.000
G29504-3-2-()	3M193A3-2-()	10-32	0.350	0.590	
G29504-3-4-()	3M193A3-4-()	10-32	0.350	0.590	
G29504-3-6-()	3M193A3-6-()	10-32	0.350	0.590	
G29504-4-2-()	3M193A4-2-()	1/4-28	0.400	0.640	
G29504-4-4-()	3M193A4-4-()	1/4-28	0.400	0.640	
G29504-4-6-()	3M193A4-6-()	1/4-28	0.400	0.640	
G29505-3-2-()	3M193C3-2-()	10-32	0.350	0.590	
G29505-3-4-()	3M193C3-4-()	10-32	0.350	0.590	
G29505-3-6-()	3M193C3-6-()	10-32	0.350	0.590	
G29505-4-2-()	3M193C4-2-()	1/4-28	0.400	0.640	
G29505-4-4-()	3M193C4-4-()	1/4-28	0.400	0.640	
G29505-4-6-()	3M193C4-6-()	1/4-28	0.400	0.640	
G49247-3-2-()	ST3M473C2M()	10-32	0.350	0.590	
G49247-3-4-()	ST3M473C4M()	10-32	0.350	0.590	
G49247-3-6-()	ST3M473C6M()	10-32	0.350	0.590	
G49247-4-2-()	ST3M474C2M()	1/4-28	0.400	0.640	
G49247-4-4-()	ST3M474C4M()	1/4-28	0.400	0.640	
G49247-4-6-()	ST3M474C6M()	1/4-28	0.400	0.640	
G49460-3-2-()	ST3M473N2M()	10-32	0.350	0.590	
G49460-3-4-()	ST3M473N4M()	10-32	0.350	0.590	
G49460-3-6-()	ST3M473N6M()	10-32	0.350	0.590	
G49460-4-2-()	ST3M464N2M()	1/4-28	0.400	0.640	
G49460-4-4-()	ST3M474N4M()	1/4-28	0.400	0.640	
G49460-4-6-()	ST3M474N6M()	1/4-28	0.400	0.640	
C178-82-()-()	MS21063L08-()	3M150N08-()-()	8-32	0.340	0.590
C178-3-()-()	MS21063L3-()	3M150N3-()-()	10-32	0.340	0.590
C178-4-()-()	MS21063L4-()	3M150N4-()-()	1/4-28	0.390	0.640
C178-5-()-()	MS21063L5-()	3M150N5-()-()	5/16-24	0.450	0.720
C178-6-()-()	MS21063L6-()	3M150N6-()-()	3/8-24	0.440	0.760
C178C-82-()-()	MS21064L08-()	3M150A08-()-()	8-32	0.340	0.590
C178C-3-()-()	MS21064L3-()	3M150A3-()-()	10-32	0.340	0.590
C178C-4-()-()	MS21064L4-()	3M150A4-()-()	1/4-28	0.390	0.640
C178C-5-()-()	MS21064L5-()	3M150A5-()-()	5/16-24	0.450	0.720
C178S-82-()-()	MS21065-08-()	3M150C08-()-()	8-32	0.340	0.590
C178S-3-()-()	MS21065-3-()	3M150C3-()-()	10-32	0.340	0.590
C178S-4-()-()	MS21065-4-()	3M150C4-()-()	1/4-28	0.390	0.640
C178S-5-()-()	MS21065-5-()	3M150C5-()-()	5/16-24	0.450	0.720

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Figure 3-69. Gang Channel Repair (Sheet 2)



BREAKDOWN OF HELICAL COIL INSERT CODE NUMBER
STANDARD CODE NUMBER

MS21209F4-15
OR
MS21209F4-20

MS21209 F 4 -15 OR -20

LENGTH OF THE INSERT WHEN IT IS INSTALLED
PLUS A HALF TURN OF THE THREADS.
LENGTH TAKEN FROM CHART 0.168.

NUMBER 4 THREAD DIAMETER

INTERNAL THREAD
F - FINE THREAD
C - COARSE THREAD

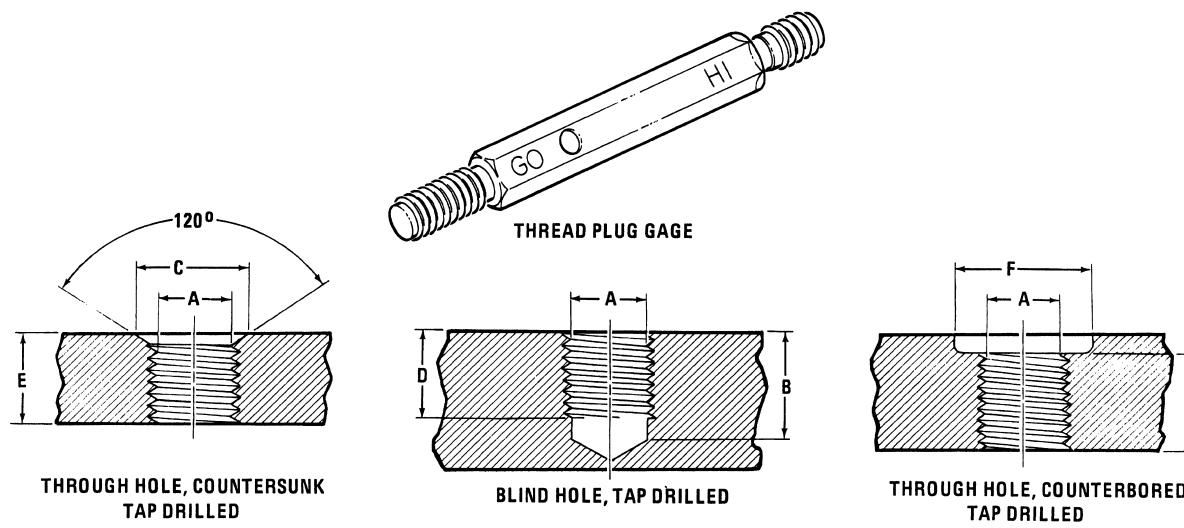
BASIC CODE NUMBER FOR HELICAL
COIL SCREW LOCK INSERT

BASIC PART NUMBER	INTERNAL THREAD	INSTALLATION DATA						
		NOMINAL LENGTH		“A” DIAMETER		NUMBER GRIP COILS	NUMBER OF FREE COILS ±1/4 TURN	
		-15	-20	MINIMUM	MAXIMUM		-15	-20
MS21209C04	4-40	0.168	0.224	0.144	0.159	1	4-3/4	6-3/4
MS21209C06	6-32	0.207	0.276	0.178	0.193	1	4-3/4	6-7/8
MS21209C08	8-32	0.246	0.328	0.205	0.220	1	6	8-3/8
MS21209F1	10-32	0.285	0.380	0.236	0.256	1	6-7/8	9-1/2
MS21209F4	1/4-28	0.375	0.500	0.306	0.326	1	8-1/4	11-3/8
MS21209F5	5/16-24	0.469	0.625	0.380	0.400	2	8-7/8	12-1/4
MS21209F6	3/8-24	0.562	0.750	0.448	0.468	2	11	15
MS21209F7	7/16-20	0.656	0.875	0.524	0.549	2	10-5/8	14-5/8
MS21209F8	1/2-20	0.750	1.000	0.592	0.617	2	12-3/8	16-7/8
MS21209F9	9/16-18	0.844	1.125	0.666	0.691	2	12-1/2	17-1/8
MS21209F10	5/8-18	0.938	1.250	0.733	0.758	2	14-1/8	19-1/4
MS21209F12	3/4-16	1.125	1.500	0.876	0.901	2	15-1/8	20-5/8
MS21209F14	7/8-14	1.312	1.750	1.021	1.051	2	15-1/2	21-1/8
MS21209F16	1-12	1.500	2.000	1.169	1.199	2	15	20-1/2

SAN301-03-103-001

Figure 3-70. Helical Coil Insert Identification

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HOLE PREPARATION FOR INSERTS

INSERT PART NUMBER	SCREW THREAD	TAP DRILL			COUNTERSINK DIAMETER C ± 0.000 0.020	FULL THREAD DEPTH MINIMUM D	MATERIAL THICKNESS MINIMUM E	COUNTER-BORE MINIMUM F	HELI-COIL TAP NO.		
		DIA A	DRILL SIZE	DEPTH B ± 0.03 0.00					ROUGHING	PLUG	BOTTOMING
MS21209C0415	4-40	0.116 - 0.121	32	0.31 0.36	0.17	0.19 0.25	0.190 0.250	0.437		04 CPB	04 CBB
MS21209C0420											
MS21209C0615	6-32	0.144 - 0.150	26	0.38 0.45	0.20	0.24 0.31	0.240 0.310	0.437		06 CPB	06 CBB
MS21209C0815											
MS21209C0820	8-32	0.170 - 0.176	17	0.42 0.50	0.23	0.28 0.36	0.280 0.360	0.437		2 CPB	2 CBB
MS21209F1-15	10-32	0.196 - 0.202	8	0.46 0.55	0.25	0.32 0.41	0.320 0.410	0.562		3 FPB	3 FBB
MS21209F1-20											
MS21209F4-15	1/4-28	0.257 - 0.264	G	0.57 0.70	0.32	0.41 0.54	0.410 0.540	0.562		4 FPB	4 FBB
MS21209F4-20											
MS21209F5-15	5/16-24	0.323 - 0.330	P	0.70 0.85	0.39	0.51 0.67	0.510 0.670	0.750		5 FPB	5 FBB
MS21209F5-20											
MS21209F6-15	3/8-24	0.385 - 0.392	W	0.79 0.97	0.45	0.60 0.79	0.600 0.790	1.062		6 FPB	6 FBB
MS21209F6-20											
MS21209F7-15	7/16-20	0.450 - 0.458	29/64	0.93 1.15	0.52	0.71 0.93	0.710 0.930	1.062	7 FRU	7 FPB	7 FBB
MS21209F7-20											
MS21209F8-15	1/2-20	0.513 - 0.522	33/64	1.03 1.28	0.59	0.80 1.05	0.800 1.050	1.062	8 FRU	8 FPB	8 FBB
MS21209F8-20											
MS21209F9-15	9/16-18	0.577 - 0.586	37/64	1.15 1.43	0.66	0.90 1.18	0.900 1.180	1.375	9 FRU	38193-9	43193-9
MS21209F9-20											
MS21209F1015	5/8-18	0.640 - 0.649	41/64	1.24 1.55	0.72	0.99 1.31	0.990 1.310	1.375	10 FRU	8193-10	10193-10
MS21209F1020											
MS21209F1215	3/4-16	0.765 - 0.775	49/64	1.47 1.84	0.85	1.19 1.56	1.190 1.560	1.750	12 FRU	8193-12	10193-12
MS21209F1220											
MS21209F1415	7/8-14	0.890 - 0.900	57/64	1.70 2.14	0.99	1.38 1.82	1.380 1.820	1.750	14 FRU	8193-14	10193-14
MS21209F1420											
MS21209F1615	1-12	1.018 - 1.028	1 1/64	1.89 2.39	1.11	1.58 2.08	1.584 2.084	2.000	161 FRU	8193-161	10193-161
MS21209F1620											

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Figure 3-71. Helical Coil Insert Installation (Sheet 1 of 3)

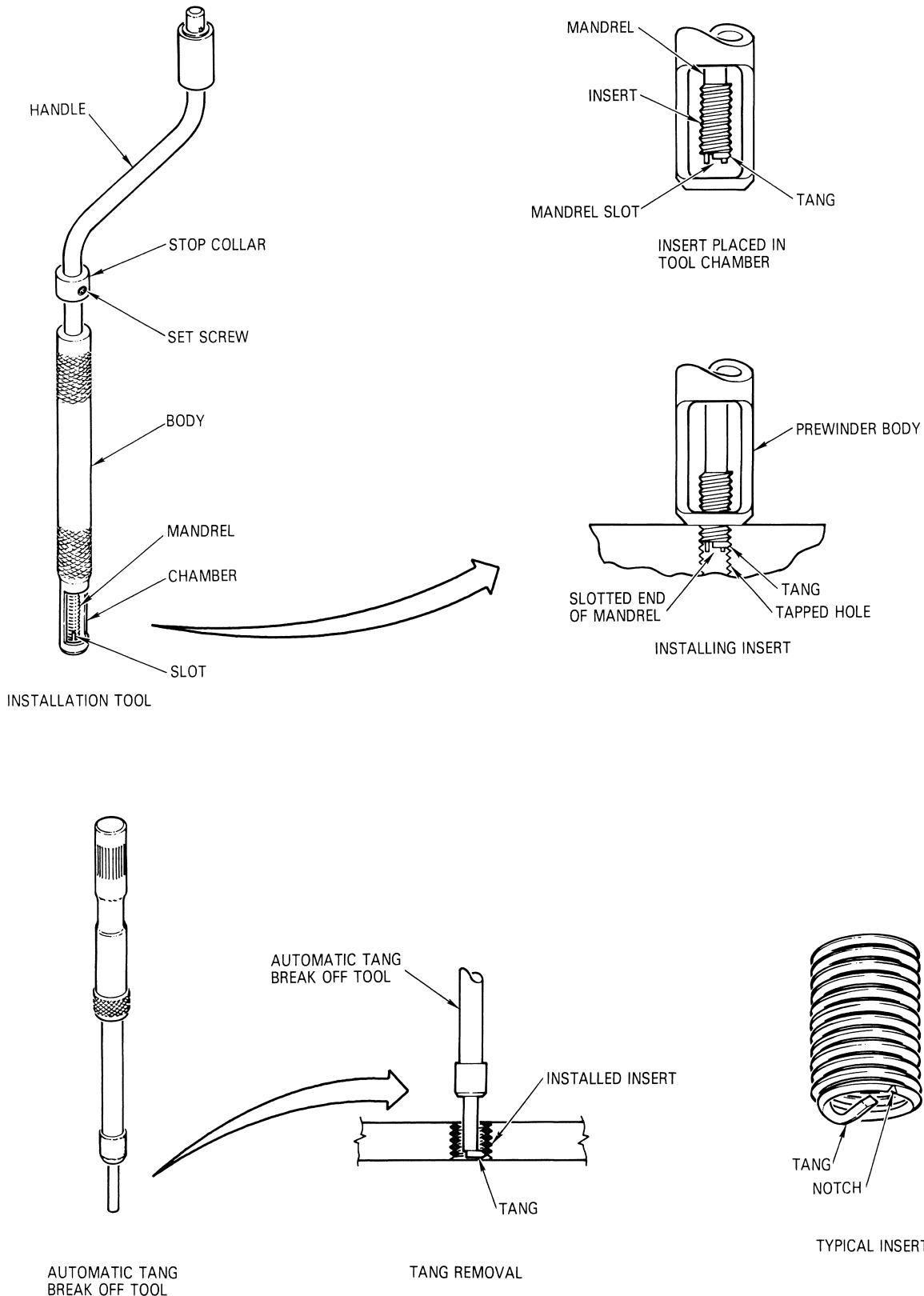
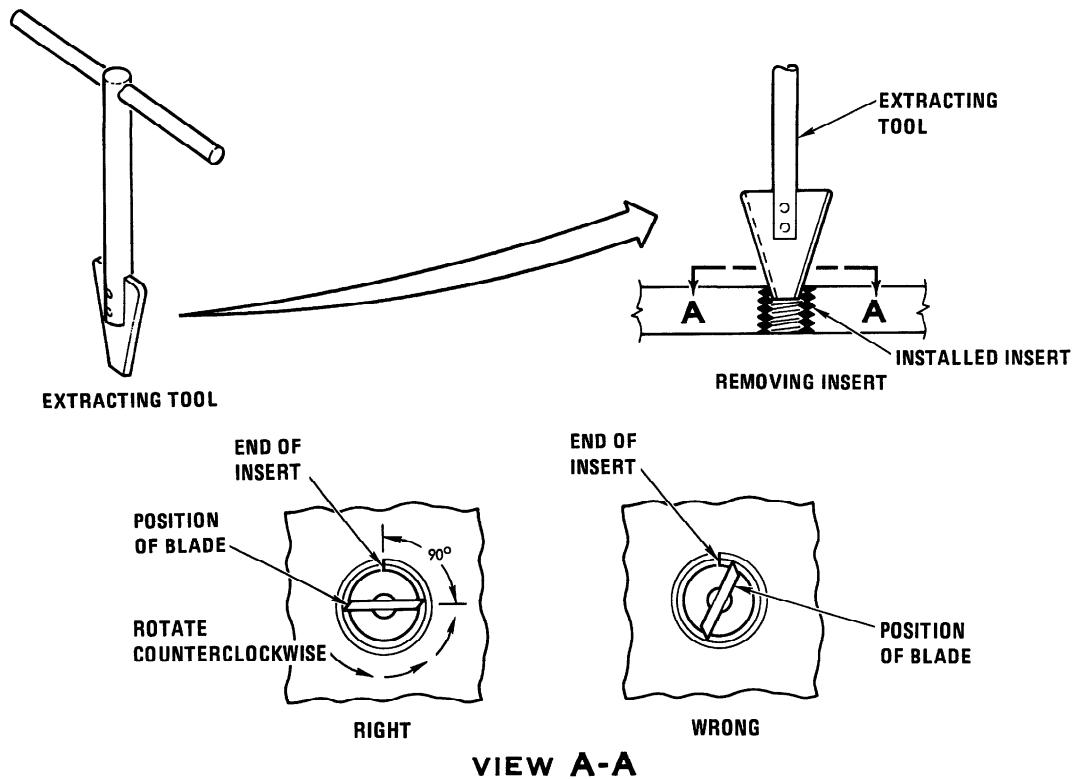


Figure 3-71. Helical Coil Insert Installation (Sheet 2)

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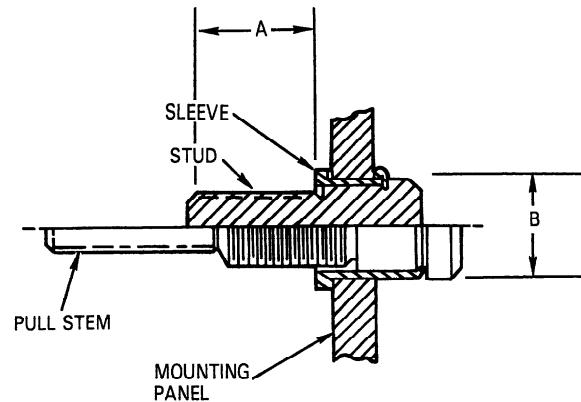
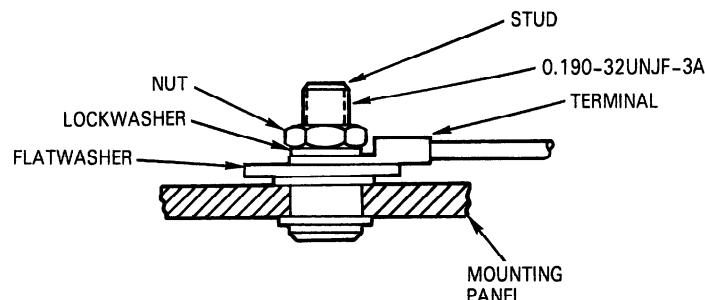
INSERT PART NUMBER	SCREW THREAD	THREAD GAGES		INSTALLATION TOOL	TANG BREAK-OFF TOOL	EXTRACTION TOOL
		WORKING	INSPECTION			
MS21209C04	4-40	3688-04	1688-04	7551-04	3695-04	1227-06
MS21209C06	6-32	3688-06	1688-06	7551-06	3695-06	1227-06
MS21209C08	8-32	3688-08	1688-08	7551-08	3695-08	1227-06
MS21208F1 MS21209F1	10-32	3694-3	1694-3	7552-3	3695-3	1227-6
MS21208F4 MS21209F4	1/4-28	3694-4	1694-4	7552-4	3695-4	1227-6
MS21208F5 MS21209F5	5/16-24	3694-5	1694-5	3552-5	3692-5	1227-6
MS21208F6 MS21209F6	3/8-24	3694-6	1694-6	3552-6	3692-6	1227-6
MS21208F7 MS21209F7	7/16-20	3694-7	1694-7	3552-7	3692-7	1227-16
MS21208F8 MS21209F8	1/2-20	3694-8	1694-8	3552-8	3692-8	1227-16
MS21209F9	9/16-18		1694-9	535-9	1227-16	
MS21209F10	5/8-18		1694-10	535-10	1227-16	
MS21209F12	3/4-16		1694-12	535-12	1227-16	
MS21209F14	7/8-14		1694-14	535-14	1227-16	
MS21209F16	1-12		1694-16	535-16	1227-16	

LEGEND

1 FOR SIZES OVER 1/2-INCH USE LONG-NOSED PLIERS.
BEND TANG UP AND DOWN TO SNAP OFF AT NOTCH.

SAN301-03-106-002

Figure 3-71. Helical Coil Insert Installation (Sheet 3)

AFTER INSTALLATION**BEFORE PULL-UP****TYPICAL STACKUP**

PART NUMBER	A	B (HOLE DIA.)	GRIP LENGTH
5M2997-AA108	0.500	0.3125 TO 0.3165	0.032 TO 0.094
5M2997-AA110	0.625	0.3125 TO 0.3165	0.032 TO 0.094
5M2997-AA208	0.500	0.3125 TO 0.3165	0.093 TO 0.157
5M2997-AA210	0.625	0.3125 TO 0.3165	0.093 TO 0.157

LEGEND

0.032 TO 0.094 STUD COLOR GOLD
0.093 TO 0.157 STUD COLOR OLIVE DRAB

SAN301-03-107-002

Figure 3-72. MIL-DTL-83454 Terminal Ground Stud

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3-178. TITANIUM TUBING AND FITTINGS.

3-179. The paragraphs below contain instructions for fabrication and handling of titanium lines, and swaging of Permaswage and Dynatube fittings.

3-180. **TITANIUM TUBING.** Ti-3Al-2.5V titanium tubing is corrosion-resistant, has a high strength to weight ratio and the ability to serve efficiently in the intermediate temperature range. Titanium tubing wall thicknesses are sized to withstand 12,000 psi proof pressure.

3-181. **TUBE CUTTING.** There are two methods of titanium tube cutting: machine cutting or hand cutting.

3-182. **Machine Cutting.** Use circular type table saw, or equivalent, an abrasive silicone carbide blade, and a heavy flow of coolant during cutting, per the procedure below:



To extend working life of cutting tool, tube shall be accurately cut.

- a. Set tube stop on saw to allow 0.0625 inch more material on each end of tube.
- b. Put tubing in holding clamp on saw.



Coolant is required to prevent excessive burrs and heat damage to tubing.
Titanium tubing shall not be cut dry.

- c. Flood tubing area to be cut and both sides of saw blade with a heavy flow of coolant.
- d. With saw running, bring saw blade into contact with tubing. Cut tubing with moderate feed pressure.
- e. After tube has been cut follow procedures for squaring and chamfering in paragraph 3-184.

3-183. **Hand Cutting.** Hand cutters and deburring tools are contained in Permaswage tool kits. Refer to Special Tools, table 6-24 for kit numbers and contents. Titanium tubing can be cut and deburred using the procedure below:

- a. Cutting tube.

1. Rotate tube cutter head to align opening in head with opening in handle.
2. Back cutter wheel adjusting screw out to provide clearance for tube between cutter wheel and roller.
3. Put tube cutter on tubing and position cutter wheel at point tube is to be cut.
4. Turn center wheel adjusting screw until cutter wheel makes light contact with tube then tighten cutter wheel adjusting screw 1/8 to 1/4 turn.
5. Rotate tube cutter handle through arc of clearance until there is obvious ease of rotation.
6. Tighten cutter wheel adjusting screw 1/8 to 1/4 turn.
7. Repeat steps 5. and 6. until cut is complete.

- b. Deburring tube.

1. Depress button and screw stem into cutting end of deburring tool.



Stem must function correctly and be free of damage to prevent chips from entering tube.

2. Check deburring tool for correct operation by pressing and releasing button. Stem will expand when button is released. Two bulges must be in stem.
3. Make sure tube end to be deburred is square.



To prevent contamination of tube, do not remove burrs before installation of stem into tube.

A large burr within end of tube will cause stem to fit tight. Slowly rotate deburring tool while pushing stem past burr.

4. Press and hold button and insert stem in end of tube until cutter of deburring tool seats against end of tube, then release button to expand stem.
5. Hold tube near end, apply light pressure on deburring tool, and rotate clockwise until deburring tool turns smoothly. Reduce pressure and rotate several more turns.
6. Without pressing button ease stem out of tube until first bulge is exposed and wipe stem and tube free of chips.
7. Remove deburring tool from end of tube.
8. If tube is not properly deburred, 75 percent of the wall thickness removed, repeat steps 4. through 7.

3-184. SQUARE AND CHAMFERING. See figure 3-73. This procedure applies only to tubes that were machine cut. After tubes have been cut to working length the ends shall be squared to finish length and chamfered per the procedures below:

NOTE

Tubes require 60 degree inside chamfer and are machined in two operations, flat squaring and chamfering.

a. Squaring.

1. Select correct size clamping dies based on tube outside diameter.
2. Clean machine die holders and clamping dies.
3. Adjust spindle speed of squaring machine to 500 to 600 rpm.
4. Select cutting tool and tool holder.

5. Install cutting tool holder on spindle of squaring machine. Insert cutting tool in holder. Adjust cutting tool as required for tube size and tighten set screw to hold cutting tool. Adjust spindle stop so that the cutting tool is close to clamp dies during squaring operations.

6. Adjust coolant to spray on end of tube. Use enough coolant to keep tube end and cutter cool.

WARNING

To prevent eye injury, personnel must wear faceshield or protective goggles at all times while doing this task.

Keep fingers clear of clamp dies.

7. Turn machine on. Place tube in lower clamp die. Close clamp dies by advancing feed handle. The initial movement of handle closes the dies. Slowly feed the cutter against tube by applying steady pressure on feed handle. Do not allow cutter to bounce on end of tube. Continue to feed cutter against tube end with moderate feed pressure until tube end is squared.

8. Return feed handle to starting position to open clamp dies. Remove tube and inspect end for finish and configuration.

9. Repeat steps 7. and 8. for opposite end of tube.

b. Chamfering.

NOTE

Chamfering tube end eliminates the possibility of flashing forming during installation of Dynatube fittings. The amount of material removed during chamfering is approximately one-half of the wall thickness of the tube.

1. Select correct size clamping dies based on tube outside diameter.

2. Clean machine die holders and clamping dies.

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3. Adjust spindle speed of squaring machine to 500 to 600 rpm.
4. Select chamfer cutting tool and tool holder.
5. Install tool holder on spindle of squaring machine. Insert cutting tool in holder. Adjust spindle stop so that the cutting tool is close to clamp dies during chamfering operations.
6. Adjust coolant to spray on end of tube. Use enough coolant to keep tube end and cutter cool.

WARNING

To prevent eye injury, personnel must wear faceshield or protective goggles at all times while doing this task.

Keep fingers clear of clamp dies.

7. Turn machine on. Place tube in lower clamp die. Close clamp dies by advancing feed handle. The initial movement of handle closes the dies. Slowly feed the cutter against tube by applying steady pressure on feed handle. Do not allow cutter to bounce on end of tube. Continue to feed cutter against tube end with moderate feed pressure until tube end is chamfered.
8. Return feed handle to starting position to open clamp dies. Remove tube and inspect end for finish and configuration.
9. Repeat steps 7. and 8. for opposite end of tube.

3-185. **TUBE BENDING.** The paragraphs below provide instructions, tools, and use of tools required to bend or form titanium tubes. Refer to TO 34G1-10-6-1 for more information.

3-186. Special Tools.

Hand Operated Tube Bender Kit, Part No. 12A0104-1.

3-187. Tools to bend 1/4 OD on a 3/4 centerline radius.

- a. Bend die. 0.25 OD x 0.75 Centerline Radius (CLR) Type D, 180 degree right and left, nitrided, 0.8 long straight grip, 6 percent lip, interloc.

- b. Clamp die. 0.25 OD x 0.8 long straight grip, heat treated and nitrided, interloc.
- c. Pressure die. 0.25 OD x 4.0 long, nitrided, interloc.
- d. Mandrel. Plug or 1 ball type, 0.25 OD x 0.016 wall thickness, standard, aluminum bronze.
- e. Wiper die. 0.25 OD on a 0.75 CLR, 8.0 long, aluminum bronze.

3-188. Tools to bend 3/8 OD on a 1-1/8 centerline radius.

- a. Bend die. 0.375 OD x 1.125 CLR, Type D, 180 degree right and left, nitrided, 1.2 long straight grip, 6 percent lip, interloc.
- b. Clamp die. 0.375 OD x 1.2 long straight grip, heat treated and nitrided, interloc.
- c. Pressure die. 0.375 OD x 5.0 long, nitrided interloc.
- d. Mandrel. 1 ball, 0.375 OD x 0.019 wall thickness, standard, aluminum bronze.
- e. Wiper die. 0.375 OD on a 1.125 CLR, 8.0 long, aluminum bronze.

3-189. Tools to bend 1/2 on a 1-1/2 centerline radius.

- a. Bend die. 0.50 OD x 1.50 CLR, Type D, 180 degree, right and left, nitrided, 1.5 long straight grip, 6 percent lip, interloc.
- b. Clamp die. 0.50 OD x 1.5 long straight grip, heat treated and nitrided, interloc.
- c. Pressure die. 0.50 OD x 7.0 long, nitrided, interloc.
- d. Mandrel. 1 ball, 0.50 OD x 0.026 wall thickness, standard, aluminum bronze.
- e. Wiper die. 0.50 OD on a 1.50 CLR, 8.0 long, aluminum bronze.

3-190. Tools to bend 5/8 OD on a 1-7/8 centerline radius.

- a. Bend die. 0.625 OD x 1.875 CLR, Type D, 180 degree, right and left, nitrided, 1.9 long straight grip, 6 percent lip, interloc.
- b. Clamp die. 0.625 OD x 1.9 long straight grip, heat treated and nitrided, interloc.
- c. Pressure die. 0.625 OD x 9.0 long, nitrided, interloc.
- d. Mandrel. 1 ball, 0.625 OD x 0.032 wall thickness, standard, aluminum bronze.
- e. Wiper die. 0.625 OD on a 1.875 CLR, 8.0 long, aluminum bronze.

3-191. Tools to bend 3/4 OD on a 2-1/4 centerline radius.

- a. Bend die. 0.75 OD x 2.25 CLR, Type D, 180 degree, right and left, nitrided, 2.3 long straight grip, 6 percent lip, interloc.
- b. Clamp die. 0.75 OD x 2.3 long straight grip, heat treated and nitrided, interloc.
- c. Pressure die. 0.75 OD x 10.0 long, nitrided, interloc.
- d. Mandrel. 1 ball, 0.75 OD x 0.039 wall thickness, standard, aluminum bronze.
- e. Wiper die 0.75 OD on a 2.25 CLR, 8.0 long, aluminum bronze.

3-192. Procedure.



Use aluminum bronze mandrels, wiper dies, interlocking pressure radius and clamp dies to prevent galling and flattening when forming titanium tubing.

- a. Select interlocking dies by outside diameter of tubing to be formed.
- b. Select mandrel and wiper die by outside diameter and wall thickness of tubing to be formed.

WARNING

AN type flare shall only be used on 1/4-inch diameter tubing. Pressure testing will straighten flare out on tubing of greater diameter.

NOTE

When 1/4-inch tubing is to be formed it should be determined if Permaswage fittings are to be used. If it is determined Permaswage fittings are used, leave approximately 2 inches excess material on end/ends receiving Permaswage fittings. After forming operation add AN type nut and sleeve and form AN type flare on end of tubing receiving Permaswage fitting.

- c. Select material, material length, and end fittings. Refer to CSTO SR1F-15SA-4-3.
- d. Inspect the tubing; it must be clean, free of chips and foreign matter. The ends of the tube must be deburred.
- e. Lubricate the inside of the titanium tubing with an excess amount of Titanlube, 1129 or equivalent.
- f. Set up tube bender. Refer to TO 34G1-10-6-1 for part number 12A0104-1.
- g. Clean the radius die mounting surfaces. They must be free of foreign matter that would prevent the die from seating properly.
- h. Install the correct size radius die on the spindle stud of the machine. Install and tighten the nut on top of the spindle stud to hold the die in place.
- i. Place the clamp die on the die holder.
- j. Install the pressure die on the pressure die mounting.

- k. Lubricate wiper die, as required, with heavy oil.
- l. Install the wiper die on the wiper die holder, as required.



Do not set the first ball of the mandrel at the tangent point. The ball and socket link will be overloaded and broken if the ball is set at the tangent point. Refer to TO 34G1-10-6-1.

- m. Install the bronze mandrel on the mandrel rod and adjust the radius of the forward end of the mandrel body to the tangent of bend.
- n. Adjust all dies and machine adjustments in accordance with general manufacturing procedures and the manufacturer's instructions for the particular machine involved. The test bends will command any fine adjustments of dies and mandrel.
- o. In addition to amount allowed for spring back, add amount shown below to allow for straightening tendencies of tubing during pressure testing.

Degree of Bend	Increase Degree of Bend
10°	0.1°
20°	0.2°
30°	0.3°
40°	0.5°
50°	0.6°
60°	0.7°
70°	0.8°
80°	1.0°
90°	1.1°
100°	1.2°
110°	1.3°
120°	1.4°
130°	1.5°
140°	1.7°
150°	1.8°
160°	1.9°
170°	2.0°
180°	2.1°

- p. Form tube.

3-193. **DYNATUBE SWAGED FITTINGS.** See figure 3-74. Dynatube fittings are used to meet the high temperature, high pressure, no leak requirements of aircraft fluid systems. Dynatube fittings are fabricated from 6Al-4V titanium and has a metal to metal seal which has a dynamic sealing capability that increases in efficiency with higher pressure.

3-194. Special Tools.

Installation and repair kit, Dynatube fitting, R27500MD.

3-195. Materials.

Solvent, cleaning compound, MIL-PRF-680 TY2

3-196. Preparation.



Solvent, cleaning compound, may cause eye, skin, and respiratory irritation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Use with adequate ventilation. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.



Do not submerge expander in cleaning solvent. Solvent will damage expander bearings.

- a. Clean dies and roller end of expander in solvent.
- b. Make sure expander rollers and dies are free of nicks, burrs, chips, and foreign matter.
- c. Turn mandrel of expander until rollers are in expanded position.
- d. Measure roller setting of expander using V-anvil micrometer for all expanders with 3 rollers and set ring for all expanders with 4 rollers. See table 3-16.
- e. If readjustment of roller setting is required, do the steps below:
 1. Remove sealant from adjustment locknut.

2. Loosen locknut and rotate adjustment sleeve clockwise to increase, or counterclockwise to decrease roller setting.
3. After final adjustment, tighten locknut and recheck roller setting.
- f. Make sure tubing ends are correctly squared, deburred, and free of foreign objects. See figure 3-73.

3-197. Swaging.

- a. Slip Dynatube fitting over end of tube until tube hits tube stop shoulder in fitting.

NOTE

Apply lubricant at lubrication point in front end of expander until lubricant extrudes past rollers.

- b. Lubricate rollers and mandrel of expander with lubricating oil.
- c. With mandrel fully retracted in expander insert expander into end of tube.
- d. Put tube, fitting, and expander in one die half.

NOTE

Make sure tube end is against tube stop shoulder in fitting.

- e. Push mandrel in and turn clockwise until finger tight.
- f. Position second die half to mate with first die half.



Thumbscrew on collar must be placed approximately 15 to 45 degrees from parting line of dies or damage to dies will result.

- g. With large diameter of taper in collar facing expander, slip collar over expander and dies

until collar bottoms out against shoulder of dies. Tighten thumbscrew of collar handtight.

- h. Using flats on collar, clamp swaging assembly in a vise or suitable holding fixture.
- i. Push in on tube to be sure that tube end is still against tube stop shoulder in fitting.

CAUTION

Do not push mandrel into tube or tube alignment with fitting will be disturbed. Mandrel will feed through expander as mandrel is rotated.

- j. Using a hand wrench, turn mandrel clockwise in continuous revolutions. When the shoulder of mandrel contacts adjustment sleeve, continue rotation for an added 10 revolutions.
- k. Turn mandrel counterclockwise until loose.

NOTE

If expander cannot be extracted from tube freely, verify that mandrel is fully retracted, then apply a light side pressure on expander to release roller or rollers that may be stuck in expanded position.

- l. Loosen thumbscrew and remove collar, die halves, and expander.

NOTE

Underswaged or overswaged tube assemblies shall be rejected. No reswaging is permitted.

- m. Measure inside diameter of tube in swaged area using internal caliper. See table 3-16 and figure 3-74.
- n. Each swaged tube assembly shall be visually examined for the below:
 1. Fittings shall be tight on tube.
 2. There shall be no gap between tube end and tube stop shoulder in fitting.

Table 3-16. Expander Settings For Dynatube Fittings

Tube Size (Inch)	Expander	1 → Expander Setting (Inch)
1/4 x 0.016	R5170MD-04016	0.2365
3/8 x 0.019	R5170MD-06019	0.3595
3/8 x 0.028	R5170MD-06028D	0.3395
1/2 x 0.026	R5170MD-08026	0.4725
1/2 x 0.028	R5170MD-08028D	0.4655
5/8 x 0.032	R5170MD-10032	0.588
5/8 x 0.035	R5170MD-10035D	0.581
3/4 x 0.039	R5170MD-12039	0.703
3/4 x 0.035	R5170MD-12035D	0.707
1.0 x 0.051	R5170MD-16051	0.933
1.0 x 0.042	R5170MD-16042D	0.946
1-1/4 x 0.065	R5170MD-20065	2 → 1.161
1-1/4 x 0.049	R5170MD-20049D	3 → 1.187

■ 1 → Tolerance: +0.001 -0.000.
2 → Use ring, R5170MDG-20065.
3 → Use set ring, R5170MDG-20049D.

3. Inside area of tube shall have smooth polished appearance in swaged area. Annular rings with dull even surface finish are acceptable.
4. Tube material shall be tight against fitting and there shall be no cracks or hanging metal slivers.

3-198. PRESSURE TESTING TUBE ASSEMBLIES USING DYNATUBE FITTINGS. See figure 3-75.

3-199. Test Equipment and Special Tools.

Hydraulic Test Stand, SAMME-70-220
 Torque Wrench
 Pressure Test Kit, Permaswage and Dynatube Fittings, 68D300021-1001
 Adapter Line (fabricate per TO 00-25-223, superpressure tubing or 18,000 PSIG proofing equivalent).

3-200. Procedure.

WARNING

When fabricating, follow all applicable requirements in TO 00-25-223 for superpressure tubing or equivalent, fitting, welding and 18,000 PSIG hydrostatic test of adapter line.

- a. Select reducers, from pressure test kit, according to outside diameter of the tube assembly to be tested.
- b. Select cap or plug, from pressure test kit, according to tables on figure 3-75.
- c. Connect tube assembly with male/female fitting to mating end of applicable reducer.
- d. Connect AN fitting of reducer to adapter line, connect adapter line to source of pressure.
- e. Tighten all connections and torque. See table 3-17.

WARNING

A tube assembly that has not been thoroughly bled of air can become dangerous if it fails under pressure.

- f. Thoroughly bleed the tube assembly of air and close off by installing applicable plug or cap.

- g. Tighten plug or cap and torque. See table 3-17.

CAUTION

Follow all applicable safety requirements. Refer to testing components and systems as contained in TO 00-25-223.

- h. Pressurize titanium tube assemblies to 12,000 psi, hold for minimum of 20 seconds, and not more than 5 minutes. Pressurize aluminum and stainless steel tube assemblies in accordance with drawings.
- i. Remove pressure.

NOTE

Dynatube fittings must be protected by plastic caps when not in use.

- j. Separate tube assembly from reducer, remove plug or cap, and replace protective plastic caps on Dynatube test fittings.
- k. Drain fluid from tube assembly, clean tube assembly and install protective caps.

3-201. PERMASWAGE FITTINGS. See figure 3-76. Permaswage fittings provide permanent connections between line assemblies which do not require removal during normal maintenance of aircraft. The outer surface of the permaswage fitting is swaged, transferring the outside configuration of the fitting to the inside of the fitting. The outside surface of the tube, within the fitting, is also swaged to the transformed configuration of the inside of the fitting, thereby providing a permanent seal.

3-202. Special Tools. Refer to TO 42E1-1-1.

3-203. Procedure. Refer to TO 42E1-1-1.

3-204. RYNGLOK FITTINGS. The Rynglok fitting, mechanically swaged on a tube, provides a permanent repair. A locking ring is advanced on the fitting to provide the permanent connection. Fitting installation is recommended on the aircraft with the fitting attached to its mating fitting. A "reversed Tool" enables fitting installation at or near bulkheads, structural members or adjacent fittings.

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3-205. **Special Tools.** Refer to TO 1-1A-8.



To prevent damage to tubes/fittings, when using separable Rynglok fittings, an adjustment in tube length may be required since the tubes were sized originally with dynamic beam fittings. Tubes should be inspected for correct fit on the aircraft before swaging the fitting on the tube. If at all possible the swaging should be done on the aircraft with the fitting attached to its mating fitting. Under no circumstances should hydraulic tubes be loaded in order to get them to fit.

Separable fittings have a hard stop in them, for that reason, it is highly probable that the tube may require to be made shorter in order to prevent loading the tubes. In cases where the tube needs to be longer, there is some leeway in the swage guide marking, however, in no case is the tube to be swaged if the swage guide mark becomes fully exposed.

3-206. **Procedure.** Refer to TO 1-1A-8.



Liquid nitrogen is a cryogenic liquid which causes freezing of tissue. Personnel must wear face shield, cryogenic gloves and apron during all operations. Avoid all contact.

3-207. **CRYOFIT COUPLINGS.** Cryofit couplings are made of a unique alloy that has shape memory properties. The couplings are shipped and stored in liquid nitrogen at a temperature of -320 degrees Fahrenheit until just before installation. When the coupling is removed from the liquid nitrogen, it will start to shrink as it warms. The coupling is placed on the tube to be repaired and the coupling continues to shrink, swaging itself to the tube and thereby providing a permanent repair.

3-208. **Special Tools.** Refer to TO 1-1A-8.

3-209. **Procedure.** Refer to TO 1-1A-8.

3-210. **PRESSURE TESTING TUBE ASSEMBLIES USING PERMASWAGE FITTINGS.** See figure 3-77.

3-211. **Test Equipment and Special Tools.**

Hydraulic Test Stand, SAMME-70-220
Torque Wrench
Cap, AN929-()
Pressure Test Kit, Permaswage and Dynatube
Fittings, 68D300021-1001
High Pressure Hose, B8788-6

3-212. **Procedure.**



Do not separate the components of the test plug assembly. The bleeder adapter (IES-749) uses a static O-ring seal that should be disturbed only by a trained tool repairman.

- a. Select test plug assembly, from pressure test kit, (Harrison test plug and attached bleeder adapter) per the outside diameter and wall thickness of tube to be tested per Harrison Test Plug Data shown on figure 3-77.
- b. Select applicable AN929 cap to fit bleeder adapter.



Tube must be fully inserted in test plug assembly for correct functioning. Less than fully inserted tube will damage test plug assembly.

- c. Connect the tube to the source of pressurizing fluid using the test plug assembly and a high pressure hose.



Threads on test plug and nut should be inspected at intervals since galling can cause false torque readings which are not enough to hold the plug on the tubing.

- d. Tighten all connections and torque. Refer to Harrison Test Plug Data.

- e. Connect the opposite end of tube to another test plug assembly.



Threads on test plug and nut should be inspected at intervals since galling can cause false torque readings which are not enough to hold the plug on the tubing.

- f. Tighten all connections and torque. Refer to Harrison Test Plug Data shown .



A tube that has not been thoroughly bled of air can become dangerous if it fails under pressure.

- g. Thoroughly bleed tube of air and close off by installing an AN929 cap.
- h. Tighten cap and torque to adapter. Refer to Harrison Test Plug Data shown.



Follow all applicable safety requirements. Refer to testing components and systems as contained in TO 00-25-223.

- i. Pressurize titanium tube assemblies to 12,000 psi, hold for minimum of 20 seconds, and not more than five minutes. Pressurize aluminum and stainless steel tube assemblies in accordance with Harrison Test Plug Data and approved procedures.
- j. Remove pressure.
- k. Loosen connections and remove tube.
- l. Drain fluid from tube, clean tube, and install protective caps.

3-213. TITANIUM AND ALUMINUM LINE REMOVAL, INSTALLATION, AND DAMAGE ASSESSMENT LIMITS.

Lines shall be removed and installed per the procedures below.

WARNING

Hydraulic fluid may cause skin irritation. Avoid contact with skin and clothing. Wash thoroughly after handling.

3-214. Materials.

Cloth, abrasive, ANSI B74.18 GRIT320 Al Oxide or finer
Hydraulic fluid, MIL-PRF-83282
Tape, insulation, A-A-59474 TY1CL1

3-215. Removal.

- a. Make sure external hydraulic (05-00-07) and electrical power (05-00-05) is removed from aircraft, and accumulator pressure is relieved (12-10-14).



Titanium alloy lines will break if excessively flexed or twisted during component removal or installation. Use two wrenches on fittings to prevent lines from twisting while being loosened or tightened.

- b. Remove/loosen adjacent line assemblies as required to gain access to damaged line assembly.
- c. Remove clamps from line assembly.
- d. Disconnect coupling nuts and remove line assembly from aircraft.
- e. If installation of line assembly is not immediate, cap and plug line assembly and fitting.

3-216. Installation and Damage Assessment Limits.

- a. Remove caps and plugs from line assembly and fittings.



To prevent contamination of hydraulic system, be sure line assembly is clean and free of foreign objects.

- b. Be sure line assembly is clean and free of foreign objects.



Line assemblies shall be rejected for scratches, dents or nicks using the standards in table 3-18. The limits in the table apply to new lines and lines installed in the aircraft.

- c. Inspect line assembly for dents, nicks and scratches.
 - 1. Aluminum lines can be used with smooth dents not deeper than 10 percent of the nominal line diameter.
 - 2. Titanium lines will not be used, if dented.
 - 3. For scratches and nicks within allowable damage limits, smooth out damage by abrading with abrasive cloth, 320 grit or finer. For allowable line damage limits, see table 3-18.
- d. Be sure all locally fabricated lines have been pressure tested per paragraph 3-210.

WARNING

Hydraulic fluid may cause skin irritation. Avoid contact with skin and clothing. Wash thoroughly after handling.

- e. Lubricate threaded area of both coupling nuts using hydraulic fluid.



Do not install line assemblies which are too short or do not align with fittings and do not pull lines into fittings with coupling nuts, or failure will result. Do alignment procedures in step f. If line is still too short or does not align, replace line. Do not exceed force specified in figure 3-78 when aligning fittings.

- f. Position line assembly in aircraft and tighten coupling nuts handtight. If line assembly is misaligned, do steps 1. or 2., as applicable.
 - 1. For lines connected to tee fittings:
 - (a) Loosen both ends of all lines connected to tee.
 - (b) Loosen line support clamps on lines connected to other sides of tee.
 - (c) Adjust lines for correct fit. If line still does not align, replace line.
 - (d) Handtighten all end fittings.
 - (e) Tighten support clamps on lines connected to tee.
 - (f) Alternately tighten end fittings, loosened in step (a), in small increments to torque values listed in table 3-17.
 - 2. For lines connected to bulkhead fittings:
 - (a) Loosen bulkhead fitting jamnut to allow fitting to float.
 - (b) Loosen line support clamps on line connected to other side of bulkhead fitting.
 - (c) Adjust bulkhead fitting and line for correct fit. If line still does not align, replace line.
 - (d) Handtighten line end fitting.
 - (e) Tighten line support clamps on line connected to other side of bulkhead fitting.
 - (f) Tighten bulkhead fitting jamnut.

NOTE

To reduce chafing of line assembly, insulation (teflon) tape may be wrapped around the area of line assembly to be secured with clamps. If required, clamp size may be increased one size.

- g. If required, double wrap insulation (teflon) tape on line 0.500 wider than width of clamp contact surface.



To prevent line damage, the allowable force to align clamps in any direction shall not exceed value specified in figure 3-78. Adjustment in clamp position to reduce strain on lines may be done by varying spacer length as listed below.

- h. Install first clamp nearest halfway point between each end of line and continue installing clamps nearest halfway point between each divided line section until all clamps are installed. Do not exceed force specified in figure 3-78. If a clamp does not fit, do steps 1., 2. or 3., as applicable.
 - 1. If no clamp mounting spacers are used, NAS42 or NAS43 spacers, up to a maximum of 1/4-inch in length may be used.
 - 2. If clamp mounting spacers of 1/2-inch or shorter are specified, spacers 1/4-inch longer or shorter may be substituted.
 - 3. If clamp mounting spacers of over 1/2-inch in length are specified, spacers down to 1/4-inch shorter may be substituted. In no case may spacers longer than specified be substituted in this length range.

- i. Torque both line end fittings to values specified in table 3-17.

- j. Install/tighten all line assemblies removed/loosened to aid line installation.

NOTE

Removal of any line between a hydraulic pump and the reservoir or the accessories manifold requires hydraulic pump manifold air bleeding (29-10-18), (29-10-32) or (29-11-13).

- k. Air bleed and inspect line assembly for evidence of leakage (29-10-03) or (29-11-03).

Table 3-17. Torque Values for Dynatube Connectors

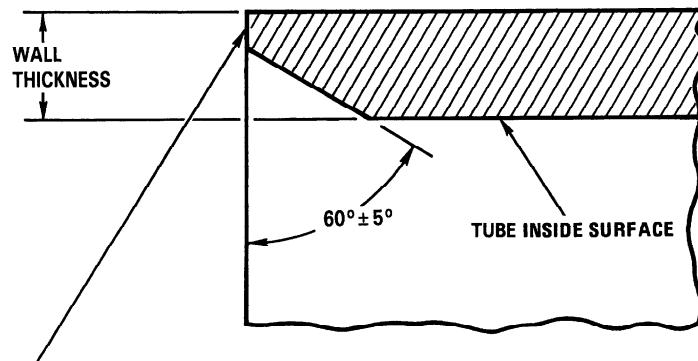
Wrench Size (Inches)	Torque Value (In-Lbs)	
	Aluminum Tubing	Titanium/ Steel Tubing
9/16	60 to 80	120 to 168
11/16	110 to 140	180 to 300
7/8	210 to 260	360 to 480
1	492 to 660	492 to 660
1-1/8	600 to 840	600 to 840
1-1/2	840 to 1128	840 to 1128
1-7/8	1296 to 1680	1296 to 1680
2-1/8	1500 to 1980	1500 to 1980

Table 3-18. Allowable Hydraulic Line Damage Limits

Tube Size (Inches)	Aluminum		Titanium		Titanium Coil or Flex	
	Straight Depth (In.)	Bend Depth (In.)	Straight Depth (In.)	Bend Depth (In.)	Straight Depth (In.)	Bend Depth (In.)
1/4	0.001	0.0005	0.0008	0.0003	0.0016	0.0006
3/8	0.0015	0.0005	0.001	0.0004	0.002	0.0008

Table 3-18. Allowable Hydraulic Line Damage Limits (CONT)

Tube Size (Inches)	Aluminum		Titanium		Titanium Coil or Flex	
	Straight Depth (In.)	Bend Depth (In.)	Straight Depth (In)	Bend Depth (In.)	Straight Depth (In.)	Bend Depth (In.)
1/2	0.0015	0.0005	0.0013	0.0005	0.003	0.001
5/8	0.0017	0.0007	0.0016	0.0006	0.0035	0.0014
3/4	0.0017	0.0007	0.002	0.0008	—	—
1	0.002	0.0008	0.0025	0.001	—	—
1-1/4	0.0025	0.001	0.0032	0.0013	—	—



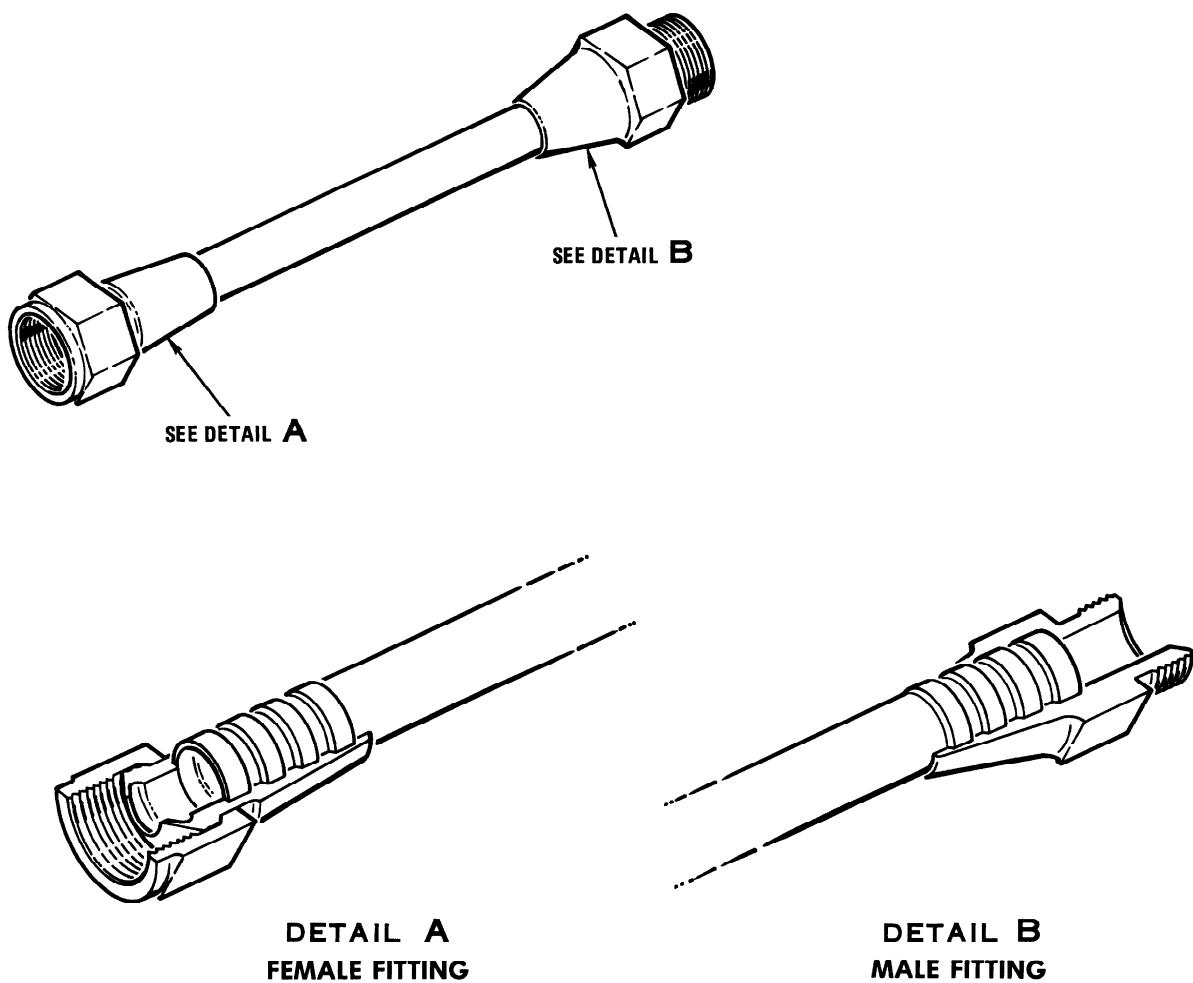
END CONFIGURATION – A KNIFE EDGE DOES NOT EXIST WHEN TWO EDGES REPRESENTING THE INSIDE DIAMETER AND OUTSIDE DIAMETER OF THE TUBE ARE STILL VISIBLE WITH NAKED EYE.

TUBE OD (INCHES)	WALL THICKNESS (INCHES)	MATERIAL	END CONFIGURATION
1/4	0.016	Ti-3AL-2.5V	1
3/8	0.019	Ti-3AL-2.5V	
1/2	0.026	Ti-3AL-2.5V	
5/8	0.032	Ti-3AL-2.5V	
3/4	0.039	Ti-3AL-2.5V	2

1 → A KNIFE-EDGE CONDITION IS ALLOWED.
 2 → A KNIFE-EDGE CONDITION IS NOT ALLOWED.

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Figure 3-73. Tube End Configuration for Dynatube Fittings



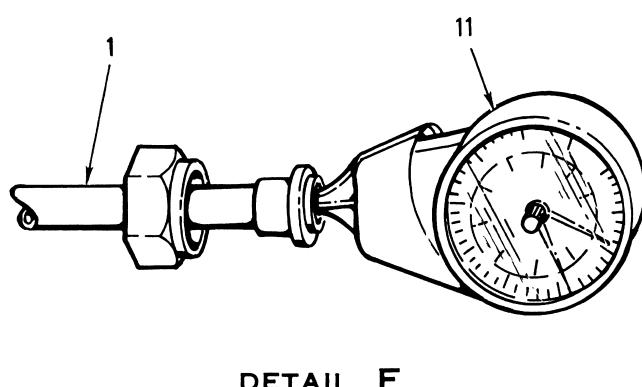
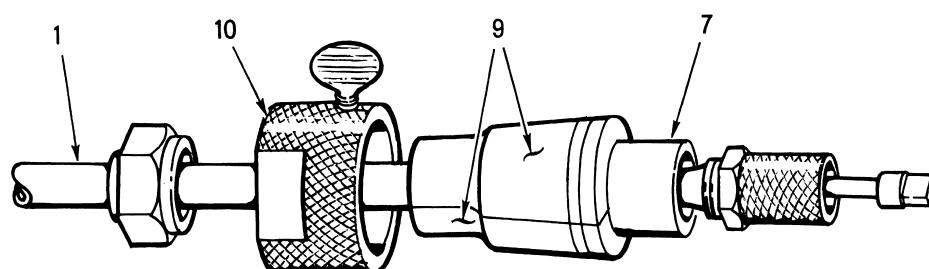
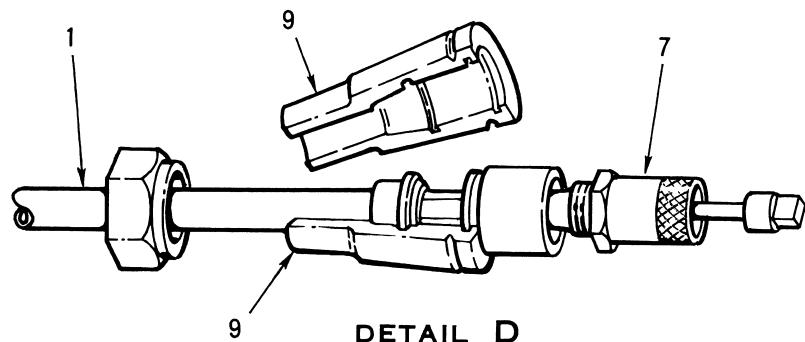
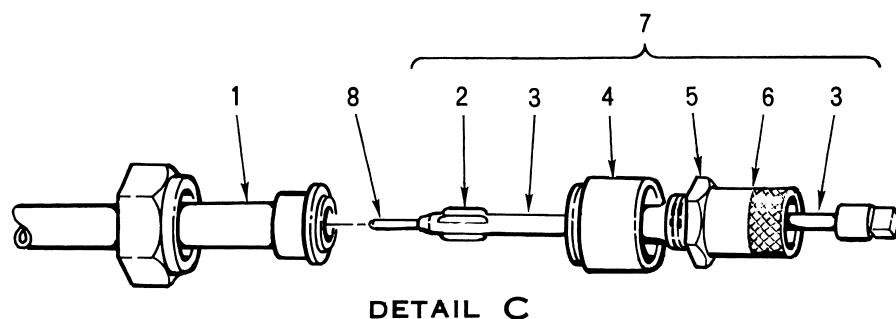
TUBING			SWAGING TOOLS				1 ID OF TUBE AFTER SWAGING
OD	WALL THICKNESS (IN)	MATERIAL	COLLAR	FEMALE DIE SET	MALE DIE SET	EXPANDER	
			R24837-1	RF26826-2	RM126826-2	R5170MD	
1/4	0.016	Ti-3AL-2.5V	-06	-04	-04	-04016	0.232 ± 0.002
3/8	0.019	Ti-3AL-2.5V	-06	-06	-06	-06019	0.352 ± 0.002
1/2	0.026	Ti-3AL-2.5V	-12	-08	-08	-08026	0.466 ± 0.002
5/8	0.032	Ti-3AL-2.5V	-12	-10	-10	-10032	0.580 ± 0.002
3/4	0.039	Ti-3AL-2.5V	-12	-12	-12	-12039	0.692 +0.003 -0.002
1.0 1-1/4	0.051 0.065	Ti-3AL-2.5V Ti-3AL-T6	R24826-1				
			-16	-18	-18	-16051	0.921 +0.003 -0.002
			-20	-20	-20	-20065	1.147 +0.003 -0.002
1 USE INTERNAL CALIPER P/N R25837-16-1 FOR SIZES 1/4 - 5/8 OR INTERNAL CALIPER P/N R24837-16-2 FOR SIZES 3/4 - 1-1/4.							



MAJOR CHANGE

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Figure 3-74. Dynatube Swaged Fitting Installation (Sheet 1 of 2)



REF NO.	NOMENCLATURE
1	TUBE ASSEMBLY
2	ROLLERS
3	MANDREL
4	BEARINGS
5	ADJUSTMENT LOCKNUT
6	ADJUSTMENT SLEEVE
7	EXPANDER
8	LUBRICATION POINT
9	DIE HALVES
10	COLLAR
11	INTERNAL CALIPERS

Figure 3-74. Dynatube Swaged Fitting Installation (Sheet 2)

CSTO SR1F-15SA-3-1

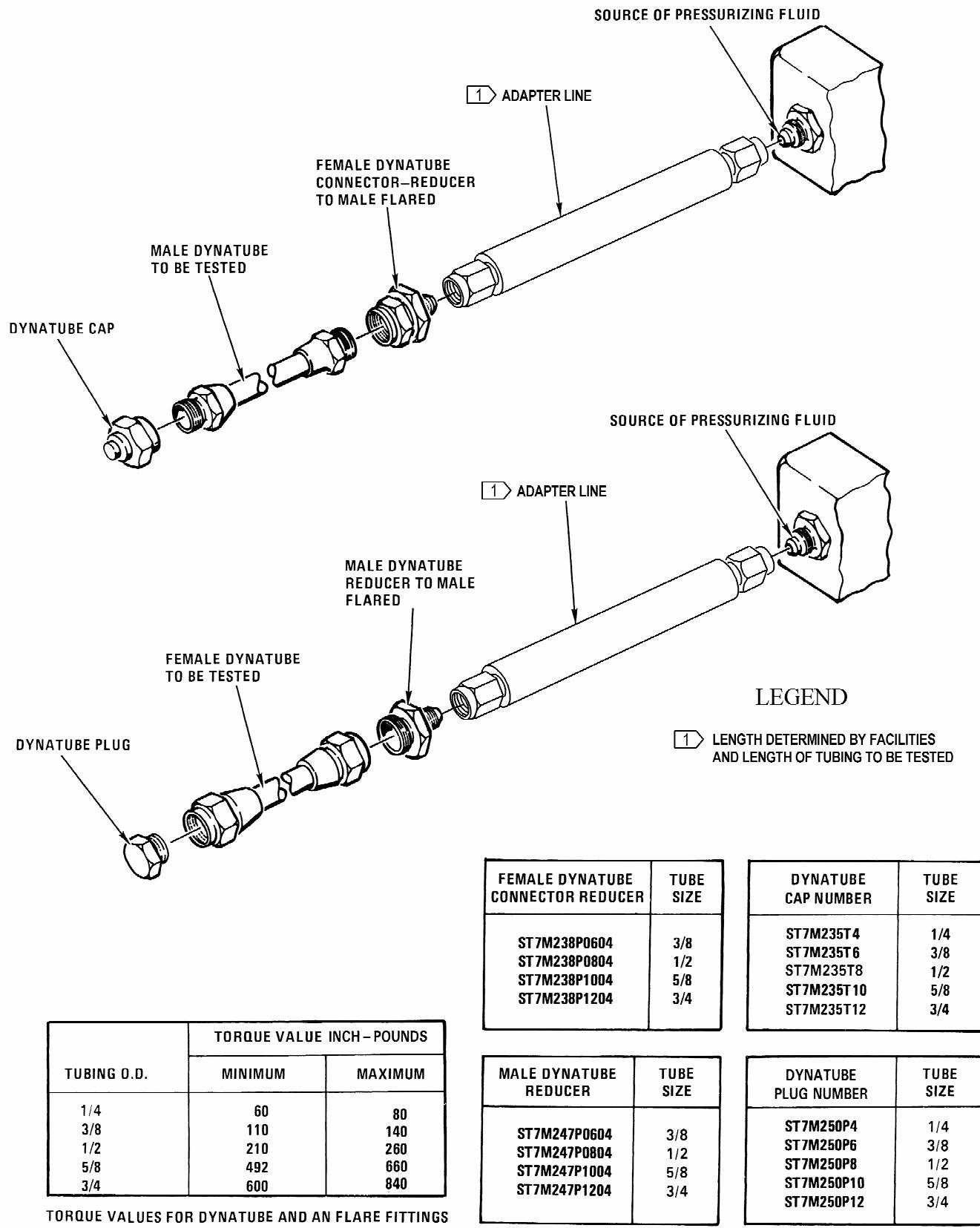
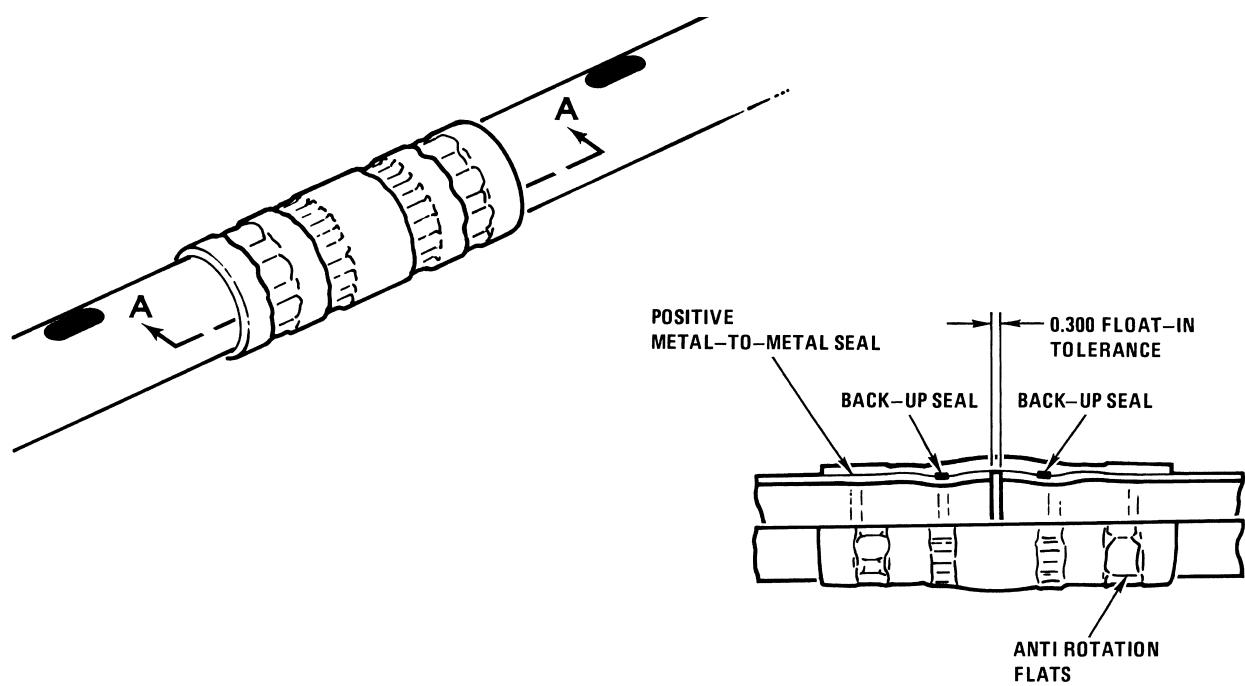


Figure 3-75. Pressure Testing Dynatube Assemblies

**SECTION A-A****TOOL CASE D10030**

TUBE SIZE (IN)	SWAGE TOOL D10001	DIE BLOCKS D10001	INSPECTION GAGE D9892	TUBE CUTTER	MARKING TOOL	DEBURRING TOOL	STEM D9851
1/4	-52	-56-4	-4	D9872	D9862-S	D9851	-13-04
3/8	-52	-56-6	-6	D9872	D9862-S	D9851	-13-06

TOOL CASE D10031

TUBE SIZE (IN)	SWAGE TOOL D10002	DIE BLOCKS D10002	INSPECTION GAGE D9892	TUBE CUTTER	MARKING TOOL	DEBURRING TOOL	STEM D9850
1/2	-52	-56-8	-8	D9853	D9862-M	D9850	-13-08
5/8	-52	-56-10	-10	D9853	D9862-M	D9850	-13-10
3/4	-52	-56-12	-12	D9852	D9862-M	D9850	-13-12

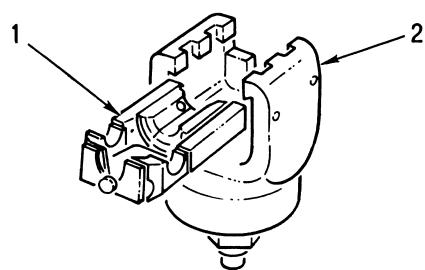
TOOL CASE D10032

TUBE SIZE (IN)	SWAGE TOOL D10003	DIE BLOCKS D10003	INSPECTION GAGE D9892	TUBE CUTTER	MARKING TOOL	DEBURRING TOOL	STEM D9849
1	-52	-56-16	-16	D9852	D9862-L	D9849	-13-16
1 - 1/4 ①	-52	-56-20	-20	D9852	D9862-L	D9849	-13-20
1 - 1/4 ②	-52	-56-20	-20	D9852	D9862-L	D9849	-13-21
1 - 1/2	-52	-56-24	-24	D9852	D9862-L	D9849	-13-24
① USE FOR WALL THICKNESS 0.049.							
② USE FOR WALL THICKNESS 0.065.							

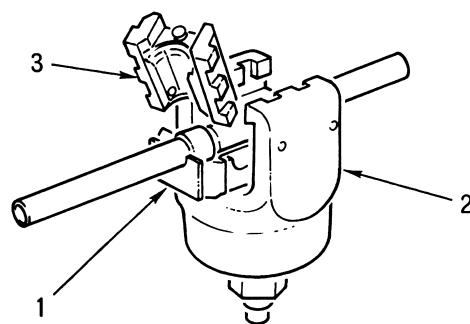
SAN301-03-112-001

Figure 3-76. Permaswage Fitting Installation (Sheet 1 of 3)

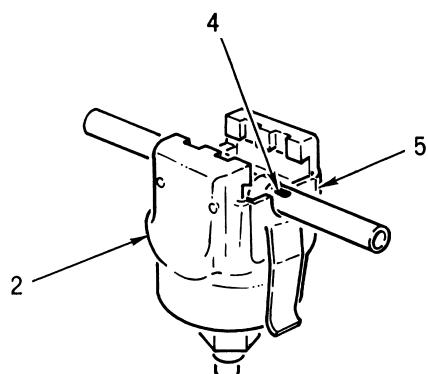
CSTO SR1F-15SA-3-1



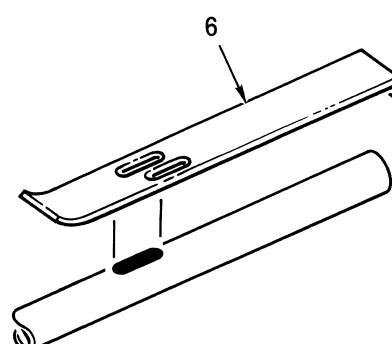
DETAIL B



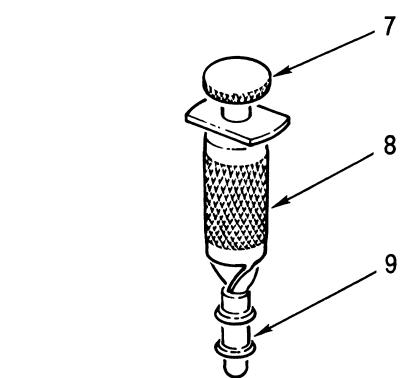
DETAIL C



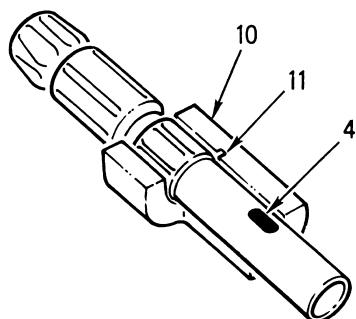
DETAIL D



DETAIL E



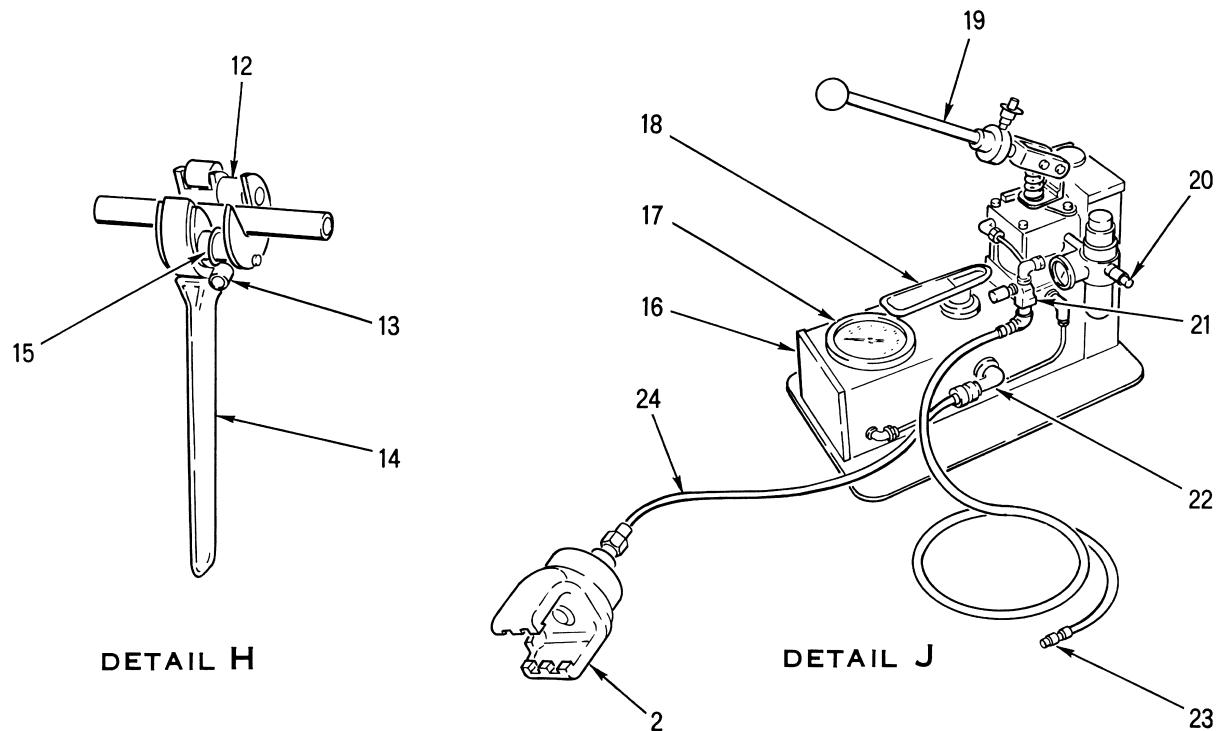
DETAIL F



DETAIL G

Figure 3-76. Permaswage Fitting Installation (Sheet 2)

SAN301-03-113-001



REF NO.	NOMENCLATURE
1	LOWER DIE BLOCK
2	SWAGING TOOL
3	UPPER DIE BLOCK
4	LOCATION BAND
5	SWAGING TOOL LATCH
6	MARKING TOOL
7	BUTTON
8	DEBURRING TOOL
9	STEM
10	INSPECTION GAGE
11	INSPECTION GAGE SHOULDER
12	ROLLER
13	CUTTERWHEEL ADJUSTING SCREW
14	TUBE CUTTER
15	CUTTERWHEEL
16	PNEUMATIC/HYDRAULIC POWER UNIT
17	OUTPUT PRESSURE GAGE
18	SELECTOR VALVE HANDLE
19	HAND PUMP
20	AIR INLET CONNECTION
21	AIR BUTTON
22	HYDRAULIC OUTLET CONNECTION
23	REMOTE AIR BUTTON
24	HYDRAULIC PRESSURE HOSE

Figure 3-76. Permaswage Fitting Installation (Sheet 3)

SAN301-03-114-001

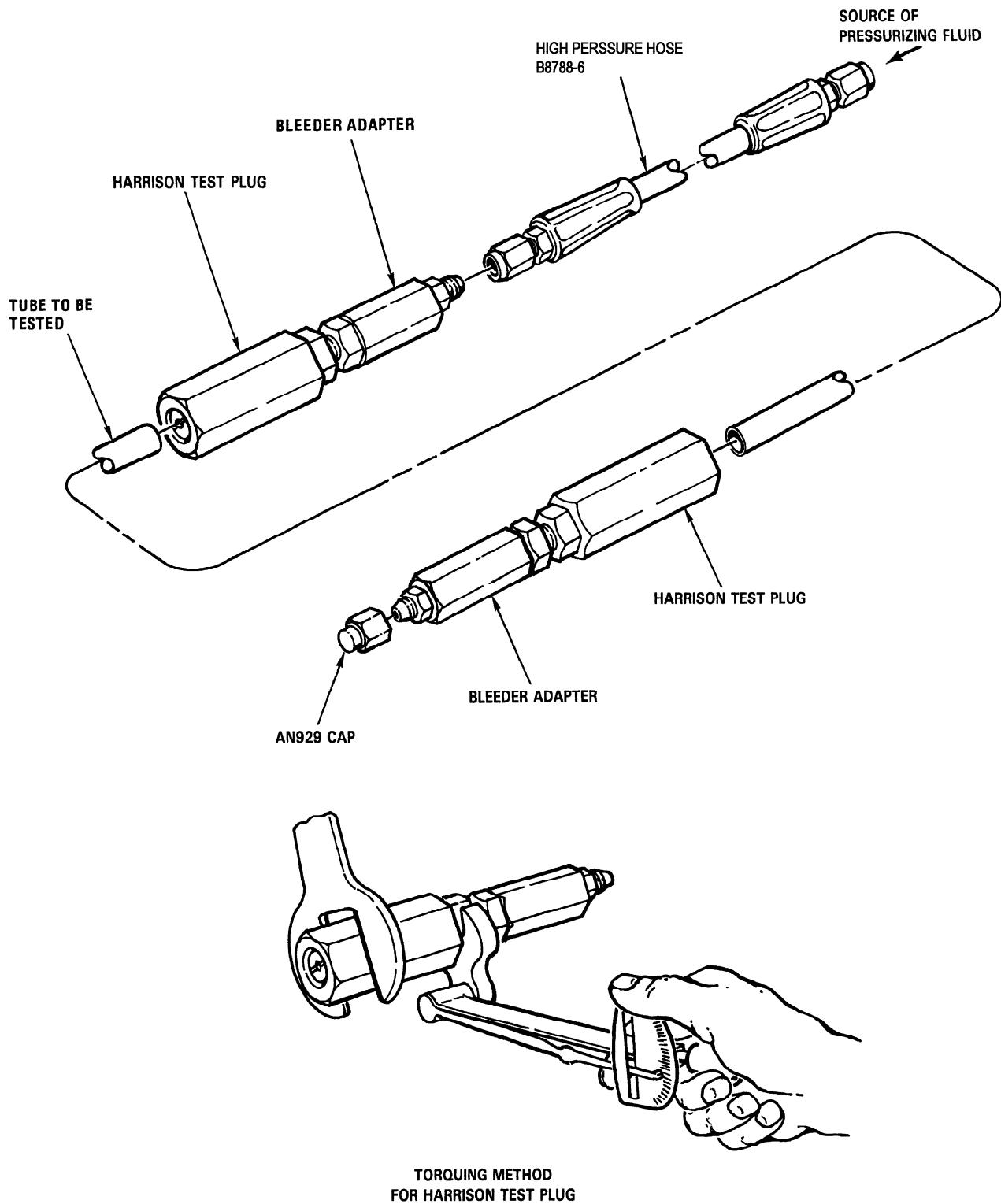


Figure 3-77. Pressure Testing Permaswage Assemblies (Sheet 1 of 2)

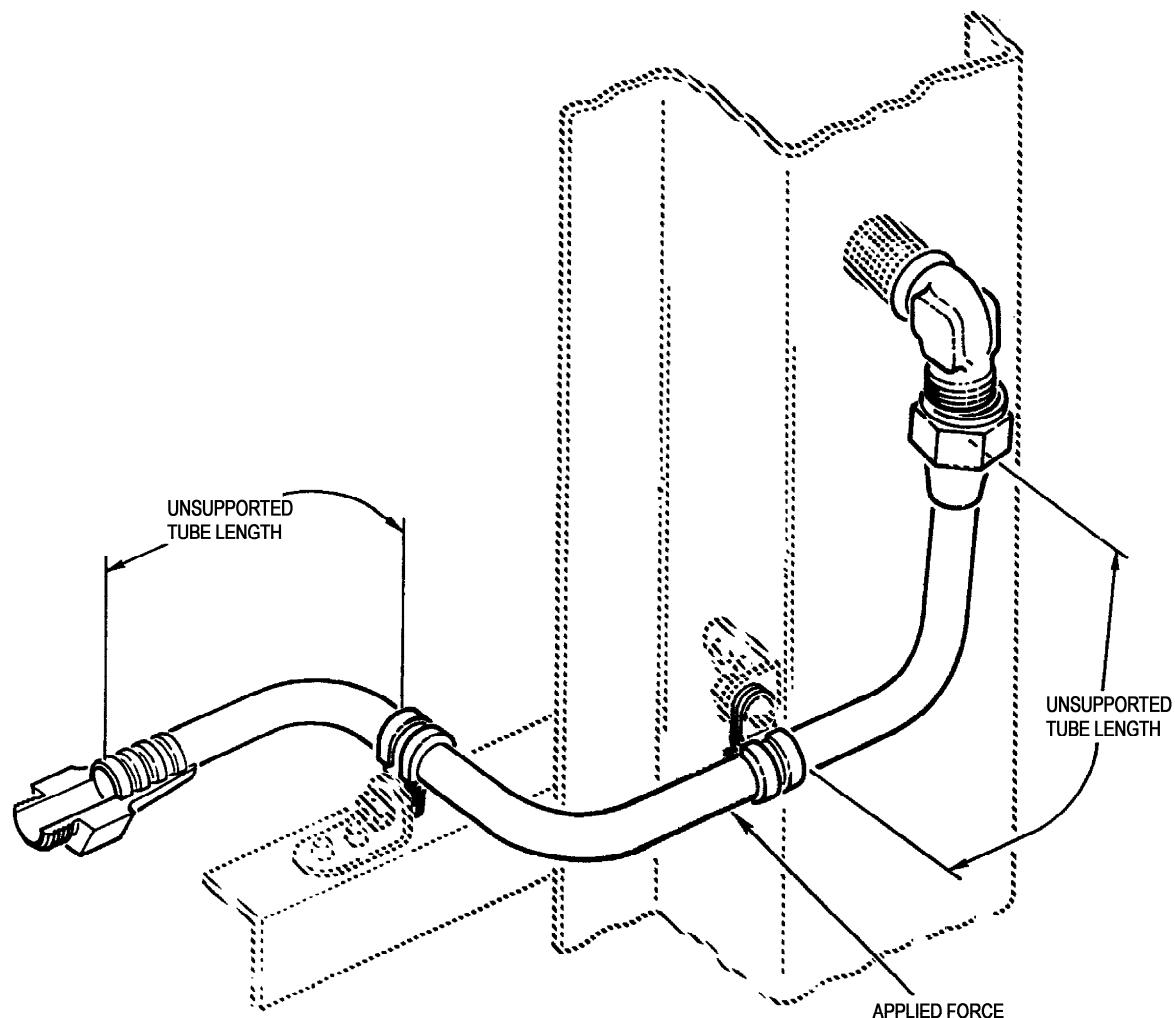
HARRISON TEST PLUG DATA

TUBE OUTSIDE DIAMETER AND WALL THICKNESS	TUBE OUTSIDE DIAMETER RANGE	HARRISON PART NUMBER 6170-	CORRESPONDING BLEEDER ADAPTER IES-749-	TORQUE VALUES INCH - POUNDS MINIMUM - MAXIMUM
1				AS REQUIRED
3/8 X 0.019 Titanium	0.375 0.376 - 0.378	0376-019 0378-019	101	50 80
3/8 X 0.028 Aluminum	0.369 - 0.373 0.373 - 0.377 0.377 - 0.381	0374-028 0378-028 0382-028		15 30
1/2 X 0.026 Titanium	0.500 - 0.503	0503-026	102	110 140
1/2 X 0.028 Aluminum	0.492 - 0.497 0.497 - 0.502 0.502 - 0.507	0498-028 0503-028 0508-028		70 140
5/8 X 0.032 Titanium	0.625 - 0.628	0628-032	103	150 180
5/8 X 0.035 Aluminum	0.617 - 0.622 0.622 - 0.627 0.627 - 0.632	0623-035 0628-035 0633-035		90 120
3/4 X 0.039 Titanium	0.750 - 0.753	0754-039	104	300 330
3/4 X 0.035 Aluminum	0.742 - 0.747 0.747 - 0.752 0.752 - 0.757	0748-035 0753-035 0758-035		190 220

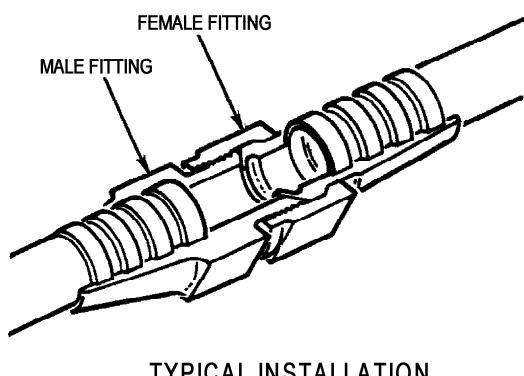
LEGEND

- 1 ALL 1/4-INCH LINES WILL HAVE EITHER "AN" FITTINGS, "AN" FLARES, AND APPROXIMATELY 2 INCHES EXCESS MATERIAL ON BOTH ENDS, OR AN "AN" FITTING, FLARE AND APPROXIMATELY 2 INCHES EXCESS MATERIAL ON ONE END AND A DYNATUBE FITTING ON THE OTHER END. THE EXCESS MATERIAL AND "AN" FITTINGS WILL BE REMOVED AND THE APPROPRIATE FITTINGS INSTALLED AFTER PRESSURE TESTING.

Figure 3-77. Pressure Testing Permaswage Assemblies (Sheet 2)



TUBING ALIGNMENT FORCE
(POUNDS)



TUBE SIZE (INCHES)	UNSUPPORTED TUBE LENGTH IN INCHES			
	10 - 30	30 - 60	60 - 90	90 - 120
TITANIUM				
1/4	1	1/2	1/4	
3/8	3	1-1/2	3/4	1/4
1/2	8	4	2	1
5/8	16	6	4	2
3/4	20	12	6	3
1	20	20	16	8
1-1/4	20	20	20	20
1-1/2	20	20	20	20
ALUMINUM				
1/4	1/2	1/4	1/8	
3/8	2	1	1/2	1/4
1/2	4	2	1	1/2
5/8	8	4	2	1
3/4	12	6	3	1 1/2
1	20	12	6	3
1 1/4	20	20	12	6

SAN301-03-117-001

Figure 3-78. Titanium and Aluminum Tubing Allowable Flex Limits

3-217. FORCETEC (FtCx) SYSTEM. The FtCx system installs a plate nut without rivets that provides superior fatigue performance over conventional riveted plate nut. The FtCx components, shown in figure 3-79 detail A, are installed with proven cold expansion technology. Cold expansion produces a zone of beneficial residual compressive stresses that shield the fastener holes from the action of cyclic tensile stresses that grow fatigue cracks. The FtCx retainer is installed with a high interference fit that provides resistance to torque and removal forces encountered during fastener installation and removal. Another important part of the FtCx process is the elimination of the small rivet holes used for attaching conventional plate nuts. These holes increase stress concentration, cause placement

problems in short edge distance configuration, and are a known source of cracks.

3-218. Installed Plate Nut Dimensions. See figure 3-79. The total installed dimensions of the FtCx plate nut system depend on the nut type since most nuts protrude above the top of the retainer, see figure 3-79 and detail A. The nut feet will also extend past the radius of the retainer base, see detail B.

a. Retainer assembly dimensions. General dimensional data for retainer assemblies after installation without nuts is shown in table 3-19. Retainer grip lengths can be specified in 0.010 increments up to 1/2-inch as required, see detail B and table 3-19.

Table 3-19. Retainer Dimensions (Inches)

Fastener Size	A Maximum	B ± 0.005	C Maximum	D ± 0.005	E Radius ± 0.005
3/16	0.502	0.360	0.187	0.055	0.032
1/4	0.640	0.460	0.199	0.055	0.032
5/16	0.750	0.540	0.212	0.060	0.040
3/8	0.861	0.620	0.222	0.060	0.050

b. Nut dimensions. See detail C. Many nuts may be used with the FtCx system; however, nuts that satisfy the dimensional requirements shown in detail C and table 3-20 will make sure of correct system performance. These values match those of

NAS1794 for 3/16, 1/4, and 5/16 diameter fasteners. Nuts that do not satisfy these requirements may result in installations with improper float and/or resistance to torque and removal.

Table 3-20. Required Nut Base Dimensions (Inches)

Fastener Size	A ± 0.005	B ± 0.005	C ± 0.005	D Minimum	V
3/16	0.487	0.300	0.300	0.194	0.040 0.028
1/4	0.562	0.400	0.362	0.254	0.052 0.040
5/16	0.727	0.480	0.478	0.317	0.060 0.045

Table 3-20. Required Nut Base Dimensions (Inches) (CONT)

Fastener Size	A ±0.005	B ±0.005	C ±0.005	D Minimum	V
3/8	0.785	0.560	0.560	0.379	0.070 0.055

c. Retainer inside diameters. See table 3-21. The final retainer inside diameters after installation are listed in table. These follow the guidelines listed in NAS618, columns C, D, and E for fastener fit and are referred to as class I, II, and III respectively.

d. Nut floats. See detail C. FtCx plate nut retainers are designed to allow the nut to float a

minimum of 0.025 radially. The maximum float of these nuts will not be greater than that which will allow the fastener to be installed. These requirements can only be met if the nuts used satisfy the dimensional requirement shown in step b.

Table 3-21. Retainer Inside Diameter Limits (Inches)

Fastener Diameter	Class I		Class II		Class III	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
3/16	0.190	0.194	0.190	0.197	0.218	0.229
1/4	0.250	0.254	0.250	0.257	0.279	0.291
5/16	0.312	0.317	0.313	0.320	0.342	0.354
3/8	0.375	0.379	0.375	0.382	0.404	0.416

1. A 0.015 final ream is required to get a class I fit. Final reaming is not required to get retainer inside diameters with class II and III fits.

3-219. Primary Structure Requirements. Primary structure into which FtCx plate nuts are to be installed must be compatible with the retainer material and process parameters as described in this section. This section outlines the specific designed criteria for primary structures.

a. Structure materials and thickness. This

system is designed for stainless steel retainer installations in aluminum or stainless and titanium retainers installed in titanium structure with the material combination minimum thicknesses specified in table 3-22. Use of thinner material requires the approval of AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH. Do not install titanium retainers on aluminum structure.

Table 3-22. Minimum Material Thickness (Inches)

Fastener Diameter (Inches)	Class of Fit	Passivated Stainless Steel Retainers		IVD Coated Stainless Steel Retainers		Titanium Retainers
		Primary Material		Primary Material		Primary Material
		2024T8	7075T6/T7	2024T8	7075T6/T7	Titanium
3/16	I	0.080	0.070	0.160	0.160	0.130
	II	0.080	0.070	0.160	0.160	0.080
	III	0.070	0.070	0.140	0.140	0.060
1/4	I	0.080	0.070	0.170	0.170	0.080
	I	0.070	0.060	0.150	0.140	0.070
	III	0.080	0.070	0.140	0.140	0.080
5/16	I	0.120	0.120	0.190	2 →	0.150
	II	0.100	0.100	0.150		0.140
	III	0.140	0.140	0.150		0.100
3/8	I	0.150	0.150	0.250	2 →	0.140
	II	0.130	0.130	0.190		0.130
	III	0.130	0.120	0.180		0.120

1. Minimum material thickness values were established from torque and push out testing using statistically significant samples.

2 → Contact AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH, for these thicknesses.

b. Starting hole diameters. See table 3-23. Starting hole diameters in the primary material must be made to the dimensions in table. The tolerance for these holes must be +0.0015 -0.0005 for 3/16 and 1/4-inch fastener diameters and

+0.002 -0.001 for 5/16 and 3/8-inch fastener diameters. Oversize retainers use the same installation tooling and result in the same final inside diameter as the nominal retainers. Nominal fasteners and nuts can be used with oversize retainers.

Table 3-23. Starting Hole Diameter (Inches)

Fastener Diameter	Class I		Class II		Class III	
	Nominal	Oversize	Nominal	Oversize	Nominal	Oversize
3/16	0.2969 (19/64)	0.3125 (5/16)	0.2969 (19/64)	0.3125 (5/16)	0.3125 (5/16)	0.3281 (21/64)
1/4	0.3438 (11/32)	0.3594 (23/64)	0.3438 (11/32)	0.3594 (23/64)	0.3750 (3/8)	0.3906 (25/64)
5/16	0.4063 (13/32)	0.4219 (27/64)	0.4063 (13/32)	0.4219 (27/64)	0.4375 (7/16)	0.4531 (29/64)

Table 3-23. Starting Hole Diameter (Inches) (CONT)

Fastener Diameter	Class I		Class II		Class III	
	Nominal	Oversize	Nominal	Oversize	Nominal	Oversize
3/8	0.4688 (15/32)	0.4844 (31/64)	0.4688 (15/32)	0.4844 (31/64)	0.5000 (1/2)	0.5156 (33/64)

1. Starting holes can be machined by hand held or machine controlled units, however, feeds and speeds should be controlled enough in order to produce a surface finish of Ra 125 or better. Residue free lubricants are recommended for the cutting fluid. If other lubricants are used, the residue must be removed by cleaning in order to prevent axial slippage of the retainer in the hole during installation and to be sure of satisfactory resistance to torque and removal.

c. Deburring. Primary materials must be deburred to allow the retainer head base to be installed flat against the primary material and slip easily into the starting hole. The maximum radius at the base is 0.010 for all retainers. A minimum radius or chamfer of 0.010 is required to be sure the retainer head will be installed flush with the primary material. It is not required to disassemble a stack up to deburr the edge of the holes at the interface. Starting holes in materials less than 0.080 thick should not be deburred more than 0.015. This may substantially reduce the resistance to torque and/or removal.

d. Edge distance and hole spacing. An edge distance (ED) of 1.50 or greater, measured relative the FtCx starting hole, is recommended. FtCx installations may be effective in edge distances of 1.00 to 1.50, but performance will depend on the type of factors including material, retainer size and other geometrical considerations. Starting hole spacing should be a minimum of three times the starting hole diameter (3D).

e. Multiple material stuck up. Retainers may be installed into multiple material stack up: aluminum with titanium, 7000 series with 2000 series aluminum. The final retainer inside diameter will remain within the limits shown in table 3-21, even though it may vary slightly because of the stack up. A stack up of material must have faying surface contact during starting hole preparation and plate nut installation. Faying surface separation between materials, after plate nut installation, is allowed, provided a 0.002 thick shim cannot be made to contact the retainer outside diameter between material layers. Materials may be clamped to avoid this gapping.

f. Perpendicularity. Both surfaces of the primary material must be perpendicular within 2 degrees to the starting hole during FtCx plate nut installations. Tapered shims may be used to compensate for non perpendicular surfaces on the puller gun side, but these will have to be removed after installation. The resultant protruding retainer end must then be shaved to be sure of a flush installation.

g. Rework of existing structure. ForceTec plate nuts without rivets may be installed into structure with existing rivet holes only if the holes are filled. Pins must be used to fill them during installation of the FtCx retainer to be sure that they are not distorted and to be sure enough cold expansion of the primary structure.

3-220. **System Parameters.** In general, FtCx plate nuts without rivets have been designed to be similar in function to typical rivet plate nuts. However, listed below are some requirements that are specific or unique to installations using the FtCx plate nuts system.

a. Retainer and clip materials. FtCx retainers are made of either 17-4 Ph stainless steel, per AMS 5643, condition H1025 (155 KSI ultimate strength), or annealed 6A1-4V or 3A1-2.5V titanium, (140 KSI for 6A1-4V 90 KSI for 3A1-2.5V ultimate strength). Standard clips are made of 17-7Ph stainless spring wire cold rolled and tempered to condition CH900. All stainless parts are passivated after machining or forming.

b. Torque or removal. ForceTec retainers are rated to the values listed in table 3-24. Fasteners installed in ForceTec retainers must not exceed

these values unless authorized in a specific application.

Table 3-24. Plate Nut Torque and Removal Requirements per MIL-N-25027G

Fastener Size	Torque (In-Lbs)	Removal (Lbs)
3/16	60	100
1/4	100	125
5/16	160	125
3/8	240	125

c. Post sizing of retainers. Class I FtCx retainers require a post sizing operation to remove 0.015 from the inside diameter. Post sizing is not required for standard class II or III installations but can be done to allow nonstandard fasteners or more fastener clearance. This, however, may result in a slight reduction in resistance to torque and removal.

d. Sleeve ridge and orientation. The axial ridge left on the retainer inside surface by the split sleeve after classes II and III installation will not affect the fastener installation and does not have to be removed. This ridge, and any shear discontinuity that may exist in the retainer, will not adversely effect the fatigue life of the structure or the torque and removal resistance of the retainer. A light ream may be used to remove this ridge if desired. Process performance is also not affected by the orientation of this ridge; however, the re-initiation of the retainer head may affect the ease of nut installation.

e. Retainer flushness and seating. Retainers must be installed no more than 0.010 under flush relative to the primary material thickness. Installations which result in retainers under flush by more than this amount may reduce the fatigue life of the primary material. Retainers may protrude from the primary material, over flush, by no more than 0.100. This protrusion may be shaved to the desired flushness using a shaving tool or other means after installation. Retainer heads must be seated within 0.005 or in accordance with the applicable drawing of standard.

f. Surface upset. Upset of the material surrounding the hole is not expected for materials

that are thicker than 0.060. However, in thin structures, slight bending may occur when several retainers are installed into large sections of unsupported structure. This is caused by the residual compressive stresses imparted to the structure.

g. Corrosion protection. Stainless steel retainers can be provided with a protective IVD coating of pure aluminum and chromate finish per MIL-C-83488, Type II, Class 3. Wet sealant or other corrosion prevention compounds applied to the starting hole or retainer barrel before installation must be allowed to dry before application of torque or push out forces. Wet sealants or primers, that are not allowed to dry, may result in not enough resistance to torque or remove. Corrosion prevention compounds, paints or primers may also be applied after installation.

h. Part identification. Retainers will be marked with the manufacture identification (FTI), a letter designation for the class of fit, a letter designation for the retainer materials and coating, and an X for oversize retainers. Clips are not marked with part number. The letter designation for retainer class of fit and materials are as noted below:

Class of Fit	Retainer Material
K = Class I	C = Stainless Steel (Bare)
L = Class II	V = Titanium
M = Class III	D = Stainless Steel (IVD Coated)

NOTE

Example: A titanium class II retainer will be marked with FTI LV. An oversize bare stainless class I retainer will be marked with FTI KCX.

3-221. **Access Restrictions.** A minimal distance around each hole must be clear of obstructions to allow access for the tooling required to install FtCx plate nuts. These distances are referred to as the frontside, backside, and radial clearances and shown in this section. Offset tooling is also available if these requirements cannot be met.

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a. Frontside clearance. The hydraulic tooling used to install FtCx plate nuts must fit in an unobstructed area enough to allow the puller unit to be perpendicular to the hole. For the standard LB-20, this distance is about 15.20 as shown in figure 3-80, detail A. Other puller units or offset adapters may be required if obstructions exist.

b. Backside clearance. The plate nut side of the workpiece must be free of obstructions within about 1.5 of the workpiece front surface. This is required to allow the mandrel to protrude through the retainer before installation. Typical required backside clearance for all FtCx standard mandrels are shown in figure 3-80, detail B, and table 3-25.

Table 3-25. Backside Clearance

Mandrel Model Number	Required Backside Clearance (Inches)
FTM-3-0-*-2	1.01
FTM-3-0-*-8	1.39
FTM-4-0-*-2	1.08
FTM-4-0-*-8	1.46
FTM-5-0-*-2	1.15
FTM-5-0-*-8	1.52
FTM-6-0-*-8	1.56

*Backside clearance is independent of class of fit.

c. Radial clearance. There must be enough clearance around the hole on the frontside, or puller unit side of the workpiece for the nose cap to sit flush against the surface of workpiece. The backside must be clear to allow the retainer to be seated flush with this surface. The minimum radial clearance for the nose cap varies with the size of the installation, as shown in table 3-26. The minimum lateral clearance for the nose cap is 1.52 as shown

in figure 3-80, detail C. Restricted access tooling can also be designed. The minimum clearance for the retainer is per paragraph 3-218, step a.

Table 3-26. Minimum Nose Cap Clearance (Inches)

Nose Cap Size (Section 4.3.7)	Radial Clearance (Inches)
FTN-3-*-*	0.330
FTN-4-*-*	0.360
FTN-5-*-*	0.390
FTN-6-*-*	0.420

*Nose Cap clearance is independent of class of fit or oversize.

3-222. **Tooling.** The tooling used to install FtCx plate nuts without rivets can be divided into three categories: Expendable tooling, durable tooling, and capital tooling. Expendable tooling is designed specifically for the FtCx system and is used only one time and then disposed of. Durable tooling is designed specifically for the FtCx system and is used repetitively with a specific size or application. Capital tooling can be used with many of FTI fatigue life enhancement systems.

a. ForceTec system number. FtCx durable and expendable tooling is available for four fastener sizes and three classes of fit. Each size and class is designated with a ForceTec System Number (FSN). The FSN designates a tooling set able to install nominal or oversize retainers, both using nominal fastener, with a specific final size and class of fit as listed in table 3-21. The first number in the FSN represents the fastener size in 1/16 of an inch, the second denotes a nominal (0) or oversize (1) installation, and the third distinguishes the class of fastener fit. The FSNs for the standard system are shown in figure 3-81 and table 3-27. All FtCx tooling is organized around this size.

Table 3-27. FSNs for FtCx Standard System

Fastener Size (Inches)		Applicable FSN		
		Class I	Class II	Class III
3/16	Nominal	3-0-1	3-0-2	3-0-3
	Oversize	3-1-1	3-1-2	3-1-3
1/4	Nominal	4-0-1	4-0-2	4-0-3
	Oversize	4-1-1	4-1-2	4-1-3
5/16	Nominal	5-0-1	5-0-2	5-0-3
	Oversize	5-1-1	5-1-2	5-1-3
3/8	Nominal	6-0-1	6-0-2	6-0-3
	Oversize	6-1-1	6-1-2	6-1-3

b. Hardware and expendable tooling. Expendable tooling is specific to an individual system of tooling and its applications and will be disposed of after a single use. Sleeves are the only expendable tools used with the FtCx system. Retainers, clips, nuts, and fasteners are considered hardware. The nuts and fasteners used with the FtCx system are not provided by FTI. These may be purchased from any supplier provided they satisfy the dimensional requirements of paragraph 3-218, step b. Nuts which do not satisfy these requirements may result in installations with not enough float or improper fits.

1. Retainer. Retainers are designed to hold the nut in position after installation and are supplied with the clip in position. The interference between the barrel of the retainer and the hole in the primary material secures the retainer while the flat sides of the retainer head prevent the nut from rotating. The clip retains the nut and restricts its float. Retainers are available for all FSN sizes, for both nominal and oversize starting holes, and are made to the lengths specified by the model number. The model number for a retainer consists of the designation for the retainer (FTR), the FSN, the barrel length designation and the material designation and coating as shown in figure 3-81, detail B. FtCx standard system retainers are available in lengths up to 1/2-inch for FSN sizes. In order to specify the correct retainer, determine the FSN, primary material and retainer length required.

Use this information to make the model number as shown in detail B. If the primary material thickness varies significantly or does not match the retainer length, a longer size, not more than 0.100 longer, can be specified and the excess trimmed flush after installation. Refer to examples listed below:

(a) Coated stainless retainers are needed for installation into 0.180 thick aluminum structure. The fasteners have 1/4 threads, and class II fit is desired, see detail B. FTR-4-0-2-.180-SA retainer should be used.

(b) Retainers are required for use with 3/16 fasteners and oversize starting holes. Titanium retainers will be installed into titanium material with a thickness that tapers from 0.240 to 0.175 thick. If a fastener class I fit is specified, FTR-3-1-1-.240-T retainers should be used. These will have to be machined flush after installation for all but the thickest section of the structure.

2. Clip. Clips are designed to hold the nut in position after installation and control the amount the nut may float. They are included with each retainer and do not have to be removed during normal assembly. The retainer should be installed with the clip in position and then slide the nut through the open end to snap it into position. To remove the nut, simply slide the nut back through the open end of the clip. This nut, or a new one, can be reinstalled, see figure 3-81, detail C.

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Replacement clips can be ordered separately, if required. The model number for a clip includes the designation for the clip, (FTCR) and the fastener size as shown in figure 3-81, detail C.

3. Split sleeve. The split sleeve, made of full hard stainless steel, serves several important functions during the FtCx process. It makes sure of radial expansion and protects the inside of the retainer by eliminating direct contact between the mandrel and the retainer material. In addition, it provides lubrication during the installation and allows for the process to be a one-sided operation. FtCx standard system sleeves are split to allow them to fit over the major diameter of the mandrel and flared to better grip the inner jaw. The model number for a sleeve includes the designation for the sleeve (FTS), the FSN and the length designation, as shown in figure 3-81, detail D. Standard split sleeves are available in two lengths for several different FSNs. Split sleeves must be long enough to extend into the nose cap and protrude past the retainer by 1/8-inch. Nose cap and protrusion allowances have been used to compute the sleeve length required to install each of the standard retainers as listed in table 3-28. Either sleeve may be used with the longer mandrel for each size, but only the short sleeves can be used with the short mandrels. Sleeve should not be stacked since longer sleeves are available. In order to select the correct sleeves, determine the FSN, retainer length and mandrel length to be used. If the shorter mandrel is to be used, the short sleeve must also be selected. If the longer mandrel is to be used to install a retainer longer than 0.125, the longer sleeve must be selected. If a long mandrel will be used to install a 0.125 or shorter retainer, either sleeve length may be selected. These restrictions are outlined in table 3-28.

Table 3-28. Sleeve and Mandrel Length Options

Maximum Retainer Length (Inches)	Mandrel Length Options	Sleeve Length Options
0.125	FTM-(FSN)-2	FTS-(FSN)-2
		FTS-(FSN)-2 or FTS-(FSN)-8

Table 3-28. Sleeve and Mandrel Length Options (CONT)

Maximum Retainer Length (Inches)	Mandrel Length Options	Sleeve Length Options
0.500	FTM-(FSN)-8	FTS-(FSN)-8

3-223. **Durable Tooling.** Durable tooling is specific to a individual system of tooling and its applications and will not remain with the aircraft nor be disposed of after use. Tooling includes cutting tools, verification pins, mandrels, mandrel check fixtures, and nose caps. These tools must have periodic inspection for wear. FtCx durable tooling is unique to each FSN and is identified by an alphanumeric model number. The first letters determine the tool type FTS for the sleeve, FTM for the mandrel, and the numbers following the tool type are the FSN. Remaining numbers in the model number determine the length or other features. Durable tooling may be purchased as a set for new applications or individually to replace worn or damaged pieces.

a. Starting drill. Twist drills are provided for either nominal or oversize starting holes for each FSN. These are sized so about 1/64-inch of material will be removed by the starting hole reamer to get the starting hole size. The model number for a starting drill includes the designation for a starting drill (FTSD), the ForceTec system number of FSN, and the letter C, for Cobalt. The C is not added for high speed steel drills. Oversize and nominal drills are available for each of the FSN sizes, see figure 3-81, detail E.

b. Starting reamer. Fatigue Technology Inc. provides straight fluted, piloted, reamers designed to size the starting holes to the sizes listed in table 3-23. The non cutting pilot will fit into the hole that has been cut by the corresponding starting hole drill. The model number for a starting hole reamer includes the designation for a starting hole reamer (FTSR), the ForceTec system number, or FSN, and the letter C for Cobalt. The C is not added for high speed steel reamer. FtCx starting reamers are available for both nominal and oversize staring holes. See figure 3-81, detail F.

c. Finish reamer. Straight fluted, piloted, finish reamer are designed to size class I retainers to the sizes listed in table 3-21. The non cutting pilot will

fit into the retainer only after installation. Finish reamers are not required for class II or class III installations. The model number for a finish reamer includes the designation for a finish reamer (FTFR), the ForceTec system number or FSN, and the letter C, for Cobalt. All finish reamers are cobalt. FtCx nominal finish reamers are used for both nominal and oversize retainer installations, see figure 3-81, detail G.

d. Verification pin. The verification pin gage is a double end gage used to inspect the starting hole and final retainer inside diameter. The stepped blade end is used to inspect the starting hole for size and out of round. The other end is used to verify the final size of the retainer inside diameter after installation. The model number for a verification pin includes the designation for a verification pin (FTG) and the ForceTec system number or FSN as shown. Verification gages are available for all FSN sizes and oversize, see figure 3-81, detail H.

e. Mandrel. While all ForceTec system components do a critical function, the mandrel is the most critical. It must not only resist breaking but must maintain precise size and form during the installation process. The mandrel, when drawn through the retainer and sleeve, expands and yields both the retainer and the primary material causing residual compressive stresses. FtCx mandrels are threaded to the puller unit and do not have to be repeatedly removed for each installation. The model number for a mandrel includes the designation for a mandrel (FTM), the FSN, and the length designation. Nominal mandrels are used for both nominal and oversize retainers since these both result in a nominal final retainer inside diameter, see figure 3-81, detail J. Even though two mandrel lengths are available for most FSN sizes, only one mandrel length is required for each application. The longer mandrel for each size can be used with any standard length retainer, while the shorter mandrel should be used in restricted backside clearance areas and may not be used with retainers longer than 0.125. In order to select the correct mandrel length, first determine the FSN and available backside clearance. Using this information and table 3-25 determine if the shorter mandrel must be used. The maximum retainer length for each standard mandrel is shown in table 3-29. Longer mandrels are also available on request. For example, see steps listed below:

1. An application requires a 0.120 long, 3/16-inch final inside diameter class III retainer to be installed. There are no obstructions within 2.00 of the backside surface of the structure into which the plate nut is to be installed. The FSN for this size is 3-0-3. Either of the 3-0-3 size mandrels (FTM-3-0-3-2 or FTM-3-0-3-8) may be used for this application.

2. An application requires a 0.110 long, 1/4-inch final inside diameter class II retainer to be installed. It is to be installed into a panel with only 1.25 of backside clearance. The FSN for this size is 4-0-2. The FTM-4-0-2-8 mandrel cannot be used because of the backside clearance restriction. An FTM-4-0-2-2 mandrel must be selected.

Table 3-29. Maximum Retainer Length for Mandrels

FSN Range	Maximum Retainer Length (Inches)	Mandrel Model Number
3-0-*	0.125	FTM-3-0-*-2
	0.500	FTM-3-0-*-8
4-0-*	0.125	FTM-4-0-*-2
	0.500	FTM-4-0-*-8
5-0-*	0.125	FTM-5-0-*-2
	0.500	FTM-5-0-*-8
6-0-*	0.500	FTM-6-0-*-8

* Maximum retainer lengths are independent of class of fit.

f. Mandrel check fixture. See figure 3-81, detail K. The mandrel check fixture verifies that the mandrel major diameter is not worn below its minimum allowable dimension, for acceptable mandrel dimension, see view 1 in detail K. If the mandrel major diameter can slide through the hole in the mandrel check fixture as shown in view 2 in detail K, the mandrel should be disposed of and replaced. The model number for a mandrel check fixture includes the designation for a mandrel check fixture (FTMG) and the ForceTec system number, or FSN as shown in detail L. Mandrel check fixtures are available for each FSN nominal size.

g. Nose Cap Assembly. The ForceTec nose cap, which is threaded on the end of the puller unit, is designed to allow the retainer flange to be pulled flush during installation. The inner jaw prevents the sleeve from being drawn into the nose cap during mandrel retraction. The outer jaw reacts to the pulling force of the mandrel against the workpiece. Jaw sets are designed to last for many installations; however, if they become worn, the sleeve may slip inside the inner jaw during installation. Both jaws should then be replaced. The model number for a nose cap or jaw set includes the designation for a nose cap (FTN) and the ForceTec system number, or FSN as shown. The initials JS are added to this model number for replacement jaw sets. Nose caps and jaw sets are available for all FSN sizes, see figure 3-81, detail M.

h. Trimming tool. When retainers are installed using the FtCx system, they may have to be trimmed flush. Fatigue Technology Inc provides a micro adjustable countersink tool with a modified cutter and pilot. It can be adjusted to shave retainers to any degree of flushness with the workpiece. The radius cutter edges are designed to allow a retainer to be shaved slightly under flush without leaving a sharp corner in the workpiece. The model number for a trimming tool includes the designation for a trimming tool (FTTT) and ForceTec system number or FSN as shown. Trimming tools are available for each FSN nominal size, see figure 3-81, detail N.

i. Retainer holder. The retainer holder is used to hold the retainer during installation. The arms may be squeezed inward until the ears pass through the retainer head slot, under the clip, and are then released. This allows the retainer to be held flush with the workpiece during installation while the operator's fingers remain clear of the mandrel. The arms can also be customized to fit around obstructions in areas of restricted access, see figure 3-81 detail P. Only one size of retainer holder is required. It can be used with any of the FSN sizes. The retainer holder model number is the tool designation code FTRH. Other retainer holder styles are also available. Contact FTI for further information.

3-224. Capital Tooling. Capital tooling includes air activated hydraulic PowerPaks and hydraulic or mechanically activated puller units. These tools can be used with all FTI tooling systems. FTI capital tooling currently available for other cold expansion

systems may be used. Frequent use, however, may cause more tooling to have to be purchased. For full details on the range of specialized tooling, contact FTI or refer to the FTI tooling catalog.

a. PowerPak. The PowerPak supplies up to 10,000 psi of hydraulic pressure to the puller unit during the cold expansion. There are two PowerPaks available, the FT-20, small portable unit, and the FT-200B, fast, high volume unit, see figure 3-82, detail A. Both PowerPaks must be supplied with clean, dry 100-psi air pressure with 50 CFM of flow. The FT-200B and FT-20 are the most commonly used PowerPaks. The FT-200B is recommended for repeated FtCx installations because of its speed and versatility. It is a full size pump designed for frequent shop floor work. The FT-20 can be used if a portable unit is required, (it weighs 18 pounds and the FT-200B weighs 65 pounds), or for a small number of installations, see detail A.

b. Puller unit. The puller unit is a device which pulls the mandrel through the sleeve to install the retainer. The Little Brute puller unit series will be used for nearly all FtCx plate nut installations. This has a maximum pulling capacity of 8,000 pounds using 10,000 psi of hydraulic pressure and weighs just over 11 pounds. It is designed for compatibility with the full range of durable and expendable tooling. The Little Brute and Big Brute puller unit series is available in several lengths to allow different material stack ups. Any of these can be used for any of the standard system retainer lengths. Offset puller or adapters are also available if a frontside access restriction exists. A Medium Brute and Big Brute are also available, see figure 3-82, detail B.

3-225. Tooling Selection. Selecting the correct FtCx tooling for any application involves the steps listed below:

- a. Use the FSN determined in paragraph 3-222, step a., to select a tooling table.
- b. Select the applicable retainer for the application as described in paragraph 3-222, step b.1.
- c. Select applicable mandrel length from the tooling table, as described in paragraph 3-223, step e.

d. Select the applicable sleeve from the tooling table, as described in paragraph 3-222, step b.3.

e. FtCx tooling tables. The tables noted below, 3-30, 3-31, 3-32, and 3-33, list all the FtCx

tooling available. These include two mandrel lengths for each FSN. Select the tooling from the applicable table for the FSN determined in paragraph 3-222, step a.

Table 3-30. FSN-3 FtCx Tooling

	Class I	Class II	Class III
Starting Drill (Oversize)	FTSD-3-0-1(-C)	FTSD-3-0-2(-C)	FTSD-3-0-3(-C)
	FTSD-3-1-1(-C)	FTSD-3-1-2(-C)	FTSD-3-1-3(-C)
Starting Reamer (Oversize)	FTSR-3-0-1(-C)	FTSR-3-0-2(-C)	FTSR-3-0-3(-C)
	FTSR-3-1-1(-C)	FTSR-3-1-2(-C)	FTSR-3-1-3(-C)
Verification Pin (Oversize)	FTG-3-0-1	FTG-3-0-2	FTG-3-0-3
	FTG-3-1-1	FTG-3-1-2	FTG-3-1-3
Mandrel	FTM-3-0-1-2 FTM-3-0-1-8	FTM-3-0-2-2 FTM-3-0-2-8	FTM-3-0-3-2 FTM-3-0-3-8
Mandrel Check Fixture	FTMG-3-0-1	FTMG-3-0-2	FTMG-3-0-3
Split Sleeve	FTS-3-0-1-2 FTS-3-0-1-8	FTS-3-0-2-2 FTS-3-0-2-8	FTS-3-0-3-2 FTS-3-0-3-8
Nose Cap (Oversize)	FTN-3-0-1	FTN-3-0-2	FTN-3-0-3
	FTN-3-1-1	FTN-3-1-2	FTN-3-1-3
Trimming Tool	FTTT-3-0-1	FTTT-3-0-2	FTTT-3-0-3
Finish Reamer	FTFR-3-0-1-C	N/A	N/A
Retainer Holder	FTRH		

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Table 3-31. FSN-4 FtCx Tooling

	Class I	Class II	Class III
Starting Drill (Oversize)	FTSD-4-0-1(-C)	FTSD-4-0-2(-C)	FTSD-4-0-3(-C)
	FTSD-4-1-1(-C)	FTSD-4-1-2(-C)	FTSD-4-1-3(-C)
Starting Reamer (Oversize)	FTSR-4-0-1(-C)	FTSR-4-0-2(-C)	FTSR-4-0-3(-C)
	FTSR-4-1-1(-C)	FTSR-4-1-2(-C)	FTSR-4-1-3(-C)
Verification Pin (Oversize)	FTG-4-0-1	FTG-4-0-2	FTG-4-0-3
	FTG-4-1-1	FTG-4-1-2	FTG-4-1-3
Mandrel	FTM-4-0-1-2 FTM-4-0-1-8	FTM-4-0-2-2 FTM-4-0-2-8	FTM-4-0-3-2 FTM-4-0-3-8
Mandrel Check Fixture	FTMG-4-0-1	FTMG-4-0-2	FTMG-4-0-3
Split Sleeve	FTS-4-0-1-2 FTS-4-0-1-8	FTS-4-0-2-2 FTS-4-0-2-8	FTS-4-0-3-2 FTS-4-0-3-8
Nose Cap (Oversize)	FTN-4-0-1	FTN-4-0-2	FTN-4-0-3
	FTN-4-1-1	FTN-4-1-2	FTN-4-1-3
Trimming Tool (Oversize)	FTTT-4-0-1	FTTT-4-0-2	FTTT-4-0-3
	FTTT-4-1-1	FTTT-4-1-2	FTTT-4-1-3
Finish Reamer	FTFR-4-0-1-C	N/A	N/A
Retainer Holder	FTRH		

Table 3-32. FSN-5 FtCx Tooling

	Class I	Class II	Class III
Starting Drill (Oversize)	FTSD-5-0-1(-C)	FTSD-5-0-2(-C)	FTSD-5-0-3(-C)
	FTSD-5-1-1(-C)	FTSD-5-1-2(-C)	FTSD-5-1-3(-C)
Starting Reamer (Oversize)	FTSR-5-0-1(-C)	FTSR-5-0-2(-C)	FTSR-5-0-3(-C)
	FTSR-5-1-1(-C)	FTSR-5-1-2(-C)	FTSR-5-1-3(-C)
Verification Pin (Oversize)	FTG-5-0-1	FTG-5-0-2	FTG-5-0-3
	FTG-5-1-1	FTG-5-1-2	FTG-5-1-3

Table 3-32. FSN-5 FtCx Tooling (CONT)

	Class I	Class II	Class III
Mandrel	FTM-5-0-1-2 FTM-5-0-1-8	FTM-5-0-2-2 FTM-5-0-2-8	FTM-5-0-3-2 FTM-5-0-3-8
Mandrel Check Fixture	FTMG-5-0-1	FTMG-5-0-2	FTMG-5-0-3
Split Sleeve	FTS-5-0-1-2 FTS-5-0-1-8	FTS-5-0-2-2 FTS-5-0-2-8	FTS-5-0-3-2 FTS-5-0-3-8
Nose Cap (Oversize)	FTN-5-0-1	FTN-5-0-2	FTN-5-0-3
	FTN-5-1-1	FTN-5-1-2	FTN-5-1-3
Trimming Tool (Oversize)	FTTT-5-0-1	FTTT-5-0-2	FTTT-5-0-3
	FTTT-5-1-1	FTTT-5-1-2	FTTT-5-1-3
Finish Reamer	FTFR-5-0-1-C	N/A	N/A
Retainer Holder	FTRH		

Table 3-33. FSN-6 FtCx Tooling

	Class I	Class II	Class III
Starting Drill (Oversize)	FTSD-6-0-1(-C)	FTSD-6-0-2(-C)	FTSD-6-0-3(-C)
	FTSD-6-1-1(-C)	FTSD-6-1-2(-C)	FTSD-6-1-3(-C)
Starting Reamer (Oversize)	FTSR-6-0-1(-C)	FTSR-6-0-2(-C)	FTSR-6-0-3(-C)
	FTSR-6-1-1(-C)	FTSR-6-1-2(-C)	FTSR-6-1-3(-C)
Verification Pin (Oversize)	FTG-6-0-1	FTG-6-0-2	FTG-6-0-3
	FTG-6-1-1	FTG-6-1-2	FTG-6-1-3
Mandrel	FTM-6-0-1-8	FTM-6-0-2-8	FTM-6-0-3-8
Mandrel Check Fixture	FTMG-6-0-1	FTMG-6-0-2	FTMG-6-0-3
Split Sleeve	FTS-6-0-1-8	FTS-6-0-2-8	FTS-6-0-3-8
Nose Cap (Oversize)	FTN-6-0-1	FTN-6-0-2	FTN-6-0-3
	FTN-6-1-1	FTN-6-1-2	FTN-6-1-3

Table 3-33. FSN-6 FtCx Tooling (CONT)

	Class I	Class II	Class III
Trimming Tool (Oversize)	FTTT-6-0-1	FTTT-6-0-2	FTTT-6-0-3
	FTTT-6-1-1	FTTT-6-1-2	FTTT-6-1-3
Finish Reamer	FTFR-6-0-1-C	N/A	N/A
Retainer Holder	FTRH		

f. Tooling selection examples. The examples noted below describe the steps listed in paragraph 3-225 for selecting the correct FtCx tooling for specific application.

1. Example 1: A series of 5/16-inch class II stainless plate nuts are to be installed into aluminum material which is 0.250 thick in an area with unlimited access during installation.

(a) Table 3-27 specifies that a 5/16-inch class II plate nut should be installed using FSN-5-0-2 tooling listed in table 3-32.

(b) The 0.250 long stainless steel retainers, FTR-5-0-2-.250-S, are selected which match this thickness.

(c) Since there are no access restrictions and the material into which the plate nuts are to be installed is greater than 0.125 thick, the longer mandrel, FTM-5-0-2-8, is selected.

(d) An FTS-5-0-2-8 sleeve is selected for this mandrel as described in paragraph 3-222, step b.3.

NOTE

These individual model numbers are arranged to make table 3-34.

Table 3-34. Example 1: FtCx Tooling Set

Component	Model Number
Starting Drill	FTSD-5-0-2
Starting Reamer	FTSR-5-0-2
Verification Pin	FTG-5-0-2

Table 3-34. Example 1: FtCx Tooling Set (CONT)

Component	Model Number
Mandrel	FTM-5-0-2-8
Mandrel Check Fixture	FTMG-5-0-2
Split Sleeve	FTS-5-0-2-8
Retainer	FTR-5-0-2-.250-S
Nose Cap	FTN-5-0-2
Retainer Holder	FTRH

2. Example 2: A large amount of 3/16-inch class I titanium plate nuts are to be installed into 0.120 thick titanium primary material with 1.25 of backside access, see table 3-35.

(a) Table 3-27 specifies that a 3/16-inch class I plate nut should be installed using FSN-3-0-1 tooling listed in table 3-30.

(b) Titanium retainers are selected which are 0.120 long, FTR-3-0-1.120-T. Because of the large quantities, a small percentage of oversize retainers should be selected, FTR-3-1-1.120-T.

(c) The backside access will not allow the longer mandrel to be used so the shorter mandrel should be selected, FTM-3-0-1-2.

(d) An FTS-3-0-1-2 sleeve is required for this mandrel as described in paragraph 3-222, step b.3.

Table 3-35. Example 2: FtCx Tooling Set

Component	Model Number
Starting Drill (Oversize)	FTSD-3-0-1-C
	FTSD-3-1-1-C
Starting Reamer (Oversize)	FTSR-3-0-1-C
	FTSR-3-1-1-C
Verification Pin	FTG-3-0-1
Mandrel	FTM-3-0-1-2
Mandrel Check Fixture	FTMG-3-0-1
Split Sleeve	FTS-3-0-1-2
Retainer (Oversize)	FTR-3-0-1-.120-T
	FTR-3-1-1-.120-T
Nose Cap (Oversize)	FTN-3-0-1
	FTN-3-1-1
Finish Reamer	FTFR-3-0-1-C
Retainer Holder	FTRH

3. Example 3: A series of 1/4-inch class II coated stainless plate nuts are to be installed in an aluminum structure with a thickness that tapers from 0.240 to 0.200.

(a) Table 3-27 specifies that a 1/4-inch class II plate nut should be installed using FSN-4-0-2 tooling listed in table 3-31.

(b) Coated stainless steel retainers with a length of 0.240 are selected, FTR-4-0-2-.240-SA. These will protrude from the primary material surface after installation and should be trimmed flush with the trimming tool.

(c) Since the material thickness is greater than that allowed for the shorter mandrel and the material into which the plate nuts are to be installed is less than 1/2-inch thick, the longer mandrel, FTM-4-0-2-8, is selected.

(d) An FTS-4-0-2-8 sleeve is required for this mandrel as described in paragraph 3-222, step b.3.

NOTE

The individual model number are arranged to make table 3-36.

Table 3-36. Example 3: FtCx Tooling Set

Component	Model Number
Starting Drill	FTSD-4-0-2
Starting Reamer	FTSR-4-0-2
Verification Pin	FTG-4-0-2
Mandrel	FTM-4-0-2-8
Mandrel Check Fixture	FTMG-4-0-2
Split Sleeve	FTS-4-0-2-8
Retainer	FTR-4-0-2-.240-SA
Nose Cap	FTN-4-0-2
Trimming Tool	FTTT-4-0-2
Retainer Holder	FTRH

3-226. **Process Procedure.** Satisfactory application of the FtCx system is straightforward, but depends on selection of the correct tooling and correct use of the verification pins and mandrel check fixtures. Operators should be trained and certified, before being allowed to install FtCx plate nuts. FTI provides a certified training service in Seattle or on site at customer locations.

a. Installation procedure. Installation of a FtCx plate nut is similar to the use of FTI Split Sleeve Cold Expansion system for fatigue enhancement of holes, or BushLoc system for bushing installations. In general, the steps listed below must be used to install FtCx plate nuts. These steps may also be used as a template to instruct operators on the use of FtCx tooling, see figure 3-82, details C, D, E, and F.

1. Select the applicable installation tools and inspect their model numbers to be sure that they are compatible with the application in paragraph 3-222.
2. Be sure correct operation of the puller unit and PowerPak by connecting the air and hydraulic lines per the instruction manual and cycling the unit.

NOTE

General safety precautions associated with the use of compressed air or hydraulic power systems should be observed when using this equipment.

3. Inspect the mandrel for wear using the mandrel check fixture, see figure 3-82, detail H. If the major diameter of the mandrel passes through the hole in the mandrel check fixture, as shown in detail C, dispose of and replace mandrel.
4. Thread the mandrel and then the nose cap assembly into the puller unit. Activate the puller unit to make sure the mandrel retracts fully into the nose cap.
5. Machine the starting hole using the starting drill and starting reamer.
6. Inspect the starting hole dimensions using the starting hole diameter verification pin. If the small step of the gage fits into the hole and the large step does not, as shown in detail D, then the hole is within tolerance. Repeat this operation twice rotating the gage 45 degrees each time to inspect for out of round. If the hole is not in tolerance, as shown, do not continue. Contact AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH, and refer to step b. for oversize procedures. Verify that the correct starting hole diameter verification pin is being used.
7. If required, class I installations only, ream the retainer diameter to the finished size, see detail E.



-1 nut elements should not be used with ForceTec retainers if possible. If required, -1 nut elements may be used but must be carefully aligned with the retainer during fastener installation.

8. Install the nut into the retainer without removing the clip, see detail F.
- b. Oversize procedure. Oversize tooling and procedures allow for repair of either oversize starting holes or damaged retainers. Oversize installations result in retainers with the same final inside diameter as nominal installations and requires nominal fasteners.
 1. Discrepant starting hole. Discrepant starting holes are those that are outside the limits of the diameter tolerance, have a bad surface finish, above Ra 125, are out of round, or have other anomalies which can be fixed by going to an oversize. Do steps listed below for discrepant starting holes:
 - (a) Measure holes to determine if oversize retainers can be used. Contact FTI if the holes are too large for this tooling.
 - (b) Select oversize tooling from paragraph 3-222.
 - (c) Do the same procedure described in paragraph 3-226, using the applicable oversize tooling.
 2. Damage retainer. Do the steps noted below for replacement of damaged or improperly seated retainer installations:
 - (a) Remove the retainer assembly from the structure.
 - (b) If the starting hole is of acceptable quality and within the required starting hole tolerance, use the nominal installation procedure, as described in paragraph 3-226, to install a new nominal retainer assembly.

- (c) If the starting hole is not of acceptable quality or not within the required nominal starting hole tolerance, use the oversize installation procedure as described in paragraph 3-226, step b.1.
- c. Troubleshooting. The ForceTec system has been designed to provide for quick and failure free retainer installations. However, this section specifies situations that may occur during retainer installations and their applicable corrective actions. It is important that these actions be followed to make sure of retainer performance.
 1. Retainer that will not fit in starting hole. Check the starting hole diameter for size and out of round, refer to paragraph 3-219, step b. Verify the correct size and class of retainer has been selected, refer to paragraph 3-222, step b.1. Make sure the hole is properly deburred and there are no burrs on the retainer, refer to paragraph 3-219, step c.
 2. Retainer that will not fit on mandrel and/or sleeve. Verify the correct size and class of mandrel, refer to paragraph 3-223, step e., sleeve, refer to paragraph 3-222, step b.3., and retainer, refer to paragraph 3-222, step b.1., have been selected. Make sure only a single sleeve has been located on the mandrel. Inspect for burrs on the inside diameter of the retainer.
 3. Retainer installed over flush or under flush. Verify the retainer length and primary material thickness are correct, refer to paragraph 3-222, step b.1. Inspect the hole for burrs, refer to paragraph 3-218, step c.

NOTE

A retainer which is over flush may be shaved. Retainers which fill less than 80 percent of the depth of the hole must be removed and replaced with the correct length retainer, refer to paragraph 3-220, step e.

4. Retainer head not seated properly. Inspect the hole for burrs, refer to paragraph 3-219, step c. Inspect the primary material for contaminates or fillets under the retainer

head. Make sure that over flush retainers protrude into the outer jaw of the nose cap before installation.

NOTE

A retainer head which is not correctly seated, within 0.005 per paragraph 3-222 step b.1., should be shimmed and/or sealed. Pulling an improperly seated retainer flush may reduce its resistance to torque and removal.

5. Partly expanded retainer. Verify the sleeve is the correct length for the retainer used, refer to paragraph 3-222, step b.1. Inspect the inner jaw for excessive wear, refer to paragraph 3-223, step g.

NOTE

If the retainer has been installed flush and seated properly, a second expansion can be done with a new sleeve without damaging the retainer, if not, this retainer must be removed and replaced, refer to paragraph 3-220, step e.

6. Missing clip. Clips should not be removed from retainers during installation or normal use; however, if they become lost or damaged, they may be replaced without removing the retainer. Replacement clips can be ordered separately, refer to paragraph 3-222, step b.2.
7. Stuck mandrel. To remove a stuck mandrel unthread it from the puller unit. However, precaution listed in this paragraph should be taken to be sure the mandrel will not get stuck. Verify the correct mandrel has been used, refer to paragraph 3-223. Be sure the puller unit has enough stroke by holding the trigger until the mandrel retracts fully into the nose cap. Inspect the pressure control valve on the PowerPak to make sure that is has been set to full pressure.
8. Fastener that will not fit in retainer. Verify the correct fastener has been selected and, for class I installations, that the retainer has been reamed. Inspect the retainer for a sleeve ridge to make sure that the retainer has been expanded. For all classes and sizes, if a sleeve ridge is visible and the

verification pin does not fit, use the mandrel check fixture to inspect the mandrel, refer to paragraph 3-223, step f. If the mandrel is worn, replace it and expand the retainer again with a new sleeve. If class I retainer has been installed and the verification pin can be inserted, final ream the retainer.

3-227. Assurance of Correct Applied Expansion.

Correct applied expansion is critical to the total performance of a plate nut installed using FtCx. The key dimensions which determine applied expansion are starting hole diameter, retainer outside diameter, retainer inside diameter, mandrel major diameter, and sleeve thickness. The specified expansion is assured by selection of the correct tooling from paragraph 3-222 and by verification of the these key dimensions.

a. Starting hole diameter. The starting hole must be verified using the stepped verification pin as shown in figure 3-82, detail G, to make sure that hole is not out of round and is within the dimensional requirements established in paragraph 3-218, step b. In deep holes and multiple material stack ups, caution must be taken to verify the whole length of the hole is within the specified hole diameter tolerance.

b. Retainer outside diameter. The retainer outside diameter is source inspected by FTI. There is no requirement to measure retainer outside diameter.

c. Retainer inside diameter. The retainer inside diameter is source inspected by FTI. There is no requirement to measure retainer inside diameter.

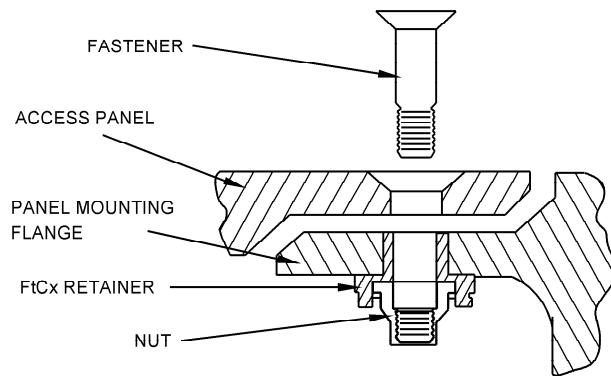
d. Mandrel major diameter. The mandrel major diameter should be frequently inspected using a mandrel check fixture, see figure 3-82, detail H and described in paragraph 3-222, step b.1. The mandrel major diameter is allowed to wear below the nominal diameter before replacement. However, if the mandrel check fixture passes over the mandrel major diameter, the mandrel is worn below its allowable limit.

e. Sleeve thickness. The specified sleeve thickness is source inspected and certified by FTI. There is no requirement to measure sleeve thickness.

3-228. Verification of FtCx Processing. When the retainer has been installed, it may be inspected in the same way as other plate nut installations.

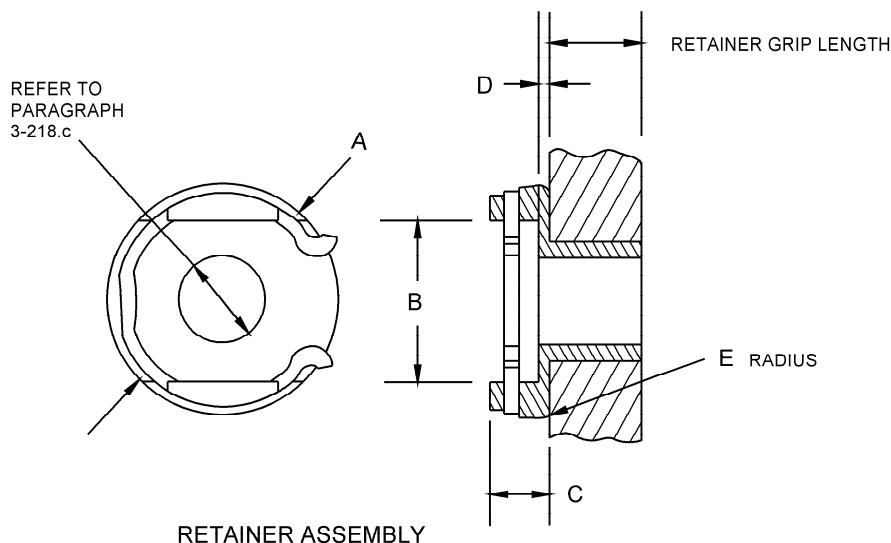
However, there are more inspection steps which may be required. These include inspection for sleeve ridge and faying surface contact, see figure 3-82, details J and K. Verify each plate nut has been installed using the FtCx process by locating the sleeve ridge on the inside wall of the retainer. The sleeve ridge is a shear discontinuity in the material, made during expansion of the retainer inside the hole. It does not adversely affect fatigue life or plate nut retention.

a. For faying surface contact applications in which a single retainer is installed into a stack up of materials, verify that faying surfaces are in contact per paragraph 3-219, step e. Inspect for faying surface contact using a 0.002 feeler gage, see detail K.



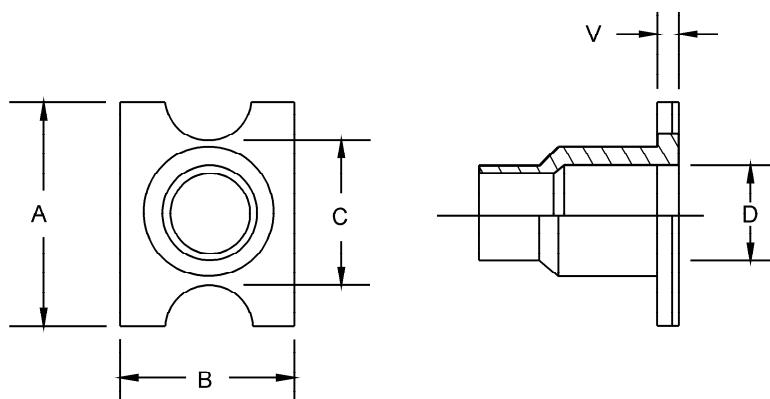
TYPICAL FORCETEC NUT PLATE INSTALLATION

DETAIL A



RETAINER ASSEMBLY

DETAIL B

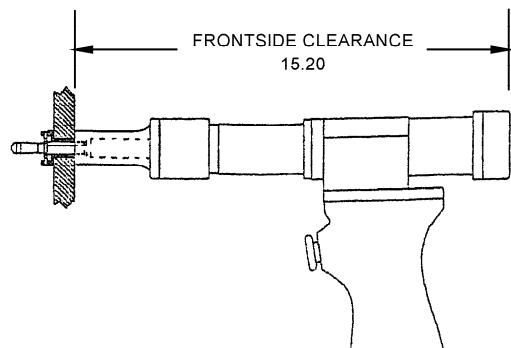


NUT BASE DIMENSIONS

DETAIL C

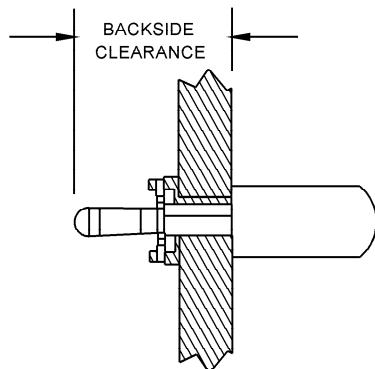
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Figure 3-79. ForceTec Plate Nut Installation



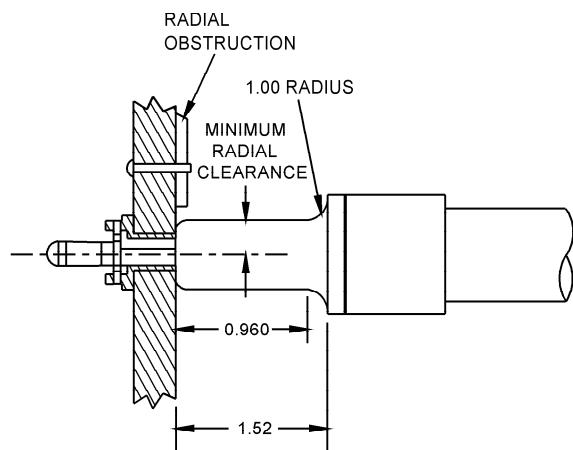
FRONTSIDE CLEARANCE

DETAIL A



BACKSIDE CLEARANCE

DETAIL B

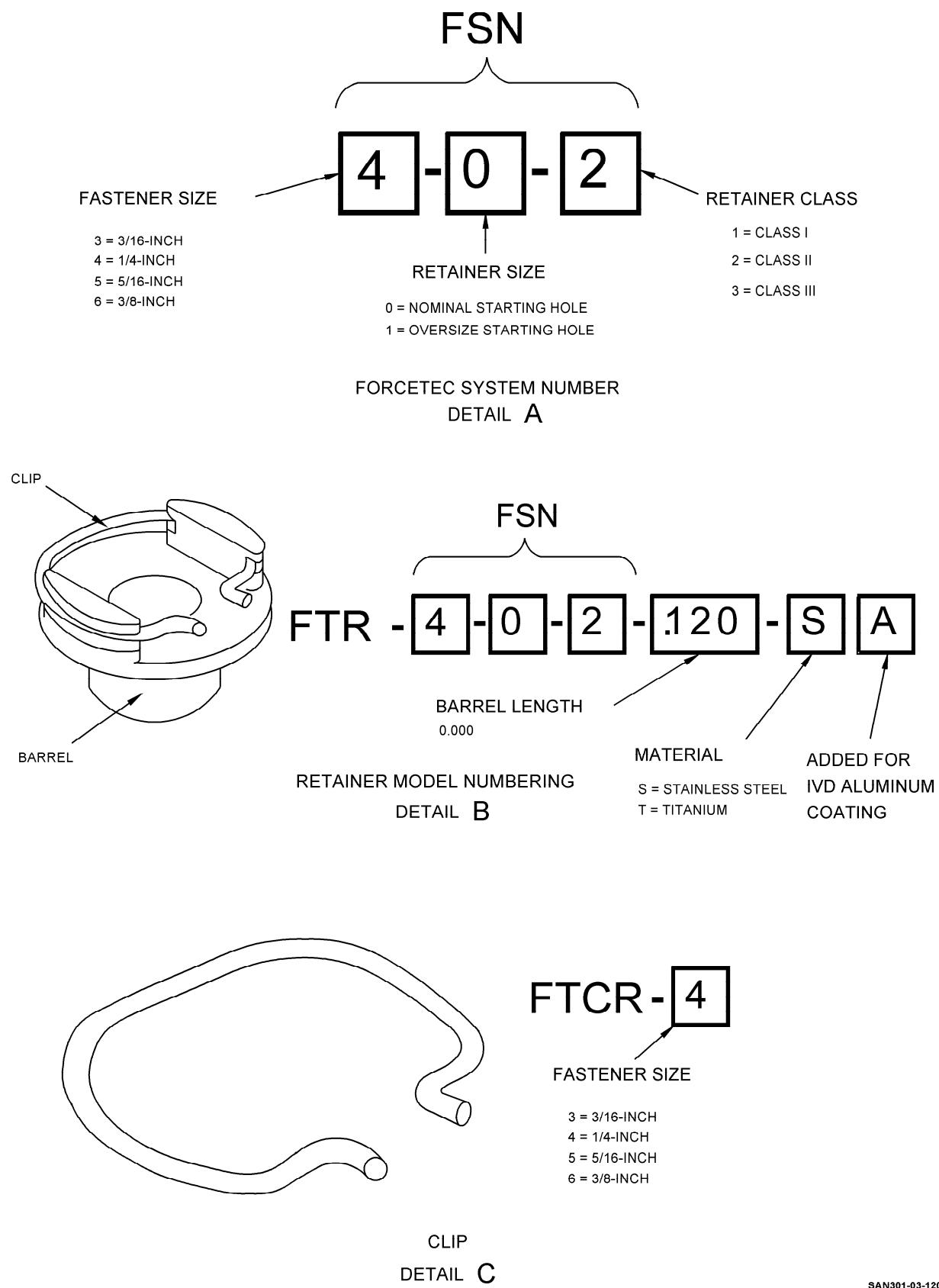


MINIMUM RADIAL CLEARANCE

DETAIL C

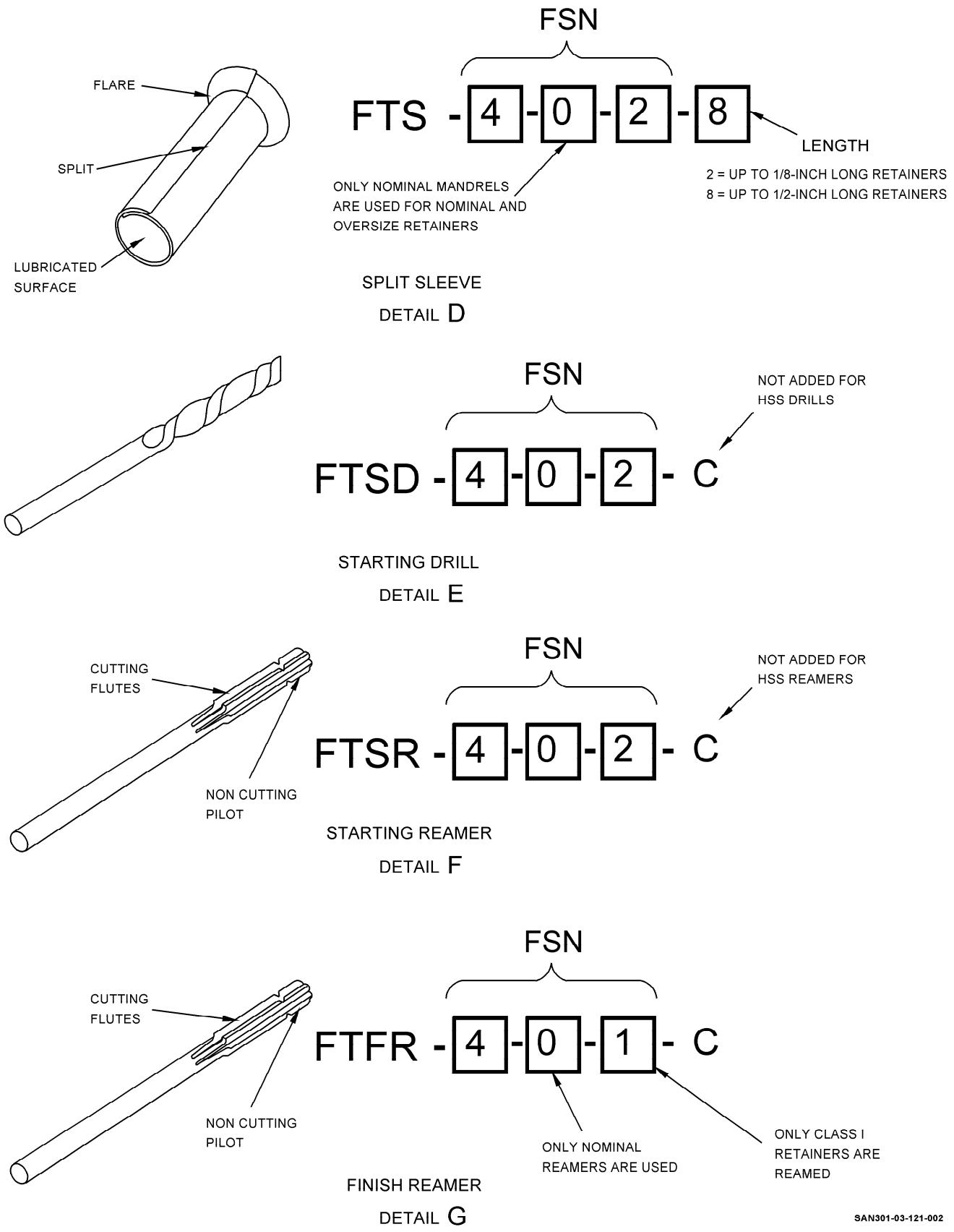
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Figure 3-80. Access Restriction for ForceTec Tooling



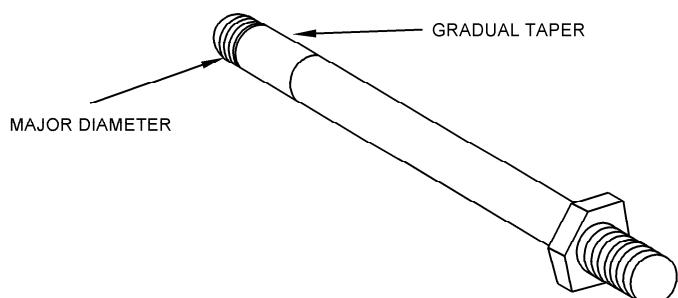
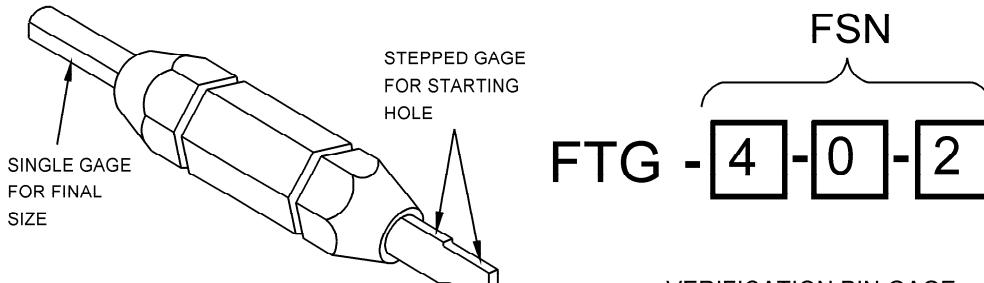
**Figure 3-81. Tooling Number System for ForceTec Tooling Plate Nut Installation
(Sheet 1 of 4)**

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**Figure 3-81. Tooling Number System for ForceTec Tooling Plate Nut Installation
(Sheet 2)**



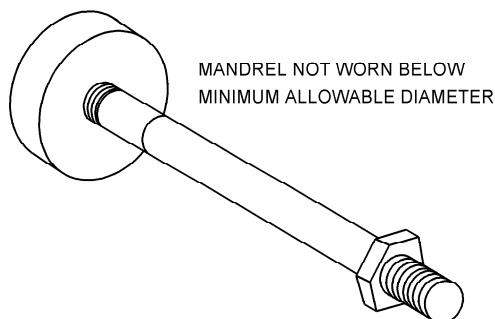
FSN

FTM - [4]-[0]-[2]-[8]

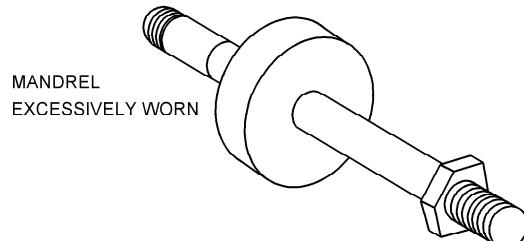
ONLY NOMINAL MANDRELS
ARE USED FOR NOMINAL AND
OVERSIZE RETAINERS

LENGTH
2 = UP TO 1/8-INCH LONG RETAINERS
8 = UP TO 1/2-INCH LONG RETAINERS

MANDREL
DETAIL J



VIEW 1
ACCEPTABLE

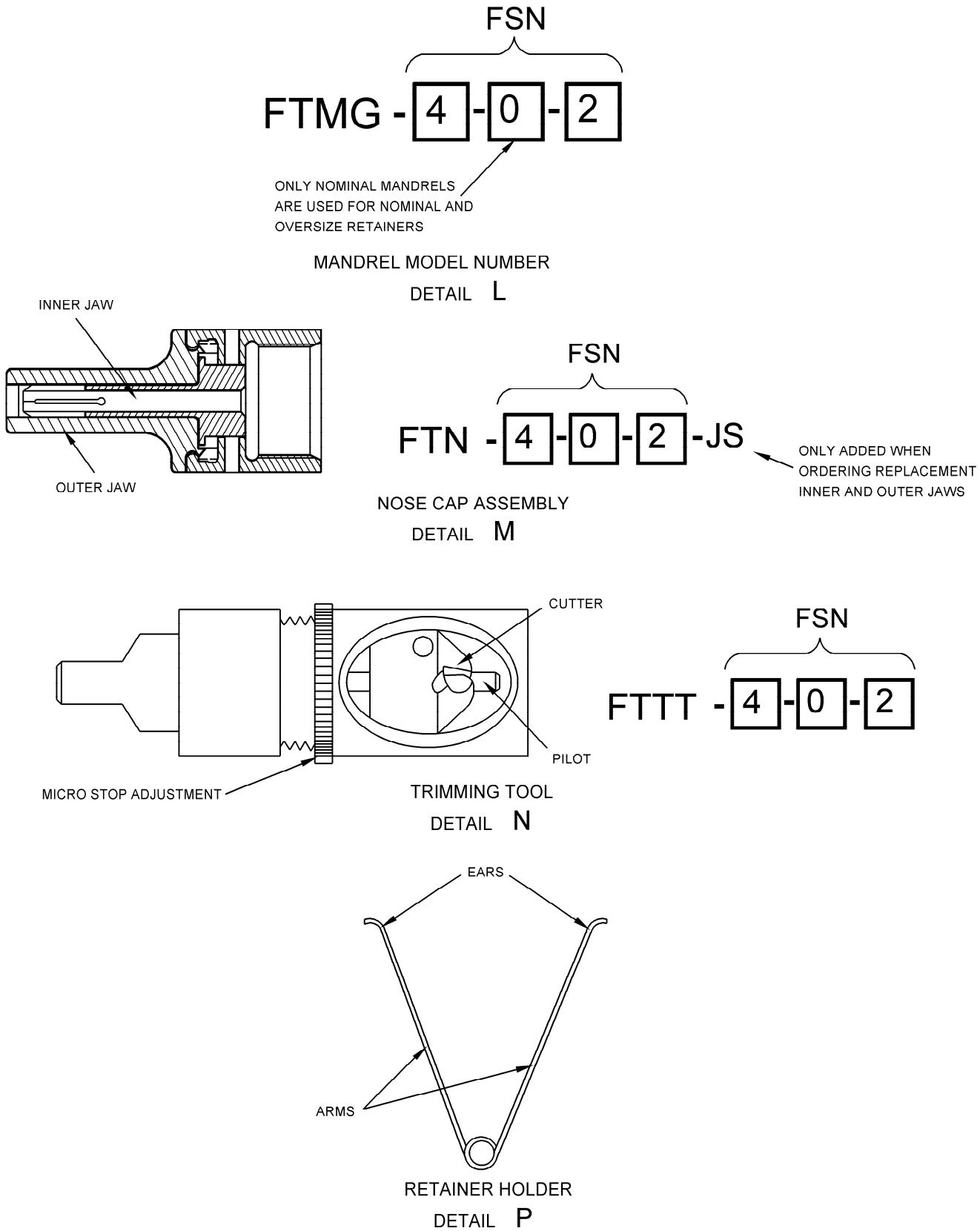


VIEW 2
NOT ACCEPTABLE

MANDREL CHECK FIXTURE
DETAIL K

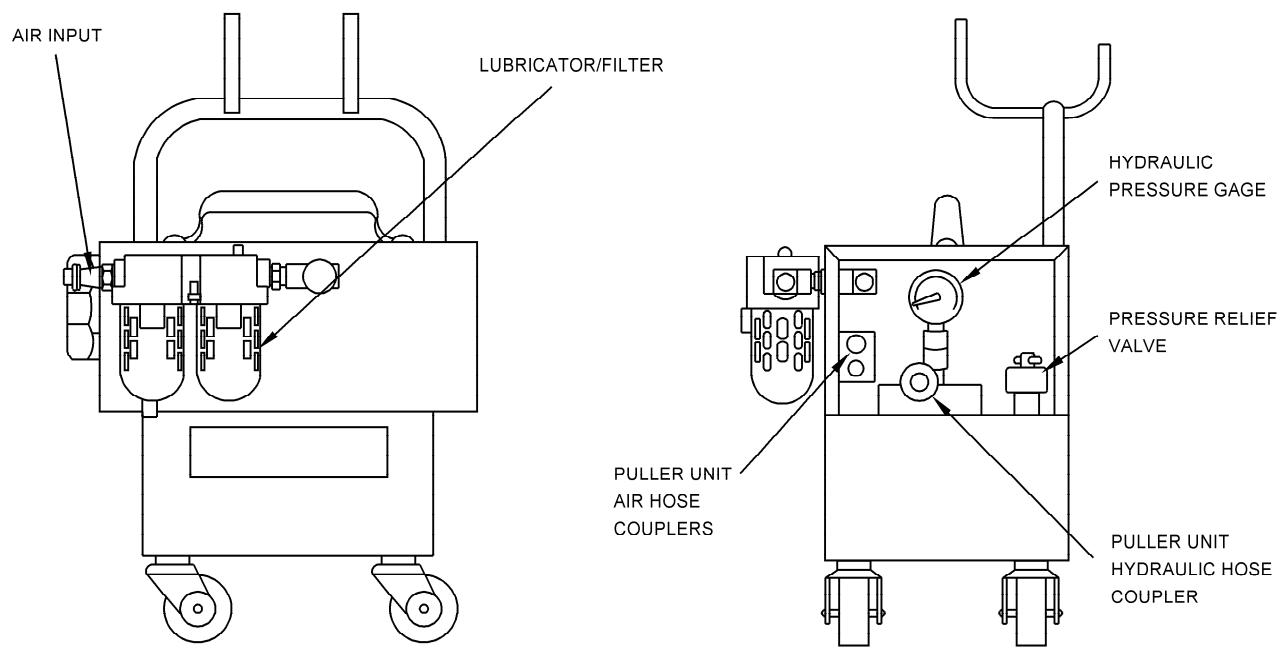
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**Figure 3-81. Tooling Number System for ForceTec Tooling Plate Nut Installation
(Sheet 3)**



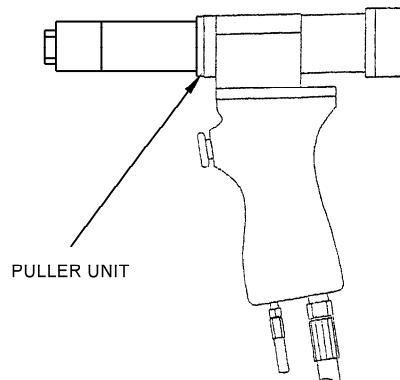
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**Figure 3-81. Tooling Number System for ForceTec Tooling Plate Nut Installation
(Sheet 4)**



POWER PAK

DETAIL A

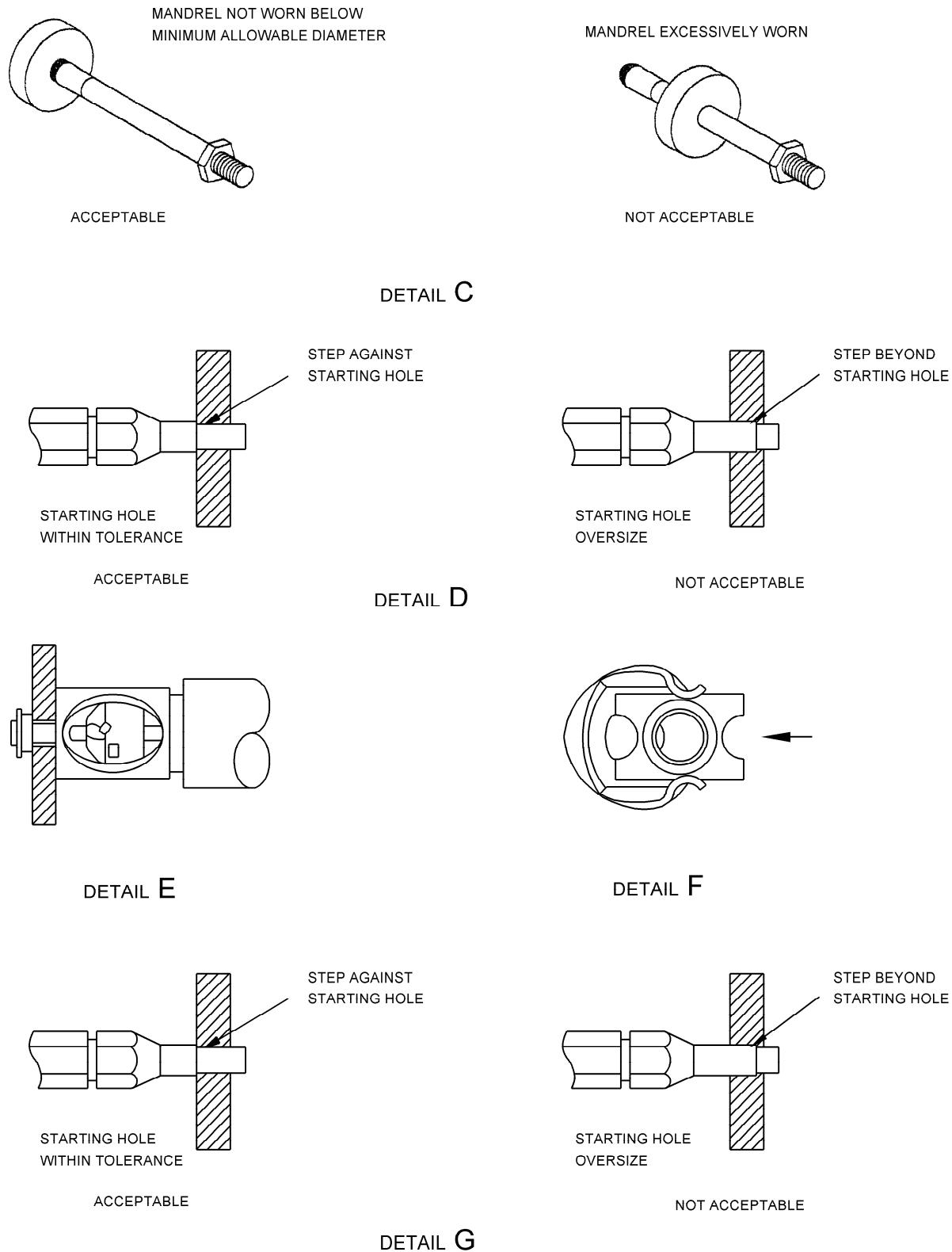


DETAIL B

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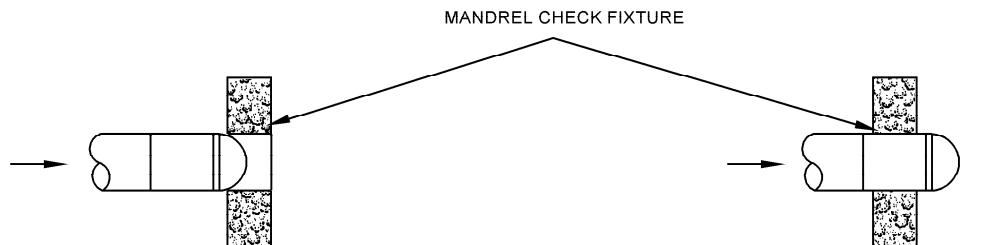
Figure 3-82. Tooling ForceTec Plate Nut Installation (Sheet 1 of 3)

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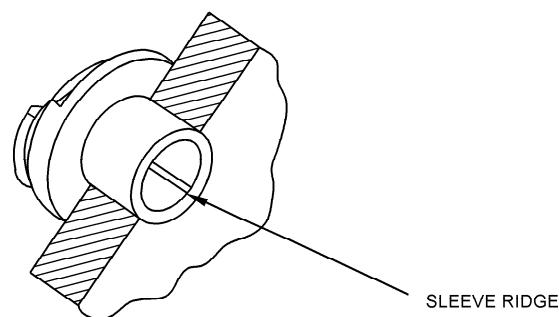


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Figure 3-82. Tooling ForceTec Plate Nut Installation (Sheet 2)

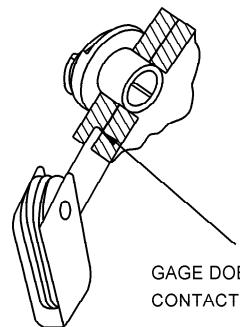


MANDREL CHECK FIXTURE
ACCEPT
DETAIL H
REJECT AND
DISCARD MANDREL



SLEEVE RIDGE

DETAIL J



FAYING SURFACE CONTACT

ACCEPTABLE

GAGES

FAYING SURFACE CONTACT

NOT ACCEPTABLE

DETAIL K

SAN301-03-126-001

Figure 3-82. Tooling ForceTec Plate Nut Installation (Sheet 3)

SECTION IV

SUPPORT OF STRUCTURE

4-1. DESCRIPTION.

4-2. Support of structure is essential during major repair to damaged components. Support of structure is used to maintain the initial alignment of the part. Unless the repair is of a minor type the structure must be adequately supported during repair. The removal of damaged parts from an unsupported component or assembly could lead to distortion with the result that the misalignment is built in during the reassembly of new parts. Tables and diagrams of jig points can be used to fabricate

supporting members such as contour boards, jigs, supports, and in the manufacturing of shipping containers. Jig points shall be used when aligning replacement components to the aircraft. After each major repair, alignment of structure shall be checked. For jig points of removable components refer to CSTO SR1F-15SA-3-4, jig points. Various external doors are an integral part of the structural make up of the aircraft. Any time the aircraft is subjected to stress, there is a requirement for some doors to be installed (07-00-01).

SECTION V

CRASH HANDLING AND SHIPPING

5-1. DESCRIPTION.

5-2. The information below applies to crash damaged aircraft. Aircraft that cannot be repaired and flown back to a repair facility will have to be dismantled and shipped. Dismantling of aircraft depends on the shipping facilities that are available. Shipping by truck allows less dismantling than by rail or air. In some cases, whole aircraft can be hoisted on a truck, blocked, and secured.



When handling damaged aircraft, all precautions shall be taken to prevent more damage.

Items suggested for handling damaged aircraft may be acquired through regular procurement source. Shipping containers can be fabricated locally.

5-3. CRASH HANDLING.

5-4. The aircraft can be disassembled into four major sections; forward fuselage, center fuselage, aft fuselage, and wing. For disassembling of the aircraft, refer to CSTO SR1F-15SA-3-6. Additional removal of components may be required for shipping as listed below:

- a. Canopy (95-21-20).
- b. Flight controls.
 - 1. Aileron (27-11-12).
 - 2. Flap (27-50-11).
 - 3. Horizontal stabilator (27-41-12).
 - 4. Rudder (27-21-11).
 - 5. Speed brake (27-60-14).
- c. Arresting hook shank (32-90-22).

d. Engines (71-03-10).

e. Main landing gear strut and doors (32-10-10, 32-10-11, 32-10-12, and 32-10-16).

f. Nose landing gear strut and doors (32-20-10, 32-20-11, and 32-20-14).

g. Radome (05-00-11).

5-5. **SAFETY PRECAUTIONS.** The safety precautions and procedures listed below should be followed before any attempt is made to work on crash damaged aircraft:



Directives that apply to personnel and aircraft safety must be followed while doing procedure to prevent injury to personnel.

a. Clean up and dispose of fibrous graphite and graphite/epoxy scrap. Fibrous graphite and graphite/epoxy scrap is divided into three classifications; each classification has its own clean up and disposal procedure.

1. Classification of scrap:

(a) Class I is prepreg material and pieces of noncharred laminate composite.

(b) Class II is graphite/epoxy material as prepreg material or pieces of laminate composite, which were burned in a fire or in which excessive heat has degraded the ability of the resin to hold the fibers in place.

(c) Class III is non-fibrous dust (particle length 0.025 or less) such as that resulting from drilling, sanding, routing, or cutting operations.

2. Cleanup and disposal:



Under no circumstance, shall any class I or II material be incinerated or placed in a waste container scheduled for incineration. Use caution in the disposal of carbon epoxy scrap. Do not incinerate and follow local environment procedures for disposal. Carbon dust is conductive and may cause malfunction of electrical and electronic devices, and may cause corrosion if allowed to settle on metallic components. Contain and extract dust away from aircraft and electrical equipment.

- (a) Class I material shall be placed in a waste container scheduled for dumping in a land fill.
 - (b) Class II material shall be placed in a polyethylene bag or, if too large for a bag, wrapped in polyethylene film and sealed. The material shall then be placed in a waste container scheduled for dumping in a land fill.
 - (c) Class III material may be cleaned up and disposed of in the same way as any general waste material.
- b. Defuel fuel system (12-10-30) and purge per TO 1-1-3.
- 1. Wing integral fuel tanks.
 - 2. Fuselage fuel cells.
 - 3. Drain and remove external fuel tanks.

NOTE

All fuel cells and tanks to be nitrogen purged.

- c. Remove the following explosive devices:
 - 1. Rocket catapult (95-11-28 and 95-11-29).
 - 2. Canopy lanyard assembly (95-21-51).
 - 3. Canopy external jettison thermal battery (95-21-56).

- d. Remove ordnance and gun from aircraft (94-50-10).
- e. If a fire extinguishing agent has been used on aircraft, fire extinguishing agent should be removed and aircraft cleaned per TO 1-1-691 to prevent further corrosion.
- f. Remove the following confidential equipment:
 1. Frequency Converter Unit (LRU-2) (99-17-12).
 2. EW Control Panel (99-17-14).
 3. Digital Processor Unit (LRU-1) (99-17-15).
 4. Electronic Control Unit (99-16-11).
- g. Remove the following radar set equipment:
 1. Receiver/Exciter, 325 (94-78-22).
 2. Power Supply, 310 (94-78-23).
 3. Analog Signal Converter, 338 (94-78-25).
 4. Radar Data Processor, 385 (94-78-27).
 5. Antenna (94-78-70).
 6. Array Power Supply (94-78-71).

5-6. MOORING AIRCRAFT. The aircraft should be securely moored as soon as practical. If aircraft crash landed wheels up, it may be moored using the forward and aft mooring lines described and shown in figure 5-1. Block and tackle should be used on all lines. This permits letting out lines while the aircraft is being lifted.

5-7. REMOVAL OF AIRCRAFT FROM CRASH SITE. The procedure for removal of aircraft from site depends on location of site in regard to convenience of normal passage routes and type of terrain. When crash site is in rough or swampy areas, aircraft must be moved to firm and level site for initial disassembly and transportation. Preliminary removal may be done by raising aircraft with pneumatic bags per paragraph 5-8 and lowering on a sled. See figure 5-3 for construction and use of sled. The aircraft should be secured to the sled with tie down strap shown in figure 5-3. When on firm ground, pneumatic bags or a crane should be used to raise aircraft enough to jack aircraft (07-00-01) or

lower aircraft landing gear (32-00-04), if gear and structure has not been badly damaged. Refer to paragraph 5-9 for lifting aircraft with crane. With aircraft supported by landing gear or jacks, defueling and disassembly operations may start. After disassembling aircraft as far as practical, aircraft may be towed on landing gear or loaded on a large flat bed truck, along with assemblies previously removed. The portions of aircraft moved by truck should be cradled in sandbags or heavy padding while in transit.

5-8. Lifting Aircraft With Pneumatic Bags. See figure 5-2. Clear area around the aircraft. Dig out under aircraft where required in order to position pneumatic bags. Allow as much surface of bag as possible to come in contact with wings and fuselage as shown in figure. Lay tarpaulin in place first, locate bag and put a felt pad on top of pneumatic bag to avoid damage to bag from protruding sharp objects on lower surface of the aircraft. It may be necessary, using sand bags, plywood, and other locally procurable materials to build a support crib to keep aircraft level. Two examples are shown in figure. To inflate bags, two outlet sleeves, stenciled with the word OUTLET directly below each sleeve, must be securely closed. Attach hoses securely to inlet connection of bag and outlet connection of blower. As bags are simultaneously inflated, slack off mooring lines to allow aircraft to rise slowly and evenly. When aircraft is high enough, support it either on landing gear, jacks, or a transportation sled. See figure 5-3 for use of sled.

5-9. Lifting Aircraft With Crane. See figures 5-4 and 5-5. Use lifting procedures (07-00-04). The aircraft must be raised high enough to allow access to all access doors for dismantling operations. Use MB-1A crane. For operation of MB-1A crane, refer to TO 36C3-5-5-1. The crane should be kept

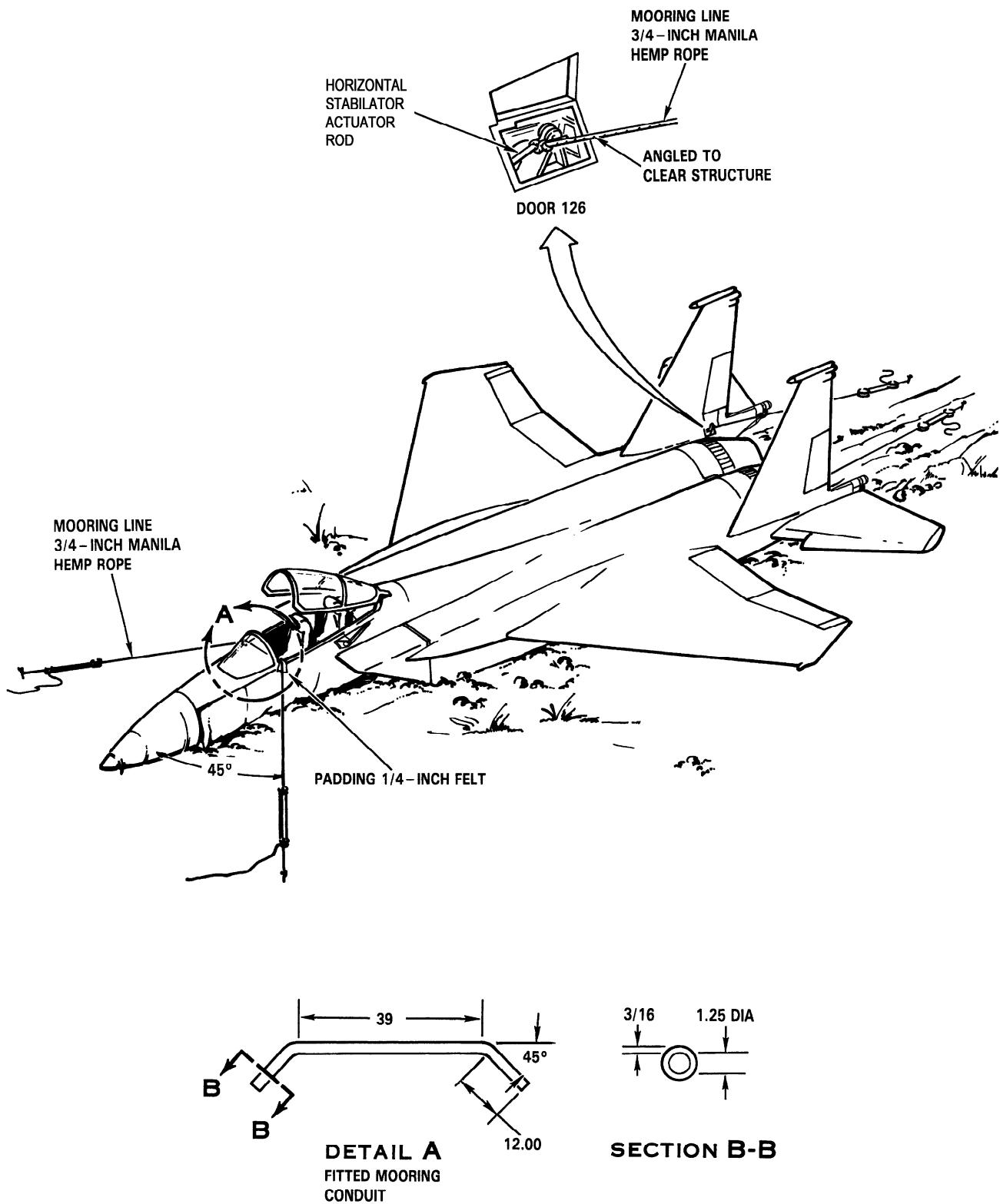
fastened during complete operation as a safety factor.

WARNING

Aircraft will shift during disassembly. Supports should be relocated and/or added as required to prevent damage to aircraft and/or personal injury.

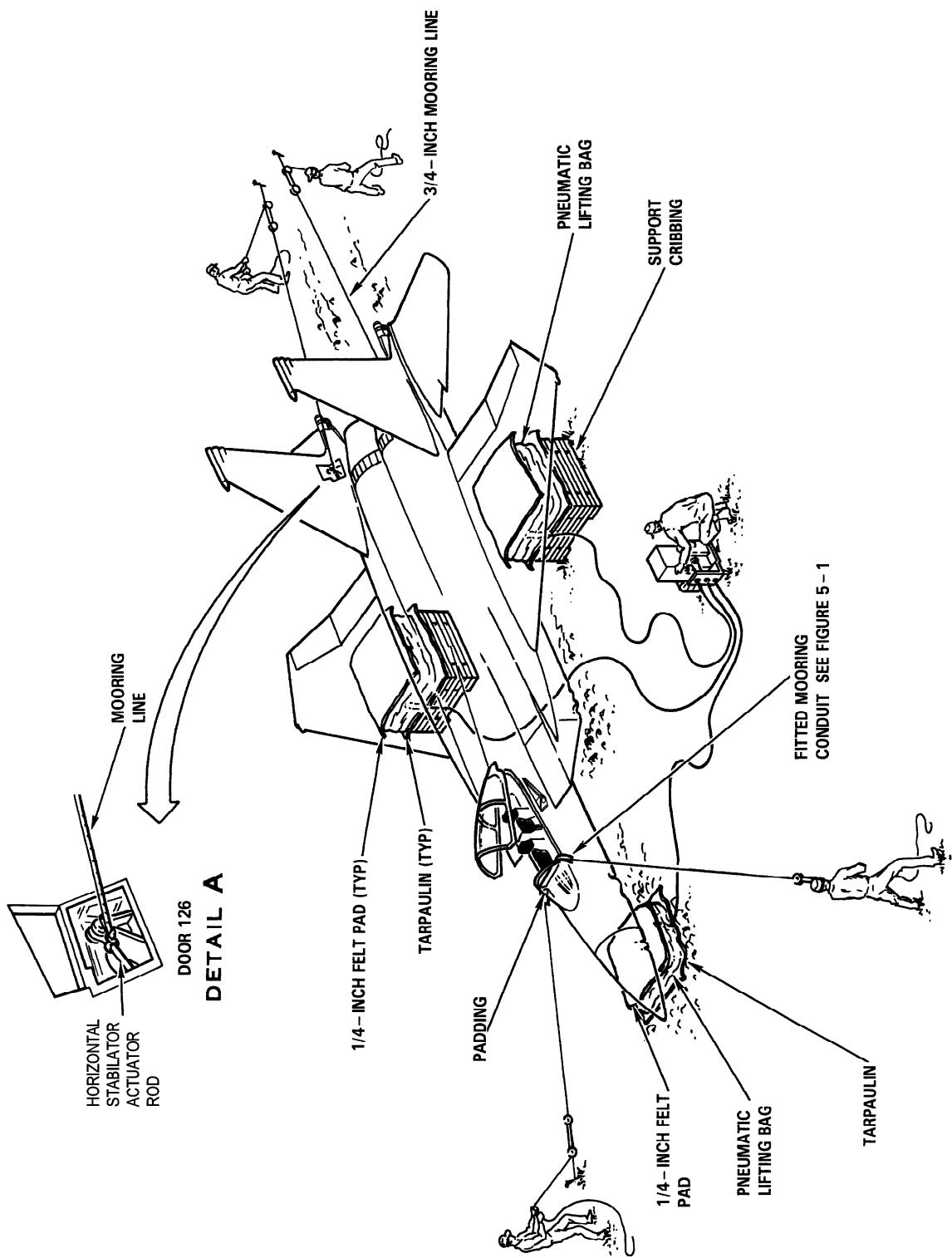
Lower aircraft on jacks, supports, or landing gear. For removal and hoisting of components refer to the below:

- a. Canopy (95-21-20).
- b. Flight controls.
 1. Aileron (27-11-12).
 2. Flap (27-50-11).
 3. Horizontal stabilator (27-41-12).
 4. Rudder (27-21-11).
 5. Speed brake (27-60-14).
- c. Main landing gear strut and doors (32-10-10, 32-10-11, 32-10-12, and 32-10-16).
- d. Nose landing gear strut and doors (32-20-10, 32-20-11, and 32-20-14).
- e. Arresting gear (32-90-22).
- f. Engine air induction ramps.
 1. First ramp (71-60-20).
 2. Second ramp (71-60-26).
 3. Third ramp (71-60-27).
 4. Diffuser ramp (71-60-28).
- g. Windshield, refer to CSTO SR1F-15SA-3-4.



SAN301-05-1-001

Figure 5-1. Mooring Crash Damaged Aircraft



SAN301-05-2-001

Figure 5-2. Lifting Aircraft With Pneumatic Bags
(Sheet 1 of 3)

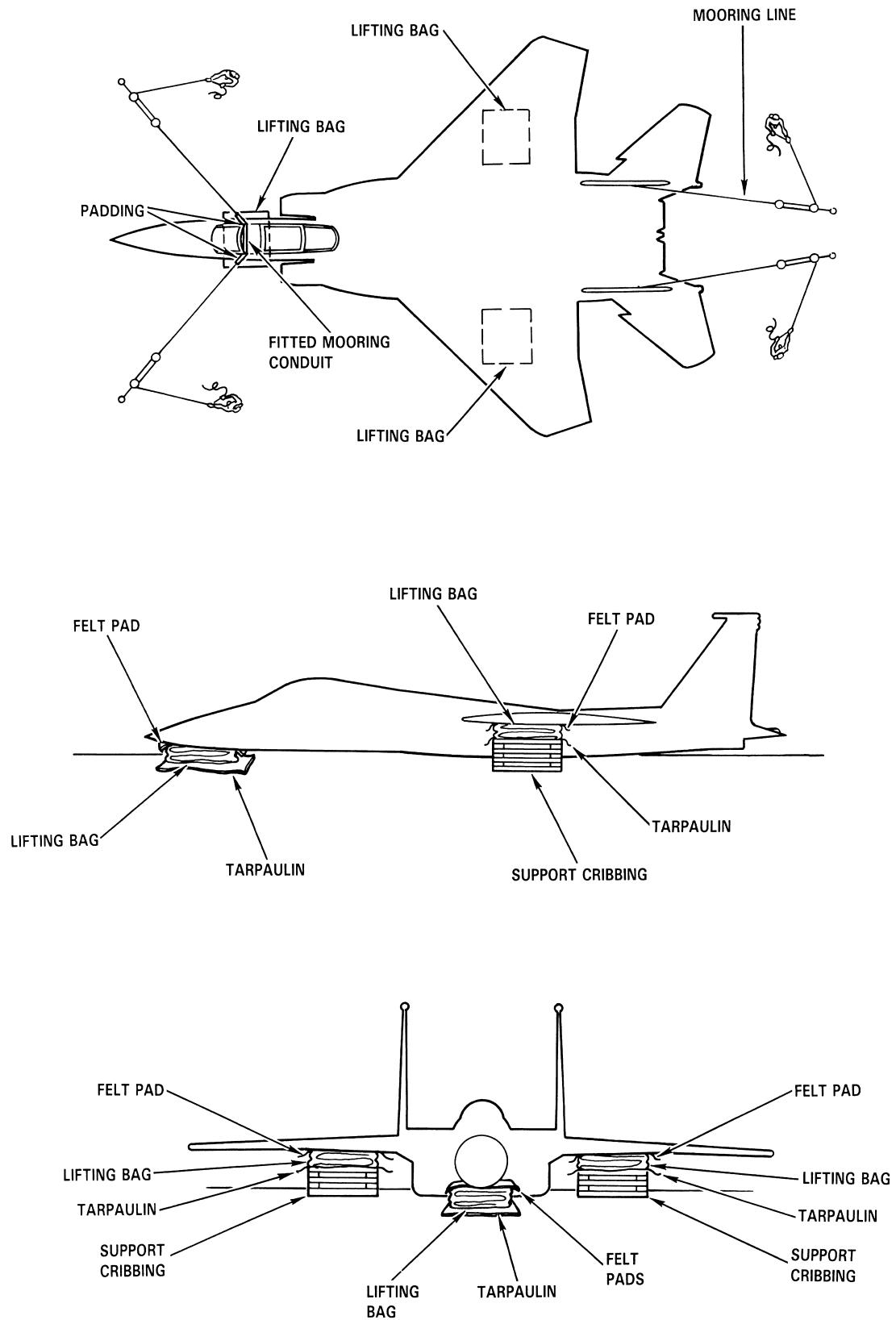


Figure 5-2. Lifting Aircraft With Pneumatic Bags (Sheet 2)

SAN301-05-3-001

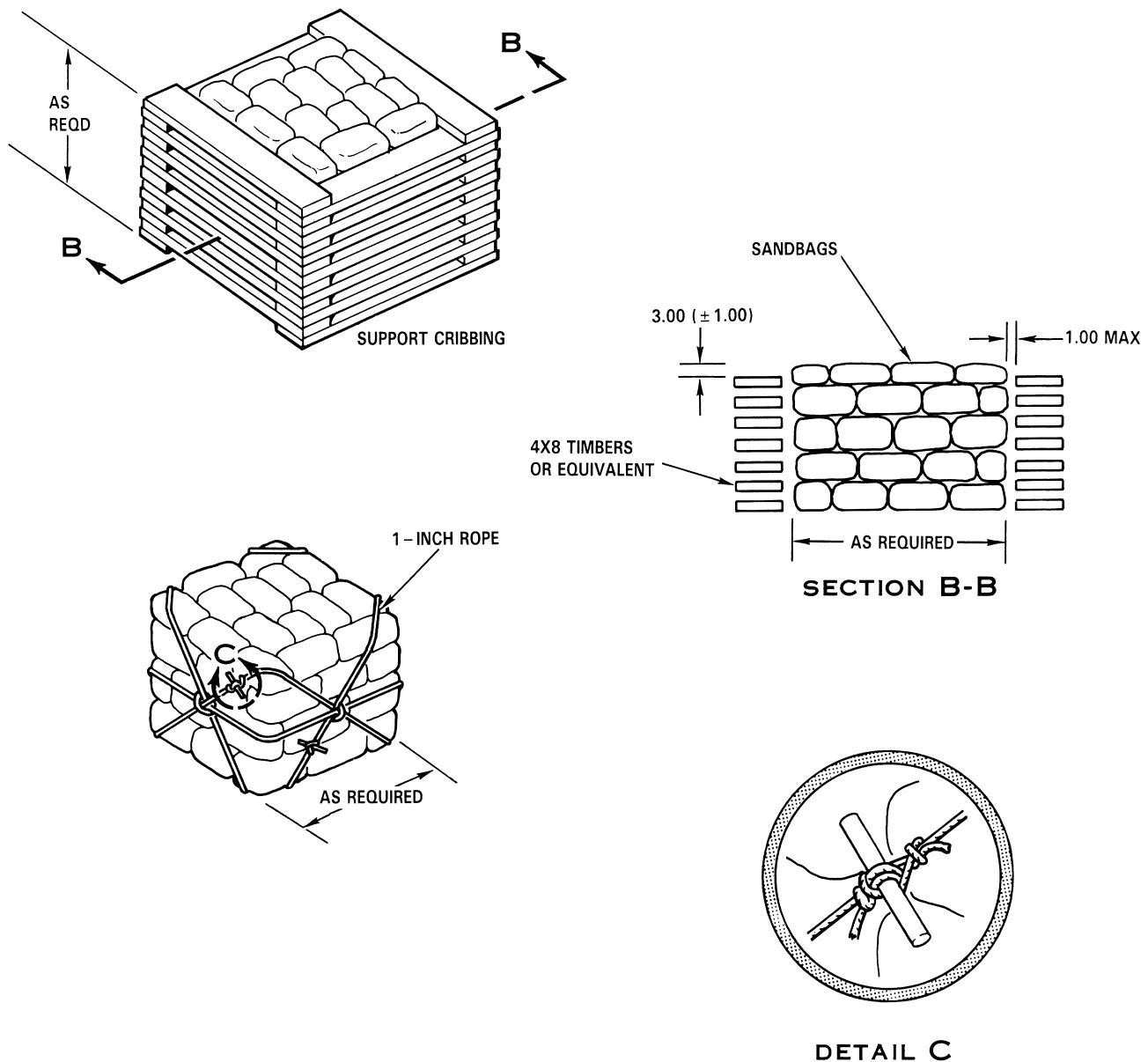
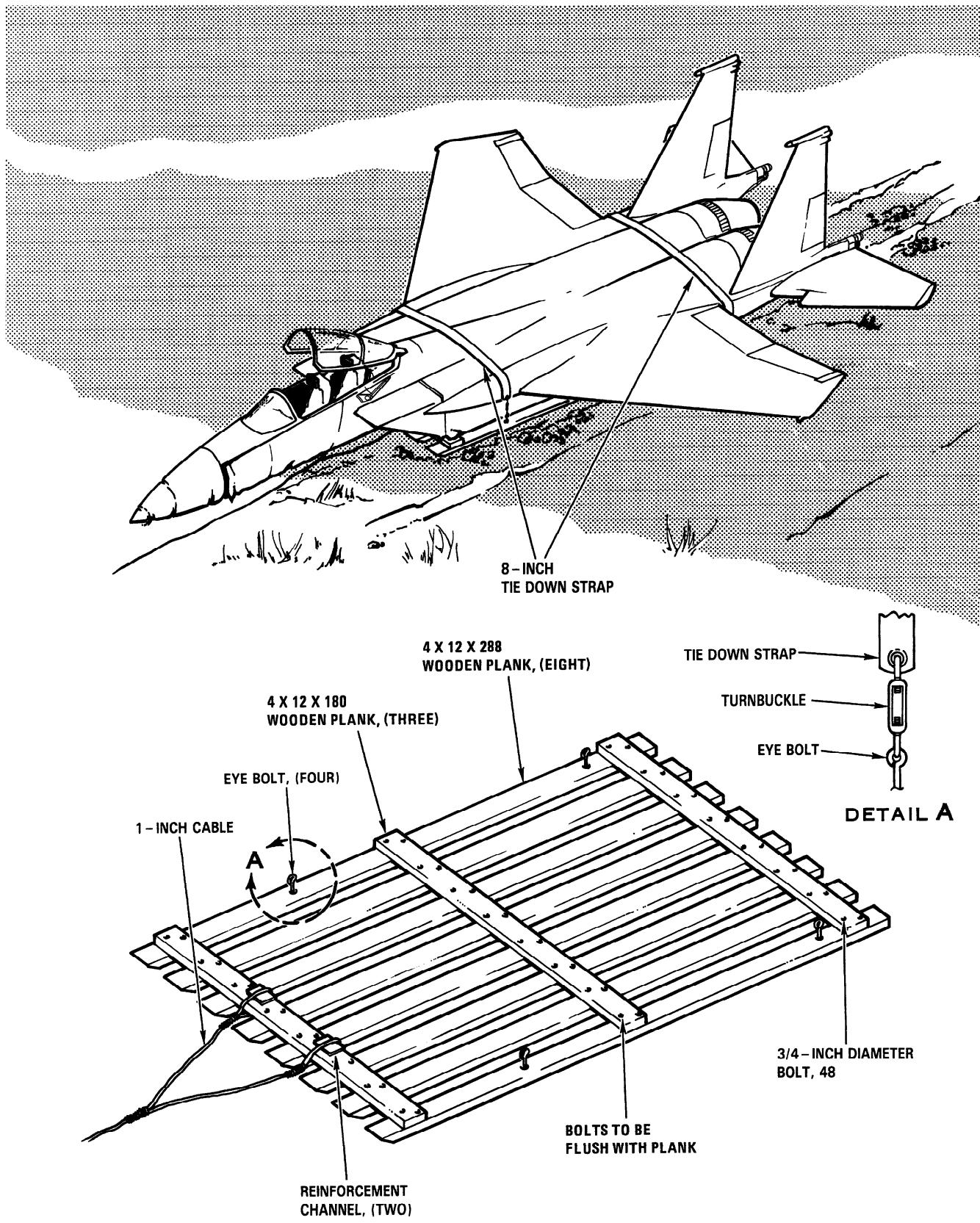


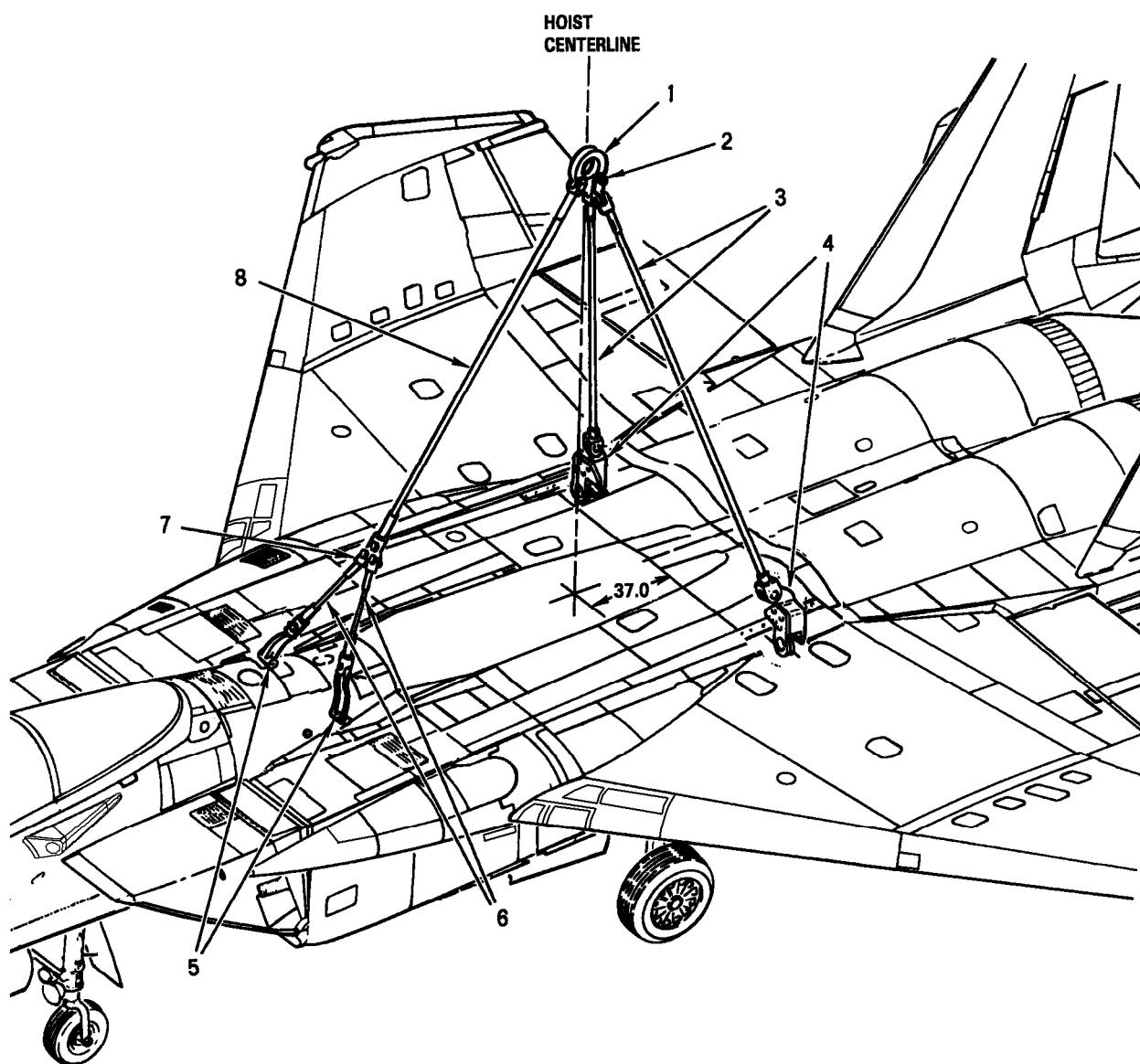
Figure 5-2. Lifting Aircraft With Pneumatic Bags (Sheet 3)

SAN301-05-4-001



SAN301-05-5-001

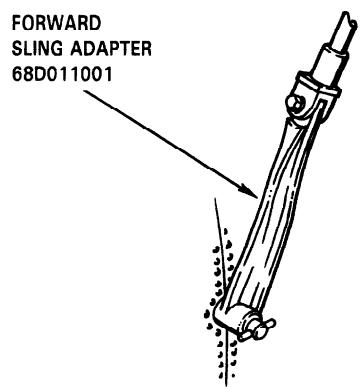
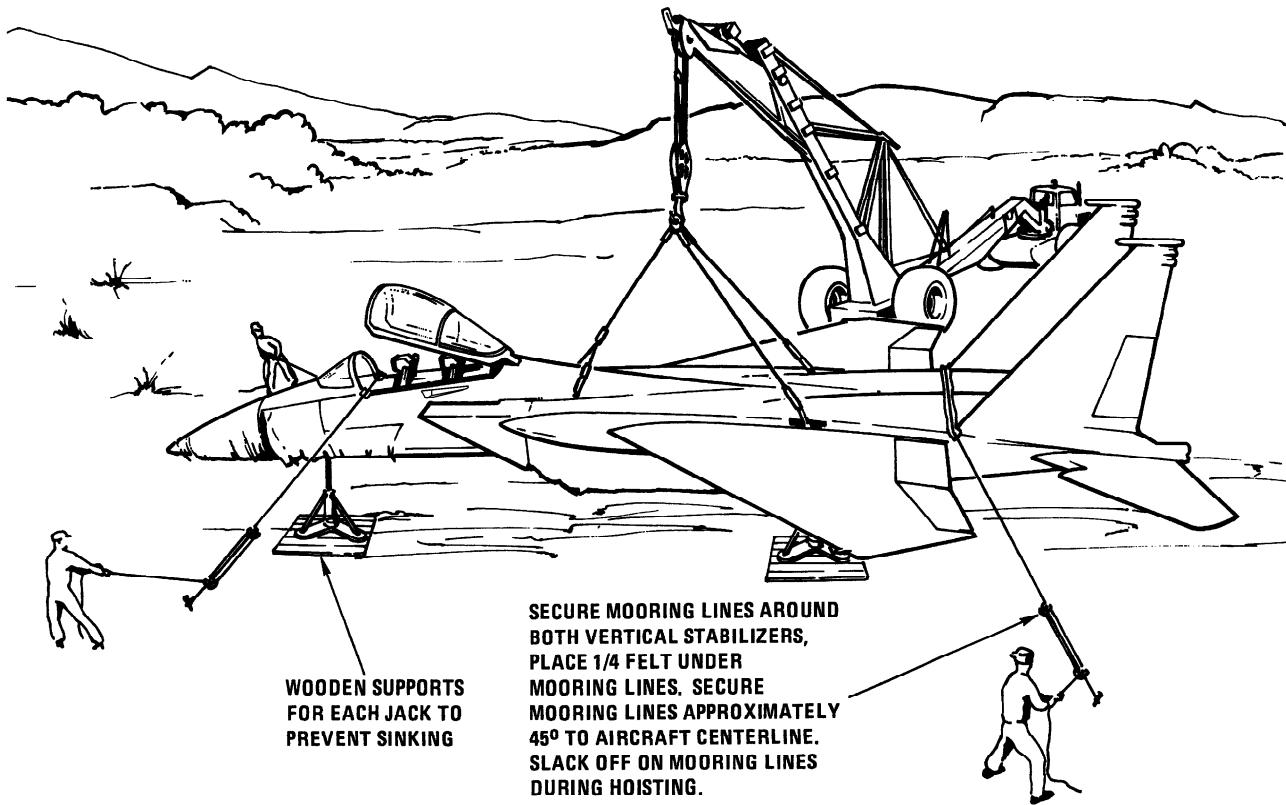
Figure 5-3. Sled Transportation Rig



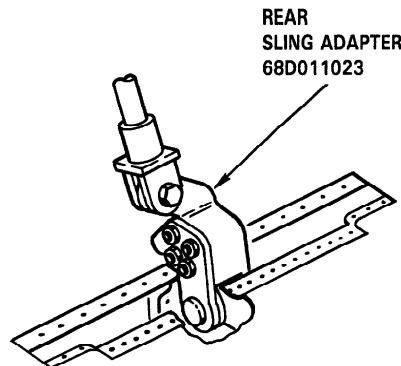
INDEX NO.	PART NUMBER	NOMENCLATURE
1	68D011002	RING
2	MDE32256	YOKE
3	68D010005	WIRE ROPE ASSY.
4	L/R 68D011023	ADAPTER
5	68D011001	ADAPTER
6	L/R 68D010001	CABLE ASSY
7	68D011008	CONNECTOR
8	68D010001	CABLE ASSY

SAN301-05-6-002

Figure 5-4. Aircraft Hoisting Sling Assembly, 68D010005



FORWARD ATTACH POINT



REAR ATTACH POINT

SAN301-05-7-001

Figure 5-5. Lifting Aircraft With Crane

WARNING

Desiccant may cause eye, skin, and respiratory irritation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Use with adequate ventilation. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

Lubricating oil may cause allergic skin reaction. May cause eye, skin, and respiratory irritation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Use with adequate ventilation. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

5-10. Preservation of Components for Shipping. The component or aircraft section shall be cleaned of all foreign matter before preserving. Painted surfaces do not require coating. Unpainted surfaces, nicks, scratches, or gouges in painted surfaces shall be coated with general purpose preservative oil, M3150-02-PL-M. All hinges shall be coated with M3150-02-PL-M oil. Put bags of desiccant, MIL-D-3464, in cavities, then cover the cavities with barrier material, MIL-B-121, and masking tape ASTM-D6123. Cap or plug ends of electrical connectors with MS90376 caps or plugs. Cap or plug ends of hydraulic connections with NAS818 plugs or NAS817 caps.

5-11. SHIPPING CONTAINERS. See table 5-1.

5-12. Shipping containers are designed to provide protection to the components against physical or environmental damage during shipment, handling and storage. Containers for heavy components are constructed of plywood or paper-overlaid wood veneer with wood cleats and rub strips. Containers for light components are constructed of corrugated paper. Interior contour blocks are fabricated from paper or plywood with either polyethylene or rubber cushions. The function of the contour blocks is to secure the component inside the container and to protect it from damage during shipping and handling. Damaged parts may require added blocking to prevent more damage during shipping. Loose hardware should be bagged and secured in the shipping container. When fabricating and/or repairing, or installing components (refer to paragraph 5-13) in shipping containers listed in table 5-1, observe the below.

WARNING

Fabricating, repairing, and loading shipping containers may be dangerous to the eyes. Approved eye protection is required.

Adhesive, scotch-grip EC847, is flammable liquid and vapor. May cause eye, skin, and respiratory irritation. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

Adhesive, MMM-A-1617 is flammable liquid and vapor. May cause allergic respiratory and skin reaction. May cause eye, skin, and respiratory irritation. Keep away from heat, sparks, and flame. Do not breathe dust (vapor, mist, gas). Use only with adequate ventilation. Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

5-13. INSTALLATION OF COMPONENTS IN CONTAINERS. Removable components such as control surfaces, radome and engine doors can be removed from aircraft and packaged in separate containers. Before installing component in container, preserve component per paragraph 5-10. The component must be held tight in container and if necessary felt padding must be added to get a tight fit. Bits and pieces from damaged components for verification of part numbers or identification of parts to overhaul facility, can be wrapped in paper and secured in shipping container. Major components such as wing and horizontal stabilizer are removed using supports and/or hoist slings. These components can be hoisted into shipping containers and secured in place.

Table 5-1. Shipping Container Index

Shipping Container	Reference
Aerial Refueling Fairing	See figure 5-14.
Aileron	See figure 5-7.
Arresting Hook	See figure 5-34.
Canopy	See figure 5-12.
Diffuser Ramp	See figure 5-19.
Door 113	See figure 5-22.
Door 117	See figure 5-21.
Door 122	See figure 5-20.
Door 95	See figure 5-23.
Flap	See figure 5-6.
Gun Fairing	See figure 5-15.
Horizontal Stabilator, Dual	See figure 5-32.
Horizontal Stabilator, Single	See figure 5-31.
Main Landing Gear	See figure 5-27.
Main Landing Gear Aft Door	See figure 5-30.
Main Landing Gear Inboard Door	See figure 5-29.
Main Landing Gear Outboard Door	See figure 5-28.
Nose Landing Gear	See figure 5-24.
Nose Landing Gear Aft Door	See figure 5-25.
Nose Landing Gear Forward Door	See figure 5-26.
Radome	See figure 5-10.
Rudder	See figure 5-33.
Second Position Ramp	See figure 5-17.
Speed Brake	See figure 5-35.
Third Position Ramp	See figure 5-18.

Table 5-1. Shipping Container Index (CONT)

Shipping Container	Reference
Variable Inlet Ramp	See figure 5-16.
Windshield	See figure 5-11.
Wing Tip	See figure 5-8.
Wing Torque Box Upper Fairing	See figure 5-9.
600 Gallon Fuel Tank	See figure 5-13.

CSTO SR1F-15SA-3-1

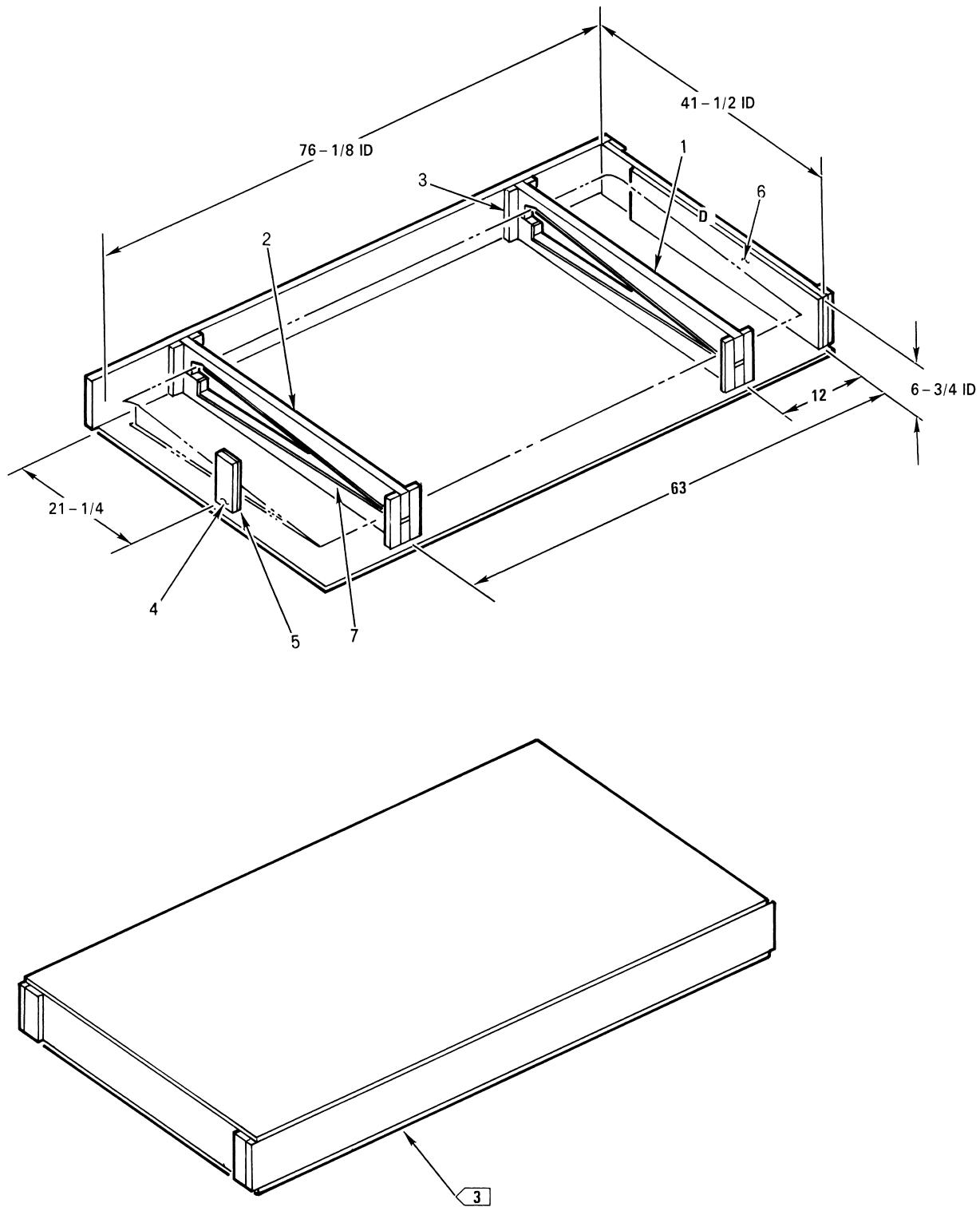
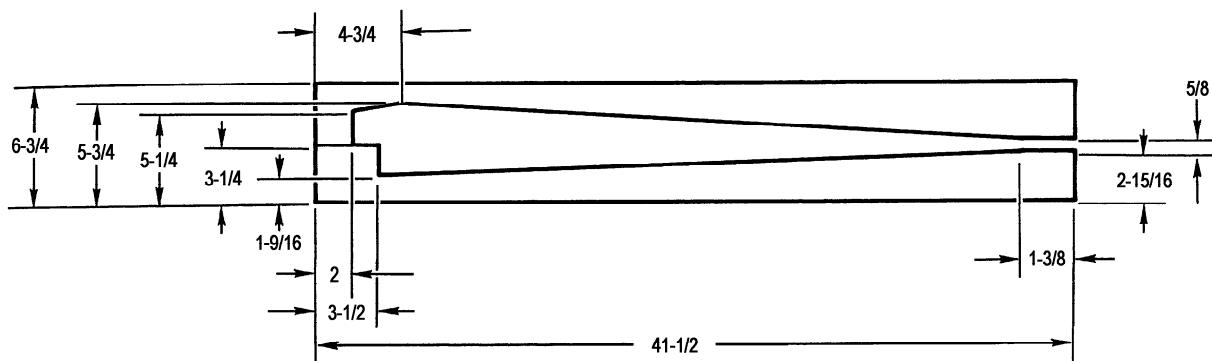
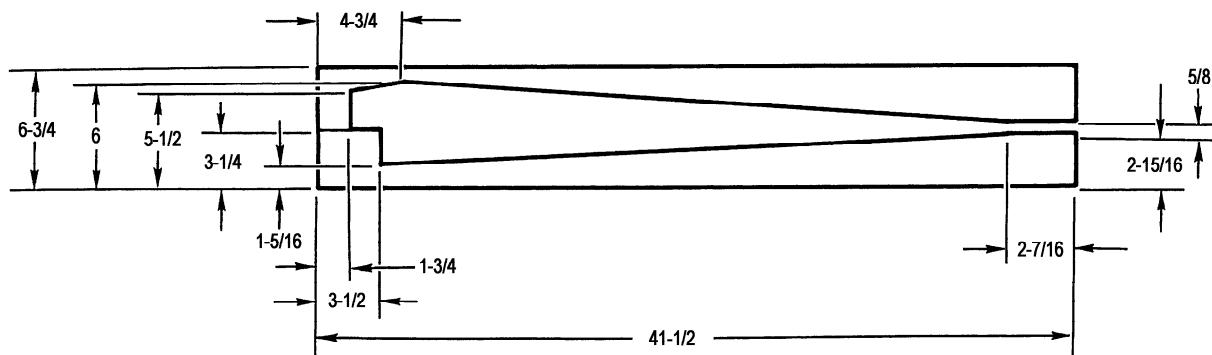


Figure 5-6. Flap Shipping Container (Sheet 1 of 2)

SAN301-05-8-001



DETAIL 1



DETAIL 2

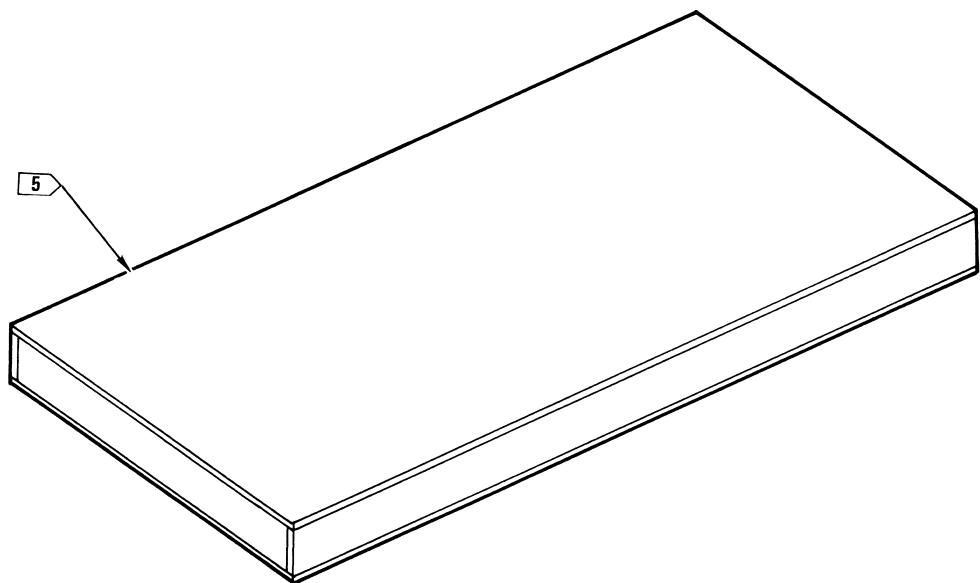
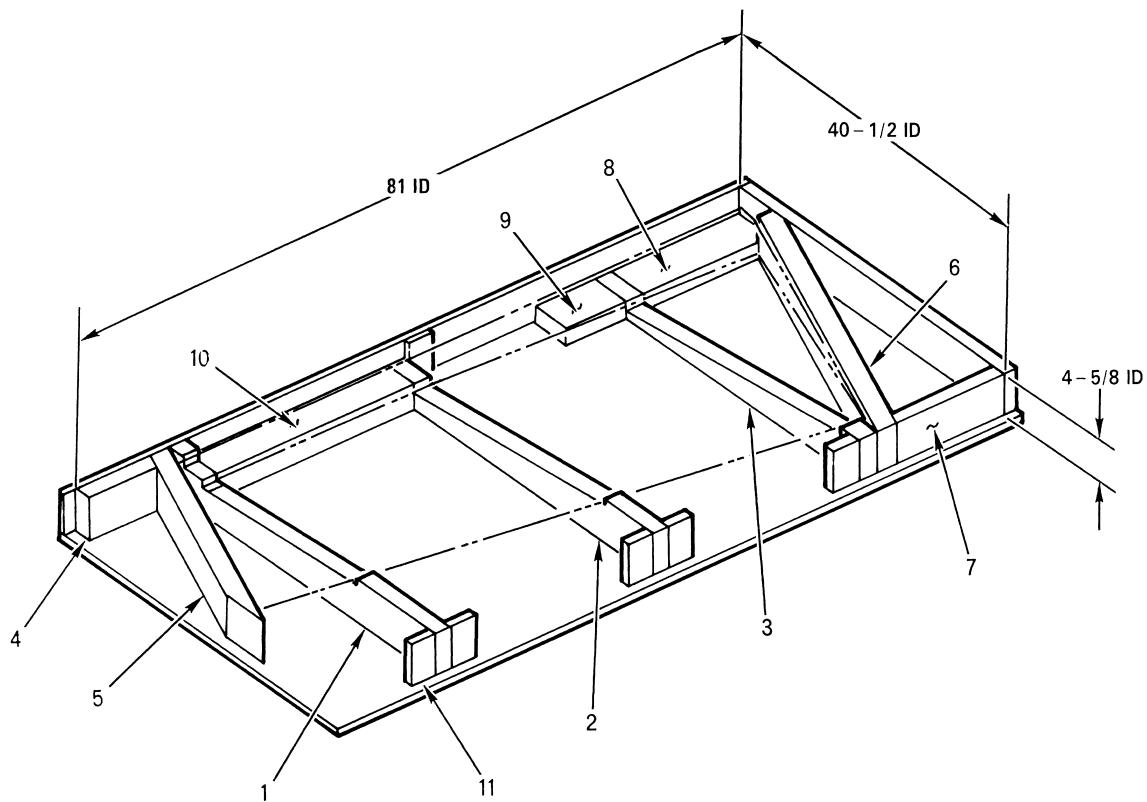
LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 53 POUNDS,
WING FLAP WEIGHT IS 60 POUNDS. GROSS WEIGHT IS 113 POUNDS.
2. RIGHT FLAP SHOWN, LEFT FLAP OPPOSITE.
3. CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6880.
USE 1 INCH (NOM) WOOD SIDES AND ENDS, 1 X 3 INCH (NOM) WOOD
CLEATS ON ENDS AS SHOWN, AND 1/4-INCH MINIMUM PLYWOOD TOP
AND BOTTOM.

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	1	1-1/2 X 6-3/4 X 41-1/2	PLYWOOD	
2	1	1-1/2 X 6-3/4 X 41-1/2	PLYWOOD	
3	8	1 X 2 (NOM) X 6-3/4	WOOD	
4	1	1 X 3 X 6-3/4	PLYWOOD	
5	1	1/2 X 3 X 6-3/4	CUSHIONING MATERIAL, POLYETHYLENE, A-A-59136	
6	1	1/2 X 6-3/4 X 36	CORRUGATED, ASTM-D4727	
7	A/R	1/4 THICK	CUSHIONING MATERIAL, POLYETHYLENE, A-A-59136	

SAN310-05-9-001

Figure 5-6. Flap Shipping Container (Sheet 2)



SAN301-05-10-001

Figure 5-7. Aileron Shipping Container (Sheet 1 of 3)

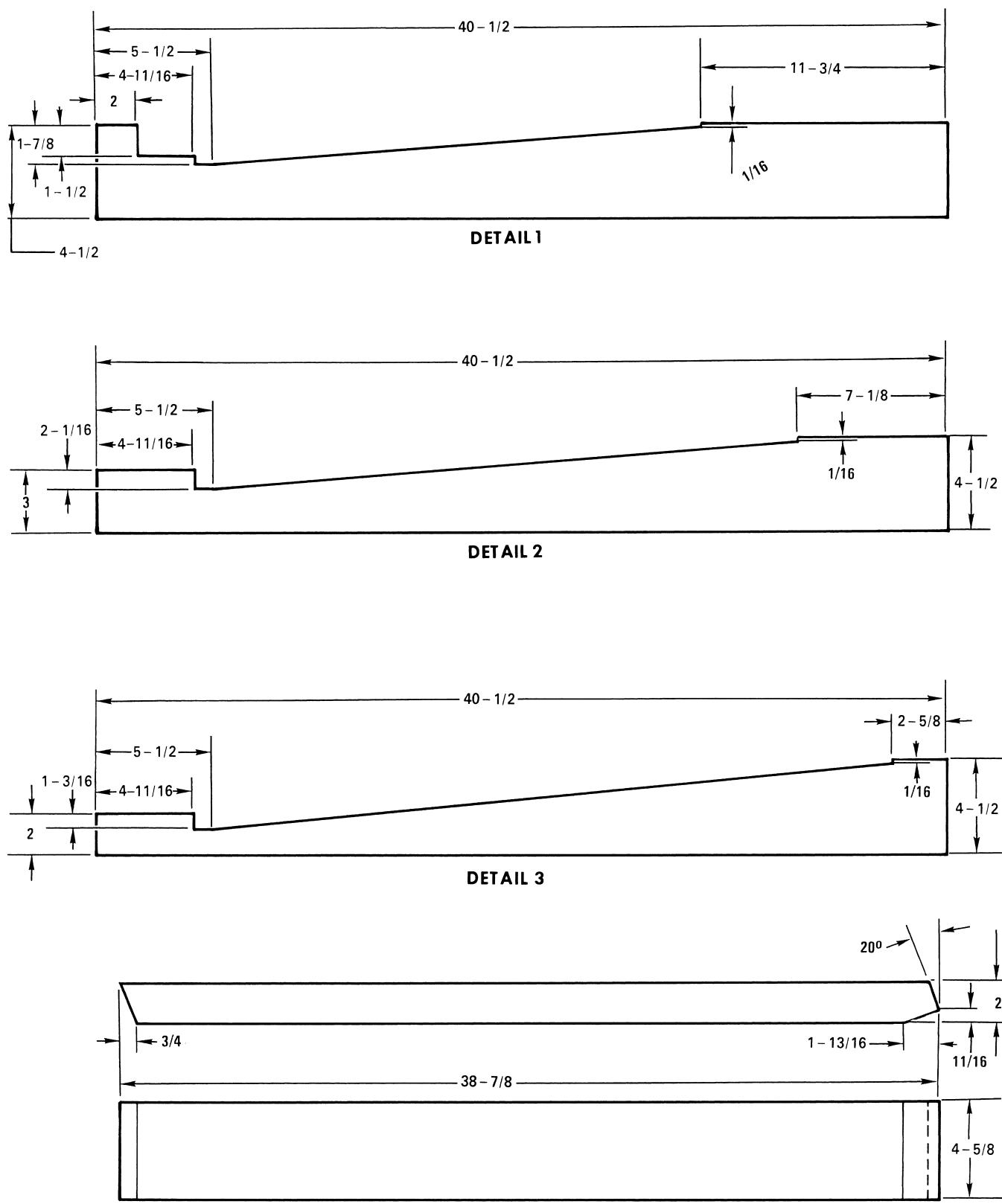
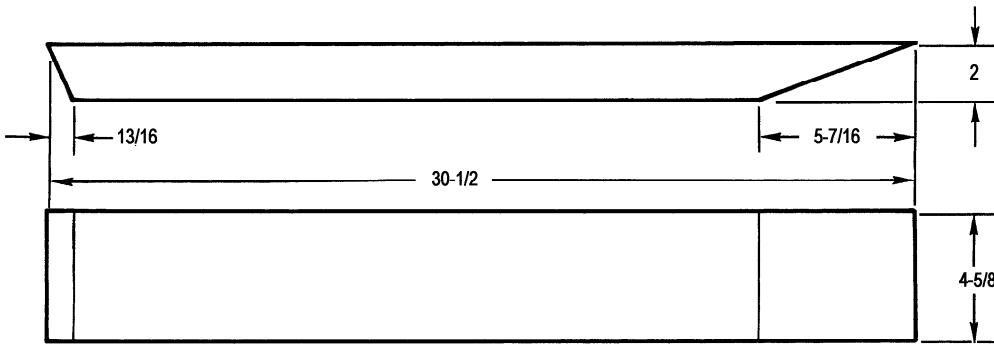
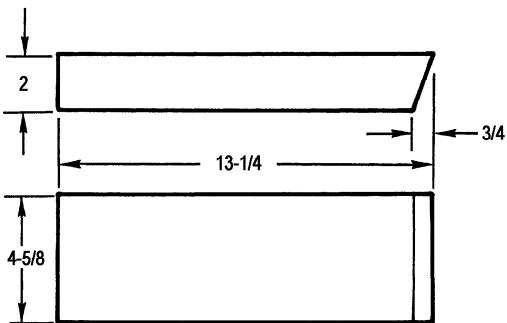


Figure 5-7. Aileron Shipping Container (Sheet 2)

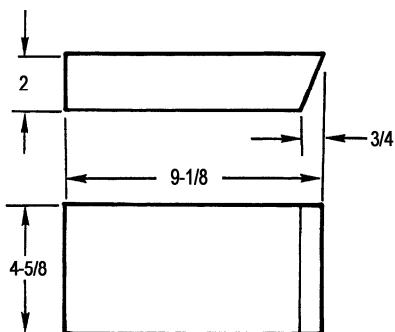
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DETAIL 5



DETAIL 7



DETAIL 4

LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 85 POUNDS, AILERON WEIGHT IS 42 POUNDS. GROSS WEIGHT IS 127 POUNDS.
2. BOND BLOCKING IN PLACE, USE EC847 ADHESIVE.
3. WRAP AILERON IN PLASTIC SHEET, FEDERAL SPECIFICATION A-A-3174, TYPE I, CLASS 1, GRADE B, FINISH 1.
4. FOR VERTICAL RESTRAINT, INSERT BETWEEN AILERON AND PLYWOOD TOP, CORRUGATED SINGLE WALL FIBERBOARD, STANDARD SPECIFICATION ASTM-D4727.
5. CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6880 USE 5/16 MINIMUM PLYWOOD TOP AND BOTTOM. USE 3/4 MINIMUM WOOD SIDES AND 1-1/2 MINIMUM WOOD ENDS.

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	1	2 X 4-1/2 X 40-1/2	CORRUGATED, ASTM-D4727	
2	1	2 X 4-1/2 X 40-1/2	CORRUGATED, ASTM-D4727	
3	1	2 X 4-1/2 X 40-1/2	CORRUGATED, ASTM-D4727	
4	1	2 X 4-5/8 X 9-1/8	CORRUGATED, ASTM-D4727	
5	1	2 X 4-5/8 X 30-1/2	CORRUGATED, ASTM-D4727	
6	1	2 X 4-5/8 X 38-7/8	CORRUGATED, ASTM-D4727	
7	1	2 X 4-5/8 X 13-1/4	CORRUGATED, ASTM-D4727	
8	1	2 X 4-11/16 X 15-5/16	CORRUGATED, ASTM-D4727	
9	1	2 X 4-11/16 X 7	CORRUGATED, ASTM-D4727	
10	1	3 X 4-11/16 X 24	CORRUGATED, ASTM-D4727	
11	6	1 X 3 X 4-5/8	CORRUGATED, ASTM-D4727	

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Figure 5-7. Aileron Shipping Container (Sheet 3)

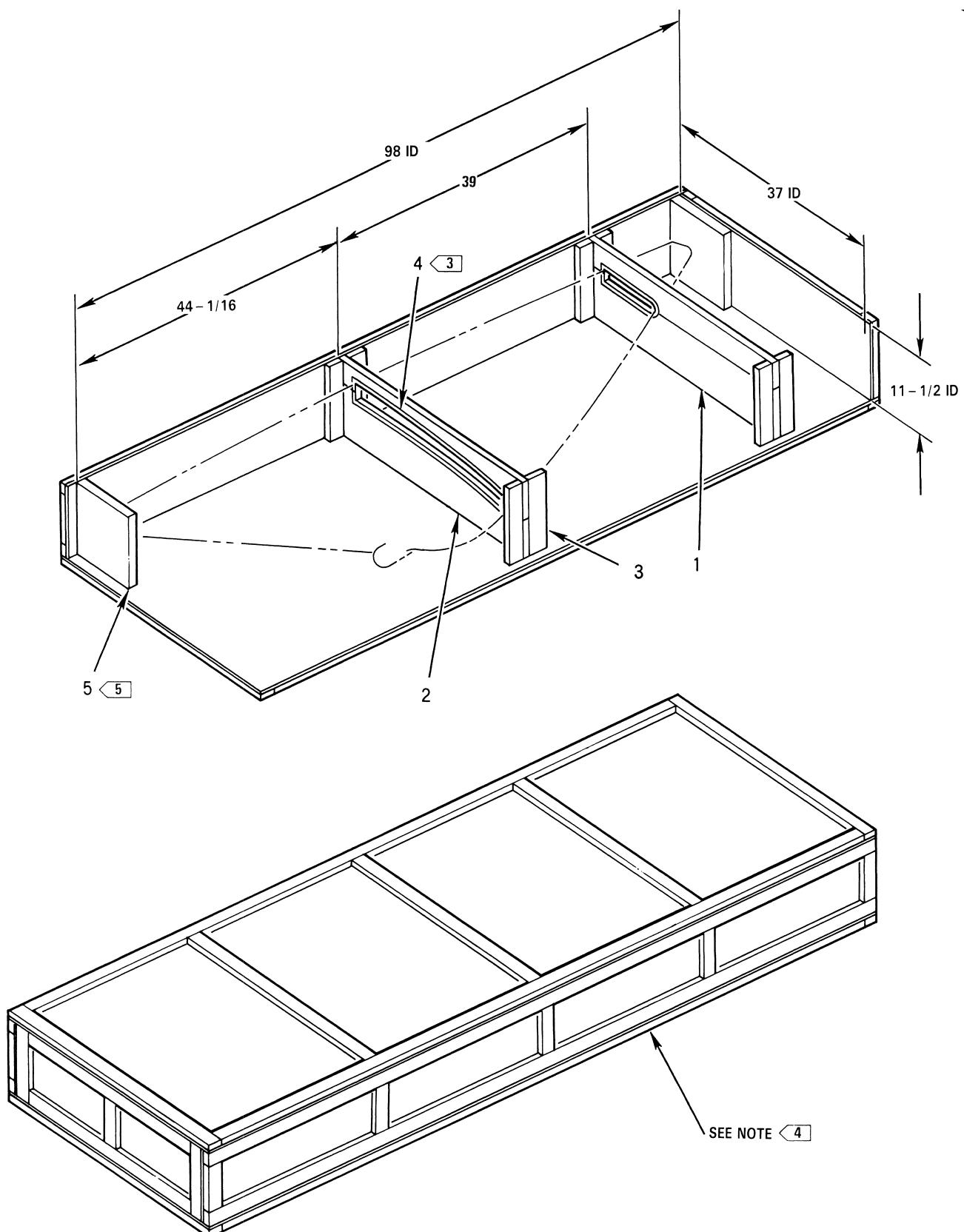
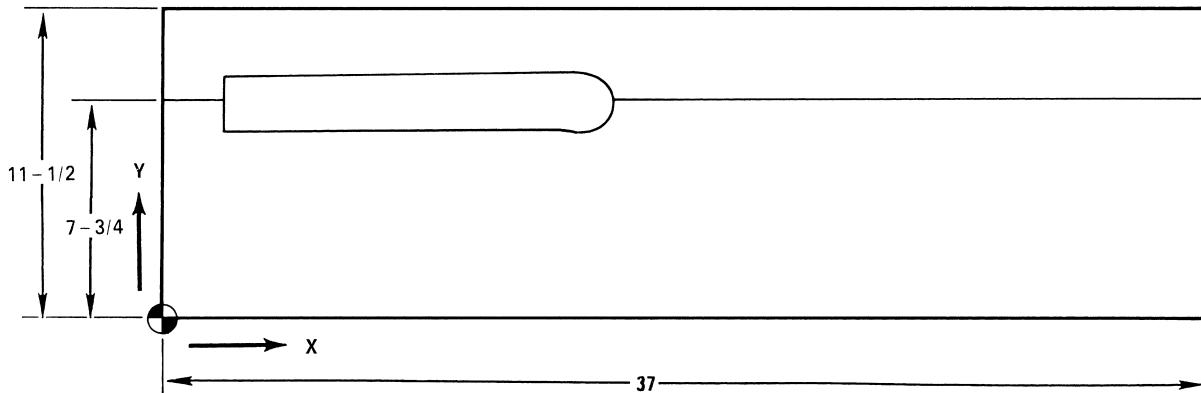


Figure 5-8. Wing Tip Shipping Container (Sheet 1 of 3)

SAN301-05-13-001



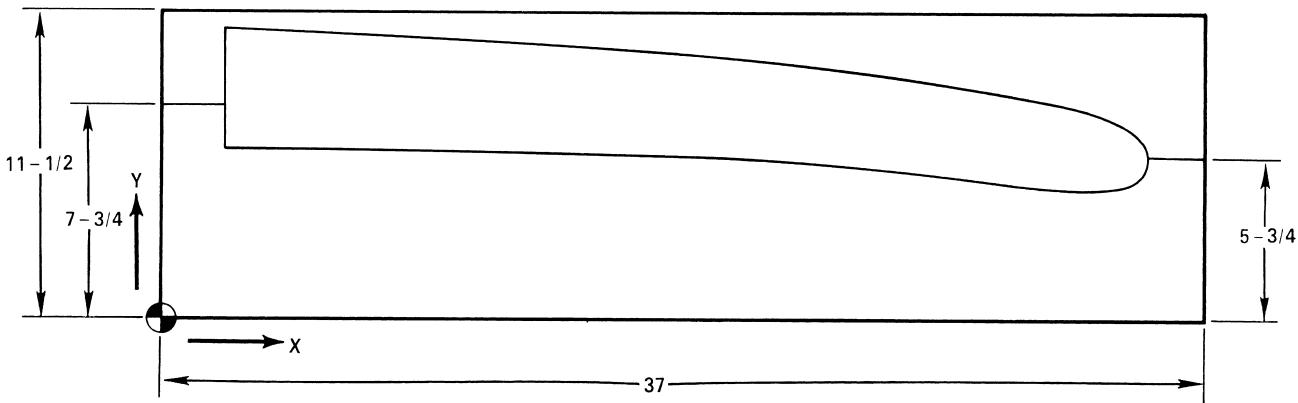
DETAIL 1

TABLE 1

X	Y UPPER ML	Y LOWER ML
2-3/16	8-5/8	6-3/8
14-1/2	8-3/4	6-11/16
15	8-11/16	6-3/4
15-1/2	8-1/2	6-15/16
15-3/4	8-1/4	7-1/8
15-15/16	8	7-7/16
16	7-3/4	7-3/4

TABLE 2

X	Y UPPER ML	Y LOWER ML
2-3/16	10-5/16	6
7	10-1/8	5-15/16
11	9-7/8	5-7/8
17	9-3/8	5-11/16
22	8-15/16	5-7/16
26	8-7/16	5-3/16
29	8-1/16	4-15/16
31	7-3/4	4-13/16
32	7-9/16	4-3/4
33	7-5/16	4-11/16
33-1/2	7-1/8	4-3/4
34	6-15/16	4-13/16
34-1/2	6-13/16	4-7/8
34-1/2	6-11/16	4-15/16
34-3/4	6-7/16	5-1/8
34-7/8	6-1/4	5-5/16
34-15/16	6-1/8	5-7/16
35	5-3/4	5-3/4



DETAIL 2

SAN301-05-14-001

Figure 5-8. Wing Tip Shipping Container (Sheet 2)

LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 54 POUNDS,
WING TIP WEIGHT IS 53 POUNDS. GROSS WEIGHT IS 107 POUNDS.

2. LEFT WING TIP SHOWN, RIGHT WING TIP OPPOSITE.

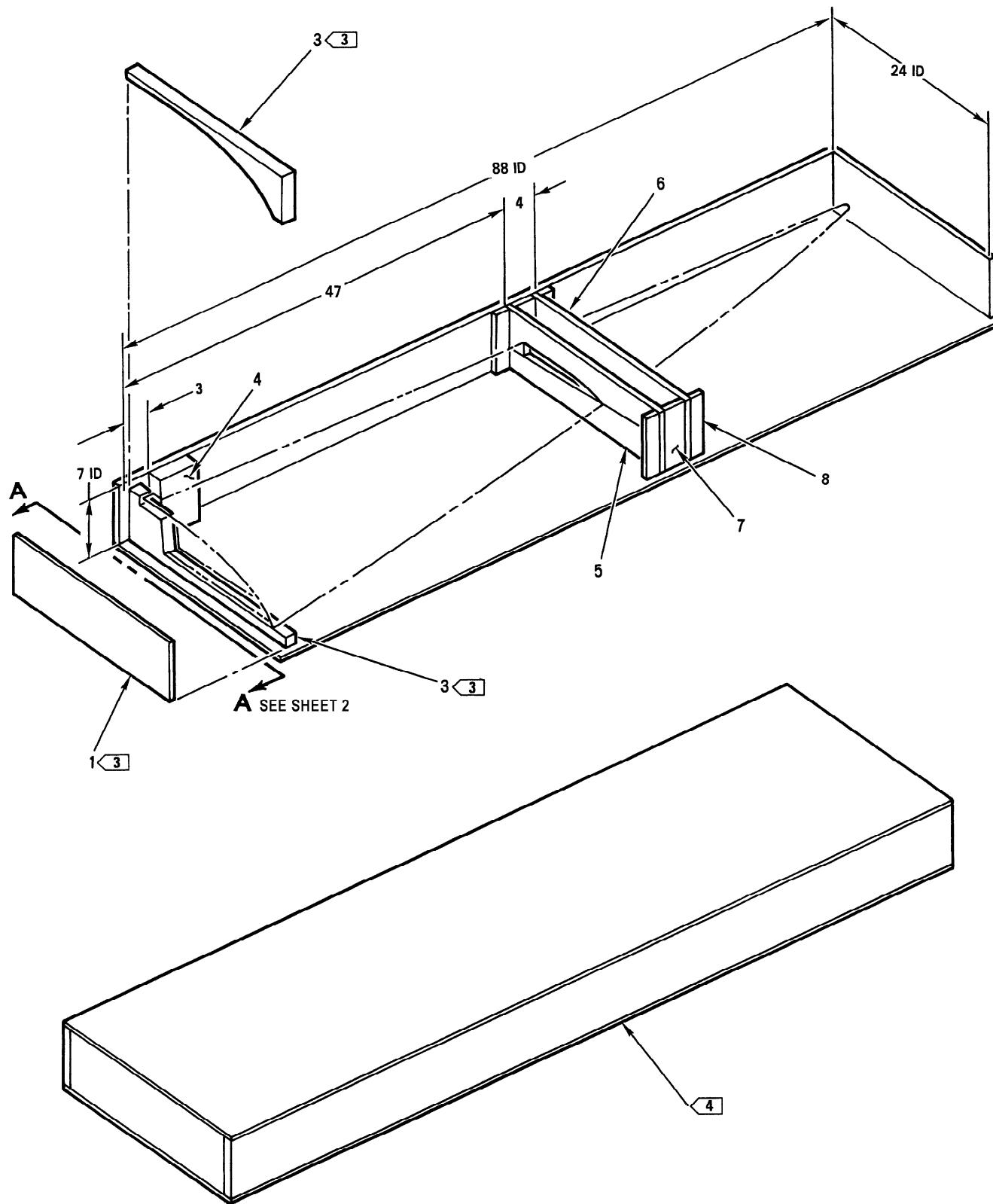
 3> BOND DETAIL 4 TO DETAILS 1 AND 2 AS SHOWN, USE EC847 ADHESIVE.

 4> CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6251. USE
0.070 INCH THICK MINIMUM PAPER OVERLAIDED VENEER, CONTAINER GRADE
PANELS, AND 5/8 X 1-3/4 INCH MINIMUM WOOD CLEATS.

 5> BOND DETAIL 5 TO ENDS OF CONTAINER AS SHOWN.

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	1	1 X 11-1/2 X 37	PLYWOOD	
2	1	1 X 11-1/2 X 37	PLYWOOD	
3	8	1 X 2 (NOM) X 11-1/2	WOOD	
4	A/R	1/2 THICK X 1 WIDE	CUSHIONING MATERIAL, POLYETHYLENE, A-A-59136	
5	2	1-1/4 X 11-1/2 X 12	CUSHIONING MATERIAL, POLYETHYLENE, A-A-59136	

Figure 5-8. Wing Tip Shipping Container (Sheet 3)



SAN301-05-16-002

Figure 5-9. Wing Torque Box Upper Fairing Shipping Container (Sheet 1 of 3)

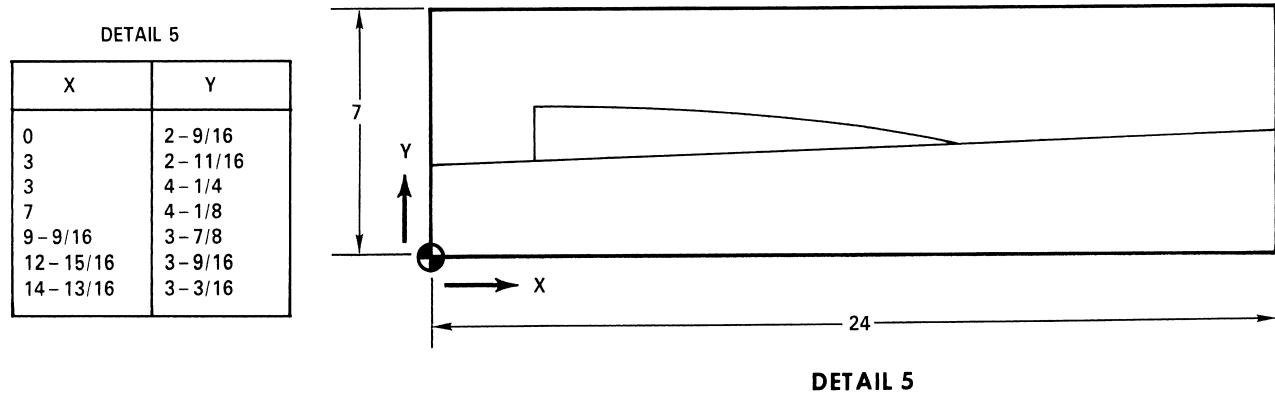
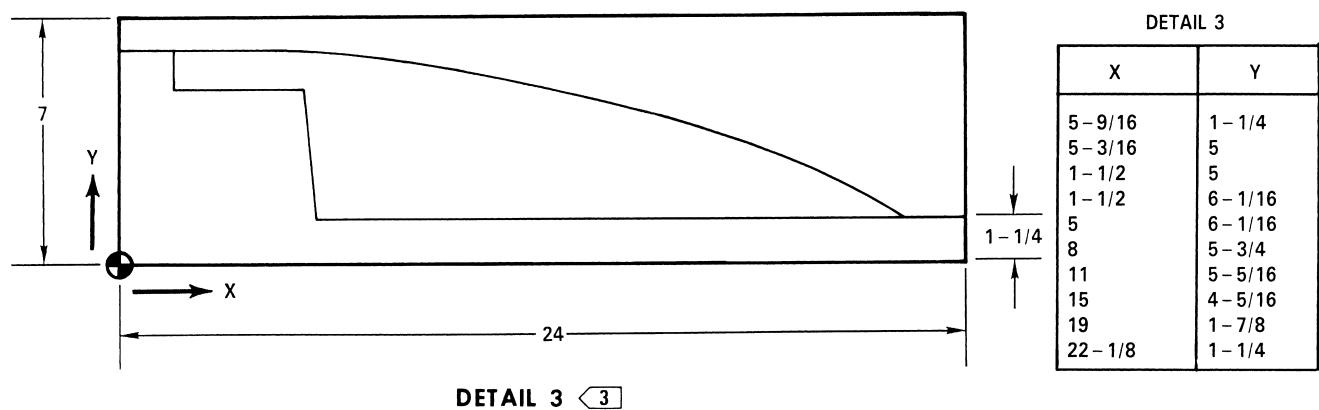
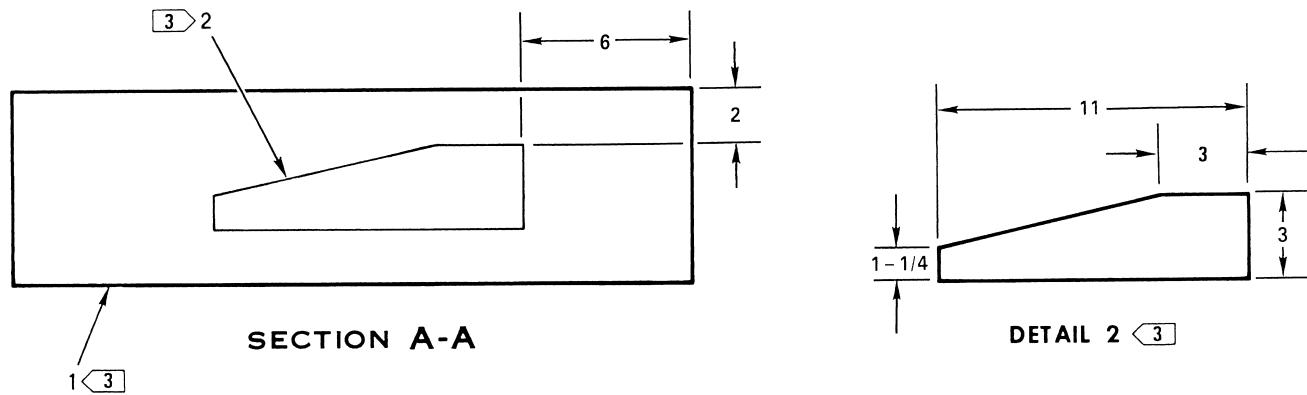
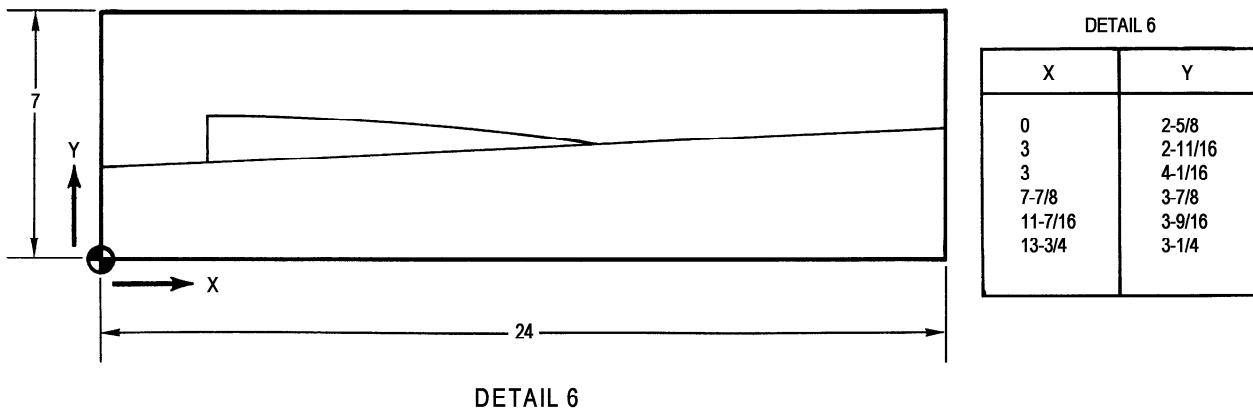


Figure 5-9. Wing Torque Box Upper Fairing Shipping Container (Sheet 2)

SAN301-05-17-001



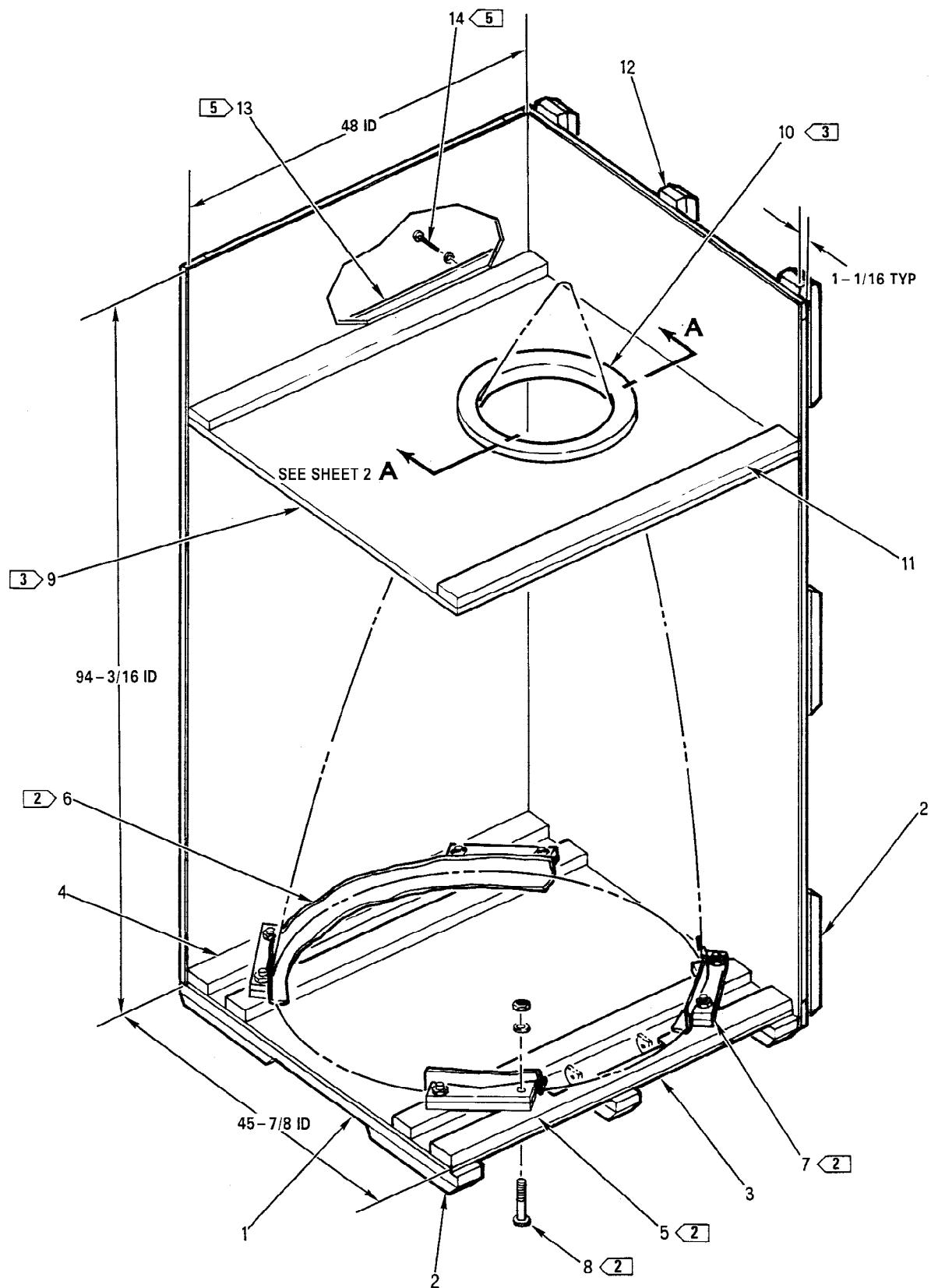
LEGEND

- APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 35 POUNDS,
FAIRING WEIGHT IS 15 POUNDS. GROSS WEIGHT IS 50 POUNDS.
- WRAP FAIRING IN PLASTIC SHEET, FEDERAL SPECIFICATION
A-A-3174, TYPE I, CLASS 1, GRADE B, FINISH 1.
- 3** BOND DETAILS 1, 2, AND 3 TOGETHER AS SHOWN, USE EC847 ADHESIVE.
- 4** CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6880.
USE 1 INCH (NOM) WOOD SIDES AND ENDS. USE 0.120 MINIMUM POV
TOP AND BOTTOM.

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	1	1/2 X 7 X 24	CORRUGATED, ASTM-D4727	
2	1	1-1/2 X 3 X 11	CORRUGATED, ASTM-D4727	
3	1	1-1/2 X 7 X 24	CORRUGATED, ASTM-D4727	
4	1	2 X 5 X 7	CORRUGATED, ASTM-D4727	
5	1	9/16 X 7 X 24	CORRUGATED, ASTM-D4727	
6	1	9/16 X 7 X 24	CORRUGATED, ASTM-D4727	
7	2	3/4 X 2-7/8 X 7	WOOD	
8	4	1 X 2 (NOM) X 7	WOOD	

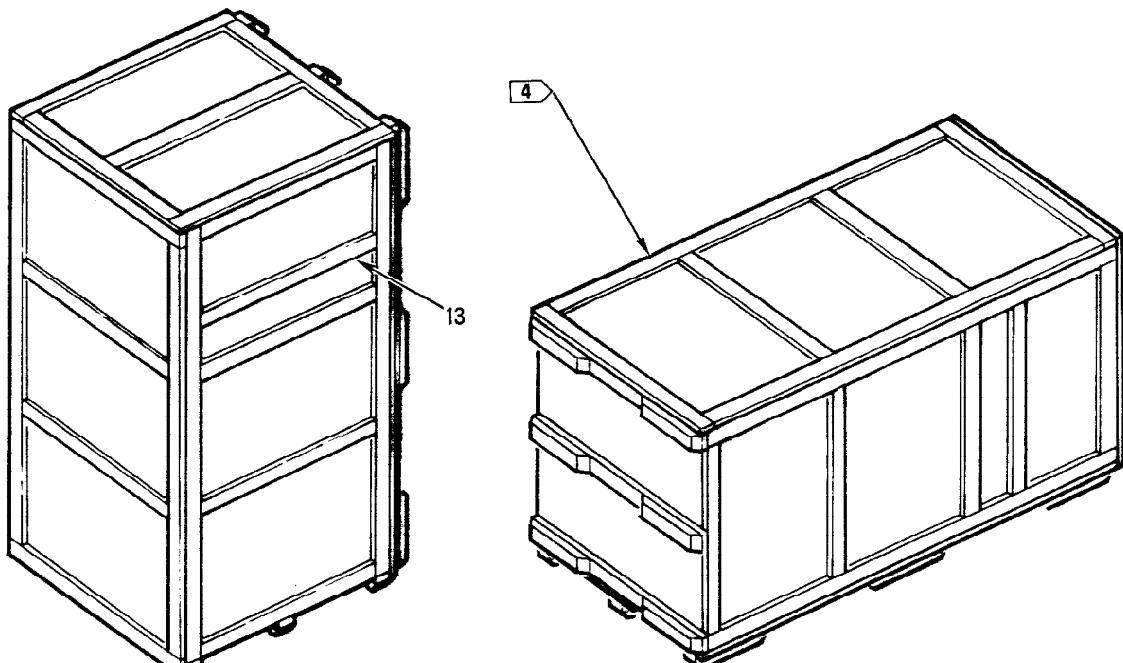
SAN301-05-18-001

Figure 5-9. Wing Torque Box Upper Fairing Shipping Container (Sheet 3)



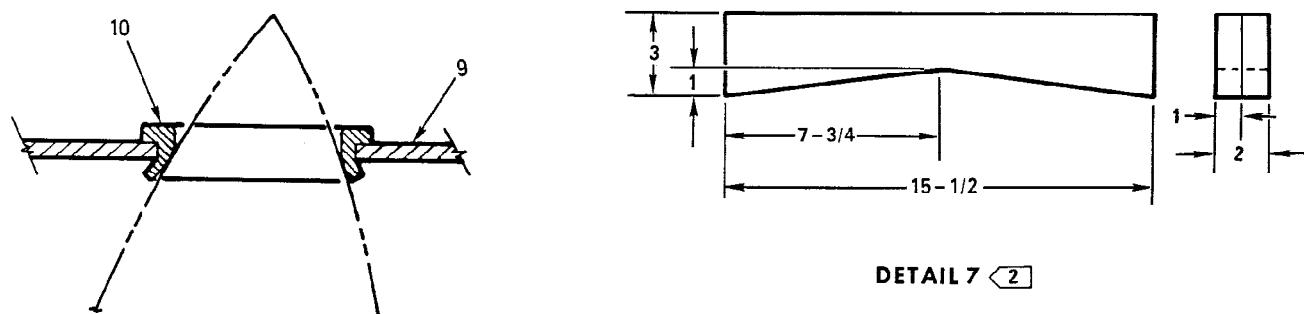
SAN301-05-96-002

Figure 5-10. Radome Shipping Container (Sheet 1 of 3)



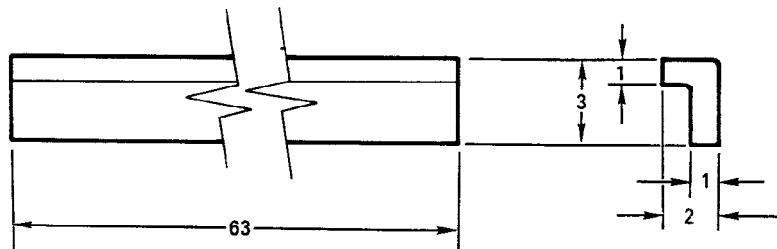
PACKING AND UNPACKING ATTITUDE

SHIPPING ATTITUDE



SECTION A-A

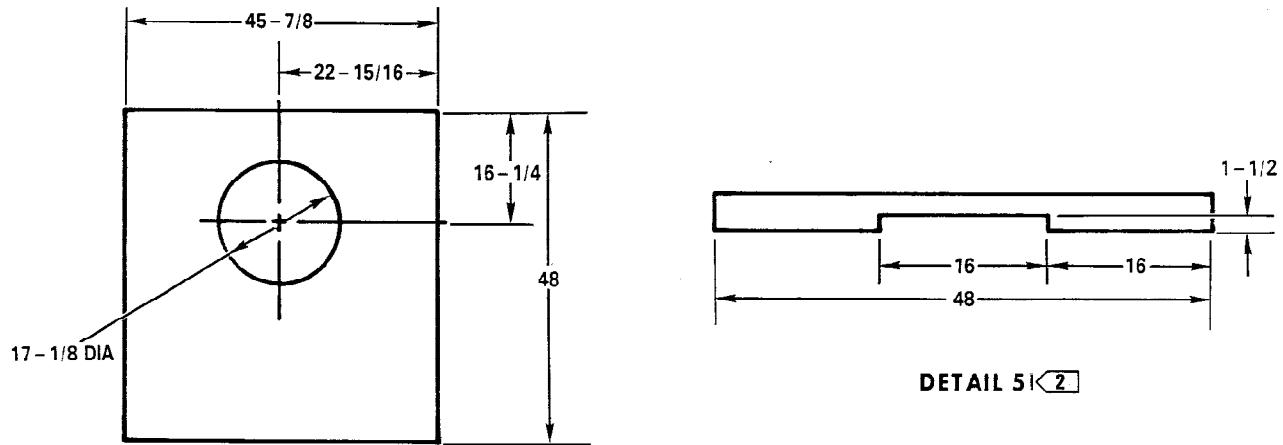
DETAIL 7 ◀ 2



DETAIL 10 ◀ 3

SAN301-05-97-002

Figure 5-10. Radome Shipping Container (Sheet 2)



DETAIL 9 ◀ 3

LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 292 POUNDS. RADOME WEIGHT IS 200 POUNDS. GROSS WEIGHT IS 492 POUNDS.
- 2 ▶ PLACE RADOME ON BASE WITH HINGE LUGS IN NOTCHED AREA OF DETAIL 5 AND WITH DETAIL 6 IN PLACE. POSITION DETAIL 7 AS SHOWN AND INSTALL WITH DETAIL 8.
- 3 ▶ BOND DETAIL 10 TO DETAIL 9 AS SHOWN IN SECTION A-A, USE EC-847 CEMENT.
- 4 ▶ CONSTRUCT CONTAINER PER MILITARY SPECIFICATION MIL-B-26195. USE 3/16-INCH MINIMUM PLYWOOD PANELS AND 3/4 X 3/4-INCH MINIMUM CLEATS PER PPP-B-601.
- 5 ▶ USE ONE CLEAT, DETAIL 13, AND THREE LAG BOLTS, DETAIL 14, ON TWO SIDES OF CONTAINER, BOLT THROUGH DETAIL 11 AS SHOWN.

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	3	2 X 4 (NOM) X 48	WOOD	
2	15	2 X 4 (NOM) X 16	WOOD	
3	1	5/16 X 45-7/8 X 48	PLYWOOD	
4	3	2 X 4 (NOM) X 48	WOOD	
5	1	2 X 4 (NOM) X 48	WOOD	
6	A/R	1/4 X 10	CUSHIONING MATERIAL, POLYETHYLENE, PPP-C-1752	◀ 2
7	8	1 X 3 X 15-1/2	PLYWOOD	◀ 2
8	8	3/8 DIA X 5	CARRIAGE BOLT (WITH HARDWARE)	◀ 2
9	1	1 X 45-7/8 X 48	PLYWOOD	◀ 3
10	1	2 X 3 X 63	CUSHIONING MATERIAL, POLYETHYLENE, PPP-C-1752	◀ 3
11	2	2 X 4 (NOM) X 48	WOOD	◀ 5
12	3	2 X 4 (NOM) X 96-15/16	WOOD	◀ 5
13	2	3/4 X 1-3/4 X 44-1/2	WOOD	◀ 5
14	6	1/4 DIA X 4	LAG BOLT	◀ 5

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Figure 5-10. Radome Shipping Container (Sheet 3)

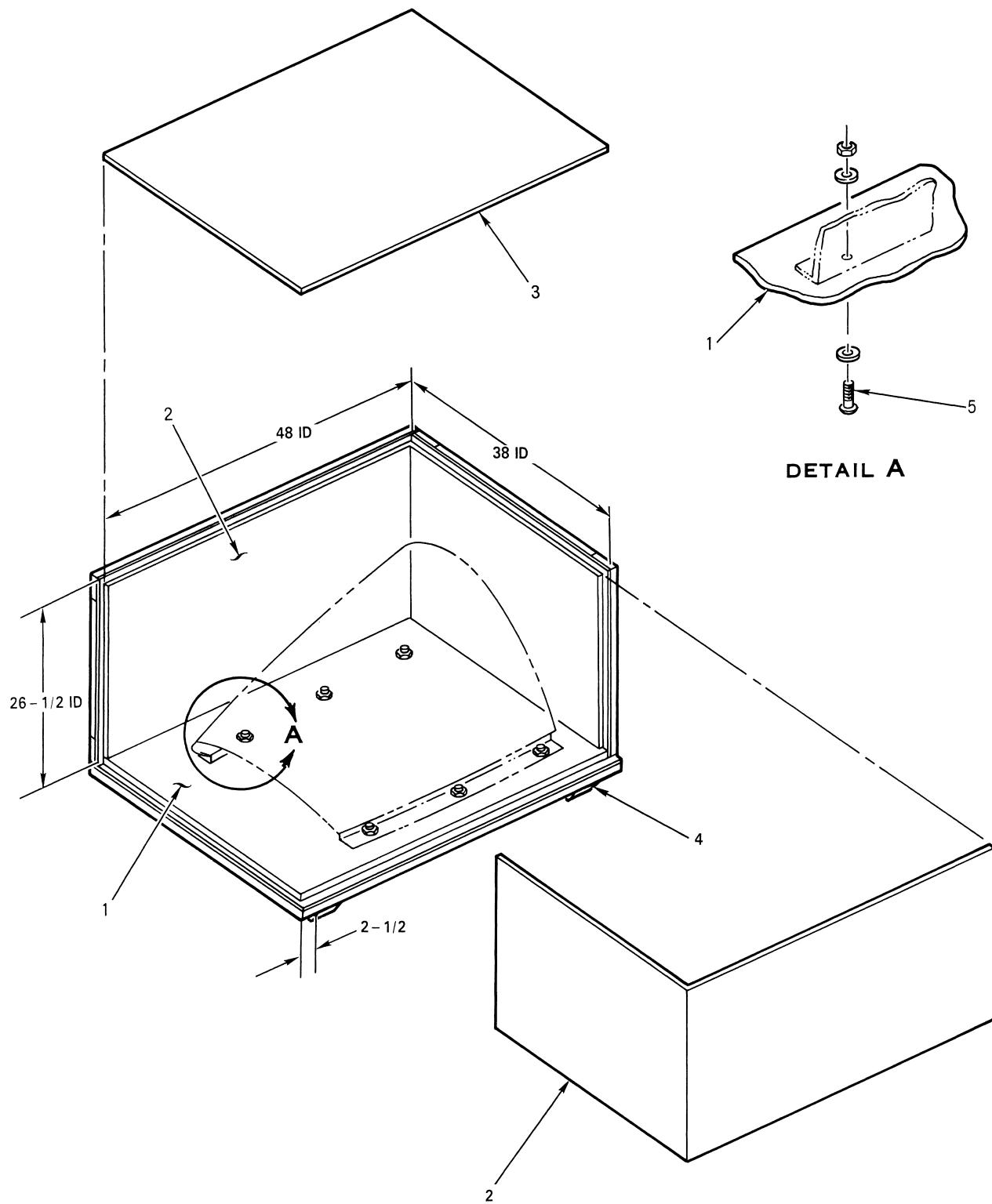
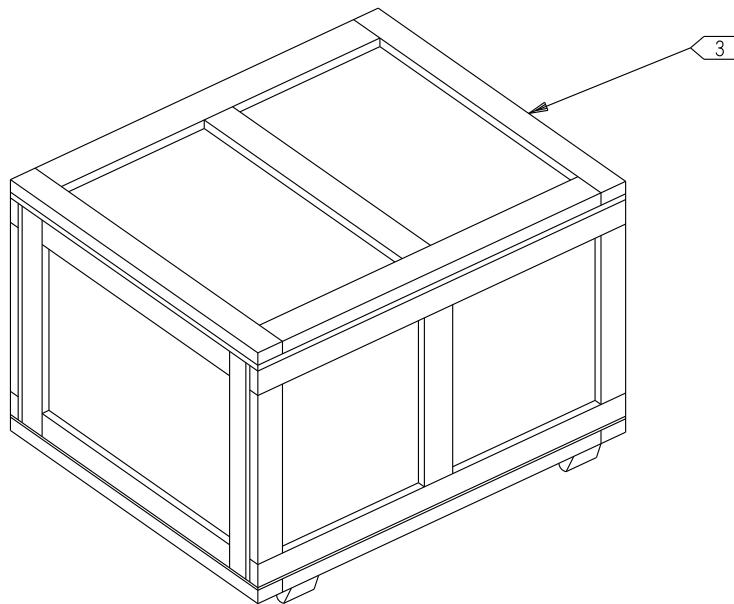


Figure 5-11. Windshield Shipping Container (Sheet 1 of 2)

SAN301-05-22-001



BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	1	1/2 X 38 X 48	PLYWOOD	
2	2	1/2 X 25 1/2 X 85 1/2	CORRUGATED, ASTM-D4727	
3	1	1/2 X 38 X 48	CORRUGATED, ASTM-D4727	
4	2	2 X 4 (NOM) X 39 3/4	WOOD	
5	6	1/4 DIA X 1	CARRIAGE BOLT (WITH HARDWARE)	ZINC PLATED

LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER 60 POUNDS.
WINDSHIELD WEIGHT 102 POUNDS. GROSS WEIGHT 162 POUNDS.
2. SECURE PART TO DETAIL 1 WITH DETAIL 5. USE PART TO LOCATE TIE DOWN HOLES AS SHOWN.

3 CONSTRUCT CONTAINER PER STANDARD SPECIFICATION
ASTM-D6251. USE 0.140 MINIMUM POV PANELS AND
3/4 X 1 3/4 MINIMUM CLEATS.

Figure 5-11. Windshield Shipping Container (Sheet 2)

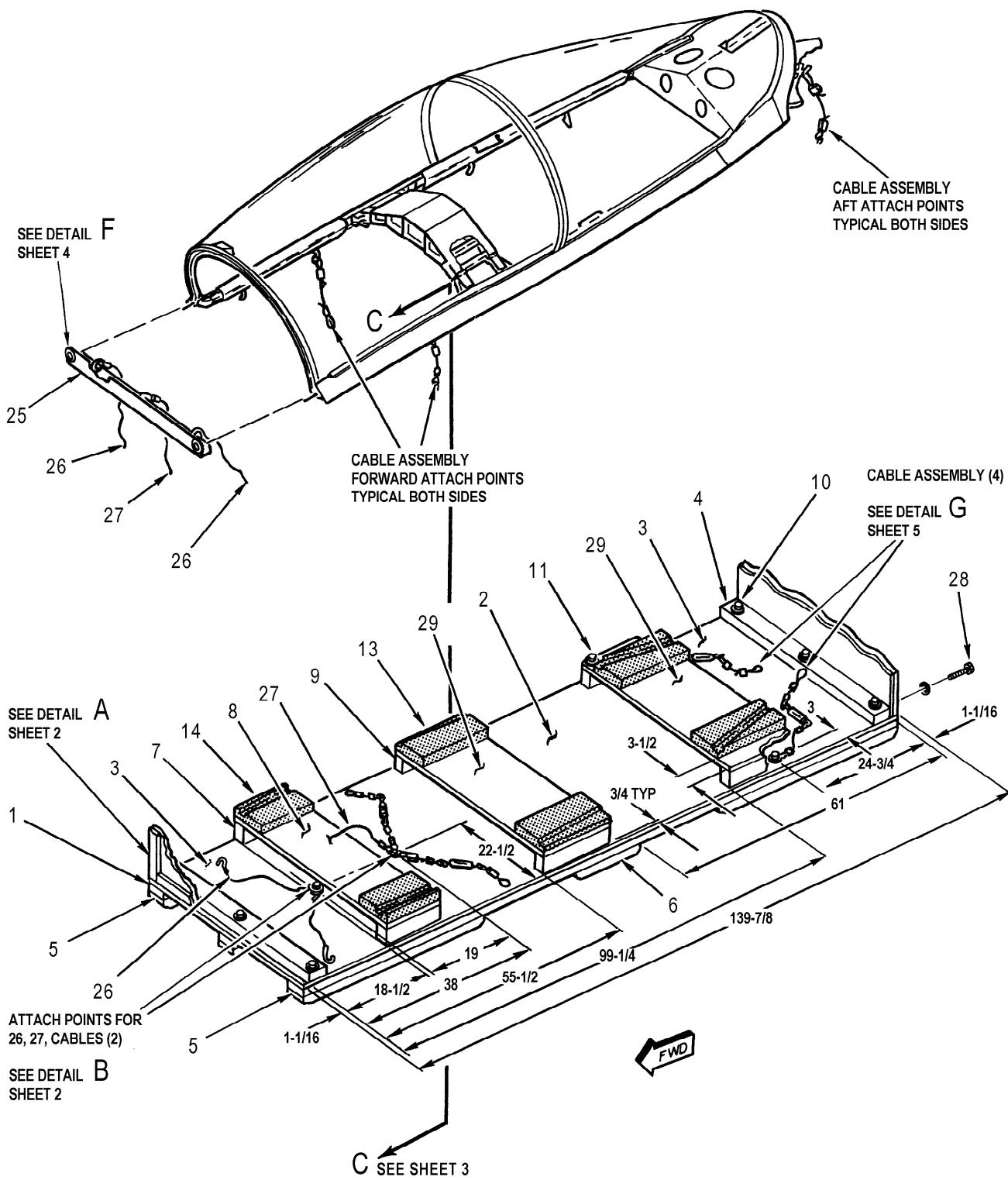
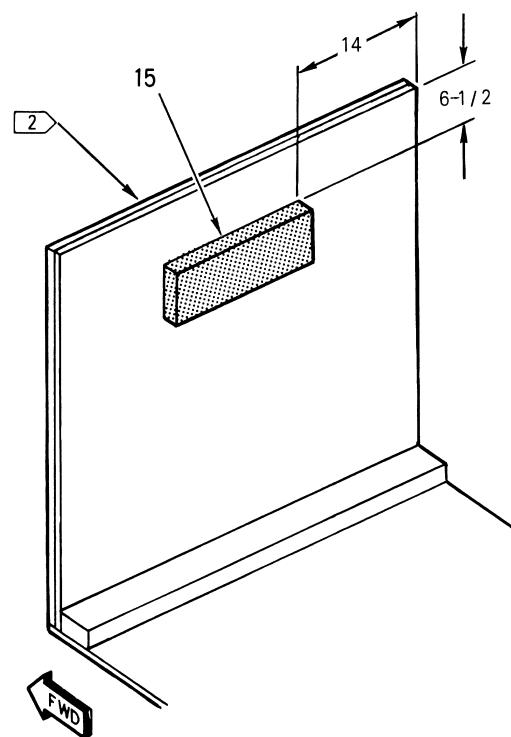
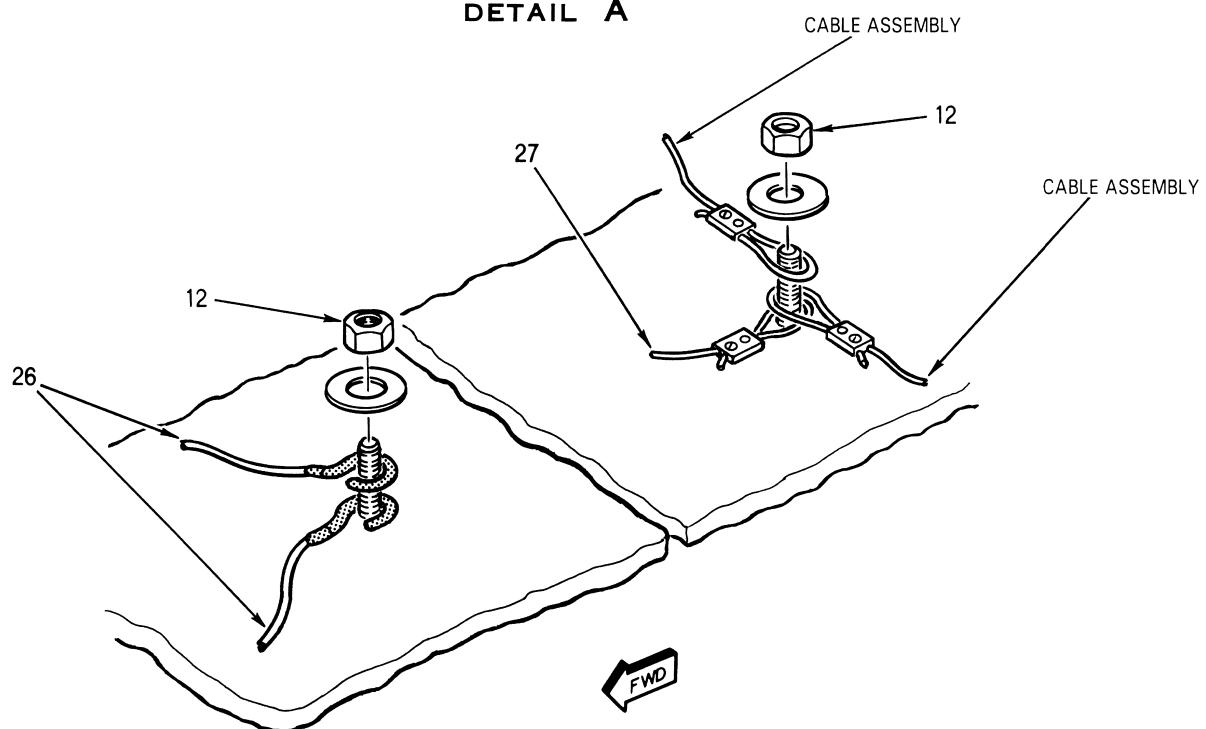


Figure 5-12. Canopy Shipping Container (Sheet 1 of 7)



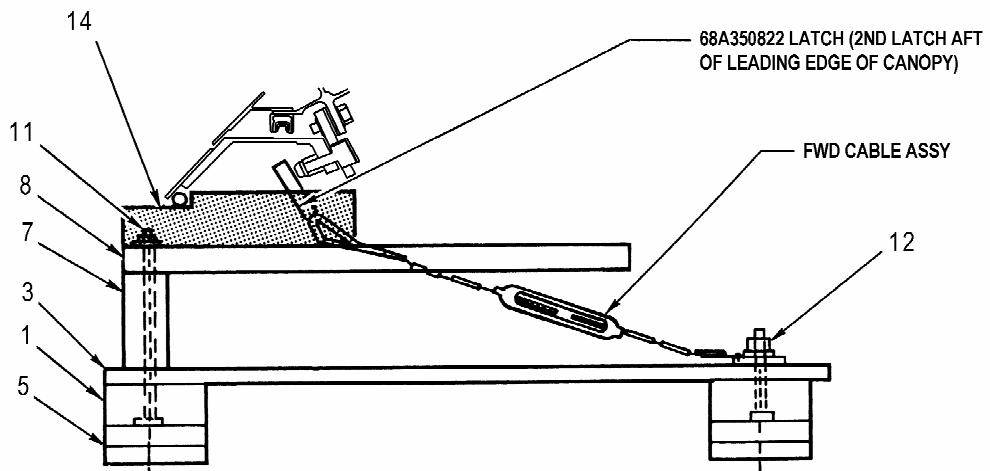
DETAIL A



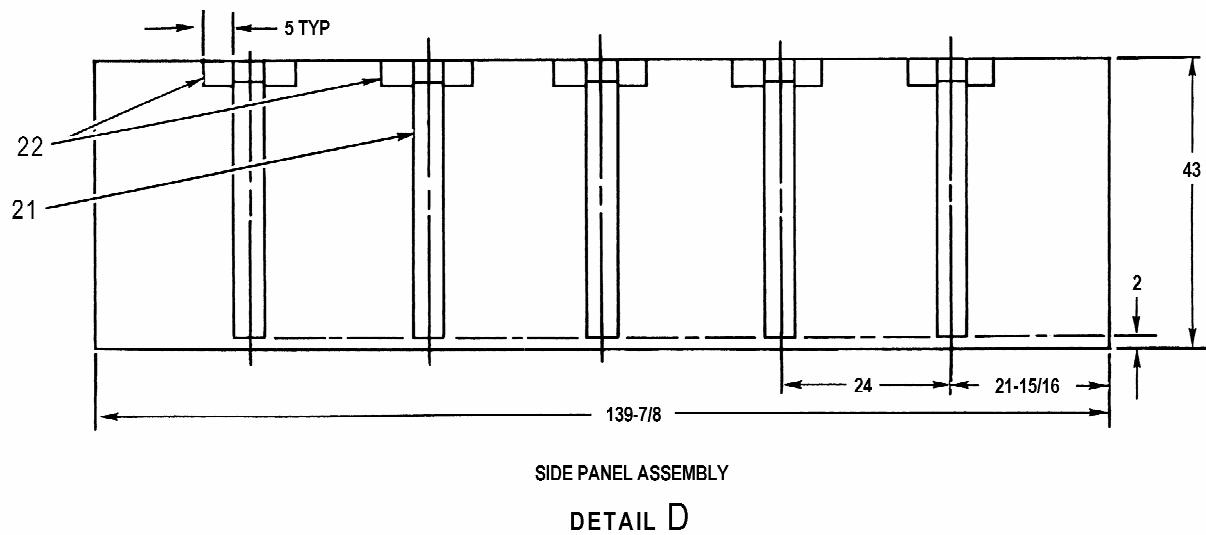
DETAIL B

Figure 5-12. Canopy Shipping Container (Sheet 2)

SAN301-05-25-001

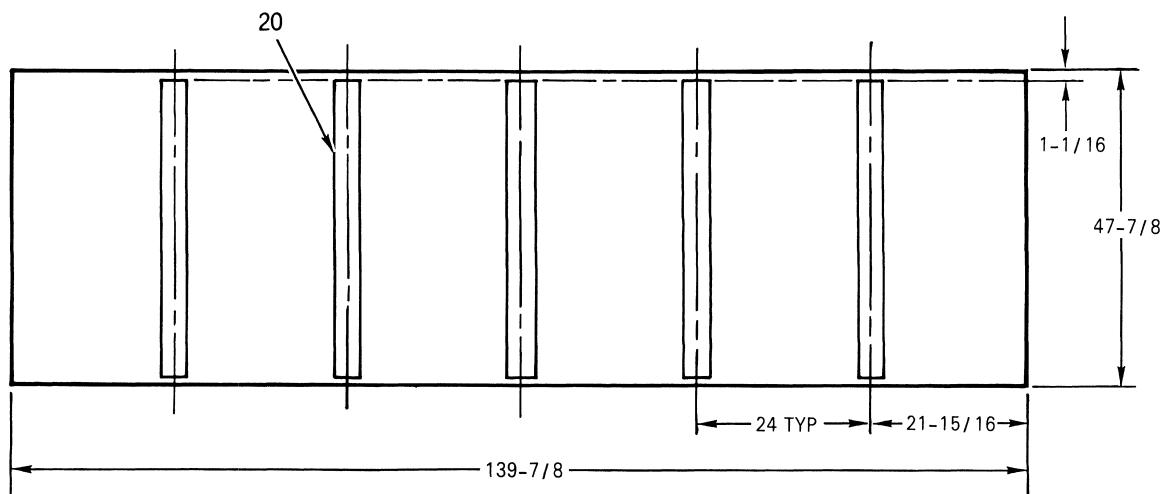


SECTION C-C

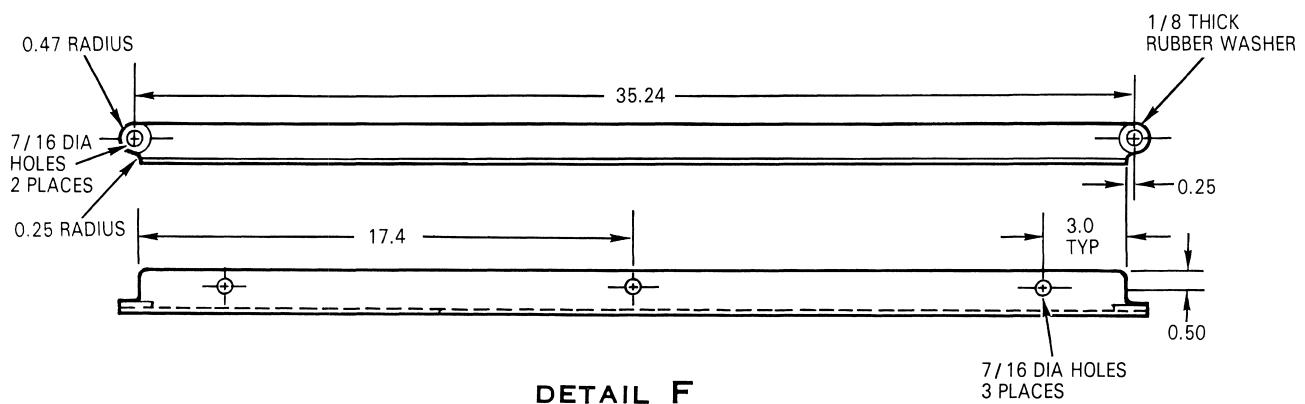


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Figure 5-12. Canopy Shipping Container (Sheet 3)

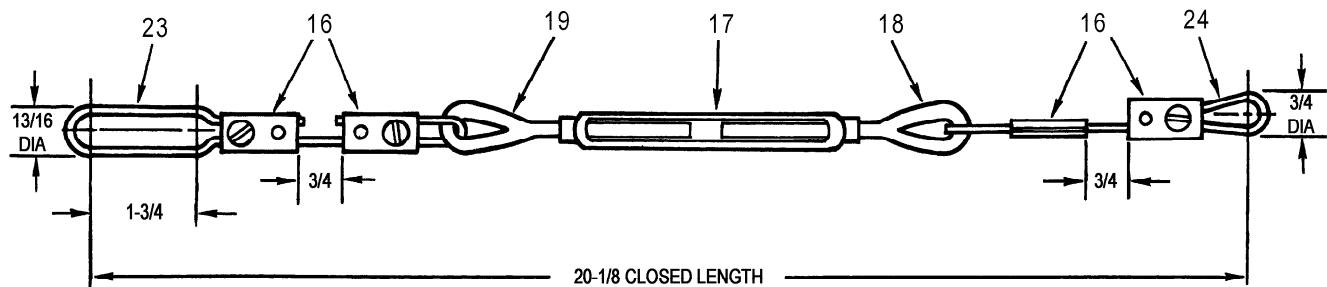


TOP PANEL ASSEMBLY

DETAIL E**DETAIL F**

SAN301-05-27-001

Figure 5-12. Canopy Shipping Container (Sheet 4)



DETAIL G

LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 334 POUNDS,
CANOPY WEIGHT IS 285 POUNDS. GROSS WEIGHT IS 619 POUNDS.

2 CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6256
AND ASTM-D6251. USE 5/16-INCH MINIMUM PLYWOOD PANEL AND
3/4 X 3-1/4 INCH MINIMUM WOOD CLEATS.

SAN301-05-28-001

Figure 5-12. Canopy Shipping Container (Sheet 5)

BILL OF MATERIAL					
DET	QTY	DESCRIPTION	SIZE	MATERIAL	NOTE
1	3	Skid	2 x 4 (Nom) x 139-7/8	ASTM-D6199	
2	1	Floor	1/2 x 45 x 96	A-A-55057	
3	2	Floor	1/2 x 45 x 21-15/16	A-A-55057	
4	2	Header	2 x 4 (Nom) x 45	ASTM-D6199	
5	12	Rubbing Strip	2 x 4 (Nom) x 42	ASTM-D6199	
6	6	Rubbing Strip	2 x 4 (Nom) x 15	ASTM-D6199	
7	2	Blocking	2 x 4 (Nom) x 12	ASTM-D6199	
8	3	Blocking	1 x 12 x 43-1/2	A-A-55057	
9	4	Blocking	2 x 4 (Nom) x 16	ASTM-D6199	
10	6	Bolt, Washer, Nut	3/8 Dia x 4-1/2	Commercial	
11	12	Bolt, Washer, Nut	3/8 Dia x 7	Commercial	2 ➔
12	4	Bolt, Washer, Nut	3/8 Dia x 3	Commercial	
13	4	Pad	16 x 8 x 2	AA59136	1 ➔
14	1	Pad	12 x 8 x 2	AA59136	1 ➔
15	1	Pad	16 x 16 x 2	AA59136	1 ➔
16	16	Clamp - Wire Rope	1/8 Dia. Cable Size	Wilcox-Crittenden or Equiv.	
17	4	Turnbuckle Body	1/4 x 4 Open Body	Wilcox-Crittenden or Equiv.	
18	4	Right Eye End Fitting	1/4 x 4	Wilcox-Crittenden or Equiv.	
19	4	Left Eye End Fitting	1/4 x 4	Wilcox-Crittenden or Equiv.	
20	5	Joist	2 x 4 (Nom) x 45	ASTM-D6199	
21	10	Vertical Support	1 x 4 (Nom) x 39-1/2	ASTM-D6199	
22	20	Lateral Support	1 x 4 (Nom) x 5	ASTM-D6199	
23	4	Cable	1/8 Dia x 14-5/8	MIL-L-60634	
24	4	Cable	1/8 Dia x 11-1/4	MIL-L-60634	
25	1	Spreader Bar	1-1/4 x 1-1/4 x 1/8 x 36- 3/16	ASTM-A36	
26	2	Bungee Cord	1/4 x 11	Commercial w/Rubber Coated Hook	

Figure 5-12. Canopy Shipping Container (Sheet 6)

BILL OF MATERIAL					
DET	QTY	DESCRIPTION	SIZE	MATERIAL	NOTE
27	1	Lanyard	1/8 Dia x 50	MIL-L-60634	
28	32	Bolt, Lag W/Washer	3/8 Dia x 3	Commercial	
29	2	Blocking	1 x 16 x 43-1/2	A-A-55057	

WARNING

EC847 adhesive is highly flammable. Do not use near open flame or sparks.
Use only in well ventilated areas.

1 → Bond details in position with EC847 adhesive.
2 → All bolts passing through skids shall be countersunk.

Figure 5-12. Canopy Shipping Container (Sheet 7)

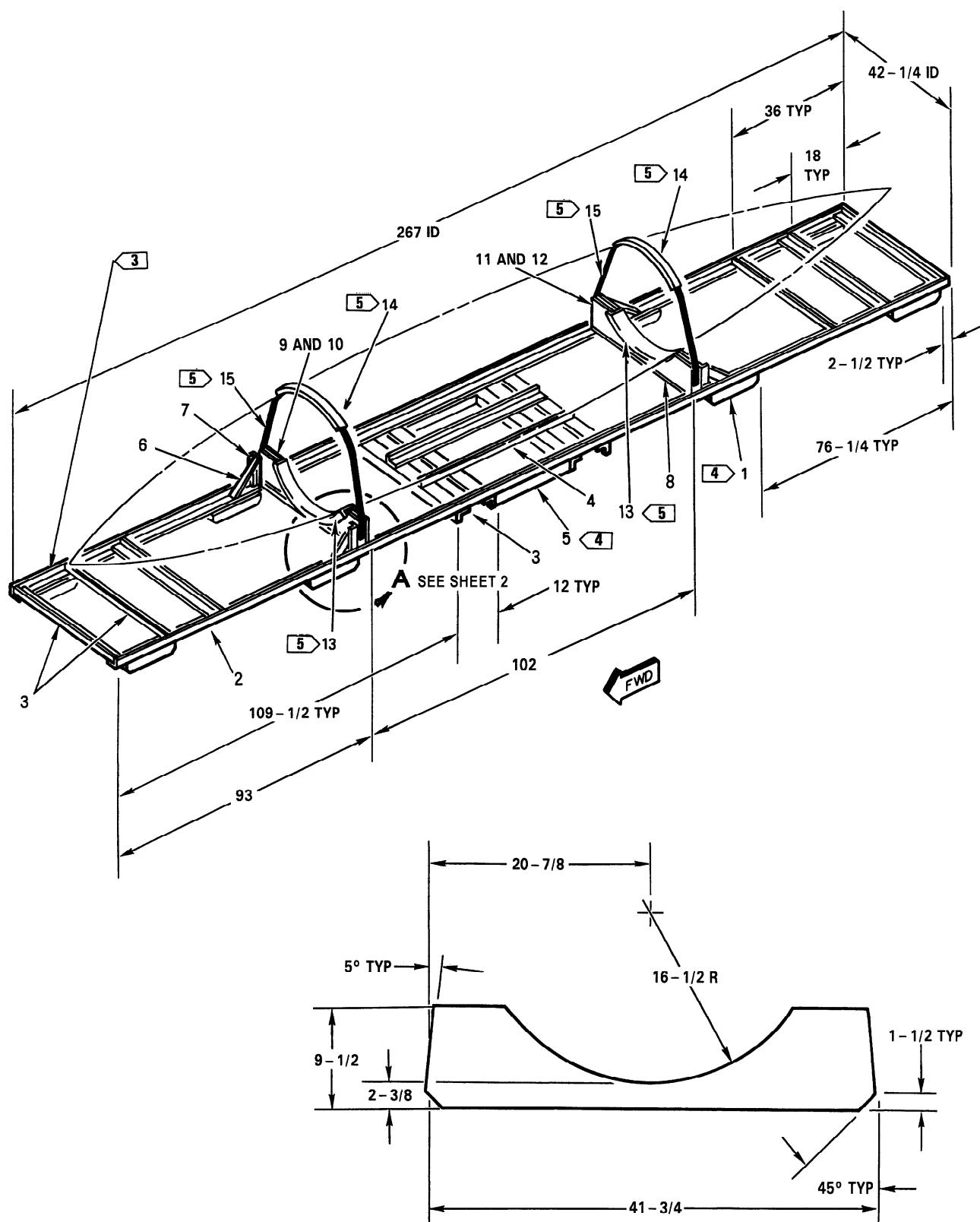
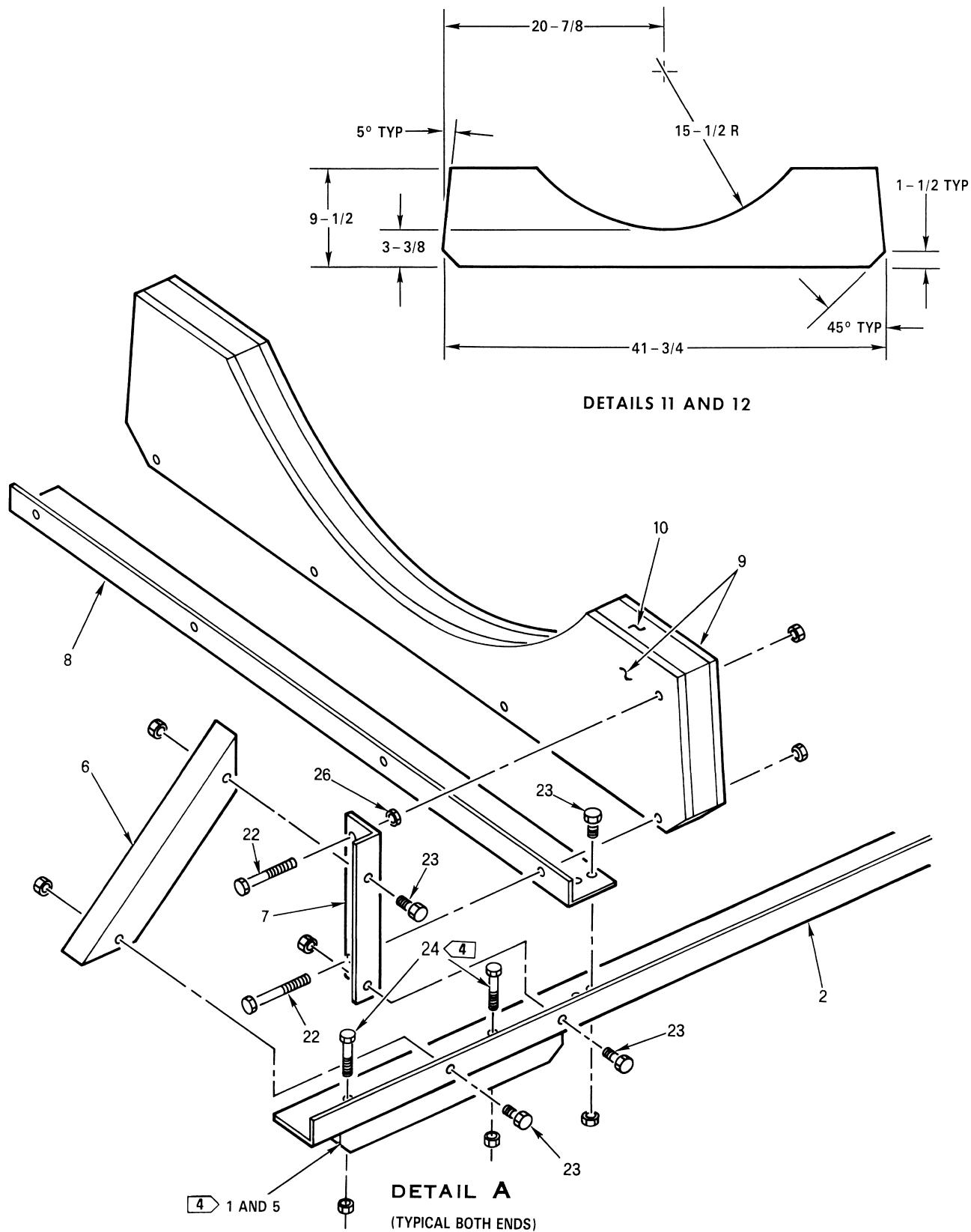


Figure 5-13. 600 Gallon Fuel Tank Shipping Container
(Sheet 1 of 4)

SAN301-05-29-002



SAN301-05-30-001

Figure 5-13. 600 Gallon Fuel Tank Shipping Container
(Sheet 2)

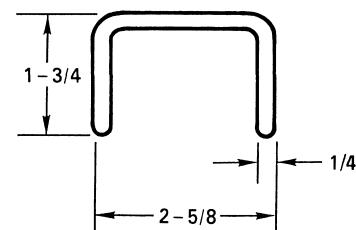
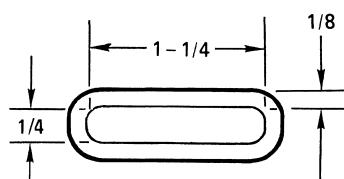
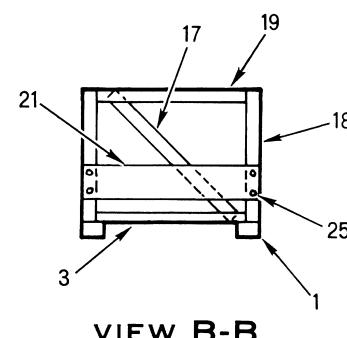
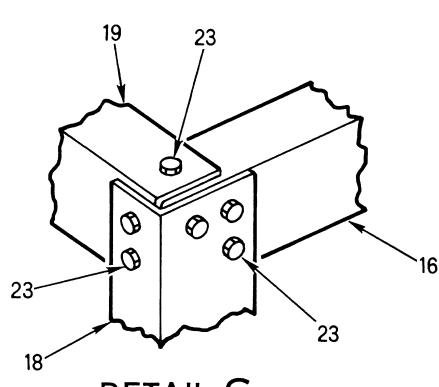
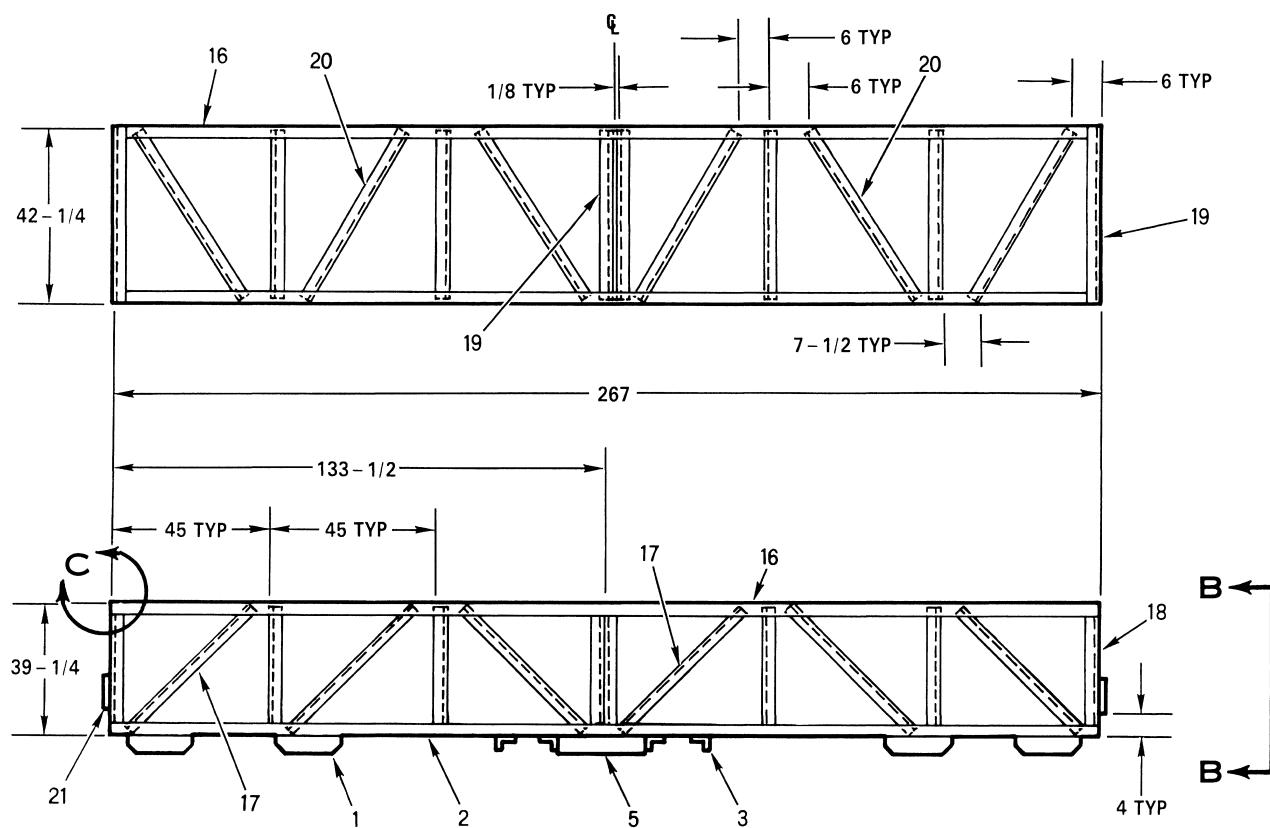


Figure 5-13. 600 Gallon Fuel Tank Shipping Container
(Sheet 3)

SAN301-05-31-001

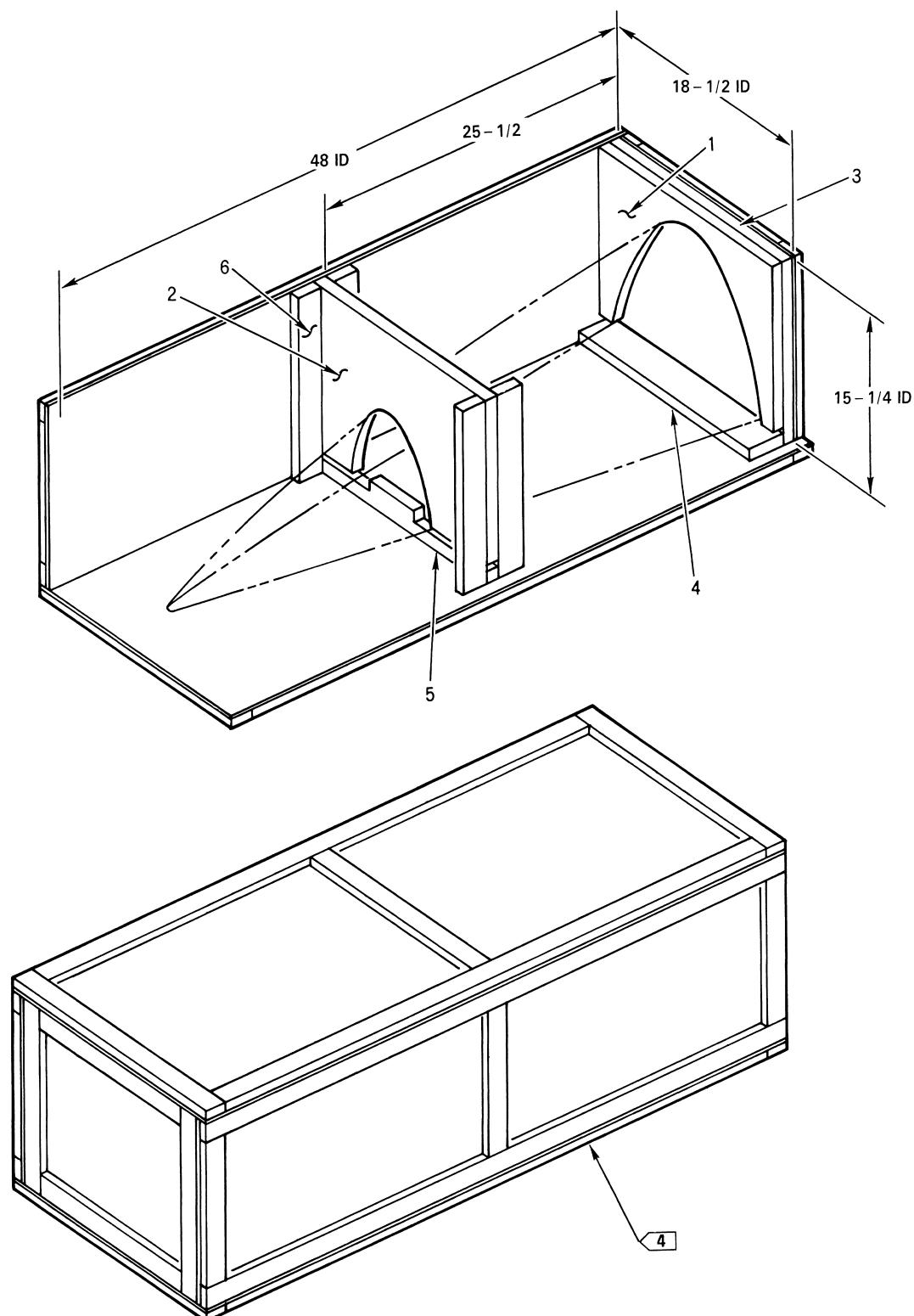
LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 380 POUNDS, FUEL TANK WEIGHT IS 382 POUNDS. GROSS WEIGHT IS 762 POUNDS.
 2. WHEN REMOVAL OF TANK FROM CRATE IS REQUIRED, REMOVE THE INNER TOP LATERAL MEMBERS (DETAIL 19) AND DIAGONAL MEMBERS (DETAIL 20) FROM THE SIDE RAILS (DETAIL 16). ATTACH CABLES TO TANK LUGS AND LIFT TANK STRAIGHT UP.
- [3] CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6255.**
- [4] ATTACH RUB STRIPS (DETAILS 1 AND 5) TO BASE WITH TWO BOLTS (DETAIL 24) PER RUB STRIP.**
- [5] POSITION DETAILS 13 ON CONTOURS. POSITION TANK WITH RIB SEAM POINTED DOWN ON CONTOURS AS SHOWN. PLACE DETAILS 14 OVER TOP OF TANK; THREAD STEEL STRAPPING (DETAIL 15) THROUGH DETAIL 14; TENSION STRAPS TIGHTLY AND SEAL. ENDS OF STRAPPING TO BE STAPLED TO SIDES OF CONTOURS. COVER FUEL AND AIR APERATURES AND ELECTRICAL PLUG WITH PLASTIC BAGS OR CAPS, OVER SEAL COMPLETELY WITH WATERPROOF TAPE.**

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	8	4 X 4 (NOM) X 16	WOOD	
2	2	1-1/2 X 3 X 267	STEEL, TYPE 4, MIL-S-21041	
3	10	1-1/2 X 3 X 42	STEEL, TYPE 4, MIL-S-21041	
4	2	1-1/2 X 3 X 48	STEEL, TYPE 4, MIL-S-21041	
5	2	4 X 4 (NOM) X 24	WOOD	
6	4	1-1/2 X 2-1/4 X 12	STEEL, TYPE 2, MIL-S-21041	
7	4	1-1/2 X 2-1/4 X 9-1/4	STEEL, TYPE 2, MIL-S-21041	
8	2	1-1/2 X 3 X 42	STEEL, TYPE 4, MIL-S-21041	
9	2	3/8 X 9-1/2 X 41-3/4	PLYWOOD	
10	1	2 X 10 (NOM) X 41-3/4	WOOD	
11	2	3/8 X 9-1/2 X 41-3/4	PLYWOOD	
12	1	2 X 10 (NOM) X 41-3/4	WOOD	
13	2	1/4 X 5-1/8 X 26	RUBBER	
14	2	1/8 X 1/2 X 1-1/2 X 26	RUBBER	
15	2	3/4 WIDE	STEEL STRAPPING ASTM-D3953	[5]
16	2	1-1/2 X 2-1/4 X 267	STEEL, STYLE 2, MIL-S-21041	[5]
17	14	1-1/2 X 2-1/4 X 54	STEEL, STYLE 2, MIL-S-21041	[5]
18	16	1-1/2 X 2-1/4 X 39	STEEL, STYLE 2, MIL-S-21041	
19	8	1-1/2 X 2-1/4 X 42	STEEL, STYLE 2, MIL-S-21041	
20	6	1-1/2 X 2-1/4 X 54-1/2	STEEL, STYLE 2, MIL-S-21041	
21	2	3/4 X 12 X 42-1/4	PLYWOOD	
22	12	5/16 DIA X 3	MACHINE BOLT (WITH HARDWARE)	
23	295	5/16 DIA X 5/8	MACHINE BOLT (WITH HARDWARE)	
24	20	5/16 DIA X 4	CARRIAGE BOLT (WITH HARDWARE)	
25	8	5/16 DIA X 1-1/2	CARRIAGE BOLT (WITH HARDWARE)	
26	4	7/16 ID (MIN)	WASHER	[4]

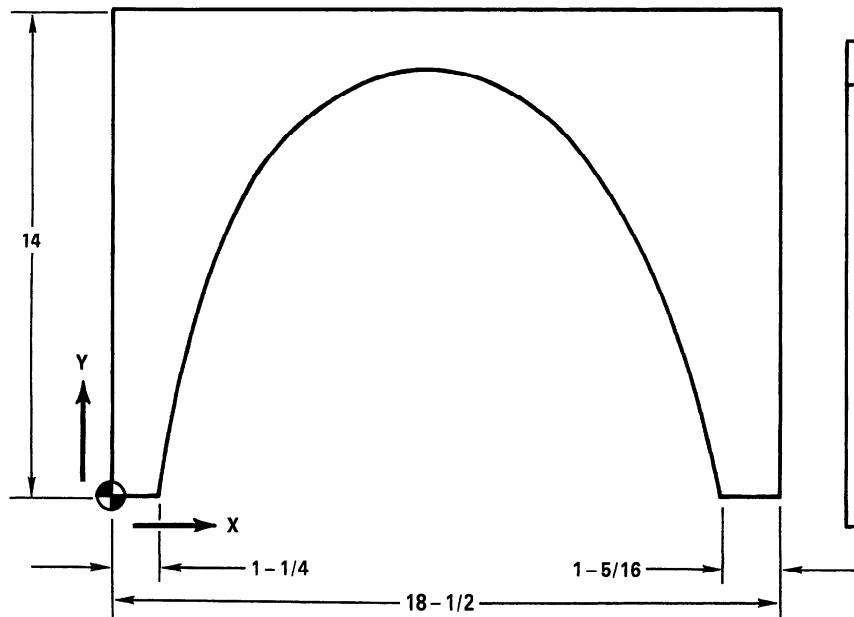
SAN301-05-32-002

**Figure 5-13. 600 Gallon Fuel Tank Shipping Container
(Sheet 4)**



SAN301-05-33-001

**Figure 5-14. Aerial Refueling Fairing Shipping Container
(Sheet 1 of 3)**

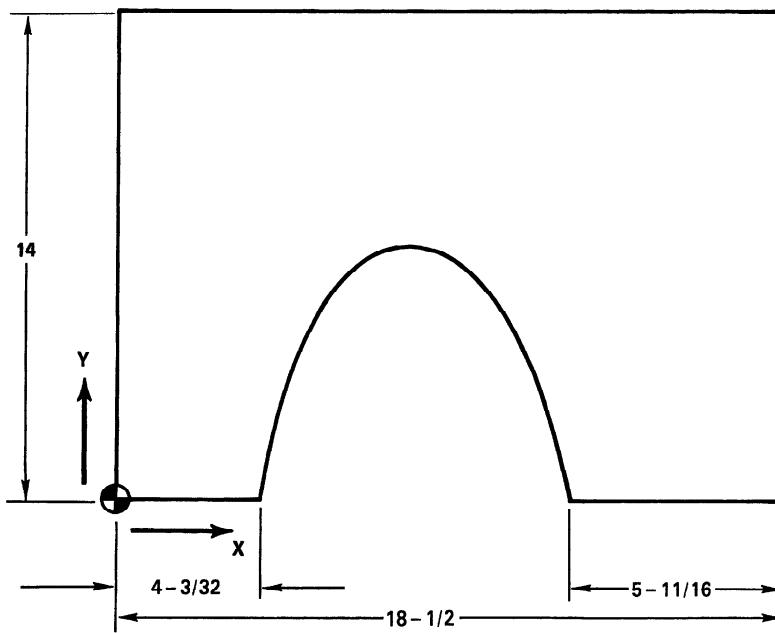


DETAIL 1

X	Y	X	Y
1 - 7/16	1	9 - 3/4	12 - 5/32
1 - 5/8	2	10 - 1/2	12
1 - 13/16	3	11 - 1/4	11 - 11/16
2 - 1/16	4	12	11 - 3/16
2 - 5/16	5	12 - 11/16	10 - 9/16
2 - 19/32	6	13 - 9/32	10
2 - 15/16	7	14	9
3 - 3/8	8	14 - 5/8	8
3 - 7/8	9	15 - 1/8	7
4 - 9/16	10	15 - 9/16	6
5	10 - 1/2	15 - 15/16	5
5 - 3/4	11 - 3/16	16 - 1/4	4
6 - 1/2	11 - 5/8	16 - 9/16	3
7 - 1/4	11 - 15/16	16 - 3/4	2
8 - 1/2	12 - 3/16	16 - 15/16	1
9 - 1/4	12 - 7/32		

DETAIL 1

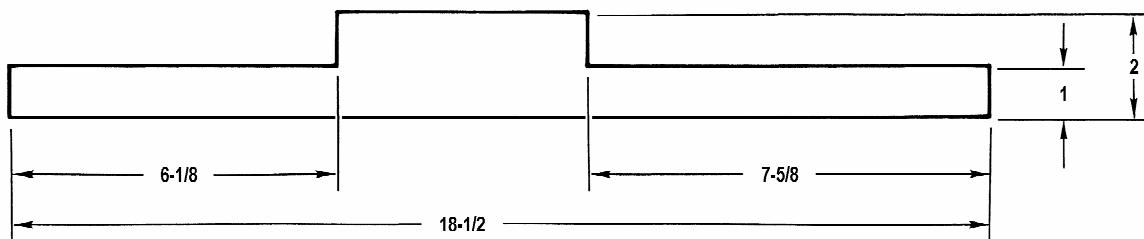
DETAIL 2			
X	Y	X	Y
4 - 1/4	1	9	7 - 7/32
4 - 1/2	2	9 - 1/2	7
4 - 3/4	3	10	6 - 5/8
5 - 3/32	4	10 - 1/2	6 - 3/32
5 - 1/2	5	10 - 7/8	5 - 9/16
6	5 - 13/16	11 - 3/16	5
6 - 1/2	6 - 3/8	11 - 11/16	4
7	6 - 13/16	12 - 3/32	3
7 - 1/2	7 - 1/8	12 - 3/8	2
8	7 - 1/4	12 - 5/8	1
8 - 1/2	7 - 9/32		



DETAIL 2

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Figure 5-14. Aerial Refueling Fairing Shipping Container
(Sheet 2)



DETAIL 5

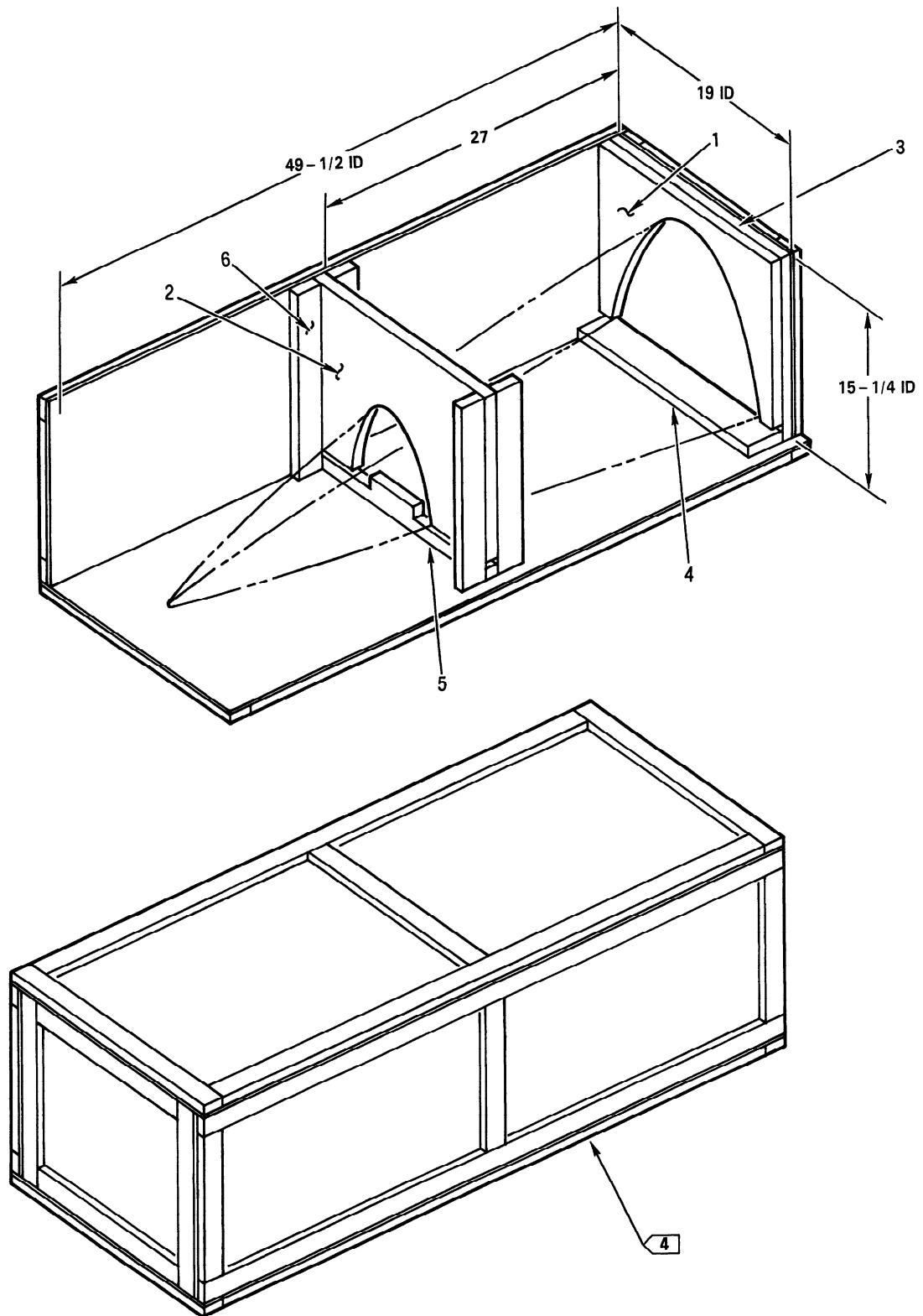
LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 25 POUNDS,
FAIRING WEIGHT IS 9 POUNDS. GROSS WEIGHT IS 34 POUNDS.
2. BOND BLOCKING IN PLACE, USE EC847 ADHESIVE.
3. WRAP FAIRING IN PLASTIC SHEET, FEDERAL SPECIFICATION
A-A-3174, TYPE I, CLASS 1, GRADE B, FINISH 1.
4. CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6251.
USE 0.070 THICK MINIMUM PAPER OVERLAIRED VENEER, CONTAINER
GRADE PANELS, AND 5/8 X 1-3/4 MINIMUM THICK WOOD CLEATS.

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	1	1 X 14 X 18-1/2	FIBERBOARD, CORRUGATED, ASTM-D4727	
2	1	1 X 14 X 18-1/2	FIBERBOARD, CORRUGATED, ASTM-D4727	
3	1	1 X 15-1/4 X 18-1/2	FIBERBOARD, CORRUGATED, ASTM-D4727	
4	1	1 X 3 X 18-1/2	FIBERBOARD, CORRUGATED, ASTM-D4727	
5	1	1 X 2 X 18-1/2	FIBERBOARD, CORRUGATED, ASTM-D4727	
6	4	1 X 2 X 15-1/4	FIBERBOARD, CORRUGATED, ASTM-D4727	

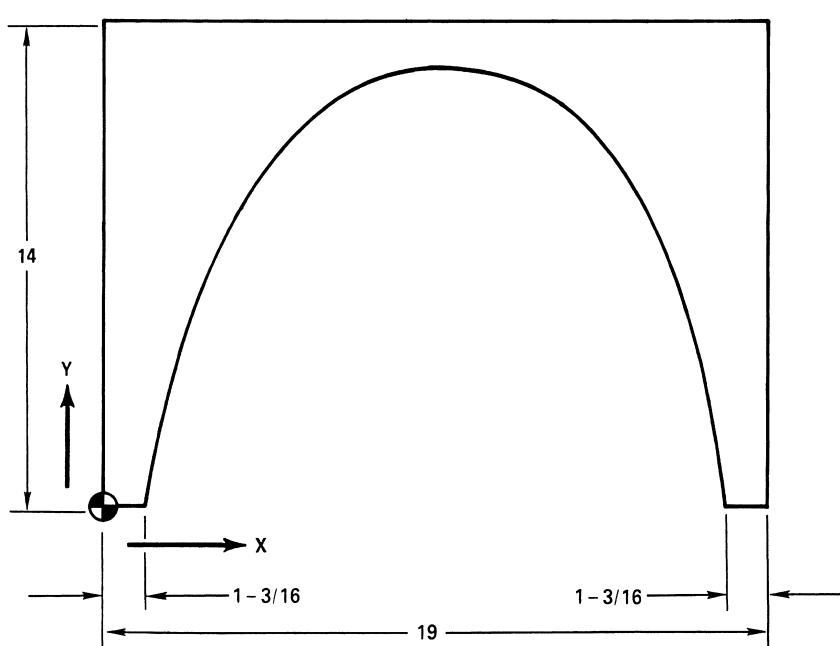
SAN301-05-35-001

Figure 5-14. Aerial Refueling Fairing Shipping Container
(Sheet 3)



SAN301-05-36-001

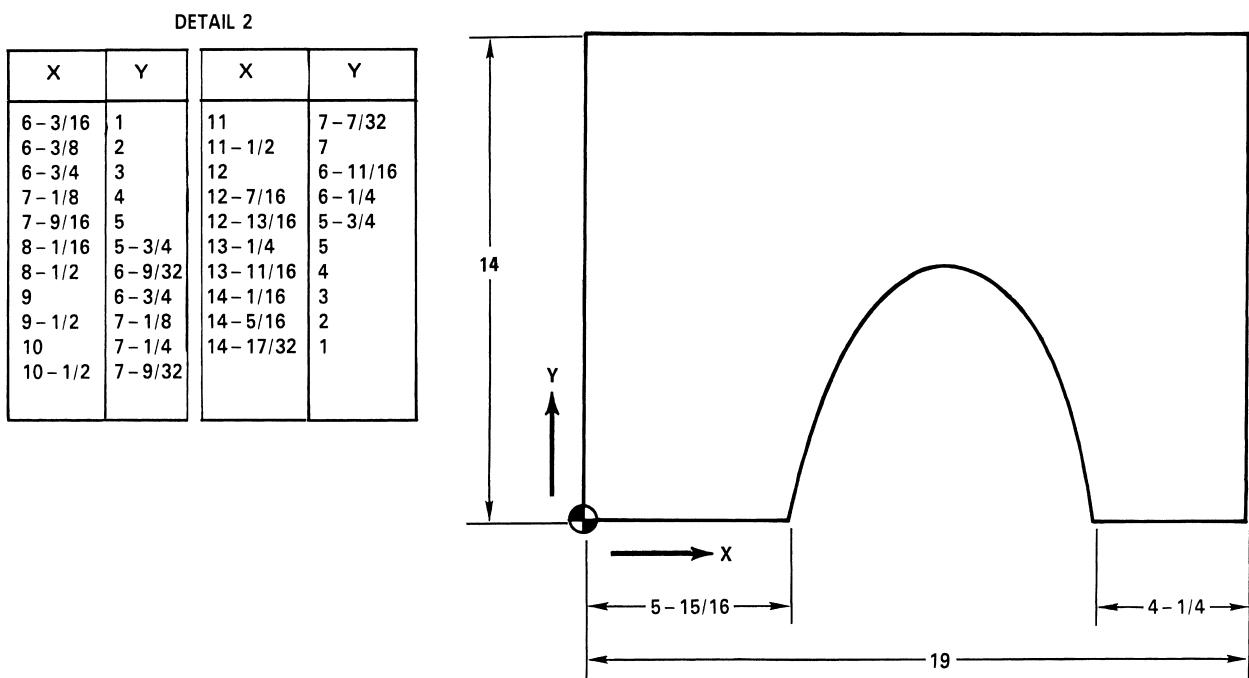
Figure 5-15. Gun Fairing Shipping Container (Sheet 1 of 3)



DETAIL 1

X	Y	X	Y
1 - 3/8	1	10 - 3/4	12 - 9/16
1 - 9/16	2	11 - 1/2	12 - 3/8
1 - 13/16	3	12 - 1/4	12 - 1/16
2 - 1/16	4	13	11 - 5/8
2 - 3/8	5	13 - 3/4	11
2 - 3/4	6	14 - 9/16	10
3 - 3/16	7	15 - 1/4	9
3 - 11/16	8	15 - 3/4	8
4 - 1/4	9	16 - 3/16	7
4 - 15/16	10	16 - 9/16	6
5 - 13/16	11	16 - 13/16	5
6 - 3/4	11 - 3/4	17 - 3/32	4
7 - 11/16	12 - 1/4	17 - 5/16	3
8 - 7/16	12 - 1/2	17 - 1/2	2
9 - 1/4	12 - 5/8	17 - 11/16	1
10	12 - 5/8		

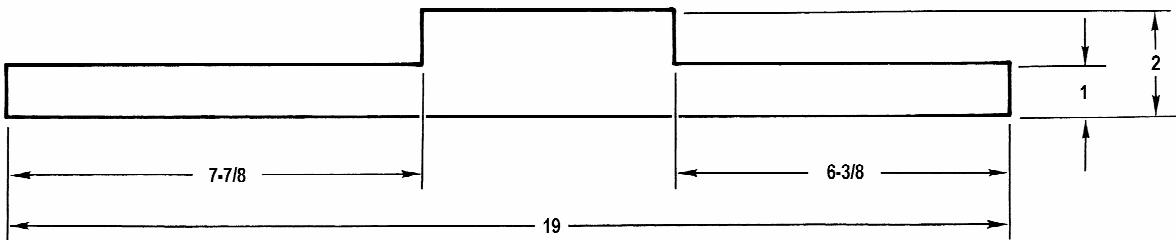
DETAIL 1



DETAIL 2

SAN301-05-37-001

Figure 5-15. Gun Fairing Shipping Container (Sheet 2)



DETAIL 5

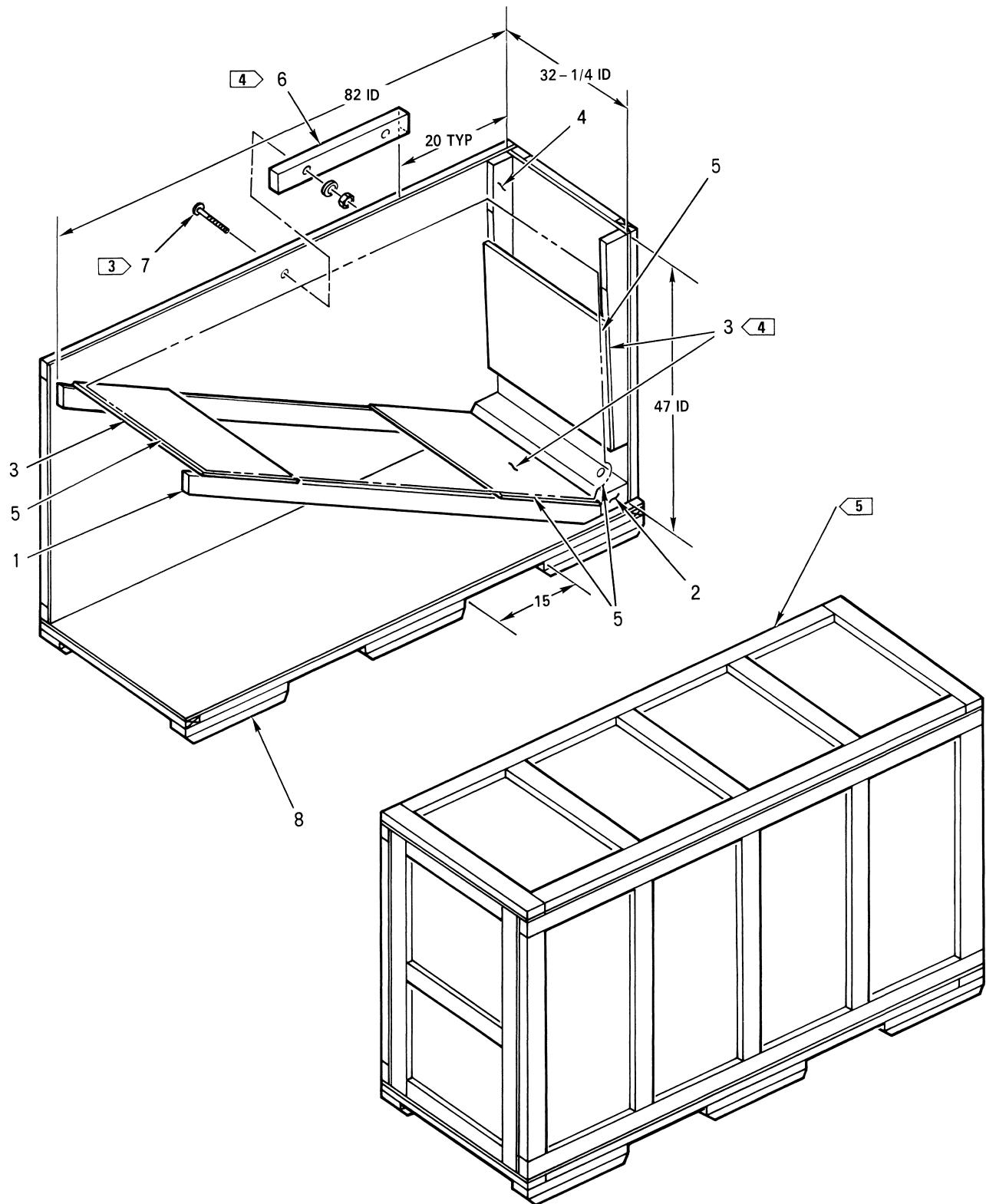
LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 25 POUNDS,
FAIRING WEIGHT IS 25 POUNDS. GROSS WEIGHT IS 50 POUNDS.
2. BOND BLOCKING IN PLACE, USE EC847 ADHESIVE.
3. WRAP FAIRING IN PLASTIC SHEET, FEDERAL SPECIFICATION
A-A-3174, TYPE I, CLASS 1, GRADE B, FINISH 1.
4. CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6251.
USE 0.070 THICK MINIMUM PAPER OVERLAID VENEER, CONTAINER
GRADE PANELS, AND 5/8 X 1-3/4 MINIMUM THICK WOOD CLEATS.

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	1	1 X 14 X 19	FIBERBOARD, CORRUGATED, ASTM-D4727	
2	1	1 X 14 X 19	FIBERBOARD, CORRUGATED, ASTM-D4727	
3	1	1 X 15-1/4 X 19	FIBERBOARD, CORRUGATED, ASTM-D4727	
4	1	1 X 3 X 19	FIBERBOARD, CORRUGATED, ASTM-D4727	
5	1	1 X 2 X 19	FIBERBOARD, CORRUGATED, ASTM-D4727	
6	4	1 X 2 X 15-1/4	FIBERBOARD, CORRUGATED, ASTM-D4727	

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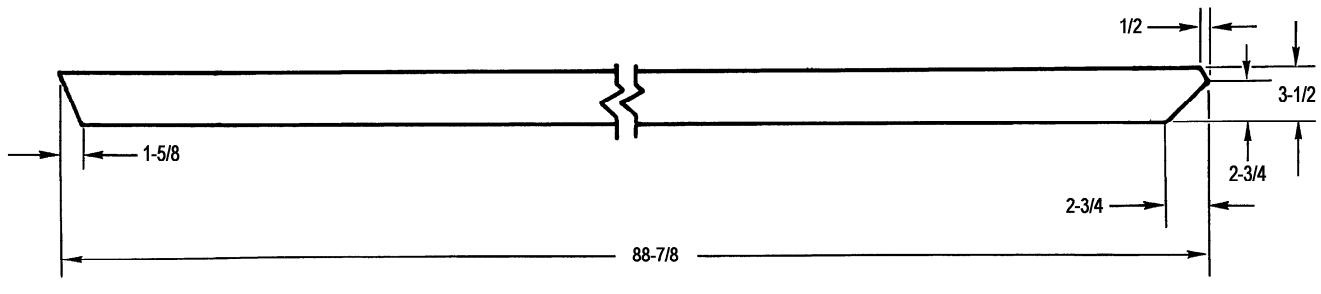
Figure 5-15. Gun Fairing Shipping Container (Sheet 3)



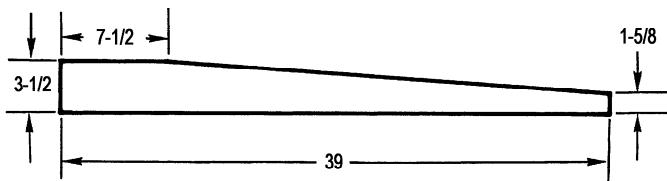
SAN301-05-39-001

**Figure 5-16. Variable Inlet Ramp Shipping Container
(Sheet 1 of 2)**

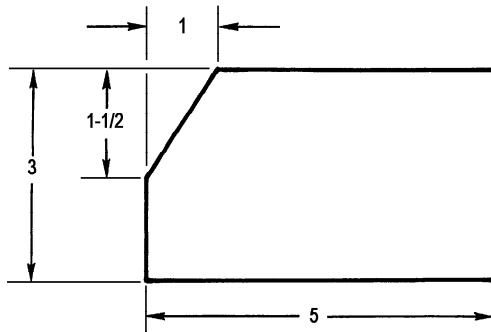
CSTO SR1F-15SA-3-1



DETAIL 1



DETAIL 4



DETAIL 2

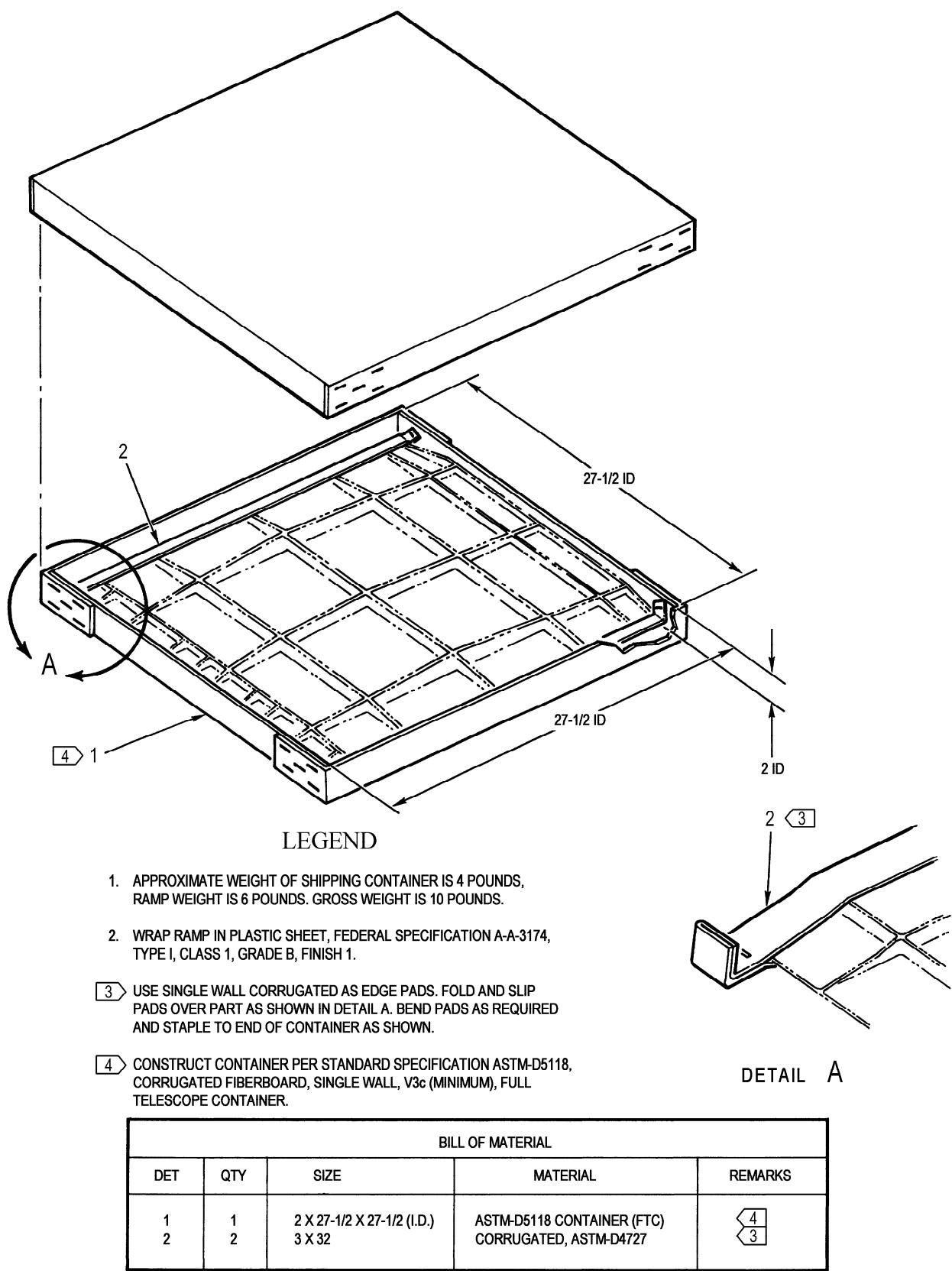
LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 71 POUNDS, RAMP WEIGHT IS 180 POUNDS. GROSS WEIGHT IS 251 POUNDS.
2. PLACE PLASTIC SHEET, A-A-3174, TYPE I, CLASS 1, GRADE B, FINISH 1, BETWEEN RAMP AND SIDES OF CONTAINER.
- 3> INSTALL DETAIL 7 THROUGH CLEATS, SIDE PANELS AND DETAIL 6; LEFT AND RIGHT SIDES OF CONTAINER.
- 4> BOND PLASTIC SHEET, A-A-3174, TYPE I, CLASS 1, GRADE B, FINISH 1, TO DETAILS 3 AND 6. USE EC847 ADHESIVE.
- 5> CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6251. USE 0.180 THICK MINIMUM PAPER OVERLAIDED VENEER, CONTAINER GRADE PANELS, AND 3/4 X 1-3/4 MINIMUM WOOD CLEATS.

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	2	2 X 4 (NOM) X 88-7/8	WOOD	
2	1	3 X 5 X 34-1/4	PLYWOOD	
3	3	5/16 X 24 X 32-1/4	PLYWOOD	4
4	2	2 X 4 (NOM) X 39	WOOD	
5	A/R	1/4 THICK	CUSHIONING MATERIAL, POLYETHYLENE AA59136	4
6	2	2 X 4 (NOM) X 24	WOOD	
7	4	3/8 DIA. X 3	CARRIAGE BOLT (WITH HARDWARE)	4
8	12	2 X 4 (NOM) X 18	WOOD	3

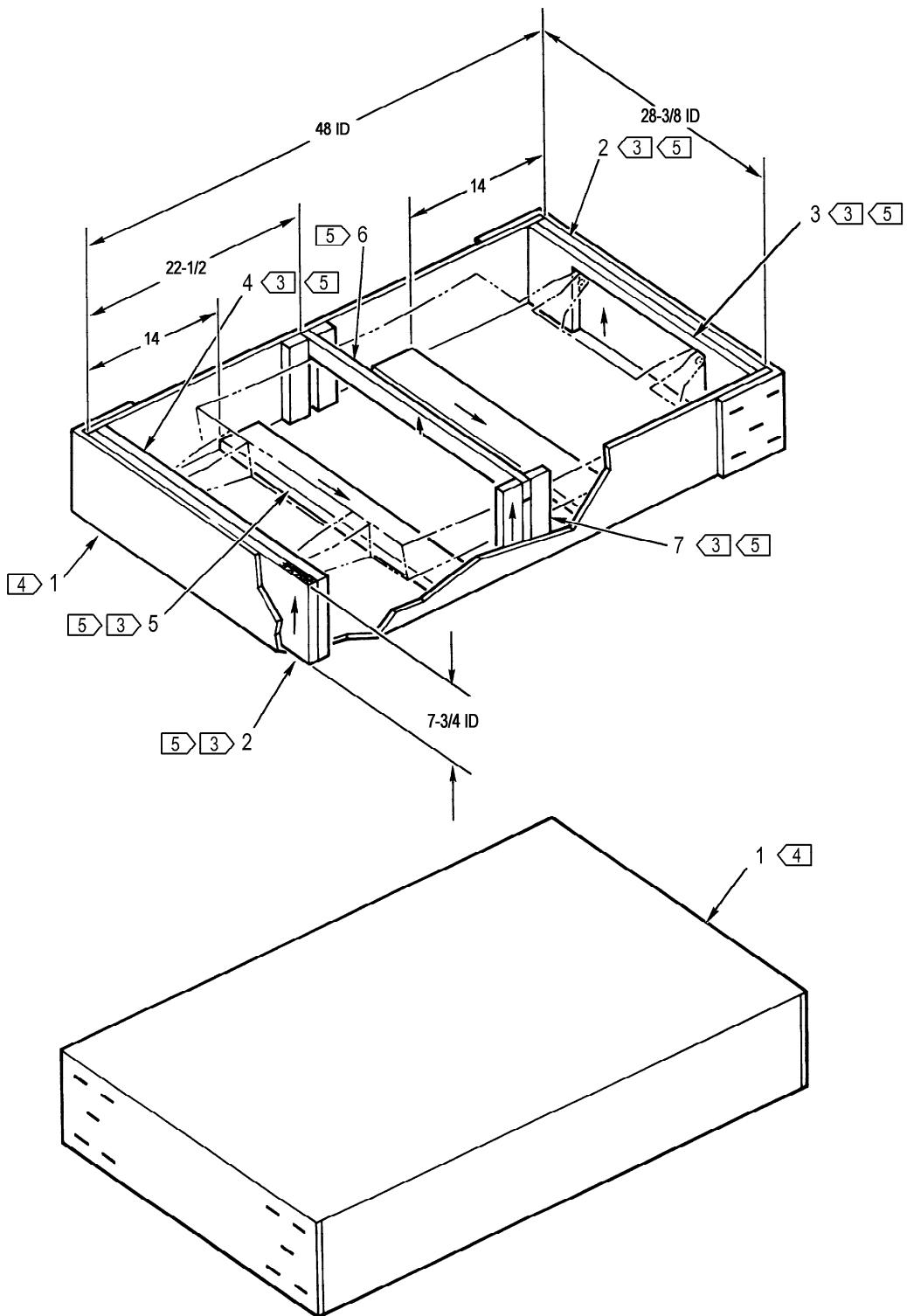
SAN301-05-40-001

**Figure 5-16. Variable Inlet Ramp Shipping Container
(Sheet 2)**



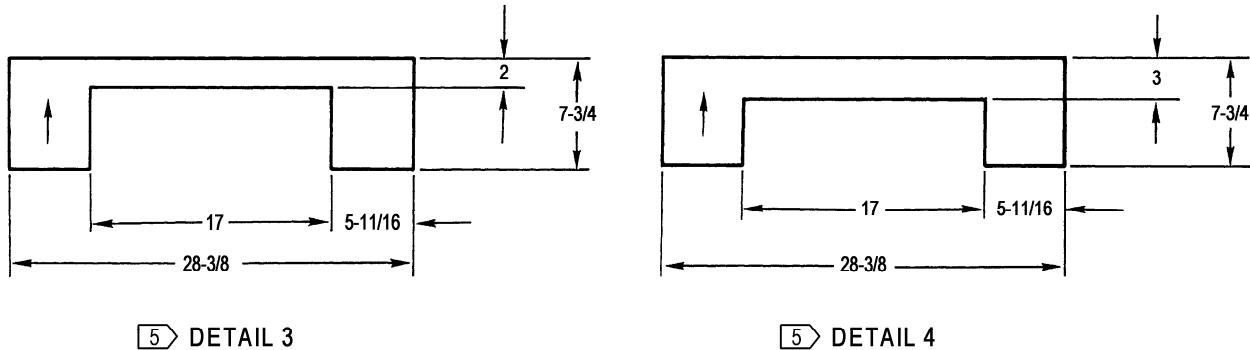
SAN301-05-41-001

Figure 5-17. Second Position Ramp Shipping Container



SAN301-05-42-001

**Figure 5-18. Third Position Ramp Shipping Container
(Sheet 1 of 2)**



LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 12 POUNDS,
RAMP WEIGHT IS 41 POUNDS. GROSS WEIGHT IS 53 POUNDS.
2. WRAP RAMP IN PLASTIC SHEET, FEDERAL SPECIFICATION
A-A-3174, TYPE I, CLASS 1, GRADE B, FINISH 1.
- 3 BOND DETAILS 2, 3, 4, 5, & 7 IN PLACE AS SHOWN, USE EC847
ADHESIVE.
- 4 CONSTRUCT CONTAINER PER STANDARD SPECIFICATION
ASTM-D5118, CORRUGATED FIBERBOARD, SINGLE WALL,
V3c (MINIMUM); FULL TELESCOPE CONTAINER.
- 5 DETAILS 2, 3, 4, 5, 6, & 7 ARE CORRUGATED FIBERBOARD,
DOMESTIC, GRADE 125 (MIN). → INDICATES FLUTE
DIRECTION.

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	1	7-3/4 X 28-3/8 X 48 (ID)	ASTM-D5118 CONTAINER (FTC)	
2	2	1 X 7-3/4 X 28-3/8	CORRUGATED, ASTM-D4727	
3	1	1 X 7-3/4 X 28-3/8	CORRUGATED, ASTM-D4727	
4	1	1 X 7-3/4 X 28-3/8	CORRUGATED, ASTM-D4727	
5	2	1 X 4 X 28-3/8	CORRUGATED, ASTM-D4727	
6	1	1 X 2-15/16 X 28-3/8	CORRUGATED, ASTM-D4727	
7	4	1 X 2 X 7-3/4	CORRUGATED, ASTM-D4727	

SAN301-05-43-001

Figure 5-18. Third Position Ramp Shipping Container
(Sheet 2)

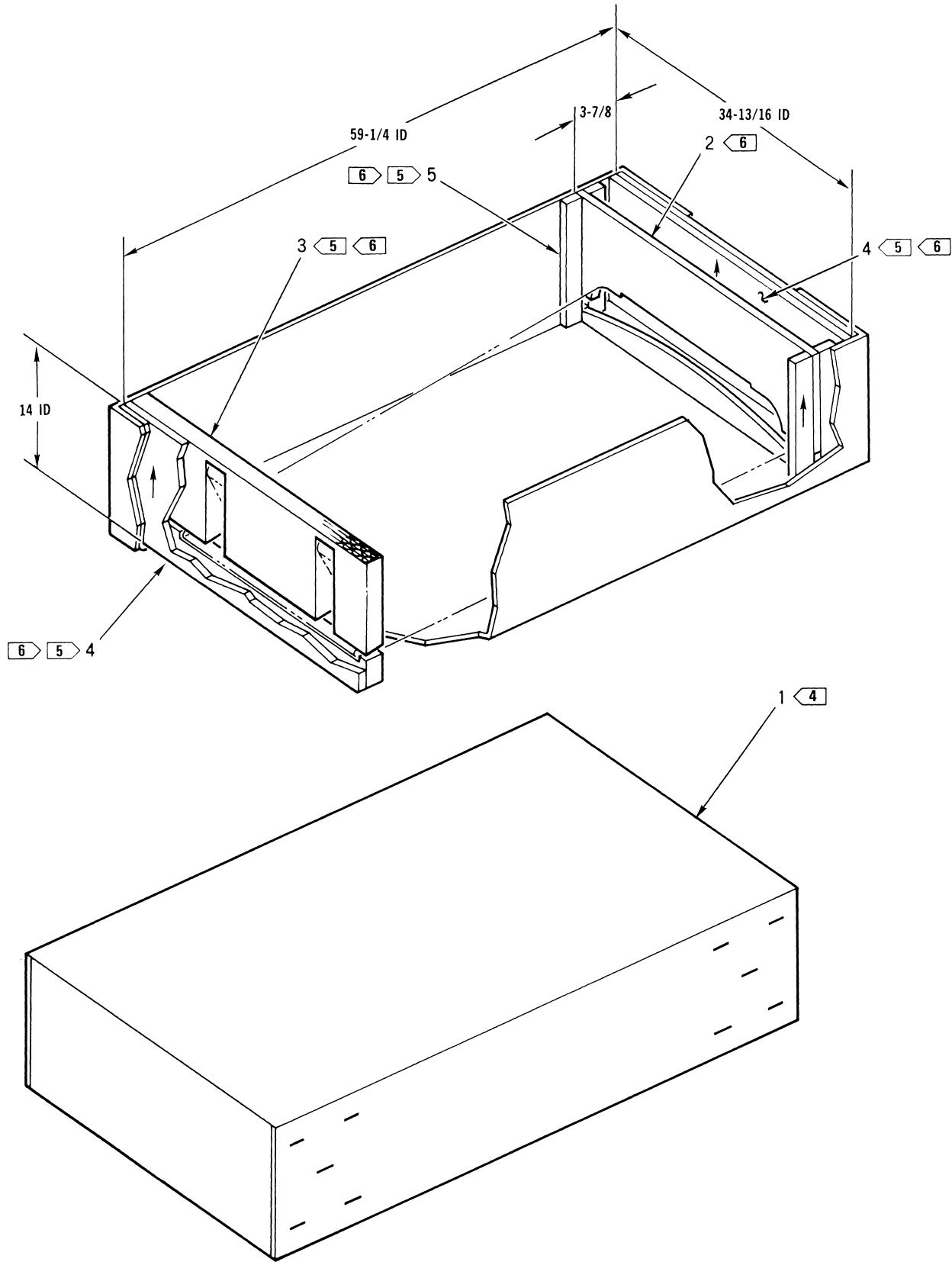


Figure 5-19. Diffuser Ramp Shipping Container (Sheet 1 of 3)

SAN301-05-44-001

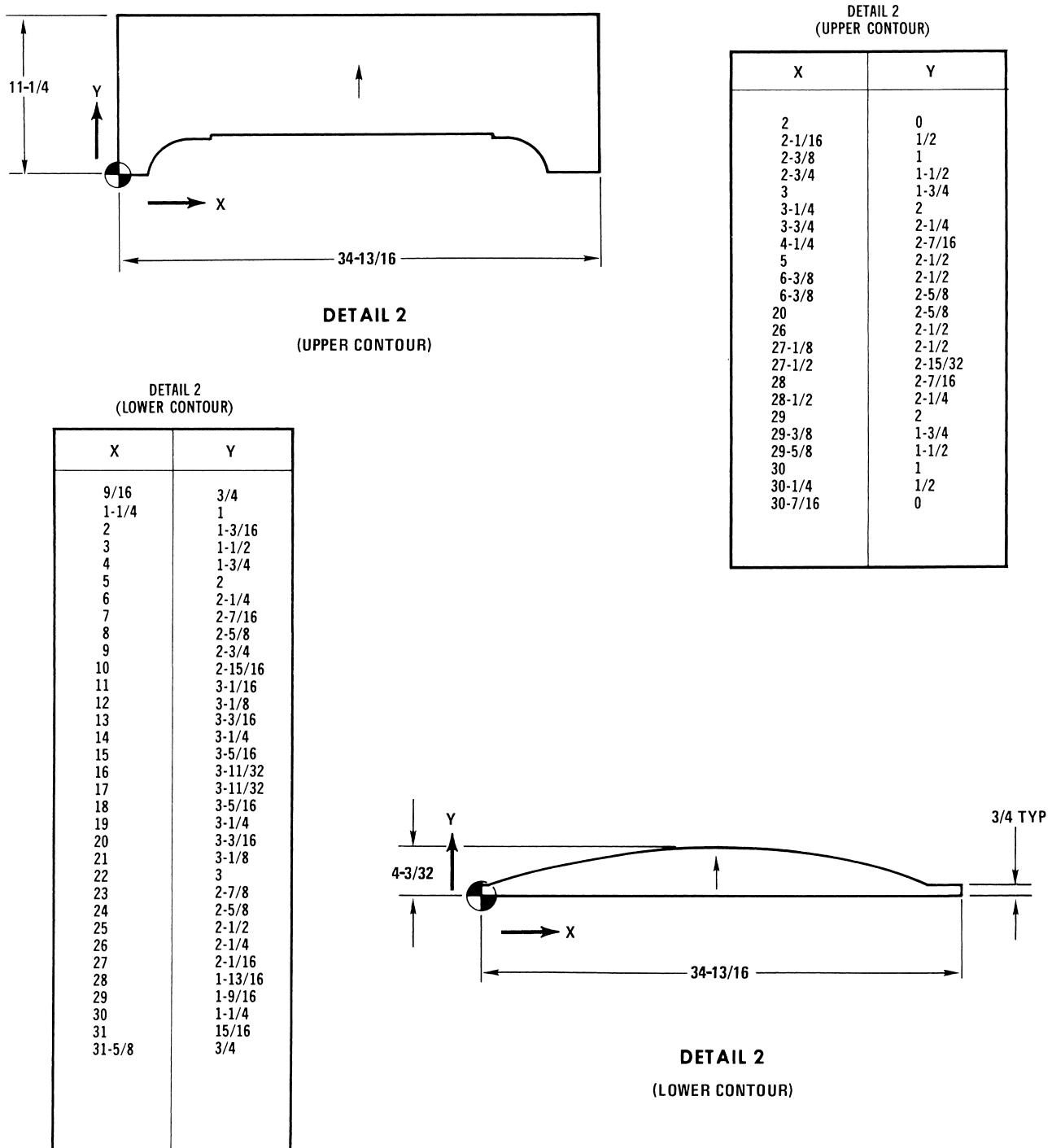
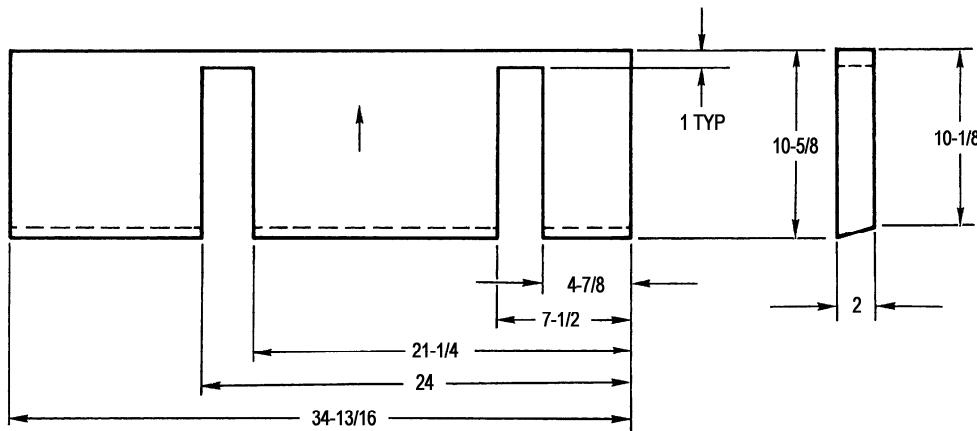
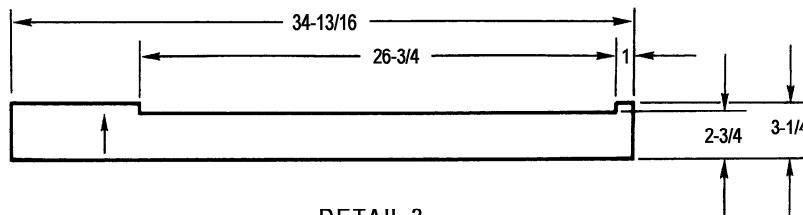


Figure 5-19. Diffuser Ramp Shipping Container (Sheet 2)



DETAIL 3
(UPPER CONTOUR)



DETAIL 3
(LOWER CONTOUR)

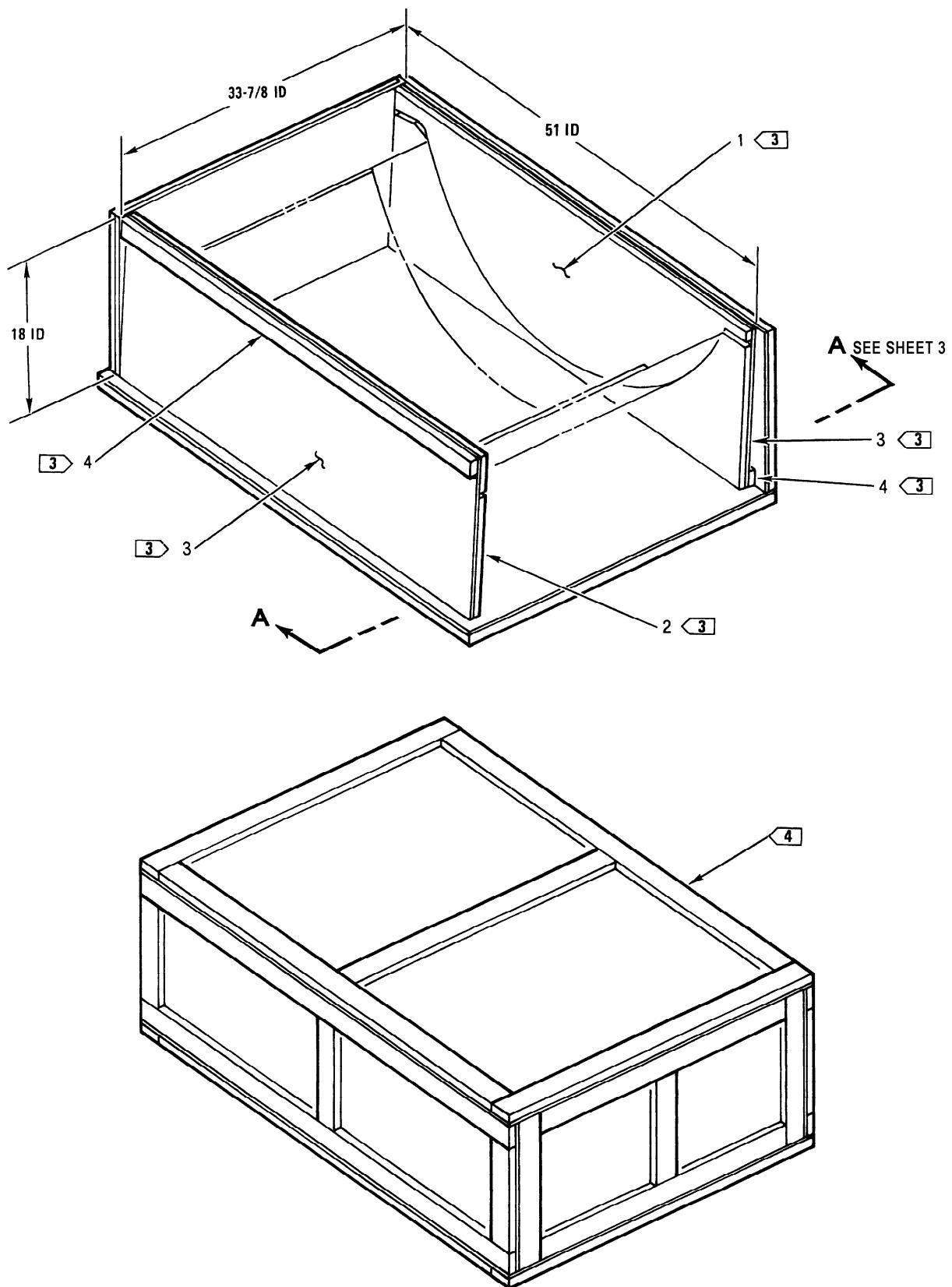
LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 28 POUNDS, RAMP WEIGHT IS 70 POUNDS. GROSS WEIGHT IS 98 POUNDS.
 2. LEFT HAND PART SHOWN, RIGHT HAND OPPOSITE.
 3. WRAP RAMP IN PLASTIC SHEET, FEDERAL SPECIFICATION A-A-3174, TYPE I, CLASS 1, GRADE B, FINISH 1.
- 4) CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6251. USE 5/16 INCH PLYWOOD PANELS AND 3/4 X 1-3/4 INCH WOOD CLEATS.
- 5) BOND DETAIL 3 TO 4 AS SHOWN. GLUE DETAILS 3, 4, & 5 IN PLACE AS SHOWN, USE EC847 ADHESIVE.
- 6) DETAILS 2, 3, 4, & 5 ARE CORRUGATED FIBERBOARD, DOMESTIC, GRADE 125 (MIN). → INDICATES FLUTE DIRECTION.

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	1	50-1/4 X 34-13/16 X 14 (ID) 1 X 14 X 34-13/16	ASTM-D6251 CONTAINER CORRUGATED, ASTM-D4727	<input type="checkbox"/> 4 <input type="checkbox"/> 6 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 5 <input type="checkbox"/> 6
2	1	2 X 14 X 34-13/16	CORRUGATED, ASTM-D4727	
3	1	1 X 14 X 34-13/16	CORRUGATED, ASTM-D4727	
4	2	1 X 2 X 14	CORRUGATED, ASTM-D4727	
5	4	1 X 2 X 14	CORRUGATED, ASTM-D4727	

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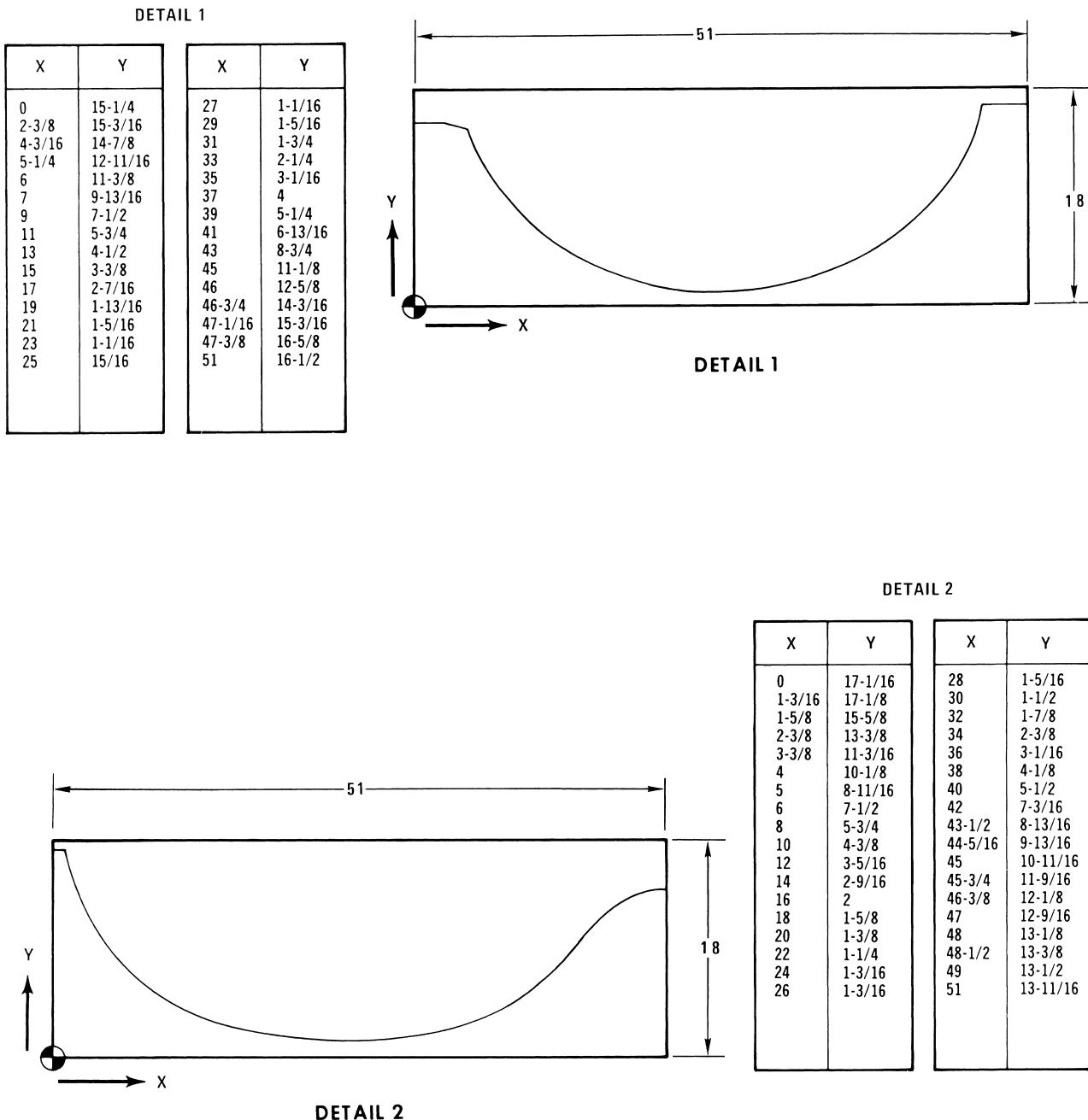
Figure 5-19. Diffuser Ramp Shipping Container (Sheet 3)



SAN301-05-47-002

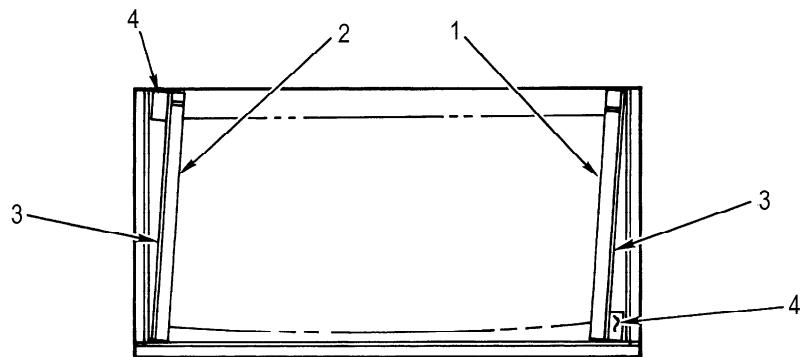
Figure 5-20. Door 122 Shipping Container (Sheet 1 of 3)

CSTO SR1F-15SA-3-1



SAN301-05-48-001

Figure 5-20. Door 122 Shipping Container (Sheet 2)



SECTION A-A

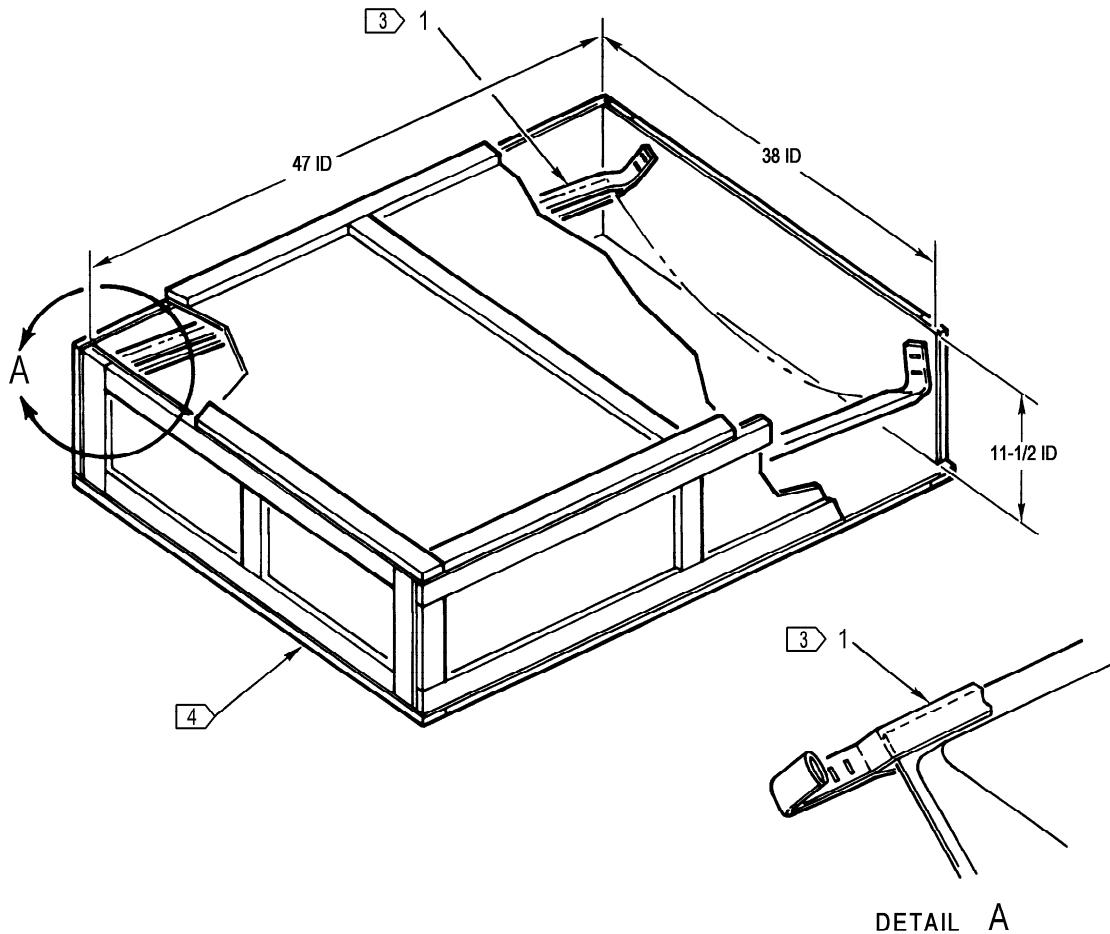
BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	1	1 X 18 X 51	CORRUGATED, ASTM-D4727	
2	1	1 X 18 X 51	CORRUGATED, ASTM-D4727	
3	2	1/8 X 18 X 51	CORRUGATED, ASTM-D4727	
4	2	1 X 2 X 51	CORRUGATED, ASTM-D4727	

LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 61 POUNDS, WEIGHT OF FAIRING IS 14 POUNDS. GROSS WEIGHT IS 75 POUNDS.
 2. WRAP DOOR IN PLASTIC SHEET, FEDERAL SPECIFICATION A-A-3174, TYPE I, CLASS 1, GRADE B, FINISH 1.
- 3 > GLUE BLOCKING TOGETHER AS SHOWN. GLUE TOPS OF CONTOURS TO BACK-UP BOARD, DETAIL 3, AFTER PART IS IN PLACE.
- 4 > CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6251. USE 0.070 MINIMUM POV PANELS AND 5/8 X 1-3/4 MINIMUM CLEATS.

SAN301-05-49-001

Figure 5-20. Door 122 Shipping Container (Sheet 3)



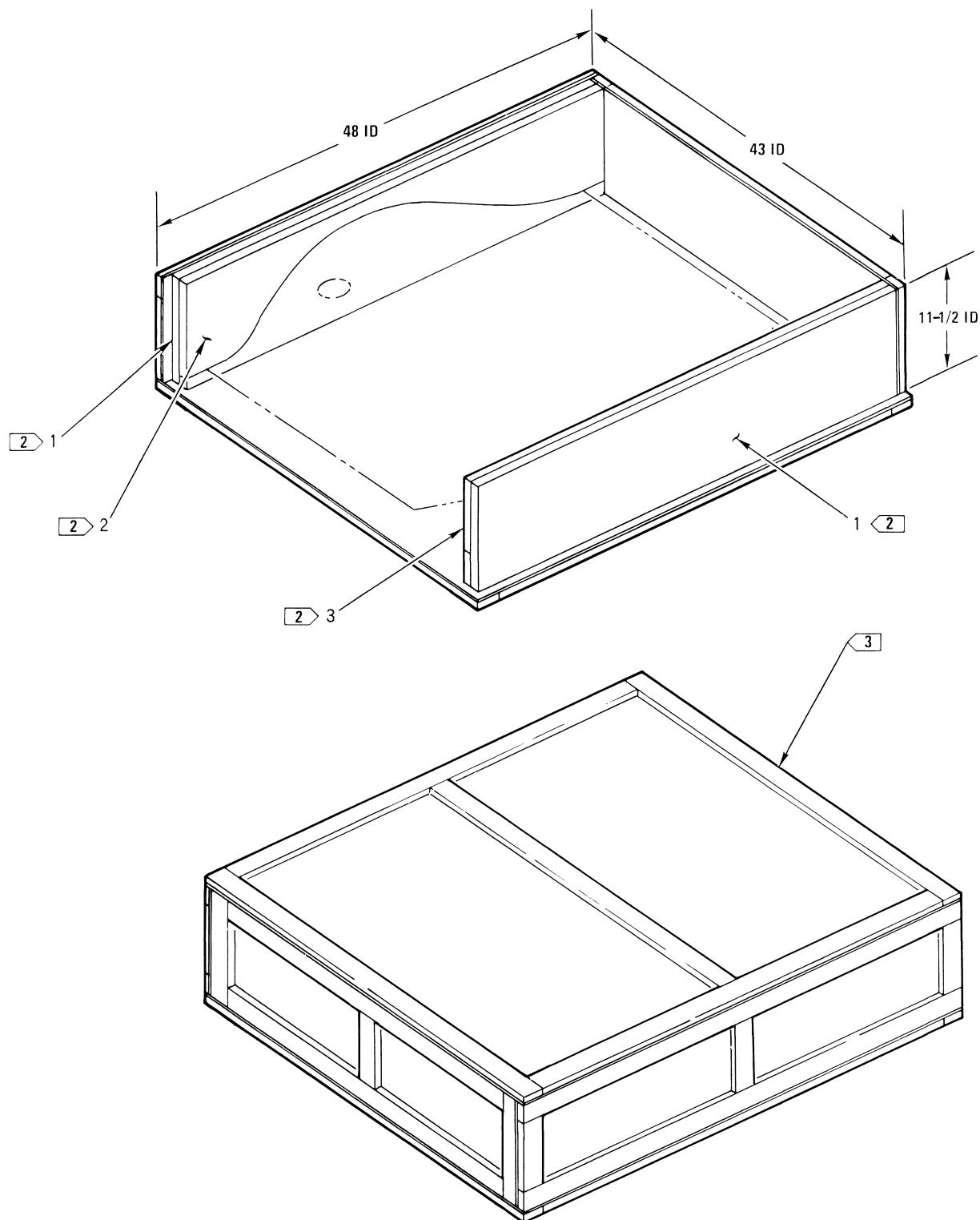
LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 30 POUNDS,
WEIGHT OF DOOR IS 7 POUNDS. GROSS WEIGHT IS 37 POUNDS.
2. WRAP DOOR IN PLASTIC SHEET, FEDERAL SPECIFICATION A-A-3174,
TYPE I, CLASS 1, GRADE B, FINISH 1.
- 3> USE SINGLE WALL CORRUGATED AS EDGE PADS. FOLD AND SLIP
PADS OVER PART AS SHOWN IN DETAIL A. BEND PADS AS REQUIRED
AND STAPLE TO END OF CONTAINER AS SHOWN.
- 4> CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6251.
USE 0.120 MINIMUM POV PANELS AND 5/8 X 1-3/4 MINIMUM WOOD
CLEATS.

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	2	2 X 51	CORRUGATED, ASTM-D4727	3

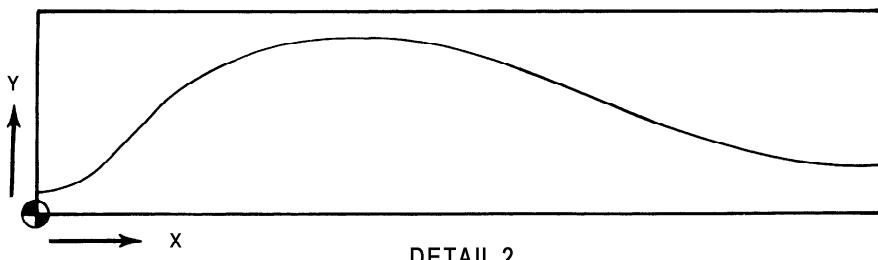
SAN301-05-50-001

Figure 5-21. Door 117 Shipping Container



SAN301-05-51-001

Figure 5-22. Door 113 Shipping Container (Sheet 1 of 2)

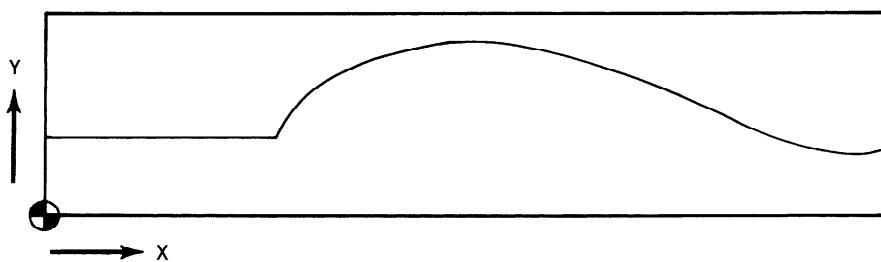


DETAIL 2

X	Y
0	1-1/8
7/8	1-1/8
3	2-3/8
5	3-1/8
12	5
24	7-9/16
31	8-11/16
33	9-1/16
34-11/16	9-1/16
36	8-13/16
38	8-1/8
41	6-5/8
42-5/16	5-7/8
44-1/2	5-1/8
48	5-1/4

DETAIL 3

X	Y
0	5
13-3/8	5
16	6
25	8-9/16
30	9-13/16
32	10-1/8
34	10-3/16
35	10-1/16
37	9-7/16
40	8
43	6-1/4
44	5-7/8
46	5-1/2
48	5-3/8



DETAIL 3

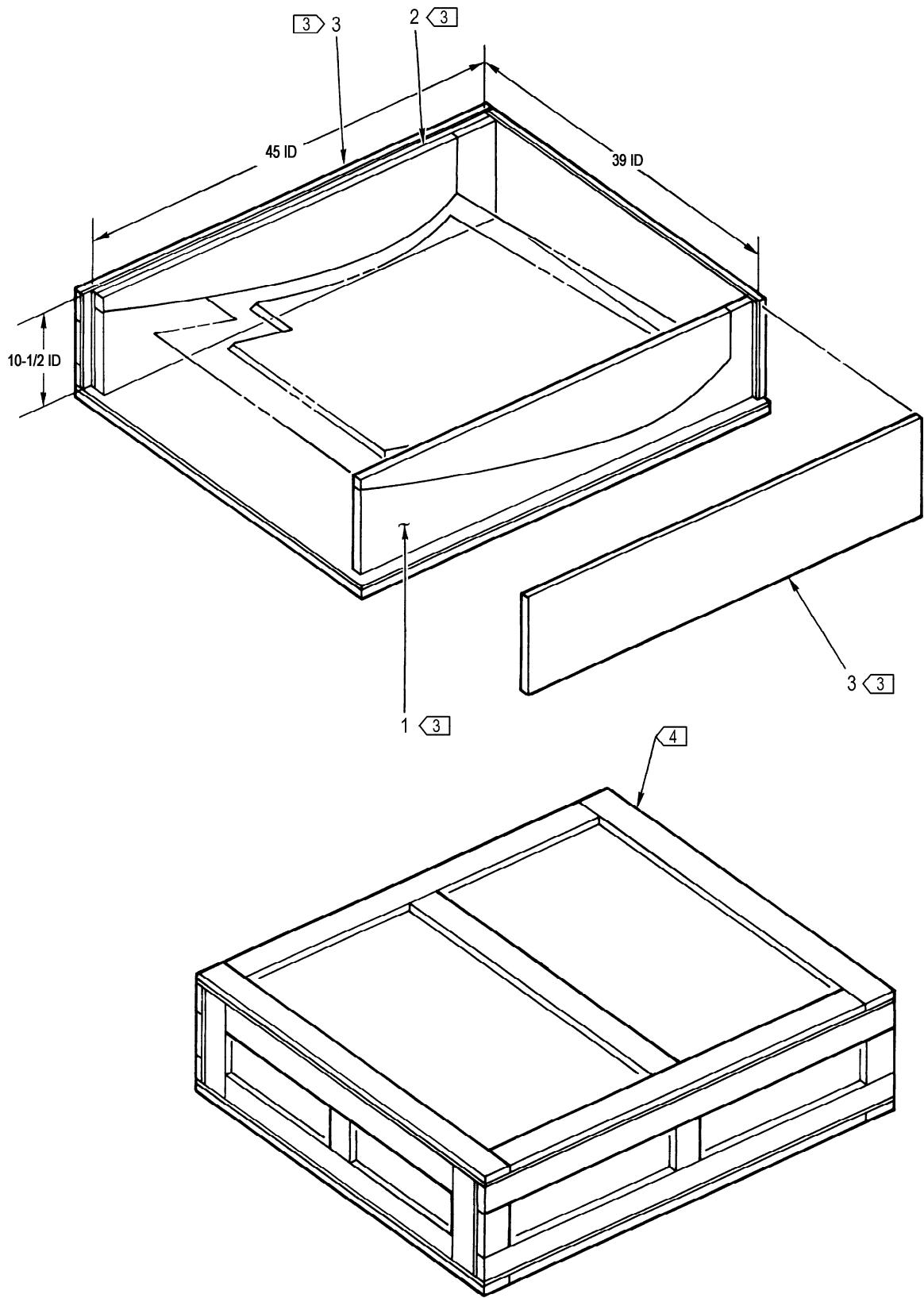
LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 60 POUNDS.
DOOR WEIGHT IS 20 POUNDS. GROSS WEIGHT IS 80 POUNDS.
2. GLUE BLOCKING TOGETHER AS SHOWN. GLUE TOP CONTOURS
TO BACK-UP BOARD AFTER PART IS IN PLACE.
3. CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-
D6251. USE 0.070 MINIMUM POV PANELS AND 5/8 X 1-3/4 MINIMUM
CLEATS.

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	2	1 X 11-1/2 X 48	CORRUGATED, ASTM-D4727	
2	1	1 X 11-1/2 X 48	CORRUGATED, ASTM-D4727	
3	1	1 X 11-1/2 X 48	CORRUGATED, ASTM-D4727	

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Figure 5-22. Door 113 Shipping Container (Sheet 2)



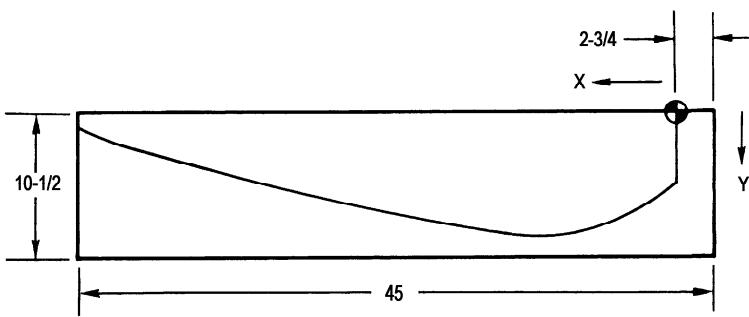
SAN301-05-53-001

Figure 5-23. Door 95 Shipping Container (Sheet 1 of 2)

CSTO SR1F-15SA-3-1

DETAIL 1

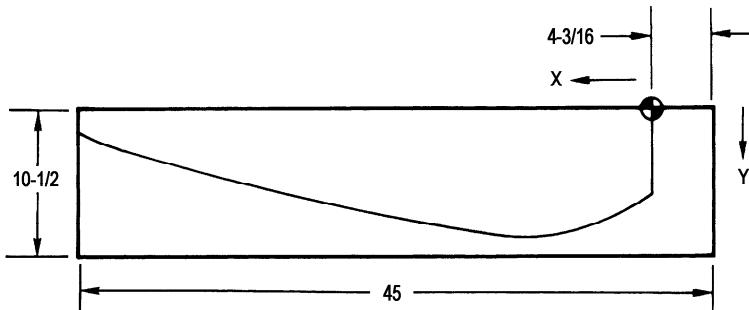
X	Y	X	Y
0	5-5/8	21	6-15/16
1	6	24	6-1/4
3	7	27	5-1/2
5	8	30	4-13/16
7	8-3/4	33	4-1/16
9	9-1/16	36	3-5/16
11	9	39	2-1/2
13	8-11/16	40	2-1/8
15	8-5/16	41	1-11/16
18	7-5/8	41-1/2	1-3/8



DETAIL 1

DETAIL 2

X	Y	X	Y
0	6-1/8	14	8-9/16
1	6-11/16	15	8-3/8
2-1/2	7-7/16	17	8
4	8-1/8	20	7-5/16
5	8-1/2	24	6-3/8
6	8-3/4	28	5-3/8
7	8-15/16	32	4-3/8
8	9-1/16	36	3-3/8
9	9-1/8	37-3/8	3
10	9-1/16	38-1/4	2-11/16
11	9	38-7/8	2-3/8
12	8-7/8	39-3/8	2-3/16
13	8-3/4	40	1-3/4



DETAIL 2

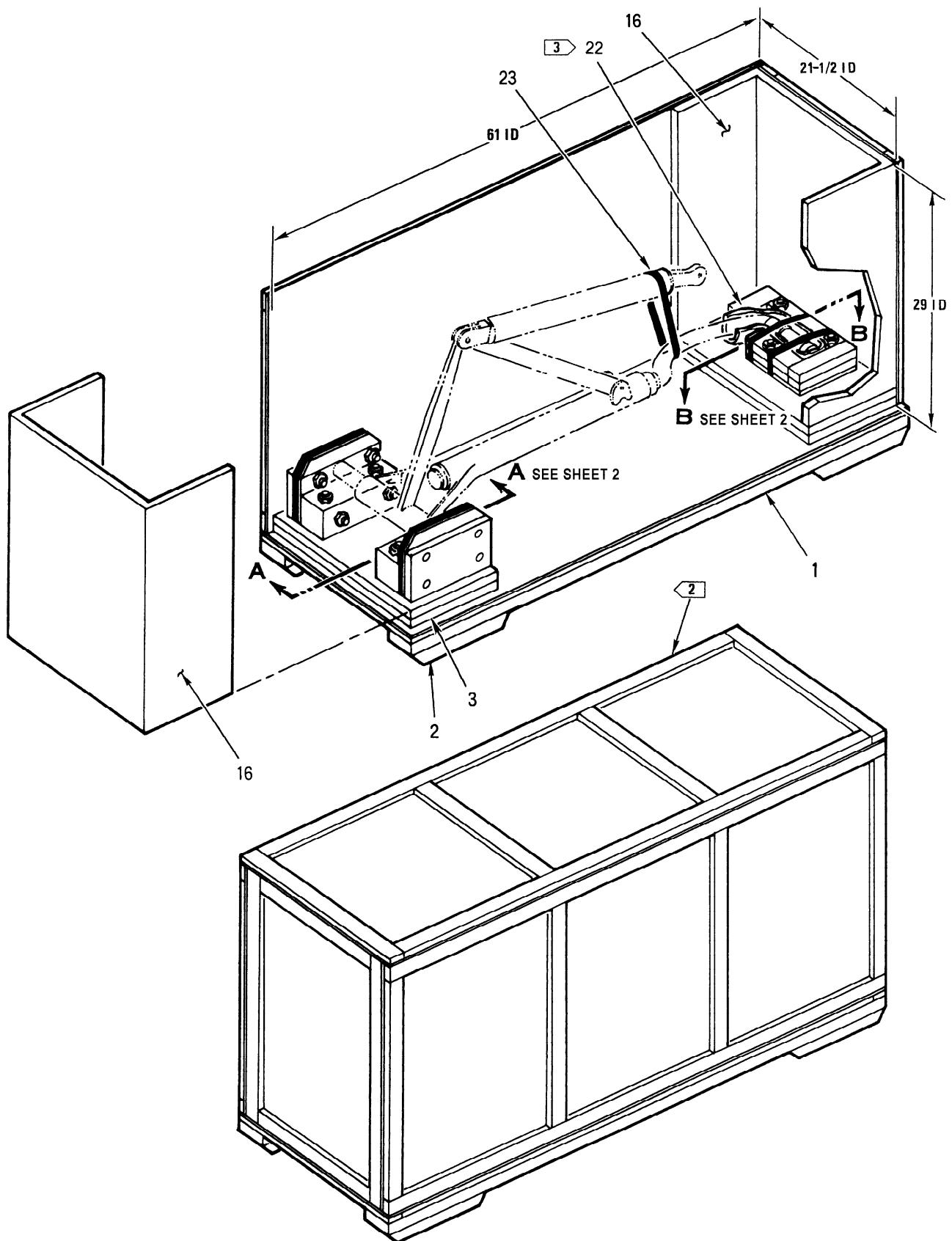
LEGEND

- APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 52 POUNDS,
DOOR WEIGHT IS 30 POUNDS. GROSS WEIGHT IS 82 POUNDS.
- WRAP DOOR IN PLASTIC SHEET, FEDERAL SPECIFICATION
A-A-3174, TYPE I, CLASS 1, GRADE B, FINISH 1.
- GLUE BLOCKING TOGETHER AS SHOWN. GLUE TOP OF CONTOURS
TO BACK-UP BOARD AFTER PART IS IN PLACE.
- CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6251.
USE 0.070 MINIMUM POV PANELS AND 5/8 X 1-3/4
MINIMUM CLEATS.

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	1	1 X 10-1/2 X 45	CORRUGATED, ASTM-D4727	
2	1	1 X 10-1/2 X 45	CORRUGATED, ASTM-D4727	
3	2	9/16 X 10-1/2 X 45	CORRUGATED, ASTM-D4727	3 3 3

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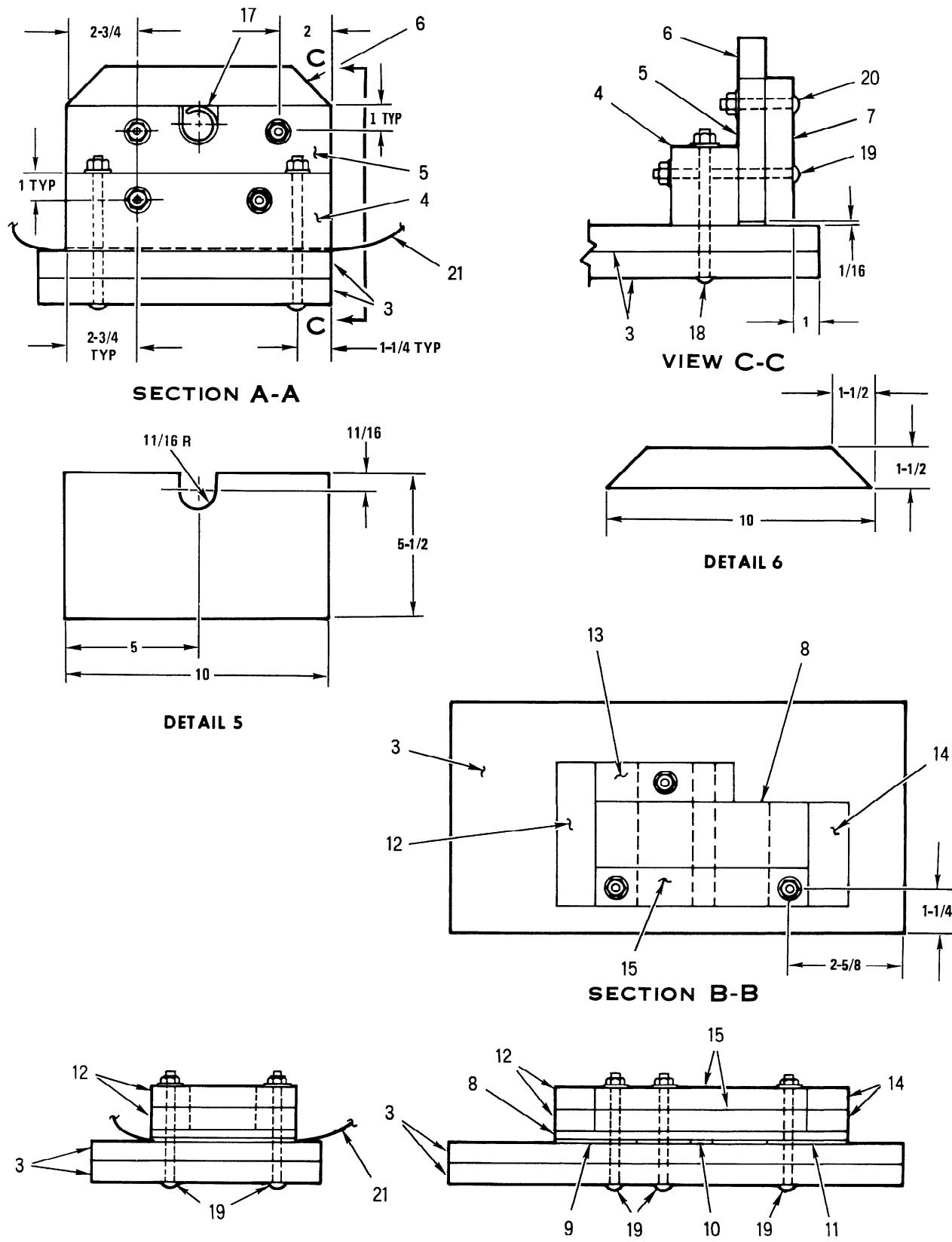
Figure 5-23. Door 95 Shipping Container (Sheet 2)



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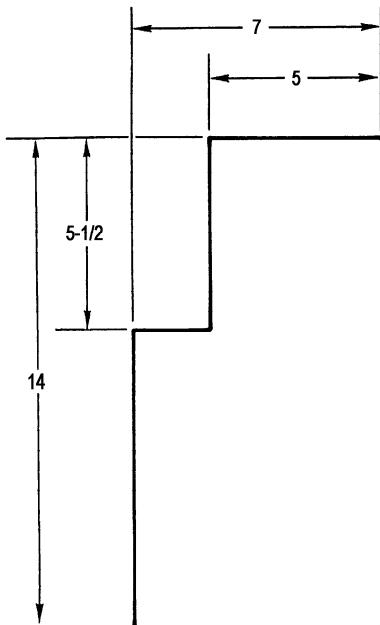
Figure 5-24. Nose Landing Gear Shipping Container
(Sheet 1 of 3)

CSTO SR1F-15SA-3-1



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Figure 5-24. Nose Landing Gear Shipping Container
(Sheet 2)



DETAIL 8

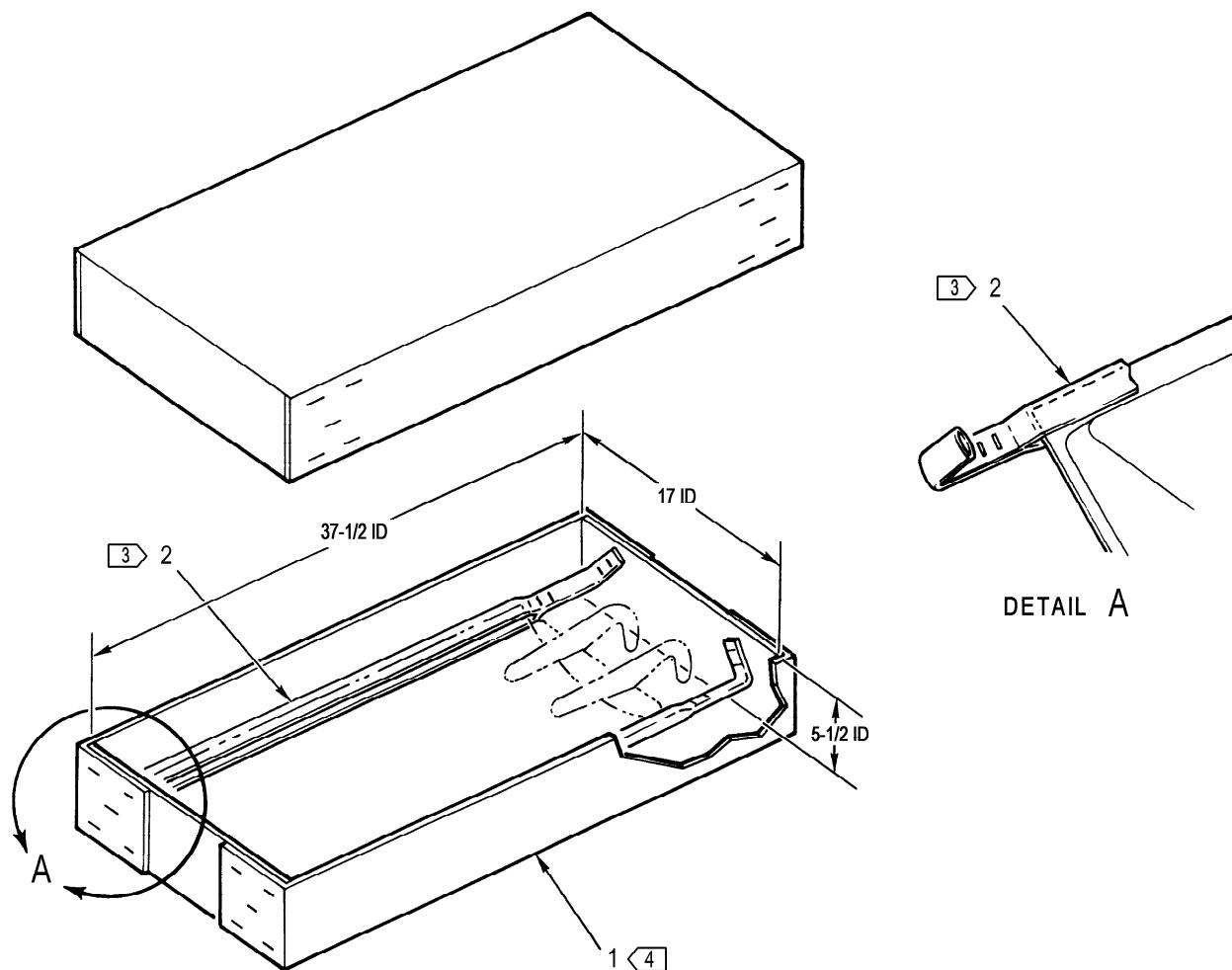
LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 130 POUNDS, NOSE LANDING GEAR WEIGHT IS 265 POUNDS. GROSS WEIGHT IS 395 POUNDS.
- 2 ➤ CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6251. USE 1/4 INCH MINIMUM PLYWOOD PANELS AND 3/4 X 1-3/4 INCH WOOD CLEATS.
- 3 ➤ PLACE POLYETHYLENE CUSHIONING MATERIAL BETWEEN PART AND BLOCKING AS SHOWN.

BILL OF MATERIAL			
DET	QTY	SIZE	MATERIAL
1	2	2 X 4 (NOM) X 63	WOOD
2	4	2 X 4 (NOM) X 12	WOOD
3	4	1 X 11 X 21-3/8	PLYWOOD
4	2	2-1/2 X 3 X 10	WOOD
5	2	1 X 5-1/2 X 10	PLYWOOD
6	2	1 X 1-1/2 X 10	PLYWOOD
7	2	1 X 5-1/2 X 10	PLYWOOD
8	1	3/8 X 7 X 14	PLYWOOD
9	1	1/8 X 4 X 7	PAPER OVERLAID VENEER
10	1	1/8 X 1 X 7	PAPER OVERLAID VENEER
11	1	1/8 X 4 X 5	PAPER OVERLAID VENEER
12	2	1 X 2 X 7	PLYWOOD
13	2	1 X 2 X 6-1/2	PLYWOOD
14	2	1 X 2 X 10	PLYWOOD
15	2	1 X 2 X 5	PLYWOOD
16	2	1 X 27 X 43-3/8	FIBERBOARD CORRUGATED, ASTM-D4727
17	2	1/8 X 1 X 4-3/4	RUBBER
18	4	3/8 DIA. X 6	CARRIAGE BOLT (WITH HARDWARE)
19	7	3/8 DIA. X 5	CARRIAGE BOLT (WITH HARDWARE)
20	4	3/8 DIA. X 3	CARRIAGE BOLT (WITH HARDWARE)
21	A/R	1/2 WIDE	STEEL STRAPPING, ASTM-D3953
22	1	1/4 X 12 X 24	CUSHIONING MATERIAL, POLYETHYLENE, AA59136 3
23	A/R	3/4 WIDE	NONMETALIC STRAPPING, ASTM-D3950

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Figure 5-24. Nose Landing Gear Shipping Container
(Sheet 3)



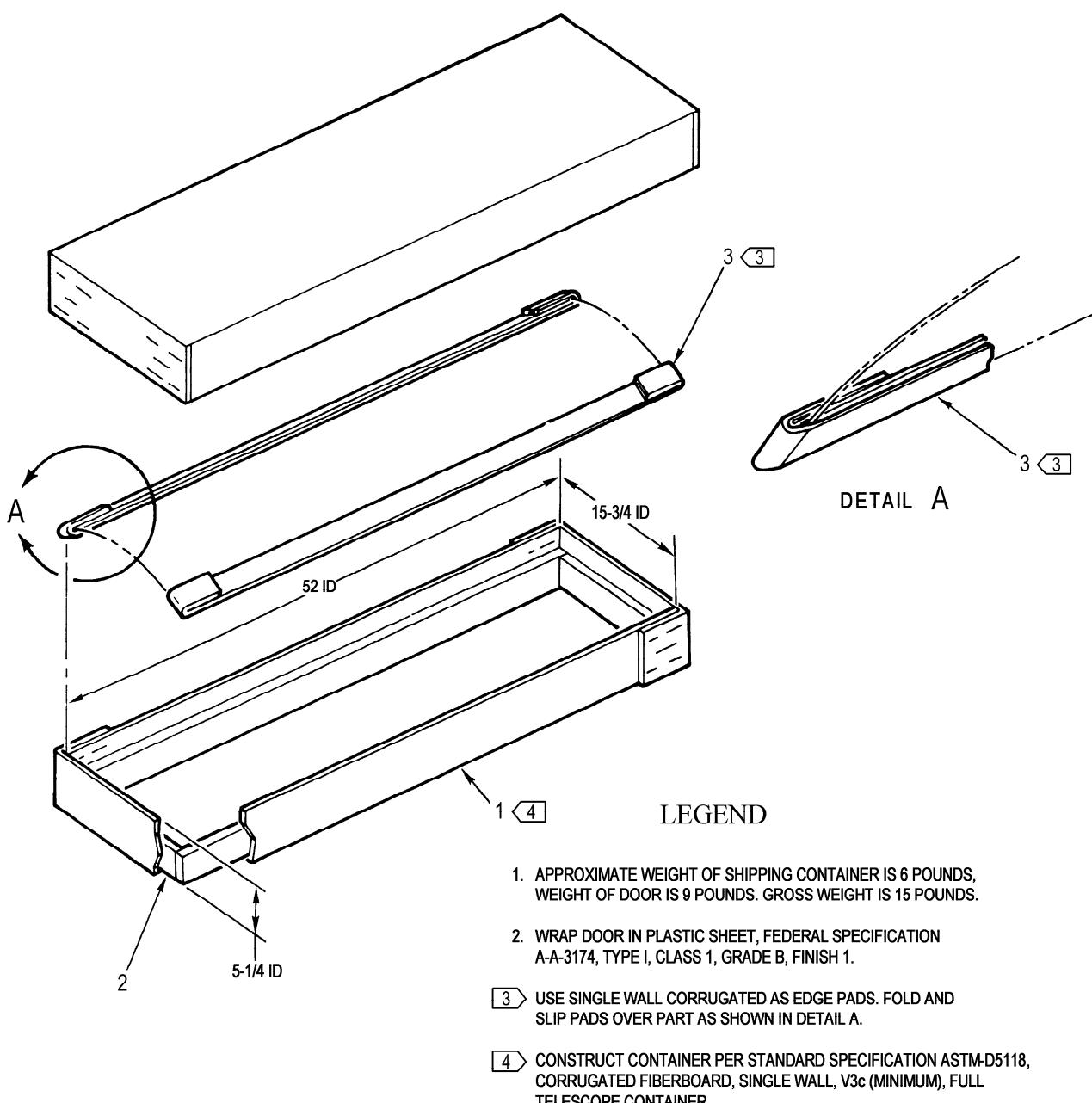
LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 5 POUNDS,
WEIGHT OF DOOR IS 7 POUNDS. GROSS WEIGHT IS 12 POUNDS.
2. WRAP DOOR IN PLASTIC SHEET, FEDERAL SPECIFICATION
A-A-3174, TYPE I, CLASS 1, GRADE B, FINISH 1.
- 3> USE SINGLE WALL CORRUGATED AS EDGE PADS. FOLD AND
SLIP PADS OVER PART AS SHOWN IN DETAIL A. BEND PADS AS
REQUIRED AND STAPLE TO END OF CONTAINER AS SHOWN.
- 4> CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D5118,
CORRUGATED FIBERBOARD, SINGLE WALL, V3c (MINIMUM), FULL
TELESCOPE CONTAINER.

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	1	5-1/2 x 17 x 37-1/2 (ID)	ASTM-D5118 CONTAINER (FTC)	
2	2	2 X 42	CORRUGATED, ASTM-D4727	4 3

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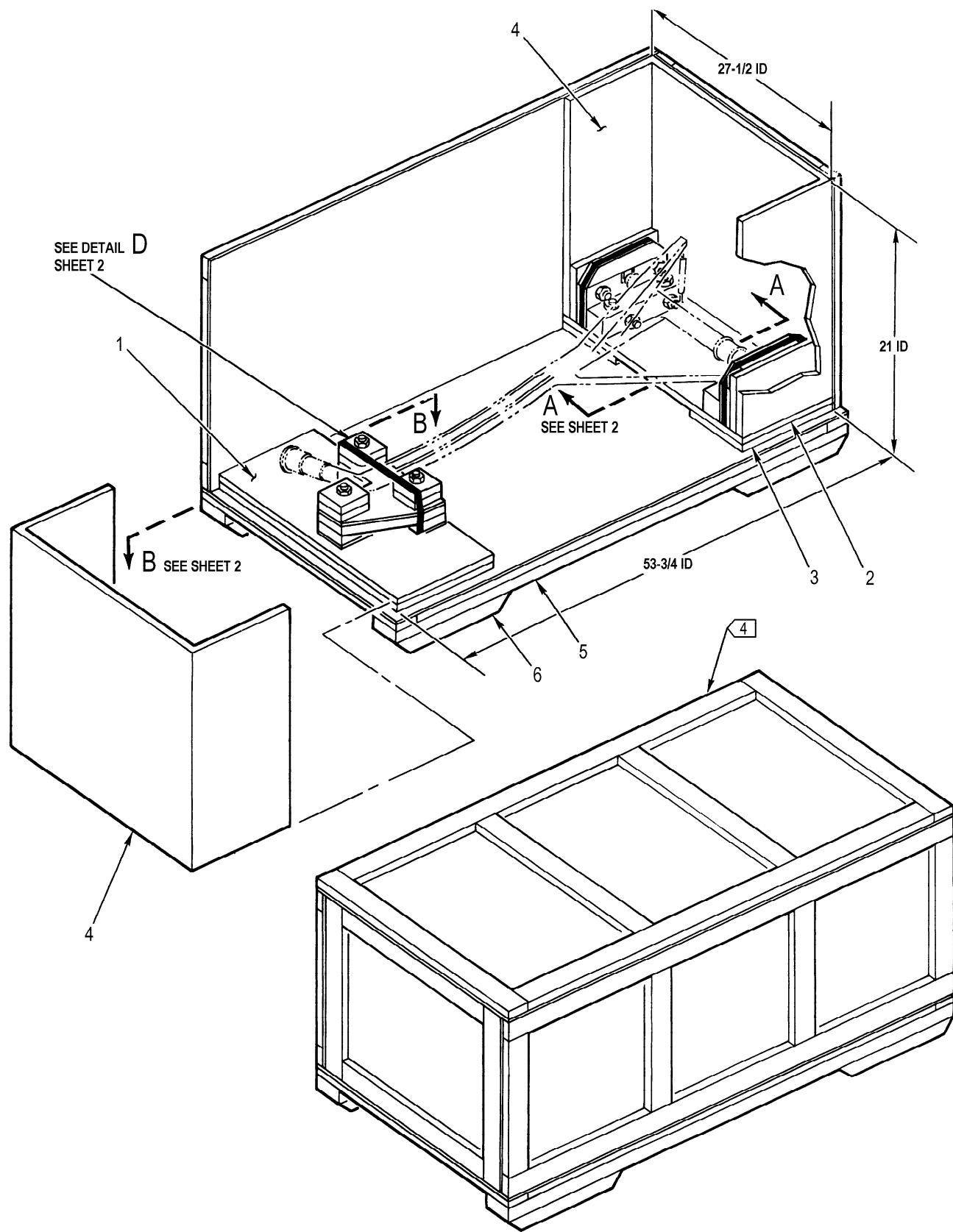
Figure 5-25. Nose Landing Gear Aft Door Shipping Container



BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	1	5-1/4 x 15-3/4 x 52 (ID)	ASTM-D5118 CONTAINER, FTC	4
2	2	1 X 3 X 66-3/4	CORRUGATED, ASTM-D4727	
3	2	5 X 60	SINGLE-WALL CORRUGATED, ASTM-D4727	3

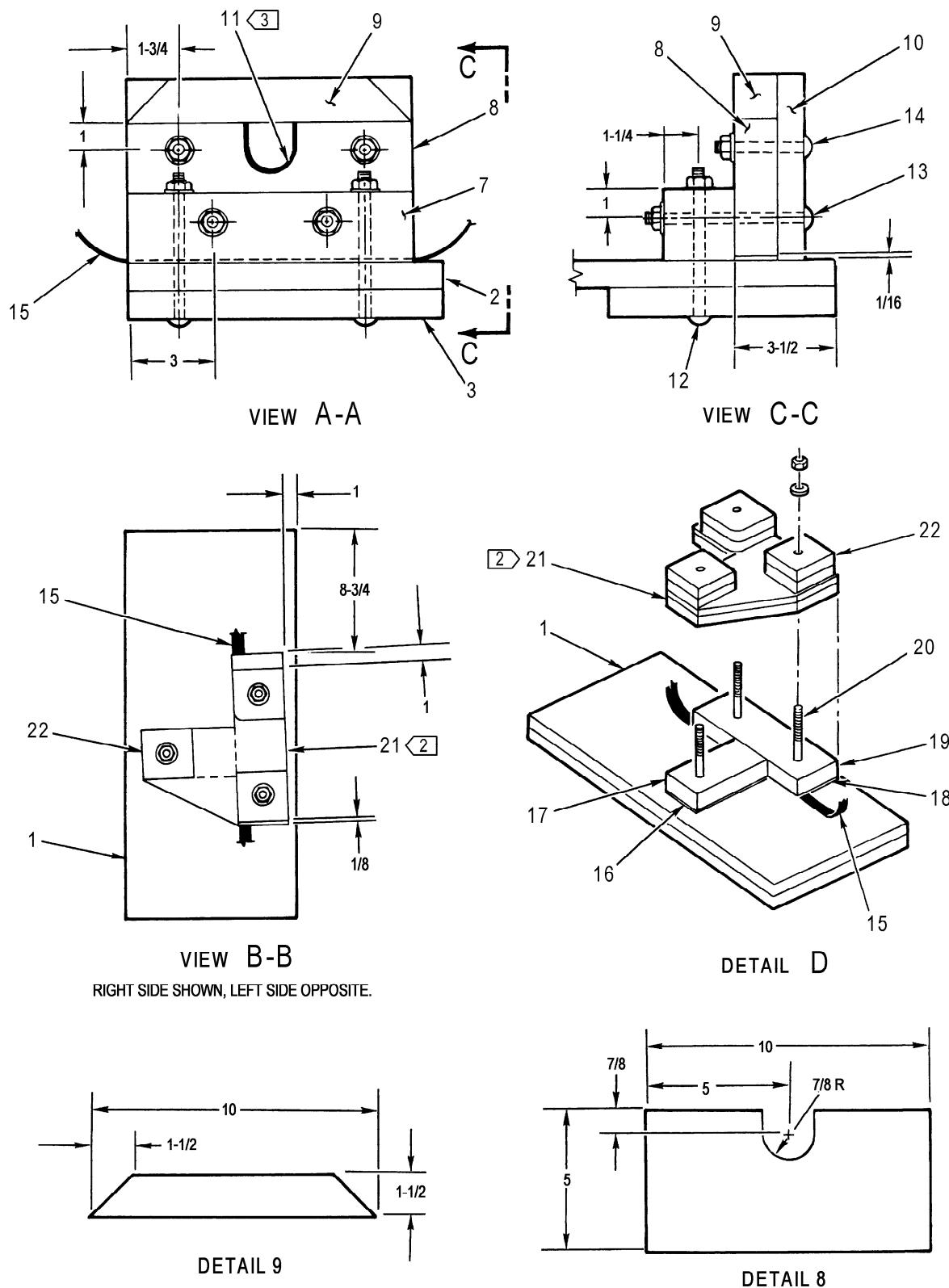
SAN301-05-59-001

Figure 5-26. Nose Landing Gear Forward Door Shipping Container

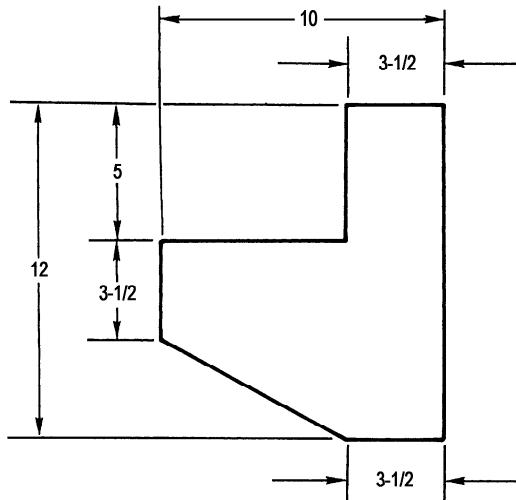


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**Figure 5-27. Main Landing Gear Shipping Container
(Sheet 1 of 3)**



**Figure 5-27. Main Landing Gear Shipping Container
(Sheet 2)**



LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 135 POUNDS, MAIN LANDING GEAR WEIGHT IS 587 POUNDS. GROSS WEIGHT IS 722 POUNDS.
- 2> RIGHT SIDE SHOWN, LEFT SIDE OPPOSITE.
- 3> BOND DETAIL 11 IN PLACE AS SHOWN, USE EC847 ADHESIVE.
- 4> CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6251. USE 3/16 MINIMUM PLYWOOD PANELS AND 3/4 X 1-3/4 MINIMUM CLEATS.

DETAIL 21 <2

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	2	1 X 12 X 27-1/2	PLYWOOD	
2	1	1 X 11 X 27-1/2	PLYWOOD	
3	2	1 X 8 X 11	PLYWOOD	
4	2	1 X 19 X 52	CORRUGATED, ASTM-D4727	
5	2	2 X 4 (NOM) X 55	WOOD	
6	4	2 X 4 (NOM) x 14	WOOD	
7	2	2-1/2 X 2 1/2 X 10	WOOD	
8	2	1-1/2 X 5 X 10	PLYWOOD	
9	2	1-1/2 X 1-1/2 X 10	PLYWOOD	
10	2	1 X 6-1/2 X 10	PLYWOOD	
11	2	1/8 X 1-1/2 X 4-1/2	RUBBER	
12	4	3/8 DIA X 5	BOLT (WITH HARDWARE)	
13	4	3/8 DIA X 6	BOLT (WITH HARDWARE)	
14	4	3/8 DIA X 3	BOLT (WITH HARDWARE)	
15	A/R	3/4 WIDE	STEEL STRAPPING, ASTM-D3953	
16	1	1/8 X 3-1/2 X 6-1/2	PAPER OVERLAIRED VENEER	
17	1	2 X 4 (NOM) X 6-1/2	WOOD	
18	1	1/8 X 2-3/4 X 12	PAPER OVERLAIDED VENEER	
19	1	2 X 4 (NOM) X 12	WOOD	
20	3	3/8 DIA X 8	BOLT (WITH HARDWARE)	
21	1	1-1/2 X 10 X 12	PLYWOOD	
22	6	1 X 3-1/2 X 3-1/2	PLYWOOD	<2

SAN301-05-62-001

Figure 5-27. Main Landing Gear Shipping Container
(Sheet 3)

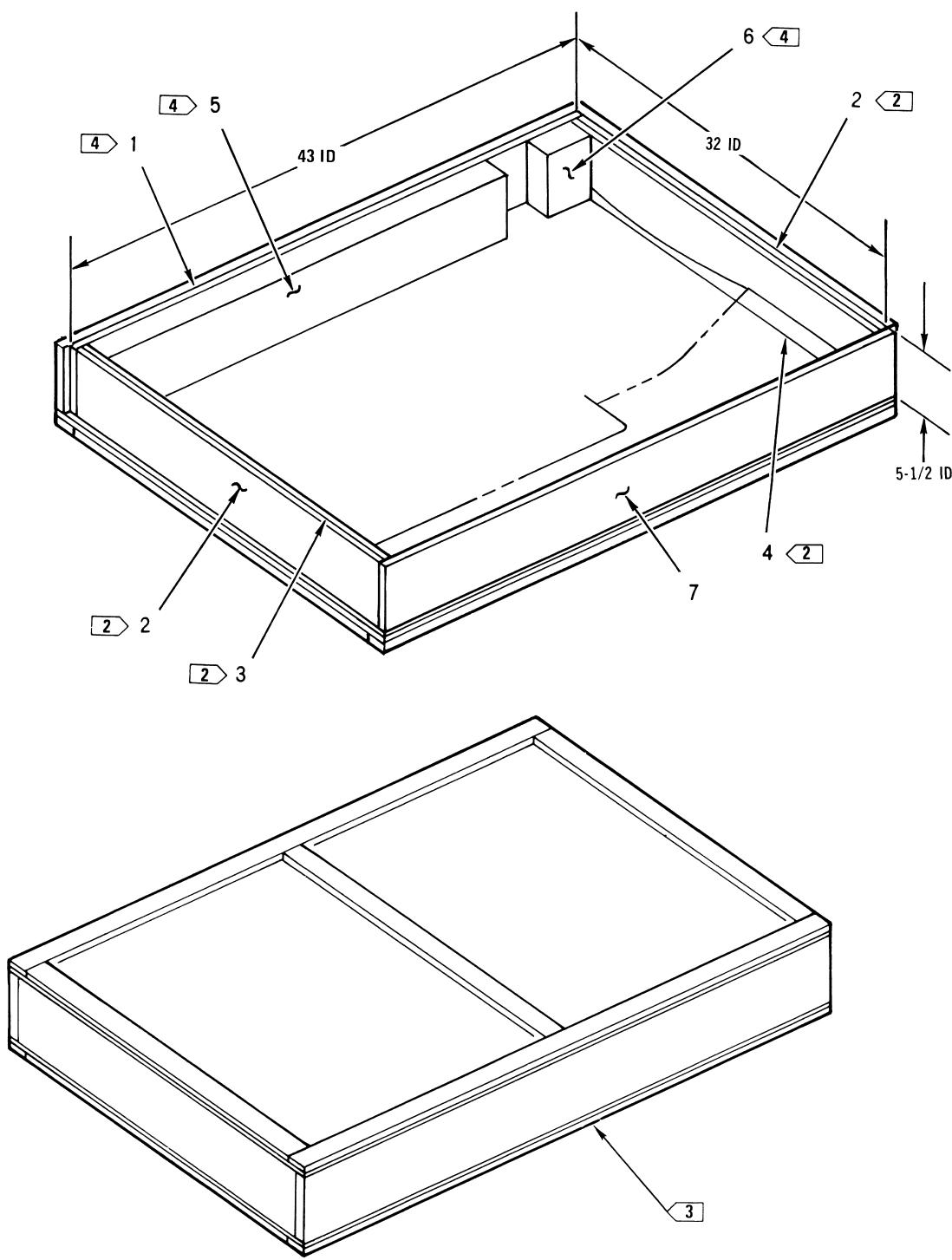
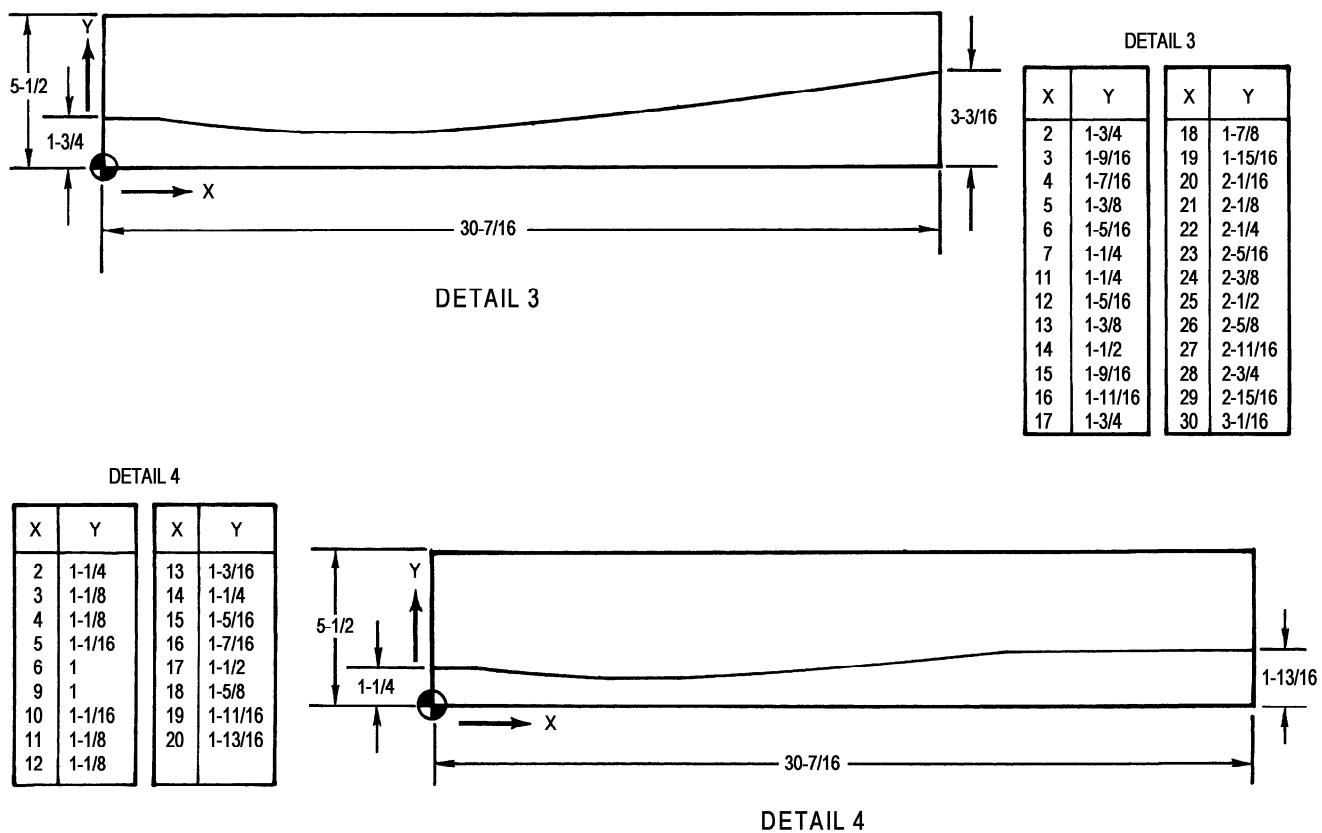


Figure 5-28. Main Landing Gear Outboard Door Shipping Container (Sheet 1 of 2)

SAN301-05-63-001



LEGEND

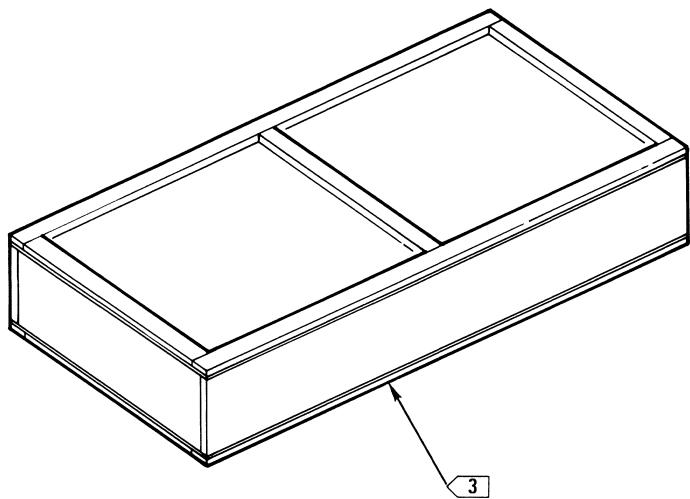
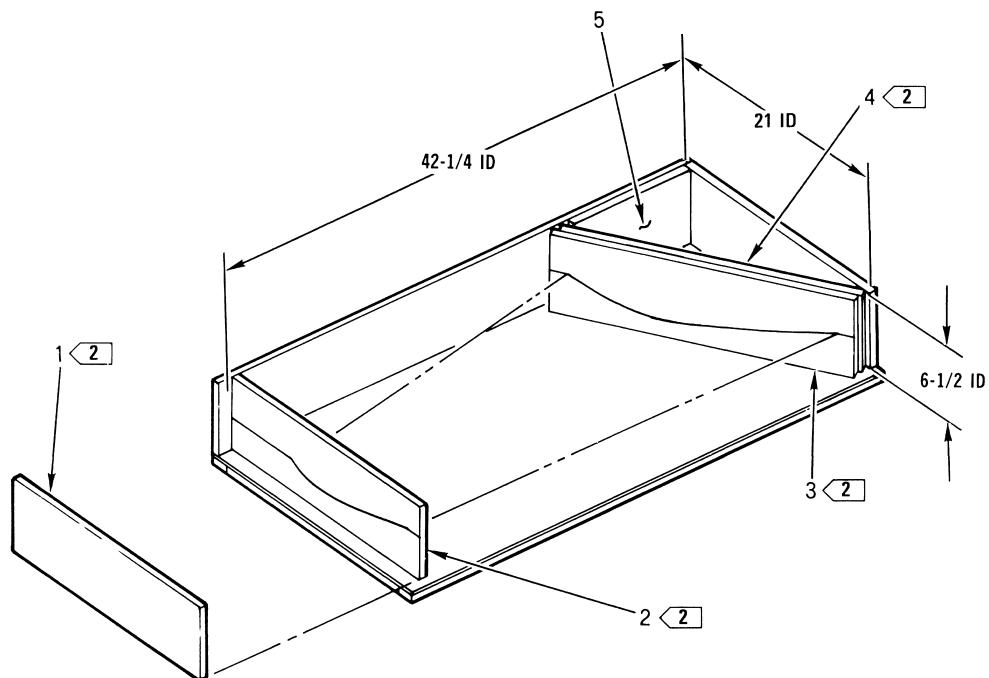
1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 29 POUNDS,
DOOR WEIGHT IS 17 POUNDS. GROSS WEIGHT IS 46 POUNDS.

- 2 ➤ GLUE DETAILS 2 AND 3 AND DETAILS 2 AND 4 TOGETHER AS SHOWN.
- 3 ➤ CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6251.
USE 3/4 MINIMUM X 5-1/2 WOOD SIDES AND ENDS. USE 5/8 X 1-3/8
MINIMUM WOOD CLEATS AND 5/16 MINIMUM PLYWOOD PANELS FOR
TOP AND BOTTOM.
- 4 ➤ GLUE DETAILS 1, 5, AND 6 TOGETHER AS SHOWN.

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	1	9/16 X 5-1/2 X 43	CORRUGATED, ASTM-D4727	4
2	2	9/16 X 5-1/2 X 28-7/16	CORRUGATED, ASTM-D4727	2
3	1	9/16 X 5-1/2 X 28-7/16	CORRUGATED, ASTM-D4727	2
4	1	9/16 X 5-1/2 X 28-7/16	CORRUGATED, ASTM-D4727	2
5	1	2 X 5-1/2 X 34-3/4	CORRUGATED, ASTM-D4727	4
6	1	2 X 5-1/2 X 4	CORRUGATED, ASTM-D4727	4
7	1	1 X 5-1/2 X 43	CORRUGATED, ASTM-D4727	4

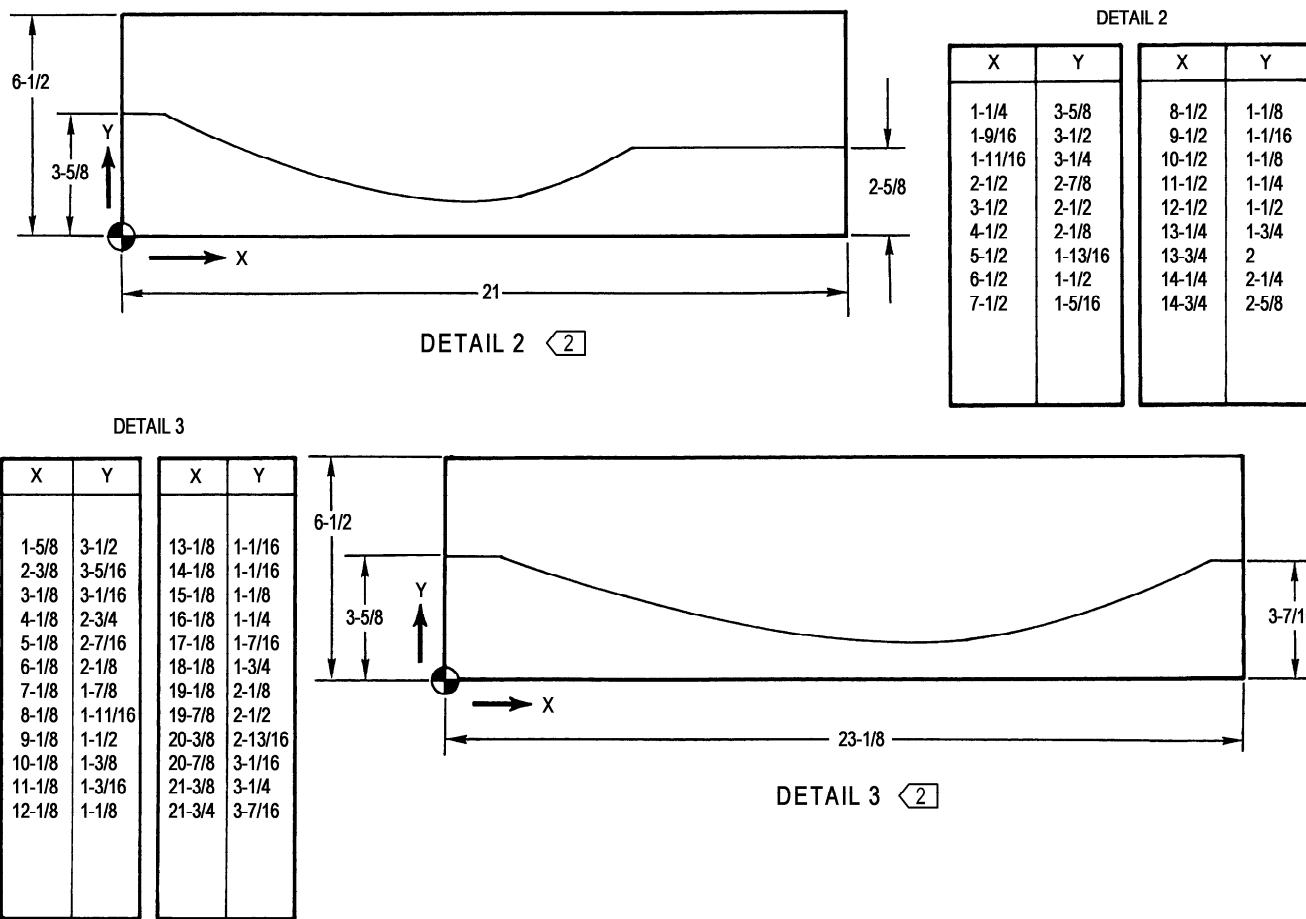
SAN301-05-64-001

Figure 5-28. Main Landing Gear Outboard Door Shipping Container (Sheet 2)



SAN301-05-65-001

Figure 5-29. Main Landing Gear Inboard Door Shipping Container (Sheet 1 of 2)



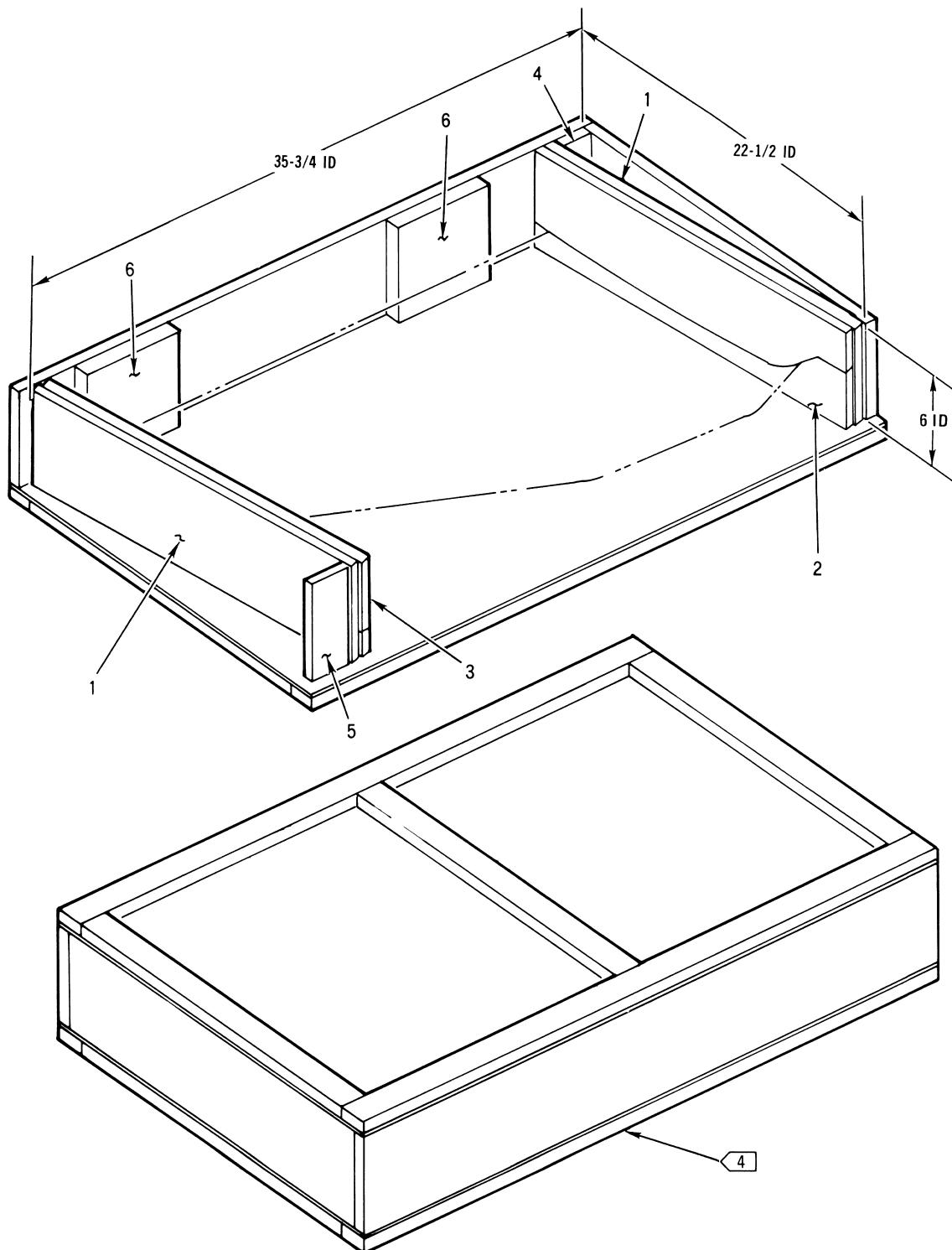
LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 23 POUNDS,
DOOR WEIGHT IS 8 POUNDS. GROSS WEIGHT IS 31 POUNDS.
2. GLUE DETAILS 1 AND 2 AND DETAILS 3 AND 4 TOGETHER AS SHOWN.
3. CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6251.
USE 3/4 X 6-1/2 WOOD FOR SIDES AND ENDS. USE 0.070 MINIMUM POV
PANELS AND 5/8 X 1-3/4 MINIMUM WOOD CLEATS.

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	1	9/16 X 6-1/2 X 21	CORRUGATED, ASTM-D4727	2
2	1	9/16 X 6-1/2 X 21	CORRUGATED, ASTM-D4727	2
3	1	9/16 X 6-1/2 X 23-1/8	CORRUGATED, ASTM-D4727	2
4	1	9/16 X 6-1/2 X 23-1/8	CORRUGATED, ASTM-D4727	2
5	1	9/16 X 6-1/2 X 10-3/4	CORRUGATED, ASTM-D4727	2

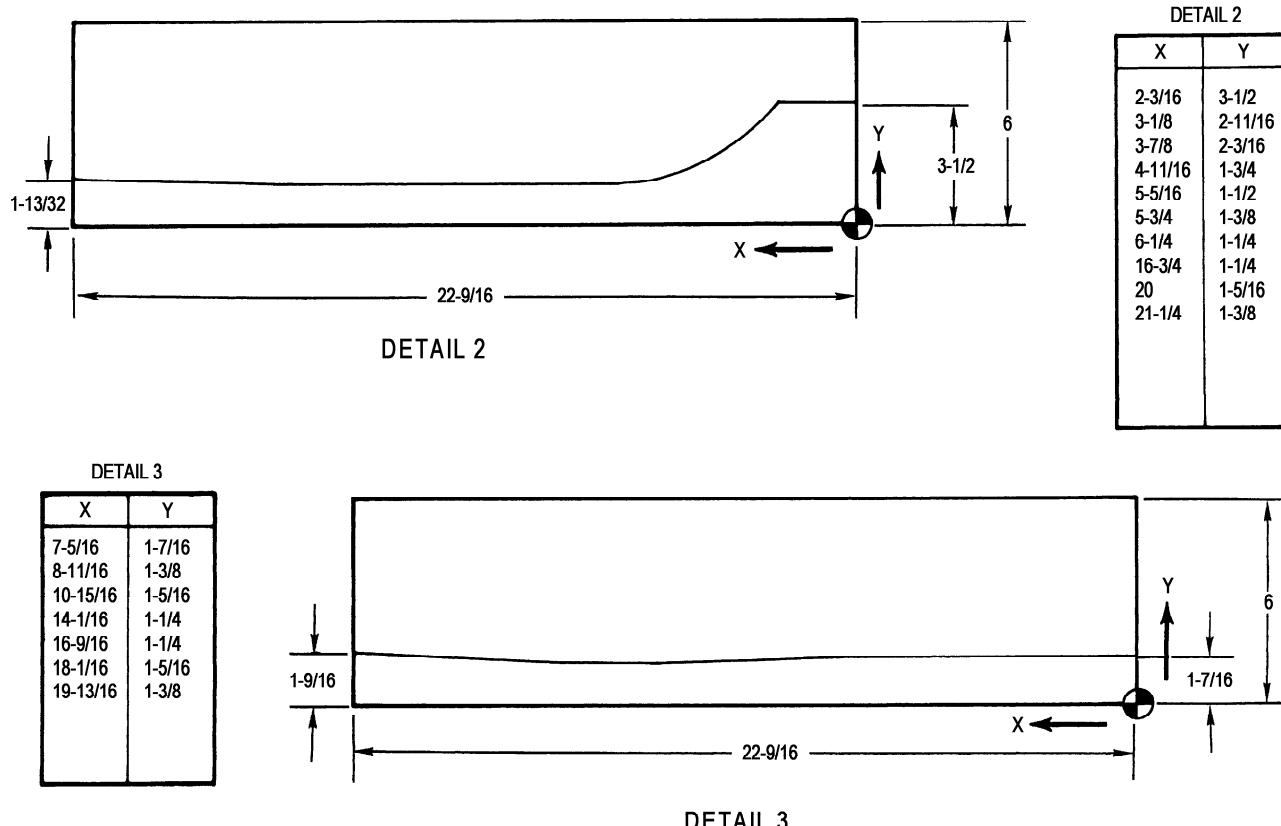
SAN301-05-66-001

Figure 5-29. Main Landing Gear Inboard Door Shipping Container (Sheet 2)



SAN301-05-67-001

Figure 5-30. Main Landing Gear Aft Door Shipping Container (Sheet 1 of 2)



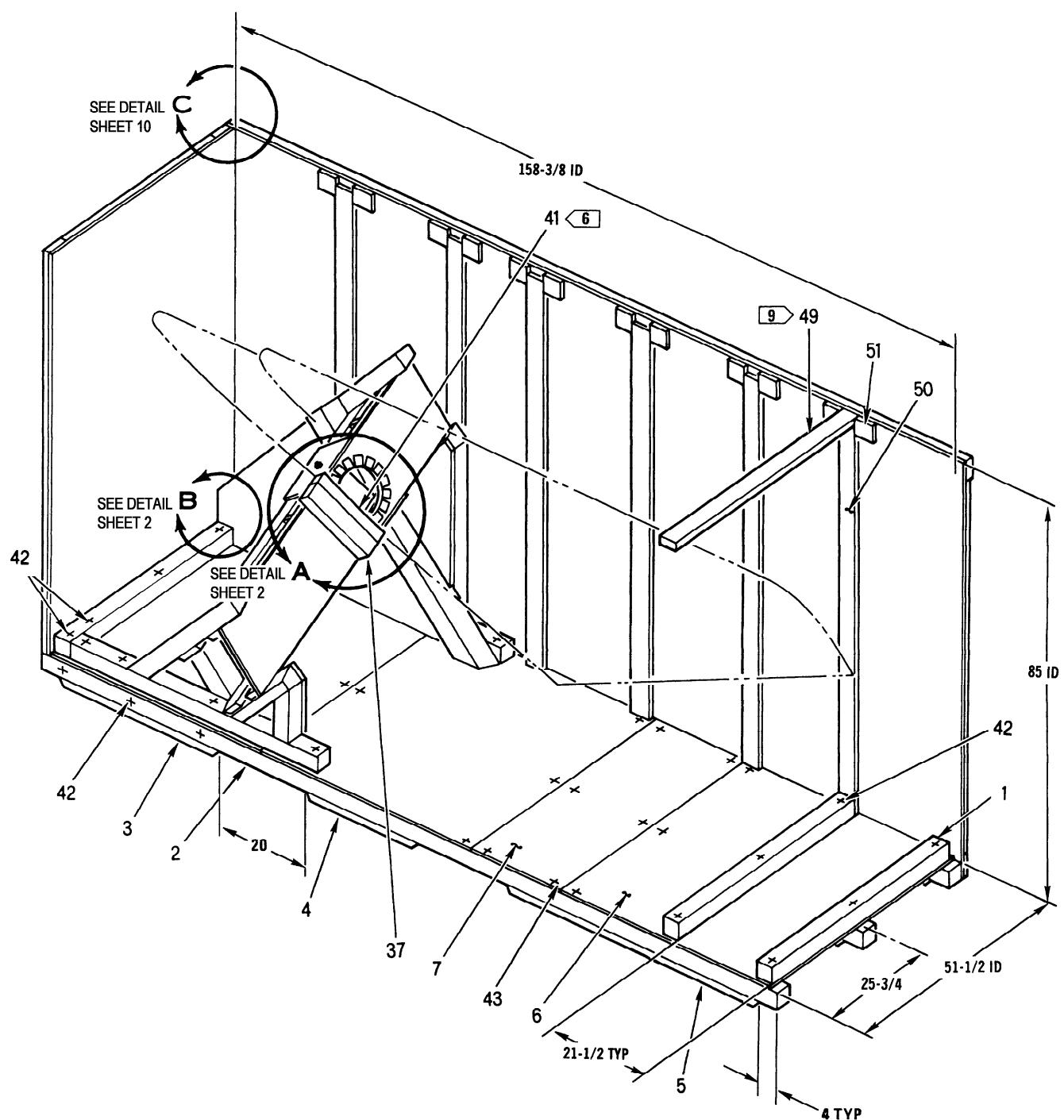
LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 16 POUNDS,
DOOR WEIGHT IS 10 POUNDS. GROSS WEIGHT IS 26 POUNDS.
2. WRAP DOOR IN PLASTIC SHEET, STANDARD SPECIFICATION A-A-3174,
TYPE I, CLASS 1, GRADE B, FINISH 1.
- 3 > GLUE BLOCKING IN PLACE AS SHOWN.
- 4 > CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6251.
USE 1 INCH (NOM) MINIMUM WOOD SIDES AND ENDS. USE 5/8 X 1-5/8
MINIMUM WOOD CLEATS AND 0.070 MINIMUM POV PANELS FOR TOP
AND BOTTOM.

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	2	9/16 X 6 X 22-9/16	CORRUGATED, ASTM-D4727	3
2	1	9/16 X 6 X 22-9/16	CORRUGATED, ASTM-D4727	3
3	1	9/16 X 6 X 22-9/16	CORRUGATED, ASTM-D4727	3
4	1	9/16 X 1-13/16 X 6	CORRUGATED, ASTM-D4727	3
5	1	9/16 X 2-3/8 X 6	CORRUGATED, ASTM-D4727	3
6	2	1 X 6 X 6	CORRUGATED, ASTM-D4727	3

SAN301-05-68-001

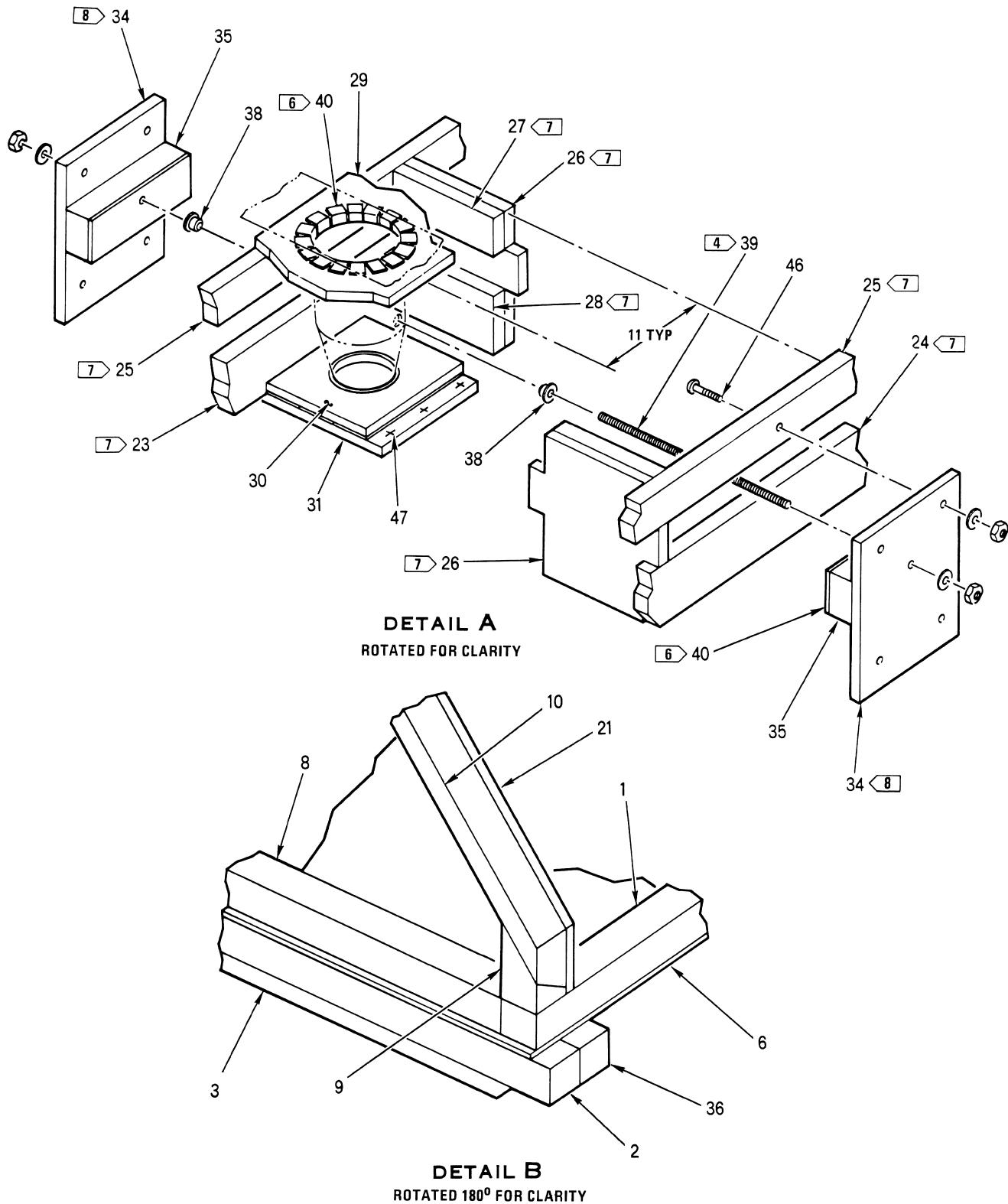
Figure 5-30. Main Landing Gear Aft Door Shipping Container (Sheet 2)



SAN301-05-69-001

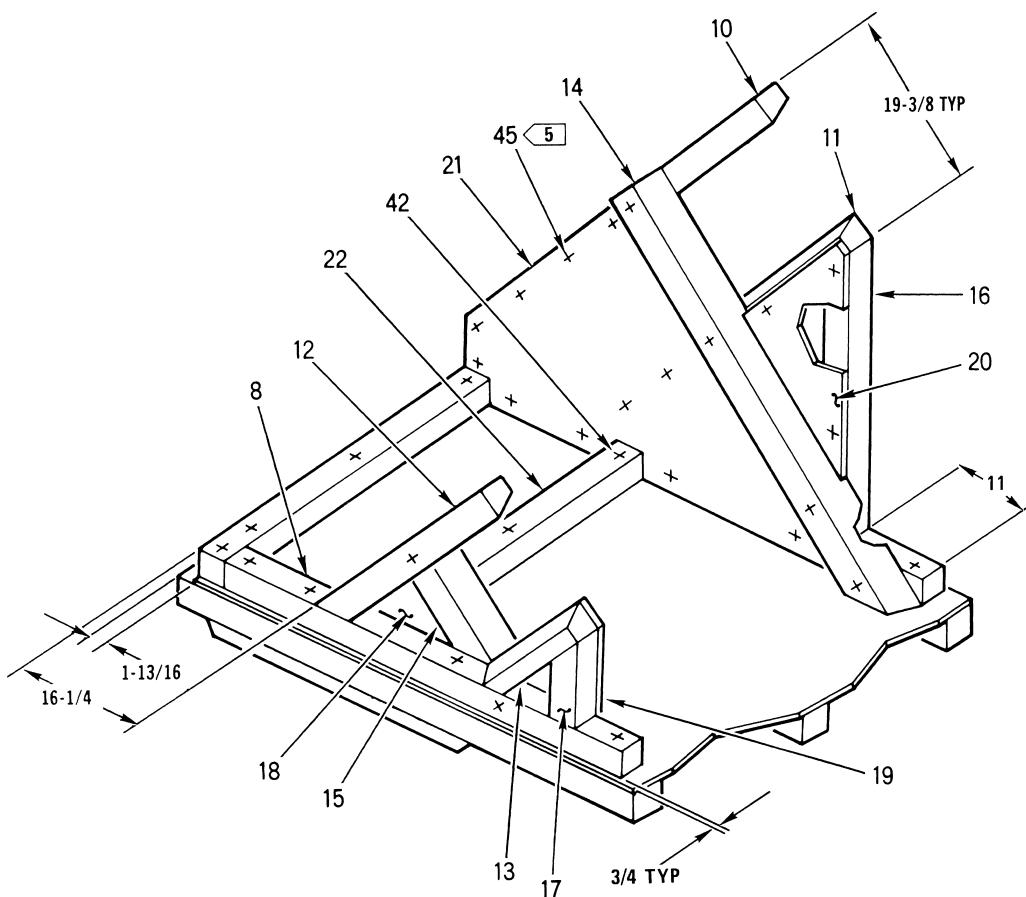
Figure 5-31. Horizontal Stabilizer Single Shipping Container (Sheet 1 of 11)

CSTO SR1F-15SA-3-1

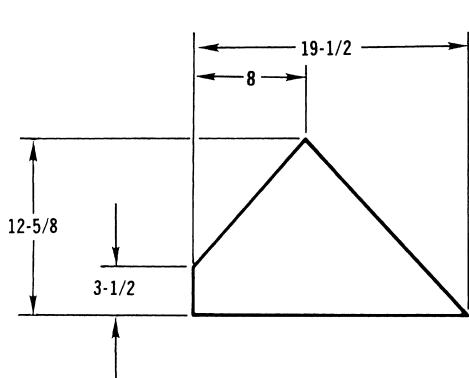


SAN301-05-70-001

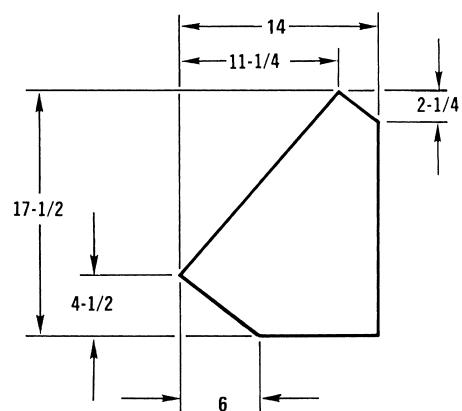
Figure 5-31. Horizontal Stabilizer Single Shipping Container (Sheet 2)



ASSEMBLY STEP 1



DETAIL 18 <5

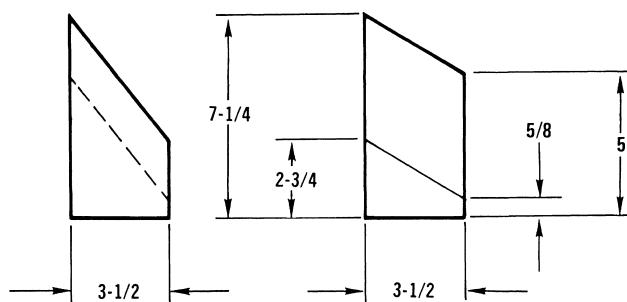
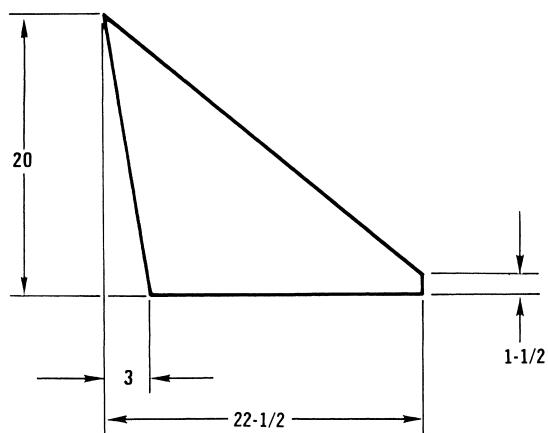


DETAIL 19 <5

SAN301-05-71-001

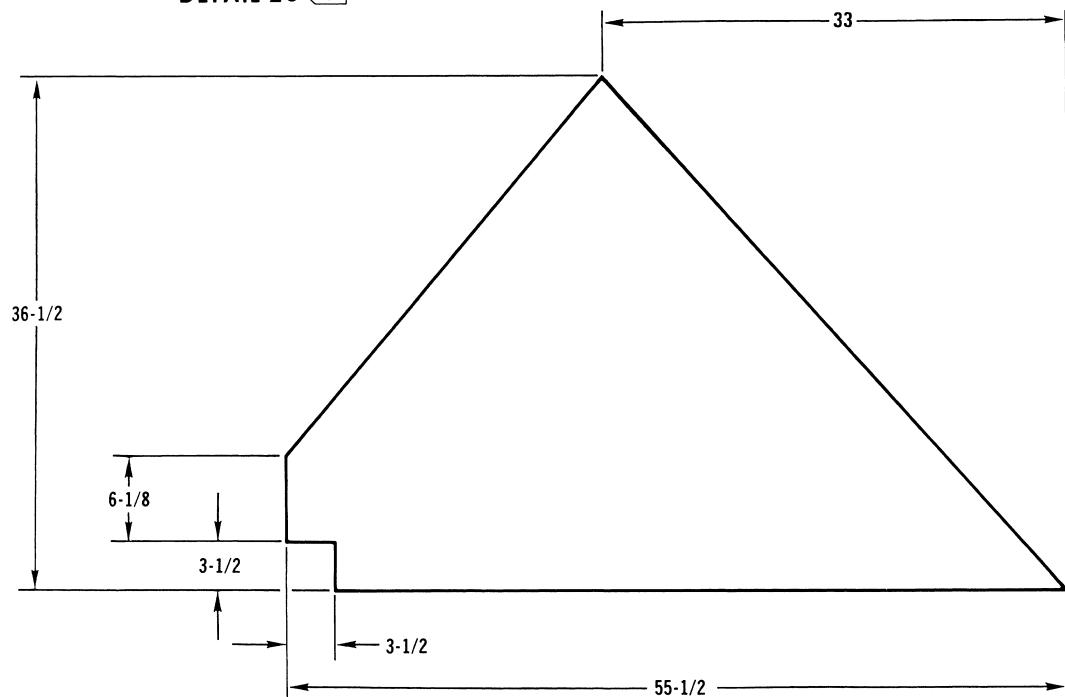
Figure 5-31. Horizontal Stabilizer Single Shipping Container (Sheet 3)

CSTO SR1F-15SA-3-1

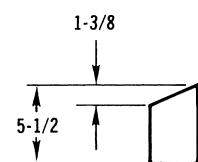
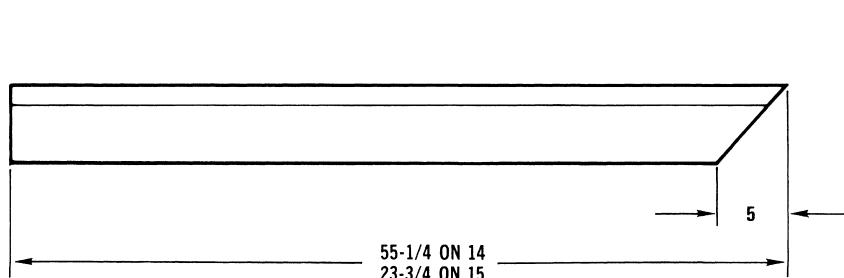


DETAIL 9

DETAIL 20 ◀ 5



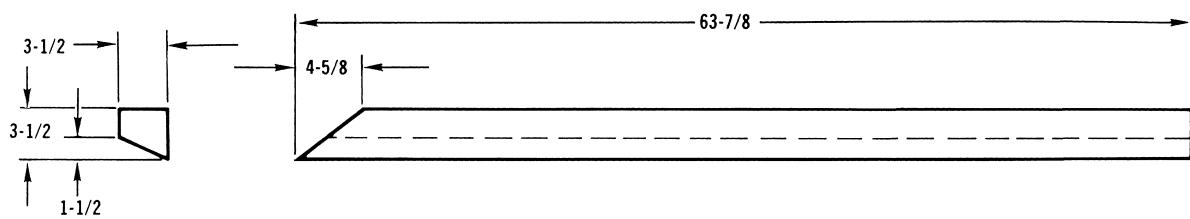
DETAIL 21



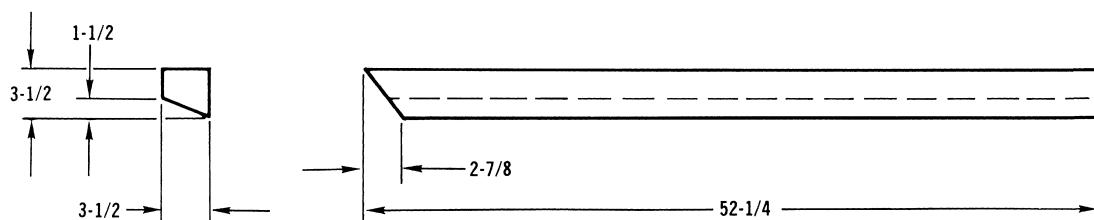
DETAIL 14 & 15 ◀ 5

SAN301-05-72-001

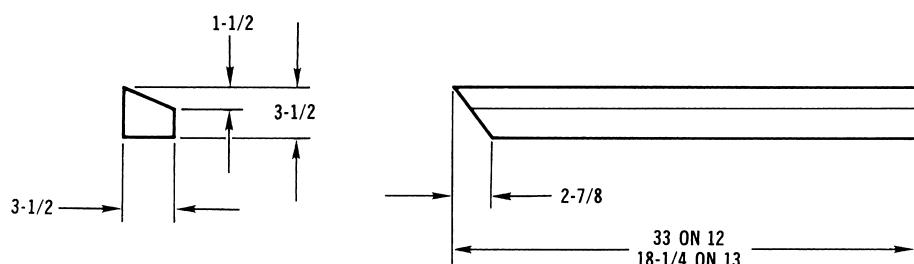
Figure 5-31. Horizontal Stabilizer Single Shipping Container (Sheet 4)



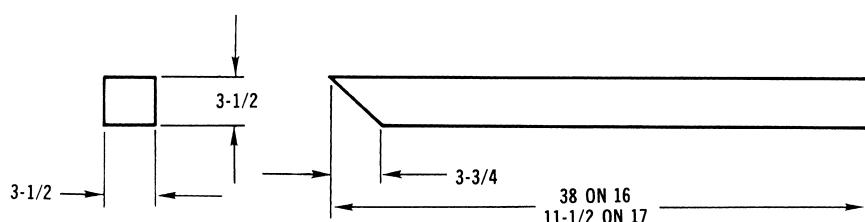
DETAIL 10



DETAIL 11

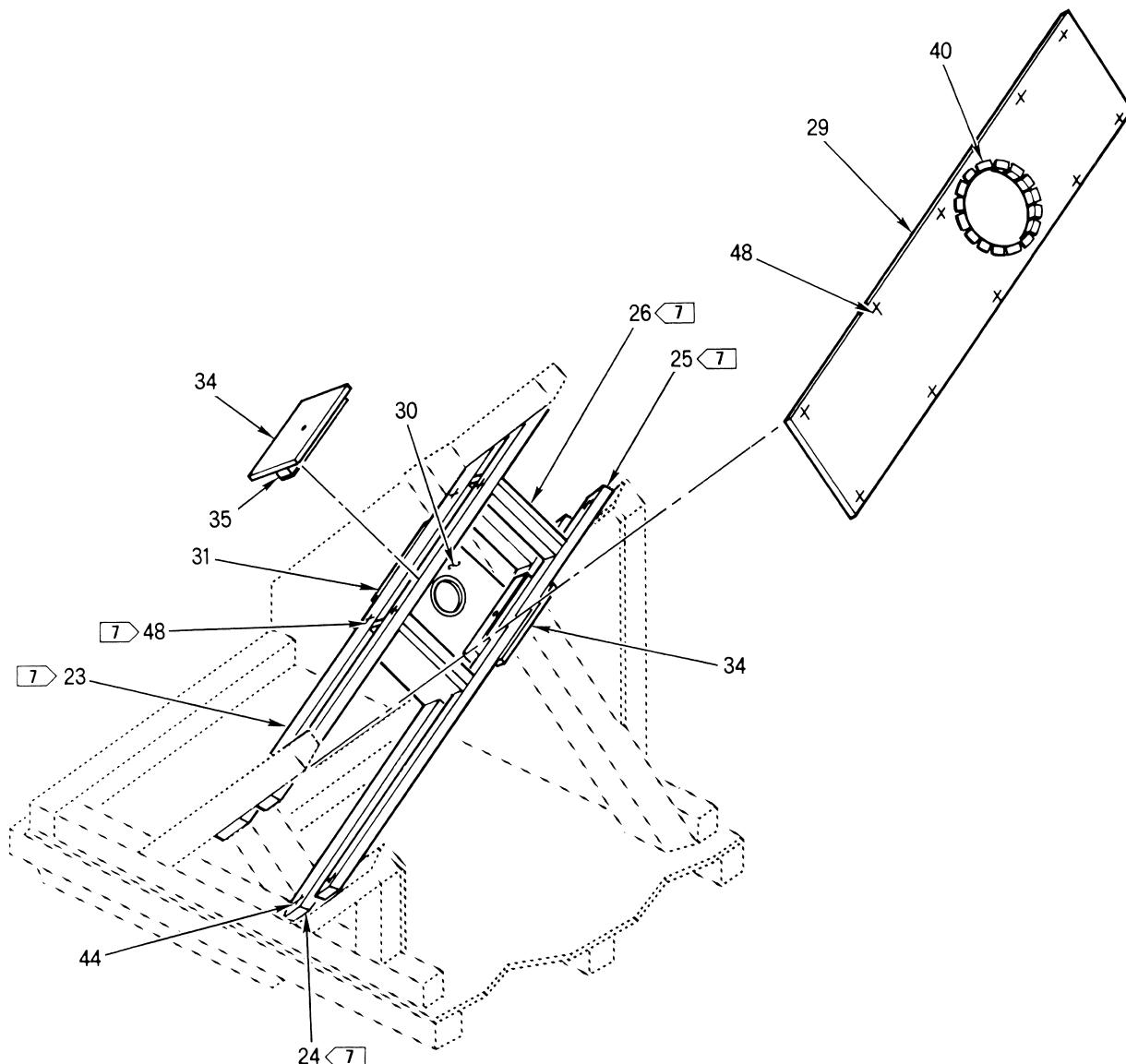


DETAIL 12 & 13

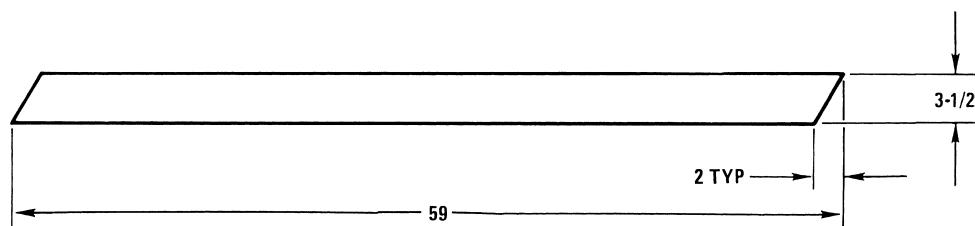


DETAIL 16 & 17

Figure 5-31. Horizontal Stabilator Single Shipping Container (Sheet 5)



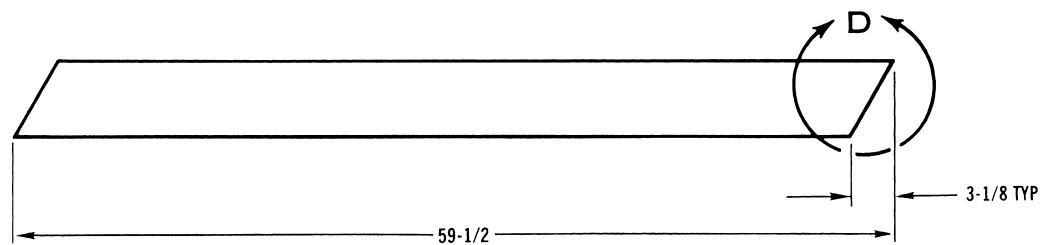
ASSEMBLY STEP 2



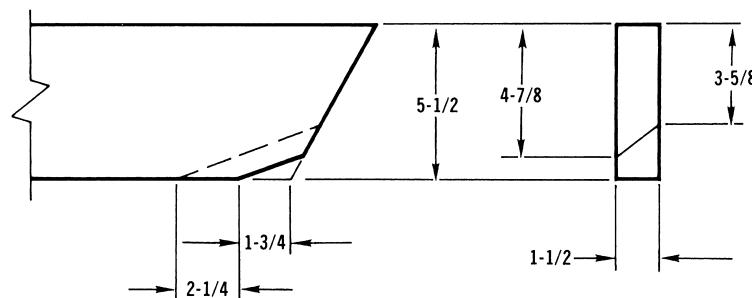
DETAIL 25 <7>

SAN301-05-74-001

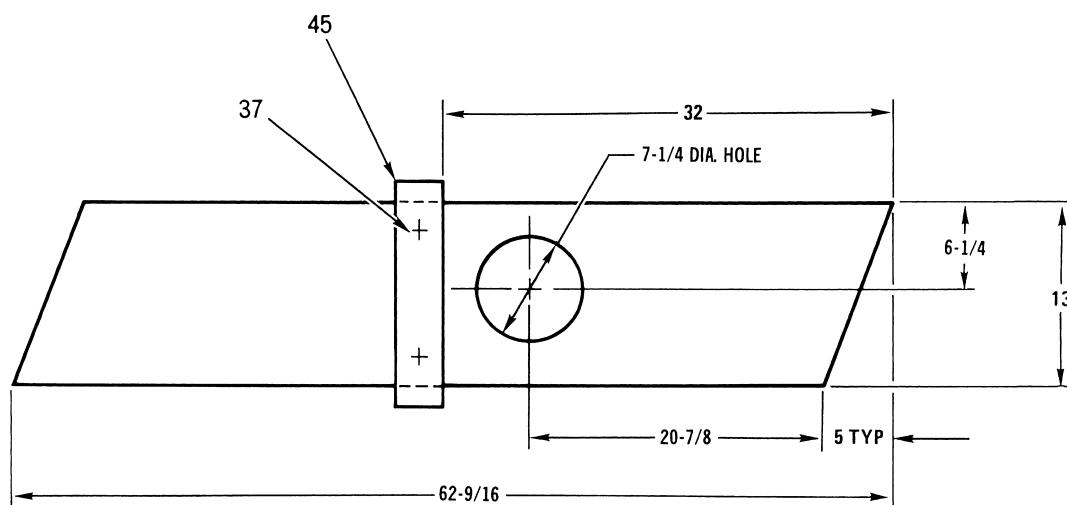
Figure 5-31. Horizontal Stabilizer Single Shipping Container (Sheet 6)



DETAIL 23 & 24 ◀ 7



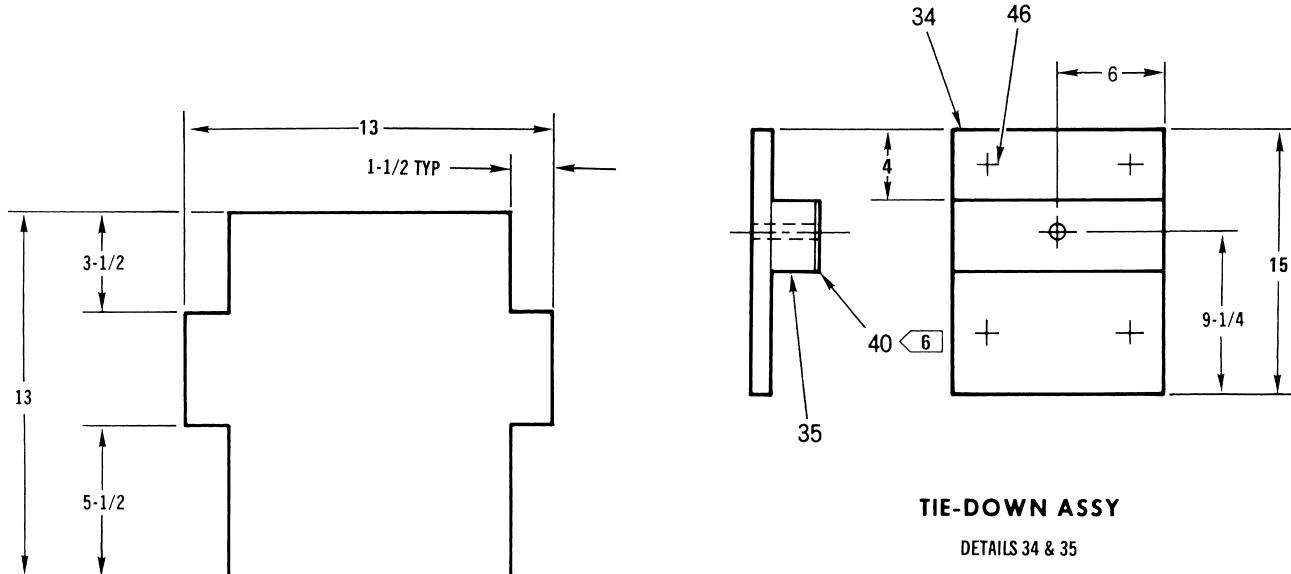
DETAIL D
FOR DETAIL 24 ONLY
ONE END ONLY



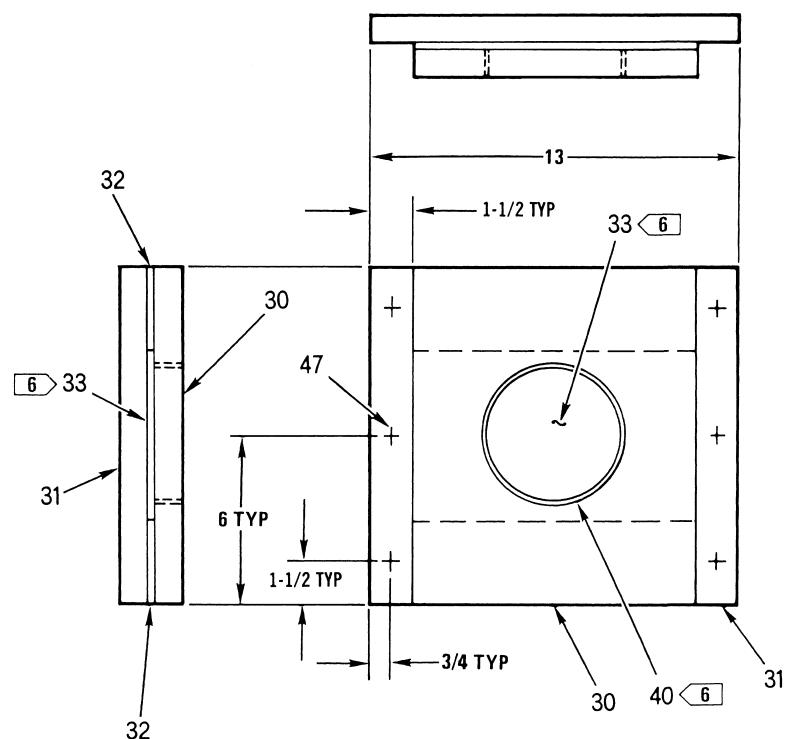
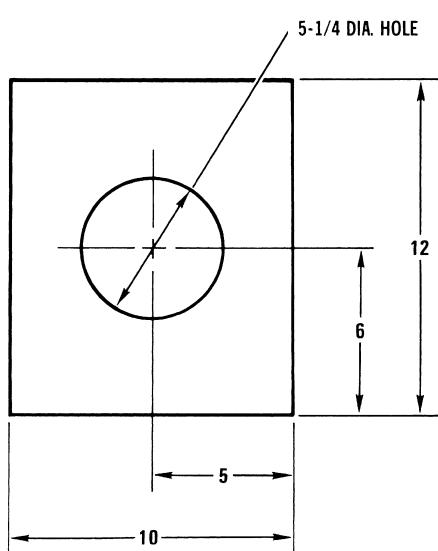
DETAIL 29

SAN301-05-75-001

Figure 5-31. Horizontal Stabilizer Single Shipping Container (Sheet 7)



DETAIL 26 7



DETAIL 30

SUPPORT ASSY
DETAILS 30, 31, 32 & 33

SAN301-05-76-001

Figure 5-31. Horizontal Stabilator Single Shipping Container (Sheet 8)

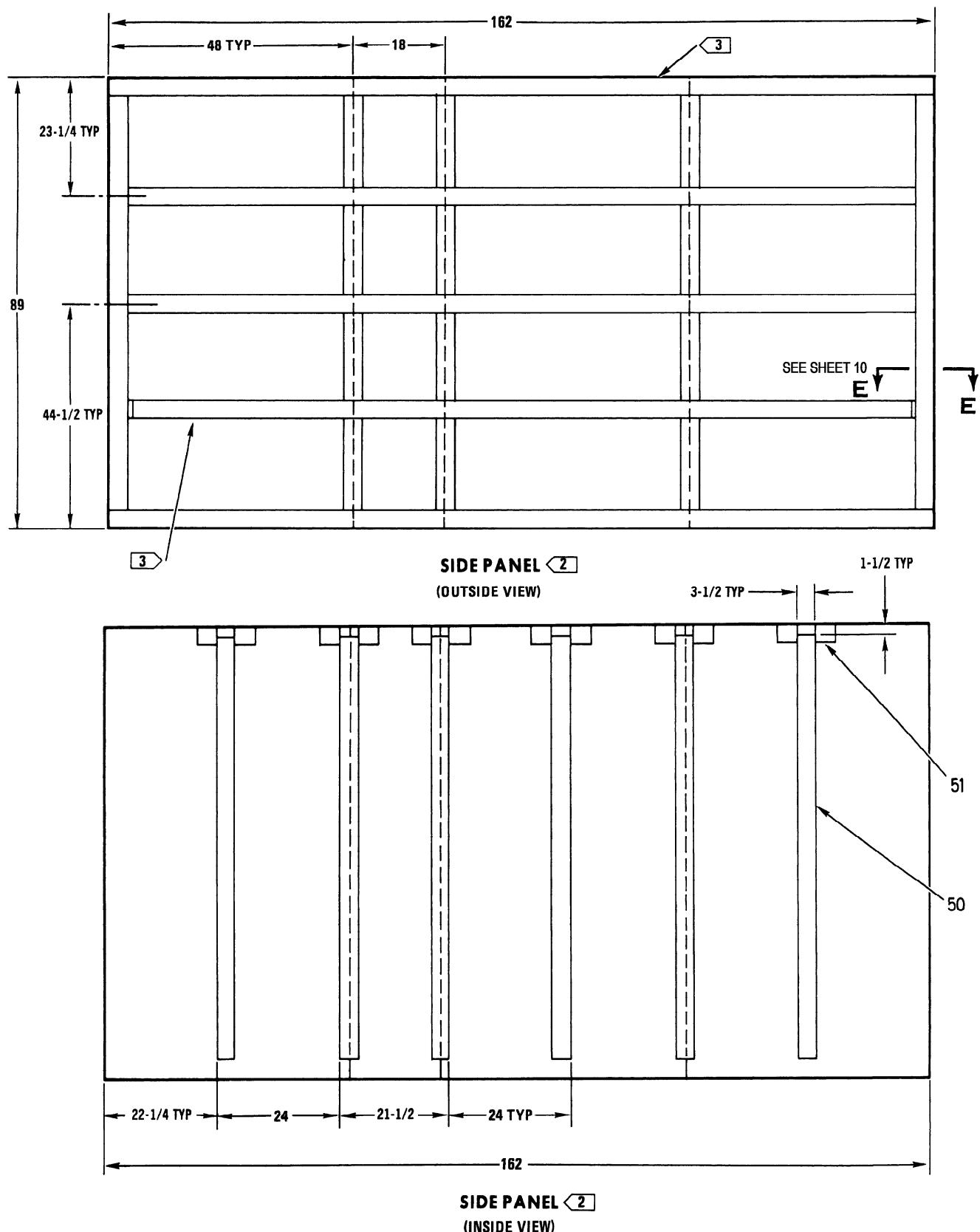
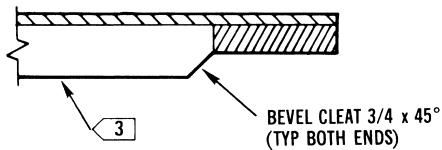
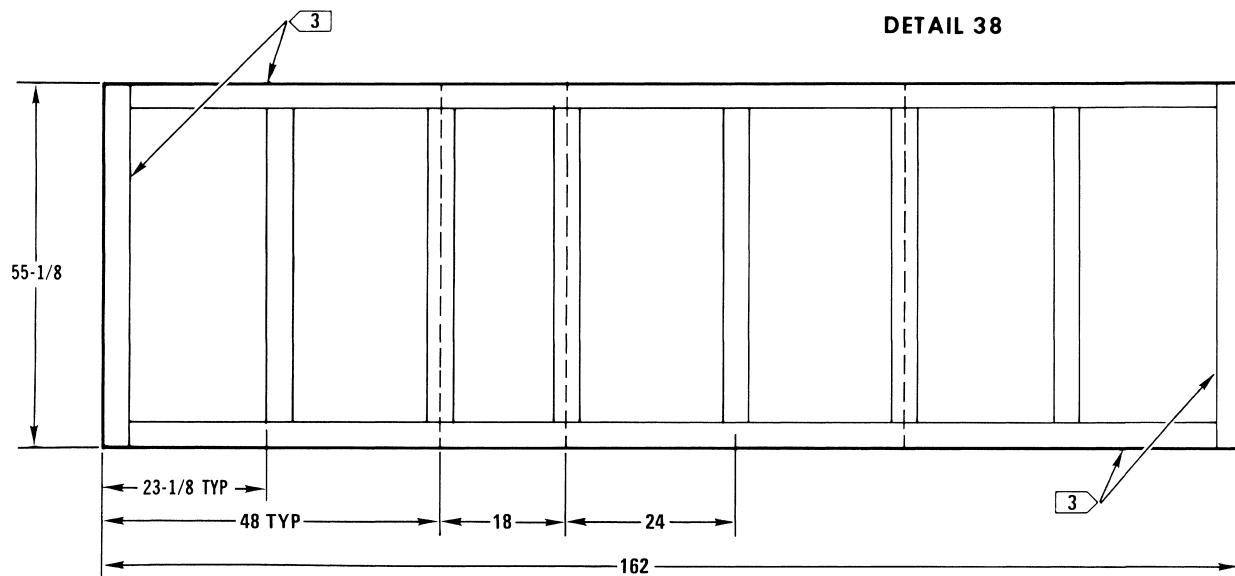
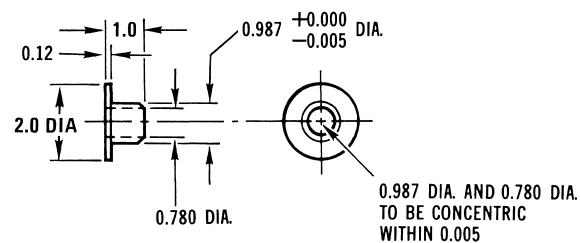


Figure 5-31. Horizontal Stabilizer Single Shipping Container (Sheet 9)

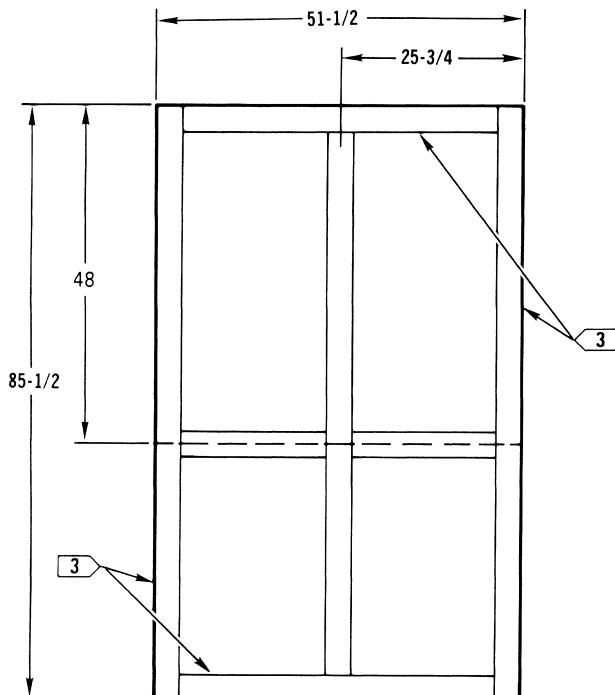
CSTO SR1F-15SA-3-1



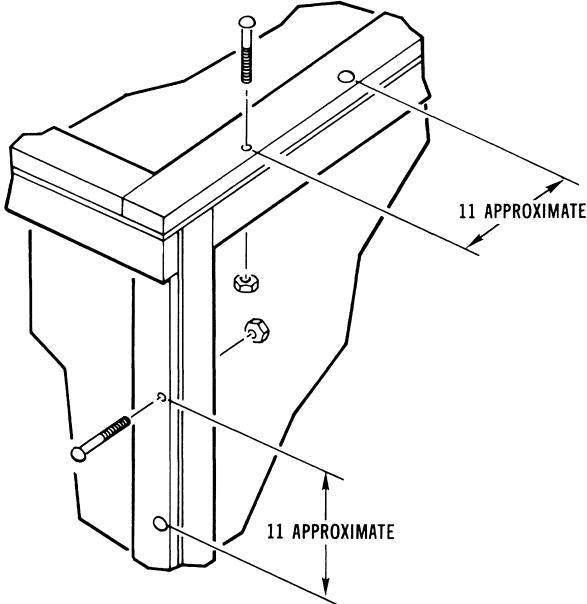
SECTION E-E



TOP PANEL ◀ 2



END PANEL ◀ 2



DETAIL C

SEE NOTE ◀ 2

SAN301-05-78-001

**Figure 5-31. Horizontal Stabilator Single Shipping Container
(Sheet 10)**

LEGEND

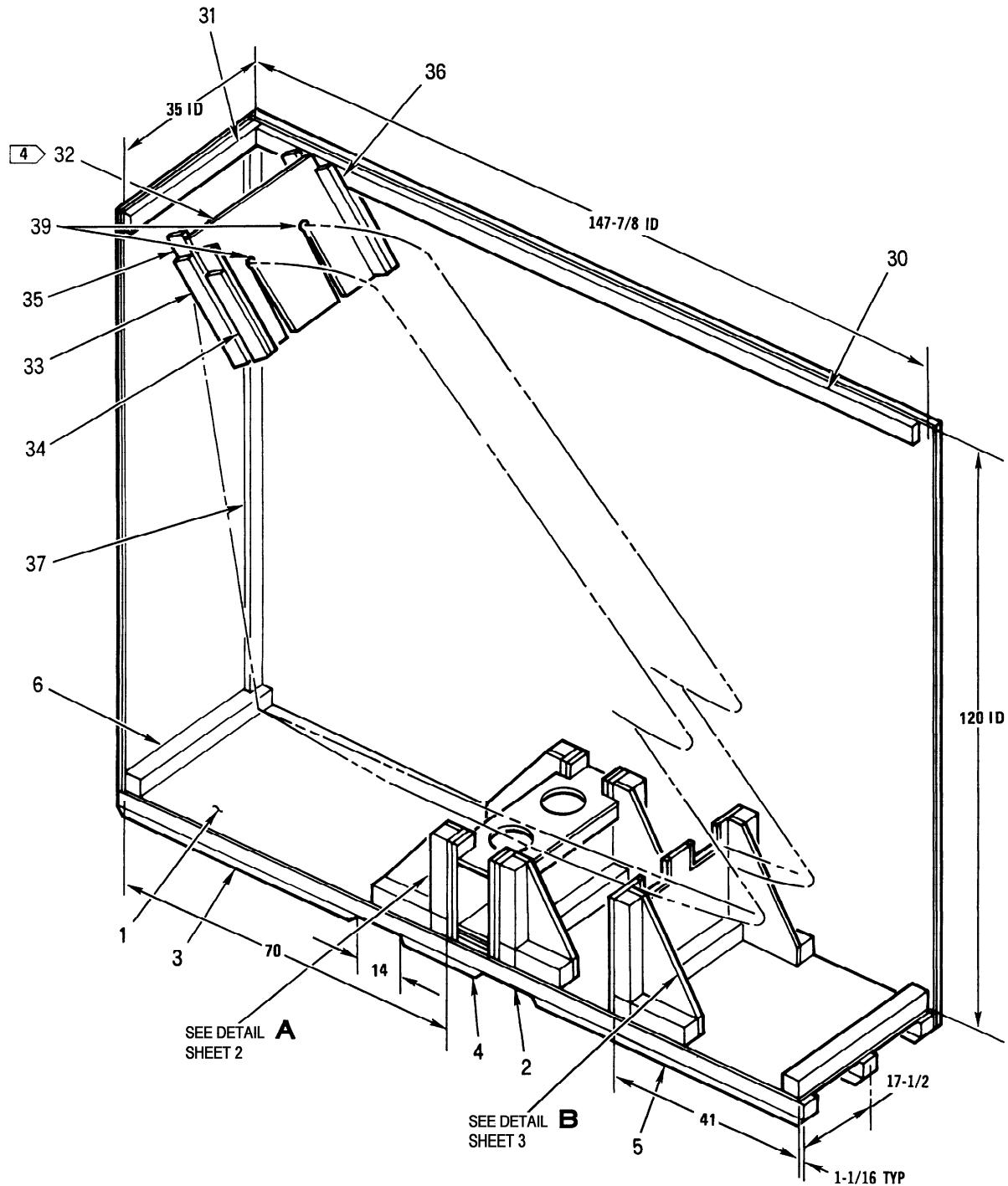
1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 930 POUNDS, HORIZONTAL STABILATOR WEIGHT IS 333 POUNDS. GROSS WEIGHT IS 1263 POUNDS.
- 2 ➤ CONSTRUCT BASE PER STANDARD SPECIFICATION ASTM-D6256 AND CLEATED PLYWOOD PANELS PER STANDARD SPECIFICATION ASTM-D6251. USE 5/16 MINIMUM PLYWOOD PANELS AND 1 X 4 (NOM) WOOD CLEATS EXCEPT AS NOTED. SECURE SIDES AND ENDS TO BASE WITH 1/4 DIA X 4 LAG SCREWS. SECURE TOP, SIDES AND ENDS WITH 1/4 DIA X 5 CARRIAGE BOLTS AS SHOWN IN DETAIL C.
- 3 ➤ CONSTRUCT CLEAT OF 2 X 4 (NOM) LUMBER.
- 4 ➤ APPLY MIL-PRF-16173 (CORROSION PREVENTIVE COMPOUND) TO DETAIL 39 AND INSTALL THROUGH DETAILS 34, 35, 38, AND SPINDLE AS SHOWN

- 5 TO SECURE PART.
- 6 SECURE ITEMS 18, 19, 20, AND 21 AS SHOWN WITH ITEM 45.
- 7 BOND ITEM 33, 40, AND 41 IN PLACE AS SHOWN, USE EC847 ADHESIVE.
- 8 NAIL ITEMS 27 AND 28 TO ITEM 26 AND SECURE TO ITEMS 23, 24, AND 25 WITH ITEM 48.
- 9 STENCIL IN RED ON ITEM 34: REMOVE ASSY ON BOTH SIDES TO REMOVE AND INSTALL PART.
STENCIL ON OUTSIDE OF CONTAINER: REMOVE TOP, SIDES, AND ENDS AS LISTED.
- 10 NAIL DETAIL 49 TO LID.

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	3	4 X 4 (NOM) X 50	WOOD	
2	3	4 X 4 (NOM) X 162	WOOD	
3	3	2 X 4 (NOM) X 36	WOOD	
4	3	2 X 4 (NOM) X 24	WOOD	
5	3	2 X 4 (NOM) X 48	WOOD	
6	3	1/2 X 48 X 51-1/2	PLYWOOD	
7	1	1/2 X 14-3/8 X 51-1/2	PLYWOOD	
8	2	4 X 4 (NOM) X 59-1/4	WOOD	
9	1	3-1/2 X 3-1/2 X 7-1/4	WOOD	
10	1	3-1/2 X 3-1/2 X 63-7/8	WOOD	
11	1	3-1/2 X 3-1/2 X 52-1/4	WOOD	
12	1	3-1/2 X 3-1/2 X 33	WOOD	
13	1	3-1/2 X 3-1/2 X 18-1/4	WOOD	
14	1	3-1/2 X 5-1/2 X 55-1/4	WOOD	
15	1	3-1/2 X 5-1/2 X 23-3/4	WOOD	
16	1	3-1/2 X 3-1/2 X 38	WOOD	
17	1	3-1/2 X 3-1/2 X 11-1/2	WOOD	
18	1	1 X 12-5/8 X 19-1/2	PLYWOOD	
19	1	1 X 14 X 17-1/2	PLYWOOD	<input checked="" type="checkbox"/>
20	1	1 X 20 X 22-1/2	PLYWOOD	<input checked="" type="checkbox"/>
21	1	1 X 36-1/2 X 55-1/2	PLYWOOD	<input checked="" type="checkbox"/>
22	1	4 X 4 (NOM) X 41	WOOD	
23	1	1-1/2 X 5-1/2 X 59-1/2	WOOD	<input checked="" type="checkbox"/>
24	1	1-1/2 X 5-1/2 X 59-1/2	WOOD	<input checked="" type="checkbox"/>
25	2	1-1/2 X 3-1/2 X 59	WOOD	<input checked="" type="checkbox"/>
26	2	1 X 13 X 13	PLYWOOD	<input checked="" type="checkbox"/>
27	2	2 X 4 (NOM) X 10	WOOD	<input checked="" type="checkbox"/>
28	2	2 X 6 (NOM) X 10	WOOD	<input checked="" type="checkbox"/>
29	1	1 X 13 X 62-9/16	PLYWOOD	<input checked="" type="checkbox"/>
30	1	1 X 10 X 12	PLYWOOD	
31	1	1 X 12 X 13	PLYWOOD	
32	2	1/4 X 3 X 10	PLYWOOD	
33	1	1/4 X 6 X 10	RUBBER	<input checked="" type="checkbox"/>
34	2	1 X 12 X 15	PLYWOOD	<input checked="" type="checkbox"/>
35	2	2-1/2 X 4 X 12	WOOD	
36	2	4 X 4 (NOM) X 36	WOOD	
37	1	4 X 4 (NOM) X 16	WOOD	
38	2	2 DIA X 1	6061-T6 ALUMINUM	
39	1	3/4 DIA X 19	THREADED STOCK (WITH HARDWARE)	
40	A/R	1/8 THICK	RUBBER	<input checked="" type="checkbox"/>
41	1	2-1/8 X 3-1/2 X 16	CUSHIONING MATERIAL, POLYETHYLENE, A-A-59136	<input checked="" type="checkbox"/>
42	33	3/8 DIA X 8	CARRIAGE BOLT (WITH HARDWARE)	
43	14	3/8 DIA X 4-1/2	CARRIAGE BOLT (WITH HARDWARE)	
44	8	3/8 DIA X 5-1/2	CARRIAGE BOLT (WITH HARDWARE)	<input checked="" type="checkbox"/>
45	A/R	3/8 DIA X 5	CARRIAGE BOLT (WITH HARDWARE)	
46	8	3/8 DIA X 3	CARRIAGE BOLT (WITH HARDWARE)	
47	6	1/4 DIA X 4	LAG SCREW	<input checked="" type="checkbox"/>
48	A/R	3/8 DIA X 3	LAG SCREW	
49	6	2 X 4 (NOM) X 51-1/2	WOOD	
50	12	3/4 X 3-1/2 X 83-1/2	WOOD	
51	24	3/4 X 3-1/2 X 4	WOOD	

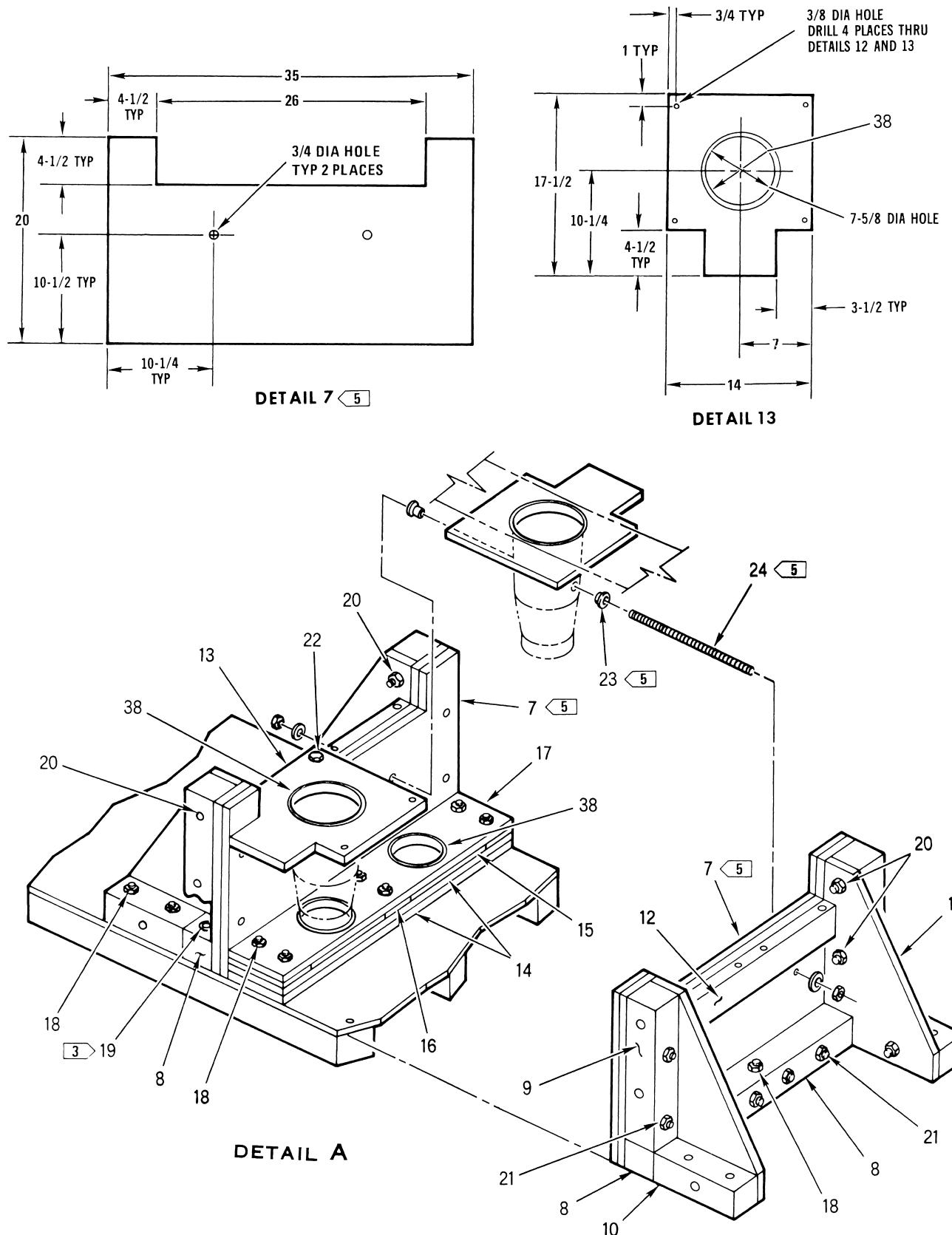
SAN301-05-79-001

Figure 5-31. Horizontal Stabilator Single Shipping Container
(Sheet 11)



SAN301-05-80-001

**Figure 5-32. Horizontal Stabilizer Dual Shipping Container
(Sheet 1 of 6)**



SAN301-05-81-001

Figure 5-32. Horizontal Stabilizer Dual Shipping Container (Sheet 2)

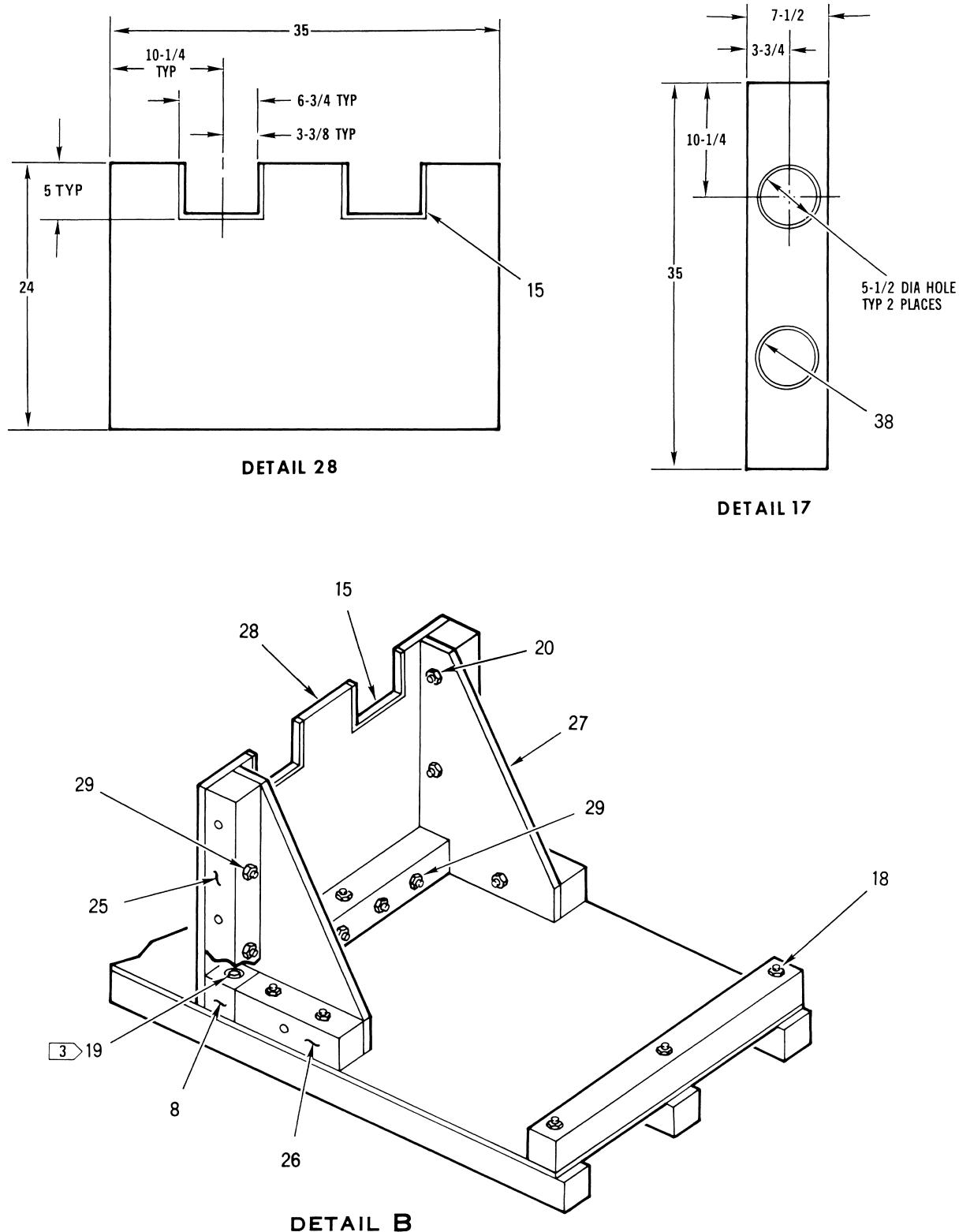
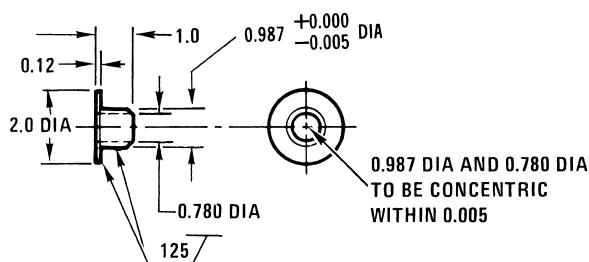
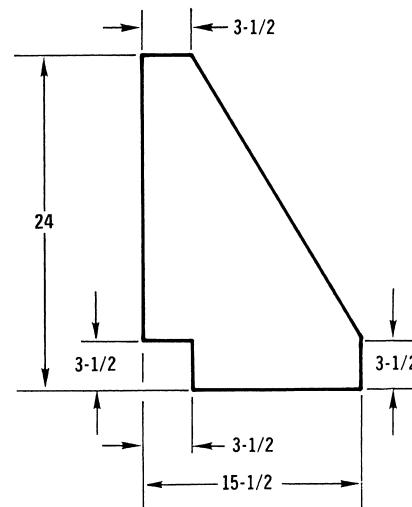
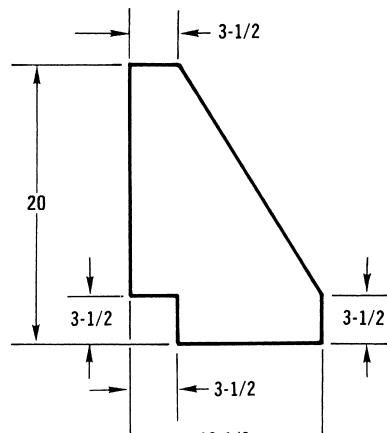
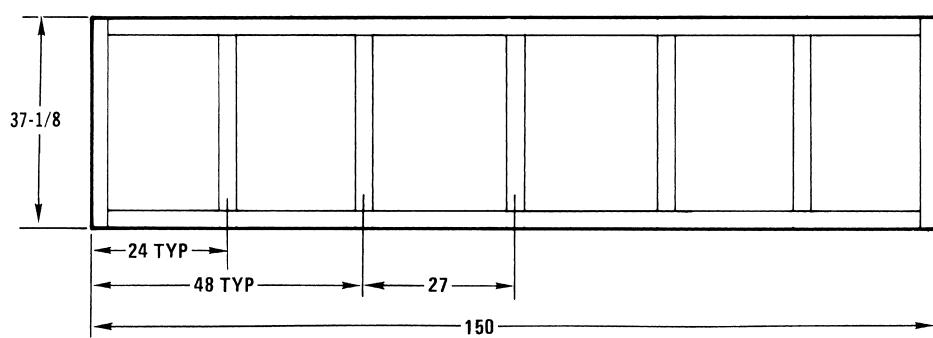
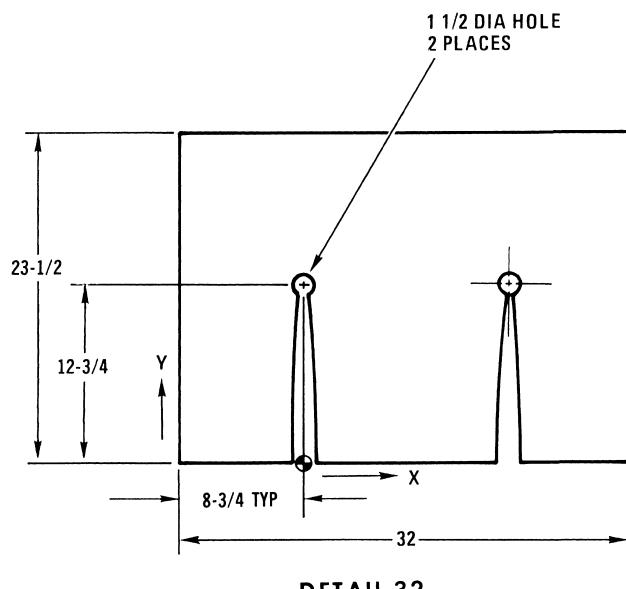


Figure 5-32. Horizontal Stabilizer Dual Shipping Container (Sheet 3)



X	Y
7/8	0
3/4	2
11/16	4
5/8	6
9/16	8
3/8	10
5/16	12

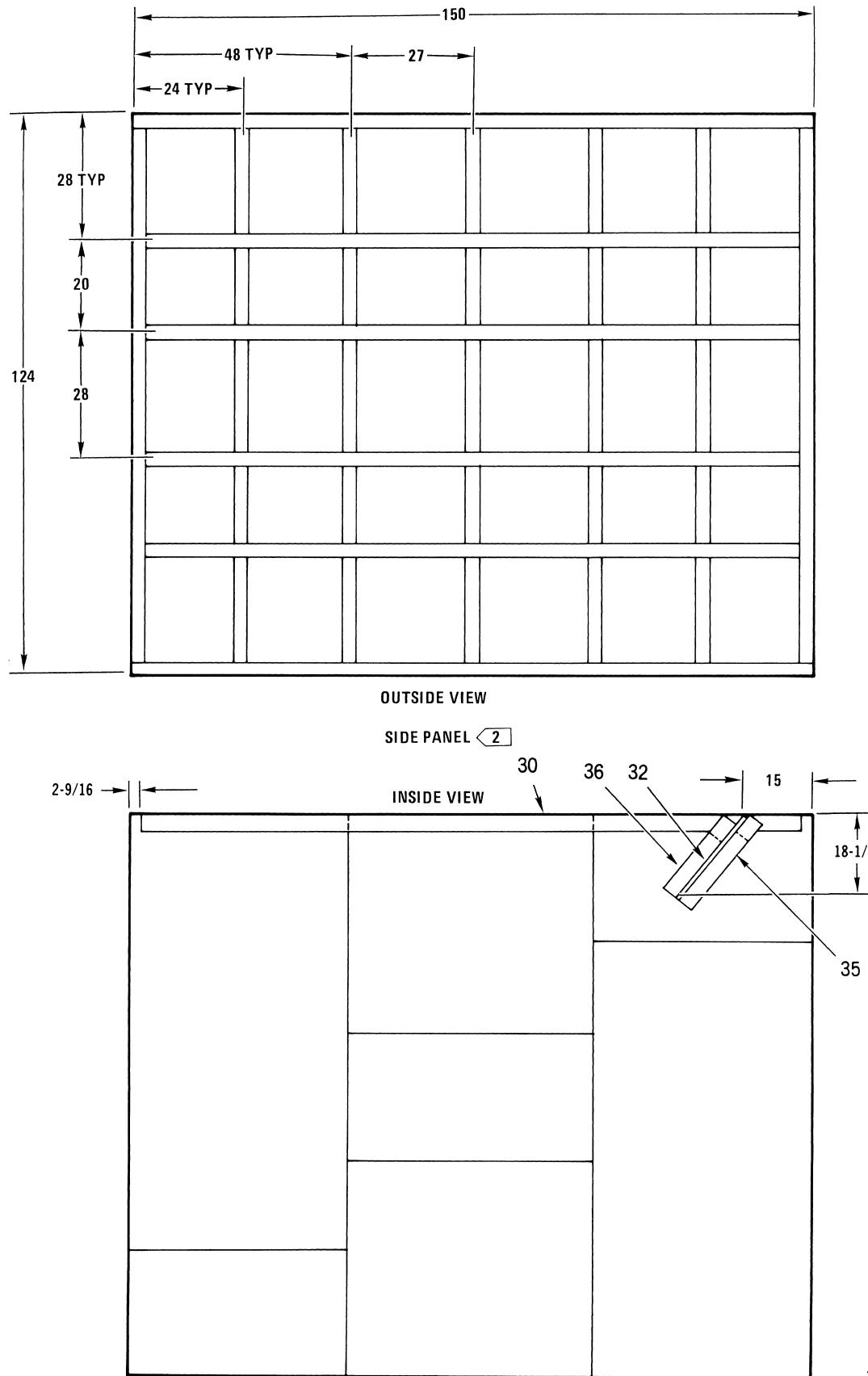
DETAIL 32



SAN301-05-83-001

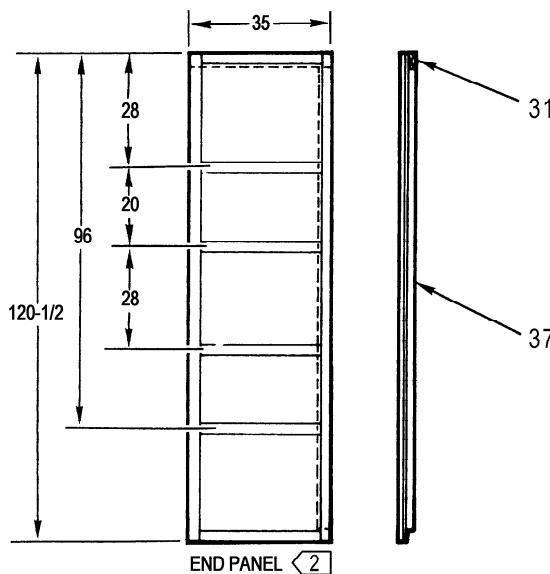
Figure 5-32. Horizontal Stabilizer Dual Shipping Container (Sheet 4)

CSTO SR1F-15SA-3-1



SAN301-05-84-001

Figure 5-32. Horizontal Stabilizer Dual Shipping Container (Sheet 5)



LEGEND

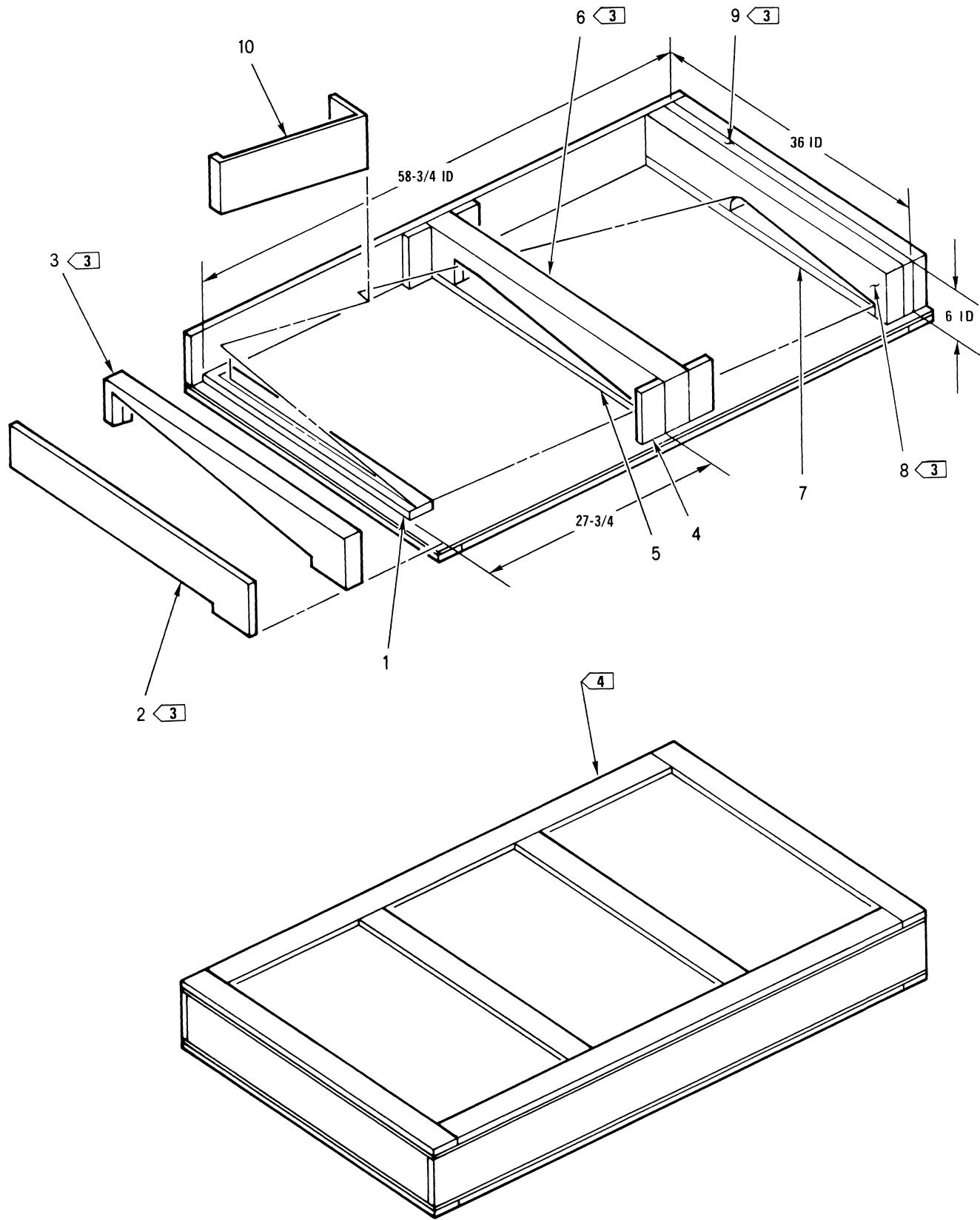
1. APPROXIMATE WEIGHT OF CONTAINER IS 600 POUNDS, TWO HORIZONTAL STABILATORS WEIGHT IS 666 POUNDS. GROSS WEIGHT IS 1266 POUNDS.
2. CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6256 AND ASTM-D6251. USE 5/16 MINIMUM PLYWOOD PANELS AND 3/4 X 2-5/8 MINIMUM CLEATS.
3. COUNTERSINK DETAIL 8 AS SHOWN, 6 PLACES.
4. PLACE POLYETHYLENE BETWEEN STABILIZERS AND DETAIL 32.
5. APPLY MIL-PRF-16173 (CORROSION PREVENTATIVE COMPOUND) TO DETAIL 24 AND INSTALL THROUGH DETAIL 7, DETAIL 23, AND SPINDLE AS SHOWN TO SECURE PART.
6. LAG SCREW ONE SIDE AND TOP TO CONTAINER WITH 1/4 X 3 SCREWS INTO ITEMS 2, 30, 31, AND 37.

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	1	1/2 X 35 X 147-7/8	PLYWOOD	
2	3	4 X 4 (NOM) X 150	WOOD	6
3	3	2 X 4 (NOM) X 48	WOOD	
4	3	2 X 4 (NOM) X 18	WOOD	
5	3	2 X 4 (NOM) X 60	WOOD	
6	2	4 X 4 (NOM) X 35	WOOD	
7	4	1 X 20 X 35	PLYWOOD	
8	3	4 X 4 (NOM) X 35	WOOD	3
9	4	4 X 4 (NOM) X 16-1/2	WOOD	
10	4	4 X 4 (NOM) X 10	WOOD	
11	4	1 X 13-1/2 X 20	PLYWOOD	
12	2	2 X 4 (NOM) X 26	WOOD	
13	2	1 X 14 X 17-1/2	PLYWOOD	
14	2	1 X 7 X 35	PLYWOOD	
15	A/R	1/2 THICK	RUBBER	
16	3	1/2 X 4 X 7	PLYWOOD	
17	1	1 X 7 X 35	PLYWOOD	
18	27	3/8 DIA X 8	CARRIAGE BOLT (WITH HARDWARE)	
19	6	3/8 DIA X 7	CARRIAGE BOLT (WITH HARDWARE)	
20	18	3/8 DIA X 4-1/2	CARRIAGE BOLT (WITH HARDWARE)	
21	16	3/8 DIA X 6	CARRIAGE BOLT (WITH HARDWARE)	
22	8	1/4 DIA X 5	CARRIAGE BOLT (WITH HARDWARE)	
23	4	2 DIA X 1	6061-T6 ALUMINUM	
24	2	5/8 X 15	THREADED STOCK	5
25	2	4 X 4 (NOM) X 20-1/2	WOOD	
26	2	4 X 4 (NOM) X 12	WOOD	
27	2	1 X 15-1/2 X 24	PLYWOOD	
28	1	1 X 24 X 35	PLYWOOD	
29	8	3/8 DIA X 5	CARRIAGE BOLT (WITH HARDWARE)	
30	2	2 X 4 (NOM) X 144-7/8	WOOD	6
31	2	2 X 4 (NOM) X 35	WOOD	6
32	1	1 X 23-1/2 X 32	PLYWOOD	4
33	2	2 X 4 (NOM) X 16-1/2	WOOD	
34	2	2 X 4 (NOM) X 15	WOOD	
35	2	2 X 4 (NOM) X 21-1/2	WOOD	
36	2	2 X 4 (NOM) X 18-3/4	WOOD	
37	2	2 X 4 (NOM) X 113	WOOD	
38	A/R	1/4 THICK	RUBBER	6
39	A/R	1/4 THICK	CUSHIONING MATERIAL, POLYETHYLENE, A-A-59136	4

SAN301-05-85-001

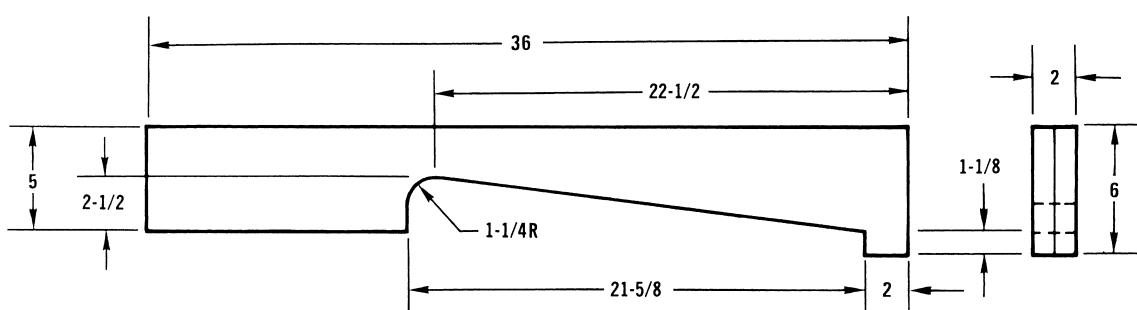
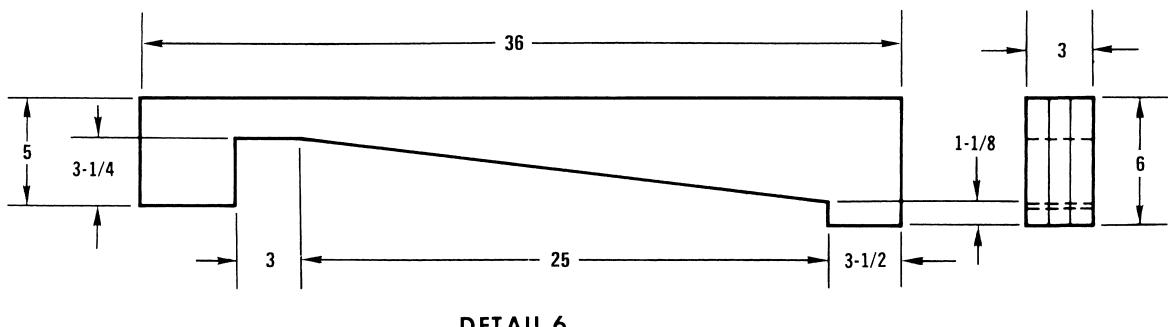
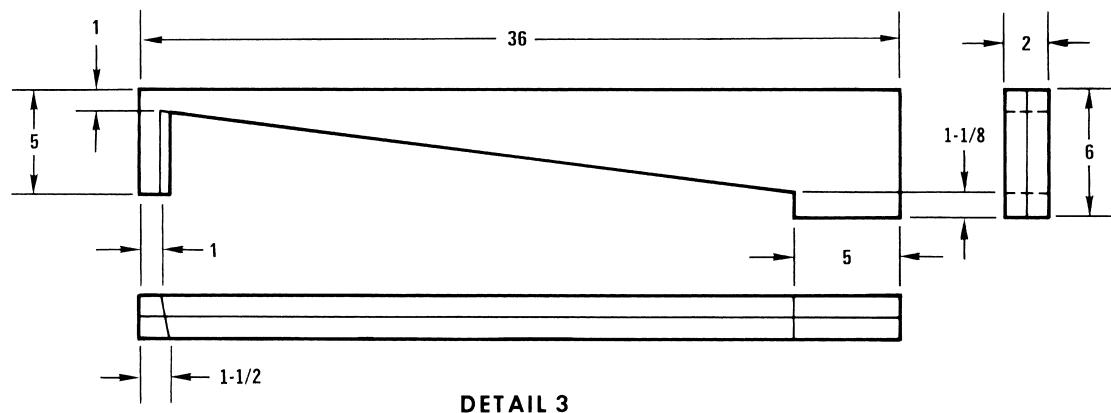
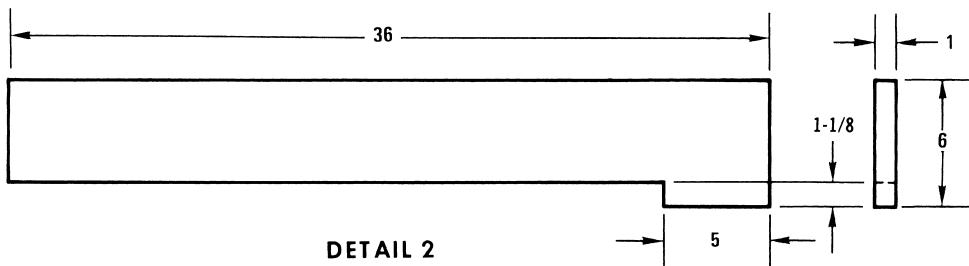
Figure 5-32. Horizontal Stabilizer Dual Shipping Container (Sheet 6)

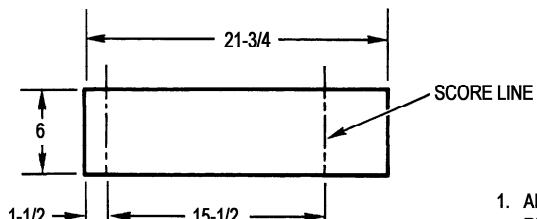
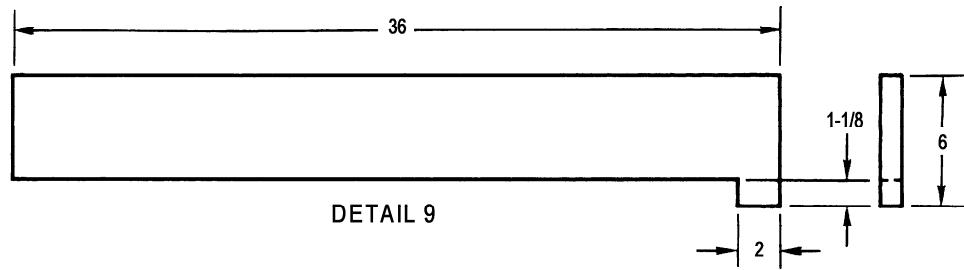
CSTO SR1F-15SA-3-1



SAN301-05-86-001

Figure 5-33. Rudder Shipping Container (Sheet 1 of 3)

**Figure 5-33. Rudder Shipping Container (Sheet 2)**



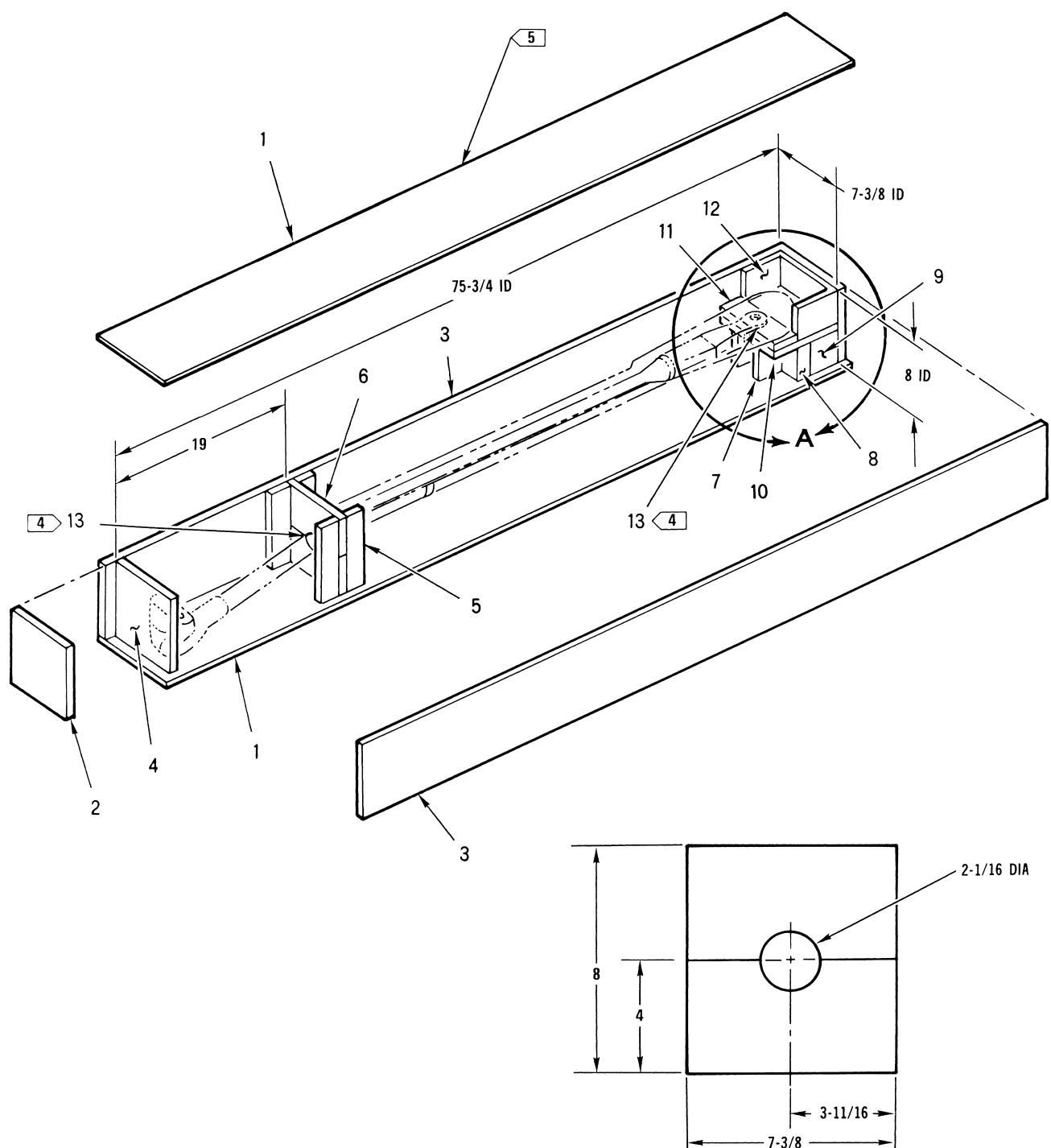
LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 16 POUNDS, RUDDER WEIGHT IS 22 POUNDS. GROSS WEIGHT IS 38 POUNDS.
 2. WRAP RUDDER IN PLASTIC SHEET, STANDARD SPECIFICATION A-A-3174, TYPE I, CLASS 1, GRADE B, FINISH 1.
- [3] BOND BLOCKING TOGETHER AS SHOWN, USE EC847 ADHESIVE.
- [4] CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6251. USE 3/4 MINIMUM WOOD SIDES AND 1-1/2 MINIMUM WOOD ENDS. FOR TOP AND BOTTOM USE 5/8 X 1-3/4 MINIMUM CLEATS AND USE 0.070 MINIMUM POV PANELS.

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	1	1 X 3 X 31	CORRUGATED, ASTM-D4727	
2	1	1 X 6 X 36	CORRUGATED, ASTM-D4727	
3	1	2 X 6 X 36	CORRUGATED, ASTM-D4727	
4	4	1 X 3 X 6	CORRUGATED, ASTM-D4727	
5	1	1 X 3 X 32-1/2	CORRUGATED, ASTM-D4727	[3]
6	1	3 X 6 X 36	CORRUGATED, ASTM-D4727	[3]
7	1	1 X 3 X 34	CORRUGATED, ASTM-D4727	
8	1	2 X 6 X 36	CORRUGATED, ASTM-D4727	[3]
9	1	1 X 6 X 36	CORRUGATED, ASTM-D4727	[3]
10	1	1/2 X 6 X 21-3/4	CORRUGATED, ASTM-D4727	

SAN301-05-88-001

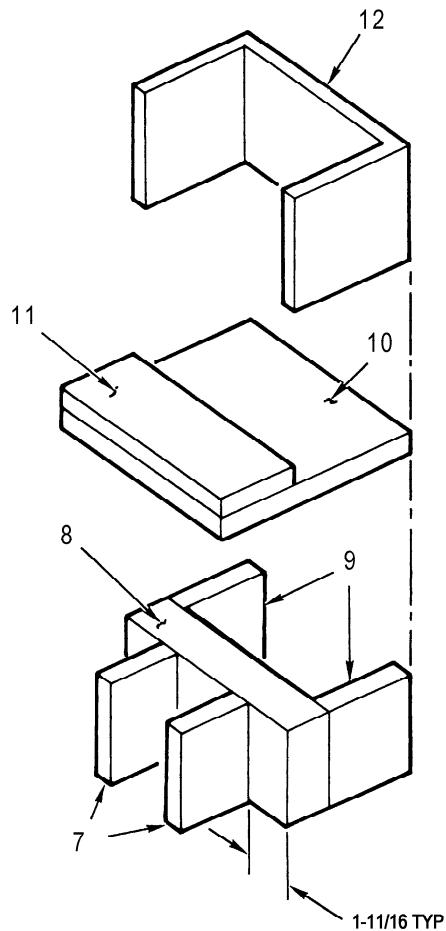
Figure 5-33. Rudder Shipping Container (Sheet 3)



DETAIL 6

SAN301-05-89-001

Figure 5-34. Arresting Hook Shipping Container (Sheet 1 of 2)



LEGEND

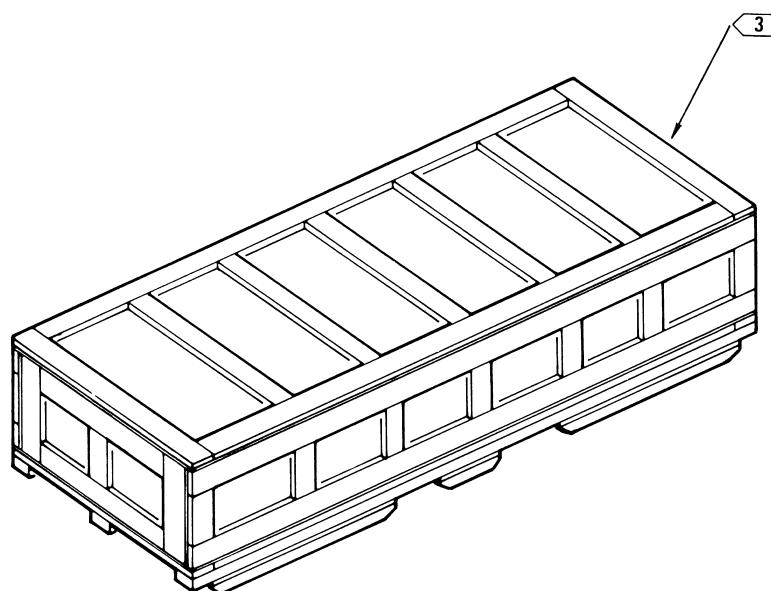
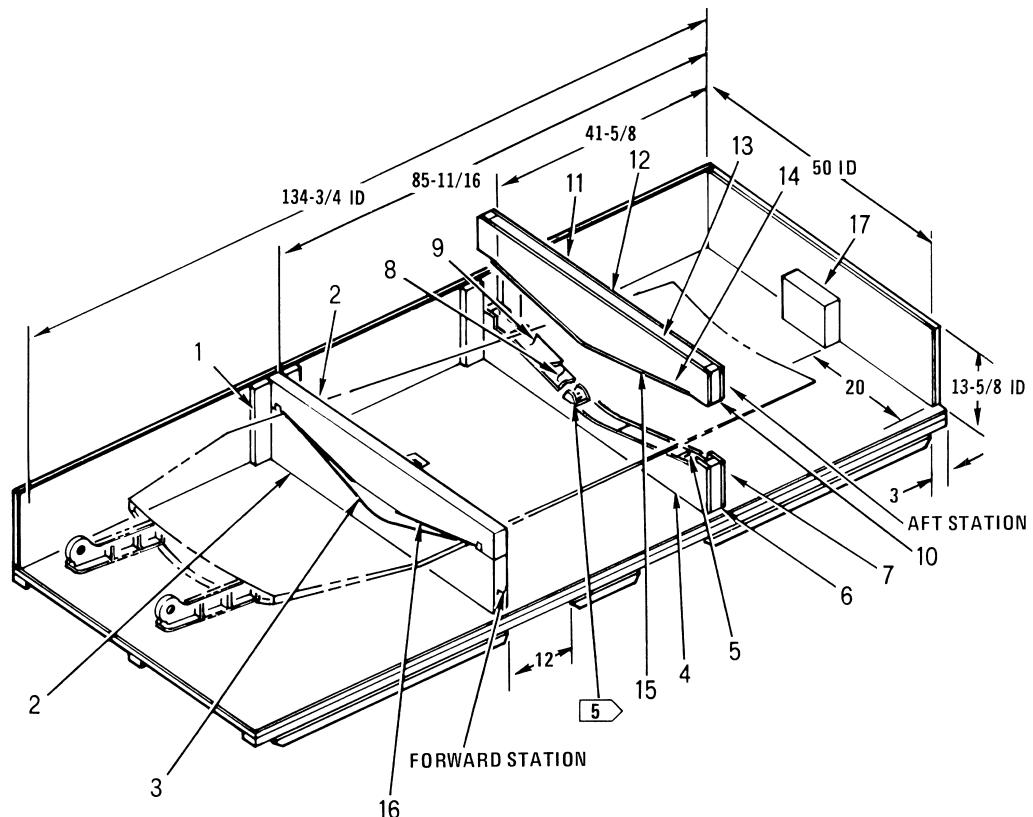
1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 25 POUNDS, ARRESTING HOOK WEIGHT IS 120 POUNDS. GROSS WEIGHT IS 145 POUNDS.
 2. WRAP LINK ASSEMBLIES, 68A480632 AND 68A480633, WITH ATTACHED DOOR, 68A480908, IN SINGLE FACED CORRUGATED AND PLACE INTO ASTM-D5118 REGULAR SLOTTED CONTAINER.
 3. WRAP LINK ASSEMBLIES, 68A480634 AND 64A480635, IN SINGLE FACED CORRUGATED AND PLACE INTO ASTM-D5118 REGULAR SLOTTED CONTAINER.
SIZE: 38 X 5-1/2 X 6 ID.
- 4** PLACE BARRIER IN ANY AREA WHERE PART MAKES CONTACT WITH BLOCKING.
- 5** CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6880.

DETAIL A

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	2	5/16 X 9-3/8 X 77-3/4	PLYWOOD	
2	2	1 X 7-3/8 X 8	WOOD	
3	2	1 X 8 X 77-3/4	WOOD	
4	1	1 X 7-3/8 X 8	CORRUGATED, ASTM-D4727	
5	4	1 X 2 (NOM) X 8	WOOD	
6	1	1 X 7-3/8 X 8	PLYWOOD	
7	2	3/4 X 2-1/2 X 3-1/2	WOOD	
8	1	1-1/2 X 3-1/2 X 7-3/8	WOOD	
9	2	3/4 X 3 X 3-1/2	WOOD	
10	1	3/4 X 7 X 7-3/8	WOOD	
11	1	3/4 X 2-3/4 X 7-3/8	WOOD	
12	1	9/16 X 3-3/4 X 15	CORRUGATED, ASTM-D4727	
13	1	A/R	BARRIER, MIL-PRF-121	4

SAN301-05-90-001

Figure 5-34. Arresting Hook Shipping Container (Sheet 2)



SAN301-05-91-001

Figure 5-35. Speed Brake Shipping Container (Sheet 1 of 4)

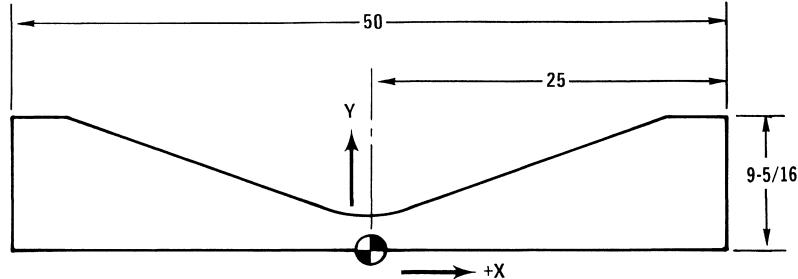
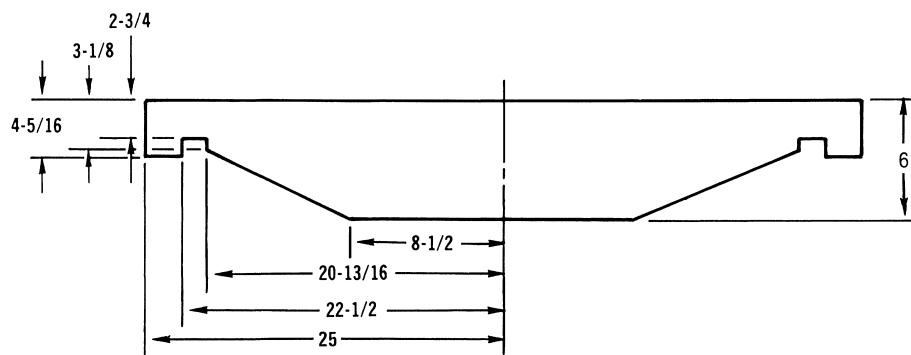


TABLE 1
LOWER CONTOUR

$\pm X$	Y
0	3-1/4
1	3-1/4
2	3-5/16
3	3-7/16
4	3-9/16
5	3-13/16
6	4-1/8
18-3/4	
19-7/16	
20-3/8	
21	9-5/16

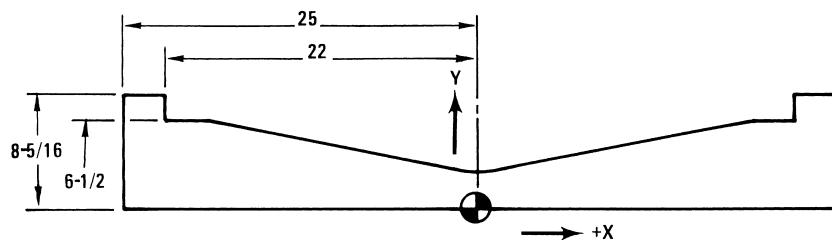
DETAIL 2
LOWER CONTOUR



DETAIL 2
UPPER CONTOUR

SAN301-05-92-001

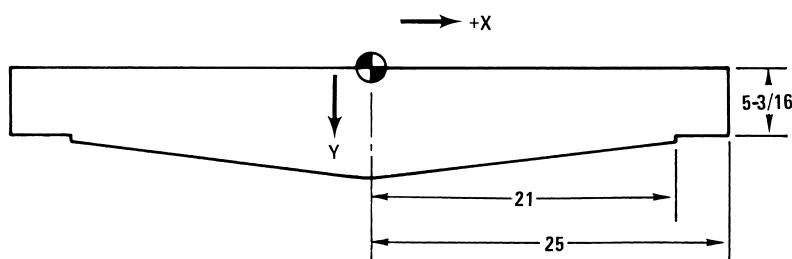
Figure 5-35. Speed Brake Shipping Container (Sheet 2)



DETAIL 4, 7
LOWER CONTOUR

TABLE 2
LOWER CONTOUR

$\pm X$	Y	
	DETAIL 4	DETAIL 7
0	2-7/8	2-7/8
1	2-15/16	2-15/16
2	3-1/16	3-1/16
3	3-1/4	3-1/4
4	3-7/16	3-1/4
5		
6	6-1/2	6-1/2
18-3/4		
19-7/16		
20-3/8		



DETAIL 11, 13
UPPER CONTOUR

TABLE 3
UPPER CONTOUR

$\pm X$	Y	
	DETAIL 11	DETAIL 13
0	7-1/4	7-1/4
1	7-3/16	7-3/16
2	7-1/8	7-1/8
3	7-1/16	7-1/16
4		
5		
6		
18-3/4		
19-7/16		
20-3/8		
21	5-5/16	5-3/16

Figure 5-35. Speed Brake Shipping Container (Sheet 3)

BILL OF MATERIAL				
DET	QTY	SIZE	MATERIAL	REMARKS
1	8	2 X 4 X 13-5/8	WOOD	
2	1	2 X 13-5/8 X 50	PLYWOOD	
3	1	1/4 X 2-1/2 X 43	CUSHIONING MATERIAL POLYETHYLENE, A-A-59136	②
4	1	1/2 X 8-5/16 X 50	PLYWOOD	
5	2	1-1/2 X 2 X 14	WOOD, ASTM-D6199	
6	2	1-1/2 X 2 X 8-5/16	WOOD, ASTM-D6199	
7	1	1/2 X 8-5/16 X 50	PLYWOOD	
8	1	5/16 X 3 X 38-5/8	PLYWOOD	
9	1	1/4 X 3-1/2 X 38-5/8	CUSHIONING MATERIAL POLYETHYLENE, A-A-59136	②
10	2	1-1/2 X 2 X 5-5/16	WOOD, ASTM-D6199	
11	1	1/2 X 7-1/2 X 50	PLYWOOD	
12	2	1-1/2 X 2 X 47	WOOD, ASTM-D6199	
13	1	1/2 X 7-1/2 X 50	PLYWOOD	
14	1	5/16 X 3 X 38	PLYWOOD	
15	1	1/4 X 3-1/2 X 38	CUSHIONING MATERIAL POLYETHYLENE, A-A-59136	②
16	2	1/4 X 2-1/1 X 12	CUSHIONING MATERIAL POLYETHYLENE, A-A-59136	②
17	1	8 X 10 X 2	PLYWOOD	④

LEGEND

1. APPROXIMATE WEIGHT OF SHIPPING CONTAINER IS 275 POUNDS, WEIGHT OF SPEED BRAKE IS 136 POUNDS. GROSS WEIGHT IS 411 POUNDS.
- ② BOND DETAILS 3, 9, 15, AND 16 TO STATIONS WITH MMM-A-1617 OR EQUIVALENT, DETAILS MUST OVERLAP STATIONS BY 1/4 INCH.
- ③ CONSTRUCT CONTAINER PER STANDARD SPECIFICATION ASTM-D6251. USE 5/16 MINIMUM PLYWOOD PANELS AND 1 X 3 MINIMUM WOOD CLEATS, CLEATS ON TOP OF CONTAINER MUST ACCOMODATE KLIMP FASTENERS.
- ④ BOND DETAIL 17 TO END OF CONTAINER WITH MMM-A-1617 OR EQUIVALENT.
- ⑤ POSITION FITTING AGAINST DETAIL 11 WITH 1/4 INCH A-A-59136 PAD BETWEEN PART AND STATION.

Figure 5-35. Speed Brake Shipping Container (Sheet 4)

SECTION VI

REPAIR MATERIALS AND SPECIAL TOOLS

6-1. DESCRIPTION.

6-2. This section lists repair materials and special tools required for making structural repairs. Both repair materials and special tools are listed according to the type of repair or the material being repaired. For typical repairs, refer to CSTO SR1F-15SA-3-5 and for corrosion control and sealing of repairs, refer to the applicable section in CSTO SR1F-15SA-23.

6-3. REPAIR MATERIALS.

6-4. Repair materials listed in this section include metal extrusions and sheet metal stock. Uncut sections of gang channel are listed along with the vendor of each. Fasteners are listed as removable, permanent and miscellaneous. Consumable materials are listed with a source of supply for each when this information is available.

6-5. **METAL EXTRUSIONS.** Extruded shapes of aluminum alloy, titanium, and CRES are used in every part of the aircraft. Most stringers are formed and cut from standard shapes. Tee caps and angles on bulkheads are also formed or stretched and cut from shapes listed below. The aluminum alloy, titanium, and corrosion resistant steel extrusions are identified by 1MA, 1MT, and 1MS prefixes of the extrusion number, respectively. The first series of numbers after the prefix designates the shape of the extrusion. For example:

1MA100 - Extruded Angle
 1MA120 - Extruded Channel
 1MA122 - Extruded Channel, Double Flange
 1MA140 - Extruded H-Section or I-Section
 1MA160 - Extruded T-Section
 1MA161 - Extruded T-Section, Bulbed
 1MA162 - Extruded T-Section, Offset
 1MA163 - Extruded T-Section, Flanged
 1MA164 - Extruded T-Section, Radiused
 1MA165 - Extruded T-Section, Canted Leg
 1MA180 - Extruded Z-Section
 1MA200 - Extruded Bar-Bulb
 1MA220 - Extruded Cross
 1MA10xxx - Extruded Special Shaped Sections

1MS10000 - Extruded Special Shaped Sections
 1MT300 - Extruded Angle
 1MT320 - Extruded Channel
 1MT340 - Extruded H-Section or I-Section
 1MT360 - Extruded T-Section
 1MT363 - Extruded T-Section, Flanged
 1MT420 - Extruded Cross
 1MT10xxx - Extruded Special Shaped Sections

Formed sheet metal substitutes for aluminum alloy extrusions are shown in CSTO SR1F-15SA-3-5, extrusions and equivalents. Below is a list of abbreviations used as a prefix to die numbers or order numbers to denote the name of the producer or supplier.

NOTE

Most aluminum extrusions with identical extrusion numbers but different alloys or heat treats use the same die. Titanium extrusions with identical extrusion numbers but difference alloys or heat treats use the same die.

Aluminum Extrusion Producers

AC	Aluminum Company of America (01634) (09192)
HC	Howmet Corporation Extrusion Sales Division (04679) (02992)
KA	Kaiser Aluminum and Chemical Sales Inc. (04379)
MM	Martin Marietta Aluminum Inc. (27610)
RM	Reynolds Metal Company (01484)
CA	Consolidated Aluminum Corporation (33282)
PI	Pimalco (55088)

CSTO SR1F-15SA-3-1

Aluminum Extrusion Suppliers

PA Pioneer Metals Incorporated
(06012)

TI Transtar Metals Corporation
(29321)

Titanium and CRES Extrusion Producers

AX ITT Harper Inc. (90123)

T Martin Marietta Aluminum Inc.
(27610)

S Martin Marietta Aluminum Inc.
(27610)

NOTE

Where die number is blank no die number is available.

For die numbers or suppliers numbers of aluminum alloy, titanium, or corrosion resistant steel extrusions see the lists below:

**2024-T62 AL ALY AMS-QQ-A-200/3 B01
(CONT)**

McDonnell Aircraft Company Number	Die Number
1MA10022	MM044823
1MA10029	MM044871
1MA10074	KA H-8252
	MM045329
1MA10149	MM045054
1MA10153	MM045083
1MA10157	MM045176
1MA10170	MM064887
1MA10171	AC264035
	RM45624
1MA10202	AC288462
1MA10219	AC298562
1MA10223	AC297532
1MA100-10010	MM014630
1MA100-10019	MM017157
1MA100-10257	AC244305
	MM045331
	RM54873
1MA100-10264	MM044919
1MA100-10275	AC278891
1MA100-10277	AC293302
1MA100-10285	MM044940
1MA100-10286	MM045116
1MA100-10287	MM045118
1MA100-10295	MM044981
1MA100-10299	MM045070
1MA100-10300	MM045072
1MA100-10305	MM045119
1MA100-10313	MM045157
1MA100-10317	AC283522
1MA100-10319	AC289902
1MA120-10127	MM027051
1MA160-10056	MM018547
1MA160-10110	MM028666
1MA160-10124	MM027033
1MA160-10149	MM045310
1MA160-10151	HC16507
1MA160-10154	MM045201
1MA160-10156	MM044785
	AC278012
	MM044780
1MA160-10157	MM044781
1MA160-10161	RM45872
1MA160-10168	AC250855
1MA160-10169	HC16508
	MM065646
	RM54871
	MM044883
	MM045133
	AC257945
	MM044884
	AC277772
	MM018106
	MM044902
	MM044890
	MM044998
	HC16732
	MM045328
	MM044985
	HC16770
	MM065752
	MM044986
	MM046436
	AC277722
1MA160-10213	
1MA160-10219	
1MA160-10226	
1MA160-10227	
1MA160-10242	

**2024-T62 AL ALY AMS-QQ-A-200/3 B01
(CONT)**

McDonnell Aircraft Company Number	Die Number
1MA160-10244	RMM45599
1MA160-10246	MM045145
1MA160-10250	T160-5850
1MA160-10254	AC290392
	MM044939
1MA160-10264	MM044995
1MA160-10273	MM045077
1MA160-10281	AC277732
1MA160-10282	MM045042
1MA160-10283	T160-5107
1MA160-10288	AC278252
1MA160-10289	MM045144
1MA160-10292	AC277712
1MA160-10297	MM045138
1MA160-10300	MM045171
1MA160-10306	MM045160
1MA160-10311	MM065612
	RM45627
1MA160-10314	MM065139
	RM45639
1MA160-10315	AC316522
	RM45640
1MA160-10318	MM045174
1MA160-10319	MM045175
1MA160-10334	MM045278
1MA160-10338	AC284612
1MA160-10340	AC284622
1MA160-10341	MM063677
1MA160-10344	AC285702
	MM046187
1MA160-10354	AC284752
1MA160-10355	AC297772
1MA160-10362	HC26357
1MA160-10370	AC318112
1MA161-10008	MM045142
1MA162-10000	MM044779
1MA162-10002	AC303702
	MM044825
1MA162-10003	MM044942
1MA162-10004	MM044988
1MA162-10008	MM044973
1MA162-10011	MM045093
1MA162-10012	MM045141

**2024-T62 AL ALY AMS-QQ-A-200/3 B01
(CONT)**

McDonnell Aircraft Company Number	Die Number
1MA162-10015	AC277702
1MA162-10017	MM045121
1MA162-10023	AC297562
1MA163-10006	HC16967
1MA163-10008	MM045045
1MA163-10009	MM045005
1MA163-10011	MM045004
1MA163-10012	MM045020
1MA163-10016	AC287442
1MA164-10003	MM045047
1MA180-10238	MM045276
1MA220-10006	MM045219
2024-T3511 AL ALY AMS-QQ-A-200/3 B02	
McDonnell Aircraft Company Number	Die Number
1MA10101	TI60-5372
1MA10114	MM044950
1MA10127	KA H-8253
1MA10186	MM045290
1MA10202	AC288462
1MA10222	AC297552
1MA10224	HC18765
1MA10237	AC305732
1MA100-10076	MM011113
1MA100-10290	TI60-4849
1MA100-10310	MM045170
1MA120-10267	AC285072
1MA120-10274	RM63317
1MA140-10265	
1MA160-10153	AC277692
1MA160-10167	TI60-1922
1MA160-10204	HC16732
	MM045328
1MA160-10213	MM045985
1MA160-10232	AC274962
1MA160-10304	MM045091
1MA160-10309	MM045173
1MA162-10020	AC241345

CSTO SR1F-15SA-3-1**2024-T8511 AL ALY AMS-QQ-A-200/3
B04****McDonnell Aircraft
Company Number**

1MA10000	HC16374
1MA10002	HC18696
	RM54892
1MA10004	MM044918
1MA10005	MM063035
1MA10006	MM063036
1MA10010	MM044830
1MA10016	AC273012
1MA10031	AC251465
	KA H-8219
1MA10042	MM065364
	RM45632
1MA10044	HC16924
1MA10051	MM063037
1MA10058	MM044913
1MA10067	AC241375
1MA10069	
1MA10075	MM045035
1MA10090	MM044915
1MA10091	AC277102
1MA10093	HC18957
	MM065988
	RM54932
1MA10109	AC292942
	KA H-8256
1MA10110	MM044952
1MA10111	HC18347
	MM065927
	RM54937
1MA10112	AC292302
	KA H-1546
1MA10118	RM54931
1MA10120	HC16825
1MA10122	HM045021
1MA10123	AC248345
	KA H-8257
1MA10124	HC16826
1MA10138	MM045132
1MA10148	HC16879
1MA10149	MM045054
1MA10156	MM045247
1MA10176	MM065715
	RM60044
1MA10192	MM045337
1MA10193	MM045353
1MA10194	RM45949

**2024-T8511 AL ALY AMS-QQ-A-200/3
B04 (CONT)****McDonnell Aircraft
Company Number**

1MA10199	AC271825
	RM45950
1MA10213	AC295672
1MA10214	TI60-6375
1MA10215	AC252885
1MA10230	AC308622
1MA10233	AC304552
1MA10234	AC307212
1MA10236	MM064893
1MA10242	AC306262
1MA10245	AC306192
1MA10246	AC307072
1MA10247	AC307592
1MA10255	AC310942
1MA10264	AC312752
1MA10281	MM046455
1MA10292	MM066707
1MA10357	AC347782
1MA100-10010	MM014630
1MA100-10017	MM014629
1MA100-10019	MM017157
1MA100-10023	MM016166
1MA100-10029	
1MA100-10040	TI60-2403
	PA28218
1MA100-10045	MM018508
1MA100-10048	MM017158
1MA100-10059	TI60-3141
1MA100-10064	TI60-5152
1MA100-10071	TI60-3815
1MA100-10247	MM045156
	RM54817
1MA100-10257	AC244305
	MM045331
	RM54873
1MA100-10264	MM044919
1MA100-10284	MM045011
1MA100-10286	MM045117
1MA100-10290	AC78137
1MA100-10299	MM045070
1MA100-10300	MM045072
1MA100-10301	MM045084
1MA100-10302	MM045139
1MA100-10303	TI60-3702
1MA100-10308	MM045147
1MA120-10010	MM025098
1MA120-10092	MM020403

**2024-T8511 AL ALY AMS-QQ-A-200/3
B04 (CONT)**

McDonnell Aircraft Company Number	Die Number
1MA120-10253	AC277742
	MM066409
1MA120-10259	MM045085
1MA120-10263	RM45622
1MA120-10268	KA H-8316
	MM046325
1MA120-10269	KA H-8317
1MA120-10271	KA H-8318
1MA122-10009	AC278002
1MA122-10020	AC265525
1MA160-10044	MM029970
1MA160-10046	MM030356
1MA160-10071	
1MA160-10086	AC265595
1MA160-10089	MM018387
1MA160-10108	MM022689
1MA160-10111	MM016133
1MA160-10123	AC313022
1MA160-10130	MM017165
1MA160-10139	MM054391
1MA160-10145	TI60-4911
1MA160-10151	HC16507
	MM045201
1MA160-10157	MM044781
1MA160-10161	RM54872
1MA160-10167	TI60-1922
1MA160-10169	MM065646
	RM54871
1MA160-10177	MM044883
1MA160-10178	MM045133
1MA160-10179	AC257945
	MM044884
1MA160-10187	RM45948
1MA160-10192	HC16731
1MA160-10198	MM044906
1MA160-10199	MM044998
1MA160-10204	MM044997
	HC16732
1MA160-10213	MM045328
1MA160-10215	MM044985
	MM052838

**2024-T8511 AL ALY AMS-QQ-A-200/3
B04 (CONT)**

McDonnell Aircraft Company Number	Die Number
1MA160-10222	MM044996
1MA160-10227	MM046436
1MA160-10240	TI60-5046
1MA160-10246	MM045145
1MA160-10250	TI60-5850
1MA160-10253	HC16729
1MA160-10254	AC290392
	MM044939
1MA160-10266	AC61862
1MA160-10268	MM045074
1MA160-10270	MM045099
1MA160-10286	MM045044
1MA160-10301	AC277832
1MA160-10311	MM065612
	RM45627
1MA160-10312	TI60-4981
1MA160-10320	AC281002
1MA160-10330	RM45641
1MA160-10333	MM045218
1MA160-10341	MM063677
1MA160-10345	MM045354
1MA160-10346	AC286322
1MA160-10380	MM067222
1MA160-10407	AC348532
1MA162-10013	MM045076
1MA162-10020	AC241345
1MA162-10028	AC309372
1MA165-1000	MM044911
1MA180-10238	MM045276
1MA180-10239	AC286912
	MM046509
1MA180-10241	AC302502
1MA200-10001	MM044904
1MA200-10005	TI60-5404
1MA200-10006	MM045355
1MA200-10007	TI60-5854
1MA200-10009	AC293962
1MA200-10011	AC307032
1MA220-10001	MM044856
1MA220-10002	AC277752

CSTO SR1F-15SA-3-1**6061-T6511 AL ALY AMS-QQ-A-200/8
C03****McDonnell Aircraft
Company Number**

1MA10107	MM063051
1MA10108	AC241455
1MA10141	
1MA10212	
1MA10257	AC390292
1MA120-10055	MM065509
1MA160-10169	MM065646
	RM54871

1 For future procurement use 1MA10212.

7050-T736511 AL ALY R13**McDonnell Aircraft
Company Number**

1MA160-10411	AC347762
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7075-T6 AL ALY AMS-QQ-A-200/11 D01**McDonnell Aircraft
Company Number**

1MA10021	MM044827
1MA10030	AC278142
	MM066447
1MA10039	MM045037
1MA10040	MM044828
1MA10065	MM044914
1MA10066	AC277192
1MA10068	MM044941
1MA10071	MM045019
1MA10089	MM044903
1MA10115	HC16968
1MA10116	HC16736
1MA10117	HC16737
1MA10121	MM045066
1MA10131	MM045071
1MA10142	MM045032
1MA10164	MM045222
1MA10165	MM065385
	RM45620
1MA10172	HC17361
	MM046407
1MA10177	MM045246

**7075-T6 AL ALY AMS-QQ-A-200/11 D01
(CONT)****McDonnell Aircraft
Company Number**

1MA10180	AC282282
	MM090000
1MA10211	AC255295
1MA10219	AC298562
1MA10226	AC301882
1MA10235	AC306122
1MA10319	PI11107
1MA10353	MM067848
1MA100-10038	TI60-1599
1MA100-10044	MM016366
1MA100-10074	MM015359
1MA100-10247	MM045156
	RM54817
1MA100-10253	MM045149
1MA100-10257	AC244305
	MM045331
	RM54873
1MA100-10270	MM045001
1MA100-10275	AC278891
1MA100-10277	AC293302
	MM044940
1MA100-10301	MM045084
1MA100-10315	AC313502
	MM045221
1MA140-10033	AC281462
1MA160-10046	TI60-2793
1MA160-10065	TI60-1118
1MA160-10092	MM018324
1MA160-10130	MM017165
1MA160-10149	MM045310
1MA160-10150	AC284842
1MA160-10152	RM548772
1MA160-10160	HC16730
1MA160-10161	RM54872
1MA160-10177	MM044883
1MA160-10178	MM045133
1MA160-10182	TI60-5872
1MA160-10183	MM044882
1MA160-10187	HC16731
1MA160-10189	AC277772
	MM018106
1MA160-10192	MM044906
1MA160-10204	MM045328
	HC16732
1MA160-10213	MM044985
1MA160-10220	MM045029
1MA160-10228	MM044965

**7075-T6 AL ALY AMS-QQ-A-200/11 D01
(CONT)**

McDonnell Aircraft Company Number	Die Number
1MA160-10249	MM044910
1MA160-10253	HC16729
1MA160-10254	AC290392
	MM044939
1MA160-10256	MM045087
1MA160-10273	MM045077
1MA160-10274	MM045078
1MA160-10295	MM045080
1MA160-10300	MM045171
1MA160-10312	MM019970
1MA160-10328	AC305942
	MM045159
1MA160-10300	MM045171
1MA160-10331	RM60025
1MA160-10364	AC310082
1MA160-10369	AC316252
1MA160-10420	PI11295
1MA160-10421	PI11298
1MA162-10001	MM065518
	RM4585
1MA162-10014	MM045094
1MA162-10024	AC307592
	MM066426
1MA163-10005	HC16733
1MA163-10018	MM046410
	RM45626
1MA163-10020	AC286922
1MA164-10001	RM54956
1MA164-10004	MM045096
1MA164-10005	AC278242
1MA164-10009	AC313882
1MA164-10010	AC318102
	MM066408
1MA165-10007	RM45879
1MA180-10238	MM045276
1MA180-10239	MM046509
	AC286912

7075-T73 AL ALY AMS-QQ-A-200/11

McDonnell Aircraft Company Number	Die Number
1MA10008	MM044862
1MA10014	HC16412
1MA10023	MM044891

**7075-T73 AL ALY AMS-QQ-A-200/11
(CONT)**

McDonnell Aircraft Company Number	Die Number
1MA10068	MM044941
1MA10115	HC16968
1MA10121	MM045066
1MA10131	MM045071
1MA10142	MM045032
1MA10164	MM045222
1MA10165	MM065385
	RM45620
1MA10172	HC17361
	MM046407
1MA10177	MM045246
1MA10180	AC282282
	MM900000
1MA10235	AC306122
1MA10238	AC307912
	MM066407
1MA10249	AC307902
	MM066406
1MA100-10074	MM015359
1MA100-10247	MM045156
	RM54817
1MA100-10253	MM045149
1MA100-10257	AC244305
	MM045331
	RM54873
1MA100-10275	TI60-5780
1MA100-10279	MM045008
1MA100-10296	MM045000
1MA140-10033	AC281462
1MA160-10130	MM017165
1MA160-10150	AC284842
1MA160-10152	RM54877A
1MA160-10183	MM044882
1MA160-10187	HC16731
1MA160-10204	HC16732
	MM045328
1MA160-10255	AC276622
1MA160-10256	MM045087
1MA160-10262	MM045089
1MA160-10312	TI60-4981
1MA160-10328	AC305942
	MM045159
1MA162-10014	MM045094
1MA162-10024	AC307592
	MM066426
1MA163-10005	HC16733

CSTO SR1F-15SA-3-1**7075-T73 AL ALY AMS-QQ-A-200/11
(CONT)**

McDonnell Aircraft Company Number	Die Number
1MA163-10018	MM046410
	RM45626
1MA164-10004	MM045096
1MA164-10005	AC278242

7075-T76 AL ALY AMS-QQ-A-200/11

McDonnell Aircraft Company Number	Die Number
1MA10030	AC278142
	MM066447
1MA10039	MM045037
1MA10089	MM044903
1MA10137	MM045123
1MA10144	MM045067
1MA10152	MM045131
1MA10211	AC255295
1MA100-10301	MM045084
1MA100-10315	AC313502
	MM045221
1MA160-10046	TI60-2793
1MA160-10092	MM018324
1MA160-10149	MM045310
1MA160-10151	HC16507
	MM045201
1MA160-10160	HC16730
1MA160-10161	RM54872
1MA160-10177	MM044883
1MA160-10182	TI60-5872
1MA160-10187	HC16731
1MA160-10192	MM044906
1MA160-10213	MM044985
1MA160-10228	MM044965
1MA160-10249	MM044910
1MA160-10295	MM045080
1MA160-10364	AC310082
1MA160-10368	AC315082
1MA164-10001	RM54956

**7075 T6511 AL ALY AMS-QQ-A-200/11
D03**

McDonnell Aircraft Company Number	Die Number
1MA10102	AC81855
1MA10248	MM046013
1MA10354	MM068037
1MA100-10003	MM016073
1MA100-10010	
1MA100-10020	MM013763
1MA100-10026	MM014662
1MA100-10028	
1MA100-10038	TI60-1599
1MA100-10045	MM018508
1MA100-10049	MM015207
1MA100-10053	MM016164
1MA100-10059	TI60-3141
1MA100-10070	MM013884
1MA100-10073	MM015208
1MA100-10111	MM065449
1MA100-10199	
1MA100-10252	MM065126
1MA100-10260	RM54824
	AC290402
1MA100-10262	RM54875A
	MM044879
1MA100-10264	MM044919
1MA100-10265	MM044908
1MA100-10266	MM044907
1MA100-10269	MM044980
1MA100-10270	MM045001
1MA100-10271	MM045009
1MA100-10275	TI60-5780
1MA100-10277	AC293302
	MM044940
1MA100-10295	MM044981
1MA100-10309	AC277812
1MA100-10310	MM045170
1MA100-10315	MM045221
	AC313502
1MA120-10055	MM065509
	RM45968
1MA120-10117	MM050255
1MA120-10121	HC2973
1MA120-10185	MM029800
1MA120-10262	MM063333
1MA120-10273	MM064384
1MA122-10001	MM044999
1MA140-10030	MM064478
	RM45870
1MA160-10047	MM035149

**7075 T6511 AL ALY AMS-QQ-A-200/11
D03 (CONT)**

McDonnell Aircraft Company Number	Die Number
1MA160-10050	MM014922
1MA160-10076	MM013252
1MA160-10086	AC265595
1MA160-10110	
1MA160-10111	MM016133
1MA160-10139	MM054391
1MA160-10151	HC16507
	MM045201
1MA160-10155	MM044782
1MA160-10156	AC278012
	MM044780
1MA160-10157	MM044781
1MA160-10161	RM54872
1MA160-10162	MM066433
	RM54888
1MA160-10167	TI60-1922
1MA160-10177	MM044883
1MA160-10179	AC255945
	MM044884
	RM45948
1MA160-10180	MM044783
1MA160-10182	TI60-5872
1MA160-10189	AC277772
	MM018106
1MA160-10192	MM044906
1MA160-10198	MM044998
1MA160-10199	MM044997
1MA160-10200	RM45629
1MA160-10201	MM045088
1MA160-10204	HC16732
	MM045328
1MA160-10211	AC307672
	MM044983
1MA160-10213	MM044985
1MA160-10216	MM044916
1MA160-10218	MM040060
1MA160-10220	MM045029
1MA160-10222	MM044996
1MA160-10227	MM046436
1MA160-10250	TI60-5850
1MA160-10252	MM052459
1MA160-10254	AC290392
	MM044939
1MA160-10271	
1MA160-10273	MM045077
1MA160-10326	TI60-4064
1MA160-10363	AC307892

**7075 T6511 AL ALY AMS-QQ-A-200/11
D03 (CONT)**

McDonnell Aircraft Company Number	Die Number
1MA160-10451	MM090000
1MA163-10000	MM045341
1MA163-10001	MM044784
1MA180-10237	MM045115
	7075-T73510 AL ALY AMS-QQ-A-200/11
McDonnell Aircraft Company Number	Die Number
1MA10232	MM064785
	7075-T73511 AL ALY AMS-QQ-A-200/11 D05
McDonnell Aircraft Company Number	Die Number
1MA10019	MM044887
1MA10025	MM044987
1MA10026	MM044932
1MA10035	KAH-8231
1MA10036	AC271582
1MA10061	MM044829
	RM45944
1MA10063	MM044931
1MA10068	MM044941
1MA10099	AC315072
	HC16735
1MA10116	HC16736
1MA10117	HC16737
1MA10128	HC16734
1MA10133	AC277872
1MA10151	MM045136
1MA10166	
1MA10167	AC281812
1MA10173	AC281822
1MA10174	AC306982
1MA10196	RM45975
1MA10198	AC288532
1MA10200	AC305252
	RM45970
1MA10225	MM064917

CSTO SR1F-15SA-3-1**7075-T73511 AL ALY AMS-QQ-A-200/11
D05 (CONT)**

McDonnell Aircraft Company Number	Die Number
1MA10249	AC307902
	MM066406
1MA10250	AC309272
1MA10254	AC308712
1MA10274	CA0259
1MA10359	MM067909
1MA10361	AC347442
1MA100-10019	MM017157
1MA100-10051	MM011112
1MA100-10135	
1MA100-10148	AC273235
1MA100-10249	HC16348
1MA100-10259	MM044880
1MA100-10262	MM044879
1MA100-10265	MM044908
1MA100-10269	MM044980
1MA100-10270	MM045001
1MA100-10277	AC293302
	MM044940
1MA100-10283	MM045010
1MA100-10284	MM045011
1MA100-10286	MM045117
1MA100-10296	MM045000
1MA100-10318	TI60-5519
1MA120-10005	MM030326
1MA120-10050	TI60-2166
1MA120-10088	MM030132
1MA120-10094	MM063355
1MA120-10120	MM017166
1MA120-10249	MM064675
	RM54938
1MA120-10251	MM044992
1MA120-10252	MM045002
1MA120-10255	AC294112
	MM044982
1MA120-10256	AC310702
	MM045055
1MA120-10266	AC285012
1MA122-10002	AC277792
1MA122-10005	MM044955
1MA122-10011	AC281572
1MA122-10013	AC305202
	RM60010

**7075-T73511 AL ALY AMS-QQ-A-200/11
D05 (CONT)**

McDonnell Aircraft Company Number	Die Number
1MA122-10018	MM065450
	RM45631
1MA122-10019	AC283232
1MA122-10021	MM065579
1MA122-10255	
1MA140-10002	MM030349
1MA160-10083	MM0302131
1MA160-10111	
1MA160-10210	RM54942
	MM045350
1MA160-10124	MM027033
1MA160-10148	
1MA160-10151	HC16507
	MM045201
1MA160-10163	RM54886
1MA160-10164	MM04485
1MA160-10168	AC250885
	HC16508
1MA160-10178	MM045133
1MA160-10179	AC257945
	MM04884
	RM45948
1MA160-10180	MM044783
1MA160-10182	TI60-5872
1MA160-10189	AC277772
	MM018106
1MA160-10192	MM044906
1MA160-10210	MM045350
	RM45942
1MA160-10211	AC307672
	MM044983
1MA160-10222	MM044996
1MA160-10223	AC292722
1MA160-10273	MM045077
	AC277782
1MA160-10285	MM045349
	AC279065
1MA160-10347	RM45971
	MM045307
1MA162-10022	MM045075
1MA163-10015	
1MA180-10121	TI60-5329
1MA220-10007	

7075-T76511 AL AMS-QQ-200/15 D06

6Al-4V TI ANL AMS 4935 A01
(CONT)

McDonnell Aircraft Company Number	Die Number	McDonnell Aircraft Company Number	Die Number
1MA10052	MM045036	1MT360-10001	T-803
1MA10113	MM044951	1MT360-10003	T-978
1MA10144	MM045067	1MT360-10006	T-859
1MA10147	MM045033	1MT360-10008	T-1051
1MA10155	AC280342	1MT360-10010	T-1183
1MA10205	AC290412	1MT360-10011	AX11634
1MA10231	AC303952	1MT360-10014	T-1229
1MA10261	AC312642	1MT360-10019	AX11408
	MM046480	1MT360-10020	T-1185
1MA10291	MM066404	1MT360-10021	AX11317
1MA10661		1MT360-10027	T-947
1MA100-10277	AC293302	1MT360-10033	T-977
	MM044940	1MT360-10037	T-1049
1MA100-10289	AC281172	1MT360-10039	T-1007
1MA140-10016	MM018546	1MT360-10040	T-1021
1MA140-10032	AC290282	1MT360-10050	T-1148
	MM045056	1MT360-10052	T-1101
1MA160-10050	MM014922	1MT363-10006	AX11269
1MA160-10056	MM018747		T-1194
1MA160-10076	MM013252	1MT363-10012	AX12113,
1MA160-10092	MM018324		T-951
1MA160-10108	MM022689	1MT363-10014	T-976
1MA160-10110	MM028666	1MT363-10016	AX12719
1MA160-10111			T-1149
1MA160-10151	HC16507	1MT420-10000	T-1075
	MM045201		
1MA160-10161	RM54872		
1MA160-10178	MM045133	6Al-6V-2Sn Ti Anl MMs-1202 B01	
1MA163-10013	MM045095		
1MA165-10001	MM045048		
1MA220-10005	MM045217		

6Al-4V TI ANL AMS 4935 A01

McDonnell Aircraft Company Number	Die Number	McDonnell Aircraft Company Number	Die Number
1MT10002	T-797	1MT10010	T-821
1MT10009	T-839	1MT10012	T-827
1MT10020	T-950	1MT10013	T-826
1MT10024	T-984	1MT10014	T-928
1MT10036	T-1102	1MT10016	T-1200
1MT10039	T-1117	1MT10017	T-1190
1MT10043	T-1119	1MT10018	T-945
1MT10045	T-1196	1MT10019	T-919
1MT320-10000	T-1153	1MT10020	T-950

**6Al-6V-2Sn Ti Anl MMs-1202 B01
(CONT)**

McDonnell Aircraft Company Number	Die Number
1MT10025	T-993
1MT10026	T-1177
1MT10028	T-1175
1MT10029	T-1066
1MT10032	
1MT10040	T-993
1MT10041	AX12986
1MT10042	T-1137
1MT10044	AX13514
1MT300-10000	T-1108
1MT300-10001	T-1187
1MT300-10006	
1MT300-10010	AX11599
1MT300-10011	T-1052
1MT300-10012	AX12812
1MT300-10013	AX12844
	T-1176
1MT300-10014	T-1169
1MT340-10000	T-1170
1MT360-10000	AX12809
	T-799
1MT360-10001	T-803
1MT360-10002	T-794
1MT360-10004	T-840
1MT360-10006	T-859
1MT360-10007	
1MT360-10010	AX11599
	T-1183
1MT360-10017	T-1188
1MT360-10019	AX11408,
	T-1172
1MT360-10020	T-1185
1MT360-10021	AX11317
1MT360-10023	T-1029
1MT360-10024	
1MT360-10025	AX12489
	T-948
1MT360-10026	AX11385
	T-1103
1MT360-10027	T-947
1MT360-10028	T-1167
1MT360-10029	T-949
1MT360-10031	AX12808
	T-972
1MT360-10038	T-1098
1MT360-10043	T-1166
1MT360-10045	T-1189

**6Al-6V-2Sn Ti Anl MMs-1202 B01
(CONT)**

McDonnell Aircraft Company Number	Die Number
1MT360-10047	T-1168
1MT360-10049	T-1136
1MT360-10051	T-1107
1MT360-10054	AX13274
	T-1152
1MT363-10001	
1MT363-10002	AX12111
1MT363-10005	T-1231
1MT363-10009	AX12780
1MT363-10010	T-920
1MT363-10015	AX11896
1MT363-10017	T-1100
	T-1151
	T-1109

15-5PH CRES CONDT H1025 AMS 5659

McDonnell Aircraft Company Number	Die Number
1MS10000	AX11204 S-699

6-6. SHEET METAL. See tables 6-1 thru 6-8. Tables include all sheet metal material types used on the aircraft. These materials are listed in their final heat treated condition; sheet stock in the O (annealed) condition is required for forming operations. In areas of very high temperature, high usage has been made of titanium and corrosion-resistant steel.

6-7. NUTS. See table 6-9. Nuts are listed by McDonnell Aircraft Company part numbers, and where applicable, two equivalent vendor part numbers. For nuts used with Taper-Lok pins, refer to paragraph 6-11.

6-8. GANG CHANNEL ASSEMBLIES WITH REPLACEABLE NUT ELEMENTS. See table 6-10 for straight gang channel assemblies, table 6-11 for curved gang channel assemblies, table 6-12 for nut elements, and table 6-13 for retaining clips. Gang channel assemblies which have replaceable nut elements are shown with equivalent part numbers of two vendors.

6-9. STANDARD GANG CHANNEL STOCK. See table 6-13. Gang channels are listed by McDonnell Aircraft Company part numbers and two vendor part numbers. Part numbers listed are for a standard straight length of gang channels, approximately 6 feet in length.

6-10. PLATE NUT ASSEMBLIES WITH REPLACEABLE NUT ELEMENTS. See table 6-14. Plate nut assemblies which have replaceable nut elements are shown with equivalent part numbers of two vendors. Nut elements and retaining clips are shown with equivalent part numbers.

6-11. FASTENERS. See tables 6-15 through 6-18. Removable fasteners are listed in table 6-15. Milson fastener sleeve bolts, receptacles, retaining rings, and shims are listed in table 6-16. Permanent fasteners listed in table 6-17 include blind rivets, Hi-Lok pins and collars, Jo-Bolts, tapered shank blind fasteners, Lockbolt pins and collars, solid rivets, and Taper-Lok pins, washers, and nuts. Miscellaneous fasteners listed in table 6-18 include the Airloc stud, receptacle, cross pin, and spacer, Chobert rivets, and Dzus fasteners.

6-12. REPAIR FASTENERS. Fasteners are listed by standard size, first oversized, which is 1/64-inch larger, and second oversized, which is 1/32-inch larger. Refer to applicable table listed below:

Lockbolts, stump type - Table 6-24
 Lockbolts, pull type - Table 6-25
 Hi-Loks - Table 6-26
 Taper-Loks - Table 6-27
 Jo-Bolts - Table 6-28
 Protruding head bolts - Table 6-29
 Flush head bolts - Table 6-30



Be careful to make sure that the oversize shank is not interfering with the nut counterbore.

6-13. SPACERS, WASHERS, AND SHIMS. Where an oversize bolt engages the blueprint gang channel

and/or plate nut, a spacer may be required between the nut and the structure because the counterbore in these type of nuts may not be large enough to receive the oversize shank of the repair bolt. The spacer shall be a NAS463 shim, 4M49 shim or custom shim made from SRP 1002 repair stock 0.063 thick (nominal). For aluminum structure, use aluminum spacer. For steel or titanium structure, use stainless steel or titanium spacer. See applicable table listed below:

Miscellaneous spacers and washers - Table 6-19
 Plate nut shims - Table 6-20
 Gang channel spacers - Table 6-21

6-14. CONSUMABLE MATERIALS. See table 6-22. Consumable materials are listed in groups according to their use. Specification number is listed where applicable and a vendor number or name is listed as source or an alternate supplier.

6-15. SPECIAL TOOLS AND REPAIR KITS.

6-16. See table 6-23. Special tools or repair kits are listed in table 6-23. Specification number is listed where applicable and the vendor name and number is listed as a procurement source.

6-17. ST3M495, ST3M496, AND ST3M506 FASTENERS.

6-18. See tables 6-31, 6-32, and 6-33 for conversion of McDonnell Standards Number for ST3M495, ST3M496, and ST3M506 to vendor numbers.

6-19. STEEL FASTENER TO IVD FASTENER CONVERSION.

6-20. See table 6-34 for conversion of steel fastener to IVD fastener basic part numbers.

6-21. FASTENER SUBSTITUTION.

6-22. Fastener substitution may be accomplished per tables 6-35 through 6-46 when there is a temporary shortage of the specified fastener. For fastener substitution, see applicable table listed below:

Solid Rivets - Table 6-35

Blind Fasteners - Table 6-36

Screws - Table 6-37

Bolts - Table 6-38

Nuts - Table 6-39

Plate Nuts - Table 6-40

Hi-Lok Pins - Table 6-41

Hi-Lok Collars - Table 6-42

Lockbolt Pins - Table 6-43

Lockbolt Collars - Table 6-44

Taper-Lok Pins - Table 6-45

Taper-Lok Nuts - Table 6-46

Milson Sleeve Bolts - Table 6-47

Milson Receptacle - Table 6-48

Table 6-1. Sheet Metal Repair Materials, Alclad (0.016 thru 0.071)

Material		Gage and Use								
Alloy	Specification	0.016	0.020	0.025	0.032	0.040	0.045	0.050	0.063	0.071
2024-0	AMS-QQ-A-250/5	3	1	1	3	1	1	1	1	1
2024-T351	AMS-QQ-A-250/5	3	1	1	3	1	3	1	1	1
2024-T361	AMS-QQ-A-250/5	7	1	3	1	3	1	1	1	1
2024-T62	AMS-QQ-A-250/5	9	MMS 1412	3	1	1	1	1	1	1
2024-T72	AMS-QQ-A-250/5	7	3	1	1	1	1	1	1	1
2024-T81	AMS-QQ-A-250/5	8	3	1	2	1	1	1	2	2
2024-T851	AMS-QQ-A-250/5	8	1	1	1	1	1	1	1	1
2024-T861	AMS-QQ-A-250/5	7075-0	AMS-QQ-A-250/13	3	2	1	1	3	3	3
7075-T6	AMS-QQ-A-250/13	7075-T76	AMS-QQ-A-250/13	3	3	1	1	1	3	3
7075-T76	AMS-QQ-A-250/26	10	AMS-QQ-A-250/26						3	4

1 Extensive use.
 2 Medium use.
 3 Limited use.
 4 Material may be used in the as received condition.
 5 Alloys which are not received in the noted condition must be heat treated or processed to get desired condition.
 6 Material must not remain in the as received condition if used in structural applications. Added heat treatment or other processing is required for desired condition.
 7 Procured as 2024-0.
 8 Procured as 2024-T351.
 9 McDonnell Material Specification 1412 is a modification of AMS-QQ-A-250/5 and alclad one side only.
 10 Strong clad.
 11 2024-T81 is interchangeable with and can be used in place of 2024-T861 sheet stock in all applications.

Table 6-2. Sheet Metal Repair Materials, Alclad (0.080 thru 0.250)

Material		Gage and Use							
Alloy	Specification	0.080	0.090	0.100	0.125	0.140	0.160	0.190	0.250
2024-0	AMS-QQ-A-250/5	1	1	2	3	3	3	3	6
2024-T351	AMS-QQ-A-250/5	1	1	2	3	3	3	3	4
2024-T361	AMS-QQ-A-250/5	1	1	2	3	3	3	3	5
2024-T62	AMS-QQ-A-250/5	2	2	1	3	3	3	3	5
2024-T72	AMS-QQ-A-250/5	2	2	1	3	3	3	3	5
2024-T81	AMS-QQ-A-250/5	2	3	1	2	3	2	2	4
2024-T851	AMS-QQ-A-250/5	8	1	1	2	3	3	3	5
2024-T861	AMS-QQ-A-250/5	3	3	3	3	3	3	3	9
7075-0	AMS-QQ-A-250/13	3	3	3	3	3	3	3	9
7075-T6	AMS-QQ-A-250/13	3	3	3	3	3	3	3	4
7075-T76	AMS-QQ-A-250/13	10	3	3	3	3	3	3	4
7075-T76	AMS-QQ-A-250/26								4

1 Extensive use.
 2 Medium use.
 3 Limited use.
 4 Material may be used in the as received condition.
 5 Alloys which are not received in the noted condition must be heat treated or processed to get desired condition.
 6 Material must not remain in the as received condition if used in structural applications. Added heat treatment or other processing is required for desired condition.
 7 Procured as 2024-0.
 8 Procured as 2024-T351.
 9 2024-T81 is interchangeable with and can be used in place of 2024-T861 sheet stock in all applications.
 10 Strong clad.

Table 6-3. Sheet Metal Repair Materials, Al Alloy (0.020 thru 0.071)

Material		Gage and Use								
Alloy	Specification	0.020	0.025	0.032	0.036	0.040	0.050	0.062	0.063	0.071
2024-0	AMS-QQ-A-250/4	3	1	1	1	1	1	3	1	6
2024-T361	AMS-QQ-A-250/4 7	3	1	1	1	1	1	3	3	4
2024-T62	AMS-QQ-A-250/4 7	3	1	1	1	1	1	3	1	5
2024-T72	AMS-QQ-A-250/4 8	3	1	1	1	2	2	3	3	5
2024-T81	AMS-QQ-A-250/4 8	3	2	2	1	1	2	2	4	4
2024-T851	AMS-QQ-A-250/4 8	3	2	2	3	3	2	3	5	5
2024-T851	MMS 149				3	3	3	3	5	5
2024-T861	AMS-QQ-A-250/4				3	3	3	3	9	9
5052-H39	AMS-QQ-A-250/8				3	3	2	2	4	4
6061-0	AMS-QQ-A-250/11 10		2	3	3	3	2	3	6	6
6061-T6	AMS-QQ-A-250/11 10		2	3	3	3	2	3	5	5
6061-T62	AMS-QQ-A-250/11 10		2	3	3	3	2	2	4	4
7075-0	AMS-QQ-A-250/11				1	1	2	2	4	4
7075-T6	AMS-QQ-A-250/12		3	3	3	3	3	1	4	4
7075-T73	AMS-QQ-A-250/12		3	3	3	3	3	1	4	4
7075-T76	AMS-QQ-A-250/24									

1 Extensive use.
2 Medium use.
3 Limited use.

4 Material may be used in the as received condition.

5 Alloys which are not received in the noted condition must be heat treated or processed to get desired condition.
6 Material must not remain in the as received condition if used in structural applications. Added heat treatment or other processing is required for desired condition.

7 Procured as 2024-0.

8 Procured as 2024-T351.

9 2024-T81 is interchangeable with and can be used in place of 2024-T861 sheet stock in all applications.

10 Procured as 6061-0.

11 Special quality.

Table 6-4. Sheet Metal Repair Materials, Al Alloy (0.0080 thru 0.250)

Material		Gage and Use							
Alloy	Specification	0.080	0.090	0.100	0.125	0.150	0.160	0.190	0.250
2024-0	AMS-QQ-A-250/4	1	2	1	3				6
2024-T361	AMS-QQ-A-250/4	1	2	1	3				5
2024-T62	AMS-QQ-A-250/4	1	2	1	3				5
2024-T72	AMS-QQ-A-250/4	3	3	3	3				5
2024-T81	AMS-QQ-A-250/4	3	3	3	3				4
2024-T851	AMS-QQ-A-250/4	8	3	3	3				5
2024-T851	AMS-QQ-A-250/4	8	3	3	3				2
5052-H39	AMS-QQ-A-250/8								3
6061-0	AMS-QQ-A-250/11	10							3
6061-T6	AMS-QQ-A-250/11	10							3
6061-T62	AMS-QQ-A-250/11								3
7075-0	AMS-QQ-A-250/12								3
7075-T6	AMS-QQ-A-250/12	3	3						3
7075-T73	AMS-QQ-A-250/12								3
7075-T76	AMS-QQ-A-250/24			1	3	2	3	3	4
									4
									4
									4

1 Extensive use.

2 Medium use.

3 Limited use.

4 Material may be used in the as received condition.

5 Alloys which are not received in the noted condition must be heat treated or processed to get desired condition.

6 Material must not remain in the as received condition if used in structural applications. Added heat treatment or other processing is required for desired condition.

7 Procured as 2024-0.

8 Procured as 2024-T351.

9 2024-T81 is interchangeable with and can be used in place of 2024-T861 sheet stock in all applications.

10 Procured as 6061-0.

11 Special quality.

Table 6-5. Sheet Metal Repair Materials, Titanium (0.008 thru 0.045)

Material		Gage and Use								
Alloy	Specification	0.008	0.016	0.020	0.025	0.028	0.032	0.036	0.040	0.045
UNALLOYED 6Al-4V ANL	AMS 4901 AMS 4911	5 6	2	3	1	3 2	1	1 2	1 1	4 4
6Al-6V-2Sn ANL	AMS 4918									
1 Extensive use. 2 Medium use. 3 Limited use. 4 Material may be used in the as received condition. 5 Type I, composition B. 6 Type III, composition C.										

Table 6-6. Sheet Metal Repair Materials, Titanium (0.050 thru 0.112)

Material		Gage and Use								
Alloy	Specification	0.050	0.056	0.063	0.062	0.071	0.080	0.091	0.100	0.112
UNALLOYED 6Al-4V ANL	AMS 4901 AMS 4911	5 6	1	1	3	1	2	1	2	4
6Al-6V-2Sn ANL	AMS 4918	1 1	3	1 1	3	1 1	2	1 1	2	4
		1	2	3	4	5	6	1	2	3

1 Extensive use.
 2 Medium use.
 3 Limited use.
 4 Material may be used in the as received condition.
 5 Type I, composition B.
 6 Type III, composition C.

Table 6-7. Sheet Metal Repair Materials, Titanium (0.125 thru 0.160)

Material		Gage and Use				
Alloy	Specification	0.125	0.140	0.160		
UNALLOYED 6Al-4V ANL	3 AMS 4901 4 AMS 4911					
6Al-6V-2Sn	AMS 4918					

1 Limited use.
 2 Material may be used in the as received condition.
 3 Type I, composition B.
 4 Type III, composition C.

Table 6-8. Sheet Metal Repair Materials, CRRES (0.010 thru 0.100)

Material		Gage and Use									
Alloy	Specification	0.010	0.020	0.032	0.040	0.048	0.050	0.062	0.063	0.080	0.100
3 ◀ 15-5PH 301 (1/4 H) 301 (1/2 H) 301 (H) 302 ANL 321 ANL	AMS 5862 AMS 5517 AMS 5518 AMS 5519 AMS 5516 AMS 5510	1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1 1		1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1 1	2 2 2 2 2 2	2 2 2 2 2 2

1 ◀ Limited use.
 2 ◀ Material may be used in the as received condition.
 3 ◀ Condition A.

Table 6-9. Nut Part Numbers and Equivalents

2 → McDonnell Standard No.	Equivalent Vendor Part No.	Equivalent Vendor Part No.
AN310-6		
AN310-9		
AN310C3 THRU C9		
AN310C12		
AN315-3R		
AN315-4R		
AN315C3R		
AN315C4R		
AN316-4R		
AN316-6R		
AN316C4R		
AN316C5R		
AN320C3		
AN320C4		
AN320C8		
AN320C9		
AN320C12		
MS20500-428		
MS20500-624		
MS21042L04		
MS21042L06		
MS21042L08		
MS21042L3		
MS21042L4		
MS21042L6		
MS21244-4		
MS21244-5		
NAS509-4 THRU-7		
NAS509-9		
NAS509-9C		
NAS509-10C		
NAS509L4		
NAS509L7		
NAS679C04MW		
NAS679C04W		
NAS679C06MW		
NAS679C06W		
NAS679C08MW		
NAS679C3M		
NAS679C3MW		
NAS679C3W		
NAS679C4M		
NAS679C4MW		
NAS679C4W		
NAS679C5M		
NAS679C5MW		
NAS679C6		
NAS679C6M		
NAS1291C02M		

Table 6-9. Nut Part Numbers and Equivalents (CONT)

2 → McDonnell Standard No.	Equivalent Vendor Part No.	Equivalent Vendor Part No.
NAS1291C04M		
NAS1291C06M		
NAS1291C08M		
NAS1291C3		
NAS1291C3M		
NAS1291C3MW		
NAS1291C4M		
NAS1291C5M		
NAS1291C6M		
NAS1291C7M		
ST3M404-7	3 → 74640-6	4 → E10079-6
ST3M404C3 THRU 10	3 → 74640C3 THRU C10	4 → E10080-3 THRU -10
ST3M404C12	3 → 74640C12	4 → E10080-12
ST3M404C14	3 → 74640C14	4 → E10080-14
ST3M404C16	3 → 74640C16	4 → E10080-16
ST3M405-2-3	3 → 70524-1032-2	4 → LHC9514-2-3
ST3M405-3-3	3 → 70524-1032-3	4 → LHC9514-3-3
ST3M405C2-3	3 → 70524CM1032-2	4 → C11009-2-3
ST3M405C3-3	3 → 70524CM1032-3	4 → C11009-3-3
ST3M436-3M THRU-10M	3 → 77019-3 THRU-10	1 → H49817-3 THRU-10
ST3M523C3M	4 → A11144-7-3	6 → 130091
ST3M523C3M1	4 → A11144-4-3	
ST3M523C3M2		
ST3M523C3M3		
ST3M524-3ME	3 → 78069M-3	
ST3M524-5ME	3 → 78069M-5	
ST3M524-6ME	3 → 78069M-6	
ST3M524-8ME	3 → 78069M-8	
ST3M524-9ME	3 → 78069M-9	
ST3M572-3M	3 → 77018-1032	1 → H49843-3
ST3M572-4M	3 → 77018-428	1 → H49843-4
ST3M572-5M	3 → 77018-524	1 → H49843-5
ST3M572-6M	3 → 77018-624	1 → H49843-6
ST3M572-7M	3 → 77018-720	1 → H49843-7
ST3M572-8M	3 → 77018-820	1 → H49843-8
ST3M572-10M	3 → 77018-1018	1 → H49843-10
ST3M572-12M	3 → 77018-1216	1 → H49843-12
ST3M610C10-9	3 → A11144-10-3	
ST3M612C4M THRU-9M	3 → 74384M4 THRU-M9	
ST3M612C12M	3 → 74384M12	
ST3M612C10ME	3 → 74384M10E	
ST3M698-3	5 → G50	
ST3M787-3	3 → 79317CM-1032	
ST3M787-4	3 → 79317CM-428	
ST3M787-5	3 → 79317CM-524	
ST3M787-6	3 → 79317CM-624	
3M129A440	3 → 38FM-440	4 → RM22LH1660-40
3M189-4T	3 →	1 → K1910-4
3M189C4M	3 →	1 → K1910-01E4

Table 6-9. Nut Part Numbers and Equivalents (CONT)

2 → McDonnell Standard No.	Equivalent Vendor Part No.	Equivalent Vendor Part No.
3M189C5M		1 → K1910-01E5
1 → Alcoa Global Fasteners Inc. (15653). 2 → McDonnell Aircraft Company (76301). 3 → SPS Technologies Inc. (56878). 4 → Harvard Industries Inc. (72962). 5 → Swan Engineering Inc. (54112). 6 → TRW Electronic Components Cinch-Monadock (76530).		

Table 6-10. Gang Channel Assemblies, Straight, Replaceable Nut Element

1 → Part No.	2 → Part No.	3 → Part No.
G18421JL1-3-10	G49439E3-1-10	ST3M463N10A57-1
G18421JL1-3-11	G49439E3-1-11	ST3M463N11A52-1
G18421JL1-3-12	G49439E3-1-12	ST3M463N12A48-1
G18421JL1-3-13	G49439E3-3-13	ST3M463N13A44-1
G18421JL1-3-14	G49439E3-1-14	ST3M463N14A41-1
G18421JL1-3-6	G49439E3-1-6	ST3M463N6A96-1
G18421JL1-3-7	G49439E3-1-7	ST3M463N7A82-1
G18421JL1-3-8	G49439E3-1-8	ST3M463N8A72-1
G18421JL1-3-9	G49439E3-1-9	ST3M463N9A64-1
G18421JL1-4-10	G49439E4-1-10	ST3M464N10A57-1
G18421JL1-4-15	G49439E4-1-15	ST3M464N15C38-1
G18421JL1-4-18	G49439E4-1-18	ST3M464N18A32-1
G18421JL1-4-8	G49439E4-1-8	ST3M464N8A72-1
G18421JL1-4-9	G49439E4-1-9	ST3M464N9A64-1
G18421JL1-4-6	G49439E4-1-6	ST3M464N6A96-1
G18421JL1-4-6	G49439E4-1-6	ST3M464N6A82-1
G18421JL1-4-6	G49439E4-1-6	ST3M464N6A52-1
G18421JL1-4-6	G49439E4-1-6	ST3M464N6A48-1
G18421JL1-4-6	G49439E4-1-6	ST3M464N6A36-1
G18421JL2-3-10	G49439E3-2-10	ST3M463N10A57-2
G18421JL2-3-11	G49439E3-2-11	ST3M463N11A52-2
G18421JL2-3-12	G49439E3-2-12	ST3M463N12A48-2
G18421JL2-3-14	G49439E3-2-14	ST3M463N14A41-2
G18421JL2-3-15	G49439E3-2-15	ST3M463N15C38-2
G18421JL2-3-16	G49439E3-2-16	ST3M463N16A36-2
G18421JL2-3-6	G49439E3-2-6	ST3M463N6A96-2
G18421JL2-3-7	G49439E3-2-7	ST3M463N7A82-2
G18421JL2-3-8	G49439E3-2-8	ST3M463N8A72-2
G18421JL2-3-9	G49439E3-2-9	ST3M463N9A64-2
G18421JL2-4-10	G49439E4-2-10	ST3M464N10A57-2
G18421JL2-4-12	G49439E4-2-12	ST3M464N12A48-2
G18421JL2-4-14	G49439E4-2-15	ST3M464N15C38-2
G18421JL2-4-8	G49439E4-2-8	ST3M464N8A72-2
G18421JL2-4-9	G49439E4-2-9	ST3M464N9A64-2
G18421JL2-4-7	G49439E4-2-7	ST3M464N7A82-2
G18421JL2-4-11	G49439E4-2-11	ST3M464N11A52-2

Table 6-10. Gang Channel Assemblies, Straight, Replaceable Nut Element (CONT)

1 → Part No.	2 → Part No.	3 → Part No.
G18421JL2-5-8	G49439E5-2-8	ST3M465N8A72-2
G18421JL2-5-8	G49439E5-2-9	ST3M465N8A57-2
G18421JL2-5-12	G49439E5-2-12	ST3M465N12A48-2
G18421JL4-3-10	G49439E3-4-10	ST3M463N10A57-4
G18421JL4-3-11	G49439E3-4-11	ST3M463N11A52-4
G18421JL4-3-12	G49439E3-4-12	ST3M463N12A48-4
G18421JL4-3-14	G49439E3-4-14	ST3M463N14A41-4
G18421JL4-3-6	G49439E3-4-6	ST3M463N6A96-4
G18421JL4-3-7	G49439E3-4-7	ST3M463N7A82-4
G18421JL4-3-8	G49439E3-4-8	ST3M463N8A72-4
G18421JL4-3-9	G49439E3-4-9	ST3M463N9A64-4
G18421JL4-3-5	G49439E3-4-5	ST3M463N5A115-4
G18421JL4-3-10	G49439E3-4-10	ST3M463N10A57-4
G18421JL4-4-8	G49439E4-4-8	ST3M464N8A72-4
G18421JL4-4-9	G49439E4-4-9	ST3M464N9A64-4
G18421JL6-3-10	G49439E3-6-10	ST3M463N10A57-6
G18421JL6-3-11	G49439E3-6-11	ST3M463N11A52-6
G18421JL6-3-12	G49439E3-6-12	ST3M463N12A48-6
G18421JL6-3-14	G49439E3-6-14	ST3M463N14A41-6
G18421JL6-3-6	G49439E3-6-6	ST3M463N6A96-6
G18421JL6-3-7	G49439E3-6-7	ST3M463N7A82-6
G18421JL6-3-8	G49439E3-6-8	ST3M463N8A72-6
G18421JL6-3-9	G49439E3-6-9	ST3M463N9A64-6
G18421JL6-4-8	G49439E4-6-8	ST3M464N8A72-6
G18421JL6-4-9	G49439E4-6-9	ST3M464N9A64-6
G18421JL4-4-6	G49439E4-4-6	ST3M464N6A96-4
G18421JL4-4-10	G49439E4-4-10	ST3M464N10A57-4
G18421JL4-4-12	G49439E4-4-12	ST3M464N12A48-4
G18421JL1-5-10	G49439E5-1-10	ST3M465N10A2F1
G18421JL1-5-11	G49439E5-1-11	ST3M465N11A3-1
G18421L1-3-10	G49250E3-1-10	ST3M463C10A57-1
G18421L1-3-12	G49250E3-1-12	ST3M463C12A48-1
G18421L1-3-13	G49250E3-1-13	ST3M463C13A44-1
G18421L1-3-7	G49250E3-1-7	ST3M463C7A82-1
G18421L1-3-9	G49250E3-1-9	3M463C9A64-1
G18421L1-4-10	G49250E4-1-10	ST3M464C10A57-1
G18421L1-4-9	G49250E4-1-9	ST3M464C9A64-1
G18421L2-3-11	G49250E3-2-11	ST3M463C11A52-2
G18421L2-3-12	G49250E3-2-12	ST3M463C12A48-2
G18421L2-3-14	G49250E3-2-14	ST3M463C14A41-2
G18421L2-3-6	G49250E3-2-6	ST3M463C6A96-2
G18421L2-3-7	G49250E3-2-7	ST3M463C7A82-2
G18421L2-3-8	G49250E3-2-8	ST3M463C8A72-2
G18421L4-3-11	G49250E3-4-11	ST3M463C11A52-4
G18421L4-3-12	G49250E3-4-12	ST3M463C12A48-4
G18421L4-3-6	G49250E3-4-6	ST3M463C6A96-4
G18421L4-3-7	G49250E3-4-7	ST3M463C7A82-4
G18421L4-3-8	G49250E3-4-8	ST3M463C8A72-4
G18421L4-4-8	G49250E4-4-8	ST3M464C8A72-4
G18421L4-4-9	G49250E4-4-9	ST3M464C9A64-4

Table 6-10. Gang Channel Assemblies, Straight, Replaceable Nut Element (CONT)

1 → Part No.	2 → Part No.	3 → Part No.
G18421L4-4-10	G49250E4-4-10	ST3M464C10A57-4
G18421L6-3-10	G49250E3-6-10	ST3M463C10A57-6
G18421L6-4-8	G49250E4-6-8	ST3M464C8A72-6
G18421L6-4-9	G49250E4-6-9	ST3M464C9A64-6
G18421L6-4-11	G49250E4-6-11	ST3M464C11A52-6
G18421L6-4-12	G49250E4-6-12	ST3M464C12A48-6

1 → Harvard Industries Inc. (72962). Vendor supplies gang channel in 6 feet lengths.
2 → Alcoa Global Fasteners Inc. (15653). Vendor supplies gang channel in 6 feet lengths.
3 → McDonnell Aircraft Company (76301).

Table 6-11. Gang Channel Assemblies, Curved, Replaceable Nut Element

1 → Part No.	2 → Part No.	3 → Part No.
RG18B4JL8-36	RG49569E4-2-8-36	ST3M484B14D36N
RG18B4JL10-40	RG49569E4-2-10-40	ST3M484B8E40N
RG18B4JL8-32	RG49569E4-2-8-32	ST3M484B13D32N
RG18B4JL10-40	RG49569E4-2-10-40	ST3M484B4E40N
RG18B4JL8-32	RG49569E4-2-8-32	ST3M484B4D32N
RG18B4JL8-30	RG49569E4-2-8-30	ST3M484B4D30N
RG18B4JL8-30	RG49569E4-2-8-30	ST3M484B5D30N
RG18B4JL8-30	RG49569E4-2-9-30	ST3M484B6D30N
RG18B4JL8-36	RG49569E4-2-8-36	ST3M484B11D36N
RG18B4JL8-36	RG49569E4-2-8-36	ST3M484B3D36N

1 → Harvard Industries Inc. (72962). Vendor supplies gang channel in 180 degree arc stock size. Last dash no. is radius in 1/8th of an inch.
2 → Alcoa Global Fasteners Inc. (15653). Vendor supplies gang channel in 180 degree arc stock size. Last dash no. is radius in 1/8th of an inch.
3 → McDonnell Aircraft Co. (76301). Last two numbers is radius in 1/8th of an inch.

Table 6-12. Gang Channel Nuts

1 → Part No.	2 → Equivalent Part No.	3 → Equivalent Part No.
ST3M445C3M4	G18421L1-3	F49249E3-1XN
ST3M445C3M5	G18421L2-3	F49249E3-2XN

1 → McDonnell Aircraft Company (76301).
2 → Harvard Industries Inc. (72962).
3 → Alcoa Global Fasteners Inc. (15653).

Table 6-13. Standard Gang Channel Stock, Straight

3 → McDonnell Standard No.	1 → Equivalent Part No.	2 → Equivalent Part No.
3M150A3-5-115	4 → MS21064L3-5	
3M150A3-6-96	4 → MS21064L3-6	

Table 6-13. Standard Gang Channel Stock, Straight (CONT)

3 → McDonnell Standard No.	1 → Equivalent Part No.	2 → Equivalent Part No.
3M150A3-7-82	4 MS21064L3-7	
3M150A3-8-72	4 MS21064L3-8	
3M150A4-6-96	4 MS21064L4-6	
3M150A4-7-82	4 MS21064L4-7	
3M150A5-8-72	4 MS21064L5-8	
3M150A5-9-64	4 MS21064L5-9	
3M150N3-6-96	4 MS21063L3-6	
3M150N3-7-82	4 MS21063L3-7	
3M150N3-8-72	4 MS21063L3-8	
3M150N3-9-64	4 MS21063L3-9	
3M150N3-10-57	4 MS21063L3-10	
3M193A3-2-12P4	G29504-3P2-12-4	
3M193C3-4-10-2	G29504-3-4-10-2	
3M193C3-6-6-7	G29504-4-6-6-7	
3M193-3-2-7-82	G19179-3-2-7	RMG15B2-02-7
3M193-3-2-8-72	G19179-3-2-8	RMG15B2-02-8
3M193-3-2-9-64	G19179-3-2-9	RMG15B2-02-9
3M193-3-4-10-57	G19179-3-4-10	RMG15B4-02-10
3M193-3-6-6-96	G19179-3-6-6	RMG15B6-02-6
3M193A3-2-10-57	G29504-3-2-10	
3M448C3M6-2	G49760-3-6	G10851-3-6
3M448C3M7-2F	G49760-3-7	G108551-3-7
3M448C3M8-2F	G49760-3-8	G10851-3-8
3M448N3M6	G49461-3-6	G10851J3-6
3M448N3M7	G49461-3-7	G10851J3-7
3M448N3M8	G49461-3-8	G10851J3-8
3M448N3M9	G49461-3-9	G10851J3-9
3M448N3M10	G49461-3-10	G10851J3-10
ST3M723C1M6	G49760-3-7	G10851-3-6
ST3M723C1M7	G49760-3-7	G10851-3-7
ST3M723C1M8	G49461-3-8	G10851J3-8
ST3M723C1M6-96	G50345-3-1-6	G12094-3-6
ST3M723C2M8-72	G50345-3-2-8	G12093-2-3-8
ST3M723N1M9	G49461-3-9	G10851J3-9
ST3M723N1M10	G49461-3-10	G10851J3-10
ST3M723N1M10-57	G50344-3-1-10	G12094J3-10
ST3M723N2M6-96	G50344-3-2-6	G12093J2-3-6
ST3M723N2M7-82	G50344-3-2-7	G12093J2-3-7
ST3M723N2M8-72	G50344-3-2-8	G12093J2-3-8
ST3M723N2M9-64	G50344-3-2-9	G12093J2-3-9
ST3M723N2M10-57	G50344-3-2-10	G12093J2-3-10
ST3M723N2M12-48	G50344-3-2-12	G12093J2-3-12
ST3M723N4M6-96	G50344-3-4-6	G12093J4-3-6
ST3M723N4M6-82	G50344-3-4-7	G12093J4-3-7
ST3M723N6M10-57	G50344-3-6-10	G12093J6-3-10
ST3M723N6M12-48	G50344-3-6-12	G12093J6-3-12
ST3M724N1M8	G49461-4-8	G10851J4-8
ST3M724N1M10	G49461-4-10	G10851J4-10

Table 6-13. Standard Gang Channel Stock, Straight (CONT)

3 → McDonnell Standard No.	1 → Equivalent Part No.	2 → Equivalent Part No.
1 → Alcoa Global Fasteners Inc. (15653), or as noted.		
2 → Harvard Industries Inc. (72962).		
3 → McDonnell Aircraft Company (76301).		
4 → Military Standards Promulgated by Military Departments Under Authority of Defense Standardization Manual 41203-M (96906).		

Table 6-14. Plate Nut Assemblies

Nomenclature	2 → Part No.	3 → Equivalent Part No.	4 → Equivalent Part No.
NUT	MS21047L3	1 → 12600-3	K1000-3
NUT	MS21048-3	1 → 12700-02	K1031-3
NUT	MS21048L3	1 → 12700E02	K1001-3
NUT	MS21048L4	1 → 12700E048	K1001-4
NUT	MS21051L3	1 → 12610-02	K2000-3
NUT	MS21052-3	1 → 12710-02	K2031-3
NUT	MS21052L4	1 → 12710E48	K2001-4
NUT	MS21055L3	1 → 12620-02	K3000-3
NUT	MS21055L4	1 → 12620-048	K3000-4
NUT	MS21056-4	1 → 12720-048	K3031-4
NUT	MS21056L08	1 → 12620-82	K3001-08
NUT	MS21056L3	1 → 12620-02	K3001-3
NUT	MS21056L4	1 → 12620-048	K3001-4
NUT	MS21056L5	1 → 12620-054	K3001-5
NUT	MS21057-L4K	1 → 12620-054BC	K3001-5BC
NUT	MS21059L04	1 → 13605-40	F5000-4
NUT	MS21059L08	1 → 13605-82	F5000-08
NUT	MS21059L3	1 → 13605-02	F5000-3
NUT	MS21059L4	1 → 13605-4	F5000-4
NUT	MS21060-06	1 → 13705-62	F5031-06
NUT	MS21060-08	1 → 13705-82	F5031-08
NUT	MS21060-3	1 → 13705-02	F5031-3
NUT	MS21060L08	1 → 13705E82	F5001-08
NUT	MS21060L5	1 → 13705E054	F5001-5
NUT	MS21060L6		F5001-6
NUT	MS21061L06	1 → 13615-62	F2000-06
NUT	MS21061L08	1 → 13615-82	F2000-08
NUT	MS21061L3	1 → 13615-02	F2000-3
NUT	MS21062-3	1 → 13715-02	F2031-3
NUT	MS21062-4	1 → 1371-048	F2031-4
NUT	MS21062L04		F2001-04
NUT	MS21062L06	1 → 13715E62	F2001-06
NUT	MS21062L08	1 → 13715E82	F2001-08
NUT	MS21062L4	1 → 13715E02	F2001-3
NUT	MS21062L4	1 → 13715E048	F2001-4
NUT	MS21069L06	1 → M12600-62	MK1000-06
NUT	MS21069L08	1 → M12600-82	MK1000-08
NUT	MS21069L3	1 → M12600-02	MK1000-3

Table 6-14. Plate Nut Assemblies (CONT)

Nomenclature	2 → Part No.	3 → Equivalent Part No.	4 → Equivalent Part No.
NUT	MS21070L06	1 MA12700E62	MK1301-06
NUT	MS21070L3	1 MA12700E02	MK1301-3
NUT	MS21073L04	1 M1260-40	MK3000-04 8
NUT	MS21073L3	1 M1260-02	MK3000-3
NUT	MS21075L06	1 MA13600-62	MF1000-06
NUT	MS21075L3	1 MA13600-02	MF1000-3
NUT	MS21076-4	MA13700-048	MF1031-4
NUT	MS21076L06N	MA13700E62	MF1001-06
NUT	MS21076L08N	MA13700E82	MF1001-08
NUT	MS21076L3	MA13700E02	MF1001-3
NUT	MS21086L3	MT13C1032	MK4000-3
NUT	MS21087L3	MT13C1032M	MK4001-3
PLATE NUT ASSEMBLY	ST3M442-3A1	F18427L1-3	F49251E3-1
PLATE NUT ASSEMBLY	ST3M442-3A2	F18427L2-3	F49251E3-2
PLATE NUT ASSEMBLY	ST3M442-3A4	F18427L4-3	F49251E3-4
PLATE NUT ASSEMBLY	ST3M442-3A6	F18427L6-3	F49251E3-6
PLATE NUT ASSEMBLY	ST3M442-4A1	F18427L1-4	F49251E4-1
PLATE NUT ASSEMBLY	ST3M442-4A2	F18427L2-4	F49251E4-2
PLATE NUT ASSEMBLY	ST3M442-4A3	F18427L3-4	F49251E4-3
PLATE NUT ASSEMBLY	ST3M442-4A4	F18427L4-4	F49251E4-4
PLATE NUT ASSEMBLY	ST3M442-4A6	F18427L6-4	F49251E4-6
PLATE NUT ASSEMBLY	ST3M443-3A1	F18421L1-3	F49249E3-1
PLATE NUT ASSEMBLY	ST3M443-3A2	F18421L2-3	F49249E3-2
PLATE NUT ASSEMBLY	ST3M443-3A4	F18421L4-3	F49249E3-4
PLATE NUT ASSEMBLY	ST3M443-3A6	F18421L6-3	F49249E3-6
PLATE NUT ASSEMBLY	ST3M443-4A1	F18421L1-4	F49249E4-1
PLATE NUT ASSEMBLY	ST3M443-4A2	F18421L2-4	F49249E4-2
PLATE NUT ASSEMBLY	ST3M443-4A4	F18421L4-4	F49249E4-4
PLATE NUT ASSEMBLY	ST3M443-4A6	F18421L6-4	F49249E4-6
PLATE NUT ASSEMBLY	ST3M443-5A1	F18421L1-5	F49249E5-1
PLATE NUT ASSEMBLY	ST3M443-5A2	F18421L2-5	F49249E5-2
NUT	ST3M445C3M4	G18421L4-3	F49249E3-4XN
NUT	ST3M445C3M6	G18421L6-3	F49249E3-6XN
NUT	ST3M445C4M4	G18421L4-4	F49249E4-4XN
PLATE NUT ASSEMBLY	ST3M521A3-2	F10429-2-3	F39782-3-2
PLATE NUT ASSEMBLY	ST3M541-3A1	F14421-1-3	F39668N3
PLATE NUT ASSEMBLY	ST3M719C3M1	F12090-1-3	F50339-3-1
PLATE NUT ASSEMBLY	ST3M719C3M2	F12090-2-3	F50339-3-2
PLATE NUT ASSEMBLY	ST3M719C3M4	F12090-4-3	F50339-3-4
PLATE NUT ASSEMBLY	ST3M719C3M6	F12090-6-3	F50339-3-6
PLATE NUT ASSEMBLY	ST3M719C4M1	F12090-1-4	F50339-4-1
PLATE NUT ASSEMBLY	ST3M719C4M4	F12090-4-4	F50339-4-4
PLATE NUT ASSEMBLY	ST3M719C4M6	F12090-6-4	F50339-4-6
PLATE NUT ASSEMBLY	ST3M719C5M1	F12090-1-5	F50339-5-1
PLATE NUT ASSEMBLY	ST3M720C3M1	F12089-1-3	F50340-3-1
PLATE NUT ASSEMBLY	ST3M720C3M2	F12089-2-3	F50340-3-2
PLATE NUT ASSEMBLY	ST3M720C3M4	F12089-4-3	F50340-3-4
PLATE NUT ASSEMBLY	ST3M720C3M6	F12089-6-3	F50340-3-6
PLATE NUT ASSEMBLY	ST3M721C3M1	F12092-1-3	F50403-3-1

Table 6-14. Plate Nut Assemblies (CONT)

Nomenclature	2 → Part No.	3 → Equivalent Part No.	4 → Equivalent Part No.
PLATE NUT ASSEMBLY	ST3M721C3M2	F12092-2-3	F50403-3-2
PLATE NUT ASSEMBLY	ST3M721C3M4	F12092-4-3	F50403-3-4
PLATE NUT ASSEMBLY	ST3M721C3M6	F12092-6-3	F50403-3-6
PLATE NUT ASSEMBLY	ST3M725C3M	F12198-3	F50405-3
<p>1 → SPS Technologies Inc. (80539).</p> <p>2 → ST3M Part Numbers McDonnell Aircraft Corp. (76301); MS Part Numbers Promulgated by Military Departments Under Authority of Defense Standardization Manual 41203-M (96906).</p> <p>3 → Harvard Industries Inc. (72962).</p> <p>4 → Alcoa Global Fasteners Inc. (75237).</p>			

Table 6-15. Removable Fasteners**Table 6-15. Removable Fasteners (CONT)**

Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
AN3-10		MS51957-43N	
AN4-5A		THRU -45	
AN4-6A		MS51957-24B	
AN42BC4A		MS51957-34B	
MS20004-4		MS51957-43B	
MS20004H1D		MS51957-46B	
MS20004H44		NAS6603-8	
MS20074-04-04		NAS6603H2	
MS24693-38		NAS6603H25	
MS24693-271B		NAS6603H27	
MS24693C1		NAS6604-8	
MS245693C4		NAS6604-30	
MS245693-C6B		NAS6604-48	
MS24693C6		NAS6604-D9	
MS24693-C26		NAS6604D10	
MS24693-C48		NAS6604D22	
MS24693C50		NAS6604H1	
MS24693-C273		NAS6606-40	
MS24693C-274		NAS1218-04-1	
MS24693C280		NAS1218-08-2	
MS24693C286		NAS1218-08-3	
MS51957-13		NAS1218-04E1	
THRU -17		NAS1218-06E2	
MS51957-19		NAS1218-06E7	
MS51957-28		NAS1218-06E11	
MS51957-29		NAS1218-06E12	
MS51957-30		NAS1218-06E13	
MS51957-31B		NAS1218-08E2	
MS51957-32		NAS1218-08E3	
MS51957-35		NAS1218-08E4	
MS51957-36		NAS1218-08E6	
MS51957-42		NAS1218-08E10	
MS51957-43		NAS1219-3E6	

**Table 6-15. Removable Fasteners
(CONT)**

Part No.	Equivalent Part No.
NAS1261-27D	
NAS1261-33D	
NAS1261-102D	
NAS1261-108D	
NAS1262-26D	
NAS1262-29D	
NAS1263-23D	
NAS1264-64D	
NAS1265-40D	
NAS1297-3-9	
NAS1297-3D4	
NAS1351-3-6	
NAS1351-3-8	
NAS1351-3-10	
NAS1351-3-16	
NAS1351-3-6P	
NAS1351-3-14P	
NAS1351-3-16P	
NAS1351-3-20P	
NAS1351-3H10P	
NAS1351-3H16P	
NAS1351C3-8	
NAS1351C3-10	
NAS1351C3-12	
NAS1351C3-16	
NAS1351C3H6	
NAS1351C3H8	
NAS1351C3H10	
NAS1351-4-12P	
NAS1351C4-16	
NAS1351C4-28	
NAS1351C5-36	
NAS1352-04-10P	
NAS1352-04H8P	
NAS1352-06-8P	
NAS1352-06-10P	
NAS1352-06-14P	
NAS1352-06-16P	
NAS1352-06H8P	
NAS1352-06H10P	
NAS1352-08-8P	
NAS1352-08H8P	
NAS1352C04-8	
NAS1352C04H4	
NAS1352C04H6	
NAS1352C06-6	
NAS1352C06-8	
NAS1352C06-10	
NAS1352C06-24	
NAS1352C06H4	

**Table 6-15. Removable Fasteners
(CONT)**

Part No.	Equivalent Part No.
NAS1352C06H5	
NAS1352C06H8	
NAS1352C08-6	
NAS1352C08-8	
NAS1352C08-10	
NAS1352C08H4	
NAS1352C08H6	
NAS1399C3AB2	
NAS1399C3AB3	
NAS1399C4AB2	
THRU C4AB9	
NAS1399C4A2	
NAS1399C5A2	
THRU C5A10	
NAS1399C5AB2	
THRU C5AB10	
NAS1399C6AB3	
THRU C6AB5	
NSA1399C6A3	
NAS1399C6AB7	
NAS1578A3H2	
NAS1578A3H12	
NAS1578A4H28	
NAS1578A4H32	
NAS1578C3H32	
THRU C3H5	
NAS1578V3H2	
THRU V3H4	
NAS1578V3H6	
NAS1578V3H9	
NAS1578V3H29	
NAS1801-04-7	
NAS1801-08-6	
NAS1801-08-8	
NAS1801-3-4	
THRU -18	
NAS1801-3-20	
THRU -22	
NAS1801-3-24	
NAS1801-3-26	
NAS1801-3-30	
NAS1801-3-36	
NAS1801-3-39	
NAS1801-3-48	
NAS514P1032-6	
NAS514P1032-6P	
NAS514P1032-7P	
NAS514P1032-8	
NAS514P1032-8B	
NAS514P1032-8P	

**Table 6-15. Removable Fasteners
(CONT)**

Part No.	Equivalent Part No.
NAS514P1032-11P	
NAS514P1032-12P	
NAS514P1032-13P	
NAS514P440-3P	
NAS514P440-5P	
NAS514P440-6	
NAS514P440-6P	
NAS514P440-7B	
NAS514P440-8	
NAS514P440-8B	
NAS514P440-8P	
NAS514P632-5P	
NAS514P632-7P	
NAS514P832-7P	
NAS600-3P	
THRU -8P	
NAS600-10P	
THRU -14P	
NAS600-16P	
NAS600-20P	
NAS600-24P	
NAS601-7B	
THRU -9B	
NAS601-5P	
THRU -9P	
NAS601-10P	
NAS601-12P	
NAS601-14P	
NAS601-16P	
NAS601-18P	
NAS602-6P	
NAS602-7P	
NAS602-8P	
NAS602-9P	
NAS602-11P	
NAS602-13P	
NAS602-16P	
NAS602-18P	
NAS603-6B	
NAS603-7B	
NAS603-10B	
NAS603-4P	
NAS603-6P	
THRU -12P	
NAS603-14P	
NAS603-16P	
NAS603-20P	
NAS603-28P	
NAS604-9P	
NAS604-12P	

**Table 6-15. Removable Fasteners
(CONT)**

Part No.	Equivalent Part No.
NAS6308U8	
NAS6303U1	
THRU U9	
NAS6303U1D	
NAS6303U7D	
NAS6303U9D	
NAS6303U10D	
NAS6303U24D	
NAS6303U26D	
NAS6303U2H	
NAS6303U4H	
THRU U5H	
NAS6303U11H	
NAS6304-10D	
NAS6304U3	
THRU U7	
NAS6304U9	
NAS6304U9	
THRU U12	
NAS6304U15	
THRU U16	
NAS6304U11D	
NAS6304U13D	
NAS6304U14D	
NAS6304U32D	
NAS6304U34D	
NAS6304U1H	
NAS6305U24	
NAS653V1	
THRU V9	
NAS653V11	
NAS653V13	
THU V14	
NAS653V18	
NAS653V20	
THRU V21	
NAS653V23	
THRU V26	
NAS653V1D	
NAS653V2D	
NAS653V5D	
NAS653V8D	
NAS653V10D	
NAS653V11D	
NAS653V13D	
NAS653V2	
NAS653V16D	
NAS653V20D	
NAS653V22D	
NAS654V3	

**Table 6-15. Removable Fasteners
(CONT)**

Part No.	Equivalent Part No.
THRU V18	
NAS654V20	
THRU V29	
NAS654V33	
NAS654V35	
NAS654V4D	
NAS654V6D	
NAS654V8D	
NAS654V21D	
NAS654V24D	
NAS654V27D	
THRU V29D	
NAS654V52D	
NAS654V54D	
NAS654V3H	
NAS655V10	
NAS655V23	
NAS655V19D	
NAS655V46D	
NAS656V13D	
NAS656V15D	
NAS656V16D	
NAS656V18D	
NAS656V30D	
NAS656V46D	
NAS656V57D	
NAS656V121D	
NAS657V26D	
NAS658V24D	
NAS6603-2	
NAS6603-4	
NAS6603-8	
NAS6603-13	
NAS6603-14	
NAS6603-16	
NAS6603-19	
NAS6603-29	
NAS6603-30	
NAS6603D7	
NAS6603H2	
THRU H6	
NAS6604-1	
NAS6604-8	
NAS6604-30	
NAS6604-48	
NAS6604D9	
NAS6604D10	
NAS6604D22	
NAS6604D56	
NAS6604D70	

**Table 6-15. Removable Fasteners
(CONT)**

Part No.	Equivalent Part No.
NAS6604H1	
NAS6604H13	
NAS6604H17	
NAS6604-1	
NAS6606-32	
NAS6606-40	
NAS664V2HT	
THRU V5HT	
NAS664V7HT	
THRU V10HT	
NAS664V12HT	
NAS664V16HT	
NAS666V7HT	
NAS6703U2	
THRU U10	
NAS6703U14	
NAS6704U3	
NAS6704U5	
THRU U10	
NAS6704U13	
NAS6704U19	
NAS6704U42	
NAS6704U91	
NAS6705HU7	
NAS6705DU8	
NAS6706DU40	
NAS6706U44	
NAS673V1	
THRU V32	
NAS673V34	
THRU V36	
NAS673V38	
NAS673V40	
NAS673V44	
NAS673V3D	
THRU V6D	
NAS673V11D	
NAS673V13D	
NAS673V1H	
THRU V20H	
NAS673V23H	
NAS673V25H	
THRU V28H	
NAS674V1	
THRU V20	
NAS674V23	
NAS674V25	
THRU V27	
NAS674V30	
NAS674V32	

**Table 6-15. Removable Fasteners
(CONT)**

Part No.	Equivalent Part No.
THRU V35	
NAS674V40	
NAS674V42	
NAS674V52	
NAS674V8D	
NAS674V9D	
THRU V16D	
NAS674V16D	
THRU V18D	
NAS674V2H	
NAS674V4H	
THRU V8H	
NAS674V9H	
NAS674V13H	
NAS674V23H	
NAS674V34H	
NAS675V1	
NAS675V3	
THRU V13	
NAS675V9D	
NAS675V10D	
NAS675V15D	
NAS675V16D	
NAS675V20D	
NAS676V5	
NAS677V20	
ST3M430V3-2ASM	HT271A3-2
ST3M430V3-4ASM	HT271A3-4
THRU -9ASM	THRU A3-8
ST3M430V3-11ASM	HT271A3-11
ST3M430V3-13ASM	HT271A3-13
ST3M430V4-5ASM	HT271A4-5
THRU -10ASM	THRU A4-10
ST3M430V5-6ASM	HT271A5-6
THRU -10ASM	THRU A5-10
ST3M430V6-8ASM	HT271A6-8
ST3M430V8-13ASM	HT271A8-13
ST3M453-3-3	MB61-3-3
ST3M453-3-4	MB61-3-4
ST3M453-3-5	MB61-3-5
ST3M453-3-6	MB61-3-6
ST3M453-3-7	MB61-3-7
ST3M453-3-9	MB61-3-9
ST3M453-3-10	MB61-3-10
ST3M453-3D5	MB61-3D5
THRU -3D6	THRU -3D6
ST3M453-4-3	MB61-4-3
THRU -4-4	THRU -4-4
ST3M453-4-18	MB61-4-18
ST3M453-4-22	MB61-4-22

**Table 6-15. Removable Fasteners
(CONT)**

Part No.	Equivalent Part No.
ST3M453-4-23	MB61-4-23
ST3M453-4-38	MB61-4-38
ST3M453-4D10	MB61-4D10
ST3M453-4D15	MB61-4D15
ST3M453-5-28	MB61-5-28
ST3M453-5-68	MB61-5-68
ST3M453-5-84	MB61-5-84
ST3M453-100	MB61-5-100
ST3M453-5D7	MB61-5D7
ST3M453-5D10	MB61-5D10
ST3M453-5D11	MB61-5D11
ST3M453-5D14	MB61-5D14
THRU -5D16	THRU -5D16
ST3M453-5D18	MB61-5D18
ST3M453-5D20	MB61-5-20
ST3M453-5D25	MB61-5D25
ST3M453-5D26	MB61-5D26
ST3M453-5D40	MB61-5D40
ST3M453-5D41	MB61-5D41
ST3M453-6-9	MB61-6-9
ST3M453-6D18	MB61-6D18
ST3M453-6D24	MB61-6D24
ST3M453-6D32	MB61-6D32
ST3M453-6D61	MB61-6D61
ST3M453-7-11	MB61-7-11
ST3M453-7D11	MB61-7D11
ST3M453-7D24	MB61-7D24
ST3M453-8D21	MB61-8D21
ST3M453-8D29	MB61-8D29
ST3M453-8D45	MB61-8D45
ST3M453-10D32	MB61-10D32
ST3M453-10D40	MB61-10D40
ST3M453-10D45	MB61-10D45
ST3M454-3L2	HT4025L3-2
THRU -3L11	THRU L3-11
ST3M454-3L14	HT4025L3-14
ST3M454-4L4	MB61-4-L4
ST3M454-4L6	MB61-4-L6
ST3M454-4L8	MB61-4-L8
ST3M454-4L9	MB61-4-L9
ST3M454-4L11	MB61-4-L11
ST3M454-4L12	HT4025L4-12
ST3M454-4L16	HT4025L4-15
ST3M454-4DL12	HT4025L4D12
ST3M454-4DL44	HT4025L4D44
ST3M454-4D30	HT4025L4-30
ST3M454-4D32	HT4025L4-32
ST3M454-4DL15	HT4025L4-15
ST3M454-4DL16	HT4025L4-16
ST3M454-4L22	HT4025L4-22

CSTO SR1F-15SA-3-1
**Table 6-15. Removable Fasteners
(CONT)**

Part No.	Equivalent Part No.
ST3M454-4L30	HT4025L4-30
ST3M454-4L32	HT4025L4-32
ST3M454-5L7	HT4025L5-7
ST3M454-5L9	HT4025L5-9
THRU -5-10	THRU L5-10
ST3M454-5L12	HT4024L5-12
THRU -5-13	THRU L5-13
ST3M455-4L5-1	HT4024L4-5
ST3M455-4L7-1	HT4024L4-7
ST3M455-5L6	HT4024L5-6
THRU -5L16	THRU L5-16
THRU -6L12	THRU L6-12
ST3M455-6L10M	HT4024L6-10M
ST3M455-6L14	HT4024L6-14
ST3M455-7L15	HT4024L7-15
ST3M455-7DL15	HT4024L7D15
ST3M455-7L7M	HT4024L7-7M
ST3M455-8L11	HT4024L8-11
THRU -8L13	THRU L8-13
ST3M455-8L12M	HT4024L8-12M
ST3M457-3-5	MB61-3-5
ST3M457-4-7	MB61-4-7
ST3M557-3-1	MB61-3-1
ST3557M-6-9	MD61-6-9
THRU -12	THRU -6-12
ST3M557-7-9M	HT4024L7-9M
ST3M557-8-12M	HT4024-8-12M
ST3M466V4L2-1	HT4028L4-2
THRU V4L10-1	THRU L4-10
ST3M466V4L11-1	THRU L4-14
ST3M466V4L24-1	HT4028L4-24
ST3M466V4DL10-1	HT4028L4D10
ST3M466V4DL11-1	HT4028L4D11
ST3M466V5L5-1	HT4028L5-5
ST3M466V5L6-1	HT4028L5-6
ST3M466V5L9-1	HT4028L5-98
THRU V5L10-1	THRU L5-10
ST3M466V6L9-1	HT4028L6-9
ST3M466V6L9M1	HT4028L6-9M
ST3M466V6L10-1	HT4028L6-10
ST3M466V7L7-1	HT4028L7-7
THRU V7L12-1	THRU L7-12
ST3M466V7LM1	HT4028L7-7M
THRU V7L12M1	THRU -12M
ST3M466V8L7-1	HT4028L8-7
THRU V8L11-1	THRU L8-11
ST3M466V8L7M1	HT4028L8-7M
THRU V8L11M1	THRU -11M
ST3M494-4-3	S11-1065-4-3
ST3M494-4-19	S11-1065-4-19

**Table 6-15. Removable Fasteners
(CONT)**

Part No.	Equivalent Part No.
ST3M494-4-24	S11-1065-4-24
ST3M494-4D14	S11-1065-4D14
ST3M494-4D24	S11-1065-4D24
ST3M494-4D25	S11-1065-4D25
ST3M494-5-20	S11-1065-5-20
ST3M494-5D36	S11-1065-5D36
ST3M496-5-10	HT4008-5-10
ST3M496-6-8	HT4008-6-8
ST3M496-6-11	HT4008-6-11
ST3M497-5-11	MB88-5-11
ST3M497-5-12	MB88-5-12
ST3M497-6-9	MB88-6-9
ST3M557-3-1	HT4027-3-1
THRU -3-19	THRU -3-19
ST3M557-3-4	HT4027-3-4
ST3M557-3-4M	HT4027-3-4M
ST3M571-3-4	MB84-3-4
THRU -3-9	THRU -3-9
ST3M571-3D67	MB84-3D67
ST3M571-3H5	MB84-3H5
ST3M571-3H6	MB84-3H6
ST3M571-4-5	MB84-4-5
THRU -4-12	THRU -4-12
ST3M571-4-15	MB84-4-15
THRU -4-20	THRU -4-20
ST3M571-4-21	MB84-4-21
THRU -4-24	THRU -4-24
ST3M571-4-26	MB84-4-26
ST3M571-4-36	MB84-4-36
ST3M571-4-38	MB84-4-38
ST3M571-4D12	MB84-4D12
ST3M571-4D13	MB84-4D13
ST3M571-4H5	MB84-4H5
ST3M571-4H6	MB84-4H6
ST3M571-4H12	MB84-4H12
ST3M571-5-10	MB84-5-10
THRU -5-14	THRU -5-14
ST3M571-5-19	MB84-5-19
ST3M571-5-21	MB84-5-21
THRU -23	THRU -5-23
ST3M571-5D12	MB84-5D12
ST3M571-5D14	THRU -15
ST3M571-5D19	MB84-5D19
THRU -5D19	THRU-5D19
ST3M571-5D23	MB84-5D23
ST3M571-5D25	MB84-5D25
ST3M571-5D26	MB84-5D26
ST3M571-5D37	MB84-5D37
ST3M571-5H4	MB84-5H4
ST3M571-4H6	MB84-4H6

**Table 6-15. Removable Fasteners
(CONT)**

Part No.	Equivalent Part No.
ST3M571-5H8	MB84-5H8
ST3M571-5H65	MB84-5H65
ST3M571-6-8	MB84-6-8
ST3M571-6-14	MB84-6-14
ST3M571-6-19	MB84-6-19
ST3M571-6-20	MB84-6-20
ST3M571-6-22	MB84-6-22
ST3M571-6-24	MB84-6-24
ST3M571-6-28	MB84-6-28
ST3M571-6D13	MB84-6D13
THRU -6D14	THRU -6D14
ST3M571-6D17	MB84-6D17
ST3M571-6D60	MB84-6D60
ST3M571-6H8	MB84-6H8
ST3M571-6H23	MB84-6H23
ST3M571-6H30	MB84-6H30
THRU -6H31	THRU -6H31
ST3M571-7-28	MB84-7-28
ST3M571-7-30	MB84-7-30
ST3M571-7-48	MB84-7-48
ST3M571-7D9	MB84-7D9
ST3M571-7H28	MB84-7H28
ST3M571-8-12	MB84-8-12
ST3M571-8-15	MB84-8-15
ST3M571-8-18	MB84-8-18
ST3M571-8-20	MB84-8-20
ST3M571-8-24	MB84-8-24
ST3M571-8-26	MB84-8-26
ST3M571-8-28	MB84-8-28
ST3M571-8D40	MB84-8D40
ST3M571-8D44	MB84-8D44
ST3M571-8D46	MB84-8D46
ST3M571-8D47	MB84-8D47
ST3M571-8D58	MB84-8D58
ST3M571-8D73	MB84-8D73
ST3M571-9D24	MB84-9D24
ST3M571-9D30	MB84-9D30
ST3M571-10D30	MB84-10D30
ST3M571-10D46	MB84-10D46
ST3M649-08-3	HT4017-08-3
THRU -08-9	THRU -08-9
ST3M649-08-11	HT4017-08-11
ST3M652C4-12A	HT4020-4-12A
ST3M714-3-4	HT4020-3-4
ST3M714-3-6	HT4020-3-6
ST3M714-4D10	HT4049-4D10
ST3M714-4D11	HT4049-4D11
ST3M714-5D17	HT4049-5D17
ST3M714-6D549	HT4049-6D549
ST3M714-6D61	HT4049-6D61

**Table 6-15. Removable Fasteners
(CONT)**

Part No.	Equivalent Part No.
ST3M729-10D40	MB145-10D40
ST3M729-10D45	MB145-10D45
ST3M729-10D55	MB145-10D55
ST3M733-3L2	HT4057-3-2A
ST3M733-3L3	HT4057-3-3A
ST3M733-3L4	HT4057-3-4A
ST3M733-3L5	HT4057-3-5A
ST3M733-3L6	HT4057-3-6A
ST3M733-3L7	HT4057-3-7A
ST3M733-3L8	HT4057-3-8A
ST3M733-3L9	HT4057-3-9A
ST3M733-3L10	HT4057-3-10A
ST3M733-4L6	HT4057-4-6A
ST3M733-4L7	HT4057-4-7A
ST3M733-4L8	HT4057-4-8A
ST3M733-4L9	HT4057-4-9A
ST3M733-4L11	HT4057-4-11A
ST3M733-4L12	HT4057-4-12A
ST3M733-4L22	HT4057-4-22A
ST3M733-5L9	HT4057-5-9A
ST3M733-5L10	HT4057-5-10A
ST3M733-6L8	HT4057-6-8A
ST3M733-6L11	HT4057-6-11A
ST3M733-4DL44	HT4057-4D44A
ST3M735-4-7	
THRU -4-22	
ST3M735-4-24	
THRU -4-27	
ST3M735-4-29	
ST3M735-4-32	
ST3M735-4-36	
THRU -4-39	
ST3M735-4-41	
ST3M735-4-42	
ST3M735-4-48	
ST3M735-4-50	
ST3M735-4-54	
ST3M735-4-58	
ST3M735-4-62	
ST3M735-4-70	
ST3M735-4-80	
ST3M735-4-98	
ST3M735-4-104	
ST3M735-4-120	
ST3M735-5-12	
ST3M735-5-19	
ST3M735-5-22	
ST3M735-5-23	
ST3M735-5-45	
ST3M735-5-58	

**Table 6-15. Removable Fasteners
(CONT)**

Part No.	Equivalent Part No.
ST747-3-8	
ST3M747-3-11	
ST3M747-3D7	
ST3M747-4-5	
THRU -4-13	
ST3M747-4-17	
ST3M747-5-6	
THRU -5-11	
ST3M747-5H12	
3M123-4-12	HT4N-12
3M123-4-23	HT4N-23
3M123-4-24	HT4N-24
3M1235C-2	
THRU C-3	
3M1235C-10	
THRU -12	
3M46-3-2	HT3UA-2
3M381-9D31	
3M707-3-2-4	HT4041-3-2M4
3M707-3-2-5	HT4041-3-2M5
3M707-3-3-4	HT4041-3-3M4
3M707-3-3-5	HT4041-3-3M5
3M707-3-4-5	HT4041-3-4M5
3M707-3-9-4	HT4041-3-9M4
3M707-4-6-5	HT4041-4-6M5
3M707-5-7-6	HT4041-5-7M6
3M925C3-3A	HT4067-3-3A
THRU -9A	THRU HT4041-3-9A
3M925C3-13A	HT4067-3-13A
3M925C4-6A	HT4067-4-6A
3M925C4-7A	HT4067-4-7A
3M925C4-8A	HT4067-4-8A
3M925C4-9A	HT4067-4-9A
3M925C4-10A	HT4067-4-10A
3M925C4-11A	HT4067-4-11A
3M925C4-12A	HT4067-4-12A
3M925C4-13A	HT4067-4-13A
3M926-3L1	HT4068-3-1A
THRU 3-L9	THRU HT4068-3-9A
3M925C5-9A	HT4067-5-9A
THRU -13A	THRU HT4067-5-13A
3M926-3L1	HT4068-3-1A
3M926-3L2	HT4068-3-2A
3M926-3L3	HT4068-3-3A
3M926-3L4	HT4068-3-4A
3M926-3L5	HT4068-3-5A
3M926-3L6	HT4068-3-6A
3M926-3L7	HT4068-3-7A
3M926-3L8	HT4068-3-8A
3M926-3L9	HT4068-3-9A

**Table 6-15. Removable Fasteners
(CONT)**

Part No.	Equivalent Part No.
3M926-3L10	HT4068-3-10A
3M926-3L11	HT4068-3-11A
3M926-3L12	HT4068-3-12A
3M926-3L13	HT4068-3-13A
3M926-3L15	HT4068-3-15A
3M926-3DL2	HT4068-3D2
THRU 3DL6	THRU HT4068-3D6
3M926-3L1	HT4068-3-1A
THRU -3L14	THRU HT4068-3-14A
3M926-3DL3	HT4068-3-3A
THRU -3DL6	THRU HT4068-3DL6
3M926-4L8	HT4068-4-8A
3M926-4L9	HT4068-4-9A
3M926-4L10	HT4068-4-10A
3M926-4L11	HT4068-4-11A
3M926-4L12	HT4068-4-12A
3M926-4L13	HT4068-4-13A
3M926-4L14	HT4068-4-14A
3M926-4L15	HT4068-4-15A
3M926-4L16	HT4068-4-16A
3M926-5L6	HT4068-5-6A
3M926-5L7	HT4068-5-7A
3M926-5L8	HT4068-5-8A
3M926-5L9	HT4068-5-9A
3M926-5L10	HT4068-5-10A
3M926-5L11	HT4068-5-11A
3M926-5L13	HT4068-5-13A
3M926-5L14	HT4068-5-14A
3M926-5L16	HT4068-5-16A
3M926-6L6	HT4068-6-6A
3M926-6L25	HT4068-6-25A
3M926-6L7	HT4068-6-7A
3M926-6L8	HT4068-6-8A
3M926-6L9	HT4068-6-9A
3M926-6L10	HT4068-6-10A
3M926-6L11	HT4068-6-11A
3M926-6L12	HT 4046-6-12A
3M927-3L1	HT4069-3-1A
THRU -3L15	THRU -3-15A
3M927-4L2	HT4069-4-2A
THRU -4L18	THRU -4-18A
3M927-4L20	HT4069-4-20A
3M927-4L23	HT4069-4-23A
3M927-4L32	HT4069-4-32A
3M927-5L6	HT4069-5-6A
THRU -5L10	THRU -5-10A
3M927-6L8	HT4069-6-8A
3M927-6L9	HT4069-6-9A
3M938-3-2-5	HT4072-3-2-5
3M938-4-6-7	HT4072-4-6-7

**Table 6-15. Removable Fasteners
(CONT)**

Part No.	Equivalent Part No.
3M938-6D6-7	HT4072-6D6-7

Table 6-16. Removable Fasteners, Milson

Part No.	Equivalent Part No.
SLEEVE BOLT PAN HEAD	
3M302A5-4	01916-5-4
3M302A5-9	01916-5-9
THRU A5-12	THRU -5-12
3M302C6-4	191012-6-4
3M302C6-5	191012-6-5
SLEEVE BOLT FLUSH HEAD	
3M303A5W3	01926-5-3
THRU A5W14	THRU -5W14
3M303A5W16	01926-5W16
3M303A5W18	01926-5W18
3M303A5W3	01926-5-3
THRU A5W14	THRU -5W14
3M303C4-2	192012-4-2
3M303C4-3	192012-4-3
3M303C5-3	192012-5-3
THRU C5-14	THRU -5-14
3M303C5-16	192012-5-16
3M303C5-18	192012-5-18
3M303C5W4	192015-5W4
THRU C5W9	THRU -5W9
THRU C6-11	THRU -6-11
3M303C6W4	192012-6-4
THRU C6W9	THRU -6-9
RECEPTACLE NONSEALING	
3M304-5-7-0	1950-5-7-0
3M304-5-7-01	1950-5-7-01
3M304-5-7-1	1950-5-7-1
THRU -5-7-3	THRU -5-7-3
3M304-5-7-5	1950-5-7-5
3M304-5-8-0	1950-5-8-0
3M304-5-8-01	1950-5-8-01
3M304-5-8-1	1950-5-8-1
THRU -5-8-10	THRU -5-8-10
3M304-5-9-0	1950-5-9-0
3M304-5-9-01	1950-5-9-01
3M304-5-9-1	1950-5-9-1
3M304-5-9-11	1950-5-9-11

**Table 6-16. Removable Fasteners, Milson
(CONT)**

Part No.	Equivalent Part No.
3M304-5-10-2	1950-5-10-2
3M304C5-7-0	195012-5-7-0
3M304C5-7-01	195012-5-7-01
3M304C5-7-1	195012-5-7-1
THRU C5-7-4	THRU -5-7-4
3M304C5-7-7	195012-5-7-7
3M304C5-7-9	195012-5-7-9
3M304C5-8-0	195012-5-8-0
3M304C5-8-1	195012-5-8-1
THRU C5-8-6	THRU -5-8-6
3M304C5-8-9	195012-5-8-9
3M304C5-9-0	195012-5-9-0
3M304C5-9-1	195012-5-9-1
3M304C5-10-0	195012-5-10-0
3M304C6-8-1	195012-6-8-1
3M304C6-8-3	195012-6-8-3
3M304C6-9-0	195012-6-9-0
3M304C6-9-01	195012-6-9-01
3M304C6-9-1	195012-6-9-1
3M304C6-9-2	195012-6-9-2
3M304C6-9-3	195012-6-9-3
3M304C6-9-4	195012-6-9-4
3M304C6-10-0	195012-6-10-0
3M304C6-10-1	195012-6-10-1
3M304C6-10-3	195012-6-10-3
3M304C6-10-4	195012-6-10-4
RECEPTACLE SEALING	
3M305-5-7-0	1970-5-7-0
3M305-5-7-1	1970-5-7-1
3M305-5-8-0	1970-5-8-0
3M305-5-8-01	1970-5-8-01
3M305-5-8-1	1970-5-8-1
THRU -5-8-4	THRU -5-8-4
3M305-5-10-2	1970-5-10-2
RECEPTACLE CORNER	
3M310-5-7-0	1960-5-7-0
3M310-5-7-3	1960-5-7-3
3M310-5-7-8	1960-5-7-8
3M310-5-8-0	1960-5-8-0
3M310-5-8-1	1960-5-8-1
3M310-5-8-2	1960-5-8-2
3M310-5-8-3	1960-5-8-3
3M310-5-8-4	1960-5-8-4
3M310-5-8-8	1960-5-8-8
3M310-5-8-10	1960-5-8-10

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**Table 6-16. Removable Fasteners, Milson
(CONT)**

Part No.	Equivalent Part No.
3M310-5-8-13	1960-5-8-13
3M310-5-9-0	1960-5-9-0
3M310-6-10-1	1960-6-10-1
3M310C4-5-1	196012-4-5-1
3M310C4-7-1	196012-4-7-1
3M310C5-3-5	196012-5-3-5
3M310C5-8-1	196012-5-8-1
THRU C5-8-5	THRU -5-8-5
3M310C6-8-1	196012-6-8-1
3M310C6-9-0	196012-6-9-0
3M310C6-9-3	196012-6-9-3
3M310C6-10-0	196012-6-10-0
3M310C6-10-1	196012-6-10-1
3M310C6-10-2	196012-6-10-2
3M310C6-10-3	196012-6-10-3
RETAINING RING	
3M394-4	1944-4
3M394-5	1944-5
3M394-6	1944-6
SHIM NONCOUNTERBORED	
3M384-5-1	
SHIM COUNTERBORED	
3M385-5	
ST4M171N5E	
ST4M171N6	
SHIM CORNER	
ST4M172N5	
ST4M172N6	

Table 6-17. Permanent Fasteners

Part No.	Equivalent Part No.
BLIND RIVET	
NAS1398B4A2	RV1250-4-2
NAS1398B4A3	RV1250-4-3
NAS1398B5A2	RV1250-5-2
NAS1398B6A4	RV1250-6-4
NAS1398C4A1	RV1240-4-1
THRU C4A6	THRU -4-6
NAS1398C5A1	RV1240-5-1
THRU C5A10	THRU -5-10
NAS1398C6A2	RV1240-6-2
THRU C6A7	THRU -6-7
NAS1398C6A10	RV1240-6-10
NAS1398C8A4	RV1240-8-4
NAS1398C8A5	RV1240-8-5
NAS1398C()AB()	AF4623
	CR4623
NAS1398C4AB1	RV1290M4-1
THRU 4AB6	RV1290M4-6
NAS1398C4AB4	RV1290-4-4
NAS1398C5AB2	RV1290M54-2
NAS1398C5AB2	RV1290M5-2
THRU 5AB9	THRU M5-9
NAS1398D5A1	RV1200-5-1
THRU D5A5	THRU -5-7
NAS1399D5AB4	RV1251-5-4
NAS1399D5AB5	RV1251-5-5
NAS1398D6AB2	RV1200-6-2
THRU D6AB6	THRU -6-6
NAS1399C4AB2	RV1241-4-2
THRU C4AB9	THRU -4-9
NAS1399C5AB2	RV1241-5-2
THRU C5AB10	THRU -5-10
NAS1399C6AB3	RV1241-6-3
THRU C6A5	THRU -6-7
NAS1399C()AB()	AF4622
	CR4622
NAS1399D4AB2	RV1201-4-2
THRU D4A5	THRU -4-5
NAS1399D5AB2	RV1201-5-2
THRU D5A5	THRU -5-5
NAS1399C4AB6	RV1291M4-6
NAS1399C5AB5	RV1291M5-5
THRU 5AB9	THRU M5-9
NAS1399C4AB4	RV1291M6-4
NAS1399C6AB6	RV1291M6-6
NAS1399M()AB()	AF4522
	CR4522

**Table 6-17. Permanent Fasteners
(CONT)**

Part No.	Equivalent Part No.
ST3M667-0306	1415-0306
ST3M667-0308	1415-0308
ST3M667-0310	1415-0310
ST3M667-0312	1415-0312
ST3M667-0314	1415-0314
ST3M806-3-6	RV1240-3-6
3M117-304	1204-304
3M117-306	1204-306
3M117-308	1204-308
3M117-310	1204-310
3M117-312	1204-312
3M117-314	1204-314
3M117-406	1204-406
3M117-408	1204-408
3M1236C3-4	1204-304
3M1236C4-1	RV1340-4-1
THRU C4-5	THRU -4-5
HI-LOK PIN	
ST3M456C08-3	HL655YE5-3
THRU C08-12	THRU YE5-12
ST3M456C3-2	HL645YE6-2
THRU C3-12	THRU YE6-12
ST3M456C3-14	HL645YE6-14
THRU C3-16	THRU YE6-16
ST3M456C4-3	HL645YE8-3
THRU C4-15	THRU YE8-15
ST3M456C5-5	HL645YE10-5
THRU C5-17	THRU YE10-17
ST3M456C6-4	HL645YE12-4
ST3M456C6-6	HL645YE12-6
THRU C6-11	THRU YE12-11
ST3M456C6-13	HL645YE12-13
ST3M457C08-2	HL654YE5-2
THRU C08-8	THRU YE5-8
ST3M457C08-12	HL654YE5-12
ST3M457C08-15	HL654YE5-15
ST3M457C3-2	HL644YE6-2
THRU C3-12	THRU YE6-12
ST3M457C08-14	HL654YE5-14
ST3M457C4-3	HL644YE8-3
THRU C4-13	THRU YE8-13
ST3M457C5-3	HL644YE10-3
THRU C5-18	THRU YE10-18
ST3M457C6-3	HL644YE12-3
ST3M457C6-4	HL644YE12-4
ST3M758D08-2	HL41-5-2
THRU D0810	THRU 5-10

**Table 6-17. Permanent Fasteners
(CONT)**

Part No.	Equivalent Part No.
ST3M758D3-2	HLT631YB-2
THRU D3-9	THRU YB-9
ST3M758D3-3	HL41-6-3
THRU D3-14	THRU HL 41-6-14
ST3M758D3-24	HL 41-3-24
ST3M758T08-2	HL511-5-2
THRU 08-15	HL511-5-15
ST3M758T3-2	HLT969DL-6-2
THRU T3-6	THRU DL-6-6
ST3M758T3-38	H11T8-3
ST3M758T4-3	HLT969DL-8-3
THRU T4-15	THRU DL-8-15
ST3M758T4-20	HLT969DL-8-20
ST3M758T5-3	HL11T10-9
ST3M758T6-5	HL11T6-5
THRU T12-10	THRU T12-10
ST3M758T08-2	HLT969DL-5-2
THRU T08-6	THRU DL-5-6
ST3M759C3-7	HLT50YB-6-7
ST3M759C3-14	HLT50YB-6-14
ST3M759C3-17	HLT50YB-6-17
ST3M759C4-3	HLT50YB-8-3
THRU C4-17	THRU YB-8-17
ST3M759C4-19	HLT50YB-8-19
ST3M759C5-5	HL40-5-5
ST3M759C5-6	HL40-5-6
ST3M759C5-14	HL40-5-14
ST3M759V3-2	HLT310DL-6-2
THRU V3-13	HLT310DL-6-13
ST3M759V4-3	HLT310DL-8-3
THRU V4-15	HLT310DL-8-15
ST3M759V4-13	HLT310DL-8-13
ST3M759V4-15	HLT310DL-8-15
ST3M759V5-3	HLT310DL-10-3
THRU V5-10	HLT310DL-10-10
ST3M759V5-14	HLT310DL-10-14
ST3M759V6-8	HLT310DL-12-8
ST3M759V08-1	HLT310DL-5-1
THRU V08-3	THRU DL-5-3
ST3M759V08-10	HLV310DL-8-10
THRU V08-12	THRU DL-8-12
ST3M759V08-14	HLV310DL-8-14
THRU V08-15	THRU DL-0815
ST3M760C	HLT53YB-6
ST3M760D3-6	HLT633YB-6-6
THRU D3-8	HLT633YB-6-8
ST3M760D08-3	HLT633YB-5-3
ST3M760D08-6	THRU YB-5-6
ST3M760D08-8	HLT633YB-6-8

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**Table 6-17. Permanent Fasteners
(CONT)**

Part No.	Equivalent Part No.
ST3M760T3-3	HLT953DL-5-3
THRU T3-12	THRU DL-5-12
ST3M760T3-31	HLT953DL-5-31
ST3M760T4-5	HLT953DL-8-5
THRU T4-9	THRU DL-8-9
ST3M760T4-14	HLT953DL-8-14
ST3M760T4-16	HLT953DL-8-16
ST3M760T08-3	HLT953DL-5-3
THRU T08-7	THRU DL-5-7
ST3M760T08-10	HLT953DL-5-10
THRU T08-11	THRU DL-5-11
ST3M761C3-2	HLT52YB-6-2
THRU C3-10	THRU YB-6-10
ST3M761C3-13	HLT52YB-6-13
ST3M761C4-4	HLT52YB-8-4
THRU C4-8	THRU YB-8-8
ST3M761C4-14	HLT52YB-8-14
ST3M761C5-4	HLT52YB-10-4
ST3M761C5-11	HLT52YB-10-11
ST3M761C5-13	HLT52YB-10-13
ST3M761C6-3	HLT52YB-12-3
ST3M761C6-8	HLT52YB-12-8
ST3M761C08-2	HLT52YB-5-2
THRU C08-11	THRU HLT52YB-5-11
ST3M761V08-2	HLT312DL-08-2
THRU 08-9	THRU 312DL08-9
ST3M761V3-2	HLT312DL-6-2
THRU V3-11	THRU DL-6-11
ST3M761V3-14	HLT312DL-6-14
ST3M761V4-3	HLT312DL-8-3
THRU V4-8	THRU DL-8-8
ST3M761V4-11	HLT312DL-8-11
ST3M761V4-13	HLT312DL-8-13
THRU V4-14	THRU DL-8-14
ST3M761V5-4	HLT312DL-10-4
ST3M761V5-9	HLT312DL-10-9
THRU V5-14	THRU DL-10-14
ST3M761V08-2	HLT312DL-5-2
THRU V08-9	THRU DL-5-9
ST3M761V08-11	HLT312DL-5-11

HI-LOK COLLAR

ST3M525N08ME	HL570-5MC
ST3M525N3ME	HL570-6MC
ST3M525N4ME	HL570-8MC
ST3M525N5ME	HL570-10MC
ST3M525N6ME	HL570-12MC
ST3M526C08M	SW1000-5M

**Table 6-17. Permanent Fasteners
(CONT)**

Part No.	Equivalent Part No.
ST3M526C3M	SW1000-6M
ST3M526C4M	SW1000-8M
ST3M526C5M	SW1000-10M
ST3M526C6M	SW1000-12M
ST3M573C08	SW2000-5A
ST3M573C3A	SW2000-6A
ST3M573C4A	SW2000-8A
ST3M573C5A	SW2000-10A
ST3M573C6A	SW2000-12A
ST3M573C3A	SW2000-6AA
ST3M573C4A	SW2000-8AA
ST3M573C5A	SW2000-10AA
ST3M573C6A	SW2000-12AA
ST3M573C08	SW2000-5AA
ST3M608N08ME	HL582-5MCA
ST3M608N3ME	HL582-6MCA
ST3M608N4ME	HL582-8MCA
ST3M608N5ME	HL582-10MCA
ST3M608N6ME	HL582-12MCA
HI-LOCK SELF ALIGNING WASHER	
ST3M683-3	SW2000-6W
ST3M683-4	SW2000-8W
ST3M683-5	SW2000-10W
ST3M683-6	SW2000-12W
JO-BOLT	
NAS1669-08DL1	
THRU -08DL9	
NAS1669-08DL12	
THRU DL14	
NAS1669-08L1	PLT210-5-1
THRU -08L9	THRU -5-8
NAS1669-08L12	PLT210-5-12
THRU -08L13	THRU -5-13
NAS1669-3DL-1	
THRU -3DL-9	
NAS1669-3L1	PLT210-6-1
THRU -3L9	THRU -6-9
NAS1669-5DL2	PLT210-10-2
NAS1669-5DL5	PLT210-10-5
NASA1670-08DL2	PLT110-5-2
THRU -08DL-8	THRU -5-8
NAS1670-08L2	PLT110-5-2
THRU -08L7	THRU -5-7

**Table 6-17. Permanent Fasteners
(CONT)**

Part No.	Equivalent Part No.
NAS1670-3DL2	PLT110-6-2
THRU -3DL7	THRU -6-7
NAS1670-3L2	PLT110-6-2
THRU -3L7	THRU -6-7
NAS1670-4DL3	PLT110-8-3
NAS1670-4L3	PLT110-8-3
NAS1670-5L4	PLT110-10-4
NAS1671-08DL1	
THRU -08DL6	
NAS1671-08L1	PLT220-5-1
THRU -08L6	THRU -5-6
NAS1671-3DL2	PLT220-6-2
THRU -3DL8	THRU -6-8
NAS1671-3L2	PLT220-6-2
THRU -3L8	THRU -6-8
NAS1671-3DL10	PLT220-6-10
NAS1671-4DL8	PLT220-8-8
NAS1671-4DL8	PLT220-8-8
NAS1672-08DL3	PLT120-5-3
THRU DL4	PLT120-5-4
NAS1672-08L3	PLT120-5-3
NAS1672-08L4	PLT120-5-4
NAS1672-08L11	PLT120-5-11
NAS1672-3DL3	PLT120-6-3
THRU DL4	THRU -6-4
NAS1672-3DL6	PLT120-6-6
THRU -3DL-9	THRU 6-9
NAS1672-3DL11	
NAS1672-3L3	PLT120-6-3
THRU -3L6	THRU -6-6
NAS1672-4DL4	PLT120-8-5
THRU-4DL7	THRU 4-7
NAS1672-4DL18	
NAS1672-4L5	PLT120-8-5
NAS1673-08DL1	
THRU -08DL5	
NAS1673-08DL7	
NAS1673-08L1	PLT230-5-1
THRU -08L5	THRU -5-5
NAS1673-08L7	PLT230-5-7
NAS1673-3DL1	
THRU -3DL5	
NAS1673-3DL7	
NAS1673-3L1	PLT230-6-1
THRU -3L8	THRU -6-8
NAS1674-08DL2	
THRU -08DL8	
NAS1674-08L2	PLT130-5-2
THRU -08L8	THRU -5-8

**Table 6-17. Permanent Fasteners
(CONT)**

Part No.	Equivalent Part No.
NAS1674-3DL3	PLT130-6-3
THRU -3DL7	THRU -6-7
NAS1674-3L3	PLT130-6-3
THRU -3L7	THRU -6-7
NAS1674-4DL4	PLT130-8-4
NAS1674-4L4	PLT130-8-4
TAPERED SHANK BLIND FASTENER	
ST3M771-6-5	VA207SA6-5
THRU -6-18	THRU SA6-8
ST3M771-6-10	VA207SA6-10
THRU -6-11	THRU SA6-11
ST3M771-8-8	VA207SA8-8
THRU -8-9	THRU SA8-9
ST3M771-10-14	VA207SA10-14
THRU -10-16	THRU SA10-16
ST3M771-10-18	VA207SA10-18
LOCKBOLT PIN	
NAS2005V02	
THRU V11	
NAS2006V05	
NAS2006V06	
NAS2008V07	
NAS2106V06	
NAS2106V07	
NAS2406V02	
THRU V08	
NAS2408V04	
THRU V08	
NAS2506V04	
NAS2506V07	
NAS2508V06	
THRU V08	
NAS2605V01	
THRU V04	
NAS2605V11	
NAS2606V01	
THRU V13	
NAS2606V2	
THRU V9	
NAS2608V03	
THRU V09	
THRU V8	
NAS2610V06	
NAS2705V02	

**Table 6-17. Permanent Fasteners
(CONT)**

Part No.	Equivalent Part No.
THRU V09	
NAS2706V02	
THRU V09	
THRU V11	
NAS2708V03	
THRU V05	
NAS2708V07	
THRU V09	
NAS2708V11	
NAS2710V11	
ST3M427C4-2	SLS100CTEU4-2
THRU C4-8	THRU EU4-8
ST3M427C4-10	SLS100CTEU4-10
ST3M427C4-16	SLS100CTEU4-16
ST3M427C4-20	SLS100CTEU4-20
ST3M427C5-4	SLS100CTEU5-4
ST3M427C5-5	SLS100CTEU5-5
ST3M427C6-4	SLS100CTEU6-3
THRU C6-6	THRU EU6-9
ST3M428C4-2	SLSPCTEU4-2
THRU C4-7	THRU EU4-7
ST3M428C4-9	SLSPCTEU4-9
ST3M428C4-10	SLSPCTEU4-10
ST3M428C5-2	SLSPCTEU5-2
THRU C5-8	THRU EU5-8
ST3M428C5-17	SLSPCTEU5-17
ST3M428C5-28	SLSPCTEU5-28
ST3M428C5-32	SLSPCTEU5-32
ST3M428C6-3	SLSPCTEU6-3
THRU C6-7	THRU EU6-7
ST3M428C8-6	SLSPCTEU8-6
ST3M428C8-8	SLSPCTEU8-8
ST3M509-5-3	2705MU3
THRU -5-8	THRU MU8
ST3M509-5-10	2705MU10
ST3M509-6-3	2706MU3
THRU -6-9	THRU MU9
ST3M509-8-6	2708MU6
THRU -6-10	THRU MU10
ST3M509-10-10	2710MU10
ST3M509-10-13	2710MU13
ST3M512-5-2	2605MU2
THRU -5-6	THRU MU6
ST3M512-6-2	2606MU2
THRU -6-8	THRU MU8
ST3M512-6-11	2606MU11
ST3M512-6-12	2606MU12
ST3M512-6-16	2606MU16
THRU 6-18	THRU MU18

**Table 6-17. Permanent Fasteners
(CONT)**

Part No.	Equivalent Part No.
ST3M512-8-4	2608MU4
THRU -8-8	THRU MU8
ST3M512-8-10	2608MU10
THRU -8-12	THRU MU12
LOCKBOLT COLLARS	
NAS1080AG04	2DC2AC4
THRU AG06	THRU 6
NAS1080AT05	DC-C4
NAS1080C04	6LC-C8
NAS1080C08	DC-2R4
NAS1080E04	2DC-EU4
SOLID RIVETS	
MS20426AD3-2	
MS20426AD3-2D	
MS20426AD3-4	
MS20426AD3-4D	
MS20426B4	
MS20426B6-5	
MS20426B8-10	
MS20426E4	
MS20426E5-7	
THRU 5-8	
MS20470AD3	
MS20470AD3-6D	
MS20470AD3-16D	
MS20470AD4-5	
MS20470AD4-5D	
MS20470AD5-6	
THRU AD5-8	
MS20470AD5-6D	
MS20470B4-5A	
MS20470B5-7A	
MS20470B5-8A	
MS20470E3-4A	
MS20470E3-5A	
MS20470E3-6A	
MS20470E3-8A	
MS20470E4-5A	
MS20470E4-6A	
MS20470E5-5A	
MS20470E6-6A	
MS20470E6-8A	
THRU E6-16A	

**Table 6-17. Permanent Fasteners
(CONT)**

Part No.	Equivalent Part No.
MS20470T4-3	
THRU T4-8	
MS20470T5-4	
THRU T5-11	
MS20470T5-12	
MS20470T5-14	
MS20470T5-16	
MS20470T6-4	
THRU T6-10	
MS20470T6-8	
MS20615-3M5	
THRU -3M6	
MS20615-4M2	
THRU -4M6	
NAS1097AD4-7	
NAS1097AD5-7	
NAS1097KE3-5A	
NAS1097KE4-4A	
NAS1097KE4-7A	
THRU KE4-10A	
NAS1097KE4-12A	
NAS1097KE5-4A	
NAS1097KE5-5A	
NAS1097KE6-8A	
NAS1097KE6-16A	
NAS1097U4-3	
THRU U4-9	
NAS1097U4-10	
NAS1097U5-4	
THRU U5-10	
NAS1097U5-17	
NAS1097U6-6	
THRU U6-10	
NAS1097U6-12	
NAS1198-3-3	
THRU -3-6	
NAS1198-4-3	
THRU -4-8	
NAS1198-5-2	
THRU -5-8	
NAS1198-6-6	
THRU 6-9	
NAS1198-6-7	
NAS1199-3-3	
THRU 3-4	
NAS1199-3-6	
NAS1200-3-3	
THRU -3-9	
NAS1200-3-10	

**Table 6-17. Permanent Fasteners
(CONT)**

Part No.	Equivalent Part No.
NAS1200-3-11	
NAS1200-4-3	
THRU -4-13	
NAS1200-5-3	
NAS1200-5-5	
THRU 5-11	
NAS1200-6-6	
THRU 6-8	
NAS1200M3-3	
THRU M3-9	
NAS1200M4-3	
THRU M4-5	
NAS1200M4-7	
THRU 4-10	
NAS1200M5-2	
NAS1200M5-4	
THRU 5-6	
NAS1200M6-5	
NAS1200M6-12	
3M268AD3-5	
3M268AD3-6	
3M268AD4-5	
3M268AD4-6	
3M268AD5-5	
3M268B4-8	
TAPER-LOK PIN	
NAS1724D4-5E	TLD100-4-5E
NAS1724D5-6E	TLD100-5-6E
NAS1724D5-8E	TLD100-5-8E
THRU 5-16E	TLD100-5-16E
NAS1724D6-8E	TLD100-6-8E
THRU D6-11E	THRU -6-11E
NAS1724V05-5E	
NAS1724V05-7E	
NAS1724V3-3E	TLV100-3-3E
THRU V3-14E	THRU -3-14E
NAS1724V3-16E	TLV100-3-16E
NAS1724V4-4E	TLV100-4-4E
THRU V4-17E	THRU -4-17E
NAS1728D3-7E	TLD200-3-7E
NAS1728D3-3E	TLD200-3-3E
NAS1728D3-6E	TLD200-3-6E
THRU 3-E16	TLD200-3-16E
NAS1728D4-4E	TLD200-4-4E
NAS1728D4-6E	TLD200-4-6E
THRU 5-12E	TLD200-5-12E

**Table 6-17. Permanent Fasteners
(CONT)**

Part No.	Equivalent Part No.
NAS1728D5-6E	TLD200-5-6E
THRU 5-9E	THRU -5-9E
NAS1728D5-7E	TLD200-5-7E
NAS1728D5-10E	TLD200-5-10E
NAS1728D5-14E	TLD200-5-14E
NAS1728D5-15E	TLD200-5-15E
NAS1728D5-18E	TLD200-5-18E
NAS1728D6-10E	TLD200-6-10E
NAS1728V3-3E	TLV200-3-3E
THRU V3-6E	THRU -3-6E
NAS1728V4-5E	TLV200-4-5E
NAS1728V4-7E	TLV200-4-7E
NAS1728V5-4E	TLV200-5-4E
NAS1728V5-6E	TLV200-5-6E
ST3M429C3-6D1	TLC300L3-6E
ST3M765C5-8E	TLC879-5-8E
THRU C5-18E	THRU -5-18E
TAPER-LOK PIN, INJECTION	
3M486C5-6-16	TLD936-5-6E16
3M486C5-7-16	TLD936-5-7E16
3M486C5-8-16	TLD936-5-8E16
3M486C5-9-16	TLD936-5-9E16
3M486C5-10-16	TLD936-5-10E16
3M486C5-11-16	TLD936-5-11E16
3M486C5-11-27	TLD936-5-11E27
ST3M530C7-11-51	TLD939-7-11E51
ST3M530C7-12-51	TLD939-7-12E51
ST3M530C7-13-51	TLD939-7-13E51
TAPER-LOK WASHER	
ST3M469C05MA	TLN1023CD3L-05W
ST3M469C3MA	TLN1023CD3L-3W
THRU C7MA	THRU CD3L-7W
TAPER-LOK NUT	
ST3M468C3M	TLN1023CD3-3N
THRU C7M	THRU CD3-7N
TAPER-LOK NUT ASSEMBLY	
ST3M426C3M	TLN1002CD3-3
ST3M426C4M	TLN1002CD3-4
ST3M426C5M	TLN1002CD3-5

Table 6-18. Miscellaneous Fasteners

Part No.	Equivalent Part No.
AIRLOC STUD	
ST3M472F5()	112030-()
ST3M472R5A090M	112031-090
ST3M472R5A120E	112031-120
ST3M472R5A120M	112031-120
ST3M472R5A130E	112031-130
ST3M472R5A130M	112031-130
9M150F5-4-360	98265-4-360
THRU -4-450	THRU -4-450
9M150F5-5-460	98265-5-460
THRU -5-500	THRU -5-500
AIRLOC RECEPTACLE	
9M152-5P130	99833P130
9M152F5P130	99947P130
AIRLOC CROSS PIN	
9M160-5	99836
9M160C5	294185
AIRLOC SPACER	
9M168-012	
CHOBERT RIVET	
ST3M667-0306	1415-0306
ST3M667-0308	1415-0308
ST3M667-0310	1415-0310
ST3M667-0312	1415-0312
ST3M667-0314	1415-0314
ST3M806-3-1	RV1240-3-1
ST3M806-3-4	RV1240-3-4
ST3M793-A3-3	RV1241-A3-3
THRU-A3-6	THRU -A3-6
ST3M806A3-1	RV1240-3-1
ST3M806A3-4	RV1240-3-4
3M949-3-1	CCR264CS-3-1
3M949-3-2	CCR264CS-3-2
3M949-3-3	CCR264CS-3-3
3M949-3-4	CCR264CS-3-4
3M949-3-5	CCR264CS-3-5
3M949-3-6	CCR264CS-3-6
3M949-3-8	CCR264CS-3-8
3M949-3-10	CCR264CS-3-10

**Table 6-18. Miscellaneous Fasteners
(CONT)**

Part No.	Equivalent Part No.
3M949-4-4	CCR264CS-4-4
3M949-4-5	CCR264CS-4-5
3M949-4-6	CCR264CS-4-6
3M949-4-7	CCR264CS-4-7
	DZUS FASTENER STUD
9M161-1-38B	DMZ1400-6A1
9M161-1-44B	DMZ1400-6C3
9M161-2-44B	DMZ1400-6A3
	DZUS FASTENER RECEPTACLE ANGLE STRIP
9M162	PR3-1/2
	DZUS FASTENER RECEPTACLE ANGLE, SINGLE HOLE
9M164-1	PRB3-1/2
	DZUS FASTENER RECEPTACLE EDGE SINGLE
9M165-1	PRC3-1/2

Table 6-19. Miscellaneous Spacers and Washers (CONT)

Part No.	Equivalent Part No.
NAS1057T3-157	
NAS1057T3-161	
NAS1057T3-182	
NAS1057T3-207	
NAS1057T3-211	
NAS1057T5-064	
NAS1057T5-079	
NAS1057T5-119	
NAS1057T10-058	
NAS1057T12-095	
NAS1057W3-023	
NAS42DD-6FC	
NAS42DD3-6	
NAS42DD3-8	
NAS42DD3-8FC	
NAS42DD3-12	
NAS42DD3-12FC	
NAS42DD3-16	
NAS42DD3-24	
NAS42DD3-42	
NAS42DD3-42FC	
NAS42DD3-48	
NAS42DD3-58	
NAS42DD3-58FC	
NAS42DD3-60	
NAS42DD4-7	
NAS42DD4-7FC	
NAS42DD4-8	
NAS42DD4-8FC	
NAS42DD4-42	
NAS42DD4-42FC	
NAS42DD4-58	
NAS42DD4-58FC	
NAS42DD5-10	
NAS42DD5-42	
NAS42DD5-42FC	
NAS42DD6-3	
NAS42DD6-3FC	
NAS42DD6-4	
NAS42DD6-4FC	
NAS42DD6-6	
THRU DD6-8	
NAS42DD6-6FC	
THRU -8FC	
NAS42DD6-10	
THRU DD6-26	
NAS42DD6-10FC	
THRU -14FC	
NAS42DD6-16FC	

Table 6-19. Miscellaneous Spacers and Washers

Part No.	Equivalent Part No.
	SPACERS
NAS1056E6-020	
NAS1057T3-011	
NAS1057T3-019	
NAS1097T3-025	
NAS1097T3-034	
NAS1057T3-035	
NAS1057T3-046	
NAS1057T3-050	
NAS1057T3-063	
NAS1057T3-075	
NAS1057T3-100	
NAS1057T3-113	
NAS1057T3-132	
NAS1057T3-140	
NAS1057T3-155	

CSTO SR1F-15SA-3-1
Table 6-19. Miscellaneous Spacers and Washers (CONT)

Part No.	Equivalent Part No.
THRU -22FC	
NAS42DD6-24FC	
THRU -26FC	
NAS42DD6-28	
THRU DD6-36	
NAS42DD6-28FC	
THRU -36FC	
NAS42DD6-39	
THRU DD6-44	
NAS42DD6-40FC	
THRU -44FC	
NAS42DD6-47	
NAS42DD6-48	
NAS42DD6-48FC	
NAS42DD6-50	
NAS42DD6-50FC	
NAS42DD6-53	
NAS42DD6-53FC	
NAS42DD6-56	
NAS42DD6-56FC	
NAS42DD6-64	
NAS42DD6-64FC	
NAS42DD6-68	
NAS42DD6-72	
NAS42DD8-20	
NAS42DD8-20FC	
NAS42DD8-30	
NAS42DD8-30FC	
NAS43DD3-4	
NAS43DD3-4FC	
NAS43DD3-6FC	
NAS43DD3-8FC	
NAS43DD3-10	
THRU DD3-18	
NAS43DD3-10FC	
NAS43DD3-12FC	
NAS43DD3-14FC	
THRU -18FC	
NAS43DD3-22	
THRU DD3-36	
NAS43DD3-38	
NAS43DD3-36FC	
NAS43DD3-40	
THRU DD3-44	
NAS43DD3-40FC	
NAS43DD3-42FC	
NAS43DD3-44FC	
NAS43DD3-45FC	
NAS43DD3-46FC	

Table 6-19. Miscellaneous Spacers and Washers (CONT)

Part No.	Equivalent Part No.
NAS43DD3-48	
NAS43DD3-48FC	
NAS43DD3-52	
NAS43DD3-52FC	
NAS43DD3-54FC	
NAS43DD3-56FC	
THRU DD3-61	
NAS43DD3-64	
NAS43DD3-64FC	
THRU DD3-65FC	
NAS43DD3-72	
NAS43DD3-82	
NAS43DD3-92	
NAS43DD3-92FC	
NAS43DD3-96	
NAS43DD3-96FC	
NAS43DD3-259	
NAS43DD3-259FC	
NAS43DD3-265	
NAS43DD3-265FC	
NAS43DD3-287	
NAS43DD3-298FC	
NAS43DD3-14A	
NAS43DD4-5	
THRU DD4-7	
NAS43DD4-11FC	
THRU DD4-12FC	
NAS43 DD4-16	
NAS43DD4-16FC	
NAS43DD4-18	
THRU DD-21	
NAS43DD4-20FC	
THRU -21FC	
NAS43DD4-31	
THRU DD4-32	
NAS43DD4-31FC	
THRU -32FC	
NAS43DD4-40	
NAS43DD4-40FC	
NAS43DD4-45	
NAS43DD4-48FC	
NAS43DD4-64	
NAS43DD4-64FC	
NAS43DD4-68	
NAS43DD4-68FC	
NAS43DD4-85	
NAS43DD4-85FC	
NAS43DD4-87	
NAS43DD4-87FC	

Table 6-19. Miscellaneous Spacers and Washers (CONT)

Part No.	Equivalent Part No.
NAS43DD4-88	
NAS43DD4-98	
NAS43DD4-98FC	
NAS43DD4-120	
NAS43DD4-120FC	
NAS43DD4-166	
NAS43DD4-166FC	
NAS43DD4-168	
NAS43DD4-168FC	
NAS43DD4-171	
NAS43DD4-171FC	
NAS43DD4-173	
NAS43DD4-173FC	
NAS43DD4-204	
NAS43DD4-204FC	
NAS43DD5-110	
NAS43DD5-110FC	
NAS43HT3-23	
4M72-3-15	WSI-10-15
4M72-3-20	WSI-10-20
4M72-3-25	WSI-10-25
4M72-3-30	WSI-10-30
4M72-3-35	WSI-10-35
4M72-3-40	WSI-10-40
4M72-3-45	WSI-10-45
4M72-3-50	WSI-10-50
4M72-3-55	WSI-10-55
4M72-3-60	WSI-10-60
4M72-3-70	WSI-10-70
4M72-3-75	WSI-10-75
4M72-3-80	WSI-10-80
4M72-3-85	WSI-10-85
4M72-3-90	WSI-10-90
4M72-3-100	WSI-10-100
4M72-3-115	WSI-10-115
4M72-3-120	WSI-10-120
4M72-3-125	WSI-10-125
4M72-3-150	WSI-10-150
4M72-4-25	WSI-11-25
4M72-4-30	WSI-11-30
4M72-4-35	WSI-11-35
4M72-4-50	WSI-11-50
WASHERS	
AN960C10	
AN960C10L	
AN960C416	NAS1149C0463R
AN960C416L	

Table 6-19. Miscellaneous Spacers and Washers (CONT)

Part No.	Equivalent Part No.
AN960JD4L	
AN960JD6L	
AN960JD8L	
AN960JD10	
AN960JD10L	
AN960JD10LL	
AN960JD416	
AN960JD416L	
AN960JD516	
AN960JD516L	
AN960JD616	
AN960JD616L	
AN960JD716	
AN960JD716L	
AN960JD816	
AN960JD816L	
AN960JD916	
AN960JD916L	
AN960JD1016	
AN960JD1216	
AN960JD1216L	
AN960JD1416	
AN960JD1416L	
AN960JD1616	
AN960JD1616L	
MS20002-4	
THRU -7	
MS20002-12	
MS20002C4	
THRU C7	
MS20002C12	
MS27111-3	
THRU -5	
MS27111-7	
MS35338-40	
THRU -44	
MS35338-101	
MS35338-135	
THRU -141	
NAS1149C0332R	
NAS1149C0363R	
NAS1149C0432R	
NAS1149C0463R	
NAS1149D0363J	
NAS1149D0416J	
NAS1149D0463J	
NAS1149D0516J	
NAS1149D0563J	
NAS1149D0616J	

Table 6-19. Miscellaneous Spacers and Washers (CONT)

Part No.	Equivalent Part No.
NAS1149D0663J	
NAS1149D0716J	
NAS1149D0763J	
NAS1149D0816J	
NAS1149D0863J	
NAS1149D0916J	
NAS1149D0963J	
NAS1149D1063J	
NAS1149D1216J	
NAS1149D1290J	
NAS1149D1416J	
NAS1149D1490J	
NAS1149D1616J	
NAS1149D1690J	
NAS1149DN416J	
NAS1149DN616J	
NAS1149DN816J	
NAS1169C8L	
NAS1197-8	
NAS1401-4D3	
NAS1515H3	
NAS1515H4	
NAS1587-3	
THRU -10	
NAS1587-4C	
THRU -10C	
NAS1587-12C	
NAS1587-16C	
NAS1587-3L	
THRU -6L	
NAS1587-8L	
NAS1587A3C	
NAS620-2	
NAS620-4L	
NAS620-6	
NAS620-6L	
NAS620-8L	
NAS620-10	
NAS620-416	
NAS620-416L	
NAS620A10	
NAS620A4L	
THRU A6L	
NAS620A8L	
NAS620A10L	
NAS620C4	
THRU C6	
NAS620C8	
NAS620C10	

Table 6-19. Miscellaneous Spacers and Washers (CONT)

Part No.	Equivalent Part No.
NAS620C4L	
THRU C5L	
NAS620C416L	
ST4M146-5V	
THRU -6V	
ST4M146-8	
ST4M146-10	
ST4M146-12	
4M113PC6D	
4M116-03011	
4M25-3 THRU -5	
4M25-3L	
THRU -4L	
4M27-3 THRU -5	
4M36-01004	
4M36-01006	
4M36-01012	
THRU -01013	
4M36-01015	
THRU -01016	
4M36-01028	
THRU -01031	
4M36-01033	
4M36-01035	
THRU-01037	
4M36-01042	
THRU -01044	
4M36-01046	
4M36-01049	
THRU -01050	
4M36-01053	
4M36-01057	
4M36-01060	
4M36-01062	
4M36-01066L	
THRU -01067L	
4M36-01086	
4M36-02001	
4M36-02003	
THRU -02004	
4M36-02008	
4M36-02010	
4M36-02014	
4M36-02018	
4M36-02023	
4M36-02033	
4M36-02034	
4M36-02043	
4M36-02050L	

Table 6-19. Miscellaneous Spacers and Washers (CONT)

Part No.	Equivalent Part No.
4M36-02053	
4M36-02066	
THRU -02067	
4M36-02071	
4M36-02074	
4M36-02077	
4M36-02079	
4M36-02082	
THRU -02087	
4M36-02089	
4M36-02090	
4M36-02093	
4M36-02050L	
4M36-02083L	
4M36-02087L	
4M36-02133	
4M36-02134	
4M36-03003	
4M36-03009	
4M36-03021	
4M36-03025	
4M36-03036	
4M36-03050	
4M36-03052	
THRU -03055	
4M36-04003	
4M36-04023	
4M36-05019	
4M36-05028	
4M36-05032	
THRU -05033	
4M36-06007	
4M36-06022	
4M36-07015	
4M36-10014	
4M36-10018	
4M38A4	
4M38A10	
4M38A10L	
4M38C8	
4M38C816L	
4M38C10	
4M38C416	
4M38C616	
4M38C1216	
4M38C10L	
4M38C716L	
4M38C816L	
4M64-1	3502-18-07- 0543DG

Table 6-19. Miscellaneous Spacers and Washers (CONT)

Part No.	Equivalent Part No.
4M64C1	3502-18-36-4102
4M64CR1	
4M64C2	3502-10-78-4102
4M65-01004	
4M65-01008	
4M65-02008	
4M65-02011	
4M65-02014	
4M65-03007	
4M65-05007	
4M65-06003	
4M65-06005	
4M65-06006	
4M65-10000	
4M65-10006	
4M65-10007	
4M65-12002	
4M65-17002	
4M79-3	CL3KFW

Table 6-20. Plate Nut Shims

Part No.	Equivalent Part No.
ONE LUG	
NAS463YC10	
NAS463YC10H	
NAS463YC416	
NAS463YC416H	
NAS463YC416M	
NAS463YC516	
NAS463YC516H	
NAS463YD10	
NAS463YD10H	
NAS463YD10M	
NAS463YDD10	
NAS463YDD10H	
NAS463YDD10L	
NAS463YDD10M	
NAS463YDD416	
NAS463YDD416H	
NAS463YDD416M	
NAS463YDD516	
NAS463YDD516H	
NAS463YKD10H	
NAS463YKDD10	
NAS463YKDD10H	
4M30B416-064	

Table 6-20. Plate Nut Shims (CONT)

Part No.	Equivalent Part No.
4M30B416-125	
	TWO LUGS
NAS463XC10	
NAS463XC10M	
NAS463XC416	
NAS463XC416H	
NAS463XC416L	
NAS463XC416M	
NAS463XC516	
NAS463XC516H	
NAS463XC516L	
NAS463XC516M	
NAS463XC616	
NAS463XC616H	
NAS463XD10	
NAS463XD10H	
NAS463XD10L	
NAS463XD10M	
NAS463XD416	
NAS463XD416H	
NAS463XD416L	
NAS463XD416M	
NAS463XDD10	
NAS463XDD10H	
NAS463XDD10L	
NAS463XDD10M	
NAS463XDD416	
NAS463XDD416H	
NAS463XDD416L	
NAS463XDD416M	
NAS463XKC10	
NAS463XKD10	
NAS463XKD10H	
NAS463XKD10M	
NAS463XKDD10	
NAS463XKDD10H	
NAS463XKDD10M	
4M30D10-125	
4M30D10C125	
4M30D10CP125	
4M30D416-125	
4M30D416C125	
4M30D416CP125	
4M30D516-125	
4M30D816C064	

Table 6-20. Plate Nut Shims (CONT)

Part No.	Equivalent Part No.
	CORNER
NAS463FD10	
NAS463FD10M	
NAS463FDD10	
NAS463FDD10H	
NAS463FDD10L	
NAS463FDD10M	
NAS463FDD10MG	
4M30C10-032	
4M30C10-064	
4M30C10-125	
4M30C416-032	
4M30C416-064	

Table 6-21. Gang Channel Spacers

Part No.	Equivalent Part No.
4M49A3CM7-2	
4MA3CM7P2	
4M49A3CM14-3	
4M49A3CM14P3	
4M49A3CM18-3	
4M49A3CM18P3	
4M49A3CT7-4	
4M49A3CT7P4	
4M49A3CT7-11	
4M49A3CT8-11	
4M49A3CT10-5	
4M49A3CT10P5	
4M49A3CT11-3	
4M49A3CT11P3	
4M49A3D6P2	
THRU D6P5	
4M49A3D6P8	
THRU D6P9	
4M49A3D7-3	
4M49A3D7-4	
4M49A3D7P2	
THRU D7P6	
4M49A3D7P9	
4M49A3D8-3	
4M49A3D8P3	
4M49A3D8P4	
THRU D8P5	
4M49A3D8-7	
4M49A3D8P7	

**Table 6-21. Gang Channel Spacers
(CONT)**

Part No.	Equivalent Part No.
4M49A3D8P18	
4M49A3D9-4	
4M49A3D9P2	
THRU D9P4	
4M49A3D9P6	
4M49A3D10P2	
4M49A3D10P5	
4M49A3D11P3	
4M49A3D11P5	
4M49A3D11P7	
4M49A3DL6-3	
THRU DL6-5	
4M49A3DL6P3	
THRU DL6P5	
4M49A3DL6-7	
THRU DL6-8	
4M49A3DL6P7	
THRU DL6P8	
4M49A3DL3P3	
THRU DL3P5	
4M49A3DL6-10	
4M49A3DL7-4	
4M49A3DL7P4	
4M49A3DL7-9	
THRU DL7-12	
4M49A3DL7P7	
THRU DL7P9	
4M49A3DL8-3	
THRU DL8-9	
4M49A3DL8P3	
THRU DL8P9	
4M49A3DL9-4	
THRU DL9-5	
4M49A3DL9P3	
THRU DL9P6	
4M49A3DL10-3	
THRU DL10-4	
4M49A3DL10P4	
THRU DL10P7	
4M49A3DL10-7	
4M49A3DL12-2	
THRU DL12-4	
4M49A3ADL12P2	
THRU DL12P4	
4M49A3DL12-8	
4M49A3DL12P8	
4M49A3DL14P3	
4M49A3DM6-3	
THRU DM6-8	

**Table 6-21. Gang Channel Spacers
(CONT)**

Part No.	Equivalent Part No.
4M49A3DM6P3	
THRU DM6P8	
4M49A3DM6-19	
4M49A3DM7-3	
THRU DM7-7	
4M49A3DM7P3	
THRU DM7P6	
4M49A3DM7-13	
4M49A3DM8-3	
THRU DM8-5	
4M49A3DM8-8	
THRU DM8-9	
4M49A3DM8P8	
THRU DM8P9	
4M49A3DM9-2	
THRU DM9-5	
4M49A3DM9P2	
THRU DM9P5	
4M49A3DM10-3	
4M49A3DM10P3	
4M49A3DM10-7	
4M49A3DM11-4	
4M49A3DM11-13	
4M49A3DM12-2	
THRU DM12-4	
4M49A3DM12-16	
4M49A3DM12P16	
4M49A3DM14-3	
4M49A3DM14P3	
4M49A3DT6-7	
4M49A3DT7P3	
THRU DT7P4	
4M49A3DT8-2	
THRU DT8-5	
4M49A3DT8P2	
THRU DT8P5	
4M49A3DT9P3	
4M49A3DT9P4	
4M49A3DT9P6	
4M49A3DT9P12	
4M49A3DT11P3	
4M49A3DT11P5	
4M49A3DT12P7	
4M49A3DT12P9	
4M49A3DT12P10	
4M49A4D8-4	
4M49A4DL7-2	
4M49A4DL7P2	
4M49A4DL11-3	

**Table 6-21. Gang Channel Spacers
(CONT)**

Part No.	Equivalent Part No.
4M49A4DL11P3	
4M49A4DL8-2	
4M49A4DL8P2	
4M49A4DL8-4	
THRU L8-5	
4M49A4DL8P4	
THRU L8P5	
4M49A4DM8-2	
THRU DM8-5	
4M49A4DM8P2	
THRU M8P5	
4M49A4DM9-3	
4M49A3D6-2	
4M49A3D6P2	
4M49F3DL6-2	
4M49F3DL6P2	

**Table 6-21. Gang Channel Spacers
(CONT)**

Part No.	Equivalent Part No.
4M49F3DL8-2	
4M49F3DL10-2	
4M49F3DL12-2	
4M49F3DM6-2	
4M49F3DM7-2	
4M49F3DM8-2	
4M49F3DM8P2	
4M49F4CL9-2	
4M49F4CL9P2	
4M49F4D9-2	
4M49F4D9P2	
4M49F4D10P2	
4M49L3D8P10	
4M49-3DM6-7	
4M49-3DM6P7	

Table 6-22. Consumable Materials

Material	Specification No. or Manufacturer No.	Manufacturer or Vendor
Abrasive Cloth	ANSI B74.18 GRIT320 AL OX-IDE	2 ►
Abrasive Mat	A-A-58054 TY1CL1GRA (9X11)	1 ►
Abrasive Paper	ANSI B74.18, (Grit Numbers 60, 80, 120, 180, 240, 320, 400 or 600)	2 ►
Adhesive	3145 RTV GRAY	Dow Corning Corp. (71984)
Adhesive	A-A-3097 TY1CL2	1 ►
Adhesive	M46106-12AWY	1 ►
Adhesive	MMM-A-1617 TY3	1 ►
Adhesive	EC776	Minnesota Mining and Manufacturing Co. (04963)
Adhesive	EC847	Minnesota Mining and Manufacturing Co. (76381)
Adhesive	Epoxylite 203/C-301	Epoxylite Corp. (11147)
Adhesive	MMM-A-132 TY1CL3FMPGP4	Hysol Division, The Dexter Corp. (80244)
Adhesive	M46106-31CRY (or) M46106-11ATY	General Electric Co. (81349)
Adhesive	MMM-A-134 TY2 (or) EPON 828	Dow Corning Corp. (81349)
Adhesive	EA956	Hysol Division, The Dexter Corp. (54527)
Adhesive	M46146-11BWY	General Dynamics Co. (33564)
		Dow Corning Corp. (81349)

Table 6-22. Consumable Materials (CONT)

Material	Specification No. or Manufacturer No.	Manufacturer or Vendor
Adhesive	EA9321 A/B	Hysol Division, The Dexter Corp. (33564)
Adhesive	2216 B/A	Minnesota Mining and Manufacturing Co. (1A9T3)
Adhesive	3145 RTV Gray	General Electric Co. (71984)
Alcohol, Denatured	27 CFR21.35	
Alcohol, Isopropyl	TT-I-735 Grade B	
Aluminum, Powdered	MIL-DTL-512 TY2GRECL6	
Argon, Technical	MILA18455	
Bag, Plastic	GSA 8105-00-397-2823	
Barrier Material	MIL-B-121, Type 1, Grade A, Class 1	
Barrier, Material	PPP-B-1055 CLB-1 (3X300)	
Board, Insulation	ASTM C591	
Brush, Acid Swabbing	GSA 7920-00-514-2417	
Brush, Varnish, 1/4-inch, 1/2-inch, 3/4-inch or 2 inch	A-A-3192 TY1GRA	
Cap, Protective, for Hydraulic Connectors	NAS817N6	
Cartridge, Sealant	Numbers 220323, 250CP6, 250WP	PRC-DeSoto International Inc. (83574)
Cellophane Film	L-C-110, Type 1	E. I. DuPont de Nemours and Co. Inc. (18873)
Chromium Trioxide	A-A-55827A-1	
Cleaner, Metal	222559	American Art Clay Co. (01795) PRC-DeSoto International Inc. (83574)
Cleaning Compound	MIL-PRF-87937	
Cloth, Abrasive	ANSI B74.18 (AA1206 TY1)	
Cloth, Airplane	MIL-C-5646	
Cloth, Cheesecloth	CCC-C-440 TY1 CL1	
Cloth, Coated	MIL-C-22787	
Cloth, Dacron	D400	Mohawk Fabric Co. (57145)
Cloth, Flannel	A-A-50129	
Cloth, Satin	AMS-C-9084 TY3CL2	
Cloth, Plain Weave	AMS-C-9084 TY4CL2	
Cloth, Satin	AMS-C-9084 TY8CL2	
Cloth, Satin	AMS-C-9084 TY4CL3	
Cloth, Satin	AMS-C-9084 TY8CL3	
Cloth, Satin	AMS-C-9084 TY8CL4	
Cloth, Plain Weave	AMS-C-9084 TY4CL1	
Cloth, Nylon	Pattern 30	Putnam Mills Corp.
Cloth, Polishing	GSA 7920-00-205-1656	
Cloth, Cleaning	Rymplecloth-301-Purified	The Kendall Company (97327)
Cloths, Cleaning	GSA 7920-01-104-5406	
Coating Compound	ECC0C0AT909C	Emerson and Cuming Inc. (04552)
Coating Compound	MIL-C-8514	
Coating, Polyurethane	M85285-1-02Q-27038	DeSoto Inc. (96595)

Table 6-22. Consumable Materials (CONT)

Material	Specification No. or Manufacturer No.	Manufacturer or Vendor
Compound, Buffing	2B17	The LEA Mfg. Co. Buff. Div. (75554)   
Cover, Plastic	MS90376	
Polish, Plastic	P-P-560 TY1	
Compound, Sealing	ASTM D5363 TYAN0411, Low Viscosity TYAN0412, Medium Viscosity TYAN0421, High Viscosity	
Compound, Rubbing,	202	E. I. DuPont de Nemours and Co. (18873)
Compound, Rubbing,	606	E. I. DuPont de Nemours and Co. (18873) 
Cup, Paper	AA2577-1A3W1S06	Hercules, Inc. (70272)
Cumene Hydroperoxide	A	Shell Chemical Co. (86961)
Curing Agent	D	Shell Chemical Co. (86961)
Curing Agent	910-156	Desoto Inc. (96595)
Curing Solution	G-771	Anchor Chemical Co. (05975)  
Cutting Fluid	MIL-R-81294 TY3CL2A (1GAL)	 
Desealant, Fuel	A-A-59162 (1 PT)	Union Carbide Corp. (87578)
Diethylenetriamine, Technical	ZZL0872	Herculese Inc. (10396)  
Diethylamino Propylamine	Dicup R	Emerson and Cuming Inc. (04552)  
Dicumyl Peroxide	MIL-D-3464	Hexcel Corp. (91610) 
Desiccant Bags	TT-D-643 Type 2	Dexcel Corp. (91610)
Drier, Paint	ECCOSPHERES SI	United Merchants and Manufacturers Inc. (88088)
Insulating Compound	TTE751	United Merchants and Manufacturers Inc. (88088)
Ethyl Acetate	PREPREG7781-44F161	United Merchants and Manufacturers Inc. (88088)
Fabric, Epoxy, Pre-Preg	F141-67-1581	Narmco Inc. (04622)
Fabrix, Polyester, Pre-Preg	Style 1000	Connecticut Hard Rubber Co. (71643)
Cloth, Fiberglass	Style 3000	Connecticut Hard Rubber Co. (71643)
Cloth, Fiberglass	Style 7500	E.I. DuPont de Nemours and Co. (18873)
Adhesive	5208-3K135-8H	3M (76381) 
Fabric, Silicone Rubber Impregnated	CF 1406	Venus Esterbrook Corp. (32988)
Fabric, Teflon Coated	CHR-3TLL, Flouopeel No. 3	Owens-Corning Fiberglass Corp. (12760)
Fabric, Teflon Coated	Armalon TG-003	
Fairing Compound	EC1184ALUM Part A and B	
Fastener Tapes, Hook and Pile	A-A-55126 TY1CL1	
Felt Tips, Flow Master, 1/4-inch round	N10	
Fiberboard, Corrugated	ASTM-D4727	
Fiberglass, chopped fibers 1/4-inch lengths	405-BA-1/4IN	

Table 6-22. Consumable Materials (CONT)

Material	Specification No. or Manufacturer No.	Manufacturer or Vendor
Fibers, milled glass (glass floc)		Owens-Corning Fiberglass Corp. (45255)
Filler Rod	AMS5680 (or) MIL-R-5031 (Class 5)	3
Filler Wire, 36 inch cut, lengths to 0.930 inch diameter	MIL-R-5031, (Class 12, Hastelloy W) (or) W17-7PH CRES	1
Film Adhesive	FM400NA	American Cyanamid Corp. (07542)
Film, Nylon, 0.002 inch	Capron Type 512H or Type 80	Allied Chemical Co., Plastics Div. (14596)
Film, plastic	MYLAR Type A (0.005)	E. I. DuPont de Nemours and Co. (18873)
Plastic sheet	A-A-3174 TY1CL1GRBF1-0.004	2
Fluorocarbon Sponge Rubber Sheet 0.500 inch thick	RL20060	Raybestos & Manhattan Inc. Manhattan Rubber Division (90200)
Flux	MIL-F-7516	1
Foam, Polyurethane	MIL-F-81334 (or) 5052	1
Foam, filler	Solimide AC-550 2.2 Inches Thick	Avco System Division (22372)
Foam, filler	Solimide AC-550 4.0 Inches Thick	IMI-Tech Corp. (61969)
Gasket	Garlock Style 8748	IMI-Tech Corp. (61969)
Glass Flock (1/32-inch Milled Fibers)		Garlock Inc. (73680)
Glass Fiber Roving 30 End, Egg 150-880 Binder, -042 Treatments	38C-11	Owens Corning Fiberglass Co. (12760)
Glass Spun Roving	410-AA-450, type 30	Owens-Corning Fiberglass Co. (12760)
Gloves, Cotton, White	MIL-G-3866, TYPE 1, (S,M,L)	1
Curing Agent	9228	Furane Plastics (99384)
Helium Gas	BB-H-1168 GRADE A	Commercial
Honeycomb Core Phenolic, 3/16-inch Cell Size, GF13, 9 pounds per cubic foot		2
Hydrofluoric Acid 70 %	O-H-795	Commercial
Inhibitor, Adhesion	Mica Powder	Commercial
Insulation Blanket, light weight, Flexible Mini-K	Soap Stone	Johns-Manville Products Corp. (92798)
Iron oxide, Black	LWS8	Pfizer Inc. (82727)
Lacquer Thinner	1843	2
Lead Pig	A-A-857	2
Line, Nylon Monofilament 0.008 to 0.012 inch dia	QQ-L-171	1
Lubricant	MIL-N-18352	
	R24837-8-3	Parker-Hannifin (50599)

Table 6-22. Consumable Materials (CONT)

Material	Specification No. or Manufacturer No.	Manufacturer or Vendor
Lubricating Oil	M3150-02-PL-M	1 →
Catalyst (or)	Luperco ATC	Lucidol Division Penwalt Corp. (75675)
Benzoyl Peroxide Paste, 50 %		
Tricresyl Phosphate		
Ink	1448Black	Banner Rubber Stamp and Seal Co. (52625)
Ink	1448Silver	Banner Rubber Stamp and Seal Co. (52625)
Ink	1448White	Banner Rubber Stamp and SealCo. (52625)
Ink	GK-6646-R, Purple	Markem Machine Co. (38360)
Ink	No. F-100, Black	Organic Products Co. (01195)
Ink	No. F-100, Silver	Organic Products Co. (01195)
Ink	Master Marker, No. 127 1/2	Pannier Co. (96379)
Ink	Opaque Fast Drying	Botts Manufacturing Co. (83263)
Ink, Drawing	S-1141	Marking Devices Manufacturing Co. (26040)
Ink	Superior Spartan, Opaque, Black	Superior Marketing Co. (82672)
Ink	Superior Spartan, Opaque, White	Superior Marketing Co. (82672)
Ink	No. 73X, Opaque, Black	Independent Ink Co. (12744)
Crayon	16001	Sanford Corp. (86874)
Crayon	16002	Sanford Corp. (86874)
Pencil	No. 2125, Blue	Eberhard-Faber Inc. (73685)
Pencil	No. 2436, Red	Faber-Castell Inc. (80988)
Dye	AA59168-2	2 →
Dye	AA59168-3	2 →
Dye	Aerosol 603, Blue	Sprayon Products Co. (09800)
Dye	Dykem, Hi-Spot Blue No. 107	Dykem Co. (98148)
Masking Materials	Spacer Rings, Paper Die Cut, 3/8-inch OD, 3/16-inch ID, and 1/2-inch OD, 1/4-inch ID, 0.015 and 0.030 inch thick	McDonnel Douglas Corp. (76301)
	Disks, Paper, Die Cut, 3/4-inch Diameter, CMC-7500	McDonnell Douglas Corp. (76301)
Metal Cleaner	Deoxidine 624	Amchem Products Inc. (84063)
Metal Treatment	MIL-DTL-81706 CL3FM2MEB	2 →
Metaphenylenodiamine	CL	Allied Chemical Corp. Industrial Chemical Division (72658)
	ASTM D4701	1 →
Naphtha, Aromatic	TT-N-97 (Type I, Grade B)	2 →
Naphtha, Aliphatic	TTN95 TYPE 2	2 →
Nitric Acid, Technical	A-A-59105	2 →
Nitrogen	A-A-59503-2B1B	2 →
Nozzles, Sealant Gun	Numbers, 420, 430, 440, and 8643	PRC - DeSoto International Inc (83574)
Nylon, Peel Ply	51789	Burlington Industries (88730)

Table 6-22. Consumable Materials (CONT)

Material	Specification No. or Manufacturer No.	Manufacturer or Vendor
Oil, Automotive, Non-Detergent, SAE 10W or 20W	MIL-L-8383	1 →
Paint Remover, Epoxy	MIL-R-81294	1 →
Paint Remover (Stripper)	TT-R-248	2 →
Paper, Sandblast	Protex 20S	Mask-Off Co. (06929)
Parting Agent	VV-P-236 (Petrolatum)	2 →
	CRC Special Formula Soft Seal	Astronautics Corp. of America (10138)
Paste Wax	GSA 7930-00-281-3267	2 →
Plaster, Hydrocal	Hydrocal A-11 Hydrocal B-11	United States Gypsum Co. (61357)
Plug, Protective, for Electrical Connectors	MS90376	1 →
Plug, Protective, for Hydraulic Connectors	NAS818	1 →
Polyethylene, cushioning material	PPP-C-1752	2 →
Plastic Film, Mylar	MYLAR - TYPE A (142 Gage)	E. I. DuPont de Nemours and Co. (18873)
Pretreatment for Titanium	Turco 4367	Turco Products, Division Purex Corp. Ltd. (61102)
Primer	A-1272B	Goodrich, B. F., General Products Co. (11005)
Primer, Adhesive Sealant Tape	DC-1204-1GL 5601, 3/16-inch Dia, Black Bead	Dow Corning Corp. (71984) Schnee-Morehead Chemicals Corp (53309)
Sealing Compound	M23586-2-2-A-1	1 →
Primer, Adhesive	AMS-S-8802	Society of Automotive Engineers (81343)
Primer, Adhesive	AMS 3277 TY1 CLB-2	Society of Automotive Engineers (81343)
Primer, Adhesive	BR400	American Cyanamid Corp. (07542)
Primer, Rubber	RTV1201	Dow Corning Corp. (71984)
Primer, Adhesive	Bostik 1007	USM Chemical Co. Division of USM Corp. (70707)
Sealing Compound	ASTM D5363 TYAN0121	1 →
Primer, Adhesive	SS4120	General Electric Co. (01139)
Primer, Adhesive	DC1200	Dow Corning Corp. (71984)
Primer, Zinc Chromate	TTP1757-1CG-001G	1 →
Primer	ASTM D5363	American Society for Testing and Materials (81346)
Putty, Zinc Chromate	MIL-P RF8116	1 →
Regulator	Selectron 5923	PPG Industries (47695)
Resin	Araldite 508 or RP1710	Huntsman Advanced Materials (07566)
Filler Core	EPOCAST 1652 A/B	Furane Plastics (99384)
Adhesive	EA9309A/B	Hysol Division, The Dexter Corp. (33564)

Table 6-22. Consumable Materials (CONT)

Material	Specification No. or Manufacturer No.	Manufacturer or Vendor
Resin, Polyamide Adhesive	Verasmid 125 Epon 828	General Mills (11884) Shell Chemical Corp. (86961)
Plastic Molding Adhesive	MIL-R-9299, GRADE B Selectron 5016 8040-00-633-8373	Monsanto Chemical Co. (76541)
Resin, Silicone	DC-2106 CAT15 DC-7146 with Dicup R Catalyst	PPG Industries Inc. (47695)
Rubber Sheet (Gasket)	MIL-R-6855, Class II Grade 40	Dow Corning Corp. (71984)
1		
Tape, Rubber Based, Pressure Sensitive Cleaning Compound	5423 PF Shopmaster LPH	Minnesota Mining and Manufacturing Co. (26066) P-T Technologies Inc. (0JVH6) Buckeye International Inc. (0YG51)
Primer, Sealing Compound Release Agent	AMS-S-8802 CLB-1/2 03068 Partall Fil No. 10	Society of Automotive Engineers (81343) CRC Industries Inc. (023V4) Rexco Chemical Co. (17629)
Retaining Compound	ASTM D5363	American Society for Testing and Materials (81346)
Roving, Spun Glass	475-BA-450, Type 30	Owens-Corning Fiberglass Co. (02866)
2		
Rubber, Silicone Sanding Screen, Wet or Dry Fabricut Cleaning Compound	AA55759-037D5 No. 400 Turco 4316L	Minnesota Mining and Manufacturing Co. (04963) Turco Products Division Purex Corp. Ltd. (61102) McDonnell Aircraft Co. (76301) Inmont Corp. (77464)
Seal Strip, Bulb Caulking Compound Sealing Compound	9M7117 582 MIL-S-81733, Type 1-1/2, Type 2-1/2, -2, -4	1
Sealing Compound High Temperature Up to 425 degrees Fahrenheit	EC-1184ALUM	Minnesota Mining and Manufacturing Co. (04963)
Up to 600 degrees Fahrenheit Up to 2000 degrees Fahrenheit	PROSEAL714 EC-1137	Essex Chemical Co. (22360) Minnesota Mining and Manufacturing Co. (04963)
Sealing Compound	MIL-S-11030, Type 3	1
Sealing Compound	MIL-S-11030, Type 1	1
Sealing Compound	AMS-S-8802	Society of Automotive Engineers (81343)
Sealing Compound for Windshield, Canopy and Other Acrylic Assemblies, Seal Gun Application	PR-1725 B-1 or B-2	Products Research and Chemical Corp. (83574)
Sealing Compound, Polysulfide	MIL-S-83430	1

Table 6-22. Consumable Materials (CONT)

Material	Specification No. or Manufacturer No.	Manufacturer or Vendor
Sealing Compound	93-006-6 DC90-102 DC92-022 PR-1425 B-1/2 M46106-31CRY RTV88-DBT	Dow Corning Corp. (71984) Dow Corning Corp. (71984) Dow Corning Corp. (71984) Courtaulds Aerospace Inc. (83574)  1 Momentive Performance Materials Inc. (01139)
Sealing Compound Adhesive Rubber Compound	MIL-S-4383 MIL-S-85334	 
Sealing Compound Sealing Compound, Channel Groove	PR-1436G B1/2	Products Research and Chemical Corp. (83574)
Sealing Compound, Aluminum Pigmented	AMS 3277 TY1 CLA-1/2, AMS 3277 TY1 CLB-2	Products Research and Chemical Corp (83574)
Sealing Compound	PR-812	Product Research and Chemical Corp. (83574)
Sealing, Compound, Firewall	RTV133 3C-1900 M23053	Teledyne Coast Pro-Seal (83527) Churchill Chemical Corp. (04011) 
Sealing Compound Sealing Compound Sleeve Solvent	AA59281-1 ASTM D4080 TY2	 American Society for Testing and Materials (81346)
Metal Cleaning Trichloroethylene	MIL-T-27602 MIL-PRF-680 TY2	 
Trichloroethylene Solvent, Cleaning Compound Solvent, Wipe	DS-108F	Dynamold Inc. (30256)
Oxygen Propellant, Compatible Ethyl Acetate Isopropyl Alcohol Toluene, Technical Xylene	TTE751 TT-I-735, GRADE A TT-T-548 A-A-59107 GG-D-226 Type 1	    
Spatula, Wooden Tongue Depressors	STEPAN FOAM C-605 PPP-S-760 QQ-S-781 STYR0N0L0- 030X48X96FNSHPM 428C	Stepan Chemical (87570)  
Stepan foam Strapping, Nonmetallic Strapping, Steel Styrene, High Impact	435 8561 2 IN 1181 1/4 WIDE Everseal	Norton Co. Plastic Synthetics Div. Allied Resinous (34384) Minnesota Mining and Manufacturing Co. (04963)  3M (52152) 3M (20999)
Tape, Aluminum Foil Metal Tape, Antichafing Tape, Copper Foil Tape, Cork, Neoprene 0.032	or M6841	Everseal Products Co. (72279) Society of Automotive Engineers (81343)

Table 6-22. Consumable Materials (CONT)

Material	Specification No. or Manufacturer No.	Manufacturer or Vendor
Tape, Double Side	No. 415	Minnesota Mining and Manufacturing Co. (04963)
Tape, Fiberglass Cloth, Pressure Sensitive	361-2-000IN	Minnesota Mining and Manufacturing Co. (26066)
Tape, Masking	ASTM D6123 (1/4-inch, 1/2-inch, 3/4-inch, 1 inch, and 2 inch)	2
Tape, polypropylene foam, 1/16-inch thick	Minicel B-302	Minnesota Mining and Manufacturing Co. (04963)
Tape, Pressure Sensitive	5423	Minnesota Mining and Manufacturing Co. (26066)
Tape, Insulation, Pressure Sensitive	M15126	1
Tape, Insulation, Pressure Sensitive	MIL-I-19166	1
Tape, Polyurethane	Y8562	Minnesota Mining and Manufacturing Co. (04963)
Tape, Pressure Sensitive, Preservation and Sealing	MIL-T-22085, TY3	1
Tape, Pressure Sensitive, Mylar	850	Minnesota Mining and Manufacturing Co. (04963)
Tape, Insulation	P211	Permacel Tape Division Johnson and Johnson, Inc. (99742)
Tape, Sound Damping	4288	Minnesota Mining and Manufacturing Co. (04963)
Tape, Tedlar PVF Film, 200 Gage	Type 40TR, S.G. Grade	E. I. DuPont de Nemours and Co. (18873)
Tape, Transparent	473	Minnesota Mining and Manufacturing Co. (26066)
Tape, Vinyl Plastic	470	Minnesota Mining and Manufacturing Co. (26066)
Thread, Glass Fiber Yarn	E-18	Owens-Corning Fiberglass Corp. (45255)
Thread, Gray Cotton, 4 or 5 Ply Hard Finish	A-A-52094 TY2SZ12	2
Uralane Adhesive	5738-A/B	Furane Plastics (99384)
Wax, Paste		Simonize Co. (78304)
Wax, Stick	140	S. C. Johnson and Son Inc. (32204)
Webbing, Nylon	MIL-W-4088	1
Wheel, Buffing	GGG-W-301	2
Wire, Soft Copper	0.004 inch diameter, 2 % Plated	Montgomery Co. (76543)
Wool and Gauze, Metallic	GSA 5350-00-286-4851	American National Standards Institute (80204)

1 → Military specifications are established by Department of Defense standardization manual 4120 3-M (81349). To get an NSN from automated supply system, it may be required to omit dashes.

2 → Federal specifications are established by General Services Administration (81348). To get an NSN from automated supply system, it may be required to omit dashes.

Table 6-22. Consumable Materials (CONT)

Material	Specification No. or Manufacturer No.	Manufacturer or Vendor
3 ➔ Aerospace Material Specification, Society of Automotive Engineers, Inc. (81343).		

Table 6-23. Special Tools and Repair Kits

Tool Number	Nomenclature	Procurement Source
68D050071-1001	Repair Kit, Composite Material	McDonnell Aircraft Co. (76301)

REPAIR KIT 68D050071-1001 HAS THE BELOW:

68D050071-2025	Case	McDonnell Aircraft Co. (76301)
MDP601MD	Mounted Cylinder	Starlite Industries Inc. (97853)
CAD402MD	Drill, Carbide	Skydyne Inc. (74284)
CD301MD	Drill, Core	Starlite Industries Inc. (97853)
CD302MD	Drill, Core	Starlite Industries Inc. (97853)
CD303MD	Drill Core	Starlite Industries Inc. (97853)
CD304MD	Drill, Core	Starlite Industries Inc. (97853)
DR201MD120	Router	Starlite Industries Inc. (97853)
DR201MD40	Router	Starlite Industries Inc. (97853)
DR201MD80	Router	Starlite Industries Inc. (97853)
DR202MD60-80	Router	Starlite Industries Inc. (97853)
DR203MD60-80	Router	Starlite Industries Inc. (97853)
DS601MD	Dressing Stone	Starlite Industries Inc. (97853)
MW101MD120	Mounted Wheel	Starlite Industries Inc. (97853)
MW101MD40	Mounted Wheel	Starlite Industries Inc. (97853)
MW101MD80	Mounted Wheel	Starlite Industries Inc. (97853)
MW102MD120	Mounted Wheel	Starlite Industries Inc. (97853)
MW102MD40	Mounted Wheel	Starlite Industries Inc. (97853)
MW102MD80	Mounted Wheel	Starlite Industries Inc. (97853) (97853)
541052	Sanding Disc Holder	Standard Abrasives Inc. (26082)
522208	Sanding Disc	Standard Abrasives Inc. (26082)
522211	Sanding Disc	Standard Abrasives Inc. (26082)
522205	Sanding Disc	Standard Abrasives Inc. (26082)
68D050071-2017	Template	McDonnell Aircraft Co. (76301)
68D050071-2019	Template	McDonnell Aircraft Co. (76301)
68D050071-2021	Template	McDonnell Aircraft Co. (76301)
68D050071-2023	Template	McDonnell Aircraft Co. (76301)
D10005	Permaswage Fitting Installation and Repair Kit	Deutsch Metal Components Division (14798)

INSTALLATION AND REPAIR KIT IS MADE UP OF 3 SUBKITS D10030, D10031, AND D10032 AS LISTED BELOW:

D10030	Permaswage Fitting Tool Kit, Tube Size 1/4 and 3/8-inch	Deutsch Metal Components Division (14798)
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Table 6-23. Special Tools and Repair Kits (CONT)

Tool Number	Nomenclature	Procurement Source
D10001-52	Swaging Tool	
D10001-56-4	Die Block, 1/4-inch	
D10001-15-6	Die Block, 3/8-inch	
D9892-4	Inspection Gage, 1/4-inch	
D9892-6	Inspection gage, 3/8-inch	
D9872	Tube Cutter	
D9862-S	Marking Tool	
D9851-14	Deburring Tool	
D9851-13-04	Deburring Tool Stem, 1/4-inch	
D9851-13-06	Deburring Tool Stem, 3/8-inch	
D10031	Permaswage Fitting Tool Kit, Tube Size 1/2, 5/8, and 3/4-inch	Deutsch Metal Components Division (14798)
D10002-52	Swaging Tool	
D10002-56-8	Die Block, 1/2-inch	
D10002-56-10	Die Block, 5/8-inch	
D10002-56-12	Die Block, 3/4-inch	
D9892-8	Inspection Gage, 1/2-inch	
D9892-10	Inspection Gage, 5/8-inch	
D9892-12	Inspection Gage, 3/4-inch	
D9853	Tube Cutter, 1/2 and 5/8-inch	
D9852	Tube Cutter, 3/4-inch	
D9862-M	Marking Tool	
D9850	Deburring Tool	
D9850-13-08	Deburring Tool Stem, 1/2-inch	
D9850-13-10	Deburring Tool Stem, 5/8-inch	
D9850-13-12	Deburring Tool Stem, 3/4-inch	
D10032	Permaswage Fitting Tool Kit, Tube Size 1, 1-1/4, and 1-1/2-inch	Deutsch Metal Components Division (14798)
D10003-52	Swaging Tool	
D10003-56-16	Die Block, 1 inch	
D10003-56-20	Die Block, 1-1/4-inch	
D10003-56-24	Die Block, 1-1/2-inch	
D9892-16	Inspection Gage 1 inch	
D9892-20	Inspection Gage, 1-1/4-inch	
D9892-24	Inspection Gage, 1-1/2-inch	
D9852	Tube Cutter	
D9862-L	Marking Tool	
D9849	Deburring Tool	
D9849-16	Deburring Tool Stem, 1 inch	
 D9849-20	Deburring Tool Stem, 1-1/4-inch	
 D9849-21	Deburring Tool Stem, 1-1/4-inch	
D9849-24	Deburring Tool Stem, 1-1/2-inch	
R27500MD	Installation and Repair Kit, Dynatube Fitting	Parker-Hannifin Corp. (50599)
REPAIR KIT R27500MD IS MADE UP OF THE BELOW:		
R24827-1-06	Collar, 1/4 and 3/8-inch tubes	Parker-Hannifin Corp. (50599)
R24837-1-12	Collar, 1/2 and 3/4-inch tubes	Parker-Hannifin Corp. (50599)
R24837-1-16	Collar, 1 inch tubes	Parker-Hannifin Corp. (50599)

Table 6-23. Special Tools and Repair Kits (CONT)

Tool Number	Nomenclature	Procurement Source
R24837-1-20	Collar, 1-1/4-inch tubes	Parker-Hannifin Corp. (50599)
RF26826-2-04	Female Die Set, 1/4-inch tube	Parker-Hannifin Corp. (50599)
RF26826-2-06	Female Die Set, 3/8-inch tube	Parker-Hannifin Corp. (50599)
RF26826-2-08	Female Die Set, 1/2-inch tube	Parker-Hannifin Corp. (50599)
RF26826-2-10	Female Die Set, 5/8-inch tube	Parker-Hannifin Corp. (50599)
RF26826-2-12	Female Die Set, 3/4-inch tube	Parker-Hannifin Corp. (50599)
RF26826-2-16	Female Die Set, 1 inch tube	Parker-Hannifin Corp. (50599)
RF26826-2-20	Female Die Set, 1-1/4-inch tube	Parker-Hannifin Corp. (50599)
RM26862-2-04	Male Die Set, 1/4-inch tube	Parker-Hannifin Corp. (50599)
RM26862-2-06	Male Die Set, 3/8-inch tube	Parker-Hannifin Corp. (50599)
RM26862-2-08	Male Die Set, 1/2-inch tube	Parker-Hannifin Corp. (50599)
RM26862-2-10	Male Die Set, 5/8-inch tube	Parker-Hannifin Corp. (50599)
RM26862-2-12	Male Die Set, 3/4-inch tube	Parker-Hannifin Corp. (50599)
RM26862-2-16	Male Die Set, 1 inch tube	Parker-Hannifin Corp. (50599)
RM26862-2-20	Male Die Set, 1-1/4-inch tube	Parker-Hannifin Corp. (50599)
R5170MD-04016	Expander, 1/4-inch tube	Parker-Hannifin Corp. (50599)
R5170MD-06019	Expander, 3/8-inch tube	Parker-Hannifin Corp. (50599)
R5170MD-08026	Expander, 1/2-inch tube	Parker-Hannifin Corp. (50599)
R5170MD-10032	Expander, 5/8-inch tube	Parker-Hannifin Corp. (50599)
R5170MD-12039	Expander, 3/4-inch tube	Parker-Hannifin Corp. (50599)
R5170MD-16051	Expander, 1 inch tube	Parker-Hannifin Corp. (50599)
R5170MD-20065	Expander, 1-1/4-inch tube	Parker-Hannifin Corp. (50599)
68D300021-1001	Pressure Test Kit, Permaswage and Fittings	McDonnell Aircraft Co. (76301)

TEST KIT 68D300021-1001 IS MADE UP OF THE BELOW:

68D300021-2001	Case	Skydyne Inc. (74284)
68D301104-1001	Adapter	McDonnell Aircraft Co. (76301)
68D301104-1003	Adapter	McDonnell Aircraft Co. (76301)
68D301104-1005	Adapter	McDonnell Aircraft Co. (76301)
68D301104-1007	Adapter	McDonnell Aircraft Co. (76301)
6170-0374-028	Test Plug	Harrison Mfg. (08199)
6170-0376-019	Test Plug	Harrison Mfg. (08199)
6170-0378-019	Test Plug	Harrison Mfg. (08199)
6170-0378-028	Test Plug	Harrison Mfg. (08199)
6170-0382-028	Test Plug	Harrison Mfg. (08199)
6170-0498-028	Test Plug	Harrison Mfg. (08199)
6170-0503-026	Test Plug	Harrison Mfg. (08199)
6170-0503-028	Test Plug	Harrison Mfg. (08199)
6170-0508-028	Test Plug	Harrison Mfg. (08199)
6170-0623-035	Test Plug	Harrison Mfg. (08199)
6170-0628-032	Test Plug	Harrison Mfg. (08199)
6170-0628-035	Test Plug	Harrison Mfg. (08199)
6170-0633-035	Test Plug	Harrison Mfg. (08199)
6170-0748-035	Test Plug	Harrison Mfg. (08199)
6170-0753-035	Test Plug	Harrison Mfg. (08199)
6170-0754-039	Test Plug	Harrison Mfg. (08199)
6170-0758-035	Test Plug	Harrison Mfg. (08199)
R44117T-04 (ST7M235T4)	Cap	Parker-Hannifin Corp. (50599)

Table 6-23. Special Tools and Repair Kits (CONT)

Tool Number	Nomenclature	Procurement Source
R44117T-06 (ST7M235T6)	Cap	Parker-Hannifin Corp. (50599)
R44117T-08 (ST7M235T8)	Cap	Parker-Hannifin Corp. (50599)
R44117T-10 (ST7M235T10)	Cap	Parker-Hannifin Corp. (50599)
R44117T-12 (ST7M235T12)	Cap	Parker-Hannifin Corp. (50599)
R44150P04 (ST7M393P4)	Connector	Parker-Hannifin Corp. (50599)
R45150P0604 (ST7M238P0604)	Connector	Parker-Hannifin Corp. (50599)
R45150P0804 (ST7M238P0804)	Connector	Parker-Hannifin Corp. (50599)
R45150P1004 (ST7M238P1004)	Connector	Parker-Hannifin Corp. (50599)
R45150P1204 (ST7M238P1204)	Connector	Parker-Hannifin Corp. (50599)
R44151P04 (ST7M241P4)	Union	Parker-Hannifin Corp. (50599)
R44180P0604 (ST7M247P0604)	Reducer	Parker-Hannifin Corp. (50599)
R44180P0804 (ST7M247P0804)	Reducer	Parker-Hannifin Corp. (50599)
R44180P1004 (ST7M247P1004)	Reducer	Parker-Hannifin Corp. (50599)
R44180P1204 (ST7M247P1204)	Reducer	Parker-Hannifin Corp. (50599)
R44119P4 (ST7M250P4)	Plug	Parker-Hannifin Corp. (50599)
R44119P6 (ST7M250P6)	Plug	Parker-Hannifin Corp. (50599)
R44119P8 (ST7M250P8)	Plug	Parker-Hannifin Corp. (50599)
R44119P10 (ST7M250P10)	Plug	Parker-Hannifin Corp. (50599)
R44119P12 (ST7M250P12)	Plug	Parker-Hannifin Corp. (50599)

SPECIAL TOOLS USED IN CSTO SR1F-15SA-3-() SERIES PUBLICATIONS ARE MADE UP OF THE BELOW:

V134-1-012	Bit, Screwdriver, Modified per V134-1-012 from MIL-B-9946	3
V134-1-032	Router, Hand Held	McDonnell Aircraft Corp. (76301)
V134-1-033	Adapter, Bushing, Horizontal Stabilator	McDonnell Aircraft Corp. (76301)
V134-1-041	Motor, Portable Pneumatic Rt. Angle, 20,000 RPM	McDonnell Aircraft Corp. (76301)
V500 ACR-3-D	Gage, Vacuum, Dial Temperature Control Unit	Ametek/US Gauge Co. (61349) Briscoe Manufacturing Co. (90411)
SRE-219-6-25-115	Blanket, Aircraft Heating	Briscoe Manufacturing Co. (90411)
SR512007X07C	Blanket, Aircraft Heating	Briscoe Manufacturing Co. (90411)
4230-109	Blanket, Aircraft Heating	Briscoe Manufacturing Co. (90411)
4230-211	Blanket, Aircraft Heating	Briscoe Manufacturing Co. (90411)
RE168335003, Subassembly B Model 12, 0-8 inch	Tool, Spring Installation	McDonnell Aircraft Corp. (76301)
RE268117001-1, -2	Gage, Caliper	B. C. Ames Co. (03249)
RE868230001-1	Tool, Wing Tip Installation	McDonnell Aircraft Corp. (76301)
RE36824000-1	Repair Tool, Rudder Actuator Attach Holes	McDonnell Aircraft Corp. (76301)
FTI-F15-AMAD-1 AJA68A325334-5003TD	Kit, Rudder Actuator Hinge Fitting Installation	McDonnell Aircraft Corp. (76301)
	Kit, Cold Work	Fatigue Technology Inc. (51439)
	Repair Tool, Reaming Fixture	McDonnell Douglas Corp. (76301)

Table 6-23. Special Tools and Repair Kits (CONT)

Tool Number	Nomenclature	Procurement Source
<p>1 → Use for 0.049 inch wall thickness tubes.</p> <p>2 → Use for 0.065 inch wall thickness tubes.</p> <p>3 → Military specifications are established by Department of Defense standardization manual 4120 3-M (81349).</p>		

Table 6-24. Repair Fasteners, Lockbolts, Stump Type

Standard Fastener	1st Oversize (1/64 or as noted)	2nd Oversize (1/32 or as noted)
NAS2605V02 THRU V13	NAS2406V02 THRU V13	ST3M564V6-2 THRU V6-13
NAS2606V02 THRU V13	NAS2406V02A THRU V13A	ST3M564V6-1 THRU V2-13
NAS2608V03 THRU V08	NAS2408V03A THRU V08A	ST3M564V8-3 THRU V8-8
NAS2610V06	NAS2410V06A	ST3M564V10-6
NAS2705V02 THRU V-12	NAS2506V02 THRU V-12	ST3M563V6-2 THRU V6-12
NAS2705V18		
NAS2705V20		
NAS2706V02 THRU V11	NAS2506V02A THRU V11A	ST3M563V6-2 THRU V6-11
NAS2708V03 THRU V09	NAS2508V03A THRU V09A	ST3M563V8-3 THRU V8-9
NAS2708V11	NAS2508V11A	ST3M563V8-11
NAS2710V11	NAS2510V11A	ST3M563V10-11
ST3M427C4-2 THRU C4-8		ST3M427C5-2 THRU C5-8
ST3M427C4-10		ST3M427C5-10
ST3M427C4-16		ST3M427C5-16
ST3M427C4-20		ST3M427C5-20
ST3M427C5-4 THRU C5-5		ST3M427C6-4 THRU C6-5
ST3M427C6-4 THRU C6-6	ST3M495-3-4-1 THRU -3-6-1	ST3M506-3-4-1 THRU -3-6-1
ST3M427C6-11	ST3M495-3-11-1	ST3M506-3-11-1
ST3M428C4-2 THRU C4-7		ST3M428C5-2 THRU C5-7
ST3M428C4-10		ST3M428C5-10
ST3M428C43		
ST3M428C5-2 THRU C5-8		ST3M428C6-2 THRU C6-8
ST3M428C5-17		ST3M428C6-17
ST3M428C5-28		ST3M428C6-28
ST3M428C6-3 THRU C6-7	ST3M501-3-3 THRU -3-7	ST3M507-3-3 THRU -3-7
ST3M428C8-6	ST3M501-4-6	ST3M507-4-6
ST3M428C8-8	ST3M501-4-8	ST3M507-4-8
ST3M509-5-3 THRU -5-8		ST3M509-6-3 THRU -6-8
ST3M509-5-13 THRU -5-14		ST3M509-5-13 THRU -5-14
ST3M509-6-3 THRU -11	ST3M495-3-3-1 THRU -11	ST3M506-3-3 THRU -11
ST3M509-6-14		
ST3M509-8-4	ST3M495-4-4	ST3M506-4-4
ST3M509-8-8	ST3M495-4-8	ST3M506-4-8
ST3M509-8-10	ST3M495-4-10	ST3M506-4-10
ST3M509-8-13	ST3M495-4-13	ST3M506-4-13
ST3M512-5-2 THRU -5-9		ST3M512-6-2 THRU -6-9
ST3M512-6-2 THRU -6-8	ST3M501-3-2 THRU -3-6	ST3M507-3-2 THRU -3-8
ST3M512-6-11	ST3M501-3-11	ST3M507-3-11
ST3M512-8-4 THRU -8-9	ST3M501-4-4 THRU -4-9	ST3M507-4-4 THRU -4-9

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Table 6-24. Repair Fasteners, Lockbolts, Stump Type (CONT)

Standard Fastener	1st Oversize (1/64 or as noted)	2nd Oversize (1/32 or as noted)
ST3M512-8-10 THRU -8-12	ST3M501-4-10 THRU-8-12	ST3M507-4-5 THRU 4-5
ST3M512-8-17 THRU -18	-	-
ST3M861V05B()	-	-
ST3M861V06B()	ST3M495-3-()	ST3M506-3-()
3M1261C5A()	-	-
3M1261C6A()	ST3M495-3-()	ST3M506-3-()
3M1261C8A()	ST3M495-4-()	ST3M506-4-()

Table 6-25. Repair Fasteners, Lockbolts, Pull Type

Standard Fastener	1st Oversize (1/64 or as noted)	2nd Oversize (1/32 or as noted)
NAS2005V01 THRU V08		NAS2006V01A THRU V08A
NAS2006V03 THRU V07	NAS2006V03A THRU V07A	
NAS2006V09	NAS2006V09A	
NAS2008V07	NAS2008V07A	
NAS2106V6 THRU V8		
NAS2406V01 THRU V08	NAS2406V01A THRU V08A	ST3M564V6-1 THRU V6-8
NAS2408V04 THRU V08	NAS2408V04A THRU V08A	ST3M564V8-4 THRU V8-8
NAS2506V04	NAS2506V04A	ST3M563V6-4
NAS2506V07	NAS2506V07A	ST3M563V6-07
NAS2508V06 THRU V08	NAS2508V06A THRU V08A	ST3M563V8-6 THRU V8-8

Table 6-26. Repair Fasteners, Hi-Loks

Standard Fastener	1st Oversize (1/64 or as noted)	2nd Oversize (1/32 or as noted)
ST3M415C08-2 THRU C08-8		1 → ST3M415C3-2 THRU C3-8
ST3M415C3-3 THRU C3-10	ST3M495-3-3-1 THRU -3-10-1	ST3M506-3-3-1 THRU -3-10-1
ST3M415C3-12	ST3M495-3-12-1	ST3M503-3-12-1
ST3M415V08-2 THRU V08-9		1 → ST3M415V3-2 THRU V3-9
ST3M415V08-11		1 → ST3M415V3-11
ST3M415V3-2 THRU V3-6	ST3M495-3-2-1 THRU -3-6-1	ST3M506-3-2-1 THRU -3-6-1
ST3M415V3-10 THRU V3-13	ST3M495-3-2-10 THRU 3-13-1	ST3M506-3-10-1 THRU 3-13-1
ST3M415V3-16	ST3M495-3-16	ST3M506-3-16-1
ST3M415V3-24	ST3M495-3-24	ST3M506-3-24-1
ST3M415V3-28	ST3M495-3-28-1	ST3M506-3-28-1
ST3M415V4-3 THRU V4-15	ST3M495-4-3-1 THRU -4-15-1	ST3M506-4-3-1 THRU -4-15-1
ST3M415V4-20	ST3M495-4-20-1	ST3M506-4-20-1
ST3M415V5-4 THRU V5-9	ST3M495-5-4 THRU -5-9	ST3M506-5-4 THRU -5-9
ST3M415V6-5 THRU V6-10	ST3M495-6-5 THRU -6-10	ST3M506-6-5 THRU -6-10
ST3M416C08-2 THRU C08-8		1 → ST3M416C3-2 THRU C3-8
ST3M416C08-14		
ST3M416C3-2 THRU C3-3	ST3M501-3-2 THRU-3-3	ST3M507-3-2 THRU -3-3

Table 6-26. Repair Fasteners, Hi-Loks (CONT)

Standard Fastener	1st Oversize (1/64 or as noted)	2nd Oversize (1/32 or as noted)
ST3M416C3-7	ST3M501-3-7	ST3M507-3-7
ST3M416C5-5 THRU C5-6	ST3M501-5-5 THRU -5-6	ST3M507-5-5 THRU -5-6
ST3M416V08-10 THRU V08-12		1 → ST3M416V3-10 THRU V3-12
ST3M416V08-14 THRU V08-15		1 → ST3M416V3-14 THRU V3-15
ST3M416V3-2 THRU V3-4	ST3M501-3-2 THRU -3-4	ST3M507-3-2 THRU -3-4
ST3M416V3-10 THRU V3-13	ST3M501-3-10 THRU 3-13	ST3M507-3-10 THRU 3-13
ST3M416V4-3 THRU V4-11	ST3M501-4-3 THRU -4-11	ST3M507-4-3 THRU -4-11
ST3M416V4-13	ST3M501-4-13	ST3M507-4-13
ST3M416V4-15	ST3M501-4-15	ST3M507-4-15
ST3M416V5-3 THRU V5-10	ST3M501-5-3 THRU -5-10	ST3M507-5-3 THRU -5-10
ST3N416V5-14	ST3M501-5-14	ST3M507-5-14
ST3M416V6-8	ST3M501-6-8	ST3M507-6-8
ST3M419C08-3		1 → ST3M419C3-3
ST3M419C08-6		1 → ST3M419C6-6
ST3M419C08-8		1 → ST3M419C3-8
ST3M419C3-6 THRU C3-8	ST3M496-3-6 THRU -3-8	ST3M505-3-3 THRU -3-8
ST3M419C3-12 THRU C3-13	ST3M496-12 THRU -3-13	ST3M505-3-12 THRU -3-13
ST3M419V08-3 THRU V08-7		1 → ST3M419V3-3 THRU V3-7
ST3M419V08-9 THRU V08-12		1 → ST3M419V3-9 THRU V3-12
ST3M419V3-3 THRU V3-12	ST3M496-33 THRU -3-12	ST3M505-3-12 THRU -3-12
ST3M419V3-31	ST3M496-3-31	ST3M505-3-31
ST3M419V4-5 THRU V4-6	ST3M496-4-5 THRU -4-6	ST3M505-4-5 THRU -4-6
ST3M419V4-9	ST3M496-4-9	ST3M505-4-9
ST3M419V4-14	ST3M496-4-14	ST3M505-4-14
ST3M419V4-16	ST3M496-4-16	ST3M505-4-16
ST3M420C08-3 THRU C08-7		1 → ST3M420C3-3 THRU C3-7
ST3M420C3-2 THRU C3-6	ST3M501-3-2 THRU -3-6	ST3M507-3-2 THRU -3-6
ST3M761C4-4	ST3M501-3-4	ST3M507-3-4
ST3M420C4-7 THRU C4-8	ST3M501-4-7 THRU -4-8	ST3M507-4-7 THRU -4-8
ST3M420V3-2 THRU V3-12	ST3M501-3-2 THRU -3-12	ST3M507-3-2 THRU -3-12
ST3M420V3-14	ST3M501-3-14	ST3M507-3-14
ST3M420V4-4 THRU V4-8	ST3M501-4-4 THRU -4-8	ST3M507-4-4 THRU -4-8
ST3M420V4-13	ST3M501-4-13	ST3M507-4-13
ST3M420V4-10 THRU V4-11	ST3M501-4-15 THRU -4-11	ST3M507-4-15 THRU -4-11
ST3M420V4-13 THRU V4-14	ST3M501-4-13 THRU -4-14	ST3M507-4-13 THRU -4-14
ST3M420V5-4	ST3M501-5-4	ST3M507-5-4
ST3M420V5-9 THRU V5-13	ST3M501-5-9 THRU V5-13	ST3M507-5-9 THRU -5-13
ST3M420V6-2	ST3M501-6-2	ST3M507-6-2
ST3M420V6-6	ST3M501-6-6	ST3M507-6-6
ST3M456C08-2 THRU C08-9		1 → ST3M456C3-2 THRU C3-9
ST3M456C3-3 THRU -3-14	ST3M495-3-3-1 THRU -3-14-1	ST3M506-3-3-1 THRU -3-14-1
ST3M456C4-3 THRU C4-18	ST3M495-4-3-1 THRU -4-18-1	ST3M506-4-3-1 THRU -4-18-1
ST3M456C5-5 THRU C5-16	ST3M495-5-5 THRU -5-16	ST3M506-5-5 THRU -5-16

CSTO SR1F-15SA-3-1
Table 6-26. Repair Fasteners, Hi-Loks (CONT)

Standard Fastener	1st Oversize (1/64 or as noted)	2nd Oversize (1/32 or as noted)
ST3M456C6-5	ST3M495-6-5	ST3M506-6-5
ST3M456C6-7	ST3M495-6-7	ST3M506-6-7
ST3M456C6-9 THRU C6-11	ST3M495-6-9 THRU -6-11	ST3M506-6-9 THRU -6-11
ST3M456C6-14	ST3M495-6-14	ST3M506-6-14
ST3M457C08-2 THRU C08-8		 ST3M457C3-2 THRU C3-8  ST3M457C3-12  ST3M457C3-15
ST3M457C08-12		ST3M507-3-2 THRU -3-11
ST3M457C08-15		ST3M507-3-14
ST3M457C3-2 THRU C3-11	ST3M501-3-2 THRU -3-11	ST3M457-3-17
ST3M457C3-14	ST3M501-3-14	ST3M507-4-3 THRU -4-17
ST3M457C3-17	ST3M501-3-17	ST3M507-5-3 THRU -5-13
ST3M457C4-3 THRU C4-17	ST3M501-4-3 THRU -4-17	ST3M507-6-3 THRU -6-4
ST3M457C5-3 THRU C5-13	ST3M501-5-3 THRU -5-13	ST3M457C6-6 THRU 6-9
ST3M457C6-3 THRU C6-4	ST3M501-6-3 THRU -6-4	ST3M507-6-12
ST3M457C6-6 THRU C6-9	ST3M501-6-6 THRU -6-9	 ST3M415C3-2 THRU C3-9
ST3M457C6-12	ST3M501-6-12	
ST3M758D08-2 THRU D08-9		
ST3M758D08-7		
ST3M758D3-3 THRU D3-12	ST3M495-3-3-1 THRU -3-12-1	ST3M506-3-3-1 THRU -3-12-1
ST3M758D3-14		
ST3M758D4-3 THRU D4-18		
ST3M758D5-5 THRU D5-16		
ST3M758D5-19		
ST3M758D6-5		
ST3M758D6-9 THRU D6-11		
ST3M758T08-2 THRU T08-9		 ST3M415V3-2 THRU V3-9
ST3M758T08-11		
ST3M758T3-2 THRU T3-14	ST3M495-3-2-1 THRU -3-14-1	ST3M506-3-2-1 THRU -3-14-1
ST3M758T3-38	ST3M495-3-38-1	ST3M506-3-38-1
ST3M758T4-3 THRU T4-15	ST3M495-4-3-1 THRU -4-15-1	ST3M506-4-3-1 THRU -4-15-1
ST3M758T4-20	ST3M495-4-20-1	ST3M506-4-20-1
ST3M758T5-3 THRU T5-11	ST3M495-5-3 THRU -5-11	ST3M506-5-3 THRU -5-11
ST3M758T6-5 THRU T6-10	ST3M495-6-5 THRU -6-10	ST3M506-6-5 THRU -6-10
ST3M759C08-2 THRU C08-8		 ST3M416C3-2 THRU C3-8
ST3M759C08-14 THRU 8-15		
ST3M759C3-2 THRU C3-8	ST3M501-3-2 THRU -3-8	ST3M507-3-2 THRU -3-8
ST3M759C5-3 THRU C5-13		
ST3M759C4-3 THRU C4-13		
ST3M759C6-3 THRU C6-4		
ST3M759C6-6 THRU C6-9		
ST3M759C6-12		
ST3M759V08-10 THRU V08-12		 ST3M416V3-10 THRU V3-12
ST3M759V08-14 THRU V08-15		 ST3M416V3-14 THRU V3-15
ST3M759V3-2 THRU V3-13	ST3M501-3-2 THRU -3-13	ST3M507-3-2 THRU -3-13

Table 6-26. Repair Fasteners, Hi-Loks (CONT)

Standard Fastener	1st Oversize (1/64 or as noted)	2nd Oversize (1/32 or as noted)
ST3M759V4-3 THRU V4-11 ST3M759V4-13 ST3M759V4-15 ST3M759V5-2 THRU V5-13 ST3M759V5-14 ST3M759V6-8 ST3M760D08-3 ST3M760D760D08-6 ST3M760D08-8 ST3M760D3-6 THRU D3-8 ST3M760D08-4 THRU D08-8 ST3M760D3-6 THRU D3-8 ST3M760T08-3 THRU T08-7	ST3M501-4-3 THRU -4-11 SST3M501-5-2 THRU -5-13 ST3M501-6-8 ST3M496-3-3 THRU -3-8	ST3M507-4-3 THRU -4-11 ST3M507-5-2 THRU -5-13 ST3M507-6-8 1 → ST3M419C3-3 1 → ST3M419C3-6 1 → ST3M419C3-8 ST3M505-3-3 THRU -3-8 1 → ST3M419V3-3 THRU V3-6
ST3M760T3-3 THRU T3-12 ST3M760T3-31 ST3M760T4-5 THRU T4-6 ST3M760T4-9 ST3M760T4-14 ST3M760T4-16 ST3M761C08-3 THRU C08-7	ST3M496-3-3 THRU -3-12 ST3M496-3-31 ST3M496-4-5 THRU -4-6 ST3M496-4-9 ST3M496-4-14 ST3M496-4-16	ST3M505-3-3 THRU -3-12 ST3M505-3-31 ST3M505-4-5 THRU -4-6 ST3M505-4-9 ST3M505-4-14 ST3M505-4-14 1 → ST3M420C3-3 THRU C3-7
ST3M761C3-2 THRU C3-6 ST3M761C4-4 ST3M761C4-7 THRU C4-8 ST3M761V08-2 THRU V08-9	ST3M501-3-2 THRU -3-6 ST3M501-3-4 ST3M501-4-7 THRU -4-8	ST3M507-3-2 THRU -3-6 ST3M507-3-4 ST3M507-4-7 THRU -4-8 1 → ST3M420V3-2 THRU V3-9
ST3M761V3-2 THRU V3-14 ST3M761V4-4 THRU V4-13 ST3M761V5-4 ST3M761V5-9 THRU V5-13 ST3M761V6-2 ST3M761V6-6	ST3M501-3-2 THRU -3-14 ST3M501-4-4 THRU -4-13 ST3M501-5-4 ST3M501-5-9 THRU -5-13	ST3M507-3-2 THRU -3-14 ST3M507-4-4 THRU -4-13 ST3M507-5-4 ST3M507-5-9 THRU -5-13
1 → Fastener of next larger diameter.		

Table 6-27. Repair Fasteners, Taper-Loks

Standard Fastener	1st Oversize (1/64 or as noted)	2nd Oversize (1/32 or as noted)
NAS1724V05-5E NAS1724V05-7E NAS1724V3-3E THRU V3-14E NAS1724V3-16E NAS1724V4-4E THRU V4-15E NAS1724V4-17E NAS1724V5-5E	NAS1725V05-5E NAS1725V05-7E NAS1725V3-3E THRU V3-14E NAS1724V3-16E NAS1725V4-4E THRU V4-15E NAS1725V4-17E NAS1725V5-5E	1 → NAS1724V3-5E 1 → NAS1724V3-7E ST3M350V3-3 THRU V3-14 ST3M350V3-16 ST3M350V4-4 THRU V4-15 ST3M350V4-17 ST3M350V5-5

Table 6-27. Repair Fasteners, Taper-Loks (CONT)

Standard Fastener	1st Oversize (1/64 or as noted)	2nd Oversize (1/32 or as noted)
NAS1724V5-7E THRU V5-9E	NAS1725V5-7E THRU V5-9E	ST3M350V5-7 THRU V5-9
NAS1724V5-11E THRU V5-12E	NAS1725V5-11E THRU V5-12E	ST3M350V5-11 THRU V5-12
NAS1724V5-15E	NAS1725V5-15E	ST3M350V5-15
NAS1728V3-3E THRU V3-6E	NAS1729V3-3E THRU V5-6E	ST3M345V3-3 THRU V3-6
NAS1728V4-5E	NAS1729V4-5E	ST3M345V4-5
NAS1728V4-7E	NAS1729V4-7E	ST3M345V4-7
NAS1728V5-6E	NAS1729V5-6E	ST3M345V5-6
ST3M429C3-6D1	ST3M344V3-6	ST3M585C3-6
ST3M429C3-8D1	ST3M344V3-8	ST3M585C3-8
NAS1724D4-5E THRU D4-16E	NAS1725D4-5E THRU D4-16E	ST3M350C4-5 THRU C4-16
NAS1724D4-20E	NAS1725D4-20E	ST3M350C4-20
NAS1724D5-6E	NAS1725D5-6E	ST3M3450D5-6
NAS1724D5-8E THRU D5-16E	NAS1725D5-8E THRU D5-16E	ST3M350C5-8 THRU C5-16
NAS1724D5-18E	NAS1725D5-18E	ST3M350D5-18
NAS1724D6-8E THRU D6-11E	NAS1725D6-8E THRU D6-11E	ST3M350C6-8 THRU C6-11
NAS1728D3-3E	NAS1729D3-3E	ST3M350D3-3
NAS1728D3-5E THRU D3-13E	NAS1729D3-5E THRU D3-13E	ST3M345C3-5 THRU C3-13
NAS1728D4-4E	NAS1729D4-4E	ST3M345C4-4
NAS1728D4-6E THRU D4-12E	NAS1729D4-6E THRU D4-12E	ST3M345C4-6 THRU C4-12
NAS1728D5-6E THRU D5-9E	NAS1729D5-6E THRU D5-9E	ST3M345C5-6 THRU C5-9
NAS1728D5-11E	NAS1729D5-11E	ST3M345C5-11
NAS1728D5-14E THRU D5-15E	NAS1729D5-14E THRU D5-15E	ST3M345C5-14 THRU C5-14
NAS1728D5-18E	NAS1729D5-18E	ST3M345C5-18
NAS1728D10-8E	NAS1729D10-8E	ST3M345C10-8
3M486C5-6-16	ST3M745C5-6-16	TLD966-5-6E16
3M486C5-7-16	ST3M745C5-7-16	TLD966-5-7E16
3M486C5-8-16	ST3M745C5-8-16	TLD966-5-8E16
3M486C5-8-17	ST3M745C5-8-17	TLD966-5-8E17
3M486C5-9-16	ST3M745C5-9-16	TLD966-5-9E16
3M486C5-9-29	ST3M745C5-9-29	TLD966-5-9E29
3M486C5-10-16	ST3M745C5-10-16	TLD966-5-10E16
3M486C5-10-17	ST3M745C5-10-17	TLD966-5-10E17
3M486C5-10-30	ST3M745C5-10-30	TLD966-5-10E30
3M486C5-11-16	ST3M745C5-11-16	TLD966-5-11E16
3M486C5-11-27	ST3M745C5-11-27	TLD966-5-11E27
3M486C5-11-30	ST3M745C5-11-30	TLD966-5-11E30
3M486C5-11-38	ST3M745C5-11-38	TLD966-5-11E38
3M486C5-12-16	ST3M745C5-12-16	TLD966-5-12E16
3M486C5-12-42	ST3M745C5-12-42	TLD966-5-12E42

1 ► Fastener of next larger diameter.

Table 6-28. Repair Fasteners, Jo-Bolts

Standard Fastener	1st Oversize (1/64 or as noted)	2nd Oversize (1/32 or as noted)
NAS1669-08DL1 THRU -08DL9	NAS1751-08L1 THRU -08L9	

Table 6-28. Repair Fasteners, Jo-Bolts (CONT)

Standard Fastener	1st Oversize (1/64 or as noted)	2nd Oversize (1/32 or as noted)
NAS1669-08DL12 THRU -08DL14	NAS1751-08L12 THRU -08L14	
NAS1669-08L1 THRU -08L9	NAS1751-08L1 THRU -08L9	
NAS1669-08L12 THRU -08L13	NAS1751-08L12 THRU -08L13	
NAS1669-3DL1 THRU -3DL9	NAS1751-3L1 THRU -3L9	
NAS1669-3L1 THRU -3L9	NAS1751-3L1 THRU -3L9	
NAS1670-08DL2 THRU -08DL8	NAS1750-08L2 THRU 08L8	
NAS1670-08L2 THRU -08L8	NAS1750-08L2 THRU -08L8	
NAS1670-3DL2 THRU -3DL9	NAS1750-3L2 THRU -3L9	
NAS1670-3L2 THRU -3L9	NAS1750-3L2 THRU -3L9	
NAS1670-4DL4 THRU -4DL8	NAS1750-4L4 THRU -4DL8	
NAS1670-4L4 THRU -4L8	NAS1750-4L4 THRU -4L8	
NAS1671-08DL1 THRU -08DL6	NAS1753-08L1 THRU -08L6	
NAS1671-08L1 THRU -08L6	NAS1753-08L1 THRU -08L6	
NAS1671-3DL2 THRU -3DL10	NAS1753-3L2 THRU -3L10	
NAS1671-3L2 THRU -3L10	NAS1753-3L2 THRU -3L10	
NAS1671-4DL8	NAS1753-4L8	
NAS1671-4L8	NAS1753-4L8	
NAS1672-08DL3 THRU -08DL4	NAS1753-08L3 THRU -08L4	
NAS1672-08L3 THRU -08L4	NAS1753-08L3 THRU -08L4	
NAS1672-08L10	NAS1752-08L10	
NAS1672-3DL3 THRU -3DL4	NAS1752-3L3 THRU -3L4	
NAS1672-3DL6 THRU -3DL9	NAS1752-3L6 THRU -3L9	
NAS1672-3LD11	NAS1752-3L11	
NAS1672-3L3 THRU -3L4	NAS1752-3L3 THRU -3L4	
NAS1672-3L6 THRU -3L9	NAS1752-3L6 THRU -3L9	
NAS1672-3L11	NAS1752-3L11	
NAS1673-08DL1 THRU -08DL5	NAS1755-08L1 THRU -08L5	
NAS1673-08L1 THRU -08L5	NAS1755-08L1 THRU -08L5	
NAS1673-08DL7	NAS1755-08L7	
NAS1673-08L7	NAS1755-08L7	
NAS1673-3DL1 THRU -3DL5	NAS1755-3L1 THRU -3L5	
NAS1673-3L1 THRU -3L5	NAS1755-3L1 THRU -3L5	
NAS1673-3DL7	NAS1755-3DL7	
NAS1673-3L7	NAS1755-3L7	
NAS1674-08DL2 THRU -08DL8	NAS1754-08L2 THRU -08L8	
NAS1674-08L2 THRU -08L8	NAS1754-08L2 THRU -08L8	
NAS1674-3DL3 THRU -3DL8	NAS1754-3L3 THRU -3L7	
NAS1674-3L3 THRU -3L7	NAS1754-3L3 THRU -3L7	
NAS1674-4DL4	NAS1754-4L4	
NAS1674-4L4	NAS1754-4L4	

Table 6-29. Repair Fasteners, Protruding Head Bolts

Standard Fastener	1st Oversize (1/64 or as noted)	2nd Oversize (1/32 or as noted)
NAS653V1 THRU V18	ST3M497-3-1 THRU -3-18	ST3M507-3-1 THRU -3-18
NAS653V20 THRU V21	ST3M497-3-20 THRU -3-21	ST3M507-3-20 THRU -3-21

Table 6-29. Repair Fasteners, Protruding Head Bolts (CONT)

Standard Fastener	1st Oversize (1/64 or as noted)	2nd Oversize (1/32 or as noted)
NAS653V25	ST3M497-3-25	ST3M507-3-25
NAS653V27 THRU V29	ST3M497-3-27 THRU -3-29	ST3M507-3-27 THRU -3-29
NAS653V36	ST3M497-3-36	ST3M507-3-36
NAS653V52	ST3M497-3-52	ST3M507-3-52
NAS653V1D THRU V2D	ST3M497-3D1 THRU -3D2	ST3M507-3D1 THRU -3D2
NAS653V5D	ST3M497-3D5	ST3M507-3D5
NAS653V8D	ST3M497-3D8	ST3M507-3D8
NAS653V10D THRU V11D	ST3M497-3D10 THRU 3D11	ST3M507-3D10 THRU -3D11
NAS653V13D	ST3M497-3D13	ST3M507-3D13
NAS653V16D	ST3M497-3D16	ST3M507-3D16
NAS653V20D	ST3M497-3D20	ST3M507-3D20
NAS653V22D	ST3M497-3D22	ST3M507-3D22
NAS654V3 THRU V11	ST3M497-4-3 THRU -4D11	ST3M507-4-3 THRU -4-11
NAS654V13 THRU V26	ST3M497-4-13 THRU -4-26	ST3M507-4-13 THRU -4-26
NAS654V28 THRU V30	ST3M497-4-28 THRU -4-30	ST3M507-4-28 THRU -4-30
NAS654V34	ST3M497-4-34	ST3M507-4-34
NAS654V4D	ST3M497-4D4	ST3M507-4D4
NAS654V8D THRU V17D	ST3M497-4D8 THRU -4D17	ST3M507-4D8 THRU -4D17
NAS654V19D THRU V23D	ST3M497-4D19 THRU -4D23	ST3M507-4D19 THRU -4D23
NAS654V26D THRU V29D	ST3M497-4D26 THRU -4D29	ST3M507-4D26 THRU -4D29
NAS655V10	ST3M497-5-10	ST3M507-5-10
NAS655V23	ST3M497-5-23	ST3M507-5-23
NAS655V13D THRU V16D	ST3M497-5D13 THRU -5D16	ST3M507-5D13 THRU -5D16
NAS655V19D THRU V20D	ST3M497-5D19 THRU -5D20	ST3M507-5D19 THRU -5D20
NAS655V22D	ST3M497-5-D22	ST3M507-5D22
NAS655V24D THRU V27D	ST3M497-5D24 THRU -27	ST3M507-5D24 THRU -5D27
NAS655V46D	ST3M497-5D46	ST3M507-5D46
NAS656V10	ST3M497-6-10	ST3M507-6-10
NAS656V13D	ST3M497-6D13	ST3M507-6D13
NAS656V16D	ST3M497-6D	ST3M507-6D16
NAS656V18D	ST3M497-6D18	ST3M507-6D18
NAS656V23D	ST3M497-6D23	ST3M507-6D23
NAS656V30D	ST3M497-6D30	ST3M507-6D30
NAS656V46D	ST3M497-6D46	ST3M507-6D49
NAS656V52D	ST3M497-6D52	ST3M507-6D52
NAS656V57D	ST3M497-6D57	ST3M507-6D57
NAS656V121D	ST3M497-6D121	ST3M507-6D121
NAS657V18D	ST3M497-7D18	ST3M507-7D18
NAS657V26D	ST3M497-7D26	ST3M507-7D26
NAS658V24D	ST3M497-8D24	ST3M507-8D24
NAS673V1 THRU V32	ST3M497-3-1 THRU -3-32	ST3M507-3-1 THRU -3-32
NAS673V34	ST3M497-3-34	ST3M507-3-34
NAS673V36	ST3M497-3-36	ST3M507-3-36
NAS673V38	ST3M497-3-38	ST3M507-3-38
NAS673V40	ST3M497-3-40	ST3M507-3-40
NAS673V44	ST3M497-3-44	ST3M507-3-44
NAS673V46	ST3M497-3-46	ST3M507-3-46
NAS673V3	ST3M497-3D3	ST3M507-3D3
NAS673V7	ST3M497-3D7	ST3M507-3D7

Table 6-29. Repair Fasteners, Protruding Head Bolts (CONT)

Standard Fastener	1st Oversize (1/64 or as noted)	2nd Oversize (1/32 or as noted)
NAS673V10D THRU V11	ST3M497-3D10 THRU -3D11	ST3M507-3D10 THRU -3D11
NAS673V16	ST3M497-3D16	ST3M507-3D16
NAS673V24	ST3M497-3D24	ST3M507-3D24
NAS673V27	ST3M497-3D27	ST3M507-3D27
NAS673V30	ST3M497-3D30	ST3M507-3D30
NAS674V1 THRU V7	ST3M497-4-1 THRU -4-7	ST3M507-4-1 THRU -4-7
NAS674V10 THRU V27	ST3M497-4-10 THRU -4-27	ST3M507-4-10 THRU -4-27
NAS674V30	ST3M497-4-30	ST3M507-4-30
NAS674V32 THRU V35	ST3M497-4-32 THRU -4-35	ST3M507-4-32 THRU -4-35
NAS674V38	ST3M497-4-38	ST3M507-4-38
NAS674V40	ST3M497-4-40	ST3M507-4-40
NAS674V42	ST3M497-4-42	ST3M507-4-42
NAS674V52	ST3M497-4-52	ST3M507-4-52
NAS674V58	ST3M497-4-58	ST3M507-4-58
NAS674V8	ST3M497-4D8	ST3M507-4D8
NAS674V8H	ST3M497-4D8H	ST3M507-4D8H
NAS674V13	ST3M497-4D13	ST3M507-4D13
NAS674V13H	ST3M497-4D13H	ST3M507-4D13H
NAS674V15D THRU V18D	ST3M497-4D15 THRU -4D18	ST3M507-4D15 THRU -4D18
NAS674V23	ST3M497-4D23	ST3M507-4D23
NAS674V23H	ST3M497-4D23H	ST3M507-4D23H
NAS674V28D	ST3M497-4D28	ST3M507-4D28
NAS675V1	ST3M497-5-1	ST3M507-5-1
NAS675V3	ST3M497-5-3	ST3M507-5-3
NAS675V5 THRU V13	ST3M497-5-5 THRU 5-13	ST3M507-5-5 THRU 5-13
NAS675V15D THRU V17D	ST3M497-5-15D THRU 5-17D	ST3M507-5-15D THRU 5-17D
NAS675V19	ST3M497-5-19	ST3M507-5-19
NAS675V20D	ST3M497-5-20D	ST3M507-5-20D
NAS675V23	ST3M497-5-23	ST3M507-5-23
NAS675V26 THRU V28	ST3M497-5-26 THRU 5-28	ST3M507-5-26 THRU 5-28
NAS675V32	ST3M497-5-32	ST3M507-5-32
NAS675V9D THRU V10D	ST3M497-5D9 THRU -5D10	ST3M507-5D9 THRU -5D10
NAS675V15D THRU V17D	ST3M497-5D15 THRU -5D17	ST3M507-5D15 THRU -5D17
NAS675V20D	ST3M497-5D20	ST3M507-5D20
NAS676V3H	ST3M497-6-3H	ST3M507-6-3H
NAS676V5H	ST3M497-6-5H	ST3M507-6-5H
NAS676V6	ST3M497-6-6	ST3M507-6-6
NAS676V7H	ST3M497-6-7H	ST3M507-6-7H
NAS676V9H	ST3M497-6-9H	ST3M507-6-9H
NAS676V15D	ST3M497-6-15D	ST3M507-6-15D
NAS676V42	ST3M497-6-42	ST3M507-6-42
NAS677V10	ST3M497-7-10	ST3M507-7-10
NAS677V20	ST3M497-7-20	ST3M507-7-20
NAS6303U1 THRU U9	ST3M497-3-1 THRU -3-9	ST3M507-3-1 THRU -3-9
NAS6303U1D	ST3M497-3-1D	ST3M507-3-1D
NAS6303U4H THRU U6H	ST3M497-3-4H THRU -3-6H	ST3M507-3-4H THRU -3-6H
NAS6303U2H	ST3M497-3-2H	ST3M507-3-2H
NAS6303U6D THRU U7D	ST3M497-3D6 THRU -3D7	ST3M507-3D6 THRU -3D7
NAS6303U9D THRU U10D	ST3M497-3D9 THRU -3D10	ST3M507-3D9 THRU -3D10

Table 6-29. Repair Fasteners, Protruding Head Bolts (CONT)

Standard Fastener	1st Oversize (1/64 or as noted)	2nd Oversize (1/32 or as noted)
NAS6303U11H	ST3M497-3-11H	ST3M507-3-11H
NAS6303U13H	ST3M497-3-13H	ST3M507-3-13H
NAS6303U26D	ST3M497-3D26	ST3M507-3D26
NAS6303U36	ST3M497-3-36	ST3M507-3-36
NAS6304U1H	ST3M497-4-1H	ST3M507-4-1H
NAS6304U3	ST3M497-4-3	ST3M507-4-3
NAS6304U6Y	ST3M497-4-6Y	ST3M507-4-6Y
NAS6304U7	ST3M497-4-7	ST3M507-4-7
NAS6304U9DH	ST3M497-4-9DH	ST3M507-4-9DH
NAS6304U15 THRU U16	ST3M497-4-15 THRU -4-16	ST3M507-4-15 THRU -4-16
NAS6304U28	ST3M497-4-28	ST3M507-4-28
NAS6304U27	ST3M497-4-27	ST3M507-4-27
NAS6304U10D THRU U12D	ST3M497-4D10 THRU -4D12	ST3M507-4D10 THRU -4D12
NAS6304U15D	ST3M497-4D15	ST3M507-4D15
NAS6304U34D	ST3M497-4D34	ST3M507-4D34
NAS6304U42D	ST3M497-4D42	ST3M507-4D42
NAS6304U58D	ST3M497-4D58	ST3M507-4D58
NAS6304U74D	ST3M497-4D74	ST3M507-4D74
NAS6305U24	ST3M497-5-24	ST3M507-5-24
NAS6305U31D	ST3M497-5D31	ST3M507-5D31
NAS6310U21D	ST3M497-10D21	ST3M507-10D21
NAS6310U24D	ST3M497-10D24	ST3M507-10D24
ST3M453-4-3 THRU -4-14	ST3M497-4-3 THRU -4-14	ST3M507-4-3 THRU -4-14
ST3M453-4-15 THRU -4-18	ST3M497-4-15 THRU -4-18	ST3M507-4-15 THRU -4-18
ST3M453-4-21 THRU -4-23	ST3M497-4-21 THRU -4-23	ST3M507-4-21 THRU -4-23
ST3M453-4-32	ST3M497-4-32	ST3M507-4-32
ST3M453-4-37 THRU -4-38	ST3M497-4-37 THRU -4-38	ST3M507-4-37 THRU -4-38
ST3M453-4D10	ST3M497-4D10	ST3M507-4D10
ST3M453-4D15	ST3M497-4D15	ST3M507-4D15
ST3M453-4D19	ST3M497-4D19	ST3M507-4D19
ST3M453-4D31	ST3M497-4D31	ST3M507-4D31
ST3M453-4D50	ST3M497-4D50	ST3M507-4D50
ST3M453-5-6 THRU -5-13	ST3M497-5-6 THRU -5-13	ST3M507-5-6 THRU -5-13
ST3M453-5-22	ST3M497-5-22	ST3M507-5-22
ST3M453-5-26	ST3M497-5-26	ST3M507-5-26
ST3M453-5-28	ST3M497-5-28	ST3M507-5-28
ST3M453-5-39	ST3M497-5-39	ST3M507-5-39
ST3M453-5-68	ST3M497-5-68	ST3M507-5-68
ST3M453-5-84	ST3M497-5-84	ST3M507-5-84
ST3M453-5-100	ST3M497-5-100	ST3M507-5-100
ST3M453-5D10	ST3M497-5D10	ST3M507-5D10
ST3M453-5D14 THRU -5D16	ST3M497-5D14 THRU -5D16	ST3M507-5D14 THRU -5D16
ST3M453-5D18	ST3M497-5D18	ST3M507-5D18
ST3M453-5D20	ST3M497-5D20	ST3M507-5D20
ST3M453-5D25	ST3M497-5D25	ST3M507-5D25
ST3M453-5D40 THRU -5D41	ST3M497-5D40 THRU -5D41	ST3M507-5D40 THRU -5D41
ST3M453-6-9 THRU 6-15	ST3M497-6-9 THRU 6-15	ST3M507-6-9 THRU 6-15
ST3M453-6D18	ST3M497-6D18	ST3M507-6D18
ST3M453-6D24	ST3M497-6D24	ST3M507-6D24

Table 6-29. Repair Fasteners, Protruding Head Bolts (CONT)

Standard Fastener	1st Oversize (1/64 or as noted)	2nd Oversize (1/32 or as noted)
ST3M453-6D32	ST3M497-6D32	ST3M507-6D32
ST3M453-6D61	ST3M497-6D61	ST3M507-6D61
ST3M453-7-11	ST3M497-7-11	ST3M507-7-11
ST3M453-7-13	ST3M497-7-13	ST3M507-7-13
ST3M453-7D11	ST3M497-7D11	ST3M507-7D11
ST3M453-7D24	ST3M497-7D24	ST3M507-7D24
ST3M453-8-12	ST3M497-8-12	ST3M507-8-12
ST3M453-8-40	ST3M497-8-40	ST3M507-8-40
ST3M453-8D21	ST3M497-8D21	ST3M507-8D21
ST3M453-8D29	ST3M497-8D29	ST3M507-8D29
ST3M453-8D45	ST3M497-8D45	ST3M507-8D45
ST3M453-10-16	ST3M497-10-16	ST3M507-10-16
ST3M453-10D34	ST3M497-10D34	ST3M507-10D34
ST3M571-3-4 THRU -3-9		ST3M607-3-4 THRU -3-9
ST3M571-3-11		ST3M607-3-11
ST3M571-4-5 THRU -4-12		ST3M607-4-5 THRU -4-12
ST3M571-4-14		ST3M607-4-14
ST3M571-4-16 THRU -4-18		ST3M607-4-16 THRU -4-18
ST3M571-4-21		ST3M607-4-21
ST3M571-4-24		ST3M607-4-24
ST3M571-4-26		ST3M607-4-26
ST3M571-4-31		ST3M607-4-31
ST3M571-4-36		ST3M607-4-36
ST3M571-4-38		ST3M607-4-38
ST3M571-4D12		ST3M607-4D12
ST3M571-4D27		ST3M607-4D27
ST3M571-4H1		ST3M6-7-4H1
ST3M571-4H6		ST3M607-4H6
ST3M571-5-10 THRU -5-14		ST3M607-5-10 THRU -5-14
ST3M571-5-19		ST3M607-5-19
ST3M571-5-21 THRU -5-23		ST3M607-5-21 THRU -5-23
ST3M571-5D4		ST3M607-5D4
ST3M571-5D8		ST3M607-5D8
ST3M571-5D12		ST3M607-5D12
ST3M571-5D14 THRU -5D15		ST3M607-5D14 THRU -5D15
ST3M571-5D17 THRU -5D18		ST3M607-5D17 THRU -5D18
ST3M571-5D21 THRU -5D23		ST3M607-5D21 THRU -5D23
ST3M571-5D25 THRU -5D26		ST3M607-5D25 THRU -5D26
ST3M571-5D37		ST3M607-5D37
ST3M571-6-8		ST3M607-6-18
ST3M571-6-14		ST3M607-6-14
ST3M571-6-19		ST3M607-6-19
ST3M571-6-20		ST3M607-6-20
ST3M571-6-22		ST3M607-6-22
ST3M571-6-24		ST3M607-6-24
ST3M571-6-28		ST3M607-6-28
ST3M571-6D9		ST3M607-6D9
ST3M571-6D13		ST3M607-6D13
ST3M571-6D14		ST3M607-6D14

CSTO SR1F-15SA-3-1
Table 6-29. Repair Fasteners, Protruding Head Bolts (CONT)

Standard Fastener	1st Oversize (1/64 or as noted)	2nd Oversize (1/32 or as noted)
ST3M571-6D17		ST3M607-6D17
ST3M571-6D60		ST3M607-6D60
ST3M571-6H23		ST3M607-6H23
ST3M571-6H30		ST3M607-6H30
ST3M571-6H31		ST3M607-6H31
ST3M571-7-28		ST3M607-7-28
ST3M571-7-30		ST3M607-7-30
ST3M571-7-48		ST3M607-7-48
ST3M571-7D9		ST3M607-7D9
ST3M571-7H28		ST3M607-7H28
ST3M571-8-12		ST3M607-8-12
ST3M571-8-15		ST3M607-8-15
ST3M571-8-18		ST3M607-8-18
ST3M571-8-20		ST3M607-8-20
ST3M571-8-24		ST3M607-8-24
ST3M571-8-28		ST3M607-8-28
ST3M571-8D40		ST3M607-8D40
ST3M571-8D44		ST3M607-8D44
ST3M571-8D46		ST3M607-8D46
ST3M571-8D57		ST3M607-8D57
ST3M571-8D73		ST3M607-8D73
ST3M571-8D88		ST3M607-8D88
ST3M571-9D27		ST3M607-9D27
ST3M571-9D30		ST3M607-9D30
ST3M747-4-5 THRU -4-13	ST3M497-4-5 THRU -4-13	ST3M507-4-5 THRU -4-13
ST3M747-4-15	ST3M497-4-15	ST3M507-4-15
ST3M747-4-17	ST3M497-4-17	ST3M507-4-17
ST3M747-5-6 THRU -5-13	ST3M497-5-6 THRU -5-13	ST3M507-5-6 THRU -5-13
ST3M747-6-13 THRU -6-14	ST3M497-6-13 THRU -6-14	ST3M507-6-13 THRU 6-14

Table 6-30. Repair Fasteners, Flush Head Bolts

Standard Fastener	1st Oversize (1/64 or as noted)	2nd Oversize (1/32 or as noted)
NAS663V2HT THRU V14HT	ST3M496-3-2 THRU -3-14	ST3M505-3-2 THRU -3-14
NAS663V16HT	ST3M496-3-16	ST3M505-3-16
NAS663V23HT	ST3M496-4-23	ST3M505-4-23
NAS663V26HT	ST3M496-4-26	ST3M505-4-26
NAS664V2HT THRU V5HT	ST3M496-4-2 THRU -4-5	ST3M505-4-2 THRU -4-5
NAS664V7HT THRU V10HT	ST3M496-4-7 THRU -4-10	ST3M505-4-7 THRU -4-10
NAS664V12HT	ST3M496-4-12	ST3M505-4-12
NAS664V16HT	ST3M496-4-16	ST3M505-4-16
NAS666V7HT	ST3M496-6-7	ST3M505-6-7
ST3M430V3-2AS	ST3M653C3-2A	3M902C3-2A
ST3M430V3-5AS	ST3M653C3-5A	3M902C3-5A
ST3M430V3-9AS THRU V3-10AS	ST3M653C3-9A THRU C3-10A	3M902C3-9A THRU C3-10A
ST3M430V3-10ASM	ST3M653C3-10A	3M902C3-10A

Table 6-30. Repair Fasteners, Flush Head Bolts (CONT)

Standard Fastener	1st Oversize (1/64 or as noted)	2nd Oversize (1/32 or as noted)
ST3M430V3-13ASM	ST3M653C3-13A	3M902C3-13A
ST3M430V3-2D	ST3M653C3-2D	3M902C3-2D
ST3M430V4-5ASM THRU V4-11ASM	ST3M653C4-5A THRU C4-11A	3M902C4-5A THRU C4-11A
ST3M430V8-13AS	ST3M653C8-13A	3M902C8-13A
ST3M454-3L2 THRU -3L11	ST3M496-3-2 THRU -3-11	ST3M505-3-2 THRU -3-11
ST3M454-3L13 THRU -3L15	ST3M496-3-13 THRU -3-15	ST3M505-3-13 THRU -3-15
ST3M454-3L18	ST3M496-3-18	ST3M505-3-18
ST3M454-4L4	ST3M496-4-4	ST3M505-4-4
ST3M454-4L6	ST3M496-4-6	ST3M505-4-6
ST3M454-4L8 THRU -4L9	ST3M496-4-8 THRU -4-9	ST3M505-4-8 THRU -4-9
ST3M454-4L11	ST3M496-4-11	ST3M505-4-11
ST3M454-4L13	ST3M496-4-13	ST3M505-4-13
ST3M454-4L16	ST3M496-4-16	ST3M505-4-16
ST3M454-4L18	ST3M496-4-18	ST3M505-4-18
ST3M454-5L7	ST3M496-5-7	ST3M505-5-7
ST3M454-5L9 THRU -5L10	ST3M496-5-9 THRU -5-10	ST3M505-5-9 THRU -5-10
ST3M454-5L12 THRU -5L13	ST3M496-5-12 THRU -5-13	ST3M505-5-12 THRU -5-13
3M123-3-4 THRU -3-6	ST3M496-3-4 THRU -3-6	ST3M505-3-4 THRU -3-6
ST3M455-3L1-1 THRU -3L15-1	ST3M495-3-1-1 THRU -3-15-1	ST3M506-3-1-1 THRU -3-15-1
ST3M455-3L1-18 THRU -3L19-1	ST3M495-3-18-1 THRU -3-19-1	ST3M506-3-18-1 THRU -3-19-1
ST3M455-4L4-3 THRU -4L12-1	ST3M495-4-3-1 THRU -4-12-1	ST3M506-4-3-1 THRU -4-12-1
ST3M455-4L20 THRU -4L21	ST3M495-4-20 THRU -4-21	ST3M506-4-20 THRU -4-21
ST3M455-4L24	ST3M495-4-24	ST3M506-4-24
ST3M455-4L26	ST3M495-4-26	ST3M506-4-26
ST3M455-5L4 THRU -5L10	ST3M495-5-4 THRU -5-10	ST3M506-5-4 THRU -5-10
ST3M455-5L13	ST3M495-5-13	ST3M506-5-13
ST3M455-5L16	ST3M495-5-16	ST3M506-5-16
ST3M455-6L9 THRU -6L12	ST3M495-6-9 THRU -6-12	ST3M506-6-9 THRU -6-12
ST3M455-6L14	ST3M495-6-14	ST3M506-6-14
ST3M455-6L16	ST3M495-6-16	ST3M506-6-16
ST3M455-7L9 THRU -7L10	ST3M495-7-9 THRU -7-10	ST3M506-7-9 THRU -7-10
ST3M455-7L12	ST3M495-7-12	ST3M506-7-12
ST3M455-7L27	ST3M495-7-27	ST3M506-7-27
ST3M455-8L12	ST3M495-8-12	ST3M506-8-12
ST3M466V4L2-1 THRU V4L10-1	ST3M495-4-2-1 THRU -4-10-1	ST3M506-4-2-1 THRU -4-10-1
ST3M466V4L12	ST3M495-4-12-1	ST3M506-4-12-1
ST3M466V4L25	ST3M495-4-25-1	ST3M506-4-25-1
ST3M466V4L27	ST3M495-4-27-1	ST3M506-4-27-1
ST3M466V5-5-1 THRU V5-7-1	ST3M495-5-5 THRU -5-7	ST3M506-5-5 THRU -5-7
ST3M466V5-9	ST3M495-5-9	ST3M506-5-9
ST3M466V5-12	ST3M495-5-12	ST3M506-5-12
ST3M466V6-9-1 THRU V6-10-1	ST3M495-6-9 THRU -6-10	ST3M506-6-9 THRU -6-10
ST3M466V7-7-1 THRU V7-11-1	ST3M495-7-7 THRU -7-11	ST3M506-7-7 THRU -7-11
ST3M466V8-7-1	ST3M495-7-9	ST3M506-7-9
ST3M466V8-9-1 THRU V8-11-1	ST3M495-8-9 THRU -8-11	ST3M506-8-9 THRU -8-11
ST3M557-3-1 THRU -3-15	ST3M495-3-1-1 THRU 3-15-1	ST3M506-3-1-1 THRU -3-15-1
ST3M557-3-18 THRU -3-19	ST3M495-3-1-18 THRU 3-19-1	ST3M506-3-1-18 THRU -3-19-1
ST3M557-4-3 THRU -4-12	ST3M495-4-3-1 THRU -4-12-1	ST3M506-4-3-1 THRU -4-12-1

Table 6-30. Repair Fasteners, Flush Head Bolts (CONT)

Standard Fastener	1st Oversize (1/64 or as noted)	2nd Oversize (1/32 or as noted)
ST3M557-4-20 THRU -4-21	ST3M495-4-3-20 THRU -4-21-1	ST3M506-4-3-20 THRU -4-21-1
ST3M557-4-24	ST3M495-4-3-24	ST3M506-4-3-24
ST3M557-4-26	ST3M495-4-3-26	ST3M506-4-3-26
ST3M557-5-6 THRU -5-16	ST3M495-5-6 THRU -5-16	ST3M506-5-6 THRU -5-16
ST3M557-6-9 THRU -6-12	ST3M495-6-9 THRU -6-12	ST3M506-6-9 THRU -6-12
ST3M557-6-14	ST3M495-6-14	ST3M506-6-14
ST3M557-6-16	ST3M495-6-16	ST3M506-6-16
ST3M557-7-9 THRU 7-10	ST3M495-7-9 THRU 7-10	ST3M506-7-9 THRU 7-10
ST3M557-7-12	ST3M495-7-12	ST3M506-7-12
ST3M557-7-27	ST3M495-7-27	ST3M506-6-27
ST3M557-8-12	ST3M495-8-12	ST3M506-8-12
ST3M649-08-3 THRU -08-9		1 → ST3M455-3L3-1 THRU -3L9-1
ST3M649-08-11		1 → ST3M455-3L11-1
ST3M652C4-12A	ST3M653C4-12A	3M902C4-12A

1 → Fastener of next larger diameter.

Table 6-31. ST3M495 to Vendor Part No.

McDonnell Standard No.	Vendor No.
ST3M495-4-5-1 THRU -4-14-1	HT4016-4-5X THRU -4-14X

Table 6-32. ST3M496 to Vendor Part No.

McDonnell Standard No.	Vendor No.
ST3M496-3-5 THRU -3-11	HT4008-3-5 THRU -3-11

Table 6-33. ST3M506 to Vendor Part No.

McDonnell Standard No.	Vendor No.
ST3M506-4-5-1 THRU -4-11-1	HT4016-4-5Y THRU 4-11Y

Table 6-34. Steel Fastener to IVD Fastener Conversion

McDonnell Standard No.	McDonnell Standard No.
ST3M562	3M925
ST3M455	3M926
ST3M454	ST3M733
ST3M557	3M927
3M707	3M938
ST3M714	ST3M733

Table 6-35. Solid Rivets, Substitution

Specified Fastener		Substitute Fastener	
Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
MS20426AD		MS20426E	
MS20426B		1 → MS20426AD	
MS20426E		2 → 3 → MS20426T	
MS20470AD		MS20470E	
MS20470B		1 → MS20470AD	
MS20470E		2 → 3 → MS20470T	
MS20470T		4 → NAS1198	
MS20615M		2 → 3 → MS20470T	
NAS1097AD		NAS1097KE	
NAS1097B		1 → NAS1097AD	
NAS1097KE		2 → 3 → NAS1097U	
NAS1097U		4 → NAS1200	
NAS1200M		2 → 3 → NAS1097U	
1 → Do not substitute when the fastener contacts magnesium or magnesium alloys. 2 → Do not substitute when the fastener contacts a cadmium or silver surface. 3 → Do not substitute when the fastener contacts 2124-T851, 7050-T7451 or 7475-T7651 material. 4 → Do not substitute when the fastener upset head contacts an aluminum part.			

Table 6-36. Blind Fasteners, Substitution

Specified Fastener		Substitute Fastener	
Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
NAS1398B		NAS1398D	
NAS1398D		NAS1398C	
NAS1398M		NAS1398C	

Table 6-36. Blind Fasteners, Substitution (CONT)

Specified Fastener		Substitute Fastener	
Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
NAS1399B		NAS1399D	
NAS1399M		NAS1399C	
3M1235D	CR2172	3M1235C	CR2572
3M1236D	CR2173	3M1236C	CR2673
3M949	CCR264CS	ST3M667	1415-()
3M116		3M949	CCR264CS

Table 6-37. Screws, Substitution

Specified Fastener		Substitute Fastener	
Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
NAS66()V		3M123	54291, HT123, HT()N, HT1209A, E128
ST3M430V	HT271A, HT8137, 110179, BM33024V	1 → ST3M652C 2 → 3M925	HT4020
ST3M454	HT4025L	2 → ST3M733	HT4057
ST3M455	HT4024L	2 → 3M926	HT4068
ST3M466V	HT4028L	1 → 3M927	HT4024L
ST3M466V	HT4028L	1 → 3 → 3M927	HT4027
ST3M557	HT4027	2 → 3M927	HT4069
ST3M652C	HT4020	2 → 3M925	HT4067
3M123	54291, HT123, HT()N, HT1209A, E128	ST3M454	HT4025
3M707	HT4041	2 → 3M938	HT4072
3M926	HT4068	3 → 1 → ST3M455	HT4024L
3M927	HT4069	1 → 3M926	HT4068
3M927	HT4069	1 → ST3M557 3 → ST3M555	HT4027 HT4024L

Table 6-37. Screws, Substitution (CONT)

Specified Fastener		Substitute Fastener	
Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
3M938	HT4072	1 → 3 → 3M707	HT4041
<p>1 Do not substitute in areas with non-magnetic requirements.</p> <p>2 Do not substitute, except when the specified fastener head is in contact with aluminum or fiberglass reinforced plastic material of an aircraft mold line surface.</p> <p>3 Do not substitute when specified fastener is installed in aircraft mold line access doors/panels/fairings.</p>			

Table 6-38. Bolts, Substitution

Specified Fastener		Substitute Fastener	
Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
NAS63()()U		1 → 2 → 3 → ST3M453	MB61
NAS65()V		2 → NAS67()V	
NAS65()V		2 → NAS63()()U	
NAS67()V		1 → 2 → 3 → ST3M453	
NAS67()()U		NAS67()()U	
NAS67()()U		1 → 2 → 3 → ST3M453	MB61
NAS1673		NAS1671/NAS1669	
ST3M453	MB61	2 → 3 → ST3M571	MB84
3M925	HT4067	1 → ST3M652C	HT4020
<p>1 Do not substitute in areas with non-magnetic requirements.</p> <p>2 The substitute fastener shall be compatible with clearance, grip, protrusion, and as applicable, cotter pin hole and nut requirements for the specified fastener. Do not substitute when protrusion into bladder type fuel cells would be increased.</p> <p>3 When a washer is specified, use countersunk washer, NAS1587-()C, under bolt head to clear the head-to-shank fillet radius.</p>			

Table 6-39. Nuts, Substitution

Specified Fastener		Substitute Fastener	
Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
AN310/C		1 → ST3M404/C	NS3/C
MS21045()		1 → NAS1291C	
NAS679C		1 → NAS1291C	
ST3M404/C	74640/C	1 → ST3M524	79318CM
ST3M436	H49817	1 → 2 → ST3M572	77018
ST3M524	78069M	1 → ST3M612C	74384

1 → The substitute fastener shall be compatible with clearance, thread engagement, and as applicable, cotter pin requirements for the specified fastener.
 2 → When retainer, ST3M439 (NS202004S), is specified, install a corresponding size retainer, ST3M440 (NS103494), for the substitute nut.

Table 6-40. Plate Nuts, Substitution

Specified Fastener		Substitute Fastener	
Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
MS21048L		1 → MS21060L 1 → ST3M719C	
MS21052L		MS21062L ST3M720C	
MS21056L		1 → ST3M470C 1 → ST3M721C	F29339-01
MS21060L ST3M719C		1 → 2 → ST3M443	F49249E
MS21062L		1 → 2 → ST3M442	F49251E
MS21070L		1 → MS21076L	
ST3M431C		1 → 2 → ST3M442	F49251E
ST3M432C		1 → 2 → ST3M443	F49249E

Table 6-40. Plate Nuts, Substitution (CONT)

Specified Fastener		Substitute Fastener	
Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
ST3M442	F49251E()	ST3M720C	F50340-()
ST3M443	F49249E()	ST3M719C	F50339-()
ST3M470C	F29339-01	ST3M471C	
ST3M719C	F50339-()	ST3M443	F49249()
ST3M720C	F50340-()	ST3M442	F49251E()

The substitute fastener shall be compatible with clearance, thread engagement and protrusion requirements for the specified fastener. Do not substitute when protrusion into bladder type fuel cells would be increased.
 Do not substitute in locations where loose or unsafetied fastener components may fall or be drawn into an engine air intake.
 Do not substitute when used as attaching hardware for doors, access panels or fairings.

Table 6-41. Hi-Lok Pins, Substitution

Specified Fastener		Substitute Fastener	
Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
ST3M415C	HL41	ST3M456C	HL645YE/655YE
ST3M415V	HL11V/611	ST3M415C	HL41
ST3M416C	HL40	ST3M457C	HL644YE/654YE
ST3M416V	HL10V/610	NAS67()V	
ST3M416V	HL10V/610	ST3M416C	HL40
ST3M419C ST3M760D	HL49	 3M123	54291
ST3M419V ST3M760T	HL13V/613	 NAS66()V	
ST3M419V	HL13V/613	ST3M419C	HL49

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Table 6-41. Hi-Lok Pins, Substitution (CONT)

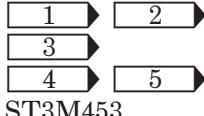
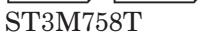
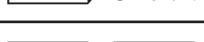
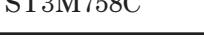
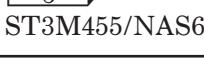
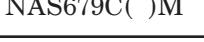
Specified Fastener		Substitute Fastener	
Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
ST3M420C ST3M761C	HL48	 ST3M453	MB61
ST3M420V ST3M761V	HL12V/612	 NAS67()V	
ST3M420V	HL12V/612	ST3M420C	HL48
ST3M456C	HL645YE/655YE	 3M926	HT4068
ST3M456C	HL645YE/655YE	 ST3M758C ST3M455	HT4024L HLT51YB
ST3M457C	HL644YE/654YE	 ST3M453	MB61
ST3M758V	HLT311DL	 ST3M758T	HLT969DL
ST3M758T	HLT969DL	 ST3M758V	HLT311DL
ST3M758V	HLT311DL	 ST3M758D	HLT969DL
ST3M758V	HLT311DL	 ST3M758C	HLT51YB
ST3M758T	HLT969DL	 ST3M758C	HLT51YB
ST3M758T	HLT969DL	 ST3M758D	HLT631YB
ST3M758D	HLT969DL	 ST3M455/NAS679C()M	HT4024L
ST3M758D	HLT631YB	 ST3M758C	HLT51YB
ST3M759V	HLT310DL	 ST3M759C	HLT50YB
ST3M759V	HLT310DL	 NAS67()V / NAS679C()M	

Table 6-41. Hi-Lok Pins, Substitution (CONT)

Specified Fastener		Substitute Fastener	
Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
ST3M759C	HLT50YB	 ST3M453 / NAS679C()M	BM17019
1 → Do not substitute in areas with non-magnetic requirements. 2 → Install self-locking nut, NAS679C, on the substitute fastener. 3 → The substitute fastener shall be compatible with clearance, thread engagement and protrusion requirements for the specified fastener. Do not substitute when protrusion into bladder type fuel cells would be increased, or when the self-locking nut, NAS679C, cannot be torqued to values specified in paragraph 3-142 (use tension values for 10/32 and 1/4-inch nuts). 4 → When a washer is specified, install countersunk washer, NAS1587-()C, under bolt head to clear the head-to-shank fillet radius. 5 → Use NAS1149DN washer between nut and aluminum structure, and NAS1149CN washer between nut and titanium or steel structure. 6 → Substitution not authorized for installations where fastener head contacts any material except aluminum or fiberglass reinforced plastic. 7 → Substitution of flat head Hi-Lock pins for the crown head is not authorized in interference fit applications.			

Table 6-42. Hi-Lok Collars, Substitution

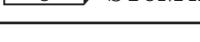
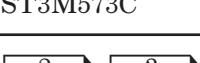
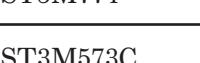
Specified Fastener		Substitute Fastener	
Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
ST3M525N	HL570	ST3M526C	SW1000
ST3M525N	HL570	 ST3M608N	HL582
ST3M525N	HL570	 NAS1291C()M	
ST3M526C	SW1000	 ST3M426C	
ST3M526C	SW1000	 ST3M573C	SW2000
ST3M573C	SW2000	 ST3M774	VN376D
ST3M608N	HL582	ST3M573C	SW2000
1 → Do not substitute in areas with non-magnetic requirement. 2 → Install self-aligning washer, ST3M683 (SW2000), with the substitute fastener. 3 → Applicable self-locking nuts may be used instead of breakoff collars only with applicable torque controls.			

Table 6-43. Lockbolt Pins, Substitution

Specified Fastener		Substitute Fastener	
Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
NAS210()V		ST3M419V ST3M760T	HL13V/613
NAS240()V		NAS200()V	
NAS250 ()V		ST3M415V	
NAS260()V		NAS240()V	
NAS260()V		ST3M416V ST3M526C	HL10V/610
NAS260()V		ST3M428C	SLSPCTEU
NAS270()V		ST3M415V ST3M526C	HL11V/611
NAS270()V		ST3M427C	SLS100CTEU
ST3M427C	SLS100CTEU	ST3M509	270()MU
ST3M428C	SLSPCTEU	ST3M512	260()MU
ST3M509	270()MU	ST3M456 ST3M526C	HL645YE/655YE
ST3M512	260()MU	ST3M457 ST3M759C	HL644YE/654YE
ST3M861V0()A	VLB240	3M1261C()A	AIC3059S
ST3M861V0()A		ST3M852V0()/ C0()	
3M1261C()A	AIC3059S	ST3M852C0()	
The substitute fastener shall be compatible with clearance, thread engagement and protrusion requirements for the specified fastener. Do not substitute when protrusion into bladder type fuel cells would be increased. Do not substitute in locations where loose or unsafetied fastener components may fall or be drawn into an engine air intake, or for installation of control surface hinges and brackets. Install collar, ST3M526C (SW1000), on the substitute fastener.			

Table 6-43. Lockbolt Pins, Substitution (CONT)

Specified Fastener		Substitute Fastener	
Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
4 → When collar, NAS1080AG, is specified, install collar, NAS1080AT, on the substitute fastener.			
5 → The substitute fastener may be reworked to a stump type by breaking away the pull stem, provided the pin and structure are not damaged. The fastener protrusion shall be gaged as a pull type and the collar swage as a stump type.			
6 → Do not substitute in areas with non-magnetic requirements.			

Table 6-44. Lockbolt Collars, Substitution

Specified Fastener		Substitute Fastener	
Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
NAS1080MG	2DC-M	NAS1080UG	2DC-EU
NAS1080MK	6DCM	NAS1080UK	6DC-EU

Table 6-45. Taper-Lok Pins, Substitution

Specified Fastener		Substitute Fastener	
Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
NAS1724V	TLV100	1 → NAS1724D	TLD100
NAS1728V	TLV200	1 → NAS1728D	TLD200
ST3M429V	TLV300L	ST3M429C	TLC300L
1 → Do not substitute in areas with non-magnetic requirements.			

Table 6-46. Taper-Lok Nuts, Substitution

Specified Fastener		Substitute Fastener	
Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
ST3M426C	TLN1002CD3	1 → ST3M468C	TLN1023CD3
1 → Install self-aligning washer, ST3M469C (TLN1023CD3L) with the substitute fastener.			

Table 6-47. Milson Sleeve Bolt, Substitution

Specified Fastener		Substitute Fastener	
Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
3M303A5-()		ST3M734-5W()	

Table 6-47. Milson Sleeve Bolt, Substitution (CONT)

Specified Fastener		Substitute Fastener	
Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
ST3M734-5W()		1 ➤ 3M303A5-()	
3M302A		ST3M783	
ST3M783		1 ➤ 3M302A	
1 ➤ Substitution is not authorized for locations exposed to fuel, hydraulic fluid, grease or oil; or where temperatures may exceed 450 degrees Fahrenheit.			

Table 6-48. Milson Receptacle, Substitution

Specified Fastener		Substitute Fastener	
Part No.	Equivalent Part No.	Part No.	Equivalent Part No.
3M304-()-()-()	1950-()-()-()	1 ➤ 3M304C()-()-()	195012-()-()-()
1 ➤ It is allowable to substitute any Milson receptacle with an increased length of up to two grip lengths, provided there is no interference resulting from the increased length.			

SECTION VII

ONE-TIME FERRY FLIGHT

7-1. DESCRIPTION.

7-2. Repairs in this section allow one-time ferry flight from a battle zone to a depot facility. Since it is not possible to anticipate all the various types of penetration damage that may happen during combat, it is also not practical to establish well defined limits on the amount of repairable structural damage. Damage limits, as minimum distance between repairs, fastener spacing, edge distance, and repair material are established either in text or on the figure. The repairs do not necessarily include all the detail procedures, such as corrosion protection and finish system requirements. Therefore, personnel who use this section are cautioned to use good judgement in selection and use of applicable repairs, and to give careful consideration to limits associated with the different repairs. Special attention shall be given to structural components with penetration damage in multiple locations. For repair of damage to aircraft components not covered in this section, and for damage exceeding the repairable limits, refer to AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH.

7-3. MAJOR STRUCTURAL GROUPS. See figure 7-1.

7-4. The major structural groups are: wing group, empennage, fuselage group, and landing gear group.

7-5. **WING GROUP.** The wing group includes the inboard and outboard leading edge, torque box,

inboard and outboard trailing edge, wing tip, flap, and aileron.

7-6. **EMPENNAGE.** The empennage includes the horizontal stabilator, rudder, and vertical stabilizer.

7-7. **FUSELAGE GROUP.** The fuselage group includes the radome, transparencies, fuselage, and speed brake.

7-8. **LANDING GEAR.** The landing gear is made up of the nose landing gear doors and main landing gear doors.

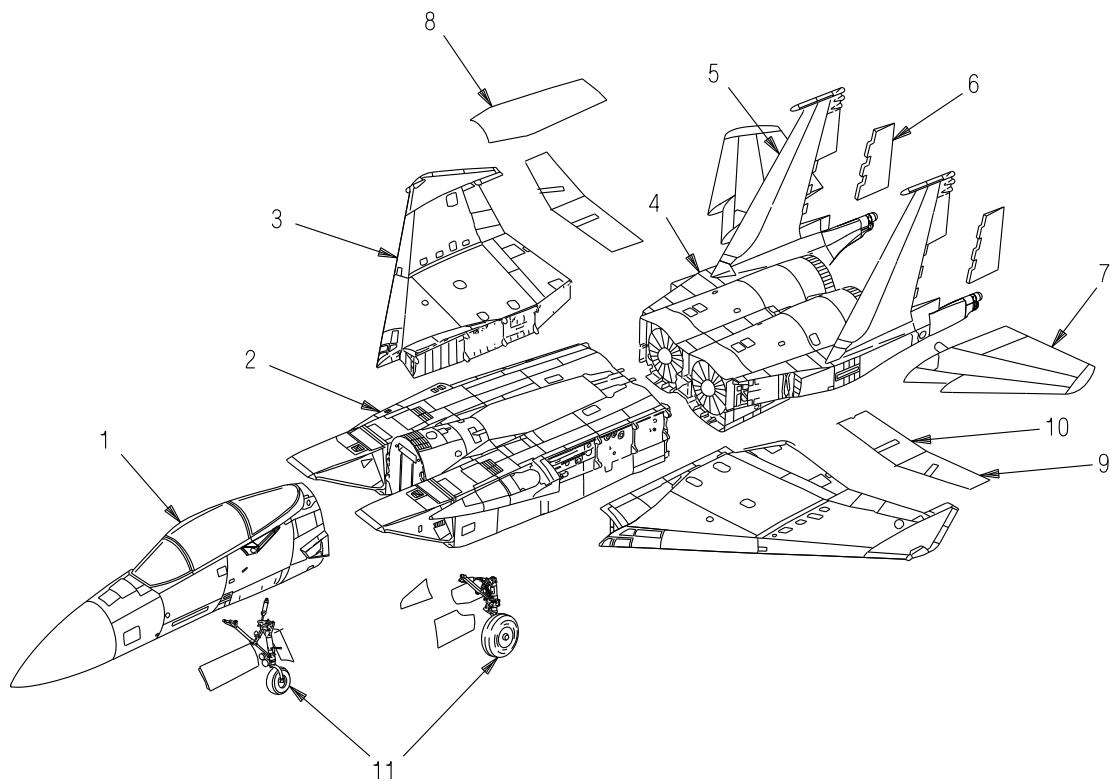
7-9. FERRY FLIGHT PLACARD.

7-10. One-time ferry flight repairs are not designed to return the damaged area to original static and fatigue strength, but only to allow aircraft to be flown from the battle zone to a depot facility for permanent repair. Whenever a one-time flight repair is installed, the ferry flight placard below shall be placed in the cockpit.

WARNING

The aircraft load factor during the ferry flight shall be limited from 0 to 2.5g with speed limited to the lesser of 350 knots EAS (equivalent airspeed) or 0.8 Mach. Roll maneuvers shall not exceed one-half stick deflection.

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INDEX NO	COMPONENT
1	FORWARD FUSELAGE
2	CENTER FUSELAGE
3	WINGS
4	AFT FUSELAGE
5	VERTICAL STABILIZERS
6	RUDDERS
7	HORIZONTAL STABILATORS
8	SPEED BRAKE
9	AILERONS
10	FLAPS
11	LANDING GEAR

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Figure 7-1. Aircraft Structural Index

7-11. **WING GROUP.** See figure 7-2.

WARNING

Personnel and aircraft safety shall be per TO 1-1-3, and applicable directives when doing repairs to fuel-wet wing areas.

7-12. The wing group section is divided into eight subsections: inboard leading edge, outboard leading edge, torque box, inboard trailing edge, outboard trailing edge, wing tip, flap, and aileron.

7-13. **LEADING EDGE, INBOARD.** See figure 7-2.

7-14. Repair for the inboard leading edge, one of the fuel-wet areas, is per the below.

7-15. **Skin Repair for Damage Up to 150 Square Inches.** See figure 7-3.

7-16. Limitations.

a. There shall be a minimum of two undamaged frames between repairs.

7-17. Materials.

Sealing compound, AMS 3276 A-1/2

7-18. Procedure.

a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical, or rectangular, with no reentrant corners. Minimum corner radius shall be 1 inch. Refer to section III.

b. Fabricate, fay surface seal, and install repair doubler. See figure 7-3. For repair doubler, refer to section III; for sealing, refer to CSTO SR1F-15SA-3-5.

c. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.

d. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-19. **LEADING EDGE, OUTBOARD.** See figure 7-2.

7-20. Repair for the outboard leading edge is per the below.

7-21. **Skin Repair for Damage Up to 150 Square Inches.** See figure 7-3.

7-22. Limitations.

a. There shall be a minimum of two undamaged frames between repairs.

7-23. Materials.

Sealing compound, AMS 3276 A-1/2

7-24. Procedure.

a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical, or rectangular, with no reentrant corners. Minimum corner radius shall be 1 inch. Refer to section III.

b. Fabricate, fay surface seal, and install repair doubler. See figure 7-3. For repair doubler, refer to section III; for sealing, refer to CSTO SR1F-15SA-3-5.

c. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.

d. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-25. **TORQUE BOX.** See figure 7-2.

7-26. Repairs for the torque box, one of the fuel-wet wing areas, are per the below.

7-27. **Skin Repair for Damage Up to 2 Inches In Diameter In Integral Stiffener Area.** See figure 7-4.

7-28. Limitations.

a. Clean-up hole shall not extend into internal structure.

b. Only one repair per skin.

c. Repair fastener holes shall be a minimum of 1 inch away from existing fastener holes and shall not fall in integral stiffener land areas.

d. Minimum spacing between repairs shall be 20 inches.

7-29. Materials.

Sealing compound, AMS 3276 A-1/2

CSTO SR1F-15SA-3-1

- 7-30. Procedure.
- a. Remove visible damage using minimum size diameter hole. Refer to section III.
 - b. Do a fluorescent penetrant inspection to be sure of damage removal. Refer to TO 33B-1-1.
 - c. Scarf off the integral stiffener. See figure 7-4, section D-D. Refer to section III.
 - d. Fabricate, fay surface seal, and install repair doubler. See figure 7-4. For repair doubler, refer to section III; for sealing, refer to CSTO SR1F-15SA-3-5.
 - e. Make a log book entry for repair to be reviewed by a structural engineer at depot facility. Refer to TO 00-20-1.
- 7-31. **Internal Structure Repairs.** For repair of internal structure, refer to CSTO SR1F-15SA-3-2-1.
- 7-32. **Skin Repair for Damage Up to 25 Square Inches, Free of Internal Structure and Integral Stiffeners.** See figure 7-5.
- 7-33. Limitations.
- a. Clean-up hole shall be a minimum of 0.75 inch away from internal structure, near integral stiffener land areas, and existing fasteners.
 - b. Minimum spacing between repairs shall be 15 inches.
- 7-34. Materials.
- Sealing compound, AMS 3276 A-1/2
- 7-35. Procedure.
- a. Remove visible damage using minimum size hole. Clean-up hole may be either circular, elliptical, or rectangular with no reentrant corners. Minimum corner radius shall be 1 inch. Refer to section III.
 - b. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.
 - c. Fabricate repair doublers and install plate nuts. Refer to section III. See figure 7-5.
- d. Fay surface seal and install repair doublers. Install fastener wet with sealing compound. See figure 7-5. For sealing, refer to CSTO SR1F-15SA-3-5.
 - e. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
 - f. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.
- 7-36. **Skin Repair for Damage Up to 25 Square Inches, Over Integral Stiffeners.** See figure 7-6.
- 7-37. Limitations.
- a. Clean-up hole shall be a minimum of 1.25 inches away from internal structure, near integral stiffener land areas, and existing fasteners.
 - b. Only one repair per skin.
 - c. Minimum spacing between repairs shall be 15 inches.
- 7-38. Materials.
- Sealing compound, AMS 3276 A-1/2
- 7-39. Procedure.
- a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical or rectangular, with no reentrant corners. Minimum corner radius shall be 1 inch. Refer to section III.
 - b. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.
 - c. Scarf off integral stiffener. See figure 7-6, section A-A. Refer to section III.
 - d. Fabricate repair doublers, fillers, and install plate nuts. Refer to section III. See figure 7-6.
 - e. Fay surface seal and install repair parts. Install fasteners wet with sealing compound. For sealing, refer to CSTO SR1F-15SA-3-5.
 - f. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
 - g. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-40. Skin Repair for Damage Up to 150 Square Inches, Over Two Integral Stiffeners. See figure 7-7.

7-41. Limitations.

- a. Clean-up hole shall be a minimum of 1.25 inches away from adjacent structure and integral stiffener land areas.
- b. Repair fasteners shall be a minimum of 1 inch away from existing fastener holes.
- c. Only one repair per skin.
- d. Minimum spacing between repairs shall be 12 inches chordwise.

7-42. Materials.

Sealing compound, AMS 3276 A-1/2

7-43. Procedure.

- a. Remove visible damage using minimum size diameter hole. Refer to section III.
- b. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.
- c. Scarf off integral stiffeners. See figure 7-7, section B-B. Refer to section III.
- d. Fabricate, fay surface seal, and install repair doubler. Install fasteners wet with sealing compound. See figure 7-7. For repair doubler, refer to section III; for sealing, refer to CSTO SR1F-15SA-3-5.
- e. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
- f. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-44. TRAILING EDGE, INBOARD. See figure 7-2.

7-45. The inboard trailing edge is divided into two repair zones; fueled area, which is part of the wing fuel tank, and nonfueled area. For location of fueled area, refer to CSTO SR1F-15SA-3-2-1.

7-46. Fueled Area. Repairs for fueled area of inboard trailing edge are per the below.

7-47. Skin Repair for Damage not Exceeding 25 Square Inches, Over Structure. See figure 7-8.

7-48. Limitations.

- a. Clean-up hole shall not extend into internal structure, unless internal structure is repaired.
- b. One repair per skin panel.

7-49. Materials.

Sealing compound, AMS 3276 A-1/2

7-50. Procedure.

- a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical, or rectangular, with no reentrant corners. Minimum corner radius shall be 0.500 inch. Refer to section III.
- b. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.
- c. Fabricate, fay surface seal, and install repair doubler and fillers. See figure 7-8. For repair doubler and fillers, refer to section III; for sealing, refer to CSTO SR1F-15SA-3-5.
- d. Make a log book entry for repair to be reviewed by a structural engineer at depot facility. Refer to TO 00-20-1.

7-51. Internal Structure Repairs. For repair of internal structure, refer to CSTO SR1F-15SA-3-2-1.

7-52. Skin Repair for Damage Up to 150 Square Inches. See figure 7-9.

7-53. Limitations.

- a. There shall be no damage to flap actuator drive ribs, actuator support fitting, and adjacent ribs.
- b. One repair per skin panel.

7-54. Materials.

Sealing compound, AMS 3726 A-1/2

CSTO SR1F-15SA-3-1

7-55. Procedure.

- a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical, or rectangular, with no reentrant corners. Minimum corner radius shall be 1 inch. Refer to section III.
- b. Trim out visible damage to internal structure, using 0.250 inch minimum radius. Refer to section III.
- c. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.
- d. Fabricate, fay surface seal, and install repair doubler. See figure 7-9. For repair doubler, refer to section III; for sealing, refer to CSTO SR1F-15SA-3-5.
- e. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
- f. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-56. Nonfueled Area. Repair for nonfueled area of inboard trailing edge is per the below.

7-57. Skin Repair for Damage Up to 150 Square Inches. See figure 7-9.

7-58. Limitations.

- a. There shall be no damage to flap actuator drive ribs, actuator support fitting, and adjacent ribs.

- b. One repair per skin panel.

7-59. Materials.

Sealing compound, AMS 3276 A-1/2

7-60. Procedure.

- a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical, or rectangular, with no reentrant corners. Minimum corner radius shall be 1 inch. Refer to section III.
- b. Trim out visible damage to internal structure, using 0.250 inch minimum radius.

- c. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.
- d. Fabricate, fay surface seal, and install repair doubler. See figure 7-9. For repair doubler, refer to section III; for sealing, refer to CSTO SR1F-15SA-3-5.
- e. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
- f. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-61. TRAILING EDGE, OUTBOARD. See figure 7-2.

7-62. Repairs for outboard trailing edge are per the below.

7-63. Skin Repair for Damage not Exceeding 25 Square Inches, Over Structure. See figure 7-8.

7-64. Limitations.

- a. Clean-up hole shall not extend into internal structure, unless internal structure is repaired.
- b. One repair per skin panel.

7-65. Materials.

Sealing compound, AMS 3276 A-1/2

7-66. Procedure.

- a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical or rectangular, with no reentrant corners. Minimum corner radius shall be 0.500 inch. Refer to section III.
- b. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.
- c. Fabricate, fay surface seal, and install repair doubler and fillers. See figure 7-8. For repair doubler and fillers, refer to section III; for sealing, refer to CSTO SR1F-15SA-3-5.
- d. Make a log book entry for repair to be reviewed by a structural engineer at depot facility. Refer to TO 00-20-1.

7-67. Internal Structure Repairs. For repair of internal structure, refer to CSTO SR1F-15SA-3-2-1.

7-68. Skin Repair for Damage Up to 150 Square Inches. See figure 7-9.

7-69. Limitations.

- a. There shall be no damage to ribs near to aileron actuator and actuator support fitting.
- b. One repair per skin panel.

7-70. Materials.

Sealing compound, AMS 3276 A-1/2

7-71. Procedure.

- a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical, or rectangular, with no reentrant corners.
Minimum corner radius shall be 1 inch. Refer to section III.

b. Trim out visible damage to internal structure, using 0.250 inch minimum radius. Refer to section III.

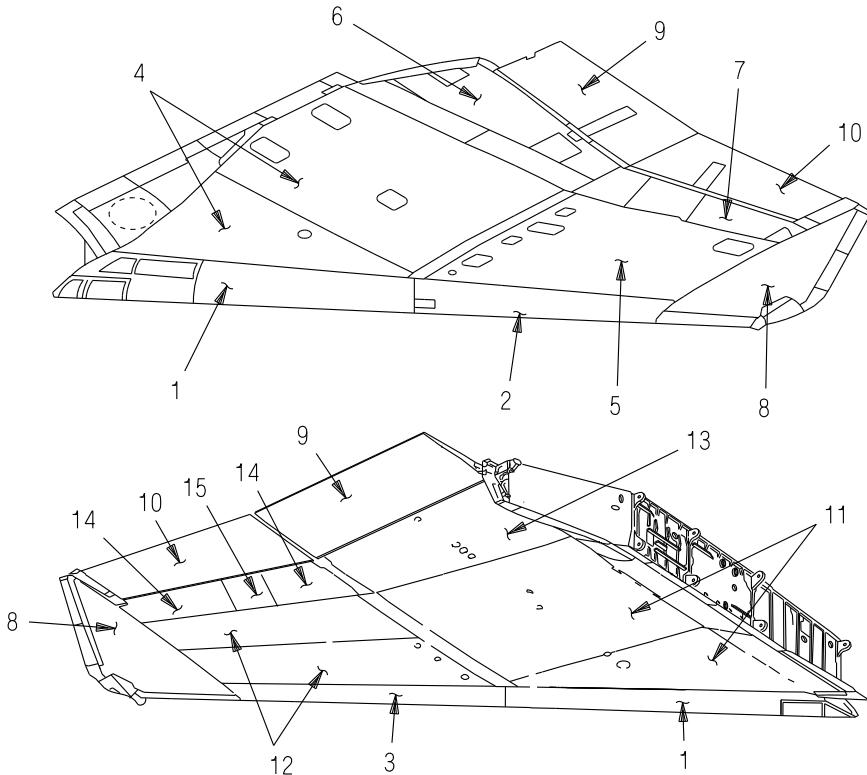
c. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.

d. Fabricate, fay surface seal, and install repair doubler. See figure 7-9. For repair doubler, refer to section III; for sealing, refer to CSTO SR1F-15SA-3-5.

e. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.

f. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

CSTO SR1F-15SA-3-1



IDX NO.	ITEM	MATERIAL
1	LEADING EDGE, INBOARD	2024-T62 AL ALY AMS-QQ-A-250/4
2	LEADING EDGE, OUTBOARD	2124-T851 AL ALY AMS-QQ-A-250/29
3	UPPER SURFACE	2124-T851 AL ALY AMS-QQ-A-250/29
4	LOWER SURFACE	2124-T851 AL ALY AMS-QQ-A-250/29
5	TORQUE BOX, INBOARD	2024-T851 AL ALY AMS-QQ-A-250/4
6	UPPER SURFACE	2024-T851 AL ALY AMS-QQ-A-250/4
7	LOWER SURFACE	2024-T851 AL ALY AMS-QQ-A-250/4
8	TRAILING EDGE, INBOARD	7075-T7651 AL ALY AMS-QQ-A-250/25
9	UPPER SURFACE	7075-T7651 AL ALY AMS-QQ-A-250/25
10	TRAILING EDGE, OUTBOARD	2024-T81 ALCLAD AMS-QQ-A-250/5
11	UPPER SURFACE	7075-T7651 AL ALY AMS-QQ-A-250/18
12	WING TIP	7075-T6 ALCLAD AMS-QQ-A-250/18
13	FLAP	2024-T851 AL ALY AMS-QQ-A-250/4
14	AILERON	7075-T7651 AL ALY AMS-QQ-A-250/25
15	LOWER SURFACE	6AL-4V TI ANL AMS-4911
	TORQUE BOX, OUTBOARD	2124-T851 AL ALY AMS-QQ-A-250/29
	LOWER SURFACE	7075-T76 AL ALY AMS-QQ-A-250/12
	TRAILING EDGE, INBOARD	7075-T76 AL ALY AMS-QQ-A-250/13
	UPPER SURFACE	6AL-4V TI ANL AMS-4911
	TRAILING EDGE, OUTBOARD	7075-T76 ALCLAD AMS-QQ-A-250/13
	LOWER SURFACE	6AL-4V TI ANL AMS-4911
	TRAILING EDGE, OUTBOARD	7075-T76 ALCLAD AMS-QQ-A-250/13
	LOWER SURFACE	6AL-4V TI ANL AMS-4911

SAN301-07-2-001

Figure 7-2. Wing Group Material Index

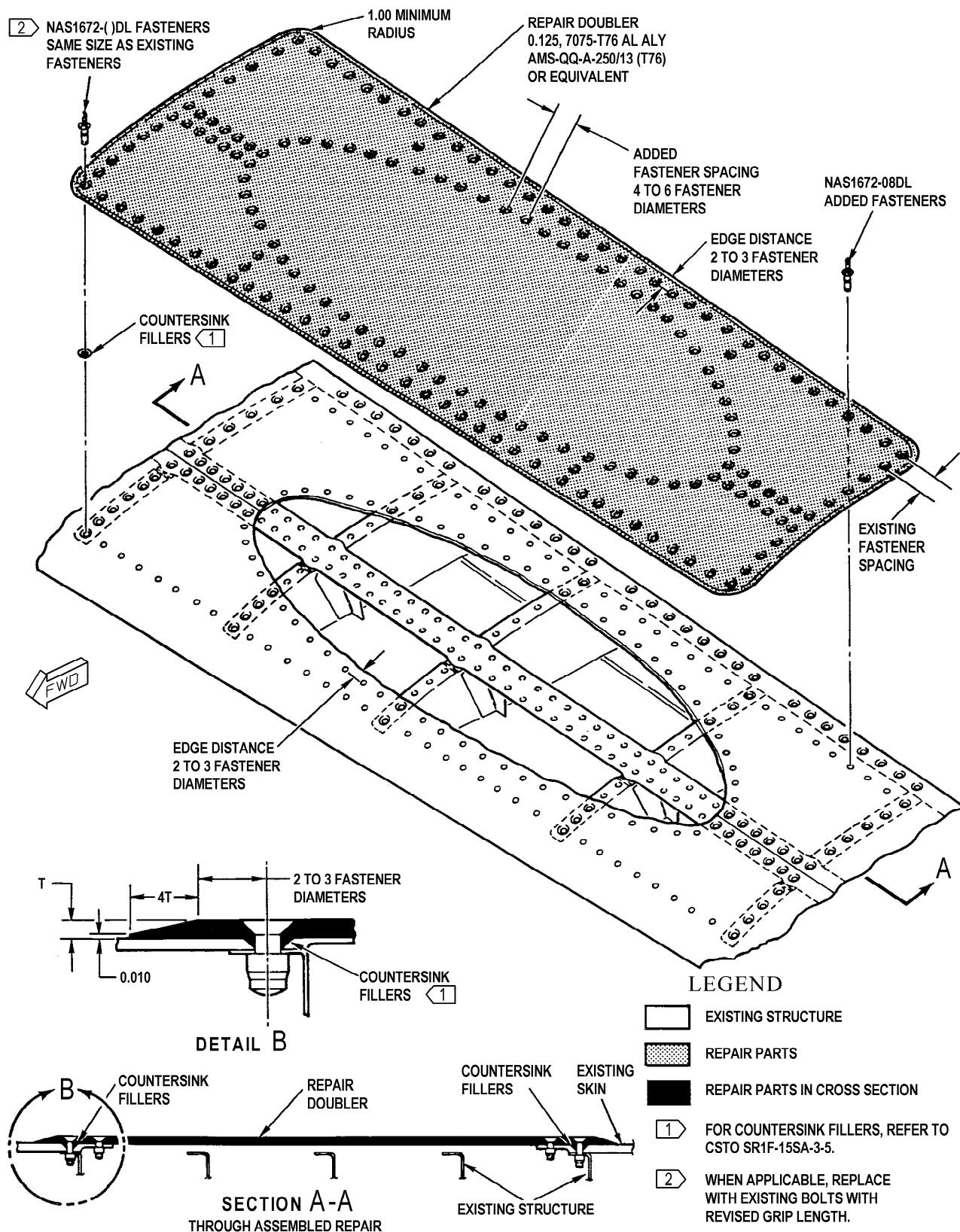
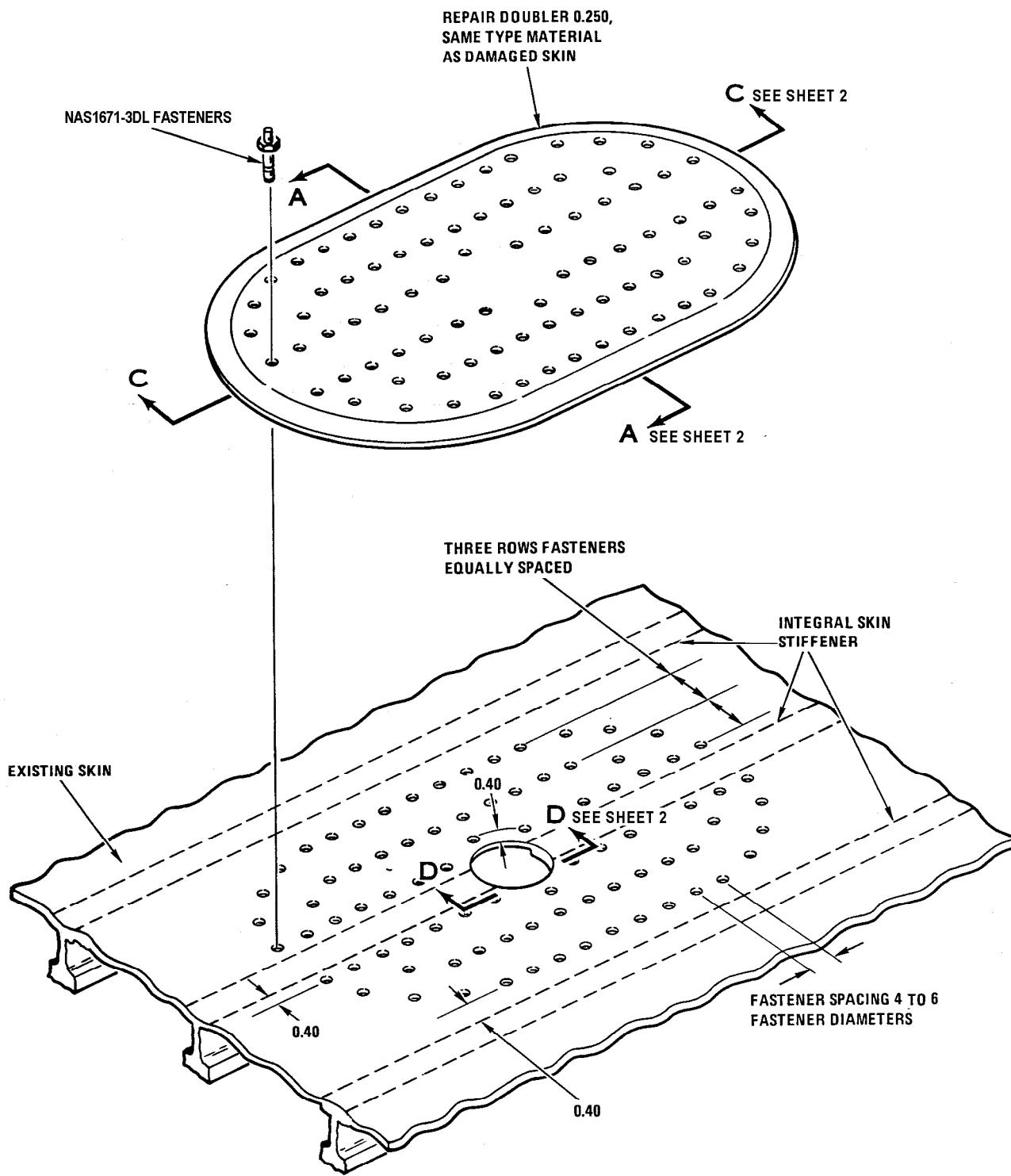


Figure 7-3. Skin Repair for Damage Up to 150 Square Inches

SAN301-07-3-002



SAN301-07-4-002

Figure 7-4. Skin Repair for Damage Up to 2 Inches In Diameter In Integral Stiffener Area
(Sheet 1 of 2)

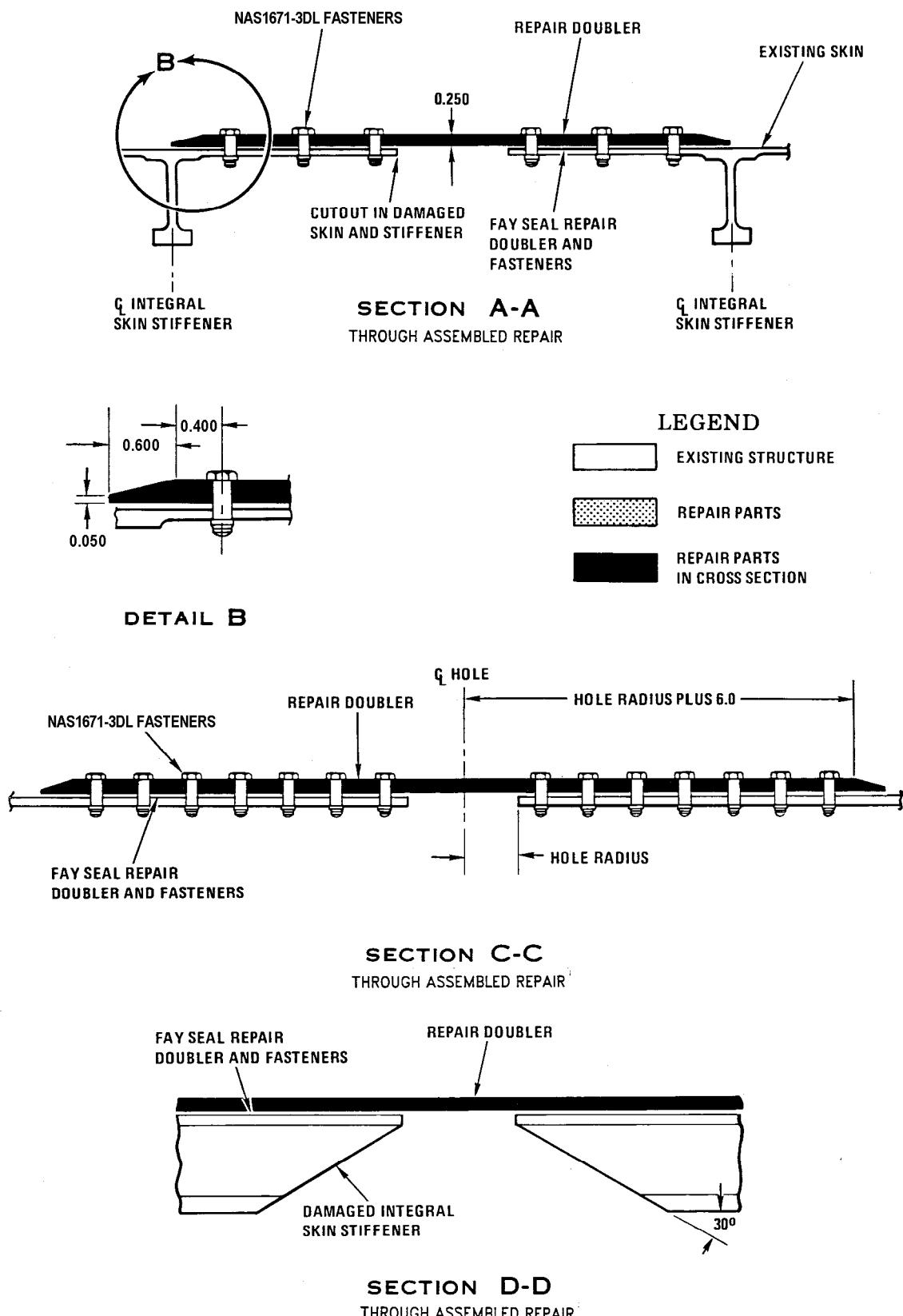


Figure 7-4. Skin Repair for Damage Up to 2 Inches In Diameter In Integral Stiffener Area
(Sheet 2)

SAN301-07-5-002

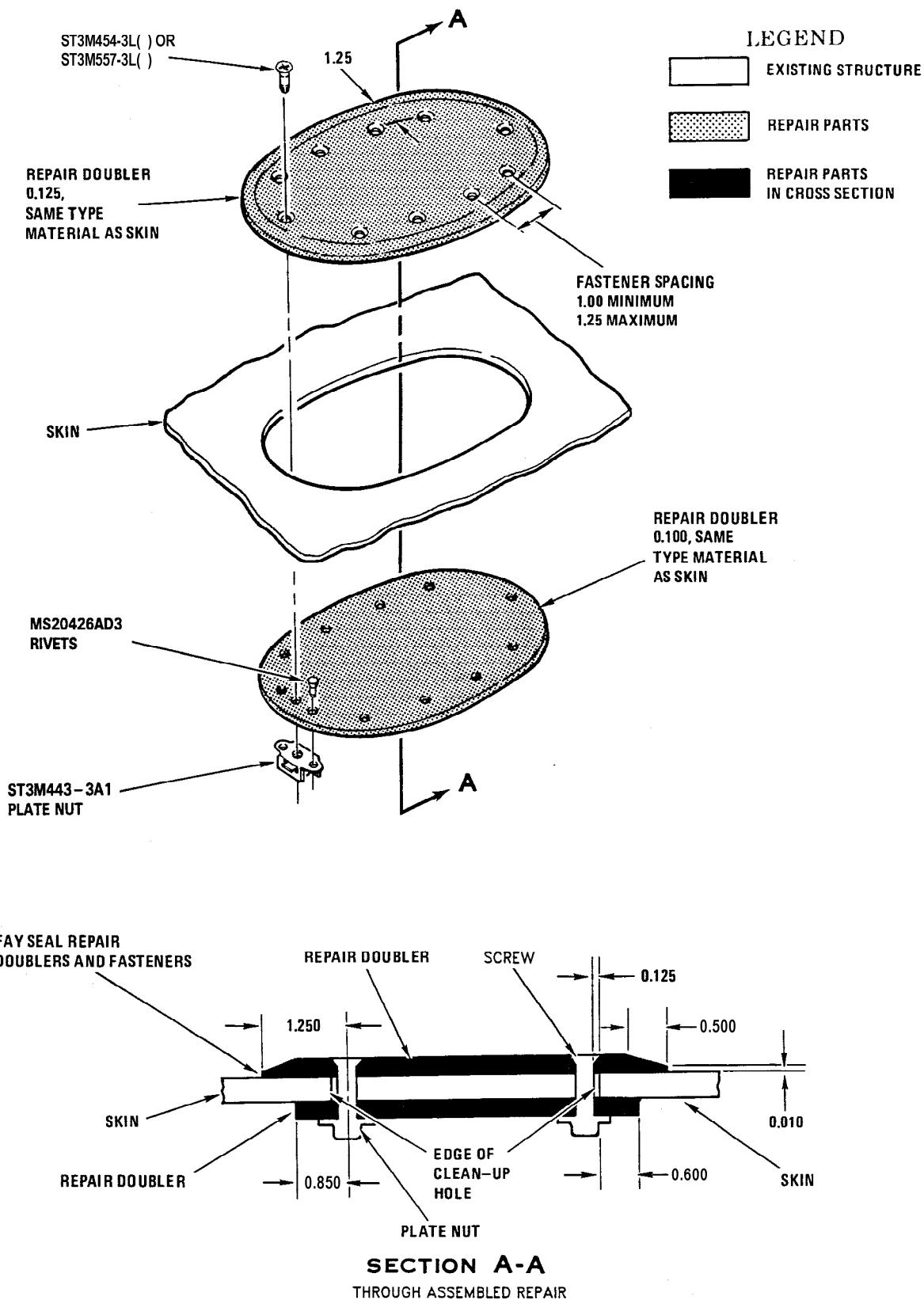


Figure 7-5. Skin Repair for Damage Up to 25 Square Inches, Free of Internal Structure and Integral Stiffeners

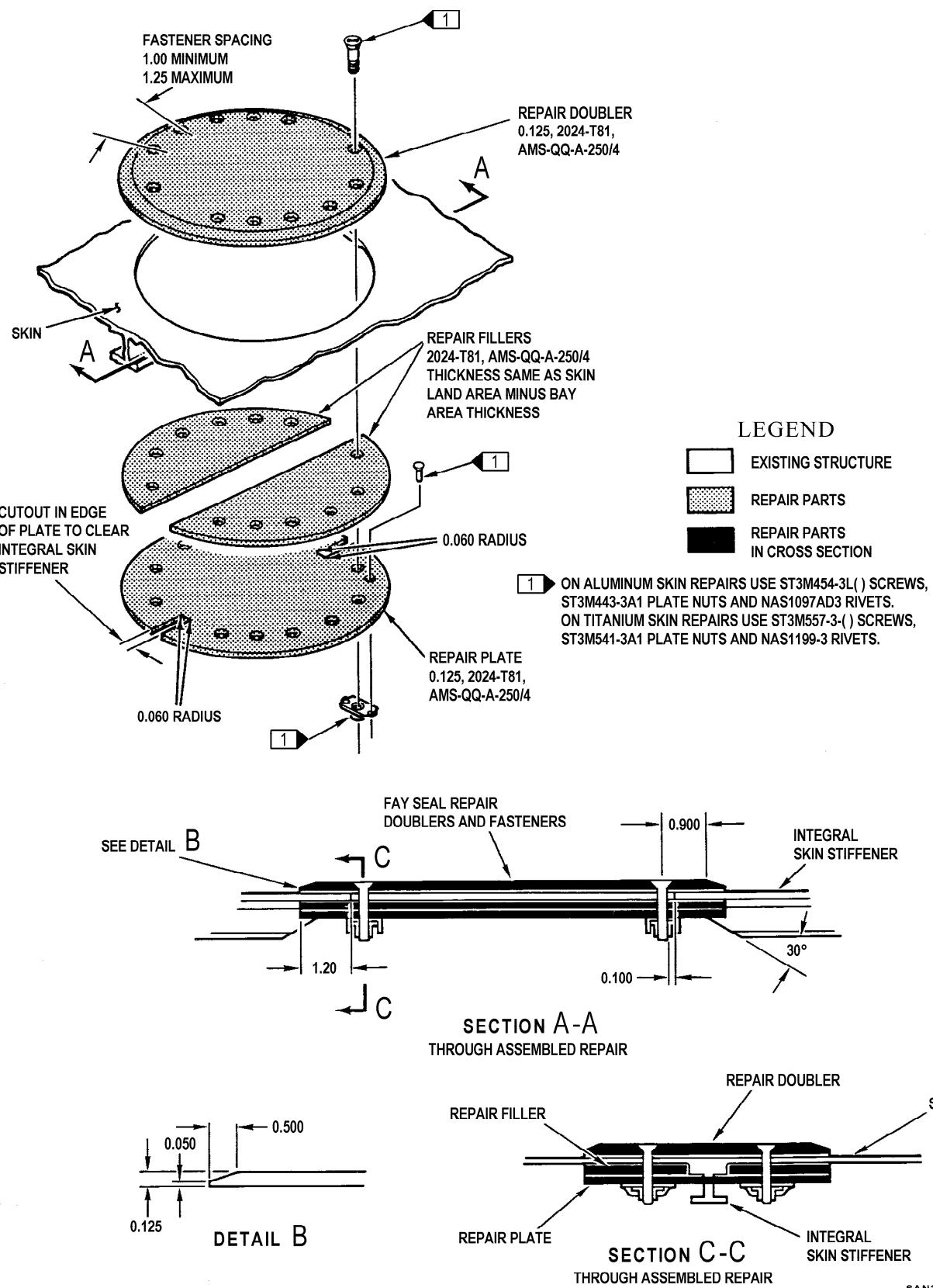
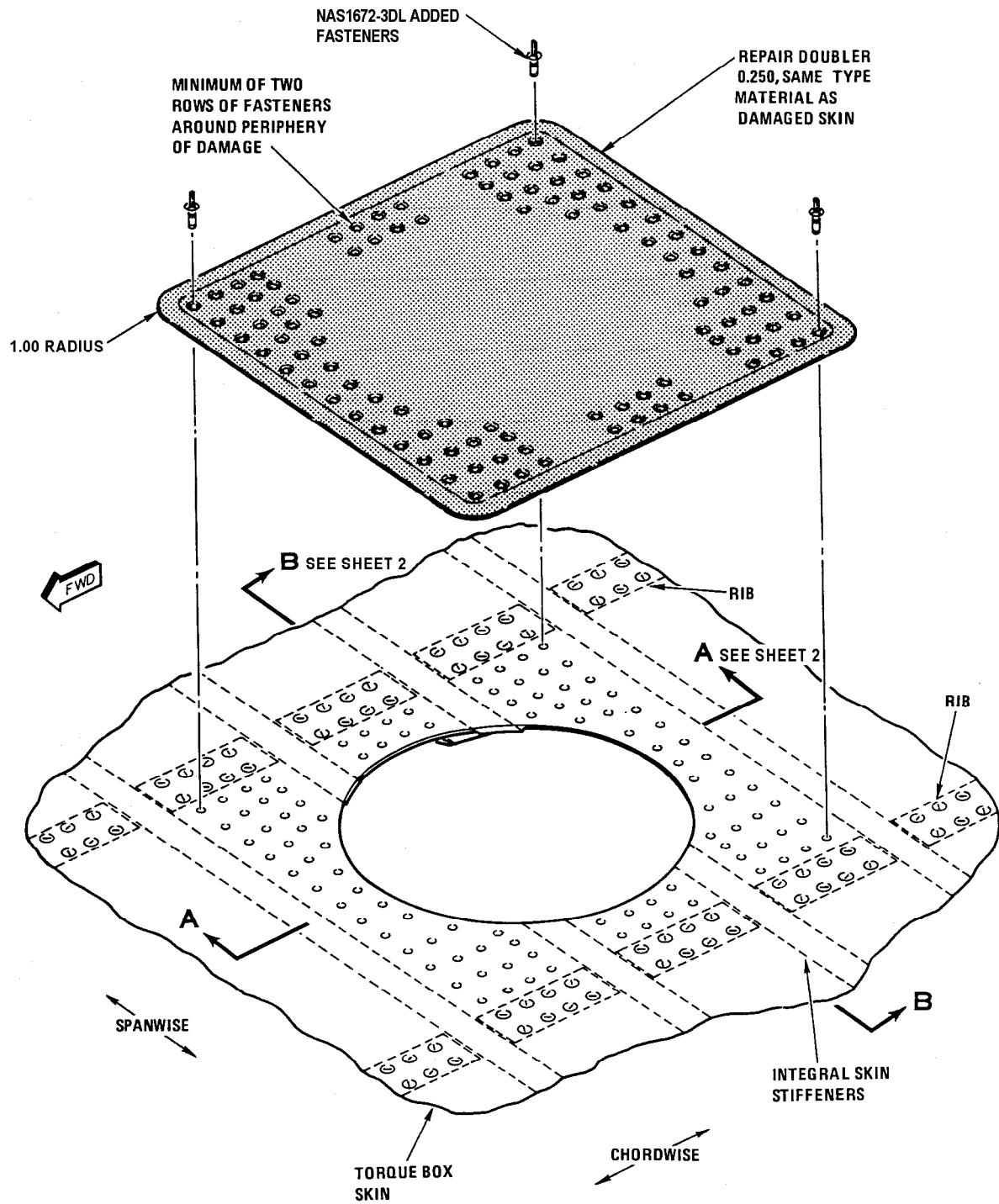


Figure 7-6. Skin Repair for Damage Up to 25 Square Inches, Over Integral Stiffeners



SAN301-07-8-002

Figure 7-7. Skin Repair for Damage Up to 150 Square Inches, Over Two Integral Stiffeners
(Sheet 1 of 2)

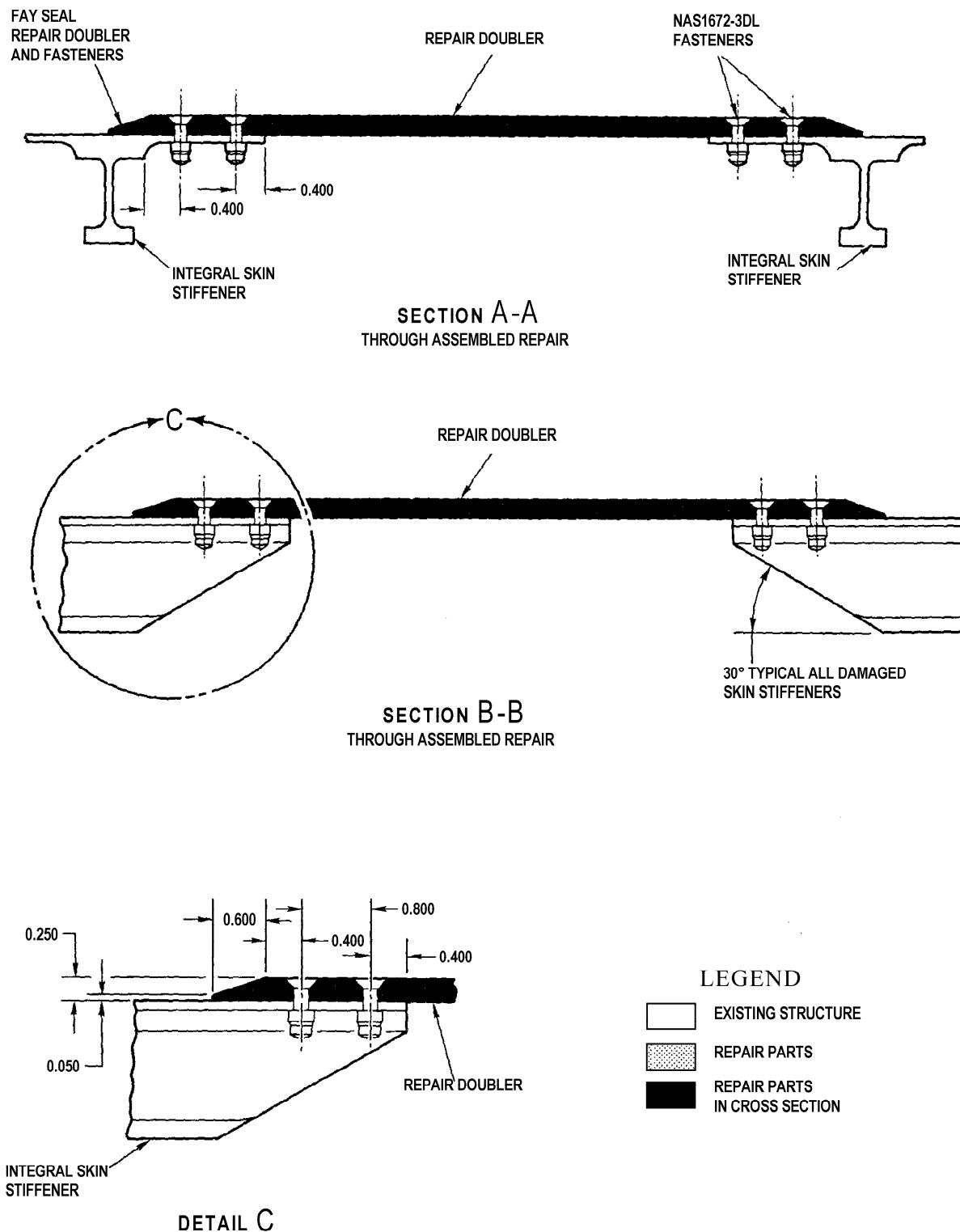


Figure 7-7. Skin Repair for Damage Up to 150 Square Inches, Over Two Integral Stiffeners
(Sheet 2)

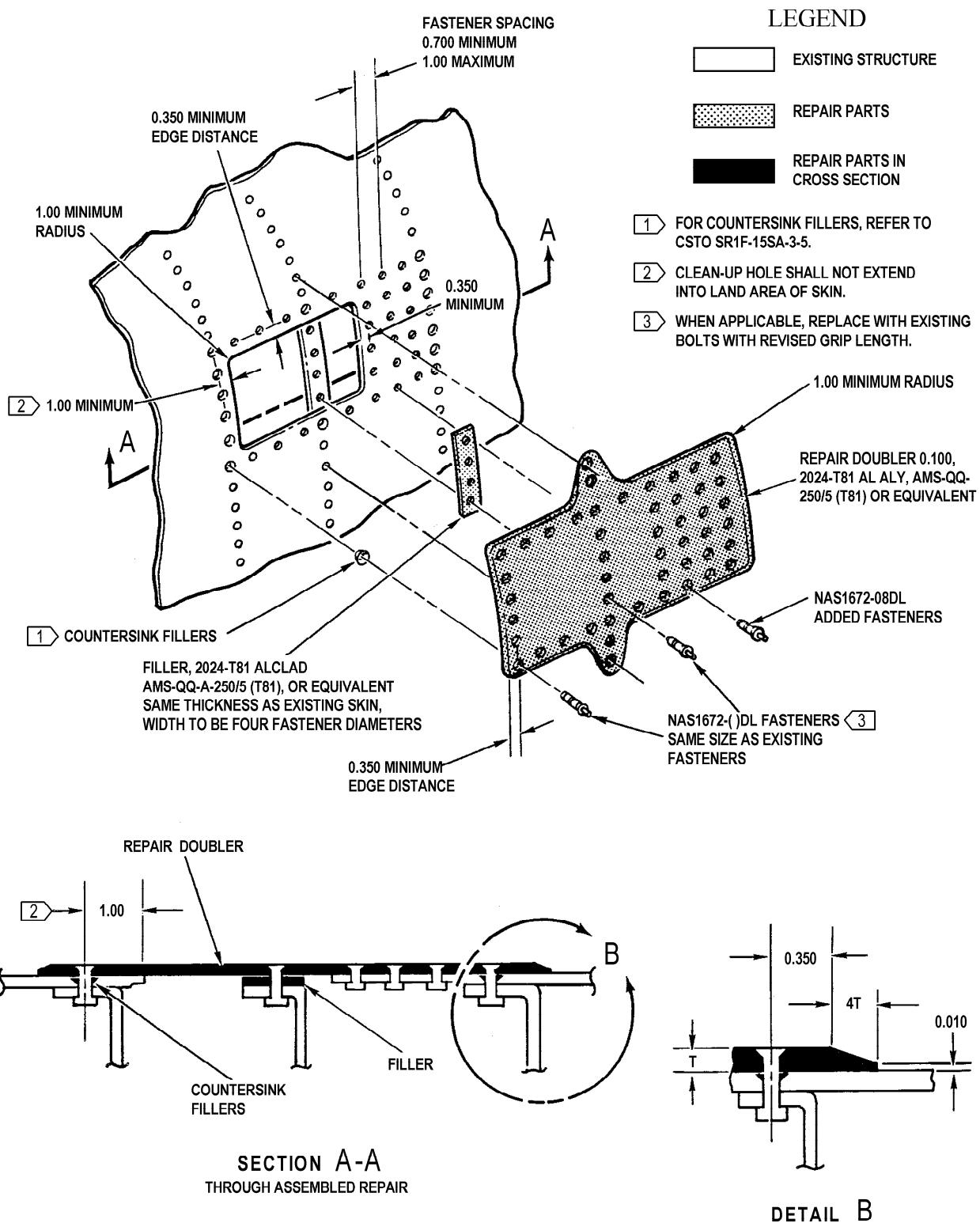


Figure 7-8. Skin Repair for Damage not Exceeding 25 Square Inches, Over Structure

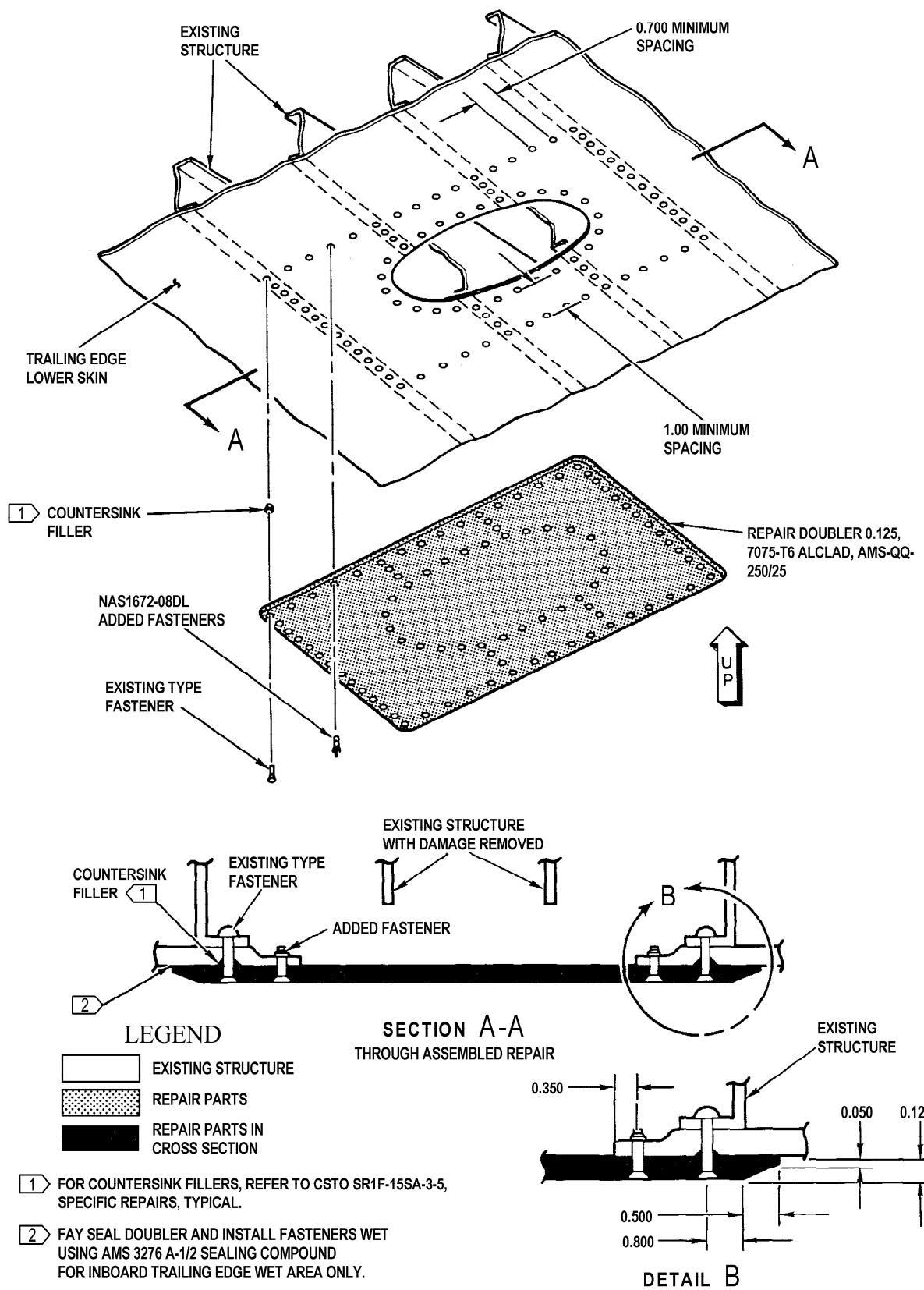


Figure 7-9. Skin Repair for Damage Up to 150 Square Inches

CSTO SR1F-15SA-3-1

7-72. **WING TIP.** Refer to CSTO SR1F-15SA-3-5 for Grid-Lock repair procedures.

7-73. **FLAP.** See figure 7-2.

7-74. Repairs for flap are per the below.

7-75. Repair of Grid-Lock Skin and Integral Stiffener for Damage Up to 8 Square Inches, with Tape or Cloth.

7-76. Limitations.

a. Clean-up hole shall not extend into internal structure, except for the skin spanwise integral stiffeners, which may be cleaned-up to a length matching the skin clean-up limits.

b. Clean-up hole in zone A shall not exceed 0.250 inch diameter. See figure 7-10. Clean-up hole in zone B shall not exceed 0.610 inch diameter.

Clean-up hole in zone C shall not exceed 8 square inches, and the long hole dimension shall not exceed 4 inches.

c. If the flap upstop contact is eliminated, zone B area is reduced and zone C area is enlarged. See figure 7-10.

d. These limitations allow 250 knots EAS, and +1.0g flap deployment.

7-77. Materials.

Cloth, airplane, MIL-C-5646; or equivalent
Sealing compound, AMS 3276 A-1/2
Tape, pressure-sensitive, MIL-T-22085, TY3

7-78. Procedure.

- a. Remove visible damage in skin with minimum size hole. Clean-up hole may be circular, elliptical, or rectangular, with no re-entrant corners. Minimum corner radius shall be 0.250 inch. Refer to section III.
- b. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.

WARNING

Sealing compound is a flammable liquid and vapor. May cause allergic skin reaction. May cause eye, skin, and respiratory irritation. Contains material which may cause cancer. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

- c. Cover hole with tape or cloth and brush coat with sealing compound. Refer to CSTO SR1F-15SA-3-5.
- d. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
- e. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-79. Repair of Skin and Honeycomb Core for Damage Up to 20 Square Inches, Free of Structure.

7-80. Limitations.

a. Clean-up hole shall not extend into internal structure.

b. Clean-up hole in zone A shall not exceed 5 square inches. See figure 7-10.

7-81. Materials.

Cloth, airplane, MIL-C-5646; or equivalent
Sealing compound, AMS 3276 A-1/2
Tape, pressure-sensitive, MIL-T-22085 TY3

7-82. Procedure.

- a. Remove visible damage in skin with minimum size hole. Clean-up hole may be circular, elliptical, or rectangular, with no re-entrant corners. Minimum corner radius shall be 0.500. Refer to section III.
- b. Do a fluorescent penetrant inspection to be sure of complete damage removal. See TO 33B-1-1.
- c. Trim out damaged honeycomb core. See section III.

WARNING

Sealing compound is a flammable liquid and vapor. May cause allergic skin reaction. May cause eye, skin, and respiratory irritation. Contains material which may cause cancer. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

- d. Cover hole with tape or cloth and brush coat with sealing compound. Refer to CSTO SR1F-15SA-3-5.
- e. Make a log book entry for a one time ferry flight. Refer to TO 00-20-5.
- f. Place a ferry flight placard in cockpit. See paragraph 7-9.

7-83. Repair of Skin and Honeycomb Core for Damage Up to 20 Square Inches, with Loss of Continuity in One Rib.

7-84. Limitations. See figure 7-10.

- a. Clean-up hole shall not extend into the three actuator drive ribs.
- b. Clean-up hole in zone A shall not exceed 5 square inches.
- c. No damage allowed in the three actuator drive ribs.
- d. One repair per flap.

7-85. Materials.

Cloth, airplane, MIL-C-5646; or equivalent
Sealing compound, AMS 3276 A-1/2
Tape, pressure-sensitive, MIL-T-22085 TY3

7-86. Procedure.

- a. Remove visible damage using minimum size diameter hole. Clean-up may be circular, elliptical, or rectangular. Minimum corner radius shall be 1.00. See section III.
- b. Trim out visible damage to closure rib using minimum corner radius of 0.250.

- c. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.
- d. Trim out damaged honeycomb core. See section III.
- e. Cover hole with tape or cloth and brush coat with sealing compound. Refer to CSTO SR1F-15SA-3-5.
- f. Remove flap upstop fitting if inboard closure rib is damaged. See figure 7-10, section A-A.
- g. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-5.
- h. Place a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-87. Repair of Skin and Honeycomb Core for Damage from 20 to 80 Square Inches, with Loss of Continuity in One Rib.

7-88. Limitations. See figure 7-10.

- a. Clean-up hole shall not extend into the three actuator drive ribs.
- b. No damage allowed in zone A.
- c. No damage allowed in the three actuator drive ribs.
- d. Clean-up hole in zone B shall not exceed 20 square inches.
- e. Clean-up hole in zone C shall not exceed 80 square inches.
- f. One repair per flap.

7-89. Materials.

Sealing compound, AMS 3276 A-1/2

7-90. Procedure.

- a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical, or rectangular with no re-entrant corners. Minimum corner radius shall be 0.500. Refer to section III.
- b. Trim out visible damage to closure rib using minimum corner radius of 0.250.

- c. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.
- d. Trim out damaged honeycomb core. Refer to section III.

WARNING

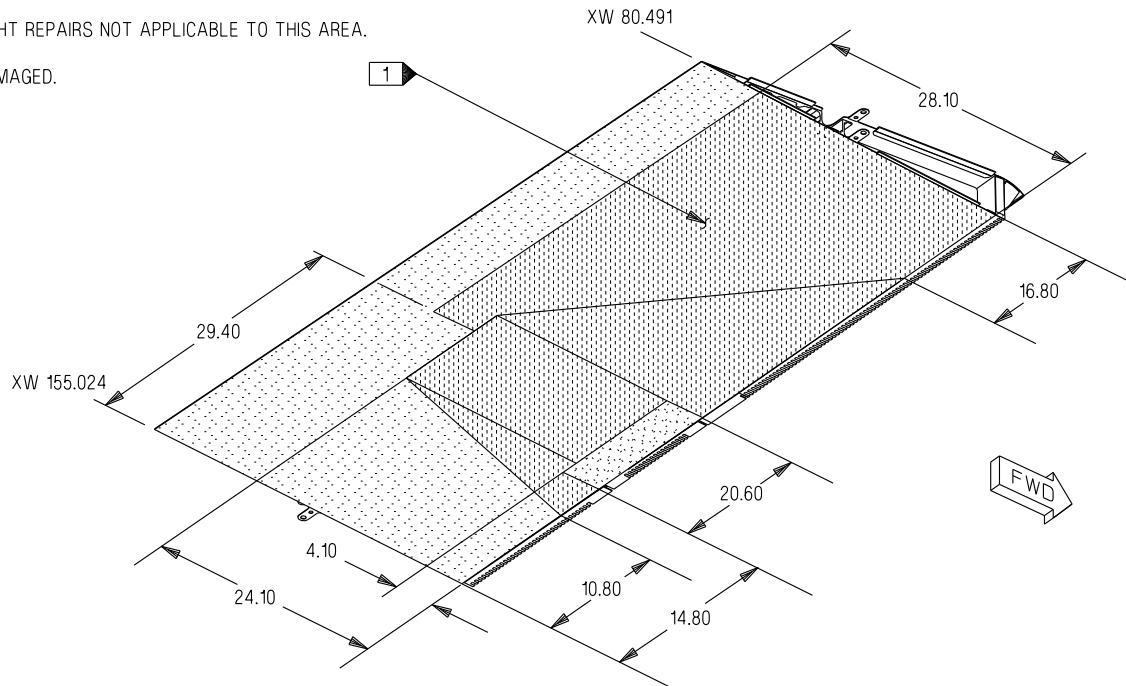
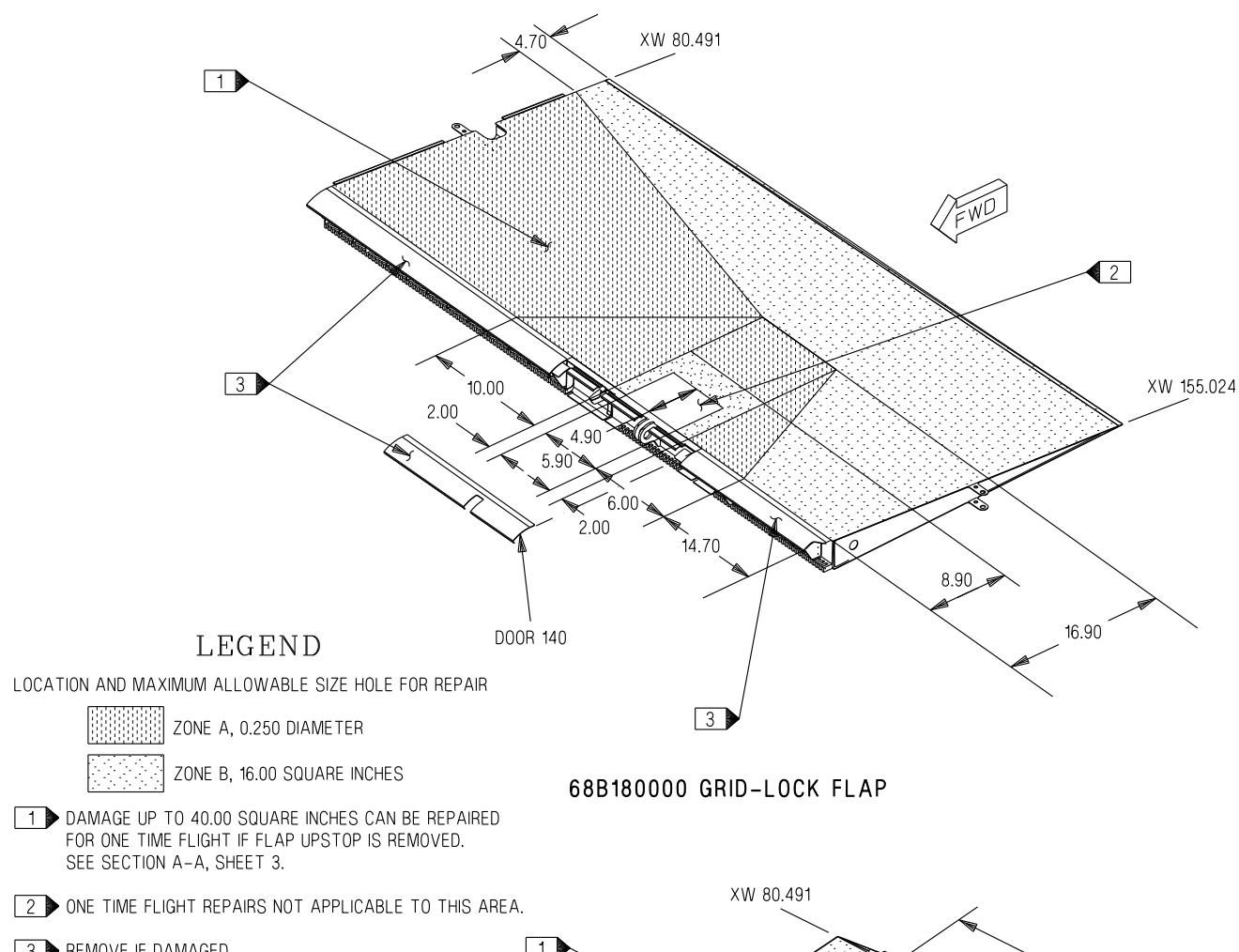
Sealing compound is a flammable liquid and vapor. May cause allergic skin reaction. May cause eye, skin, and respiratory irritation. Contains material which may cause cancer. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

- e. Fabricate, fay surface seal, and install repair doubler. See figure 7-12. For repair doubler, see section III; for sealing, refer to CSTO SR1F-15SA-3-5.
- f. Remove flap upstop fitting if inboard closure rib is damaged. See figure 7-11, section A-A.
- g. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-5.
- h. Place a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-91. Repair of Grid-Lock Skin and Integral Stiffeners for Damage Up to 40 Square Inches, with Loss of Continuity In One Rib. See figure 7-11.**7-92. Limitations.** See figure 7-10.

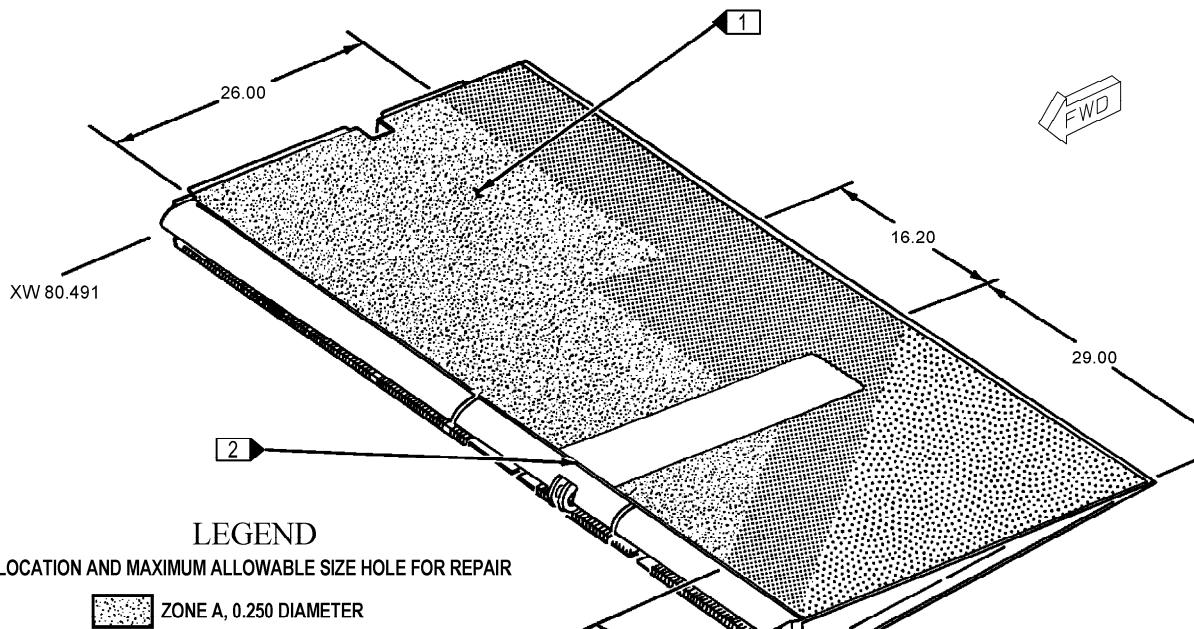
- a. Clean-up hole shall not extend into the five actuator drive ribs, or the closure ribs.
- b. No damage allowed in zone A.
- c. No damage allowed in the five actuator drive ribs, or the closure ribs.
- d. Clean-up hole in zone B shall not exceed 16 square inches.

- e. Clean-up hole in zone C shall not exceed 40 square inches.
 - 1. Spanwise skin damage not to exceed 4 inches.
 - 2. Chordwise damage not to exceed 10 inches.
 - f. Multiple repairs are possible. Minimum spacing between repairs is four times the maximum dimension of the largest clean-up hole.
 - g. Upper and lower surface damage in the same area may be repaired as long as the former damage is less than 4 inches long. If the former damage is greater than 4 inches long the former damage is limited to 50 percent of the former height, and the former must be continuously attached to one skin.
- 7-93. Materials.
- Sealing compound, AMS 3276 A-1/2
- 7-94. Procedure.
- a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical, or rectangular with no reentrant corners. Minimum corner radius shall be 0.250 inch. Refer to section III.
 - b. Trim out visible damage to rib using minimum corner radius of 0.250 inch.
 - c. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.
 - d. Fabricate and install repair doubler. See figure 7-11.
 - e. Remove flap upstop fitting if the damaged rib is in the part of zone B covered by . See figure 7-10.
 - f. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
 - g. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.



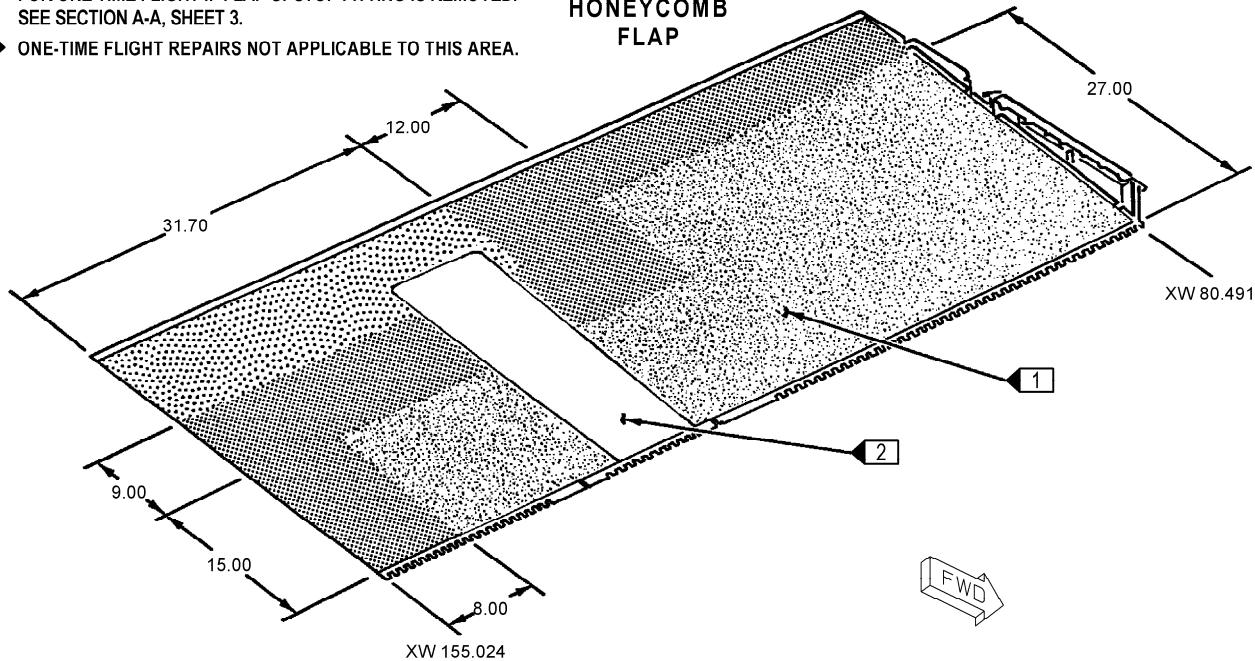
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Figure 7-10. Flap, One-Time Ferry Flight Repair Limits (Sheet 1 of 3)



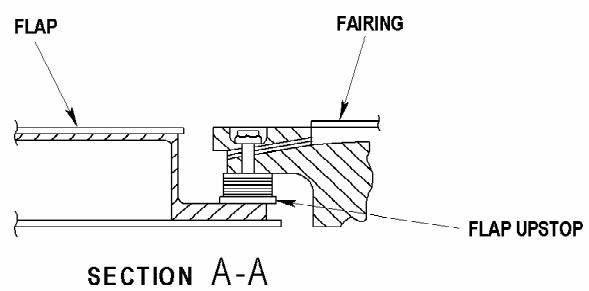
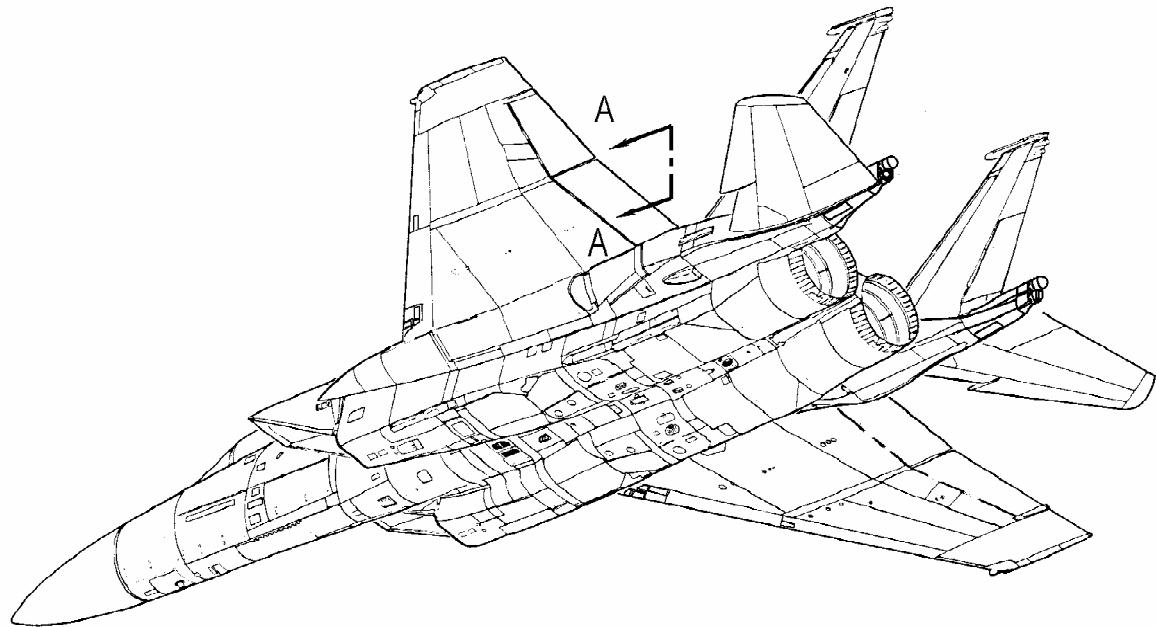
- 1 ► DAMAGE UP TO 40.00 SQUARE INCHES CAN BE REPAIRED FOR ONE TIME FLIGHT IF FLAP UPSTOP FITTING IS REMOVED. SEE SECTION A-A, SHEET 3.
- 2 ► ONE-TIME FLIGHT REPAIRS NOT APPLICABLE TO THIS AREA.

68A180001
HONEYCOMB
FLAP



SAN301-07-17-1-002

Figure 7-10. Flap, One-Time Ferry Flight Repair Limits (Sheet 2)

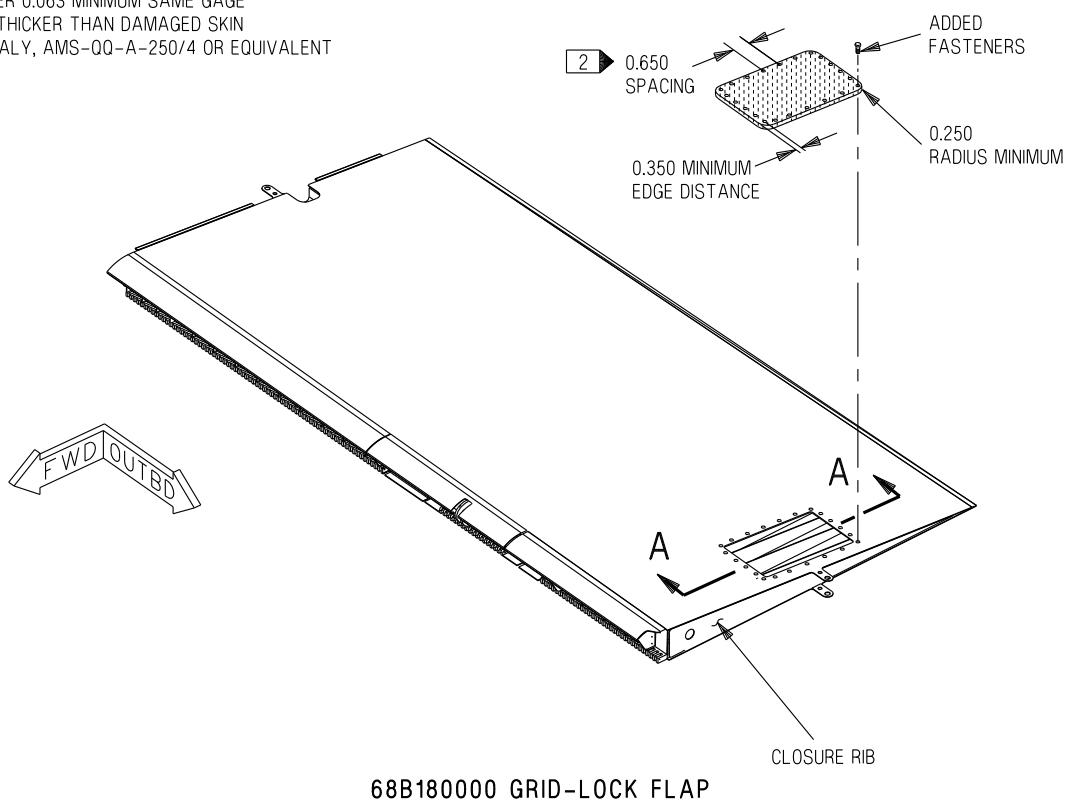


SAN301-07-48-002

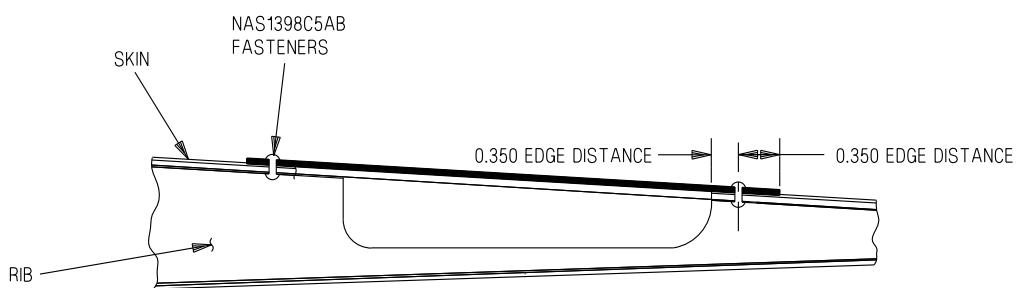
Figure 7-10. Flap, One-Time Ferry Flight Repair Limits (Sheet 3)

CSTO SR1F-15SA-3-1

REPAIR DOUBLER 0.063 MINIMUM SAME GAGE
OR ONE GAGE THICKER THAN DAMAGED SKIN
2024-T81, AL ALY, AMS-QQ-A-250/4 OR EQUIVALENT



68B180000 GRID-LOCK FLAP



VIEW A-A
THROUGH ASSEMBLED REPAIR

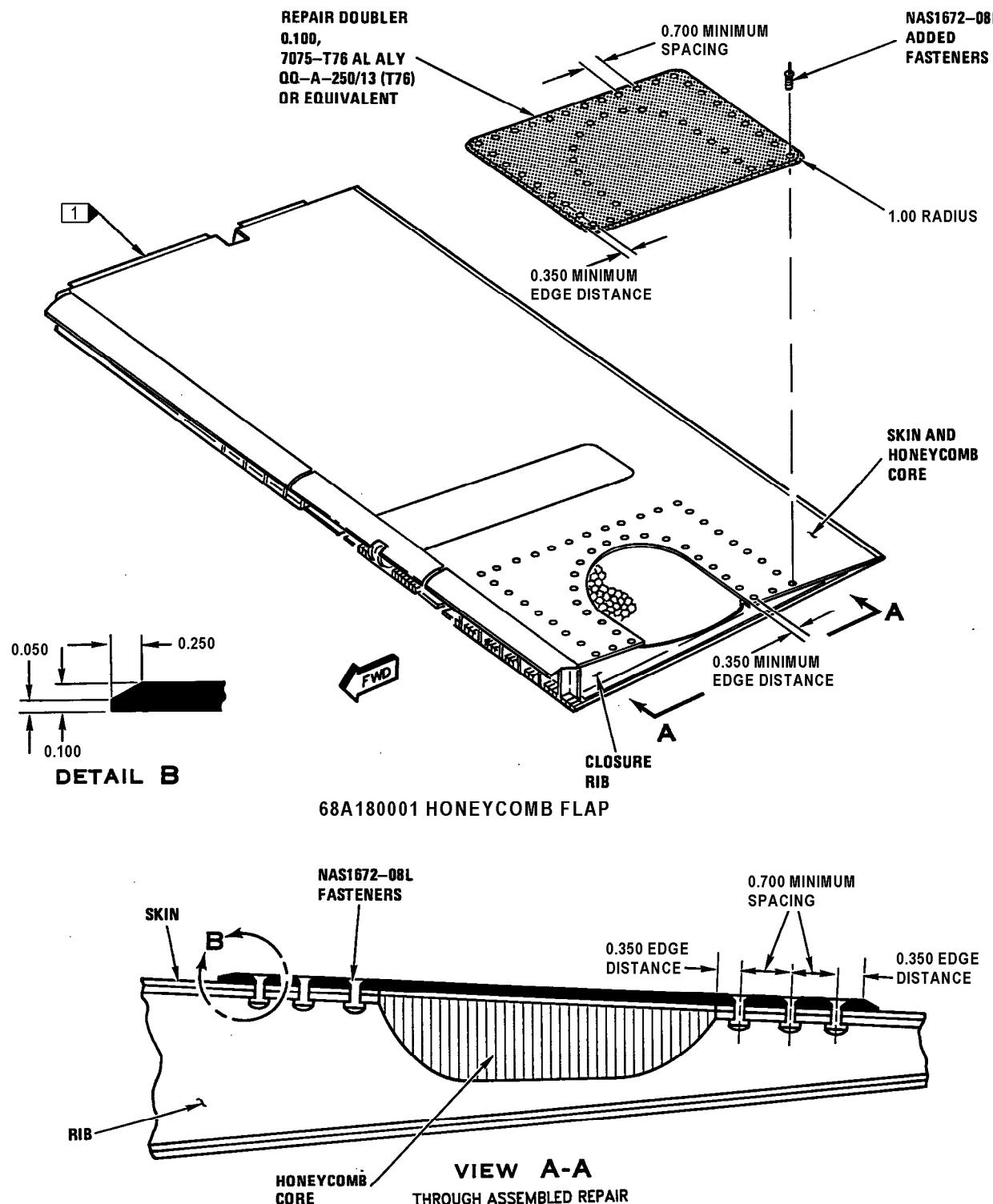
LEGEND

- EXISTING STRUCTURE
- REPAIR PARTS
- REPAIR PARTS IN CROSS SECTION

- 1 IF FLAP INBOARD CLOSURE RIB IS DAMAGED REMOVE FLAP UPSTOP FITTING. SEE FIGURE 7-10, SHEET 3.
- 2 0.500 MINIMUM 0.750 MAXIMUM LOCALLY TO CLEAR FORMERS OR STIFFENERS.

SAN301-07-19-002

Figure 7-11. Repair of Skin and Integral Stiffeners or Honeycomb Core for Damage Up to 40 Square Inches, with Loss of Continuity In One Rib (Sheet 1 of 2)



MAJOR CHANGE

SAN301-07-19-1-002

Figure 7-11. Repair of Skin and Integral Stiffeners or Honeycomb Core for Damage Up to 40 Square Inches, with Loss of Continuity In One Rib (Sheet 2)

CSTO SR1F-15SA-3-1

■ 7-95. **AILERON, 68A170000.** See figure 7-2.

7-96. Repairs for the aileron are per the below.

7-97. Repair of Skin and Honeycomb Core for Damage Up to 20 Square Inches.

7-98. Limitations. See figure 7-12.

a. Clean-up hole shall not extend into internal structure.

b. Clean-up hole in Zone A shall not exceed 5 square inches.

7-99. Materials.

Cloth, airplane, MIL-C-5646, or equivalent Sealing Compound, AMS 3276 A-1/2 Tape, pressure-sensitive, MIL-T-22085 TY3

7-100. Procedure.

- a. Remove visible damage with minimum size hole. Clean-up hole may be circular, elliptical, or rectangular, with no re-entrant corners. Minimum corner radius shall be 1. Refer to section III.
- b. Perform a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.
- c. Trim out damaged honeycomb area. Refer to section III.

WARNING

Sealing compound is a flammable liquid and vapor. May cause allergic skin reaction. May cause eye, skin, and respiratory irritation. Contains material which cause cancer. Keep away from heat, sparks and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

- d. Cover hole with tape or cloth and brush coat with sealing compound. Refer to CSTO SR1F-15SA-3-5.

e. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-5.

f. Place a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-101. Repair of Skin and Honeycomb Core for Damage Up to 20 Inches in Diameter, with Loss of Continuity in One Rib.

7-102. Limitations. See figure 7-12.

a. Clean-up hole shall not extend into the actuator drive ribs.

b. Clean-up hole in Zone A shall not exceed 5 square inches.

c. No damage allowed in actuator drive ribs.

d. One repair per aileron.

7-103. Materials.

Cloth, airplane, MIL-C-5646, or equivalent Sealing Compound, AMS 3276 A-1/2 Tape, pressure-sensitive, MIL-T-22085 TY3

7-104. Procedure.

- a. Remove visible damage using minimum size diameter hole. Clean-up hole may be circular or elliptical. Refer to section III.
- b. Trim out visible damage to rib using minimum corner radius of 0.250.
- c. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.
- d. Trim out damaged honeycomb core. Refer to section III.

WARNING

Sealing compound is a flammable liquid and vapor. May cause allergic skin reaction. May cause eye, skin, and respiratory irritation. Contains material which cause cancer. Keep away from heat, sparks and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

- e. Cover hole with tape or cloth and brush coat with sealing compound. Refer to CSTO SR1F-15SA-3-5.
- f. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-5.
- g. Place a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-105. Repair of Skin and Honeycomb Core for Damage 20 to 80 Square Inches, With Loss of Continuity in One Rib.

7-106. Limitations. See figure 7-12.

- a. Clean-up hole shall not extend into actuator drive ribs.
- b. No damage allowed in Zone A.
- c. No damage allowed in actuator ribs.
- d. Clean-up hole in Zone B shall not exceed 20 square inches.
- e. Clean-up hole in Zone C shall not exceed 80 square inches.
- f. One repair per aileron.

7-107. Materials.

Sealing compound, AMS 3276 A-1/2

7-108. Procedure.

- a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical, or rectangular with no re-entrant corners. Minimum corner radius shall be 0.500. Refer to section III.

- b. Trim out visible damage to rib using minimum corner radius of 0.250.
- c. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.
- d. Trim out damaged honeycomb core. Refer to section III.

WARNING

Sealing compound is a flammable liquid and vapor. May cause allergic skin reaction. May cause eye, skin, and respiratory irritation. Contains material which may cause cancer. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

- e. Fabricate, fay surface seal, and install repair doubler. See figure 7-12. For repair doubler, refer to section III; for sealing, refer to CSTO SR1F-15SA-3-5.
- f. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-5.
- g. Place a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-109. **AILERON, 68B170000.** See figure 7-2.

7-110. Repairs for aileron are per the below.

7-111. Repair of Grid-Lock Skin and Integral Stiffeners for Damage Up to 20 Square Inches, with Tape or Cloth.

7-112. Limitations. See figure 7-12.

- a. Clean-up hole shall not extend into the five actuation drive ribs, the closure ribs or any of the zone A and B internal ribs.
- b. Clean-up hole in zone A shall not exceed 0.500 inch diameter. Clean-up hole in zone B shall not exceed 1 inch diameter. Clean-up hole in zone C shall not exceed 20 square inches area, 4 inches in the spanwise direction and 10 inches in the chordwise direction.

CSTO SR1F-15SA-3-1

c. Full height damage and clean-up to internal ribs, other than the five drive ribs, is allowed in zone C up to 4 inches in length. If more than one rib is damaged, and the largest damage exceeds one half the rib height, the damage ribs must be separated by four or more undamaged ribs.

7-113. Materials.

Cloth, airplane, MIL-C-5646; or equivalent Sealing compound, AMS 3276 A-1/2

Tape, pressure-sensitive, MIL-T-22085, TY3

7-114. Procedure.

- a. Remove visible damage with minimum size hole. Clean-up hole may be circular, elliptical, or rectangular, with no reentrant corners. Minimum corner radius shall be 1 inch. Refer to section III.
- b. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.

WARNING

Sealing compound is a flammable liquid and vapor. May cause allergic skin reaction. May cause eye, skin, and respiratory irritation. Contains material which may cause cancer. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

- c. Cover hole with tape or cloth and brush coat with sealing compound. Refer to CSTO SR1F-15SA-3-5.
- d. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
- e. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-115. Repair of Grid-Lock Skin and Integral Stiffeners for Damage Up to 80 Square Inches, with Loss of Continuity In One Rib.

7-116. Limitations. See figure 7-12.

- a. Clean-up hole shall not extend into the ribs in zone A.

- b. No damage allowed to the closure ribs.
- c. No damage allowed in the five actuator drive ribs in zone A and B.
- d. Clean-up hole in zone B shall not exceed 20 square inches. Spanwise skin damage shall not exceed 4 inches in length.
- e. Clean-up hole in zone C shall not exceed 80 square inches. Spanwise skin damage shall not exceed 8 inches in length, and chordwise skin damage shall not exceed 20 inches in length.

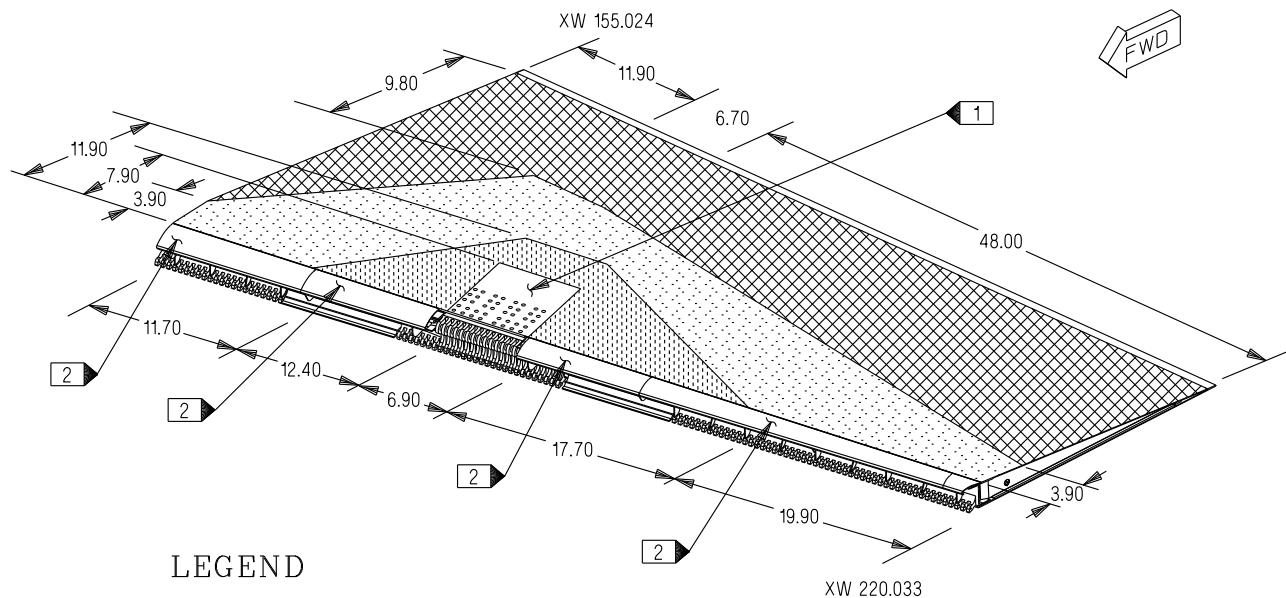
- f. Multiple repairs are possible. Minimum spacing between repairs is four times the maximum dimension of the largest clean-up hole.
- g. Upper and lower surface damage in the same area may be repaired as long as the rib damage is less than 4 inches long in zone B, and 8 inches long in zone C. If the rib damage is longer than these limits, the rib damage is limited to one half of the rib height, and the rib must be continuously attached to one skin.

7-117. Materials.

Sealing compound, AMS 3276 A-1/2

7-118. Procedure.

- a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical, or rectangular with no reentrant corners. Minimum corner radius shall be 0.250 inch. Refer to section III.
- b. Trim out visible damage to rib using minimum corner radius of 0.250 inch.
- c. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.
- d. Fabricate, fay surface seal, and install repair doubler. For sealing, refer to CSTO SR1F-15SA-3-5, fay surface sealing application.
- e. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
- f. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

**LEGEND**

LOCATION AND MAXIMUM ALLOWABLE
SIZE HOLE FOR REPAIR

ZONE A, 2.00 INCHES DIAMETER

ZONE B, 20.00 SQUARE INCHES

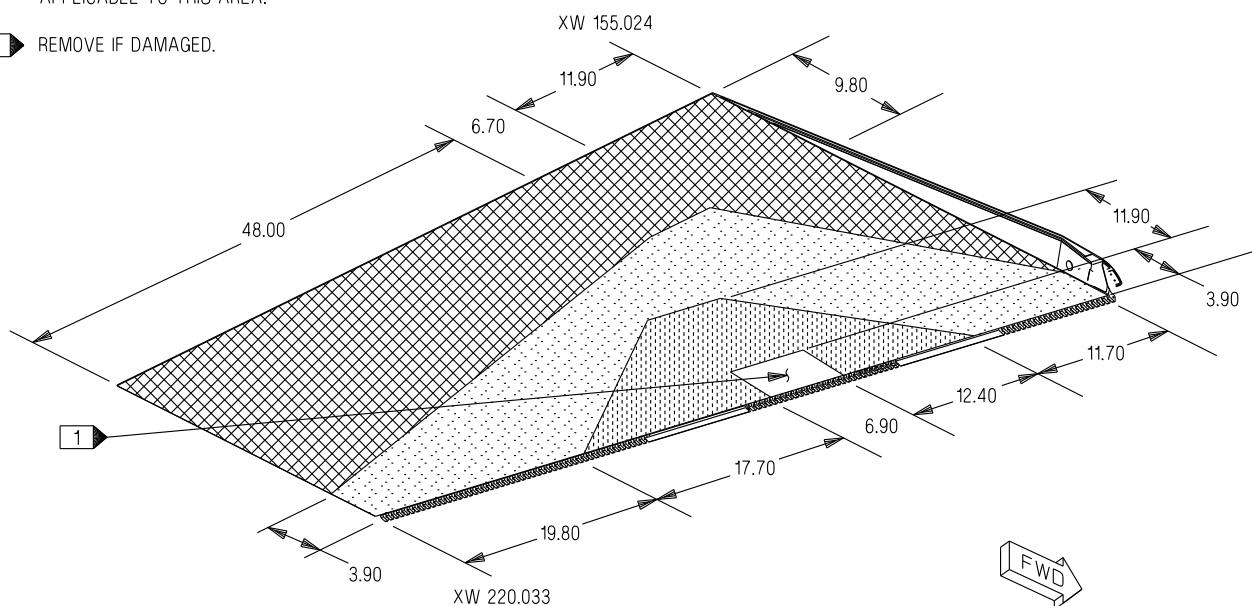
ZONE C, 80.00 SQUARE INCHES

1 ONE-TIME FLIGHT REPAIRS NOT
APPLICABLE TO THIS AREA.

2 REMOVE IF DAMAGED.

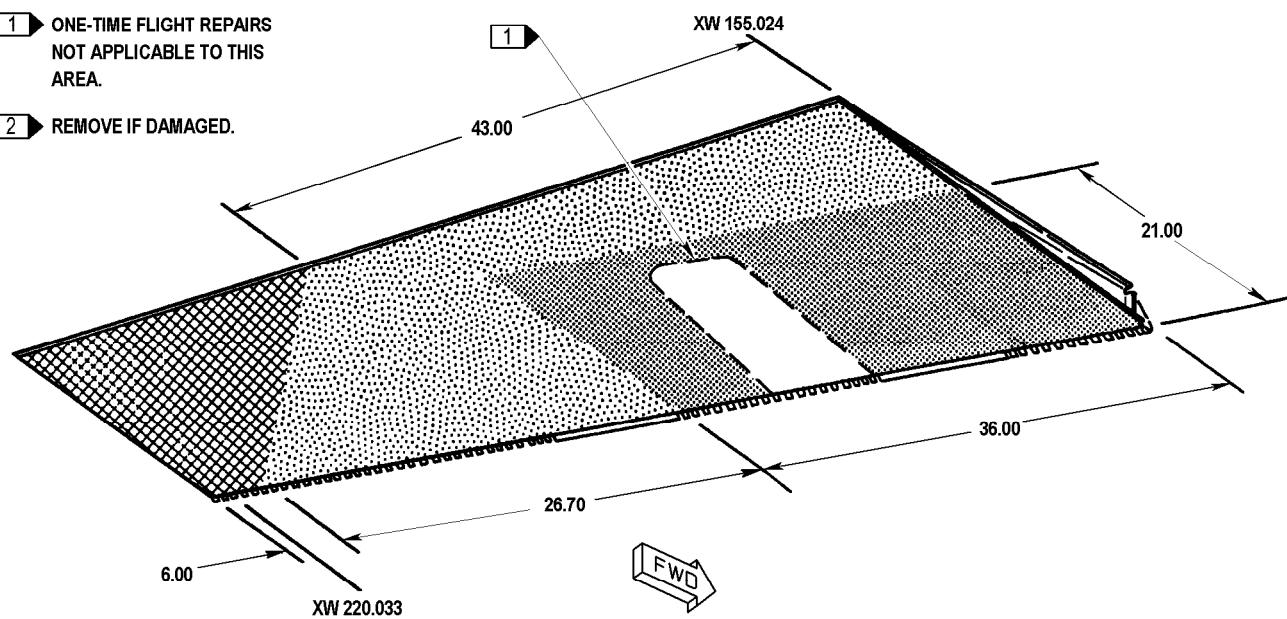
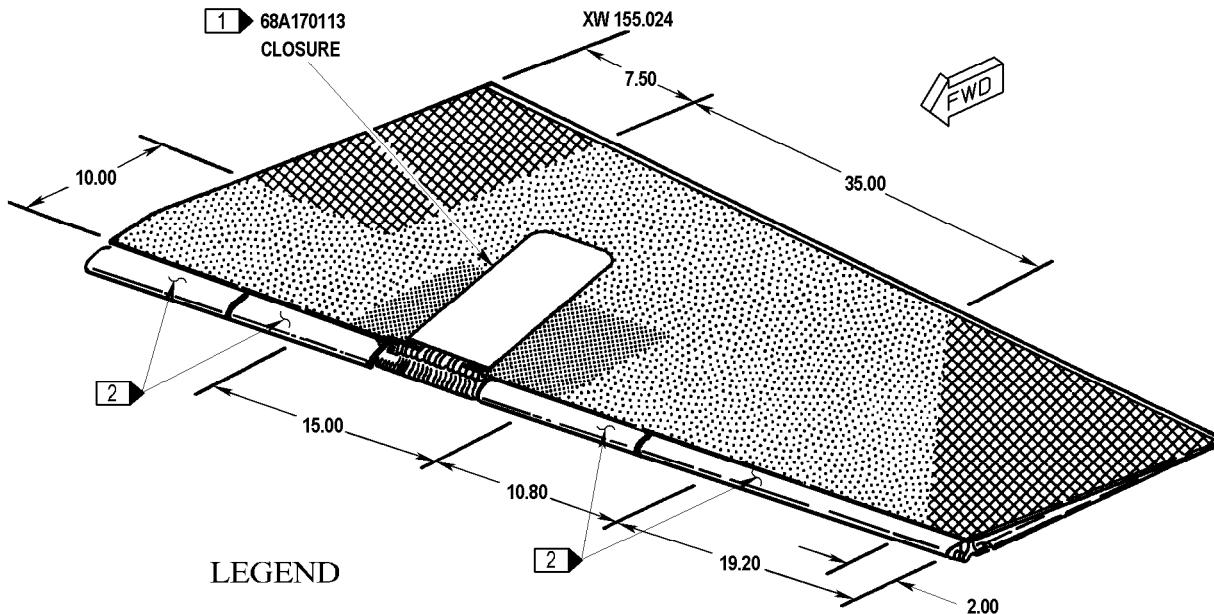
GRID-LOCK AILERON

68B170000



SAN301-07-21-002

Figure 7-12. Aileron, One-Time Ferry Flight Limits (Sheet 1 of 2)



SAN301-07-47-002

Figure 7-12. Aileron, One-Time Ferry Flight Limits (Sheet 2)

7-119. EMPENNAGE.

7-120. The empennage section is divided into three subsections; horizontal stabilator, rudder, and vertical stabilizer.

7-121. HORIZONTAL STABILATOR. See figure 7-13.

7-122. The horizontal stabilator is divided into five areas for classification of repairs, because of construction and/or materials: aluminum skin and honeycomb core, refer to paragraph 7-123; boron composite skin and aluminum honeycomb core, refer to paragraph 7-131; conventional skin over structure, refer to paragraph 7-137; Grid-Lock skin and structure, refer to paragraph 7-146; and Unitized Machined Assembly (UMA). The aft box is classified as aluminum skin and honeycomb core, 68A210070, or Grid-Lock, 68B210001, and the tip is classified as aluminum skin and honeycomb core. The outboard forward box is classified as aluminum skin and honeycomb core, 68B210066, or UMA, 68A2210200. Refer to CSTO SR1F-15SA-3-4 for UMA repair procedures.

7-123. **Aluminum Skin and Honeycomb Core.** See figure 7-13. The aluminum skin and honeycomb core repairs are per the below.

7-124. Repair for Damage Up to 20 Square Inches.

7-125. Limitations.

- a. Clean-up hole shall be a minimum of 1 inch away from existing fastener holes.
- b. Maximum of one clean-up hole per tip.
- c. Total damage in the tip shall not exceed 10 square inches in any 100 square inches. Example: If damage is 20 square inches, there shall be a minimum of 180 square inches of undamaged skin.

7-126. Materials.

Cloth, airplane, MIL-C-5646; or equivalent
Sealing compound, AMS 3276 A-1/2
Tape, pressure-sensitive, MIL-T-22085, TY3

7-127. Procedure.

- a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical, or rectangular, with no reentrant corners. Minimum corner radius shall be 0.500 inch. Refer to section III.

- b. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.

WARNING

Sealing compound is a flammable liquid and vapor. May cause allergic skin reaction. May cause eye, skin, and respiratory irritation. Contains material which may cause cancer. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

- c. Repair damage by covering clean-up hole with tape or cloth and brush coat with sealing compound. Refer to CSTO SR1F-15SA-3-5.
- d. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
- e. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-128. Repair for Damage from 20 to 64 Square Inches. See figure 7-14.

7-129. Limitations.

- a. Clean-up hole shall be a minimum of 1 inch away from existing fastener holes.
- b. Clean-up hole shall not extend into internal structure.
- c. Maximum of one clean-up hole per tip.
- d. Total damage in the tip shall not exceed 10 square inches in any 100 square inches. Example: If damage is 30 square inches, there shall be 270 square inches of undamaged skin.

7-130. Procedure.

- a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical, or rectangular, with no reentrant corners. Minimum corner radius shall be 0.500 inch. Refer to section III.
- b. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.

CSTO SR1F-15SA-3-1

- c. Fabricate and install repair doublers. See figure 7-14. Refer to section III.
- d. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
- e. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-131. Boron Composite Skin and Aluminum Honeycomb Core. See figure 7-13. The boron composite skin and aluminum honeycomb core repair is per the below.

7-132. Repair for Damage with an Effective Diameter from 1-1/2 to 4 Inches, Perpendicular to 50 Percent Chord. To decide the effective diameter of damage, refer to CSTO SR1F-15SA-3-5.

7-133. Limitations.

- a. Effective diameter of damage shall not exceed 4 inches, perpendicular to 50 percent chord.
- b. One clean-up hole in any cross-section normal to 50 percent chord.
- c. Minimum spacing between repairs shall be 10 hole diameters, parallel to 50 percent chord.
- d. Maximum number of repairs are one inboard of BL 125.000, and two outboard of BL 125.000.
- e. Damage in boron composite skin to titanium skin splice area is not allowed.
- f. Clean-up hole inboard of BL 110.000 shall not exceed 2 inches in diameter.

7-134. Materials.

Sealing compound, AMS 3276 A-1/2

7-135. Procedure.

- a. Remove visible damage using minimum size diameter hole. Be careful during removal of damaged skin and core to not damage adjacent bonded areas. Refer to section III.
- b. Fabricate, fay surface seal, and install repair doublers. For repair doublers, refer to section III; for sealing, refer to CSTO SR1F-15SA-3-5.
- c. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.

- d. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-136. Internal Structure Repairs. For repair of internal structure, refer to CSTO SR1F-15SA-3-4.

7-137. **Conventional Skin Over Structure.** See figure 7-13. The conventional skin over structure repairs are per the below.

7-138. Repair for Damage Up to 20 Square Inches.

7-139. Limitations.

a. The maximum size clean-up hole in the inboard torque box aft section, inboard of BL 900.000, shall not exceed 1 inch in diameter provided:

- 1. It does not extend into land thickness greater than 0.190 inch.
- 2. It is not in land areas over structure.
- 3. Structure is not damaged.

7-140. Materials.

Cloth, airplane, MIL-C-5646; or equivalent Sealing compound, AMS 3276 A-1/2 Tape, pressure-sensitive, MIL-T-22085, TY3

7-141. Procedure.

- a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical, or rectangular, with no reentrant corners. Minimum corner radius shall be 0.500 inch. Refer to section III.

WARNING

Sealing compound is a flammable liquid and vapor. May cause allergic skin reaction. May cause eye, skin, and respiratory irritation. Contains material which may cause cancer. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

- b. Cover hole with tape or cloth, and brush coat with sealing compound. Refer to CSTO SR1F-15SA-3-5.

- c. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
- d. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-142. Repair for Damage Exceeding 20 Square Inches. See figure 7-15 and 7-16.

7-143. Limitations.

- a. This repair is not allowed on the inboard torque box aft section, inboard of BL 90.000.

7-144. Materials.

Sealing compound, AMS 3276 A-1/2

7-145. Procedure.

- a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical, or rectangular, with no reentrant corners. Minimum corner radius shall be 1/2-inch. Refer to section III.
- b. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.
- c. Fabricate, fay surface seal, and install repair doubler, and filler, as applicable; use approximately 2 inch fastener spacing. See figures 7-15 and/or 7-16, as applicable. For repair doubler and filler, refer to section III; for sealing, refer to CSTO SR1F-15SA-3-5.
- d. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
- e. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-146. **Grid-Lock Skin and Structure.** See figure 7-17. The Grid-Lock skin and structure core repairs are below.

7-147. Repair for Damage up to 20 Square Inches in Area and 4 Inches in Length in the Spanwise Direction.

7-148. Limitations.

- a. Clean-up hole shall be a minimum of 1 inch away from existing fastener holes.

- b. Clean-up hole shall not extend into internal structure, other than the spanwise stiffeners integral to the skin.

- c. Clean-up hole shall not extend into the area from the trailing edge to 4 inches forward or into the area 6 inches aft of leading edge.

- d. Spacing between adjacent damages must be greater than four times the largest damage dimension.

7-149. Materials.

Cloth, cotton, MIL-C-5646; or equivalent
Sealing compound, AMS 3276 A-1/2
Tape, pressure-sensitive, MIL-T-22085, TY3

7-150. Procedure.

- a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical or rectangular, with no reentrant corners. Minimum corner radius shall be 0.500 inch.
- b. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.

WARNING

Sealing compound is a flammable liquid and vapor. May cause allergic skin reaction. May cause eye, skin, and respiratory irritation. Contains material which may cause cancer. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

- c. Cover hole with tape or cloth, and brush coat with sealing compound. Refer to CSTO SR1F-15SA-3-5.
- d. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
- e. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-151. Repair for Damage Exceeding 20 Square Inches. See figure 7-17.

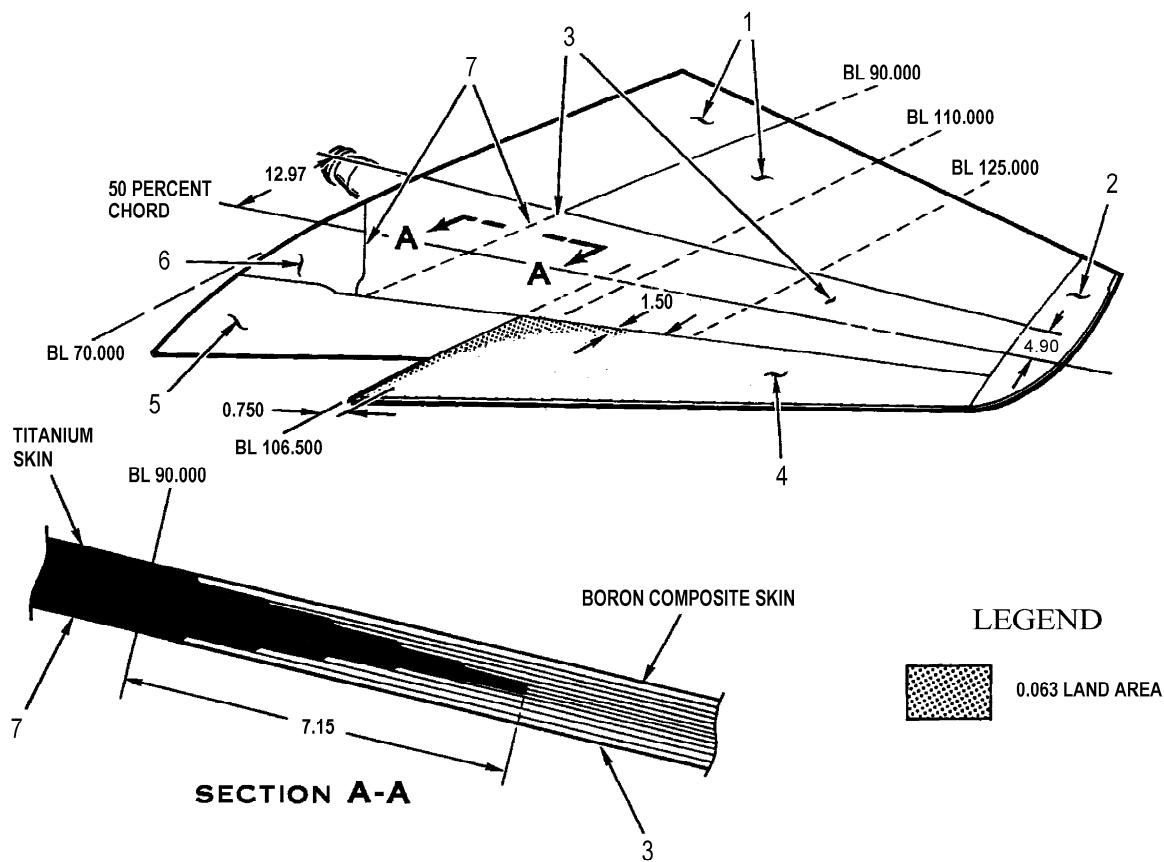
CSTO SR1F-15SA-3-1

7-152. Limitations.

- a. Clean-up hole shall be a minimum of 1 inch away from existing fastener holes.
- b. Adjacent damage closer than three diameters of the largest damage or existing holes shall be considered a single damage area.
- c. Clean-up hole can extend into internal structure. Repair rib to skin attachment with an angle. See figure 7-17. Multiple rib to skin attachments can be repaired.
- d. Concurrent upper and lower surface damage can be repaired.

7-153. Procedure.

- a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical or rectangular, with no reentrant corners. Minimum corner radius shall be 0.500 inch.
- b. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.
- c. Fabricate, fay seal, and install repair doubler and angle, if required. See figure 7-17. For repair doubler, refer to section III; for sealing, refer to CSTO SR1F-15SA-3-5.
- d. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
- e. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

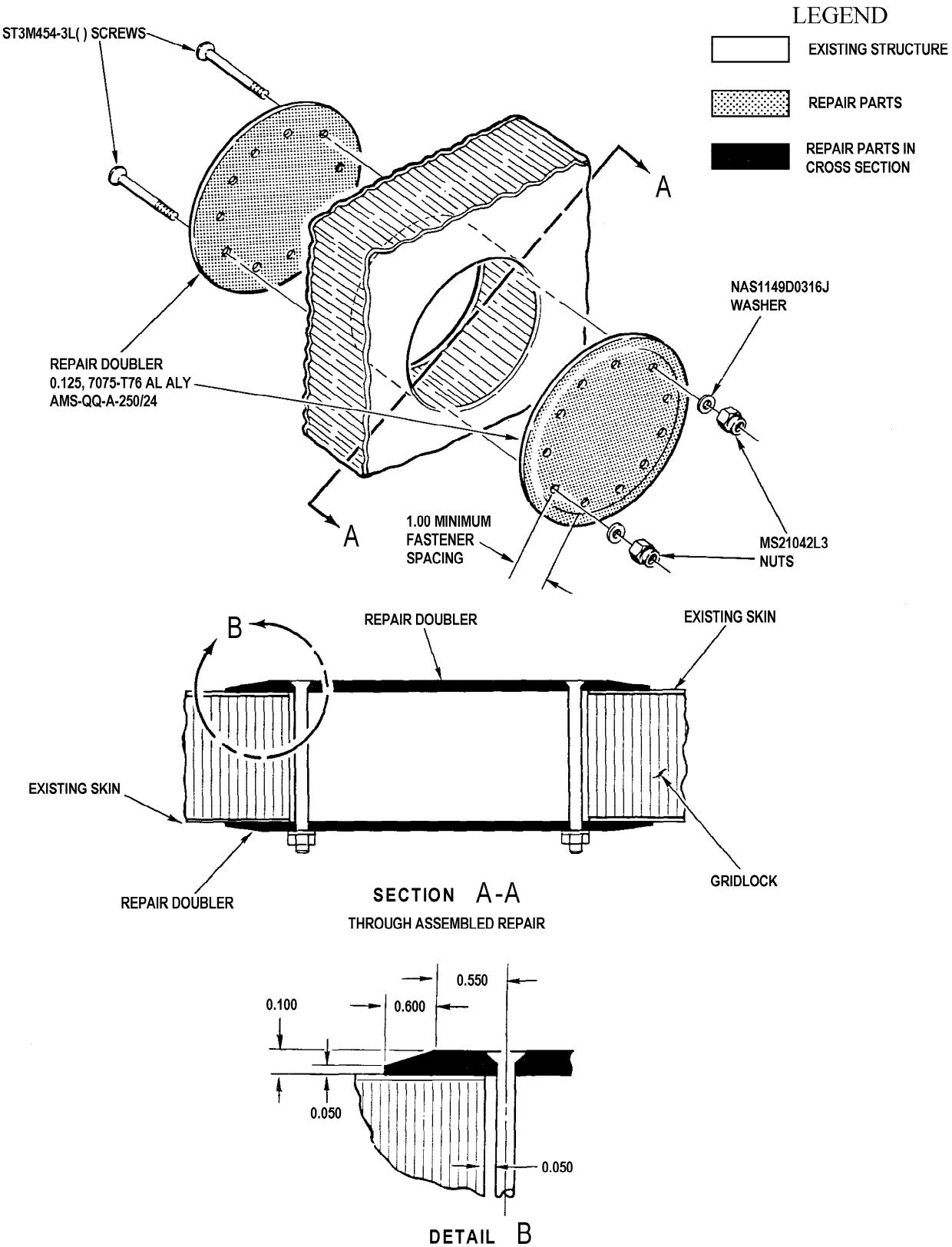


INDEX NO.	NOMENCLATURE	TYPE OF CONSTRUCTION
1	AFT BOX	GRIDLOCK OR ALUMINUM SKIN AND HONEYCOMB CORE
2	TIP	ALUMINUM SKIN AND HONEYCOMB CORE
3	OUTBOARD TORQUE BOX	BORON COMPOSITE SKIN AND ALUMINUM HONEYCOMB CORE
4	OUTBOARD FORWARD BOX	UNITIZED MACHINED ASSEMBLY OR ALUMINUM SKIN AND HONEYCOMB CORE
5	INBOARD FORWARD BOX	CONVENTIONAL SKIN OVER STRUCTURE
6	FORWARD SECTION INBOARD TORQUE BOX	CONVENTIONAL SKIN OVER STRUCTURE
7	AFT SECTION INBOARD TORQUE BOX	CONVENTIONAL SKIN OVER STRUCTURE

 MAJOR CHANGE

SAN301-07-22-002

Figure 7-13. Horizontal Stabilator Repair Index

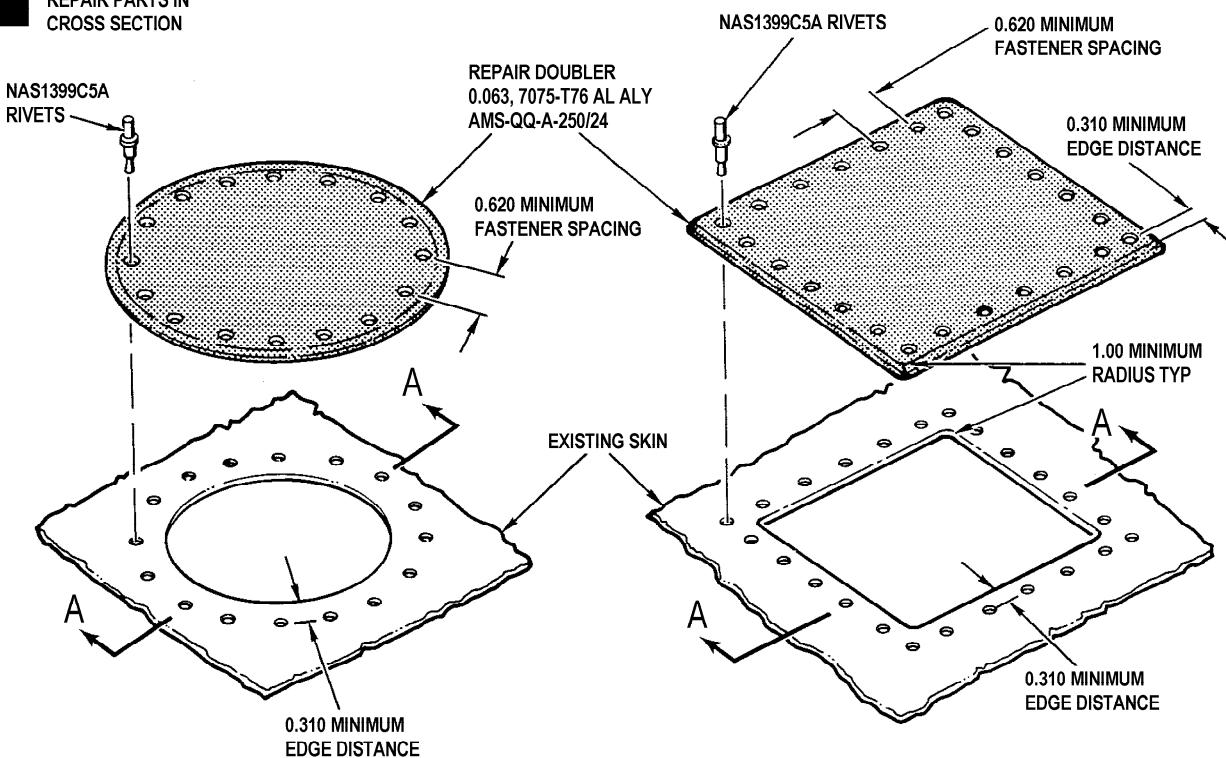


SAN301-07-23-002

Figure 7-14. Repair for Damage from 20 to 64 Square Inches

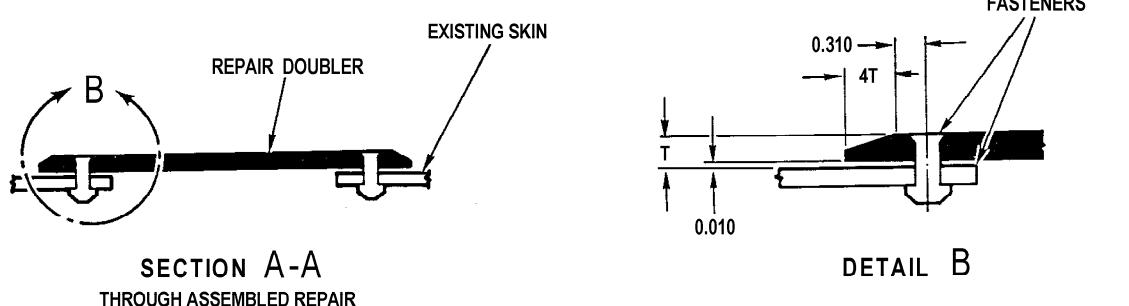
LEGEND

- EXISTING STRUCTURE
- REPAIR PARTS
- REPAIR PARTS IN CROSS SECTION



PREFERRED CIRCULAR TYPE REPAIR

ALTERNATE RECTANGULAR TYPE REPAIR

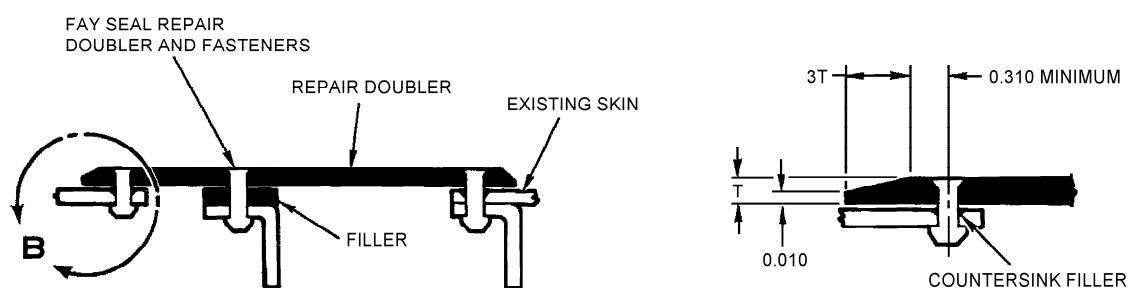
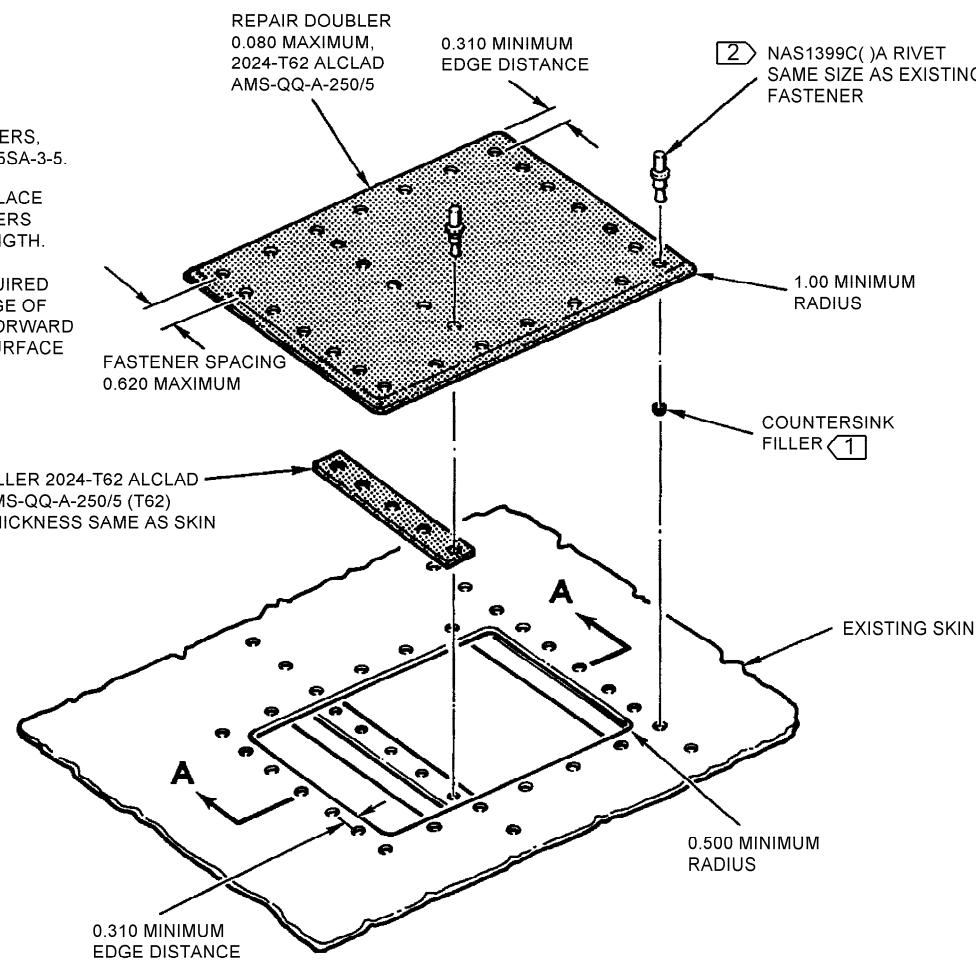


SAN301-07-26-002

Figure 7-15. Repair for Damage Greater than 1 Inch Diameter, Free of Structure

LEGEND

- EXISTING STRUCTURE
- REPAIR PARTS
- REPAIR PARTS IN CROSS SECTION
- 1 FOR COUNTERSINK FILLERS, REFER TO CSTO SR1F-15SA-3-5.
- 2 WHEN APPLICABLE REPLACE WITH EXISTING FASTENERS WITH REVISED GRIP LENGTH.
- 3 CHAMFER IS ONLY REQUIRED FOR THE FORWARD EDGE OF THE REPAIR FOR THE FORWARD 1/3 OF THE CONTROL SURFACE CHORD.



SECTION A-A
THROUGH ASSEMBLED REPAIR

DETAIL B

SAN301-07-27-002

Figure 7-16. Honeycomb, Repair for Damage Over Structure

LEGEND

EXISTING STRUCTURE

REPAIR PARTS

REPAIR PARTS
IN CROSS SECTION

1 CHAMFER IS ONLY REQUIRED FOR THE FWD EDGE OF THE REPAIR FOR THE FORWARD 1/3 OF THE CONTROL SURFACE CHORD.

2 NOT REQUIRED IF CLEAN-UP HOLE CHORD-WISE DIMENSION IS LESS THAN 4.00 AND IF THE CLOSEST DAMAGED RIB IS AT LEAST 8.00 AWAY.

REPAIR DOUBLER
0.063 MINIMUM, OR ONE GAUGE THICKER THAN DAMAGED SKIN, 2024-T81 AL ALY AMS-QQ-A-250/4

0.310 MINIMUM EDGE DISTANCE

NAS1398C5A RIVETS
TYPICAL
NAS1399C5A RIVETS
OPTIONAL

0.250 MINIMUM RADIUS

FASTENER SPACING
0.620 MAXIMUM

2 ANGLE
2024-T81 ALCLAD
AMS-QQ-A-250/4
THICKNESS SAME AS RIB

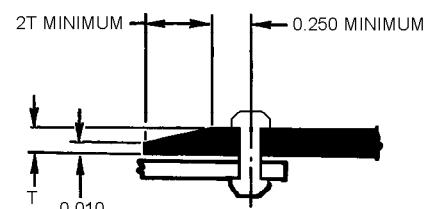
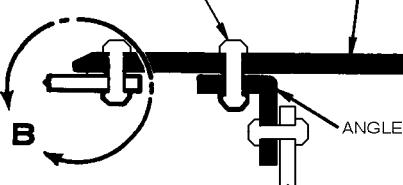
0.500 MINIMUM RADIUS

0.310 MINIMUM EDGE DISTANCE

FAY SEAL REPAIR DOUBLER AND FASTENERS

REPAIR DOUBLER

EXISTING SKIN



SECTION A
THROUGH ASSEMBLED REPAIR

DETAIL B

SAN301-07-28-002

Figure 7-17. Grid-Lock, Repair for Damage Over Structure

CSTO SR1F-15SA-3-1

7-154. **RUDDER.** See figure 7-18.

7-155. The rudder repairs are per the below.

7-156. **Repair for Damage Up to 6 Inches In Diameter.** See figure 7-19 and 7-15.

7-157. Limitations.

a. Clean-up hole shall be at least 1 inch away from spar and upper and lower closure ribs.

b. Minimum spacing between repairs shall be 4 inches.

c. No damage allowed in drive rib area within 12 inches aft of rudder leading edge. See figure 7-18.

d. Maximum number of repairs in one rudder are two, provided:

1. The other rudder shall not have one-time flight repairs exceeding 2 inches in diameter.

7-158. Materials.

Sealing compound, AMS 3276 A-1/2

7-159. Procedure.

a. Remove rudder (27-21-11).

b. Remove visible damage using minimum size diameter hole. Refer to section III.

c. Fabricate, fay surface seal, and install repair doublers. See figure 7-19 for repair of damage up to 2 inches in diameter, and figure 7-15 for repair of damage from 2 to 6 inches in diameter. For repair doublers, refer to section III; for sealing, refer to CSTO SR1F-15SA-3-5.

d. Test rudder center of gravity. Refer to paragraph 7-148.

e. Reinstall rudder (27-21-11).

f. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.

7-160. **Rudder Center of Gravity Check For One-Time Ferry Flight.** See figure 7-20. Rudder moment of inertia is very critical; for that reason, since moment of inertia of the rudder is determined by weight and center of gravity location, it is

necessary to determine if the rudder weight and center of gravity location are within allowable limits after repair.

7-161. Special Tools.

Bench, work type

Scale, weighing type, 0 to 70 pound range, BP 13-70PP or equivalent

Scales, 24.00 inches long by 2.00 inches wide by 0.250 inch thick, two required

Square, combination, 24.00 inches

Vises, machinist type, four required

7-162. Materials.

Sealing compound, MIL-S-11030, Type 1

7-163. Procedure.

NOTE

Make sure rudder assembly is complete when being weighed.

a. Weigh rudder assembly and record weight. If rudder assembly weight exceeds maximum allowable limit of 22.50 pounds, replace rudder (27-21-11).

WARNING

Sealing compound may cause eye, skin, and respiratory irritation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Use with adequate ventilation. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

b. Draw a straight line on bench or work surface, and set up vises and scales along this line as shown on figure 7-20. Apply sealing compound as required to hold vises in place during procedure.

c. Layout and mark two lines on rudder skin, one at each end of rudder, 9 inches aft of the hinge hole centerline. These are the parallel reference lines.

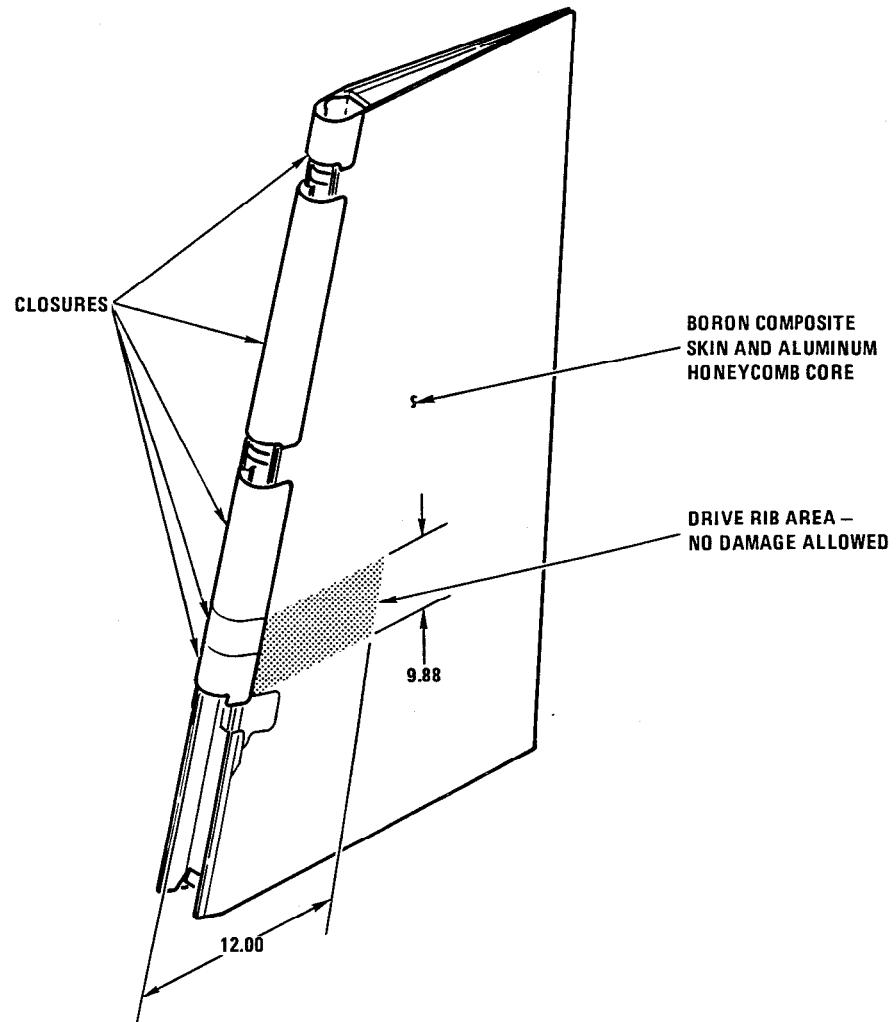


Make sure reference lines are parallel to scale centerline during the balancing operation or center of gravity line will not be accurate.

- d. Place rudder assembly on the scales as shown in figure 7-20. Adjust rudder position until rudder is balanced on the scales, keeping reference lines parallel to the scales.
- e. Draw a line on rudder skin at the top end to index with center of scale. This is the vertical

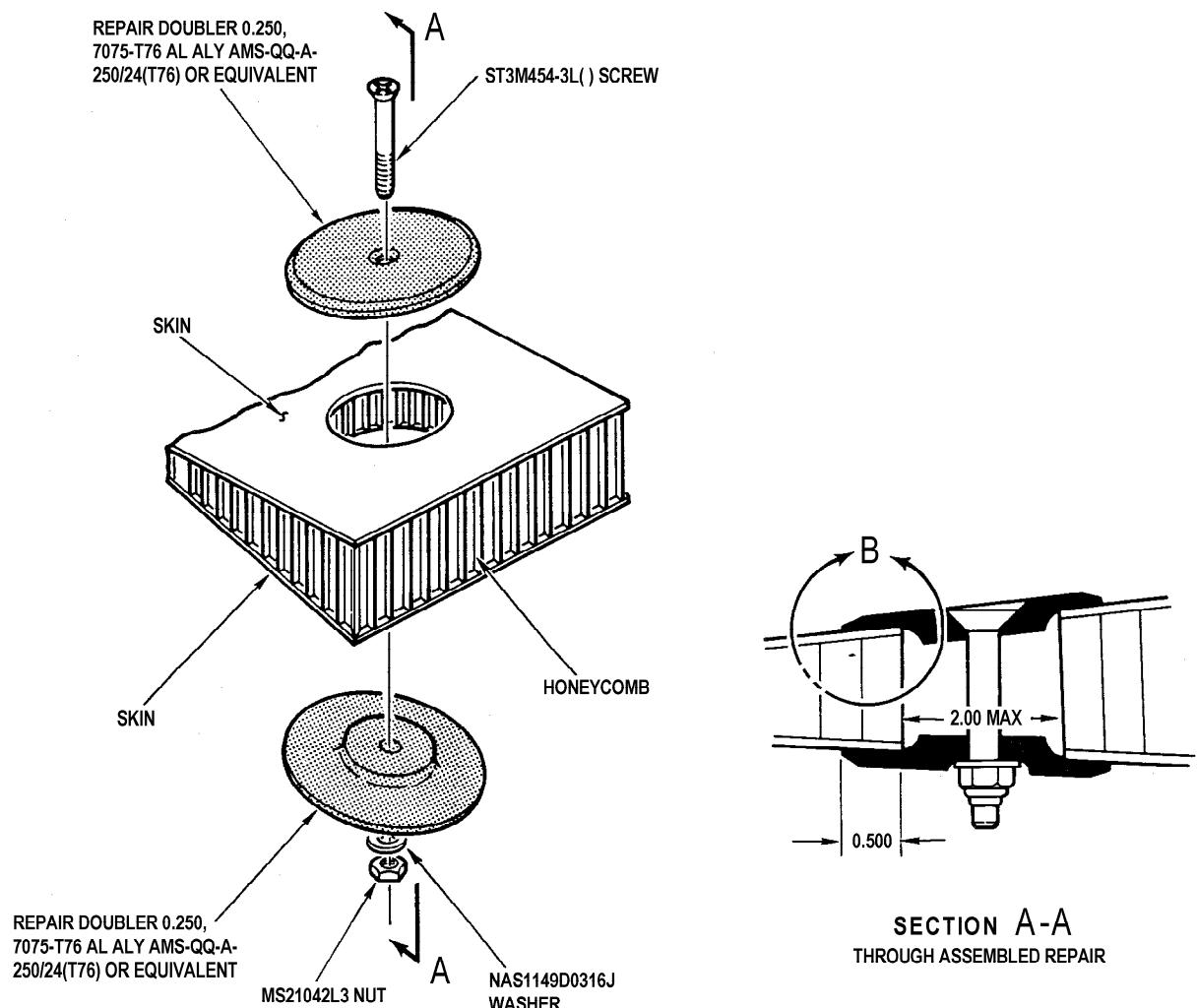
axis line of rudder center of gravity. Remove rudder assembly from scales and lay flat on the bench, or work surface, as applicable.

- f. Measure and record distance from the hinge hole centerline to center of gravity line shown in figure 7-20.
- g. Using rudder weight recorded in step a. and center of gravity location recorded in step f., decide if rudder center of gravity location is within limits. See diagram in figure 7-20. If center of gravity location is not within allowable limits, replace rudder (27-21-11).

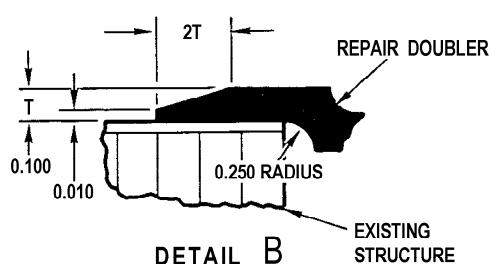


SAN301-07-29-002

Figure 7-18. Rudder Repair Index



PREFERRED REPAIR METHOD



SAN301-07-30-002

Figure 7-19. Repair of Skin and Honeycomb Core for Damage 1 of 2 Inches in Diameter (Sheet 1 of 2)

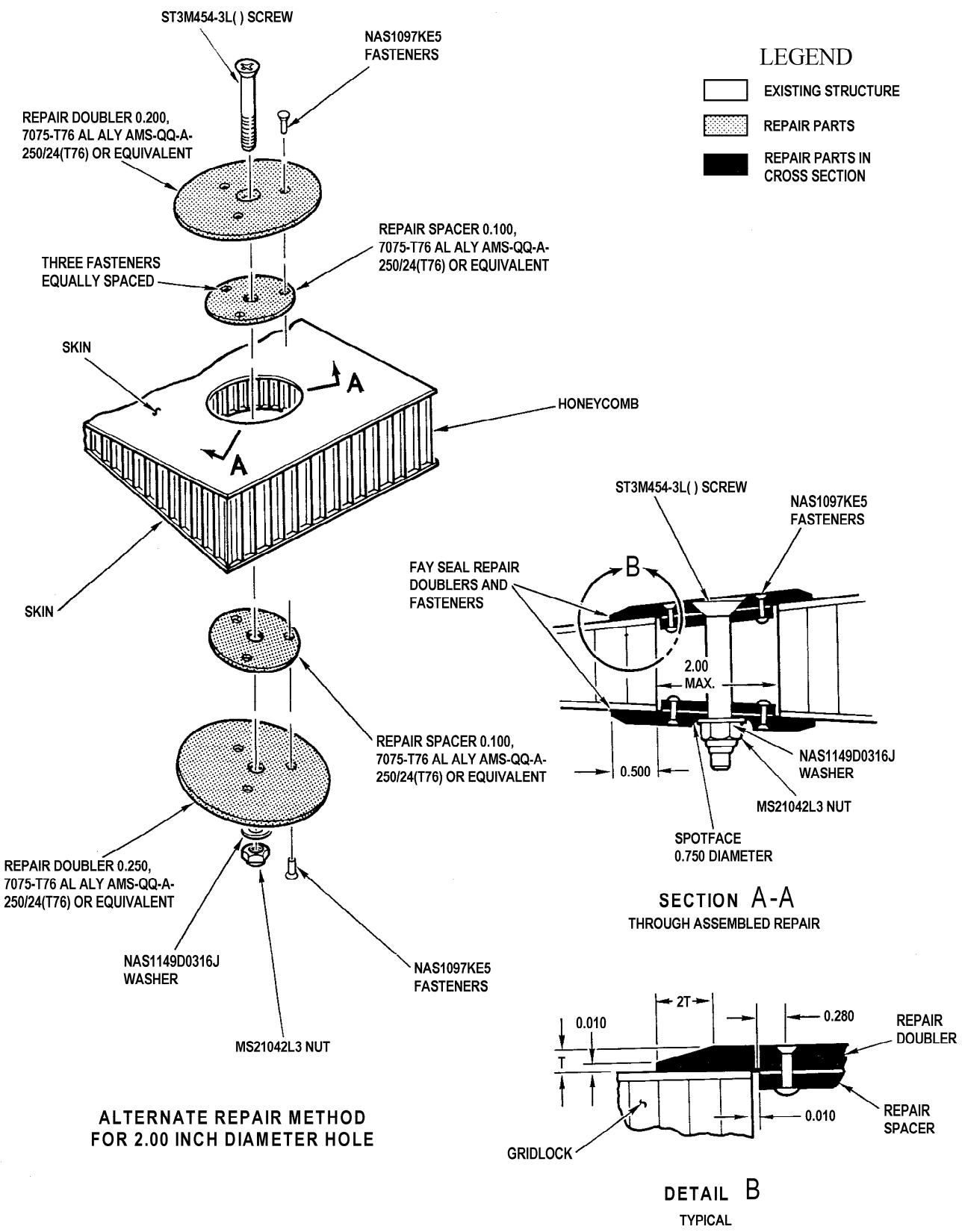
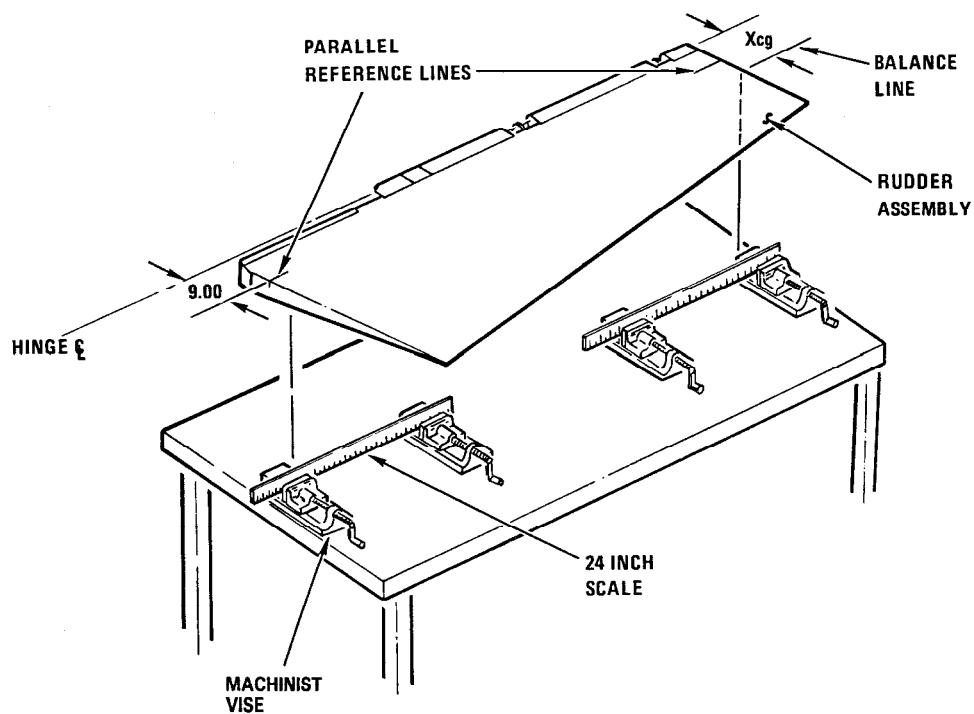


Figure 7-19. Repair of Skin and Honeycomb Core for Damage 1 of 2 Inches in Diameter (Sheet 2)



SAN301-07-32-002

Figure 7-20. Rudder Center of Gravity Check for One-Time Ferry Flight (Sheet 1 of 2)

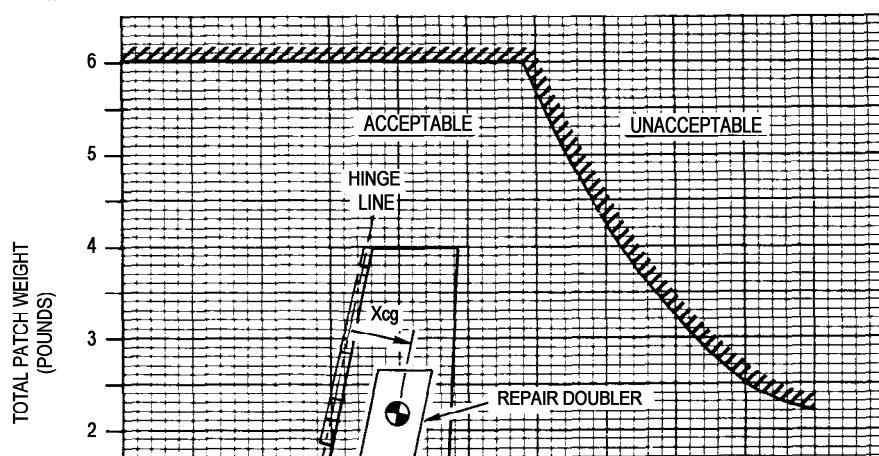
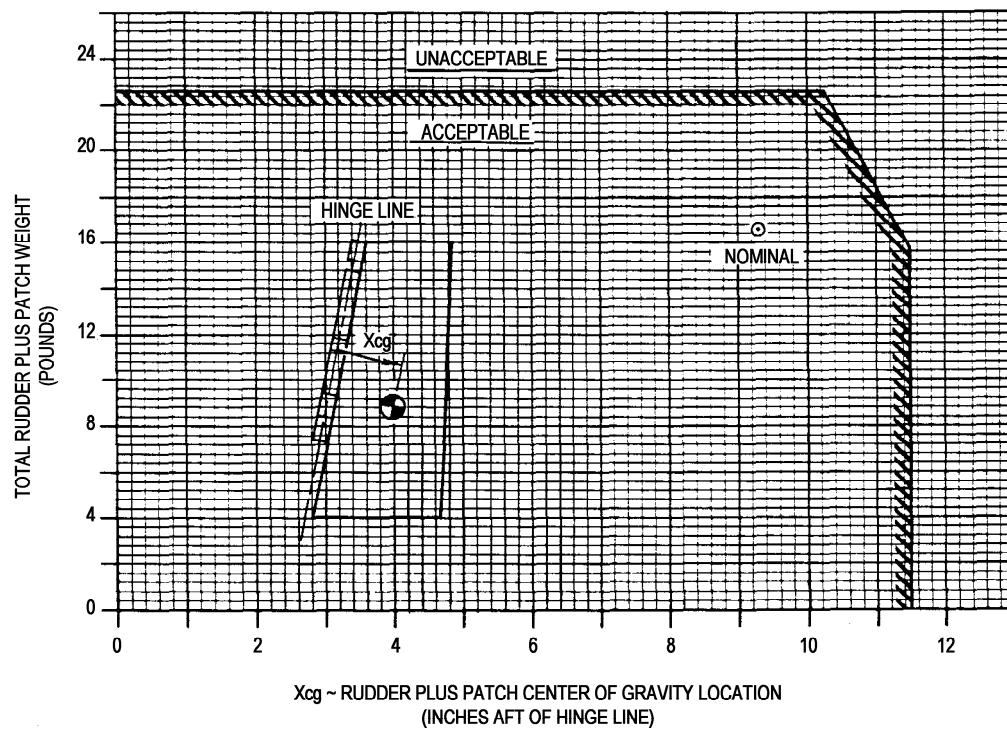


Figure 7-20. Rudder Center of Gravity Check for One-Time Ferry Flight (Sheet 2)

7-164. VERTICAL STABILIZER See figure 7-21.

7-165. The vertical stabilizer is divided into three areas for classification of one-time ferry flight repairs because of construction and/or materials: boron composite skin and aluminum honeycomb core, refer to paragraph 7-154; Grid-Lock skin and structure, refer to paragraph 7-159, and conventional skin over structure, refer to paragraph 7-167. The torque box is classified as boron composite skin and aluminum honeycomb core. The right vertical stabilizer, lower forward box, including the leading edge, are classified as Grid-Lock. The left vertical stabilizer lower forward box is classified as conventional skin over structure. The left vertical stabilizer leading edge is classified as Grid-Lock or honeycomb core. The right vertical stabilizer leading edge is classified as Grid-Lock. The left and right vertical stabilizer upper forward box, tip, and upper aft box are classified as conventional skin over structure. The right and left vertical stabilizer lower aft boxes are may be Grid-Lock, or honeycomb. Verify structure type before proceeding. Refer to CSTO SR1F-15SA-3-5.

7-166. Boron Composite Skin and Aluminum Honeycomb Core. See figure 7-21. The boron composite skin and aluminum honeycomb core repair is per the below.

7-167. Repair for Damage with an Effective Diameter from 1/2-inch to 4 inches, Perpendicular to 50 percent Chord. To decide the effective diameter of damage, refer to CSTO SR1F-15SA-3-5.

7-168. Limitations.

- a. Effective diameter of damage shall not exceed 4 inches.
- b. Maximum of one clean-up hole in any cross section normal to 50 percent chord.
- c. Minimum spacing between repairs shall be 10 hole diameters parallel to 50 percent chord.
- d. Maximum number of repairs are, one below WL 160.000, and two above WL 160.000.
- e. Clean-up hole below WL 160.000 shall not exceed 2 inches in diameter.

7-169. Materials.

Sealing compound, AMS 3276 A-1/2

7-170. Procedure.

- a. Remove visible damage using minimum size diameter hole. Be careful during removal of damaged skin and core to not damage adjacent bonded area. Refer to section III.
- b. Fabricate, fay surface seal, and install repair doublers. See figure 7-14. For repair doublers, refer to section III; for sealing, refer to CSTO SR1F-15SA-3-5.
- c. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
- d. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-171. Grid-Lock Skin and Structure. See figure 7-21. The Grid-Lock skin and structure repairs are below.

7-172. Repair for Damage up to 20 Square Inches in Area, and 4 Inches in Length in the Spanwise Direction.

7-173. Limitations.

- a. Clean-up hole shall be a minimum of 1 inch away from existing fastener holes.
- b. Clean-up hole shall not extend into internal structure, other than the spanwise stiffeners, integral to the skin.
- c. Spacing between adjacent damage must be greater than four times the largest damage dimension.

7-174. Materials.

Cloth, airplane, MIL-C-5646; or equivalent Sealing compound, AMS 3276 A-1/2 Tape, pressure-sensitive, MIL-T-22085, TY3

7-175. Procedure.

- a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical, or rectangular, with no reentrant corners. Minimum corner radius shall be 0.500 inch.

- b. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.

WARNING

Sealing compound is a flammable liquid and vapor. May cause allergic skin reaction. May cause eye, skin, and respiratory irritation. Contains material which may cause cancer. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

- c. Repair damage by covering clean-up hole with tape or cloth, and brush coat with sealing compound. Refer to CSTO SR1F-15SA-3-5.
- d. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
- e. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-176. Repair for Damage Exceeding 20 Square Inches. See figure 7-17.

7-177. Limitations.

- a. Clean-up hole shall be a minimum of 1 inch away from existing fastener holes.

- b. Adjacent damage closer than three diameters of the largest damage or existing holes shall be considered a single damage.

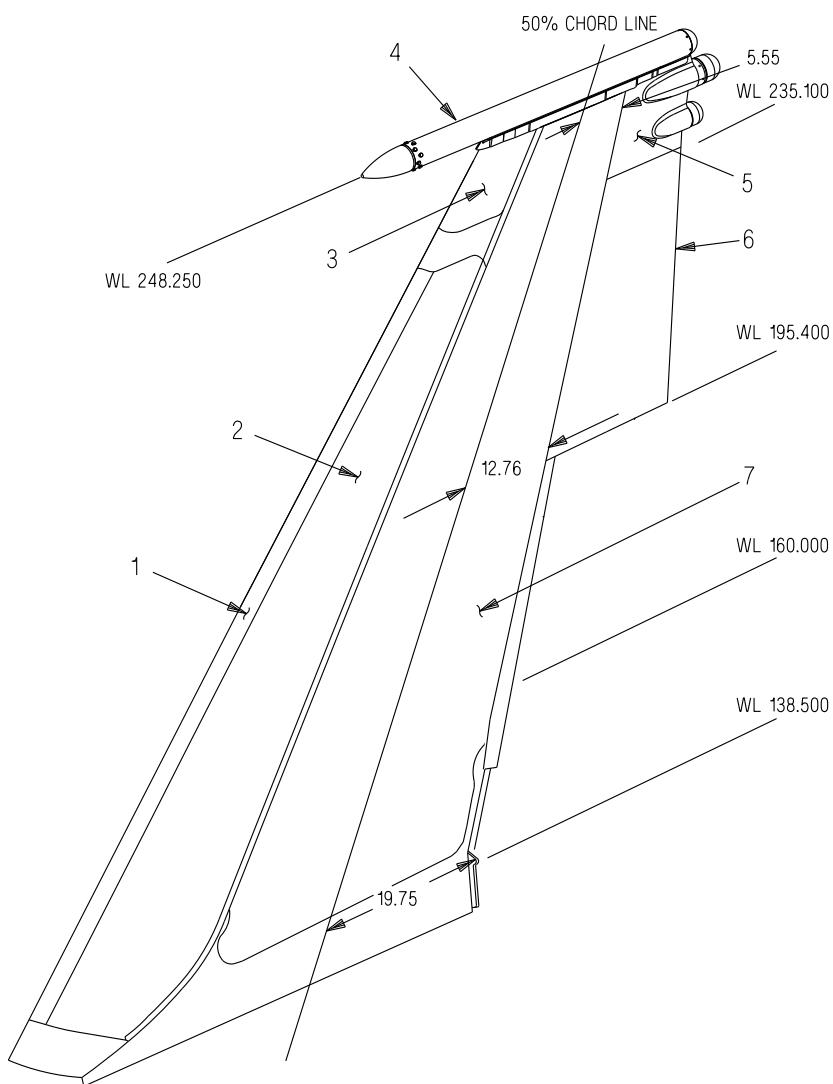
c. Clean-up hole can extend into internal structure. Repair rib to skin attachment with a doubler or an angle similar to doubler or angle in figure 7-16 or 7-17 respectively. Multiple rib to skin attachments can be repaired.

- d. Concurrent inboard and outboard surface damage can be repaired.

7-178. Procedure.

- a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical, or rectangular, with no reentrant corners. Minimum corner radius shall be 0.500 inch.
- b. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.
- c. Fabricate and install repair doublers or angles. See figures 7-16 or 7-17.
- d. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
- e. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-179. **Conventional Skin Over Structure.** Repair for damage to conventional skin over structure requires a disposition from AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH.



INDEX NO.	NOMENCLATURE	TYPE OF CONSTRUCTION
1 ► 1	FORWARD BOX LEADING EDGE	GRID-LOCK
2 ► 1	FORWARD BOX LEADING EDGE	ALUMINUM HONEYCOMB CORE OR GRID-LOCK
1 ► 2	LOWER FORWARD BOX	GRID-LOCK
2 ► 2	LOWER FORWARD BOX	ALUMINUM HONEYCOMB CORE OR GRID-LOCK
3	UPPER FORWARD BOX	CONVENTIONAL SKIN OVER STRUCTURE
4	TIP POD	CONVENTIONAL SKIN OVER STRUCTURE
5	UPPER AFT BOX	CONVENTIONAL SKIN OVER STRUCTURE
6	LOWER AFT BOX	ALUMINUM SKIN AND HONEYCOMB CORE OR GRIDLOCK
7	TORQUE BOX	BORON COMPOSITE SKIN AND ALUMINUM HONEYCOMB CORE ABOVE WL 138.500 AND CONVENTIONAL SKIN OVER STRUCTURE BELOW WL 138.500
1 ►	RIGHT STABILIZER.	
2 ►	LEFT STABILIZER: HF ANTENNA	

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Figure 7-21. Vertical Stabilizer Repair Index

CSTO SR1F-15SA-3-1

7-180. **FUSELAGE GROUP.** See figure 7-22.

7-181. The fuselage is divided into six areas for ferry flight repairs: radome, refer to paragraph 7-170; transparencies, refer to paragraph 7-187; engine air inlet duct internal skins, refer to paragraph 7-197; speed brake, refer to paragraph 7-208; aft fuselage skin and doors, refer to paragraph 7-215; titanium skin/honeycomb core, engine nozzle fairings, and engine doors 122L/R, refer to paragraph 7-221.

7-182. **RADOME.** See figure 7-23. The radome repairs are per the below.

7-183. **Repair for Damage Up to 2 Inches In Diameter.**

7-184. Limitations.

a. Clean-up hole shall not extend within 2 of nose plug assembly zone 1. For location of zones, see figure 7-23.

b. Clean-up hole shall not extend into zone 5.

c. Minimum spacing between repairs shall be 10 inches.

d. Maximum number of repairs is six.

7-185. Materials.

Tape, aluminum foil, 428C, 4.00 inch, or equivalent
Sealing compound, AMS 3276 A-1/2

7-186. Procedure.

a. Remove visible damage using minimum size diameter hole. Refer to section III.

WARNING

Sealing compound is a flammable liquid and vapor. May cause allergic skin reaction. May cause eye, skin, and respiratory irritation. Contains material which may cause cancer. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

b. Cover hole with a 4 inch square piece of aluminum foil tape. Apply a brush coat of sealing compound. Clear acrylic enamel or lacquer may be used as an alternate method of sealing. Refer to CSTO SR1F-15SA-3-5.

c. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.

d. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-187. **Repair for Damage Greater than 2 Inches In Diameter, but not Exceeding 25 Square Inches.** See figure 7-24.

7-188. Limitations.

a. Clean-up hole shall not extend into either zone 1 or solid laminate attach region. For location of zones, see figure 7-23.

b. Minimum spacing between repairs shall be 18 inches.

c. Maximum number of repairs is two.

7-189. Materials.

Sealing compound, AMS 3276 A-1/2

7-190. Procedure.

a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical or rectangular, with no reentrant corners. Minimum corner radius shall be 0.500 inch. Refer to section III.

WARNING

Sealing compound is a flammable liquid and vapor. May cause allergic skin reaction. May cause eye, skin, and respiratory irritation. Contains material which may cause cancer. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

b. Fabricate, fay surface seal, and install repair doubler. See figure 7-24. For repair doubler, refer to section III; for sealing, refer to CSTO SR1F-15SA-3-5.

- c. Apply a brush coat of sealing compound around the periphery of repair doubler. Refer to CSTO SR1F-15SA-3-5.
- d. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
- e. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-191. Repair for Damage Greater than 25 Square Inches, but not Exceeding 100 Square Inches.

Damage may be repaired by one of the methods below.

7-192. Limitations.

- a. Clean-up hole shall not extend into either zone 1 solid laminate attach region. For location of zones, see figure 7-23.
- b. Maximum number of repairs is one.

7-193. Tape and Cloth Repair.

7-194. Materials.

Cloth, airplane, MIL-C-5646; or equivalent
Sealing compound, AMS 3276 A-1/2
Tape, pressure-sensitive, MIL-T-22085, TY3

7-195. Procedure.

- a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical, or rectangular, with no reentrant corners. Minimum corner radius shall be 1 inch. Refer to section III.

WARNING

Sealing compound is a flammable liquid and vapor. May cause allergic skin reaction. May cause eye, skin, and respiratory irritation. Contains material which may cause cancer. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

- b. Apply a brush coat of sealing compound to exterior surface of radome in an area 6 inches each side of damaged area. Refer to CSTO SR1F-15SA-3-5.

- c. Cover hole with tape, using as many strips as required.
- d. Wrap, starting from the aft side of damage, a 4 inch wide layer of cloth completely around the radome, overlapping each wrap approximately 3 inches. Apply a brush coat of sealing compound to each wrap of cloth. Refer to CSTO SR1F-15SA-3-5.
- e. Repeat step d. four additional times.
- f. Apply a brush coat of sealing compound over the completed repair. Refer to CSTO SR1F-15SA-3-5.
- g. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
- h. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-196. Patch Repair. See figure 7-24.

7-197. Materials.

Sealing compound, AMS 3276 A-1/2

7-198. Procedure.

- a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical or rectangular, with no reentrant corners. Minimum corner radius shall be 1 inch. Refer to section III.
- b. Fabricate repair doubler, repair angle, and repair filler.

CSTO SR1F-15SA-3-1

- c. Install repair angle.

WARNING

Sealing compound is a flammable liquid and vapor. May cause allergic skin reaction. May cause eye, skin, and respiratory irritation. Contains material which may cause cancer. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

- d. Fay surface seal and install repair doubler and repair filler. Refer to CSTO SR1F-15SA-3-5.
- e. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
- f. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-199. **TRANSPARENCIES.** The windshield and canopy transparency repairs are per the below.

7-200. Repair of Cracks.

7-201. Limitations.

- a. Damage to windshield transparency shall not be located in main forward viewing area of pilot.

7-202. Materials.

Tape, aluminum foil, 436, 2.00 inch width or equivalent

7-203. Procedure.

- a. Stop drill crack using a 1/8-inch diameter drill. Refer to section III.
- b. Clean both surfaces of damaged area (12-10-02).
- c. Cover damaged area, inner and outer surfaces, with 2 inch wide pieces of aluminum foil tape.
- d. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.

- e. Put the below ferry flight warning placard in cockpit.

WARNING

Do not pressurize cockpit. Aircraft load factor during the ferry flight shall be limited from 0 to 2.5g with a maximum speed of 350 knots EAS (equivalent airspeed) or 0.8 Mach, whichever is less. Roll maneuvers shall not exceed one-half stick deflection.

7-204. **Repair for Damage Up to 1 Inch Diameter.**

7-205. Limitations.

- a. Damage to windshield transparency shall not be located in main forward viewing area of pilot.
 - 1. Minimum spacing between repairs shall be five diameters of largest hole.

7-206. Materials.

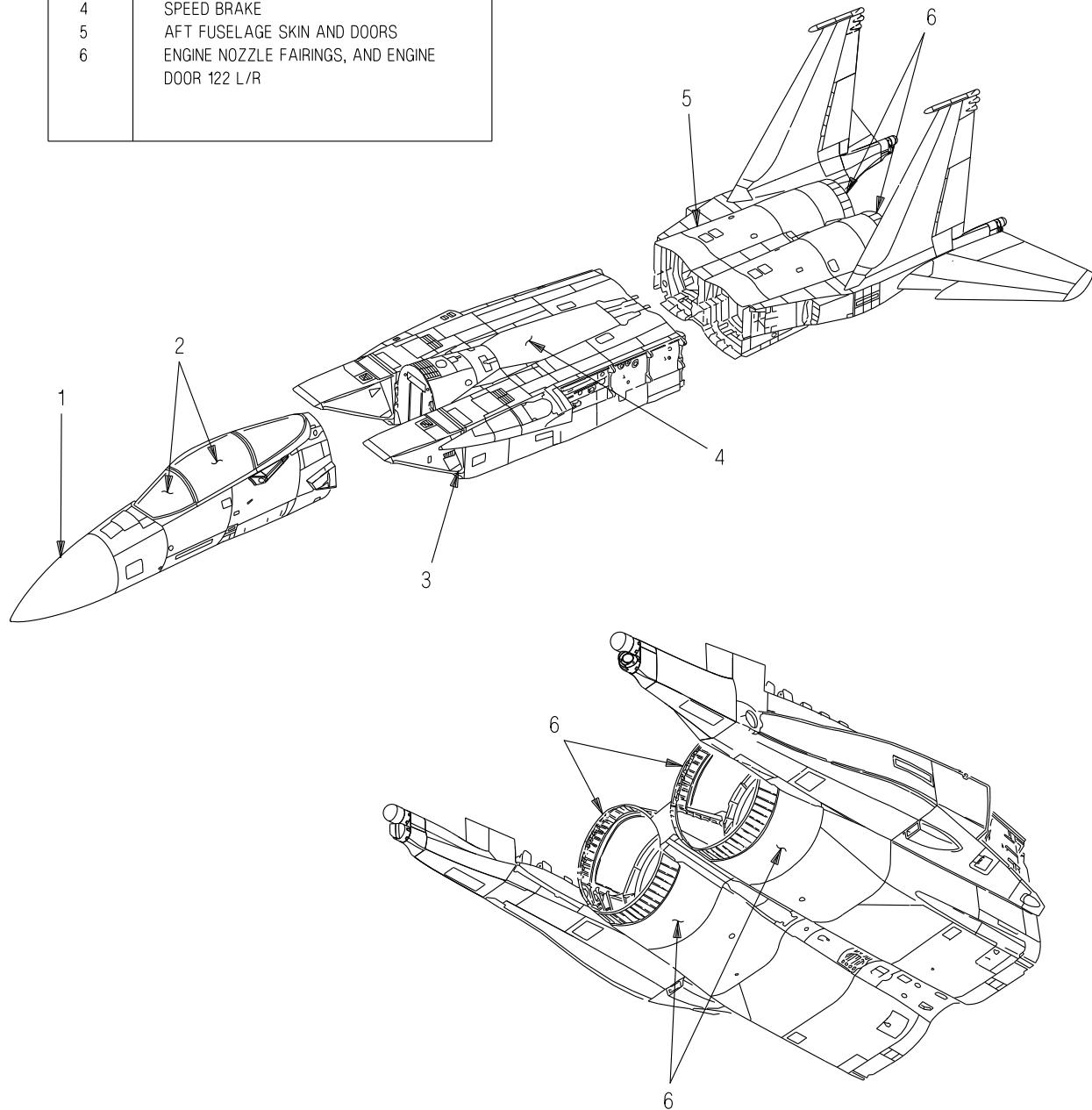
Tape, aluminum foil, 436, 4.00 inch width, or equivalent

7-207. Procedure.

- a. Remove visible damage using minimum size diameter hole. Refer to section III.
- b. Clean both surfaces of damaged area (12-10-02).
- c. Cover damaged area inner and outer surfaces with 4 inch square pieces of aluminum foil tape.
- d. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
- e. Put a ferry flight warning placard in cockpit. For ferry flight placard, refer to paragraph 7-191, step e.

7-208. **Repair for Damage Exceeding 1 Inch In Diameter.** For repair of damage exceeding 1 inch in diameter, refer to AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH.

INDEX NO.	NOMENCLATURE
1	RADOME
2	TRANSPARENCIES
3	ENGINE AIR INLET DUCT INTERNAL SKINS
4	SPEED BRAKE
5	AFT FUSELAGE SKIN AND DOORS
6	ENGINE NOZZLE FAIRINGS, AND ENGINE DOOR 122 L/R

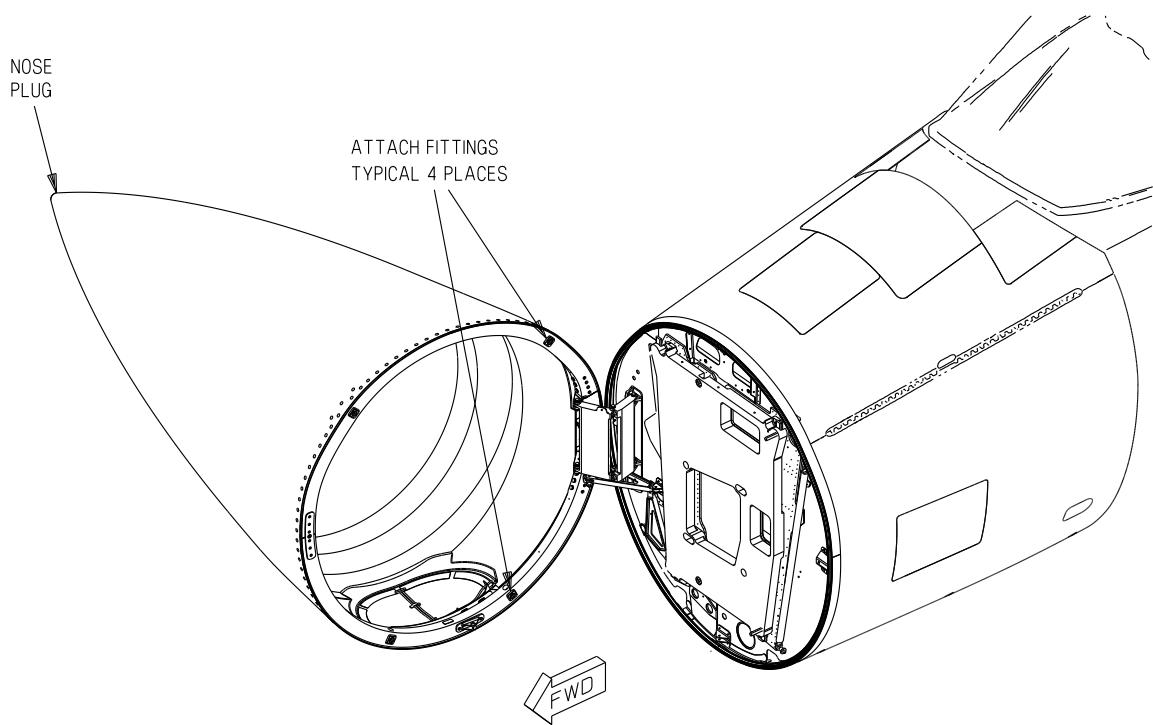
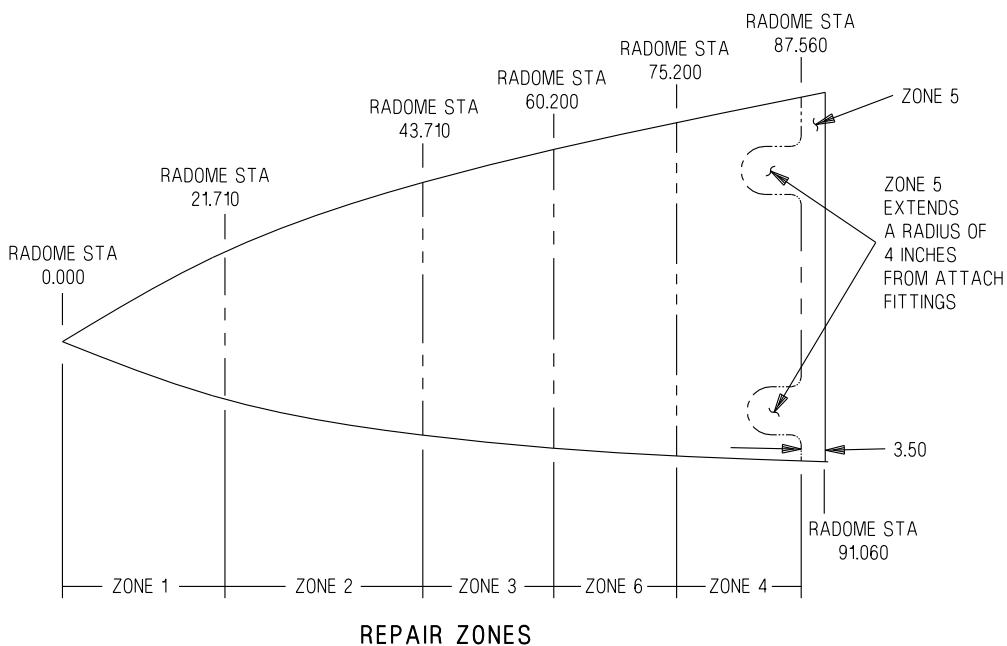


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Figure 7-22. Fuselage Group Repair Index

CSTO SR1F-15SA-3-1

RADOME WALL THICKNESS INDEX	
RADOME STATION	WALL THICKNESS 
2.50	0.310
5.00	0.310
10.00	0.310
15.00	0.292
20.00	0.291
25.00	0.290
30.00	0.289
35.00	0.289
40.00	0.286
45.00	0.284
50.00	0.281
55.00	0.278
60.00	0.275
65.00	0.273
70.00	0.271
75.00	0.269
80.00	0.268



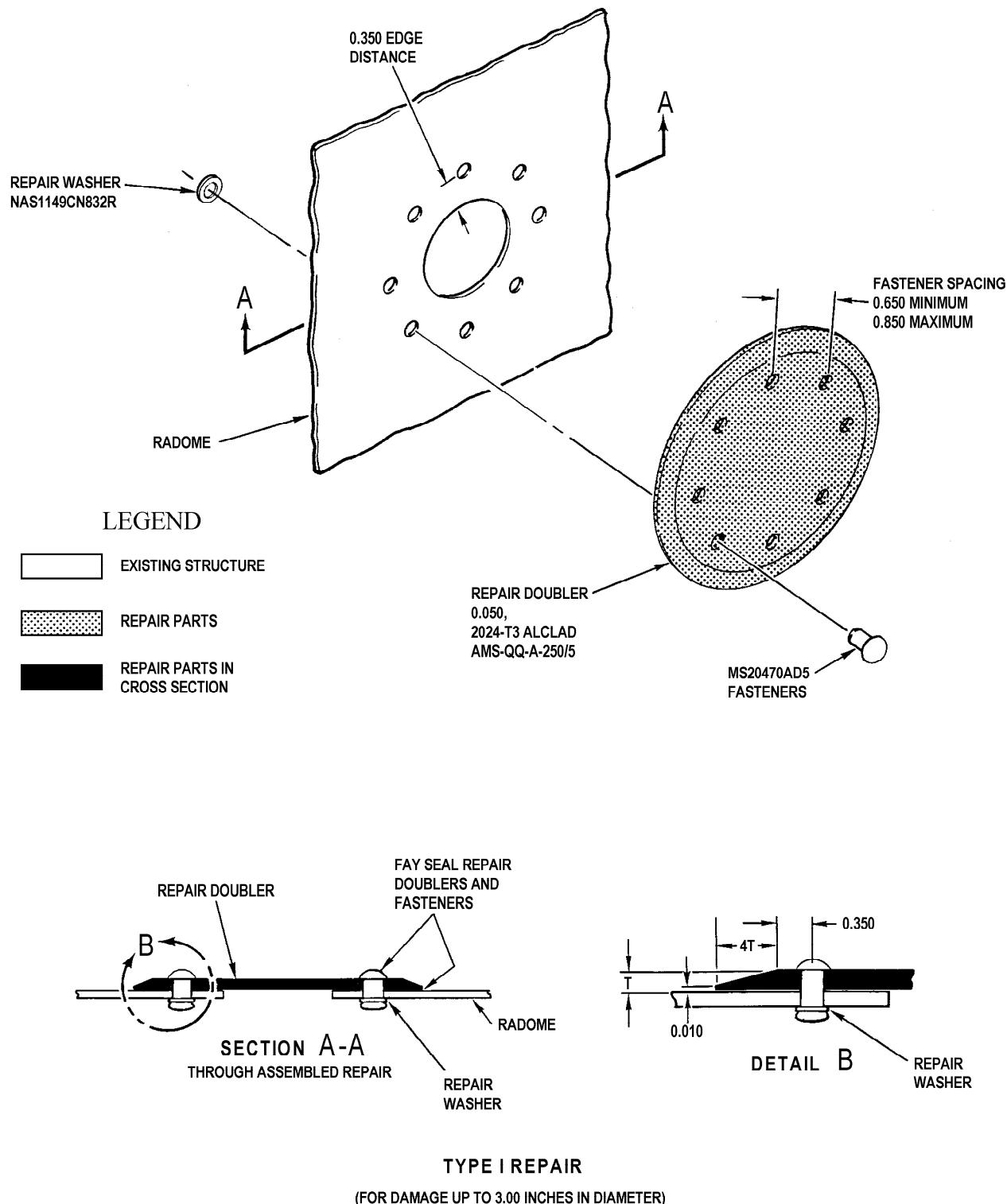
LEGEND

 DOES NOT INCLUDE THICKNESS OF WOVEN GLASS FABRIC OR PAINT COATING.

 MAJOR CHANGE

SAN301-07-36-002

Figure 7-23. Radome Repair Index



SAN301-07-37-002

Figure 7-24. Repair for Damage Greater than 2 Inches In Diameter, but not Exceeding 25 Square Inches, One-Time Ferry Flight (Sheet 1 of 2)

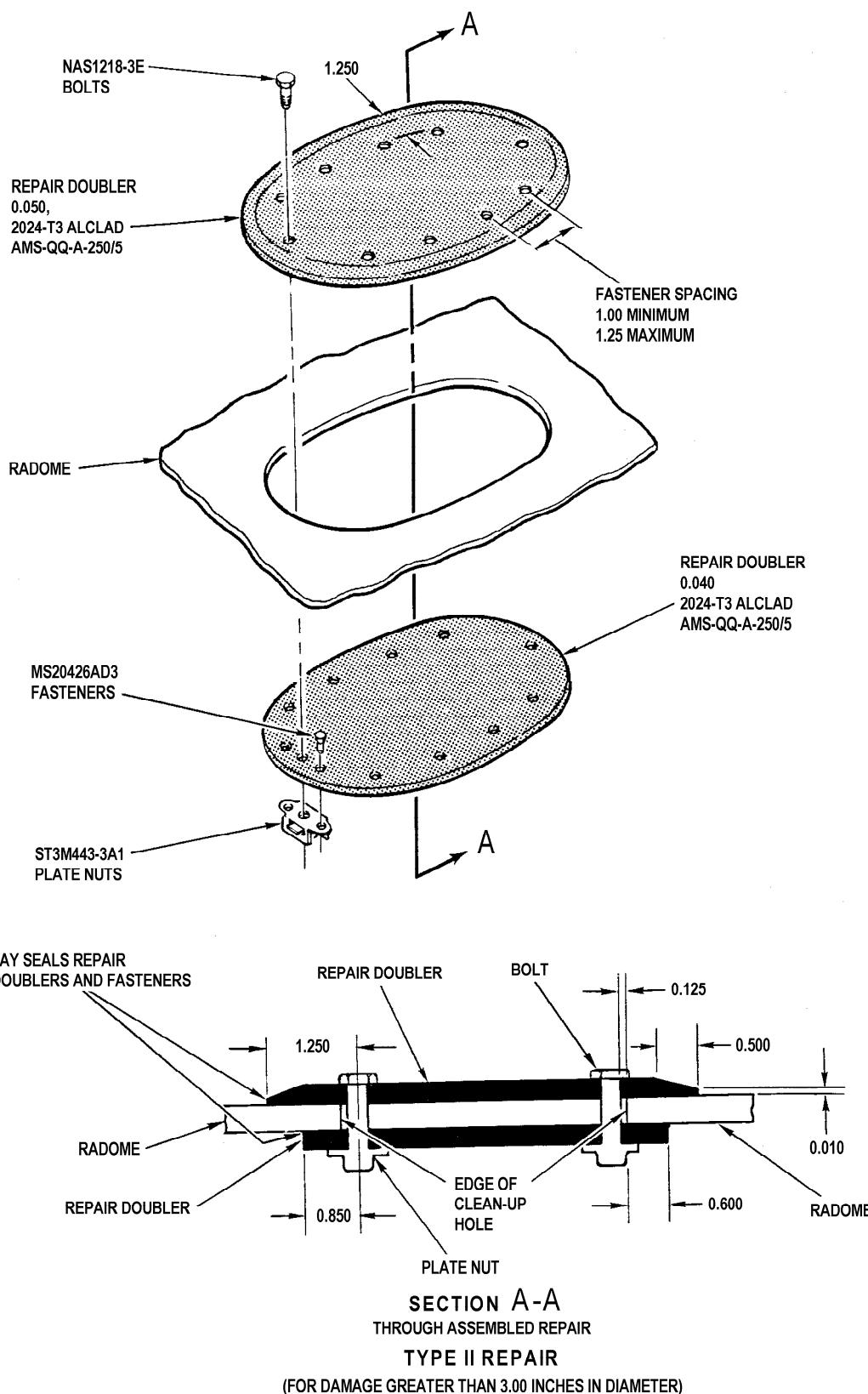


Figure 7-24. Repair for Damage Greater than 2 Inches in Diameter, but not Exceeding 25 Square Inches, One-Time Ferry Flight (Sheet 2)

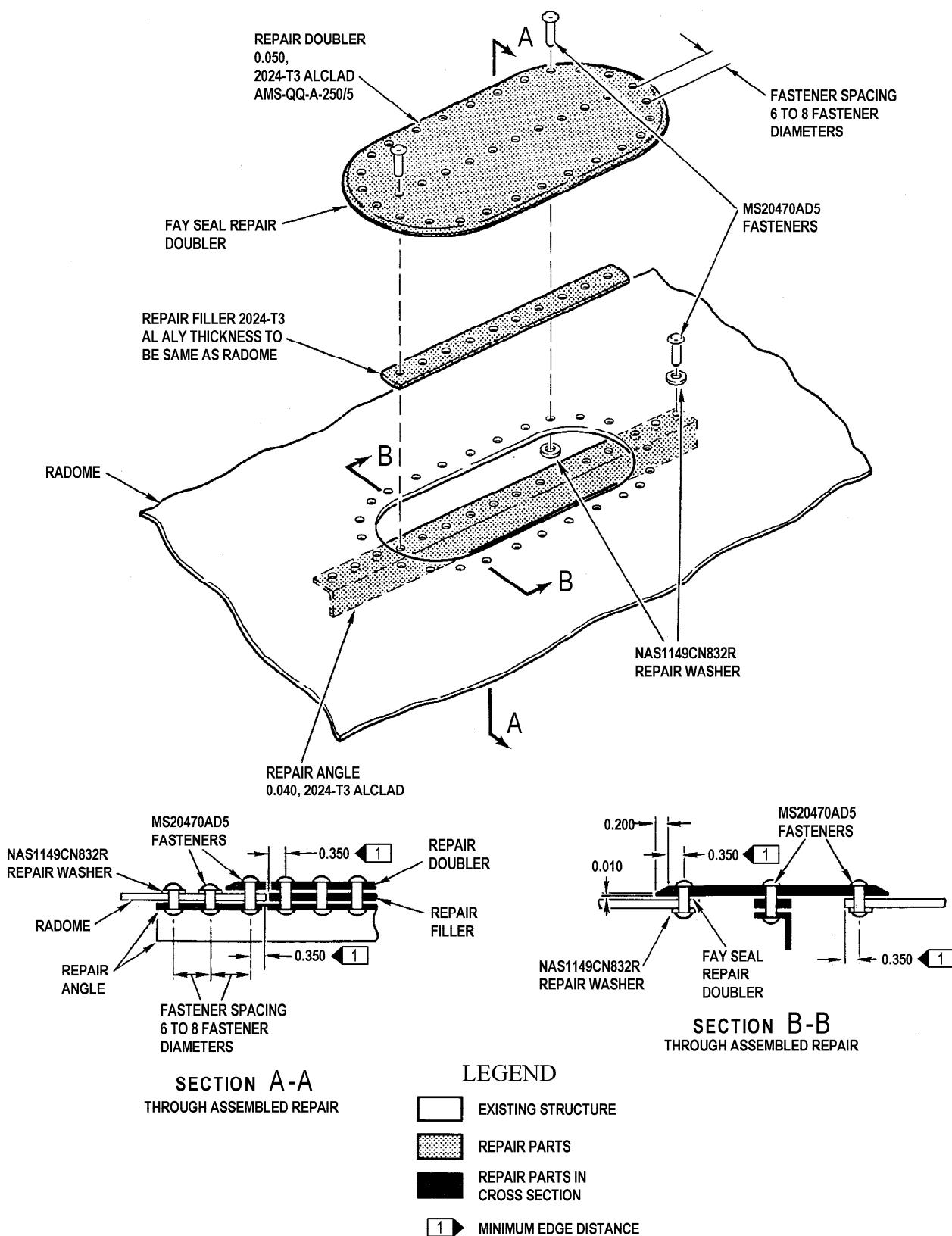


Figure 7-25. Repair of Damage Greater than 25 Square Inches, but not Exceeding 100 Square Inches, One-Time Ferry Flight

CSTO SR1F-15SA-3-1

7-209. ENGINE AIR INLET DUCT INTERNAL SKINS. See figure 7-26.

7-210. The engine air inlet duct skins include the air induction first ramp, second ramp, third ramp, and diffuser ramp, and inlet duct internal skins. For one-time ferry flight repairs to damage exceeding repairs for continued operation per CSTO SR1F-15SA-39-1 (12-1001 THRU 12-1024; ALSO; 93-0852 THRU 93-0923) CSTO SR1F-15SA-39-2 (12-1025 AND UP) and/or repairs in CSTO SR1F-15SA-3-2-1 (12-1001 THRU 12-1024; ALSO; 93-0852 THRU 93-0923) CSTO SR1F-15SA-3-2-2 (12-1025 AND UP) or CSTO SR1F-15SA-3-4, refer to AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH.

7-211. Repair for Damage Up to 3/8 Inch In Diameter.

7-212. Limitations.

- a. Clean-up hole shall be a minimum of 1 inch away from existing fastener holes.
- b. Clean-up hole shall not extend into internal structure.
- c. Minimum spacing between repairs shall be 4 inches.

7-213. Materials.

Sealing compound, AMS 3276 A-1/2 Tape, aluminum foil, 436, 4.00 inch width, or equivalent

7-214. Procedure.

- a. Remove visible damage using 0.375 +0.007 -0.000 inch diameter hole.
- b. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.
- c. If backside of repair is not accessible, drill a sufficient size access hole in outer skin to allow installation of 3/8-inch lockbolt collar. Maximum access hole shall be 1 inch in diameter.

WARNING

Sealing compound is a flammable liquid and vapor. May cause allergic skin reaction. May cause eye, skin, and respiratory irritation. Contains material which may cause cancer. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

- d. Install ST3M428C4-5 lockbolt, wet with sealing compound, and NAS1080AG05 collar into the drilled 3/8-inch hole. For lockbolt installation, refer to section III; for sealing, refer to CSTO SR1F-15SA-3-5.
- e. Repair access hole by covering with 4 inch square piece of aluminum foil tape. Apply a brush coat of sealing compound. Clear acrylic enamel or lacquer may be used as an alternate method of sealing. Refer to CSTO SR1F-15SA-3-5.
- f. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.

7-215. Repair for Damage 3/8 to 1 Inch In Diameter.

7-216. Limitations.

- a. Clean-up hole shall be a minimum of 1 inch away from existing fastener holes.
- b. Clean-up hole shall not extend into internal structure.
- c. Minimum spacing between repairs shall be 4 inches.
- d. This repair is not authorized on the second or third ramps.

7-217. Materials.

Sealing compound, AMS 3276 A-1/2

7-218. Procedure.

- a. Remove visible damage using minimum size diameter hole.
- b. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.
- c. If backside of repair is not accessible, drill a sufficient size access hole in outer skin to allow installation of 1/4-inch lockbolt collar. Maximum access hole shall be 1 inch in diameter.

WARNING

Sealing compound is a flammable liquid and vapor. May cause allergic skin reaction. May cause eye, skin, and respiratory irritation. Contains material which may cause cancer. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

- d. Fabricate, fay surface seal, and install repair doubler. See figure 7-26. For repair doubler, refer to section III; for sealing, refer to CSTO SR1F-15SA-3-5.
- e. Repair access hole by covering with 4 inch square piece of aluminum foil tape. Apply a brush coat of sealing compound. Clear acrylic enamel or lacquer may be used as an alternate method of sealing. Refer to CSTO SR1F-15SA-3-5.
- f. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.

7-219. Repair for Damage Greater than 1 Inch In Diameter. Refer to AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH for engineering disposition.

7-220. **SPEED BRAKE, 68A360194.** Repair for damage to speed brake requires a disposition from AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH.

7-221. **SPEED BRAKE, 68A360006.** See figure 7-27. Repair for damage to the graphite composite speed brake is listed below.

WARNING

Sanding and cutting on graphite composite skin produces a fine dust that may cause excessive skin irritation. Breathing of an excessive amount of dust may be injurious.

CAUTION

Use care in disposal of fibrous graphite and graphite/epoxy scrap.

Carbon/graphite fibers have high electrical conductivity and if free, floating fibers can get inside unsealed or unprotected electrical equipment, causing failures or malfunctions.

7-222. Graphite Composite Skin and Aluminum Honeycomb Core Repair for Damage From 2 to 6 Inches in Diameter.

7-223. Limitations. See figure 7-27.

- a. Total dimension of clean-up holes in any fuselage station cut in zone A shall not exceed 6 inches.
- b. Minimum spacing between repairs shall be 12 inches.
- c. Total dimension of clean-up holes in any fuselage station cut in both zone A and zone B shall not exceed 12 inches.

7-224. Materials.

Sealing compound, MIL-S-83430, Class A-1/2 Tape, aluminum foil, 436, 4.00 inch width or equivalent

CSTO SR1F-15SA-3-1

7-225. Procedure.

WARNING

Sealing compound is a flammable liquid and vapor. May cause allergic skin reaction. May cause eye, skin, and respiratory irritation. Contains material which may cause cancer. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

- a. Remove visible damage using minimum size diameter hole. Clean-up hole may be circular or elliptical. Use care not to damage nearby bonded areas. Maintain a minimum radius of 1/16-inch. Refer to section III. For clean up and disposal of graphite/epoxy scrap material, refer to paragraph 7-214.
- b. Cover damaged area with strips of tape, using as many strips as required. Brush coat with sealing compound. Refer to CSTO SR1F-15SA-3-5.
- c. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-5.
- d. Place the below ferry flight warning placard in cockpit.

WARNING

Do not extend speed brake during ferry flight. Aircraft load factor during ferry flight shall be limited to 0 to 3g.

7-226. Fibrous Graphite and Graphite/Epoxy

Scrap Clean Up and Disposal. The fibrous graphite and graphite epoxy scrap is divided into three classifications. Each classification has a clean up and disposal requirement.

- a. Classification of scrap:

1. Class I is made up of prepreg material and pieces of noncharred laminate composite.

2. Class II is made up of graphite/epoxy material such as, prepreg material or pieces of laminate composite, which were burned in a fire or in which excessive heat has degraded ability of resin to hold fibers in place.

3. Class III is made up of non-fibrous dust (partial length 0.025 or less) resulting from drilling, sanding, or routing operations.

- b. Clean up and disposal of scrap:

CAUTION

Under no circumstance, shall any class I or class II material be incinerated or placed in a waste container scheduled for incineration.

1. Class I material shall be placed in waste container scheduled for dumping in a land fill.

2. Class II material shall be placed in a polyethylene bag or if too large for a bag, wrapped in polyethylene film and sealed. The material shall then be placed in a waste container scheduled for dumping in a land fill.

3. Class III material may be cleaned up and disposed of the same as any general waste material.

7-227. AFT FUSELAGE SKIN AND DOORS.

Repair per the below.

7-228. Repair for Damage Up to 200 Square Inches.

7-229. Limitations. See figure 7-28.

a. Clean-up hole shall not extend into internal structure, unless internal structure is repaired, refer to CSTO SR1F-15SA-3-5.

b. One repair per skin or door panel.

7-230. Materials.

Sealing compound, AMS 3276 A-1/2

7-231. Procedure.

- a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical, or rectangular, with no reentrant corners. Minimum corner radius shall be 0.500 inch. Refer to section III.
- b. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.

WARNING

Sealing compound is a flammable liquid and vapor. May cause allergic skin reaction. May cause eye, skin, and respiratory irritation. Contains material which may cause cancer. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

- c. Fabricate, fay surface seal and install repair doubler. See figure 7-26. For repair doubler, refer to section III; for sealing, refer to CSTO SR1F-15SA-3-5.
- d. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
- e. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-232. TITANIUM SKIN/HONEYCOMB CORE ENGINE NOZZLE FAIRINGS, AND ENGINE DOORS

- **122L/R.** For door 122L, 68A334004-1007, refer to AFLCMC/WWQL (F-15SA Engineering), Wright-Patterson AFB, OH for engineering disposition. For door 122L/R, 68A334004-1009, see figure 7-22. Repair is per the below.

7-233. Repair for Damage Greater than 2 Inches In Diameter.

7-234. Limitations.

- a. Clean-up hole shall not extend into engine nozzle fairing or door 122 attach points.

7-235. Procedure.

- a. Remove visible damage as below:
 - 1. Engine nozzle fairing.
 - (a) Small sheet metal fairings.
 - (1) Trim out damage using minimum corner radius of 0.250 inch. If damage is major, fairings may be trimmed back to attach points. If 50 percent of fairings are removed, the strap from door 122 fairings shall also be removed. Refer to section III.
 - (b) Skin and honeycomb core.
 - (1) Trim out damage using minimum corner radius of 0.250 inch. Skin and honeycomb core may be trimmed back to attach points. Refer to section III.
 - 2. Door 122L/R.
 - (a) Small sheet metal fairings.
 - (1) Trim out damage using minimum corner radius of 0.250 inch. If damage is major, fairings may be trimmed back to attach points. If 50 percent of the fairings are removed, the strap on engine nozzle fairings shall also be removed. Refer to section III.
 - (b) Skin and honeycomb core.
 - (1) Trim out damage using minimum corner radius of 0.250 inch. If damage is major remove door. Refer to section III.
 - b. Do a fluorescent penetrant inspection to be sure of complete damage removal. Refer to TO 33B-1-1.
 - c. Leave hole open.
 - d. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.
 - e. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

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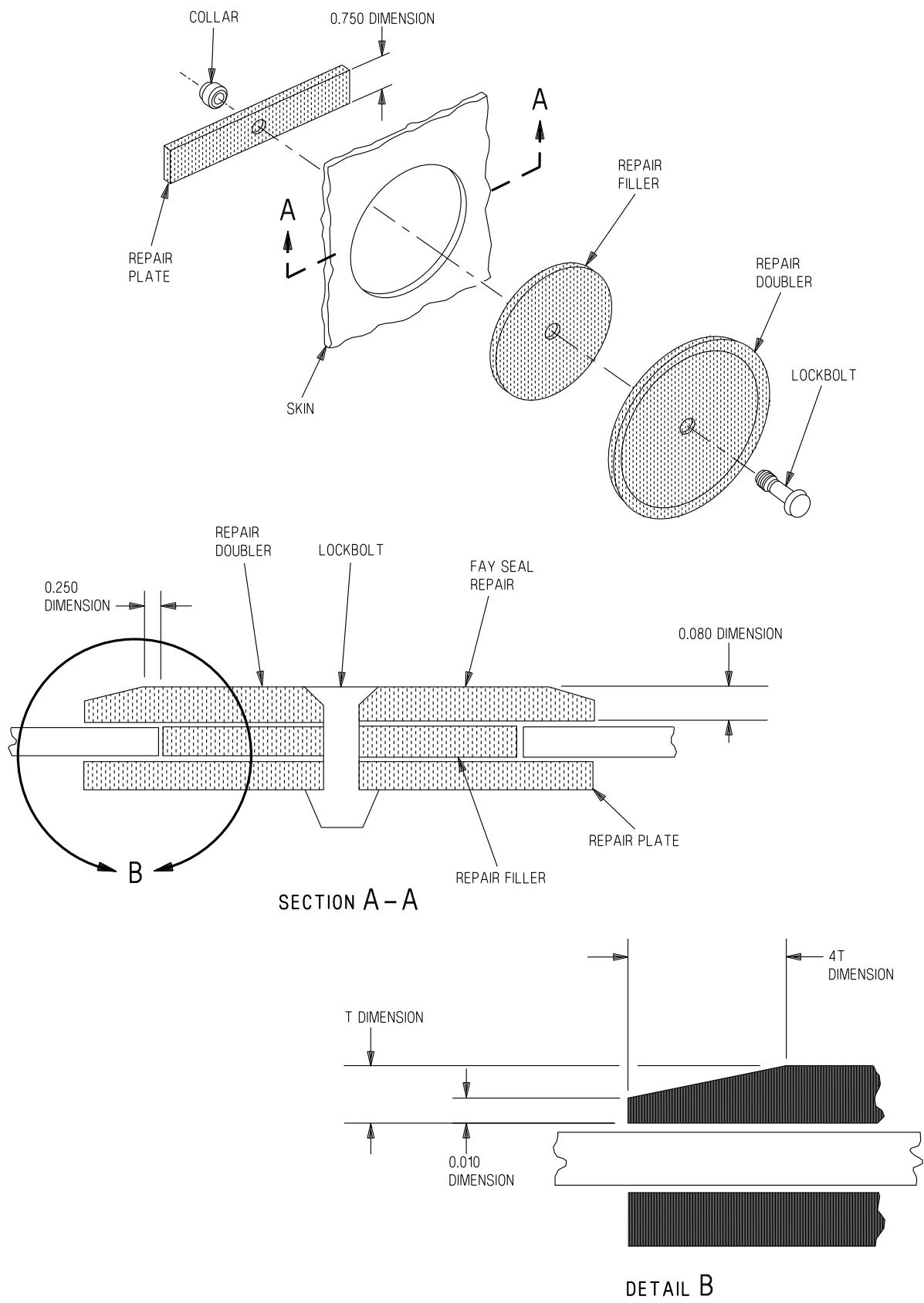
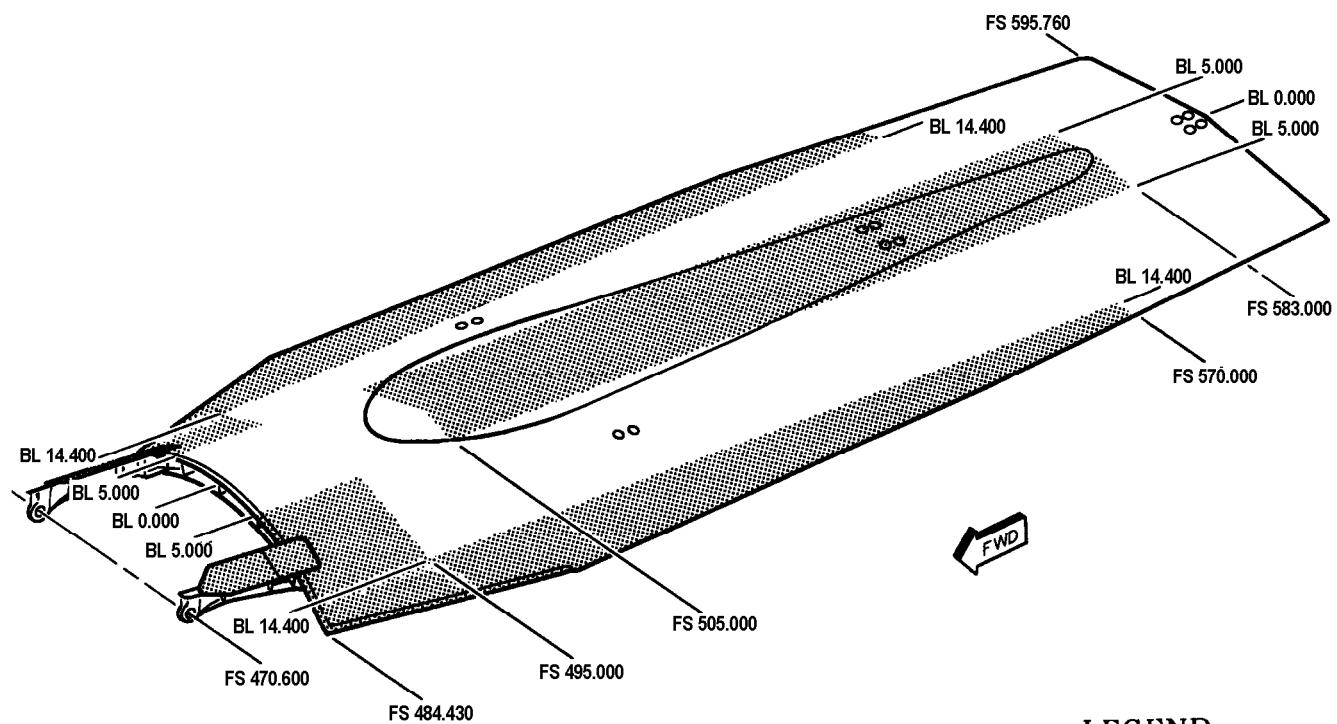


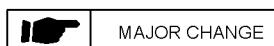
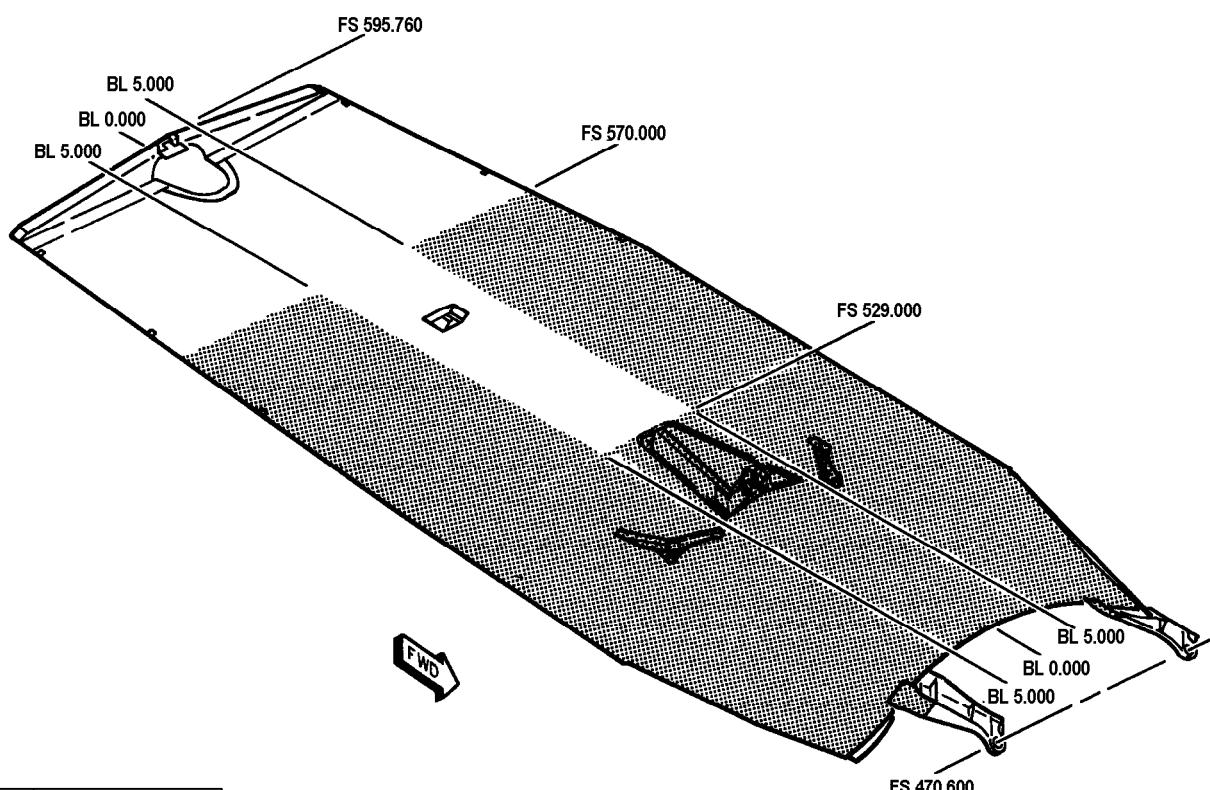
Figure 7-26. Engine Air Inlet Duct Internal Skins

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LEGEND

- | | |
|--|---------|
| | ZONE A. |
| | ZONE B. |



SAN301-38-1-002

Figure 7-27. Speed Brake Repair Index

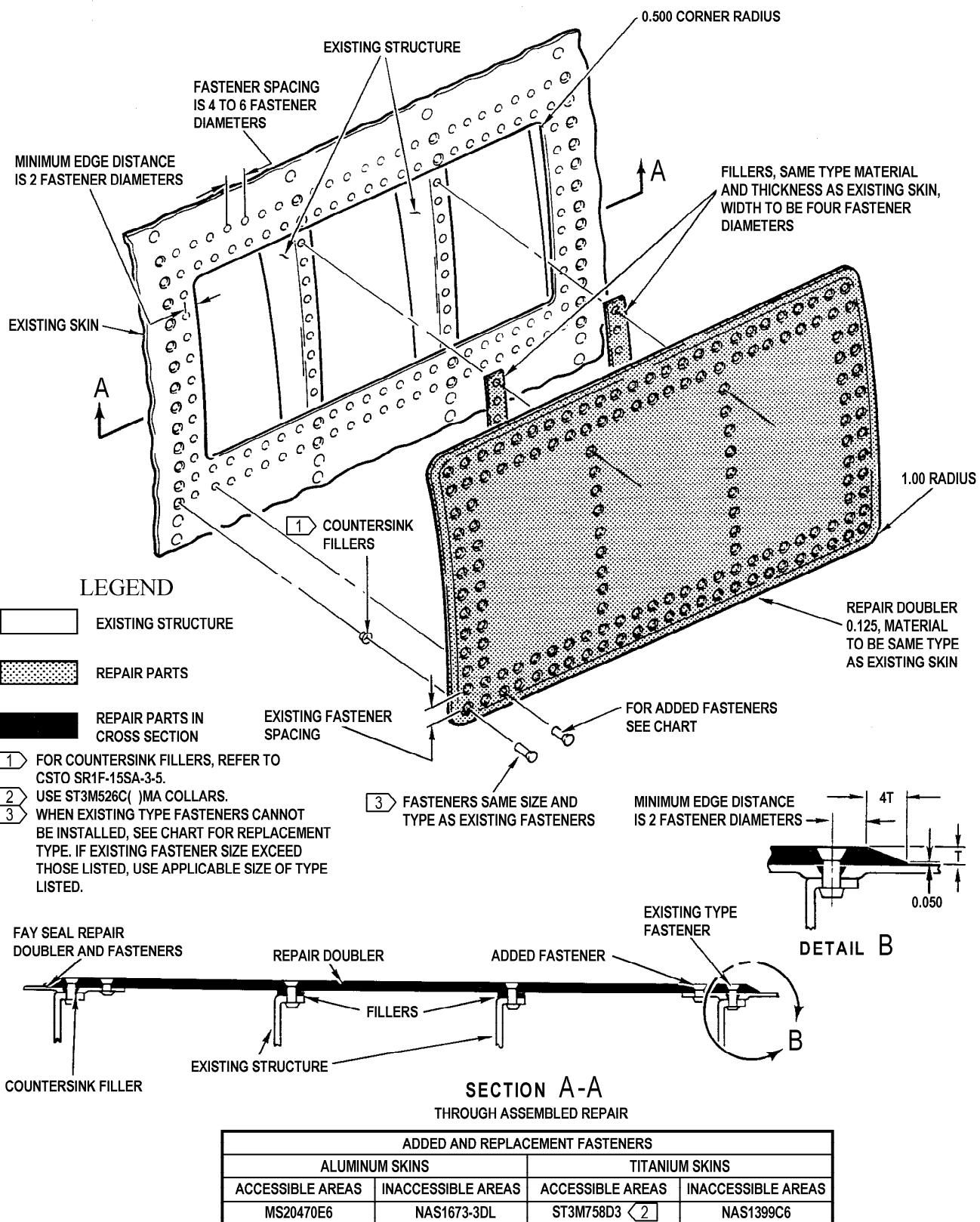


Figure 7-28. Aft Fuselage, Repair for Damage Up to 200 Square Inches

7-236. **LANDING GEAR DOORS.** See figure 7-29.

7-237. The landing gear door repairs are for main landing gear aft doors and nose landing gear doors per the below.

7-238. **Repair for Damage Greater than 50 Square Inches, but not Exceeding 100 Square Inches.** Damage may be repaired by either of the methods below. See figure 7-30.

7-239. Doubler Repair.

7-240. Limitations.

a. Clean-up hole shall be a minimum of 2 inches away from edge of door.

b. Clean-up hole shall not extend into the door linkage and up-latch fitting area.

c. One repair per door.

d. Damage shall not extend into internal structure, unless internal structure is repaired. Refer to CSTO SR1F-15SA-3-5.

7-241. Materials.

Sealing compound, AMS 3276 A-1/2

7-242. Procedure.

a. Remove visible damage using minimum size hole. Clean-up hole may be circular, elliptical, or rectangular, with no reentrant corners. Minimum corner radius shall be 0.500 inch. Refer to section III.

WARNING

Sealing compound is a flammable liquid and vapor. May cause allergic skin reaction. May cause eye, skin, and respiratory irritation. Contains material which may cause cancer. Keep away from heat, sparks, and flame. Use only with adequate ventilation. Avoid breathing dust (vapor, mist, gas). Keep container closed. Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling.

b. Fabricate, fay seal, and install repair doubler. See figure 7-30. For repair doubler, refer to

section III; for sealing, refer to CSTO SR1F-15SA-3-5.

c. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.

d. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

7-243. Door Removal. When damage is so major that a patch repair would be impractical, remove landing gear doors as follows:

a. Nose landing gear doors.

1. Nose landing gear forward door damaged: remove both forward and aft doors (32-20-11 and 32-20-10).

2. Nose landing gear aft door damaged: remove aft door (32-20-10).

b. Main landing gear doors.

1. Outboard door damaged: remove outboard door (32-10-11).

2. Inboard door damaged: remove inboard, outboard, and aft door (32-10-10, 32-10-11, and 32-10-16).

3. Aft door damaged: remove aft door (32-10-16).

c. Make a log book entry for a one-time ferry flight. Refer to TO 00-20-1.

d. Put a ferry flight placard in cockpit. Refer to paragraph 7-9.

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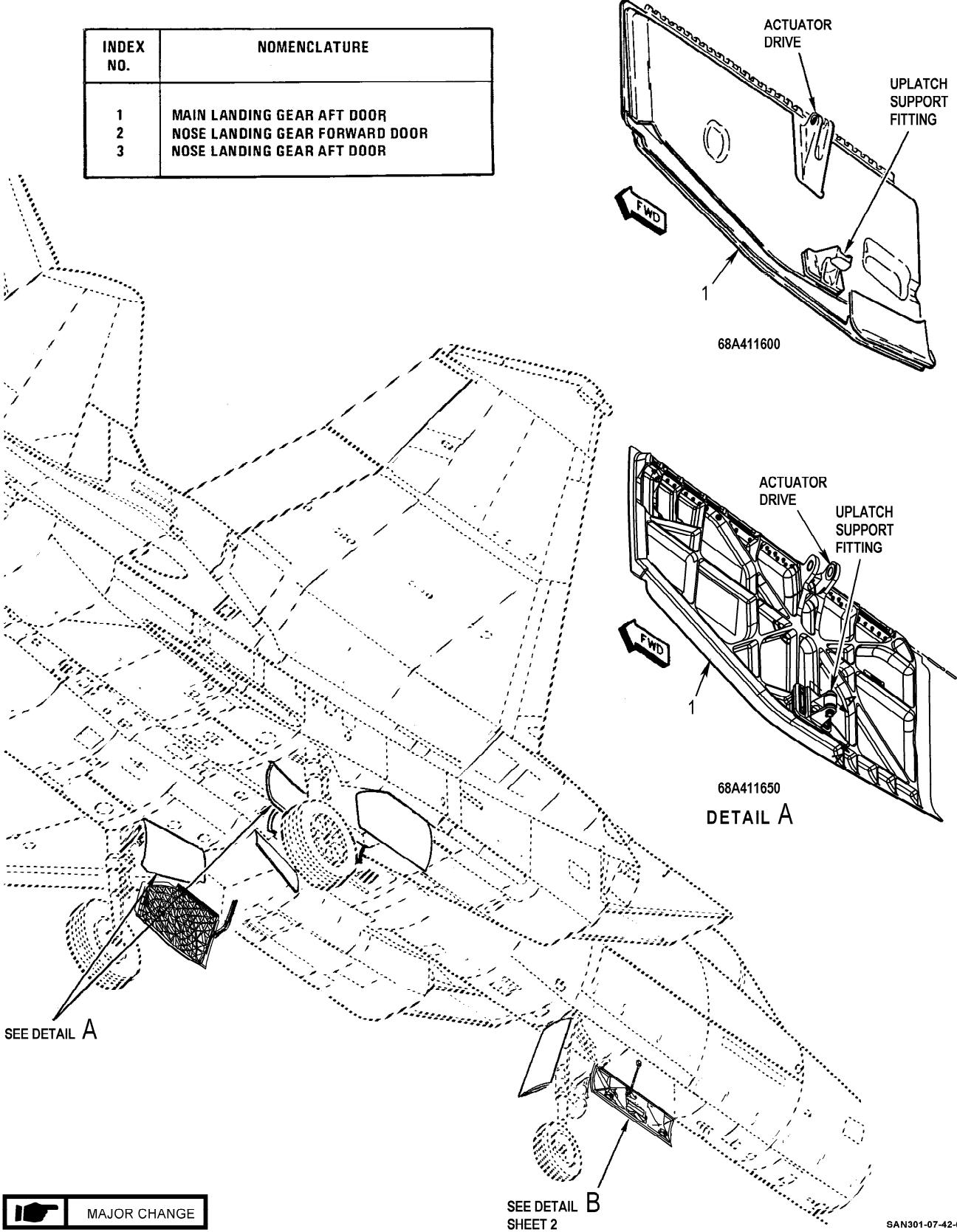
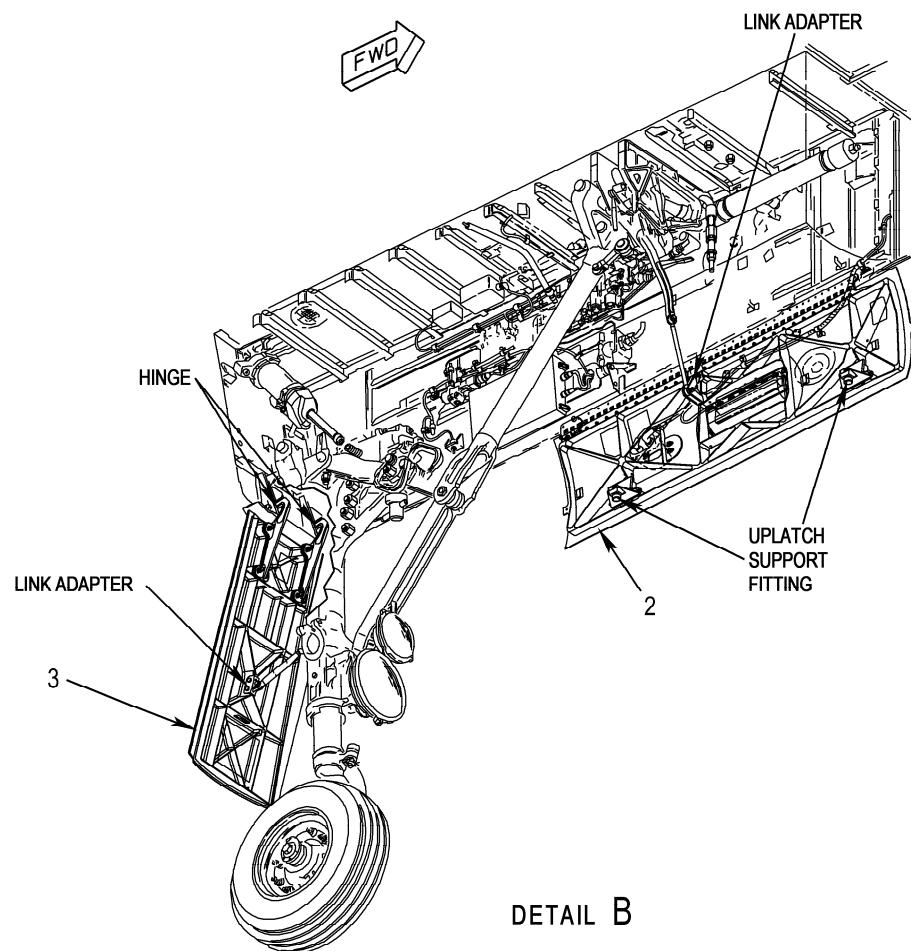


Figure 7-29. Landing Gear Doors Repair Index (Sheet 1 of 2)



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Figure 7-29. Landing Gear Doors Repair Index (Sheet 2)

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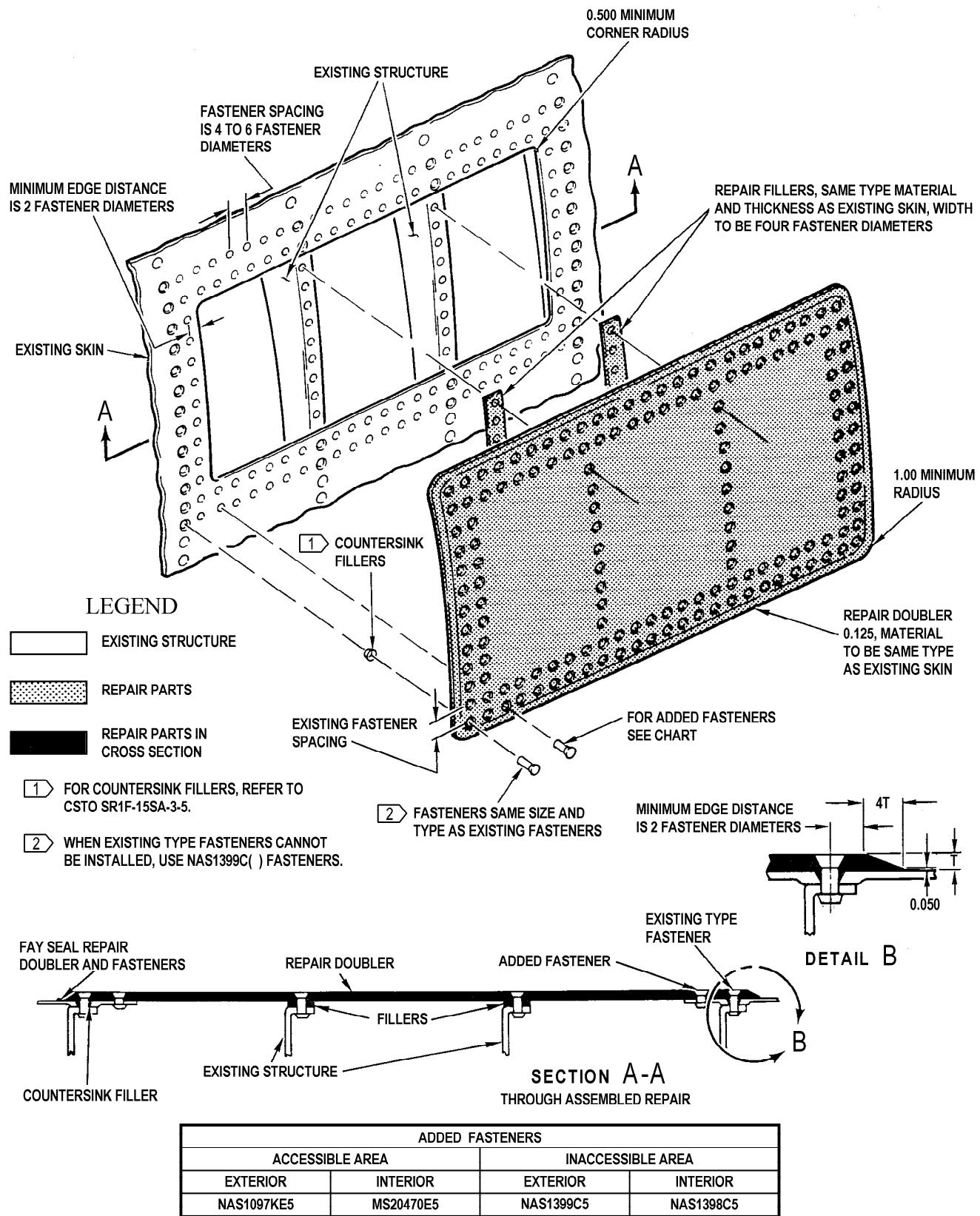


Figure 7-30. Repair for Damage Greater than 50 Inches, but not Exceeding 100 Square Inches, One-Time Ferry Flight

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