

**CHAPTER**

**20**

**STANDARD  
PRACTICES**



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1	Jun 15/2015		409	Feb 15/2015		401	Feb 15/2015	
2	Jun 15/2015		410	BLANK		402	Feb 15/2015	
3	Jun 15/2015	20-10-07				403	Oct 15/2015	
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20-00-00			214	Jun 15/2015		407	Feb 15/2016	
201	Oct 15/2015		215	Jun 15/2015		408	Feb 15/2016	
202	Oct 15/2015		216	Jun 15/2015		409	Feb 15/2016	
203	Oct 15/2014		217	Jun 15/2015		410	Feb 15/2016	
204	BLANK		218	Jun 15/2015		20-10-11		
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201	Oct 15/2014		220	Jun 15/2015		801	Oct 15/2014	
202	BLANK		221	Jun 15/2015		802	BLANK	
20-10-02			222	Oct 15/2015		20-10-14		
401	Oct 15/2014		223	Jun 15/2015	R	401	Jun 15/2016	
402	BLANK		224	Jun 15/2015	R	402	Jun 15/2016	
20-10-04			225	Oct 15/2015		403	Feb 15/2016	
401	Feb 15/2015		226	Oct 15/2015		404	BLANK	
402	Oct 15/2015		227	Oct 15/2015		20-10-15		
403	Oct 15/2015		228	Oct 15/2015		401	Oct 15/2014	
404	Feb 15/2015		229	Feb 15/2016		402	Oct 15/2014	
405	Feb 15/2015		230	BLANK				

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403	Oct 15/2015		413	Oct 15/2015		403	Oct 15/2014	
404	BLANK		414	Oct 15/2015		404	Oct 15/2015	
20-10-20			20-10-27			405	Oct 15/2015	
R 201	Jun 15/2016		201	Jun 15/2015		406	Oct 15/2015	
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401	Jun 15/2015		401	Oct 15/2014		20-10-47		
R 402	Jun 15/2016		402	Oct 15/2015		R 201	Jun 15/2016	
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404	Feb 15/2015		R 401	Jun 15/2016		203	Oct 15/2015	
405	Feb 15/2015		402	Jun 15/2015		204	BLANK	
406	BLANK		R 403	Jun 15/2016		20-10-51		
20-10-24			404	Feb 15/2015		R 201	Jun 15/2016	
301	Oct 15/2015		20-10-34			202	Jun 15/2015	
302	Oct 15/2015		701	Jun 15/2015		203	Jun 15/2015	
20-10-24			702	Jun 15/2015		204	Oct 15/2015	
401	Feb 15/2016		703	Jun 15/2015		205	Jun 15/2015	
402	Oct 15/2014		R 704	Jun 15/2016		206	Jun 15/2015	
403	Oct 15/2014		705	Oct 15/2015		207	Oct 15/2015	
404	Oct 15/2015		706	BLANK		208	Oct 15/2015	
20-10-25			20-10-37			209	Oct 15/2015	
201	Oct 15/2014		R 601	Jun 15/2016		210	Oct 15/2015	
202	BLANK		O 602	Jun 15/2016		211	Oct 15/2015	
20-10-26			603	Feb 15/2015		212	Oct 15/2015	
401	Feb 15/2015		604	Oct 15/2015		213	Oct 15/2015	
402	Oct 15/2014		605	Oct 15/2015		214	Oct 15/2015	
403	Oct 15/2015		606	Oct 15/2015		215	Oct 15/2015	
404	Oct 15/2015		607	Oct 15/2015		216	Oct 15/2015	
405	Oct 15/2015		608	BLANK		217	Oct 15/2015	
406	Oct 15/2015		20-10-41			218	Oct 15/2015	
407	Oct 15/2015		401	Oct 15/2015		219	Oct 15/2015	
408	Oct 15/2015		402	Feb 15/2015		220	Oct 15/2015	
409	Feb 15/2015		403	Oct 15/2015		221	Oct 15/2015	
410	Feb 15/2015		404	BLANK		222	Oct 15/2015	

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223	Oct 15/2015		426	BLANK		835	Jun 15/2015	
224	Oct 15/2015		20-10-51			836	Jun 15/2015	
225	Oct 15/2015		801	Feb 15/2016		837	Jun 15/2015	
226	Oct 15/2015		802	Oct 15/2014		838	Oct 15/2015	
227	Oct 15/2015		803	Oct 15/2014		839	Oct 15/2015	
228	Oct 15/2015		804	Oct 15/2014		840	Oct 15/2015	
229	Oct 15/2015		805	Oct 15/2014		841	Oct 15/2015	
230	Oct 15/2015		806	Oct 15/2014		842	Oct 15/2015	
231	Oct 15/2015		807	Oct 15/2014		843	Oct 15/2015	
232	Oct 15/2015		808	Oct 15/2015		844	Oct 15/2015	
20-10-51			809	Oct 15/2015		845	Oct 15/2015	
401	Oct 15/2014		810	Oct 15/2015		846	Oct 15/2015	
402	Oct 15/2014		811	Oct 15/2015		847	Oct 15/2015	
403	Feb 15/2016		812	Oct 15/2015		848	Oct 15/2015	
404	Oct 15/2014		813	Oct 15/2015		849	Oct 15/2015	
405	Oct 15/2014		814	Oct 15/2015		850	Oct 15/2015	
406	Oct 15/2014		815	Oct 15/2014		851	Oct 15/2015	
407	Oct 15/2014		816	Oct 15/2014		852	Oct 15/2015	
408	Feb 15/2015		817	Oct 15/2014		853	Oct 15/2015	
R 409	Jun 15/2016		818	Oct 15/2015		854	Oct 15/2015	
410	Feb 15/2015		819	Oct 15/2015		855	Oct 15/2015	
411	Oct 15/2015		820	Oct 15/2015		856	Oct 15/2015	
412	Oct 15/2015		821	Oct 15/2014		857	Oct 15/2015	
413	Oct 15/2015		822	Jun 15/2015		858	Oct 15/2015	
414	Oct 15/2015		823	Jun 15/2015		859	Oct 15/2015	
415	Oct 15/2015		824	Feb 15/2016		860	Oct 15/2015	
416	Feb 15/2015		825	Jun 15/2015		861	Oct 15/2015	
417	Oct 15/2014		826	Jun 15/2015		862	Oct 15/2015	
418	Oct 15/2014		827	Jun 15/2015		863	Jun 15/2015	
419	Oct 15/2014		828	Jun 15/2015		864	Oct 15/2015	
420	Feb 15/2015		829	Jun 15/2015		865	Oct 15/2015	
421	Oct 15/2015		830	Jun 15/2015		866	Oct 15/2015	
422	Oct 15/2015		831	Jun 15/2015		867	Oct 15/2015	
423	Oct 15/2015		832	Jun 15/2015		868	Oct 15/2015	
424	Oct 15/2015		833	Jun 15/2015		869	Oct 15/2015	
425	Oct 15/2015		834	Jun 15/2015		870	Oct 15/2015	

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871	Oct 15/2015		898.9	Feb 15/2016		898.45	Feb 15/2016	
872	Feb 15/2016		898.10	Feb 15/2016		898.46	Feb 15/2016	
873	Jun 15/2015		898.11	Feb 15/2016		898.47	Feb 15/2016	
874	Feb 15/2016		898.12	Feb 15/2016		898.48	Feb 15/2016	
875	Jun 15/2015		898.13	Feb 15/2016		898.49	Feb 15/2016	
876	Oct 15/2015		898.14	Feb 15/2016		898.50	Feb 15/2016	
877	Oct 15/2015		898.15	Feb 15/2016		898.51	Feb 15/2016	
878	Jun 15/2015		898.16	Feb 15/2016		898.52	BLANK	
879	Jun 15/2015		898.17	Feb 15/2016		20-10-52		
880	Jun 15/2015		898.18	Feb 15/2016		201	Oct 15/2014	
881	Oct 15/2015		898.19	Feb 15/2016		202	Oct 15/2014	
882	Feb 15/2016		898.20	Feb 15/2016		203	Oct 15/2015	
883	Jun 15/2015		898.21	Feb 15/2016		204	Oct 15/2015	
884	Jun 15/2015		898.22	Feb 15/2016		205	Oct 15/2014	
885	Jun 15/2015		898.23	Feb 15/2016		206	Oct 15/2014	
886	Jun 15/2015		898.24	Feb 15/2016		207	Oct 15/2015	
887	Jun 15/2015		898.25	Feb 15/2016		208	Oct 15/2015	
888	Oct 15/2015		898.26	Feb 15/2016		209	Oct 15/2015	
889	Oct 15/2015		898.27	Feb 15/2016		210	Oct 15/2015	
890	Oct 15/2015		898.28	Feb 15/2016		211	Oct 15/2014	
891	Jun 15/2015		898.29	Feb 15/2016		212	Oct 15/2014	
892	Feb 15/2016		898.30	Feb 15/2016		213	Oct 15/2015	
893	Jun 15/2015		898.31	Feb 15/2016		214	Oct 15/2015	
894	Oct 15/2015		898.32	Feb 15/2016		215	Oct 15/2015	
895	Feb 15/2016		898.33	Feb 15/2016		216	Oct 15/2015	
896	Feb 15/2016		898.34	Feb 15/2016		217	Oct 15/2015	
897	Feb 15/2016		898.35	Feb 15/2016		218	BLANK	
898	Jun 15/2015		898.36	Feb 15/2016		20-10-52		
898.1	Oct 15/2015		898.37	Feb 15/2016		401	Jun 15/2015	
898.2	Feb 15/2016		898.38	Feb 15/2016		402	Jun 15/2015	
898.3	Feb 15/2016		898.39	Feb 15/2016		403	Jun 15/2015	
898.4	Feb 15/2016		898.40	Feb 15/2016		404	Oct 15/2015	
898.5	Feb 15/2016		898.41	Feb 15/2016		20-10-52		
898.6	Feb 15/2016		898.42	Feb 15/2016		801	Jun 15/2015	
898.7	Feb 15/2016		898.43	Feb 15/2016		802	Oct 15/2014	
898.8	Feb 15/2016		898.44	Feb 15/2016		803	Jun 15/2015	

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805	Oct 15/2015		20-15-01			202	Feb 15/2015	
806	Feb 15/2015		201	Feb 15/2015		203	Oct 15/2014	
807	Feb 15/2015		202	Oct 15/2014		204	BLANK	
808	Oct 15/2014		20-15-11			20-30-21		
809	Oct 15/2014		201	Oct 15/2014		201	Oct 15/2014	
810	Oct 15/2015		202	Oct 15/2014		202	BLANK	
811	Oct 15/2015	R	203	Jun 15/2016		20-30-31		
812	Oct 15/2015		204	Oct 15/2014		201	Oct 15/2014	
813	Oct 15/2015		205	Jun 15/2015		202	BLANK	
814	BLANK		206	Jun 15/2015		20-30-41		
20-10-53			207	Jun 15/2015		201	Oct 15/2014	
401	Oct 15/2014		208	Oct 15/2014		202	BLANK	
402	Oct 15/2014		209	Jun 15/2015		20-30-51		
20-10-61			210	Jun 15/2015		201	Oct 15/2014	
401	Oct 15/2015		211	Oct 15/2014		202	BLANK	
R 402	Jun 15/2016		212	Oct 15/2014		20-30-61		
403	Oct 15/2014		213	Jun 15/2015		201	Oct 15/2014	
404	Oct 15/2014		214	Oct 15/2015		202	BLANK	
405	Oct 15/2014		215	Oct 15/2015		20-30-71		
406	Oct 15/2014		216	BLANK		201	Oct 15/2014	
20-10-72			20-20-21			202	BLANK	
201	Feb 15/2015		601	Feb 15/2016		20-30-80		
202	BLANK		602	Feb 15/2016		201	Oct 15/2014	
20-10-91			603	Oct 15/2014		202	Oct 15/2014	
401	Feb 15/2015		604	Feb 15/2016		20-30-81		
402	Feb 15/2015		20-20-31			201	Oct 15/2014	
403	Oct 15/2015		R 601	Jun 15/2016		202	BLANK	
404	Feb 15/2015		R 602	Jun 15/2016		20-30-82		
405	Feb 15/2015		R 603	Jun 15/2016		201	Oct 15/2014	
406	Feb 15/2015		R 604	Jun 15/2016		202	Oct 15/2014	
407	Feb 15/2015		O 605	Jun 15/2016		201	Oct 15/2014	
408	Oct 15/2015		O 606	Jun 15/2016		20-30-83		
409	Oct 15/2015		20-30-00			202	Oct 15/2014	
410	Oct 15/2015		201	Oct 15/2014		201	Oct 15/2014	
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202	Oct 15/2014		202	BLANK		204	Feb 15/2015	
20-30-85			20-30-97			205	Oct 15/2015	
201	Oct 15/2014		201	Oct 15/2014		206	Oct 15/2015	
202	BLANK		202	BLANK		207	Feb 15/2015	
20-30-86			20-30-98			208	Feb 15/2015	
201	Oct 15/2014		201	Oct 15/2014	R	209	Jun 15/2016	
202	Oct 15/2014		202	Oct 15/2014		210	Feb 15/2015	
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201	Oct 15/2014		204	BLANK		212	Oct 15/2015	
202	Oct 15/2014		20-30-99			213	Oct 15/2015	
20-30-88			201	Feb 15/2016		214	Oct 15/2015	
201	Oct 15/2014		202	BLANK		215	Oct 15/2015	
202	BLANK		20-40-11			216	Oct 15/2015	
20-30-89			201	Oct 15/2014		217	Oct 15/2015	
201	Feb 15/2016		202	Oct 15/2014		218	Oct 15/2015	
202	BLANK		203	Jun 15/2015		219	Oct 15/2015	
20-30-90			204	Feb 15/2015		220	Oct 15/2015	
201	Oct 15/2014		205	Oct 15/2015		221	Oct 15/2015	
202	BLANK		206	BLANK		222	Oct 15/2015	
20-30-91			20-40-12			223	Oct 15/2015	
201	Oct 15/2014		201	Feb 15/2015		224	Oct 15/2015	
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20-30-92			203	Jun 15/2015		226	Oct 15/2015	
201	Oct 15/2014		204	Jun 15/2015		227	Oct 15/2015	
202	BLANK		205	Jun 15/2015		228	Oct 15/2015	
20-30-93			206	Feb 15/2015		229	Oct 15/2015	
201	Oct 15/2014		207	Jun 15/2015		230	Oct 15/2015	
202	BLANK		208	Feb 15/2015	R 231	Jun 15/2016		
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201	Oct 15/2014		210	Feb 15/2015		20-60-01		
202	BLANK		211	Feb 15/2015		201	Oct 15/2014	
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201	Oct 15/2014		20-50-11			203	Oct 15/2014	
202	BLANK		201	Feb 15/2016		204	BLANK	
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20-60-04			R 201	Jun 15/2016				
			R 202	Jun 15/2016				
			R 203	Jun 15/2016				
			204	BLANK				
20-60-05			201	Jun 15/2015				
			202	Oct 15/2014				
20-60-06			201	Feb 15/2015				
			202	BLANK				
20-60-07			201	Oct 15/2014				
			202	Oct 15/2014				
			203	Oct 15/2014				
			204	BLANK				
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Control Cable Pulleys Installation	TASK 20-10-09-400-801			401	AKS ALL
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Electronic LRU Cleaning					201	AKS ALL
TASK 20-60-06-100-801						
<u>WIRE BUNDLE PROTECTION (EZAP) - PROTECTION OF EWIS (EZAP) - MAINTENANCE PRACTICES</u>	20-60-07				201	AKS ALL
Protection of the EWIS During Maintenance					201	AKS ALL
TASK 20-60-07-913-801						
<u>INSTRUMENT PANEL CLEANING</u>	20-60-08				201	AKS ALL
Instrument Panel Cleaning					201	AKS ALL
TASK 20-60-08-100-801						

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STANDARD PRACTICES - MAINTENANCE PRACTICES

**TASK 20-00-00-910-801**

**1. Airworthiness Limitation Precautions**

**A. General**

- (1) Critical Design Configuration Control Limitations (CDCCLs)
  - (a) All occurrences of CDCCLs found in this chapter of the AMM are identified by this note after each applicable CDCCL design feature:
    - 1) NOTE: CDCCL - Refer to the task: Airworthiness Limitation Precautions, TASK 20-00-00-910-801, for important information on Critical Design Configuration Control Limitations (CDCCLs).
  - (b) Design features that are CDCCLs are defined and controlled by Special Federal Aviation Regulation (SFAR) 88, and can be found in Section 9 of the Maintenance Planning Data (MPD) document. CDCCLs are a means of identifying certain design configuration features intended to preclude a fuel tank ignition source for the operational life of the airplane. CDCCLs are mandatory and cannot be changed or deleted without the approval of the FAA Oversight Office that is responsible for the airplane model Type Certificate. A critical fuel tank ignition source prevention feature may exist in the fuel system and its related installation or in systems that, if a failure condition were to develop, could interact with the fuel system in such a way that an unsafe condition would develop without this limitation. Strict adherence to configuration, methods, techniques, and practices as prescribed is required to ensure the CDCCL is complied with. Any use of parts, methods, techniques or practices not contained in the applicable CDCCL must be approved by the FAA Oversight Office that is responsible for the airplane model Type Certificate.
- (2) Airworthiness Limitation Instructions (ALIs)
  - (a) All occurrences of fuel tank system ALIs found in this chapter of the AMM are identified by this note after each applicable ALI inspection feature:
    - 1) NOTE: ALI - Refer to the task: Airworthiness Limitation Precautions, TASK 20-00-00-910-801, for important information on airworthiness limitation instructions (ALIs).
  - (b) Inspection features that are ALIs are defined and controlled by Special Federal Aviation Regulation (SFAR) 88, and can be found in Section 9 of the Maintenance Planning Data (MPD) document. These ALIs identify inspection features related to fuel tank ignition source prevention which must be done to maintain the design level of safety for the operational life of the airplane. These inspection features are mandatory and cannot be changed or deleted without the approval of the FAA Oversight Office that is responsible for the airplane model Type Certificate. Strict adherence to methods, techniques and practices as prescribed is required to ensure the ALI is complied with. Any use of methods, techniques or practices not contained in these ALIs must be approved by the FAA Oversight Office that is responsible for the airplane model Type Certificate.

**B. Location Zones**

Zone	Area
100	Lower Half of Fuselage
200	Upper Half of Fuselage
500	Left Wing
600	Right Wing

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C. Critical Design Configuration Control Limitations (CDCCLs)

SUBTASK 20-00-00-910-001

**WARNING:** OBEY THE MANUFACTURER'S PROCEDURES WHEN YOU DO MAINTENANCE THAT HAS AN EFFECT ON A CDCCL. IF YOU DO NOT OBEY THE PROCEDURES, IT CAN INCREASE THE RISK OF A SOURCE OF FUEL TANK IGNITION. INJURIES TO PERSONNEL, AND DAMAGE TO EQUIPMENT CAN OCCUR IF THERE IS A FIRE OR EXPLOSION.

- (1) Make sure you follow the procedures for items identified as CDCCLs.

D. Airworthiness Limitation Instructions (ALIs)

SUBTASK 20-00-00-910-002

**WARNING:** OBEY THE MANUFACTURER'S PROCEDURES WHEN YOU DO ANY MAINTENANCE THAT MAY AFFECT AN ALI. IF YOU DO NOT FOLLOW THE PROCEDURES, IT CAN INCREASE THE RISK OF A FUEL TANK IGNITION SOURCE.

- (1) Make sure you follow the procedures for items identified as ALIs.

— END OF TASK —



EWIS

**TASK 20-00-00-910-802**

2. Enhanced Zonal Inspection Program (EZAP) Precautions

A. General

- (1) Enhanced Zonal Analysis Procedure (EZAP) and associated Electrical Wiring Interconnection System (EWIS)
  - (a) Enhanced Zonal Analysis Procedure (EZAP) is an analytical procedure required by Part 25, Appendix H, Section H25.5(a)(1) that identifies the physical and environmental conditions contained in each zone of an airplane, analyzes the effects of these conditions on electrical wiring and components, and assesses the possibilities for smoke and fire. The end result of the analysis are inspection and restoration tasks in the form of EWIS ICA.
  - (b) Electrical Wiring Interconnection System (EWIS): means any wire, power feeder, wiring device, or combination of these, including termination devices, installed in any area of the airplane for the purpose of transmitting electrical energy, including data and signals, between two or more intended termination points. EWIS is defined in full by 14 CFR section 25.1701.
  - (c) The Zonal Inspection Program includes a general visual and, if required, physical check of the general condition and security of attachment of the accessible systems and structures items contained in defined zones. This includes checks for degradation such as chafing of tubing, loose duct supports, damage to wiring and connected EWIS, cable and pulley wear, fluid leaks, electrical bonding, general condition of fasteners, inadequate drainage, etc., and general corrosion, not covered in the MSG-3 analysis. The zonal inspection is not intended as a quality assurance after maintenance check for determining proper reassembly of systems, components, structures, or powerplants. The zonal program packages a number of General Visual (GV) Inspections into one or more zonal inspections. The program includes any GV inspection tasks required to assure security of attachment and general condition of any system or structural items within the zone.

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- (2) Equivalent Tools, Fixtures, Test Equipment, and Consumable Materials
- (a) When the procedures in this manual identify tools, equipment, and consumable materials, you can use equivalent alternatives. If you use alternative tools, equipment, or consumable materials, make sure that they give the same results and are as safe to the parts and personnel as the tools, equipment, or consumable materials specified in the procedure.
- B. Enhanced Zonal Analysis Procedure (EZAP) and associated Electrical Wiring Interconnection System (EWIS).**

SUBTASK 20-00-00-910-003

**WARNING:** OBEY THE MANUFACTURER'S PROCEDURES WHEN YOU DO EZAP MAINTENANCE, OR MAINTENANCE THAT HAS AN EFFECT ON EWIS. IF YOU DO NOT OBEY THE PROCEDURES, IT CAN INCREASE THE RISK OF AN IGNITION SOURCE FOR FIRES. INJURIES TO PERSONS, AND DAMAGE TO EQUIPMENT CAN OCCUR.

- (1) Make sure you follow the procedures for items identified as EZAP.

———— END OF TASK ————

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AKS ALL

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FLOOR PANEL PROTECTION - MAINTENANCE PRACTICES

**1. General**

- A. This procedure has this task:
- (1) Floor Panel Damage Prevention During Maintenance

**TASK 20-09-01-610-801**

**2. Floor Panel Damage Prevention During Maintenance**

**A. To prevent possible damage to floor panels during maintenance, do these steps:**

SUBTASK 20-09-01-980-001

- (1) Let only one person at a time use the ladder, stand, or scaffolding.

SUBTASK 20-09-01-820-001

- (2) Use plywood bearing pads that are a minimum of 0.5 in. (1.3 cm) thick and 1 ft<sup>2</sup> (0.1 m<sup>2</sup>) under each leg, if you have these conditions:
  - (a) You use ladders, stands, or scaffolding with leg-bearing surfaces. Leg-bearing surfaces include rollers, screws, and sharp edges.
  - (b) You have a leg-bearing surface of less than 8 in<sup>2</sup> (51.6 cm<sup>2</sup>) for each leg.

———— END OF TASK ————

EFFECTIVITY	AKS ALL
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**20-09-01**

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BEARINGS AND BUSHINGS - REMOVAL/INSTALLATION

**TASK 20-10-02-900-801**

**1. Bearings and Bushings - Removal/Installation**

**A. References**

Reference	Title
SOPM 20-50-03	Bearing and Bushing Replacement

**B. Procedure**

SUBTASK 20-10-02-960-001

- (1) For the removal and installation of bearings and bushings (SOPM 20-50-03).

———— END OF TASK ————



**20-10-02**



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CONTROL CABLE AIR AND PRESSURE SEALS - REMOVAL/INSTALLATION

**1. General**

- A. This procedure has these tasks:
- (1) Control Cable Air Seal Removal.
  - (2) Control Cable Air Seal Installation.
  - (3) Control Cable Half Ball Pressure Seal Removal.
  - (4) Control Cable Half Ball Pressure Seal Installation.

**TASK 20-10-04-000-802**

**2. Control Cable Air Seal Removal**

Figure 401

**A. General**

- (1) This task includes the steps to remove the nose landing gear manual extension release mechanism control cable air seal [1].

**B. Location Zones**

Zone	Area
114	Area Above and Outboard of Nose Landing Gear Wheel Well - Right

**C. Control Cable Air Seal Removal**

SUBTASK 20-10-04-000-001

- (1) Remove the two small rings and one large ring from the ends of the control cable air seal [1].

SUBTASK 20-10-04-000-002

- (2) Remove the seal [1] from the nose wheel well panel.

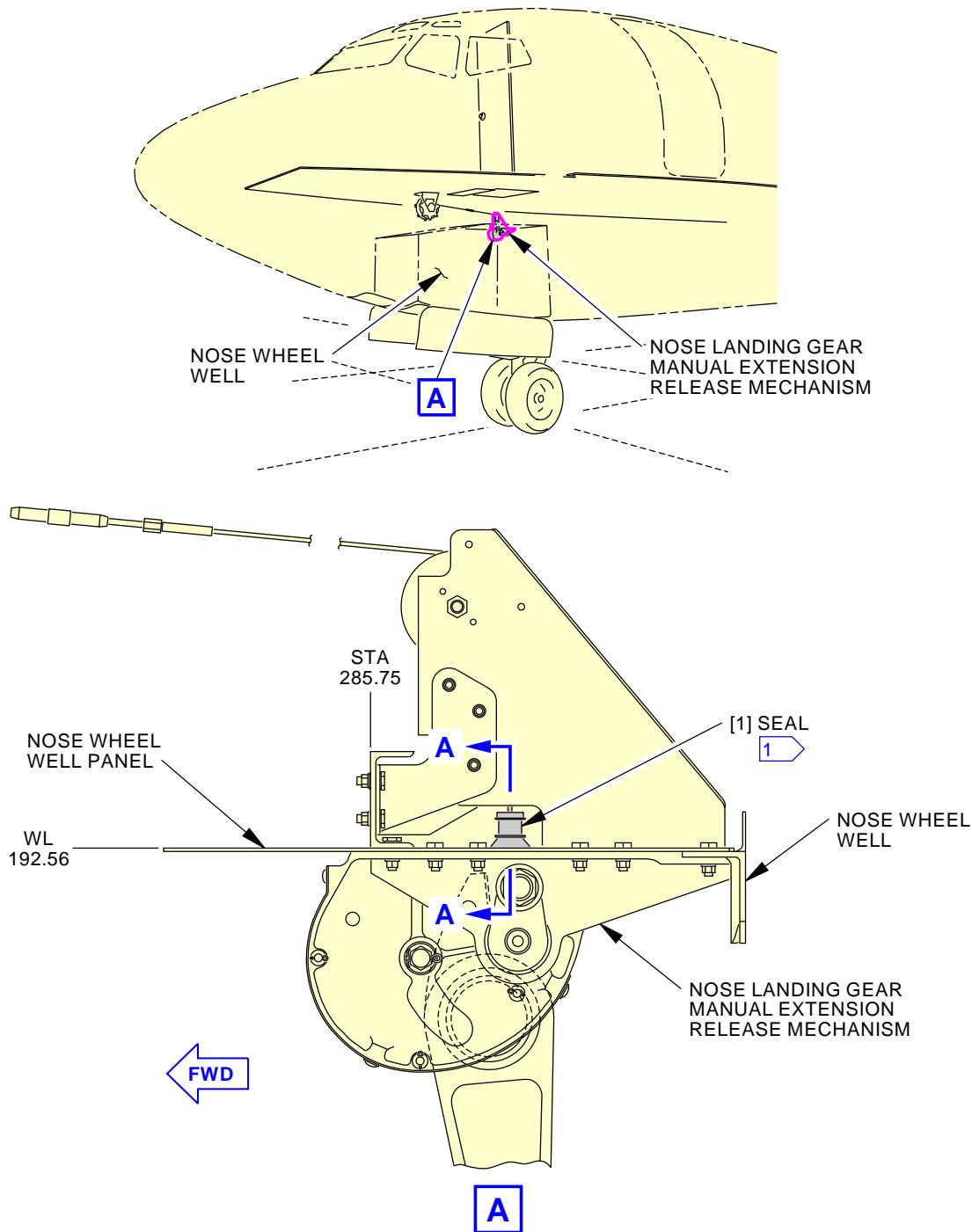
SUBTASK 20-10-04-000-003

- (3) Remove the seal [1] from the cable.

— END OF TASK —



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**1** INSTALL PER BAC5502 EXCEPT DO NOT FILL THE SEAL WITH LUBRICANT.

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**Control Cable Air Seal Installation  
Figure 401/20-10-04-990-802 (Sheet 1 of 2)**

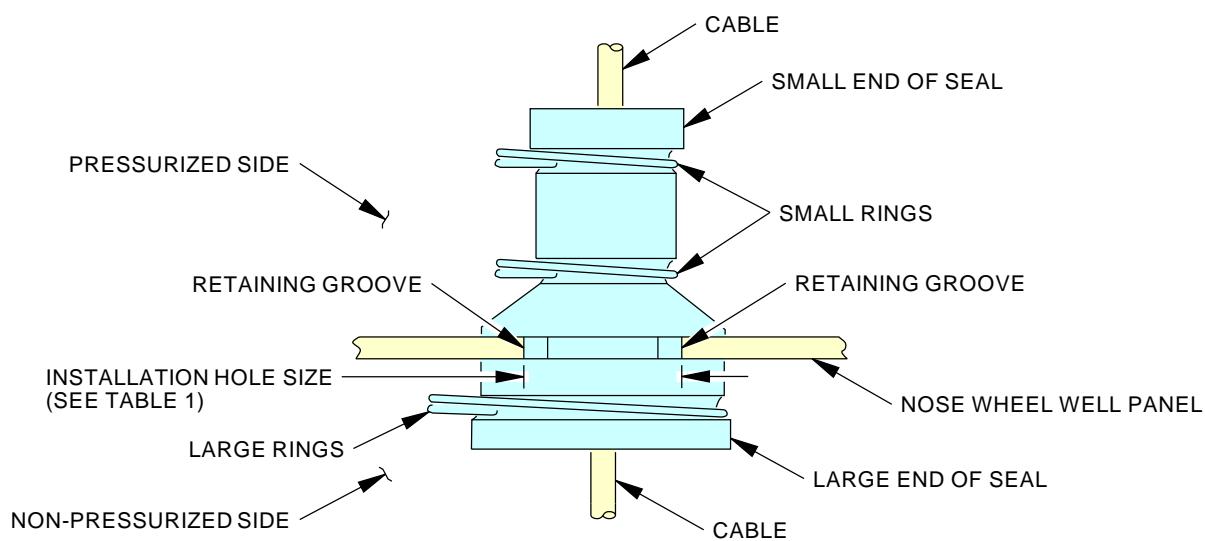
EFFECTIVITY  
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A-A

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Control Cable Air Seal Installation  
Figure 401/20-10-04-990-802 (Sheet 2 of 2)

EFFECTIVITY  
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**TASK 20-10-04-400-802**

**3. Control Cable Air Seal Installation**

**A. General**

- (1) This task includes the steps to install the nose landing gear manual extension release mechanism control cable air seal [1].

**B. References**

Reference	Title
12-26-00-600-801	Control Cable Lubrication (P/B 301)
32-35-11-400-801	Nose Gear Manual Extension Release Mechanism Installation (P/B 401)

**C. Consumable Materials**

Reference	Description	Specification
D00633	Grease - Aircraft General Purpose	BMS3-33

**D. Location Zones**

Zone	Area
114	Area Above and Outboard of Nose Landing Gear Wheel Well - Right

**E. Prepare for the Installation**

SUBTASK 20-10-04-640-003

- (1) Apply grease, D00633 to the cable for the full length of travel in the seal [1] and plus 20 inches on each side. Do this task: Control Cable Lubrication, TASK 12-26-00-600-801.

**F. Control Cable Air Seal Installation**

SUBTASK 20-10-04-420-012

- (1) Install the control cable air seal [1] per Boeing Specification BAC5502, but do not fill the seal [1] with lubricant.

NOTE: The seal [1] will receive lubricant during cable movement.

SUBTASK 20-10-04-350-001

- (2) Break sharp edges of the seal hole with a chamfer or radius of approximately 0.01 inch. This will prevent seal [1] damage during and after installation.

SUBTASK 20-10-04-420-013

- (3) Put the seal [1] on the cable through the non-pressurized side of the nose wheel well panel with the small end of the seal [1] towards the panel.

SUBTASK 20-10-04-420-014

- (4) Put the seal [1] through the panel hole.

(a) Make sure that the retaining groove of the seal [1] attached correctly with the panel.

(b) Make sure that the small end of the seal [1] is in the pressurized side of the panel.

SUBTASK 20-10-04-420-015

- (5) Install two small rings into the grooves of the small end of the seal [1] in the pressurized side of the panel.

SUBTASK 20-10-04-420-016

- (6) Install one large ring into the groove of the large end of the seal [1] in the non-pressurized side of the panel.

EFFECTIVITY  
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SUBTASK 20-10-04-211-001

- (7) Make sure to install the correct part number and dimensions for the seal [1] installation. Refer to Table 1.

**Table 1. Control Cable Air Seal Installation**

SEAL PART NUMBER	CABLE DIAMETER (INCH)	INSTALLATION HOLE SIZE (+0.00 TO -0.06) (INCH)	LARGE RESTRAINING RING	SMALL RESTRAINING RING
BACS11T3A <sup>[1]</sup>	0.094	0.59	BACS11L132C	BACS11L131C

\*[1] BACS11T= basic seal part number

3= for specific cable diameter and installation hole size.

A= for elastomeric compound 1546 material requirement for the seal.

#### G. Control Cable Air Seal Installation Test

SUBTASK 20-10-04-480-001

- (1) Make sure that the control cable and air seal [1] is correctly installed. Refer to Table 1.
  - (a) Make sure that the cable has sufficient lubricant.
  - (b) Make sure there is no cable deflection.
  - (c) Make sure that the cable moves freely.

SUBTASK 20-10-04-480-002

- (2) For the mechanism installation and test with the seal [1] refer to: Nose Gear Manual Extension Release Mechanism Installation, TASK 32-35-11-400-801.

**— END OF TASK —**

#### TASK 20-10-04-000-801

#### 4. Control Cable Half Ball Pressure Seal Removal

(Figure 402)

##### A. General

- (1) This task includes the steps to remove the main landing gear manual extension control cable half ball pressure seals [2].

##### B. Location Zones

Zone	Area
133	Main Landing Gear Wheel Well, Body Station 663.75 to Body Station 727.00 - Left
134	Main Landing Gear Wheel Well, Body Station 663.75 to Body Station 727.00 - Right

##### C. Control Cable Half Ball Pressure Seal Removal

SUBTASK 20-10-04-020-003

- (1) Remove the two screws and washers that attach the seal plate, seal cover, nutplates and half ball pressure seals [2] to the pressure floor web.

SUBTASK 20-10-04-020-004

- (2) Remove the two half ball pressure seals [2] from the cable.

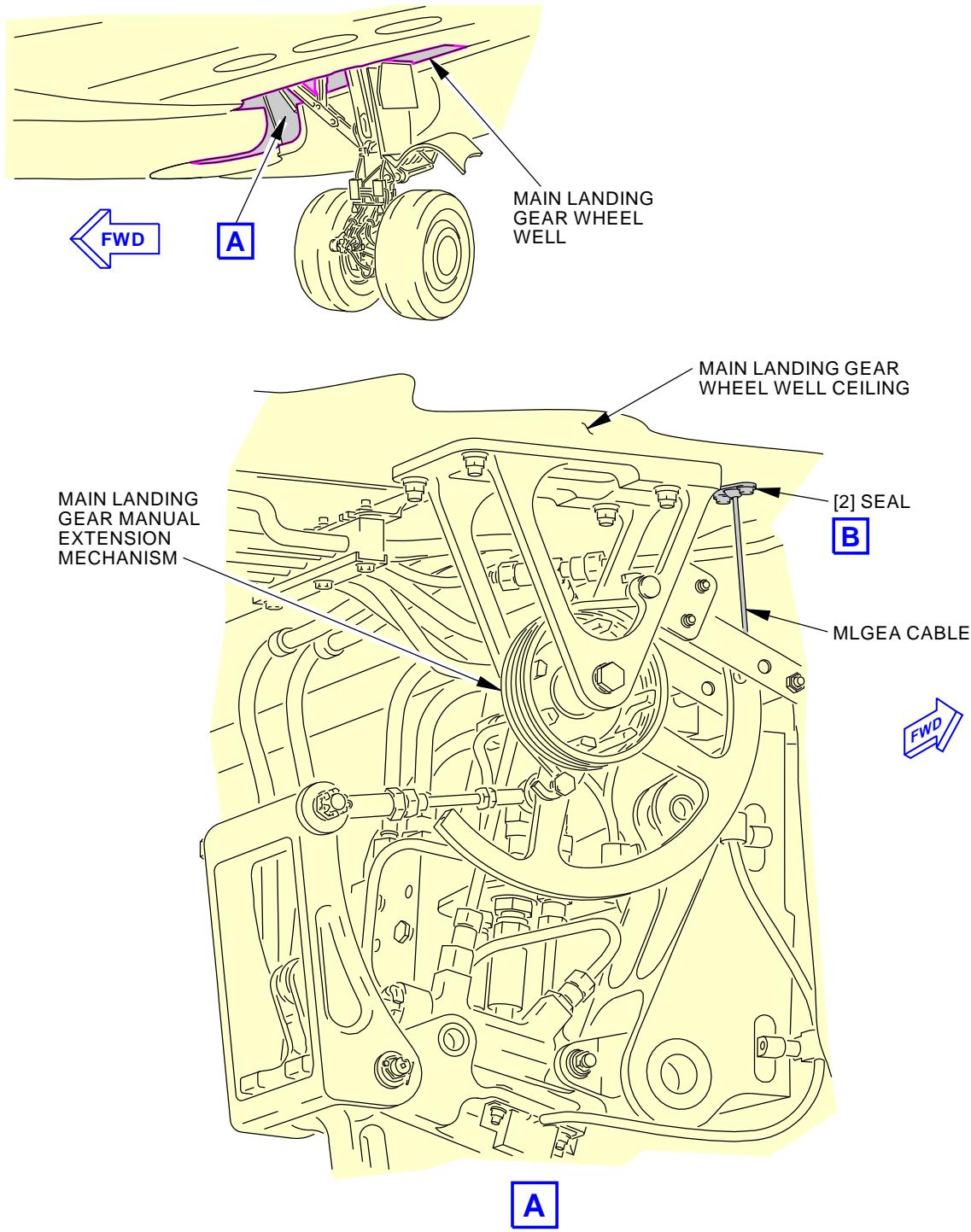
SUBTASK 20-10-04-020-001

- (3) If it is necessary, replace the seal plate and seal cover.

**— END OF TASK —**

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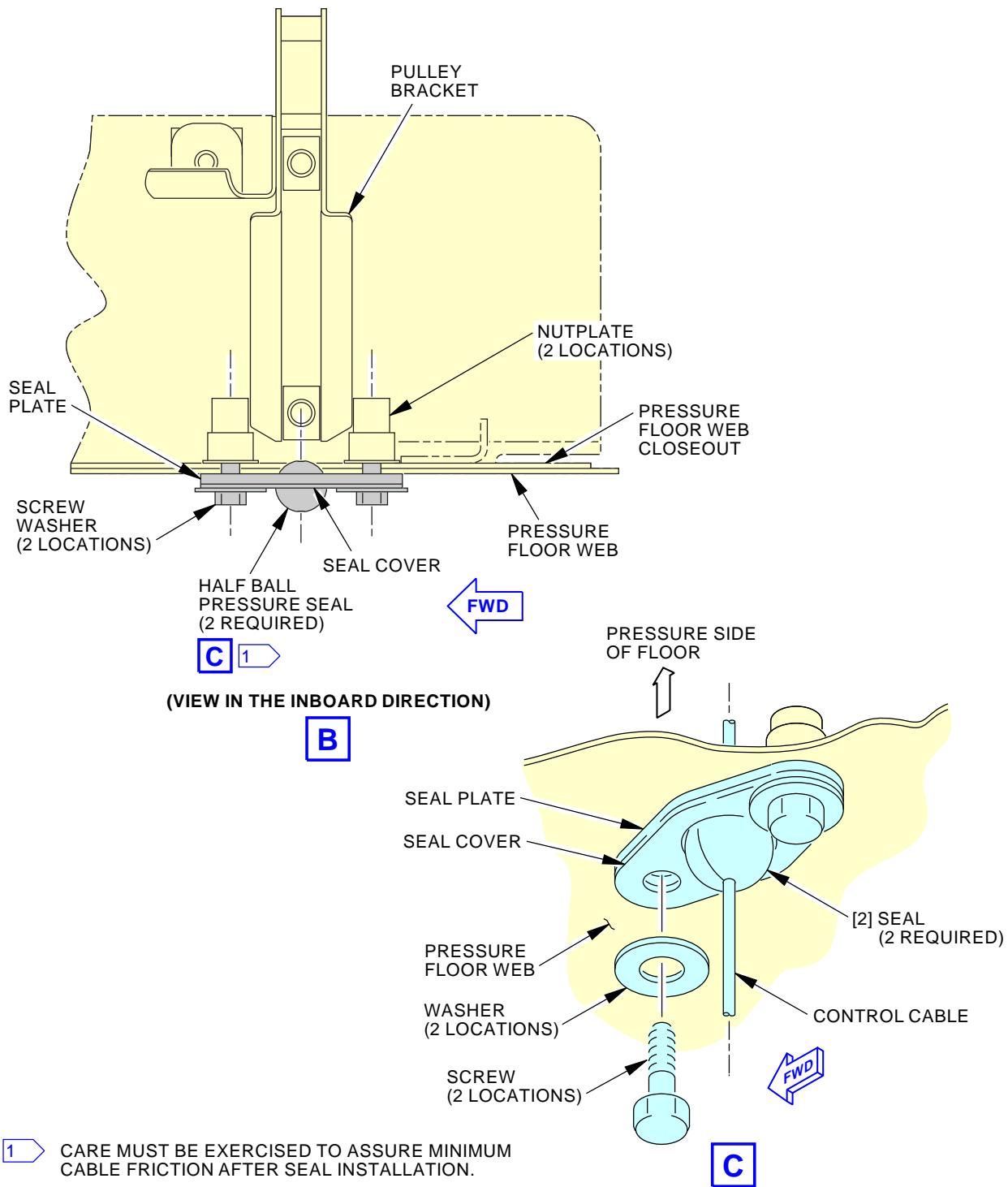
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**Control Cable Half Ball Pressure Seal Installation**  
**Figure 402/20-10-04-990-803 (Sheet 1 of 2)**

EFFECTIVITY  
**AKS ALL**

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**Control Cable Half Ball Pressure Seal Installation**  
**Figure 402/20-10-04-990-803 (Sheet 2 of 2)**

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**TASK 20-10-04-400-801**

**5. Control Cable Half Ball Pressure Seal Installation**

(Figure 402)

**A. General**

- (1) This task includes the steps to install the main landing gear manual extension mechanism half ball pressure seals [2].

**B. References**

Reference	Title
12-26-00-600-801	Control Cable Lubrication (P/B 301)

**C. Consumable Materials**

Reference	Description	Specification
D00633	Grease - Aircraft General Purpose	BMS3-33

**D. Location Zones**

Zone	Area
133	Main Landing Gear Wheel Well, Body Station 663.75 to Body Station 727.00 - Left
134	Main Landing Gear Wheel Well, Body Station 663.75 to Body Station 727.00 - Right

**E. Prepare for the Installation**

SUBTASK 20-10-04-640-001

- (1) Apply grease, D00633 to the cable for the full length of travel in the seals [2], do this task: Control Cable Lubrication, TASK 12-26-00-600-801.

SUBTASK 20-10-04-420-001

- (2) If you removed the seal plate and seal cover, do these steps:
  - (a) Install the seal plate and seal cover to the non-pressurized side of the floor web.
  - (b) Make sure that the cable goes through the center hole of the seal plate and seal cover after installation.

**F. Control Cable Half Ball Pressure Seal Installation**

SUBTASK 20-10-04-420-004

- (1) Connect the two half ball pressure seals [2] on the cable and put in the center hole of the seal cover and seal plate.

SUBTASK 20-10-04-420-005

- (2) Loosely install the two screws and washers.

SUBTASK 20-10-04-420-006

- (3) Adjust the seals [2] to attain minimum cable deflection and tighten the screws.

SUBTASK 20-10-04-820-001

- (4) If necessary, refer to the specific system rigging instructions to adjust the control cable.
  - (a) Care must be exercised to assure minimum cable friction after seal installation.
  - (b) Install the half ball pressure seals [2] and adjust the cable after rigging to achieve minimum misalignment.

**G. Control Cable Half Ball Pressure Seal Installation Test**

SUBTASK 20-10-04-200-001

- (1) Make sure that the cable and pressure seals are correctly installed.
  - (a) Make sure that the cable has sufficient lubricant.

EFFECTIVITY
AKS ALL

**20-10-04**



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- (b) Make sure there is no cable deflection.
- (c) Make sure that the cable moves freely.

———— END OF TASK ————

EFFECTIVITY  
AKS ALL

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E/E RACK-MOUNTED COMPONENTS AND PRINTED CIRCUIT CARD - REMOVAL/INSTALLATION

**1. General**

- A. This procedure has these tasks:
- (1) The removal of the electrical/electronics (E/E) box from the rack.
  - (2) Adjustment of the lever latch fork.
  - (3) The installation of the E/E box.
  - (4) The removal of a printed circuit card.
  - (5) The installation of a printed circuit card.
  - (6) The removal of an E/E shelf assembly.
  - (7) The installation of an E/E shelf assembly.

**TASK 20-10-07-000-801**

**2. E/E Box Removal**

(Figure 201)

**A. References**

Reference	Title
20-40-12-000-802	ESDS Handling for Metal Encased Unit Removal (P/B 201)
20-40-12-400-804	Conductive Dust Cap and Connector Cover Installation (P/B 201)

**B. Location Zones**

Zone	Area
117	Electrical and Electronics Compartment - Left
118	Electrical and Electronics Compartment - Right

**AKS ALL; AIRPLANES WITH REXNORD AEROSPACE MECHANISMS EXTRACTOR**

**C. E/E Box Removal Procedure**

SUBTASK 20-10-07-860-001

- (1) Open the applicable circuit breakers to remove electrical power.

SUBTASK 20-10-07-910-001

**CAUTION:** DO NOT TOUCH THE E/E BOX BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE E/E BOX.

- (2) If the E/E box is sensitive to electrostatic discharge, make sure you do this task: ESDS Handling for Metal Encased Unit Removal, TASK 20-40-12-000-802.

SUBTASK 20-10-07-020-001

**CAUTION:** DO NOT TOUCH THE CONDUCTOR PINS OR OTHER CONDUCTORS ON THE E/E BOX. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE E/E BOX.

- (3) Remove the connections from the front of the E/E box if it is necessary.

SUBTASK 20-10-07-020-002

- (4) Turn the knob on the front hold-down extractor counterclockwise to disengage the clutch.



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**AKS ALL; AIRPLANES WITH REXNORD AEROSPACE MECHANISMS EXTRACTOR (Continued)**

SUBTASK 20-10-07-020-003

- (5) Do these steps to disconnect the front hold-down extractor:

**NOTE:** Apply light pressure down on the E/E box handle while you disconnect the front hold-down extractor.

- (a) Turn the keeper to align the deep slot with the T-hook.
- (b) Lower the front hold-down extractor to be clear of the T-hook.

SUBTASK 20-10-07-420-001

**CAUTION:** DO NOT TOUCH THE CONDUCTOR PINS OR OTHER CONDUCTORS ON THE E/E BOX. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE E/E BOX

- (6) Install conductive or anti-static caps to the connectors.

SUBTASK 20-10-07-020-004

- (7) Carefully move the E/E box out from the tray and remove the E/E box.

**NOTE:** Move the front of the E/E box from side to side approximately 1/8 inch (3 mm) to help disconnect the E/E box from the electrical connector.

SUBTASK 20-10-07-420-002

- (8) If the E/E box is not sensitive to electrostatic discharge, put protective covers on the electrical connector(s).

SUBTASK 20-10-07-420-003

- (9) If the E/E box is sensitive to electrostatic discharge, do this task: Conductive Dust Cap and Connector Cover Installation, TASK 20-40-12-400-804.

**AKS ALL; AIRPLANES WITH HOLLINGSEAD EXTRACTOR**

**D. E/E Box Removal Procedure**

SUBTASK 20-10-07-860-002

- (1) Open the applicable circuit breakers to remove electrical power.

SUBTASK 20-10-07-910-002

**CAUTION:** DO NOT TOUCH THE E/E BOX BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE E/E BOX.

- (2) If the E/E box is sensitive to electrostatic discharge, make sure you do this task: ESDS Handling for Metal Encased Unit Removal, TASK 20-40-12-000-802.

SUBTASK 20-10-07-020-005

**CAUTION:** DO NOT TOUCH THE CONDUCTOR PINS OR OTHER CONDUCTORS ON THE E/E BOX. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE E/E BOX.

- (3) Remove the connections from the front of the E/E box, if it is necessary.

SUBTASK 20-10-07-020-006

- (4) Turn the knob on the front hold-down extractor counterclockwise until you can see the red band.

EFFECTIVITY
AKS ALL

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**AKS ALL; AIRPLANES WITH HOLLINGSEAD EXTRACTOR (Continued)**

SUBTASK 20-10-07-020-007

- (5) Do these steps to disconnect the front hold-down extractor:

NOTE: Apply light pressure down on the E/E box handle while you disconnect the front hold-down extractor.

- (a) Turn the latch counterclockwise to disengage the front hold-down extractor from the T-hook.  
(b) Lower the front hold-down extractor to be clear of the T-hook.

SUBTASK 20-10-07-020-008

**CAUTION:** DO NOT TOUCH THE CONDUCTOR PINS OR OTHER CONDUCTORS ON THE E/E BOX. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE E/E BOX.

- (6) Carefully move the E/E box out from the tray and remove the E/E box.

NOTE: Shake the front of the E/E box from side to side approximately 1/8 inch (3 mm) to help disconnect the E/E box from the electrical connector.

SUBTASK 20-10-07-420-004

- (7) If the E/E box is not sensitive to electrostatic discharge, put protective covers on the electrical connector(s).

SUBTASK 20-10-07-420-005

- (8) If the E/E box is sensitive to electrostatic discharge, do this task: Conductive Dust Cap and Connector Cover Installation, TASK 20-40-12-400-804.

**AKS ALL; AIRPLANES WITH HARTWELL EXTRACTOR**

**E. E/E Box Removal Procedure**

SUBTASK 20-10-07-860-003

- (1) Open the applicable circuit breakers to remove electrical power.

SUBTASK 20-10-07-910-003

**CAUTION:** DO NOT TOUCH THE E/E BOX BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE E/E BOX.

- (2) If the E/E box is sensitive to electrostatic discharge, make sure you do this task: ESDS Handling for Metal Encased Unit Removal, TASK 20-40-12-000-802.

SUBTASK 20-10-07-020-009

**CAUTION:** DO NOT TOUCH THE CONDUCTOR PINS OR OTHER CONDUCTORS ON THE E/E BOX. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE E/E BOX.

- (3) Remove the connections from the front of the E/E box, if it is necessary.

SUBTASK 20-10-07-020-010

- (4) Turn the knob on the front hold-down extractor counterclockwise to disengage the clutch.

SUBTASK 20-10-07-020-011

- (5) Do these steps to disconnect the front hold-down extractor:

NOTE: Apply light pressure down on the E/E box handle while you disconnect the front hold-down extractor.

EFFECTIVITY  
AKS ALL

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**AKS ALL; AIRPLANES WITH HARTWELL EXTRACTOR (Continued)**

- (a) Compress the keeper to disengage the extractor from the T-hook.
- (b) Lower the front hold-down extractor to be clear of the T-hook.

SUBTASK 20-10-07-020-012

**CAUTION:** DO NOT TOUCH THE CONDUCTOR PINS OR OTHER CONDUCTORS ON THE E/E BOX. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE E/E BOX.

- (6) Carefully move the E/E box out from the tray and remove the E/E box.

**NOTE:** Shake the front of the E/E box from side to side approximately 1/8 inch (3 mm) to help disconnect the E/E box from the electrical connector.

SUBTASK 20-10-07-420-006

- (7) If the E/E box is not sensitive to electrostatic discharge, put protective covers on the electrical connector(s).

SUBTASK 20-10-07-420-007

- (8) If the E/E box is sensitive to electrostatic discharge, do this task: Conductive Dust Cap and Connector Cover Installation, TASK 20-40-12-400-804.

**AKS ALL; AIRPLANES WITH LEVER LATCH HANDLES**

**F. E/E Box Removal Procedure**

SUBTASK 20-10-07-860-012

- (1) Open the applicable circuit breakers to remove electrical power.

SUBTASK 20-10-07-910-009

**CAUTION:** DO NOT TOUCH THE E/E BOX BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE E/E BOX.

- (2) If the E/E box is sensitive to electrostatic discharge, make sure you, do this task: ESDS Handling for Metal Encased Unit Removal, TASK 20-40-12-000-802.

SUBTASK 20-10-07-020-017

**CAUTION:** DO NOT TOUCH THE CONDUCTOR PINS OR OTHER CONDUCTORS ON THE E/E BOX. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE E/E BOX.

- (3) Remove the connections from the front of the E/E box, if it is necessary.

SUBTASK 20-10-07-020-018

- (4) Do these steps to disconnect the lever latch:

- (a) Depress the lever latch allowing the lever to move away from the handles.
- (b) Move the lever in an opening direction forcing the unit away from the shelf-mounted connector.

EFFECTIVITY  
AKS ALL

**20-10-07**



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**AKS ALL; AIRPLANES WITH LEVER LATCH HANDLES (Continued)**

SUBTASK 20-10-07-020-019

**CAUTION:** DO NOT TOUCH THE CONDUCTOR PINS OR OTHER CONDUCTORS ON THE E/E BOX. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE E/E BOX.

- (5) Carefully move the E/E box out from the tray and remove the E/E box.

NOTE: Shake the front of the E/E box from side to side approximately 1/8 inch (3 mm) to help disconnect the E/E box from the electrical connector.

SUBTASK 20-10-07-420-027

- (6) If the E/E box is not sensitive to electrostatic discharge, put protective covers on the electrical connector(s).

SUBTASK 20-10-07-420-028

- (7) If the E/E box is sensitive to electrostatic discharge, do this task: Conductive Dust Cap and Connector Cover Installation, TASK 20-40-12-400-804.

**AKS ALL**

**G. E/E Box Removal Procedure**

SUBTASK 20-10-07-040-002

- (1) Open the applicable circuit breakers to remove electrical power.

SUBTASK 20-10-07-580-002

**CAUTION:** DO NOT TOUCH THE UNIT BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE UNIT.

- (2) If the E/E box is sensitive to electrostatic discharge, make sure you do this task: ESDS Handling for Metal Encased Unit Removal, TASK 20-40-12-000-802.

SUBTASK 20-10-07-020-030

**CAUTION:** DO NOT TOUCH THE CONNECTOR PINS OR OTHER CONDUCTORS ON THE UNIT. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE UNIT.

- (3) Remove the connections from the front of the E/E box, if it is necessary.

SUBTASK 20-10-07-020-031

- (4) To unlock the Barry-type retaining fasteners, turn the fastener counter-clockwise.

(a) Pull and turn the fasteners counter-clockwise, if it is necessary.

SUBTASK 20-10-07-020-032

**CAUTION:** DO NOT TOUCH THE CONNECTOR PINS OR OTHER CONDUCTORS ON THE UNIT. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE UNIT.

- (5) Carefully move the E/E box out from the tray and remove the E/E box.

NOTE: Shake the front of the E/E box from side to side approximately 1/8 in. (3 mm) to help disconnect the E/E box from the electrical connector.

SUBTASK 20-10-07-420-048

- (6) If the E/E box is not sensitive to electrostatic discharge, put protective covers on the electrical connector(s).

EFFECTIVITY
AKS ALL

**20-10-07**



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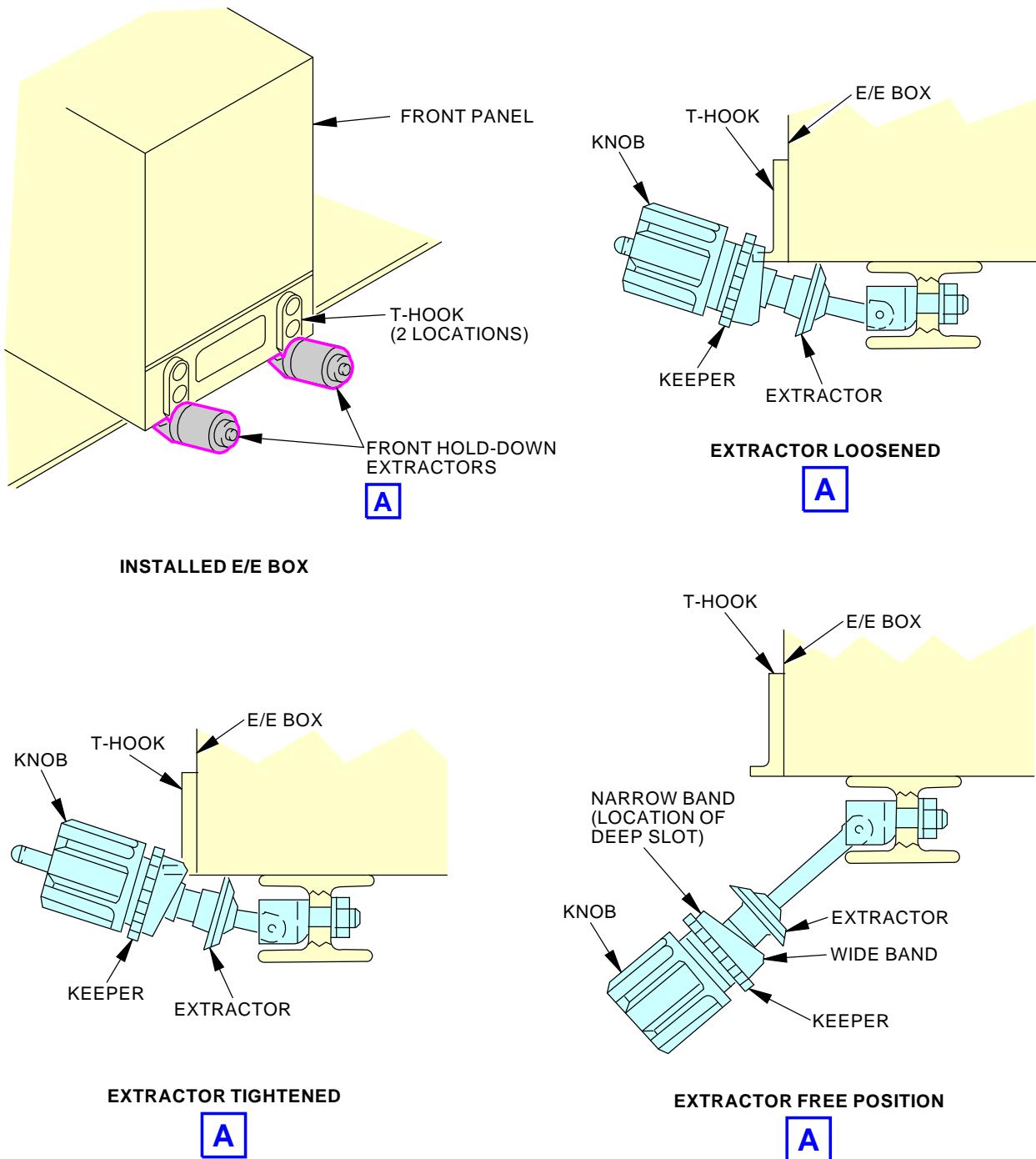
SUBTASK 20-10-07-580-003

- (7) If the E/E box is sensitive to electrostatic discharge, do this task: Conductive Dust Cap and Connector Cover Installation, TASK 20-40-12-400-804.

———— END OF TASK ————

EFFECTIVITY  
AKS ALL

**20-10-07**

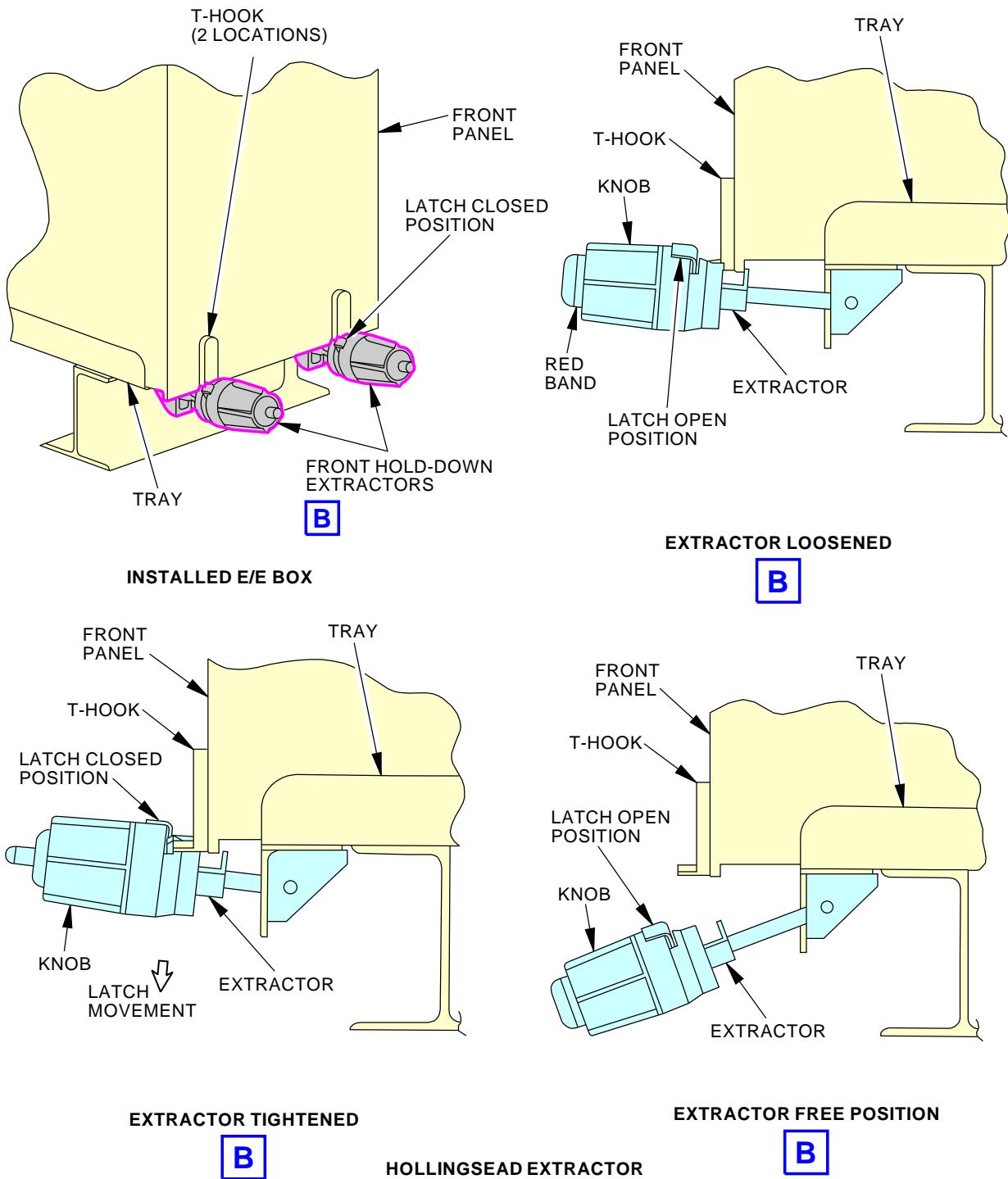

**REXNORD AEROSPACE MECHANISMS EXTRACTOR**

F24337 S0006561811\_V2

**E/E Box Installation**  
**Figure 201/20-10-07-990-801 (Sheet 1 of 5)**

EFFECTIVITY  
AKS ALL

**20-10-07**



F24338 S0006561812\_V2

**E/E Box Installation**  
**Figure 201/20-10-07-990-801 (Sheet 2 of 5)**

EFFECTIVITY  
 AKS ALL

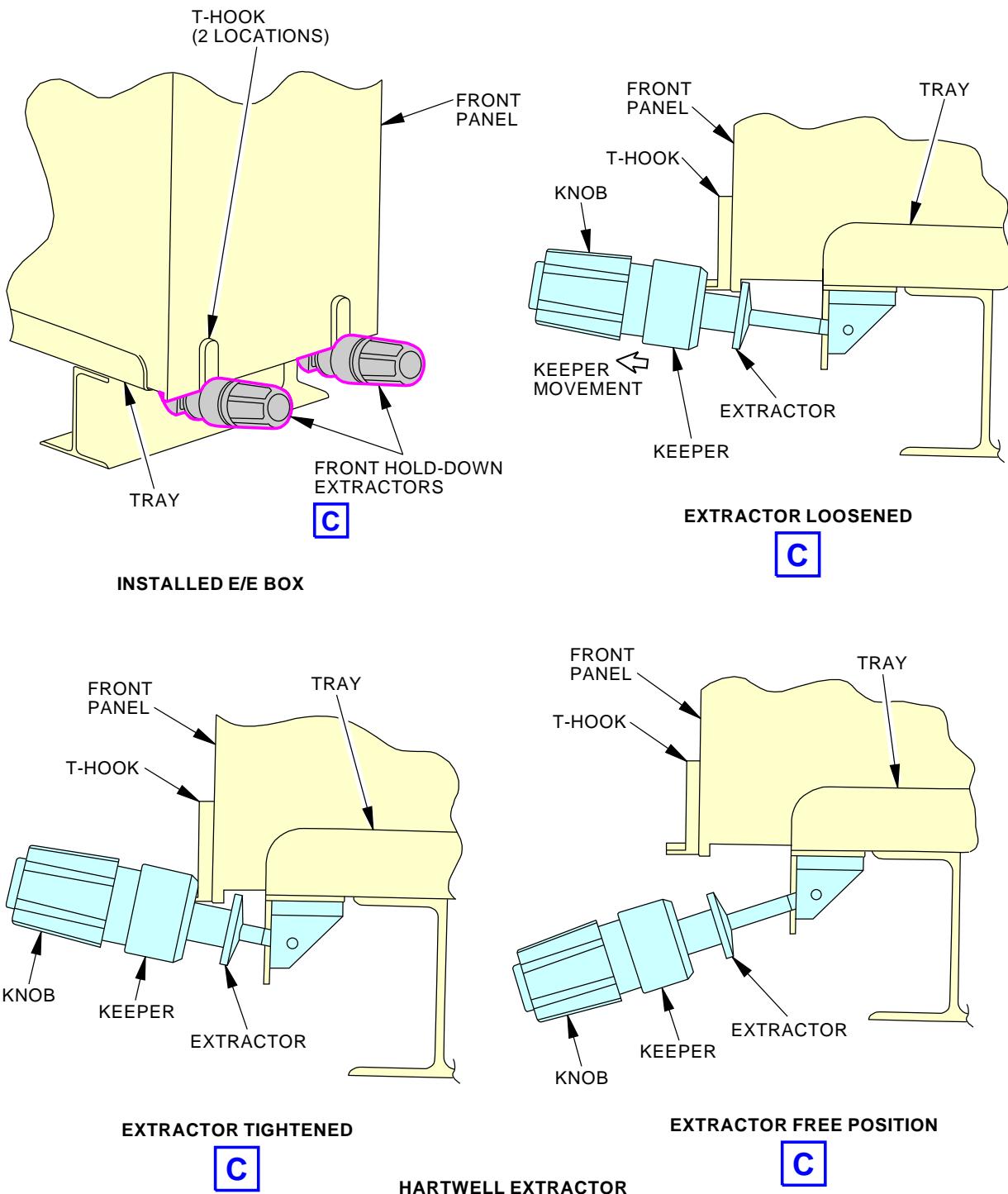
**20-10-07**

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**737-600/700/800/900  
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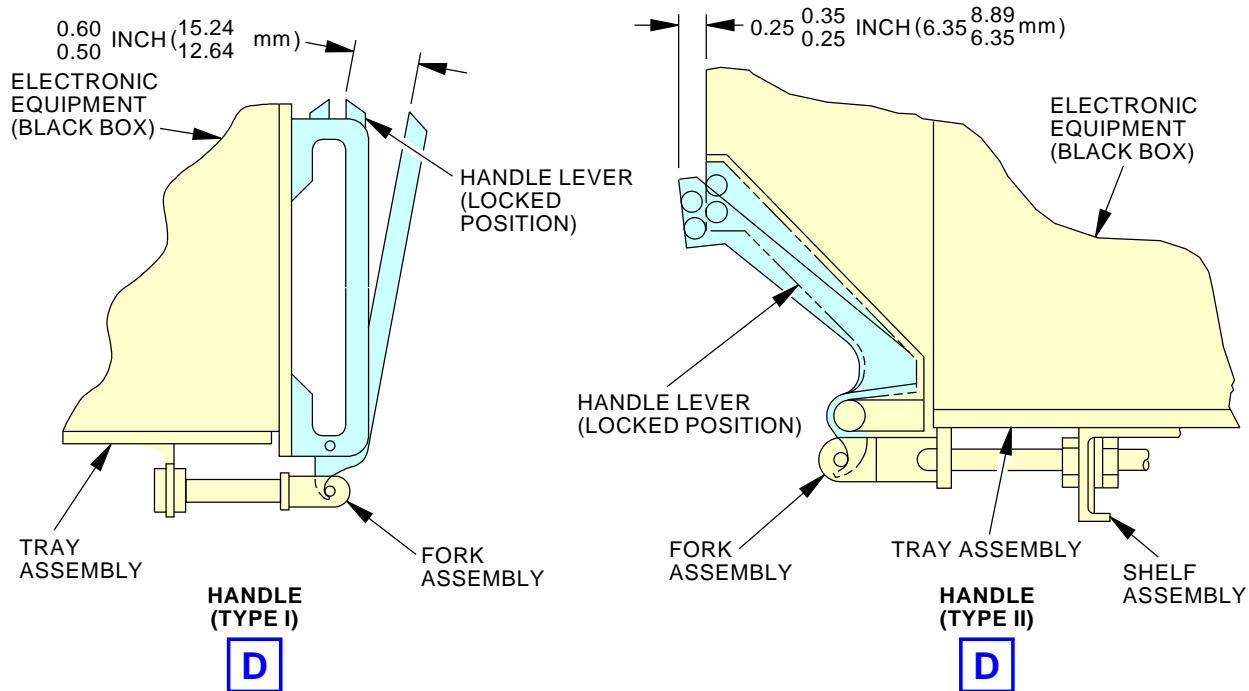
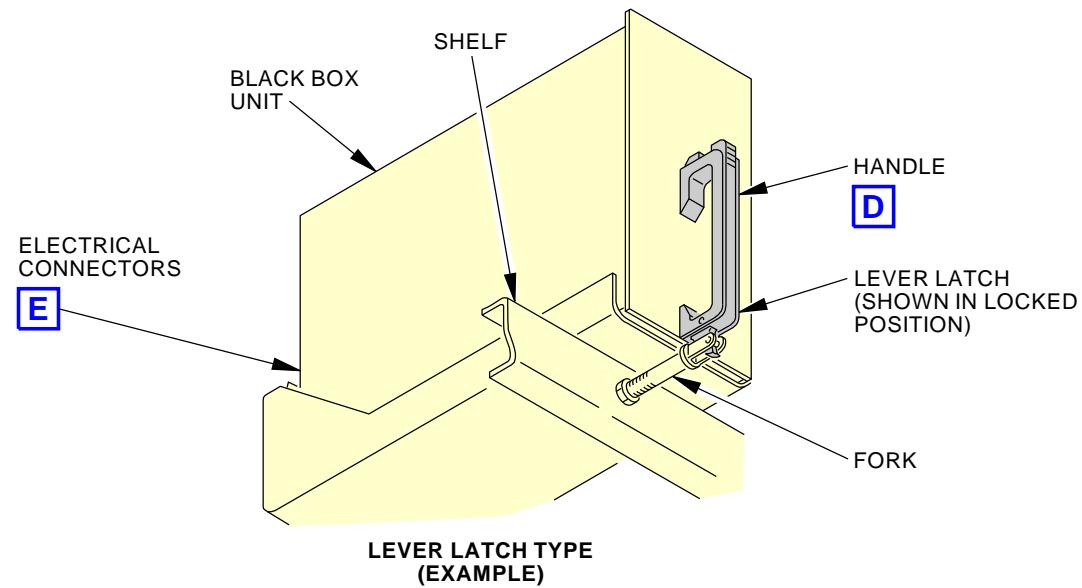


F24343 S0006561813\_V2

**E/E Box Installation**  
**Figure 201/20-10-07-990-801 (Sheet 3 of 5)**

EFFECTIVITY  
AKS ALL

**20-10-07**


**NOTE:**

ADJUST FRONT HOLD DOWNS AS FOLLOWS:  
WITH PLUG ON THE REAR OF UNIT FULLY ENGAGED AND THE HANDLE LEVER ON THE FRONT OF THE UNIT AT THE DIMENSION SHOWN, ADJUST FORKS BY ROTATING TO A POSITION WHERE THEY START TO EXERT PRESSURE ON THE LOCKING LEVER.

M12304 S0006561814\_V2

**E/E Box Installation**  
**Figure 201/20-10-07-990-801 (Sheet 4 of 5)**

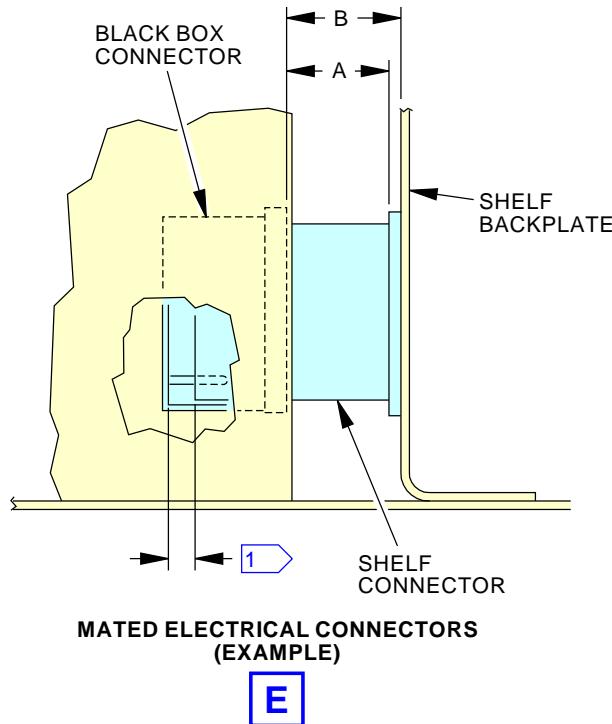
EFFECTIVITY  
AKS ALL

**20-10-07**

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CONNECTOR TYPE	A INCH (mm) MAXIMUM	B INCH (mm) MAXIMUM
AD2		0.297 (7.544)
AMP		0.297 (7.544)
DPA	0.157 (3.988)	
DPD	0.138 (3.505)	
DPE	UNKNOWN	
DPDMA	0.138 (3.505)	UNKNOWN
DPD2	0.138 (3.505)	
DPXA		0.297 (7.544)
DPXB		0.297 (7.544)
DPX2		0.297 (7.544)
SR-RAI		0.581 (14.757)

NOTE:

DIMENSIONS CAN BE MEASURED WITH PUTTY OR A PAPER SLEEVE OR RING OF A SUITABLE LENGTH THAT WILL BE CRUSHED WHEN THE CONNECTOR IS MATED PROPERLY.

- 1 0.09 INCH (2.286 mm) MAXIMUM FOR ANY CONNECTOR FULLY MATED (ALTERNATE METHOD)

M12346 S0006561815\_V2

E/E Box Installation  
Figure 201/20-10-07-990-801 (Sheet 5 of 5)

EFFECTIVITY  
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**TASK 20-10-07-400-801**

**3. E/E Box Installation**

(Figure 201)

**A. References**

Reference	Title
20-40-12-000-804	Conductive Dust Cap and Conductor Cover Removal (P/B 201)
20-40-12-400-802	ESDS Handling for Metal Encased Unit Installation (P/B 201)
SWPM 20-30-00 Electrical Connection of Equipment	Standard Wiring Practices Manual

**B. Location Zones**

Zone	Area
117	Electrical and Electronics Compartment - Left
118	Electrical and Electronics Compartment - Right

**AKS ALL; AIRPLANES WITH REXNORD AEROSPACE MECHANISMS EXTRACTOR**

**C. E/E Box Installation Procedure**

**SUBTASK 20-10-07-860-004**

- (1) Make sure the applicable circuit breakers for the E/E box are open.

**SUBTASK 20-10-07-210-001**

- (2) Compare the quantity and location of the rubber plugs with the decal installed on the tray, if applicable.

NOTE: Each rubber plug location will agree with a block dot on the decal installed on the tray.

- (a) Install or remove rubber plugs if it is necessary.

**SUBTASK 20-10-07-910-004**

- (3) If the E/E box is sensitive to electrostatic discharge, do these steps:

**CAUTION:** DO NOT TOUCH THE E/E BOX BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE E/E BOX.

- (a) Do this task: ESDS Handling for Metal Encased Unit Installation, TASK 20-40-12-400-802.  
(b) Do this task: Conductive Dust Cap and Conductor Cover Removal, TASK 20-40-12-000-804.

**SUBTASK 20-10-07-020-013**

- (4) If the E/E box is not sensitive to electrostatic discharge, remove the protective covers from the electrical connector(s).

**SUBTASK 20-10-07-210-002**

**CAUTION:** MAKE SURE THE ELECTRICAL PINS AND CONTACTS ON THE E/E BOX CONNECTOR AND TRAY CONNECTOR ARE NOT BENT OR DAMAGED. INSTALLATION OF THE E/E BOX WITH DAMAGED PINS OR CONTACTS CAN CAUSE DAMAGE TO THE E/E BOX, THE TRAY ELECTRICAL CONNECTOR, OR THE SYSTEM COMPONENTS.

- (5) Visually make sure the electrical pins of the E/E box and tray connector are not bent or damaged.

EFFECTIVITY  
AKS ALL

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**AKS ALL; AIRPLANES WITH REXNORD AEROSPACE MECHANISMS EXTRACTOR (Continued)**

- (a) Replace components if they are damaged, refer to SWPM 20-30-00 Electrical Connection of Equipment.

SUBTASK 20-10-07-420-008

- (6) Carefully start to install the E/E box into the tray.

NOTE: For easier installation of the E/E box, lift the front of the E/E box approximately 1/8 inch (3 mm) above the tray surface.

SUBTASK 20-10-07-420-009

- (7) Continue to move the E/E box into the tray and engage the electrical connector.

NOTE: The hold-down extractor mechanism does not always provide enough force to completely engage the E/E box with the electrical connector. The E/E box must first be fully engaged and seated before using the hold-down extractor mechanism to secure the installation.

NOTE: The E/E box will engage with the electrical connector easier if you move the front of the E/E box from side to side approximately 1/8 inch (3 mm). While you shake the box, apply a strong and steady horizontal force to the front of the E/E box.

SUBTASK 20-10-07-210-018

- (8) Make sure the electrical connector is engaged.

SUBTASK 20-10-07-210-019

- (9) Move the E/E box to make sure of a tight fit.

SUBTASK 20-10-07-820-001

- (10) Turn the keeper to put the deep slot near to and aligned with the T-hook.

SUBTASK 20-10-07-420-019

- (11) Put the extractor on the T-hook and turn the keeper 180 degrees.

SUBTASK 20-10-07-420-020

- (12) To tighten the front hold-down extractor, turn the knob clockwise until the clutch engages fully.

NOTE: You will feel clicks while you turn the knob.

SUBTASK 20-10-07-420-010

- (13) Tighten the extractor.

SUBTASK 20-10-07-420-041

- (14) Re-tighten the extractor.

- (a) Press firmly on the front of the unit.

NOTE: This is to make sure the unit is fully seated before re-tightening.

- (b) Re-tighten the extractor screws.

SUBTASK 20-10-07-420-021

- (15) Install the connections to the front of the E/E box, if it is necessary.

SUBTASK 20-10-07-860-005

- (16) Close the applicable circuit breakers for the E/E box.

**AKS ALL; AIRPLANES WITH HOLLINGSEAD EXTRACTOR**

**D. E/E Box Installation Procedure**

SUBTASK 20-10-07-860-006

- (1) Make sure the applicable circuit breakers for the E/E box are open.

EFFECTIVITY
AKS ALL

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**AKS ALL; AIRPLANES WITH HOLLINGSEAD EXTRACTOR (Continued)**

SUBTASK 20-10-07-210-005

- (2) Compare the quantity and location of the rubber plugs with the decal installed on the tray, if applicable.

**NOTE:** Each rubber plug location will agree with a block dot on the decal installed on the tray.

- (a) Install or remove rubber plugs if it is necessary.

SUBTASK 20-10-07-910-005

- (3) If the E/E box is sensitive to electrostatic discharge, do these steps:

**CAUTION:** DO NOT TOUCH THE E/E BOX BEFORE YOU DO THE PROCEDURE FOR  
DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE.  
ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE E/E BOX.

- (a) Do this task: ESDS Handling for Metal Encased Unit Installation,  
TASK 20-40-12-400-802.
- (b) Do this task: Conductive Dust Cap and Conductor Cover Removal,  
TASK 20-40-12-000-804.

SUBTASK 20-10-07-020-014

- (4) If the E/E box is not sensitive to electrostatic discharge, remove the protective covers from the electrical connector(s).

SUBTASK 20-10-07-210-006

**CAUTION:** MAKE SURE THE ELECTRICAL PINS AND CONTACTS ON THE E/E BOX  
CONNECTOR AND TRAY CONNECTOR ARE NOT BENT OR DAMAGED.  
INSTALLATION OF THE E/E BOX WITH DAMAGED PINS OR CONTACTS CAN  
CAUSE DAMAGE TO THE E/E BOX, THE TRAY ELECTRICAL CONNECTOR, OR  
THE SYSTEM COMPONENTS.

- (5) Visually make sure the electrical pins of the E/E box and tray connector are not bent or damaged.
- (a) Replace components if they are damaged.

SUBTASK 20-10-07-420-011

- (6) Carefully start to install the box into the tray.

**NOTE:** For easier installation of the E/E box, lift the front of the E/E box approximately about 1/8 inch (3 mm) above the tray surface.

SUBTASK 20-10-07-420-012

- (7) Continue to move the box into the tray and engage the electrical connector.

**NOTE:** The E/E box will engage with the electrical connector easier if you shake the front of the E/E box from side to side approximately 1/8 inch (3 mm). While you shake the box, apply a light horizontal force to the front of the E/E box.

SUBTASK 20-10-07-820-002

- (8) Align the front hold-down extractor with the T-hook.

SUBTASK 20-10-07-420-022

- (9) Put the extractor on the T-hook and turn the latch clockwise.

SUBTASK 20-10-07-420-023

- (10) Turn the knob on the front hold-down extractor clockwise until you cannot see the red band and the clutch engages.

EFFECTIVITY  
AKS ALL

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**AKS ALL; AIRPLANES WITH HOLLINGSEAD EXTRACTOR (Continued)**

SUBTASK 20-10-07-210-007

- (11) Shake the E/E box to make sure of a tight fit.

SUBTASK 20-10-07-420-013

- (12) Tighten the extractor.

SUBTASK 20-10-07-420-042

- (13) Re-tighten the extractor.

- (a) Press firmly on the front of the unit.

NOTE: This is to make sure the unit is fully seated before re-tightening.

- (b) Re-tighten the extractor screws.

SUBTASK 20-10-07-210-008

- (14) Make sure the electrical connector is engaged.

SUBTASK 20-10-07-420-024

- (15) Install the connections to the front of the E/E box, if it is necessary.

SUBTASK 20-10-07-860-007

- (16) Close the applicable circuit breakers for the E/E box.

**AKS ALL; AIRPLANES WITH HARTWELL EXTRACTOR**

**E. E/E Box Installation**

SUBTASK 20-10-07-860-008

- (1) Make sure the applicable circuit breakers for the E/E box are open.

SUBTASK 20-10-07-210-009

- (2) Compare the quantity and location of the rubber plugs with the decal installed on the tray, if applicable.

NOTE: Each rubber plug location will agree with a block dot on the decal installed on the tray.

- (a) Install or remove rubber plugs if it is necessary.

SUBTASK 20-10-07-910-006

- (3) If the E/E box is sensitive to electrostatic discharge, do these steps:

**CAUTION:** DO NOT TOUCH THE E/E BOX BEFORE YOU DO THE PROCEDURE FOR  
DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE.  
ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE E/E BOX.

- (a) Do this task: ESDS Handling for Metal Encased Unit Installation,  
TASK 20-40-12-400-802.  
(b) Do this task: Conductive Dust Cap and Conductor Cover Removal,  
TASK 20-40-12-000-804.

SUBTASK 20-10-07-020-015

- (4) If the E/E box is not sensitive to electrostatic discharge, remove the protective covers from the electrical connector(s).



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AKS ALL; AIRPLANES WITH HARTWELL EXTRACTOR (Continued)

SUBTASK 20-10-07-210-010

**CAUTION:** MAKE SURE THE ELECTRICAL PINS AND CONTACTS ON THE E/E BOX CONNECTOR AND TRAY CONNECTOR ARE NOT BENT OR DAMAGED. INSTALLATION OF THE E/E BOX WITH DAMAGED PINS OR CONTACTS CAN CAUSE DAMAGE TO THE E/E BOX, THE TRAY ELECTRICAL CONNECTOR, OR THE SYSTEM COMPONENTS.

- (5) Visually make sure the electrical pins of the E/E box and tray connector are not bent or damaged.
  - (a) Replace components if they are damaged.

SUBTASK 20-10-07-420-014

- (6) Carefully start to install the box into the tray.

NOTE: For easier installation of the E/E box, lift the front of the E/E box approximately about 1/8 inch (3 mm) above the tray surface.

SUBTASK 20-10-07-420-015

- (7) Continue to move the box into the tray and engage the electrical connector.

NOTE: The E/E box will engage with the electrical connector easier if you shake the front of the E/E box from side to side approximately 1/8 inch (3 mm). While you shake the box, apply a light horizontal force to the front of the E/E box.

SUBTASK 20-10-07-820-003

- (8) Compress the keeper to engage the T-hook on the E/E box.

SUBTASK 20-10-07-420-025

- (9) To tighten the front hold-down extractors, turn the knob clockwise until the clutch engages fully.

NOTE: You will feel clicks while you turn the knob.

SUBTASK 20-10-07-210-011

- (10) Move the E/E box to make sure of a tight fit.

SUBTASK 20-10-07-420-016

- (11) Tighten the extractor.

SUBTASK 20-10-07-420-043

- (12) Re-tighten the extractor.

- (a) Press firmly on the front of the unit.

NOTE: This is to make sure the unit is fully seated before re-tightening.

- (b) Re-tighten the extractor screws.

SUBTASK 20-10-07-210-012

- (13) Make sure the electrical connector is engaged.

SUBTASK 20-10-07-420-026

- (14) Install the connections to the front of the E/E box, if it is necessary.

SUBTASK 20-10-07-860-009

- (15) Close the applicable circuit breakers for the E/E box.



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**AKS ALL; AIRPLANES WITH LEVER LATCH HANDLES**

**F. E/E Box Installation**

SUBTASK 20-10-07-860-013

- (1) Make sure the applicable circuit breakers for the E/E box are open.

SUBTASK 20-10-07-210-015

- (2) Compare the quantity and location of the rubber plugs with the decal installed on the tray, if applicable.

NOTE: Each rubber plug location will agree with a block dot on the decal installed on the tray.

- (a) Install or remove rubber plugs if it is necessary.

SUBTASK 20-10-07-910-010

- (3) If the E/E box is sensitive to electrostatic discharge, do these steps:

**CAUTION:** DO NOT TOUCH THE E/E BOX BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE E/E BOX.

- (a) Do this task: ESDS Handling for Metal Encased Unit Installation, TASK 20-40-12-400-802.
- (b) Do this task: Conductive Dust Cap and Conductor Cover Removal, TASK 20-40-12-000-804.

SUBTASK 20-10-07-020-020

- (4) If the E/E box is not sensitive to electrostatic discharge, remove the protective covers from the electrical connector(s).

SUBTASK 20-10-07-210-016

**CAUTION:** MAKE SURE THE ELECTRICAL PINS AND CONTACTS ON THE E/E BOX CONNECTOR AND TRAY CONNECTOR ARE NOT BENT OR DAMAGED. INSTALLATION OF THE E/E BOX WITH DAMAGED PINS OR CONTACTS CAN CAUSE DAMAGE TO THE E/E BOX, THE TRAY ELECTRICAL CONNECTOR, OR THE SYSTEM COMPONENTS.

- (5) Visually make sure the electrical pins of the E/E box and tray connector are not bent or damaged.
  - (a) Replace components if they are damaged.

SUBTASK 20-10-07-420-029

- (6) Carefully start to install the box into the tray with the lever in the open position.

NOTE: For easier installation of the E/E box, lift the front of the E/E box approximately about 1/8 inch (3 mm) above the tray surface.

SUBTASK 20-10-07-420-030

- (7) Continue to move the box into the tray until the lever engages the shelf-mounted fork and the electrical connector is engaged.

NOTE: The E/E box will engage with the electrical connector easier if you shake the front of the E/E box from side to side approximately 1/8 inch (3 mm). While you shake the box, apply a light horizontal force to the front of the E/E box.

SUBTASK 20-10-07-820-004

- (8) Move lever latch to its locked position and verify proper adjustment.
  - (a) To adjust the lever latch fork, do this task, do this task: Lever Latch Fork Adjustment, TASK 20-10-07-820-801.

EFFECTIVITY  
AKS ALL

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**AKS ALL; AIRPLANES WITH LEVER LATCH HANDLES (Continued)**

SUBTASK 20-10-07-210-017

- (9) Make sure the electrical connector is engaged.

SUBTASK 20-10-07-420-031

- (10) Install the connections to the front of the E/E box, if it is necessary.

SUBTASK 20-10-07-860-014

- (11) Close the applicable circuit breakers for the E/E box.

**AKS ALL**

**G. E/E Box Installation Procedure**

SUBTASK 20-10-07-040-001

- (1) Make sure that the applicable circuit breakers for the E/E box are open.

SUBTASK 20-10-07-200-001

- (2) Compare the quantity and location of the rubber plugs with the decal installation on the tray, if applicable.

NOTE: Each rubber plug location will agree with a black dot on the decal installed on the tray.

- (a) Install or remove rubber plugs if it is necessary.

SUBTASK 20-10-07-580-001

- (3) If the E/E box is sensitive to electrostatic discharge, do the steps that follow.

**CAUTION:** DO NOT TOUCH THE UNIT BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE UNIT.

- (a) Do this task: ESDS Handling for Metal Encased Unit Installation, TASK 20-40-12-400-802.  
(b) Do this task: Conductive Dust Cap and Conductor Cover Removal, TASK 20-40-12-000-804.

SUBTASK 20-10-07-020-029

- (4) If the E/E box is sensitive to electrostatic discharge, remove the protective covers from the electrical connector(s).

SUBTASK 20-10-07-200-002

**CAUTION:** MAKE SURE THAT THE ELECTRICAL PINS ON THE E/E BOX CONNECTOR AND TRAY CONNECTOR ARE NOT BENT OR DAMAGED. IF YOU INSTALL THE E/E BOX WITH DAMAGED PINS, DAMAGE TO THE E/E BOX, TRAY ELECTRICAL CONNECTOR, OR SYSTEM COMPONENTS CAN OCCUR.

- (5) Visually make sure that the electrical pins of the E/E box and tray connector are not bent or damaged.  
(a) Replace components if they are damaged, refer to SWPM 20-30-00 Electrical Connection of Equipment.

SUBTASK 20-10-07-420-044

- (6) Carefully start to install the E/E box into the tray.

- (a) For easier installation of the E/E box, lift the front of the E/E box approximately  $\frac{1}{8}$  in. (3 mm) above the tray surface.

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SUBTASK 20-10-07-420-045

- (7) Continue to move the E/E box into the tray and engage the electrical connector.

NOTE: The hold-down extractor mechanism does not always provide enough force to completely engage the E/E box with the electrical connector. The E/E box must first be fully engaged and seated before using the hold-down extractor mechanism to secure the installation.

NOTE: The E/E box will engage with the electrical connector easier if you move the front of the E/E box from side to side approximately  $\frac{1}{8}$  in. (3 mm). While you shake the box, apply a strong and steady horizontal force to the front of the E/E box.

SUBTASK 20-10-07-200-003

- (8) Make sure the electrical connector is engaged.

SUBTASK 20-10-07-420-046

- (9) Tighten the Barry-type retaining fastener by hand.

SUBTASK 20-10-07-200-004

- (10) Move the E/E box to make sure of a tight fit.

SUBTASK 20-10-07-420-047

- (11) Re-tighten the Barry-type retaining fastener by hand.

SUBTASK 20-10-07-400-001

- (12) Install the connections to the front of the E/E box, if it is necessary.

SUBTASK 20-10-07-440-001

- (13) Close the applicable circuit breakers for the E/E box.

———— END OF TASK ————

**TASK 20-10-07-820-801**

**4. Lever Latch Fork Adjustment**

(Figure 201)

**A. Prepare For Adjustment**

SUBTASK 20-10-07-020-021

- (1) To remove the unit with the lever latch, do this task: E/E Box Removal, TASK 20-10-07-000-801.

SUBTASK 20-10-07-020-022

- (2) If installed, loosen jamnut on fork assembly.

SUBTASK 20-10-07-010-002

- (3) Examine all parts of latching mechanism for serviceability.

**B. Adjust Lever Latch Fork**

SUBTASK 20-10-07-420-032

- (1) Install unit back on shelf until connectors are partially engaged, do this task: E/E Box Installation, TASK 20-10-07-400-801.

SUBTASK 20-10-07-420-033

- (2) Engage lever latch hook with fork assembly pin.

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SUBTASK 20-10-07-420-034

- (3) Start closing lever latch handle.

NOTE: It is possible to determine full connector engagement by feel. A sudden increase in handle pressure, resistance to handle movement, indicates that the connectors are fully engaged.

SUBTASK 20-10-07-820-005

- (4) Adjust the fork assembly until resistance to handle movement occurs within the required gap tolerance, as shown in Figure 201.

NOTE: Loosen the nut at the shelf area for fork adjustment.

**CAUTION:** MAKE SURE THERE IS SUFFICIENT THREAD ENGAGEMENT IN THE LATCH FORK. WITHOUT SUFFICIENT THREAD ENGAGEMENT THE LATCH LEVER COULD FAIL, ALLOWING THE BLACK BOX TO SLIDE OUT OF POSITION.

- (a) Make sure there is sufficient thread engagement in the latch fork.

SUBTASK 20-10-07-820-006

- (5) Close handle until latched.

SUBTASK 20-10-07-420-035

- (6) Tighten jamnut to snug fit.

————— END OF TASK ————

**TASK 20-10-07-000-802**

**5. Printed Circuit Card Removal**

(Figure 202)

**A. References**

Reference	Title
20-40-12-000-801	ESDS Handling for Printed Circuit Board Removal (P/B 201)

**B. Procedure**

SUBTASK 20-10-07-860-010

- (1) Make sure you remove electrical power from the printed circuit card.

SUBTASK 20-10-07-910-007

**CAUTION:** DO NOT TOUCH THE PRINTED CIRCUIT CARD BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE PRINTED CIRCUIT CARD.

- (2) Make sure you, do this task: ESDS Handling for Printed Circuit Board Removal, TASK 20-40-12-000-801.

SUBTASK 20-10-07-010-001

- (3) Open the cardfile door.

SUBTASK 20-10-07-020-016

- (4) Remove the printed circuit card assembly:

- Turn the two ejector levers approximately 90 degrees to give the printed-circuit card a lateral play.
- While you push the two latch levers, turn the two lock release levers to release the latch lock.

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- (c) Turn the ejectors on the printed-circuit card assembly until the printed-circuit card disengages from the electrical connector.
- (d) Carefully move the printed-circuit card assembly out along the guide.
- (e) Remove the printed-circuit card assembly.

———— END OF TASK ————

EFFECTIVITY  
AKS ALL

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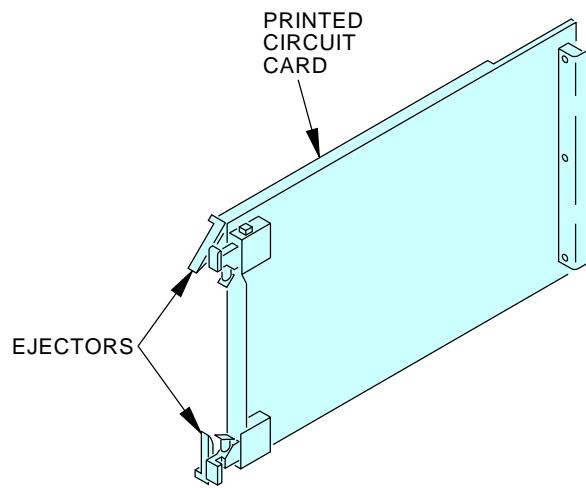
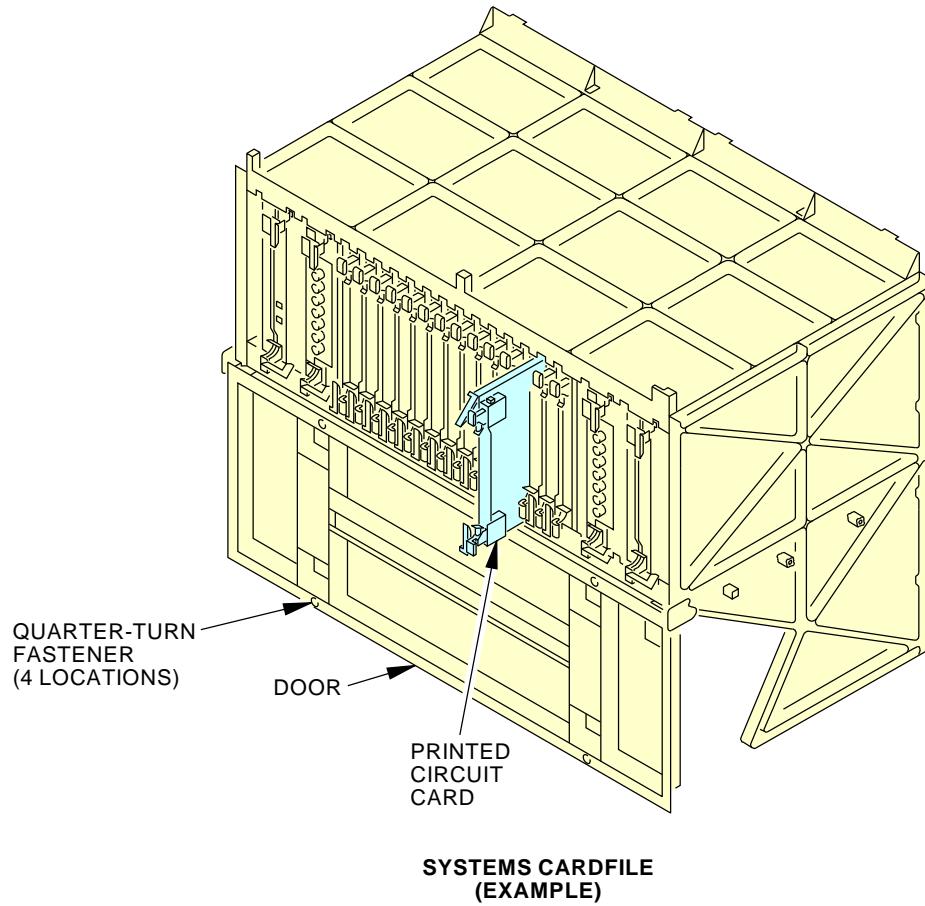
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**Printed Circuit Card Installation**  
**Figure 202/20-10-07-990-802**

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**TASK 20-10-07-400-802**

**6. Printed Circuit Card Installation**

(Figure 202)

**A. References**

Reference	Title
20-40-12-400-801	ESDS Handling for Printed Circuit Board Installation (P/B 201)

**B. Procedure**

SUBTASK 20-10-07-860-011

- (1) Make sure electrical power is removed from the printed circuit card.

SUBTASK 20-10-07-910-008

**CAUTION:** DO NOT TOUCH THE PRINTED CIRCUIT CARD BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE PRINTED CIRCUIT CARD.

- (2) Make sure you, do this task: ESDS Handling for Printed Circuit Board Installation, TASK 20-40-12-400-801.

SUBTASK 20-10-07-210-013

- (3) Make sure the edge connector has no bent pins.

SUBTASK 20-10-07-420-017

- (4) Install the printed circuit card assembly:
  - (a) Install the printed-circuit card assembly
  - (b) Carefully move the printed-circuit card assembly in along the guide.
  - (c) Turn the ejectors on the printed-circuit card assembly until the printed-circuit card engages in to the electrical connector.
  - (d) While you push the two latch levers, turn the two lock levers to lock the latch.
  - (e) Manually turn the ejector levers to tighten the printed circuit card assembly.

NOTE: The levers should be approximately vertical.

———— END OF TASK ————

**TASK 20-10-07-020-801**

**7. E/E Shelf Assembly Removal**

(Figure 203)

**A. Location Zones**

Zone	Area
117	Electrical and Electronics Compartment - Left

**B. Procedure**

SUBTASK 20-10-07-020-023

- (1) Remove each LRU form the applicable rack-mounted shelf. To do this, refer to each applicable LRU removal procedure.

SUBTASK 20-10-07-020-024

- (2) Remove the electrical connector receptacles from the electronic equipment shelf assembly as required.



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- (a) Remove the grounding wires as required.

SUBTASK 20-10-07-020-025

- (3) Disconnect the grounding wire from the electronic equipment rack.

SUBTASK 20-10-07-020-026

- (4) Disconnect the electronic equipment cooling hoses as required.

SUBTASK 20-10-07-020-027

- (5) Remove the shelf assembly attach bolts, washers, and nuts.

SUBTASK 20-10-07-020-028

- (6) Remove the shelf assembly.

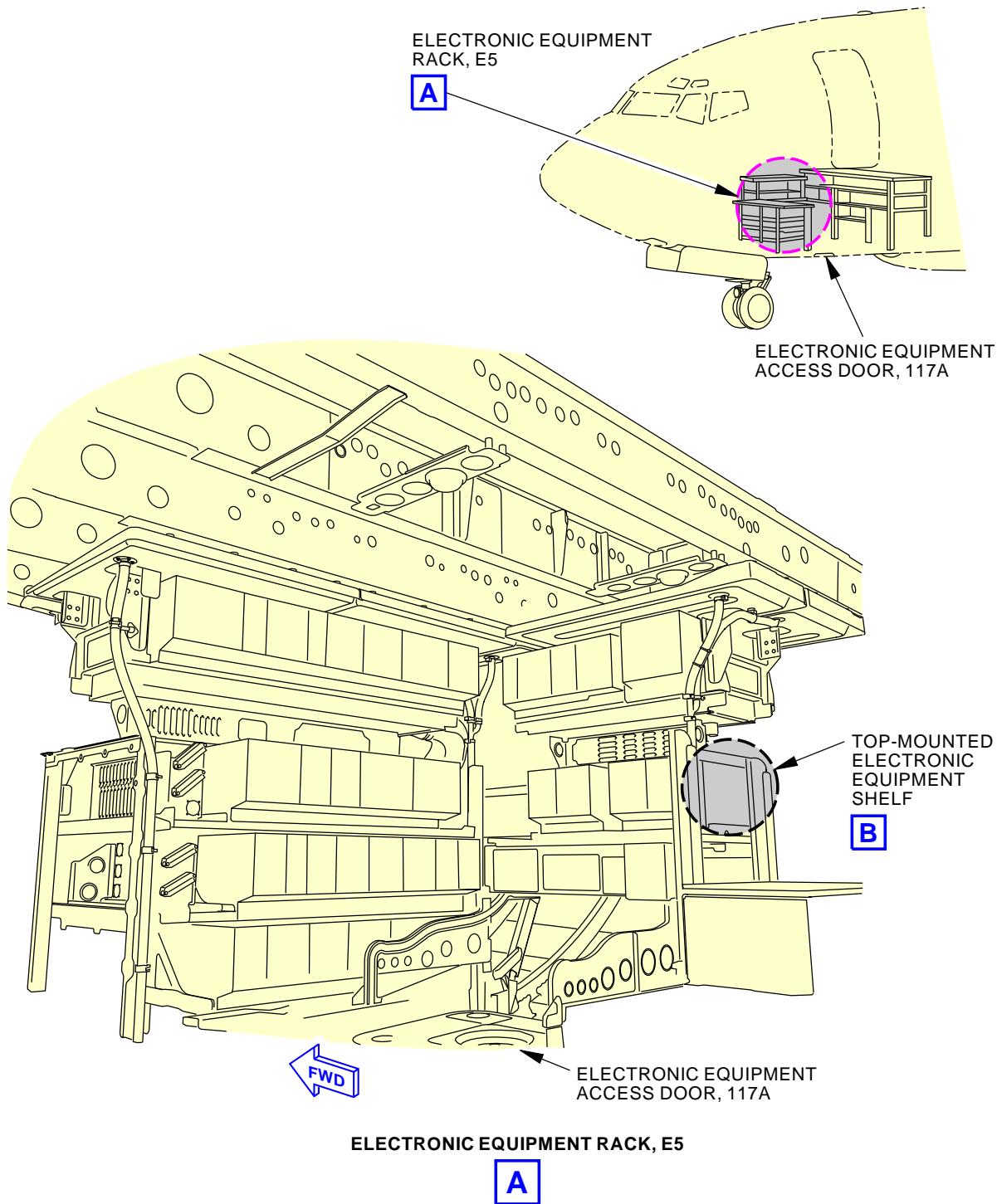
———— END OF TASK ————

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ELECTRONIC EQUIPMENT RACK, E5

A

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Electronic Equipment Shelf  
Figure 203/20-10-07-990-803 (Sheet 1 of 4)

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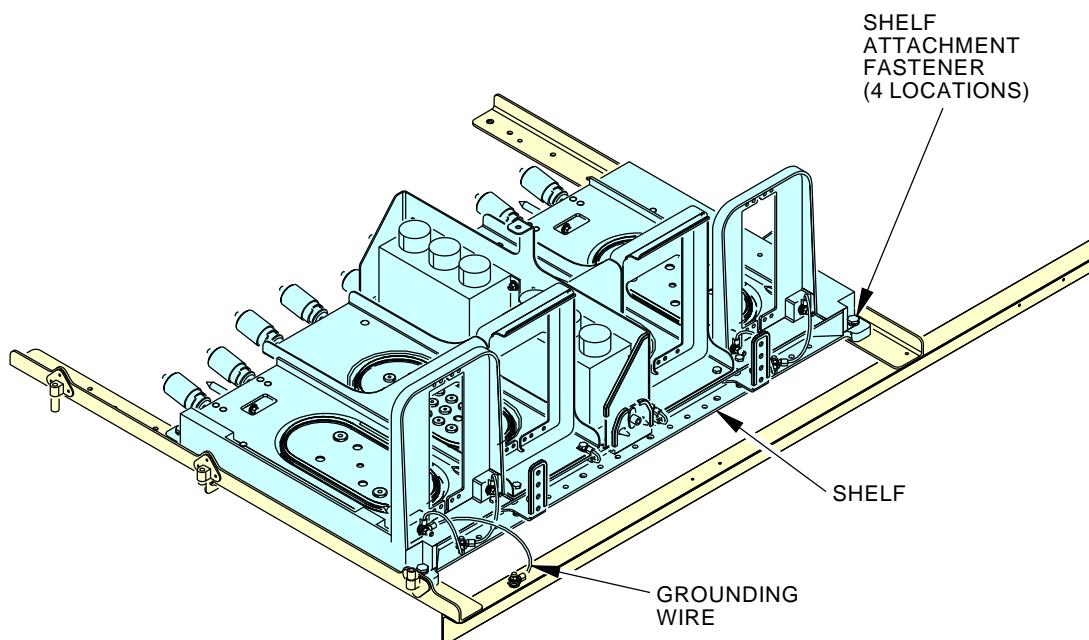
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TOP-MOUNTED ELECTRONIC EQUIPMENT SHELF  
(EXAMPLE)

B

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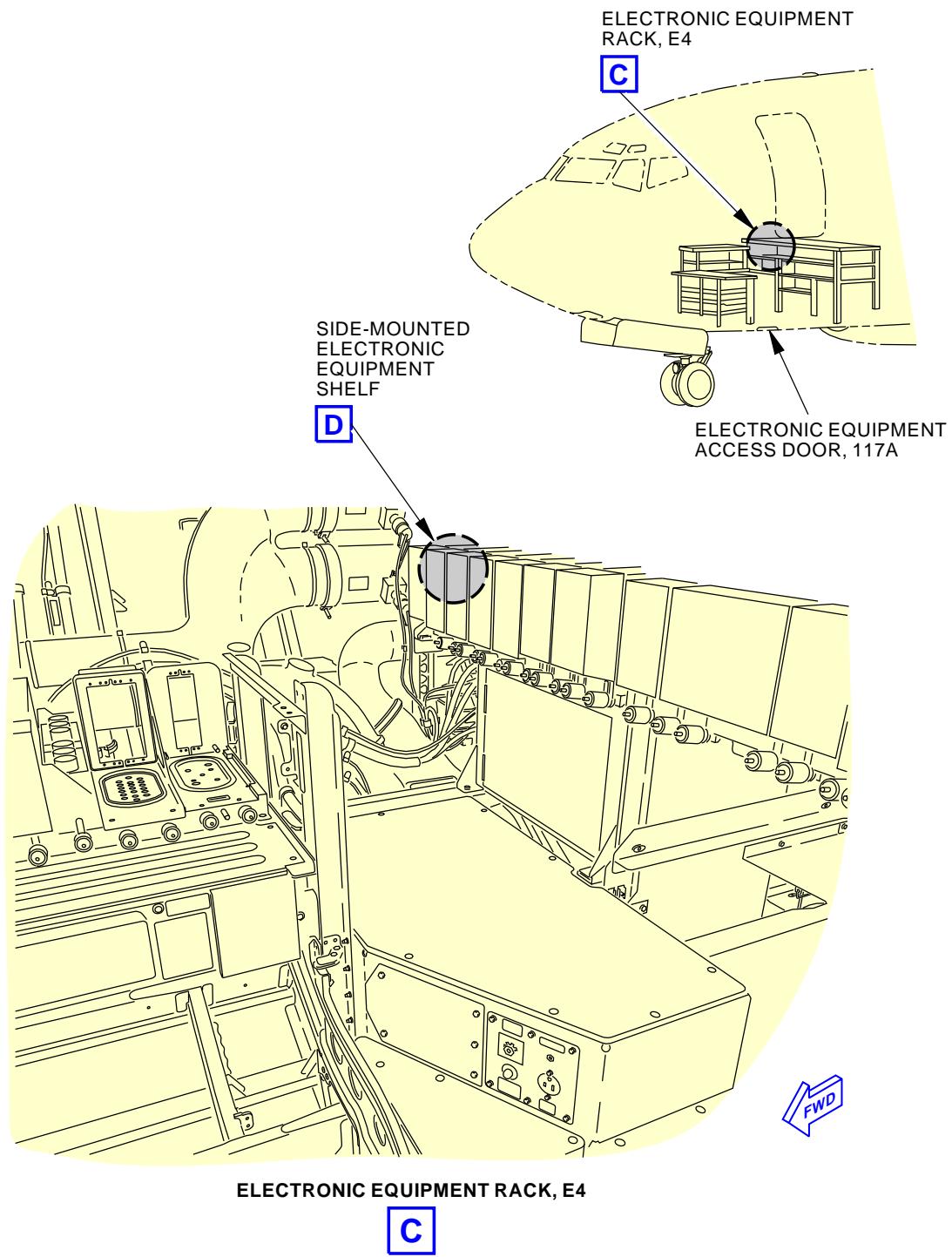
Electronic Equipment Shelf  
Figure 203/20-10-07-990-803 (Sheet 2 of 4)

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Electronic Equipment Shelf  
Figure 203/20-10-07-990-803 (Sheet 3 of 4)

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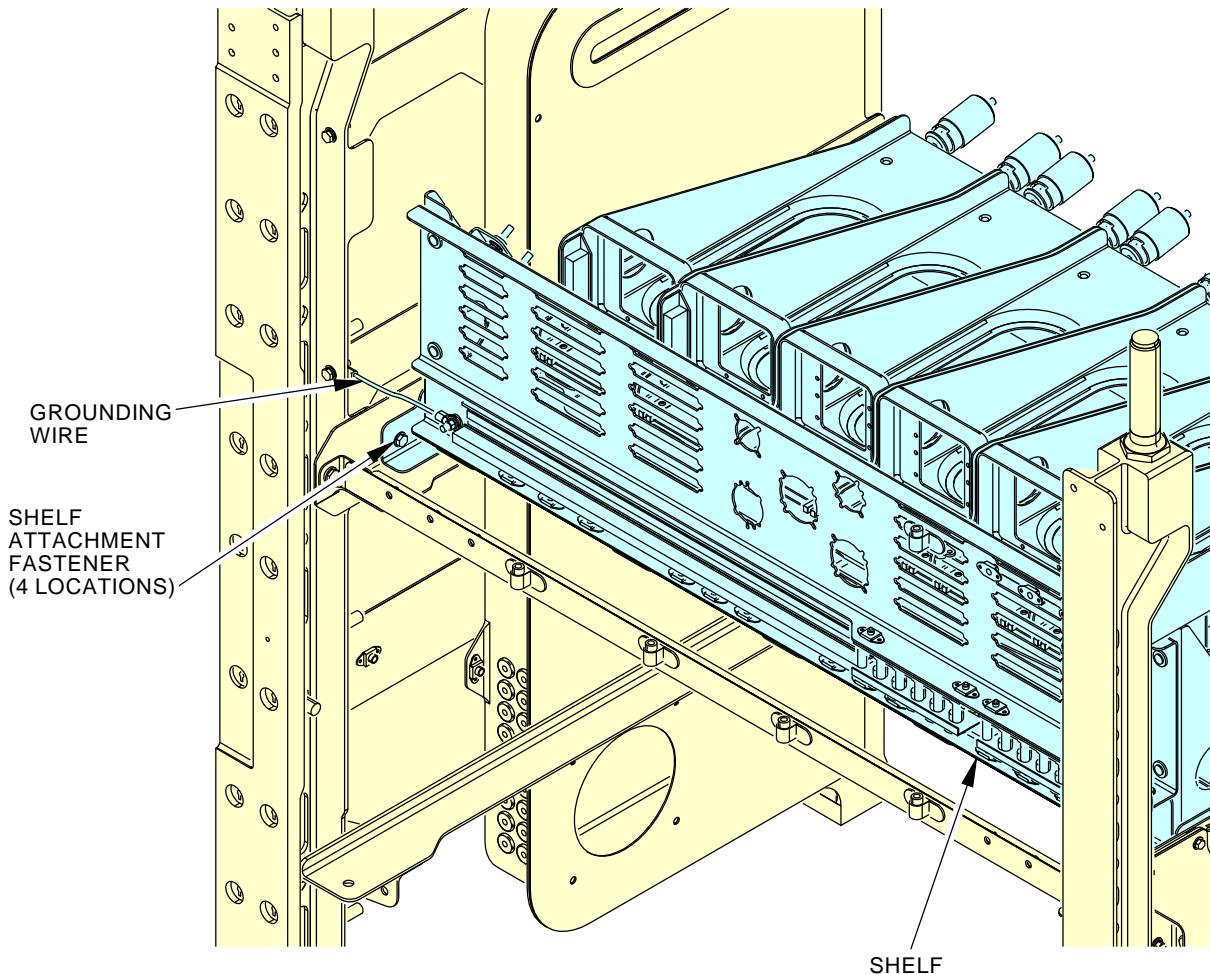
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SIDE-MOUNTED ELECTRONIC EQUIPMENT SHELF  
(EXAMPLE)

D

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Electronic Equipment Shelf  
Figure 203/20-10-07-990-803 (Sheet 4 of 4)

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**TASK 20-10-07-400-803**

**8. E/E Shelf Assembly Installation**

(Figure 203)

**A. References**

Reference	Title
SWPM 20-20-00	Standard Wiring Practices Manual

**B. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-1550	Bonding Meters - Approved, Intrinsically Safe (Approved for use in Class I, Divisions I & II hazardous (classified) locations. Outside these hazardous locations, COM-614 can be used in lieu of COM-1550).  Part #: C15292 (MODEL T477W) Supplier: 01014 Part #: M1 Supplier: 3AD17 Opt Part #: M1B Supplier: 3AD17

**C. Location Zones**

Zone	Area
117	Electrical and Electronics Compartment - Left

**D. Procedure**

SUBTASK 20-10-07-420-036

- (1) Install the shelf assembly in the electronic equipment rack with the attach bolts, washers, and nuts.

SUBTASK 20-10-07-420-037

- (2) Install the equipment cooling hoses as required.

SUBTASK 20-10-07-420-038

- (3) Install the shelf assembly grounding wire to the electronic equipment rack.
  - (a) Use an intrinsically safe approved bonding meter, COM-1550 to make sure the resistance between the electronic equipment rack and the electronic equipment shelf is less than or equal to .0025 ohms (SWPM 20-20-00).

SUBTASK 20-10-07-420-039

- (4) Install the electrical receptacles in the electronic equipment shelf, as applicable.
  - (a) Connect the electrical connector grounding wires, as applicable.
  - (b) Use an intrinsically safe approved bonding meter, COM-1550 to make sure the resistance between each connector grounding wire and the electronic equipment shelf is less than or equal to .0010 ohms (SWPM 20-20-00).

SUBTASK 20-10-07-420-040

- (5) Install each applicable LRU. To do this, refer to each applicable LRU installation procedure.
  - (a) Make sure you do the LRU replacement test for each LRU installed.

———— END OF TASK ————

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**CONTROL CABLE STOPS - REMOVAL/INSTALLATION**

**1. General**

- A. This procedure has these tasks:
- (1) A removal of the control cable stops.
  - (2) An installation of the control cable stops.

**TASK 20-10-08-960-801**

**2. Control Cable Stops Removal**

(Figure 401)

**A. Procedure**

SUBTASK 20-10-08-020-001

- (1) Remove the lockwire that attaches the control cable stop to the swaged cable terminal stud.

SUBTASK 20-10-08-020-002

- (2) Move the control cable stop longitudinally away from the swaged cable terminal stud until the control cable stop disengages.

SUBTASK 20-10-08-980-001

- (3) Move the control cable stop laterally to permit the cable to go through the slot in the control cable stop.

———— END OF TASK ————

**TASK 20-10-08-420-801**

**3. Control Cable Stops Installation**

(Figure 401)

**A. References**

Reference	Title
20-10-44-400-801	Lockwire, Cotter Pins, and Lockrings - Installation (P/B 401)

**B. Procedure**

SUBTASK 20-10-08-420-001

- (1) Put the large center hole of the control cable stop near the swaged cable terminal stud.

SUBTASK 20-10-08-420-002

- (2) Move the slot of the control cable stop along the cable.

SUBTASK 20-10-08-420-003

- (3) Push the control cable stop on the end of the swaged cable terminal stud until the control cable stop fully engages.

SUBTASK 20-10-08-820-001

- (4) To adjust the control cable stop, twist the swaged cable terminal stud to get the dimension shown.

SUBTASK 20-10-08-420-004

- (5) Install a lockwire from the control cable stop to the swaged cable terminal stud, do this task: Lockwire, Cotter Pins, and Lockrings - Installation, TASK 20-10-44-400-801.

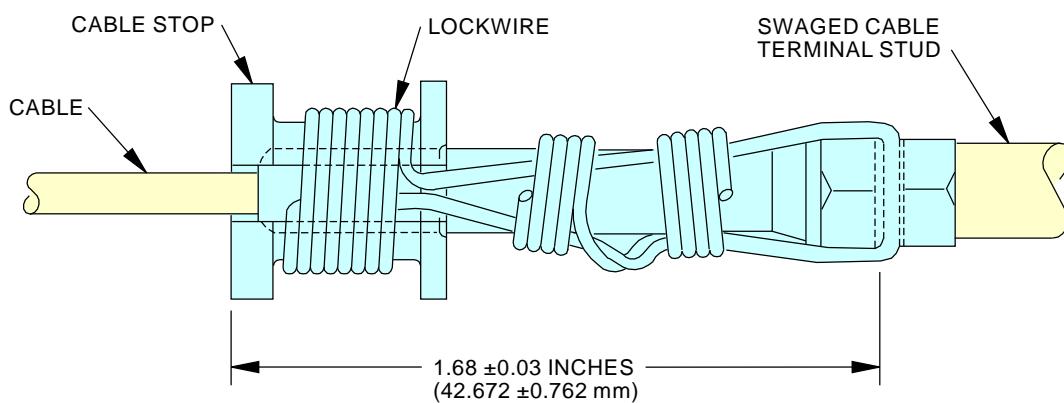
———— END OF TASK ————

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**Control Cable Stops Installation**  
**Figure 401/20-10-08-990-801**

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CONTROL CABLE PULLEYS - REMOVAL/INSTALLATION

**1. General**

- A. This procedure has these tasks:
  - (1) A removal of the control cable pulleys.
  - (2) An installation of the control cable pulleys.
- B. (Figure 401) shows examples of control cable pulleys. If this procedure does not agree with specified maintenance procedures, use the specified maintenance procedures.

**TASK 20-10-09-000-801**

**2. Control Cable Pulleys Removal**

(Figure 401)

**A. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
SPL-1569	Clamp - Control Cable Part #: A20005-9 Supplier: 81205

**B. Procedure**

SUBTASK 20-10-09-020-002

- (1) Install cable control cable clamp, SPL-1569 on the cable between the pulley to keep light tension.

NOTE: Keep light tension on cables not removed so that cable drums will not unwrap and the cable will not move out of the pulley guides. As an option, you can install rigging pins through the applicable drum or quadrant to isolate cable sections.

SUBTASK 20-10-09-020-003

- (2) Loosen the turnbuckle nearest to the control cable pulley to release tension.

SUBTASK 20-10-09-020-004

- (3) Remove the bolt from the pulley disk.

SUBTASK 20-10-09-020-001

- (4) Remove the pulley disk.

— END OF TASK —

**TASK 20-10-09-400-801**

**3. Control Cable Pulleys Installation**

(Figure 401)

**A. References**

Reference	Title
20-10-10-400-801	Turnbuckle Lock Installation (P/B 401)

**B. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

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Reference	Description
COM-1553	Tensiometer - Cable, Low Tension (200 lbs and below) Part #: 102-03120 Supplier: 21844 Part #: ACX-250 Supplier: 13331 Part #: T60-1001-C8-1A Supplier: 0N8U4 Opt Part #: 102-03110 Supplier: 21844 Opt Part #: ACM-200 Supplier: 13331
SPL-1569	Clamp - Control Cable Part #: A20005-9 Supplier: 81205

**C. Procedure**

SUBTASK 20-10-09-420-001

- (1) Install the components applicable to the control cable pulley.

SUBTASK 20-10-09-420-002

- (2) Install the turnbuckles with the turnbuckle barrel installed an equal distance on the two threaded terminals.

NOTE: Do not let more than three threads show out of the turnbuckle barrel.

SUBTASK 20-10-09-020-005

- (3) Remove the cable control cable clamp, SPL-1569 and rigging pins from the control cable and drums.

SUBTASK 20-10-09-420-003

- (4) Tighten the cable as shown in the temperature-tension chart of the applicable system chapter.
  - (a) Do a check of the cable tension with a low tension cable tensiometer, COM-1553.

NOTE: Attach the tensiometer to the cable at least 6 in. (15 cm) from the turnbuckle terminal or other fittings.

SUBTASK 20-10-09-420-004

- (5) Do this task: Turnbuckle Lock Installation, TASK 20-10-10-400-801.  
on all turnbuckles that you adjusted.

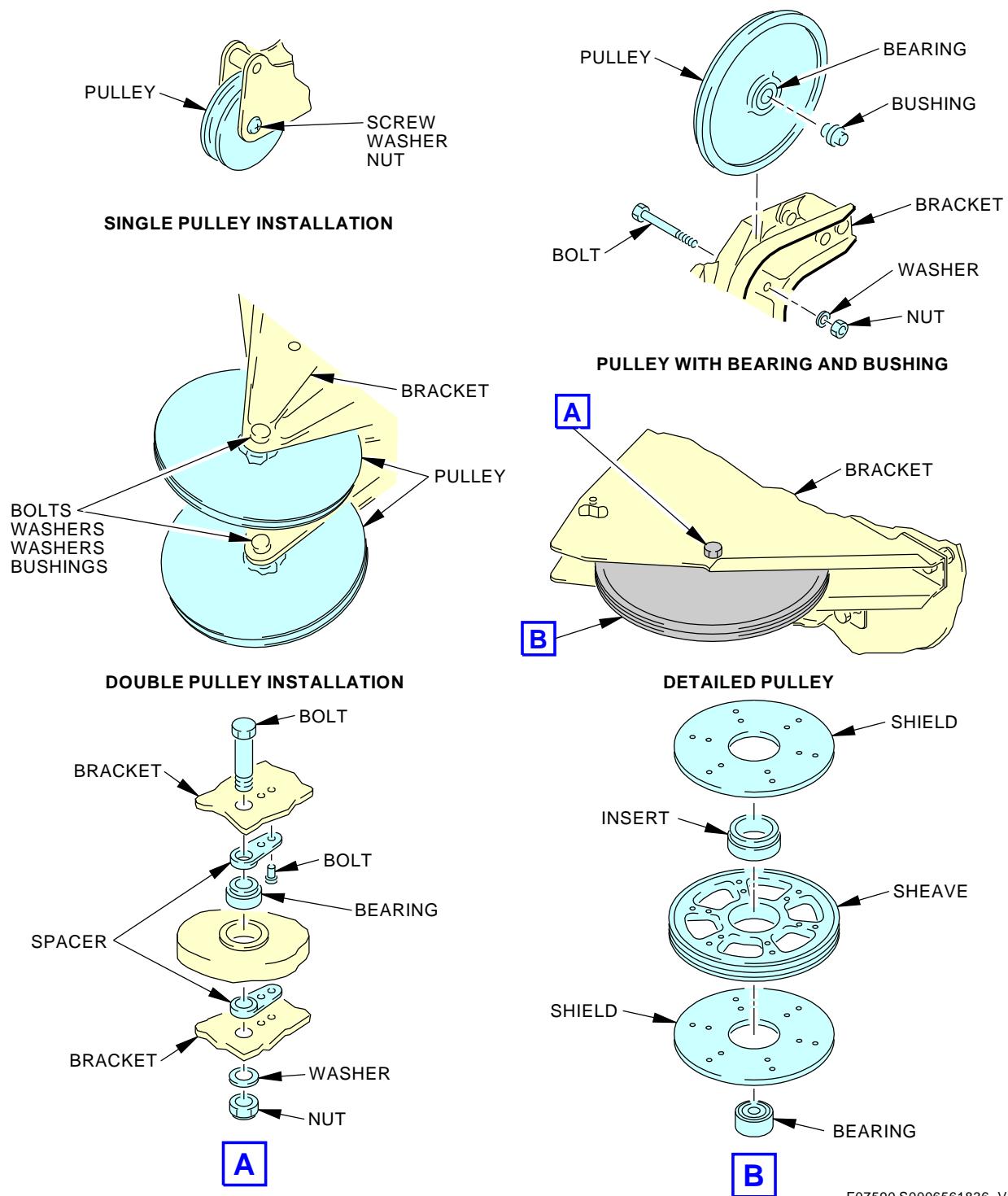
SUBTASK 20-10-09-710-001

- (6) Operate the controls, as specified in the applicable system chapter, through full travel.
  - (a) Make sure the controls move freely.
  - (b) Make sure the force is not excessive or abnormal.

———— END OF TASK ———



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**Control Cable Pulleys Installation**  
**Figure 401/20-10-09-990-801**

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TURNBUCKLE LOCK - REMOVAL/INSTALLATION

**1. General**

- A. This procedure has these tasks:
- (1) Turnbuckle lock removal.
  - (2) Turnbuckle lock installation.

**TASK 20-10-10-000-801**

**2. Turnbuckle Locking Clips Removal**

(Figure 401)

**A. Procedure**

SUBTASK 20-10-10-860-001

- (1) Twist the turnbuckle locking clip.

SUBTASK 20-10-10-860-002

- (2) Push the locking hook out of the hole in the center of the turnbuckle barrel.

SUBTASK 20-10-10-020-001

- (3) Move the turnbuckle locking clip out from the turnbuckle slot.

————— END OF TASK ————

**TASK 20-10-10-400-801**

**3. Turnbuckle Lock Installation**

(Figure 401)

**A. Consumable Materials**

Reference	Description	Specification
C00528	Compound - Corrosion Preventive, Petroleum Hot Application (Soft Film)	MIL-C-11796 Class III

**B. Locking Clip Installation**

SUBTASK 20-10-10-420-001

**CAUTION:** DO NOT USE THE TURNBUCKLE LOCKING CLIPS AGAIN. THEY CAN BE DEFECTIVE IF YOU USE THEM AGAIN. THIS CAN CAUSE DAMAGE TO EQUIPMENT.

- (1) Tighten the turnbuckle until not more than three threads are out of the barrel and until you have correct cable tension.

SUBTASK 20-10-10-820-001

- (2) Align the slot in the barrel and the cable terminal.

SUBTASK 20-10-10-420-006

- (3) Put the straight end of the locking clip into the aligned slot.

SUBTASK 20-10-10-420-002

- (4) Put the locking clip hook over the hole in the center of the turnbuckle.

SUBTASK 20-10-10-420-003

- (5) Engage the hook into the hole.

SUBTASK 20-10-10-420-004

- (6) Push the hook shoulder to engage the hook in the turnbuckle.

EFFECTIVITY  
AKS ALL

**20-10-10**



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SUBTASK 20-10-10-420-005

- (7) Do steps 3 through 5 again to lock the second terminal.

NOTE: You can put the locking clips in the same side or in the opposite side of the turnbuckle holes.

SUBTASK 20-10-10-820-002

- (8) To make sure the two turnbuckle locking clips are correctly installed, turn the turnbuckle slightly.

SUBTASK 20-10-10-210-001

- (9) Visually examine the turnbuckle locking clip to make sure the hook is engaged in the turnbuckle.

**C. Lockwire Installation (alternate method to locking clips)**

SUBTASK 20-10-10-600-001

- (1) Apply a thin coat of compound, C00528 to barrel and cable terminals.

SUBTASK 20-10-10-420-007

- (2) Engage turnbuckle barrel equally with cable terminals and turn barrel until not more than three threads are exposed outside the barrel and the proper cable tension is reached.

SUBTASK 20-10-10-420-008

- (3) Insert correct diameter stainless steel soft annealed wire into either cable terminal. Use .024 for 1/16 inch cable, .031 for 3/32 or 1/8 inch cable, and .043 for 5/32 through 5/16 inch cable.

SUBTASK 20-10-10-420-009

- (4) Twist wire.

NOTE: Do not use a tool which might damage the wire.

SUBTASK 20-10-10-420-010

- (5) Insert ends of wire through opposite holes in barrel. Pull wire through. If tool is used, apply only on ends of wire.

SUBTASK 20-10-10-420-011

- (6) Twist wire down to hole in terminal; insert end of one wire in hole, pull through and twist ends together. Cut off length in excess of 5/8 inch of twisted ends.

SUBTASK 20-10-10-420-012

- (7) Push twisted ends back to lie flat against terminal.

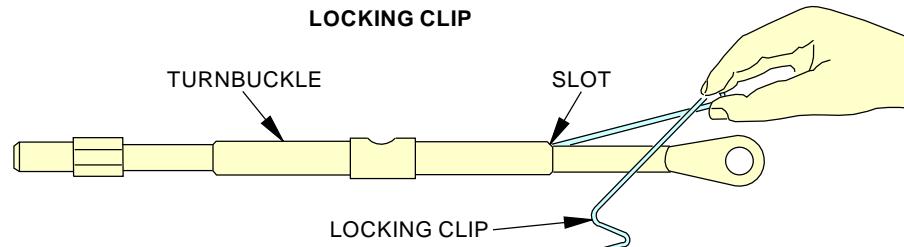
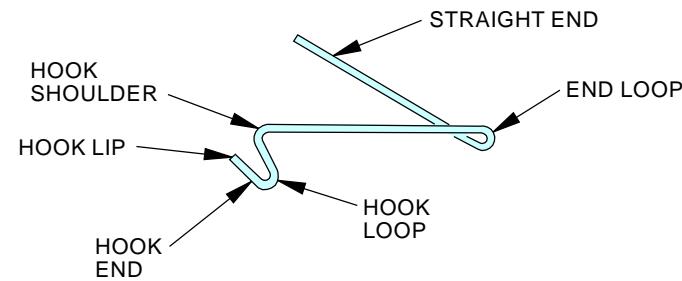
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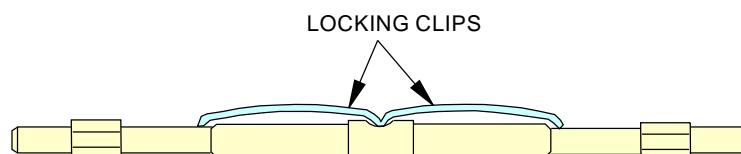
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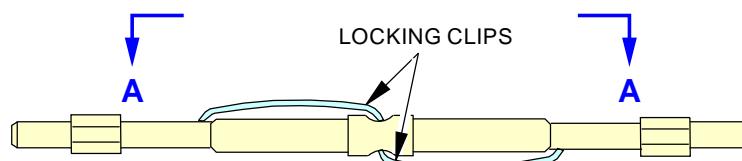
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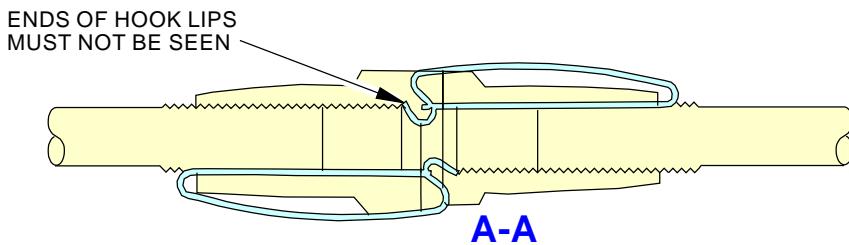
INSERT CLIP IN SLOT



LOCKING CLIP INSERTED IN SAME TURNBUCKLE BARREL HOLE



LOCKING CLIP INSERTED IN OPPOSITE TURNBUCKLE BARREL HOLE



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Turnbuckle Locking Clip  
Figure 401/20-10-10-990-801

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20-10-10

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PRESSURE-SENSITIVE DECALS - REMOVAL/INSTALLATION

**1. General**

- A. This procedure has these tasks:
  - (1) A removal of the pressure-sensitive decals.
  - (2) An installation of the pressure-sensitive decals.
- B. Apply external decal sections in a sequence where the ends make an overlap downstream from the line of flight.
- C. All exterior decals require edge sealing using paint or an edge sealer unless specified differently.
- D. Clean plastic film decals with naphtha. Do not use adhesive activator.
- E. You can remove air bubbles in the eight hours after you apply the decal. Make a small hole in the decal film with a sharp pointed instrument, at the edge of bubble, and push air out through the hole.
- F. You can also install interior decals with the same procedure you use for pressure-sensitive placards. These are the tasks:
  - Pressure Sensitive Placard Removal, TASK 20-10-14-000-801,
  - Pressure Sensitive Placard Installation, TASK 20-10-14-400-801.

**TASK 20-10-11-000-802**

**2. Pressure-Sensitive Decal Removal**

(Figure 401)

**A. References**

Reference	Title
20-30-89-910-801	Final Cleaning of All Organic Coatings Prior to Non-structural Bonding (Series 89) (P/B 201)
51-21-11-150-801	Paint Stripping (P/B 701)

**B. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.



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<b>Reference</b>	<b>Description</b>
COM-2481	Tool - Sealant Removal, BAC5000, PSD 6-184 Approved Part #: 1-6390-A Supplier: 63318 Part #: 10810 Supplier: \$0855 Part #: 234350 Supplier: \$0857 Part #: 235072 Supplier: \$0857 Part #: 235073 Supplier: \$0857 Part #: 235074 Supplier: \$0857 Part #: 235075 Supplier: \$0857 Part #: 235076 Supplier: \$0857 Part #: 235077 Supplier: \$0857 Part #: 235078 Supplier: \$0857 Part #: 235079 Supplier: \$0857 Part #: 235080 Supplier: \$0857 Part #: 235081 Supplier: \$0857 Part #: 311 Supplier: KA861 Part #: 411B60 Supplier: 3DN12 Part #: 411B90 Supplier: 3DN12 Part #: DAD5013 Supplier: \$0856 Part #: DFD5019 Supplier: \$0856 Part #: J5-0275-2010 Supplier: 435R8 Part #: SCD5019 Supplier: \$0856 Part #: ST982LF-9 Supplier: 3Z323 Part #: TS1275-4 Supplier: 1DWR5
COM-2615	Light - Work Part #: EP215-16I-25 Supplier: 15664 Part #: EP326-16S-50 Supplier: 15664 Opt Part #: EP-300-026-50 Supplier: 15664
STD-3925	Heater - Blower, Explosion Proof, Electric

**C. Consumable Materials**

<b>Reference</b>	<b>Description</b>	<b>Specification</b>
B01009	Solvent - Final Cleaning Of All Organic Ctgs Before Non-Structural Bonding (AMM20-30-89/201) - Series 89	
G00034	Cotton Wiper - Process Cleaning Absorbent Wiper (Cheesecloth, Gauze)	BMS15-5 Class A

**D. Procedure**

**SUBTASK 20-10-11-020-001**

- (1) To remove external decals, do this task: Paint Stripping, TASK 51-21-11-150-801 on the decal.
  - (a) Be careful to protect adjacent structure and paint from the paint stripping material.

**SUBTASK 20-10-11-020-002**

**CAUTION:** THE TEMPERATURE OF THE SURFACE TO WHICH THE DECAL IS APPLIED MUST NOT BE MORE THAN 130°F.

- (2) To remove internal decals, use heat or solvent.
  - (a) To remove decals with heat, do these steps:
    - 1) Heat the decal with a explosion proof electric blower - heater, STD-3925 or a work light, COM-2615, to approximately 120°F until the adhesive becomes soft.  
**NOTE:** If you use too much heat, the decal will melt. If the decal melts, remove it with solvent.

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**CAUTION:** ONLY USE APPROVED SCRAPERS ON THE AIRPLANE SKIN.  
SCRAPERS THAT ARE NOT APPROVED CAN MAKE SCRATCHES ON  
THE SKIN, AND CAUSE FATIGUE CRACKS.

- 2) Lift the corner of the decal with a sealant removal tool, COM-2481.
  - 3) Remove the decal from the surface.
- (b) Remove decals with solvent:
- 1) Apply Series 89 solvent, B01009 (TASK 20-30-89-910-801) to the decal with a brush or cloth.
  - 2) When the decal has wrinkles (after approximately two minutes), apply solvent again.
  - 3) After approximately two minutes, move the soft decal off of the surface or remove with a spatula.
- (c) If necessary, clean the surface with a cotton wiper, G00034 that is moist with Series 89 solvent, B01009 (TASK 20-30-89-910-801).

———— END OF TASK ———

**TASK 20-10-11-400-801**

**3. Pressure-Sensitive Decal Installation**

(Figure 401)

**A. References**

Reference	Title
20-30-89-910-801	Final Cleaning of All Organic Coatings Prior to Non-structural Bonding (Series 89) (P/B 201)
51-21-00-100-801	Airplane Surface Preparation for Application of Finish (P/B 701)
51-21-31-350-801	Removal and Control of Corrosion for Aluminum and Aluminum Alloys (P/B 701)
51-31-00 P/B 201	SEALS AND SEALING - MAINTENANCE PRACTICES

**B. Tools/Equipment**

**NOTE:** When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

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<b>Reference</b>	<b>Description</b>
COM-2481	Tool - Sealant Removal, BAC5000, PSD 6-184 Approved Part #: 1-6390-A Supplier: 63318 Part #: 10810 Supplier: \$0855 Part #: 234350 Supplier: \$0857 Part #: 235072 Supplier: \$0857 Part #: 235073 Supplier: \$0857 Part #: 235074 Supplier: \$0857 Part #: 235075 Supplier: \$0857 Part #: 235076 Supplier: \$0857 Part #: 235077 Supplier: \$0857 Part #: 235078 Supplier: \$0857 Part #: 235079 Supplier: \$0857 Part #: 235080 Supplier: \$0857 Part #: 235081 Supplier: \$0857 Part #: 311 Supplier: KA861 Part #: 411B60 Supplier: 3DN12 Part #: 411B90 Supplier: 3DN12 Part #: DAD5013 Supplier: \$0856 Part #: DFD5019 Supplier: \$0856 Part #: J5-0275-2010 Supplier: 435R8 Part #: SCD5019 Supplier: \$0856 Part #: ST982LF-9 Supplier: 3Z323 Part #: TS1275-4 Supplier: 1DWR5

**C. Consumable Materials**

<b>Reference</b>	<b>Description</b>	<b>Specification</b>
B00083	Solvent - VM&P Naphthas	ASTM D-3735 Type III
B00130	Alcohol - Isopropyl	TT-I-735
B00137	Abrasive - Garnet Coated Paper	
B01009	Solvent - Final Cleaning Of All Organic Ctg's Before Non-Structural Bonding (AMM20-30-89/2011) - Series 89	
C00260	Coating - Chemical And Solvent Resistant Finish, Epoxy Resin Enamel	BMS10-11 Type II
C50020	Kit - Edge Seal With Activator (Desothane) - CA8000/B900B with CA8000B	BAC5312
G00034	Cotton Wiper - Process Cleaning Absorbent Wiper (Cheesecloth, Gauze)	BMS15-5 Class A
G00270	Tape - Scotch Flatback Masking 250	ASTM D6123 (Supersedes A-A-883)

**D. Prepare the Surfaces for Installation**

**SUBTASK 20-10-11-110-001**

- (1) To clean corroded aluminum surfaces, do this task: Removal and Control of Corrosion for Aluminum and Aluminum Alloys, TASK 51-21-31-350-801.

**SUBTASK 20-10-11-110-002**

- (2) Clean wax-coated aluminum surfaces until area shows a water-break-free surface, do this task: Airplane Surface Preparation for Application of Finish, TASK 51-21-00-100-801.



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SUBTASK 20-10-11-110-003

**WARNING:** DO NOT GET SOLVENTS IN YOUR MOUTH, YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE DANGEROUS MATERIALS. SOLVENTS CAN BE FLAMMABLE. OBEY THE MATERIAL SAFETY DATA SHEETS (MSDS) FOR SOLVENTS. OBEY LOCAL REGULATIONS FOR THE CORRECT PROCEDURES TO USE OR DISCARD SOLVENTS. SOLVENTS CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO EQUIPMENT.

- (3) Use solvent, B00083 or alcohol, B00130, cleaner and a cotton wiper, G00034, to clean polyester or phenolic plastics that are not painted.
  - (a) Dry surface with a cotton wiper, G00034.

NOTE: Do not let air dry.

SUBTASK 20-10-11-110-004

- (4) Lightly sand cork surfaces with abrasive, B00137, 150 grit, until you get a clean cork surface.

NOTE: The sanded surface must be 0.38 inches (0.97 cm) wider than the decal area.

- (a) Remove sanding dust with a cotton wiper, G00034.

SUBTASK 20-10-11-110-005

**WARNING:** DO NOT GET SOLVENTS IN YOUR MOUTH OR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE HAZARDOUS MATERIALS. SOLVENTS MAY BE FLAMMABLE OR HARMFUL TO THE ENVIRONMENT. REFER TO PRODUCT MATERIAL SAFETY DATA SHEETS (MSDS) AND LOCAL REQUIREMENTS FOR PROPER HANDLING PROCEDURES.

- (5) Clean all other surfaces thoroughly with solvent, B00083, and cotton wiper, G00034, except in preparation for application of the Refuel Panel Placard (BAC27NSF223) which requires the use of Series 89 solvent, B01009 (TASK 20-30-89-910-801), a clean dry cloth in place of solvent, B00083.

NOTE: Verify that no grease is present on the surface prior to the application of the Refuel Panel Placard.

- (a) Dry the surface with a cotton wiper, G00034.

NOTE: Do not let air dry.

## E. Prepare the Decal for Installation

SUBTASK 20-10-11-800-002

- (1) On decals with an area less than one square foot (0.093 meter<sup>2</sup>), remove the backing and put the decal face down on a smooth surface.

SUBTASK 20-10-11-420-001

- (2) On decals with an area more than one square foot (.093 meter<sup>2</sup>), use Scotch Flatback Masking Tape 250, G00270, to put the decal on the receiving surface.
  - (a) Cut a sheet of carrier tape approximately four inches (10 cm) longer than the decal and approximately the same width.

NOTE: When you use premasked decals, you can use the premask as a carrier.
  - (b) Put the carrier over the decal, with the edge you will hang two to three inches beyond the decal edge.
  - (c) Hang the carrier on the receiving surface with cotton wiper, G00034.



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- (d) Rub the carrier on with a sealant removal tool, COM-2481.  
NOTE: Use short strokes and work from the middle of the joint to the edges. Be sure to remove all wrinkles and air bubbles.
- (e) Fold the carrier and decal back at the joint, along the surface with the backing up.  
NOTE: Use masking tape to hold in this position.
- (f) Remove the decal backing.

SUBTASK 20-10-11-800-003

- (3) On strip decals, remove about one foot (30 cm) of backing and put the decal face down on a smooth surface.

## F. Procedure

SUBTASK 20-10-11-420-002

- (1) To apply decal to a smooth (nonbreak) surface, do these steps:
  - (a) Put the decals with areas less than one square foot (.093 meter <sup>2</sup>) in position and bond one edge to the surface.
    - 1) Hold the remainder of the decal taut and a small distance from the surface with a piece of backing on the adhesive side.
  - (b) For decals with an area greater than one square foot (.093 meter <sup>2</sup>), move the carrier into position.
    - 1) Hold the free end taut and a small distance from the surface with a piece of backing on the adhesive side.
  - (c) Align and bond approximately three inches (7.6 cm) of strip decals to the receiving surface.
    - 1) Use the applied section as a joint and strip up to three feet (91.4 cm) of the backing.
    - 2) If necessary, apply activator to the adhesive.
    - 3) Align the stripping and hold it taut and a small distance away from the receiving surface.
  - (d) Start at the joint and rub the decal on the surface with the sealant removal tool, COM-2481 with short fan-like strokes.  
NOTE: Do not let the adhesive touch the surface until the sealant removal tool, COM-2481 pushes it down.
  - (e) Continue to apply strip decals until you apply all of the decal.
  - (f) When you apply strip decals around a corner and a splice occurs, overlap decal a minimum of 0.5 inches (1.27 cm) and maximum of 2.0 inches (5.1 cm).

SUBTASK 20-10-11-420-003

- (2) To apply decals to a surface with a butt or overlap joint, do these steps:

**CAUTION:** DO NOT CAUSE DAMAGE TO THE AIRPLANE SKIN WHEN YOU CUT THE DECAL. NICKS, CUTS, SCRATCHES, OR SCRIBE LINES WILL DECREASE THE FATIGUE STRENGTH AND LIFE OF THE STRUCTURE.

- (a) If you damage the skin or sealant, obey all the specified steps, cautions and references to inspect and repair the sealant and skin (PAGEBLOCK 51-31-00/201) and the applicable structural repair manual.
- (b) To apply decals on a butt joint between two surfaces which move with respect to each other or butt joint, do one of these steps:

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- 1) For distances of 0.100 inch (2.54 mm) and more, cut the decal at the approximate center of the distance.
  - a) Fold the decal around the two edges (Figure 401).
- 2) For distances of less than 0.100 inch (2.54 mm), cut the decal aligned with the forward or top skin edge.
  - a) Fold the decal around the aft or bottom skin edge (Figure 401).
- (c) To apply decals across overlap joints, do one of these steps:
  - 1) Fold the decal smoothly and continuously around the edge of the overlap joint (Figure 401).  
NOTE: This is the recommended procedure.
  - 2) Cut the decal aligned with the overlap edge and touch the remainder of the decal to the overlap edge (Figure 401).  
NOTE: You can use this method when the decal extends along the overlap joint for a long distance.

**SUBTASK 20-10-11-420-005**

- (3) To apply decals over surfaces with raised or recessed rivets and fasteners, do these steps:

**CAUTION:** DO NOT CAUSE DAMAGE TO THE AIRPLANE SKIN WHEN YOU CUT THE DECAL. NICKS, CUTS, SCRATCHES, OR SCRIBE LINES WILL DECREASE THE FATIGUE STRENGTH AND LIFE OF THE STRUCTURE.

- (a) If you damage the skin or sealant, obey all the specified steps, cautions and references to inspect and repair the sealant and skin (PAGEBLOCK 51-31-00/201) and the applicable structural repair manual.
- (b) Use tool ST732 to cut decals, except pressure-sensitive Polyester, around the heads of fasteners or rivets.
- (c) Cut and remove an area of film, of pressure-sensitive polyester decals, and approximate the size of a nonflush rivet or fastener, with a Scotchcal cutter.
- (d) Push the decal firmly in position around the rivet or fastener.
- (e) Make a small hole in the decal film, with a sharp pointed instrument, at each rivet on decals applied over pressurized areas.

**SUBTASK 20-10-11-000-001**

- (4) To apply decals to external emergency exit handles, do these steps:
  - (a) Before you remove the backing paper, put the decal on the handle and cut the decal overlap around each rounded corner (Figure 401).
  - (b) Remove the backing paper and apply the decal. Push the overlap around the edges of the handle.

**SUBTASK 20-10-11-800-005**

- (5) To remove carrier, or premask and masking tape, pull back parallel to the decal surface.

NOTE: If you will paint the adjacent area, leave the premask in position.

**SUBTASK 20-10-11-390-002**

- (6) Seal the edges or overcoat.
  - (a) For edge seal, do these steps:
    - 1) If you painted up to the edges of decals, seal the edges of the decal with paint.



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**WARNING:** USE ONLY APPROVED TRANSPARENT MATERIALS ON THE ACRYLIC WINDOW PANES. PAINT, MATERIALS THAT ARE NOT TRANSPARENT, AND TRANSPARENT MATERIALS THAT ARE NOT APPROVED CAN PREVENT DETECTION OF DAMAGE. THESE MATERIALS CAN ALSO CAUSE DAMAGE TO THE STRUCTURE OF ACRYLIC WINDOWS. THIS CAN MAKE FLIGHT DANGEROUS.

- a) If the decal has a premask, remove the premask only after you apply the last layer of paint up to the decal.

**NOTE:** The paint will flow sufficiently well to seal the edges. If this condition does not occur, seal the edges by the recommended procedure.

- 2) Use a brush to apply CA8000/B900B with CA8000B kit, C50020 or clear base 683-3-2 with X-310A catalyst (edge sealer) to the edges of the decals that follow:

**NOTE:** Make sure you have a dry film thickness of 0.0015 in. (0.0381 mm) to 0.0020 in. (0.0508 mm).

- a) Solvent-activated vinyl decals
- b) BMS10-26, Type 1 and 3 pressure-sensitive elastomeric vinyl decals
- c) Solvent-activated reflective decals
- d) Pressure-sensitive reflective decals
- e) Pressure-sensitive aluminized, mylar decals

- 3) Seal the edges of pressure-sensitive polyester decals with clear base 683-3-2 and X-310A catalyst (edge sealer).

- 4) Use a brush to apply the applicable color of coating, C00260 enamel on all open exposed rivet or fastener heads on pressure-sensitive polyester decals.

**NOTE:** Make an overlap on the edge of the decal of 0.250 in. (6.350 mm).

- 5) Use a brush to apply RFE96J edge sealer to the edges of the reflective (fluorescent) vinyl decals.

**NOTE:** Make sure you have a dry film thickness of 0.0015 in. (0.0381 mm) to 0.0020 in. (0.0508 mm).

- (b) For overcoat, do this task:

**NOTE:** Some decals may not accept clearcoat due to the design and chemical composition of the decal face.

- 1) Use a brush to apply the clearcoat in a single layer on the full decal and extend a minimum of 0.05 inches overlap on the edge.
- 2) Let the clearcoat fully dry.

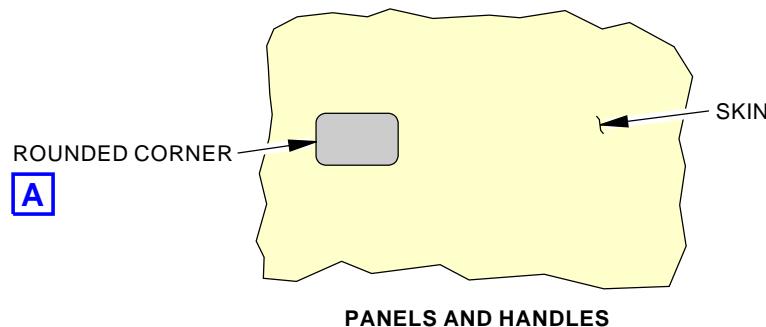
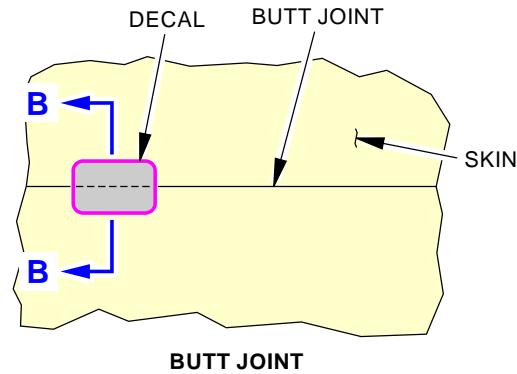
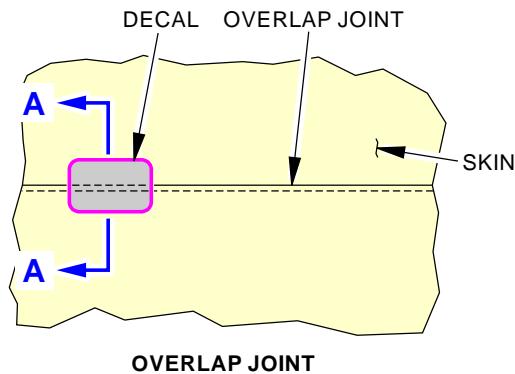
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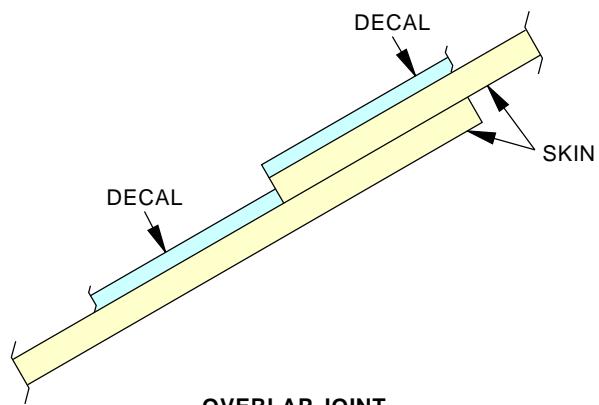
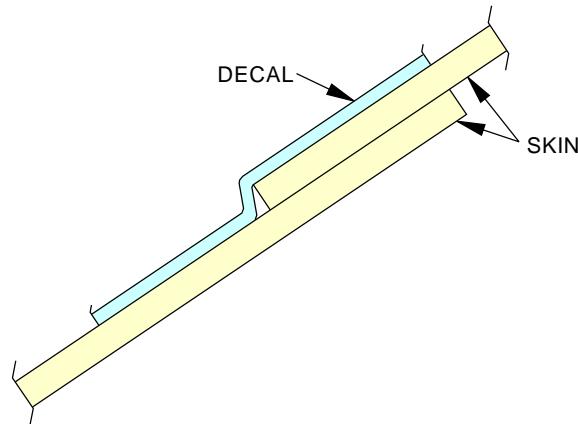
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EXAMPLES OF IRREGULAR SURFACES



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Decal Application Over Irregular Surfaces  
Figure 401/20-10-11-990-801 (Sheet 1 of 2)

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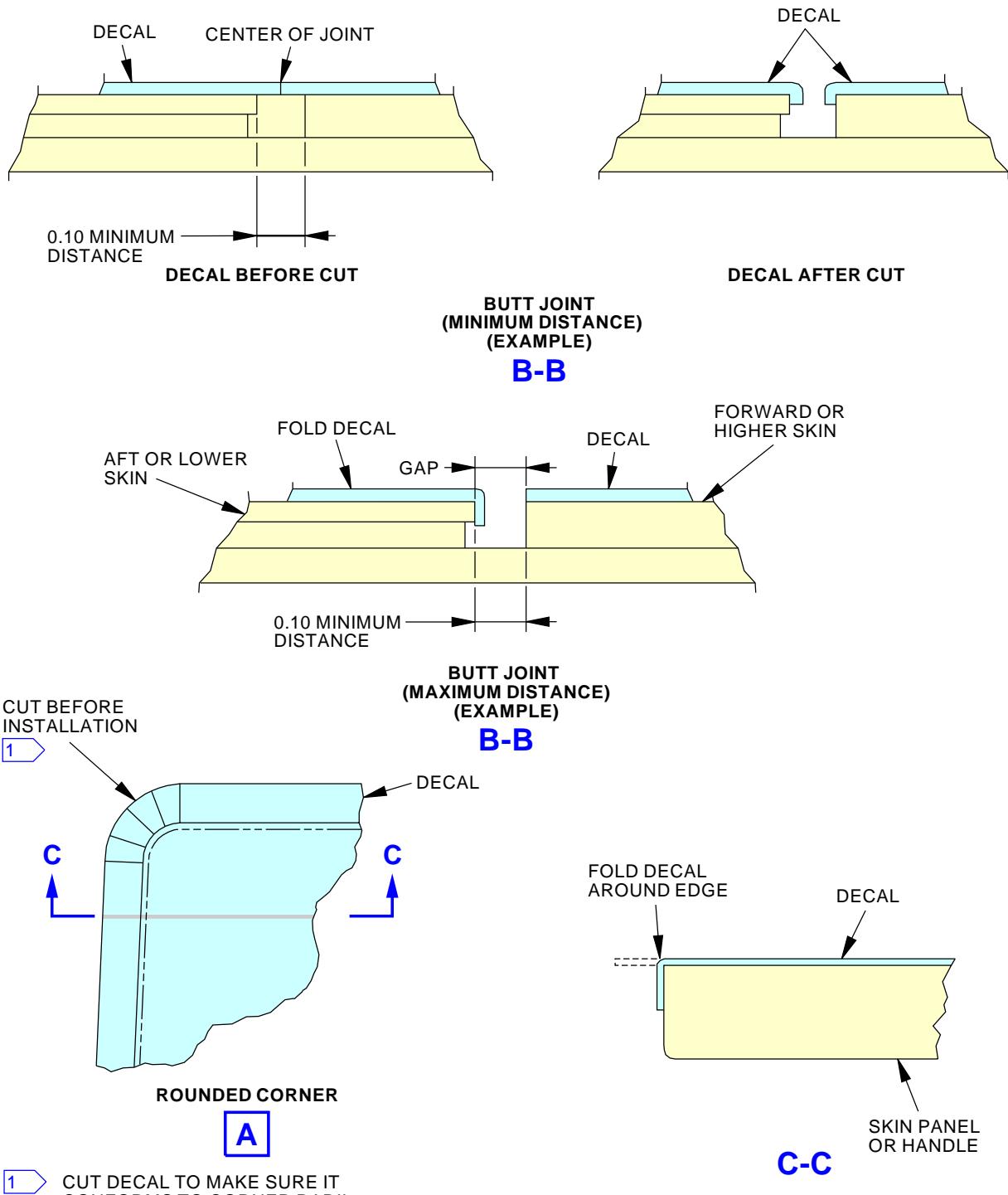
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**Decal Application Over Irregular Surfaces**  
**Figure 401/20-10-11-990-801 (Sheet 2 of 2)**

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PRESSURE-SENSITIVE DECALS - REPAIRS

**1. General**

- A. This procedure contains one task. The task is to repair external decals.
- B. To repair damaged external decals, apply patches of equivalent decals.

NOTE: Replace damaged internal decals.

**TASK 20-10-11-000-801**

**2. Repair External Pressure Sensitive Decals**

**A. References**

Reference	Title
51-31-00 P/B 201	SEALS AND SEALING - MAINTENANCE PRACTICES

**B. Procedure**

SUBTASK 20-10-11-020-003

- (1) Cut away all loose decal film but be careful not to cut the airplane skin.

SUBTASK 20-10-11-800-001

**CAUTION:** DO NOT CAUSE DAMAGE TO THE AIRPLANE SKIN WHEN YOU CUT THE DECAL. NICKS, CUTS, SCRATCHES, OR SCRIBE LINES WILL DECREASE THE FATIGUE STRENGTH AND LIFE OF THE STRUCTURE.

- (2) Cut a patch of decal film of the same type and color as the initial decal.

- (a) Make sure the patch is of sufficient size to make an overlap of 1/4 inch on the part of the decal that is not damaged.
    - 1) If you damage the skin or sealant, obey all the specified steps, cautions and references to inspect and repair the sealant and skin (SEALS AND SEALING - MAINTENANCE PRACTICES, PAGEBLOCK 51-31-00/201) and the applicable structural repair manual.

SUBTASK 20-10-11-420-004

- (3) Apply the patch.

SUBTASK 20-10-11-390-001

- (4) Seal all around the repair with the applicable edge sealer.

———— END OF TASK ————

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PRESSURE SENSITIVE PLACARDS - REMOVAL/INSTALLATION

**1. General**

- A. This procedure has these tasks:
  - (1) A removal of the pressure sensitive placards.
  - (2) An installation of the pressure sensitive placards.
- B. Vinyl placards are prepared on a material that will not easily follow the contour of rough or textured surfaces. The placard will touch only the high spots and have a poor bond. Use an adhesive with vinyl placards to get a smooth surface and a firm bond for the placard. Foil markers are made on a soft metal that, when applied, will have the contour of the surface and make a good bond. If the surface is textured, you can apply adhesive to get a smoother surface and more satisfactory installation of foil markers.

**TASK 20-10-14-000-801**

**2. Pressure Sensitive Placard Removal**

**A. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-2481	Tool - Sealant Removal, BAC5000, PSD 6-184 Approved Part #: 1-6390-A Supplier: 63318 Part #: 10810 Supplier: \$0855 Part #: 234350 Supplier: \$0857 Part #: 235072 Supplier: \$0857 Part #: 235073 Supplier: \$0857 Part #: 235074 Supplier: \$0857 Part #: 235075 Supplier: \$0857 Part #: 235076 Supplier: \$0857 Part #: 235077 Supplier: \$0857 Part #: 235078 Supplier: \$0857 Part #: 235079 Supplier: \$0857 Part #: 235080 Supplier: \$0857 Part #: 235081 Supplier: \$0857 Part #: 311 Supplier: KA861 Part #: 411B60 Supplier: 3DN12 Part #: 411B90 Supplier: 3DN12 Part #: DAD5013 Supplier: \$0856 Part #: DFD5019 Supplier: \$0856 Part #: J5-0275-2010 Supplier: 435R8 Part #: SCD5019 Supplier: \$0856 Part #: ST982LF-9 Supplier: 3Z323 Part #: TS1275-4 Supplier: 1DWR5

**B. Consumable Materials**

Reference	Description	Specification
B00083	Solvent - VM&P Naphthas	ASTM D-3735 Type III
B00130	Alcohol - Isopropyl	TT-I-735
B00143	Solvent - Trichlorotrifluoroethane (Freon)	MIL-C-81302



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C. Removal

SUBTASK 20-10-14-210-001

- (1) Do a check of the placard to see if it is sufficiently bonded.

NOTE: If the placard is bonded firmly and the new placard is the same size, you can install the new placard over the used placard.

SUBTASK 20-10-14-020-001

**CAUTION:** ONLY USE APPROVED SCRAPERS ON THE AIRPLANE SKIN. SCRAPERS THAT ARE NOT APPROVED CAN MAKE SCRATCHES ON THE SKIN, AND CAUSE FATIGUE CRACKS.

- (2) Lift the corner of the placard with a sealant removal tool, COM-2481.

SUBTASK 20-10-14-110-001

- (3) Remove remaining adhesive film with solvent, B00143, solvent, B00083, or alcohol, B00130.

————— END OF TASK ————

**TASK 20-10-14-400-801**

3. Pressure Sensitive Placard Installation

A. Consumable Materials

Reference	Description	Specification
A00016	Adhesive - Pressure Sensitive Film For Interior Non-Structural Bonding	BMS5-91
A00119	Adhesive - Synthetic Rubber Cement, Naphtha Soluble	BMS5-55
B00083	Solvent - VM&P Naphthas	ASTM D-3735 Type III
B00130	Alcohol - Isopropyl	TT-I-735
B00137	Abrasive - Garnet Coated Paper	
B00143	Solvent - Trichlorotrifluoroethane (Freon)	MIL-C-81302
G00034	Cotton Wiper - Process Cleaning Absorbent Wiper (Cheesecloth, Gauze)	BMS15-5 Class A
G00270	Tape - Scotch Flatback Masking 250	ASTM D6123 (Supersedes A-A-883)

B. Prepare for the Installation

SUBTASK 20-10-14-800-001

- (1) If the placard uses adhesive, A00016, no special placard preparation is necessary.

SUBTASK 20-10-14-840-001

- (2) If the placard has no backing adhesive, prepare placard as follows:
- Make the rear surface of the placard rough with abrasive, B00137.
  - Clean the placard with solvent, B00083.
  - Remove the release paper from one side of the adhesive, A00016.
  - Apply the adhesive, A00016 to the rear of placard.
  - Cut the unwanted adhesive, A00016.
  - Laminate the adhesive, A00016 to the placard with one of these steps:
    - Roll placard on hot roll laminator heated to 140°F (60°C).



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- 2) Heat the placard to not more than 140°F (60°C) with a dry air blast or other applicable source and rub release paper with cotton wiper, G00034.

**NOTE:** Heat makes the bond between the adhesive and the release paper soft. Be careful not to move the release paper.

**C. Installation**

SUBTASK 20-10-14-110-002

- (1) Clean the surface with solvent, B00143, alcohol, B00130, or solvent, B00083.

SUBTASK 20-10-14-800-002

- (2) Dry fully.

SUBTASK 20-10-14-420-001

- (3) Install the placard.

**NOTE:** You can install the new placard immediately if you did not remove the old placard. If you removed the old placard, do the steps that follow.

**CAUTION:** MAKE SURE THE MASKED AREA IS IN THE CORRECT POSITION. YOU CAN REMOVE DRY ADHESIVE WITH NAPHTHA CLEANER. IF YOU TRY TO REMOVE CURED ADHESIVE, YOU WILL CAUSE DAMAGE TO THE SURFACE.

- (a) Mask an area approximately 1/16 inch smaller than the placard with masking tape or attach a mask of necessary size.
- (b) Use a brush to apply adhesive, A00119 to the prime contact area.
- (c) Let the adhesive dry fully (approximately 15 minutes).
- (d) Remove the Scotch Flatback Masking Tape 250, G00270 or mask.
- (e) Remove the release paper from the placard.
- (f) Apply the placard to the center of the surface, but be careful to prevent air pockets.
- (g) Rub the placard with firm hand pressure and a cheesecloth pad.
- (h) If the primed surface shows around the placard, remove unwanted adhesive with solvent, B00083.

———— END OF TASK ————



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RECESSED BOSS SEAL FITTINGS - REMOVAL/INSTALLATION

**1. General**

- A. This procedure has these tasks:
- (1) Removal of adapter fittings and positioning fittings (boss fittings).
  - (2) Installation of adapter (straight) fittings.
  - (3) Installation of the positioning (elbow) fittings.

**TASK 20-10-15-000-801**

**2. Boss Fitting Removal**

**A. Procedure**

SUBTASK 20-10-15-020-002

- (1) Loosen the jamnut.

SUBTASK 20-10-15-020-003

- (2) Disconnect the hose or tube, from the fitting as applicable.

SUBTASK 20-10-15-020-001

- (3) Remove the fitting from the boss.

———— END OF TASK ————

**TASK 20-10-15-400-801**

**3. Adapter (Straight) Fitting Installation**

**A. References**

Reference	Title
20-50-11-910-801	Standard Torque Values (P/B 201)

**B. Procedure**

SUBTASK 20-10-15-640-001

- (1) Lubricate a new O-ring and backup ring and install them in the fitting groove.

SUBTASK 20-10-15-420-004

- (2) Lubricate a new O-ring and put it in the groove under the nut hex.

SUBTASK 20-10-15-420-001

**CAUTION:** IF YOU DO NOT INSTALL THE BACK-UP RING CORRECTLY, YOU CAN CAUSE DAMAGE TO EQUIPMENT.

- (3) Install the fitting into the boss and tighten to the correct torque for the size of the fitting, (TASK 20-50-11-910-801).

———— END OF TASK ————

**TASK 20-10-15-400-802**

**4. Positioning (Elbow Type) Fitting Installation**

**A. References**

Reference	Title
20-50-11-910-801	Standard Torque Values (P/B 201)

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**B. Procedure**

SUBTASK 20-10-15-420-005

- (1) Install the jamnut on the fitting and turn it to the stop.

SUBTASK 20-10-15-640-002

- (2) Lubricate a new O-ring and install it in the groove between the two sets of threads.

SUBTASK 20-10-15-420-006

- (3) Lubricate a new O-ring and backup ring with the applicable system lubricant and install them in the fitting groove.

SUBTASK 20-10-15-420-002

**CAUTION:** INSTALL THE BACK-UP RING CORRECTLY. IF YOU DO NOT INSTALL THE BACK-UP RING CORRECTLY, YOU CAN CAUSE DAMAGE TO EQUIPMENT.

- (4) Install the fitting into the boss until it touches bottom, then loosen until the fitting aligns with the hose or tube (one turn maximum).

SUBTASK 20-10-15-420-003

- (5) Hold the fitting stable and tighten the jamnut to the correct torque for the size of the fitting, (TASK 20-50-11-910-801).

SUBTASK 20-10-15-420-007

- (6) Connect the hose or tube, to the fitting and tighten according to (TASK 20-50-11-910-801).

———— END OF TASK ————

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O-RINGS - REMOVAL/INSTALLATION

**1. General**

- A. This procedure has these tasks:
  - (1) A removal of O-Rings.
  - (2) An installation of O-Rings.
- B. You may install O-Rings over sharp edges. Sharp edges include threaded fasteners, keyways, slots, splines, and ports.

**TASK 20-10-17-000-801**

**2. O-Rings Removal**

(Figure 401)

**A. Removal**

SUBTASK 20-10-17-210-001

- (1) Examine the old O-rings for cuts, abrasions, deformities, and surface defects.

SUBTASK 20-10-17-020-001

- (2) Remove the used O-Rings with an appropriate hook or tool.
  - (a) Be careful not to scratch the groove or adjacent surfaces.

SUBTASK 20-10-17-020-002

- (3) Cut the used O-ring and discard.

———— END OF TASK ————

**TASK 20-10-17-400-801**

**3. O-Rings Installation**

(Figure 401)

(Table 401)

**A. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
SPL-1575	Kit - O-Ring Tool, Installation
	Part #: SP-0786 Supplier: 62209
	Part #: ST848 Supplier: 81205
	Part #: ST848R Supplier: 81205
	Opt Part #: PSAT-KIT Supplier: 1V757

**B. Procedure**

SUBTASK 20-10-17-800-001

- (1) Use one of the installation tools ((Table 401)) in the O-ring toolkit, SPL-1575:

**Table 401/20-10-17-993-802 Installation tools**

TOOL NO.	TUBE OR HOSE FITTING SIZE
ST848 -187	1/16
-250	1/4

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Table 401/20-10-17-993-802 Installation tools (Continued)

TOOL NO.	TUBE OR HOSE FITTING SIZE
-312	5/16
-375	3/8
-500	1/2
-625	5/8
-750	3/4
-1000	1
-1250	1-1/4
-1500	1-1/2
-1750	1-3/4

SUBTASK 20-10-17-640-001

**CAUTION:** REPLACE USED O-RINGS WITH NEW O-RINGS. USED O-RINGS CAN CAUSE LEAKAGE.

- (2) Lubricate the O-ring with a thin layer of the fluid used with the component or system.

SUBTASK 20-10-17-420-003

**CAUTION:** DO NOT MAKE THE ELASTOMERIC O-RING INNER DIAMETERS LARGER BY MORE THAN 50% DURING INSTALLATION. DO NOT MAKE THE TEFLON AND PLASTIC O-RING INNER DIAMETERS LARGER BY MORE THAN 5% DURING INSTALLATION. FAILURE CAN OCCUR.

- (3) Put the thimble over the fitting.

SUBTASK 20-10-17-420-001

- (4) Put the O-ring on the thimble.

SUBTASK 20-10-17-420-002

- (5) Move the expanding body over the thimble and against the O-ring, then push the O-ring into the groove.

SUBTASK 20-10-17-020-003

- (6) Use the extracting rod to remove the expanding body from the thimble.

SUBTASK 20-10-17-020-004

- (7) Remove the thimble.

SUBTASK 20-10-17-210-002

**CAUTION:** DO NOT PINCH THE O-RINGS. MAKE SURE ATTACHED BOLTS ARE CORRECTLY TIGHTENED. FAILURE CAN OCCUR.

- (8) Examine the O-ring for twists and pinches caused by installation.

- (a) Make sure you align the O-ring with no twists before you close the gland.

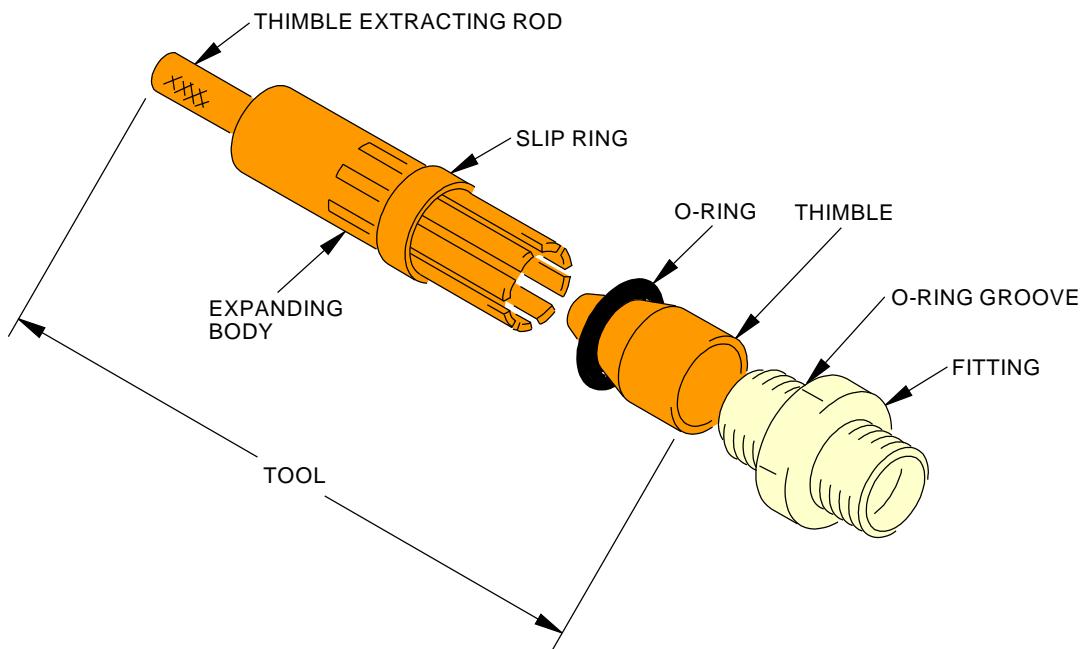
— END OF TASK —

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O-Ring Installation  
Figure 401/20-10-17-990-801

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Hydraulic Caps and Plugs - Maintenance Practices

1. General

- A. This task gives maintenance practices for hydraulic fitting caps and plugs.

**TASK 20-10-20-800-801**

2. Cap and Plug Hydraulic Fittings

A. General

- (1) This procedure lists the recommended caps and plugs for hydraulic fittings on tube ends and components.
- (2) Caps and plugs are used on the ports and disconnected hydraulic lines to prevent leakage and contamination.

B. Procedure

SUBTASK 20-10-20-860-001

**WARNING:** USE ONLY THE SPECIFIED CAPS OR PLUGS. OTHER CAPS AND PLUGS CAN CAUSE INJURIES TO PERSONNEL, AND DAMAGE TO EQUIPMENT.

- (1) Determine the applicable cap or plug (Table 201).

**NOTE:** Do not use protective metal or plastic caps or plugs for system pressure testing. Use protective caps or plugs before and after test as needed, to prevent system contamination.

**Table 201/20-10-20-993-801 Recommended Caps and Plugs**

CAPS/PLUGS	TUBE SIZE	FLARELESS/ SHORT FLARELESS	PART NUMBER
PLUG	20, 24	SHORT FLARELESS	AS4662
CAP, FITTING ASSEMBLY	20, 24	SHORT FLARELESS	AS4694
PLUG	02 thru 32	FLARELESS	MS21913
CAP ASSEMBLY	04 thru 24	FLARELESS	BACC14AD <sup>*[1]*[2]</sup>
PLUG	02 thru 12	FLARELESS	BACP20AU
PLUG	02 thru 32	FLARELESS	AS5169

\*[1] BACC14AD( )(NO CODE) (NO CODE) is inactive for design and procurement. Use AS5233V( )P as a CLASS V supersession. Carbon steel parts are prone to corrosion.

\*[2] BACC14AD( )D(NO CODE) is inactive for design and procurement. Use AS5233W( ) as a CLASS II supersession.

- (2) Install the applicable cap or plug on tube ends and components.

———— END OF TASK ————

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ALUMINUM FOIL MARKERS - REMOVAL/INSTALLATION

**1. General**

- A. This procedure has these tasks:
  - (1) A removal of aluminum foil markers.
  - (2) An installation of aluminum foil markers.
- B. Replace aluminum foil markers that have creases, damaged edges, or words you cannot read.
- C. Replace aluminum foil markers that are not satisfactorily bonded to external primed or painted surfaces.
- D. Replace aluminum foil markers that are not satisfactorily bonded to internal primed or painted surfaces.
- E. Remove and replace aluminum foil markers that are not satisfactorily bonded to bare metal surfaces.

NOTE: For aluminum foil markers that you install on textured surfaces or that do not bond satisfactorily, you can use the procedure for pressure sensitive placards. This gives a better installation (TASK 20-10-14-400-801).

- F. Do not install a new aluminum foil marker on a used aluminum foil marker. Remove the used aluminum foil marker and install the new aluminum foil marker.

**TASK 20-10-21-000-801**

**2. Aluminum Foil Markers Removal**

**A. References**

Reference	Title
20-30-88-910-801	Final Cleaning of Metal Prior to Non-structural Bonding (Series 88) (P/B 201)

**B. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-12342	Scrapers, BAC5000, PSD 6-184 Approved
	Part #: 234350 Supplier: \$0857
	Part #: 311 Supplier: KA861
	Part #: 411B60 Supplier: 3DN12
	Part #: J5-0275-2010 Supplier: 435R8
	Part #: TS1275-4 Supplier: 1DWR5

**C. Consumable Materials**

Reference	Description	Specification
B00344	Solvent - Xylene, Nitration Grade	ASTM D843
B01008	Solvent - Final Cleaning Of Metal Prior To Non-Structural Bonding (AMM 20-30-88/201) - Series 88	
G00034	Cotton Wiper - Process Cleaning Absorbent Wiper (Cheesecloth, Gauze)	BMS15-5 Class A



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D. Procedure

SUBTASK 20-10-21-020-001

- (1) Put scraper, COM-12342, or equivalent object, under the edge of the placard and remove the marker from the adhesive area.

SUBTASK 20-10-21-110-001

- (2) On primed, painted, or plastic interior surfaces, use solvent, B00344, to remove all adhesive from surfaces and markers.

SUBTASK 20-10-21-110-002

**WARNING:** DO NOT GET SOLVENTS IN YOUR MOUTH, OR YOUR EYES, OR YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE HAZARDOUS MATERIALS. SOLVENTS MAY BE FLAMMABLE OR HARMFUL TO THE ENVIRONMENT. REFER TO PRODUCT MATERIAL SAFETY DATA SHEETS (MSDS) AND LOCAL REQUIREMENTS FOR PROPER HANDLING PROCEDURES.

- (3) On metal surfaces, use a cotton wiper, G00034 that is wet with Series 88 solvent, B01008 (TASK 20-30-88-910-801) to remove all adhesive from surfaces and markers.

————— END OF TASK ————

**TASK 20-10-21-400-801**

3. Aluminum Foil Markers Installation

A. Consumable Materials

Reference	Description	Specification
A00119	Adhesive - Synthetic Rubber Cement, Naphtha Soluble	BMS5-55
A00134	Adhesive - Synthetic Rubber, Buna-N, 1 Part, Fuel Resistant	BMS5-14
A00253	Adhesive - Room Temperature Curing Two Part Epoxy	BMS5-109 Type II Class 2
B00046	Acid - Corrosion Removing, Metal Conditioning, Phosphoric	MIL-C-10578
B00083	Solvent - VM&P Naphthas	ASTM D-3735 Type III
B00137	Abrasive - Garnet Coated Paper	
B00148	Solvent - Methyl Ethyl Ketone (MEK)	ASTM D740
B00344	Solvent - Xylene, Nitration Grade	ASTM D843
C00012	Coating - Akzo Nobel Clear Polyurethane Topcoat, 683-3-2 Base with X-310A Catalyst (Akzo Nobel Aerospace Coatings)	
G00034	Cotton Wiper - Process Cleaning Absorbent Wiper (Cheesecloth, Gauze)	BMS15-5 Class A

B. Prepare for installation

SUBTASK 20-10-21-020-002

- (1) Do not install a new aluminum foil marker on a used aluminum foil marker.

SUBTASK 20-10-21-080-001

- (2) Remove the used foil marker, clean the surface and then install the new foil marker.



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SUBTASK 20-10-21-820-001

- (3) If it is necessary, use an electric typewriter with pica type set at the highest impression level to add data to the placard.

SUBTASK 20-10-21-820-002

- (4) Make sure all typed data is clear with letters that do not cut through the aluminum foil marker.

SUBTASK 20-10-21-800-001

- (5) If it is necessary, cut the aluminum foil marker to the necessary dimension before you remove the protective backing.

SUBTASK 20-10-21-100-001

- (6) Clean the surface to apply the aluminum foil marker.

- (a) To clean aluminum surfaces, do these steps:

- 1) Clean aluminum surfaces that have corrosion with a wire brush.

**WARNING:** DO NOT GET SOLVENTS IN YOUR MOUTH, OR YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE HAZARDOUS MATERIALS. SOLVENTS MAY BE FLAMMABLE OR HARMFUL TO THE ENVIRONMENT. REFER TO PRODUCT MATERIAL SAFETY DATA SHEETS (MSDS) AND LOCAL REQUIREMENTS FOR PROPER HANDLING PROCEDURES.

- 2) Clean surfaces that have grease with solvent, B00083.

- 3) Apply a solution of one-fourth phosphoric acid and three-fourths water, by volume, with a brush, rag, or sponge to the surface.

- 4) Let the acid, B00046, stay on the metal approximately 1/2 minute.

- 5) Rub the surface with a damp cotton wiper, G00034, and then with a dry cotton wiper, G00034, until the surface is dry and free of corrosion.

- (b) Use solvent, B00344, xylene to clean polyester, epoxy, phenolic or polyurethane surfaces that are not painted.

- (c) To clean aluminized paint (EC-843) coated surfaces, do these steps:

- 1) Sand with abrasive, B00137.

- 2) Clean with solvent, B00083.

- (d) To clean cork surfaces, do these steps:

- 1) Lightly sand with abrasive, B00137, until you get a clean cork surface.

- 2) Rub the surface with a clean cotton wiper, G00034, to remove any dust.

- (e) Clean all other surfaces with solvent, B00083.

SUBTASK 20-10-21-800-002

- (7) On cadmium-plated surfaces, laminated not painted polyester materials, laminated not painted phenolic materials, and rough surfaces that are not painted, do these steps:

- (a) Apply a light layer of adhesive, A00134, to the cleaned surface.

- (b) Let the adhesive dry for 5 to 20 minutes. The adhesive must be tacky but will not bond to a clean finger when lightly touched.

SUBTASK 20-10-21-800-003

- (8) Do these steps on primed or painted rough interior surfaces:

**NOTE:** Do not use this procedure on external surfaces open to the weather.

- (a) Apply a light layer of adhesive, A00119, to the cleaned surface.

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- (b) Let the adhesive dry for 5 to 20 minutes. The adhesive must be tacky but will not bond to a clean finger when lightly touched.

**C. Install the Aluminum Foil Marker**

SUBTASK 20-10-21-480-001

- (1) Use supports for surfaces of thin panels during the installation of markers.

SUBTASK 20-10-21-420-006

- (2) Do not use an aluminum foil marker that is not flat or is damaged.

SUBTASK 20-10-21-840-001

- (3) Do not touch or contaminate the adhesive on the aluminum foil marker after you remove the protective backing.

SUBTASK 20-10-21-840-002

- (4) Make sure the aluminum foil marker and the open surface are free of moisture.

SUBTASK 20-10-21-840-003

- (5) During the installation of a large or complicated aluminum foil marker, keep a small section of backing attached.

NOTE: A small section of backing will help you to touch and move the aluminum foil marker.

SUBTASK 20-10-21-420-001

- (6) To install a cellophane-backed aluminum foil marker, do these steps:

- (a) Put the aluminum foil marker in water (50 to 120°F) (10 to 48.9°C) for approximately 30 to 120 seconds.
- (b) Remove the aluminum foil marker from the water and remove unwanted water with a clean, cotton wiper, G00034.
- (c) With dry hands, move a finger across the edge of the aluminum foil marker and move back the cellophane.
- (d) Carefully remove the backing from the aluminum foil marker.

SUBTASK 20-10-21-420-002

- (7) To install a paper-backed aluminum foil marker, do these steps:

- (a) Remove the paper backing from the aluminum foil marker, but be careful not to touch the adhesive coating.
  - 1) Where the paper backing has a cut, bend the paper backing lightly along the cut line. Hold the backing and move it slowly away from the aluminum foil marker to prevent damage to the marker.
  - 2) Where the paper backing does not have a cut, move a finger across the edge of the aluminum foil marker to move back one edge of the paper backing.

NOTE: The backing can also have a tab which will help to remove the backing.

SUBTASK 20-10-21-420-003

- (8) To install aluminum foil markers without self-contained adhesive, do these steps:

- (a) On primed, painted, or plastic interior airplane surfaces that are not open to the weather, do these steps:
  - 1) Apply a light layer of adhesive, A00119, to the rear of the aluminum foil marker.
  - 2) Let the adhesive dry until it is tacky but will not bond to a clean finger when lightly touched.
- (b) On bare metal surfaces, do these steps:

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- 1) Apply a light layer of adhesive, A00134, to the rear of the aluminum foil marker.
- 2) Let the adhesive dry until it is tacky but will not bond to a clean finger when lightly touched.

SUBTASK 20-10-21-420-004

- (9) Put the aluminum foil marker in the correct position and push down to attach it.

SUBTASK 20-10-21-420-005

- (10) Use a roller and start at one end of the marker and roll the marker into position. Be careful to prevent air bubbles. To prevent roll marks, do not let the edge of the roller touch the aluminum foil marker.

SUBTASK 20-10-21-800-004

- (11) To remove air bubbles, make a small hole with a pin and make a smooth surface with a roller.

SUBTASK 20-10-21-110-003

**WARNING:** DO NOT GET SOLVENT IN YOUR MOUTH OR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENT. PUT ON A PROTECTIVE SPLASH GOGGLE AND GLOVES WHEN YOU USE SOLVENT. KEEP SOLVENT AWAY FROM SPARKS, FLAME, AND HEAT. SOLVENTS CAN BE POISONOUS AND FLAMMABLE WHICH CAN CAUSE INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT.

- (12) If it is necessary, remove unwanted adhesive. Use solvent, B00148 for adhesive, A00134 or solvent, B00083 for adhesive, A00119.

SUBTASK 20-10-21-020-003

- (13) To remove the protective paper facing, strip it parallel to the surface of the aluminum foil marker.

SUBTASK 20-10-21-210-001

- (14) Make sure there is a good bond on the edge of the aluminum foil marker.

NOTE: Be careful not to lift the edge.

SUBTASK 20-10-21-390-001

- (15) For protection of markers from fuel, hydraulic fluid, or outdoor weather do the following

- (a) Seal the marker edges or put an overcoat on the markers by brush or spray with adhesive, A00253 or Akzo Nobel 683-3-2 coating, C00012.

———— END OF TASK ————



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LUBRICATION FITTINGS - SERVICING

**1. General**

- A. This procedure contains this task.
  - (1) A temporary lubrication for blown-out lubrication fittings.

**TASK 20-10-24-600-801**

**2. Temporary Lubrication for Blown Out Lubrication Fittings**

**A. General**

- (1) This task contains temporary lubrication instructions for lubrication fittings that were blown out.
- (2) This procedure is only to be used in the event that a grease fitting has been blown out and the maintenance to repair the fitting is inconvenient, but lubrication is necessary to continue service.
  - (a) This procedure is only a temporary and should only be used until the fitting can be conveniently repaired or replaced.

**B. References**

Reference	Title
20-30-21-910-801	Lubricants (P/B 201)

**C. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-7616	Adapter - Rubber Tipped Part #: LX-1418 Supplier: \$1273 Opt Part #: B411 Supplier: OFKM1
STD-438	Gun - Grease

**D. Procedure**

SUBTASK 20-10-24-010-001

- (1) Gain access to the blown-out lubrication fitting(s).

SUBTASK 20-10-24-940-001

- (2) Using the applicable grease gun, STD-438 and the proper grease for the location, attach the rubber tipped adapter, COM-7616 to the grease gun, STD-438.
  - (a) Refer to Lubricants, TASK 20-30-21-910-801 for a list of appropriate lubricants for the area.

SUBTASK 20-10-24-940-002

- (3) Press the rubber tipped adapter, COM-7616 firmly against the opening where the lubrication fitting was blown out.

SUBTASK 20-10-24-640-001

- (4) Gently pump the grease into the fitting opening, making sure that the rubber tipped adapter, COM-7616 remains firmly seated against the opening.

SUBTASK 20-10-24-140-001

- (5) Clean up any excess grease.



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SUBTASK 20-10-24-410-001

- (6) Close any panels opened for access.

SUBTASK 20-10-24-840-003

- (7) Return the aircraft to normal.

———— END OF TASK ————

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LUBRICATION FITTINGS - REMOVAL/INSTALLATION

**1. General**

- A. This procedure has these tasks:
  - (1) A removal of the lubrication fitting.
  - (2) An installation of the lubrication fitting.
- B. This procedure contains the installation instructions for a lubrication fitting (press-in type). Refer to the repair instructions in the Component Maintenance Manual for lubrication fittings on landing gear components.

**TASK 20-10-24-000-801**

**2. Lubrication Fitting Removal**

(Figure 401)

**A. Procedure**

SUBTASK 20-10-24-020-001

- (1) Remove damaged or broken lubrication fittings.

SUBTASK 20-10-24-160-001

- (2) Clean the area before installing a new fitting.

———— END OF TASK ————

**TASK 20-10-24-420-801**

**3. Lubrication Fitting Installation**

(Figure 401)

**A. General**

- (1) This task contains instructions for the installation of new lubrication fittings and lubrication fittings that were blown out.

**B. References**

Reference	Title
20-30-89-910-801	Final Cleaning of All Organic Coatings Prior to Non-structural Bonding (Series 89) (P/B 201)

**C. Consumable Materials**

Reference	Description	Specification
A00026	Compound - Sealing, Locking And Retaining, Single Component	ASTM D5363
A50086	Primer - Loctite 7471 Primer T Activator	ASTM D5363 (Supersedes MIL-S-22473)
B01009	Solvent - Final Cleaning Of All Organic Ctgs Before Non-Structural Bonding (AMM20-30-89/201) - Series 89	
G00018	Nitrogen - Gaseous, Pressurizing, 99.5 Percent Pure	A-A-59503 Type I Grade B, MIL-PRF-27401 Type I Grade A
G01659	Swab - Cotton Or Rayon, (Disposable)	

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**D. Procedure**

SUBTASK 20-10-24-840-001

- (1) Get an applicable standard fitting to install in the hole.

SUBTASK 20-10-24-160-002

**CAUTION:** BE CAREFUL NOT TO CONTAMINATE THE BEARING, JOINT OR ITEM THAT IS LUBRICATED THROUGH THE FITTING HOLE. DAMAGE TO EQUIPMENT MAY OCCUR.

- (2) Do these steps to clean the lubrication fitting hole:

- (a) Use swab, G01659 to remove as much grease as possible from the inner surface of the lubrication fitting hole.
- (b) Clean the hole to a depth of at least 0.5 in. (12.7 mm) with Series 89 solvent, B01009 (TASK 20-30-89-910-801) on a clean cotton swab.
- (c) Clean the hole until you can see no more grease or dirt removed from the hole.

SUBTASK 20-10-24-420-001

**CAUTION:** MAKE SURE YOU USE THE CORRECT TOOL TO INSTALL THE LUBRICATION FITTING. MOVE THE FITTING IN A STRAIGHT LINE TO PREVENT DAMAGE TO THE MATING PART.

- (3) Use a drive tool to install the lubrication fitting.

**E. Procedure For Blown-Out Fittings**

SUBTASK 20-10-24-840-002

- (1) Get a special approved or an oversized fitting to install in the hole.

SUBTASK 20-10-24-160-003

- (2) Do these steps to clean the lubrication fitting hole:

- (a) Use swab, G01659 to remove as much grease as possible from the inner surface of the lubrication fitting hole.

**CAUTION:** BE CAREFUL NOT TO CONTAMINATE THE BEARING, JOINT OR ITEM THAT IS LUBRICATED THROUGH THE FITTING HOLE. DAMAGE TO EQUIPMENT MAY OCCUR.

- (b) Clean the hole to a depth of at least 0.5 in. (12.7 mm) with Series 89 solvent, B01009 (TASK 20-30-89-910-801) with a clean swab, G01659.

- (c) Clean the hole until you can see no more grease or dirt removed from the hole.

SUBTASK 20-10-24-390-001

- (3) Do these steps to apply the primer Loctite 7471 Primer T Activator, A50086 and compound, A00026:

- (a) Use swab, G01659 to apply a thin layer of Loctite 7471 Primer T Activator, A50086 to the inner diameter of the hole.

- 1) Apply the primer to a maximum depth of 0.4 in. (10.2 mm).

- (b) Let the primer air dry at approximately 70°F (21°C) for at least five minutes before you apply the retainer compound, A00026.

- 1) Apply the retainer compound to a depth of 0.25 in. (6.35 mm) to 0.40 in. (10.16 mm)

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SUBTASK 20-10-24-420-002

**CAUTION:** DO NOT APPLY TOO MUCH COMPOUND ON THE FITTING AND THE PART IT CONNECTS TO. TOO MUCH COMPOUND ON THE FITTING WILL CAUSE A BLOCKAGE TO THE LUBRICATION PASSAGES AND CAUSE DAMAGE TO EQUIPMENT.

- (4) Do these steps to install the lubrication fitting:

- (a) Use swab, G01659 to apply a thin layer of adhesive to the inner diameter of the hole (between 0.25 in. (6.35 mm) and 0.40 in. (10.16 mm) in depth).
- (b) Put the lubrication fitting into nitrogen, G00018 for at least one minute to make sure the fitting is fully cool.

**CAUTION:** MAKE SURE YOU USE THE CORRECT TOOL TO INSTALL THE LUBRICATION FITTING. MOVE THE FITTING IN A STRAIGHT LINE TO PREVENT DAMAGE TO THE MATING PART.

- (c) Use a drive tool to install the lubrication fitting.

**NOTE:** Install the lubrication fitting into the hole in the mating part immediately. If you do not install the fitting immediately it will become too warm.

- (d) Let the lubrication fitting cure for 24 hours at approximately 70°F (21°C) before you use it.

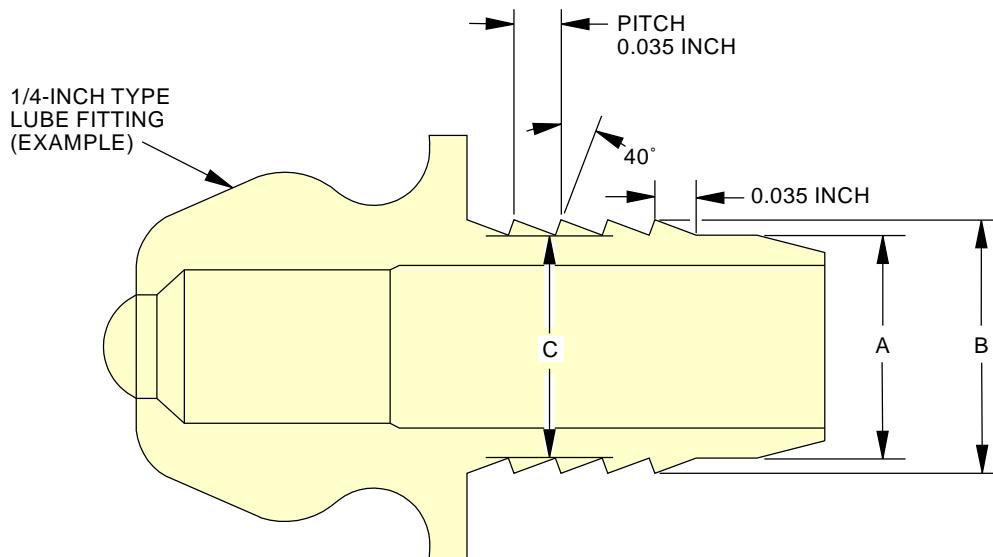
———— END OF TASK ————

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LUBE HOLE DIA (X) (INCHES)	LUBE FITTING DIA (INCHES)
0.194 MAX	3/16 <span style="border: 1px solid blue; padding: 0 2px;">1</span>
0.195-0.247	1/4 MODIFIED <span style="border: 1px solid blue; padding: 0 2px;">1</span>
0.248-0.249	1/4 <span style="border: 1px solid blue; padding: 0 2px;">2</span>
0.250-0.254	1/4 <span style="border: 1px solid blue; padding: 0 2px;">1</span>

NOTE: DESIGN LUBE HOLE DIA IS 0.188/0.189 INCH.

ALL DIMENSIONS ARE IN INCHES  
X (NOT SHOWN) = HOLE DIA IN MATING COMPONENT  
A = SHANK DIA (X MINUS 0.007/0.012)  
B = SERRATION OD (X PLUS 0.005/0.010)  
C = SERRATION ROOT OD (X MINUS 0.003/0.010)

1 INSTALL WITH ADHESIVE

2 INSTALLATION WITH ADHESIVE OPTIONAL

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**Lubrication Fitting Modification and Installation**  
**Figure 401/20-10-24-990-801**

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RIG PINS - MAINTENANCE PRACTICES

**1. General**

- A. This procedure has one task:
- (1) Rig pin maintenance practices.

**TASK 20-10-25-910-801**

**2. Rig Pin Maintenance Practices**

**A. General**

- (1) This procedure gives a list of rig pin sets with a list of the rig pins contained in each set.
- (2) The list gives:
  - (a) Rig pin number.
  - (b) Rig pin part number (P/N).
  - (c) ATA location.

**B. Procedure**

SUBTASK 20-10-25-480-001

- (1) Use the correct rig pin for the application.

**Table 201/20-10-25-993-801**

F70207 Assembly Number	AMM Rig Pin Prefix	ATA No.
-4	ST-4	27-41-51
-7	A/S-1, E-4, LGE1, NS4, LGP2	27-11-00, 27-61-00, 27-31-00, 32-51-00, 32-31-00, 32-44-00
-8	R-5	27-21-00, 27-81-00
-9	A/S-4, A/S-15, E-1, E-5, LGEA1, LGEA2, LGEA3, MNGEA	27-11-00, 27-61-00, 27-31-00, 27-41-51, 32-34-00, 32-35-00
-10	A/S-14	27-61-00
-14	R-1, R-2, LGB1, LGB2, LGP1	27-21-00, 32-41-00, 32-44-00
-66	E-2, E-3	27-31-00
-85	S/B-1, S/B-3, NS2, NS5, NS10	27-62-00, 32-51-00
-88	A/S-3, NS1, LGB3, LGB4	27-11-00, 27-61-00, 27-51-22, 32-51-00, 32-41-00
-101	S/B-2	27-61-00, 27-62-00
-113	A/S-8, A/S-9, A/S-10, A/S-11	27-51-14, 27-61-00
-115	R-3, R-4	27-21-00, 32-51-00
-117	A/S-1A	27-11-00, 27-61-00

— END OF TASK —

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CAPTIVE SCREWS - REMOVAL/INSTALLATION

**1. General**

- A. This procedure has these tasks:
- (1) A removal of captive screws.
  - (2) An installation of captive screws.

**TASK 20-10-26-000-801**

**2. Captive Screws Removal**

**A. General**

- (1) This task includes the steps to remove the captive screws.

**B. Tools/Equipment**

**NOTE:** When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
SPL-14272	Adapter - Removal Part #: RNC7913-10 Supplier: 17446
SPL-14273	Sleeve - Removal Part #: T2136SL-10 Supplier: 17446

**C. Captive Screw Removal**

**SUBTASK 20-10-26-000-001**

- (1) Removal adapter component part numbers are in accordance with Table 401.

**Table 401/20-10-26-993-801**

RECOMMENDED SUPPLIER	REMOVAL ADAPTOR	REMOVAL SLEEVE	SPACE WASHER (IF REQUIRED)
HUCK INTERNATIONAL DEUTSCH OPERATIONS	adapter, SPL-14272	sleeve, SPL-14273	T1319SP-100-XXX <sup>[1]</sup>

\*[1] XXX specifies thickness in increments of 0.063 in. (1.600 mm)..

- (2) Measure distance A with screw fully retracted. See Figure 401 (Sheet 1).
- (3) Engage threaded portion of the Removal Adapter to Hand Tool Puller.
- (4) Set dimension B from top of the adaptor to correspond with distance A. Use a 3/32 inch Hex key, turn clockwise to increase B dimension as required. See Figure 402 (Sheet 1). Screw Removal Adaptor onto Hand Tool.
- (5) Engage Removal Sleeve to the stud of the fastener to be removed and thread it all the way except for one thread while maintaining fully retracted position on screw. See Figure 403 (Sheet 1).
- (6) Place Removal Tool slot around the head of screw to be removed. Inner stud slot shall push against the head. See Figure 404 (Sheet 1).
- (7) Squeeze handle of the Hand Tool fully to unflare captive screw sleeve by pulling sleeve out of the hole. See Figure 405 (Sheet 1).

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- (8) For extra long screws to be removed where distance A exceeds 0.600 in. (15.240 mm), Spacer Washer shall be used and placed under the tool. Washer is available in thickness of 1/16 inch increments. See Figure 406 (Sheet 1).

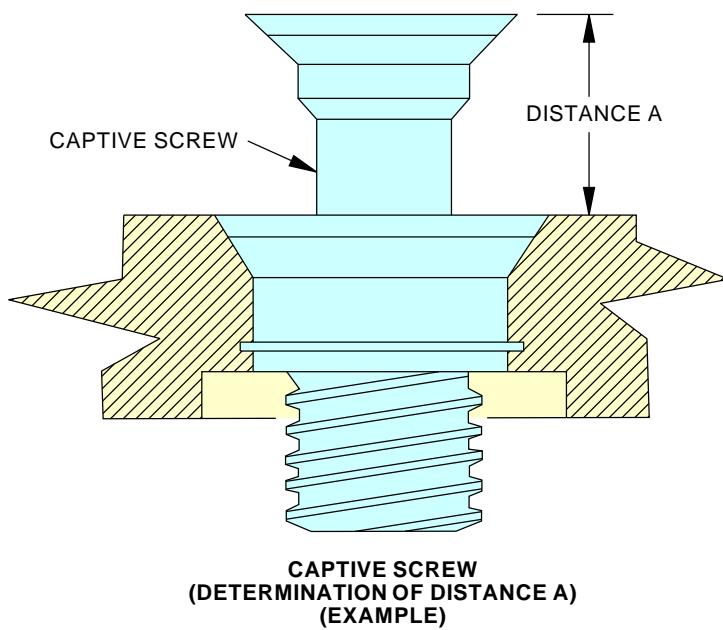
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**Captive Screw Installation**  
**Figure 401/20-10-26-990-801**

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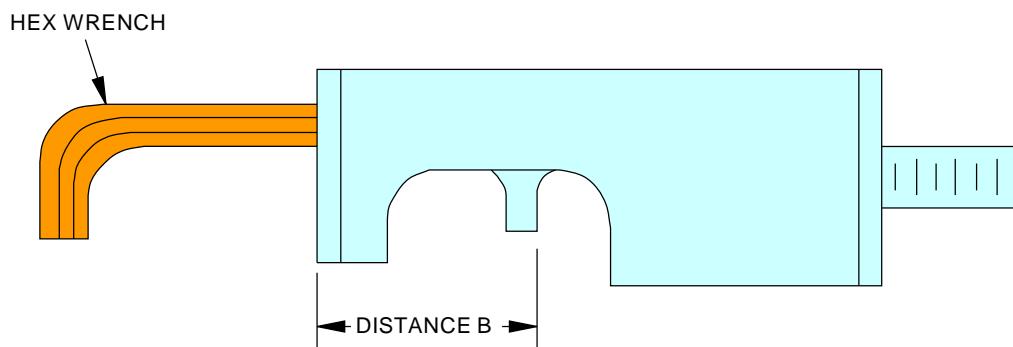
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**Flush Head Removal Adaptor**  
**Figure 402/20-10-26-990-802**

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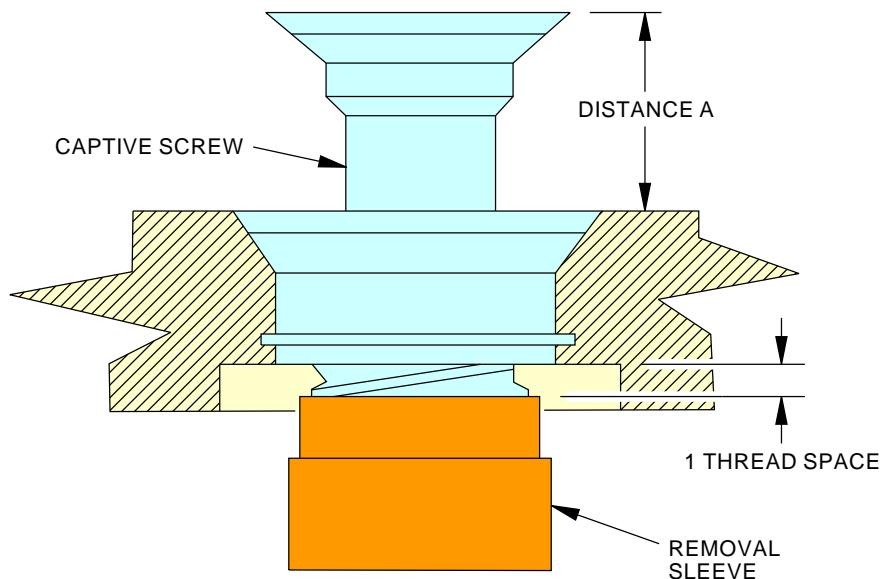
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**Removal Sleeve Engagement**  
**Figure 403/20-10-26-990-803**

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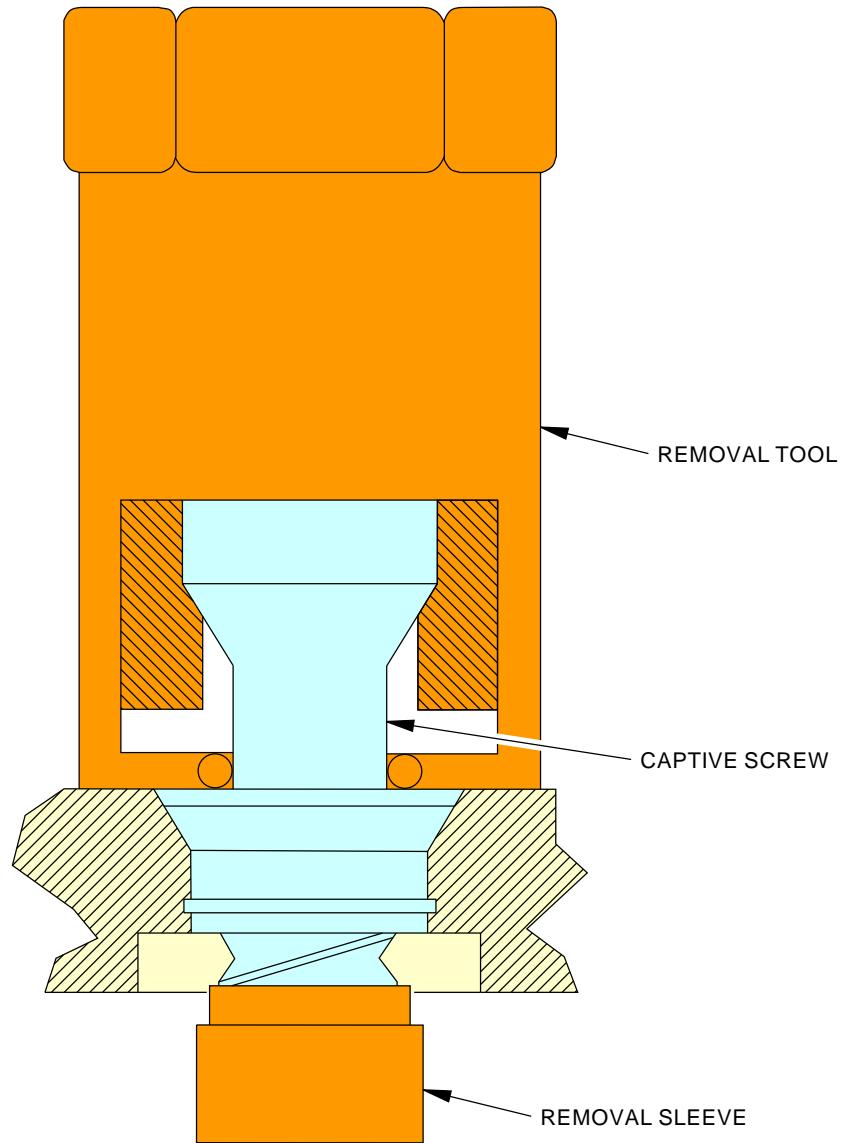
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**Remove Tool Installation**  
**Figure 404/20-10-26-990-804**

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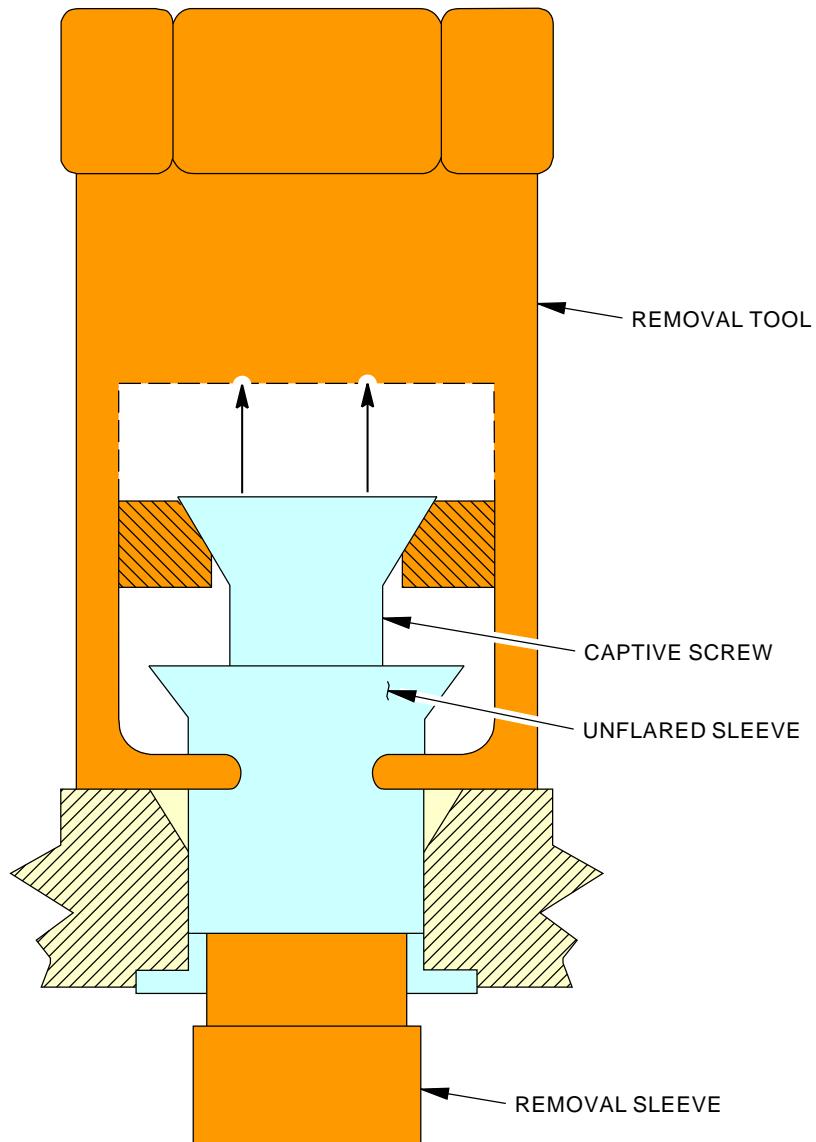
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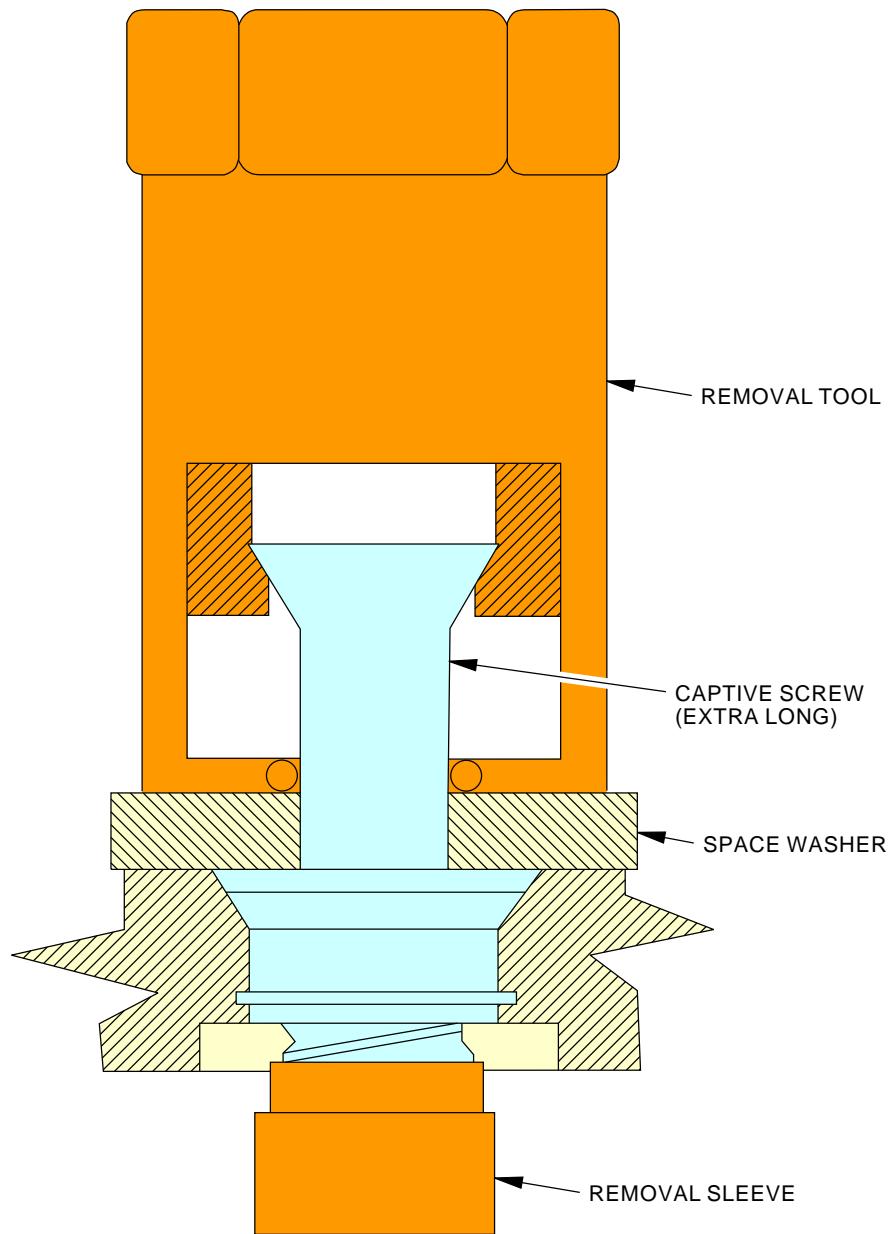
Unflaring Sleeve  
Figure 405/20-10-26-990-805

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**Removal of Extra Long Screws**  
**Figure 406/20-10-26-990-806**

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**TASK 20-10-26-400-801**

**3. Captive Screws Installation**

**A. General**

- (1) This task includes the steps to install the Captive Screws.

**B. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

<b>Reference</b>	<b>Description</b>
SPL-14274	Assembly - Hand Tool Part #: H8603 Supplier: 17446
SPL-14275	Nose Piece Part #: HN7513-10 Supplier: 17446
SPL-14276	Assembly - Handle Part #: TA7533 Supplier: 17446
SPL-14277	Puller Part #: HP7523-10 Supplier: 17446
SPL-14278	Air Hydraulic Tool Part #: DTP3000 Supplier: 17446
SPL-14279	Spline Driver Part #: T3098DR Supplier: 17446
SPL-14280	Adapter Part #: T3151AD Supplier: 17446
SPL-14281	Thrust Washer Part #: T3134WA-1 Supplier: 17446
SPL-14282	Puller Part #: HP7523-10F Supplier: 17446

**C. Captive Screws Installation**

**SUBTASK 20-10-26-400-001**

- (1) Recommended installation tooling is in accordance with Table 402.

**Table 402/20-10-26-993-802**

<b>RECOMMENDED SUPPLIER</b>	<b>THREAD SIZE CODE</b>	<b>NOMINAL THREAD DIA.</b>	<b>HAND TOOL ASSEMBLY</b>	<b>AIR HYDRAULIC TOOL</b>
HUCK INTERNATIONAL DEUTSCH OPERATIONS	10	0.190-32UNF-3A	hand tool, SPL-14274	Air Hydraulic Tool, SPL-14278

- (2) Hand Installation.

- (a) Hand Tool is in accordance with Figure 407 (Sheet 1).  
(b) Recommended components part numbers for the hand tool are in accordance with Table 403.

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**Table 403/20-10-26-993-803**

RECOMMENDED SUPPLIER	HAND TOOL ASSEMBLY	NOSE PIECE	PULLER	HANDLE ASSEMBLY
HUCK INTERNATIONAL DEUTSCH OPERATIONS	hand tool, SPL-14274	nose piece, SPL-14275	puller, SPL-14277	handle assembly, SPL-14276

- (c) Place screw assembly into prepared hole in panel.
  - (d) Engage the nose piece of the hand tool to the threaded end of the captive screw (screw shall be engaged in tool as far as possible until the end of the sleeve makes contact with the flaring surface of the nose piece).
  - (e) Squeeze handles of tool together to flare sleeve, excessive force is not required.
  - (f) Remove tool from fastener by unscrewing.
  - (g) Should flare require additional tightening, repeat procedure, exerting additional squeezing force.
- (3) Air Hydraulic Installation
- (a) Air Hydraulic tool is in accordance with Figure 408 (Sheet 1).
    - 1) Lubricated shop air should be used.
    - 2) Air supply requirements: 90 psi (621 kPa) to 100 psi (689 kPa).
  - (b) Components for the Air Hydraulic tool are shown in Table 404 and Figure 409 (Sheet 1).

**Table 404/20-10-26-993-804**

RECOMMENDED SUPPLIER	SPLINE DRIVER	ADAPTER	THRUST WASHER	PULLER	NOSE PIECE
HUCK INTERNATIONAL DEUTSCH OPERATIONS	spline driver, SPL-14279	adapter, SPL-14280	thrust washer, SPL-14281	puller, SPL-14282	nose piece, SPL-14275

- 1) To replace puller do these steps:
  - a) Disconnect tool from air supply.
  - b) Unscrew lock ring and remove air motor assembly.
  - c) Remove nose piece from cylinder.
  - d) Slide puller assembly towards rear of cylinder for access to set screw holding spine driver in position.
- (c) Select grip thickness in accordance with Table 405.

**Table 405/20-10-26-993-805**

GRIP CODE	TOP PANEL GRIP THICKNESS
A	0.075 in. (1.90 mm) to 0.089 in. (2.26 mm)
B	0.090 in. (2.29 mm) to 0.125 in. (3.18 mm)
C	0.126 in. (3.20 mm) to 0.187 in. (4.75 mm)
D	0.188 in. (4.78 mm) to 0.250 in. (6.35 mm)
E	0.251 in. (6.38 mm) to 0.312 in. (7.92 mm)
F	0.313 in. (7.95 mm) to 0.375 in. (9.52 mm)
G	0.376 in. (9.55 mm) to 0.437 in. (11.10 mm)

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**Table 405/20-10-26-993-805 (Continued)**

GRIP CODE	TOP PANEL GRIP THICKNESS
H	0.438 in. (11.13 mm) to 0.500 in. (12.70 mm)
J	0.501 in. (12.73 mm) to 0.562 in. (14.27 mm)
M	0.563 in. (14.30 mm) to 0.625 in. (15.88 mm)

- (d) Insert captive screw assembly through prepared hole in panel.
- (e) Adjust pressure regulator to 40 psi (276 kPa) to 50 psi (345 kPa) for size -10 ( dia.) steel collars.
- (f) Hold fastener from head side with appropriate driver to prevent rotation.
- (g) With air motor direction knob set to forward direction (knob to right as looking from rear of tool) place nose piece against threaded end of fastener and activate motor trigger (on pistol grip) to engage puller threads.
- (h) Depress Hydraulic booster activation button (lower button on pistol grip) to move nose piece forward, flaring skirted portion of fastener sleeve. Release button when flared portion of sleeve is seated against the panel.
- (i) Change air motor direction knob to reverse position (knob to left when looking from rear of tool) and press motor trigger to disengage puller threads from fastener.

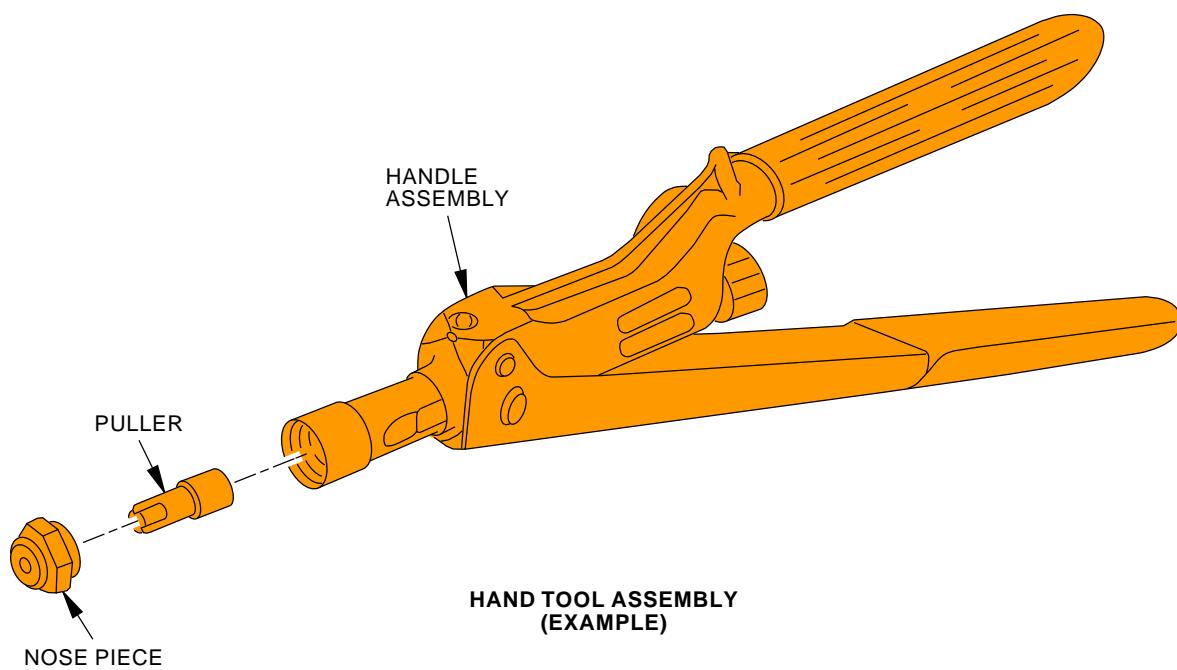
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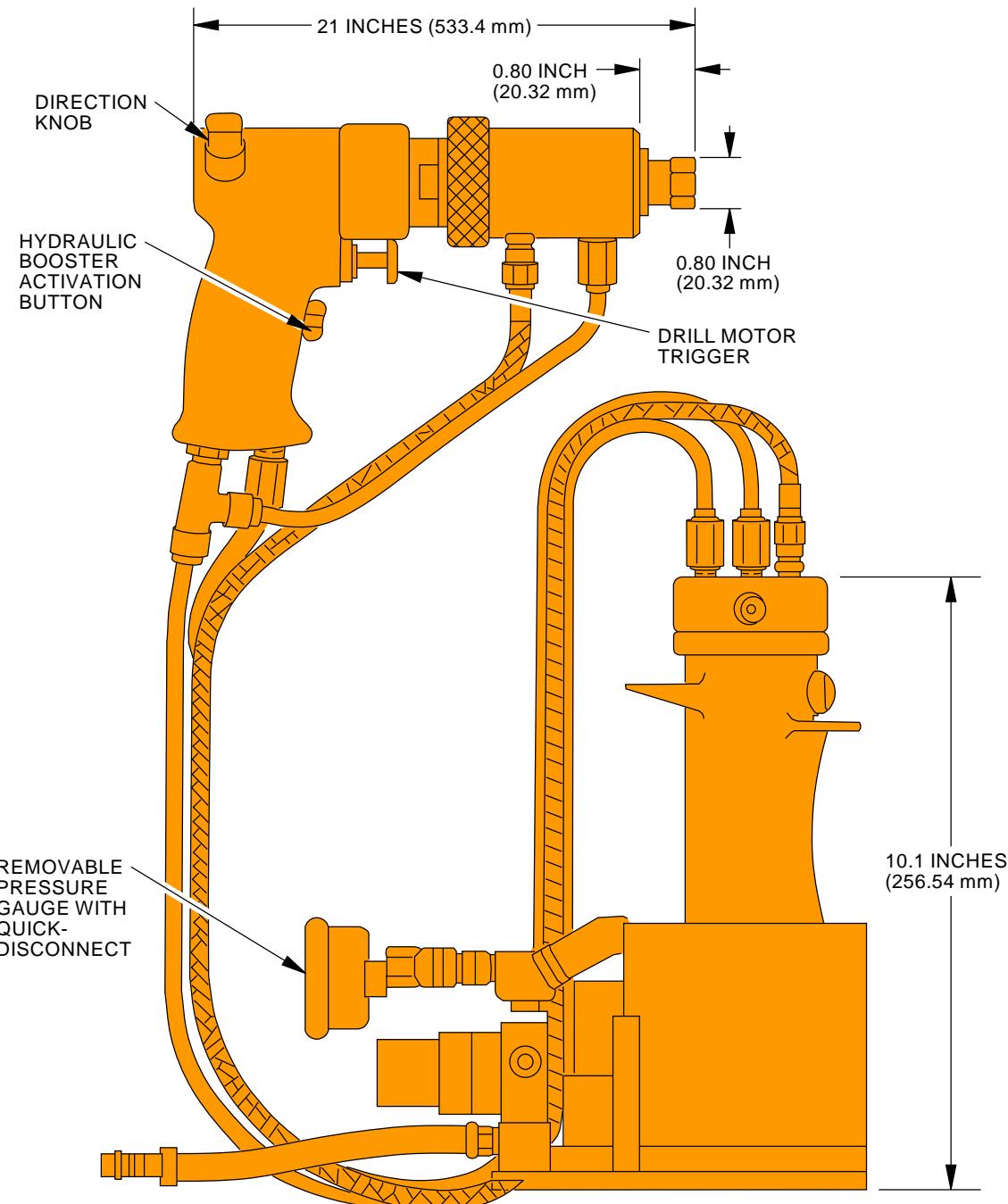
Hand Tool  
Figure 407/20-10-26-990-807

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Air Hydraulic Tool P/N DTP3000  
Figure 408/20-10-26-990-808

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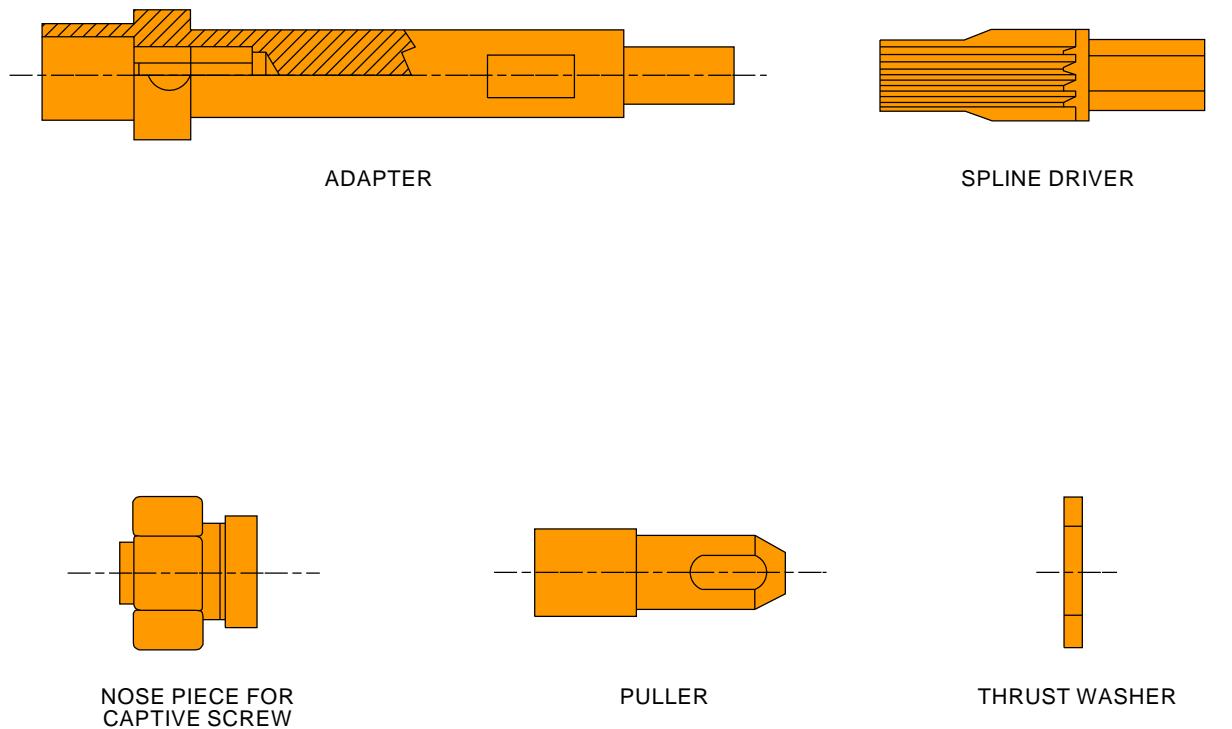
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**Puller Assembly Components**  
**Figure 409/20-10-26-990-809**

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HEAT DEVICES - MAINTENANCE PRACTICES

**1. General**

- A. This procedure contains one task:  
(1) Precautions for Heat Devices.

**TASK 20-10-27-910-801**

**2. Precautions for Heat Devices**

**A. General**

- (1) This procedure has the minimum recommended safety procedures for the operation of heat guns, soldering guns, soldering irons, and other heat devices.  
(2) You must also obey the regulations of your airline and local agencies.  
(3) In this procedure heat guns, soldering guns, and soldering irons are referred to as heat devices.  
(4) We recommend you use crimped splices and (1) sleeves with nylon ties or (2) heat shrinkable covering in areas that could have flammable fumes.

**B. Tools/Equipment**

Reference	Description
STD-4057	Combustible Gas Indicator - Explosion Proof Gastech Model 1314 Super Surveyor

**C. Precautions**

SUBTASK 20-10-27-880-001

**WARNING:** DO NOT USE HEAT DEVICES NEAR FLAMMABLE FLUIDS OR FUMES. HEAT OR SPARKS FROM HEAT DEVICES CAN CAUSE EXPLOSIONS AND FIRES.

- (1) Use heat devices only in safe areas.  
(a) Do not use heat devices in areas that are less than 100 feet (31 meters) from the airplane if these conditions are present:  
    1) Airplane fueling  
    2) Airplane defueling  
    3) The fuel tanks are open.  
(b) Do not use heat devices in areas where smoking is not permitted.

**D. How to Measure Fume Levels**

SUBTASK 20-10-27-750-001

**WARNING:** DO NOT USE HEAT DEVICES UNLESS AN AREA HAS NO FUMES. A FUME LEVEL OF ZERO IS THE ONLY SAFE LEVEL. HEAT OR SPARKS FROM HEAT DEVICES CAN CAUSE EXPLOSIONS AND FIRES.

- (1) Measure the fumes:  
(a) Use the gas indicator, STD-4057 to measure the fume level.  
**NOTE:** The following conditions can occur.  
    1) A liquid fuel or fume source is near.  
    2) The local fuel fume levels are high or the ventilation is not sufficient.  
(b) Make sure the fuel fume levels are at zero.

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- (c) Continue to monitor the fume levels during the repair
- (d) Keep a good flow of air in the fuel tanks

NOTE: You can make the fuel tanks safer with nitrogen inert equipment installed to maintain the fuel system oxygen content at 10% or less by volume.

**E. How to Keep the Area Safe**

SUBTASK 20-10-27-800-001

- (1) If it is possible for other persons to move flammable fluids into the area, obey these steps:
  - (a) Do not use a possible ignition source near open fuel tanks, fuel vents, or fuel leaks where fume concentrations cannot be known or controlled.
  - (b) Make sure a person monitors the work area.

NOTE: A person who can measure the risk of the repair to be done must identify the emergency or fire fighting equipment necessary at the work area of the repair. The person must be authorized to monitor airplane fire safety.
  - (c) Do not start or continue to do work on a fuel system component while equipment that can cause the fuel to burn is near.
  - (d) Keep the number of maintenance and safety persons included to a minimum.

———— END OF TASK ————

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TEFLON BACKUP RINGS - REMOVAL/INSTALLATION

**1. General**

- A. This procedure has these tasks:
- (1) A removal of teflon backup rings, MS28783.
  - (2) An installation of teflon backup rings.

**TASK 20-10-31-000-801**

**2. Teflon Backup Rings Removal**

(Figure 401)

**A. Procedure**

SUBTASK 20-10-31-020-001

- (1) If you see a broken teflon ring, remove it.
  - (a) Use an appropriate hook or tool.
  - (b) Use care not to scratch the groove or the adjacent surfaces.

———— END OF TASK ————

**TASK 20-10-31-400-801**

**3. Teflon Backup Rings Installation**

(Figure 401)

**A. Procedure**

SUBTASK 20-10-31-420-001

- (1) Install split-teflon backup rings, MS28783, with the direction of the spiral clockwise.
  - (a) Make sure the scarfed ends face as shown in (Figure 401).

———— END OF TASK ————

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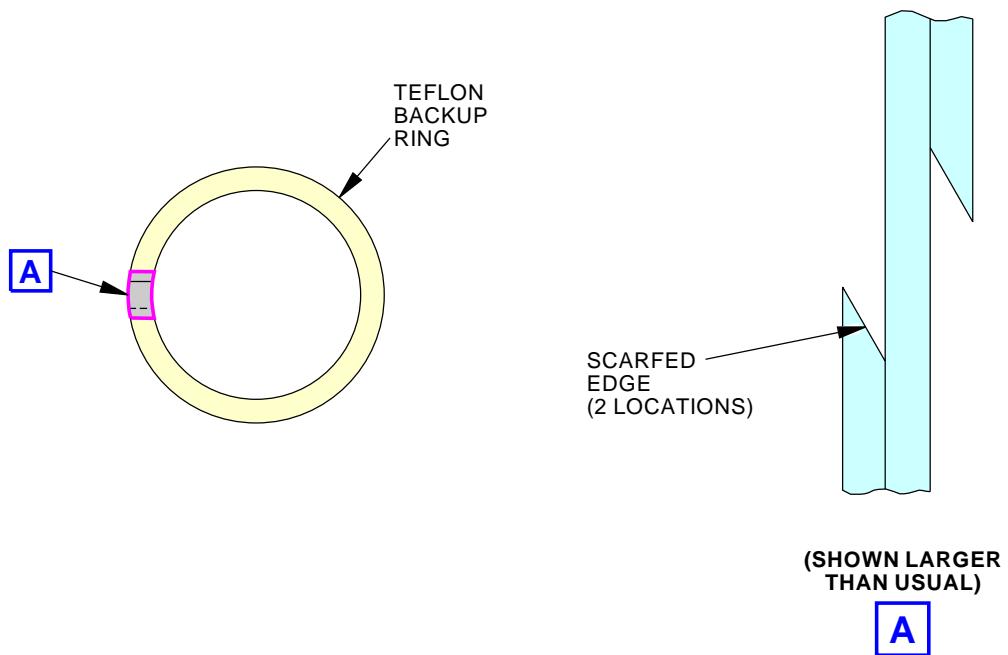
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**Teflon Backup Ring Installation**  
**Figure 401/20-10-31-990-801**

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POWER DEVICE CARTRIDGE - REMOVAL/INSTALLATION

**1. General**

- A. This procedure contains two tasks.
  - (1) The first task is the removal of cartridge.
  - (2) The second task is the installation of cartridge.

**TASK 20-10-33-000-801**

**2. Power Device Cartridge (Squib) Removal**

**A. References**

Reference	Title
20-40-11-910-801	Static Grounding (P/B 201)
24-22-00-860-812	Remove Electrical Power (P/B 201)

**B. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-1565	Strap - Adjustable Wrist, Conductive, Static Control <ul style="list-style-type: none"><li>Part #: 09070 Supplier: 62576</li><li>Part #: 14810 Supplier: 62576</li><li>Part #: 2214 Supplier: 55203</li><li>Opt Part #: 2211 Supplier: 55203</li><li>Opt Part #: 2212 Supplier: 55203</li><li>Opt Part #: 2213 Supplier: 55203</li></ul>
COM-1793	Multimeter - Digital/Analog (or equivalent meter meets task requirements) <ul style="list-style-type: none"><li>Part #: 117 Supplier: 89536</li><li>Part #: 260-8XPI Supplier: 55026</li><li>Part #: 260-8XPI Supplier: 88277</li><li>Part #: 287 Supplier: 89536</li><li>Part #: 289 Supplier: 89536</li><li>Part #: 87V Supplier: 89536</li><li>Part #: FLUKE 27 II Supplier: 89536</li><li>Part #: FLUKE-77-4 Supplier: 89536</li><li>Opt Part #: 187 Supplier: 89536</li><li>Opt Part #: 189 Supplier: 89536</li><li>Opt Part #: 21 Supplier: 89536</li><li>Opt Part #: 77 SERIES III Supplier: 89536</li><li>Opt Part #: 87 Supplier: 89536</li><li>Opt Part #: FLUKE 27 Supplier: 89536</li></ul>
STD-1168	Cap - Shorting or Faraday Cap

**C. Procedure**

SUBTASK 20-10-33-940-001

- (1) Ground the airplane, do this task: Static Grounding, TASK 20-40-11-910-801.

SUBTASK 20-10-33-940-002

- (2) Make sure you remove electrical power before you remove the squib, do this task: Remove Electrical Power, TASK 24-22-00-860-812.

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SUBTASK 20-10-33-760-001

- (3) You must wear a static control wrist strap, COM-1565 during the removal of the squib.

**WARNING:** USE A WRIST STRAP WITH A MINIMUM GROUNDING LEAD RESISTANCE OF 250 KILOHMS AND A MAXIMUM OF 1.5 MEGOHMS. USE OF A LOW RESISTANCE WRIST STRAP CAN CAUSE INJURY TO PERSONS IF A HIGH VOLTAGE SOURCE IS TOUCHED.

- (a) Do the following steps to do a resistance test of the static control wrist strap, COM-1565:
- 1) Use an digital/analog multimeter, COM-1793 to make sure the static control wrist strap, COM-1565, assembly has a minimum resistance of 250 kilohms and a maximum of 1.5 megohms.
  - 2) Put the static control wrist strap, COM-1565, on the wrist of the person that will remove the squib.
  - 3) Use an digital/analog multimeter, COM-1793 to make sure the resistance is less than 10 megohms.

SUBTASK 20-10-33-480-001

- (4) Connect the static control wrist strap, COM-1565 to an applicable electrostatic ground jack.

SUBTASK 20-10-33-940-003

**WARNING:** PUT CAPS ON THE BOTTLE SQUIBS AND FLOW VALVE SQUIBS. IF YOU DO NOT PUT CAPS ON THE SQUIBS, THE SQUIBS CAN FIRE ACCIDENTALLY AND CAUSE INJURIES TO PERSONNEL.

- (5) Stray voltage on the airplane can cause the squib to discharge. Make sure any stray voltage is discharged before you remove the aircraft electrical connector.

SUBTASK 20-10-33-020-001

- (6) Remove the electrical connector.

SUBTASK 20-10-33-480-002

- (7) Make sure the shorting cap, STD-1168 (protective cap) is installed on the squib whenever the airplane electrical connector is removed from the squib.

SUBTASK 20-10-33-940-004

- (8) After the shorting cap, STD-1168 (protective cap) is attached to the squib, the wrist strap may be removed.

— END OF TASK —

**TASK 20-10-33-400-801**

**3. Power Device Cartridge (Squib) Installation**

**A. References**

Reference	Title
24-22-00-860-812	Remove Electrical Power (P/B 201)

**B. Tools/Equipment**

**NOTE:** When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.



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Reference	Description
COM-1565	Strap - Adjustable Wrist, Conductive, Static Control Part #: 09070 Supplier: 62576 Part #: 14810 Supplier: 62576 Part #: 2214 Supplier: 55203 Opt Part #: 2211 Supplier: 55203 Opt Part #: 2212 Supplier: 55203 Opt Part #: 2213 Supplier: 55203
COM-1793	Multimeter - Digital/Analog (or equivalent meter meets task requirements) Part #: 117 Supplier: 89536 Part #: 260-8XPI Supplier: 55026 Part #: 260-8XPI Supplier: 88277 Part #: 287 Supplier: 89536 Part #: 289 Supplier: 89536 Part #: 87V Supplier: 89536 Part #: FLUKE 27 II Supplier: 89536 Part #: FLUKE-77-4 Supplier: 89536 Opt Part #: 187 Supplier: 89536 Opt Part #: 189 Supplier: 89536 Opt Part #: 21 Supplier: 89536 Opt Part #: 77 SERIES III Supplier: 89536 Opt Part #: 87 Supplier: 89536 Opt Part #: FLUKE 27 Supplier: 89536
STD-1168	Cap - Shorting or Faraday Cap

### C. Procedure

SUBTASK 20-10-33-940-005

- (1) Make sure you remove electrical power before you install the squib, do this task: Remove Electrical Power, TASK 24-22-00-860-812.

SUBTASK 20-10-33-940-006

- (2) Wear a static control wrist strap, COM-1565 during the installation of the squib.

SUBTASK 20-10-33-760-002

**WARNING:** USE A WRIST STRAP WITH A MINIMUM GROUNDING LEAD RESISTANCE OF 250 KILOHMS AND A MAXIMUM OF 1.5 MEGOHMS. USE OF A LOW RESISTANCE WRIST STRAP CAN CAUSE INJURY TO PERSONS IF A HIGH VOLTAGE SOURCE IS TOUCHED.

- (3) Do these steps to do a resistance test of the static control wrist strap, COM-1565:
  - (a) Use an digital/analog multimeter, COM-1793 to make sure the static control wrist strap, COM-1565, assembly has a minimum resistance of 250 kilohms and a maximum of 1.5 megohms.
  - (b) Put the static control wrist strap, COM-1565, on the wrist of the person that will install the squib.
  - (c) Use an digital/analog multimeter, COM-1793 to make sure the resistance is less than 10 megohms.

SUBTASK 20-10-33-480-003

- (4) Connect the static control wrist strap, COM-1565 to an applicable electrostatic ground jack.



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SUBTASK 20-10-33-940-007

**WARNING:** PUT CAPS ON THE BOTTLE SQUIBS AND FLOW VALVE SQUIBS. IF YOU DO NOT PUT CAPS ON THE SQUIBS, THE SQUIBS CAN FIRE ACCIDENTALLY AND CAUSE INJURIES TO PERSONNEL.

- (5) Make sure the shorting cap, STD-1168 (protective cap) is installed on the squib whenever the airplane electrical connector is removed from the squib.

SUBTASK 20-10-33-480-004

- (6) Stray voltage on the airplane can cause the squib to discharge. Make sure any stray voltage is discharged before you install the aircraft electrical connector.

SUBTASK 20-10-33-420-001

- (7) Remove the shorting cap, STD-1168 (protective cap) and install the electrical connector.

SUBTASK 20-10-33-940-008

- (8) After the electrical connector is installed, the static control wrist strap, COM-1565 may be removed.

———— END OF TASK ————

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METAL SURFACES - CLEANING/PAINTING

**1. General**

- A. Use this procedure for faying surface bonds and bonding jumper installation. Do not use abrasives or wire brushes on CRES, plated surfaces, or clad aluminum that is not painted.
- B. This procedure is for cleaning by one of the following methods:
  - (1) Hand Clean Metal Surfaces with Abrasives.
  - (2) Clean Metal Surface with a Rotary Bonding Brush.
  - (3) Clean with a Rotary Abrasive Disk.
  - (4) Remove Paint from Metal Surfaces with solvent, B00139 or solvent, B00083.
  - (5) Clean Bare, Clad, or Plated Metal with solvent, B00139.

**TASK 20-10-34-120-801**

**2. Hand Clean Metal Surfaces with Abrasives**

**A. General**

- (1) Do not use abrasives on plated surfaces, clad aluminum, or CRES that is not painted.
- (2) This is the only procedure you can use to clean titanium.

**B. Consumable Materials**

Reference	Description	Specification
B00062	Solvent - Acetone (99.5% Grade)	ASTM D 329 (Supersedes O-A-51)
G00034	Cotton Wiper - Process Cleaning Absorbent Wiper (Cheesecloth, Gauze)	BMS15-5 Class A

**C. Procedure**

**SUBTASK 20-10-34-100-001**

- (1) Make the surface wet with solvent, B00062 and wipe or scrub the surface with a cotton wiper, G00034
  - (a) Spray or flow the solvent, B00062 on the surface to assist in cleaning or rinsing.
  - (b) Wipe up the excessive solvent and allow the surface to drain dry.

**SUBTASK 20-10-34-120-001**

**CAUTION:** DO NOT LET PARTICLES FROM THE ABRASIVE CAUSE CONTAMINATION OF THE MECHANISMS OR ELECTRICAL EQUIPMENT. DAMAGE CAN OCCUR.

- (2) Manually use a circular or elliptical movement of the abrasive to get an equally smooth surface.

**SUBTASK 20-10-34-100-002**

- (3) Make the surface wet with solvent, B00062 and wipe or scrub the surface with a cotton wiper, G00034

———— END OF TASK ————



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**TASK 20-10-34-140-801**

**3. Clean Metal Surfaces with a Rotary Bonding Brush**

(Figure 701)

**A. General**

- (1) Use this procedure to remove paint from metal or to remove Alodine, Iridite, or light anodize from aluminum. Do not use a bonding brush on plated surfaces or on metals that are not painted, for example, CRES, titanium, or clad aluminum. Clean these surfaces with solvent.

**B. Consumable Materials**

Reference	Description	Specification
B00062	Solvent - Acetone (99.5% Grade)	ASTM D 329 (Supersedes O-A-51)
B00102	Abrasive - Aluminum Oxide Coated Cloth	
G00034	Cotton Wiper - Process Cleaning Absorbent Wiper (Cheesecloth, Gauze)	BMS15-5 Class A

**C. Procedure**

SUBTASK 20-10-34-930-001

- (1) Identify the bonding brush housings by color.

NOTE: The colors show which bonding brush housings you will use on which metal. The chart below gives color codes for identification of bonding brushes for individual metals.

**Table 701/20-10-34-993-801**

BONDING BRUSH COLOR CODE		
METAL	COLOR CODE	COLOR IDENTIFICATION
Aluminum	None	None
Ferritic	Blue	J7-42-5200
Magnesium	Green	J7-42-5700
Beryllium	Brown	J7-42-5400

SUBTASK 20-10-34-140-001

**CAUTION:** DO NOT USE CARBON STEEL BONDING BRUSHES. STEEL PARTICLES ON METAL SURFACES COULD CAUSE CORROSION.

- (2) Use a drill motor or other applicable drive to apply a stainless steel bonding brush of the correct size to clean the necessary diameter.

- (a) Apply brush intermittently and keep the cutting face parallel with the surface.  
(b) Examine results after each time you apply the brush and continue operation until necessary area is clean.

NOTE: Keep the decrease in surface metal to a minimum.

- (c) If it is a problem to get through an anodic film, clean it with abrasive cloth, B00102.

SUBTASK 20-10-34-100-003

- (3) Make the surface wet with solvent, B00062 and wipe or scrub the surface using a cotton wiper, G00034.

- (a) Spray or flow the solvent, B00062 on the surface to assist in cleaning or rinsing.

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- (b) Wipe up the excessive solvent and allow the surface to drain dry.

———— END OF TASK ——

**TASK 20-10-34-120-802**

**4. Clean with a Rotary Abrasive Disk**

(Figure 701)

**A. General**

- (1) Use this task to remove anodize, Iridite, Alodine, BMS 3-11 resistant finish, or equivalent hard finishes that are not painted. You can also remove paint with this task, but the disk will become quickly clogged.
- (2) Do not use this procedure on plated surfaces or metals that are not painted, for example, CRES, titanium, or clad aluminum.

**B. Consumable Materials**

Reference	Description	Specification
B00062	Solvent - Acetone (99.5% Grade)	ASTM D 329 (Supersedes O-A-51)
B00102	Abrasive - Aluminum Oxide Coated Cloth	
G00034	Cotton Wiper - Process Cleaning Absorbent Wiper (Cheesecloth, Gauze)	BMS15-5 Class A

**C. Procedure**

SUBTASK 20-10-34-120-002

**CAUTION:** DO NOT LET PARTICLES FROM THE ABRASIVE CAUSE CONTAMINATION OF THE MECHANISMS OR ELECTRICAL EQUIPMENT. DAMAGE TO EQUIPMENT CAN OCCUR.

- (1) Use a drill motor or other applicable drive to apply an abrasive disk (abrasive cloth, B00102) (Figure 701) of correct size to clean the necessary diameter.
  - (a) Apply the disk intermittently with light pressure and keep the face of the disk parallel to the metal surface.
  - (b) Examine results after each time you apply the disk and continue operation until necessary area is clean.

NOTE: Keep the decrease in surface metal to minimum.

SUBTASK 20-10-34-100-004

- (2) Make the surface wet with solvent, B00062 and wipe or scrub the surface with a cotton wiper, G00034

———— END OF TASK ——

**TASK 20-10-34-110-801**

**5. Remove Paint from Metal Surfaces with Lacquer Thinner or Solvent**

**A. General**

- (1) Use this procedure to remove lacquer-based primer or enamel from clad aluminum or other metal surfaces. Do not use lye, alkaline paint remover, or hydroxides to clean surfaces.

**B. References**

Reference	Title
20-30-81-910-801	General Cleaning of All Organic Coatings (Series 81) (P/B 201)

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C. Consumable Materials

Reference	Description	Specification
B00139	Solvent - Lacquer Thinner	A-A-857
B01001	Solvent - General Cleaning Of All Organic Coatings (AMM 20-30-81/201) - Series 81	
G00034	Cotton Wiper - Process Cleaning Absorbent Wiper (Cheesecloth, Gauze)	BMS15-5 Class A

D. Remove Paint

SUBTASK 20-10-34-110-001

**WARNING:** DO NOT GET SOLVENTS IN YOUR MOUTH, OR YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE HAZARDOUS MATERIALS. SOLVENTS MAY BE FLAMMABLE OR HARMFUL TO THE ENVIRONMENT. REFER TO PRODUCT MATERIAL SAFETY DATA SHEETS (MSDS) AND LOCAL REQUIREMENTS FOR PROPER HANDLING PROCEDURES.

- (1) Apply solvent, B00139 or Series 81 solvent, B01001 (TASK 20-30-81-910-801) to the specified area with a cotton wiper, G00034.

SUBTASK 20-10-34-110-002

- (2) Use a clean part of the cloth each time you apply solvent to the surface.
  - (a) Make sure you do not get solvent on adjacent surfaces.

SUBTASK 20-10-34-110-003

- (3) When the specified area is fully clean, immediately rub dry with cotton wiper, G00034.

———— END OF TASK ————

**TASK 20-10-34-110-802**

6. Clean Bare, Clad, or Plated Metal with Solvent

A. General

- (1) Use this procedure to clean plated surfaces and CRES, titanium, or clad aluminum that is not painted.

B. Consumable Materials

Reference	Description	Specification
B00083	Solvent - VM&P Naphthas	ASTM D-3735 Type III
G00034	Cotton Wiper - Process Cleaning Absorbent Wiper (Cheesecloth, Gauze)	BMS15-5 Class A

C. Procedure

SUBTASK 20-10-34-110-004

- (1) Apply solvent, B00083 to bonding surfaces with a cotton wiper, G00034.

SUBTASK 20-10-34-110-005

- (2) Rub with the necessary force to remove contamination you can see.

SUBTASK 20-10-34-110-006

- (3) Immediately dry surfaces with a cotton wiper, G00034.

———— END OF TASK ————

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BRUSH OR DISK DIA. (INCH)	PILOT DIA. (INCH)	SHANK DIA. (INCH)	BONDING BRUSHES			
			WIRE SIZE (INCH)		OSBORN NO.	MORRIS NO.
			MAX	MIN		
11/32	1/4	1/4	0.005	0.004		
1/2	3/32	1/4	0.005	0.004	94-SV-37	P-31-SS
1/2	1/8	1/4	0.005	0.004	94-SV-47	P-32-SS
1/2	5/32	1/4	0.005	0.004	94-SV-48	P-33-SS
1/2	3/16	1/4	0.005	0.004	94-SV-36	P-34-SS
3/4	3/16	1/4	0.006	0.005		P-31-516-SS
3/4	1/4	1/4	0.006	0.005		P-31-517-SS
3/4	5/16	1/4	0.006	0.005		P-31-53-SS
1.0	3/16	1/4	0.008	0.006		P-36-SS
1.0	1/4	1/4	0.008	0.006		P-36-S1-SS
1.0	5/16	1/4	0.008	0.006		P-36-S5-SS

BRUSH OR DISK DIA. (INCH)	BONDING BRUSHES		DISK MANDRELS	
	MANUFAC- TURERS BRUSH CO.	BOEING ST NO.		
		BOEING ST NO.		
11/32		ST913K-34-24	ST913M-34-24	
1/2	220-NN	ST913K-50-09	ST913M-50-09	
1/2	221-NN	ST913K-50-12	ST913M-50-12	
1/2	222-NN	ST913M-50-16	ST913M-50-16	
1/2	223-NN	ST913M-50-19	ST913M-50-19	
3/4	224-NN	ST913K-75-19	ST913M-75-19	
3/4	225-NN	ST913K-75-25	ST913M-75-25	
3/4	226-NN	ST913K-75-31	ST913M-75-31	
1.0	227-NN	ST913K-100-19	ST913M-100-19	
1.0	228-NN	ST913K-100-25	ST913M-100-25	
1.0	229-NN	ST913K-100-31	ST913M-100-31	

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**Rotary Bonding Brushes and Abrasive Disk Mandrels**  
**Figure 701/20-10-34-990-801**

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ELECTRICAL BONDING - INSPECTION/CHECK

**1. General**

- A. This procedure provides requirements for airplane electrical bonding.
- B. This procedure has one task:
  - (1) An inspection of electrical bonding.

**TASK 20-10-37-120-801**

**2. Electrical Bonding Inspection**

**A. General**

- (1) This task provides information to help an operator determine which bonding meter to select for electrical bonding inspections.
  - (a) The information in this procedure is used to describe the fire zone, flammable zone, flammable leakage zone, and National Electrical Code (NEC) hazardous locations.
  - (b) An operator should also take into consideration their environmental conditions that could impact the zone and location information.
  - (c) Boeing recommends that the intrinsically safe approved bonding meter, COM-1550 be used for all bonding checks. If it is not available, the non-intrinsically safe bonding meter, COM-614 can be used outside of the fire zones, flammable zones, flammable leakage zones, and areas classified as NEC Class I, Division I or II hazardous locations.

**B. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-614	Bonding Meters - Non-Intrinsically Safe (Used in non-hazardous locations) Part #: 247000 Supplier: 00426 Part #: 620LK Supplier: 1CRL2 Opt Part #: 247001 Supplier: 00426
COM-1550	Bonding Meters - Approved, Intrinsically Safe (Approved for use in Class I, Divisions I & II hazardous (classified) locations. Outside these hazardous locations, COM-614 can be used in lieu of COM-1550). Part #: C15292 (MODEL T477W) Supplier: 01014 Part #: M1 Supplier: 3AD17 Opt Part #: M1B Supplier: 3AD17

**C. Select a Bonding Meter**

SUBTASK 20-10-37-750-001

- (1) Inside the zones that follow, Boeing recommends that the intrinsically safe approved bonding meter, COM-1550 be used.
  - (a) Fire Zone
    - 1) In a fire zone, ignition sources are normally present.
    - 2) A single failure can cause a flammable mixture to be present.
    - 3) Fire Zone locations are as follows (Figure 601):
      - a) Engines

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- b) Tail Cone
- (b) Flammable Zone
  - 1) In a flammable zone, flammable fluid is normally present.
  - 2) An ignition source is not present normally after a single failure.
  - 3) Flammable Zone locations are as follows (Figure 602):
    - a) Wing - Center Fuel Tank: Rib 1 to Rib 5
    - b) Wing - Main Tank: Rib 5 to Rib 22 (WS 204.25 to WS 643.50)
    - c) Wing - Surge Tank: Rib 22 to Rib 25 (WS 616.75 to WBL 643.50)
    - d) Wing - Dry Bay
- (c) Flammable Leakage Zone
  - 1) Leakage of flammable vapors can occur as a result of the following:
    - a) One failure
    - b) Leakage during normal operation
  - 2) All flames, smoking, sparks, and other ignition sources must not occur.
  - 3) Tools and test equipment that can make a spark must not be used.
  - 4) Flammable Leakage Zone locations are as follows (Figure 603):
    - a) Nose Landing Gear and Main Landing Gear Wheel Wells
    - b) Wing-to-Body Fairings
    - c) Engine Struts and Nacelles
    - d) Wing Leading Edges
    - e) ECS Bay
    - f) Wing Trailing Edges
    - g) Horizontal Stabilizer
    - h) Empennage and Rudder
    - i) Fuselage Aft of the Pressure Bulkhead
- (d) National Electrical Code (NEC) Class I, Division I and II Hazardous Locations (Figure 604)

NOTE: Figure 604 is for the condition with open fuel tanks.

- 1) Class I, Division I Hazardous Locations (or equivalent standard):
  - a) Locations where ignitable concentrations of flammable gases or vapors can exist under standard operational conditions.
  - b) Locations where ignitable concentrations of flammable gases or vapors may exist frequently because of repair or maintenance operations.
  - c) Locations where ignitable concentrations of flammable gases or vapors can exist because of leakage.
  - d) Locations where equipment problems or incorrect operation of equipment or processes can release ignitable concentrations of flammable gases or vapor, and can also cause failure of electrical equipment at the same time.
- 2) Class I, Division II Hazardous Locations (or equivalent standard):

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- a) Locations where flammable liquids or gases are handled, processed, or used, but where the liquid, vapors, or gases will usually be in closed containers or closed systems. The containers or systems will not allow the release of liquid, gas, or vapor in sufficient quantity or produce an ignitable fuel and air mixture unless the container or system fails or is damaged.
- 3) See Figure 604 for the locations of the NEC Class I, Division I & II Hazardous Locations.

**D. Procedure**

SUBTASK 20-10-37-100-001

- (1) For electrical bonding requirements, refer to the Standard Wiring Practices Manual (SWPM).

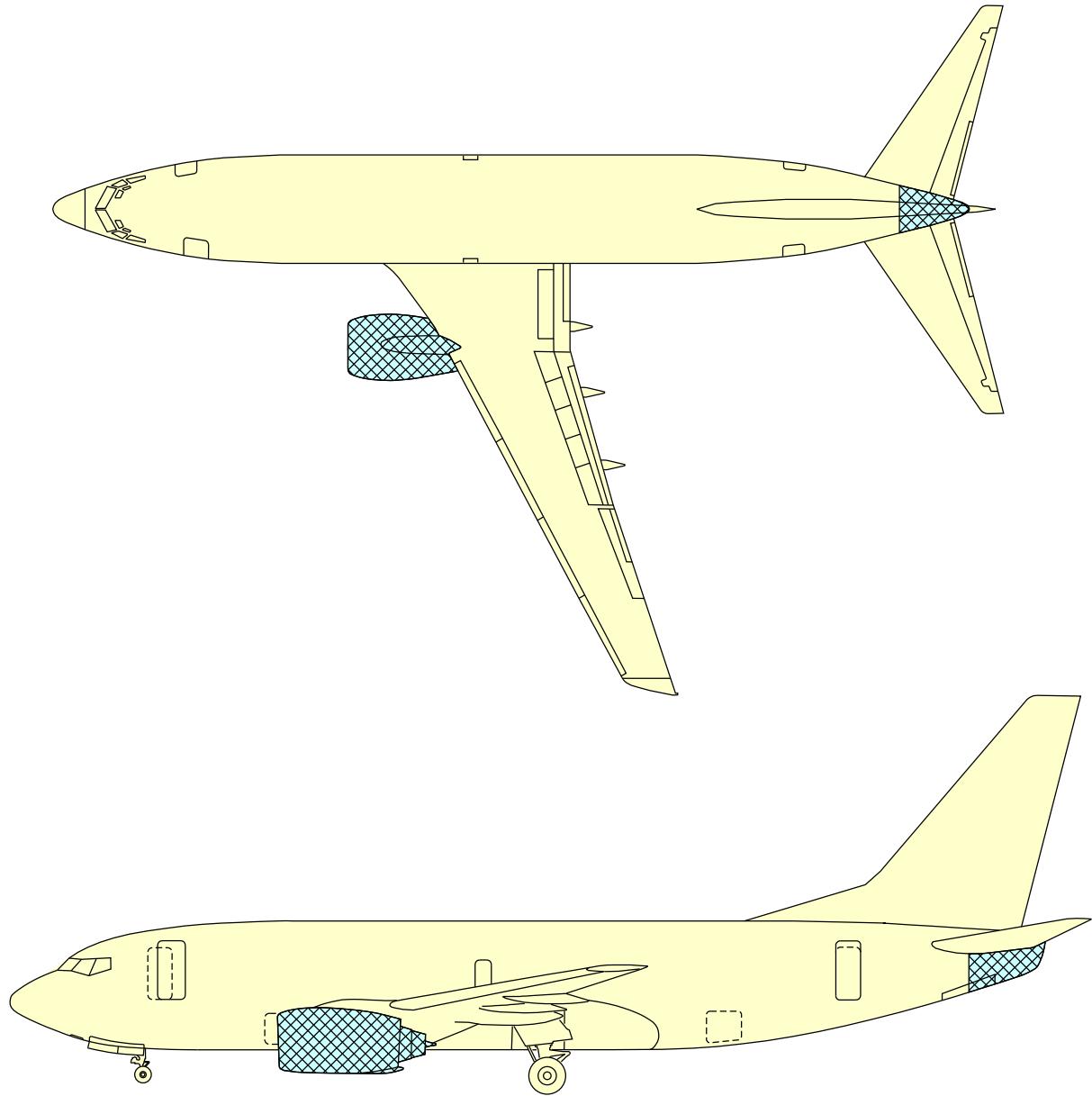
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**LEGEND:**



FIRE ZONES

2089664 S0000441046\_V2

**Fire Zone Locations**  
**Figure 601/20-10-37-990-801**

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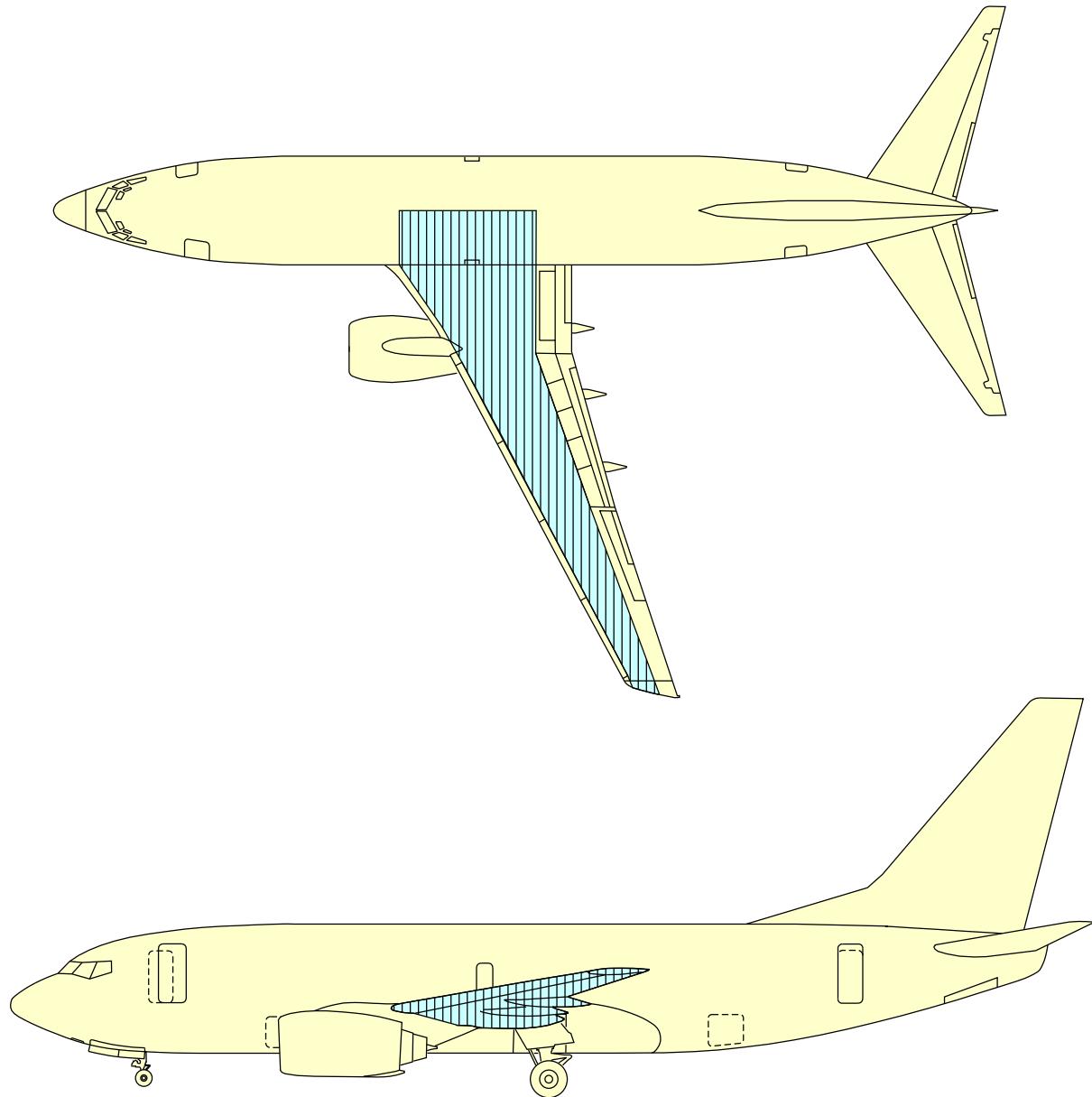
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**LEGEND:**



FLAMMABLE ZONES

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**Flammable Zone Locations**  
**Figure 602/20-10-37-990-802**

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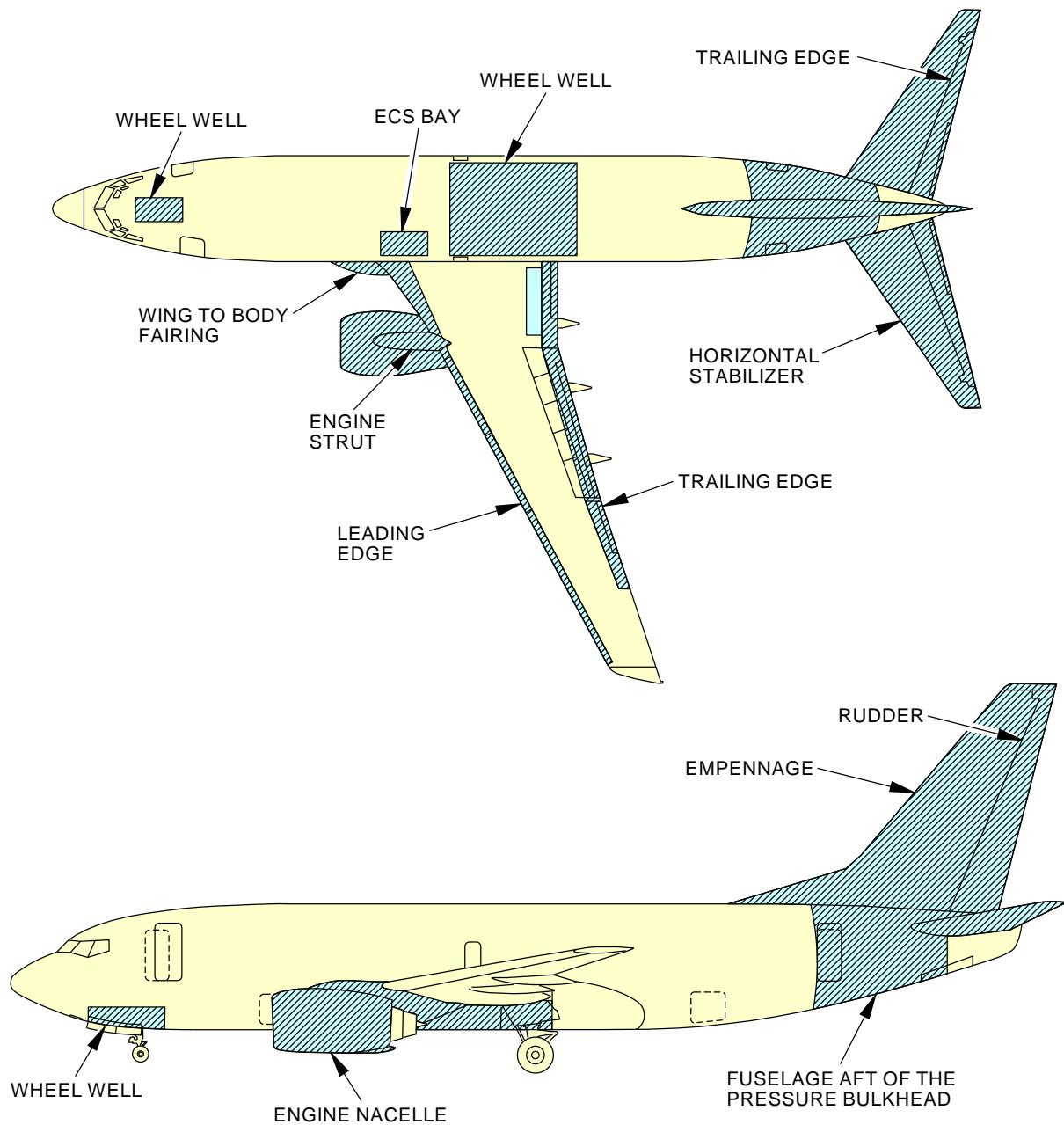
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**LEGEND:**



FLAMMABLE LEAKAGE ZONES

2089704 S0000441049\_V2

**Flammable Leakage Zone Locations**  
Figure 603/20-10-37-990-803

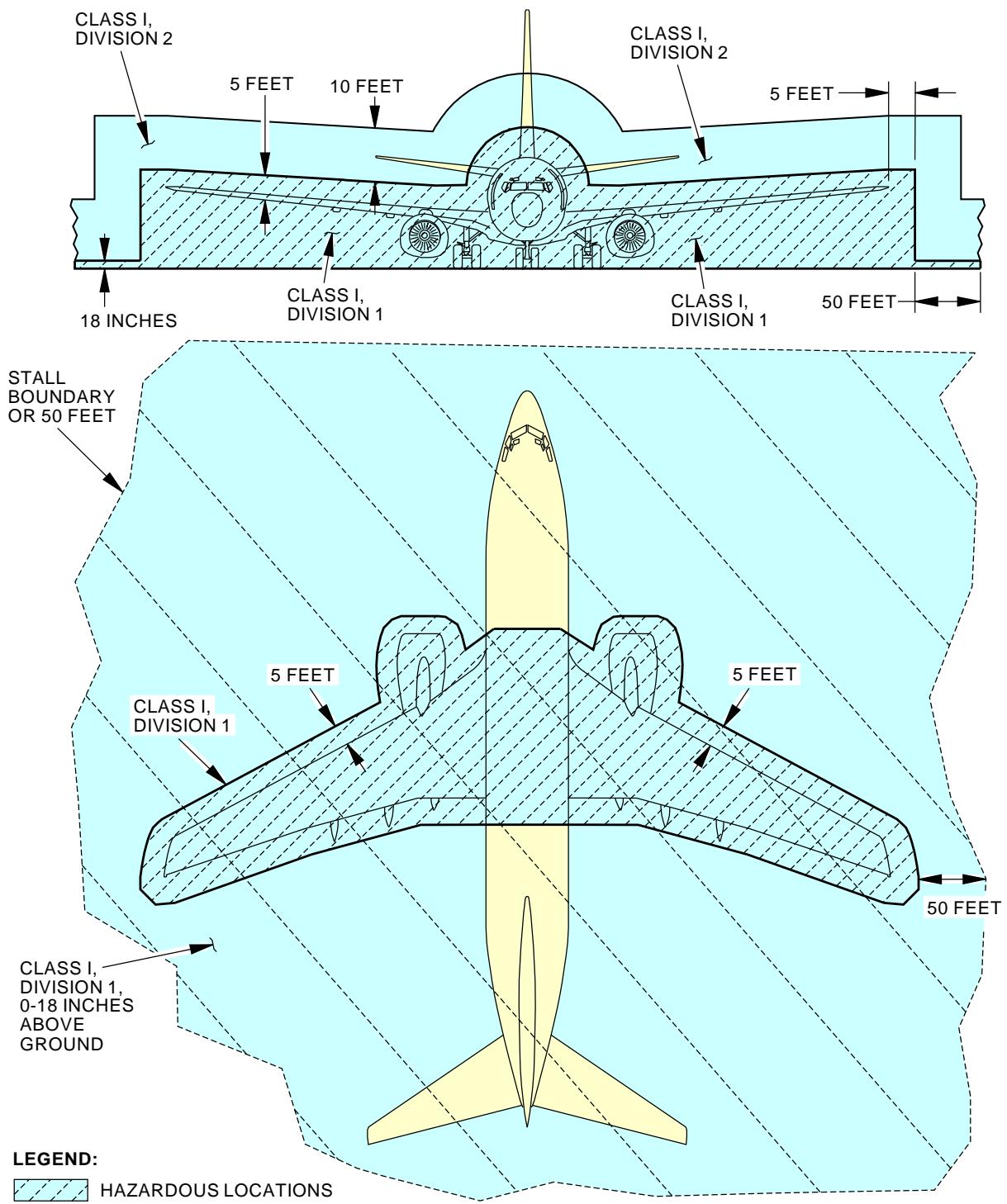
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**Hazardous Locations - Open Fuel Tank(s)**  
**Figure 604/20-10-37-990-804**

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CONTROL CABLE GROMMET - REMOVAL/INSTALLATION

**1. General**

- A. This procedure has these tasks:
  - (1) A removal of the control cable grommet.
  - (2) An installation of the control cable grommet.
- B. You can replace the control cable grommets in the 3/4, 1, and 1-1/4 inch (19.05, 25.4, 31.75 mm) holes with the control cable removed or installed. You have two alternatives for the replacement of an NAS1368 plastic grommet with the control cable installed:
  - (1) You can use a replacement NAS1368 grommet and cut one side of the grommet for installation.
  - (2) You can use a BACG20H nylon grommet, which is a divided grommet.

**TASK 20-10-41-000-801**

**2. Control Cable Grommet Removal**

(Figure 401)

**A. Procedure**

SUBTASK 20-10-41-020-001

- (1) Cut the grommet to remove the grommet from the bulkhead.

————— END OF TASK ————

**TASK 20-10-41-400-801**

**3. Control Cable Grommet Installation**

(Figure 401)

**A. References**

Reference	Title
20-30-98-910-802	Cleaning of Phenolics or Nylon (Series 98-1) (P/B 201)

**B. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
SPL-1549	Set - Installation, NAS 1368 Grommets Part #: A20006-32 Supplier: 81205 Opt Part #: ST1065C Supplier: 81205

**C. Consumable Materials**

Reference	Description	Specification
A00119	Adhesive - Synthetic Rubber Cement, Naphtha Soluble	BMS5-55
A00273	Adhesive - Epoxy Polyamide, 2 Part, Natural Colored	BMS5-126 Type II Class 1
A00435	Adhesive - Epoxy Polyamide, 2 Component, Natural Color	BMS5-126 Type III Class 1
B01051	Solvent - Cleaning Of Phenolics Or Nylon (AMM 20-30-98/201) - Series 98-1	

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**D. Install the Grommet with the Control Cable Removed**

SUBTASK 20-10-41-110-001

**WARNING:** DO NOT GET SOLVENTS IN YOUR MOUTH, OR YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE HAZARDOUS MATERIALS. SOLVENTS MAY BE FLAMMABLE OR HARMFUL TO THE ENVIRONMENT. REFER TO PRODUCT MATERIAL SAFETY DATA SHEETS (MSDS) AND LOCAL REQUIREMENTS FOR PROPER HANDLING PROCEDURES.

- (1) Clean the bulkhead area that will touch the grommet with Series 98-1 solvent, B01051 (TASK 20-30-98-910-802).

SUBTASK 20-10-41-640-001

- (2) Apply adhesive, A00273, or adhesive, A00435 on the NAS1368 grommet area that will touch the bulkhead.

SUBTASK 20-10-41-420-001

- (3) Put the grommet in the bulkhead hole.

SUBTASK 20-10-41-480-001

- (4) Put the grommet tool NAS 1368 grommet installation set, SPL-1549 around the grommet and tighten the NAS1801 screw.

SUBTASK 20-10-41-080-001

- (5) Remove the grommet tool.

**NOTE:** The grommet can be loose in the bulkhead hole, but it should not fall out.

**E. Install the Grommet with the Control Cable Installed**

SUBTASK 20-10-41-110-002

**WARNING:** DO NOT GET SOLVENTS IN YOUR MOUTH, OR YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE HAZARDOUS MATERIALS. SOLVENTS MAY BE FLAMMABLE OR HARMFUL TO THE ENVIRONMENT. REFER TO PRODUCT MATERIAL SAFETY DATA SHEETS (MSDS) AND LOCAL REQUIREMENTS FOR PROPER HANDLING PROCEDURES.

- (1) Clean the bulkhead area that will touch the grommet with Series 98-1 solvent, B01051 (TASK 20-30-98-910-802).

SUBTASK 20-10-41-420-002

- (2) Do these steps to install the NAS1368 grommet:
  - (a) Cut one side of the NAS1368 grommet.
  - (b) Place the grommet over the control cable.
  - (c) Apply adhesive, A00273, or adhesive, A00435, on the NAS1368 grommet area that will touch the bulkhead.
  - (d) Install the grommet in the bulkhead hole.
  - (e) Align the slit part of the grommet at the 12 o'clock position.

SUBTASK 20-10-41-420-003

- (3) Do this step to install the BACG20H grommet:
  - (a) Apply adhesive, A00119, on the BACG20H grommet area that will touch the bulkhead.
  - (b) Install the grommet in the bulkhead hole.
  - (c) Align the cut part of the grommet at the 12 o'clock position.

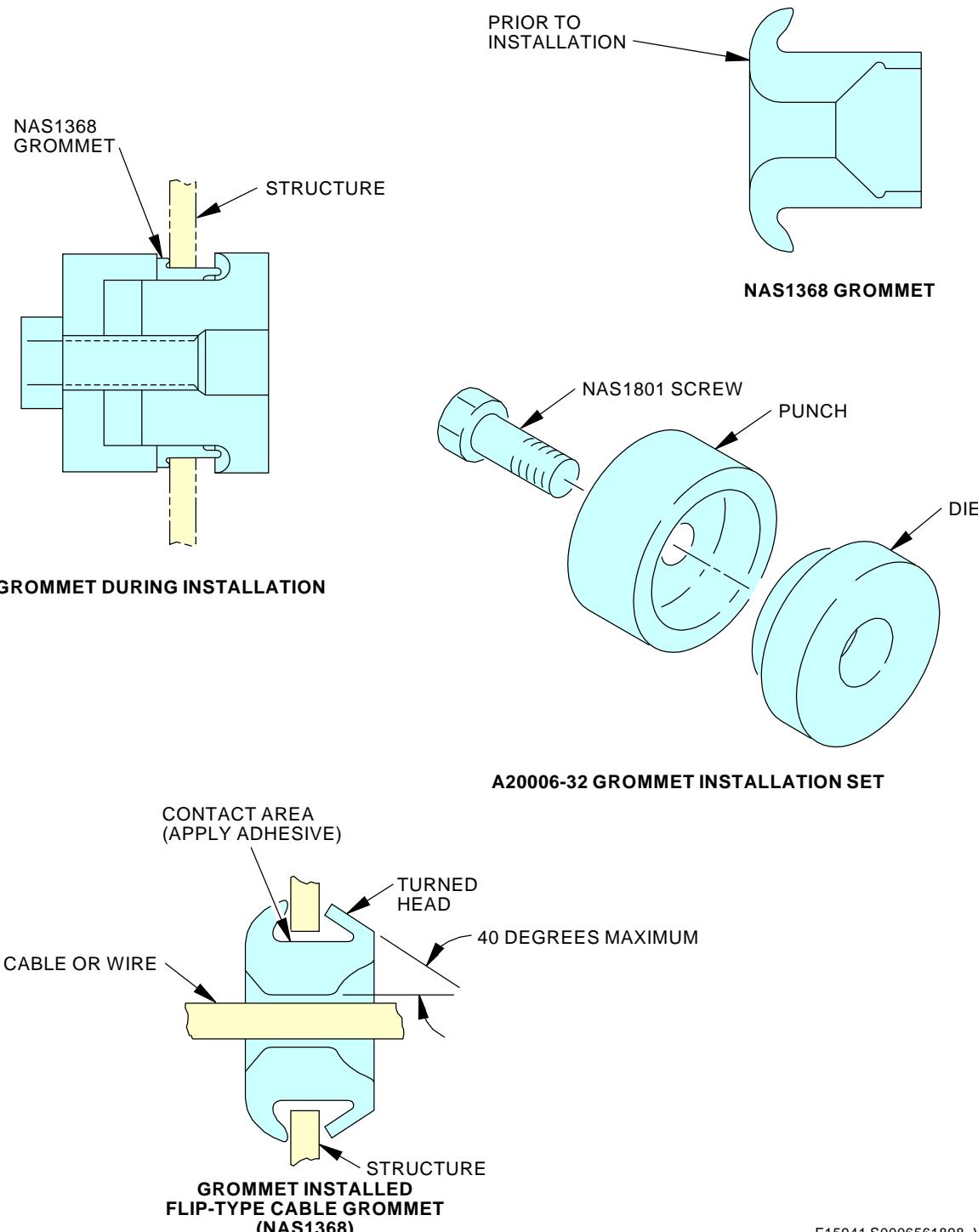
———— END OF TASK ———

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Control Cable Grommets Installation  
Figure 401/20-10-41-990-801

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LOCKING DEVICES - REMOVAL/INSTALLATION

**1. General**

- A. This procedure has these tasks:
- (1) A removal of the lockwire, cotter pins, and lockrings.
  - (2) An installation of the lockwire, cotter pins, and lockrings.
  - (3) A removal of the safety cable.
  - (4) An installation of the safety cable.

**TASK 20-10-44-000-801**

**2. Lockwire, Cotter Pins, and Lockrings - Removal**

(Figure 401, Figure 402, Figure 403)

**A. Remove the Lockwire, Cotter Pins, and Lockrings**

SUBTASK 20-10-44-020-001

- (1) Cut and remove the lockwire or remove the cotter pin or lockring.

————— END OF TASK ————

**TASK 20-10-44-400-801**

**3. Lockwire, Cotter Pins, and Lockrings - Installation**

**A. General**

- (1) CRES, MONEL, and INCONEL lockwire (safety wire) interchangeability:
  - (a) CRES, MONEL, and INCONEL lock wire are interchangeable when the same length and diameter are used, except for airplane areas/systems where temperatures exceed 700°F (371°C) or the magnetic properties of CRES do not meet the necessary requirements.
  - (b) INCONEL must be used for all areas which exceed 700°F (371°C).
  - (c) If a specific lockwire material is listed in a maintenance procedure, Boeing recommends to use the listed material if available. Otherwise, follow the interchangeability information above.
- (2) Copper wire (Wire sealing):
  - (a) Wiresealing is a practice for the security of selected switches, levers, switchguards, etc., to deter inadvertent operation, to allow for physical breakout in an emergency, to identify to the Flight Crew and Engineers that, when present and intact, the relevant switches, levers, switchguards, etc., are in their correct configuration positions, to show that no person has used the emergency equipment.
  - (b) Emergency equipment includes portable fire extinguishers, first aid kits, emergency valve, and oxygen regulators.
  - (c) Copper wire is not interchangeable with CRES, MONEL, and INCONEL lockwire.
  - (d) Copper wire, 0.020 in. (0.508 mm) in diameter is the only option for wiresealing.
- (3) Clad 5056 Aluminum alloy wire should be used for lockwire which touches magnesium to prevent galvanic corrosion.
- (4) Lockwiring guidelines:
  - (a) Do not use lockwire more than once.
  - (b) Install lockwire so it is in tension when the parts become loose.

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- (c) Make three to six twists at the end of the wire. Bend the twists back or under to give the ends protection so they will not catch something.
- (d) Use the double twist procedure for all lockwire unless a single wire procedure is specified.
- (e) Install and twist the safety wire so the loop around the head stays down. (If the loop tended to come up over the bolt head there would be a slack loop.)
- (f) For multiple fasteners spaced less than 4 in. (10 cm) apart, the maximum number which can be safety wired together shall be the number than can be wired with a 24 in. (61 cm) length of wire.
- (g) For fasteners 4 in. (10 cm) to 6 in. (15 cm) apart, wire together in series no more than three fasteners.
- (h) Where fasteners are more than 6 in. (15 cm) apart, do not tie them in series unless tie points are provided on adjacent parts to shorten the wire span to less than 6 in. (15 cm).
- (i) Use a right-handed twist for all double twist installations.
- (j) Safety wire diameter shall be between 1/3 and 3/4 of the hole diameter, 0.032 in. (0.813 mm) diameter minimum.
- (k) Safety wire 0.020 in. (0.508 mm) in diameter may be used if:
  - 1) The safety wire hole is 0.045 in. (1.143 mm) diameter or smaller, or
  - 2) The spacing between parts is less than two inches and the safety wire hole diameter is between 0.045 in. (1.143 mm) and 0.062 in. (1.575 mm) in diameter.

TWIST PER INCH					
SAFETY WIRE DIA. INCH	LESS THAN 0.019	0.019 TO 0.026	0.023 TO 0.042	0.043 TO 0.065	MORE THAN 0.065
Twist/inch	11 to 14	9 to 12	7 to 10	5 to 8	4 to 7

**Lockwire Material Specification**

NASM20995( )	
CRES	C
MONEL	NC
INCONEL	N
Copper	CY

**B. Install the Lockwire, Cotter Pins, and Lockrings**

SUBTASK 20-10-44-800-001

- (1) Use these types of wires for lockwire:
  - (a) Use monel, inconel, or corrosion-resistant lockwire in high temperature areas.
  - (b) Use copper wire, 0.020 in. diameter, on emergency equipment only.

NOTE: Use it where a seal is necessary on emergency equipment to show no person has used the equipment. Emergency equipment includes portable fire extinguishers, first aid kits, emergency valve, and oxygen regulators.
  - (c) Use Clad 5056 aluminum alloy wire for lockwire that touches magnesium to prevent galvanic corrosion.
  - (d) This table shows standard wire sizes.

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Table 401/20-10-44-993-801

BAC Standard Wire Sizes	
MATERIAL	SIZE (INCH)
Monel or Inconel	.020 .032 .040 .051 .091
Corrosion Resistant Steel	.020 .032 .040 .051 .091
Aluminum Alloy	.020 .032 .040 .051 .091

SUBTASK 20-10-44-420-001

- (2) Use these steps to install lockwire to bolts and screws (Figure 401):
  - (a) On all fittings where you install lockwire, attach the fitting to the mating part or an adjacent part.
  - (b) Install lockwire for right threads as shown in (Figure 401, Figure 402, Figure 403).
  - (c) Install lockwire for left threads opposite to that shown in (Figure 401, Figure 402, Figure 403).
  - (d) Make sure the loop of double wire goes around, not above, the head of the bolt or screw.

**CAUTION:** NEVER LOOSEN OR TIGHTEN A NUT OR BOLT OUT OF ITS SPECIFIED TORQUE RANGE. DAMAGE CAN OCCUR.

- (e) When you install lockwires on nuts and bolts, tighten the nuts and bolts to the low values of the torque range.

**NOTE:** If necessary, continue to tighten until a slot aligns with the safety hole.

SUBTASK 20-10-44-420-002

- (3) To install lockwire on electrical connectors, (Figure 402).
  - (a) Use the instructions for the installation of lockwires to bolt and screws when you install lockwires on electrical connectors.

SUBTASK 20-10-44-420-003

- (4) To install cotter pins (Figure 403), do the applicable step:
  - (a) To install cotter pins in castellated nuts, install the pin with the head parallel to the slot in the nut.
    - 1) Bend the cotter pin ends to the bolt end or to the castellated nut's slit adjacent to the pin end.
  - (b) To install cotter pins and washers on clevis pins, put the pin through the hole on the bolt and bend the pin ends around the side of the bolt.
  - (c) To install cotter pins in non-castellated nuts, install the pin through the hole on the bolt and bend the pin ends back on each side of the bolt approximately 90 degrees.

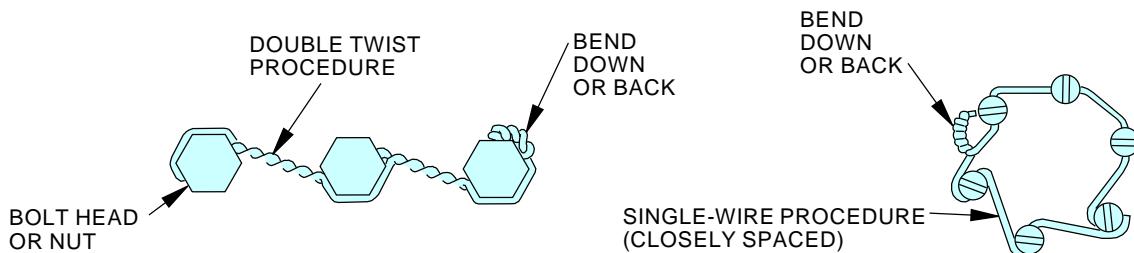
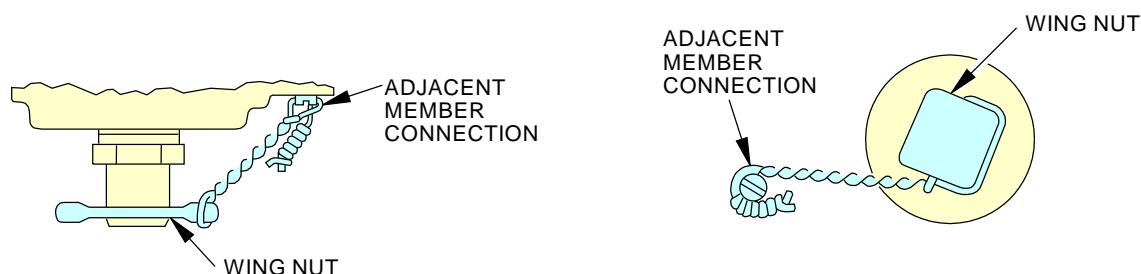
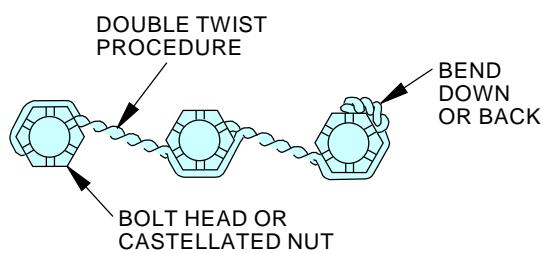
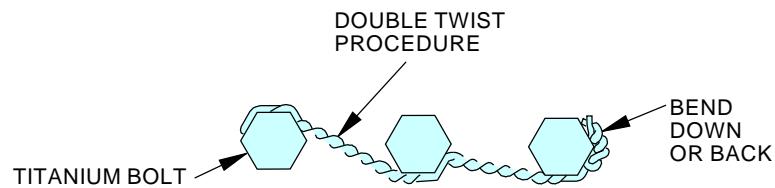
SUBTASK 20-10-44-420-004

- (5) To install lockrings (Figure 403), do these steps:
  - (a) Put the bent hook of the lockring into an aligned locking hole in the shaft and nut but do not spring the ring.
  - (b) Move the lockring over the flange into the groove with minimum expansion of the lockring.

— END OF TASK —

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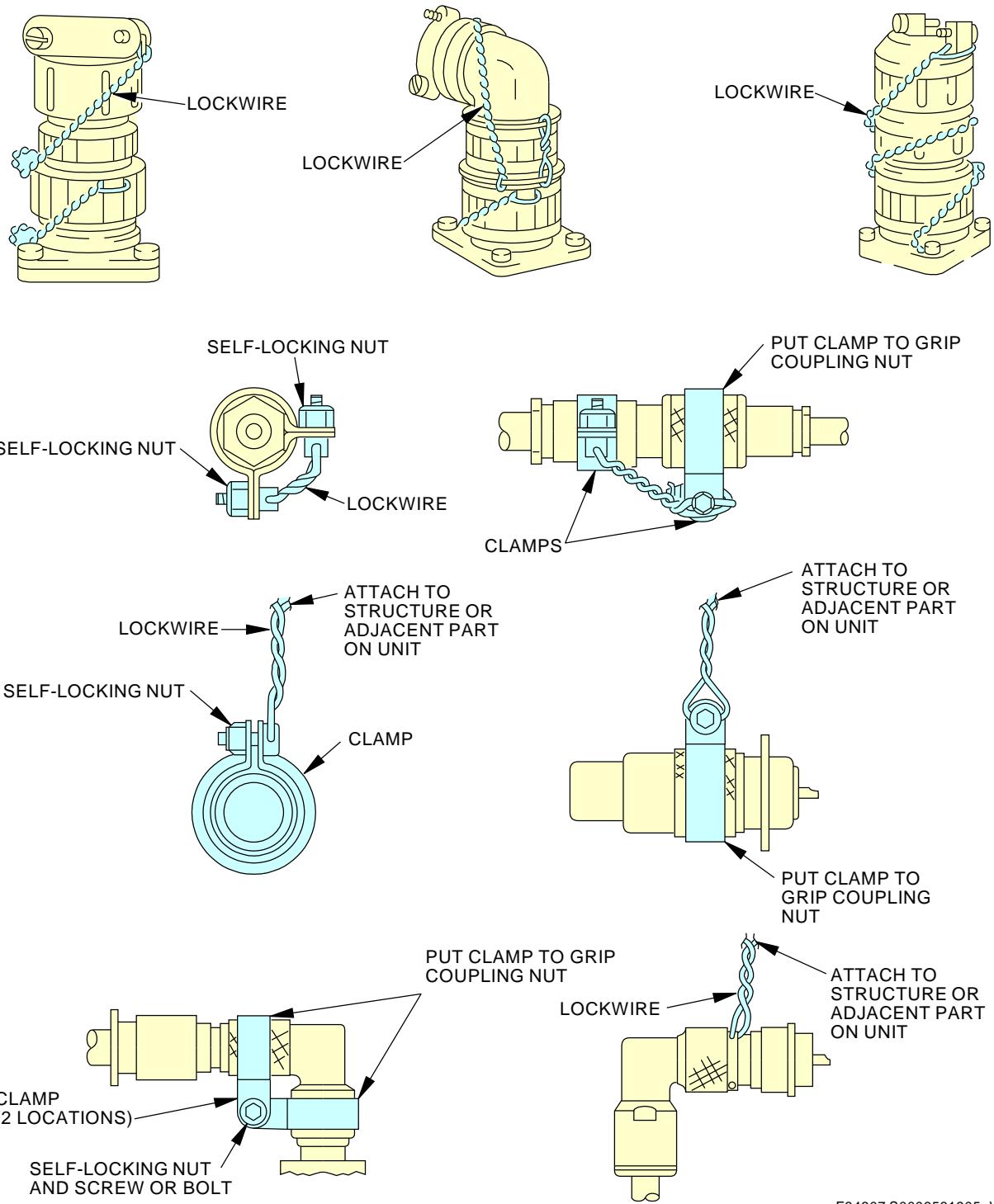
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**Lockwire Installation**  
**Figure 401/20-10-44-990-801**

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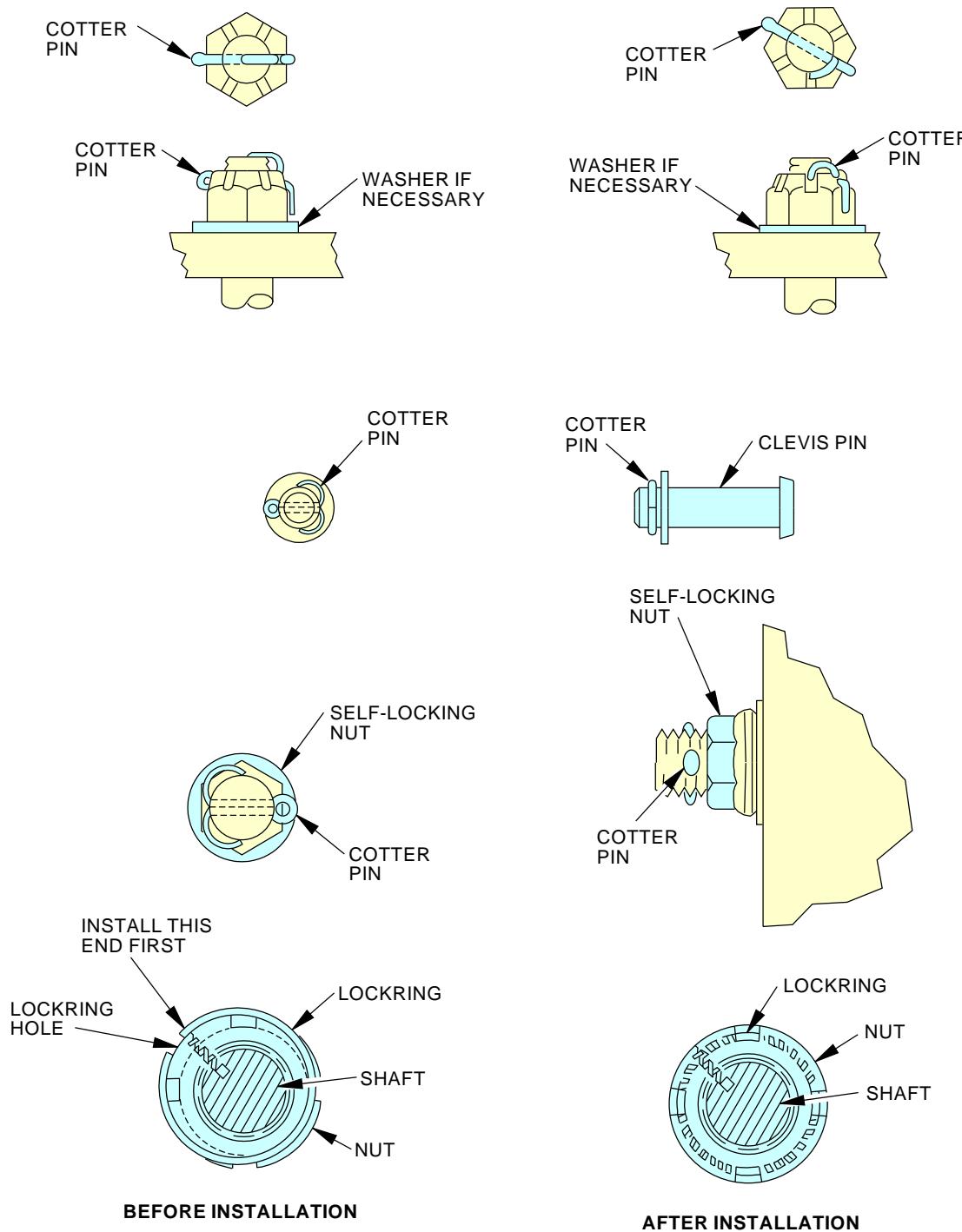
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**Connector Lockwire Installation  
Figure 402/20-10-44-990-802**

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**Locking Pins Installation**  
**Figure 403/20-10-44-990-803**

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**TASK 20-10-44-000-802**

**4. Safety Cable Removal**

**A. Remove the Safety Cable**

SUBTASK 20-10-44-020-002

- (1) Cut and remove the safety cable.

———— END OF TASK ————

**TASK 20-10-44-400-802**

**5. Safety Cable Installation**

**A. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-2046	Tool - Installation, Safety Cable, 0.032 Inch Dia, 5 Inch Tool Nose Part #: BM325 Supplier: 70958 Opt Part #: M305 Supplier: 70958
COM-2048	Tool - Installation, Safety Cable, 0.020 Inch Dia Part #: BM203 Supplier: 70958 Part #: SCT203 Supplier: 11851 Part #: SCT207 Supplier: 11851

**B. Install the Safety Cable**

SUBTASK 20-10-44-420-005

- (1) The use of corrosion and heat resistant safety cable is acceptable in place of safety wire only if specified by engineering documents.
- (2) A maximum of 3 fasteners can be safety-cabled together in series.
- (3) The maximum space between fasteners to be safety-cabled together must not exceed 6 inches.
- (4) Nicks, frays, kinks and other mutilations of the safety cable between tension points are not acceptable. The safety cable shall be installed so that the only tension imposed on the cable is from the safety cable installation tool, COM-2048, safety cable installation tool, COM-2046.
- (5) Maximum hole diameter shall be in accordance with this table.

**Maximum Cable Hole Diameters**

CABLE DIAMETER	MAX HOLE DIAMETER
0.020 in. (0.508 mm) to 0.026 in. (0.660 mm)	0.035 in. (0.889 mm)
0.032 in. (0.813 mm) to 0.038 in. (0.965 mm)	0.080 in. (2.032 mm)
0.040 in. (1.016 mm) to 0.046 in. (1.168 mm)	0.080 in. (2.032 mm)

- (6) Safety cable must meet the flex requirements of this table.

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**Safety Cable Flex Limits**

<b>Space Between Fastener</b>	<b>Maximum Flex at Center</b>
0.0 in. (0.0 mm) to 0.5 in. (12.7 mm)	0.125 in. (3.175 mm)
0.5 in. (12.7 mm) to 1.0 in. (25.4 mm)	0.250 in. (6.350 mm)
1.0 in. (25.4 mm) to 2.0 in. (50.8 mm)	0.375 in. (9.525 mm)
2.0 in. (50.8 mm) to 3.0 in. (76.2 mm)	0.375 in. (9.525 mm)
3.0 in. (76.2 mm) to 4.0 in. (101.6 mm)	0.500 in. (12.700 mm)
4.0 in. (101.6 mm) to 5.0 in. (127.0 mm)	0.500 in. (12.700 mm)
5.0 in. (127.0 mm) to 6.0 in. (152.4 mm)	0.625 in. (15.875 mm)

- (7) Correctly crimped ferrules have a general triangular shape. The die indentation must extend a minimum length from the outer end of the ferrule as specified in this table.

**Minimum Die Indentation Length**

<b>Cable Diameter</b>	<b>Minimum Extension</b>
0.032 in. (0.813 mm), 0.040 in. (1.016 mm)	0.10 in. (2.54 mm)
0.020 in. (0.508 mm)	0.075 in. (1.905 mm)

- (a) The cut cable shall extend a maximum of .06 inch beyond the installed ferrule.

— END OF TASK —

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SEALS ON OPEN ELECTRICAL TERMINALS IN FLAMMABLE LEAKAGE ZONES - MAINTENANCE  
PRACTICES

**1. General**

- A. This procedure has this task:
  - (1) The task is to seal the uninsulated electrical terminals and connections in the flammable leakage zones.
- B. When you replace or install components on the lighting systems in flammable leakage zones, seal these uninsulated items:
  - (1) Lamp terminals
  - (2) Terminal strips
  - (3) Circuit breakers
  - (4) Transformers
  - (5) Switches
  - (6) Hardwire
  - (7) Wire junctions.
  - (8) Lamp terminals with a rubber sleeve are open.
- C. Do not seal the dual grounds in the flammable leakage zones or the wire junctions in fuel tanks.
- D. Do not seal the generator terminals on the engines or APU.
- E. Install wire and protectors on all secondary switch leads and seal all secondary switch terminals in the flammable leakage zones. Insulated splices are not open.
- F. To identify flammable leakage zones, (SWPM 20-30-00), Protection of Electrical Connections in a Flammable Leakage Zone.

**TASK 20-10-47-390-801**

**2. Seal the Unprotected Terminals**

(Figure 201)

**A. References**

Reference	Title
SWPM 20-30-00 Electrical Connection of Equipment	Standard Wiring Practices Manual

**B. Tools/Equipment**

Reference	Description
STD-1080	Brush - Paint

**C. Consumable Materials**

Reference	Description	Specification
B00083	Solvent - VM&P Naphthas	ASTM D-3735 Type III
G00034	Cotton Wiper - Process Cleaning Absorbent Wiper (Cheesecloth, Gauze)	BMS15-5 Class A

**D. Procedure**

SUBTASK 20-10-47-110-001

- (1) Remove all dirt and grease for a minimum of 1.00 in. (25.40 mm) adjacent to the area you will seal.

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- (a) Use a cotton wiper, G00034 moist with solvent, B00083.

SUBTASK 20-10-47-390-001

**CAUTION:** DO NOT SEAL THE SHANK OF LAMP TERMINALS THAT ARE MOVABLE SPRING-LOADED PART OF THE BAYONET LAMP SOCKET BASE. SEAL ONLY THE TERMINAL END AND ATTACHED HARDWARE. SEALANT ON THE SHANK LIMITS MOVEMENT OF THE LAMP CONTACT.

- (2) Use a paint brush, STD-1080 to apply one layer of sealant to the uninsulated areas.
- (a) Refer to SWPM 20-30-00 Electrical Connection of Equipment, Protection of Electrical Connections in a Flammable Leakage Zone, for approved sealants.

SUBTASK 20-10-47-390-002

- (3) On ring torque terminals, apply sealant as follows:
- (a) Apply sealant to the uninsulated parts of the terminal (Figure 201).

———— END OF TASK ————

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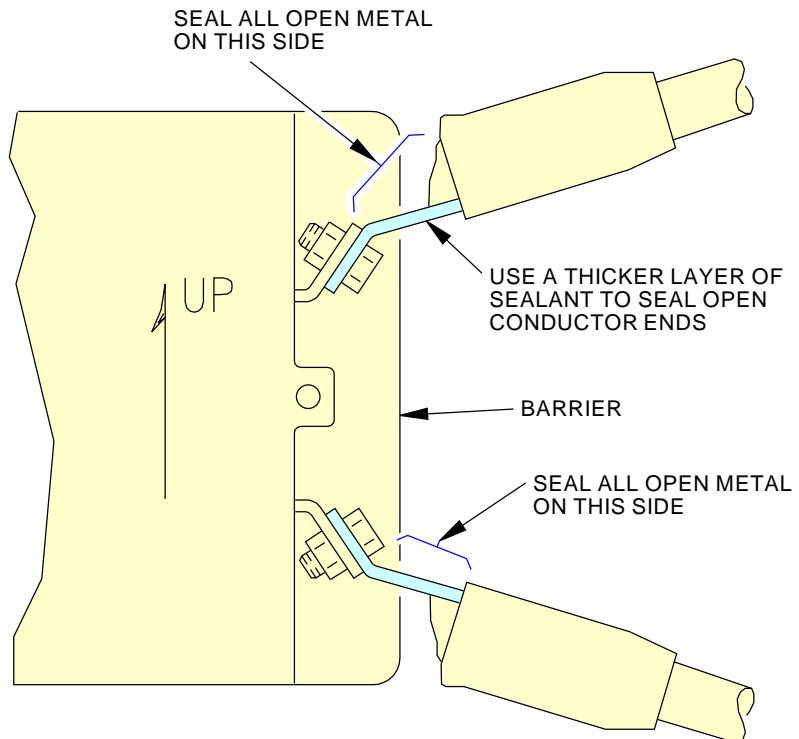
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**Sealant Installation on Ring Tongue Terminals**  
**Figure 201/20-10-47-990-802**

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DETERMINE INSTALLATION TORQUE FOR TUBES/FITTINGS/HOSES

**TASK 20-10-51-910-801**

**1. Tube Material and End Fitting Determination for Hydraulic Tube Assembly**

**A. General**

- (1) This task provides the steps on how to find the correct torque value for the hydraulic tube assembly, fitting or hose assembly. Use this task when the specific torque value is not given in the procedure. For further information, please refer to Service Letter per model (see Table 201).

**Table 201/20-10-51-993-935 Service Letter for All Models**

Models
737-SL-29-118
747-SL-29-077
757-SL-29-053
767-SL-29-066
777-SL-29-040

**B. Procedure**

**SUBTASK 20-10-51-910-002**

- (1) Use the Boeing drawing system to determine tube material and end fittings. Do the following:
- Review the Parts List (PL) for the Tube Assembly  
NOTE: GA notes indicate hydraulic system, tube size and material
  - Determine the outer diameter in inches  
NOTE: Dimension may also be referred to as a size or dash number. For example, a Hydraulic System A with dimension 3/8 can also be defined as sixteenths of an inch = 6/16 = size 06 or —6.
  - Review breakdown of tube sizes and corresponding thread sizes. Table 202.

**Table 202/20-10-51-993-926 Typical Tube Size Designation/Corresponding Thread**

Tube - Actual Diameter (inches)	Tube Size in Sixteenths of an Inch	Typical Dash No. Designation	Typical Size Designation	Corresponding Thread Size for Threaded End
1/4	4	-4	04	0.4375-20
3/8	6	-6	06	0.5625-18
1/2	8	-8	08	0.7500-16
5/8	10	-10	10	0.8750-14
3/4	12	-12	12	1.0625-12
1	16	-16	16	1.3125-12
1-1/4	20	-20	20	1.6250-12
1-1/2	24	-24	24	1.8750-12
2	32	-32	32	2.5000-12

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- (d) Review the same entry in the Parts List (PL) to determine the end fittings for the Tube Assembly.

NOTE: For example, may need 2 each P/N AS1581T06 sleeves ("T" in P/N means titanium material) and 2 each P/N BACN10YA6L B-nuts (N10YA nut made from titanium material). See Figure 202

NOTE: Contact Boeing if no drawing system access is available.

SUBTASK 20-10-51-800-015

- (2) Use Tubing Specification and Wall Thickness table for Hydraulic Tubes:

NOTE: The table shows the standard tube materials, related procurement specification, tube diameter and wall thickness. The tube materials and respective outside diameters/wall thickness listed in the table include 3AL-2.5V titanium, 21-6-9 corrosion resistant steel (CRES) and 6061-T6 aluminum.

- (a) Information is provided for all models in Table 203

**Table 203/20-10-51-993-927 Tube Specification and Wall Thickness Table for All Models**

Models	Location in AMM
737-300/400/500	20-10-51/801
737-600/700/800/900	20-10-51/801
747-100/200	20-11-05/801
747-400	20-11-05/801
747-8	20-11-05/801
757	20-10-09/801
767	20-10-09/801
777	20-10-09/801

SUBTASK 20-10-51-800-016

- (3) Use Cross Reference of Tubing table to correspond to Boeing Material Specification (BMS):

- (a) Information is provided for all models in Table 204

**Table 204/20-10-51-993-928**

Models	Location in AMM
737-300/400/500	20-10-51/801
737-600/700/800/900	20-10-51/801
747-100/200	20-11-05/801
747-400	20-11-05/801
747-8	20-11-05/801
757	20-10-09/801
767	20-10-09/801
777	20-10-09/801

SUBTASK 20-10-51-800-017

- (4) Use Hydraulic Tubing Material Identification in Multi-Model Maintenance Tip to determine the material of hydraulic tubing:

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- (a) Information is provided for all models in Table 205

**Table 205/20-10-51-993-929 Multi-Model Maintenance Tip Table for All Models**

Models
737NG-737 MT 29-014
747-8 MT 29-027
747-400 MT 29-007
757 MT 29-007
767 MT 29-012
777 MT 29-008

SUBTASK 20-10-51-200-005

- (5) Use the Illustrated Parts Catalog (IPC) to find the type of material that you will attach each end of the tubing to:

NOTE: This step is necessary to determine the torque value that you will apply to the reconnectable fittings on the ends of the tube assembly. For example: A titanium B-nut that will be assembled to an aluminum fitting will require a lower torque value than is required for a similar fitting made from titanium or CRES material.

- (a) Hydraulic fittings have the material code marked on the wrench pas area. Use Table 206 to identify the materials

**Table 206/20-10-51-993-930 Hydraulic Fitting Material Codes**

Codes	Material
"No Code" or "-"	Carbon Steel with Cadmium Plate Finish
"D"	2014/2024 Aluminum - Green Anodize Finish ("D" code now inactive)
"H"	15-5PH CRES - no Finish (dull gray to metallic bright)- See also "V" code. "H" used for earlier fittings in the 15-5PH CRES material, such as flareless BACS13BX sleeves and BACU24AB unions ("H" + "P" suffix code used for these fittings in 15-5PH CRES material with Cadmium plate finish)
"J"	304 CRES - no finish (dull gray to metallic bright)
"K"	3169 CRES - no finish (dull gray to metallic bright)
"P"	15-5PH CRES with Cadmium Plate Finish*
"R"	321 CRES - no Finish (dull gray to metallic bright)
"S"	347 CRES (now cancelled)
"T"	6AL-4V Titanium - usually Gray from Fluride Phosphate Finish
"V"	15-5PH CRES - no Finish (dull gray to metallic bright)*
"W"	7075 Aluminum - Brown Anodize Finish
"V — P"	15-5PH CRES with Cadmium Plate Finish

SUBTASK 20-10-51-910-003

- (6) Select and apply the correct torque value as follows:

- (a) Use Table 207 to locate the correct torque values per model for Flareless Tubing Fittings:

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**Table 207/20-10-51-993-931 Installation Torque for Flareless Tubing Fittings Table for All Models**

Models	Location in AMM
737-300/400/500	20-50-11/201
737-600/700/800/900	20-50-11/201
747-400	20-51-01/201
748-8	20-51-01/201
757	20-11-00/201
767	20-11-00/201
777	20-11-00/201

- (b) Use Table 208 to locate the correct torque values per model for Flareless Fittings in pressurized area:

NOTE: Pressurized area refers to parts of the airplane that are subject to cabin pressure. These are cockpit, passenger and cargo.

**Table 208/20-10-51-993-932 Installation Torque for Flareless Fittings in Pressurized Area**

Models	Location in AMM
737-300/400/500	20-10-51/401
737-600/700/800/900	20-10-50/401
747-400	20-51-01/401
747-8	20-11-05/401
757	20-10-09/401
767	20-10-09/401
777	20-10-09/401

———— END OF TASK ————

**TASK 20-10-51-910-802**

**2. Torque Values for Tubes, Hoses or Fittings installed to Components Determination**

**A. General**

- (1) This task will help determine the correct torque value for Tubes, Hoses or Fittings installed to Components. For further information, refer to Service Letter per model (see Table 209).

**Table 209/20-10-51-993-933 Service Letter for All Models**

Models
737-SL-29-119
747-SL-29-078
757-SL-29-054
767-SL-29-067
777-SL-29-041

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**B. References**

Reference	Title
20-10-52-990-812	Figure: Hydraulic Hose Identification (P/B 201)

**C. Procedure**

SUBTASK 20-10-51-200-006

- (1) Determine torque for Hydraulic Tube or Hose End with seal (e.g. Union P/N MS21902) installed in Component Boss Port (see Figure 201). Do the following:
  - (a) Determine the materials. Do one of the following:
    - 1) Tube Assembly (see Tube Material and End Fitting Determination for Hydraulic Tube Assembly, TASK 20-10-51-910-801).
    - 2) Hose End (see Figure 20-10-52-990-812).
    - 3) Union (see Figure 202).
  - (b) Use Component Maintenance Manual (CMM) to determine the component material
 

NOTE: Most components have flareless union fittings on their external ports. Determine the material of the union fitting (see Table 206).

NOTE: Contact Boeing if no CMM access is available.
  - (c) Select the correct torque (see Table 210).

**Table 210/20-10-51-993-934 Selecting Torque for Tube or Hose Assembly on Mating Union or Component**

--		Mating Union Fitting or Component Material (if no union fitting is present)		
		Aluminum	Corrosion Resistant Steel (CRES)	Titanium (Ti)
Tube Material or Tube End / Hose End Fitting Material	Aluminum or Annealed CRES	Use Aluminum Values	Use Aluminum Values	Use Aluminum Values
	Corrosion Resistant Steel(CRES)	Use Aluminum Values	Use CRES/Titanium Values	Use CRES/Titanium Values
	Titanium (Ti)	Use Aluminum Values	Use CRES/Titanium Values	Use CRES/Titanium Values

**CAUTION:** USE TWO WRENCHES WHEN YOU TIGHTEN THE TUBE CONNECTORS. USE ONE WRENCH TO HOLD THE MATING TUBE ADAPTER. USE THE OTHER WRENCH TO TURN THE TUBE CONNECTOR. IF YOU DO NOT OBEY THIS INSTRUCTION, YOU CAN CAUSE DAMAGE TO THE TUBES.

- (d) Apply torque value for the end of the tube or hose assembly attached to the union fitting clockwise (see Table 207 and Table 208).

NOTE: Do not align or rotate fittings or tube assemblies after the joint has been tightened. Rotating the joint after tightening may cause leaks.

SUBTASK 20-10-51-200-007

- (2) Determine torque for Hydraulic Tube or Hose End installed to Union Fitting that has a Recessed Seal Boss End and Seal (e.g. Union Fitting P/N BACA14AZ with Flareless End per AS33541 and Boss End per BACD2037) (See Figure 201). Do the following:
  - (a) Determine the materials. Do one of the following:

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- 1) Tube Assembly (see Tube Material and End Fitting Determination for Hydraulic Tube Assembly, TASK 20-10-51-910-801).
    - 2) Hose End (See Figure 20-10-52-990-812).
    - 3) Union (see Figure 202).
  - (b) Use Component Maintenance Manual (CMM) to determine the component material.  
NOTE: Most components have flareless union fittings on their external ports. Determine the material of the union fitting (see Table 206).  
NOTE: Contact Boeing if no CMM access is available.
  - (c) Select the correct torque (see Table 210).
- CAUTION:** USE TWO WRENCHES WHEN YOU TIGHTEN THE TUBE CONNECTORS. USE ONE WRENCH TO HOLD THE MATING TUBE ADAPTER. USE THE OTHER WRENCH TO TURN THE TUBE CONNECTOR. IF YOU DO NOT OBEY THIS INSTRUCTION, YOU CAN CAUSE DAMAGE TO THE TUBES.
- (d) Apply torque value for the end of the tube or hose assembly attached to the union fitting clockwise (see Table 207 and Table 208).  
NOTE: Do not align or rotate fittings or tube assemblies after the joint has been tightened. Rotating the joint after tightening may cause leaks.

SUBTASK 20-10-51-200-008

- (3) Determine torque for Hydraulic Swivel Elbow Fitting (e.g. P/N BACE21BR) installed to Standard Union Fitting with Seal (e.g. Union P/N MS21902) in Component Boss Port (see Figure 201). Do the following:
    - (a) Determine the materials of Elbow Fitting and Union (see Figure 202).
    - (b) Use Component Maintenance Manual (CMM) to determine the component material.  
NOTE: Most components have flareless union fittings on their external ports. Determine the material of the union fitting (see Table 206).  
NOTE: Contact Boeing if no CMM access is available.
    - (c) Select the correct torque (see Table 210).
- CAUTION:** USE TWO WRENCHES WHEN YOU TIGHTEN THE TUBE CONNECTORS. USE ONE WRENCH TO HOLD THE MATING TUBE ADAPTER. USE THE OTHER WRENCH TO TURN THE TUBE CONNECTOR. IF YOU DO NOT OBEY THIS INSTRUCTION, YOU CAN CAUSE DAMAGE TO THE TUBES.
- (d) Apply torque value for the end of the tube or hose assembly attached to the union fitting clockwise (see Table 207 and Table 208).  
NOTE: Do not align or rotate fittings or tube assemblies after the joint has been tightened. Rotating the joint after tightening may cause leaks.

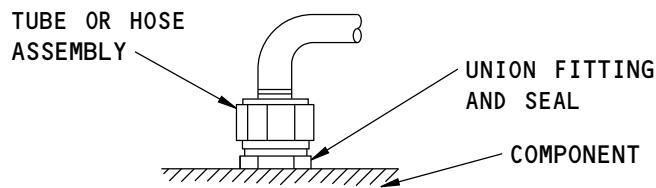
———— END OF TASK ————

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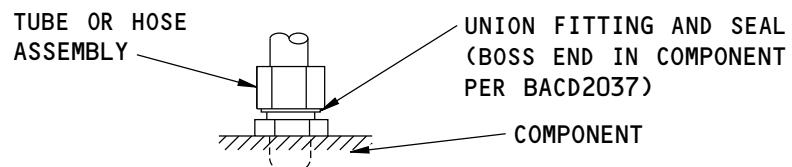
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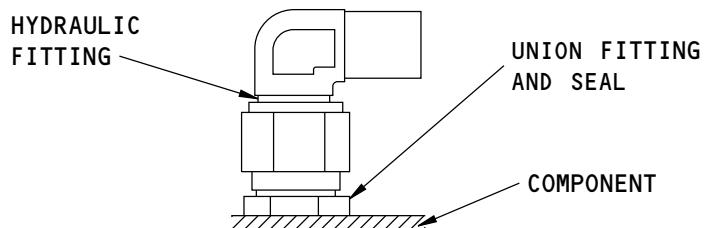
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HYDRAULIC TUBE OR HOSE END TO UNION WITH SEAL (eg., UNION P/N MS21902) INSTALLED IN COMPONENT BOSS PORT



HYDRAULIC TUBE OR HOSE END INSTALLED TO UNION FITTING THAT HAS A RECESSED SEAL BOSS END AND SEAL (EG., UNION FITTING P/N BACA14AZ WITH FLARELESS END PER AS33514 AND BOSS PER BACD2037)



SWIVEL ELBOW FITTING (eg., P/N BACE21BR) INSTALLED TO STANDARD UNION FITTING WITH SEAL (eg., UNION P/N MS21902) IN COMPONENT BOSS PORT

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Tubes, Hoses, and Fittings Installed to Components  
Figure 201/20-10-51-990-926

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SLEEVE AND B-NUT FITTINGS						
FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
SLEEVE, INTERNAL SWAGED		BAC513BX	CRES	H = 15-5PH, FINISH; HP = 15-5PH, CADMIUM PLATE FINISH	NATURAL SILVER COLOR OR YELLOWISH BROWN (CADMIUM PLATED)	BAC513BX06HP
SLEEVE, WELDED		AS1581	TITANIUM (CRES VERSION NOT USED)	T = 6AI-4V	NATURAL SILVER COLOR	AS1581T06
NUT, TUBE COUPLING, LIGHTWEIGHT, REDUCED CROSS-SECTION		BACN10YA	TITANIUM	NONE (BASE P/N = 6AI-4V)	DULL GRAY OR, IF DRY FILM LUBRICATED (N SUFFIX CODE), DARK	BACN10YA6N
		BACN10YE	CRES	NONE (BASE P/N = 15-5PH)	NATURAL SILVER COLOR ("L" CODE = DRY FILM ON ID ONLY)	BACN10YE6L
		BACN10YL	ALUMINUM	NONE (BASE P/N = 7075)	BROWN	BACN10YLD6
		BACN11AU	TITANIUM	NUT - NONE (BASE P/N = 6AI-4V); WIRE - CRES (BACN11BB)	DARK GRAY, FROM DRY FILM LUBRICATION	BACN11AU06 NOTE: PHASE-IN TO AIRPLANE PRODUCTION UNDERWAY
NUT, COUPLING, WIRED FLARELESS, 3,000 PSI		MS21921 (SEE STANDARD AS21921)	CRES	V--P = 15.5PH WITH CADMIUM PLATE FINISH (REPLACES "--" OR NO CODE CARBON STEEL)	YELLOWISH BROWN (CADMIUM PLATED)	
				V = 15-5PH (NO FINISH)	NATURAL SILVER COLOR	CODES J, K, R, S - SEE BACN10YE; CODE T - SEE BACN10YA;
		J (304), R (321)		J (316), R (321)	NATURAL SILVER COLOR	CODE W - SEE BACN10YL
		ALUMINUM	W = 7075		BROWN	MS21921V4P
TITANIUM T = 6AI-4V DULL GRAY						

NOTE: NOT KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.

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**Hydraulic Fitting Identification Information**  
**Figure 202/20-10-51-990-927 (Sheet 1 of 25)**

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UNION FITTINGS						
FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
STANDARD FLARELESS UNION (NO REDUCER PROVISIONS)	  <b>MS21902</b> (SEE STANDARD AS21902)	<b>CRES</b>  <b>MS21902</b> (SEE STANDARD AS21902)	CARBON STEEL	NO CODE (REPL BY V--P)	YELLOWISH BROWN	
			J (304), K (316), R (321)	NATURAL SILVER COLOR	"_" OR "NO CODE" - USE CODE V-P; CODES J, K, R - SEE AS5230U;	
			V (15-5PH) NO FINISH	NATURAL SILVER COLOR	CODE T - SEE AS5230T;	
			V--P (15-5PH WITH CADMIUM PLATE FINISH)	YELLOWISH BROWN	CODE W - SEE AS5230W	<b>MS21902V4P</b>
			ALUMINUM W = 7075	BROWN		
	  <b>MS21916</b> (REDUCER - SEE STANDARD AS21916)	<b>TITANIUM</b>  <b>MS21916</b> (REDUCER - SEE STANDARD AS21916)	T (6AI-4V)	DULL GRAY		
			CARBON STEEL	NO CODE (REPL BY V--P)	YELLOWISH BROWN	
			J (304), K (316), R (321)	NATURAL SILVER COLOR	"_" OR "NO CODE" - USE CODE V-P; CODES J, K, R - SEE AS5230U;	
			V (15-5PH) NO FINISH	NATURAL SILVER COLOR	CODE T - SEE AS5230T;	
			V--P (15-5PH WITH CADMIUM PLATE FINISH)	YELLOWISH BROWN	CODE W - SEE AS5230W	<b>MS21916V8-4P</b>
	  <b>BACR17E</b>	<b>ALUMINUM</b>  <b>BACR17E</b>	W = 7075	BROWN		
			T (6AI-4V)	DULL GRAY		
			TITANIUM T (6AI-4V)	DULL GRAY		
			BACR17E			<b>BACR17E8-4</b>

**NOTE:** NOT KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.

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**Hydraulic Fitting Identification Information**  
**Figure 202/20-10-51-990-927 (Sheet 2 of 25)**

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UNION FITTINGS (CONTINUED)						
FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
LIGHTWEIGHT FLARELESS SWAGE UNION		BACU24AB (ONE SWAGED END)	CRES	H (15-5PH)	NATURAL SILVERY COLOR	BACU24AB10HP
LIGHTWEIGHT FLARELESS WELD UNION		AS1582 (CONE WELDED END)	ALUMINUM	W = 7075	YELLOWISH BROWN TUBE ONLY	
FLARELESS BULKHEAD UNION (NO REDUCER PROVISIONS)		MS21924 (SEE STANDARD AS21924)	CRES	TITANIUM T (6AI-4V)	NATURAL SILVERY COLOR	AS1582T08
FLARELESS BULKHEAD UNION, REDUCER		EFFECTIVITY AKS ALL	CARBON STEEL BY V-P	NO CODE (REPL BY V-P)	YELLOWISH BROWN	
				J (304), K (316), R (321)	NATURAL SILVERY COLOR	"-" OR "NO CODE" - USE CODE V-P;
				V (15-5PH) NO FINISH	NATURAL SILVERY COLOR	CODES K, S - USE CODE J;
				V--P (15-5PH WITH CADMIUM PLATE FINISH)	YELLOWISH BROWN	CODE W, J, K, R, S, T - SEE AS1007 IN CODES W, J, T, RESPECTIVELY
				ALUMINUM W (7075)	BROWN	MS21924V4P
				TITANIUM T (6AI-4V)	DULL GRAY	
				CARBON STEEL "	YELLOWISH BROWN	
				CRES J (304), R (321)	NATURAL SILVERY COLOR	CODES "NO CODES" J, K, R - SEE AS1007J;
				ALUMINUM D (2024)	GREEN	CODE D, SEE AS1007W; CODE T - SEE AS1007T
				TITANIUM T (6AI-4V)	DULL GRAY	BACU24AA0812J

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**Hydraulic Fitting Identification Information**  
**Figure 202/20-10-51-990-927 (Sheet 3 of 25)**

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EXTERNALLY SWAGED (PERMASWAGE TYPE) ADAPTER UNION FITTINGS						
FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
ADAPTER, EXTERNALLY SWAGED TO FLARELESS BULKHEAD, REDUCER		BACA14BP	CREST	NO CODE (21-6-9, ANNEALED)	GREEN ON TIP AND HEX FLATS, YELLOWISH BROWN	BACA14BP1212J
ADAPTER, EXTERNALLY SWAGED TO BOSSED FLANGE		BACA14BM	ALUMINUM	D (6061-T6, OVERAGED)	GREEN, EXCEPT FOR BULKHEAD END (GOLDISH ANODIZE)	
			CREST	NO CODE (21-6-9, ANNEALED)	GREEN ON TIP AND BACK OF FLANGE, YELLOWISH BROWN	CODE J - USE CODE JA; CODE DA - USE CODE DA
			ALUMINUM	D (6061-T6, OVERAGED)	GREEN, EXCEPT FOR BULKHEAD END (GOLDISH ANODIZE)	SUFFIX CODE E = EXTENDED LENGTH OPTION

NOTE: NOT KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.

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**Hydraulic Fitting Identification Information**  
**Figure 202/20-10-51-990-927 (Sheet 4 of 25)**

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FLARELESS FITTINGS WITH BOEING RECESSED SEAL BOSS END						
FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
ADAPTER, STRAIGHT, FLARELESS TUBE TO RECESSED SEAL BOSS		BACA14AZ	CRES	J (304), K (316), R (321)	NATURAL SILVERY COLOR	NOTE: SIZE DESIGNATION IN P/N HAS "A" INCLUDED, EG., SIZE 08 IS "8A"
			ALUMINUM	D (2024)	GREEN	
			TITANIUM	T (6Al-4V)	DULL GRAY	
ADAPTER, 45 DEGREE, FLARELESS TUBE TO RECESSED SEAL BOSS		BACA14BA	CRES	NO CODE (WITH CADMIUM PLATE FINISH)	YELLOWISH BROWN	NOTE: SIZE DESIGNATION IN P/N HAS "B" INCLUDED, EG., SIZE 12 IS "12B", AVAILABLE IN NON-REDUCER ONLY
			CARBON STEEL	J (304), K (316), R (321)	NATURAL SILVERY COLOR	
			ALUMINUM	W (7075)	BROWN	
ADAPTER, 90 DEGREE, FLARELESS TUBE TO RECESSED SEAL BOSS		BACA14BB	CRES	NO CODE (WITH CADMIUM PLATE FINISH)	YELLOWISH BROWN	NOTE: SIZE DESIGNATION IN P/N HAS "B" INCLUDED, EG., SIZE 12 IS "12B", AVAILABLE IN NON-REDUCER ONLY
			CARBON STEEL	J (304), K (316), R (321)	NATURAL SILVERY COLOR	
			ALUMINUM	W (7075)	BROWN	

**Hydraulic Fitting Identification Information**  
**Figure 202/20-10-51-990-927 (Sheet 5 of 25)**

NOTE: NOT KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.  
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FITTING SHAPES WITH FLARELESS ENDS						
FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
ELBOW, 45 DEGREE, SWIVEL, REDUCER (LIGHTWEIGHT REDUCED BODY)		BACE21BR	CRES	JN (304) - WITH DRY FILM LUBE P (15-5PH WITH CADMIUM PLATE FINISH)	NATURAL SILVERY COLOR YELLOWISH BROWN	CODES JN, P, T - SEE AS4137 IN CODES J, P, T, RESPECTIVELY
		AS4137	TITANIUM	T (6AI-4V)	DARK GRAY	AS4137V0806P  NOTE: PHASE-IN TO AIRPLANE PRODUCTION UNDERWAY.
			CRES	J (304), DRY FILM ON NUT ID V (15-5PH), DRY FILM ON NUT ID	NATURAL SILVERY COLOR NATURAL SILVERY COLOR	
				V--P (15-5PH WITH CADMIUM PLATE FINISH)	YELLOWISH BROWN	
			TITANIUM	T (6AI-4V), DRY FILM ON NUT ID	DARK GRAY	

**Hydraulic Fitting Identification Information**  
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FITTING SHAPES WITH FLARELESS ENDS (CONTINUED)						
FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
BACE21AU  ELBOW, 45 DEGREE, SWIVEL, REDUCER (STANDARD WEIGHT)		CARBON STEEL	"NO CODE" WITH N SUFFIX	YELLOWISH BROWN (WITH DRY FILM LUBE ON SWIVEL NUT)		CODES N, M, RM - SEE BACE21BR P, J, RESPECTIVELY;
			L (2014/2024)	GREEN (DRY FILM LUBE)		CODES "NO CODE", D, J, K, S - SEE NAS1761 "-" , W, J, K, S, RESPECTIVELY;
		ALUMINUM	R (2014/2024)	GREEN (DRY FILM LUBE-SWIVEL NUT ONLY)		BACE21AU1208W
			M SUFFIX FOR CODES J (304), K (316), S (347)	NATURAL SILVERY COLOR (WITH DRY FILM LUBE)	NOTE: BACE21BR IN CODES JN, P, T NOW SUPERSEDED BY AS4137J, P, T RESPECTIVELY	
		CRES	RM SUFFIX CODE FOR R (321)	NATURAL SILVERY COLOR (WITH DRY FILM LUBE)		
			ALUMINUM W (7075)	BROWN (DRY FILM LUBE-SWIVEL NUT ONLY)		
		ALUMINUM	D (2014/2024)	GREEN	CODES "NO CODES", T, J, K, S - SEE BACE21BR CODES P, T, J, RESPECTIVELY;	
			CRES J (304), S (347)	NATURAL SILVERY COLOR	CODE W - SEE BACE21AU CODE W	NAS1761J0812
		NAS1761	ALUMINUM W (7075)	BROWN	NOTE: BACE21BR IN CODES JN, P, T NOW SUPERSEDED BY AS4137J, F, T, RESPECTIVELY	
			TITANIUM T (6AI-4V)	DULL GRAY		

NOTE: NOT KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.

2336924 S0000533496\_V1

**Hydraulic Fitting Identification Information**  
**Figure 202/20-10-51-990-927 (Sheet 7 of 25)**

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FITTING SHAPES WITH FLARELESS ENDS (CONTINUED)						
FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
ELBOW, 45 DEGREE, BULKHEAD, REDUCER (LIGHTWEIGHT REDUCED BODY)		BACE21BM	CRES	J (304)	NATURAL SILVER COLOR	CODES J, P, T - SEE AS4130V-P, J, T, RESPECTIVELY
			TITANIUM	T (6AI-4V)	DULL GRAY	
				J (304), DRY FILM ON NUT ID	NATURAL SILVER COLOR	AS4130V0806P
				V (15-5PH) DRY FILM ON NUT ID	NATURAL SILVER COLOR	NOTE: PHASE-IN TO AIRPLANE PRODUCTION UNDERWAY.
		AS4130	CRES	V--P (15-5PH) WITH CADMIUM PLATE FINISH	YELLOWISH BROWN	
			TITANIUM	T (6AI-4V), DRY FILM ON NUT ID	DARK GRAY	
			CAREON STEEL	"-" OR NO CODE	YELLOWISH BROWN	"NO CODE", P, T, J, K, S, R - SEE BACE21BM CODES P, T, J, RESPECTIVELY;
			CRES	J (304), K (316), R (321), S (347)	NATURAL SILVER COLOR	CODE W - SEE AS1010W
		BACE21AT	ALUMINUM	W (7075)	BROWN	BACE21AT1008W
			CRES	V--P (15-5PH) WITH CADMIUM PLATE FINISH	YELLOWISH BROWN	CODES "NO CODE", P, T, J, K - SEE BACE21BM CODES P, T, J, RESPECTIVELY;
ELBOW, 45 DEGREE, FLARELESS, STANDARD WEIGHT		MS21907 (SEE STANDARD AS21907)		J (304), K (316), R (321)	NATURAL SILVER COLOR	CODE S - SEE CODE R; CODE W - SEE AS1010W; CODES V-P, R, V - SEE AS4130 IN CODES V-P, J AND V, RESPECTIVELY.
		ALUMINUM	W (7075)		BROWN	CODES V-P, R, V - SEE AS4130 IN CODES V-P, J AND V, RESPECTIVELY.
NOTE: NOT KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.						

**Hydraulic Fitting Identification Information**  
**Figure 202/20-10-51-990-927 (Sheet 8 of 25)**

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FITTING SHAPES WITH FLARELESS ENDS (CONTINUED)						
FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
ELBOW, 45 DEGREE, FLARELESS, NON-REDUCER, STANDARD WEIGHT		AS1010	CARBON STEEL	"NO CODE" OR F	YELLOWISH BROWN	AS1010W0808
			CRES	J (304), K (316), R (321), S (347)	NATURAL SILVERY COLOR	(NO CODE) (-OR F) - SEE AS4130V-P; (NO CODE) D - SEE AS1010 (NO CODE) J, K, R, S - SEE AS4130J (NO CODE) T - SEE AS4130T;
			TITANIUM	T (6AI-4V)	DULL GRAY	G - SEE AS4130V-P; G - (D, F, J, K, R, S, T, W) - SEE AS1010G (D, F, J, K, R, S, T, W) - ; GD - SEE AS1010GW-;
			W (2024-T6)		GREEN	GF - SEE AS4130V-P; G (J, K, S) - SEE AS4130J GT - SEE AS4130T-
			ALUMINUM	W (7075)	BROWN	
		BACE21BT	CRES	JN (304) WITH DRY FILM LUBE ON SWIVEL NUT	NATURAL SILVERY COLOR	CODES JN, P, T - SEE AS4138 IN CODES J, V--P, T, RESPECTIVELY
				P (15-5PH WITH CADMIUM PLATE FINISH)	YELLOWISH BROWN	
			TITANIUM	T (6AI-4V)	DULL GRAY	
			AS4138	J (304) DRY FILM ON NUT ID	NATURAL SILVERY COLOR	
				V (15-5PH) DRY FILM ON NUT ID	NATURAL SILVERY COLOR	
				V--P (15-5PH WITH CADMIUM PLATE FINISH)	YELLOWISH BROWN	
			TITANIUM	T (6AI-4V), DRY FILM ON NUT ID	DARK GRAY	

NOTE: NOT KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.

2325784 S0000527698\_V1

**Hydraulic Fitting Identification Information**  
**Figure 202/20-10-51-990-927 (Sheet 9 of 25)**

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FITTING SHAPES WITH FLARELESS ENDS (CONTINUED)						
FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
ELBOW, 90 DEGREE, SWIVEL, REDUCER (STANDARD BODY)		BACE21AW	CARBON STEEL	"NO CODE" WITH N SUFFIX	YELLOWISH BROWN (WITH DRY FILM LUBE ON SWIVEL NUT)	CODES L, R - USE CODE W; CODES N, JM, KM, SM, RM, M AND T - SEE BACE21BT IN CODES P, J AND T, RESPECTIVELY;
			ALUMINUM	L (2014/2024)	GREEN (DRY FILM LUBE)	BACE21AM1208W
			ALUMINUM	R (2014/2024)	GREEN (DRY FILM LUBE, SWIVEL NUT ONLY)	NOTE: BACE21BT IN CODES JN, P AND T NOW SUPERSEDED BY AS4138 CODES J, V-P AND T, RESPECTIVELY.
			CRES	M SUFFIX - CODES J (304), K (316), S (347), R (321)	NATURAL SILVERY COLOR (WITH DRY FILM LUBE)	
			ALUMINUM	W (7075)	BROWN (WITH DRY FILM ON SWIVEL NUT ONLY)	
		NAS1762	CARBON STEEL	"—" OR NO CODE	YELLOWISH BROWN	CODES "NO CODE", J, K, S AND T - SEE BACE21BT IN CODES P, J AND T, RESPECTIVELY;
			CRES	J (304), K (316), S (347)	NATURAL SILVERY COLOR	CODE W - SEE BACE21AW CODE W.
			ALUMINUM	W (7075)	BROWN	NOTE: BACE21BT IN CODES JN, P AND T NOW SUPERSEDED BY AS4138 CODES J, V-P AND T, RESPECTIVELY.
			TITANIUM	T (6AI-4V)	DULL GRAY	NAS1762J0812

NOTE: NOTE KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.

2325934 S00000527699\_V1

**Hydraulic Fitting Identification Information**  
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FITTING SHAPES WITH FLARELESS ENDS (CONTINUED)						
FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
ELBOW, 90 DEGREE, BULKHEAD, REDUCER (LIGHTWEIGHT BODY)		BACE21BN	CRES	J (304)	NATURAL SILVER COLOR	CODES J, P, T - SEE AS4132 IN CODES J, V-P, T, RESPECTIVELY.
			P (15-5PH WITH CADMIUM PLATE FINISH)		YELLOWISH BROWN	BACE21BN1208T
		TITANIUM	T (6AI-4V)	DULL GRAY		
			CRES	J (304)	NATURAL SILVER COLOR	AS4132V0806P
			V (15-5PH), DRY FILM ON NUT ID	NATURAL SILVER COLOR		
		AS4132	V--P (15-5PH WITH CADMIUM PLATE FINISH)		YELLOWISH BROWN	NOTE: PHASE-IN TO AIRPLANE PRODUCTION UNDERWAY.
		TITANIUM	T (6AI-4V), DRY FILM ON NUT ID	DARK GRAY		
			CARBON STEEL	-- OR NO CODE	YELLOWISH BROWN	"NO CODE" J, K, R, S, T - SEE BACE21BN IN CODES J, P, T, RESPECTIVELY;
		CRES	J (304), K (316), R (321), S (347)	NATURAL SILVER COLOR	BROWN	NOTE: BACE21BN IN CODES J, P AND T NOW SUPERSEDED BY AS4132 IN CODES J, V-P AND T RESPECTIVELY.
		ALUMINUM	W (7075)		DULL GRAY	BACE21AS1008W
		TITANIUM	T (6AI-4V)			
		BACE21AS (REDUCER ONLY)				
		ELBOW, 90 DEGREE, FLARELESS, STANDARD WEIGHT				

NOTE: NOT KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.

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**Hydraulic Fitting Identification Information**  
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**FITTING SHAPES WITH FLARELESS ENDS (CONTINUED)**

FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N	
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION		
ELBOW, 90 DEGREE, FLARELESS, STANDARD WEIGHT		MS21908 (SEE STANDARD AS21908, NON-REDUCER)	CRES	V (15-5PH) V--P (15-5PH WITH CADMIUM PLATE FINISH)	NATURAL SILVER COLOR YELLOWISH BROWN	"NO CODE" J, K, S, T, V - SEE BACE21BN IN CODES K, P, T, CODE S - USE CODE R; CODES R, V, V-P - SEE AS4132 IN CODES J, V, V-P, RESPECTIVELY; CODE W - SEE AS1008 CODE W;	
			J (304), K (316), R (321), S (347)		NATURAL SILVER COLOR	NOTE: BACE21BN IN CODES J, P AND T IS NOW SUPERSEDED BY AS4130 IN CODES J, V-P AND T RESPECTIVELY.	
		ALUMINUM	W (7075)	BROWN			
		TITANIUM	T (6AI-4V)	DULL GRAY			
		CARBON STEEL	"NO CODE" OR F	YELLOWISH BROWN	(NO CODE) (- OR F) - SEE AS4132V-P; (NO CODE) D - SEE AS1008 (NO CODE) W;		
		CRES	J (304), K (316), R (321), S (347)	NATURAL SILVER COLOR	(NO CODE) J, K, R, S - SEE AS4132L; (NO CODE) T - SEE AS4132T;	AS1008W0808	
ELBOW, 90 DEGREE, FLARELESS, STANDARD WEIGHT		AS1008	TITANIUM	T (6AI-4V)	DULL GRAY	G - SEE AS4132V-P; G-(D, F, J, K, R, S, T, W) - SEE AS1008G (D, F, J, K, R, S, T, W)-; GD - SEE AS1008GW-;	NOTE: PHASE-IN TO AIRPLANE PRODUCTION UNDERWAY
			D (2024-T6)	GREEN		GF - SEE AS41320V-P;	
		ALUMINUM	W (7075)	BROWN	G (J, K, S) - SEE AS4132J		
					GT - SEE AS4132T		

NOTE: NOTE KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.

2326190-S0000527701\_V1

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FITTING SHAPES WITH FLARELESS ENDS (CONTINUED)						
FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
ELBOW, 90 DEGREE, REDUCER (LIGHTWEIGHT REDUCED BODY)		BACE21BL	CRES	J (304)	NATURAL SILVER COLOR	CODES J, P, T - SEE AS4131 IN CODES V-P, J, T RESPECTIVELY
		TITANIUM	T (6AI-4V)	DULL GRAY		
			J (304), DRY FILM ON NUT ID	NATURAL SILVER COLOR		AS413V0806P
			V (15-5PH), DRY FILM ON NUT ID	NATURAL SILVER COLOR		NOTE: PHASE-IN TO AIRPLANE PRODUCTION UNDERWAY.
		AS4131	CRES	V--P (15-5PH WITH CADMIUM PLATE FINISH)	YELLOWISH BROWN	
			TITANIUM	T (6AI-4V), DRY FILM ON NUT ID	DARK GRAY	
			CARBON STEEL	"-" OR NO CODE	YELLOWISH BROWN	"NO CODE" J, K, R, S, T - SEE BACE21BL IN CODES J, P, T, RESPECTIVELY; CODE W SEE AS1004, CODE W;
		BACE21AR (STANDARD WEIGHT)	CRES	J (304)	NATURAL SILVER COLOR	BACE21AR1008W
			ALUMINUM	W (7075)	BROWN	NOTE: BACE21BL IN CODES J, P, T, NOW SUPERSEDED BY AS4131 IN CODES J, V--P, T, RESPECTIVELY.
		ELBOW, 90 DEGREE, REDUCER	TITANIUM	T (6AI-4V)	DULL GRAY	
AS1004		ALUMINUM	D (2024-T6)	GREEN		AS1004/VW0808
			W (7075)	BROWN	(NO CODE) D - SEE AS1004 (NO CODE) W;	NOTE: PHASE-IN TO AIRPLANE PRODUCTION UNDERWAY.
		CRES	J (304), R (321), S (347)	NATURAL SILVER COLOR	(NO CODE) J, K, R, S - SEE AS4131 (NO CODE) T - SEE AS4131T.	
NOTE: NOT KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.						

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FITTING SHAPES WITH FLARELESS ENDS (CONTINUED)						
FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
TEE, FLARELESS, REDUCER, LIGHTWEIGHT		BACT16BL	CRES	J (304)	NATURAL SILVER COLOR	CODES J, P, T - SEE AS4133 IN CODES J, V-P, T RESPECTIVELY.
			TITANIUM	T (6AI-4V)	DULL GRAY	
			CRES	J (304)	NATURAL SILVER COLOR	
			V (15-5PH)	V (15-5PH)	NATURAL SILVER COLOR	
			V--P (15-5PH WITH CADMIUM PLATE FINISH)	V--P (15-5PH WITH CADMIUM PLATE FINISH)	YELLOWISH BROWN	
		AS4133	TITANIUM	T (6AI-4V), DRY FILM ON NUT ID	DARK GRAY	
			CARBON STEEL	"-" OR NO CODE	YELLOWISH BROWN	CODES J, K, S, R, "NO CODE", T - SEE BACT16BL IN CODES J, P, T, RESPECTIVELY;
			CRES	J (304), K (316), R (321), S (347)	NATURAL SILVER COLOR	CODE W - SEE AS1005 CODE W;
			ALUMINUM	W (7075)	BROWN	
			TITANIUM	T (6AI-4V)	DULL GRAY	
TEE, FLARELESS, REDUCER, STANDARD WEIGHT		BACT16AS				NOTE: BACT16BL IN CODES J, P, T NOW SUPERSEDED BY AS4133 CODES J, V-P AND T, RESPECTIVELY.
						BACT16AS120810J

**NOTE:** NOT KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.

2327234 S0000527703\_V1

**Hydraulic Fitting Identification Information**  
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FITTING SHAPES WITH FLARELESS ENDS (CONTINUED)							
FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA				EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	MATERIAL CODE SUPERSESSION DATA	
TEE, FLARELESS, REDUCER, STANDARD WEIGHT		MS21905 (SEE STANDARD AS21905 NON- REDUCER)	CARBON STEEL	"-" OR NO CODE	YELLOWISH BROWN	CODE "NO CODE", - SEE BACT16BL IN CODE P; CODE P SEE AS4133	
		CRES	J (304)		NATURAL SILVERY COLOR	CODE P; CODE W - SEE AS1005	
		ALUMINUM	W (7075)	BROWN		CODE W; CODES J, K - SEE SUPERSEDED BACT16BL	MS21905V4P
		TITANIUM	T (6AI-4V)	DULL GRAY		CODE J; CODE S - SEE AS4133	
						CODE J; CODE V - SEE AS4133V.	
		AS1005	ALUMINUM (ONLY MATERIAL CODE USED BY BOEING)	BROWN		USE AS4133 FOR ALL MATERIAL APPLICATIONS EXCEPT ALUMINUM.	AS1005W0808
		BACT16BM	CRES	J (304)	NATURAL SILVERY COLOR	CODES J, P, T - SEE AS4135 IN CODES J, V-P AND T RESPECTIVELY.	
			P (15-5PH WITH CADMIUM PLATE FINISH)	P (15-5PH WITH CADMIUM PLATE FINISH)	YELLOWISH BROWN		BACT16BM060410T
			TITANIUM	T (6AI-4V)	DULL GRAY		
		AS4135		J (304)	NATURAL SILVERY COLOR		AS4135V080608P
			V (15-5PH)	V (15-5PH)	NATURAL SILVERY COLOR		
			V--P (15-5PH WITH CADMIUM PLATE FINISH)	V--P (15-5PH WITH CADMIUM PLATE FINISH)	YELLOWISH BROWN		
			T (6AI-4V), DRY FILM ON NUT ID	T (6AI-4V), DRY FILM ON NUT ID	DULL GRAY		

NOTE: NOT KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.

2327232 S00000527704\_V1

**Hydraulic Fitting Identification Information**  
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**FITTING SHAPES WITH FLARELESS ENDS (CONTINUED)**

FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
TEE, BULKHEAD- ON-SIDE, STANDARD WEIGHT, REDUCER		BACT16AW	CARBON STEEL	"-" OR NO CODE	YELLOWISH BROWN	CODES "NO CODE", J, K, R, S, T - SEE BACT16BM IN CODES J, P, T, RESPECTIVELY; CODE W - SEE AS1009, CODE W;
			CRES	J (304)	NATURAL SILVERY COLOR	CODES J, P, T NOW SUPERSEDED BY AS4135 IN CODES J, V--P AND T, RESPECTIVELY.
			ALUMINUM	W (7075)	BROWN	
			TITANIUM	T (6AI-4V)	DULL GRAY	
TEE, BULKHEAD- ON-SIDE, STANDARD WEIGHT, NON-REDUCER		MS21909 (SEE STANDARD AS21909)	CRES	J (304)	NATURAL SILVERY COLOR	CODES "NO CODE", J, K, S, R AND T - SEE BACT16BM IN CODES P, J AND T, RESPECTIVELY; CODES V-P, R AND V - SEE AS4135 IN CODES P, J AND V, RESPECTIVELY;
			ALUMINUM	W (7075)	BROWN	CODE W - SEE AS1009 IN NON-REDUCER SIZES ONLY;
			TITANIUM	T (6AI-4V)	DULL GRAY	NOTE: BACT16BM IN CODES J, P, T NOW SUPERSEDED BY AS4135 IN CODES J, V--P AND T, RESPECTIVELY.
						MS21909V4P

**NOTE:** NOT KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.

2327557 S00000527705\_V1

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FITTING SHAPES WITH FLARELESS ENDS (CONTINUED)						
FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
		CARBON STEEL	"-" (NO CODE)		YELLOWISH BROWN	CODES (NO CODE) (-, F) - SEE AS4135V; CODES (NO CODE) (D) - USE (NO CODE) (W); CODES (NO CODE) (J, K, R, S) - SEE AS4135;
		CRES	J (304), K (316), R (321), S (347)		NATURAL SILVERY COLOR	CODES (NO CODE) (T) -SEE AS4135T; CODE G "-" - SEE AS4135V-P; CODE G, CODES D, F, J, K, R, S, T, W USE G, D, F, J, K, R, S, T, W NOTE: "—" IN P/N IS DROPPED; CODE GD -SEE GW G CODES J, K, R, S SEE AS4135J; CODE GF - SEE AS4135V--P; GJ K, R, S - SEE AS4135; AS1009 T SEE AS4135T.
		ALUMINUM	W (7075)		BROWN	CODES (NO CODE) (-, F) - SEE AS4135V; CODE G, CODES D, F, J, K, R, S, T, W USE G, D, F, J, K, R, S, T, W NOTE: "—" IN P/N IS DROPPED; CODE GD -SEE GW G CODES J, K, R, S SEE AS4135J; CODE GF - SEE AS4135V--P; GJ K, R, S - SEE AS4135; AS1009 T SEE AS4135T.
		TITANIUM	T (6AI-4V)		DULL GRAY	CODES (NO CODE) (-, F) - SEE AS4135V; CODE G, CODES D, F, J, K, R, S, T, W USE G, D, F, J, K, R, S, T, W NOTE: "—" IN P/N IS DROPPED; CODE GD -SEE GW G CODES J, K, R, S SEE AS4135J; CODE GF - SEE AS4135V--P; GJ K, R, S - SEE AS4135; AS1009 T SEE AS4135T.

NOTE: NOT KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.

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EFFECTIVITY  
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FITTING SHAPES WITH FLARELESS ENDS (CONTINUED)						
FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
TEE, BULKHEAD- ON-RUN, LIGHTWEIGHT, REDUCER 	BACT16BN	CRES	J (304)	NATURAL SILVER COLOR	CODES J, P, T - SEE AS4134 IN CODES J, V-P AND T RESPECTIVELY.	BACT16BN121008T
			P (15-5PH WITH CADMIUM PLATE FINISH)	YELLOWISH BROWN		
			T (6AI-4V)	DULL GRAY		
	AS4134	CRES	J (304)	NATURAL SILVER COLOR	CODES J, P, T - SEE AS4134V080608P	
			V (15-5PH)	NATURAL SILVER COLOR	NOTE: PHASE-IN TO AIRPLANE PRODUCTION UNDERTAKING.	
			V--P (15-5PH WITH CADMIUM PLATE FINISH)	YELLOWISH BROWN		
TEE, BULKHEAD- ON-RUN, STANDARD WEIGHT, REDUCER 	BACT16AX	TITANIUM	T (6AI-4V), DRY FILM ON NUT ID	DARK GRAY	CODES "NO CODE", T AND J, S, R - SEE BACT16BN IN CODES P, T AND J,	BACT16AX120810J
			V--P	YELLOWISH BROWN	RESPECTIVELY;	
		CRES		DULL GRAY TO METALLIC BRIGHT	CODE W - SEE AS1003, CODE W;	
		ALUMINUM	W (7075)	BROWN	CODES J, P, T - SEE AS4134 IN CODES J, V--P AND T, RESPECTIVELY.	

**NOTE:** NOT KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.

2327589 S0000527706\_V1

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**FITTING SHAPES WITH FLARELESS ENDS (CONTINUED)**

FITTING TYPE	ILLUSTRATION	PART NUMBER	AVAILABLE MATERIALS	MATERIAL DATA		EXAMPLE OF P/N
				MATERIAL CODE LETTER	COLOR IDENTIFICATION	
TEE, BULKHEAD- ON-RUN, STANDARD WEIGHT, NON-REDUCER		MS21912 (SEE STANDARD AS21912)	CARBON STEEL	"-" OR NO CODE (4130)	YELLOWISH BROWN	CODES "—" , J, K, T - SEE BACT16BN IN CODES J, P AND T, RESPECTIVELY; CODES S, V - SEE AS4134 CODES J, V; CODE W - SEE AS1003 CODE W.
		CRES	J		NATURAL SILVERY COLOR	NOTE: BACT16BN SUPERSEDED BY AS4134; BACT16BN CODES J, P, T NOW SUPERSEDED BY AS4134 CODES J, V-P AND T, RESPECTIVELY.
		ALUMINUM	W (7075)		BROWN	MS21912V4P
		TITANIUM	T (6AI-4V)		DULL GRAY	
TEE, BULKHEAD- ON-RUN, (STANDARD WEIGHT, REDUCER)		MS21912 (SEE STANDARD AS21912)	CARBON STEEL	"-" (NO CODE)	YELLOWISH BROWN	AS1003W080806 NOTES: (1) PHASE-IN TO AIRPLANE PRODUCTION UNDERWAY. (2) SUFFIX "G" FOLLOWING BASIC P/N IS FOR PARTS WITH AS4377 STYLE G FITTING END AND ARE NOT FOR USE IN PORTS (SEE AS1003 STANDARD FOR DETAILS).
		CRES	J (304), K (316), R (321), S (347)		NATURAL SILVERY COLOR	CODES (NO CODE) (- F) - SEE AS4135V-P; CODES (NO CODE) W - SEE AS1003W; CODES (NO CODE) (J, K, R, S) - SEE AS4134; ; CODES (NO CODE) T - SEE AS4135T; G - (NO CODE) - SEE AS4135V-P; G - (NO CODE) D, F, J, K, R, S, T, W - SEE G (CODES D, F, J, K, R, S, T, W, RESPECTIVELY.
		ALUMINUM	W (7075)		BROWN	
		TITANIUM	T (6AI-4V)		DULL GRAY	GD -USE GW GF - SEE AS4134V--P; G (CODES J, K, R, S) - SEE AS4134; GT - SEE AS4135T.

NOTE: NOT KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.

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FITTING SHAPES WITH FLARELESS ENDS (CONTINUED)						
FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
TEE, SWIVEL-ON-RUN, LIGHTWEIGHT, REDUCER		BACT16BR	CRES	JN (304), DRY FILM ON NUT ID	NATURAL SILVER COLOR	CODES JN, P, T SUPERSEDED BY AS4139 CODES J, P, T, RESPECTIVELY.
			TITANIUM	T (6AI-4V)	DULL GRAY	
TEE, SWIVEL-ON-RUN, LIGHTWEIGHT, REDUCER		AS4139	CRES	JN (304), DRY FILM ON NUT ID V (15-5PH)	NATURAL SILVER COLOR	AS4139V080608P NOTE: PHASE-IN TO AIRPLANE PRODUCTION UNDERWAY.
			TITANIUM	T (6AI-4V)	DULL GRAY	
TEE, SWIVEL-ON-RUN, STANDARD WEIGHT, REDUCER		BACT16AY	CRES	N (CARBON STEEL WITH DRY FILM ON SWIVEL NUT) K (316), M (304, S (347)	YELLOWISH BROWN NATURAL SILVER COLOR	CODES M, N - SEE BACT16BR CODES J, P RESPECTIVELY; W CODE STILL ACTIVE.
			ALUMINUM	W (7075-T73)	BROWN	
TEE, SWIVEL-ON-RUN, STANDARD WEIGHT, NON-REDUCER		NAS1763	CRES	"- WITH CADMIUM PLATE FINISH	YELLOWISH BROWN	CODES "-" J, K, S, T - SEE BACT16BR CODES J, P, T RESPECTIVELY; CODE W - SEE BACT16AY IN CODE W.
			ALUMINUM	W (7075)	BROWN	
			TITANIUM	T (6AI-4V)	DULL GRAY	

**NOTE:** NOTE KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.

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FITTING SHAPES WITH FLARELESS ENDS (CONTINUED)						
FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
TEE, SWIVEL-ON-IDE, LIGHTWEIGHT, REDUCER		BACT16BT	CRES	JN (304), DRY FILM ON NUT ID	NATURAL SILVER COLOR	CODES JN, P, T - SEE AS4140 IN CODES J, V-P, T RESPECTIVELY.
TEE, SWIVEL-ON-SIDE, LIGHTWEIGHT, REDUCER		AS4140	TITANIUM	T (6AI-4V)	DULL GRAY	AS4140V080806P  NOTE: PHASE-IN TO AIRPLANE PRODUCTION UNDERWAY.
TEE, SWIVEL-ON-IDE, STANDARD WEIGHT, REDUCER		NAS1764	CRES	JN (304), DRY FILM ON NUT ID	NATURAL SILVER COLOR	CODES M, RN, N - SEE BACT16BT IN CODES J, P RESPECTIVELY; CODE W STILL ACTIVE.
TEE, SWIVEL-ON-SIDE, STANDARD WEIGHT, REDUCER			TITANIUM	V (15-5PH)	NATURAL SILVER COLOR	CODES "—" J, K (304), L (316), M (316), N (321) OR S (347) WITH DRY FILM ON NUT
			CRES	V-P (15-5PH) WITH CADMIUM PLATE FINISH	YELLOWISH BROWN	CODES J, P, T RESPECTIVELY; CODE W SEE BACT16AZ IN CODE W.
			TITANIUM	T (6AI-4V), DRY FILM ON NUT ID	DULL GRAY	
			CRES	N OR NO CODE WITH DRY FILM ON NUT	YELLOWISH BROWN	
			TITANIUM	"—" OR NO CODE	YELLOWISH BROWN	
			CRES	W (7075) WITH DRY FILM ON NUT	BROWN	
			CRES	W (7075)	BROWN	
			ALUMINUM	"—" OR NO CODE	YELLOWISH BROWN	
			ALUMINUM	W (7075)	BROWN	
			CRES	J (304), K (316), S (347)	NATURAL SILVER COLOR	CODES "—" J, K, S, T - SEE BACT16BT IN CODES J, P, T RESPECTIVELY; CODE W SEE BACT16AZ IN CODE W.
			ALUMINUM	W (7075)	BROWN	NAS1764J040608
			TITANIUM	T (6AI-4V)	DULL GRAY	

NOTE: NOT KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.

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FITTING SHAPES WITH FLARELESS ENDS (CONTINUED)						
FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
CROSS, REDUCER ONLY		BACC27AC	CARBON STEEL CRES ALUMINUM TITANIUM	F J (304), K (316), R (321) W (7075)	YELLOWISH BROWN NATURAL SILVERY COLOR BROWN DULL GRAY	CODES F, J, K, R, T - SEE AS4136 CODES V--P, J, T RESPECTIVELY; CODE W - SEE AS1006W.
CROSS, REDUCER AND NON-REDUCER		AS4136	CRES	J (304) V (15-5PH)	NATURAL SILVERY COLOR NATURAL SILVERY COLOR	AS4136V 08050608P
				V--P (15-5PH WITH CADMIUM PLATE FINISH)	YELLOWISH BROWN	NOTE: PHASE-IN TO AIRPLANE PRODUCTION UNDERWAY.
			TITANIUM	T (6AI-4V), DRY FILM ON NUT ID	DARK GRAY	
			CARBON STEEL	"-" OR NO CODE	YELLOWISH BROWN	
				J (304), K (316), S (347)	NATURAL SILVERY COLOR	CODES V, V--P, "-", J, R, S, T - SEE AS4136 CODES V, V--P, J, T, RESPECTIVELY;
				V (15-5PH)	NATURAL SILVERY COLOR	CODE W IS NOW SUPERSEDED BY AS1006W (NON-REDUCER SIZE COMBINATIONS ONLY)
			CRES (SEE STANDARD AS21906)	V--P (15-5PH WITH CADMIUM PLATE FINISH)	YELLOWISH BROWN	MS21906V4P
			ALUMINUM	W (7075)	BROWN	
			TITANIUM	T (6AI-4V)	DULL GRAY	

NOTE: NOT KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.

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FITTING SHAPES WITH FLARELESS ENDS (CONTINUED)						
FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
CROSS, REDUCER		AS1006	CARBON STEEL	NO CODE	YELLOWISH BROWN	AS1006W0808080808
			CRES	J (304), K (316), R (321), S (347)	NATURAL SILVER COLOR	NOTE: CODE J - SEE AS4136 CODE K; CODE R - SEE AS4136 CODE T; CODE S - SEE AS4136 CODE W IS ACTIVE.
			ALUMINUM	W (7075)	BROWN	
			TITANIUM	T (6AI-4V)	DULL GRAY	
CROSS, SWIVEL-ON- ONE-LEG, STANDARD WEIGHT, REDUCER		BACC27AD	CARBON STEEL	F (WITH CADMIUM PLATE FINISH)	YELLOWISH BROWN	BACC27AD 10080412WN
			CRES	J (304), K (316), R (321)	NATURAL SILVER COLOR	(1) N SUFFIX = DRY FILM LUBE ON SWIVEL NUT (2) BACC27AD P/N NOW SPECIFIED WITH 1ST PORT BEING THE LARGER PORT (FORMERLY SMALLER PORT WAS 1ST PORT)
			ALUMINUM	W (7075)	BROWN	CODES F, FN - SEE AS4141 CODES V-P; CODES J, K, R - SEE AS4141J; CODES (NO CODE) (NO CODE), (NO CODE) N USE CODES W AND WN

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NOTE: NOT KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.

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AXIAL SWAGE FITTING CONFIGURATIONS WITH ONE OR MORE FLARELESS ENDS					
FITTING TYPE	ILLUSTRATION	MATERIAL DATA			EXAMPLE OF P/N
		AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
STRAIGHT, FEMALE FLARELESS ADAPTER		AS5792	TITANIUM T (6AI-4V)	DULL GRAY WITH BLUE STRIPE ON SWAGE ENDS	AS5792T0806
STRAIGHT, MALE FLARELESS ADAPTER		AS5793	TITANIUM T (6AI-4V)	DULL GRAY WITH BLUE STRIPE ON SWAGE ENDS	AS5793T0806
ELBOW, 90 DEGREE, FEMALE FLARELESS		AS5801	TITANIUM T (6AI-4V)	DULL GRAY WITH BLUE STRIPE ON SWAGE ENDS	AS5801T0806
ELBOW, 45 DEGREE, FEMALE FLARELESS		AS5803	TITANIUM T (6AI-4V)	DULL GRAY WITH BLUE STRIPE ON SWAGE ENDS	AS5803T0806

**NOTE:** NOT KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.

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AXIAL SWAGE FITTING CONFIGURATIONS WITH ONE OR MORE FLARELESS ENDS (CONTINUED)						
FITTING TYPE	ILLUSTRATION	PART NUMBER	MATERIAL DATA			EXAMPLE OF P/N
			AVAILABLE MATERIALS	MATERIAL CODE LETTER	COLOR IDENTIFICATION	
TEE, FEMALE FLARELESS ON RUN		AS5804	TITANIUM	T (6AI-4V)	DULL GRAY WITH BLUE STRIPE ON SWAGE ENDS	AS5804T080808
TEE, FEMALE FLARELESS ON BRANCH		AS5806	TITANIUM	T (6AI-4V)	DULL GRAY WITH BLUE STRIPE ON SWAGE ENDS	AS5806T080606
TEE, MALE FLARELESS ON BRANCH		AS5807	TITANIUM	T (6AI-4V)	DULL GRAY WITH BLUE STRIPE ON SWAGE ENDS	AS5807T080808
TEE, FEMALE FLARELESS ON RUN		AS5809	TITANIUM	T (6AI-4V)	DULL GRAY WITH BLUE STRIPE ON SWAGE ENDS	AS5809T080808
TEE, MALE FLARELESS ON RUN		AS5810	TITANIUM	T (6AI-4V)	DULL GRAY WITH BLUE STRIPE ON SWAGE ENDS	AS5810T080606

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FLARELESS TUBING ASSEMBLY - REMOVAL/INSTALLATION

**1. General**

- A. You must consult with Boeing before conducting any repairs to oxygen system tubing.
- B. This procedure contains these tasks:
  - (1) A removal of the flareless tubing assembly.
  - (2) An installation of the flareless tubing assembly.
  - (3) A check of the electrical resistance specifications in the fuel tank.
  - (4) An installation of flareless fittings in pressurized areas.
  - (5) A check of the tubing clearances.
  - (6) A check of the space between tubing clamps.
- WARNING:** DO NOT USE THIS PROCEDURE ON OXYGEN TUBING. GREASE, DIRT, OR OTHER FLAMMABLE MATERIALS IN THE OXYGEN TUBING CAN CAUSE A FIRE OR EXPLOSION.
- C. You can use these procedures to remove and install all flareless tubing except tubing for the oxygen systems and water and waste systems. Refer to AMM Chapter 38 for repairs on Water and Waste Systems.
- D. You must identify the tubing assembly configuration and the tubing material before removal.
- E. When you disconnect the tubing, always use the necessary precautions to prevent leakage of fluids. If fluids fall on the airplane, identify the fluid and clean the area as specified for that fluid.
- F. When you remove, install, or do work with hydraulic tube assemblies, obey the guidelines that follow:
  - (1) When you remove tubes, make sure the tubes and port fittings have tags that identify the correct connection locations.
  - (2) Do not move or change the tube bends. If you move or change the bend in the tube, these bad effects can occur:
    - (a) If you move or change the bend in the tube, it can become possible that the tube will align with the incorrect port. If this occurs, incorrect reconnection or cross-connection of the tubes can become possible.
    - (b) If you move or change the bend in the tube, it can become possible that the tube will have too much stress. Stress can cause cracks in the tubes.
  - (3) Do this task: Clean (Wet Wash) the External Surfaces of the Airplane, TASK 12-40-00-100-801.
- G. You can use the nuts and fittings again if they are not damaged and there is a good seal on the assembly. Make sure the threads on the nuts and fittings turn smoothly.
- H. Flareless BACS13AP sleeves that are not correctly set can cause leaks. It is recommended that you set flareless sleeves by machine. Set the flareless sleeves by hand only when you cannot set them by machine.

**NOTE:** It is recommended that cadmium-plated corrosion-resistant steel or cadmium-plated steel fittings be used as replacements for aluminum fittings in the high pressure and normal brake return systems between the antiskid module and parking brake module. Cadmium-plated corrosion-resistant steel or cadmium-plated steel fittings can be used as replacements for aluminum fittings in other systems.

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- I. When you install the tubing, align the fittings and tubing so you can tighten the B-nuts by hand before you tighten the B-nuts with a wrench. Do not use the fitting nuts to align the tubing and connections.

NOTE: Move the sleeve until it touches the mating surface. Do not use the nut to pull the tube into position. Leakage from the fittings or the tubing can occur if you cause damage to the fittings or the tubing.

J. B-Nut torquing:

- (1) The correct torquing can be applied to B-nut only if the tubing material is identified correctly (aluminum, titanium or steel).
- (2) If the normal finish color of the B-nut is covered by the gray drilube coating, a color-coded ring is applied on the back side of the B-nut.

**Table 401/20-10-51-993-903**

TUBE MATERIAL	TUBE FINISH	COLOR	B-NUT (MAY BE COVERED WITH DRILUBE)
ALUMINUM	Primer	Green	GOLD OR BROWN
CRES	None, or Primer	Natural, or Green	SILVER, BRIGHT
TITANIUM	None	Natural	DULL GRAY

- (3) If a steel or titanium B-nut connects to an aluminum tube or fitting, use the lower torque value (aluminum).
- (4) FLARELESS TUBING ASSEMBLY - REPAIRS, PAGEBLOCK 20-10-51/801.

**TASK 20-10-51-000-801**

**2. Flareless Tubing Assembly Removal**

**A. References**

Reference	Title
20-10-51-300-805	Tube Repair (P/B 801)

**B. Procedure**

SUBTASK 20-10-51-010-001

**WARNING:** REMOVE ALL PRESSURE FROM THE SYSTEM AS SPECIFIED IN THE APPLICABLE MAINTENANCE INSTRUCTIONS BEFORE YOU START THE REMOVAL OF THE FLARELESS TUBING ASSEMBLY. A PRESSURIZED SYSTEM CAN CAUSE INJURY.

- (1) Depressurize the applicable system.
- (2) Get access to the tube assembly fittings.

SUBTASK 20-10-51-020-002

- (3) Remove the support clamps on the tubing you will remove.



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SUBTASK 20-10-51-020-004

**WARNING:** MAKE SURE EACH TUBE AND THE PORT FITTINGS HAVE TAGS TO IDENTIFY THE CORRECT INSTALLATION LOCATIONS. IF YOU DO NOT PUT TAGS ON THE TUBES AND PORT FITTINGS, CROSS-CONNECTION OF THE TUBES CAN OCCUR DURING INSTALLATION. IF THIS OCCURS, UNINTENDED OPERATION OR MALFUNCTION OF AIRPLANE SYSTEMS CAN RESULT AND CAUSE INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.

- (4) Install tags on the tubes and port fittings to clearly identify the correct connection locations.

SUBTASK 20-10-51-020-003

- (5) Loosen the adjacent tubing assemblies and clamps if it is necessary.

SUBTASK 20-10-51-020-001

- (6) Remove the tubing assembly from the airplane.

SUBTASK 20-10-51-420-015

- (7) Install caps on the ports and the hydraulic lines to prevent leakage and contamination.

SUBTASK 20-10-51-160-001

**CAUTION:** QUICKLY CLEAN THE AREA OF ALL HYDRAULIC FLUID. THE HYDRAULIC FLUID CAN CAUSE DAMAGE TO THE AIRPLANE EQUIPMENT.

- (8) Clean all hydraulic fluid from the area.
  - (a) Do this task: Tube Repair, TASK 20-10-51-300-805.

———— END OF TASK ————

**TASK 20-10-51-400-804**

**3. Flareless Tubing Assembly Installation**

(Figure 404, Figure 405)

**A. References**

Reference	Title
12-40-00-100-801	Clean (Wet Wash) the External Surfaces of the Airplane (P/B 201)

**B. Procedure**

SUBTASK 20-10-51-160-002

**CAUTION:** QUICKLY CLEAN THE INSTALLATION AREA OF ALL HYDRAULIC FLUID. THE HYDRAULIC FLUID CAN CAUSE DAMAGE TO THE AIRPLANE EQUIPMENT.

- (1) Clean all hydraulic fluid from the installation area.
  - (a) Do this task: Clean (Wet Wash) the External Surfaces of the Airplane, TASK 12-40-00-100-801.

SUBTASK 20-10-51-210-015

- (2) Examine the tube ends and fittings for defects or contamination that can prevent a good seal when you install them.
  - (a) Clean the area if necessary.

SUBTASK 20-10-51-210-016

- (3) Look for worn areas or dents on the tube.
  - (a) Replace the tube if it is necessary.

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SUBTASK 20-10-51-640-002

- (4) Apply the thread compound applicable to your system Table 402 immediately before installation as follows (Figure 404):
- Apply the thread compound to the outer diameter of the external threads, the shoulder, and the conical seal surface of the sleeve.
- NOTE: Thread compound is not required when you assemble Dri-Lubed B-nuts.
- Do not get the thread compound on the internal surfaces of the tube or the inner surface of the bore of the fitting.

**Table 402/20-10-51-993-842 Thread Compounds**

SYSTEM	BULK CODE	APPROVED THREAD COMPOUND (Straight Thread Fittings)
Compressed Gas (Not Oxygen)	D50004	Antiseize Compound BMS3-28
Deicing or Anti-icing	D50004	Antiseize Compound BMS3-28
Instrument Air	D50004	Antiseize Compound BMS3-28
Pneumatic	D50004 D00062	Antiseize Compound BMS3-28 or Pneumatic Grease AMS-G-4343
Air Conditioning	D50004 D01062 D00062	Antiseize Compound BMS3-28 or Never-Seez Pure Nickel Special or Pneumatic Grease AMS-G-4343
Fire Protection	D50004	Antiseize Compound BMS3-28
Coolant	D00070 D00467	Hydraulic Fluid MIL-PRF-5606 or Shock Strut Fluid BMS 3-32 Type II
Water Injection	D50004	Antiseize Compound BMS3-28
Fuel	D00070 D00467	Hydraulic Fluid MIL-PRF-5606 or Shock Strut Fluid BMS 3-32 Type II
Lubrication	D00070 D00467	Hydraulic Fluid MIL-PRF-5606 or Shock Strut Fluid BMS 3-32 Type II
Hydraulic MIL-PRF-5606	D00070 D00467	Hydraulic Fluid MIL-PRF-5606 or Shock Strut Fluid BMS 3-32 Type II
Hydraulic BMS3-11	D00054	Skydrol Assy Lube MCS 352B
Hydraulic MIL-PRF-6083	D00070 D00106 D00467	Hydraulic Fluid MIL-PRF-5606 or Hydraulic Fluid MIL-PRF-6083 or Shock Strut Fluid BMS 3-32 Type II
Miscellaneous Tubing	D50004 D00053	Antiseize Compound BMS3-28 or Grease AMS-G-6032

SUBTASK 20-10-51-420-008

- (5) Put the tubing assembly in the airplane and keep the tube clamps loose to permit you to align the tube in the fitting.
- Make sure that you do not clamp the tube at the repair fitting location.
- NOTE: Clamps are sized to fit standard tube diameters. If a repair swage is clamped, the clamp can move off of the uniform surface because the tube can migrate or flex.

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SUBTASK 20-10-51-820-003

- (6) Align the tube and fitting by hand and make the tube end touch the bottom of the fitting.

SUBTASK 20-10-51-210-017

- (7) Look at the tags to make sure the tubes are aligned with the correct port fittings.

SUBTASK 20-10-51-420-016

- (8) Keep the tube end at the bottom and aligned in the fitting.

- (a) Turn the B-nut by hand until the B-nut touches the bottom of the sleeve shoulder.

SUBTASK 20-10-51-420-009

**CAUTION:** USE TWO WRENCHES TO TIGHTEN THE TUBE COUPLING NUTS. USE ONE TO HOLD THE NIPPLE, AND THE OTHER TO TIGHTEN THE COUPLING NUT. IF YOU DO NOT USE TWO WRENCHES, DAMAGE TO THE TUBES AND NIPPLES CAN OCCUR.

- (9) Tighten the flareless tubing assembly with a torque wrench to the installation torque in (Table 405), if it is one of the following types:

- (a) Steel, Titanium, and Cres Tubes:

- 1) 21-6-9 Cres and all other Cres tube ends with BACS13BX swaged sleeves
- 2) MIL-T-6845, MIL-T-8504 and MIL-T-8808 Cres flared tube ends
- 3) MIL-T-6845 (304-1/8 hard) Cres with BACS13AP preset sleeve with a minimum wall thickness shown in (Table 403):

**Table 403/20-10-51-993-843 Minimum Wall Thickness**

Tube Dash No.	Wall Thickness Inches (mm)
-4	0.020 (.508)
-5	0.020 (.508)
-6	0.028 (.711)
-8	0.035 (.889)
-10	0.049 (1.245)
-12	0.049 (1.245)
-16	0.065 (1.651)

- 4) Hose end fittings with steel inserts (nipples).

- 5) All titanium tube ends.

- (b) Aluminum and Annealed Cres Tubes:

- 1) Aluminum with BACS13BX swaged sleeves
- 2) 6061-T6 aluminum and Annealed Cres with BACS13AP sleeves with a minimum wall thickness shown in Table 404:

**Table 404/20-10-51-993-844 Minimum Wall Thickness**

Tube Dash No.	Wall Thickness Inches (mm)
-3	0.028 (.711)
-4	0.028 (.711)
-5	0.028 (.711)

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**Table 404/20-10-51-993-844 Minimum Wall Thickness (Continued)**

Tube Dash No.	Wall Thickness Inches (mm)
-6	0.028 (.711)
-8	0.028 (.711)
-10	0.028 (.711)
-12	0.028 (.711)
-16	0.035 (.889)
-20	0.049 (1.245)
-24	0.049 (1.245)

3) Flareless type hose end fittings with aluminum inserts (nipples)

4) Aluminum flared tube ends.

(c) Tube Material Specifications:

- 1) 6061-T6 aluminum - MIL-T-7081, WW-T-700/6, AMS4083
- 2) Annealed Cres - MIL-T-8504, MIL-T-8606, MIL-T-8808
- 3) 1/8 hard Cres - MIL-T-6845
- 4) 21-6-9 Cres - BMS7-185
- 5) TI-3AL-2.5V-BMS7-234 and AMS4945.

**Table 405/20-10-51-993-845 Installation Torque**

ANNEALED OUTER DIAM. Inch (mm)	TUBE DASH NO.	STEEL, TITANIUM, AND CRES TUBES TORQUE <sup>*[1]</sup> Pound-Inches +/- 5% (N-m) +/- .56%	ALUMINUM & ANNEALED CRES TUBES TORQUE <sup>*[1]</sup> Pound-Inches +/- 5% (N-m) +/- .56%
3/16 (4.76)	-3	100 (11.3)	80 (9.03)
1/4 (6.35)	-4	140 (15.8)	110 (12.4)
5/16 (7.94)	-5	190 (21.5)	140 (15.8)
3/8 (9.53)	-6	270 (30.5)	170 (19.2)
1/2 (12.7)	-8	500 (56.5)	280 (31.6)
5/8 (15.88)	-10	700 (79.1)	360 (40.7)
3/4 (19.05)	-12	900 (101.7)	450 (50.8)
1 (25.4)	-16	1200 (135.6)	750 (84.7)
1-1/4 (31.75)	-20	1600 (180.8)	900 (101.7)
1-1/2 (38.1)	-24	2000 (226)	900 (101.7)
2 (50.8)	-32	2000 (226)	--

\*[1] For ACS Ducts all torque values must be reduced by 50%.

SUBTASK 20-10-51-420-010

- (10) If the flareless tubing assembly is a reducer fitting, use the boss or bulkhead size to get the correct torque and tighten the assembly.

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SUBTASK 20-10-51-420-011

**CAUTION:** USE TWO WRENCHES TO TIGHTEN THE TUBE COUPLING NUTS. USE ONE TO HOLD THE NIPPLE, AND THE OTHER TO TIGHTEN THE COUPLING NUT. IF YOU DO NOT USE TWO WRENCHES, DAMAGE TO THE TUBES AND NIPPLES CAN OCCUR.

- (11) Tighten the flareless tubing assembly with a torque wrench to the installation torques in Table 405 if it is an assembly that follows:
  - (a) Steel, Titanium, and Cres Tubes:
    - 1) MIL-T-6845 (304-1/8 hard) Cres with BACS13AP preset sleeve with a wall thickness shown in Table 406:

**Table 406/20-10-51-993-846 Wall Thickness**

Tube Dash No.	Wall Thickness Inch (mm)	Torque Pound-Inches (Newton-Meters)
-8	0.028 (.7112)	375 (42.37)
-10	0.035 (.889)	575 (64.97)
-12	0.042 (1.0668)	725 (81.91)

- (b) Aluminum and Annealed Cres Tubes:

- 1) 6061-T6 aluminum and annealed Cres with BACS13AP sleeves with a wall thickness shown in Table 407:

**Table 407/20-10-51-993-847 Wall Thickness**

Tube Dash No.	Wall Thickness Inches (mm)	Torque Pound-Inches (Newton-Meters)
-6	0.020 (.508)	160 (18.08)
-10	0.020 (.508)	250 (28.25)
-12	0.020 (.508)	325 (36.72)

SUBTASK 20-10-51-420-012

- (12) Tighten the flareless tubing assembly with a torque wrench to the installation torque (Table 405) if it is a material listed above as follows:
  - (a) Hold the union with a wrench and tighten the B-nut to the installation torque value.
 

NOTE: If you have a leak, you can loosen and tighten the B-nut again.

    - 1) Do not use the B-nut to align the tube.
    - 2) Do not let the B-nut touch the bottom of the sleeve shoulder.

SUBTASK 20-10-51-420-013

**CAUTION:** USE TWO WRENCHES TO TIGHTEN THE TUBE COUPLING NUTS. USE ONE TO HOLD THE NIPPLE, AND THE OTHER TO TIGHTEN THE COUPLING NUT. IF YOU DO NOT USE TWO WRENCHES, DAMAGE TO THE TUBES AND NIPPLES CAN OCCUR.

- (13) On nuts that you can not get access to with a torque wrench, tighten the nuts with your hand as follows:
  - (a) Hand tighten until a clear increase in torque occurs, then tighten 1/6 to 1/3 turn more.

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- (b) Tighten the flareless fittings with the BACS13AP sleeves two times (tighten, loosen, and tighten again).

NOTE: The maximum tube collapse permitted after you tighten the BACS13AP sleeves is 0.015 inches (.381 mm) less than the tube inside diameter.

SUBTASK 20-10-51-420-014

**CAUTION:** ALWAYS KEEP THE CLAMPS TIGHT. TIGHT CLAMPS KEEP THE AREA BETWEEN THE TUBE AND THE CLAMP SURFACES FREE OF UNWANTED MATERIALS AND CONTAMINATION. IF SURFACES ARE NOT CLEAN, DAMAGE BY FRICTION CAN OCCUR.

- (14) Tighten all of the tube clamps.

- (a) Make sure that you do not clamp the tube at the repair fitting location.

NOTE: Clamps are sized to fit standard tube diameters. If a repair swage is clamped, the clamp can move off of the uniform surface because the tube can migrate or flex.

SUBTASK 20-10-51-710-001

- (15) If you disconnected more than one hydraulic tube and you think there is a possibility you connected the tubes incorrectly or cross-connected the tubes, do an operational check:

NOTE: Use your own judgement to determine if a check is necessary.

- (a) Do the post-installation test of one or more of the components to which the tubes are connected as a check.

SUBTASK 20-10-51-710-002

- (16) If you disconnected electrical wires to get access to the tubes and you think there is a possibility you connected the wires incorrectly or cross-connected the wires, do an operational check:

NOTE: Use your own judgement to determine if a check is necessary.

- (a) Do the post-installation test of one or more of the components to which the wires are connected as a check.

———— END OF TASK ————

**TASK 20-10-51-760-801**

**4. Electrical Resistance Specifications in the Fuel Tank Check**

(Figure 406, Figure 407)

**A. General**

- (1) This task has steps to measure the electrical bonding resistance of hydraulic tubes in the fuel tank.
- (2) This task has one or more steps which are a means to satisfy Critical Design Configuration Control Limitation (CDCCL) requirements. A CDCCL note will follow the step to which it applies. Any step or sub-step that precedes or follows a CDCCL identified step is not subject to the CDCCL requirement.
- (a) For important information on CDCCL requirements, refer to this task: Airworthiness Limitation Precautions, TASK 20-00-00-910-801.  
NOTE: This is applicable to Airworthiness Limitation 28-AWL-10.
- (3) Refer to Bulkhead Fittings - Removal/Installation, PAGEBLOCK 29-11-55/401, to replace the bulkhead fittings for the hydraulic tubes in the fuel tank.

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**B. References**

Reference	Title
20-00-00-910-801	Airworthiness Limitation Precautions (P/B 201)
28-11-00-910-802	Purging and Fuel Tank Entry (P/B 201)
29-11-55 P/B 401	Bulkhead Fittings - Removal/Installation

**C. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-1550	Bonding Meters - Approved, Intrinsically Safe (Approved for use in Class I, Divisions I & II hazardous (classified) locations. Outside these hazardous locations, COM-614 can be used in lieu of COM-1550).  Part #: C15292 (MODEL T477W) Supplier: 01014 Part #: M1 Supplier: 3AD17 Opt Part #: M1B Supplier: 3AD17

**D. Procedure**

SUBTASK 20-10-51-910-001

**WARNING:** OBEY THE PRECAUTIONS FOR PURGING AND FUEL TANK ENTRY. IF YOU DO NOT OBEY THE PRECAUTIONS, INJURIES TO PERSONNEL AND DAMAGE TO EQUIPMENT CAN OCCUR.

- (1) Do all the applicable steps in this task: Purging and Fuel Tank Entry, TASK 28-11-00-910-802.

SUBTASK 20-10-51-760-003

**WARNING:** MAKE SURE THE METER YOU USE WILL NOT CAUSE AN EXPLOSION. IF NOT, MAKE SURE THE AMOUNT OF DANGEROUS GAS, AS MEASURED BY A GAS DETECTOR, IS LESS THAN 10 PERCENT OF THE LOWER EXPLOSIVE LIMIT. IF NOT, AN EXPLOSION CAN OCCUR THAT CAN CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

- (2) Do a check of the electrical bonding resistance with the intrinsically safe approved bonding meter, COM-1550.

SUBTASK 20-10-51-760-006

**► 28-AWL-10: CDCCL**

- (3) Measure the electrical bonding resistance across the in-line union/tee fittings (tube-to-tube) that you replaced (Figure 403).

NOTE: CDCCL - Refer to the task: Airworthiness Limitation Precautions, TASK 20-00-00-910-801, for important information on Critical Design Configuration Control Limitations (CDCCLs).

NOTE: This is applicable to Airworthiness Limitation 28-AWL-10.

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**► 28-AWL-10: CDCCL**

- (a) Make sure the electrical bonding resistance is 0.00095 ohm (0.95 milliohm) or less.

NOTE: CDCCL - Refer to the task: Airworthiness Limitation Precautions, TASK 20-00-00-910-801, for important information on Critical Design Configuration Control Limitations (CDCCLs).

NOTE: This is applicable to Airworthiness Limitation 28-AWL-10.

———— END OF TASK ————

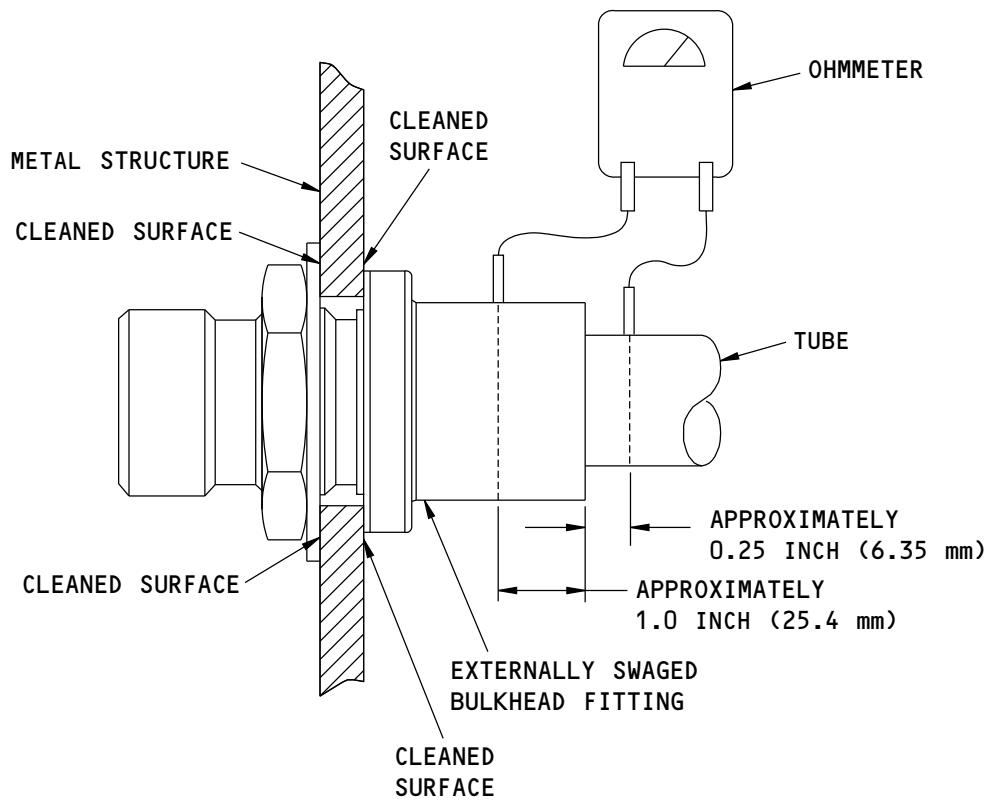
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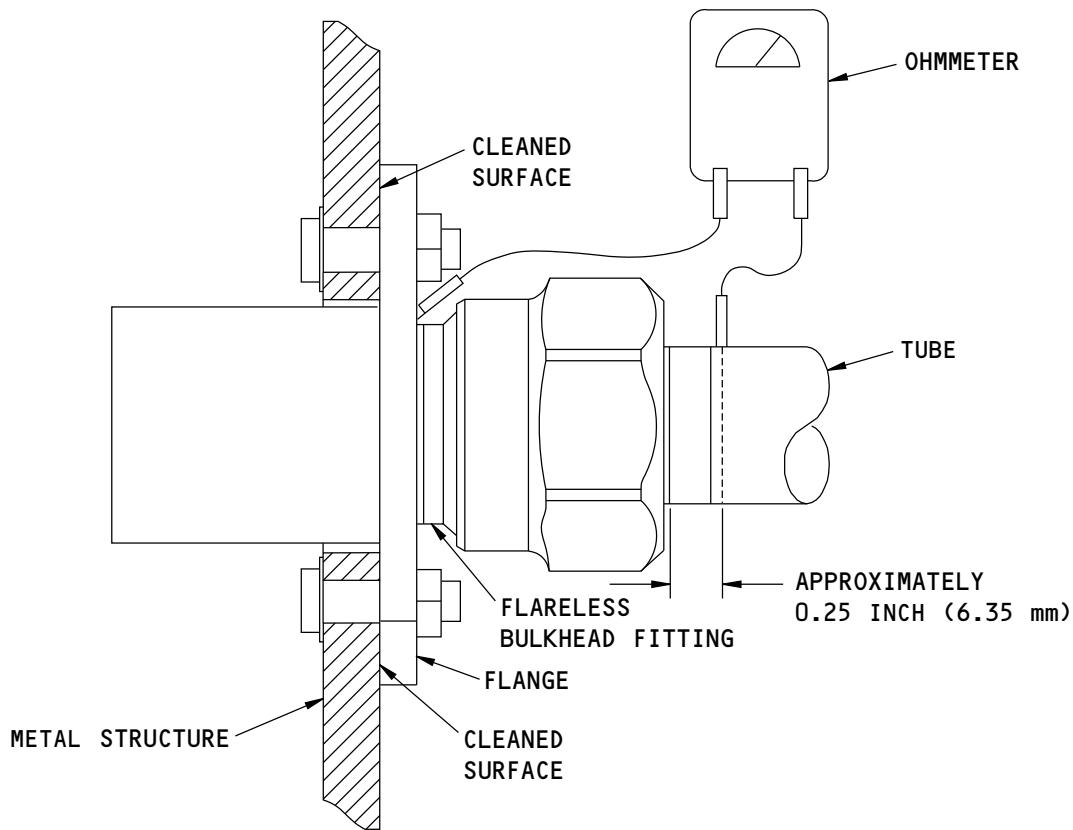
Resistance Measurement from Externally Swaged Bulkhead Fitting to Hydraulic Tube  
Figure 401/20-10-51-990-902 (Sheet 1 of 2)

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Resistance Measurement from Externally Swaged Bulkhead Fitting to Hydraulic Tube  
Figure 401/20-10-51-990-902 (Sheet 2 of 2)

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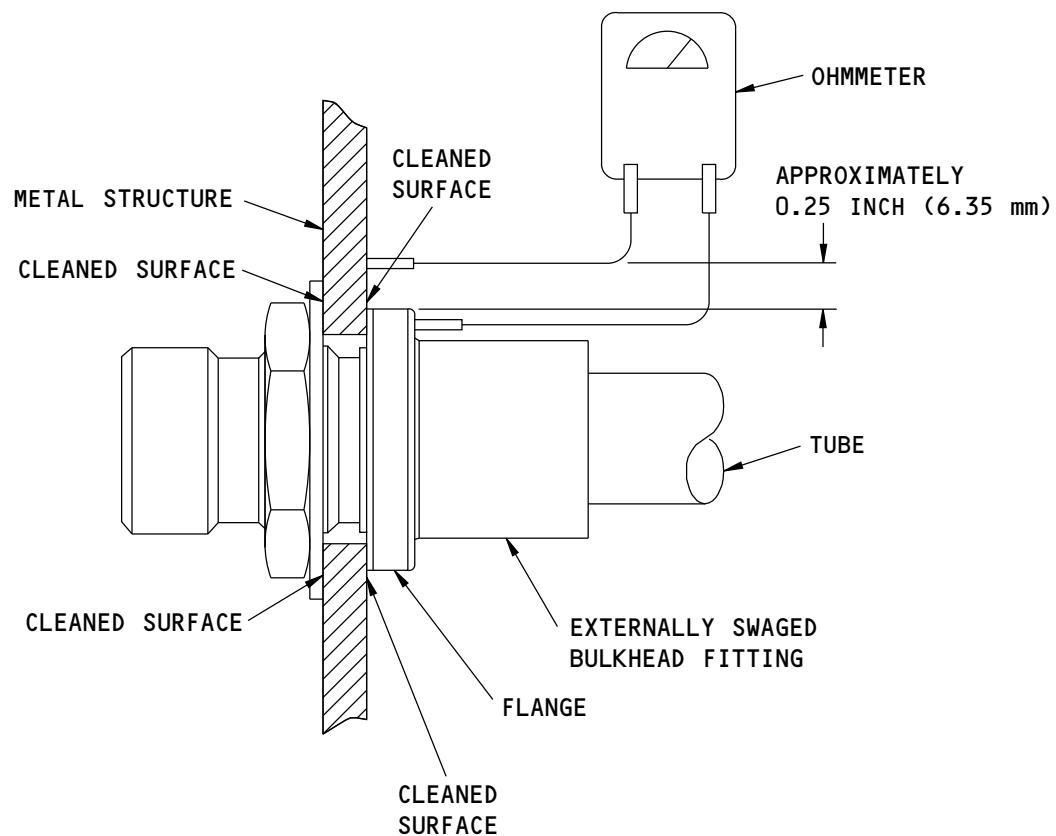
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Resistance Measurement from Externally Swaged Bulkhead Fitting to Structure  
Figure 402/20-10-51-990-903 (Sheet 1 of 2)

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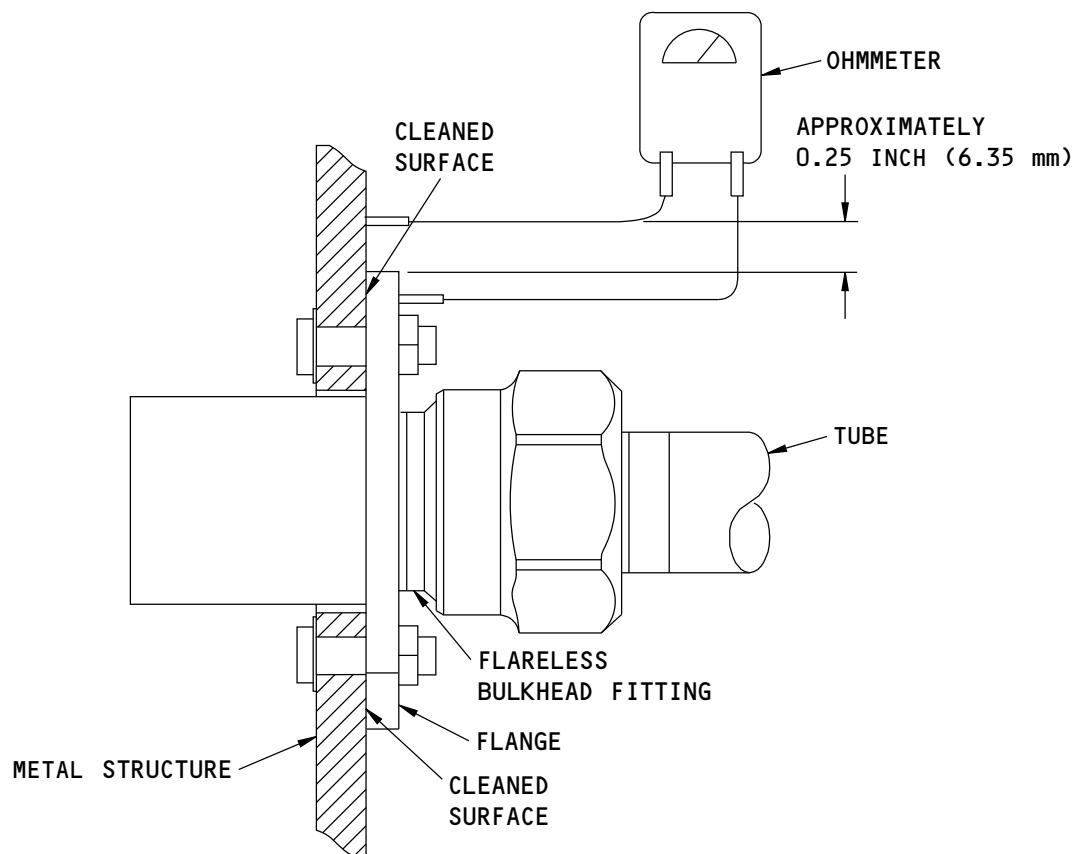
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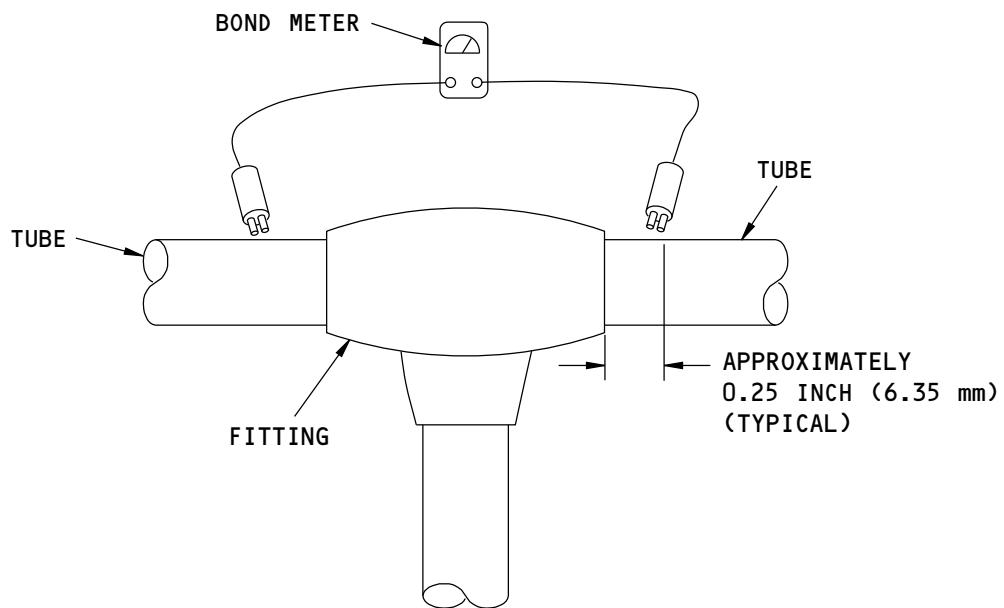
Resistance Measurement from Externally Swaged Bulkhead Fitting to Structure  
Figure 402/20-10-51-990-903 (Sheet 2 of 2)

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Resistance Measurement Across Tee/Union Fittings  
Figure 403/20-10-51-990-904

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**TASK 20-10-51-000-802**

**5. Flareless Fittings in Pressurized Areas Installation**

**A. References**

Reference	Title
20-10-51-300-805	Tube Repair (P/B 801)

**B. Procedure**

SUBTASK 20-10-51-300-001

- (1) Make the necessary repairs to the flareless tubing assembly.
  - (a) Do this task: Tube Repair, TASK 20-10-51-300-805.

SUBTASK 20-10-51-420-017

**CAUTION:** USE TWO WRENCHES TO TIGHTEN THE TUBE COUPLING NUTS. USE ONE TO HOLD THE NIPPLE, AND THE OTHER TO TIGHTEN THE COUPLING NUT. IF YOU DO NOT USE TWO WRENCHES, DAMAGE TO THE TUBES AND NIPPLES CAN OCCUR.

- (2) Tighten the flareless fittings with the BACS13AP sleeves two times (tighten, loosen, and tighten again).

NOTE: Be careful to make sure that the fittings will not have leaks after you tighten the fittings.

SUBTASK 20-10-51-420-018

- (3) Tighten flareless fittings with BACS13BX, welded-on, or NAS1760-type sleeves as follows:
  - (a) Tighten the fitting to the applicable torque shown in (Table 408).
  - (b) Loosen the fitting to release the torque.
  - (c) Tighten the fitting to the torque shown in (Table 408).

**Table 408/20-10-51-993-850 Installation Torques**

Tube Size	Titanium Cres Tube Pound-Inches (Newton-meters)	Aluminum Pound-Inches (Newton-meters)
0.250	210 (23.73)	170 (19.21)
0.375	400 (45.19)	250 (28.25)
0.500	750 (84.74)	420 (47.45)
0.625	1050 (118.6)	540 (61.01)
0.750	1350 (152.5)	675 (76.26)
1.000	1800 (203.4)	1125 (127.1)
1.250	2400 (271.2)	1350 (152.5)
1.500	3000 (339)	1350 (152.5)

SUBTASK 20-10-51-760-007

- (4) If you install flareless fittings in the fuel tanks, do this task: Electrical Resistance Specifications in the Fuel Tank Check, TASK 20-10-51-760-801.

SUBTASK 20-10-51-790-002

- (5) Do a leak test on the repair installations of the flareless fittings in pressurized areas as follows:
  - (a) Pressurize the system for a minimum of 15 minutes.

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- (b) With the system pressurized, use a clean white cloth to do a check on the tube-to-fitting interface for signs of hydraulic leakage.

NOTE: You can tighten the tube again to the torque value shown above, if you find leakage. If leakage occurs in subsequent leak tests, you must replace the repair installation.

SUBTASK 20-10-51-710-003

- (6) If you disconnected more than one hydraulic tube and you think there is a possibility you connected the tubes incorrectly or cross-connected the tubes, go back and verify that the connections are correct:

NOTE: Use your own judgement to determine if a check is necessary.

- (a) After verifying the connections, do the post-installation test of one or more of the components to which the tubes are connected as a check.

SUBTASK 20-10-51-710-004

- (7) If you disconnected electrical wires to get access to the tubes and you think there is a possibility you connected the wires incorrectly or cross-connected the wires, go back and verify that the connections are correct:

NOTE: Use your own judgement to determine if a check is necessary.

- (a) After verifying the connections, do the post-installation test of one or more of the components to which the wires are connected as a check.

————— END OF TASK ————

**TASK 20-10-51-200-801**

**6. Tubing Clearances Check**

**A. General**

- (1) This task gives you the minimum clearances necessary between tubes and all other components (hoses, fittings, structure, and other tubes). These clearances prevent tube damage in all positions of operation.
- (2) High vibration areas are the areas that follow:
- Engine core.
  - Engine nacelle.
  - APU compartment.

**B. Definitions**

- Supported Tube Locations
  - Tubes at supported locations are tubes that are clamped to the aircraft structure and have up to 3.0 in. (76.2 mm) on each side from where the tube is clamped to the structure.
- Non-Supported Tube Locations
  - Tubes at non-supported locations are tubes that do not meet the definition of tubes at supported locations.

**C. Procedure**

SUBTASK 20-10-51-220-032

- (1) For hydraulic system tubing, do the checks that follow.



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- (a) At supported locations, make sure that the tube clearance is a minimum of 0.10 in. (2.54 mm).
- NOTE: Where the tube is attached directly with a clamp to structure, the minimum clearance is the thickness of the clamp.
- (b) At non-supported locations, make sure that the tube clearance is a minimum of 0.25 in. (6.35 mm).
- 1) Install loop-type clamps to maintain clearance, if necessary.
    - a) Make sure that you do not force the clamp into place.
    - b) Make sure that you use a clamp that is compatible with BMS3-11 hydraulic oil (M85052/2 or equivalent clamp).
    - c) Use one of the methods that follow (Figure 408).
      - <1> Back-to-back clamping in the vertical or horizontal position.
        - <a> Make sure that you do not use back-to-back clamping in the high vibration areas that follow.
          - Engine core.
          - Engine nacelle.
          - APU compartment.
      - <2> Side-by-side clamping.
      - <3> Butterfly clamping.

(c) Make sure that the tube clearance with electrical wiring is a minimum of 0.50 in. (12.70 mm).

    - 1) Install loop-type clamps and spacers to maintain clearance, as necessary.
      - a) Make sure that you do not force the clamps or spacers into place.
      - b) Make sure that you use clamps and spacers that are compatible with BMS3-11 hydraulic oil (M85052/2 or equivalent clamp for tube/BACC10JU clamp for wire bundle/NAS43DD spacer).
      - c) Use variations of the clamping configurations in Figure 408.

(d) Make sure that the tubes are clear of any mechanism that operates.

    - 1) At supported locations, make sure that the clearance is a minimum of 0.25 in. (6.35 mm).
    - 2) At non-supported locations, make sure that the clearance is a minimum of 0.38 in. (9.65 mm).

SUBTASK 20-10-51-220-033

- (2) For tubing in systems other than hydraulic systems, do the checks that follow.
- (a) Make sure that the tube clearance from electrical wires and cables is a minimum of 2.0 in. (50.8 mm) for the systems that follow.
- 1) Flammable gas.
  - 2) Fuel.
  - 3) Oxygen.
- (b) At supported locations, make sure that the tube clearance is a minimum of 0.10 in. (0.00 mi).

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- (c) At non-supported locations, make sure that the tube clearance is a minimum of 0.20 in. (5.08 mm).

NOTE: Where the tube is attached directly with a clamp to structure, the minimum clearance is the thickness of the clamp.

SUBTASK 20-10-51-220-034

- (3) If one tube goes across a tube, or if two tubes are in parallel, make sure that the tubes are clear of one another.
- (a) The minimum clearance in areas other than high vibration areas is 0.25 in. (6.35 mm).
- 1) If the clearance is less than 0.25 in. (6.35 mm), do the steps that follow.
    - a) Loosen the existing clamps in the area.
    - b) Loosen the fittings at the ends of the tube, if necessary.
    - c) Adjust the tubes to make the 0.25 in. (6.35 mm) clearance.
    - d) Install new back-to-back clamps to maintain the clearance, if necessary.
      - <1> Make sure that the clamps are compatible with BMS3-11 hydraulic oil (M85052/2 or equivalent clamps).
      - <2> Make sure that you do not force the clamps into place.
    - e) Retighten the clamps in the area.
    - f) Retighten the fitting ends if they were loosened.

SUBTASK 20-10-51-220-035

- (4) To get the necessary clearance where loop-type clamps are attached to structure, use BACS18AF2 or BACS18AF4 spacers.
- (a) Make sure that you do not use NAS42 or NAS43 spacers for hydraulic tubing.

SUBTASK 20-10-51-220-036

- (5) To get the necessary clearance where U-type clamps are used, use BACS18AN spacers.
- (a) Make sure that you do not use NAS42 or NAS43 spacers for hydraulic tubing.

SUBTASK 20-10-51-220-037

- (6) Make sure that the tubes are clear of the control cables between the break points or fairleads and the control cable linkage.
- (a) The minimum clearance is 0.625 in. (15.875 mm).

- (7) Make sure the clearance between the tubes and the clamp blocks and the channels on the clamp blocks is a minimum of 0.05 in. (1.27 mm).
- (a) If the clearance is less than 0.05 in. (1.27 mm), do one of the steps that follow.
- 1) Adjust the spacer tube length.
  - 2) Adjust the clamp and the tube fit-up.

NOTE: This will correct the force on the tubes in the clamp block.

———— END OF TASK ————

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**TASK 20-10-51-200-802**

**7. Space Between Tubing Clamps Check**

**A. Procedure**

SUBTASK 20-10-51-220-019

- (1) Make sure the space between the tubing clamps is within the limits shown in (Table 409), unless it is specified differently.

**Table 409/20-10-51-993-851 Maximum Space Between Tubing Clamps**

TUBE OD Inch (mm)	MATERIAL	CLAMP SPACE - VISUAL Inches (cm)	CLAMP SPACE - SPECIAL <sup>[1]</sup>
1/4 (6.35)	Steel, Titanium	16.0 (40.6)	12.0 (30.4)
3/8 (9.53)	Steel, Titanium	20.0 (50.8)	15.0 (38.1)
3/8 (9.53)	Aluminum	16.5 (41.9)	12.0 (30.5)
1/2 (12.7)	Steel, Titanium	23.0 (58.4)	17.0 (43.2)
1/2 (12.7)	Aluminum	19.0 (48.3)	14.0 (35.6)
5/8 (15.88)	Steel, Titanium	22.0 (55.9)	18.5 (47.0)
5/8 (15.88)	Aluminum	22.0 (55.9)	16.5 (41.9)
3/4 (19.05)	Steel, Titanium	27.5 (69.9)	20.5 (52.1)
3/4 (19.05)	Aluminum	24.0 (61.0)	18.0 (45.7)
1.0 (25.4)	Steel, Titanium	30.0 (76.2)	22.5 (57.2)
1.0 (25.4)	Aluminum	26.5 (67.3)	19.5 (49.5)
1-1/4 (31.75)	Steel, Titanium	31.5 (80.0)	23.5 (59.7)
1-1/4 (31.75)	Aluminum	28.5 (72.4)	21.0 (53.3)

<sup>[1]</sup>[1] Special: Wing Rear Spar, Engine Strut, Engine Aft Fairing.

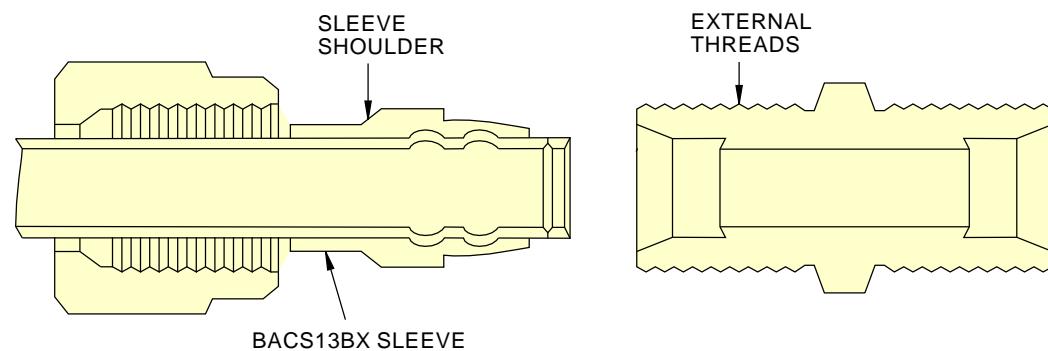
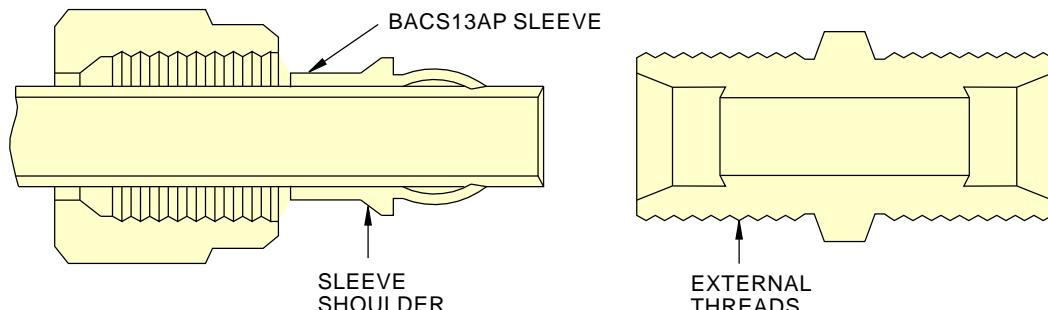
———— END OF TASK ————

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LUBRICATION POINTS

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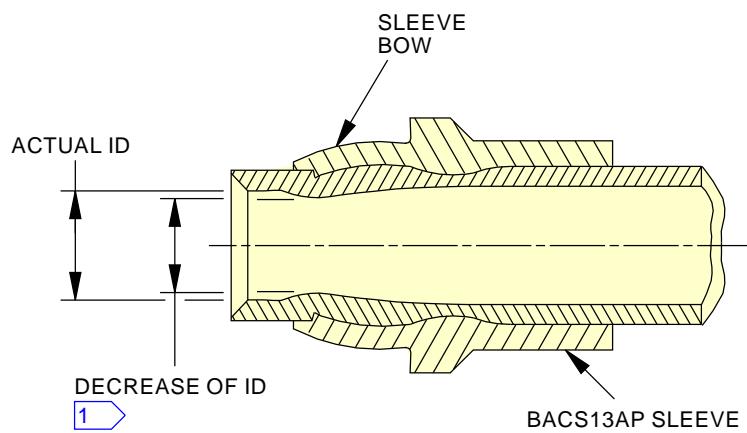
Flareless Tubing Assembly Lubrication Points  
Figure 404/20-10-51-990-838

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- 1 MAKE SURE THE DECREASE OF ID IS NOT MORE THAN 0.005 INCH AFTER PRESET OR 0.015 INCH AFTER MANY TIGHTENINGS

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Maximum Collapse of Preset Flareless Sleeve  
Figure 405/20-10-51-990-839

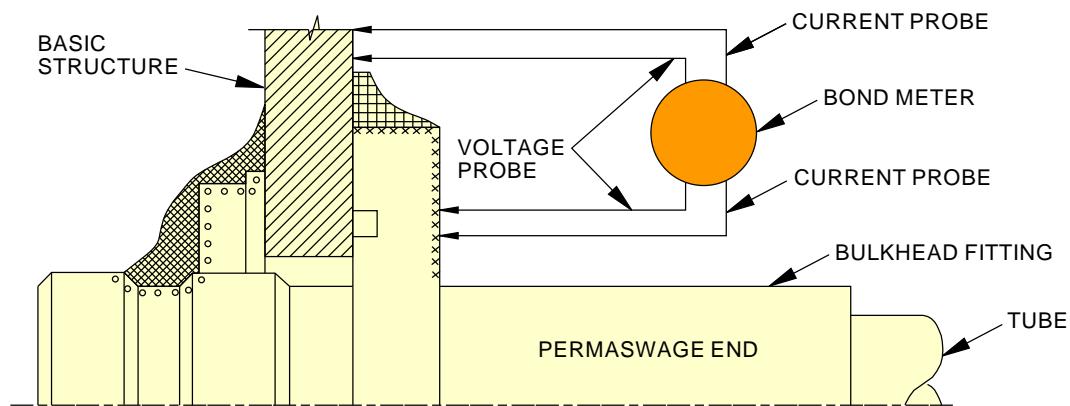
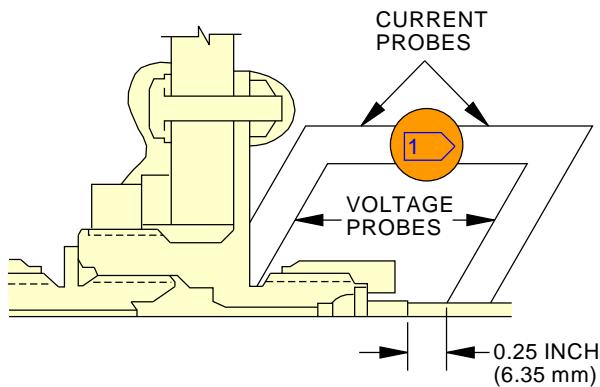
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**ELECTRICAL BONDING PROCESSES**

**TEST POINTS FOR A PERMASWAGE BULKHEAD FITTING AND BASIC STRUCTURE**

**SCREW TOGETHER WELD-ON BULKHEAD FITTING**

**MICRO-OHMMMETER**

F15926 S0006561932\_V3

**Bulkhead Fittings**  
**Figure 406/20-10-51-990-840**

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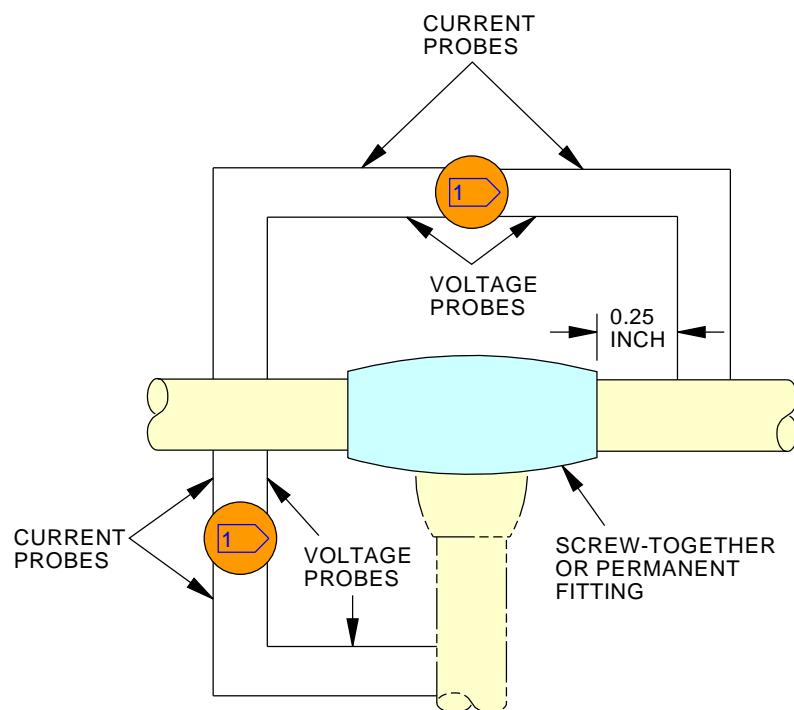
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MICRO-OHMmeter

F15929 S0006561933\_V2

Union/Tee Fittings  
Figure 407/20-10-51-990-841

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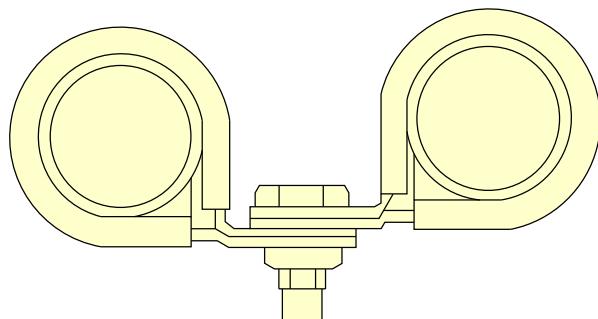
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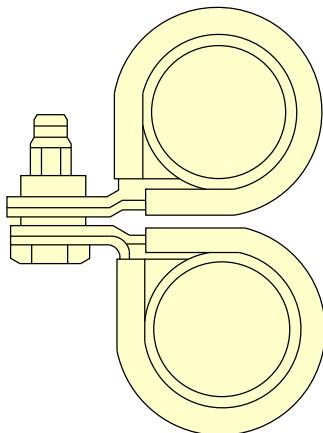
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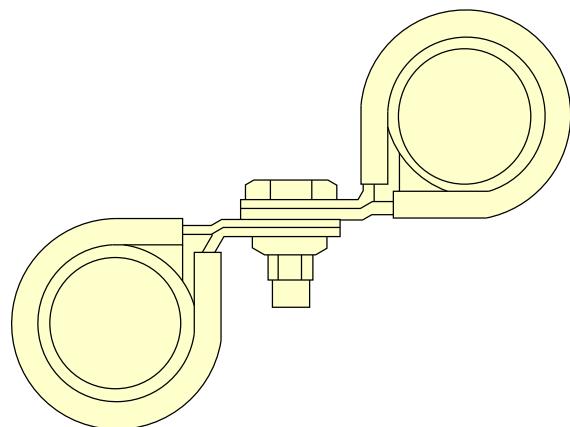
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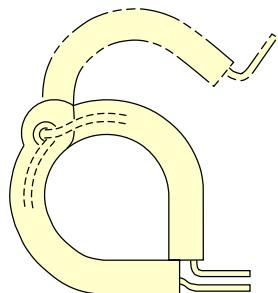
SIDE-BY-SIDE CLAMP



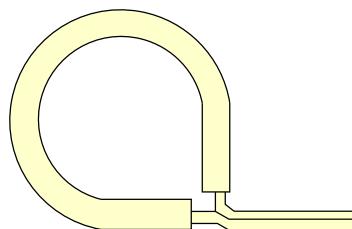
BACK-TO-BACK CLAMP



BUTTERFLY CLAMP



LOOP CLAMP



CLAMPING TO MAINTAIN CLEARANCES

2032766 S0000407445\_V4

Tubing Clearances Check Clamps  
Figure 408/20-10-51-990-868

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FLARELESS TUBING ASSEMBLY - REPAIRS

**1. General**

- A. The customer must consult Boeing before conducting any repairs to oxygen system tubing.
- B. This procedure has these tasks:
  - (1) Tube and Fitting Leakage
  - (2) Retightening of Fitting Joints with Persistent Hydraulic Leaks
  - (3) Tube repair
  - (4) Titanium Hydraulic Tubing, 3000 psi - Roll Swaging Harrison 53211 Sleeves and 53212 Unions using the Harrison 6777 Swage Machine
  - (5) Install the CRYOLIVE Flareless Sleeve Assembly.
  - (6) BACS13BX Flareless Sleeve Swaging with the Harrison Swagers 5175, 5570, and 5720
  - (7) BACS13BX Flareless Sleeve Swaging with the 6633K01 Harrison Roller Swaging Kit
  - (8) BACS13AP Flareless Sleeve Preset
  - (9) BACC42W H-Coupling Installation
  - (10) 3P02111/3PHS111 Cryofit Coupling Installation
  - (11) Externally Swaged (Permaswage) Fittings Installation
- NOTE: The use of Permaswage fitting to repair potable water line tubes is not recommended because of possible microbe growth in the cavity of the fitting.

  - (12) Axial Swage Fitting Union (8,000 psi rated - Rynlok)
  - (13) Axial Swage Fitting Installation (5,000 psi rated - Union) or Male/Female Adapter Fittings
  - (14) Axial Swage Fitting Installation (5,000 psi rated - Shape, Elbow, Tee)
  - (15) Hydraulic Tubing Repair with Flexible Hoses
  - (16) Repair Size 16 (1 inch) and Size 20 (1-1/4 inch) 6061-T4 Aluminum Tubing in the Hydraulic System of the Airplane
  - (17) Part Marking of Flareless Tubing Assemblies
  - (18) Possible Tube Repair Scenarios - Axial Swage Fittings
- C. Airplane line numbers 3100 and on have been delivered with both B-nut fittings and Axial Swage fittings. However, it is an option to use the Axial Swage fittings for applicable tube repairs on all 737NG aircraft.
- D. This procedure gives the approved repairs for hydraulic, pneumatic, water, electrical rigid conduit, pitot/static tubing, cargo fire protection tubing, and other tube assemblies.
  - (1) Repair procedures include the replacement of damaged tube ends or the replacement of small damaged tube parts. You can use flareless tubes and sleeves, H-Coupling assemblies, Cryofit couplings, Permaswage fittings, Cryolive assemblies, or Rynlok unions.
  - (2) For repair of electrical flexible conduit, do this task: SWPM 20-10-91.
- E. You can replace existing axial swage shape (elbow and tee, 5,000 psi rated) fittings on the aircraft (Axial Swage Fitting Installation (5,000 psi rated - Shape, Elbow and Tee), TASK 20-10-51-400-811).
- F. For the approved repair of aluminum fuel system tubes, refer to the Component Maintenance Manual (CMM).
- G. You can repair 6061-T4 aluminum tubes using 6061-T4 or 6061-T6 aluminum tube and flareless fittings. It is not acceptable to repair 6061-T6 aluminum tube with 6061-T4 aluminum tube or use 6061-T4 tube in place of 6061-T6 aluminum tube.

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- H. You can use approved 304-1/8 Hard or 21-6-9 corrosion-resistant steel tube material for replacement or repair of titanium tube assemblies. You can also use approved 304-1/8 Hard corrosion-resistant steel tube material for replacement or repair of 21-6-9 corrosion-resistant steel tube assemblies. When a new tube is fabricated to replace an existing tube assembly, the replacement tube assembly should be marked with a part number similar to, but not the same, as the original tube. (Refer to the task for Part Marking of Flareless Tubing Assemblies.)

**CAUTION:** USE CADMIUM PLATED STEEL FITTINGS WHEN REPLACING ALUMINUM LINES WITH CORROSION RESISTANT STEEL LINES. GALVANIC CORROSION MAY OCCUR IF CADMIUM PLATED STEEL IS NOT USED.

- I. Replacements for aluminum lines may be made from corrosion resistant steel material.
- J. When you do repairs, the type of flareless tube sleeves will tell you the installation method to use.
- (1) Use the approved power swaging equipment, or roller swaging, to do all swaged-on sleeves and fittings.
  - (2) You can preset BACS13AP flareless sleeves by machine. Preset by hand only when a hydraulic or pneumatic-operated presetting tool is not available. If you must preset by hand, we recommend you preset some samples. Cut the samples into sections longitudinally and make an inspection of the ring cut depth before you preset the part to be repaired.
  - (3) You can install the Cryolive sleeve assembly, consisting of Cryolive sleeve, coupling nut and protective cover/inspection tool, by removing the assembly from liquid nitrogen and sliding it onto the tube end. Note that the size 10, 12, and 16 coupling nuts used with the Cryolive sleeve are slightly longer than standard MS type coupling nuts and are not interchangeable with MS type coupling nuts.
- K. The H-coupling assembly is a repair coupling which has a union coupling, a slide, and a nut. You can install the H-coupling assembly in straight sections of the tube. Use two end wrenches of applicable size. This assembly is approved for fuel and hydraulic high pressure lines of 21-6-9, titanium 3AL-2.5V, and 304-1/8 hard CRES tubing. The H-coupling assembly is also approved for the repair of 304 CRES annealed and 6061-T6 aluminum tubing lines of 3000 psi (10342.1 kPa) or less.
- L. You can use a Cryofit coupling for the inline repair of 3AL-2.5V titanium tubing. To install the Cryofit coupling in a straight tube section, shrink fit the coupling in its position.
- M. You can use the Permaswage coupling for inline repair of 6061-T6 aluminum, 21-6-9 CRES or 304-1/8 hard CRES, and 3AL-2.5V titanium tubing.
- N. 5,000 psi rated Axial Swage
- (1) You can use the Axial Swage union or Adapter fittings (5,000 psi rated) for inline repair of 3,000 psi rated 3AI-2.5V titanium tubing or 21-6-9 CRES tubing.
  - (2) You can use the Axial Swage shape fittings (5,000 psi rated - tee and elbows) to replace existing Axial Swage fittings (5,000 psi rated) of the same configuration.
  - (3) The Axial Swage fittings (5,000 psi rated) are made of lightweight 6AL-4V titanium alloy and are not to be used in oxygen systems, fuel cells, or in the repair of tubes installed in the engines.
  - (4) The 5,000 psi rated Axial Swage fittings and tooling are color-coded blue to distinguish them from the 8,000 psi rated Axial Swage fittings and tooling.
- O. 8,000 psi rated Axial Swage
- (1) You can use the Axial Swage union (8,000 psi rated - Rynglok) for inline repair of 3AI-2.5V titanium tubing, 21-6-9 CRES tubing, 304 1/8 hard CRES tubing, or 6061-T6 aluminum tubing.

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- (2) The 8,000 psi rated Axial Swage union in sizes 04, 06, 08, 10, and 12 have no color coding on the outside.
  - (3) The 8,000 psi rated Axial Swage union in sizes 16 and 20 have a black band on the collars at the permanent ends.
  - (4) There is no color code for the Axial Swage (8,000 psi rated) union tooling.
- P. The tooling for the 5,000 psi rated Axial Swage fittings and the tooling for the 8,000 psi rated Axial Swage fittings are not interchangeable.
- (1) The tooling for the 5,000 psi rated Axial Swage fitting cannot be used to swage the 8,000 psi rated Axial Swage fitting.
  - (2) The tooling for the 8,000 psi rated Axial Swage fitting cannot be used to swage the 5,000 psi rated Axial Swage fitting.
- Q. You can use the 8,000 psi rated Axial Swage union (Rynglok) for inline repair of 6061-T6 aluminum, 21-6-9 CRES or 304-1/8 hard CRES, and 3AL-2.5V titanium tubing. Rynglok unions are made of lightweight 6AL-4V titanium alloy and are not to be used in oxygen systems, in fuel cells, or in the repair of tubes installed in engines.

**CAUTION: DO NOT USE FITTING NUTS TO ALIGN THE FITTINGS. FITTING NUTS USED TO ALIGN FITTINGS DURING THE TUBE INSTALLATION WILL INCREASE THE RISK OF LEAKAGE, BLOW-OFF, OR OTHER FAILURE.**

- R. When you repair a section of a tube, correctly align the tube and the fittings. Make sure the fittings touch the bottom at the two ends of the repaired section.
- S. Do a pressure test on completed repairs in all general areas. In pressurized areas, pressurize the system for 15 minutes minimum to do a leak test. To make sure there are no signs of hydraulic leakage, rub the area with a finger or a white cloth.
- T. When you remove, install, or do work with hydraulic tube assemblies, obey the guidelines that follow:
  - (1) Make sure that you do not clamp the tube at the repair fitting location.  
NOTE: Clamps are sized to fit standard tube diameters. If a repair swage is clamped, the clamp can move off of the uniform surface because the tube can migrate or flex.
  - (2) When you remove tubes, make sure the tubes and the port fittings have tags that identify the correct connection locations.
  - (3) Do not move or change the tube bends. If you move or change the bend in the tube, these bad effects can occur:
    - (a) If you move or change the bend in the tube, it can become possible that the tube will align with the incorrect port. If this occurs, incorrect reconnection or cross-connection of the tubes can become possible.
    - (b) If you move or change the bend in the tube, it can become possible that the tube will have too much stress. Stress can cause cracks in the tubes.
  - (4) If you disconnected more than one hydraulic tube and you think there is a possibility you connected the tubes incorrectly or cross-connected the tubes, do an operational check:  
NOTE: Use your own judgement to determine if a check is necessary.
    - (a) Do the post-installation test of one or more components to which the tubes are connected as a check.

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- (5) If you disconnected electrical wires to get access to the hydraulic tube and you think there is a possibility you connected the wires incorrectly or cross-connected the wires, do an operational check:

NOTE: Use your own judgement to determine if a check is necessary.

- (a) Do the post-installation test of one or more components to which the wires are connected as a check.

**U. Hydraulic system pressure specifications are below:**

- (1) Maximum working pressure:

- (a) Anytime repairs to the tubes are made on the airplane, or when any hydraulic component is to be checked.

- (2) Proof pressure:

- (a) If the tubes are repaired and to be tested in the shop.

- (3) Burst pressure:

- (a) This is for design reference only.

**V. B-Nut torquing:**

- (1) The correct torquing can be applied to B-nut only if the tubing material is identified correctly (aluminum, titanium or steel).

- (2) If the normal finish color of the B-nut is covered by the gray drilube coating, a color-coded ring is applied on the back side of the B-nut.

**Table 801/20-10-51-993-902**

TUBE MATERIAL	TUBE FINISH	COLOR	B-NUT (MAY BE COVERED WITH DRILUBE)
ALUMINUM	Primer	Green	GOLD OR BROWN
CRES	None, or Primer	Natural, or Green	SILVER, BRIGHT
TITANIUM	None	Natural	DULL GRAY

- (3) If a steel or titanium B-nut connects to an aluminum tube or fitting, use the lower torque value (aluminum).

**CAUTION:** DO NOT ALLOW PUMPS, VALVES, ACTUATORS OR OTHER COMPONENTS TO HANG FROM KEVLAR HOSES. KEVLAR HYDRAULIC HOSES KINK EASILY AND MAY CAUSE LEAKAGE.

- W.** When you do repairs to Kevlar hydraulic hoses, remember Kevlar hoses kink more easily than CRES (steel) wire braided hoses.

**TASK 20-10-51-360-802**

**2. Tube and Fitting Leakage**

**A. General**

- (1) Use this procedure to help find and repair hydraulic leaks in tubes and fittings.

- (a) Leakages and Failures in Tubes can be caused by the following:

- 1) Fatigue cracks that start because of damage from an external impact.
- 2) Fatigue cracks that start from vibration as a result of incorrect support.
- 3) Fatigue cracks that start because of a preload that is induced during installation.

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- 4) Fatigue because of loss of the tube wall from chafing contact with another tube, structure or other component.
- 5) Fatigue from stress because of excess ovality at a tube bend.

**B. References**

Reference	Title
20-10-15 P/B 401	RECESSED BOSS SEAL FITTINGS - REMOVAL/INSTALLATION
20-10-17 P/B 401	O-RINGS - REMOVAL/INSTALLATION
20-10-51 P/B 401	FLARELESS TUBING ASSEMBLY - REMOVAL/INSTALLATION
20-10-51-400-804	Flareless Tubing Assembly Installation (P/B 401)

**C. Procedure**

SUBTASK 20-10-51-790-006

- (1) Do a leak check to check for the location of the leak.
    - (a) Pressurize the system for a minimum of 15 minutes.
    - (b) With the system pressurized, do a check of the tubes and fittings for signs of hydraulic leakage.
      - 1) Use a clean white cloth to find hydraulic leakage.
      - 2) Record the location of the leak.
        - a) If the hydraulic tube is pressurized, some leaks will be easy to find because the fluid will spray some distance from the source. [See Figure 801, sheet 1]
        - b) If the hydraulic tube is not pressurized, the source of the leak may not be clear. In this condition, examine areas above and around the fluid for the possible source.
- NOTE: The source of the leak may be some distance away from the visible fluid.
- c) For aluminum tubes examine at or below the end sleeve for signs of corrosion that can cause a leak. [See Figure 801, sheet 2]

SUBTASK 20-10-51-860-013

- (2) Depressurize the system.

SUBTASK 20-10-51-211-003

- (3) Do a visual inspection of the tube installation that is the source of the leakage.
  - (a) Check for the following:
    - 1) Worn clamps.
    - 2) Missing clamps.
    - 3) Interference.
    - 4) Dents.
    - 5) Chafing.
  - (b) Repair/Replace the tube assembly if necessary.
    - 1) Use this procedure to replace the tube assembly: FLARELESS TUBING ASSEMBLY - REMOVAL/INSTALLATION, PAGEBLOCK 20-10-51/401.
    - 2) Use this procedure to repair the tube assembly: Tube Repair, TASK 20-10-51-300-805.
  - (c) Correct the cause of the chafing if present and replace any worn or missing clamps.

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SUBTASK 20-10-51-211-004

- (4) If the leak is at a Hydraulic joint, examine for the following:
- (a) Damage to joints, for example rough seal surfaces, cracked fittings or cracks in tubing. [See Figure 801, sheet 3]
    - 1) Replace damaged parts.
  - (b) Incorrectly torqued or swaged connections. [See Figure 801, sheet 4]
    - 1) To repair or replace these parts, refer to procedures:
      - a) Flareless Tubing Assembly Installation, TASK 20-10-51-400-804
      - b) Retightening of Fitting Joints with Persistent Hydraulic Leaks, TASK 20-10-51-360-803
      - c) FLARELESS TUBING ASSEMBLY - REPAIRS, 20-10-51/801 for improperly swaged connections for specific permanently swaged fitting joints.
  - NOTE: It can be necessary to replace parts if the leak can not be corrected by swage.
  - (c) Insufficient or incorrect support of hydraulic lines.
    - 1) To reposition existing clamps or install additional clamps if necessary use procedure Flareless Tubing Assembly Installation, TASK 20-10-51-400-804.
  - (d) Foreign material in the join.
    - 1) Remove and clean off the foreign material as necessary, then reassemble and re-torque the joint.
  - (e) Incorrectly installed, mismated or pre-loaded parts.
    - 1) For correcting the fit-up or installation of parts, refer to procedure Retightening of Fitting Joints with Persistent Hydraulic Leaks, TASK 20-10-51-360-803.
  - (f) Seized or galled threads. [See Figure 801, sheet 5]
    - 1) Replace damaged parts.
  - (g) Stress corrosion cracking from over-torque on the fitting joint, put together with the effects of external contaminants. [See Figure 801, sheet 6]
    - 1) Replace damaged parts.

NOTE: Install hydraulic fittings carefully, take care when applying torque to mating fittings. Retightening or applying a higher torque than recommended to a mating part can introduce stresses to the fitting that can contribute to cracks. If a crack already exists and a higher torque is applied to stop a leak, it will make the crack and leakage worse.

SUBTASK 20-10-51-211-005

- (5) If the leak is at a threaded 'boss' joint [See Figure 801, sheet 7] that uses o-rings this most commonly occurs due to mistakes during assembly, check for the following:
- (a) Incorrect positioning of the o-ring on the fitting.
  - (b) Damaged o-ring seal.
  - (c) Insufficient wrench torque to squeeze the o-ring and make the seal.
  - (d) Incorrect o-ring selection.



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- 1) To correct these leaks refer to procedure RECESSED BOSS SEAL FITTINGS - REMOVAL/INSTALLATION, PAGEBLOCK 20-10-15/401 and O-RINGS - REMOVAL/INSTALLATION, PAGEBLOCK 20-10-17/401.

———— END OF TASK ————

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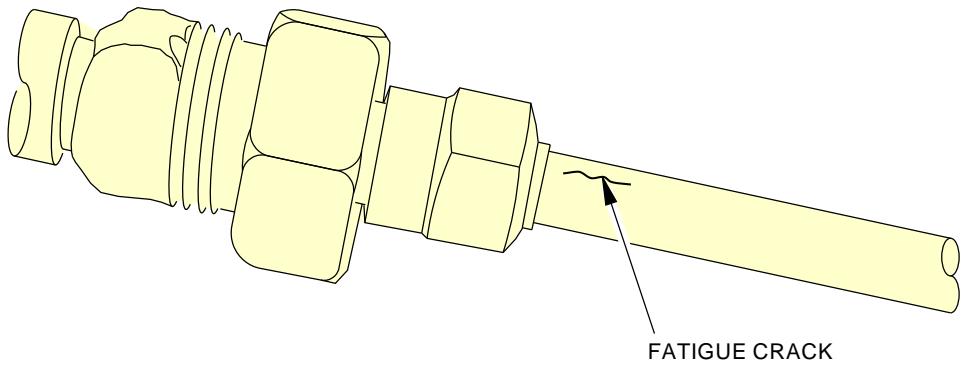
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PRESSURIZED TUBE LEAK

**NOTE:**

EXAMPLE OF LEAK FROM FATIGUE CRACK ADJACENT TO WELD SLEEVE (TUBE SIDE OF WELD) ON TITANIUM HYDRAULIC TUBE ASSEMBLY.

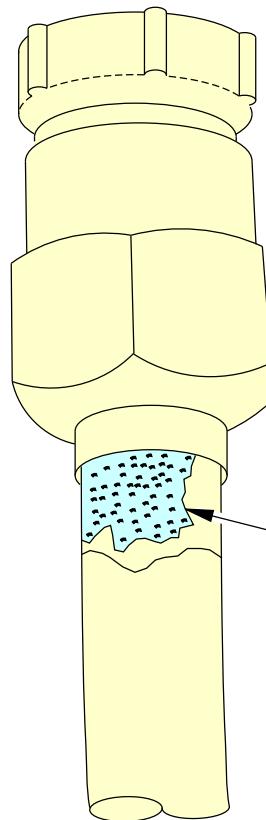
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**Tube and Fitting Leakage Identification**  
**Figure 801/20-10-51-990-925 (Sheet 1 of 7)**

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EXAMPLE OF TUBE CORROSION  
AT FLARELESS SLEEVE ON  
ALUMINUM TUBE MATERIAL

ALUMINUM TUBE CORROSION

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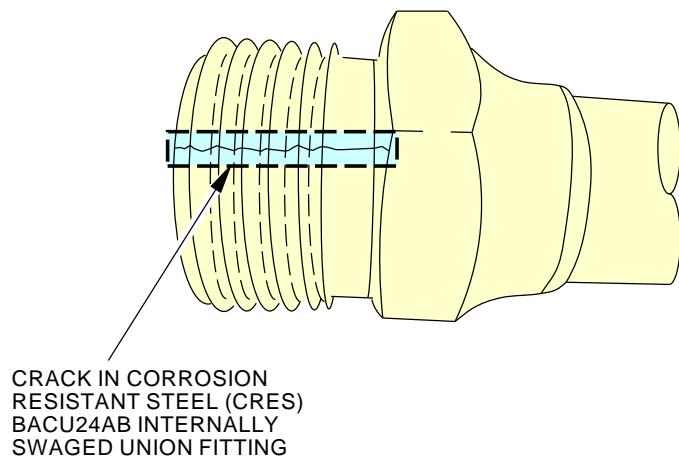
**Tube and Fitting Leakage Identification**  
**Figure 801/20-10-51-990-925 (Sheet 2 of 7)**

EFFECTIVITY  
AKS ALL

**20-10-51**



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**CRACKED FITTINGS**

2324326 S0000527015\_V2

**Tube and Fitting Leakage Identification**  
**Figure 801/20-10-51-990-925 (Sheet 3 of 7)**

EFFECTIVITY  
AKS ALL

**20-10-51**

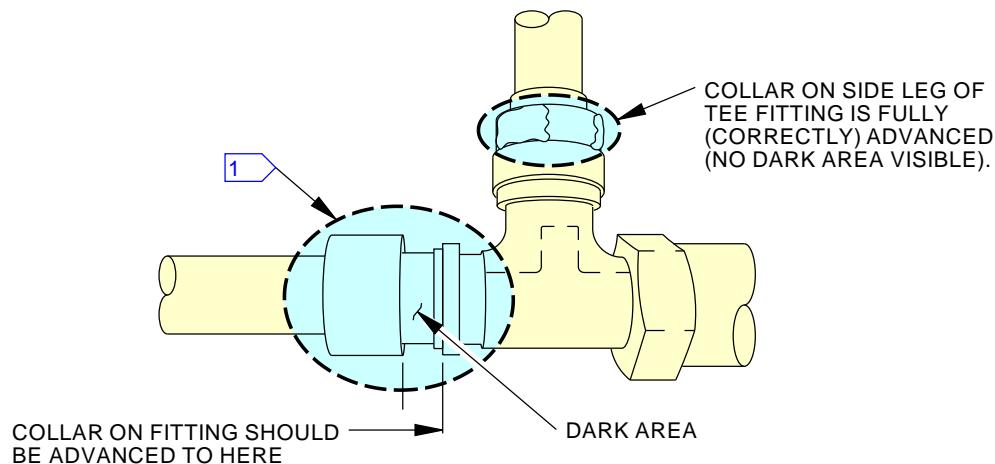
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COMBINATION AXIALLY SWAGED/FLARELESS TEE FITTING WITH INCOMPLETELY SWAGED END

- 1 POSITION OF COLLAR ON TEE FITTING THAT LEAKED IN SERVICE DUE TO INCOMPLETE SWAGE (DARK AREA SHOWS THAT COLLAR IS NOT FULLY ADVANCED - FOR COMPARISON, SEE SIDE LEG.).

2324353 S0000527017\_V2

Tube and Fitting Leakage Identification  
Figure 801/20-10-51-990-925 (Sheet 4 of 7)

EFFECTIVITY  
AKS ALL

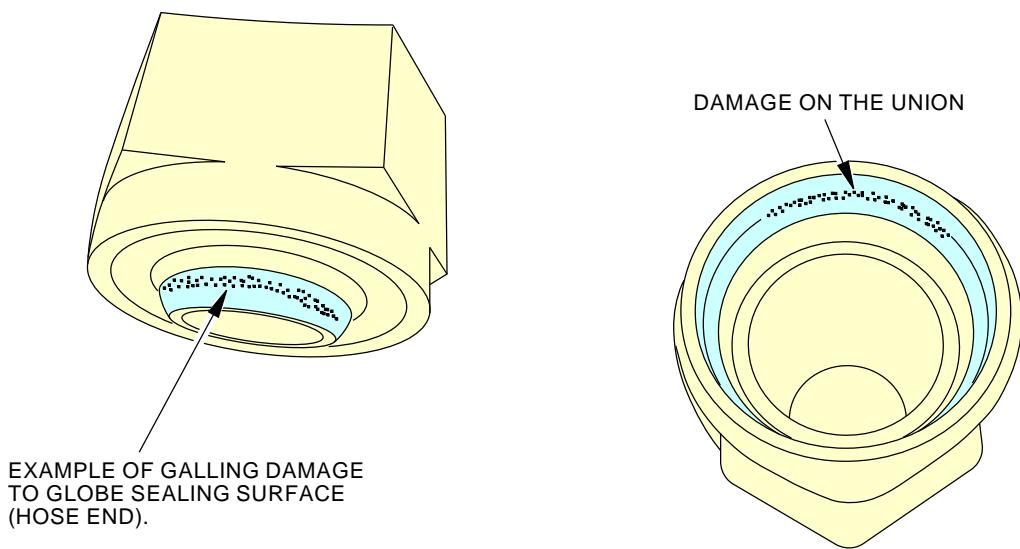
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**GALLING DAMAGE**

2324433 S0000527018\_V2

**Tube and Fitting Leakage Identification**  
**Figure 801/20-10-51-990-925 (Sheet 5 of 7)**

EFFECTIVITY  
AKS ALL

**20-10-51**

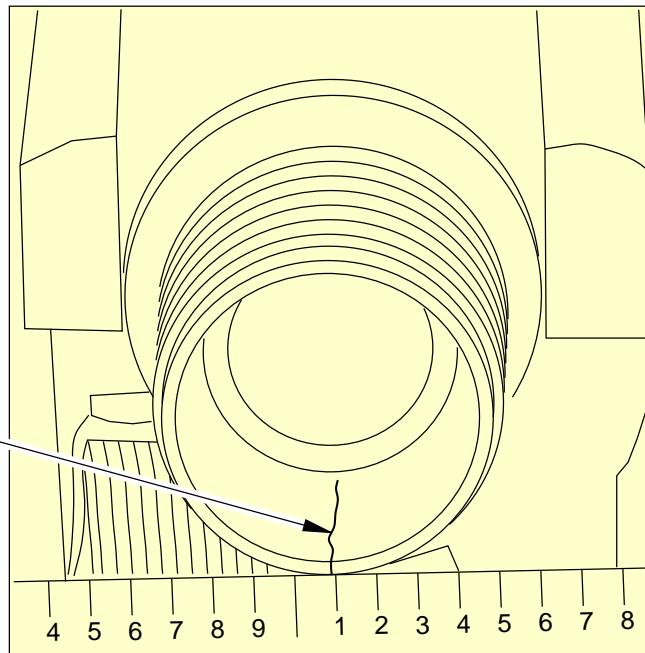
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ALUMINUM HYDRAULIC  
FITTING - CRACK IS  
LOCATED ON THE  
PARTING PLANE OF THE  
ALUMINUM FORGING



**STRESS CORROSION CRACKING**

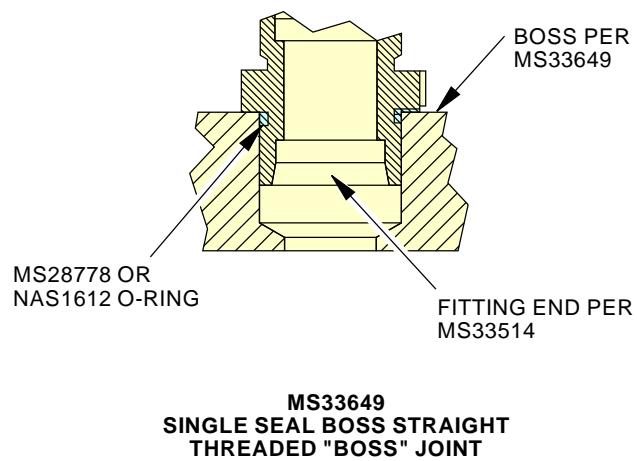
2324455 S0000527019\_V2

**Tube and Fitting Leakage Identification**  
Figure 801/20-10-51-990-925 (Sheet 6 of 7)

EFFECTIVITY  
AKS ALL

**20-10-51**

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2324602 S0000527020\_V2

**Tube and Fitting Leakage Identification**  
Figure 801/20-10-51-990-925 (Sheet 7 of 7)

EFFECTIVITY  
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**TASK 20-10-51-360-803**

**3. Retightening of Fitting Joints with Persistent Hydraulic Leaks**

**A. General**

- (1) Use this procedure to help resolve a persistent hydraulic leak at a tube joint that is not located in a pressurized area, a strut, a fuel tank, or a cargo area.
  - (a) For joints located in a pressurized area, a strut, a fuel tank, or a cargo area, use this tightening procedure: Flareless Fittings in Pressurized Areas Installation, TASK 20-10-51-000-802.
- (2) Use this procedure only for flareless joints that have continual leakage that cannot be resolved.
  - (a) Do not use this procedure as a routine torque tightening method for flareless fittings.
- (3) For repairs and replacements of the flareless tubing assemblies, refer to the applicable flareless tubing assembly approved repairs above.

**B. References**

Reference	Title
20-10-51-000-802	Flareless Fittings in Pressurized Areas Installation (P/B 401)
20-10-51-200-802	Space Between Tubing Clamps Check (P/B 401)
20-10-51-400-804	Flareless Tubing Assembly Installation (P/B 401)
20-10-51-993-842	Table: Thread Compounds (P/B 401)
20-10-51-993-845	Table: Installation Torque (P/B 401)
20-10-51-993-850	Table: Installation Torques (P/B 401)

**C. Procedure**

SUBTASK 20-10-51-280-001

- (1) Do a leak check to confirm the location of the leak.
  - (a) Pressurize the system for a minimum of 15 minutes.
  - (b) With the system pressurized, do a check of the tube-to-fitting interface for signs of hydraulic leakage.
    - 1) Use a clean white cloth to find hydraulic leakage.
    - 2) Record the location of the leak.

SUBTASK 20-10-51-864-001

- (2) Depressurize the system.

SUBTASK 20-10-51-211-001

- (3) Do a visual inspection of the tube installation that is the source of the leakage.
  - (a) Check for the external damage that follows:
    - 1) Worn clamps.
    - 2) Missing clamps.
    - 3) Interference.
    - 4) Dents.
  - (b) If external damage is found, replace the tube assembly.
    - 1) Use this procedure: Flareless Tubing Assembly Installation, TASK 20-10-51-400-804.

SUBTASK 20-10-51-030-001

- (4) Loosen the flareless fittings to check for preload on the tube assembly.

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- (a) Check for side-to-side or end-to-end preload in the line.
  - 1) If there is preload, adjust the tube assembly. Do this procedure: Space Between Tubing Clamps Check, TASK 20-10-51-200-802.
    - a) If the preload cannot be relieved, replace the tube assembly.
    - <1> Use this procedure: Flareless Tubing Assembly Installation, TASK 20-10-51-400-804.

**SUBTASK 20-10-51-020-005**

- (5) Remove the tube assembly that is the source of the leakage to check for sealing surface damage on mating fittings.
  - (a) Check the mating surfaces of the tube-to-fitting interface for damage.
    - 1) Examples of such damage are as follows:
      - a) Machining flaws.
      - b) Galling or scratches.
      - c) Dimples.
      - d) Cracks.
    - (b) If damage is found, replace the damaged part.
    - 1) Use this procedure: Flareless Tubing Assembly Installation, TASK 20-10-51-400-804.

**SUBTASK 20-10-51-430-001**

- (6) If flareless fittings with BACS13AP preset sleeves are used (Figure 802), do the steps that follow.
  - (a) Apply the appropriate lubricant to the BACS13AP sleeves, found in Table 20-10-51-993-842.
  - (b) Tighten the flareless fittings with BACS13AP sleeves two times (tighten, loosen, and tighten again) to nominal torque shown in Table 20-10-51-993-845

**SUBTASK 20-10-51-430-002**

- (7) If the flareless fittings with internally swaged BACS13BX (Figure 803), internally swaged BACS13BD (Figure 803), or welded-on NAS1760-type sleeves (Figure 804) are used, do the steps that follow.
  - (a) Apply the appropriate lubricant to the BACS13BX, BACS13BD, or welded-on NAS1760-type sleeves, found in Table 20-10-51-993-842.
  - (b) Tighten the flareless fittings with BACS13BX, BACS13BD, or welded-on NAS1760-type sleeves as follows:
    - 1) Tighten the fitting to the torque shown in Table 20-10-51-993-845.
    - 2) Loosen the fitting to release the torque.
    - 3) Tighten the fitting to the torque value specified in Table 20-10-51-993-850.

**SUBTASK 20-10-51-280-002**

- (8) Do a leak test on the installations of the flareless fittings.
  - (a) Pressurize the system for 15 minutes minimum.
  - (b) With the system pressurized, do a check at the tube-to-fitting interface for signs of hydraulic leakage.
    - 1) Use a clean white cloth to find hydraulic leakage.
    - 2) If you find leakage, do the steps that follow.

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- a) De-pressurize the system.
- b) Loosen the fitting.
- c) Check the mating surfaces of the tube-to-fitting interface for signs of damage.
  - <1> Examples of such damage are as follows:
    - <a> Machining flaws.
    - <b> Galling or scratches.
    - <c> Dimples.
    - <d> Cracks.
  - <2> If damage is found, replace any damaged assemblies.
    - <a> Use this procedure: Flareless Tubing Assembly Installation, TASK 20-10-51-400-804.
- d) If no signs of damage are found on the mating surfaces of flareless fittings with BACS13AP sleeves, retighten the fittings using the steps that follow.
  - <1> Use the appropriate lubricant found in Table 20-10-51-993-842.
  - <2> Tighten the fittings two times (tighten, loosen, and tighten) to nominal torque shown in Table 20-10-51-993-845.
  - <3> Re-pressurize the system.
  - <4> Repeat the leak test.
  - <5> If you find leakage, replace one or both of the mating fittings and tube assemblies.
    - <a> Use this procedure: Flareless Tubing Assembly Installation, TASK 20-10-51-400-804.
- e) If no signs of damage are found on the mating surfaces of flareless fittings with BACS13BX, BACS13BD, or welded-on NAS1760-type sleeves, retighten the fittings using the steps that follow.
  - <1> Use the appropriate lubricant found in Table 20-10-51-993-842.
  - <2> Tighten the fitting to the torque shown in Table 20-10-51-993-845.
  - <3> Loosen the fitting to release the torque.
  - <4> Tighten the fitting to the torque value specified in Table 20-10-51-993-850.
  - <5> Re-pressurize the system.
  - <6> Repeat the leak test.
    - <a> If you find leakage, replace one or both of the mating fittings and tube assemblies. Use this procedure: Flareless Tubing Assembly Installation, TASK 20-10-51-400-804.

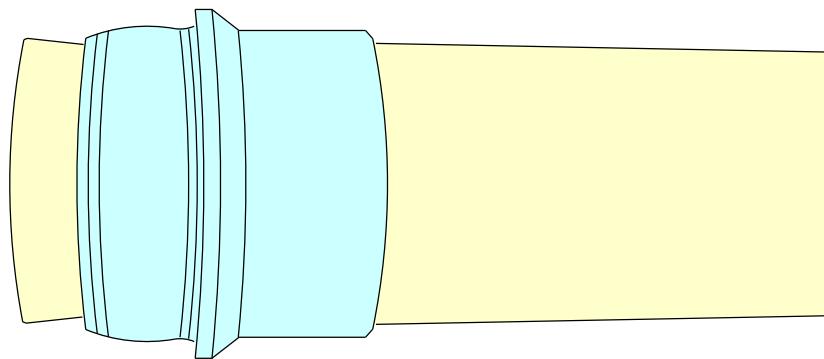
———— END OF TASK ————

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**BACS13AP Flareless Preset Sleeve**  
**Figure 802/20-10-51-990-861**

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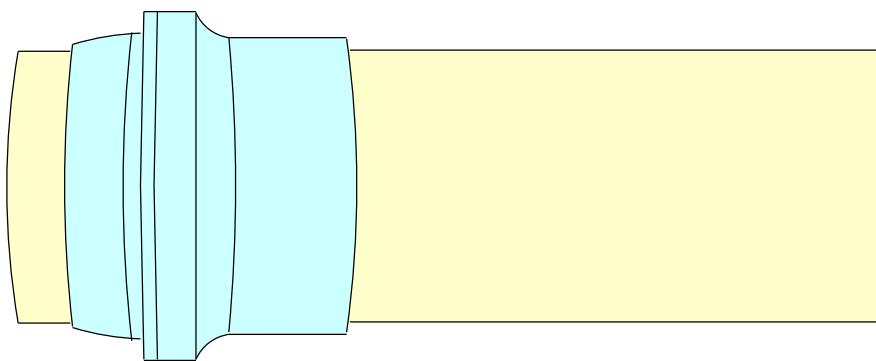
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1847485 S0000328863\_V2

**BACS13BX/BACS13BD Flareless Internally Swaged Sleeve**  
**Figure 803/20-10-51-990-862**

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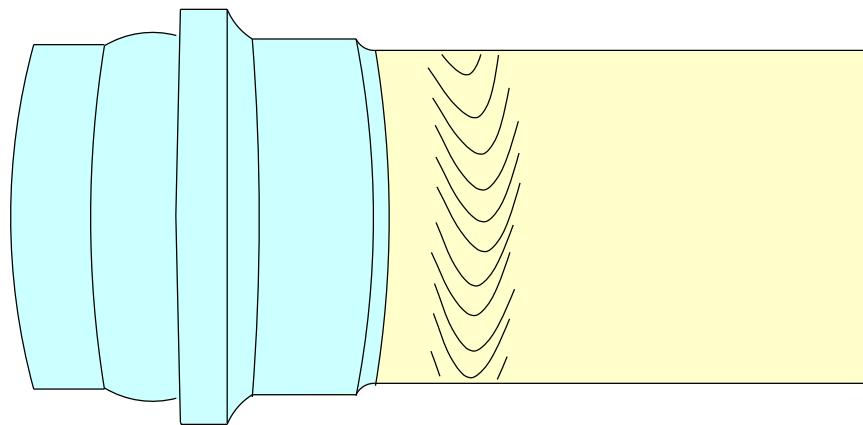
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NAS1760 Flareless Weld Sleeve  
Figure 804/20-10-51-990-863

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**TASK 20-10-51-300-805**

**4. Tube Repair**

**A. General**

**CAUTION:** DO NOT REPAIR COIL TUBES. NORMAL MOVEMENT OF COIL MAY BE RESTRICTED BY REPAIR.

- (1) You can repair tubes if you obey the permitted repair limits. When it is possible do the following:
  - (a) Replace the damaged tube.
  - (b) Replace the damaged part with a tube splice.
  - (c) Repair the damaged tube with a fitting if the damaged area is sufficiently small.
  - (d) Completely remove all corrosion and treat affected surface area as described in the Corrosion Prevention Manual.
- (2) When you remove, install or do work with hydraulic tube assemblies, obey the guidelines that follow:
  - (a) When you remove tubes, make sure that the tubes and port fittings have tags that clearly identify the correct connection locations.
  - (b) Do not move or change the tube bends. If you move or change the bends in the tube, these bad effects can occur:
    - 1) If you move or change a bend in the tube, it can become possible that the tube will align with the incorrect port. If this occurs, incorrect reconnection or cross-connection of the tubes can become possible.
    - 2) If you move or change the bend in the tube, it can become possible that the tube will have too much stress when it is connected. Stress can cause cracks in the tubes.
  - (c) If you must bend the tube assemblies to fit the installation, do not bend more than permitted by the ovality limits in Figure 805 and Table 802. We recommend that you use a bend block or tool equivalent to the Parker G-824 hand bender. Make sure the bend block supports the tube bend beyond the neutral axis of the bend, as shown in Figure 805 and Table 802, and that the bend-ovality allowables are not exceeded.

**Table 802/20-10-51-993-905 Permitted Ovality and Wrinkle of Hydraulic Tube Bends**

SYSTEM OPERATING PRESSURE	TUBE OUTER DIAMETER (OD)	TUBE MATERIAL	ALLOWABLE WRINKLE HEIGHT	ALLOWABLE OVALITY (PERCENTAGE OF SPECIFIED OD) <sup>*[1]*[2]</sup>
Liquid: 1000 psi to 3000 psi (including return lines)	All Sizes	Stainless Steel	0.010 in. (0.254 mm)	5
		Aluminum	0.010 in. (0.254 mm)	5
		3AL-2.5V Titanium	None visible	3
Pneumatic and Oxygen: Pressure above 1500 psi or Temperature above 60°F (16°C)	All Sizes	Stainless Steel	0.010 in. (0.254 mm)	5

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**Table 802/20-10-51-993-905 Permitted Ovality and Wrinkle of Hydraulic Tube Bends (Continued)**

Other Liquid Systems: Pressure less than 1000 psi Pneumatic and Oxygen Systems	Less than 1.0	Stainless Steel	0.040 in. (1.016 mm)	10
		Aluminum Alloy & Copper	0.020 in. (0.508 mm)	10
	1.0 to 2.0	Stainless Steel	0.060 in. (1.524 mm)	10
		Aluminum Alloy & Copper	0.030 in. (0.762 mm)	10
	2.0 to 3.0	Stainless Steel	0.080 in. (2.032 mm)	5
		Aluminum Alloy & Copper	0.040 in. (1.016 mm)	5
	3.0 or over	Stainless Steel	0.100 in. (2.540 mm)	5
		Aluminum Alloy & Copper	0.050 in. (1.270 mm)	5

\*[1] Specified diameter is the drawing specified tube diameter.

\*[2] Percent (ovality) =  $([\text{OD Max} - \text{OD Min}]/\text{OD Specified}) \times 100$ . The OD is measured in the same plane.

- (d) Do not repair dents or chafed areas. Replace the tube or tube section if the defect depth is more than the values in Table 803. It is not necessary for you to repair or replace the tubes with defect depth less than these values.

**Table 803/20-10-51-993-906 Permitted Tube Problem Depth - Hydraulic Pressure (3,000 psi) and Return Lines (1,500 psi)**

TUBE MATERIAL (PRESSURE)	PROBLEM TYPE	TUBE OUTER DIAMETER <sup>[2]</sup>						
		1/4	3/8	1/2	5/8	3/4	1	1-1/4
Ti-3Al-2.5V 21-6-9 (3,000 psi)	CHAFED	0.006	0.007	0.008	0.010	0.011	0.012	0.030 (Ti)
	DENT	0.005	0.007	0.010	0.015	0.018	0.020	0.030 (Ti)
Ti-3Al-2.5V 21-6-9 (1500 psi)	CHAFED	N/A	N/A	0.008	0.010	0.011	0.012	0.050 (Ti)
	DENT	N/A	N/A	0.010	0.015	0.018	0.020	0.030
304 1/8 HARD (3,000 psi)	CHAFED	0.006	0.007	0.008	0.010	0.011	0.012	N/A
	DENT	0.005	0.010	0.020	0.03	0.040	0.040	N/A
6061-T6 (1,000 psi) except <sup>[1]</sup>	CHAFED	0.015	0.015	0.010	0.005	0.004 0.015 <sup>[1]</sup>	0.003 0.015 <sup>[1]</sup>	0.003 0.015 <sup>[1]</sup>
	DENT	0.015	0.015	0.010	0.005	0.005	0.005	0.005

\*[1] Suction line, 150 psi.

\*[2] The limits were verified by hydraulic impulse fatigue and burst testing (for additional information, see SAE-AIR 1388).

- (e) Any damage having a sharp point or small radius not smooth bottomed can cause a stress point in the tube that could lead to fatigue cracking. Service limits found in Table 803 apply only to damage having a smooth bottom. Service damage located on or near the tube ends, welded areas, fittings, and formed transitions is not allowed.
- (3) Electrical rigid conduit repair.
  - (a) Smooth dents are permitted to the electrical rigid conduit with these limits (Table 804).

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- 1) Dent depth damage is not more than 20 percent of outer diameter.
  - 2) The conduit is not dented or has a crack that causes it to have kinks, to rub, or to show the inner wire.
  - 3) The dent is smooth and does not make a sharp wrinkle on the outer surface of the conduit.
  - 4) There are no cracks in the conduit.
  - 5) Dents are not permitted on rigid electrical conduits in the fuel tanks.
- (b) Repair or replace electrical rigid conduits if the damage is more than the limits.
- (c) If you must form the electrical rigid conduit tube to fit an installation, do not bend more than permitted by the forming limits (Figure 814, Table 805)

**Table 804/20-10-51-993-907 Smooth Dent Damage Limits for Electrical Rigid Conduits**

CONDUIT SIZE (OD)	MAXIMUM DENT DEPTH
0.25 in. (6.35 mm)	0.050 in. (1.270 mm)
0.31 in. (7.87 mm)	0.063 in. (1.600 mm)
0.38 in. (9.65 mm)	0.075 in. (1.905 mm)
0.50 in. (12.70 mm)	0.100 in. (2.540 mm)
0.63 in. (16.00 mm)	0.125 in. (3.175 mm)
0.75 in. (19.05 mm)	0.150 in. (3.810 mm)
0.88 in. (22.35 mm)	0.175 in. (4.445 mm)
1.00 in. (25.40 mm)	0.200 in. (5.080 mm)
1.25 in. (31.75 mm)	0.250 in. (6.350 mm)
1.50 in. (38.10 mm)	0.300 in. (7.620 mm)
1.75 in. (44.45 mm)	0.350 in. (8.890 mm)
2.00 in. (50.80 mm)	0.400 in. (10.160 mm)

**Table 805/20-10-51-993-908 Permitted Forming Limits for Electrical Rigid Conduits**

CONDUIT SIZE (OD)	CONDUIT MATERIAL	ALLOWABLE WRINKLE HEIGHT	ALLOWABLE OVALITY (PERCENT OF SPECIFIED OD)
1.0 OR LESS	STAINLESS STEEL	0.040 in. (1.016 mm)	10
	ALUMINUM ALLOY	0.020 in. (0.508 mm)	10
OVER 1.0	STAINLESS STEEL	0.060 in. (1.524 mm)	10
	ALUMINUM ALLOY	0.030 in. (0.762 mm)	10

- (4) To repair a damaged tube section, cut out the damaged tube section and replace it with a fitting or with an assembled tube and fitting assembly.

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- (5) To replace a BACA14BP fitting, you must use another BACA14BP fitting. To install the new BACA14BP or D10203 fitting on the new tube section, use this procedure: Flareless Fittings in Pressurized Areas Installation, TASK 20-10-51-000-802 and Externally Swaged (Permaswage) Fittings Installation, TASK 20-10-51-400-808. Refer to Electrical Resistance Specifications in the Fuel Tank Check, TASK 20-10-51-760-801 for verifying electrical resistance where required.

**NOTE:** Use BACA14BP fittings only for replacement of other BACA14BP fittings unless approved by The Boeing Company on a case-by-case basis. The MS flareless screw-together ends on this fitting are prone to deformation and galling from repeated assembly and disassembly and may leak.

- (6) To replace a BACU24AB swage union, cut out the damaged fitting and replace it with a B-nut, BACS13AP sleeve or BACS13BX sleeve or a CRYOLIVE flareless sleeve assembly and an MS21924 bulkhead union, or a P/N DAS5792T axial swage adapter with either an MS21902 union or an MS21924 bulkhead union, using the procedures in Figure 810, Table 806.

**Table 806/20-10-51-993-909 Procedure to Replace a BACU24AB Union**

FITTINGS REPLACING BACU24AB				TUBE CUTOUT LENGTHS REQUIRED (IN.)							
SLEEVE PART NO.	SWAGE METHOD	UNION PART NO.	DIM.	04	06	08	10	12	16	20	24
BACS13BX	Harrison Roller Swage Kit 66330K01	MS21924	A (Fig. 805)	1.562	1.705	1.886	2.100	2.341	2.319	N/A	N/A
35211	Harrison Swage Machine 6777	MS21924	A (Fig. 805)	1.562	1.705	1.886	2.100	2.341	2.319	N/A	N/A
BACS13BX	Harrison Portable Swagers 5175, 5720, or equivalent stationary 5570	MS21924	B (Fig. 805)	0.487	1.612	1.791	1.965	2.199	2.122	2.119	2.049
BACS13AP	Hand or Machine Preset	MS21924	C (Fig. 805)	1.422	1.547	1.726	1.900	2.134	N/A	N/A	N/A
CRYOIVE Assembly	N/A	MS21924	B (Fig. 805)	1.487	1.612	1.791	1.965	2.100	2.122	N/A	N/A

- (7) To make tube repairs, use tube sections of the same material and use the fittings as shown in Figure 806, Table 807, Table 808, Table 809, and Table 810. You can make splice a repair of 21-6-9 and Ti-3AL-2.5V tube with 304-1/8 Hard tube of the wall thickness shown in Table 822, Table 823, Table 826. You can also make a splice repair of a Ti-3AL-2.5V tube with 21-6-9 tube of the wall thickness shown in Table 822, Table 823, Table 826.

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**Table 807/20-10-51-993-868**

REF LETTER FOR TABLES A AND B	TOOL REQUIRED
A	Harrison Portable Swagers No. 5175 and 5720 or equivalent stationary Swager No. 5770
B	Pressure Presetting Tools ST878D
C	Hand Presetting Tools St879A
D	Harrison Roller Swage Tool Kit 6633K01
D (1)	Harrison Roller Swaging Machine 6777
E	DMC Permaswage Kits: DLT Series - Refer to Fig. 825 for individual tool numbers - Consult DMC for tool kit numbers - One pump unit, DLT02MAPP1000 (pneumatic, 10,000 psi) or - DLT05MAPM1000 (manual, 10,000 psi) is necessary for swaging with the tool kits shown
F	AMCI: FRK3P02111-001
G	None necessary - hand tools only
H	Aeroquip Rynlok Kit RTS8-02-006 for sizes 04, 06, 08, 10, 12, 16, and 20 of the 8,000 psi rated Axial Swage - Rynlok - fitting.
I	DMC Tool Kit P/N DAT08AEFKT5000 for sizes 04, 06, 08, 10, 12, 16 (includes hand pump). All sizes can be operated in both directions (forward and reverse). 5,000 psi rated.
I	DMC Tool Kit P/N DATA08AEFKT5001 for sizes 04, 06, 08, 10, 12, 16, 20 (includes hand pump). All sizes can be operated in both directions (forward and reverse). 5,000 psi rated.
I	DMC Tool Kit P/N DAT08AEFKT5003 for sizes 04, 06, 08, 10, 12 (includes hand pump). All sizes can be operated in both directions (forward and reverse). 5,000 psi rated.
I	Eaton Aeroquip Tool Kit P/N RTLK5-01S-007 (includes hand pump) for sizes 04 (forward and reverse), 06 (tooling for both forward and reverse), 08 (forward and reverse), 10 (tooling for both forward and reverse), 12 (tooling for both forward and reverse), and 16 (tooling for both forward and reverse). 5,000 psi rated.

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**Table 807/20-10-51-993-868 (Continued)**

REF LETTER FOR TABLES A AND B	TOOL REQUIRED
I	Eaton Aeroquip Tool Kit P/N RCLK5C02S002 (includes hand pump and cutting/deburring tooling) for sizes 04 (universal), 06 (universal), 08 (universal), 10 (forward and reverse), and 12 (forward and reverse). 5,000 psi rated.
I	Eaton Aeroquip Tool Kit P/N RTLK5-01S111 (includes hand pump) for sizes 04 (universal), 06 (universal), 08 (universal), 10 (forward and reverse), and 12 (forward and reverse). 5,000 psi rated.

**Table 808/20-10-51-993-869**

PART NUMBER	ASSOCIATED APPROVED FITTINGS	
	FITTING NUTS* <sup>[1]</sup> * <sup>[3]</sup>	UNIONS* <sup>[2]</sup>
BACS13AP (BITE-Type) BABS13BX (Elastomer Swage) BACS13BX (Roller Swage)	For Aluminum tubes less than size 20, use: - BACN10YL-Alum - MS21921-Alum or Steel - BACN10CS-Alum or Steel For size 20 and 24 Aluminum tubes used with short flareless fittings, use: - AS4660-Alum	For Aluminum tubes less than size 20, use: - MS21902-Alum or Steel - MS21924-Alum or Steel For size 20 and 24 Aluminum tubes used with short flareless fittings, use: - AS4663-Alum
	For CRES tubes, use: - BACN10YE-CRES - MS21921-CRES, Steel, or Ti - BACN10CS-CRES, or Steel - BACN10YA-Ti	For CRES tubes, use: - MS21902-CRES, Steel, or Ti - MS21924-CRES, Steel, or Ti
	For Ti tubes, use: - BACN10YA-Ti - BACN10YE-CRES - MS21921-Ti, CRES - AS4660-Ti (sizes 20 and 24 only)	For Ti tubes, use: - MS21902-CRES or Ti MS21924-CRES or Ti - AS4660-Ti (sizes 20 and 24 only) - 35212 swaged union
35211 Sleeve (Roller Swage)	For Ti tubes, use: - BACN10YA-Ti - BACN10YE-CRES - MS21921-Ti, CRES - AS4660-Ti (sizes 20 and 24 only)	For Ti tubes, use: - MS21902-CRES or Ti MS21924-CRES or Ti - AS4660-Ti (sizes 20 and 24 only) - 35212 swaged union
35212 Union (Roller Swage)	N/A	N/A

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**Table 808/20-10-51-993-869 (Continued)**

PART NUMBER	ASSOCIATED APPROVED FITTINGS
CRYOLIVE Assembly 921721	For Aluminum tubes, use: - 921721W-Sizes 04 thru 12 only For CRES tubes, use: - 921721J For Ti tubes, use: 921721T

\*[1] Do not use aluminum nuts or unions on tube materials other than aluminum.

\*[2] Associated approved fittings for other unions, reducers, elbows, and tees with MS33514 or MS33515 fitting ends; and for short flareless fitting applications, other unions, reducers, elbows and tees with AS4658 or AS4659 fitting ends.

\*[3] Use only the Cryolive flareless sleeve assembly, consisting of the cryolive sleeve, coupling nut and plastic cap. The cryolive flareless sleeve assembly, in sizes 10, 12, and 16, requires use of a longer length AMCI P/N 9211699 (material code)(size) N coupling nut. The longer length coupling nuts are not interchangeable with standard BACN10- and MS21921 coupling nuts.

**Table 809/20-10-51-993-870**

MATERIAL	TUBE SIZES (IN)								
	04	05	06	08	10	12	16	20	24
	.250	.312	.375	.500	.625	.750	1.00	1.25	1.50
21-6-9	.016	.020	.020	.026	.033	.039	.052		
3AL-2.5V	.016		.019	.026	.032	.039	.052	.070	
6061-t6	.035	.035	.035	.035	.035	.035	.035	.035	.049
304 1/8 H	.020	.020	.028	.035	.049	.058	.065*[1]	.035*[1]	.049*[1]

\*[1] Not qualified for 3000 psi systems, lower pressures only.

Note: Alternative wall thicknesses for tube repairs of 3000 psi and lower system pressure applications. When performing a hydraulic tube repair with the same tube material, the alternate tube wall thicknesses listed in the above table may be used in place of wall thicknesses developed with the airplane when performing a repair on tubes in systems with 3000 psi or less operating pressure.

Cres 321 tubing per MIL-T-8808 may be used as a substitute for 304 tubing per MIL-T-8504, 6061-T6 aluminum tubing per MIL-T-7081 or AMS 4083. 6061-T6 aluminum per MIL-T-7081 or AMS 4083 may be used as a substitute for 6061-T6 aluminum tubing per 22-T-700/6. Contact The Boeing Company when considering use of tube materials other than those specified.

**Table 810/20-10-51-993-871**

TUBING MATERIAL	LOCATION ON AIRPLANE	TUBING SURFACE	FINISH RECOMMENDATION AND OPTIONS	FINISH CODE FOR COMMERCIAL AIRPLANES
Titanium	All	Inside	None	F-25.01
		Outside	None	F-25.01

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**Table 810/20-10-51-993-871 (Continued)**

TUBING MATERIAL	LOCATION ON AIRPLANE	TUBING SURFACE	FINISH RECOMMENDATION AND OPTIONS	FINISH CODE FOR COMMERCIAL AIRPLANES
CRES	All	Inside	Passivate	F-17.25
		Outside	Passivate Optional: Passivate + Primer (green) Passivate + Primer (green) + Paint (white)	F-17.25 F-17.25 + F-20.02 or F-20.49 F-17.25 + F-20.02 or F-20.49 + F-21.30
		Inside and Outside	Alodine (transparent gold)	F-17.08 or F-17.27 (F-17.08 and F-17.27 cover application of alodine to inside and outside of tube)
		Inside and Outside	Alodine (transparent gold)	F-17.08 or F-17.27 (F-17.08 and F-17.27 cover application of alodine to inside and outside of tube)
Aluminum	All Other (see NOTE)	Outside Only	+ Primer (green) Optional: + Primer (green) + Paint (white)	+ F-20.02 or F-20.49 + F-20.02 or F-20.49 + F-21.30
		Inside and Outside	Alodine (transparent gold)	F-17.08 or F-17.27 (F-17.08 and F-17.27 cover application of alodine to inside and outside of tube)
		Inside and Outside	Alodine (transparent gold)	F-17.08 or F-17.27 (F-17.08 and F-17.27 cover application of alodine to inside and outside of tube)
		Inside and Outside	Alodine (transparent gold)	F-17.08 or F-17.27 (F-17.08 and F-17.27 cover application of alodine to inside and outside of tube)
<p><b>NOTE:</b> Some earlier airplane models were delivered with aluminum tubes having anodize finish (F-17.19 - now an inactive finish) in combination with primer (F-20.02). Current airplane models are delivered with aluminum tubes having alodine finish, some in combination with primer and paint, as shown.</p>				

**Table 811/20-10-51-993-895**

DMC PART NO.	FITTING MATERIAL	FOR USE WITH TUBE MATERIAL	APPROVED TUBE SIZES OD/WALL						
			04	06	08	10	12	16	20
D10282-() <sup>[1][2]</sup>	21-6-9 CRES	21-6-9 CRES	.016	.020	.026	.033	.039	.052	--
		3AL-2.5V Ti	.016	.019	.026	.032	.039	.051	.070
		304-1/8 Hard CRES (MIL-T-6845)	.020	.028	.035	.049	.058	.065	--
D10282D() <sup>[1][2]</sup>	6061T6	6061T6 Al (MIL-T-7081)	.035	.035	.035	.035	.035	.035	.040

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**Table 811/20-10-51-993-895 (Continued)**

DMC PART NO. BOEING PART NO.	FITTING MATERIAL	FOR USE WITH TUBE MATERIAL	APPROVED TUBE SIZES OD/WALL						
			APPROVED TUBE SIZES OD/WALL						
		04	06	08	10	12	16	20	
BACU24BS (SIZE)(SIZE) J *[1]*[2]	21-6-9 CRES	21-6-9 CRES	.016	.020	.026	.033	.039	.052	--
		3AL-2.5V	.016	.019	.026	.032	.039	.051	.070
		304-1/8 Hard CRES (MIL-T-6845)	.020	.028	.035	.049	.058	.065	--
BACU24BS (SIZE)(SIZE) D *[1]*[2]	6061T6 Al	6061T6Al (MIL-T-7081)	.035	.035	.035	.035	.035	.035	.040

\*[1] Material code (J) with the Boeing part number or no material code (-) with the DMC part number indicates 21-6-9 CRES fitting with two internal grooves on each end, one each filled with silicone.

Material code (D) on either Boeing or DMC part number indicates 6061T6 aluminum fitting with two internal grooves on each end, all filled with silicone.

Aluminum unions without all grooves filled with the silicone sealant are not approved for Boeing airplanes.

\*[2] A Boeing standard for an externally swaged union - BACU24BS (SIZE)(SIZE)(MATERIAL) - based on the DMC permaswage D10282 union has been developed by Boeing for use on the 777 airplane. The BACU24BS (SIZE)(SIZE) J union (both sizes the same) and the D10282-(SIZE) union are interchangeable. In addition, the BACU24BS (SIZE)(SIZE) D union (both sizes the same) and D10282D (SIZE) D union are interchangeable.

The corrosion resistant steel D10282-(SIZE) and aluminum D10282D(SIZE) permaswage unions are improved replacements for the standard corrosion resistant steel D10036D (SIZE) and aluminum D10036D (SIZE) unions, respectively. The D10036 unions are functionally interchangeable with the D10282 unions.

BACU24BS (SIZE)(SIZE) J - (both sizes the same), BACU24BS (SIZE)(SIZE) D - (both sizes the same), D10282-(SIZE) and D10282D (SIZE) unions are not shown in DMC catalogs, but you can make an order directly to Designed Metal Connections, 14800 South Figueroa St., Los Angeles, CA 90248.

- (8) The permitted limits of hydraulic line tubing damage caused by dents, chafes, or the corrosion removal process per the Corrosion Prevention Manual, are shown in Table 803.
- (9) A repair of a tube section can be in one of three groups. The groups have a relation to the location of the tube damage and the quantity of damage. The three groups are as follows:
  - (a) Replace a tube end section that has a flareless end fitting you can move apart, with an assembled tube and fitting assembly or an axially swaged adapter fitting (Figure 809).
  - (b) Replace a tube center section that has a short damaged segment with a single union or a fitting joint with a male and a female axially swaged adapter fitting (Figure 808 and Table 812).

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**Table 812/20-10-51-993-910 Tube Cutout Lengths (Inches)**

UNION PART NO.	SLEEVE PART NO.	TUBE SIZE								
		.04	.05	.060	.08	.10	.12	.16	.20	.24
MS21902	BACS13AP	.59	.56	.68	.76	.86	1.05	N/A	N/A	N/A
MS21902	BACS13BX (Harrison Elastomer Swager) CRYOLIVE Assembly	.63	.60	.72	.80	.90	1.09	.96	.96	.96
MS21902	BACS13BX (Harrison Roller Swager) 35212 (Harrison Roller Swager 6777)	.82	N/A	.95	1.03	1.21	1.40	1.40	N/A	N/A
MS21924	BACS13AP	1.18	1.18	1.29	1.42	1.55	1.78	N/A	N/A	N/A
MS21924	BACS13BX (Harrison Elastomer Swager) CRYOLIVE Assembly	1.22	1.22	1.33	1.46	1.59	1.82	1.68	1.67	1.67
MS21924	BACS13BX (Harrison Roller Swager) 35211 (Harrison Roller Swager 6777)	.41	N/A	1.56	1.69	1.90	2.13	2.13	N/A	N/A
Axial Swage Union 8010T - Rynlok (8,000 psi rated)	None Necessary	.30	N/A	.30	.35	.35	.35	.40	.40	N/A
Axial Swage Union AS5969T/ DAS5969T (5,000 psi rated)	None Necessary	.30	N/A	.30	.375	.375	.375	.40	N/A	N/A
Permswage Cryofit H-Coupling	None Necessary	0.15 INCH MAXIMUM								

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**Table 813/20-10-51-993-911 Tube Cutout Dimensions for Installing DAS5792T/DAS5793T Adapter Fittings**

AXIAL SWAGE ADAPTER FITTING P/N	SLEEVE PART NO.	TUBE SIZE					
		04	06	08	10	12	16
"J" AS5792T/ DAS5792T Female Flareless (5,000 psi rated)	None Necessary	0.669 ±0.030 in.	0.694 ±0.030 in.	0.810 ±0.030 in.	0.979 ±0.030 in.	1.003 ±0.030 in.	1.134 ±0.030 in.
"K" AS5793T/ DAS5793T Male Flareless (5,000 psi rated)	None Necessary	0.665 ±0.150 in.	0.694 ±0.150 in.	0.811 ±0.150 in.	0.878 ±0.175 in.	0.954 ±0.175 in.	0.969 ±0.200 in.

- (c) Replace a tube center section that has very much damage with an assembled tube and fitting assembly, or axially swaged adapter fittings and a tube assembly (Figure 811).
- (10) If you disconnected more than one hydraulic tube and you think there is a possibility you connected the tubes incorrectly or cross-connected the tubes, do an operational check:  
NOTE: Use your own judgement to determine if a check is necessary.
  - (a) Do the post-installation test of one or more of the components to which the tubes are connected as a check.
- (11) If you disconnected electrical wires to get access to the tubes and you think there is a possibility you connected the wires incorrectly or cross-connected the wires, do an operational check:  
NOTE: Use your own judgement to determine if a check is necessary.
  - (a) Do the post-installation test of one or more of the components to which the wires are connected as a check.

**B. References**

Reference	Title
20-10-51-000-802	Flareless Fittings in Pressurized Areas Installation (P/B 401)
20-10-51-760-801	Electrical Resistance Specifications in the Fuel Tank Check (P/B 401)
20-50-11-910-801	Standard Torque Values (P/B 201)

**C. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

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Reference	Description
COM-1794	Swager - Portable Tube, Hand Swaging, 1/4 - 1" Dia. Stainless Steel or Titanium Tubing Part #: 6633K-01 Supplier: 08199

**D. Procedure**

SUBTASK 20-10-51-350-009

- (1) For hydraulic tubing specifications and wall thicknesses, see Table 814.

NOTE: Table 801 applies to hydraulic tubing outside of the engine fire zones, and more than 18 inches (457 mm) from the engine firewall. For tubing inside the engine fire zones, and within 18 inches (457 mm) of the engine firewall, refer to the propulsion maintenance manual for tubing specifications.

NOTE: You can replace damaged titanium tubing or aluminum tubing with 21-6-9 CRES (BMS 7-185) or 304 1/8 Hard CRES (MIL-T-6845).

**Table 814/20-10-51-993-861 Tubing Specifications and Wall Thickness for 737 Hydraulic Tubes**

	-4	-6	-8	-10	-12	-16	-20	-24
Aluminum 6061-T6 AMS 4083 (R) <sup>[1]</sup>	NU <sup>[1]</sup>	0.035 (.889)	0.035 (.889)	0.035 (.889)	0.035 (.889)	0.035 (.889)	0.049 (1.245)	0.049 (1.245)
CRES 21-6-9 BMS 7-185 (P,R) <sup>[1]</sup>	0.016 (.4064)	0.020 (.508)	0.026 (.6604)	0.033 (.8382)	0.039 (.9906)	0.052 (1.321)	NU	NU
TITANIUM 3AL-2.5V AS5620 (P,R) <sup>[1]</sup>	0.016 (.4046)	0.019 (.4826)	0.026 (.6604)	0.032 (.8128)	0.039 (.9906)	0.051 (1.295)	0.074 (1.880)	NU
CRES 304 1/8 HARD MIL-T-6845 (P,R) <sup>[1]</sup>	0.020 (.508)	0.028 (.7112)	0.035 (.889)	0.049 (1.245)	0.058 (1.473)	0.065 (1.651)	NU	NU

\*[1] Inches, (millimeters) NU = This tubing size is "Not Used" in the 737 hydraulic systems. P = Use in pressure (3,000 psi or 20,684 kPa) lines . R = Use in return lines (600 psi or 4,137 kPa).

SUBTASK 20-10-51-800-007

- (2) Use the tube materials shown in Table 815.

**Table 815/20-10-51-993-862 Cross Reference of Tubing to BMS/MIL Specification**

TUBING MATERIAL	BMS	MIL	OTHER
ALUMINUM 6061-T6, T4	---	WW-T-700/6 WW-T-7081 <sup>[1]</sup>	AMS4083
CRES 21-6-9	7-185	---	---
1/8 HARD CRES 304-1/8h	---	T-6845	AMS 5566
ANNEALED CRES 304	---	T-8504	AMS 5567
ANNEALED CRES 321	---	T-8808	AMS 5556 AMS 5557
TITANIUM 3AL-2.5V	7-234	---	AS5620

\*[1] Low Pressure, Non-Hydraulic Systems Only



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SUBTASK 20-10-51-800-008

- (3) Use the Hydraulic System Design Pressure shown in (Table 816) during the repairs.

**Table 816/20-10-51-993-863 Hydraulic System Design Pressures**

COMPONENT	Maximum Working Pressure Psi (kPa)	Proof Pressure Psi (kPa)	Burst Pressure Psi (kPa)
Pressure lines (including hoses and fittings) and units with air under full system pressure (such as accumulators).	3000 (20684.3)	6000 (41368.5)	12000 (82737.1)
Return and case drain lines, fittings and units	600 (4136.9)	900 (6205.3)	1500 (10342.1)
Return line hoses	600 (4136.9)	1500 (10342.1)	3000 (20684.3)
Pump Supply Reservoirs, units, lines, and fittings	65 (448.2)	100 (689.5)	200 (1378.9)
Airbleed Line (Upstream of the regulator)	250 (1723.7)	500 (3447.4)	1000 (6894.8)
Drains and vents open to the atmosphere	15 (103.4)	50 (344.7)	75 (517.1)

SUBTASK 20-10-51-940-016

- (4) Make a decision about the type of repair necessary.

- (a) Use Figure 806, Table 807, Table 808, Table 809, and Table 810 to make a decision about the group the repair is in.

SUBTASK 20-10-51-940-017

- (5) Refer to Figure 808 and Table 812 and Table 813 to find the necessary tube cutout length when you use a single union or axially swaged adapter fittings and a tube or hose assembly to replace a damaged tube area.

SUBTASK 20-10-51-420-025

- (6) To use assembled tube ends or a center section to do a repair, find the cutout length and install as follows:

- (a) Make an estimate of the total length (L1) of the repair section necessary to replace the damaged tube (Figure 809, Figure 811).  
 (b) Cut and trim the repair tube as follows (Figure 807):  
 1) Use the correct size ratchet chipless cutter.  
 2) Turn the cutter drive screw counter clockwise to retract the cutter wheel.  
 3) Put the cutter over the tube.  
 4) Turn the screw clockwise until the cutter touches the tube at the necessary cut location.  
 5) Turn the screw 1/8 to 1/4 turn and rotate the cutter until the cutter is easy to rotate.  
 6) Cut the tube.  
 7) Remove the tool.  
 8) To deburr the tube use the correct stem subassembly and deburring tool.  
 a) To assemble the tool refer to Figure 807.  
 9) Push down on the plunger and install the tool into the end of the tube.  
 10) Release the plunger.

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- 11) Let the plug fill the inside of the tube.
  - 12) Rotate the deburring tool until the inside burr is removed.
  - 13) Remove the tool with the plug expanded
- NOTE: The expanded plug should remove metal particles from the inside of the tube. Make sure no metal particles fall inside the tube.
- (c) Install the necessary flareless sleeves or alternate end fittings to the repair tube as told in the following applicable tasks:
    - 1) (Install the CRYOLIVE Flareless Sleeve Assembly, TASK 20-10-51-400-805)
    - 2) (BACS13BX Flareless Sleeve Swaging with the Harrison Swagers 5175, 5570, and 5720, TASK 20-10-51-300-806)
    - 3) (BACS13BX Flareless Sleeve Swaging with the 6633K01 Harrison Roller Swaging Kit, TASK 20-10-51-300-807)
    - 4) (BACS13AP Flareless Sleeve Preset, TASK 20-10-51-300-808)
    - 5) (Axial Swage Fitting Installation (5,000 psi rated - Union) or Male/Female Adapter Fittings, TASK 20-10-51-400-810)
  - (d) Assemble and tighten the flareless fittings which are part of the repair section.
  - (e) Measure all of the tube assembly length (L1) (Figure 809, Figure 811).
  - (f) To find the necessary cutout length (L2) as shown in Figure 809, Figure 810, use the procedure given in Figure 811, Table 817, Figure 818.
  - (g) To find the necessary cutout length (L3) as shown in Figure 809 and Figure 810, use the procedure given in Figure 811, Table 817, Figure 818.

**Table 817/20-10-51-993-912 Procedure to Find the Tube Cutout Length L2**

FITTINGS USED FOR REPAIR TUBE ASSEMBLY		L2 CUTOUT LENGTH FORMULA <sup>[1]</sup>		
FLARELESS SLEEVE		UNION PART NO.	FOR TUBE END SECTION	FOR TUBE CENTER SECTION
PART NO.	SWAGE METHOD			
BACS13BX	Harrison Portable Swagers 5175 and 5720 or equivalent stationary swager 5570	MS21902 or equivalent	L1 minus 2P	L1 minus 2P
BACS13BX	Harrison Roller Swage Kit 6633K01	MS21902 or equivalent	L1 minus 2[Z1]	L1 minus 2[Z2]
BACS13AP	Hand or Machine Preset	MS21902 or equivalent	L1 minus 2H	L1 minus 2H
CRYOLIVE Assembly 921721	N/A	MS21902 or equivalent	L1 minus 2P	L1 minus 2P
35211	Harrison Roller Swage Machine 6777	MS21902 or equivalent	L1 minus 2[Z2]	L1 minus 2[Z2]
BACS13BX	Harrison Portable Swagers 5175 or 5720 or equivalent stationary swager 5570	Permaswage Cryofit H-Fitting	L1 minus (P+0.10)	N/A

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**Table 817/20-10-51-993-912 Procedure to Find the Tube Cutout Length L2 (Continued)**

BACS13BX	Harrison Roller Swage Kit 6633K01	Permaswage Cryofit H-Fitting	L1 minus (Z1+0.10)	N/A
BACS13AP	Hand or Hacmine Preset	Permswage Cryofit H-Fitting	L1 minus (H+0.10)	N/A
CRYOLIVE Assembly 921721	N/A	Permaswage Cryofit H-Fitting	L1 minus (P+0.10)	N/A
35211	Harrison Roller Swage Machine 6777	Permaswage Cryofit H-Fitting	L1 minus 2[Z2]	L1 minus 2[Z2]
N/A	N/A	Rynglok Permaswage Cryofit H-Coupling		L1 plus 0.20

\*[1] See the Figure for Flareless Sleeve Tube End Values in the procedure to Install the CRYOLIVE Flareless Sleeve Assembly for values for H, P, Z1, and Z2.

- (h) Remove the pressure from the systems where you will do the repairs.
- (i) Cut out the damaged tube (L2).
- (j) Trim the tube ends as shown in Figure 807.
- (k) When you make the installation, refer to the applicable section as follows:
  - 1) To use the Harrison Elastomer Swager to install BACS13BX flareless sleeves, refer to this task: (TASK 20-10-51-300-806).
 

NOTE: Make sure the correct P dimension (position of the BACS13BX sleeve on the tube) is used. A different value applies to Size 20 and 24 sleeves when used with short flareless fittings.
  - 2) TASK 20-10-51-300-807 to use the tube swager, COM-1794 for installation of BACS13BX flareless sleeves.
  - 3) To use the Harrison 6777 Roller Swage Machine for installing 35211 sleeves or 35212 unions, refer to "Swage Harrison 35211 sleeves and 35212 unions with the Harrison 6777 Roller Swage Machine."
  - 4) To install the Cryolive flareless sleeve assembly, do this task: Install the CRYOLIVE Flareless Sleeve Assembly, TASK 20-10-51-400-805.
  - 5) To install the BACS13AP flareless sleeves, do this task: BACS13AP Flareless Sleeve Preset, TASK 20-10-51-300-808.
  - 6) To install H-couplings (BACC42W), do this task: BACC42W H-Coupling Installation, TASK 20-10-51-400-806.
  - 7) To install Cryofit unions (3P02111) or (3PHS111), do this task: 3P02111/3PHS111 Cryofit Coupling Installation, TASK 20-10-51-400-807.
  - 8) For installation of Permaswage fittings (BACU24BS), (TASK 20-10-51-400-808).
  - 9) For installation of Axial Swage unions (8,000 psi rated - Rynglok), do this task: Axial Swage Fitting Union Installation (8,000 psi rated - Rynglok), TASK 20-10-51-400-809.
  - 10) For installation of Axial Swage unions (5,000 psi rated - DAS5969T) or adapter fittings (5,000 psi rated - DAS5792T, DAS5793T), do this task: Axial Swage Fitting Installation (5,000 psi rated - Union) or Male/Female Adapter Fittings, TASK 20-10-51-400-810.

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- 11) For installation of Axial Swage shape fittings (5,000 psi rated), do this task: Axial Swage Fitting Installation (5,000 psi rated - Shape, Elbow and Tee),  
TASK 20-10-51-400-811.
- (l) Install the repair section.  
1) To tighten the nuts, do this task: Standard Torque Values, TASK 20-50-11-910-801.
- (m) When you use a Cryofit union or an H-Coupling in the repair section, install it after you tighten the flareless fittings in their positions.
- (n) When you use a Permaswage union in the repair section, you must make allowance for swage growth.  
NOTE: Tighten the repair section in position after installation of the Permaswage union.
- (o) When you replace a tube bend section, make sure you keep the minimum straight length specifications for all fittings (Figure 812).
- (p) To install the Cryolive flareless sleeve assembly, do this task: Install the CRYOLIVE Flareless Sleeve Assembly, TASK 20-10-51-400-805.  
1) Use only the complete Cryolive flareless sleeve assembly, consisting of a Cryolive sleeve, coupling nut, and plastic cap.  
NOTE: The Cryolive flareless sleeve assembly, in sizes 10, 12, and 16, requires use of a longer length coupling nut. The longer length coupling nuts are not interchangeable with standard BACN10- and MS21921 coupling nuts.  
2) See Table 818 for approved Cryolive sleeve, coupling nut, and plastic cap combinations.

**Table 818/20-10-51-993-913 CRYOLIVE Flareless Sleeve/Coupling Nut/Plastic Cap Combinations**

TUBE SIZE	COUPLING NUT MATERIAL	COMBINATION - SLEEVE/COUPLING NUT/PLASTIC CAP PART NO.* <sup>[1]</sup>
04	304 CRES	921721J04
	7075-T73 Al	921721W04
	6AL-4V Ti	921721T04
06	304 CRES	921721J06
	7075-T73 Al	921721W06
	6AL-4V Ti	921721T06
08	304 CRES	921721J08
	7075-T73 Al	921721W08
	6AL-4V Ti	921721T08
10	304 CRES	921721J10
	7075-T73 Al	921721W10
	6AL-4V Ti	921721T10
12	304 CRES	921721J12
	7075-T73 Al	921721W12
	6AL-4V Ti	921721T12
16	304 CRES	921721J16
	7075-T73 Al	(Combination not Approved)
	6AL-4V Ti	921721T16

\*[1] Do not replace coupling nuts included with the CRYOLIVE flareless sleeve/coupling nut/plastic cap combinations.  
Use only the coupling nut provided with the assembly.

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- (q) When you use a Cryolive flareless sleeve/coupling nut in conjunction with a permanent Cryofit, H-Coupling, Permaswage, Axial Swage fitting (5,000 psi rated, or 8,000 psi rated-Rynglok), tighten the flareless coupling nut hand-tight before installing the permanent fitting to minimize axial preload on the Cryolive sleeve.
- (r) To install the Axial Swage union (8,000 psi rated - Rynglok), do this task: Axial Swage Fitting Union Installation (8,000 psi rated - Rynglok), TASK 20-10-51-400-809.
- (s) To install the Axial Swage union (5,000 psi rated - DAS5969T) or adapter fittings (5,000 psi rated - DAS5792T, DAS5793T), do this task: Axial Swage Fitting Installation (5,000 psi rated - Union) or Male/Female Adapter Fittings, TASK 20-10-51-400-810.
- (t) To install the Axial Swage tee and elbow fittings (5,000 psi rated), do this task: Axial Swage Fitting Installation (5,000 psi rated - Shape, Elbow and Tee), TASK 20-10-51-400-811.

SUBTASK 20-10-51-710-007

- (7) If you disconnected more than one hydraulic tube and you think there is a possibility you connected the tubes incorrectly or cross-connected the tubes, do an operational check:  
NOTE: Use your own judgement to determine if a check is necessary.
  - (a) Do the post-installation test of one or more of the components to which the tubes are connected as a check.

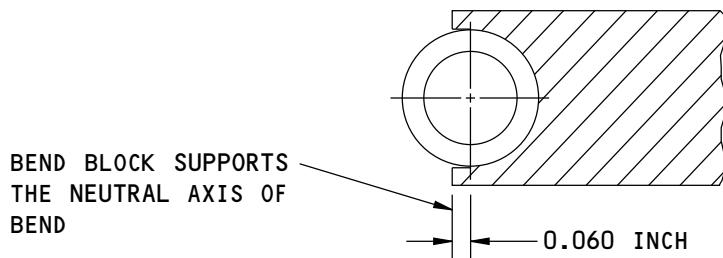
———— END OF TASK ————

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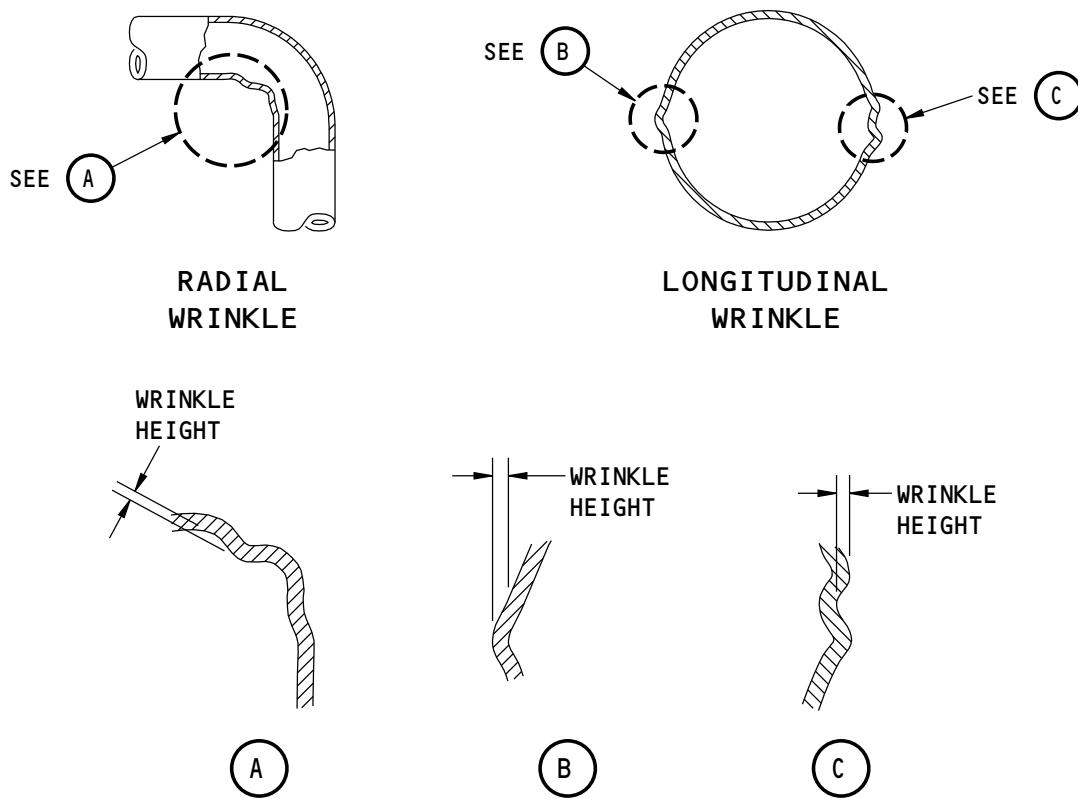


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NOTE: IF THE OVALITY OF ANY PART OF THE BEND IS MORE THAN THE MAXIMUM PERMITTED OVALITY, DISCARD THE TUBE.

TUBE BEND BLOCK



WRINKLE MEASUREMENTS

L19628 S0006402386\_V1

Permitted Ovality and Wrinkle of Hydraulic Tube Bends  
Figure 805/20-10-51-990-869

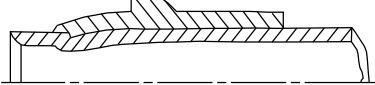
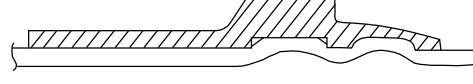
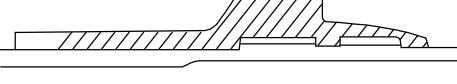
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AKS ALL

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**CAUTION:** DO NOT USE CADMIUM PARTS ON TITANIUM TUBES. CORROSION WILL OCCUR IF YOU USE CADMIUM PARTS ON TITANIUM TUBES.

TUBE JOINING		TUBE MATERIAL 8	REF TABLE C FOR TOOLS REQUIRED	APPROVED SIZES
ILLUSTRATION	PART NUMBER*			
	BACS13AP (BITE-Type) 1	6061T6	B,C	04, 06, 08, 10, 12
		304 ANN.	B,C	04, 06, 08, 10, 12
		304 1/8 Hard	B,C	04, 06, 08, 10, 12
	BACS13BX (Elastomer Swage) 2 3	6061T6	A	06, 08, 10, 12, 16, 20 4, 24 4
		304 ANN.	A	16, 20
		304 1/8 Hard	A	06, 08, 10, 12, 16, 20 4, 24 4
		21-6-9	A	04, 06, 08, 10, 12, 16
	BACS13BX (Roller Swage) 2	21-6-9	D	04, 06, 08, 10, 12, 16
		Ti-3AL-2.5V	D	04, 06, 08, 10, 12, 16, 20

**REPAIR METHOD - RECONNECTABLE WITH FLARELESS FITTING SLEEVES**  
**TABLE A**

L19633 S0006402388\_V1

**Tube Material and Fitting Selection Tables**  
**Figure 806/20-10-51-990-870 (Sheet 1 of 8)**

EFFECTIVITY  
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<b>CAUTION:</b> DO NOT USE CADMIUM PARTS ON TITANIUM TUBES. CORROSION WILL OCCUR IF YOU USE CADMIUM PARTS ON TITANIUM TUBES.				
TUBE JOINING		TUBE MATERIAL 8	REF TABLE C FOR TOOLS REQUIRED	APPROVED SIZES
ILLUSTRATION	PART NUMBER*			
	35211 SLEEVE (Roller Swage)	Ti-3Al-2.5V	D(1)	04, 06, 08, 10, 12, 16, 20
	35212 UNION (Roller Swage)	Ti-3Al-2.5V	D(1)	04, 06, 08, 10, 12, 16, 20
	CRYOLIVE Assembly 921721	6061T6	G	04, 06, 08, 10, 12, 16
		21-6-9	G	04, 06, 08, 10, 12, 16
		Ti-3Al-2.5V	G	04, 06, 08, 10, 12, 16
		304 1/8 Hard	G	04, 06, 08, 10, 12, 16

\* SEE TABLE D FOR ASSOCIATED APPROVED FITTINGS.

**REPAIR METHOD - RECONNECTABLE WITH FLARELESS FITTING SLEEVES**  
**TABLE A**

L19634 S0006402389\_V1

**Tube Material and Fitting Selection Tables**  
**Figure 806/20-10-51-990-870 (Sheet 2 of 8)**

EFFECTIVITY  
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TUBE JOINING		TUBE MATERIAL <b>8</b>	REF TABLE C FOR TOOLS REQUIRED	APPROVED SIZES
ILLUSTRATION	PART NUMBER			
	BACC42W Repair H-Coupling BACC42W-T	6061T6	G	04, 06, 08, 10
		304 ANN.	G	04, 06, 08, 10, 12, 16
		304 1/8 Hard	G	04, 06, 08, 10, 12, 16
		21-6-9	G	04, 06, 08, 10, 12, 16
		Ti-3Al-2.5V	G	04, 06, 08, 10
	3P02111 or 3PHS111 Cryofit	Ti-3Al-2.5V	F	04, 06, 08, 10, 12, 16
	Permaswage D10282-D (AL)  Permaswage D10282 - (Cres)	6061T6	E	04, 06, 08, 10, 12, 16
		Ti-3Al-2.5V	E	04, 06, 08, 10, 12, 16
		304 1/8 Hard	E	04, 06, 08, 10, 12, 16
		21-6-9	E	04, 06, 08, 10, 12, 16
	Ryng Lok 80101T - (TITANIUM)	6061T6	H	04, 06, 08, 10, 12, 16
		Ti-3Al-2.5V	H	04, 06, 08, 10, 12, 16, 20
		304 1/8 Hard	H	04, 06, 08, 10, 12, 16
		21-6-9	H	04, 06, 08, 10, 12, 16

**REPAIR METHOD - PERMANENT UNIONS, TUBE-TO-TUBE  
TABLE B**

L19640 S0006402390\_V1

**Tube Material and Fitting Selection Tables  
Figure 806/20-10-51-990-870 (Sheet 3 of 8)**

EFFECTIVITY  
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737-600/700/800/900  
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REF LETTER FOR TABLES A AND B	TOOL REQUIRED
A	Harrison Portable Swagers No. 5175 and 5720 or equivalent stationary Swager No. 5570
B	Pressure Presetting Tools ST878D
C	Hand Presetting Tools ST879A
D	Harrison Roller Swage Tool Kit 6633K01
D (1)	Harrison Roller Swaging Machine 6777
E	DMC Permaswage Kits: • DLT Series - Refer to Fig. 825 for individual tool numbers - Consult DMC for tool kit numbers - One pump unit, DLTO2MAPP1000 (pneumatic, 10,000 psi) or - DLTO5MAPM1000 (manual, 10,000 psi) is necessary for swaging with the tool kits shown.
F	AMCI: • TS3P02111
G	None necessary - hand tools only.
H	Aeroquip Rynglok Kit RTS8-02-006 for sizes 04, 06, 08, 10, 12, 16, 20.

TOOL REQUIRED FOR REPAIR METHOD  
TABLE C

L19644 S0006402391\_V2

Tube Material and Fitting Selection Tables  
Figure 806/20-10-51-990-870 (Sheet 4 of 8)

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PART NUMBER	ASSOCIATED APPROVED FITTINGS	
	FITTING NUTS [5] [7]	UNIONS [6]
BACS13AP (BITE-Type)  BACS13BX (Elastomer Swage)  BACS13BX (Roller Swage)	For <u>Aluminum</u> tubes less than size 20, use: <ul style="list-style-type: none"> <li>• BACN10YL-Alum</li> <li>• MS21921-Alum or Steel</li> <li>• BACN10CS-Alum or Steel</li> </ul> For size 20 and 24 Aluminum tubes used with short flareless fittings, use: <ul style="list-style-type: none"> <li>• AS4660-Alum</li> </ul>	For <u>Aluminum</u> tubes less than size 20, use: <ul style="list-style-type: none"> <li>• MS21902-Alum or Steel</li> <li>• M21924-Alum or Steel</li> </ul> For size 20 and 24 Aluminum tubes used with short flareless fittings, use: <ul style="list-style-type: none"> <li>• AS4663-Alum</li> </ul>
	For <u>Cres</u> tubes, use: <ul style="list-style-type: none"> <li>• BACN10YE-Cres</li> <li>• MS21921-Cres, Steel or Ti</li> <li>• BACN10CS-Cres, Steel</li> <li>• BACN10YA-Ti</li> </ul>	For <u>Cres</u> tubes, use: <ul style="list-style-type: none"> <li>• MS21902-Cres, Steel or Ti</li> <li>• MS21924-Cres, Steel or Ti</li> </ul>
	For <u>Ti</u> tubes, use: <ul style="list-style-type: none"> <li>• BACN10YA-Ti</li> <li>• BACN10YE-Cres</li> <li>• MS21921-Ti, Cres</li> <li>• AS4660-Ti (sizes 20 and 24 only)</li> </ul>	For <u>Ti</u> tubes, use: <ul style="list-style-type: none"> <li>• MS21902-Cres or Ti</li> <li>• MS21924-Cres or Ti</li> <li>• AS4660-Ti (sizes 20 and 24 only)</li> <li>• 35212 swaged union</li> </ul>
35211 Sleeve (Roller Swage)	For <u>Ti</u> tubes, use: <ul style="list-style-type: none"> <li>• BACN10YA-Ti</li> <li>• BACN10YE-Cres</li> <li>• MS21921-Ti, Cres</li> <li>• AS4660-Ti (sizes 20 and 24 only)</li> </ul>	For <u>Ti</u> tubes, use: <ul style="list-style-type: none"> <li>• MS21902-Cres or Ti</li> <li>• MS21924-Cres or Ti</li> <li>• AS4660-Ti (sizes 20 and 24 only)</li> <li>• 35212 swaged union</li> </ul>
35212 Union (Roller Swage)	N/A	N/A
CRYOLIVE Assembly 921721	For <u>Aluminum</u> tubes, use: <ul style="list-style-type: none"> <li>• 921721W- (sizes 04 thru 12 only)</li> </ul> For <u>Cres</u> tubes, use: <ul style="list-style-type: none"> <li>• 921721J-</li> </ul> For <u>Ti</u> tubes, use: <ul style="list-style-type: none"> <li>• 921721T-</li> </ul>	For <u>Ti</u> tubes, use: <ul style="list-style-type: none"> <li>• MS21902-Cres or Ti</li> <li>• MS21924-Cres or Ti</li> </ul>

**ASSOCIATED APPROVED FITTINGS**  
**TABLE D**

L19645 S0006402392\_V1

**Tube Material and Fitting Selection Tables**  
**Figure 806/20-10-51-990-870 (Sheet 5 of 8)**

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MATERIAL	TUBE SIZES								
	04	05	06	08	10	12	16	20	24
	0.250	0.312	0.375	0.500	0.625	0.750	1.000	1.250	1.500
21-6-9	0.016	0.020	0.020	0.026	0.033	0.039	0.052		
3A1-2.5V	0.016		0.019	0.026	0.032	0.039	0.052	0.070	
6061-T6	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.049	0.049
304 1/8 H	0.020	0.020	0.028	0.035	0.049	0.058	0.065*	0.035*	0.049*
304/321 ANNEALED CRES	0.035*		0.035*	0.035*	0.035*	0.035*	0.035*	0.035*	0.035*

\* NOT QUALIFIED FOR 3000 PSI SYSTEMS, LOWER PRESSURES ONLY.

NOTE: ALTERNATIVE WALL THICKNESSES FOR TUBE REPAIRS OF 3000 PSI AND LOWER SYSTEM PRESSURE APPLICATIONS PER FLAGNOTE 8.

CRES 321 TUBING PER MIL-T-8808 MAY BE USED AS A SUBSTITUTE FOR 304 TUBING PER MIL-T-8504, 6061-T6 ALUMINUM TUBING PER MIL-T-7081 OR AMS 4083. 6061-T6 ALUMINUM PER MIL-T-7081 OR AMS 4083 MAY BE USED AS A SUBSTITUTE FOR 6061-T6 ALUMINUM TUBING PER 22-T-700/6. CONTACT THE BOEING COMPANY WHEN CONSIDERING USE OF TUBE MATERIALS OTHER THAN THOSE SPECIFIED.

TABLE E

L19647 S0006402393\_V2

**Tube Material and Fitting Selection Tables  
Figure 806/20-10-51-990-870 (Sheet 6 of 8)**

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TUBING MATERIAL	LOCATION ON AIRPLANE	TUBING SURFACE	FINISH RECOMMENDATION AND OPTIONS	FINISH CODE FOR COMMERCIAL AIRPLANES
Titanium	ALL	Inside	None	F-25.01
		Outside	None	F-25.01
CRES	ALL	Inside	Passivate	F-17.25
		Outside	Passivate Optional: Passivate + Primer (Green) Passivate + Primer (Green) + Paint (White)	F-17.25 F-17.25 + F-20.02 or F-20.49 F-17.25 + F-20.02 or F-20.49 + F-21.30
Aluminum	Fuel Tanks	Inside and Outside	Alodine (Transparent Gold)	F-17.08 or F-17.27 (F-17.08 and F-17.27 cover application of alodine to inside and outside of tube)
	All Other (See NOTE)	Inside and Outside	Alodine (Transparent Gold)	F-17.08 or F-17.27 (F-17.08 and F-17.27 cover application of alodine to inside and outside of tube)
		Outside Only	+ Primer (Green) Optional: + Primer (Green) + Paint (White)	+ F-20.02 or F-20.49 + F-20.02 or F-20.49 + F-21.30
NOTE: Some earlier airplane models were delivered with aluminum tubes having anodize finish (F-17.19 - now an inactive finish) in combination with primer (F-20.02). Current airplane models are delivered with aluminum tubes having alodine finish, some in combination with primer and paint, as shown.				

**TYPICAL FINISHES FOR HYDRAULIC TUBING**

TABLE F

L08177 S0006604335\_V3

**Tube Material and Fitting Selection Tables**  
**Figure 806/20-10-51-990-870 (Sheet 7 of 8)**

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NOTE: REFER TO FIG. 824 TO MAKE AN ORDER FOR PARTS.

- [1] STANDARD CADMIUM-PLATED SLEEVE BACS13AP (SIZE)
- [2] STANDARD CADMIUM-PLATED SLEEVE:
  - BACS13BX (SIZE) HP
- [3] BACS13BD20H.HP AND BACS13BD24H.HP HAVE BEEN SUPERSEDED BY BAC13BX20H.HP AND BAC13BX24H.HP.
- [4] THE BACSBX SLEEVE CAN BE USED TO REPAIR SIZE 20 AND 24 ALUMINUM TUBES WITH SHORT FLARELESS FITTINGS. IT CAN ALSO BE USED TO REPAIR SIZE 20 ALUMINUM TUBES AND SIZE 20 AND 24 CRES TUBES WITH STANDARD FLARELESS FITTINGS. MAKE SURE YOU DETERMINE THE APPLICATION BEFORE SWAGGING. SHORT FLARELESS FITTINGS REQUIRE A SHORTER "Z<sub>1</sub>" DIMENSION (FIG. 811).
- [5] DO NOT USE ALUMINUM NUTS OR UNIONS ON TUBE MATERIALS OTHER THAN ALUMINUM.
- [6] ASSOCIATED APPROVED FITTINGS FOR OTHER UNIONS, REDUCERS, ELBOWS, AND TEES WITH MS33514 OR MS33515 FITTING ENDS; AND FOR SHORT FLARELESS FITTING APPLICATIONS, OTHER UNIONS, REDUCERS, ELBOWS AND TEES WITH AS4658 OR AS4659 FITTING ENDS.
- [7] USE ONLY THE CRYOLIVE FLARELESS SLEEVE ASSEMBLY, CONSISTING OF THE CRYOLIVE SLEEVE, COUPLING NUT AND PLASTIC CAP. THE CRYOLIVE FLARELESS SLEEVE ASSEMBLY, IN SIZES 10, 12 AND 16, REQUIRES USE OF A LONGER LENGTH AMCI P/N 9211699 (MATERIAL CODE)(SIZE) N COUPLING NUT. THE LONGER LENGTH COUPLING NUTS ARE NOT INTERCHANGEABLE WITH STANDARD BACN10- AND MS21921 COUPLING NUTS.
- [8] WHEN PERFORMING A HYDRAULIC TUBE REPAIR WITH THE SAME TUBE MATERIAL, THE ALTERNATE TUBE WALL THICKNESSES LISTED IN FIG. 802 (SHEET 6) MAY BE USED IN PLACE OF WALL THICKNESSES DELIVERED WITH THE AIRPLANE WHEN PERFORMING A REPAIR ON TUBES IN SYSTEMS WITH 3000 PSI OR LESS OPERATING PRESSURE.

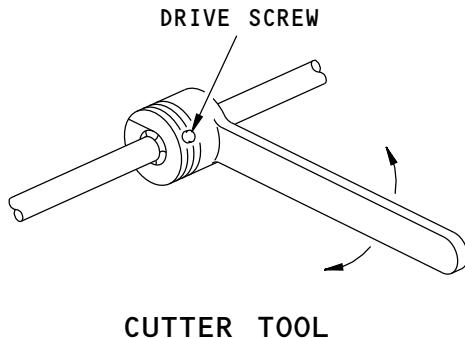
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Tube Material and Fitting Selection Tables  
Figure 806/20-10-51-990-870 (Sheet 8 of 8)

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TUBE SIZE	CHIPLESS CUTTER PART NUMBER	CUTTER WHEEL PART NUMBER
04	D12530-001	D12530-009
06	D12530-001	D12530-009
08	D12531-001	D12531-009
10	D12531-001	D12531-009
12	D12531-001	D12531-009

**DMC CHIPLESS CUTTERS AND CUTTER WHEELS**  
**TABLE A**

L19653 S0006402397\_V2

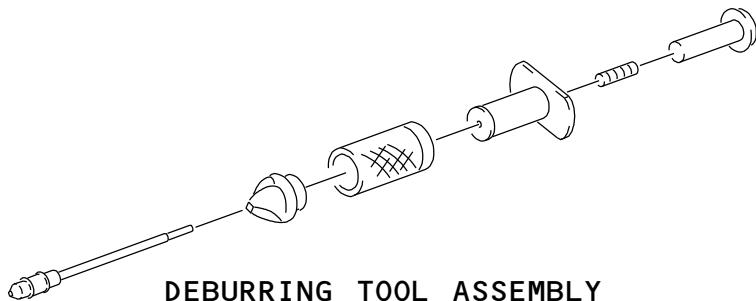
**DMC Tools**  
**Figure 807/20-10-51-990-871 (Sheet 1 of 2)**

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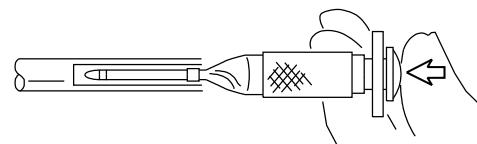
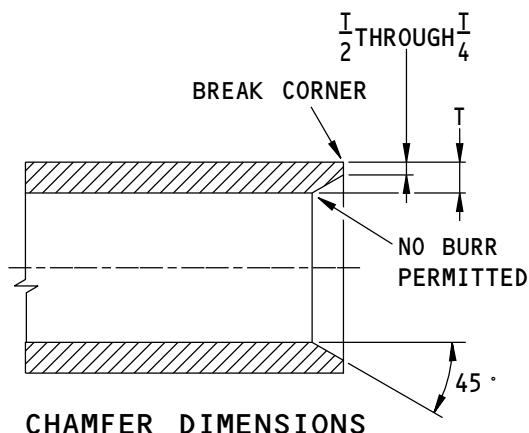
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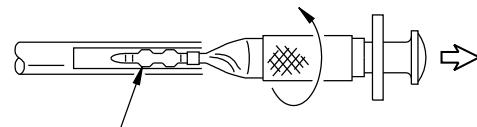
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DEBURRING TOOL ASSEMBLY



DEBURRING TOOL INSERTION



PLUG EXPANDED

DEBURRING TOOL EXTRACTION

TUBE SIZE	TUBE WALL THICKNESS (INCHES)	STEM SUBASSEMBLY PART NUMBER	DEBURRING TOOL PART NUMBER
04	0.016-0.028	D9851-13-04	D9851
04	0.028-0.050	D9851-13-03	D9851
06	0.016-0.035	D9851-13-06	D9851
06	0.035-0.058	D9851-13-07	D9851
08	0.016-0.042	D9850-13-08	D9850
10	0.016-0.058	D9850-13-10	D9850
12	0.016-0.058	D9850-13-12	D9850
16	0.016-0.058	D9849-13-16	D9849
20	0.016-0.058	D9849-13-20	D9849

DMC STEM SUBASSEMBLIES, DEBURRING TOOLS, AND  
REQUIRED CHAMFER DIMENSIONS

TABLE B

L19654 S0006402398\_V2

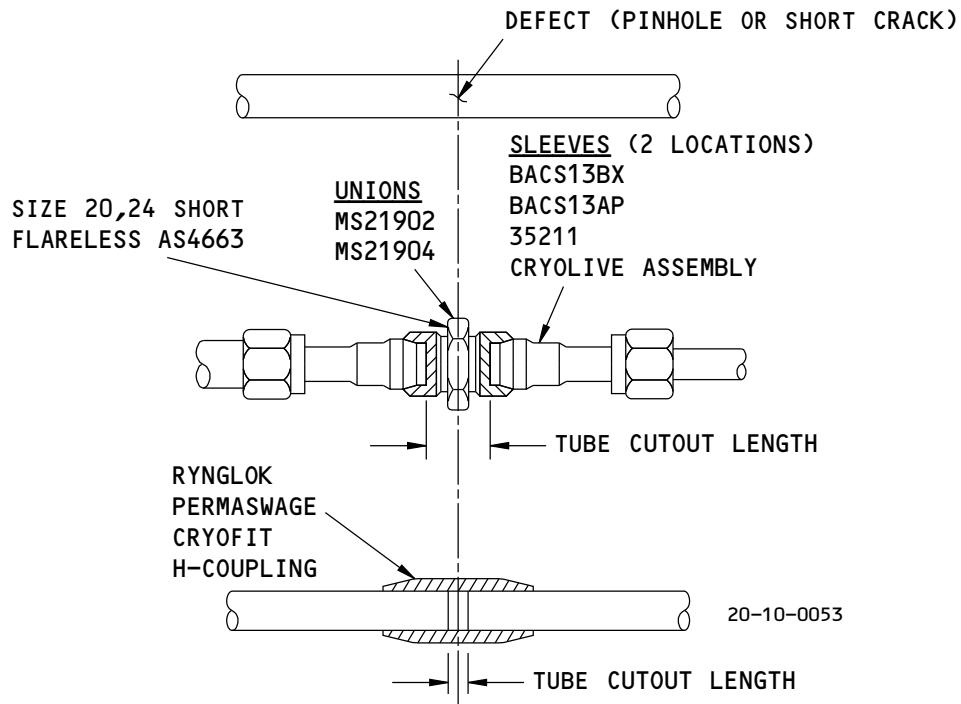
DMC Tools  
Figure 807/20-10-51-990-871 (Sheet 2 of 2)

EFFECTIVITY  
AKS ALL

20-10-51



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NOTE: FITTING NUTS NOT SHOWN.

L19655 S0006402399\_V1

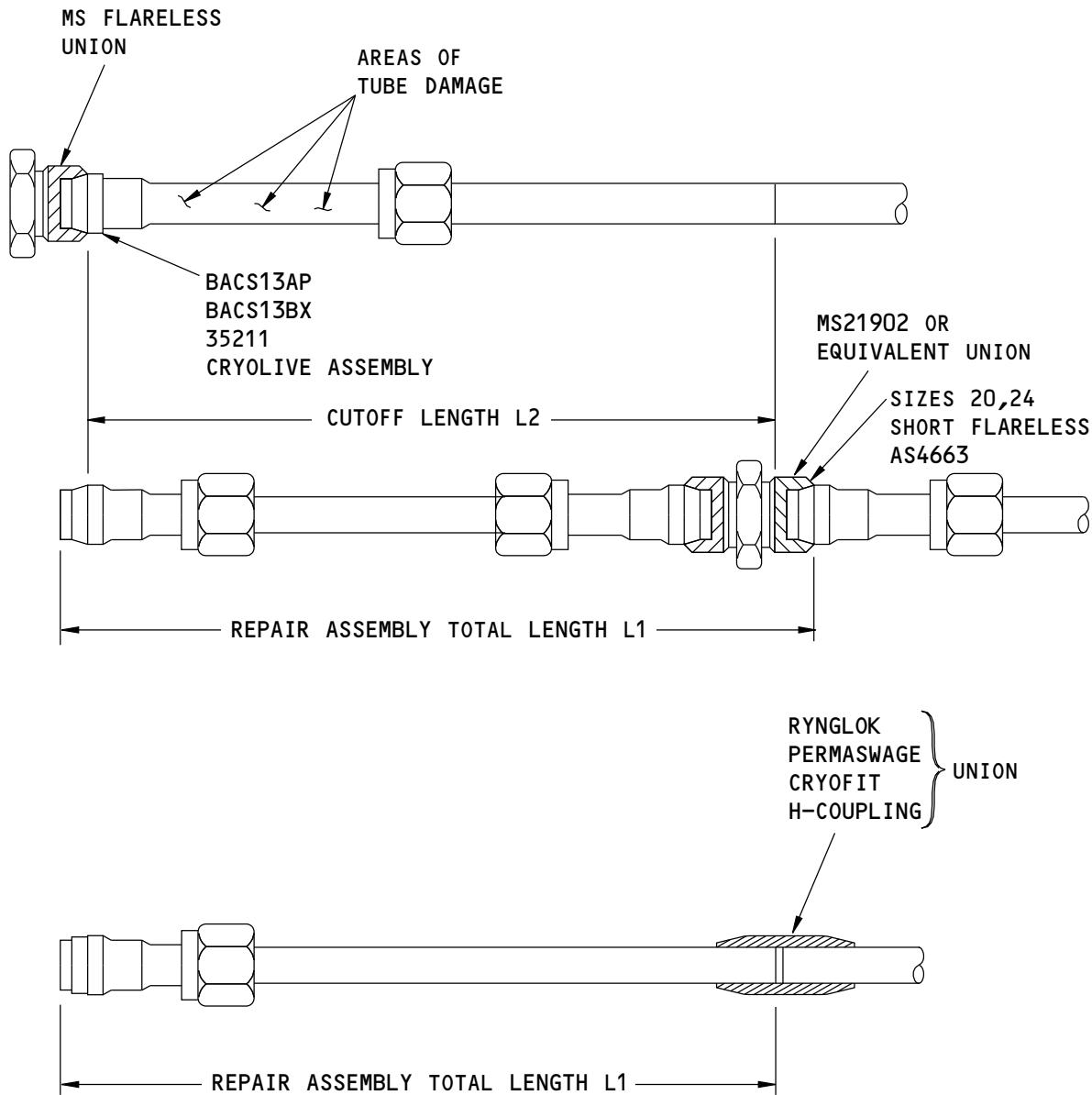
Tubing Repair with Unions - Short Damage  
Figure 808/20-10-51-990-872

EFFECTIVITY  
AKS ALL

**20-10-51**



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NOTE: REFER TO FIG. 810 (SHEET 1) FOR THE LENGTHS L1 AND L2.

L19665 S0006402401\_V1

Tubing Repair by End Replacement  
Figure 809/20-10-51-990-873 (Sheet 1 of 2)

EFFECTIVITY  
AKS ALL

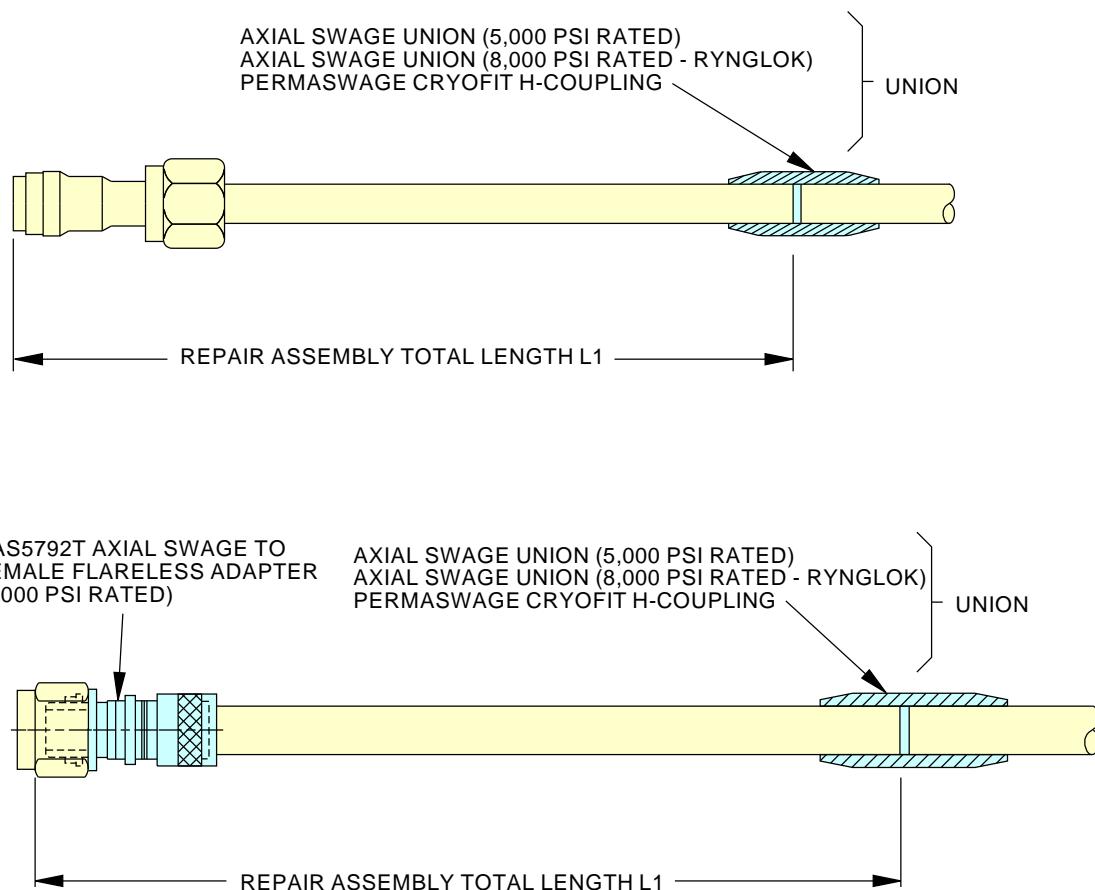
D633A101-AKS

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**NOTE:**

REFER TO FIG. 810 FOR MINIMUM LENGTHS L1 AND L2.

2069547 S0000430357\_V2

Tubing Repair by End Replacement  
Figure 809/20-10-51-990-873 (Sheet 2 of 2)

EFFECTIVITY	AKS ALL
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TUBE CUTOUT LENGTH TO USE  
ROLLER SWAGE AND BACS13BX SLEEVE

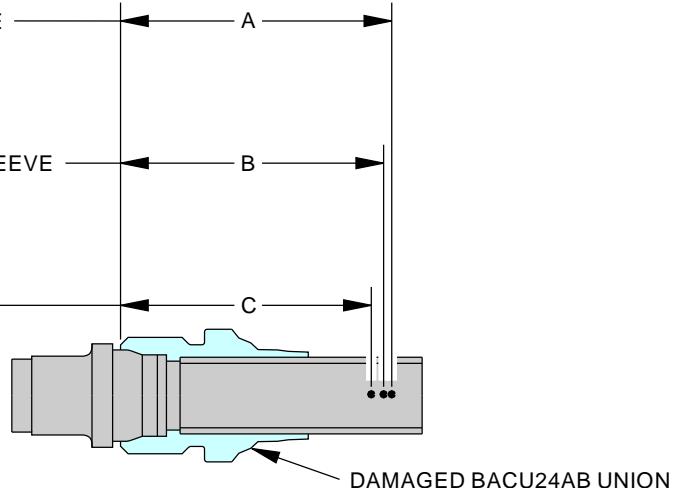
**A**

TUBE CUTOUT LENGTH TO USE  
ELASTOMER SWAGE AND BACS13BX SLEEVE

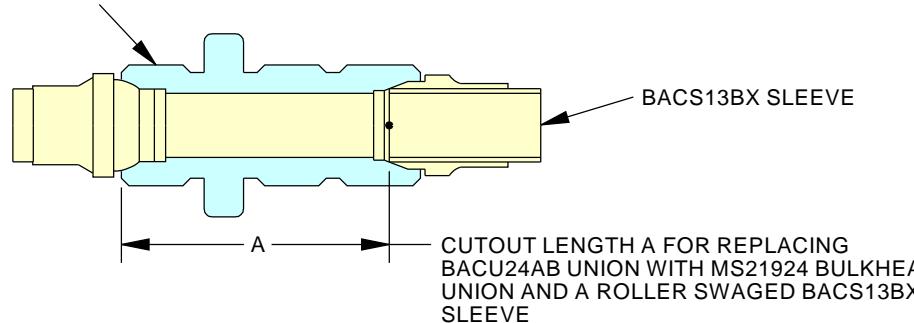
**B**

TUBE CUTOUT LENGTH TO USE  
PRESET BACS13AP SLEEVE

**C**



MS21924 OR  
EQUIVALENT  
BULKHEAD UNION



**A**

**NOTE:**

REFER TO FIG. 808 FOR THE LENGTHS A,B AND C.  
COUPLING NUTS NOT SHOWN.

F15978 S0006561969\_V3

Tube Cutout Lengths for Replacement of Damaged BACU24AB Swage Unions  
Figure 810/20-10-51-990-874 (Sheet 1 of 3)

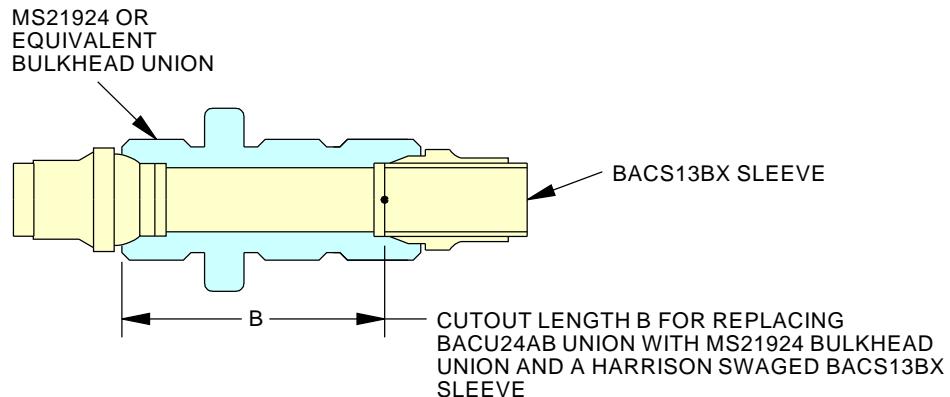
EFFECTIVITY  
AKS ALL

**20-10-51**

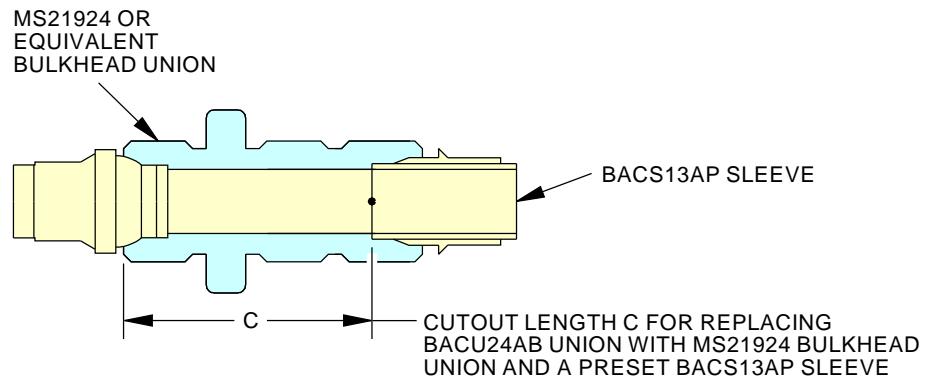
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**B**



**C**

**NOTE:**

REFER TO FIG. 808 FOR THE LENGTHS A, B, AND C.  
COUPLING NUTS NOT SHOWN.

F15979 S0006561970\_V3

**Tube Cutout Lengths for Replacement of Damaged BACU24AB Swage Unions**  
**Figure 810/20-10-51-990-874 (Sheet 2 of 3)**

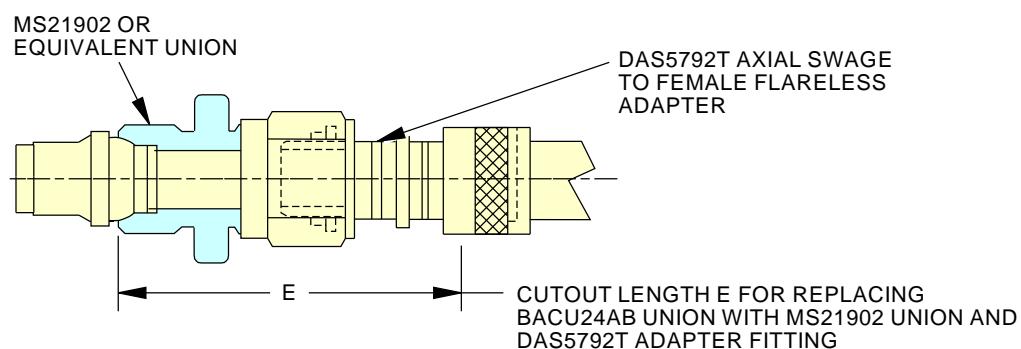
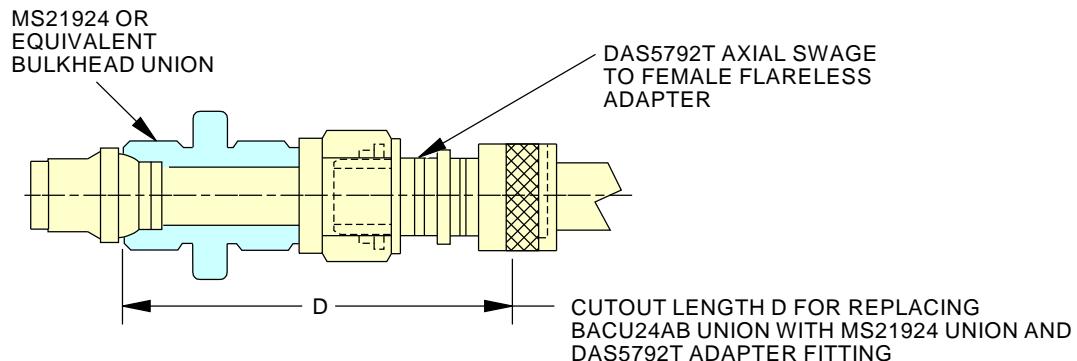
EFFECTIVITY  
AKS ALL

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**NOTE:**

REFER TO TABLE 805 FOR THE LENGTHS D AND E.

2070625 S0000430370\_V3

**Tube Cutout Lengths for Replacement of Damaged BACU24AB Swage Unions**  
**Figure 810/20-10-51-990-874 (Sheet 3 of 3)**

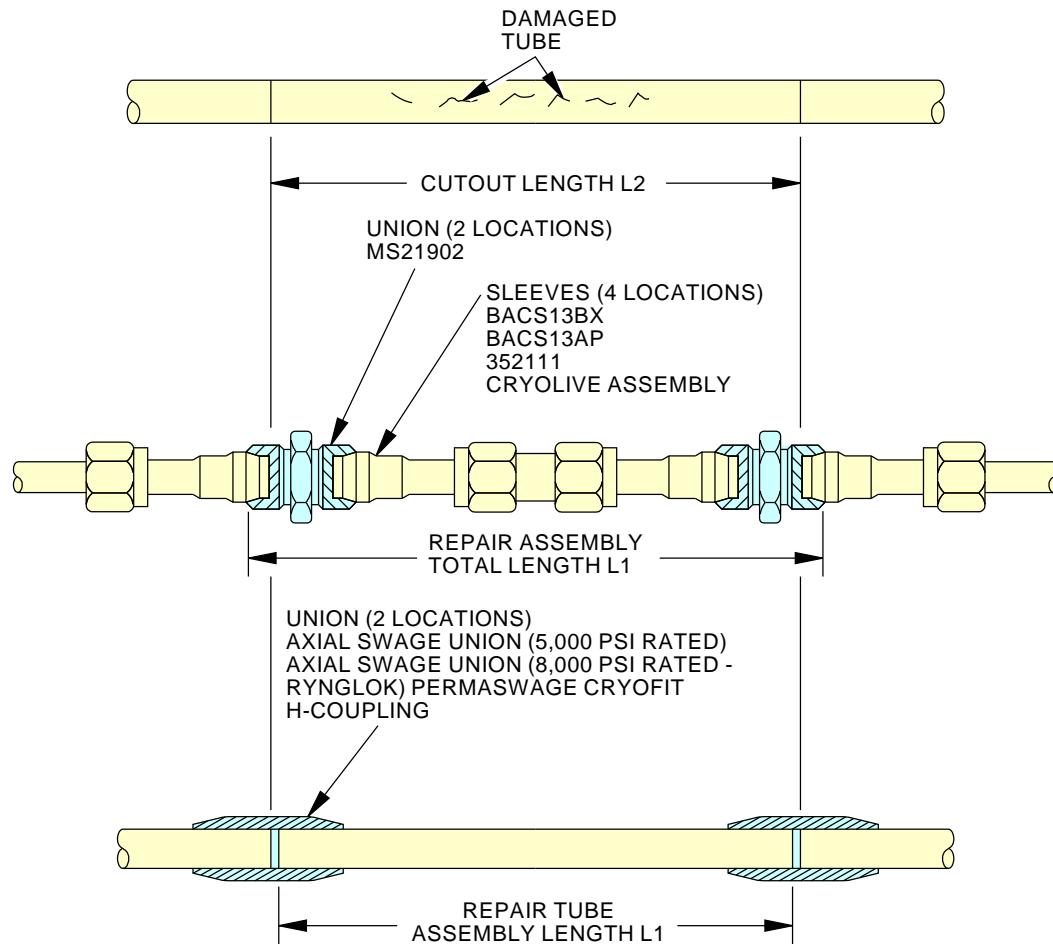
EFFECTIVITY  
**AKS ALL**

**20-10-51**

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**NOTE:**

REFER TO FIG. 810 FOR MINIMUM LENGTHS L1 AND L2.

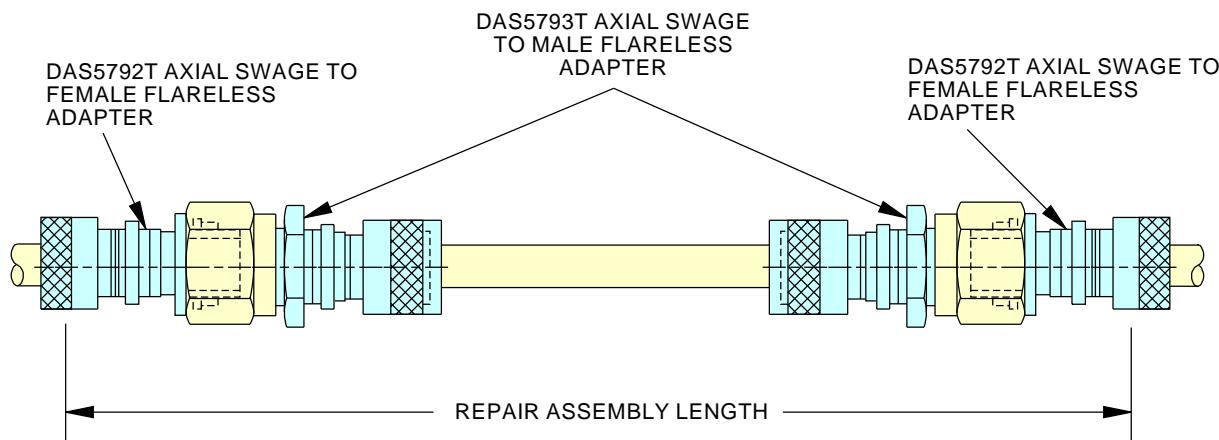
F15981 S0006561972\_V5

**Tubing Repair by Section Replacement, Straight or Bend - Extensive Damage**  
**Figure 811/20-10-51-990-876 (Sheet 1 of 2)**

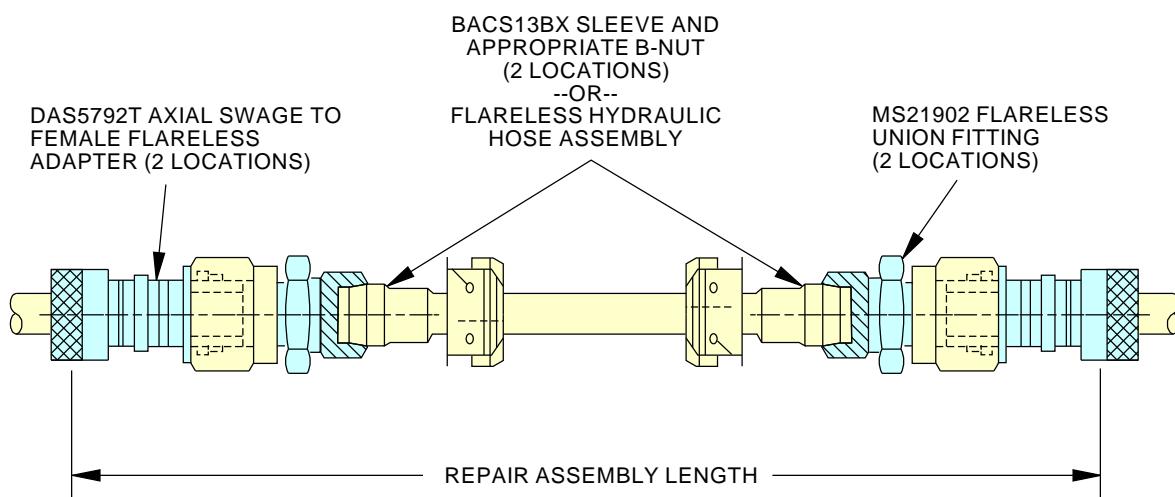
EFFECTIVITY  
AKS ALL

D633A101-AKS

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REPAIR ASSEMBLY TOTAL LENGTH = 2 X TUBE CUTOUT LENGTHS FOR DAS5792T FROM TABLE 812 + 2 X TUBE CUTOUT LENGTHS FOR DAS5793T FROM TABLE 812 + REMAINING FREE TUBE LENGTH. OBSERVE MINIMUM TUBE LENGTHS REQUIRED FOR AXIALLY SWAGED FITTINGS FROM FIGURE 810.



REPAIR ASSEMBLY TOTAL LENGTH = 2 TUBE CUTOUT LENGTHS FOR DAS5792T FROM TABLE 812 + TWO "P" DIMENSION VALVES FOR BACS13BX SLEEVE FROM FIGURE 809 + TWO DIMENSION "D" FOR MS21902 FLARELESS UNION FROM TABLE 805 + FREE TUBE LENGTH. OBSERVE MINIMUM TUBE LENGTHS REQUIRED FOR AXIALLY SWAGED FITTINGS FROM FIGURE 810.

**NOTE:**

REFER TO FIG. 810 FOR MINIMUM LENGTHS L1 AND L2.

2069883 S0000430477\_V3

**Tubing Repair by Section Replacement, Straight or Bend - Extensive Damage**  
**Figure 811/20-10-51-990-876 (Sheet 2 of 2)**

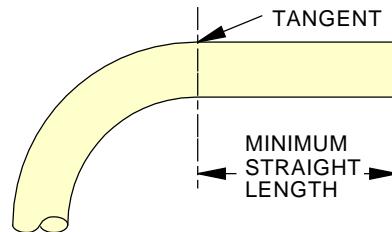
EFFECTIVITY  
AKS ALL

**20-10-51**

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FITTING TYPE	TUBE END MINIMUM STRAIGHT LENGTH - INCHES								
	04	05	06	08	10	12	16	20	24
BACS13BX (Harrison Elastomer Swager) and CRYOLIVE Flareless Sleeve Assembly	1.23	1.25	1.28	1.39	1.48	1.51	1.47	1.46	1.46
BACS13BX (Harrison Roller Swager)	2.25	2.25	2.25	2.25	2.25	2.25	2.25	N/A	N/A
BACS13AP (BITE Type)	0.80	0.90	1.00	1.10	1.15	1.15	N/A	N/A	N/A
D10282 * (Permaswage)	1.07	N/A	1.15	1.65	1.70	1.80	1.90	2.15	N/A
BACC42W * (H-Coupling)	2.80	2.80	2.80	2.80	2.80	2.80	2.80	N/A	N/A
3p02111 * (Cryofit)	0.71	0.81	0.90	0.98	1.17	1.35	1.76	N/A	N/A
35211 Sleeve (Harrison Roller Swager)	1.30	N/A	1.30	1.38	1.42	1.40	1.40	N/A	N/A
35212 Union (Harrison Roller Swager)	1.22	N/A	1.30	1.48	1.46	1.50	1.50	N/A	N/A
80101T Axial Swage Fitting (8,000 psi rated 80101T - Rynlok)	1.236	N/A	1.362	1.480	1.628	1.777	2.109	2.143	N/A
DAS5969T, DAS5792T, DAS5793T, DAS5801T, DAS5803T, DAS5804T, DAS5806T, DAS5972T and other Axial Swage Fittings (5,000 psi rated)	0.90	N/A	1.12	1.54	1.69	1.84	2.17	N/A	N/A

\* Based on 1/2 fitting length

F15988 S0006561976\_V5

**Minimum Straight Length Specifications for Repair Fitting Installations Adjacent to Tube Bends**  
**Figure 812/20-10-51-990-878**

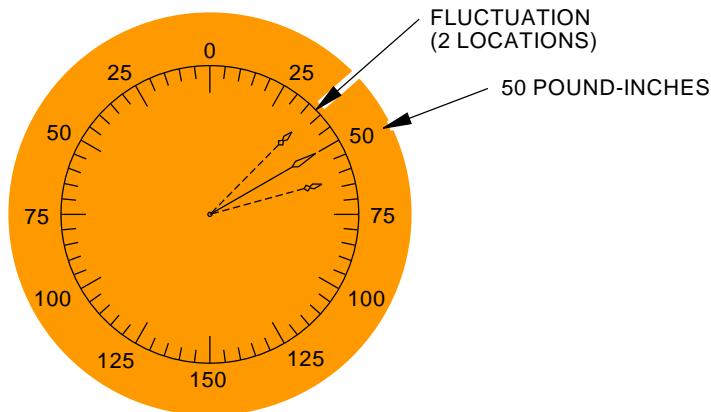
EFFECTIVITY  
**AKS ALL**

**20-10-51**

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TORQUE WRENCH DIAL - PROCEDURE TO READ TORQUE

TUBE SIZE	MATERIAL		SWAGE TORQUE (POUNDS-INCH)	
	WALL THICKNESS - INCHES		MIN	MAX
	3AL-2.5V TITANIUM <span style="color:blue;">1</span>	21Cr-6Ni-9Mn CRES <span style="color:blue;">2</span>		
04	0.016	0.016	4	5
06	0.019	0.020	12	15
08	0.026	0.026	20	25
10	0.032	0.033	40	45
12	0.039	0.039	40	45
16	0.051	0.052	80	85

SWAGE TORQUES NECESSARY TO ROLLER SWAGE  
BACS13BX SLEEVES TO Ti-3AL-2.5V CWSR OR  
21-6-9 CRES TUBE USING HARRISON 6633K01  
ROLLER SWAGING KIT

1 AS SPECIFIED IN SPECIFICATION AS5620/BMS 7-234

2 AS SPECIFIED IN SPECIFICATION BMS 7-185

F16045 S0006561986\_V3

Swage Torques, Sleeve Dimensions, and Wall Thicknesses for Roller Swaging  
Figure 813/20-10-51-990-883 (Sheet 1 of 3)

EFFECTIVITY  
AKS ALL

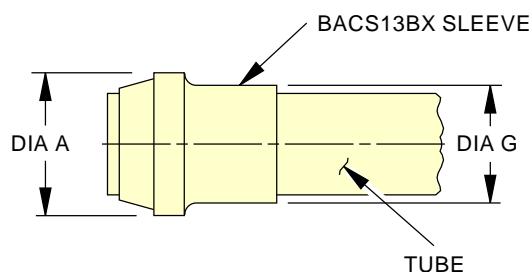
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DIAMETER	TUBE SIZE					
	04	06	08	10	12	16
A MAX	0.374	0.493	0.673	0.789	0.964	1.214
G MAX	0.298	0.423	0.550	0.686	0.822	1.070

MAXIMUM PERMITTED SHOULDER AND SKIRT DIAMETERS (INCH)

F16046 S0006561987\_V2

Swage Torques, Sleeve Dimensions, and Wall Thicknesses for Roller Swaging  
Figure 813/20-10-51-990-883 (Sheet 2 of 3)

EFFECTIVITY  
AKS ALL

20-10-51

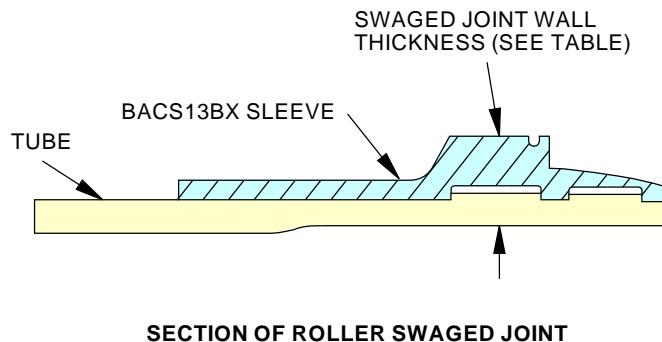
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TUBE SIZE	TUBE DIMENSIONS		SWAGED JOINT WALL THICKNESS FOR "NOMINAL" TUBE WALLS - INCHES <b>[1]</b>	
	"NOMINAL" WALL THICKNESS - INCHES <b>[2]</b>			
	Ti-3AL-2.5V	21-6-9 CRES		
04	0.016	0.016	0.068	
06	0.019	0.020	0.066	
08	0.026	0.026	0.100	
10	0.032	0.033	0.101	
12	0.039	0.039	0.132	
16	0.051	0.052	0.143	

**SWAGED JOINT WALL THICKNESS SPECIFICATION **[1]** **[2]****

**[1]** "NOMINAL" WALL THICKNESS DEFINITION: TUBE WALL THICKNESS WITHOUT TOLERANCES AS SPECIFIED BY TUBE SPECIFICATION: AS5620 FOR Ti-3AL-2.5V AND BMS 7-185 FOR 21-6-9 CRES.

**[2]** IF THE THICKNESS OF A MEASURED TUBE WALL IS DIFFERENT THAN THE "NOMINAL", ADD OR SUBTRACT THE DIFFERENCE FROM THE NECESSARY SWAGED JOINT WALL THICKNESS FOR "NOMINAL" TUBE WALLS.

EXAMPLE: 1. MEASURED 10 SIZE TITANIUM 3AL-2.5V TUBE WALL = 0.035 INCH  
 2. WALL DIFFERENCE IS 0.035 INCH, MINUS 0.032 INCH = 0.003 INCH  
 3. ADD 0.003 INCH TO 0.101 INCH = 0.104 INCH

F16047 S0006561988\_V3

**Swage Torques, Sleeve Dimensions, and Wall Thicknesses for Roller Swaging**  
**Figure 813/20-10-51-990-883 (Sheet 3 of 3)**

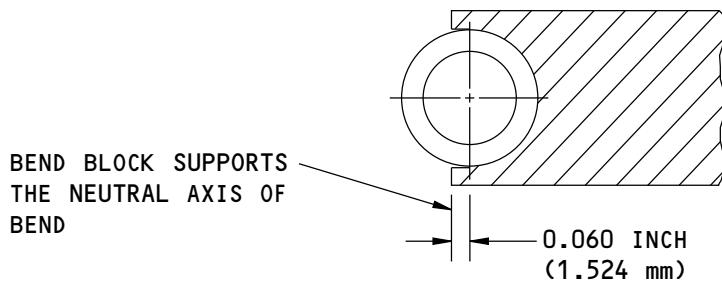
EFFECTIVITY  
 AKS ALL

**20-10-51**

D633A101-AKS

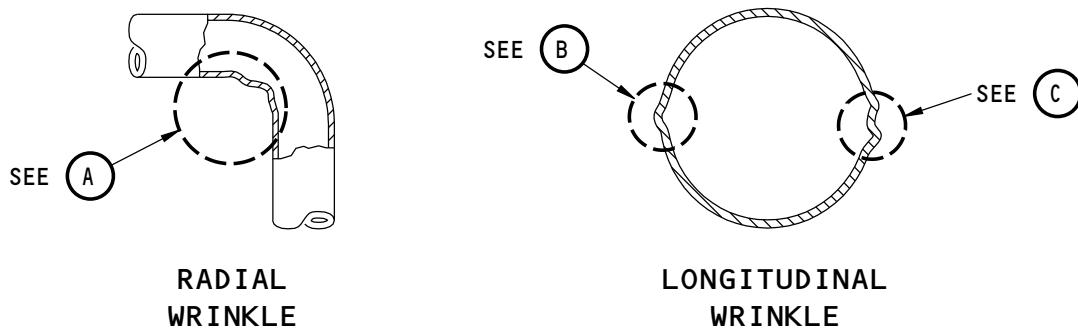


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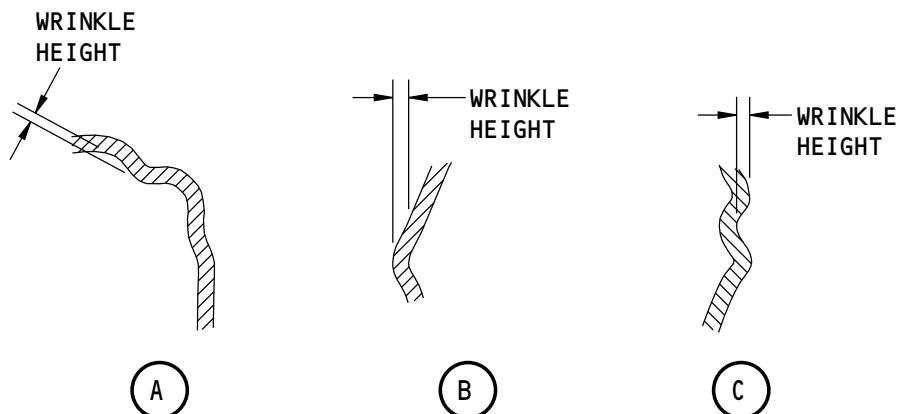
NOTE: IF THE OVALITY OF ANY PART OF THE BEND IS MORE THAN THE MAXIMUM PERMITTED OVALITY, DISCARD THE TUBE.

TUBE BEND BLOCK



RADIAL WRINKLE

LONGITUDINAL WRINKLE



WRINKLE MEASUREMENTS

L97117 S0006402450\_V1

Permitted Forming Limits for Electrical Rigid Conduits  
Figure 814/20-10-51-990-899

EFFECTIVITY  
AKS ALL

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SEQ. NUMBER	DMC PART NUMBER	DESCRIPTION	PART DEFINITION	
			CONFIGURATION (CROSS-HATCHING INDICATES AXIAL SWAGE ENDS)	PORT DESIGNATIONS
1	DAS5801T /AS5801T	ELBOW 90 DEGREE, FEMALE FLARELESS, 3000 psi		PORT NO. 1 = FEMALE FLARELESS END. PORT NO. 2 = AXIAL SWAGE END.
2	DAS5803T /AS5803T	ELBOW 45 DEGREE, FEMALE FLARELESS, 3000 psi		PORT NO. 1 = FEMALE FLARELESS END. PORT NO. 2 = AXIAL SWAGE END.
3	DAS5804T /AS5804T	TEE, FEMALE FLARELESS ON RUN, 3000 psi		PORT NO. 1 = FEMALE FLARELESS END ON THE RUN. PORT NO. 2 = AXIAL SWAGE END ON THE RUN. PORT NO. 3 = AXIAL SWAGE END ON THE SIDE.
4	DAS5806T /AS5806T	TEE, FEMALE FLARELESS ON BRANCH, 3000 psi		PORT NO. 1 = LARGEST AXIAL SWAGE END ON THE RUN. PORT NO. 2 = REMAINING AXIAL SWAGE END ON THE RUN. PORT NO. 3 = FEMALE FLARELESS END ON THE SIDE.
5	DAS5972T /AS5972T	FITTING ASSEMBLY, TEE, AXIALLY SWAGED, HYDRAULIC, 5080 psi		PORT NO. 1 = LARGEST AXIAL SWAGE END ON THE RUN. PORT NO. 2 = REMAINING AXIAL SWAGE END ON THE RUN. PORT NO. 3 = AXIAL SWAGE END ON THE SIDE.
6	DAS5969T /AS5969T	UNION, AXIALLY SWAGED, HYDRAULIC, 5080 psi		PORT NO. 1 = LARGEST AXIAL SWAGE END. PORT NO. 2 = REMAINING AXIAL SWAGE END.

1931831 S0000365197\_V4

**Tube Material and Fitting Selection Tables  
Figure 815/20-10-51-990-900**

EFFECTIVITY  
AKS ALL

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**TASK 20-10-51-300-809**

**5. Titanium Hydraulic Tubing, 3000 psi - Roll swaging Harrison 53211 Sleeves and 35212 Unions  
using the Harrison 6777 Swage Machine**

**A. General**

- (1) The sleeves, unions, and nuts used for this repair are listed in Figure 806, Table 807, Table 808, Table 809, Table 810, Figure 808, and Table 812.
- (2) Get the necessary tools and dies as listed in the operating manual with the Harrison 6777 Swage Machine.

NOTE: This procedure does not apply to repair of aluminum and CRES tubing.

**B. Procedure**

SUBTASK 20-10-51-300-002

- (1) Do the repair:
  - (a) Cut and chamfer tubes as shown in Figure 807. Length requirements are shown in Figure 808, Table 812, Figure 809, Figure 810, Table 806, Figure 811, Table 817 as applicable. Correct for swage growth according to data provided in the manufacturer's operating manual.
  - (b) Clean the tube with Methyl Ethyl Ketone or an equivalent cleaning agent and blow air through the tube to remove particles.
  - (c) Use swage dies as illustrated in Figure 816.
  - (d) Use Swage Torques as shown in Figure 817.
  - (e) After swaging the tube ends, inspect the after-swage inside diameter of the tube end to the values specified in (Figure 816, Sheet 5). Also, inspect swage area for any signs of roller wear or defective rollers.
  - (f) Make sure that there are no scratches or other damage on the seal areas of the sleeve and union.
  - (g) Conduct a Proof Pressure Test of the tube assembly:
    - 1) Connect the Harrison sleeve and union of the tube assembly and torque it to the specified value.
    - 2) Pressurize the tube to 6000psi.
    - 3) There shall be no leakage in proof testing.
    - 4) If there is leakage, loosen and retighten the fitting. If leakage persists, remove the tube and inspect tube end and test fittings for defects.

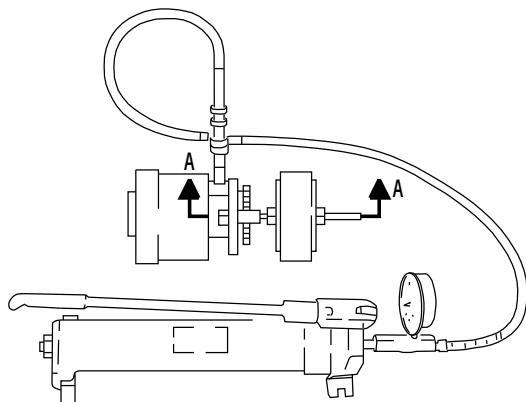
———— END OF TASK ————

EFFECTIVITY  
AKS ALL

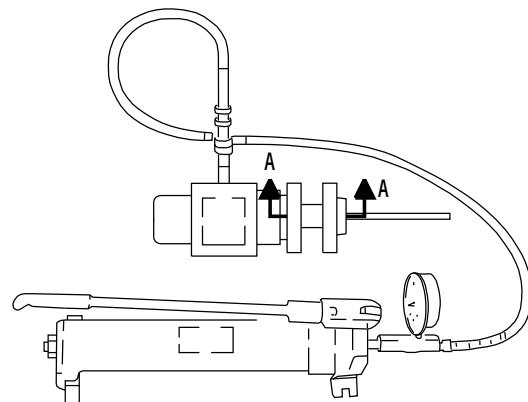
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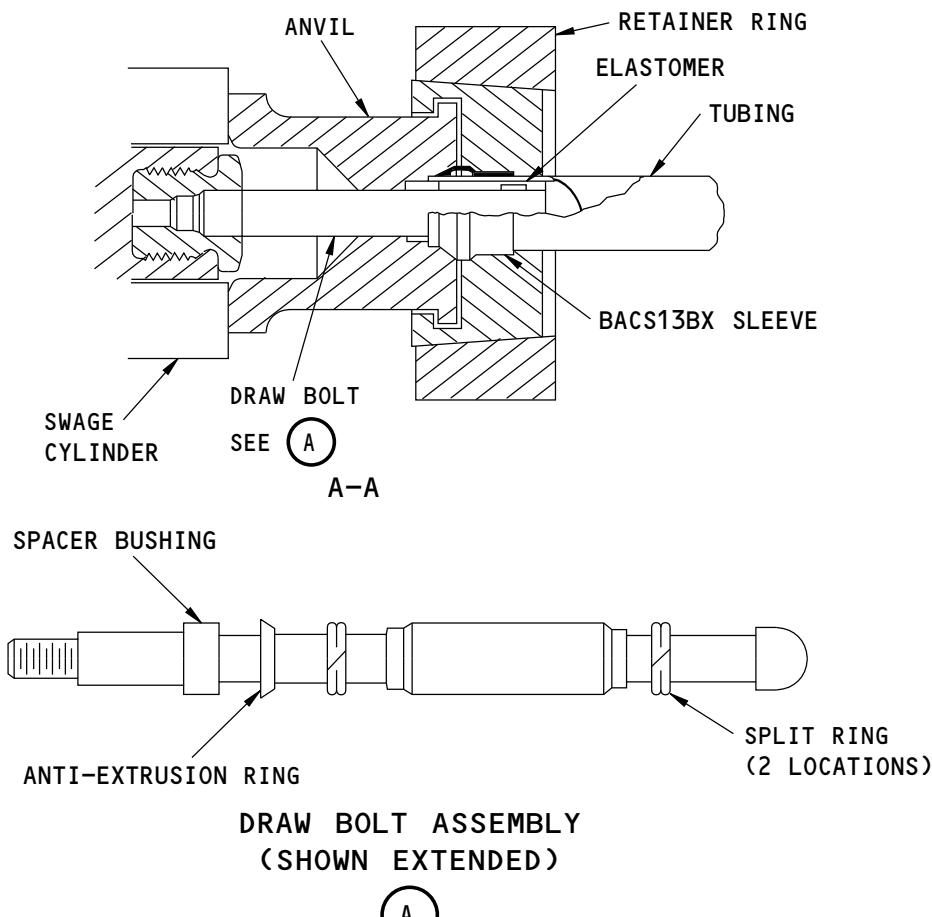
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HARRISON MODEL 5720



HARRISON MODEL 5175



L19677 S0006402410\_V1

Harrison Portable Swagers for BACS13BX Sleeves  
Figure 816/20-10-51-990-905 (Sheet 1 of 5)

EFFECTIVITY  
AKS ALL

**20-10-51**

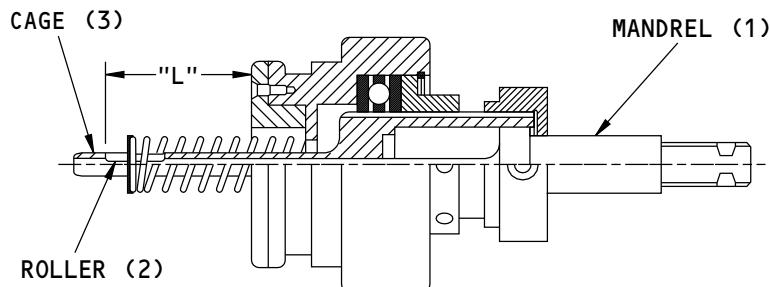
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SIZE	EXPANDER ASSEMBLY	MANDREL (1)	ROLLERS (2)	CAGE (3)
-04	7320-04016	7321-04016	7322-04016	7323-04016
-06	7320-06019	7321-06019	7322-06019	7323-06019
-08	7320-08026	7321-08026	7322-08026	7323-08026
-10	7320-10032	7321-10032	7322-10032	7323-10032
-12	7320-12039	7321-12039	7322-12039	7323-12039
-16	7320-16051	7321-16051	7322-16051	7323-16051

EXPANDERS P/N AND SPARE PARTS P/N REQUIRED  
TO ROLLER SWAGE 35211 AND 35212 TO 3AI-2.5V TITANIUM TUBING

TUBE O.D.	SET LENGTH "L" (INCHES) $\pm .005$
-04	1.010
-06	1.205
-08	1.310
-10	1.382
-12	1.474
-16	1.600

TOOL ADJUSTMENT

HARRISON 6777 MACHINE

L19678 S0006402411\_V1

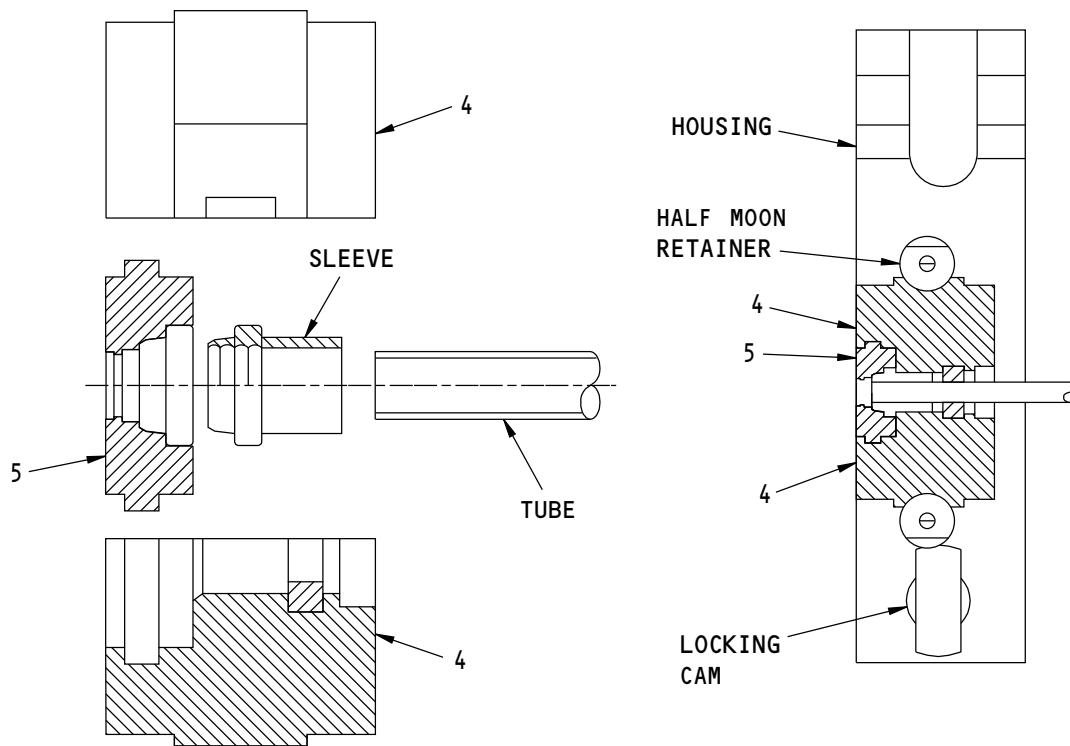
Harrison Portable Swagers for BACS13BX Sleeves  
Figure 816/20-10-51-990-905 (Sheet 2 of 5)

EFFECTIVITY  
AKS ALL

20-10-51



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TUBE AND SLEEVE DIA. INCHES	TWO HALF JAWS (4)	RETAINER (5)
1/4	6884-04	6885-104
3/8	6884-06	6885-106
1/2	6884-08	6885-108
5/8	6884-10	6885-110
3/4	6884-12	6885-112
1	6884-16	6885-116

HARRISON 6777 MACHINE

L19679 S0006402412\_V1

Harrison Portable Swagers for BACS13BX Sleeves  
Figure 816/20-10-51-990-905 (Sheet 3 of 5)

EFFECTIVITY  
AKS ALL

**20-10-51**

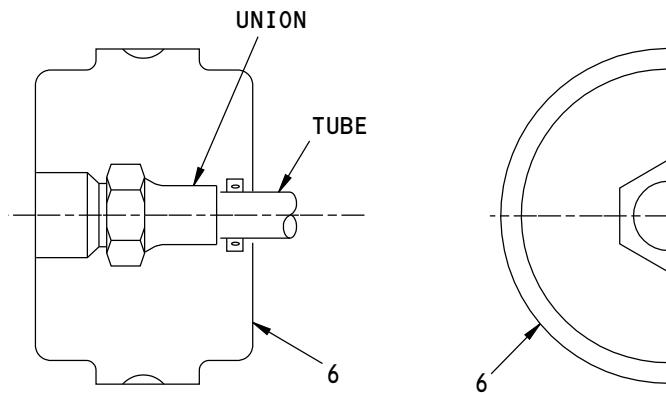
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TUBE AND UNION DIA. INCHES	TWO HALF JAWS (6)
1/4	6886-04
3/8	6886-06
1/2	6886-08
5/8	6886-10
3/4	6886-12
1	6886-16

EXTERNAL ROLLER SWAGE TOOLS FOR UNIONS

L19680 S0006402413\_V1

Harrison Portable Swagers for BACS13BX Sleeves  
Figure 816/20-10-51-990-905 (Sheet 4 of 5)

EFFECTIVITY  
AKS ALL

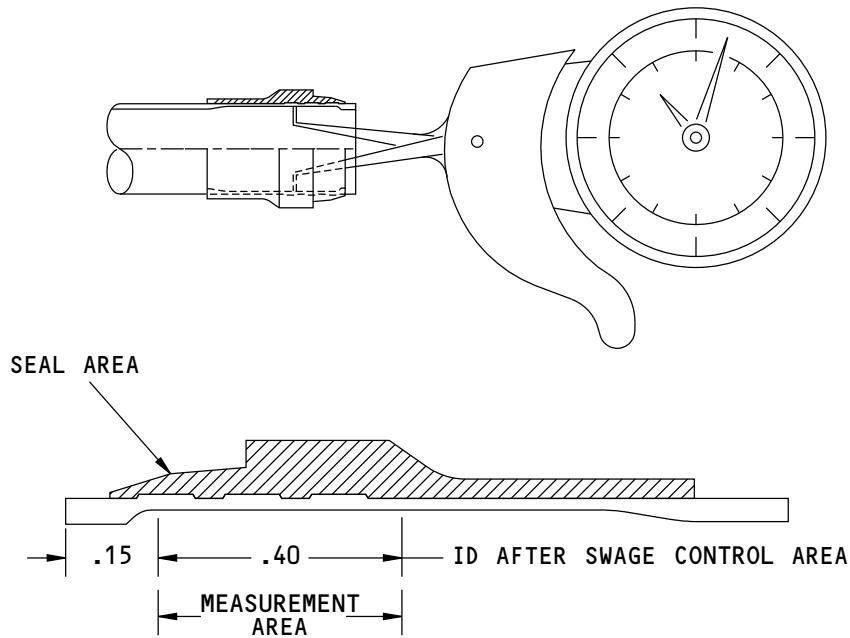
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NOTE: I.D. AFTER SWAGE REQUIREMENTS-MEASURING METHOD  
FOR 35211 SLEEVE AND 35212 UNION

TUBE O.D./DASH NO.	TUBE WALL	TORQUE	I.D. AFTER SWAGE
TUBE MATERIAL: 3AI-2.5V TITANIUM PER AS5620			
0.250/-04	0.016	6-7	0.225-0.232
0.375/-06	0.019	11-12	0.347-0.354
0.500/-08	0.026	20-22	0.458-0.465
0.625/-10	0.032	40-43	0.575-0.587
0.750/-12	0.039	40-43	0.684-0.695
1.000/-16	0.051	65-68	0.913-0.919

**SWAGING TORQUE AND I.D. AFTER SWAGE REQUIREMENTS  
FOR 35211 SLEEVE AND 35212 UNIONS**

L19681 S0006402414\_V2

**Harrison Portable Swagers for BACS13BX Sleeves**  
Figure 816/20-10-51-990-905 (Sheet 5 of 5)

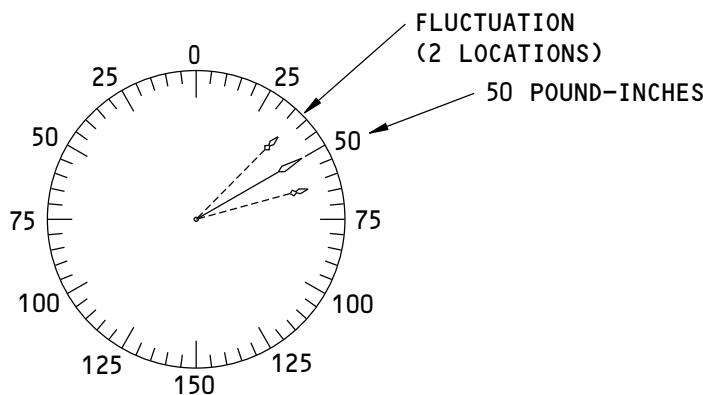
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TORQUE WRENCH DIAL - PROCEDURE TO READ TORQUE

TUBE SIZE	MATERIAL		SWAGE TORQUE (POUNDS-INCH)	
	WALL THICKNESS - INCHES		MIN	MAX
	3AL-2.5V TITANIUM [1]	21Cr-6Ni-9Mn CRES [2]		
04	0.016	0.016	4	5
06	0.019	0.020	12	15
08	0.026	0.026	20	25
10	0.032	0.033	40	45
12	0.039	0.039	40	45
16	0.051	0.052	80	85

SWAGE TORQUES NECESSARY TO ROLLER SWAGE  
BACS13BX SLEEVES TO Ti-3AL-2.5V CWSR OR  
21-6-9 CRES TUBE USING HARRISON 6633K01  
ROLLER SWAGING KIT

[1] AS SPECIFIED IN SPECIFICATION AS5620/BMS 7-234

[2] AS SPECIFIED IN SPECIFICATION BMS 7-185

L19690 S0006402419\_V2

Swage Torques, Sleeve Dimensions, and Wall Thicknesses for Roller Swaging  
Figure 817/20-10-51-990-906 (Sheet 1 of 3)

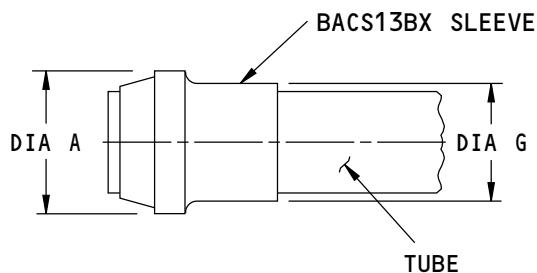
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DIAMETER	TUBE SIZE					
	04	06	08	10	12	16
A MAX	0.374	0.493	0.673	0.789	0.964	1.214
G MAX	0.298	0.423	0.550	0.686	0.822	1.070

MAXIMUM PERMITTED SHOULDER AND SKIRT DIAMETERS (INCH)

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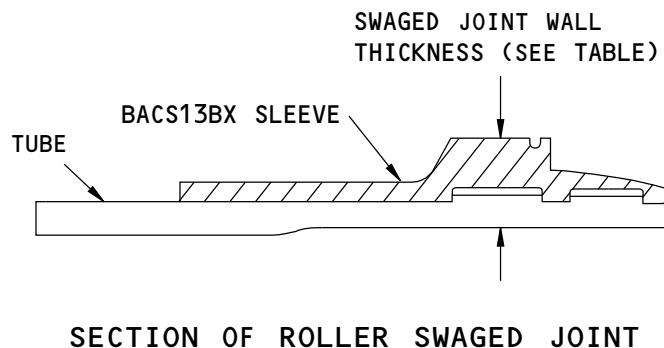
**Swage Torques, Sleeve Dimensions, and Wall Thicknesses for Roller Swaging**  
**Figure 817/20-10-51-990-906 (Sheet 2 of 3)**

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TUBE SIZE	TUBE DIMENSIONS		SWAGED JOINT WALL THICKNESS FOR "NOMINAL" TUBE WALLS - INCHES 1	
	"NOMINAL" WALL THICKNESS - INCHES 2			
	Ti-3AL-2.5V	21-6-9 CRES		
04	0.016	0.016	0.068	
06	0.019	0.020	0.066	
08	0.026	0.026	0.100	
10	0.032	0.033	0.101	
12	0.039	0.039	0.132	
16	0.051	0.052	0.143	

SWAGED JOINT WALL THICKNESS SPECIFICATION 1 2

1 "NOMINAL" WALL THICKNESS DEFINITION: TUBE WALL THICKNESS WITHOUT TOLERANCES AS SPECIFIED BY TUBE SPECIFICATION: AS5620 FOR Ti-3AL-2.5V AND BMS 7-185 FOR 21-6-9 CRES.

2 IF THE THICKNESS OF A MEASURED TUBE WALL IS DIFFERENT THAN THE "NOMINAL", ADD OR SUBTRACT THE DIFFERENCE FROM THE NECESSARY SWAGED JOINT WALL THICKNESS FOR "NOMINAL" TUBE WALLS.

EXAMPLE: 1. MEASURED 10 SIZE TITANIUM 3AL-2.5V TUBE WALL = 0.035 INCH  
 2. WALL DIFFERENCE IS 0.035 INCH, MINUS 0.032 INCH = 0.003 INCH  
 3. ADD 0.003 INCH TO 0.101 INCH = 0.104 INCH

L19692 S0006402421\_V2

**Swage Torques, Sleeve Dimensions, and Wall Thicknesses for Roller Swaging**  
**Figure 817/20-10-51-990-906 (Sheet 3 of 3)**

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**TASK 20-10-51-400-805**

**6. Install the CRYOLIVE Flareless Sleeve Assembly**

**A. General**

**WARNING:** USE EXTREME CAUTION WHEN USING LIQUID NITROGEN. THE TEMPERATURE OF LIQUID NITROGEN IS 320 DEGREES BELOW ZERO (-195.5°C). PROVIDE PROPER VENTILATION AS LIQUID NITROGEN VAPORS CAN DISPLACE OXYGEN IN CONFINED AREAS. USE SAFETY GLASSES AND A FACE SHIELD WHEN USING LIQUID NITROGEN. MISUSE OF LIQUID NITROGEN CAN CAUSE INJURY TO PERSONS.

**WARNING:** SLOWLY AND CAREFULLY SUBMERGE WARM ITEMS IN LIQUID NITROGEN TO PREVENT RAPID BOILING OFF AND SPLASHING. MISUSE OF LIQUID NITROGEN CAN CAUSE INJURY TO PERSONS.

- (1) The CRYOLIVE flareless sleeve, shown in Figure 806, Table 807, Table 808, Table 809, and Table 810 and Figure 819, is installed as part of an assembly consisting of the sleeve, a coupling and nut and plastic cap that acts as an assembly tool and a protective cover for the tube end until the tube is installed in the airplane. The assembly is stored in liquid nitrogen until ready for use. During installation, the assembly is removed from the liquid nitrogen, slipped onto the tube end and allowed to warm to room temperature. The sleeve shrink fits into position at the correct distance from the tube end as it warms to room temperature.

**NOTE:** Do not use CRYOLIVE flareless sleeve assemblies on any oxygen lines or on fluid lines inside the fire zones on engines or APU's. The CRYOLIVE flareless sleeve assembly is not qualified for these applications.

- (2) The CRYOLIVE flareless sleeve cryolive flareless sleeve/coupling nut/protective cap assembly, STD-1353 can be used, as shown in Figure 806, Table 807, Table 808, Table 809, and Table 810 and Figure 819, with 304 1/8 hard CRES, Ti-3Al-2.5V and 21-6-9 CRES tube and 6061-T6 aluminum tube. Titanium coupling nuts (part of CRYOLIVE assembly 921721T-) or CRES coupling nuts (part of CRYOLIVE assembly 921721J-) can be used with the CRYOLIVE sleeve on 304 1/8 hard CRES, Ti-3Al-2.5V or 21-6-9 CRES tube. Aluminum coupling nuts (part of CRYOLIVE assembly 921721W-) and aluminum mating fittings must be used to avoid galvanic corrosion when the CRYOLIVE flareless sleeve assembly is installed on 6061-T6 aluminum tube.
- (3) The coupling nut used with the cryolive flareless sleeve/coupling nut/protective cap assembly, STD-1353 in sizes 10, 12, and 16 is longer than the standard MS21921/BACN10-coupling nut in the same sizes and is not interchangeable with the MS21921/BACN10-nuts. See Table 819 for approved Cryolive sleeve, coupling nut and plastic cap combinations.

**Table 819/20-10-51-993-914 CRYOLIVE Flareless Sleeve/Coupling Nut/Plastic Cap Combinations**

TUBE SIZE	COUPLING NUT MATERIAL	COMBINATION - SLEEVE/COUPLING NUT/PLASTIC CAP PART NO. <sup>[1]</sup>
04	304 CRES	921721J04
	7075-T73 Al	921721W04
	6AL-4V Ti	921721T04
06	304 CRES	921721J06
	7075-T73 Al	921721W06
	6AL-4V Ti	921721T06

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**Table 819/20-10-51-993-914 CRYOLIVE Flareless Sleeve/Coupling Nut/Plastic Cap Combinations  
(Continued)**

08	304 CRES 7075-T73 Al 6AL-4V Ti	921721J08 921721W08 921721T08
10	304 CRES 7075-T73 Al 6AL-4V Ti	921721J10 921721W10 921721T10
12	304 CRES 7075-T73 Al 6AL-4V Ti	921721J12 921721W12 921721T12
16	304 CRES 7075-T73 Al 6AL-4V Ti	921721J16 (Combination not Approved) 921721T16

\*[1] Do not replace coupling nuts included with the CRYOLIVE flareless sleeve/coupling nut/plastic cap combinations. Use only the coupling nut provided with the assembly.

- (4) Ensure that the CRYOLIVE flareless sleeve cryolive flareless sleeve/coupling nut/protective cap assembly, STD-1353 is installed so that the joint will not be subjected to axial preload during final torquing of the joint.

**B. References**

<b>Reference</b>	<b>Title</b>
20-30-80-910-801	General Cleaning of Metal (Series 80) (P/B 201)
29-09-00-860-802	Hydraulic Reservoirs Depressurization (P/B 201)

**C. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

<b>Reference</b>	<b>Description</b>
COM-1355	Gloves - Insulated Part #: OE-GLOVE Supplier: 30974 Opt Part #: EO-GLOVE-LINER- (S-M-L) Supplier: 30974
COM-1356	Work Box - Insulated Part #: WB910825-01 Supplier: 30974
STD-203	Container - Oil Resistant, 1 U.S.-Gal (3.8 l)
STD-1353	Assembly - Cryolive, Flareless Sleeve/Coupling Nut/Protective Cap
STD-1354	Tongs

**D. Consumable Materials**

<b>Reference</b>	<b>Description</b>	<b>Specification</b>
B01000	Solvent - General Cleaning Of Metal (AMM 20-30-80)	
G00262	Nitrogen - Liquid	A-A-59503 Type II, MIL-PRF-27401 Type II

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E. Procedure

SUBTASK 20-10-51-040-001

- (1) Remove pressure from the system where you will do repairs, do this task: Hydraulic Reservoirs Depressurization, TASK 29-09-00-860-802.
  - (a) Allow the hydraulic fluid to drain in to a suitable container (example, 1 U.S.-gal (3.81 l) oil resistant container, STD-203).

SUBTASK 20-10-51-800-009

- (2) Make sure that the tube end where you will install the cryolive flareless sleeve/coupling nut/protective cap assembly, STD-1353 is round, smooth and free of scratches and burrs.

SUBTASK 20-10-51-110-011

**WARNING:** DO NOT GET SOLVENTS IN YOUR MOUTH, OR YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE HAZARDOUS MATERIALS. SOLVENTS MAY BE FLAMMABLE OR HARMFUL TO THE ENVIRONMENT. REFER TO PRODUCT MATERIAL SAFETY DATA SHEETS (MSDS) AND LOCAL REQUIREMENTS FOR PROPER HANDLING PROCEDURES.

- (3) Use Series 80 solvent, B01000 (TASK 20-30-80-910-801) to clean the tube in the area where you will install the cryolive flareless sleeve/coupling nut/protective cap assembly, STD-1353.

SUBTASK 20-10-51-800-010

- (4) Put on the insulated gloves, COM-1355.

SUBTASK 20-10-51-880-001

**WARNING:** USE EXTREME CAUTION WHEN USING LIQUID NITROGEN. THE TEMPERATURE OF LIQUID NITROGEN IS 320 DEGREES BELOW ZERO (-195.5°C). PROVIDE PROPER VENTILATION AS LIQUID NITROGEN VAPORS CAN DISPLACE OXYGEN IN CONFINED AREAS. USE SAFETY GLASSES AND A FACE SHIELD WHEN USING LIQUID NITROGEN. MISUSE OF LIQUID NITROGEN CAN CAUSE INJURY TO PERSONS.

**WARNING:** SLOWLY AND CAREFULLY SUBMERGE WARM ITEMS IN LIQUID NITROGEN TO PREVENT RAPID BOILING OFF AND SPLASHING. MISUSE OF LIQUID NITROGEN CAN CAUSE INJURY TO PERSONS.

- (5) Put nitrogen, G00262, into a small, insulated work box, COM-1356.
- (6) Remove the cryolive flareless sleeve/coupling nut/protective cap assembly, STD-1353 from the main storage container and put it into the liquid nitrogen.
  - (a) Make sure that the assembly is fully covered by the liquid nitrogen.

SUBTASK 20-10-51-510-001

- (7) Move the cryolive flareless sleeve/coupling nut/protective cap assembly, STD-1353 which is in the liquid nitrogen to the repair location.

SUBTASK 20-10-51-420-026

- (8) Install the cryolive flareless sleeve/coupling nut/protective cap assembly, STD-1353:
  - (a) Using tongs, STD-1354, remove the CRYOLIVE flareless sleeve cryolive flareless sleeve/coupling nut/protective cap assembly, STD-1353 from the liquid nitrogen and allow the excess liquid nitrogen to run off.

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**WARNING:** DO NOT PUT GLOVED HAND IN LIQUID NITROGEN. THE LIQUID NITROGEN CAN "WICK" INTO THE GLOVE MATERIAL AND CAUSE INJURY TO YOUR HAND.

- (b) Grasp the CRYOLIVE flareless sleeve with the gloved hand and immediately slide it onto the tube end until the assembly bottoms on the tube.
  - 1) Make sure that the tube end is visible in the slotted end of the protective cap.

SUBTASK 20-10-51-880-002

- (9) Allow the CRYOLIVE flareless sleeve to warm and shrink on to the tube.

SUBTASK 20-10-51-540-001

**CAUTION:** THE TUBE END MUST BE FULLY BOTTOMED AGAINST THE INSIDE END OF THE CAP SO THAT THE SLEEVE IS CORRECTLY POSITIONED ON THE TUBE END. IF THE TUBE END IS NOT BOTTOMED AGAINST THE INSIDE END OF THE CAP, REMOVE THE PLASTIC CAP AND MEASURE THE TUBE PROTRUSION PER THE "P" DIMENSION REQUIREMENT OF (FIGURE 818). IF THE "P" DIMENSION IS INCORRECT, THE INSTALLATION MUST BE REPLACED.

- (10) When ready to complete final joining/torquing of the coupling nut/CRYOLIVE flareless sleeve to the mating fitting, remove and discard the plastic cap by unscrewing the coupling nut. Refer to Table 819.

**NOTE:** The plastic caps are manufactured from polycarbonate material and can be recycled.

————— END OF TASK ————

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FLARELESS SLEEVE JOINT TYPE	TUBE SIZES								
	04	05	06	08	10	12	16	20	24
BACS13BX (Roller Swaged)									
		0.140	N/A	0.137	0.190	0.195	0.195	N/A	N/A
35211 (Harrison Roller Swaged)									
		0.210	N/A	0.207	0.250	0.255	0.255	N/A	N/A
BACS13BX (Elastomer Swaged)									
		0.214	0.230	0.230	0.285	0.330	0.330	0.392	0.395 1 0.355 2
BACS13AP (Preset)									
		0.234	0.250	0.250	0.305	0.350	0.350	N/A	N/A

ALL EXCEPT SHORT FLARELESS

SHORT FLARELESS

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**Flareless Sleeve Tube End Values  
Figure 818/20-10-51-990-907**

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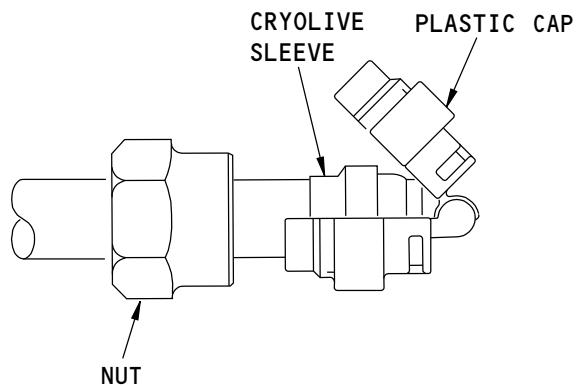
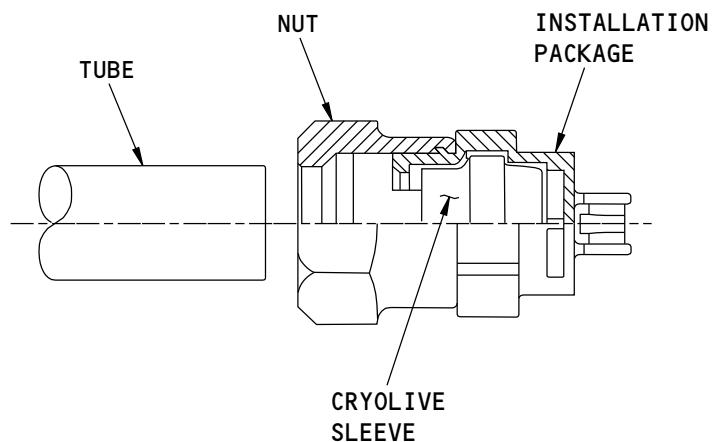
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NOTE: REMOVAL OF PLASTIC CAP AFTER INSTALLATION.

L19732 S0006402440\_V1

**CRYOLIVE Flareless Sleeve Assembly**  
**Figure 819/20-10-51-990-908**

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**TASK 20-10-51-300-806**

7. **BACS13BX Flareless Sleeve Swaging with the Harrison Swagers 5175, 5570, and 5720**  
(Figure 816)

**A. References**

Reference	Title
29-09-00-860-802	Hydraulic Reservoirs Depressurization (P/B 201)

**B. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-1388	Kit - Power Swaging, Stationary Automatic (1/4 - 3/4 Tube Size) Part #: 6520 Supplier: 08199 Opt Part #: 5570 Supplier: 08199
COM-1789	Kit - Hand Swaging, Portable (1/4-1/2 Inch Tube Size) Part #: 5175K-200 Supplier: 08199
COM-1790	Kit - hand Swaging, Portable (5/8 to 1-1/2 Tube Size) Part #: 5720K-200 Supplier: 08199
STD-203	Container - Oil Resistant, 1 U.S.-Gal (3.8 l)

**C. Procedure**

**SUBTASK 20-10-51-040-002**

- (1) Remove pressure from the system where you will do repairs, do this task: Hydraulic Reservoirs Depressurization, TASK 29-09-00-860-802.
  - (a) Allow the hydraulic fluid to drain into a suitable container (example, 1 U.S.-gal (3.81 l) oil resistant container, STD-203).

**SUBTASK 20-10-51-940-022**

**WARNING:** POINT THE TUBE AWAY FROM PERSONS AND EQUIPMENT WHEN YOU SWAGE. DRAW-BOLTS CAN BREAK AND COME QUICKLY OUT OF THE TUBE. THE DRAW-BOLTS CAN HIT PERSONS OR EQUIPMENT AND CAUSE INJURY OR DAMAGE.

- (2) Get the necessary tools as shown in the instruction manual supplied with portable (1/4-1/2 inch tube size) hand swaging kit, COM-1789, power swaging kit, COM-1388, or portable (5/8 to 1-1/2 tube size) hand swaging kit, COM-1790.

**SUBTASK 20-10-51-640-003**

- (3) Apply a light layer of antiscorching lubricant to the outer surfaces of the bushings and expanders of the drawbar assemblies.

NOTE: Do not let the lubricant go into the grooves of the sleeve. Lubricant in the grooves will prevent correct swaging.

- (a) Make sure the tube and sleeve are clean and dry.

**SUBTASK 20-10-51-340-002**

- (4) Apply the necessary swage pressure, shown in Figure 820, and hold the pressure for a minimum of two seconds.



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Table 820/20-10-51-993-915

TUBE SIZE	SWAGER MODEL NO.	21-6-9 CRES PER BMS7-185		6061T AL PER WW-T-700/6 OR MIL-T-7081 OR AMS4083		6061-T4 AL PER MIL-T-7081 OR AMS4081		304 AND 321 ANNEALED CRES PER MIL-T- 8504 AND MIL-T- 8808		304-1/8 HARD CRES PER MIL-T- 6845	
		Wall (in.)	Swage Pres- sure (PSI) <sup>[1]</sup>	Wall (in.)	Swage Pres- sure (PSI) ±5%	Wall (in.)	Swage Pres- sure (PSI ) ±5%	Wall (in.)	Swage Pres- sure (PSI) <sup>[1]</sup>	Wall (in.)	Swage Pres- sure (PSI) <sup>[1]</sup>
04	5175 (portable)	0.016	475	N/A	N/A	N/A	N/A	N/A	N/A	0.020	475 <sup>[2]</sup>
05	5175 (portable)	0.020	1000	0.035	450 <sup>[3]</sup>	N/A	N/A	N/A	N/A	N/A	N/A
06	5175 (portable)	0.020	1150	0.028 0.035	500 <sup>[3]</sup>	N/A	N/A	0.035	940 <sup>[3]</sup>	0.035	1150 <sup>[2]</sup>
08	5175 (portable)	0.026	2000	0.035	950 <sup>[3]</sup>	N/A	N/A	N/A	N/A	0.35	2000 <sup>[2]</sup>
10	5570 (stationary)	0.033	1000	0.020 0.028 0.035	280 <sup>[3]</sup> 320 <sup>[3]</sup> 355 <sup>[3]</sup>	0.035	250	N/A	N/A	0.049	1000
10	5720 (portable)	0.033	850	0.035	375	N/A	N/A	0.035 0.049	425	0.035 0.049	850 <sup>[2]</sup>
12	5570 (stationary)	0.039	900	0.035	400 <sup>[3]</sup>	N/A	N/A	N/A	N/A	N/A	N/A
12	5720 (portable)	0.039	1600	0.035	600	N/A	N/A	N/A	N/A	0.035 0.049 0.058	1300 1350 1600
16	5720 (portable)	0.052	3050	0.035	950 <sup>[3]</sup>	0.035	750 <sup>[3]</sup>	N/A	N/A	0.035 0.065	1650 <sup>[3]</sup> 3050
20	5570 (stationary) 5720 (portable)	N/A	N/A	0.049	N/A	0.035	700 <sup>[3]</sup>	0.035	1650 <sup>[3]*[4]</sup>	N/A	N/A
24	5720 (portable)	N/A	N/A	0.049	N/A	N/A	N/A	0.035 0.049	2550 <sup>*[3]*[4]</sup> 2280 <sup>*[3]*[5]</sup>	N/A	N/A

\*[1] Minimum swage pressure - if you must swage again, increase in 5% increments.

\*[2] Swage pressures necessary to install BACS13BX flareless sleeves on tube materials with the Harrison portable and stationary swager.

\*[3] Not qualified for 3000 psi (20,684 kPa). Use for lower pressures only.

\*[4] Swage pressure for BACS13BX sleeves with standard or shortened "P" dimensions.

\*[5] Swage pressure for BACS13BX sleeves with shortened "P" dimensions only.

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SUBTASK 20-10-51-220-020

- (5) Do a check of the groove depth with a Tiplar or Mueller bore gage (Figure 821).

SUBTASK 20-10-51-220-021

- (6) Do a check on the external dimensions of the swaged fitting (Figure 820).

SUBTASK 20-10-51-220-022

- (7) Make sure the tooling die marks on the outside diameter of the tube do not have a height or depth larger than 10% of the tube wall specified thickness.

NOTE: Other permitted defects include marks or scratches on the outer tube which are less than 0.20 in. (5.08 mm) in length and 0.002 in. (0.051 mm) in depth.

SUBTASK 20-10-51-210-018

- (8) Make sure the seal areas of the sleeves and unions are not scratched or damaged during fabrication.

SUBTASK 20-10-51-210-019

- (9) Make sure each seal area keeps the usual finish specifications.

SUBTASK 20-10-51-220-023

- (10) Make sure the tool and die marks on the external skirt and shoulder areas of the sleeves and unions are not more than 0.002 in. (0.051 mm) in height.

SUBTASK 20-10-51-220-024

- (11) Make sure the tool and die marks on the external skirt and shoulder areas of the sleeves and unions do not touch the nut.

———— END OF TASK ————

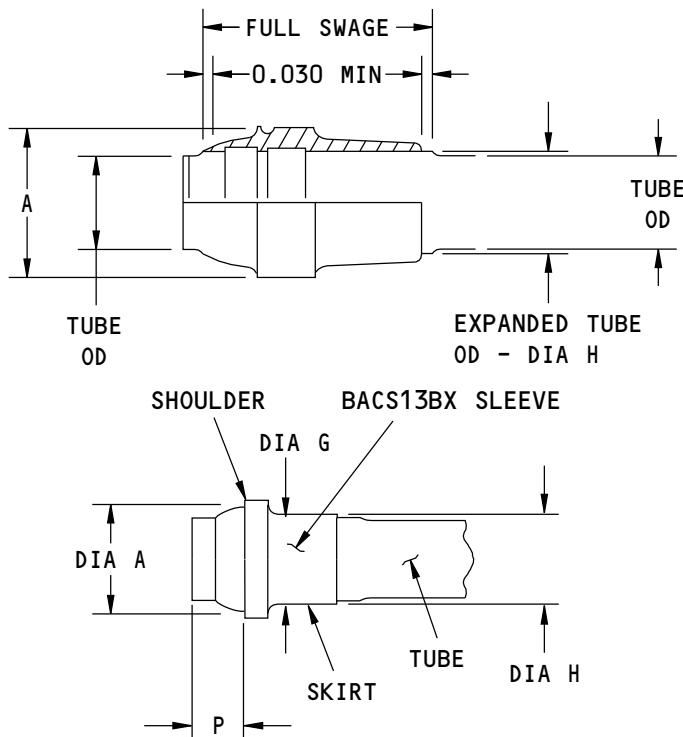
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DIMENSION	SIZE								
	04	05	06	08	10	12	16	20	
P ±0.010	0.214	0.230	0.230	0.285	0.330	0.330	0.392	0.395 1 0.355 2	0.465 1 0.350 2
A max	0.374	0.437	0.493	0.673	0.789	0.964	1.214	1.474	1.723
G max	0.298	0.364	0.423	0.550	0.686	0.822	1.070	1.323	1.573
H max	0.260	0.322	0.385	0.511	0.636	0.761	1.011	1.262	1.517

NOTE: ALL DIMENSIONS ARE IN INCHES.

**DIMENSIONS OF FLARELESS TUBE ENDS AND  
BACS13BX SLEEVES AFTER ELASTOMERIC SWAGING**

1 → ALL EXCEPT SHORT FLARELESS

2 → SHORT FLARELESS

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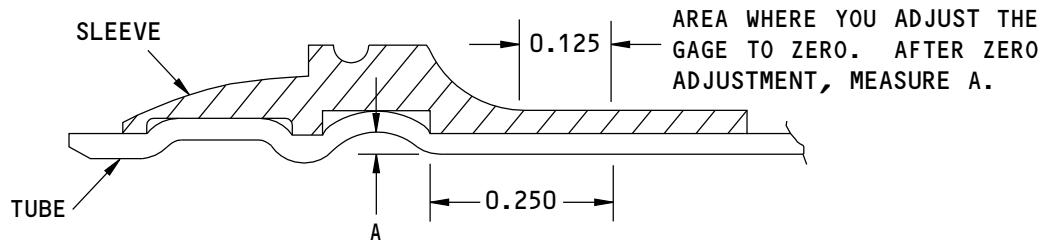
**BACS13BX Flareless Sleeve Dimensions After Elastomeric Swaging**  
**Figure 820/20-10-51-990-909**

EFFECTIVITY  
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BACS13BX (TWO GROOVES)

TUBE SIZE	DEPTH 2A - INCHES	
	MINIMUM	MAXIMUM
04	0.020	0.032
05	0.020	0.032
06	0.020	0.032
08	0.020	0.032
10	0.022	0.034
12	0.026	0.038
16	0.028	0.040
20	0.026	0.042
24	0.026	0.042

BACS13BX SWAGE  
GROOVE DEPTH LIMITS

NOTE: ALL DIMENSIONS ARE IN INCHES.

L19685 S0006402418\_V2

Groove Depth Measurement for BACS13BX Sleeves  
Figure 821/20-10-51-990-910

EFFECTIVITY  
AKS ALL

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**TASK 20-10-51-300-807**

**8. BACS13BX Flareless Sleeve Swaging with the 6633K01 Harrison Roller Swaging Kit**

**A. References**

Reference	Title
29-09-00-860-802	Hydraulic Reservoirs Depressurization (P/B 201)

**B. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-1794	Swager - Portable Tube, Hand Swaging, 1/4 - 1" Dia. Stainless Steel or Titanium Tubing Part #: 6633K-01 Supplier: 08199
STD-203	Container - Oil Resistant, 1 U.S.-Gal (3.8 l)

**C. Procedure**

SUBTASK 20-10-51-040-003

- (1) Remove pressure from the system where you will do repairs, do this task: Hydraulic Reservoirs Depressurization, TASK 29-09-00-860-802.
  - (a) Allow the hydraulic fluid to drain into a suitable container (example, 1 U.S.-gal (3.81 l) oil resistant container, STD-203).

SUBTASK 20-10-51-940-023

- (2) Get the necessary tools as told in the operating instruction manual supplied with the tube swager, COM-1794.

SUBTASK 20-10-51-350-010

- (3) Apply the necessary torque, shown in Figure 813, to the expander mandrel.

SUBTASK 20-10-51-220-025

- (4) After you swage, make sure the BACS13BX sleeve and tube agree with the specifications of Figure 813.
  - (a) Do not trim the tube after you roller swage.
  - (b) If it is necessary, remove the burrs with an approved deburring tool.

SUBTASK 20-10-51-210-020

- (5) Make sure the seal areas of the sleeves are not scratched or damaged during fabrication.

SUBTASK 20-10-51-210-021

- (6) Make sure each seal area keeps the 63 RHR (no annular tool marks) finish specifications of its standard.

SUBTASK 20-10-51-220-026

- (7) Make sure the die marks on the external skirt and shoulder areas of the sleeves are not more than 0.002 in. (0.051 mm) in height.

SUBTASK 20-10-51-220-027

- (8) Make sure the die marks on the external skirt and shoulder areas of the sleeves do not touch the nut.

EFFECTIVITY  
AKS ALL

**20-10-51**

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SUBTASK 20-10-51-210-022

- (9) Make sure the tube inner surfaces at the swage area do not have scratches or marks caused by defective rollers.

———— END OF TASK ————

**TASK 20-10-51-300-808**

**9. BACS13AP Flareless Sleeve Preset**

**A. General**

- (1) We recommend you pressure preset and do not preset by hand. If you must preset by hand, we recommend you preset some samples first. Then you can preset the section to repair. On samples, cut away the sleeve to make sure the ring cut on the tube makes a circle around the tube circumference and has a depth of 0.002 in. (0.051 mm).

**B. References**

Reference	Title
29-09-00-860-802	Hydraulic Reservoirs Depressurization (P/B 201)

**C. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-1785	Gun - Lockbolt, 13/16 Inch Stroke and Minimum of 6500 Lb Pulling Capacity Part #: G85D Supplier: 05693 Part #: G85D-S Supplier: 11815
SPL-1589	Kit - Preset Tube Fitting, "Sleeve Set", (Not for Titanium Tubing) (Set of 25 Ea. Dies, Mandrels, & Clamps) Part #: ST878D Supplier: 81205 Part #: ST879A Supplier: 81205
SPL-1590	Holder - Tube Fitting, Preset Part #: ST879AF Supplier: 81205
STD-203	Container - Oil Resistant, 1 U.S.-Gal (3.8 l)

**D. Procedure**

SUBTASK 20-10-51-040-004

- (1) Remove pressure from the system where you will do repairs, do this task: Hydraulic Reservoirs Depressurization, TASK 29-09-00-860-802.  
(a) Allow the hydraulic fluid to drain into a suitable container (example, 1 U.S.-gal (3.81 l) oil resistant container, STD-203).

SUBTASK 20-10-51-350-011

- (2) Do these steps to do the pressure preset with the Cherry 13/16 inch stroke and minimum of 6500 lb pulling capacity lockbolt gun, COM-1785:  
(a) Attach the thrust sleeve and die holder to the Cherry 13/16 inch stroke and minimum of 6500 lb pulling capacity lockbolt gun, COM-1785.  
(b) Install the mandrel and the preset die in the Cherry (Figure 822, Table 821).

EFFECTIVITY  
AKS ALL

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**Table 821/20-10-51-993-916 Preset Pressures for Cherry G-85 Lockbolt Gun with ST878D Presetting Tool Assembly**

TUBE SIZE	WALL THICKNESS	TOOL NO.	RECOMMENDED AIR PRESSURE (PSI)	
			ALUMINUM	STEEL
			6061-T6	AISI 304-1/8 HARD
3/16	0.020-0.035	ST878D-3-020 ST878D-3-035	22.5	30.0
1/4	0.020-0.035	ST878D-4-020 ST878D-4-035	27.5	40.0
5/16	0.020-0.035	ST878D-5-020 ST878D-5-035	30.0	40.0
3/8	0.020-0.035	ST878D-6-020 ST878D-6-035	30.0	52.5
1/2	0.028-0.035	ST878D-8-028 ST878D-8-035	42.5	75.0
5/8	0.028-0.083	ST878D-10-028 ST878D-10-083	50.0	80.0
3/4	0.020-0.049	ST878D-12-020 ST878D-12-049	52.5	85.0

- (c) Connect the air pressure line and use the correct pressure (Figure 822, Table 821).
- (d) Do several cycles of the Cherry 13/16 inch stroke and minimum of 6500 lb pulling capacity lockbolt gun, COM-1785 and make sure the pressure is set correctly.
- (e) Assemble the split-clamp die, the clamp nut, and the sleeve.
- (f) Put the assembly into the die holder.
- (g) Put the B-nut on the tube and make the tube end touch the bottom of the die holder.
- (h) Start the Cherry 13/16 inch stroke and minimum of 6500 lb pulling capacity lockbolt gun, COM-1785.
- (i) Hold the tube in its position while the die installs the sleeve on the tube.
- (j) Maintain the pressure while you preset the sleeve on the tube.
- (k) Unclamp the nut.
- (l) Remove the tube and die from the holder.
- (m) Open the die to show the preset sleeve.

**SUBTASK 20-10-51-350-012**

- (3) To preset the sleeve by hand, do these steps:
  - (a) Use the correct mandrel for the preset tube sleeve set fitting kit, SPL-1589 and tube fitting holder, SPL-1590 (Figure 823).
  - (b) Lubricate the threads, sleeve shoulder, and conical seal area of the fitting.  
**NOTE:** Do not lubricate the tube.
  - (c) Assemble the sleeve on the tube.
  - (d) Insert the tube into the preset tube sleeve set fitting kit, SPL-1589 and tube fitting holder, SPL-1590 union.
  - (e) Tighten the nut as shown in Table 822 and Table 823.

EFFECTIVITY  
AKS ALL

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- (f) If the preset tube sleeve set fitting kit, SPL-1589 and tube fitting holder, SPL-1590 is not available, you can preset the sleeves with a carbon steel union and nut as shown in Table 822 and Table 823.

**Table 822/20-10-51-993-917 Displacement Turns and Torque Values for Hand Preset of Flareless Sleeves - Steel Tubing**

TUBE OUTER DIAMETER <sup>[1]</sup>		1/4	5/16	3/8	1/2	5/8	3/4	1	1-1/4
Wall Thickness (in.)	304	0.020	0.020	0.028	0.035	0.049	0.058	N/A	N/A
	21-6-9	0.016	0.020	0.020	0.026	0.033	0.039	N/A	N/A
Procedure A (Displacement, Turns) <sup>[2]</sup>		1-1/6	1-1/6	1-1/6	1-1/6	1-1/6	1-1/6	N/A	N/A
Procedure B (Torque) <sup>[3]</sup> Pound- Inches	304	145	200	290	545	780	900	N/A	N/A
	21-6-9	145	200	290	545	780	1200	N/A	N/A

\*[1] Use an internal mandrel preset tool on tubes with thinner walls (refer to ST879A). When in doubt, make a test preset to make sure the ring cut minimum depth is 0.002 in. (0.051 mm).

\*[2] Measure displacement from the point where the fitting, sleeve, and nut are firmly hand-tightened, and wrench is necessary to further tighten.

\*[3] Apply torque, loosen, and apply indicated torque three times.

**Table 823/20-10-51-993-918 Displacement Turns and Torque Values for Hand Preset of Flareless Sleeves - Aluminum Tubing**

TUBE DIAMETER <sup>[1]</sup>		1/4	4/16	3/8	1/2	5/8	3/4	1	1-1/4
Wall Thickness (in.)	6061-T6	0.035	0.035	0.035	0.035	0.035	0.035	N/A	N/A
	Procedure A <sup>[2]</sup> (Displacement, Turns)	1-1/6	1-1/6	1-1/6	1	1	1	N/A	N/A
Procedure B (Torque) <sup>[3]</sup> Pound- Inches	6061-T6	110	140	170	280	360	450	N/A	N/A

\*[1] Use an internal mandrel preset tool on tubes with inner walls (refer to ST879A). When in doubt, make a test preset to make sure the ring cut minimum depth is 0.002 in. (0.051 mm).

\*[2] Measure displacement from the point where the fitting, sleeve, and nut are firmly hand-tightened, and a wrench is necessary to further tighten.

\*[3] Apply torque, loosen, and apply indicated torque three times.

SUBTASK 20-10-51-220-028

- (4) After you preset, make sure the BACS13AP sleeve and tube joint have the properties that follow (Figure 824):
  - (a) Corrosion resistant steel tubing (MIL-T-6845):
    - 1) Make sure the sleeves have a maximum of 0.005 in. (0.127 mm) longitudinal end play.
    - 2) Make sure the sleeves do not turn freely on the tube under finger pressure (without the use of force).



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- (b) Annealed corrosion resistant tubing (MIL-T-8504 and MIL-T-8808) and aluminum alloy tubing (MIL-T-7081 or WW-T-700/6):

NOTE: Sleeves can have 0.015 in. (0.381 mm) maximum longitudinal end play and turn on the tube under finger pressure.

- (c) These conditions apply to all tubing materials:

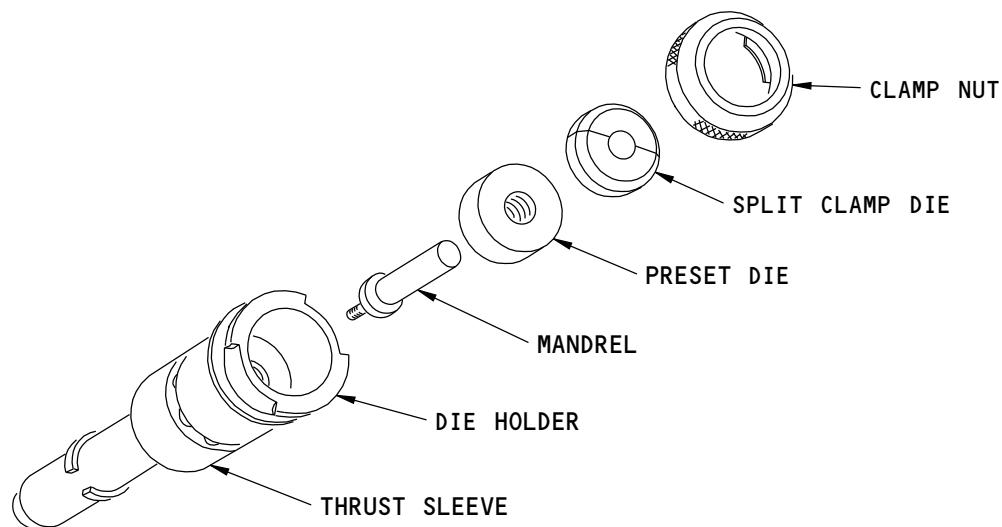
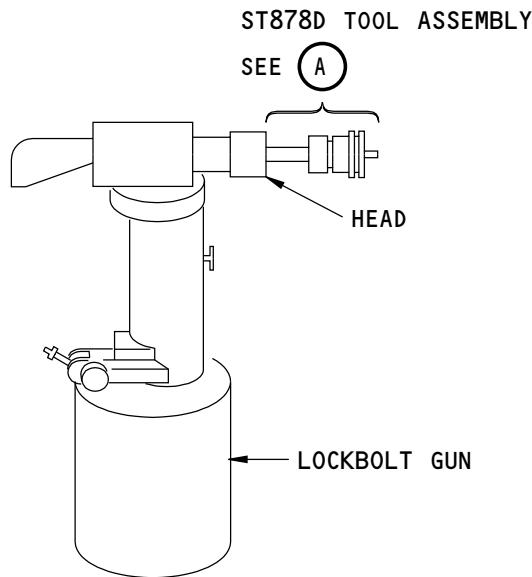
- 1) Make sure the tube inner diameter does not decrease more than 0.005 in. (0.127 mm) (Figure 824).
- 2) Make sure the sealing surface of the sleeve bow is free of scratches, marks, or other defects.
- 3) The tube end is permitted to flare if the flare diameter does not prevent entrance of the MS21902 or MS21924 union into the MS flareless fitting end.

———— END OF TASK ————

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**ST878D TOOL ASSEMBLY**

(A)

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**Preset Pressures (PSI) for the Cherry G-85 Lockbolt Gun with ST878D Presetting Tool Assembly  
(BACS13AP Sleeves)  
Figure 822/20-10-51-990-911**

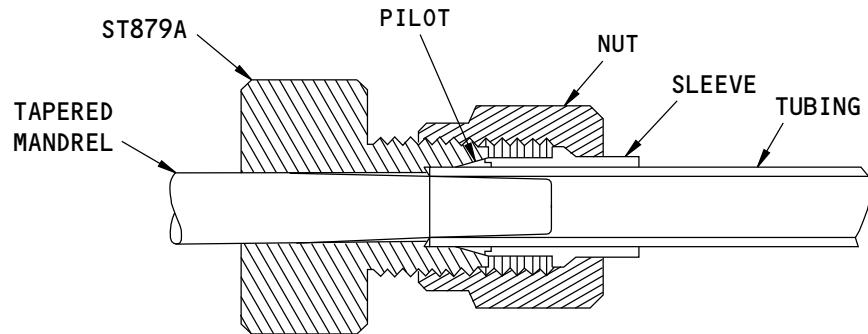
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AKS ALL

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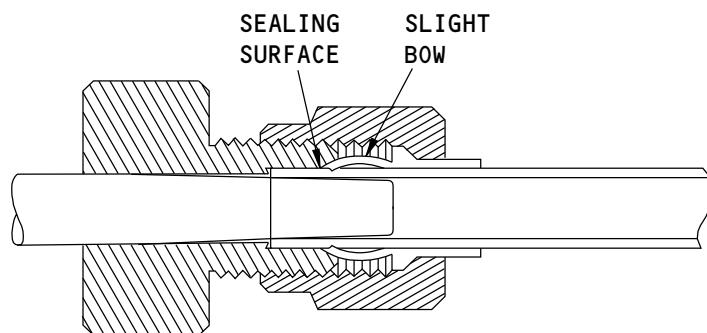
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BEFORE PRESET BY HAND



AFTER PRESET BY HAND

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Preset by Hand with Preset Tool ST879A  
Figure 823/20-10-51-990-912

EFFECTIVITY  
AKS ALL

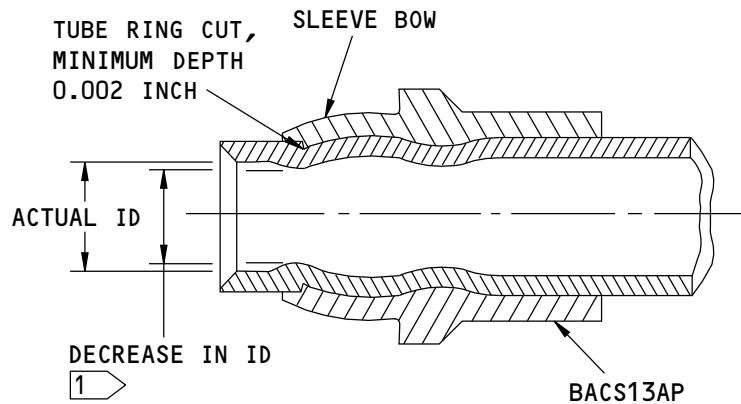
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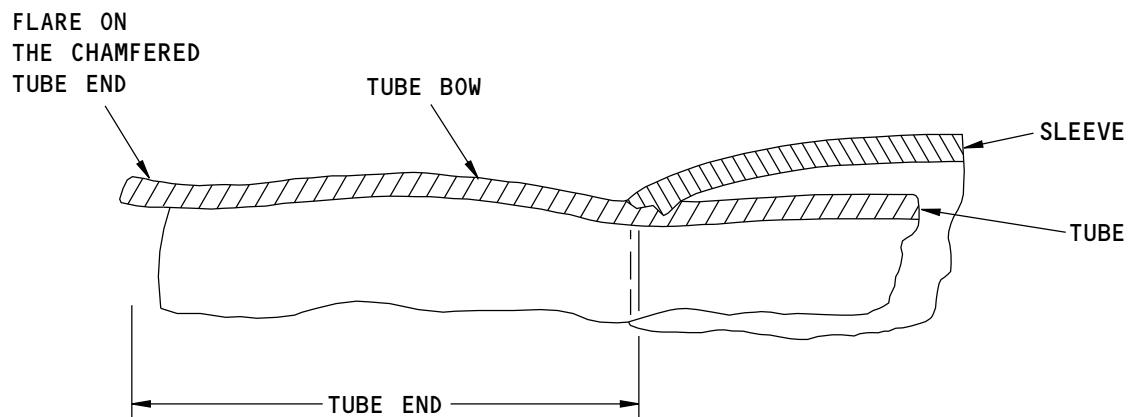
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ASSEMBLED AND PRESET SLEEVE



TUBE END DEFORMATION

1 MAKE SURE THE ID DOES NOT DECREASE MORE THAN 0.005 INCH AFTER PRESSET OR 0.015 INCH AFTER YOU TIGHTEN MANY TIMES.

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Properties of Preset BACS13AP Flareless Sleeve/Tube End  
Figure 824/20-10-51-990-913



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TASK 20-10-51-400-806

10. BACC42W H-Coupling Installation

A. General

**WARNING:** DO NOT USE BACC42W H-COUPINGS ON ANY OXYGEN LINES OR ON FLUID LINES IN THE FIRE ZONES OF THE ENGINES OR APU'S. DAMAGE TO EQUIPMENT OR INJURY TO PERSONS CAN OCCUR.

- (1) The BACC42W H-coupling has a union, coupling, slide, and nut. You can use the H-coupling on fuel and hydraulic high pressure (3000 psi (20,684 kPa)) lines of Ti-3AL-2.5V, CRES 21-6-9, and CRES 304 1/8 hard tubing. This repair is also approved for line repair of CRES 304 annealed and 6061-T6 aluminum lines in 3000 psi (20,684 kPa) or lower pressure applications. You can use this repair on tubing that is installed and in use.
- (2) You can repair defects that have a maximum width of 0.375 in. (9.525 mm). You must make splices on larger defects. The minimum workable splice section with two H-couplings and a length of tube is 4.5 in. (114.3 mm) (Figure 809).

B. References

Reference	Title
20-30-80-910-801	General Cleaning of Metal (Series 80) (P/B 201)
29-09-00-860-802	Hydraulic Reservoirs Depressurization (P/B 201)

C. Tools/Equipment

Reference	Description
STD-203	Container - Oil Resistant, 1 U.S.-Gal (3.8 l)
STD-1357	Assembly - Tube Coupling

D. Consumable Materials

Reference	Description	Specification
B01000	Solvent - General Cleaning Of Metal (AMM 20-30-80)	

E. Procedure

**CAUTION:** DO NOT TIGHTEN THE COUPLING ASSEMBLY BY HAND AFTER YOU REMOVE IT FROM THE SHIPPING CONTAINER OR BEFORE YOU INSTALL IT ON THE TUBE. THE COUPLING ASSEMBLY HAS NO MORE THAN ONE THREAD ENGAGED. YOU CAN COMPRESS THE UNION AND MAKE THE COUPLING ASSEMBLY DIFFICULT TO PUT IN POSITION.

SUBTASK 20-10-51-860-006

- (1) Remove pressure from the system where you will do repairs, do this task: Hydraulic Reservoirs Depressurization, TASK 29-09-00-860-802.
  - (a) Allow the hydraulic fluid to drain into a suitable container (example, 1 U.S.-gal (3.81 l) oil resistant container, STD-203).

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SUBTASK 20-10-51-110-012

**WARNING:** DO NOT GET SOLVENTS IN YOUR MOUTH, OR YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE HAZARDOUS MATERIALS. SOLVENTS MAY BE FLAMMABLE OR HARMFUL TO THE ENVIRONMENT. REFER TO PRODUCT MATERIAL SAFETY DATA SHEETS (MSDS) AND LOCAL REQUIREMENTS FOR PROPER HANDLING PROCEDURES.

- (2) Use Series 80 solvent, B01000 (TASK 20-30-80-910-801) to clean the tube in the area where you will install the H-coupling tube coupling assembly, STD-1357.

**NOTE:** The number after the W in the part number gives the size of the coupling in sixteenths. For example, BACC42W56 fits 3/8-inch tube size. The BACC42W is superseded by BACC42W-T which is used on Ti-3AL-2.5V and all other hydraulic tubing. You can use BACC42W on all hydraulic tubes except Ti-3AL-2.5V.

SUBTASK 20-10-51-350-013

- (3) Cut the tube.

SUBTASK 20-10-51-110-013

- (4) Chamfer and remove the burrs from the inside diameter and outside diameter edges..

SUBTASK 20-10-51-110-014

**WARNING:** DO NOT GET SOLVENTS IN YOUR MOUTH, OR YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE HAZARDOUS MATERIALS. SOLVENTS MAY BE FLAMMABLE OR HARMFUL TO THE ENVIRONMENT. REFER TO PRODUCT MATERIAL SAFETY DATA SHEETS (MSDS) AND LOCAL REQUIREMENTS FOR PROPER HANDLING PROCEDURES.

- (5) Clean the edges with Series 80 solvent, B01000 (TASK 20-30-80-910-801).

SUBTASK 20-10-51-940-024

- (6) Install tape on the nut side of the clearance with a minimum of 0.56 in. (14.22 mm) from the tube end and a maximum of 0.675 in. (17.145 mm) from the center of the clearance (Figure 825).

SUBTASK 20-10-51-940-025

- (7) Use the same measurements to make a mark (index line) on the coupling side of the tube.

SUBTASK 20-10-51-940-026

- (8) Find and make a mark (marking dots) on the nut and coupling side of the tube (Figure 825).

**NOTE:** These marks will be used for the last inspection check (dimension "C").

SUBTASK 20-10-51-420-027

- (9) Install the tube coupling assembly, STD-1357 over the coupling side of the tube.

SUBTASK 20-10-51-210-023

- (10) Make sure the large radius and the large diameter end of the sleeve are toward the center of the union.

SUBTASK 20-10-51-420-028

- (11) Install the nut and sleeve over the tape on the nut side of the tube.

SUBTASK 20-10-51-210-024

- (12) Make sure the sleeve large bore is toward the clearance.

SUBTASK 20-10-51-820-012

- (13) Align the tubes and move the union until it touches the tape on the nut side on the tube.

EFFECTIVITY  
AKS ALL

20-10-51



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SUBTASK 20-10-51-210-025

- (14) Make sure the union meets or cover the index line on the coupling side of the tube.

SUBTASK 20-10-51-940-027

- (15) Install tape on the coupling side of the tube, with the tape edge even with the end of the union.

SUBTASK 20-10-51-420-029

- (16) Push the sleeve and coupling body on the ends of the union.

NOTE: Make sure the tape does not move and the coupling body does not turn.

SUBTASK 20-10-51-420-030

- (17) Engage the threads of the nut with the coupling body and tighten the nut handtight.

SUBTASK 20-10-51-420-031

- (18) Hold the coupling body with a wrench and tighten the coupling assembly nut to the stop.

SUBTASK 20-10-51-210-026

- (19) Examine the completed repair to make sure you can see the two marking dots (Figure 825).

NOTE: If you cannot see the two dots, this shows that the sleeve and coupling are not fully seated against the center land of the union.

SUBTASK 20-10-51-210-027

- (20) Make sure dimension "C" did not increase.

SUBTASK 20-10-51-200-003

- (21) Do an inspection as follows:

- (a) Remove the nut.
- (b) Make sure the slide and coupling are no more than 0.015 in. (0.38 mm) from the union shoulder.
- (c) Make sure the union touches the tape.
- (d) If the clearance between the slide or coupling and the union is more than 0.015 in. (0.38 mm), install the nut and tighten it until you get the necessary clearance (Figure 825).
- (e) Install the nut again and tighten the nut. See BACC42W Standard.
  - 1) If the union does not touch the tape, remove the coupling and a sufficient tube length.
    - a) Install a new repair section.

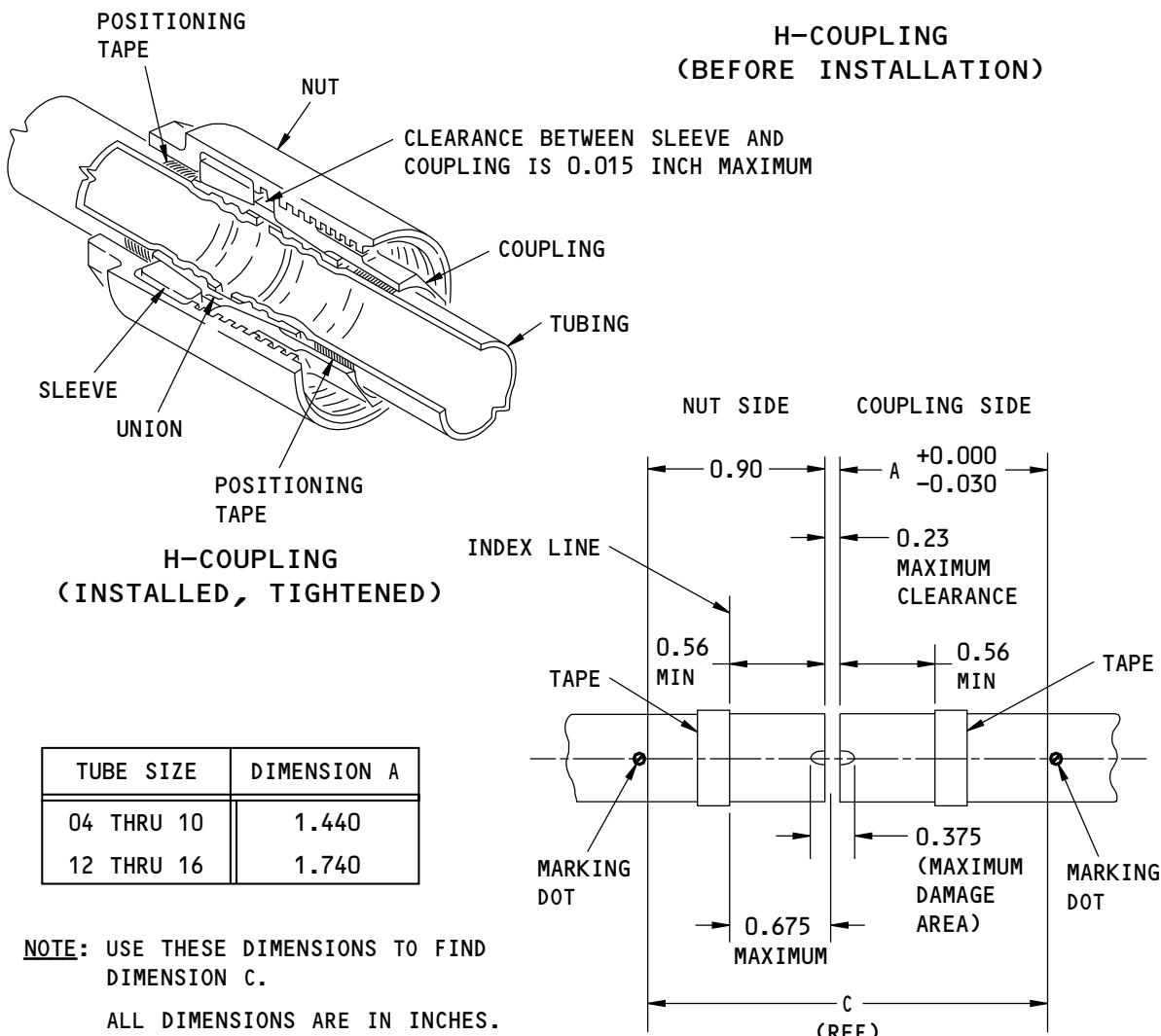
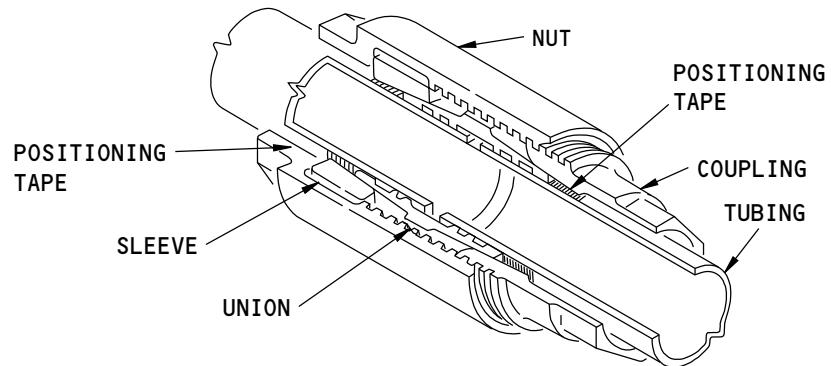
———— END OF TASK ————

EFFECTIVITY
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**H-Coupling Installation**  
**Figure 825/20-10-51-990-919**

EFFECTIVITY  
AKS ALL

**20-10-51**



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**TASK 20-10-51-400-807**

**11. 3P02111/3PHS111 Cryofit Coupling Installation**

(Figure 826)

**A. General**

**WARNING:** DO NOT USE CRYOFIT COUPLINGS ON ANY OXYGEN LINES OR ON FLUID LINES INSIDE THE FIRE ZONES OF ENGINES OR APU'S. DAMAGE TO EQUIPMENT OR INJURY TO PERSONS CAN OCCUR.

**WARNING:** USE EXTREME CAUTION WHEN USING LIQUID NITROGEN. THE TEMPERATURE OF LIQUID NITROGEN IS 320 DEGREES BELOW ZERO (-195.5°C). PROVIDE PROPER VENTILATION AS LIQUID NITROGEN VAPORS CAN DISPLACE OXYGEN IN CONFINED AREAS. USE SAFETY GLASSES AND A FACE SHIELD WHEN USING LIQUID NITROGEN. MISUSE OF LIQUID NITROGEN CAN CAUSE INJURY TO PERSONS.

**WARNING:** SLOWLY AND CAREFULLY SUBMERGE WARM ITEMS IN LIQUID NITROGEN TO PREVENT RAPID BOILING OFF AND SPLASHING. MISUSE OF LIQUID NITROGEN CAN CAUSE INJURY TO PERSONS.

- (1) The Cryofit coupling is a fitting which you can use to repair Ti-3AL-2.5V tubing as shown in (Figure 806, Table 807, Table 808, Table 809, and Table 810). To install the fitting in a straight section, shrink fit it in its position.

**B. References**

Reference	Title
20-30-80-910-801	General Cleaning of Metal (Series 80) (P/B 201)
29-09-00-860-802	Hydraulic Reservoirs Depressurization (P/B 201)

**C. Tools/Equipment**

**NOTE:** When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-1355	Gloves - Insulated Part #: OE-GLOVE Supplier: 30974 Opt Part #: EO-GLOVE-LINER- (S-M-L) Supplier: 30974
COM-1356	Work Box - Insulated Part #: WB910825-01 Supplier: 30974
STD-203	Container - Oil Resistant, 1 U.S.-Gal (3.8 l)
STD-1354	Tongs
STD-4058	Kit - Cryofit Repair, Model FRK3P02111-001

**D. Consumable Materials**

Reference	Description	Specification
B01000	Solvent - General Cleaning Of Metal (AMM 20-30-80)	
G00262	Nitrogen - Liquid	A-A-59503 Type II, MIL-PRF-27401 Type II
G00270	Tape - Scotch Flatback Masking 250	ASTM D6123 (Supersedes A-A-883)

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E. Procedure

SUBTASK 20-10-51-860-007

- (1) Remove pressure from the system where you will do repairs, do this task: Hydraulic Reservoirs Depressurization, TASK 29-09-00-860-802.
  - (a) Allow the hydraulic fluid to drain into a suitable container (example, 1 U.S.-gal (3.81 l) oil resistant container, STD-203).

SUBTASK 20-10-51-110-015

**WARNING:** DO NOT GET SOLVENTS IN YOUR MOUTH, OR YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE HAZARDOUS MATERIALS. SOLVENTS MAY BE FLAMMABLE OR HARMFUL TO THE ENVIRONMENT. REFER TO PRODUCT MATERIAL SAFETY DATA SHEETS (MSDS) AND LOCAL REQUIREMENTS FOR PROPER HANDLING PROCEDURES.

- (2) Use Series 80 solvent, B01000 (TASK 20-30-80-910-801) to clean the tube in the area where you will install the Cryofit coupling cryofit repair kit, STD-4058.

SUBTASK 20-10-51-420-032

- (3) Use Scotch Flatback Masking Tape 250, G00270 to make a mark on the tube to make sure you put the Cryofit coupling over the center of the tube repair.

SUBTASK 20-10-51-320-002

- (4) Cut the tube.

SUBTASK 20-10-51-350-014

- (5) Chamfer and remove burrs from the inside diameter and outside diameter edges.

SUBTASK 20-10-51-110-016

- (6) Clean the edges with Series 80 solvent, B01000 (TASK 20-30-80-910-801).

SUBTASK 20-10-51-110-017

- (7) Apply a thin layer (one to two drops) of Loctite 290 around the tube circumference in the area under the serrations.

NOTE: Be careful not to let the Loctite into the tube.

SUBTASK 20-10-51-500-001

- (8) Put on insulated gloves, COM-1355.

SUBTASK 20-10-51-110-018

**WARNING:** USE EXTREME CAUTION WHEN USING LIQUID NITROGEN. THE TEMPERATURE OF LIQUID NITROGEN IS 320 DEGREES BELOW ZERO (-195.55°C). PROVIDE PROPER VENTILATION AS LIQUID NITROGEN VAPORS CAN DISPLACE OXYGEN IN CONFINED AREAS. USE SAFETY GLASSES AND A FACE SHIELD WHEN USING LIQUID NITROGEN. MISUSE OF LIQUID NITROGEN CAN CAUSE INJURY TO PERSONS.

- (9) Put nitrogen, G00262 into a small, insulated work box, COM-1356.

SUBTASK 20-10-51-110-019

**WARNING:** SLOWLY AND CAREFULLY SUBMERGE WARM ITEMS IN LIQUID NITROGEN TO PREVENT RAPID BOILING OFF AND SPLASHING. MISUSE OF LIQUID NITROGEN CAN CAUSE INJURY TO PERSONS.

- (10) Remove the Cryofit coupling from the main storage container and put it into the small container of liquid nitrogen.
  - (a) Make sure the fitting is fully covered by nitrogen, G00262.

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SUBTASK 20-10-51-940-028

- (11) Move the Cryofit coupling in the nitrogen, G00262 (-320° F) (-195.55°C) to the repair location.

SUBTASK 20-10-51-420-033

- (12) Slip the coupling (from the installation kit) over the ends to ensure that the tubes are round and free of burrs. The test coupling should slide freely.

SUBTASK 20-10-51-480-004

- (13) Position the test coupling so that both tubes are visible in the coupling window.
- (a) For 3PO2111 couplings, make sure that a gap of less than 0.120 in. (3.048 mm) exists between the tube ends.
  - (b) For 3PHS111 couplings, make sure that the gap is less than 0.300 in. (7.620 mm).

SUBTASK 20-10-51-080-002

- (14) Remove the test coupling and place the marking gauge over one of the tube ends.
- (a) Using a marking pen, color in the rectangular slot in the gauge to provide an installation mark on the tube.
  - (b) Follow the same procedure to mark the remaining tube end.

SUBTASK 20-10-51-480-005

- (15) Place an installation stop ("O" ring) or SNAP-ON coupling in the middle of the mark on one of the tube ends.

SUBTASK 20-10-51-480-006

- (16) Check the location by positioning the test coupling so that it is butted against the stop.
- (a) Make sure that both tube ends are visible in the window and the test coupling covers approximately half of the installation mark on each tube.

SUBTASK 20-10-51-820-013

- (17) Adjust the tubes and installation stop as necessary.
- (18) Remove the test coupling.

SUBTASK 20-10-51-420-034

- (19) Make sure that the tube ends within half the coupling length of the end are free of scratches.

SUBTASK 20-10-51-840-005

- (20) If a fitting must be installed over a tube end containing a scratch, apply a thin layer (one to two drops) of Loctite 290 around the tube circumference in the area under the serration.

NOTE: Loctite is not required for tube ends without scratches.

- (a) Make sure you do not let the Loctite into the tube.

SUBTASK 20-10-51-840-006

- (21) For a 3PO2111, remove a Cryofit coupling from the liquid nitrogen and immediately place it into a pre-chilled, extended time tool.

- (22) Close the tool and immediately return the coupling/tool to the liquid nitrogen.

NOTE: This step is omitted for 3PHS111 couplings since they are preassembled in the tool and furnished in Lexan Plastic Packaging from the manufacturer.

SUBTASK 20-10-51-840-007

- (23) Place the cooled tube chiller over the tubes to be joined.

NOTE: This step may be omitted. However, placing Cryofit coupling in contact with a tube which has not been pre-chilled with Liquid nitrogen may initiate premature warming and shrinkage of the coupling.

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- (a) Remove the chiller after 20 to 30 seconds.

SUBTASK 20-10-51-420-035

- (24) Install the coupling and following the steps below in rapid sequence:
- (a) Remove the chiller.
  - (b) Using the cooled tongs, STD-1354, remove the Cryofit installation package from the Liquid nitrogen and grasp the package between thumb and forefinger.
  - (c) Deflect the tube without the installation stop to allow the coupling to be slipped over the tube end.
  - (d) Slip the coupling on the tube, realign the tubes and slide the coupling against the installation stop.
  - (e) Make sure that the Cryofit coupling is against the installation stop and that the fitting is in correct position relative to the installation marks.
  - (f) Allow the coupling to warm and shrink on to the tube. Remove the Cryofit installation package and the installation stop.

SUBTASK 20-10-51-200-004

- (25) Verify that both ends of the coupling lie within the installation marks on both tubes.
- (a) If one or both ends of the fitting do not cover a portion of the installation mark, replace the fitting installation.

NOTE: This is because the installation is incorrect.

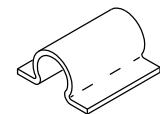
———— END OF TASK ————

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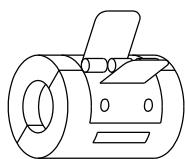
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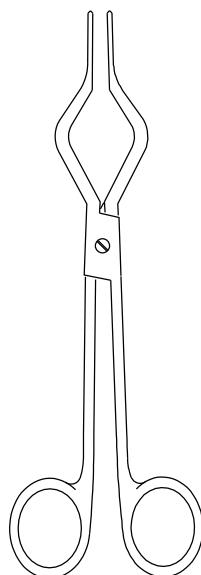
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SNAP-ON  
INSTALLATION STOP



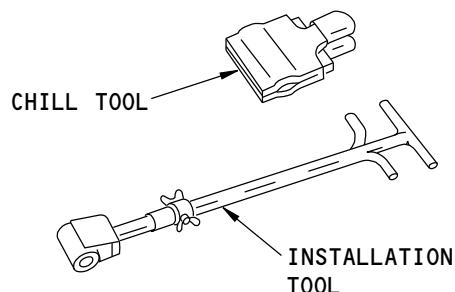
EXTENDED TIME TOOL



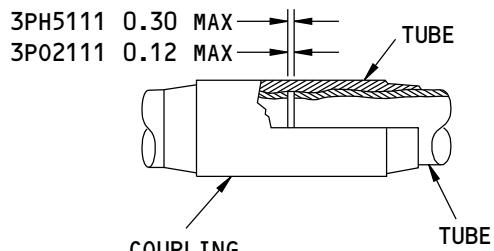
TONGS



O-RINGS INSTALLATION STOP



CHILL TOOL  
INSTALLATION  
TOOL



CRYOFIT COUPLING INSTALLATION

NOTE: CRYOFIT KITS INCLUDE ADDITIONAL ITEMS.

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Cryofit Coupling 3P02111 and 3PH5111 Repair  
Figure 826/20-10-51-990-914 (Sheet 1 of 2)

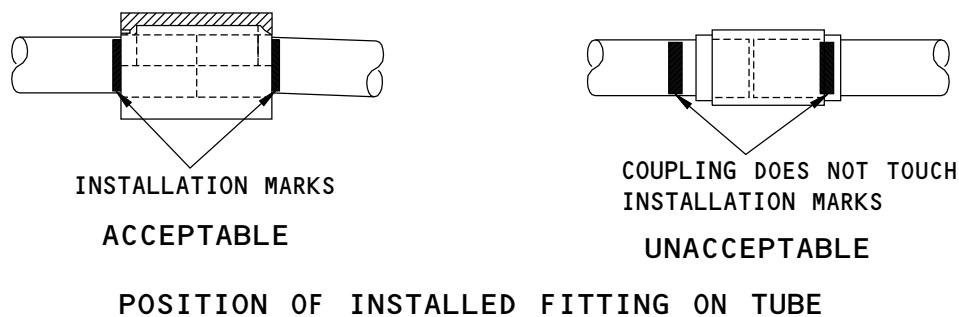
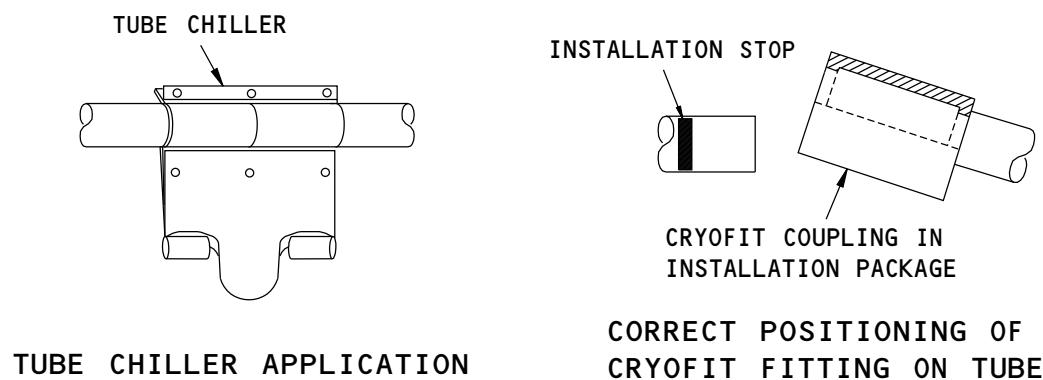
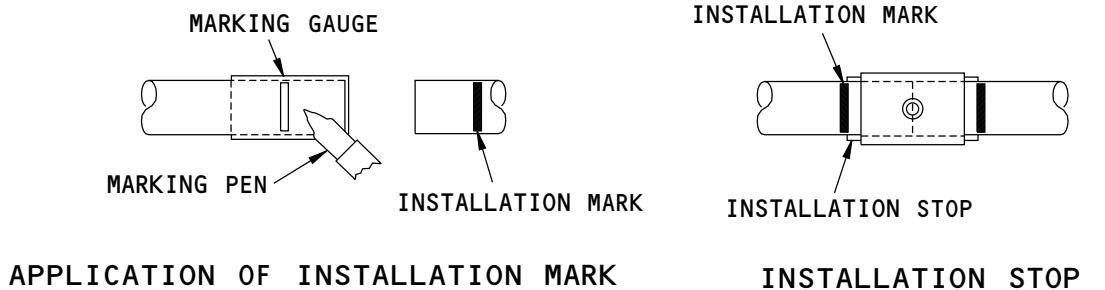
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NOTE: CRYOFIT KITS INCLUDE ADDITIONAL ITEMS.

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Cryofit Coupling 3P02111 and 3PH5111 Repair  
 Figure 826/20-10-51-990-914 (Sheet 2 of 2)

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**TASK 20-10-51-400-808**

**12. Externally Swaged (Permaswage) Fittings Installation**

**A. General**

- (1) To do the externally swaged fitting (Permaswage) repair procedure, use the DLT series swaging tool and one the following parts:

- (a) BACU24BS or D10282 in-line tube unions (sizes 04, 06, 08, 10, 12, 16 and 20).  
(b) BACA14BP or D10203 in-line tube unions (sizes 04, 06, 08, 10, 12, 16 and 20).

NOTE: BACA14BP or D10203 has both an swaged end and a flareless fitting end, to install the flareless fitting end, use this procedure: Flareless Fittings in Pressurized Areas Installation, TASK 20-10-51-000-802

NOTE: The use of permaswage fitting to repair potable water line tubes is not recommended because of possible microbe growth in the cavity of the fitting.

- (2) You can use CRES externally swaged (Permaswage) fittings, as shown in Figure 806, Table 807, Table 808, Table 809, and Table 810, with 304-1/8 hard CRES tube to repair Ti-3AL-2.5V and 21-6-9 CRES. Repair 6061T6 aluminum tubing with aluminum fittings with D suffix in the basic part number.

- (3) When you do a repair, remove the part of the tube with the defect. Put in a tube splice and install the splice with two fittings. Fittings and tubing material sizes are shown in Figure 827

- (4) The splice must be shorter than the removed tube section. At a maximum length, make the splice shorter than the tube section by four times the growth value shown in Figure 829 (four fittings). This permits an increase in length as a result of swaging. As a minimum length, make the splice longer than 0.300 in. (7.62 mm) less than the cut-out. This permits tube gaps (not more than 0.150 in. (3.81 mm) as shown in Figure 828 .

NOTE: Include the length growth caused by swaging when you work with short tube sections with small flexibility. Short tube sections or tube repairs between rigidly installed fittings can buckle.

- (5) DMC Permaswage Lightweight series (DLT Series) - Tool numbers are listed in Table 824. You can get tool kits in different size combinations. Contact DMC for tool kit part numbers. Make sure that the DLT Series tooling has been inspected to the following DMC Tooling Control Documents:

NOTE: One pump is required to actuate the power units, as shown in Table 824 (Designed Metal Connections, P.O. Box 61188, 14800 S Figueroa St, Los Angeles, CA 90061).

- (a) MCP-016 - Inspection Criteria of DMC, DLT Series, Swage Head Assembly - Standard Permaswage, 3,000 psi (20684.3 kPa) Application.  
(b) SOPG-01-05 - Instructional Manual for 3,000 psi Systems  
(c) DMC-1320 - DLT - Tools Prevention Maintenance

**Table 824/20-10-51-993-919 Swage and Inspection Tool Part Numbers**

TUBE SIZE	SWAGE TOOL ASSEMBLY	SWAGE HEAD ASSEMBLY	POWER UNIT <sup>[1]</sup>	INSPECTION GAGE
04	DLT05PSKT3000	DLT05PSHA3004	DLT05MAPW0000	D12-9892-04
06	DLT10PSKT3000	DLT10PSHA3006	DLT10MAPW0000	D-12-9892-06
08	DLT20PSKT3000	DLT20PSHA3008	DLT20MAPW0000	D12-9892-08
10	DLT20PSKT3000	DLT20PSHA3010	DLT20MAPW0000	D1209892-10

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**Table 824/20-10-51-993-919 Swage and Inspection Tool Part Numbers (Continued)**

12	DLT30PSKT3000	DLT30PSHA3012	DLT30MAPW0000	D1209892-12
16	DLT40PSKT3302	DLT40PSHA4016	DLT40MAPW0000	DNR9892-016
20	DLT40PSKT3003	DLT40PSHA3020	DLT40MAPW0000	D12-9892-20

\*[1] One of the following pumps is necessary to actuate the power units: DLT02MAPP1000 pneumatic pump 10,000 psi; DLT05MAPM1000 manual pump 10,000 psi.

**B. References**

Reference	Title
20-10-51-000-802	Flareless Fittings in Pressurized Areas Installation (P/B 401)
20-10-51-760-801	Electrical Resistance Specifications in the Fuel Tank Check (P/B 401)
29-09-00-860-802	Hydraulic Reservoirs Depressurization (P/B 201)

**C. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
SPL-541	Kit - Tube Repair, 3000 PSI Part #: DLTFRPSKT3300 Supplier: 14798
STD-203	Container - Oil Resistant, 1 U.S.-Gal (3.8 l)

**D. Consumable Materials**

Reference	Description	Specification
B00138	Abrasive - Silicon Carbide Coated Cloth	
C00064	Coating - Aluminum Chemical Conversion	BAC5719 Type II Class A (MIL-DTL-5541 Class 1A)
C00259	Coating - Chemical And Solvent Resistant Finish, Corrosion Inhibiting Primer	BMS10-11 Type I

**E. Prepare Tube for Installation**

**SUBTASK 20-10-51-040-005**

- (1) Remove pressure from the system where you will do repairs, do this task: Hydraulic Reservoirs Depressurization, TASK 29-09-00-860-802.

- (a) Allow the hydraulic fluid to drain into a suitable container (example, 1 U.S.-gal (3.8 l) oil resistant container, STD-203).

**SUBTASK 20-10-51-940-029**

**WARNING: DO NOT USE PERMASWAGE FITTINGS ON ANY OXYGEN LINES OR ON FLUID LINES INSIDE THE FIRE ZONES OF ENGINES OR APU'S. DAMAGE TO EQUIPMENT OR INJURY TO PERSONS CAN OCCUR.**

**WARNING: DO NOT USE PERMASWAGE FITTINGS TO REPAIR THESE COMPONENTS. IF YOU USE PERMASWAGE FITTINGS FOR THESE COMPONENTS, INJURIES TO PERSONNEL, AND DAMAGE TO EQUIPMENT CAN OCCUR.**

- (2) Boeing does not approve Permaswage fittings for these applications:

- (a) For the repair of tubing in the fuel system (such as fuel pressure sensing lines)

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- (b) On pneumatic ducts
- (c) Potable water lines or waste water drain lines
- (d) The repair of electrical conduits

SUBTASK 20-10-51-940-035

- (3) Use the tools, tube repair kit, SPL-541, shown in (Table 824).

SUBTASK 20-10-51-940-030

- (4) Cut out the damaged section of the tube:

- (a) Make sure the section you cut out of the tube is a straight section with a minimum straight length as shown in Figure 827.

NOTE: Make sure the fitting and swage tool will fit.

- (b) Use one Permaswage fitting for the repair if the damaged section is no more than 0.150 in. (3.81 mm) long.

NOTE: In this case, the cut can be through the center of the damaged section.

- (c) If the damage is too near to a bend (less than 0.500 in. (12.7 mm)) or longer than 0.150 in. (3.81 mm), use a tube splice and two fittings to make the repair (Figure 827).

SUBTASK 20-10-51-940-031

- (5) For tube cutouts with a bend, use the cutout tube section as a template to mark and cut the new tube segment.

NOTE: The maximum gap between the tube ends is approximately 0.150 in. (3.81 mm) for the union installation.

SUBTASK 20-10-51-110-020

- (6) Clean the tube in the swage area:

- (a) Use an applicable solvent (for example, ethyl alcohol) to clean the not painted tube sections that you will repair.

- (b) Make sure the sections are free of dirt, grease, and other unwanted material for a distance equal to the values shown in Figure 827.

- (c) Remove paint and anodize from the tubes in an area equal to the values shown in Figure 827.

- 1) Use the methods shown in Table 825.

**Table 825/20-10-51-993-920 Cleaning and Paint Removal Procedures for Aluminum Tubes**

MATERIAL SURFACE	PROCEDURE TO CLEAN TUBE
Bare or Alodine	Solvent clean
Anodize	Hand apply abrasive material, 180-grit or finer: - Fed Spec P-P-121 - Fed Speck P-C-451 - Abrasive Scotch Brite, Type A
Primer/Paint	1. Hand apply abrasive material, 240-grit or finer 2. Lacquer thinner (refer to TT-T-266)(flammable) MEK (refer to TT-T-261)(flammable) for primed surfaces (MIL-P-6889) and lacquer base paint/enamel

- (d) Make sure the cleaned surfaces are smooth, uniform, bright, and free of unwanted materials.
  - (e) Use a brush to apply coating, C00064 to the open surfaces of aluminum tubes.

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SUBTASK 20-10-51-940-032

- (7) Remove the burrs from the tube ends:

- (a) To remove burrs from the inner bore of the tube ends, use DMC plug-type deburring tools or equivalent.
  - 1) Refer to Figure 807 for the correct deburring procedure.
  - 2) Remove burrs from the tube inner diameter each time you cut the tube.
  - 3) Make sure that the shavings do not get into the system.
  - 4) Do not release the spring pressure of the deburring tool while you pull the tool from the tube.
- (b) If it is necessary to remove burrs from the tube outer diameter, use abrasive, B00138 to remove particles.

NOTE: It is not usually necessary to remove burrs from the tube outer diameter.

SUBTASK 20-10-51-940-033

- (8) Use one of these steps to apply witness marks:

- (a) Use a felt pen or equivalent to apply witness marks as shown in Figure 829.
  - 1) Use DMC tools D12580-1, -2, -3, or equivalent.
- (b) Make marks directly on the tube to show the minimum insertion depths as shown in Figure 829.
- (c) Swage fittings to the marks.

SUBTASK 20-10-51-370-004

- (9) Apply paint to bare areas.

- (a) For example, apply paint to tool marks and areas where you removed paint (fittings and painted tubes).

SUBTASK 20-10-51-370-005

- (10) Apply coating, C00064 to open areas of aluminum and primer, C00259 to all other tubes and fittings.

## F. Procedure

SUBTASK 20-10-51-860-008

- (1) Remove pressure from the system where you will do repairs, do this task: Hydraulic Reservoirs Depressurization, TASK 29-09-00-860-802.
- (a) Allow the hydraulic fluid to drain into a suitable container (example, 1 U.S.-gal (3.81 l) oil resistant container, STD-203).

SUBTASK 20-10-51-940-034

- (2) Use a union and a tube.

- (a) For BACU24BS or D10282 reference Table 826

**Table 826/20-10-51-993-921 Fitting/Tube Material Combinations for Repair with Permaswage Unions**

DMC PART NO.* <sup>[1]</sup>	FITTING MATERIAL	FOR USE WITH TUBE MATERIAL	APPROVED TUBE SIZES OD/WALL						
			04	06	08	10	12	16	20
D10282-(*) <sup>[2]</sup>	21-6-9 CRES	21-6-9 CRES	0.016	0.020	0.026	0.033	0.039	0.052	--

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**Table 826/20-10-51-993-921 Fitting/Tube Material Combinations for Repair with Permaswage Unions  
(Continued)**

D10282-() <sup>[2]</sup>	21-6-9 CRES	3AL-2.5V Ti	0.016	0.019	0.026	0.032	0.039	0.051	0.070
D10282-() <sup>[2]</sup>	21-6-9 CRES	304-1/8 HARD CRES (MIL-T-6845)	0.020	0.028	0.035	0.049	0.058	0.065	--
D10282D() <sup>[2]</sup>	6061T6 AL (MIL-T-7081)	6061T6 AL (MIL-T-7081)	0.035	0.035	0.035	0.035	0.035	0.035	0.049
BACU24BS (SIZE)(SIZE)J <sup>[2]</sup>	21-6-9	21-6-9 CRES	0.016	0.020	0.026	0.033	0.039	0.052	--
BACU24BS (SIZE)(SIZE)J <sup>[2]</sup>	21-6-9	3AL-2.5V Ti	0.016	0.019	0.026	0.032	0.039	0.051	0.070
BACU24BS (SIZE)(SIZE)J <sup>[2]</sup>	21-6-9	304-1/8 HARD CRES (MIL-T-6845)	0.020	0.028	0.035	0.049	0.058	0.065	--
BACU24BS (SIZE)(SIZE)D <sup>[2]</sup>	6061T AL	6061T6 AL (MIL-T-7081)	0.035	0.035	0.035	0.035	0.035	0.035	0.049

\*[1] Material code "J" with the Boeing part number or no material code (-) with the DMC part number indicates 21-6-9 CRES fitting with two internal grooves on each end, one each filled with silicone. Material code "D" on either the Boeing or DMC part number indicates 6061T Aluminum fitting with two internal grooves on each end, all filled with silicone. Aluminum unions without all grooves filled with the silicone sealant are not approved for Boeing airplanes.

\*[2] A Boeing standard for an externally swaged union (BACU24BS (SIZE)(SIZE) Material) based on the DMC Permaswage D10282 Union has been developed by Boeing for use on the 777 airplane. The BACU24BS (SIZE)(SIZE) J union (both sizes the same) and the D10282-(SIZE) union are interchangeable. In addition, the BACU24BS (SIZE)(SIZE) D union (both sizes the same) and D10282D (SIZE) D union are interchangeable. The Corrosion Resistant Steel (CRES) D10282-(SIZE) and Aluminum D10282D(SIZE) Permaswage unions are improved replacements for the standard CRES D10036D (SIZE) and Aluminum D10036D (SIZE) unions, respectively. The D10036 unions are functionally interchangeable with the D10282 unions. BACU24BS (SIZE)(SIZE) J - (both sizes the same), BACU24BS (SIZE)(SIZE) D - (both sizes the same), D10282-(SIZE) and D10282D (SIZE) union are not shown in DMC catalogs, but you can make an order directly to Designed Metal Connections, 14800 South Figueroa St., Los Angeles, CA 90248.

(b) For BACA14BP or D10203 reference Table 827

**Table 827/20-10-51-993-936 BACA14BP(D10203) Fitting/Tube Material Combinations for Repair with Permaswage Unions**

DMC PART NO. <sup>[1]</sup>	FITTING MATERIAL	FOR USE WITH TUBE MATERIAL	APPROVED TUBE SIZES OD/WALL						
			04	06	08	10	12	16	20
D10203-() <sup>[2]</sup>	21-6-9 CRES	21-6-9 CRES	0.016	0.020	0.026	0.033	0.039	0.052	--
D10203-() <sup>[2]</sup>	21-6-9 CRES	3AL-2.5V Ti	0.016	0.019	0.026	0.032	0.039	0.051	0.070

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**Table 827/20-10-51-993-936 BACA14BP(D10203) Fitting/Tube Material Combinations for Repair with Permaswage Unions (Continued)**

D10203-(-) <sup>[2]</sup>	21-6-9 CRES	304-1/8 HARD CRES (MIL-T-6845)	0.020	0.028	0.035	0.049	0.058	0.065	--
D10203D() <sup>[2]</sup>	6061T6 AL (MIL-T-7081)	6061T6 AL (MIL-T-7081)	0.035	0.035	0.035	0.035	0.035	0.035	0.049
BACA14BP (SIZE)(SIZE)J <sup>[2]</sup>	21-6-9	21-6-9 CRES	0.016	0.020	0.026	0.033	0.039	0.052	--
BACA14BP (SIZE)(SIZE)J <sup>[2]</sup>	21-6-9	3AL-2.5V Ti	0.016	0.019	0.026	0.032	0.039	0.051	0.070
BACA14BP (SIZE)(SIZE)J <sup>[2]</sup>	21-6-9	304-1/8 HARD CRES (MIL-T-6845)	0.020	0.028	0.035	0.049	0.058	0.065	--
BACA14BP (SIZE)(SIZE)D <sup>[2]</sup>	6061T AL	6061T6 AL (MIL-T-7081)	0.035	0.035	0.035	0.035	0.035	0.035	0.049

\*[1] Material code "J" with the Boeing part number or no material code (-) with the DMC part number indicates 21-6-9 CRES fitting with two internal grooves on each end, one each filled with silicone. Material code "D" on either the Boeing or DMC part number indicates 6061T Aluminum fitting with two internal grooves on each end, all filled with silicone. Aluminum unions without all grooves filled with the silicone sealant are not approved for Boeing airplanes.

\*[2] A Boeing standard for an externally swaged union (BACA14BP (SIZE)(SIZE) Material) based on the DMC Permaswage D10203 Union has been developed by Boeing for use on the 777 airplane. The BACA14BP (SIZE)(SIZE) J union (both sizes the same) and the D10203-(SIZE) union are interchangeable. In addition, the BACA14BP (SIZE)(SIZE) D union (both sizes the same) and D10203D (SIZE) D union are interchangeable.

**NOTE:** Keep the Permaswage fittings in their container until you are ready to install them.

**SUBTASK 20-10-51-350-015**

- (3) Make sure the tube is sufficiently long to do the repair (Figure 827).

**SUBTASK 20-10-51-110-021**

- (4) Clean the tube as shown in Table 825.  
 (5) Cut the tube.  
 (a) If you do not join the tube immediately, seal the tube ends with a cap.

**SUBTASK 20-10-51-210-028**

- (6) Examine the unions for silicone seals (Table 826).

**SUBTASK 20-10-51-420-036**

- (7) Move the union over the tube ends.  
 (a) Center the union on the witness marks or put it in position at the correct insertion depth.

**SUBTASK 20-10-51-350-016**

**WARNING:** MAKE SURE YOU MAKE NO PUMP ADJUSTMENT THAT CAN CAUSE THE SWAGE TOOL HYDRAULIC PRESSURE TO BE MORE THAN THE MANUFACTURERS RECOMMENDATIONS. DLT SERIES TOOLS ARE  $10,000 \pm 250$  PSI ( $68,948 \pm 1724$  KPA) MAXIMUM. IF PRESSURE IS GREATER THAN ABOVE MAXIMUM/MINIMUM VALUES, INJURY OR DAMAGE CAN OCCUR.

- (8) Swage the union to the tube as shown in the manufacturer's recommended procedures.

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AKS ALL

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SUBTASK 20-10-51-350-017

- (9) Swage each end three times.
  - (a) After the initial swage, move the swage head between 30 and 45 degrees from the previous swage position before you swage again.

SUBTASK 20-10-51-110-022

- (10) Lubricate the head and lower die block regularly.

SUBTASK 20-10-51-210-029

- (11) Examine the end plates for loose retaining screws.

SUBTASK 20-10-51-220-029

- (12) Examine the finished swage as shown in the manufacturer's recommended procedure or measure with Vernier caliper for dimensions as shown in (Figure 830).

SUBTASK 20-10-51-760-008

- (13) In the fuel tanks and vapor areas, do a check of the electrical resistance specifications across each tube/fitting interface (TASK 20-10-51-760-801).

SUBTASK 20-10-51-760-009

- (14) Make resistance measurements for all Permaswage repair installations in wing tanks and fuel vapor areas (TASK 20-10-51-760-801).

SUBTASK 20-10-51-790-003

- (15) For Permaswage fitting repairs in general areas, do a leak test as follows:
  - (a) Pressurize the system for 15 minutes minimum.
  - (b) Make sure there is no sign of hydraulic leaks.
    - 1) Use your finger or a white cloth to do a check for leaks.

SUBTASK 20-10-51-210-030

- (16) Examine the tube-to-fitting interface for hydraulic leaks you can see.

NOTE: You must replace fittings you cannot seal.

- (a) If dimensional or leakage specifications are not met, you can swage again.
    - 1) After swaging again, do a leak test.

SUBTASK 20-10-51-370-006

- (17) Apply primer, C00259 to the Alodine areas of the finished tube joint where the bare metal is open.

SUBTASK 20-10-51-820-014

- (18) If you disconnected more than one hydraulic tube and you think there is a possibility you connected the tubes incorrectly or cross-connected the tubes, do an operational check:

NOTE: Use your own judgement to determine if a check is necessary.

- (a) Do the post-installation test of one or more of the components to which the tubes are connected as a check.

SUBTASK 20-10-51-820-015

- (19) If you disconnected electrical wires to get access to the tubes and you think there is a possibility you connected the wires incorrectly or cross-connected the wires, do an operational check:

NOTE: Use your own judgement to determine if a check is necessary.



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- (a) Do the post-installation test of one or more of the components to which the wires are connected as a check.

———— END OF TASK ————

———— EFFECTIVITY ————  
**AKS ALL**

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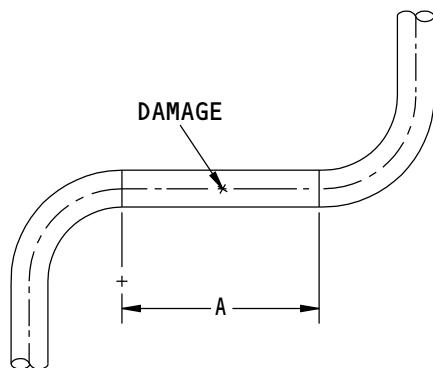
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SIZE	TUBE SIZE						
	04	06	08	10	12	16	20
Fitting length	1.540/ 1.530	1.690/ 1.680	2.700/ 2.686	2.780/ 2.766	2.920/ 3.906	3.209/ 3.195	3.664/ 3.650
A tube length (min)	2.15	2.30	3.30	3.40	3.55	3.80	4.30

NOTE: ALL DIMENSIONS ARE IN INCHES.

L19715 S0006402433\_V1

Minimum Straight Length for Permaswage Fitting Installation  
Figure 827/20-10-51-990-915

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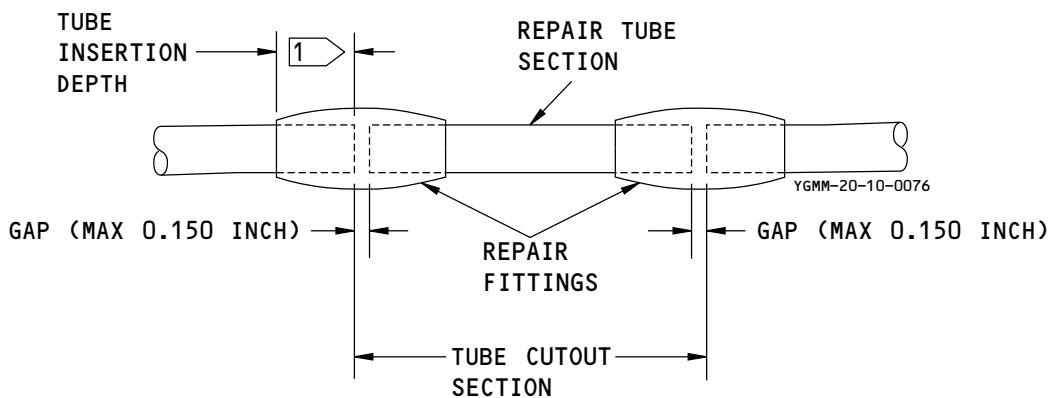
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MATERIAL	TUBE SIZE						
	04	06	08	10	12	16	20
Cres/Ti	0.02	0.02	0.03	0.04	0.057	0.049	0.05
Al	None	0.04	0.06	0.06	0.061	0.048	0.06

SWAGE GROWTH VALUES (INCH)

[1] THE A DIMENSION IS SHOWN IN FIG. 829.

L19716 S0006402434\_V1

Tube Splice Repair  
Figure 828/20-10-51-990-916

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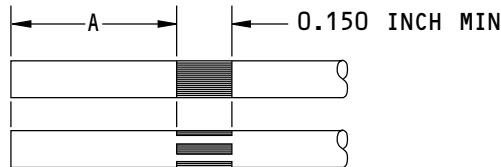
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DIMENSION (FIG. 827)	TUBE SIZE AND INSERTION DEPTH - INCHES					
	04	06	08	10	12	16
A	0.69	0.77	1.27	1.31	1.38	1.52

MARK FOR THE MINIMUM TUBE INSERTION DEPTHS

L19718 S0006402436\_V1

**Witness Mark Location and Usual Marking Procedures**  
**Figure 829/20-10-51-990-917**

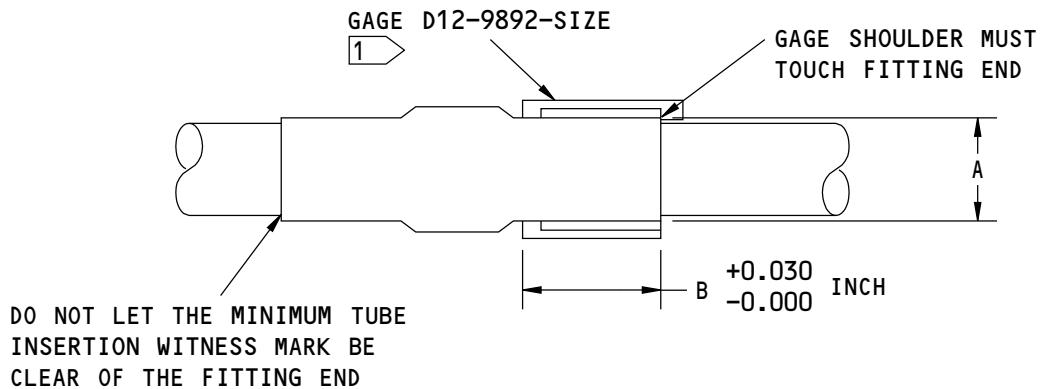
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TUBE DIAMETER (INCHES)	SWAGED DIAMETER MAX A DIMENSIONS (INCHES)	SWAGED LENGTH MIN B DIMENSIONS (INCHES)
1/4 (04)	0.315	0.46
3/8 (06)	0.447	0.53
1/2 (08)	0.606	1.02
5/8 (10)	0.735	1.02
3/4 (12)	0.863	1.02
1 (16)	1.181	1.406
1-1/4 (20)	1.390	1.406

AFTER SWAGE DIMENSIONS (INCH)

1 USE DNR9892-016 FOR SIZE 16.

L19721 S0006402437\_V2

Final Swage Dimensions  
Figure 830/20-10-51-990-918

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**TASK 20-10-51-400-809**

**13. Axial Swage Fitting Union Installation (8,000 psi rated - Rynlok)**

**A. General**

**WARNING:** DO NOT USE AXIAL SWAGE FITTINGS ON OXYGEN LINES. IF YOU USE AXIAL SWAGE FITTINGS ON OXYGEN LINES, DAMAGE TO EQUIPMENT AND INJURY TO PERSONNEL CAN OCCUR.

**WARNING:** DO NOT USE RYNGLOK FITTINGS TO REPAIR THESE COMPONENTS. IF YOU USE RYNGLOK FITTINGS FOR THESE COMPONENTS, INJURIES TO PERSONNEL, AND DAMAGE TO EQUIPMENT CAN OCCUR.

- (1) Boeing does not approve Rynlok (8,000 psi rated) fittings for these applications:
  - (a) For the repair of tubing in the fuel system (such as fuel pressure sensing lines) or fuel tanks
  - (b) On pneumatic ducts
  - (c) Potable water lines or waste water drain lines
  - (d) The repair of electrical conduits
- (2) The Axial Swage (8,000 psi rated - Rynlok) in-line tube unions (Figure 831), sizes 04, 06, 08, 10, 12, and 16, are used with 304 1/8 hard CRES tube to repair Ti-3AL-2.5 and 21-6-9 CRES. The same unions plus a size 20 are used with 6061-T6 aluminum tube, provided the bare areas of the tubing are painted after swaging to limit the possibility for galvanic corrosion to occur.

**NOTE:** Do not use Axial Swage (8,000 psi rated - Rynlok) tube to tube fittings on fluid lines inside airplane fuel tanks, in engine areas, or on lines used in oxygen systems. The Axial Swage (8,000 psi rated - Rynlok) tube to tube fitting is not qualified for these applications.

- (3) When you do a repair, remove the part of the tube with the damage. If the area of the tube damage is less than the value listed in Figure 808 and Table 812, use one Axial Swage union (8,000 psi rated - Rynlok) for repair.
- (4) If the tube damage is longer than the value listed in Table 812, put in a tube splice and install the splice with two fittings. The splice must be equal to or slightly shorter than the removed tube section. The minimum length of tubing to be removed is shown in Table 829. Fittings and tubing material sizes are shown in Table 828.

**Table 828/20-10-51-993-922 Approved Fitting/Tube Material Combinations for Repair with Rynlok Unions (8,000 psi Rated)**

AEROQUIP PART NUMBER	FOR USE WITH TUBE MATERIALS	APPROVED TUBE SIZES OD/WALL						
		04	06	08	10	12	16	20

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**Table 828/20-10-51-993-922 Approved Fitting/Tube Material Combinations for Repair with Rynlok Unions (8,000 psi Rated) (Continued)**

Axial Swage (8,000 psi rated 8010T - Rynlok) (Titanium Material)	21-6-9 CRES	0.016	0.020	0.026	0.033	0.039	0.052	N/A
	304 1/8 Hard CRES (MIL-T-6845)	0.020	0.028	0.035	0.049	0.058	0.065	N/A
		0.035	0.035	0.035	0.035	0.035	0.035	0.035
		0.016	0.019	0.026	0.032	0.039	0.051	N/A

**Table 829/20-10-51-993-923 Splice Repair with More Than One Axial Swage (5,000 psi Rated and 8,000 psi Rated - Rynlok) Tube-to-Tube Union - Minimum Removed Tube Section**

TUBE DASH NUMBER	TUBE OUTER DIAMETER (INCHES)	AXIAL SWAGE FITTING UNION, 5,000 PSI RATED OR 8,000 PSI RATED - RYNGLOK, MINIMUM REMOVED TUBE SECTION (INCHES)
04	0.250	2.38
06	0.375	2.64
08	0.500	2.92
10	0.625	3.18
12	0.750	3.56
16	1.000	4.15
20	1.250	4.81

**B. References**

Reference	Title
29-09-00-860-802	Hydraulic Reservoirs Depressurization (P/B 201)

**C. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-1803	Swager - Rynlok Hydraulic Fitting Part #: RCSK8-02-004 Supplier: 00624 Part #: RTSK8-02-013 Supplier: 00624
STD-203	Container - Oil Resistant, 1 U.S.-Gal (3.8 l)

**D. Consumable Materials**

Reference	Description	Specification
B00068	Alcohol - Denatured, Ethyl (Ethanol)	AMS 3002, MIL-E-51454 Type II
C00064	Coating - Aluminum Chemical Conversion	BAC5719 Type II Class A (MIL-DTL-5541 Class 1A)
C00259	Coating - Chemical And Solvent Resistant Finish, Corrosion Inhibiting Primer	BMS10-11 Type I

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**E. Procedure**

SUBTASK 20-10-51-860-009

- (1) Remove pressure from the system where you will do repairs, do this task: Hydraulic Reservoirs Depressurization, TASK 29-09-00-860-802.
  - (a) Allow the hydraulic fluid to drain into a suitable container (example, 1 U.S.-gal (3.81 l) oil resistant container, STD-203).

SUBTASK 20-10-51-360-001

- (2) Use the tools contained in swager hydraulic fitting, COM-1803.

NOTE: The RCSK tool kits have tools to cut and deburr. The RTSK tool kits do not have tools to cut and deburr. If you use an RTSK tool kit, use tools to cut and deburr that are not in the tool kit.

SUBTASK 20-10-51-360-002

- (3) Cut out the damaged section of the tube using a chipless tube cutter (Figure 807) and the following:
  - (a) Make sure the section you cut out of the tube is a straight section with a minimum straight length as shown in Figure 812.

NOTE: This is to make sure that the fitting and the swage tool will fit.
  - (b) Use one Axial Swage union (8,000 psi rated - Rynglok) for the repair if the damaged section is not longer than the dimensions listed in Figure 808 and Table 812.
    - 1) If the damage is within the dimensions, you can make the cut through the center of the damaged section.

SUBTASK 20-10-51-150-001

- (4) Remove the paint and the anodize from the tubes to the dimensions shown in Figure 812.

SUBTASK 20-10-51-110-023

- (5) Clean the non-painted tube sections that you will repair with alcohol, B00068.

SUBTASK 20-10-51-370-007

- (6) Use a brush to apply coating, C00064 to the cut ends of the tube.

SUBTASK 20-10-51-360-003

- (7) Seal the tube ends with a cap if you do not join the tubing immediately.

SUBTASK 20-10-51-360-004

- (8) Apply positioning and inspection marks on the tube to be repaired using the appropriate gage from the swager hydraulic fitting, COM-1803 and a Sanford Sharpie (or equivalent) felt tip pen with a fine or extra fine point (Figure 832, Figure 833, Figure 834).

NOTE: The RCSK tool kits have tools to cut and deburr. The RTSK tool kits do not have tools to cut and deburr. If you use an RTSK tool kit, use tools to cut and deburr that are not in the tool kit.

- (a) Bottom the gage on the cut edge of the tube before making the marks.

SUBTASK 20-10-51-360-005

- (9) Move the Axial Swage union (8,000 psi rated - Rynglok) over the tube ends.

SUBTASK 20-10-51-360-006

- (10) Put the edge of the fitting ring over the center of the positioning mark (nominal tube insertion) as shown in Figure 833.

NOTE: The edge of the fitting ring may be anywhere along the length of the positioning mark but the nominal position is recommended.

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SUBTASK 20-10-51-360-007

**WARNING:** MAKE SURE THAT THERE IS NO PUMP ADJUSTMENT THAT CAN CAUSE THE SWAGE TOOL TO BE MORE THAN WHAT THE MANUFACTURER RECOMMENDS. THE AEROQUIP RECOMMENDS THAT ITS TOOL OPERATE AT 8000 PSI TO 8500 PSI MAXIMUM. IF THE PRESSURE IS MORE THAN THIS VALUE, INJURY AND DAMAGE CAN OCCUR.

- (11) Swage the union to the tube as shown in the Aeroquip Rynlok Installation Guide supplied with the swager hydraulic fitting, COM-1803.

**NOTE:** The fitting must always be fully installed in the tool to maximize tool life.

SUBTASK 20-10-51-360-008

- (12) Examine the finished installation for correct ring advancement using the appropriate size inspection gage from the swager hydraulic fitting, COM-1803.
- (a) Make sure that the inspection gage fits over the ring area as shown in Figure 834 so that the ring is flush with the center portion of the union.

SUBTASK 20-10-51-780-001

- (13) Pressurize the hydraulic system to operating pressure for the system which was repaired.

SUBTASK 20-10-51-790-004

- (14) Examine the tube-to-union interface for hydraulic leakage.
- (a) If leakage is found, cut out the union and repair the tube by section replacement.

SUBTASK 20-10-51-370-008

- (15) Apply coating, C00064 to bare areas of the aluminum tubing where paint was removed, followed by a coat of primer, C00259.

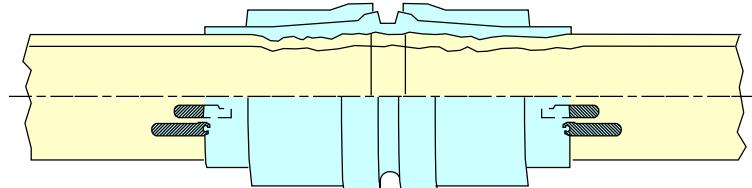
———— END OF TASK ————

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Axial Swage Tube to Tube Union (5,000 psi Rated and 8,000 psi Rated)  
Figure 831/20-10-51-990-920

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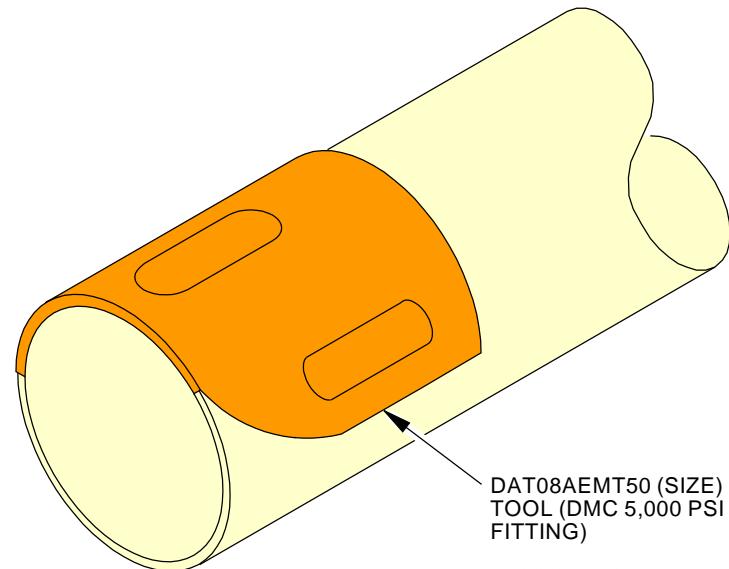
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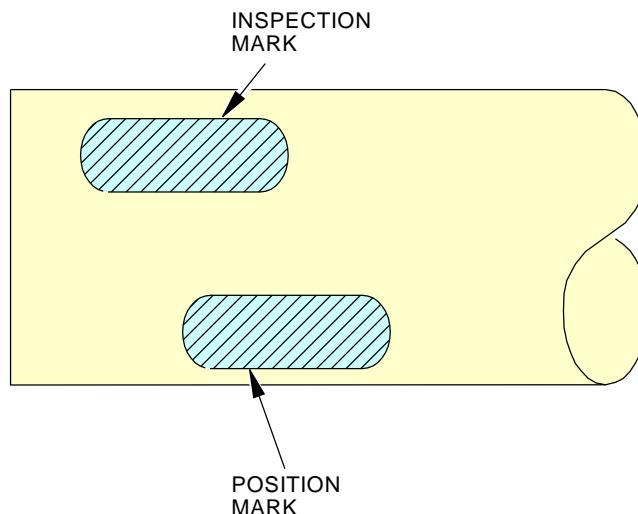
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DAT08AEMT50 (SIZE) MARKING  
TOOL (DMC 5,000 PSI RATED  
FITTING)

LTSGO-01-SIZE MARKING TOOL  
(AEROQUIP 5,000 PSI RATED  
FITTING)

RTSGO-01-SIZE MARKING TOOL  
(AEROQUIP 8,000 PSI RATED  
RYNGLOK FITTING)



H79298 S0006562013\_V3

**Mark Location During Rynglok Fitting Installation**  
**Figure 832/20-10-51-990-921**

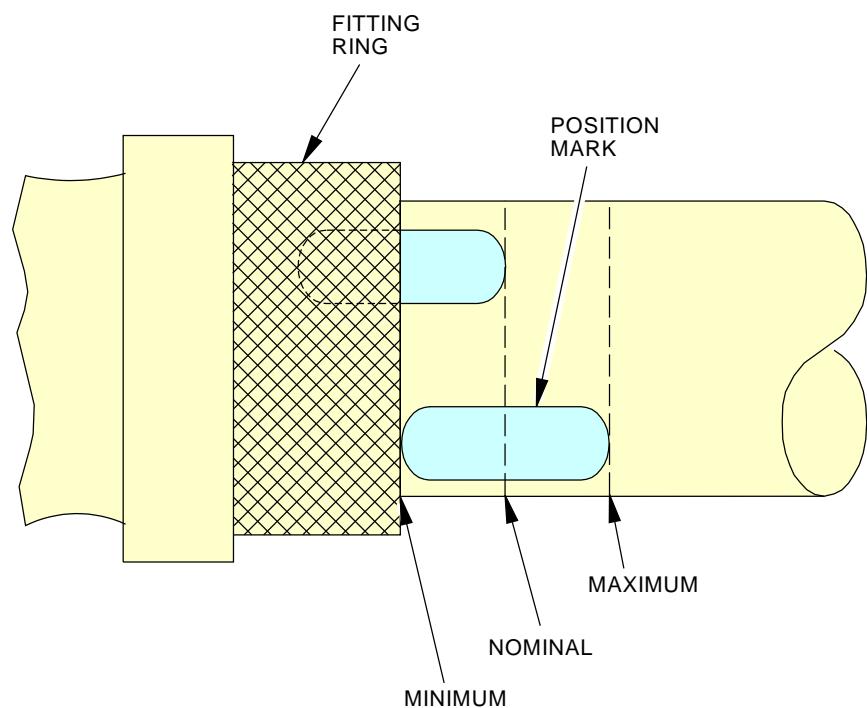
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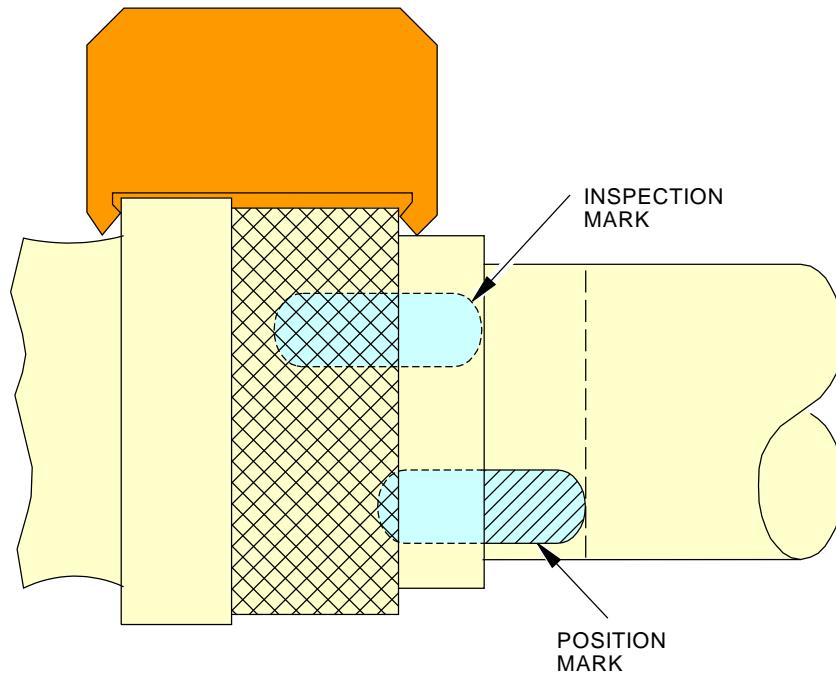
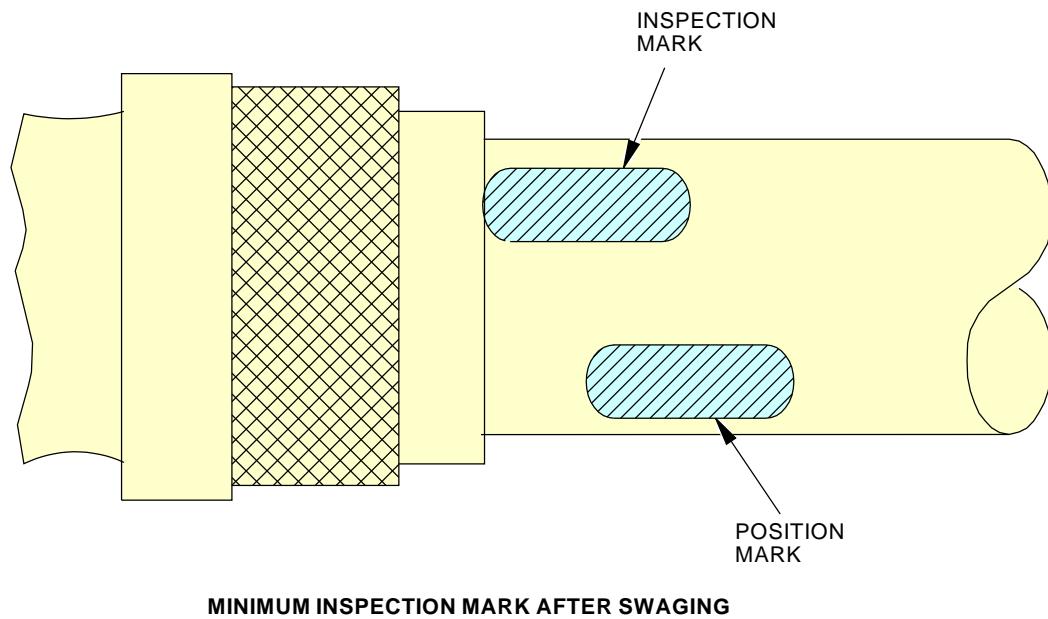


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Fitting Position for Tube Insertion  
Figure 833/20-10-51-990-922

EFFECTIVITY  
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H79312 S0006562015\_V3

**Use of Inspection Gage After Swage of Axial Swage Fittings (5,000 psi Rated or 8,000 psi Rated - Rynglok)**  
**Figure 834/20-10-51-990-923**

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**TASK 20-10-51-400-810**

**14. Axial Swage Fitting Installation (5,000 psi rated - Union) or Male/Female Adapter Fittings**

**A. General**

- (1) Make sure that you do not use Axial Swage shape fittings (tees, elbows) to repair tubes.

**WARNING:** DO NOT USE AXIAL SWAGE FITTINGS TO REPAIR THESE COMPONENTS. IF YOU USE AXIAL SWAGE FITTINGS FOR THESE COMPONENTS, INJURY TO PERSONNEL AND DAMAGE TO EQUIPMENT CAN OCCUR.

- (2) Boeing does not approve Axial Swage Union or Adapter Fittings (5,000 psi rated) for the applications that follow.
- (a) The repair of tubing in the fuel system (such as fuel pressure sensing lines) or fuel tanks.
  - (b) On pneumatic ducts.
  - (c) On potable water lines or waste water drain lines.
  - (d) The repair of electrical conduits.

**WARNING:** DO NOT USE AXIAL SWAGE FITTINGS ON OXYGEN LINES. IF YOU USE AXIAL SWAGE FITTINGS ON OXYGEN LINES, DAMAGE TO EQUIPMENT AND INJURY TO PERSONNEL CAN OCCUR.

- (3) Do not use the Axial Swage tube-to-tube union or adapter fittings on fluid lines inside the airplane fuel tanks, in engine areas, or on lines used in oxygen systems. The Axial Swage tube-to-tube union and adapter fittings are not qualified for these applications.
- (4) The 5,000 psi rated Axial Swage union or adapter fittings can be used to repair the 3,000 psi 3Al-2.5V titanium and 21-6-9 CRES hydraulic tubing.
- (5) The 5,000 psi rated Axial Swage union or adapter fittings and tooling are color-coded blue to distinguish them from the 8,000 psi rated Axial Swage fittings and tooling.
- (6) The 5,000 psi rated Axial Swage tube-to-tube union or adapter fittings (Figure 831), sizes 04, 06, 08, 10, 12, and 16, are approved for use with 3Al-2.5V titanium tubing and 21-6-9 CRES tubing to repair Ti-3AL-2.5V titanium and 21-6-9 CRES tubing.

NOTE: Sizes 04, 06, 08, 10, and 12 are approved for use on the 737NG.

- (7) When you do a repair, remove the part of the tube with the damage. If the area of the tube damage is less than the tube cutout length dimension illustrated in Figure 808 and listed in Table 812, use one Axial Swage union fitting for repair.
- (8) If the tube damage is longer than the tube cutout length dimension illustrated in Figure 808 and listed in Table 812, put in a tube splice and install the splice with two fittings (tube-to-tube union, or adapters plus flareless tube assembly or hose assembly as illustrated in ).
- (a) The splice must be equal to or slightly shorter than the removed tube section.
  - (b) The minimum length of tubing to be removed is shown in Table 829.
- (9) Fittings and tubing material sizes are shown in Table 830.

**Table 830/20-10-51-993-924**

DMC PART NUMBER	FOR USE WITH TUBE MATERIALS	APPROVED TUBE SIZES OD/WALL (IN.)					
		04	06	08	10	12	16
Titanium Material:	21-6-9 CRES	0.016	0.019	0.026	0.032	0.039	

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**Table 830/20-10-51-993-924 (Continued)**

DMC PART NUMBER	FOR USE WITH TUBE MATERIALS	APPROVED TUBE SIZES OD/WALL (IN.)					
		0.016	0.020	0.026	0.033	0.039	
DAS5969T, Tube-to-Tube Union	3AL-2.5V Titanium	0.016	0.020	0.026	0.033	0.039	
DAS5792T, Female Adapter							
DAS5793T, Male Adapter							

**B. References**

Reference	Title
29-09-00-860-801	Hydraulic Reservoirs Pressurization (P/B 201)
29-09-00-860-802	Hydraulic Reservoirs Depressurization (P/B 201)

**C. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-8946	Kit - Axial Swage Tube Repair With Pump, 5000 PSI Part #: DAT08AEFKT5001 Supplier: 14798 Part #: DAT08AEFKT5003 Supplier: 14798 Part #: RCLK5C01S020 Supplier: 00624
STD-203	Container - Oil Resistant, 1 U.S.-Gal (3.8 l)

**D. Consumable Materials**

Reference	Description	Specification
B00068	Alcohol - Denatured, Ethyl (Ethanol)	AMS 3002, MIL-E-51454 Type II
C00064	Coating - Aluminum Chemical Conversion	BAC5719 Type II Class A (MIL-DTL-5541 Class 1A)

**E. Procedure**

**SUBTASK 20-10-51-860-012**

- (1) Remove pressure from the system where you will do the repairs, do this task: Hydraulic Reservoirs Depressurization, TASK 29-09-00-860-802.
  - (a) Drain the hydraulic fluid into a suitable container.
    - 1) An example of a suitable container is a 1 U.S.-gal (3.81 l) oil resistant container, STD-203.

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SUBTASK 20-10-51-800-011

- (2) Use the tools contained in tube repair kit, COM-8946.

NOTE: The COM-8946 tool kit contains sizes 04 through 20. However, only sizes 04, 06, 08, 10, and 12 are applicable to 737NG aircraft. Operators with multiple airplane models may need the complete kit (sizes 04 through 20) if their other aircraft require the use of sizes 16 and 20.

NOTE: The RCSK tool kits have tools to cut and deburr. The RTSK tool kits do not have tools to cut and deburr. If you use an RTSK tool kit, use tools to cut and deburr that are not in the tool kit.

SUBTASK 20-10-51-000-001

- (3) Cut out the damaged section of the tube using a chipless tube cutter (Figure 807).
- (a) Make sure that the section you cut out of the tube is a straight section with a minimum straight length as shown in Figure 812.

NOTE: This will make sure the fitting and the swage tool will fit.
  - (b) If the damage is shorter than the dimensions listed in Figure 808, Table 812, use one Axial Swage union (5,000 psi rated) for the repair.
  - (c) If the damage is within the dimensions listed in Figure 808, Table 812, the cut can be through the center of the damaged section.

SUBTASK 20-10-51-150-002

- (4) Remove the paint and the anodize from the tubes to the dimensions shown in Figure 812.

SUBTASK 20-10-51-100-001

- (5) Clean the non-painted tube sections that you will repair with alcohol, B00068.

SUBTASK 20-10-51-800-012

- (6) Use a brush to apply coating, C00064 to the cut ends of the tube.

SUBTASK 20-10-51-390-001

- (7) Seal the tube ends with a cap if you do not join the tube immediately.

SUBTASK 20-10-51-930-004

- (8) Apply positioning and inspection marks on the tube to be repaired using the appropriate gage from the tube repair kit, COM-8946 and a Sanford Sharpie (or equivalent) felt tip pen with a fine or extra-fine point.

NOTE: The RCSK tool kits have tools to cut and deburr. The RTSK tool kits do not have tools to cut and deburr. If you use an RTSK tool kit, use tools to cut and deburr that are not in the tool kit.

- (a) See Figure 832, Figure 833, and Figure 834.
- (b) Bottom the gage on the cut edge of the tube before making the marks.

SUBTASK 20-10-51-400-001

- (9) Move the Axial Swage union or adapter fitting (5,000 psi rated) over the tube ends.

SUBTASK 20-10-51-400-002

- (10) Put the edge of the fitting ring over the center of the positioning mark (nominal tube insertion) as shown in Figure 833.

- (a) Make sure that the edge of the fitting ring is anywhere along the length of the positioning mark.

NOTE: Nominal position is recommended.



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SUBTASK 20-10-51-400-003

**WARNING:** DO NOT ADJUST THE PUMP TO A PRESSURE THAT CAN CAUSE THE SWAGE TOOL TO BE ABOVE THE LEVEL SPECIFIED. IF YOU ADJUST PRESSURE TO MORE THAN SPECIFIED, INJURY TO PERSONNEL AND DAMAGE TO EQUIPMENT CAN OCCUR.

- (11) Make sure that you do not make a pump adjustment that can cause the swage tool hydraulic pressure to be outside the manufacturer's recommendations.
  - (a) The manufacturer's recommendations for the tool is 8000 psi (55,158 kPa) to 8500 psi (58,605 kPa) maximum.
- (12) Swage the union or adapter fitting to the tube as shown in the installation guide supplied with the swaging equipment.

NOTE: The fitting must always be fully installed in the tool to maximize tool life.

SUBTASK 20-10-51-211-002

- (13) Examine the finished installation for correct ring advancement.
  - (a) Use the appropriate size inspection gage from the tube repair kit, COM-8946.
    - 1) The inspection gage should fit over the ring area as shown in Figure 834.

NOTE: This is so the ring is flush with the center portion of the union.

SUBTASK 20-10-51-780-002

- (14) Pressurize the hydraulic system to operating pressure for the system that was repaired (Hydraulic Reservoirs Pressurization, TASK 29-09-00-860-801).

———— END OF TASK ————

**TASK 20-10-51-400-811**

**15. Axial Swage Fitting Installation (5,000 psi rated - Shape, Elbow and Tee)**

**A. General**

**WARNING:** PUT AN IDENTIFIER ON THE TUBES ON EACH SIDE OF THE CONNECTION BEFORE YOU DISCONNECT. IF YOU CONNECT THEM AT AN INCORRECT LOCATION, DAMAGE TO THE COMPONENTS WILL OCCUR.

- (1) Make sure that you do not cross-connect tube assemblies.
  - (a) Label all separated connections so that the correct tube identification and position is maintained.

**WARNING:** DO NOT USE AXIAL SWAGE FITTINGS TO REPAIR THESE COMPONENTS. IF YOU USE AXIAL SWAGE FITTINGS FOR THESE COMPONENTS, INJURY TO PERSONNEL AND DAMAGE TO EQUIPMENT CAN OCCUR.

- (2) Boeing does not approve Axial Swage shape fittings for the applications that follow:
  - (a) The repair of tubing in the fuel system (such as fuel pressure sensing lines) or fuel tanks.
  - (b) The repair of tubing in the hydraulic system (a shape fitting may not be used for a splice repair of hydraulic tubing. A shape fitting can only be used to replace the same shape fitting in the hydraulic system.)
  - (c) On pneumatic ducts.
  - (d) On potable water lines or waste water drain lines.
  - (e) The repair of electrical conduits.

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- (3) The 5,000 psi rated Axial Swage shape (elbow and tee) fittings are installed in the main landing gear wheel well area.
- (4) The 5,000 psi rated Axial Swage fittings and tooling are color-coded blue to distinguish them from the 8,000 psi rated Axial swage fittings and tooling.
- (5) The use of 5,000 psi rated Axial Swage elbow and tee configurations for repair is limited to replacement of existing parts in the same configuration.
- (6) Do not use the 5,000 psi rated Axial Swage elbow and tee fittings for tube repair (a shape fitting may not be used for a splice repair of hydraulic tubing. A shape fitting can only be used to replace the same shape fitting in the hydraulic system).
- (7) The Axial swage shape fittings (5,000 psi rated) listed in Table 830 and illustrated in Figure 815, in sizes 04, 06, 08, 10, and 12 are used with 3Al-2.5V titanium tubing and 21-6-9 CRES tubing.

**NOTE:** The tube repair kit, COM-8946 tool kit contains sizes 04 through 20. However, only sizes 04, 06, 08, 10, and 12 are applicable to 737NG aircraft. Operators with multiple airplane models may need the complete kit (sizes 04 through 20) if their other aircraft require the use of sizes 16 and 20.

**WARNING:** DO NOT USE AXIAL SWAGE FITTINGS ON OXYGEN LINES. IF YOU USE AXIAL SWAGE FITTINGS ON OXYGEN LINES, DAMAGE TO EQUIPMENT AND INJURY TO PERSONNEL CAN OCCUR.

- (8) Do not use the Axial Swage shape fittings on fluid lines inside the airplane fuel tanks, in engine areas, or on lines used in oxygen systems. The Axial swage shape fittings are not qualified for these applications.
- (9) When you do a repair that involves replacement of an Axial Swage shape fitting, it may be necessary to remove the tubes intersecting the Axial Swage shape fitting along with the Axial Swage shape fitting at the opposite ends of the affected tubes.
- (10) It is important to make sure that you have the necessary parts and Axial Swage tooling available before you begin the repair. Possible Tube Repair Scenarios - Axial Swage Fittings, TASK 20-10-51-800-801 provides a tube repair scenario demonstrating the steps required to replace a hydraulic tube, where related end fittings and a portion of a mating tube must also be replaced.

**B. References**

Reference	Title
29-09-00-860-801	Hydraulic Reservoirs Pressurization (P/B 201)
29-09-00-860-802	Hydraulic Reservoirs Depressurization (P/B 201)

**C. Tools/Equipment**

**NOTE:** When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-8946	Kit - Axial Swage Tube Repair With Pump, 5000 PSI Part #: DAT08AEFKT5001 Supplier: 14798 Part #: DAT08AEFKT5003 Supplier: 14798 Part #: RCLK5C01S020 Supplier: 00624



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**D. Procedure**

SUBTASK 20-10-51-040-006

- (1) Remove pressure from the system where you will do the repairs, do this task: Hydraulic Reservoirs Depressurization, TASK 29-09-00-860-802.

SUBTASK 20-10-51-020-006

- (2) Back off swivel nuts on the Axial Swage elbow tee system.

SUBTASK 20-10-51-350-019

- (3) Cut the mating tube in a straight section.

- (a) Use a chipless tube cutter (Figure 807).

- 1) Make sure that the straight section where you cut the mating tube has a minimum straight length as shown in Figure 812.

NOTE: This will make sure the fitting and the swage tool will fit.

- 2) Use one Axial Swage union fitting (5,000 psi rated) for the splice repair of the mating tube.

SUBTASK 20-10-51-020-007

- (4) Remove the fittings, the tube assembly, and the cut tube section as an assembly.

SUBTASK 20-10-51-800-013

- (5) Discard the fittings, the tube assembly, and the cut tube section.

SUBTASK 20-10-51-800-014

- (6) Put the items that follow in position for installation.

- (a) The new Axial Swage elbow fitting (5,000 psi rated) or the new Axial Swage tee fitting (5,000 psi rated).

- (b) The new tube.

SUBTASK 20-10-51-420-039

- (7) Tighten the swivel nuts hand-tight.

SUBTASK 20-10-51-420-040

- (8) Cut a section of the new tube so that it will match the cut section of the old tube.

- (a) Make sure to prepare the ends of the new tube for swaging.

SUBTASK 20-10-51-420-041

- (9) Install the new tube.

- (a) Put the new tube section and the Axial Swage union fitting in position for installation.

- (b) Torque the swivel nuts on the flareless ends of the Axial Swage shape fittings.

- (c) Make sure that the Axial swage union (5,000 psi rated) and Axial Swage shape fittings are in place.

- (d) Swage the parts as shown in the installation guide for the swaging equipment.

NOTE: The fitting must always be fully installed in the tool to maximize tool life.

SUBTASK 20-10-51-440-001

- (10) Pressurize the hydraulic system, do this task: Hydraulic Reservoirs Pressurization, TASK 29-09-00-860-801.

———— END OF TASK ————

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**TASK 20-10-51-350-802**

**16. Hydraulic Tubing Repair with Flexible Hoses**

**A. General**

- (1) The Boeing Company recommends that the operator do these procedures:
  - (a) Make a record of the flexible hoses that you install as temporary repairs for rigid lines.
  - (b) Make a schedule for the regular inspection of flexible hose installations.
  - (c) Make sure the installation stays an airworthy repair until the system is put back to its initial configuration.
  - (d) Make a procedure to make sure that flexible hoses, installed as temporary repairs, are replaced as soon as possible.

**NOTE:** You must replace the hoses no later than the scheduled time check approved by the assigned principal maintenance inspector.
- (2) You can use many different repair techniques. The Boeing Company cannot know about or control these repair techniques. It is your responsibility to decide if this procedure is applicable to your repair techniques.
- (3) This procedure is not acceptable for engine hydraulic tube repair or for the replacement of rigid or flexible coiled tubing. Engine hydraulic tubes are those tubes below or forward of the firewall, and within the engine cowls. Consult Boeing when considering a repair to any engine hydraulic tube or coiled tube.
- (4) Use the hydraulic tubing repair kit, SPL-5276 or equivalent

**B. References**

Reference	Title
20-10-52-400-801	Flexible Hose Installation (P/B 401)
29-09-00-860-802	Hydraulic Reservoirs Depressurization (P/B 201)

**C. Tools/Equipment**

**NOTE:** When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
SPL-5276	Repair Kit, Hydraulic Tubing (Temp. Repairs Only) (Approved for Titanium) Part #: 65-92528-1 Supplier: 81205

**D. Install the Flexible Hose**

(Figure 835)

**CAUTION:** DO NOT ALLOW PUMPS, VALVES, ACTUATORS OR OTHER COMPONENTS TO HANG FROM KEVLAR HOSES. KEVLAR HYDRAULIC HOSES KINK EASILY AND MAY DEVELOP LEAKAGE.

**NOTE:** Kevlar hydraulic hoses kink more easily than CRES (steel) wire braided hoses.

**NOTE:** Kevlar fibers are usually not damaged by kinking. After the hose is pressurized, all signs of kinking may disappear. However, the inner Teflon tube may be damaged and eventually leak. Kinking is especially critical for larger hoses such as the ADP pressure hoses (1 1/4 inches) (31.75 mm).





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SUBTASK 20-10-51-220-030

- (1) Use a flexible hose that has the specifications that follow:
- (a) Make sure the flexible hose is specified for at least the same operating pressure and fluid type as the system in which you will install the flexible hose.  
**NOTE:** The 737 airplanes use the new kevlar reinforced hydraulic hose. This hose may be used provided the guidelines of (Table 831) are met.
  - (b) Make sure the new flexible hose has a minimum of the same inner diameter as the damaged tube.
  - (c) Make sure the new flexible hose is sufficiently long to replace the damaged tube or the damaged section of the tube.
  - (d) Make sure the new flexible hose has sufficient slack, flex, twisting, bending, clearance, and support specifications as shown below and in (Figure 835).
    - 1) Slack - Do not install the hose assemblies in a way that will cause a mechanical load on the hose. Hoses will change length from +2 to -4 percent when pressurized. Supply sufficient slack or bend to make the allowance for a change in length and length tolerances.
    - 2) Flex - When hose assemblies will have much vibration or flexing, make sure there is sufficient slack between the rigid fittings. Install the hose so flexing does not occur at the end fittings. The hose must stay straight for at least two hose diameters from the end fittings. Do not use clamp locations that will restrict or prevent the hose from flexing.
    - 3) Twisting - Make sure you install the hoses without twists to prevent loose nuts and possible rupture of the hose. You can use swivel connections at one or two ends to release the twist stresses.
    - 4) Bending - To prevent sharp bends in the hose assembly, use elbow fittings, hose with elbow type end fittings, or the applicable bend radii, as shown in (Table 831).

**Table 831/20-10-51-993-864 Minimum Hose Bend Radius**

HOSE	HOSE INNER DIAMETER INCH (mm)	MINIMUM HOSE BEND RADIUS MEASURED AT INNER BEND INCH (mm)
AS115-04	1/4 (6.35)	1.50 (38.1)
AS115-06	3/8 (9.53)	2.50 (63.5)
AS115-08	1/2 (12.7)	2.88 (73.15)
AS115-10	5/8 (15.87)	3.25 (82.55)
AS115-12	3/4 (19.05)	4.00 (101.6)
AS4568-16	1 (25.4)	7.50 (190.5)
AS4568-20	1-3/4 (44.45)	15.00 (381)

- 5) Clearance - Make sure the hose assembly is clear of all other lines, equipment, and adjacent structure under all operating conditions. The hoses must have the minimum clearance specifications shown in (Table 832).

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Table 832/20-10-51-993-865 Minimum Hose Bend Clearance

HOSE CLEARANCE TO	MINIMUM CLEARANCE INCH (mm)
Control Cables and Linkages	1.0 <sup>[1]</sup> (25.4)
Cable at Pulleys	0.5 (12.7)
Cable at Mid-span	2.0 (50.8)
Electrical Wiring	0.5 (12.7)
Hydraulic Tubes or Hoses	0.2 (5.08)

\*[1] Measured at a relative position where the hose is closest to the cable or linkage.

- 6) Support - Make sure the hose assembly has supports that do not cause deflection of rigid lines because of the relative motion that can occur. Use sufficient clamps to follow the contour of the structure to prevent hose abrasive wear, kinking, and entanglement during flexing. At a minimum, put clamps at locations where the tube clamps were. Make sure the hose is not rigidly supported by tight, rigid clamps around its outer diameter. If a hose between rigid connections must move longitudinally, clamps must be of a type that will not cause wear on the hose casing. Make sure the connections have supports at the tube, not at the hose.

SUBTASK 20-10-51-860-010

- (2) For the hydraulic system where you will do the repair, do this task: Hydraulic Reservoirs Depressurization, TASK 29-09-00-860-802.

SUBTASK 20-10-51-960-003

- (3) If you can replace all of the damaged tube with a flexible hose, do these steps:
  - (a) Remove the damaged tube.
  - (b) If necessary, prepare the ends of the tubes to which you will install the flexible hose.
  - 1) Use the applicable fittings as shown in Tube Repair, TASK 20-10-51-300-805.

SUBTASK 20-10-51-960-004

- (4) If the damaged tube is too long to replace by a flexible hose, do the steps that follow:
  - (a) Cut out the damaged tube section to accept the flexible hose.
  - (b) Prepare the ends of the cut tube with the applicable fittings as told in the Tubing Repair paragraph.

SUBTASK 20-10-51-420-037

- (5) Do this task: Flexible Hose Installation, TASK 20-10-52-400-801.

SUBTASK 20-10-51-860-011

- (6) Supply the usual operating pressure to the repaired tube.

SUBTASK 20-10-51-210-031

- (7) Examine the hose and connections for leaks.

SUBTASK 20-10-51-220-031

- (8) Make sure the repair agrees with all specifications for slack, flex, twisting, bending, clearance, and support.

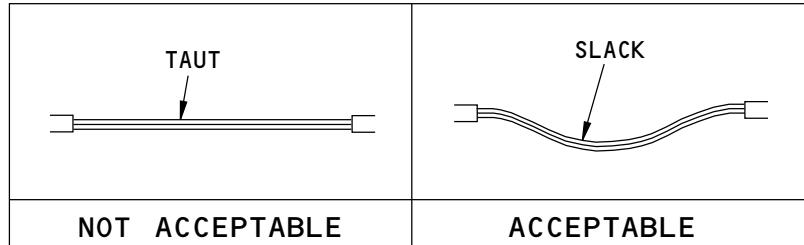
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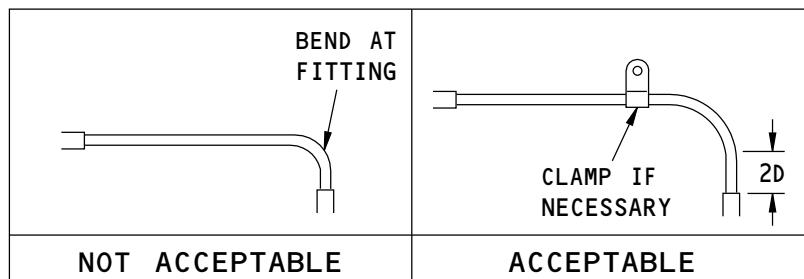
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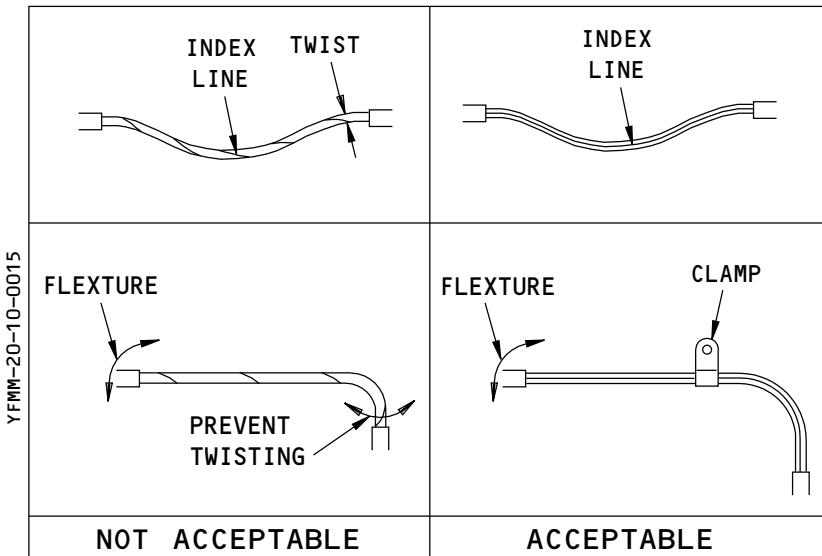
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SLACK



FLEX



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TWISTING

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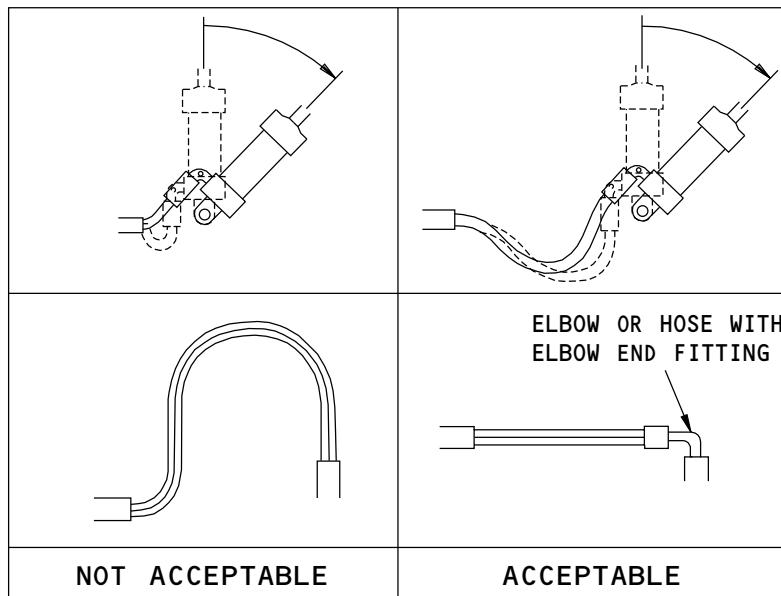
Hydraulic Tubing Repair with Flexible Hose  
Figure 835/20-10-51-990-924 (Sheet 1 of 2)

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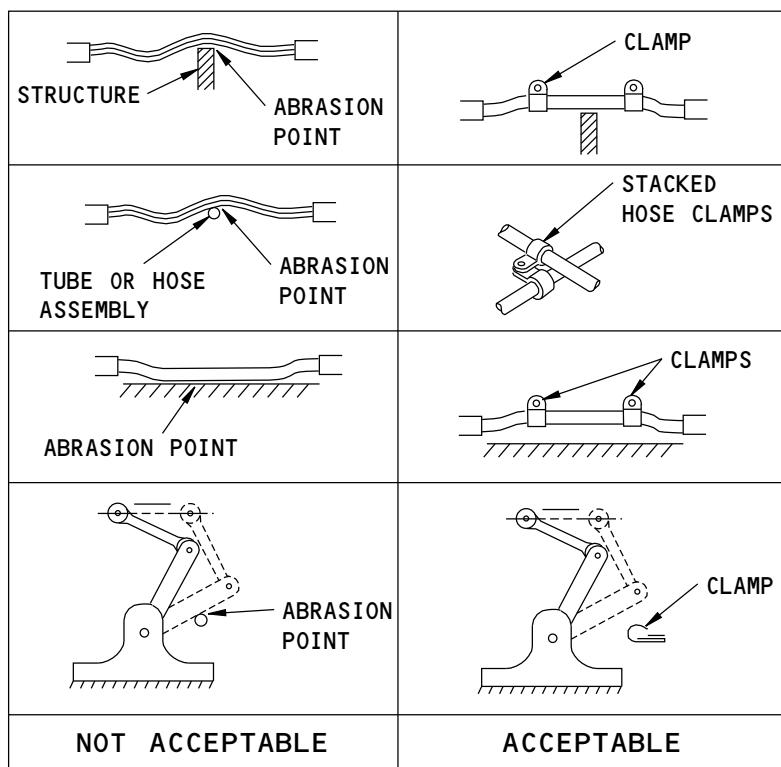
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BENDING



CLEARANCE

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Hydraulic Tubing Repair with Flexible Hose  
Figure 835/20-10-51-990-924 (Sheet 2 of 2)

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**TASK 20-10-51-300-810**

**17. Repair Size 16 (1 inch) and Size 20 (1-1/4 inch) 6061-T4 Aluminum Tubing in the Hydraulic System of the Airplane**

**A. General**

**WARNING:** DO NOT USE THIS PROCEDURE ON OXYGEN TUBING. GREASE, DIRT, OR OTHER FLAMMABLE MATERIALS IN THE OXYGEN TUBING CAN CAUSE A FIRE OR EXPLOSION.

- (1) The hydraulic system in the airplane contains both 6061-T4 and T6 aluminum tubes.
- (2) This is a repair method that applies only to 6061-T4 hydraulic aluminum tubes in Sizes 16 (1 inch) and 20 (1-1/4 inch) and uses 6061-T6 aluminum tube material for making a splice. 6061-T6 material may be used as an alternate material for repair of 6061-T4 aluminum tubes, but 6061-T4 aluminum tube material may NOT be used to repair 6061-T6 aluminum tubes.
- (3) Approved repairs to 6061-T6 aluminum hydraulic tube material are covered elsewhere in this AMM.
- (4) Repair is accomplished using only the BACS13BX sleeve, the elastomer swaging process, and other applicable methods specified in this procedure for flareless tube repairs.
- (5) The wear depth limit for 6061-T4 tubes is 1/3 the wall thickness of the tube.

**B. References**

Reference	Title
20-10-09-400-801	Control Cable Pulleys Installation (P/B 401)
20-50-11-910-801	Standard Torque Values (P/B 201)

**C. Procedure**

SUBTASK 20-10-51-300-003

- (1) Do the repair:
  - (a) Decide if 6061-T6 aluminum tube splice is necessary or if the damage is small enough to repair by installing a flareless MS21902 union between two BACS13BX sleeves.
  - (b) Refer to Figure 808 and Table 812 to find the necessary tube cutout length when you use a single flareless MS21902 union to replace a damaged tube area.
  - (c) To use assembled tube ends or a center section to do a repair, find the cutout length and install as follows:
    - 1) Make an estimate of the total length (L1) of the 6061-T6 aluminum tube repair section necessary to replace the damaged tube (Figure 809, Figure 811).
    - 2) Cut and trim the repair tube as follows: (Figure 807)
      - a) Use the correct size ratchet chipless cutter.
      - b) Turn the cutter drive screw counter clockwise to retract the cutter wheel.
      - c) Put the cutter over the tube.
      - d) Turn the screw clockwise until the cutter touches the tube at the necessary cut location.
      - e) Turn the cutter screw 1/8 to 1/4 turn and rotate the cutter until the cutter is easy to rotate.  
**NOTE:** The tube should now be cut.
      - f) Remove the tool.
    - g) To deburr the tube, use the correct stem subassembly and deburring tool.

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- <1> To assemble the tool, refer to Figure 807.
  - h) Push down on the plunger and install the tool into the end of the tube.
  - i) Release the plunger.
    - <1> Let the plug fill the inside of the tube.
  - j) Rotate the deburring tool until the inside burr is removed.
  - k) Remove the tool with the plug expanded.
- NOTE: The expanded plug should remove particles from the inside of the tube.
- <1> Make sure that you do not drop metal particles in the area of the repair.
- 3) Swage the necessary flareless BACS13BX sleeves to the repair tube using the applicable section: Swage BACS13BX Flareless Sleeves with the Harrison Elastomer Swagers 5175, 5570, 5720.
  - 4) Assemble and tighten the flareless fittings which are part of the repair section (TASK 20-10-09-400-801).
  - 5) Measure all of the tube assembly length with BACS13BX sleeves (L1) (Figure 809, Figure 811).
  - 6) To find the necessary cutout length (L2) as shown in Figure 809, Figure 811, use the procedure given in Table 817 for BACS13BX sleeves and Harrison Portable Swagers with MS21902 unions.
  - 7) Remove the pressure from the systems where you will do the repairs.
  - 8) Cut out the damaged tube (L2). Trim the tube ends as shown in Figure 807.
  - 9) When you make the installation, refer to the section: "Swage the BACS13BX flareless sleeves with the Harrison Elastomer Swagers 5175, 5570, 5720".
  - 10) Install the repair section and tighten the nuts, do this task: Standard Torque Values, TASK 20-50-11-910-801.

———— END OF TASK ————

**TASK 20-10-51-930-801**

**18. Part Marking of Flareless Tubing Assemblies**

**A. General**

- (1) Use this task to part-mark the hydraulic tubes that do not have part-numbers.
  - (a) Use one of the methods that follow to apply the original tube part-number on the installed hydraulic-tubes that have lost identification.
  - (b) Use one of the methods that follow to apply a NEW part-number on a field-manufactured replacement- tube. First, select a NEW tube part-number. This new tube part-number will include the data to let you easily identify and find the part for future use (65C26841-1002REPL). For example, if the tubes require repair or replacement, the new tube part-number will help you find the tubes.

**B. Consumable Materials**

Reference	Description	Specification
B50095	Solvent	BAC5750
C00033	Coating - Protective Enamel, Flexibility Use	BMS10-60 Type II
C50066	Coating - Protective Enamel, Clear	BMS10-60 Type I Class A

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Reference	Description	Specification
G00251	Abrasive - Mat, Non-Woven, Non-Metallic	A-A-58054
G02061	Marker - Permanent, Felt Tip Pen	
G50393	Tape - Adhesive, Label	BAC5307 Type III Polyester (Mylar)
G50395	Ink - Laundry Marking	TT-I-542
G50396	Ink - Marking, Silk Screen	Standard Overhaul Practices Manual (SOPM) 20-50-10
G50410	Stamp Pad (Commercially Available)	

**C. Procedure**

SUBTASK 20-10-51-930-001

- (1) Rubber Stamp Method
  - (a) Clean the tube surface with solvent, B50095.
    - 1) Remove oxide from the tubing surface with abrasive mat, G00251.
  - (b) Select an ink, G50396 (see SOPM 20-50-10) that is applicable to the tube material and visible on the tube surface.
  - (c) Hand Stamp the new tube part-number on the tube.
    - 1) For tubes longer than 24 in. (610 mm), mark the new part number in the locations that follow.
      - a) In the area 6 in. (152 mm) or less of each end.
      - b) The newest straight area that is not in a clamp area.
    - 2) Apply liquid ink, G50396 to a stamp pad, G50410.
    - 3) Apply the part number to the tube surface with the stamp.
  - (d) Apply a clear coating, C00033.

SUBTASK 20-10-51-930-002

- (2) Hand letter Method
  - (a) Clean the tube surface with solvent, B50095.
    - 1) Remove oxide from the tubing surface with abrasive mat, G00251
  - (b) Use a ink, G50395 or marker, G02061 to mark the part-number on the tube.
    - 1) For tubes longer than 24 in. (610 mm), mark the new part number in the locations that follow.
      - a) In the area 6 in. (152 mm) or less of each end.
      - b) The newest straight area that is not in a clamp area.

SUBTASK 20-10-51-930-003

- (3) Tape or Adhesive Label Method
  - (a) Cut the adhesive tape, G50393 length to encircle the tube a minimum of two times on a 0.250 in. (6.350 mm) to 0.500 in. (12.700 mm) diameter tube.
    - 1) For tubes with diameters of 0.625 in. (15.875 mm) or more, encircle the tube two times with the adhesive tape, G50393.
  - (b) Attach the adhesive tape, G50393 with the part number.

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- 1) For tubes longer than 24 in. (610 mm), mark the new part number in the locations that follow.
    - a) In the area 6 in. (152 mm) or less of each end.
    - b) The newest straight area that is not in a clamp area.
  - 2) Use the original identification tapes, part number BACT11Y-(), to mark the replacement tubes.
- NOTE: The BACY11Y tapes require special handling equipment.
- (c) Apply a clear coating, C50066.

———— END OF TASK ————

**TASK 20-10-51-800-801**

**19. Possible Tube Repair Scenarios - Axial Swage Fittings**

Figure 837

**A. General**

- (1) This procedure has three possible tube scenarios. These scenarios are to demonstrate how a tube repair should be approached for tubes attached to permanent axial swage fittings in the main wheel well.

**B. Possible Scenario 1 (Tube-to-Tube Splice)**

- (1) Repair Damage on Tube Near Aileron Centering Mechanism on the Rear Spar
  - (a) Prepare for the Repair
    - 1) Identify the damaged tube and the parts necessary to do the repair.
      - a) Locate the damaged area.
      - b) Identify the damaged tube as part number 272A4451-1009 (0.375 in. (9.525 mm) diameter and 0.019 in. (0.483 mm) wall thickness titanium, ends permanently attached).
      - c) Follow the tube in both directions to determine where you can make a splice using AS5969T/DAS5969T axial swage fittings.
        - <1> The straight portion of the tube directly below the bend that has the damage is straight and long enough for a splice with one axial swage union fitting.
        - <2> The portion of the tube above the damage has a straight section long enough for a splice with one axial swage union fitting close to the permanent union fitting attaching the 272A4451-1009 tube to the next tube.
        - <3> See Figure 836 for the splice locations.
      - d) Determine where to cut the 272A4451-1009 tube.
      - e) Determine what parts and tooling are needed to do the repair.
        - <1> Required Fittings (New)
          - <a> AS5969T0606/DAS5969T0606 Tube-to-Tube Union (two)
        - <2> Required Tubes (New)
          - <a> 272A4451-1009 (one)
        - <3> Required Tools
          - <a> See Table 807 for the required tooling.

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- (b) Remove the Damaged Tube Section
- 1) Remove pressure from the hydraulic system.
  - 2) Cut the 272A4451-1009 tube.
    - a) Loosen or remove tube support clamps, as necessary, to cut the tube for splicing.
    - b) Cut the tube in two places, approximately halfway between the bends.
  - 3) Remove the cut portion of the tube.
    - a) Loosen or remove tube support clamps (as necessary).
    - b) Keep the damaged tube for reference.
  - 4) Deburr and chamfer the tube ends that are still connected to the airplane structure.
  - 5) Make witness marks on the tube ends that are still connected to the airplane structure (see FLARELESS TUBING ASSEMBLY - REPAIRS, 20-10-51/801 and the fitting manufacturer's instructions).
  - 6) Cut the new 272A4451-1009 tube.
    - a) Use the damaged 272A4451-1009 tube that was removed from the airplane as a template.
    - b) Deburr and chamfer the new 272A4451-1009 tube.
    - c) Make witness marks on the new tube (see FLARELESS TUBING ASSEMBLY - REPAIRS, 20-10-51/801 and the fitting manufacturer's instructions).
- (c) Do the Repair
- 1) Slide the AS5969T0606/DAS5969T0606 union fittings on the ends of the 272A4451-1009 tubes that are attached to the airplane structure.
  - 2) Slide the new 272A4451-1009 tube section into the AS5969T0606/DAS5969T0606 union fittings.
  - 3) Reinstall and tighten any support clamps that were removed from 272A4451-1009.
    - a) Make sure that you do not clamp the tube at the repair fitting location.  
NOTE: Clamps are sized to fit standard tube diameters. If a repair swage is clamped, the clamp can move off of the uniform surface because the tube can migrate or flex.
    - b) Make sure that there is no preload on the new 272A4451-1009 tube when the support clamps are tightened.
    - c) Make sure that there is enough clearance to the adjacent tubes or the structure.
  - 4) Make a felt tip mark across each fitting and tube to mark the position of the AS5969T0606/DAS5969T0606 union fittings on the 272A4451-1009 tubes that are attached to the airplane structure and on the new 272A4451-1009 tube section.  
NOTE: These marks will be used for clocking the new 272A4451-1009 tube.
  - 5) Position one AS5969T0606/DAS5969T0606 union fitting to the witness marks and the clocking marks on the 272A4451-1009 tube that is attached to the airplane structure and to the new 272A4451-1009 tube.
  - 6) Swage the AS5969T0606/DAS5969T0606 union fitting to the 272A4451-1009 tube that is attached to the airplane structure and the new 272A4451-1009 tube.
    - a) Swage one fitting end at a time.

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- b) Use FLARELESS TUBING ASSEMBLY - REPAIRS, 20-10-51/801 and the tool manufacturer's instructions.
  - c) Make sure that fitting is centered on the tube ends at both sides of the joint.
  - d) Make sure that the tube and fitting remain in position to the witness marks and the clocking marks.
- 7) Position the remaining AS5969T0606/DAS5969T0606 union fitting to the witness marks and the clocking marks on the 272A4451-1009 tube that is attached to the airplane structure and to the new 272A4451-1009 tube section at the other end of the splice.
- 8) Swage the AS5969T0606/DAS5969T0606 union fitting to the 272A4451-1009 tube that is attached to the airplane structure and the new 272A4451-1009 tube section.
- a) Swage one fitting end at a time.
  - b) Use FLARELESS TUBING ASSEMBLY - REPAIRS, 20-10-51/801 and the tool manufacturer's instructions.
  - c) Make sure that fitting is centered on the tube ends at both sides of the joint.
  - d) Make sure that the tube and fitting remain in position to the witness marks and the clocking marks.
- 9) After the swaging is complete, do the steps that follow.
- a) Make sure that the fittings are correctly installed.
    - <1> Use a go/no-go gage that is supplied with the tooling to verify that the fittings are installed correctly or check the dimensions using the tool manufacturer's instructions.
    - b) Reinstall any loose support clamps.
      - <1> Make sure that all support clamps are in place and secure at each location on the tube.
      - <2> Make sure that you do not clamp the tube at the repair fitting location.

NOTE: Clamps are sized to fit standard tube diameters. If a repair swage is clamped, the clamp can move off of the uniform surface because the tube can migrate or flex.

10) Pressurize the hydraulic system.

11) Do a leak check.

**C. Possible Scenario 2 (Replacement of Elbow, Tee Adapter, and Two Tube Sections)**

- (1) Repair Damage at Bend in Tube of P/N 272A4453-1007
- (a) Prepare for the Repair
    - 1) Required Tooling
      - a) DMC Tooling for Axially Swaged 5,000 psi rated fittings, sizes 04 and 06.
    - 2) Required Fittings (New)
      - a) AS5801T0404/DAS5801T0404 Elbow, Axial Swage to flareless swivel.
      - b) AS5806T060406/DAS5806T060406 Tee, Axial Swage on run to flareless swivel.
      - c) AS5969T0606/DAS5969T0606 Union, Axial Swage, tube-to-tube.
    - 3) Required Tubes (New)
      - a) Tube P/N 272A4453-1007 (no end fittings)

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- b) Tube P/N 272A4453–1001 (no end fittings)
- (b) Procedure
- 1) Remove pressure on the hydraulic system.
  - 2) Remove the old components.
    - a) Back off swivel nuts on AS5801T0404/DAS5801T0404 and AS5806T060406/DAS5806T060406 fittings.
    - b) Cut tube P/N 272A4453–1001 in a straight section.
    - c) Remove, as an assembly, the fittings, the -1007 tube, and the cut section of the -1001 tube.
    - d) Discard the fittings, the -1007 tube, and the cut section of the -1001 tube.
  - 3) Install the new components.
    - a) Put the new fittings, the -1007 tube, and the support clamps in place.
      - <1> Make sure that you do not clamp the tube at the repair fitting location.  
NOTE: Clamps are sized to fit standard tube diameters. If a repair swage is clamped, the clamp can move off of the uniform surface because the tube can migrate or flex.
    - b) Hand-tighten the swivel nuts.
    - c) Cut an appropriate section of new -1001 tube to replace the cut section.
    - d) Put the new section of the -1001 tube in place.
    - e) Splice the tube with AS5969T tube-to-tube union.
    - f) Torque the swivel nuts on the fittings.
      - <1> Use a backup wrench on the fitting wrench pad.
    - g) Secure the tube support clamps.
      - <1> Make sure that you do not clamp the tube at the repair fitting location.  
NOTE: Clamps are sized to fit standard tube diameters. If a repair swage is clamped, the clamp can move off of the uniform surface because the tube can migrate or flex.
    - h) Swage the parts using the tool manufacturer's instructions.
  - (c) Pressurize the system.
  - (d) Do a leak check of the system.

**D. Possible Scenario 3 (Replacement of Permanent Tee Fitting and Three Tube Sections)**

- (1) Repair Damage in Main Landing Gear Wheel Well Pressure Deck
- (a) Prepare for the Repair
- 1) Identify the damaged tube, the parts, and the tooling necessary to do the repair.
    - a) Locate the damaged area.
    - b) Identify the tube as part number 272A4452-1029 (0.375 in. (10 mm) diameter and 0.019 in. (0.483 mm) diameter).
    - c) Follow the tube in both directions to determine where you can make a splice.  
NOTE: The tube leading aft is permanently attached (axial swage) to the tee fitting. The tube length is less than the minimum tube length that can be replaced without replacing the tee fitting (see Figure 812 and Figure 816).



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- <1> The left section of the tube is very straight which is suitable for a splice. However, this section of the tube is behind a stringer which could make access to the splice area difficult.
- <2> The tube leading aft is permanently attached (axial swage) to the tee fitting. The tube length is less than the minimum tube length that can be replaced without replacing the tee fitting (see Figure 812 and Figure 816). Replace the tee fitting and portions of tubes 272A4452-1001, 272A4452-1026, and 272A4452-1029 using splice repairs in straight sections of each tube.
- d) Determine where to cut each tube that will be replaced.
  - <1> The 272A4452-1001 tube: cut approximately halfway (forward to aft direction) along the straight length before the bend.
  - <2> The 272A4452-1026 tube: cut approximately halfway between the support clamps that hold the 272A4452-1026 and 272A4452-1029 tubes.
  - <3> The 272A4452-1029 tube: cut behind the stringer at the location on the left side of the bend, approximately halfway between the support clamps that hold the 272A4452-1026 and 272A4452-1029 tubes.
- e) Determine the parts and tools that will be required to replace the tubes and fittings.
  - <1> Required Tooling
    - <a> See Table 807 for required tooling.
  - <2> Required Fittings (New)
    - <a> AS5972T060606/DAS5972T060606 Tee (one)
    - <b> AS5969T0606/DAS5969T0606 Tube-to-Tube Union (three)
  - <3> Required Tubes (New)
    - <a> 272A4452-1001 (no end fittings)
    - <b> 272A4452-1026 (no end fittings)
    - <c> 272A4452-1029 (no end fittings)
- (b) Remove the Damaged Tube Section
  - 1) Remove pressure from the hydraulic system.
  - 2) Tag each tube run outside of the sections that will be removed.
  - 3) Loosen or remove tube support clamps (as necessary).
    - a) For 272A4452-1026 Tube:
      - <1> Remove and retain the support clamps along the portion of the tube to the left.
      - <2> Make sure to remove the support clamp far enough to move the tube section away from the pressure deck so that you can cut the tube for splicing.
    - b) For 272A4452-1029 Tube:
      - <1> Remove and retain the support clamps along the portion of the tube to the left.
      - <2> Make sure to move the support clamp far enough to move the tube section from behind the stringer so that you can cut the tube for splicing.

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- 4) Cut each tube that you will replace.
  - a) Cut one tube at a time.
  - b) Tag each tube run after you remove each tube section.
  - c) Make a record of the original installation.

NOTE: This will help to make sure there is no tube cross-connection when the replacement tubes are installed.
- (c) Do the Repair
  - 1) Remove the 272A4452-1026 tube.

NOTE: Remove this tube first. This will allow access to the 272A4452-1029 tube.

    - a) Remove the support clamps (as necessary).
    - b) Move the tube away from the structure.
    - c) Cut the tube approximately halfway between the support clamp locations.
    - d) Cut the tube adjacent to the tee fitting (AS5972T060606/DAS5972T060606).

NOTE: This will allow the remaining section of the tube to be moved away from the stringer for the second cut where the splice will be placed.
    - e) Remove the cut portion of the tube.
      - <1> Save this section of tube for reference.
    - f) Deburr and chamfer the part of the 272A4452-1026 tube that is still attached to the airplane structure.
    - g) Make witness marks (see FLARELESS TUBING ASSEMBLY - REPAIRS, 20-10-51/801 and the fitting manufacturer's instructions).
    - h) Mark and cut a new section of 272A4452-1026 tubing.
      - <1> Use the cut section of tubing that was removed from the airplane to determine where the new tube should be cut.
      - <2> Use the Axial Swage Fitting Installation (5,000 psi rated - Union) or Male/Female Adapter Fittings, TASK 20-10-51-400-810 for making a splice repair with a AS5969T0606/DAS5969T0606 union.
      - <3> Deburr and chamfer both ends of the new tube section.
      - <4> Make witness marks on both ends of the new tube section (see FLARELESS TUBING ASSEMBLY - REPAIRS, 20-10-51/801 and the fitting manufacturer's instructions).
  - 2) Remove the 272A4452-1029 tube.
    - a) Remove the support clamps (as necessary).
    - b) Move the tube away from the structure.
    - c) Cut the tube approximately halfway between the support clamp locations.
    - d) Cut the tube adjacent to the tee fitting (AS5972T060606/DAS5972T060606).

NOTE: This will allow the remaining section of the tube to be moved away from the stringer for the second cut where the splice will be placed.
    - e) Remove the cut portion of the tube.
      - <1> Save this section of tube for reference.
    - f) Deburr and chamfer the part of the 272A4452-1029 tube that is still attached to the airplane structure.

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- g) Make witness marks (see FLARELESS TUBING ASSEMBLY - REPAIRS, 20-10-51/801 and the fitting manufacturer's instructions).
- h) Mark and cut a new section of 272A4452-1029 tubing.
  - <1> Use the cut section of tubing that was removed from the airplane to determine where the new tube should be cut.
  - <2> Use the Axial Swage Fitting Installation (5,000 psi rated - Union) or Male/Female Adapter Fittings, TASK 20-10-51-400-810 for making a splice repair with a AS5969T0606/DAS5969T0606 union.
  - <3> Deburr and chamfer both ends of the new tube.
  - <4> Make witness marks on both ends of the new tube (see FLARELESS TUBING ASSEMBLY - REPAIRS, 20-10-51/801 and the fitting manufacturer's instructions).
- 3) Remove the 272A4452-1001 tube.
  - a) Remove the support clamps (as necessary).
  - b) Move the tube away from the structure.
  - c) Cut the tube at the locations shown in FIGURE.
  - d) Remove the AS5972T060606/DAS5972T060606 tee fitting and the cut portion of the tube.
    - <1> Save this section of tube for reference.
  - e) Deburr and chamfer the part of the 272A4452-1001 tube that is still attached to the airplane structure.
  - f) Make witness marks (see FLARELESS TUBING ASSEMBLY - REPAIRS, 20-10-51/801 and the fitting manufacturer's instructions).
  - g) Mark and cut a new section of 272A4452-1001 tubing.
    - <1> Use the cut section of tubing that was removed from the airplane to determine where the new tube should be cut.
    - <2> Use the Axial Swage Fitting Installation (5,000 psi rated - Union) or Male/Female Adapter Fittings, TASK 20-10-51-400-810 for making a splice repair with a AS5969T0606/DAS5969T0606 union.
    - <3> Deburr and chamfer both ends of the new tube section.
    - <4> Make witness marks on both ends of the new tube section (see FLARELESS TUBING ASSEMBLY - REPAIRS, 20-10-51/801 and the fitting manufacturer's instructions).
- (d) Pre-assemble the tubes and fittings.
  - 1) Slide the AS5969T0606/DAS5969T0606 union fittings on the prepared ends of the 272A4452-1001, 272A4452-1026, and 272A4452-1029 tubes that are still attached to the airplane structure.
  - 2) Slide the replacement 272A4452-1029 tube section into the AS5969T0606/DAS5969T0606 union that is on the remaining section of 272A4452-1029 section that is attached to the airplane structure.
  - 3) Slide the replacement 272A4452-1026 tube section into the AS5969T0606/DAS5969T0606 union that is on the remaining section of the 272A4452-1026 section that is attached to the airplane structure.

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- 4) Slide the side leg of the new AS5972T060606/DAS5972T060606 tee fitting on the end of the new 272A4452-1026 tube.
  - 5) Slide the free end of the new 272A4452-1029 tube into one run leg of the new AS5972T060606/DAS5972T060606 tee fitting.
  - 6) Slide the forward end of the new 272A4452-1001 tube into the AS5972T060606/DAS5972T060606 tee fitting.
  - 7) Reinstall and tighten the support clamps on the 272A4452-1001, 272A4452-1026, and 272A4452-1029 tubes.
    - a) Make sure the AS5972T060606/DAS5972T060606 tee fitting stays in position.
    - b) Make sure that you do not clamp the tube at the repair fitting location.

NOTE: Clamps are sized to fit standard tube diameters. If a repair swage is clamped, the clamp can move off of the uniform surface because the tube can migrate or flex.
  - 8) On the new 272A4452-1001, 272A4452-1026, and 272A4452-1029 tubes, mark the position of the AS5969T0606/DAS5969T0606 union.
    - a) Make a felt tip mark across each fitting and tube.

NOTE: This will indicate the correct clocking during final installation.
    - b) Make sure that the new AS5972T060606/DAS5972T060606 tee fitting, AS5969T0606/DAS5969T0606 union fittings, and the replacement tubes are in the correct position.
      - <1> Make sure that they are correctly routed with no clearance issues and with no preload introduced.
  - 9) Mark the position of the AS5972T060606/DAS5972T060606 tee fitting on the 272A4452-1001, 272A4452-1026, and 272A4452-1029 tubes.
    - a) Make a felt tip mark across each fitting and tube.

NOTE: This will indicate the correct clocking during final installation.
- (e) Do the final installation of the tubes and fittings.
- 1) Remove the 272A4452-1026 and 272A4452-1029 tube sections.
    - a) Loosen and remove the clamps on the 272A4452-1026 and 272A4452-1029 tubes (as necessary).
      - <1> Make sure that you do not clamp the tube at the repair fitting location.

NOTE: Clamps are sized to fit standard tube diameters. If a repair swage is clamped, the clamp can move off of the uniform surface because the tube can migrate or flex.
    - b) Remove the end of the 272A4452-1026 tube from the AS5972T060606/DAS5972T060606 tee fitting.
      - <1> Swing the 272A4452-1026 tube to allow access to the 272A4452-1029 tube for swaging.
    - c) Remove the end of 272A4452-1029 tube from the AS5972T060606/DAS5972T060606 tee fitting.
      - <1> Move the tube away from the stringer far enough to allow for access to swage the tube to the AS5969T0606/DAS5969T0606 union fitting.
  - 2) Swage the fittings to 272A4452-1029 tube section.

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- a) Position the AS5969T0606/DAS5969T0606 union fitting to the witness marks on the end of the 272A4452-1029 tube that is attached to the airplane structure.
    - <1> Make sure that the fitting is centered on the tube ends at both sides of the joint.
  - b) Swage the fitting using Axial Swage Fitting Installation (5,000 psi rated - Union) or Male/Female Adapter Fittings, TASK 20-10-51-400-810 and the fitting manufacturer's instructions.
  - c) Position the AS5969T0606/DAS5969T0606 union fitting to the witness marks and to the clocking mark on the end of the new 272A4452-1029 tube.
    - <1> Make sure that the fitting is centered on the tube ends at both sides of the joint.
  - d) Swage the fitting using Axial Swage Fitting Installation (5,000 psi rated - Union) or Male/Female Adapter Fittings, TASK 20-10-51-400-810 and the fitting manufacturer's instructions.
  - e) Position the end of the 272A4452-1029 tube into the forward end of the AS5972T060606/DAS5972T060606 tee fitting.
  - f) Reposition the AS5972T060606/DAS5972T060606 tee and the 272A4452-1026 and the 272A4452-1029 tubes.
  - g) Reposition and tighten the support clamps on the straight portions to the left on the 272A4452-1026 and 272A4452-1029 tubes.
    - <1> Make sure that you do not tighten the forward support clamp on the 272A4452-1029 tube.
    - <2> Make sure that you do not clamp the tube at the repair fitting location.

NOTE: Clamps are sized to fit standard tube diameters. If a repair swage is clamped, the clamp can move off of the uniform surface because the tube can migrate or flex.
- 3) Swage the fittings to the 272A4452-1026 tube section.
    - a) Reposition the end of the 272A4452-1026 tube into the side leg of the AS5972T060606/DAS5972T060606 tee fitting.
    - b) Position the AS5969T0606/DAS5969T0606 union fitting to the witness marks on the end of the 272A4452-1026 tube that is attached to the airplane structure.
    - c) Swage the DAS5969T0606 union and 272A4452-1026 tube.
      - <1> Move the 272A4452-1026 tube away from the airplane structure if necessary for access.
      - <2> Use Axial Swage Fitting Installation (5,000 psi rated - Union) or Male/Female Adapter Fittings, TASK 20-10-51-400-810 and the fitting manufacturer's instructions.
    - d) Position the AS5969T0606/DAS5969T0606 union fitting to the witness marks and the clocking mark on the end of the new 272A4452-1026 tube.
      - <1> Make sure that the AS5972T060606/DAS5972T060606 tee fitting is in the correct position at the end of the 272A4452-1026 tube.
    - e) Swage the AS5969T0606/DAS5969T0606 union and 272A4452-1026 tube.

EFFECTIVITY  
AKS ALL

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- <1> Use Axial Swage Fitting Installation (5,000 psi rated - Union) or Male/Female Adapter Fittings, TASK 20-10-51-400-810 and the fitting manufacturer's instructions.
- 4) Swage the fittings to the 272A4452-1001 tube section.
- a) Position the AS5972T060606/DAS5972T060606 tee fitting to the witness marks and clock position mark on the 272A4452-1029 tube.
  - b) Position the AS5972T060606/DAS5972T060606 tee fitting to the witness marks and clock position mark on the 272A4452-1026 tube.
  - c) Position the AS5969T0606/DAS5969T0606 union fitting to the witness marks on the end of the 272A4452-1001 tube that is attached to the airplane structure.
  - d) Make sure that the opposite end of the 272A4452-1001 tube is correctly positioned in the AS5972T060606/DAS5972T060606 tee fitting.
  - e) Swage the AS5969T0606/DAS5969T0606 union fitting and the 272A4452-1001 tube that is attached to the airplane structure.  
<1> Use Axial Swage Fitting Installation (5,000 psi rated - Union) or Male/Female Adapter Fittings, TASK 20-10-51-400-810 and the fitting manufacturer's instructions.
  - f) Position the new 272A4452-1001 tube to the clocking mark on the AS5972T060606/DAS5972T060606 tee fitting.
  - g) Position the new AS5969T0606/DAS5969T0606 union fitting to the witness marks and the clocking mark on the new 272A4452-1001 tube.
  - h) Swage the AS5969T0606/DAS5969T0606 union fitting and the new 272A4452-1001 tube.  
<1> Use Axial Swage Fitting Installation (5,000 psi rated - Union) or Male/Female Adapter Fittings, TASK 20-10-51-400-810 and the fitting manufacturer's instructions.
  - i) Position the AS5972T060606/DAS5972T060606 tee fitting to the fitting marks and the clocking position mark on the 272A4452-1001 tube.
  - j) Swage the AS5972T060606/DAS5972T060606 tee fitting and the 272A4452-1001 tube.  
<1> Use Axial Swage Fitting Installation (5,000 psi rated - Union) or Male/Female Adapter Fittings, TASK 20-10-51-400-810 and the fitting manufacturer's instructions.
- 5) After the swaging is complete, do the steps that follow.
- a) Make sure that the fittings are correctly installed.  
<1> Use a go/no-go gage that is supplied with the tooling to verify that the fittings are installed correctly, or check the dimensions using the tool manufacturer's instructions.
  - b) Reinstall any loose support clamps.  
<1> Make sure that all support clamps are in place and secure at each location on each tube.

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AKS ALL

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<2> Make sure that you do not clamp the tube at the repair fitting location.

NOTE: Clamps are sized to fit standard tube diameters. If a repair swage is clamped, the clamp can move off of the uniform surface because the tube can migrate or flex.

- c) Remove any tagging used for marking the tubes for installation.
- 6) Pressurize the hydraulic system.
- 7) Do a leak check.

———— END OF TASK ————

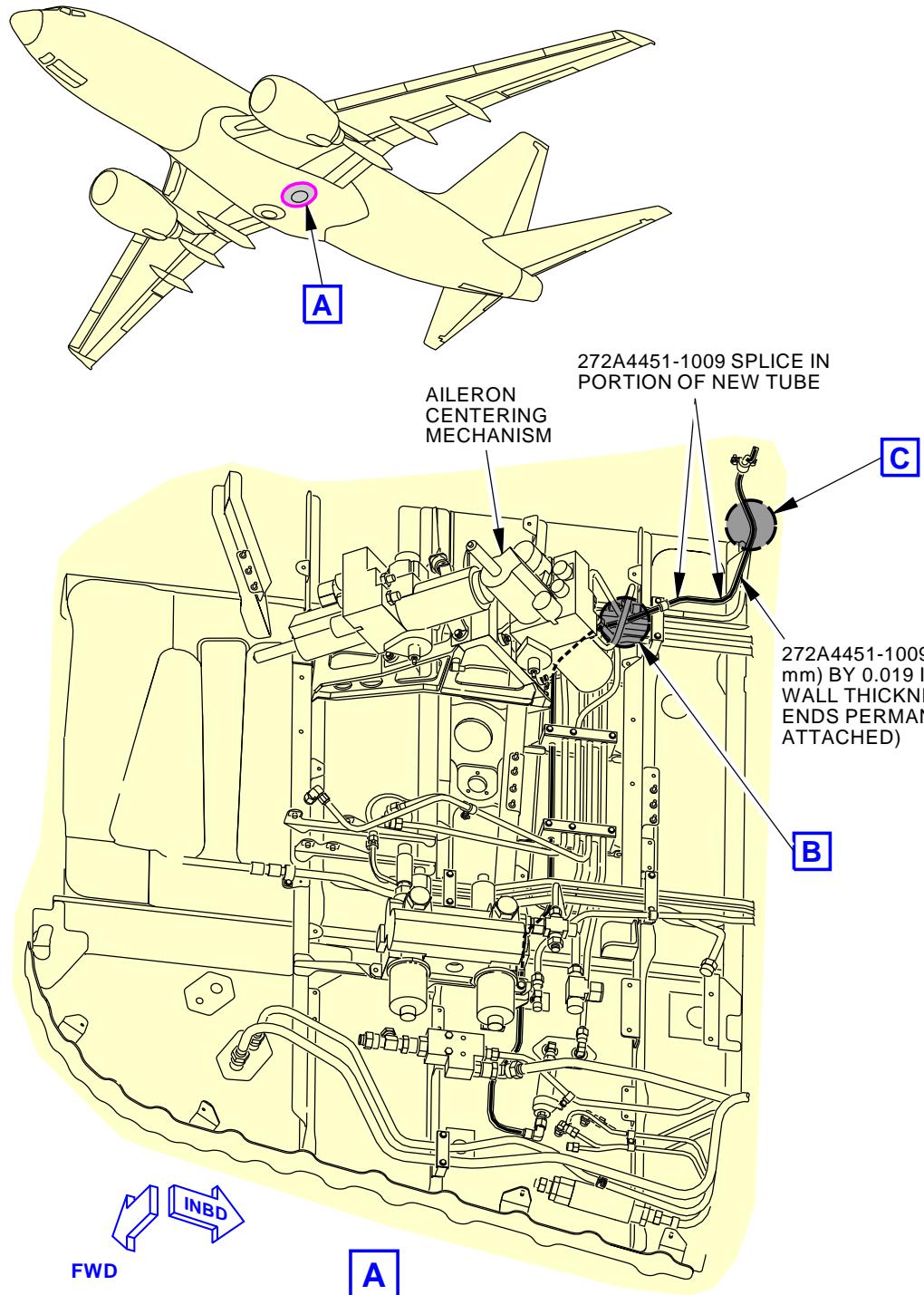
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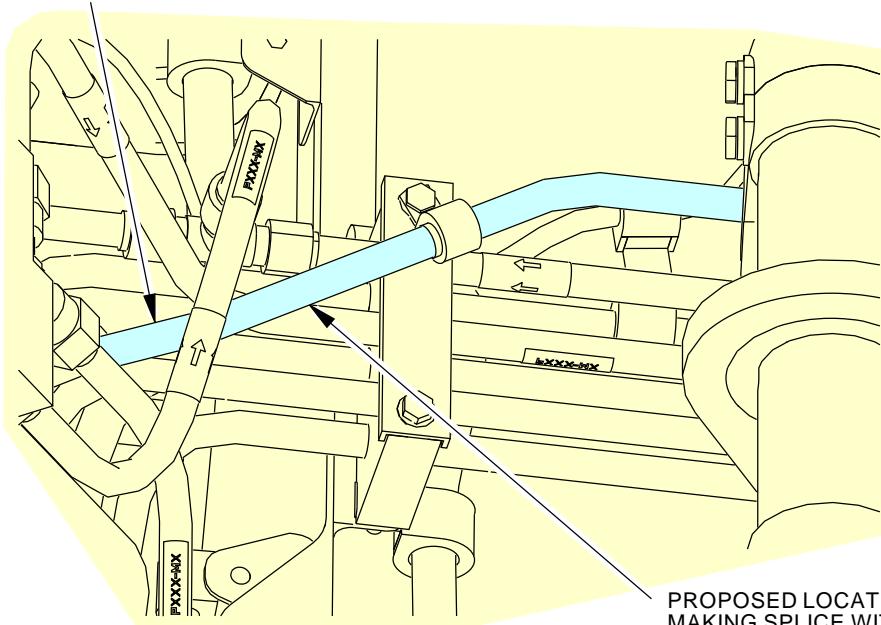
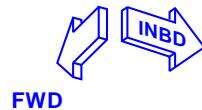
2017622 S0000399080\_V3

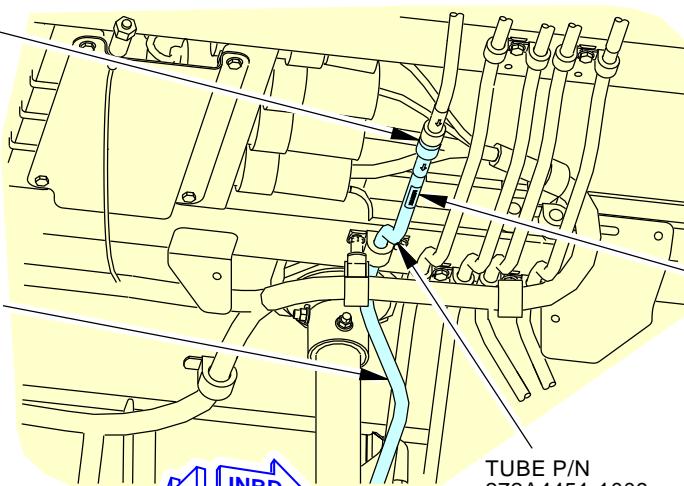
**Scenario 1**  
**Figure 836/20-10-51-990-866 (Sheet 1 of 2)**

EFFECTIVITY  
 AKS ALL

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TUBE P/N 272A4451-1009


PROPOSED LOCATION FOR  
MAKING SPLICING WITH  
TUBE-TO-TUBE AXIAL SWAGE  
(OR ALTERNATE) FITTING AT  
LOWER END OF TUBE.

**B**

EXISTING DAS5969T  
TUBE-TO-TUBE UNION  
FITTING (DELIVERED ON  
AIRPLANE)

PROPOSED LOCATION  
FOR MAKING SPLICING  
WITH TUBE-TO-TUBE  
AXIAL SWAGE FITTING  
AT TOP END OF TUBE.

**C**

2018568 S0000399456\_V2

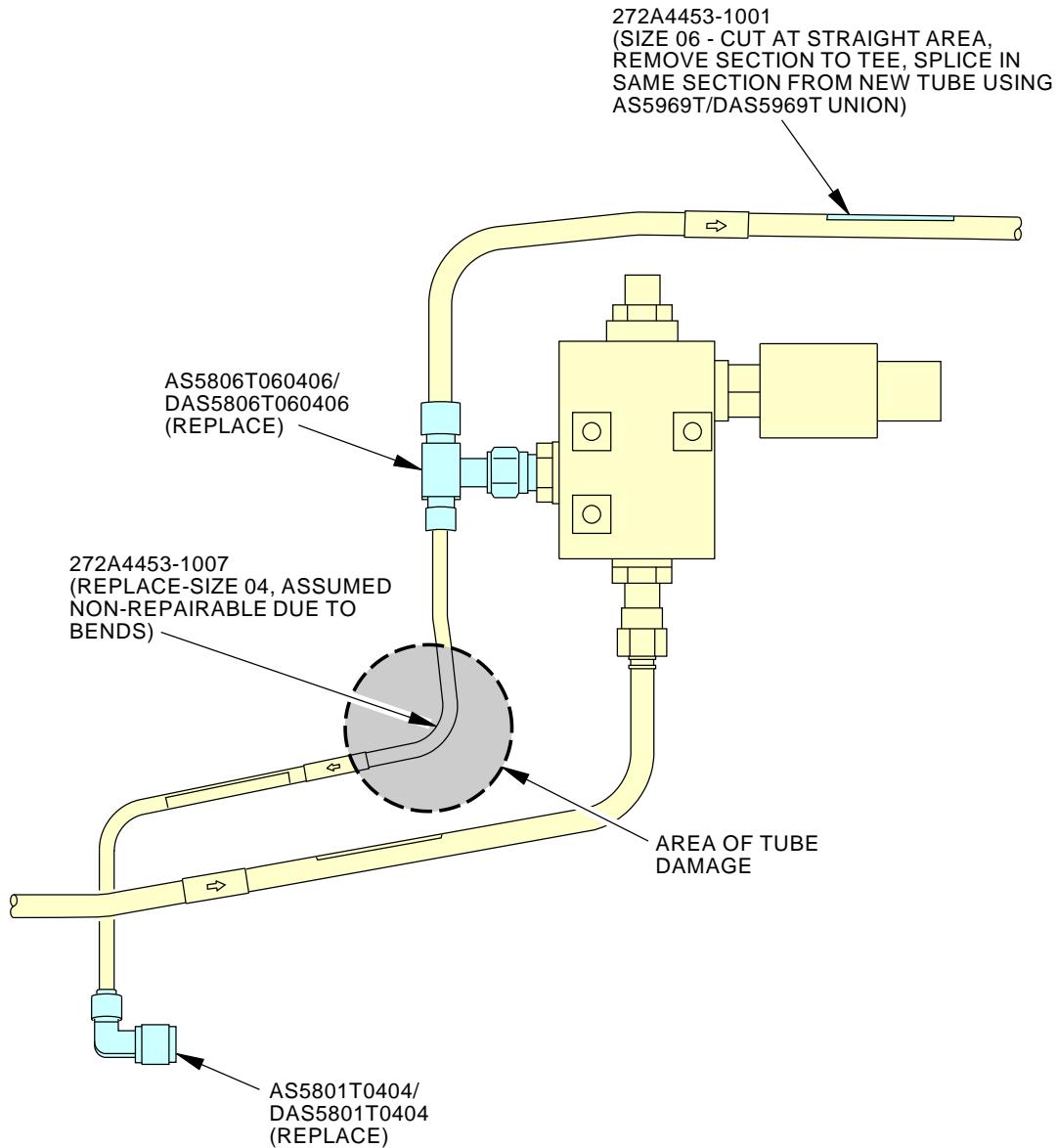
**Scenario 1**  
**Figure 836/20-10-51-990-866 (Sheet 2 of 2)**

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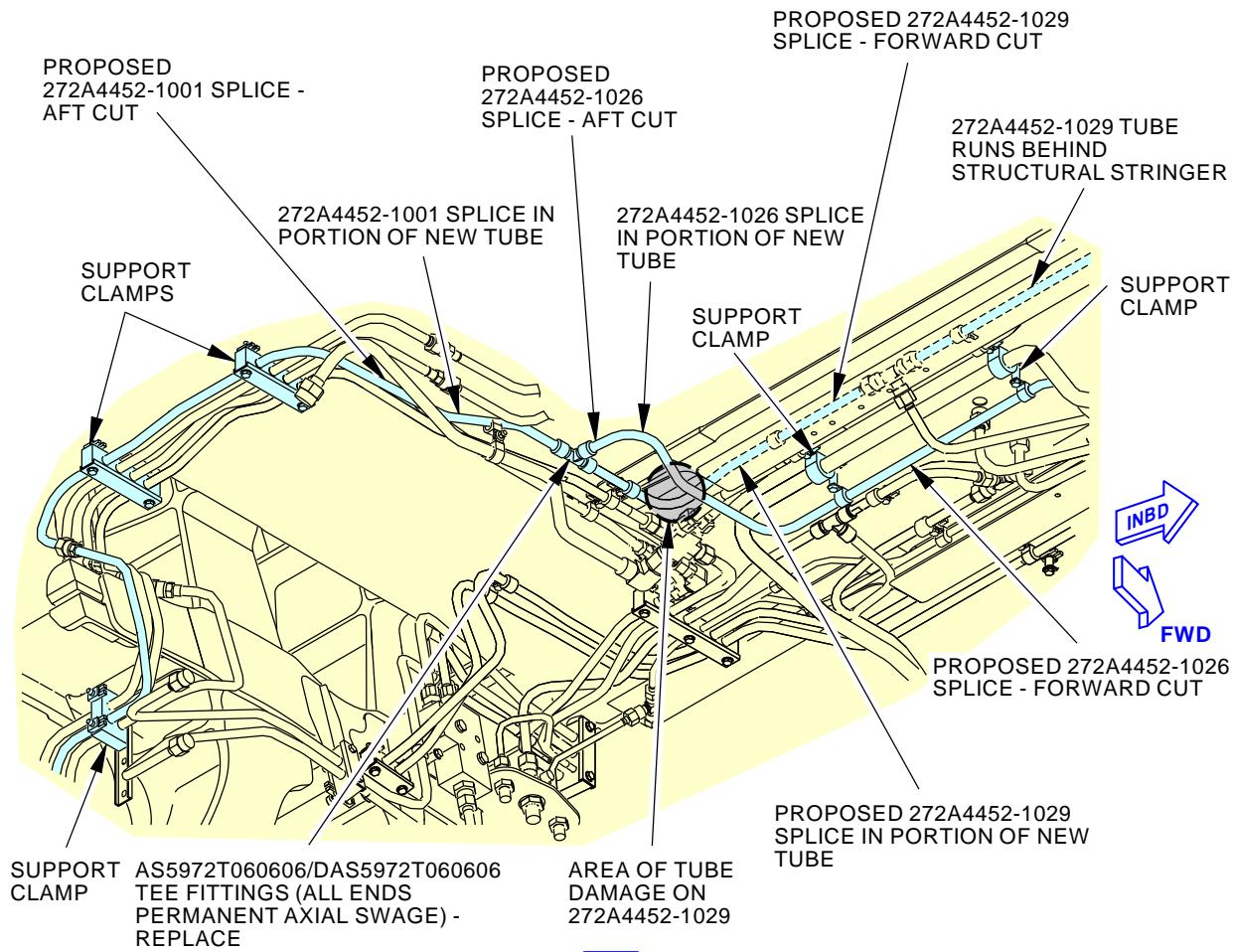
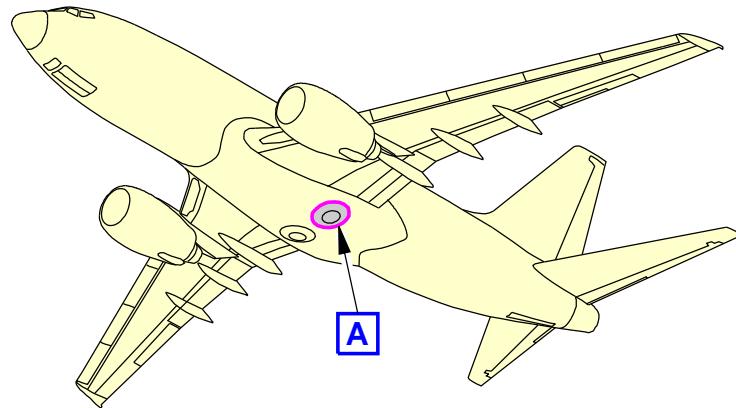


1931675 S0000365353\_V5

**Scenario 2**  
Figure 837/20-10-51-990-865

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2018450 S0000399083\_V4

**Scenario 3**  
**Figure 838/20-10-51-990-867**

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FLEXIBLE HOSE - MAINTENANCE PRACTICES

**1. General**

- A. This task gives maintenance practices for hydraulic hoses.

**TASK 20-10-52-211-801**

**2. CRES Hydraulic Hose - Examination**

**A. General**

- (1) CRES hydraulic hoses can also be referred to as "Teflon Hoses."
- (2) Teflon hoses are not subject to aging. The design objective for teflon hoses is that they are not life-limited.
- (3) Teflon is inert to contaminants found in aircraft applications. However, corrosive contaminants on a hose, particularly chlorine compounds, have resulted in corrosion pitting of the CRES wire braiding. Corrosion pitting of CRES hydraulic tubing has also been found in wheel wells and other areas. Periodic cleaning with a Boeing recommended cleaning solution (AIRPLANE CLEANING AND POLISHING - MAINTENANCE PRACTICES, PAGEBLOCK 12-40-00/201) along with coating of the hoses with corrosion preventative compound or equivalent could be beneficial.
- (4) Hose leakage and failure can be caused by:
  - (a) External damage that can cause a fatigue crack in the inner teflon tube.
  - (b) Vibration as a result of incorrect support.
  - (c) Preload induced in the hose during installation that will result in a fatigue related failure of the hose.

**B. References**

Reference	Title
12-40-00 P/B 201	AIRPLANE CLEANING AND POLISHING - MAINTENANCE PRACTICES
20-10-52 P/B 401	FLEXIBLE HOSE - REMOVAL/INSTALLATION

**C. CRES Hydraulic Hose Examination**

**SUBTASK 20-10-52-211-001**

- (1) CRES hoses should be examined for the conditions that follow.
  - (a) Kinks.
  - (b) Twisting.
  - (c) Chafing.
  - (d) Corrosion.
  - (e) Broken wires.
  - (f) Leakage.
  - (g) Missing/incorrect support.
  - (h) Bird-caging
- (2) Hoses that are found to be damaged should be replaced and the condition that caused the damage should be corrected.
  - (a) To replace the hose use the procedure FLEXIBLE HOSE - REMOVAL/INSTALLATION, PAGEBLOCK 20-10-52/401.

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- (3) Replace hoses if two or more wires in one plait are broken, or if several wires are broken in the same area. [See Figure 201]
  - (a) Broken wires can be found by careful visual inspection and/or carefully running a soft cloth over the outside of the hose.
  - (b) To replace the hose use the procedure FLEXIBLE HOSE - REMOVAL/INSTALLATION, PAGEBLOCK 20-10-52/401.
- (4) Special attention must be given to examine the sleeve and wire braid for damage at the hose end (hose-to-fitting transition).
  - (a) Replace hoses that have damaged fire sleeves (installed in high temperature areas) using procedure FLEXIBLE HOSE - REMOVAL/INSTALLATION, PAGEBLOCK 20-10-52/401.
- (5) Do a detailed visual inspection of the hose for bird-caging. [See Figure 202]  
NOTE: Bird-caging is a failure condition where the metal braiding is extended to a diameter more than the outer diameter of the braid ring.
  - (a) If bird-caging is found in the hose assembly, replace the hose.

———— END OF TASK ————

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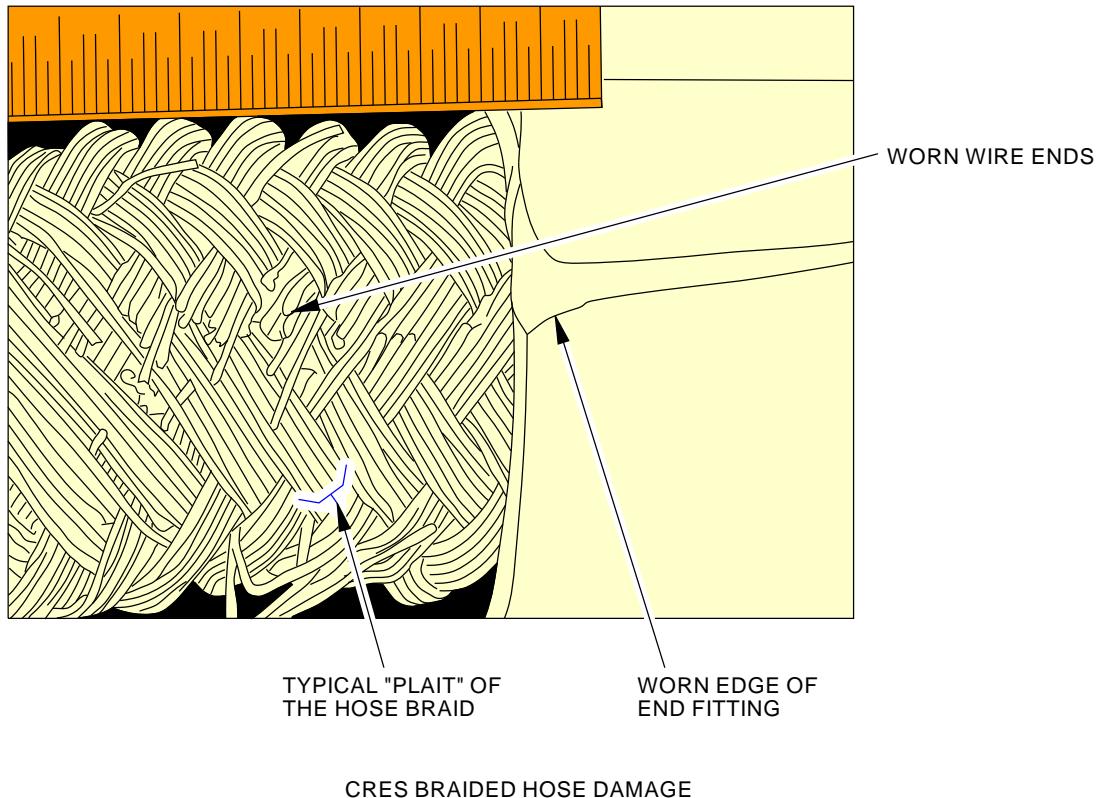
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**NOTE:**

EXAMPLE OF DAMAGED/FRACTURED WIRES IN HOSE SUPPORT BRAID  
AT ONE END OF A RUPTURED HOSE CAUSED BY CHAFING AND  
TWISTING OF THE HOSE IN SERVICE.

2324213 S0000527021\_V2

Hose Leakage Identification  
Figure 201/20-10-52-990-811

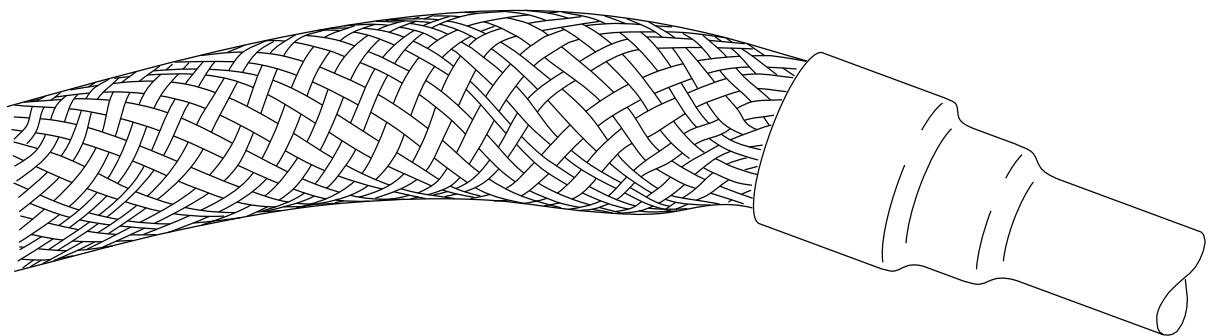
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EXAMPLE OF BIRD-CAGING

2020925 S0000401446\_V1

Hose Wear  
Figure 202/20-10-52-990-810

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**TASK 20-10-52-800-801**

**3. Spiral Sleeving - Installation**

**A. General**

- (1) This task gives the procedure to install spiral sleeving on hydraulic tubes and hoses.
- (2) Teflon or Nylon spiral cut sleeving can be used on hose assemblies or tube assemblies. The approved sleeving material is in Table 201 below.

**Table 201/20-10-52-993-804**

NAME	SPECIFICATION	RECOMMENDED MATERIALS
Nylon Sleeving	AS1294	Spirap 500036
		Spirap 500037
		V00779
		V05593
Teflon Sleeving		Spirap 500024
		V00779
		V05593
		V09106

- (3) The use of self-fusing silicone tape to secure the ends of the spiral cut sleeving that is installed around the hose or tube should only be used as a temporary repair if heat shrink tubing is not immediately available.

**B. Install the Spiral Sleeving**

**SUBTASK 20-10-52-420-005**

- (1) Wrap the spiral cut sleeving around the hose or tube.
  - (a) Make sure that each end of the sleeving is no closer than 0.5 in. (12.7 mm) from the end fitting.
  - (b) Cut the spiral sleeving ends perpendicular to the lead of the coil or the longitudinal axis of the coil.  
**NOTE:** This is to avoid sharp edges.
    - 1) Make sure to break any sharp corners at the cut.

**SUBTASK 20-10-52-420-006**

- (2) Secure the ends of the spiral cut sleeving.
  - (a) If it is available, use heat shrink tubing to secure both ends.
    - 1) See Table 202 for approved heat shrinking materials.

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Table 202/20-10-52-993-806

NAME	SPECIFICATION	RECOMMENDED MATERIALS
Heat Shrinkable Sleeving	MIL-I-23053	*[1]
	MIL-R-46846	*[1]
		Raychem RT850 (V06090) Raychem RT876 (V06090) Raychem MIL-LT (V06090) Plastronics PLF100 (V00Q87) Raychem RNF100 (V06090)

\*[1] Refer to the applicable Qualified Parts List, or equivalent list, of the specification listed for approved material part numbers and vendors.

- (b) If heat shrink tubing is not available, use self-fusing silicone tape until heat shrink tubing is available to use.

NOTE: Boeing recommends that the operator use self-fusing silicone tape only as a temporary repair.

- 1) Use self-fusing silicone tape and tie wraps to secure the sleeving.
  - a) See Table 203 below for allowable silicone tape material.

Table 203/20-10-52-993-805

NAME	SPECIFICATION	RECOMMENDED MATERIAL
Silicone Tape		Permacel 2650, V99742
		Scotch 70, V76381

— END OF TASK —

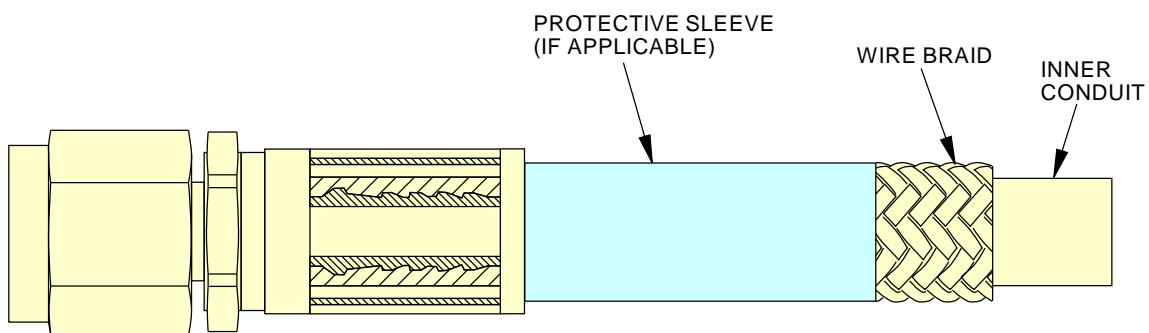
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1971078 S0000378685\_V2

CRES Spiral Sleeving  
Figure 203/20-10-52-990-805

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**TASK 20-10-52-400-802**

**4. Protective Lacing - Installation**

**A. Consumable Materials**

Reference	Description	Specification
A00027	Adhesive - Silicone Rubber, 1 Part, RTV	BAC5010 Type 60
G00057	Tape - PTFE Film With Acrylic Adhesive, 3M 63 Tape	
G02503	Lacing - Varflex Nylon Untreated Sleeving, 1/8 Inch I.D. (Ref P/N 65-96194-1)	A-A-59301

**B. Procedure - Install the Protective Lacing**

SUBTASK 20-10-52-400-001

- (1) Install the protective Varflex lacing sleeve, G02503 as shown in (Figure 204), steps 1 through 3, except nose landing gear.

SUBTASK 20-10-52-400-002

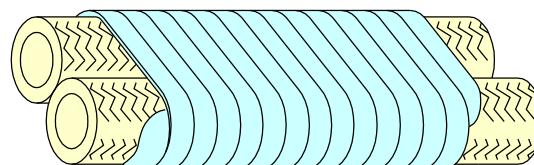
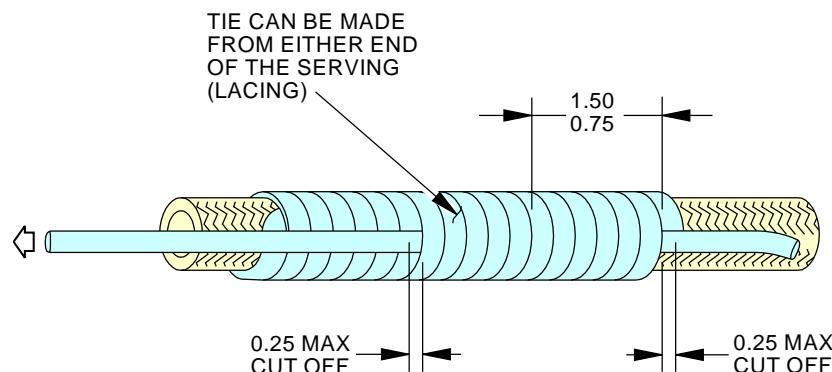
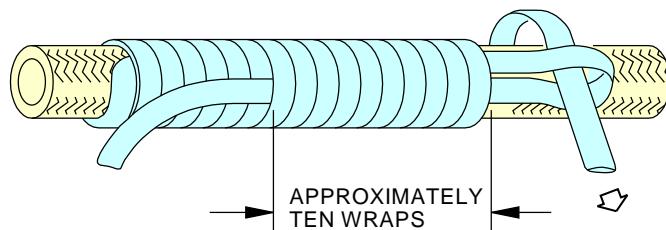
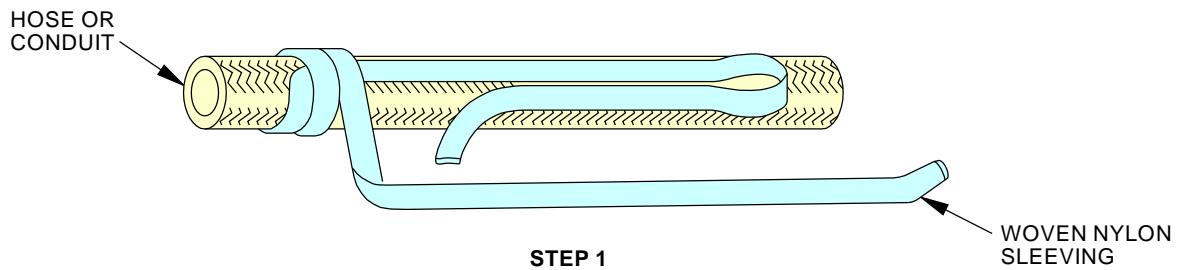
- (2) Install the protective Varflex lacing sleeve, G02503 on nose landing gear as shown in (Figure 204), steps 1 through 3.
  - (a) Prior to pulling lock lace through, (step 3), apply adhesive, A00027 to the lace.
  - (b) Pull laces into place, (step 3), this will bond the laces in place.
  - (c) Apply two layers of 3M 63 tape, G00057 over the lacing.
    - 1) Spirally wrap each layer with a 50% overlap and reverse the direction of the spiral with each layer.
    - 2) Extend the tape 1.0 in. (25.4 mm) to 1.5 in. (38.1 mm) beyond each end of the lacing.

———— END OF TASK ————

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**FOR TWO OR MORE HOSES**

**NOTE:**

ALL DIMENSIONS ARE IN INCHES.

K12749 S0006562037\_V3

**Protective Lacing Installation**  
**Figure 204/20-10-52-990-806**

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TASK 20-10-52-910-801

5. Correct Torque Value Determination for a Hydraulic Hose Assembly

A. General

- (1) This task will help determine the correct torque value for Hydraulic Hose Assembly. For further information, please refer to Service Letter per model (see Table 204).

**Table 204/20-10-52-993-812 Service Letter for All Models**

Models
737-SL-29-119
747-SL-29-078
757-SL-29-054
767-SL-29-067
777-SL-29-041

B. References

Reference	Title
20-10-51-993-930	Table: Hydraulic Fitting Material Codes (P/B 201)

C. Procedure

SUBTASK 20-10-52-200-003

- (1) Evaluate the hose part number to verify the fitting end sizes and materials on the hose. See example namesplates Table 205, Table 206, Table 207 and Figure 205 for additional data.

**Table 205/20-10-52-993-813 Example Hose Definition 1: Hydraulic Hose P/N BACH8A04EN0294K**

Breakdown	Definition
BACH8A	Basic Hose Part Number (P/N)
04	Hose size (04 = 0.250 Inch Dia.)
EN	Fitting End Size "E" = Expander End No. 1 — 06 (0.375 inch) "N" = Nominal End No. 2 — 04 (0.250 inch) Note: an "R" code letter appearing here = Reducer
029	Length in Whole Inches 029 X 1.0 = 29.0 Inches
4	Fractional Length in Eighths of an Inch Increments 4 X 0.125 = 0.500
K	Braided Polyester Abrasion Sleeve (Blue Color)

NOTE: Basic hose P/N, BACH8A, defines a 3,000 PSI operating pressure, PTFE inner tube with corrosion resistant Steel (CRES) wire braid reinforcement, lightweight Hydraulic hose with straight flareless CRES end fittings.

**Table 206/20-10-52-993-815 Example Hose Definition 2: Hydraulic Hose P/N AS115-06K0344**

Breakdown	Definition
AS115	Basic Hose Part Number (P/N)
06	Hose Size (06 = 0.375 Inch Dia.)
K	Integral Braided Polyester Abrasion Sleeve (Blue Color)

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**Table 206/20-10-52-993-815 Example Hose Definition 2: Hydraulic Hose P/N AS115-06K0344  
(Continued)**

Breakdown	Definition
034	Length in Whole Inches 034 X 1.0 = 34.0 Inches
4	Fractional Length in Eighths of an Inch Increments 4 X 0.125 = 0.500 Inch

NOTE: Basic hose P/N, AS115, defines a 3,000 PSI operating pressure, PTFE inner tube with corrosion resistant Steel (CRES) wire braid reinforcement, lightweight hydraulic hose with straight flareless CRES end fittings.

**Table 207/20-10-52-993-816 Example Hose Definition 3: "Para-Aramid" Reinforced Hydraulic Hose P/N AS4568G0344SS**

Breakdown	Definition
AS4568	Basic Hose Part Number (P/N)
G	Hose Size (G = 0.375 Inch)
-	Sleeve Code, (-) = No Sleeve
034	Length in Whole Inches, 034 X 1.0 = 34.0 Inches
4	Fractional Length in Eighths of an Inch Increments 4 x 0.125 = 0.500 Inch
S	1st Straight Fitting End (Hose Size)
S	2nd Straight Fitting End (Hose Size)

NOTE: Basic hose P/N, AS4568, defines a 3,000 PSI operating pressure, PTFE inner tube with "Para-Aramid" braid reinforcement, lightweight hydraulic hose with straight flareless titanium end fittings, reduce/expander options available.

**SUBTASK 20-10-52-200-004**

- (2) Use the Illustration Parts Catalog (IPC) to determine the materials of the parts that you will attach the hose ends to.

NOTE: A mating fitting made from aluminum material requires lower torque value than a titanium or CRES fitting.

NOTE: Components that are attached to hose ends usually have flareless union fittings installed to the external ports. See Table 20-10-51-993-930 to identify hydraulic fitting materials.

**SUBTASK 20-10-52-910-001**

- (3) Select and apply the correct torque values. Use Table 208 to locate the correct torque values per model:

**Table 208/20-10-52-993-817 Installation Torque for Flareless Tubing Fittings Table for all Models**

Models	Location in AMM
737-300/400/500	20-50-11/201
737-600/700/800/900	20-50-11/201
747-400	20-51-01/201
747-8	20-51-01/201
757	20-11-00/201
767	20-11-00/201

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**Table 208/20-10-52-993-817 Installation Torque for Flareless Tubing Fittings Table for all Models  
(Continued)**

Models	Location in AMM
777	20-11-00/201

———— END OF TASK ————

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HYDRAULIC HOSE IDENTIFICATION					
HOSE CONFIGURATION AND USAGE	ILLUSTRATION	PART NUMBER	HOSE SIZES	END SIZES (NON-REDUCER - SAME AS HOSE SIZE)	
				MATERIAL AND RATING DATA HOSE BRAID MATERIAL / END FITTING MATERIAL	
Straight-to-Straight, Non-Reducer		AS115	04 THROUGH 16	04 THROUGH 16	CRES/CRES 3,000 PSI
Straight-to-45 Degree, Non-Reducer		AS116	04 THROUGH 16	04 THROUGH 16	CRES/CRES 3,000 PSI
Straight-to-90 Degree, Non-Reducer		AS117	04 THROUGH 16	04 THROUGH 16	CRES/CRES 3,000 PSI
45 Degree-to-45 Degree, Non-Reducer		AS118	04 THROUGH 16	04 THROUGH 16	CRES/CRES 3,000 PSI
45 Degree-to-90 Degree, Non-Reducer		AS119	04 THROUGH 16	04 THROUGH 16	CRES/CRES 3,000 PSI
90 Degree-to-90 Degree, Non-Reducer		AS120	04 THROUGH 16	04 THROUGH 16	CRES/CRES 3,000 PSI
EXAMPLE OF PART NUMBER:					
AS115 08 K 024 2 BASIC P/N _____ FRACTION OF HOSE HOSE SIZE (08) LENGTH IN EIGHTHS OF K = INTEGRAL BLUE POLYESTER ABRASION SLEEVE AN INCH (0.25 INCH) HOSE LENGTH IN WHOLE INCHES L = COTL ABRASION SLEEVE					
BOEING APPROVED SLEEVE CODES: " " = NO SLEEVING B = NYLON ABRASION SLEEVE F = POLYOLEFIN ABRASION SLEEVE H = INTEGRAL SILICONE FIRESLEEVE (15 MINUTE) K = INTEGRAL BLUE POLYESTER ABRASION SLEEVE L = COTL ABRASION SLEEVE PROCUREMENT SPECIFICATION IS AS1339.					

**NOTE:** NOT KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.

2331246S0000527957\_V1

**Hydraulic Hose Identification**  
**Figure 205/20-10-52-990-812 (Sheet 1 of 5)**

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HYDRAULIC HOSE IDENTIFICATION (CONTINUED)				END SIZES (NON-REDUCER - SAME AS HOSE SIZE)	MATERIAL AND RATING DATA	
HOSE CONFIGURATION AND USAGE	ILLUSTRATION	PART NUMBER	HOSE SIZES		HOSE BRAID MATERIAL/END FITTING MATERIAL	PRESSURE RATING
STRAIGHT-TO-STRAIGHT, EXPANDER-REDUCER		BACH8A	04 THROUGH 12	04 THROUGH 16	CRES/CRES	3,000 PSI
STRAIGHT-TO-45 DEGREE, EXPANDER-REDUCER		BACH8B	04 THROUGH 12	04 THROUGH 16	CRES/CRES	3,000 PSI
STRAIGHT-TO-90 DEGREE, EXPANDER-REDUCER		BACH8C	04 THROUGH 12	04 THROUGH 16	CRES/CRES	3,000 PSI
<b>EXAMPLE OF PART NUMBER:</b>  <b>FITTING ENDS (SEE STANDARD):</b> NO. 1 END - SIZE 10', STRAIGHT NO. 2 END - SIZE 06', STRAIGHT				BOEING APPROVED SLEEVE CODES: " " = NO SLEEVING B = NYLON ABRASION SLEEVE F = POLYOLEFIN ABRASION H = INTEGRAL SILICONE FIRESLEEVE (15 MINUTE) K = INTEGRAL BLUE POLYESTER ABRASION SLEEVE L = COIL ABRASION SLEEVE		
E = EXPANDER N = NORMAL (SAME AS HOSE SIZE) R = REDUCER					PROCUREMENT SPECIFICATION IS AS1339.	

**Hydraulic Hose Identification  
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HYDRAULIC HOSE IDENTIFICATION (CONTINUED)						
HOSE CONFIGURATION AND USAGE	ILLUSTRATION	PART NUMBER	HOSE SIZE	MINIMUM END SIZE	MAXIMUM END SIZE	MATERIAL AND RATING DATA
						HOSE BRAID MATERIAL/END FITTING MATERIAL
A. STRAIGHT-TO-Straight, EXPANDER/REDUCER	A.	BACH6M	04	04	06	MULTI-LAYER CRES/CRES 3,000 PSI
B. STRAIGHT-TO-45 DEGREE, EXPANDER/REDUCER	B.	BACH6P	06	04	08	MULTI-LAYER CRES/CRES 3,000 PSI
C. STRAIGHT-TO-90 DEGREE, EXPANDER/REDUCER	C.	BACH6R	08	06	10	MULTI-LAYER CRES/CRES 3,000 PSI
	NOTE: SEE BOEING STANDARD BACH6MTHRUH6V.	BACH6S	10	08	12	MULTI-LAYER CRES/CRES 3,000 PSI
A. STRAIGHT-TO-Straight, EXPANDER/REDUCER	A.	BACH6T	12	10	16	MULTI-LAYER CRES/CRES 3,000 PSI
B. STRAIGHT-TO-45 DEGREE, EXPANDER/REDUCER	B.					
C. STRAIGHT-TO-90 DEGREE, EXPANDER/REDUCER	C.	BACH6V	16	12	16	MULTI-LAYER CRES/CRES 3,000 PSI
	NOTE: SEE BOEING STANDARD BACH6MTHRUH6V					
<b>EXAMPLE OF PART NUMBER:</b> BACH6 P 035 4 AT N BASIC P/N _____ HOSE LENGTH IN WHOLE INCHES _____ HOSE SIZE (06) _____ N = PTFE ABRASION SLEEVE PURPLE BM33-11 BAND CRES FITTINGS END NO. 1: SIZE 06, 90 DEGREE ELBOW END NO. 2: SIZE 04, STRAIGHT FITTING FRACTION OF HOSE LENGTH IN EIGHTHS OF AN INCH (0.50 INCH)						
BOEING APPROVED SLEEVE CODES: CONSULT BOEING STANDARD BACH6MTHRUH6V FOR TABLES SHOWING SLEEVE CODES AND END FITTING SIZE COMBINATIONS. PROCUREMENT SPECIFICATION IS BPS-H-95. NOTE: BACH6MTHRUH6V IS NOW INACTIVE FOR BOEING DESIGN AND PROCUREMENT.						

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HOSE CONFIGURATION AND USAGE	ILLUSTRATION	PART NUMBER	HOSE SIZE	MINIMUM END SIZE	MAXIMUM END SIZE	MATERIAL AND RATING DATA	
						HOSE BRAID MATERIAL/END FITTING MATERIAL	PRESSURE RATING
A. STRAIGHT-TO-STRaight, EXPANDER/REDUCER	A.	BACH5M	04	04	06	CRES/304 CRES OR ALUM*	1,500 PSI
B. STRAIGHT-TO-45 DEGREE, EXPANDER/REDUCER	B.	BACH5P	06	04	08	CRES/304 CRES OR ALUM*	1,500 PSI
C. STRAIGHT-TO-90 DEGREE, EXPANDER/REDUCER	C.	BACH5R	08	06	10	CRES/304 CRES OR ALUM*	1,500 PSI
*NOTE: SEE BOEING STANDARD BACH5MTHRUH5X.		BACH5S	10	08	12	CRES/304 CRES OR ALUM*	1,500 PSI
*NOTE: SEE BOEING STANDARD BACH5MTHRUH5X.		BACH5T	12	10	16	CRES/304 CRES OR ALUM*	1,000 PSI
*NOTE: SEE BOEING STANDARD BACH5MTHRUH5X.		BACH5V	16	12	20	CRES/304 CRES OR ALUM*	1,000 PSI
*NOTE: SEE BOEING STANDARD BACH5MTHRUH5X.		BACH5W	20	16	20	CRES/304 CRES OR ALUM*	1,000 PSI
*NOTE: SEE BOEING STANDARD BACH5MTHRUH5X.		BACH5X	16	20 (SHORT FLARELESS)	20 (SHORT FLARELESS)	CRES/304 CRES OR ALUM*	1,000 PSI
<b>EXAMPLE OF PART NUMBER:</b> BACH5 P 040 6 AT T = TFE ABRASION SLEEVE BASIC P/N _____ HOSE SIZE (06) _____ GRES FITTINGS END NO. 1: SIZE 04 STRAIGHT END NO. 2: SIZE 06 90 DEGREE ELBOW HOSE LENGTH IN _____ WHOLE INCHES _____ FRACTION OF HOSE LENGTH IN EIGHTHS OF AN INCH (0.75 INCH)							
L SUFFIX = COUPLING NUTS DRILLED FOR LOCKWIRE BOEING APPROVED SLEEVE CODES: BLANK = NONE F = FIRE SLEEVE S = SPIRAL WRAP POLYAMIDE OR TEFLON ABRASION SLEEVE T = TUBULAR TEFLON ABRASION SLEEVE P = TUBULAR POLYOLEFIN ABRASION SLEEVE CONSULT BOEING STANDARD BACH5MTHRUH5X FOR TABLE SHOWING END FITTING SIZE COMBINATIONS; PROCUREMENT SPECIFICATION IS AS1946							

**Hydraulic Hose Identification  
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HYDRAULIC HOSE IDENTIFICATION (CONTINUED)						MATERIAL AND RATING DATA	
HOSE CONFIGURATION AND USAGE	ILLUSTRATION	PART NUMBER	HOSE SIZE	MINIMUM END SIZE	MAXIMUM END SIZE	HOSE BRAID MATERIAL / END FITTING MATERIAL	
						PRESSURE RATING	1,000 PSI (SIZES 04 THROUGH 20, 750 PSI (SIZE 24))
STRAIGHT-TO-Straight, Non-REDUCER		AS1633	04 THROUGH 24	04	24	CRES/CRES	1,000 PSI (SIZES 04 THROUGH 20, 750 PSI (SIZE 24))
STRAIGHT-TO-45 DEGREE, Non-REDUCER		AS1634	04 THROUGH 24	04	24	CRES/CRES	1,000 PSI (SIZES 04 THROUGH 20, 750 PSI (SIZE 24))
STRAIGHT-TO-90 DEGREE, Non-REDUCER		AS1635	04 THROUGH 24	04	24	CRES/CRES	1,000 PSI (SIZES 04 THROUGH 20, 750 PSI (SIZE 24))
45 DEGREE-TO-45 DEGREE, Non-REDUCER		AS1636	04 THROUGH 24	04	24	CRES/CRES	1,000 PSI (SIZES 04 THROUGH 20, 750 PSI (SIZE 24))
45 DEGREE-TO-90 DEGREE, Non-REDUCER		AS1637	04 THROUGH 24	04	24	CRES/CRES	1,000 PSI (SIZES 04 THROUGH 20, 750 PSI (SIZE 24))
90 DEGREE-TO-90 DEGREE, Non-REDUCER		AS1638	04 THROUGH 24	04	24	CRES/CRES	1,000 PSI (SIZES 04 THROUGH 20, 750 PSI (SIZE 24))
EXAMPLE OF PART NUMBER: AS1638 H 24 2 H 270 A						AS1634, AS1635, AS1636, AS1637, AS1638 HOSE SIZE INFORMATION:	
HOSE SIZE (08) ————— ANGULAR ORIENTATION OF END FITTINGS IN 1 DEGREE INCREMENTS (270 DEGREES)						E = SIZE 04 G = SIZE 06 H = SIZE 08	J = SIZE 10 K = SIZE 12 M = SIZE 16
HOSE LENGTH IN WHOLE INCHES ————— H = INTEGRAL FIRESLEEVE FRACTION OF HOSE LENGTH IN EIGHTHS OF AN INCH (0.25 INCH)						N = SIZE 20 P = SIZE 24	BOEING APPROVED SLEEVE CODES:
						B = SPIRAL ABRASION SLEEVE	H = INTEGRAL FIRE SLEEVE
						K = INTEGRAL BLUE POLYESTER ABRASION SLEEVE	PROCUREMENT SPECIFICATION IS AS1633; HOSE FITTING PER AS620.

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NOTE: NOT KEPT UP TO DATE - ALWAYS CONSULT LATEST REVISION OF FITTING STANDARD FOR P/N AND SUPERSESSION DATA.

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**Hydraulic Hose Identification  
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FLEXIBLE HOSE - REMOVAL/INSTALLATION

**1. General**

- A. You must consult with Boeing before conducting any repairs to oxygen tubing system.
- B. This procedure has these tasks:
  - (1) A removal of the flexible hose.
  - (2) An installation of the flexible hose.
- C. This procedure gives general instructions for the installation of flexible hoses. If there is a special procedure for a specified system, use the special procedure.
- D. Flexible hoses do not have a specified life limit. Inspect flexible hoses to the applicable operator's standard.
- E. Before you do maintenance on oxygen system flexible hoses, read the oxygen system safety precautions and general maintenance instructions, Crew Oxygen System: CREW OXYGEN SYSTEM - MAINTENANCE PRACTICES, PAGEBLOCK 35-12-00/201, or the applicable Passenger Oxygen System maintenance practices.
- F. Use thread compounds from Table 401.

**Table 401/20-10-52-993-818 Flexible Hose Assembly Thread Compounds**

TYPE OF SYSTEM	BULK CODE	APPROVED THREAD COMPOUNDS (STRAIGHT THREAD FITTINGS)
Compressed Gas	D50004	Antiseize Compound BMS 3-28
Deicing or (Anti-icing)	D50004	Antiseize Compound BMS 3-28
Instrument Air	D50004	Antiseize Compound BMS 3-28
Pneumatic	D50004 D50062	Antiseize Compound BMS 3-28 or Pneumatic Grease AMS-G-4343
Air Conditioning	D50004 D01062 D00062	Antiseize Compound BMS3-28 or Never-Seez Pure Nickel Special or Pneumatic Grease AMS-G-4343
Fire Protection	D50004	Antiseize Compound BMS 3-28
Coolant	D00070 D00467	Hydraulic Fluid MIL-PRF-5606 or Shock Strut Fluid BMS 3-32 Type II
Water Injection	D50004	Antiseize Compound BMS3-28
Fuel	D00070 D00467	Hydraulic Fluid MIL-PRF-5606 or Shock Strut Fluid BMS 3-32 Type II
Lubrication	D00070 D00467	Hydraulic Fluid MIL-PRF-5606 or Shock Strut Fluid BMS 3-32 Type II
Hydraulic MIL-PRF-5606	D00070 D00467	Hydraulic Fluid MIL-PRF-5606 or Shock Strut Fluid BMS 3-32 Type II
Hydraulic BMS 3-11	D00054	Skydrol Assy Lube MCS 352B
Hydraulic Tubing MIL-PRF-6083	D00070 D00106 D00467	Hydraulic Fluid MIL-PRF-5606 or Hydraulic Fluid MIL-PRF-6083 or Shock Strut Fluid BMS 3-32 Type II

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Table 401/20-10-52-993-818 Flexible Hose Assembly Thread Compounds (Continued)

TYPE OF SYSTEM	BULK CODE	APPROVED THREAD COMPOUNDS (STRAIGHT THREAD FITTINGS)
Misc Tubing	D50004 D00053	Antiseize Compound BMS3-28 or Grease AMS-G-6032

**TASK 20-10-52-000-801**

**2. Flexible Hose Removal**

(Figure 401)

**A. Procedure**

SUBTASK 20-10-52-480-001

**CAUTION:** PUT CAPS ON THE HOSES AND FITTINGS. UNWANTED MATERIAL CAN CAUSE CONTAMINATION OF HOSES, DAMAGE TO SYSTEM COMPONENTS, AND LEAKAGE OF FLUID. SOME FLUID CAN CAUSE CORROSION OR OTHER DAMAGE.

- (1) Install caps on the hose assemblies and mating connections.

**NOTE:** Caps keep out moisture and unwanted material until the hose is again connected to its system.

SUBTASK 20-10-52-020-001

- (2) Remove the flexible hose.

(a) Do not use the hose if two or more wires in one plait are broken, or if several wires are broken in a concentrated area.

- (3) If it is necessary, remove the clamps.

— END OF TASK —

**TASK 20-10-52-400-801**

**3. Flexible Hose Installation**

(Figure 401)

**A. References**

Reference	Title
20-50-11-910-801	Standard Torque Values (P/B 201)

**B. Procedure**

SUBTASK 20-10-52-210-001

- (1) Prior to hose installation do a visual check of the hose assembly to determine its condition.

(a) Look at the hose, fittings, sealing surfaces, and outer coverings for damage.

(b) Do the following if you find broken wires in the outer covering:

- 1) Put a tag on the hoses that have isolated or random broken wires.

**NOTE:** This is to identify the hose for future inspections.

- 2) Do not use the hose if two or more wires in one plait are broken, or if several wires are broken in a concentrated area.

- (2) Make sure all the hose fittings are clean and free of defects.

**NOTE:** Hoses that look like they have been kinked must be replaced.

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SUBTASK 20-10-52-640-001

- (3) Lubricate the external threads as necessary with the correct lubricant.

SUBTASK 20-10-52-420-001

- (4) Put the hose in position and tighten the fitting by hand.

SUBTASK 20-10-52-210-002

- (5) Examine the installation for the correct alignment and length.

SUBTASK 20-10-52-420-003

**CAUTION:** USE THE INDEX LINE ON THE SIDE OF THE HOSE TO MAKE SURE THE HOSE IS NOT TWISTED. IF THE HOSE IS TWISTED, HOSE FAILURE OR HOSE COUPLING LEAKAGE CAN OCCUR.

- (6) Tighten the B-nut to the correct torque, do this task: Standard Torque Values, TASK 20-50-11-910-801.

SUBTASK 20-10-52-420-004

- (7) Tighten the coupling-type ends, do this task: Standard Torque Values, TASK 20-50-11-910-801.

NOTE: Use two wrenches, one on each end, to prevent twisted flexible tubing.

SUBTASK 20-10-52-420-002

**CAUTION:** MAKE SURE THAT THE FLEXIBLE HOSE AND TUBE HAVE SUFFICIENT CLEARANCE FROM THE ADJACENT COMPONENTS. IF THE FLEXIBLE HOSE OR TUBE RUB ON THE COMPONENTS, DAMAGE TO THEM CAN OCCUR.

- (8) Clamp the hose when it is necessary and adjust the slack.

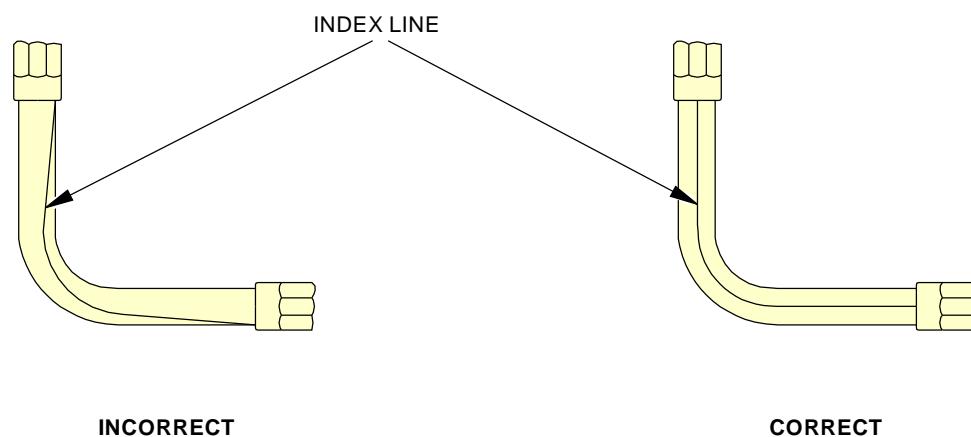
———— END OF TASK ————

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Flexible Hose Installation  
Figure 401/20-10-52-990-801

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FLEXIBLE HOSE - REPAIRS

**1. General**

- A. This procedure contains a task for the replacement of unserviceable hydraulic rigid tubes with flexible hoses as a temporary repair.
- B. This procedure contains a task for the temporary repair of flexible hydraulic hoses.

**CAUTION:** PUT CAPS ON HOSES AND FITTINGS WHEN THEY ARE NOT CONNECTED. IF YOU DO NOT USE CAPS, CONTAMINATION OF THE HOSES, AND DAMAGE TO THE SYSTEM COMPONENTS AND LEAKAGE OF HYDRAULIC FLUID COULD OCCUR. YOU MUST REMOVE ALL HYDRAULIC FLUID THAT CAME OUT OF THE HOSE AND FELL ON THE AIRPLANE. HYDRAULIC FLUID CAN CAUSE CORROSION AND DAMAGE TO THE AIRPLANE.

- C. Keep caps on hoses and connections to keep moisture or other contamination out of the system until the hose is connected again.

**TASK 20-10-52-300-801**

**2. Hydraulic Tubing Repair**

(Figure 801)

**A. General**

- (1) You can use many possible repair procedures. The airline must make a decision if a procedure is applicable and safe. This procedure is not applicable to engine hydraulic tube repair or for replacement of coiled flexible tubing.

**B. References**

Reference	Title
20-10-51-000-802	Flareless Fittings in Pressurized Areas Installation (P/B 401)
29-09-00-860-802	Hydraulic Reservoirs Depressurization (P/B 201)

**C. Procedure - Flexible Hose Installation**

SUBTASK 20-10-52-860-001

- (1) Make a record of the flexible hoses that you install as temporary repairs for rigid lines.

SUBTASK 20-10-52-200-001

- (2) Make a schedule for regular inspections of the flexible hose installation. Do this to make sure the installation stays an airworthy repair until the system is put back to its initial configuration.

SUBTASK 20-10-52-800-001

- (3) Make a procedure to make sure that you replace flexible hoses as soon as possible. This must not be later than an operator-scheduled time check that has been approved by the assigned principal maintenance inspector.

SUBTASK 20-10-52-220-001

- (4) Use a flexible hose that has these properties:

- (a) The pressure and the fluid properties of the hose must be applicable and correct for the system it will be used on.
- (b) The inner diameter of the hose must not be less than the inner diameter of the damaged tube.
- (c) The length of the hose must be sufficient to keep the slack, flex, twisting, bending, clearance, and support acceptable, see (Figure 801).

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- 1) Slack - Do not install hose assemblies in a way that will cause a mechanical load on the hose. Hoses will change length from +2 to -4 percent when pressurized. Give sufficient slack or bend to let the length change.
- 2) Flex - When very much vibration or flexing occurs to hose assemblies, there must be sufficient slack between the rigid fittings. Install the hose to prevent flexing at the end fitting(s). The hose must stay straight for at least two hose diameters from the end fitting(s). Avoid clamp locations that will limit or prevent hose flexing.
- 3) Twisting - Install hoses without twists. Twists can cause the hose to break or the nuts to loosen. Use swivel connections at one of the two ends to prevent twist stresses.
- 4) Bending - To prevent sharp bends in the hose assembly, use elbow fittings, a hose with elbow-type end fittings, or the appropriate bend radii from (Table 801).
- 5) Clearance - The hose assembly must be clear of all other lines, equipment, and adjacent structure under every operating condition. Hoses must have the minimum clearance shown in (Table 802).

**Table 801/20-10-52-993-802 Minimum Hose Bend Radius**

AS 115 HOSE	HOSE INSIDE DIAMETER INCHES (mm)	MINIMUM HOSE BEND RADIUS MEASURED INSIDE OF BEND INCHES (mm)
-04	1/4 (6.350)	1.50 (38.1)
-06	3/8 (9.53)	2.50 (63.5)
-08	1/2 (12.7)	2.88 (73.2)
-10	5/8 (15.9)	3.25 (82.6)
-12	3/4 (19.1)	4.00 (101.6)

**Table 802/20-10-52-993-803 Minimum Clearance**

HOSE CLEARANCE TO	MINIMUM CLEARANCE INCH (mm)
CONTROL CABLE LINKAGES	1.0 * <sup>[1]</sup> (25.4)
CABLE AT PULLEYS	0.5 (12.7)
CABLE AT MIDSPAN	2.0 (50.8)
ELECTRICAL WIRING	0.5 (12.7)
HYDRAULIC TUBES OR LINES	0.2 (5.08)

\*[1] \*<sup>[1]</sup> Measured at the position where the hose is closest to the cable or linkage.

- 6) Support - Make sure the hose assembly is held by supports that will not cause deflection of rigid lines if movement occurs. Use sufficient clamps to follow the contour of the structure. This prevents hose abrasive wear, kinks, and entanglement during flexure. At a minimum, put clamps at locations where the tube clamps were. Make sure the hose is not rigidly held by tight, rigid clamps about its outer diameter. If the hose between the rigid connections must move longitudinally, make sure the clamps are of a type that will not cause wear on the hose casing. The supports must hold the connections at the tube, not the hose.

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**SUBTASK 20-10-52-860-002**

- (5) Remove the pressure from the hydraulic system where you will do the repair. To remove the pressure, do this task: Hydraulic Reservoirs Depressurization, TASK 29-09-00-860-802.

**SUBTASK 20-10-52-350-001**

- (6) If you will replace all of the damaged tube with a flexible hose, do these steps:
- Remove the damaged tube.
  - If it is necessary, prepare the ends of the tubes to which you will install the flexible hose. For selection of the applicable fittings, do this task: Flareless Fittings in Pressurized Areas Installation, TASK 20-10-51-000-802.

**SUBTASK 20-10-52-300-002**

- (7) If the damaged tube is too long to be replaced by a flexible hose, do these steps:
- Cut the damaged tube section from the line.
  - Install the applicable fittings on the tubes. To install them, do this task: Flareless Fittings in Pressurized Areas Installation, TASK 20-10-51-000-802.
  - Install the tubing on the fittings.

**SUBTASK 20-10-52-860-003**

- (8) Supply the usual pressure to the line.

**SUBTASK 20-10-52-210-003**

- (9) Do a check of the hose and the connections for leaks.

**SUBTASK 20-10-52-200-002**

- (10) Do a check to make sure the slack, flex, twisting, bending, clearance, and support is correct.

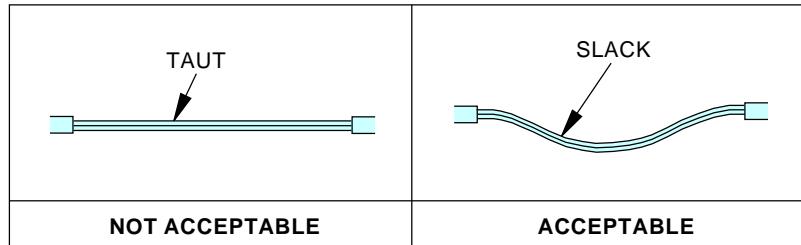
———— END OF TASK ————



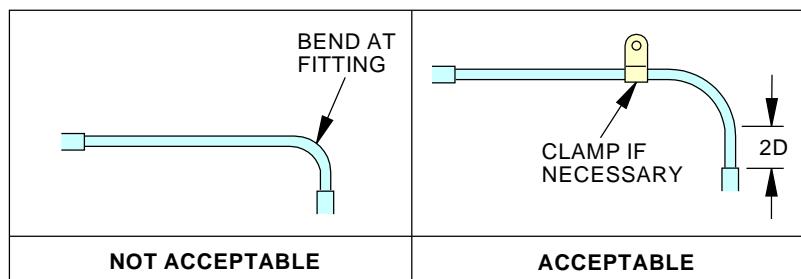
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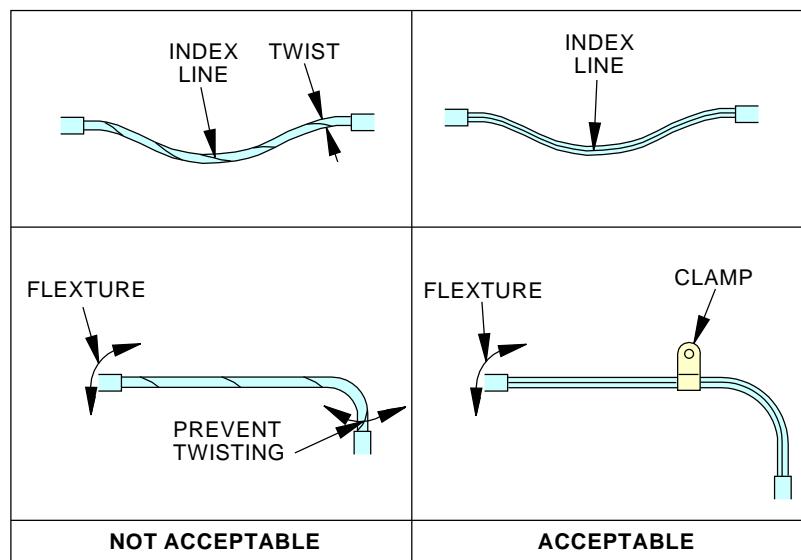
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SLACK



FLEX



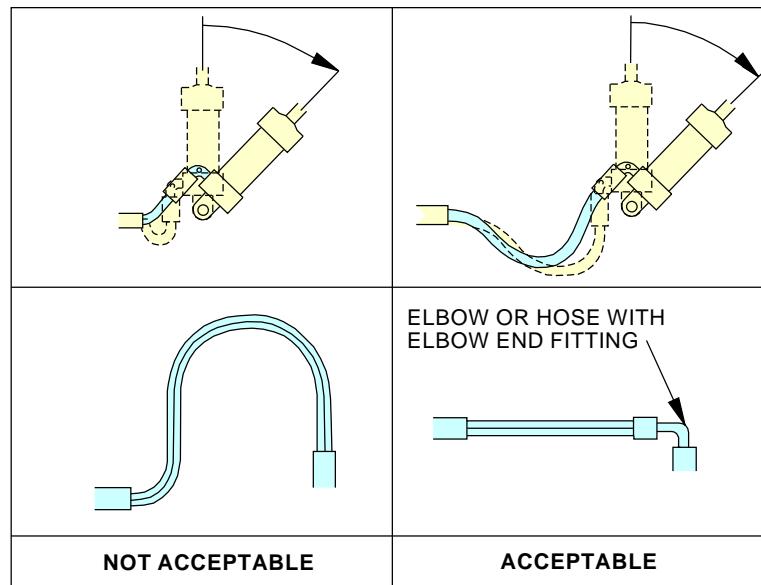
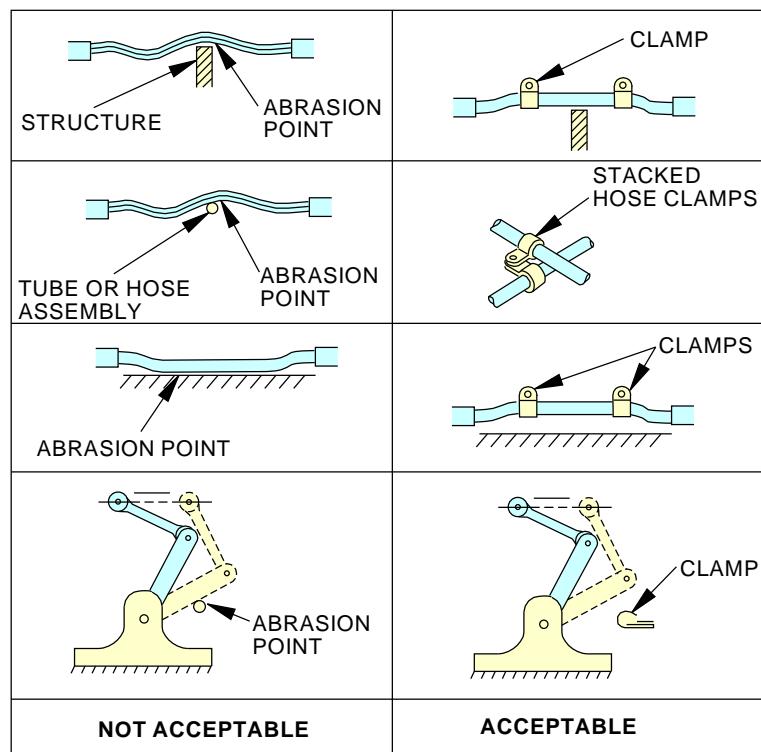
TWISTING

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Hydraulic Tubing Repair  
Figure 801/20-10-52-990-804 (Sheet 1 of 2)

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**BENDING**

**CLEARANCE**

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**Hydraulic Tubing Repair**  
**Figure 801/20-10-52-990-804 (Sheet 2 of 2)**

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**TASK 20-10-52-300-803**

**3. Temporary Repair of Flexible Hydraulic Hoses**

**A. General**

- (1) This procedure is for the temporary repair of flexible hydraulic hoses with a different flexible hose.
  - (a) It is to the discretion of the operator to determine whether this procedure is applicable to their operations.
- (2) The Boeing Company recommends that the operator do these procedures.
  - (a) Make a record of the flexible hoses that you install as temporary repairs for flexible lines.
  - (b) Make a schedule for the regular inspection of flexible hose installations. Make sure that the installation stays an airworthy repair until the system is put back to its original configuration.
  - (c) Make a procedure to make sure that the flexible hoses that are installed as temporary repairs are replaced as soon as possible. You must replace the hoses no later than the scheduled time check approved by the assigned principal maintenance inspector.
- (3) This procedure is not applicable for replacement of hydraulic hoses on the engines. In general, hydraulic hoses with damaged firesleeves must be replaced.
  - (a) Engine hydraulic hoses are hoses below or forward of the firewall and within the engine cowls.
- (4) Hoses in the hydraulic tubing repair kit, SPL-5276 or equivalent, can be used when temporarily replacing a damaged hydraulic hose with another hydraulic hose.

**B. References**

<b>Reference</b>	<b>Title</b>
29-00-00 P/B 201	HYDRAULIC POWER - MAINTENANCE PRACTICES

**C. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

<b>Reference</b>	<b>Description</b>
SPL-5276	Repair Kit, Hydraulic Tubing (Temp. Repairs Only) (Approved for Titanium) Part #: 65-92528-1 Supplier: 81205

**D. Prepare to Install the Flexible Hose**

**SUBTASK 20-10-52-300-003**

- (1) Choose a flexible hose to do the temporary repair.
  - (a) Choose a flexible hose that is qualified for at least the same operating pressure, temperature, and fluid type as the system in which you will install the flexible hose.
  - (b) Make sure that the new flexible hose has the same inner diameter (or a larger inner diameter) as the original flexible hose.
  - (c) Make sure that the end fitting sizes and configurations (such as straights, 45 degree bends, or 90 degree bends) on the replacement hose match those of the original flexible hose (Figure 802).
    - 1) You can do expansion using one of the methods that follow.
      - a) Use a hose assembly with expander end fittings.

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- b) Use a non-expander replacement hose assembly and reconnectable fittings that have different size ends to make the transition.
- (d) Make sure that the new flexible hose meets the installation requirements for the items that follow (Figure 803).
  - 1) Slack
    - a) Make sure that you do not install the flexible hose in a way that will cause a mechanical load on the hose.  
NOTE: Hoses will change length from +2/-4 percent when pressurized.
  - 2) Flex
    - a) Make sure that there is slack between the rigid fittings where hose assemblies will be exposed to vibration or flexing.
    - b) Make sure that the hose is straight for at least two hose diameters from the end fittings.  
NOTE: This will help make sure that the hose will not flex at the end fittings.
    - c) Make sure that you do not use clamps at locations that will stop the hose from flexing.
  - 3) Twisting
    - a) Make sure that you install the hoses without twists.  
NOTE: This will help prevent loose nuts and rupture of the hoses.  
<1> Use swivel fittings with positioning ends at one or two ends of the temporary replacement hose, if necessary (Figure 802).  
NOTE: This will help to closely match the configuration of the original hose and will help relieve the twist stresses.
  - 4) Bending
    - a) Use elbow fittings, hoses with elbow type end fittings or the applicable end fittings, or the applicable bend radii (Table 803).  
NOTE: This will help prevent sharp bends in the hose assembly.
  - 5) Clearance

**Table 803/20-10-52-993-810**

AS 115 HOSE	HOSE INNER DIAMETER (INCH)	MINIMUM HOSE BEND RADIUS MEASURED AT INNER BEND (INCH)
-04	1/4	1.50
-06	3/8	2.50
-08	1/2	2.88
-10	5/8	3.25
-12	3/4	4.00

- <1> Make sure to take into account the change in allowable minimum bend radii due to external sleeving.
- <a> For replacement with hoses that have "C" coded sleeves, multiply the minimum hose bend radii by 1.2 to calculate the minimum allowable bend radii (Figure 802).

5) Clearance

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- a) Make sure that the hose assembly is clear of all other lines, equipment, and adjacent structure under all operating conditions.
- b) Make sure that the hoses meet the minimum clearance requirements in (Table 804).

**Table 804/20-10-52-993-811**

HOSE CLEARANCE TO	MINIMUM CLEARANCE INCHES (mm)
Control Cables and Linkages	1.0 in. (25.4 mm) <sup>[1]</sup>
Cable at Pulleys	0.5 in. (12.7 mm)
Cable at Mid-Span	2.0 in. (50.8 mm)
Electrical Wiring	0.5 in. (12.7 mm)
Hydraulic Tubes or Hoses	0.2 in. (5.1 mm)

\*[1] Measured at a relative position where the hose is closest to the cable or linkage.

6) Support

- a) Make sure that the hose assembly has supports at the same points as the original flexible hose (at a minimum).

NOTE: This will help prevent contact with the mating or adjacent parts due to relative motion.

<1> Size clamps as necessary.

NOTE: This will help to account for change in the hose diameter from the original flexible hose (due to extra sleeving, etc.).

**E. Install the Flexible Hose**

SUBTASK 20-10-52-040-001

- (1) Remove hydraulic pressure from the system on which you will do a repair (HYDRAULIC POWER - MAINTENANCE PRACTICES, PAGEBLOCK 29-00-00/201).

SUBTASK 20-10-52-020-002

- (2) Remove the damaged hose.

SUBTASK 20-10-52-420-007

- (3) If you can replace all of the damaged hose with one flexible hose, install the new temporary flexible hose.

SUBTASK 20-10-52-420-008

- (4) If the damaged hose is too long to replace by one flexible hose, do the steps that follow.

- (a) Use two or three shorter hoses to make the necessary length hose.

1) Make sure that you do not use more than three shorter hoses to make the necessary length hose.

- (b) Use a union or smaller fitting as a splice between the shorter hoses.

- (c) Make sure that the total length of the two or three shorter hoses and splice fittings is close to the length of the original, damaged hose.

NOTE: A total length that is too long will create kinks or bends in the hoses; a total length too short will create a tension load on the hoses.

- (d) Use the necessary installation torque on the mating hoses and splice fittings.



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- 1) The torque is determined based on size and material of the splice fitting and hose end fittings.

**NOTE:** For example, when the materials of the two mating parts are dissimilar, select the torque value based on the lower-strength material.

**SUBTASK 20-10-52-440-001**

- (5) Supply hydraulic pressure to the system on which you did the temporary repair (HYDRAULIC POWER - MAINTENANCE PRACTICES, PAGEBLOCK 29-00-00/201).

**SUBTASK 20-10-52-280-001**

- (6) Examine the temporary flexible hose repair and connections for leaks.

**SUBTASK 20-10-52-700-001**

- (7) Make sure that the temporary repair installation operates.

- (a) Do a functional test for the system on which the temporary repair was made, as necessary.
  - 1) Make sure that there is clearance with the temporary repair hose.
  - 2) Make sure that there is no interference through the range of hose operation.
  - 3) Make sure that the temporary repair meets the requirements with items that follow.
    - a) Slack
    - b) Flex
    - c) Twisting
    - d) Bending
    - e) Clearance
    - f) Support

———— END OF TASK ————

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FITTING TYPE	PART NUMBER	MATERIAL
HYDRAULIC HOSE 	AS115-(SIZE) (C) 1 (LENGTH-INCHES) (FRACTIONAL LENGTH IN EIGHTHS OF AN INCH) 2	
TUBE-TO-TUBE FLARELESS UNION 	MS21902V (SIZE) (P)	15-5PH CRES MATERIAL WITH CADMIUM PLATE FINISH
	MS21902 (SIZE) (T)	6AL-4V TITANIUM MATERIAL
FLARELESS SWIVEL TO MALE FLARELESS 45 DEGREE ELBOW 	BACE21BR (SWIVEL LEG SIZE) (MALE PORT LEG SIZE) (P)	15-5PH CRES WITH CADMIUM PLATE FINISH
	BACE21BR (SWIVEL LEG SIZE) (MALE PORT LEG SIZE) (T)	6AL-4V TITANIUM
FLARELESS SWIVEL TO MALE FLARELESS 90 DEGREE ELBOW 	BACE21BT (SWIVEL LEG SIZE) (MALE PORT SIZE) (P)	15-5PH CRES WITH CADMIUM PLATE FINISH
	BACE21BT (SWIVEL LEG SIZE) (MALE PORT SIZE) (T)	6AL-4V TITANIUM

CODE LETTER "C" REFERS TO 15 MINUTE FIRESLEEVE PER AS1072

TEMPORARY REPLACEMENT OF A DAMAGED HOSE MAY BE MADE USING HOSES OTHER THAN AS115. FOR EXAMPLE, HOSE COMBINATIONS WITH ONE 45 DEGREE ELBOW END FITTING (AS116) OR ONE 90 DEGREE ELBOW END FITTING (AS117), OR WITH A COMBINATION OF FITTING ENDS MORE SIMILAR TO THE DAMAGED HOSE MAY BE USED AS LONG AS THE GUIDELINES IN THE PROCEDURE ARE FOLLOWED.

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**Possible Repair of Flexible Hydraulic Hoses**  
**Figure 802/20-10-52-990-807 (Sheet 1 of 2)**

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DAMAGED HOSE	POSSIBLE TEMPORARY REPLACEMENT COMBINATION		
AS115 (STRAIGHT TO STRAIGHT)	AS115		
AS116 (STRAIGHT TO 45 DEGREE END)	AS115 +  BACE21BR		
AS117 (STRAIGHT TO 90 DEGREE END)	AS115 +  BACE21BT		
AS118 (45 DEGREE TO 45 DEGREE END)	BACE21BR +  AS115 +  BACE21BR		
AS119 (45 DEGREE TO 90 DEGREE END)	BACE21BR +  AS115 +  BACE21BT		
AS120 (90 DEGREE TO 90 DEGREE END)	BACE21BT +  AS115 +  BACE21BT		
AS115 (STRAIGHT TO STRAIGHT) - LONG LENGTH	AS115 +  MS21902 +  AS115  <u>NOTE:</u> USE A MAXIMUM OF THREE SHORTER HOSES WITH UNION FITTINGS TO MAKE UP THE REQUIRED REPLACEMENT LENGTH FOR THE DAMAGED ORIGINAL HOSE.		
HOSE P/N OTHER THAN AS115, STRAIGHT TO ELBOW (45 DEGREE) - LONG LENGTH	AS115 +  MS21902 +  AS115 +  BACE21BR  <u>NOTE:</u> USE A MAXIMUM OF THREE SHORTER HOSES WITH UNION FITTINGS TO MAKE UP THE REQUIRED REPLACEMENT LENGTH FOR THE DAMAGED ORIGINAL HOSE.		

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**Possible Repair of Flexible Hydraulic Hoses  
Figure 802/20-10-52-990-807 (Sheet 2 of 2)**

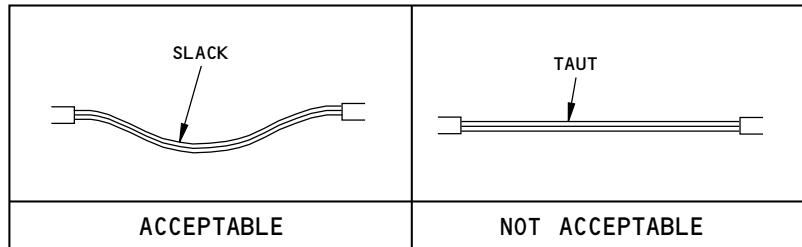
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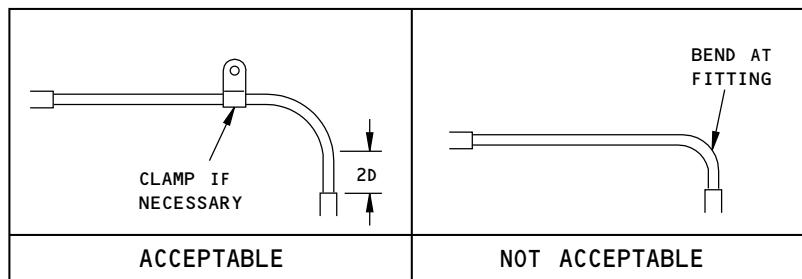
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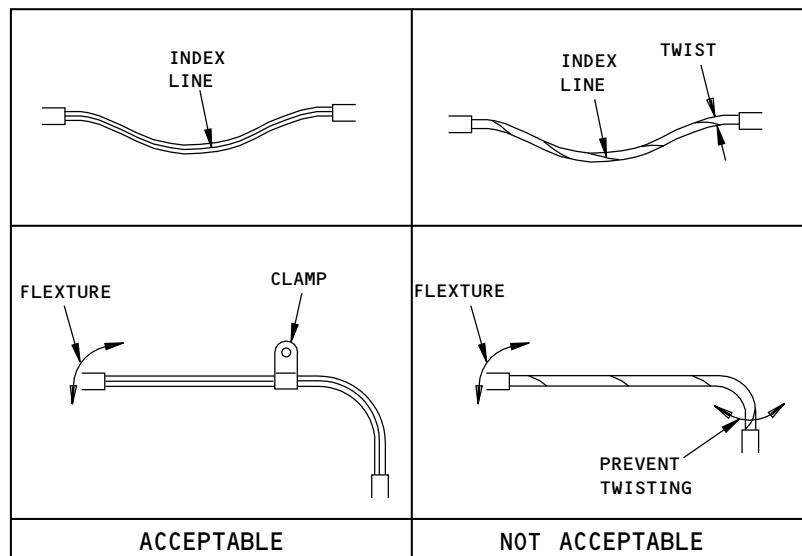
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SLACK



FLEX



TWISTING

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Replacement Flexible Hose Requirements  
Figure 803/20-10-52-990-808 (Sheet 1 of 2)

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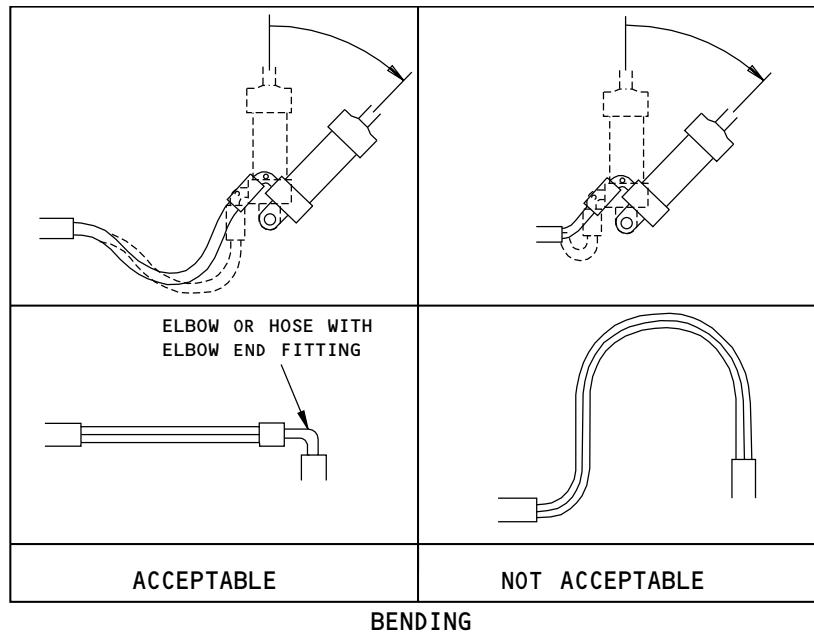
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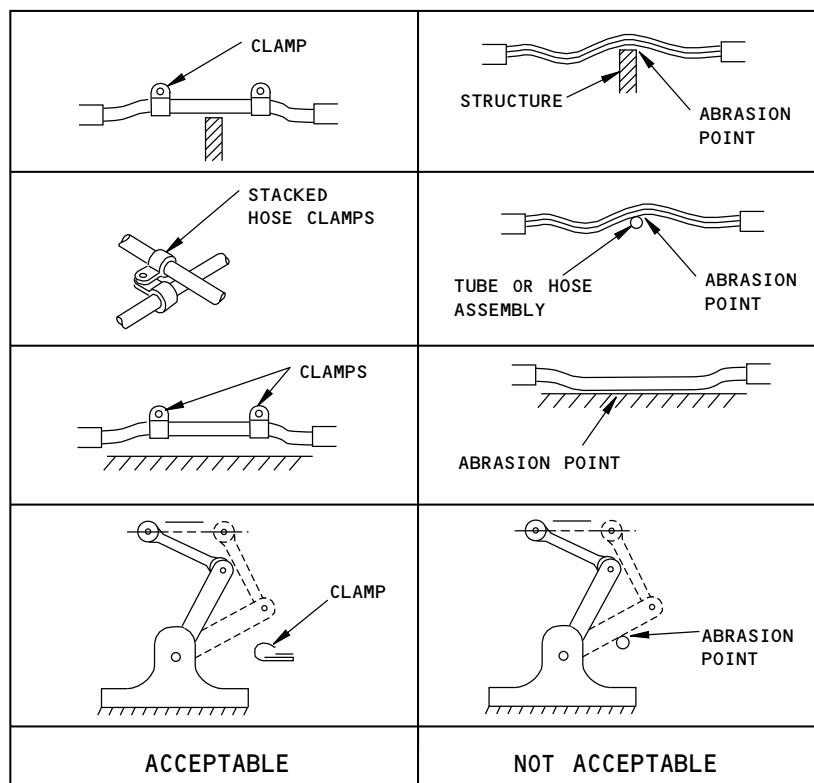
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BENDING



CLEARANCE

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Replacement Flexible Hose Requirements  
Figure 803/20-10-52-990-808 (Sheet 2 of 2)

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FLUID LINE TUBING CLAMPS - REMOVAL/INSTALLATION

**1. General**

- A. This procedure has these tasks:
  - (1) A removal of the block clamps.
  - (2) An installation of the block clamps.
  - (3) A removal of P-clamps.
  - (4) A installation of P-clamps.
- B. Different types of clamps hold the fluid systems tubing:
  - (1) Loop or P-clamps where normal support is required.
  - (2) Saddle clamps where more support is required.
  - (3) Block clamps in the area of high vibration, or where a number of tubes or hoses must be supported in one location.
- C. Loop or saddle clamps holding hydraulic tubes or hoses must be cushioned metal clamps.

**TASK 20-10-53-960-801**

**2. Block Clamps Removal**

**A. Procedure**

SUBTASK 20-10-53-020-001

- (1) Remove the nuts, bolts and washers that hold the block clamp assembly together.

SUBTASK 20-10-53-020-002

- (2) Remove the block clamp assembly.

SUBTASK 20-10-53-020-003

- (3) If there is a tape under the clamp blocks, remove and discard used tape from the tube.

— END OF TASK —

**TASK 20-10-53-400-801**

**3. Block Clamps Installation**

**A. Consumable Materials**

Reference	Description	Specification
G00150	Tape - Nitto P-421 NAT (Formerly Permacel) PTFE Film Tape	

**B. Procedure**

SUBTASK 20-10-53-020-004

- (1) Remove and discard all used tape from the tube.

SUBTASK 20-10-53-420-001

- (2) At the location of the block clamps and tube overlap, apply three layers of Nitto P-421 tape, G00150 to the tube.

SUBTASK 20-10-53-420-002

- (3) Apply the Nitto P-421 tape, G00150  $\pm 0.25$  inch (6.4 mm) from each edge of the block.

SUBTASK 20-10-53-420-007

- (4) Put the tubes in the applicable notches in one-half of the block clamp assembly.

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SUBTASK 20-10-53-420-003

- (5) Put the other half of the block clamp assembly in position.

SUBTASK 20-10-53-420-008

- (6) Put the channel over the half of the block clamp assembly that the bolthead will touch.

SUBTASK 20-10-53-420-009

- (7) Put the washers on the bolts and put the bolts through the holes in the block clamp assembly.

SUBTASK 20-10-53-420-010

- (8) Put the washer and nut on the threaded end of the bolt and tighten the nut.

NOTE: Make sure the washers are under the bolthead and the nut so the bolthead does not wear into the block clamp channel.

———— END OF TASK ————

**TASK 20-10-53-000-801**

**4. P-Clamps Removal**

**A. Procedure**

SUBTASK 20-10-53-020-005

- (1) Remove the fastener from the clamp and the structure.

SUBTASK 20-10-53-020-006

- (2) Remove the pan dirt strap from the clamp.

SUBTASK 20-10-53-020-007

- (3) Remove the clamp away from the tubes and structure.

———— END OF TASK ————

**TASK 20-10-53-400-802**

**5. P-Clamp Installation**

**A. Procedure**

SUBTASK 20-10-53-420-004

- (1) Put the P-clamp on the tube.

SUBTASK 20-10-53-420-005

- (2) Put the pan dirt strap in the hole of the clamp.

SUBTASK 20-10-53-420-006

- (3) Put the fasteners on the clamp and structure.

SUBTASK 20-10-53-210-001

- (4) Make sure everything is tight.

———— END OF TASK ————



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**STENCIL MARKINGS - REMOVAL/INSTALLATION**

**1. General**

- A. This procedure has these tasks:
  - (1) A removal of the stencil markings.
  - (2) An installation of the stencil markings.
- B. For decorative finishes used on airplane external surfaces, do this task: Decorative Exterior Paint System Application, TASK 51-21-99-300-801.
- C. Paint used for markings is determined by the surface you will paint and the type of finish necessary. Paint must be compatible with the initial surface finish.

**TASK 20-10-61-000-801**

**2. Stencil Markings Removal**

**A. References**

Reference	Title
51-21-11-150-801	Paint Stripping (P/B 701)
51-21-21-370-801	Prepare the Surface to be Painted (P/B 701)
51-21-99-300-801	Decorative Exterior Paint System Application (P/B 701)

**B. Consumable Materials**

Reference	Description	Specification
C00319	Primer - Urethane Compatible, Corrosion Resistant	BMS10-79 Type II

**C. Removal**

SUBTASK 20-10-61-420-001

- (1) Remove the old markings if necessary:
  - (a) Strip the markings. To strip them, do this task: Paint Stripping, TASK 51-21-11-150-801.
  - (b) Prepare the surface for the coating. To prepare the surface, do this task: Prepare the Surface to be Painted, TASK 51-21-21-370-801.
  - (c) Apply primer, C00319 that is equivalent to the initial material. To apply it, do this task: Decorative Exterior Paint System Application, TASK 51-21-99-300-801.

— END OF TASK —

**TASK 20-10-61-400-801**

**3. Stencil Markings Installation**

**A. General**

- (1) Make sure clean surfaces do not become dirty when you clean the adjacent surfaces.
- (2) Use a polyethylene wash bottle to apply solvents. Identify the contents.
- (3) Do not contaminate adjacent areas when you spray.
- (4) Make sure all coatings or finishes are uniform and free from unusual particles.
- (5) Apply the stencil marking paint with spray equipment only.
- (6) Make sure all coating or finish materials are correctly mixed and labeled. Discard materials with expired pot life.
- (7) Make sure the painted markings are well made and have a solid, homogeneous color.

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**B. References**

Reference	Title
20-30	SPECIFICATIONS AND MATERIALS
51-21-11-150-801	Paint Stripping (P/B 701)
51-21-21-370-801	Prepare the Surface to be Painted (P/B 701)
51-21-72-370-801	BMS10-79 Primer - Application (P/B 701)
51-21-72-370-804	BMS10-11 Primer - Application (P/B 701)
51-21-73-370-802	Chemical Reactivator Application (P/B 701)
51-21-73-370-803	BMS10-60 Topcoat Application (P/B 701)
51-21-73-370-804	BMS10-11 Topcoat Application (P/B 701)

**C. Tools/Equipment**

Reference	Description
STD-1104	Bottle - Polyethylene, Capacity 1 Pint, with Polyethylene Screw Cap and Seal
STD-1133	Gun - Spray, Paint, with Interchangable Nozzles

**D. Consumable Materials**

Reference	Description	Specification
B00083	Solvent - VM&P Naphthas	ASTM D-3735 Type III
C00032	Coating - Protective Enamel, General Use	BMS10-60 Type I
C00175	Primer - Urethane Compatible, Corrosion Resistant (Less Than 1% Aromatic Amines)	BMS10-79 Type III
C00259	Coating - Chemical And Solvent Resistant Finish, Corrosion Inhibiting Primer	BMS10-11 Type I
C00260	Coating - Chemical And Solvent Resistant Finish, Epoxy Resin Enamel	BMS10-11 Type II
C00319	Primer - Urethane Compatible, Corrosion Resistant	BMS10-79 Type II
G00034	Cotton Wiper - Process Cleaning Absorbent Wiper (Cheesecloth, Gauze)	BMS15-5 Class A
G00270	Tape - Scotch Flatback Masking 250	ASTM D6123 (Supersedes A-A-883)
G50262	Wiper - Cleaning	BMS15-5

**E. Prepare the Surface for Stencil Markings**

SUBTASK 20-10-61-950-001

- (1) Mask or put a protective cover on all adjacent surfaces that you will not clean, treat, or coat.

SUBTASK 20-10-61-110-001

- (2) Solvent clean the surface.

NOTE: This is to remove loose soil and unwanted grease or oil.



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**WARNING:** DO NOT GET SOLVENTS IN YOUR MOUTH, YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE DANGEROUS MATERIALS. SOLVENTS CAN BE FLAMMABLE. OBEY THE MATERIAL SAFETY DATA SHEETS (MSDS) FOR SOLVENTS. OBEY LOCAL REGULATIONS FOR THE CORRECT PROCEDURES TO USE OR DISCARD SOLVENTS. SOLVENTS CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO EQUIPMENT.

**WARNING:** MAKE SURE YOU DO NOT SPRAY SOLVENTS OR KEEP THEM IN OPEN CONTAINERS. DO NOT USE FLAMMABLE SOLVENTS IN THE AIRPLANE. SOLVENTS AND CLEANERS CONTAIN TOXIC INGREDIENTS. WEAR PROTECTIVE GLOVES, AND DO NOT GET SOLVENT OR CLEANER ON SKIN OR EYES. MAKE SURE YOU HAVE SUFFICIENT VENTILATION OR USE RESPIRATOR MASKS. INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT CAN OCCUR.

**CAUTION:** MAKE SURE YOU DO NOT USE SOLVENTS OTHER THAN THOSE SPECIFIED. THEY CAN CAUSE DAMAGE TO THE FINISH.

- (a) Use the applicable solvent (SPECIFICATIONS AND MATERIALS, SECTION 20-30).
- (b) Use a polyethylene bottle (1 pint), STD-1104 to apply solvent to the work surface or to a clean wiper.
  - NOTE:** Do not put the wiper into the solvent container.
  - NOTE:** Do not get the solvent on a larger area than is necessary.
- (c) Rub the surface with a cotton wiper, G00034 or a soft brush.
- (d) Rinse the surface with clean solvent and a clean, cotton wiper, G00034.
- (e) Remove unwanted solvent.
- (f) Let the surface drain.
- (g) Rub the surface dry.

SUBTASK 20-10-61-120-002

- (3) Sand the surface with 320-grit or finer abrasive paper.
  - (a) Make sure that you do not sand down to the base material.

SUBTASK 20-10-61-110-002

- (4) Solvent clean the surface again.

**NOTE:** This is to remove sanding dust.

SUBTASK 20-10-61-110-003

- (5) If you sanded to the base material, do the steps that follow.
  - (a) If the base material is metal, use a brush-on stripper to remove the coating from the damaged area (Paint Stripping, TASK 51-21-11-150-801, Brush-On Stripping).
  - (b) If the base material is plastic, see this task for paint stripping: Paint Stripping, TASK 51-21-11-150-801.
  - (c) Solvent clean the area to remove contamination.
  - (d) Feather the edge to the area adjacent to the damaged area.
    - 1) Use 320-grit or finer abrasive paper.
  - (e) Solvent clean the area to remove sanding dust.
  - (f) Wipe the surface with a clean, dry wiper, G50262.

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- (g) Prepare the surface for paint (Prepare the Surface to be Painted, TASK 51-21-21-370-801).

SUBTASK 20-10-61-950-002

- (6) Apply the stencil masking.
- Make sure that all stencil cuts are sharp and do not have burrs.
  - Attach the stencil tightly with Scotch Flatback Masking Tape 250, G00270.

NOTE: This is to make sure that the paint does not go below the edges.

SUBTASK 20-10-61-950-003

- (7) Apply masking to prevent overspray onto adjacent surfaces, if necessary.

SUBTASK 20-10-61-160-001

- (8) Reactivate the surface.
- For plastic laminates and painted surfaces, use one of the methods that follow to reactivate the surface.
    - Method 1: Chemically reactivate the surface (Chemical Reactivator Application, TASK 51-21-73-370-802).

NOTE: Chemically reactivate the surface if the painted surface and the stencil coating are BMS10-60.

- Method 2: Sand the surface.
  - Lightly sand the surface with 280-grit or finer abrasive paper.
  - Solvent clean the surface to remove sanding dust.
- For stainless steel surfaces, do the steps that follow to reactivate the surface.
  - Abrasive clean the surface.
    - Use 180-grit or finer aluminum oxide abrasive to clean the area.
  - Solvent clean the surface.
- For Alclad, Aluminum alloys, and all other materials, no surface reactivation is necessary.

SUBTASK 20-10-61-370-002

- (9) Prepare the stencil paint using the manufacturer's instructions.

- Use Table 401 to select a stencil paint.

**Table 401/20-10-61-993-801 Stencil Paint Selection**

SUBSTRATE		LETTER HEIGHT AND WIDTH		FINISH
PAINTED	UNPAINTED	≥ 2 in. (51 mm)	< 2 in. (51 mm)	
--	X	--	X	BMS10-11, Type II
X	--	X	X	BMS10-60 <sup>[1]</sup>
--	X	X	--	BMS10-11, Type I + BMS10-11, Type II <sup>[2]</sup> BMS10-79, Type II or III + BMS10-60 <sup>[3]</sup>

\*[1] BMS10-11, Type II enamel may be used if the finish requirements are met and then substrate topcoat is BMS10-11, Type II.

\*[2] Interior applications.

\*[3] Exterior applications.

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SUBTASK 20-10-61-370-003

- (10) For insignia markings and for stencils with a letter size more than 2 in. (51 mm) in height and width, apply primer to the surface.

NOTE: The application of primer to previously painted surfaces is optional.

- (a) Make sure that you do not apply primer to surfaces that have been treated with BMS10-127 chemical reactivator.

**F. Install Stencil Markings**

SUBTASK 20-10-61-380-001

**WARNING:** MAKE SURE YOU DO NOT BREATHE THE FUMES OF FINISHES AND SOLVENTS. DO WORK IN A WELL-VENTILATED AREA. USE APPROVED RESPIRATORY PROTECTION AS NECESSARY. DO NOT GET FINISHES AND SOLVENTS IN EYES OR ON SKIN AND CLOTHING. KEEP MATERIALS AWAY FROM SOURCE OF IGNITION. FINISHES AND SOLVENTS ARE TOXIC AND FLAMMABLE. THEY CAN CAUSE INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

- (1) Apply the stencil paint with the paint spray gun with interchangeable nozzles, STD-1133.

NOTE: Make sure that no paint gets under the stencil masking.

- (a) Use the procedures in the applicable tasks to apply the paint.
- 1) BMS10-79, Type II primer, C00319 or Type III primer, C00175: BMS10-79 Primer - Application, TASK 51-21-72-370-801.
  - 2) BMS10-60, Type I topcoat coating, C00032: BMS10-60 Topcoat Application, TASK 51-21-73-370-803.
  - 3) BMS10-11, Type I primer, C00259: BMS10-11 Primer - Application, TASK 51-21-72-370-804.
  - 4) BMS10-11, Type II topcoat coating, C00260: BMS10-11 Topcoat Application, TASK 51-21-73-370-804.
- (b) Make sure that the marking is a solid color.
- (c) Make sure there is a sufficiently wet layer to give uniform flow but not to cause runs and sags.

SUBTASK 20-10-61-950-004

- (2) Remove the masking materials immediately after the application of the stencil paint, while the paint is still wet.

NOTE: This is to minimize rough edges.

SUBTASK 20-10-61-370-004

- (3) Cure the stencil paint.

- (a) For BMS10-79 cure times, see BMS10-79 Primer - Application, TASK 51-21-72-370-801.
- (b) For BMS10-60 cure times, see BMS10-60 Topcoat Application, TASK 51-21-73-370-803.
- (c) For BMS10-11, Type I, cure times, see BMS10-11 Primer - Application, TASK 51-21-72-370-804.
- (d) For BMS10-11, Type II, cure times, see BMS10-11 Topcoat Application, TASK 51-21-73-370-804.

SUBTASK 20-10-61-220-001

- (4) Measure the dry film thickness of the stencil paint.

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- (a) For BMS10-79 dry film thicknesses, see BMS10-79 Primer - Application, TASK 51-21-72-370-801.
- (b) For BMS10-60 dry film thicknesses, see BMS10-60 Topcoat Application, TASK 51-21-73-370-803.
- (c) For BMS10-11, Type I, dry film thicknesses, see BMS10-11 Primer - Application, TASK 51-21-72-370-804.
- (d) For BMS10-11, Type II, dry film thicknesses, see BMS10-11 Topcoat Application, TASK 51-21-73-370-804

**SUBTASK 20-10-61-370-005**

- (5) If you applied BMS10-79, Type II primer, C00319 or Type III primer, C00175, apply BMS10-60 topcoat coating, C00032 (BMS10-60 Topcoat Application, TASK 51-21-73-370-803).
  - (a) Cure the BMS10-60 topcoat (BMS10-60 Topcoat Application, TASK 51-21-73-370-803).
  - (b) Measure the dry film thickness of the stencil paint (BMS10-60 Topcoat Application, TASK 51-21-73-370-803).

**SUBTASK 20-10-61-370-006**

- (6) If you applied BMS10-11, Type I primer, C00259, apply BMS10-11, Type II topcoat coating, C00260 (BMS10-11 Topcoat Application, TASK 51-21-73-370-804).
  - (a) Cure the BMS10-11, Type II topcoat (BMS10-11 Topcoat Application, TASK 51-21-73-370-804).
  - (b) Measure the dry film thickness of the stencil paint (BMS10-11 Topcoat Application, TASK 51-21-73-370-804).

**G. Put the Airplane Back to Its Usual Condition**

**SUBTASK 20-10-61-950-005**

- (1) Remove all masking material.

**SUBTASK 20-10-61-800-001**

- (2) Remove the rough edges from the markings with aliphatic naphtha solvent, B00083 or with a burnishing tool after the marking cures.

———— END OF TASK ————



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COAXIAL CABLE - MAINTENANCE PRACTICES

**1. General**

- A. Use a time domain reflectometer (TDR) to examine coaxial cables. The TDR can locate opens, shorts, crimps and other defects in coaxial cables of lengths up to 1,200 feet long. The TDR can also be used on a twisted pair or parallel wires which are the same length.
- B. The TDR transmits pulses of energy down the cable. The TDR then monitors the impedance changes in the pulse energy that is reflected back. You can see these reflections on the liquid crystal display (LCD). You then find failures in the cable from the properties of the waveform shown on the LCD.
- C. Use the time domain reflectometer, COM-5187 to examine the coaxial cable.

**TASK 20-10-72-210-801**

**2. Coaxial Cable Inspection**

**A. General**

- (1) Refer to time domain reflectometer, COM-5187 Instruction Manual for information on how to test the coaxial cable.

**B. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-5187	Reflectometer - Time Domain (TDR) Part #: 1205CXA Supplier: 93929 Part #: 1270A Supplier: 93929 Part #: 6021-5154 Supplier: 1UW81 Opt Part #: 1205 Supplier: 0GXM1 Opt Part #: 1270 Supplier: 0GXM1 Opt Part #: 1502C Supplier: 80009 Opt Part #: 900AST Supplier: 53387

— END OF TASK —

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CONTROL CABLES - REMOVAL/INSTALLATION

**1. General**

A. This procedure has these tasks:

- (1) A removal of the control cables, except for the stabilizer control cables.

NOTE: To remove the stabilizer control cables, do the following task: (Stabilizer Control Cable Removal, TASK 27-41-82-000-801).

- (2) An installation of the control cables, except for the stabilizer control cables.

NOTE: To install the stabilizer control cables, do the following task: (Stabilizer Control Cable Installation, TASK 27-41-82-000-802).

B. The installation procedure contains prefabricated and nonprefabricated cables for easier installation when portable swaging machines are available.

**TASK 20-10-91-000-801**

**2. Control Cables Removal**

**A. Equipment**

- (1) Tension Regulator Tool

**B. References**

Reference	Title
20-10-04-000-801	Control Cable Half Ball Pressure Seal Removal (P/B 401)
20-10-09-000-801	Control Cable Pulleys Removal (P/B 401)
20-10-10-000-801	Turnbuckle Locking Clips Removal (P/B 401)

**C. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
SPL-1569	Clamp - Control Cable Part #: A20005-9 Supplier: 81205

**D. Consumable Materials**

Reference	Description	Specification
G00270	Tape - Scotch Flatback Masking 250	ASTM D6123 (Supersedes A-A-883)

**E. Procedure**

**SUBTASK 20-10-91-930-001**

- (1) Use Scotch Flatback Masking Tape 250, G00270 to make a mark on the cable and fittings.

NOTE: The masking tape lets you refer to the initial position when you install the new cable.

**SUBTASK 20-10-91-020-001**

- (2) Do this task: Turnbuckle Locking Clips Removal, TASK 20-10-10-000-801.

**SUBTASK 20-10-91-020-002**

- (3) Do this task: Control Cable Half Ball Pressure Seal Removal, TASK 20-10-04-000-801.



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SUBTASK 20-10-91-420-001

- (4) Install control cable clamp, SPL-1569 on the cable you do not remove to keep light tension on the cable.

NOTE: Light tension on the cable will prevent wind off on the cable drums. Light tension will also make sure the cables do not move out of the pulley guides.

SUBTASK 20-10-91-480-002

- (5) If applicable, install the tension regulator tool on the elevator control cables to keep light tension on the cables.

NOTE: The tension regulator tool is for use on the elevator control cables only.

SUBTASK 20-10-91-480-001

- (6) If you can isolate the cable between rigging pin locations, it is acceptable to install rigging pins through the applicable drum or quadrant.

SUBTASK 20-10-91-420-002

- (7) Prior to removing the cable, do this task: Control Cable Pulleys Removal, TASK 20-10-09-000-801.

- (a) Remove the cable.

————— END OF TASK ————

### TASK 20-10-91-400-801

#### 3. Control Cables Installation

##### A. General

- (1) If this procedure does not agree with a specified maintenance procedure, use the specified maintenance procedure.  
(2) Detailed data is in Chapter 27 for flight control cables and Chapter 32 for Landing Gear Control Cables.

##### B. References

Reference	Title
20-10-04-400-801	Control Cable Half Ball Pressure Seal Installation (P/B 401)
20-10-09-400-801	Control Cable Pulleys Installation (P/B 401)
20-10-10-400-801	Turnbuckle Lock Installation (P/B 401)
27-09-14-860-801	Control Cables Identification and Assembly Specifications (P/B 201)

##### C. Tools/Equipment

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
SPL-1583	Kit - Swager, Portable Cable Part #: AT520JK Supplier: 00784 Part #: ATI520HK Supplier: 00784

##### D. Consumable Materials

Reference	Description	Specification
C00308	Compound - Corrosion Preventive, Petrolatum Hot Application	MIL-C-11796



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Reference	Description	Specification
D00015	Grease - Aircraft Bearing (Use BMS 3-24 until existing stocks are depleted, BMS 3-33 supersedes BMS 3-24)	BMS3-24 (Superseded by BMS3-33)
D00633	Grease - Aircraft General Purpose	BMS3-33
G00034	Cotton Wiper - Process Cleaning Absorbent Wiper (Cheesecloth, Gauze)	BMS15-5 Class A

## E. Prefabricated Cable Installation

SUBTASK 20-10-91-420-003

- (1) Install the cable.

- (a) Attach the new cable to the old cable.

NOTE: If you do not attach the new cable to the old cable, you will have a problem in routing the new cable.

- (b) Pull the old cable out, which pulls the new cable through at the same time.
  - (c) Keep light tension on the new cable.

SUBTASK 20-10-91-410-001

- (2) Do this task: Control Cable Pulleys Installation, TASK 20-10-09-400-801 and do this task: Control Cable Half Ball Pressure Seal Installation, TASK 20-10-04-400-801.

## F. Nonprefabricated Cable Installation

SUBTASK 20-10-91-820-001

- (1) Identify the cable you remove.

- (a) Refer to the applicable system chapter to prepare a new cable.
  - (b) Refer to Figure 401 to calculate cable length.

NOTE: The total length of the cable after assembly and the test will be longer than the lengths of the terminals and the cable before they are assembled. The terminals will be longer after they are swaged, and the cable will be longer after the proof test. Make sure you include an allowance for each of these changes before you cut the cable to the required length.

SUBTASK 20-10-91-420-004

- (2) Install only those fittings that will permit cable installation.

- (a) If the wire rope has a nylon jacket, remove the nylon from the end of the wire rope before you put the rope in the terminal.

- 1) Remove a length of nylon to give 0.50 in. (12.70 mm) maximum clearance between the terminal and the jacket after the rope is installed in the terminal.

- (b) Put the cut end of the wire rope into the full depth of the bore of the terminal.

- 1) If the bore of the terminal does not go completely through, make sure the wire rope is at the full depth as follows:

- a) Measure the depth of the bore.

- b) Mark this as a length from the end of the wire rope before you install and swage the fittings.

- (c) Terminals can be staked on the wire rope to keep them in the correct position before they are swaged

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- 1) The maximum allowable stake depth after swaging is 0.003 in. (0.076 mm).
- 2) The stake must be within the minimum swage length given by Table 401 or Table 402.

SUBTASK 20-10-91-830-001

- (3) Use the portable cable swager kit, SPL-1583 to install the fittings as follows:
  - (a) The swaging must smoothly cold-work the fitting until its dimension agree with the data given by the table below.
  - (b) During the swaging process, do not let die touch the these areas of the fitting:
    - 1) The hex.
    - 2) The fork.
    - 3) The eye of the terminal.
  - (c) Do not swage the same terminal a second time.
  - (d) The completed swage dimensions are as follows:

**Table 401/20-10-91-993-801 Terminal Dimensions After Swaging**

Cable Diameter	1/16 in. (1.588 mm)	3/32 in. (2.381 mm)	1/8 in. (3.175 mm)	5/32 in. (3.969 mm)	3/16 in. (4.762 mm)
X (Minimum)	0.700 in. (17.780 mm)	0.800 in. (20.320 mm)	1.050 in. (26.670 mm)	1.290 in. (32.766 mm)	1.310 in. (33.274 mm)
AS Diameter (Maximum)	0.138 in. (3.505 mm)	0.190 in. (4.826 mm)	0.219 in. (5.563 mm)	0.250 in. (6.350 mm)	0.313 in. (7.950 mm)
AS Diameter (Minimum) *[1]	0.133 in. (3.378 mm)	0.185 in. (4.699 mm)	0.214 in. (5.436 mm)	0.243 in. (6.172 mm)	0.306 in. (7.772 mm)
AS Diameter (Minimum) *[2]	0.128 in. (3.251 mm)	0.180 in. (4.572 mm)	0.209 in. (5.309 mm)	0.236 in. (5.994 mm)	0.299 in. (7.595 mm)

\*[1] BASIC MINIMUM DIAMETER AFTER SWAGING

\*[2] IN THE AREA OF THE ORIGINAL DESIGN TAPER, THE END OF THE SWAGED AREA CAN HAVE THIS MINIMUM DIAMETER

**Table 402/20-10-91-993-802 Terminal Dimensions After Swaging**

Cable Diameter	7/32 in. (5.556 mm)	1/4 in. (6.350 mm)	9/32 in. (7.144 mm)	5/16 in. (7.938 mm)	3/8 in. (9.525 mm)
X (Minimum)	1.550 in. (39.370 mm)	1.700 in. (43.180 mm)	1.890 in. (48.006 mm)	2.060 in. (52.324 mm)	3.120 in. (79.248 mm)
AS Diameter (Maximum)	0.375 in. (9.525 mm)	0.438 in. (11.125 mm)	0.500 in. (12.700 mm)	0.563 in. (14.300 mm)	0.625 in. (15.875 mm)
AS Diameter (Minimum) *[1]	0.368 in. (9.347 mm)	0.431 in. (10.947 mm)	0.492 in. (12.497 mm)	0.555 in. (14.097 mm)	0.617 in. (15.672 mm)
AS Diameter (Minimum) *[2]	0.361 in. (9.169 mm)	0.424 in. (10.770 mm)	0.484 in. (12.294 mm)	0.547 in. (13.894 mm)	0.609 in. (15.469 mm)

\*[1] BASIC MINIMUM DIAMETER AFTER SWAGING

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\*[2] IN THE AREA OF THE ORIGINAL DESIGN TAPER, THE END OF THE SWAGED AREA CAN HAVE THIS MINIMUM DIAMETER

- (e) The swaged terminal must have no pits, die marks, cracks that could be seen with a 10-power lens.
  - 1) Small nicks or dents are satisfactory if the swaged surface is 63 microinches or smoother.
- (f) The threaded, eye, or fork end of the terminal must be straight with the centerline of the swaged end as shown in Figure 401.
- (g) The cable assembly must not have the following:
  - 1) Kinks.
  - 2) Damaged nylon jacket.
  - 3) Popped cores.
  - 4) Broken wire strands.
  - 5) Wire ends above the terminal ends.

SUBTASK 20-10-91-820-002

- (4) Apply a proof load (Figure 401) to the cable and to the installed fittings.

NOTE: This will check the swaging and this will also stretch the cable.

NOTE: If you use prestretched cable you do not have to use a proof load. You can use other applicable procedures to do a check on the swaging.

NOTE: The proof load for stabilizer trim cables shall be  $900 \pm 25$  lb ( $408 \pm 12$  kg).

**Table 403/20-10-91-993-803 Proof Loads For Cable Assemblies**

WIRE ROPE TYPE		CABLE DIAMETER * <sup>[1]</sup>				
		1/16 in. (1.588 mm)	3/32 in. (2.381 mm)	1/8 in. (3.175 mm)	5/32 in. (3.969 mm)	3/16 in. (5 mm)
PROOF LOAD						
BMS 7-265 OR MIL-DTL-83420 Carbon Steel, Tin-Zinc Coated (Composition "A (TZ)")	7X7	288 +25 / -0 lb (131 +12 / -0 kg)	552 +25 / -0 lb (250 +12 / -0 kg)	---	---	---
	7X19	---	600 +25 / -0 lb (272 +11 / -0 kg)	1200 +60 / -0 lb (544 +28 / -0 kg)	1680 +85 / -0 lb (762 +39 / -0 kg)	2520 +125 / -0 lb (1143 +57 / -0 kg)
BMS 7-265 OR MIL-DTL-83420 Corrosion Resistant Steel (CRES) (Composition "B")	7X7	288 +25 / -0 lb (131 +12 / -0 kg)	552 +25 / -0 lb (250 +12 / -0 kg)	---	---	---
	7X19	---	552 +25 / -0 lb (250 +12 / -0 kg)	1056 +50 / -0 lb (479 +23 / -0 kg)	1440 +70 / -0 lb (653 +32 / -0 kg)	2220 +110 / -0 lb (1007 +50 / -0 kg)

\*[1] THE DIAMETER OF THE WIRE ROPE TELLS YOU THE PROOF LOAD TO USE ON NYLON JACKETED CABLE. DO NOT INCLUDE THE JACKETED CABLE. DO NOT INCLUDE THE JACKET IN THE DIAMETER.

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**Table 404/20-10-91-993-804 Proof Loads For Cable Assemblies**

WIRE ROPE TYPE		CABLE DIAMETER *[1]				
		7/32 in. (5.556 mm)	1/4 in. (6.350 mm)	9/32 in. (7.144 mm)	5/16 in. (7.938 mm)	3/8 in. (9.525 mm)
		PROOF LOAD				
BMS 7-265 OR MIL-DTL-83420 Carbon Steel, Tin-Zinc Coated (Composition "A (TZ)")	7X19	3360 +170 / - 0 lb (1524 +77 / - 0 kg)	4200 +210 / - 0 lb (1905 +95 / - 0 kg)	4800 +240 / - 0 lb (2177 +109 / - 0 kg)	5880 +295 / - 0 lb (2667 +134 / - 0 kg)	8640 +435 / - 0 lb (3919 +197 / - 0 kg)
BMS 7-265 OR MIL-DTL-83420 Corrosion Resistant Steel (CRES) (Composition "B")	7X19	3000 +150 / - 0 lb (1361 +68 / - 0 kg)	3840 +190 / - 0 lb (1742 +86 / - 0 kg)	4680 +230 / - 0 lb (2123 +105 / - 0 kg)	5400 +270 / - 0 lb (2449 +123 / - 0 kg)	7200 +360 / - 0 lb (3266 +163 / - 0 kg)

\*[1] THE DIAMETER OF THE WIRE ROPE TELLS YOU THE PROOF LOAD TO USE ON NYLON JACKETED CABLE.  
DO NOT INCLUDE THE JACKETED CABLE. DO NOT INCLUDE THE JACKET IN THE DIAMETER.

SUBTASK 20-10-91-160-001

- (5) Rub the full length of the cable with cotton wiper, G00034.

SUBTASK 20-10-91-640-001

**CAUTION:** DO NOT APPLY SOLVENTS, GREASE, OR OIL TO STAINLESS STEEL CONTROL CABLES. THESE MATERIALS CAN COLLECT CONTAMINATION THAT CAN CAUSE DAMAGE TO THE INTERNAL SURFACES OF THE CRES CABLE STRANDS. THIS CAN DECREASE THE SERVICE LIFE OF THE CABLE.

- (6) Lubricate the cable.

**NOTE:** Only lubricate carbon steel cables. It is not necessary to lubricate CRES cables. CRES cables can be wiped with a clean cloth.

- (a) Apply a light, thin layer of grease, D00633 (recommended) or grease, D00015 to the carbon steel cable.
- (b) Wipe the cable with a clean rag to leave a thin film of grease between the strands on the cable.

SUBTASK 20-10-91-930-002

- (7) Make marks on the positions of the fittings not installed on the cable before installation.

SUBTASK 20-10-91-820-003

- (8) Put tape on the old cable so it will not unravel.

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SUBTASK 20-10-91-820-004

- (9) Cut off the cable end fitting of the old cable and make a splice to attach the old cable to the new cable.

NOTE: If you do not attach the new cable to the old cable, you will have a problem in routing the new cable. Make the splice of minimum diameter and sufficiently strong not to break when you pull the cable through. Make the splice on only the center strands of the cable. Put tape on the loose outer strands.

NOTE: If a person can assist with control cable installation, have them remove retainer pins and fairleads as new cable passes through pulley. Connect retainer pins and fairleads when new cable is in place. Continue with next pulley until done.

SUBTASK 20-10-91-820-005

- (10) Pull the old cable out with light tension on the new cable.

SUBTASK 20-10-91-420-005

- (11) Install the remaining fittings and apply a proof load to fittings (Figure 401).

- (a) Apply the full proof load in more than three (3) seconds.  
(b) Hold the load for a minimum of five (5) seconds.

SUBTASK 20-10-91-160-002

- (12) If necessary, remove unwanted corrosion preventive compound, C00308 from the surface of the control cable with a clean cotton wiper, G00034.

NOTE: Clean all of the cable, including through the fairleads and air seals, and over the pulleys, quadrants, and drums.

SUBTASK 20-10-91-640-002

**CAUTION:** DO NOT APPLY SOLVENTS, GREASE, OR OIL TO STAINLESS STEEL CONTROL CABLES. THESE MATERIALS CAN COLLECT CONTAMINATION THAT CAN CAUSE DAMAGE TO THE INTERNAL SURFACES OF THE CRES CABLE STRANDS. THIS CAN DECREASE THE SERVICE LIFE OF THE CABLE.

- (13) Lubricate the cable.

NOTE: Only lubricate carbon steel cables. It is not necessary to lubricate CRES cables. CRES cables can be wiped with a clean cloth.

- (a) Apply a light thin layer of grease, D00633 (recommended) or grease, D00015 to the carbon steel cable.  
(b) Wipe the cable with a clean rag to leave a thin film of grease between the strands on the cable.

SUBTASK 20-10-91-420-006

- (14) Install the turnbuckles with the turnbuckle barrel installed an equal distance on the two threaded terminals. Do not let more than three threads show out of the barrel.

SUBTASK 20-10-91-020-003

- (15) Remove the cable clamps and rigging pins from the control cable and drums.

SUBTASK 20-10-91-080-001

- (16) If applicable, remove the tension regulator tool from the elevator control cable.



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SUBTASK 20-10-91-420-007

- (17) Tighten the cable as told in the temperature - tension chart in the system chapter.

NOTE: Use a tensiometer to do a check on the cable tension. Apply the tensiometer to the cable at least 6 in. (152 mm) from the turnbuckle terminal or other fittings. To make sure you have the correct cable tension, permit a minimum of one hour at constant ambient temperature ( $\pm 5^{\circ}\text{F}$  [ $\pm 3^{\circ}\text{C}$ ]) for airplane temperature to become stable.

SUBTASK 20-10-91-710-001

- (18) If a new cable is installed, operate the system for a number of test cycles, with cables tightened to two times the working tension.

NOTE: See the applicable chapter for tension specifications.

SUBTASK 20-10-91-820-006

- (19) Make the last rigging adjustments.

NOTE: Refer to the applicable chapter for rigging load.

SUBTASK 20-10-91-210-001

- (20) Do this task: Control Cable Half Ball Pressure Seal Installation, TASK 20-10-04-400-801.

NOTE: Correctly adjusted seals stop deflection of the cable and make sure the cable is free to move.

SUBTASK 20-10-91-220-001

- (21) The minimum clearance from the adjacent structure shall be as follows.

NOTE: The clearances that follow are general guidelines only. Refer to the applicable chapter to find any special conditions for a specific system.

- (a) Between different cable systems - 0.50 in. (12.70 mm).

NOTE: A clearance of 2.00 in. (50.80 mm) is recommended.

- (b) Between structure, wiring, tubing and fixed equipment:

1) At a fairlead - 0.50 in. (12.70 mm).

2) At a rubstrip - 0.10 in. (2.54 mm).

NOTE: A clearance of 1.50 in. (38.10 mm) is recommended below the cable, and 1.00 in. (25.40 mm) is recommended in the other directions.

- (c) Between doors, landing gear, and components that move - 2.00 in. (50.80 mm).

NOTE: A clearance of 4.00 in. (101.60 mm) is recommended.

SUBTASK 20-10-91-420-008

- (22) Do this task: Turnbuckle Lock Installation, TASK 20-10-10-400-801.

on all the turnbuckles adjusted.

SUBTASK 20-10-91-710-002

- (23) Operate controls through full travel to make sure that cables move freely with minimum force.

SUBTASK 20-10-91-860-001

- (24) Do this task: (Control Cables Identification and Assembly Specifications, TASK 27-09-14-860-801).

SUBTASK 20-10-91-420-009

- (25) Install the cable.



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- (a) Attach the new cable to the old cable.

NOTE: If you do not attach the new cable to the old cable, you will have a problem in routing the new cable.

- (b) Pull the old cable out, which pulls the new cable through at the same time.  
(c) Keep light tension on the new cable.

SUBTASK 20-10-91-410-002

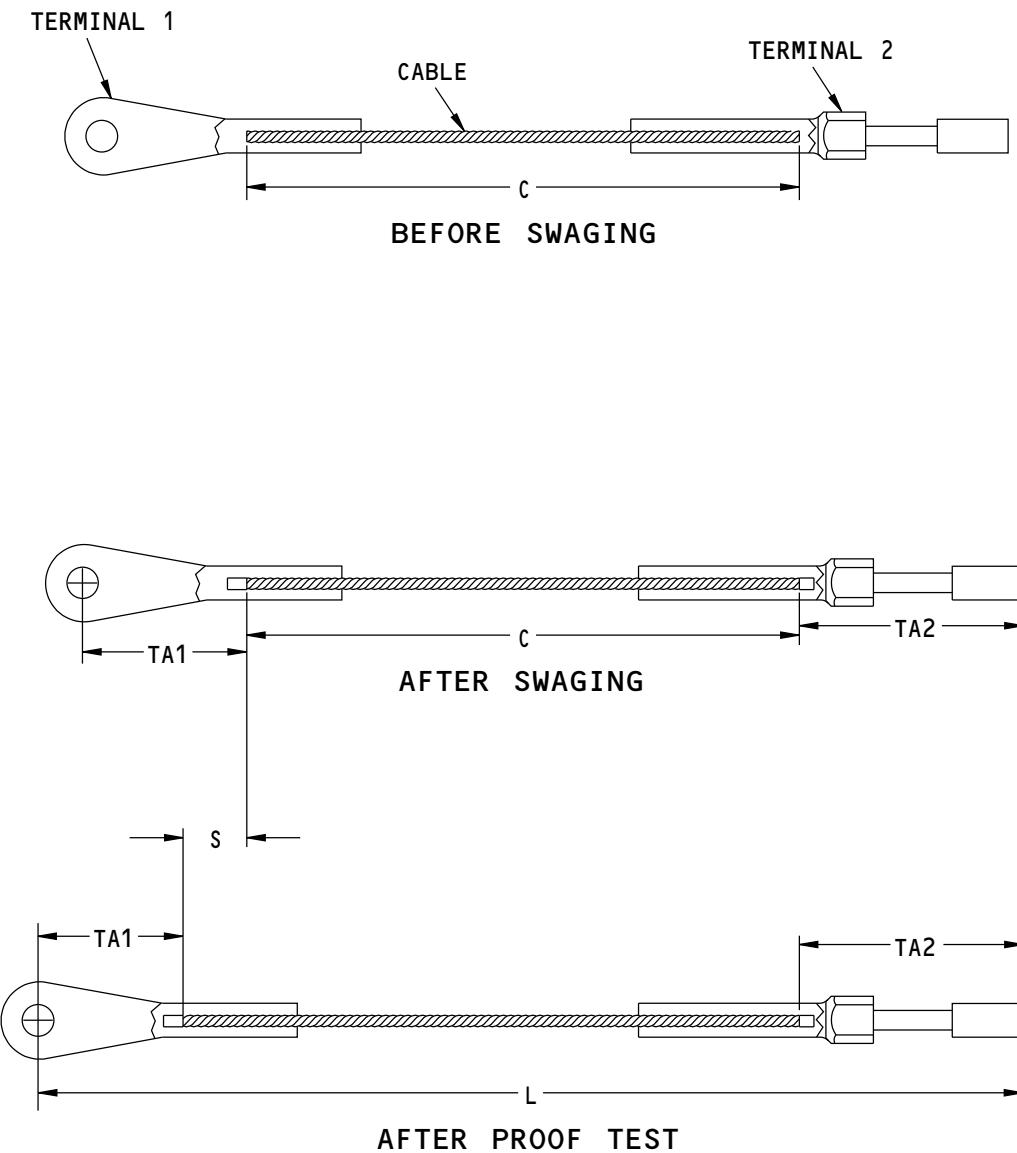
- (26) Do this task: Control Cable Pulleys Installation, TASK 20-10-09-400-801  
and do this task: Control Cable Half Ball Pressure Seal Installation, TASK 20-10-04-400-801.

———— END OF TASK ————



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$C = L - (TA_1 + TA_2 + S)$  WHERE:

$C$  = CUT LENGTH OF CABLE

$L$  = FINAL ASSEMBLY LENGTH

$S$  = AMOUNT OF INCREASED CABLE LENGTH AFTER PROOF TEST

$TA_1$  = TERMINAL 1 ALLOWANCE AFTER SWAGING

$TA_2$  = TERMINAL 2 ALLOWANCE AFTER SWAGING

C24465 S0006402321\_V2

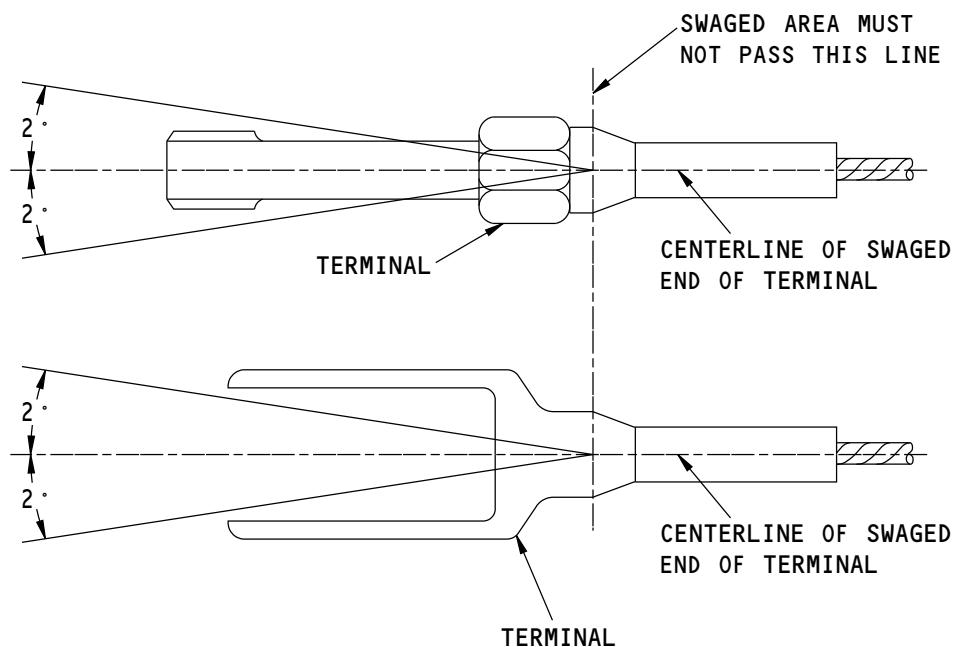
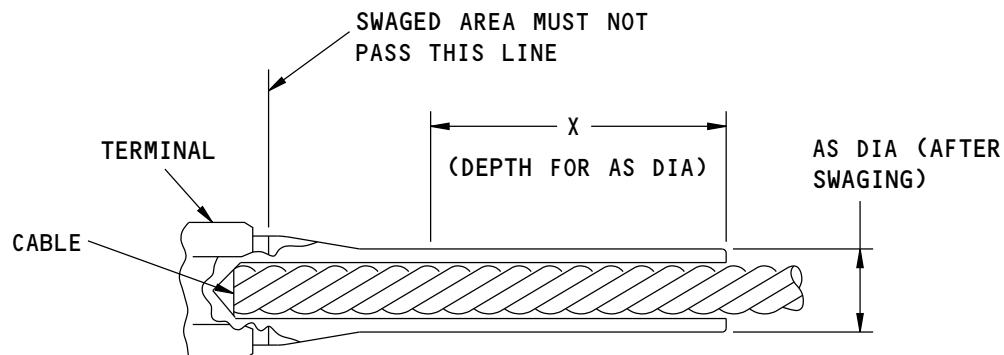
**Control Cables Installation**  
**Figure 401/20-10-91-990-801 (Sheet 1 of 2)**

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Control Cables Installation  
Figure 401/20-10-91-990-801 (Sheet 2 of 2)

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OFF-AIRPLANE DATA LOADING - MAINTENANCE PRACTICES

**1. General**

- A. On-board software loadable LRUs can be loaded with software on the airplane using the AMM Software Installation procedures for each software loadable LRU or off the airplane using these off-airplane loading procedures. The AMM on-airplane Software Installation procedure for each software loadable LRU is contained within the respective ATA chapter for the LRU. This procedure provides details for the software loading of an LRU off the airplane.

**TASK 20-15-01-410-801**

**2. Off-Airplane Software Installation**

**A. General**

- (1) Off-airplane data loading equipment may have the capability to support various interfaces: ie ARINC 429, ARINC 629, RS232, and PC cards. Off-airplane data loading equipment may be used to load several software loadable LRUs. Reference the airlines off-airplane data loading policy to determine which LRUs can be off-airplane loaded with the following equipment. For off-airplane data loading equipment information contact an off-airplane data loading equipment vendor directly. Equipment information for the shop data loader, COM-1407 follows.

**B. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-1407	Loader - Data, Shop Part #: QSL7X7 Supplier: 0D4J3 Opt Part #: 615 FDS Supplier: 0D4J3

**C. Additional Alternative Equipment**

SUBTASK 20-15-01-860-001

- (1) Data Loader - Shop, Pentar Avionics Headquarters, 19820 North Creek Parkway Suite 102, Bothell, WA 98011

**D. Procedures**

SUBTASK 20-15-01-410-001

- (1) Off-airplane data loading is accomplished on software loadable LRUs that are removed from the airplane or are taken out of stores.

SUBTASK 20-15-01-410-002

- (2) An LRU which is removed from the airplane for the purpose of off-airplane loading must be installed using the AMM Removal and Installation procedures. The R & I procedures will require that you make sure that the correct software is installed in the LRU.

SUBTASK 20-15-01-410-003

- (3) Refer to the appropriate airline's documentation for the correct software part number or numbers for each software loadable LRU prior to performing this software loading procedure.

SUBTASK 20-15-01-410-004

- (4) The procedures for software loading using off-airplane data loading equipment are documented in the respective supplier's off-airplane data loading equipment user's manual.

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SUBTASK 20-15-01-410-005

- (5) Refer to the airline's off-airplane data loading policy for additional off-airplane loading equipment and procedures information.

———— END OF TASK ————

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ON-AIRPLANE SOFTWARE INSTALLATION - MAINTENANCE PRACTICES

**TASK 20-15-11-400-801**

**1. On-Airplane Software Installation**

(Figure 201)

**A. General**

- (1) This task provides the common instructions on how to install software on-airplane.
  - (a) The complete software installation procedure can be found in the AMM chapter of the component.
- (2) Software Installation Times
  - (a) The time required to install software in a component is variable and is dependent on several factors which include:
    - 1) Retrieval of the correct software media, applicable equipment and Maintenance Manual procedure.
    - 2) Setup procedures.
    - 3) Data transfer time.
    - 4) Software configuration check.
    - 5) Return to usual airplane configuration.
    - 6) Airline completion procedures.
- (3) Data Transfer Times
  - (a) The data transfer time is the time from disk or disks insertion into the data loader until the data transfer is complete.
  - (b) The data transfer time depends on:
    - 1) The number of disks.
    - 2) The type and size of software files on each disk.
    - 3) The unique protocols and processors of the data loader.
    - 4) The unique internal protocols and processors of the component.
    - 5) Disks inserted in a timely manner.
  - (c) Typical data transfer times are:
    - 1) Operational Program Software (OPS): approximately 5 to 16 minutes for each disk. For example, if the OPS has four disks, then the complete installation can take as long as 64 minutes.
    - 2) Operational Program Configuration (OPC): approximately 1 to 3 minutes for each disk.
    - 3) Databases (DB): approximately 3 to 15 minutes for each disk.
  - (d) Short Load
    - 1) Some components can do a short load.
    - 2) During a short load, only pieces of software that are different from what is already in the component are installed during data transfer. This can cause a data transfer time that is much shorter than the time given in Table 201. It is possible that some disks will not be used during software installation.

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- 3) You know that the correct software is installed when the correct software part number shows for the software configuration check.
  - 4) The display electronic unit (DEU) for the Common Display System is an example of a component that can do a short load.
- (4) Table 201 - Data Transfer Times
- (a) Table 201 shows data transfer times for components that are approved for on-airplane software installation. Not all components are installed on all airplanes. If a component is installed on an airplane, then there is a software installation procedure applicable to that airplane. The software installation procedure is in the AMM chapter-section given in the table.
  - (b) The types of software installed in a component on one airplane can be different than the types of software installed in the component on a different airplane.
    - 1) A component on the list can have some hardware part numbers that are approved for software installation and other hardware part numbers that are not approved for software installation.
    - 2) Refer to airline part number records to find software part numbers for applicable components.
  - (c) Data transfer times are approximate times in minutes for software installed with a data loader. Data transfers can fail, and failure of the data transfer will increase the total time necessary for software installation. Data transfer times are supplied only as an aid to help you schedule work.
  - (d) The times given are for the installation of one piece of software into one component.
    - 1) If a component has more than one piece of software, then you must add the time for each piece to find the total data transfer time for the component.
    - 2) If a system has more than one of the given component, and software is to be installed in each one, you must multiply the time given in the table by the total number of components to find the total data transfer time for the system.
      - a) For example, if a left and a right component are installed on the airplane, you must multiply the time given in the table by two to find the total data transfer time for the two components.
      - b) Some systems can cross-load software between components. Usually it is faster to cross-load software than to install software with a data loader. The Flight Management Computer System (FMCS) is an example of a system that can cross-load.

**Table 201/20-15-11-993-801 Table 201**

AMM CHAPTER	COMPONENT	SOFTWARE	DATA TRANSFER TIME (MINUTES)
22-11	Flight Control Computer (FCC)	OPS	5 to 16
23-15	Satellite Data Unit (Rockwell Collins)	OPS ORT (DB)	15 to 48 1 to 5
23-15	Satellite Data Unit (Honeywell)	USER ORT (DB) SECURED ORT (DB)	1 to 5 1 to 5

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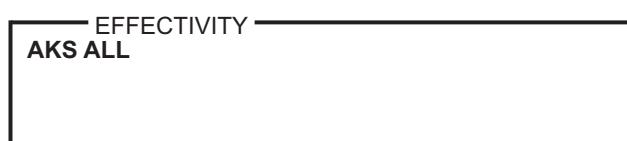


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**Table 201/20-15-11-993-801 Table 201 (Continued)**

AMM CHAPTER	COMPONENT	SOFTWARE	DATA TRANSFER TIME (MINUTES)
23-15	Satellite Data Unit (Thales)	OPS ORT (DB)	15 to 48 1 to 5
23-27	ACARS Management Unit (AlliedSignal)	CORE & App (OPS) Airplane Database (DB)	5 to 16 1 to 15
23-27	ACARS Management Unit (Rockwell Collins)	CORE (OPS) AOC (DB)	2 to 16 3 to 15
23-27	ACARS Management Unit (Teledyne)	Application (OPS)	5 to 16
23-27	ACARS Multi-Purpose Display Unit (MIDU) (AlliedSignal)	OPS *[1]	5 to 6
23-32	Digital Interface Unit (Passenger Flight Information Display System)	Airshow DB *[2]	3 to 15
23-42	Attendant Control Panel APC Lighting	OPS ACP(DB)	5 to 10 5 to 10
31-31	Digital Flight Data Acquisition Unit	DFDAU Mandatory (OPS) *[3] ACMS Monitoring (OPS) *[3]	5 to 32 3 to 20
31-31	Optical Quick Access Recorder (Teledyne)	OPS *[5]	30
31-62	Display Electronic Unit (Common Display System)	OPS OPC DB	35 to 128 1 to 3 2 to 15
34-46	Enhanced Ground Proximity Warning Computer (EGPWC)	DB *[1]	5 to 45
34-61	Flight Management Computer (FMCS)	OPS OPC MEDB NAV DB ACARS Datalink DB *[4] Perf Defaults DB *[4]	10 to 32 1 to 3 3 to 15 3 to 75 3 to 15 3 to 15
34-61	LCD Control Display Unit	OPS	5 to 16
<b>AKS 001-006, 009, 010, 013, 015-018, 020-025, 027</b>			
46-15	Electronic Flight Bag System (EFB) Class 2	OS OPS ADMW SW	*[6]*[6]
<b>AKS ALL</b>			
49-61	APU Electronic Control Unit	OPS	5 to 16

\*[1] Software installed from PCMCIA card



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- \*[2] Software installed from disk or CD-ROM
- \*[3] Software installed from disk or PCMCIA card
- \*[4] Optional software
- \*[5] Software installed from disk drive at component front panel
- \*[6] No software load time available.

(5) Data Loaders

- (a) This procedure supplies general information about data load equipment. You can find the data load equipment for the airplane configuration in the Flight Management Computer System (34-61).
- (b) A data loader is a disk drive that connects to a component through interface wiring. Software disks are inserted into the disk drive and the data is transferred to the component.
- (c) These are the types of data loaders:
  - 1) Airborne Data Loader (ADL)
    - a) An airborne data loader is a data loader that is installed in the flight compartment on the P61 panel.
  - 2) Portable Data Loader (PDL)
    - a) A portable data loader (PDL) is equipment that is moved to the airplane to install software. The PDL is removed from the airplane when the task is complete.
  - 3) Enhanced Airborne Data Loader (eADL)
    - a) An enhanced airborne data loader is a data loader that is installed in the flight compartment on the P61 panel.
    - b) The eADL has two procedures for software installation:
      - <1> Floppy Disk Software Installation
      - <2> USB Flash Drive Software Installation
        - <a> This procedure uses the USB port on the front panel of the eADL to install software from a valid USB flash drive to the Mass Storage Device (MSD). Once the software is installed on the MSD, the software is loaded to the component.
        - <b> The USB flash drive must be configured correctly using the USB stick creator tool defined in the eADL Operations Guide.
- (d) A data loader control panel is installed on the P61 panel. The control panel has interface wiring to components that can receive software installation from a data loader in the flight compartment. The control panel has a switch position for each applicable component. There are INOP labels on switch positions that are not available for software installation.
- (e) There is an airborne data loader (ADL) or a connector for a portable data loader (PDL) on the P61 panel.
  - 1) A P61 panel with a ADL and PDL switching function, there will only be one data load source at a time.
    - a) When a PDL is connected to the PDL connector, then the PDL will be the primary data source for data loading.
    - b) The ADL will be the primary data source for data loading when the PDL is not connected to the PDL connector.

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- (f) Figure 201 shows examples of data loader control panels, airborne data loaders, and the connector panel for a portable data loader.
- (6) Alternative Software Installation
  - (a) Usually software is installed with a data loader in the flight compartment. But some components have an interface connector, disk drive, CD-ROM drive, or PCMCIA (personal computer memory card international association) interface for software installation at the front of the component.
- (7) Airborne Data Loaders (ADL)
  - (a) This procedure supplies examples for operation of these ADLs:
    - 1) AlliedSignal (Sundstrand)
    - 2) Teledyne
    - 3) SFIM
- (8) Portable Data Loaders (PDL)
  - (a) A PDL has an interface cable that is connected to the DATA TRANSFER UNIT RECEPTACLE connector on the P61 panel. The circuit breaker that supplies power for the PDL must be open when a PDL is connected or disconnected.
  - (b) PDLs are not Boeing supplied parts. Refer to the data loader supplier for instructions for PDL operation.
- (9) Enhanced Airborne Data Loader (eADL)
  - (a) Teledyne
- (10) SEL CONFIG prompt on CDU
  - (a) The SEL CONFIG prompt shows on the INIT/REF INDEX page on the FMCS control display unit (CDU).
  - (b) The SEL CONFIG page will show software part numbers for some systems. For example, the flight data acquisition unit (FDAU) will show software part numbers when selected.
  - (c) To show software part numbers, first set the data loader control panel to the applicable system. Then push the line select key adjacent to SEL CONFIG.
    - 1) If the configuration supports this page, then software part numbers will show for the selected system.
    - 2) If the configuration does not support the SEL CONFIG function or if the selected system is not operational, then the selected page will be blank.
    - 3) The selected system controls the format of the SEL CONFIG page.

**B. References**

Reference	Title
24-22-00-860-811	Supply Electrical Power (P/B 201)
24-22-00-860-812	Remove Electrical Power (P/B 201)

**C. AlliedSignal (Sundstrand) Airborne Data Loader Procedure**

SUBTASK 20-15-11-860-002

- (1) The AlliedSignal ADL has these status lights:
  - (a) PROG (In Progress) - shows as software installation occurs.
  - (b) CHNG (Change) - shows when it is time to install the subsequent disk.
  - (c) COMP (Complete) - shows when the software installation is completed.



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- (d) RDY (Ready) - shows when the disk is in the disk drive and the ADL is ready to install the software in the component.
  - 1) If the RDY indication flashes, then the data loader is in standby mode while it waits for the component to validate the data.
- (e) XFER (Transfer Fail) - shows the software installation is not completed. Open and close the circuit breaker for the component, and start the installation again.
- (f) R/W (Read/Write) - shows when the ADL cannot read or write the data on the disk. Open and close the circuit breaker for the component, and start the installation again. If the problem continues, then replace the disk.
- (g) HRDW (Hardware) - shows when the ADL fails the self test.

**SUBTASK 20-15-11-860-003**

- (2) Do these steps to prepare for the software installation:
  - (a) Do this task: Supply Electrical Power, TASK 24-22-00-860-811.
    - 1) Make sure that the power is not removed while you install software.  
NOTE: A power interruption will cause a failure of the software installation.
  - (b) Make sure that the system select switch on the data loader control panel (P61) is set to NORM or NORMAL.
  - (c) Open this circuit breaker:

**CAPT Electrical System Panel, P18-2**

<u>Row</u>	<u>Col</u>	<u>Number</u>	<u>Name</u>
A	9	C00923	DATA LOADER

- (d) To open the ADL front cover, pull at the top edge.
- (e) Push the eject button on the ADL.
  - 1) If a plastic protective disk is ejected from the disk drive, then remove it.
- (f) Close this circuit breaker:

**CAPT Electrical System Panel, P18-2**

<u>Row</u>	<u>Col</u>	<u>Number</u>	<u>Name</u>
A	9	C00923	DATA LOADER

- (g) Wait until all the status lights are off.  
NOTE: The status lights will flash on and off while the ADL does a self test.
- (h) Make sure that the circuit breakers are closed for the applicable component or system that will receive the new software.

**SUBTASK 20-15-11-420-001**

- (3) Do these steps at the ADL to install the software:

NOTE: You must know the correct software part numbers for the component. For the component to be an approved installation, software with the correct part numbers must be installed.

NOTE: This is a general procedure for software installation. Some components have other steps that are necessary. The software installation task for the component will include all necessary steps.

- (a) Set the switch or switches on the data loader control panel to the applicable position for your component or system.



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- (b) Carefully push the first disk (label up) into the disk drive.

NOTE: If the destination component is active, the installation sequence will begin and the RDY light will come on. When the data transfer begins, the PROG light will come on. The RDY light can flash when the component validates the data. If the software is on more than one disk, the CHNG light will come on when it is time to put in the subsequent disk.

- (c) If the CHNG light comes on, wait approximately 10 seconds and then push the eject button.

NOTE: The installation can fail if you wait too long before you remove and install disks.

1) Remove the disk from the disk drive.

2) Put the subsequent disk into the disk drive.

3) If there are more than two disks for the software installation, then remove and install disks until the COMP light shows.

- (d) When the COMP light comes on, wait approximately 10 seconds and then push the eject button.

- (e) Remove the disk from the disk drive.

- (f) If there was a plastic protective disk in the disk drive before you installed software, then put it back into the disk drive.

**SUBTASK 20-15-11-860-004**

- (4) Set the system select switch on the data loader control panel to NORM or NORMAL.

**SUBTASK 20-15-11-410-001**

- (5) Close the front cover on the ADL.

**SUBTASK 20-15-11-740-001**

- (6) Make sure that the correct software part numbers are installed in the component.

NOTE: The software installation task for the component has the steps to do a software configuration check.

**SUBTASK 20-15-11-860-005**

- (7) Do this task: Remove Electrical Power, TASK 24-22-00-860-812.

**D. Teledyne Airborne Data Loader Procedure**

**SUBTASK 20-15-11-860-006**

- (1) Do these steps to prepare for the software installation:

- (a) Do this task: Supply Electrical Power, TASK 24-22-00-860-811.

1) Make sure that the power is not removed while you install software.

NOTE: A power interruption will cause a failure of the software installation.

- (b) Make sure that the system select switch on the data loader control panel (P61) is set to NORM or NORMAL.

- (c) Open this circuit breaker:

**CAPT Electrical System Panel, P18-2**

<u>Row</u>	<u>Col</u>	<u>Number</u>	<u>Name</u>
A	9	C00923	DATA LOADER

- (d) To open the ADL front cover, turn the cover knob clockwise and pull.

- (e) Push the eject button on the ADL.



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- 1) If a plastic protective disk is ejected from the disk drive, then remove it.
- (f) Close this circuit breaker:

**CAPT Electrical System Panel, P18-2**

<u>Row</u>	<u>Col</u>	<u>Number</u>	<u>Name</u>
A	9	C00923	DATA LOADER

- (g) Wait until the display shows INSERT DISK #1.

NOTE: The display lights and the ADL FAIL light will go on and off while the ADL does a self test. When the self test is complete, the display will show INSERT DISK #1.

- (h) Make sure that the circuit breakers are closed for the applicable component or system that will receive the new software.

SUBTASK 20-15-11-420-002

- (2) Do these steps at the ADL to install the software:

NOTE: You must know the correct software part numbers for the component. For the component to be an approved installation, software with the correct part numbers must be installed.

NOTE: This is a general procedure for software installation. Some components have other steps that are necessary. The software installation task for the component will include all necessary steps.

- (a) Set the switch or switches on the data loader control panel to the applicable position for your component or system.
- (b) Carefully push the first disk (label up) into the disk drive.

NOTE: The display will show DISK INSERTED and then VOL:. If the destination component is active, the display will then show the file, extension and the percent of the file transfer completed. If there is more than one file, the ADL will install the next file until all files are completed. If the software is on more than one disk, then the display will show CHANGE DISK or INSERT DISK when it is time to put in the subsequent disk.

NOTE: If TRANSFER FAIL shows, then the installation is not completed. Open and close the circuit breaker for the component, and start the installation again. If READ/WRITE FAIL shows, then there is a problem with the disk. Open and close the circuit breaker for the component, and start the installation again. If the problem continues, then replace the disk.

- (c) If CHANGE DISK or INSERT DISK shows on the display, wait approximately 10 seconds and then push the eject button.

NOTE: The installation can fail if you wait too long before you remove and install disks.

- 1) Remove the disk from the disk drive.
- 2) Put the subsequent disk into the disk drive.
- 3) If there are more than two disks for the software installation, then remove and install disks until LOAD COMPLETE shows on the display.

- (d) When LOAD COMPLETE shows on the display, wait approximately 10 seconds and then push and eject button.

- (e) Remove the disk from the disk drive.

- (f) If there was a plastic protective disk in the disk drive before you installed software, then put it back in the disk drive.

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SUBTASK 20-15-11-860-007

- (3) Set the system select switch on the data loader control panel to NORM or NORMAL.

SUBTASK 20-15-11-410-002

- (4) Close the front cover on the ADL.

SUBTASK 20-15-11-740-002

- (5) Make sure that the correct software part numbers are installed in the component.

NOTE: The software installation task for the component has the steps to do a software configuration check.

SUBTASK 20-15-11-860-008

- (6) Do this task: Remove Electrical Power, TASK 24-22-00-860-812.

### E. SFIM Airborne Data Loader Procedure

SUBTASK 20-15-11-860-009

- (1) Do these steps to prepare for the software installation:

- (a) Do this task: Supply Electrical Power, TASK 24-22-00-860-811.

- 1) Make sure that the power is not removed while you install software.

NOTE: A power interruption will cause a failure of the software installation.

- (b) Make sure that the system select switch on the data loader control panel (P61) is set to NORM or NORMAL.

- (c) Open this circuit breaker:

#### CAPT Electrical System Panel, P18-2

<u>Row</u>	<u>Col</u>	<u>Number</u>	<u>Name</u>
A	9	C00923	DATA LOADER

- (d) To open the ADL front cover, pull at the top edge.

- (e) Push the eject button on the ADL.

- 1) If a plastic protective disk is ejected from the disk drive, then remove it.

- (f) Close this circuit breaker:

#### CAPT Electrical System Panel, P18-2

<u>Row</u>	<u>Col</u>	<u>Number</u>	<u>Name</u>
A	9	C00923	DATA LOADER

- (g) Wait until the display shows UNIT READY.

NOTE: While the ADL does a self test, the display indicators can flash on and off. TEST IN PROG, TEST COMPLETE and then UNIT READY will show on the display.

- (h) Make sure that the circuit breakers are closed for the applicable component or system that will receive the new software.

SUBTASK 20-15-11-420-003

- (2) Do these steps at the ADL to install the software:

NOTE: You must know the correct software part numbers for the component. For the component to be an approved installation, software with the correct part numbers must be installed.

NOTE: This is a general procedure for software installation. Some components have other steps that are necessary. The software installation task for the component will include all necessary steps.

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- (a) Set the switch or switches on the data loader control panel to the applicable position for your component or system.
- (b) Carefully push the first disk (label up) into the disk drive.

NOTE: If the destination component is active, the installation sequence will begin. READY and then TRANSF IN PROG will show on the display. Then the display will show the data bus transmitter number and the amount of data. If there is more than one file, the ADL will install the next file until all files are completed. If the software is on more than one disk, the display will show DISK CHANGE or INSERT DISK when it is time to put in the subsequent disk.

NOTE: If TRANSF FAIL shows, then the installation is not completed. Open and close the circuit breaker for the component, and start the installation again. If DISK ERROR shows, then there is a problem with the disk. Open and close the circuit breaker for the component, and start the installation again. If the problem continues, then replace the disk.

- (c) If DISK CHANGE or INSERT DISK shows in the display, wait approximately 10 seconds and then push the eject button.

NOTE: The installation can fail if you wait too long before you remove and install disks.

- 1) Remove the disk from the disk drive.
- 2) Put the subsequent disk into the disk drive.
- 3) If there are more than two disks for the software installation, then remove and install disks until the display shows TRANSF COMPLETE.

- (d) When TRANSF COMPLETE shows on the display, wait approximately 10 seconds and then push the eject button.

- (e) Remove the disk from the disk drive.

- (f) If there was a plastic protective disk in the disk drive before you installed software, then put it back into the disk drive.

SUBTASK 20-15-11-860-010

- (3) Set the system select switch on the data loader control panel to NORM or NORMAL.

SUBTASK 20-15-11-410-003

- (4) Close the front cover on the ADL.

SUBTASK 20-15-11-740-003

- (5) Make sure that the correct software part numbers are installed in the component.

NOTE: The software installation task for the component has the steps to do a software configuration check.

SUBTASK 20-15-11-860-011

- (6) Do this task: Remove Electrical Power, TASK 24-22-00-860-812.

**F. Teledyne Enhanced Airborne Data Loader (eADL)**

SUBTASK 20-15-11-860-017

- (1) Do these steps to prepare for the Installation:

- (a) Do this task: Supply Electrical Power, TASK 24-22-00-860-811.
- (b) Make sure that the power is not removed while you install software.

NOTE: A power interruption will cause a failure of the software installation.



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- (2) Make sure that this circuit breaker is closed:

**CAPT Electrical System Panel, P18-2**

<u>Row</u>	<u>Col</u>	<u>Number</u>	<u>Name</u>
A	9	C00923	DATA LOADER

- (a) Make sure that the circuit breakers are closed for the applicable component or system that will receive the new software.
- (b) Set the switch or switches on the data loader control panel to the applicable position for the component or system to receive the new software.
- (c) Open the eADL front cover by releasing the two screws and lifting up on the cover.

SUBTASK 20-15-11-470-005

- (3) Do these steps to install software from a floppy disk:

- (a) Wait until the display shows the eADL Main Menu.

NOTE: To navigate UP or DOWN and make a selection on the eADL screen, use the appropriate buttons on the eADL front panel.

NOTE: If the eADL Main Menu does not show, select MAIN or GO BACK until the eADL shows the Main Menu.

- (b) Select "Target Page."

- 1) The eADL will show the Select Target System screen.

- (c) Select "Floppy Drive."

- 1) The eADL will show a Load Confirmation screen.

- (d) Carefully push the first disk (label up) into the disk drive.

- (e) Select "CONFIRM."

- 1) The eADL will show "LOADING" on the Transfer In Progress screen.

NOTE: It may take one to two minutes for the installation to start.

NOTE: If the disk set has more than one disk and the data of the current disk is completely transferred, the eADL will prompt you to insert the next diskette. Eject the current diskette, insert the next diskette and select "CONTINUE."

- (f) In the Transfer In Progress screen, wait for the eADL to show "LOAD COMPLETE."

- (g) Select "MAIN" to go back to the main menu.

- (h) Eject the disk from the disk drive when the software installation is completed.

SUBTASK 20-15-11-470-006

- (4) Do these steps to install software from a USB flash drive to the eADL MSD:

- (a) Put the USB flash drive into the eADL USB port.

NOTE: The USB flash drive must be configured correctly by the USB stick creator tool as specified in the eADL Operations Guide.

- (b) Make sure that the "eADL Main Menu" is shown.

NOTE: To navigate UP or DOWN and make a selection on the eADL screen, use the appropriate buttons on the eADL front panel.

NOTE: If the eADL Main Menu does not show, select MAIN or GO BACK until the eADL shows the Main Menu.

- (c) Select "Maintenance Page."

- 1) This will show the "Maintenance Menu" screen.



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- (d) Select "Transfer Parts From USB."

NOTE: If the error message "USB Is Not Mounted Or Is Not A Valid USB" is shown, select "GO BACK" and do the steps again.

NOTE: Make sure the USB flash drive is configured correctly by the USB stick creator tool as specified in the eADL Operations Guide.

- 1) The eADL screen will show "CONFIRM TO BEGIN TRANSFERRING."

- 2) Select "CONFIRM."

NOTE: The USB and MSD annunciators will turn yellow during the transfer procedure.

NOTE: If the software is already on the eADL MSD, this message will show: "Skipping, the software part number already exists."

- (e) When the software transfer is complete, the USB and MSD annunciators will turn green and this message will show:

"Part Transfer Complete"

NOTE: The annunciators will turn red if the transfer procedure is aborted or if there is a failure.

- (f) Select "GO BACK" two times to go back to the main menu.

SUBTASK 20-15-11-470-007

- (5) Do these steps to install the software from the eADL MSD to the LRU:

- (a) Make sure that the "eADL Main Menu" is shown.

NOTE: To navigate UP or DOWN and make a selection on the eADL screen, use the appropriate buttons on the eADL front panel.

NOTE: If the eADL Main Menu does not show, select MAIN or GO BACK until the eADL shows the Main Menu.

- (b) Select "Target Page."

- 1) This will show the "Select Target System" screen.

- (c) Select the LRU to receive the software.

- 1) This will show the "Select Software Part" screen.

- (d) Push the "SELECT" button for the desired software.

NOTE: The listed software will appear as it was originally configured in the USB stick creator tool.

- (e) Make sure that the "Load Confirmation" screen shows.

- (f) Select "CONFIRM."

- 1) This will show the "Transfer In Progress" screen.

- 2) The "TRANSFER" annunciator will change to "LOADING" and turn yellow during the installation procedure.

- 3) The "LOADING" annunciator will change to "COMPLETE" and turn green when the installation procedure is completed.

- (g) Select "MAIN" to go back to the main menu.



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SUBTASK 20-15-11-470-002

- (6) Make sure that the correct software part numbers are installed in the component.

NOTE: The software installation task for the component has the steps to do a software configuration check.

SUBTASK 20-15-11-860-018

- (7) Do these steps to put the airplane back to its usual condition:

- (a) Close the eADL cover and tighten screws.
- (b) Set the system select switch on the data loader control panel (P61) to NORM or NORMAL.
- (c) Do this task: Remove Electrical Power, TASK 24-22-00-860-812.

### G. Optional Loading Methods

NOTE: Use this procedure when an airplane is configured for an ADL, but a PDL is the only type of loader available.

SUBTASK 20-15-11-860-012

- (1) Make an adapter cable to attach the PDL to an ADL connector.

- (a) Use the PDL supplier's manual to find the pins on these connectors to assemble an adapter cable:
  - 1) The MS27473T18A53S connector connects with the PDL connection.
  - 2) The MS27508E18A53P connector connects with the airplane connection.

SUBTASK 20-15-11-860-013

- (2) Make sure that the ADL is not energized and the select switch is in the NORMAL position.

SUBTASK 20-15-11-020-001

- (3) Turn four mounting screws to the left to remove the ADL.

SUBTASK 20-15-11-020-002

- (4) Remove the ADL.

SUBTASK 20-15-11-860-014

- (5) Disconnect the airplane connector from the rear of the ADL.

SUBTASK 20-15-11-860-015

- (6) Connect the adapter cable as follows:

- (a) The MS27473T18A53S connector connects with the PDL connection.
- (b) The MS27508E18A53P connector connects with the airplane connection.

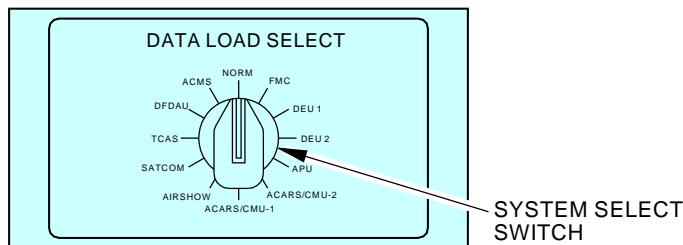
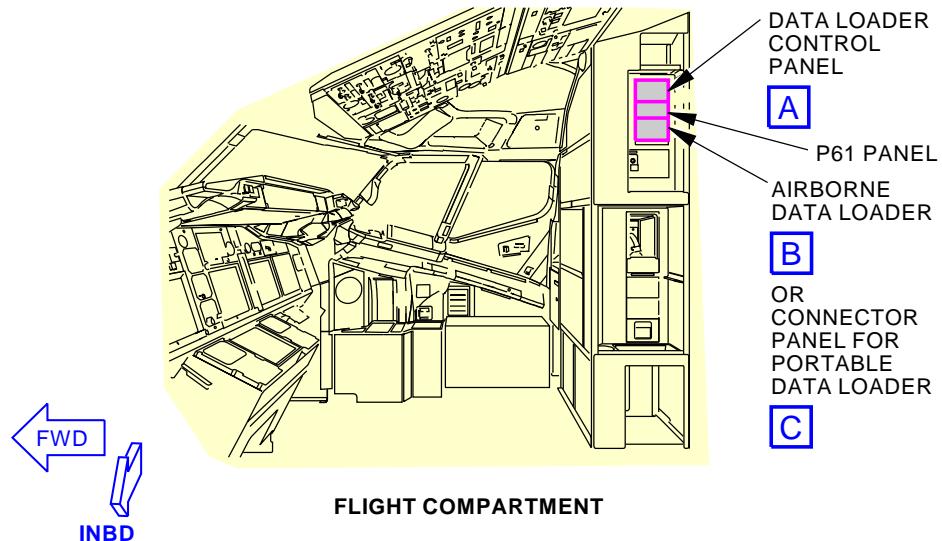
SUBTASK 20-15-11-860-016

- (7) Use one of the PDL procedures to install the LRU software.

———— END OF TASK ———

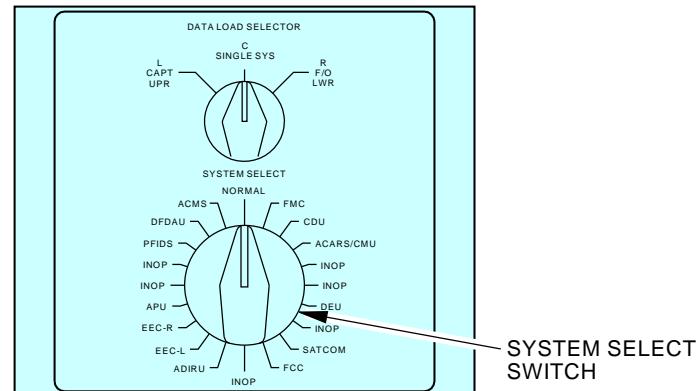


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**DATA LOADER CONTROL PANEL  
(EXAMPLE)**

**A**



**DATA LOADER CONTROL PANEL  
(EXAMPLE)**

**A**

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**On-Airplane Software Installation  
Figure 201/20-15-11-990-801 (Sheet 1 of 2)**

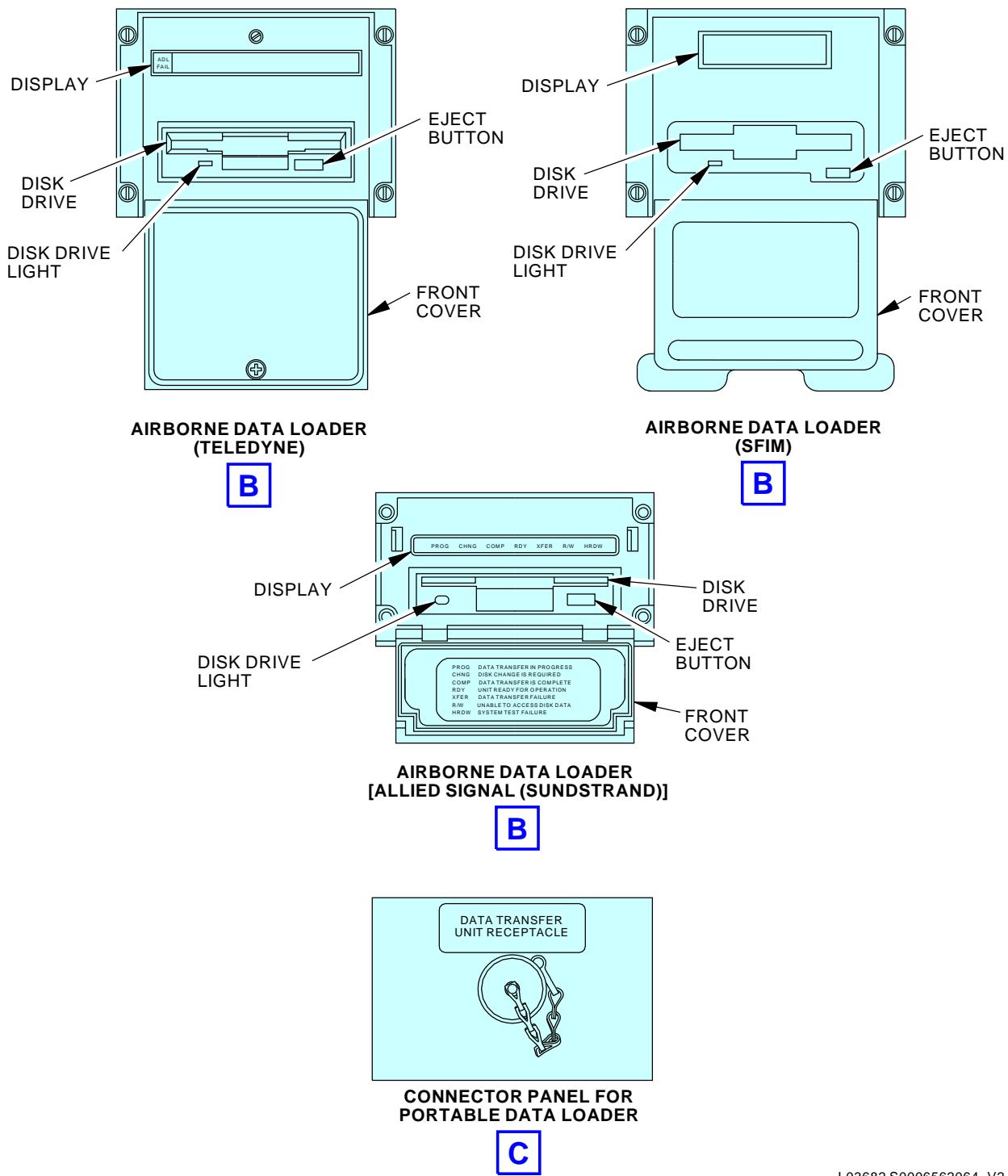
EFFECTIVITY  
**AKS ALL**

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On-Airplane Software Installation  
Figure 201/20-15-11-990-801 (Sheet 2 of 2)

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SELF-LUBRICATING BEARINGS AND BUSHINGS - INSPECTION/CHECK

**1. General**

- A. This procedure contains three tasks:
  - (1) The first task has two inspection/check procedures of bearings and bushings. One procedure is for bearings and bushings that are installed on the airplane. The other procedure is when the bearings and bushing are on the bench.
  - (2) The second is an inspection/check of special bushing and bearing configurations. Special bushings and bearings are those with holes, keyways, flanges, threads, or other special properties.
  - (3) The third is an inspection/check of bushings and bearings (bench check). Do this task after you have done the bench test instructions from the first task. This task gives steps to do a check of the breakaway torques of spherical bearings.
- B. You can examine the self-lubricated (teflon-cloth lining) bearings and bushings on the airplane or removed (bench check). The recommended procedure is the bench check. During the bench check you fully examine the parts for signs of damage from corrosion or cracks. Also, you can do a torque check of the bearing inner race.

**TASK 20-20-21-210-801**

**2. Bearing and Bushings - Inspection/Check**

**A. Procedure - Check of Self-Lubricated Bearings and Bushings (Installed on the Airplane)**

SUBTASK 20-20-21-210-001

**CAUTION:** DO NOT LUBRICATE TEFLON BEARINGS. TEFLON BEARINGS ARE SELF-LUBRICATED. GREASE OR OTHER LUBRICANTS CAN CAUSE LINING DETERIORATION.

- (1) Examine the bearings or bushings to make sure they are not too worn or too loose as follows:

**NOTE:** If you find more than 0.010 inch internal diametrical play, you must carefully examine the bearing or bushing. Reject a bearing that has signs of galling of the bearing surfaces. If there is play but not galling, then examine the parts for a failure condition given at each maintenance inspection. These bearings and bushing do not always have noise when they are loose.

- (a) Try to move and turn the assembly to make sure the bearing or bushing is not too worn.
- (b) Make sure the bearing is not loosely held by its housing or turns in its housing.
- (c) Make sure there is not damage, cracks or too much corrosion on the bearing or housing

SUBTASK 20-20-21-210-002

- (2) If you can turn the bearing, or if removal of bolts permits you to turn the bearing, do the steps that follow:

**NOTE:** If you can see the lining after bolt removal, refer to the bench check instructions and examine the lining material.

- (a) Turn the bearing without a load on the bearing.
  - 1) Make sure it is not too worn, is rough, or has too much drag.
- (b) Turn the bearing while you apply a load.
  - 1) Make sure it is not too worn, is rough, or has too much drag.

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SUBTASK 20-20-21-210-003

- (3) Examine the bearings and bushings to make sure there is not lining material that comes out of the housing too far.

NOTE: Some bushings and bearings have some lining material that comes out a small distance when they are made. These bearing and bushings can be serviceable.

**B. Procedure - Check of Self-Lubricated Bearing and Bushing (Bench Check)**

SUBTASK 20-20-21-210-004

**CAUTION:** DO NOT LUBRICATE TEFLON BEARINGS. TEFLON BEARINGS ARE SELF-LUBRICATED. GREASE OR OTHER LUBRICANTS CAN CAUSE LINING DETERIORATION.

- (1) Examine the bearing and bushing for physical damage, cracks, or corrosion.

SUBTASK 20-20-21-210-005

- (2) Examine the bearing or bushing to see if it turns in the housing or for fretting on the surfaces without the lining.

NOTE: If the bearing or bushing turns in the housing, you must measure the dimension to make sure it is not too worn.

SUBTASK 20-20-21-210-006

- (3) Manually turn the bearing and feel for signs that it is too rough, too loose, has too much drag or unusual drag.

SUBTASK 20-20-21-210-007

- (4) Do a check of the bearing lining:

NOTE: On most spherical bearings, you can turn the ball and look at the lining through the bearing bore.

- (a) Examine the lining for worn areas.

- 1) Usually, reject bearings and bushings that have internal diametrical play of 0.010 inch. But, use service experience and the applicable permitted wear limits to know if the part is serviceable.

- (b) Examine the lining load pattern.

- 1) Examine the surface where the lining and ball/pin touch. Make sure all of the surface has an equal load.

NOTE: Incorrect swaging during manufacture or installation can cause the edges of the lining to wear too much. These bearings and bushings are not serviceable.

- (c) Examine the lining for unwanted material.

- 1) Examine the lining to make sure that no unwanted material becomes attached.

- (d) Examine the lining for chemical deterioration.

- 1) Examine the lining and lining bond for signs of chemical damage.

SUBTASK 20-20-21-210-008

- (5) Do the Bearings and Bushings (Bench Check) - Inspection/Check, TASK 20-20-21-220-801 task.

———— END OF TASK ————

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**TASK 20-20-21-210-802**

**3. Special Bearing and Bushing Configuration - Inspection/Check**

**A. Procedure - Special Bearing and Bushing Configurations - Check**

SUBTASK 20-20-21-210-009

- (1) Examine aluminum bearing races for serviceable surface treatment or plating, and for corrosion and cracks.

SUBTASK 20-20-21-210-010

- (2) Examine special configurations bearings with threads, holes, keyways, flanges, or equivalent properties for cracks in these areas.

NOTE: These special configurations can cause stress risers in these areas.

SUBTASK 20-20-21-210-011

- (3) Do the Bearing/Bushing - Inspection/Check (Bench Check) task.

———— END OF TASK ————

**TASK 20-20-21-220-801**

**4. Bearings and Bushings (Bench Check) - Inspection/Check**

**A. General**

- (1) Before you do this task, do the Procedure Bearing and Bushings - Inspection/Check, TASK 20-20-21-210-801 (Bench Check) in the first task.

**B. Procedure - Wear Check**

SUBTASK 20-20-21-220-001

- (1) To determine the amount of bearing wear, manually apply a reversing load to bearing in a simple holding fixture and measure play with a dial indicator. Radial wear should be measured by applying a reversing radial load of 10 to 15 pounds and total diametrical play measured. A reversing load of the same magnitude should then be applied in a axial (thrust) direction and axial play measured.

NOTE: When measuring play in the radial direction, several points should be checked by rotating the outer race relative to the inner race to establish the point where maximum play exists before attempting to make an accurate wear reading.

**C. Procedure - Bearing Breakaway Torque on Spherical Bearing Check**

SUBTASK 20-20-21-220-002

- (1) To do the breakaway preload torque checks, measure the torque necessary to turn one race with the other race held.

NOTE: The bearing must not have lubricants or other contaminants. The breakaway torque must not be more than twice the permitted rotational preload torque as listed in the applicable drawing for the specific bearing.

NOTE: Measure the breakaway torque before you do the rotational torque checks. Do the test at room temperature.

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**D. Procedure - Bearing Rotational Torque on Spherical Bearing Check**

SUBTASK 20-20-21-220-003

- (1) To do the rotational preload torques checks, measure the torque necessary to turn one race with the other race held.

NOTE: The bearing must not have lubricants or other contaminants. The permitted rotational preload torques values are listed in the applicable drawing for the specific bearing.

NOTE: Measure the breakaway torque before you do the rotational torque checks. For rotational torque tests, you must turn the bearing through two or three full turns immediately before you measure the torque. Do the tests at room temperature.

———— END OF TASK ————

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CONTROL CABLES - INSPECTION/CHECK

**1. General**

- A. This procedure contains scheduled maintenance task data.
- B. This procedure has these tasks:
  - (1) An inspection of the control cables wire rope
  - (2) An inspection of the control cable fittings
  - (3) An inspection of the pulleys
- C. These three tasks may be performed concurrently to one location of the control cable system on the airplane if desired for convenience.
- D. Use these procedures to verify the integrity of the control cable system.
- E. The procedures must be performed along the entire cable run in each system.
- F. To ensure verification of the portions of the cables that are in contact with pulleys and quadrants, the control cables must be moved by operation of the applicable system's controls to expose those portions of the cables.
- G. This procedure gives the inspections for control cables. If the inspections for specified control cables are different from these inspections, use the inspections for the specified control cables.
- H. Control cables are made of strands of thin wires. Each strand is one unit of hard steel. Thus, if one strand is broken, the control cable is not fully weak.
- I. Control cable type and construction are identified by two numbers. The first number is the number of strands. The second number is the number of wires in a strand. For example, a 7x7 flexible cable has seven strands, each of which has seven wires. The more strands a cable has, the more flexible it is. Thus, use 7x7 and 7x19 cables when cables go through pulleys or when you must bend the wires.
- J. Wires break most frequently where cables go through fairleads or around pulleys. Examine these areas carefully.

**TASK 20-20-31-200-801**

**2. Inspection of the Control Cable Wire Rope**

(Figure 601)

NOTE: This procedure is a scheduled maintenance task.

**A. References**

<u>Reference</u>	<u>Title</u>
12-26-00-600-801	Control Cable Lubrication (P/B 301)

**B. Location Zones**

<u>Zone</u>	<u>Area</u>
100	Lower Half of Fuselage
300	Empennage
400	Powerplant and Nacelle Struts
500	Left Wing
600	Right Wing

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C. Prepare for the Inspection

SUBTASK 20-20-31-100-001

**CAUTION:** DO NOT APPLY SOLVENTS, GREASE, OR OIL TO STAINLESS STEEL CONTROL CABLES. THESE MATERIALS CAN COLLECT CONTAMINATION THAT CAN CAUSE DAMAGE TO THE INTERNAL SURFACES OF THE CRES CABLE STRANDS. THIS CAN DECREASE THE SERVICE LIFE OF THE CABLE.

- (1) Clean the cables (as necessary) for the inspection, do this task: Control Cable Lubrication, TASK 12-26-00-600-801.

SUBTASK 20-20-31-200-003

- (2) Perform a detailed visual inspection to make sure that the cable does not contact parts other than pulleys, quadrants, cable seals, or grommets installed to control cable routing.

**NOTE:** The minimum cable clearance from other parts is 0.20 inches, except 0.10 inches within 10 inches of a pulley or quadrant.

- (a) Look for evidence of contact with other parts. Correct the condition if evidence of contact is found.

D. Perform a detailed visual inspection of the cable runs for incorrect routing, kinks in the wire rope, or other damage.

SUBTASK 20-20-31-200-004

- (1) Replace the cable assembly if:

- (a) A wear pattern exists where the individual wires in a strand appear to blend together (outer wires worn by more than 40 percent) (Figure 601).
- (b) If a kink is found.
- (c) If corrosion is found.

E. Perform a detailed visual inspection of the cable.

**NOTE:** Most cables are identified by the manufacturer using a color tracer filament or thread per MIL-83420H. The condition of the colored nonmetallic threads within a control cable does not affect the performance or strength of the cable.

**NOTE:** To do a check for broken wires, rub a cloth along the cable. The cloth will catch on any broken wires

SUBTASK 20-20-31-160-001

- (1) Replace the 7X7 cable assembly if:

- (a) There are two or more broken wires in 12 continuous inches of cable.
- (b) There are three or more broken wires anywhere in the total cable assembly.

SUBTASK 20-20-31-200-006

- (2) Replace the 7X19 cable assembly if:

- (a) There are four or more broken wires in 12 continuous inches of cable.
- (b) There are six or more broken wires anywhere in the total cable assembly.

SUBTASK 20-20-31-210-011

- (3) Inspect the carbon steel control cable lubrication.

- (a) Make sure there is sufficient lubrication on the control cable.

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- (b) If the lubrication is not sufficient, do this task: Control Cable Lubrication, TASK 12-26-00-600-801.

NOTE: Do not apply the grease or oil to the stainless steel (CRES) control cables.

———— END OF TASK ————

**TASK 20-20-31-200-802**

**3. Inspection of the Control Cable Fittings**

NOTE: This procedure is a scheduled maintenance task.

**A. Location Zones**

Zone	Area
100	Lower Half of Fuselage
300	Empennage
400	Powerplant and Nacelle Struts
500	Left Wing
600	Right Wing

**B. Procedure**

SUBTASK 20-20-31-200-007

- (1) Perform a detailed visual inspection to make sure that the means of locking the joints are intact (wire locking, cotter pins, turnbuckle clips, etc.).  
(a) Install any missing parts.

SUBTASK 20-20-31-200-008

- (2) Perform a detailed inspection of the swaged portions of swaged end fittings for surface cracks or corrosion.  
(a) Replace the cable assembly if cracks or corrosion are found.

SUBTASK 20-20-31-200-009

- (3) Perform a detailed visual inspection of the unswaged portion of the end fitting.  
(a) Replace the cable assembly if a crack is found, if corrosion is present, or if the end fitting is bent more than 2 degrees.

SUBTASK 20-20-31-200-010

- (4) Perform a detailed visual inspection of the turnbuckle.  
(a) Replace the turnbuckle if a crack is visible or if corrosion is present.

———— END OF TASK ————

**TASK 20-20-31-200-805**

**4. Inspection of Pulleys**

NOTE: This procedure is a scheduled maintenance task.

**A. Location Zones**

Zone	Area
100	Lower Half of Fuselage
300	Empennage
400	Powerplant and Nacelle Struts
500	Left Wing
600	Right Wing

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**B. Procedure**

SUBTASK 20-20-31-200-011

- (1) Perform a detailed visual inspection to make sure that pulleys are free to rotate.
  - (a) Replace pulleys which are not free to rotate.

SUBTASK 20-20-31-200-012

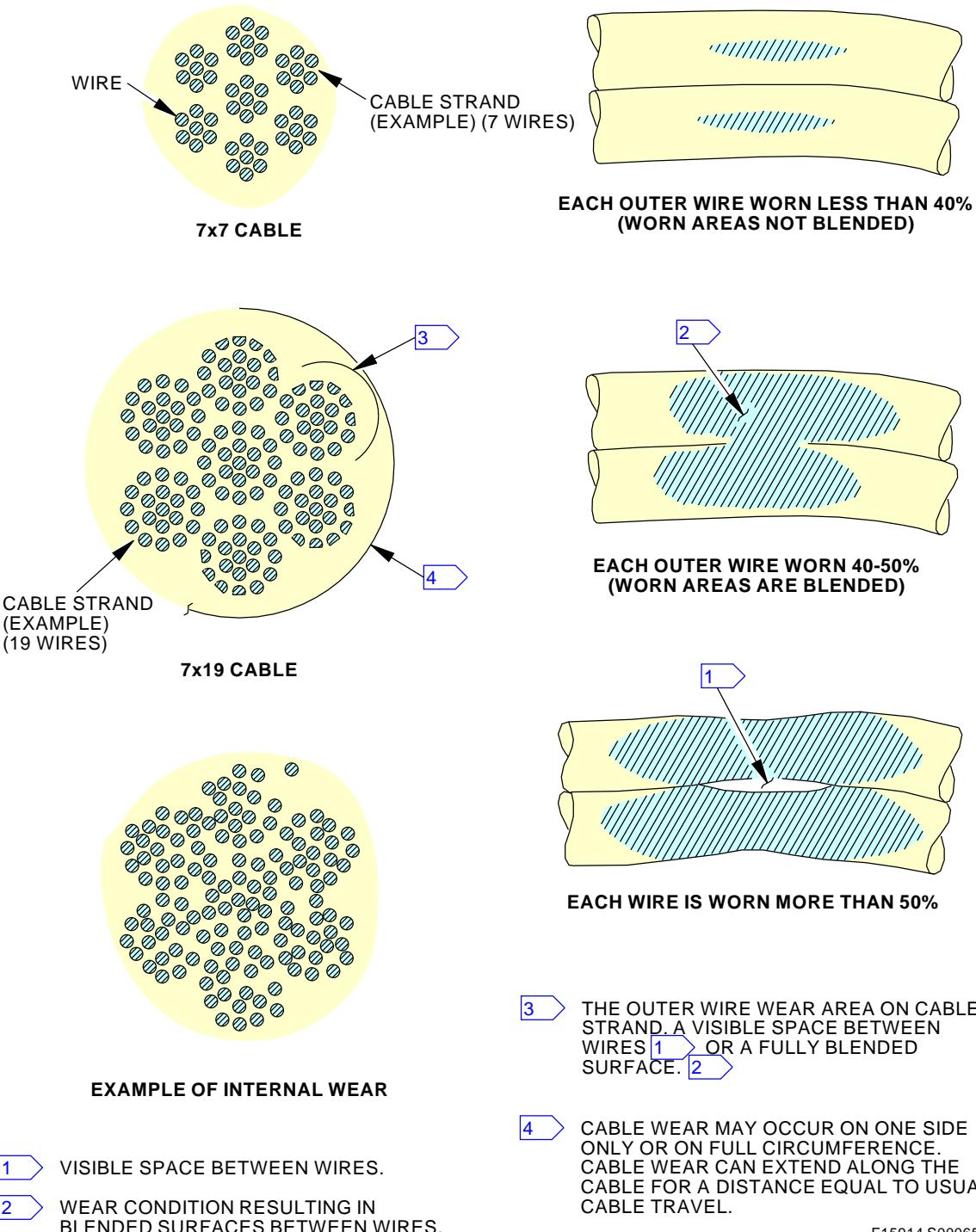
- (2) Perform a detailed visual inspection of the pulleys for conditions shown in (Figure 602).
  - (a) Replace pulleys which are not in a normal condition.

———— END OF TASK ————

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**Cable Wear Patterns**  
**Figure 601/20-20-31-990-801**

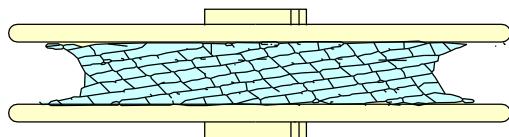
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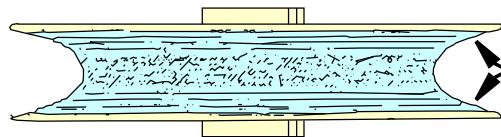
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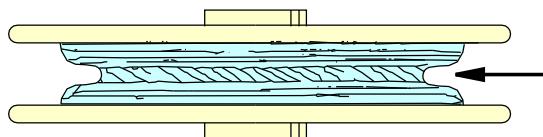
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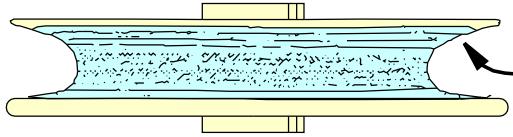
CABLE TENSION TOO HIGH



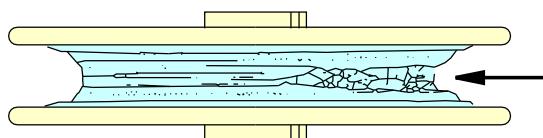
PULLEY NOT ALIGNED CORRECTLY



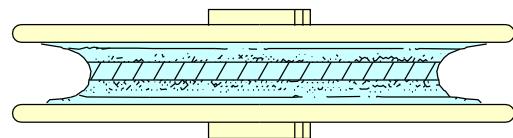
PULLEY GROOVE WITH EXCESSIVE WEAR



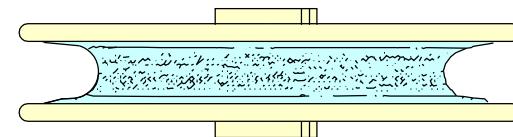
CABLE NOT ALIGNED CORRECTLY



PULLEY WILL NOT TURN



NORMAL CONDITION



NORMAL CONDITION

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**Pulley Wear Patterns**  
Figure 602/20-20-31-990-802

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AKS ALL

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AIRCRAFT MAINTENANCE MANUAL

SPECIFICATIONS AND MATERIALS - MAINTENANCE PRACTICES

**1. General**

- A. This procedure contains one task:
  - (1) Specifications and Materials

**TASK 20-30-00-800-801**

**2. Specifications and Materials**

**A. General**

- (1) Specifications and materials sections contain lists of consumable materials that can be necessary during regular maintenance of the airplane.
- (2) Whenever possible, consumable materials will be referenced in the Maintenance Manual by a material specification.
- (3) In the event a material is shown with no material specification, the material will be a specific vendor product or it will be commercially available.
- (4) For specific vendor information on a product, you should refer to the U-File or the IPC Specification Cross-reference Index. Or, you should refer to the qualified products list of the applicable material specification.
- (5) Material other than those listed can be tested using the procedures in Boeing document D6-17487, Certification Testing of Aircraft Maintenance Materials, to verify that any substitute material will not be injurious to airplane surfaces when used as specified by the manufacturer.

**B. References**

Reference	Title
20-30-11-910-801	Adhesives, Cements, and Sealants (P/B 201)
20-30-21-910-801	Lubricants (P/B 201)
20-30-31-910-801	Cleaners and Polishes (P/B 201)
20-30-41-910-801	Finishing Materials (P/B 201)
20-30-51-910-801	Miscellaneous Materials (P/B 201)
20-30-61-910-801	Welding Materials (P/B 201)
20-30-71-910-801	Strippers (P/B 201)
70-30-11-910-801-F00	Adhesives, Cements, and Sealants (P/B 201)
70-30-21-910-801-F00	Lubricants (P/B 201)
70-30-31-910-801-F00	Cleaners and Polishes (P/B 201)
70-30-41-910-801-F00	Finishing Materials (P/B 201)
70-30-51-910-801-F00	Miscellaneous Materials (P/B 201)

**C. Procedure**

**SUBTASK 20-30-00-800-002**

- (1) Use these tasks for information on airframe consumable materials:
  - (a) Adhesives, Cements, and Sealers (Adhesives, Cements, and Sealants, TASK 20-30-11-910-801)
  - (b) Cleaners and Polishes (Cleaners and Polishes, TASK 20-30-31-910-801)
  - (c) Finishing Materials (Finishing Materials, TASK 20-30-41-910-801)
  - (d) Lubricants (Lubricants, TASK 20-30-21-910-801)
  - (e) Strippers (Strippers, TASK 20-30-71-910-801)

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- (f) Welding Materials (Welding Materials, TASK 20-30-61-910-801)
- (g) Miscellaneous Materials (Miscellaneous Materials, TASK 20-30-51-910-801)

SUBTASK 20-30-00-800-001

- (2) Use these tasks for information on General Electric/CFMI engine consumable materials:
  - (a) Adhesives, Cements, and Sealers (Adhesives, Cements, and Sealants, TASK 70-30-11-910-801-F00)
  - (b) Cleaners and Polishes (Cleaners and Polishes, TASK 70-30-31-910-801-F00)
  - (c) Finishing Materials (Finishing Materials, TASK 70-30-41-910-801-F00)
  - (d) Lubricants (Lubricants, TASK 70-30-21-910-801-F00)
  - (e) Miscellaneous Materials (Miscellaneous Materials, TASK 70-30-51-910-801-F00)

———— END OF TASK ——

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**ADHESIVES, CEMENTS, AND SEALANTS - MAINTENANCE PRACTICES**

**1. General**

- A. This procedure lists adhesives, cements, and sealants for airplane maintenance. There are no procedural steps in this procedure.

**TASK 20-30-11-910-801**

**2. Adhesives, Cements, and Sealants**

**A. General**

- (1) The list of adhesives, cements, and sealers has been moved to the introduction section of the AMM.

**Table 201/20-30-11-993-806 Permitted Substitutes for Initial Specified Sealant**

Initial Specified Sealants	Permitted Substitutes for Initial Specified Sealant							
	BMS 5-45	BMS 5-63	BMS 5-95	BMS 5-142 <sup>[1]</sup>	PR-1826 <sup>[2]</sup>	PR-1828	BMS 5-150	BMS 5-168 <sup>[3]</sup>
BMS 5-19	Yes	No	No	No	Yes	No	No	Yes
BMS 5-26	See Table 203	No	No	No	Yes	Yes	No	Yes
BMS 5-32	Yes	No	Yes	Yes	Yes	Yes	No	Yes
BMS 5-45	---	No	No	No	Yes	No	No	Yes
BMS 5-63	No	---	No	No	No	No	No	No
BMS 5-79	Yes	No	See Table 202	Yes	Yes	Yes	No	Yes
BMS 5-95	Yes <sup>[4]</sup>	No	---	Yes	Yes	Yes	Yes (class B-2 only)	Yes <sup>[4]</sup>
BMS 5-142	Yes	No	Yes	---	Yes	Yes	Yes	Yes
BMS 5-168	Yes	No	No	No	No	No	No	---

\*[1] This alternative is not permitted for mating surface seal, pre-pack sealing, and wet fastener installation procedures.

\*[2] This sealant has a primer that must also be used.

\*[3] See Table 205

\*[4] Substitution is not allowed for faying surface sealing of fuselage skin lap splices or door skin lap splices (a skin lap splice is a joint where one skin overlaps another skin and the two skins are fastened together at this overlap area). Substitution is not allowed for faying surface sealing common to any unprimed fuselage skin or door skin surface. Substitution is not allowed for faying surface sealing common to unprimed nacelle or pylon/strut box structure. Substitution is not allowed for wet fastener installation common to nacelle or pylon/strut box structure. Substitution is not allowed for landing gear components. Substitution is not applicable to usage per any of the BAC 5117-XX specifications. Substitution is not applicable to Class E sealant.

**Table 202/20-30-11-993-807 BMS 5-79 Sealant Alternatives**

BMS 5-79 Sealant Alternatives	
Initial Material	Alternate Material

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**Table 202/20-30-11-993-807 BMS 5-79 Sealant Alternatives (Continued)**

<b>BMS 5-79 Sealant Alternatives</b>	
BMS 5-79	BMS 5-95
Class B-1/2	Class B-2
Class B-2	Class B-2
Class B-4	None
Class B-8	None
Class C-24	Class C-20
Class C-48	Class C-80
Class D-2	BMS 5-16

**Table 203/20-30-11-993-808 BMS 5-26 Superseded by BMS 5-45**

<b>BMS 5-26, Types, Classes, Grade</b>	<b>Superseded by BMS 5-45, Classes, Grade</b>
Type I, Class A-1/2, Grade 1	Class A-2, Grade 1 or Grade 2
Type I, Class A-2, Grade 1	Class A-2, Grade 1 or Grade 2
Type I, Class B-1/2	Class B-1/2
Type I, Class B-2	Class B-2
Type II, Class A-2, Grade 1	Class A-2, Grade 1
Type II, Class A-2, Grade 2	Class A-2, Grade 2
Type II, Class B-2	Class B-2
Type II, Class C-24	Class C-24
Type II, Class C-48	Class C-48
Type II, Class C-168	Class C-168

**Table 204/20-30-11-993-804 BMS 5-95 Availability and Uses**

<b>BMS 5-95, Types, Classes</b>	<b>Availability, Uses</b>
Type I	Available in Form B (bulk), Form K (kit), or Form P (mixed and frozen sealant (also known as Premixed and Frozen (PMF))).
Type II	Available in Form P (also known as Premixed and Frozen (PMF)) only. Superseded by Type I for future design and procurement.
Class B	For filleting, injection, and prepacking and faying surface applications.
Class C	For brush and faying surface sealing applications where a long squeeze-out life is required.
Class E	For spray application as a coating.
Class F	For spray application as a primer.
Class G	For spray, brush, or roller applications where long squeeze-out life and lower viscosity are required.

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Table 205/20-30-11-993-805 Differences Between BMS 5-45 and BMS 5-168 Requirements

PROPERTIES	BMS5-45	BMS5-168 CLASS A-2, GRADE 1 AND CLASS B
Specific Gravity (maximum)		
Class A	1.65	1.60
Class B	1.30	1.40
Tack free time (maximum)		
Class A-2 Grade 1	36 h	8 h
Class B-2	12 h	8 h
Curing Rate (time to 30 Type A durometer hardness (maximum))		
Class A-2 Grade 1	72 h	8 h
Class B-2	24 h	8 h
Squeeze-out life		
Class B-2	6 h	4 h

— END OF TASK —

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LUBRICANTS - MAINTENANCE PRACTICES

1. General

- A. This procedure contains a list of lubricants for airplane maintenance. There are no procedural steps in this procedure.

**TASK 20-30-21-910-801**

2. Lubricants

A. General

- (1) The data contained in this task has been moved to the Introduction section of the AMM.

———— END OF TASK ————

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CLEANERS AND POLISHES - MAINTENANCE PRACTICES

**1. General**

- A. This procedure contains a list of cleaners and polishes for airplane maintenance. There are no procedural steps in this procedure.

**TASK 20-30-31-910-801**

**2. Cleaners and Polishes**

**A. General**

- (1) The data contained in this task has been moved to the Introduction section of the AMM.

———— END OF TASK ————



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FINISHING MATERIALS - MAINTENANCE PRACTICES

**1. General**

- A. This procedure lists finishing materials for airplane maintenance. There are no procedural steps in this procedure.

**TASK 20-30-41-910-801**

**2. Finishing Materials**

**A. General**

- (1) The data contained in this task has been moved to the Introduction section of the AMM.

———— END OF TASK ————

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MISCELLANEOUS MATERIALS - MAINTENANCE PRACTICES

**1. General**

- A. This procedure lists miscellaneous consumable materials for airplane maintenance. There are no procedural steps in this procedure.

**TASK 20-30-51-910-801**

**2. Miscellaneous Materials**

**A. General**

- (1) The data contained in this task has been moved to the Introduction section of the AMM.

———— END OF TASK ————

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WELDING MATERIALS - MAINTENANCE PRACTICES

1. **General**

- A. This procedure lists the consumable materials which are necessary for welding and soldering. There are no procedural steps in this procedure.

**TASK 20-30-61-910-801**

2. **Welding Materials**

A. **General**

- (1) The data contained in this task has been moved to the Introduction section of the AMM.

———— END OF TASK ————



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STRIPPERS - MAINTENANCE PRACTICES

1. **General**

- A. This procedure lists the consumable materials which are necessary for stripping organic and inorganic coatings. There are no procedural steps in this procedure.

**TASK 20-30-71-910-801**

2. **Strippers**

A. **General**

- (1) The data contained in this task has been moved to the Introduction section of the AMM.

———— END OF TASK ————



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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 80) - MAINTENANCE PRACTICES

**1. General**

- A. This subject contains a list of solvents for general cleaning of metals as listed in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

**TASK 20-30-80-910-801**

**2. General Cleaning of Metal (Series 80)**

**A. General**

- (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01000, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown.

Do not use the Series Bulk Code. Refer to the U-File for the applicable vendors. Mixture ratios are given by volume with a tolerance of plus or minus 2%.

**B. Procedure**

SUBTASK 20-30-80-800-001

- (1) In Table 201, find the applicable solvent.

**Table 201/20-30-80-993-801 General Cleaning of Metal (Series 80)**

Material Name	Material Bulk Code	Other Specifications
1,1,1-Trichloroethane	B00090	
Acetone	B00062	JIS-K-1503
BMS 11-7 or A-A-59281, Type I	B00184	MIL-C-38736B
BMS 11-10		
CDG-110		
CDG-211		
Citra Safe	B00634	
Citra Safe, Deodorized		
d-Limonene		
DeSo Clean 45	B00647	
DS-108		
EP-921		
Ethyl alcohol, denatured	B00068	
Ethyl-3-Ethoxy propionate(EEP)		
Extra Solv		
FCC-55		
Freon TES or Genesolve DES		
Freon TF or Genesolve D	B00143	
Glidsafe Prepsolv		

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Table 201/20-30-80-993-801 General Cleaning of Metal (Series 80) (Continued)

Material Name	Material Bulk Code	Other Specifications
HFE-7100		
HFE-71D7		
HFE-71DE		
Isopropyl alcohol(IPA)	B00130	
Lenium BA		
MEK:1,1,1-Trichloroethane 1:1		
MEK:sec-Butyl alcohol 42:58 percent		
MEK:Toluene 1:1		
Methyl ethyl ketone (MEK)	B00148	
Methyl isobutyl ketone (MIBK)	B00151	JIS-K-8903
Methyl propyl ketone (MPK)	B00666	
MIBK:MEK 3:2		
MIL-C-81302, Type I	B00143	
MOK or MOK*		
MPK:MEK 70:30		
P-D-680, Type I, II, or III	B00074	
Shopmaster RTU		
Skykleen 1000	B50085	
Toluene	B00094	
TT-N-95, Type II	B00083	
TT-T-291, Type I, II, or III	B00762	
Turco 4460 BK		
Turco 6226		
Turco 6709		
Vertrel MCA		
Wedco 3500		

— END OF TASK —

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 81) - MAINTENANCE PRACTICES

**1. General**

- A. This subject contains a list of solvents for general cleaning of all organic coatings as listed in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

**TASK 20-30-81-910-801**

**2. General Cleaning of All Organic Coatings (Series 81)**

**A. General**

- (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01001, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown.

Do not use the Series Bulk Code. Refer to the U-File for the applicable vendors. Mixture ratios are given by volume with a tolerance of plus or minus 2%.

**B. Procedure**

SUBTASK 20-30-81-800-001

- (1) In Table 201, find the applicable solvent.

**Table 201/20-30-81-993-801 General Cleaning of All Organic Coatings (Series 81)**

Material Name	Material Bulk Code	Other Specifications
CDG-110		
CDG-211		
Ethyl alcohol, denatured	B00068	
Extra Solv		
Freon TES or Genesolve DES		
Freon TF or Genesolve D	B00143	
HFE-7100		
HFE-71D7		
HFE-71DE		
Isopropyl alcohol (IPA)	B00130	
Lenium BA		
MIL-C-81302, Type I	B00143	
P-D-680, Type I, II, or III	B00074	
Shopmaster RTU		
TT-N-95, Type II	B00083	
TT-T-291, Type I, II, or III	B00762	
Turco 6226		
Vertrel MCA		

— END OF TASK —

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 82) - MAINTENANCE PRACTICES

**1. General**

- A. This subject contains a list of solvents for general cleaning of solvent resistant organic coatings as listed in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

**TASK 20-30-82-910-801**

**2. General Cleaning of Solvent Resistant Organic Coatings (Series 82)**

**A. General**

- (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01002, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown.

Do not use the Series Bulk code. Refer to the U-File for this applicable vendors. Mixture ratios are given by volume with a tolerance of plus or minus 2%.

**B. Procedure**

SUBTASK 20-30-82-800-001

- (1) In Table 201, find the applicable solvent.

**Table 201/20-30-82-993-801 General Cleaning of Solvent Resistant Organic Coatings (Series 82)**

Material Name	Material Bulk Code	Other Specifications
1,1,1-Trichloroethane	B00090	
Acetone	B00062	JIS-K-1503
BMS 11-7 or A-A-59281, Type I	B00184	MIL-C-38736B
BMS 11-10		
CDG-110		
CDG-211		
Citra Safe	B00634	
Citra Safe, Deodorized		
d-Limonene		
DeSo Clean 45	B00647	
DS-108		
EP-921		
Ethyl alcohol, denatured	B00068	
Ethyl-3-Ethoxy propionate (EEP)		
Extra Solv		
FCC-55		
Glidsafe Prepsolv		
HFE-7100		
HFE-71D7		

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Table 201/20-30-82-993-801 General Cleaning of Solvent Resistant Organic Coatings (Series 82)  
(Continued)

Material Name	Material Bulk Code	Other Specifications
HFE-71DE		
Isopropyl alcohol (IPA)	B00130	
Lenium BA		
MEK:1,1,1-Trichloroethane 1:1		
MEK:sec-Butyl alcohol 42:58 percent		
MEK:Toluene 1:1		
Methyl ethyl ketone (MEK)	B00148	
Methyl isobutyl ketone (MIBK)	B00151	JIS-K-8903
Methyl propyl ketone (MPK)	B00666	
MIBK:MEK 3:2		
MOK or MOK*		
MPK:MEK 70:30		
P-D-680, Type I, II or III	B00074	
Shopmaster RTU		
Toluene	B00094	
TT-N-95, Type II	B00083	
TT-T-291, Type I, II or III	B00762	
Turco 4460 BK		
Turco 6226		
Turco 6709		
Vertrel MCA		
Wedco 3500		

— END OF TASK —

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 83) - MAINTENANCE PRACTICES

**1. General**

- A. This subject contains a list of solvents for general cleaning of composites as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

**TASK 20-30-83-910-801**

**2. General Cleaning of Composites (Series 83)**

**A. General**

- (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk code of B01003, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown.

Do not use the Series Bulk Code. Refer to the U-File for the applicable vendors. Mixture ratios are given by volume with a tolerance of plus or minus 2%.

**B. Procedure**

SUBTASK 20-30-83-800-001

- (1) In Table 201, find the applicable solvent.

**Table 201/20-30-83-993-801 General Cleaning of Composites (Series 83)**

Material Name	Material Bulk Code	Other Specifications
Acetone	B00062	JIS-K-1503
BMS 11-7 or A-A-59281, Type I	B00184	MIL-C-38736B
BMS 11-10		
CDG-110		
CDG-211		
Citra Safe	B00634	
Citra Safe, Deodorized		
d-Limonene		
Ethyl alcohol, denatured	B00068	
FCC-55		
Glidsafe Prepsolv		
Isopropyl alcohol (IPA)	B00130	
MEK:1,1,1-Trichloroethane 1:1		
MEK:sec-Butyl alcohol 42:58 percent		
MEK:Toluene 1:1		
Methyl ethyl ketone (MEK)	B00148	
Methyl propyl ketone (MPK)	B00666	
MIBK:MEK 3:2		
MPK:MEK 70:30		

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Table 201/20-30-83-993-801 General Cleaning of Composites (Series 83) (Continued)

Material Name	Material Bulk Code	Other Specifications
TT-N-95, Type II	B00083	
Turco 4460 BK		
Turco 6709		

———— END OF TASK ————

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 84) - MAINTENANCE PRACTICES

**1. General**

- A. This subject contains a list of solvents for final cleaning of metal before painting as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

**TASK 20-30-84-910-801**

**2. Final Cleaning of Metal Prior to Painting (Series 84)**

**A. General**

- (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01004, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown.

Do not use the Series Bulk code. Refer to the U-File for the applicable vendors. Mixture ratios are given by volume with a tolerance of plus or minus 2%.

**B. Procedure**

SUBTASK 20-30-84-800-001

- (1) In Table 201, find the applicable solvent.

**Table 201/20-30-84-993-801 Final Cleaning of Metal Prior to Painting (Series 84)**

Material Name	Material Bulk Code	Other Specifications
Acetone	B00062	JIS-K-1503
BMS 11-7 or A-A-59281, Type I	B00184	MIL-C-38736B
BMS 11-10		
CDG-110		
CDG-211		
Citra Safe	B00634	
Citra Safe, Deodorized		
d-Limonene		
DeSo Clean 45	B00647	
DS-108 <sup>[1]</sup>		
FCC-55		
Glidsafe Prepsolv		
Isopropyl alcohol (IPA)	B00130	
MEK:1,1,1-Trichloroethane 1:1		
MEK:sec-Butyl alcohol 42:58 percent		
MEK:Toluene 1:1		
Methyl ethyl ketone (MEK)	B00148	
Methyl propyl ketone (MPK)	B00666	
MIBK:MEK 3:2		

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Table 201/20-30-84-993-801 Final Cleaning of Metal Prior to Painting (Series 84) (Continued)

Material Name	Material Bulk Code	Other Specifications
MIL-C-81302, Type I	B00143	
MPK:MEK 70:30		
Toluene	B00094	
Turco 4460 BK		
Turco 6709		

\*[1] DS-108 shall be completely dried prior to application of paint. Use only on organic coatings applied to metal substrates.

———— END OF TASK ——

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 85) - MAINTENANCE PRACTICES

**1. General**

- A. This subject contains a list of solvents for final cleaning of all organic coatings before painting as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

**TASK 20-30-85-910-801**

**2. Final Cleaning of All Organic Coatings Prior to Painting (Series 85)**

**A. General**

- (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01005, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown.

Do not use the Series Bulk Code. Refer to the U-File for the applicable vendors. Mixture ratios are given by volume with a tolerance of plus or minus 2%.

**B. Procedure**

SUBTASK 20-30-85-800-001

- (1) In Table 201, find the applicable solvent.

**Table 201/20-30-85-993-801 Final Cleaning of All Organic Coatings Prior to Painting (Series 85)**

Material Name	Material Bulk Code	Other Specifications
BMS 11-7 or A-A-59281, Type I	B00184	MIL-C-38736B
CDG-110		
CDG-211		
DS-108 <sup>[1]</sup>		
FCC-55		
Isopropyl alcohol (IPA)	B00130	
MEK:sec-Butyl alcohol 42:58 percent		
MEK:Toluene 1:1		
Methyl ethyl ketone (MEK)	B00148	
Methyl propyl ketone (MPK)	B00666	
MIBK:MEK 3:2		
MIL-C-81302, Type I	B00143	
MPK:MEK 70:30		
Toluene	B00094	
Turco 4460 BK		
Turco 6709		

\*[1] DS-108 shall be completely dried prior to application of paint. Use only on organic coatings applied to metal substrates.

———— END OF TASK ————

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**20-30-85**

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 86) - MAINTENANCE PRACTICES

**1. General**

- A. This subject contains a list of solvents for final cleaning of solvent resistant organic coatings before painting as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

**TASK 20-30-86-910-801**

**2. Final Cleaning of Solvent Resistant Coatings Prior to Painting (Series 86)**

**A. General**

- (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01006, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown.

Do not use the Series Bulk Code. Refer to the U-File for the applicable vendors. Mixture ratios are given by volume with a tolerance of plus or minus 2%.

**B. Procedure**

SUBTASK 20-30-86-800-001

- (1) In Table 201, find the applicable solvent.

**Table 201/20-30-86-993-801 Final Cleaning of Solvent Resistant Organic Coatings Prior to Painting (Series 86)**

Material Name	Material Bulk Code	Other Specifications
Acetone	B00062	JIS-K-1503
BMS 11-7 or A-A-59281, Type I	B00184	MIL-C-38736B
BMS 11-10		
CDG-110		
CDG-211		
Citra Safe	B00634	
Citra Safe, Deodorized		
d-Limonene		
DeSo Clean 45	B00647	
DS-108 <sup>[1]</sup>		
FCC-55		
Glidsafe Prepsolv		
Isopropyl alcohol (IPA)	B00130	
MEK:1,1,1-Trichloroethane 1:1		
MEK:sec-Butyl alcohol 42:58 percent		
MEK:Toluene 1:1		
Methyl ethyl ketone (MEK)	B00148	
Methyl propyl ketone (MPK)	B00666	



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Table 201/20-30-86-993-801 Final Cleaning of Solvent Resistant Organic Coatings Prior to Painting (Series 86) (Continued)

Material Name	Material Bulk Code	Other Specifications
MIBK:MEK 3:2		
MPK:MEK 70:30		
Toluene	B00094	
Turco 4460 BK		
Turco 6709		

\*[1] DS-108 shall be completely dried prior to application of paint. Use only on organic coatings applied to metal substrates.

———— END OF TASK ————

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 87) - MAINTENANCE PRACTICES

**1. General**

- A. This subject contains a list of solvents for final cleaning of composites before painting as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

**TASK 20-30-87-910-801**

**2. Final Cleaning of Composites Prior to Painting (Series 87)**

**A. General**

- (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01007, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown.

Do not use the Series Bulk Code. Refer to the U-File for the applicable vendors. Mixture ratios are given by volume with a tolerance of plus or minus 2%.

**B. Procedure**

SUBTASK 20-30-87-800-001

- (1) In Table 201, find the applicable solvent.

**Table 201/20-30-87-993-801 Final Cleaning of Composites Prior to Painting (Series 87)**

Material Name	Material Bulk Code	Other Specifications
Acetone	B00062	JIS-K-1503
BMS 11-7 or A-A-59281, Type I	B00184	MIL-C-38736B
BMS 11-10		
CDG-110		
CDG-211		
Citra Safe	B00634	
Citra Safe, Deodorized		
d-limonene		
FCC-55		
Glidsafe Prepsolv		
Isopropyl alcohol (IPA)		
MEK:1,1,1-Trichloroethane 1:1		
MEK:sec-Butyl alcohol 42:58 percent		
MEK:Toluene 1:1		
Methyl ethyl ketone (MEK)	B00148	
Methyl propyl ketone (MPK)		
MIBK:MEK 3:2		
MPK:MEK 70:30		
Turco 4460 BK		

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Table 201/20-30-87-993-801 Final Cleaning of Composites Prior to Painting (Series 87) (Continued)

Material Name	Material Bulk Code	Other Specifications
Turco 6709		

———— END OF TASK ————

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 88) - MAINTENANCE PRACTICES

**1. General**

- A. This subject contains a list of solvents for final cleaning of metal before non-structural bonding as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

**TASK 20-30-88-910-801**

**2. Final Cleaning of Metal Prior to Non-structural Bonding (Series 88)**

**A. General**

- (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01008, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown.

Do not use the Series Bulk Code. Refer to the U-File for the applicable vendors. Mixture ratios are given by volume with a tolerance of plus or minus 2%.

**B. Procedure**

SUBTASK 20-30-88-800-001

- (1) In Table 201, find the applicable solvent.

**Table 201/20-30-88-993-801 Final Cleaning of Metal Prior to Non-structural Bonding (Series 88)**

Material Name	Material Bulk Code	Other Specifications
Acetone	B00062	JIS-K-1503
BMS 11-7 or A-A-59281, Type I	B00184	MIL-C-38736B
CDG-110		
CDG-211		
Ethyl alcohol, denatured	B00068	
FCC-55		
Isopropyl alcohol (IPA)	B00130	
MEK:1,1,1-Trichloroethane 1:1		
MEK:sec-Butyl alcohol 42:58 percent		
Methyl ethyl ketone (MEK)	B00148	
Methyl propyl ketone (MPK)	B00666	
MIBK:MEK 3:2		
MIL-C-81302, Type I	B00143	
MPK:MEK 70:30		
Turco 6709		

— END OF TASK —

EFFECTIVITY  
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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 89) - MAINTENANCE PRACTICES

**1. General**

- A. This subject contains a list of solvents for final cleaning of all organic coatings before non-structural bonding as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

**TASK 20-30-89-910-801**

**2. Final Cleaning of All Organic Coatings Prior to Non-structural Bonding (Series 89)**

**A. General**

- (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01009, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown.

Do not use the Series Bulk Code. Refer to the U-File for the applicable vendors. Mixture ratios are given by volume with a tolerance of plus or minus 2%.

**B. Procedure**

SUBTASK 20-30-89-800-001

- (1) In Table 201, find the applicable solvent.

**Table 201/20-30-89-993-801 Final Cleaning of All Organic Coatings Prior to Non-structural Bonding (Series 89)**

Material Name	Material Bulk Code	Other Specifications
CDG-110		
CDG-211		
Ethyl alcohol, denatured	B00068	
Isopropyl alcohol (IPA)	B00130	
MIL-C-81302, Type I	B00143	

———— END OF TASK ————



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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 90) - MAINTENANCE PRACTICES

**1. General**

- A. This subject contains a list of solvents for final cleaning of solvent resistant organic coatings before non-structural bonding as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

**TASK 20-30-90-910-801**

**2. Final Cleaning of Solvent Resistant Organic Coatings Prior to Non-structural Bonding (Series 90)**

**A. General**

- (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01010, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown.

Do not use the Series Bulk Code. Refer to the U-File for the applicable vendors. Mixture ratios are given by volume with a tolerance of plus or minus 2%.

**B. Procedure**

SUBTASK 20-30-90-800-001

- (1) In Table 201, find the applicable solvent.

**Table 201/20-30-90-993-801 Final Cleaning of Solvent Resistant Organic Coatings Prior to Non-structural Bonding (Series 90)**

Material Name	Material Bulk Code	Other Specifications
BMS 11-7 or A-A-59281, Type I	B00184	MIL-C-38736B
CDG-110		
CDG-211		
Ethyl alcohol, denatured	B00068	
FCC-55		
Isopropyl alcohol (IPA)	B00130	
MEK:1,1,1-Trichloroethane 1:1		
MEK:sec-Butyl alcohol 42:58 percent		
Methyl ethyl ketone (MEK)	B00148	
Methyl propyl ketone (MPK)	B00666	
MIBK:MEK 3:2		
MPK:MEK 70:30		
Turco 6709		

— END OF TASK —

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 91) - MAINTENANCE PRACTICES

**1. General**

- A. This subject contains a list of solvents for final cleaning of composites before non-structural bonding as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

**TASK 20-30-91-910-801**

**2. Final Cleaning of Composites Prior to Non-structural Bonding (Series 91)**

**A. General**

- (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk code of B01011, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown.

Do not use the Series Bulk code. Refer to the U-File for the applicable vendors. Mixture ratios are given by volume with a tolerance of plus or minus 2%.

**B. Procedure**

SUBTASK 20-30-91-800-001

- (1) In Table 201, find the applicable solvent.

**Table 201/20-30-91-993-801 Final Cleaning of Composites Prior to Non-structural Bonding (Series 91)**

Material Name	Material Bulk Code	Other Specifications
Acetone	B00062	JIS-K-1503
BMS 11-7 or A-A-59281, Type I	B00184	MIL-C-38736B
CDG-110		
CDG-211		
Ethyl alcohol, denatured	B00068	
FCC-55		
Isopropyl alcohol (IPA)	B00130	
MEK:1,1,1-Trichloroethane 1:1		
MEK:sec-Butyl alcohol 42:58 percent		
Methyl ethyl ketone (MEK)	B00148	
Methyl propyl ketone (MPK)	B00666	
MIBK:MEK 3:2		
MPK:MEK 70:30		
Turco 6709		

— END OF TASK —

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 92) - MAINTENANCE PRACTICES

**1. General**

- A. This subject contains a list of solvents for final cleaning before general sealing as given in BAC5000. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

**TASK 20-30-92-910-801**

**2. Final Cleaning Prior to General Sealing (Series 92)**

**A. General**

- (1) This selection of solvents uses BAC5000 as a guide and may be used on all surfaces except unpainted composite laminated surfaces. This list of solvents has the Series Bulk Code of B01012, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk code. Refer to the U-File for the applicable vendors.

**B. Procedure**

SUBTASK 20-30-92-800-001

- (1) In Table 201, find the applicable solvent.

**Table 201/20-30-92-993-801 Final Cleaning Prior to General Sealing (Series 92)**

Material Name	Material Bulk Code	Other Specifications
Aliphatic Naphtha (for acrylic surfaces only)	B00083	TT-N-95(TyII)
BMS 11-7	B00184	
FCC-55		
FD Cleaner		JIS-K-1522-78
MEK:sec-Butyl alcohol 42:58 percent		
Methyl ethyl ketone (MEK)	B00148	ASTM D740 JIS-K-1524
Methyl propyl ketone (MPK)	B00666	

———— END OF TASK ————

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 93) - MAINTENANCE PRACTICES

**1. General**

- A. This subject contains a list of solvents for final cleaning before fuel tank sealing as given in BAC5504. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

**TASK 20-30-93-910-801**

**2. Final Cleaning Prior to Fuel Tank Sealing (Series 93)**

**A. General**

- (1) This selection of solvents uses BAC5504 as a guide. This list of solvents has the Series Bulk Code of B01013, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown.

Do not use the Series Bulk Code. Refer to the U-File for the applicable vendors.

**B. Procedure**

SUBTASK 20-30-93-800-001

- (1) In Table 201, find the applicable solvent.

**Table 201/20-30-93-993-801 Final Cleaning Prior to Fuel Tank Sealing (Series 93)**

Material Name	Material Bulk Code	Other Specifications
BMS 11-7	B00184	
MEK:sec-Butyl alcohol 42:58 percent		
Methyl ethyl ketone (MEK)	B00148	ASTM D740 JIS-K-1524
Methyl propyl ketone (MPK)	B00666	

— END OF TASK —



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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 94) - MAINTENANCE PRACTICES

**1. General**

- A. This subject contains a list of solvents for final cleaning before application of rain erosion coating before painting as given in BAC5880. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

**TASK 20-30-94-910-801**

**2. Final Cleaning Prior to Application of Rain Erosion Resistant Coating (Series 94)**

**A. General**

- (1) This selection of solvents uses BAC5880 as a guide. This list of solvents has the Series Bulk Code of B01014, but this code is only for reference, to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown.

Do not use the Series Bulk Code. Refer to the U-File for the applicable vendors.

**B. Procedure**

SUBTASK 20-30-94-800-001

- (1) In Table 201, find the applicable solvent.

**Table 201/20-30-94-993-801 Final Cleaning Prior to Application of Rain Erosion Resistant Coating (Series 94)**

Material Name	Material Bulk Code	Other Specifications
Methyl ethyl ketone (MEK)	B00148	TT-M-261

———— END OF TASK ————



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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 95) - MAINTENANCE PRACTICES

**1. General**

- A. This subject contains a list of solvents for final cleaning before aerodynamic smoothing and fairing as given in BAC5030. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

**TASK 20-30-95-910-801**

**2. Final Cleaning Prior to Aerodynamic Smoothing and Fairing (Series 95)**

**A. General**

- (1) This selection of solvents uses BAC5030 as a guide. This list of solvents has the Series Bulk Code of B01015, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown.

Do not use the Series Bulk Code. Refer to the U-File for the applicable vendors.

**B. Procedure**

SUBTASK 20-30-95-800-001

- (1) In Table 201, find the applicable solvent.

**Table 201/20-30-95-993-801 Final Cleaning Prior to Aerodynamic Smoothing and Fairing (Series 95)**

Material Name	Material Bulk Code	Other Specifications
1,1,1-Trichloroethane	B00090	O-T-620
Aliphatic naphtha (for acrylic surfaces only)	B00083	TT-N-95, TyII
BMS11-7	B00184	MIL-C-38736B
Citra Safe	B00634	
FCC-55		
Methyl ethyl ketone (MEK)	B00148	ASTM D740
Methyl propyl ketone (MPK)	B00666	

———— END OF TASK ————

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**20-30-95**

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 96) - MAINTENANCE PRACTICES

1. **General**

- A. This subject contains a list of solvents for final cleaning of oxygen components exposed to oxygen as given in BAC5402. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

**TASK 20-30-96-910-801**

2. **Final Cleaning of Oxygen Components Exposed to Oxygen (Series 96)**

A. **General**

- (1) This selection of solvents uses BAC5402 as a guide. This list of solvents has the Series Bulk code of B01016, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown.

Do not use the Series Bulk Code. Refer to the U-File for the applicable vendors.

B. **Procedure**

SUBTASK 20-30-96-800-001

- (1) In Table 201, find the applicable solvent.

**Table 201/20-30-96-993-801 Final Cleaning of Oxygen Components Exposed to Oxygen (Series 96)**

Material Name	Material Bulk Code	Other Specifications
Freon TF (trichlorotrifluoroethane)	B00143	
Genesolve D (trichlorotrifluoroethane)		
Isopropyl Alcohol	B00130	TT-I-735
Trichloroethylene	B00081	ASTM D 4080
Tetrachloroethylene	B00093	O-T-236
HFE 7100	B50002	
HFE 71DE	B50003	
Vertrel XF	B50004	
Vertrel MCA	B50005	

— END OF TASK —

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**20-30-96**



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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 97) - MAINTENANCE PRACTICES

**1. General**

- A. This procedure contains a list of solvents for final cleaning before structural bonding as given in BAC5514. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

**TASK 20-30-97-910-801**

**2. Final Cleaning Prior to Structural Bonding (Series 97)**

**A. General**

- (1) This selection of solvents uses BAC5514 as a guide. This list of solvents has the Series Bulk Code of B01017, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code. Refer to the U-File for the applicable vendors.

**B. Procedure**

SUBTASK 20-30-97-800-001

- (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

**Table 201/20-30-97-993-801 Final Cleaning Prior to Structural Bonding (Series 97)**

Material Name	Material Bulk Code	Other Specifications
MEK:sec-Butyl alcohol 42:58 percent		
Methyl ethyl ketone (MEK)	B00148	ASTM D740
Methyl isobutyl ketone (MIBK)	B00151	ASTM D1153
Methyl propyl ketone (MPK)	B00666	
MIBK:MEK 3:2		
Sec-Butyl alcohol		ASTM D1007

— END OF TASK —

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 98 & 98-1) - MAINTENANCE PRACTICES

**1. General**

- A. This procedure contains a list of solvents for general cleaning of various polymerics as given in BAC5750. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents. This procedure contains two tasks:
- (1) Cleaning of specific polymerics (Series 98).
  - (2) Cleaning of phenolics or nylon (Series 98-1).

**TASK 20-30-98-910-801**

**2. Cleaning of Specific Polymerics (Series 98)**

**A. General**

- (1) This selection of solvents uses BAC5750 as a guide. This procedure contains a list of solvents for general cleaning of specific polymerics as given in BAC5750. This list of solvents has the Series Bulk Code of B01018, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code. Refer to the U-File for the applicable vendors.
- (2) The solvents in this list may be used for:
  - (a) The general cleaning of:
    - 1) Polyester (Vibrin, Mylar, Dacron)
    - 2) Polytetrafluoroethylene (Teflon)
    - 3) Polyvinyl fluoride (Tedlar).
  - (b) OR, the final cleaning of the following prior to painting:
    - 1) Polyester (Vibrin, Mylar, Dacron)
    - 2) Polytetrafluoroethylene (Teflon)
    - 3) Polyvinyl fluoride (Tedlar).
  - (c) OR, the final cleaning of the following prior to non-structural bonding:
    - 1) Polyester (Vibrin, Mylar, Dacron)
    - 2) Polytetrafluoroethylene (Teflon)
    - 3) Polyvinyl fluoride (Tedlar).

**B. Procedure**

SUBTASK 20-30-98-800-001

- (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

**Table 201/20-30-98-993-801 Cleaning of Specific Polymerics (Series 98)**

Material Name	Material Bulk Code	Other Specifications
Acetone	B00062	JIS-K-1503
BMS11-7	B00184	MIL-C-38736B
CDG-110		
CDG-211		
Ethyl alcohol, denatured	B00068	

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**Table 201/20-30-98-993-801 Cleaning of Specific Polymerics (Series 98) (Continued)**

Material Name	Material Bulk Code	Other Specifications
Ethyl-3-Ethoxy propionate(EEP)		
FCC-55		
Isopropyl alcohol(IPA)	B00130	
MEK:sec-Butyl alcohol 42:58 percent		
Methyl ethyl ketone (MEK)	B00148	
Methyl isobutyl ketone (MIBK)	B00151	JIS-K-8903
Methyl propyl ketone (MPK)	B00666	
MOK or MOK*		
TT-N-95, Type II	B00083	
Turco 6709		

———— END OF TASK ————

**TASK 20-30-98-910-802**

**3. Cleaning of Phenolics or Nylon (Series 98-1)**

**A. General**

- (1) This selection of solvents uses BAC5750 as a guide. This procedure contains a list of solvents for general cleaning of phenolics or nylon as given in BAC5750. This list of solvents has the Series Bulk Code of B01051, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code. Refer to the U-File for the applicable vendors.

**B. Procedure**

SUBTASK 20-30-98-800-002

- (1) When your procedure refers to this subject (Table 202), use a solvent from this list.

**Table 202/20-30-98-993-802 Cleaning of Phenolics or Nylon (Series 98-1)**

Material Name	Material Bulk Code	Other Specifications
Acetone (Nylon only)	B00062	JIS-K-1503
CDG-110		
CDG-211		
Ethyl alcohol, denatured	B00068	
FCC-55		
Isopropyl alcohol(IPA)	B00130	
MEK:sec-Butyl alcohol 42:58 percent		
Methyl ethyl ketone (MEK) (Nylon only)	B00148	
Methyl isobutyl ketone (MIBK) (Nylon only)	B00151	JIS-K-8903
Methyl propyl ketone (MPK) (Nylon only)	B00666	
Toluene (Nylon only)	B00094	

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Table 202/20-30-98-993-802 Cleaning of Phenolics or Nylon (Series 98-1) (Continued)

Material Name	Material Bulk Code	Other Specifications
TT-N-95, Type II	B00083	
Turco 6709		

— END OF TASK —

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 99) - MAINTENANCE PRACTICES

**1. General**

- A. This procedure contains a list of solvents for final cleaning of composites prior to structural bonding as given in BAC5578. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

**TASK 20-30-99-910-801**

**2. Final Cleaning of Composites Prior to Structural Bonding (Series 99)**

**A. General**

- (1) This selection of solvents uses BAC5578 and D6-53900 as a guide. This list of solvents has the Series Bulk Code of B01019, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code. Refer to the U-File for the applicable vendors.

**B. Procedure**

SUBTASK 20-30-99-800-001

- (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

**Table 201/20-30-99-993-801 Final Cleaning of Composites Prior to Structural Bonding (Series 99)**

Material Name	Material Bulk Code	Other Specifications
1,1,1-Trichloroethane (Non-metallic core only)	B00090	
Acetone	B00062	O-A-51
BMS11-7 (Non-Metallic core only)	B00184	
Isopropyl Alcohol (IPA) (Non Metallic Core Only)	B00130	
MEK: Toluene 1:1		ASTM D 740 TT-T-548
Methyl Ethyl Ketone (MEK)	B00148	ASTM D 780
Methyl Propyl Ketone (MPK) (High purity)	B00666	
Naphtha (Non-Metallic core only)	B00083	TT-N-95

— END OF TASK —

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AIRPLANE GROUNDING - MAINTENANCE PRACTICES

**1. General**

- A. This procedure contains these tasks:
  - (1) Static Grounding
  - (2) Electrical Bonding
  - (3) Measurement of Airplane Electrical Resistance to Ground
- B. If operators choose not to do these recommended tasks, they should develop alternate procedures which adequately protect personnel and equipment. Local fire codes and customs may require alternative or additional procedures to those shown here.

**TASK 20-40-11-910-801**

**2. Static Grounding**

(Figure 201)

**A. General**

- (1) Static grounding is not necessary if the airplane is parked for turnaround flight and no maintenance is to be done.
- (2) During pressure refueling of the airplane:
  - (a) An electrical bond is necessary between the airplane and the refueling vehicle.
- (3) Static grounding is necessary when performing maintenance tasks using these devices:
  - (a) power tools
  - (b) electrical power sources
  - (c) lights
  - (d) powered instruments
  - (e) flammable conditions (such as painting and solvent application)
- (4) When static grounding is recommended in a detailed procedure, the airplane must be statically grounded to a common, approved, identified ground.
- (5) Where a grid system is used, any number of individual grounds will provide a common ground, since all grounds are interconnected. If an area does not have a grid system, use a single approved and identified ground as the common ground for all grounding cables.

**WARNING:** ALL WORK AROUND THE AIRPLANE MUST STOP WHEN LIGHTNING OCCURS AT A DISTANCE OF 6 MILES OR LESS. ALL PERSONNEL MUST GO IN A BUILDING OR THE AIRPLANE. LIGHTNING CAN KILL PERSONNEL OR CAUSE INJURY.

**WARNING:** DO NOT WEAR HEADSET OR HANDLE ANY UMBILICAL CONNECTIONS TO AIRPLANE DURING ATMOSPHERIC ELECTRICAL DISTURBANCES. LIGHTNING STRIKE CAN CAUSE SEVERE INJURY.

- (6) Stop ground servicing operations, external to the airplane, during electrical storms.
- (7) The airplane is normally electrostatically grounded through conductive tires (Refer to the task, Measure Electrical Resistance to Ground). However, static grounding is necessary for:
  - (a) Airplanes having inadequate conductivity to ground through the tires.
  - (b) Airplanes on parking sites that have inadequate conductivity.

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B. Location Zones

Zone	Area
731	Left Main Landing Gear - Outboard Door
741	Right Main Landing Gear - Outboard Door

C. Grounding Procedure:

SUBTASK 20-40-11-480-001

**WARNING:** DO NOT CONNECT A HEADSET AND DO NOT TOUCH CONNECTIONS TO THE AIRPLANE DURING ATMOSPHERIC ELECTRICAL ACTIVITY OR IN STRONG ELECTROMAGNETIC FIELDS. LIGHTNING STRIKE AND HIGH DISCHARGE CURRENTS CAN CAUSE SEVERE INJURY.

**WARNING:** ALWAYS ATTACH THE GROUNDING CABLE TO THE GROUND CONNECTION FIRST. NEVER ATTACH THE CABLE TO THE AIRPLANE AND THEN TO THE GROUND CONNECTION.

**CAUTION:** ATTACH GROUNDING CABLES ONLY TO SPECIFIED POINTS ON THE AIRPLANE. INCORRECTLY ATTACHED GROUNDING CABLES CAN CAUSE SCRATCHES WHICH CAN CAUSE CORROSION AND CRACKS ON STRESSED PARTS. GROUND WIRES ATTACHED TO DOORS OR FAIRINGS MADE FROM COMPOSITE MATERIALS DO NOT PROVIDE A GROUND.

- (1) Attach grounding cable to a ground and to the airplane in the following sequence:
  - (a) Connect the grounding cable to an approved, identified static ground point.  
NOTE: These points may be located in the parking surface or in another fixed location.
  - (b) Connect the grounding cable to approved grounding attach point on the airplane (Figure 201).
    - 1) Connect the grounding cable to the jack pad during landing gear retraction tests. The jack pad must be completely installed and the grounding stud on it must be unpainted and free from oil.

SUBTASK 20-40-11-020-001

- (2) Before the airplane is moved, remove the ground cables in reverse sequence of attachment.

———— END OF TASK ————

**TASK 20-40-11-760-801**

3. Electrical Bonding

A. Procedure:

SUBTASK 20-40-11-420-001

**WARNING:** DO NOT CONNECT A HEADSET AND DO NOT TOUCH CONNECTIONS TO THE AIRPLANE DURING ATMOSPHERIC ELECTRICAL ACTIVITY OR IN STRONG ELECTROMAGNETIC FIELDS. LIGHTNING STRIKE AND HIGH DISCHARGE CURRENTS CAN CAUSE SEVERE INJURY.

**CAUTION:** ATTACH BONDING CABLES ONLY TO SPECIFIED POINTS ON THE AIRPLANE. INCORRECTLY ATTACHED BONDING CABLES CAN CAUSE SCRATCHES WHICH CAN CAUSE CORROSION AND CRACKS ON STRESSED PARTS. BOND WIRES ATTACHED TO DOORS OR FAIRINGS MADE FROM COMPOSITE MATERIALS DO NOT PROVIDE A BOND.

- (1) Connect a bonding cable to a known bonding or grounding point on the airplane.

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SUBTASK 20-40-11-480-002

- (2) Connect the other end of the bonding cable to a known bonding or grounding point on the support equipment in use.

SUBTASK 20-40-11-020-002

- (3) Before the airplane is moved, remove the ground cables in the opposite sequence that you attached them.

———— END OF TASK ————

**TASK 20-40-11-760-802**

**4. Measurement of Airplane Electrical Resistance to Ground**

**A. References**

Reference	Title
24-22-00-860-812	Remove Electrical Power (P/B 201)
24-41-11-200-803	External Power Receptacle Neutral Pin to Ground Continuity Check (P/B 601)
SWPM 20-02-10	Airplane Flammable Leakage Zones

**B. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-6457	Meter - Insulation (Range: 1-1,000 VDC or equivalent, select meter per test requirements) Part #: 1863-9700 Supplier: 62015 Part #: 1864-9700 Supplier: 62015 Part #: 1865PLUS Supplier: 62015 Part #: 1865PLUSCE Supplier: 62015 Part #: 2471F Supplier: 21844 Opt Part #: 1865-00-CE Supplier: 62015

**C. Prepare to Check**

SUBTASK 20-40-11-840-001

- (1) Make sure that the airplane is not parked on painted surfaces.

SUBTASK 20-40-11-860-001

- (2) Do this task: External Power Receptacle Neutral Pin to Ground Continuity Check, TASK 24-41-11-200-803.

SUBTASK 20-40-11-000-001

- (3) Do this task: Remove Electrical Power, TASK 24-22-00-860-812.

SUBTASK 20-40-11-940-001

**WARNING:** DO NOT USE A MEGOHMMETER NEAR A FUEL TANK VENT. IT CAN CAUSE AN EXPLOSION OR FIRE. FIRE AND EXPLOSIONS CAN CAUSE INJURIES TO PERSONNEL, AND DAMAGE TO EQUIPMENT.

- (4) Use these precautions for possible fuel vapors when you use a megohmmeter to measure the discharger resistance.
  - (a) Use a insulation meter, COM-6457 or equivalent meter with a 500 VDC test voltage and a maximum 5 milliampere short circuit current.

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- (b) Do not use a megohmmeter at these locations:
  - 1) Area adjacent to or below a wing fuel tank vent, 5 ft (1.524 m) diameter column, from vent to ground.
  - 2) Area defined as a Flammable Leakage Zone in SWPM 20-02-10.
  - 3) Zero to 18 in. (457 mm) above the ground in the area around the airplane.
- (c) Make sure that:
  - 1) Area is well ventilated.
  - 2) Metal workstands are grounded.
  - 3) Megohmmeter is plugged into a grounded receptacle.
  - 4) Megohmmeter is insulated from metal work stand.

**SUBTASK 20-40-11-480-003**

- (5) Connect a insulation meter, COM-6457, or equivalent, to a known bonding/grounding point in the wheel well.

**SUBTASK 20-40-11-480-004**

- (6) Connect the other end of the insulation meter, COM-6457, or equivalent, to an identified ground point on the ramp.

**SUBTASK 20-40-11-420-002**

- (7) Set the insulation meter, COM-6457, or equivalent, to the 50 Vdc range.

**SUBTASK 20-40-11-970-001**

- (8) Measure the resistance to ground and record the resistance in the maintenance log.

NOTE: The resistance should be less than 1.0 megohms. If the resistance is more than 1.0 megohms this may be the result of a bad grounding location. There may be a very high surface resistance on the airplane.

- (a) If the resistance is more than 1.0 megohms, tell the flight crews of subsequent flights in this airplane the conductivity to ground is not sufficient through the tires to electrostatically ground this airplane on a parking surface.

NOTE: Positive ground procedures may apply.

**SUBTASK 20-40-11-210-001**

- (9) Make sure the airplane is not parked over painted surfaces.

- (a) Make sure the tires have sufficient conductivity.

**SUBTASK 20-40-11-970-003**

- (10) Repeat the measurement at other parking site locations where successful measurements have been made.

NOTE: This will make sure the airplane has sufficient conductivity.

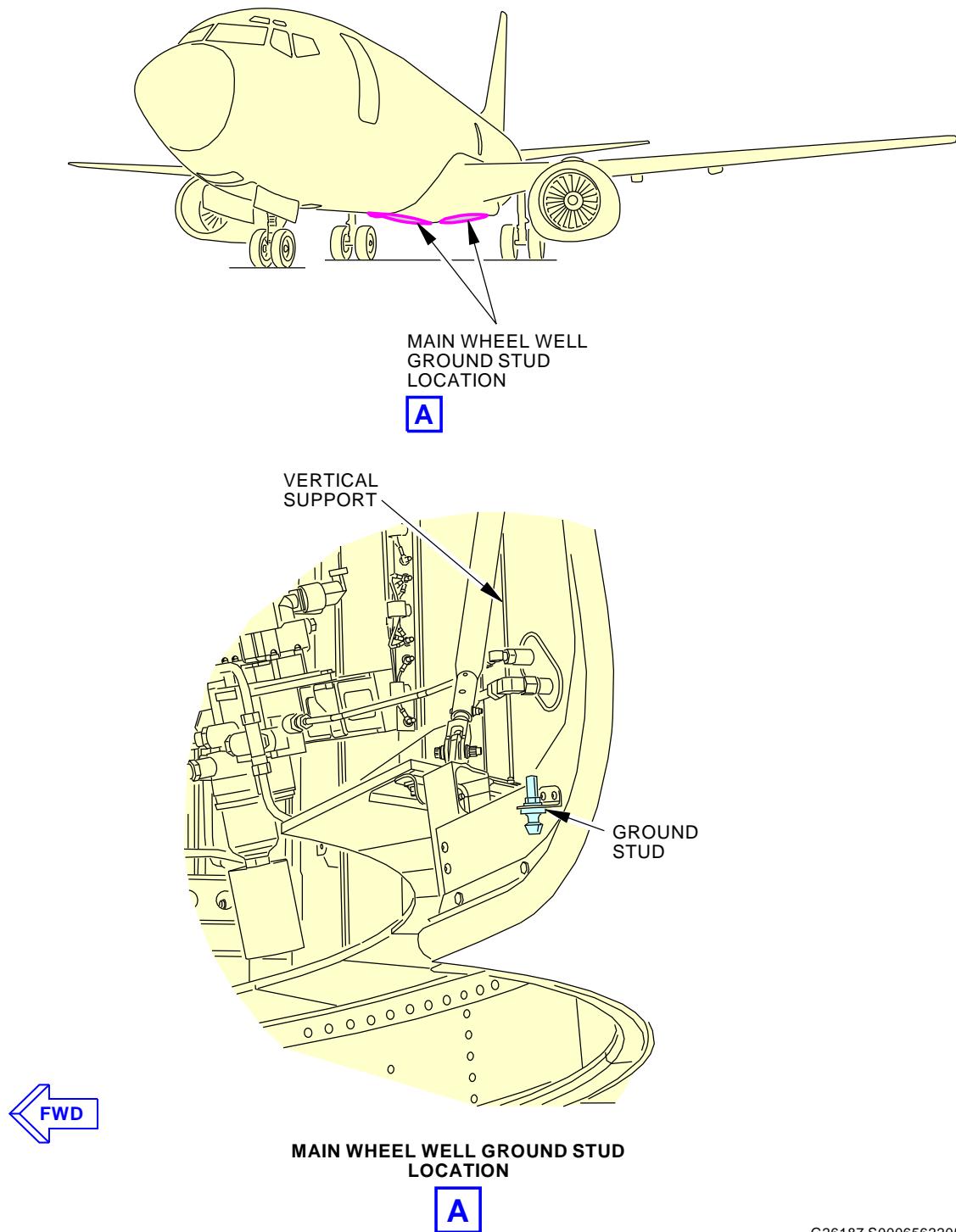
———— END OF TASK ————



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Static Ground Point Location  
Figure 201/20-40-11-990-801

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ELECTROSTATIC DISCHARGE SENSITIVE (ESDS) DEVICES - MAINTENANCE PRACTICES

**1. General**

- A. This procedure has these tasks:
  - (1) Wrist Strap continuity test.
  - (2) The ESDS handling for printed circuit board removal.
  - (3) The ESDS handling for printed circuit board installation.
  - (4) The ESDS handling for removal of metal encased units.
  - (5) The ESDS handling for installation of metal encased units.
  - (6) The installation of conductive dust caps and connector covers.
  - (7) The removal of conductive dust caps and connector covers.
- B. Many electronic line replaceable units (LRUs) contain micro-circuits and other sensitive devices which can be damaged internally by electrostatic discharges. These LRUs are identified as ESDS. The placards installed on the ESDS LRUs show that you must be careful. The persons who remove, install, and move the ESDS LRUs must know about static electricity and how to protect ESDS LRUs from static discharges.
- C. Electrostatic charges can be caused by these: human bodies, hair, clothing, floors, equipment racks, and equipment units. An electrostatic discharge is electrostatic energy transmitted between substances of different electrical potentials. Electrostatic discharges from nylon clothing or human hair onto polyethylene or steel can damage ESDS components. Damage to the internal components of an ESDS LRU can cause failure with one static discharge. System properties can change with time because of many static discharges.
- D. The function of this procedure is to show the maintenance persons how to handle the ESDS LRUs. This procedure contains the precautions that are necessary to safely touch the units that are identified by the ESDS placard. Three types of decals are used to identify the units with ESDS sensitive circuits. The military and commercial symbols are used on some units, while the international (JEDEC) symbol is used on most ESDS placards (Figure 201). The ESDS printed circuit boards that are LRU's are identified with a "STATIC SENSITIVE" placard (Figure 201).
- E. The placards on the outer area of the cardfiles show the cards that contain electrostatic sensitive devices.

**TASK 20-40-12-820-801**

**2. Wrist Strap Continuity Test**

**A. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-1565	Strap - Adjustable Wrist, Conductive, Static Control Part #: 09070 Supplier: 62576 Part #: 14810 Supplier: 62576 Part #: 2214 Supplier: 55203 Opt Part #: 2211 Supplier: 55203 Opt Part #: 2212 Supplier: 55203 Opt Part #: 2213 Supplier: 55203

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(Continued)

Reference	Description
COM-1793	Multimeter - Digital/Analog (or equivalent meter meets task requirements) Part #: 117 Supplier: 89536 Part #: 260-8XPI Supplier: 55026 Part #: 260-8XPI Supplier: 88277 Part #: 287 Supplier: 89536 Part #: 289 Supplier: 89536 Part #: 87V Supplier: 89536 Part #: FLUKE 27 II Supplier: 89536 Part #: FLUKE-77-4 Supplier: 89536 Opt Part #: 187 Supplier: 89536 Opt Part #: 189 Supplier: 89536 Opt Part #: 21 Supplier: 89536 Opt Part #: 77 SERIES III Supplier: 89536 Opt Part #: 87 Supplier: 89536 Opt Part #: FLUKE 27 Supplier: 89536

**B. Procedure**

SUBTASK 20-40-12-700-001

- (1) Plug the jack end of the static control wrist strap, COM-1565 into the ground or common receptacle of digital/analog multimeter, COM-1793.

SUBTASK 20-40-12-820-001

- (2) Adjust digital/analog multimeter, COM-1793 to the applicable resistance range.

SUBTASK 20-40-12-820-002

- (3) Touch the red lead of digital/analog multimeter, COM-1793 to the resistor portion of static control wrist strap, COM-1565. The acceptable range is from 250 kilohms to 1.5 megohms.

SUBTASK 20-40-12-980-001

- (4) Put static control wrist strap, COM-1565 on the wrist of the person who will be handling the ESDS unit.

SUBTASK 20-40-12-820-003

- (5) Hold the red lead of digital/analog multimeter, COM-1793 between the person's forefinger and thumb. The acceptable range is less than 10 megohms.

SUBTASK 20-40-12-090-001

- (6) Discard static control wrist strap, COM-1565 if it does not operate in the acceptable range.

———— END OF TASK ————

**TASK 20-40-12-000-801**

**3. ESDS Handling for Printed Circuit Board Removal**

(Figure 201)

**A. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.



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Reference	Description
COM-1565	Strap - Adjustable Wrist, Conductive, Static Control Part #: 09070 Supplier: 62576 Part #: 14810 Supplier: 62576 Part #: 2214 Supplier: 55203 Opt Part #: 2211 Supplier: 55203 Opt Part #: 2212 Supplier: 55203 Opt Part #: 2213 Supplier: 55203
COM-1566	Bags - Conductive, Static Shielding Part #: 13020 Supplier: 63070 Part #: 13670 Supplier: 62576 Part #: 2100RX4X6 Supplier: 55203 Part #: 2120R Supplier: 55203 Part #: 2120R6X7 Supplier: 55203
COM-1567	Container - Conductive, Antistatic Part #: PCC-700-ADE Supplier: 62049 Opt Part #: 2217-12 Supplier: 9A807

## B. Handling Procedure

SUBTASK 20-40-12-860-001

- (1) Make sure you remove electrical power from the printed circuit board.

SUBTASK 20-40-12-750-001

**WARNING:** USE A WRIST STRAP WITH A MINIMUM GROUNDING LEAD RESISTANCE OF 250 KILOHMS AND A MAXIMUM OF 1.5 MEGOHMS. USE OF A LOW RESISTANCE WRIST STRAP CAN CAUSE INJURY TO PERSONS IF A HIGH VOLTAGE SOURCE IS TOUCHED.

- (2) Do this task: Wrist Strap Continuity Test, TASK 20-40-12-820-801 to do a resistance test of the static control wrist strap, COM-1565:

**CAUTION:** THE GROUNDING LEAD ON THE WRIST STRAP MUST TOUCH THE SKIN TO GIVE THE PROTECTION THAT IS NECESSARY. FAILURE TO USE THE WRIST STRAP CORRECTLY CAN CAUSE DAMAGE TO THE ESDS PRINTED CIRCUIT BOARDS.

- (a) Connect the static control wrist strap, COM-1565 to an applicable electrostatic ground jack.

SUBTASK 20-40-12-020-001

- (3) Remove the printed circuit board with the applicable removal task.

SUBTASK 20-40-12-860-002

- (4) Put the printed circuit board in a static shielding bag, COM-1566, or antistatic conductive container, COM-1567, with an ESDS placard.

SUBTASK 20-40-12-860-003

**CAUTION:** DO NOT USE STAPLES OR ADHESIVE TAPES TO CLOSE THE BAG OR CONTAINER. FAILURE TO CLOSE CORRECTLY CAN CAUSE DAMAGE TO THE PRINTED CIRCUIT BOARD.

- (5) Use 100% cotton twine to close the antistatic conductive container, COM-1567.

**NOTE:** The static shielding bag, COM-1566, or antistatic conductive container, COM-1567 must be put in a rigid container to make sure it stays in a satisfactory condition.



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SUBTASK 20-40-12-860-004

- (6) Do not remove the static control wrist strap, COM-1565, until you close the applicable access door.

————— END OF TASK ————

**TASK 20-40-12-400-801**

**4. ESDS Handling for Printed Circuit Board Installation**

(Figure 201)

**A. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-1565	Strap - Adjustable Wrist, Conductive, Static Control Part #: 09070 Supplier: 62576 Part #: 14810 Supplier: 62576 Part #: 2214 Supplier: 55203 Opt Part #: 2211 Supplier: 55203 Opt Part #: 2212 Supplier: 55203 Opt Part #: 2213 Supplier: 55203
COM-1566	Bags - Conductive, Static Shielding Part #: 13020 Supplier: 63070 Part #: 13670 Supplier: 62576 Part #: 2100RX4X6 Supplier: 55203 Part #: 2120R Supplier: 55203 Part #: 2120R6X7 Supplier: 55203
COM-1567	Container - Conductive, Antistatic Part #: PCC-700-ADE Supplier: 62049 Opt Part #: 2217-12 Supplier: 9A807

**B. Handling Procedure**

SUBTASK 20-40-12-860-005

- (1) Make sure electrical power is removed from the printed circuit board.

SUBTASK 20-40-12-750-002

**WARNING:** USE A WRIST STRAP WITH A MINIMUM GROUNDING LEAD RESISTANCE OF 250 KILOHMS AND A MAXIMUM OF 1.5 MEGOHMS. USE OF A LOW RESISTANCE WRIST STRAP CAN CAUSE INJURY TO PERSONS IF A HIGH VOLTAGE SOURCE IS TOUCHED.

- (2) Do this task: Wrist Strap Continuity Test, TASK 20-40-12-820-801 to do a resistance test of the static control wrist strap, COM-1565:

**CAUTION:** THE GROUNDING LEAD ON THE WRIST STRAP MUST TOUCH THE SKIN TO GIVE THE PROTECTION THAT IS NECESSARY. FAILURE TO USE THE WRIST STRAP CORRECTLY CAN CAUSE DAMAGE TO THE ESDS PRINTED CIRCUIT BOARDS.

- (a) Connect the static control wrist strap, COM-1565, to an applicable electrostatic ground jack.

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SUBTASK 20-40-12-860-006

- (3) Remove the ESDS printed circuit board from the static shielding bag, COM-1566, or antistatic conductive container, COM-1567.

SUBTASK 20-40-12-860-007

- (4) Install the printed circuit board with the applicable installation procedure.

SUBTASK 20-40-12-860-008

- (5) Do not remove the static control wrist strap, COM-1565, until you close the applicable access door.

————— END OF TASK ————

### TASK 20-40-12-000-802

#### 5. ESDS Handling for Metal Encased Unit Removal

(Figure 201)

##### A. General

- (1) This task provides instructions to touch an ESDS metal encased unit during removal.

##### B. Tools/Equipment

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-1565	Strap - Adjustable Wrist, Conductive, Static Control Part #: 09070 Supplier: 62576 Part #: 14810 Supplier: 62576 Part #: 2214 Supplier: 55203 Opt Part #: 2211 Supplier: 55203 Opt Part #: 2212 Supplier: 55203 Opt Part #: 2213 Supplier: 55203
COM-1566	Bags - Conductive, Static Shielding Part #: 13020 Supplier: 63070 Part #: 13670 Supplier: 62576 Part #: 2100RX4X6 Supplier: 55203 Part #: 2120R Supplier: 55203 Part #: 2120R6X7 Supplier: 55203
COM-1567	Container - Conductive, Antistatic Part #: PCC-700-ADE Supplier: 62049 Opt Part #: 2217-12 Supplier: 9A807

##### C. ESDS Metal Encased Units Removal

SUBTASK 20-40-12-860-009

- (1) Make sure you remove electrical power from the metal encased unit.

SUBTASK 20-40-12-750-003

**WARNING:** USE A WRIST STRAP WITH A MINIMUM GROUNDING LEAD RESISTANCE OF 250 KILOHMS AND A MAXIMUM OF 1.5 MEGOHMS. USE OF A LOW RESISTANCE WRIST STRAP CAN CAUSE INJURY TO PERSONS IF A HIGH VOLTAGE SOURCE IS TOUCHED.

- (2) Do this task: Wrist Strap Continuity Test, TASK 20-40-12-820-801 to do a resistance test of the static control wrist strap, COM-1565:

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**WARNING:** PUT ON A WRIST STRAP THAT IS ATTACHED TO A GROUND BEFORE YOU MAKE ELECTRICAL CONNECTIONS TO AN ELECTRICAL EXPLOSIVE DEVICE. STATIC ELECTRICITY CAN CAUSE AN EXPLOSION.

- (a) Connect the static control wrist strap, COM-1565 on the wrist of the person that will remove the device.

**CAUTION:** THE GROUNDING LEAD ON THE WRIST STRAP MUST TOUCH THE SKIN TO GIVE THE PROTECTION THAT IS NECESSARY. FAILURE TO USE THE WRIST STRAP CORRECTLY CAN CAUSE DAMAGE TO THE ESDS METAL ENCASED UNIT.

- (b) Connect the static control wrist strap, COM-1565, to an applicable electrostatic ground jack.

SUBTASK 20-40-12-860-010

- (3) Remove the ESDS unit with the applicable removal task.

SUBTASK 20-40-12-420-001

- (4) Do this task: Conductive Dust Cap and Connector Cover Installation, TASK 20-40-12-400-804.

SUBTASK 20-40-12-860-020

- (5) Put the ESDS unit in the static shielding bag, COM-1566 or antistatic conductive container, COM-1567 with an ESDS placard.

**CAUTION:** DO NOT USE STAPLES OR ADHESIVE TAPES TO CLOSE THE BAG OR CONTAINER. IF YOU DO NOT USE THE CORRECT MATERIAL TO CLOSE THE PACKING, DAMAGE CAN OCCUR TO THE PRINTED-CIRCUIT BOARD.

- (a) Use 100% cotton twine to close the antistatic bag or container.

SUBTASK 20-40-12-860-013

- (6) Remove the static control wrist strap, COM-1565.

———— END OF TASK ————

**TASK 20-40-12-400-802**

**6. ESDS Handling for Metal Encased Unit Installation**

(Figure 201)

**A. General**

- (1) This task provides instructions to touch an ESDS metal encased unit during installation.

**B. Tools/Equipment**

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-1565	Strap - Adjustable Wrist, Conductive, Static Control Part #: 09070 Supplier: 62576 Part #: 14810 Supplier: 62576 Part #: 2214 Supplier: 55203 Opt Part #: 2211 Supplier: 55203 Opt Part #: 2212 Supplier: 55203 Opt Part #: 2213 Supplier: 55203



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(Continued)

Reference	Description
COM-1566	Bags - Conductive, Static Shielding Part #: 13020 Supplier: 63070 Part #: 13670 Supplier: 62576 Part #: 2100RX4X6 Supplier: 55203 Part #: 2120R Supplier: 55203 Part #: 2120R6X7 Supplier: 55203
COM-1567	Container - Conductive, Antistatic Part #: PCC-700-ADE Supplier: 62049 Opt Part #: 2217-12 Supplier: 9A807

### C. ESDS Metal Encased Unit Installation

SUBTASK 20-40-12-860-014

- (1) Make sure electrical power is removed from the metal encased unit.

SUBTASK 20-40-12-750-004

**WARNING:** USE A WRIST STRAP WITH A MINIMUM GROUNDING LEAD RESISTANCE OF 250 KILOHMS AND A MAXIMUM OF 1.5 MEGOHMS. USE OF A LOW RESISTANCE WRIST STRAP CAN CAUSE INJURY TO PERSONS IF A HIGH VOLTAGE SOURCE IS TOUCHED.

- (2) Do this task: Wrist Strap Continuity Test, TASK 20-40-12-820-801 to do a resistance test of the static control wrist strap, COM-1565:

**CAUTION:** THE GROUNDING LEAD ON THE WRIST STRAP MUST TOUCH THE SKIN TO GIVE THE PROTECTION THAT IS NECESSARY. FAILURE TO USE THE WRIST STRAP CORRECTLY CAN CAUSE DAMAGE TO THE ESDS METAL ENCASED UNIT.

- (a) Connect the static control wrist strap, COM-1565, to an applicable electrostatic ground jack.

SUBTASK 20-40-12-000-001

- (3) Remove the ESDS unit from the static shielding bag, COM-1566 or antistatic conductive container, COM-1567.

SUBTASK 20-40-12-420-003

- (4) Do this task: Conductive Dust Cap and Conductor Cover Removal, TASK 20-40-12-000-804.

SUBTASK 20-40-12-860-016

- (5) Install the ESDS unit with the applicable installation task.

SUBTASK 20-40-12-860-017

- (6) Remove the static control wrist strap, COM-1565.

— END OF TASK —



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**TASK 20-40-12-000-804**

**7. Conductive Dust Cap and Conductor Cover Removal**

(Figure 201)

**A. Conductive Dust Cap and Conductor Cover Removal**

SUBTASK 20-40-12-020-005

**CAUTION:** DO NOT TOUCH THE CONDUCTOR PINS OR OTHER CONDUCTORS ON THE UNIT. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE UNIT.

- (1) Remove all of the conductive dust caps and the connector covers from the unit to be installed.

SUBTASK 20-40-12-020-006

- (2) Install the ESDS unit with the applicable installation task.

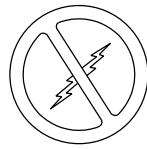
———— END OF TASK ————

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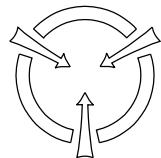
**20-40-12**



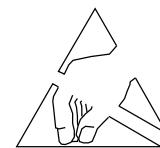
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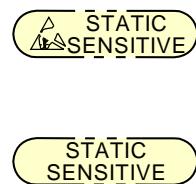
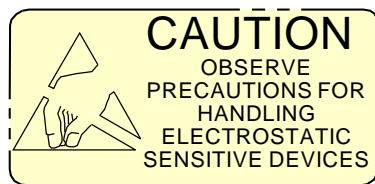
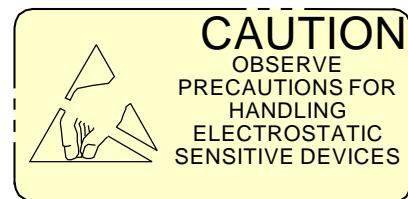
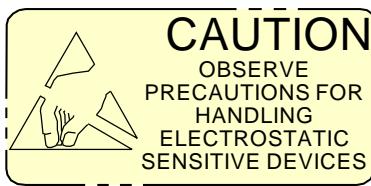


GOVERNMENT



INTERNATIONAL  
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TYPES OF ESDS SYMBOLS



BOEING ESDS DECALS (EXAMPLE)

F77521 S0006562216\_V2

Static Discharge Sensitive Devices Identifiers  
Figure 201/20-40-12-990-801

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**TASK 20-40-12-400-804**

**8. Conductive Dust Cap and Connector Cover Installation**

(Figure 201)

(Table 201 Table 202)

**A. General**

- (1) Conductive dust caps and connector covers must be installed on the connectors of ESDS units when the units are removed.
- (2) Use ITT Cannon dust caps and connectors as applicable (stamped "CONDUCTIVE") (Table 201).

**Table 201/20-40-12-993-804**

Table 1 ITT CANON		
PART NUMBER	MARKING ON CAP	CONNECTOR
025-1155-001	BKAD1-A&B-R	BKAD1-A-R BKAD1-B-R
025-1156-001 025-1157-001	BKAD1-C-R BKAD2&3-A&B-R	BKAD2-A-R BKAD2-B-R BKAD3-A-R BKAD3-B-R
025-1158-001	BKAD2&3-C-R	BKAD2-C-R BKAD3-C-R

- (3) Use Souriau dust caps and connectors as applicable (Table 202).

**Table 202/20-40-12-993-805**

TABLE 2 SOURIAU		
PART NUMBER	TYPE CONNECTOR	SHELL SIZE
8660-1404	Power	1
8660-1405	Signal	1
8660-1406	Power	2 & 3
8660-1407	Signal	2 & 3

**B. Conductive Dust Cap and Connector Cover Installation**

SUBTASK 20-40-12-420-005

**CAUTION:** DO NOT TOUCH THE CONDUCTOR PINS OR OTHER CONDUCTORS ON THE UNIT. IF YOU TOUCH THESE CONDUCTORS, ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE UNIT.

- (1) Remove the ESDS unit as shown in the applicable removal procedure.

NOTE: Make sure a static sensitive placard is installed adjacent to the electrical connector(s).

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SUBTASK 20-40-12-420-006

- (2) Install conductive dust covers on the connectors with a static sensitive placard and standard dust covers on the connectors that do not have the placard.

NOTE: The conductive dust caps and the connector covers are black in color. The conductive dust caps and the connector covers from the installed unit can be used on the removed unit. Conductive bags can be used as an alternate to conductive dust caps and covers.

SUBTASK 20-40-12-860-019

- (3) Move the unit, as shown in the applicable procedure, with the conductive dust caps and connector covers installed.

———— END OF TASK ————

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STANDARD TORQUE VALUES - MAINTENANCE PRACTICES

**1. General**

- A. This procedure has one task:
  - (1) Standard Torque Values

**TASK 20-50-11-910-801**

**2. Standard Torque Values**

**A. General**

- (1) If the fastener torque value and the nut torque value are different, use the torque range that has the lowest maximum value.
- (2) Lubrication
  - (a) If one of the compounds that follow is applied to the fastener, use the torque value for "lubed fastener."
    - 1) BMS3-33 grease, D00633
    - 2) BMS3-38 corrosion inhibiting compound, G50136
    - 3) MIL-PRF-23827 grease, D00013
    - 4) MIL-PRF-46010 lubricant, D00110
    - 5) Bostik Never Seez Pure Nickel Special Never Seez NSBT, D50237
    - 6) Cetyl Alcohol lubricant, D50197
    - 7) Dry Film Lubricant or Solid Film Lubricant
  - (b) If the torque is applied to the fastener head, and the joint is fay-sealed or not fay-sealed, then use the torque value in the column labeled "TURN THE FASTENER HEAD AND/OR FAY SEAL".
  - (c) If the torque is applied to the nut, and the joint is fay-sealed, then use the torque value in the column labeled "TURN THE FASTENER HEAD AND/OR FAY SEAL".
  - (d) If torque is applied to the nut, and the joint is not fay-sealed, then use the torque value in the column labeled "TURN THE NUT AND NO FAY SEAL".

**B. Consumable Materials**

Reference	Description	Specification
C00308	Compound - Corrosion Preventive, Petrolatum Hot Application	MIL-C-11796
D00010	Compound - Thread Antiseize, High Temperature	MIL-PRF-907
D00013	Grease - Aircraft And Instrument Grease	MIL-PRF-23827 (NATO G-354) (Supersedes MIL-G-23827)
D00110	Lubricant - Solid Film, Heat Cured, Corrosion Inhibiting	MIL-PRF-46010
D00633	Grease - Aircraft General Purpose	BMS3-33
D50197	Lubricant - Cetyl Alcohol	SAE AS87132 (Supersedes MIL-L-87132)

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(Continued)

Reference	Description	Specification
D50237	Compound - Antiseize, Pure Nickel Special - Never Seez NSBT	BAC5008
G50136	Compound - Corrosion Inhibiting, Non-drying	BMS3-38

**C. Torque Tables**

SUBTASK 20-50-11-580-001

- (1) Refer to the figures and tables that follow for the torque data.
  - (a) Torque Wrench Adapter, Figure 201.
  - (b) Nuts and Bolts, Table 201, Table 202, Table 203, Table 204, Table 205, Table 206, Table 207, Table 208, Table 209, Table 210, Table 211, Table 212, Table 213, Table 214,.

**Table 201/20-50-11-993-802 220 KSI TENSION FASTENERS AND NUTS (EXCEPT BACB31G)**

FASTENER CLASS	220 KSI			
FASTENER PART NUMBER	BACB30MT, BACB30TR, BACB30NH, BACB30US, BACS21EK			
NUT PART NUMBER	BACN10HC, BACN10HR, BACN10JG, BACN10YN, BACN11X			
NOMINAL THREAD SIZE	DRY FASTENERS		LUBED FASTENERS	
	TURN THE NUT AND NO FAY SEAL	TURN THE FASTENER HEAD AND/OR FAY SEAL	TURN THE NUT AND NO FAY SEAL	TURN THE FASTENER HEAD AND/OR FAY SEAL
0.1900-32	82 in-lb (9 N·m) to 88 in-lb (10 N·m)	97 in-lb (11 N·m) to 103 in-lb (12 N·m)	53 in-lb (6 N·m) to 57 in-lb (6 N·m)	58 in-lb (7 N·m) to 62 in-lb (7 N·m)
0.2500-28	107 in-lb (12 N·m) to 113 in-lb (13 N·m)	121 in-lb (14 N·m) to 129 in-lb (15 N·m)	73 in-lb (8 N·m) to 77 in-lb (9 N·m)	78 in-lb (9 N·m) to 82 in-lb (9 N·m)
0.3125-24	204 in-lb (23 N·m) to 216 in-lb (24 N·m)	243 in-lb (27 N·m) to 258 in-lb (29 N·m)	155 in-lb (18 N·m) to 165 in-lb (19 N·m)	175 in-lb (20 N·m) to 185 in-lb (21 N·m)
0.3750-24	388 in-lb (44 N·m) to 412 in-lb (47 N·m)	485 in-lb (55 N·m) to 515 in-lb (58 N·m)	291 in-lb (33 N·m) to 309 in-lb (35 N·m)	320 in-lb (36 N·m) to 340 in-lb (38 N·m)
0.4375-20	655 in-lb (74 N·m) to 695 in-lb (79 N·m)	815 in-lb (92 N·m) to 865 in-lb (98 N·m)	388 in-lb (44 N·m) to 412 in-lb (47 N·m)	427 in-lb (48 N·m) to 453 in-lb (51 N·m)
0.5000-20	1067 in-lb (121 N·m) to 1133 in-lb (128 N·m)	1261 in-lb (142 N·m) to 1339 in-lb (151 N·m)	558 in-lb (63 N·m) to 592 in-lb (67 N·m)	631 in-lb (71 N·m) to 670 in-lb (76 N·m)
0.5625-18	1504 in-lb (170 N·m) to 1597 in-lb (180 N·m)	1746 in-lb (197 N·m) to 1854 in-lb (209 N·m)	873 in-lb (99 N·m) to 927 in-lb (105 N·m)	970 in-lb (110 N·m) to 1030 in-lb (116 N·m)
0.6250-18	2037 in-lb (230 N·m) to 2163 in-lb (244 N·m)	2231 in-lb (252 N·m) to 2369 in-lb (268 N·m)	1455 in-lb (164 N·m) to 1545 in-lb (175 N·m)	1601 in-lb (181 N·m) to 1700 in-lb (192 N·m)
0.7500-16	3686 in-lb (416 N·m) to 3914 in-lb (442 N·m)	4171 in-lb (471 N·m) to 4429 in-lb (500 N·m)	2959 in-lb (334 N·m) to 3142 in-lb (355 N·m)	3201 in-lb (362 N·m) to 3399 in-lb (384 N·m)
0.8750-14	5723 in-lb (647 N·m) to 6077 in-lb (687 N·m)	6499 in-lb (734 N·m) to 6901 in-lb (780 N·m)	4074 in-lb (460 N·m) to 4326 in-lb (489 N·m)	4365 in-lb (493 N·m) to 4635 in-lb (524 N·m)

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**Table 201/20-50-11-993-802 220 KSI TENSION FASTENERS AND NUTS (EXCEPT BACB31G) (Continued)**

FASTENER CLASS	220 KSI			
1.0000-12 OR 1.0000-14	8682 in-lb (981 N·m) to 9219 in-lb (1042 N·m)	10,573 in-lb (1195 N·m) to 11,227 in-lb (1268 N·m)	6402 in-lb (723 N·m) to 6798 in-lb (768 N·m)	6790 in-lb (767 N·m) to 7210 in-lb (815 N·m)
1.1250-12	10,961 in-lb (1238 N·m) to 11,639 in-lb (1315 N·m)	12,610 in-lb (1425 N·m) to 13,390 in-lb (1513 N·m)	8585 in-lb (970 N·m) to 9116 in-lb (1030 N·m)	9118 in-lb (1030 N·m) to 9682 in-lb (1094 N·m)
1.2500-12	16,975 in-lb (1918 N·m) to 18,025 in-lb (2037 N·m)	18,624 in-lb (2104 N·m) to 19,776 in-lb (2234 N·m)	11,155 in-lb (1260 N·m) to 11,845 in-lb (1338 N·m)	11,640 in-lb (1315 N·m) to 12,360 in-lb (1396 N·m)
1.3750-12	21,340 in-lb (2411 N·m) to 22,660 in-lb (2560 N·m)	23,280 in-lb (2630 N·m) to 24,720 in-lb (2793 N·m)	16,005 in-lb (1808 N·m) to 16,995 in-lb (1920 N·m)	16,490 in-lb (1863 N·m) to 17,510 in-lb (1978 N·m)

**Table 202/20-50-11-993-803 BACB31G**

FASTENER CLASS	220 KSI			
FASTENER PART NUMBER OR STYLE	BACB31G			
NOMINAL THREAD SIZE	DRY FASTENER		LUBED FASTENER	
	TURN THE NUT AND NO FAY SEAL	TURN THE FASTENER HEAD OR FAY SEAL	TURN THE NUT AND NO FAY SEAL	TURN THE FASTENER HEAD OR FAY SEAL
0.1900-32	82 in-lb (9 N·m) to 88 in-lb (10 N·m)	97 in-lb (11 N·m) to 103 in-lb (12 N·m)	53 in-lb (6 N·m) to 57 in-lb (6 N·m)	58 in-lb (7 N·m) to 62 in-lb (7 N·m)
0.2500-28	107 in-lb (12 N·m) to 113 in-lb (13 N·m)	121 in-lb (14 N·m) to 129 in-lb (15 N·m)	73 in-lb (8 N·m) to 77 in-lb (9 N·m)	78 in-lb (9 N·m) to 82 in-lb (9 N·m)
0.3125-24	204 in-lb (23 N·m) to 216 in-lb (24 N·m)	243 in-lb (27 N·m) to 258 in-lb (29 N·m)	155 in-lb (18 N·m) to 165 in-lb (19 N·m)	175 in-lb (20 N·m) to 185 in-lb (21 N·m)
0.3750-24	388 in-lb (44 N·m) to 412 in-lb (47 N·m)	485 in-lb (55 N·m) to 515 in-lb (58 N·m)	291 in-lb (33 N·m) to 309 in-lb (35 N·m)	320 in-lb (36 N·m) to 340 in-lb (38 N·m)
0.4375-20	514 in-lb (58 N·m) to 546 in-lb (62 N·m)	669 in-lb (76 N·m) to 711 in-lb (80 N·m)	340 in-lb (38 N·m) to 361 in-lb (41 N·m)	412 in-lb (47 N·m) to 438 in-lb (49 N·m)
0.5000-20	825 in-lb (93 N·m) to 876 in-lb (99 N·m)	1038 in-lb (117 N·m) to 1102 in-lb (125 N·m)	529 in-lb (60 N·m) to 561 in-lb (63 N·m)	631 in-lb (71 N·m) to 670 in-lb (76 N·m)
0.5625-18	1213 in-lb (137 N·m) to 1288 in-lb (146 N·m)	1426 in-lb (161 N·m) to 1514 in-lb (171 N·m)	786 in-lb (89 N·m) to 834 in-lb (94 N·m)	892 in-lb (101 N·m) to 948 in-lb (107 N·m)
0.6250-18	1601 in-lb (181 N·m) to 1700 in-lb (192 N·m)	1843 in-lb (208 N·m) to 1957 in-lb (221 N·m)	1067 in-lb (121 N·m) to 1133 in-lb (128 N·m)	1164 in-lb (132 N·m) to 1236 in-lb (140 N·m)

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**Table 202/20-50-11-993-803 BACB31G (Continued)**

FASTENER CLASS	220 KSI			
0.7500-16	2862 in-lb (323 N·m) to 3039 in-lb (343 N·m)	3395 in-lb (384 N·m) to 3605 in-lb (407 N·m)	1892 in-lb (214 N·m) to 2009 in-lb (227 N·m)	2086 in-lb (236 N·m) to 2215 in-lb (250 N·m)

**Table 203/20-50-11-993-804 160-200 KSI TENSION FASTENERS, NUTS, NUTPLATES**

FASTENER CLASS	160-200 KSI			
FASTENER MATERIAL	STEEL/CRES			
FASTENER PART NUMBER	BACB30EM, BACB30FD, BACB30LE, BACB30LM, BACB30LN, BACB30LP, BACB30LR, BACB30LU, BACB30NE, BACB30PN, BACB30UG, BACB30ZF, MS20004-MS20024, NAS1216, NAS6603-NAS6620, NAS6703-NAS6720			
NUT PART NUMBER	AS3485, AS3486, BACN10B, BACN10GW, BACN10JA, BACN10JB, BACN10RM, BACN11W, BACN11Z, BACN10ZC, NAS1804, NAS1805, NAS577			
NOMINAL THREAD SIZE	DRY FASTENERS		LUBED FASTENERS	
	TURN THE NUT AND NO FAY SEAL	TURN THE FASTENER HEAD AND/OR FAY SEAL	TURN THE NUT AND NO FAY SEAL	TURN THE FASTENER HEAD AND/OR FAY SEAL
0.1120-40 OR 0.1120-48	8 in-lb (1 N·m)	8 in-lb (1 N·m)	6 in-lb (1 N·m)	6 in-lb (1 N·m)
0.1380-32 OR 0.1380-40	15 in-lb (2 N·m)	15 in-lb (2 N·m)	12 in-lb (1 N·m)	12 in-lb (1 N·m)
0.1640-32 OR 0.1640-36	19 in-lb (2 N·m) to 21 in-lb (2 N·m)	19 in-lb (2 N·m) to 21 in-lb (2 N·m)	15 in-lb (2 N·m)	15 in-lb (2 N·m)
0.1900-32	34 in-lb (4 N·m) to 36 in-lb (4 N·m)	34 in-lb (4 N·m) to 36 in-lb (4 N·m)	24 in-lb (3 N·m) to 26 in-lb (3 N·m)	24 in-lb (3 N·m) to 26 in-lb (3 N·m)
0.2500-28	82 in-lb (9 N·m) to 88 in-lb (10 N·m)	97 in-lb (11 N·m) to 103 in-lb (12 N·m)	63 in-lb (7 N·m) to 67 in-lb (8 N·m)	73 in-lb (8 N·m) to 77 in-lb (9 N·m)
0.3125-24	165 in-lb (19 N·m) to 175 in-lb (20 N·m)	194 in-lb (22 N·m) to 206 in-lb (23 N·m)	107 in-lb (12 N·m) to 113 in-lb (13 N·m)	121 in-lb (14 N·m) to 129 in-lb (15 N·m)
0.3750-24	310 in-lb (35 N·m) to 330 in-lb (37 N·m)	398 in-lb (45 N·m) to 422 in-lb (48 N·m)	194 in-lb (22 N·m) to 206 in-lb (23 N·m)	243 in-lb (27 N·m) to 258 in-lb (29 N·m)
0.4375-20	514 in-lb (58 N·m) to 546 in-lb (62 N·m)	669 in-lb (76 N·m) to 711 in-lb (80 N·m)	340 in-lb (38 N·m) to 361 in-lb (41 N·m)	412 in-lb (47 N·m) to 438 in-lb (49 N·m)
0.5000-20	825 in-lb (93 N·m) to 876 in-lb (99 N·m)	1038 in-lb (117 N·m) to 1102 in-lb (125 N·m)	529 in-lb (60 N·m) to 561 in-lb (63 N·m)	631 in-lb (71 N·m) to 670 in-lb (76 N·m)
0.5625-18	1213 in-lb (137 N·m) to 1288 in-lb (146 N·m)	1426 in-lb (161 N·m) to 1514 in-lb (171 N·m)	786 in-lb (89 N·m) to 834 in-lb (94 N·m)	892 in-lb (101 N·m) to 948 in-lb (107 N·m)
0.6250-18	1601 in-lb (181 N·m) to 1700 in-lb (192 N·m)	1843 in-lb (208 N·m) to 1957 in-lb (221 N·m)	1067 in-lb (121 N·m) to 1133 in-lb (128 N·m)	1164 in-lb (132 N·m) to 1236 in-lb (140 N·m)
0.7500-16	2862 in-lb (323 N·m) to 3039 in-lb (343 N·m)	3395 in-lb (384 N·m) to 3605 in-lb (407 N·m)	1892 in-lb (214 N·m) to 2009 in-lb (227 N·m)	2086 in-lb (236 N·m) to 2215 in-lb (250 N·m)

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**Table 203/20-50-11-993-804 160-200 KSI TENSION FASTENERS, NUTS, NUTPLATES (Continued)**

FASTENER CLASS	160-200 KSI			
0.8750-14	4462 in-lb (504 N·m) to 4738 in-lb (535 N·m)	5335 in-lb (603 N·m) to 5665 in-lb (640 N·m)	2910 in-lb (329 N·m) to 3090 in-lb (349 N·m)	3298 in-lb (373 N·m) to 3502 in-lb (396 N·m)
1.0000-12 OR 1.0000-14	6790 in-lb (767 N·m) to 7210 in-lb (815 N·m)	8633 in-lb (975 N·m) to 9167 in-lb (1036 N·m)	4414 in-lb (499 N·m) to 4687 in-lb (530 N·m)	5335 in-lb (603 N·m) to 5665 in-lb (640 N·m)
1.1250-12	8536 in-lb (964 N·m) to 9064 in-lb (1024 N·m)	10,379 in-lb (1173 N·m) to 11,021 in-lb (1245 N·m)	5626 in-lb (636 N·m) to 5974 in-lb (675 N·m)	6499 in-lb (734 N·m) to 6901 in-lb (780 N·m)
1.2500-12	12,222 in-lb (1381 N·m) to 12,978 in-lb (1466 N·m)	15,229 in-lb (1721 N·m) to 16,171 in-lb (1827 N·m)	8342 in-lb (943 N·m) to 8858 in-lb (1001 N·m)	9409 in-lb (1063 N·m) to 9991 in-lb (1129 N·m)

**Table 204/20-50-11-993-805 160-200 KSI TITANIUM TENSION FASTENERS, NUTS, NUTPLATES**

FASTENER CLASS	160-200 KSI			
FASTENER MATERIAL	TITANIUM			
FASTENER PART NUMBER	BACB30MR, BACB30MS, BACB30NM, BACB30NN, BACB30NS, BACB30XJ, BACB30XK, BACB30XL, BACB30XM, BACS21EJ, NAS1189, NAS6803-NAS6820			
NUT PART NUMBER	AS3485, AS3486, BACN10B, BACN10GW, BACN10JA, BACN10JB, BACN10RM, BACN11W, BACN11Z, BACN10ZC, NAS1804, NAS1805, NAS577			
NOMINAL THREAD SIZE	DRY FASTENERS		LUBED FASTENERS	
	TURN THE NUT AND NO FAY SEAL	TURN THE FASTENER HEAD AND/OR FAY SEAL	TURN THE NUT AND NO FAY SEAL	TURN THE FASTENER HEAD AND/OR FAY SEAL
0.1120-40 or 0.1120-48	8 in-lb (1 N·m)	8 in-lb (1 N·m)	6 in-lb (1 N·m)	6 in-lb (1 N·m)
0.1380-32 or 0.1380-40	15 in-lb (2 N·m)	15 in-lb (2 N·m)	12 in-lb (1 N·m)	12 in-lb (1 N·m)
0.1640-32 or 0.1640-36	19 in-lb (2 N·m) to 21 in-lb (2 N·m)	19 in-lb (2 N·m) to 21 in-lb (2 N·m)	15 in-lb (2 N·m)	15 in-lb (2 N·m)
0.1900-32	34 in-lb (4 N·m) to 36 in-lb (4 N·m)	34 in-lb (4 N·m) to 36 in-lb (4 N·m)	24 in-lb (3 N·m) to 26 in-lb (3 N·m)	24 in-lb (3 N·m) to 26 in-lb (3 N·m)
0.2500-28	82 in-lb (9 N·m) to 88 in-lb (10 N·m)	97 in-lb (11 N·m) to 103 in-lb (12 N·m)	63 in-lb (7 N·m) to 67 in-lb (8 N·m)	73 in-lb (8 N·m) to 77 in-lb (9 N·m)
0.3125-24	165 in-lb (19 N·m) to 175 in-lb (20 N·m)	194 in-lb (22 N·m) to 206 in-lb (23 N·m)	107 in-lb (12 N·m) to 113 in-lb (13 N·m)	121 in-lb (14 N·m) to 129 in-lb (15 N·m)
0.3750-24	310 in-lb (35 N·m) to 330 in-lb (37 N·m)	398 in-lb (45 N·m) to 422 in-lb (48 N·m)	194 in-lb (22 N·m) to 206 in-lb (23 N·m)	243 in-lb (27 N·m) to 258 in-lb (29 N·m)
0.4375-20	514 in-lb (58 N·m) to 546 in-lb (62 N·m)	669 in-lb (76 N·m) to 711 in-lb (80 N·m)	340 in-lb (38 N·m) to 361 in-lb (41 N·m)	412 in-lb (47 N·m) to 438 in-lb (49 N·m)

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**Table 204/20-50-11-993-805 160-200 KSI TITANIUM TENSION FASTENERS, NUTS, NUTPLATES  
(Continued)**

FASTENER CLASS	160-200 KSI			
0.5000-20	825 in-lb (93 N·m) to 876 in-lb (99 N·m)	1038 in-lb (117 N·m) to 1102 in-lb (125 N·m)	529 in-lb (60 N·m) to 561 in-lb (63 N·m)	631 in-lb (71 N·m) to 670 in-lb (76 N·m)
0.5625-18	1213 in-lb (137 N·m) to 1288 in-lb (146 N·m)	1426 in-lb (161 N·m) to 1514 in-lb (171 N·m)	786 in-lb (89 N·m) to 834 in-lb (94 N·m)	892 in-lb (101 N·m) to 948 in-lb (107 N·m)
0.6250-18	1601 in-lb (181 N·m) to 1700 in-lb (192 N·m)	1843 in-lb (208 N·m) to 1957 in-lb (221 N·m)	1067 in-lb (121 N·m) to 1133 in-lb (128 N·m)	1164 in-lb (132 N·m) to 1236 in-lb (140 N·m)
0.7500-16	1843 in-lb (208 N·m) to 1957 in-lb (221 N·m)	2134 in-lb (241 N·m) to 2266 in-lb (256 N·m)	1892 in-lb (214 N·m) to 2009 in-lb (227 N·m)	2086 in-lb (236 N·m) to 2215 in-lb (250 N·m)

**Table 205/20-50-11-993-806 95-156 KSI SHEAR FASTENERS (EXCEPT BACB31V)**

FASTENER CLASS	95-156 KSI			
FASTENER PART NUMBER OR STYLE	BACB30LH, BACB30LJ, BACB30LK, BACB30LT, BACB30NF, BACB30NJ, BACB30NL, BACB30NR, BACB30NT, BACB30PC, BACB30PF <sup>[1]</sup> , BACB30PU <sup>[1]</sup> , BACB30PW <sup>[1]</sup> , BACB30SW, BACB30TP, BACB30UU, BACB30WP, BACB30XN, BACB30ZC, BACB30ZG, BACS12BE(-), BACS12BE(A), BACS12BE(B), BACS12BF(-), BACS12BF(A), BACS12BF(B), BACS12BG(-), BACS12BG(A), BACS12BG(B), BACS12BP(/no 'C' CODES), BACS12CB, BACS12CK, BACS12ER, BACS12FA, BACS12GM, BACS12GP, BACS12GR, BACS12GU, BACS12GX, BACS12HC, BACS12HJ, BACS12HL, BACS12HM, BACS12HN, BACS12HP, BACS12HU, BACS12HV, BACS12HW, BACS12HY, BACS12JA, BACS12JB, BACS12JD, BACS12JE, BACS12JL, BACS12N, MS21262, MS24678, MS24694-S(), NAS1217, NAS1218, NAS1351, NAS1352, NAS1801, NAS1802, NAS220-() <sup>[2]</sup> , NAS220C() <sup>[2]</sup> , NAS221-() <sup>[2]</sup> , NAS221C() <sup>[2]</sup> , NAS428, NAS514, NAS517, NAS563, NAS600-NAS606, NAS6203-NAS6220, NAS623, NAS7600-NAS7616, NAS8200-NAS8206, THREADED ROD (STEEL, CRES, NICKEL ALLOY)			
NOMINAL THREAD SIZE	DRY FASTENER		LUBED FASTENER	
	TURN THE NUT AND NO FAY SEAL	TURN THE FASTENER HEAD AND/OR FAY SEAL	TURN THE NUT AND NO FAY SEAL	TURN THE FASTENER HEAD AND/OR FAY SEAL
0.0860-56 or 0.0860-64	3 in-lb (0 N·m)	3 in-lb (0 N·m)	3 in-lb (0 N·m)	3 in-lb (0 N·m)
0.1120-40 or 0.1120-48	8 in-lb (1 N·m)	8 in-lb (1 N·m)	6 in-lb (1 N·m)	6 in-lb (1 N·m)
0.1380-32 or 0.1380-40	15 in-lb (2 N·m)	15 in-lb (2 N·m)	12 in-lb (1 N·m)	12 in-lb (1 N·m)
0.1640-32 or 0.1640-36	19 in-lb (2 N·m) to 21 in-lb (2 N·m)	19 in-lb (2 N·m) to 21 in-lb (2 N·m)	15 in-lb (2 N·m)	15 in-lb (2 N·m)
0.1900-32	29 in-lb (3 N·m) to 31 in-lb (4 N·m)	29 in-lb (3 N·m) to 31 in-lb (4 N·m)	24 in-lb (3 N·m) to 26 in-lb (3 N·m)	24 in-lb (3 N·m) to 26 in-lb (3 N·m)
0.2500-28	63 in-lb (7 N·m) to 67 in-lb (8 N·m)	78 in-lb (9 N·m) to 82 in-lb (9 N·m)	63 in-lb (7 N·m) to 67 in-lb (8 N·m)	73 in-lb (8 N·m) to 77 in-lb (9 N·m)
0.3125-24	121 in-lb (14 N·m) to 129 in-lb (15 N·m)	146 in-lb (16 N·m) to 155 in-lb (18 N·m)	107 in-lb (12 N·m) to 113 in-lb (13 N·m)	121 in-lb (14 N·m) to 129 in-lb (15 N·m)

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**Table 205/20-50-11-993-806 95-156 KSI SHEAR FASTENERS (EXCEPT BACB31V) (Continued)**

FASTENER CLASS	95-156 KSI			
0.3750-24	194 in-lb (22 N·m) to 206 in-lb (23 N·m)	233 in-lb (26 N·m) to 247 in-lb (28 N·m)	170 in-lb (19 N·m) to 180 in-lb (20 N·m)	194 in-lb (22 N·m) to 206 in-lb (23 N·m)
0.4375-20	291 in-lb (33 N·m) to 309 in-lb (35 N·m)	340 in-lb (38 N·m) to 361 in-lb (41 N·m)	262 in-lb (30 N·m) to 278 in-lb (31 N·m)	291 in-lb (33 N·m) to 309 in-lb (35 N·m)
0.5000-20	616 in-lb (70 N·m) to 654 in-lb (74 N·m)	766 in-lb (87 N·m) to 814 in-lb (92 N·m)	529 in-lb (60 N·m) to 561 in-lb (63 N·m)	631 in-lb (71 N·m) to 670 in-lb (76 N·m)
0.5625-18	946 in-lb (107 N·m) to 1004 in-lb (113 N·m)	1116 in-lb (126 N·m) to 1185 in-lb (134 N·m)	786 in-lb (89 N·m) to 834 in-lb (94 N·m)	892 in-lb (101 N·m) to 948 in-lb (107 N·m)
0.6250-18	1261 in-lb (142 N·m) to 1339 in-lb (151 N·m)	1455 in-lb (164 N·m) to 1545 in-lb (175 N·m)	1067 in-lb (121 N·m) to 1133 in-lb (128 N·m)	1164 in-lb (132 N·m) to 1236 in-lb (140 N·m)
0.7500-16	2571 in-lb (290 N·m) to 2730 in-lb (308 N·m)	2910 in-lb (329 N·m) to 3090 in-lb (349 N·m)	1867 in-lb (211 N·m) to 1983 in-lb (224 N·m)	2086 in-lb (236 N·m) to 2215 in-lb (250 N·m)
0.8750-14	3395 in-lb (384 N·m) to 3605 in-lb (407 N·m)	4365 in-lb (493 N·m) to 4635 in-lb (524 N·m)	2910 in-lb (329 N·m) to 3090 in-lb (349 N·m)	3298 in-lb (373 N·m) to 3502 in-lb (396 N·m)
1.0000-12 or 1.0000-14	5432 in-lb (614 N·m) to 5768 in-lb (652 N·m)	7275 in-lb (822 N·m) to 7725 in-lb (873 N·m)	4414 in-lb (499 N·m) to 4687 in-lb (530 N·m)	5335 in-lb (603 N·m) to 5665 in-lb (640 N·m)
1.1250-12	6790 in-lb (767 N·m) to 7210 in-lb (815 N·m)	8730 in-lb (986 N·m) to 9270 in-lb (1047 N·m)	5626 in-lb (636 N·m) to 5974 in-lb (675 N·m)	6499 in-lb (734 N·m) to 6901 in-lb (780 N·m)
1.2500-12	10,670 in-lb (1206 N·m) to 11,330 in-lb (1280 N·m)	12,610 in-lb (1425 N·m) to 13,390 in-lb (1513 N·m)	8342 in-lb (943 N·m) to 8858 in-lb (1001 N·m)	9409 in-lb (1063 N·m) to 9991 in-lb (1129 N·m)

\*[1] Use the thread diameter of the nut to find the applicable torque value. Do not use the nominal fastener diameter.

\*[2] No BZ, BZP, or DD material codes are covered for the NAS220-NAS221.

**Table 206/20-50-11-993-807 BACB31U, BACB31V**

FASTENER CLASS	160 KSI				95 KSI	
FASTENER PART NUMBER OR STYLE	BACB31U				BACB31V	
NOMINAL THREAD SIZE	DRY FASTENER		LUBED FASTENER		DRY FASTENER	LUBED FASTENER
	TURN THE NUT AND NO FAY SEAL	TURN THE FASTENER HEAD AND/OR FAY SEAL	TURN THE NUT AND NO FAY SEAL	TURN THE FASTENER HEAD AND/OR FAY SEAL	TURN THE NUT OR FASTENER HEAD	TURN THE NUT OR FASTENER HEAD
					FAY SEAL OR NO FAY SEAL	
0.1900-32	29 in-lb (3 N·m) to 31 in-lb (4 N·m)	29 in-lb (3 N·m) to 31 in-lb (4 N·m)	29 in-lb (3 N·m) to 31 in-lb (4 N·m)	29 in-lb (3 N·m) to 31 in-lb (4 N·m)	29 in-lb (3 N·m) to 31 in-lb (4 N·m)	29 in-lb (3 N·m) to 31 in-lb (4 N·m)



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**Table 206/20-50-11-993-807 BACB31U, BACB31V (Continued)**

FASTENER CLASS	160 KSI				95 KSI	
0.2500-28	107 in-lb (12 N·m) to 113 in-lb (13 N·m)	121 in-lb (14 N·m) to 129 in-lb (15 N·m)	63 in-lb (7 N·m) to 67 in-lb (8 N·m)	73 in-lb (8 N·m) to 77 in-lb (9 N·m)	39 in-lb (4 N·m) to 41 in-lb (5 N·m)	29 in-lb (3 N·m) to 31 in-lb (4 N·m)
0.3125-24	204 in-lb (23 N·m) to 216 in-lb (24 N·m)	243 in-lb (27 N·m) to 258 in-lb (29 N·m)	107 in-lb (12 N·m) to 113 in-lb (13 N·m)	121 in-lb (14 N·m) to 129 in-lb (15 N·m)	—	—
0.3750-24	388 in-lb (44 N·m) to 412 in-lb (47 N·m)	485 in-lb (55 N·m) to 515 in-lb (58 N·m)	170 in-lb (19 N·m) to 180 in-lb (20 N·m)	243 in-lb (27 N·m) to 258 in-lb (29 N·m)	—	—

**Table 207/20-50-11-993-808 160 KSI CASTELLATED NUTS**

NUT CLASS	160 KSI			
NUT PART NUMBER OR STYLE	BACN10JD7-BACN10JD20 ONLY			
NOMINAL THREAD SIZE	DRY FASTENER		LUBED FASTENER	
	TURN THE NUT AND NO FAY SEAL <sup>*[1]</sup>	TURN THE FASTENER HEAD AND/OR FAY SEAL <sup>*[1]</sup>	TURN THE NUT AND NO FAY SEAL <sup>*[1]</sup>	TURN THE FASTENER HEAD AND/OR FAY SEAL <sup>*[1]</sup>
0.4375-20	360 in-lb (41 N·m) to 690 in-lb (78 N·m)	620 in-lb (70 N·m) to 760 in-lb (86 N·m)	260 in-lb (29 N·m) to 425 in-lb (48 N·m)	383 in-lb (43 N·m) to 468 in-lb (53 N·m)
0.5000-20	630 in-lb (71 N·m) to 1070 in-lb (121 N·m)	963 in-lb (109 N·m) 1170 in-lb (132 N·m)	440 in-lb (50 N·m) to 650 in-lb (73 N·m)	585 in-lb (66 N·m) to 715 in-lb (81 N·m)
0.5625-18	1000 in-lb (113 N·m) to 1470 in-lb (166 N·m)	1320 in-lb (149 N·m) to 1610 in-lb (182 N·m)	700 in-lb (79 N·m) to 920 in-lb (104 N·m)	828 in-lb (94 N·m) to 1010 in-lb (114 N·m)
0.6250-18	1400 in-lb (158 N·m) to 1900 in-lb (215 N·m)	1710 in-lb (193 N·m) to 2090 in-lb (236 N·m)	1000 in-lb (113 N·m) to 1200 in-lb (136 N·m)	1080 in-lb (122 N·m) to 1320 in-lb (149 N·m)
0.7500-16	2400 in-lb (271 N·m) to 3500 in-lb (395 N·m)	3150 in-lb (356 N·m) to 3850 in-lb (435 N·m)	1700 in-lb (192 N·m) to 2150 in-lb (243 N·m)	1930 in-lb (218 N·m) to 2360 in-lb (267 N·m)
0.8750-14	3700 in-lb (418 N·m) to 5500 in-lb (621 N·m)	4950 in-lb (559 N·m) to 6050 in-lb (684 N·m)	2600 in-lb (294 N·m) to 3400 in-lb (384 N·m)	3060 in-lb (346 N·m) to 3740 in-lb (423 N·m)
1.0000-12 or 1.0000-14	5100 in-lb (576 N·m) to 8900 in-lb (1006 N·m)	8010 in-lb (905 N·m) to 9790 in-lb (1106 N·m)	3600 in-lb (407 N·m) to 5500 in-lb (621 N·m)	4950 in-lb (559 N·m) to 6050 in-lb (684 N·m)
1.1250-12	6900 in-lb (780 N·m) to 10,700 in-lb (1209 N·m)	9630 in-lb (1088 N·m) to 11,700 in-lb (1322 N·m)	4900 in-lb (554 N·m) to 6700 in-lb (757 N·m)	6030 in-lb (681 N·m) to 7370 in-lb (833 N·m)

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**Table 207/20-50-11-993-808 160 KSI CASTELLATED NUTS (Continued)**

NUT CLASS	<b>160 KSI</b>			
1.2500-12	11,500 in-lb (1299 N·m) to 15,700 in-lb (1774 N·m)	14,100 in-lb (1593 N·m) to 17,200 in-lb (1943 N·m)	7500 in-lb (847 N·m) to 9700 in-lb (1096 N·m)	8730 in-lb (986 N·m) to 10,600 in-lb (1198 N·m)

\*[1] Change the fastener grip length or add washers to align the nut slot to the cotter pin hole in the specified torque range.

**Table 208/20-50-11-993-809 125 KSI - NUTS, NUT PLATES, CLIP NUTS, STANDOFFS, INSERTS IN METAL, TAPPED HOLES**

NUT CLASS	<b>125 KSI</b>	
NUT PART NUMBER OR STYLE	AS3479, AS3481, BACN10DW, BACN10DY, BACN10DZ, BACN10FX, BACN10GH, BACN10JC04-BACN10JC7 ONLY, BACN10JN, BACN10JP, BACN10JQ, BACN10JR, BACN10JS, BACN10JT, BACN10JY, BACN10JZ, BACN10KA, BACN10KB, BACN10KE, BACN10KF, BACN10KH, BACN10KJ, BACN10MS, BACN10MX, BACN10NW, BACN10TL, BACN10TM, BACN10VR, BACN10YC, BACN10YD, BACN10YF, BACN10YK, BACN10YR, BACN11P, MS21042, MS21043, NAS1474, NAS679, NAS686, INSERTS IN METAL, TAPPED HOLES	
NOMINAL THREAD SIZE	DRY FASTENERS	
0.0860-56 or 0.0860-64	3 in-lb (0 N·m)	3 in-lb (0 N·m)
0.1120-40 or 0.1120-48	8 in-lb (1 N·m)	6 in-lb (1 N·m)
0.1380-32 or 0.1380-40	15 in-lb (2 N·m)	12 in-lb (1 N·m)
0.1640-32 or 0.1640-36	19 in-lb (2 N·m) to 21 in-lb (2 N·m)	15 in-lb (2 N·m)
0.1900-32	34 in-lb (4 N·m) to 36 in-lb (4 N·m)	24 in-lb (3 N·m) to 26 in-lb (3 N·m)
0.2500-28	78 in-lb (9 N·m) to 82 in-lb (9 N·m)	73 in-lb (8 N·m) to 77 in-lb (9 N·m)
0.3125-24	146 in-lb (16 N·m) to 155 in-lb (18 N·m)	121 in-lb (14 N·m) to 129 in-lb (15 N·m)
0.3750-24	233 in-lb (26 N·m) to 247 in-lb (28 N·m)	194 in-lb (22 N·m) to 206 in-lb (23 N·m)
0.4375-20	340 in-lb (38 N·m) to 361 in-lb (41 N·m)	291 in-lb (33 N·m) to 309 in-lb (35 N·m)
0.5000-20	766 in-lb (87 N·m) to 814 in-lb (92 N·m)	631 in-lb (71 N·m) to 670 in-lb (76 N·m)
0.5625-18	1116 in-lb (126 N·m) to 1185 in-lb (134 N·m)	892 in-lb (101 N·m) to 948 in-lb (107 N·m)
0.6250-18	1455 in-lb (164 N·m) to 1545 in-lb (175 N·m)	1164 in-lb (132 N·m) to 1236 in-lb (140 N·m)
0.7500-16	2910 in-lb (329 N·m) to 3090 in-lb (349 N·m)	2086 in-lb (236 N·m) to 2215 in-lb (250 N·m)
0.8750-14	4365 in-lb (493 N·m) to 4635 in-lb (524 N·m)	3298 in-lb (373 N·m) to 3502 in-lb (396 N·m)

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**Table 209/20-50-11-993-810 80-125 KSI CASTELLATED NUTS**

NUT CLASS	80 KSI		125 KSI			
NUT PART NUMBER	BACN10JD103-BACN10JD120 BACN11N103-BACN11N120 MS14145		BACN10JD3-BACN10JD6 ONLY BACN11N3-BACN11N20 ONLY MS14144			
NOMINAL THREAD SIZE	DRY OR LUBED FASTENERS		DRY FASTENERS		LUBED FASTENERS	
	TURN THE NUT AND NO FAY SEAL	TURN THE FASTENER HEAD AND/OR FAY SEAL	TURN THE NUT AND NO FAY SEAL	TURN THE FASTENER HEAD AND/OR FAY SEAL	TURN THE NUT AND NO FAY SEAL	TURN THE FASTENER HEAD AND/OR FAY SEAL
0.1900-32	18 in-lb (2 N·m) to 25 in-lb (3 N·m)	18 in-lb (2 N·m) to 25 in-lb (3 N·m)	25 in-lb (3 N·m) to 35 in-lb (4 N·m)	31 in-lb (4 N·m) to 38 in-lb (4 N·m)	25 in-lb (3 N·m) to 35 in-lb (4 N·m)	25 in-lb (3 N·m) to 35 in-lb (4 N·m)
0.2500-28	30 in-lb (3 N·m) 50 in-lb (6 N·m)	45 in-lb (5 N·m) to 55 in-lb (6 N·m)	50 in-lb (6 N·m) to 80 in-lb (9 N·m)	72 in-lb (8 N·m) to 88 in-lb (10 N·m)	50 in-lb (6 N·m) to 75 in-lb (8 N·m)	68 in-lb (8 N·m) to 83 in-lb (9 N·m)
0.3125-24	60 in-lb (7 N·m) to 90 in-lb (10 N·m)	80 in-lb (9 N·m) to 100 in-lb (11 N·m)	100 in-lb (11 N·m) to 150 in-lb (17 N·m)	135 in-lb (15 N·m) to 165 in-lb (19 N·m)	90 in-lb (10 N·m) to 125 in-lb (14 N·m)	113 in-lb (13 N·m) to 137 in-lb (15 N·m)
0.3750-24	95 in-lb (11 N·m) to 160 in-lb (18 N·m)	144 in-lb (16 N·m) to 176 in-lb (20 N·m)	160 in-lb (18 N·m) to 240 in-lb (27 N·m)	216 in-lb (24 N·m) to 264 in-lb (30 N·m)	150 in-lb (17 N·m) to 200 in-lb (23 N·m)	180 in-lb (20 N·m) to 220 in-lb (25 N·m)
0.4375-20	220 in-lb (25 N·m) to 280 in-lb (32 N·m)	252 in-lb (28 N·m) to 308 in-lb (35 N·m)	250 in-lb (28 N·m) to 350 in-lb (40 N·m)	315 in-lb (36 N·m) to 385 in-lb (43 N·m)	240 in-lb (27 N·m) to 300 in-lb (34 N·m)	270 in-lb (31 N·m) to 330 in-lb (37 N·m)
0.5000-20	290 in-lb (33 N·m) to 510 in-lb (58 N·m)	459 in-lb (52 N·m) to 561 in-lb (63 N·m)	480 in-lb (54 N·m) to 790 in-lb (89 N·m)	710 in-lb (80 N·m) to 870 in-lb (98 N·m)	440 in-lb (50 N·m) to 650 in-lb (73 N·m)	585 in-lb (66 N·m) to 715 in-lb (81 N·m)
0.5625-18	480 in-lb (54 N·m) to 850 in-lb (96 N·m)	765 in-lb (86 N·m) to 935 in-lb (106 N·m)	800 in-lb (90 N·m) to 1150 in-lb (130 N·m)	1035 in-lb (117 N·m) to 1265 in-lb (143 N·m)	700 in-lb (79 N·m) to 920 in-lb (104 N·m)	828 in-lb (94 N·m) to 1010 in-lb (114 N·m)
0.6250-18	660 in-lb (75 N·m) to 980 in-lb (111 N·m)	882 in-lb (100 N·m) to 1080 in-lb (122 N·m)	1100 in-lb (124 N·m) to 1500 in-lb (169 N·m)	1350 in-lb (153 N·m) to 1650 in-lb (186 N·m)	1000 in-lb (113 N·m) to 1200 in-lb (136 N·m)	1080 in-lb (122 N·m) to 1320 in-lb (149 N·m)
0.7500-16	1300 in-lb (147 N·m) to 2000 in-lb (226 N·m)	1800 in-lb (203 N·m) to 2200 in-lb (249 N·m)	2300 in-lb (260 N·m) to 3000 in-lb (339 N·m)	2700 in-lb (305 N·m) to 3300 in-lb (373 N·m)	1700 in-lb (192 N·m) to 2150 in-lb (243 N·m)	1940 in-lb (219 N·m) to 2360 in-lb (267 N·m)

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**Table 209/20-50-11-993-810 80-125 KSI CASTELLATED NUTS (Continued)**

NUT CLASS	80 KSI		125 KSI			
0.8750-14	1500 in-lb (169 N·m) to 3300 in-lb (373 N·m)	2970 in-lb (336 N·m) to 3630 in-lb (410 N·m)	2500 in-lb (282 N·m) to 4500 in-lb (508 N·m)	4050 in-lb (458 N·m) to 4950 in-lb (559 N·m)	2600 in-lb (294 N·m) to 3400 in-lb (384 N·m)	3060 in-lb (346 N·m) to 3740 in-lb (423 N·m)
1.0000-12 or 1.0000-14	2200 in-lb (249 N·m) to 5300 in-lb (599 N·m)	4770 in-lb (539 N·m) to 5830 in-lb (659 N·m)	3700 in-lb (418 N·m) to 7500 in-lb (847 N·m)	6750 in-lb (763 N·m) to 8250 in-lb (932 N·m)	3600 in-lb (407 N·m) to 5500 in-lb (621 N·m)	4950 in-lb (559 N·m) to 6050 in-lb (684 N·m)
1.1250-12	3000 in-lb (339 N·m) to 6200 in-lb (701 N·m)	5580 in-lb (630 N·m) to 6820 in-lb (771 N·m)	5000 in-lb (565 N·m) to 9000 in-lb (1017 N·m)	8100 in-lb (915 N·m) to 9900 in-lb (1119 N·m)	4900 in-lb (554 N·m) to 6700 in-lb (757 N·m)	6080 in-lb (687 N·m) to 7370 in-lb (833 N·m)
1.2500-12	5400 in-lb (610 N·m) to 8600 in-lb (972 N·m)	7740 in-lb (874 N·m) to 9460 in-lb (1069 N·m)	9000 in-lb (1017 N·m) to 13,000 in-lb (1469 N·m)	11,700 in-lb (1322 N·m) to 14,300 in-lb (1616 N·m)	7500 in-lb (847 N·m) to 9700 in-lb (1096 N·m)	8730 in-lb (986 N·m) to 10,600 in-lb (1198 N·m)

**Table 210/20-50-11-993-811 REDUCED SHEAR HEAD FASTENERS**

FASTENER CLASS	95 KSI	
FASTENER PART NUMBER	BACB30DP, BACB30EL, BACB30FB, BACB30LL, BACB30NU, BACB30RF, BACB30UR, BACB30UW, BACB30VF, BACB30XD, BACB30YE, BACB30ZE, BACB31A, BACS12HB, BACS12HE, BACS12JC, NAS1992, NAS1993-NAS2000, NAS8704-NAS8716	
NUT PART NUMBER OR STYLE	ALL NON-CASTELLATED NUTS, NUT PLATES, CLIP NUTS, METALLIC STANDOFFS, INSERTS, TAPPED HOLES	ALL CASTELLATED NUTS
NOMINAL THREAD SIZE		DRY AND CETYL ALCOHOL LUBED FASTENERS <sup>*[1]*[2]</sup>
TURN THE HEAD OR THE NUT -FAY SEAL OR NO FAY SEAL		
0.1640-32 or 0.1640-36	15 in-lb (2 N·m)	10 in-lb (1 N·m) to 18 in-lb (2 N·m)
0.1900-32	29 in-lb (3 N·m) to 31 in-lb (4 N·m)	18 in-lb (2 N·m) to 25 in-lb (3 N·m)
0.2500-28	39 in-lb (4 N·m) to 41 in-lb (5 N·m)	30 in-lb (3 N·m) to 40 in-lb (5 N·m)
0.3125-24	92 in-lb (10 N·m) to 98 in-lb (11 N·m)	90 in-lb (10 N·m) to 100 in-lb (11 N·m)
0.3750-24	97 in-lb (11 N·m) to 103 in-lb (12 N·m)	95 in-lb (11 N·m) to 105 in-lb (12 N·m)
0.4375-20	155 in-lb (18 N·m) to 165 in-lb (19 N·m)	150 in-lb (17 N·m) to 170 in-lb (19 N·m)
0.5000-20	223 in-lb (25 N·m) to 237 in-lb (27 N·m)	220 in-lb (25 N·m) to 245 in-lb (28 N·m)
0.5625-18	301 in-lb (34 N·m) to 319 in-lb (36 N·m)	290 in-lb (33 N·m) 325 in-lb (37 N·m)
0.6250-18	407 in-lb (46 N·m) to 433 in-lb (49 N·m)	395 in-lb (45 N·m) to 435 in-lb (49 N·m)
0.7500-16	660 in-lb (75 N·m) to 700 in-lb (79 N·m)	645 in-lb (73 N·m) to 720 in-lb (81 N·m)

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**Table 210/20-50-11-993-811 REDUCED SHEAR HEAD FASTENERS (Continued)**

FASTENER CLASS	95 KSI	
0.8750-14	1067 in-lb (121 N·m) to 1133 in-lb (128 N·m)	1040 in-lb (118 N·m) to 1150 in-lb (130 N·m)
1.0000-12 or 1.0000-14	1601 in-lb (181 N·m) to 1700 in-lb (192 N·m)	1560 in-lb (176 N·m) to 1730 in-lb (195 N·m)

\*[1] This table only gives the torque value for dry fasteners or fasteners that are lubricated with cetyl alcohol. The applicable torque value must be specified in the AMM procedure for fasteners that are installed with other lubricants (including solid film lubricants).

\*[2] An 'S' in the part number code may indicate solid film lubricant.

**Table 211/20-50-11-993-812 60-80 KSI SCREWS AND NUTS, NYLON NUTS**

FASTENER CLASS	60-80 KSI		NYLON NUTS	
FASTENER PART NUMBER OR STYLE	BACS12BP()(all codes that contain 'C')() , BACS12BE(C), BACS12BF(C), BACS12BG(C), MS24693-C(), MS24693-S(), MS24694-C(), MS51957, MS51958		ALL FASTENERS	
NUT PART NUMBER OR STYLE	BACN10JC8-BACN10JC24 ONLY, BACN11BN, MS21245		BACN10YJ08, BACN10YJ3	
NOMINAL THREAD SIZE	DRY OR LUBED FASTENER		DRY OR LUBED FASTENER	
	TURN THE NUT AND NO FAY SEAL	TURN THE FASTENER HEAD AND/OR FAY SEAL	TURN THE NUT AND NO FAY SEAL	TURN THE FASTENER HEAD OR FAY SEAL
0.0860-56 or 0.0860-64	3 in-lb (0 N·m)	3 in-lb (0 N·m)	-	-
0.1120-40 or 0.1120-48	6 in-lb (1 N·m)	6 in-lb (1 N·m)	-	-
0.1380-32 or 0.1380-40	12 in-lb (1 N·m)	12 in-lb (1 N·m)	-	-
0.1640-32 or 0.1640-36	15 in-lb (2 N·m)	15 in-lb (2 N·m)	5 in-lb (1 N·m)	6 in-lb (1 N·m)
0.1900-32	19 in-lb (2 N·m) to 21 in-lb (2 N·m)	24 in-lb (3 N·m) to 26 in-lb (3 N·m)	7 in-lb (1 N·m)	8 in-lb (1 N·m)
0.2500-28	39 in-lb (4 N·m) to 41 in-lb (5 N·m)	49 in-lb (6 N·m) to 52 in-lb (6 N·m)	-	-
0.3125-24	78 in-lb (9 N·m) to 82 in-lb (9 N·m)	92 in-lb (10 N·m) to 98 in-lb (11 N·m)	-	-
0.3750-24	126 in-lb (14 N·m) to 134 in-lb (15 N·m)	155 in-lb (18 N·m) to 165 in-lb (19 N·m)	-	-
0.4375-20	243 in-lb (27 N·m) to 258 in-lb (29 N·m)	272 in-lb (31 N·m) to 288 in-lb (33 N·m)	-	-
0.5000-20	388 in-lb (44 N·m) to 412 in-lb (47 N·m)	495 in-lb (56 N·m) to 525 in-lb (59 N·m)	-	-

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**Table 211/20-50-11-993-812 60-80 KSI SCREWS AND NUTS, NYLON NUTS (Continued)**

FASTENER CLASS	60-80 KSI	NYLON NUTS
0.5625-18	650 in-lb (73 N·m) to 690 in-lb (78 N·m)	825 in-lb (93 N·m) to 876 in-lb (99 N·m)
0.6250-18	795 in-lb (90 N·m) to 845 in-lb (95 N·m)	951 in-lb (107 N·m) to 1009 in-lb (114 N·m)
0.7500-16	1601 in-lb (181 N·m) to 1700 in-lb (192 N·m)	1940 in-lb (219 N·m) to 2060 in-lb (233 N·m)
0.8750-14	2328 in-lb (263 N·m) to 2472 in-lb (279 N·m)	3201 in-lb (362 N·m) to 3399 in-lb (384 N·m)
1.0000-12 or 1.0000-14	3638 in-lb (411 N·m) to 3863 in-lb (436 N·m)	5141 in-lb (581 N·m) to 5459 in-lb (617 N·m)
1.1250-12	4462 in-lb (504 N·m) to 4738 in-lb (535 N·m)	6014 in-lb (679 N·m) to 6386 in-lb (722 N·m)
1.2500-12	6790 in-lb (767 N·m) to 7210 in-lb (815 N·m)	8342 in-lb (943 N·m) to 8858 in-lb (1001 N·m)
1.3750-12	7760 in-lb (877 N·m) to 8240 in-lb (931 N·m)	8730 in-lb (986 N·m) to 9270 in-lb (1047 N·m)
1.5000-12	10,670 in-lb (1206 N·m) to 11,330 in-lb (1280 N·m)	11,640 in-lb (1315 N·m) to 12,360 in-lb (1396 N·m)

**Table 212/20-50-11-993-813 STAKE SCREWS**

FASTENER CLASS	60-80 KSI	95-160 KSI
STAKE SCREW PART NUMBERS <sup>[1]</sup>	FCM(***)(*)CP(**); FH(***)(*)CP(**); PS(***)(*)CP(**); C(***)(*)CP(**); S(***)(*)CP(**); SFSW(***)(*)CP(**); PS(***)(*)CS(**); S10(***)(*)CP(**); SFSW(***)(*)CS(**); FHC(***)(*)CP(**)	CPS(***)(*)D(**); FCM(***)(*)D(**); FH(***)(*)D(**); PS(***)(*)D(**); S(***)(*)D(**); SFS(***)(*)D(**); SFSW(***)(*)D(**); WHS(***)(*)TPS(**)
NOMINAL THREAD SIZE	STAKE DASH NUMBER	TORQUE TOOL SETPOINT <sup>[2]</sup>
		DRY SCREWS LUBED SCREWS DRY SCREWS LUBED SCREWS
0.0860-56 or 0.0860-65	2C	3 in-lb (0 N·m) 3 in-lb (0 N·m) 3 in-lb (0 N·m) 3 in-lb (0 N·m)
0.1120-40 or 0.1120-48	4C	6 in-lb (1 N·m) 5 in-lb (1 N·m) 8 in-lb (1 N·m) 6 in-lb (1 N·m)
0.1380-32 or 0.1380-40	6C	12 in-lb (1 N·m) 8 in-lb (1 N·m) 15 in-lb (2 N·m) 12 in-lb (1 N·m)

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**Table 212/20-50-11-993-813 STAKE SCREWS (Continued)**

FASTENER CLASS		60-80 KSI		95-160 KSI	
0.1640-32 or 0.1640-36	8C	16 in-lb (2 N·m)	12 in-lb (1 N·m)	19 in-lb (2 N·m) to 21 in-lb (2 N·m)	15 in-lb (2 N·m)
0.1900-32	10C	19 in-lb (2 N·m) to 21 in-lb (2 N·m)	15 in-lb (2 N·m)	34 in-lb (4 N·m) to 36 in-lb (4 N·m)	24 in-lb (3 N·m) to 26 in-lb (3 N·m)

\*[1] (\*\*\*) = screw diameter; (\*) = length (dash number); (\*\*) = color code (glossiness and color).

\*[2] Use the torque values for dry screws unless the AMM procedure specifies additional lubricant.

**Table 213/20-50-11-993-814 JAM NUTS**

NUT STYLE	LOCKWIRE HOLES	NO LOCKWIRE HOLES
NUT PART NUMBER	BACN11U(), NAS1423, NAS509	AN315, AN316, BACN11U()N, MS35649, MS35650, MS3591
NOMINAL THREAD SIZE		
0.1900-32	15 in-lb (2 N·m)	19 in-lb (2 N·m) to 21 in-lb (2 N·m)
0.2500-28	19 in-lb (2 N·m) to 21 in-lb (2 N·m)	24 in-lb (3 N·m) to 26 in-lb (3 N·m)
0.3125-24	34 in-lb (4 N·m) to 36 in-lb (4 N·m)	49 in-lb (6 N·m) to 52 in-lb (6 N·m)
0.3750-24	44 in-lb (5 N·m) to 46 in-lb (5 N·m)	63 in-lb (7 N·m) to 67 in-lb (8 N·m)
0.4375-20	63 in-lb (7 N·m) to 67 in-lb (8 N·m)	97 in-lb (11 N·m) to 103 in-lb (12 N·m)
0.5000-20	78 in-lb (9 N·m) to 82 in-lb (9 N·m)	112 in-lb (13 N·m) to 118 in-lb (13 N·m)
0.5625-18	87 in-lb (10 N·m) to 93 in-lb (11 N·m)	131 in-lb (15 N·m) to 139 in-lb (16 N·m)
0.6250-18	97 in-lb (11 N·m) to 103 in-lb (12 N·m)	146 in-lb (16 N·m) to 155 in-lb (18 N·m)
0.7500-16	155 in-lb (18 N·m) to 165 in-lb (19 N·m)	233 in-lb (26 N·m) to 247 in-lb (28 N·m)
0.8750-14	213 in-lb (24 N·m) to 227 in-lb (26 N·m)	320 in-lb (36 N·m) to 340 in-lb (38 N·m)
1.0000-12 or 1.0000-14	272 in-lb (31 N·m) to 288 in-lb (33 N·m)	407 in-lb (46 N·m) to 433 in-lb (49 N·m)
1.1250-12	359 in-lb (41 N·m) to 381 in-lb (43 N·m)	534 in-lb (60 N·m) to 567 in-lb (64 N·m)
1.2500-12	437 in-lb (49 N·m) to 464 in-lb (52 N·m)	655 in-lb (74 N·m) to 695 in-lb (79 N·m)

**Table 214/20-50-11-993-815 COARSE THREAD FASTENERS AND NUTS**

FASTENER PART NUMBER	ALL COARSE THREAD FASTENERS (DESIGNATED BY UNC OR UNJC)		
NUT PART NUMBER OR STYLE	ALL COARSE THREAD NUTS, INSERTS, AND TAPPED HOLES (DESIGNATED BY UNC OR UNJC)		
NOMINAL THREAD SIZE	DRY FASTENERS ONLY		
	TURN THE NUT AND NO FAY SEAL	TURN THE FASTENER HEAD AND/OR FAY SEAL	MAXIMUM TORQUE ALLOWED TO ALIGN THE COTTER PIN AND THE HOLE
0.1900-24	14 in-lb (2 N·m)	15 in-lb (2 N·m)	20 in-lb (2 N·m)
0.2500-20	29 in-lb (3 N·m) to 31 in-lb (4 N·m)	29 in-lb (3 N·m) to 31 in-lb (4 N·m)	45 in-lb (5 N·m)
0.3125-18	49 in-lb (6 N·m) to 52 in-lb (6 N·m)	53 in-lb (6 N·m) to 57 in-lb (6 N·m)	100 in-lb (11 N·m)

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**Table 214/20-50-11-993-815 COARSE THREAD FASTENERS AND NUTS (Continued)**

FASTENER PART NUMBER	ALL COARSE THREAD FASTENERS (DESIGNATED BY UNC OR UNJC)		
0.3750-16	97 in-lb (11 N·m) to 103 in-lb (12 N·m)	107 in-lb (12 N·m) to 113 in-lb (13 N·m)	170 in-lb (19 N·m)
0.4375-14	146 in-lb (16 N·m) to 155 in-lb (18 N·m)	155 in-lb (18 N·m) to 165 in-lb (19 N·m)	280 in-lb (32 N·m)
0.5000-13	262 in-lb (30 N·m) to 278 in-lb (31 N·m)	281 in-lb (32 N·m) to 299 in-lb (34 N·m)	520 in-lb (59 N·m)
0.5625-12	349 in-lb (39 N·m) to 371 in-lb (42 N·m)	407 in-lb (46 N·m) to 433 in-lb (49 N·m)	650 in-lb (73 N·m)
0.6250-11	466 in-lb (53 N·m) to 494 in-lb (56 N·m)	524 in-lb (59 N·m) to 556 in-lb (63 N·m)	900 in-lb (102 N·m)
0.7500-10	800 in-lb (90 N·m) to 850 in-lb (96 N·m)	907 in-lb (102 N·m) to 963 in-lb (109 N·m)	1500 in-lb (169 N·m)
0.8750-9	1499 in-lb (169 N·m) to 1591 in-lb (180 N·m)	1746 in-lb (197 N·m) to 1854 in-lb (209 N·m)	2700 in-lb (305 N·m)
1.0000-8	2566 in-lb (290 N·m) to 2724 in-lb (308 N·m)	2910 in-lb (329 N·m) to 3090 in-lb (349 N·m)	4500 in-lb (508 N·m)
1.1250-7	3541 in-lb (400 N·m) to 3760 in-lb (425 N·m)	3880 in-lb (438 N·m) to 4120 in-lb (465 N·m)	7200 in-lb (813 N·m)
1.2500-7	4360 in-lb (493 N·m) to 4630 in-lb (523 N·m)	4850 in-lb (548 N·m) to 5150 in-lb (582 N·m)	10,000 in-lb (1130 N·m)

(c) Self-Locking Nuts, Table 215, Table 216.

**Table 215/20-50-11-993-816 Locking Torques for Self-Locking Nuts**

SIZE	TORQUE	
	MINIMUM BREAKAWAY	MAXIMUM LOCKING
0.1120-40	0.5 in-lb (0.1 N·m)	10.0 in-lb (1.1 N·m)
0.1380-32	1.0 in-lb (0.1 N·m)	20.0 in-lb (2.3 N·m)
0.1640-32	1.5 in-lb (0.2 N·m)	30.0 in-lb (3.4 N·m)
0.1900-32	2.0 in-lb (0.2 N·m)	36.0 in-lb (4.1 N·m)
0.2500-28	3.5 in-lb (0.4 N·m)	60.0 in-lb (6.8 N·m)
0.3125-24	6.5 in-lb (0.7 N·m)	120.0 in-lb (13.6 N·m)
0.3750-24	9.5 in-lb (1.1 N·m)	160.0 in-lb (18.1 N·m)
0.4375-20	14.0 in-lb (1.6 N·m)	200.0 in-lb (22.6 N·m)
0.5000-20	18.0 in-lb (2.0 N·m)	300.0 in-lb (33.9 N·m)
0.5625-18	24.0 in-lb (2.7 N·m)	400.0 in-lb (45.2 N·m)
0.6250-18	32.0 in-lb (3.6 N·m)	600.0 in-lb (67.8 N·m)
0.7500-16	50.0 in-lb (5.6 N·m)	800.0 in-lb (90.4 N·m)
0.8750-14	70.0 in-lb (7.9 N·m)	1200.0 in-lb (135.6 N·m)

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**Table 215/20-50-11-993-816 Locking Torques for Self-Locking Nuts (Continued)**

SIZE	TORQUE	
1.0000-14	90.0 in-lb (10.2 N·m)	1600.0 in-lb (180.8 N·m)
1.0000-12	90.0 in-lb (10.2 N·m)	1600.0 in-lb (180.8 N·m)
1.1250-12	117.0 in-lb (13.2 N·m)	1800.0 in-lb (203.4 N·m)
1.2500-12	143.0 in-lb (16.2 N·m)	2000.0 in-lb (226.0 N·m)
1.3750-12	165.0 in-lb (18.6 N·m)	2200.0 in-lb (248.6 N·m)
1.5000-12	195.0 in-lb (22.0 N·m)	2500.0 in-lb (282.5 N·m)
1.7500-12	245.0 in-lb (27.7 N·m)	2900.0 in-lb (327.7 N·m)
2.0000-12	300.0 in-lb (33.9 N·m)	3400.0 in-lb (384.1 N·m)

**Table 216/20-50-11-993-817 Locking Torques for Self-Locking Nuts (Coarse Threads)**

SIZE	TORQUE	
	MINIMUM BREAKAWAY	MAXIMUM LOCKING
0.086-56	0.2 in-lb (0.0 N·m)	2.0 in-lb (0.2 N·m)
0.112-40	0.5 in-lb (0.1 N·m)	5 in-lb (1 N·m)
0.138-32	1.0 in-lb (0.1 N·m)	10 in-lb (1 N·m)
0.164-32	1.5 in-lb (0.2 N·m)	15 in-lb (2 N·m)
0.190-24	2.0 in-lb (0.2 N·m)	18 in-lb (2 N·m)
0.250-20	4.5 in-lb (0.5 N·m)	30 in-lb (3 N·m)
0.312-18	7.5 in-lb (0.8 N·m)	60 in-lb (7 N·m)
0.375-16	12.0 in-lb (1.4 N·m)	80 in-lb (9 N·m)
0.437-14	16.5 in-lb (1.9 N·m)	100 in-lb (11 N·m)
0.500-13	24.0 in-lb (2.7 N·m)	150 in-lb (17 N·m)
0.562-12	30.0 in-lb (3.4 N·m)	200 in-lb (23 N·m)
0.625-11	40.0 in-lb (4.5 N·m)	300 in-lb (34 N·m)
0.750-10	60.0 in-lb (6.8 N·m)	400 in-lb (45 N·m)
0.875-9	82.0 in-lb (9.3 N·m)	600 in-lb (68 N·m)
1.000-8	110.0 in-lb (12.4 N·m)	800 in-lb (90 N·m)
1.125-7	137.0 in-lb (15.5 N·m)	900 in-lb (102 N·m)
1.250-7	165.0 in-lb (18.6 N·m)	1000 in-lb (113 N·m)
1.375-6	200.0 in-lb (22.6 N·m)	1200 in-lb (136 N·m)
1.500-6	230.0 in-lb (26.0 N·m)	1400 in-lb (158 N·m)
1.750-5	300.0 in-lb (33.9 N·m)	1800 in-lb (203 N·m)
2.000-4.5	360.0 in-lb (40.7 N·m)	2200 in-lb (249 N·m)
2.250-4.5	430.0 in-lb (48.6 N·m)	2600 in-lb (294 N·m)
2.500-4	500.0 in-lb (56.5 N·m)	3000 in-lb (339 N·m)

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- (d) Reduced-Head Bolts, Figure 202.
- (e) Rigid Tube Coupling Connections, Table 217.

**Table 217/20-50-11-993-818 Standard Torque Values for Rigid Tube Coupling Connectors**

TUBE OD (INCHES)	TORQUE VALUE			
	ALUMINUM ALLOY FITTINGS NAS591-NAS593		STAINLESS STEEL FITTINGS NAS594, NAS596, BACN10HX COUPLING	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
1	480 in-lb (54 N·m)	720 in-lb (81 N·m)	480 in-lb (54 N·m)	720 in-lb (81 N·m)
1-1/4	600 in-lb (68 N·m)	900 in-lb (102 N·m)	600 in-lb (68 N·m)	900 in-lb (102 N·m)
1-1/2	600 in-lb (68 N·m)	900 in-lb (102 N·m)	600 in-lb (68 N·m)	900 in-lb (102 N·m)
2	900 in-lb (102 N·m)	1200 in-lb (136 N·m)	900 in-lb (102 N·m)	1200 in-lb (136 N·m)
2-1/2	1500 in-lb (169 N·m)	1800 in-lb (203 N·m)	1800 in-lb (203 N·m)	2100 in-lb (237 N·m)
3	--	--	1800 in-lb (203 N·m)	2100 in-lb (237 N·m)
4	--	--	2400 in-lb (271 N·m)	2700 in-lb (305 N·m)

- (f) Pipe Thread Fittings, Table 218.

**Table 218/20-50-11-993-819 Standard Torque Values for Pipe Thread Fittings**

MATING PIPE FITTING MATERIAL COMBINATIONS	SIZE (INCHES)	TORQUE	
		MINIMUM	MAXIMUM
All Except CRES-to-CRES	1/8	100 in-lb (11 N·m)	175 in-lb (20 N·m)
	1/4	150 in-lb (17 N·m)	300 in-lb (34 N·m)
	3/8	225 in-lb (25 N·m)	450 in-lb (51 N·m)
CRES-to-CRES	1/8	100 in-lb (11 N·m)	150 in-lb (17 N·m)
	1/4	100 in-lb (11 N·m)	275 in-lb (31 N·m)
	3/8	100 in-lb (11 N·m)	400 in-lb (45 N·m)
	1/2	100 in-lb (11 N·m)	500 in-lb (56 N·m)
	3/4	150 in-lb (17 N·m)	600 in-lb (68 N·m)
	1	200 in-lb (23 N·m)	800 in-lb (90 N·m)

- (g) Low Pressure and Return Line Fittings, Table 219.

**Table 219/20-50-11-993-822 Standard Torque Values for Low Pressure and Return Line Fittings**

TUBE SIZE	FLARED AND FLARELESS COMPONENTS TORQUE
	TUBE MATERIAL-END CONFIGURATION

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Table 219/20-50-11-993-822 Standard Torque Values for Low Pressure and Return Line Fittings  
(Continued)

OUTER DIAMETER (INCHES)	SIZE	FLARED AND FLARELESS COMPONENTS TORQUE	
		ALUMINUM FLARED TUBE ENDS ALUMINUM TUBE ENDS WITH BACS13BD AND BACS13BX SWAGED SLEEVES FLARELESS TYPE HOSE END FITTINGS WITH ALUMINUM INSERTS TORQUE	FLARED HOSE END FITTINGS WITH ALUMINUM INSERTS
3/16	03	80 in-lb (9 N·m)	35 in-lb (4 N·m)
1/4	04	110 in-lb (12 N·m)	65 in-lb (7 N·m)
5/16	05	140 in-lb (16 N·m)	90 in-lb (10 N·m)
3/8	06	170 in-lb (19 N·m)	130 in-lb (15 N·m)
1/2	08	280 in-lb (32 N·m)	260 in-lb (29 N·m)
5/8	10	360 in-lb (41 N·m)	360 in-lb (41 N·m)
3/4	12	450 in-lb (51 N·m)	500 in-lb (56 N·m)
7/8	14	--	--
1	16	750 in-lb (85 N·m)	700 in-lb (79 N·m)
1-1/4	20	900 in-lb (102 N·m)	900 in-lb (102 N·m)
1-1/2	24	900 in-lb (102 N·m)	900 in-lb (102 N·m)
1-3/4	28	--	--
2	32	--	2000 in-lb (226 N·m)

(h) Flared, Flareless, and Short Flareless Fittings, Table 220, Table 221, Table 222, Table 223.

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**Table 220/20-50-11-993-820 Installation Torques for Flared, Flareless, and Short Flareless Fittings with Lubricated Threads Used on Aluminum and Annealed CRES Tube In-Line Fittings and Hose Ends**

TUBE SIZE; FITTING END SIZE, HOSE END SIZE <sup>[1]</sup>		TUBE MATERIAL/END CONFIGURATION <sup>[2][3][4][5][6][7]</sup>						
NOMINAL TUBE DIAMETER (INCH)	SIZE	TUBING ENDS; FITTING ENDS; HOSE ENDS <sup>*[8]*[9]*[10]</sup>	BACS13AP BITE TYPE SLEEVES WITH 6061T ALUMINUM MIL-T-7081 OR ANNEALED CRES (MIL-T-8504, MIL-T-8606, MIL-T-8808) TUBE					
		TORQUE (IN-LB ± 5%)	MINIMUM TUBE WALL THICKNESS ALUMINUM AND ANNEALED CRES (INCH)	TORQUE (IN-LB ± 5%)	SPECIAL THIN WALL ANNEALED CRES WALL THICKNESS (INCH)	TORQUE (IN-LB ± 5%)	SPECIAL HEAVY WALL ANNEALED CRES WALL THICKNESS (INCH)	TORQUE (IN-LB ± 5%)
1/8 (0.125)	02	--	--	--	--	--	--	--
3/16 (0.188)	03	80 ±4 in-lb (9 ±0 N·m)	0.028	80 ±4 in-lb (9 ±0 N·m)	--	--	--	--
1/4 (0.250)	04	110 ±6 in-lb (12 ±1 N·m)	0.028	110 ±6 in-lb (12 ±1 N·m)	--	--	--	--
5/16 (0.313)	05	140 ±7 in-lb (16 ±1 N·m)	0.028	140 ±7 in-lb (16 ±1 N·m)	--	--	--	--
3/8 (0.375)	06	170 ±9 in-lb (19 ±1 N·m)	0.028	170 ±9 in-lb (19 ±1 N·m)	0.020	160 ±8 in-lb (18 ±1 N·m)	--	--
1/2 (0.500)	08	280 ±14 in-lb (32 ±2 N·m)	0.028	280 ±14 in-lb (32 ±2 N·m)	--	--	0.035	550 ±28 in-lb (62 ±3 N·m)
5/8 (0.625)	10	360 ±18 in-lb (41 ±2 N·m)	0.028	360 ±18 in-lb (41 ±2 N·m)	0.020	250 ±13 in-lb (28 ±2 N·m)	0.049	450 ±23 in-lb (51 ±3 N·m)
							0.035	450 ±23 in-lb (51 ±3 N·m)
3/4 (0.750)	12	450 ±23 in-lb (51 ±3 N·m)	0.028	450 ±23 in-lb (51 ±3 N·m)	0.020	325 ±16 in-lb (37 ±2 N·m)	--	--
7/8 (0.875)	14	--	--	--	--	--	--	--
1 (1.000)	16	750 ±38 in-lb (85 ±5 N·m)	0.035	750 ±38 in-lb (85 ±5 N·m)	--	--	--	--
1-1/4 (1.250)	20	900 ±45 in-lb (102 ±5 N·m)	--	--	--	--	--	--
1-1/2 (1.500)	24	900 ±45 in-lb (102 ±5 N·m)	--	--	--	--	--	--

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**Table 220/20-50-11-993-820 Installation Torques for Flared, Flareless, and Short Flareless Fittings with Lubricated Threads Used on Aluminum and Annealed CRES Tube In-Line Fittings and Hose Ends (Continued)**

TUBE SIZE; FITTING END SIZE, HOSE END SIZE <sup>[1]</sup>		TUBE MATERIAL/END CONFIGURATION <sup>*[2]*[3]*[4]*[5]*[6]*[7]</sup>						
NOMINAL TUBE DIAMETER (INCH)	SIZE	TUBING ENDS; FITTING ENDS; HOSE ENDS <sup>*[8]*[9]*[10]</sup>	BACS13AP BITE TYPE SLEEVES WITH 6061T ALUMINUM MIL-T-7081 OR ANNEALED CRES (MIL-T-8504, MIL-T-8606, MIL-T-8808) TUBE					
		TORQUE (IN-LB ± 5%)	MINIMUM TUBE WALL THICKNESS ALUMINUM AND ANNEALED CRES (INCH)	TORQUE (IN-LB ± 5%)	SPECIAL THIN WALL ANNEALED CRES WALL THICKNESS (INCH)	TORQUE (IN-LB ± 5%)	SPECIAL HEAVY WALL ANNEALED CRES WALL THICKNESS (INCH)	TORQUE (IN-LB ± 5%)
1-3/4 (1.750)	28	--	--	--	--	--	--	--
2 (2.000)	32	--	--	--	--	--	--	--

\*[1] For fittings and hoses with ends of more than one size, select the torque value for each end that matches its size. Compare the fitting or hose part number to the part standard to determine the part size and material.

NOTE: The end fitting size for standard BAC, AS and NAS fittings and hoses is determined by reference to the appropriate part standard. Table: "Standard End Fitting Size and Thread Size" (check the table for each model) may be used to determine the end fitting size for non-standard fittings and hoses that must be tightened in accordance with BAC5001.

\*[2] Controlled Tooling: ST 2599A, Torque Wrench for Tube Fittings or ST 2599B, Torque Wrench for Tube Components shall be used where possible to connect fittings. Equivalent micrometer style torque wrenches, adapters, and extensions are permitted only when the installation prohibits the use of the Controlled Tooling. When torque tool adapters or extensions are used, torque indicator reading correction factors may be required. Instructions for adapter/extension use and methods for obtaining the correction factor are given in BSS7083.

\*[3] Use aluminum fitting torque values for aluminum, steel, or titanium fittings installed in aluminum bosses.

\*[4] Use aluminum fitting torque values for aluminum jambnus installed on aluminum, titanium, or steel bulkhead fittings.

\*[5] Use steel fitting torque values for steel or titanium fittings installed in steel or titanium bosses.

\*[6] Use steel fitting torque values for steel or titanium jambnus installed on steel or titanium bulkhead fittings.

\*[7] The boss or bulkhead fitting size determines the torque value for reducer fittings.

\*[8] Aluminum flared tube ends, aluminum tube ends with BAC13BD and BAC13BX swaged sleeves, flareless type hose end fittings with aluminum inserts, aluminum swivel nuts and externally threaded ends on flareless elbow, tee and cross fittings, and flareless aluminum union fittings.

\*[9] Unless otherwise specified on the Engineering Drawing, tighten the following items to each other using the torque values on the table:

-Tube assemblies made with material specifications: 6061-T4 or -T6 aluminum tubing - MIL-T-7081, AMS-T-7081, AMS4081, AMS4083, AMS-WW-T-700/6 or BMS7-328;

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-Flareless tube assemblies made with annealed CRES tubing with material specifications: MIL-T-8504 (alloy 304), MIL-T-8606 (alloys 321 or 347), MIL-T-8808 (alloys 321 or 347), AMS556 (alloy 347), AMS5557 (alloy 321), or AMS5567 (alloy 304);

-Tube assemblies with aluminum coupling nuts;

-In-line fittings made of aluminum. In-line fittings such as tube-to-tube union, elbow, tee or cross fittings, adapter or reducer fittings, or in-line components with flareless ends such as BAC check valves that the Engineering Drawing requires shall be installed in accordance with BAC5001-10.

-Hoses made with flareless aluminum end fittings;

- \*[10] If an item on Table: "Installation Torques for Flared, Flareless, and Short Flareless Fittings with Lubricated Threads Used on Aluminum and Annealed CRES Tube In-Line Fittings and Hose Ends" is mated to an item on Table: "Installation Torques for Flared, Flareless, and Short Flareless Fittings with Lubricated Threads Used on CRES and Titanium Tube Fittings and Hose Ends", then tighten these mixed items using the torque values on Table: "Installation Torques for Flared, Flareless, and Short Flareless Fittings with Lubricated Threads Used on Aluminum and Annealed CRES Tube In-Line Fittings and Hose Ends", unless otherwise specified on the Engineering Drawing.

**Table 221/20-50-11-993-823 Installation Torques for Flared, Flareless, and Short Flareless Fittings with Lubricated Threads Used on CRES and Titanium Tube Fittings and Hose Ends**

TUBE SIZE; FITTING END SIZE; HOSE END SIZE <sup>[1]</sup>		TUBE MATERIAL/END CONFIGURATION * <sup>[2]</sup> * <sup>[3]</sup> * <sup>[4]</sup> * <sup>[5]</sup> * <sup>[6]</sup> * <sup>[7]</sup>				
NOMINAL TUBE DIAMETER (INCH)	SIZE	TUBING ENDS; FITTING ENDS; HOSE ENDS <sup>[8]</sup>	BACS13AP BITE TYPE SLEEVES WITH 1/8 HARD (MIL-T-6845, AMS-T-6842 OR AMS5566) CRES TUBE			
		TORQUE (IN-LB ±5%)	MINIMUM WALL THICKNESS (INCH)	TORQUE (IN-LB ±5%)	SPECIAL THIN-WALL TUBE WALL THICKNESS (INCH)	TORQUE (IN-LB ±5%)
1/8 (0.125)	02	--	--	--	--	--
3/16 (0.188)	03	100 ±5 in-lb (11 ±1 N·m)	0.016	100 ±5 in-lb (11 ±1 N·m)	--	--
1/4 (0.250)	04	140 ±7 in-lb (16 ±1 N·m)	0.020	140 ±7 in-lb (16 ±1 N·m)	--	--
5/16 (0.313)	05	190 ±10 in-lb (21 ±2 N·m)	0.020	190 ±10 in-lb (21 ±2 N·m)	--	--
3/8 (0.375)	06	270 ±14 in-lb (31 ±2 N·m)	0.028	270 ±14 in-lb (31 ±2 N·m)	--	--
1/2 (0.500)	08	500 ±25 in-lb (56 ±3 N·m)	0.034	500 ±25 in-lb (56 ±3 N·m)	0.028	375 ±19 in-lb (42 ±3 N·m)
5/8 (0.625)	10	700 ±35 in-lb (79 ±4 N·m)	0.049	700 ±35 in-lb (79 ±4 N·m)	0.035	575 ±29 in-lb (65 ±3 N·m)
3/4 (0.750)	12	900 ±45 in-lb (102 ±5 N·m)	0.049	900 ±45 in-lb (102 ±5 N·m)	0.042	725 ±36 in-lb (82 ±4 N·m)
7/8 (0.875)	14	--	--	--	--	--
1 (1.000)	16	1200 ±60 in-lb (136 ±7 N·m)	--	--	--	--

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**Table 221/20-50-11-993-823 Installation Torques for Flared, Flareless, and Short Flareless Fittings with Lubricated Threads Used on CRES and Titanium Tube Fittings and Hose Ends (Continued)**

TUBE SIZE; FITTING END SIZE; HOSE END SIZE <sup>*[1]</sup>		TUBE MATERIAL/END CONFIGURATION * <sup>[2]</sup> * <sup>[3]</sup> * <sup>[4]</sup> * <sup>[5]</sup> * <sup>[6]</sup> * <sup>[7]</sup>				
NOMINAL TUBE DIAMETER (INCH)	SIZE	TUBING ENDS; FITTING ENDS; HOSE ENDS <sup>*[8]</sup>	BACS13AP BITE TYPE SLEEVES WITH 1/8 HARD (MIL-T-6845, AMS-T-6842 OR AMS5566) CRES TUBE			
		TORQUE (IN-LB ±5%)	MINIMUM WALL THICKNESS (INCH)	TORQUE (IN-LB ±5%)	SPECIAL THIN-WALL TUBE WALL THICKNESS (INCH)	TORQUE (IN-LB ±5%)
1-1/4 (1.250)	20	1600 ±80 in-lb (181 ±9 N·m)	--	--	--	--
1-1/2 (1.500)	24	2000 ±100 in-lb (226 ±11 N·m)	--	--	--	--
1-3/4 (1.750)	28	--	--	--	--	--
2 (2.000)	32	2000 ±100 in-lb (226 ±11 N·m)	--	--	--	--

\*[1] For fittings and hoses with ends of more than one size, select the torque value for each end that matches its size. Compare the fitting or hose part number to the part standard to determine the part size and material.

NOTE: The end fitting size for standard BAC, AS and NAS fittings and hoses is determined by reference to the appropriate part standard. Table: "Standard End Fitting Size and Thread Size" (check the table for each model) may be used to determine the end fitting size for non-standard fittings and hoses that must be tightened in accordance with BAC5001.

\*[2] Controlled Tooling: ST 2599A, Torque Wrench for Tube Fittings or ST 2599B, Torque Wrench for Tube Components shall be used where possible to connect fittings. Equivalent micrometer style torque wrenches, adapters, and extensions are permitted only when the installation prohibits the use of the Controlled Tooling. When torque tool adapters or extensions are used, torque indicator reading correction factors may be required. Instructions for adapter/extension use and methods for obtaining the correction factor are given in BSS7083.

\*[3] Use aluminum fitting torque values for aluminum, steel, or titanium fittings installed in aluminum bosses.

\*[4] Use aluminum fitting torque values for aluminum jambnus installed on aluminum, titanium, or steel bulkhead fittings.

\*[5] Use steel fitting torque values for steel or titanium fittings installed in steel or titanium bosses.

\*[6] Use steel fitting torque values for steel or titanium jambnus installed on steel or titanium bulkhead fittings.

\*[7] The boss or bulkhead fitting size determines the torque value for reducer fittings.

\*[8] Unless otherwise specified on the Engineering Drawing, tighten these items to each other using the torque values on the table:

-Tube assemblies made with Titanium 3AL-2.5V tubing with material specifications: BMS7-234 or AS5620;

-Tube assemblies made with 21-6-9 CRES or Alloy 304, 1/8 Hard CRES tubing (for example BMS7-185 (alloy 21-6-9), MIL-T-6845, AMS-T-6845 or AMS5566 (alloy 304, 1/8 Hard));

-Flared tube assemblies made with annealed CRES tubing with material specifications: MIL-T-8504 (alloy 304), MIL-T-8808 (alloy 321 or 347), AMS5556 (alloy 347), AMS5557 (alloy 321), or AMS5567 (alloy 304);

-In-line fittings made of titanium, CRES or steel. In-line fittings such as tube-to-tube union, elbow, tee or cross fittings, adapter or reducer fittings, or in-line components with flareless ends such as BAC check valves that the Engineering Drawing requires shall be installed in accordance with BAC5001-10.

-Hoses made with titanium or CRES end fittings.

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**Table 222/20-50-11-993-828 Installation Torques for Flared Hose End Fittings with Aluminum Inserts**

TUBE SIZE		TUBE MATERIAL/END CONFIGURATION *[1]*[2]*[3]*[4]*[5]*[6]*[7]
NOMINAL DIAMETER (INCH)	SIZE	FLARED HOSE END FITTINGS WITH ALUMINUM INSERTS
		TORQUE (IN-LB ±5%)
1/8 (0.125)	02	--
3/16 (0.188)	03	35 ±2 in-lb (3.95 ±0.20 N·m)
1/4 (0.250)	04	65 ±3 in-lb (7 ±1 N·m)
5/16 (0.313)	05	90 ±5 in-lb (10 ±1 N·m)
3/8 (0.375)	06	130 ±7 in-lb (15 ±1 N·m)
1/2 (0.500)	08	260 ±13 in-lb (29 ±2 N·m)
5/8 (0.625)	10	360 ±18 in-lb (41 ±2 N·m)
3/4 (0.750)	12	500 ±25 in-lb (56 ±3 N·m)
7/8 (0.875)	14	--
1 (1.000)	16	700 ±35 in-lb (79 ±4 N·m)
1-1/4 (1.250)	20	900 ±45 in-lb (102 ±5 N·m)
1-1/2 (1.500)	24	900 ±45 in-lb (102 ±5 N·m)
1-3/4 (1.750)	28	--
2 (2.000)	32	2000 ±100 in-lb (226 ±11 N·m)

\*[1] Controlled Tooling: ST 2599A, Torque Wrench for Tube Fittings or ST 2599B, Torque Wrench for Tube Components shall be used where possible to connect fittings. Equivalent micrometer style torque wrenches, adapters, and extensions are permitted only when the installation prohibits the use of the Controlled Tooling. When torque tool adapters or extensions are used, torque indicator reading correction factors may be required. Instructions for adapter/extension use and methods for obtaining the correction factor are given in BSS7083.

- \*[2] Use aluminum fitting torque values for aluminum, steel, or titanium fittings installed in aluminum bosses.
- \*[3] Use aluminum fitting torque values for aluminum jambnus installed on aluminum, titanium, or steel bulkhead fittings.
- \*[4] Use steel fitting torque values for steel or titanium fittings installed in steel or titanium bosses.
- \*[5] Use steel fitting torque values for steel or titanium jambnus installed on steel or titanium bulkhead fittings.
- \*[6] The boss or bulkhead fitting size determines the torque value for reducer fittings.
- \*[7] Tube material specifications: 6061-T6 Aluminum - MIL-T-7081, WW-T-700/6; Annealed CRES - MIL-T-8504, MIL-T-8606, MIL-T-8808; 1/8 Hard CRES - MIL-T-6845; 21-6-9 CRES - BMS7-185; TI-3AL-2.5V - BMS7-234.

**Table 223/20-50-11-993-829 Standard End Fitting Size and Thread Size**

END FITTING SIZE <sup>[1]</sup>	THREAD SIZE ALL OTHER PRESSURE RATINGS (MAJOR DIAMETER - TPI)
04	.4375 - 20
05	.5000 - 20
06	.5625 - 18
08	.7500 - 16
10	.8750 - 14

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**Table 223/20-50-11-993-829 Standard End Fitting Size and Thread Size (Continued)**

END FITTING SIZE <sup>[1]</sup>	THREAD SIZE ALL OTHER PRESSURE RATINGS (MAJOR DIAMETER - TPI)
12	1.0625 - 12
16	1.3125 - 12
20	1.6250 - 12
24	1.8750 - 12
32	2.5000 - 12

\*[1] To use the table, measure the major diameter and number of threads per inch (TPI) of the external thread, find thread size on the table and follow the row to the left for the end fitting size.

- (i) Clamps, V-Band, Channel-Band and Couplings, Table 224, Table 225, Table 226, Table 227.

**Table 224/20-50-11-993-824 Standard Torque Values for Coupling Clamps, V-Band, and Channel-Band**

BOEING PART NUMBER	NOTES	DASH NUMBER ()	TORQUE
BACC10AU()	--	250-275	70 +5 / -0 in-lb (8 +1 / -0 N·m)
		300-500	100 +5 / -0 in-lb (11 +1 / -0 N·m)
BACC10BR8()	*[1]	100-900	100 +5 / -0 in-lb (11 +1 / -0 N·m)
BACC10CT2-()	*[1]	100-600	100 +5 / -0 in-lb (11 +1 / -0 N·m)
BACC10DP()A	--	150-250	50 +5 / -0 in-lb (6 +1 / -0 N·m)
	--	350-400	50 +5 / -0 in-lb (6 +1 / -0 N·m)
	--	45-600	70 +5 / -0 in-lb (8 +1 / -0 N·m)
BACC10DP()B	--	300	50 +5 / -0 in-lb (6 +1 / -0 N·m)
BACC10DP()AB	--	350-400	50 +5 / -0 in-lb (6 +1 / -0 N·m)
		450-600	70 +5 / -0 in-lb (8 +1 / -0 N·m)

EFFECTIVITY  
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737-600/700/800/900  
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Table 224/20-50-11-993-824 Standard Torque Values for Coupling Clamps, V-Band, and Channel-Band  
(Continued)

BOEING PART NUMBER	NOTES	DASH NUMBER ()	TORQUE
BACC10DU()AB	--	100-175	50 +5 / -0 in-lb (6 +1 / -0 N·m)
		200-275	55 +5 / -0 in-lb (6 +1 / -0 N·m)
		300-450	60 +5 / -0 in-lb (7 +1 / -0 N·m)
		500-600	65 +5 / -0 in-lb (7 +1 / -0 N·m)
		700-1000	75 +5 / -0 in-lb (8 +1 / -0 N·m)
BACC10EY()B	--	150-800	105 +5 / -0 in-lb (12 +1 / -0 N·m)
		150-400	75 +5 / -0 in-lb (8 +1 / -0 N·m)
		425-800	105 +5 / -0 in-lb (12 +1 / -0 N·m)
BACC10EZ()B	--	125-275	75 +5 / -0 in-lb (8 +1 / -0 N·m)
		300	105 in-lb (12 N·m)
BACC10GY()	--	150-175	40 +5 / -0 in-lb (5 +1 / -0 N·m)
		200-275	45 +5 / -0 in-lb (5 +1 / -0 N·m)
		300-450	50 +5 / -0 in-lb (6 +1 / -0 N·m)
		475-600	55 +5 / -0 in-lb (6 +1 / -0 N·m)
		650-900	65 +5 / -0 in-lb (7 +1 / -0 N·m)
BACC10HX()	*[2]	100-300	10 +5 / -0 in-lb (1 +1 / -0 N·m)
		325-500	15 +5 / -0 in-lb (2 +1 / -0 N·m)
		550-800	20 +5 / -0 in-lb (2 +1 / -0 N·m)

EFFECTIVITY  
AKS ALL

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**Table 224/20-50-11-993-824 Standard Torque Values for Coupling Clamps, V-Band, and Channel-Band (Continued)**

BOEING PART NUMBER	NOTES	DASH NUMBER ()	TORQUE
BACC10KH	--	200-275	45 +5 / -0 in-lb (5 +1 / -0 N·m)
		300-475	55 +5 / -0 in-lb (6 +1 / -0 N·m)
		500-550	60 +5 / -0 in-lb (7 +1 / -0 N·m)
		600-650	65 +5 / -0 in-lb (7 +1 / -0 N·m)
		700	70 +5 / -0 in-lb (8 +1 / -0 N·m)
BACC10LE()	--	500-600	55 +5 / -0 in-lb (6 +1 / -0 N·m)
		650-900	65 +5 / -0 in-lb (7 +1 / -0 N·m)
BACC10NU()	--	500-600	55 +5 / -0 in-lb (6 +1 / -0 N·m)
		650-900	65 +5 / -0 in-lb (7 +1 / -0 N·m)

\*[1] Inside of coupling not lubricated.

\*[2] Inside of coupling and T-bolt threads not lubricated.

**Table 225/20-50-11-993-825 Installation Torques for BACR12H Roylyn Couplings**

NOMINAL DUCT OUTER DIAMETER (INCHES)	DUCT MATERIAL	TORQUE	
		MINIMUM	MAXIMUM
1.50	5052-0	600 in-lb (68 N·m)	1000 in-lb (113 N·m)
	Stainless Steel	900 in-lb (102 N·m)	1200 in-lb (136 N·m)
1.75	5052-0	900 in-lb (102 N·m)	1200 in-lb (136 N·m)
2.00	5052-0	1300 in-lb (147 N·m)	2500 in-lb (282 N·m)
2.50	5052-0	2000 in-lb (226 N·m)	3000 in-lb (339 N·m)

**Table 226/20-50-11-993-826 Duct Support Clamp Installation Torques**

BOEING PART NUMBER	DASH NUMBER	RECOMMENDED TORQUE
BACC10Q	ALL	25 ±5 in-lb (3 ±1 N·m)
BACC10GW	ALL	40 in-lb (5 N·m) maximum*[1]
BACC10HN	ALL	40 in-lb (5 N·m) maximum*[1]

\*[1] The torque value may depend on the duct material and size. See AMM procedure for specific torque value.

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Table 227/20-50-11-993-827 Installation Torques for True Circle Machine Screw Type Clamps

HOSE DUCT OR CAP PART NUMBER SERIES	TORQUE	
	BACC10BN	
	MINIMUM	MAXIMUM
AS1505 Series		
BACC14AU (10.25 to 12.00 inches in diameter)	13 in-lb (1 N·m)	17 in-lb (2 N·m)
BACD40 Series (except BACD40AF)		
BACD40AF (10.25 to 13.00 inches in diameter)		
MIL-DTL-6000	22 in-lb (2 N·m)	28 in-lb (3 N·m)
MIL-H-7938		
MIL-PRF-7061	13 in-lb (1 N·m)	17 in-lb (2 N·m)
S417N802	22 in-lb (2 N·m)	28 in-lb (3 N·m)
10-20353	13 in-lb (1 N·m)	17 in-lb (2 N·m)

D. Procedure

SUBTASK 20-50-11-420-001

- (1) Tighten the bolt, nut, fitting, clamps, or connector (Figure 201, Table 201, Table 202, Table 203, Table 204, Table 205, Table 206, Table 207, Table 208, Table 209, Table 210, Table 211, Table 212, Table 213, Table 214, Figure 202).
  - (a) Lubricate the threads with one of these materials if required:
    - 1) corrosion preventive compound, C00308.
    - 2) grease, D00013.
    - 3) compound, D00010.
  - (b) Tighten the bolts, nuts, fitting, clamps, or connectors to the correct torque.
  - (c) Make sure that one male tread (minimum), plus the chamfer of the male tread, extends above the top of the nut.

NOTE: If the male thread does not have a chamfer, the male thread must extend one and one-half treads (minimum) above the top of the nut.

———— END OF TASK ————

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AKS ALL

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**BOEING**  
**737-600/700/800/900**  
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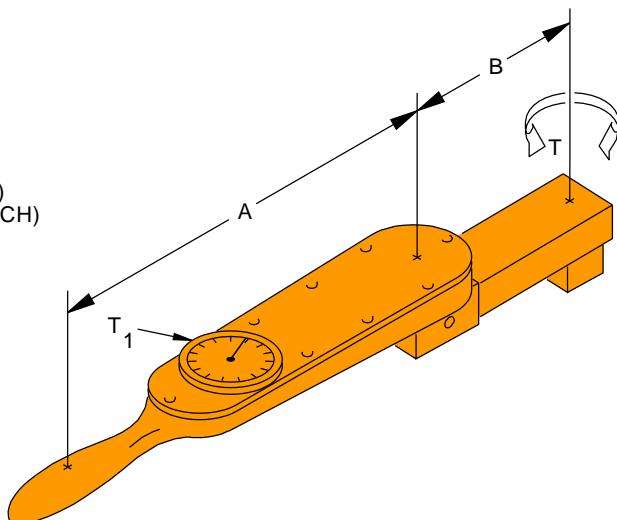
$$T_1 = \frac{TA}{A+B}$$

A = LENGTH OF THE TORQUE WRENCH  
 B = EFFECTIVE LENGTH OF THE ADAPTER  
 T = APPROVED TORQUE (SHOWN IN TORQUE TABLE)  
 T<sub>1</sub> = ADJUSTED TORQUE (SHOWN ON TORQUE WRENCH)

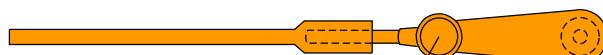
EXAMPLE: A = 12 INCHES  
 B = 3 INCHES  
 T = 160 POUND -INCHES

$$T_1 = \frac{160 \times 12}{12+3}$$

$$T_1 = 128 \text{ POUND -INCHES}$$

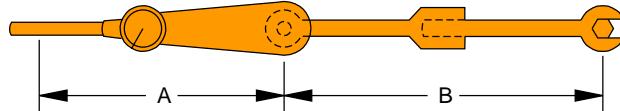


METHOD 1



HANDLE EXTENSION ONLY.  
 NO CORRECTION NECESSARY.

METHOD 2



ADAPTER WITH THE EXTENSION BETWEEN THE ADAPTER AND THE WRENCH. BOTH ARE IN LINE WITH THE WRENCH. INDICATED TORQUE T<sub>1</sub>:

$$T_1 = \frac{TA}{A+B}$$

METHOD 3

F15915 S0006562221\_V2

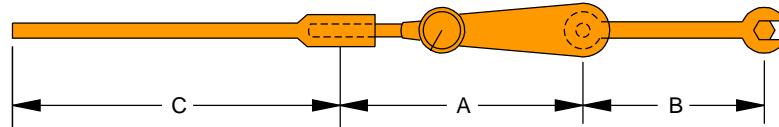
**Finding Torque Values for a Torque Wrench with an Adapter**  
**Figure 201/20-50-11-990-801 (Sheet 1 of 2)**

EFFECTIVITY  
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**20-50-11**



737-600/700/800/900  
AIRCRAFT MAINTENANCE MANUAL



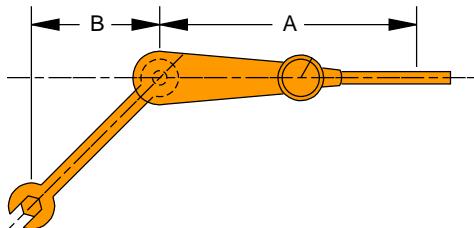
BOTH HANDLE EXTENSION AND ADAPTER,  
INDICATED TORQUE  $T_1$ :

$$T_1 = \frac{T_x(A+C)}{A+B+C}$$

METHOD 4

IF POSSIBLE, METHODS 5 AND 6 SHOULD NOT BE USED. WHEN IT IS NECESSARY TO USE THESE METHODS, THE FOLLOWING CONDITIONS MUST BE APPLICABLE:

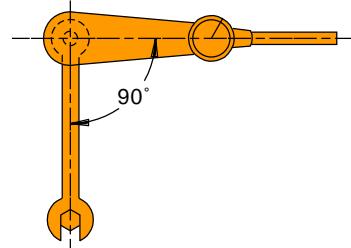
1. THE ADAPTER PLUS ANY EXTENSIONS USED BETWEEN THE WRENCH AND THE ADAPTER MUST NOT BE MORE THAN THE LENGTH OF THE WRENCH.
2. WHEN A FORCE IS APPLIED AT  $90 \pm 3^\circ$  TO THE HANDLE OF THE WRENCH, IT IS RECOMMENDED THAT A STIRRUP-TYPE HANDLE WITH A POINTER (INDICATING ANGLE OF LOADING) BE USED TO MAKE SURE LOADING IS AT THE CORRECT ANGLE.



ADAPTER AT ANGLE OTHER THAN  
 $90^\circ$ . INDICATED TORQUE  $T_1$ :

$$T_1 = \frac{TA}{A+B}$$

METHOD 5



ADAPTER AT RIGHT ANGLE TO THE  
WRENCH. NO CORRECTION NECESSARY.

METHOD 6

F44268 S0006562222\_V3

Finding Torque Values for a Torque Wrench with an Adapter  
Figure 201/20-50-11-990-801 (Sheet 2 of 2)

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BACB30DP (CRES)  
BACB30EL (STEEL)



BACB30NU  
(TITANIUM)



BACB30LL  
(CRES)



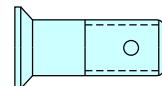
BACB30FB (STEEL)  
BACB30RF (STEEL)  
BACB30UW (STEEL)



BACB30UR (TITANIUM)



BACB30VF (TITANIUM)  
BACB30XD (TITANIUM)



NAS1992 THRU NAS2000



NAS8702 THRU  
NAS8716



BACB30ZE (CRES)



BACB30YE (TITANIUM)  
BACB31A (CRES)



BACS12HB (CRES)



BACS12HE (TITANIUM)



BACS12JC

BOLT PART NUMBERS AND STYLES

F15953 S0006562234\_V5

Torque Values for Reduced-Head Bolts  
Figure 202/20-50-11-990-804

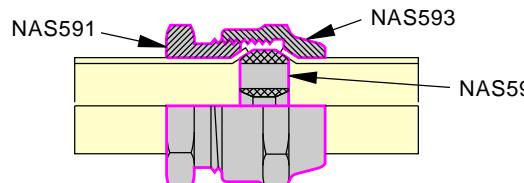
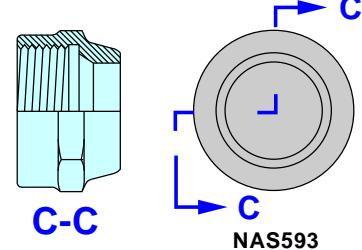
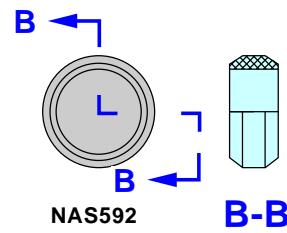
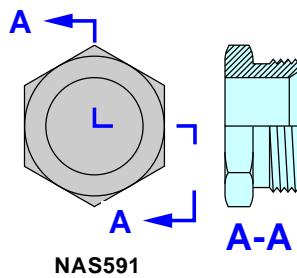
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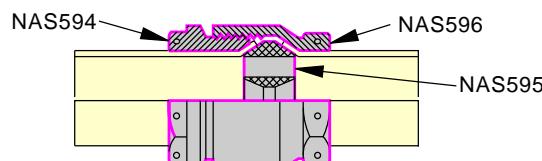
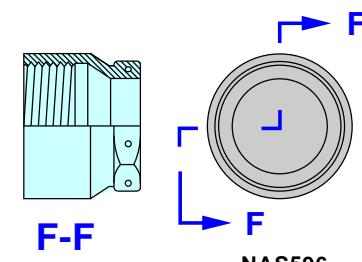
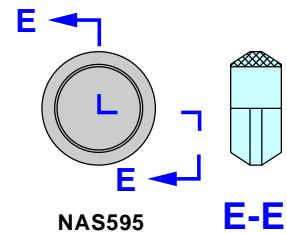
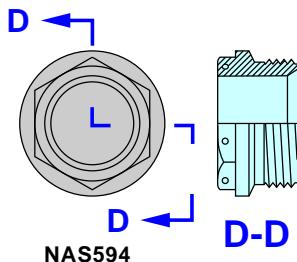
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CONNECTION ASSEMBLY FOR ALUMINUM ALLOY FITTINGS  
NAS591-NAS593



CONNECTION ASSEMBLY FOR STAINLESS STEEL FITTINGS  
NAS594-NAS596

F15954 S0006562235\_V4

Connection Assemblies for Rigid Tube Couplings  
Figure 203/20-50-11-990-805

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CIRCUIT BREAKER RESET - MAINTENANCE PRACTICES

**1. General**

- A. This procedure has one task:
- (1) Circuit Breaker Reset.

**TASK 20-60-01-860-801**

**2. Circuit Breaker Reset**

**A. General**

- (1) This procedure is for on-the-ground maintenance.
    - (a) Circuit breakers open when there is an electrical overload in the airplane system. A circuit breaker that opens because of an electrical overload is known as a "tripped" circuit breaker.
    - (b) You must use the Fault Isolation Manual (FIM) for troubleshooting open fuel pump circuit breakers.
      - 1) You can not use this procedure to reset a tripped fuel pump circuit breaker.
- NOTE: Reset of the fuel pump circuit breakers is a Critical Design Configuration Control Limitation (CDCCL) item.
- (c) If there are currently specific instructions for the reset of a tripped circuit breaker in maintenance and troubleshooting procedures, follow those instructions.
  - (d) A defective circuit breaker can cause the circuit breaker to open. Make sure that the circuit breaker is serviceable.
  - (e) Use your judgement and airline policy to reset a tripped circuit breaker.
  - (f) Monitor the airplane to see if a tripped circuit breaker occurs again on subsequent flights.
  - (g) Do not reset a tripped circuit breaker until you know the cause for the tripped circuit breaker and that the circuit breaker can be safely reset. Fires have occurred in which the tripped circuit breakers were reset without an examination of the cause.
  - (h) Use this procedure to reset a tripped circuit breaker:
    - 1) If you know that the circuit breaker is serviceable.
    - 2) If this procedure is in agreement with your airline policy.
    - 3) If you cannot determine the cause for the tripped circuit breaker.
    - 4) If you cannot determine whether it is safe to reset the circuit breaker.

**B. References**

Reference	Title
SWPM 20-02-10	Airplane Flammable Leakage Zones

**C. Location Zones**

Zone	Area
100	Lower Half of Fuselage
200	Upper Half of Fuselage

**D. Procedure**

SUBTASK 20-60-01-860-001

- (1) Attach a DO-NOT-CLOSE tag to the tripped circuit breaker.

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SUBTASK 20-60-01-860-002

- (2) Install a circuit breaker lock on the tripped circuit breaker.

SUBTASK 20-60-01-860-003

- (3) If the tripped circuit breaker is one of three circuit breakers protecting a 3-phase circuit:
- (a) Open the other two circuit breakers.
  - (b) Attach DO-NOT-CLOSE tags.
  - (c) Install circuit breaker locks.

SUBTASK 20-60-01-860-004

- (4) Look in the aircraft logbook to find if there is recorded data about a "tripped" circuit breaker, such as:
- (a) The condition existing when the circuit breaker trip occurred.
  - (b) The conditions existing when the circuit breaker was reset.
  - (c) The results of resetting the circuit breaker.

SUBTASK 20-60-01-860-005

- (5) Do a visual check for damage to electrical wiring and system components related to the tripped circuit breaker. If necessary, refer to the Wiring Diagram Manual (WDM). Look for these types of damage:
- (a) Electrical shorting
  - (b) Electrical arcing
  - (c) Corrosion on the contacts of the electrical wiring and system components
  - (d) Abrasion of the electrical wiring and system components
  - (e) Cracks on the insulation of the electrical wiring
  - (f) Split wires

NOTE: A split wire is when you can see the conductor through the crack in the insulation of the electrical wiring.
  - (g) Broken wires
  - (h) Discoloration of the insulation of the electrical wiring
  - (i) Fluid or dust contamination of electrical wiring and system components

NOTE: Contamination can be a fuel source during electrical arcing.
  - (j) Metal shavings

NOTE: Metal shavings can cause electrical shorting.

SUBTASK 20-60-01-860-006

- (6) Make sure that there are no loose terminal connections.

NOTE: Loose terminal connections can be a source of electrical arcing.

SUBTASK 20-60-01-860-007

- (7) If you find damage to the electrical wiring, refer to the Standard Wiring Practices Manual (SWPM) and repair the electrical wiring.

SUBTASK 20-60-01-860-008

- (8) If you find damage to a system component, refer to the applicable Aircraft Maintenance Manual (AMM) procedure and replace the component.

SUBTASK 20-60-01-860-009

- (9) Remove contamination and metal shavings if necessary.

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SUBTASK 20-60-01-860-010

- (10) Remove the DO-NOT-CLOSE tag(s).

SUBTASK 20-60-01-860-011

- (11) Remove the circuit breaker lock(s).

SUBTASK 20-60-01-860-012

**WARNING:** BEFORE YOU CLOSE A FUEL PUMP CIRCUIT BREAKER THAT OPENED DURING PUMP OPERATION, DO THE APPLICABLE FIM PROCEDURE. A DAMAGED PUMP, OR A PROBLEM WITH THE PUMP WIRING CAN CAUSE THE CIRCUIT BREAKER TO OPEN. THIS CONDITION CAN CAUSE A FIRE, OR AN EXPLOSION.

**WARNING:** KEEP PERSONS AND EQUIPMENT CLEAR OF THE SYSTEM RELATED TO THE TRIPPED CIRCUIT BREAKER. MAKE SURE THAT THERE IS NO DAMAGE TO THE ELECTRICAL WIRING AND SYSTEM COMPONENTS. MAKE SURE THAT ALL TERMINAL CONNECTIONS ARE TIGHT. DAMAGED ELECTRICAL WIRING, DAMAGED SYSTEM COMPONENTS AND LOOSE TERMINAL CONNECTIONS CAN CAUSE ELECTRICAL ARCING AND A FIRE WHEN THE CIRCUIT BREAKER IS CLOSED.

MAKE SURE THROUGH SWPM 20-02-10 THAT THE OPEN CIRCUIT BREAKER DOES NOT HAVE AN EFFECT ON FLAMMABLE LEAKAGE ZONES. IF THE CIRCUIT BREAKER IS CLOSED WITHOUT FLAMMABLE LEAKAGE ZONE VERIFICATION, SPARKS CAN CAUSE A FIRE OR EXPLOSION.

- (12) Close the circuit breaker(s).

**NOTE:** Reset of the fuel pump circuit breakers is a Critical Design Configuration Control Limitation (CDCCL) item.

SUBTASK 20-60-01-860-013

- (13) After you close the circuit breaker(s), make sure that there is no electrical arcing or other damage to the system.

SUBTASK 20-60-01-860-014

- (14) To make sure that the airplane system operates correctly, refer to the applicable procedure in the Aircraft Maintenance Manual (AMM).

———— END OF TASK ————

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CLEANING TO REMOVE COMBUSTIBLE MATERIAL (EZAP) - MAINTENANCE PRACTICES

1. **General**

- A. This procedure contains scheduled maintenance task data.

**EWIS**

**TASK 20-60-02-100-801**

2. **Cleaning to Remove Combustible Material**

NOTE: This procedure is a scheduled maintenance task.

A. **General**

- (1) This procedure is an enhanced zonal analysis procedure (EZAP) task.
- (2) This procedure cleans the area(s) and/or item(s) to significantly reduce the accumulation of combustible material.

B. **Definition:**

- (1) A combustible material is any solid, liquid, or gaseous material that has the ability to cause a fire to be sustained after removal of the ignition source. Refer to Advisory Circular AC 25-27 for additional information regarding combustible materials and wiring contamination.

C. **References**

Reference	Title
20-40-11-910-801	Static Grounding (P/B 201)
20-60-07-913-801	Protection of the EWIS During Maintenance (P/B 201)
51-00	CORROSION PREVENTION
SWPM 20-10-04	Cleaning of Wire Harnesses

D. **Tools/Equipment**

Reference	Description
STD-123	Brush - Soft Bristle
STD-10711	Shop Vacuum (400Hz if using aircraft power)

E. **Procedure**

SUBTASK 20-60-02-010-001

- (1) Do this task: Static Grounding, TASK 20-40-11-910-801.

SUBTASK 20-60-02-860-001

**WARNING:** EXERCISE EXTREME CAUTION WHEN WORKING AROUND ENERGIZED PANELS.  
HIGH VOLTAGES PRESENT CAN BE FATAL.

- (2) If it is necessary to touch the EWIS, it is recommended to remove electrical power in the area(s) or from the item(s) to be cleaned:

NOTE: You can remove all electrical power from the airplane if the removal from one or more systems is not possible.

- (a) Identify the applicable electrical system(s) in the area(s) and/or from the item(s) to be cleaned.
- (b) Open circuit breakers and switches for the applicable area(s) and/or from the item(s) to be cleaned.
- (c) Put a collar/warning tag on the applicable circuit breaker(s), and warning tag on the applicable switch(s) for the area(s) and/or from the item(s) to be cleaned.

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SUBTASK 20-60-02-010-002

- (3) Remove panels as necessary to gain access to the area(s)/item(s).

SUBTASK 20-60-02-100-001

- (4) Do these steps to clean the area(s)/item(s):

NOTE: This procedure cleans the area(s)/item(s) where significant combustible material accumulates.

- (a) Do this task: Protection of the EWIS During Maintenance, TASK 20-60-07-913-801.

**CAUTION:** DO NOT CUT, CAUSE NICKS, OR CAUSE OTHER DAMAGE TO THE CABLES, WIRES, METAL-BRAIDED SHIELD, OR OVERBRAID. DAMAGE TO THESE COMPONENTS CAN CAUSE MALFUNCTIONS, OR DAMAGE TO OTHER EQUIPMENT.

- (b) Remove loose contamination by hand.

- (c) Use a vacuum, STD-10711 with a soft bristle brush head to remove accumulations of combustible materials.

NOTE: The vacuum cleaner head should be made of plastic or non-conductive material.

- (d) Use a soft bristle brush, STD-123 to loosen accumulations of combustible materials that remain and vacuum the area(s)/item(s) again.

- (e) For contamination in the area(s) that can not be removed with a brush and vacuum, do the applicable procedure(s): CORROSION PREVENTION, SECTION 51-00.

- (f) For contamination on wiring harnesses that you can not remove with a brush and vacuum, do this procedure: SWPM 20-10-04.

SUBTASK 20-60-02-410-001

**CAUTION:** MAKE SURE THAT YOU REMOVE ALL TOOLS, LOOSE PARTS AND UNWANTED MATERIAL FROM THE AREA WHEN YOU COMPLETE MAINTENANCE. DAMAGE TO EQUIPMENT COULD OCCUR.

- (5) Install all panels removed for access.

SUBTASK 20-60-02-860-002

- (6) Restore electrical power in the area(s) and/or from the item(s) that had the electrical power removed.

- (a) Remove the collar/warning tag on the applicable circuit breaker(s), and warning tag on the applicable switch(s) for the area(s) and/or from the item(s) that had the electrical power removed.

———— END OF TASK ————

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AIRCRAFT MAINTENANCE MANUAL

DETAILED INSPECTION OF EWIS (EZAP) - MAINTENANCE PRACTICES

1. **General**

- A. This procedure contains scheduled maintenance task data.

**EWIS**

**TASK 20-60-03-100-801**

2. **Detailed Inspection of EWIS**

NOTE: This procedure is a scheduled maintenance task.

**A. General**

- (1) This procedure is an Enhanced Zonal Analysis Procedure (EZAP) task.
- (2) This procedure performs a detailed inspection of Electrical Wiring Interconnection System (EWIS).

**B. Definitions:**

- (1) Electrical Wiring Interconnection System (EWIS): means any wire, power feeder, wiring device, or combination of these, including termination devices, installed in any area of the airplane for the purpose of transmitting electrical energy, including data and signals, between two or more intended termination points. EWIS is defined in full by 14 CFR section 25.1701.
- (2) Detailed Inspection (DET)—An intensive examination of a specific item, installation, or assembly to detect damage, failure, or irregularity. Available lighting is normally supplemented with a direct source of good lighting at an intensity deemed appropriate. Inspection aids such as mirrors, magnifying lenses, or other means may be necessary. Surface cleaning and elaborate access procedures may be required. A DET can be more than just a visual inspection, since it may include tactile assessment in which a component or assembly is checked for tightness/security. It may require the removal of items such as access panels and drip shields, or the moving of components.

**C. References**

Reference	Title
20-40-11-910-801	Static Grounding (P/B 201)
20-60-02-100-801	Cleaning to Remove Combustible Material (P/B 201)
20-60-07-913-801	Protection of the EWIS During Maintenance (P/B 201)
SWPM 20, Standard Wiring Practices	Standard Wiring Practices
SWPM 20-10-20	Standard Wiring Practices Manual

**D. Procedure**

SUBTASK 20-60-03-100-001

- (1) Do this task: Static Grounding, TASK 20-40-11-910-801.

SUBTASK 20-60-03-860-001

**WARNING:** BE CAREFUL WHEN YOU DO WORK AROUND ENERGIZED PANELS. HIGH VOLTAGES CAN KILL YOU.

- (2) If it is necessary to touch the EWIS, it is recommended to remove electrical power from the EWIS to be inspected:

NOTE: You can remove all electrical power from the airplane if the removal from one or more systems is not possible.

- (a) Identify the applicable electrical system(s) for the EWIS to be inspected.

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- (b) Open circuit breakers and switches for the EWIS to be inspected.
- (c) Put a collar/warning tag on the applicable circuit breaker(s), and warning tag on the applicable switch(s) for the EWIS to be inspected.

SUBTASK 20-60-03-010-003

- (3) Remove panels as necessary to gain access to the EWIS.

SUBTASK 20-60-03-211-001

- (4) Do these steps to perform a detailed inspection of the EWIS:

NOTE: You do not need to pull on the wire bundles, shake the wire bundles, or disconnect the connectors to perform this inspection.

- (a) Protect all EWIS during the inspection:

**CAUTION:** KEEP TOOLS, TOOL TRAYS, AND OTHER WORK ITEMS OFF OF THE WIRES. OBJECTS PUT ON THE WIRE BUNDLES OR THEIR RELATED COMPONENTS CAN CAUSE DAMAGE TO THE WIRES, INSULATION, AND CONNECTORS.

**CAUTION:** DO NOT PUT PRESSURE ON THE WIRE BUNDLES, ELECTRONIC SYSTEMS, OR STRUCTURES IN THE COMPARTMENT. PRESSURE CAN CAUSE DAMAGE TO WIRE BUNDLES AND ELECTRICAL CONNECTIONS.

**CAUTION:** DO NOT CUT, CAUSE NICKS, OR CAUSE OTHER DAMAGE TO THE CABLES, WIRES, METAL-BRAIDED SHIELD, OR OVERBRAID. DAMAGE TO THESE COMPONENTS CAN CAUSE MALFUNCTIONS, OR DAMAGE TO OTHER EQUIPMENT.

- 1) EWIS that are undisturbed and kept free of contamination will provide trouble-free service without the need for unscheduled maintenance.

**CAUTION:** DO NOT USE WIRE BUNDLES, TUBING, DUCTS, OR OTHER ENGINE COMPONENTS AS A STEP OR HAND-HOLD. DAMAGE TO EQUIPMENT CAN OCCUR.

- 2) EWIS can be easily damaged during the inspection if they are used as a handheld or support for personal equipment.

- (b) Check the EWIS and the area around them for combustible material such as dust, lint and other surface contamination.

- 1) If combustible material is found, do this task: Cleaning to Remove Combustible Material, TASK 20-60-02-100-801.

- (c) Check the EWIS for: contact, chafing, sagging, security, visible damage, lacing tape/ties installation, sheath / conduit deformity or installation, end of sheath rubbing on end attachment, missing or damaged grommets, dust and lint accumulation, surface contamination, deterioration of previous repairs.

- (d) Check connectors for: external corrosion, backshell tail, rubber pad/packing on backshell, backshell wire securing device, missing or broken safety wire, discoloration or evidence of overheating on terminal lugs or blocks, torque stripe misalignment.

- (e) Check switches for rear protection cap damage.

- (f) Check ground points for: corrosion, bonding braid/bonding jumper, broken or disconnected braid, multiple strands corroded or broken.

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- (g) Check EWIS clamps or brackets for: presence, corrosion, condition, bends or twists, attachment, protection/cushion.
- (h) Check EWIS supports such as rails, racks, shelves, or tubes/conduits for: breaks, deformity, missing fasteners, missing edge protection on rims of feed through holes, race track cushion damage.
- (i) If damage is found on any EWIS, do the following:
  - 1) Do this task: Protection of the EWIS During Maintenance, TASK 20-60-07-913-801
  - 2) Repair or replace per the applicable task: SWPM 20, Standard Wiring Practices.
- (j) If damage is found with the pressure seals, replace the component: SWPM 20-10-20.

SUBTASK 20-60-03-410-001

**CAUTION:** MAKE SURE THAT YOU REMOVE ALL TOOLS, LOOSE PARTS AND UNWANTED MATERIAL FROM THE AREA WHEN YOU COMPLETE MAINTENANCE. DAMAGE TO EQUIPMENT COULD OCCUR.

- (5) Install all panels removed for access.

SUBTASK 20-60-03-860-002

- (6) Restore electrical power in the area(s) and/or from the item(s) that had the electrical power removed.
  - (a) Remove the collar/warning tag on the applicable circuit breaker(s), and warning tag on the applicable switch(s) for the area(s) and/or from the item(s) that had the electrical power removed.

———— END OF TASK ————

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GENERAL VISUAL INSPECTION OF EWIS (EZAP) - MAINTENANCE PRACTICES

1. **General**

- A. This procedure contains scheduled maintenance task data.

**EWIS**

**TASK 20-60-04-100-801**

2. **General Visual Inspection of EWIS**

NOTE: This procedure is a scheduled maintenance task.

A. **General**

- (1) This procedure is an Enhanced Zonal Analysis Procedure (EZAP) task.
- (2) This procedure performs a general visual inspection of Electrical Wiring Interconnection System (EWIS).

B. **Definitions:**

- (1) Electrical Wiring Interconnection System (EWIS): means any wire, power feeder, wiring device, or combination of these, including termination devices, installed in any area of the airplane for the purpose of transmitting electrical energy, including data and signals, between two or more intended termination points. EWIS is defined in full by 14 CFR section 25.1701.
- (2) General Visual Inspection (GVI)—A visual examination of an interior or exterior area, installation, or assembly to detect obvious damage, failure, or irregularity. This level of inspection is made from within touching distance unless otherwise specified. A mirror may be necessary to enhance visual access to all exposed surfaces in the inspection area. This level of inspection is made under normally available lighting conditions such as daylight, hangar lighting, flashlight, or droplight and may require removal or opening of access panels or doors. Stands, ladders, or platforms may be required to gain proximity to the area being checked.

C. **References**

Reference	Title
20-40-11-910-801	Static Grounding (P/B 201)
20-60-02-100-801	Cleaning to Remove Combustible Material (P/B 201)
20-60-07-913-801	Protection of the EWIS During Maintenance (P/B 201)
SWPM 20, Standard Wiring Practices	Standard Wiring Practices
SWPM 20-10-20	Standard Wiring Practices Manual

D. **Procedure**

**SUBTASK 20-60-04-210-001**

- (1) Do this task: Static Grounding, TASK 20-40-11-910-801.

**SUBTASK 20-60-04-860-001**

**WARNING: BE CAREFUL WHEN YOU DO WORK AROUND ENERGIZED PANELS. HIGH VOLTAGES CAN KILL YOU.**

- (2) If it is necessary to touch the EWIS, it is recommended to remove electrical power from the EWIS to be inspected:

NOTE: You can remove all electrical power from the airplane if the removal from one or more systems is not possible.

- (a) Identify the applicable electrical system(s) for the EWIS to be inspected.



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- (b) Open circuit breakers and switches for the EWIS to be inspected.
- (c) Put a collar/warning tag on the applicable circuit breaker(s), and warning tag on the applicable switch(s) for the EWIS to be inspected.

SUBTASK 20-60-04-010-002

- (3) Remove panels as necessary to gain access to the EWIS.

SUBTASK 20-60-04-210-002

- (4) Do these steps to perform a general inspection of the EWIS:

NOTE: You do not need to pull on the wire bundles, shake the wire bundles, or disconnect the connectors to perform this inspection.

- (a) Protect all EWIS during the inspection:

**CAUTION:** KEEP TOOLS, TOOL TRAYS, AND OTHER WORK ITEMS OFF OF THE WIRES. OBJECTS PUT ON THE WIRE BUNDLES OR THEIR RELATED COMPONENTS CAN CAUSE DAMAGE TO THE WIRES, INSULATION, AND CONNECTORS.

**CAUTION:** DO NOT PUT PRESSURE ON THE WIRE BUNDLES, ELECTRONIC SYSTEMS, OR STRUCTURES IN THE COMPARTMENT. PRESSURE CAN CAUSE DAMAGE TO WIRE BUNDLES AND ELECTRICAL CONNECTIONS.

**CAUTION:** DO NOT CUT, CAUSE NICKS, OR CAUSE OTHER DAMAGE TO THE CABLES, WIRES, METAL-BRAIDED SHIELD, OR OVERBRAID. DAMAGE TO THESE COMPONENTS CAN CAUSE MALFUNCTIONS, OR DAMAGE TO OTHER EQUIPMENT.

- 1) EWIS that are undisturbed and kept free of contamination will provide trouble-free service without the need for unscheduled maintenance.

**CAUTION:** DO NOT USE WIRE BUNDLES, TUBING, DUCTS, OR OTHER ENGINE COMPONENTS AS A STEP OR HAND-HOLD. DAMAGE TO EQUIPMENT CAN OCCUR.

- 2) EWIS can be easily damaged during the inspection if they are used as a handheld or support for personal equipment.

- (b) Check the EWIS and the area around them for combustible material such as dust, lint and other surface contamination.

- 1) If combustible material is found, do this task: Cleaning to Remove Combustible Material, TASK 20-60-02-100-801.

- (c) Check the EWIS for: contact, chafing, sagging, security, visible damage, lacing tape/ties installation, sheath / conduit deformity or installation, end of sheath rubbing on end attachment, missing or damaged grommets, dust and lint accumulation, surface contamination, deterioration of previous repairs.

- (d) Check connectors for: external corrosion, backshell tail, rubber pad/packing on backshell, backshell wire securing device, missing or broken safety wire, discoloration or evidence of overheating on terminal lugs or blocks, torque stripe misalignment.

- (e) Check switches for rear protection cap damage.

- (f) Check ground points for: corrosion, bonding braid/bonding jumper, broken or disconnected braid, multiple strands corroded or broken.

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- (g) Check EWIS clamps or brackets for: presence, corrosion, condition, bends or twists, attachment, protection/cushion.
- (h) Check EWIS supports such as rails, racks, shelves, or tubes/conduits for: breaks, deformity, missing fasteners, missing edge protection on rims of feed through holes, race track cushion damage.
- (i) If damage is found on any EWIS, do the following:
  - 1) Do this task: Protection of the EWIS During Maintenance, TASK 20-60-07-913-801
  - 2) Repair or replace per the applicable task: SWPM 20, Standard Wiring Practices.
- (j) If damage is found with the pressure seals, replace the component: SWPM 20-10-20.

SUBTASK 20-60-04-410-002

**CAUTION:** MAKE SURE THAT YOU REMOVE ALL TOOLS, LOOSE PARTS AND UNWANTED MATERIAL FROM THE AREA WHEN YOU COMPLETE MAINTENANCE. DAMAGE TO EQUIPMENT COULD OCCUR.

- (5) Install all panels removed for access.

SUBTASK 20-60-04-860-002

- (6) Restore electrical power in the area(s) and/or from the item(s) that had the electrical power removed.
  - (a) Remove the collar/warning tag on the applicable circuit breaker(s), and warning tag on the applicable switch(s) for the area(s) and/or from the item(s) that had the electrical power removed.

———— END OF TASK ————

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CIRCUIT BREAKER CYCLE - MAINTENANCE PRACTICES

**1. General**

- A. This procedure has this task:
  - (1) Circuit Breaker Cycle
- B. This procedure is for on-the-ground maintenance.
  - (1) This procedure is for on-the-ground maintenance and is preventative maintenance for those circuit breakers that are less frequently used. It is not necessary to do this procedure for frequently used circuit breakers. Because each airline operates differently, it is an airline decision as to which circuit breakers are frequently used and which circuit breakers are less frequently used.
  - (2) Research has shown that the cycling of less frequently used circuit breakers can help to improve operational system reliability. If a circuit breaker has not been operated for some time, it is possible that the circuit breaker may not open when an electrical fault occurs.
  - (3) Circuit breakers are located in all areas of the airplane such as the flight compartment, electrical equipment bays, cargo compartments, passenger compartment, and other areas.
  - (4) Too much repeated use of a circuit breaker can result in premature failure of the circuit breaker.

**TASK 20-60-05-800-801**

**2. Circuit Breaker Cycle**

**A. References**

Reference	Title
24-22-00-860-812	Remove Electrical Power (P/B 201)

**B. Procedure**

SUBTASK 20-60-05-020-001

- (1) Do this task: Remove Electrical Power, TASK 24-22-00-860-812

NOTE: Electrical power must be off so that subsequent incorrect fault indications or nuisance messages are prevented.

SUBTASK 20-60-05-860-001

- (2) Do these steps to cycle a circuit breaker on the airplane.
  - (a) Open the circuit breaker.
  - (b) Do a visual check of the circuit breaker area for damage. Look for these types of damage:
    - 1) Electrical shorting
    - 2) Electrical arcing
    - 3) Discoloration of the circuit breaker
    - 4) Contamination of the circuit breaker
  - (c) If you find damage to the circuit breaker, replace the circuit breaker.
  - (d) Close the circuit breaker.
    - NOTE: After you open and close the circuit breaker, you can possibly find contamination.
  - (e) Remove contamination, if necessary.
  - (f) If you find that the circuit breaker is unserviceable after you open and close it, replace the circuit breaker.

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SUBTASK 20-60-05-860-002

- (3) If necessary, do this procedure again to cycle another circuit breaker.

———— END OF TASK ————

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ELECTRONIC LRU CLEANING - MAINTENANCE PRACTICES

1. General

- A. This procedure cleans the electronic line replaceable units (LRU) and the area around it where dust can accumulate and obstruct filters and cooling systems.

**TASK 20-60-100-801**

2. Electronic LRU Cleaning

A. Tools/Equipment

Reference	Description
STD-123	Brush - Soft Bristle
STD-10711	Shop Vacuum (400Hz if using aircraft power)

B. Consumable Materials

Reference	Description	Specification
B01000	Solvent - General Cleaning Of Metal (AMM 20-30-80)	

C. Procedure

SUBTASK 20-60-06-010-001

- (1) Remove panels as necessary to gain access to the LRUs and the area around them.

SUBTASK 20-60-06-140-001

- (2) Do the steps that follow to clean the LRUs and the area around them:
- Remove any contamination by hand.
  - Use a vacuum, STD-10711 to remove any loose dirt or debris.
  - Use a soft bristle brush, STD-123 to loosen any dust on or around the LRU and vacuum the area again.
  - Do the following steps to clean the LRU filters if applicable:
    - Replace fiberglass and paper filters if contaminated.
    - Clean metallic screens and filters with Series 80 solvent, B01000 if contaminated.

SUBTASK 20-60-06-410-001

- (3) Install all panels removed for access.

———— END OF TASK ————

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**WIRE BUNDLE PROTECTION (EZAP) - PROTECTION OF EWIS (EZAP) - MAINTENANCE PRACTICES**

**1. General**

- A. This procedure has one task.
  - (1) Instructions for protections and caution information that will minimize contamination and accidental damage to EWIS, as applicable, during performance of maintenance, alteration, or repairs.
- B. This procedure is an Enhanced Zonal Analysis Procedure (EZAP) task.

**► EWIS**

**TASK 20-60-07-913-801**

**2. Protection of the EWIS During Maintenance**

**A. General**

- (1) Definition:
  - (a) Electrical Wiring Interconnection System (EWIS): means any wire, power feeder, wiring device, or combination of these, including termination devices, installed in any area of the airplane for the purpose of transmitting electrical energy, including data and signals, between two or more intended termination points. EWIS is defined in full by 14 CFR section 25.1701.
- (2) This procedure gives instructions for the installation of temporary protection for EWIS during maintenance work when contamination or mechanical damage can occur.
- (3) Protect all airplane EWIS, regardless of the gauge or insulation material, during airplane maintenance to prevent or significantly decrease the potential for damage from contamination and debris.
  - (a) Protection of EWIS starts with identification of the potential for contamination or mechanical damage.
  - (b) The protection ends with making sure that EWIS is free of all sources of contamination.
  - (c) Prevention and frequent removal of contamination during all maintenance work is necessary to maintain EWIS in an airworthy condition.
  - (d) EWIS can be easily damaged during removal of airplane equipment, or if it is used as a handhold or support for personal equipment.
  - (e) In general, EWIS that is undisturbed and kept free of contamination will provide trouble-free service without the need for unscheduled maintenance.
- (4) To maintain necessary properties of EWIS, it must be kept free of chemicals and debris.
  - (a) Hydraulic fluid is a common cause of wire bundle and wire component degradation. Hydraulic fluid is very damaging to connector grommets, wire bundle clamps, and to wire insulation when exposed over a long time. This can cause indirect damage such as arcing and chafing, and break down of the insulation.
- (5) Make sure that EWIS is protected from the accumulation of contamination before you start maintenance work such as servicing, repairing, cleaning, or modifying.

**B. References**

Reference	Title
20-60-02-100-801	Cleaning to Remove Combustible Material (P/B 201)
SWPM 20, Standard Wiring Practices	Standard Wiring Practices

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C. Procedure

SUBTASK 20-60-07-913-001

**WARNING:** KEEP THESE MATERIALS AWAY FROM WIRES. THESE MATERIALS WILL DECREASE THE LIFE OF WIRES. IF YOU SPILL THESE MATERIALS, OR LET LEAKAGE GET ON THE WIRES, INJURY TO PERSONNEL AND DAMAGE TO EQUIPMENT CAN OCCUR.

- (1) Make sure that chemicals such as, but not limited to the following, are kept away from the EWIS:
- (a) Hydraulic fluid
  - (b) Battery electrolytes
  - (c) Fuel
  - (d) Corrosion-inhibiting compounds
- NOTE: Avoid overspray of CIC on wire bundles and joined electrical connectors. Light overspray to an adjacent area is acceptable.
- (e) Waste system chemicals
  - (f) Cleaning agents
  - (g) Deicing fluids
  - (h) Paint
  - (i) Sealants
  - (j) Potting compounds.

SUBTASK 20-60-07-913-002

**CAUTION:** KEEP TOOLS, TOOL TRAYS, AND OTHER WORK ITEMS OFF OF THE WIRES. OBJECTS PUT ON THE WIRE BUNDLES OR THEIR RELATED COMPONENTS CAN CAUSE DAMAGE TO THE WIRES, INSULATION, AND CONNECTORS.

**CAUTION:** DO NOT PUT PRESSURE ON THE WIRE BUNDLES, ELECTRONIC SYSTEMS, OR STRUCTURES IN THE COMPARTMENT. PRESSURE CAN CAUSE DAMAGE TO WIRE BUNDLES AND ELECTRICAL CONNECTIONS.

**CAUTION:** DO NOT CUT, CAUSE NICKS, OR CAUSE OTHER DAMAGE TO THE CABLES, WIRES, METAL-BRAIDED SHIELD, OR OVERBRAID. DAMAGE TO THESE COMPONENTS CAN CAUSE MALFUNCTIONS, OR DAMAGE TO OTHER EQUIPMENT.

**CAUTION:** DO NOT USE WIRE BUNDLES, TUBING, DUCTS, OR OTHER ENGINE COMPONENTS AS A STEP OR HAND-HOLD. DAMAGE TO EQUIPMENT CAN OCCUR.

- (2) Install temporary protective covers on the areas below and adjacent to the maintenance area.
- (a) Use a cover that is applicable to protect components from the specific contaminant.
- 1) Examples of covers are as follows:
    - a) Plastic sheeting for liquid
    - b) Canvas sheeting for liquid or debris
    - c) Paper for debris
    - d) Cardboard for debris.
- (b) Use tape to attach the cover to the aircraft structure.

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- 1) Examples of tapes are:
  - a) Masking tape for debris
  - b) Vinyl tape for liquids.
- 2) Make sure that the cover is in a shape to collect and contain fluids and debris.
- 3) Install the tape carefully to prevent damage to the structure and hold the shape of the cover to collect and contain fluids and debris.
- 4) Make sure that you do not tape the cover to any EWIS.
- (c) Make sure that the cover is attached in place.
  - 1) Make sure that EWIS stay covered during all of the maintenance work.

**D. Put the Airplane Back to Its Original Condition**

SUBTASK 20-60-07-010-001

- (1) Carefully remove the temporary protective covers.
  - (a) Make sure that the contaminants are contained and do not spill.

SUBTASK 20-60-07-211-001

- (2) Examine the area to make sure that no contaminants were spilled.
  - (a) If there is contamination on the EWIS, do this procedure: Cleaning to Remove Combustible Material, TASK 20-60-02-100-801.
- (3) Make sure the EWIS was not damaged during the maintenance.
  - (a) If any of the EWIS was damaged during maintenance, repair or replace per the applicable task: SWPM 20, Standard Wiring Practices.

———— END OF TASK ————



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INSTRUMENT PANEL CLEANING

1. General

- A. This procedure cleans all instrument panels located in the flight compartment.

**TASK 20-60-08-100-801**

2. Instrument Panel Cleaning

A. General

- (1) This procedure cleans the flight compartment instrument panels area where dust can accumulate.

B. Consumable Materials

Reference	Description	Specification
B00130	Alcohol - Isopropyl	TT-I-735
G01043	Cloth - Lint-free	

C. Location Zones

Zone	Area
211	Flight Compartment - Left
212	Flight Compartment - Right

D. Instrument Panel Cleaning

**CAUTION:** DO NOT USE ABRASIVE MATERIALS WHEN YOU CLEAN THE DISPLAY SURFACE.  
ABRASIVE MATERIALS WILL CAUSE SCRATCHES IN THE DISPLAY SURFACE.

SUBTASK 20-60-08-160-001

- (1) Blow off the instrument panel with dry, filtered air to remove the large dust and dirt particles.

SUBTASK 20-60-08-160-002

**CAUTION:** DO NOT APPLY CLEANER DIRECTLY ON THE DISPLAY SURFACE OR THE UNIT.  
ALWAYS APPLY CLEANER TO THE CLOTH. THIS WILL HELP PREVENT DAMAGE  
TO THE DISPLAY SURFACE OR THE UNIT.

- (2) Soak a clean lint-free cloth, G01043 with alcohol, B00130.

SUBTASK 20-60-08-160-004

**CAUTION:** DO NOT USE TOO MUCH FORCE WHEN YOU CLEAN THE DISPLAY SURFACE.  
TOO MUCH FORCE WILL CAUSE DAMAGE TO THE DISPLAY SURFACE.

- (3) Clean the instrument panel with the moist lint-free cloth, G01043.

SUBTASK 20-60-08-160-003

- (4) Dry the instrument panel fully with a clean dry lint-free cloth, G01043.

———— END OF TASK ————

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