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Rockwell Aerospace
Rocketdyne

SSME
SYSTEMS JOINT DATA

Prepared by
SSME Logistics Engineering
Publications & Training

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INTRODUCTION

Hardware descriptions are provided as a reference only. Refer to E41000-8/RSS-8559-2-1 volume III, Illustrated Parts Breakdown (IPB), for complete part information. Data presented is based on engines incorporating ECPs through SSME-1259.

Furnish corrections to Robert Maas, D/705, 055-CB26; comnet prefix is 586; commercial (FTS) access is (818) 586-7734.

GENERAL INFORMATION

A. FIELD REUSE POLICY ON SEALS

1. Replace all removed stretch joint seals, hard-to-get-at nonstretch joint seals, and RES1244 seals with new seals, except for the seal in joint F16. Inspect and reuse the nondiscrepant seal in this joint.

2. Inspect and reuse the nondiscrepant, nonstretch joint seals that are easy-to-get-at in the same joint from which the seal was removed.

B. INSTALLING BOLTS IN TAPPED HOLES AND NONLOCKING INSERTS. (Following are excerpts from Specification RA0101-002, Installation of Bolts, Nuts, Screws, and Studs.)

All bolts used in tapped holes and nonlocking inserts shall be free-running before preloading the joint. To ensure bolts are free-running, proceed as follows:

NOTE

The following procedure must be used in conjunction with RL00114 when installing SSME stretch-type bolts.

1. Position joint components for assembly as required by the applicable installation drawing.

2. Install each bolt 3 to 4 turns by hand (without tools) to ensure that threads are free-running; indicating adequate lubrication, undamaged threads, and that there is not adverse side-loading on the fasteners caused by misalignment.

3. If bolts cannot be installed and rotated by hand (without tools), proceed to step 4. If bolts can be installed and rotated, proceed to step 7.

4. Remove each bolt that cannot be rotated freely and check for damaged threads and lack of lubricant.

5. Lubricate undamaged bolts, replace damaged bolts, and make sure tapped hole or insert threads are clean and undamaged.

6. Ensure joint components are adequately constrained in alignment to prevent adverse side-loading of the bolts.

7. Install lubricated and new bolts as required in step 2.

NOTE

If bolts cannot be seated in the following step, an evaluation of the condition and directions for proceeding must be obtained.

8. Rotate bolts gradually, sequentially, and uniformly by hand (without tools), or with a small wrench if necessary to overcome possible minor misalignment. It may be necessary to carefully manipulate the joint components in the installation process to relieve misalignment.

9. After all bolts have been seated, preload each bolt to the specified values using the authorized methods and tooling.

C. REMOVING BOLTS FROM TAPPED HOLES AND NONLOCKING INSERTS

During removal, bolts shall be free-running after the preload is removed. To remove bolts, proceed as follows: (Following are excerpts from Specification RA0101-002, Installation of Bolts, Nuts, Screws, and Studs.)

NOTE

This procedure must be used in conjunction with RL00114 when removing SSME stretch-type bolts.

- Devices used for constraint and alignment of components during installation should be used during component removal.

1. Constrain components as necessary to maintain alignment, prevent excessive side-loading on bolts, and support components after removal.

NOTE

Unusual or excessive forces encountered during unloading in the following step can indicate galling. When encountered, removal must be stopped and an evaluation of the condition and directions for proceeding must be obtained.

2. Loosen bolts gradually, sequentially, and uniformly with a wrench until preload is removed from the joint. This will help prevent abnormal friction heating of the threads, which can cause galling.

NOTE

If bolts cannot be removed in the following step, and evaluation of the condition and directions for proceeding must be obtained.

3. Continue to loosen bolts gradually, sequentially, and uniformly by hand (without tools), or with a small wrench, until all bolts are removed. It may be necessary to carefully manipulate components in the removal process to relieve misalignment.

D. REUSE OF THREADED FASTENERS FOR SSME

1. Cleaning. Fasteners shall be free from foreign material before visual inspection. Cleaning methods shall not remove the original lubricant. Fasteners with foreign material in threads that cannot be easily removed with a nonmetallic bristle brush shall be rejected.

2. Visual Inspection. Fasteners shall be inspected without removing the original lubricant. Fasteners shall be inspected visually with the naked eye for the following conditions:

a. Galled Bearing Surfaces. The bearing surfaces shall be inspected for evidence of galling. Fasteners with galled bearing surfaces shall be rejected. The bearing surface is the surface that comes in contact with the mating part and is subjected to load. In the case of bolts, screws, and nuts, the bearing surface is the surface under the bolt or screw head or under the nut.

b. Visible Thread Damage. The threads shall be inspected for galling, stripping, scoring, or deformations that may impair the function of the fasteners. Fasteners with thread damage shall be rejected, except for studs which may be reworked.

3. Replacement of Lubricant. The removal of a fastener that was originally lubricated (i.e., baked-on dry film lubricant) from a tapped hole, insert, or nut is cause for relubrication regardless of the torque or load applied. Fastener load bearing surfaces and thread grooves shall be relubricated with a thin and uniform film before the fastener is reinstalled. Lubricant shall be replaced as specified in RA0112-002. Excess lubricant shall be wiped off.

LIST OF ACRONYMS

AFV	Anti-Flood Valve
ASI	Augmented Spark Igniter Augmented Spark Ignition System
CCV	Chamber Coolant Valve
CCVA	Chamber Coolant Valve Actuator
FPB	Fuel Preburner
FPOV	Fuel Preburner Oxidizer Valve
FPOVA	Fuel Preburner Oxidizer Valve Actuator
GCV	Gaseous Oxygen Control Valve
GOX	Gaseous Oxygen
HEX	Heat Exchanger
HGM	Hot-Gas Manifold
HPFTP	High-Pressure Fuel Turbopump
HPOTP	High-Pressure Oxidizer Turbopump
HPV	Helium Precharge Valve
LPFTP	Low-Pressure Fuel Turbopump
LPOTP	Low-Pressure Oxidizer Turbopump
LRU	Line-Replaceable Unit
MCC	Main Combustion Chamber
MFV	Main Fuel Valve
MFVA	Main Fuel Valve Actuator
MOV	Main Oxidizer Valve
MOVA	Main Oxidizer Valve Actuator
OPB	Oxidizer Preburner
OPOV	Oxidizer Preburner Oxidizer Valve
OPOVA	Oxidizer Preburner Oxidizer Valve Actuator
PEBB	Pump End Ball Bearing
PCA	Pneumatic Control Assembly
RIV	Recirculation Isolation Valve

TABLE 1. DRAIN SYSTEM JOINTS (Sheet 1 of 7)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
D1	5B	HPOTP to primary turbine seal drain line.	Seal RD261-3014-0175	1				
			Bolt RD111-4105-3410	6	64 ±3 in-lb			
			Washer RD153-5009-0001	6				
D2	5B	HPOTP to secondary turbine seal drain line.	Seal RD261-3014-0175	1				
			Bolt RD111-4105-3410	6	64 ±3 in-lb			
			Washer RD153-5009-0001	6				
D3	5B	HPOTP to oxidizer seal drain line.	Seal RD261-3014-0175	1				
			Bolt RD111-4105-3414	6	64 ±3 in-lb			
			Washer RD153-5009-0001	6				
D3.12	5B	Cover to oxidizer drain manifold boss S01.	Seal RD261-3017-0600	1				
			Bolt RD111-4105-3404	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
			Cover RS007055-005	1				
D4	7B	MOV to pneumatic package oxidizer drain manifold.	Seal RD261-3017-0600	1				
			Bolt RD111-4105-3405	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D5	7C	MOVA to main hydraulic drain manifold.	Seal RS008844-041	1				
			Bolt RD111-4105-3410	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D6	9B	MFV to MFV drain line.	Seal RS008856-003	1				
			Bolt RD111-4105-3409	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D7	9A	MFVA to MFVA hydraulic drain line.	Seal RS008844-041	1				
			Bolt RD111-4105-3410	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				

TABLE 1. DRAIN SYSTEM JOINTS (Sheet 2 of 7)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
D7.1	9A	MFV hydraulic drain line to MFV hydraulic line to manifold.	Seal RS008844-041	1				
			Bolt RD111-4105-3412	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
			Nut RD114-8011-0004 (1)	2				
D8	5C	OPOV to OPOV drain line.	Seal RD261-3017-0600	1				
			Bolt RD111-4105-3405	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D9	5D	OPOVA to OPOVA hydraulic drain line.	Seal RS008844-041	1				
			Bolt RD111-4105-3410	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D9.1	7C	OPOVA hydraulic drain line to main hydraulic drain manifold.	Seal RD261-3017-0600	1				
			Bolt RD111-4105-3405	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D10	10C	FPOV to FPOV drain line.	Seal RD261-3017-0600	1				
			Bolt RD111-4105-3405	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D11	11D	FPOVA to FPOVA hydraulic drain line.	Seal RS008844-041	1				
			Bolt RD111-4105-3410	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D11.1	10A	FPOVA hydraulic drain line to MFVA hydraulic drain line.	Seal RS008844-041	1				
			Bolt RD111-4105-3416	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D11.2	10A	MFVA hydraulic drain line to main hydraulic drain manifold.	Seal RD261-3017-0600 (See joint D11.1 for fastener data.)	1				

(1) Allowable alternate: RD114-8013-0004.

TABLE 1. DRAIN SYSTEM JOINTS (Sheet 3 of 7)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
D12	7B	CCV to CCV fuel drain line.	Seal RD261-3017-0600	1				
			Bolt RD111-4105-3407	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D13	7A	CCVA to main hydraulic drain manifold.	Seal RS008844-041	1				
			Bolt RD111-4105-3410	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D14	1D	PCA to component oxidizer drain manifold.	Seal RD261-3017-1300	1				
	8E		Bolt RD111-4105-3409	3	64 ±3 in-lb			
			Washer RD153-5009-1001	3				
D14.3	6C	Pneumatic package oxidizer drain manifold to component oxidizer drain manifold.	Seal RD261-3017-0600	1				
			Bolt RD111-4105-3405	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D14.4	6A	OPOV drain line to component oxidizer drain manifold.	Seal RD261-3017-0600	1				
			Bolt RD111-4105-3405	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D14.5	6A	FPOV drain line to component oxidizer drain manifold.	Seal RD261-3017-0600	1				
			Bolt RD111-4105-3406	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D15	1A	PCA to component fuel drain manifold.	Seal RD261-3017-1300	1				
	8D		Bolt RD111-4105-3409	3	64 ±3 in-lb			
			Washer RD153-5009-1001	3				
D15.2	8A	Seal cavity upper vent line to component fuel drain manifold.	Seal RD261-3017-0600	1				
			Bolt RD111-4105-3405	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D15.3	8A	Fuel drain purge line to component fuel drain manifold.	Seal RD261-3017-0700	1				
			Bolt RD111-4105-3405	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				

TABLE 1. DRAIN SYSTEM JOINTS (Sheet 4 of 7)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
D15.4	8A	MCC drain line to component fuel drain manifold.	Seal RD261-3017-0850	1				
			Bolt RD111-4105-3407	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
D15.5	9B	MCC burst diaphragm to MCC.	Seal RD261-3017-1100	1				
			Burst Diaphragm RS009176-011	1	350 ±15 in-lb			
D15.5.1	9B	MCC drain line (R033302) to MCC burst diaphragm.	Seal RD261-3017-0900	1				
			Bolt NAS1004-5H	4	52 ±3 in-lb			
D15.6	9B	MCC burst diaphragm to MCC.	Seal RD261-3017-1100	1				
			Burst Diaphragm RS009176-011	1	350 ±15 in-lb			
D15.6.1	9B	MCC drain line (R0017310) to MCC burst diaphragm.	Seal RD261-3017-0900	1				
			Bolt NAS1004-5H	4	52 ±3 in-lb			
D16	11B	HPFTP to HPFTP fuel drain manifold.	Seal RD261-3017-0600	1				
			Bolt RD111-4105-3404	2	64 ±3 in-lb			
			Washer RD153-5009-0001	1				
			Bracket MS9102-03	1				
D16.1	9A	CCV fuel drain line to HPFTP fuel drain manifold.	Seal RD261-3017-0600	1				
			Bolt RD111-4105-3405	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D16.2	9A	MFV fuel drain manifold to HPFTP fuel drain manifold.	Seal RD261-3017-0600	1				
			Bolt RD111-4105-3405	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D16.3	8A	HPFTP fuel drain manifold to component fuel drain manifold.	Seal RD261-3017-1150	1				
			Bolt RD111-4105-3406	4	64±3 in-lb			
			Washer RD153-5009-0001	4				

TABLE 1. DRAIN SYSTEM JOINTS (Sheet 5 of 7)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
D17	12E	LPFTP to LPFTP seal vent line.	Seal RD261-3017-0700	1				
			Bolt RD111-4105-3406	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
			Bracket MS9102-20	1				
D18	11D	LPFTP seal vent line to liftoff seal vent flexible line.	Seal RS008844-061	1				
			Bolt RD111-4105-3407	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D19	11A	Liftoff seal vent flexible line to seal cavity upper vent line.	Seal RS008844-061	1				
			Bolt RD111-4105-3414	2	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Nut RD114-8011-0004 (1)	2				
D25	4A	Primary turbine seal drain line to primary turbine seal drain on nozzle.	Seal RD261-3014-0200	1				
			Bolt RD111-4105-3412	6	64 ±3 in-lb			
			Washer RD153-5009-0001	6				
			Nut RD114-8011-0004 (1)	6				
D26	6A	Secondary turbine seal drain line to secondary turbine seal drain on nozzle.	Seal RD261-3014-0200	1				
			Bolt RD111-4105-3415	6	64 ±3 in-lb			
			Washer RD153-5009-0001	6				
			Nut RD114-8011-0004 (1)	6				
D27	6A	Oxidizer seal drain manifold to oxidizer seal drain on nozzle.	Seal RD261-3014-0200	1				
			Bolt RD111-4105-3412	6	64 ±3 in-lb			
			Washer RD153-5009-0001	6				
			Nut RD114-8011-0004 (1)	6				
D28	10A	Main hydraulic drain manifold to hydraulic drain on nozzle.	Seal RS008844-041	1				
			Bolt RD111-4105-3412	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
			Nut RD114-8011-0004 (1)	2				

(1) Allowable alternate: RD114-8013-0004.

TABLE 1. DRAIN SYSTEM JOINTS (Sheet 6 of 7)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
D29	4C	HPV to Pogo suppression system oxidizer drain line.	Seal RD261-3017-0600	1				
			Bolt RD111-4105-3404	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D29.1	3C	HPV to HPV drain line.	Seal RD261-3017-0750	1				
			Bolt RD111-4105-3405	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D29.2	4A	HPV drain line to Pogo suppression system oxidizer drain line.	Seal RD261-3017-0600	1				
			Bolt RD111-4105-3406	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D30 and D30.1	6A	Pogo suppression system oxidizer drain line to AFV line and AFV line to component oxidizer drain manifold.	Seal RD261-3017-0750	2				
			Bolt RD111-4105-3416	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D30.2	6B	AFV to AFV vent line.	Seal RD261-3017-0600	1				
			Bolt RD111-4105-3405	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D31	3B	RIV to Pogo suppression system oxidizer drain line.	Seal RD261-3017-0600	1				
			Bolt RD111-4105-3404	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D33	8A	Component fuel drain manifold to component fuel drain on nozzle.	Seal RD261-3014-0200	1				
			Bolt RD111-4105-3415	6	64 ±3 in-lb			
			Washer RD153-5009-0001	6				
			Nut RD114-8011-0004 (1)	6				
D34	6A	Component oxidizer drain manifold to component oxidizer drain on nozzle.	Seal RD261-3014-0200	1				
			Bolt RD111-4105-3407	6	64 ±3 in-lb			
			Washer RD153-5009-0001	6				

(1) Allowable alternate: RD114-8013-0004.

TABLE 1. DRAIN SYSTEM JOINTS (Sheet 7 of 7)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
D35.1 (2)	5B	Intermediate seal cavity pressure line to turbopump boss SG5.	Seal RD261-3017-0600	1				
			Bolt RD111-4105-3407	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
D35.2 (2)	4B	Transducer to intermediate seal cavity pressure line.	Seal RD261-3017-0800 (3)	1				
			Sensor RES7001-102 (4)	1				
			Sensor RE2233-001 (5,6)	1				
			Block RS007349-003	1				
			Bolt MS21280-35	4	50 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Nut RD114-8017-0004	4				

(2) Engines to 2035.
(3) Allowable alternate: RD261-3019-0800.
(4) Allowable alternates: RES7001-202, -222, -242.
(5) On engines incorporating ECP SSME-1159.
(6) Allowable alternates: RES7001-202, -222.

TABLE 2. FUEL SYSTEM JOINTS (Sheet 1 of 10)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
F1	12E	Interface to LPFTP.	Orbiter Interface					
F1.1	11E	LPFTP shaft speed sensor to LPFTP boss JZ2aV.	Seal RD261-3019-0800	1				
			Bolt RS007645-003	2	50 ±3 in-lb			
			Washer MS9549-10	2				
			Sensor RES7005-076	1				
F2	12E	LPFTP to insulated LPFTP discharge duct.	Seal RS008862-003	1				
			Bolt RD111-4101-0509	16	140 ±8 in-lb	.1046 +.0000, -.0003	.1042 to .1046	Sheet 1
			Bracket R0019167-005	1				
			Bolt RD111-4022-0501	4	50 ±2 in-lb			
			Washer RD153-5009-0002	4				
			Bracket R0017841-3	1				
			Bolt RD111-4022-0501	2	50 ±2 in-lb			
F2.2	11B	Insulated LPFTP discharge duct boss KF1dI to joint F2.2 to transducer line.	Seal RD261-3017-0800 (1)	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
F2.2.1	11A	Joint F2.2 to transducer line to LPFTP discharge pressure sensor.	Seal RD261-3017-0800 (1)	1				
			Bolt RD111-4105-3418	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4	(Torque before			
			Sensor RES7001-102 (2)	1	nut)			
			Sensor RE2233-001 (3,4)	1				
			Washer LD153-0010-0010	4				
			Nut RD114-1019-0004	4	50 ±2 in-lb			

(1) Allowable alternate: RD261-3019-0800.
(2) Allowable alternates: RES7001-202, -222, -242.
(3) On engines incorporating ECP SSME-1159.
(4) Allowable alternates: RES7001-202, -222.

TABLE 2. FUEL SYSTEM JOINTS (Sheet 2 of 10)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
F2.3	11B	LPFTP discharge temperature sensor to insulated LPFTP discharge duct boss KF1el.	Seal RD261-3017-0800 (1)	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-1001	4				
			Sensor RES7002-261	1				
F3	11B	Insulated LPFTP discharge duct to HPFTP.	Seal RS008854-017	1				
			Bolt RD111-4101-0509	14	140 ±8 in-lb	.1045 +.0000, -.0003	.1042 to .1045	Sheet 1
F3.1	10A	HPFTP shaft speed sensor to HPFTP boss KZ2aV.	Seal RS008856-013	1				
			Bolt RD111-1009-3412	2	52 ±3 in-lb			
			Washer LD153-0013-0002	2				
			Sensor RES7005-085	1				
F3.2	11B	HPFTP thrust bearing cap to thrust bearing housing.	Seal RS008858-015	1				
			Bolt MS9575-53	14	110 ±5 in-lb			
			Washer LD153-0013-0002	14				
			Cover RS007540-031 (5)	1				
F3.3	11B	HPFTP thrust bearing housing to HPFTP.	Seal RS008858-015	1				
			Capscrew ND112-0001-0638 (6)	2	52 ±3 in-lb			
			Housing R0019204-005	1				
F4	10B	HPFTP to Inconel 718 insulated high-pressure fuel duct.	Seal RS008854-019	1				
			Bolt RD111-4100-0922	12	69 ±3 ft-lb	.1109 +.0000, -.0003	.1106 to .1109	Sheet 1
			Washer RD153-5002-0009	12				
F4.1	10B	Insulated high-pressure fuel duct boss KF4P to joint F4.1 to transducer line.	Seal RS008856-009	1				
			Bolt RD111-4105-3406	4	64±3 in-lb			
			Washer RD153-5009-0001	4				

(1) Allowable alternate: RD261-3019-0800.

(5) Allowable alternate: RS007540-021.

(6) Lubricate per RA0112-002, method A, using G-n metal assembly paste, Dow Corning Corp.

TABLE 2. FUEL SYSTEM JOINTS (Sheet 3 of 10)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
F4.1.1	10B	Joint F4.1 to transducer line to HPFTP discharge pressure sensor.	Seal RD261-3017-0800 (1)	1				
			Bolt RD111-4105-3421	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4	(Torque before			
			Sensor RES7001-119 (7)	1	nut)			
			Sensor RE2233-061 (3,8)	1				
			Block RS007349-003	1				
			Washer LD153-0010-0010	4				
			Nut RD114-1019-0004	4	50 ±2 in lb			
F4.2	9B	Inconel 718 insulated high-pressure fuel duct to insulated rigid fuel bleed duct.	Seal RS008854-005	1				
			Bolt RD111-4100-0708	8	390 ±20 in-lb	.1055 +.0000, -.0003	.1052 to .1055	Sheet 2
			Washer RD153-5009-0004	8				
F4.2.1	10B	Insulated rigid fuel bleed duct to articulating insulated fuel bleed duct.	Seal RD261-3014-0185	1				
			Bolt RD111-4103-3508	6	140 ±8 in-lb			
			Washer RD153-5009-0002	6				
F4.3	10E	Articulating insulated fuel bleed duct to interface.	Orbiter Interface					
F5	9B	Inconel 718 insulated high-pressure fuel duct to MFV.	Seal RS008854-009	1				
			Bolt RD111-4100-0924	13	58 ±2 ft-lb	.1076 +.0000, -.0007	.1069 to .1076	Sheet 2
			Washer RD153-5002-0009	13				

(1) Allowable alternate: RD261-3019-0800.
(3) On engines incorporating ECP SSME-1159.
(7) Allowable alternates: RES7001-219, -239, -259.
(8) Allowable alternates: RES7001-219, -239, -259, RE2233-161.

TABLE 2. FUEL SYSTEM JOINTS (Sheet 4 of 10)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
F5.1 and F5.1.1	8B	ASI fuel supply line to ASI fuel supply filter to nozzle fuel manifold.	Seal RD261-3017-1050	2				
			Filter R0018225-21	1				
			Washer RD153-5009-0002	6				
			Bolt RD111-4105-3517	6	110 ±5 in-lb			
			Bolt RD111-4010-3524 (9)	6	130 ±5 in-lb			
			Spacer R0017855-3 (10)	6				
F5.2	8B	ASI fuel supply line to MCC.	Seal RD261-3017-0850	1				
			Bolt RD111-4105-3418 (11,12)	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Washer RD153-5007-0004	4				
			Nut RD114-8013-0004	4				
F5.3	9A	MFVA to MFV.	Packing MS28775-246 (13)	1				
			Insulator RS008085-003	1				
			Nut RD114-8010-0005	6	106 ±5 in-lb	.1075 +.0000, -.0007	.1068 to .1075	Sheet 2
			Washer RD153-5006-0005	6				
			Shim RS008194-003	1				
			Bolt RD111-1010-3358	1	2 in-lb			
			Washer RS010358-003	1	(minimum			
			Coupling RS008084-023	1	running torque)			
			Coupling RS008083-009	1				
			Coupling RS008180-007	1				
			Retainer RS010357-003	1				

(9) Allowable alternate.

(10) To be used with bolt RD111-4010-3524 instead of washers.

(11) Allowable alternates: RD111-4105-3419 thru -3421.

(12) Manufacturing option: Install one washer RD153-1008-1004 between ASI line flange and support bracket at each support bolt hole and replace the two respective bolts with bolts RD111-4105-3421.

(13) Lubricate per RA0112-002, method I, using RB0140-012.

TABLE 2. FUEL SYSTEM JOINTS (Sheet 5 of 10)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
F6	9B	MFV to fuel diffuser.	Seal RS008854-007	1				
			Bolt RD111-4100-0922	14	69 ±3 ft-lb	.1108 +.0000, -.0003	.1100 to .1108	Sheet 3
			Bracket R0012135-005	1				
			Bolt RD111-4022-0801	4	50 ±2 in-lb			
			Bracket R0019551-003	1				
			Bolt RD111-4022-0801	3	50 ±2 in-lb			
			Washer RD153-5009-0005	3				
			Bracket RS007272-007	1				
			Bolt RD111-4022-0801	1	50 ±2 in-lb			
			Washer RD153-5009-0005	1				
F6.1 and	9B	Fuel system purge line to fuel system gaseous nitrogen	Seal RD261-3017-1200	1				
F6.1.1	8B	purge line and to fuel diffuser.	Seal RD261-3017-1250	1				
			Bolt RD111-4008-6414	7	66 ±3 in-lb			
			Washer RD153-5006-0004	7				
F6.1.2 (14)	8B	Cover to fuel system drying purge manifold fitting.	Seal RD261-3017-0750	1				
			Bolt RD111-4102-3406	2	66 ±3 in-lb			
			Washer RD153-5009-0001	2				
			Cover R039332-3	1				
F6.4	8B	Fuel diffuser to MCC coolant manifold.	Seal RD261-3014-0265	1				
			Bolt RD111-4100-0520	15	80 ±5 in-lb	.1054 +.0000, -.0003	.1051 to .1054	Sheet 3
			Washer RS009404-003	30				
			Nut RD114-8010-0005	15				
F6.6	8B	Plate to coolant manifold purge boss.	Seal RD261-3017-0800	1				
			Bolt RD111-4105-3409	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Plate RS007167-007	1				
			Bracket R0019571-011	1				

(14) Engines 2036 and subs.

TABLE 2. FUEL SYSTEM JOINTS (Sheet 6 of 10)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
F6.6.1	7B	Plug to MCC body.	Seal RD261-3017-0750	1				
			Plug RS009115-003	1	270 ±15 in-lb			
F6.10	8A	Plug to nozzle fuel manifold.	Seal RES1244-01	1				
			Plug RD273-6004-0001 (Lubricate threads with RB0140-018 using method A.)	1	93 ±2 in-lb			
F6.11	8A	Plug to nozzle fuel manifold.	Seal RES1244-01	1				
			Plug RD273-6004-0001 (Lubricate threads with RB0140-018 using method A.)	1	93 ±2 in-lb			
F6.13	7A	CCVA to CCV.	Packing MS28775-234 (15)	1				
			Insulator RS008176-005	1				
			Nut RD114-8010-0005	6	106 ±5 in-lb	.1059 +.0000, -.0005	.1048 to .1059	Sheet 3
			Washer RD153-5006-0005	6				
			Shim RS008321-003	9	maximum			
			Bolt RD111-4009-6304	2	28 ±1 in-lb			
			Plug R0015517-1	2				
			Coupling RS008318-013	2				
			Slider RS008320-007	1				
			Retainer RS010357-005	1				
F7	8B	MCC to LPFTP turbine drive duct.	Seal RD261-3014-0290	1				
			Bolt RD111-4101-0511	15	140 ±8 in-lb	.1054 +.0000, -.0003	.1050 to .1054	Sheet 4
			Orifice R0014407-1XXXXX (16,17)	1				

(15) Lubricate per RA0112-002, method J, using RB0140-012.

(16) Allowable alternate: R0014407-2XXXXX.

(17) Refer to Engine Acceptance Data Package for complete orifice part number.

TABLE 2. FUEL SYSTEM JOINTS (Sheet 7 of 10)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
F7.1	8B	MCC coolant outlet temperature sensor to LPFTP turbine drive duct boss CF7l.	Seal RD261-3019-0800	2				
			Bolt RD111-4105-3417	4	64 ±3 in-lb			
			Washer RD153-5009-1001	4				
			Spacer R0019432-007	1				
			Sensor RES7004-22	1				
F7.1a	8A	MCC coolant outlet pressure sensor to LPFTP turbine drive duct boss CF7a.	Seal RD261-3017-0800 (1)	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-1001	4				
			Sensor RES7001-114 (18)	1				
			Sensor RE2233-051 (3,19)	1				
F7.2	12E	Plug to LPFTP turbine drive duct boss JC1a.	Seal RD261-3017-0800 (1)	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-1001	4				
			Plug RS009528-009	1				
F8	12E	LPFTP turbine drive duct to LPFTP.	Seal RD261-3014-0295	1				
			Bolt RD111-4101-0511	15	140 ±8 in-lb	.1054 +.0000, -.0003	.1050 to .1054	Sheet 4
F9	12E	LPFTP to LPFTP turbine discharge duct.	Seal RD261-3014-0915	1				
			Bolt RD111-4101-0616	36	210 ±10 in-lb	.1051 +.0000, -.0003	.1046 to .1051	Sheet 5
			Bracket MS9103-24	4				
			Bolt RD111-4022-0501	4	50 ±2 in-lb			
			Washer RD153-5009-0002	4				
F9.1	12E	Plug to LPFTP turbine discharge duct.	Seal RD261-3017-0900	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-1001	4				
			Plug RS009528-009	1				

(1) Allowable alternate: RD261-3019-0800.
(3) On engines incorporating ECP SSME-1159.
(18) Allowable alternates: RES7001-214, -234, -254.
(19) Allowable alternates: RES7001-214, -234, -254, RE2233-151.

TABLE 2. FUEL SYSTEM JOINTS (Sheet 8 of 10)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
F9.2	12E	LPFTP turbine discharge duct to fuel tank pressurant line.	Seal RD261-3017-1050	1				
			Bolt RD111-4103-3407	8	70 ±4 in-lb			
			Washer RD153-5009-0001	8				
F9.3	11E	Fuel tank pressurant line to interface.	Orbiter Interface					
F10	11B	LPFTP turbine discharge duct to HGM.	Seal RD261-3014-0335	1				
			Bolt RD111-4101-0509	12	140 ±8 in-lb	.1047 +.0000, -.0003	.1044 to .1047	Sheet 5
			Bracket MS9103-40	2				
			Bolt RD111-4022-0501	2	50 ±3 in-lb			
			Washer RD153-5009-0002	2				
F11	7A	CCV to chamber coolant duct.	Seal RD261-3014-0375	1				
			Seal RD261-3017-0600	1				
			Bolt RD111-4101-0908	6	69 ±3 ft-lb	.1055 +.0000, -.0003	.1049 to .1055	Sheet 6
F12.1 (14)	7B	Plate to HGM boss CF9l.	Seal RD261-3017-0800	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-1001	4				
			Plate RS007167-005	1				
F16	7B	HGM to MCC. (Not an LRU)	Seal RS008864-001	1				
			Bolt RD111-4100-0925	60	69 ±3 ft-lb	.1106 +.0000, -.0003	.1096 to .1106	Sheet 6
			Bracket R034158-3 (20)	1				
			Bracket R032911-3 (21)	1				
			Bolt RD111-4022-0801	2	50 ±2 in-lb			
			Washer RD153-1008-0008 (22,23)	6				

(14) Engines 2036 and subs.

(20) R034156-3 on engines 2028.

(21) R034144-3 on engines 2028.

(22) Install from zero to 3 washers between bracket and head of Bolt RD111-4100-0925 to control thread engagement of Bolt RD111-4022-0801. Two complete threads engagement is required and bottoming bolt is not permitted.

(23) RD153-1004-0015 on engines 2029, 2030.

TABLE 2. FUEL SYSTEM JOINTS (Sheet 9 of 10)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
F16 cont'd.		Seal monitoring port for joint F16.	Seal RE261-3005-1002	1				
			Plug RD265-3017-0002 (Lubricate thread with RB0140-018 using method A.)	1	64 ±7 in-lb			
F17	7B	Mixer to OPB and FPB fuel supply duct.	Seal RD261-3014-0535	1				
			Bolt RD111-4101-0819	20	580 ±30 in-lb	.1089 +.0000, -.0003	.1082 to .1089	Sheet 1
			Washer RD153-5009-0005	20				
			Bracket R0019963-005	1				
			Bolt RD111-4022-0502	4	50 ±2 in-lb			
			Washer RD153-5009-0002	4				
			Bracket MS9104-55	1				
			Bolt RD111-4022-0501	1	50 ±2 in-lb			
			Washer RD153-5009-0002	1				
F20	10B	Plate to HPFTP boss KF2a.	Seal RD261-3017-0800	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	3				
			Plate RS007167-005	1				
			Bracket MS9102-03	1				
F21	10B	FPB ASI fuel line to FPB.	Seal RD261-3017-0850	1				
			Bolt RD111-4105-3418	4	64 ±3 in-lb			
			Nut RD114-8013-0004	4				
			Washer RD153-5009-0001	4				
F22	8C	ASI fuel supply line to FPB ASI fuel line.	Seal RD261-3017-0850	1				
			Bolt RD111-4105-3409	4	64 ±4 in-lb			
			Washer RD153-5009-1001	4				

TABLE 2. FUEL SYSTEM JOINTS (Sheet 10 of 10)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
F23	8C	ASI fuel supply line to OPB ASI fuel line.	Seal RD261-3017-0850	1				
			Bolt RD111-4105-3409	4	64 ±3 in-lb			
			Washer RD153-5009-1001	4				
			Bracket R0012835-11 (24)	1				
F25	5B	OPB ASI fuel line to OPB.	Seal RD261-3017-0850	1				
			Bolt RD111-4105-3418	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Nut RD114-8013-0004	4				

(24) Allowable alternate: R039345-3.

TABLE 3. HOT GAS SYSTEM JOINTS (Sheet 1 of 8)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
G1	5B	Plug to OPB boss 0G1a.	Seal RD261-3019-0800	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Plug RS009557-005	1				
G1.1	5B	Plug to OPB boss 0G1b.	Seal RD261-3019-0800	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Plug RS009557-005	1				
G1.3	5B	Plug to OPB boss 0G1d.	Seal RD261-3019-0800	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Plug RS009528-009	1				
G2 (1)	5B	HPOTP to OPB. (No external leakage.)	Seal RS008857-003	1				
			Seal RS008848-005	1				
			Screw RD112-5014-1008 (2)	2	18-20 in-lb			
			Retainer RS007786-003	2				
			Eccentric ring R055017-X (3)	1				
G2 (4)	5B	HPOTP to OPB. (No external leakage)	Gasket 4751170-01	1				
			Gasket 4751171-01	1				
			Ring 4750820	1				
G3	5B	HPOTP to HGM.	Seal RD261-3016-1450	1				
			Nut RD114-8010-0012	30	160 ±8 ft-lb	.1113 +.0000, -.0003	.1104 to .1113	Sheet 7
			Stud RE113-3003-3237	30				

(1) Engines to 2035.
(2) Allowable alternate: RD112-5001-1008.
(3) Refer to Engine Acceptance Data Package for complete eccentric ring part number.
(4) Engines 2036 and subs.

TABLE 3. HOT GAS SYSTEM JOINTS (Sheet 2 of 8)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
G3.1	5B	HPOTP turbine discharge temperature sensor to HGM boss BG2dT.	Seal RD261-3019-0800	1				
			Bolt RD111-4105-3407	1	64 ±3 in-lb			
			Bolt RD111-4105-3406	3	64 ±3 in-lb			
			Washer RD153-5009-1001	4				
			Bracket MS9593-130	1				
			Sensor RE7013-01 (5)	1				
G3.2	5B	HPOTP turbine discharge temperature sensor to HGM boss BG2cT.	Seal RD261-3019-0800	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-1001	4				
			Sensor RE7013-01 (5)	1				
G3.3 (4)	5B	Plug to HPOTP roller bearing borescope access port.	Gasket 4750379-01	1				
			Plug 4750861	1	410 ±20 in-lb			
G3.4 (4)	5B	Plug to HPOTP turbine borescope access.	Gasket 4750973-01	1				
			Bolt 4790025-10	4	42-46 in-lb			
			Plug 4750376-01	1				
G4 (4)	11B	Plug to FPB boss FG1a.	Seal RD261-3019-0800	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Plug R0011044-041	1				
			Cap R0017433-3	1				
G4.1	11B	FPB combustion pressure sensor to FPB boss FG1b.	Seal RD261-3019-0800	1				
			Bolt RD111-4105-3408 (1)	4	64 ±3 in-lb			
			Bolt RD111-4105-3419 (4)	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Mount R0014416-11 (1)	1				
			Adapter R0018031-11 (4)	1				

(1) Engines to 2035.
(4) Engines 2036 and subs.
(5) Allowable alternate: RES7004-91.

TABLE 3. HOT GAS SYSTEM JOINTS (Sheet 3 of 8)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
G4.1.1	11B	FPB combustion pressure sensor to mount.	Seal RD261-3019-0800 (1)	1				
			Seal RD261-3019-0800 (4)	2				
			Bolt RD111-4105-3426	4	64 ±3 in-lb			
			Block RS007349-003	1	(Torque before			
			Washer RD153-5009-0001	4	nut)			
			Nut RD114-1019-0004 (1)	4	50 ±2 in-lb			
			Spacer R0019432-003 (4)	1				
			Sensor RES7001-114 (6)	1				
			Sensor RE2233-051 (7,8)	1				
G4.2 (4)	11B	Plug to FPB boss FG1c.	Seal RD261-3019-0800	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Plug R0017434-3	1				
G4.3 (1)	11B	Plug to FPB boss FG1d.	Seal RD261-3019-0800	1				
			Bolt RD111-4105-3408	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Plug R0011044-031	1	30 ±3 in-lb			
			Cap R0011045-003	1				
			Bracket R0011156-009	1				
G5	11B	HPFTP to FPB. (No external leakage.)	Seal RS008857-005	1				

(1) Engines to 2035.
(4) Engines 2036 and subs.
(6) Allowable alternates: RES7001-214, -234, -254.
(7) On engines incorporating ECP SSME-1159.
(8) Allowable alternates: RES7001-214, -234, -254, RE2233-151.

TABLE 3. HOT GAS SYSTEM JOINTS (Sheet 4 of 8)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
G5.1	10B	HPFTP turbine discharge temperature sensor to HGM boss KG2aT.	Seal RD261-3019-0800	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-1001	3				
			Sensor RE7013-01 (5)	1				
			Bracket MS9593-164	1				
G5.2	10B	HPFTP turbine discharge temperature sensor to HGM boss KG2bT.	Seal RD261-3019-0800	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-1001	3				
			Bracket MS9593-164	1				
			Sensor RE7013-01 (5)	1				
G5.11 (4)	10B	Plate to HGM boss KG2cT.	Seal RD261-3019-0800	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Plate RS007167-005	1				
G5.12 (4)	10B	Plate to HGM boss KG2dT.	Seal RD261-3019-0800	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Plate RS007167-005	1				
G6	11B	HPFTP to HGM.	Seal RD261-3016-1675	1				
			Nut RD114-8010-0012	36	160 ±8 ft-lb	.1146 +.0000, -.0003	.1134 to .1146	Sheet 8
			Shim R0011082-003 (9)	1				
			Stud RE113-3003-3247	36				

(4) Engines 2036 and subs.
(5) Allowable alternate: RES7004-91.
(9) R0011082-005 on engine 2030 only.

TABLE 3. HOT GAS SYSTEM JOINTS (Sheet 5 of 8)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
G7	8B	Plate to MCC injector boss CG1b.	Seal RD261-3019-0800	1				
			Bolt RD111-4105-3411	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Plate RS007167-015(10)	1				
			Bracket R0012834-11 (1)	1				
			Bracket R0018053-1 (4)	1				
			Bolt RD111-4103-3402	4	70 ±4 in-lb			
			Washer RD153-5006-0004 (11)	4				
G7.2	8B	MCC fuel injector pressure sensor mount to MCC boss CG1p.	Seal RD261-3019-0800	1				
			Bolt RD111-4105-3408	4	64 ±3 in-lb			
			Washer RD153-5009-1001	4				
			Mount RS007371-031	1				
G7.2.1	8B	MCC fuel injector pressure sensor to mount.	Seal RD261-3019-0800	1				
			Bolt RD111-4105-3424	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4	(Torque before			
			Block RS007349-003	1	nut)			
			Washer LD153-0010-0009	4				
			Nut RD114-1019-0004	4	50 ±2 in-lb			
			Sensor RES7001-114 (6)	1				
			Sensor RE2233-051 (7,8)	1				

(1) Engines to 2035.
(4) Engines 2036 and subs.
(6) Allowable alternates: RES7001-214, -234, -254.
(7) On engines incorporating ECP SSME-1159.
(8) Allowable alternates: RES7001-214, -234, -254, RE2233-151.
(10) RS007167-017 on engine 2017 only.
(11) On engine 2017, use 8 washers with two required under each bolt head.

TABLE 3. HOT GAS SYSTEM JOINTS (Sheet 6 of 8)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
G8.2 (12) and G8.2.4	7B	MCC pressure sensor to MCC boss CG2bP.	Seal RD261-3017-0800	2				
			Bolt RD111-4105-3424	4	64 ±3 in-lb			
			Washer RD153-5009-1001	4				
			Mount R0010760-031	1				
			Block R0010821-003	1				
			Sensor RES7001-110 (13)	1				
			Sensor RE2233-031 (7,14)	1				
G8.3 (12) and G8.3.4	7B	MCC pressure sensor to MCC boss CG2cP.	Seal RD261-3017-0800 (15)	2				
			Bolt RD111-4105-3424	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Mount R0010760-031	1				
			Block R0010821-003	1				
			Sensor RES7001-110 (13)	1				
			Sensor RE2233-031 (7,14)	1				
G8.7	8B	MCC boss CG2dP to MCC pressure sensor mount.	Seal RD261-3017-0800 (15)	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-1001	3				
			Mount RS007371-021	1				
			Bracket MS9593-130	1				
G8.7.1	8B	MCC pressure sensor mount to sensor.	Seal RD261-3017-0800 (15)	1				
			Bolt RD111-4105-3421	4	64 ±3 in-lb			
			Washer RD153-5009-1001	4				
			Block R0010821-003	1				
			Sensor RES7001-110 (13)	1				
			Sensor RE2233-031 (7,14)	1				

(7) On engines incorporating ECP SSME-1159.

(12) Engine 2028 only.

(13) Allowable alternates: RES7001-210, -230, -250.

(14) Allowable alternates: RES7001-210, -230.

(15) Allowable alternate: RD261-3019-0800.

TABLE 3. HOT GAS SYSTEM JOINTS (Sheet 7 of 8)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
G8.8 and G8.8.1	8B	MCC boss CG2eP to MCC pressure sensor.	Seal RD261-3017-0800 (15)	2				
			Bolt RD111-4105-3424	4	64 ±3 in-lb			
			Washer RD153-5009-1001	4				
			Mount R0010760-031	1				
			Block R0010821-003	1				
			Sensor RES7001-110 (13)	1				
			Sensor RE2233-031 (7,14)	1				
G9	5B	Spark igniter to OPB.	Seal RD261-3016-0110	1				
			Seal RS003699-003	1				
			Igniter RS003685-191 (16)	1	260 ±15 in-lb			
			Igniter R0013000-1 (17,18)	1	260 ±15 in-lb			
G10	5B	Spark igniter to OPB.	Seal RD261-3016-0110	1				
			Seal RS003699-003	1				
			Igniter RS003685-191 (16)	1	260 ±15 in-lb			
			Igniter R0013000-1 (17,18)	1	260 ±15 in-lb			
G11	11B	Spark igniter to FPB.	Seal RD261-3016-0110	1				
			Seal RS003699-003	1				
			Igniter RS003685-191 (16)	1	260 ±15 in-lb			
			Igniter R0013000-1 (17,18)	1	260 ±15 in-lb			
G12	11B	Spark igniter to FPB.	Seal RD261-3016-0110	1				
			Seal RS003699-003	1				
			Igniter RS003685-191 (16)	1	260 ±15 in-lb			
			Igniter R0013000-1 (17,18)	1	260 ±15 in-lb			

(7) On engines incorporating ECP SSME-1159.
(13) Allowable alternates: RES7001-210, -230, -250.
(14) Allowable alternates: RES7001-210, -230.
(15) Allowable alternate: RD261-3019-0800.
(16) Allowable alternates: R0013000-1, R0013000-11, R0013000-21.
(17) Engines 2031 and subs.
(18) Allowable alternates: RS003685-191, R0013000-11, R0013000-21.

TABLE 3. HOT GAS SYSTEM JOINTS (Sheet 8 of 8)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
G13	8B	Spark igniter to MCC.	Seal RD261-3016-0110	1				
			Seal RS003699-003	1				
			Igniter RS003685-201 (16)	1	260 ±15 in-lb			
			Igniter R0013000-1 (17,19)	1	260 ±15 in-lb			
G14	8B	Spark igniter to MCC.	Seal RD261-3016-0110	1				
			Seal RS003699-003	1				
			Igniter RS003685-201 (16)	1	260 ±15 in-lb			
			Igniter R0013000-1 (17,19)	1	260 ±15 in-lb			
G15	8B	MCC to nozzle.	Seal RS008861-015	1				
			Bolt RD111-4101-0607	68	245 ±10 in-lb	.1045 +.0000, -.0003	.1042 to .1045	Sheet 9
			Bolt RD111-4101-0624	12	245 ±10 in-lb	.1103 +.0000, -.0003	.1094 to .1103	
			Bolt RD111-4022-0501	12	50 ±2 in-lb			
			Washer R0014415-3	12				
			Packing R039124-1	2				
			Packing R039124-11	2				

(16) Allowable alternates: R0013000-1, R0013000-11, R0013000-21.

(17) Engines 2031 and subs.

(19) Allowable alternates: RS003685-201, R0013000-11, R0013000-21.

TABLE 4. HYDRAULIC SYSTEM JOINTS (Sheet 1 of 3)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
H1	9E	Interface to quick-disconnect.	Orbiter Interface					
H1.1	9E	Quick-disconnect to hydraulic fluid interface flexible line.	Female coupling half RE2201-01	1	660 ±60 in-lb			
H2	9D	Hydraulic supply fluid interface flexible line to filter.	Seal RS008843-091 Bolt RD111-4105-3413 Washer RD153-5009-0001	1 3 3	 64 ±3 in-lb			
H3 and H3.1	10C	Filter to MFVA hydraulic supply manifold and MFVA hydraulic supply manifold boss NH1a to hydraulic supply pressure sensor.	Seal RS008851-011 Bolt RD111-4105-3423 Washer RD153-5009-0001 Sensor RES7007-62 (1) Sensor RE2233-071 (1,2)	2 4 4 1 1	 64 ±3 in-lb			
H3.2	9C	MFVA hydraulic supply manifold to MOVA hydraulic supply manifold.	Seal RS008843-111 Bolt RD111-4105-3410 Washer RD153-5009-0001	1 3 3	 64 ±3 in-lb			
H4	8B	MOVA hydraulic supply line to MOVA.	Seal RS008843-121 Bolt RD111-4105-3511 Washer RD153-5009-0002	1 3 3	 125 ±5 in-lb			
H5	9B	MFVA hydraulic supply manifold to MFVA.	Seal RS008843-121 Bolt RD111-4105-3511 Washer RD153-5009-0002	1 3 3	 125 ±5 in-lb			
H6	5C	MOVA hydraulic supply manifold to OPOVA.	Seal RS008843-121 Bolt RD111-4105-3511 Washer RD153-5009-0002	1 3 3	 125 ±5 in-lb			
H7	10C	MFVA hydraulic supply manifold to FPOVA.	Seal RS008843-121 Bolt RD111-4105-3511 Washer RD153-5009-0002	1 3 3	 125 ±5 in-lb			
H8	7A	MOVA hydraulic supply manifold to CCVA.	Seal RS008843-121 Bolt RD111-4105-3511 Washer RD153-5009-0002	1 3 3	 125 ±5 in-lb			

(1) Allowable alternates: RES7007-72, -82, -92, or RE2233-171.
(2) On engines incorporating ECP SSME-1159.

TABLE 4. HYDRAULIC SYSTEM JOINTS (Sheet 2 of 3)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
H9	7A	CCVA to MOVA hydraulic return manifold.	Seal RS008843-131 Bolt RD111-4105-3410 Washer RD153-5009-0001	1 3 3	64 ±3 in-lb			
H10	11D	FPOVA to MFVA hydraulic return manifold.	Seal RS008843-131 Bolt RD111-4105-3410 Washer RD153-5009-0001	1 3 3	64 ±3 in-lb			
H11	5C	OPOVA to MOVA hydraulic return manifold.	Seal RS008843-131 Bolt RD111-4105-3410 Washer RD153-5009-0001	1 3 3	64 ±3 in-lb			
H12	9B	MFVA to MFVA hydraulic return manifold.	Seal RS008843-131 Bolt RD111-4105-3425 Washer RD153-5009-0001	1 3 3	64 ±3 in-lb			
H12.1	9A	MFVA hydraulic return fluid temperature sensor to MFVA hydraulic return manifold boss NH2.	Seal RS008851-011 Bolt RD111-4105-3410 Washer RD153-5009-0001 Sensor RES7002-235	1 4 4 1	64 ±3 in-lb			
H13	7C	MOVA to MOVA hydraulic return line.	Seal RS008843-131 Bolt RD111-4105-3425 Washer RD153-5009-0001	1 3 3	64 ±3 in-lb			
H13.1	7C	MOVA hydraulic return fluid temperature sensor to MOVA hydraulic return line boss NH3.	Seal RS008851-011 Bolt RD111-4105-3410 Washer RD153-5009-0001 Sensor RES7002-235	1 4 4 1	64 ±3 in-lb			
H14	9D	MFVA hydraulic return manifold to hydraulic return fluid interface flexible line.	Seal RS008843-111 Bolt RD111-4011-3429 Washer RD153-5009-0001 Bracket MS9102-41 Nut RD114-8011-0004	1 3 3 1 3	64 ±3 in-lb			
H15	9D	MOVA hydraulic return manifold to hydraulic return fluid interface flexible line.	Seal RS008843-111 (See joint H14 for fastener data.)	1				
H16	9E	Hydraulic return fluid interface flexible line to quick-disconnect.	Female coupling half RE2201-03	1	420 ±60 in-lb			

TABLE 4. HYDRAULIC SYSTEM JOINTS (Sheet 3 of 3)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
H17	9E	Quick-disconnect to interface.	Orbiter Interface					
H18	7C	MOVA hydraulic supply manifold to MOVA hydraulic supply line.	Seal RS008843-111	1				
			Bolt RD111-4105-3416	3	64 ±3 in-lb			
			Washer RD153-5009-0001	3				
			Nut RD114-8011-0004	3				
H19	7C	MOVA hydraulic return manifold to MOVA hydraulic return line.	Seal RS008843-111	1				
			Bolt RD111-4105-3415	3	64 ±3 in-lb			
			Washer RD153-5009-0001	3				
			Nut RD114-8011-0004	3				

TABLE 5. NITROGEN SYSTEM JOINTS (Sheet 1 of 3)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
N1	9E	Interface to nitrogen supply fluid interface flexible line.	Orbiter Interface					
N1.1	8E	Nitrogen supply fluid interface flexible line to interface end nitrogen supply line.	Seal RS008842-011	1				
			Bolt RD111-4105-3414	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
N1.2	8E	Interface end nitrogen supply line to PCA end nitrogen supply line.	Seal RS008842-011	1				
			Bolt RD111-4105-3411	4	64 ±3 in-lb			
			Washer RD153-5009-0001	3				
			Bracket MS9103-22	1				
N2	2D 8E	PCA end nitrogen supply line to PCA.	Seal RS008858-007	1				
			Bolt RD111-4105-3409	1	64 ±3 in-lb			
			Bolt RD111-4105-3408	3	64 ±3 in-lb			
			Bolt RD111-4105-3418	2	64 ±3 in-lb			
			Washer RD153-5009-1001	6				
			Bracket MS9593-082	1				
N2.2	1D 8E	PCA to HPV warmant line.	Seal RD261-3017-0700	1				
			Bolt RD111-4105-3408	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
N2.3	1D 8E	PCA to preburner oxidizer purge line.	Seal RD261-3017-0700	1				
			Bolt RD111-4105-3408	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
N2.4	2D 8E	PCA to FPB purge valve line.	Seal RD261-3017-0700	1				
			Bolt RD111-4105-3507 (1)	2	125 ±5 in-lb			
			Washer RD153-5009-0002	2				
N5	6D	Preburner oxidizer purge line to OPB purge valve line.	Seal RD261-3017-0850	2				
			Bolt RD111-4105-3527 (2)	4	125 ±5 in-lb			
			Washer RD153-5009-0002 (3)	4				
			Orifice RS007184-003XXX (4,5)	1				

(1) Allowable alternate: RD111-4101-0507.
(2) Allowable alternates: RD111-4010-6529, RD111-4010-6530. (Lubricate per RA0112-002, Method A, using RB0140-015.)
(3) Use washer RD153-5002-0005 with allowable alternate bolts listed in footnote 2, above.
(4) Allowable alternates: RS007184-310600 thru -310650.
(5) Refer to Engine Acceptance Data Package for complete orifice part number.

TABLE 5. NITROGEN SYSTEM JOINTS (Sheet 2 of 3)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
N6	4C	HPV warmant line to HPV.	Seal RD261-3017-0750	1				
			Bolt RD111-4105-3405	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
N7	4C	HPV to main injector purge valve line.	Seal RD261-3017-0750	1				
			Bolt RD111-4105-3405	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
N8	7D	Preburner oxidizer purge line to FPB ASI purge check valve line.	Seal RD261-3017-0850	2				
			Bolt RD111-4105-3511	4	125 ±5 in-lb			
			Washer RD153-5009-0002	4				
			Orifice RS007184-019XXX (5)	1				
N9	6D	Preburner oxidizer purge line to OPB ASI purge check valve line.	Seal RD261-3017-0850	2				
			Bolt RD111-4105-3511	4	125 ±5 in-lb			
			Washer RD153-5009-0002	4				
			Orifice RS007184-005XXX (5,6)	1				
N11 and N11.1	11B	HPFTP bearing purge line and HPFTP coolant liner pressure sense line to HPFTP bearing purge port.	Seal RD261-3017-0600	2				
			Bolt RD111-4105-3415	2	70 ±4 in-lb			
			Washer RD153-5009-0001	2				
N11.2	11A	HPFTP coolant liner pressure sense line to sensor.	Seal RD261-3017-0800 (7)	1				
			Sensor RES7001-111 (8)	1				
			Sensor RE2233-041 (9,10)	1				
			Block RS007349-003	1				
			(See joint D35.2 for fastener data.)					
N12	11A	HPFTP heat shield end bearing purge line to HPFTP bearing purge line.	Seal RD261-3017-0650	1				
			Bolt RD111-4103-3417	2	70 ±4 in-lb			
			Washer RD153-5009-0001	2				
			Nut RD114-8013-0004	2				

(5) Refer to Engine Acceptance Data Package for complete orifice part number.
(6) Allowable alternates: RS007184-330600 thru 330650.
(7) Allowable alternate: RD261-3019-0800.
(8) Allowable alternates: RES7001-211, -231, -251.
(9) On engines incorporating ECP SSME-1159.
(10) Allowable alternates: RES7001-211, -231.

TABLE 5. NITROGEN SYSTEM JOINTS (Sheet 3 of 3)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
N13	11A	Plate to HPFTP heat shield end bearing purge line.	Seal RD261-3017-0650	1				
			Bolt RD111-4102-3405	2	70 ±4 in-lb			
			Washer RD153-5009-0001	2				
			Plate R0011086-007 (11)	1				
N14	5B	Plate to HPOTP turbine shaft coolant passage purge port.	Seal RD261-3017-0800 (7)	1				
			Bolt RD111-4102-3503	2	140 ±8 in-lb			
			Washer RD153-5009-0002	2				
			Cover R0019584-005	1				
N15	10A	Drying purge line to fuel system gaseous nitrogen purge line.	Seal RD261-3017-0600	1				
			Bolt RD111-4102-3515	2	140 ±8 in-lb			
			Washer RD153-5009-0002	2				
			Nut RD114-8013-0005	2				
N16	10A	Plate to drying purge line.	Seal RD261-3017-0600	1				
			Bolt RD111-4102-3504 (1)	2	140 ±8 in-lb			
			Washer RD153-5009-0002	2				
			Plate R0011086-009 (12)	1				
N18	5B	Bearing purge line to HPOTP.	Seal RD261-3017-0650	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				

(1) Allowable alternate: RD111-4101-0507.
(7) Allowable alternate: RD261-3019-0800.
(11) Allowable alternate: R0011086-003.
(12) Allowable alternate: R0011086-005.

TABLE 6. OXIDIZER SYSTEM JOINTS (Sheet 1 of 12)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
O1	3E	Interface to LPOTP.	Orbiter Interface					
O1.1	3E	LPOTP shaft speed sensor to LPOTP at boss AZ2aV.	Seal RES1277-01	1				
			Bolt RD111-1011-3313	8	22 ±1 in-lb			
			Washer LD153-0013-0001	6				
			Bracket MS9101-11	1				
			Bracket MS9102-03	1				
			Sensor RES7005-084	1				
O1.2	3E	Cover to LPOTP turbine drive manifold.	Seal RD261-3017-0650	1				
			Bolt RS007837-003	3	52 ±3 in-lb			
			Washer MS9321-10	3				
			Disk RS007836-003	1				
O1.3	3E	Cover to LPOTP turbine drive manifold.	Seal RD261-3017-0650	1				
			Bolt RS007837-003	3	52 ±3 in-lb			
			Washer MS9321-10	3				
			Disk RS007836-003	1				
O2	3E	LPOTP to LPOTP discharge duct.	Seal RS008862-005	1				
			Bolt RD111-4101-0511	24	140 ±8 in-lb	.1054 +.0000, -.0003	.1050 to .1054	Sheet 9
			Bracket R0019309-013 (1)	1				
			Bracket MS9103-40	3				
			Bolt RD111-4022-0501	8	50 ±2 in-lb			
			Washer RD153-5009-0002	8				
O2.2	3B	LPOTP discharge duct boss B01a to tap B01a to transducer line.	Seal RD261-3017-0800 (2)	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				

(1) Allowable alternate: R0019309-015.
(2) Allowable alternate: RD261-3019-0800.

TABLE 6. OXIDIZER SYSTEM JOINTS (Sheet 2 of 12)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
O2.2.1	3A	Tap B01a to transducer line to LPOTP discharge pressure sensor.	Seal RD261-3017-0800 (2)	1				
			Bolt RD111-4105-3421	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4	(Torque before			
			Sensor RES7001-104 (3)	1	nut)			
			Sensor RE2233-011 (4,5)	1				
			Block RS007349-003	1				
			Washer LD153-0010-0010	4				
			Nut RD114-1019-0004	4	50 ±2 in-lb			
O2.3	3B	Plate to LPOTP discharge duct boss B01b.	Seal RD261-3017-0800 (2)	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Plate RS007167-005	1				
O2.5 and O2.6	3B	LPOTP discharge duct to plate and plate to Pogo suppressor accumulator.	Seal RD261-3014-0865	2				
			Bolt RD111-4101-0510	24	140 ±8 in-lb	.1051 +.0000, -.0003	.1047 to .1051	Sheet 10
			Plate R0012666-021 (6)	1				
			Plate R0012666-031 (7)	1				
O3	5B	LPOTP discharge duct to HPOTP.	Seal RD261-3014-0700	1				
			Bolt RD111-4101-0509	24	140 ±8 in-lb	.1049 +.0000, -.0003	.1045 to .1049	Sheet 10
			Bolt RD111-4022-0502	5	50 ±2 in-lb			
			Washer RD153-5009-0002	5				
			Bracket RS007348-007	1				
O3.1 (6)	5B	Pressure transducer to HPOTP boss B02b.	Seal RD261-3017-0800	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Plug RS009528-009	1				
O3.1 (7)	5B	Cover to HPOTP balance piston cavity pressure port.	Gasket 4750839-01	1				
			Bolt 4790025-10	4	42-46 in-lb			
			Washer 4790426-10	4				
			Cover 4750863	1				

(2) Allowable alternate: RD261-3019-0800.
(3) Allowable alternates: RES7001-204, -224, -244.
(4) On engines incorporating ECP SSME-1159.
(5) Allowable alternates: RES7001-204, -224.
(6) Engines to 2035.
(7) Engines 2036 and subs.

TABLE 6. OXIDIZER SYSTEM JOINTS (Sheet 3 of 12)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
O3.2 (6)	5A	Pressure transducer to HPOTP boss B02a.	Seal RD261-3017-0800	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Plug RS009528-009	1				
O3.2 (7)	5B	Cover to HPOTP balance piston cavity pressure port.	Gasket 4750839-01	1				
			Bolt 4790025-10	4	42-46 in-lb			
			Washer 4790426-10	4				
			Cover 4750863	1				
O3.3 (6)	5B	Plug to HPOTP.	Seal RD261-3017-0800 (2)	1				
			Bolt RD111-1011-3411	2	52 ±3 in-lb			
			Washer LD153-0013-0002	2				
			Plug R0012132-003	1				
			Bracket MS9593-105	1				
O3.4 (7)	5B	Plug to HPOTP PEBB borescope access port.	Gasket 4750839-01	1				
			Bolt 4750451-12	4	23-25 in-lb			
			Plug 4750728	1				
O4	5A	HPOTP to LPOTP turbine drive duct.	Seal RD261-3014-0325	1				
			Bolt RD111-4101-0611	12	245 ±10 in-lb	.1057 +.0000, -.0003	.1052 to .1057	Sheet 11
O5 (6)	3E	LPOTP turbine drive duct to LPOTP.	Seal RD261-3014-0290	1				
			Bolt RD111-4101-0611	14	245 ±10 in-lb	.1057 +.0000, -.0003	.1053 to .1057	Sheet 11
			Bracket MS9103-40	1				
			Bracket MS9103-50	1				
			Bolt RD111-4022-0501	2	50 ±2 in-lb			
			Washer RD153-5009-0002	2				
O5 (7) and O5.1	3E	LPOTP turbine drive duct to orifice plate to LPOTP.	Seal RD261-3014-0290	2				
			Bolt RD111-4101-0616	14	210 ±10 in-lb	.1057 +.0000, -.0003	.1053 to .1057	Sheet 11
			Plate R037863-701850	1				
			Bracket MS9103-40	1				
			Bracket MS9103-50	1				
			Bolt RD111-4022-0501	2	50 ±2 in-lb			
			Washer RD153-5009-0002	2				

(2) Allowable alternate: RD261-3019-0800.
(6) Engines to 2035.
(7) Engines 2036 and subs.

TABLE 6. OXIDIZER SYSTEM JOINTS (Sheet 4 of 12)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
O6	5B	HPOTP to high-pressure oxidizer duct.	Seal RD261-3014-0520	1				
			Bolt RD111-4101-0716	20	390 ±20 in-lb	.1072 +.0000, -.0003	.1066 to .1072	Sheet 11
			Bracket MS9595-161	1				
			Bolt RD111-4022-0501	1	50 ±2 in-lb			
			Washer RD153-5009-0002	1				
O6.1	6B	High-pressure oxidizer duct boss B04dI to joint O6.1 to transducer line.	Seal RD261-3017-0800 (2)	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
O6.1.1	6B	Joint O6.1 to transducer line to HPOTP discharge pressure sensor.	Seal RD261-3017-0800 (2)	1				
			Bolt RD111-4105-3421	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4	(Torque before			
			Sensor RES7001-114 (8)	1	nut)			
			Sensor RE2233-051 (4,9)	1				
			Block RS007349-003	1				
			Washer LD153-0010-0010	4				
			Nut RD114-1019-0004	4	50 ±2 in-lb			
O6.2	6B	Cover to high-pressure oxidizer duct B04eI.	Seal RD261-3017-0800 (2)	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Cover RS007167-005	1				
O7	7B	High-pressure oxidizer duct to MOV.	Seal RD261-3014-0525	1				
			Bolt RD111-4101-0920	14	69 ±3 ft-lb	.1097 +.0000, -.0003	.1089 to .1097	Sheet 12
			Bracket R0019548-003	1				
			Bracket RS007272-007	1				
			Bracket RS007272-005	1				
			Bolt RD111-4022-0801	5	50 ±2 in-lb			
			Washer RD153-5009-0005	5				
			Bracket R034145-5 (10)	1				
			Bracket R034702-5 (11)	1				
			Bolt RD111-4022-0801	4	50 ±2 in-lb			
			Washer RD153-1008-0008 (12,13)	12				

(2) Allowable alternate: RD261-3019-0800.
(4) On engines incorporating ECP SSME-1159.
(8) Allowable alternates: RES7001-214, -234, -254.
(9) Allowable alternates: RES7001-214, -234, -254, RE2233-151.
(10) R034145-3 on engine 2030.
(11) R034702-3 on engine 2030.
(12) Install from zero to 3 washers between bracket and head of bolt RD111-4101-0920 to control thread engagement of bolt RD111-4022-0801. Two complete threads engagement is required and bottoming of bolt is not permitted.
(13) RD153-1004-0015 on engines 2029, 2030.

TABLE 6. OXIDIZER SYSTEM JOINTS (Sheet 5 of 12)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
O7.1	7B	MOV to main combustion spark igniter oxidizer line.	Seal RD261-3017-0850	1				
			Bolt RD111-4105-3507	4	125 ±8 in-lb			
			Washer RD153-5009-0002	4				
O7.2	7B	MOVA to MOV. (Not an LRU)	Packing MS28775-246 (14)	1				
			Insulator RS008085-003	1				
			Nut RD114-8010-0005	6	106 ±5 in-lb	.1075 +.0000, -.0007	.1068 to .1075	Sheet 12
			Washer RD153-5006-0005	6				
			Shim RS008194-003	1				
			Bolt RD111-1010-3358	1				
			Washer RS010358-003	1				
			Coupling RS008084-009	1				
			Coupling RS008180-007	1				
			Coupling RS008083-007	1				
			Retainer RS010357-003	1				
O8	7B	MOV to MCC injector.	Seal RD261-3014-0420	1				
			Bolt RD111-4101-1222	12	160 ±8 ft-lb	.1091 +.0000, -.0003	.1082 to .1091	Sheet 13
			Washer RS009335-005	12				
			Bracket RS007272-009	1				
			Bolt RD111-4022-0801	1	50 ±3 in-lb			
			Washer RD153-5009-0005	1				
O8.1 (6)	8B	Plate to oxidizer inlet elbow boss C01I.	Seal RD261-3017-0800	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Plate RS007167-005	1				
O8.2	8B	Plate to oxidizer manifold injector base boss CO2c.	Seal RD261-3017-0800	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Plate RS007167-005	1				
O8.3	8B	Sensor to oxidizer manifold injector base boss C02d.	Seal RD261-3017-0800 (2)	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
			Sensor RES7002-243	1				
			Bracket MS9593-052	2				

(2) Allowable alternate: RD261-3019-0800.
(6) Engines to 2035.
(14) Lubricate per RA0112-002, Method J, using RB0140-012.

TABLE 6. OXIDIZER SYSTEM JOINTS (Sheet 6 of 12)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
O8.4	8B	Main injector purge valve line to oxidizer inlet elbow.	Seal RD261-3017-1250	1				
			Bolt RD111-4102-3405	8	70 ±4 in-lb			
			Washer RD153-5006-0004	8				
O8.5 (6)	8B	Plate to oxidizer inlet elbow at boss C01H.	Seal RD261-3017-0800	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Plate RS007167-005	1				
O9	6B	High-pressure oxidizer duct to preburner oxidizer pump supply duct.	Seal RD261-3014-0240	1				
			Bolt RD111-4101-0611	12	245 ±10 in-lb	.1057 +.0000, -.0003	.1052 to .1057	Sheet 13
			Bracket R0010961-013	1				
			Bolt RD111-4022-0501	4	50 ±2 in-lb			
O9.1	5A	Plate to preburner oxidizer pump supply duct.	Seal RD261-3017-1100	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Plate RS007162-003	1				
O10	5A	Preburner oxidizer pump supply duct to HPOTP.	Seal RD261-3014-0325	1				
			Bolt RD111-4101-0611	12	245 ±10 in-lb	.1057 +.0000, -.0003	.1052 to .1057	Sheet 14
O11	5B	HPOTP to OPB oxidizer supply duct.	Seal RD261-3014-0290	1				
			Bolt RD111-4101-0615	12	245 ±10 in-lb	.1066 +.0000, -.0003	.1062 to .1066	Sheet 14
			Bracket R039132-3	1				
			Bolt RD111-4022-0501	3	50 ±2 in-lb			
			Washer RD153-5009-0002	3				
O11.1 and O11.1.2	6A	OPB oxidizer supply duct boss B06a to tap B06a to transducer line.	Seal RD261-3017-0800 (2)	2				
			Bolt RD111-4105-3415	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Sensor RES7002-261	1				

(2) Allowable alternate: RD261-3019-0800.
(6) Engines to 2035.

TABLE 6. OXIDIZER SYSTEM JOINTS (Sheet 7 of 12)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
O11.1.1	6A	Tap B06a to transducer line to HPOTP boost stage discharge pressure sensor.	Seal RD261-3017-0800 (2)	1				
			Bolt RD111-4105-3421	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4	(Torque before			
			Sensor RES7001-119 (15)	1	nut)			
			Sensor RE2233-061 (4,16)	1				
			Block RS007349-003	1				
			Washer LD153-0010-0010	4				
			Nut RD114-1019-0004	4	50 ±2 in-lb			
O12	5C	OPB oxidizer supply duct to OPOV.	Seal RD261-3014-0295	1				
			Bolt RD111-4101-0615	12	245 ±10 in-lb	.1068 +.0000, -.0003	.1063 to .1068	Sheet 14
			Bracket MS9103-20	1				
			Bolt RD111-4022-0501	1	50 ±2 in-lb			
			Washer RD153-5009-0002	1				
O12.1 and O12.2	5C	OPOV to OPB oxidizer purge adapter and adapter to OPB spark igniter line.	Seal RD261-3017-0850	2				
			Bolt RD111-4105-3520 (17)	4	125 ±5 in-lb			
			Washer RD153-5009-0002	4				
			Adapter RS007258-007	1				
O12.1.2	5C	OPB to OPB spark igniter oxidizer line.	Seal RD261-3017-0650	2				
			Bolt RD111-1009-3311	4	22 ±1 in-lb			
			Washer RS009098-003	4				
			Orifice RS009100-003 (18)	1				
O12.1.3	5C	OPB spark igniter oxidizer line to OPB ASI.	Seal RD261-3017-0650	2				
			Bolt RD111-1009-3311	4	22 ±1 in-lb			
			Washer RS009098-003	4				
			Orifice RS009100-005 (19)	1				
O12.1.4	5C	OPB ASI purge check valve line to OPB spark igniter line.	Seal RD261-3017-1250	1				
			Bolt RD111-4102-3405	7	70 ±4 in-lb			
			Washer RD153-5006-0004	7				

(2) Allowable alternate: RD261-3019-0800.
(4) On engines incorporating ECP SSME-1159.
(15) Allowable alternates: RES7001-219, -239, -259.
(16) Allowable alternates: RE7001-219, -239, -259, RE2233-161.
(17) Allowable alternates: RD111-4008-6518, RD111-4010-3524, RD111-4010-3525, RD111-4102-3517, RD111-4103-3520, RD111-4105-3519.
(18) Allowable alternates: RS009100-050764 thru -050774.
(19) Allowable alternates: RS009100-060565 thru -060575.

TABLE 6. OXIDIZER SYSTEM JOINTS (Sheet 8 of 12)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
O12.3	5C	OPB purge valve line to OPB oxidizer purge adapter.	Seal RD261-3017-1200	1				
			Bolt RD111-4102-3405	7	70 ±4 in-lb			
			Washer RD153-5006-0004	7				
O12.4	5C	OPOVA to OPOV.	Packing MS28775-234 (14)	1				
			Insulator RS008176-005	1				
			Nut RD114-8010-0005	6	106 ±5 in-lb	.1059 +.0000, -.0005	.1048 to .1059	Sheet 15
			Washer RD153-5006-0005	6				
			Shim RS008321-003	10	Maximum			
			Bolt RD111-4009-6304	2	28 ±1 in-lb			
			Plug R0015517-1	2				
			Coupling RS008318-013	2				
			Slider RS008320-007	1				
			Retainer RS010357-005	1				
O13	5C	OPOV to OPB.	Seal RD261-3014-0300	1				
			Bolt RD111-4101-0712	12	390 ±20 in-lb	.1060 +.0000, -.0003	.1055 to .1060	Sheet 15
			Bolt RD111-4022-0504 (20)	5	50 ±2 in-lb			
			Bracket R0019586-003 (21)	1				
			Bolt RD111-4022-0501	3	50 ±3 in-lb			
O14	10C	FPB oxidizer supply duct to oxidizer bleed line.	Seal RD261-3014-0285	1				
			Bolt RD111-4101-0711	8	390 ±20 in-lb	.1058 +.0000, -.0003	.1053 to .1058	Sheet 16
			Washer RD153-5009-0004	8				
O14.1	10D	Recirculation line to oxidizer bleed fluid interface flexible line.	Seal RD261-3017-1500	1				
			Bolt RD111-4103-3605	6	245 ±10 in-lb			
			Washer RD153-5009-0003	6				
O15	10E	Oxidizer bleed fluid interface flexible line to interface.	Orbiter interface					
O16	10C	FPB oxidizer supply duct to FPOV.	Seal RD261-3014-0295	1				
			Bolt RD111-4101-0615	12	245 ±10 in-lb	.1069 +.0000, -.0003	.1063 to .1069	Sheet 16
O16.1 and O16.2	11C	FPOV to FPB oxidizer purge adapter and adapter to FPB spark igniter line.	Seal RD261-3017-0850	2				
			Bolt RD111-4105-3520(17)	4	12 ±5 in-lb			
			Washer RD153-5009-0002	4				

(14) Lubricate per RA0112-002, Method J, using RB0140-012.
(17) Allowable alternates: RD111-4008-6518, RD111-4010-3524, RD111-4010-3525, RD111-4102-3517, RD111-4103-3520, RD111-4105-3519.
(20) Allowable alternate: R0011923-003. (Lubricate per RA0112-002, Method A, using RB0140-015.)
(21) See joints P1.2 and P20 for bracket attach hardware.

TABLE 6. OXIDIZER SYSTEM JOINTS (Sheet 9 of 12)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
O16.1.2	11C	FPB to FPB spark igniter oxidizer line.	Seal RD261-3017-0650	2				
			Bolt RD111-1009-3311	4	22 ±1 in-lb			
			Washer RS009098-003	4				
			Orifice RS010458-003	1				
			Bolt RD111-1009-3414	2	52 ±3 in-lb			
			Washer RD153-5002-0004	2				
			Nut RD114-8017-0004	2				
O16.1.3	11C	FPB spark igniter oxidizer line to FPB ASI.	Seal RD261-3017-0650	2				
			Bolt RD111-1009-3311	4	22 ±1 in-lb			
			Washer RS009098-003	4				
			Orifice RS009100-009 (22)	1				
O16.1.4	10B	FPB ASI purge check valve line to FPB spark igniter line.	Seal RD261-3017-1250	1				
			Bolt RD111-4102-3405	7	70 ±4 in-lb			
			Washer RD153-5006-0004	7				
O16.3	11C	FPB purge valve line to FPB oxidizer purge adapter.	Seal RD261-3017-1200	1				
			Bolt RD111-4102-3405	8	70 ±4 in-lb			
			Washer RD153-5006-0004	8				
O16.4	11D	FPOVA to FPOV.	Packing MS28775-234 (14)	1				
			Insulator RS008176-005	1				
			Nut RD114-8010-0005	6	106 ±5 in-lb	.1059 +.0000, -.0005	.1048 to .1059	Sheet 17
			Washer RD153-5006-0005	6				
			Shim RS008321-003	10	Maximum			
			Bolt RD111-4009-6304	2	28 ±1 in-lb			
			Plug R0015517-1	2				
			Coupling RS008318-013	2				
			Slider RS008320-007	1				
			Retainer RS010357-005	1				
O17	11C	FPOV to FPB.	Seal RD261-3014-0300	1				
			Bolt RD111-4101-0712	12	390 ±20 in-lb	.1060 +.0000, -.0003	.1055 to .1060	Sheet 17
			Bolt RD111-4022-0503	4	50 ±2 in-lb			
O18	6B	Preburner oxidizer pump supply duct to heat exchanger inlet line.	Seal RD261-3017-1250	1				
			Bolt RD111-4101-0607	4	245 ±10 in-lb	.1046 +.0000, -.0003	.1042 to .1046	Sheet 18
			Washer RD153-5009-0003	4				

(14) Lubricate per RA0112-002, Method J, using RB0140-012.
(22) Allowable alternates: RS009100-090497 thru -090507.

TABLE 6. OXIDIZER SYSTEM JOINTS (Sheet 10 of 12)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
O18.1	6B	Test port cover to AFV test port.	Seal RES1257-04	1				
			Bolt RD111-4010-3407	4	66 ±3 in-lb			
			Cover R0019128-005	1				
			Filter 286-5008-001	1				
			Seal R0019413-005	1				
O19	5B	HEX inlet line to HEX.	Seal RD261-3017-1350	1				
			Bolt RD111-4105-3407	6	64 ±3 in-lb			
			Washer RD153-5009-0001	6				
O19.0.1 (7)	5B	HEX inlet manifold to HEX.	Seal RD261-3019-0900	1				
			Bolt RD111-4008-6404	6	73 ±3 in-lb			
			Washer RD153-5004-1004	6				
			Manifold R039052-3	1				
O19.1 (6) and O19.2	5B	HEX inlet to HEX bypass line orifice to HEX outlet.	Seal RD261-3017-0850	2				
			Bolt RD111-4008-6414	4	66 ±3 in-lb			
			Orifice R035519-13XXXX (23)	1				
O19.1 (7) and O19.2	5B	HEX inlet to HEX bypass line orifice to HEX outlet.	Seal RD261-3017-0850	2				
			Bolt RD111-4008-6410	4	108 ±5 in-lb			
			Washer MS14183-C4	4				
			Orifice R035519-130930	1				
O20 (7)	5B	HEX outlet to HEX outlet mixer.	Seal RD261-3019-0900	1				
			Screw NAS1351N04-6	2	6 ± 1 in-lb			
			Mixer R039053-3	1				
O20.0.1 (7)	5B	HEX outlet mixer to HEX outlet manifold.	Seal RD261-3019-1500	1				
			Bolt RD111-4102-3419	6	101 ±4 in-lb			
			Washer MS14183-C4	6				
			Manifold R0018001-591	1				
O20.1	4C	Tap H02aP to transducer line to HEX duct boss H02aP.	Seal RD261-3017-0800 (2)	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				

(2) Allowable alternate: RD261-3019-0800.
(6) Engines to 2035.
(7) Engines 2036 and subs.
(23) Refer to Engine Acceptance Data Package for complete orifice part number.

TABLE 6. OXIDIZER SYSTEM JOINTS (Sheet 11 of 12)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
O20.1.1	4C	Oxidizer tank pressure sensor to tap H02aP to transducer line.	Seal RD261-3017-0800 (2)	1				
			Bolt RD111-4105-3418	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Sensor RES7001-114 (24)	1				
			Sensor RE2233-051 (4,25)	1				
O20.2	4C	Rigid oxidizer tank pressurant duct to oxidizer tank pressurant duct.	Seal RD261-3016-0170	1				
			Bolt RD111-4101-0506	6	140 ±8 in-lb	.1036 +.0000, -.0003	.1032 to .1036	Sheet 18
			Bolt RD111-4105-3412	2				
			Washer LD153-0013-0002	2				
			Spacer RS007218-003	1				
			Nut RD114-1019-0004	2	115 ±5 in-lb			
			Orifice R039366-3288 (7)	1				
O21	4E	Oxidizer tank pressurant duct to interface.	Orbiter Interface					
O22	6C	OPB oxidizer supply duct to FPB oxidizer supply duct.	Seal RD261-3014-0295	1				
			Bolt RD111-4100-0623	12	245 ±10 in-lb	.1109 +.0000, -.0003	.1101 to .1109	Sheet 18
			Nut RD114-8023-0006 (26)	12				
O23	4C	Oxidizer tank pressurant duct to GOX supply line.	Seal RD261-3017-0600	1				
			Bolt RD111-4103-3404	4	70 ±4 in-lb			
			Washer RD153-5009-0001	4				
O24	4C	GOX supply line to GCV.	Seal RD261-3017-0600	1				
			Bolt RD111-4103-3404	4	70 ±4 in-lb			
			Washer RD153-5009-0001	4				
O24.1	3C	GCV to RIV override line.	Seal RD261-3017-0600	1				
			Bolt RD111-4103-3406	2	70 ±4 in-lb			
			Washer RD153-5009-0001	2				
O24.2	4B	RIV override line to RIV.	Seal RD261-3017-0600	1				
			Bolt RD111-4103-3406	2	70 ±4 in-lb			
			Washer RD153-5009-0001	2				

(2) Allowable alternate: RD261-3019-0800.
(4) On engines incorporating ECP SSME-1159.
(7) Engines 2036 and subs.
(23) Refer to Engine Acceptance Data Package for complete orifice part number.
(24) Allowable alternates: RES7001-214, -234, -254.
(25) Allowable alternates: RES7001-214, -234, -254, RE2233-151.
(26) Allowable alternate: RD114-8010-0006.

TABLE 6. OXIDIZER SYSTEM JOINTS (Sheet 12 of 12)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
O25 and O26	3C	GCV to accumulator precharge helium supply line to accumulator supply line.	Seal RD261-3017-0900	2				
			Bolt RD111-4103-3417	2	70 ±4 in-lb			
			Washer RD153-5009-0001	2				
O26.1	3C	HPV to accumulator precharge helium supply line.	Seal RD261-3017-1000	1				
			Bolt RD111-4105-3406	3	64 ±3 in-lb			
			Bolt RD111-4105-3407	1	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Bracket MS9593-038 (27)	1				
O26.2	3D	Pogo suppressor GOX system pressure sensor to HPV at boss NE3.	Seal RD261-3017-0800 (2)	1				
			Bolt RD111-4105-3406	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
			Sensor RES7001-107 (28)	1				
			Sensor RE2233-021 (4,29)	1				
O27	3B	Accumulator supply line to accumulator.	Seal RD261-3017-1100	1				
			Bolt RD111-4103-3405	3	70 ±4 in-lb			
			Washer RD153-5009-0001	3				
O28	4B	Accumulator to adapter.	Seal RD261-3014-0225	1				
			Bolt RD111-4103-3610	4	245 ±10 in-lb			
			Washer RD153-5009-0003	4				
O29	4B	Adapter to RIV.	Seal RD261-3014-0245	1				
			Bolt RD111-4103-3614	4	245 ±10 in-lb			
			Washer RD153-5009-0003	4				
O30	10D	Oxidizer bleed line to recirculation line.	Seal RD261-3017-1150	1				
			Bolt RD111-4103-3406	5	70 ±4 in-lb			
			Washer RD153-5009-0001	5				
O31	5D	RIV line to recirculation line.	Seal RD261-3017-1500	1				
			Bolt RD111-1009-3616	6	190 ±10 in-lb			
			Washer RD153-5009-0003	6				

(2) Allowable alternate: RD261-3019-0800.
(4) On engines incorporating ECP SSME-1159.
(27) Allowable alternates: MS9593- (any dash number) or MS9102- (any dash number) as required to support line.
(28) Allowable alternates: RES7001-207, -227, -247.
(29) Allowable alternates: RES7001-207, -227.

TABLE 7. PNEUMATIC (HELIUM) SYSTEM JOINTS (Sheet 1 of 6)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
P1	9E	Interface to helium supply fluid interface flexible line.	Orbiter interface					
P1.1	9D	Helium supply fluid interface flexible line to interface end helium supply line.	Seal RS008842-021	1				
			Bolt RD111-4105-3410	4	64 ±3 in-lb			
			Washer RD153-5009-0001	4				
P1.2 and P20	9D	Interface end helium supply line to HPV helium supply line and HPV helium supply line to PCA helium supply line.	Seal RS008842-021	2				
			Bolt RD111-4105-3421	2	64 ±3 in-lb			
			Bolt RD111-4105-3432	2	64 ±3 in-lb			
			Washer RD153-5009-0001	6				
			Nut RD114-8011-0004	2				
			Bracket R0019587-005 (1)	1				
			Bolt NAS1005-3A (1)	2	105 ±10 in-lb			
			Washer LD153-0013-0003 (1)	2				
			Nut RD114-8011-0005 (1)	2				
			Bracket R0019587-001 (2)	1				
			Bolt R0015357-3 (2,3)	2	105 ±10 in-lb			
			Washer RD153-5007-1005 (2,4)	6				
P2	2A 8D	PCA helium supply line to PCA.	Seal RS008858-007	1				
			Bolt RD111-4105-3408	4	64 ±3 in-lb			
			Bolt RD111-4105-3418	2	64 ±3 in-lb			
			Washer RD153-5009-1001	4				
			Washer RD153-5009-0001	2				
P2.1	1C 8E	HPOTP intermediate seal purge pressure sensor to PCA boss SE3.	Seal RD261-3017-0800 (5)	1				
			Bolt RD111-4105-3410	4	64 ±3 in-lb			
			Washer RD153-5009-1001	4				
			Sensor RES7001-104 (6)	1				
			Sensor RE2233-011 (7,8)	1				

(1) Engine 2012 only.
(2) Engines 2109, 2017, and subs.
(3) Use 1, 2, or 3 washers under bolt head to achieve minimum of 0.040 protrusion of bolt from nut plate and 0.010 minimum clearance of bolt from helium line assembly flange. Bolt NAS1005-1A may be substituted to comply with above requirements.
(4) Allowable alternate: R0018231-3.
(5) Allowable alternate: RD261-3019-0800.
(6) Allowable alternates: RES7001-204, -224, -244.
(7) On engines incorporating ECP SSME-1159.
(8) Allowable alternates: RES7001-204, -224.

TABLE 7. PNEUMATIC (HELIUM) SYSTEM JOINTS (Sheet 2 of 6)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
P2.2	1A 8D	Fuel system purge pressure sensor to PCA boss SE2.	Seal RD261-3017-0800 (5) Bolt RD111-4105-3410 Washer RD153-5009-1001 Sensor RES7001-104 (6) Sensor RE2233-011 (7,8)	1 4 4 1 1	 64 ±3 in-lb			
P2.3	1B 8E	Emergency shutdown pressure sensor to PCA boss SE6.	Seal RD261-3017-0800 (5) Bolt RD111-4105-3410 Washer RD153-5009-1001 Sensor RES7001-107 (9) Sensor RE2233-021 (7,10)	1 4 4 1 1	 64 ±3 in-lb			
P2.4	1C 8E	Oxidizer preburner purge pressure sensor to PCA boss SE7.	Seal RD261-3017-0800 (5) Bolt RD111-4105-3410 Washer RD153-5009-1001 Sensor RES7001-107 (9) Sensor RE2233-021 (7,10)	1 4 4 1 1	 64 ±3 in-lb			
P2.5	2C 8E	Fuel preburner purge pressure sensor to PCA boss SE8.	Seal RD261-3017-0800 (5) Bolt RD111-4105-3410 Washer RD153-5009-1001 Sensor RES7001-107 (9) Sensor RE2233-021 (7,10)	1 4 4 1 1	 64 ±3 in-lb			
P3	1A 8D	PCA to fuel system purge line.	Seal RD261-3017-0700 Bolt RD111-4105-3408 Washer RD153-5009-0001	1 2 2	 64 ±3 in-lb			
P4	1C 8E	PCA to intermediate seal purge line.	Seal RD261-3017-0700 Bolt RD111-4105-3408 Washer RD153-5009-0001	1 2 2	 64 ±3 in-lb			

(5) Allowable alternate: RD261-3019-0800.
(6) Allowable alternates: RES7001-204, -224, -244.
(7) On engines incorporating ECP SSME-1159.
(8) Allowable alternates: RES7001-204, -224.
(9) Allowable alternates: RES7001-207, -227, -247.
(10) Allowable alternates: RES7001-207, -227.

TABLE 7. PNEUMATIC (HELIUM) SYSTEM JOINTS (Sheet 3 of 6)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
P5 and P5.1	2B 8E	PCA to fuel drain purge line and FBV control line.	Seal RD261-3017-0700 Seal RS008844-061 Bolt RD111-4105-3418 Washer RD153-5009-0001	1 1 2 2	 64 ±3 in-lb 			
P6	9C	FBV control line to valve end FBV control line.	Seal RS008844-061 Bolt RD111-4105-3415 Washer RD153-5009-1001 Nut RD114-8011-0004	1 2 2 2	 64 ±3 in-lb 			
P8	10C	OBV control line to OBV.	Seal RS008856-007 Bolt RD111-4105-3406 Bracket MS9593-488 (11)	1 2 2	 64 ±3 in-lb 			
P9 and P24	2B 8E	PCA to recirculation isolation control line and OBV control line.	Seal RD261-3017-0700 Seal RS008844-061 Bolt RD111-4105-3418 Washer RD153-5009-0001	1 1 2 2	 64 ±3 in-lb 			
P10	5B	Intermediate seal purge line to HPOTP.	Seal RS008856-007 Bolt RD111-4105-3408 Washer RD153-5009-0001	1 2 2	 64 ±3 in-lb 			
P11	9B	Valve end FBV control line to FBV.	Seal RS008856-007 Bolt RD111-4105-3406 Washer RD153-5009-0001	1 2 2	 64 ±3 in-lb 			
P12	1B 8E	PCA to emergency shutdown control manifold line.	Seal RD261-3017-0700 Bolt RD111-4105-3408 Washer RD153-5009-0001	1 2 2	 64 ±3 in-lb 			
P13	5C	Emergency shutdown control manifold line to OPOVA.	Seal RS008844-061 Bolt RD111-4105-3410 Washer RD153-5009-0001	1 2 2	 64 ±3 in-lb 			

(11) On engine 2012, use only 1 bracket MS9593-488 and add 1 washer RD153-5009-0001.

TABLE 7. PNEUMATIC (HELIUM) SYSTEM JOINTS (Sheet 4 of 6)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
P14	5D	OPOVA Emergency shutdown MOVA line.	Seal RS008844-061	1				
			Bolt RD111-4105-3410	2	64 ±3 in-lb			
			Bolt RD111-4105-3413 (12)	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
			Flange R055339-1 (12)	1				
P15	7C	Emergency shutdown MOVA line to MOVA.	Seal RS008844-061	1				
			Bolt RD111-4105-3410	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
P16	10D	Emergency shutdown MOVA line to emergency shutdown control manifold line.	Seal RS008844-061	1				
			Bolt RD111-4105-3414	2	66 ±3 in-lb			
			Washer RD153-5009-0001	2				
			Nut RD114-8011-0004	2				
P17	11C	Emergency shutdown control manifold line to FPOVA.	Seal RS008844-061	1				
			Bolt RD111-4105-3410	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
P18	11D	FPOVA to MFVA emergency shutdown line.	Seal RS008844-061	1				
			Bolt RD111-4105-3410	2	64 ±3 in-lb			
			Bolt RD111-4105-3413 (12)	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
			Flange R055339-1 (12)	1				
P18.1	8A	MFVA emergency shutdown line to CCVA emergency shutdown line.	Seal RS008844-061	1				
			Bolt RD111-4105-3413	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
			Nut RD114-8012-0004	2				
P19	9B	MFVA emergency shutdown line to MFVA.	Seal RS008844-061	1				
			Bolt RD111-4105-3410	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
P20	9D	See joint P1.2.						
P20.1	4C	See joint P21.						

(12) On engines incorporating ECP SSME-1247.

TABLE 7. PNEUMATIC (HELIUM) SYSTEM JOINTS (Sheet 5 of 6)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
P20.2	4C	Hose adapter flange to tee assembly.	Seal RS008856-007	1				
			Bolt RD111-4105-3406	2	64 ±3 in-lb			
			Washer RD153-5009-1001	2				
P21	4C	HPV helium supply line to tee assembly to HPV.	Seal RD261-3014-0215	2				
			Tee Assy R032139-11	1				
			Bolt RD111-4103-3417	6	70 ±4 in-lb			
			Washer RD153-5009-0001	6				
P22	4C	GCV control line to HPV.	Seal RD261-3017-0750	1				
			Bolt RD111-4105-3405	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
P23	3C	GCV control line to GCV.	Seal RD261-3017-0750	1				
			Bolt RD111-4105-3405	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
P24	8E	See joint P9.						
P25	3B	Recirculation isolation control line to RIV.	Seal RD261-3017-0750	1				
			Bolt RD111-4105-3405	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
P25.1	3B	Test port cover to RIV test port.	Seal RD261-3017-0750	1				
			Screw RD112-5007-1710	2	58 ±3 in-lb			
			Cover RS010153-003	1				
P26	7A	CCVA emergency shutdown line to CCVA.	Seal RS008844-061	1				
			Bolt RD111-4105-3410	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
P27	7A	CCVA to CCVA to PCA emergency shutdown line.	Seal RS008844-061	1				
			Bolt RD111-4105-3410	2	64 ±3 in-lb			
			Bolt RD111-4105-3413 (12)	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				
			Flange R055339-1 (12)	1				
P28	2C 8E	CCVA to PCA emergency shutdown line to PCA.	Seal RD261-3017-0700	1				
			Bolt RD111-4105-3408	2	64 ±3 in-lb			
			Washer RD153-5009-0001	2				

(12) On engines incorporating ECP SSME-1247.

TABLE 7. PNEUMATIC (HELIUM) SYSTEM JOINTS (Sheet 6 of 6)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
P34	2C 8E	PCA to Pogo helium charge line.	Seal RD261-3017-0700 Bolt RD111-4105-3408 Washer RD153-5009-0001	1 2 2	 64 ±3 in-lb			
P35	3C	Pogo helium charge line to HPV.	Seal RD261-3017-0700 Bolt RD111-4105-3408 Washer RD153-5009-0001	1 2 2	 64 ±3 in-lb			

TABLE 8. HPOTP/AT SYSTEM JOINTS (Sheet 1 of 1)

JOINT NO.	ZONE	DESCRIPTION	ATTACHING PARTS	QTY	FASTENER TORQUE	TIGHTEN TO	INSPECTION RANGE	TORQUE PATTERN (FIGURE 3)
HEP10A	5B	HPOTP helium supply manifold to HPOTP.	Gasket 4750362-01	1				
			Bolt 4790025-04	2	42-46 in-lb			
			Bolt 4750451-06	1	20-22 in-lb			
			Connector 4750726-01	1				
OD3A	5B	HPOTP oxidizer drain manifold to HPOTP.	Gasket 4750369-01	1				
			Bolt 4750392-04	4	70-75 IN-LB			
			Manifold 4751042-01	1				
OD3B	5B	HPOTP oxidizer drain manifold to HPOTP.	Gasket 4750369-01	1				
			Bolt 4750392-04	2	70-75 IN-LB			
			Manifold 4751042-01	REF				
OD3C	5B	HPOTP oxidizer drain manifold to HPOTP.	Gasket 4750369-01	1				
			Bolt 4750392-04	2	70-75 IN-LB			
			Manifold 4751042-01	REF				
PTD1A	5B	HPOTP primary turbine seal drain manifold to HPOTP.	Gasket 4750369-01	1				
			Bolt 4750392-04	4	70-75 IN-LB			
			Manifold 4751043-01	1				
PTD1B	5B	HPOTP primary turbine seal drain manifold to HPOTP.	Gasket 4750369-01	1				
			Bolt 4750392-04	2	70-75 IN-LB			
			Manifold 4751043-01	REF				
STD2A	5B	HPOTP secondary turbine seal drain manifold to HPOTP.	Gasket 4750369-01	1				
			Bolt 4750392-04	4	70-75 IN-LB			
			Tube 4751137-01	1				
STD2B	5B	HPOTP secondary turbine seal drain manifold to HPOTP.	Gasket 4750369-01	1				
			Bolt 4750392-04	2	70-75 IN-LB			
			Tube 4751137-01	REF				

TABLE 9. HPOTP/AT SYSTEM JOINTS (Sheet 1 of 1)

PART NO.	NAME	ZONE	PART NO.	NAME	ZONE	PART NO.	NAME	ZONE	PART NO.	NAME	ZONE
RES1001	Flex line	9D	RS007116	Line	6C	RS007286	Line	6D	R0011628	Line	4B
RES1002	Flex line	9D	RS007117	Line	9A	RS007287	Line	4C	R0011935	Line	4C
RES1004	Flex line	9E	RS007118	Line	4A	RS007288	Line	6C	R0011936	Line	6E
RES1006	Flex line	11C	RS007119	Manifold	6C	RS007289	Line	4A	R0015963	Battery	11E
RES1008	CCVA	7A	RS007120	Manifold	9A	RS007297	Line	6D	R0017310	Line	9A
RES1008	FPOVA	10C	RS007121	Manifold	10D	RS007363	Line	6A	R0017856	Line	11A
RES1008	MFVA	9B	RS007122	Manifold	6D	RS007365	Line	3A	R0018001	Powerhead	9B
RES1008	MOVA	8C	RS007123	Line	6E	RS007367	Line	4B	R0018041	Duct	9A
RES1008	OPOVA	5D	RS007124	Line	6E	RS007368	Line	7E	R0018043	Duct	10B
RES1221	Flex line	10D	RS007125	Manifold	6D	RS007369	Line	4B	R0018051	Line	11C
RES1222	Flex line	9E	RS007126	Line	10D	RS007501	HPFTP	11B	R0018052	Line	9C
RE1493	Controller	11E	RS007127	Line	9E	RS007601	LPFTP	12E	R0019349	Line	6B
RE2062	Bag	12D	RS007128	Line	9D	RS007701	HPOTP	5B	R0019353	Line	8A
RS007010	Powerhead	9B	RS007130	Line	7D	RS007801	LPOTP	3E	R0019421	Line	7E
RS007015	Duct	4B	RS007132	Line	8E	RS008255	MOV	7B	R0019422	Line	6D
RS007016	Duct	4C	RS007133	Line	9D	RS008256	MFV	9B	R0019431	Line	11A
RS007018	Duct	12B	RS007134	Line	6D	RS008257	FPOV	11C	R0019438	Line	6D
RS007021	Duct	7B	RS007135	Line	10D	RS008258	OPOV	5C	R0019439	Line	10D
RS007029	Duct	5A	RS007150	Line	11D	RS008259	CCV	7B	R0019440	Line	10A
RS007031	Duct	7C	RS007163	Line	6A	RS009105	MCC	7B	R0019450	PCA	8E
RS007032	Duct	6C	RS007168	Line	10B	RS010141	GCV	4C	R0019481	Line	9A
RS007034	Duct	9A	RS007171	Line	9A	RS010161	RIV	4B	R0019550	Line	6B
RS007035	Duct	4A	RS007172	Line	7E	RS010180	HPV	4C	R0019552	Line	10B
RS007037	Duct	11B	RS007186	Line	5C	RS010427	Line	9A	R0019554	Line	11A
RS007041	Duct	10D	RS007187	Line	11C	RS010439	Line	4D	R0019561	Line	8E
RS007043	Duct	10D	RS007212	Line	7C	R0010747	Line	9C	R0019565	Line	8A
RS007046	Duct	11E	RS007215	Line	7C	R0010751	Line	6C	R0019585	Line	9B
RS007083	Duct	6B	RS007270	Line	9D	R0010752	Line	9C	R0020621	Nozzle	8A
RS007103	Line	6D	RS007271	Line	9B	R0010758	Line	8C	R035533	Duct	9B
RS007107	Duct	9A	RS007280	Pogo Accum	4B	R0010828	Line	6B	R039138	Line	5A
RS007111	Duct	6B	RS007283	Line	3B	R0010938	Line	8C	4750000	HPOTP	5B
RS007113	Line	9A	RS007284	Line	4C	R0010939	Line	8A			
RS007114	Line	7B	RS007285	Line	4C	R0010940	Line	9A			

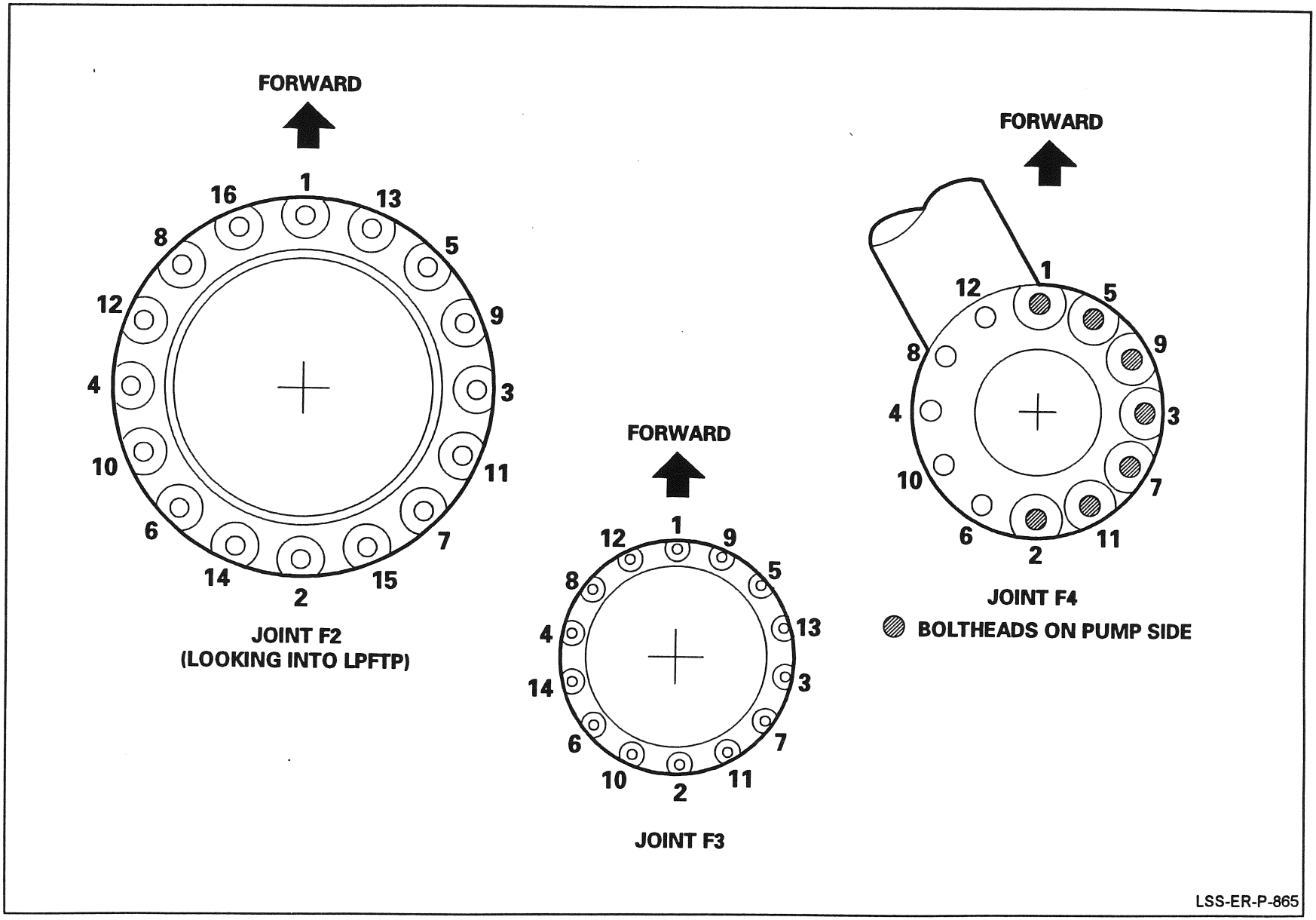

Figure 3. Torque Patterns (Sheet 1 of 18)

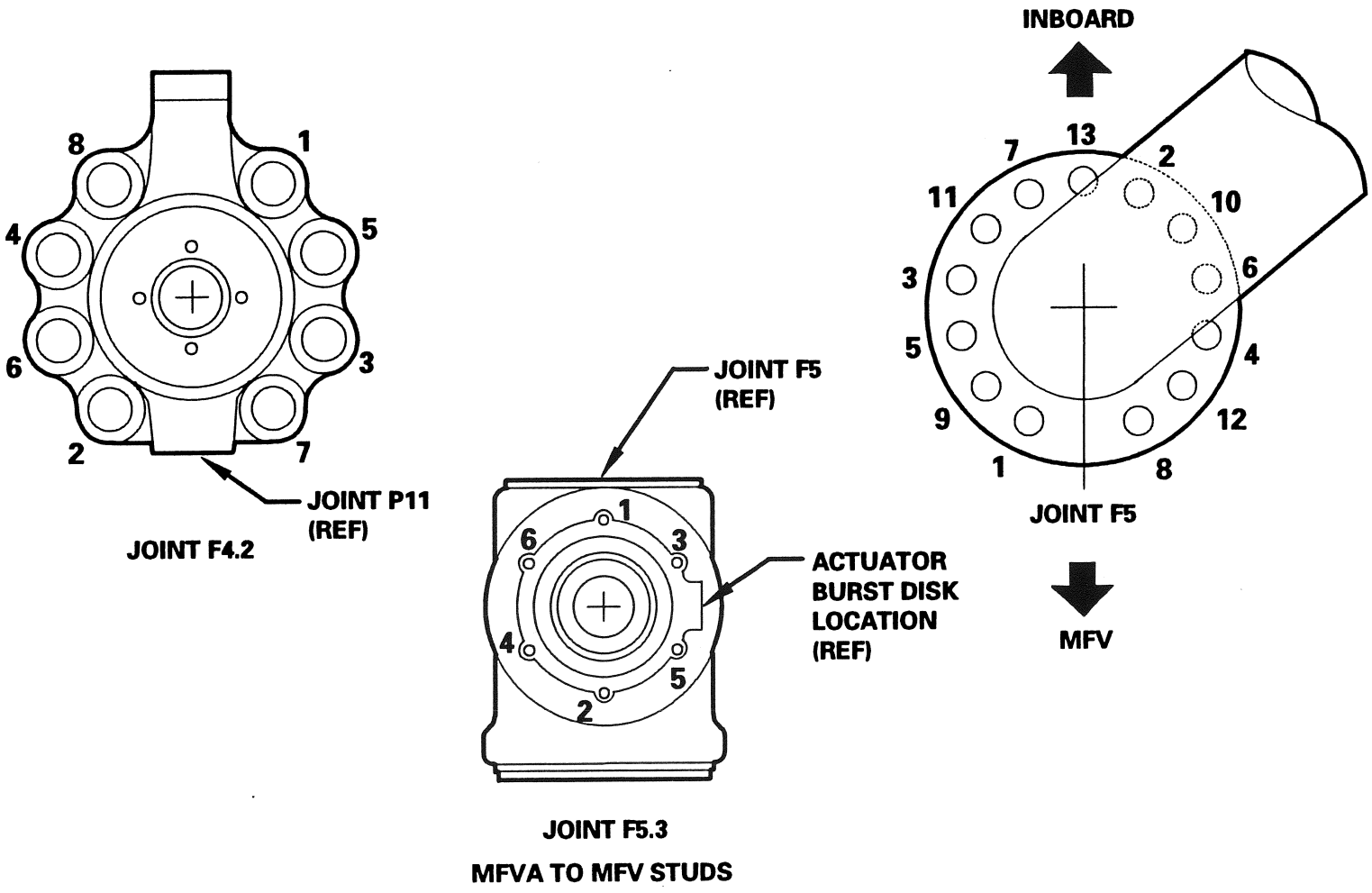

Figure 3. Torque Patterns (Sheet 2 of 18)

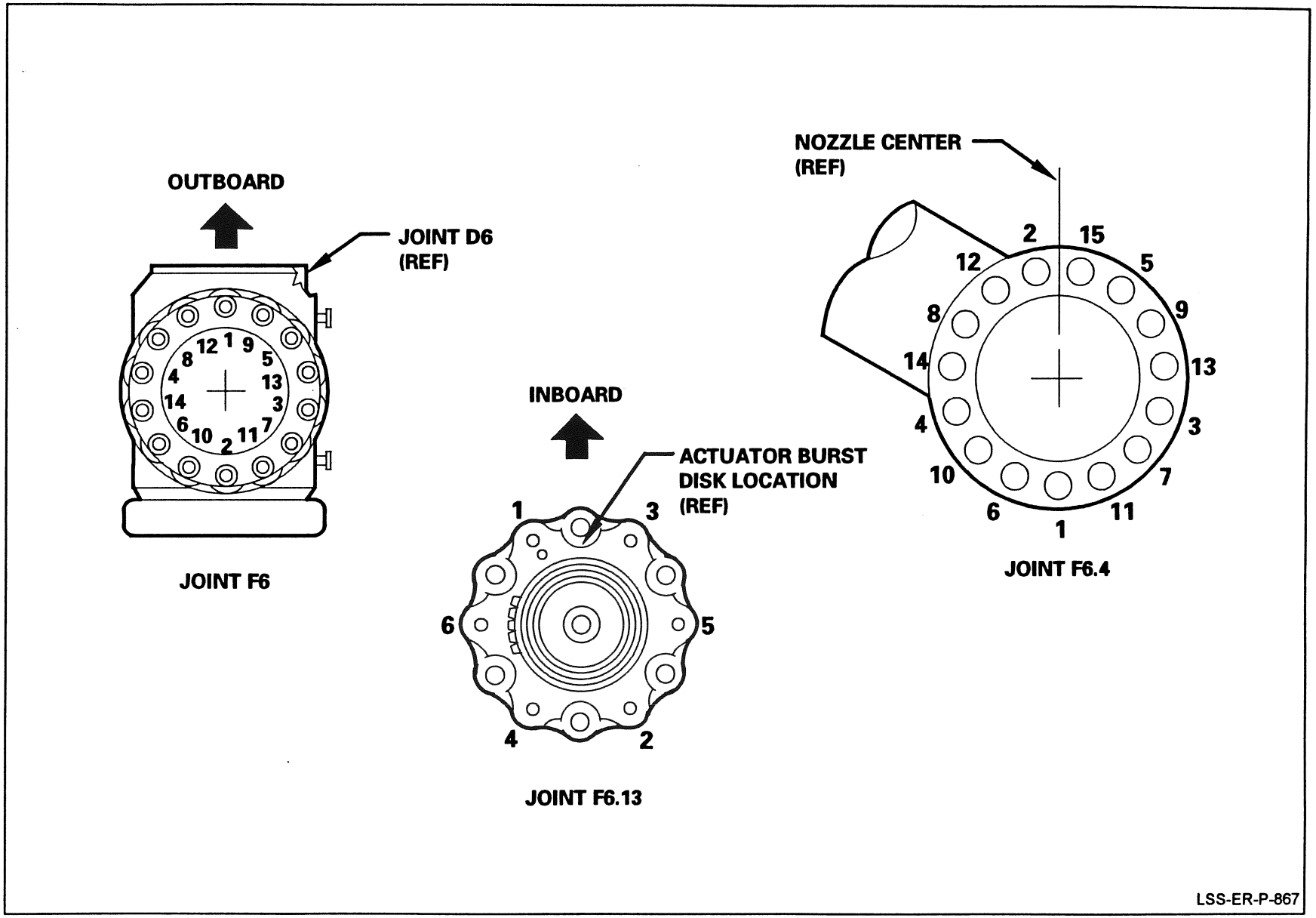

Figure 3. Torque Patterns (Sheet 3 of 18)

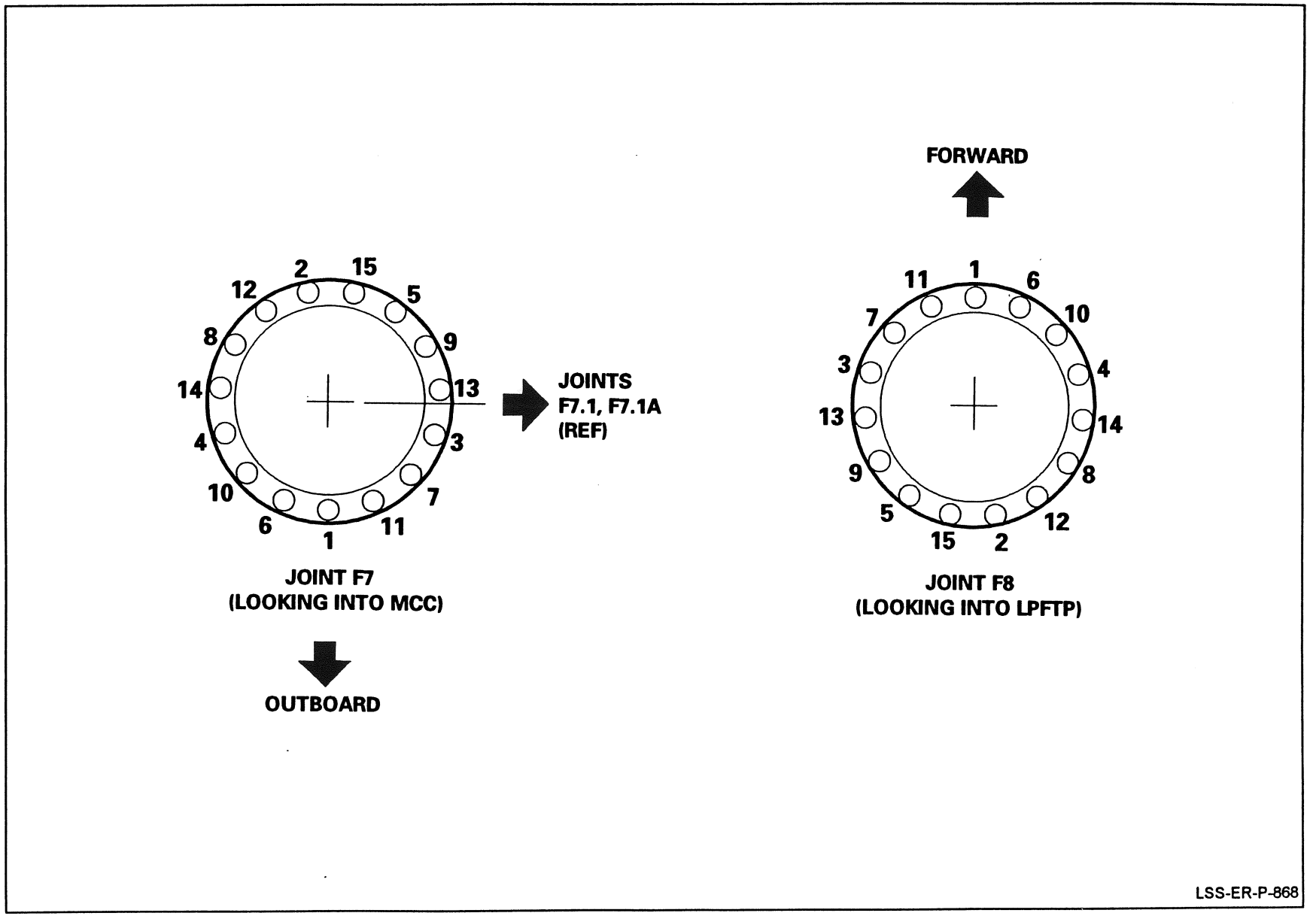

Figure 3. Torque Patterns (Sheet 4 of 18)

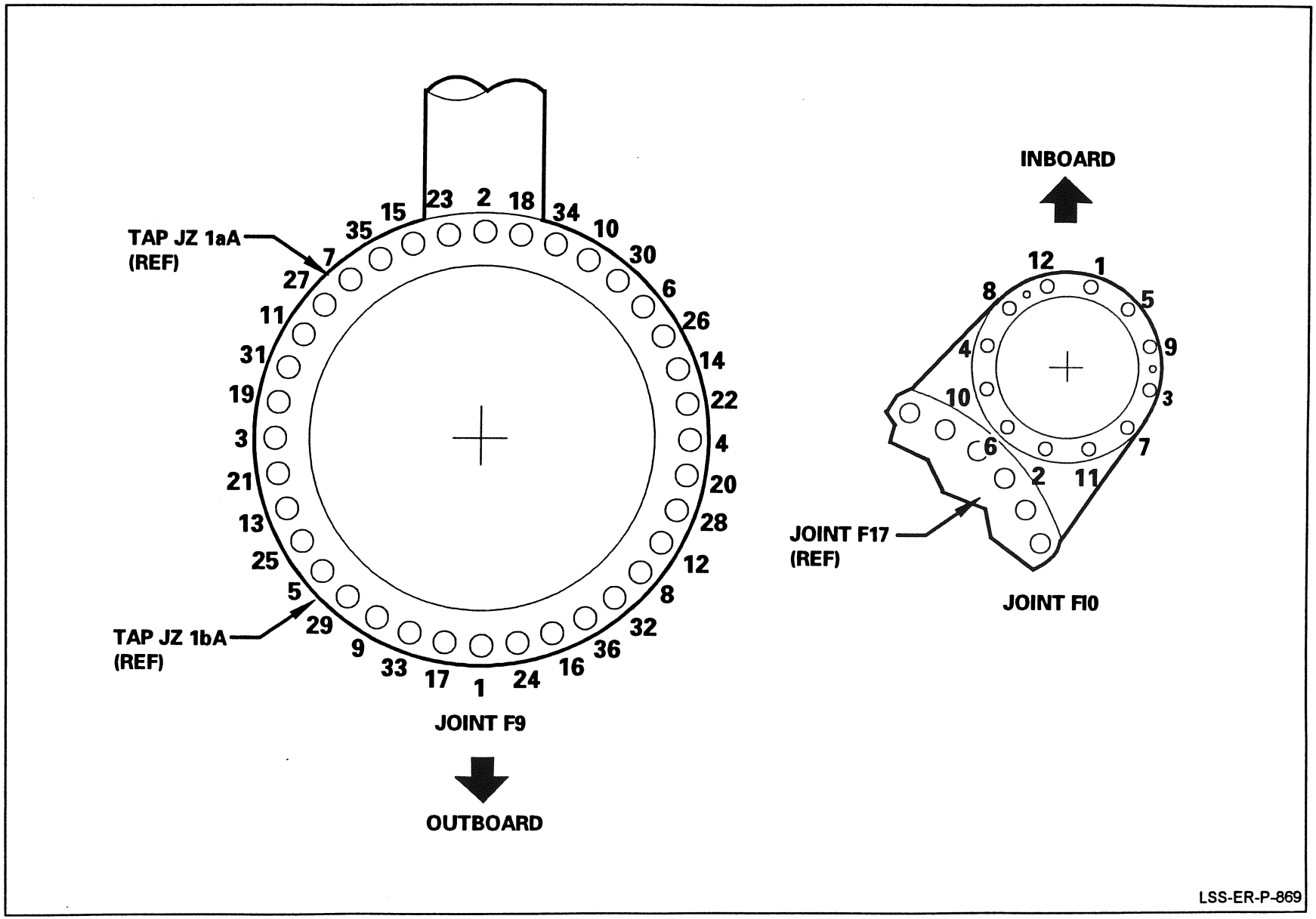

Figure 3. Torque Patterns (Sheet 5 of 18)

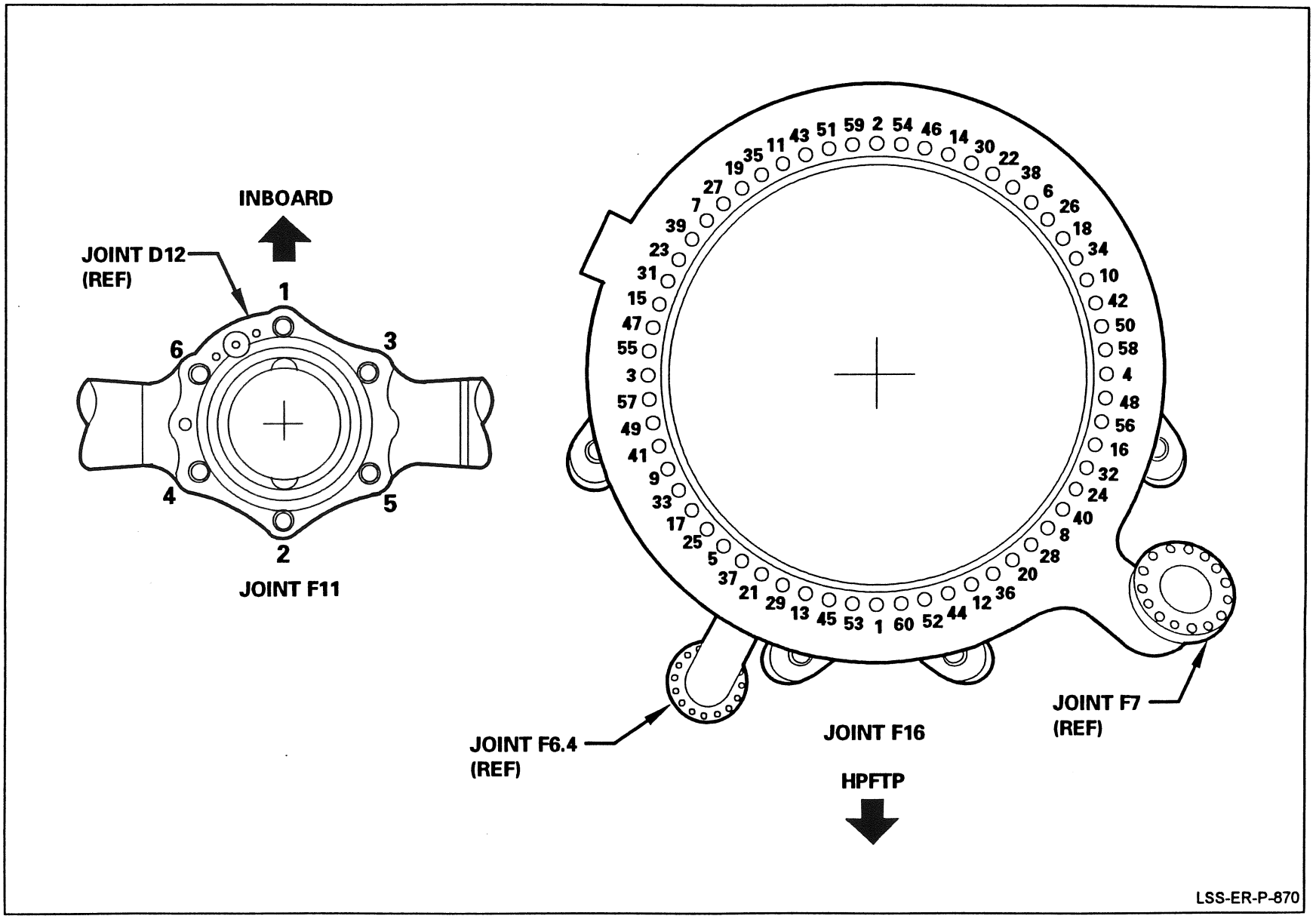

Figure 3. Torque Patterns (Sheet 6 of 18)

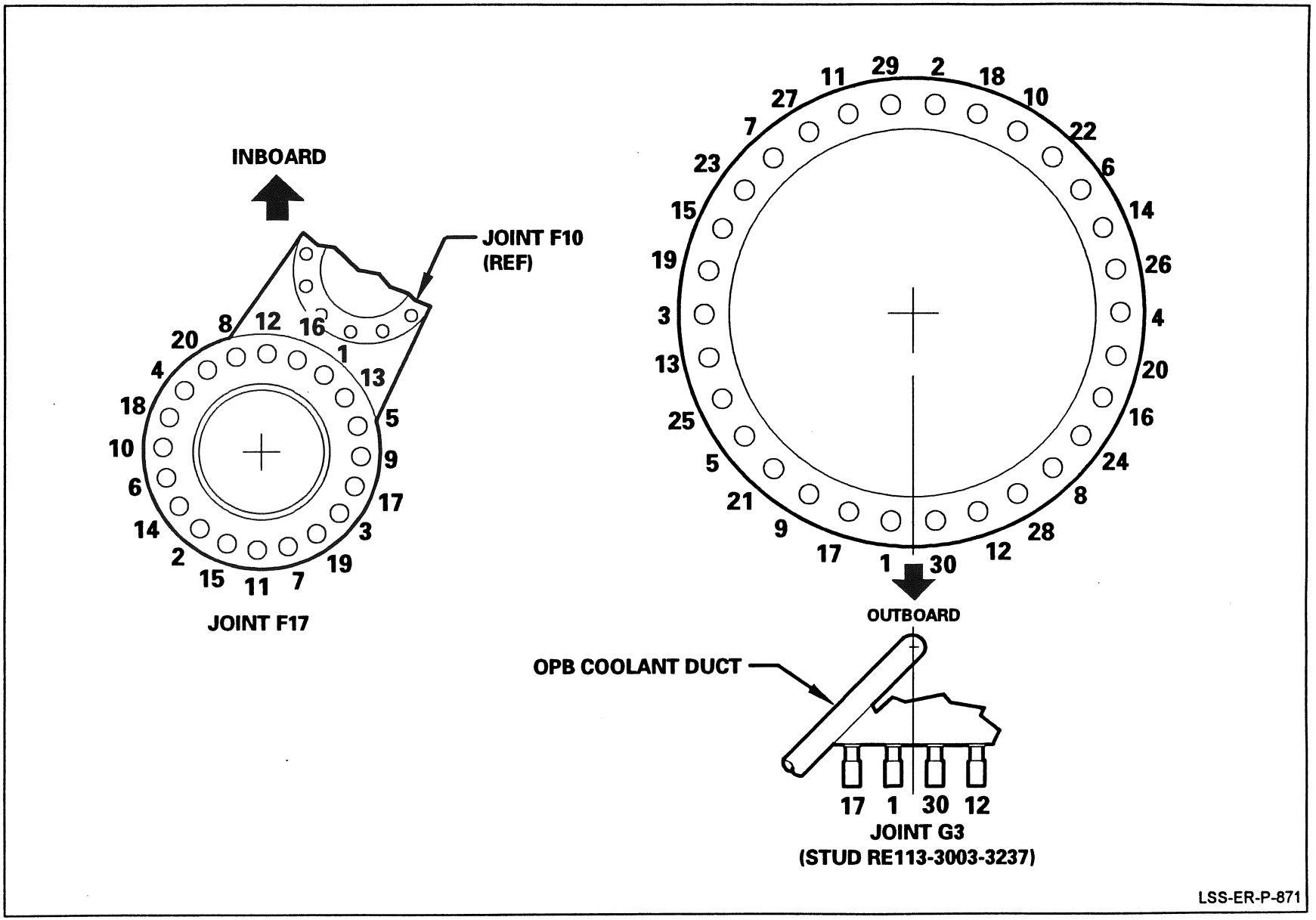

Figure 3. Torque Patterns (Sheet 7 of 18)

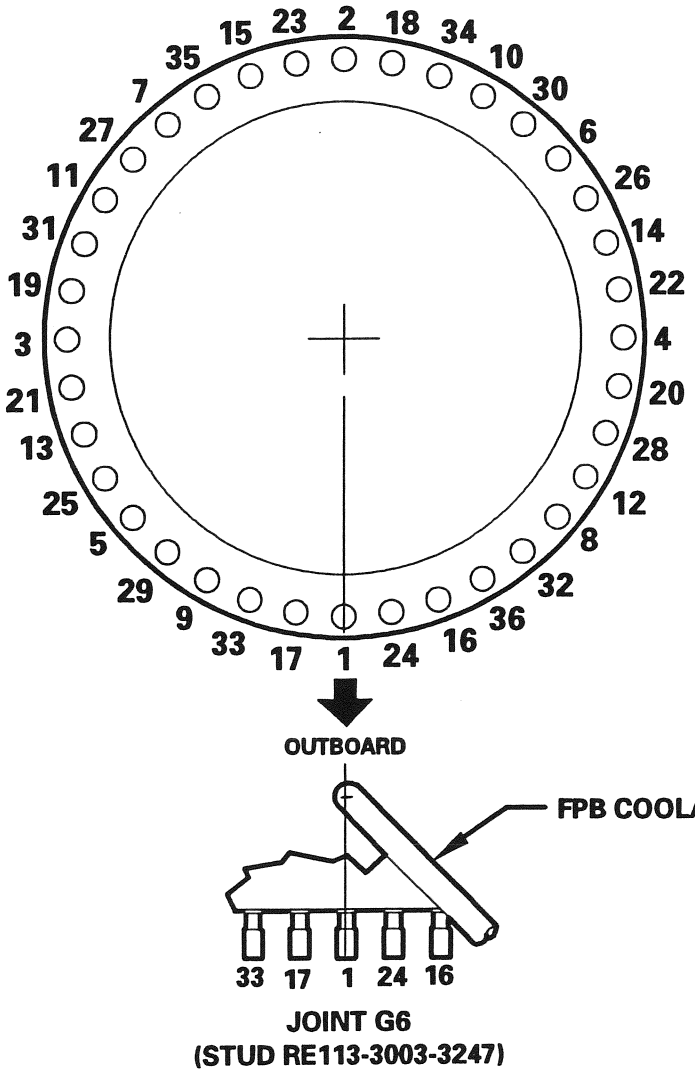

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Figure 3. Torque Patterns (Sheet 8 of 18)

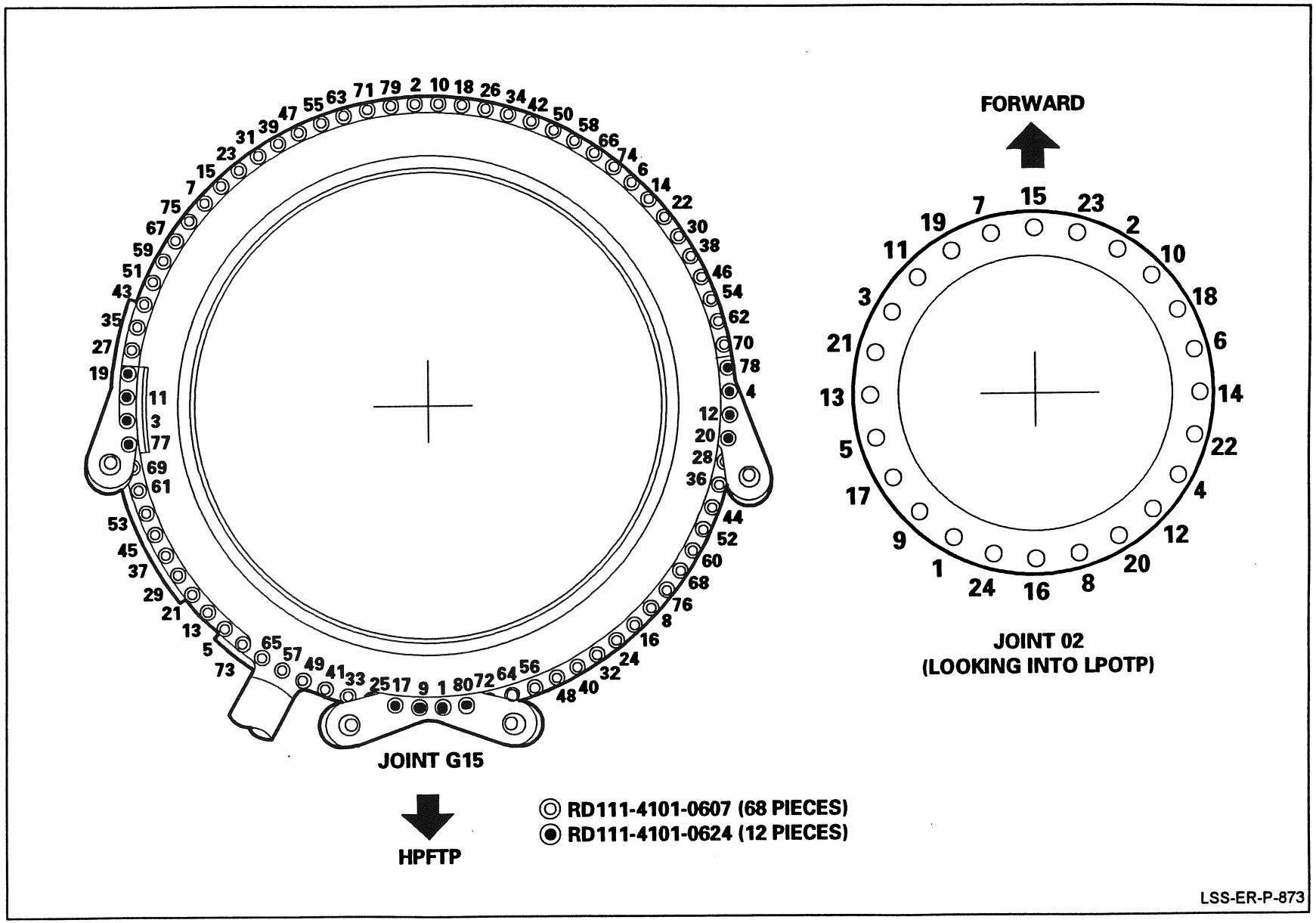


Figure 3. Torque Patterns (Sheet 9 of 18)

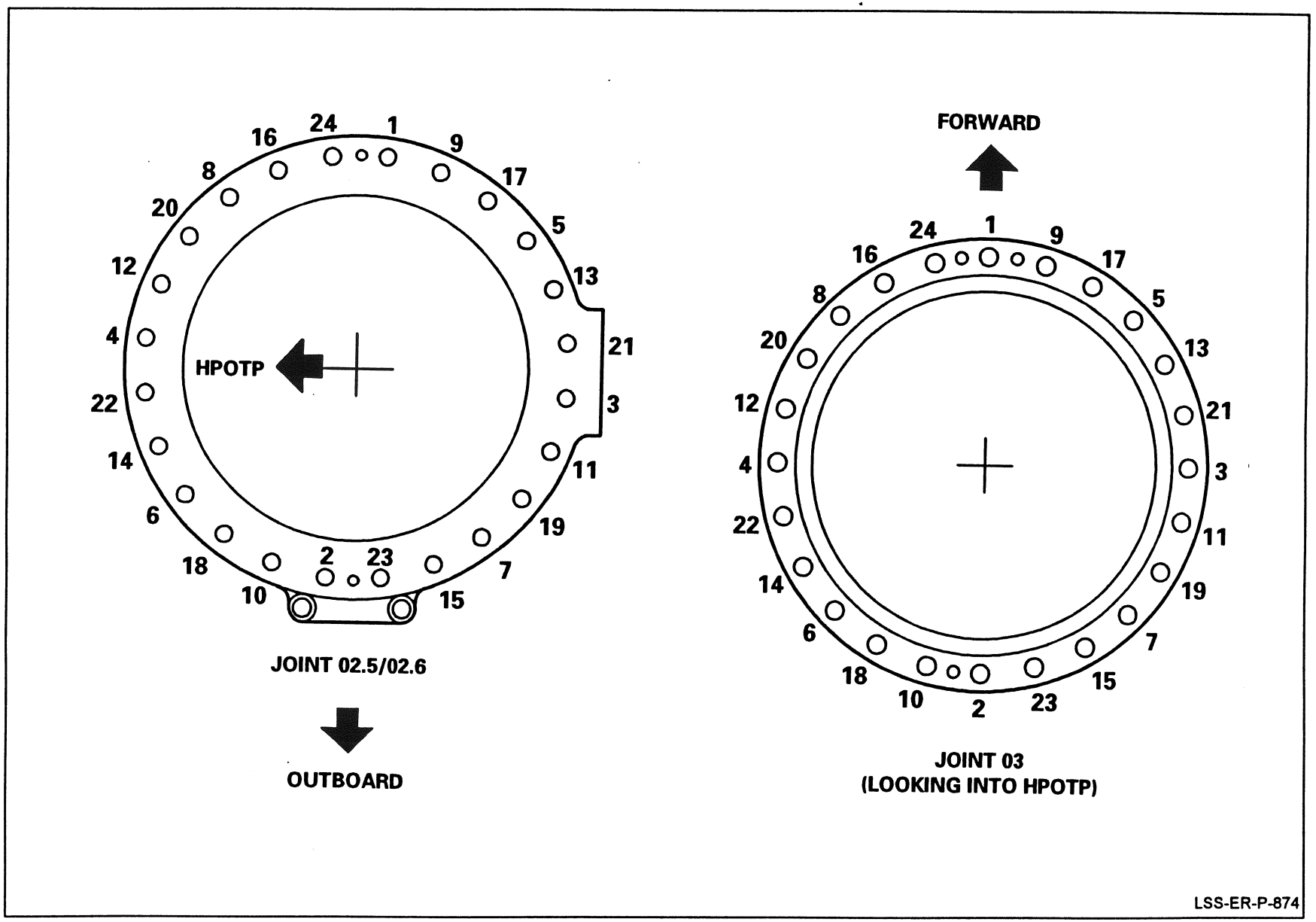


Figure 3. Torque Patterns (Sheet 10 of 18)

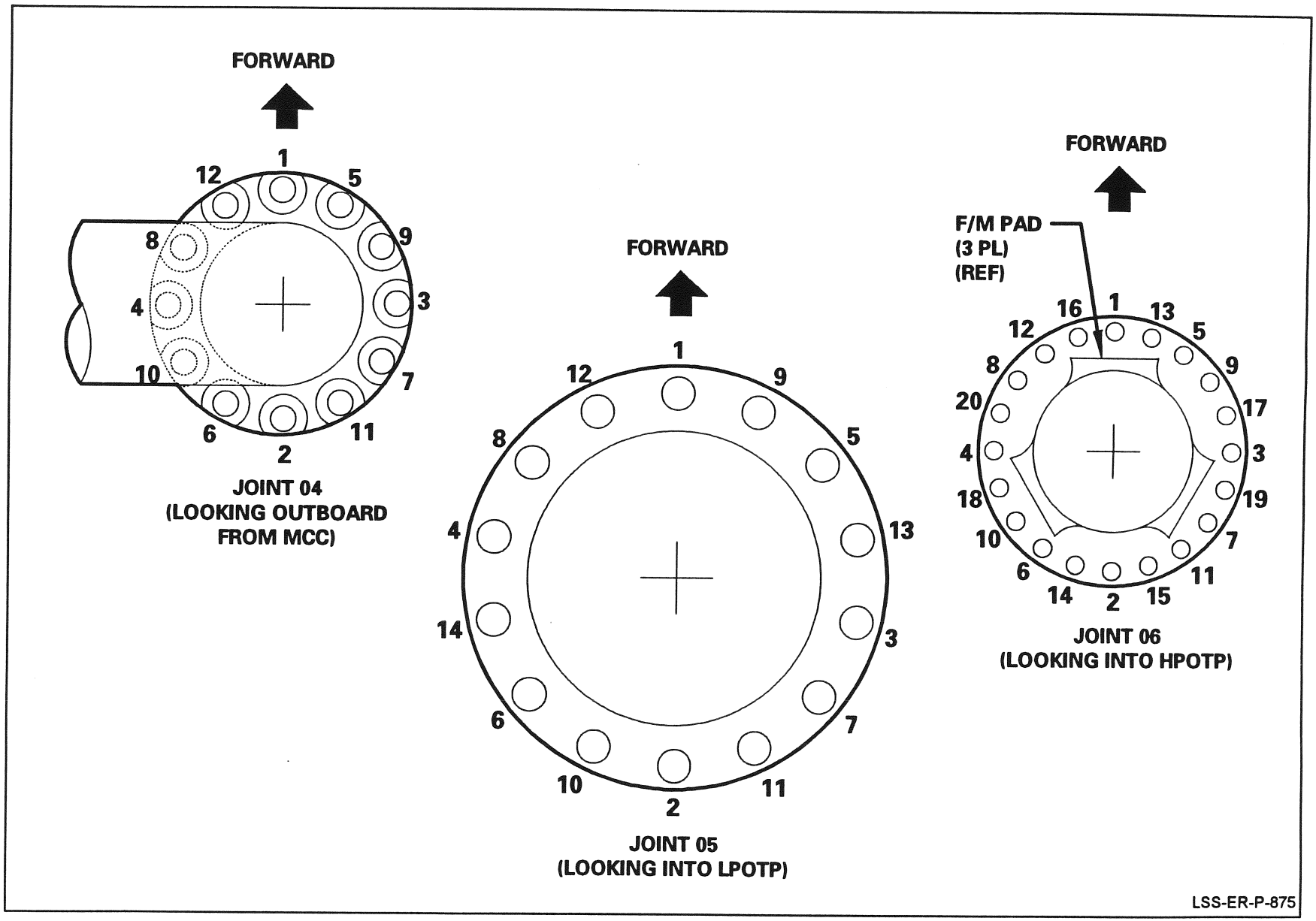
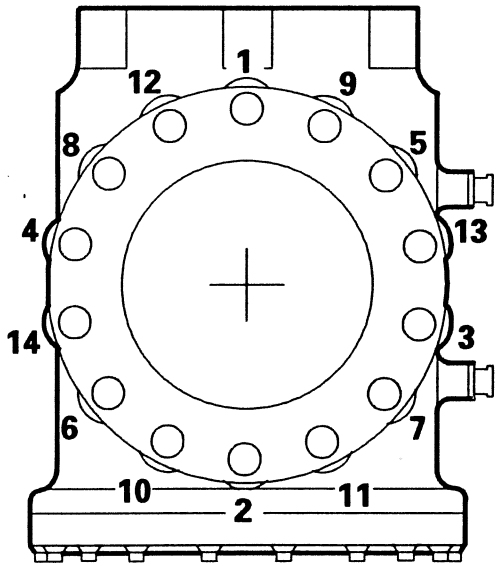
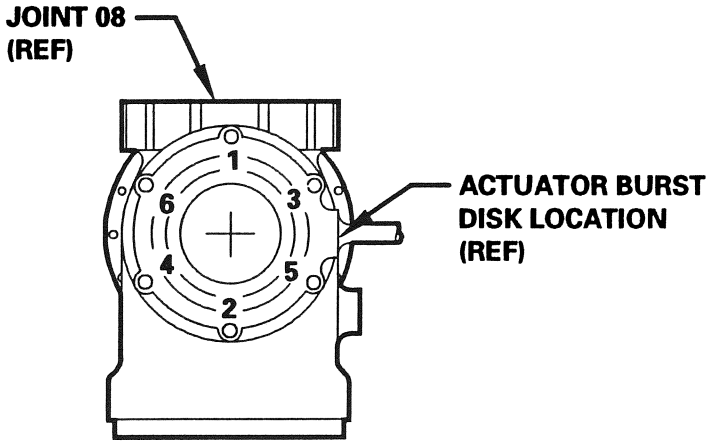


Figure 3. Torque Patterns (Sheet 11 of 18)



JOINT 07



JOINT 07.2
MOVA TO MOV STUDS

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Figure 3. Torque Patterns (Sheet 12 of 18)

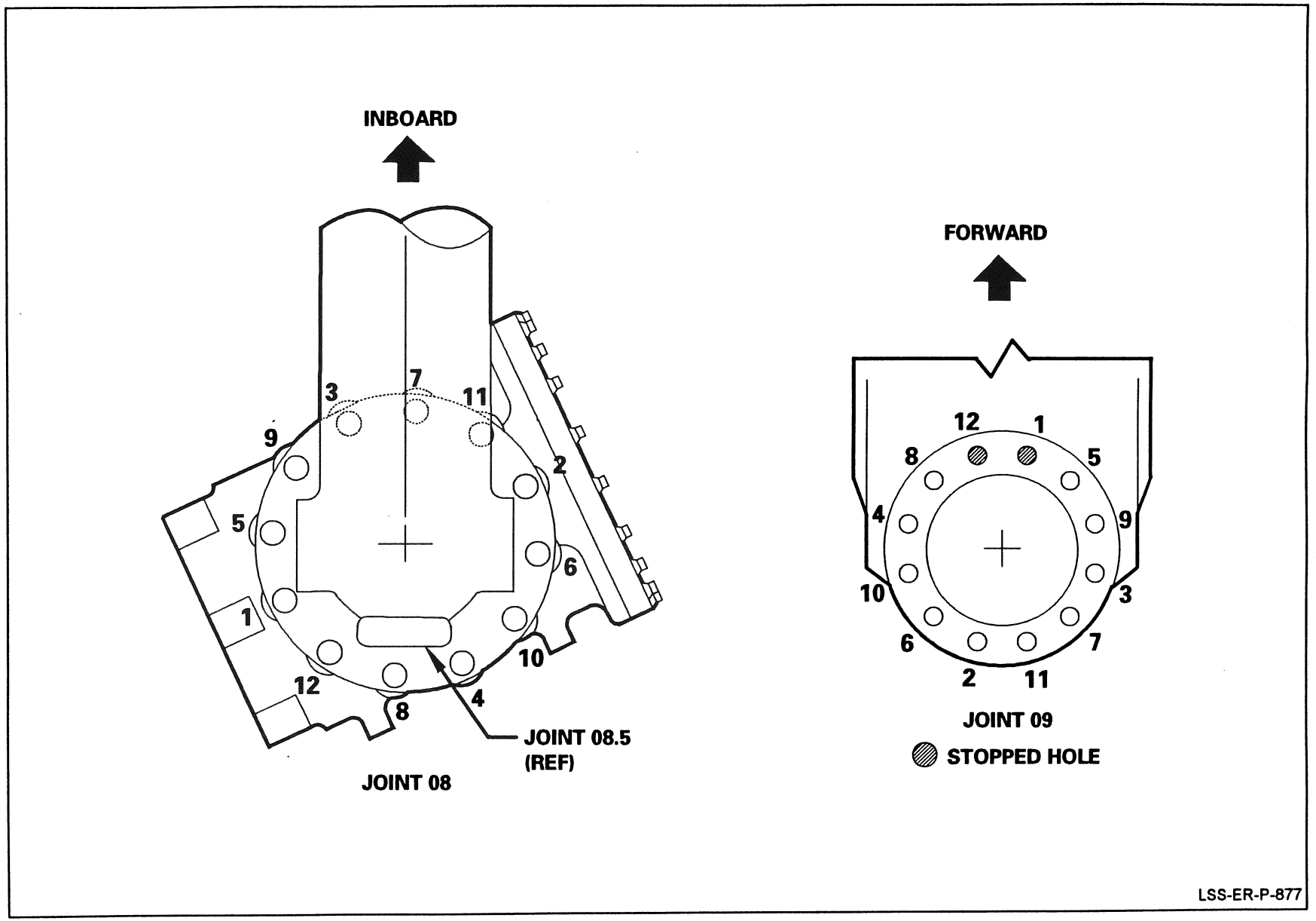

Figure 3. Torque Patterns (Sheet 13 of 18)

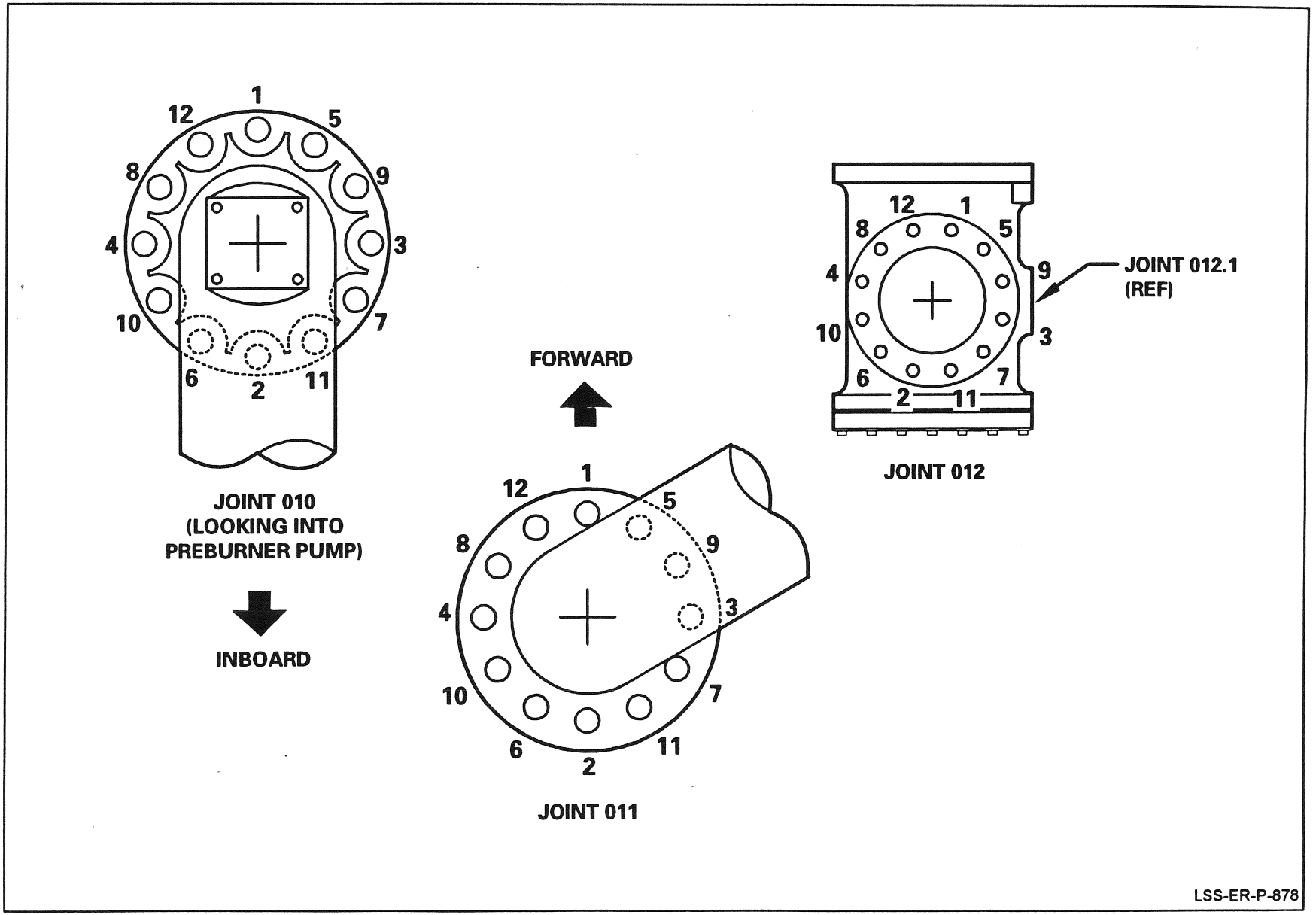

Figure 3. Torque Patterns (Sheet 14 of 18)

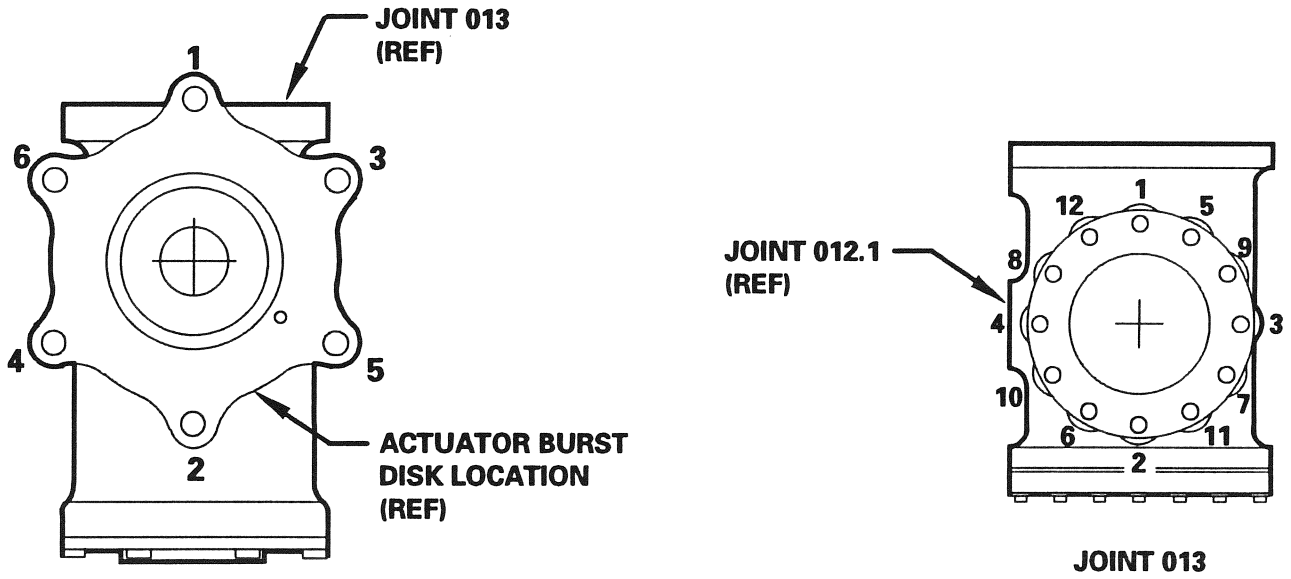

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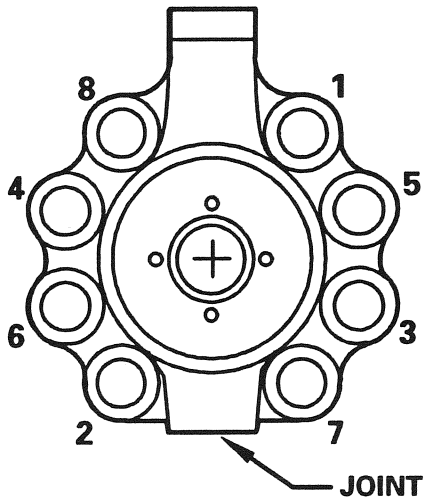
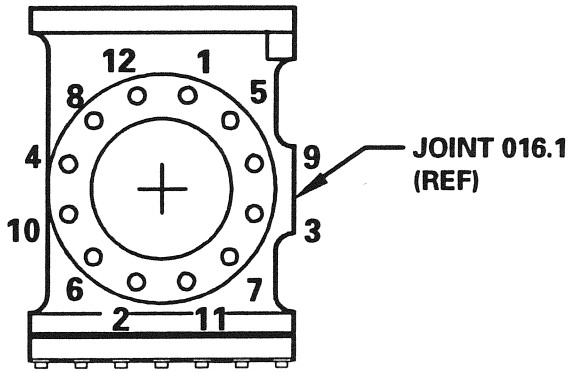
Figure 3. Torque Patterns (Sheet 15 of 18)



JOINT 014



JOINT 016

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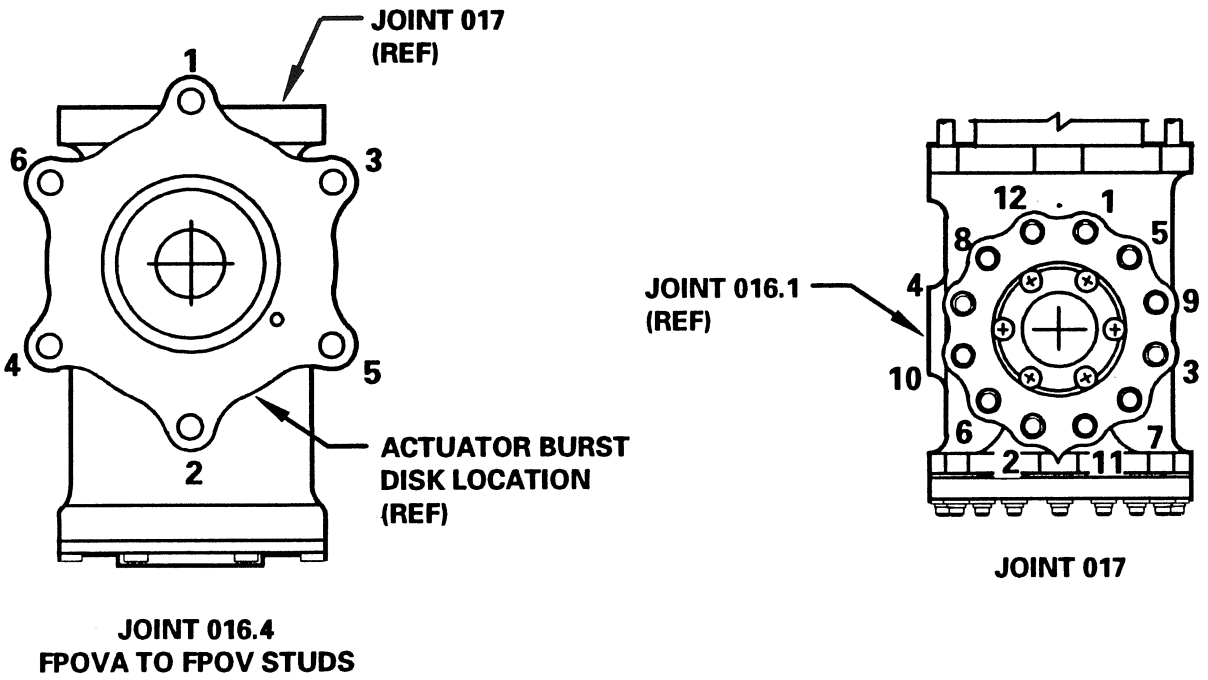
Figure 3. Torque Patterns (Sheet 16 of 18)



LSS-ER-P-881

Figure 3. Torque Patterns (Sheet 17 of 18)

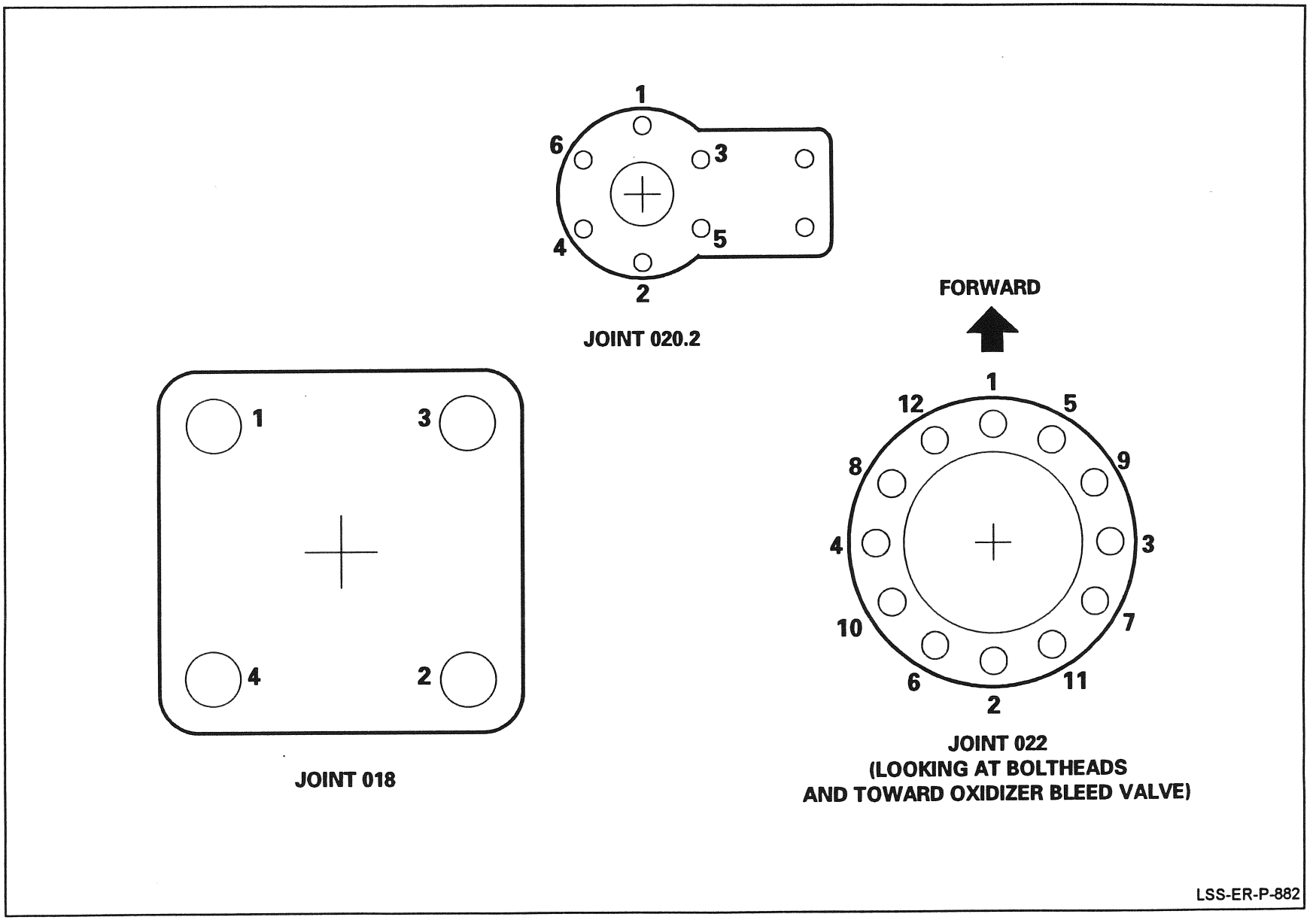
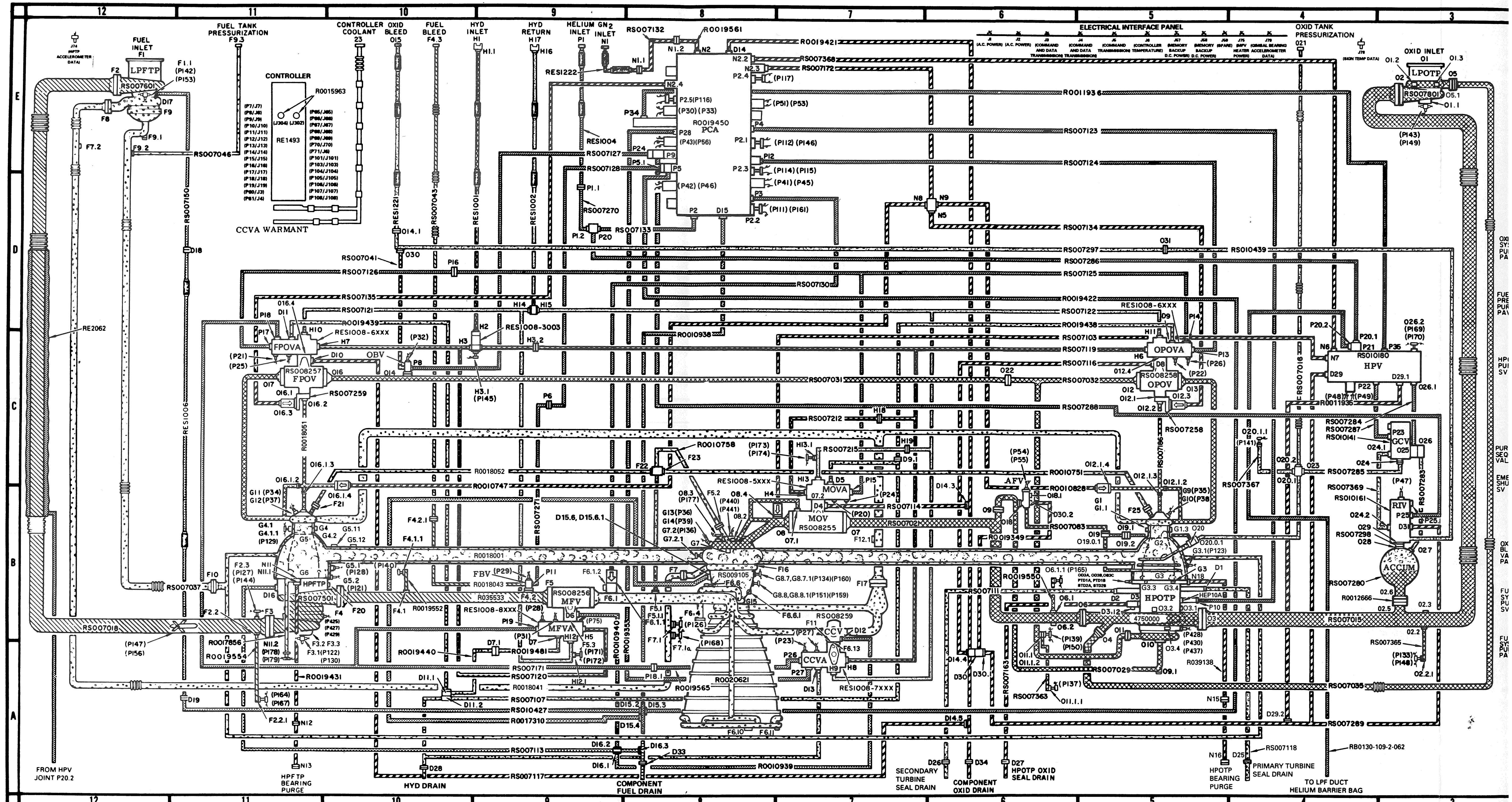
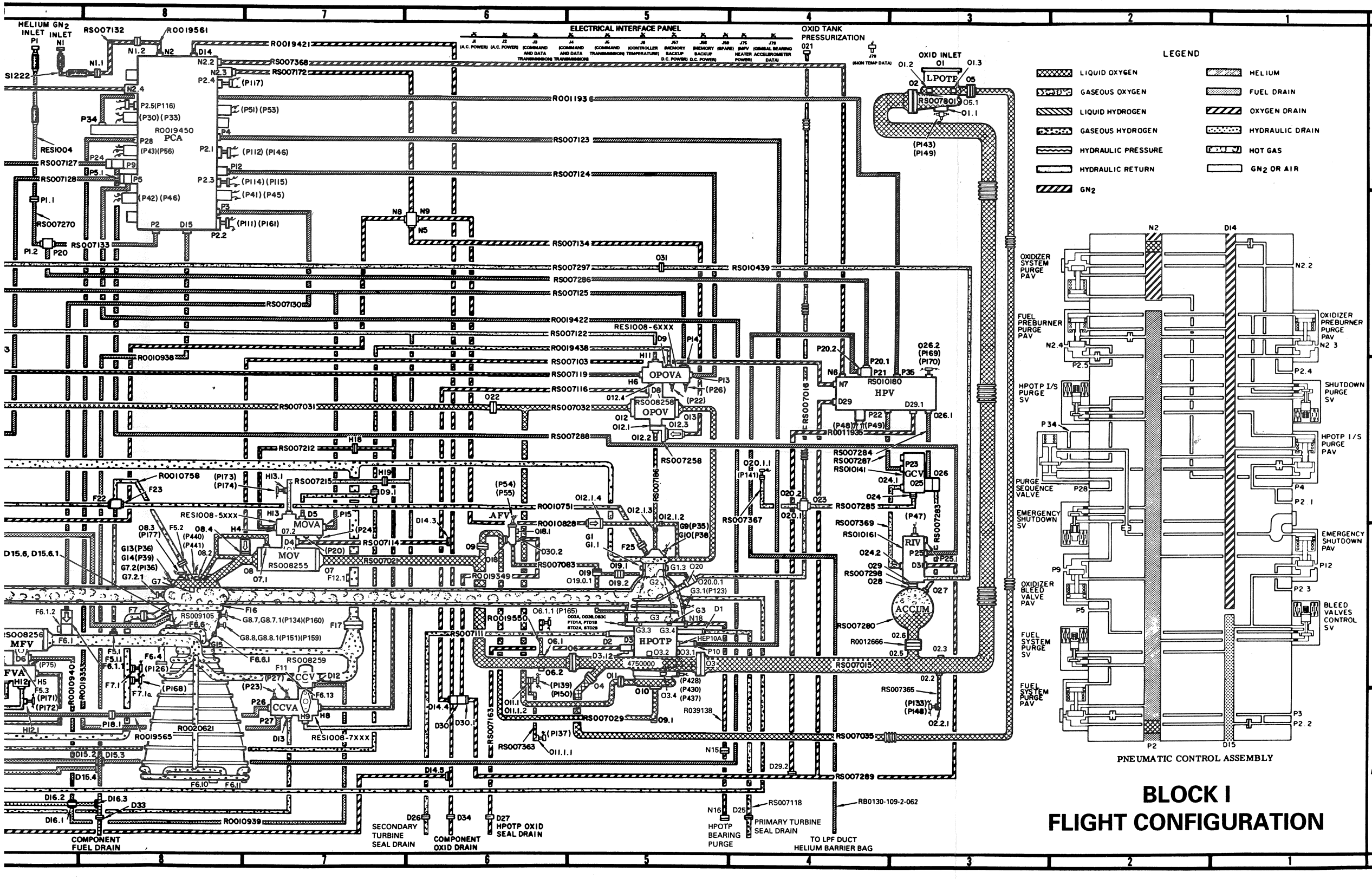


Figure 3. Torque Patterns (Sheet 18 of 18)



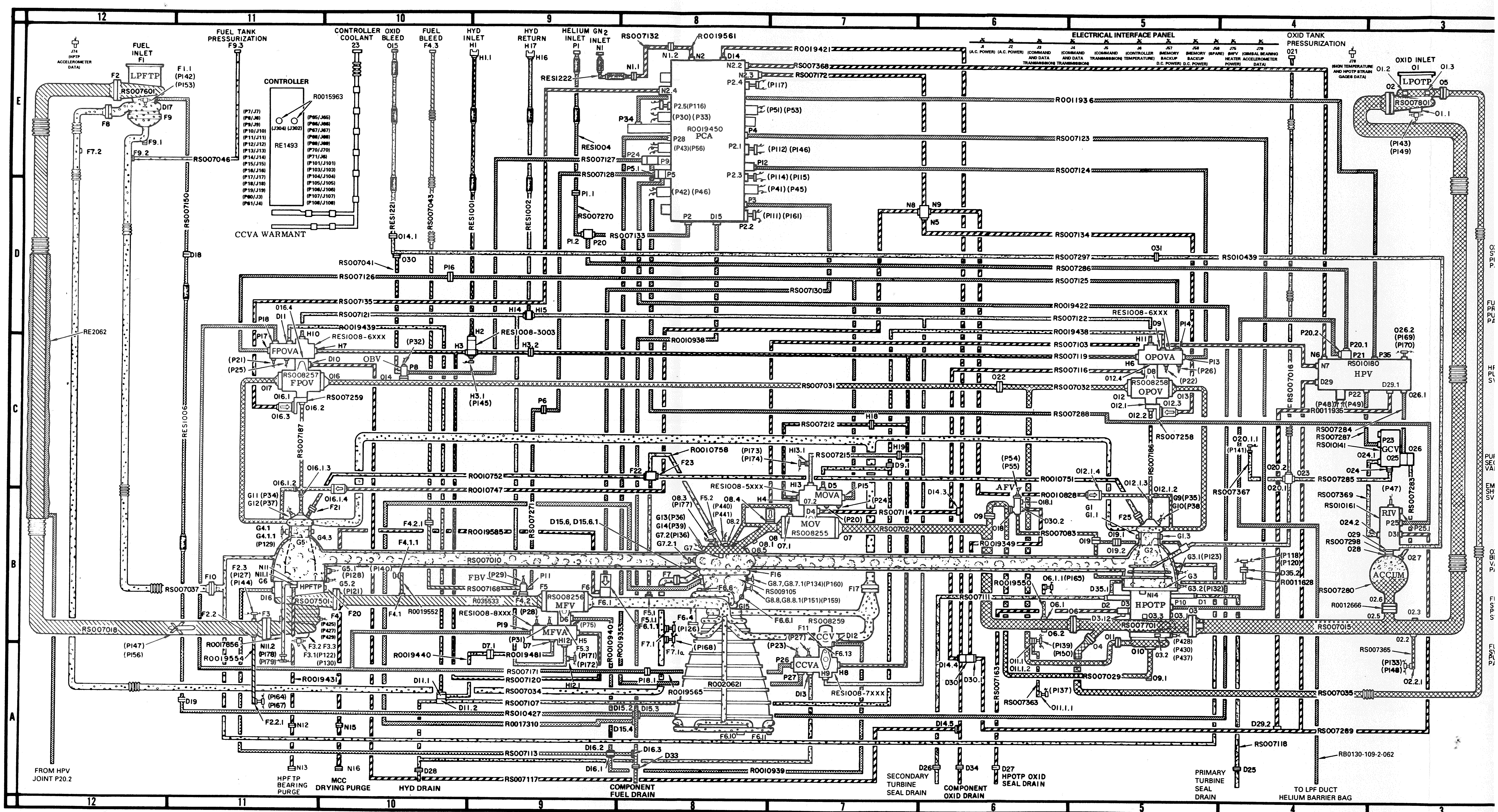
ELECTRICAL INTERFACE PANEL
OXID TANK PRESSURIZATION
OXID INLET
LPOTP
FUEL TANK PRESSURIZATION
FUEL INLET
LPFTP
CONTROLLER COOLANT
OXID BLEED
FUEL BLEED
HYD INLET
HYD RETURN
HELIUM INLET
GN2 INLET
CONTROLLER
CCVA WARMANT
PCA
HPV
OPOVA
OPOV
FPOVA
FPOV
OBV
AFV
MOVA
MOV
GCV
RIV
ACCUM
HPOTP
HPFTP
FBV
MFV
MFVA
CCV
CCVA
FROM HPV JOINT P20.2
HPFTP BEARING PURGE
HYD DRAIN
COMPONENT FUEL DRAIN
SECONDARY TURBINE SEAL DRAIN
COMPONENT OXID DRAIN
HPOTP OXID SEAL DRAIN
HPOTP BEARING PURGE
PRIMARY TURBINE SEAL DRAIN
TO LPF DUCT HELIUM BARRIER BAG

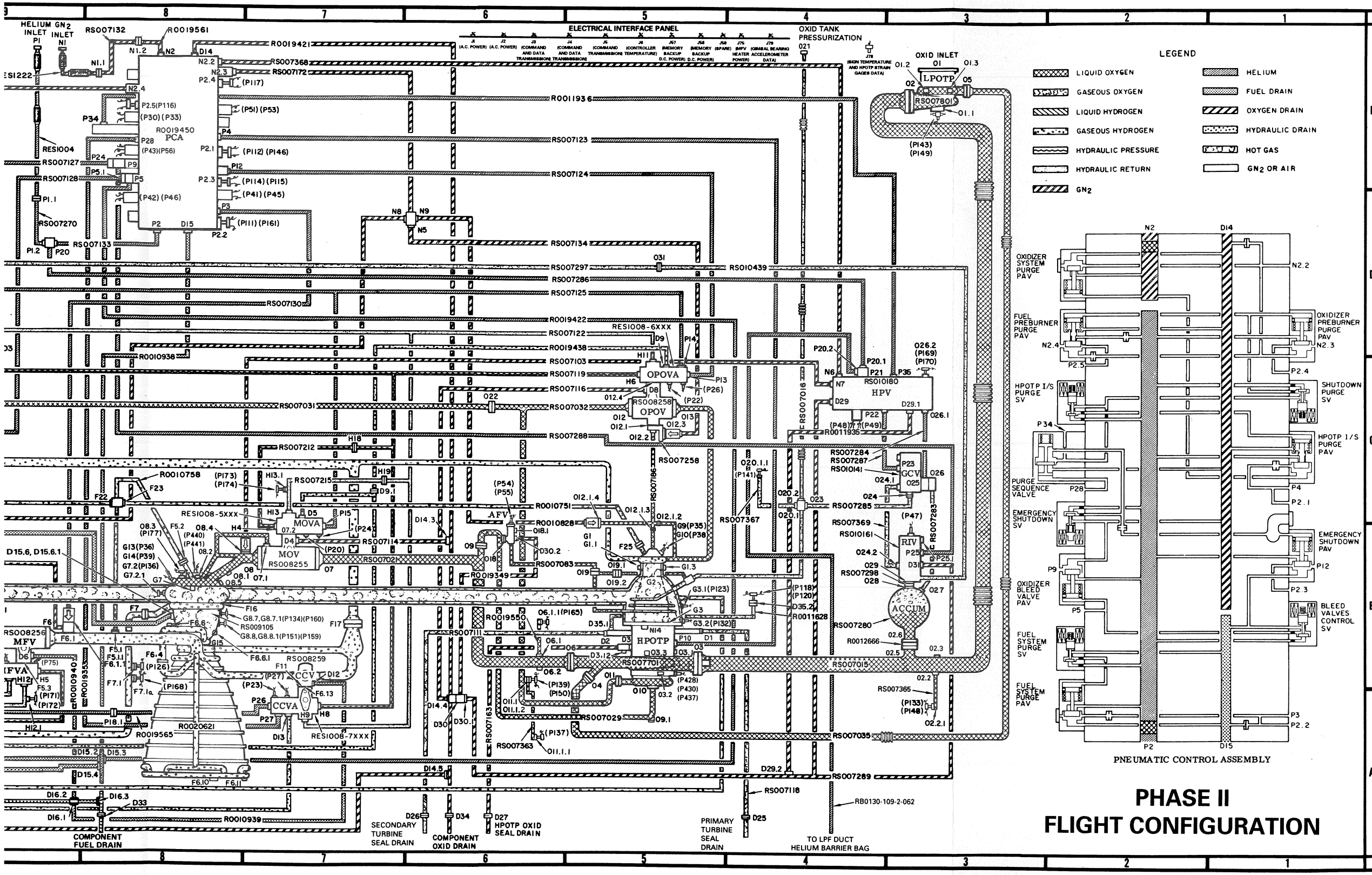


PART NO.	NAME	ZONE
RE1493	CONTROLLER	11E
RE2062	BARRIER BAG	12D
RES1001	FLEX LINE	9D
RES1002	FLEX LINE	9D
RES1004	FLEX LINE	9E
RES1006	FLEX LINE	11C
RES1008	CCVA	7A
RES1008	FPOVA	10C
RES1008	MFVA	9B
RES1008	MOVA	8C
RES1008	OPOVA	5D
RES1221	FLEX LINE	10D
RES1222	FLEX LINE	9E
RS007015	DUCT	4B
RS007016	DUCT	4C
RS007018	DUCT	12B
RS007021	DUCT	7B
RS007029	DUCT	5A
RS007031	DUCT	7C
RS007032	DUCT	6C
RS007035	DUCT	4A
RS007037	DUCT	11B
RS007041	DUCT	10D
RS007043	DUCT	10D
RS007046	DUCT	11E
RS007083	DUCT	6B
RS007103	LINE	6D
RS007107	DUCT	9A
RS007111	DUCT	6B
RS007113	LINE	9A
RS007114	LINE	7B
RS007116	LINE	6C
RS007117	LINE	9A
RS007118	LINE	4A
RS007119	MANIFOLD	6C
RS007120	MANIFOLD	9A
RS007121	MANIFOLD	10D
RS007122	MANIFOLD	6D
RS007123	LINE	6E
RS007124	LINE	6E
RS007125	MANIFOLD	6D
RS007126	LINE	10D
RS007127	LINE	9E
RS007128	LINE	9D
RS007130	LINE	7D
RS007132	LINE	8E
RS007133	LINE	9D
RS007134	LINE	6D
RS007135	LINE	10D
RS007150	LINE	11D
RS007163	LINE	6A
RS007171	LINE	9A
RS007172	LINE	7E
RS007186	LINE	5C
RS007212	LINE	7C
RS007215	LINE	7C
RS007270	LINE	9D
RS007271	LINE	9B
RS007280	POGO ACCUM	4B
RS007283	LINE	3B
RS007284	LINE	4C
RS007285	LINE	4C
RS007286	LINE	6D

PART NO.	NAME	ZONE
RS007287	LINE	4C
RS007288	LINE	6C
RS007289	LINE	4A
RS007297	LINE	6D
RS007298	ADAPTER	4B
RS007365	LINE	6A
RS007365	LINE	3A
RS007367	LINE	4B
RS007368	LINE	6E
RS007369	LINE	4B
RS007501	HPFTP	11B
RS007601	LPFTP	12E
RS007801	LPOTP	3E
RS008255	MOV	7B
RS008256	MFV	9B
RS008257	FPOV	11C
RS008258	OPOV	5C
RS008259	CCV	7B
RS009170	MCC	7B
RS010141	GCV	4C
RS010161	RIV	4B
RS010180	HPV	4C
RS010427	LINE	9A
RS010439	LINE	4D
R0010747	LINE	9C
R0010751	LINE	6C
R0010758	LINE	8C
R0010828	LINE	6B
R0010938	LINE	8C
R0010939	LINE	8A
R0010940	LINE	9A
R0011628	LINE	4B
R0011935	LINE	4C
R0011936	LINE	6E
R0012666	BAFFLE	3B
R0015963	BATTERY	11E
R0017310	LINE	9A
R0017856	LINE	11A
R0018001	POWERHEAD	9B
R0018041	DUCT	9A
R0018043	LINE	9B
R0018051	LINE	11C
R0018052	LINE	9C
R0019353	LINE	8A
R0019421	LINE	7E
R0019422	LINE	6D
R0019431	LINE	11A
R0019438	LINE	6D
R0019439	LINE	10D
R0019440	LINE	10A
R0019450	PCA	8E
R0019481	LINE	9A
R0019550	LINE	6B
R0019552	LINE	10B
R0019554	LINE	11A
R0019561	LINE	8E
R0019565	LINE	8A
R0019585	LINE	9B
R0020621	NOZZLE	8A
R033302	LINE	9A
R035533	DUCT	9B
4750000	HPOTP	5B

Figure 1. SSME Fluid Schematic (Sheet 1 of 2)


ELECTRICAL INTERFACE PANEL
OXID TANK PRESSURIZATION
OXID INLET
FUEL INLET
FUEL TANK PRESSURIZATION
CONTROLLER COOLANT
OXID BLEED
FUEL BLEED
HYD INLET
HYD RETURN
HELIUM INLET
GN2 INLET
CONTROLLER
CCVA WARMANT
PCA
LPFTP
LPOTP
HPFTP
HPOTP
FPOVA
FPOV
OPOVA
OPOV
HPV
GCV
RIV
ACCUM
MOVA
MOV
AFV
FBV
MFV
MFVA
CCV
CCVA
OBV
FROM HPV JOINT P20.2
HPFTP BEARING PURGE
MCC DRYING PURGE
HYD DRAIN
COMPONENT FUEL DRAIN
SECONDARY TURBINE SEAL DRAIN
COMPONENT OXID DRAIN
HPOTP OXID SEAL DRAIN
PRIMARY TURBINE SEAL DRAIN
TO LPF DUCT HELIUM BARRIER BAG
RB0130-109-2-062



PART NO.	NAME	ZONE
RE1493	CONTROLLER	11E
RE2062	BARRIER BAG	12D
RES1001	FLEX LINE	9D
RES1002	FLEX LINE	9D
RES1004	FLEX LINE	9E
RES1006	FLEX LINE	11C
RES1008	CCVA	7A
RES1008	FPOVA	10C
RES1008	MFVA	9B
RES1008	MOVA	8C
RES1008	OPOVA	5D
RES1221	FLEX LINE	10D
RES1222	FLEX LINE	9E
RS007010	POWERHEAD	9B
RS007015	DUCT	4B
RS007016	DUCT	4C
RS007018	DUCT	12B
RS007021	DUCT	7B
RS007029	DUCT	5A
RS007031	DUCT	7C
RS007032	DUCT	6C
RS007034	DUCT	9A
RS007035	DUCT	4A
RS007037	DUCT	11B
RS007041	DUCT	10D
RS007043	DUCT	10D
RS007046	DUCT	11E
RS007083	DUCT	6B
RS007103	LINE	6D
RS007107	DUCT	9A
RS007111	DUCT	6B
RS007113	LINE	9A
RS007114	LINE	7B
RS007116	LINE	6C
RS007117	LINE	9A
RS007118	LINE	4A
RS007119	MANIFOLD	6C
RS007120	MANIFOLD	9A
RS007121	MANIFOLD	10D
RS007122	MANIFOLD	6D
RS007123	LINE	6E
RS007124	LINE	6E
RS007125	MANIFOLD	6D
RS007126	LINE	10D
RS007127	LINE	9E
RS007128	LINE	9D
RS007130	LINE	7D
RS007132	LINE	8E
RS007133	LINE	9D
RS007134	LINE	6D
RS007135	LINE	10D
RS007150	LINE	11D
RS007163	LINE	6A
RS007168	LINE	9B
RS007171	LINE	9A
RS007172	LINE	7E
RS007186	LINE	5C
RS007187	LINE	11C
RS007212	LINE	7C
RS007215	LINE	7C
RS007270	LINE	9D
RS007271	LINE	9B
RS007280	POGO ACCUM	4B

PART NO.	NAME	ZONE
RS007283	LINE	3B
RS007284	LINE	4C
RS007285	LINE	4C
RS007286	LINE	6D
RS007287	LINE	4C
RS007288	LINE	6C
RS007289	LINE	4A
RS007297	LINE	6D
RS007298	ADAPTER	4B
RS007363	LINE	6A
RS007365	LINE	3A
RS007367	LINE	4B
RS007368	LINE	6E
RS007369	LINE	4B
RS007501	HPFTP	11B
RS007601	LPFTP	12E
RS007701	HPOTP	5B
RS007801	LPOTP	3E
RS008255	MOV	7B
RS008256	MFV	9B
RS008257	FPOV	11C
RS008258	OPOV	5C
RS008259	CCV	7B
RS009170	MCC	7B
RS010141	GCV	4C
RS010161	RIV	4B
RS010180	HPV	4C
RS010427	LINE	9A
RS010439	LINE	4D
R0010747	LINE	9C
R0010751	LINE	6C
R0010752	LINE	9C
R0010758	LINE	8C
R0010828	LINE	6B
R0010938	LINE	8C
R0010939	LINE	8A
R0010940	LINE	9A
R0011628	LINE	4B
R0011935	LINE	4C
R0011936	LINE	6E
R0012666	BAFFLE	3B
R0015963	BATTERY	11E
R0017310	LINE	9A
R0017856	LINE	11A
R0019349	LINE	6B
R0019353	LINE	8A
R0019421	LINE	7E
R0019422	LINE	6D
R0019431	LINE	11A
R0019438	LINE	6D
R0019439	LINE	10D
R0019440	LINE	10A
R0019450	PCA	8E
R0019481	LINE	9A
R0019550	LINE	6B
R0019552	LINE	10B
R0019554	LINE	11A
R0019561	LINE	8E
R0019565	LINE	8A
R0019585	LINE	9B
R0020621	NOZZLE	8A
R033302	LINE	9A
R035533	DUCT	9B

Figure 1. SSME Fluid Schematic (Sheet 2 of 2)

BLOCK I HARNESS SCHEMATIC

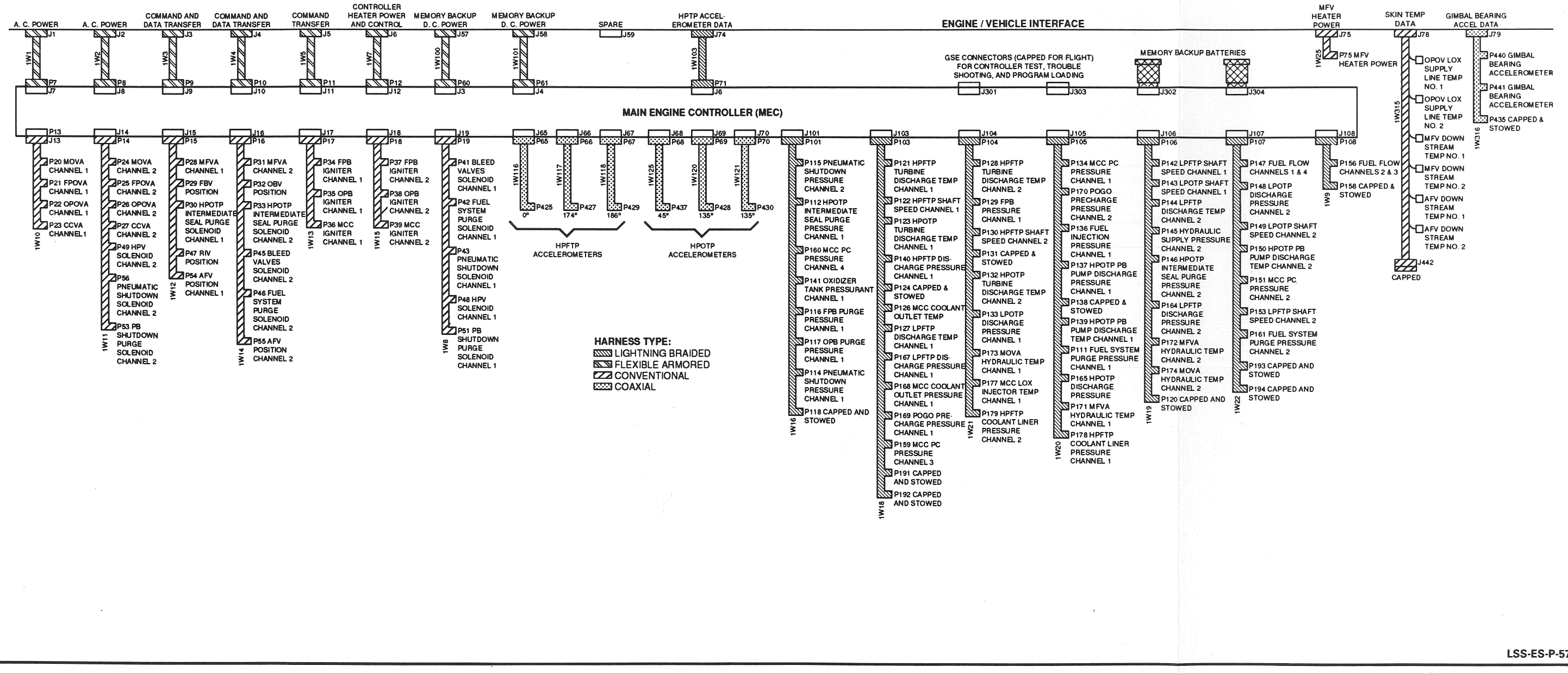


Figure 2. SSME Harness Schematic (Sheet 1 of 2)

PHASE II HARNESS SCHEMATIC

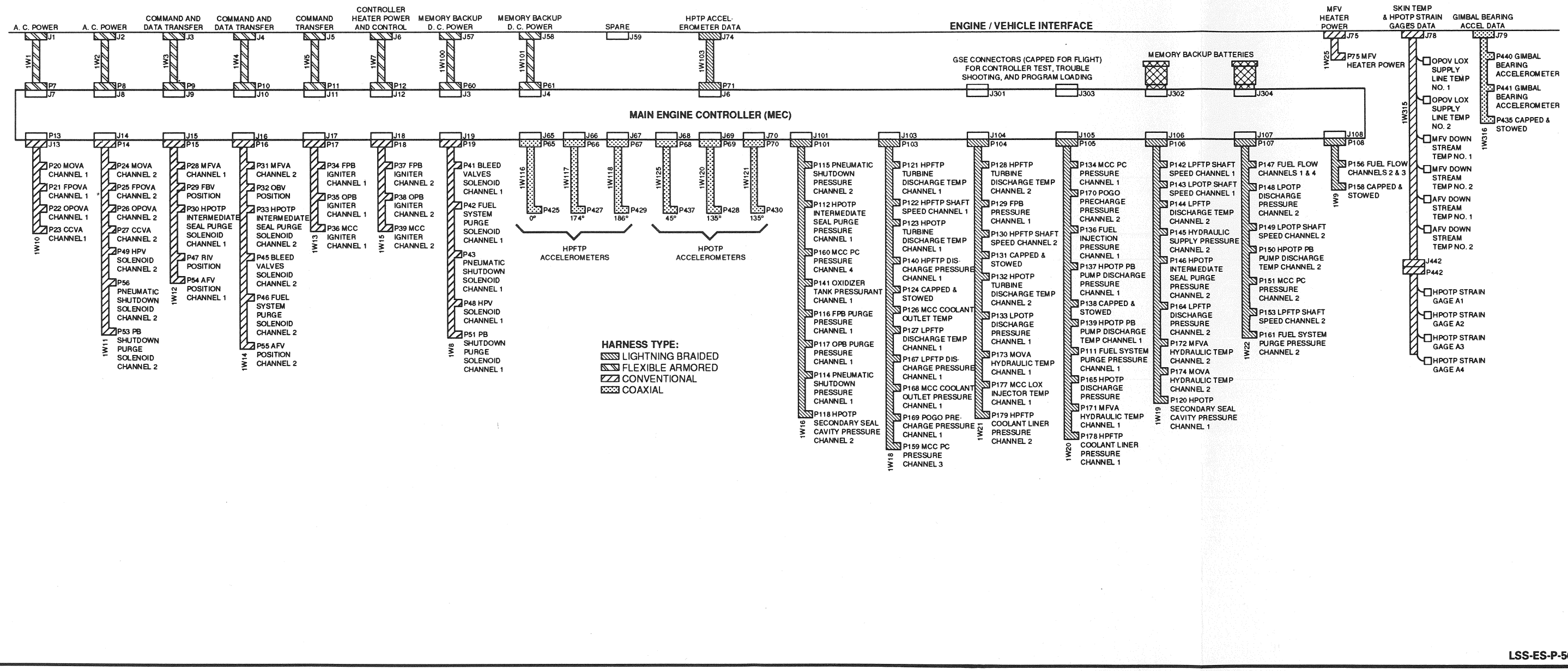


Figure 2. SSME Harness Schematic (Sheet 2 of 2)