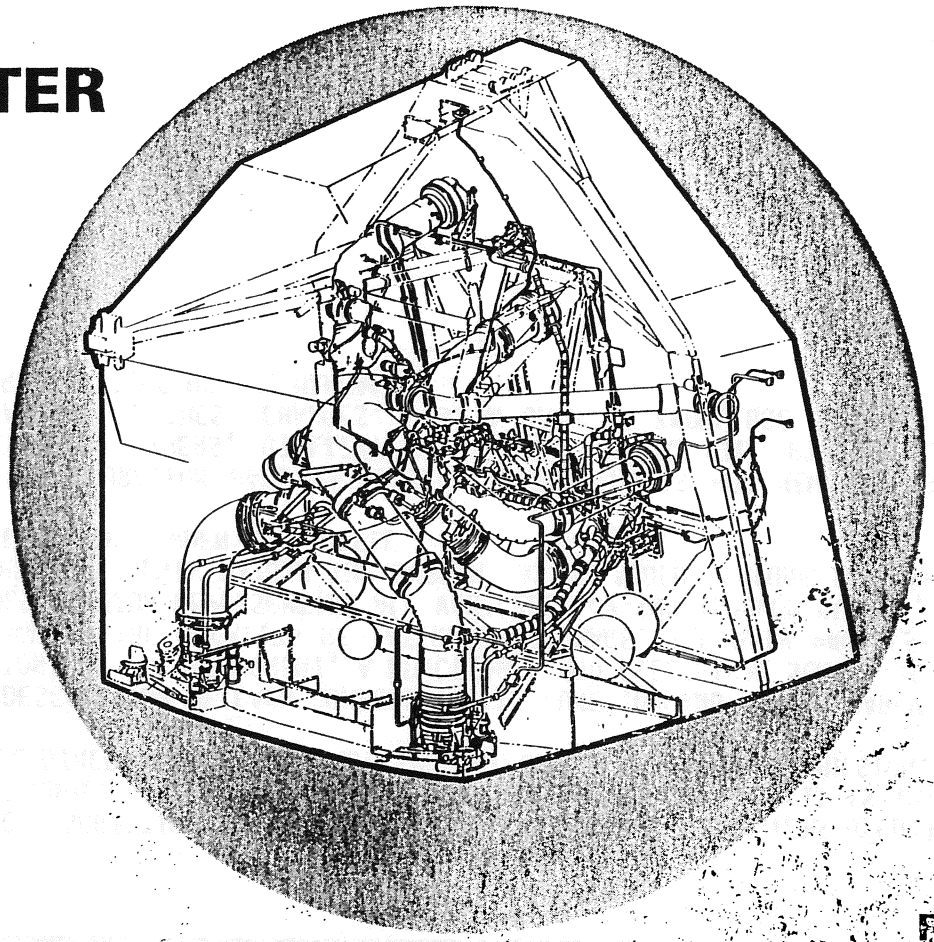
MPS COMPONENTS MANUAL

MAIN PROPULSION SYSTEMS

SHUTTLE ORBITER



Prepared By

THE PROPULSION AND FLUID
SYSTEMS COMPONENTS GROUP

J E Osland

Rockwell International
Space Transportation

PREFACE

THIS MANUAL FURNISHES A BASIC DESCRIPTION OF THE COMPONENTS AND RELATED SUBSYSTEMS USED IN THE MAIN PROPULSION SYSTEM OF ALL SHUTTLE ORBITER VEHICLES BUILT BY ROCKWELL INTERNATIONAL. IT IS INTENDED PRIMARILY FOR USE BY TECHNICAL PERSONNEL DIRECTLY INVOLVED WITH SUPPORT OF ORBITER MAIN PROPULSION.

THE MANUAL INCLUDES A BRIEF DESCRIPTION OF EACH COMPONENT, ITS FUNCTION AND DESIGN PARAMETERS. FOLLOWING THESE ARE PICTORIAL DESCRIPTIONS OF THE COMPONENT, A FUNCTIONAL AND ELECTRICAL SCHEMATIC, IF APPLICABLE, AND A COMPONENT SCHEMATIC SHOWING THE LOCATION OF INTERNAL HARDWARE. THE MAIN PROPULSION SYSTEM SCHEMATIC PROVIDES A COMPONENT DESCRIPTION REPRESENTING ALL VEHICLES, OV-102 THROUGH OV-105, AND IS INTENDED TO SHOW ONLY LOCATIONS OF THE COMPONENTS WITHIN THE SYSTEM. AS AN ADDED FEATURE THE FMEA/CIL NUMBER IS INCLUDED ON EACH COMPONENT TITLE PAGE, WHEN APPLICABLE.

SINCE CHANGES TO COMPONENT CONFIGURATION HAVE ESTABLISHED REQUIREMENTS FOR NEW CONFIGURATIONS, WHILE CHANGING THE DESIGN PARAMETERS OF OTHERS, UTILIZATION OF THIS MANUAL WILL PROVIDE THE MOST CURRENT INFORMATION REGARDING SUCH ARTICLES. THESE CHANGES, PLUS A GAIN IN KNOWLEDGE THROUGH EXPERIENCE, MAY MAKE IT NECESSARY FOR FURTHER REVISIONS OF THE MANUAL.

INDEX BY: FUNCTION AND TAB NO.

COMPONENT	TAB NO.	CONTROLLING SPECIFICATION	RESPONSIBLE ENGINEER	ENGINEER TELEPHONE	SUPPLIER
VALVES					
FLOW CONTROL (GH_2, GO_2)	17	MC280-0017	S. HAUVER	213-922-4545	EATON CONSOLIDATED CONTROLS
BALL 1-1/2" & 2" (LO_2, LH_2)	24	MC284-0395	B. MARUMOTO	-1822	EATON CONSOLIDATED CONTROLS
FILL & DRAIN 8" (LO_2, LH_2)	26	MC284-0397	H. WOLFSON	-1289	FAIRCHILD CONTROLS
PREVALVES, 12" (LO_2, LH_2)	25	MC284-0396	H. WOLFSON	-1289	FAIRCHILD CONTROLS
2-WAY SOLENOID (GHe)	29	MC284-0403	B. MARUMOTO	-1822	WRIGHT CONTROLS
3-WAY SOLENOID(GHe)	30	MC284-0404	B. MARUMOTO	-1822	WRIGHT CONTROLS
1" MANIFOLD RELIEF SHUTOFF (LO_2, LH_2)	31	MC284-0406	H. WOLFSON	-1289	FAIRCHILD CONTROLS
RELIEF VALVES					
LO_2, LH_2 MANIFOLD FEEDLINE	32	MC284-0501	J. YOSHINAGA	-4234	PARKER HANNIFIN
850 PSIG (GHe)	27	MC284-0398	T. LIU	-1016	EATON CONSOLIDATED CONTROLS
LH_2 RECIRCULATION MANIFOLD	43	ME284-0474	S. HAUVER	-4545	CIRCLE SEAL CONTROLS
CHECK VALVES					
1/4 TO 1.0" (GHe)	42	ME284-0472	S. HAUVER	-4545	CIRCLE SEAL CONTROLS
LO_2 DUAL BLEED	33	MC284-0515	J. YOSHINAGA	-4234	PARKER HANNIFIN
ENGINE PRESSURIZATION ISOLATION (GO_2, GH_2)	44	ME284-0479	S. HAUVER	213-922-4545	CIRCLE SEAL CONTROLS

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COMPONENT	TAB NO.	CONTROLLING SPECIFICATION	RESPONSIBLE ENGINEER	ENGINEER TELEPHONE	SUPPLIER
LINES/MANIFOLDS/SEALS					
GH_2 PREPRESS/PRESS SYSTEM	3	V070-415425	T. SHUPE	213-922-1174	ROCKWELL INTL.
GO_2 PREPRESS/PRESS SYSTEM	5	V070-415462	T. SHUPE	-1174	ROCKWELL INTL.
FEED (LH_2)	9	MC271-0073	T. BUSTAMANTE	-1554	ARROWHEAD PRODUCTS
FEED (LO_2)	10	MC271-0074	T. BUSTAMANTE	-1554	ARROWHEAD PRODUCTS
RECIRCULATION & REPLENISHMENT, LH_2	11	MC271-0075	T. BUSTAMANTE	-1554	AMETEK/STRAZA
FILL & DRAIN LH_2, LO_2	12	MC271-0076	T. BUSTAMANTE	-1554	AMETEK/STRAZA
HOSE, METAL FLEX	13	MC271-0077	T. BUSTAMANTE	-1554	COAST METAL CRAFT
GO_2 PREPRESS/PRESS SYSTEM	7	V070-415490	T. SHUPE	-1174	ROCKWELL INTL.
MANIFOLD, GH_2, PREPRESS/PRESS SYSTEM	2	V070-415422	T. SHUPE	-1174	ROCKWELL INTL.
MANIFOLD, SLIDE MOUNT, GO_2 PRESS	6	V070-415486	T. SHUPE	-1174	ROCKWELL INTL.
K-SEALS MPS METALLIC BOSS	38	ME261-0033	T. BUSTAMANTE	-1554	SIERRACIN/HARRISON
SEALS, FLANGE FACE, MPS	39	ME261-0045	T. BUSTAMANTE	-1554	LANGLEY/SPACECRAFT/HYDRODYNE
GIMBAL JOINT	40	ME271-0092	T. BUSTAMANTE	-1554	AMETEK/STRAZA
SCREEN, MPS FEED LINE	46	ME286-0083	T. BUSTAMANGE	-1554	VACCO INDUSTRIES
VALVE, EVACUATION	48	7046-7	T. BUSTAMANTE	-1554	CRYO LAB
THERMOCOUPLE, VACUUM SENSING GAUGE TUBE	49	7780-1	T. BUSTAMANTE	-1554	CRYO LAB
GETTER, CONTAINER	50	7808-2	T. BUSTAMANTE	-1554	CRYO LAB
BURST DISC ASSY	51	7841A, 7842A	T. BUSTAMANTE	213-922-1554	CRYO LAB
SEALS, SSME INTERFACE	52	RS0088XX	T. BUSTAMANTE	213-922-1554	CRYO LAB

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COMPONENT	TAB NO.	CONTROLLING SPECIFICATION	RESPONSIBLE ENGINEER	ENGINEER TELEPHONE	SUPPLIER
QUICK DISCONNECTS					
1" ORB/Ground GHe (GN_2)	14	MC276-0003	J. YOSHINAGA	213-922-4234	FAIRCHILD CONTROLS
1.5 ORB/Ground (LO_2, LH_2)	15	MC276-0004	J. YOSHINAGA	-4234	FAIRCHILD CONTROLS
2" ET/ORB, PRESS (GO_2, GH_2)	23	MC284-0391	B. MARUMOTO	-1822	EATON CONSOLIDATED CONTROLS
4" ET/ORB, RECIRC (LH_2)	22	MC284-0390	B. MARUMOTO	-1822	EATON CONSOLIDATED CONTROLS
8" FILL & DRAIN (LO_2, LH_2)	16	MC276-0005	J. YOSHINAGA	-4234	PARKER HANNIFIN
17" ET/ORB (LO_2, LH_2)	21	MC284-0389	C. SCHROEDER	-1263	PARKER HANNIFIN
COUPLING, TEST POINT	41	ME276-0032	J. YOSHINAGA	213-922-4234	LEAR SIEGLER/ROMEC
REGULATORS					
20 PSIG (GHe)	28	MC284-0399	T. LIU	213-922-1016	EATON CONSOLIDATED CONTROLS
750 PSIG (GHe)	34	MC284-0533	T. LIU	-1016	EATON CONSOLIDATED CONTROLS
PUMPS					
PUMP, RECIRCULATION (LH_2)	18	MC281-0030	L. HANSON	213-922-1445	SUNDSTRAND

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COMPONENT	TAB NO.	CONTROLLING SPECIFICATION	RESPONSIBLE ENGINEER	ENGINEER TELEPHONE	SUPPLIER
TANKS					
ACCUMULATOR, GHe (500 cu. in.)	19	MC282-0070	J. YOSHINAGA	213-922-4234	WINTEC/BRUNSWICK
SUPPLY, GHe (4.7 & 17 cu.ft.)	20	MC282-0082	J. YOSHINAGA	-4234	WINTEC/BRUNSWICK
INSTRUMENTATION/CONTROL SYSTEMS					
POINT SENSORS & ELECTRONICS	35	MC432-0205	H. WOLFSON	-1289	SIMMONDS PRECISION
$\triangle$P TRANSDUCERS & ELECTRONICS (LH_2)	36	MC449-0164	H. WOLFSON	-1289	PACIFIC SCIENTIFIC
ULLAGE PRESSURE SIGNAL CONDITIONER	37	MC476-0148	H. WOLFSON	-1289	PACIFIC SCIENTIFIC
TRANSDUCER, OUTLET PRESSURE	47	ME449-0177	SEE INSTRUMENTATION GROUP		
MISC. COMPONENTS					
FLAME ARRESTOR, LH_2 FEEDLINE RELIEF	4	V070-415430	T. SHUPE	-1174	ROCKWELL INTL.
HEATSHIELD, ENGINE	1	V070-410364	T. SHUPE	-1174	ROCKWELL INTL.
ISOLATORS, VIBRATION	8	MC196-0009	T. LIU	-1016	AEROFLEX LABS
FILTER (GHe)	45	ME286-0056	J. YOSHINAGA	213-922-4234	WINTEC/BRUNSWICK

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SUPPLIER NAME	TELEPHONE	RESPONSIBLE ENGINEER	TELEPHONE EXTENSION	
AEROFLEX LABS	(516) 694-6700			
AMETEK/STRAZA	(619) 442-3451			
ARROWHEAD PRODUCTS	(213) 860-0435			
CIRCLE SEAL CONTROLS	(714) 774-6110			
COAST METAL CRAFT	(213) 774-5800			
CRYO LAB	(805) 541-CRYO			
EATON CONSOLIDATED CONTROLS	(213) 643-9938			
FAIRCHILD CONTROLS	(213) 643-9222			
HYDRODYNE	(818) 841-9667			
LANGLEY CORT	(619) 264-3181			
LEAR SIEGLER/ROMEL	(216) 323-3211			
PACIFIC SCIENTIFIC	(818) 359-9317			
PARKER HANNIFIN	(714) 833-3000			
SIMMONDS PRECISION	(802) 877-2911			
SPACECRAFT MACHINE PRODUCTS	(213) 373-8988			
SUNDSTRAND CORP.	(815) 394-2037			
VACCO INDUSTRIES	(818) 443-7121			
WINTEC/BRUNSWICK	(714) 546-8037			
WRIGHT CONTROLS	(305) 548-9501			

INDEX BY: REF DESIGNATOR AND FMEA/CIL NO.

TAB NO.	REF DESIG	PROCUREMENT SPEC	DWG ZONE	NOMENCLATURE	FMEA/CIL NO.
29	LV1	MC284-0403-0017	G12	E1 HE SUPPLY ISOLATION VALVE	V3-0204
	LV2	MC284-0403-0017	G12	E1 HE SUPPLY ISOLATION VALVE	V3-0204
	LV3	MC284-0403-0017	G10	E2 HE SUPPLY ISOLATION VALVE	V3-0204
	LV4	MC284-0403-0017	G11	E2 HE SUPPLY ISOLATION VALVE	V3-0204
	LV5	MC284-0403-0017	G8	E3 HE SUPPLY ISOLATION VALVE	V3-0204
	LV6	MC284-0403-0017	G9	E3 HE SUPPLY ISOLATION VALVE	V3-0204
	LV7	MC284-0403-0011	G13	PNEU VALVE HE SUPPLY-ISOLATION VALVE	V3-0255,0238,0113
29	LV8	MC284-0403-0011	G13	PNEU VALVE HE SUPPLY-ISOLATION VALVE	V3-0255,0238
29	LV10	MC284-0403-0003	F12	E2 PNEU HE CROSS OVER SOLENOID	V3-0208
30	LV12	MC284-0404-0021	D12	E1 LO2 PREVALVE OPENING SOLENOID	V1-0225
	LV13	MC284-0404-0021	C12	E1 LO2 PREVALVE CLOSING SOLENOID	V1-0226
	LV14	MC284-0404-0021	D10	E2 LO2 PREVALVE OPENING SOLENOID	V1-0225
	LV15	MC284-0404-0021	C10	E2 LO2 PREVALVE CLOSING SOLENOID	V1-0226
	LV16	MC284-0404-0021	D8	E3 LO2 PREVALVE OPENING SOLENOID	V1-0225
	LV17	MC284-0404-0021	C8	E3 LO2 PREVALVE CLOSING SOLENOID	V1-0226
	LV18	MC284-0404-0021	C13	E1 LH2 PREVALVE OPENING SOLENOID	V1-0227
	LV19	MC284-0404-0021	C13	E1 LH2 PREVALVE CLOSING SOLENOID	V1-0228
	LV20	MC284-0404-0021	C11	E2 LH2 PREVALVE OPENING SOLENOID	V1-0227
	LV21	MC284-0404-0021	C11	E2 LH2 PREVALVE CLOSING SOLENOID	V1-0228
	LV22	MC284-0404-0021	C10	E3 LH2 PREVALVE OPENING SOLENOID	V1-0227
	LV23	MC284-0404-0021	C10	E3 LH2 PREVALVE CLOSING SOLENOID	V1-0228
	LV24	MC284-0404-0012	C7	LO2 FEEDLINE RELIEF SHUTOFF VALVE CLOSING SOLENOID	V2-0231
30	LV25	MC284-0404-0012	C9	LH2 FEEDLINE RELIEF SHUTOFF VALVE CLOSING SOLENOID	V2-0232
29	LV26	MC284-0403-0002	F13	HE SUPPLY BLOWDOWN VALVE	V3-0143,0233
29	LV27	MC284-0403-0002	F13	HE SUPPLY BLOWDOWN VALVE	V30143,0233,0144
30	LV28	MC284-0404-0012	D7	LO2 OUTBOARD FILL VALVE OPENING SOLENOID	V1-0221
30	LV29	MC284-0404-0012	D7	LO2 OUTBOARD FILL VALVE CLOSING SOLENOID	V1-0222
30	LV30	MC284-0404-0012	D7	LO2 INBOARD FILL VALVE OPENING SOLENOID	V1-0223

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TAB NO.	REF DESIG	PROCUREMENT SPEC	DWG ZONE	NOMENCLATURE	FMEA/CIL NO.
30	LV31	MC284-0404-0012	D7	LO2 INBOARD FILL VALVE CLOSING SOLENOID	V1-0224
↑	LV32	MC284-0404-0012	E7	LH2 OUTBOARD FILL VALVE OPENING SOLENOID	V1-0270
↕	LV33	MC284-0404-0012	E7	LH2 OUTBOARD FILL VALVE CLOSING SOLENOID	V1-0271
↕	LV34	MC284-0404-0012	D10	LH2 INBOARD FILL VALVE OPENING SOLENOID	V1-0272
↕	LV35	MC284-0404-0012	C10	LH2 INBOARD FILL VALVE CLOSING SOLENOID	V1-0273
↕	LV36	MC284-0404-0012	C11	LH2 RECIRC PUMP VALVE OPENING SOLENOID	V2-0229
30	LV39	MC284-0404-0012	E8	LH2 REPLENISH VALVE OPENING SOLENOID	V2-0230
29	LV40	MC284-0403-0003	D12	LO2 MANIFOLD REPRESS VALVE	V3-0601,0636
↑	LV41	MC284-0403-0003	D12	LO2 MANIFOLD REPRESS VALVE	V3-0601,0626,0635
↕	LV42	MC284-0403-0003	D12	LH2 MANIFOLD REPRESS VALVE	V3-0606
29	LV43	MC284-0403-0003	D12	LH2 MANIFOLD REPRESS VALVE	V3-0606,0637
30	LV46	MC284-0404-0021	D14	LO2 FEED DISCONNECT VALVE OPENING SOLENOID	V1-0219
↑	LV47	MC284-0404-0021	D14	LO2 FEED DISCONNECT VALVE CLOSING SOLENOID	V1-0220
↕	LV48	MC284-0404-0021	C14	LH2 FEED DISCONNECT VALVE OPENING SOLENOID	V1-0217
↕	LV49	MC284-0404-0021	C14	LH2 FEED DISCONNECT VALVE CLOSING SOLENOID	V1-0218
↕	LV50	MC284-0404-0012	E14	LH2 RECIRC DISCONNECT VALVE OPENING SOLENOID	V2-0215
30	LV51	MC284-0404-0012	E14	LH2 RECIRC DISCONNECT VALVE CLOSING SOLENOID	V2-0216
29	LV52	MC284-0403-0002	E14	LH2 PRESS LINE VENT VALVE	V3-0512,0521
17	LV53	MC280-0017-0447	B8	E1 GO2 PRESS FLOW CONTROL VALVE	V3-0519
↑	LV54	MC280-0017-0447	B8	E2 GO2 PRESS FLOW CONTROL VALVE	V3-0519
↕	LV55	MC280-0017-0447	B8	E3 GO2 PRESS FLOW CONTROL VALVE	V3-0519
↕	LV56	MC280-0017-0361	B9	E1 GH2 PRESS FLOW CONTROL VALVE	V3-0504
↕	LV57	MC280-0017-0361	B9	E2 GH2 PRESS FLOW CONTROL VALVE	V3-0504
17	LV58	MC280-0017-0361	B8	E3 GH2 PRESS FLOW CONTROL VALVE	V3-0504
29	LV59	MC284-0403-0017	G13	E1 HE SUPPLY INTERCONNECT PANEL IN VALVE	V3-0260
↑	LV60	MC284-0403-0011	G12	E1 HE SUPPLY INTERCONNECT PANEL OUT VALVE	V3-0262
↕	LV61	MC284-0403-0017	G11	E2 HE SUPPLY INTERCONNECT PANEL IN VALVE	V3-0260
↕	LV62	MC284-0403-0011	G10	E2 HE SUPPLY INTERCONNECT PANEL OUT VALVE	V3-0262
↕	LV63	MC284-0403-0017	G9	E3 HE SUPPLY INTERCONNECT PANEL IN VALVE	V3-0260
29	LV64	MC284-0403-0011	G8	E3 HE SUPPLY INTERCONNECT PANEL OUT VALVE	V3-0262

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TAB NO.	REF DESIG	PROCUREMENT SPEC	DWG ZONE	NOMENCLATURE	FMEA/CIL NO.
30	LV65	MC284-0404-0012	D14	LO2 FEED DISCONNECT VALVE LATCH LOCK SOLENOID	V1-0263
	LV66	MC284-0404-0012	D14	LO2 FEED DISCONNECT VALVE LATCH UNLOCK SOLENOID	V1-0264
	LV67	MC284-0404-0012	C14	LH2 FEED DISCONNECT VALVE LATCH LOCK SOLENOID	V1-0263
	LV68	MC284-0404-0012	C14	LH2 FEED DISCONNECT VALVE LATCH UNLOCK SOLENOID	V1-0264
	LV72	MC284-0404-0012	C14	LH2 FEED RTLS INBOARD DUMP VALVE OPENING SOLENOID	V2-0245
30	LV73	MC284-0404-0012	B14	LH2 FEED RTLS OUTBOARD DUMP VALVE OPENING SOLENOID	V2-0245
29	LV74	MC284-0403-0002	D9	LH2 FEED MANIFOLD RTLS PRESS VALVE	V3-0122,0246
29	LV75	MC284-0403-0002	D9	LH2 FEED MANIFOLD RTLS PRESS VALVE	V3-0122,0246,0119
30	LV76	MC284-0404-0012	B7	LO2 OVERBOARD BLEED VALVE CLOSING SOLENOID	V2-0244
	LV77	MC284-0404-0012	E13	LO2 POGO ACCUM RECIRC VALVE CLOSING SOLENOID	V2-0243
	LV78	MC284-0404-0012	E13	LO2 POGO ACCUM RECIRC VALVE CLOSING SOLENOID	V2-0243
	LV79	MC284-0404-0012	D11	LH2 HI POINT BLEED VALVE OPENING SOLENOID	V2-0250
	LV80	MC284-0404-0021	C12	E1 LO2 PREVALVE REDUNDANT CLOSING SOLENOID	V1-0226
	LV81	MC284-0404-0021	C10	E2 LO2 PREVALVE REDUNDANT CLOSING SOLENOID	V1-0226
	LV82	MC284-0404-0021	C8	E3 LO2 PREVALVE REDUNDANT CLOSING SOLENOID	V1-0226
	LV83	MC284-0404-0021	D12	E1 LO2 PREVALVE REDUNDANT OPENING SOLENOID	V1-0225
	LV84	MC284-0404-0021	D10	E2 LO2 PREVALVE REDUNDANT OPENING SOLENOID	V1-0225
30	LV85	MC284-0404-0021	D8	E3 LO2 PREVALVE REDUNDANT OPENING SOLENOID	V1-0225
25	PV1	MC284-0396-0005	D12	E1 LO2 PREVALVE	V1-0401
	PV2	MC284-0396-0005	D9	E2 LO2 PREVALVE	V1-0401
	PV3	MC284-0396-0005	D7	E3 LO2 PREVALVE	V1-0401
	PV4	MC284-0396-0008	C13	E1 LH2 PREVALVE	V1-0402
	PV5	MC284-0396-0008	C11	E2 LH2 PREVALVE	V1-0402
	PV6	MC284-0396-0008	C9	E3 LH2 PREVALVE	V1-0402
	PV7	MC284-0406-0002	D7	LO2 FEEDLINE RELIEF SHUTOFF VALVE	V2-0424
25	PV8	MC284-0406-0002	D9	LH2 FEEDLINE RELIEF SHUTOFF VALVE	V2-0423,0437
26	PV9	MC284-0397-0019	D7	LO2 OUTBOARD FILL VALVE	V1-0311
26	PV10	MC284-0397-0020	D7	LO2 INBOARD FILL VALVE	
26	PV11	MC284-0397-0021	E7	LH2 OUTBOARD FILL VALVE	

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TAB NO.	REF DESIG	PROCUREMENT SPEC	DWG ZONE	NOMENCLATURE	FMEA/CIL NO.
26	PV12	MC284-0397-0021	D9	LH2 INBOARD FILL VALVE	
24	PV13	MC284-0395-0051	E8	LH2 REFLENISH VALVE	V2-0304
	PV14	MC284-0395-0051	C13	E1 LH2 RECIRC PUMP VALVE	V2-0403
	PV15	MC284-0395-0051	C11	E2 LH2 RECIRC PUMP VALVE	V2-0403
	PV16	MC284-0395-0051	C9	E3 LH2 RECIRC PUMP VALVE	
	PV17	MC284-0395-0053	C14	LH2 FEED RTLS INBOARD VALVE	V2-0430,0432,0651
	PV18	MC284-0395-0054	B14	LH2 FEED RTLS OUTBOARD VALVE	V2-0651,0652
	PV19	MC284-0395-0055	B7	LO2 BLEED SHUTOFF VALVE	
	PV20	MC284-0395-0052	D13	LO2 POGO ACCUM RECIRC VALVE	
	PV21	MC284-0395-0052	D13	LO2 POGO ACCUM RECIRC VALVE	
24	PV22	MC284-0395-0053	D11	LH2 HI POINT BLEED VALVE	V2-0249,0430,0431
21	PD1	MC284-0389-0511	D14	LO2 FEED (ORB/ET) DISCONNECT VALVE (ORB HALF)	V1-0219,0220,0409
21	PD2	MC284-0389-0411	C14	LH2 FEED (ORB/ET) DISCONNECT VALVE (ORB HALF)	V1-0218,0407
22	PD3	MC284-0390-0046	E14	LH2 RECIRC (ORB/ET) DISCONNECT VALVE (ORB HALF)	V1-0405
23	PD4	MC284-0391-0001	F14	GO2 PRESSURIZATION (ORB/ET) DISCONNECT (ORB HALF)	V2-0403,V3-0513
23	PD5	MC284-0391-0001	E11	GH2 PRESSURIZATION (ORB/ET) DISCONNECT (ORB HALF)	V2-0403,V3-0513
14	PD8	MC276-0003-0006	H7	HE SUPPLY (ORB/GND) DISCONNECT (ORB HALF)	V3-0201
14	PD9	MC276-0003-0007	F7	LO2 TANK GROUND PRE-PRESS (ORB/GND)DISC. (ORB HALF)	V3-0501
14	PD10	MC276-0003-0007	E7	LH2 TANK GROUND PRE-PRESS (ORB/GND) DISC. (ORB HALF)	V3-0501
16	PD11	MC276-0005-0041	E7	LH2 GROUND FILL & DRAIN (ORB/GND) DISC. (ORB HALF)	
16	PD12	MC276-0005-0032	D7	LO2 GROUND FILL & DRAIN (ORB/GND) DISC. (ORB HALF)	
15	PD13	MC276-0004-0001	B7	LO2 OVERBOARD BLEED (ORB/GND) DISC. (ORB HALF)	
14	PD14	MC276-0003-0007	B7	MAIN ENGINE GN2 PURGE (ORB/GND) DISC. (ORB HALF)	V1-0303,V3-0409
41	PD15	ME276-0032-0017	F8	GO2 PRESS MANIF TEST POINT COUPLING (ORB HALF)	V3-0201,0516
41	PD16	ME276-0032-0017	F8	GH2 PRESS MANIF TEST POINT COUPLING (ORB HALF)	V3-0201,0516
15	PD17	MC276-0004-0003	F7	LH2 HI POINT BLEED (ORB/GND) DISC. (ORB HALF)	V2-0406

V1 = VOLUME I FMEA/CIL BOOK
V2 = VOLUME II
V3 = VOLUME III

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TAB NO.	REF DESIG	PROCUREMENT SPEC	DWG ZONE	NOMENCLATURE	FMEA/CIL NO.
42	CV1	ME284-0472-0002	H12	E1 HE SUPPLY CHECK VALVE	V3-0204
	CV2	ME284-0472-0002	H10	E2 HE SUPPLY CHECK VALVE	V3-0204
	CV3	ME284-0472-0002	H9	E3 HE SUPPLY CHECK VALVE	V3-0204
	CV4	ME284-0472-0002	H13	PNEU VALVE HE SUPPLY CHECK VALVE	V3-0204
	CV5	ME284-0472-0034	F12	E1 HE REG OUTLET CHECK VALVE-PANEL NO. 1A	V3-0207
	CV6	ME284-0472-0034	F10	E2 HE REG OUTLET CHECK VALVE-PANEL NO. 2A	V3-0207
	CV7	ME284-0472-0034	F8	E3 HE REG OUTLET CHECK VALVE-PANEL NO. 3A	V3-0207
	CV8	ME284-0472-0024	F13	PNEU VALVE HE REG OUTLET CHECK VALVE-PANEL NO. 4	V3-0114,0236,0241
	CV9	ME284-0472-0013	F13	PNEU VALVE HE ISOLATION CHECK VALVE-PANEL NO. 4	V1-0290,0110,0209
	CV10	ME284-0472-0011	E12	GO2 PRESS MANIF REPRESS CHECK VALVE	V3-0631
	CV12	ME284-0472-0013	D12	LO2 FEED MANIF REPRESS CHECK VALVE	V3-0603
	CV13	ME284-0472-0011	D12	GH2 PRESS MANIF REPRESS CHECK VALVE	V3-0605,0634
	CV14	ME284-0472-0011	D13	LH2 RECIRC MANIF REPRESS CHECK VALVE	V3-0632
	CV15	ME284-0472-0024	D12	LH2 FEED MANIF NOM REPRESS CHECK VALVE	V3-0630
	CV16	ME284-0472-0005	F7	LO2 TANK PRE-PRESS CHECK VALVE	V3-0502
42	CV17	ME284-0472-0005	F7	LH2 TANK PRE-PRESS CHECK VALVE	V3-0502
44	CV18	ME284-0479-0023	A12	E1 GO2 PRESS ISOLATION CHECK VALVE	V3-0514
	CV19	ME284-0479-0023	A10	E2 GO2 PRESS ISOLATION CHECK VALVE	V3-0514
	CV20	ME284-0479-0023	A7	E3 GO2 PRESS ISOLATION CHECK VALVE	V3-0514
	CV21	ME284-0479-0012	B13	E1 GH2 PRESS ISOLATION CHECK VALVE	V3-0505
	CV22	ME284-0479-0012	B11	E2 GH2 PRESS ISOLATION CHECK VALVE	V3-0503
44	CV23	ME284-0479-0012	B9	E3 GH2 PRESS ISOLATION CHECK VALVE	V3-0503
42	CV24	ME284-0472-0011	E12	GH2 PRESS MANIFOLD REPRESS CHECK VALVE	V3-0605,0634
	CV25	ME284-0472-0002	G12	E1 HE SUPPLY CHECK VALVE	V3-0258
	CV26	ME284-0472-0002	G12	E1 HE SUPPLY CHECK VALVE	V3-0258
42	CV27	ME284-0472-0002	G13	E1 HE INTERCONNECT CHECK VALVE-PANEL IN	V3-0259

V1 = VOLUME I FMEA/CIL BOOK
V2 = VOLUME II
V3 = VOLUME III

INDEX BY: REF DESIGNATOR AND FMEA/CIL NO.

TAB NO.	REF DESIG	PROCUREMENT SPEC	DWG ZONE	NOMENCLATURE	FMEA/CIL NO.
42	CV28	ME284-0472-0002	G12	E1 HE INTERCONNECT CHECK VALVE-PANEL OUT	V3-0261
42	CV29	ME284-0472-0034	F13	E1 HE REG OUTLET CHECK VALVE-PANEL NO. 1B	V3-0207
42	CV30	ME284-0472-0024	C9	LH2 FEED MANIF RTLS REPRESS CHECK VALVE	V20423,0119,0248
33	CV31	MC284-0515-0003	B12	E1 LO2 BLEED CHECK VALVE	V1-0415
33	CV33	MC284-0515-0003	B10	E2 LO2 BLEED CHECK VALVE	V1-0415
33	CV35	MC284-0515-0003	B8	E3 LO2 BLEED CHECK VALVE	
42	CV36	ME284-0472-0002	G11	E2 HE SUPPLY CHECK VALVE	V3-0209,0258
	CV37	ME284-0472-0002	G10	E2 HE SUPPLY CHECK VALVE	V3-0258
	CV38	ME284-0472-0002	G11	E2 HE INTERCONNECT CHECK VALVE-PANEL IN	V3-0259
	CV39	ME284-0472-0002	G10	E2 HE INTERCONNECT CHECK VALVE-PANEL OUT	V3-0261
	CV40	ME284-0472-0034	F11	E2 HE REG OUTLET CHECK VALVE-PANEL NO. 2B	V3-0207
	CV41	ME284-0472-0002	G9	E3 HE SUPPLY CHECK VALVE	V3-0258
	CV42	ME284-0472-0002	G8	E3 HE SUPPLY CHECK VALVE	V3-0258
	CV43	ME284-0472-0002	G9	E3 HE INTERCONNECT CHECK VALVE-PANEL IN	V3-0259
	CV44	ME284-0472-0002	G8	E3 HE INTERCONNECT CHECK VALVE-PANEL OUT	V3-0261
42	CV45	ME284-0472-0034	F9	E3 HE REG OUTLET CHECK VALVE-PANEL NO. 3B	V3-0207
8		MC196-0009-3001		VIBRATION ISOLATOR	
8		MC196-0009-3002		VIBRATION ISOLATOR	
8		MC196-0009-3003		VIBRATION ISOLATOR	
34	PR1	MC284-0533-0004	F12	E1 HE REGULATOR-PANEL NO. 1A	V3-0205
34	PR2	MC284-0533-0004	F10	E2 HE REGULATOR-PANEL NO. 2A	V3-0205
34	PR3	MC284-0533-0004	F8	E3 HE REGULATOR-PANEL NO. 3A	V3-0205
34	PR4	MC284-0533-0004	G13	PNEU VALVE HE SUPPLY REGULATOR-PANEL NO. 4	V3-0114,0239
28	PR5	MC284-0399-0004	D12	LO2 MANIF REPRESS REGULATOR	V3-0602,0636
28	PR6	MC284-0399-0004	D12	LH2 MANIF REPRESS REGULATOR	V3-0629,0637
34	PR7	MC284-0533-0004	F12	E1 HE REGULATOR-PANEL NO. 1B	V3-0205
34	PR8	MC284-0533-0004	F11	E2 HE REGULATOR-PANEL NO. 2B	V3-0205
34	PR9	MC284-0533-0004	F9	E3 HE REGULATOR-PANEL NO. 3B	V3-0205

V1 = VOLUME I FMEA/CIL BOOK
V2 = VOLUME II
V3 = VOLUME III

INDEX BY: REF DESIGNATOR AND FMEA/CIL NO.

TAB NO.	REF DESIG	PROCUREMENT SPEC	DWG ZONE	NOMENCLATURE	FMEA/CIL NO.
27	RV1	MC284-0398-0005	F12	E1 HE RELIEF VALVE-PANEL NO. 1A	V3-0206
	RV2	MC284-0398-0005	F10	E2 HE RELIEF VALVE-PANEL NO. 2A	V3-0206
	RV3	MC284-0398-0005	F8	E3 HE RELIEF VALVE PANEL NO. 3A	V3-0206
27	RV4	MC284-0398-0005	G13	PNEU VALVE HE SUPPLY RELIEF VALVE	V3-0251
32	RV5	MC284-0501-0001	A7	LO2 FEED MANIF RELIEF VALVE	V2-0424
32	RV6	MC284-0501-0002	A12	LH2 FEED MANIF RELIEF VALVE	V2-0423,0436
43	RV7	ME284-0474-0003	D13	LH2 RECIRC MANIF RELIEF VALVE	V2-0411
27	RV8	MC284-0398-0005	F13	E1 HE RELIEF VALVE-PANEL NO. 1B	V3-0206
27	RV9	MC284-0398-0005	F11	E2 HE RELIEF VALVE-PANEL NO. 2B	V3-0206
27	RV10	MC284-0398-0005	F9	E3 HE RELIEF VALVE-PANEL NO. 3B	V3-0206
18	PP1	MC281-0030-0002	C13	E1 LH2 RECIRC PUMP	V2-0404
18	PP2	MC281-0030-0002	C12	E2 LH2 RECIRC PUMP	V2-0404
18	PP3	MC281-0030-0002	C10	E3 LH2 RECIRC PUMP	V2-0404
20	TK1	MC282-0082-0010	G12	E1 HE SUPPLY TANK	V3-0203,V2-0257
	TK2	MC282-0082-0010	G10	E2 HE SUPPLY TANK	V3-0203
	TK3	MC282-0082-0010	G8	E3 HE SUPPLY TANK	V3-0203
	TK4	MC282-0082-0010	G14	PNEU VALVE HE SUPPLY TANK	V3-0237
	TK6	MC282-0082-0001	H12	E1 HE SUPPLY TANK (MID-BODY)	V30256
	TK7	MC282-0082-0010	H13	E1 HE SUPPLY TANK (MID-BODY)	V3-0257
	TK8	MC282-0082-0001	H11	E2 HE SUPPLY TANK (MID-BODY)	V3-0256
	TK9	MC282-0082-0010	H11	E2 HE SUPPLY TANK (MID-BODY)	V3-0257
	TK10	MC282-0082-0001	H9	E3 HE SUPPLY TANK (MID-BODY)	V3-0256
20	TK11	MC282-0082-0010	H9	E3 HE SUPPLY TANK (MID-BODY)	V3-0257

V1 = VOLUME I FMEA/CIL BOOK
V2 = VOLUME II
V3 = VOLUME III

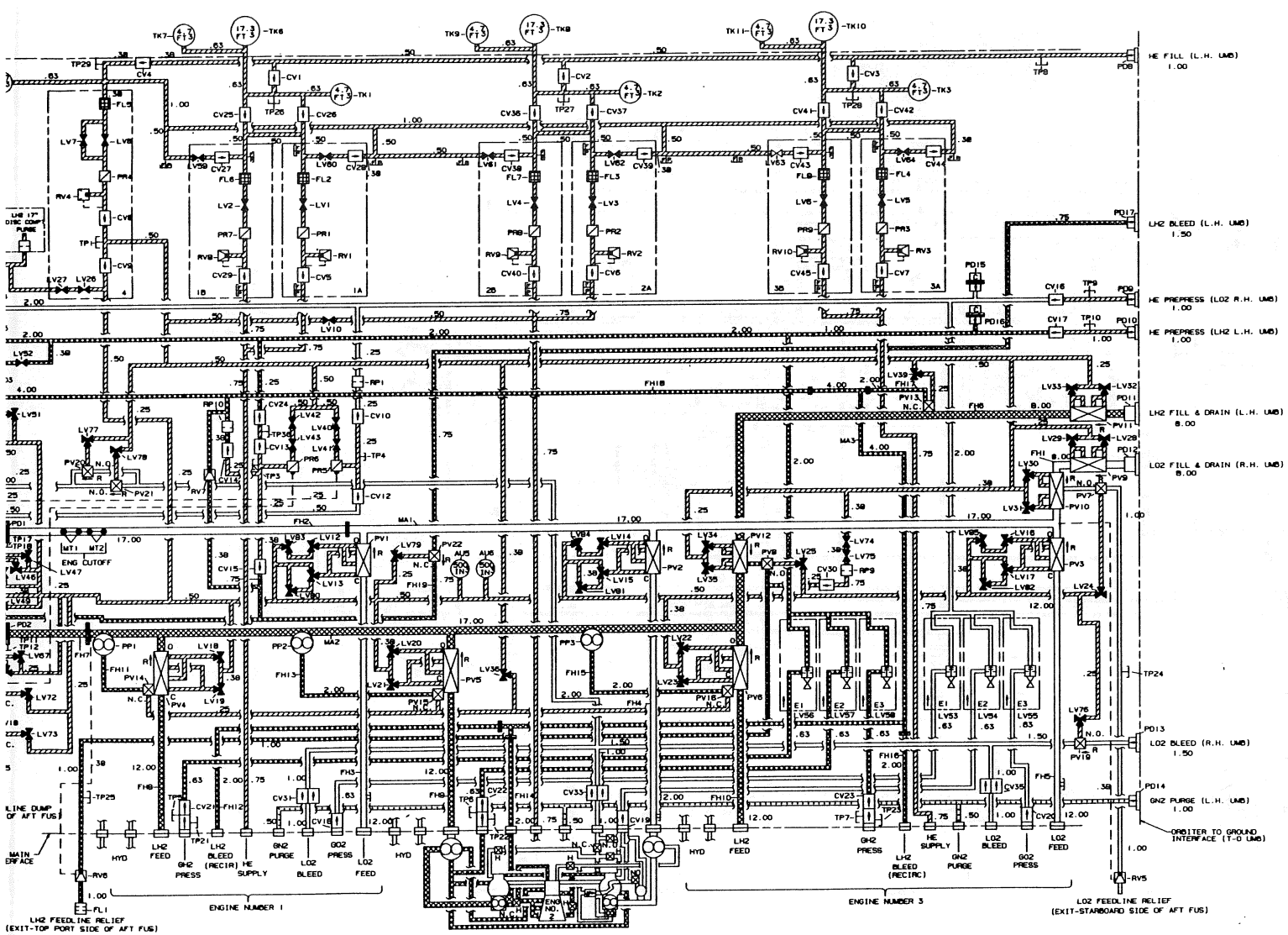
INDEX BY: REF DESIGNATOR AND FMEA/CIL NO.

TAB NO.	REF DESIG	PROCUREMENT SPEC	DWG ZONE	NOMENCLATURE	FMEA/CIL NO.
19	AU5	MC282-0070-0001	D11	LO2 PREVALVE PNEU ACCUMULATOR	V3-0210
19	AU6	MC282-0070-0001	D11	LH2 PREVALVE PNEU ACCUMULATOR	V3-0210
5		V070-415462		LINE ASSY 2", GO_2 PREPRESS/PRESS SYSTEM	
4	FL1	V070-415430-004	A13	LH2 FEEDLINE RELIEF FLAME ARRESTER	V2-0435
45	FL2	ME286-0056-0001	G12	E1 HE SUPPLY FILTER-PANEL NO. 1A	V3-0242
	FL3	ME286-0056-0001	G10	E2 HE SUPPLY FILTER-PANEL NO. 2A	V3-0242
	FL4	ME286-0056-0001	G8	E3 HE SUPPLY FILTER-PANEL NO. 3A	V3-0242
	FL5	ME286-0056-0001	G13	PNEUMATIC HE SUPPLY FILTER-PANEL NO. 4	V3-0145
	FL6	ME286-0056-0001	G12	E1 HE SUPPLY FILTER-PANEL NO. 1B	
	FL7	ME286-0056-0001	G11	E2 HE SUPPLY FILTER-PANEL NO. 2B	
45	FL8	ME286-0056-0001	G9	E3 HE SUPPLY FILTER-PANEL NO. 3B	
35	MT1	MC432-0205-0027	E14	LO2 LOW LEVEL LIQUID SENSORS NO. 1 & NO. 2	0427
35	MT2	MC432-0205-0027	E14	LO2 LOW LEVEL LIQUID SENSORS NO. 3 & NO. 4	
10	MA1	MC271-0074-0005	D11	LO2 FEEDLINE MANIFOLD	
9	MA2	MC271-0073-0005	C12	LH2 FEEDLINE MANIFOLD	
11	MA3	MC271-0075-0017	D9	LH2 PRESTART CONDITIONING MANIFOLD	V2-0309

V1 = VOLUME I FMEA/CIL BOOK
V2 = VOLUME II
V3 = VOLUME III

INDEX BY: REF DESIGNATOR AND FMEA/CIL NO.

TAB NO.	REF DESIG	PROCUREMENT SPEC	DWG ZONE	NOMENCLATURE	FMEA/CIL NO.
12	FH1	MC271-0076-0012	D8	LO2 FILL & DRAIN LINE	
10	FH2	MC271-0074-0201	D12	LO2 17 IN. FEEDLINE	
10	FH3	MC271-0074-0302	B12	LO2 E1 12 IN. FEEDLINE	
10	FH4	MC271-0074-0303	B10	LO2 E2 12 IN. FEEDLINE	
10	FH5	MC271-0074-0304	B7	LO2 E3 12 IN. FEEDLINE	
12	FH6	MC271-0076-0021	D8	LH2 FILL & DRAIN LINE	0307
9	FH7	MC271-0073-0001	C14	LH2 17 IN. FEEDLINE	0417
9	FH8	MC271-0073-0302	B13	LH2 E1 12 IN. FEEDLINE	0416
9	FH9	MC271-0073-0303	B11	LH2 E2 12 IN. FEEDLINE	0417
9	FH10	MC271-0073-0304	B9	LH2 E3 12 IN. FEEDLINE	
11	FH11	MC271-0075-0011	C13	LH2 E1 PRESTART CONDITIONING PUMP LINE	0309
	FH12	MC271-0075-0024	B13	LH2 E1 PRESTART CONDITIONING RETURN LINE	V2-0425
	FH13	MC271-0075-0012	C12	LH2 E2 PRESTART CONDITIONING PUMP LINE	V2-0425
	FH14	MC271-0075-0015	B11	LH2 E2 PRESTART CONDITIONING RETURN LINE	0429
	FH15	MC271-0075-0013	C10	LH2 E3 PRESTART CONDITIONING PUMP LINE	0421
	FH16	MC271-0075-0016	B8	LH2 E3 PRESTART CONDITIONING RETURN LINE	V2-0425
	FH17	MC271-0075-0019	E8	LH2 PRESTART CONDITIONING REPLENISH LINE	V2-0309
	FH18	MC271-0075-0018	E10	LH2 PRESTART CONDITIONING RETURN LINE	V2-0309
11	FH19	MC271-0075-0010	C11	LH2 HI POINT BLEED LINE	
11		MC271-0075-0025		LINE ASSY 2", GO2 PREPRESS/PRESS SYSTEM	
13		MC271-0077		METAL FLEX HOSE ASSY.	0607
36	MT44	MC449-0164-0001		LO2 TRANSDUCER,DIFERENTIAL PRESSURE	0401
47		MC449-0177		GH2 TRANSDUCER, OUTLET PRESSURE	0740
37		MC476-0148		SIGNAL CONDITIONER, ULLAGE PRESSURE	0515
3		V070-415425		LINE ASSY, LH2 PREPRESS/PRESS SYSTEM	
39		ME261-0045		SEALS, MPS	0701
46		ME286-0083		SCREEN, PROPELLENT FEEDLINE	V1-0434
1		V070-415364		HEAT SHIELD, ENGINE	
2		V070-415422		MANIFOLD ASSY.,GH2 PRESSURIZATION	0522
6		V070-415486		GO2, GH2 -SLIDE MOUNT MANIFOLD ASSY.	0773
7		V070-415490		GO2, MANIFOLD ASSY.	0522



- PYRO VALVE
- N.C. NORMALLY CLOSE
- N.O. NORMALLY OPEN
- R VALVE WITH INTERNAL RELIEF
- FLOW CONTROL VALVE HIGH FLOW/LOW FLOW
- H HYDRAULIC ACTUATED ENGINE VALVE
- SENSE LINE
- LEVEL SENSOR
- STORAGE SPHERE
- SURGE CHAMBER
- DIFFUSER
- PUMP
- PORT
- 0.6 FT^3 POGO ACCUMULATOR
- TEST PORT
- FACILITY PORT
- NITROGEN
- OXYGEN
- HELIUM
- HYDROGEN
- FLANGE
- DISCONNECT CAP
- ANTI-FLOOD VALVE
- QUICK DISC. COUPLING WITH VALVE THAT OPENS ON MATING
- QUICK DISC. COUPLING WITHOUT VALVE
- VENT & RELIEF VALVE
- FLAME ARRESTER
- PNEUMATIC ACTUATED VALVE
- ORIFICE
- REGULATOR (WITH REMOTE SENSING)
- PRESSURE TRANSDUCER
- QUICK DISCONNECT COUPLING WITH CHECK VALVE
- RELIEF VALVE
- FILTER
- REGULATOR
- CHECK VALVE
- 3 WAY SOL (N.C.)
- 2 WAY SOL (N.C.)
- 2 WAY SOL (N.O.)

LEGEND

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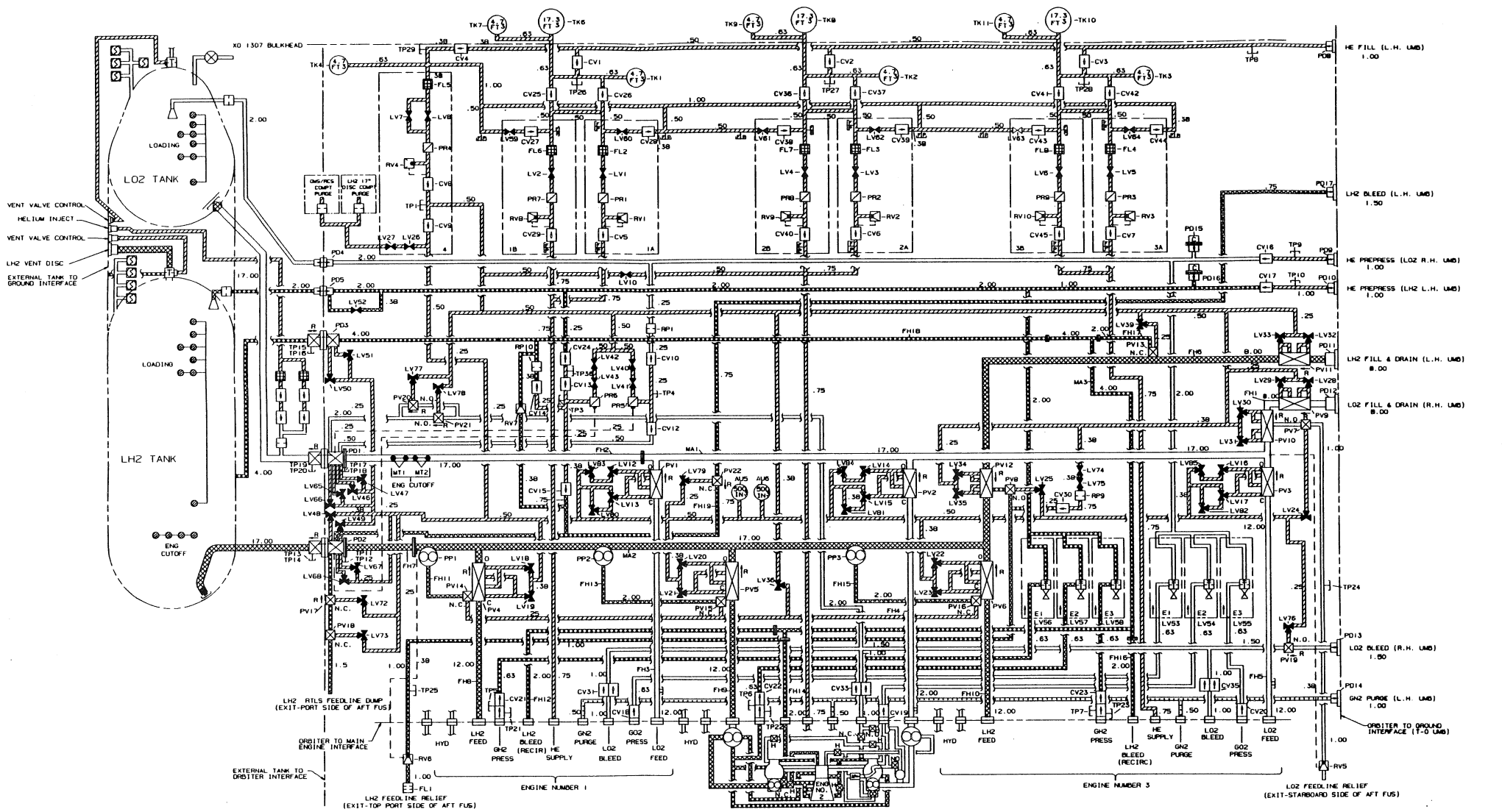
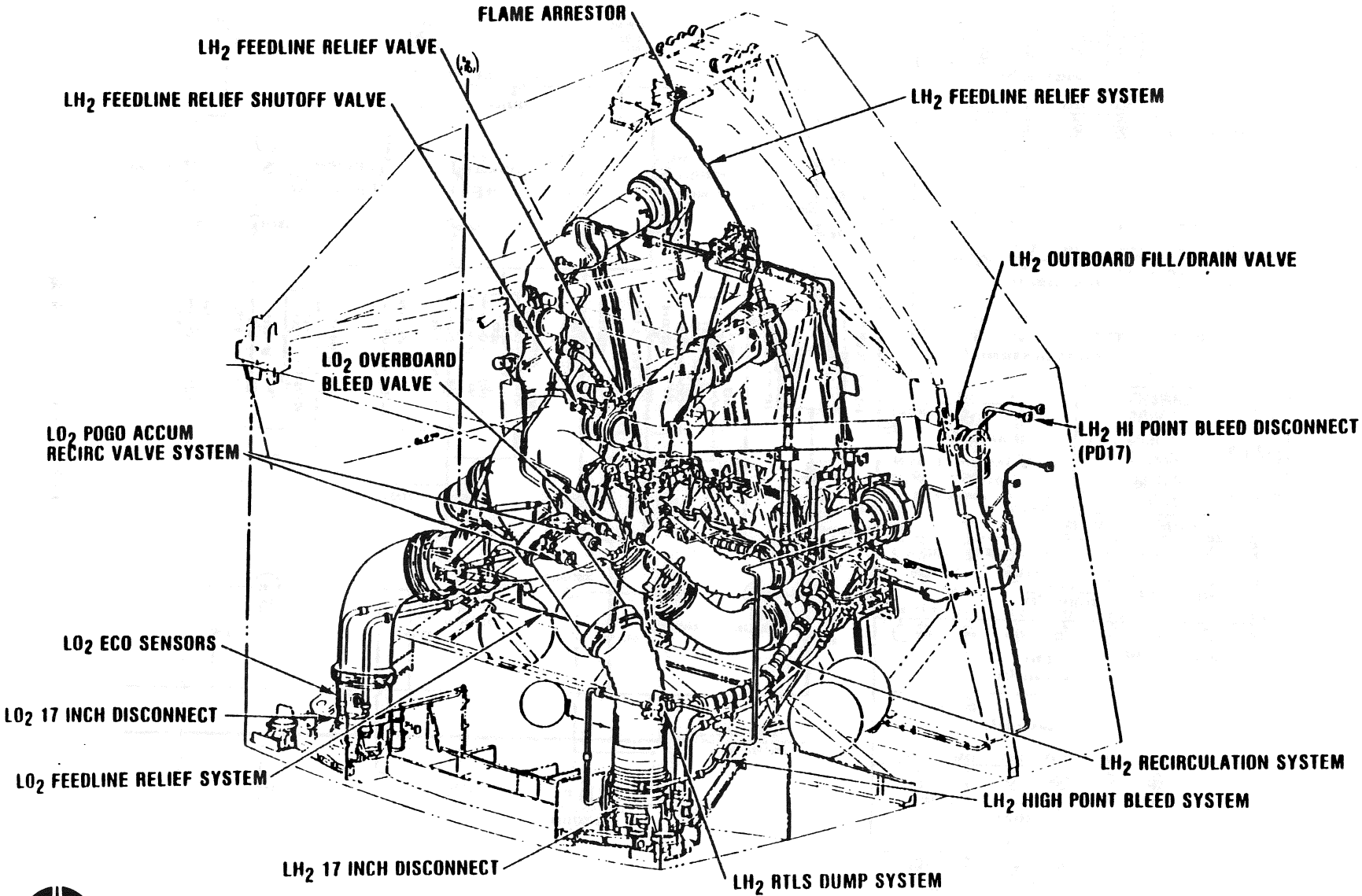

LO2 TANK
LH2 TANK
LOADING
LOADING
VENT VALVE CONTROL
HELIUM INJECT
VENT VALVE CONTROL
LH2 VENT DISC
EXTERNAL TANK TO GROUND INTERFACE
ENG CUTOFF
XO 1307 BULKHEAD
GH2/RCS COMPT PURGE
LH2 T.P. DISC COMPT PURGE
ENG CUTOFF
LH2 RTLS FEEDLINE DUMP (EXIT-PORT SIDE OF AFT FUS)
ORBITER TO MAIN ENGINE INTERFACE
EXTERNAL TANK TO ORBITER INTERFACE
LH2 FEEDLINE RELIEF (EXIT-TOP PORT SIDE OF AFT FUS)
HYD
LH2 FEED
GH2 PRESS
LH2 BLEED (RECIR)
HE SUPPLY
GN2 PURGE
LO2 BLEED
LO2 PRESS
LO2 FEED
HYD
ENGINE NUMBER 1
HYD
LH2 FEED
GH2 PRESS
LH2 BLEED (RECIRC)
HE SUPPLY
GN2 PURGE
LO2 BLEED
GO2 PRESS
LO2 FEED
ENGINE NUMBER 3
LO2 FEEDLINE RELIEF (EXIT-STARBOARD SIDE OF AFT FUS)
ORBITER TO GROUND INTERFACE (T-0 UMB)
HE FILL (L.H. UMB) 1.00
LH2 BLEED (L.H. UMB) 1.50
HE PREPRESS (LO2 R.H. UMB) 1.00
HE PREPRESS (LH2 L.H. UMB) 1.00
LH2 FILL & DRAIN (L.H. UMB) 8.00
LO2 FILL & DRAIN (R.H. UMB) 8.00
LO2 BLEED (R.H. UMB) 1.50
GN2 PURGE (L.H. UMB) 1.00

Main Propulsion System



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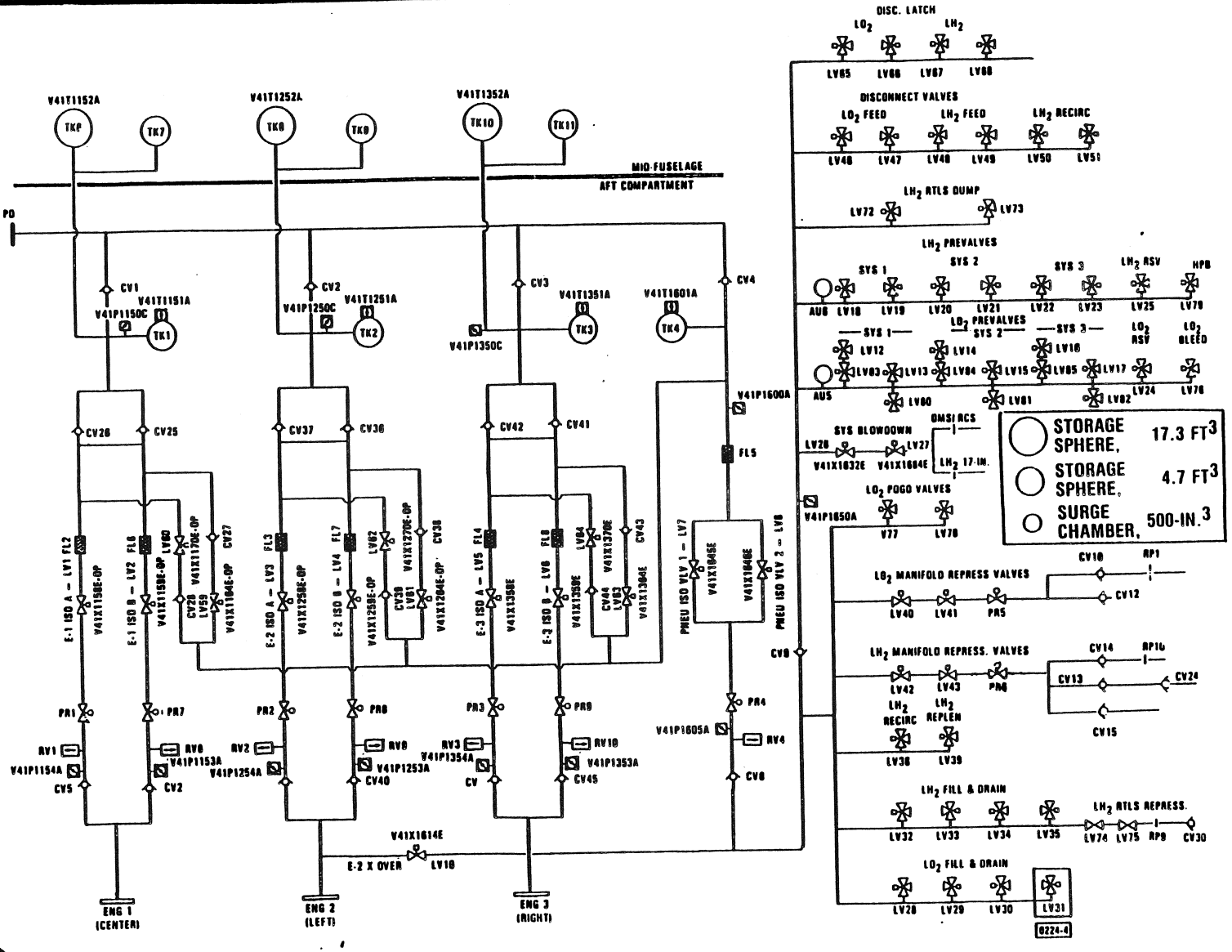
MPS—HELIUM SYSTEM SCHEMATIC



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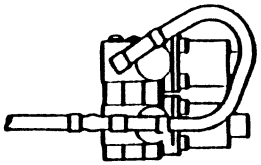
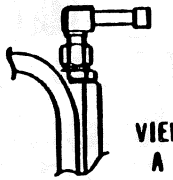
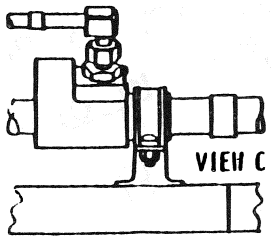
GHe MPS VALVE ACTUATION PANEL NO. 4



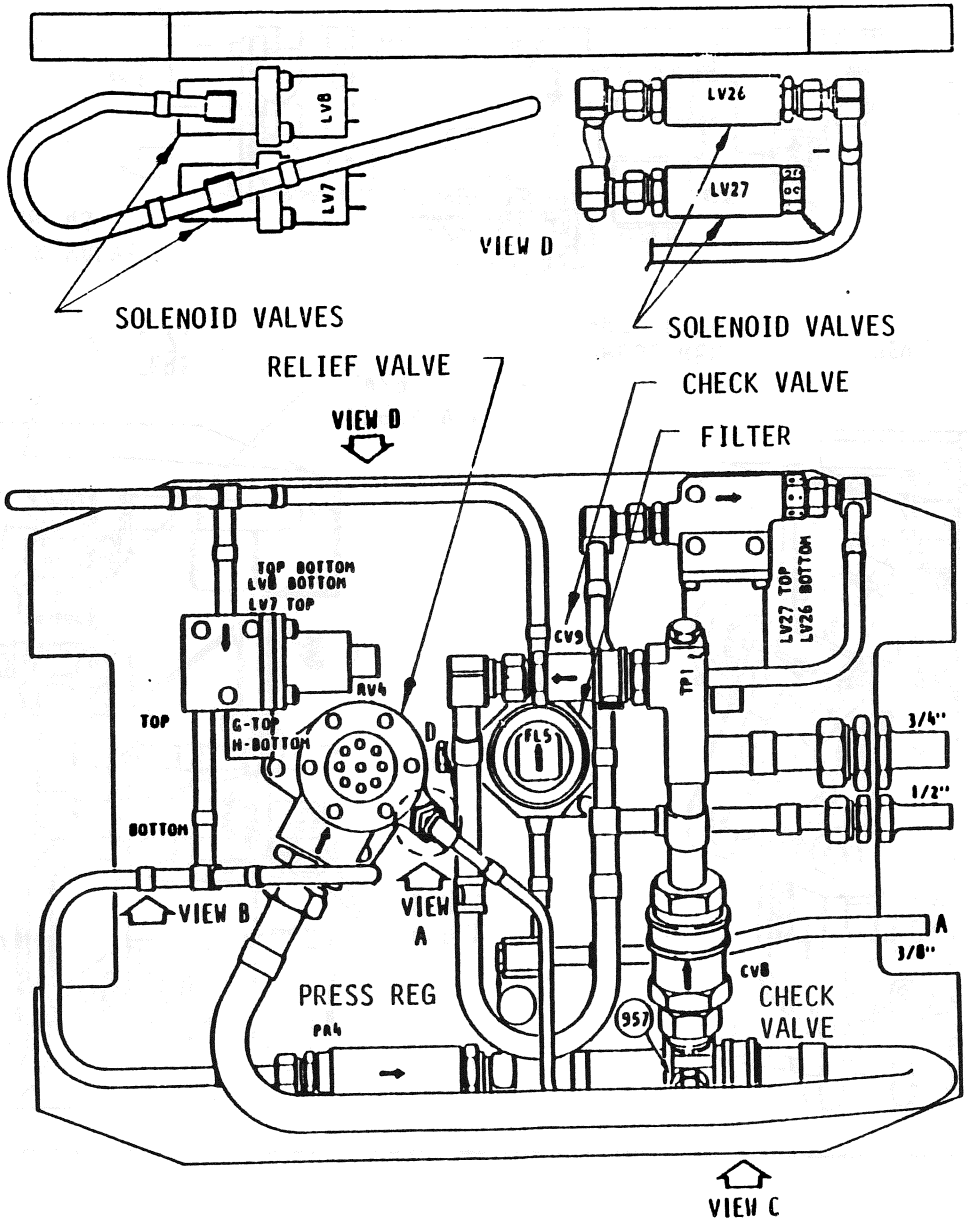
VIEW B



VIEW A



VIEW C



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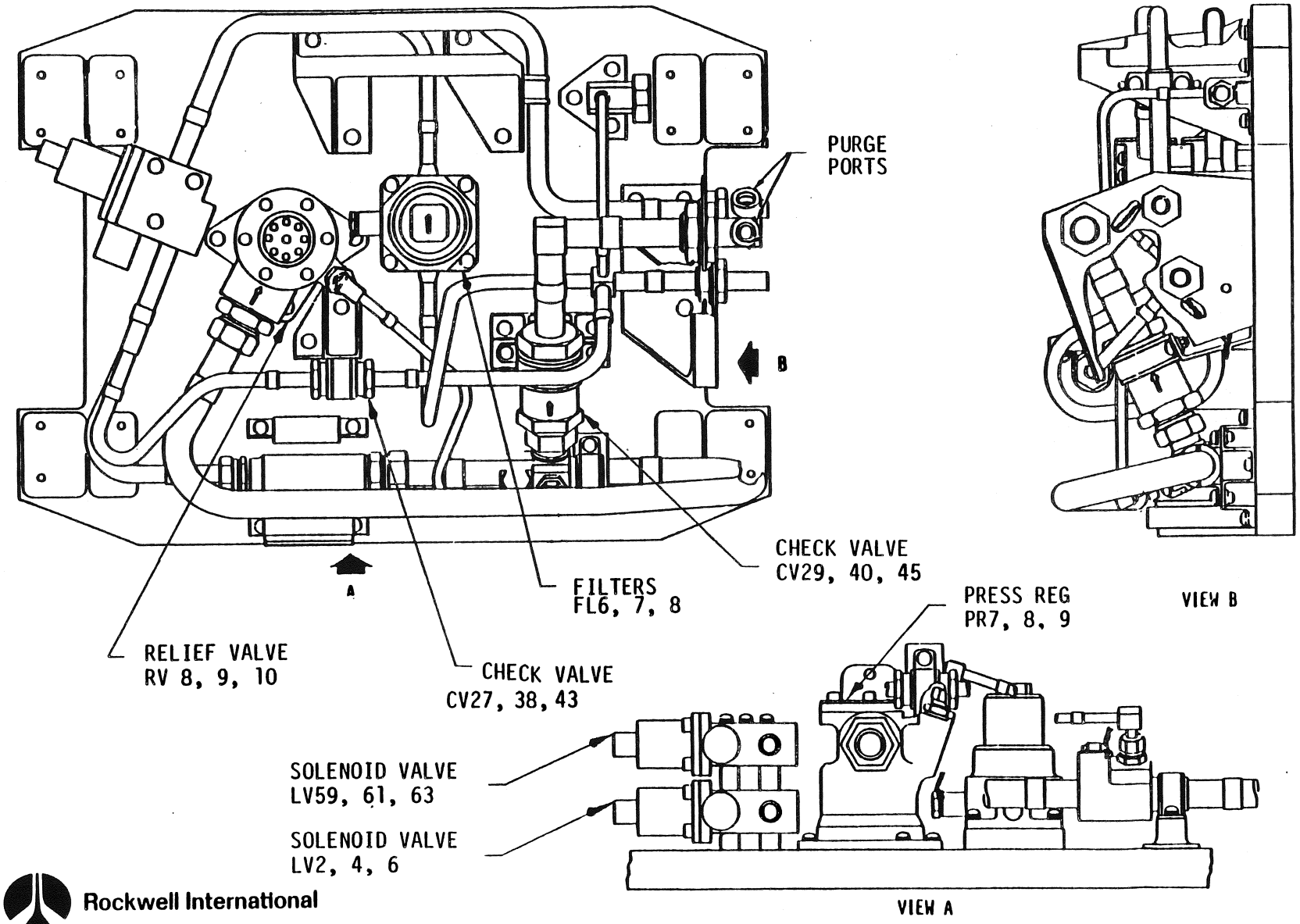
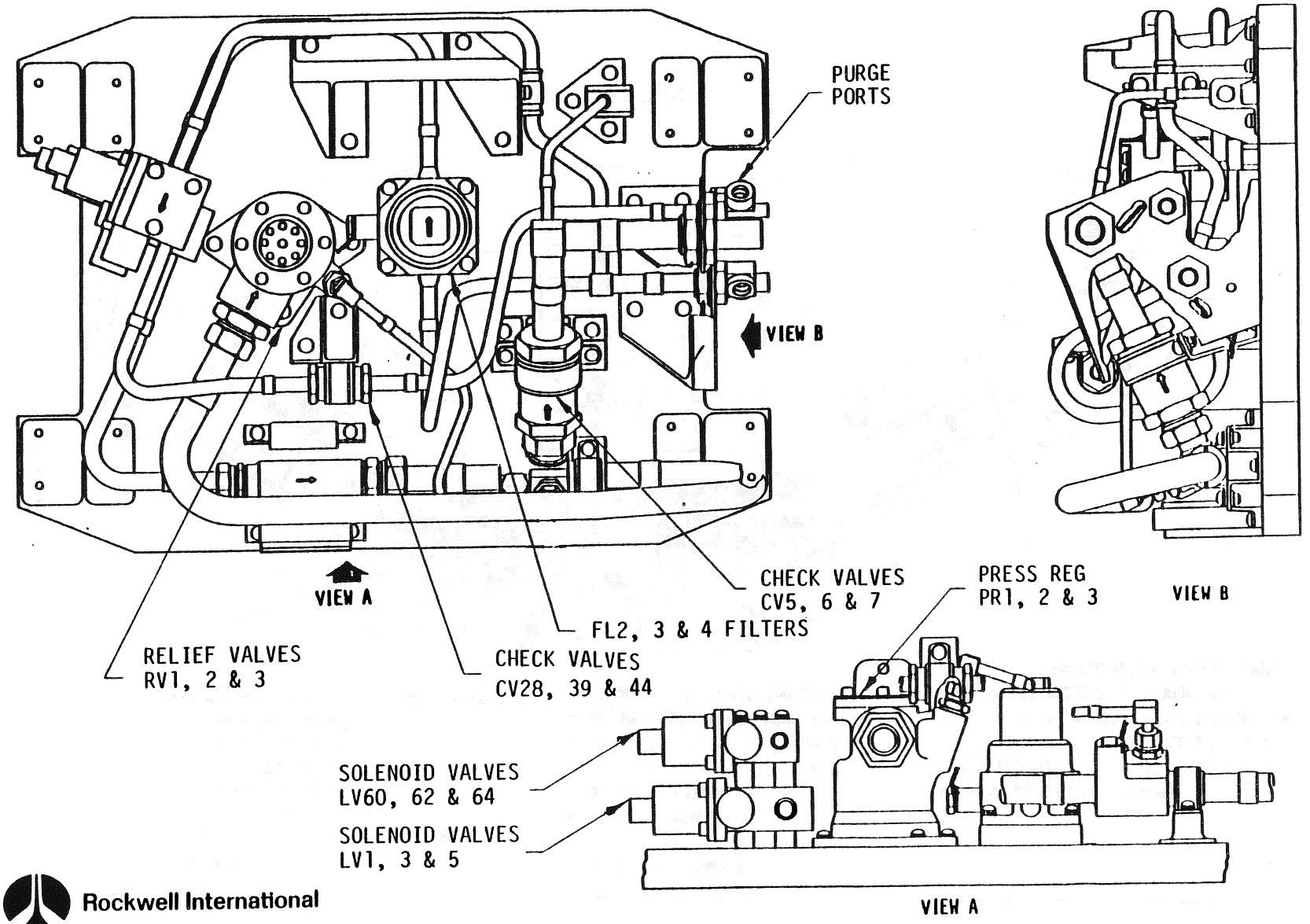
GHe ENGINE PURGE PANELS NO. 1B, 2B AND 3B



GHe ENGINE PURGE PANELS NO. 1A, 2A AND 3A



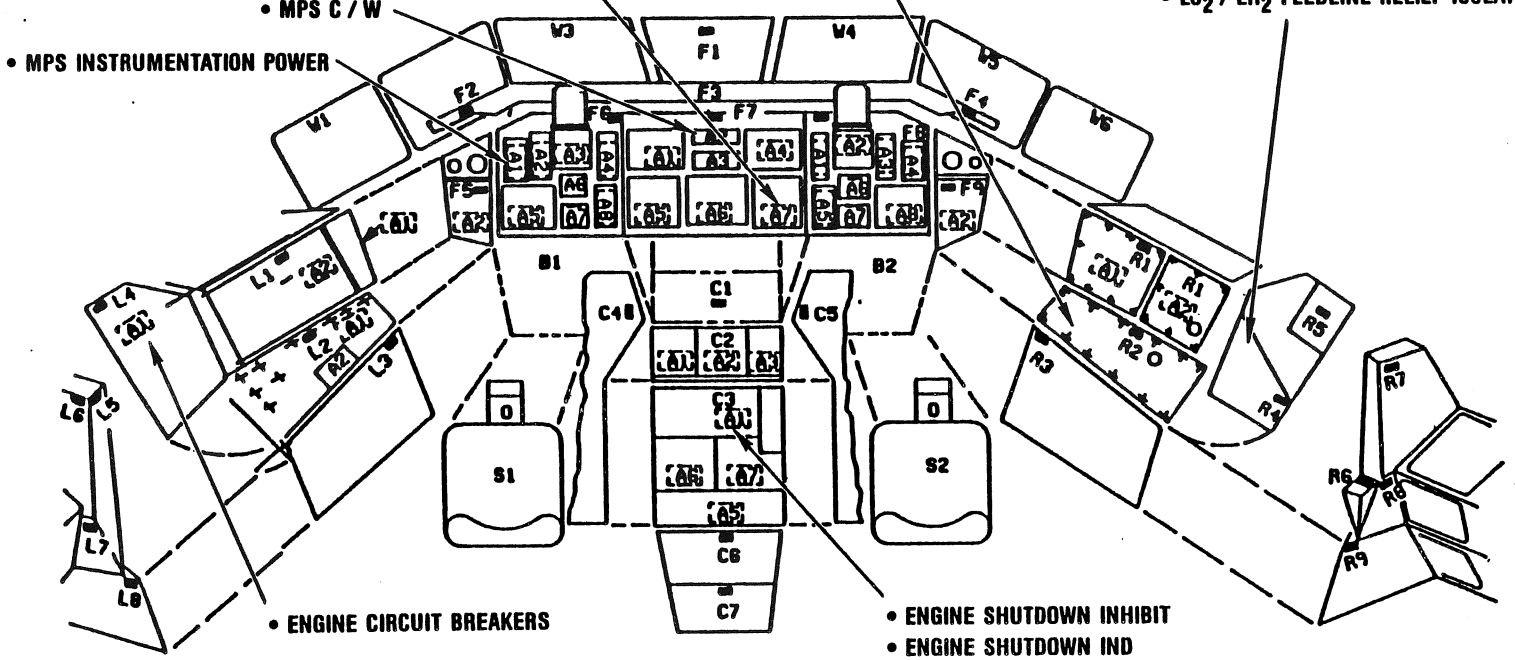
MAIN PROPULSION SYSTEM—DISPLAYS AND CONTROLS

- ENGINE CHAMBER PRESSURE DISPLAY
- LO_2 & LH_2 ENGINE MANIFOLD PRESSURE DISPLAY
- MAIN ENGINE STATUS LITE
- PNEUMATIC REG OUT PRESS / PNEUMATIC He SUPPLY PRESSURE DISPLAY
- ENGINE He REG OUT PRESSURE / He SUPPLY PRESSURE DISPLAY
- He SUPPLY PRESSURE / REG OUT PRESS. SEL SWITCH

- PROPELLANT DUMP SEQUENCE
- BACKUP LH_2 RTLS DUMP VLV
- ENGINE AC POWER
- HELIUM ISOLATION VLV
- LEFT ENGINE HELIUM XOVER VLE
- PNEUMATIC HELIUM ISOLATION VLV
- GH_2 PRESSURIZATION FLOW CONTROL VLV
- ENGINE HELIUM INTERCONNECT VLV

- ENGINE CONTROLLER HEATER
- LO_2 / LH_2 MAINFOLD REPRESS VLV
- LO_2 INBOARD / OUTBOARD FILL & DRAIN VLV
- LH_2 INBOARD / OUTBOARD FILL & DRAIN VLV
- GH_2 PRESSURIZATION LINE VENT VLV
- LO_2 / LH_2 FEEDLINE RELIEF ISOLATION VLV

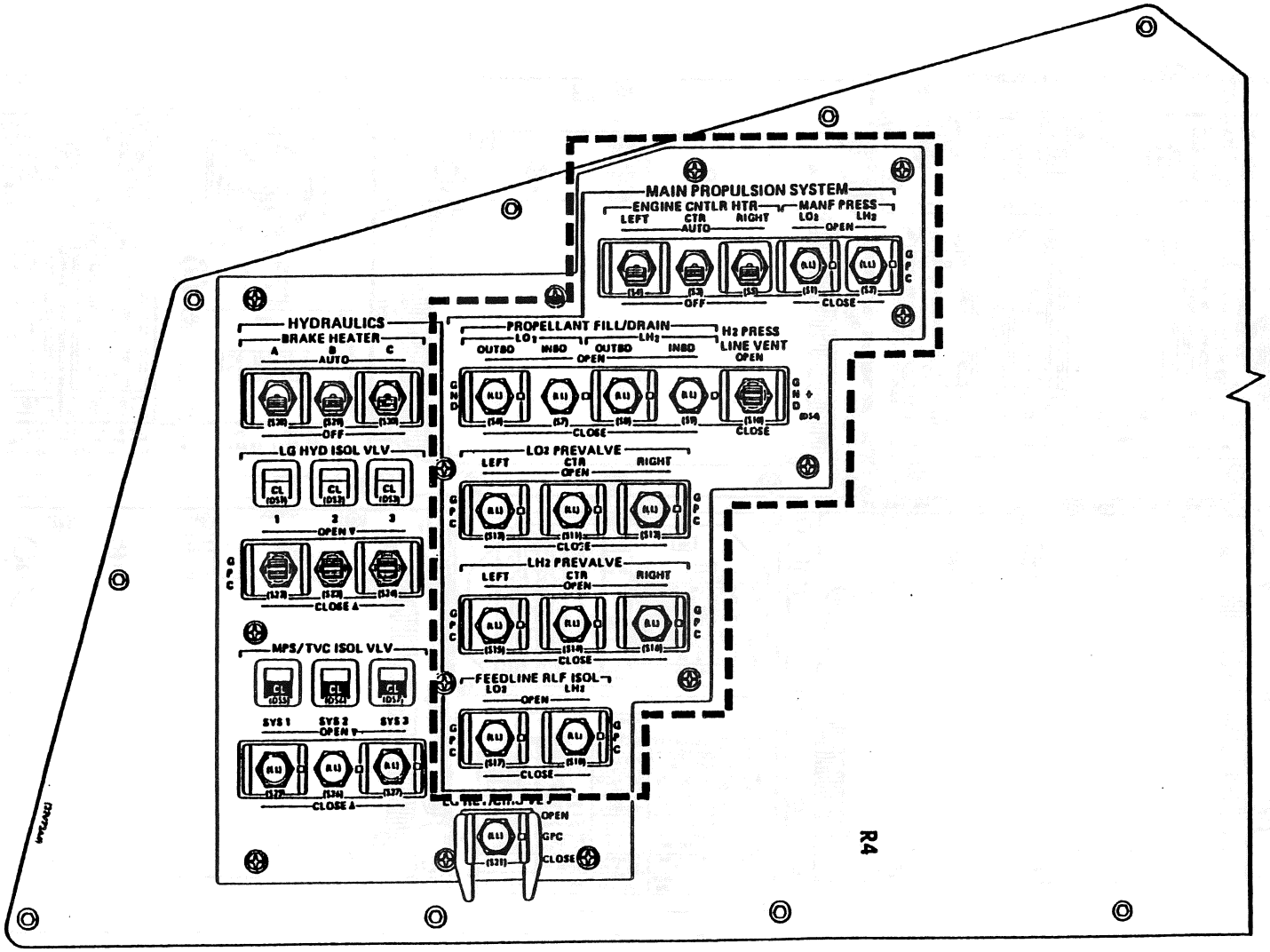
- MPS C / W
- MPS INSTRUMENTATION POWER



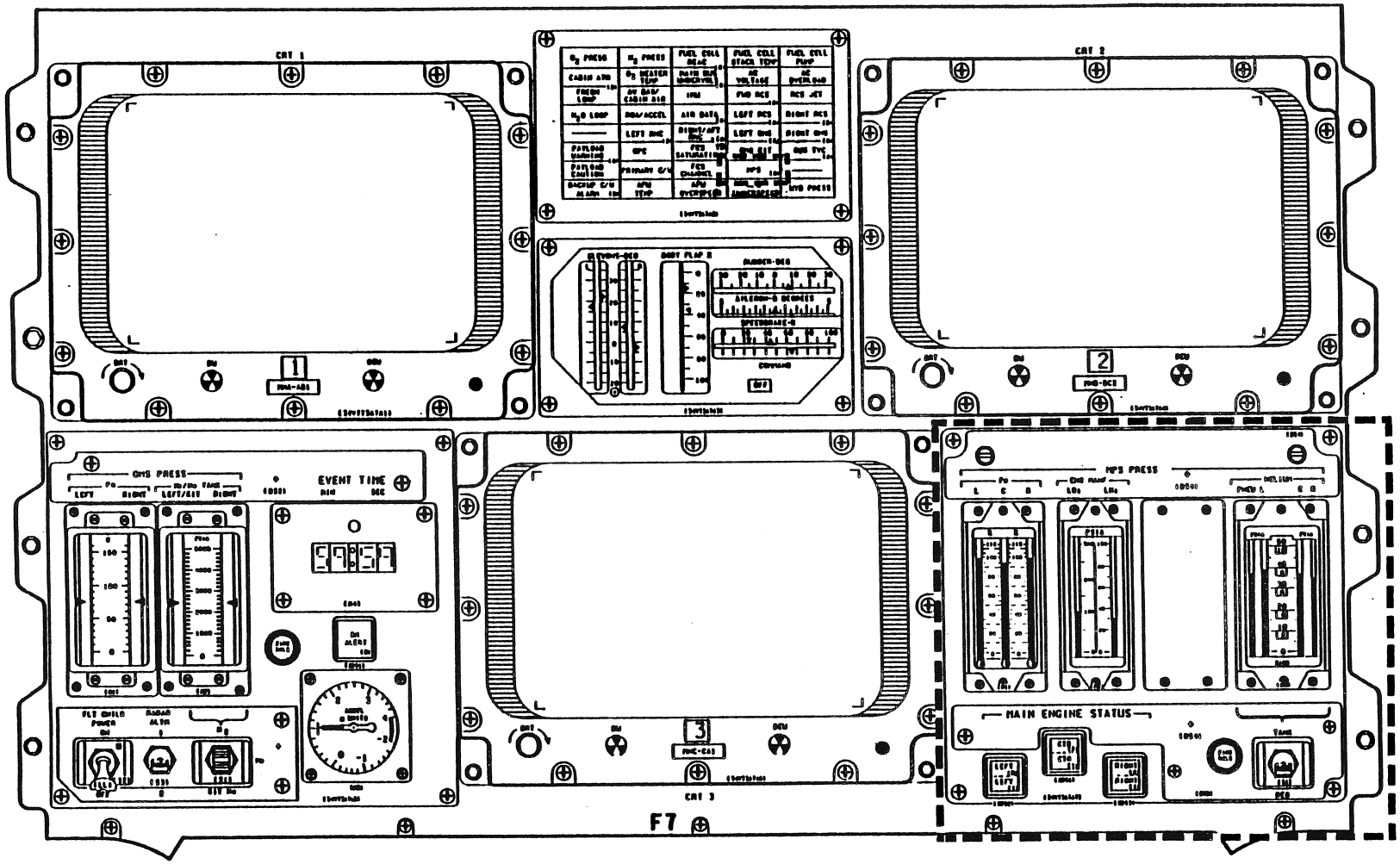
- ENGINE CIRCUIT BREAKERS
- ENGINE SHUTDOWN INHIBIT
- ENGINE SHUTDOWN IND

FLIGHT STATION

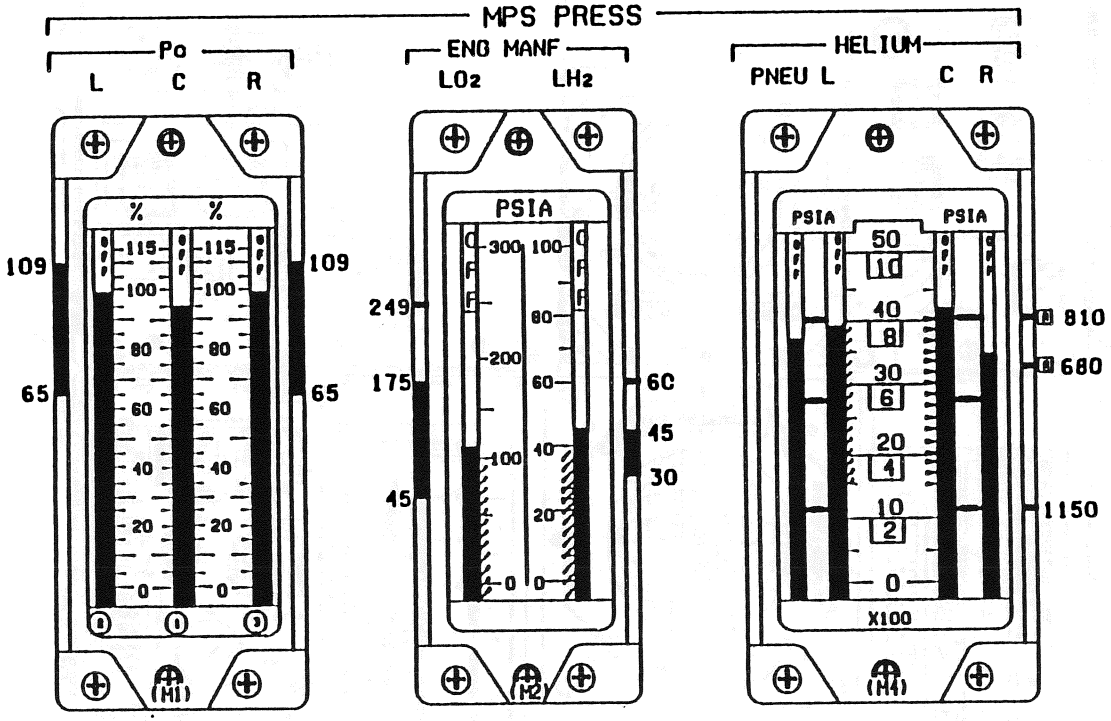
MAIN PROPULSION SYSTEM—DISPLAYS AND CONTROLS (PANEL R4)



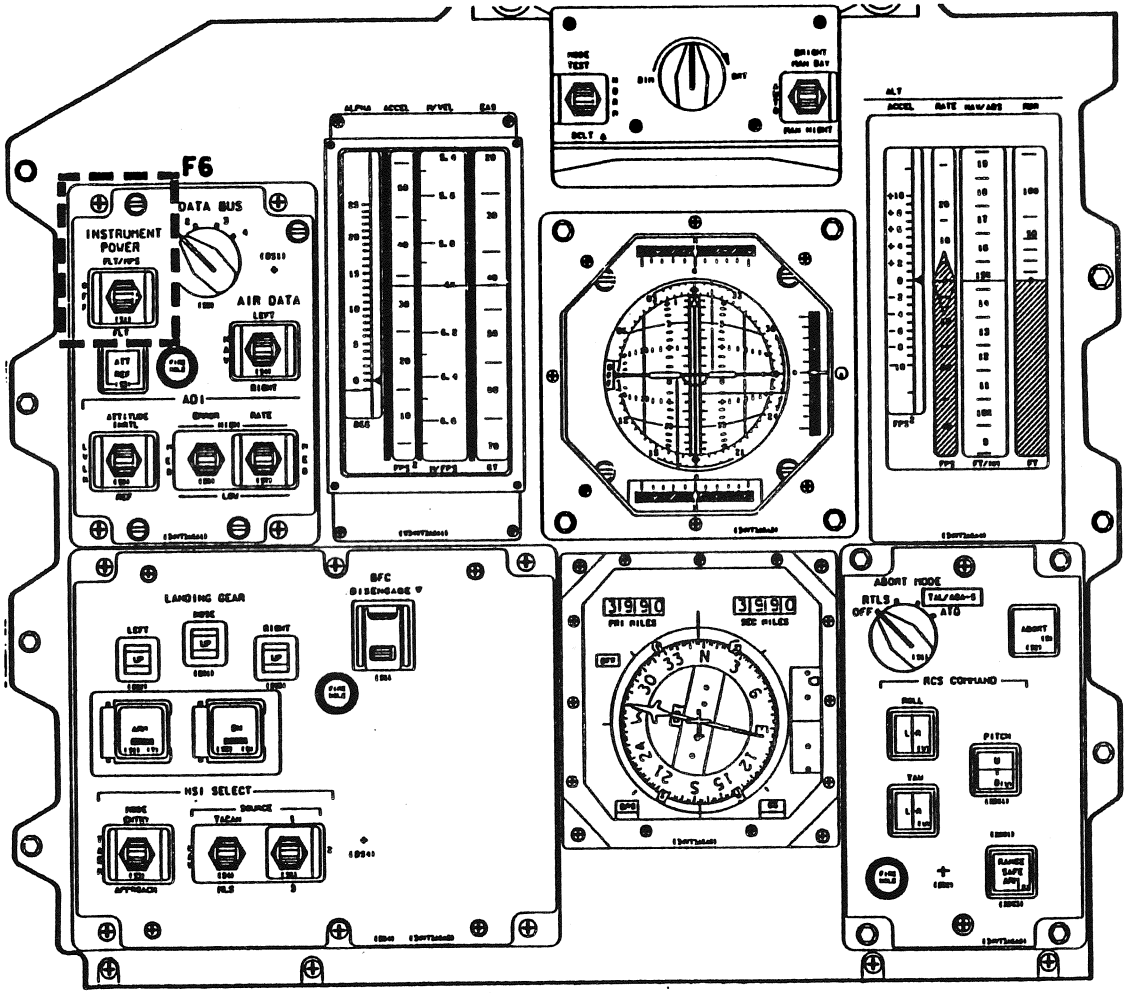
MAIN PROPULSION SYSTEM—DISPLAYS AND CONTROLS (PANEL F7)



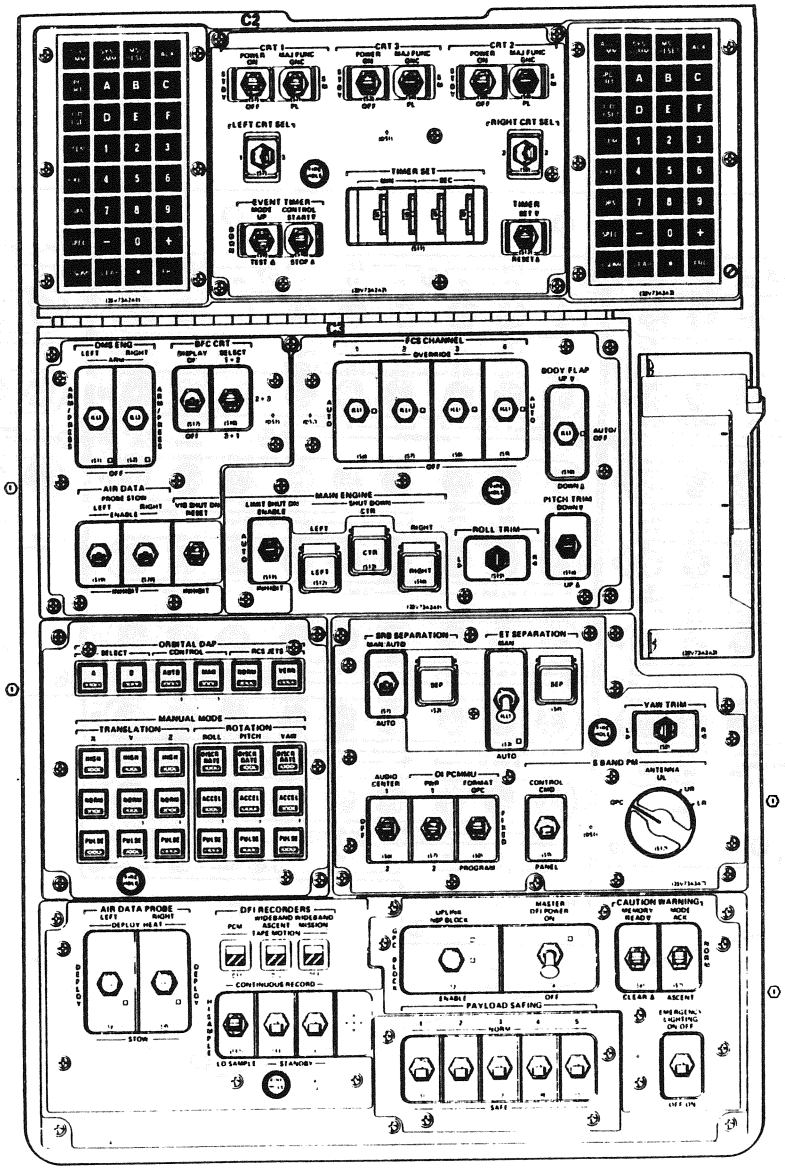
MAIN PROPULSION SYSTEM—PANEL F7 METERS



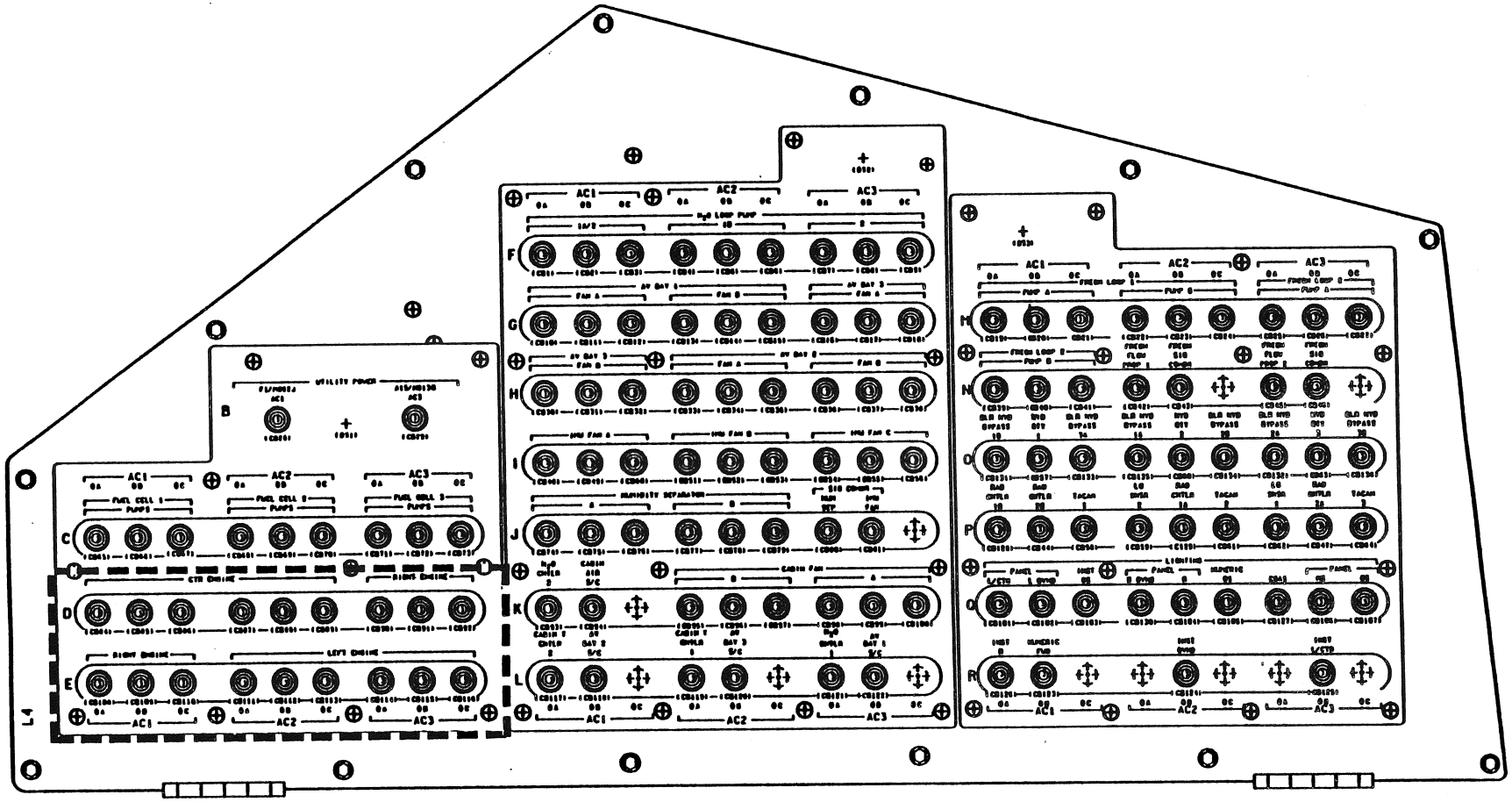
MAIN PROPULSION SYSTEM—DISPLAYS AND CONTROLS (PANEL F6)



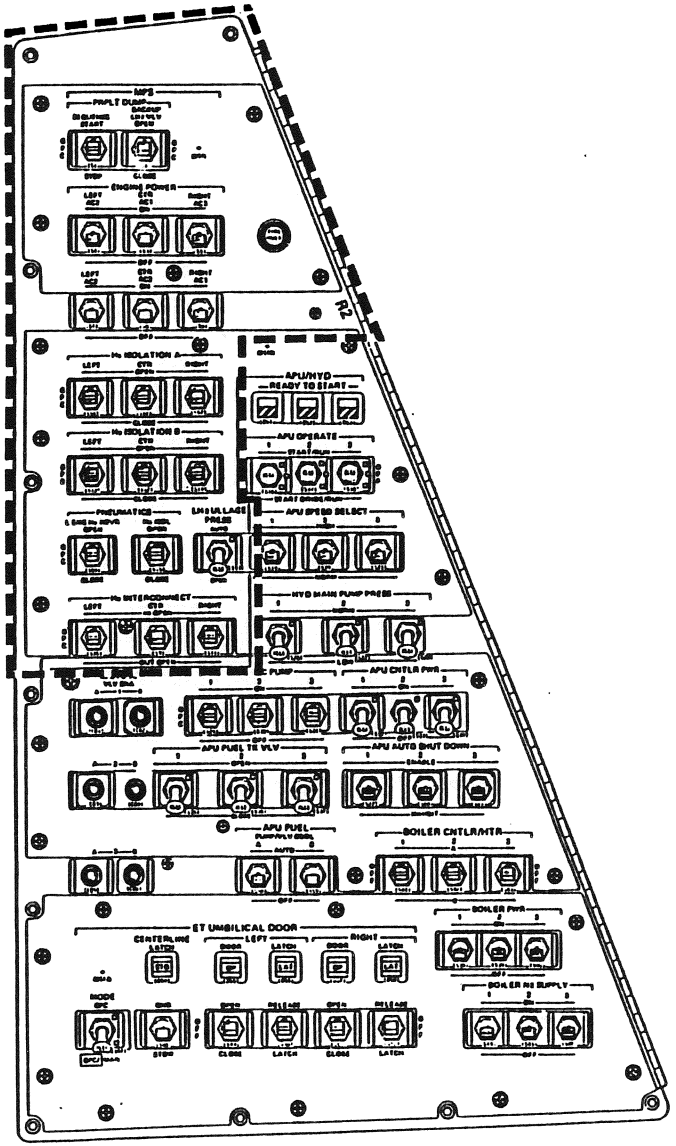
MAIN PROPULSION SYSTEM—DISPLAYS AND CONTROLS (PANEL C3)



MAIN PROPULSION SYSTEM—DISPLAYS AND CONTROLS (PANEL L4)



MAIN PROPULSION SYSTEM—DISPLAYS AND CONTROLS (PANEL R2)



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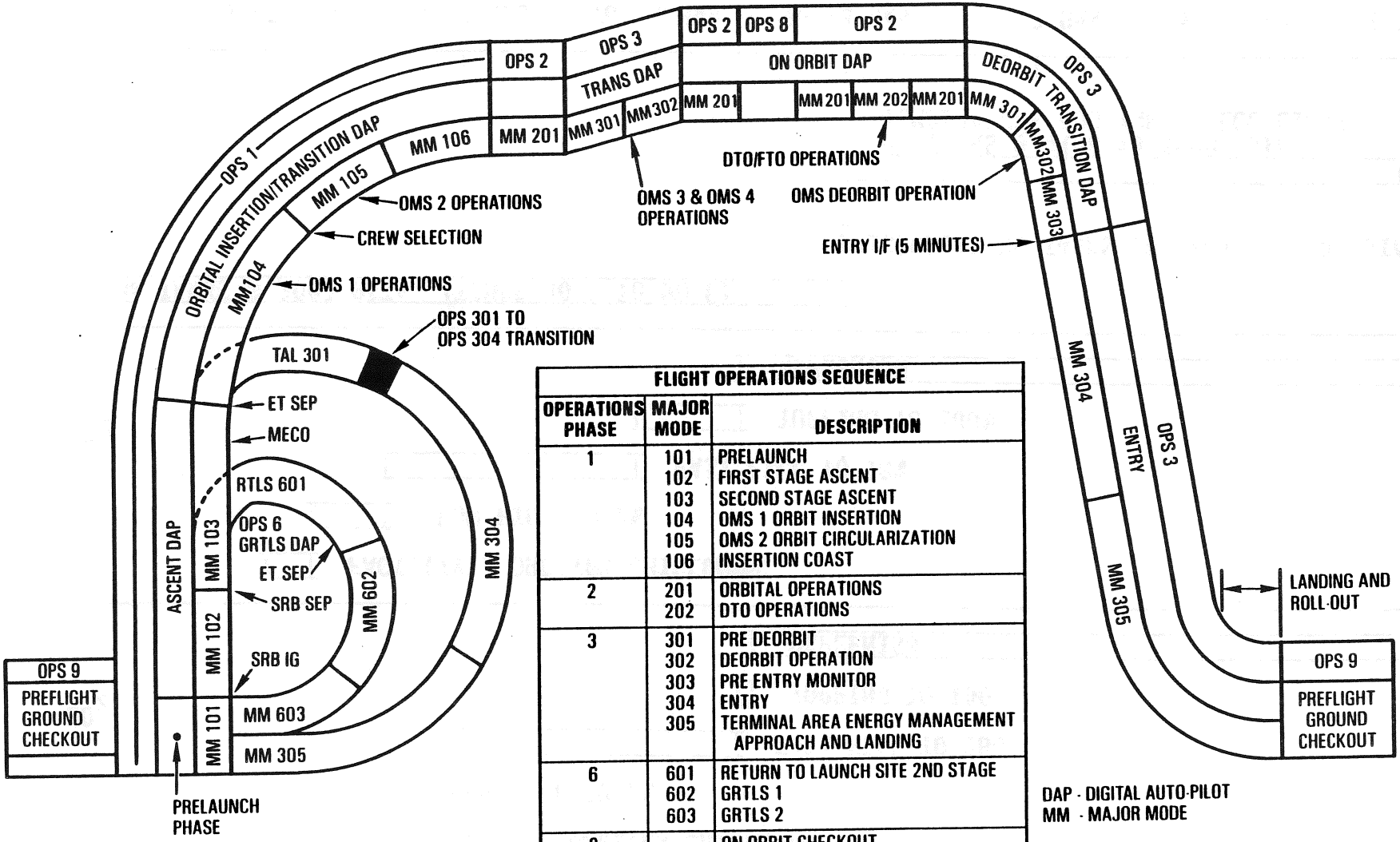
FLIGHT OPERATIONS SEQUENCE

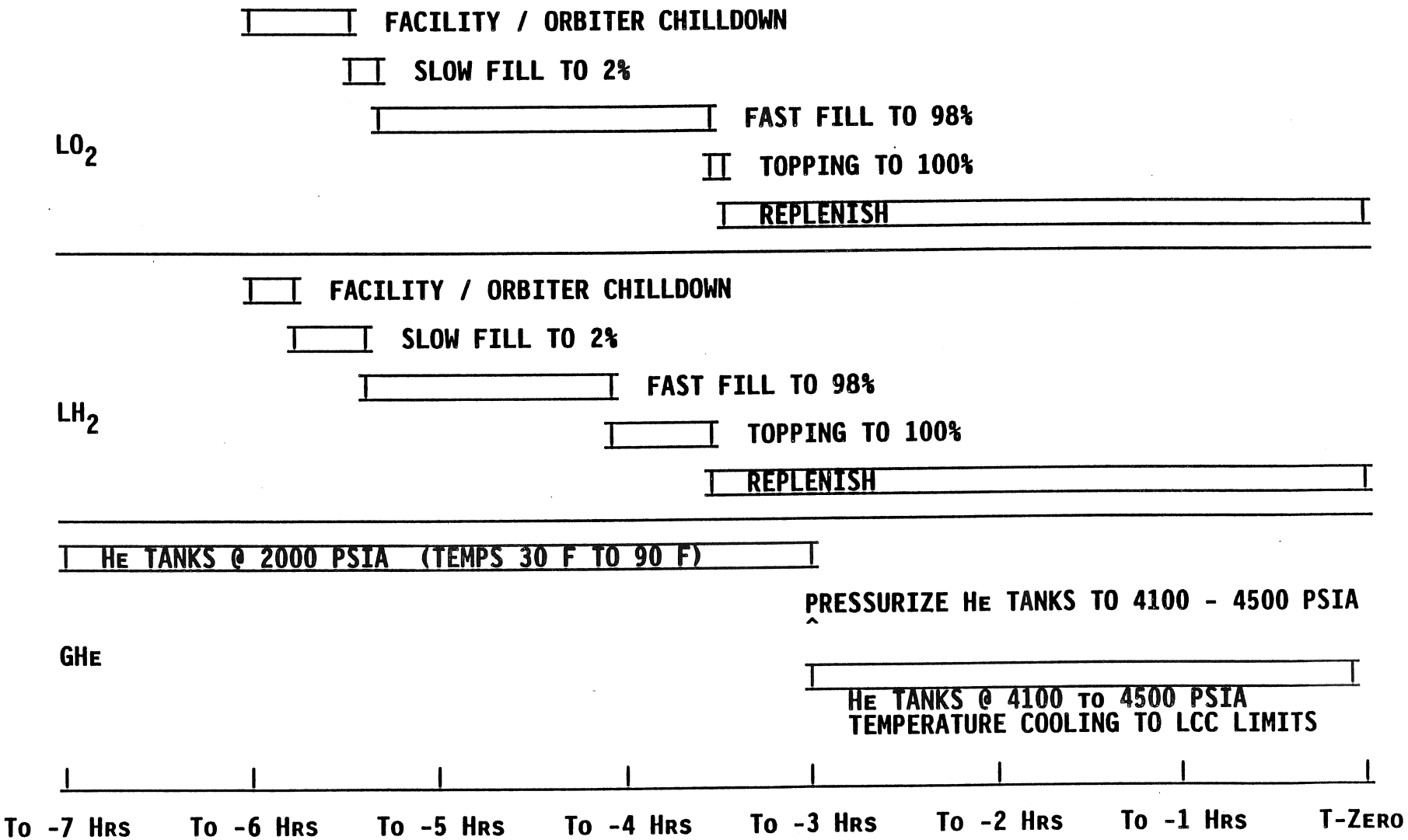


FLIGHT OPERATIONS SEQUENCE		
OPERATIONS PHASE	**MAJOR MODE**	**DESCRIPTION**
1	101	PRELAUNCH
	102	FIRST STAGE ASCENT
	103	SECOND STAGE ASCENT
	104	OMS 1 ORBIT INSERTION
	105	OMS 2 ORBIT CIRCULARIZATION
	106	INSERTION COAST
2	201	ORBITAL OPERATIONS
	202	DTO OPERATIONS
3	301	PRE DEORBIT
	302	DEORBIT OPERATION
	303	PRE ENTRY MONITOR
	304	ENTRY
	305	TERMINAL AREA ENERGY MANAGEMENT APPROACH AND LANDING
6	601	RETURN TO LAUNCH SITE 2ND STAGE
	602	GRTLS 1
	603	GRTLS 2
8	–	ON ORBIT CHECKOUT
9	–	PREFLIGHT GROUND CHECKOUT

DAP - DIGITAL AUTO-PILOT
MM - MAJOR MODE

MPS—LH_2, LO_2 AND GHe LOADING TIMELINE EVENTS

(NORMAL MISSIONS AND FRF's)



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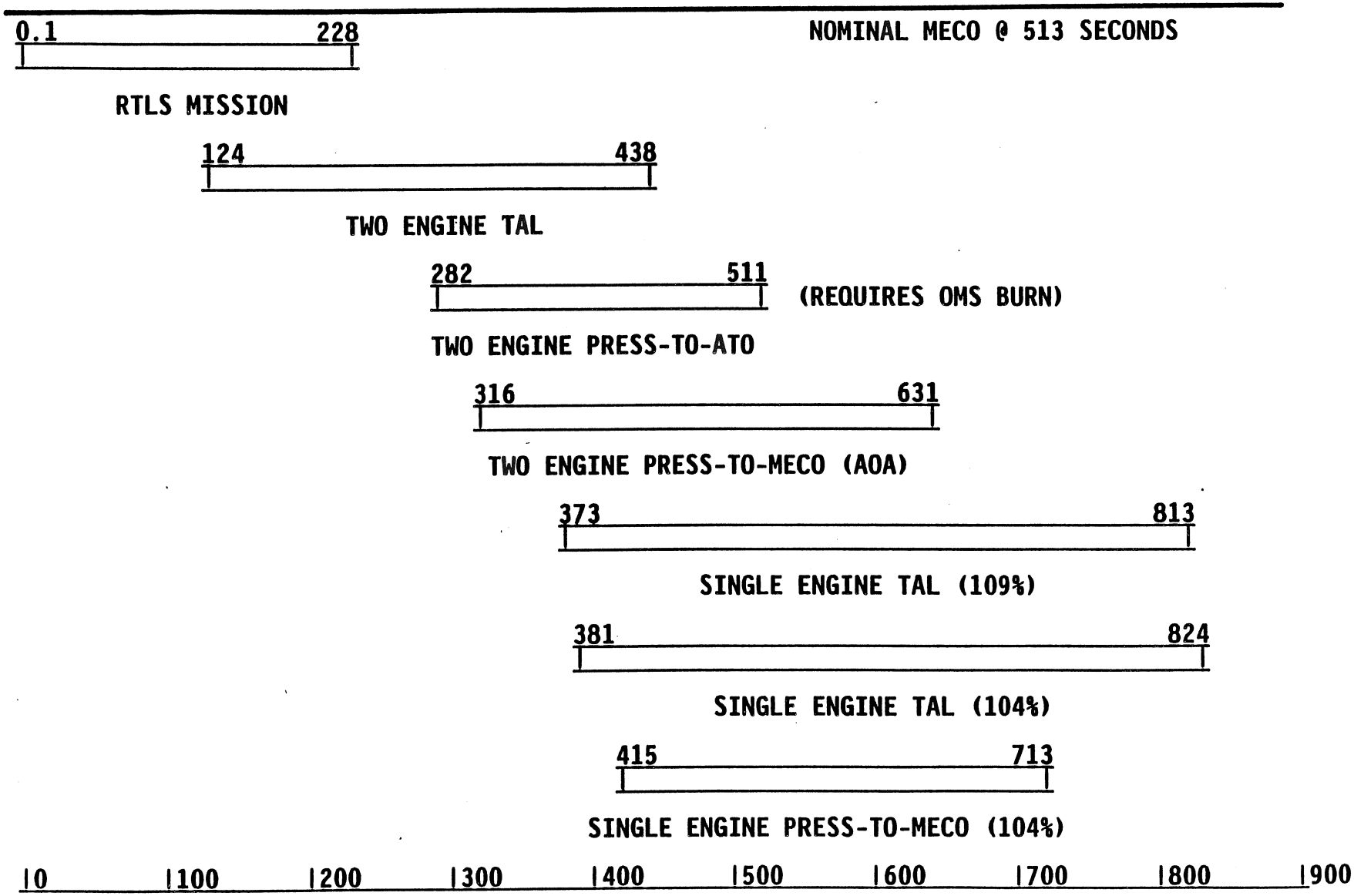
MPS AUTO-SEQUENCE EVENTS

(ALL MISSIONS)

COUNTDOWN TIME MIN SECS	(FWC)	EVENT
-9 : 0.00		START AUTO-SEQUENCE
-5 : 0.00		APU START, TERMINATE LO2 REPLENISH
-4 : 55.00		CLOSE MPS LO2 I/B F/D VLV (PV10)
-4 : 0.00		START SSME PURGE SEQUENCE 4
-2 : 35.00		START LO2 ET PREPRESSURIZATION
-1 : 57.00		TERMINATE LH2 REPLENISH, CLOSE MPS LH2 TOPPING VLV (PV13)
-1 : 46.00		START LH2 ET PREPRESSURIZATION
-48.00		CLOSE LO2 & LH2 O/B F/D VLV's (PV9 & 11)
-20.00		CLOSE MPS LH2 HI POINT BLEED VLV (PV22)
-13.00		TERMINATE GROUND MPS HE FILL
-12.50	(-13.3)	OPEN LO2 POGO RECIRCULATION VLV's (PV20 & 21)
-9.50	(-10.3)	OPEN MPS LH2 PREVALVES (PV4, 5 & 6)
-9.40	(-10.2)	CLOSE MPS LO2 O/B B/V (PV19)
-9.00	(-9.8)	CLOSE MPS LH2 RECIRCULATION VLV's (PV14, 15 & 16)
-6.60	(-7.40)	START SSME #3
-6.48	(-7.28)	START SSME #2
-6.36	(-7.16)	START SSME #1
-0.00		SRB IGNITION, LIFT-OFF

SAMPLE INTACT ABORT PROFILE

(DOES NOT APPLY TO ANY PARTICULAR MISSION)



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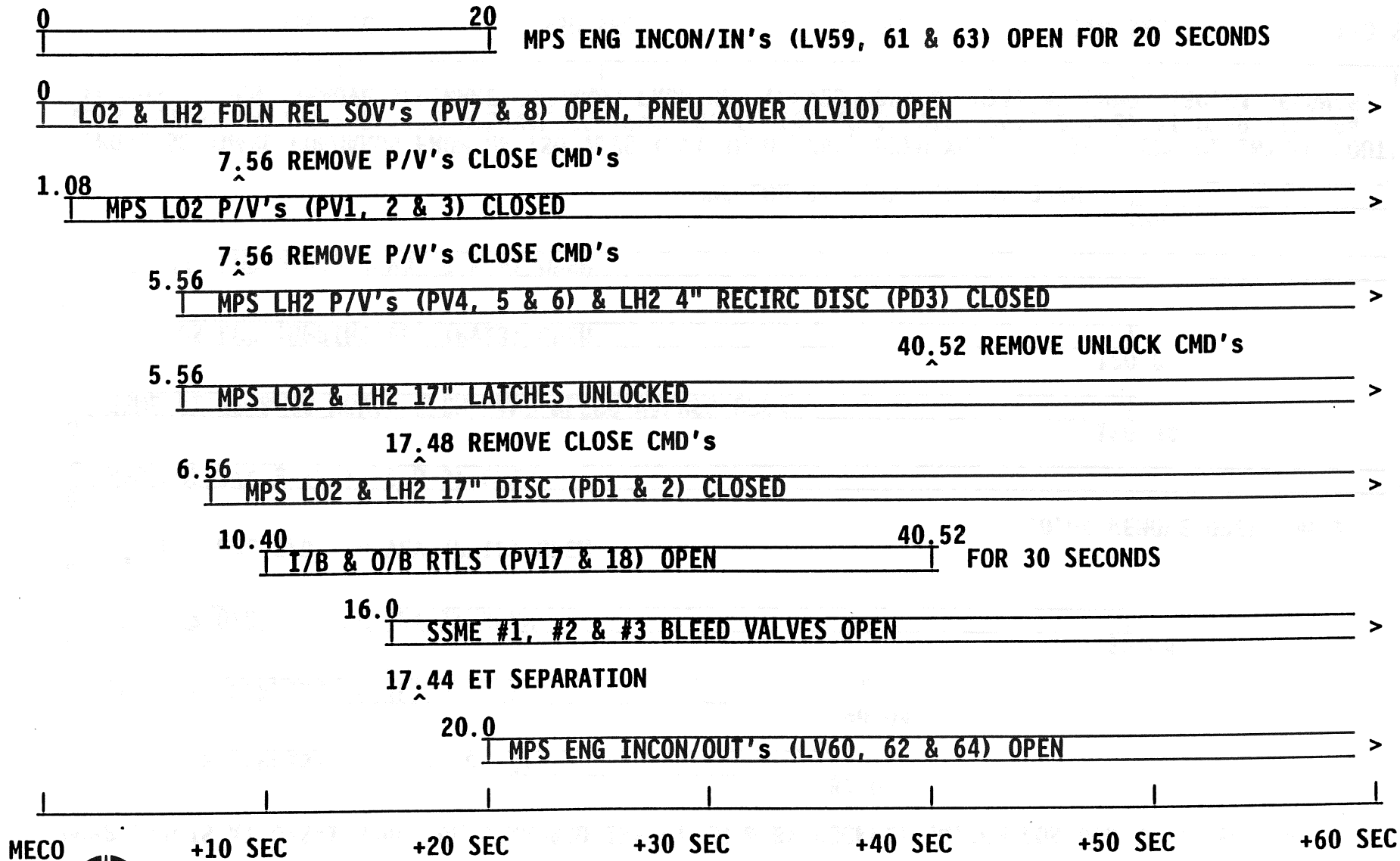
MPS MECO EVENTS

(NOMINAL MISSION)



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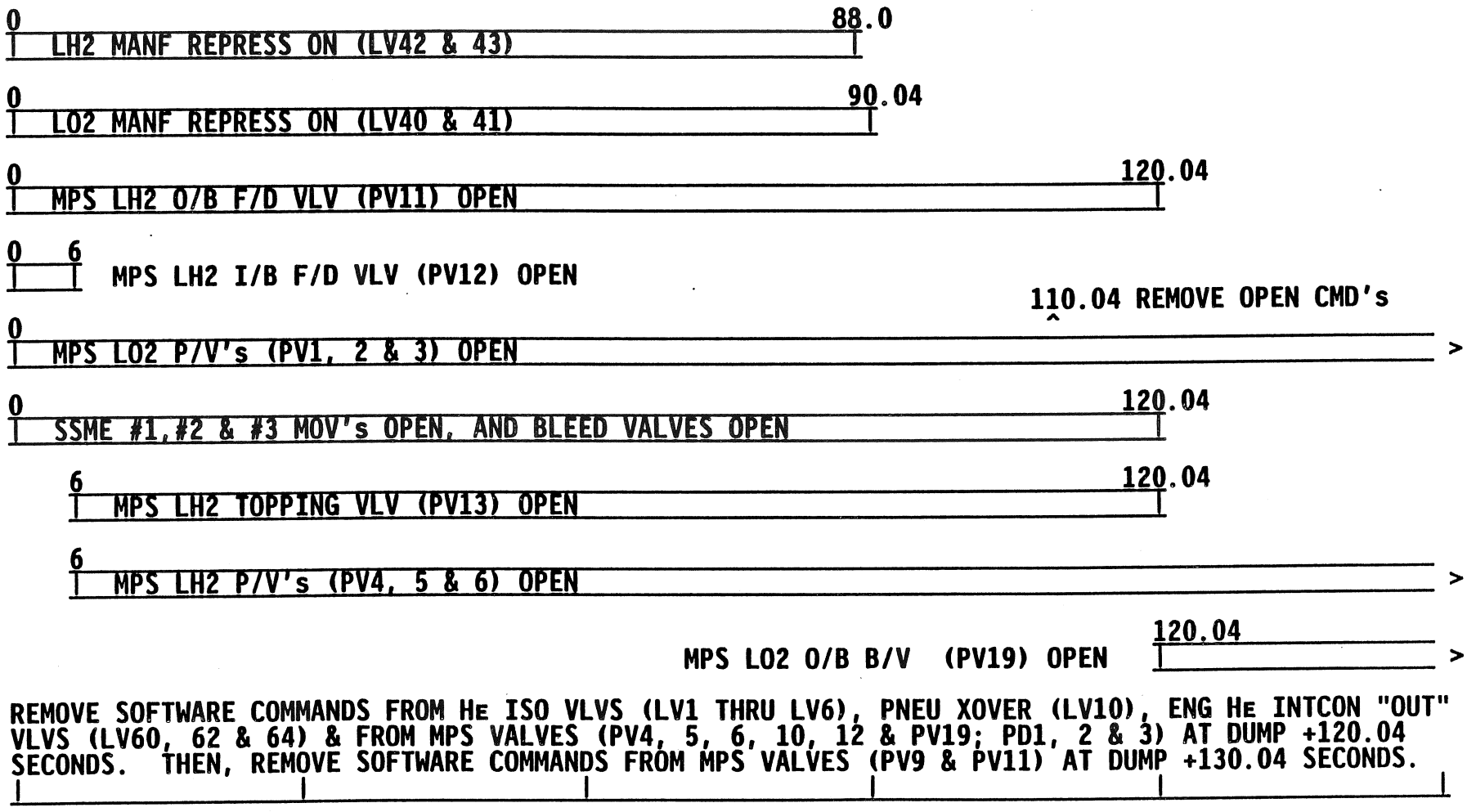
MPS DUMP SEQUENCE

(NOMINAL MISSION)

DUMP STARTS AT OMS-1 BURN FOR STANDARD INSERTION & BY COCKPIT SWITCH FOR DIRECT INSERTION.

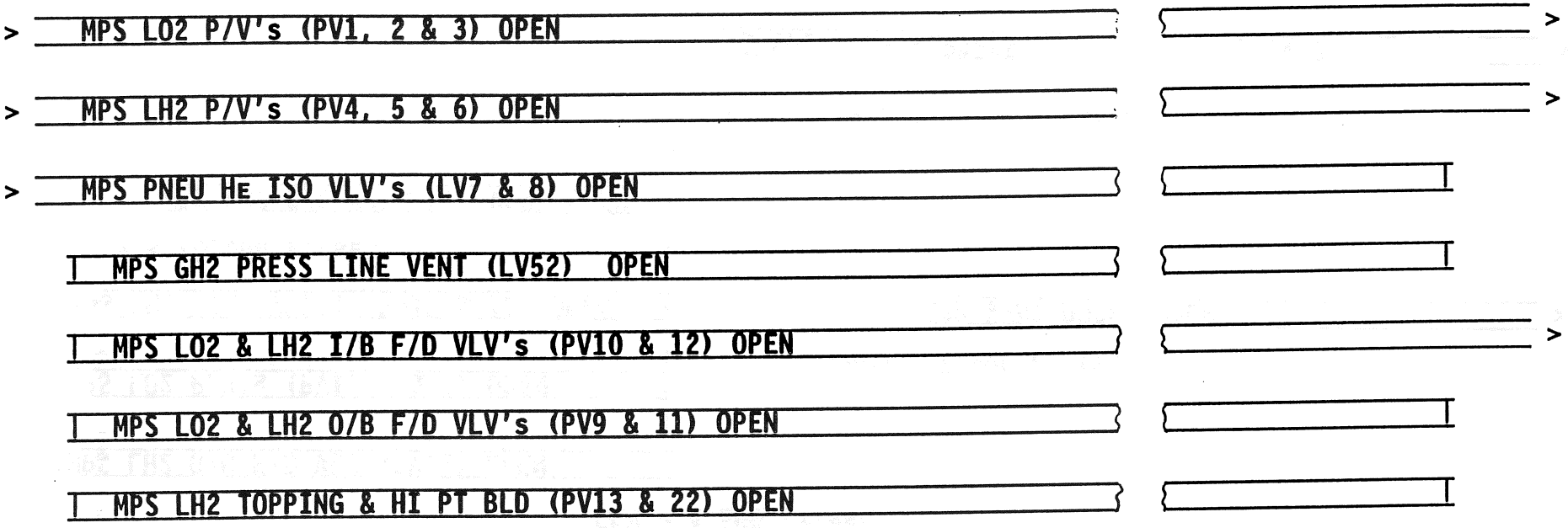


REMOVE SOFTWARE COMMANDS FROM He ISO VLVS (LV1 THRU LV6), PNEU XOVER (LV10), ENG He INTCON "OUT" VLVS (LV60, 62 & 64) & FROM MPS VALVES (PV4, 5, 6, 10, 12 & PV19; PD1, 2 & 3) AT DUMP +120.04 SECONDS. THEN, REMOVE SOFTWARE COMMANDS FROM MPS VALVES (PV9 & PV11) AT DUMP +130.04 SECONDS.

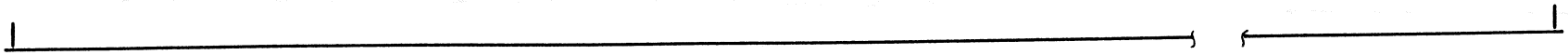
START +30 SEC +60 SEC +90 SEC +120 SEC +150 SEC

MPS VACUUM INERTING

(NOMINAL MISSION)



THE MPS VACUUM INERTING IS A MANUAL OPERATION THAT IS PERFORMED BY THE MISSION PILOT (RIGHT SEAT). HE ACTUATES THE VALVES BY OPERATING SWITCHES ON PANELS 'R2' AND 'R4'. THE DURATION OF THE INERTING IS VARIABLE BETWEEN 15 AND 30 MINUTES. AT THE END OF THE INERTING, THE OUTBOARD FILL/DRAIN VALVES ARE CLOSED AND THE INBOARD FILL/DRAIN VALVES ARE LEFT OPEN (BOTH LO2 & LH2). WHEN THE LH2 INBOARD FILL/DRAIN VALVE SWITCH IS RETURNED TO THE GND POSITION, THE TOPPING AND HI POINT BLEED VALVES RETURN TO THE CLOSED POSITION. LO2 & LH2 PREVALVES REMAIN OPEN. THE PNEU He ISOLATION VALVES ARE CLOSED TO POWER DOWN THE HELIUM SYSTEM AND CLOSING LV52 COMPLETES THE MPS VACUUM INERTING.

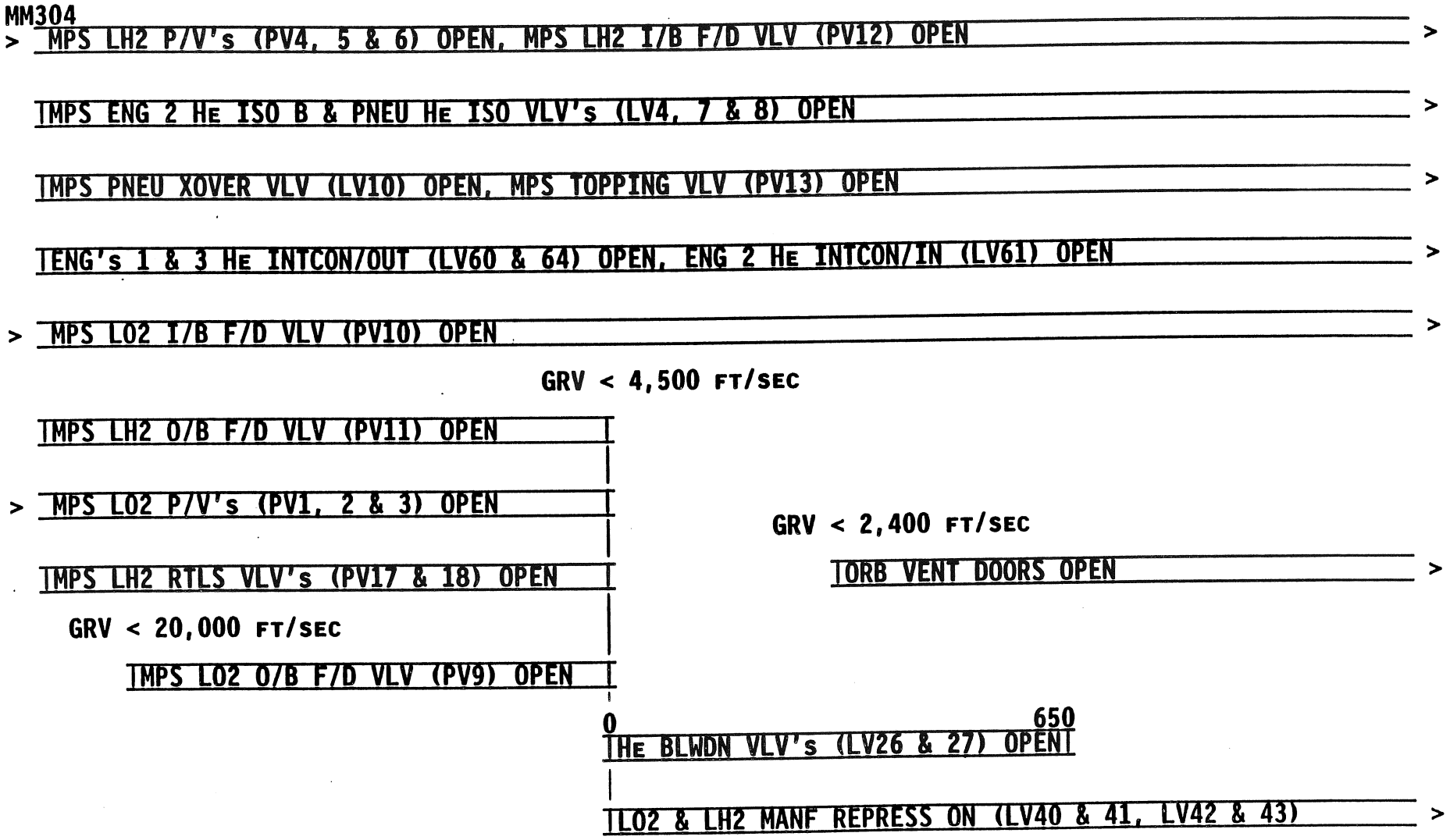


START

15 - 30 MIN

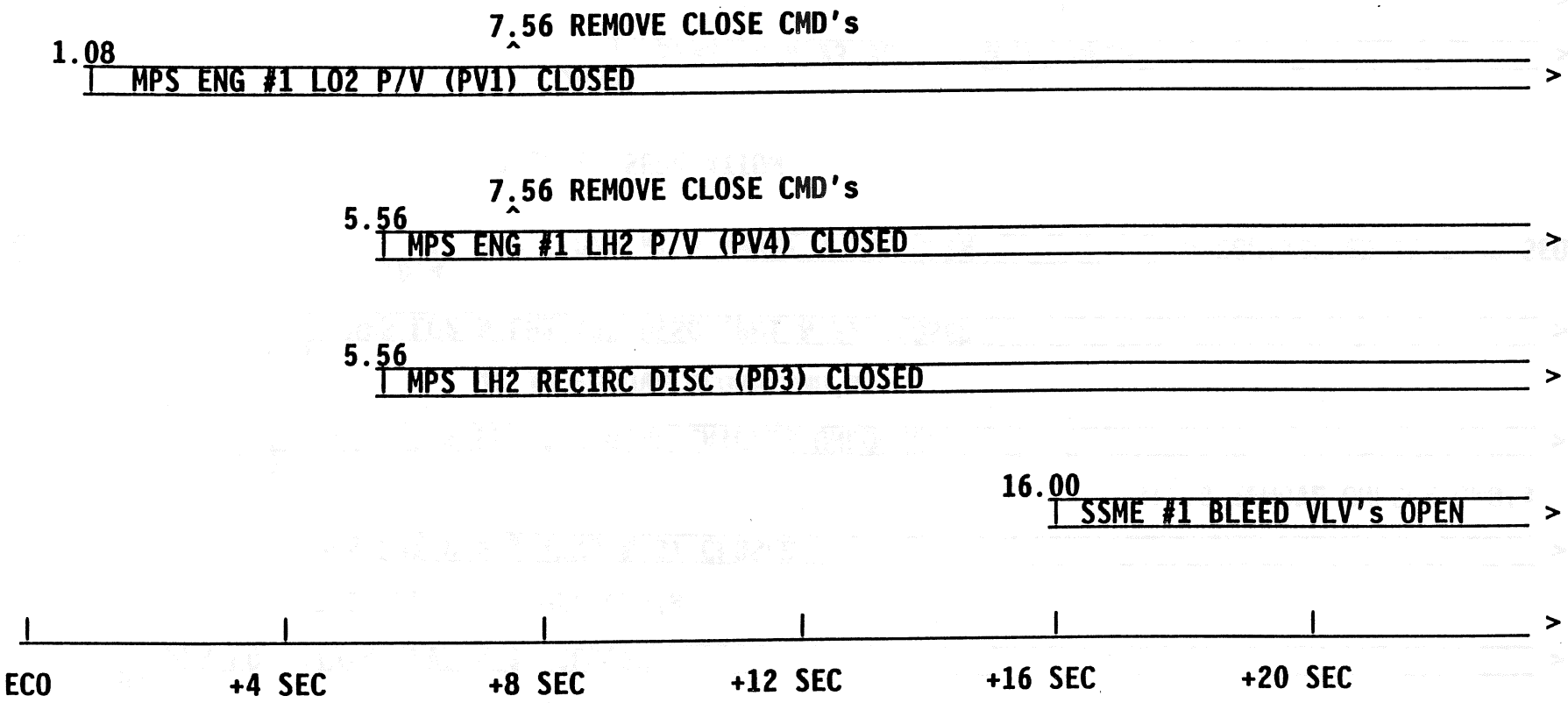
MPS REENTRY PURGE

(NOMINAL MISSION)



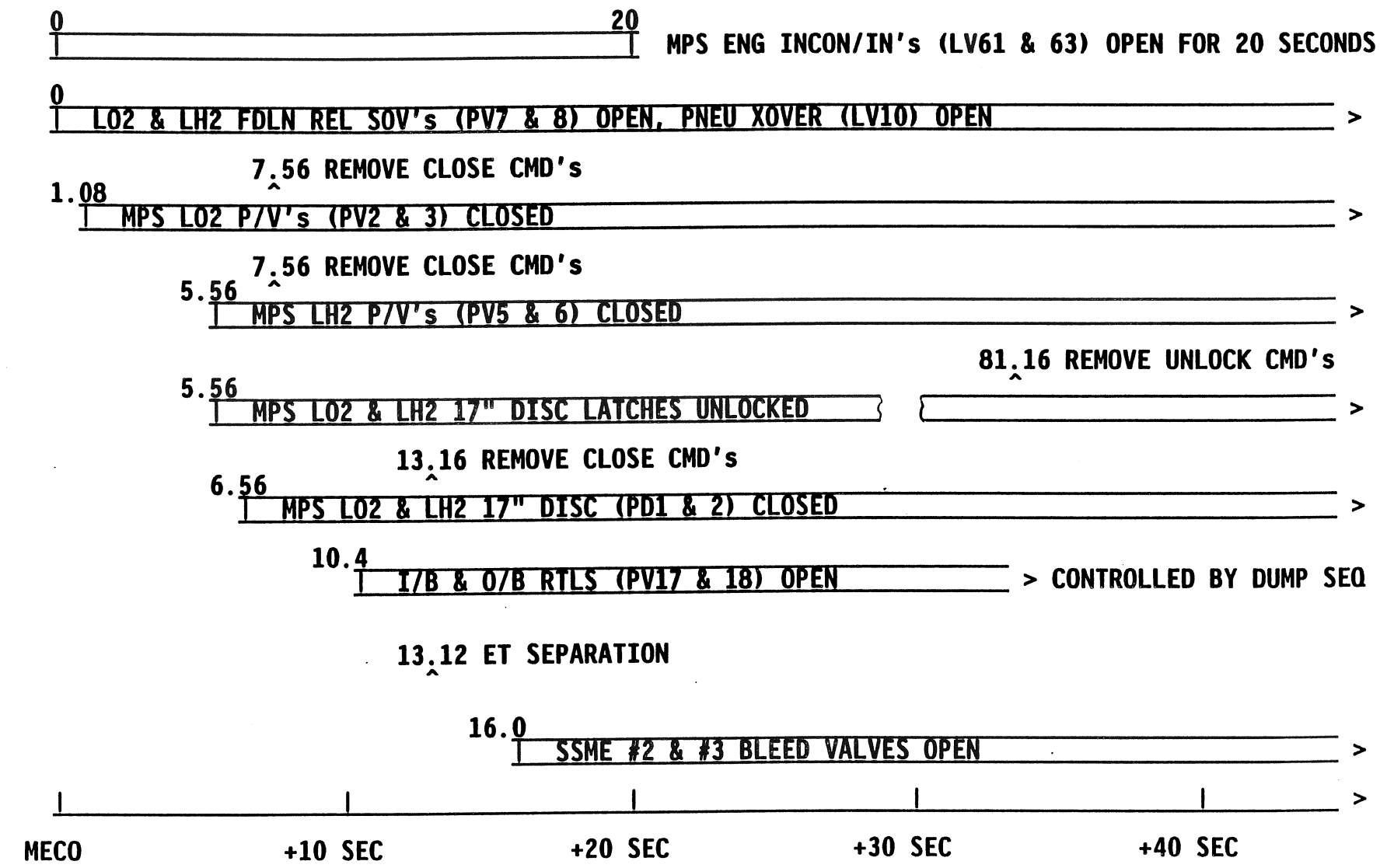
MPS ECO EVENTS
(EARLY ENGINE OUT)

(SSME NO. 1)



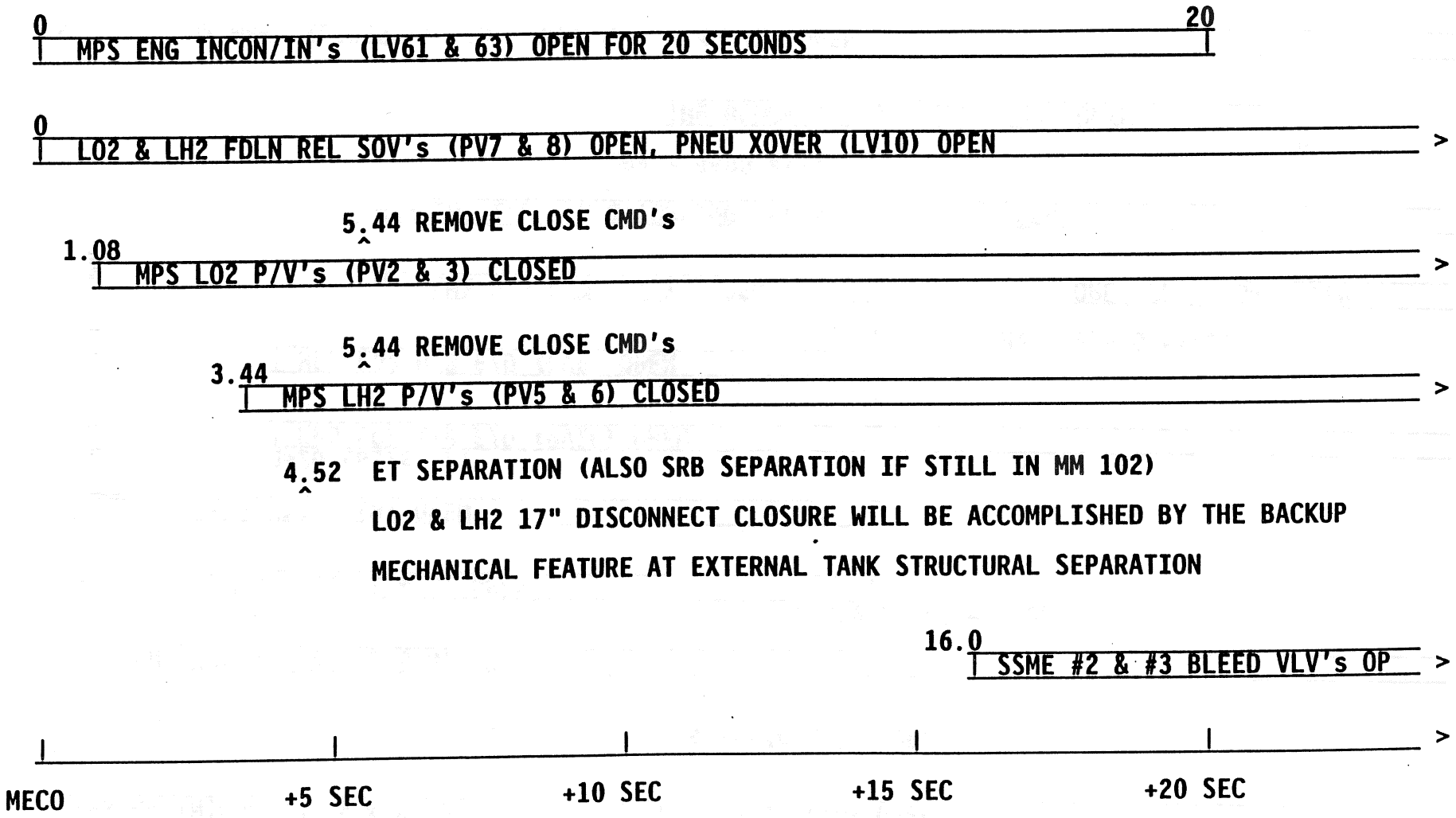
MPS MECO EVENTS

(RTLS MISSION [ENG 1 OUT])



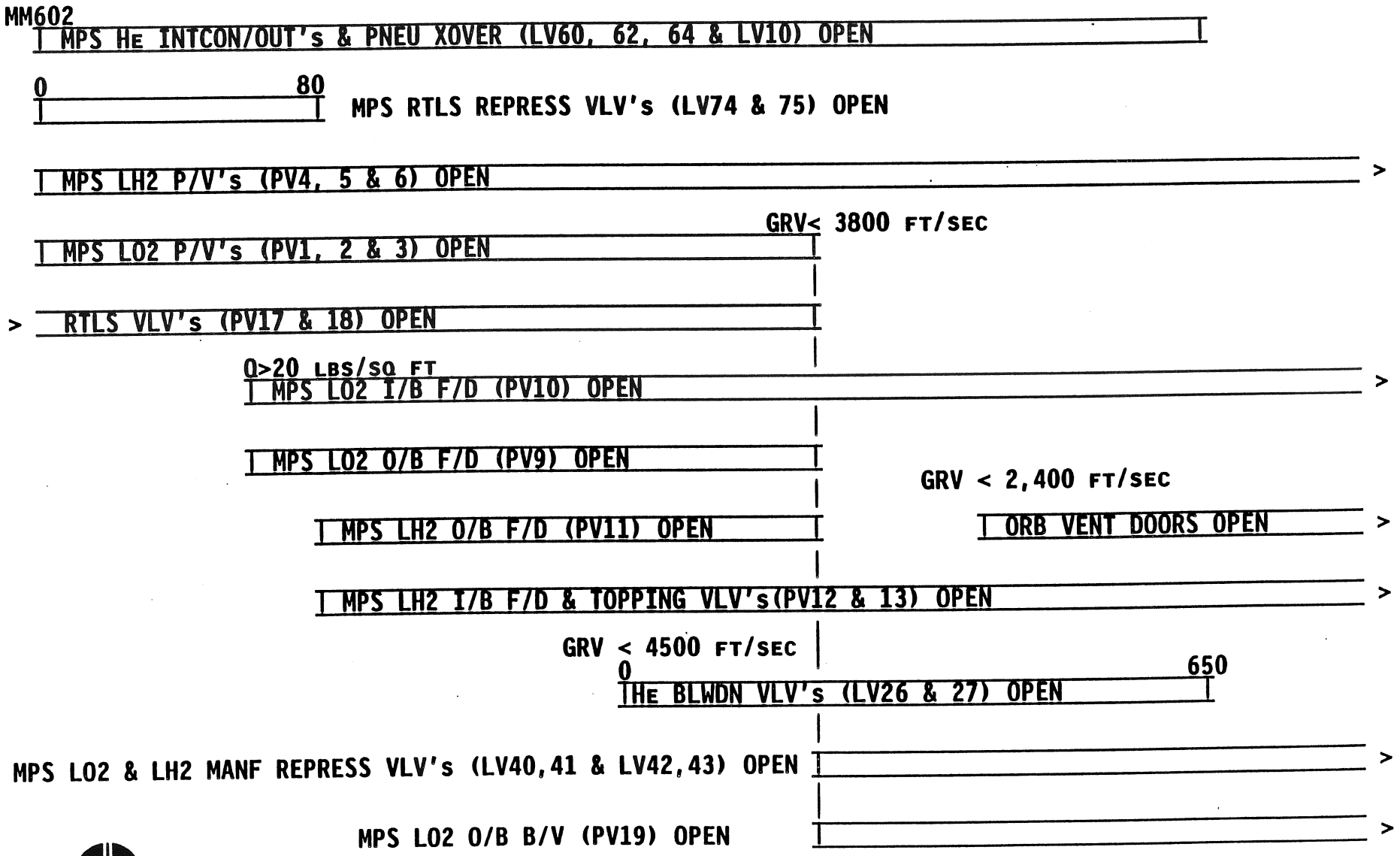
MPS MECO EVENTS

(RTLS FAST-SEP MISSION)



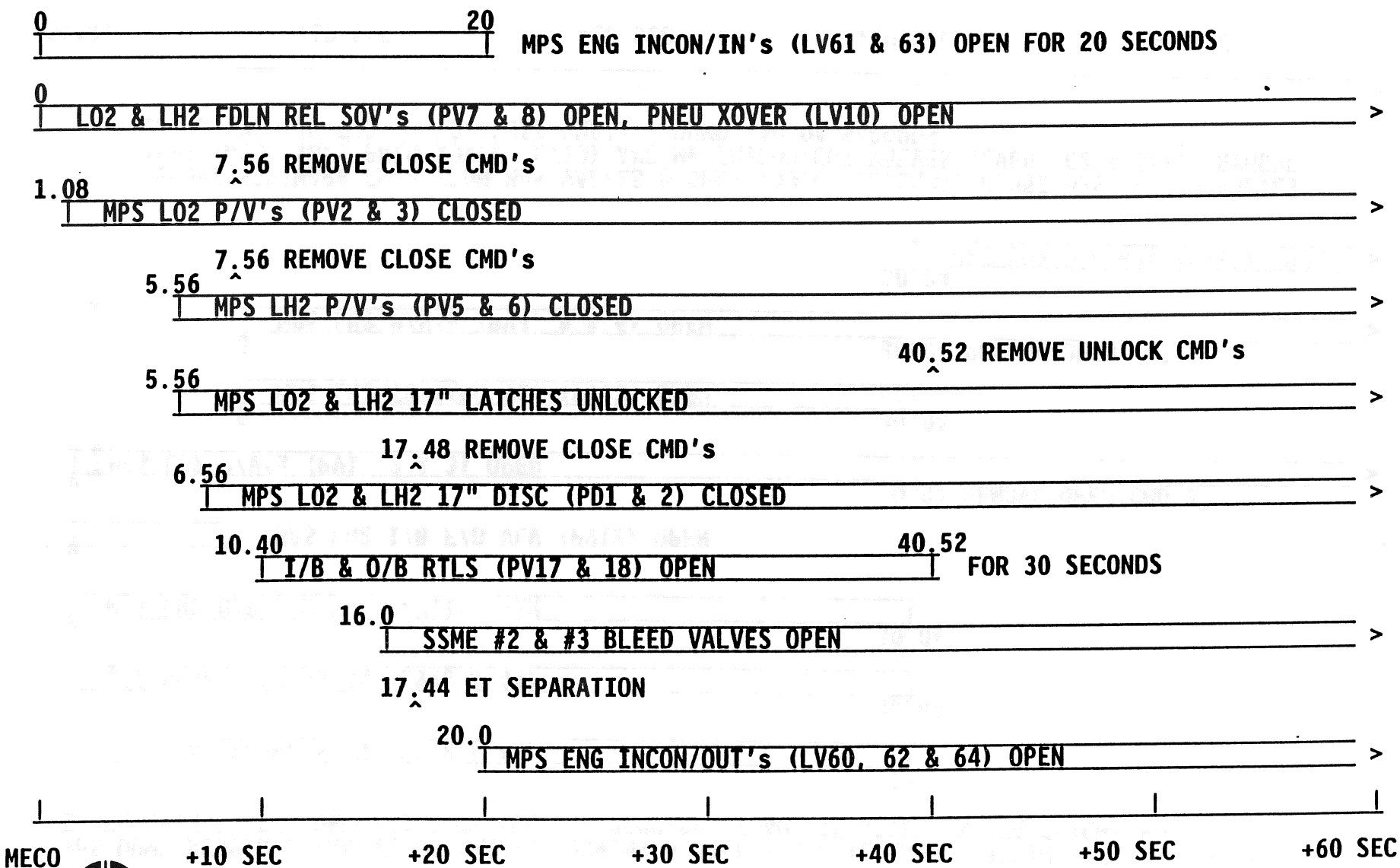
MPS DUMP SEQUENCE

(RTLS MISSION)



MPS MECO EVENTS

(TAL ABORT MISSION [ENG 1 OUT])



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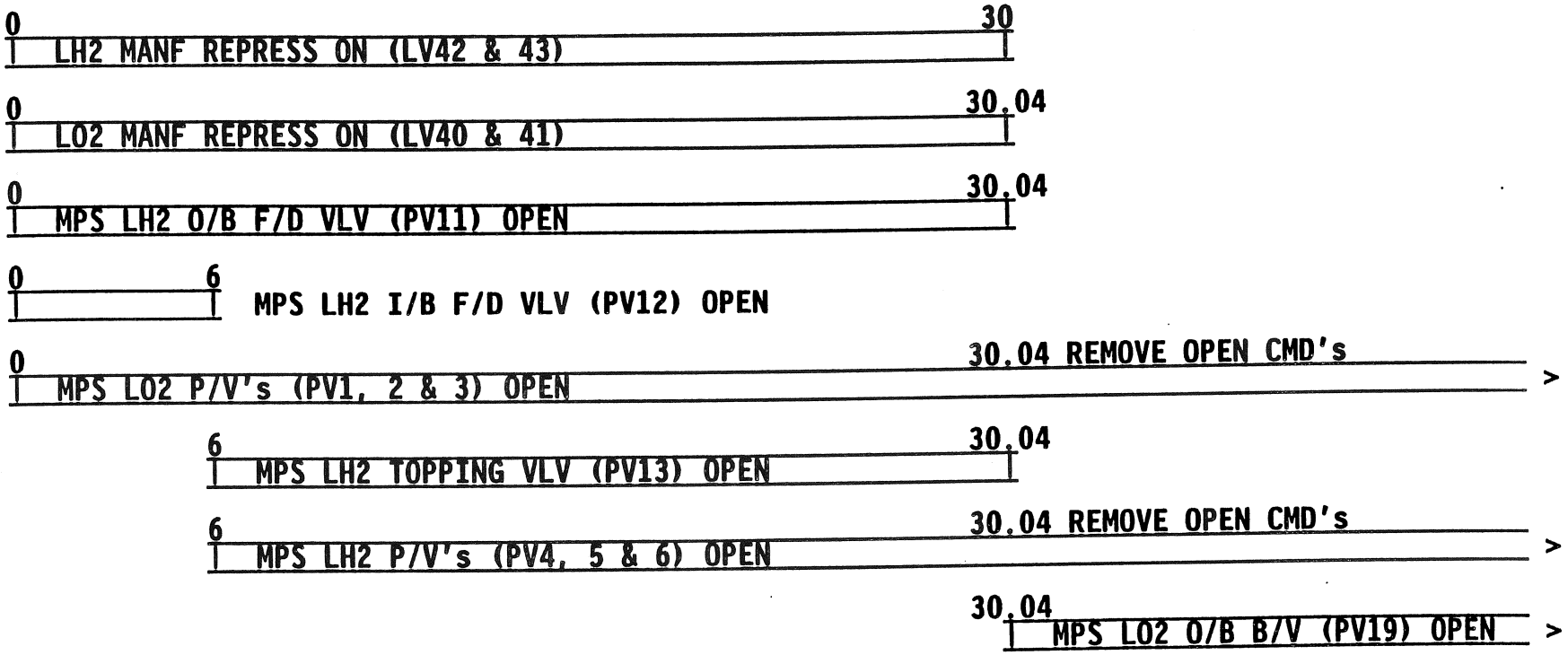
MPS DUMP SEQUENCE

(TAL ABORT MISSION)

MPS DUMP REQUIRES MANUAL ACTIVATION DURING A TRANSATLANTIC ABORT LANDING (TAL) MISSION. SEQUENCE HAS BEEN DELETED FROM ALL TAL PROCEDURES BUT IS STILL IN THE FLIGHT SOFTWARE.

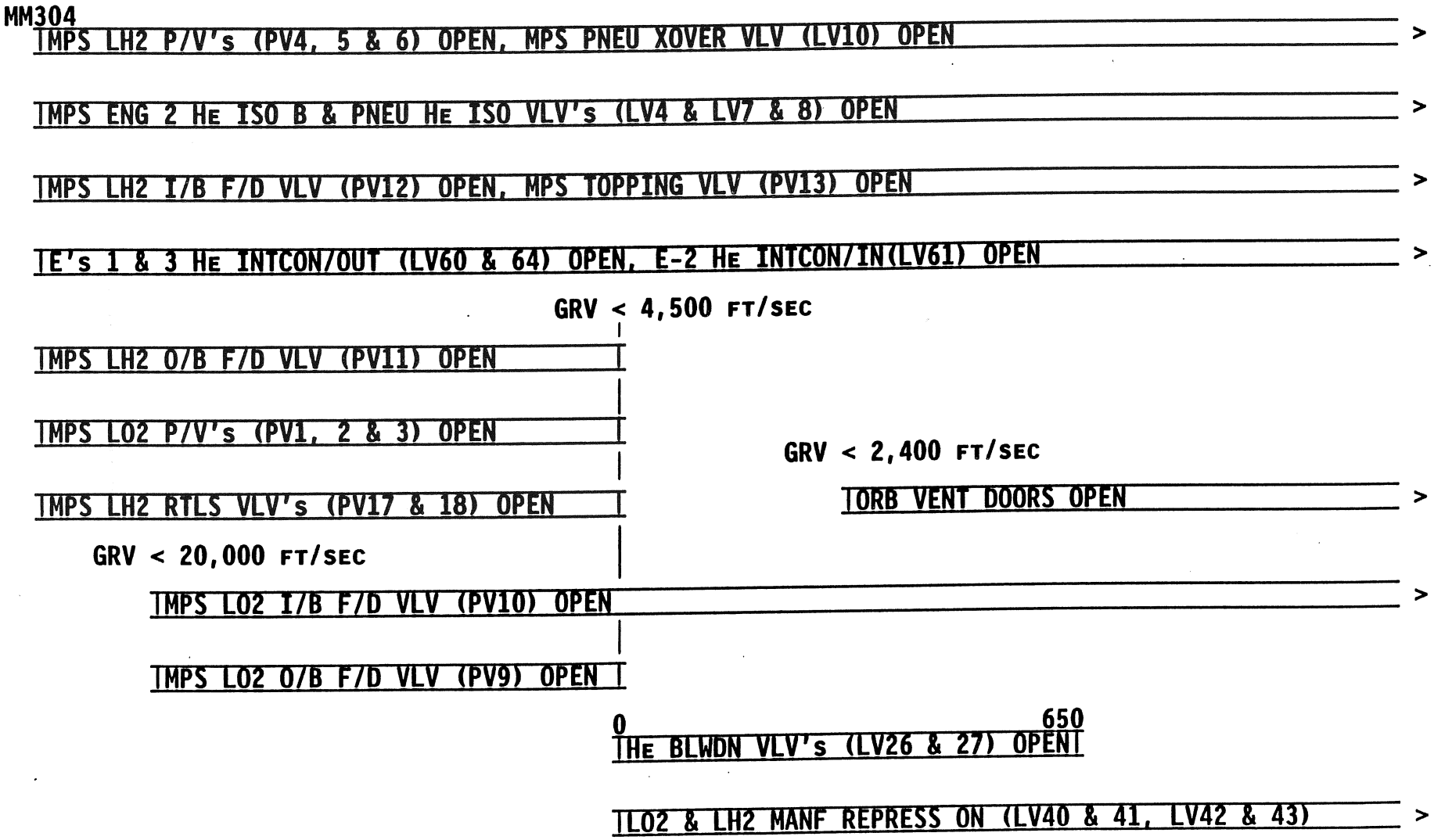


REMOVE SOFTWARE CMDS FROM MPS VALVES @ DUMP +30.04 SECONDS, CLOSE MPS HE ISO VALVES (LV1 THRU LV8), PNEU XOVER (LV10) AND HE INTCON/OUT VALVES (LV60, 62 & 64). REMOVE LO2 & LH2 O/B F/D VALVE CLOSE CMD's @ DUMP +40.04 SECONDS.

START +10 SEC +20 SEC +30 SEC +40 SEC

MPS REENTRY PURGE

(TAL ABORT MISSION)



COMPONENT: HEATSHIELD, ENGINE

(V070-410364-001)

VENDOR : ROCKWELL INTERNATIONAL
P/N RI : V070-410364
P/N VENDOR:
QUANTITY : 1
: ONE PER ENGINE
:
:

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

HEAT SHIELD--MATCHED SET

FUNCTION:

THE HEAT SHIELD SET PROVIDES CLOSEOUT OF THE SSME PENETRATION OPENING THROUGH THE BASE HEAT SHIELD OF THE AFT FUSELAGE WHICH PREVENTS EXCESSIVE LEAKAGE OUT OF AND INTO THE AFT FUSELAGE. DURING ASCENT AND REENTRY, THE SHIELD ALSO PROTECTS SSME POWER HEAD AND AFT FUSELAGE HARDWARE FROM HOT GAS IMPINGEMENT AND RADIANT HEAT.

DESIGN:

THE HEAT SHIELD SET CONSISTS OF TWO PANEL SEGMENTS OF INCO 625, TWO DOUBLERS OF INCO 718, AND TWO SHEAR PLATES OF RENE 41 NICKEL WHICH, WHEN BOLTED TOGETHER, FORM A SPHERICAL DISC ASSEMBLY. THE SHIELD MOUNTS TO AND MOVES WITH THE SSME.

DESIGN PARAMETERS:

HEAT SHIELD PRESSURES:

POSITIVE ΔP = 2.65 PSI (INTERNAL > EXTERNAL)
NEGATIVE ΔP = 1.35 PSI (EXTERNAL > INTERNAL)

COMPONENT: HEATSHIELD, ENGINE

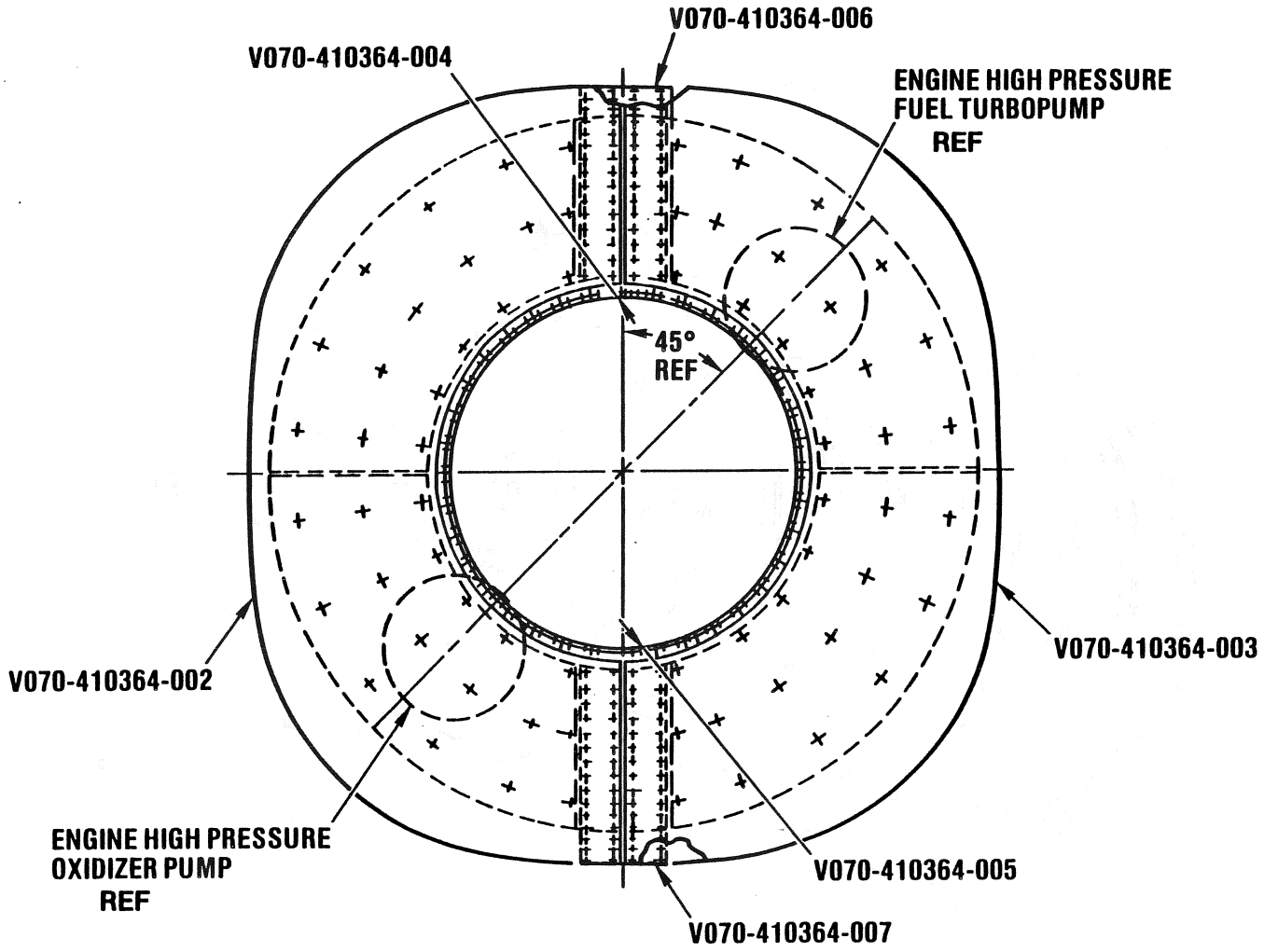
(V070-410364-001)

HEAT SHIELD TEMPERATURES: TEMPERATURE PROFILE FOR ENGINE NO. 1 (SEE PAGE 4) IS HIGHEST OF THE THREE ENGINES.

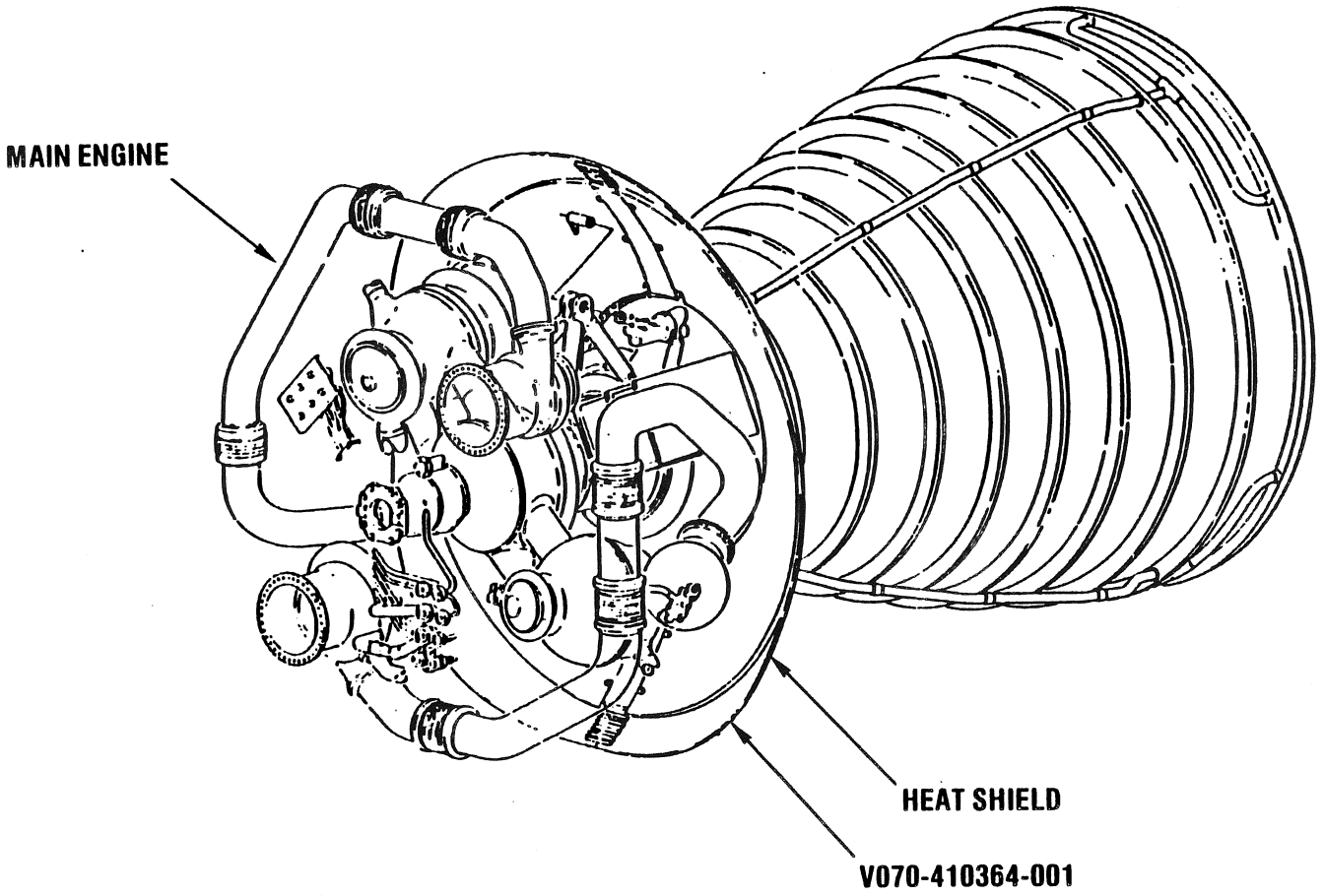
ENVELOPE DIMENSIONS: 102 DIAMETER (APPROX.) X 23 DEEP

NOMENCLATURE	PART NUMBER	MAX WEIGHT (LB)	MATERIAL	MAKE FROM
SHIELD-EMISSIVE COATED (MATCHED SET)	V070-410364-001	104	INCONEL 625	
SEGMENT HALF	V070-410364-002	102		ME364-0009-0013
SEGMENT HALF	V070-410364-003	102		ME364-0009-0014
DOUBLER--MATCHED	V070-410364-004	1.0	INCONEL 718	ME364-0009-0017
DOUBLER--MATCHED	V070-410364-005	1.0	INCONEL 718	ME364-0009-0018
SPLICE PLATE	V070-410364-006	1.0	RENE' 41--NICKEL ALLOY	ME364-0009-0015
SPLICE PLATE	V070-410364-007	1.0	RENE' 41--NICKEL ALLOY	ME364-0009-0016

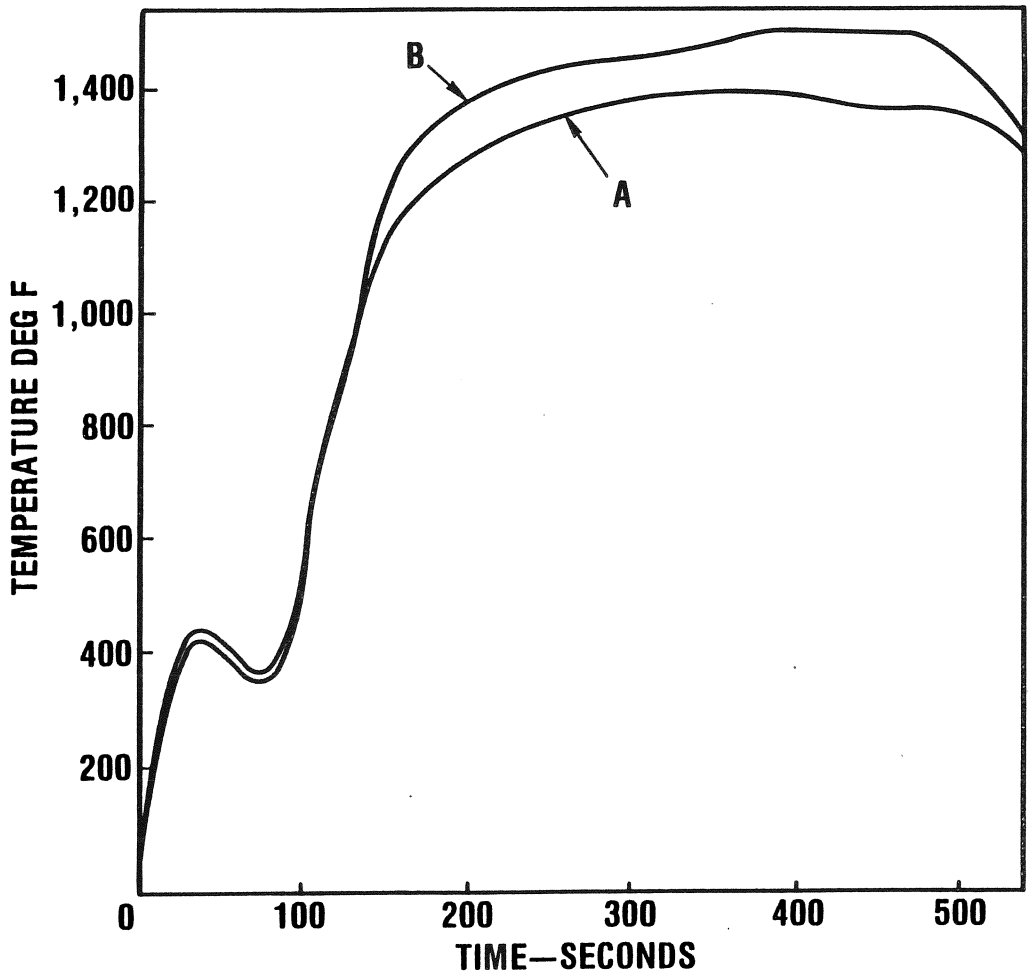
COMPONENT: HEATSHIELD, ENGINE
(V070-410364-001)

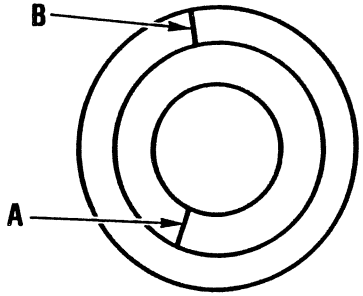


COMPONENT: HEATSHIELD, ENGINE
(V070-410364-001)



COMPONENT: HEATSHIELD, ENGINE
(V070-410364-001)





ENGINE NO. 1

COMPONENT: MANIFOLD GH_2 PREPRESSURIZATION/PRESSURIZATION SYSTEM

(V070-415422)

FMEA/CIL NO. 03-1-0522

VENDOR : ROCKWELL INTERNATIONAL
P/N RI : V070-415422
P/N VENDOR:
QUANTITY : 1 PER END ITEM

VEHICLE EFFECTIVITY:

102	103	104	105
X	X	X	X

ITEM:

MANIFOLD ASSEMBLY, GH_2 PRESSURIZATION. THE MANIFOLD ASSEMBLY CONSISTS OF TUBE SEGMENTS AND A MANIFOLD.

FUNCTION:

PROVIDES A FLOW PATH FOR GH_2 FROM THE THREE FLOW CONTROL VALVES TO THE TWO INCH GH_2 PRESSURIZATION LINE INTERFACE FOR ET ULLAGE PRESSURIZATION DURING ENGINE OPERATION. MANIFOLD ASSEMBLY INCLUDES A MANIFOLD, THREE ONE INCH DIAMETER LINES, AND CONNECTING UNIONS.

DESIGN:

THE GH_2 MANIFOLD IS DESIGNED TO PROVIDE THE MAXIMUM FLOW CAPACITY FROM 3 FULLY OPENED FLOW CONTROL VALVES. THE DESIGN CONSISTS OF A RIGID MANIFOLD MACHINED FROM 21-6-9 CRES BAR. THE MANIFOLD HAS 3 TUBE ATTACH INTERFACES (1 INCH DIAMETER BY 0.028 INCH WALL THICKNESS) FOR CONNECTING THE TUBE SEGMENTS (1 INCH DIAMETER BY 0.028 INCH WALL THICKNESS, 21-6-9 CRES FROM EACH FLOW CONTROL VALVE.

THE TUBE SEGMENTS ARE CONNECTED TO THE MANIFOLD ATTACH INTERFACE WITH A BRAZE UNION 21-6-9 CRES. FACTORS OF SAFETY ON THE FINAL ASSEMBLY ARE 1.5 PROOF AND 2.0 BURST. STRUCTURAL ANALYSIS OF THE MANIFOLD ASSEMBLY INDICATED POSITIVE MARGINS OF SAFETY FOR ALL CONDITIONS OF ENGINE OPERATION.

COMPONENT: MANIFOLD GH_2 PREPRESSURIZATION/PRESSURIZATION SYSTEM
(V070-415422)

DESIGN PARAMETERS:

OPERATING PRESSURE:	650 PSIG MAXIMUM
PROOF PRESSURE:	975 PSIG
BURST PRESSURE:	1300 PSIG
OPER TEMP:	-160°F TP +200°F

FEATURES:

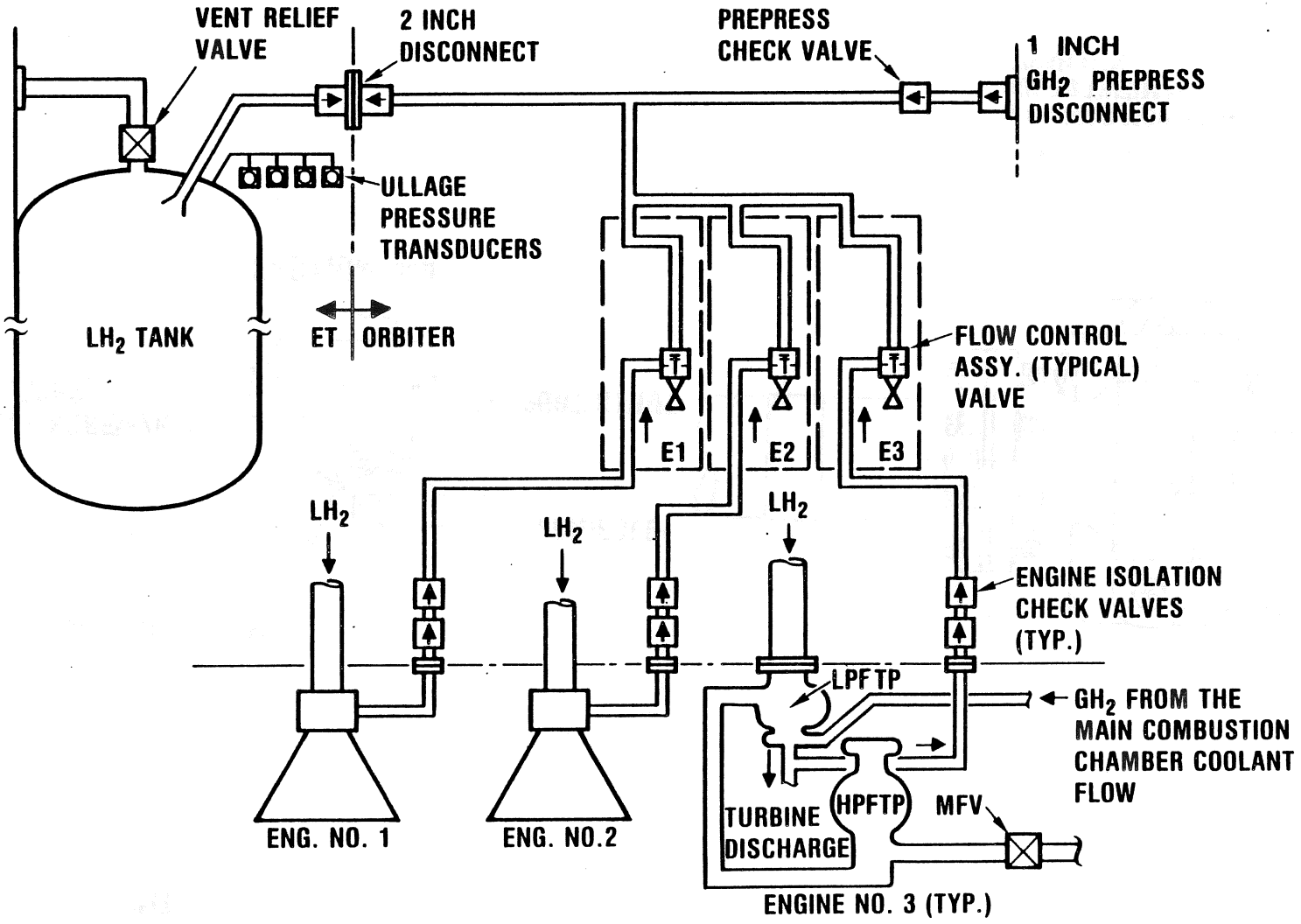
- SLIDING MOUNT ALLOWS FOR THERMAL EXPANSION
- ATTACHED TO SECONDARY STRUCTURE USING SCREWS AND NUT PLATES
- THERMAL EXPANSION ON THE LH_2 MANIFOLD IS MINIMAL SINCE TEMPERATURE RARELY EXCEEDS AMBIENT

MATERIALS	
MANIFOLD:	21-6-9 BAR
TUBING:	21-6-9 CRES

COMPONENT: MANIFOLD GH_2 PREPRESSURIZATION/PRESSURIZATION SYSTEM

(V070-415422)

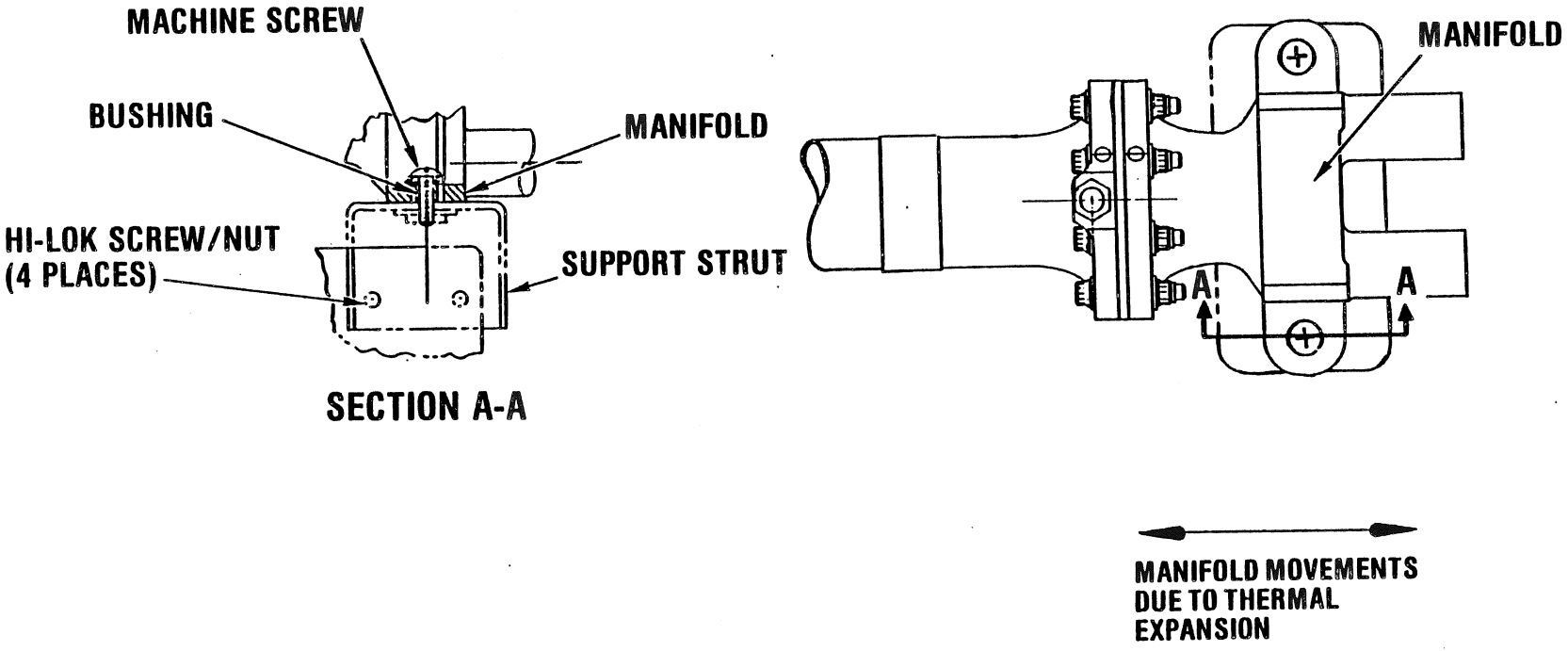
GH_2 PRESSURIZATION SYSTEM SCHEMATIC



COMPONENT: MANIFOLD GH_2 PREPRESSURIZATION/PRESSURIZATION SYSTEM

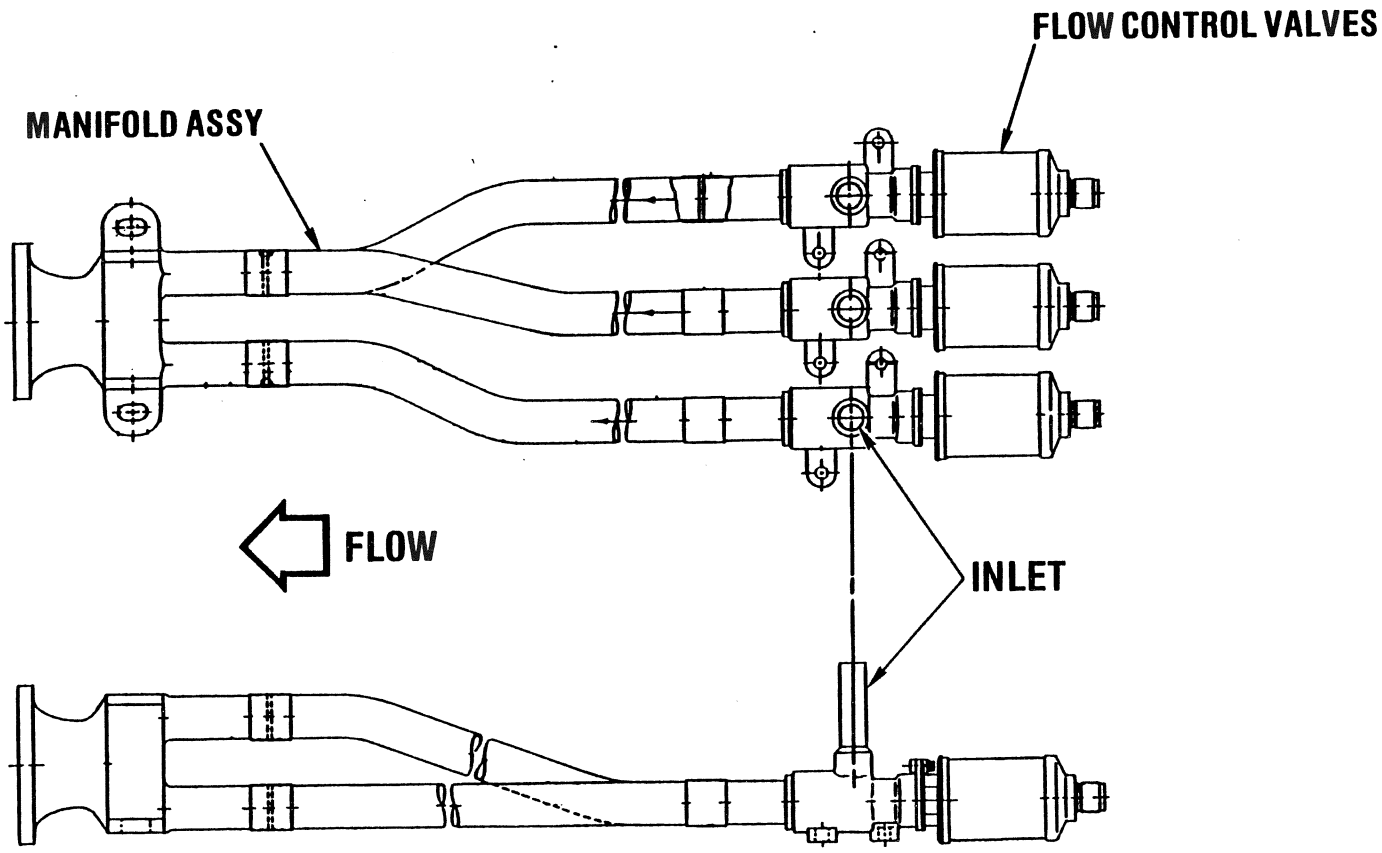
(V070-415422)

SLIDING MOUNT



COMPONENT: MANIFOLD GH_2 PREPRESSURIZATION/PRESSURIZATION SYSTEM

(V070-415422)



COMPONENT: LINE GH_2 PREPRESSURIZATION/PRESSURIZATION SYSTEM

(V070-415425)

VENDOR : ROCKWELL INTERNATIONAL
P/N RI : V070-415425
P/N VENDOR:
QUANTITY : 1 PER END ITEM

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

LINE ASSEMBLY, 2 INCH DIAMETER

FUNCTION:

DIRECT GH_2/HELIUM FLOW FROM THE FLOW CONTROL MANIFOLD ASSEMBLY TO THE ET

DESIGN PARAMETERS:

OPERATING PRESSURE: 745 PSIG MAXIMUM

PROOF PRESSURE: 975 PSIG

BURST PRESSURE: 1300 PSIG

MATERIALS
TUBES: 21-6-9 CRES
TEE: 21-6-9 CRES
FLANGES: 21-6-9 CRES
UNIONS: 21-6-9 CRES
GIMBAL: INCONEL 718

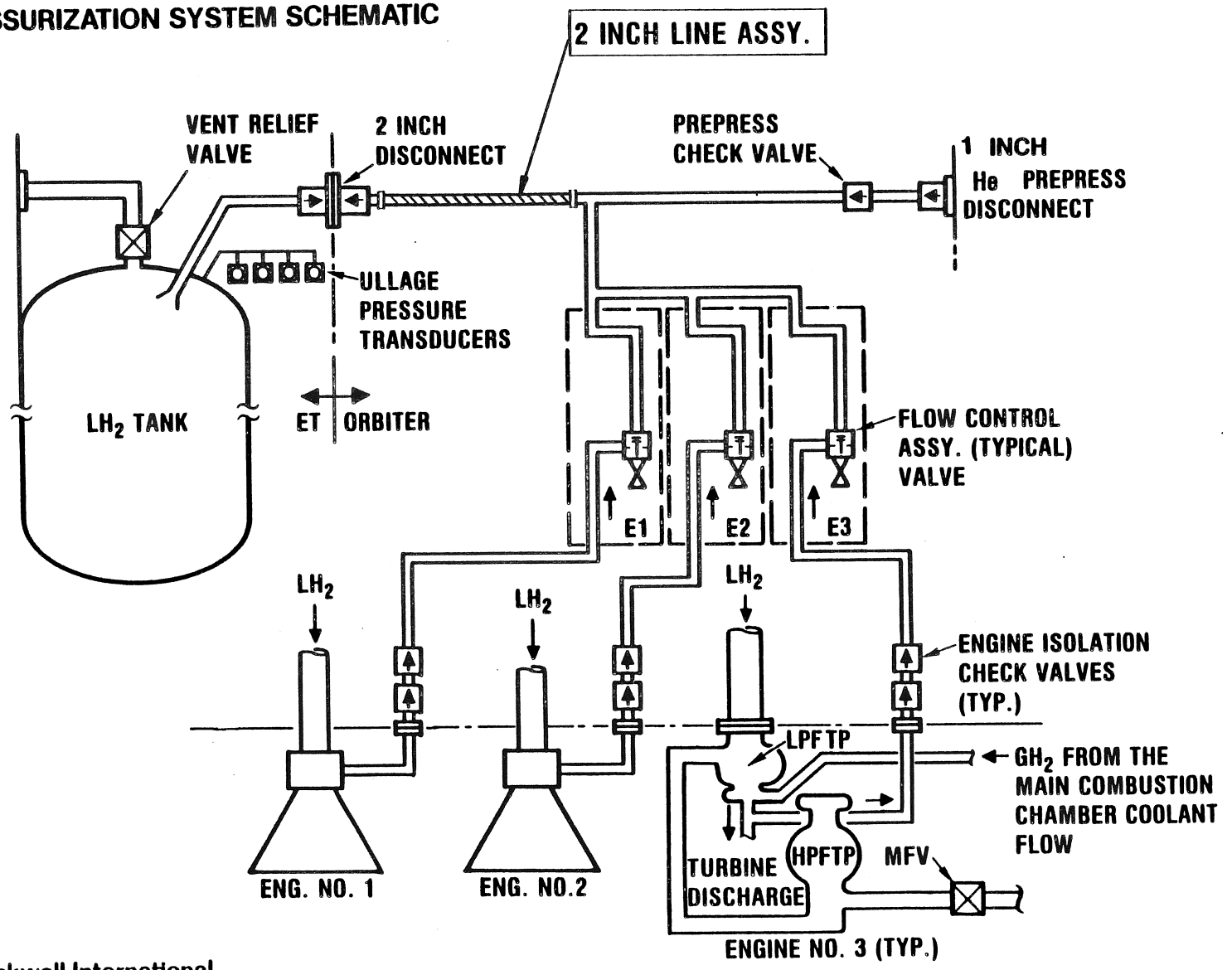
FEATURES:

- INCORPORATES THREE GIMBAL JOINTS TO ACCOMMODATE STRUCTURAL DEFLECTION, THERMAL, VIBRATION AND PRESSURE LOADS INDUCED TO LINE ASSEMBLY, AND 17 INCH UMBILICAL RETRACTION PRIOR TO ET SEPARATION
- INCORPORATES INLET TEE FOR HELIUM PREPRESS SUPPLY
- INCORPORATES PORTS FOR INSTRUMENTATION, MANIFOLD REPRESS SUPPLY INLET, AND LEAK DETECTION

COMPONENT: LINE GH_2 PREPRESSURIZATION/PRESSURIZATION SYSTEM

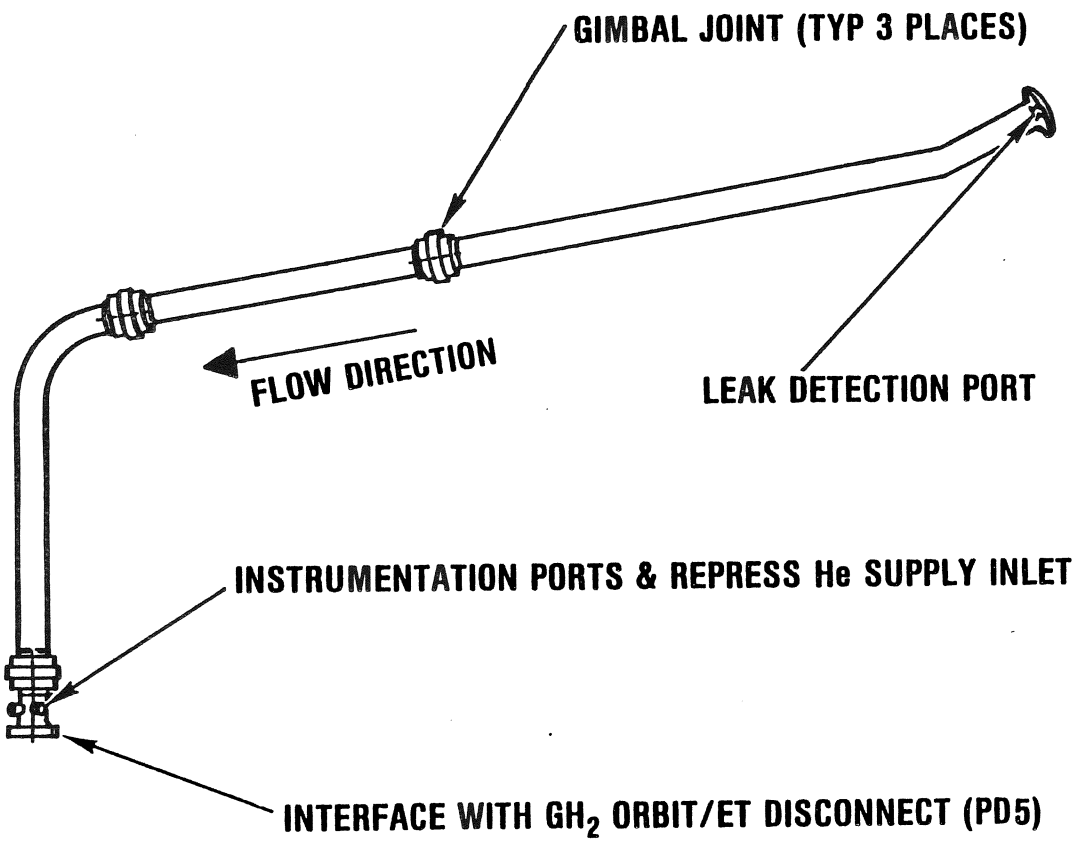
(V070-415425)

GH_2 PRESSURIZATION SYSTEM SCHEMATIC



COMPONENT: LINE GH_2 PREPRESSURIZATION/PRESSURIZATION SYSTEM

(V070-415425)



COMPONENT: FLAME ARRESTOR, LH_2 FEEDLINE RELIEF

(V070-415430)

FMEA/CIL NO. 03-1-0435

VENDOR : ROCKWELL INTERNATIONAL
P/N RI : V070-415430-004
P/N VENDOR: N/A
QUANTITY : 1 PER END ITEM

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

FLAME ARRESTER, LH_2 (FL1) 1.8 INCH DIAMETER.

FUNCTION:

THE FLAME ARRESTER IS LOCATED AT THE LH_2 VENT LINE OUTLET BETWEEN THE BASE OF THE VERTICAL STABILIZER AND THE LEFT OMS POD. THE DEVICE PREVENTS EXTERNAL FLAME (FROM RELIEF SYSTEM) FROM PROPAGATING BACK INTO THE LH_2 VENT SYSTEM.

FOR NOMINAL, ATO, AOA, AND TAL MISSIONS, GH_2 VENTING OCCURS AFTER MECO WHEN THE MANIFOLD RELIEF SHUTOFF VALVE (PV8) OPENS. AFTER COMPLETION OF PROPELLANT DUMP AND VACUUM INERTING NO ADDITIONAL VENTING IS EXPECTED FOR NOMINAL, AOA, AND ATO MISSIONS. FOR RTLS AND TAL MISSIONS GH_2 VENTING WILL OCCUR AFTER COMPLETION OF PROPELLANT DUMP AND CONTINUES UNTIL BOILOFF OF LH_2 RESIDUALS STOP (POSTLANDING).

DESIGN:

VENTING IN THE ATMOSPHERE FROM THE LH_2 FEEDLINE RELIEF MAY RESULT IN COMBUSTION. THE FLAME ARRESTER PREVENTS THE RESULTING FLAME FROM PROPAGATING BACK INTO THE ORBITER LH_2 PLUMBING. THE ARRESTER CONSISTS OF FOUR PARTS: A HOUSING THAT CONTAINS TWO DISCS THAT ARE SEPARATED BY A SPACER. EACH 304 CRES DISC HAS A 1.750 INCHES O.D., IS 0.500 INCH THICK, AND CONTAINS APPROXIMATELY 6,000 0.017-INCH DIAMETER HOLES THROUGH THE THICKNESS. IF FLAME ATTEMPTS TO PASS THROUGH THE DISC, ITS TEMPERATURE IS REDUCED BELOW THE THRESHOLD OF FLAMMABILITY AND IS QUENCHED. THE SECOND DISC IS REDUNDANT.

COMPONENT: FLAME ARRESTOR, LH_2 FEEDLINE RELIEF

(V070-415430)

DESIGN PARAMETERS:

DESIGN ENVELOPE: 9 IN. X 4 IN. DIAMETER

ARRESTOR HOLE SIZE: .0002269 SQ IN. MAXIMUM (.017 DIAMETER)

ARRESTOR FLOW AREA: 60 PERCENT MINIMUM OF TOTAL FILTER AREA

ARRESTOR TEST CONDITIONS:

	GH_2	GN_2 EQUIVALENT
FLOW:	.22 LB/SEC	.28 LB/SEC
TEMPERATURE:	60°R	530°R
PRESSURE:	19 PSIA	19 PSIA
MAXIMUM PRESSURE DROP:	4 PSID	4 PSID
LEAK TEST PRESSURE:	150 PSIG	
PROOF PRESSURE:	300 PSIG	

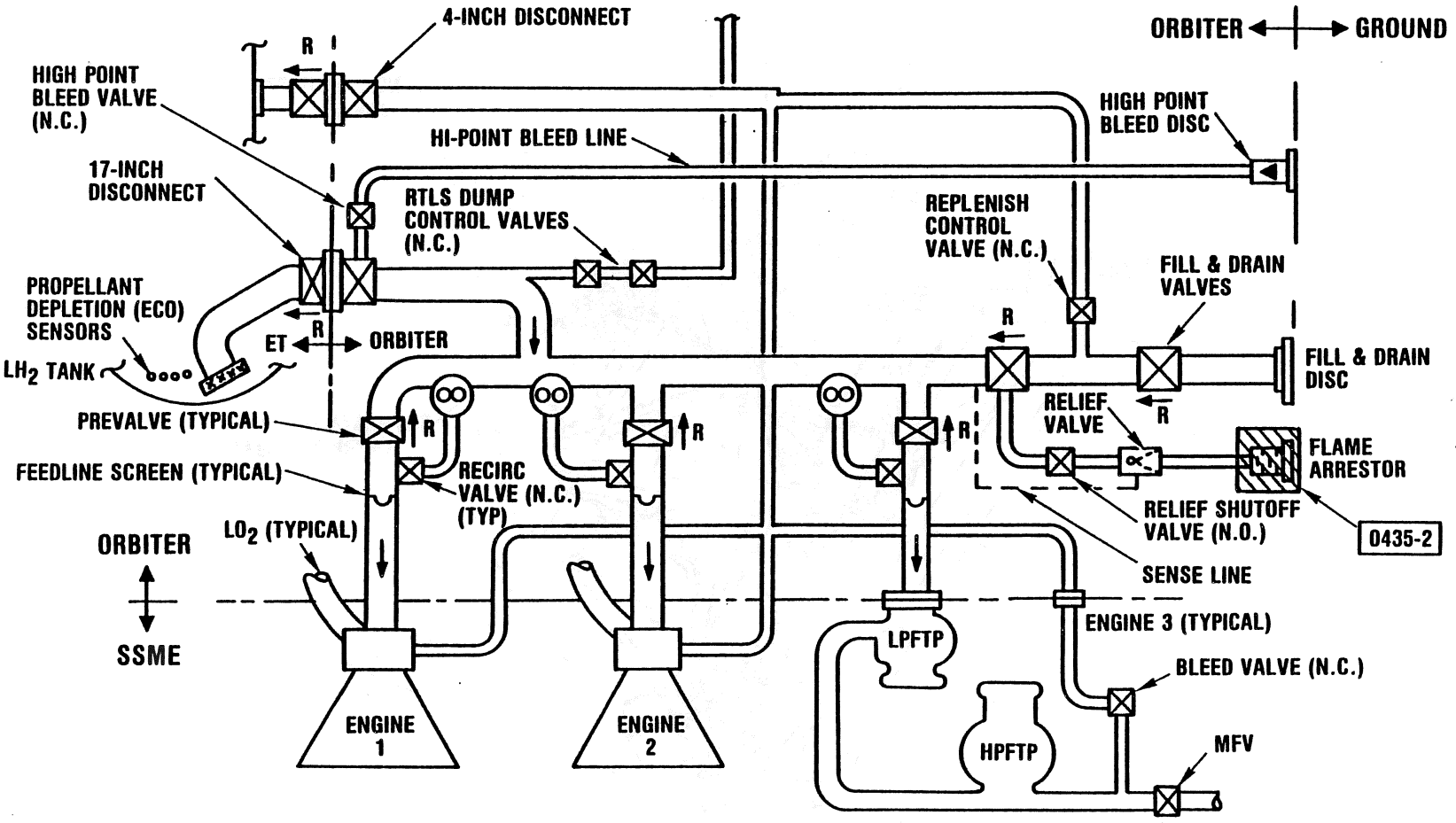
OPERATING PRESSURE: 55 PSIG

MATERIALS
TUBE: INCONEL 718 DISC: 304L CRES SPACER: INCONEL SHEET

COMPONENT: FLAME ARRESTOR, LH_2 FEEDLINE RELIEF

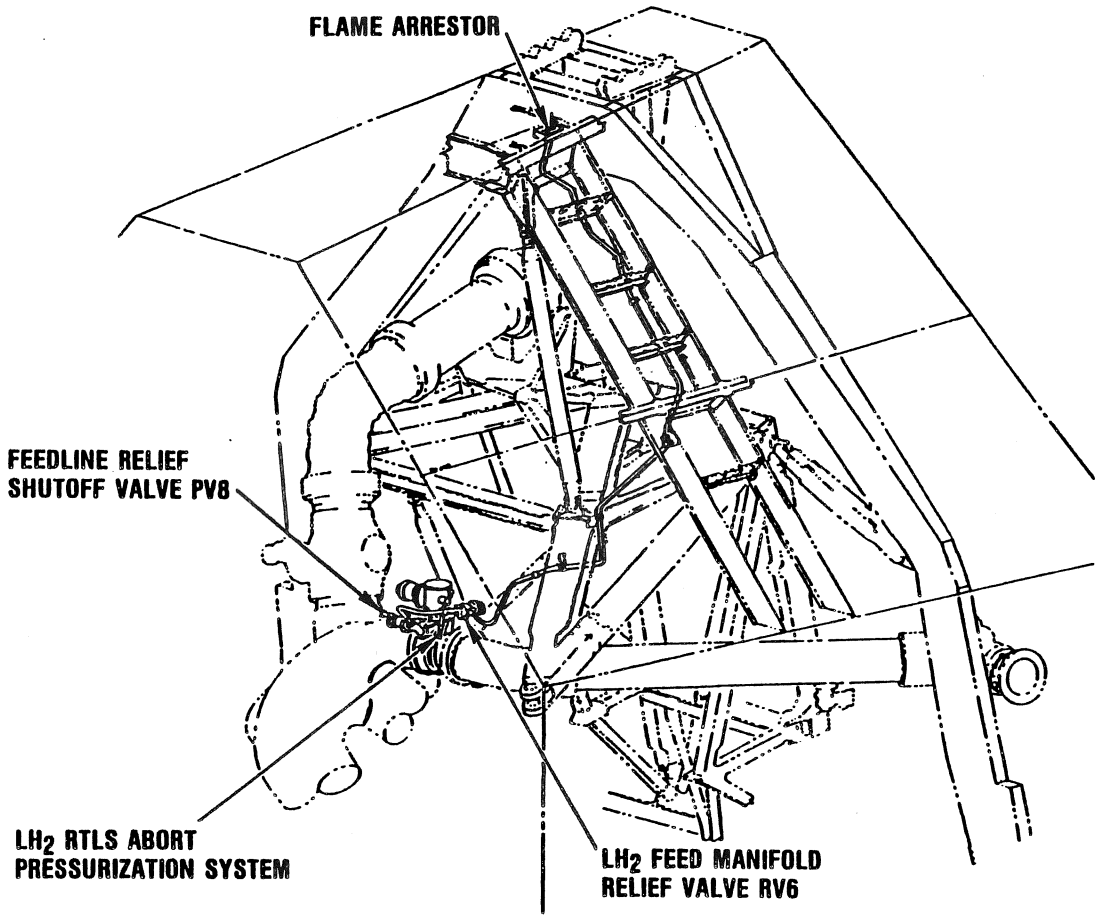
(V070-415430)

LH_2 FILL/FEED SYSTEM



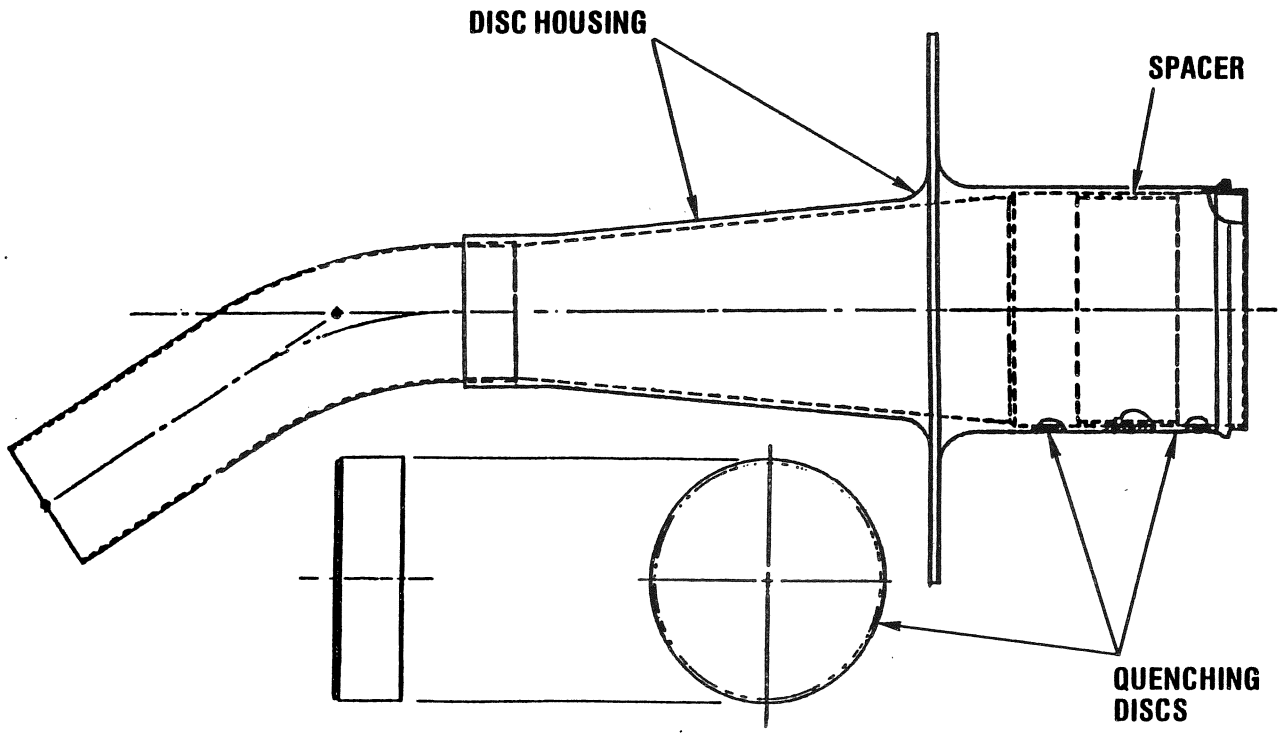
COMPONENT: FLAME ARRESTOR, LH_2 FEEDLINE RELIEF

(V070-415430)



COMPONENT: FLAME ARRESTOR, LH_2 FEEDLINE RELIEF

(V070-415430)



COMPONENT: LINE GO_2 PREPRESSURIZATION/PRESSURIZATION SYSTEM

(V070-415462)

VENDOR : ROCKWELL INTERNATIONAL
P/N RI : V070-415462
P/N VENDOR :
QUANTITY : 1 PER END ITEM

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

LINE ASSEMBLY, 2 INCH DIAMETER

FUNCTION:

DIRECT GO_2 FLOW FROM FLOW CONTROL MANIFOLD ASSEMBLY AND FROM HELIUM PREPRESS SUPPLY TO THE ET

DESIGN PARAMETERS:

OPERATING PRESSURE: 650 PSIG MAXIMUM

PROOF PRESSURE: 975 PSIG

BURST PRESSURE: 1300 PSIG

MATERIALS	
TUBES:	21-6-9 CRES
FLANGES:	21-6-9-CRES
UNIONS:	21-6-9-CRES
GIMBAL:	INCONEL 718

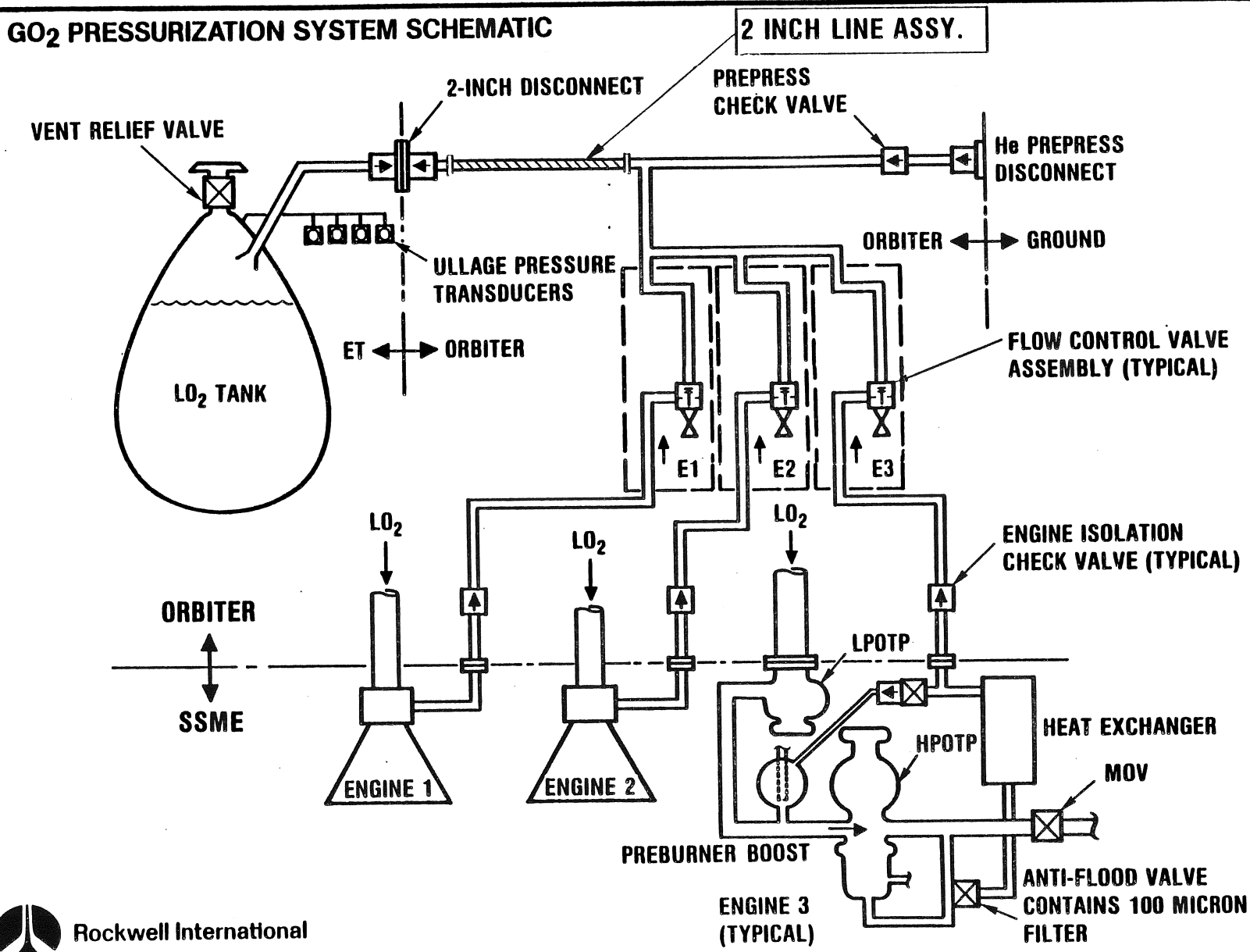
FEATURES:

- INCORPORATES THREE GIMBAL JOINTS TO ACCOMMODATE STRUCTURAL DEFLECTION, THERMAL VIBRATION, AND PRESSURE LOADS INDUCED TO LINE ASSEMBLY, AND 17 INCH UMBILICAL RETRACTION PRIOR TO ET SEPARATION
- INCORPORATES PORTS FOR INSTRUMENTATION AND MANIFOLD REPRESS SUPPLY INLET
- INCORPORATES LEAK DETECTION PORT

COMPONENT: LINE GO_2 PREPRESSURIZATION/PRESSURIZATION SYSTEM

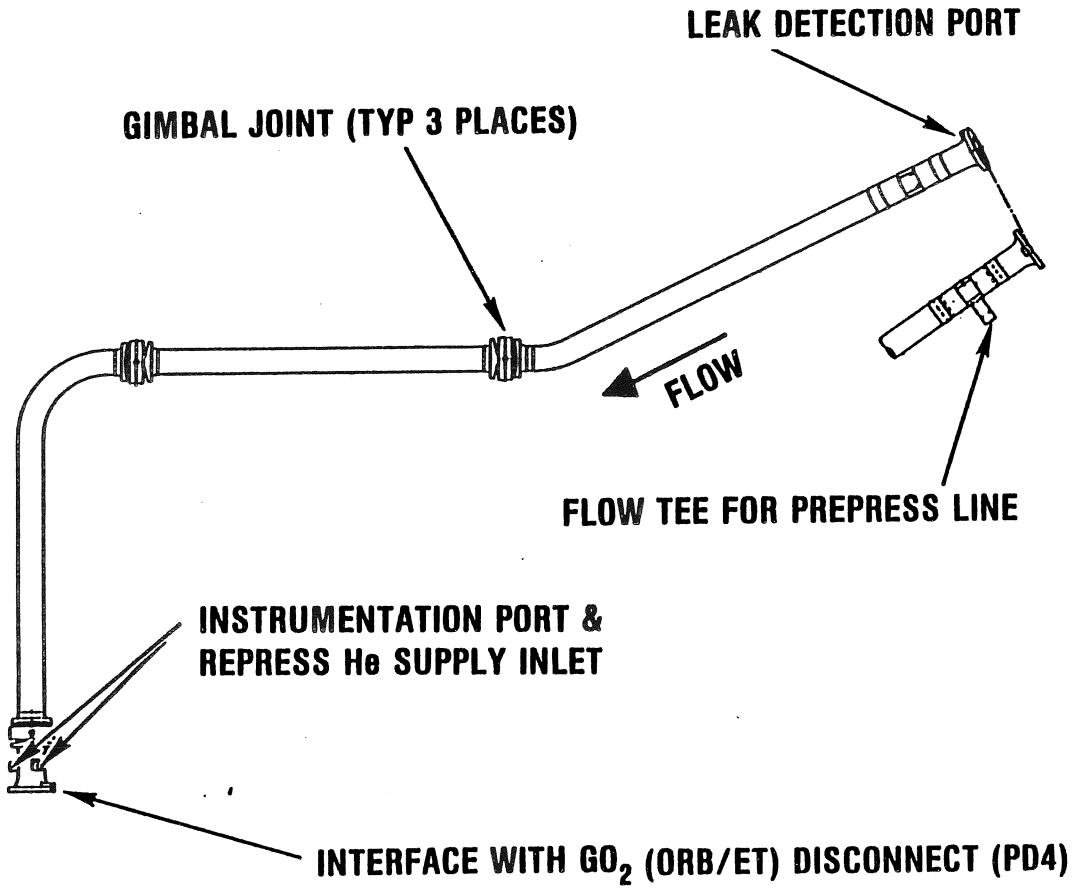
(V070-415462)

GO_2 PRESSURIZATION SYSTEM SCHEMATIC



COMPONENT: LINE GO_2 PREPRESSURIZATION/PRESSURIZATION SYSTEM

(V070-415462)



COMPONENT: GO_2 PRESSURIZATION MANIFOLD/SLIDING MOUNT

(V070-415486)

FMEA/CIL NO. 03-1-0773

VENDOR : ROCKWELL INTERNATIONAL
P/N RI : V070-415486 (GO_2)
QUANTITY : ONE PER END ITEM

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

SLIDING MOUNT, GO_2 PRESSURIZATION MANIFOLD ASSEMBLY

FUNCTION:

SLIDING MOUNT ALLOWS THE MANIFOLD ASSEMBLY TO EXPAND IN THE AXIAL DIRECTION DUE TO THERMAL EXPANSION.

DESIGN:

THE BASE OF THE MANIFOLD HAS SLOTTED MOUNTING EARS (INCONEL 718) CUT IN THE AXIAL DIRECTION. THE SLOTS ARE DESIGNED TO PROVIDE THERMAL EXPANSION OF THE MANIFOLD ASSEMBLY DURING ENGINE OPERATION WHEN THE MANIFOLD EXPERIENCES EXTREME TEMPERATURE CHANGES. THE MOUNTING EARS ARE USED TO ATTACH THE MANIFOLD ASSEMBLY TO A SECONDARY STRUCTURE USING SCREWS AND NUT PLATES.

DESIGN PARAMETERS:

V070-415486

OPERATING PRESSURE: 650 PSIG MAX

PROOF PRESSURE: 975 PSIG

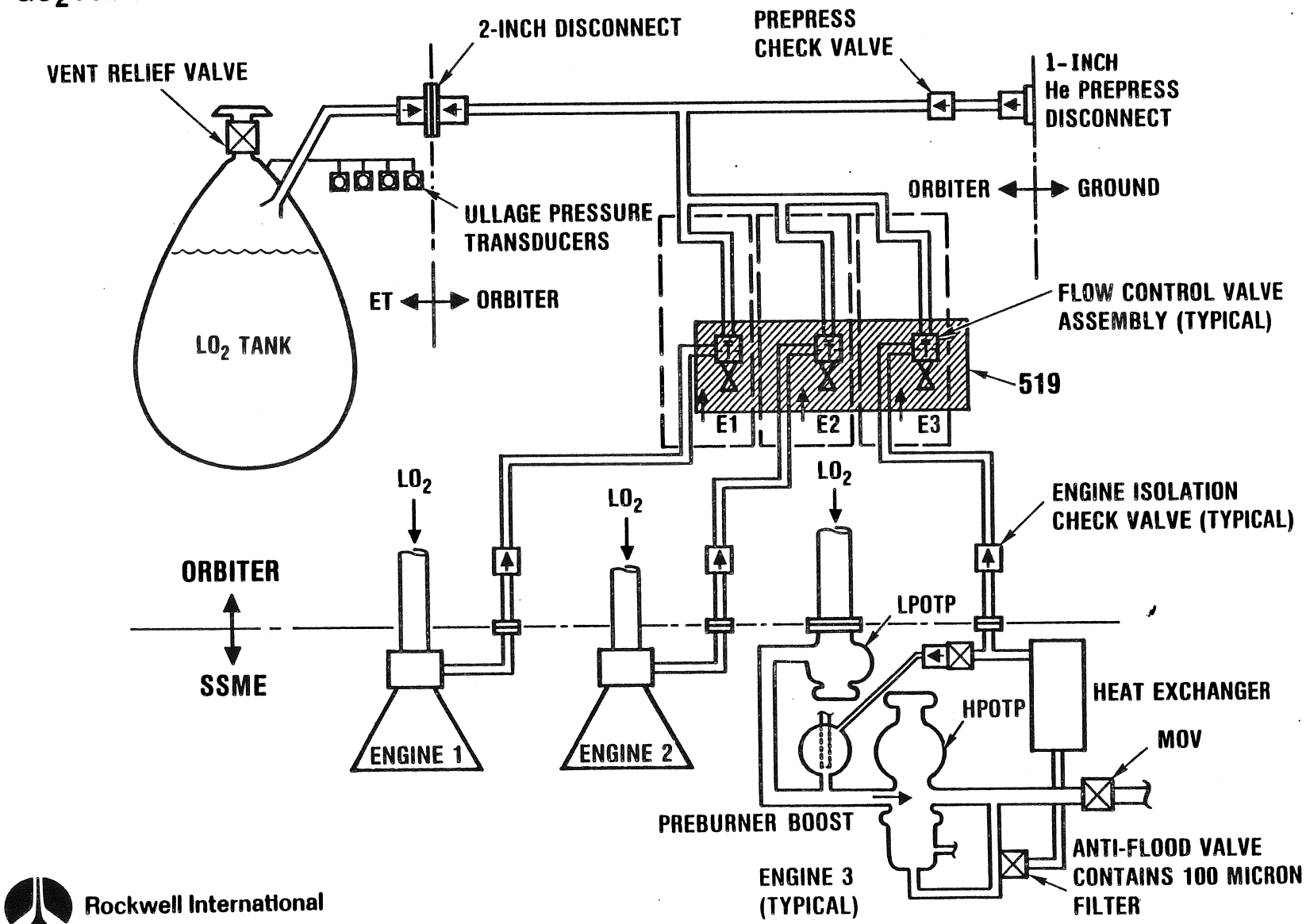
BURST PRESSURE: 1300 PSIG

MATERIALS
MANIFOLD: INCONEL 718

COMPONENT: GO_2 PRESSURIZATION MANIFOLD/SLIDING MOUNT

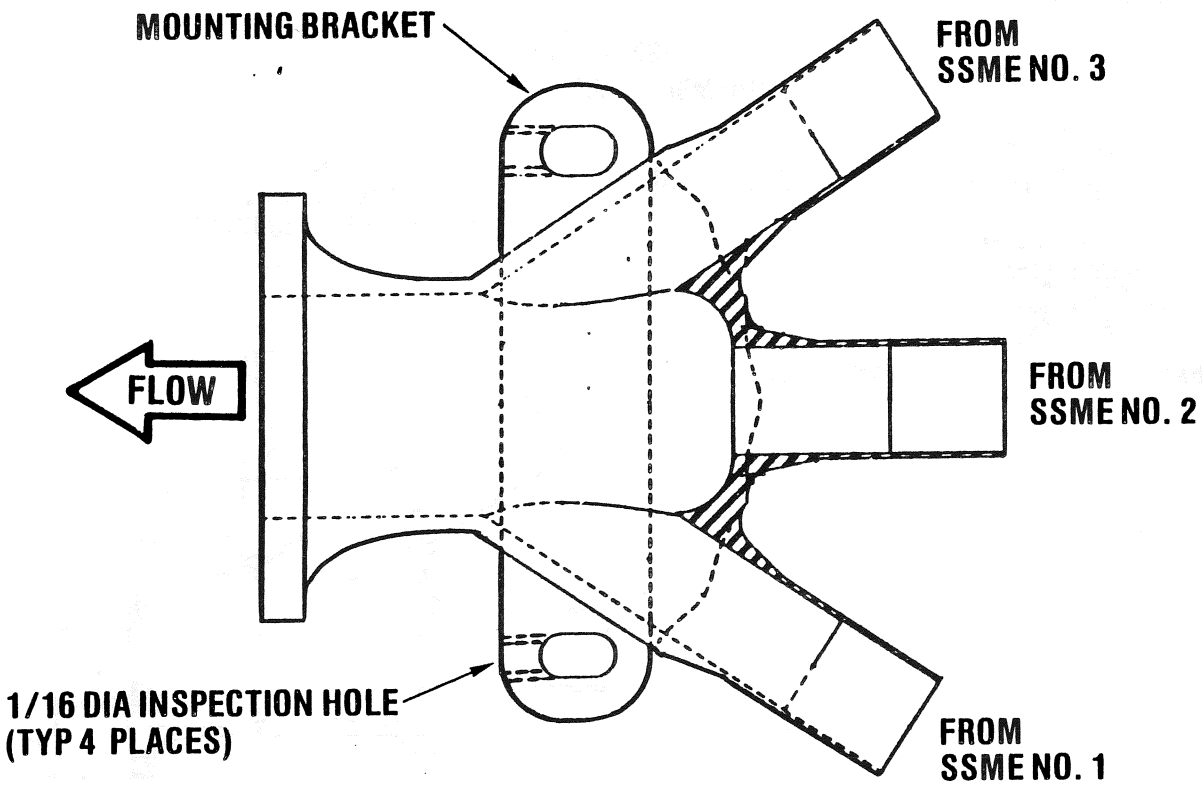
(V070-415486)

GO_2 PRESSURIZATION SYSTEM



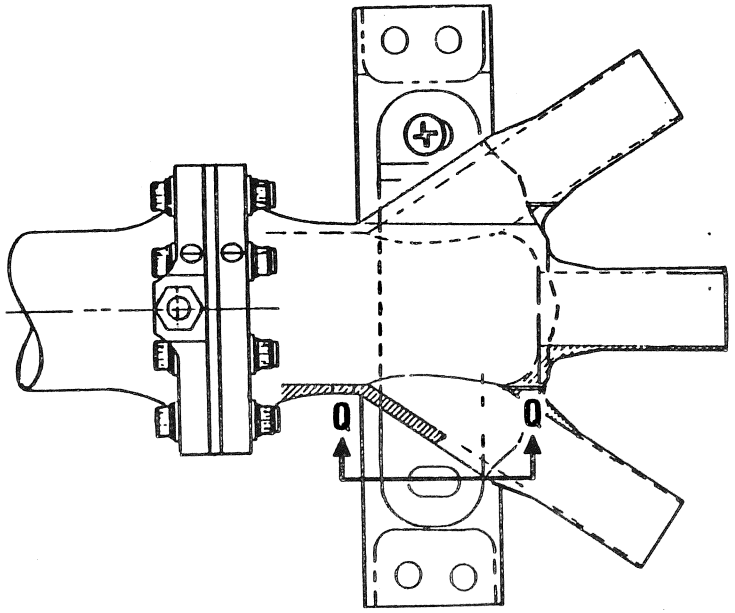
COMPONENT: GO_2 PRESSURIZATION MANIFOLD/SLIDING MOUNT

(V070-415486)

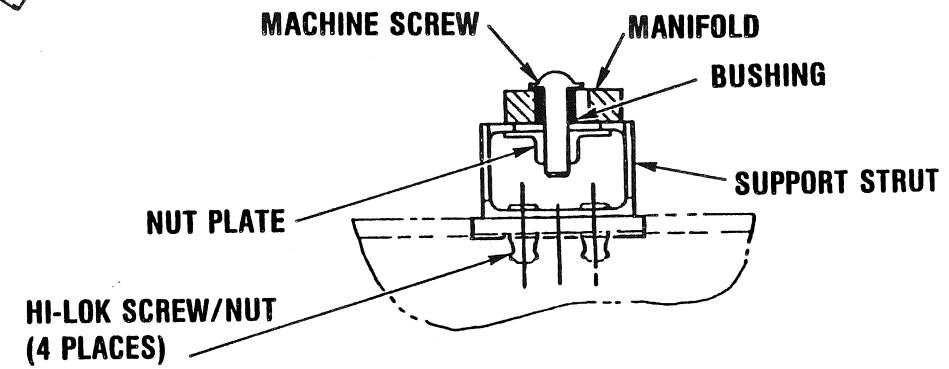


COMPONENT: GO_2 PRESSURIZATION MANIFOLD/SLIDING MOUNT

(V070-415486)



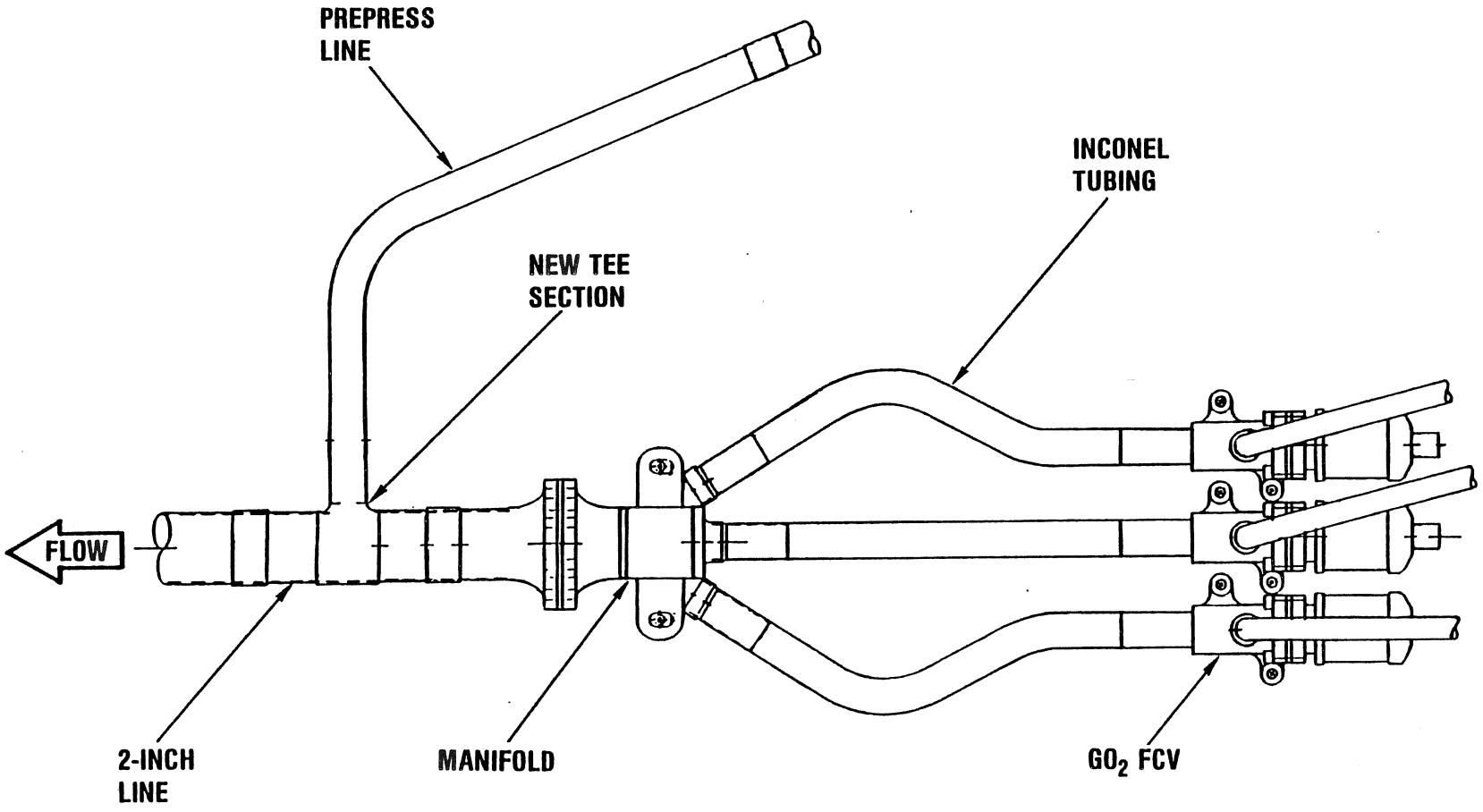
MANIFOLD MOVEMENTS DUE TO THERMAL EXPANSION



SECTION Q-Q

COMPONENT: GO_2 PRESSURIZATION MANIFOLD/SLIDING MOUNT

(V070-415486)



COMPONENT: MANIFOLD ASSEMBLY, GO_2 PRESSURIZATION SYSTEM

(V070-415490)

FMEA/CIL NO: 03-1-0522

ASSEMBLY : ROCKWELL INTERNATIONAL
P/N RI : V070-415490
P/N VENDOR:
QUANTITY : 1 PER END ITEM
:

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

MANIFOLD ASSEMBLY, GO_2 PRESSURIZATION. THE MANIFOLD ASSEMBLY CONSISTS OF TUBE SEGMENTS AND A MANIFOLD.

FUNCTION:

PROVIDES A FLOW PATH FOR GO_2 FROM THE THREE FLOW CONTROL VALVES TO THE TWO INCH GO_2 PRESSURIZATION LINE INTERFACE FOR ET ULLAGE PRESSURIZATION DURING ENGINE OPERATIONS. MANIFOLD ASSEMBLY INCLUDES A MANIFOLD, THREE ONE INCH DIAMETER LINES, AND CONNECTING UNIONS.

DESIGN:

THE GO_2 MANIFOLD IS DESIGNED TO PROVIDE THE MAXIMUM FLOW CAPACITY FROM 3 FULLY OPENED FLOW CONTROL VALVES. THE DESIGN CONSISTS OF A RIGID MANIFOLD MACHINED FROM FORGED INCONEL 718. THE MANIFOLD HAS 3 TUBE ATTACH INTERFACES (1 INCH DIAMETER BY 0.036 INCH WALL THICKNESS) FOR CONNECTING THE TUBE SEGMENTS (1 INCH DIAMETER BY 0.028 INCH WALL THICKNESS, INCONEL 718) FROM EACH FLOW CONTROL VALVE.

THE TUBE SEGMENTS ARE CONNECTED TO THE MANIFOLD ATTACH INTERFACE WITH A WELDED UNION (INCONEL 718) FACTORS OF SAFETY ON THE FINAL ASSEMBLY ARE 1.5 PROOF AND 2.0 BURST. STRUCTURAL ANALYSIS OF THE MANIFOLD ASSEMBLY INDICATED POSITIVE MARGINS OF SAFETY FOR ALL CONDITIONS OF ENGINE OPERATION.

COMPONENT: MANIFOLD ASSEMBLY, GO_2 PRESSURIZATION SYSTEM

(V070-415490)

DESIGN PARAMETERS:

OPERATING PRESSURE:	650 PSIG
PROOF PRESSURE:	975 PSIG
BURST PRESSURE:	1300 PSIG
OPER TEMP:	-160°F TP +530°F (NO HAZARD AT 710°F)

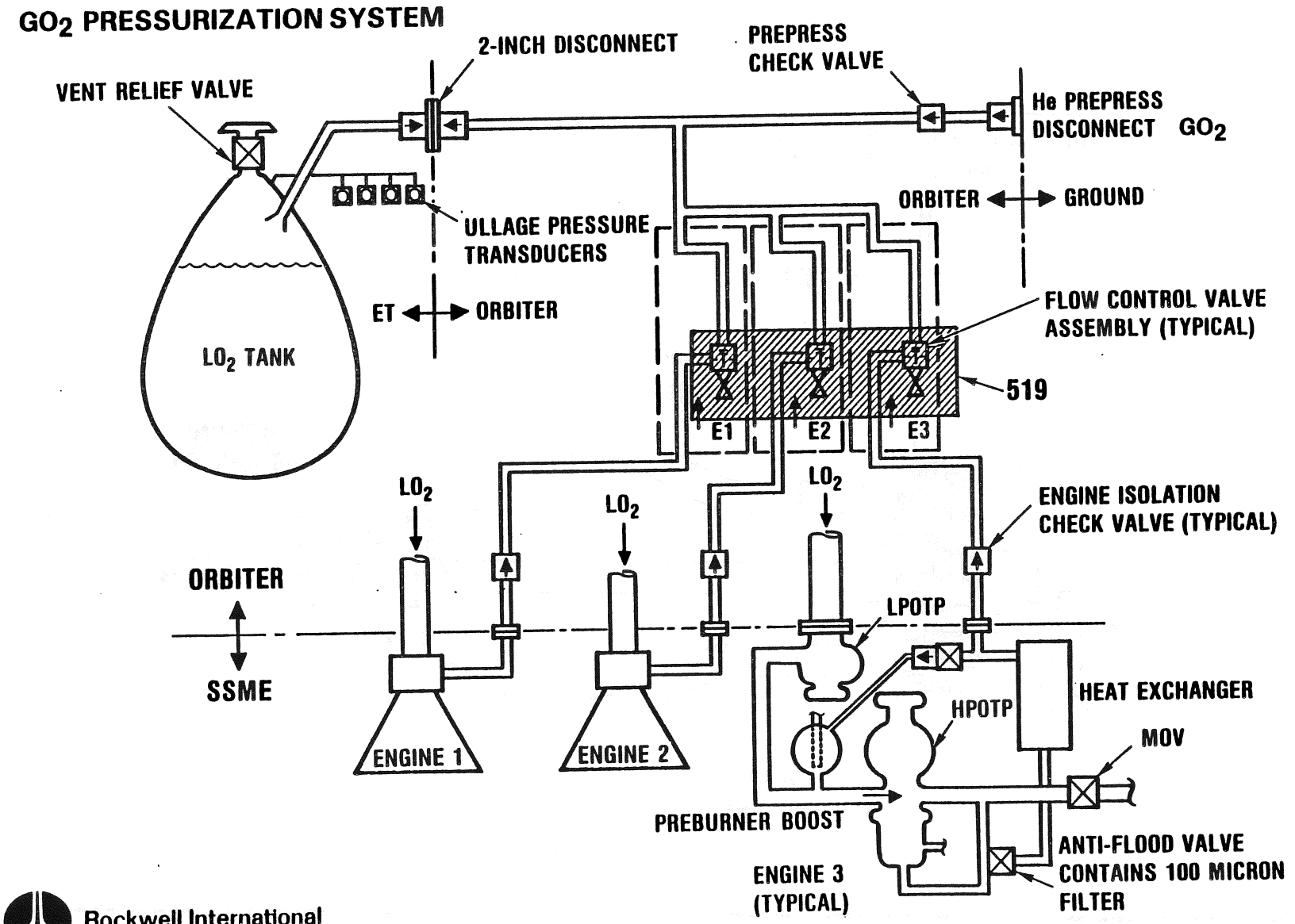
FEATURES:

- SLIDING MOUNT ALLOWS FOR THERMAL EXPANSION
- ATTACHED TO SECONDARY STRUCTURE USING SCREWS AND NUT PLATES

MATERIALS	
MANIFOLD:	INCONEL 718 BAR
TUBING:	INCONEL 718

COMPONENT: MANIFOLD ASSEMBLY, GO_2 PRESSURIZATION SYSTEM

(V070-415490)



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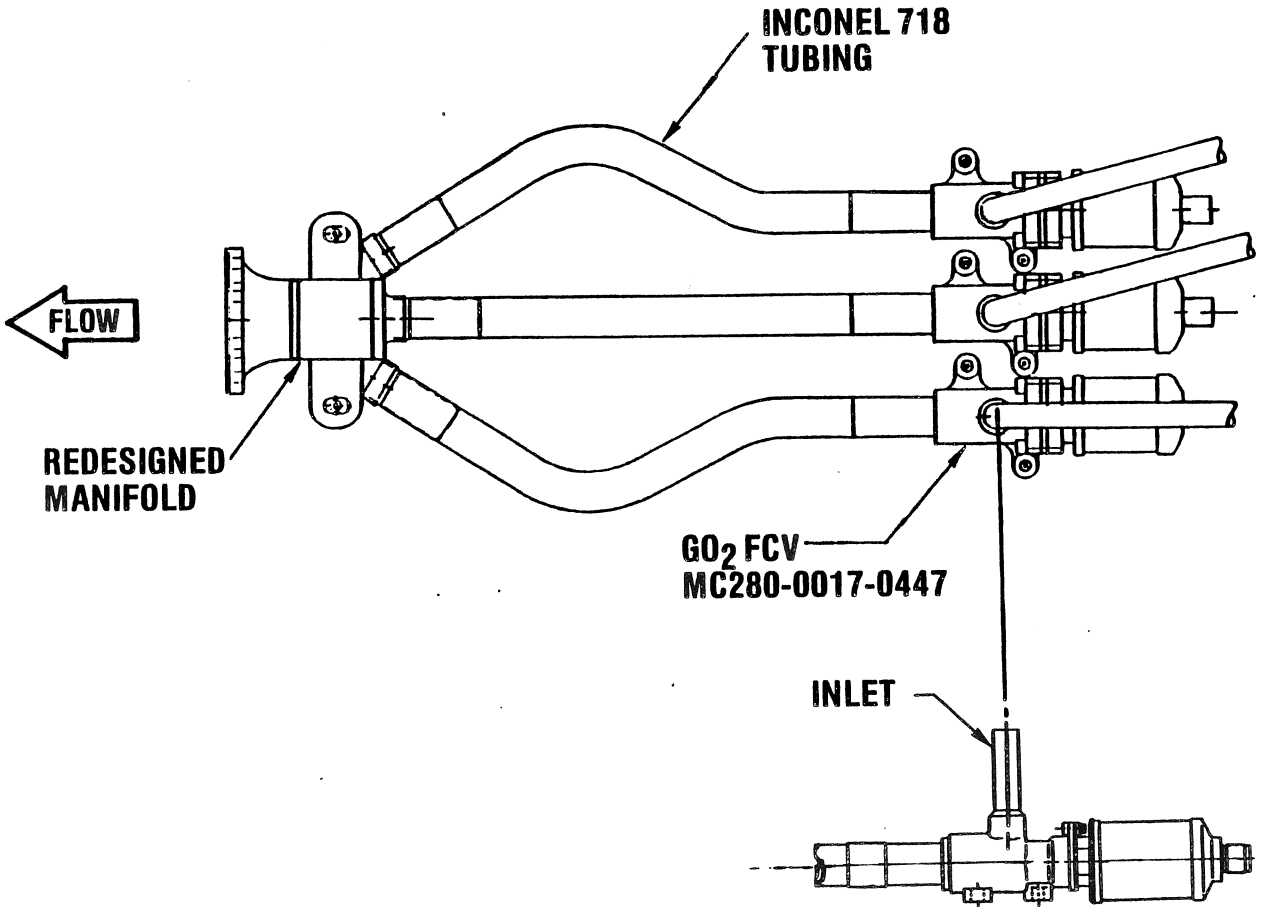
COMPONENT: MANIFOLD ASSEMBLY, GO_2 PRESSURIZATION SYSTEM

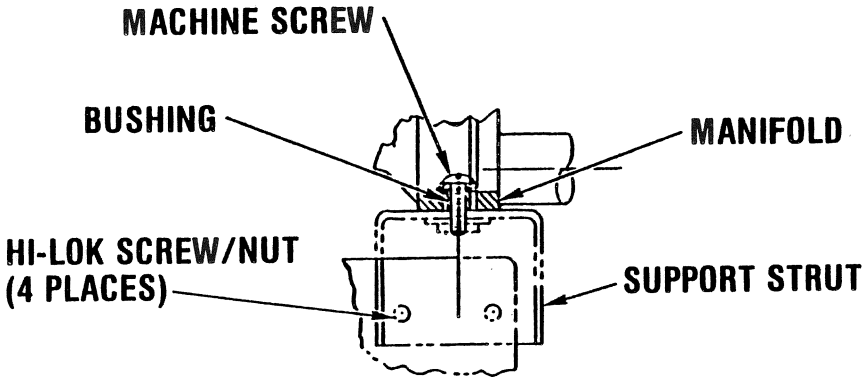
(V070-415490)



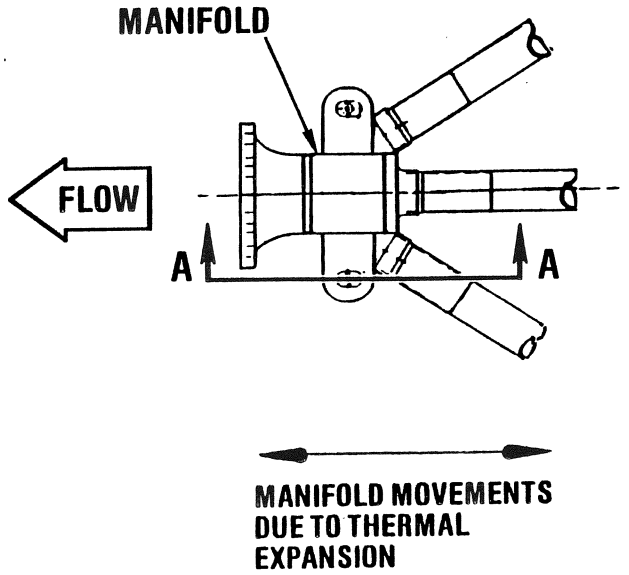
COMPONENT: MANIFOLD ASSEMBLY, GO_2 PRESSURIZATION SYSTEM

(V070-415490)

SLIDING MOUNT



SECTION A-A



COMPONENT: VIBRATION ISOLATORS

(MC196-0009)

VENDOR : AEROFLEX LABORATORIES
P/N RI : MC196-0009-3001, -3002, -3003
P/N VENDOR: 82378
QUANTITY : EACH VEHICLE USES: 18 OF THE -3001
: 23 OF THE -3002
: 21 OF THE -3003

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

VIBRATION ISOLATORS - ATTENUATION AND SHOCK PROTECTION FOR MPS COMPONENTS AND CONNECTING TUBING

FUNCTION:

THE VIBRATION ISOLATORS PROVIDE PROTECTION FROM THE VIBRATION ENVIRONMENT, ALLOW FOR INSTALLATION MISALIGNMENT AND ALLOW AXIAL MOTION OF THE ORBITERS MAIN PROPULSION SYSTEM (MPS) LINE ASSEMBLIES DUE TO DIFFERENTIAL EXPANSION AND CONTRACTION BETWEEN THE ORBITER AND THE MPS LINE ASSEMBLY.

DESIGN:

THE COMPONENTS ARE HELICAL ISOLATOR ASSEMBLIES OF STRANDED CRES MIL-W-83420, TYPE I CABLES STRESSED BETWEEN METAL RETAINERS (ALUM ALY 2024-T4/T6).

EACH ISOLATOR TYPE HAS SPECIFIC RESPONSE CHARACTERISTICS DEPENDENT UPON CABLE DIAMETER, NUMBER OF STRANDS PER CABLE, CABLE LENGTH, CABLE TWIST OR LAY, AND NUMBER OF CABLES PER SECTION. DAMPENING AND MOTION CONTROL AT RESONANCE IS PROVIDED BY FLEXURE HYSTERESIS (RUBBING AND SLIDING FRICTION BETWEEN THE STRANDS).

DESIGN PARAMETERS AND FEATURES:

TEMPERATURE: -160 TO +350°F (TYPE III); -160° TO +300°F (TYPE I AND II)

COMPONENT: VIBRATION ISOLATORS

(MC196-0009)

MAXIMUM PANEL LOADS: 31 POUNDS TESTED IN MULTIPLE ISOLATOR PANEL CONFIGURATION.

ENVELOPE DIMENSIONS:

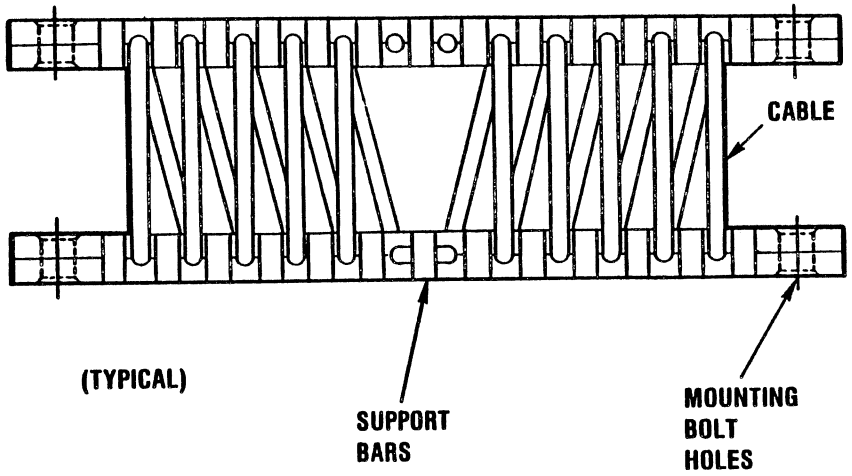
-3001	1.63 X 2.18 X 5.00 INCHES
-3002	1.40 X 1.60 X 4.42 INCHES
-3003	1.63 X 2.18 X 5.00 INCHES

WEIGHT:

-3001	.47 POUND
-3002	.40 POUND
-3003	.45 POUND

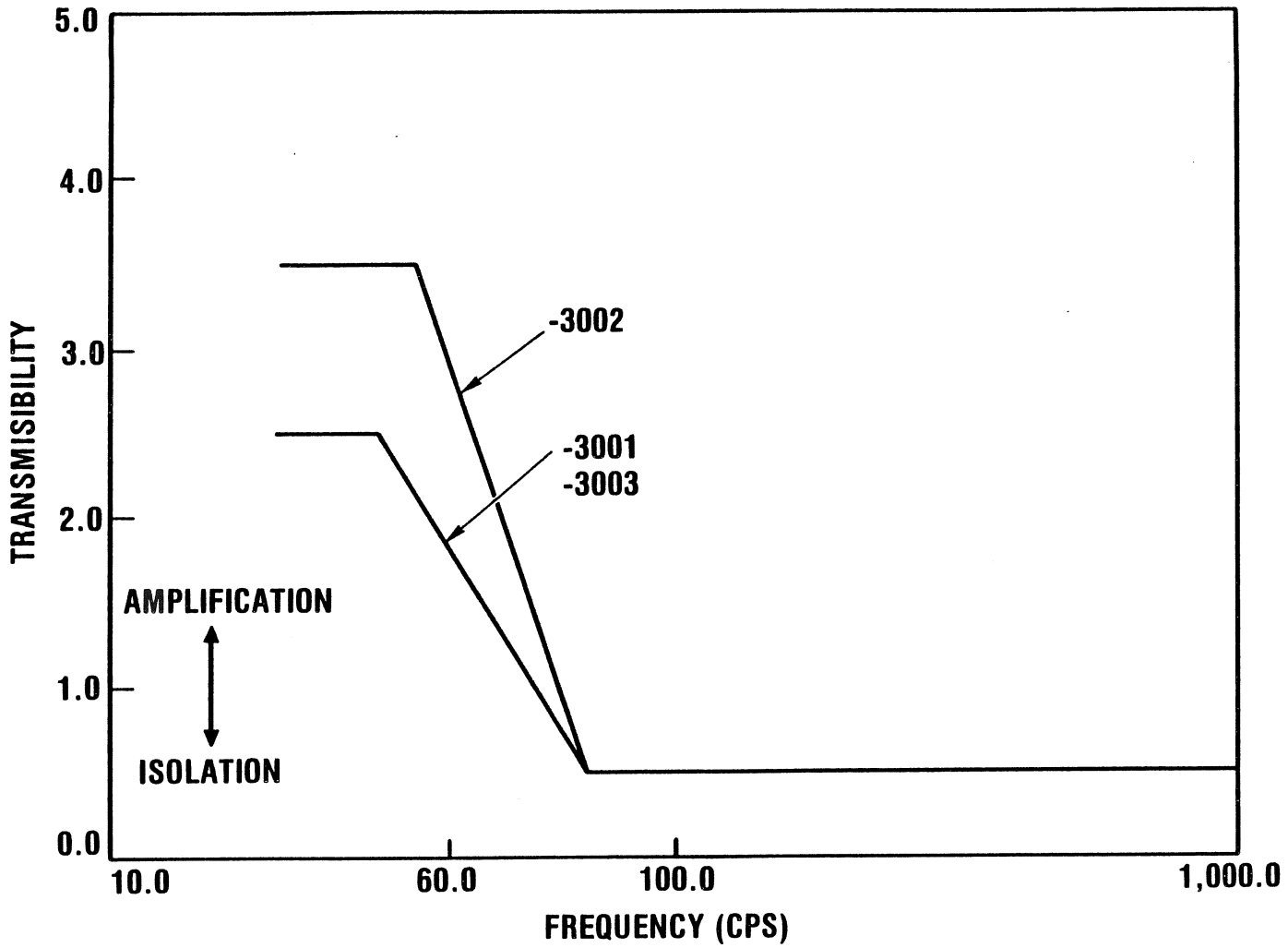
FEATURES:

- HELICAL ISOLATOR ASSEMBLIES OF STRANDED STAINLESS STEEL CABLES STRESSED BETWEEN METAL RETAINERS
- EACH ISOLATOR TYPE HAS SPECIFIC RESPONSE CHARACTERISTICS DEPENDENT ON CABLE DIAMETER, LENGTH, TWIST, NUMBER OF CABLES, AND NUMBER OF STRANDS PER CABLE
- DAMPENING AND MOTION CONTROL AT RESONANCE IS PROVIDED BY FLEXURE HYSTERESIS (RUBBING AND SLIDING FRICTION BETWEEN THE STRANDS)



COMPONENT: VIBRATION ISOLATORS

(MC196-0009)



COMPONENT: LH_2 FEEDLINES

(MC271-0073)

FMEA/CIL NO. 03-1-0417
-0415
-0416

VENDOR : ARROWHEAD PRODUCTS
P/N RI : SEE BELOW
P/N VENDOR: SEE BELOW
QUANTITY : 1 EACH PER P/N PER END ITEM

	VEHICLE EFFECTIVITY:	*102	103	104	105
P/N RI : MC271-0073-0001, TYPE I P/N VENDOR: 13531-302		X	X	X	X
P/N RI : MC271-0073-0302, TYPE II P/N VENDOR: 13532-304			X	X	X
P/N RI : MC271-0073-0303, TYPE III P/N VENDOR: 13535-304			X	X	X
P/N RI : MC271-0073-0304, TYPE IV P/N VENDOR: 13534-304			X	X	X
P/N RI : MC271-0073-0005, TYPE V P/N VENDOR: 13535-302		X	X	X	X

*OV-102 UTILIZES CRES 321 FLOW LINERS
OV-103, 104, 105 UTILIZE INCONEL 718 FLOW LINERS

COMPONENT: LH_2 FEEDLINES

(MC271-0073)

	VEHICLE EFFECTIVITY:	102	103	104	105
P/N RI : MC271-0073-0202, TYPE II P/N VENDOR: 13532-303		X			
P/N RI : MC271-0073-0203, TYPE III P/N VENDOR: 13533-303		X			
P/N RI : MC271-0073-0204, TYPE IV P/N VENDOR: 13534-303		X			

ITEM:

LINE, LH_2 FEED, VACUUM JACKETED.

FUNCTION:

THE LINES PROVIDE FUEL FLOW FROM THE ET/ORBITER DISCONNECT TO EACH SSME FOR ENGINE CONDITIONING AND OPERATION.

DESIGN

ALL LH_2 FEEDLINES ARE FABRICATED WITH A DOUBLE WALL TO FORM A VACUUM-TIGHT ANNULUS. THIS ANNULUS IS EVACUATED TO PROVIDE A HIGH PERFORMANCE THERMAL INSULATION. THE VACUUM INSULATION IS ENHANCED BY ELECTRO-POLISHING ALL ANNULUS SURFACES AND THE INCLUSION OF GETTERING AND SORBENT MATERIALS.

THE TYPE I LINE IS A SINGLE SECTION COMPRISED OF THREE BELLOWS-ENCLOSED BALL STRUT TIE ROD ASSEMBLY (BSTRA) UNIVERSAL ANGULAR MOTION FLEX JOINTS. THE LINE IS SUPPORTED AT AND INTERFACES WITH THE ET/ORBITER 17-INCH DISCONNECT OUTLET AND THE TYPE V MANIFOLD INLET.

COMPONENT: LH_2 FEEDLINES

(MC271-0073)

THE TYPES II, III, AND IV LINES ARE SINGLE SECTIONS, EACH COMPRISED OF TWO BELLOWS ENCLOSED BSTRA FLEX JOINTS AND ONE BELLOWS ENCLOSED GIMBAL UNIVERSAL ANGULAR MOTION FLEX JOINT. THE GIMBAL JOINT IS JUST UPSTREAM OF THE SSME INTERFACE. THE TYPE II, III, AND IV LINES INTERFACE WITH THE OUTLET OF THE PREVALVE/SCREEN AND WITH THE INLET END OF THE SSME TURBOPUMP FOR ENGINES 1, 2, AND 3, RESPECTIVELY. THE LINES ARE SUPPORTED BY THE PREVALVES AND BY STRUCTURE "HORSESHOE" BRACKETS AT THE SSME INTERFACE.

THE TYPE V LINE (MANIFOLD) IS COMPRISED OF A SERIES OF ELBOWS, TRANSITIONS, AND THERMAL COMPENSATING JACKET BELLOWS. THE MANIFOLD PROVIDES THE MAIN SUPPORT OF THE LH_2 FEEDLINE SYSTEM INTERCONNECTING THE TYPE I LINE, THE PREVALVES AND TYPE II, III, AND IV LINES, PLUS THE INBOARD END OF THE LH_2 FILL AND DRAIN LINE. THE MANIFOLD ALSO INCLUDES A PORT FOR THE LH_2 RECIRCULATION PUMP ASSEMBLY. THE MANIFOLD IS SUPPORTED FROM SPHERICAL BEARING LUGS ON THE MANIFOLD THROUGH SUPPORT STRUTS TO THE 1307 BULKHEAD AND THE THRUST STRUCTURE. EACH LINE CONTAINS A BURST DISC/GETTER CONTAINER, A VACUUM SENSING THERMOCOUPLE GAUGE TUBE AND AN EVACUATION VALVE. (SEE PAGES 7046-7, 7780-1, 7808-2, 7839-5-8.) THE TYPES I, II, III, AND IV LINE CONTAIN PRESSURE AND TEMPERATURE INSTRUMENTATION PORTS.

THE SPHERICAL BEARING LUGS ON THE MANIFOLD AND THE BSTRA'S AND GIMBALS COMBINE TO ACCOMMODATE INSTALLATION TOLERANCES AND THE RELATIVE MOTIONS INDUCED DURING TANKING AND ENGINE FIRING.

THE FLEXIBLE JOINTS INCORPORATE 2 PLY BELLOWS TO MINIMIZE STRESS LEVELS AND FLOW LINERS TO ELIMINATE FLOW INDUCED VIBRATION. THE PROOF PRESSURE FACTOR IS 1.2 AND THE BURST PRESSURE FACTOR IS 1.5, THE USEFUL DYNAMIC LIFE IS 14.2 HOURS (EQUIVALENT TO 100 ORBITER MISSIONS). THE PRESSURE CARRIER MEETS THE FRACTURE ANALYSIS REQUIREMENT FOR 400 MISSIONS. STRUCTURAL ANALYSIS INDICATES POSITIVE (GREATER THAN 1.4) MARGINS OF SAFETY FOR ALL CONDITIONS OF LINE OPERATION. THE LINE ASSEMBLY WILL WITHSTAND AN IMPLOSION PRESSURE OF 22 PSI, PRESSURE SURGE 40 TO 50 PSIG IN 200 MILLISECONDS AND A THERMAL CHANGE FROM 200 F TO MINUS 423 F.

DESIGN PARAMETERS AND FEATURES:

	TYPE I	TYPES II, III, IV	TYPE V
OPERATING PRESSURE, MAXIMUM:	55 PSIG	105 PSIG	55 PSIG
PROOF PRESSURE:	66 PSIG	126 PSIG	66 PSIG
BURST PRESSURE:	83 PSIG	158 PSIG	83 PSIG

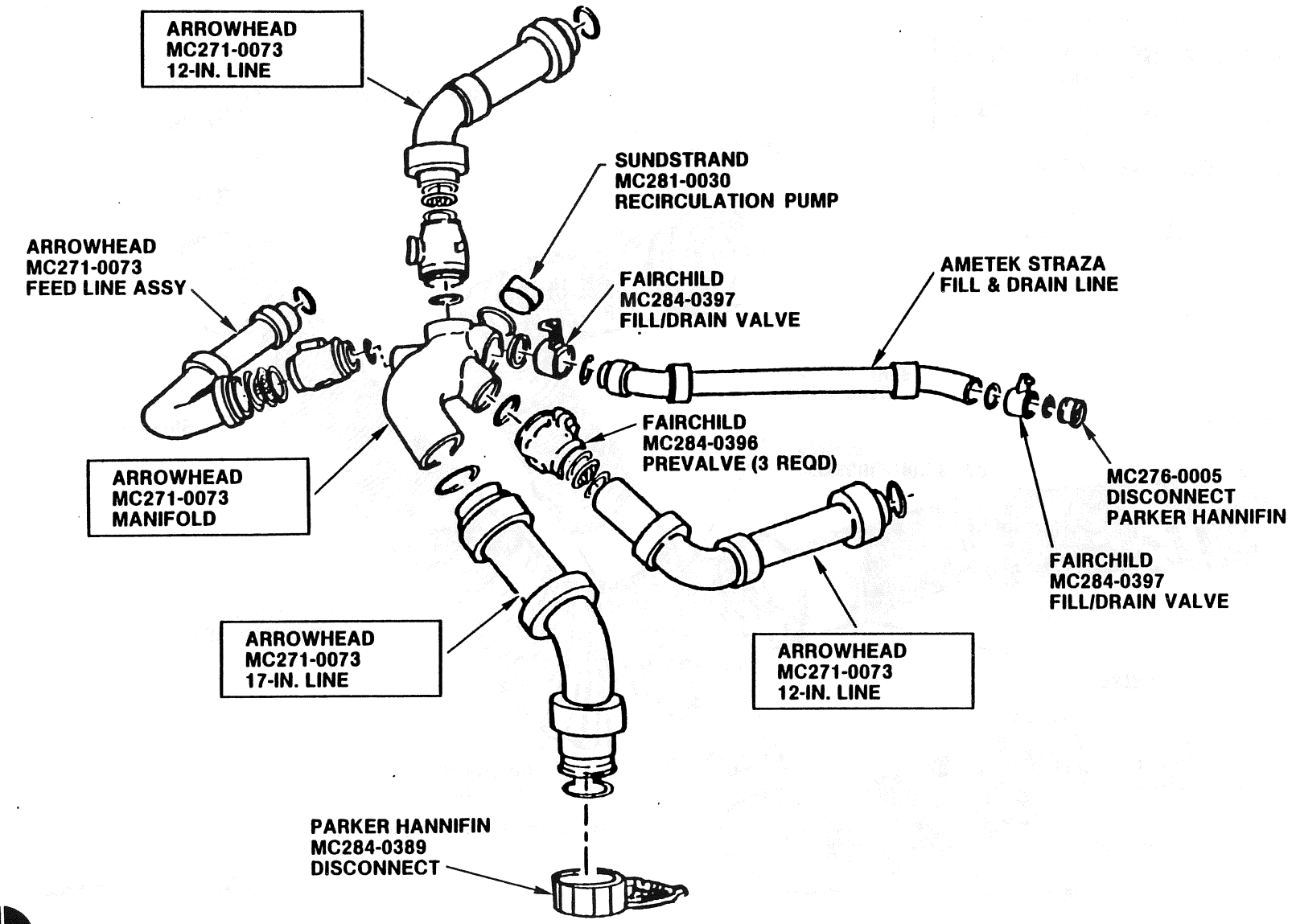
COMPONENT: LH_2 FEEDLINES

(MC271-0073)

	TYPE I	TYPES II, III, IV	TYPE V
LINE SIZE:			
PRESSURE CARRIER:	17-INCH ID	12-INCH ID	8 TO 17-INCH
FLOW CAPACITY (MAXIMUM):	495 PPS	165 PPS	415 PPS
PRESSURE DROP (MAXIMUM):	1.9 PSI	0.7 PSI	2.5 PSI
WEIGHT (MAXIMUM):	337 LB	269 LB	296 LB
INSULATION:	VACUUM JACKET	VACUUM JACKET	VACUUM JACKET
MAXIMUM VACUUM JACKET PRESSURE:	1,000 MICRONS Hg (TYPICAL ALL LINES)		
EXTERNAL HEAT TRANSFER:	1,510 BTU/HR	1,180 BTU/HR	1,150 BTU/HR

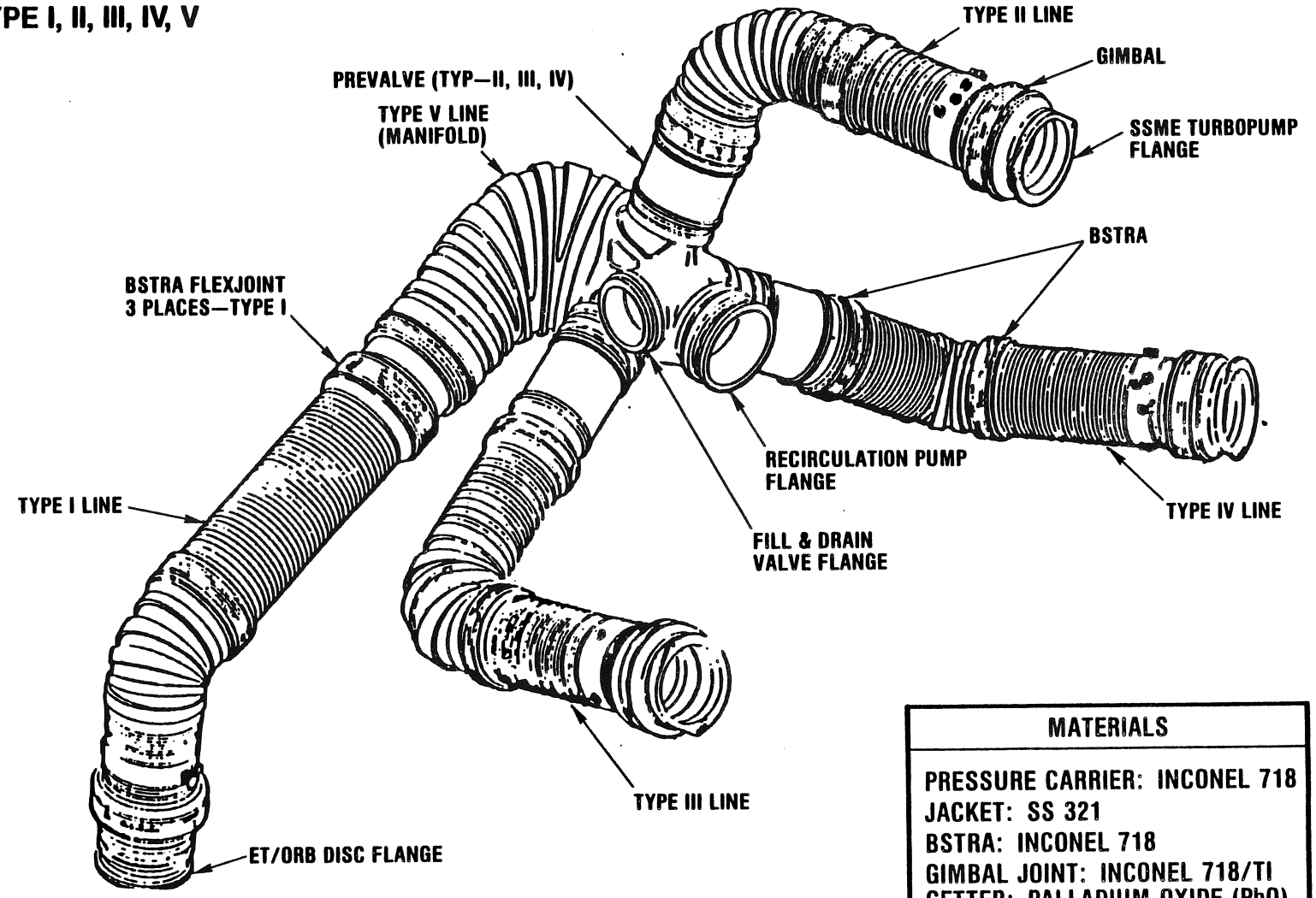
COMPONENT: LH_2 FEEDLINES

(MC271-0073)



COMPONENT: LH_2 FEEDLINES
(MC271-0073)

TYPE I, II, III, IV, V

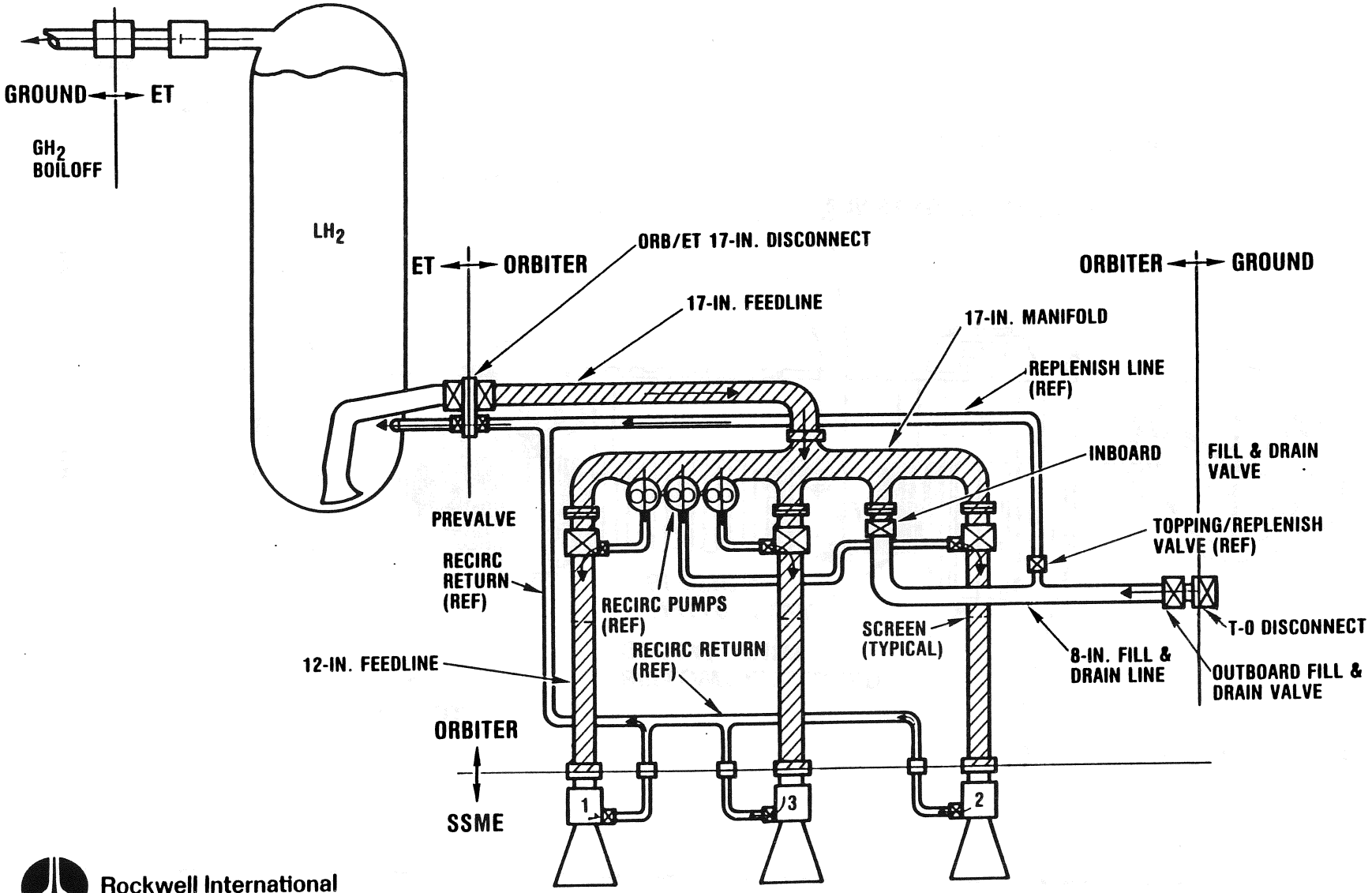


MATERIALS
PRESSURE CARRIER: INCONEL 718
JACKET: SS 321
BSTRA: INCONEL 718
GIMBAL JOINT: INCONEL 718/TI
GETTER: PALLADIUM OXIDE (PbO)

COMPONENT: LH_2 FEEDLINES

(MC271-0073)

LH_2 FILL/FEED SYSTEM



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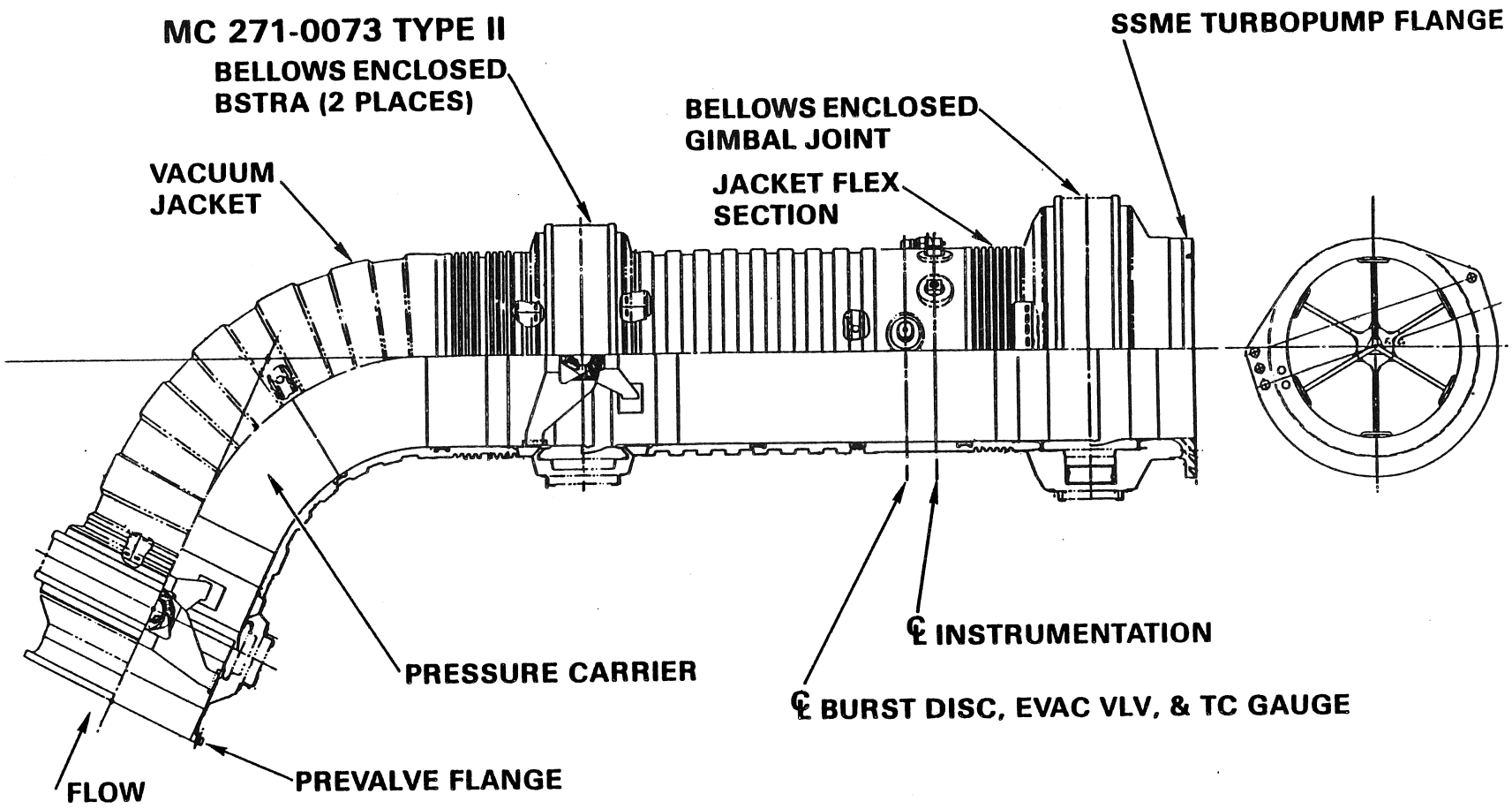
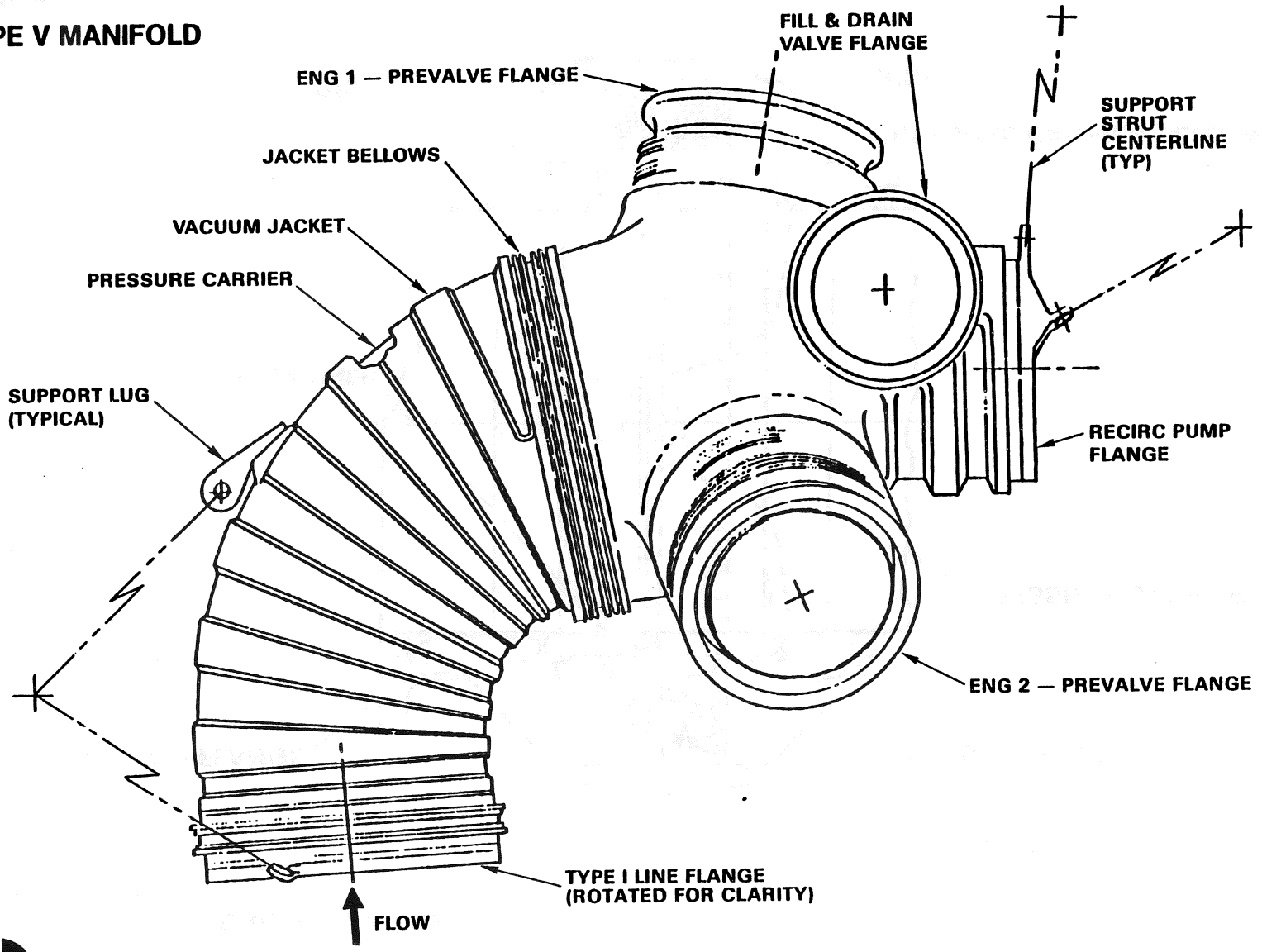
COMPONENT: LH_2 FEEDLINES
(MC271-0073)

TYPES II, III, & IV (TYP)



COMPONENT: LH_2 FEEDLINES
(MC271-0073)

TYPE V MANIFOLD



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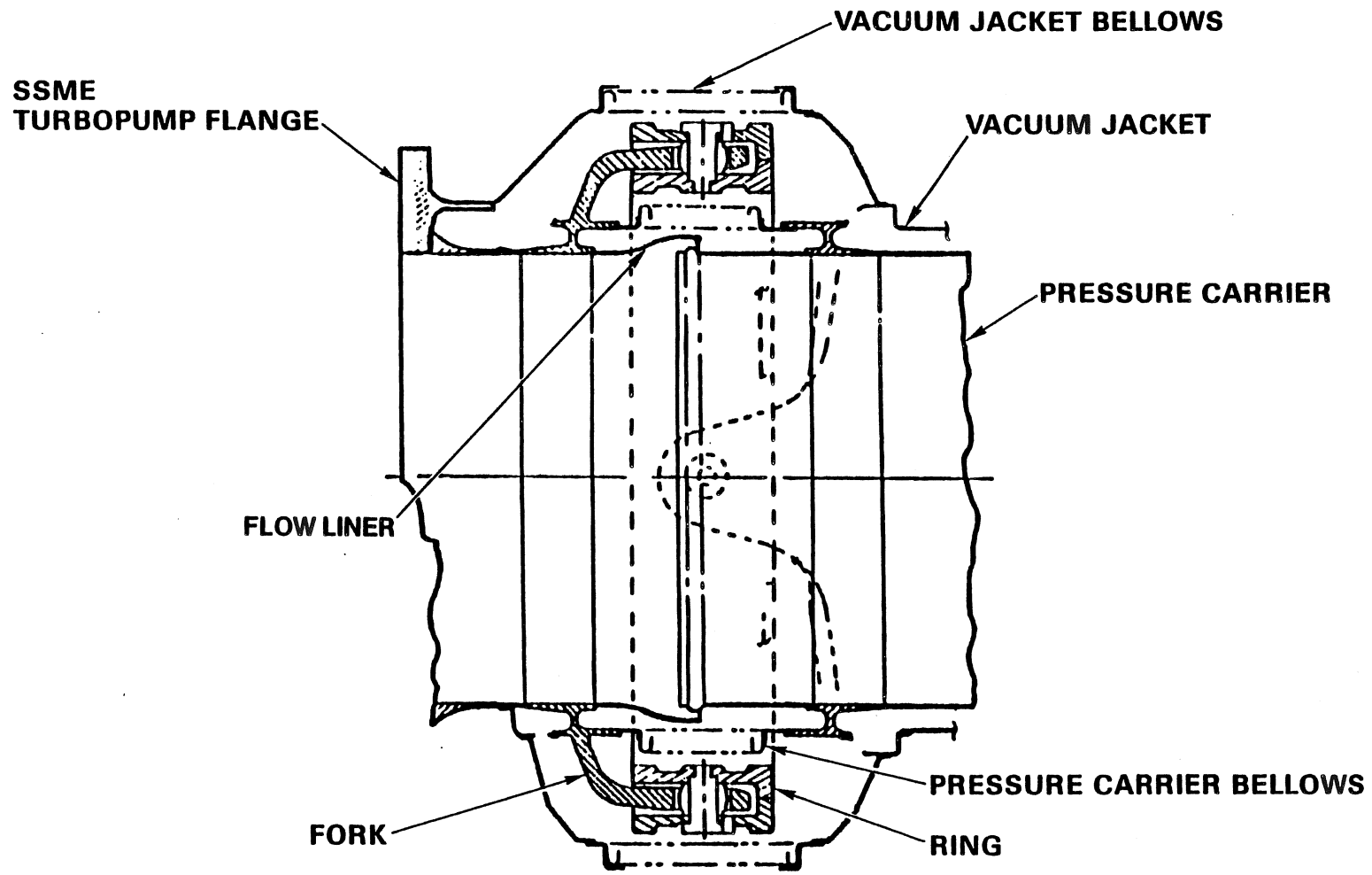
Space Transportation Systems Division

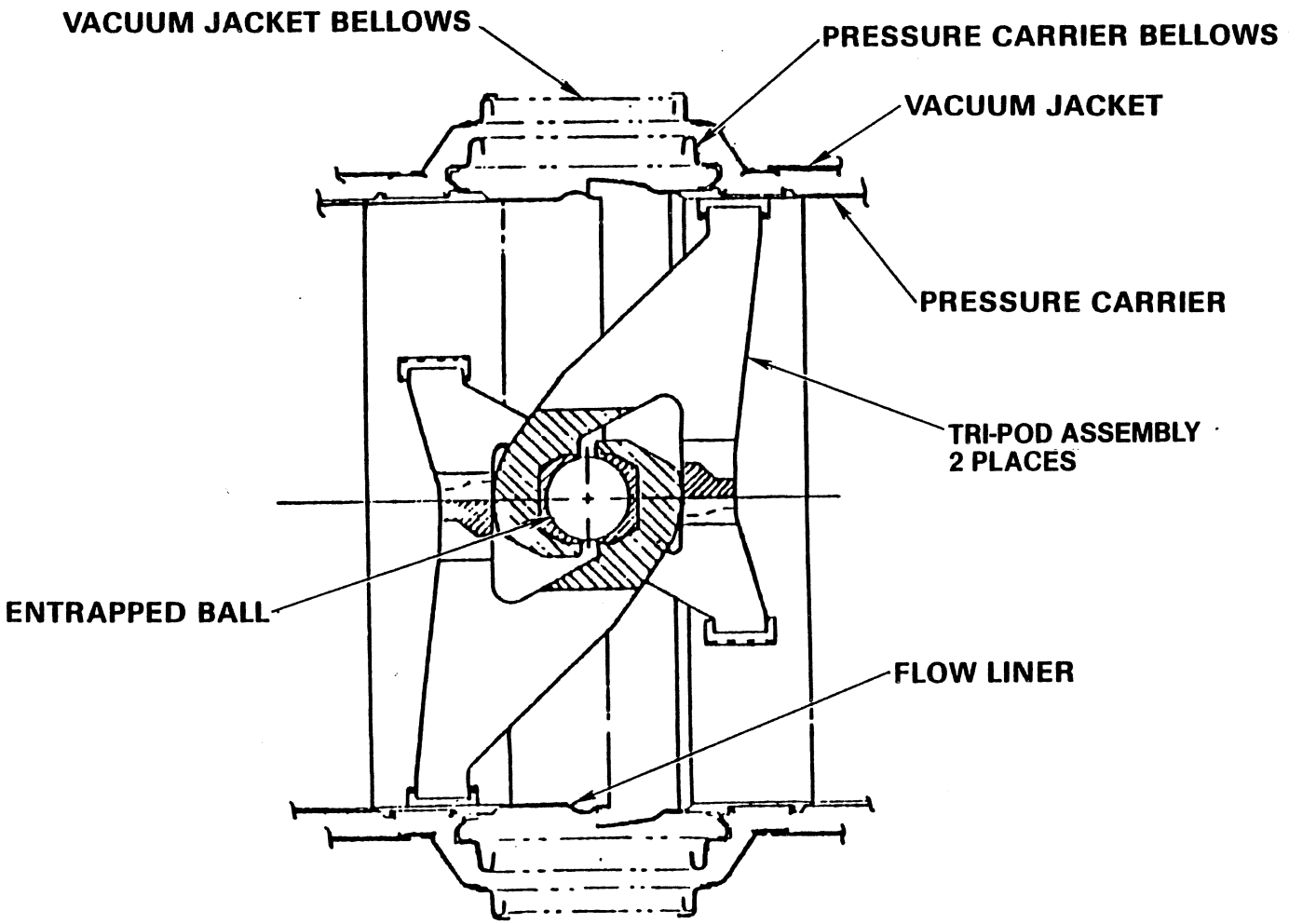
COMPONENT: LH_2 FEEDLINES
(MC271-0073)

GIMBAL JOINT TYPICAL—LO_2 & LH_2
TYPE II, III, & IV



COMPONENT: LH_2 FEEDLINES
(MC271-0073)

BALL STRUT TIE ROD ASSY (BSTRA)—LO_2 & LH_2
TYPICAL TYPE I, II, III, & IV



COMPONENT: LO_2 FEEDLINES

(MC271-0074)

VENDOR : ARROWHEAD PRODUCTS
P/N RI : SEE BELOW
P/N VENDOR: SEE BELOW
QUANTITY : 1 PER EACH P/N PER END ITEM

VEHICLE EFFECTIVITY	102	103	104	105
P/N RI : MC271-0074-0001, TYPE I P/N VENDOR: 13541-302	X			
P/N RI : MC271-0074-0202, TYPE II P/N VENDOR: 13532-303	X			
P/N RI : MC271-0074-0203, TYPE III P/N VENDOR: 13543-303	X			
P/N RI : MC271-0074-0204, TYPE IV P/N VENDOR: 13544-303	X			
P/N RI : MC271-0074-0005, TYPE V P/N VENDOR: 13545-303	X	X	X	X
P/N RI : MC271-0074-0201, TYPE I P/N VENDOR: 13541-303		X	X	X
P/N RI : MC271-0074-0302, TYPE II P/N VENDOR: 13542-304		X	X	X
P/N RI : MC271-0074-0303, TYPE III P/N VENDOR: 13543-304		X	X	X
P/N RI : MC271-0074-0304, TYPE IV P/N VENDOR: 13544-304		X	X	X

COMPONENT: LO_2 FEEDLINES

(MC271-0074)

FUNCTION:

THE LINES DIRECT THE FLOW OF OXIDIZER (LIQUID OXYGEN) FROM THE ET/ORBITER DISCONNECT TO THE RESPECTIVE ENGINES.

DESIGN

THE TYPE I, II, III, AND IV FEEDLINES INSTALLED ON MPTA AND OV-102 ARE FABRICATED WITH A DOUBLE WALL TO FORM A VACUUM-TIGHT ANNULUS. THIS ANNULUS IS EVACUATED TO PROVIDE A HIGH PERFORMANCE THERMAL INSULATION. THE VACUUM INSULATION IS ENHANCED BY ELECTROPOLISHING ALL ANNULUS SURFACES AND THE INCLUSION OF GETTERING AND SORBENT MATERIALS. THE TYPE V LINE (MANIFOLD) ON ALL VEHICLES, AND THE TYPE I, II, III, AND IV FEEDLINES ON OV-103 AND SUBSEQUENT (AND SPARES), IS THERMALLY INSULATED BY PRECAST FOAM INSULATION SECTIONS CONTAINED WITHIN AN LO_2 COMPATIBLE MATERIAL ENVELOPE WITH AN ALUMINUM TAPE EXTERNAL OVERWRAP. A VAPOR BARRIER BOOT IS INSTALLED OVER THE FLEX JOINTS.

THE TYPE I LINE IS A SINGLE SECTION COMPRISED OF THREE BELLOWS ENCLOSED BALL STRUT TIE ROD ASSEMBLY (BSTRA) UNIVERSAL ANGULAR MOTION FLEX JOINTS. THE LINE IS SUPPORTED AT AND INTERFACES WITH THE ET/ORBITER 17-INCH DISCONNECT OUTLET AND THE TYPE V MANIFOLD INLET.

THE TYPE II, III, AND IV LINES ARE SINGLE SECTIONS, EACH COMPRISED OF TWO BELLOWS ENCLOSED BSTRA FLEX JOINTS AND ONE BELLOWS ENCLOSED GIMBAL UNIVERSAL ANGULAR MOTION FLEX JOINT. THE GIMBAL JOINT IS JUST UPSTREAM OF THE SSME INTERFACE. THE TYPE II, III, AND IV LINES INTERFACE WITH THE OUTLET OF THE PREVALVE/SCREEN AND WITH THE INLET END OF THE SSME TURBOPUMP FOR ENGINES 1, 2, AND 3, RESPECTIVELY. THE LINES ARE SUPPORTED BY THE PREVALVES AND BY STRUCTURE "HORSESHOE" BRACKETS AT THE SSME INTERFACE.

THE TYPE V LINE (MANIFOLD) IS COMPRISED OF A SERIES OF ELBOWS AND TRANSITIONS. THE MANIFOLD PROVIDES THE MAIN SUPPORT OF THE LO_2 FEEDLINE SYSTEM, INTERCONNECTING THE TYPE I LINE, THE PREVALVES, THE TYPE II, III, AND IV LINES, AND THE INBOARD END OF THE LO_2 FILL AND DRAIN LINE. THE MANIFOLD IS SUPPORTED FROM SPHERICAL BEARING LUGS ON THE MANIFOLD THROUGH SUPPORT STRUTS TO THE 1307 BULKHEAD AND THE THRUST STRUCTURE.

COMPONENT: LO_2 FEEDLINES

(MC271-0074)

EACH TYPE I, II, III, AND IV LINE CONTAINS PRESSURE AND TEMPERATURE INSTRUMENTATION PORTS. THE VACUUM JACKETED LINES CONTAIN A BURST DISC/GETTER CONTAINER, A VACUUM SENSING THERMOCOUPLE GAUGE TUBE AND AN EVACUATION VALVE (SEE PAGES 7046-7, 7780-1, 7808-2, 7839-5-8). ON THE TYPE II, III, AND IV LINES, A TURBOPUMP INSPECTION PORT IS INCLUDED. ON THE TYPE I LINE, THERE ARE PROVISIONS FOR INSTALLATION OF LIQUID DEPLETION SENSORS JUST UPSTREAM OF THE ET/ORBITER DISC FLANGE.

THE SPHERICAL BEARING LUGS ON THE MANIFOLD AND THE BSTRA'S AND GIMBALS COMBINE TO ACCOMMODATE INSTALLATION TOLERANCES AND THE RELATIVE MOTIONS INDUCED DURING TANKING AND ENGINE FIRING.

THE FLEXIBLE JOINTS INCORPORATE MULTI-PLY BELLOWS TO MINIMIZE STRESS LEVELS AND FLOW LINERS TO ELIMINATE FLOW INDUCED VIBRATION. THE PROOF PRESSURE FACTOR IS 1.2 AND THE BURST PRESSURE FACTOR IS 1.5, THE USEFUL DYNAMIC LIFE IS 14.2 HOURS (EQUIVALENT TO 100 ORBITER MISSIONS). THE PRESSURE CARRIER MEETS THE FRACTURE ANALYSIS REQUIREMENT FOR 400 MISSIONS. STRUCTURAL ANALYSIS INDICATES POSITIVE (GREATER THAN 1.4) MARGINS OF SAFETY FOR ALL CONDITIONS OF LINE OPERATION. THE LINE ASSEMBLY WILL WITHSTAND AN IMPLOSION PRESSURE OF 22 PSI, PRESSURE SURGE OF 215 TO 275 PSIG (TYPES II, III, AND IV) AND 200 TO 260 PSIG (TYPES I AND V) IN 200 MILLISECONDS AND A THERMAL CHANGE FROM 200°F TO MINUS 297°F.

DESIGN PARAMETERS AND FEATURES:

	TYPE I	TYPES II, III, IV	TYPE V
OPERATING PRESSURE, MAXIMUM:	260 PSIG	275 PSIG	260 PSIG
PROOF PRESSURE:	312 PSIG	330 PSIG	312 PSIG
BURST PRESSURE:	390 PSIG	413 PSIG	390 PSIG

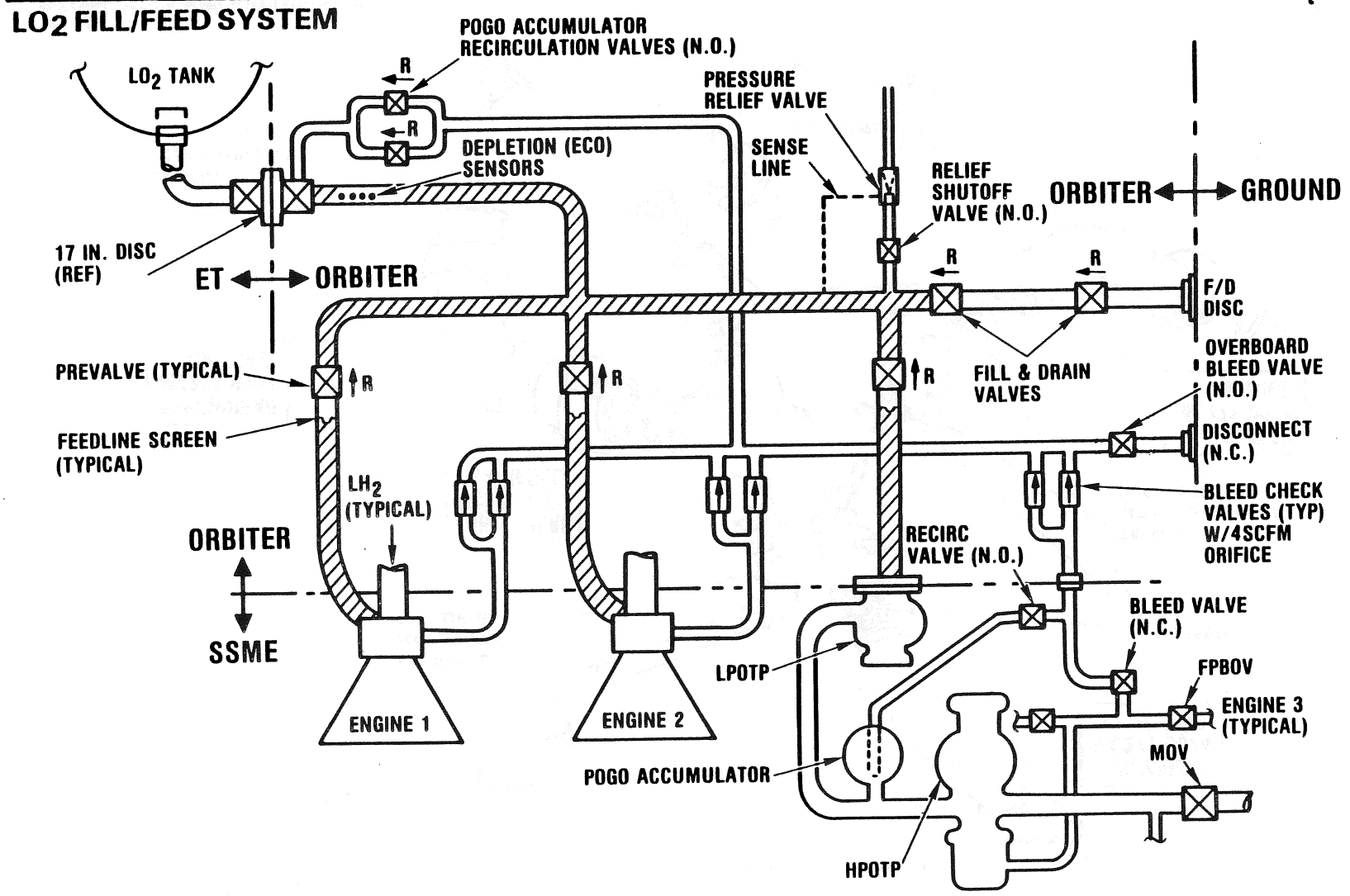
COMPONENT: LO_2 FEEDLINES

(MC271-0074)

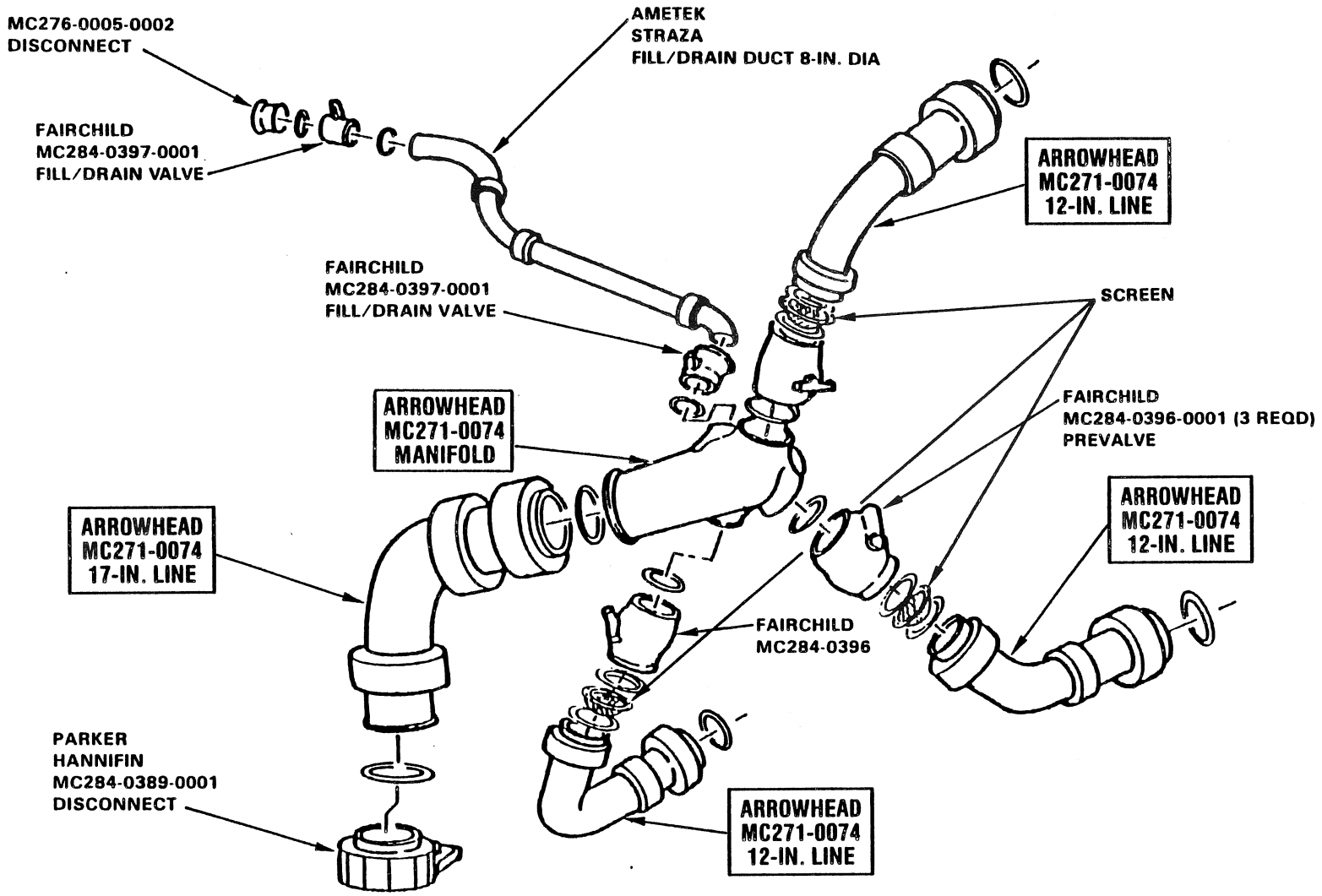
	TYPE I	TYPES II, III, IV	TYPE V
LINE SIZE:			
PRESSURE CARRIER:	17-INCH	12-INCH	8 TO 17 INCHES
WEIGHT (AVERAGE):	450 LB* 390 LB**	311 LB* 291 LB**	129 LB
FLOW CAPACITY (MAXIMUM):	2,946 LB/S	982 LB/S	2,946 LB/S
PRESSURE DROP (MAXIMUM):	4.4 PSI	1.7 PSI	5.3 PSI
INSULATION:	VACUUM JACKET* FOAM**	VACUUM JACKET* FOAM**	FOAM
MAXIMUM VACUUM JACKET PRESSURE:	1,000 MICRONS Hg*		
EXTERNAL HEAT TRANSFER:	7,590 BTU/HR	4,950 BTU/HR (PER LINE TYPE)	1,940 BTU/HR

*MPTA AND OV-102 ONLY
**OV-103 AND SUBSEQUENT; SPARES

COMPONENT: LO_2 FEEDLINES
(MC271-0074)

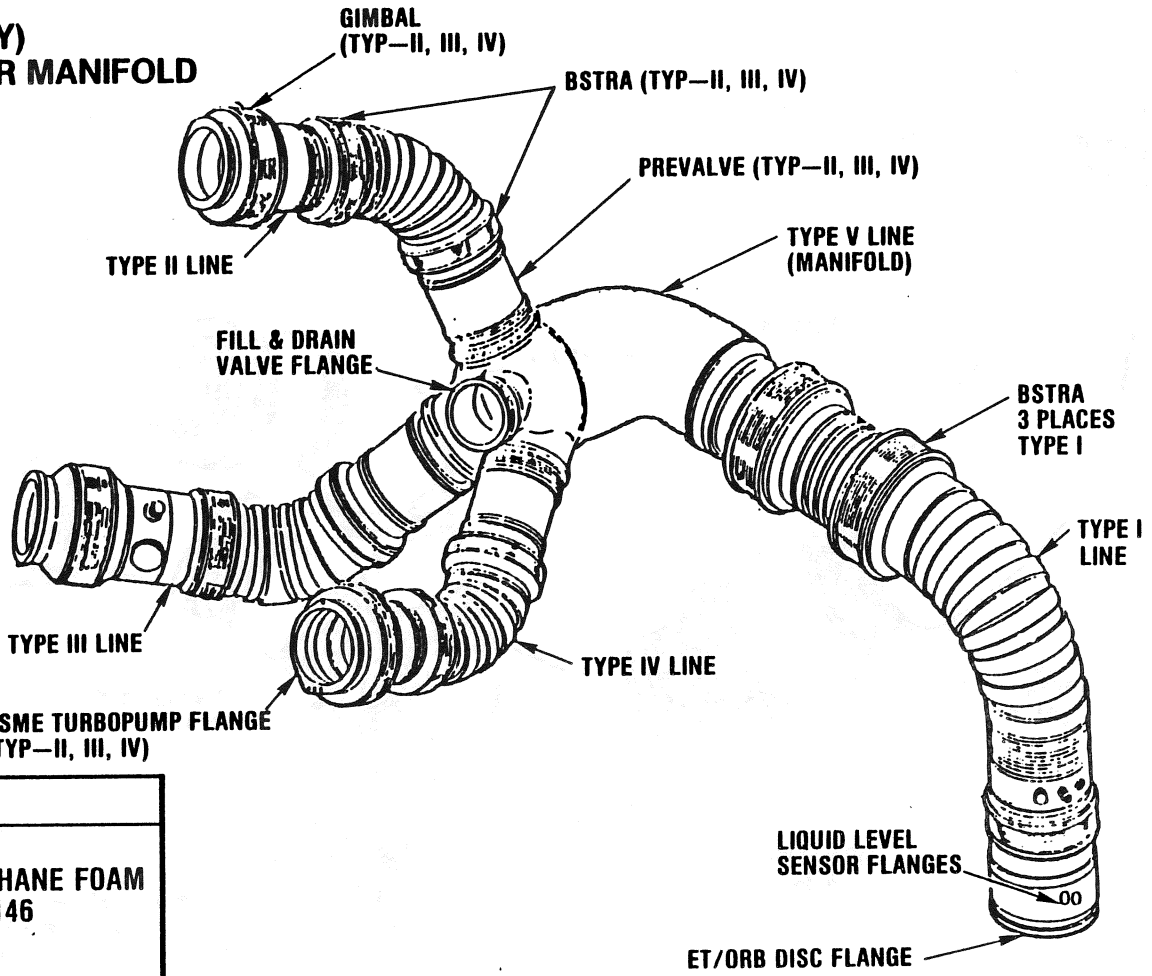


COMPONENT: LO_2 FEEDLINES
(MC271-0074)



COMPONENT: LO_2 FEEDLINES
(MC271-0074)

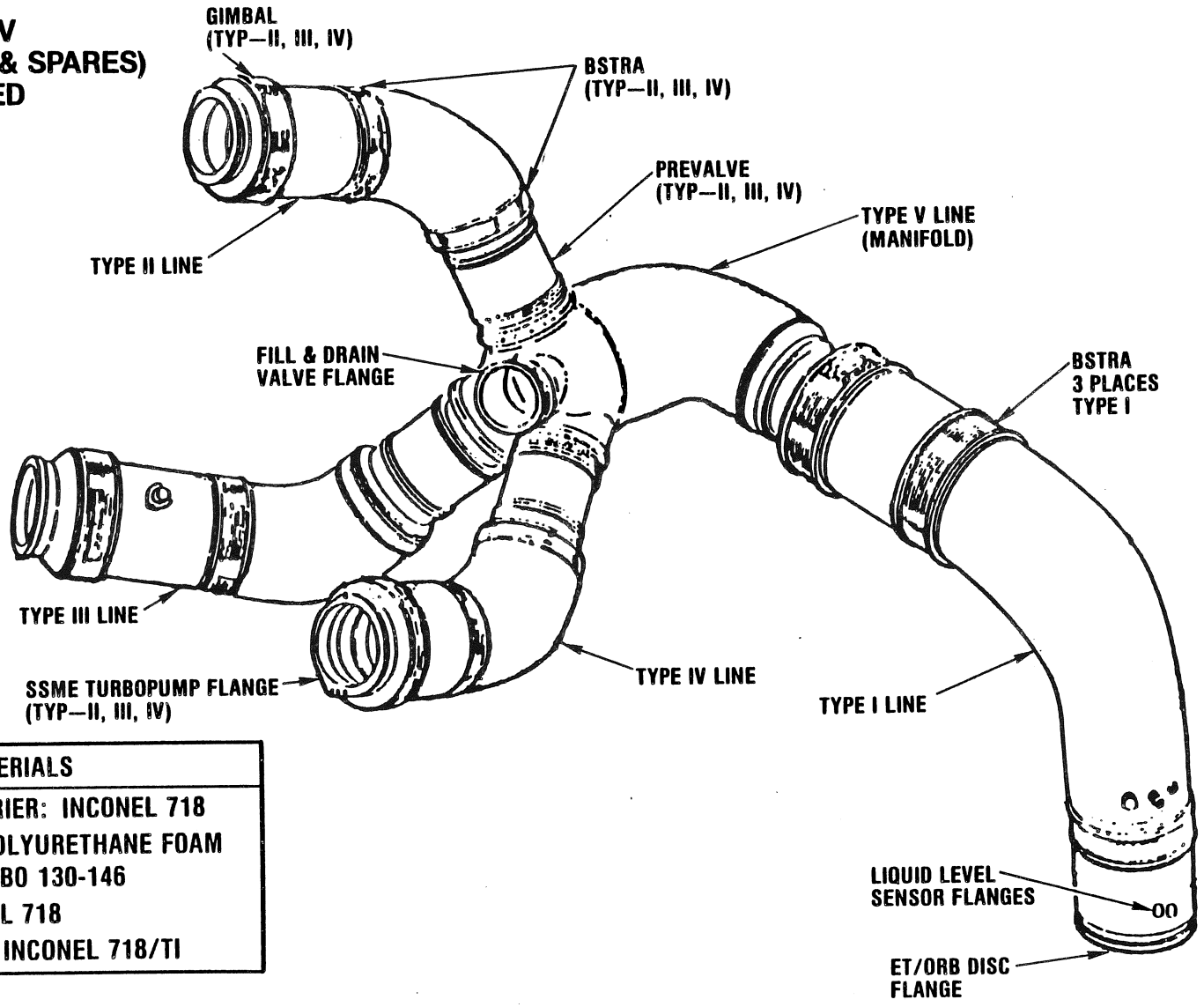
TYPE I, II, III, IV, V (OV102 ONLY)
VACUUM JACKET EXCEPT FOR MANIFOLD



MATERIALS
PRESSURE CARRIER: INCONEL 718
MANIFOLD INSULATION: POLYURETHANE FOAM MBO 130-146
JACKET: SS 321
BSTRA: INCONEL 718
GIMBAL JOINT: INCONEL 718/TI
GETTER: PALLADIUM OXIDE (PbO)

COMPONENT: LO_2 FEEDLINES
(MC271-0074)

TYPE I, II, III, IV, V
(OV103 & SUBS & SPARES)
FOAM INSULATED



MATERIALS
PRESSURE CARRIER: INCONEL 718
INSULATION: POLYURETHANE FOAM MBO 130-146
BSTRA: INCONEL 718
GIMBAL JOINT: INCONEL 718/TI

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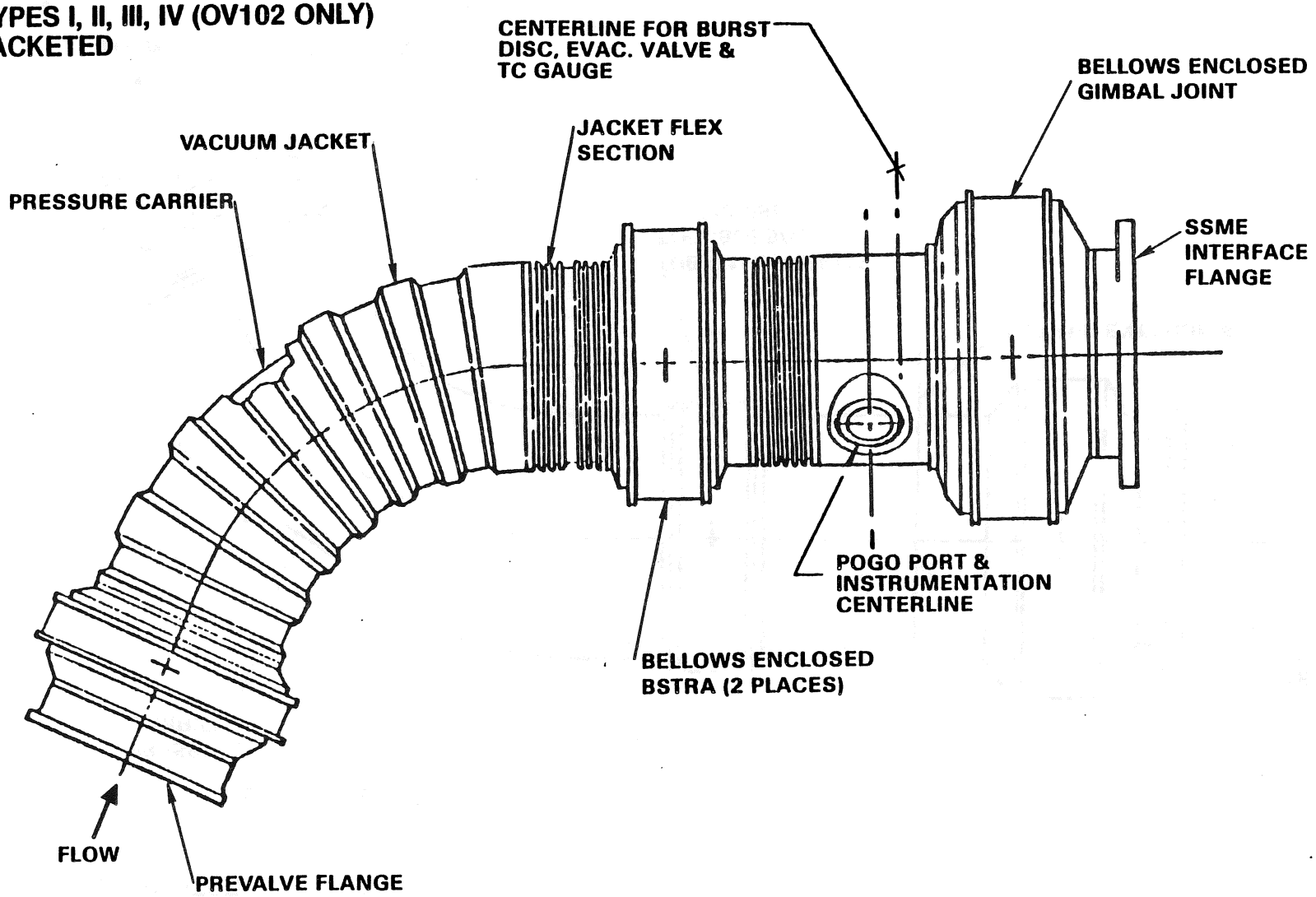
Systems Division

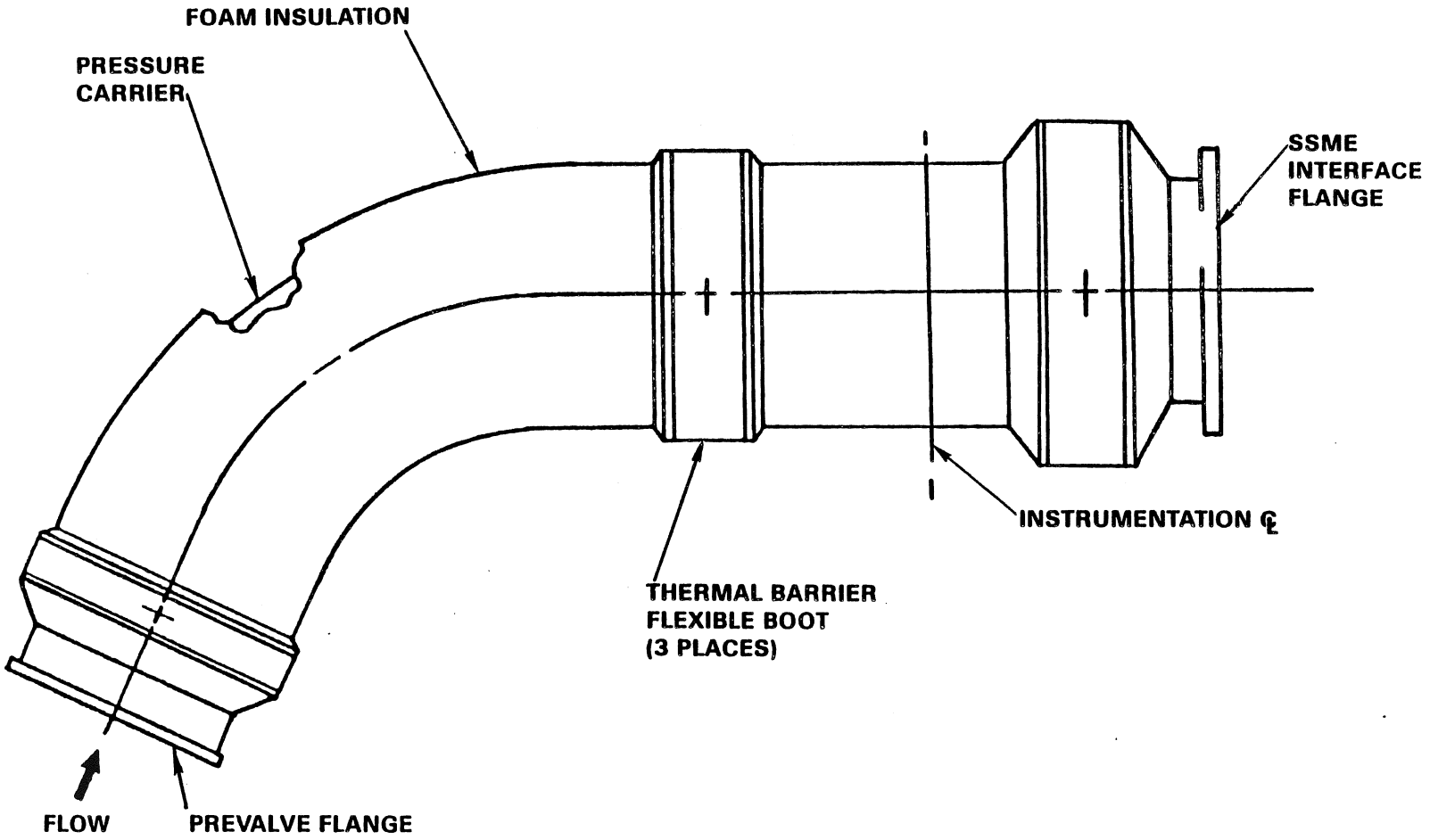
COMPONENT: LO_2 FEEDLINES
(MC271-0074)

TYPES I, II, III, IV (OV102 ONLY)
JACKETED



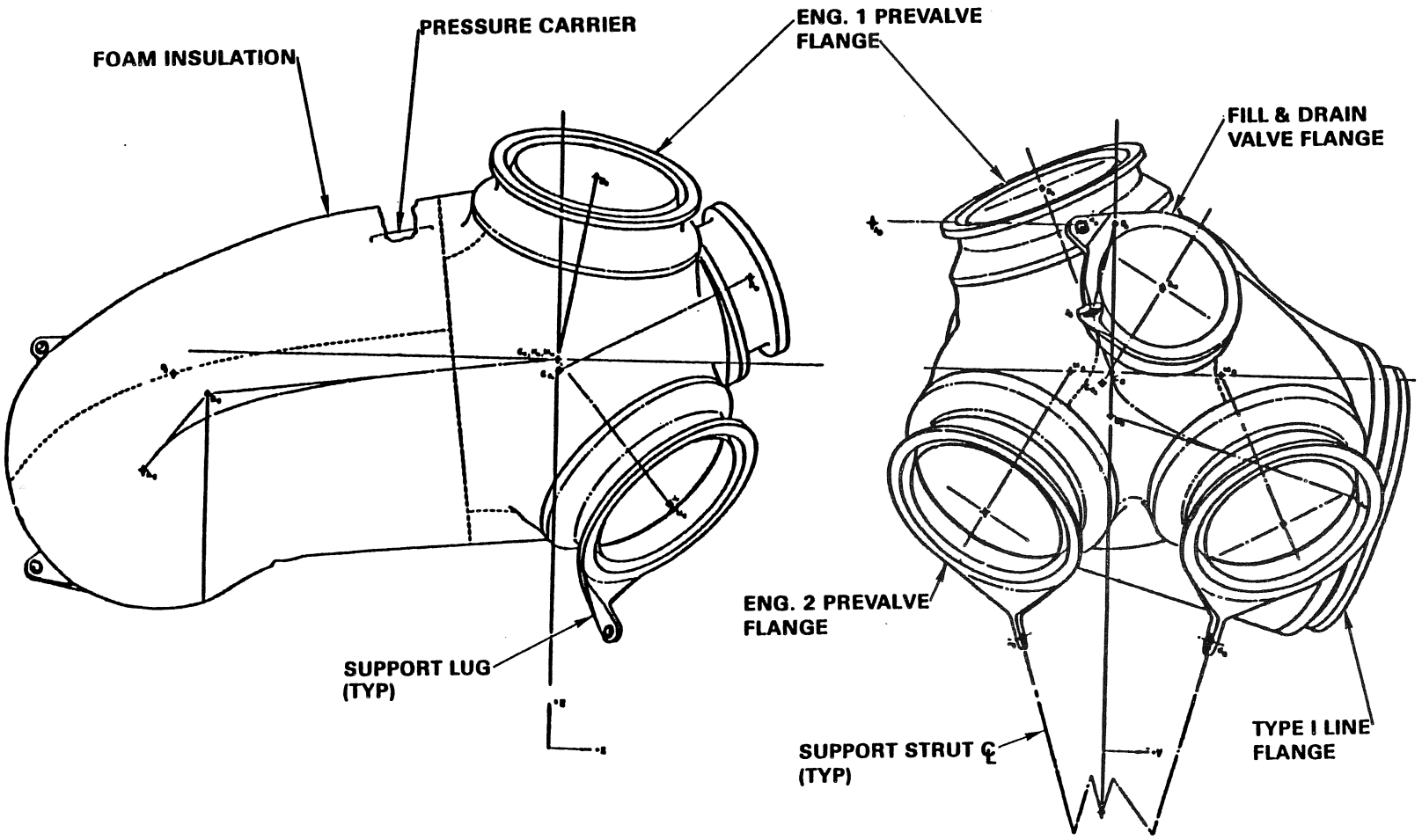
COMPONENT: LO_2 FEEDLINES
(MC271-0074)

TYPES I, II, III, IV (OV103 & SUBS & SPARES)
FOAM INSULATED



COMPONENT: LO_2 FEEDLINES
(MC271-0074)

MC271-0074-0005 TYPE V



COMPONENT: LH_2 RECIRCULATION AND REPLENISHMENT LINES

(MC271-0075)

FMEA/CIL NO. 03-1-0309
-0421
-0425
-0429

VENDOR : AMETEK STRAZA
P/N RI : MC271-0075-XXXX (SEE BELOW)
P/N VENDOR:
QUANTITY : 1 PER EACH P/N PER END ITEM

: TYPE I, -0011	TYPE IV, -0024	TYPE VIII, -0018	
: TYPE II, -0012	TYPE V, -0025	TYPE IX, -0019	
TYPE III, -0013	TYPE VI, -0016	TYPE X, -0010	
	TYPE VI, -0017		

VEHICLE EFFECTIVITY:

102	103	104	105
X	X	X	X

ITEM:

LH_2 PROPELLANT RECIRCULATION LINES

FUNCTION:

THE LINES INTRODUCE LH_2 INTO THE LH_2 FEEDLINES AND RETURN IT TO THE ET FOR SSME PRECONDITIONING.

DESIGN: (TYPES I THROUGH X)

THE LH_2 RECIRCULATION AND REPLENISHMENT LINES, WHICH ALSO INCLUDES THE LH_2 HIGH-POINT BLEED LINE, ARE FABRICATED WITH A DOUBLE WALL TO FORM A VACUUM-TIGHT ANNULUS. THIS ANNULUS IS EVACUATED TO PROVIDE A HIGH PERFORMANCE THERMAL INSULATION. THE VACUUM INSULATION IS ENHANCED BY ELECTROPOLISHING ALL ANNULUS SURFACES AND THE INCLUSION OF GETTERING MATERIALS.

LH_2 RECIRCULATION LINES:

THE TYPE I, II AND III LINES ARE SINGLE SECTIONS EACH COMPRISED OF THREE BELLOWS ENCLOSED GIMBAL UNIVERSAL ANGULAR FLEX JOINTS. THE LINES TRANSFER THE ENGINE PRECONDITIONING LH_2 FROM THE RECIRCULATION PUMPS TO THE

PREVALVES. THE LINES INTERFACE WITH THE OUTLET OF THE LH_2 RECIRCULATION PUMP AND WITH A PORT ON THE LH_2 PREVALVE FOR ENGINES 1, 2, AND 3, RESPECTIVELY. THE LINES ARE SUPPORTED BY THE RECIRCULATION PUMP AND THE PREVALVE.

THE TYPE IV AND VI LINES ARE SINGLE SECTIONS, EACH COMPRISED OF FOUR BELLOWS ENCLOSED GIMBAL UNIVERSAL ANGULAR FLEX JOINTS, THREE AT THE ENGINE FLUID PANEL END AND ONE AT THE MANIFOLD END. THE LINES RETURN THE ENGINE PRECONDITIONING LH_2 FROM THE FLUID PANEL-ENGINE RECIRCULATION RETURN FLANGE, FOR ENGINES 1 AND 3, RESPECTIVELY, TO THE RECIRCULATION RETURN MANIFOLD. THE LINES ARE SUPPORTED BY THE FLUID PANEL, THE MANIFOLD, AND WITH INTERMEDIATE LINE SUPPORTS ATTACHED TO THE THRUST STRUCTURE.

THE TYPE V LINE IS A SINGLE SECTION COMPRISED OF THREE BELLOWS ENCLOSED GIMBAL UNIVERSAL ANGULAR MOTION FLEX JOINTS. THE LINE RETURNS THE ENGINE PRECONDITIONING LH_2 FROM THE FLUID PANEL-ENGINE RECIRCULATION RETURN FLANGE FOR ENGINE 2 TO THE RECIRCULATION RETURN MANIFOLD. THE LINE IS SUPPORTED BY THE FLUID PANEL AND THE MANIFOLD.

THE TYPE VII LINE (MANIFOLD) IS A SINGLE SECTION COMPRISED OF A SERIES OF "WYES" AND ELBOWS MANIFOLDING THE TYPE IV, V, VI, VII, VIII, AND IX LINES TOGETHER. THERE ARE NO FLEXIBLE JOINTS IN THE TYPE VII MANIFOLD; HOWEVER, THERE ARE THERMAL COMPENSATING BELLOWS IN THE VACUUM JACKET ADJACENT TO THE TYPE IV, V, VI, AND IX LINE ATTACH FLANGES.

THE TYPE VIII LINE IS A SINGLE SECTION COMPRISED OF THREE BELLOWS ENCLOSED GIMBAL UNIVERSAL ANGULAR MOTION FLEX JOINTS. THE LINE RETURNS THE ENGINE PRECONDITIONING LH_2 AND THE REPLENISHING LH_2 TO THE LH_2 ET. THE TYPE VIII LINE INTERFACES WITH THE TYPE VII MANIFOLD AND WITH THE 4-INCH DISCONNECT AT THE ET/ORB UMBILICAL DISCONNECT ASSEMBLY. THE LINE IS SUPPORTED AT THE MANIFOLD AND AT THE DISCONNECT END PLUS ONE INTERMEDIATE LINE SUPPORT AND A SINGLE AXIS "BOOKEND" SUPPORT NEAR THE MANIFOLD END OF THE LINE.

REPLENISHING LINE:

THE TYPE IX LINE IS A SINGLE SECTION COMPRISED OF THREE BELLOWS ENCLOSED GIMBAL UNIVERSAL ANGULAR MOTION FLEX JOINTS AND IS USED FOR TRANSFERRING TOPPING AND REPLENISHING FLOW FROM THE LH_2 FILL AND DRAIN LINE TO

COMPONENT: LH_2 RECIRCULATION AND REPLENISHMENT LINES

(MC271-0075)

THE TYPE VII MANIFOLD AND INTO THE LH_2 ET. THE TYPE IX LINE INTERFACES WITH, AND IS SUPPORTED BY, THE REPLENISHING VALVE ATTACHED TO THE LH_2 FILL AND DRAIN LINE AND TYPE VII MANIFOLD. THE BELLOWS IN THE 3 GIMBALS ARE LINED TO PREVENT FLOW INDUCED VIBRATION.

HIGH-POINT BLEED LINE:

THE TYPE X LINE IS A SINGLE SECTION COMPRISED OF THREE BELLOWS ENCLOSED GIMBAL UNIVERSAL ANGULAR MOTION FLEX JOINTS AND IS USED FOR BLEEDING GH_2 ENTRAPPED AT THE HIGH-POINT IN THE LH_2 17-INCH LINE IN LAUNCH ATTITUDE. THE LINE INTERFACES WITH THE ET/ORB 17-INCH DISCONNECT AND THE HIGH-POINT BLEED VALVE ATTACHED TO THE THRUST STRUCTURE. LINE SUPPORT IS PROVIDED BY THE ET/ORB DISCONNECT AND THE HIGH-POINT BLEED VALVE, PLUS A SUPPORT ATTACHED TO STRUCTURE NEAR THE VALVE END OF THE LINE.

EACH LH_2 RECIRCULATION AND REPLENISHMENT LINE CONTAINS A BURST DISC, A VACUUM SENSING THERMOCOUPLE GAUGE TUBE, AN EVACUATION VALVE, AND A GETTER CONTAINER. (SEE PAGES 7046-7, 7780-1, 7808-2, 7839-5-8.) THE TYPES IV, V, AND VI CONTAIN A PRESSURE INSTRUMENTATION PORT. THE TYPE VII MANIFOLD CONTAINS TEMPERATURE AND PRESSURE PORTS. THE TYPE VIII LINE CONTAINS AN LH_2 SYSTEM REPRESSURIZATION PORT AT THE 4-INCH DISC FLANGE.

THE GIMBAL FLEX JOINTS IN THE TYPES I THROUGH VI, VIII, IX, AND X LINES COMBINE TO ACCOMMODATE INSTALLATION TOLERANCES AND THE RELATIVE MOTION INDUCED DURING PRECONDITIONING, TANKING AND ENGINE FIRING.

DESIGN PARAMETERS AND FEATURES: RECIRCULATION SYSTEM LINES

	LINE TYPE							
	I	II	III	IV	V	VI	VII	VIII
CURRENT CONFIGURATION:	(-0011)	(-0012)	(-0013)	(-0024)	(-0025*)	(-0016)	(-0017)	(-0018)
OPERATING PRESSURE MAXIMUM (PSIG):	55	55	55	105	105	105	105	105
PROOF PRESSURE (PSIG):	83	83	83	158	158	158	158	158
BURST PRESSURE (PSIG):	110	110	110	210	210	210	210	210

COMPONENT: LH_2 RECIRCULATION AND REPLENISHMENT LINES

(MC271-0075)

LINE SIZE:

PRESSURE CARRIER:	2-IN.	2-IN.	2-IN.	2-IN.	2-IN.	2-IN.	2-4 IN.	4-IN.
WEIGHT (MAXIMUM):	11 LB	13 LB	11 LB	24 LB	11 LB	19 LB	32 LB	34 LB
MAXIMUM VACUUM JACKET PRESSURE:	1000 MICRONS Hg (TYPICAL)							
FLOW CAPACITY:								
AT 60 PSIG; ΔP OF 0.1	1.5 LB/S	1.5 LB/S	1.5 LB/S					
AT 55 PSIG; ΔP OF 0.75				1.5 LB/S	1.5 LB/S	1.5 LB/S	7.5 LB/S	7.5 LB/S

MATERIALS (TYPICAL ALL LINES)
PRESSURE CARRIER: INCONEL 718 VACUUM JACKET: INCONEL 718 BELLOWS: INCONEL 718 GIMBAL JOINT: INCONEL 718 GETTER:* PALLADIUM OXIDE (PdO)

*-0015 ON OV-102 AND OV-103

COMPONENT: LH_2 RECIRCULATION AND REPLENISHMENT LINES

(MC271-0075)

DESIGN PARAMETERS AND FEATURES: LH_2 REPLENISHMENT AND TOPPING LINE (LINE TYPE IX)	
CURRENT CONFIGURATION:	(-0019)
OPERATING PRESSURE, MAXIMUM:	105 PSIG
PROOF PRESSURE:	158 PSIG
BURST PRESSURE:	210 PSIG
LINE SIZE:	
PRESSURE CARRIER:	2-INCH
WEIGHT (MAXIMUM):	12 LB
MAXIMUM VACUUM JACKET PRESSURE:	1000 MICRONS Hg
FLOW CAPACITY (AT 55 PSIG; ΔP OF 0.75):	3.0 LB/S
DESIGN PARAMETERS AND FEATURES: HIGH POINT BLEED LINE (LINE TYPE X)	
CURRENT CONFIGURATION:	(-0010)
OPERATING PRESSURE, MAXIMUM:	55 PSIG
PROOF PRESSURE:	110 PSIG
BURST PRESSURE:	220 PSIG

COMPONENT: LH_2 RECIRCULATION AND REPLENISHMENT LINES

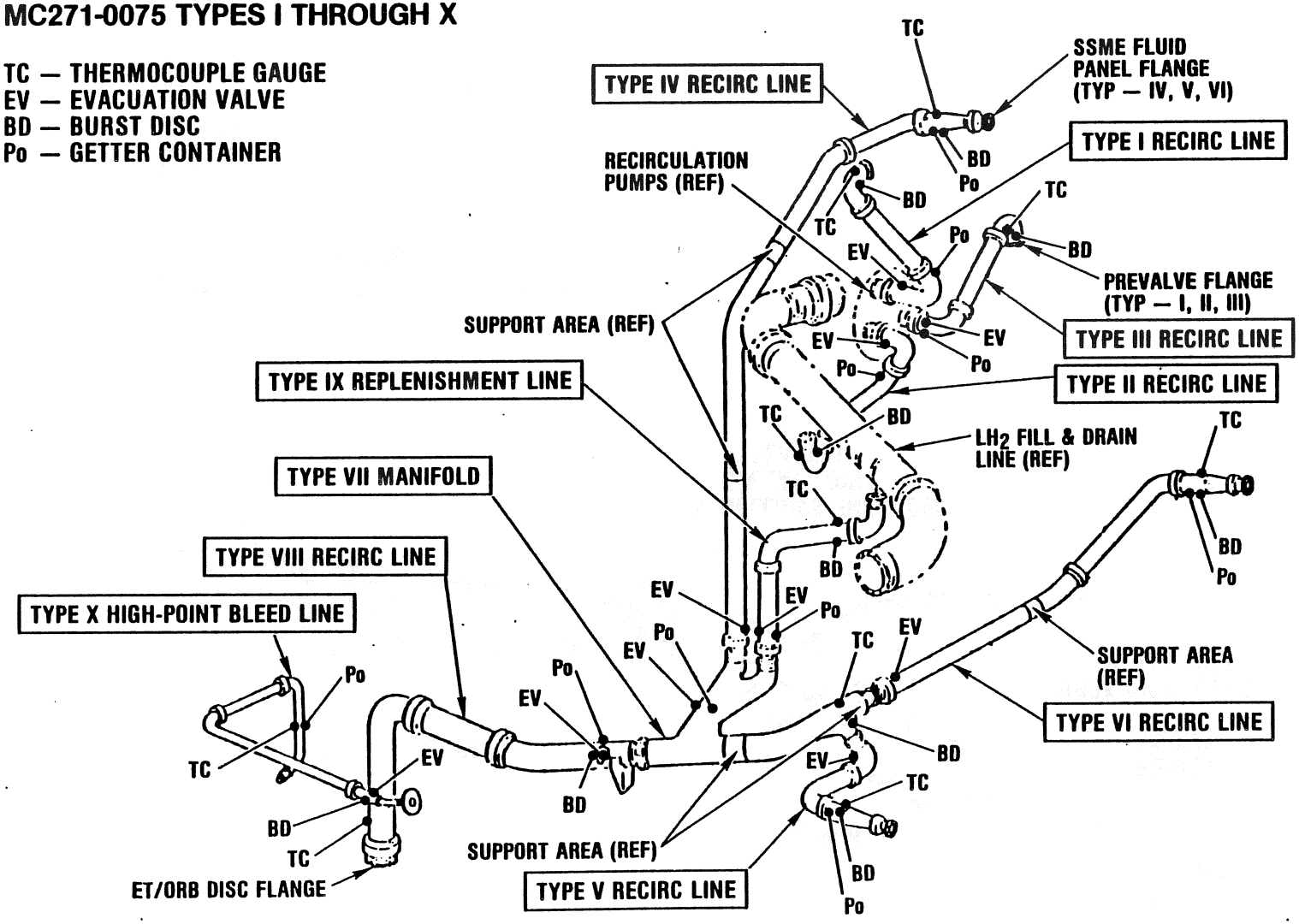
(MC271-0075)

LINE SIZE:	
PRESSURE CARRIER:	0.75 IN.
WEIGHT (MAXIMUM):	11 LB
MAXIMUM VACUUM JACKET PRESSURE:	1000 MICRONS Hg
FLOW CAPACITY (AT 3.5 PSIG; ΔP OF 0.50):	0.037 (GH_2)

COMPONENT: LH_2 RECIRCULATION AND REPLENISHMENT LINES
(MC271-0075)

MC271-0075 TYPES I THROUGH X

TC — THERMOCOUPLE GAUGE
EV — EVACUATION VALVE
BD — BURST DISC
Po — GETTER CONTAINER



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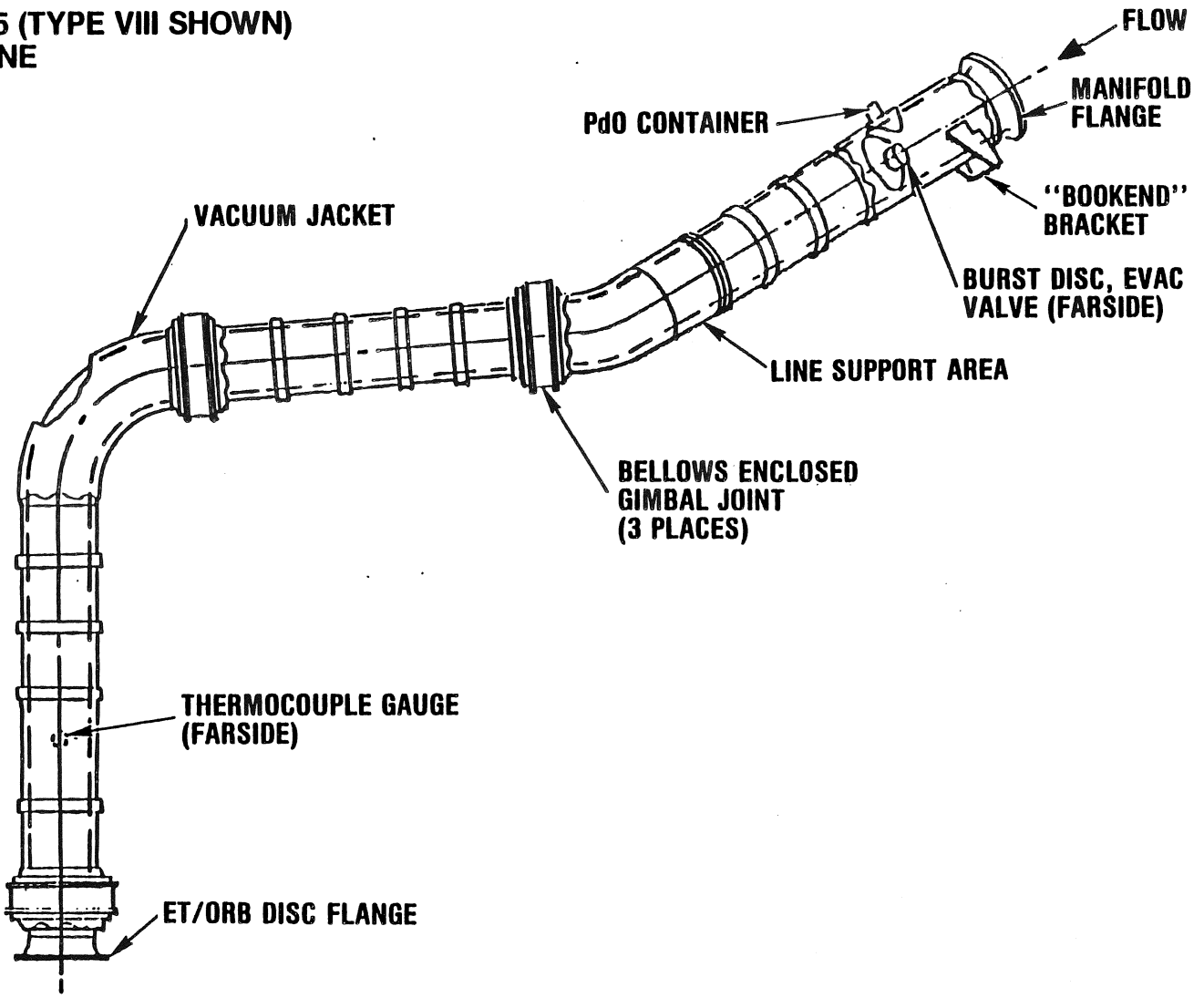
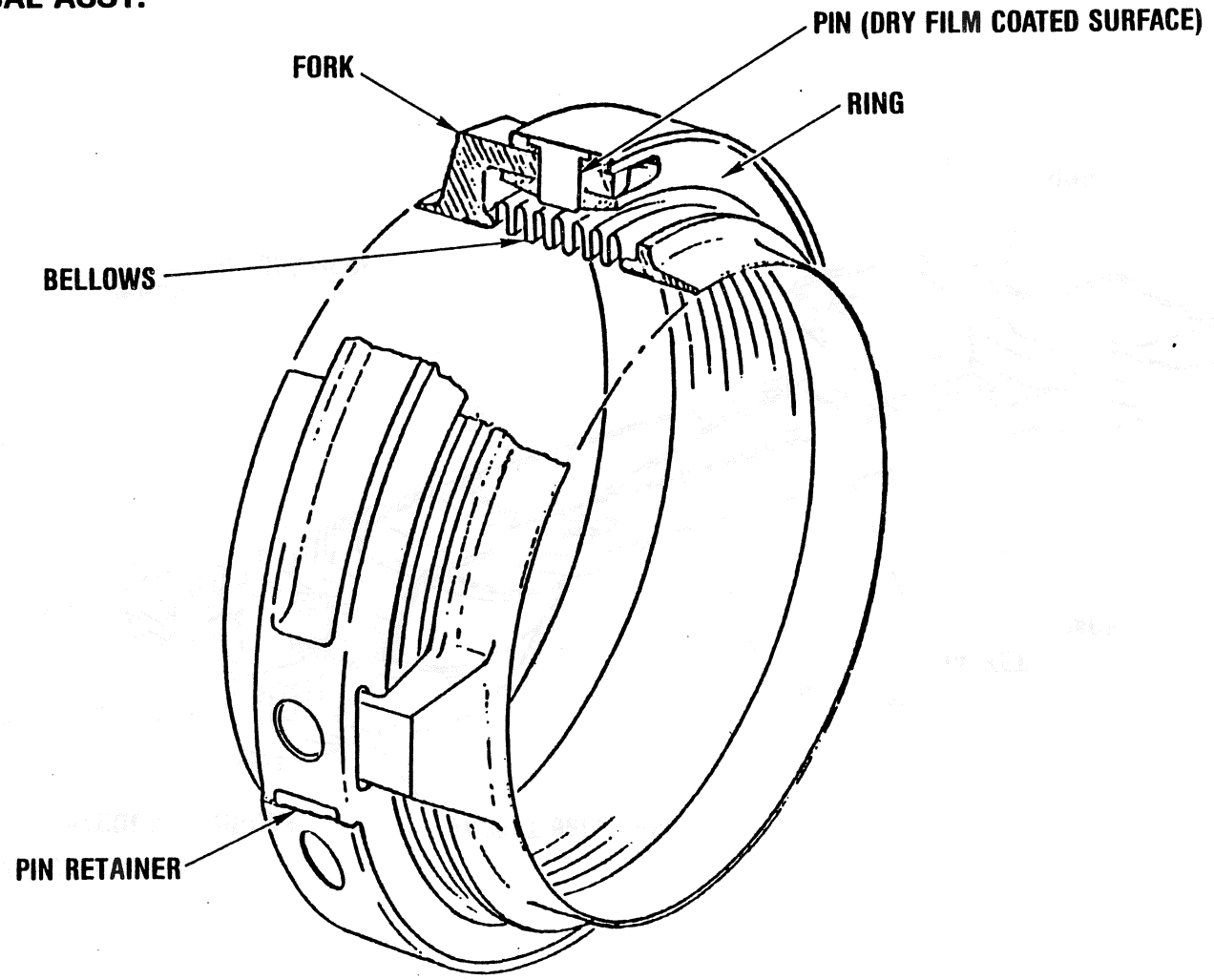
COMPONENT: LH_2 RECIRCULATION AND REPLENISHMENT LINES
(MC271-0075)

MC271-0075 (TYPE VIII SHOWN)
TYPICAL LINE



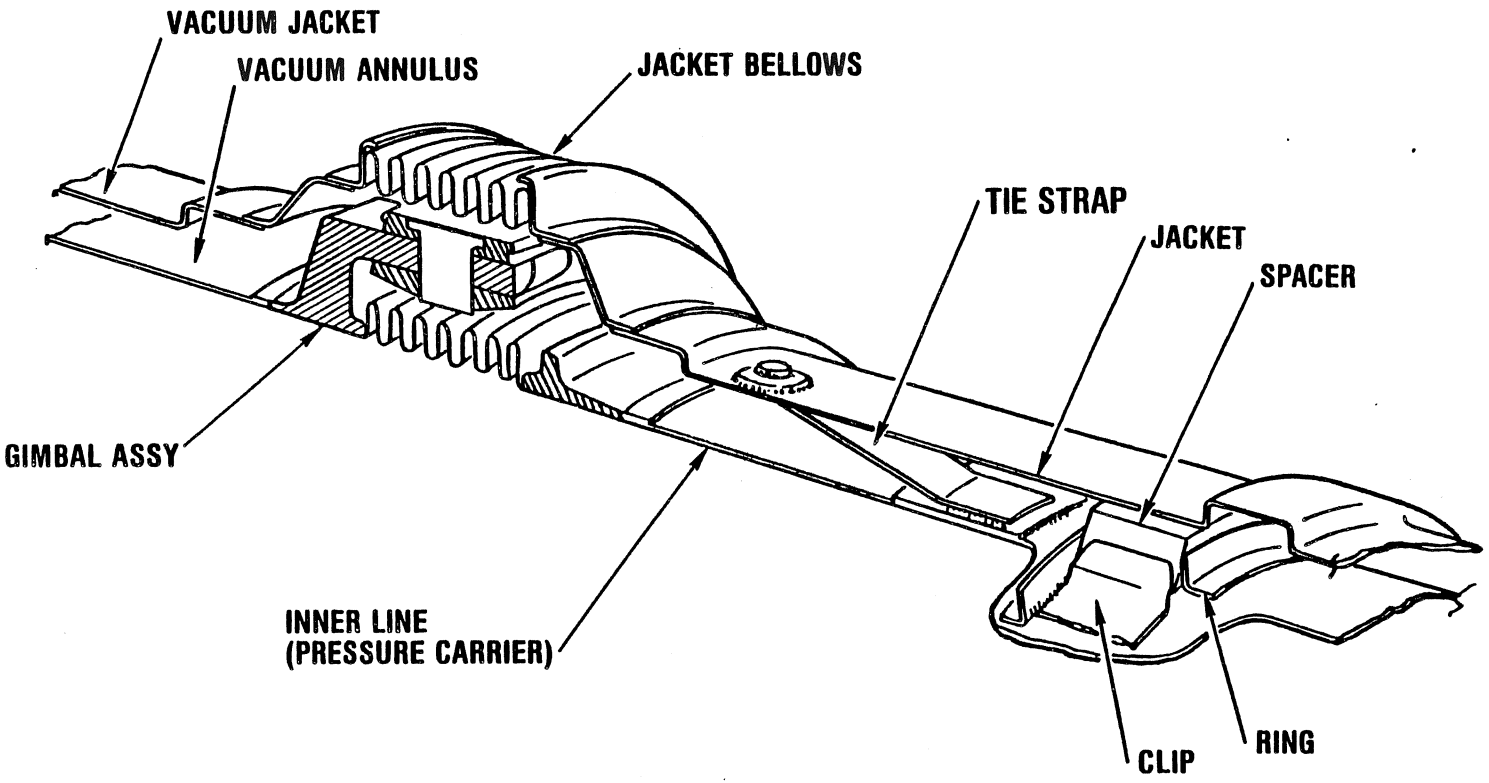
COMPONENT: LH_2 RECIRCULATION AND REPLENISHMENT LINES
(MC271-0075)

TYPICAL GIMBAL ASSY:



COMPONENT: LH_2 RECIRCULATION AND REPLENISHMENT LINES
(MC271-0075)

TYPICAL VACUUM JACKET/PRESSURE CARRIER SECTION



COMPONENT: LO_2 FILL AND DRAIN LINE

(MC271-0076)

FMEA/CIL NO. 03-1-0307

VENDOR : AMETEK/STRAZA
P/N RI : MC271-0076-0002*
: MC271-0076-0012

NOTE:
FOR LH_2, -0011 & -0021
SEE PAGE NO. 6

P/N VENDOR: 8-031175-1
: 8-031175-3
QUANTITY : 1 PER END ITEM

VEHICLE EFFECTIVITY:	102*	103	104	105
	X	X	X	X

ITEM:

LINE, LO_2 FILL, FOAM INSULATED (OV-103 AND SUBS). 8 INCH DIA. (FH1)

FUNCTION:

THE 8 INCH DIAMETER LINE EXTENDS FROM THE OUTBOARD FILL VALVE (PV9) TO THE INBOARD FILL VALVE (PV10). THE LINE PROVIDES A MEANS OF LOADING AND DRAINING THE ET LO_2 TANK THROUGH THE PROPELLANT FEED SYSTEM. THE INBOARD VALVE IS CLOSED AFTER COMPLETION OF LOADING IN ORDER TO GRAVITY-DRAIN THE FILL LINE (PRIOR TO CLOSING THE OUTBOARD FILL AND DRAIN VALVE). BOTH THE INBOARD AND OUTBOARD VALVES REMAIN CLOSED DURING ENGINE OPERATION. THE INBOARD VALVE ALSO INCORPORATES A RELIEF VALVE, RELIEVING ANY PRESSURE BUILD-UP IN THE FILL LINE. THE LINE TRANSPORTS OXYGEN OVERBOARD DURING PROPELLANT INERTING (NOMINAL MISSIONS) AND DUMP (RTLS AND TAL MISSIONS). THE LINE IS PRESSURIZED WITH HELIUM DURING ENTRY. THE LINE INCORPORATES PENETRATIONS FOR LO_2 PRESSURE AND TEMPERATURE TRANSDUCERS.

DESIGN:

THE LO_2 FILL AND DRAIN LINE IS OF SINGLE WALL CONSTRUCTION. ON MPTA AND OV-102, THE LINE IS UNINSULATED (BARE). ON OV-103 AND SUBS, AND SPARES, THE LINE IS THERMALLY INSULATED BY PRE-CAST FOAM INSULATION SECTIONS CONTAINED WITHIN AN LO_2 COMPATIBLE MATERIAL ENVELOPE WITH AN ALUMINUM TAPE EXTERNAL OVERWRAP. A VAPOR BARRIER BOOT IS INSTALLED OVER THE FLEX JOINTS. THE LINE ENCOMPASSES THREE BELLOWS ENCLOSED GIMBAR UNIVERSAL ANGULAR MOTION FLEX JOINTS. THE LINE INTERFACES WITH, AND IS SUPPORTED BY, THE FILL AND DRAIN VALVE AT THE LO_2 T-O UMBILICAL ON THE SIDEWALL AND THE FILL AND DRAIN VALVE MOUNTED ON THE LO_2 FEEDLINE TYPE V MANIFOLD.

COMPONENT: LO_2 FILL AND DRAIN LINE

(MC271-0076)

THE GIMBAR FLEX JOINTS COMBINE TO ACCOMMODATE THE INSTALLATION TOLERANCES AND THE RELATIVE MOTIONS INDUCED DURING TANKING, DETANKING, AND ENGINE FIRING.

THE PRESSURE CARRIER PORTION OF THE LINE ASSEMBLY IS CONSTRUCTED OF INCONEL 718 AND INCORPORATES THREE FLEXIBLE JOINTS AND A FLANGE AT EACH END. THE FLEXIBLE JOINTS INCORPORATE MULTI-PLY BELLOWS TO MINIMIZE STRESS LEVELS AND FLOW LINERS TO ELIMINATE FLOW INDUCED VIBRATION. THE FLEXIBLE JOINTS PROVIDE FREE MOVEMENT WITHOUT BINDING TO ACCOMMODATE THERMAL, STRUCTURAL AND VIBRATION INDUCED DEFLECTIONS.

THE MAXIMUM OPERATING PRESSURE DURING GROUND FILL OR DRAIN IS 103 PSIG (AT 10,000 GPM, MINUS 297 DEG F) AND 260 PSIG AT STATIC CONDITIONS. THE MAXIMUM OPERATING PRESSURE DURING LIFTOFF, BOOST, ORBIT, REENTRY, AND LANDING (LINE EMPTY OF FLUID) IS 275 PSIG. THE PROOF PRESSURE FACTOR IS 1.2 (330 PSIG) AND THE BURST PRESSURE FACTOR IS 1.5 (413 PSIG). THE PRESSURE CARRIER WILL WITHSTAND AN IMPLOSION PRESSURE OF AT LEAST 22 PSID AND THERMAL CHANGE OF 90 DEG F TO MINUS 320 DEG F WITHOUT PERMANENT DISTORTION OR LEAKAGE.

THE USEFUL DYNAMIC LIFE IS 14.2 HOURS (EQUIVALENT TO 100 ORBITER MISSIONS). THE PRESSURE CARRIER MEETS THE FRACTURE ANALYSIS REQUIREMENT FOR 400 MISSIONS. STRUCTURAL ANALYSIS INDICATES POSITIVE (GREATER THAN 1.4) MARGINS OF SAFETY FOR CONDITIONS OF LINE OPERATION.

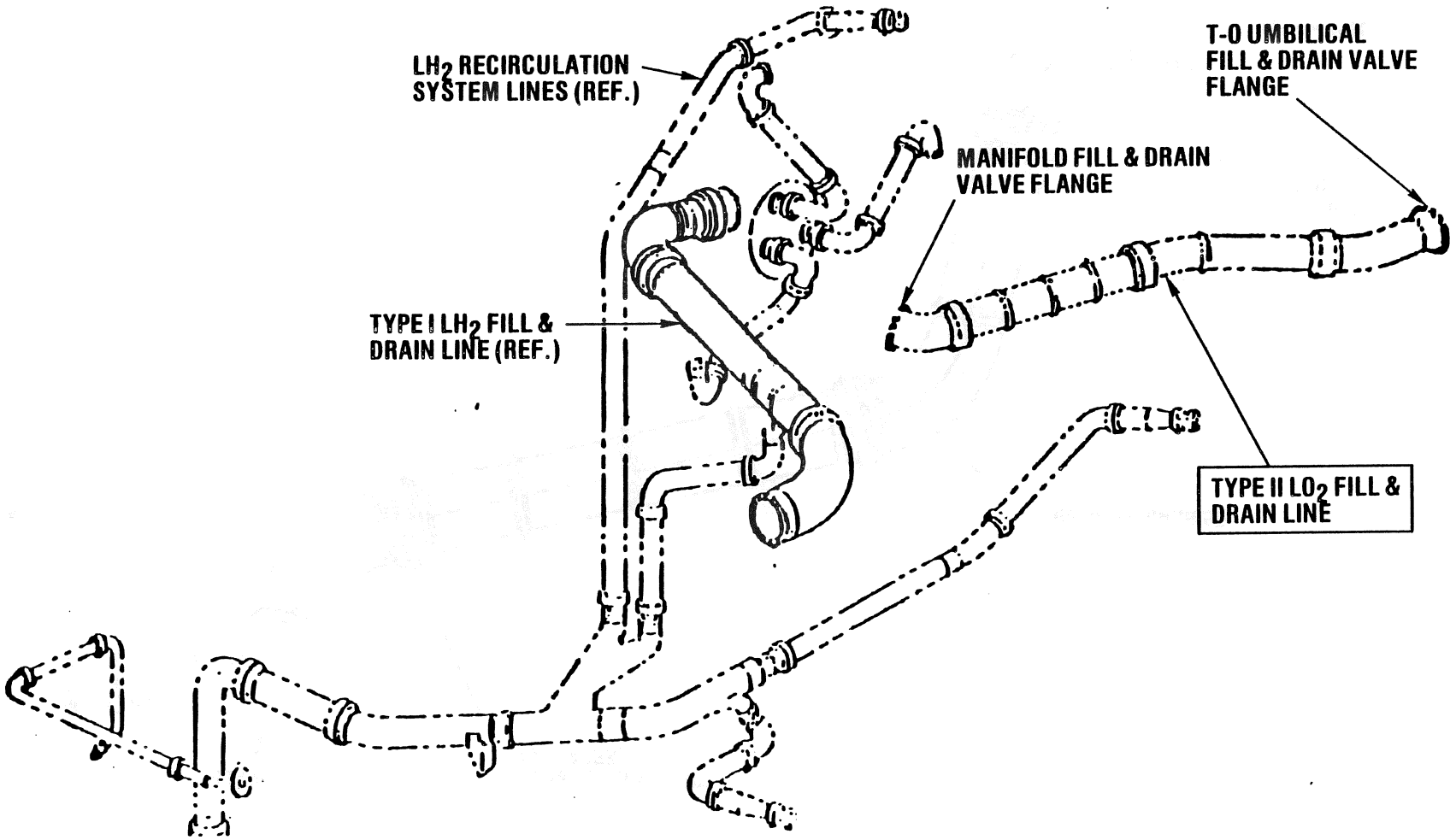
DESIGN PARAMETERS AND FEATURES:

OPERATING PRESSURE, MAXIMUM:	275 PSIG
PROOF PRESSURE:	330 PSIG
BURST PRESSURE:	413 PSIG
LINE SIZE:	
PRESSURE CARRIER:	8-INCH
FLOW CAPACITY:	10,000 GPM
PRESSURE DROP:	7.0 PSI AT 5,000 GPM
WEIGHT (MAXIMUM):	82 LB* 112 LB**

INSULATION:	NONE* FOAM**

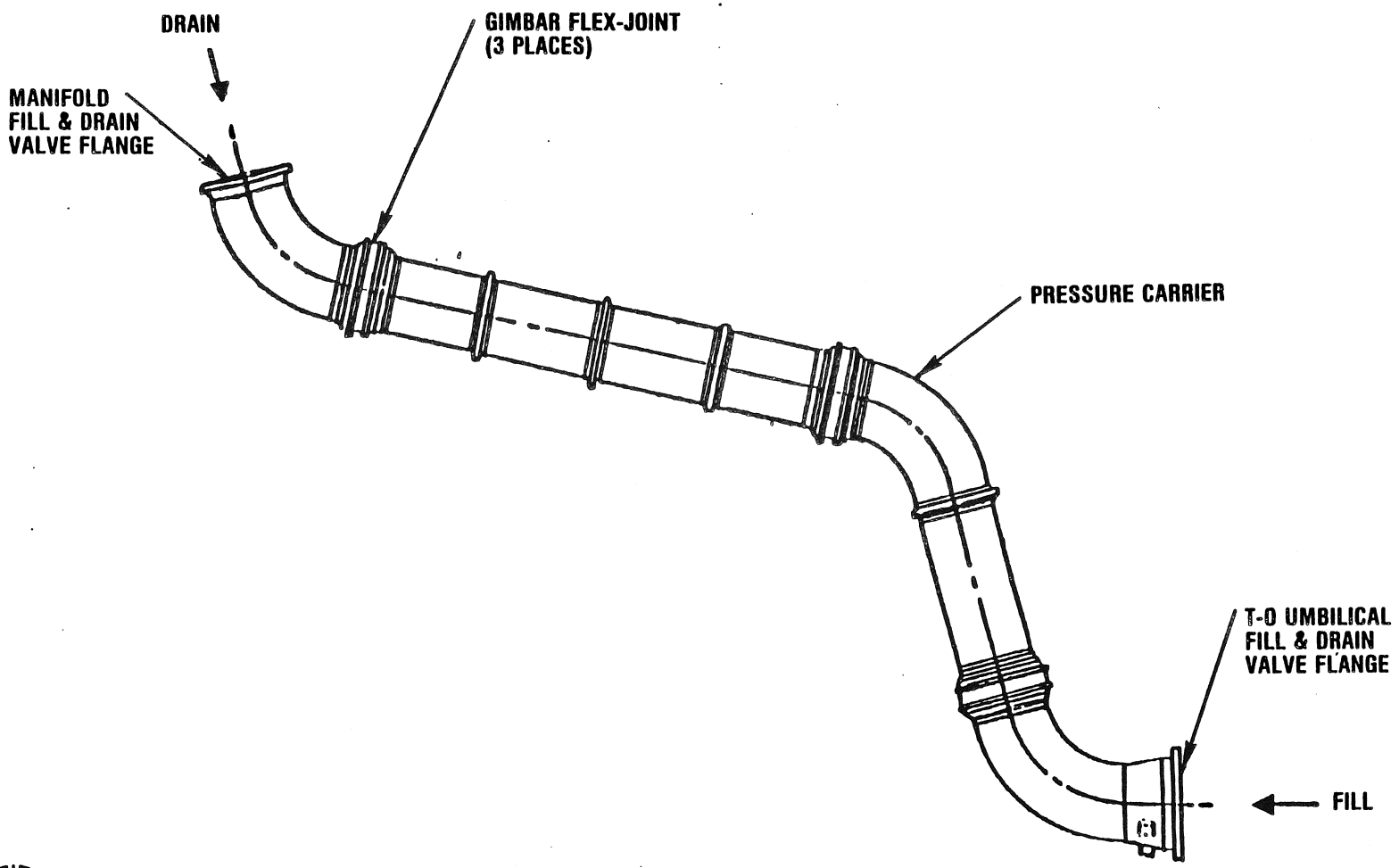
*MC271-0076-0002
**MC271-0076-0012

COMPONENT: LO_2 FILL AND DRAIN LINE
(MC271-0076)



COMPONENT: LO_2 FILL AND DRAIN LINE
(MC271-0076)

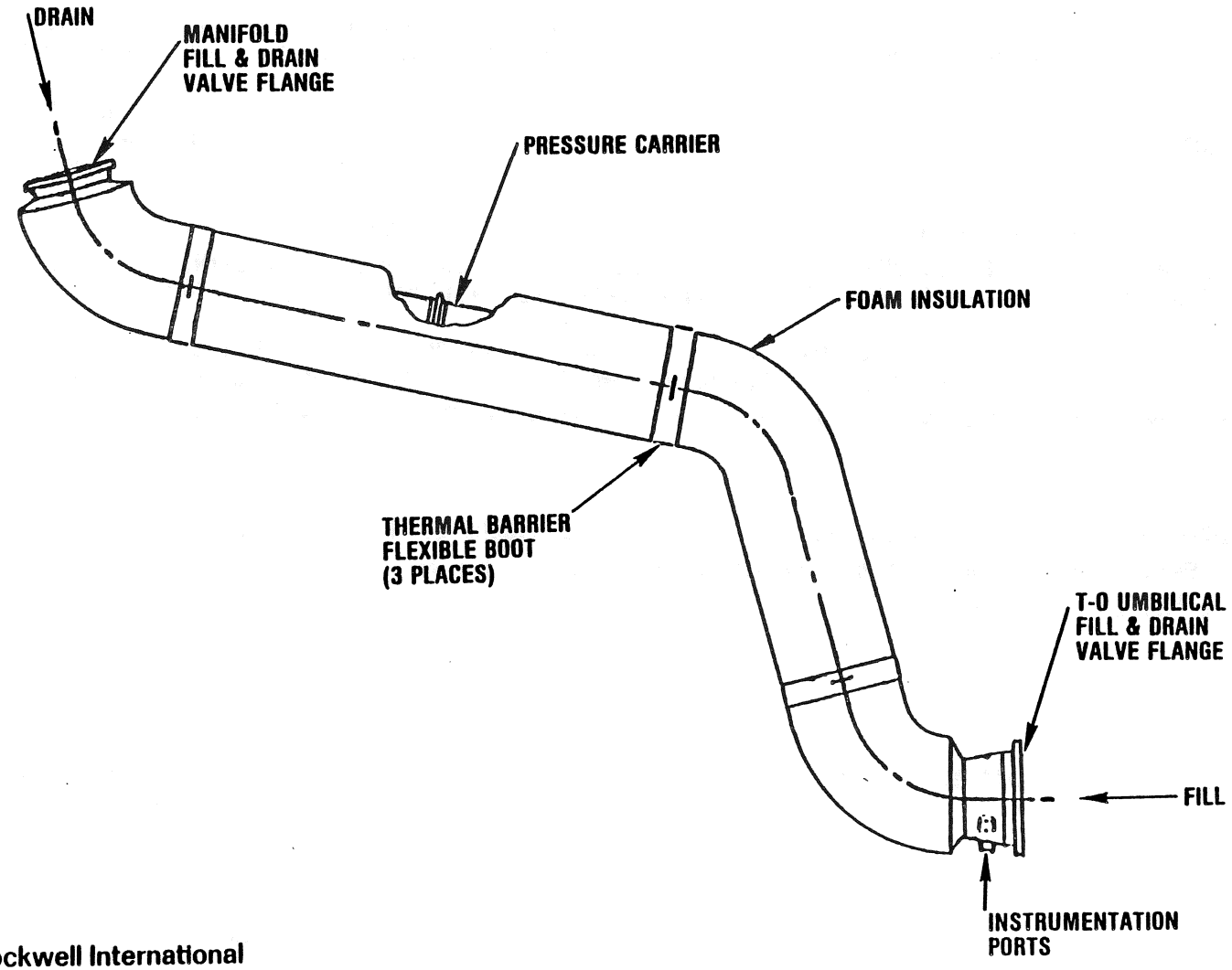
MC271-0076-0002
(MPTA AND OV102 ONLY)



COMPONENT: LO_2 FILL AND DRAIN LINE

(MC271-0076)

MC271-0076-0012
(OV103 & SUBS & SPARES)



COMPONENT: LH_2 FILL AND DRAIN LINE

(MC271-0076)

VENDOR : AMETEK/STRAZA
P/N RI : MC271-0076-0011*
: MC271-0076-0021

P/N VENDOR: 8-031174-3*
: 8-031174-7
QUANTITY : 1 PER EACH EFFECTIVITY

VEHICLE EFFECTIVITY:	102*	103	104	105
	X	X	X	X

FUNCTION: LH_2 FILL AND DRAIN LINE

THE LINE DIRECTS THE FLOW OF FUEL (LIQUID HYDROGEN) FROM THE FILL AND DRAIN VALVE AT LH_2 T-O UMBILICAL TO OR FROM THE FILL AND DRAIN VALVE ON THE LH_2 FEEDLINE MANIFOLD FOR THE PURPOSE OF FILLING OR DRAINING THE ET LH_2 TANK. THE LINE IS ALSO USED TO SUPPLY TOPPING OR REPLENISHMENT FUEL TO THE REPLENISHMENT LINE.

DESIGN:

THE LH_2 FILL AND DRAIN LINE IS FABRICATED WITH A DOUBLE WALL TO FORM A VACUUM-TIGHT ANNULUS. THIS ANNULUS IS EVACUATED TO PROVIDE A HIGH PERFORMANCE THERMAL INSULATION. THE VACUUM INSULATION IS ENHANCED BY ELECTROPOLISHING ALL ANNULUS SURFACES AND THE INCLUSION OF GETTERING MATERIALS.

THE LINE IS A SINGLE SECTION COMPRISED OF THREE BELLOWS ENCLOSED GIMBAR UNIVERSAL ANGULAR MOTION FLEX JOINTS. THE LINE INTERFACES WITH, AND IS SUPPORTED AT, THE FILL AND DRAIN VALVE AT LH_2 T-O UMBILICAL ON THE SIDEWALL AND THE FILL AND DRAIN VALVE MOUNTED ON THE LH_2 FEEDLINE TYPE V MANIFOLD.

THE LINE CONTAINS A BURST DISC, A VACUUM SENSING THERMOCOUPLE GAUGE TUBE, A VACUUM EVACUATION VALVE, AND A GETTER CONTAINER. (7046-7, 7780-1, 7808-2, 7839-5-8). THE LINE ALSO HAS PRESSURE AND TEMPERATURE INSTRUMENTATION PORTS.

THE GIMBAR FLEX JOINTS COMBINE TO ACCOMMODATE INSTALLATION TOLERANCES AND THE RELATIVE MOTIONS INDUCED DURING TANKING OR DETANKING AND ENGINE FIRING.

COMPONENT: LH_2 FILL AND DRAIN LINE

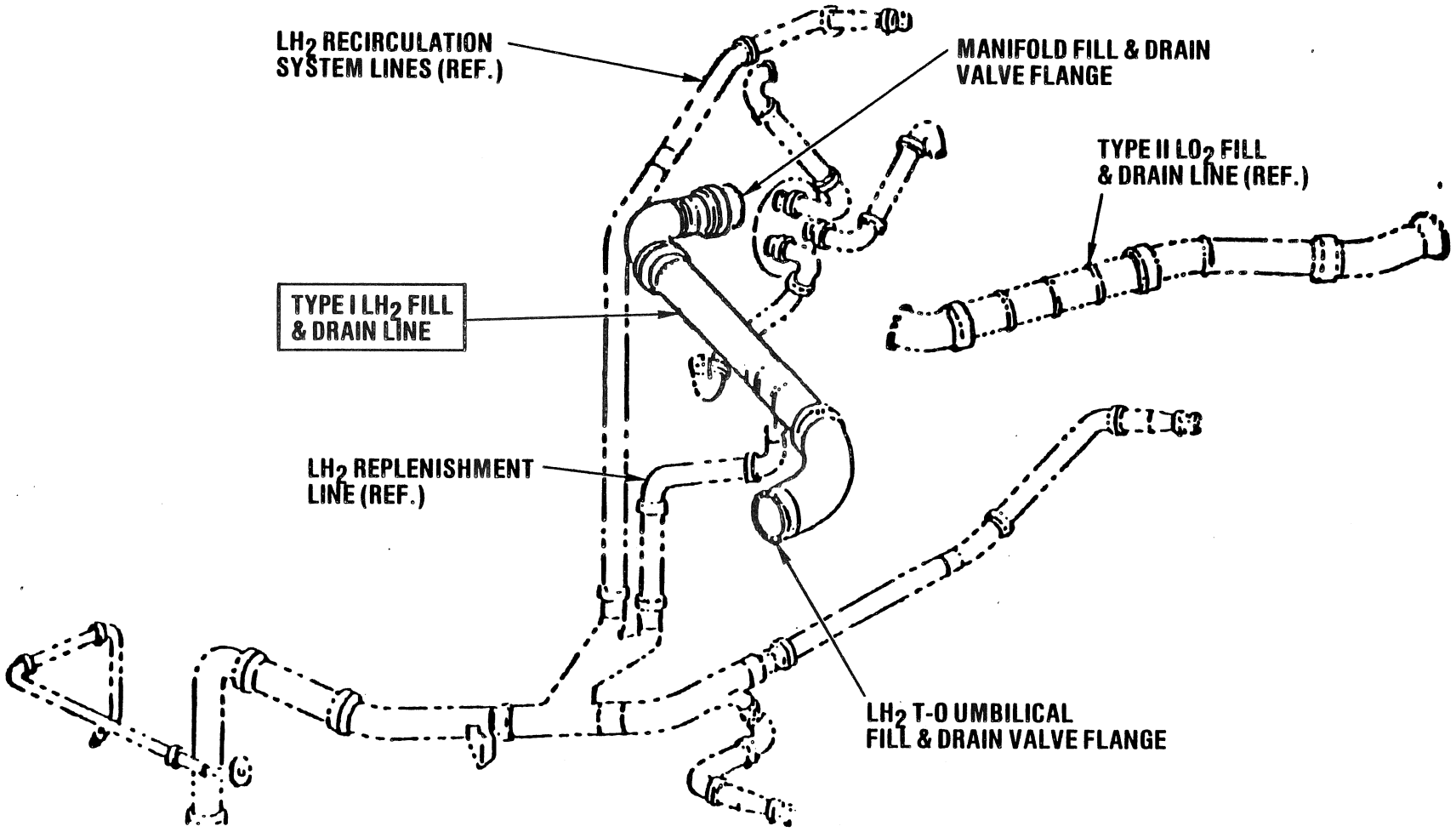
(MC271-0076)

DESIGN PARAMETERS AND FEATURES:

OPERATING PRESSURE, MAXIMUM:	105 PSIG
PROOF PRESSURE:	126 PSIG
BURST PRESSURE:	158 PSIG
LINE SIZE:	8.00-INCH
FLOW CAPACITY (MAX):	12000 GPM
PRESSURE DROP (MAX):	3.4 PSI
WEIGHT:	122 LBS (MAX)
MAXIMUM VACUUM JACKET PRESSURE:	1000 MICRONS Hg
EXTERNAL HEAT TRANSFER:	30.0 BTU/HR.

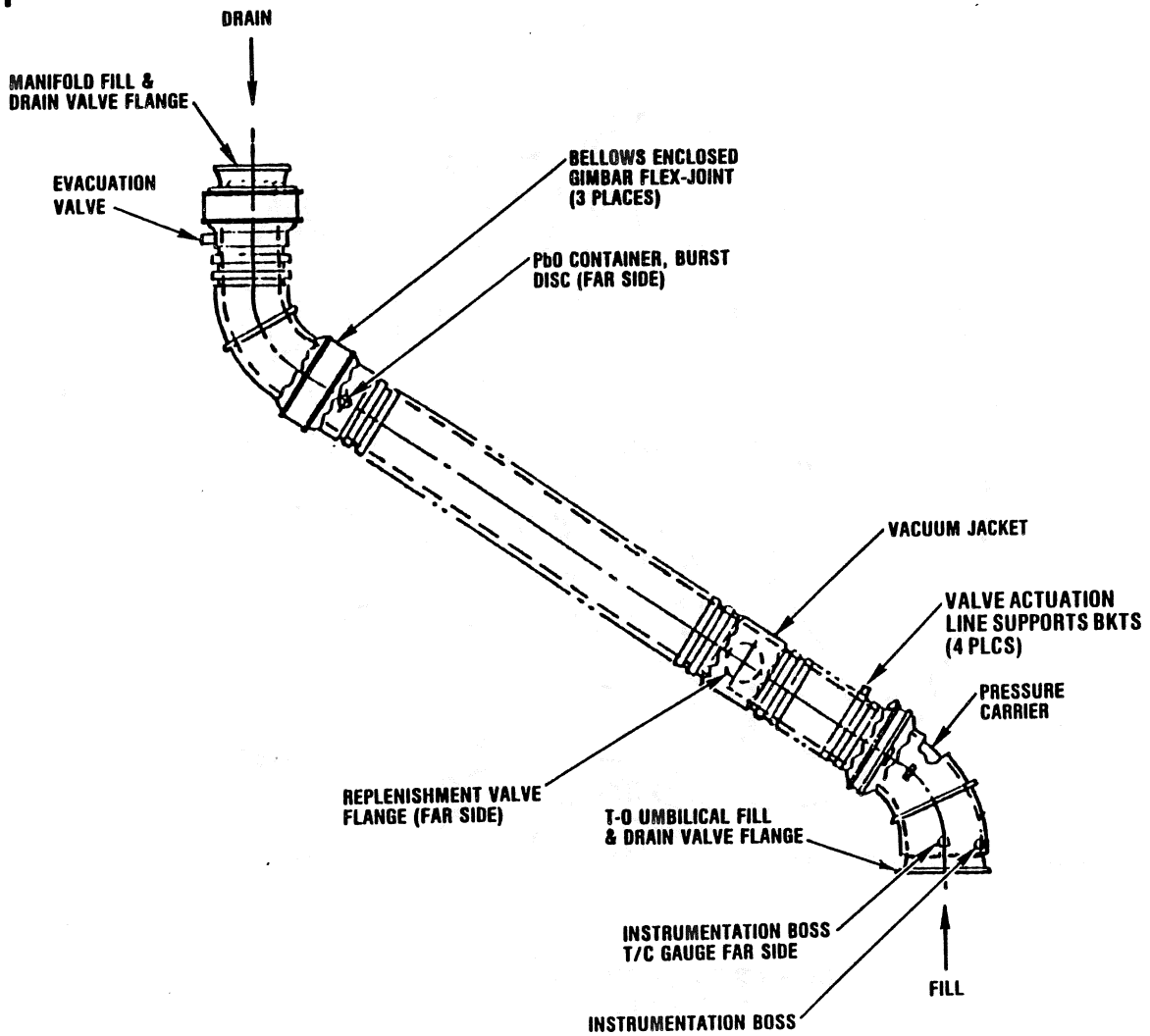
MATERIALS
PRESSURE CARRIER: INCONEL 718 VACUUM JACKET: INCONEL 718 BELLOWS: INCONEL 718 FLEX JOINTS: INCONEL 718 GETTER: PALLADIUM OXIDE (PdO)

COMPONENT: LH_2 FILL AND DRAIN LINE
(MC271-0076)



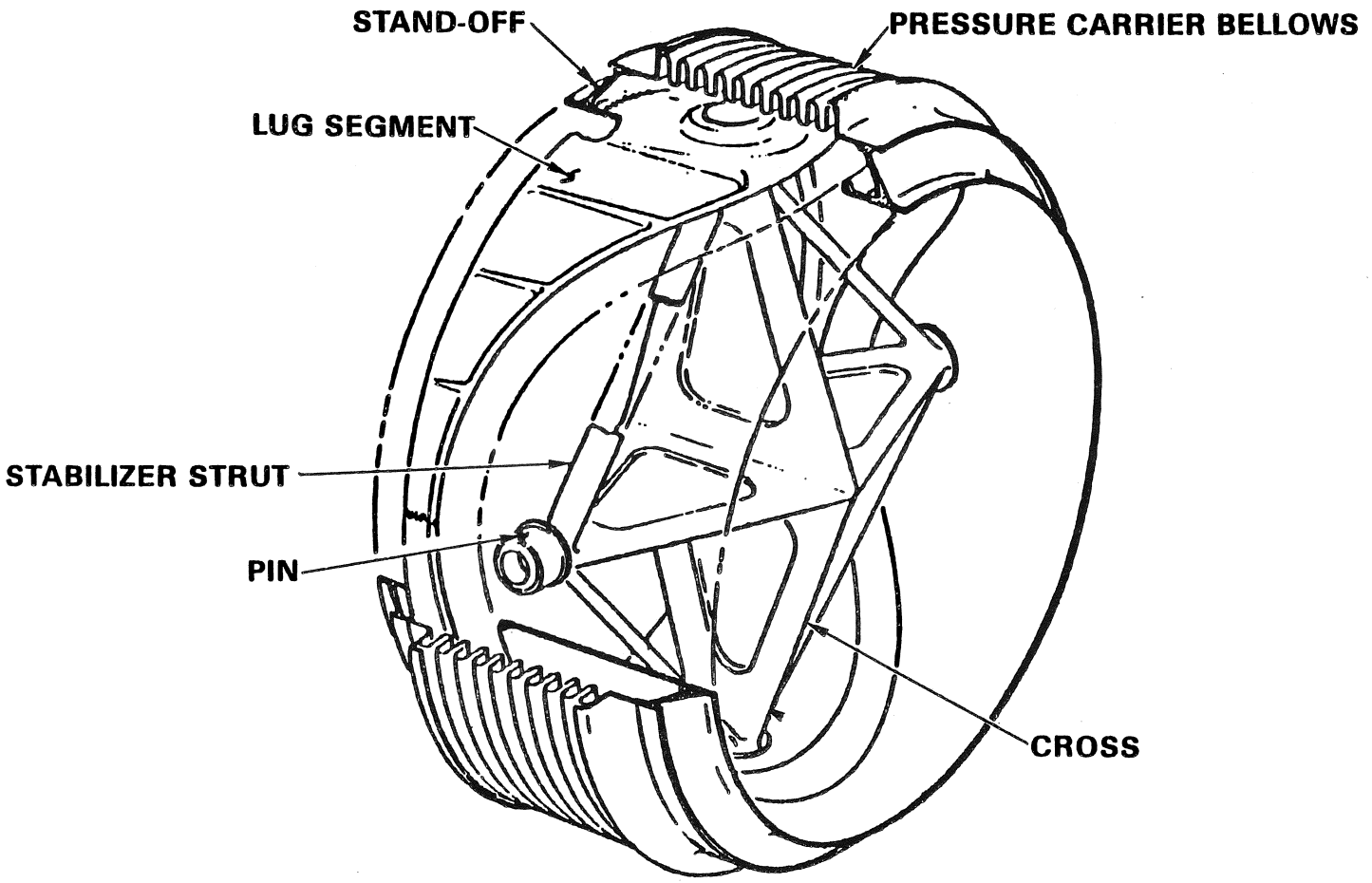
COMPONENT: LH_2 FILL AND DRAIN LINE
(MC271-0076)

MC271-0076 -0011
-0021



COMPONENT: LH_2 FILL AND DRAIN LINE
(MC271-0076)

TYPICAL GIMBAR FLEX-JOINT
(ALSO APPLICABLE TO THE LO_2 FILL & DRAIN LINE)



COMPONENT: METAL FLEX HOSE ASSEMBLIES

(MC271-0077)

FMEA/CIL NO. 03-1-0607
-0604
-0633

VENDOR : COAST METAL CRAFT
P/N RI : MC271-0077-XXXX (SEE BELOW)
P/N VENDOR:
QUANTITY : 1 PER P/N PER END ITEM

TYPE IV, -0014
TYPE V, -0015
TYPE VI, -0016
TYPE VII, -0017
TYPE VIII, -0018
TYPE IX, -0029

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM: FLEX HOSE LINE ASSEMBLY

FUNCTION:

THE FLEXIBLE HOSE ASSEMBLIES ACCOMMODATE THE VIBRATION AND STRUCTURAL DEFLECTIONS BETWEEN THE FORWARD THRUST STRUCTURE AND THE LH_2 AND LO_2 ET/ORBITER 17-INCH DISCONNECT PNEUMATIC PANELS AS PART OF THE MPS FEEDLINE REPRESSURIZATION AND HELIUM SUPPLY SYSTEM. THE HOSES ARE CLUSTERED IN GROUPS OF THREE AT EACH DISCONNECT. THE INDIVIDUAL HOSES, IN EACH CLUSTER, MAINTAIN THEIR RELATIVE POSITION TO EACH OTHER BY THE USE OF ELBOW TIES MADE OF KEVLAR CORD MATERIAL.

DESIGN:

THE TYPE IV, V, VI, VII, AND VIII FLEXIBLE HOSE ASSEMBLY IS CONSTRUCTED USING 321 CRES TUBING FLEX LINES (321 CRES BELLOWS COVERED WITH ONE OR MORE LAYERS OF 321 CRES BRAID) AND ONE MECHANICAL FITTING (DYNATUBE) MADE OF 718 INCONEL. THE ASSEMBLY IS DESIGNED TO A MINIMUM FACTOR OF SAFETY OF 2.0 PROOF PRESSURE AND 4.0 BURST PRESSURE. THE TYPE IX IS IDENTICAL EXCEPT THE BELLOWS IS INCO 718 MATERIAL AND THE BRAID IS 2 LAYERS OF INCO 600 MATERIAL.

COMPONENT: METAL FLEX HOSE ASSEMBLIES

(MC271-0077)

THE COMPONENT IS COMPRISED OF TWO IN-LINE FLEXIBLE SECTIONS SEPARATED BY A 90-DEGREE ELBOW. ONE END OF THE HOSE ASSEMBLY INTERFACES WITH A BRAZE FITTING. THE OPPOSITE END IS A STRAIGHT SECTION CONTAINING A DYNA-TUBE FITTING. EACH FLEX SECTION HAS A CONVOLUTED FLEXIBLE PRESSURE CARRIER AND A BRAIDED-WIRE LOAD CARRYING SHEATH AND END FITTINGS.

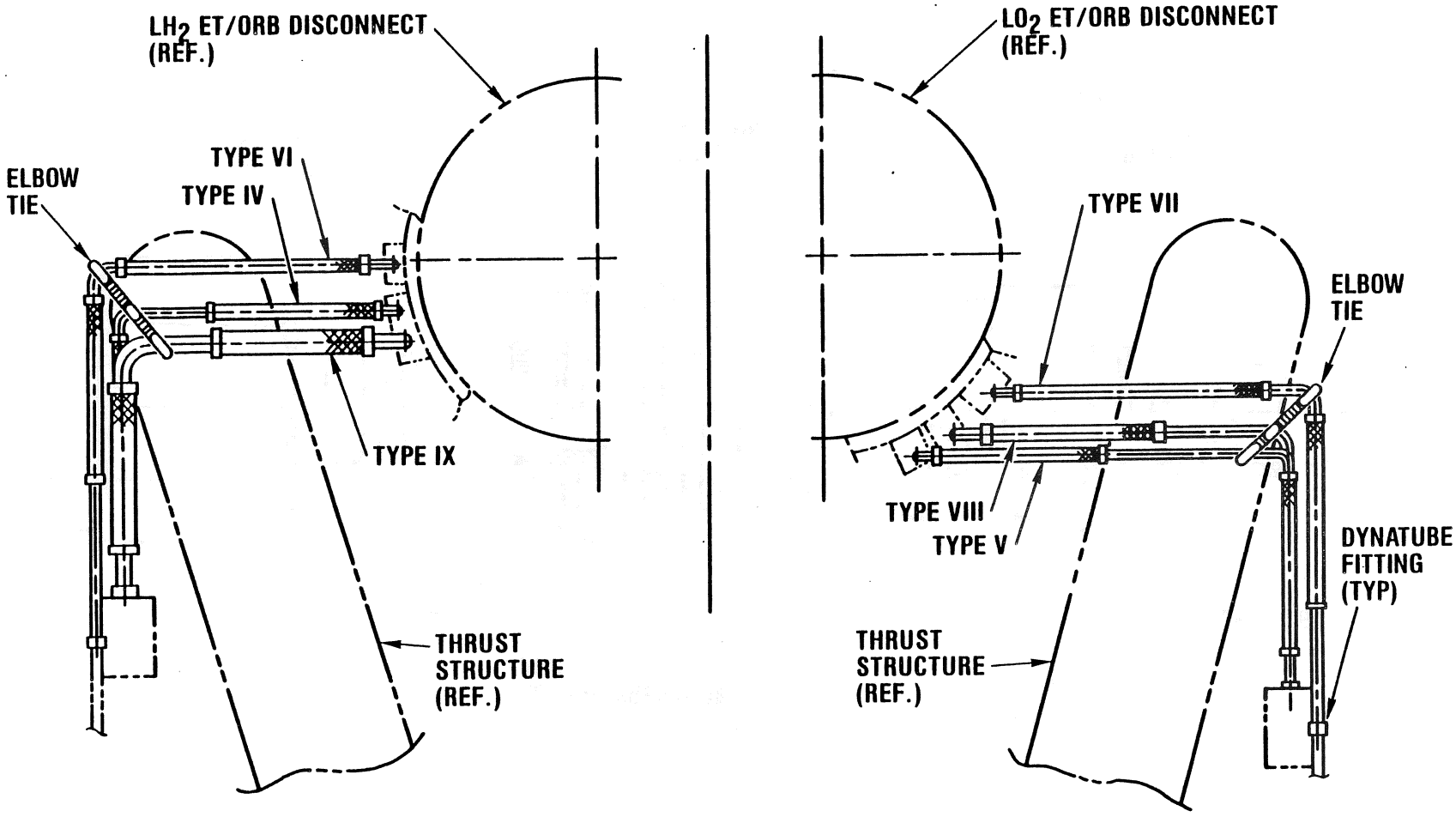
THE CONVOLUTED PRESSURE CARRIER IS MADE FROM AT LEAST TWO PLYS OF SEAMLESS TUBING. THE NUMBER OF PLYS AND LENGTH IS DEPENDENT UPON THE PRESSURE, FLOW, AND INSTALLATION REQUIREMENTS. THE CONVOLUTED SECTION IS WELDED TO THE END FITTINGS, AND ENCASED IN A BRAIDED-WIRE SHEATH WHICH IS ALSO WELDED TO THE END FITTINGS. THE BRAIDED-WIRE PROVIDES THE TENSILE LOAD CARRYING CAPABILITY FOR THE CONVOLUTED SECTION.

DESIGN PARAMETERS:

	TYPE					
	LH_2 SIDE			LO_2 SIDE		
	IV	VI	IX	V	VII	VIII
CURRENT CONFIGURATION:	(-0014)	(-0016)	(-0029)	(-0015)	(-0017)	(-0018)
NOMINAL TUBE O.D., INCHES	.250	.375	.750	.250	.375	.500
FLEX LENGTH, INCHES	9.88	10.24 & 14.24	9.25	9.88	10.24	10.13
FLEX O.D., INCHES (APPROXIMATELY)	.50	.70	1.33	.50	.70	.75
PRESSURE, PSIG:						
OPERATING, MAXIMUM	83	1275	300	413	1275	525
PROOF:	110	1700	400	550	1700	700
BURST:	220	3400	800	1100	3400	1400
WEIGHT, MAXIMUM, LB	.39	.71	1.77	.40	.71	.98

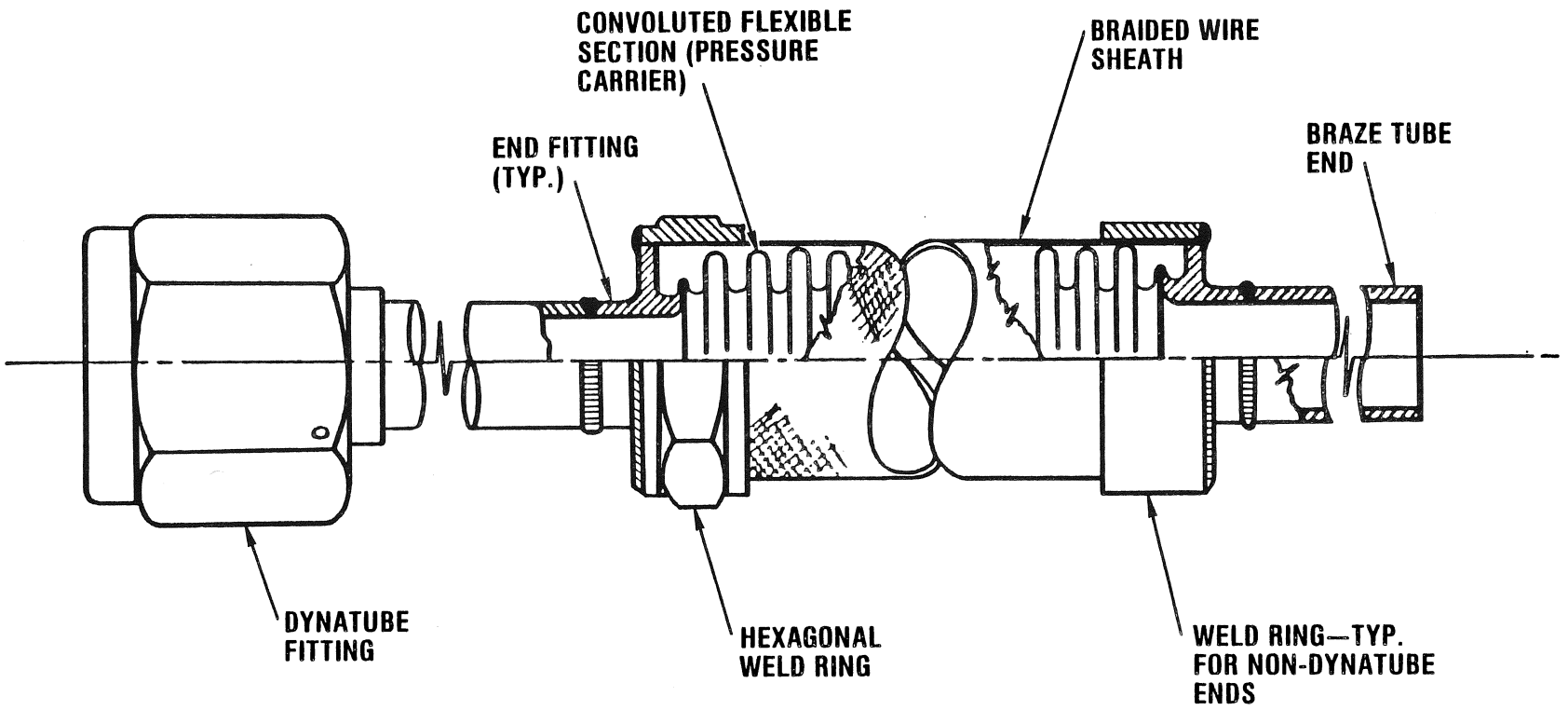
COMPONENT: METAL FLEX HOSE ASSEMBLIES
(MC271-0077)

TYPES IV, V, VI, VII, VIII, & IX ORBITER ORIENTATION



COMPONENT: METAL FLEX HOSE ASSEMBLIES
(MC271-0077)

TYPICAL HOSE ASSEMBLY



COMPONENT: DISCONNECT 1-INCH HELIUM AND GASEOUS NITROGEN

(MC276-0003)

FMEA/CIL NO: 03-1-0201
03-1-0409
03-1-0501
03-1-0517

VENDOR : FAIRCHILD
P/N RI : MC276-0003-0006 (FLT)
: MC276-0003-0007 (FLT)
: MC276-0003-0008 (GND)
P/N VENDOR: 74332000-1
QUANTITY : (4) MATED PAIRS/PER END ITEM
: (1) -0006/-0008 MATED PAIR
(3) -0007/-0008 MATED PAIRS

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

DISCONNECT, HELIUM FILL 1-INCH SELF SEALING WITH REVERSE FLOW CHECK VALVES (PD8, PD9, PD10, PD14).

FUNCTION:

MATED--THE MATED TYPE I/II DISCONNECTS PROVIDE FLOW AND LEAK CHECK CAPABILITY BETWEEN THE GROUND (UMBILICAL PLATE) AND THE ORBITER FOR PURPOSES OF:

(A) PURGING AND PRESSURIZATION OF THE LO_2 AND LH_2 TANKS (PD9, 10).

(B) PRESSURIZATION (FILLING) OF THE HELIUM STORAGE BOTTLES (PD8).

(C) PURGING OF THE ENGINES WITH GN_2 (PD14).

(D) LEAK CHECKING THE TYPE I DISCONNECT FOR REVERSE FLOW LEAKAGES, FOR USAGES (A) AND (B) ABOVE, THROUGH THE TYPE II DISCONNECT WHEN GROUND PRESSURE REDUCED TO ZERO.

COMPONENT: DISCONNECT 1-INCH HELIUM AND GASEOUS NITROGEN

(MC276-0003)

UNMATED--AFTER LAUNCH THE UNMATED TYPE I/II DISCONNECTS PROVIDE THE FOLLOWING:

(A) TYPE I SERVES AS A BACKUP CHECK VALVE TO PREVENT LOSS OF ORBITER'S HELIUM AND PROPELLANTS.

(B) TYPE II SERVES AS A CHECK VALVE FOR THE GROUND SUPPLY IN CASE OF A FAILURE OF ANY GROUND SUPPORT EQUIPMENT (REGULATORS, VALVES, ETC.)

TYPE III--THE TYPE III IS USED WHEN GROUND UMBILICAL CARRIER PLATE IS NOT AVAILABLE, FOR SYSTEM CHECKOUT AND POSTLANDING PURGING AND/OR SAFING. THE TYPE III IS MANUALLY ENGAGED AND DISENGAGED FROM THE TYPE I.

DESIGN:

THE DISCONNECT IS A MECHANICAL FLOW-THROUGH DEVICE. THE TYPE I ORBITER, TYPE II GROUND AND TYPE III GROUND SECTION (WITH INTEGRAL LOCKING FEATURE) CONTAIN SPRING LOADED NORMALLY CLOSED POPPETS. THE POPPET OF THE TYPE I IS ACTUATED OPEN DURING PRESSURIZATION AND CLOSED AUTOMATICALLY WHEN FLOW IS STOPPED. THE POPPETS OF THE TYPE II AND III ARE MECHANICALLY ACTUATED TO THE OPEN POSITION DURING ENGAGEMENT AND CLOSE AUTOMATICALLY DURING DISENGAGEMENT WITH THE TYPE I. INDEXING KEYS ON THE TYPE I PREVENTS INADVERTENT INSTALLATION WITH AN IMPROPER TYPE III CONFIGURATION.

THE DISCONNECT IS COMPRISED OF TWO HALVES: THE FLIGHT (ORBITER) HALF AND THE GROUND HALF. THE FLIGHT HALF IS A CHECK VALVE REQUIRING 15 PSID (GROUND TO ORBITER) MINIMUM CRACKING PRESSURE. THE NORMALLY CLOSED GROUND HALF DISCONNECT IS OPENED MECHANICALLY UPON ENGAGEMENT WITH THE FLIGHT HALF. THE FLIGHT AND GROUND DISCONNECT HALVES INCORPORATE A SWIVEL WHICH ACTS AS A SELF-ALIGNING DEVICE FOR PROPER ENGAGEMENT (THE TWO HALVES CAN ACCOMMODATE 0.062-INCH RADIAL AND 0.5 DEGREE MISALIGNMENT).

STRUCTURAL FAILURE OF ANY OF THE FOLLOWING PARTS MAY CAUSE THE FLIGHT HALF TO FAIL TO CLOSE: SWIVEL, POPPET, POPPET GUIDE, SEAL RETAINER (ALL OF A286 CRES), AND THE SEAL (VESPEL). DESIGN FACTORS OF SAFETY ARE: PROOF - 1.5 (6,750 PSIG) FLIGHT HALF, 2.0 (9,000 PSIG) GROUND HALF; BURST - 2.4 (10,800 PSIG) FLIGHT HALF, 4.0 (18,000 PSIG) BURST. STRUCTURAL ANALYSIS, PERFORMED BY THE DISCONNECT SUPPLIER, INDICATES POSITIVE MARGINS OF SAFETY FOR ALL CONDITIONS OF DISCONNECT OPERATION, AND FRACTURE ANALYSES SHOW THAT ALL CRITICAL PARTS ARE SATISFACTORY FOR FOUR TIMES THE ORBITER LIFE OF 100 MISSIONS.

COMPONENT: DISCONNECT 1-INCH HELIUM AND GASEOUS NITROGEN

(MC276-0003)

THE DISCONNECT IS DESIGNED TO PREVENT FAILURE TO CLOSE DUE TO BINDING BY THE APPLICATION OF A DRY LUBRICANT (TIO-LUBE) TO ALL SLIDING SURFACES. ALSO THE POPPET STEM IS GUIDED FOR OVER 65% OF ITS LENGTH.

CONTAMINATION IS MINIMIZED BY THE USE OF MULTI-FILTERED HELIUM. GROUND SUPPLIED HELIUM (EITHER THROUGH THE T-O UMBILICAL OR THE TEST POINT COUPLINGS) IS FILTERED TO 25 MICRONS ABSOLUTE.

FAILURE TO REMAIN CLOSED COULD BE CAUSED BY ANY OF THE STRUCTURAL FAILURES DESCRIBED ABOVE FOR THE FAILS-TO-CLOSE CASE. STRUCTURAL FAILURE OF THE POPPET SPRING MAY RESULT IN FAILURE TO REMAIN CLOSED FOR LOW OR NO FLOW CONDITIONS. THAT SPRING IS OF 0.070 INCH DIAMETER ELGILOY WIRE, HAS A SPRING RATE OF 13.75 LB/INCH, AND EXERTS A FORCE OF 19 POUNDS IN THE INSTALLED CONDITION.

INTERNAL LEAKAGE IN BOTH HALVES IS PREVENTED BY THE USE OF VESPEL SEALS SEATING ONTO 16 MICRO-INCH SURFACE FINISHED A286 CRES SEATS.

DESIGN PARAMETERS:

OPERATING PARAMETERS:

TYPE	DASH NO.	PRESSURE RANGE	TEMP RANGE
I	-0006	0 - 4,500 PSIG	-250 TO 165°F
I	-0007	0 - 950 PSIG	-250 TO 165°F
II	-0008	0 - 4,500 PSIG	-250 TO 165°F

EXTERNAL LEAKAGE (MATED): 200 SCIM (GHe) (MAX)

EXTERNAL LEAKAGE (UNMATED):

TYPE	DASH NO.	FLOW DIRECTION	FLUID TEMP (°F)	PRESSURE (PSIG)	MAX ALLOW. LEAKAGE (SCIM)
I	-0006	CHECKED	-100 TO +350	4500^{+0}_{-100}	20
I	-0006	CHECKED	AMBIENT	5 ±1	1.0

COMPONENT: DISCONNECT 1-INCH HELIUM AND GASEOUS NITROGEN

(MC276-0003)

TYPE	DASH NO.	FLOW DIRECTION	FLUID TEMP (°F)	PRESSURE (PSIG)	MAX ALLOW. LEAKAGE (SCIM)
I	-0006	CHECKED	-250 TO -100	100 - 4500	150
I	-0007	CHECKED	AMBIENT	5 ±1	1.0
I	-0007	CHECKED	-250 TO -100	100 - 950	150
I	-0007	CHECKED	-100 TO +350	950 $^{+0}_{-50}$	20
II	-0008	CHECKED	-250 TO +165	0 - 4500	200

MATED DASH NO.	FLUID MEDIA	FLOW (LB/SEC)	INLET PRESS. (PSIG)	DIFF. PRESS (PSID)	FLUID TEMP (°F)
-0007/-0008	He	1.5 $^{+0}_{-0.2}$	800 ± 10	70 - 140	AMBIENT
-0007/-0008	He	0.6 $^{+0}_{-0.05}$	700 ± 10	18 - 36	AMBIENT
-0006/-0008	He	0.10 $^{+0}_{-0.02}$	4,100 ± 200	18 - 20	AMBIENT
-0007/-0008	GN_2	1.27 $^{+0}_{-0.2}$	675 $^{+0}_{-25}$	18 - 23	250 $^{+25}_{-0}$

COMPONENT: DISCONNECT 1-INCH HELIUM AND GASEOUS NITROGEN

(MC276-0003)

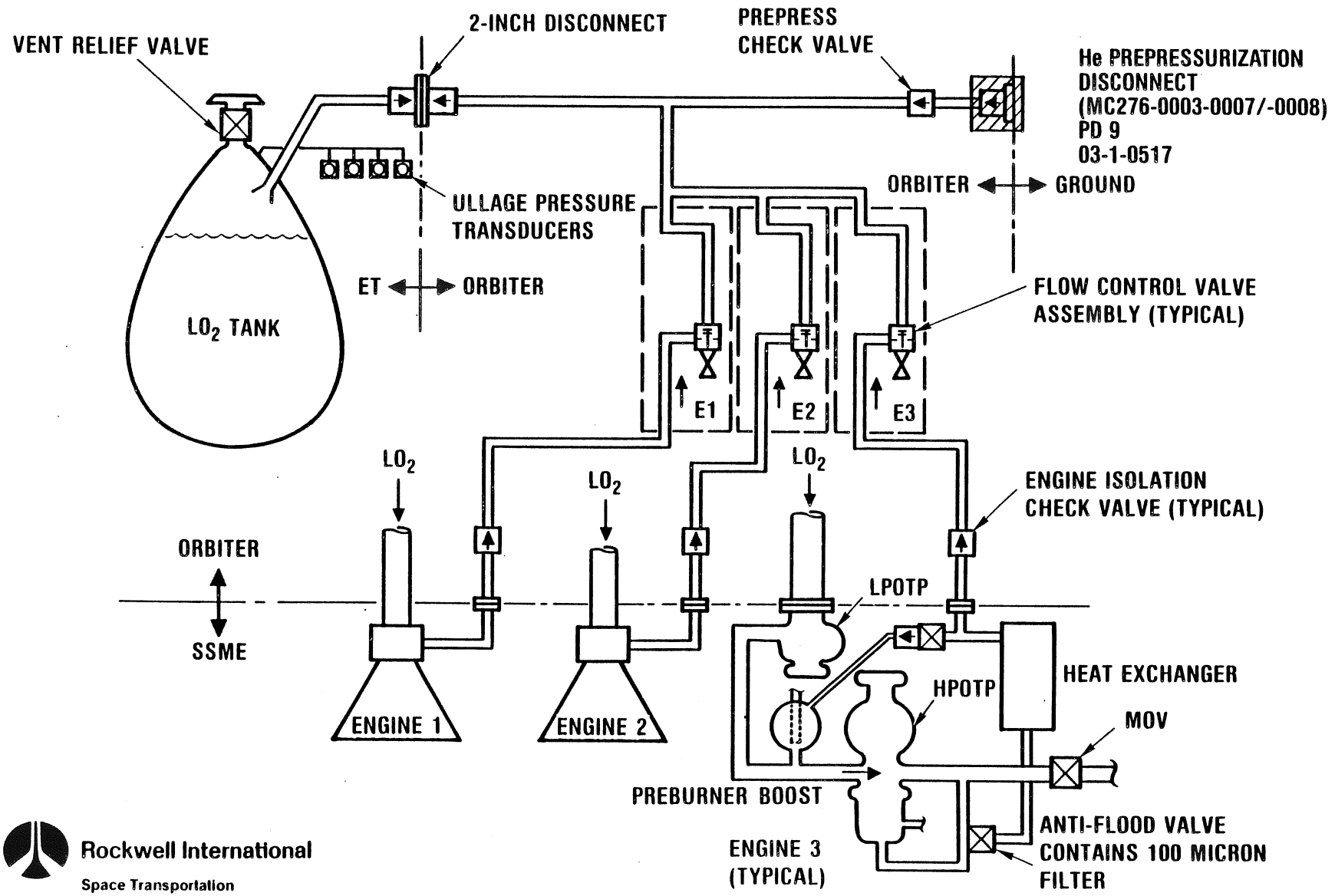
DESIGN FEATURES:

CRACKING/RESEAT	15 PSID
ENVELOPE DIMENSION	TYPE I 4-11/16 X 2.95
WEIGHT	TYPE I, 3.4 LB MAX; TYPE II, 5.7 LB MAX; TYPE III, 4.8 LB MAX
ALLOWABLE MISALIGNMENT	.062 RADIAL/.5° ANGULAR

COMPONENT: DISCONNECT 1-INCH HELIUM AND GASEOUS NITROGEN

(MC276-0003)

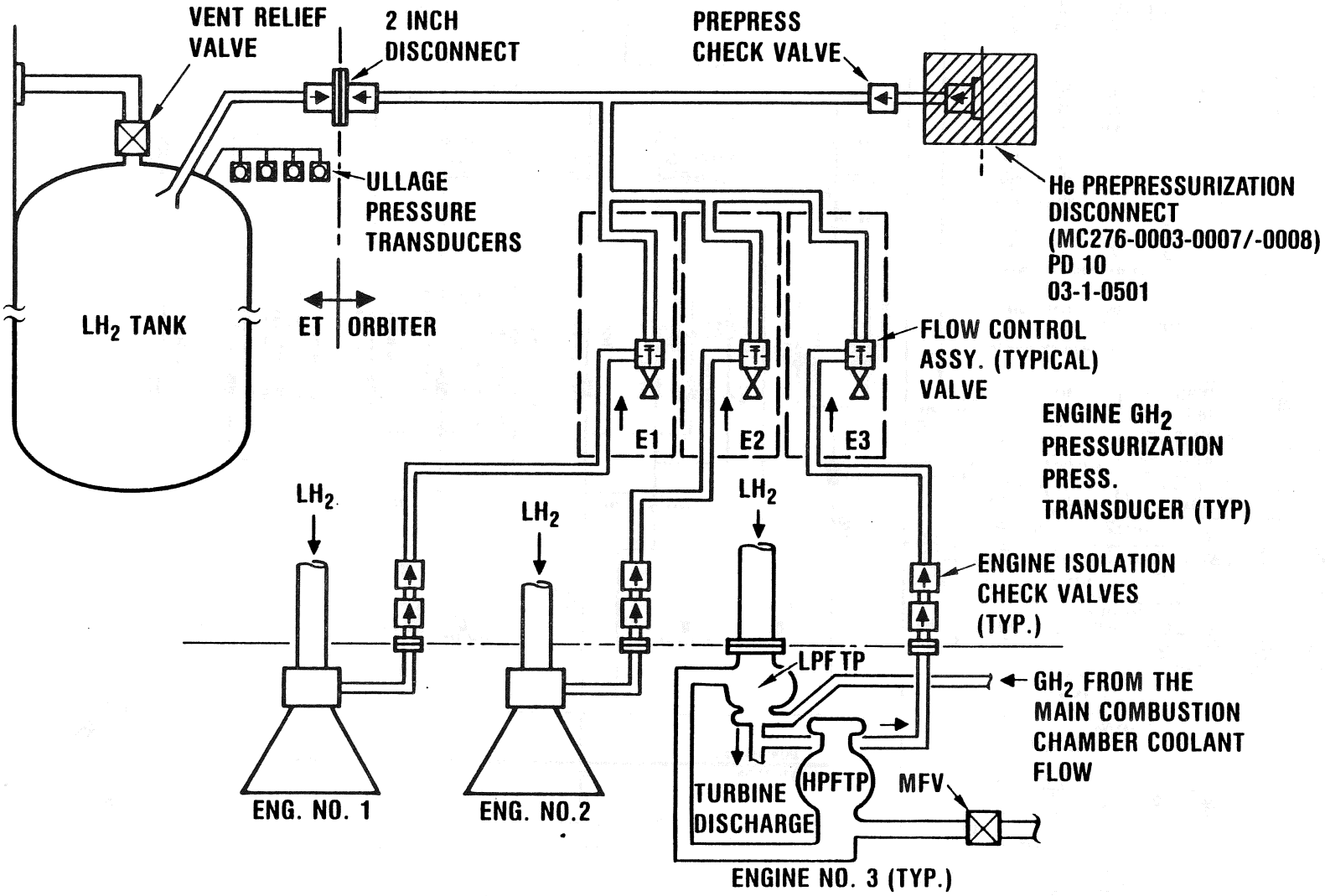
GO_2 PRESSURIZATION SYSTEM SCHEMATIC



COMPONENT: DISCONNECT 1-INCH HELIUM AND GASEOUS NITROGEN

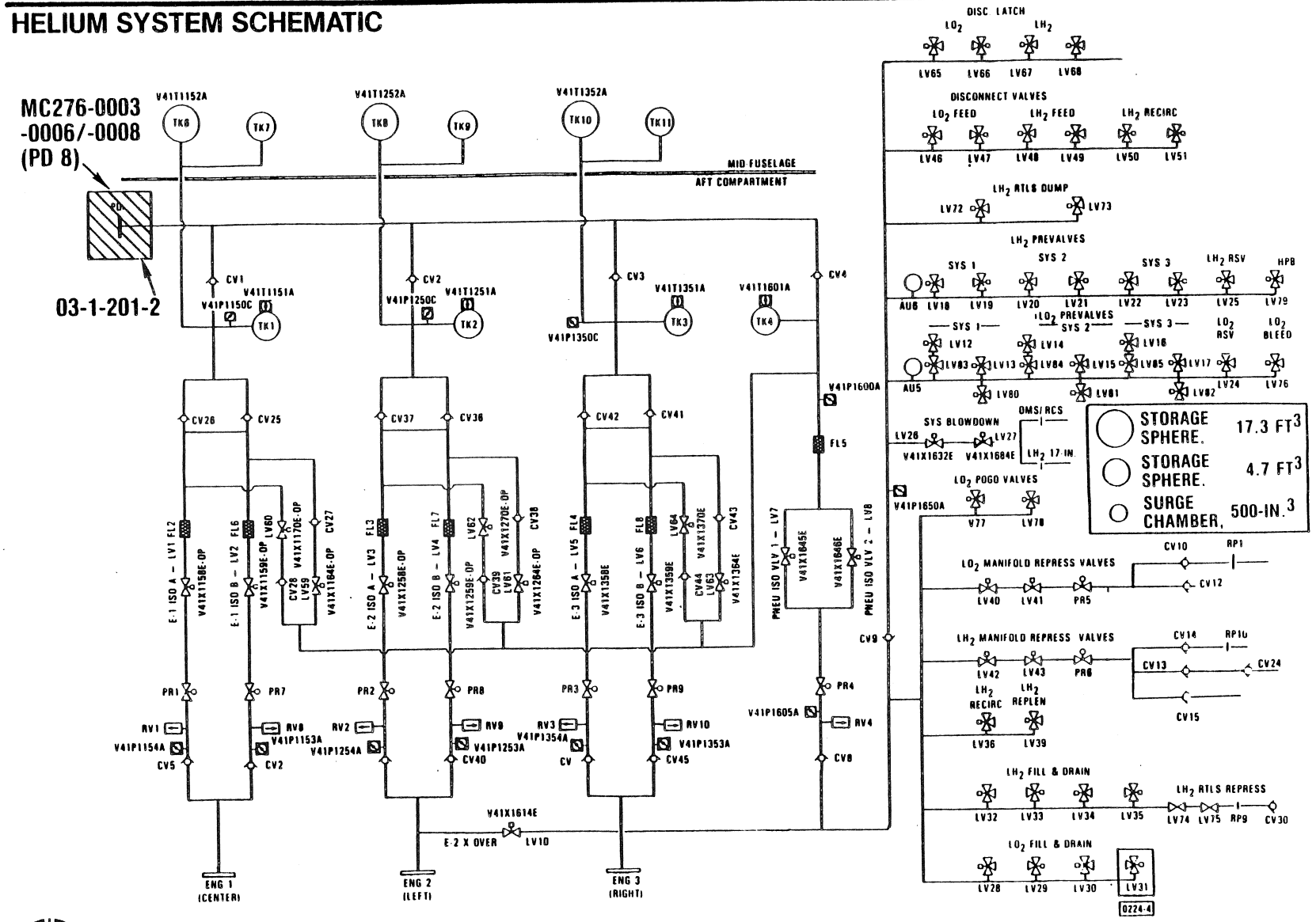
(MC276-0003)

GH_2 PRESSURIZATION SYSTEM SCHEMATIC



COMPONENT: DISCONNECT 1-INCH HELIUM AND GASEOUS NITROGEN
(MC276-0003)

HELIUM SYSTEM SCHEMATIC

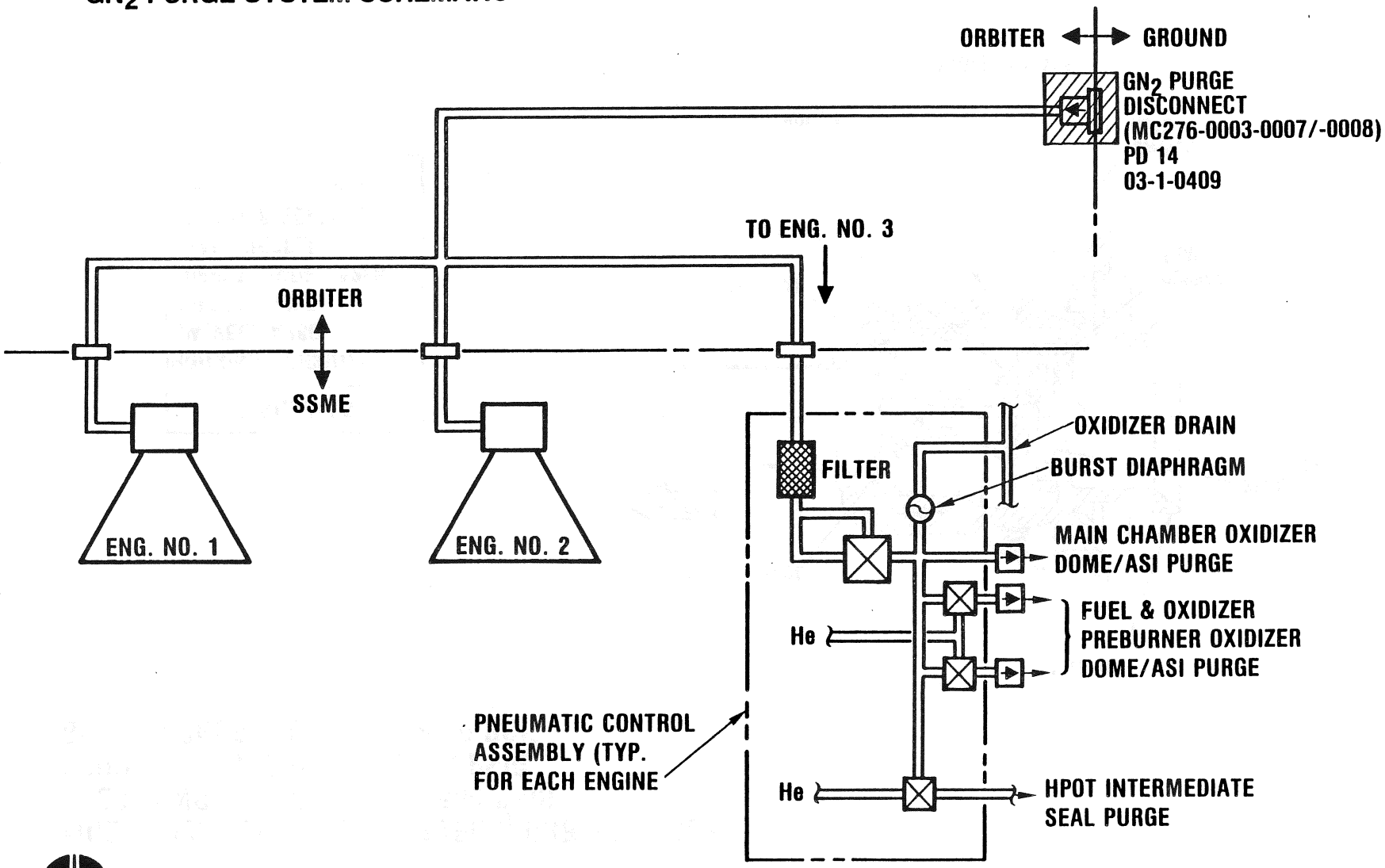


Rockwell International
Space Transportation
Systems Division

COMPONENT: DISCONNECT 1-INCH HELIUM AND GASEOUS NITROGEN

(MC276-0003)

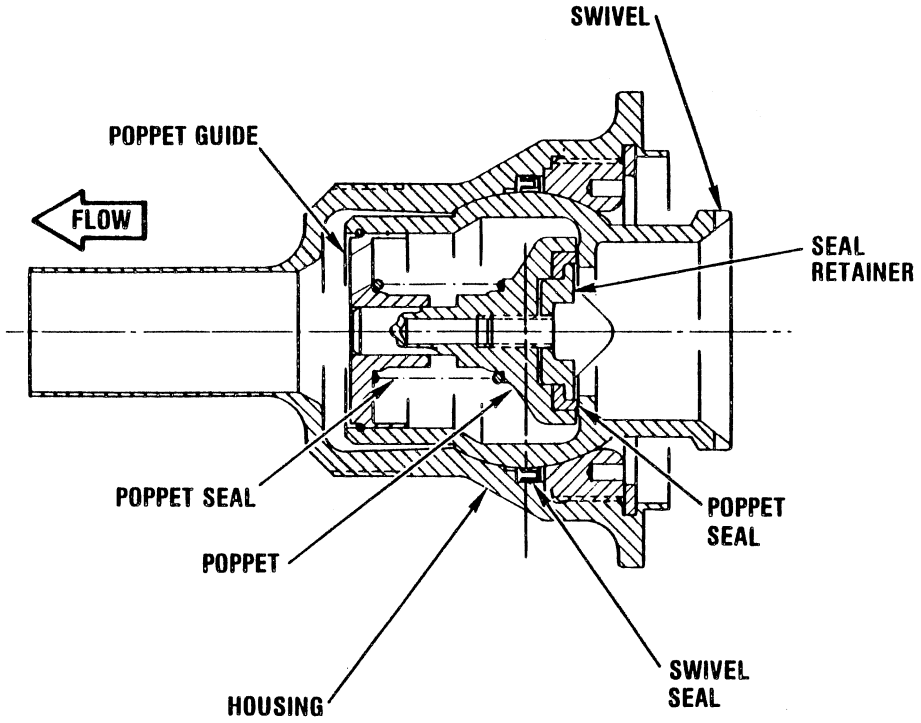
GN_2 PURGE SYSTEM SCHEMATIC



COMPONENT: DISCONNECT 1-INCH HELIUM AND GASEOUS NITROGEN
(MC276-0003)

MC276-0003-0006/-0007 (TYPE I) ORBITER HALF
OPERATING PRESSURE: 0-4500 PSIG
PROOF PRESSURE: 6750 PSIG
BURST PRESSURE: 10800 PSIG

MATERIALS
HOUSING: INCONEL 718
SWIVEL: A286
POPPET: A286
POPPET GUIDE: A286
SEAL: VESPEL
RETAINER SEAL: A286
SPRING: 302 CRES



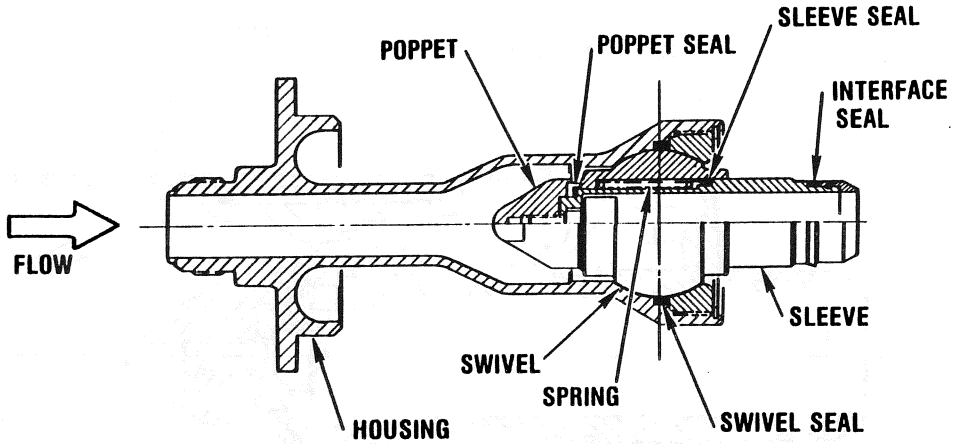
ORBITER HALF

COMPONENT: DISCONNECT 1-INCH HELIUM AND GASEOUS NITROGEN

(MC276-0003)

MC276-0003-0008 (TYPE II) GROUND HALF
OPERATING PRESSURE: 0-4500 PSIG
PROOF PRESSURE: 9000 PSIG
BURST PRESSURE: 18,000 PSIG

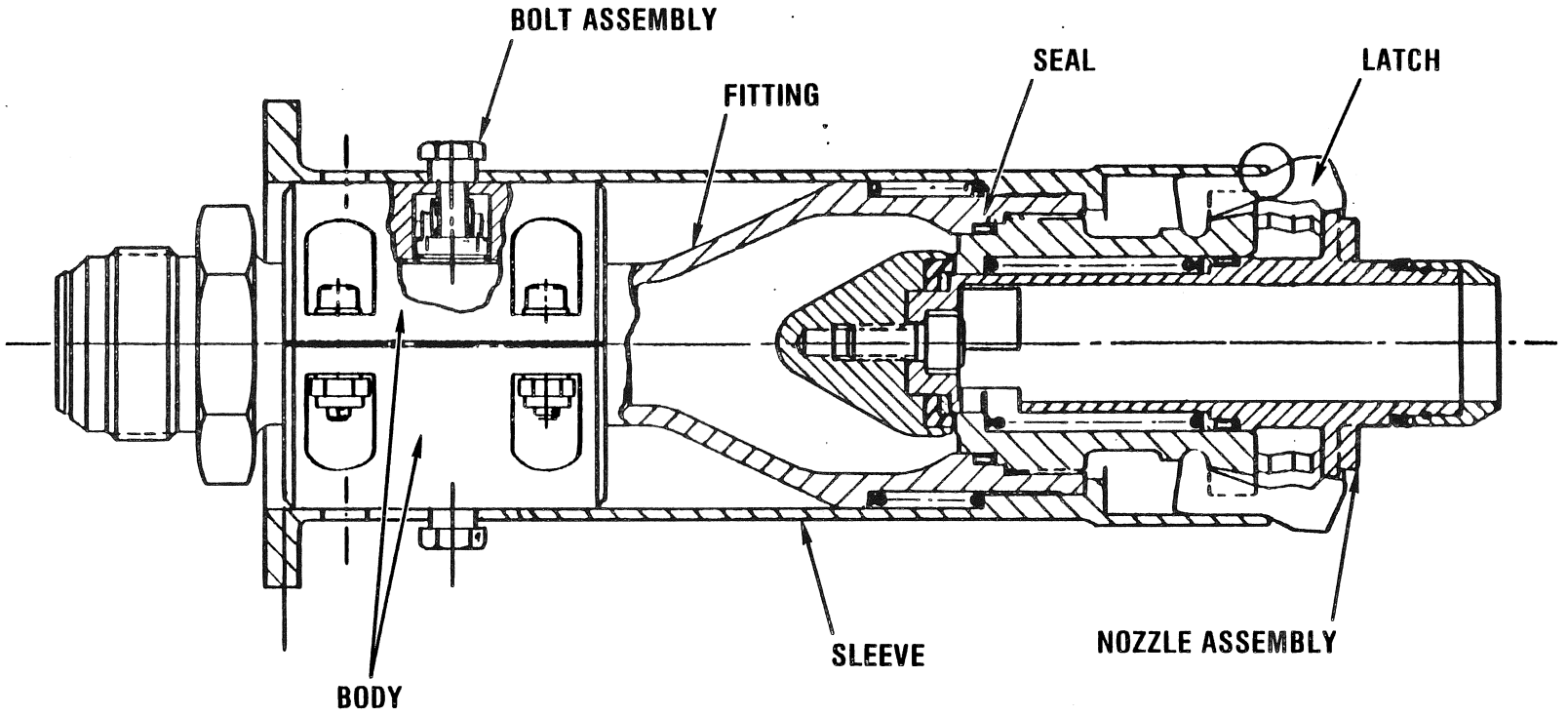
MATERIALS
HOUSING: A286
SWIVEL: A286
POPPET: 304 CRES
SEAL: VESPEL
SLEEVE: A286
SPRING: 302 CRES



GROUND HALF

COMPONENT: DISCONNECT 1-INCH HELIUM AND GASEOUS NITROGEN
(MC276-0003)

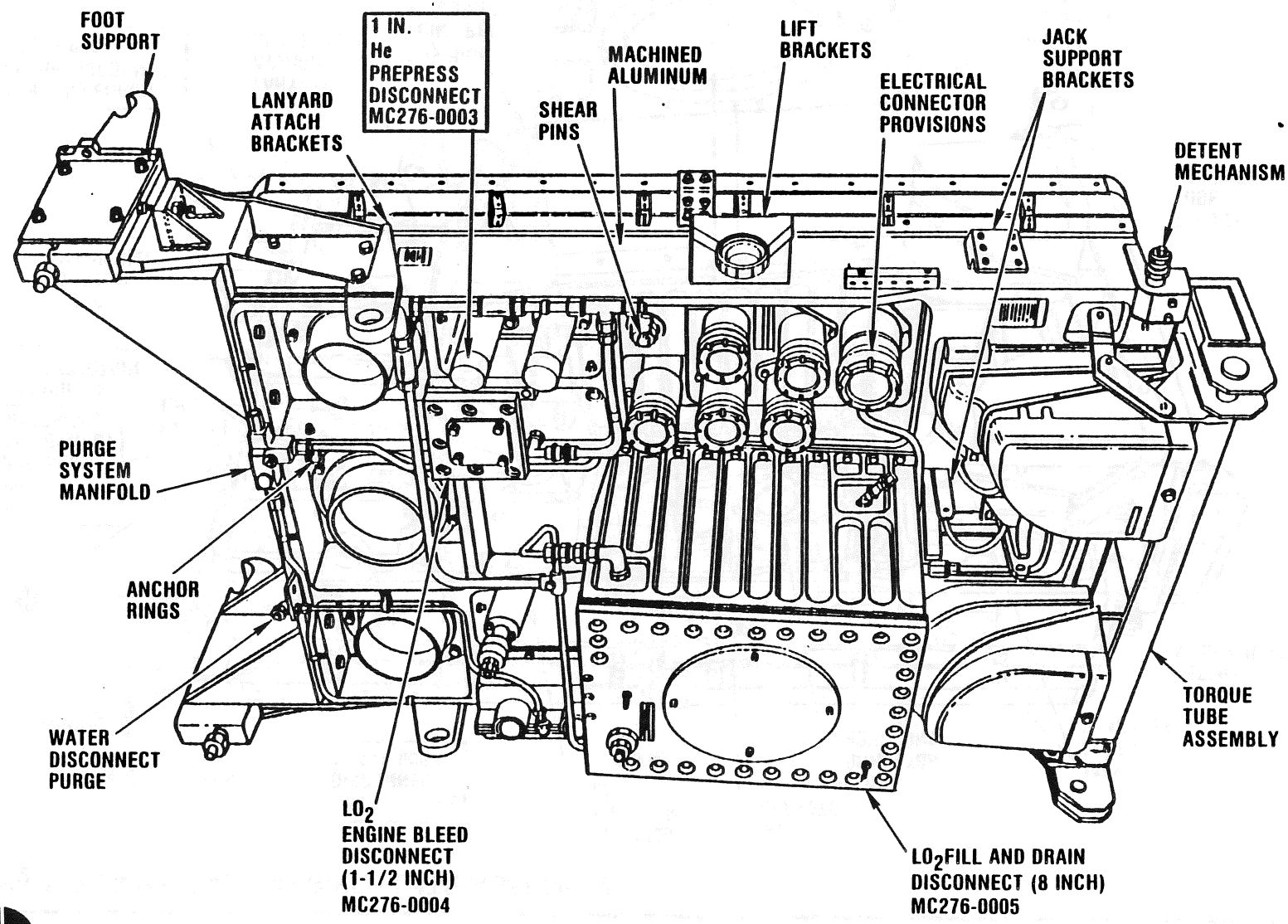
MC276-0003-1001 (TYPE III) GROUND HALF GN_2
MC276-0003-1005 (TYPE III) GROUND HALF H_e



COMPONENT: DISCONNECT 1-INCH HELIUM AND GASEOUS NITROGEN

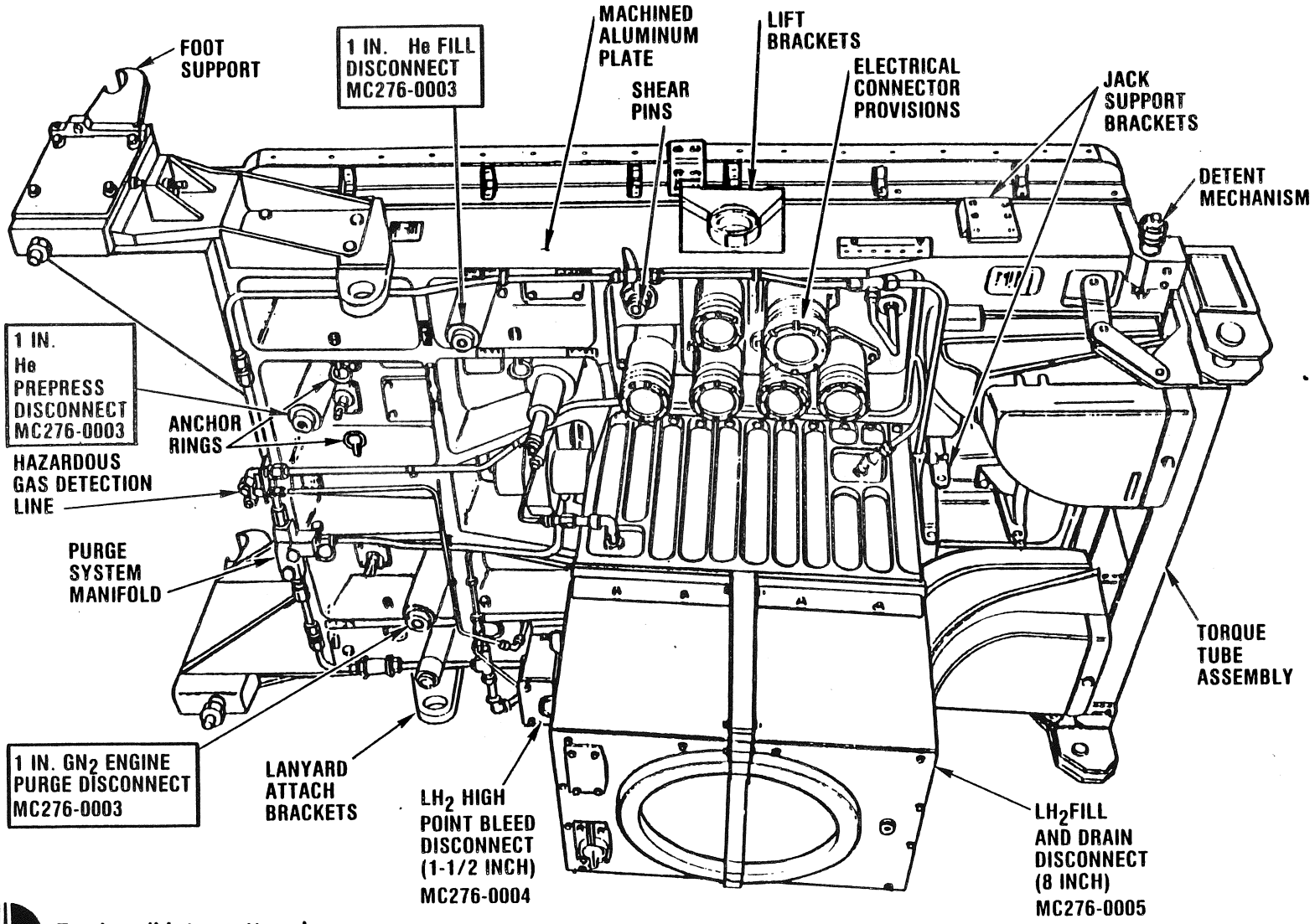
(MC276-0003)

LO_2 T-O UMBILICAL CARRIER PLATE ASSEMBLY



COMPONENT: DISCONNECT 1-INCH HELIUM AND GASEOUS NITROGEN
(MC276-0003)

LH_2 T-O UMBILICAL CARRIER PLATE ASSEMBLY



COMPONENT: DISCONNECT, 1.5-INCH, LO_2 AND LH_2 OVERBOARD BLEED

(MC276-0004)

FMEA/CIL NO. 03-1-0406
03-1-0432

VENDOR : FAIRCHILD CONTROLS
P/N RI : MC276-0004-0001 (FLT HALF, LO_2)
: MC276-0004-0002 (GND HALF, LO_2 AND LH_2)
: MC276-0004-0003 (FLT HALF, LH_2)
QUANTITY : 2 MATED PAIRS PER END ITEM

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

DISCONNECT, LO_2 AND LH_2 BLEED, 1.5 INCH, SELF SEALING, FLIGHT AND GROUND HALF (PD13, PD17)

FUNCTION:

THE DISCONNECT WHEN MATED PROVIDES A PATH FOR LO_2 AND LH_2 TO BLEED OVERBOARD FROM THE LO_2 OVERBOARD BLEED VALVE (PV19) AND THE LH_2 OVERBOARD BLEED VALVE (PV22) INTO THE GROUND VENT SYSTEM. LO_2 AND LH_2 IS BLED OVERBOARD TO MAINTAIN PROPER SSME CRYOGENIC START CONDITIONS. THE LO_2 POGO ACCUMULATOR RETURN LINE IS ALSO FLUSHED PRIOR TO ENGINE START THROUGH THIS DISCONNECT. PRIOR TO LIFTOFF THE DISCONNECTS ARE ISOLATED FROM THEIR RESPECTIVE SYSTEMS BY CLOSING THE OVERBOARD BLEED VALVES (PV19 AND 20). THE DESIGN INCORPORATES A POPPET TO PREVENT FLOW OF LO_2 AND LH_2 OVERBOARD AFTER T-0 UMBILICAL DISENGAGEMENT AND LIFT OFF.

DESIGN:

THE DISCONNECT IS A MECHANICAL FLOW-THROUGH DEVICE. THE TYPE I ORBITER AND TYPE II GROUND SECTION CONTAIN SPRING LOADED NORMALLY CLOSED POPPETS. THE POPPETS ARE ACTUATED AUTOMATICALLY OPEN DURING THE ENGAGEMENT AND DISCONNECTED DURING THE DISENGAGEMENT OF THE TWO DISCONNECTS.

COMPONENT: DISCONNECT, 1.5-INCH, LO_2 AND LH_2 OVERBOARD BLEED

(MC276-0004)

THE GROUND HALF POPPET AND PROBE IS MACHINED FROM 6061 ALUMINUM. THE GROUND HALF HOUSING AND INTEGRAL SUPPORT WEBS IS MACHINED FROM 6061 ALUMINUM. TO REDUCE MASS, THE INSIDE OF THE POPPET (INCLUDING THE PROBE) IS MACHINED SO THAT THE PROBE BECOMES A 0.625 INCH O.D. CYLINDER WITH A 0.1 INCH WALL AND IS ABOUT 5 INCHES LONG.

STRUCTURAL ANALYSIS INDICATES POSITIVE MARGINS OF SAFETY FOR ALL CONDITIONS OF VALVE OPERATIONS. DURING QUAL TESTING 2000 MATE/DEMATE CYCLES WERE SUCCESSFULLY PERFORMED.

DESIGN PARAMETERS:

OPERATING PRESSURE AND TEMPERATURES	PRESSURE RANGE	TEMPERATURE RANGE
MATED - TYPE I/II	0 TO 100 PSIG	-423°F TO 100°F
UNMATED - TYPE II	0 TO 100 PSIG	
UNMATED - TYPE I	0 TO 400 PSIG	-423°F TO 350°F
CHECKOUT PLATE	0 TO 400 PSIG	

PROOF PRESSURE:

OPERATING PRESSURE AND TEMPERATURES	PRESSURE RANGE	TEMPERATURE RANGE
MATED - TYPE I/II	200 PSIG	-423°F TO 100°F
UNMATED - TYPE I	520 PSIG	-423°F TO 100°F
UNMATED - TYPE II	200 PSIG	-423°F TO 100°F
CHECKOUT PLATE	800 PSIG	

COMPONENT: DISCONNECT, 1.5-INCH, LO_2 AND LH_2 OVERBOARD BLEED

(MC276-0004)

BURST PRESSURE:

OPERATING PRESSURE AND TEMPERATURES	PRESSURE RANGE
MATED - TYPE I/II	400 PSIG
UNMATED - TYPE I	600 PSIG
UNMATED - TYPE II	400 PSIG
CHECKOUT PLATE	1,600 PSIG

EXTERNAL LEAKAGE (MATED):

MATED DASH NO.	PRESSURE	AMBIENT	CRYOGENIC TEMPS
-0001/-0002	0-100 PSIG	115 SCIM (He)	40 SCIM LOX/GOX at -255°F (MAX)
-0003/-0002	0-100 PSIG	40 SCIM (He)	75 SCIM LH_2 GH_2 at -400°F (MAX)

EXTERNAL LEAKAGE (UNMATED):

THE TOTAL EXTERNAL LEAKAGE (EXCLUDING CLOSURE DEVICE AND LINE ATTACHMENTS) OF THE TYPE I OR II DISCONNECTS, WITH THE CLOSURE DEVICE CLOSED, SHALL NOT EXCEED 1.0 SCIM OF GASEOUS HELIUM AT 400 PLUS ZERO MINUS 50 PSIG FOR THE TYPE I AND 100 PLUS ZERO MINUS 10 FOR THE TYPE II.

COMPONENT: DISCONNECT, 1.5-INCH, LO_2 AND LH_2 OVERBOARD BLEED

(MC276-0004)

THE TOTAL LEAKAGE PAST THE CLOSURE DEVICE OF THE TYPE I OR TYPE II DISCONNECTS SHALL NOT EXCEED THE FOLLOWING:

TYPE	DASH NO.	FLOW DIRECTION	FLUID MEDIA	FLUID TEMP (°F)	PRESS. (PSIG)	MAX ALLOWABLE LEAKAGE
I	-0001	CHECKED	He	AMBIENT TO +350	20 ±2	3 SCIM
I	-0001	CHECKED	GOX	-275 MAX	0-400	200 SCIM
I	-0003	CHECKED	He	AMBIENT TO +350	20 ±2	3 SCIM
I	-0003	CHECKED	GH_2	-400 MAX	0-100	50 SCIM
II	-0002	CHECKED	He	AMBIENT	0-100	200 SCIM
II	-0002	CHECKED	GH_2	-400 MAX	0-100	200 SCIM
II	-0002	CHECKED	GOX	-275 MAX	0-100	200 SCIM

FLOW RATE (MATED):

FLUID MEDIA	FLUID TEMP (°F)	FLOW (LB/SEC)	INLET PRESS.	ΔP
LOX	-289 MAX (SUBCOOLED)	12 MIN	41 PSIA MAX	3.0 PSID MAX

COMPONENT: DISCONNECT, 1.5-INCH, LO_2 AND LH_2 OVERBOARD BLEED

(MC276-0004)

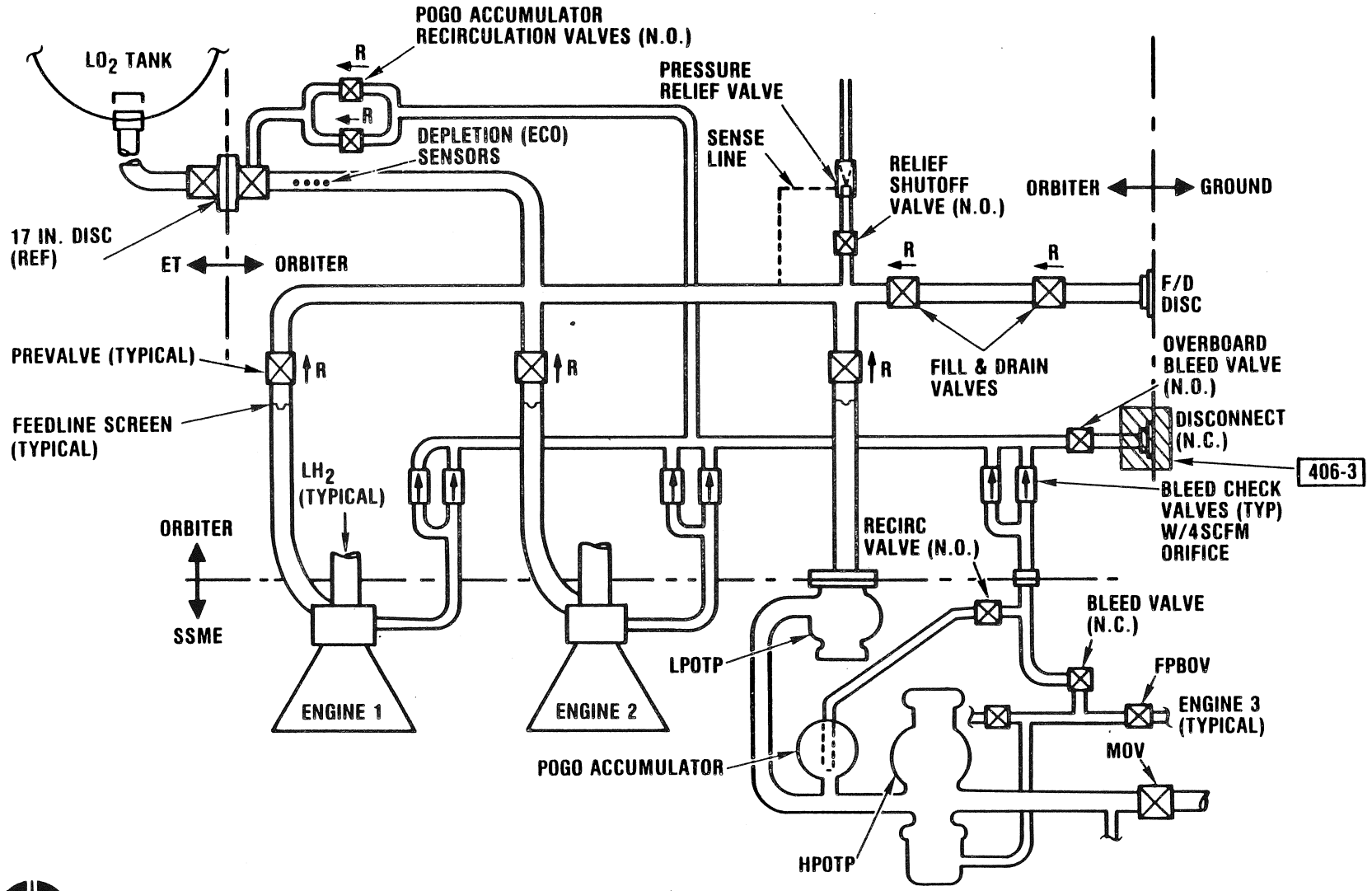
DESIGN FEATURES:

ENVELOPE DIMENSION	TYPE I, 6 DIA X 4.700 TYPE II, 5-3/16 DIA X 4.700 (CHECKOUT PLATE 3.20 DIA MAX X 3.0 MAX
WEIGHT	TYPE I, 1.9 LB MAX; TYPE II, 3.6 LB MAX CHECKOUT PLATE 1.0 LB MAX)
USEFUL LIFE	MINIMUM USEFUL LIFE OF 2,000 CYCLES, WHICH IS EQUIVALENT TO 100 ORBITAL MISSIONS IN A 10 YEAR PERIOD FROM DATE OF DELIVERY
SEPARATION FORCE	400 LB (MAX)

MATERIALS
HOUSING: A357-CL10, T6
POPPET: 6061-T651
POPPET SEAL: VESPEL SP21 (POLYIMIDE)
INTERFACE SEAL: VESPEL SP21 (POLYIMIDE)
BELLOWS: INCONEL 718/304L CRES
SPRING: ELGILOY
SPHERICAL SEAT: 304L CRES

COMPONENT: DISCONNECT, 1.5-INCH, LO_2 AND LH_2 OVERBOARD BLEED
(MC276-0004)

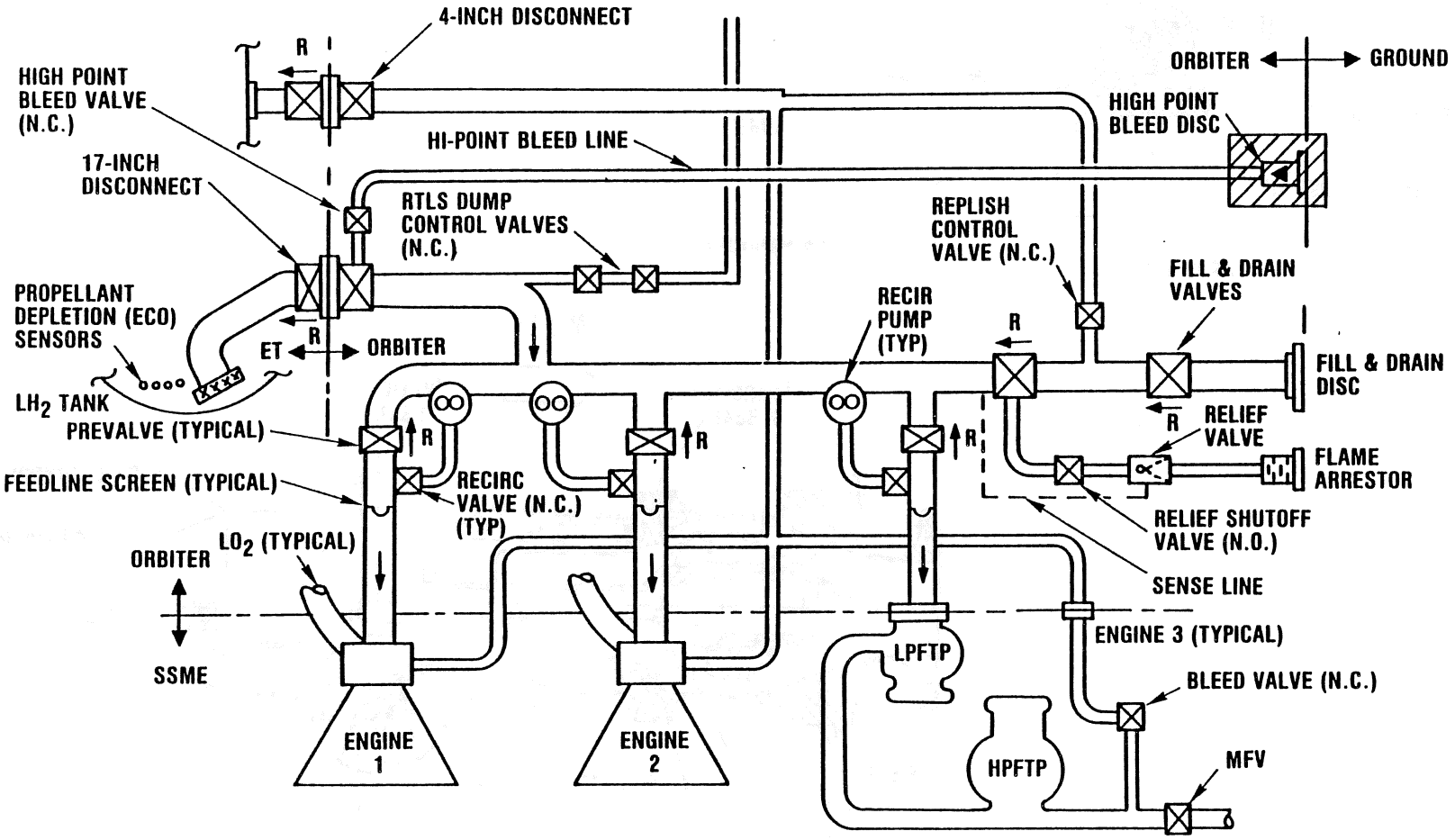
LO_2 SYSTEM



COMPONENT: DISCONNECT, 1.5-INCH, LO_2 AND LH_2 OVERBOARD BLEED

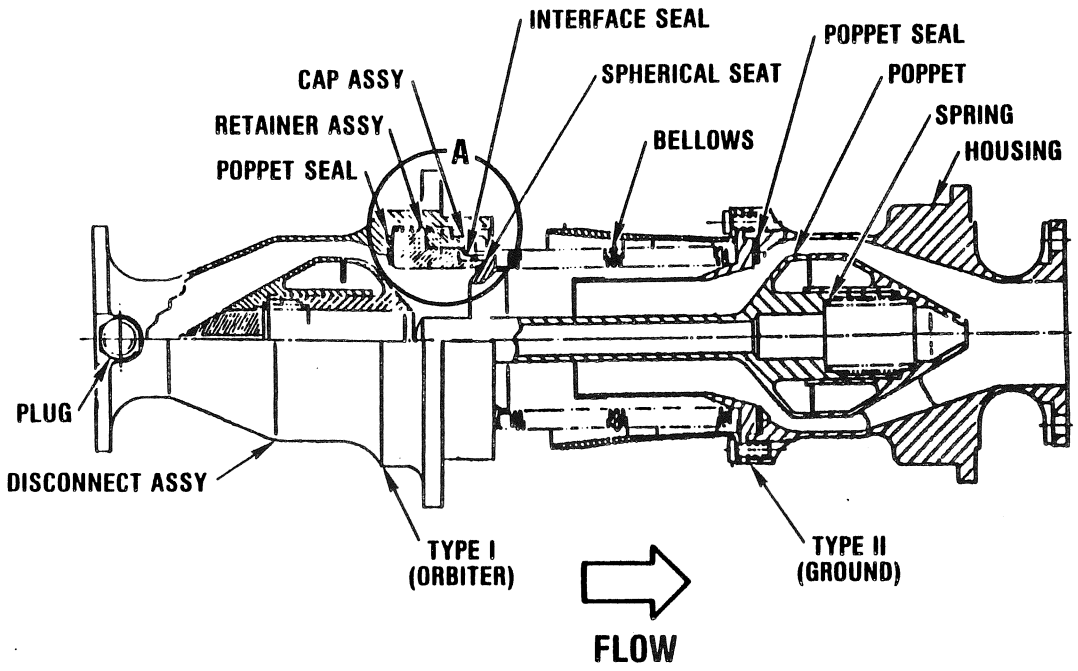
(MC276-0004)

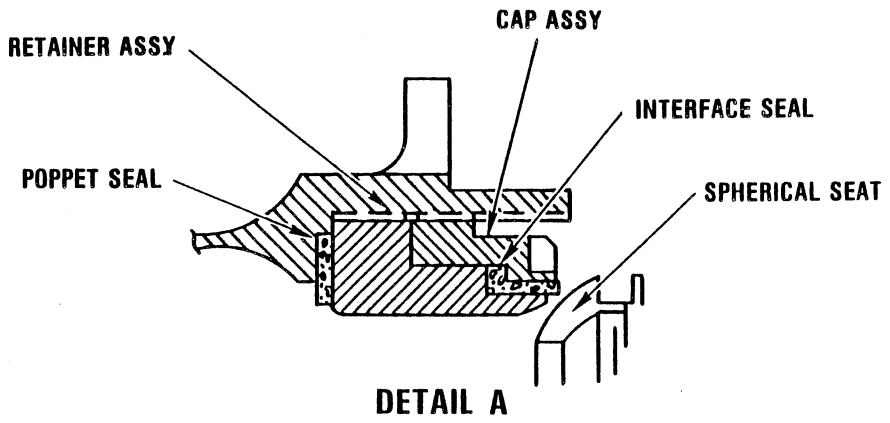
LH_2 SYSTEM



COMPONENT: DISCONNECT, 1.5-INCH, LO_2 AND LH_2 OVERBOARD BLEED

(MC276-0004)



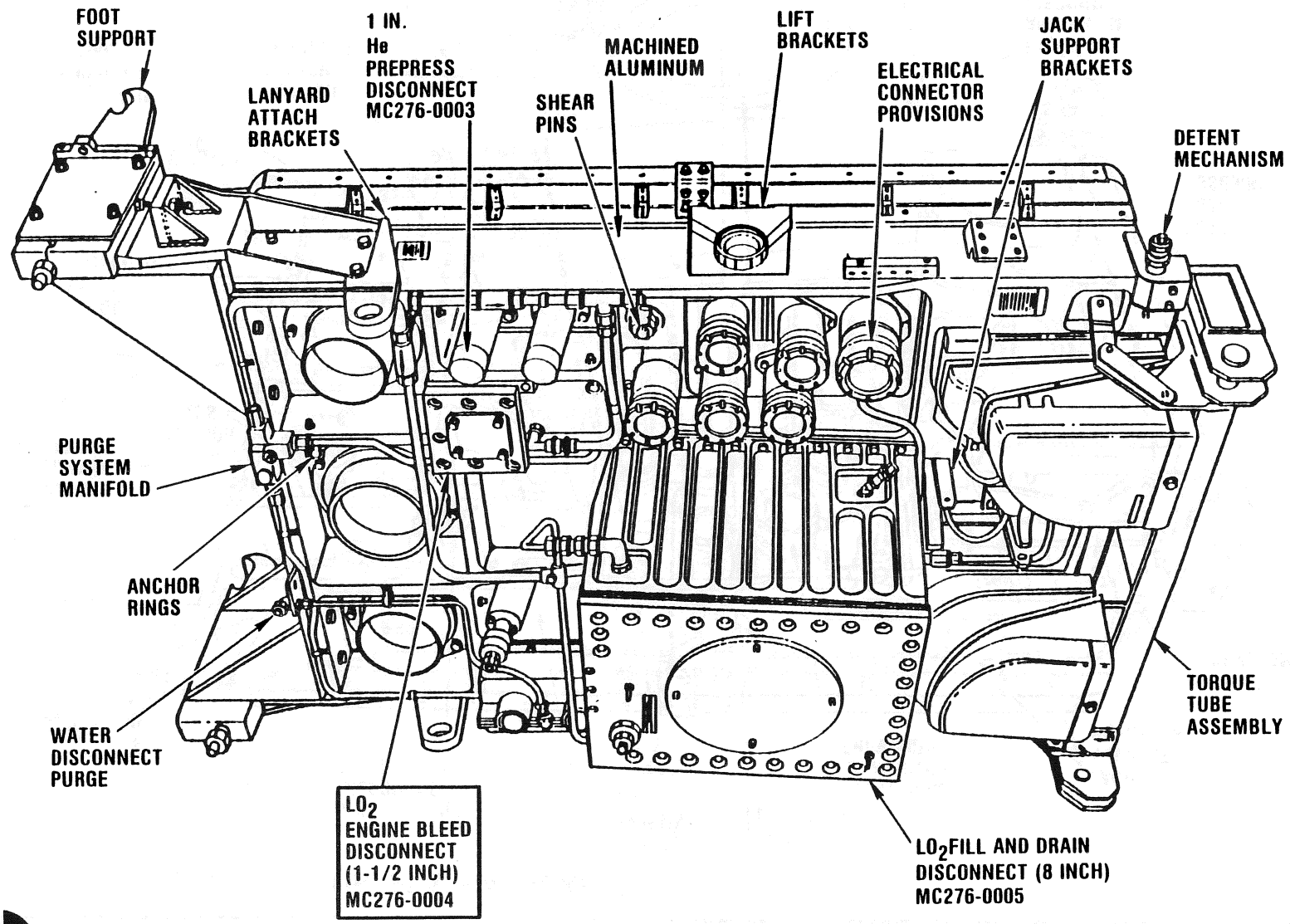


DETAIL A

COMPONENT: DISCONNECT, 1.5-INCH, LO_2 OVERBOARD BLEED

(MC276-0004)

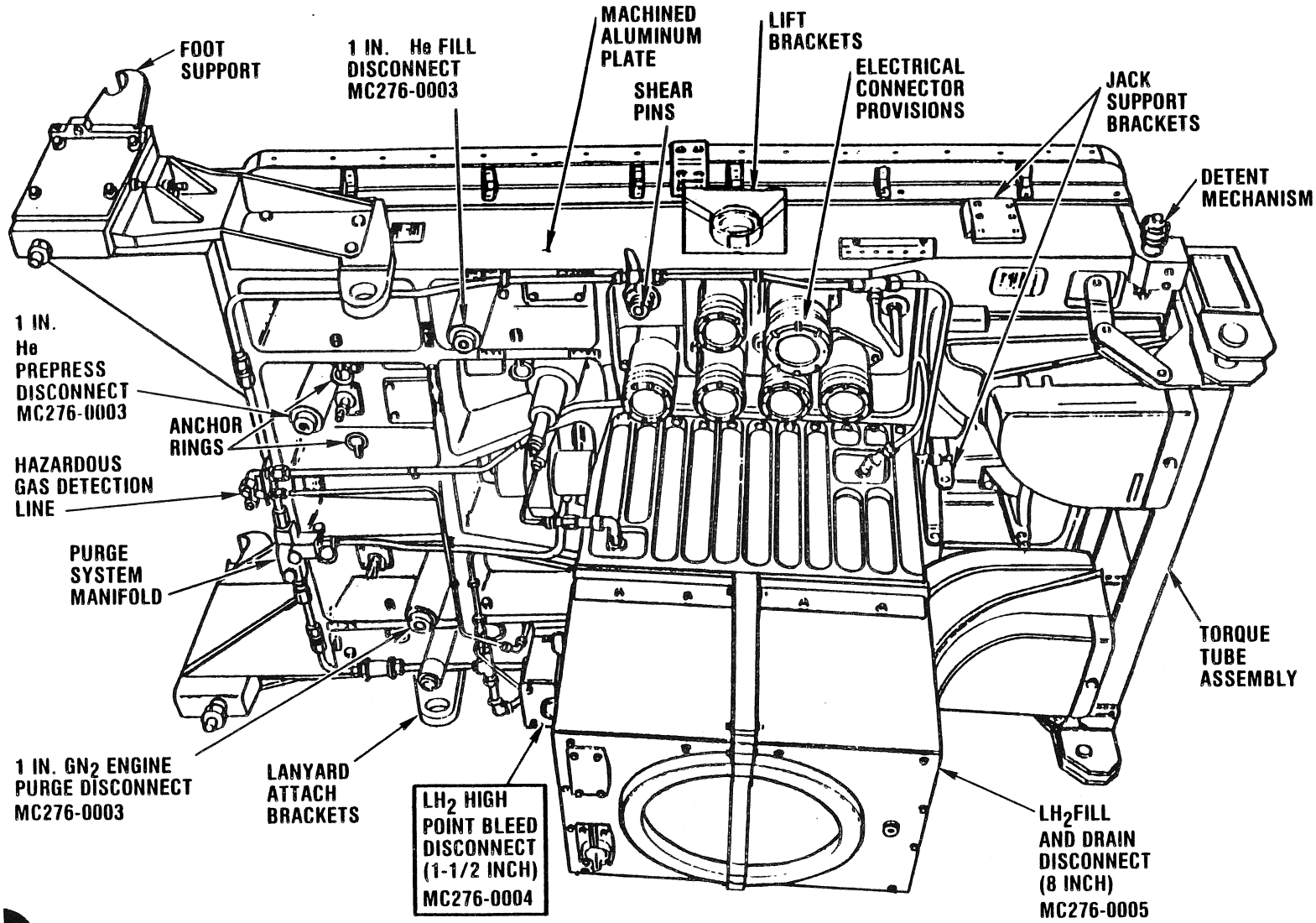
LO_2 T-O UMBILICAL CARRIER PLATE ASSEMBLY



COMPONENT: DISCONNECT, 1.5-INCH, LO_2 OVERBOARD BLEED

(MC276-0004)

LH_2 T-O UMBILICAL CARRIER PLATE ASSEMBLY



COMPONENT: DISCONNECT, 8 INCH FILL AND DRAIN, LO_2/LH_2

(MC276-0005)

FMEA/CIL NO. 03-1-0303

VENDOR : PARKER HANNIFIN
P/N RI : MC276-0005-0041 (ORB-LH_2)
: MC276-0005-0032 (ORB-LO_2)
: MC276-0005-0063 (GND)
QUANTITY : (2) - GROUND HALF DISCONNECTS
: (1 EACH) - LH_2 AND LO_2 AIRBORNE DISCONNECTS

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

NEXT ASSEMBLY: G070-582353

ITEM:

DISCONNECT, FILL AND DRAIN, GROUND AND AIRBORNE HALF (PD11-LH_2, PD12-LO_2) 8 INCH, LO_2 AND LH_2.

FUNCTION:

THE DISCONNECT IS A MECHANICAL DEVICE THAT MATES THE GROUND FILL AND DRAIN SYSTEM TO THE ORBITER DURING PROPELLANT LOADING, REPLENISH AND DRAIN OPERATIONS.

THE GROUND HALF DISCONNECT INCORPORATES A SPRING LOADED CLOSURE DEVICE WHICH IS HELD OPEN WHEN MATED TO THE AIRBORNE HALF BY A PUSH ROD THAT ENGAGES A SOCKET IN THE AIRBORNE REPLACEABLE INSERT ASSEMBLY. THE AIRBORNE DISCONNECT ACTS AS A STRUCTURAL COMPONENT CONNECTING THE ORBITER FILL AND DRAIN SYSTEM TO THE T-0 UMBILICAL PLATE.

COMPONENT: DISCONNECT, 8 INCH FILL AND DRAIN, LO_2/LH_2

(MC276-0005)

DESIGN:

THE 8-INCH DISCONNECT CONSISTS OF AN AIRBORNE AND GROUND SECTION. THE GROUND SECTION IS SPRING LOADED CLOSED, AND MECHANICALLY OPENED WHEN MATED. THE AIRBORNE SECTION IS A FLOW-THROUGH PASSAGE AND CONTAINS THE INTERFACE MATING SEAL WHICH CAN BE REPLACED AFTER EACH FLIGHT IF REQUIRED.

THE AIRBORNE HALF DISCONNECT ASSEMBLY IS COMPRISED PRIMARILY OF A AIRBORNE HOUSING AND REPLACEABLE INSERT. THE HOUSING MATERIAL IS 2219-T852 ALUMINUM ALLOY AND THE REPLACEABLE INSERT IS A356-T6 ALUMINUM ALLOY. THE AIRBORNE REPLACEABLE INSERT CONTAINS A PREFORMED TEFLON INTERFACE SEAL AND A PRESSURE ACTIVATED STATIC SEAL, WHICH IS LOCATED IN A GLAND LOCATED BETWEEN THE INSERT ASSEMBLY AND THE AIRBORNE HOUSING.

THE AIRBORNE HALF AND GROUND HALF BELLOWS ASSEMBLY ARE DESIGNED TO A MINIMUM FACTOR OF SAFETY OF 1.3 PROOF, 1.5 BURST FOR INTERNAL PRESSURE. THE GROUND DISCONNECT BELLOWS IS OF 4-PLY INCONEL 718 CONSTRUCTION AND IS PROOF PRESSURE TESTED AT 260 PSIG. THE GROUND HALF DISCONNECT BODY IS MADE FROM AN ALUMINUM ALLOY A356-T6 CASTING AND DESIGNED TO A MINIMUM FACTOR OF SAFETY OF 2.0 PROOF AND 4.0 BURST FOR INTERNAL PRESSURE. FRACTURE AND FATIGUE ANALYSIS SHOW THAT ALL CRITICAL PARTS ARE SATISFACTORY FOR 4 TIMES EXPECTED LIFE.

THE 8-INCH FILL AND DRAIN DISCONNECT IS DESIGNED FOR LIMITED MISALIGNMENT. WHEN THE T-0 UMBILICAL CARRIER IS MATED TO THE AIRBORNE PANEL, CORRESPONDING ALIGNMENT TOOLING HOLES ARE USED TO VERIFY ALIGNMENT. THE MATED DISCONNECT IS DESIGNED FOR A 0.060 INCH RADIAL MISALIGNMENT AND A 22.5 MINUTES OF ANGULAR MISALIGNMENT.

THE GROUND HALF DISCONNECT BELLOWS ASSEMBLY PROVIDES A PRELOAD OF 313 MAX POUNDS AT THE AIRBORNE INTERFACE SEAL. THE GROUND HALF DISCONNECT IS SHIMMED TO A PRESET DIMENSION TO PROVIDE A NOMINAL BELLOWS COMPRESSION OF 0.670 INCH.

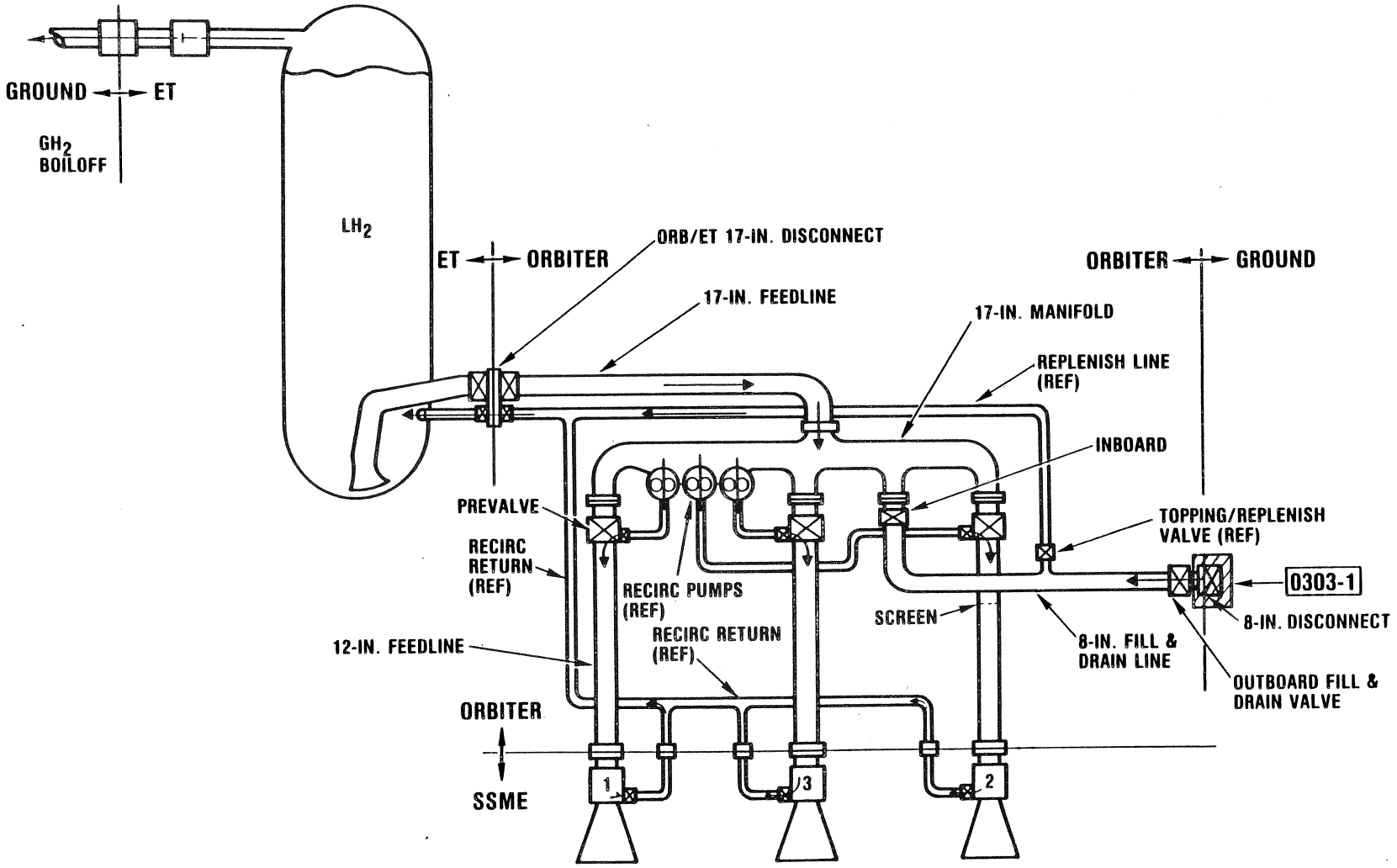
COMPONENT: DISCONNECT, 8 INCH FILL AND DRAIN, LO_2/LH_2

(MC276-0005)

DESIGN PARAMETERS:	LO_2	LH_2	LO_2/LH_2
CURRENT CONFIGURATION:	TYPE II (-0032)	TYPE I (-0041)	TYPE III (-0063)
OPERATING PRESSURE:	130 PSIG ±10 PSIG	30 ±5 PSIG	130 ±10 PSIG
FLOW CAPACITY (MIN):	800 LBS/SEC	120 LBS/SEC	800 LBS/SEC
TEMPERATURE RANGE:	MINUS 290°F ±10°F	MINUS 413°F ±10°F	MINUS 413°F ±10°F
SURGE PRESSURE:	260 PSIG	130 PSIG	260 PSIG
PRESSURE DROP (MAX) BOTH DIRECTIONS:	3.0 PSID (MATED)	1.25 PSID (MATED)	3.0 PSID (MATED)/ 1.25 PSID (MATED)
ACCEPTANCE TEST PARAMETERS:			
MATING SEAL LEAKAGE (AT AMB):	10 SCIM GHe AT 130 PSIG	10 SCIM GHe AT 30 PSIG	10 SCIM GHe AT 30 PSIG
(AT CRYO):	300 SCIM GN_2 AT 130 PSIG	300 SCIM GH_2 AT 30 PSIG	300 SCIM GN_2 AT 130 PSIG
EXTERNAL LEAKAGE (AT AMB):	-----	-----	2 SCIM GN_2 AT 130 PSIG
INTERNAL LEAKAGE, CLOSURE DEVICE (AT CRYO):	-----	-----	1,500 SCIM GN_2 AT 90 PSIG ON GRND SIDE OF FLAPPER

COMPONENT: DISCONNECT, 8 INCH FILL AND DRAIN, LO_2/LH_2
(MC276-0005)

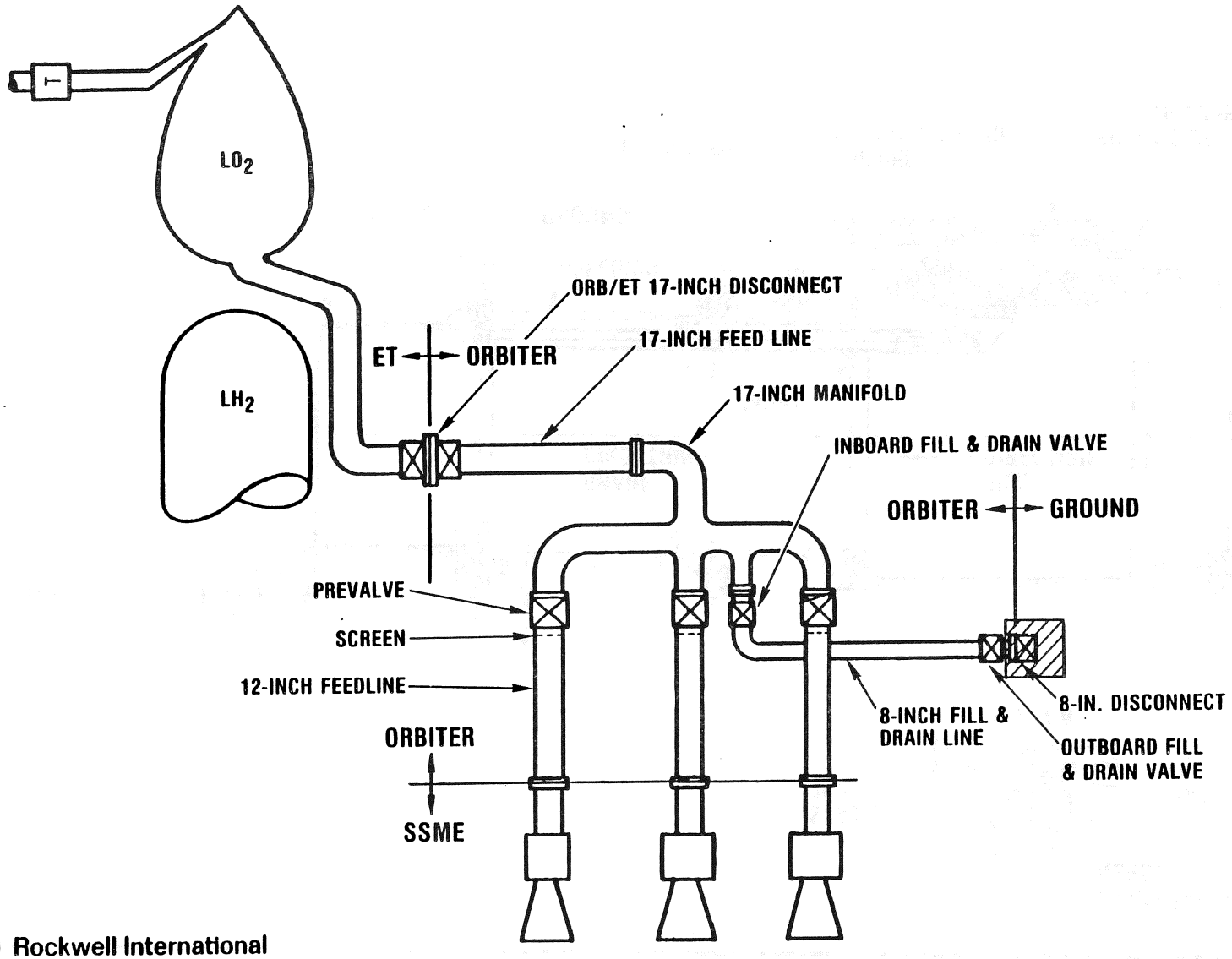
LH_2 SCHEMATIC:



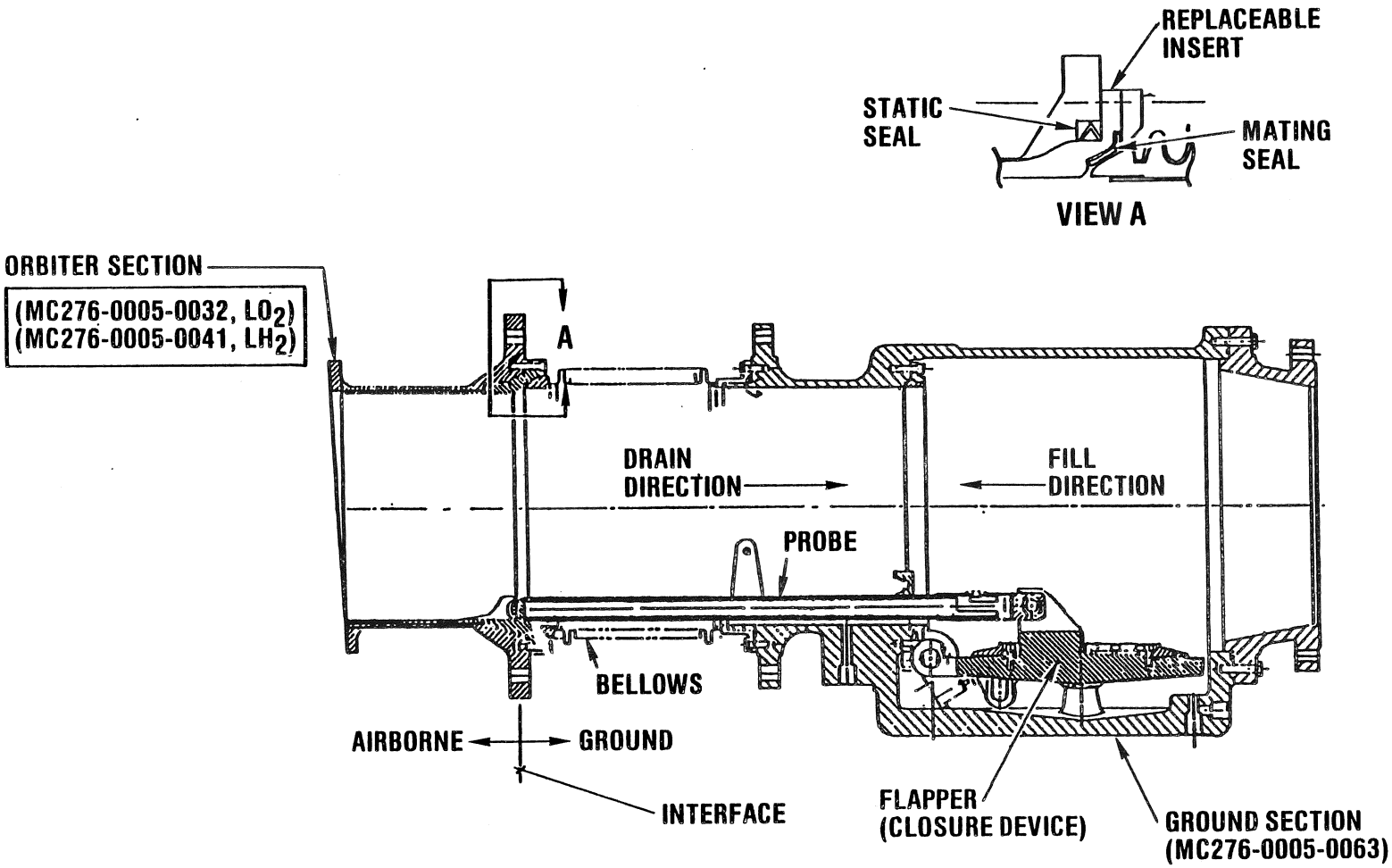
COMPONENT: DISCONNECT, 8 INCH FILL AND DRAIN, LO_2/LH_2

(MC276-0005)

LO_2 SCHEMATIC:



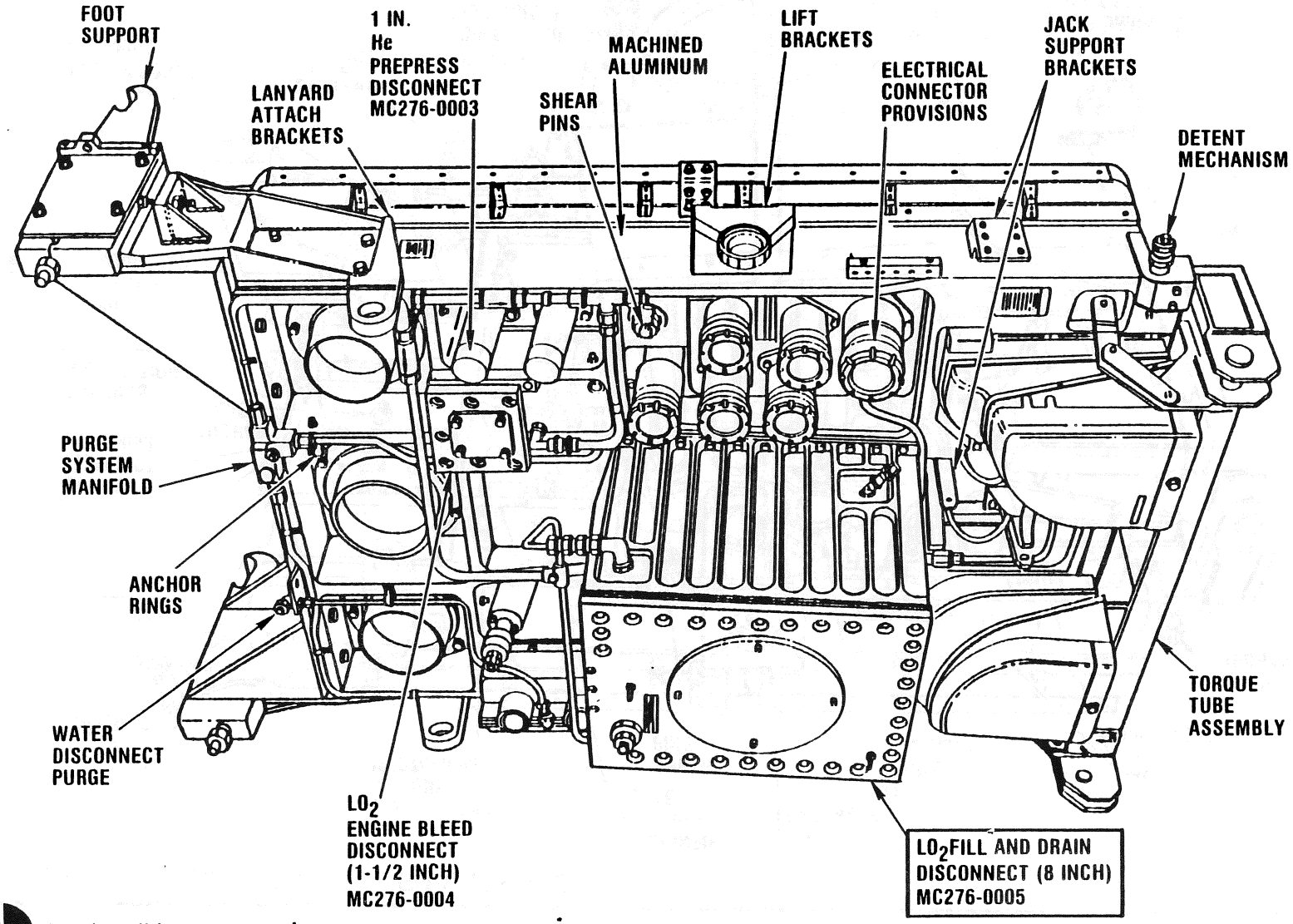
COMPONENT: DISCONNECT, 8 INCH FILL AND DRAIN, LO_2/LH_2
(MC276-0005)



COMPONENT: DISCONNECT, 8 INCH FILL AND DRAIN, LO_2/LH_2

(MC276-0005)

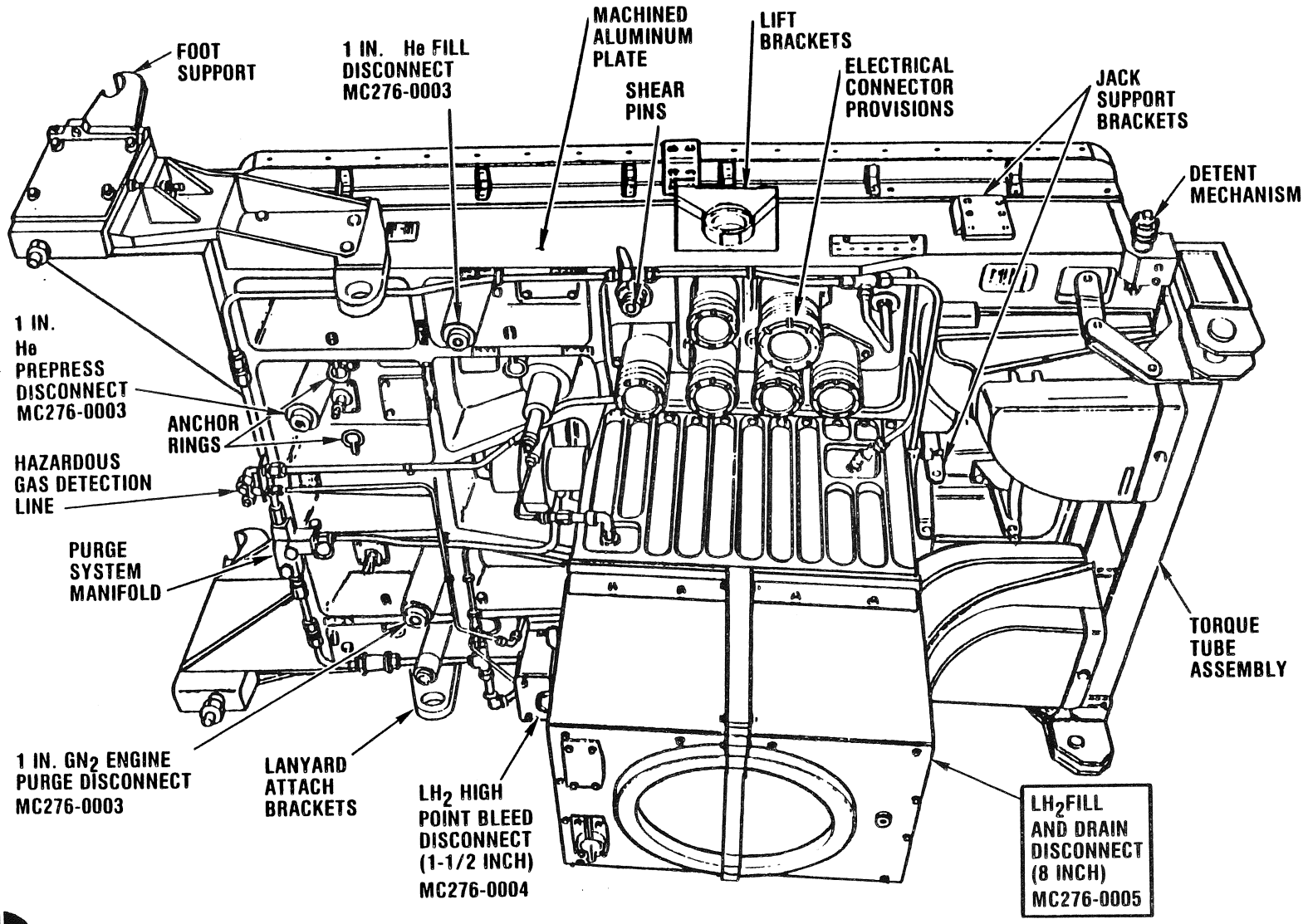
LO_2 T-O UMBILICAL CARRIER PLATE ASSEMBLY



COMPONENT: DISCONNECT, 8 INCH FILL AND DRAIN, LO_2/LH_2

(MC276-0005)

LH_2 T-O UMBILICAL CARRIER PLATE ASSEMBLY



COMPONENT: VALVE, PRESSURANT FLOW CONTROL, HYDROGEN AND OXYGEN
(MC280-0017)

FMEA/CIL NO. 03-1-0504

VENDOR : EATON CONSOLIDATED CNTLS.
P/N RI : MC280-0017-0447 ON GO_2
: MC280-0017-0361 ON GH_2
P/N VENDOR: 84400-1447 ON GO_2
: 80410-0361 ON GH_2
QUANTITY : 6 PER END ITEM
: THREE GO_2, THREE GH_2
:

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

VALVE, FLOW CONTROL, SOLENOID, GO_2 AND GH_2 PRESSURANT, NORMALLY HIGH FLOW (0.625 INCH DIAMETER INLET, 1.0 INCH DIAMETER OUTLET) (LV53, 54, 55) AND (LV56, 57, 58).

FUNCTION:

THE COMPONENT IS A SOLENOID ACTUATED VALVE USED FOR CONTROL OF HYDROGEN AND OXYGEN PRESSURANT FLOW PROVIDED BY THE THREE ORBITER MAIN ENGINES FOR EXTERNAL TANK (ET) PRESSURIZATION. THE VALVE METERS FLOW AT EITHER OF TWO RATES UPON RECEPTION OR LOSS OF AN ELECTRICAL COMMAND FROM THE ET ULLAGE PRESSURE CONTROLLER. THERE ARE A TOTAL OF SIX VALVES PER ORBITER, THREE IN THE HYDROGEN SYSTEM AND THREE IN THE OXYGEN SYSTEM WITH ATTENDANT SYSTEM FLOW REQUIREMENTS. EACH VALVE IN EACH SYSTEM PROVIDES INDEPENDENT CONTROL OF THE PARTICULAR PRESSURANT DELIVERED BY THE RESPECTIVE ENGINE.

COMPONENT: VALVE, PRESSURANT FLOW CONTROL, HYDROGEN AND OXYGEN
(MC280-0017)

DESIGN:

THE VALVE IS A SINGLE FLOW PATH, DUAL POSITION TYPE. IT IS SHIMMED TO ALLOW FLOW AT THE REQUIRED HIGH AND LOW FLOW SETTINGS. IT IS SPRING LOADED TO THE HIGH FLOW POSITION AND SOLENOID ACTUATED TO THE LOW FLOW POSITION. IT INCORPORATES A MECHANICAL JOINT AT THE SOLENOID TO HOUSING INTERFACE SUCH THAT THE INTERNAL ASSEMBLY CAN BE REMOVED AND REPLACED WHEN THE VALVE IS INSTALLED IN THE VEHICLE.

THE H_2 FCV HAS A THREADED SOLENOID TO HOUSING JOINT WITH A BUNA-N RUBBER O-RING SEAL EXPOSED TO VALVE OUTLET PRESSURE. A SINGLE K-MINI SEAL, EXPOSED TO THE VALVE INLET PRESSURE, IS UTILIZED AT THE SLEEVE TO HOUSING INTERFACE.

THE O_2 FCV HAS A BOLTED FLANGE AT THE SOLENOID TO HOUSING JOINT WITH FOUR K-MINI SEALS: A PRIMARY SEAL EXPOSED TO THE VALVE INLET PRESSURE WITH A SECONDARY BACK UP SEAL AND A PRIMARY SEAL EXPOSED TO THE VALVE OUTLET PRESSURE WITH A SECONDARY BACK UP SEAL. EACH PRIMARY SEAL HAS A LEAK DETECTION PORT.

DESIGN PARAMETERS:

	TYPE III (HYDROGEN)	TYPE IV (OXYGEN)
CURRENT CONFIGURATION:	-0361	-0447
MAX OPERATING PRESSURE:	4,100 PSIA	4,600 PSIA
PROOF PRESSURE:	8,200 PSIA	9,200 PSIA
BURST PRESSURE:	16,400 PSIA	18,400 PSIA
EXTERNAL LEAKAGE (MAX):	4 SCCM (2 SCCM HELIUM)	4 SCCM (4 SCCM HELIUM)
LINE SIZE:	INLET 5/8 INCH, OUTLET 1 INCH	INLET 5/8 INCH, OUTLET 1 INCH
PULL-IN (MAX)/DROPOUT VOLTAGE (MIN):	22 VOLTS DC/1 VOLT DC	22 VOLTS DC/1 VOLT DC

COMPONENT: VALVE, PRESSURANT FLOW CONTROL, HYDROGEN AND OXYGEN
(MC280-0017)

TYPE III (HYDROGEN) TYPE IV (OXYGEN) (CONT)

WEIGHT:	3.7 POUNDS MAX	
VALVE RESPONSE TIME:	200 MILLISECONDS MAX	
OPERATING TEMP:	-160 TO +210°F	-160 TO +530°F [NO HAZARD AT 710°F]

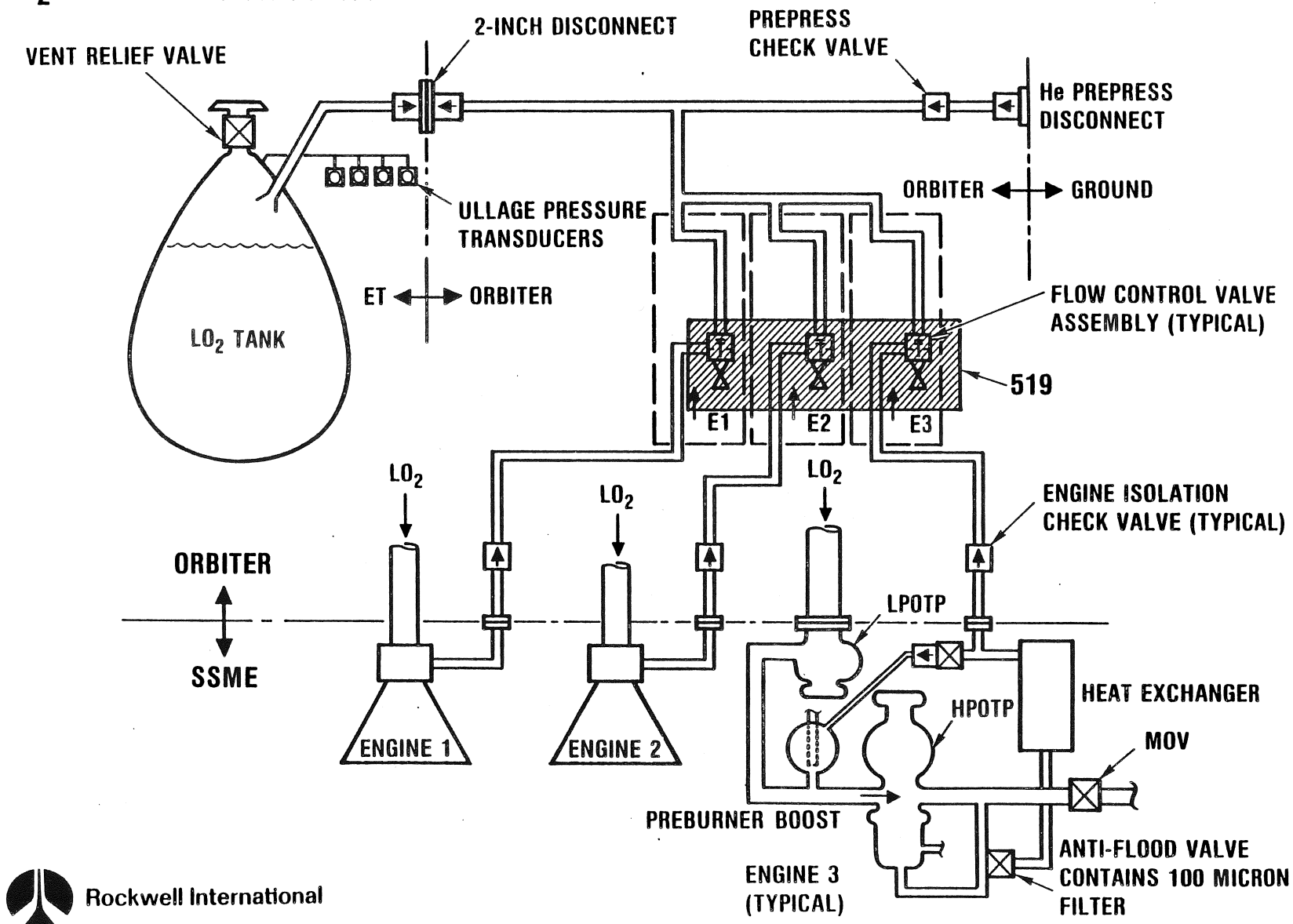
MATERIALS - GO_2 FCV
HOUSING: INCONEL 718 POPPET: MONEL 500 POPPET SEAL: INCONEL 718 SLEEVE: MONEL 500 OUTLET TUBE INSERT: MONEL 500 INLET/OUTLET TUBES: INCONEL 718 K-MINISEALS: INCONEL 718 (GOLD-PLATED)

MATERIALS - GH_2 FCV
HOUSING: CRES A286 POPPET: CRES 440A PISTON SEAL : CRES 440A SLEEVE: CRES 440A INLET/OUTLET TUBES: CRES 21-6-9 K-MINISEAL: CRES A286 (GOLD-PLATED) O-RING SEAL: BUNA-N

COMPONENT: VALVE, PRESSURANT FLOW CONTROL, OXYGEN

(MC280-0017)

GO_2 PRESSURIZATION SYSTEM SCHEMATIC

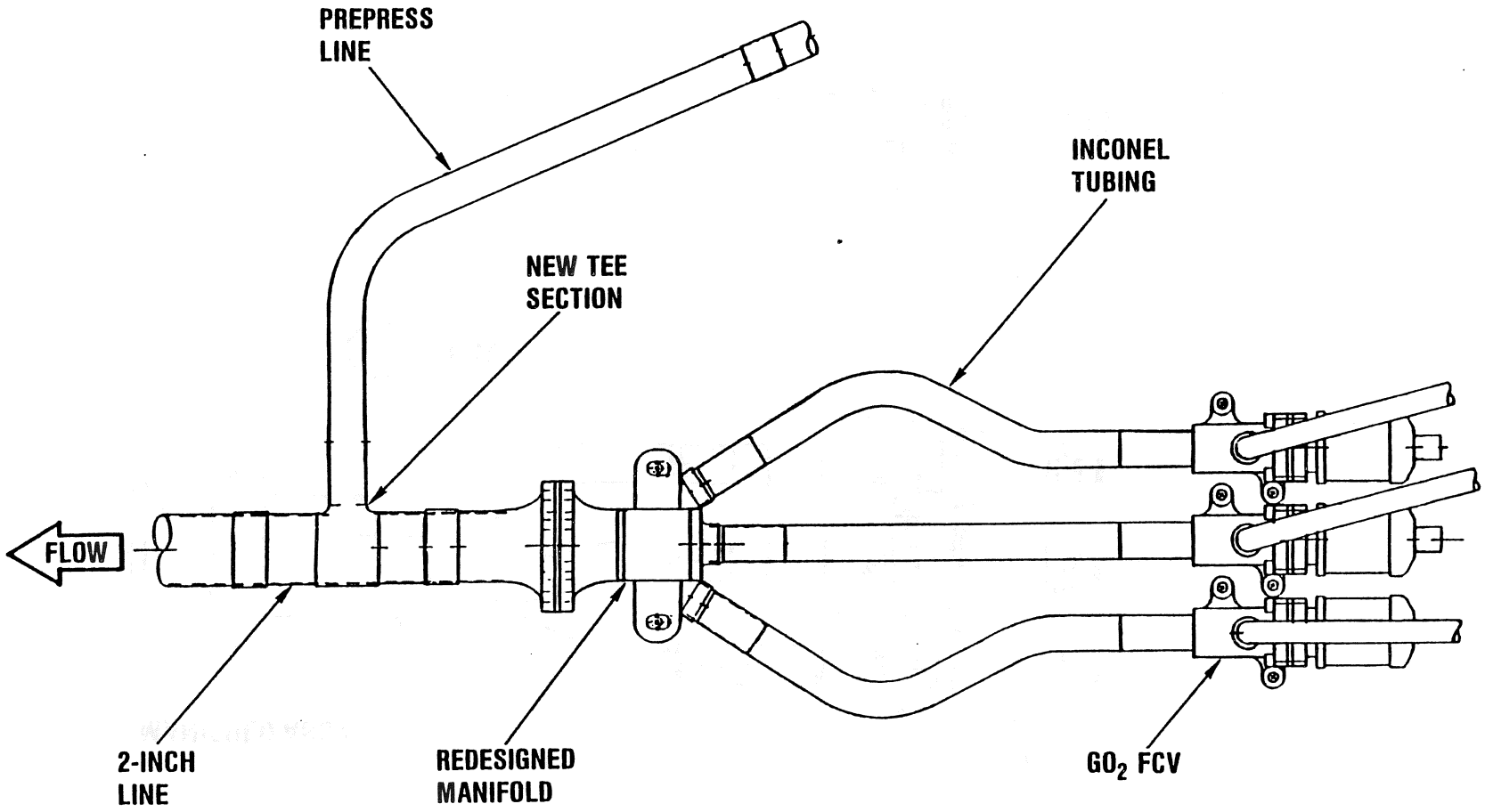


Rockwell International

Space Transportation Systems Division

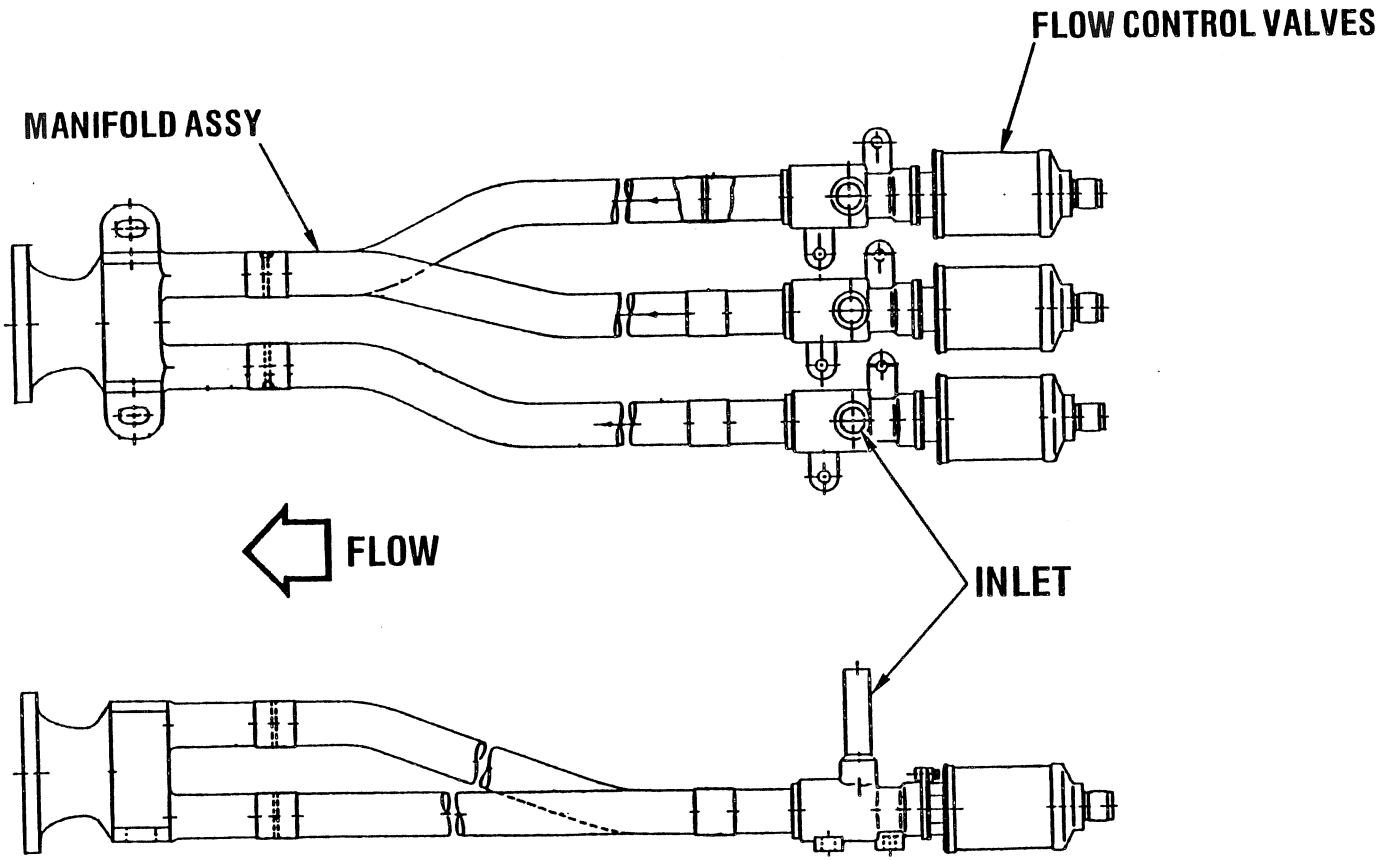
COMPONENT: VALVE, PRESSURANT FLOW CONTROL, OXYGEN
(MC280-0017)

GO_2 FCV INSTALLATION



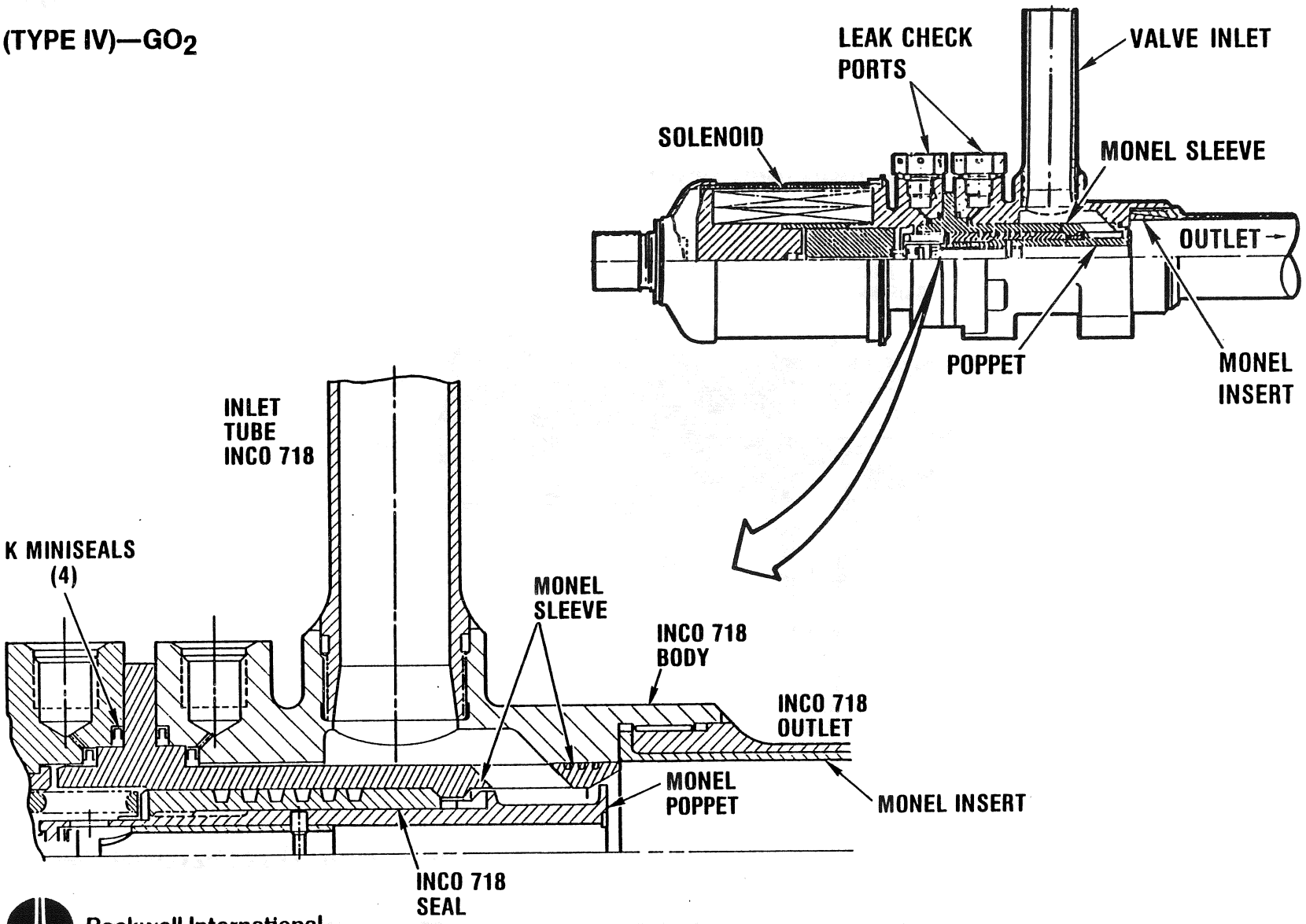
COMPONENT: VALVE, PRESSURANT FLOW CONTROL, HYDROGEN
(MC280-0017)

GH_2 FCV INSTALLATION



COMPONENT: VALVE, PRESSURANT FLOW CONTROL, OXYGEN
(MC280-0017)

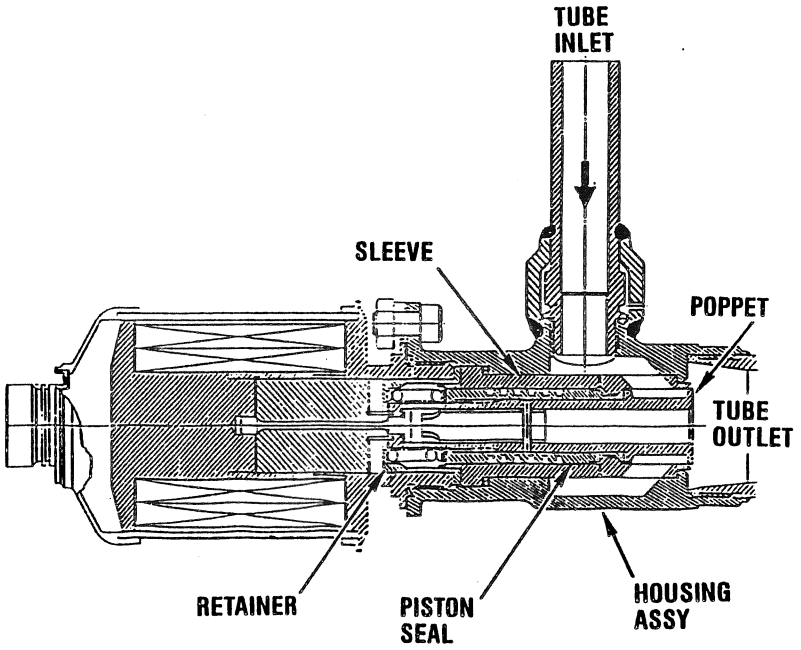
(TYPE IV)—GO_2



Rockwell International
Space Transportation Systems Division

COMPONENT: VALVE, PRESSURANT FLOW CONTROL, HYDROGEN AND OXYGEN
(MC280-0017)

MC280-0017-0361 (TYPE III)—GH_2



SHOWN IN ENERGIZED (LOW FLOW) POSITION

COMPONENT: PUMP ASSEMBLY, HYDROGEN, RECIRCULATION

(MC281-0030)

FMEA/CIL NO. 03-1-0404

SUBSYSTEM : MAIN PROPULSION

ASSEMBLY : SUNDSTRAND
P/N RI : MC281-0030-0002
P/N VENDOR:
QUANTITY : 1 PER END ITEM
:

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

PUMP ASSEMBLY, RECIRCULATION, THREE ELECTRICALLY DRIVEN PUMPS.

FUNCTION:

RECIRCULATES LH_2 DURING PRELAUNCH PAUSE TO PROVIDE PROPER ENGINE INLET TEMPERATURE CONDITIONS PRIOR TO MAIN ENGINE START. THE PUMP ASSEMBLY CONSISTS OF 3 SEPARATE PUMP-MOTORS MOUNTED IN A COMMON HOUSING WHICH IS INSTALLED IN THE LH_2 MANIFOLD FEEDLINE. PUMP POWER IS SUPPLIED BY THE MOBILE LAUNCH PLATFORM (MLP).

DESIGN:

SYSTEM PRESSURE IS 60 PSI MAXIMUM. HOUSING IS DESIGNED WITH SAFETY FACTOR OF 1.3 PROOF, 1.5 BURST. PROOF PRESSURE FOR THE RECIRCULATION PUMP HOUSING IS 78 PSIG.

THE THREE PUMP-MOTOR BOLTED COVERS ARE EXTERNALLY SEALED TO THE HOUSING FLANGE WITH A NAFLEX-TYPE SEAL (METAL STATIC FACE SEAL, WITH A TEFLON COATING). LEAK DETECTION PORTS ARE PROVIDED IN THE HOUSING FOR EACH PUMP-MOTOR COVER SEAL HOUSING FLANGE SEAL. INPUT POWER AND PUMP SPEED ELECTRICAL CONNECTORS ARE WELDED INTO EACH PUMP-MOTOR COVER. THE HOUSING IS CONSTRUCTED OF C355 CAST ALUMINUM ALLOY, AND THE MOTOR COVERS ARE CONSTRUCTED FROM AMS 5370, 300 SERIES, CAST STAINLESS STEEL.

COMPONENT: PUMP ASSEMBLY, HYDROGEN, RECIRCULATION

(MC281-0030)

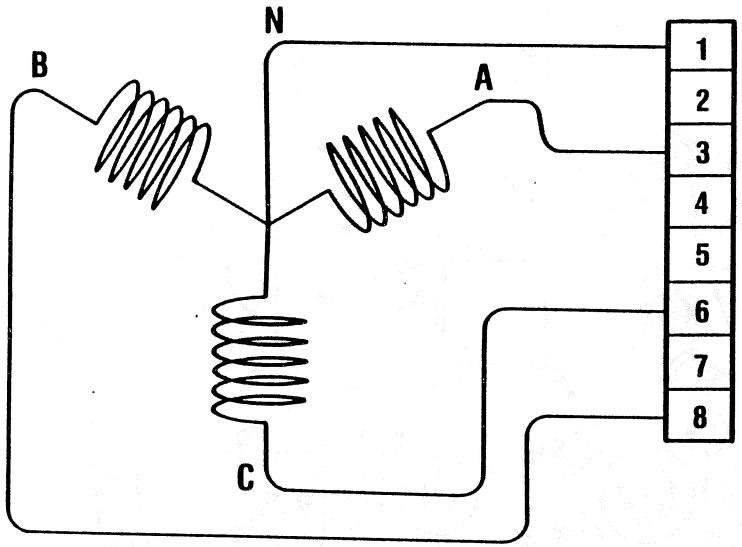
DESIGN PARAMETERS AND FEATURES:

CURRENT CONFIGURATION:	(-0002)
OPERATING SPEED:	11,000/12,000 RPM
ELECTRICAL CHARACTERISTICS:	115 V, 400 HZ, 3.5 AMP/PHASE, 890 WATTS MAXIMUM
FLOW CAPACITY:	135 GPM AT 7.6 PSI PSID
OPERATING TEMPERATURE:	-413°F TO -423°F
NOMINAL LINE SIZE:	2.0 INCH (NOMINAL)
WEIGHT:	30.50 LB
TOTAL EXTERNAL LEAKAGE:	80 SCCM AT AMB

COMPONENT: PUMP ASSEMBLY, HYDROGEN, RECIRCULATION
(MC281-0030)

MOTOR

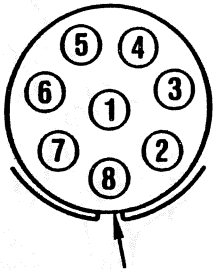
SCHEMATIC



ROTATION TO BE CLOCKWISE VIEWING FROM DRIVE (PUMP) END OF MOTOR WITH A-B-C SEQUENCE OF POWER.

ELECTRICAL CONNECTOR

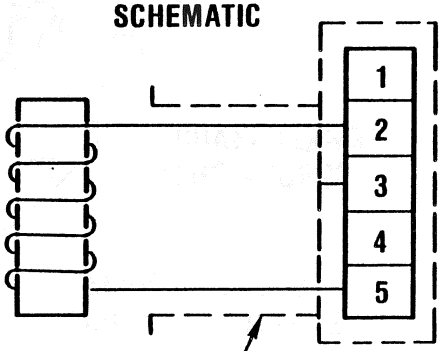
CONNECTOR TYPE & SIZE
AS SPECIFIED IN 3.1.2.3.1
PIN ARRANGEMENT AS SHOWN.



MAIN POLARIZING KEYWAY

SPEED MONITOR

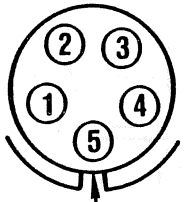
SCHEMATIC



ELECTROMAGNETIC COUNTER

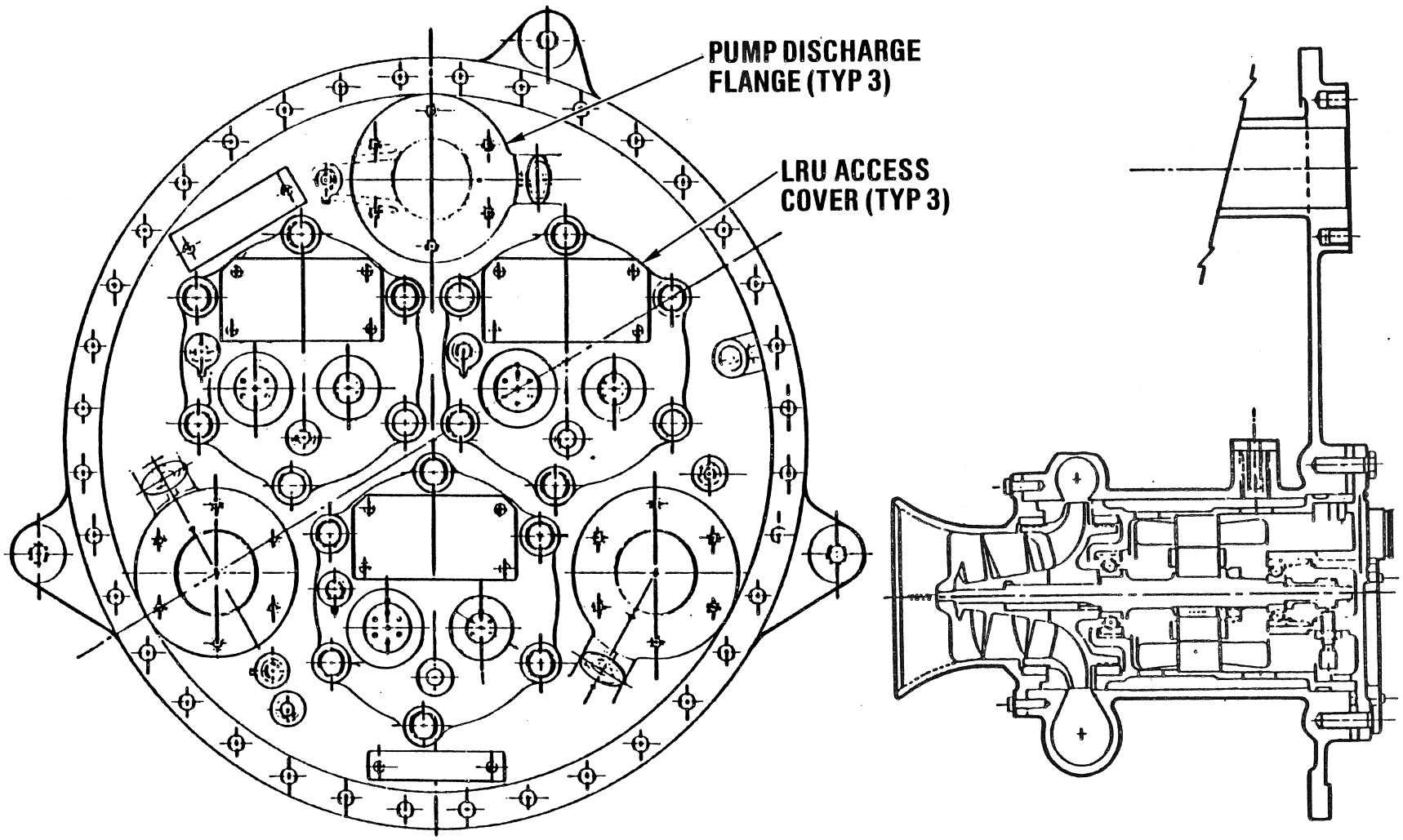
BRAIDED SHIELDING

ELECTRICAL CONNECTOR

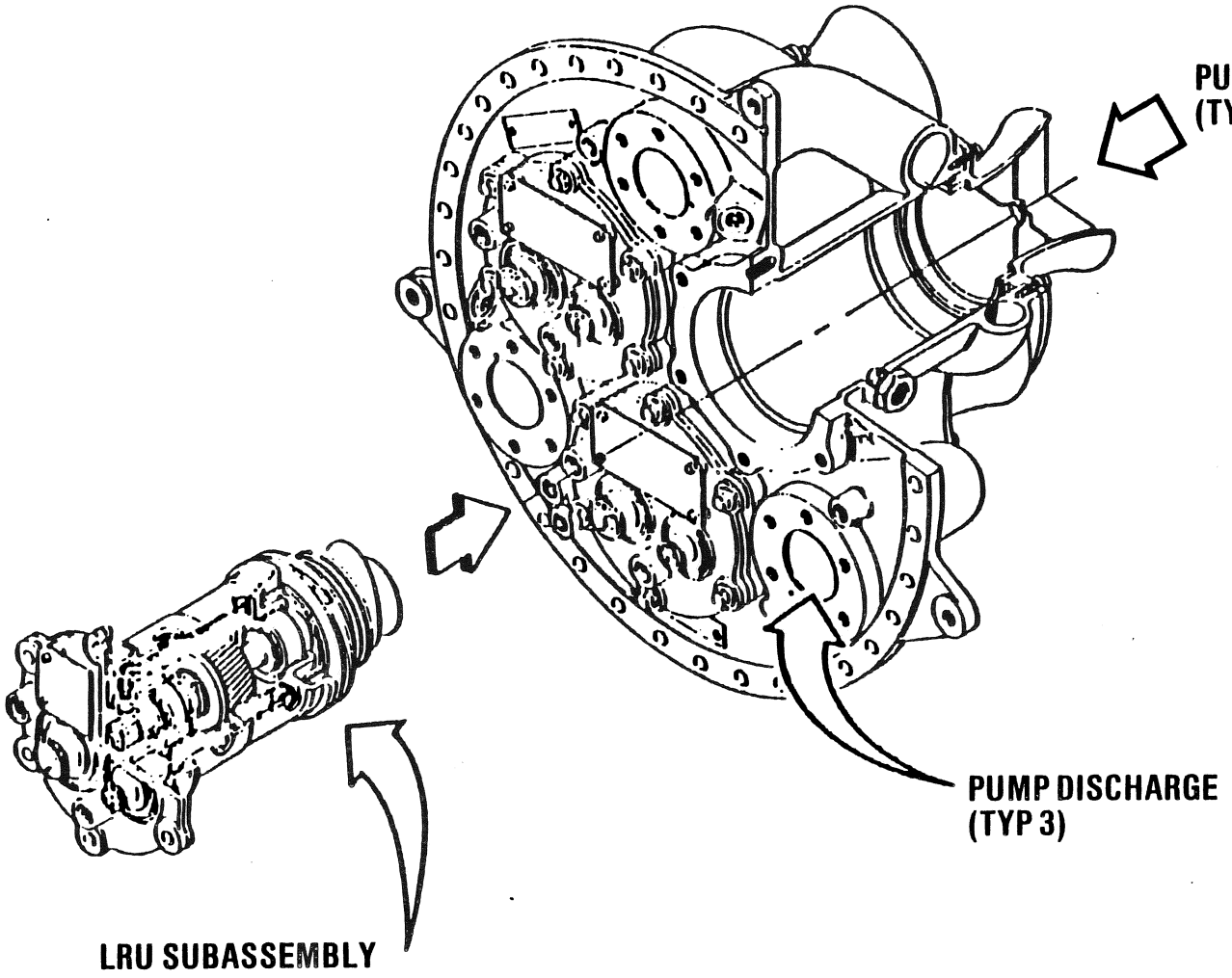


MAIN POLARIZING KEYWAY

COMPONENT: PUMP ASSEMBLY, HYDROGEN, RECIRCULATION
(MC281-0030)



COMPONENT: PUMP ASSEMBLY, HYDROGEN, RECIRCULATION
(MC281-0030)



COMPONENT: HELIUM SURGE CHAMBER

(MC282-0070)

FMEA/CIL NO: 03-1-0210

ASSEMBLY : SARGENT
P/N RI : MC282-0070-0001
P/N VENDOR: 9257-1
QUANTITY : 2 PER END ITEM
NEXT
ASSEMBLY : V070-415145
V070-415505*

VEHICLE EFFECTIVITY:	*102	103	104	105
	X	X	X	X

ITEM: -0001, AU5, AU6 SPHERICAL SURGE CHAMBER HELIUM PNEUMATIC SYSTEM LOCATION AFT COMPARTMENT

FUNCTION:

THE SURGE CHAMBER SHALL PROVIDE A VOLUME FOR PROTECTION FROM EXCESSIVE SURGE PRESSURE DROP DURING HELIUM PNEUMATIC ACTUATION OF THE MAIN PROPULSION SUBSYSTEM PREVALVES, EXTERIOR TANK DISCONNECTS, AND FEEDLINE RELIEF SYSTEM SHUTOFF VALVES.

DESIGN:

THE SURGE CHAMBER CONSISTS OF TWO HEMISPHERICAL TITANIUM, 6AL-4V, HALVES JOINED BY WELDING. THE ULTIMATE PRESSURE FACTOR OF SAFETY FOR THE SURGE CHAMBER IS A MINIMUM OF 40. THE PROOF PRESSURE FACTOR OF SAFETY IS 20 ABOVE LIMIT PRESSURE. THE MAXIMUM ALLOWABLE EXTERNAL LEAKAGE IS 1.0×10^{-6} SCCS OF HELIUM AT 850 PSIG. THE SURGE CHAMBER SHALL HAVE A MINIMUM USEFUL LIFE OF 5,000 PRESSURE CYCLES WHICH ARE EQUIVALENT TO 100 ORBITAL MISSIONS IN A 10 YEAR PERIOD FROM DATE OF DELIVERY. THE SURGE CHAMBER MUST HAVE A FATIGUE LIFE OF 4 TIMES THE REQUIRED OPERATING LIFE PRESSURE CYCLES. THE MAXIMUM SHELF LIFE IS 12 YEARS FROM THE DATE OF DELIVERY.

COMPONENT: HELIUM SURGE CHAMBER

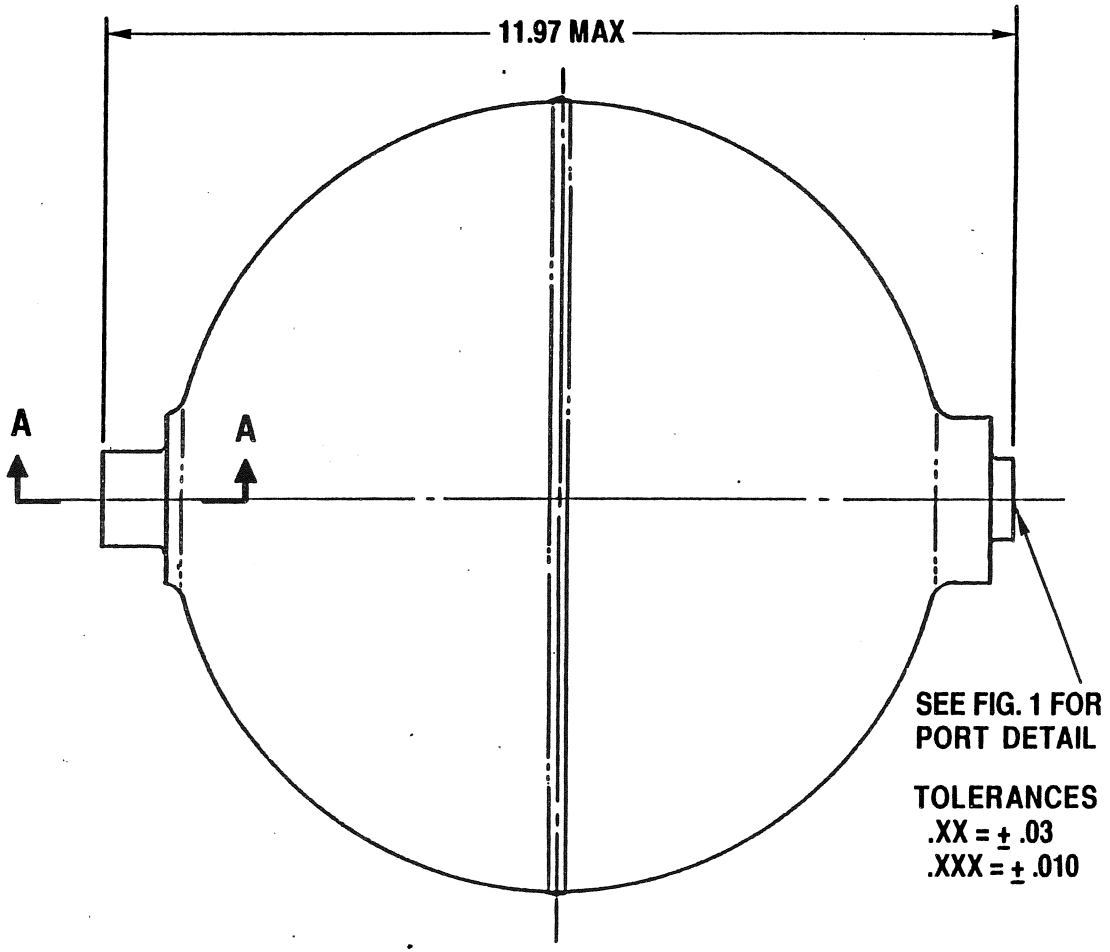
(MC282-0070)

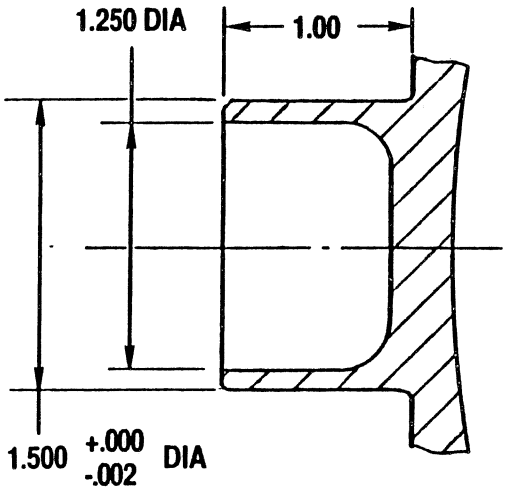
DESIGN PARAMETERS:

DASH NO.	VOLUME	NORMAL OPERATING PRESSURE (PSIG)	SURGE PRESSURE (PSIG)	BURST PRESSURE (PSIG)	PROOF PRESSURE (PSIG)	OPERATING RANGE TEMPERATURE (°F)	WEIGHT
-0001	500 $IN.^3$ (MAX)	750^{+30}_{-50}	400 TO 780	3400	1700	-160 TO +250	4.00 LB (MAX)

COMPONENT: HELIUM SURGE CHAMBER

(MC282-0070)





SECTION A-A

Rockwell International

Space Transportation
Systems Division

COMPONENT: HELIUM SUPPLY TANK

(MC282-0082)

FMEA/CIL NO: 03-1-0237
03-1-0256
03-1-0257

VENDOR : BRUNSWICK
P/N RI : MC282-0082-0001 (17.3 CUBIC FEET)
: MC282-0082-0010 (4.7 CUBIC FEET)
P/N VENDOR:
QUANTITY : 3 (-0001) PER END ITEM
: 7 (-0010) PER END ITEM

VEHICLE EFFECTIVITY:

102	103	104	105
X	X	X	X

NEXT ASSEMBLY: V070-415770 (AFT COMPARTMENT INSTALLATION)
: V070-415280 (MID FUSELAGE INSTALLATION)

ITEM: -0010 (TK4)

TANK, HELIUM, 4.7 CUBIC FEET, PNEUMATIC VALVE SUPPLY, 4,500 PSIA. LOCATED IN AFT COMPARTMENT.

FUNCTION:

THE TANK STORES THE HELIUM SUPPLY REQUIRED FOR MPS MANIFOLD REPRESSURIZATION, AFT COMPARTMENT PURGE, AND ACTUATION OF THE FOLLOWING MPS PNEUMATIC VALVES: POGO ACCUMULATOR RECIRCULATION VALVES; LH_2 RECIRCULATION PUMP VALVES; LH_2 TOPPING VALVE; LO_2 FILL AND DRAIN VALVES (I/B AND O/B); LH_2 FILL AND DRAIN VALVES (I/B AND O/B); LO_2 PREVALVES (PV1, 2, 3); LH_2 PREVALVES (PV4, 5, 6); LO_2/LH_2 17 INCH ET/ORBITER DISCONNECT VALVES AND LATCH ASSEMBLY (PD1, 2); LH_2 4 INCH RECIRCULATION DISCONNECT VALVE (PD3); LH_2 RTLS DUMP VALVES (PV17, 18); LH_2 HIGH POINT BLEED VALVE (PV22); LO_2 BLEED SHUTOFF VALVE (PV19); AND LO_2/LH_2 RELIEF ISOLATION VALVES (PV7, 8).

COMPONENT: HELIUM SUPPLY TANK

(MC282-0082)

ITEM: -0010 (TK7, TK9, TK11)

TANK, HELIUM, 4.7 CUBIC FEET, 4,500 PSIA. LOCATED IN MID FUSELAGE.

FUNCTION:

STORES A PORTION OF THE HELIUM REQUIRED FOR MAIN ENGINE USAGE. ONE TANK, INTERCONNECTED WITH ANOTHER 4.7 (LOCATED IN THE AFT COMPARTMENT) AND A 17.3 CUBIC FOOT TANK (LOCATED IN THE MID FUSELAGE), IS DEDICATED TO EACH MAIN ENGINE. USES INCLUDE: PURGE OF LO_2 HIGH PRESSURE OXIDIZER TURBOPUMP (HPOT) INTERMEDIATE SEAL; EMERGENCY SHUTDOWN; BLEED VALVE ACTUATION; FUEL SYSTEM PURGE (ANTI-ICE); AND POST SHUTDOWN HELIUM PURGE. RESIDUAL HELIUM WILL BE USED FOR PROPELLANT DUMP, MPS LINE REPRESSURIZATION AND ET UMBILICAL, OMS POD, AND AFT COMPARTMENT PURGES. TANK TK9 IS USED TO SUPPLEMENT THE PNEUMATIC HELIUM SYSTEM BY CROSSOVER VALVE (LV10).

ITEM: -0010 (TK1, TK2, TK3)

TANK, HELIUM, 4.7 CUBIC FEET, ENGINE SUPPLY, 4,500 PSIA. LOCATED IN AFT COMPARTMENT.

FUNCTION:

STORES A PORTION OF THE HELIUM REQUIRED FOR MAIN ENGINE USAGE. ONE TANK, INTERCONNECTED WITH ANOTHER 4.7 AND A 17.3 CUBIC FOOT TANK (BOTH LOCATED IN THE MID FUSELAGE), IS DEDICATED TO EACH MAIN ENGINE. USES INCLUDE: PURGE OF LO_2 HIGH PRESSURE OXIDIZER TURBOPUMP (HPOT) INTERMEDIATE SEAL; EMERGENCY SHUTDOWN; BLEED VALVE ACTUATION; FUEL SYSTEM PURGE; AND POST SHUTDOWN HELIUM PURGE. RESIDUAL HELIUM IS USED FOR PROPELLANT DUMP, MPS LINE REPRESSURIZATION AND ET UMBILICAL, OMS POD, AND AFT COMPARTMENT PURGES. TANK TK2 IS USED TO SUPPLEMENT THE PNEUMATIC HELIUM SYSTEM BY CROSSOVER VALVE (LV10).

COMPONENT: HELIUM SUPPLY TANK

(MC282-0082)

ITEM: -0001 (TK6, TK8, TK10)

TANK, HELIUM, 17.3 CUBIC FEET, 4,500 PSIA. LOCATED IN THE MID FUSELAGE.

FUNCTION:

STORES A PORTION OF THE HELIUM REQUIRED FOR MAIN ENGINE USAGE. ONE TANK, INTERCONNECTED WITH TWO 4.7 CUBIC FOOT TANKS (ONE LOCATED IN THE MID FUSELAGE AND ONE IN THE AFT FUSELAGE), IS DEDICATED TO EACH MAIN ENGINE. USES INCLUDE: PURGE OF LO_2 HIGH PRESSURE OXIDIZER TURBOPUMP (HPOT) INTERMEDIATE SEAL; EMERGENCY SHUTDOWN; BLEED VALVE ACTUATION; FUEL SYSTEM PURGE (ANTI-ICE); AND POST SHUTDOWN PREBURNER PURGE. RESIDUAL HELIUM WILL BE USED FOR PROPELLANT DUMP, MPS LINE REPRESSURIZATION, AND ET UMBILICAL, OMS POD AND AFT COMPARTMENT PURGES. TANK TK8 IS USED TO SUPPLEMENT THE PNEUMATIC HELIUM SYSTEM BY CROSSOVER VALVE (LV10).

DESIGN:

THE TANK LINER CONSISTS OF TWO FORGED HEMISPHERES FABRICATED FROM TITANIUM 6AL-4V ALLOY (0.05 INCH MINIMUM THICKNESS, 130 KSI ULTIMATE STRENGTH). THE TWO HEMISPHERES ARE WELDED TOGETHER. THE LINER IS WOUND WITH EPOXY-IMPREGNATED KEVLAR-49 FIBER (500 KSI TENSILE STRENGTH). FILAMENT WOUND CONSTRUCTION PRECLUDES FRAGMENTATION DAMAGE. THE DESIGN MEETS FRACTURE ANALYSIS REQUIREMENTS FOR 400 MISSIONS. FACTORS OF SAFETY ARE 1.33 PROOF AND 1.5 BURST.

TO PRECLUDE RUPTURE THE PRESSURE VESSEL IS DESIGNED TO ASSURE THAT UNDER NORMAL OPERATING CONDITIONS, ANY FAILURE RESULTING FROM METAL FATIGUE OR ANY OTHER DEFECTS WILL RESULT IN A LEAK BEFORE BURST FAILURE MODE.

DESIGN PARAMETERS:

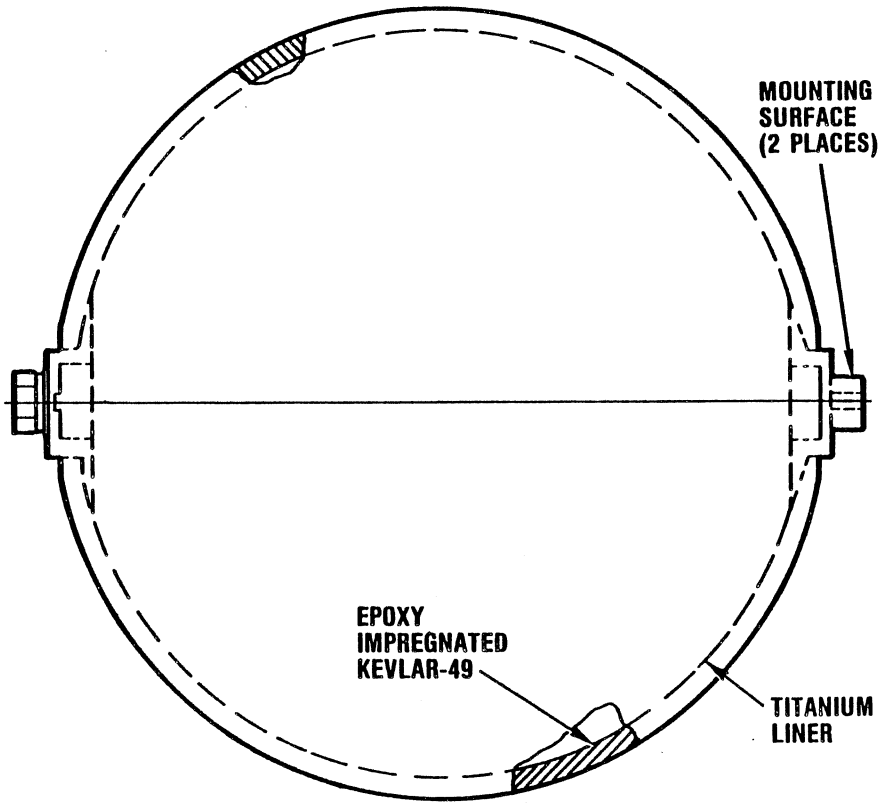
DASH NO.	TANK	MAXIMUM O.D. AT ZERO PRESSURE	MAXIMUM PRESSURE AT 40 TO 200°F	BURST PRESSURE	MAXIMUM NEGATIVE INTERNAL PRESSURE	MINIMUM DETANKING TEMPERATURE	WEIGHT
-0001	17.34 CU FT	40.3 IN.	4,500 PSIG	6750 PSIG	15.23 PSID	-175°F	289 LB
-0010	4.73 CU FT	26.125 IN.	4,500 PSIG	6750 PSIG	15.23 PSID	-175°F	77.5 LB

OPERATING LIFE:

250 PRESSURE CYCLES FROM AMBIENT TO MAXIMUM OPERATING PRESSURE.

COMPONENT: HELIUM SUPPLY TANK

(MC282-0082)



COMPONENT: DISCONNECT, LH_2/LO_2 ORBITER TO TANK FEED SYSTEM

(MC284-0389)

(17" DISCONNECT) FMEA/CIL NO: 03-1-0407-4

	ORBITER ASSEMBLY	MATING E.T. ASSEMBLY
	(PD2)	
P/N RI :	MC284-0389-0451 LH_2	MC284-0389-0452 LH_2
P/N VENDOR:	(5790012-106)	(5790014-105)
	MC284-0389-1451 LH_2	MC284-0389-0452 LH_2
	(5790012-111)	(5790014-105)
	MC284-0389-2091 LH_2	MC284-0389-0452 LH_2
	(5790012-112)	(5790014-105)
	(PD1)	
	MC284-0389-1551 LO_2	MC284-0389-0552 LO_2
	(5790013-109)	(5790015-105)

QUANTITY : 1
: ONE LH_2; ONE LO_2

VEHICLE EFFECTIVITY:	102	103	104
	X	X	X

ITEM:
DISCONNECT, LH_2/LO_2 FEED (WITH LATCH) 17 INCH, ORBITER AND ET HALF. (PD1 AND PD2)

COMPONENT: DISCONNECT, LH_2/LO_2 ORBITER TO TANK FEED SYSTEM

(MC284-0389)

FUNCTION:

ET/ORBITER FEED LINE DISCONNECTS PROVIDE A MEANS OF LOADING AND DETANKING THE ET AND SUPPLYING PROPELLANTS TO THE ORBITER MPS. EACH ORBITER AND ET DISCONNECT HALF CONTAINS A PNEUMATICALLY ACTUATED FLAPPER CLOSURE DEVICE WHICH REMAINS IN ITS LAST ACTUATED POSITION (BISTABLE). AFTER THE ORBITER AND EXTERNAL TANK HAVE BEEN STRUCTURALLY MATED, THE ORBITER/ET UMBILICAL IS MATED AND THREE BOLTS WITH PYROTECHNIC FRANGIBLE NUTS ARE INSTALLED. PRIOR TO THE START OF TANKING, THE DISCONNECTS ARE OPENED AND REMAIN OPEN UNTIL MAIN ENGINE SHUTDOWN. THE VALVES ARE PNEUMATICALLY CLOSED AFTER MECO AND BEFORE TANK SEPARATION TO PREVENT PROPULSIVE VENTING OF PROPELLANTS WHICH COULD CAUSE ET/ORBITER RECONTACT, LOSS OF MANIFOLD REPRESSURIZATION HELIUM SUPPLY DURING REENTRY, LEAKAGE OF H_2 AND O_2 INTO THE ENGINE COMPARTMENT DURING RTLS AND TAL ABORTS (RTLS/TAL ABORT CRITICAL), AND SYSTEM CONTAMINATION DURING ENTRY. DURING UMBILICAL SEPARATION, THE VALVE SYSTEM IS DESIGNED TO MECHANICALLY CLOSE BOTH THE ORBITER AND ET DISCONNECT FLAPPERS IF UNABLE TO CLOSE THEM BY PNEUMATIC COMMAND (POST MECO).

A PNEUMATICALLY ACTUATED LATCH MECHANISM IS PROVIDED AS AN INTEGRAL PART OF THE VALVE TO PREVENT INADVERTENT VALVE CLOSURE DURING FLOW CONDITIONS. THE LATCH IS BISTABLE AND IS CONTROLLED BY A SEPARATE PNEUMATIC ACTUATOR ASSEMBLY WITH REDUNDANT POSITION SWITCHES IN EACH POSITION. THE LATCH INCORPORATES A PIVOT WHICH ALLOWS FLAPPER CLOSURE WITH LATCH IN LOCKED POSITION DURING BACKUP MECHANICAL SEPARATION.

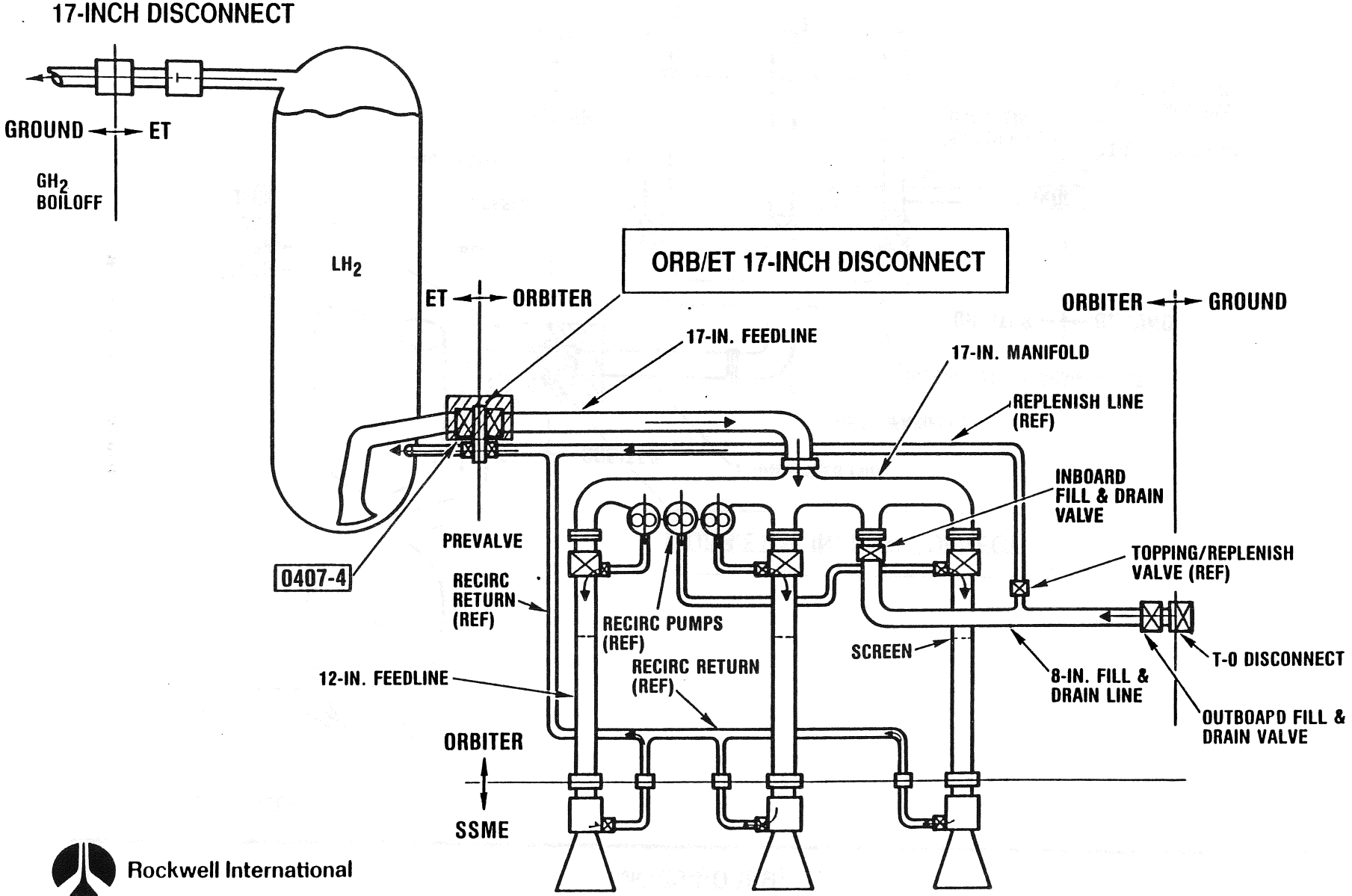
THE ORBITER AND EXTERNAL TANK SECTIONS OF THE DISCONNECT CONTAIN A SHUTOFF VALVE (FLAPPER) WHICH IS ROTATED FROM CLOSED POSITION TO OPEN POSITION BY A PNEUMATIC ACTUATOR. IN THE OPEN POSITION, THE MECHANISM IS LOCKED OVER-CENTER AND AN OPEN DIRECTION FORCE IS MAINTAINED ON THE FLAPPER. THE FLAPPERS ARE POSITIONED IN THE VALVE BODY SUCH THAT THE FLUID FLOW WILL DEVELOP ADDITIONAL OPENING FORCES.

THE DESIGN OF THE FLAPPER LINKAGE PROVIDES FOR RELIEF OF PRESSURE BUILDUP BETWEEN THE TWO FLAPPERS WHEN THE UNITS ARE MATED BY ALLOWING THE FLAPPER TO LIFT OFF THE SEAT AGAINST A SPRING FORCE. THE FLAPPER IS SEALED BY A FLEXIBLE TEFLON COATED METAL DISC ON THE FLAPPER SEATING ON A SEAT RING IN THE DISCONNECT BODY.

THE MAIN VALVE PNEUMATIC ACTUATOR AND POSITION INDICATOR ARE MOUNTED ON THE ORBITER SECTION. THE PNEUMATIC ACTUATOR DYNAMIC SEALS ARE MOUNTED ON THE PISTON, AND PISTON BUMPER SEALS ARE PROVIDED FOR LEAKAGE CONTROL AT EACH END OF THE STROKE. THE POSITION INDICATOR CONTAINS REDUNDANT SWITCHES IN BOTH THE OPEN AND CLOSED POSITION. THE ACTUATOR AND POSITION INDICATOR CAN BE REPLACED WITHOUT AFFECTING DISCONNECT ADJUSTMENT.

COMPONENT: DISCONNECT, LH_2 ORBITER TO TANK FEED SYSTEM

(MC284-0389)



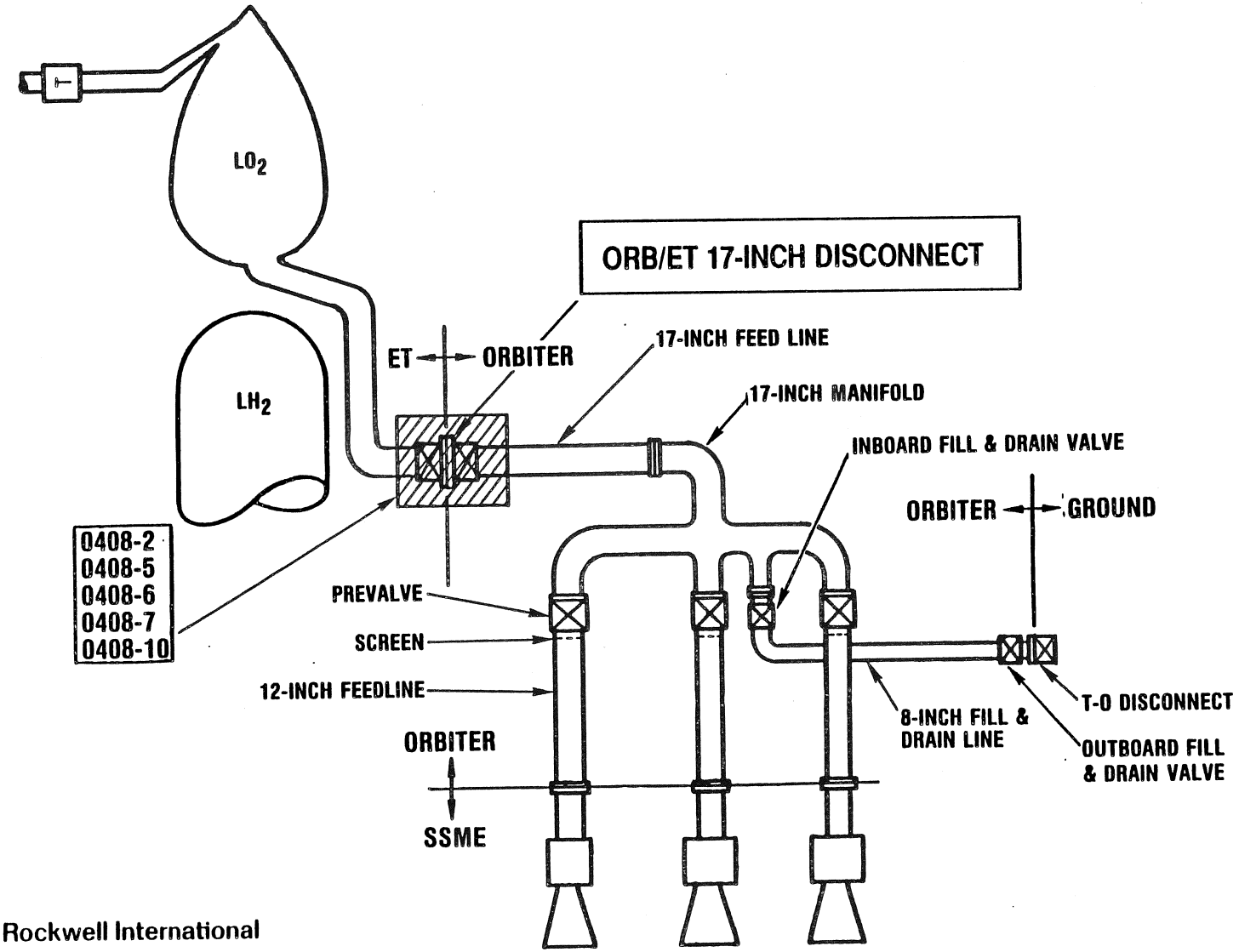
Rockwell International

Space Transportation Systems Division

COMPONENT: DISCONNECT, LO_2 ORBITER TO TANK FEED SYSTEM

(MC284-0389)

17-INCH DISCONNECT



COMPONENT: DISCONNECT, LH_2/LO_2 ORBITER TO TANK FEED SYSTEM

(MC284-0389)

DESIGN PARAMETERS:

LEAKAGE ALLOWABLES (SEE PROCUREMENT SPEC MC 284-0389, SECTION 3.2.1.12)

	LEAKAGE ALLOWED	PRESSURE	TEMPERATURE
PRIMARY MATING SEAL:	600 SCIM H_2 310 SCIM O_2	0 - 50 PSIG 0 - 200 PSIG	-423 F -297 F
SECONDARY MATING SEAL:	10 SCIM He	0 - 10 PSIG	70 TO 160 F
DISCONNECT BODY (MATED) (EXCLUSIVE OF MATING SEAL & END FLANGES)	200 SCIM H_2 300 SCIM O_2	0 - 50 PSIG 0 - 200 PSIG	-423 F -297 F
ORBITER FLAPPER SEAL:	5,000 SCIM H_2 2,500 SCIM O_2 1,000 SCIM He	60 PSID 220 PSID 15 ±5 PSID	-423 TO +160 F -297 TO +160 F 70 TO 160 F
VALVE ACTUATOR: INTERNAL (EITHER PORT) EXTERNAL (EITHER PORT OR BOTH)	 100 SCIM He 100 SCIM He	 740 ±40 PSIG 740 ±40 PSIG	 -423 TO 200 F -423 TO 200 F
LATCH ACTUATOR: INTERNAL (EITHER PORT) EXTERNAL: STATIC CAP SEALS PISTON SHAFT SEAL	 400 SCIM He 150 SCIM He 1,000 SCIM He	 740 ±40 PSIG 740 ±40 PSIG 740 ±40 PSIG	 -423 TO 200 F -423 TO 200 F -423 TO 200 F

COMPONENT: DISCONNECT, LH_2/LO_2 ORBITER TO TANK FEED SYSTEM

(MC284-0389)

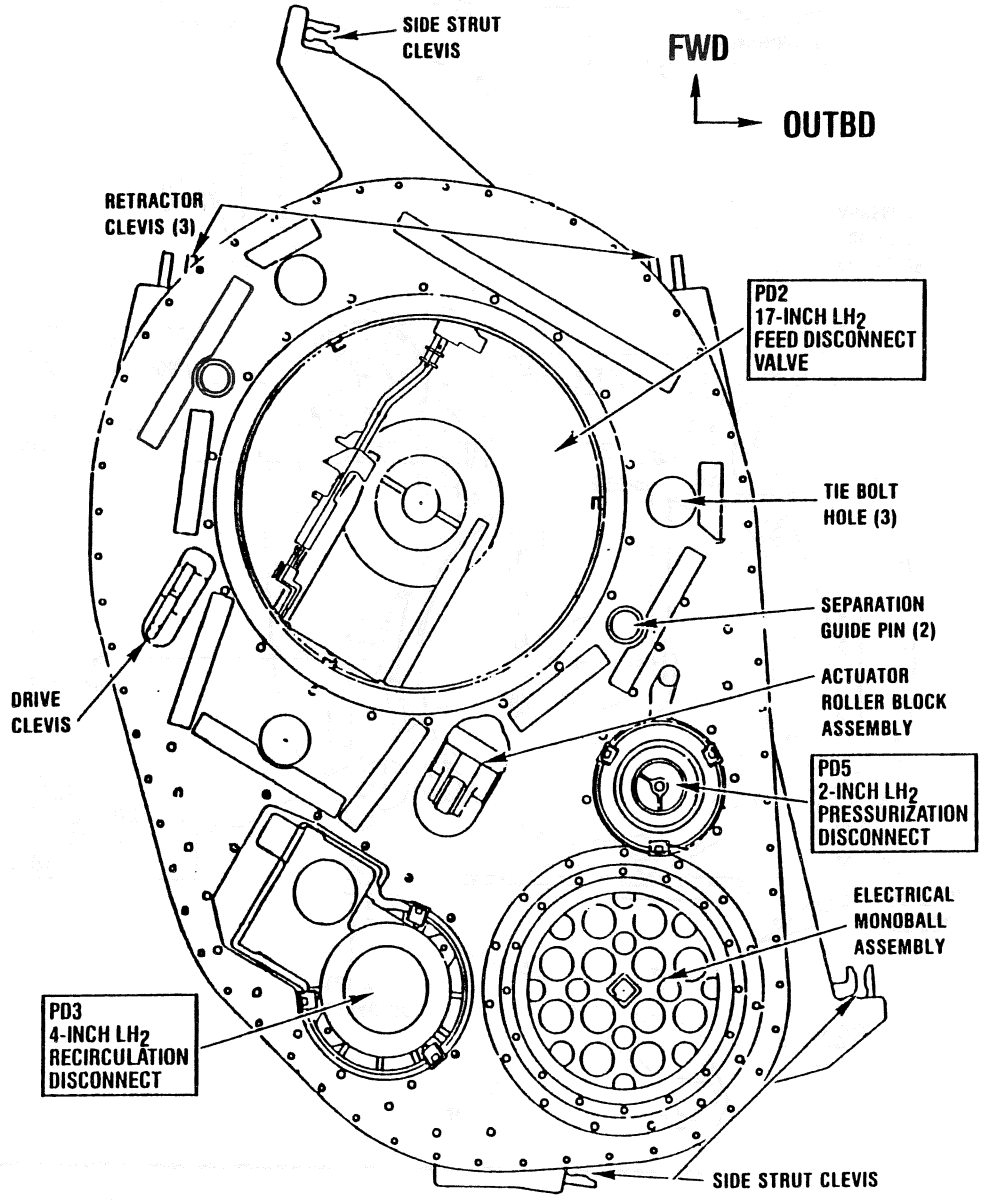
DESIGN PARAMETERS AND FEATURES:

OPERATING PRESSURE:	MAIN BODY = 265 PSIG ACTUATOR = 710 TO 850 PSIG
PROOF PRESSURE:	MAIN BODY OPEN = 390 PSIG CLOSED = 286 PSIG ORBITER, 58.5 PSIG ET ACTUATOR = 1,275 PSIG
FLOW CAPACITY: (MATED)	LO_2 2,655 LB/SEC AT 4.3 PSID LO_2 444 LB/SEC AT 1.8 PSID
RELIEF CAPABILITY:	0.1 LB/SEC GH_2 OR 1.8 LB/SEC GO_2 AT 5.0 PSID MAX.
OPERATING TIME: VALVE:	AMBIENT - OPEN 3 + 2 SEC; CLOSE 1.9 SEC MAX. CRYOGENIC - OPEN 3 + 2 SEC; CLOSE 2.75 SEC MAX.
LATCH:	AMBIENT - 0.060 TO 0.600 SEC (EXPERIENCE RANGE) CRYOGENIC - 0.95 SEC MAX.
TEMPERATURE RANGE:	-423°F TO +150°F
POSITION INDICATOR:	2 TO 32 VDC
NOMINAL SIZE:	17 INCH (16.875 I.D. AT FEEDLINE INTERFACE)
(FACE-TO-FACE) DIMENSIONS: ORBITER OVERALL ENVELOPE: ET OVERALL ENVELOPE:	11.0 (EACH SECTION) 17.5 X 24.6 X 26.38 12.20 X 24.6 X 24.4
WEIGHT:	ORBITER SECTION 160 MAX LB W/LATCH ET SECTION 134 LB

UMBILICAL ASSEMBLY, LH_2 ORBITER TO TANK FEED SYSTEM

(MC284-0389)

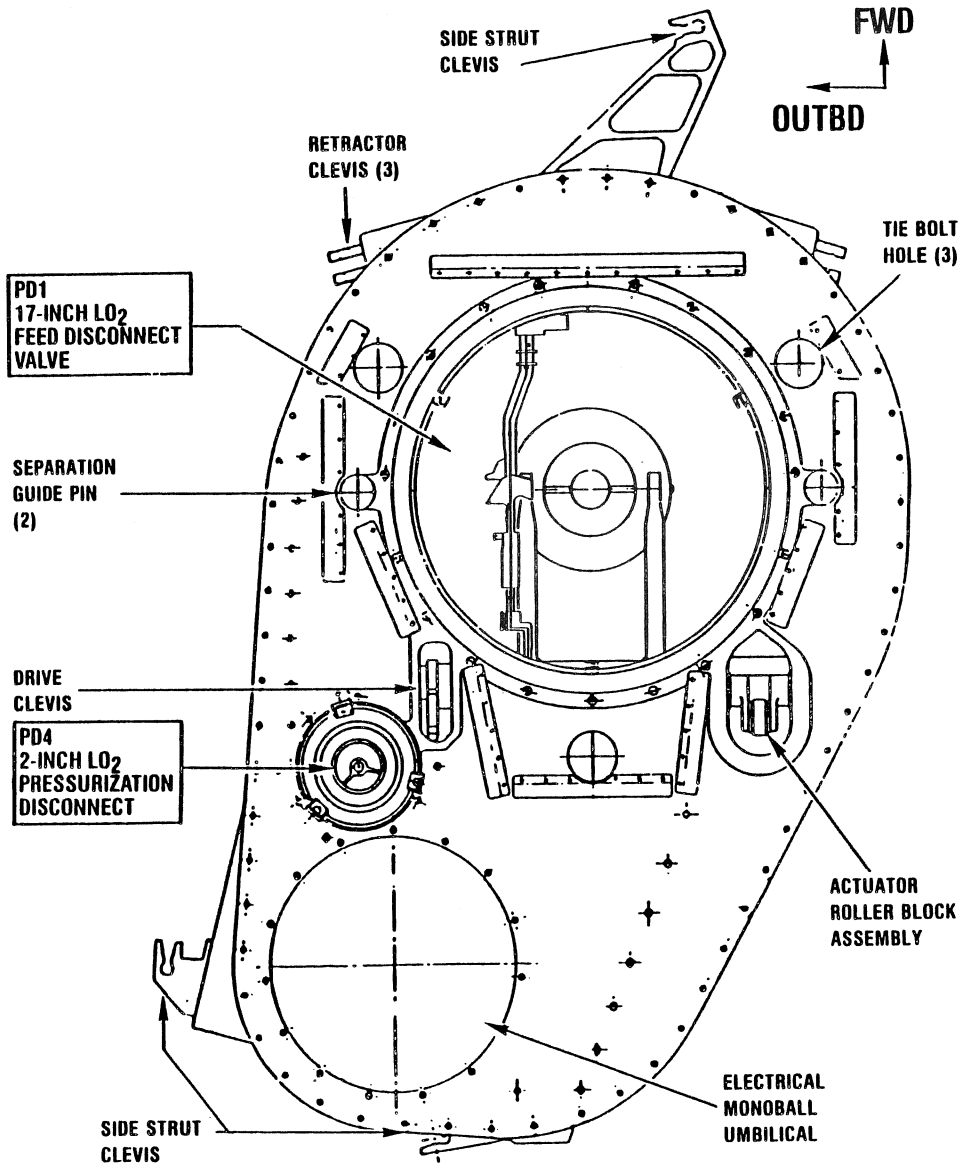
- (PD2) 17-INCH LH_2 FEED DISCONNECT MC284-0389
- (PD3) 4-INCH LH_2 RECIRCULATION DISCONNECT MC284-0389
- (PD5) 2-INCH LH_2 PRESSURIZATION DISCONNECT MC284-0389



UMBILICAL ASSEMBLY, LO_2 ORBITER TO TANK FEED SYSTEM

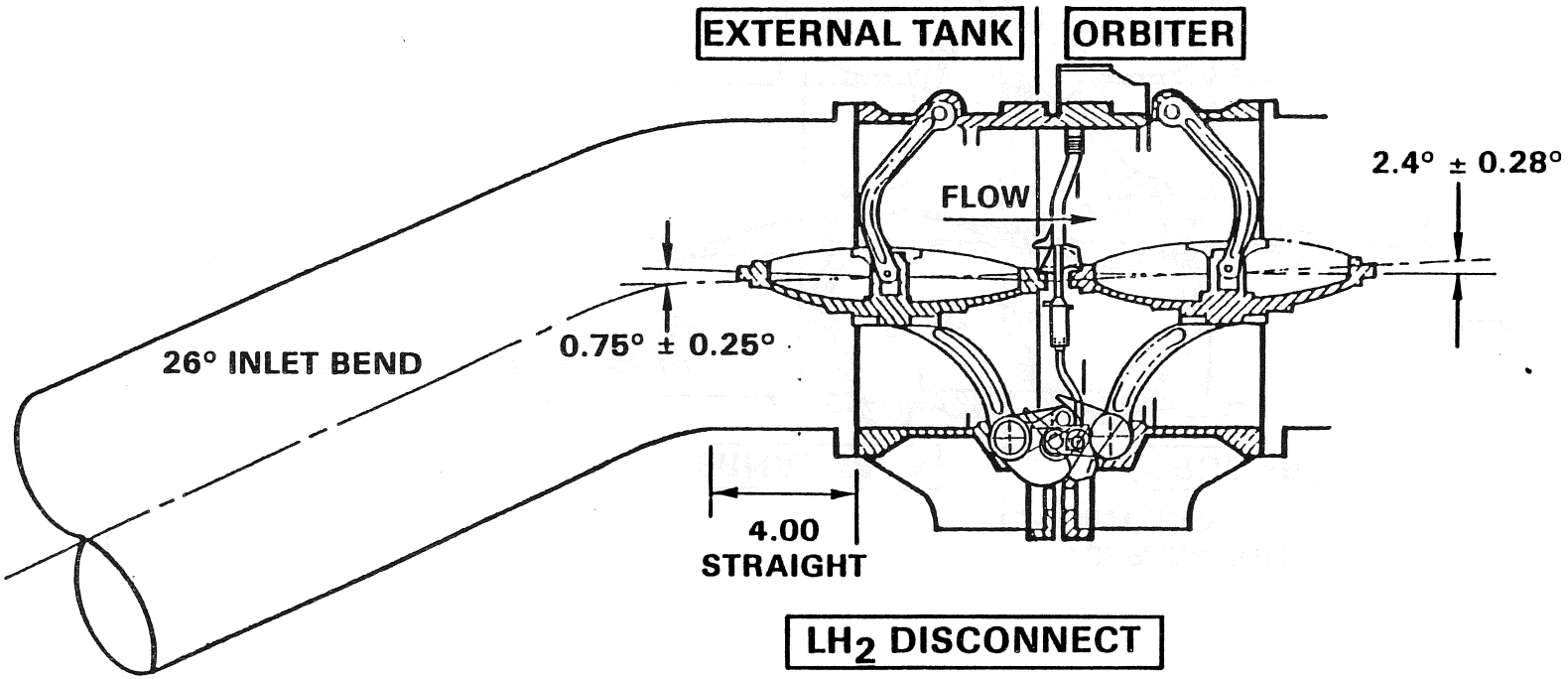
(MC284-0389)

- 17-INCH LO_2 FEED (PD1) DISCONNECT MC284-0389
- 2-INCH LO_2 PRESSURIZATION DISCONNECT (PD4) MC284-0389



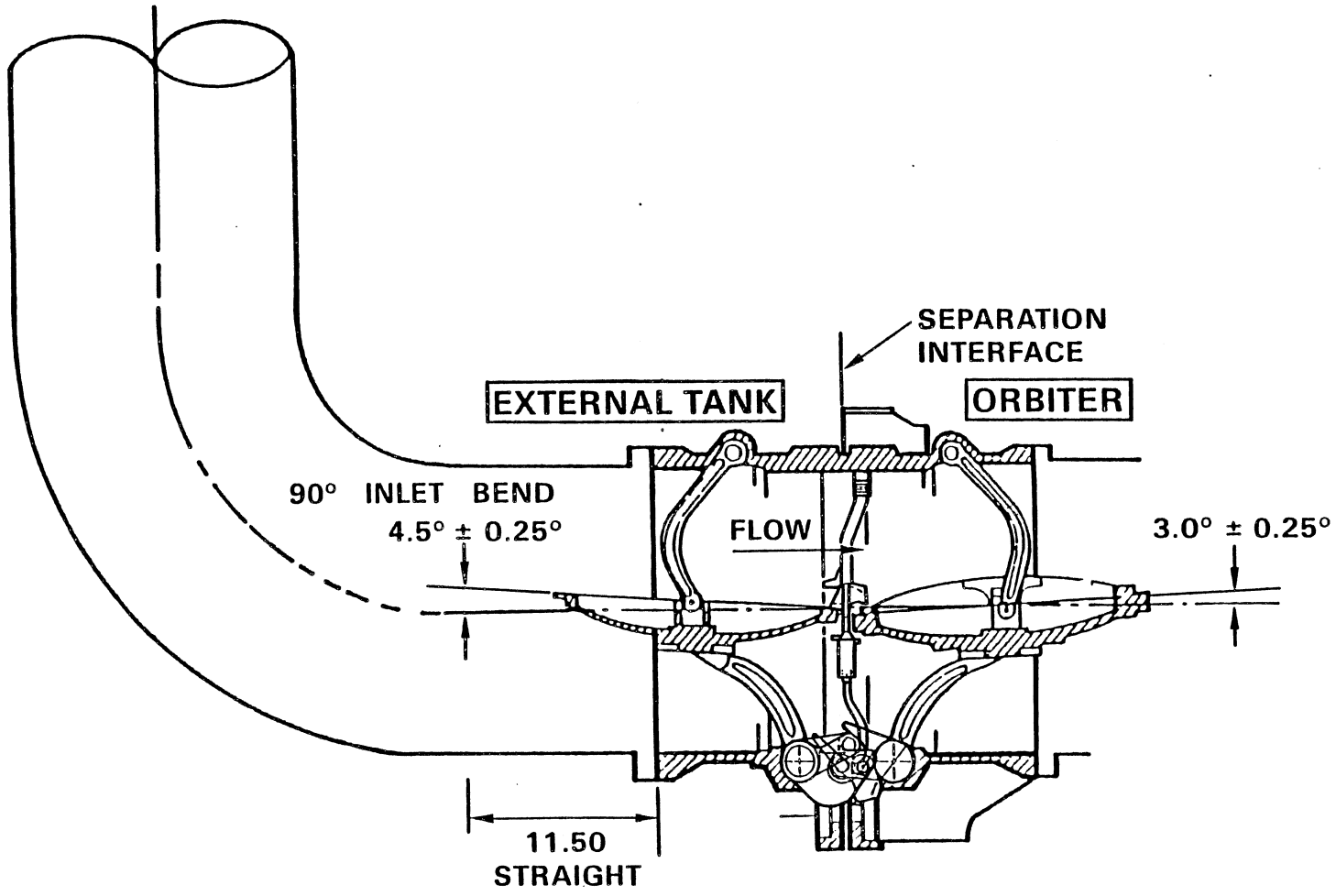
COMPONENT: DISCONNECT, LH_2 ORBITER TO TANK FEED SYSTEM

(MC284-0389)



COMPONENT: DISCONNECT, LO_2 ORBITER TO TANK FEED SYSTEM

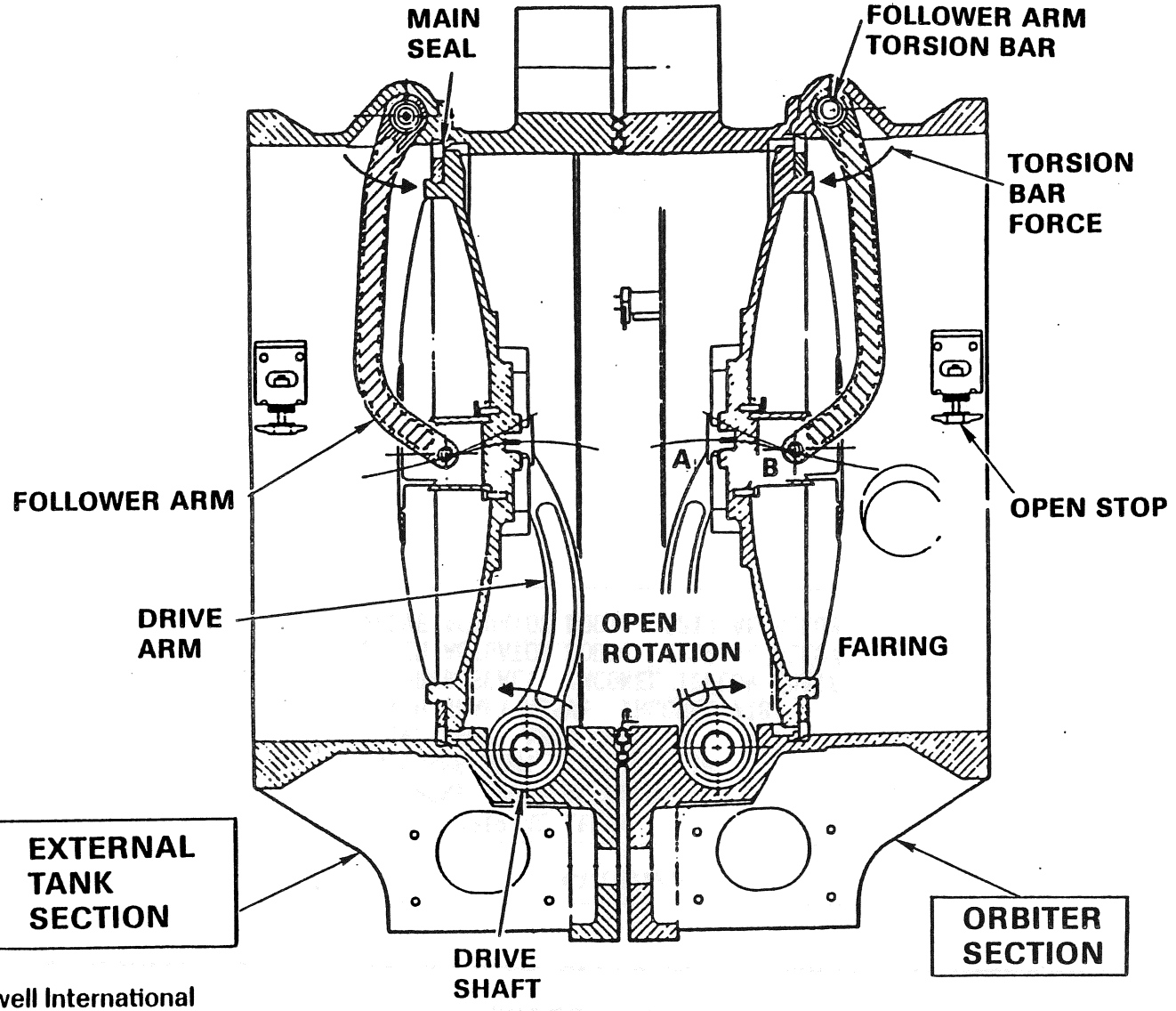
(MC284-0389)



COMPONENT: DISCONNECT, LH_2/LO_2 ORBITER TO TANK FEED SYSTEM

(MC284-0389)

17-INCH DISCONNECT IN CLOSED POSITION



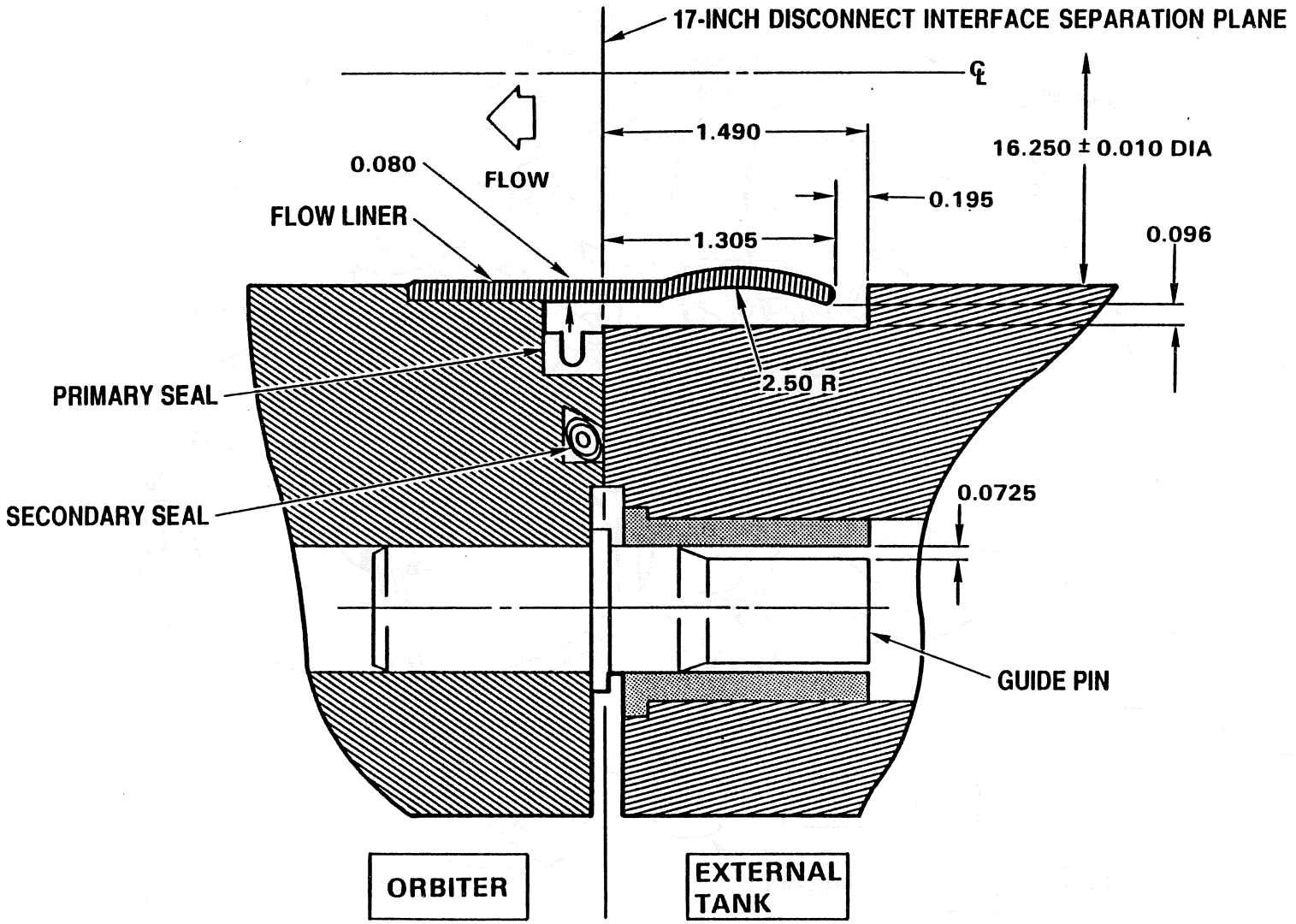
COMPONENT: DISCONNECT, LH_2/LO_2 ORBITER TO TANK FEED SYSTEM

(MC284-0389)

MATERIALS
BODY: 2219 AL ALLOY
FLAPPER: 2024 AL ALLOY
FOLLOWER ARM: INCONEL 718
DRIVE ARM: A286 CRES
LATCH SHAFT ASSY: INCONEL 718
FLAPPER SEAL: INCONEL/TEFLON COATED
LATCH ACTUATOR BODY: 2219 AL ALLOY
VALVE ACTUATOR BODY: 2219 AL ALLOY

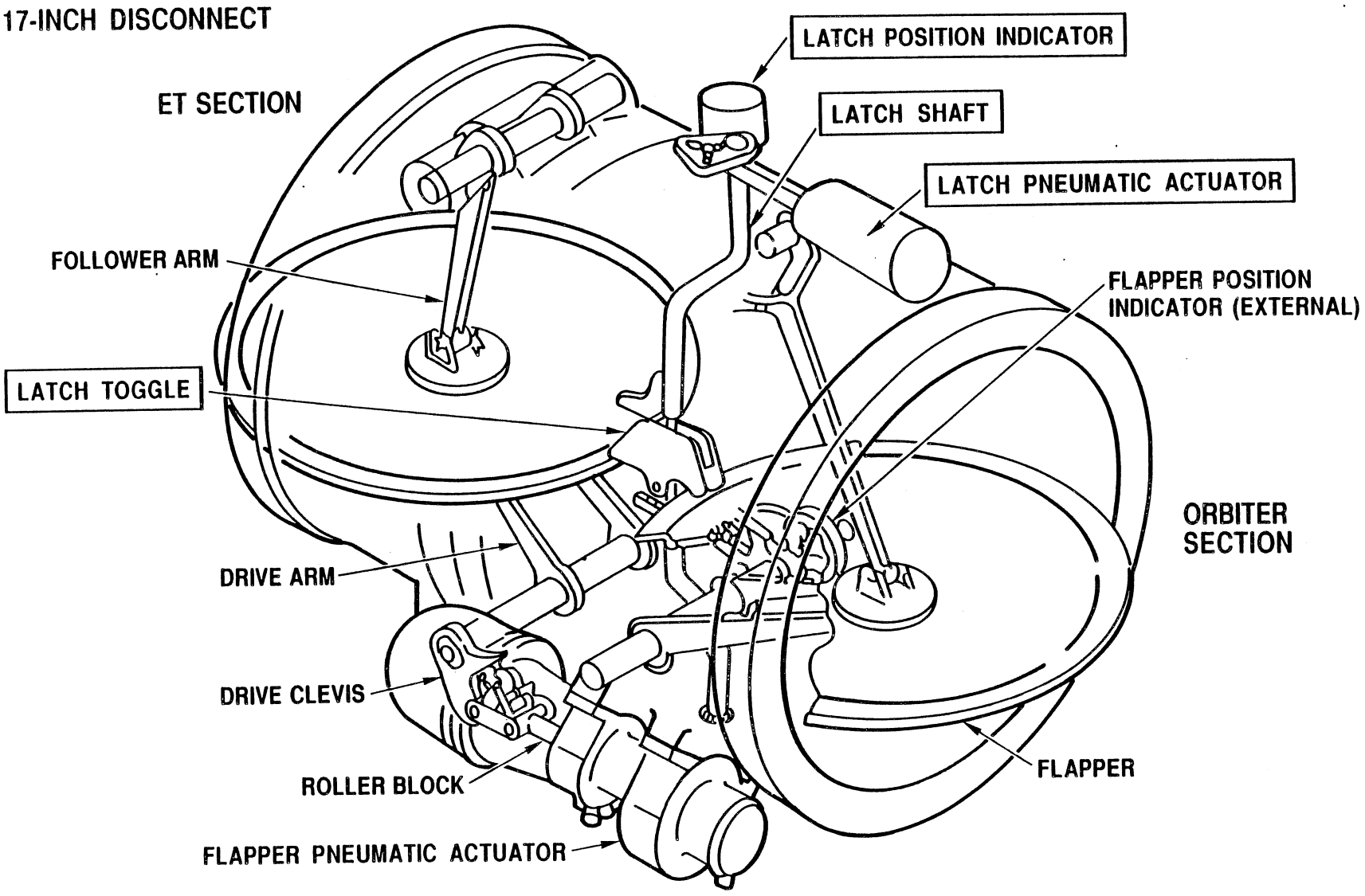
COMPONENT: DISCONNECT, LH_2/LO_2 ORBITER TO TANK FEED SYSTEM INTERFACE

(MC284-0389)



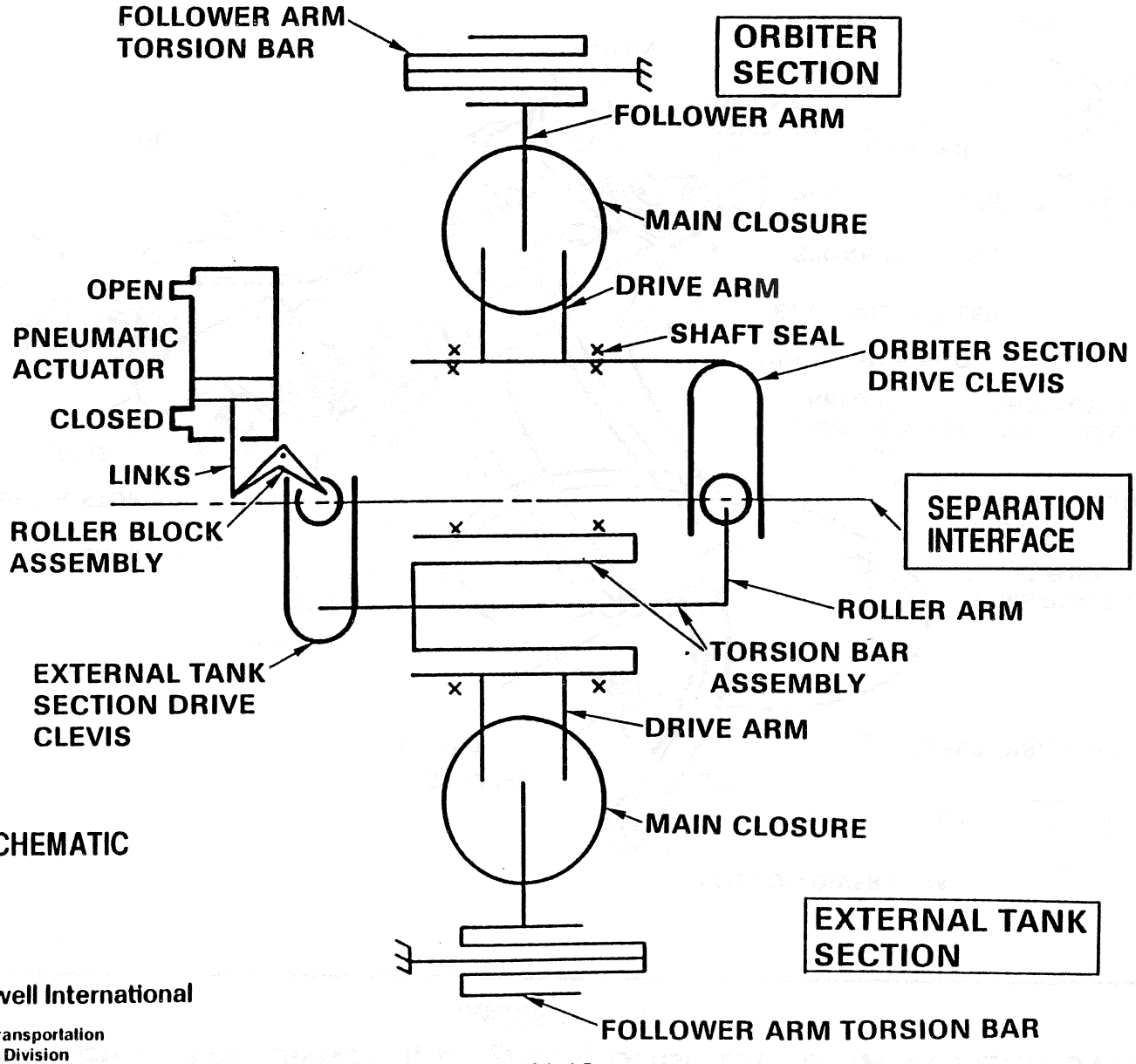
COMPONENT: DISCONNECT, LH_2/LO_2 ORBITER TO TANK FEED SYSTEM

(MC284-0389)



COMPONENT: DISCONNECT, LH_2/LO_2 ORBITER TO TANK FEED SYSTEM

(MC284-0389)



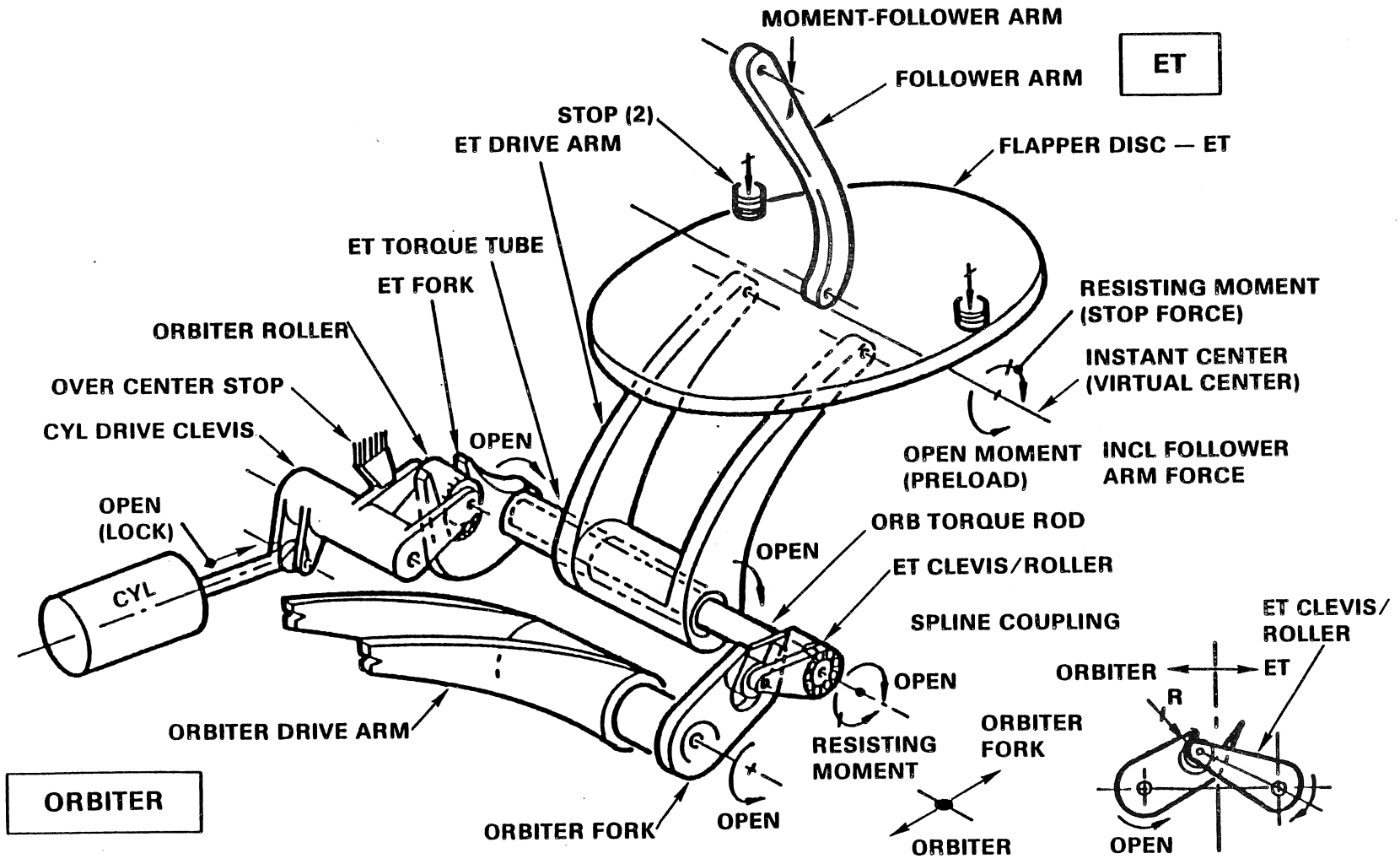
LINKAGE SCHEMATIC

Rockwell International
Space Transportation Systems Division

COMPONENT: DISCONNECT, LH_2/LO_2 ORBITER TO TANK FEED SYSTEM

(MC284-0389)

17-INCH DISCONNECT



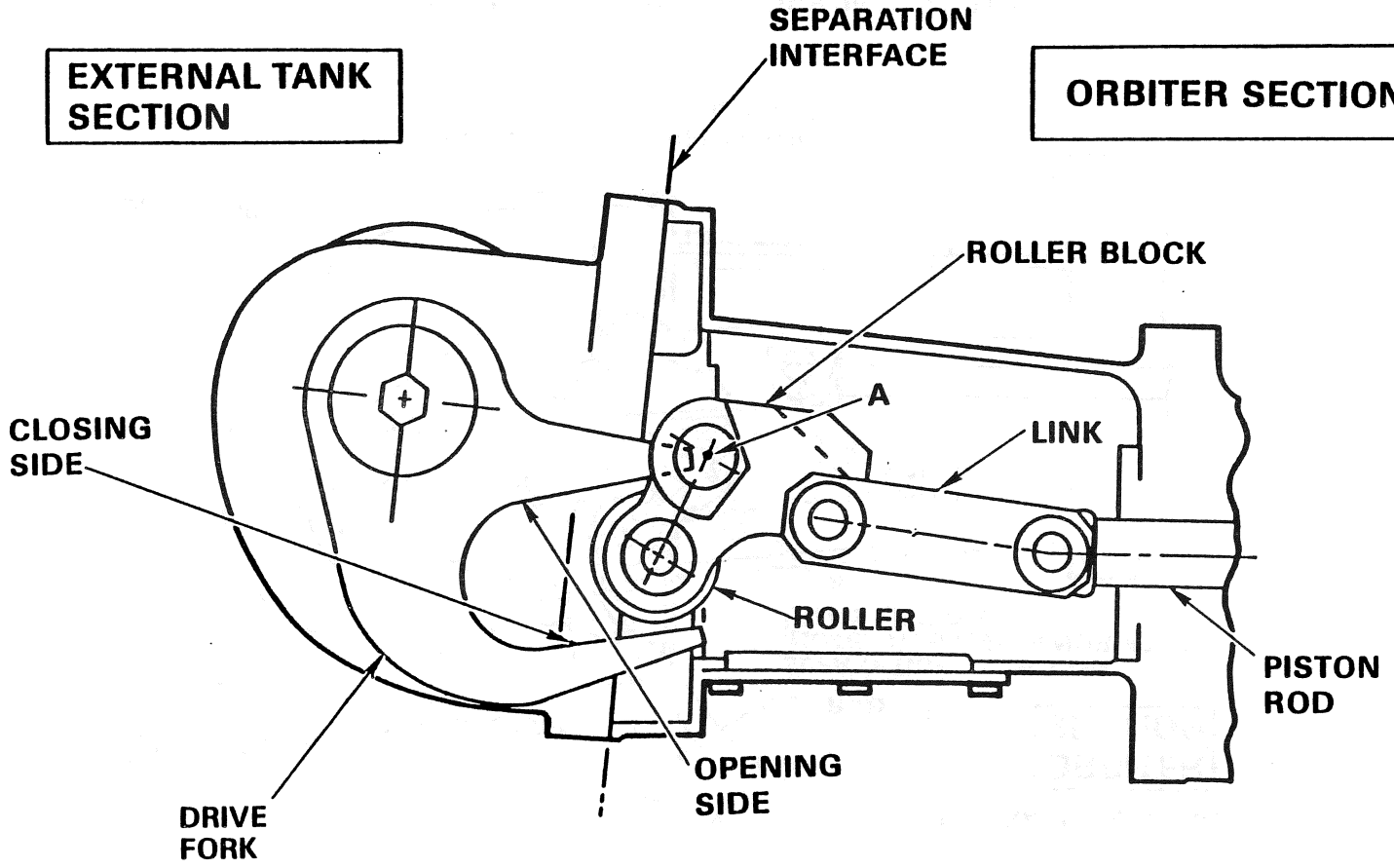
Rockwell International

Space Transportation
Systems Division

COMPONENT: DISCONNECT, LH_2/LO_2 ORBITER TO TANK FEED SYSTEM

(MC284-0389)

17 IN. DISCONNECT



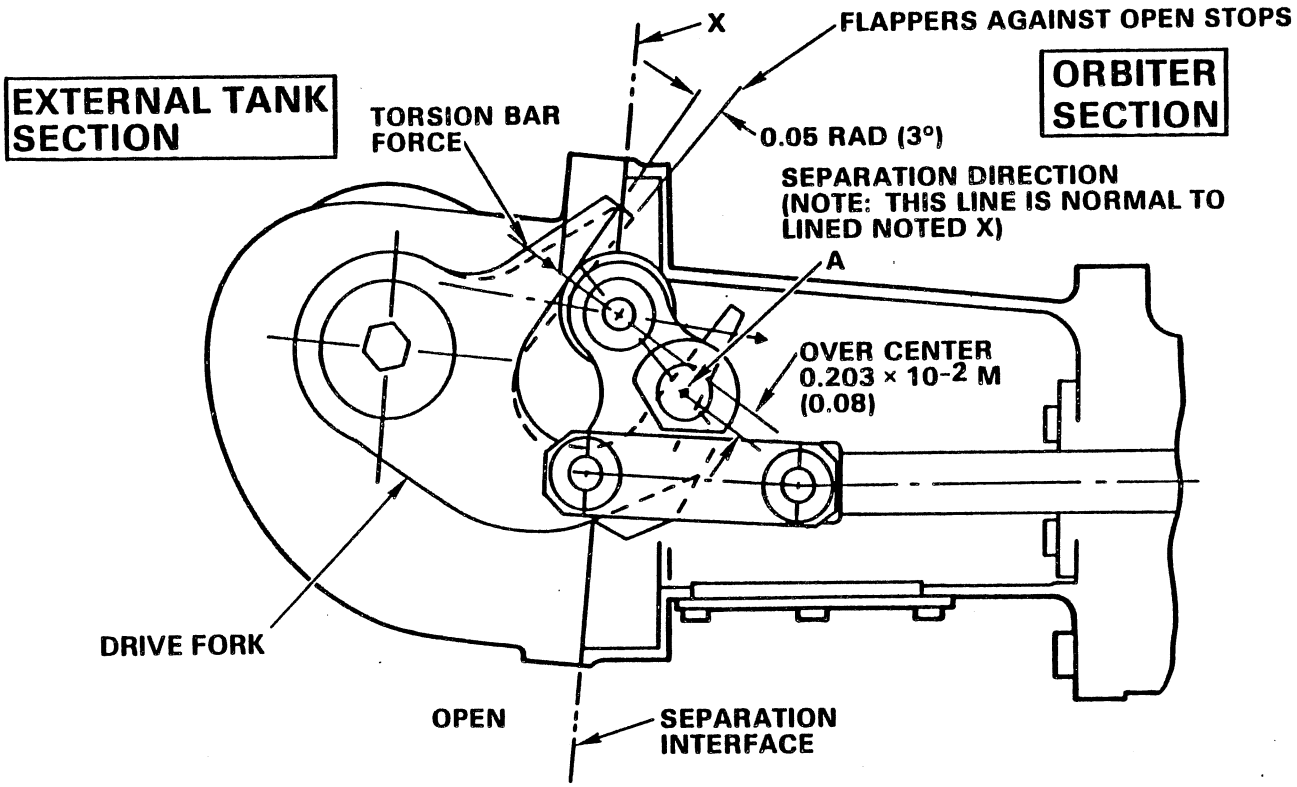
ACTUATOR/DRIVE FORK INTERFACE

VALVE CLOSED POSITION

COMPONENT: DISCONNECT, LH_2/LO_2 ORBITER TO TANK FEED SYSTEM

(MC284-0389)

17 IN. DISCONNECT



ACTUATOR/DRIVE FORK INTERFACE

VALVE OPEN POSITION

COMPONENT: DISCONNECT, LH_2/LO_2 ORBITER TO TANK FEED SYSTEM

(MC284-0389)

THE LATCH SYSTEM CONSISTS OF THREE SUBASSEMBLIES:

A. ACTUATOR

B. ROD AND TOGGLE

C. SHOCK ABSORBER

THE ACTUATOR IS A DOUBLE-ACTING PISTON THAT CONVERTS LINEAR MOTION TO ROTARY MOTION BY MEANS OF A SCOTCH YOKE. OVERTRAVEL IS PROVIDED IN EITHER DIRECTION TO SECURE THE SHAFT IN THE LAST ACTUATED POSITION. THE SCOTCH YOKE IS INDEXED TO THE LATCH SHAFT BY SLOT AND KEY, AND IS ATTACHED TO A CAM THAT OPERATES THE ELECTRICAL POSITION INDICATOR SWITCHES. THE ACTUATOR ASSEMBLY IS FULLY ASSEMBLED AND TESTED BEFORE MOUNTING ON THE 17-INCH DISCONNECT.

THE LATCH ROD ASSEMBLY IS HOUSED IN THE ORBITER DISCONNECT HALF. THE INPUT END OF THE ROD IS A THROUGH-THE-BODY PENETRATION WITH REDUNDANT CRYOGENIC SEALS AND TWO NONMETALLIC BEARINGS. THE ROD ASSEMBLY CONSISTS OF TWO SECTIONS; THE UPPER ROD HAS A SQUARE END THAT INDEXES INTO A CLOSELY FITTED SLOT IN THE LOWER PIVOT ARM AND IS SECURED BY A BOLTED COVER PLATE.

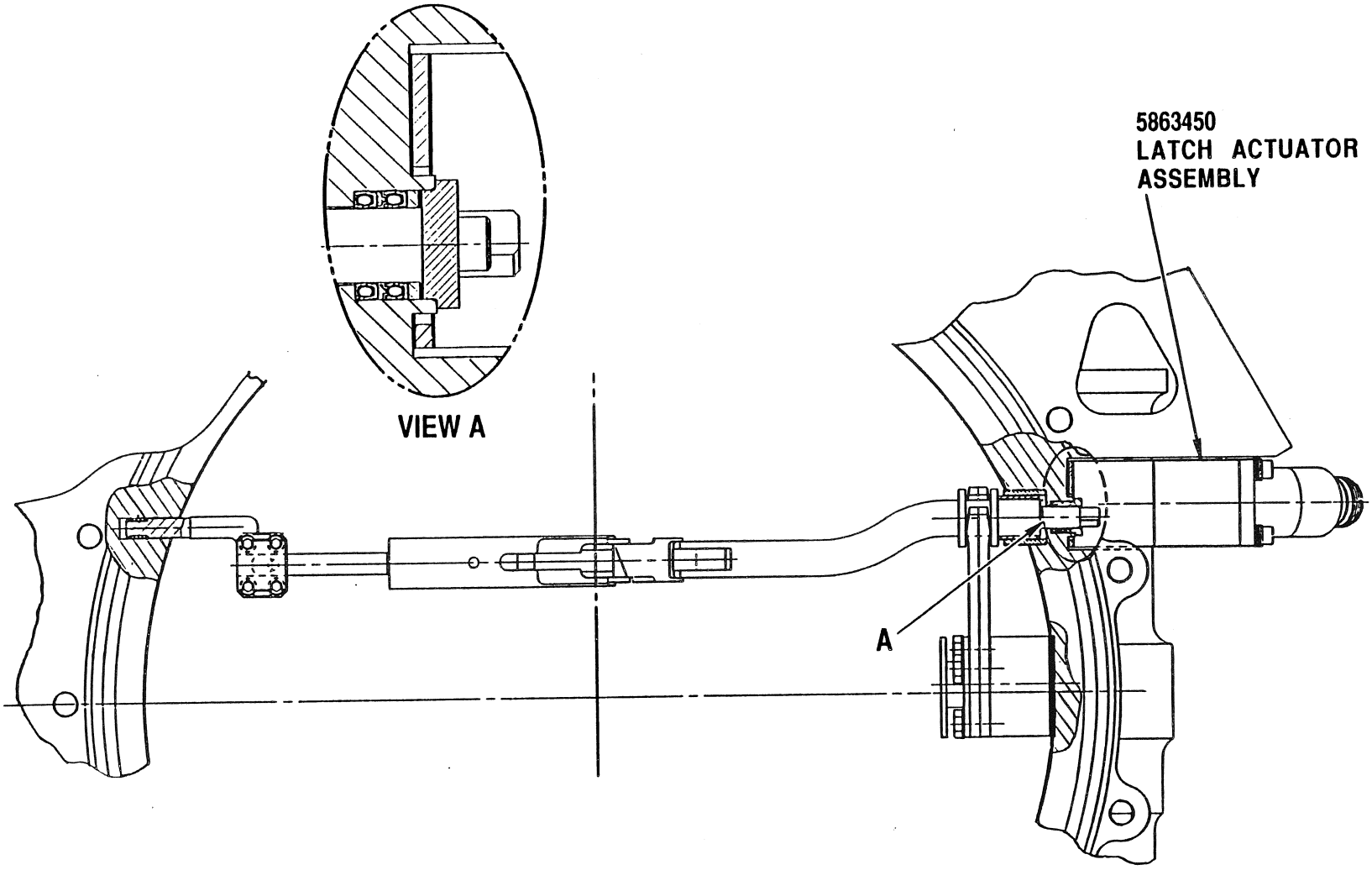
THE LATCH IS ATTACHED TO THE LATCH SHAFT AT THE APPROPRIATE POSITION TO PROVIDE ADEQUATE CLEARANCE WITH THE OPEN ORBITER AND EXTERNAL TANK HALF FLAPPERS. THE LATCH IS SPRING ENERGIZED TOWARD A NEUTRAL POSITION OVERLAPPING BOTH FLAPPERS IN THE LATCHED POSITION.

DURING MECHANICAL SEPARATION (FOLLOWING PNEUMATIC SYSTEM FAILURE), THE FLAPPERS WILL ROTATE TO THE CLOSED POSITION EVEN IF LATCH IS STILL ENGAGED. DURING INITIAL DISCONNECT SEPARATION MOTION, THE ET FLAPPER TO LATCH OVERLAP IS ELIMINATED AND THE ET FLAPPER IS CLEAR TO ROTATE TOWARD THE CLOSED POSITION. THE ORBITER FLAPPER WILL TOGGLE THE LATCH ALLOWING THE FLAPPER TO CONTINUE ROTATION TOWARD THE CLOSED POSITION. UPON CLEARING THE FLAPPER, THE LATCH TOGGLE WILL RETURN TO THE NEUTRAL POSITION.

THE SHOCK ABSORBER CONSISTS OF A SET OF CANTILEVER BEAM FLEXURES BOLTED INTO THE ORBITER VALVE BODY. IT IS SHIMMED TO LOCATE THE LATCH ROD IN A POSITION WHERE LATCH ROD LOADS CAN BE ABSORBED IN EITHER AN UPWARD OR DOWNWARD DIRECTION WITHOUT THE ROD BOTTOMING OUT IN EITHER DIRECTION.

COMPONENT: 17-INCH DISCONNECT FLAPPER LATCH ASSEMBLY

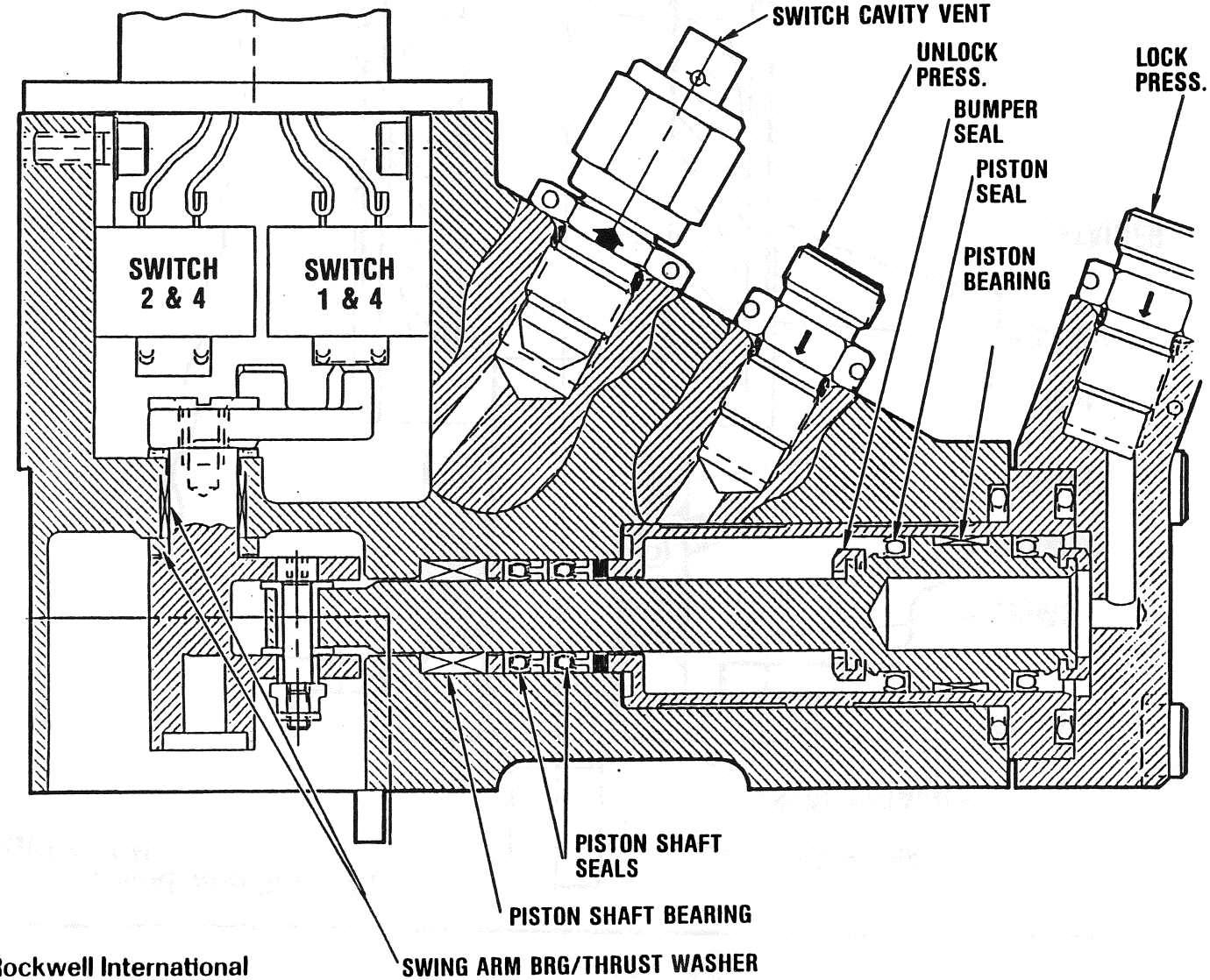
(MC284-0389)



COMPONENT: 17-INCH DISCONNECT LATCH

(MC284-0389)

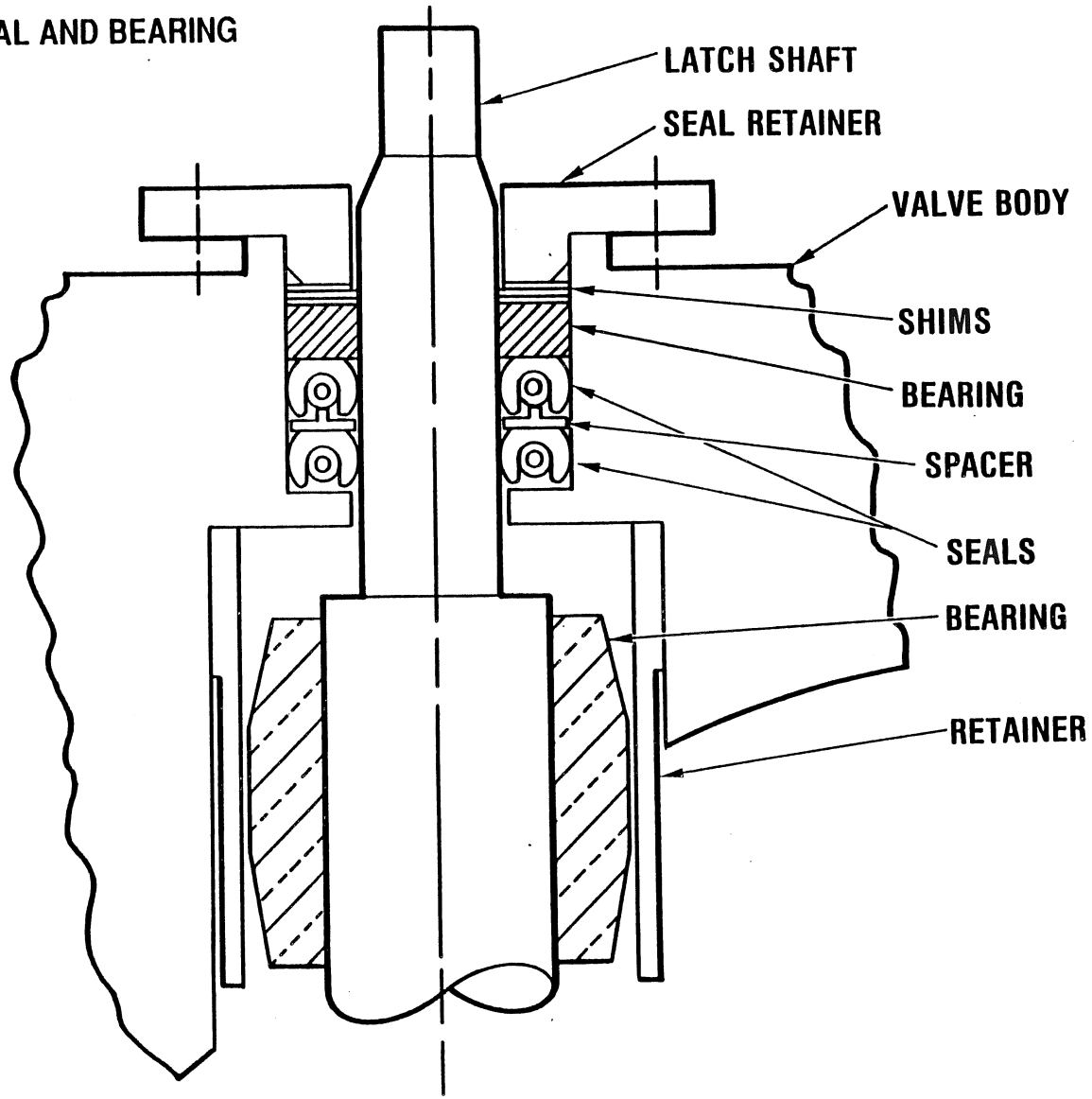
ACTUATOR ASSEMBLY



COMPONENT: 17-INCH DISCONNECT LATCH

(MC284-0389)

LATCH SHAFT SEAL AND BEARING CONFIGURATION



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Systems Division

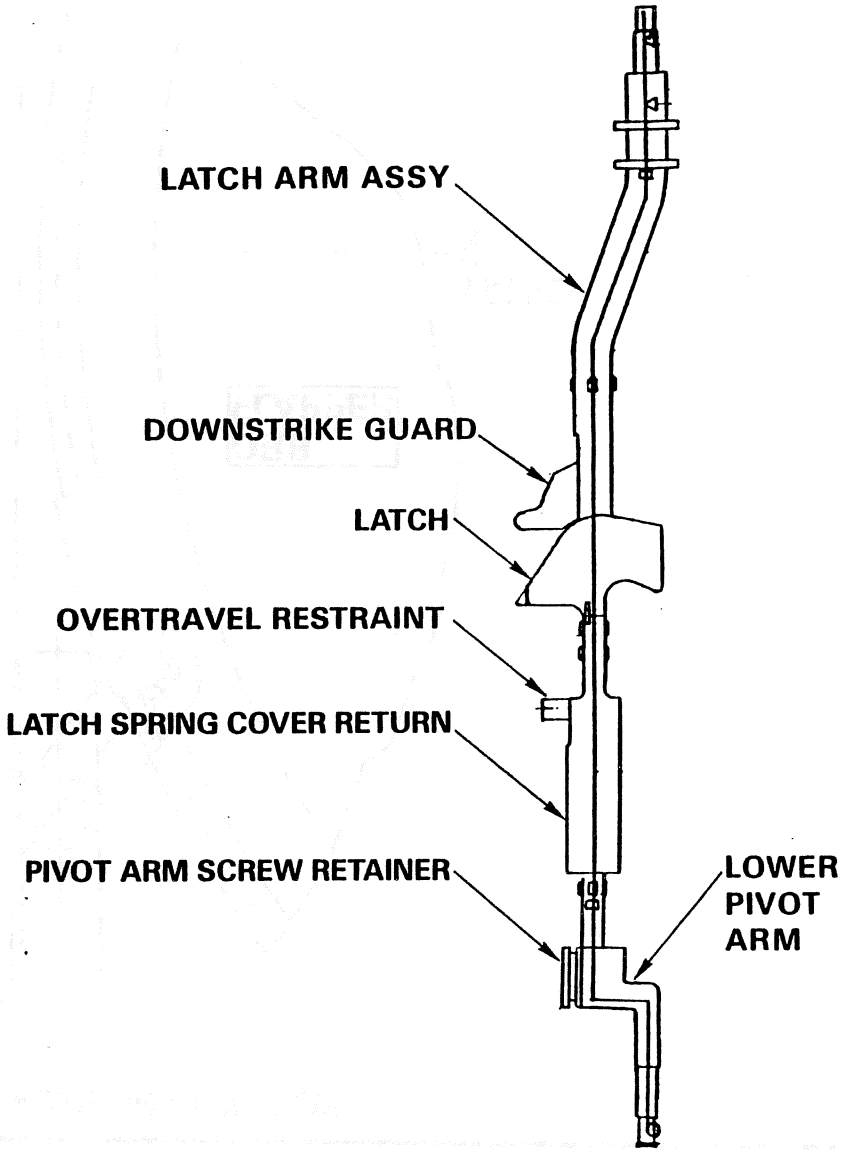
COMPONENT: 17-INCH DISCONNECT FLAPPER LATCH ASSEMBLY

(MC284-0389)

SUBASSEMBLY TO:
MC 284-0389-0451 LH_2 ORB HALF
MC 284-0389-0551 LO_2 ORB HALF

MATERIALS

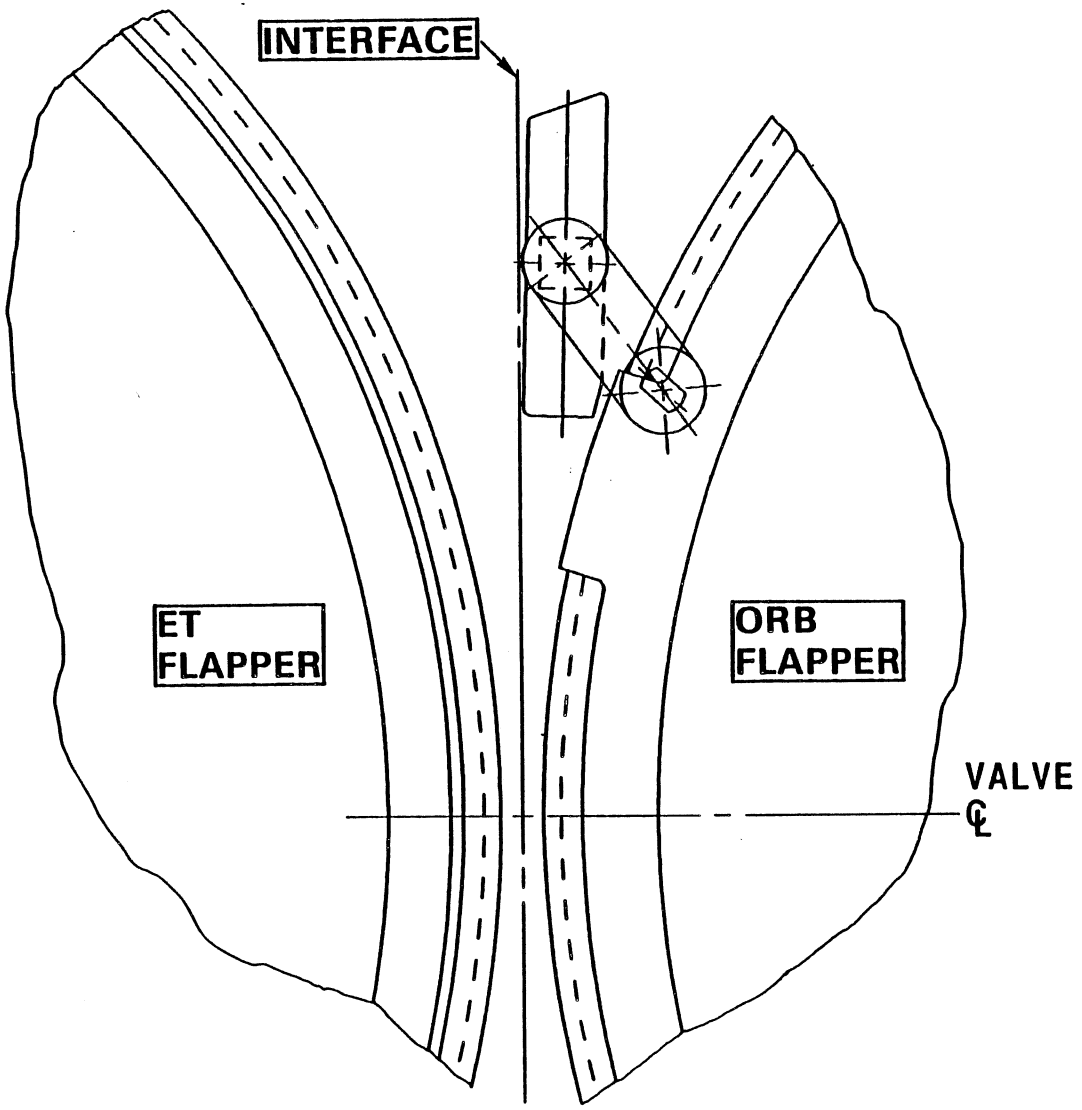
LATCH ARM ASSY: INCONEL 718
DOWNSTRIKE GUARD: INCONEL 718
LATCH: INCONEL 718
OVERTRAVEL RESTRAINT: INCONEL 718
LATCH RETURN SPRING COVER: 316 CRES
PIVOT ARM SCREW RETAINER: INCONEL 718
LATCH PIN: INCONEL 718 (NOT SHOWN)
LOWER PIVOT ARM: INCONEL 718
SPRING: 302 CRES (NOT SHOWN)



COMPONENT: 17-INCH DISCONNECT FLAPPER LATCH

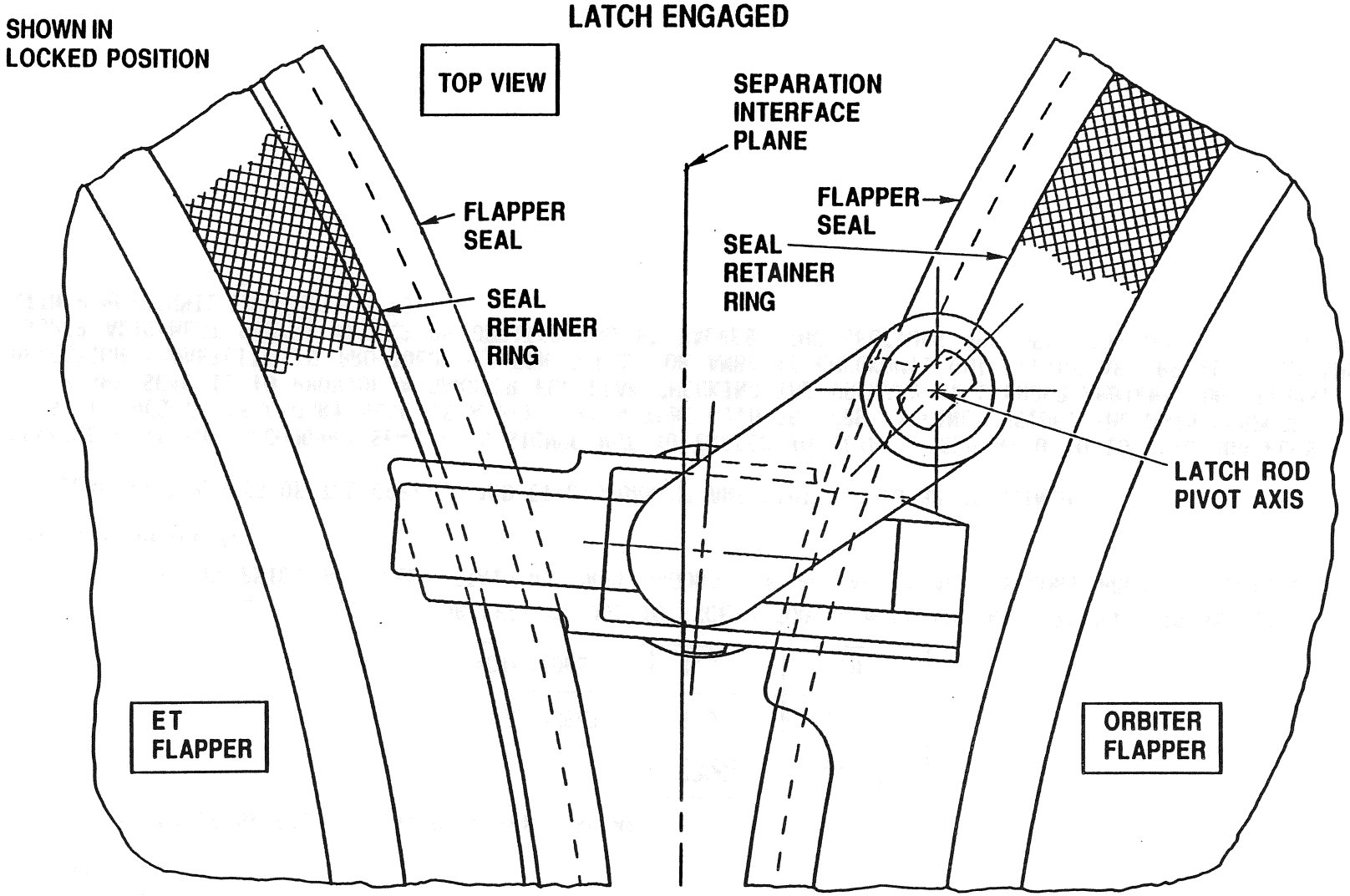
(MC284-0389)

SHOWN IN UNLOCKED POSITION - TOP VIEW



COMPONENT: 17-INCH DISCONNECT FLAPPER LATCH

(MC284-0389)



COMPONENT: DISCONNECT, LH_2/LO_2 ORBITER TO TANK FEED SYSTEM

(MC284-0389)

DESIGN:

DESIGN FACTORS OF SAFETY FOR INTERNAL PRESSURE ARE:

	PROOF	BURST
DISCONNECT	1.3	1.5
ACTUATORS	1.5	2.0

PRIMARY MATING SEAL IS DESIGNED FOR LEAKAGE NOT TO EXCEED 600 SCIM OF GH_2 AT 0 TO 50 PSIG AND 310 SCIM OF GO_2 AT 0 TO 200 PSIG. A STEEL RETAINING BAND AROUND THE PRIMARY SEAL (TEFLON) PREVENTS SEAL BLOW-OUT DURING SEPARATION.

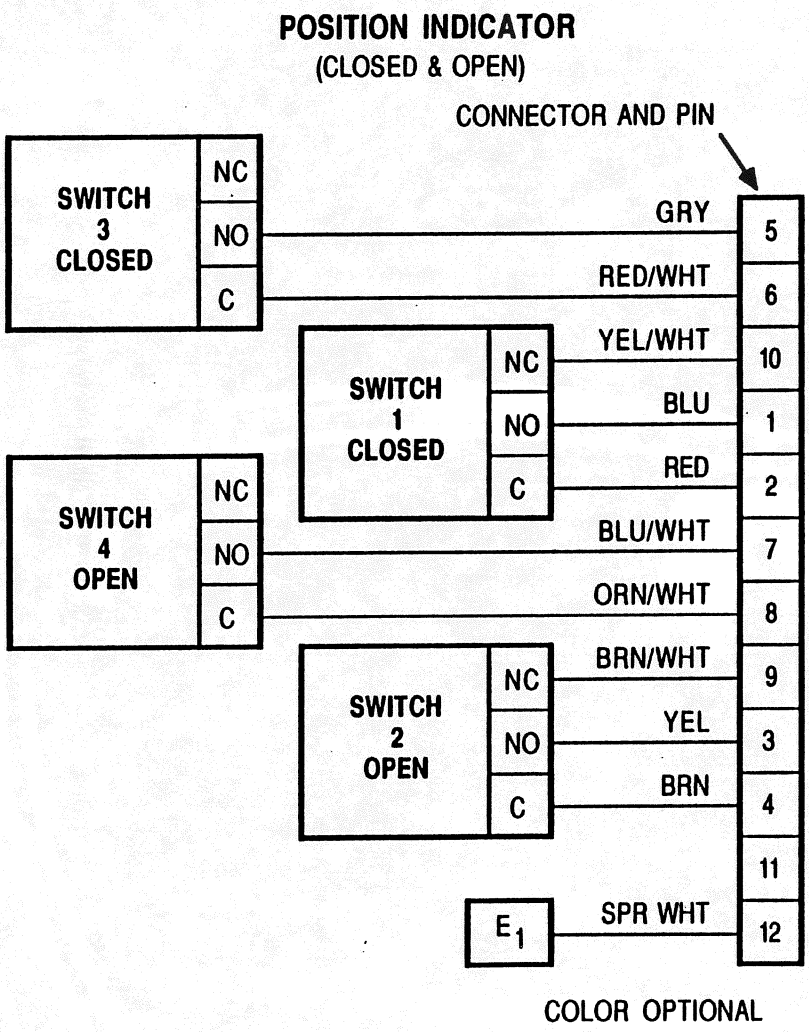
THE SEALING SURFACES OF THE ORBITER AND ET DISCONNECT ARE FINISHED TO 32 MICROINCH.

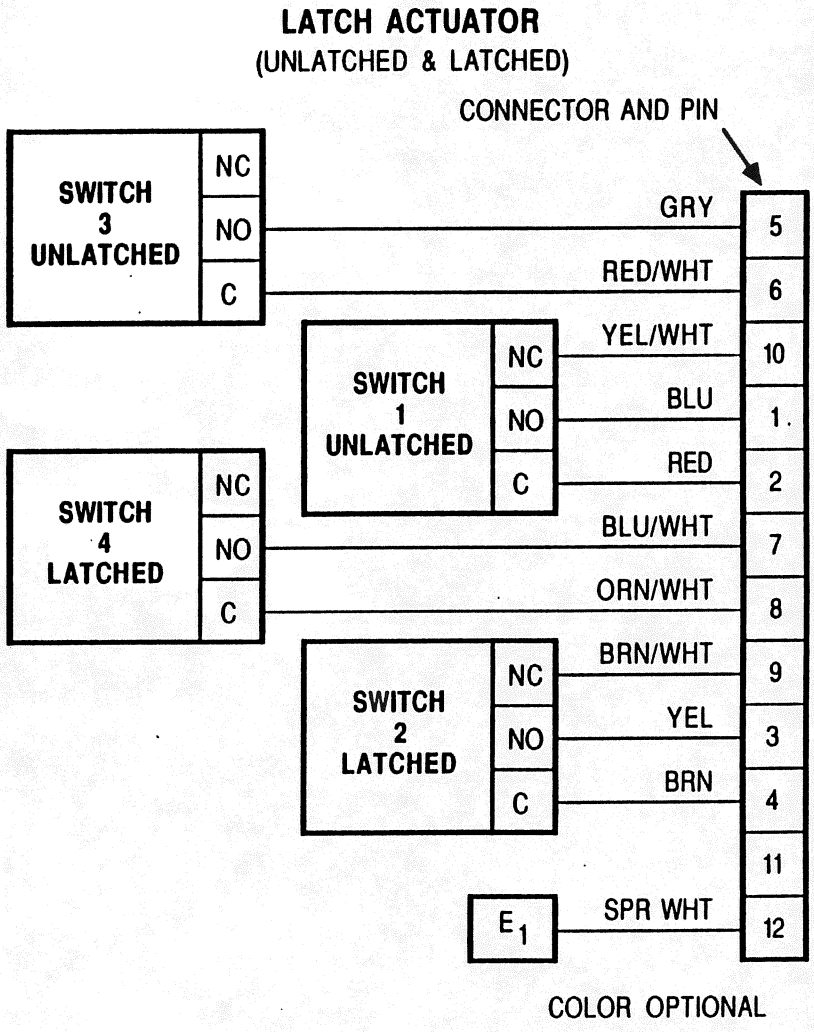
LEAKAGE PAST THE SECONDARY SEAL IS DESIGNED NOT TO EXCEED 10 SCIM OF GHe AT 0 TO 10 PSIG AND PLUS 70 TO PLUS 160 DEG F. SECONDARY SEAL IS A FEP TEFLON TUBE WITH 302 CRES SPRING INSIDE. THE MAIN PURPOSE OF THE SECONDARY SEAL IS TO PROVIDE A BARRIER FOR LEAK CHECKING THE PRIMARY SEAL UNDER AMBIENT CONDITIONS. LEAK DETECTION CAPABILITY IS PROVIDED BETWEEN SEALS FOR AMBIENT CHECKOUT. GUIDE PINS ARE PROVIDED TO ENSURE PROPER ALIGNMENT DURING MATING OF ORBITER AND ET HALVES. THE SECTIONS ARE HELD TOGETHER BY THREE BOLTS WITH PYROTECHNIC FRANGIBLE NUTS.

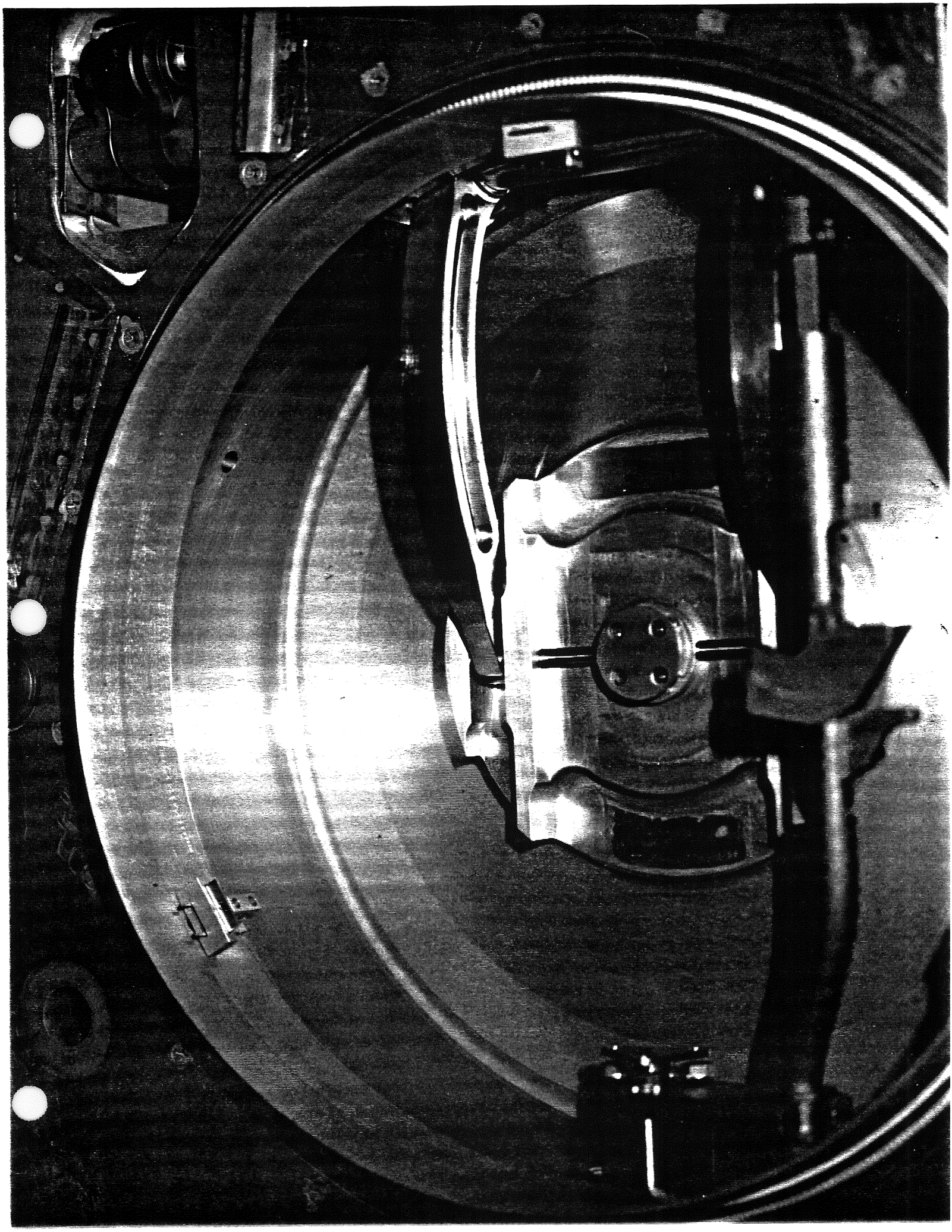
COMPONENT: 17-INCH DISCONNECT LATCH

(MC284-0389)

LATCH ACTUATOR WIRING DIAGRAM







COMPONENT: DISCONNECT, LH_2 ORBITER TO TANK, RECIRCULATION AND REPLENISHMENT SYSTEM
(MC284-0390)

FMEA/CIL NO: 03-1-0405

VENDOR : EATON CONSOL. CONTROLS
P/N RI : MC284-0390-0046 (ORB) TYPE I
: MC284-0390-0014 (ET) TYPE II
P/N VENDOR:
QUANTITY : (1) TYPE I PER END ITEM
: (1) TYPE II PER END ITEM

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

DISCONNECT, LH_2 RECIRCULATION RETURN 4 INCH DIAMETER, ORBITER AND ET HALF (PD3)

FUNCTION:

PROVIDES LH_2 FLOW CAPABILITY BETWEEN THE ORBITER AND THE EXTERNAL TANK WHICH ALLOWS ENGINE LH_2 RECIRCULATION AND OPERATION OF EXTERNAL TANK REPLENISH SYSTEM. THE DISCONNECT IS A PNEUMATICALLY ACTUATED VALVE THAT IS DESIGNED TO REMAIN IN THE LAST ACTUATED POSITION (BISTABLE). THE DISCONNECT PROVIDES A MEANS FOR TOPPING AND REPLENISHING THE ET TANK, AND RECIRCULATING LH_2. THE DISCONNECT VALVE IS CLOSED AFTER MAIN ENGINE CUT-OFF (MECO). THE DISCONNECT VALVE IS CLOSED FOR A PREMATURE ENGINE SHUTDOWN DURING ASCENT OR FOR A PAD ABORT. THE DISCONNECT VALVE IS CLOSED TO PREVENT PROPELLANT LEAKAGE THROUGH THE ENGINE FUEL BLEED VALVE (BLEED VALVE OPENS 16 SECONDS AFTER ENGINE SHUTDOWN). FLUID TRAPPED BETWEEN THE CLOSED ET AND ORBITER HALVES IS RELIEVED THROUGH EITHER THE ET OR ORBITER FLAPPERS. THE DISCONNECT INCORPORATES A DEVICE TO CLOSE THE VALVE MECHANICALLY AT SEPARATION IF IT WAS NOT CLOSED BY ACTUATION PRESSURE.

DESIGN:

DESIGN FACTORS OF SAFETY FOR INTERNAL PRESSURE ARE: 1.3 PROOF, 1.5 BURST. THE INTERFACE CONSISTS OF A PRIMARY SEAL AND A SECONDARY SEAL. THE PRIMARY SEAL IS A RACO TYPE SEAL CONTAINING A SPRING WHICH FORCES THE TEFLON JACKET AGAINST THE EXTERNAL TANK SEALING SURFACE WHEN MATED. PRIMARY MATING SEAL IS DESIGNED FOR LEAKAGE NOT TO EXCEED 144 SCIM OF GH_2 AT 0 TO 47 PSIG. A RETAINING BAND AROUND THE PRIMARY SEAL (TEFLON) PREVENTS SEAL BLOW-OUT DURING SEPARATION.

COMPONENT: DISCONNECT, LH_2 ORBITER TO TANK, RECIRCULATION AND REPLENISHMENT SYSTEM
(MC284-0390)

THE SECONDARY SEAL WILL PREVENT EXCESSIVE LEAKAGE BUT IS NOT DESIGNED TO SERVE AS A BACKUP TO THE PRIMARY SEAL. LEAKAGE PAST THE SECONDARY SEAL IS DESIGNED NOT TO EXCEED 144 SCIM OF GHE AT 0 TO 47 PSIG. THE SECONDARY SEAL IS A CREAVEY SEAL WHICH CONSISTS OF A SPIRAL SPRING INSIDE A TEFLON TUBE. THE MAIN PURPOSE OF THE SECONDARY SEAL IS TO PROVIDE A BARRIER FOR LEAK CHECKING THE PRIMARY SEAL.

LEAK DETECTION CAPABILITY IS PROVIDED BETWEEN SEALS FOR AMBIENT CHECKOUT. TWO GUIDE PINS ARE PROVIDED FOR PROPER ENGAGEMENT.

IN THE INSTALLED POSITION (ET/ORBITER UMBILICAL MATED), A SET OF BELLEVILLE SPRINGS PROVIDE AN INTERFACE SEALING PRELOAD OF 2,005 POUNDS MINIMUM. THE BELLEVILLE MATERIAL IS CURRENTLY OF CRES PH15-7MO, HEAT TREATED TO RH-1050.

THE BELLEVILLE SPRINGS ARE TO BE REPLACED WITH SPRINGS MADE FROM STRESS CORROSION RESISTANT MP35N (NICKEL-COBALT-CHROMIUM ALLOY) MULTIPHASE MATERIAL STARTING WITH STS-30.

DESIGN PARAMETERS

LIFE CYCLE: THE TYPE I ORBITER SECTION HAS A MINIMUM USEFUL LIFE OF 1,400 CYCLES AND 400 ENGAGE-DISENGAGE CYCLES OR A 100-ORBITAL MISSION EQUIVALENT. THE TYPE II EXTERNAL TANK SECTION HAS A MINIMUM USEFUL LIFE OF 150 CLOSURE CYCLES AND 10 ENGAGE-DISENGAGE CYCLES OR A ONE-ORBITAL MISSION EQUIVALENT.

	ACTUATOR	TYPE I (-0046)	TYPE II (-0014)
PROOF PRESSURE: (PSIG)	1700	156	48
BURST PRESSURE: (PSIG)	3400	180	56
ENVELOPE SIZE:		7.88 X 11.91 X 6.49	7.88 X 11.91 X 6.00
WEIGHT:		11:70	9.40
LINE SIZE:		4.0 INCHES	4.0 INCHES

COMPONENT: DISCONNECT, LH_2 ORBITER TO TANK, RECIRCULATION AND REPLENISHMENT SYSTEM

(MC284-0390)

OPERATING TIME: OPENING TIME 4 SECONDS MAX
CLOSING TIME 1.2 SECONDS MAX

CRACK AND RESEAT (RELIEF): 0.75 PSID TO 10 PSID

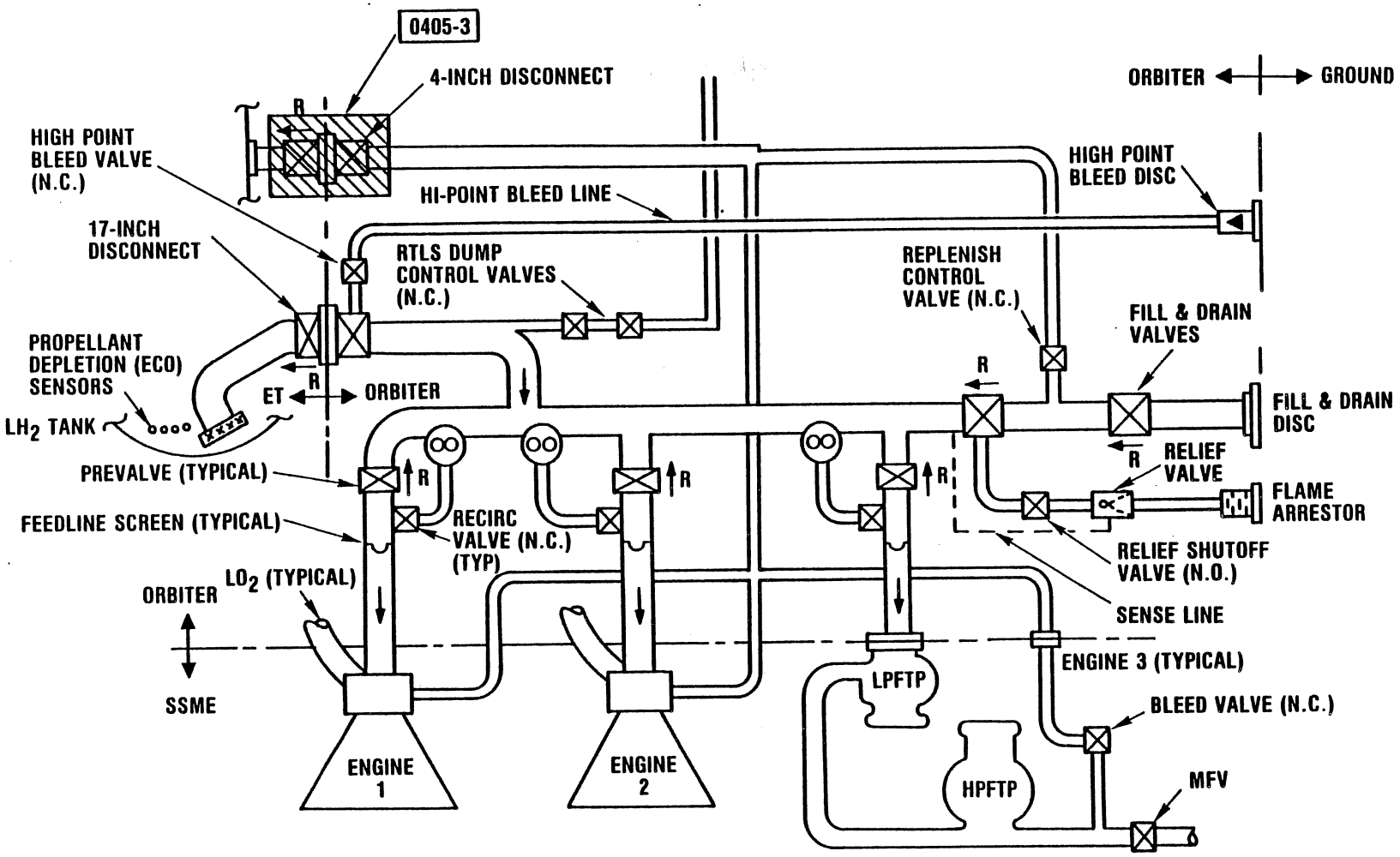
MATING SEAL LEAKAGE: 47 PSIG; -400°F; 144 SCIM GH_2
EXTERNAL BODY LEAKAGE: 37 PSIG; -400°F; 2 SCIM GH_2
SHAFT SEAL: TYPE I; 120 PSIG; -400°F; 16 SCIM GH_2
CLOSURE SEAL: TYPE I; 120 PSIG; -400°F; 200 SCIM GH_2
CLOSURE SEAL: TYPE II; 37 PSIG; -400°F; 200 SCIM GH_2
ACTUATOR RETRACTED LEAKAGE: -400°F; 780 PSIG; 125 SCIM
ACTUATOR EXTENDED LEAKAGE: -400°F; 780 PSIG; 125 SCIM
ACTUATOR SHAFT SEAL LEAKAGE: -400°F; 780 PSIG; 25 SCIM

MATERIALS
BODY: A356-T6 AL ALLOY
PLATE: 6061-T651 AL ALLOY
ARM: 6061-T651 AL ALLOY
POPPET SEAL: TEFLON JACKET CRES 501 SPRING
SHAFT: INCONEL 718
SECTOR GEAR: INCONEL 718
NEGATOR SPRINGS: 301 FULL HARD
BEARINGS: VESPEL SP-21, FLUOROGOLD

COMPONENT: DISCONNECT, LH_2 ORBITER TO TANK, RECIRCULATION AND REPLENISHMENT SYSTEM

(MC284-0390)

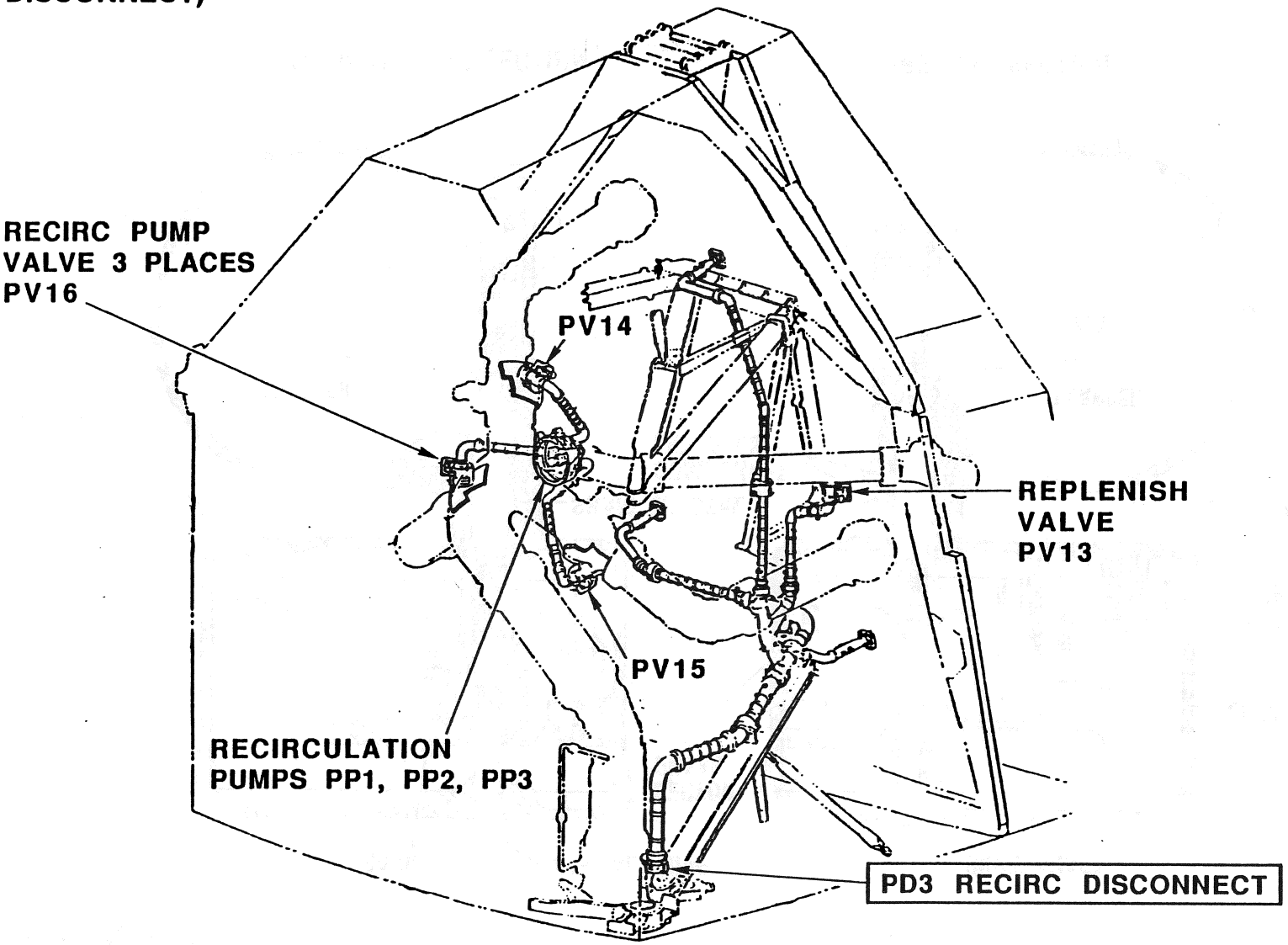
(4'' DISCONNECT)



COMPONENT: DISCONNECT, LH_2 ORBITER TO TANK, RECIRCULATION AND REPLENISHMENT SYSTEM

(MC284-0390)

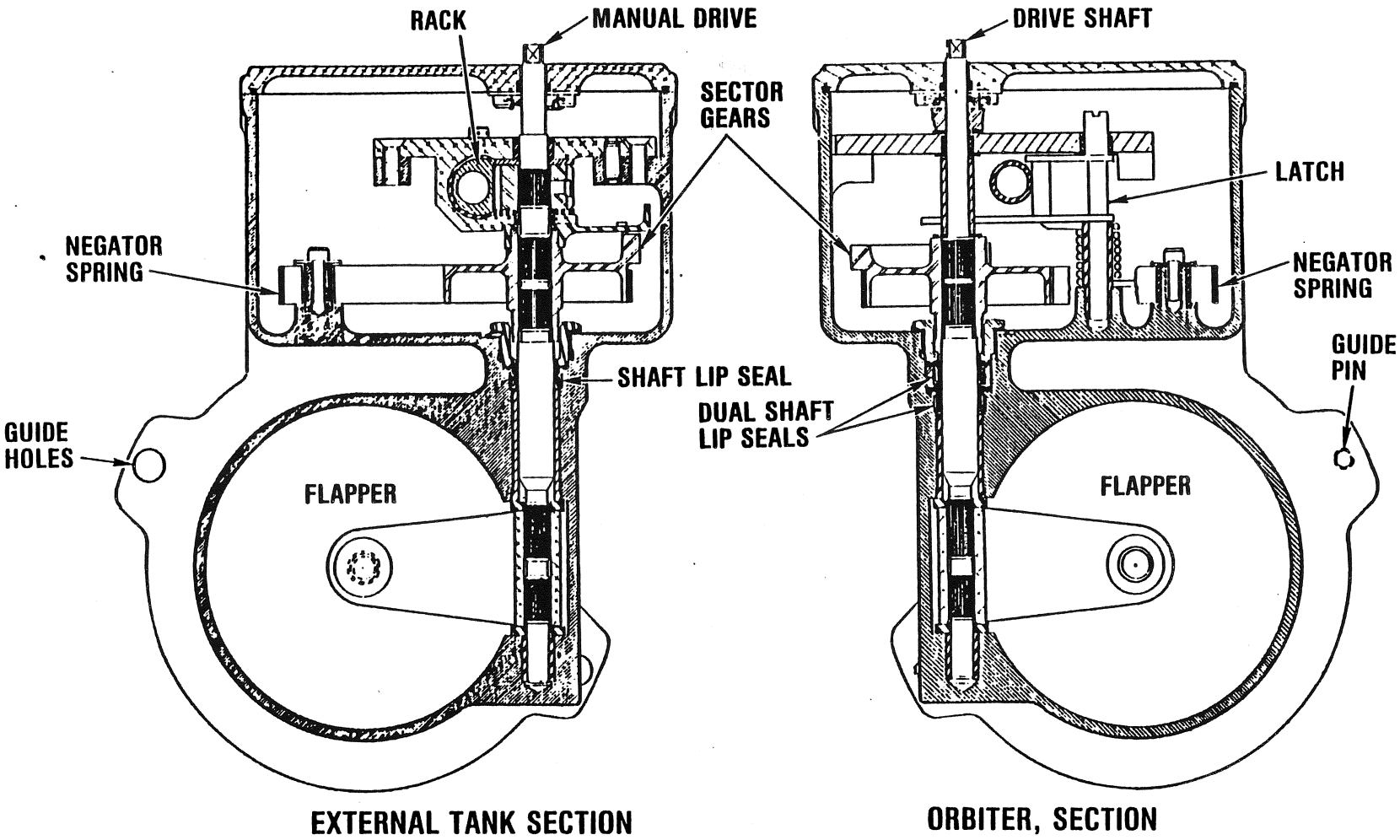
(4'' DISCONNECT)



COMPONENT: DISCONNECT, LH_2 ORBITER TO TANK, RECIRCULATION AND REPLENISHMENT SYSTEM

(MC284-0390)

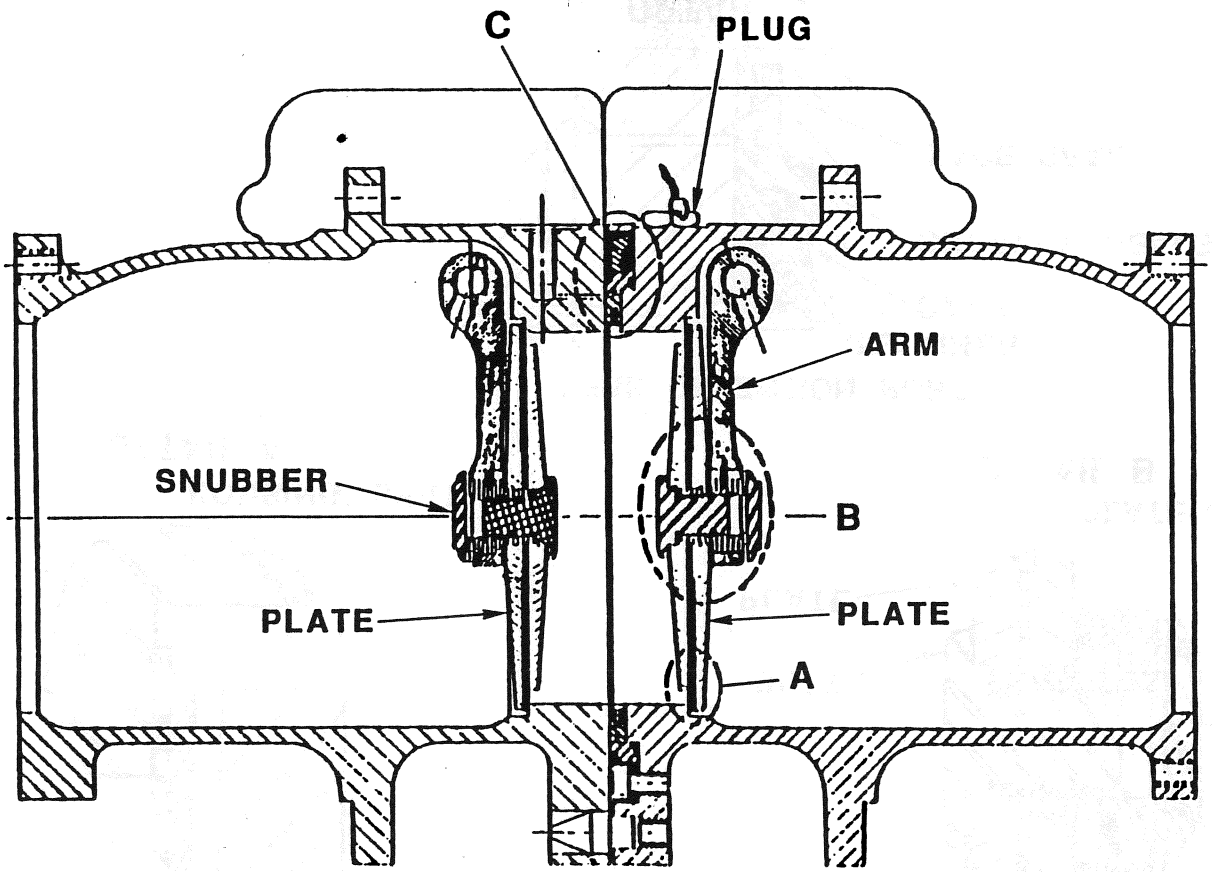
(4'' DISCONNECT)



COMPONENT: DISCONNECT, LH_2 ORBITER TO TANK, RECIRCULATION AND REPLENISHMENT SYSTEM

(MC284-0390)

(4'' DISCONNECT)

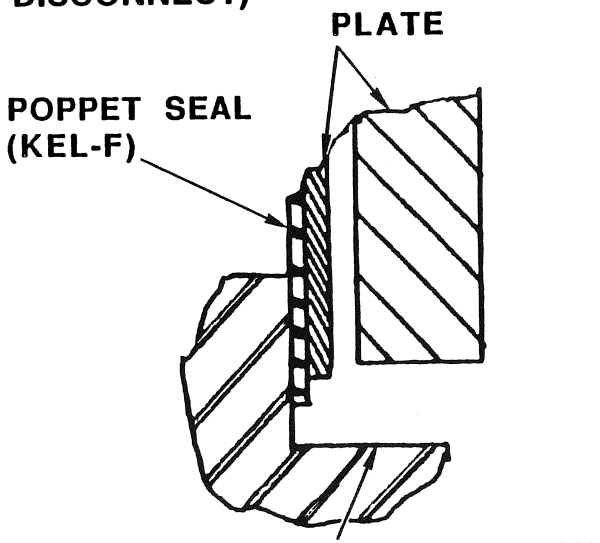


EXTERNAL TANK SECTION **ORBITER SECTION**

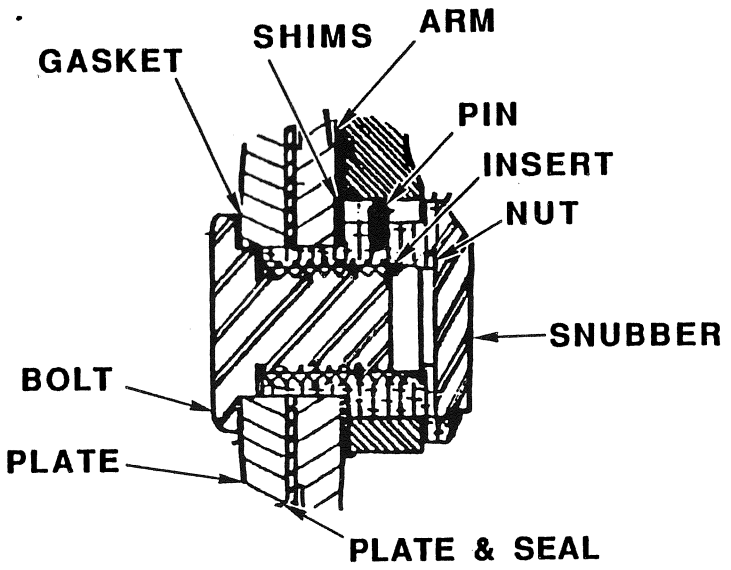
COMPONENT: DISCONNECT, LH_2 ORBITER TO TANK, RECIRCULATION AND REPLENISHMENT SYSTEM

(MC284-0390)

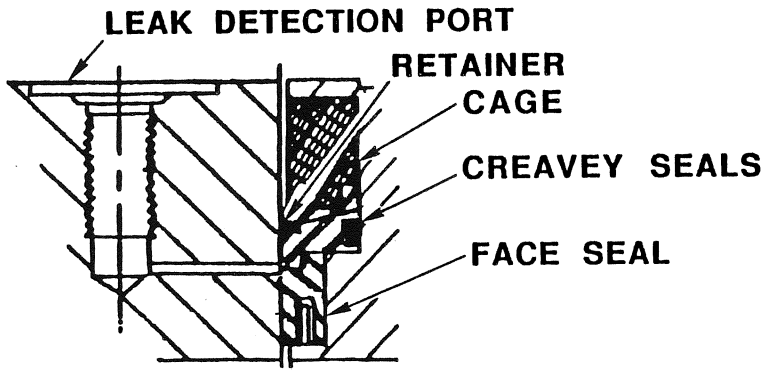
(4'' DISCONNECT)



DETAIL A



DETAIL B

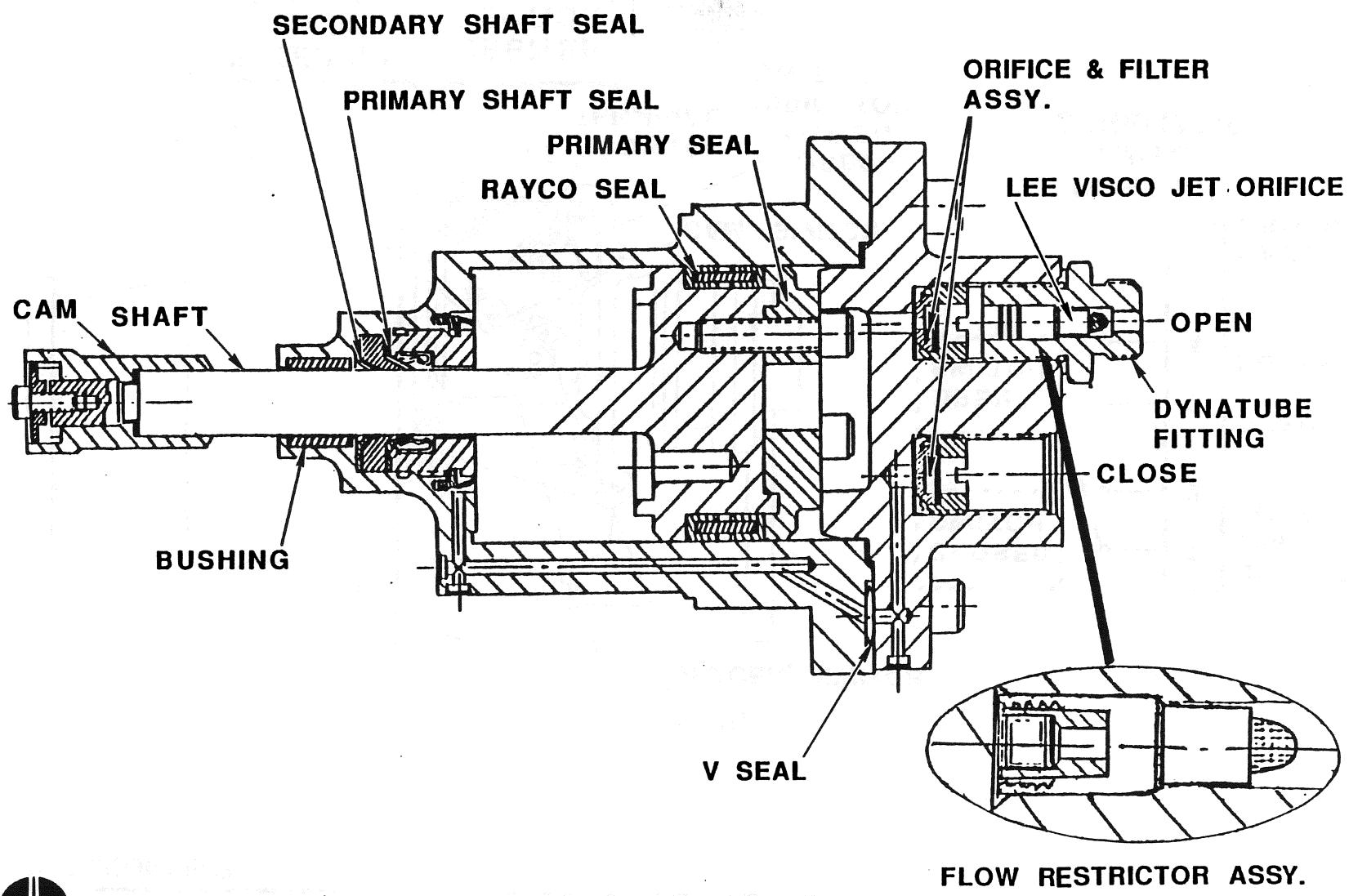


DETAIL C

COMPONENT: DISCONNECT, LH_2 ORBITER TO TANK, RECIRCULATION AND REPLENISHMENT SYSTEM

(MC284-0390)

(4'' DISCONNECT)



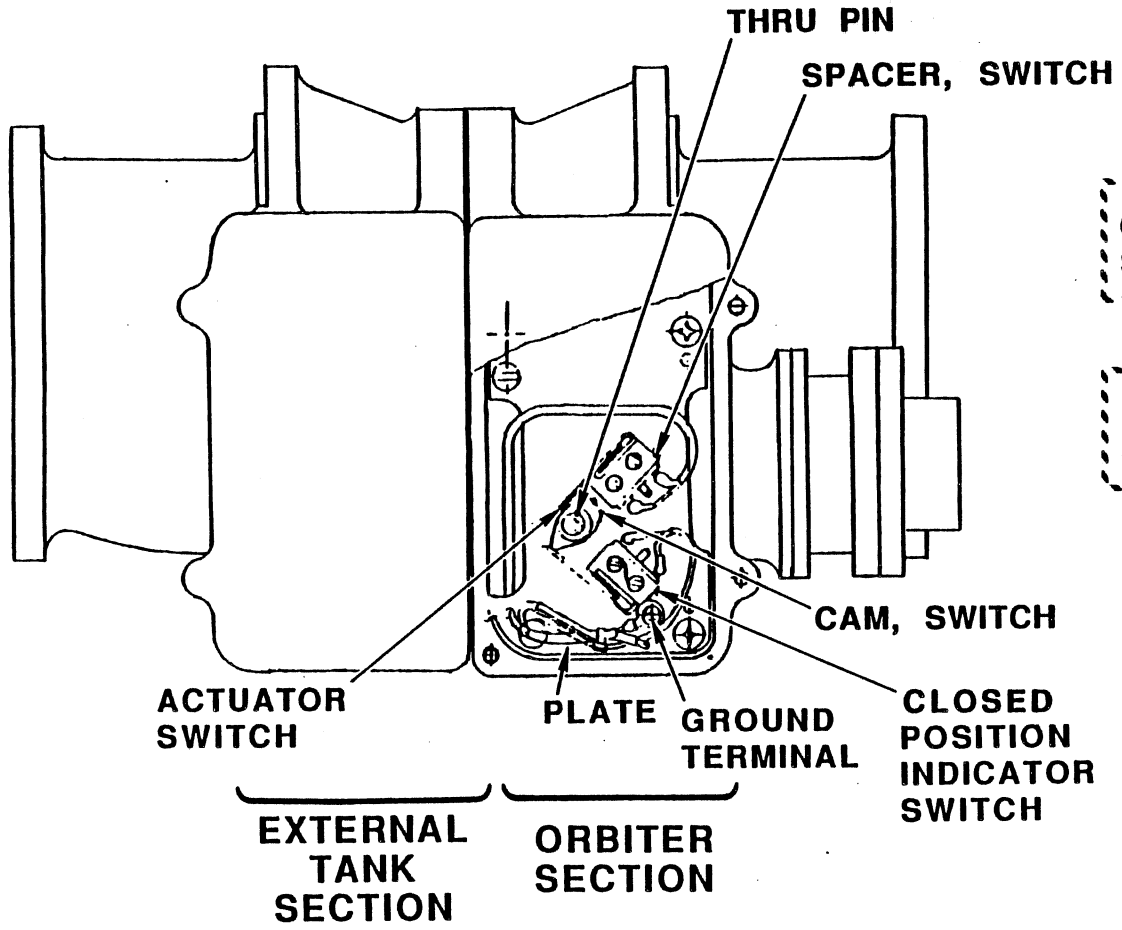
Rockwell International

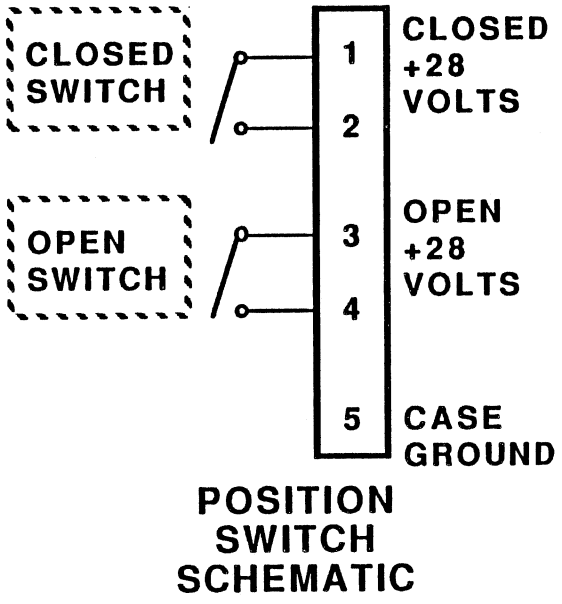
Space Transportation Systems Division

COMPONENT: DISCONNECT, LH_2 ORBITER TO TANK, RECIRCULATION AND REPLENISHMENT SYSTEM

(MC284-0390)

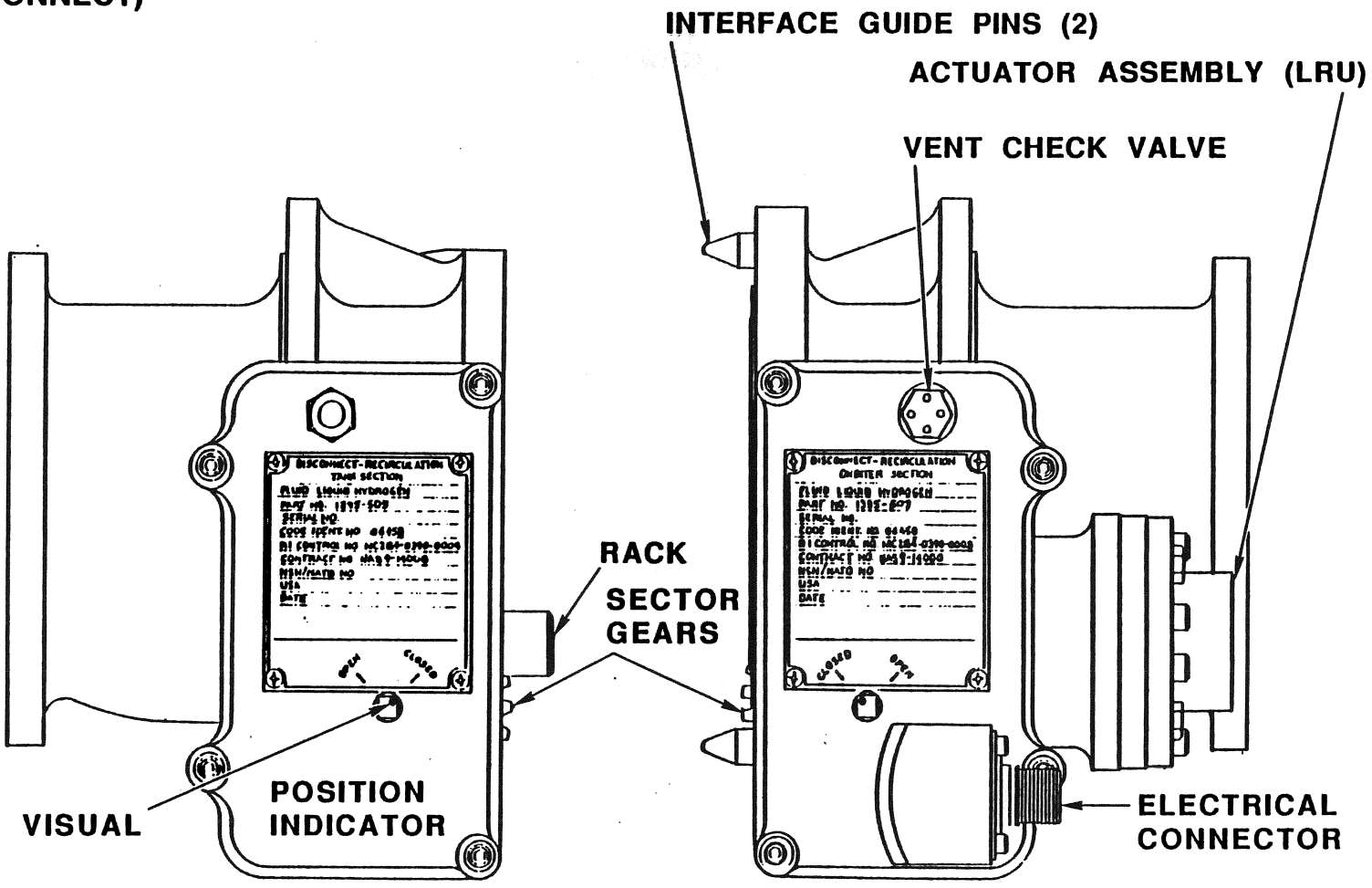
(4" DISCONNECT)





COMPONENT: DISCONNECT, LH_2 ORBITER TO TANK, RECIRCULATION AND REPLENISHMENT SYSTEM
(MC284-0390)

(4'' DISCONNECT)



COMPONENT: DISCONNECT, GH_2/GO_2 ORBITER TO TANK PRESSURIZATION SYSTEM

(MC284-0391)

FMEA/CIL NO: 03-1-0503
03-1-0513

VENDOR : EATON CONSOLIDATED CONTROLS
P/N RI : MC284-0391-0001, TYPE I, ORBITER SECTION
MC284-0391-0022, TYPE II, EXTERNAL TANK SECTION
P/N VENDOR: 1414 (TYPE I)
1414-507 (TYPE II)
QUANTITY : (2) TYPE I
(2) TYPE II

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

THE 2-INCH DISCONNECT IS NORMALLY CLOSED WITH A POPPET TYPE CLOSURE IN EACH SECTION WHICH ARE OPENED, WHEN THE SECTIONS ARE MATED MECHANICALLY. BELLEVILLE SPRINGS LOCATED IN THE ORBITER UMBILICAL ASSEMBLY PROVIDE THE CLAMPING FORCE TO MAINTAIN INTERFACE INTEGRITY. WHEN SEPARATION OCCURS, THE POPPETS ARE SPRING-ACTUATED CLOSED. ONE SET IS UTILIZED TO PRESSURIZE THE LO_2 TANK ULLAGE AND ONE SET TO SUPPLY PRESSURIZATION TO THE LH_2 TANK ULLAGE.

FUNCTION:

THE DISCONNECTS, WHEN MATED, PROVIDE THE FLOW PATH BETWEEN THE ET AND THE ORBITER FOR THE GH_2 AND GO_2 FROM THE MAIN ENGINES TO PRESSURIZE THE ET. ALSO USED FOR HELIUM ANTI-ICING FLOW (PRELAUNCH) AND HELIUM PREPRESSURIZATION PRIOR TO ENGINE START. THE DISCONNECT POPPETS ARE OPEN UNTIL ORBITER/ET SEPARATION, AT WHICH TIME THE DISCONNECT CLOSES TO PREVENT CONTAMINATION OF THE MPS DURING ENTRY. THE DISCONNECT INCORPORATES A PORT USED IN CONJUNCTION WITH THE GH_2 PRESSURIZATION LINE VENT VALVE (LV-52) TO VENT THE GH_2 SYSTEM DURING VACUUM INERTING.

COMPONENT: DISCONNECT, GH_2/GO_2 ORBITER TO TANK PRESSURIZATION SYSTEM

(MC284-0391)

DESIGN:

THE DISCONNECT CONSISTS OF A TANK HALF AND AN ORBITER HALF. THE DISCONNECT IS A MECHANICAL DEVICE, EACH HALF CONTAINING A POPPET ASSEMBLY WHICH IS SPRING LOADED TO THE CLOSED POSITION. EACH POPPET IS ACTUATED TO THE OPEN POSITION DURING THE MATING OF THE ET AND ORBITER UMBILICALS. THE ORBITER HALF IS MOUNTED TO A BELLEVILLE WASHER ARRANGEMENT WHICH PROVIDES THE CLAMPING FORCE TO MAINTAIN INTERFACE SEAL REQUIREMENTS TO PREVENT LEAKAGE WHEN MATED TO THE EXTERNAL TANK HALF. IN THE INSTALLED POSITION (ET/ORBITER UMBILICAL MATED), A SET OF BELLEVILLE SPRINGS PROVIDE AN INTERFACE SEALING PRELOAD OF GO_2 = 1,861/GH_2 = 2,732 LBS. MINIMUM. THE BELLEVILLE MATERIAL IS CURRENTLY CRES PH15-7MO, HEAT TREATED TO RH-1050. THE BELLEVILLE SPRINGS ARE TO BE REPLACED WITH SPRINGS MADE FROM STRESS CORROSION RESISTANT MP35N (NICKLE-COBALT-CHROMIUM ALLOY MULTIPHASE MATERIAL, STARTING WITH STS-30.

THE CLOSURE SEAL (301 CRES, FULL HARD), POPPET (316 CRES INVESTMENT CAST), POPPET RETURN SPRING (302 CRES CONDITION B), BUSHINGS (ALUMINUM BRONZE), AND BODY (316 CRES INVESTMENT CAST) ARE IDENTICAL FOR EACH HALF. THE TWO HALVES DIFFER ONLY IN THEIR CAP SECTIONS. THE ORBITER CAP SECTION CONTAINS THE WASHER TYPE INTERFACE SEAL (301 CRES, FULL HARD) RETAINED AGAINST THE CAP SECTION BY A RETAINER (304 CRES, CONDITION A) WHICH SCREWS ON THE CAP SECTION AND IS TORQUED TO 275 FOOT-POUNDS. LEAKAGE PAST THE RETAINER AND SEAL IS PREVENTED BY A SOFT COPPER GASKET. THE ET CAP SECTION INCORPORATES A GUIDE SECTION AT THE INTERFACE, TO PROPERLY ALIGN AND MAINTAIN THE ORBITER SECTION, AND A SEAT SURFACE COATED WITH TEFLON. EACH OF THE CAP SECTIONS IS MATED TO ITS RESPECTIVE BODY USING A SOFT COPPER GASKET AND 18 INCONEL 718 SCREWS TORQUED TO 30 INCH-POUNDS MAXIMUM. THE COPPER GASKET IS UTILIZED TO PREVENT EXTERNAL LEAKAGE AT HIGH TEMPERATURES.

EACH POPPET IS GUIDED BY TWO LINEAR BUSHINGS. THESE BUSHINGS ARE INSTALLED IN AND SUPPORTED BY A PAIR OF RADIAL STRUTS. EACH RADIAL STRUT CONSISTS OF TWO SUPPORTING LEGS WHICH ARE 120-DEGREES APART. THE STRUTS ARE AN INTEGRAL PART OF THE BODY AND CAP SECTION AND ARE ALIGNED DURING ASSEMBLY OF THE CAP SECTION TO THE BODY TO MINIMIZE THERMAL STRESSES AND PREVENT COCKING BETWEEN THE POPPET SHAFT AND BUSHING. INDEX MARKS ARE LOCATED ON EACH FLANGE TO INSURE PROPER CLOCKING OF THE ET AND ORBITER SECTIONS.

THE DISCONNECT HAS DESIGN PRESSURE FACTORS OF SAFETY OF 1.5 PROOF (900 PSIG) AND 2.0 BURST (1,200 PSIG). STRUCTURAL ANALYSIS INDICATES POSITIVE MARGINS OF SAFETY FOR ALL CONDITIONS OF DISCONNECT OPERATION. FRACTURE ANALYSES SHOW THAT ALL CRITICAL PARTS ARE SATISFACTORY FOR FOUR TIMES THE ORBITER LIFE OF 100 MISSIONS.

COMPONENT: DISCONNECT, GH_2/GO_2 ORBITER TO TANK PRESSURIZATION SYSTEM

(MC284-0391)

DESIGN PARAMETERS

LIFE CYCLE: THE TYPE I ORBITER SECTION HAS A MINIMUM USEFUL LIFE OF 600 ENGAGE-DISENGAGE CYCLES OR A 100-ORBITAL MISSION EQUIVALENT. THE TYPE II EXTERNAL TANK SECTION HAS A MINIMUM USEFUL LIFE OF 15 ENGAGE-DISENGAGE CYCLES OR A ONE-ORBITAL MISSION EQUIVALENT.

CURRENT CONFIGURATION: TYPE I (-0001), TYPE II (-0022)*

OPERATING PRESSURE: PROOF PRESSURE (CLOSURE DEVICE): PROOF PRESSURE (MATED):	600 PSIG 500 PSIG TYPE I; 56 PSIG TYPE II 900 PSIG
BURST PRESSURE:	TYPE I AND II MATED--1,200 PSIG TYPE I CLOSURE DEVICE - 600 PSIG TYPE II CLOSURE DEVICE - 75 PSIG
LINE SIZE: WEIGHT:	TYPE I AND II--2 INCHES TYPE I 6.3 LB TYPE II 6.6 LB
ENVELOPE SIZE:	TYPE I 5.356 DIAMETER X 6.156 INCHES TYPE II 5.356 DIAMETER X 6.375 INCHES

*NOTE: INTERFACE SEALING SURFACE IS COATED WITH TEFLON.

COMPONENT: DISCONNECT, GH_2/GO_2 ORBITER TO TANK PRESSURIZATION SYSTEM

(MC284-0391)

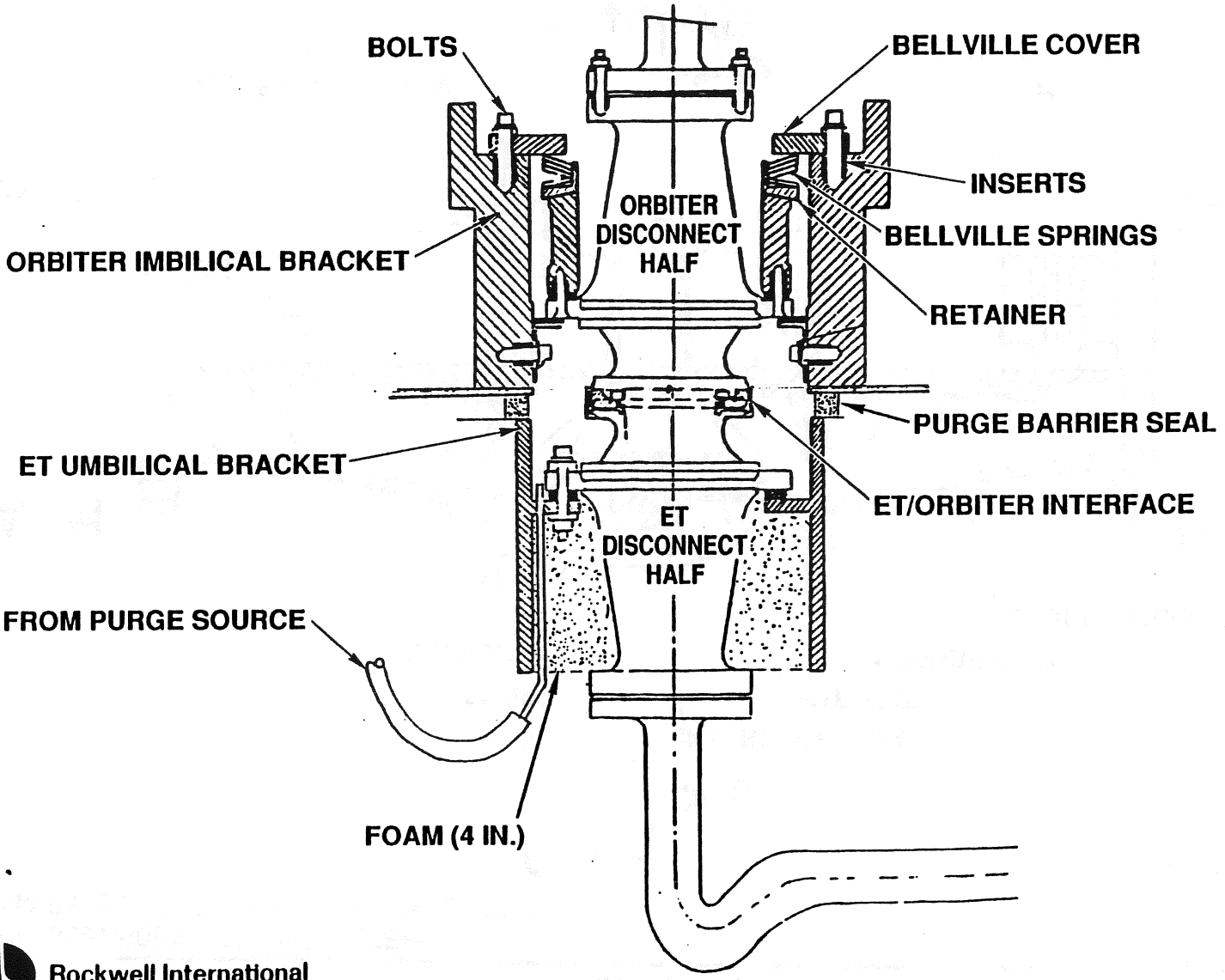
INTERNAL LEAKAGE:	
CLOSURE DEVICE:	20 PSIG HELIUM; 18 SCIM MAXIMUM 40 PSIG HELIUM; 100 SCIM MAXIMUM
EXTERNAL LEAKAGE:	
MATED:	600 PSIG GHe; 100 SCIM MAX

MATERIALS
HOUSING: 316 CRES (CASTING) POPPET: 316 CRES (CASTING) CAP (ET/ORB): 316 CRES (CASTING) RETURN SPRING: ELGILOY CLOSURE AND INTERFACE SEAL: 301 CRES (FULL HARD) RETAINER: INCONEL 718 TEFLON COATING ON ET SECTION CAP

COMPONENT: DISCONNECT, GH_2/GO_2 ORBITER TO TANK PRESSURIZATION SYSTEM

(MC284-0391)

(2" DISCONNECT) TYP INSTL.

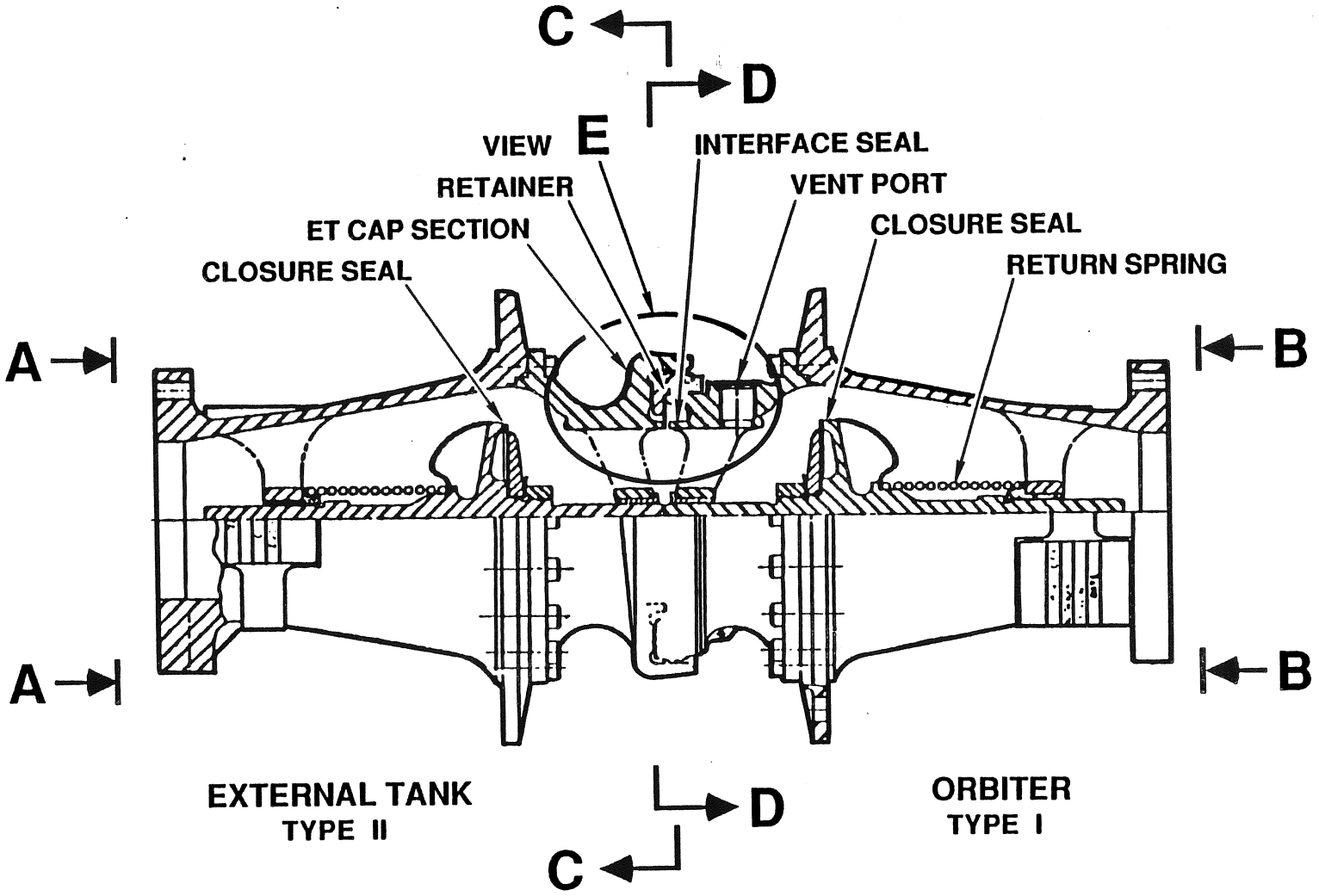


Rockwell International
Space Transportation Systems Division

COMPONENT: DISCONNECT, GH_2/GO_2 ORBITER TO TANK PRESSURIZATION SYSTEM

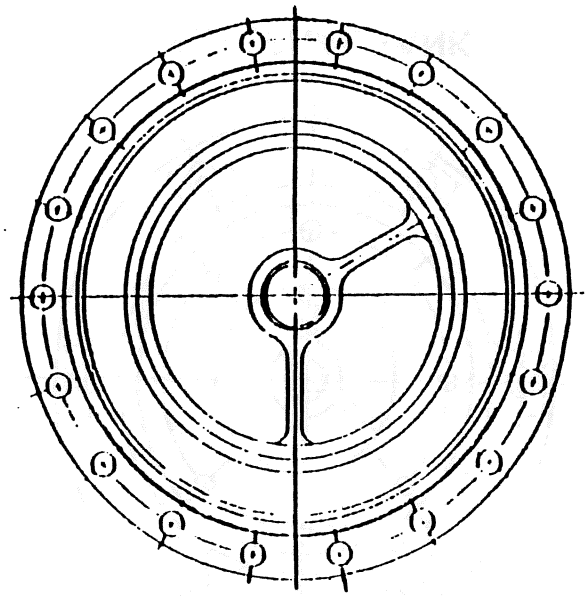
(MC284-0391)

MC284-0391-0001 TYPE I (ORBITER),
MC284-0391-0022 TYPE II (EXTERNAL TANK)



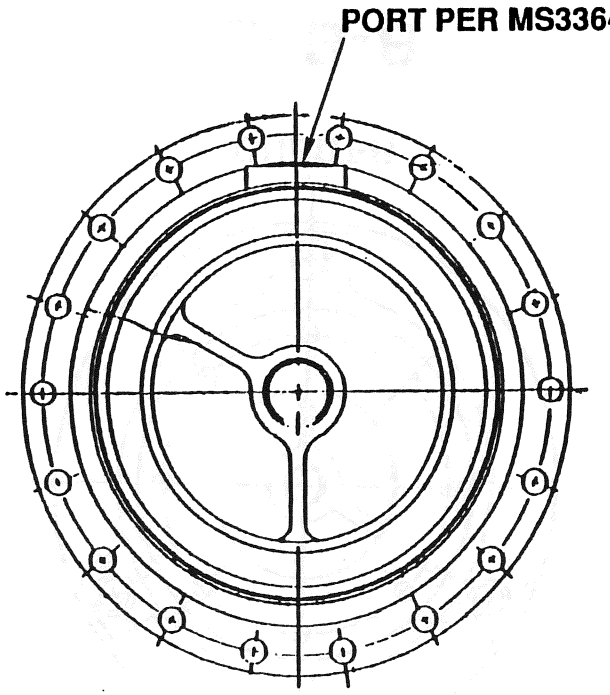
COMPONENT: DISCONNECT, GH_2/GO_2 ORBITER TO TANK PRESSURIZATION SYSTEM

(MC284-0391)



EXTERNAL TANK

VIEW C-C

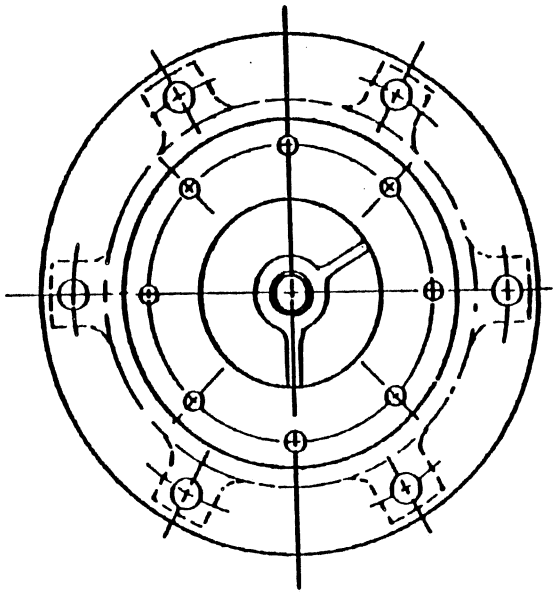


ORBITER

VIEW D-D

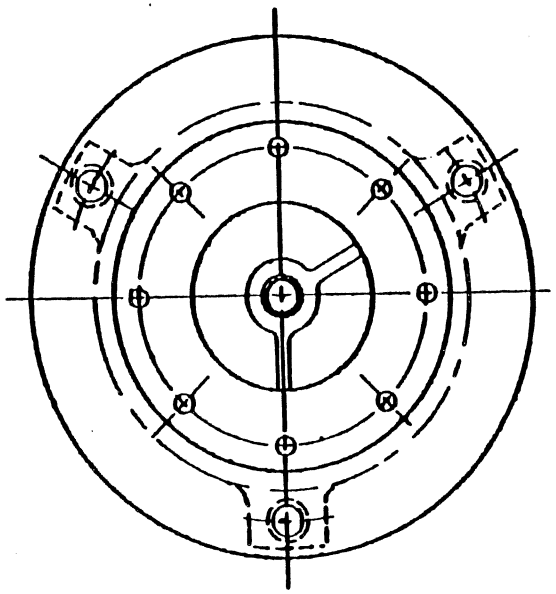
COMPONENT: DISCONNECT, GH_2/GO_2 ORBITER TO TANK PRESSURIZATION SYSTEM

(MC284-0391)



EXTERNAL TANK

VIEW **A-A**

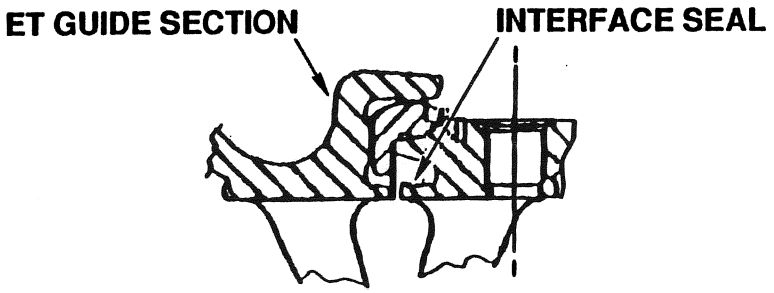


ORBITER

VIEW **B-B**

COMPONENT: DISCONNECT, GH_2/GO_2 ORBITER TO TANK PRESSURIZATION SYSTEM

(MC284-0391)



VIEW **E**

COMPONENT: VALVE, SHUTOFF, LO_2/LH_2, 1-1/2, 2-INCH

(MC284-0395)

FMEA/CIL NO: See Below

VENDOR : EATON CONSOLIDATED CONTROLS
P/N RI : MC284-0395-0051, -0052, -0053, -0054, -0055
P/N VENDOR: 1397-513, 1397-501-511, 1440-511, 1441-511, 1442-511

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

QUANTITY : 10 PER END ITEM (VARIOUS DASH NUMBERS)

:	(3) (-0051) LH_2 RECIRCULATION VALVES (PV-14, PV-15 AND PV-16)	FMEA 03-1-0403
:	(1) (-0051) LH_2 REPLENISHMENT VALVE (PV-13)	FMEA 03-1-0304
:	(2) (-0052) LO_2 POGO ACCUMULATOR RECIRCULATION VALVES (PV-20 AND PV-21)	FMEA 03-1-0453
:	(1) (-0053) LH_2 HIGH POINT BLEED VALVE (PV-22)	FMEA 03-1-0431
:	(1) (-0053) LH_2 RTLS DUMP VALVE, INBOARD (PV-17)	FMEA 03-1-0651
:	(1) (-0054) LH_2 RTLS DUMP VALVE, OUTBOARD (PV-18)	
:	(1) (-0055) LO_2 OVERBOARD BLEED VALVE (PV-19)	FMEA 03-1-0452

ITEM:

(-0051) TYPE I: LH_2, 2-INCH SHUTOFF VALVE, NORMALLY CLOSED, PNEUMATICALLY OPERATED TO OPEN POSITION AND PROVIDES POSITION INDICATION.

(-0052) TYPE II: LO_2, 2-INCH SHUTOFF VALVE, NORMALLY OPEN, PNEUMATICALLY OPERATED CLOSED, PROVIDES POSITION INDICATION AND INTERNAL RELIEF CAPABILITY.

(-0053) TYPE III: LH_2, 1-1/2-INCH SHUTOFF VALVE, NORMALLY CLOSED, PNEUMATICALLY OPERATED OPEN, PROVIDES POSITION INDICATION AND INTERNAL RELIEF CAPABILITY.

COMPONENT: VALVE, SHUTOFF, LO_2/LH_2, 1-1/2, 2-INCH

(MC284-0395)

(-0054) TYPE IV: SAME AS -0053 EXCEPT NO INTERNAL RELIEF CAPABILITY.

(-0055) TYPE V: LO_2, 1-1/2-INCH SHUTOFF VALVE, NORMALLY OPEN, PNEUMATICALLY OPERATED CLOSED, PROVIDES INTERNAL RELIEF CAPABILITY AND PROVIDES POSITION INDICATION WITH DUAL SWITCHES PROVIDED ON CLOSED MODE.

FUNCTION:

LH_2 RECIRCULATION VALVES:

THE VALVE IS MOUNTED IN PARALLEL WITH EACH LH_2 PREVALVE PROVIDING A PATH FOR LH_2 TO BYPASS THE PREVALVE AND FLOW THROUGH THE FEEDLINES TO THE ENGINE FOR ENGINE PRESTART CONDITIONING. VALVES ARE CLOSED PRIOR TO ENGINE START AND REMAINS CLOSED TO PROVIDE ENGINE ISOLATION WHENEVER THE PREVALVES ARE CLOSED (T-0 -8.5 SECONDS).

LH_2 REPLENISHMENT (TOPPING) VALVE:

PROVIDES CONTROL OF REPLENISH/TOPPING OF LH_2 AFTER THE TANK IS FILLED. THE VALVE IS MOUNTED ON THE FILL AND DRAIN LINE LOCATED BETWEEN THE INBOARD AND OUTBOARD LH_2 FILL AND DRAIN VALVES. THE VALVE IS OPENED AT START OF SLOW RATE AFTER THE INBOARD FILL AND DRAIN VALVE CLOSES (WHEN LH_2 TANK IS APPROXIMATELY 85 PERCENT FULL: T-0 -6.8 HOURS). VALVE CLOSED AT T-0 -113 SECONDS. VALVE REOPENED AT DUMP +6 SECONDS AND CLOSED AT DUMP +120 SECONDS. VALVE IS OPENED DURING REENTRY AND CLOSED AFTER LANDING.

LO_2 POGO ACCUMULATOR RECIRCULATION VALVE:

TWO VALVES ARE MOUNTED IN PARALLEL BETWEEN THE LO_2 BLEED VALVE (PV-19) AND THE LO_2 MANIFOLD. THEY PERFORM A PREFLIGHT FUNCTION DURING LO_2 TURBOPUMP CHILL DOWN (T-0 -8.5 HOURS TO T-0 -12.5 SECONDS) AND DURING FLIGHT BY PROVIDING A RETURN PATH TO ALLOW RECIRCULATION OF THE LO_2 POGO ACCUMULATORS. AFTER THE VALVES ARE OPENED AT T-0 -12.5 SECONDS, THEY REMAIN OPEN THROUGHOUT THE MISSION. TWO VALVES INSURE MAXIMUM FLOW RATE IS MAINTAINED THROUGHOUT THE MISSION WITH A FAILURE OF ONE VALVE TO OPEN OR REMAIN OPEN.

COMPONENT: VALVE, SHUTOFF, LO_2/LH_2, 1-1/2, 2-INCH

(MC284-0395)

LH_2 RTLS INBOARD DUMP VALVE AND OUTBOARD DUMP VALVE:

THE INBOARD VALVE IS MOUNTED TO THE ORBITER SIDE OF THE 17-INCH DISCONNECT AND THE OUTBOARD VALVE NEAR THE LEFT SIDEWALL. THE OUTBOARD VALVE SERVES AS A REDUNDANT VALVE TO PREVENT DUMPING OF LH_2 IF THE INBOARD VALVE FAILS TO CLOSE.

IN A NOMINAL MISSION, THE VALVES ARE OPENED AT MECO +10.2 SECONDS TO ASSIST IN VACUUM INERTING THE LH_2 MANIFOLD AND FEEDLINE AND CLOSED AT MECO +40.2 SECONDS. THE VALVE IS REOPENED AT MM 304 TRANSITION DURING REENTRY AND CLOSED DURING REENTRY WHEN GRV < 4,500 FEET PER SECOND.

IN A RTLS MISSION THE VALVES ARE OPENED AND CLOSED AT SPECIFIC TIME LINES BASED ON ABORT SITUATIONS (ONE ENGINE OUT, FAST-SEPARATION MISSION, ETC.).

LH_2 HIGH POINT BLEED VALVE:

THE VALVE IS LINE MOUNTED TO THE 17 INCH LH_2 DISCONNECT TO BLEED OFF EXCESS HYDROGEN GAS BUILDUP TO PREVENT SSME PUMP CAVATION. THE VALVE IS OPENED AT (T-0 -6.8 HOURS) AT START OF LH_2 SLOW RATE (WHEN LH_2 TANK IS APPROXIMATELY 85 PERCENT FULL) AND CLOSED AT T-0 -8.5 SECONDS.

CONTROLS OVERBOARD BLEED FLOW (DURING PROPELLANT LOADING) THROUGH LO_2 BLEED DISCONNECT (PD13) TO MAINTAIN PROPER CRYOGENIC START CONDITIONS FOR LO_2 ENGINE FEED.

LO_2 OVERBOARD BLEED VALVE:

THE VALVE IS LINE MOUNTED BETWEEN THE ENGINE LO_2 BLEED LINE AND THE LO_2 BLEED DISCONNECT LOCATED AT THE T-0 UMBILICAL. THE VALVE IS IN THE NORMALLY OPEN POSITION FROM START OF TANKING AND CLOSED FOR 3 SECONDS AT START OF LO_2 TOPPING TO VERIFY VALVE OPERATION. IT IS CLOSED AT T-0 -9.4 SECONDS. AT LO_2 DUMP PLUS 120 SECONDS THE VALVE IS OPENED AND REMAINS OPEN THROUGHOUT THE REMAINDER OF THE MISSION.

COMPONENT: VALVE, SHUTOFF, LO_2/LH_2, 1-1/2, 2-INCH

(MC284-0395)

DESIGN:

THE VALVE ACTUATOR IS SPRING LOADED TO THE CLOSED POSITION (-0051, -0053, AND -0054 CONFIGURATION) AND TO THE OPEN POSITION (-0052 AND -0055) CONFIGURATIONS. THE ACTUATOR PISTON DRIVES A SPRING LOADED RACK WHICH, IN TURN, DRIVES A PINION GEAR SHAFT WHICH ROTATES THE VALVE BALL CLOSURE DEVICE. THE SPRING IS MANUFACTURED FROM 0.177-INCH DIAMETER ELGILOY WIRE AND HAS A SPRING RATE OF 96 POUNDS PER INCH. IN THE INSTALLED POSITION, WITH THE ACTUATOR VENTED, THE SPRING EXERTS A FORCE OF 275 POUNDS. IF THE SPRING SHOULD BREAK WITH THE VALVE CLOSED, THE INTERNAL FRICTION OF THE ACTUATOR AND VALVE WOULD PREVENT THE VALVE FROM DRIFTING OUT OF THE CLOSED POSITION.

THE RACK AND PINION ARE OF INCONEL 718 AND THE PINION GEAR/SHAFT IS MACHINED FROM A SINGLE PIECE OF STOCK. PRESSURE LOADS ON THE VALVE BALL, FROM EITHER DIRECTION, ARE EVENLY DISTRIBUTED AND WOULD NOT TEND TO OPEN THE VALVE. STRUCTURAL ANALYSIS INDICATES POSITIVE MARGINS OF SAFETY FOR ALL CONDITIONS OF VALVE OPERATION; FRACTURE/FATIGUE ANALYSES SHOW THAT ALL CRITICAL PARTS ARE SATISFACTORY FOR FOUR TIMES EXPECTED LIFE.

INTERNAL LEAKAGE IS CONTROLLED BY A FLUOROGOLD BALL SEAL WHICH IS LOADED BY A BELLEVILLE SPRING.

THE ACTUATOR AND VALVE BEARINGS ARE OF EITHER VESPEL OR FLUOROGOLD AND ARE DESIGNED SO THAT THEY WILL TURN WITHIN THEIR HOUSING IN THE EVENT OF SHAFT/BEARING SEIZURE/BINDING. TO PREVENT BINDING IN THE ACTUATOR, THE RACK IS GUIDED ON EACH END BY A FLUOROGOLD GUIDE RING. THE CHROME PLATED PISTON SLIDES THROUGH RETAINERS TREATED WITH A DRY FILM LUBRICANT. THE ACTUATOR PISTON SEAL DESIGN USES A KEL-F STATIC SEAL AGAINST THE MOVING, CHROME-PLATED PISTON.

TO CONTROL CONTAMINATION, A 10-MICRON FILTER IS DESIGNED INTO THE ACTUATOR PRESSURIZATION PORT.

THE VALVE CONTAINS A POSITION INDICATING DEVICE WHICH UTILIZES TWO IHM25 SWITCHES OPERATED BY A CAM ATTACHED TO THE DRIVE SHAFT. EACH SWITCH, ONE FOR OPEN POSITION INDICATION AND ONE FOR CLOSED POSITION INDICATION, IS POSITIVELY MOUNTED WITH TWO SCREWS TO AN ADJUSTABLE BRACKET AND A CAM FOLLOWING ARM WHICH ACTIVATES THE SWITCH WHEN THE CAM LIFTS THE ARM AWAY FROM THE SWITCH. THE CAM FOLLOWING ARM ALWAYS MAINTAINS A LOAD ON THE SWITCH ARM TO PREVENT CHATTER DUE TO VIBRATION.

COMPONENT: VALVE, SHUTOFF, LO_2/LH_2, 1-1/2, 2-INCH

(MC284-0395)

DESIGN PARAMETERS AND FEATURES: (TYPE I)

VALVE SIZE:
2 INCH

OPERATING TEMPERATURE:
-423°F TO +275°F

OPERATING PRESSURES:
ACTUATOR:
500 TO 850 PSIG HELIUM
VALVE INTERNAL PRESSURE:
INLET PRESSURE: 55 PSIG
OUTLET PRESSURE: 55 PSIG
SURGE PRESSURE: 130 PSIG (OPEN)

PROOF PRESSURE:
ACTUATOR:
1,700 PSIG
VALVE BODY:
195 OPEN/CLOSED

BURST PRESSURE:
ACTUATOR:
3,400 PSIG
VALVE BODY:
260 PSIG

WEIGHT:
7.5 POUNDS

FLANGE SIZE:
INLET: 3.717 INCHES OUTSIDE DIAMETER
OUTLET: 4.747 INCHES OUTSIDE DIAMETER

VALVE OPERATING TIME:
OPENING RESPONSE:
SWITCH TO SWITCH: .750 SEC
COMMAND TO OPEN SWITCH: 1.500 SEC
CLOSING TIME:
SWITCH TO SWITCH: .750 SEC
COMMAND TO CLOSE SWITCH: 1.500 SEC

LEAKAGE:
ACTUATOR:
100 SCIM He AT 740 ± 40 PSIG (INTERNAL AND EXTERNAL COMBINED)
VALVE INTERNAL:
INLET TO OUTLET: 200 SCIM AT 55 PSIG
OUTLET TO INLET: 2.0 SCFM AT 40 PSIG
SHAFT SEAL: 20 SCIM AT 130 PSIG

VALVE EXTERNAL:
2.0 SCIM AT 130 PSIG

COMPONENT: VALVE, SHUTOFF, LO_2/LH_2, 1-1/2, 2-INCH

(MC284-0395)

DESIGN PARAMETERS AND FEATURES: (TYPE II)

VALVE SIZE:
2 INCH

OPERATING TEMPERATURE:
-297°F TO +275°F

OPERATING PRESSURES:
ACTUATOR:
600 TO 850 PSIG HELIUM
VALVE INTERNAL PRESSURE:
INLET PRESSURE: 105 PSIG
OUTLET PRESSURE: CLOSED 0-350 PSIG
SURGE PRESSURE: OPEN 400 PSIG

PROOF PRESSURE:
ACTUATOR:
1,700 PSIG
VALVE BODY: OPEN 600 PSIG
CLOSED (INLET) 157 PSIG

BURST PRESSURE:
ACTUATOR:
3,400 PSIG
VALVE BODY:
800 PSIG

WEIGHT:
7.8 POUNDS

FLANGE SIZE:
INLET: 3.717 INCHES OUTSIDE DIAMETER
OUTLET: 4.747 INCHES OUTSIDE DIAMETER

VALVE OPERATING TIME:
OPENING RESPONSE:
SWITCH TO SWITCH: .750 SEC
COMMAND TO OPEN SWITCH: 1.500 SEC
CLOSING TIME:
SWITCH TO SWITCH: .750 SEC
COMMAND TO CLOSE SWITCH: 1.500 SEC

LEAKAGE:
ACTUATOR:
100 SCIM He AT 740 ± 40 PSIG (INTERNAL AND EXTERNAL COMBINED)
VALVE INTERNAL:
INLET TO OUTLET: 400 SCIM AT 105 PSIG
OUTLET TO INLET: N/A RELIEF VALVE
SHAFT SEAL: 10 SCIM AT 400 PSIG

VALVE EXTERNAL:
2.0 SCIM MAX AT 130 PSIG

COMPONENT: VALVE, SHUTOFF, LO_2/LH_2, 1-1/2, 2-INCH

(MC284-0395)

DESIGN PARAMETERS AND FEATURES: (TYPE III)

VALVE SIZE:
1½ INCH

OPERATING TEMPERATURE:
-423°F TO +275°F

OPERATING PRESSURES:
- ACTUATOR:
  - 500 TO 850 PSIG HELIUM
- VALVE INTERNAL PRESSURE:
  - INLET PRESSURE: 55 PSIG
  - OUTLET PRESSURE: 55 PSIG
  - SURGE PRESSURE: 130 PSIG (OPEN)

PROOF PRESSURE:
- ACTUATOR:
  - 1,700 PSIG
- VALVE BODY:
  - 195 PSIG OPEN/CLOSED

BURST PRESSURE:
- ACTUATOR:
  - 3,400 PSIG
- VALVE BODY:
  - 260 PSIG

WEIGHT:
6.9 POUNDS

FLANGE SIZE:
- INLET: 4.747 INCHES OUTSIDE DIAMETER
- OUTLET: 3.074 INCHES OUTSIDE DIAMETER

VALVE OPERATING TIME:
- OPENING RESPONSE:
  - SWITCH TO SWITCH: .750 SEC
  - COMMAND TO OPEN SWITCH: 1.500 SEC
- CLOSING TIME:
  - SWITCH TO SWITCH: .750 SEC
  - COMMAND TO CLOSE SWITCH: 1.500 SEC

LEAKAGE:
- ACTUATOR:
  - 100 SCIM He AT 740 ± 40 PSIG (INTERNAL AND EXTERNAL COMBINED)
- VALVE INTERNAL:
  - INLET TO OUTLET: 200 SCIM AT 55 PSIG
  - OUTLET TO INLET: N/A RELIEF VALVE
  - SHAFT SEAL: 20 SCIM AT 130 PSIG

VALVE EXTERNAL:
2.0 SCIM AT 130 PSIG

COMPONENT: VALVE, SHUTOFF, LO_2/LH_2, 1-1/2, 2-INCH

(MC284-0395)

DESIGN PARAMETERS AND FEATURES: (TYPE IV)

VALVE SIZE:
1½ INCH

OPERATING TEMPERATURE:
-423°F TO +275°F

OPERATING PRESSURES:
- ACTUATOR:
  - 500 TO 850 PSIG HELIUM
- VALVE INTERNAL PRESSURE:
  - INLET PRESSURE: 55 PSIG
  - OUTLET PRESSURE: 55 PSIG
  - SURGE PRESSURE: 130 PSIG (OPEN)

PROOF PRESSURE:
- ACTUATOR:
  - 1,700 PSIG
- VALVE BODY:
  - 195 PSIG (OPEN/CLOSED)

BURST PRESSURE:
- ACTUATOR:
  - 3,400 PSIG
- VALVE BODY:
  - 260 PSIG

WEIGHT:
6.5 POUNDS

FLANGE SIZE:
- INLET: 4.247 INCHES DIAMETER
- OUTLET: 3.074 INCHES DIAMETER

VALVE OPERATING TIME:
- OPENING RESPONSE:
  - SWITCH TO SWITCH: .750 SEC
  - COMMAND TO OPEN SWITCH: 1.500 SEC
- CLOSING TIME:
  - SWITCH TO SWITCH: .750 SEC
  - COMMAND TO CLOSE SWITCH: 1.500 SEC

LEAKAGE:
- ACTUATOR:
  - 100 SCIM He AT 740 ± 40 PSIG (INTERNAL AND EXTERNAL COMBINED)
- VALVE INTERNAL:
  - INLET TO OUTLET: 200 SCIM AT 55 PSIG
  - OUTLET TO INLET: 200 SCIM AT 15 PSIG
  - SHAFT SEAL: 20 SCIM AT 130 PSIG

VALVE EXTERNAL:
2.0 SCIM AT 130 PSIG

COMPONENT: VALVE, SHUTOFF, LO_2/LH_2, 1-1/2, 2-INCH

(MC284-0395)

DESIGN PARAMETERS AND FEATURES: (TYPE V)

VALVE SIZE:
1½ INCH

OPERATING TEMPERATURE:
-297°F TO +275°F

OPERATING PRESSURES:
- ACTUATOR:
  - 500 TO 850 PSIG HELIUM
- VALVE INTERNAL PRESSURE:
  - INLET PRESSURE: 0-220 PSIG
  - OUTLET PRESSURE: CLOSED 0-225 PSIG
  - SURGE PRESSURE: 400 PSIG CLOSED

PROOF PRESSURE:
- ACTUATOR:
  - 1,700 PSIG
- VALVE BODY: OPEN 600 PSIG
  - CLOSED (INLET) 600 PSIG

BURST PRESSURE:
- ACTUATOR:
  - 3,400 PSIG
- VALVE BODY:
  - 800 PSIG

WEIGHT:
6.8 POUNDS

FLANGE SIZE:
- INLET: 3.074 INCHES DIAMETER
- OUTLET: 4.247 INCHES DIAMETER

VALVE OPERATING TIME:
- OPENING RESPONSE:
  - SWITCH TO SWITCH: .750 SEC
  - COMMAND TO OPEN SWITCH: 1.500 SEC
- CLOSING TIME:
  - SWITCH TO SWITCH: .750 SEC
  - COMMAND TO CLOSE SWITCH: 1.500 SEC

LEAKAGE:
- ACTUATOR:
  - 100 SCIM He AT 740 ± 40 PSIG (INTERNAL AND EXTERNAL COMBINED)
- VALVE INTERNAL:
  - INLET TO OUTLET: 400 SCIM AT 105 PSIG
  - OUTLET TO INLET: N/A RELIEF VALVE
  - SHAFT SEAL: 10 SCIM AT 400 PSIG

VALVE EXTERNAL:
2.0 SCIM MAX AT 400 PSIG

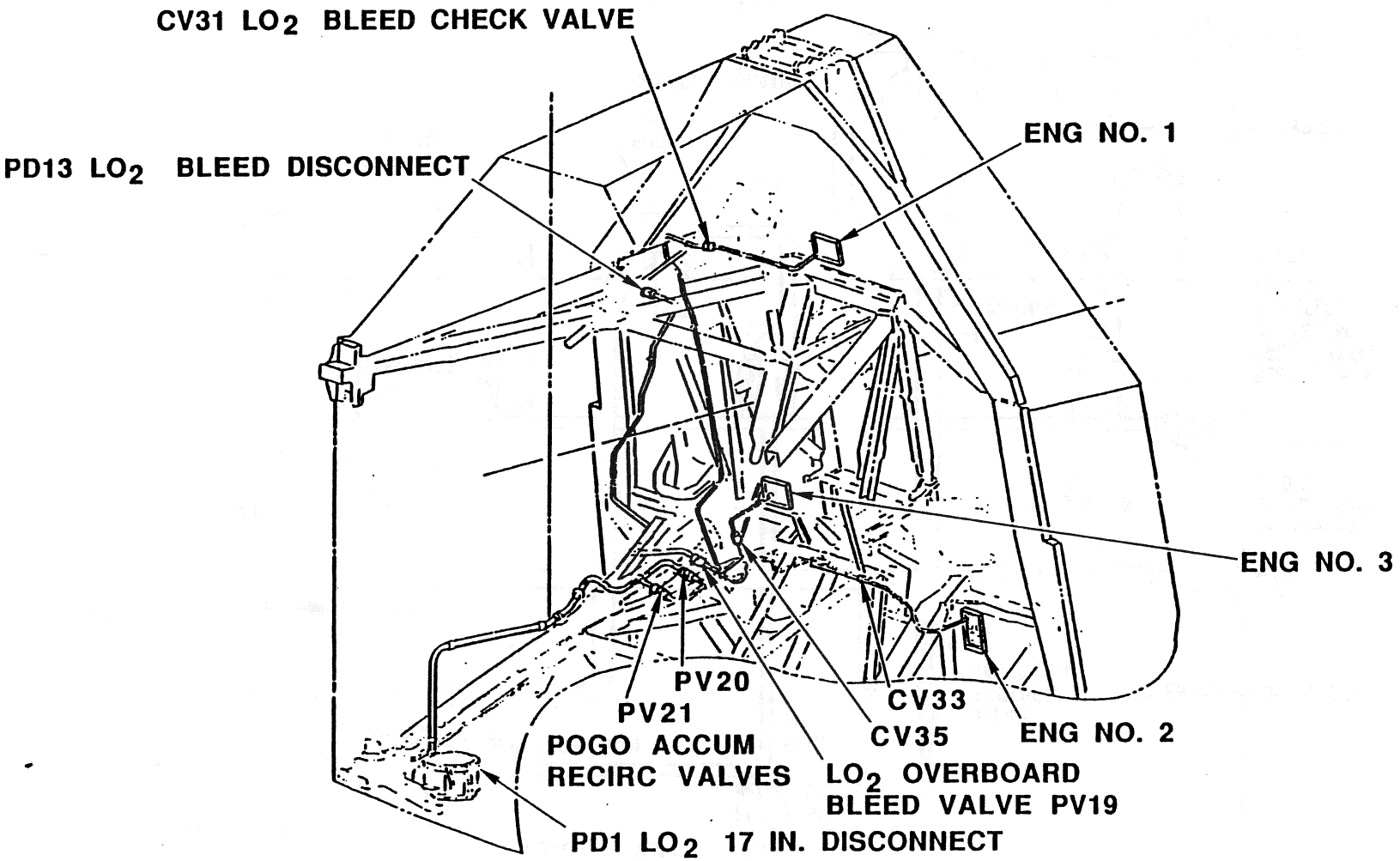
COMPONENT: VALVE, SHUTOFF, LO_2/LH_2, 1-1/2, 2-INCH

(MC284-0395)

MATERIAL:
VALVE BODY: A356-T6 AL ALLOY
ACTUATOR BODY: A356-T6 AL ALLOY
BALL CLOSURE: 7075-T7351 AL ALLOY
BALL SEAL: FLUOROGOLD
ACTUATOR PISTON: 304 CRES
PINION GEAR: INCONEL 718
SHAFT: INCONEL 718
ACTUATOR SPRING: ELGILOY
ACTUATOR SHAFT BEARING: FLUOROGOLD
RACK: INCONEL 718
CAM: 304 CRES
ACTUATOR PISTON SEAL: KEL-F
PISTON GUIDE RING: FLUOROGOLD
BUSHING: AL-BRONZE
TRUNNION SHAFT: 7075-T7351
SHAFT BEARING: VESPEL
SHAFT SEAL: TEFLON
SHAFT SEAL BACKUP SPRING: BERYLLIUM COPPER

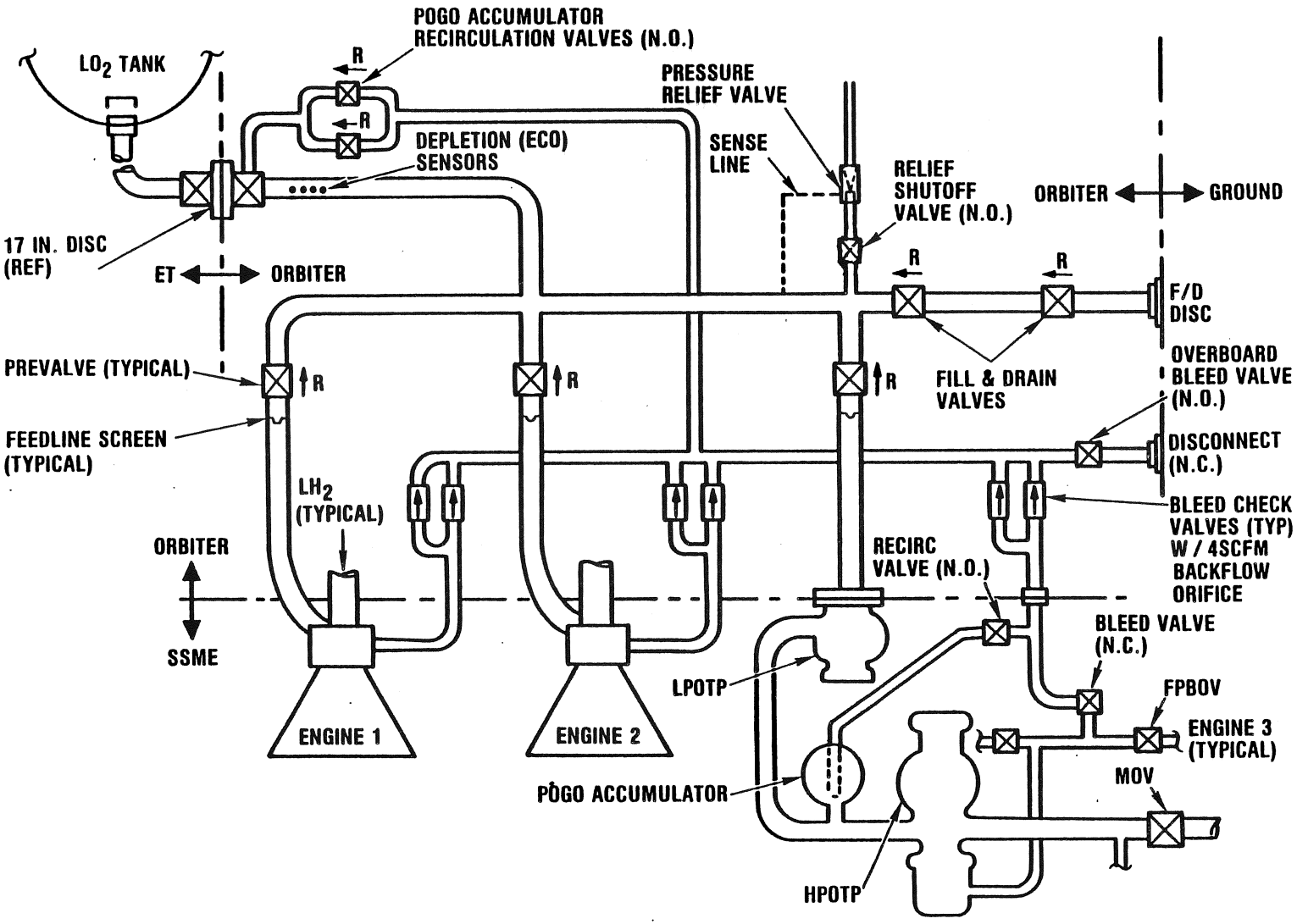
COMPONENT: VALVE, SHUTOFF, LO_2 POGO ACCUMULATOR SYSTEM

(MC284-0395)



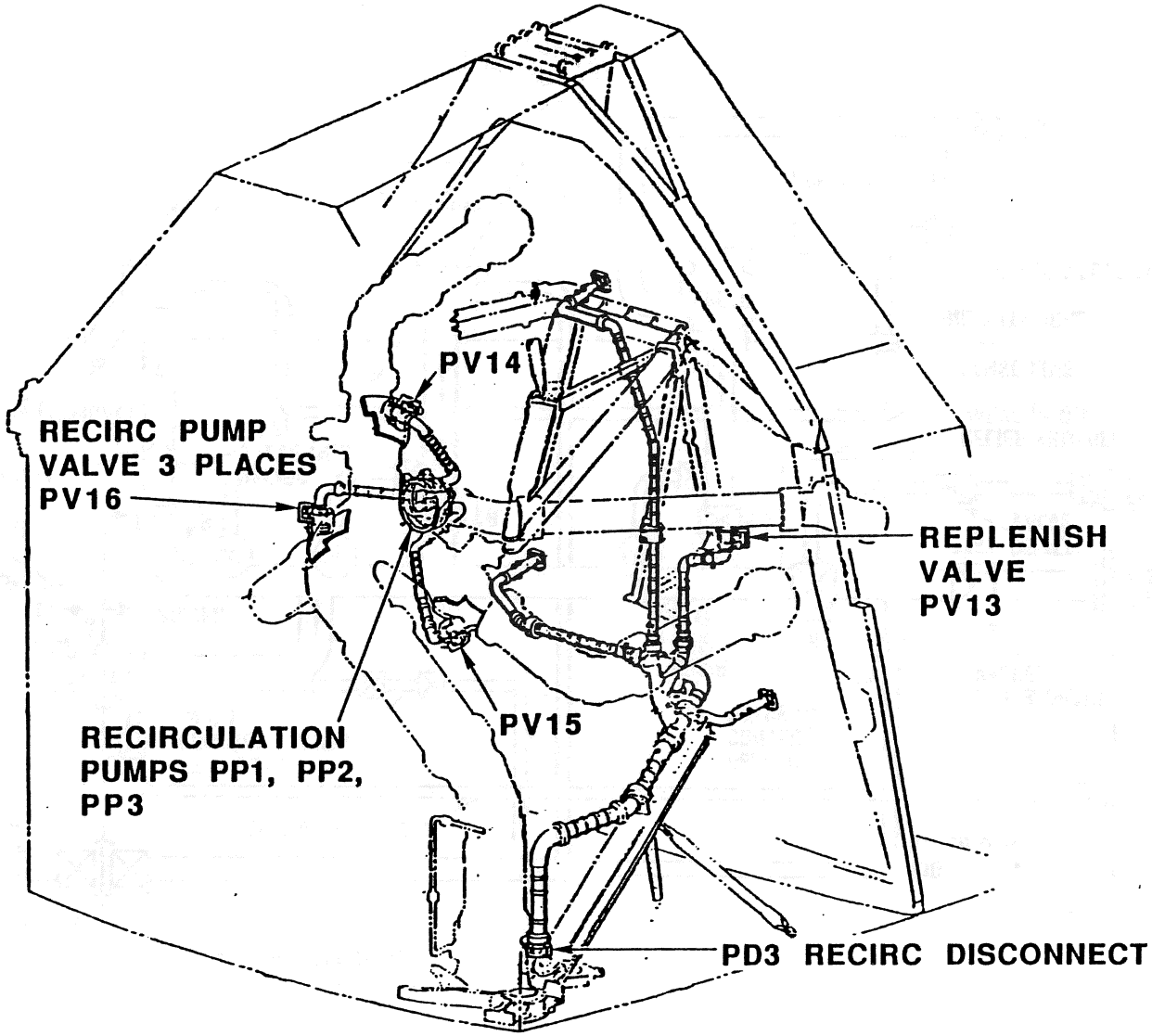
COMPONENT: LO_2 OVERBOARD BLEED AND POGO SYSTEM

(MC284-0395)



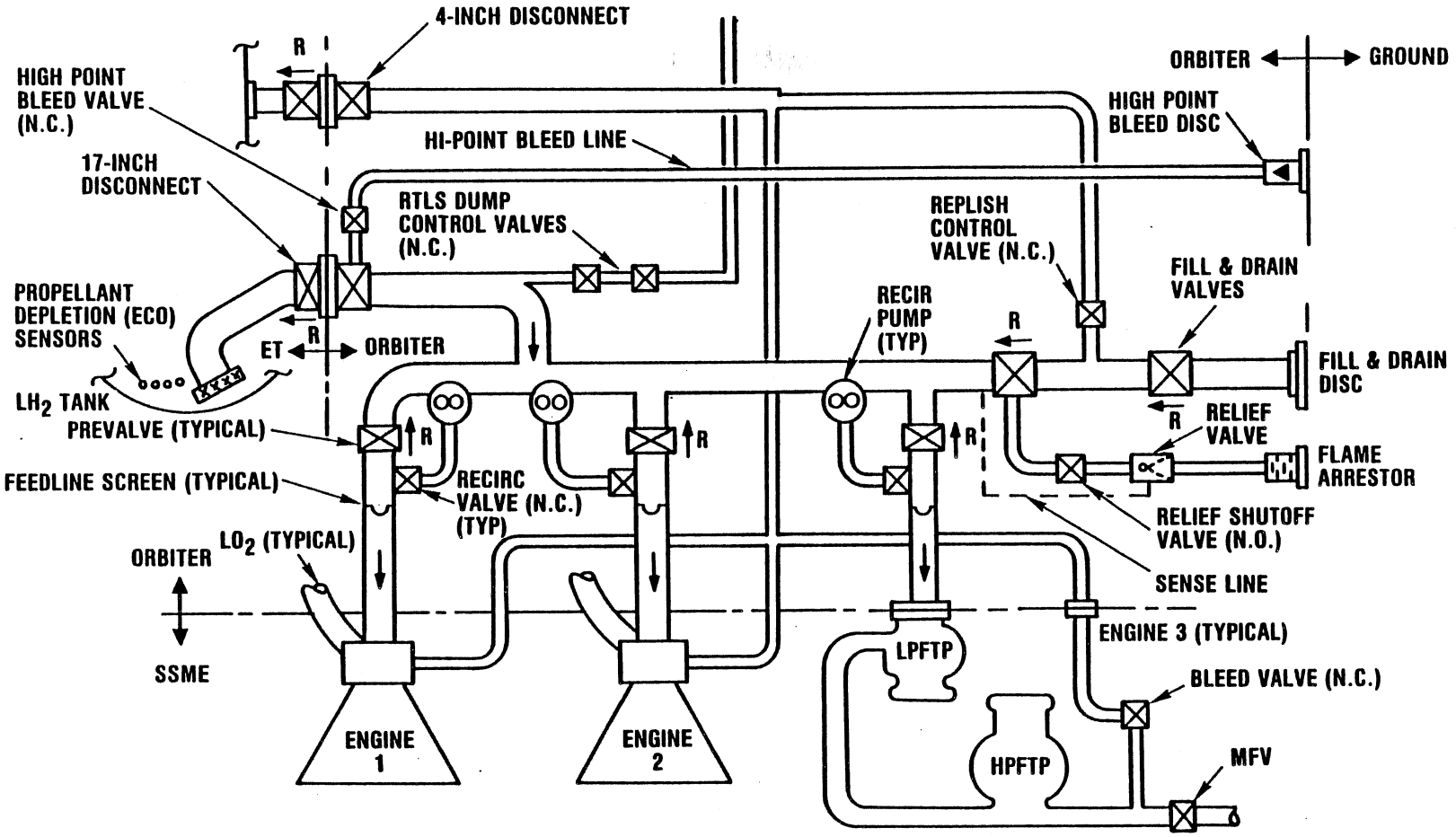
COMPONENT: VALVE, SHUTOFF, LH_2 RECIRCULATION AND REPLENISHMENT SYSTEM

(MC284-0395)



COMPONENT: VALVE, SHUTOFF, LH_2 RECIRCULATION AND REPLENISHMENT SYSTEM

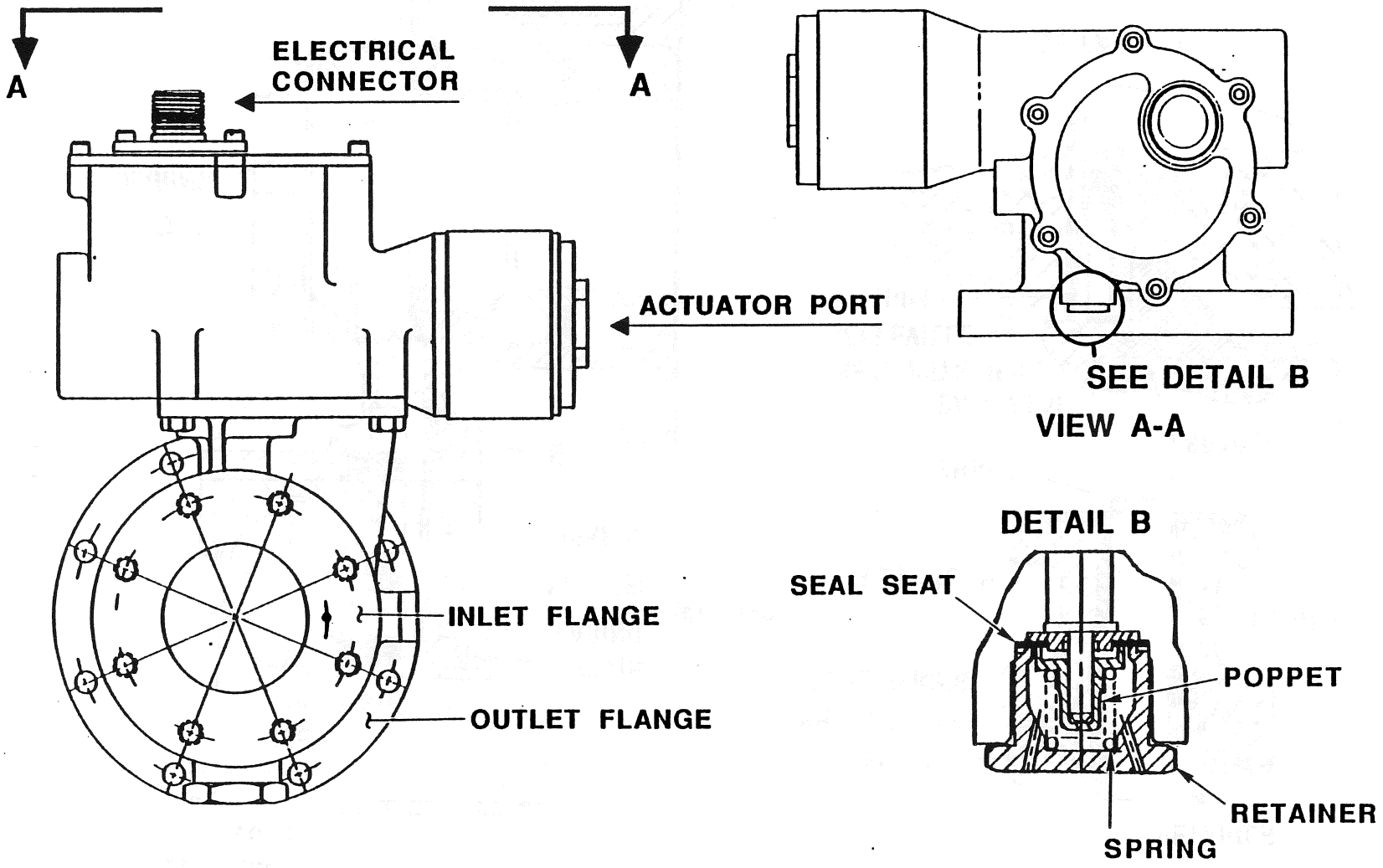
(MC284-0395)



COMPONENT: VALVE, SHUTOFF, LH_2 RECIRCULATION AND REPLENISHMENT SYSTEM

(MC284-0395)

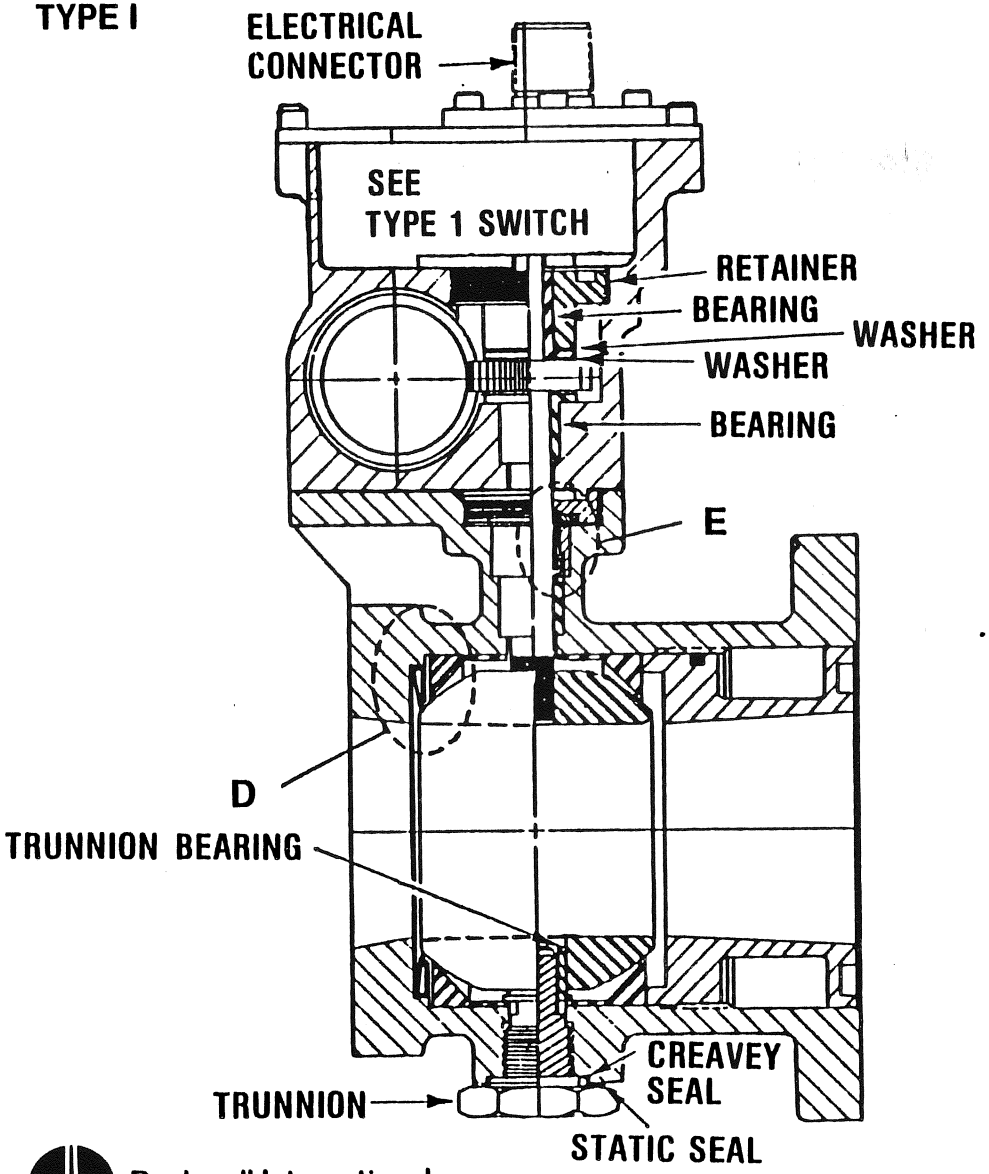
TYPE I CONFIGURATION

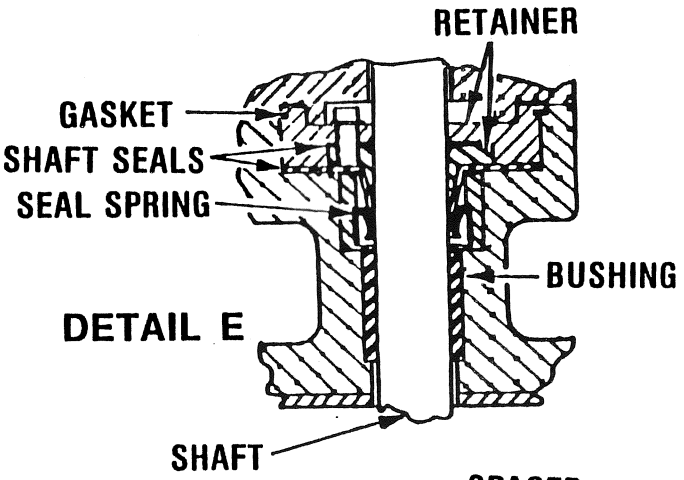


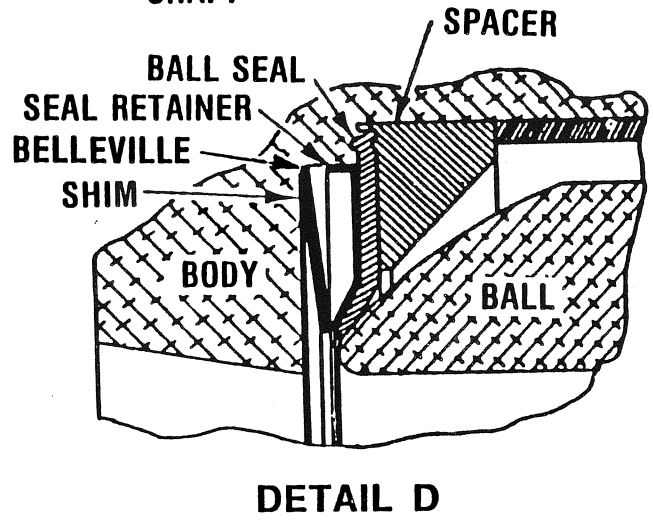
COMPONENT: VALVE, SHUTOFF, LH_2 RECIRCULATION AND REPLENISHMENT SYSTEM

(MC284-0395)

TYPE I







DETAIL D

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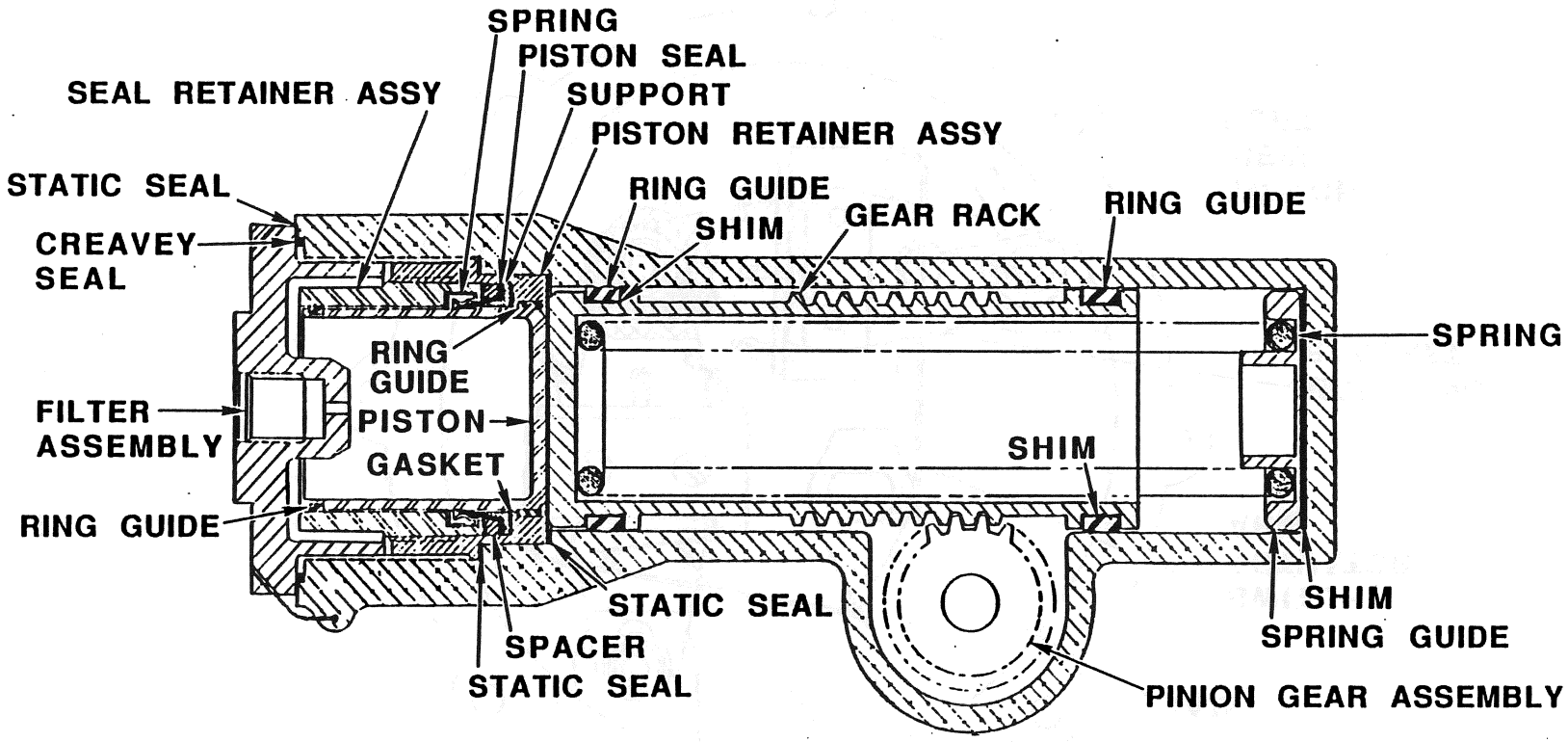
Space Transportation Systems Division

COMPONENT: VALVE, SHUTOFF, LO_2/LH_2, 1-1/2, 2-INCH

(MC284-0395)

ACTUATOR

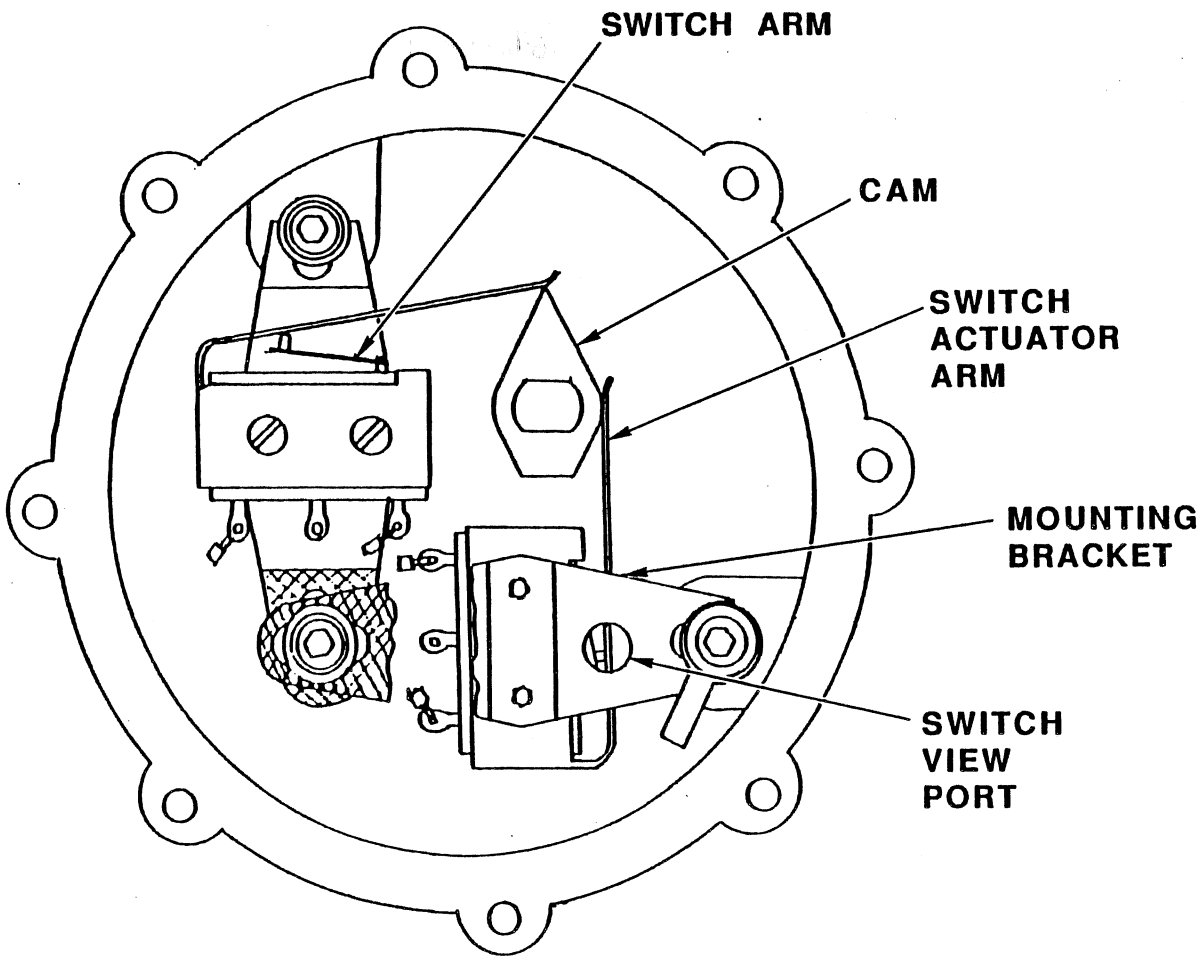


NOTE:
ACTUATOR CONFIGURATION FOR TYPES I THRU V. TYPE II HAS PISTON REVERSED

COMPONENT: VALVE, SHUTOFF, LO_2/LH_2, 1-1/2, 2-INCH

(MC284-0395)

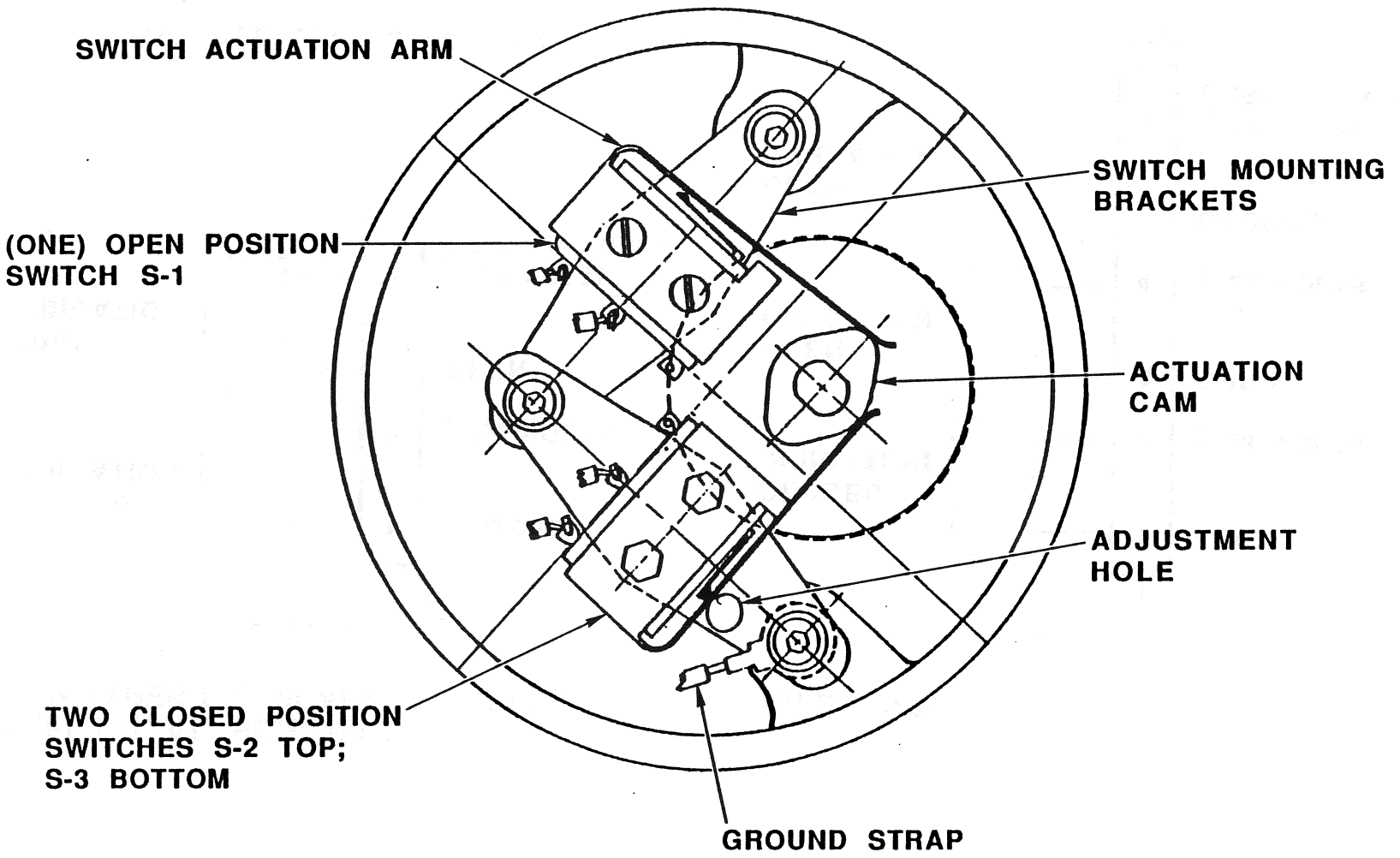
TYPE 1 THRU 4 POSITION SWITCH



COMPONENT: VALVE, SHUTOFF, LO_2 OVERBOARD BLEED

(MC284-0395)

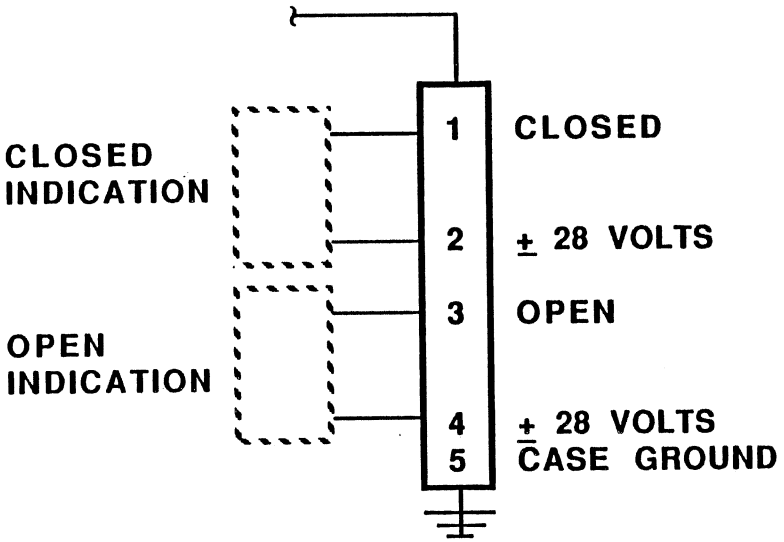
TYPE V POSITION SWITCHES



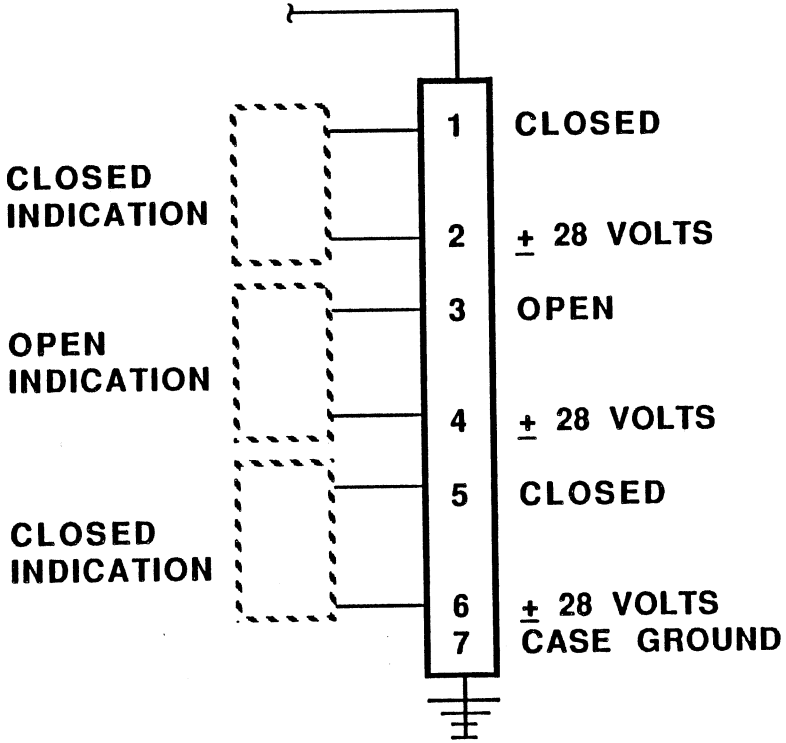
COMPONENT: VALVE, SHUTOFF, LO_2/LH_2, 1-1/2, 2-INCH

(MC284-0395)

ELECTRICAL SCHEMATIC FOR TYPES I, II, III AND IV VALVES



TYPE V VALVE

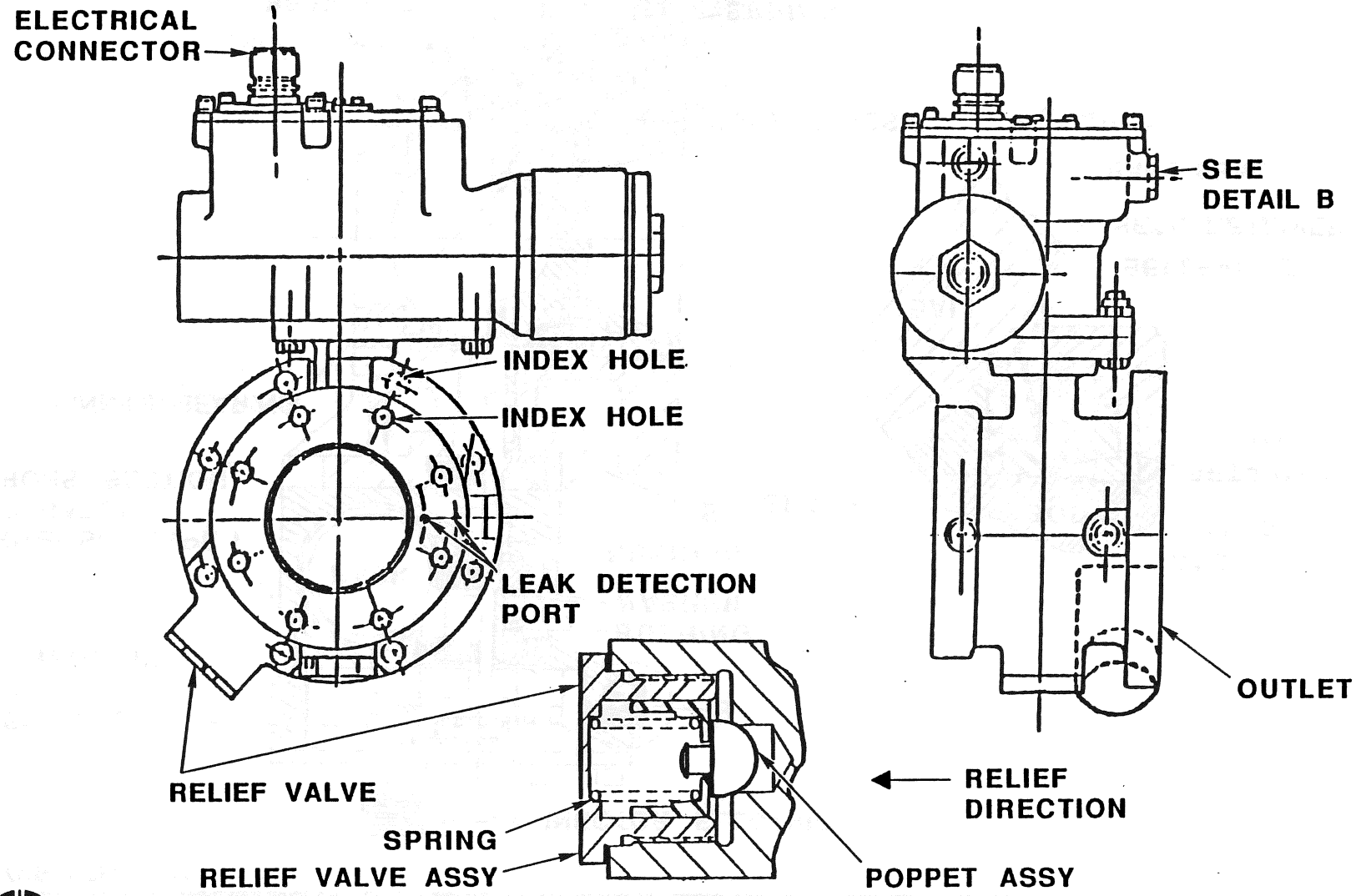


NOTE: ALL SWITCHES NORMALLY OPEN

COMPONENT: VALVE, SHUTOFF, LO_2 POGO ACCUMULATOR SYSTEM

(MC284-0395)

TYPE II CONFIGURATION

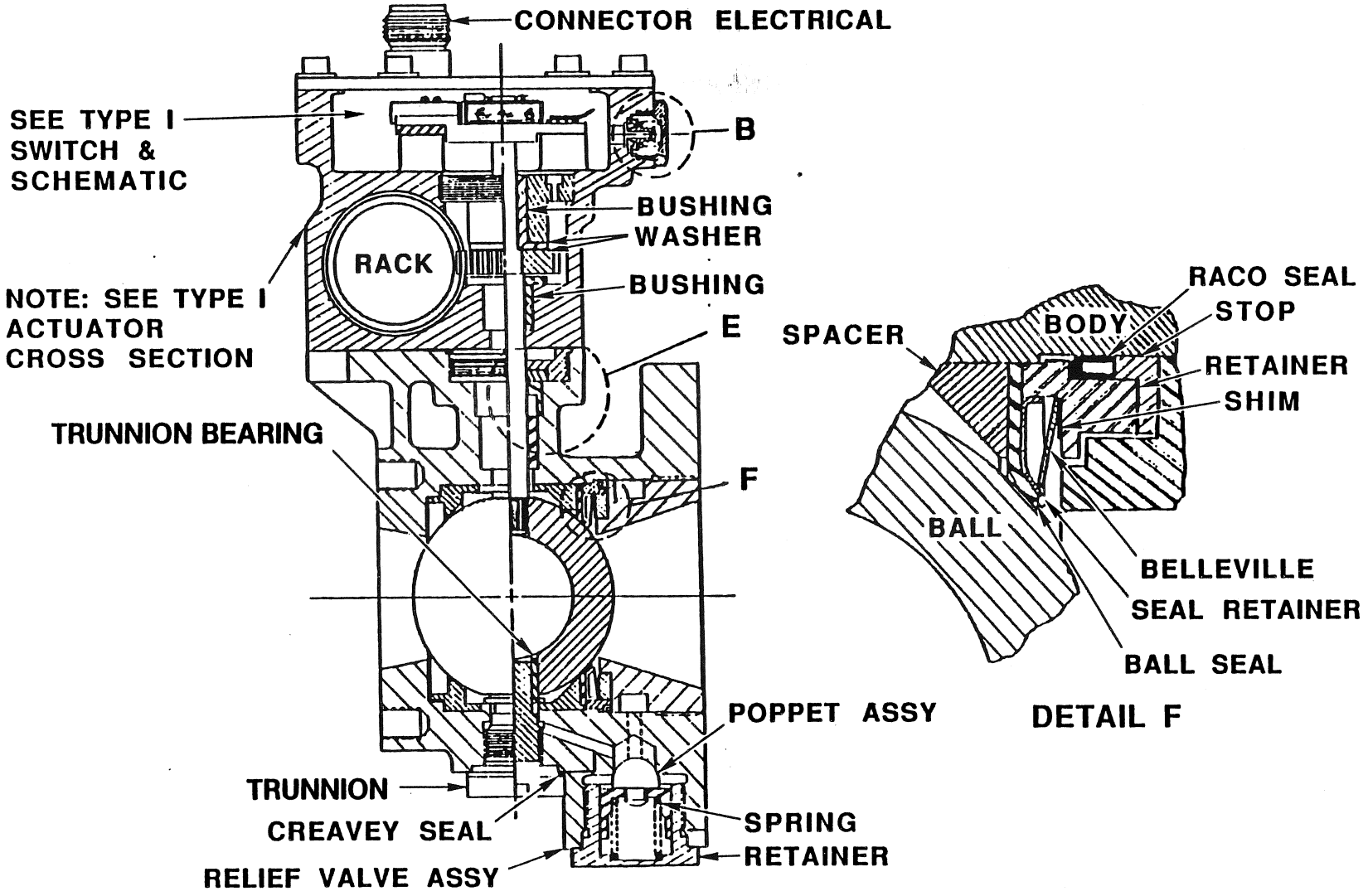


DETAIL C

COMPONENT: VALVE, SHUTOFF, LO_2/LH_2, 1-1/2, 2-INCH

(MC284-0395)

TYPE II THRU IV

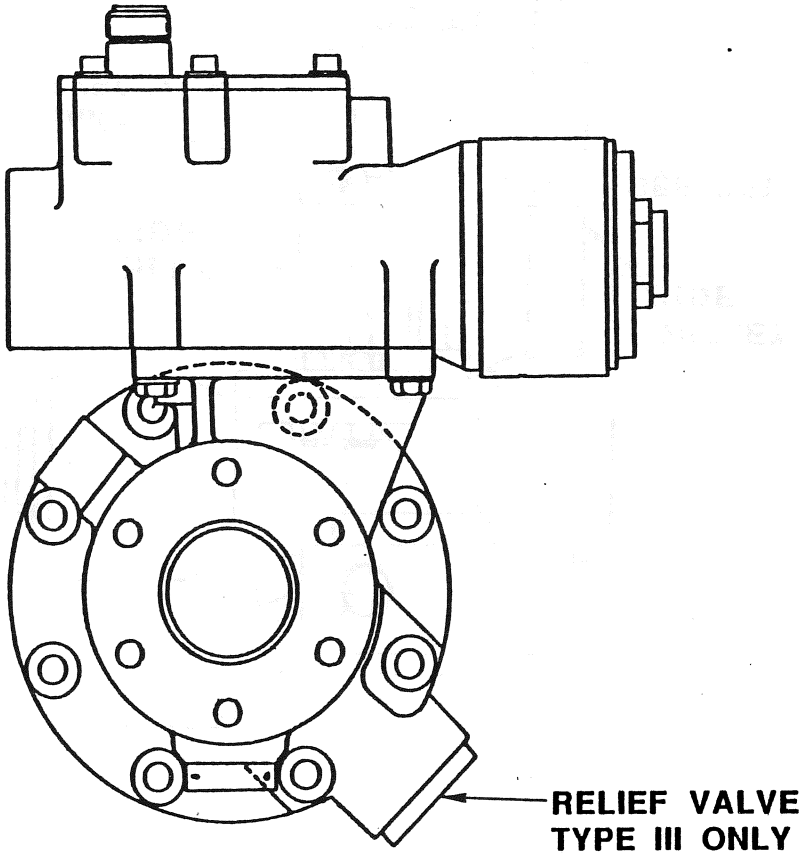


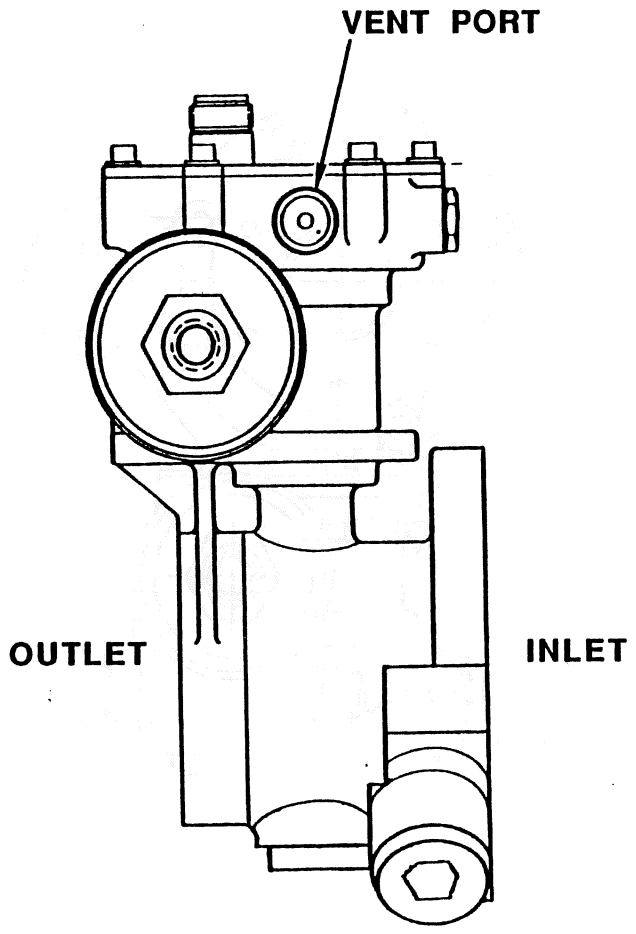
COMPONENT: VALVE, SHUTOFF, LH_2 HIGH POINT BLEED AND RTLS SYSTEM

(MC284-0395)

TYPE III & IV

NOTE:
SEE TYPE I ACTUATOR CROSS SECTION, POSITION SWITCH & SCHEMATIC

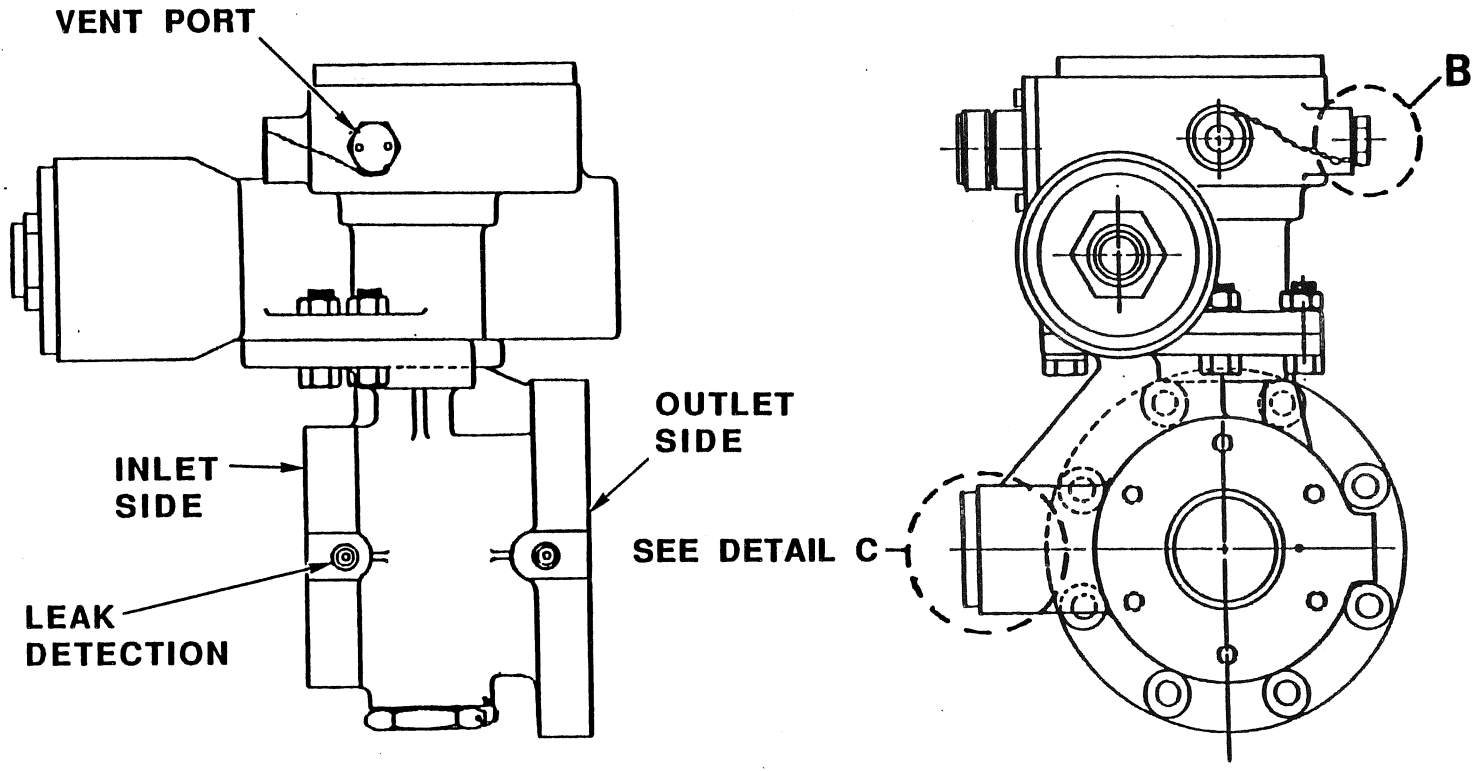




COMPONENT: VALVE, SHUTOFF, LO_2 OVERBOARD BLEED SYSTEM

(MC284-0395)

TYPE V



NOTE:
SEE ACTUATOR CROSS SECTION & SWITCH SCHEMATIC

COMPONENT: PREVALVE, SHUTOFF, PROPELLANT

(MC284-0396)

FMEA/CIL NO. 03-1-0401
FMEA/CIL NO. 03-1-0402

ASSEMBLY :
P/N RI : MC284-0396-0007 (LO_2), -0008 (LH_2)
P/N VENDOR: FAIRCHILD STRATOS
QUANTITY : 3 (LO_2) PV1, PV2, PV3
: 3 (LH_2) PV4, PV5, PV6

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

VALVE, PRE, LO_2 AND LH_2 12 INCH PNEUMATICALLY OPERATED, INCORPORATES REVERSE FLOW RELIEF VALVE.

FUNCTION:

THIS VALVE IS USED AS AN ISOLATION VALVE FOR THE PROPELLANT FEED SYSTEM FOR A SHUTDOWN/FAILED SSME. THE VALVE IS REOPENED FOR DUMPS AND CLOSED FOR REENTRY. THE VALVE IS HELD OPEN DURING CHILLDOWN, LOADING, AND ENGINE OPERATION. PREVALVE CLOSURE IS INHIBITED UNTIL THE THRUST CHAMBER PRESSURE DECAYS TO 30% POWER LEVEL OR MECO + 1 SECOND HAS OCCURRED. CLOSING OF THE PREVALVE BECOMES CRITICAL DURING MAIN ENGINE CUTOFF (MECO). DURING THIS ZERO G CONDITION, HELIUM IS INJECTED INTO SYSTEM VIA SSME POGO ACCUMULATOR TO MAINTAIN REQUIRED LO_2 PRESSURE AT THE SSME HPOTP TO PREVENT OVERSPEED.

WHEN THE VALVE IS CLOSED, A REVERSE FLOW RELIEF VALVE AND A VISOR LIFTOFF MECHANISM PROVIDE MEANS OF RELIEVING BOILOFF PRESSURE WITHIN FEEDLINE WITH PREVALVE IN CLOSED POSITION.

DESIGN:

THE COMPONENT IS A BISTABLE TWO-POSITION SHUTOFF VALVE (OPEN AND CLOSED) WITH A 12-INCH INSIDE (OR I.D.) DIAMETER. THE CLOSURE DEVICE IS A HALF MOON SHAPED INCONEL VISOR WHICH IS ACTUATED TO THE OPEN OR CLOSED POSITION BY A PNEUMATIC ACTUATOR. ELECTRICAL SWITCHES PROVIDE OPEN AND CLOSED POSITION INDICATION. THE VALVE REMAINS IN THE LAST SELECTED POSITION UNTIL ACTUATION PRESSURE IS APPLIED TO CYCLE THE VALVE. IN THE CLOSED POSITION, WITH NO PNEUMATICS APPLIED, THE VALVE MAIN VISOR LIFTS OFF THE SEAT WHEN BACK PRESSURE

IS APPLIED FROM THE OUTLET TO THE INLET OF THE VALVE. A RELIEF VALVE IS BUILT-IN WHICH PREVENTS THE ACCUMULATION OF EXCESSIVE PRESSURE ON THE DOWNSTREAM SIDE WHEN THE VALVE IS CLOSED. THE POWERTRAIN IS MANUFACTURED FROM A286 CRES, 21-6-9 CRES AND COPPER-BERYLLIUM COMPONENTS. BINDING IS GUARDED AGAINST BY USE OF ROLLER BEARINGS THROUGHOUT.

THE ACTUATOR DRIVES THE VALVE VIA A LINEAR RACK AND PINION GEAR (BOTH OF COPPER-BERYLLIUM), AND THE RACK IS POWERED BY HELIUM-DRIVEN DUAL PISTONS. LEAKAGE ACROSS THE PISTONS IS PRECLUDED BY TWO SEALS OF THE TEFLON JACKETED, METALLIC "V" TYPE (THE METALLIC "V" SPRING IS OF 301 CRES). THIS TYPE OF SEAL IS USED TO PREVENT EXTERNAL LEAKAGE AT ALL ACTUATOR JOINTS.

THE RELIEF VALVE IS REQUIRED TO FLOW 3,000 SCIM AT 15 TO 50 PSID. THE MAIN VALVE VISOR (POPPET) IS DESIGNED TO ALLOW REVERSE FLOW OF 3,000 SCIM AT 15 PSID MAX. THEREFORE, IF THE RELIEF VALVE FAILS TO RELIEVE, THE MAIN VISOR WILL ACCOMPLISH THE SAME TASK. THE RELIEF VALVE EMPLOYS A GUIDED, SPRING-LOADED 6061-T651 POPPET AGAINST A KEL-F SEAT. THE SPRING IS CONSTRUCTED OF 0.047 INCH DIAMETER ELGILOY SPRING TEMPER WIRE WHICH HAS A SPRING RATE OF 12.4 LB/INCH, AND EXERTS A FORCE OF 3.8 LB AFTER INSTALLATION.

DESIGN PARAMETERS AND FEATURES:

PRESSURE OPERATING	0 TO +275 PSIA (OXYGEN) 0 TO +110 PSIA (HYDROGEN)
TEMPERATURE OPERATING	-320°F TO +170°F (OXYGEN) -423°F TO +170°F (HYDROGEN)
TEMPERATURE NON-OPERATING	200°F MAXIMUM
FLOW OXYGEN	6,100 GAL/MIN (966 LB/SEC) AT 45 PSIG; ΔP 0.5 PSI (MAX)
FLOW HYDROGEN	16,500 GAL/MIN (161 LB/SEC) AT 15 PSIG; ΔP 0.25 PSI (MAX)
FLOW RELIEF VALVE	2.0 LB/SEC LO_2 AT 50 PSID

COMPONENT: PREVALVE, SHUTOFF, PROPELLANT

(MC284-0396)

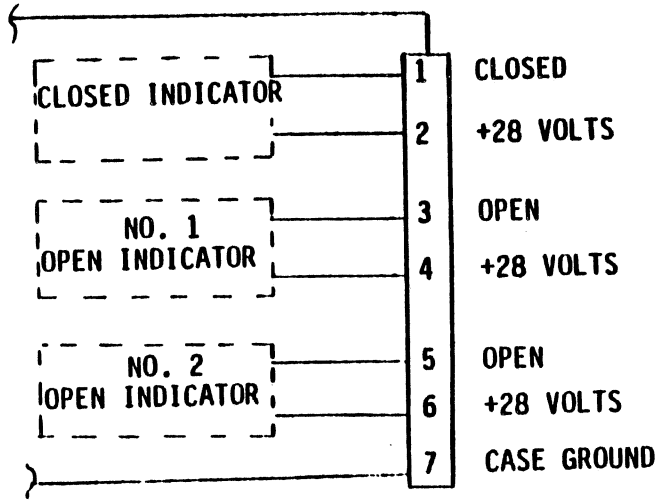
LEAKAGE (MAX)--INTERNAL (VLV CLOSED)	
INLET-TO-OUTLET (LO_2)	1,000 SCIM AT -320 TO +170°F AND 0 TO +200 PSID
INLET-TO-OUTLET (LH_2)	2,000 SCIM AT -423 TO +170°F AND 0 TO +50 PSID
INLET-TO-OUTLET (GH_e)	300 SCIM AT AMBIENT TEMPERATURE
OUTLET-TO-INLET (LO_2 & LH_2)	2,500 SCIM AT: -150 TO +170°F AND 0 TO 5 PSID : -423 TO -150°F AND 0 TO 15 PSID
LEAKAGE (MAX)--EXTERNAL (LO_2 & LH_2)	10 SCIM AT -423 TO +170°F
LEAKAGE (MAX)--ACTUATOR (TOTAL) (GHe)	150 SCIM AT -423 TO +170°F
CRACK & RESEAT-RELIEF VALVE	15 PSID TO 50 PSID AT -423°F TO -150°F 6.7 PSID CRACK, 5 PSID RESEAT AT -150°F TO +170°F
MAIN VISOR BACKUP RELIEF (LIFT-OFF SEAT)	15 PSID (WITHOUT PNEUMATICS) APPLIED FROM OUTLET TO INLET
ACTUATION PRESSURE	400 PSIG MIN, 700 PSIG TO 780 PSIG
ACTUATION TEMPERATURE	-423 TO +170°F

COMPONENT: PREVALVE, SHUTOFF, PROPELLANT

(MC284-0396)

RESPONSE TIME OPENING (ACTUATION COMMAND TO POSITION SWITCH PICKUP)	1.5 SEC MAX AT CRYO TEMP: 85 PSID GO_2 (FROM INLET TO OUTLET) : 35 PSID GH_2 FROM INLET TO OUTLET : Δ FROM OUTLET TO INLET WITH 2.0 LB FLOW FROM RELIEF OF LO_2
RESPONSE TIME CLOSING (ACTUATION COMMAND TO POSITION SWITCH PICKUP)	0.95 ± 0.20 SEC: 0 TO 275 PSIA LO_2 : 0 TO 110 PSIA LH_2
RESPONSE TIME CLOSING (LO_2 ONLY)	0.5 SEC MIN, 1.15 SEC MAX (WITH FLOW)
WEIGHT	LO_2, 92.8 LB; LH_2, 99.9 LB

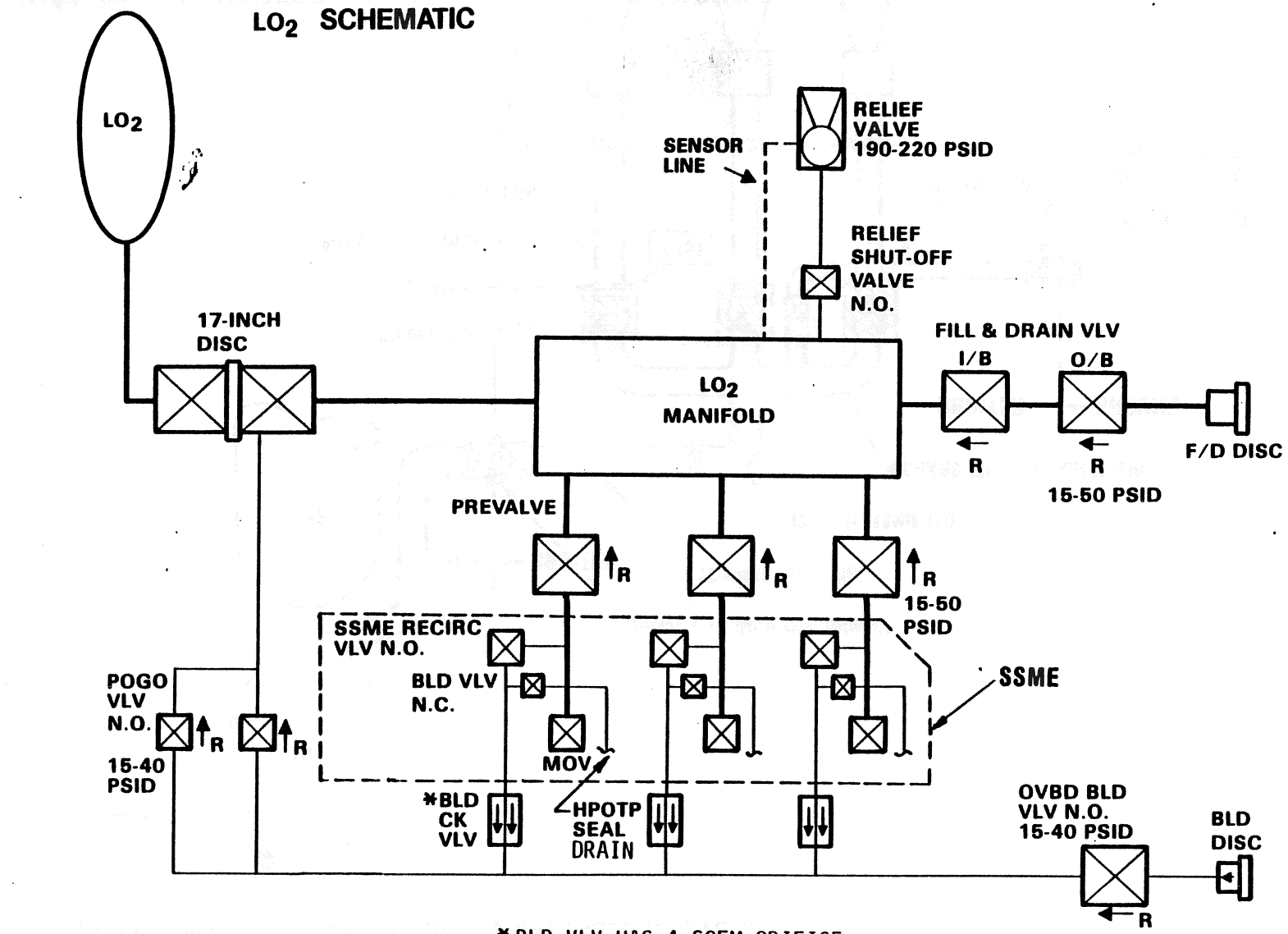
ELECTRICAL SCHEMATIC:



MATERIALS
PREVALVE HOUSING: 2219-T852 VISOR: INCONEL 718 VISOR SHAFT: 21-6-9 CRES GUIDE: 6061-T651 MAIN SEAT SEAL: KEL-F, TYPE 81-6061 ACTUATOR HOUSING: 6061-T651

COMPONENT: PREVALVE, SHUTOFF, PROPELLANT

(MC284-0396)

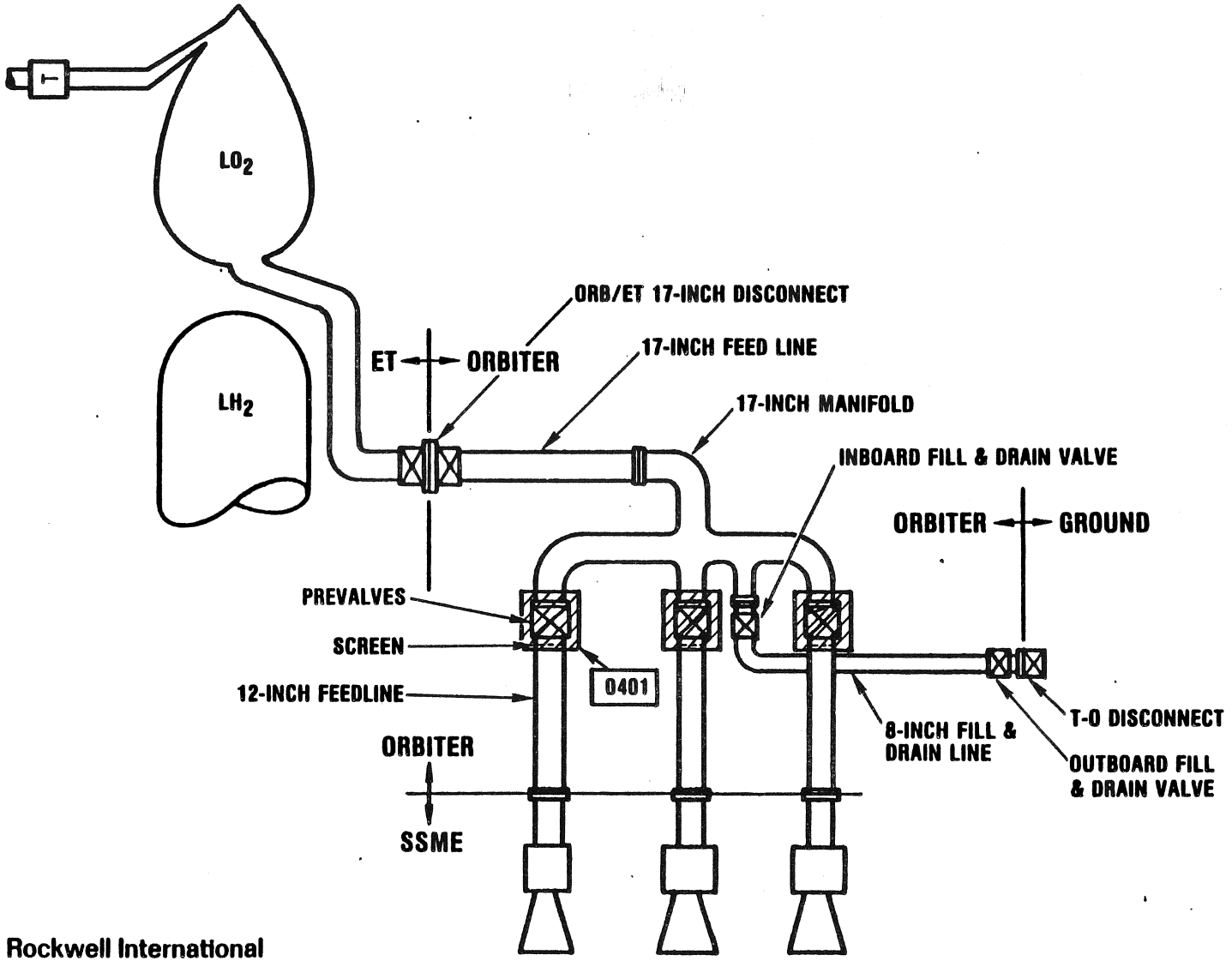


*BLD VLV HAS 4 SCFM ORIFICE

COMPONENT: PREVALVE, SHUTOFF, PROPELLANT

(MC284-0396)

LO_2 FILL AND DRAIN AND PROPELLANT FEED SYSTEM



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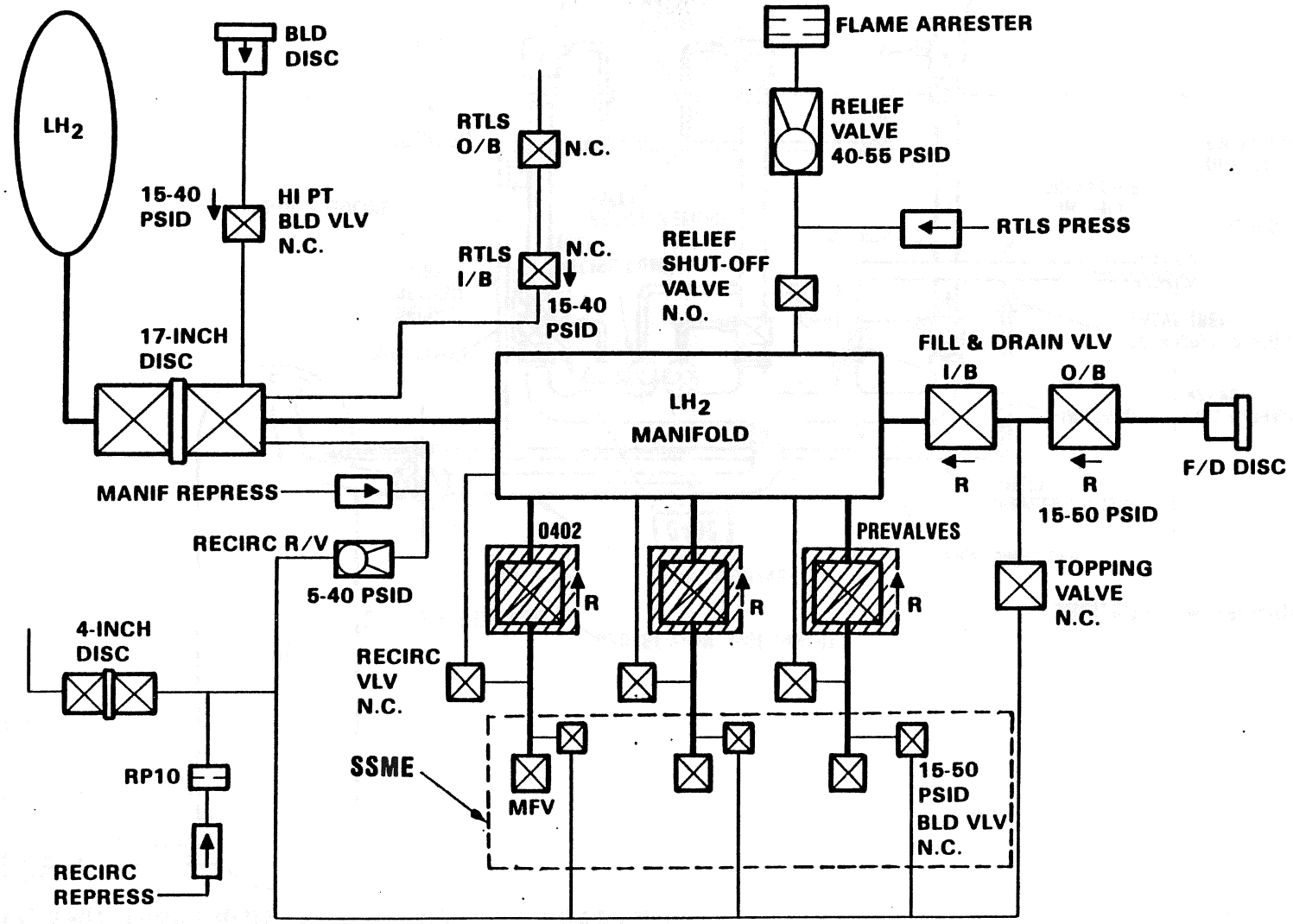
COMPONENT: PREVALVE, SHUTOFF, PROPELLANT

(MC284-0396)

LH_2 SCHEMATIC



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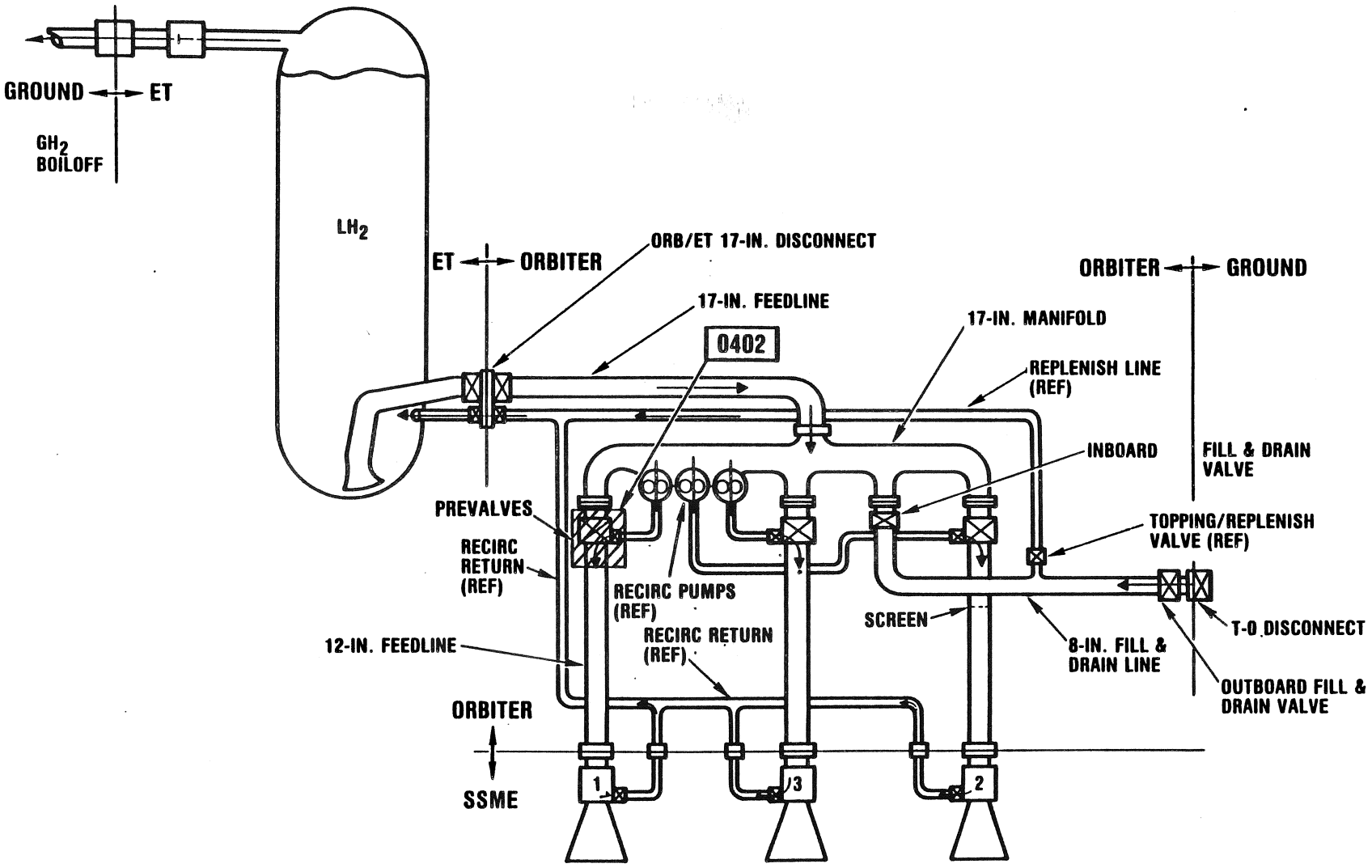
COMPONENT: PREVALVE, SHUTOFF, PROPELLANT

(MC284-0396)

LH_2 FILL AND DRAIN AND PROPELLANT FEED SYSTEM



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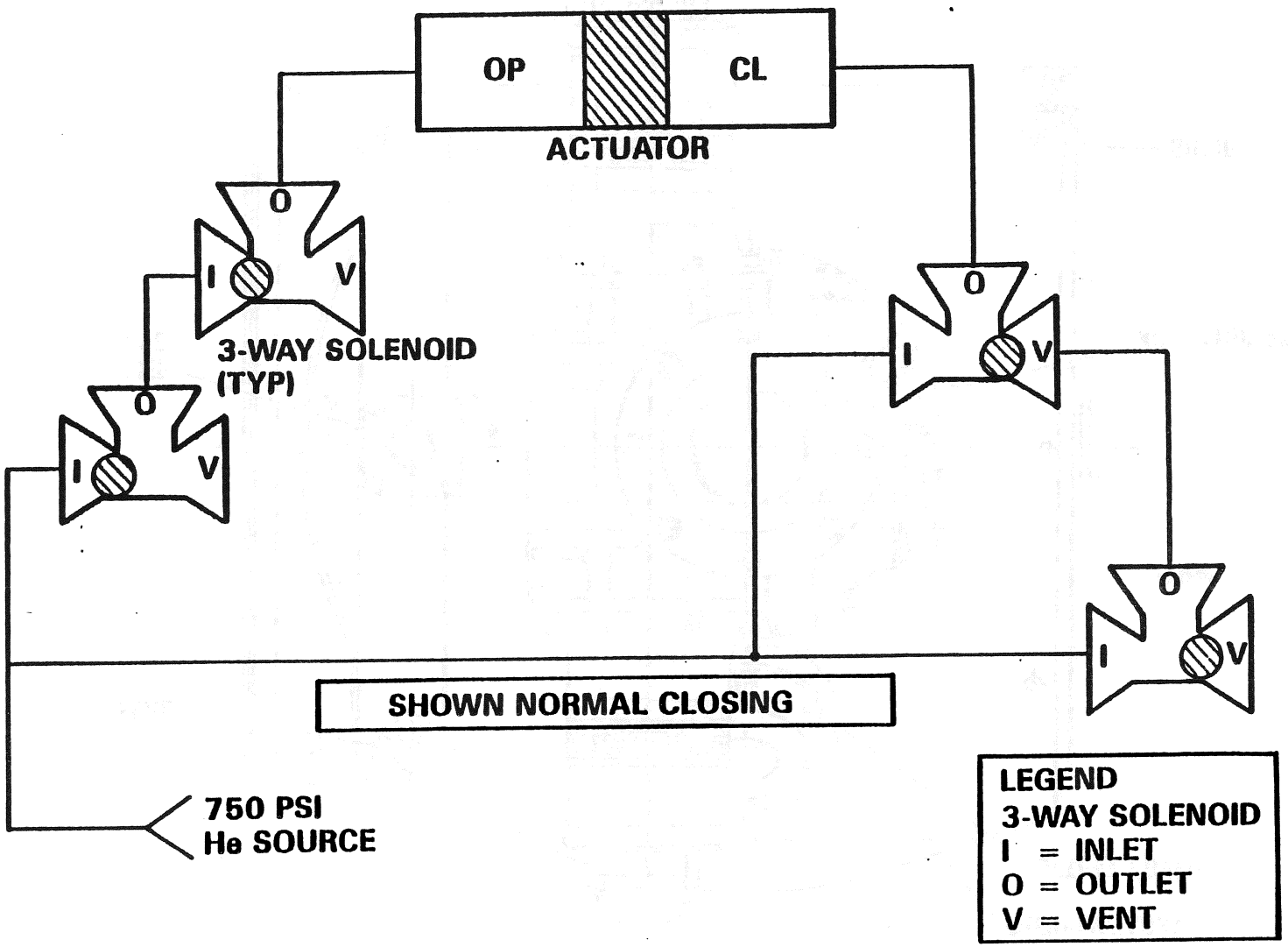
COMPONENT: PREVALVE, SHUTOFF, PROPELLANT

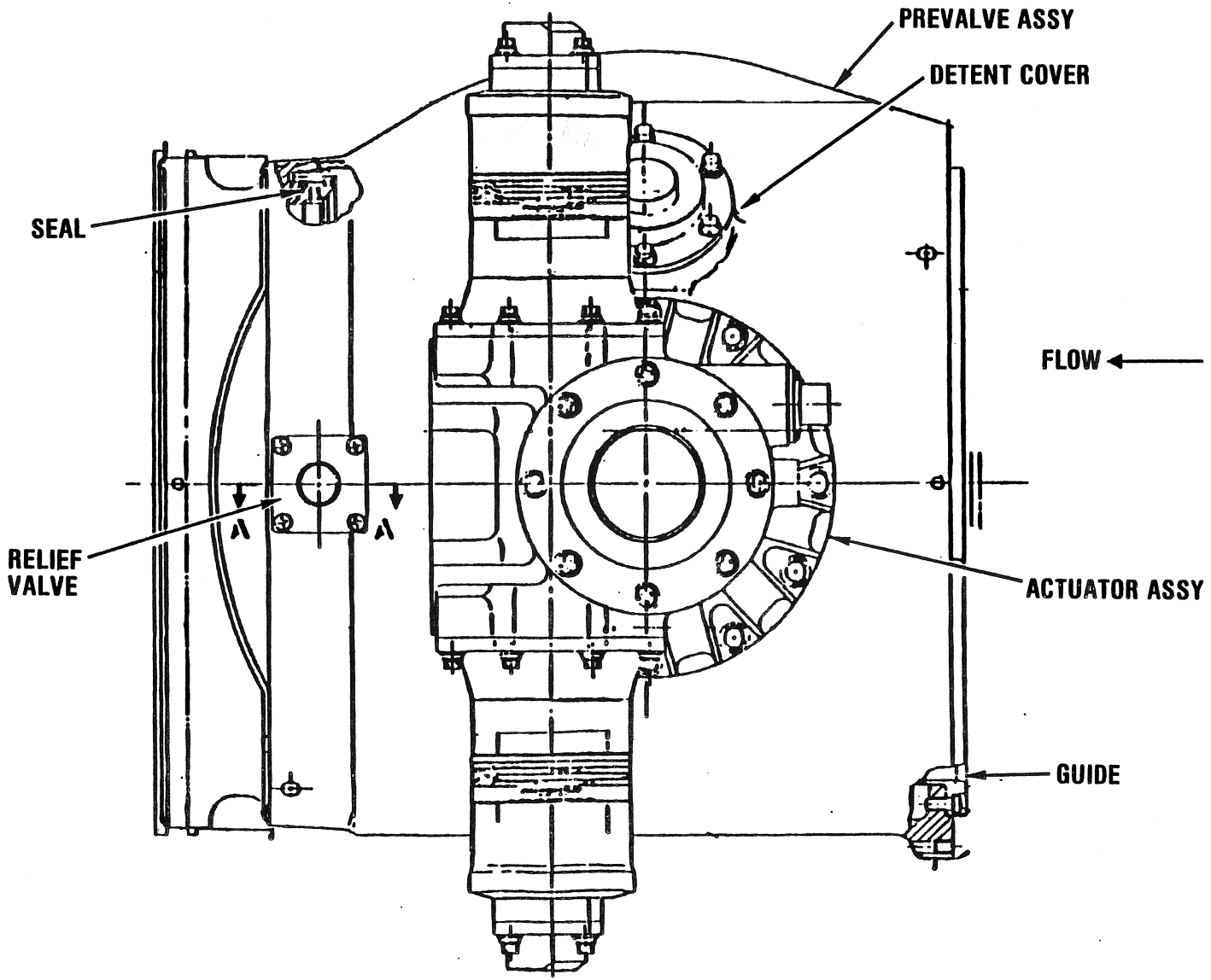
(MC284-0396)

LO_2 PREVALVE ACTUATOR/SOLENOID SCHEMATIC



COMPONENT: PREVALVE, SHUTOFF, PROPELLANT

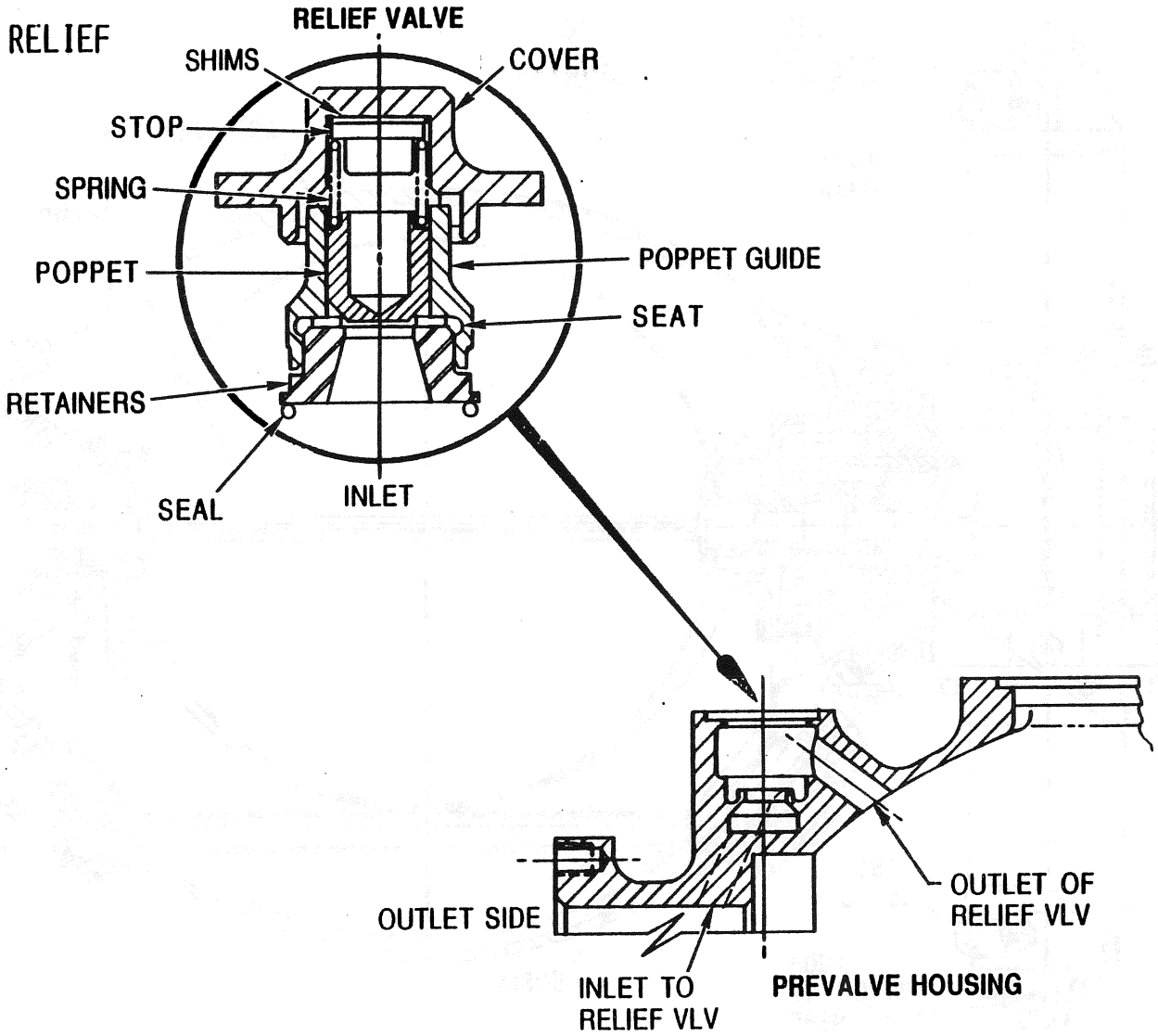
(MC284-0396)



COMPONENT: PREVALVE, SHUTOFF, PROPELLANT

(MC284-0396)

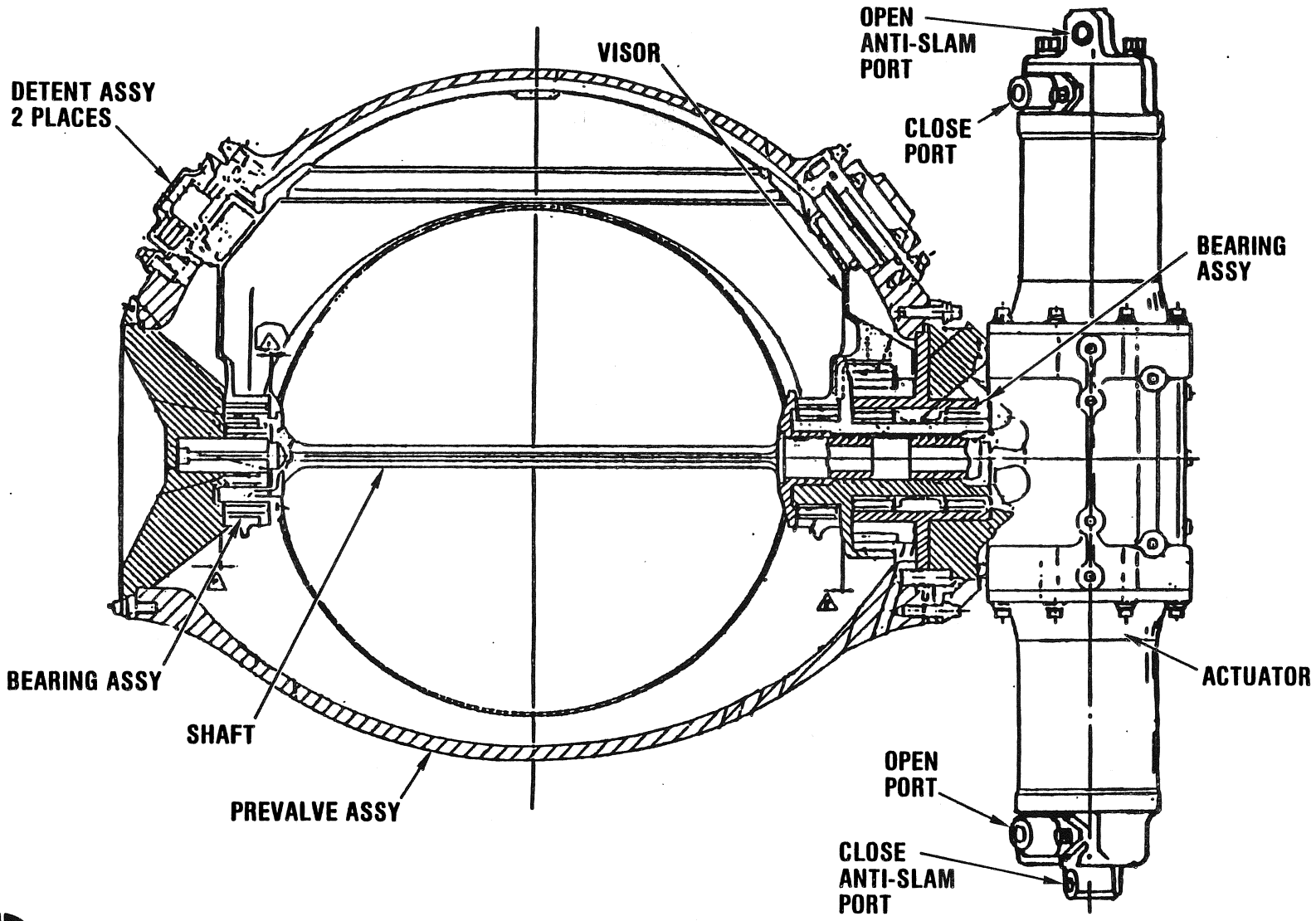
FEED LINE RELIEF MECHANISM



SECTION A–A

COMPONENT: PREVALVE, SHUTOFF, PROPELLANT

(MC284-0396)



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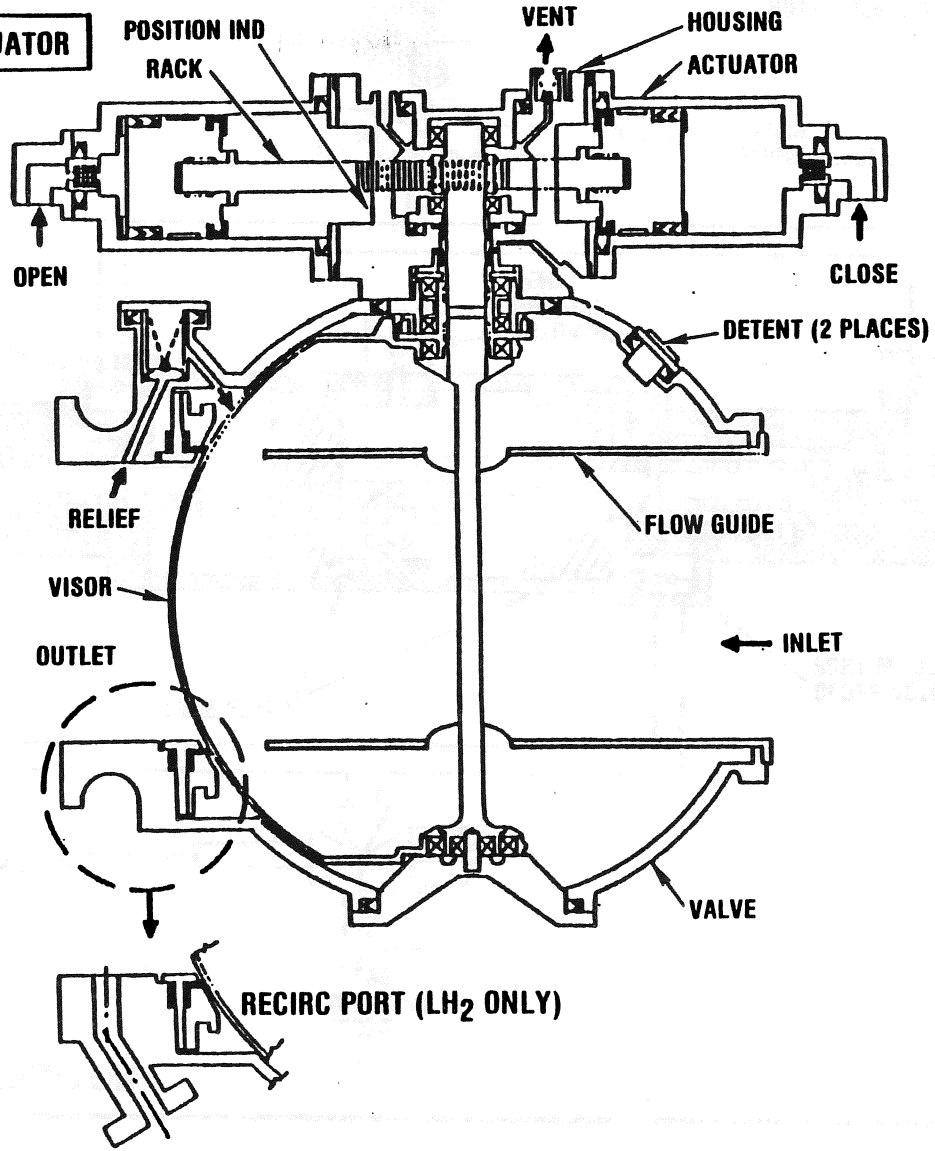
COMPONENT: PREVALVE, SHUTOFF, PROPELLANT

(MC284-0396)

SHOWN WITHOUT ANTISLAM ACTUATOR

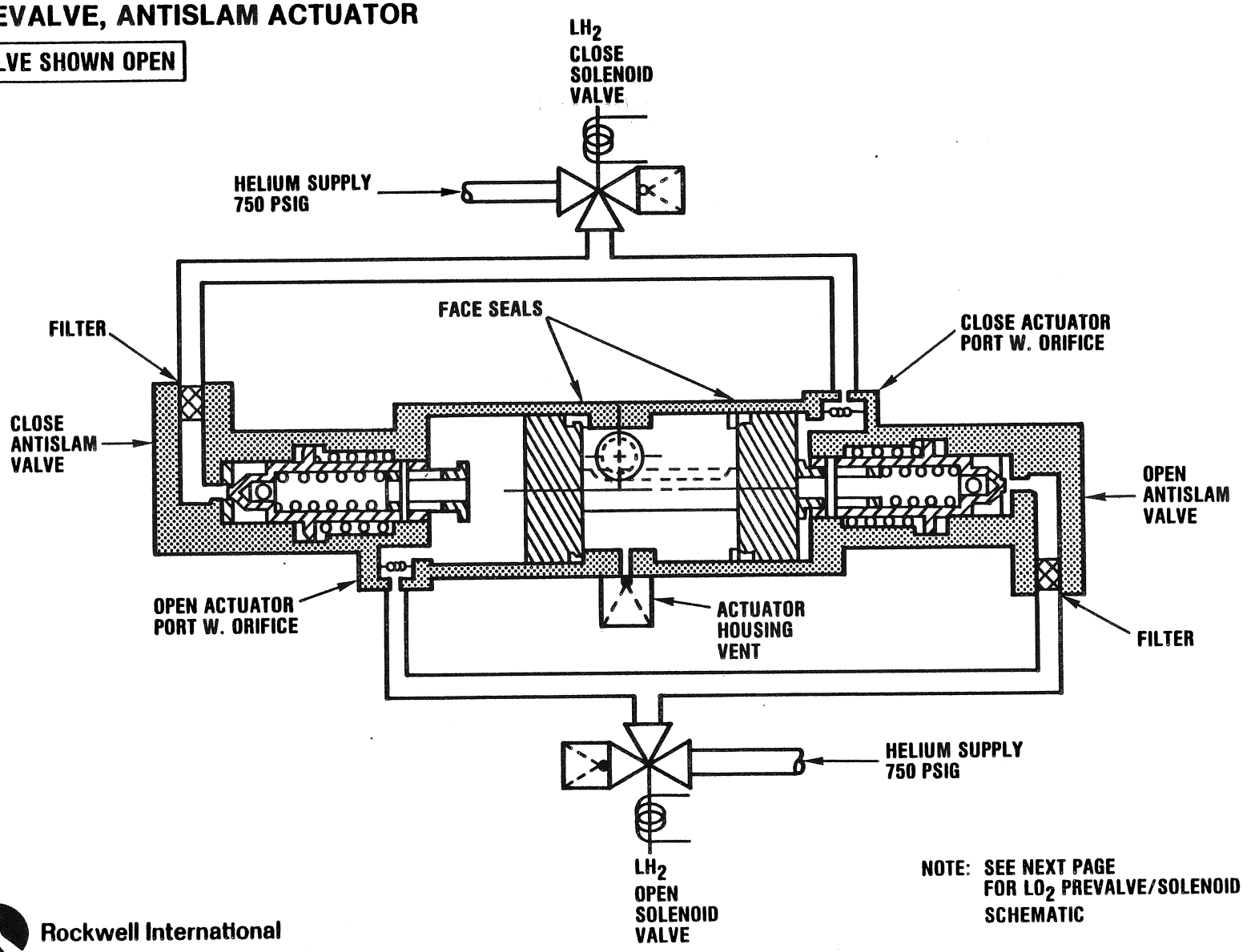


COMPONENT: PREVALVE, SHUTOFF, PROPELLANT

(MC284-0396)

PREVALVE, ANTISLAM ACTUATOR

VALVE SHOWN OPEN

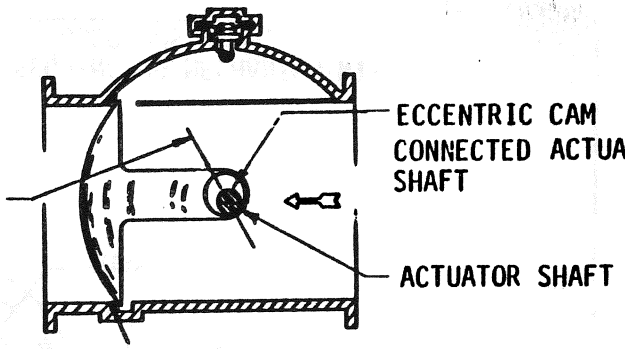


NOTE: SEE NEXT PAGE FOR LO_2 PREVALVE/SOLENOID SCHEMATIC

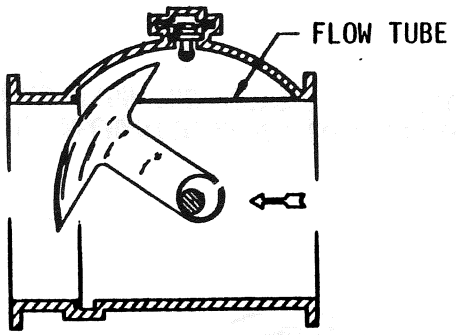
COMPONENT: PREVALVE, SHUTOFF, PROPELLANT

(MC284-0396)

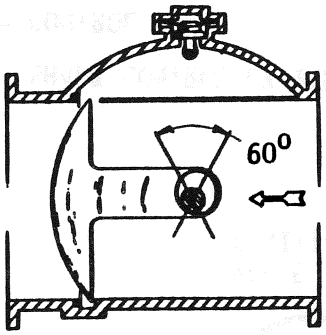
ROTATIONAL CONCEPT



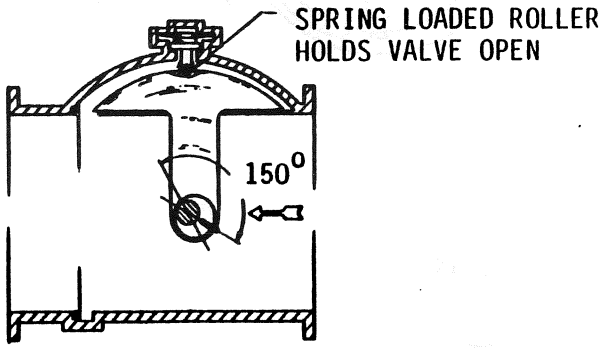
(1) FULLY CLOSED POSITION



(3) VISOR FULLY RETRACTED AND PARTIALLY ROTATED



(2) VISOR RETRACTED. ACTUATOR OUTPUT SHAFT HAS ROTATED 60°. ECCENTRIC RETRACTS BLADE .12 INCH

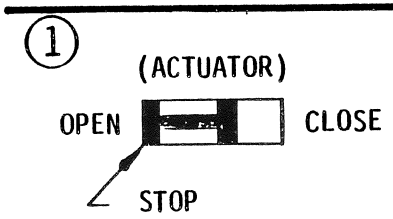


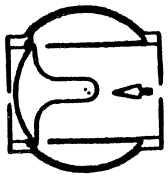
(4) FULLY OPEN POSITION. TOTAL SHAFT ROTATION IS 150°

COMPONENT: PREVALVE, SHUTOFF, PROPELLANT

(MC284-0396)

VISOR CONTROL CONCEPT





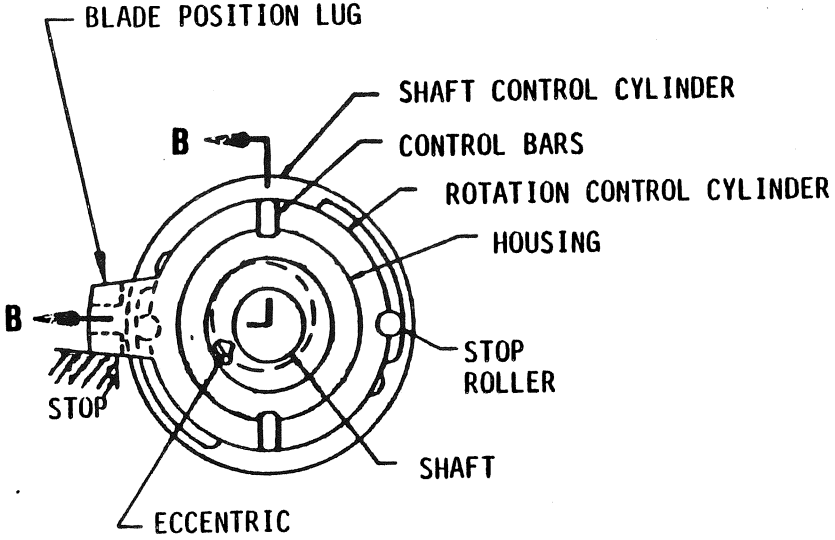
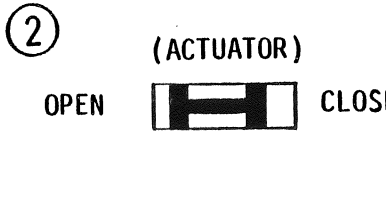
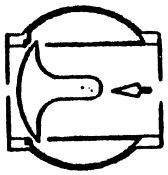
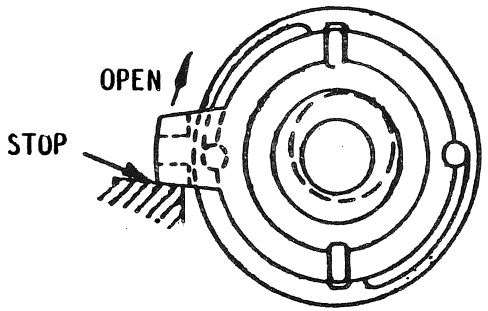


ILLUSTRATION OF SEQUENCING MECHANISM WITH THE VISOR IN THE CLOSED POSITION.







SEQUENCING MECHANISM AFTER COMPLETION OF VOSOR RETRACTION AND PRIOR TO ROTATION.

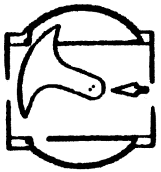
COMPONENT: PREVALVE, SHUTOFF, PROPELLANT

(MC284-0396)

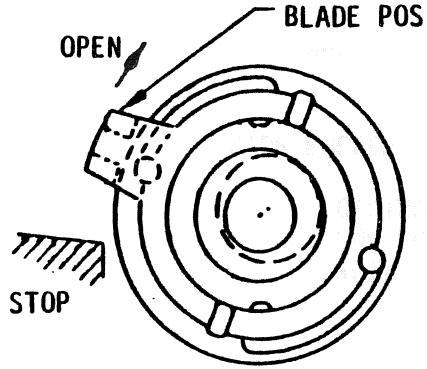
VISOR CONTROL CONCEPT

③ (ACTUATOR)

OPEN CLOSE



VALVE POSITION

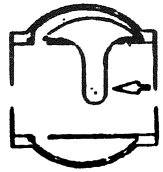


POSITION OF THE MECHANISM WITH THE VISOR PARTIALLY ROTATED.

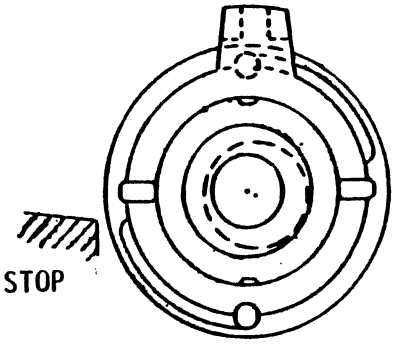
④ (ACTUATOR)

OPEN CLOSE

STOP



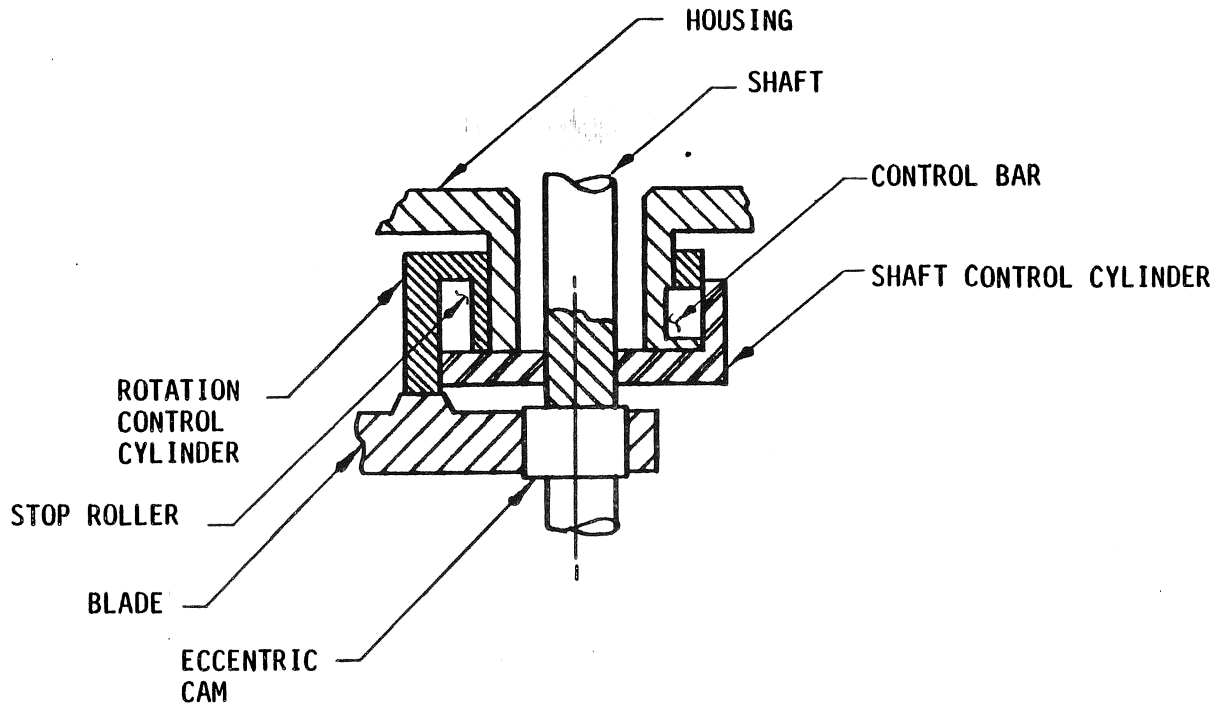
VALVE POSITION



POSITION OF THE MECHANISM WITH THE VISOR IN THE FULL OPEN POSITION.

COMPONENT: PREVALVE, SHUTOFF, PROPELLANT

(MC284-0396)



SECTION B-B

COMPONENT: VALVE, FILL AND DRAIN, PROPELLANT

(MC284-0397)

FMEA/CIL NO: 03-1-0301
03-1-0302
03-1-0310
03-1-0311

VENDOR : FAIRCHILD CONTROL SYS.
P/N RI : MC284-0397-0021, -0019, -0020
P/N VENDOR:
QUANTITY : 1 LH_2 (-0021) INBOARD (PV12)
: 1 LH_2 (-0021) OUTBOARD (PV11)
: 1 LO_2 (-0020) INBOARD VLV (PV10)
: 1 LO_2 (-0019) OUTBOARD VLV (PV9)

VEHICLE EFFECTIVITY:

102	103	104	105
X	X	X	X

ITEM:

VALVE, FILL. INBOARD AND OUTBOARD, LO_2 AND LH_2, 8-INCH, PNEUMATICALLY OPERATED, INCLUDES A RELIEF VALVE. (PV9 TO PV12)

FUNCTION:

PROVIDES A MEANS OF LOADING AND DRAINING THE ET THROUGH THE PROPELLANT FEED SYSTEM. THE INBOARD VALVE, ALONG WITH THE OUTBOARD FILL AND DRAIN VALVE, PROVIDES A REDUNDANT MEANS OF CONTAINING PROPELLANT IN THE FEED SYSTEM. THE INBOARD VALVES ARE MOUNTED ON THE FEED LINE MANIFOLDS TO ISOLATE THE FILL LINE FROM THE FEED SYSTEM. THE OUTBOARD VALVES ARE MOUNTED ON THE 8-INCH QUICK DISCONNECT AIRBORNE HALF. THE LH_2 INBOARD VALVE IS REQUIRED TO BE CLOSED FOR PROPELLANT TOPPING/REPLENISHMENT OPERATIONS. BOTH THE INBOARD AND OUTBOARD VALVES REMAIN CLOSED DURING ENGINE OPERATION. FOLLOWING NOMINAL OR RTLS/TAL ABORT MECO, THE LH_2 INBOARD AND OUTBOARD FILL VALVES ARE SOFTWARE COMMANDED OPEN FOR DUMP OF RESIDUAL LH_2. BOTH LO_2 AND LH_2 OUTBOARD AND INBOARD VALVES ARE OPENED FOR THE MPS SYSTEM VACUUM INERTING. THE INBOARD VALVES REMAIN OPEN

AFTER VACUUM INERTING THROUGH REENTRY AND LANDING. THE VALVES INCORPORATE ANTI-SLAM MECHANISMS TO PREVENT VALVE SLAMMING DAMAGE DURING IMPROPER VALVE OPEN/CLOSE OPERATIONS. THE VALVE ALSO INCORPORATES A RELIEF VALVE, RELIEVING FROM THE FILL LINE INTO THE MANIFOLD; AND A PORT FOR INSTALLATION OF LH_2 RELIEF SHUTOFF ISOLATION VALVE (PV8) ON THE INBOARD LH_2 FILL AND DRAIN UNIT (PV12).

THE VALVE IS A BI-STABLE UNIT (REMAINS IN THE LAST COMMANDED POSITION--OPEN OR CLOSED). IT IS ACTUATED TO THE OPEN OR CLOSED POSITION BY A PNEUMATIC ACTUATOR. ELECTRICAL SWITCHES PROVIDE OPEN AND CLOSED POSITION INDICATION. THE VALVES ARE CLASSIFIED INTO THREE TYPES: IA OXYGEN, IB OXYGEN, II HYDROGEN (TYPE IA AND IB ARE IDENTICAL EXCEPT THE ACTUATOR ON IB IS ROTATED 90° CLOCKWISE).

DESIGN:

THE ASSEMBLY IS A TWO POSITION (OPEN AND CLOSE), PNEUMATICALLY ACTUATED, BUTTERFLY VALVE WITH AN 8-INCH INSIDE DIAMETER. IT IS A BI-STABLE ASSEMBLY WHICH REMAINS IN THE LAST COMMANDED POSITION. THE VALVE HAS AN ALUMINUM HOUSING (2219-T852) WITH A POWER TRAIN OF INCONEL 718 AND BERRYLLIUM-COPPER RIDING ON ROLLER BEARINGS. THE MAIN BLADE SEAL IS MADE FROM KEL-F81-6061. THIS SEAL IN COMBINATION WITH THE INCONEL 718 BLADE IS USED TO SEAL THE VALVE CLOSED.

THE VALVE BI-STABLE MECHANISM IS IMPLEMENTED BY THE ACTUATOR BERYLLIUM-COPPER SHAFT WITH A CAM WITH DETENT POSITIONS (OPEN AND CLOSED). THE CAM IS FOLLOWED BY A BELLVILLE--SPRING LOADED DETENT ROLLER. THE SEVEN STACKED BELLVILLES ARE SHIMMED, UPON INSTALLATION, TO PRODUCE A FORCE OF 140 LB BY THE ROLLER UPON THE CAM, WHEN IN EITHER THE OPEN OR CLOSED POSITION. TO LEAVE EITHER POSITION THE ROLLER MUST PASS OVER A 0.105 INCH HIGH SHOULDER ON THE CAM. LOADED TANK PRESSURE TENDS TO FORCE THE GATE INTO GATE SEAL CONTRIBUTING TO AN EFFECTIVE SEAL AND TO HOLDING THE GATE CLOSED.

THE ACTUATOR DRIVES THE VALVE VIA A LINEAR RACK AND PINION GEAR/SHAFT (BOTH OF COPPER-BERRYLLIUM), AND THE RACK IS POWERED BY A HELIUM-DRIVEN DOUBLE-ACTING PISTON. LEAKAGE ACROSS THE PISTON IS PRECLUDED BY FOUR SEALS (TWO AT EACH END OF THE PISTON) OF TEFLON JACKETED, METALLIC "V" TYPE (THE METALLIC "V" SPRING IS OF 301 CRES). THIS SAME TYPE OF SEAL IS USED TO PREVENT EXTERNAL LEAKAGE AT ALL ACTUATOR JOINTS.

COMPONENT: VALVE, FILL AND DRAIN, PROPELLANT

(MC284-0397)

THE ACTUATOR SHAFT MATES TO THE VALVE BLADE CONTROL MECHANISM WHICH DRIVES THE BLADE TO THE OPEN OR CLOSED POSITION. THE BLADE MOTION CONTROL CONCEPT IS SHOWN ON PAGE 13. MOVING THE BLADE FROM THE CLOSED TO OPEN POSITION IS ACCOMPLISHED BY RETRACTING THE BLADE FROM THE SEAL AND THEN ROTATING IT TO THE OPEN POSITION. THIS MOTION ROTATES THE ACTUATOR SHAFT CAM WHICH RELEASES THE HOLD CLOSED DETENT AND ENGAGES THE HOLD OPEN DETENT MECHANISM (SEE PAGE 12). CLOSING THE VALVE IS THE REVERSE MOTION.

DURING NORMAL OPENING OPERATIONS GAS PRESSURE IS INITIALLY ALLOWED TO ENTER THE CLOSED ACTUATOR PORT TO PROVIDE A GAS CUSHION WHICH PREVENTS SLAMMING THE VALVE OPEN WHEN THE GAS PRESSURE IS APPLIED TO THE OPEN ACTUATOR PORT. CLOSING GAS PRESSURE IS THEN ALLOWED TO BLEED FROM THE ACTUATOR AND THE VALVE IS THEN OPENED WITHOUT SLAMMING. THE SAME TECHNIQUE IS UTILIZED TO CLOSE THE VALVES BY APPLYING PRESSURES TO THE CLOSED AND OPEN PORTS IN A REVERSE MANNER TO PREVENT VALVE SLAMMING.

IF THE ACTUATOR IS OPENED OR CLOSED WITHOUT AN INITIAL GAS CUSHION ON THE OPPOSING SIDE OF THE ACTUATOR, ANTI-SLAM VALVES (OPEN AND CLOSE) WILL BLEED PRESSURE INTO THE OPPOSITE SIDE OF THE PISTON BEING PRESSURIZED. THIS ACTION PROVIDES A SMALL GAS CUSHION TO PREVENT THE FILL AND DRAIN VALVES SLAMMING OPEN OR CLOSED WHICH COULD DAMAGE THE UNIT.

THE ANTI-SLAM VALVES USE A286 CRES POPPETS SPRING LOADED TO KEL-F SEATS. WITH THE ANTI-SLAM PORT VENTED, ACTUATION PRESSURE ASSISTS THE SPRING IN SEALING THE POPPET TO THE SEAT. BINDING IS CONSIDERED UNLIKELY BECAUSE ALL SLIDING SURFACES ARE COATED WITH A DRY FILM LUBRICANT WHICH HAS HAD EXTENSIVE UTILIZATION WITHOUT PROBLEMS.

THE VALVE IS DESIGNED FOR 5,000 LIFE CYCLES AND WAS TESTED THROUGH 5,256 CYCLES (OVER 100 MISSIONS) AT BOTH CRYOGENIC AND AMBIENT TEMPERATURE CONDITIONS AND AT BOTH NORMAL AND ACCELERATED (SLAM) CYCLE TIMES. THE VALVE, DURING THIS LIFE CYCLE TESTING, NEVER FAILED TO CLOSE. FILTERS ARE PROVIDED ON ALL PNEUMATIC PORTS TO PREVENT CONTAMINATION.

COMPONENT: VALVE, FILL AND DRAIN, PROPELLANT

(MC284-0397)

DESIGN PARAMETERS AND FEATURES:

PRESSURE OPERATING	0 TO 275 PSIA (OXYGEN) 0 TO 110 PSIG (HYDROGEN)
BODY TEMPERATURE OPERATING	150°F TO -320°F (OXYGEN) 150°F TO -423°F (HYDROGEN)
TEMPERATURE NON-OPERATING	200°F MAXIMUM
FLOW (OXYGEN)	5,000 GAL/MINIMUM AT 130 ± 5 PSIA, ΔP 5 PSI (FILL) ΔP 3.3 PSI (DRAIN)
FLOW (HYDROGEN)	12,000 GAL/MINIMUM AT 35 ± 5 PSIA, ΔP 1.8 PSI (FILL) ΔP 1.2 PSI (DRAIN)
FLOW (RELIEF)	0.3 LB/SEC LO_2 AND GO_2 AT 50 PSID MAXIMUM 0.1 LB/SEC LH_2 AND GH_2 AT 50 PSID MAXIMUM
CRACK AND RESEAT (RELIEF)	15-50 PSID
ACTUATION PRESSURE	740 ± 40 PSIG NOMINAL, 850 PSIG MAXIMUM, 400 PSIG MINIMUM
ACTUATION TEMPERATURE	-160 TO +130°F (FLUID) -423 TO +150°F (BODY) 200°F MAXIMUM NON-OPERATING
RESPONSE TIME OPENING AND CLOSING	7 ± 2 SECONDS
WEIGHT	LO_2, 49.0 LB; LH_2, 42.5 LB

COMPONENT: VALVE, FILL AND DRAIN, PROPELLANT

(MC284-0397)

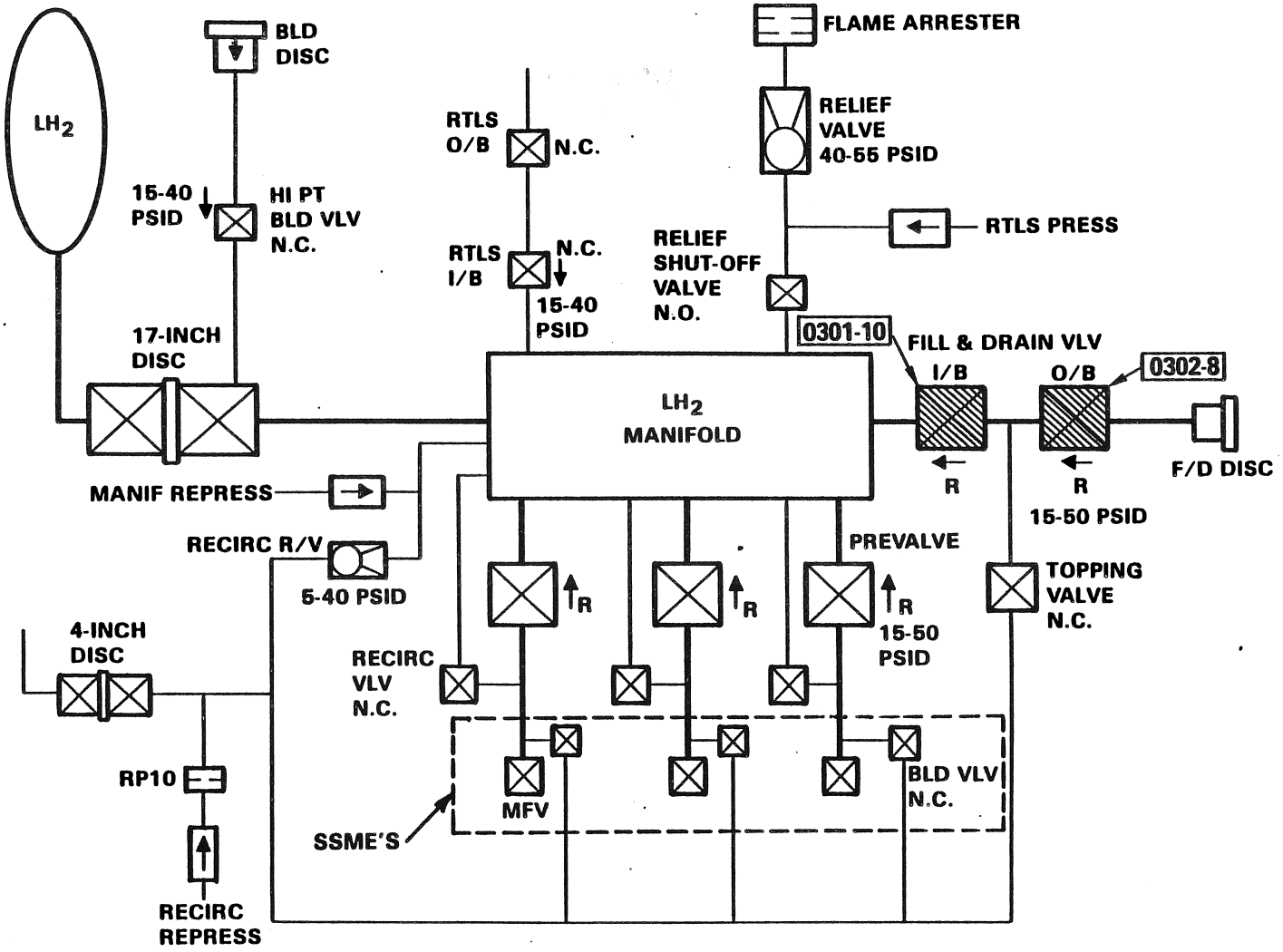
LEAKAGE:(VLV CLOSED)

INTERNAL:(INLET TO OUTLET)	500 SCIM MAXIMUM AT 15 PSIG (GAS AND LIQUID O_2 AND H_2)
(OUTLET TO INLET)	100 SCIM MAXIMUM AT 110 PSIG (GAS AND LIQUID H_2)
EXTERNAL:	5 SCIM MAXIMUM AT MAXIMUM OPERATION PRESSURES
ACTUATOR (TOTAL INTERNAL AND EXTERNAL)	270 SCIM MAXIMUM AT 740 PSIG

COMPONENT: VALVE, FILL AND DRAIN, PROPELLANT

(MC284-0397)

SCHEMATIC – LH_2 FILL/FEED SYSTEM



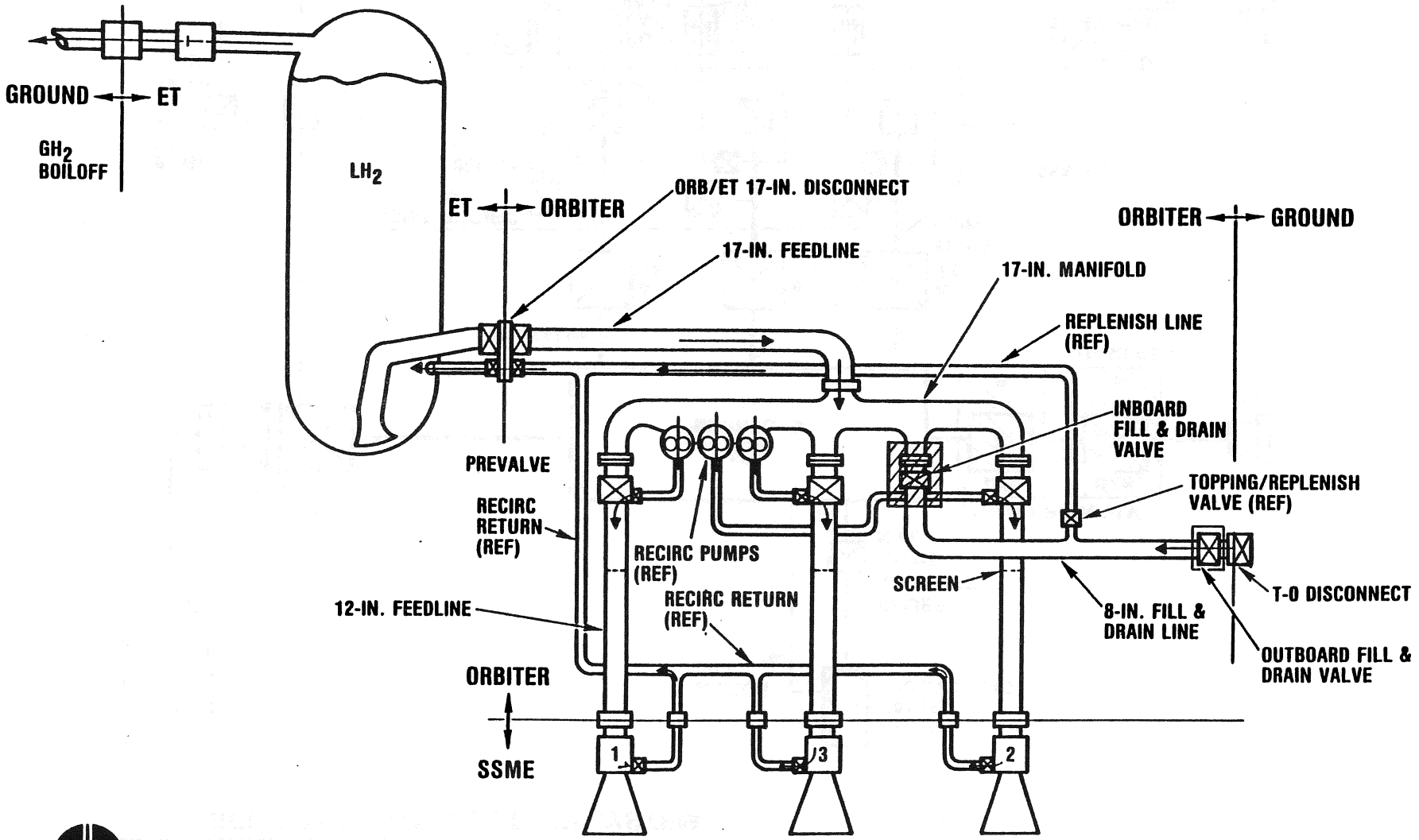
Rockwell International

Space Transportation Systems Division

COMPONENT: VALVE, FILL AND DRAIN, PROPELLANT

(MC284-0397)

LH_2 FILL/FEED SYSTEM



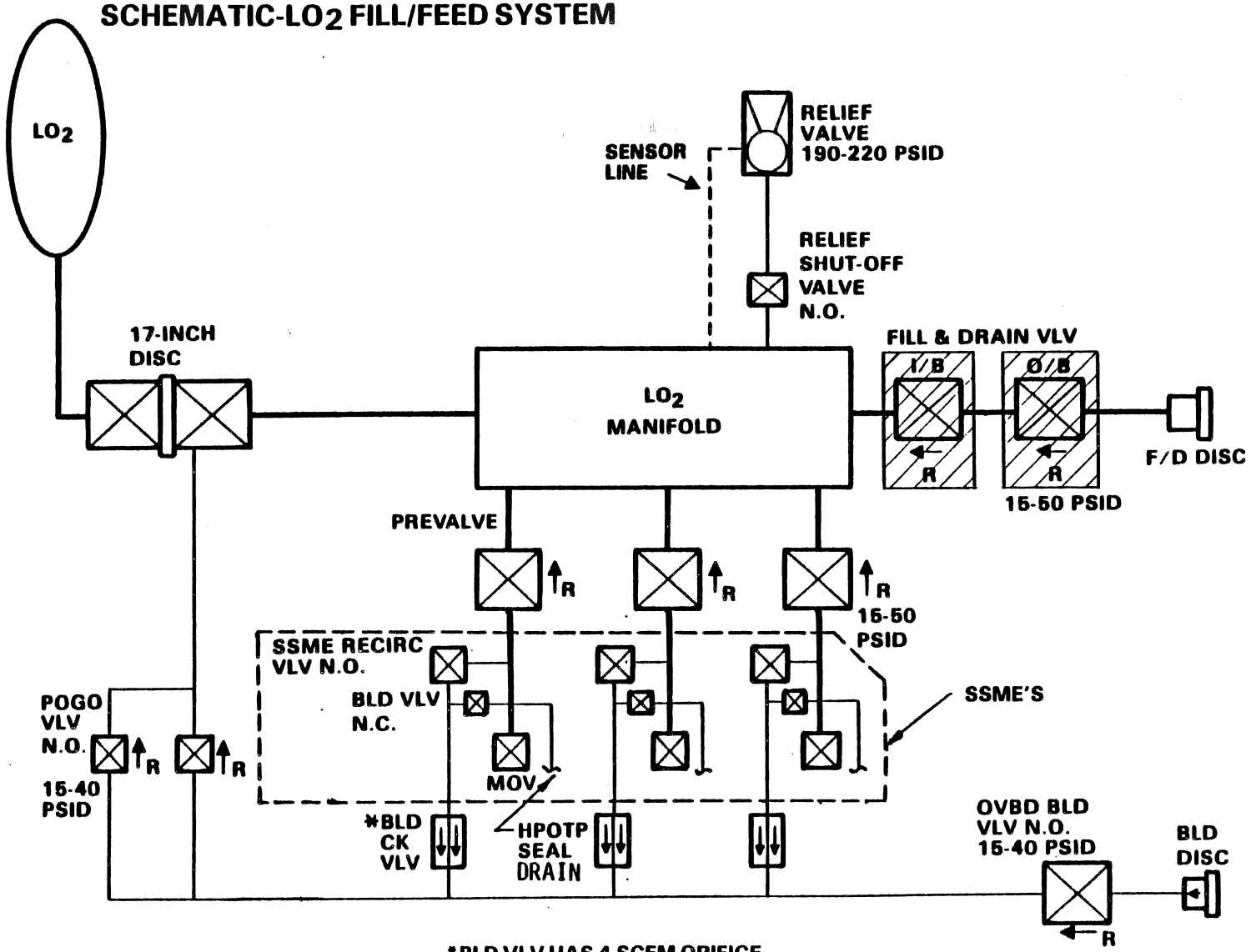
Rockwell International

Space Transportation Systems Division

COMPONENT: VALVE, FILL AND DRAIN, PROPELLANT

(MC284-0397)

SCHEMATIC-LO_2 FILL/FEED SYSTEM



*BLD VLV HAS 4 SCFM ORIFICE

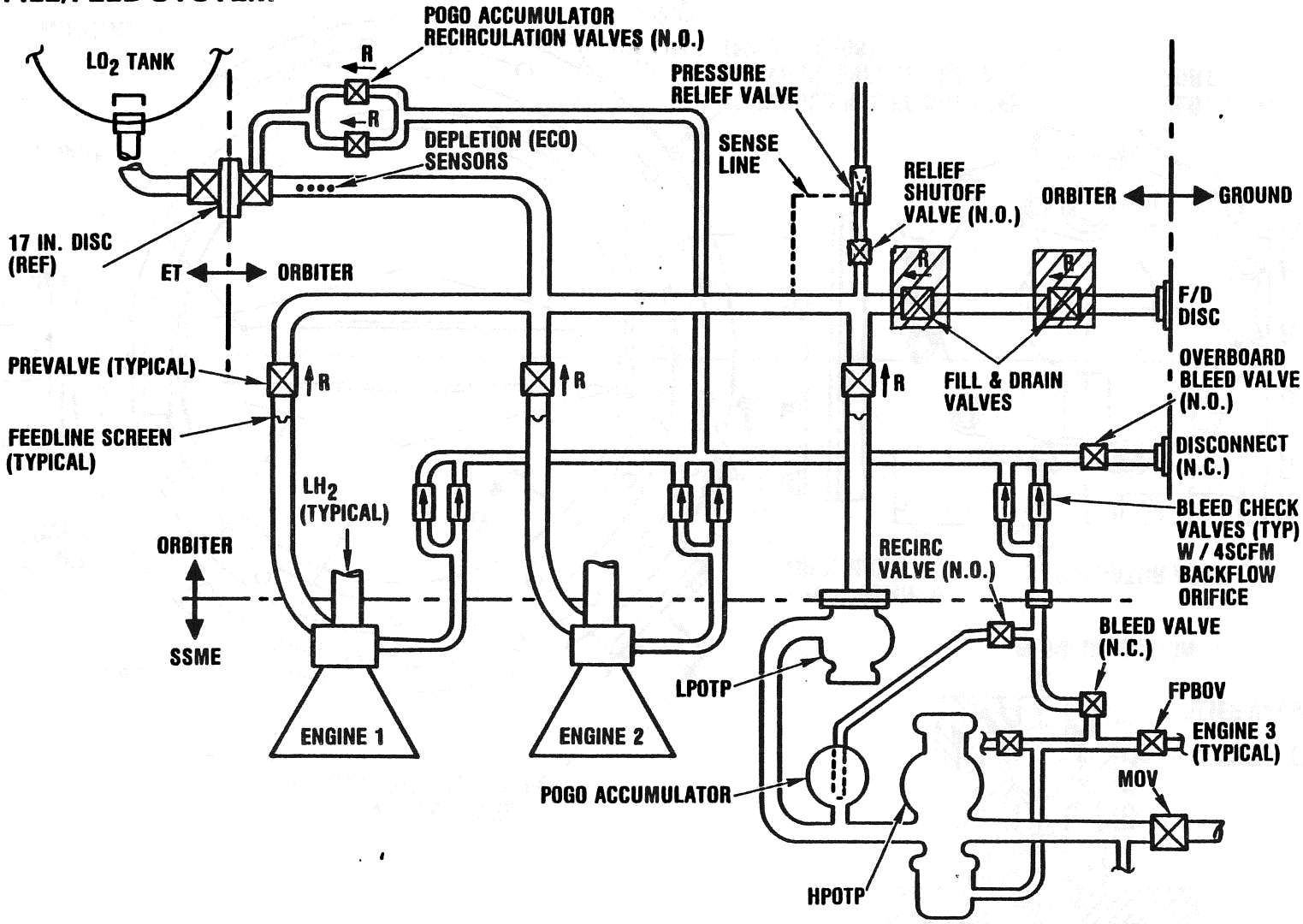
Rockwell International

Space Transportation Systems Division

COMPONENT: VALVE, FILL AND DRAIN, PROPELLANT

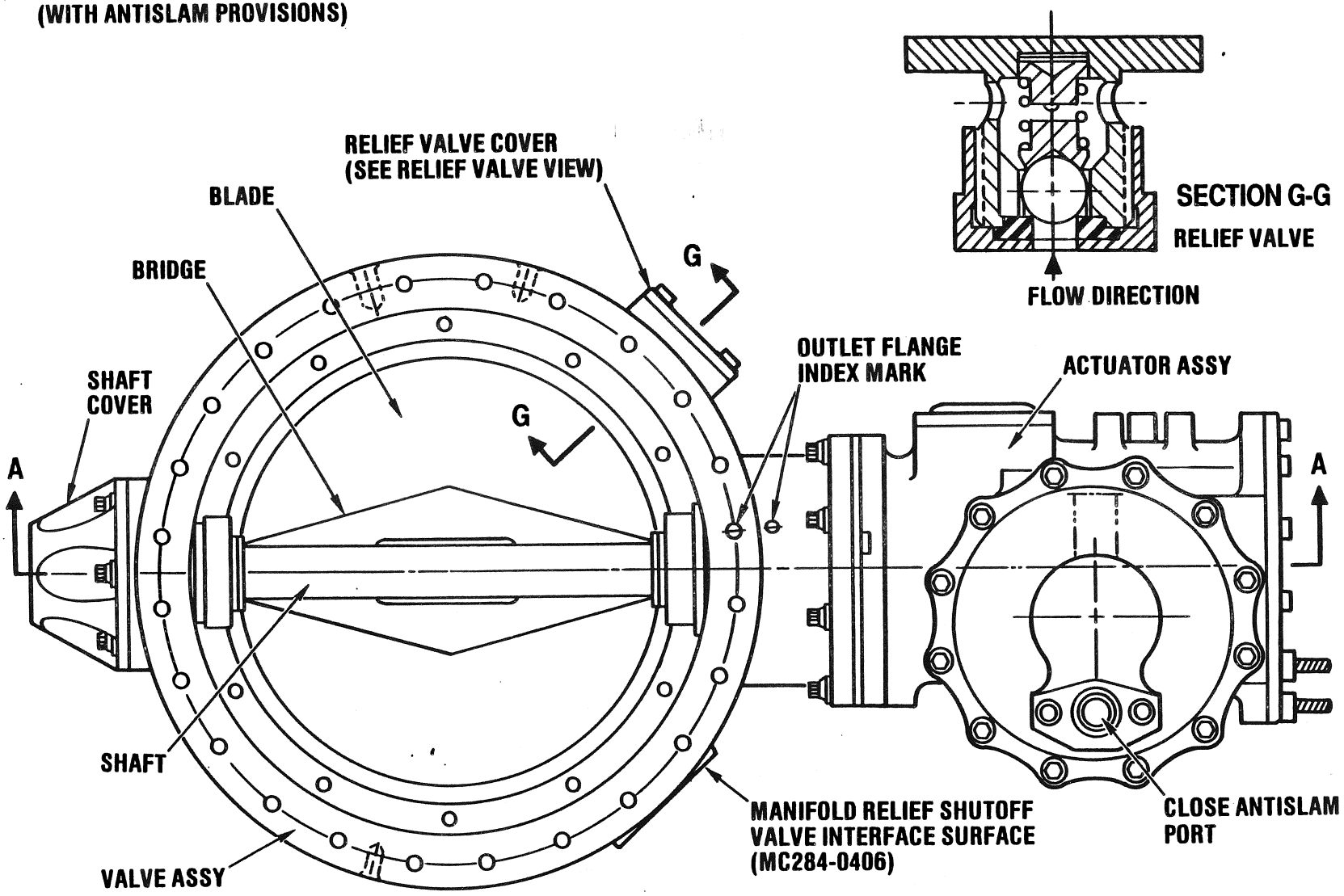
(MC284-0397)

LO_2 FILL/FEED SYSTEM



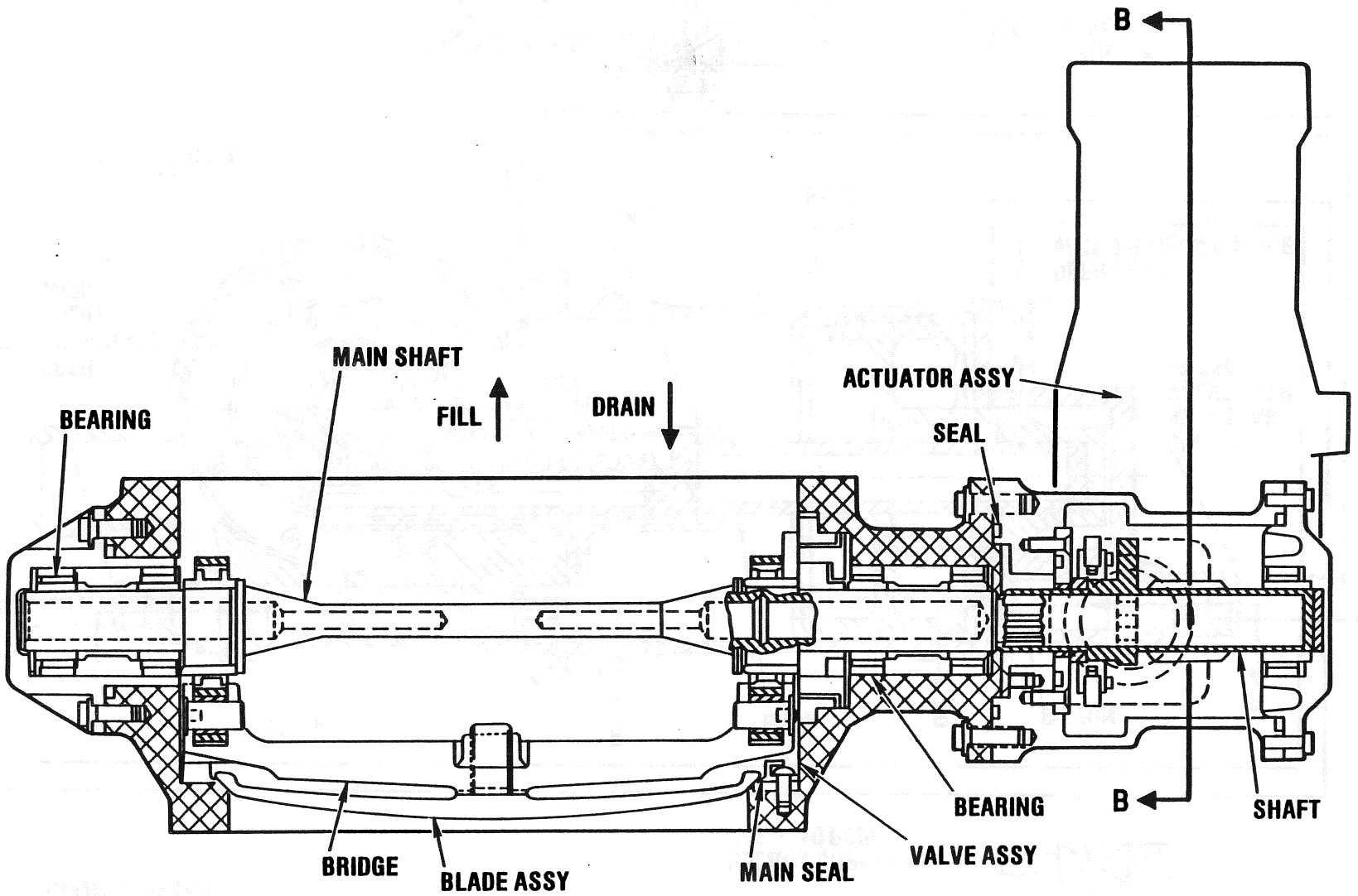
COMPONENT: VALVE, FILL AND DRAIN, PROPELLANT
(MC284-0397)

(WITH ANTISLAM PROVISIONS)



Rockwell International
Space Transportation
Systems Division

COMPONENT: VALVE, FILL AND DRAIN, PROPELLANT
(MC284-0397)

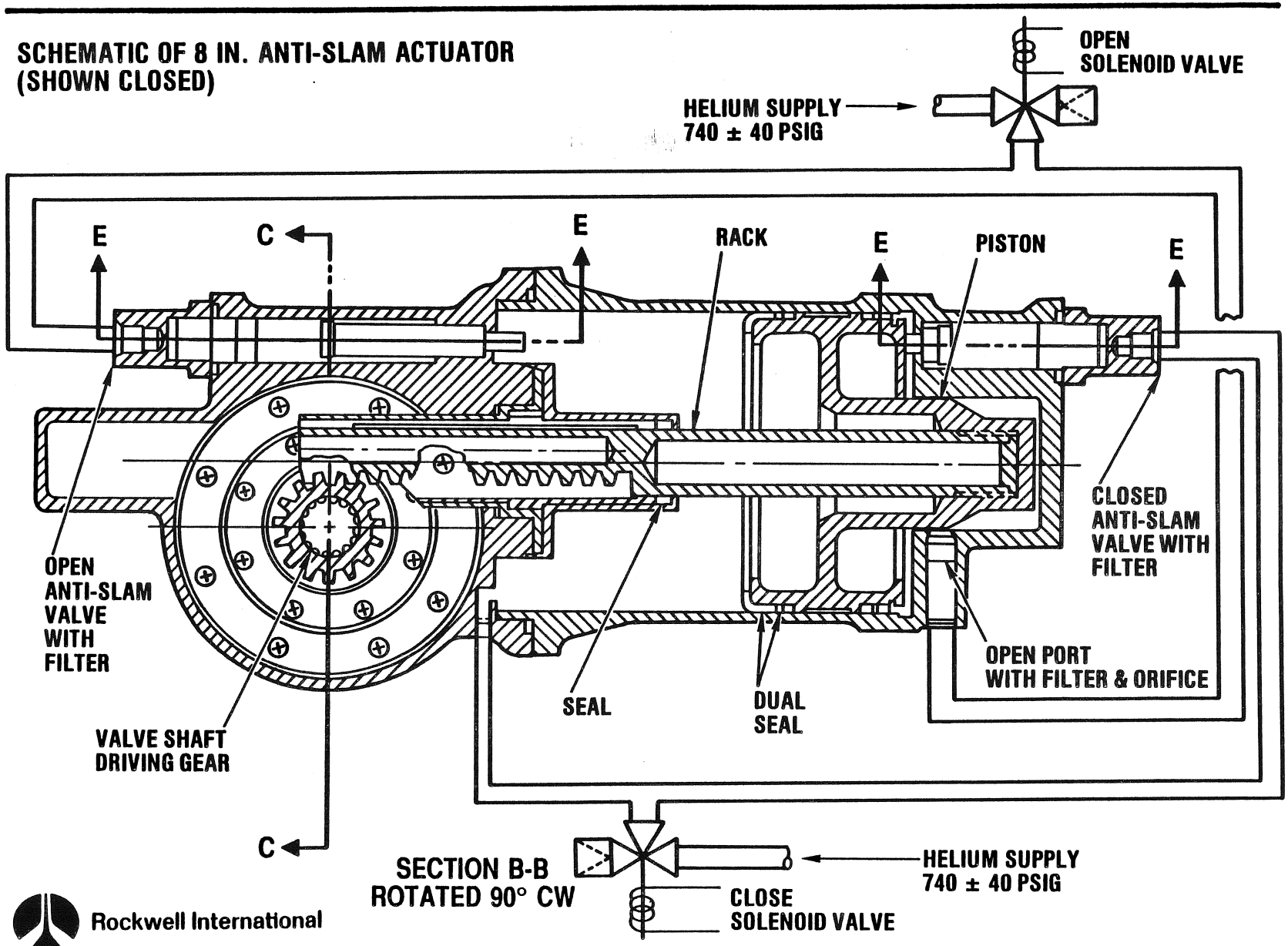


SECTION A-A

Rockwell International
Space Transportation
Systems Division

COMPONENT: VALVE, FILL AND DRAIN, PROPELLANT
(MC284-0397)

SCHEMATIC OF 8 IN. ANTI-SLAM ACTUATOR (SHOWN CLOSED)

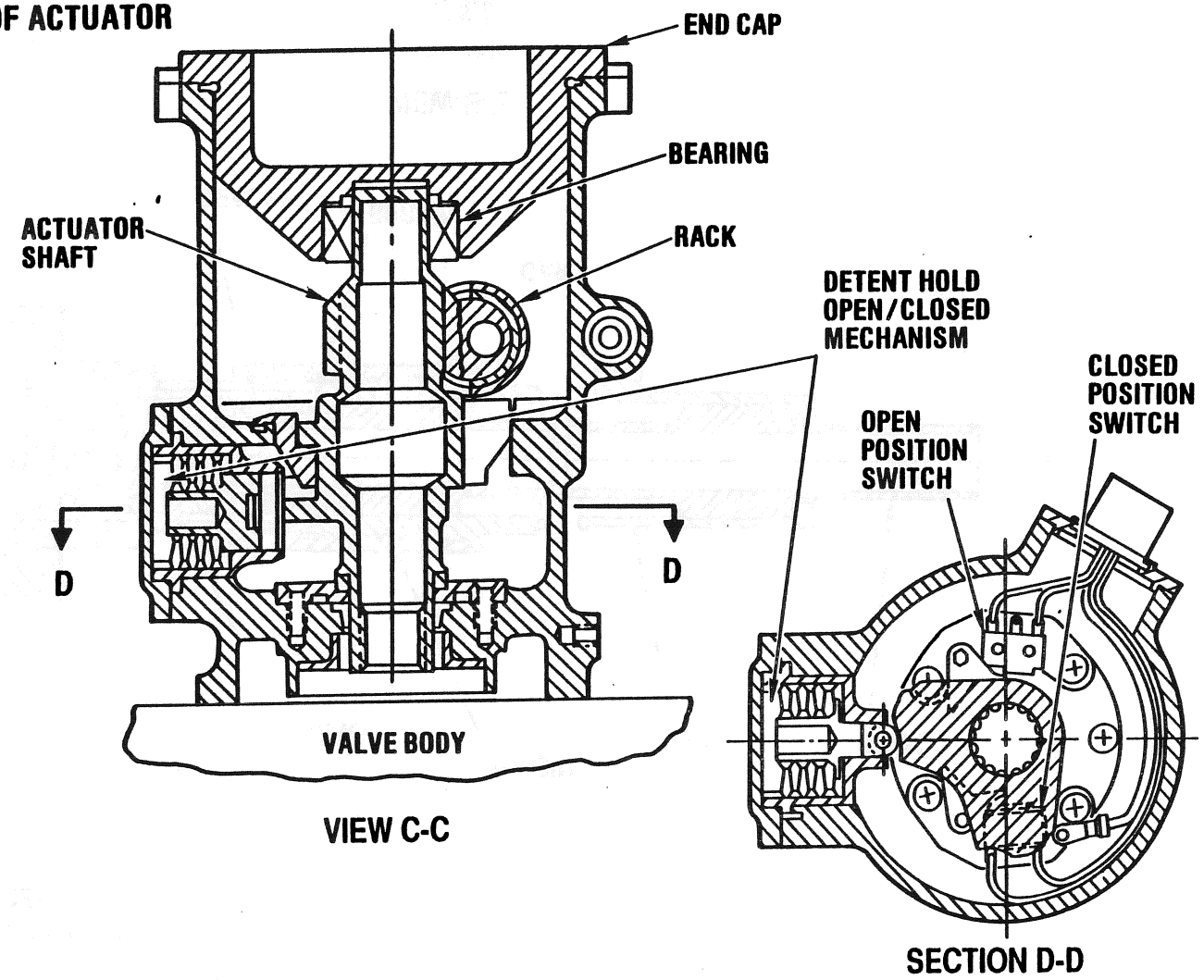


Rockwell International
Space Transportation Systems Division

COMPONENT: VALVE FILL AND DRAIN, PROPELLANT

(MC284-0397)

CROSS SECTION OF ACTUATOR



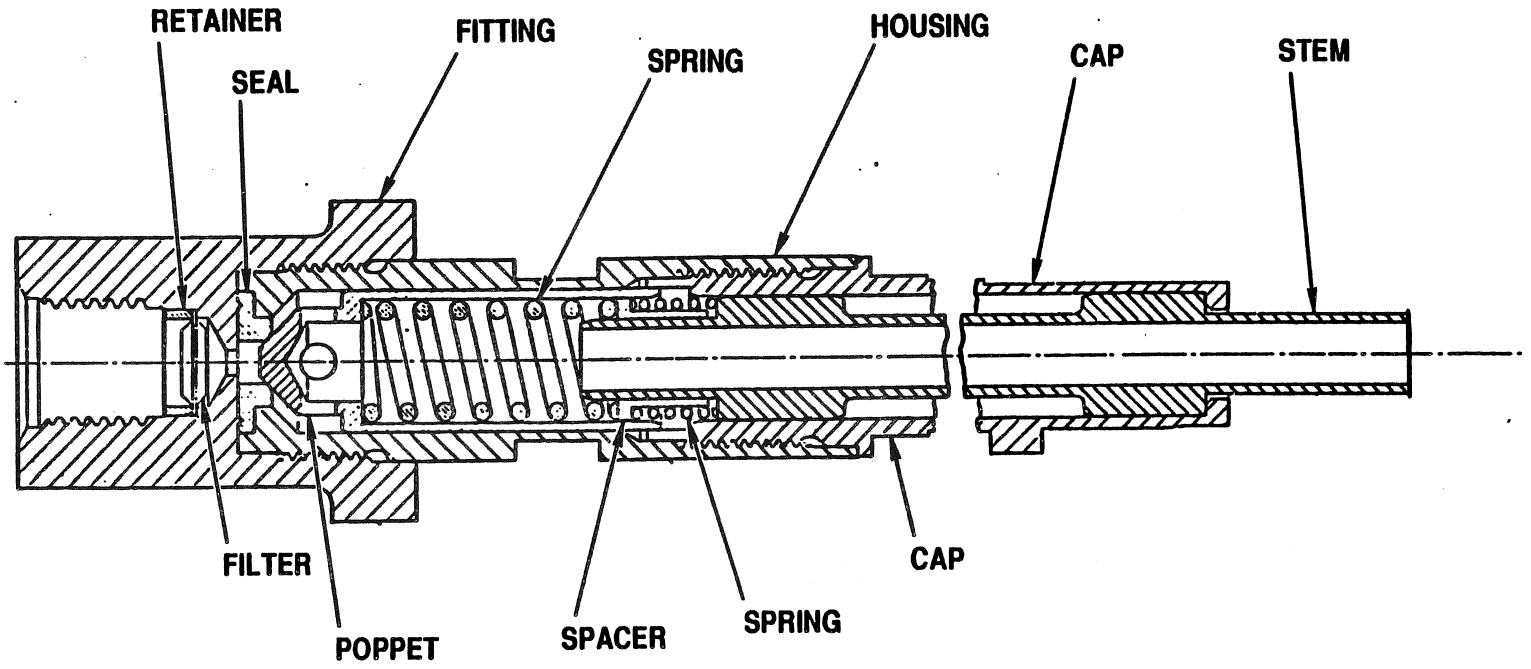
Rockwell International

Space Transportation Systems Division

COMPONENT: VALVE, FILL AND DRAIN, PROPELLANT

(MC284-0397)

FILL & DRAIN VALVE ACTUATOR
ANTI-SLAM VALVE ASSEMBLY
CROSS SECTION



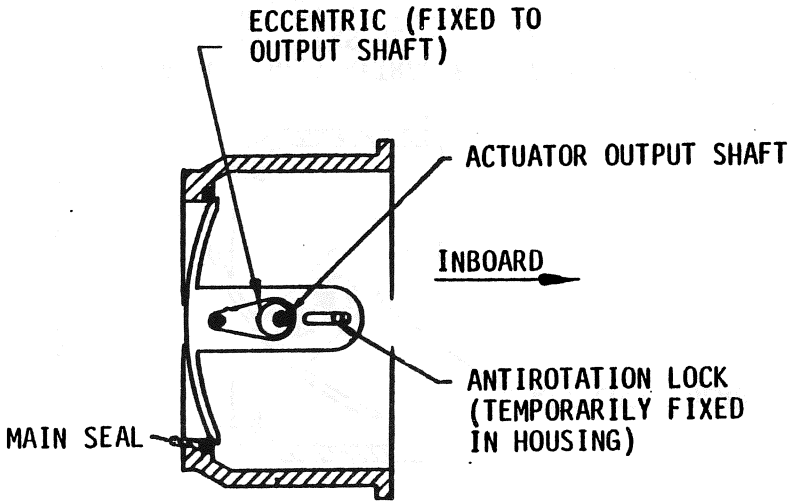
VIEW E-E

COMPONENT: VALVE, FILL AND DRAIN, PROPELLANT

(MC284-0397)

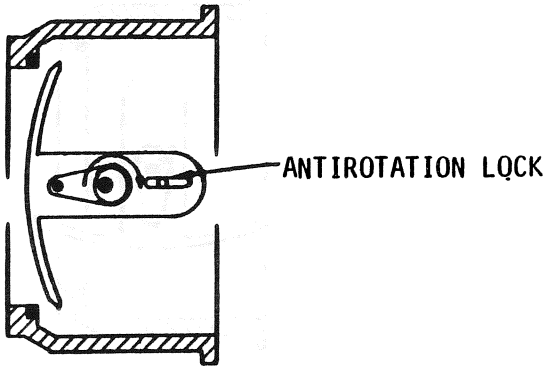
BLADE MOTION CONTROL
CONCEPT

(1)



THE FILL AND DRAIN VALVE IN THE FULLY CLOSED POSITION

(2)



VALVE WITH BLADE RETRACTED. ACTUATOR OUTPUT SHAFT HAS ROTATED 180° - ECCENTRIC RETRACTS BLADE 0.25 INCHES ROTATION OF BLADE PREVENTED BY ANTIROTATION LOCK TEMPORARILY FIXED IN HOUSING.

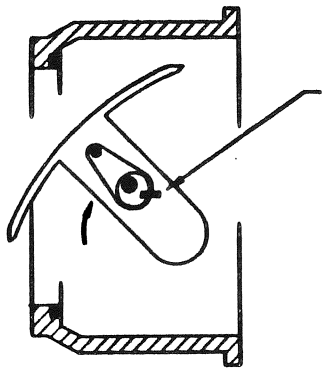
(CONTINUED ON NEXT PAGE)

COMPONENT: VALVE, FILL AND DRAIN, PROPELLANT

(MC284-0397)

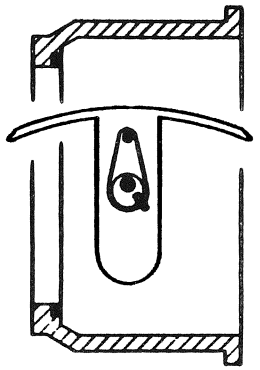
BLADE MOTION CONTROL
CONCEPT (CONTINUED)

(3)



VALVE BLADE FULLY RETRACTED AND PARTIALLY ROTATED. KEY LOCKS BLADE TO SHAFT, ANTIROTATION LOCK RELEASED.

(4)



VALVE IN THE FULL OPEN POSITION. BLADE IS LOCKED IN THIS POSITION BY A DETENT (NOT SHOWN).

COMPONENT: RELIEF VALVE, HELIUM PRESSURE, 850 PSIG

(MC284-0398)

FMEA/CIL NO. 03-1-0206

VENDOR : EATON CONSOLIDATED CONTROLS
P/N RI : MC284-0398-0005, MC284-0398-0004*
P/N VENDOR: 76130
QUANTITY : 7 PER END ITEM
:
VENDOR : EATON CONSOLIDATED CONTROLS

VEHICLE EFFECTIVITY:	*102	103	104	105
	X	X	X	X

ITEM:

RELIEF VALVE–PROVIDE PRESSURE RELIEF IN THE ORBITER HELIUM PNEUMATIC & PURGE SYSTEMS

FUNCTION:

THE RELIEF VALVE IS USED IN THE ORBITER HELIUM PNEUMATIC AND PURGE SYSTEMS TO PROVIDE A PRESSURE RELIEF IN THE EVENT A SYSTEM MALFUNCTION RESULTS IN A PRESSURE INCREASE WHICH EXCEEDS THE PRESET RELIEVING PRESSURE. THE RELIEF VALVE SHALL CLOSE AND MEET THE LEAKAGE REQUIREMENTS WHEN THE PRESSURE HAS BEEN REDUCED TO A PRESET RESEAT PRESSURE. THE RELIEF VALVE IS FUNCTIONAL CONTINUOUSLY.

DESIGN:

THE RELIEF VALVE IS PILOT OPERATED AND PRESSURE ACTUATED. AS THE SENSE LINE PRESSURE EXCEEDS 790 PSIG THE INLET PRESSURE FORCE ON THE POPPET SEAT PISTON BECOMES GREATER THAN THE RESEATING FORCE OF THE BELLEVILLE SPRINGS AND BELLOWS. THE UNBALANCED FORCE CAUSES THE POPPET SEAT PISTON TO MOVE. THE PILOT SPRING CAUSES THE POPPET TO MOVE WITH THE SEAT PISTON UNTIL THE PILOT POPPET CONTACTS ITS UPPER SEAT. THE POPPET SEAT PISTON CONTINUES TO MOVE CAUSING SEPARATION BETWEEN THE POPPET SEAT PISTON AND THE PILOT POPPET.

COMPONENT: RELIEF VALVE, HELIUM PRESSURE, 850 PSIG

(MC284-0398)

PRESSURE MAINTAINING THE MAIN POPPET SEATED IS VENTED THROUGH THE UNSEATED PILOT POPPET INTO THE AFT FUSELAGE. A DIFFERENTIAL PRESSURE ACROSS THE MAIN POPPET IS CREATED FORCING THE MAIN POPPET TO UNSEAT. THIS RELIEVES INLET PRESSURES FROM 850 PSIG (MAXIMUM) DOWN TO 785 PSIG (MINIMUM RESEAT) INTO THE AFT FUSELAGE THROUGH THE PILOT VENT AT A RATE OF 1.0 LB/SEC (MINIMUM AT 850 PSIG).

AS THE SENSE LINE PRESSURE DECREASES, THE PRESSURE FORCE ON THE POPPET SEAT PISTON BECOMES LESS THAN THE RESEATING FORCE CAUSED BY THE BELLEVILLE SPRINGS AND BELLOWS. THIS UNBALANCED FORCE CAUSES THE POPPET SEAT PISTON TO MOVE INTO CONTACT WITH THE PILOT POPPET'S LOWER SEAT CAUSING THE PILOT POPPET TO LEAVE ITS UPPER SEAT. THIS ALLOWS INLET PRESSURE TO AUGMENT THE MAIN POPPET RETURN SPRING FORCE CLOSING THE VALVE. ONCE SEATED, THE POPPET IS HELD CLOSED BY THE DIFFERENTIAL PRESSURE ACROSS THE MAIN POPPET AND BY THE MAIN POPPET RETURN SPRING FORCE. THE PILOT VENT CLOSES BY SPRING FORCE TO SEAL AGAINST CRYO PUMPING.

THE RELIEF VALVE ALSO INCORPORATES A FAST SENSING POPPET TO CONTROL THE RATE AT WHICH UPSTREAM PRESSURE IS SENSED. THIS FAST SENSING POPPET IS CONNECTED TO THE MAIN PRESSURIZATION LINE BY A 0.25 INCH (OUTER DIAMETER) TUBE. UNDER STEADY STATE CONDITIONS, INLET PRESSURE IS SENSED THROUGH ORIFICES IN BOTH THE INLET PORT AND THE FAST SENSING POPPET. INSTANTANEOUS PRESSURE RISES THAT EXCEED 775 PSIG UNSEAT THE FAST SENSING POPPET EXPOSING FOUR ADDITIONAL LARGER ORIFICES IN THE POPPET. THIS INCREASES THE RATE OF RELIEF VALVE RESPONSE. WHEN THE PRESSURE DECREASES TO A PREDETERMINED DIFFERENTIAL ACROSS THE FAST SENSING POPPET, SPRING FORCE RESEATS THE POPPET, THUS DAMPENING VALVE RESPONSE.

THE VALVE BODY CONSISTS OF THREE ALUMINUM ALLOY 6061-T651 PARTS: THE HOUSING, THE END CAP, AND THE SEAT RETAINER. THE POTENTIAL LEAK PATHS ARE THE HOUSING/END CAP INTERFACE AND THE HOUSING/SEAT RETAINER INTERFACE. THE HOUSING/END CAP AND THE HOUSING/SEAT RETAINER INTERFACES ARE SEALED USING RAYCO TYPE SEALS. THE SEALS USE CRES 302 SPRINGS WITH TEFLON (TFE) JACKETS. THE SEAL GLANDS ARE MACHINED INTO THE HOUSING WITH AN 8 MICROINCH SURFACE FINISH. THE END CAP IS THREADED INTO THE HOUSING AND TORQUED TO 630 IN.-LB BEFORE BEING LOCK WIRED TO THE HOUSING. THE RETAINER IS ATTACHED TO THE HOUSING USING SIX 19-32 CRES A286 SOCKET HEAD CAP SCREWS WITH A MINIMUM ULTIMATE TENSILE STRENGTH OF 160 KSI (NAS 1351). THESE CAP SCREWS ARE TORQUED TO 45 IN.-LB BEFORE BEING LOCK WIRED TO EACH OTHER. FLAT AND LOCK WASHERS ARE USED WITH THE SCREWS.

THE FACTORS OF SAFETY ARE 2.0 PROOF AND 4.0 BURST. STRUCTURAL ANALYSES INDICATE POSITIVE MARGINS OF SAFETY FOR ALL CONDITIONS OF VALVE OPERATION. FRACTURE/FATIGUE ANALYSIS SHOW THAT ALL CRITICAL PARTS ARE SATISFACTORY FOR FOUR TIMES EXPECTED LIFE.

COMPONENT: RELIEF VALVE, HELIUM PRESSURE, 850 PSIG

(MC284-0398)

DESIGN PARAMETERS:

LIFE CYCLE: THE VALVE HAS A USEFUL LIFE OF 2000 CYCLES OR A 100-ORBITAL MISSION EQUIVALENT.

CURRENT CONFIGURATION: (-0005)

PROOF PRESSURE: 1750 PSIG

BURST PRESSURE: 3400 PSIG

WEIGHT: 2.27 LB

LINE SIZE: INLET, 0.75 INCH: SENSE, 0.25 INCH

OPERATING BAND: 785 TO 850 PSIG

OPERATING TEMPERATURE: -160 F TO +220 F (MEDIA)
-100 F TO +220 F (ENVIRONMENT)

DIMENSION ENVELOPE: 4.95 MAX X 3.81 MAX

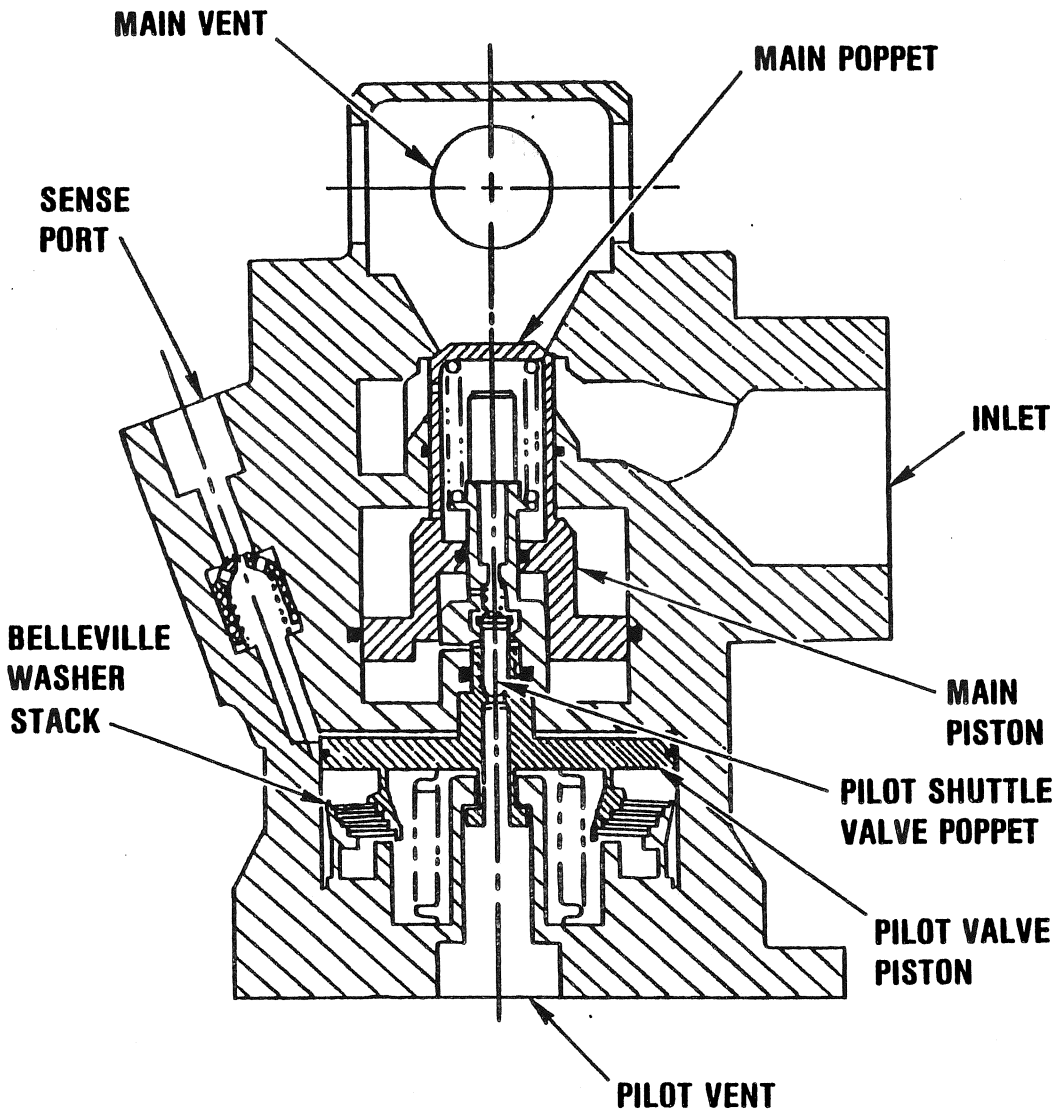
LEAKAGE RATE: INCREASING TO 785 PSIG - 20 SCIM AT -100 F TO -150 F
DECREASING TO 785 PSIG - 50 SCIM AT -100 F TO -150 F

MATERIALS
HOUSING: 6061 T651 AL ALLOY
MAIN PISTON: 6061 T651 AL ALLOY
BELLEVILLE WASHER: NI-SPAN-C
MAIN POPPET: 6061 T651 AL ALLOY
BELLOWS: INCONEL 718
PILOT VALVE PISTON: 304 CRES
PILOT VALVE POPPET: VESPEL

FEATURES:

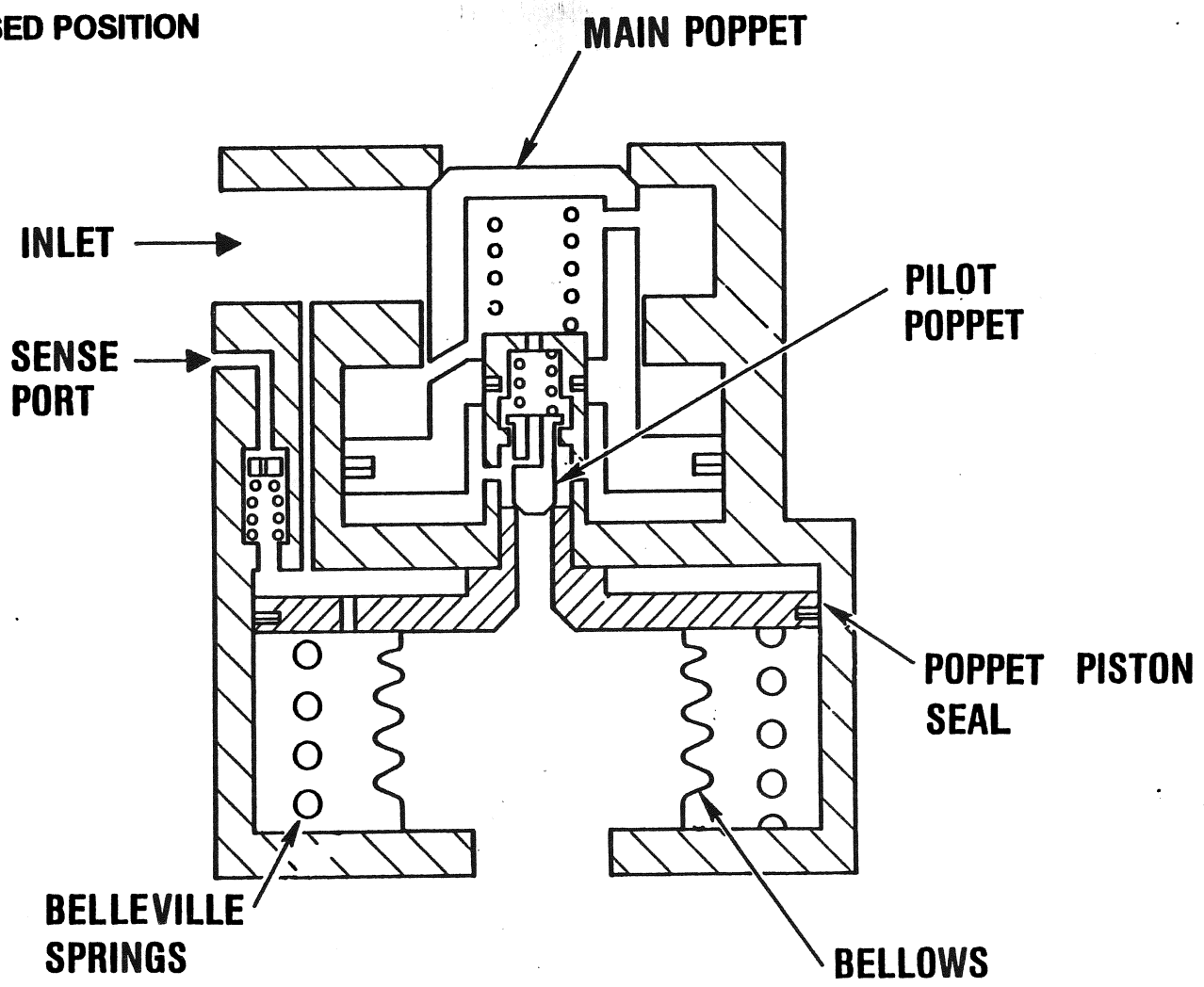
- FAST RESPONSE, PILOT OPERATED GAGE REFERENCE VALVE
- INTERNAL AND REMOTE SENSING TO AID STABILITY
- THE PILOT IS PROTECTED BY A LOW PRESSURE OPERATED FLAPPER AT THE PILOT VENT OUTLET
- THE MAIN POPPET FLOW EXITS THE VALVE BODY SEPARATELY FROM THE PILOT FLOW

COMPONENT: RELIEF VALVE, HELIUM PRESSURE, 850 PSIG
(MC284-0398)



COMPONENT: RELIEF VALVE, HELIUM PRESSURE, 850 PSIG
(MC284-0398)

MC284-0398
SHOWN IN CLOSED POSITION



COMPONENT: REGULATOR, HELIUM PRESSURE, 20 PSIG

(MC284-0399)

FMEA/CIL NO. 03-1-0629
03-1-0602

VENDOR : EATON CONSOLIDATED CNTRLS
P/N RI : MC284-0399-0004
P/N VENDOR: 76500-0004
QUANTITY : 2 PER END ITEM
:

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

REGULATOR, 20 PSIG, LO_2 AND LH_2 MANIFOLD REPRESSURIZATION (PR5) AND (PR6), (0.5 INCH DIAMETER INLET, 0.75 INCH DIAMETER OUTLET, 0.25 INCH DIAMETER SENSE PORT).

FUNCTION:

REGULATES THE HELIUM SUPPLY PRESSURE FROM 750 PSI DOWN TO 20 PSI TO PURGE THE MPS LO_2 AND LH_2 FEED AND PRESSURIZATION SYSTEMS FOLLOWING ENGINE SHUTDOWN AND TO PROVIDE FOR SYSTEM REPRESSURIZATION DURING ENTRY. SENSES LO_2 AND LH_2 MANIFOLD PRESSURE TO CONTROL PURGE FLOW. REGULATOR OPENS AT MANIFOLD PRESSURES BELOW 17 PSI AND CLOSES AT PRESSURES ABOVE 30 PSI.

DESIGN:

THE TWO STAGE DESIGN MAKES IT POSSIBLE TO CONTROL VERY LOW FLOWS WITH THE PILOT POPPET AND HIGH FLOW RANGES WITH THE MAIN POPPET. INITIALLY, WITHOUT SYSTEM PRESSURE, THE PILOT POPPET IS SPRING LOADED OPEN FROM ITS SEAL AND THE MAIN POPPET IS SPRING LOADED CLOSED. WHEN SYSTEM PRESSURE IS APPLIED TO THE REGULATOR, THERE IS FLOW PAST THE PILOT POPPET AND PRESSURE STARTS TO RISE IN THE OUTLET CIRCUIT. AS PRESSURE RISES AT THE SENSE PORT, IT WILL ACT AGAINST THE BELLOWS ASSEMBLY AND THE PILOT POPPET WILL START TO CLOSE. THE ACTION OF THE MAIN POPPET WILL BE TO OPEN SLIGHTLY, THEN FOLLOW THE PILOT POPPET TO THE CLOSED POSITION AS THE SENSE PRESSURE REACHES 30 PSIG.

AS FLOW IS REQUIRED BY THE LOAD, THE OUTLET PRESSURE DECREASES WHICH IS REFLECTED AT THE SENSE PRESSURE AREA AND THE PILOT POPPET STARTS TO OPEN. FOR SMALL FLOW DEMANDS, THE MAIN POPPET WILL NOT MOVE AS IT IS BIASED CLOSED BY PRESSURE UNBALANCE AND SPRING PRELOAD. THE SEAL FRICTION ALSO ACTS TO PREVENT MOVEMENT OF THE MAIN POPPET. THE MAIN POPPET WILL START TO MOVE OFF ITS SEAL WHEN CONTROL PRESSURE IS LESS THAN A PRE-DESIGNED VALUE.

COMPONENT: REGULATOR, HELIUM PRESSURE, 20 PSIG

(MC284-0399)

THE SPRING AND BELLOWS PROVIDE SPRING PRELOAD TO OPEN THE PILOT POPPET WHEN THE SENSE PRESSURE IS LESS THAN 30 PSI. THE SPRING PRELOAD ALSO ESTABLISHES THE MINIMUM 30 PSI LOCK-UP PRESSURE OF THE REGULATOR. THE NORMAL TRAVEL OF THE PILOT POPPET IS 0.0325 INCH AT 400 PSIG. THE REQUIRED TRAVEL TO START MOVEMENT OF THE MAIN POPPET IS 0.0075 INCH AND THE MAIN POPPET CAN MOVE 0.025 INCH TO ASSURE IT MEETS THE MINIMUM/MAXIMUM FLOW CONDITIONS.

DESIGN PARAMETERS:

CURRENT CONFIGURATION:	(-0004)
PROOF PRESSURE:	1700 PSIG INLET - 570 PSIG OUTLET
BURST PRESSURE:	3400 PSIG INLET - 1140 PSIG OUTLET
OPERATING PRESSURE:	850 PSIG INLET - 30 PSIG OUTLET
WEIGHT:	2.35 LB
LINE SIZE:	INLET 1/2, OUTLET 3/4, SENSE 1/4
SENSE PRESSURE:	17 TO 30 PSIG
OPERATING BAND:	17 TO 30 PSIG
OPERATING TEMPERATURE:	-140°F TO +150°F (MEDIA) -100°F TO +250°F (ENVIRONMENT)
EXTERNAL LEAKAGE:	3 SCIM MAX AT OPERATING PRESSURE

MATERIALS	
BODY:	6061 T651 AL ALLOY
SEAT:	VESPEL SP-21
BELLOWS:	304 CRES
MAIN SPRING:	302
MAIN POPPET:	6061AL
PILOT POPPET:	VESPEL SP-21
PILOT SPRING:	302 CRES

COMPONENT: REGULATOR, HELIUM PRESSURE, 20 PSIG

(MC284-0399)

OPERATION: LOCK-UP AND DORMANT

GAS ENTERS THE REGULATOR THROUGH THE SUPPLY INLET PRESSURE PORT, BUT IS PREVENTED FROM BEING PASSED THROUGH TO THE OUTLET BY THE CLOSED MAIN POPPET (6). SOME OF THE SUPPLY GAS ENTERS THE MAIN POPPET CONTROL CHAMBER THROUGH ORIFICE (1). THIS GAS FINDS ITS WAY TO THE BACK SIDE OF THE MAIN POPPET (3) AND (5) THROUGH ORIFICE (13) WHERE IT APPLIES PRESSURE TO THE POPPET (6) KEEPING THE REGULATOR CLOSED. THE SUPPLY GAS ALSO FILLS THE OUTER CHAMBER (4) AND EQUALIZES THE PRESSURE ON THE POPPET. IN ADDITION, THE MAIN POPPET SPRING PROVIDES A NET CLOSING FORCE ON THE MAIN POPPET SEALING THE INLET FROM THE OUTLET. THE PILOT PORTION OF THE REGULATOR REMAINS CLOSED BY THE SENSE PRESSURE ACTING ON THE SENSOR DIAPHRAGM (16), THE PILOT SPRING (7), AND THE BELLOWS ASSEMBLY (10) WORKING AGAINST THE BELLEVILLE SPRING ASSEMBLY (19). THE OUTLET PRESSURE ACTS ON THE BELLOWS EFFECTIVE AREA ALSO TRYING TO CLOSE THE PILOT POPPET. AS LONG AS THE SENSE PRESSURE STAYS ABOVE 17-30 PSIG, THE REGULATOR WILL STAY CLOSED OR LOCKED-UP.

OUTLET FLOW DEMAND

PRIOR TO FLOW DEMAND, THE CONTROL PRESSURE (3) AND (5) HAS BEEN EQUAL TO THE SUPPLY OR INLET PRESSURE (715 TO 850 PSIG), AND THE NET PRESSURE AND SPRING FORCE HAS BEEN HOLDING THE MAIN POPPET CLOSED. WHEN THE SENSE PRESSURE FALLS BELOW 17 PSIG, THE REGULATOR WILL OPEN AND FLOW HELIUM TO INCREASE THE OUTLET PRESSURE AND ULTIMATELY THE SENSE PRESSURE. WHEN THIS HAPPENS, THE LARGE AREA OF THE SENSOR DIAPHRAGM ASSEMBLY (16) SENSES AN OUTLET PRESSURE DECREASE AND CONTRACTS, ALLOWING THE BELLEVILLE SPRING TO FORCE THE SHAFT (20) AGAINST THE PILOT POPPET (7). THIS ACTION OPEN THE PILOT POPPET ALLOWING FLOW FROM THE CONTROL AREA (3) THROUGH THE PILOT ORIFICE AND TO THE OUTLET THROUGH AN INTERNAL PASSAGE (8). THE PRESSURE IN THE MAIN POPPET CONTROL CHAMBER VENTS QUICKLY TO CAUSE A PRESSURE IMBALANCE ACROSS THE MAIN POPPET (6). THIS OCCURS IN A CONTROLLED FASHION THROUGH THE PILOT ORIFICE AND THE ORIFICE IN THE MAIN POPPET (22). THE CONTROL PRESSURE CONTINUES TO DROP UNTIL THE FORCE IT EXERTS IN COMBINATION WITH THE MAIN POPPET SPRING (TENDING TO HOLD THE MAIN POPPET CLOSED), IS EQUAL TO THE SUPPLY PRESSURE FORCE TENDING TO OPEN THE POPPET. A FURTHER DECREASE IN THE CONTROL CHAMBER PRESSURE CAUSES THE MAIN POPPET (6) TO OPEN, PERMITTING GAS TO FLOW THROUGH THE OUTLET PORT. AS THE SENSE PRESSURE BEGINS TO BUILD UP, IT IS FED BACK TO THE CONTROLLER SECTION (21) THROUGH THE OUTLET PRESSURE SENSING PORT WHERE IT IS APPLIED TO THE UNDERSIDE OF THE SENSOR DIAPHRAGM (16). THE SENSE PRESSURE CONTINUES TO INCREASE UNTIL THE FORCE IT EXERTS ON THE SENSOR DIAPHRAGM BEGINS TO OVERCOME THE FORCE EXERTED BY THE BELLEVILLE SPRING ON THE PILOT POPPET. A FURTHER INCREASE IN THE SENSE PRESSURE CAUSES THE PILOT VALVE TO CLOSE, ALLOWING GAS TO FLOW INTO THE CONTROL CHAMBER WITH A RESULTANT INCREASE IN CONTROL PRESSURE. AS THE CONTROL PRESSURE BEGINS TO

BUILD, THE MAIN POPPET GRADUALLY CLOSES, BUILDING UP THE BALANCE PRESSURE AND CAUSING THE MAIN POPPET TO MOVE TO THE CLOSED POSITION. WHEN THE MAIN POPPET FINALLY CLOSES, GAS FLOW TO THE OUTLET PORT CEASES AND THE SENSE PRESSURE STABILIZES.

REGULATOR STABILITY

THE SMALL BELLOWS ASSEMBLY (10), EMPLOYED TO SEAL THE PILOT PLUNGER, NOT ONLY ISOLATES THE SENSOR CHAMBER BUT ALSO ACTS AS AN INNER LOOP FEEDBACK AREA IN PARALLEL WITH THE SENSOR DIAPHRAGM FOR HIGH FREQUENCY STABILIZATION OF THE REGULATOR. THE CONSTRUCTION OF THE CONTROL SECTION OF THE REGULATOR IS SUCH THAT IT PROVIDES LOW INERTIA AND SENSITIVITY UNDER THE NORMAL 30 PSI OPERATING RANGE TO STABILIZE THE MAIN POPPET DURING A TRANSIENT OPERATION SUCH AS OPENING AND CLOSING. THE BELLEVILLE LOADING SPRINGS ARE USED TO PROVIDE SUITABLE DAMPING LEVELS AND HIGH NATURAL FREQUENCIES FOR BOTH THE PILOT AND THE RELIEF PORTIONS OF THE VALVE.

THE DOWNSTREAM PRESSURE, P2, IS ESTABLISHED BY THE BAFFLE RESISTANCE AND THE DOWNSTREAM SYSTEM IMPEDANCE. THIS PRESSURE IS APPLIED TO THE ISOLATION BELLOWS (10), AND ALSO TO ESTABLISH P3. THE BELLOWS ASSEMBLY PROVIDES DAMPING AT THE SENSOR DIAPHRAGM TO AVOID ADVERSE PHASE LAG INSTABILITY. THIS IS CRITICAL SINCE THE DESIRED PRESSURE CHANGE IN THE FEEDLINE MANIFOLD IS NOT SENSED AT THE SENSOR DIAPHRAGM UNTIL SOME LATER TIME.

RELIEF VALVE

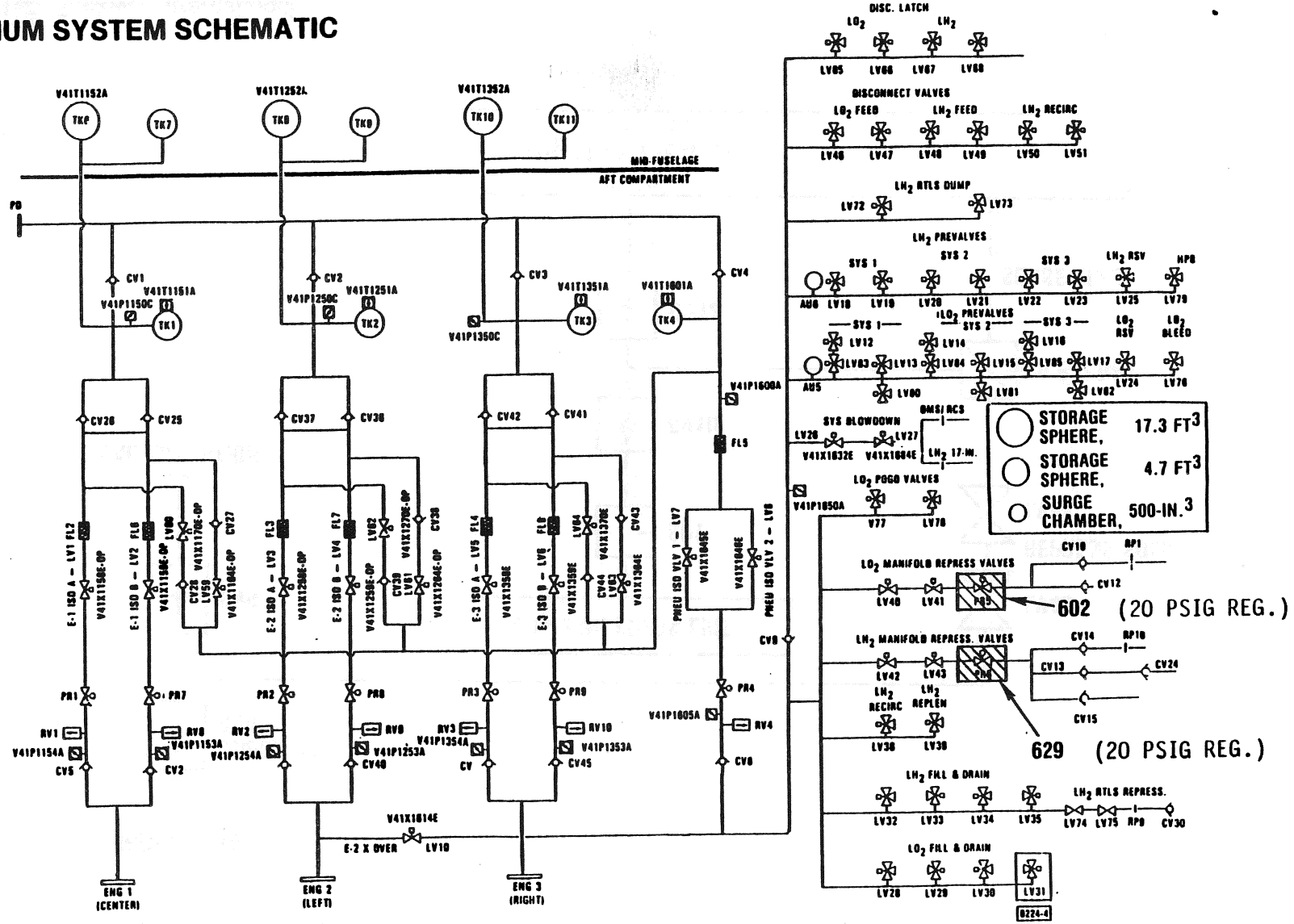
A DIAPHRAGM TYPE RELIEF VALVE IS LOCATED BETWEEN THE PILOT DISCHARGE AND THE SENSOR CHAMBERS. UNDER SLAM START CONDITIONS WITH LOW SENSED PRESSURE, THE OUTLET PRESSURE IS RELIEVED THROUGH THE SENSING LINE AT PRESSURES BETWEEN 160 AND 200 PSID. THE RELIEF FLOW RAPIDLY BUILDS UP THE SENSOR CHAMBER PRESSURE TO CLOSE THE PILOT (AT HIGH OUTLET PRESSURES) AND CONTROL THE INITIAL PRESSURIZATION RATES.

SETTING THE SET-POINT

IMPACTS TO REGULATED PRESSURE SETTINGS ARE INTRODUCED BY SPRING FORCES, DIMENSIONAL TOLERANCES OF PARTS, PRESSURE FORCES, FRICTION, VIBRATION, THERMAL EFFECTS, AND FLOW FORCES. TO SET EACH REGULATOR TO THE DESIRED SET-POINT VALUE (17-30 PSIG), THE REGULATOR MUST BE CAPABLE OF ADJUSTMENT. THIS IS ACCOMPLISHED BY SHIMMING THE SLEEVE ASSEMBLY AND TESTING FOR REGULATION PRIOR TO FINAL ASSEMBLY.

COMPONENT: REGULATOR, HELIUM PRESSURE, 20 PSIG
(MC284-0399)

HELIUM SYSTEM SCHEMATIC

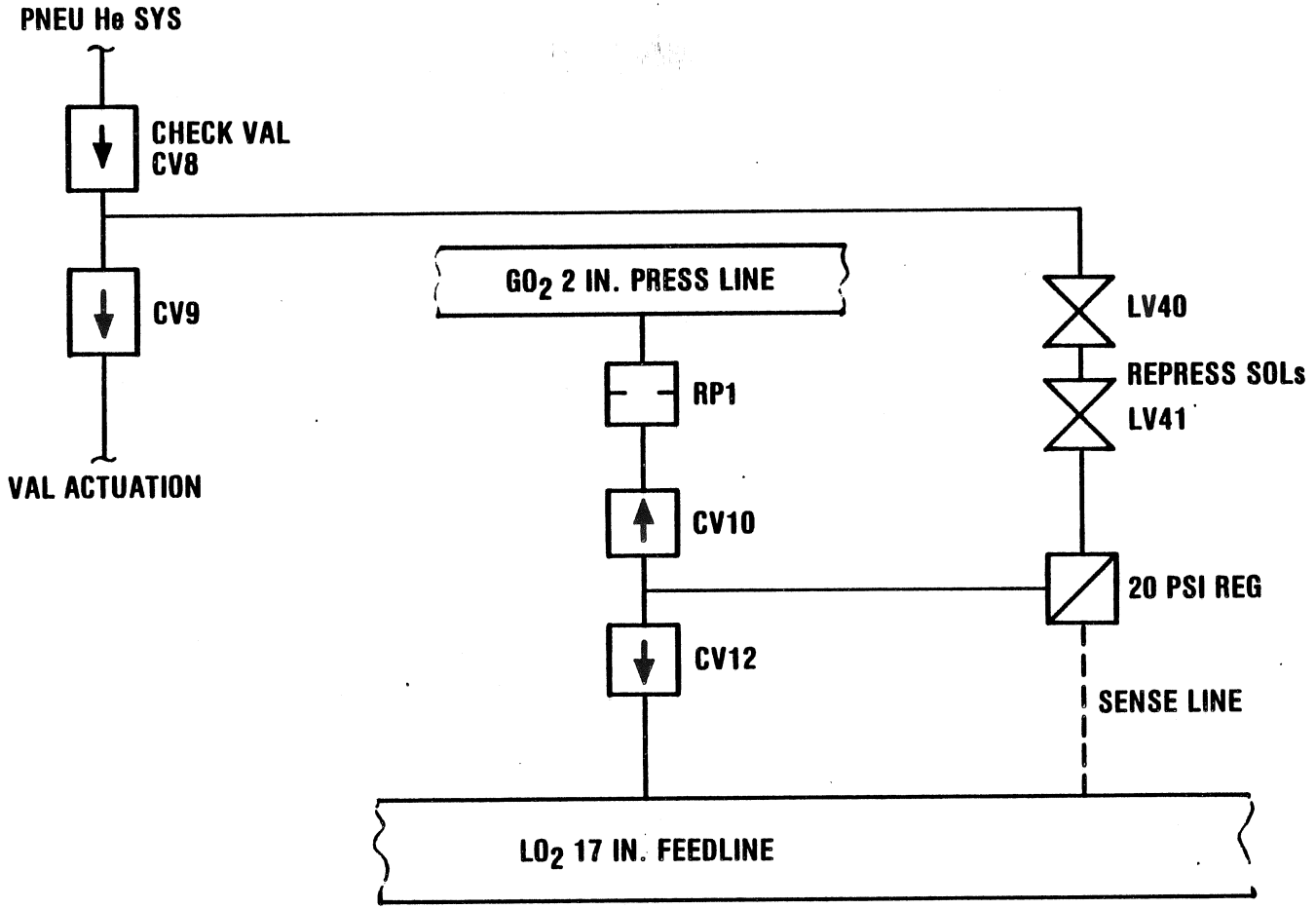


Rockwell International
Space Transportation
Systems Division

COMPONENT: REGULATOR, HELIUM PRESSURE, 20 PSIG

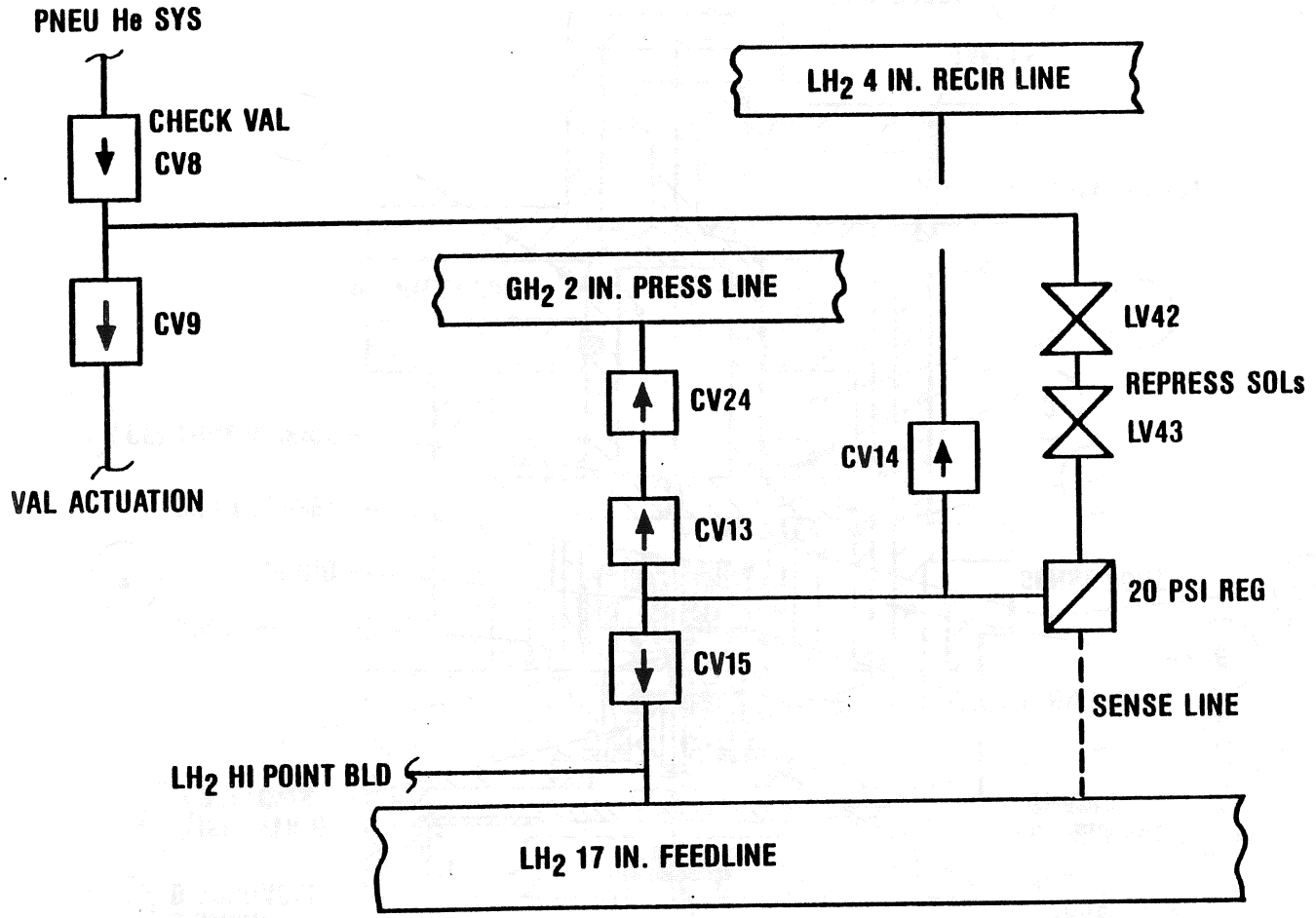
(MC284-0399)

LO_2 MANIFOLD PRESSURIZATION SYSTEM

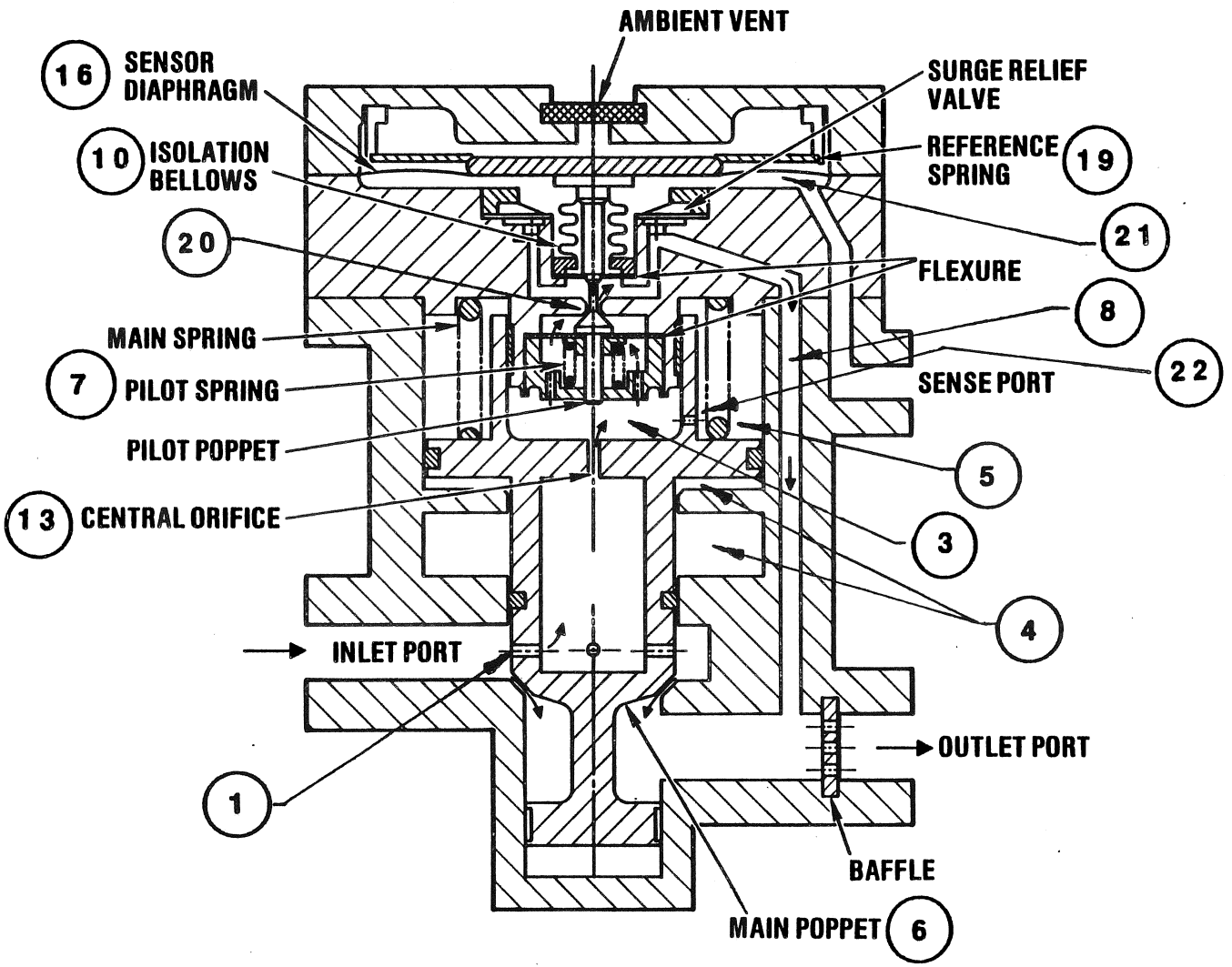


COMPONENT: REGULATOR, HELIUM PRESSURE, 20 PSIG
(MC284-0399)

LH_2 MANIFOLD PRESSURIZATION SYSTEM



COMPONENT: REGULATOR, HELIUM PRESSURE, 20 PSIG
(MC284-0399)



Rockwell International
Space Transportation
Systems Division

COMPONENT: VALVE, SOLENOID, 2-WAY, HELIUM

(MC284-0403)

FMEA/CIL NO: 03-1-0260 03-1-0204
03-1-0238 03-1-0246
03-1-0233 03-1-0601
03-1-0262 03-1-0606
03-1-0512 03-1-0208
03-1-0606 03-1-0204
03-1-0208

VENDOR : EG&G WRIGHT COMPONENTS
P/N RI : MC284-0403-0011, -0002, -003, -0017
P/N VENDOR: 12199-3, 12200, 12201, 12238-1
QUANTITY : TOTAL 24 PER END ITEM

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

: (2) -0011, PNEUMATIC HELIUM SUPPLY ISOLATION VALVE (LV-7 AND 8)
(3) -0011, IN E-1, E-2, AND E-3 HELIUM INTERCONNECT PANEL OUT VALVES (LV-60, 62, AND 64)
(2) -0002, FOR HELIUM SUPPLY BLOWDOWN VALVE (LV-26 AND 27)
(1) -0002, FOR LH_2 PRESS LINE VENT VALVE (LV-32)
(2) -0002, FOR LH_2 FEED MANIFOLD R&LS PRESS VALVE (LV-74 AND 75)
(2) -0003, FOR LO_2 MANIFOLD REPRESS VALVE (LV-40 AND 41)
(2) -0003, FOR LH_2 MANIFOLD REPRESS VALVE (LV-42 AND 43)
(1) -0003, FOR E_2 PNEU HELIUM CROSSOVER VALVE (LV-10)
(6) -0017, FOR E-1, E-2, AND E-3 HELIUM SUPPLY ISOLATION VALVE (LV-1 THROUGH LV-6)
(3) -0017, FOR E-1, E-2, AND E-3 HELIUM SUPPLY INTERCONNECT PANEL IN VALVES (LV-59, LV-61, AND LV-63)

ITEM: (-0011) TYPE I: VALVE, SOLENOID, NORMALLY CLOSED, 2-WAY, PILOT OPERATED, 3/8 INCH PORTING.
(-0002) TYPE II: VALVE, SOLENOID, NORMALLY CLOSED, 2-WAY DIRECT ACTING, 3/8 INCH PORTING.
(-0003) TYPE III: VALVE, SOLENOID, NORMALLY CLOSED, 2-WAY DIRECT ACTING, 1/2 INCH PORTING.
(-0017) TYPE V: VALVE SOLENOID, NORMALLY CLOSED, 2-WAY, PILOT OPERATED 1/2 INCH PORTING.

COMPONENT: VALVE, SOLENOID, 2-WAY, HELIUM

(MC284-0403)

FUNCTION:

PNEUMATIC HELIUM SUPPLY ISOLATION VALVE:

TWO VALVES ARE LINE MOUNTED (WELDED IN PLACE) IN PARALLEL IN THE V070-415752 PANEL AND LOCATED BETWEEN THE FL-5 FILTER AND THE PR-4 REGULATOR. THE PARALLEL REDUNDANT VALVES ISOLATE THE PNEUMATIC HELIUM SUPPLY FROM THE REMAINDER OF THE SYSTEM AND ASSURE A HELIUM SUPPLY FOR MPS VALVE ACTUATION. THE VALVES ARE OPEN FROM PRELAUNCH THROUGH VACUUM INERTING AND AGAIN FOR ENTRY PURGE.

HELIUM INTERCONNECT PANEL OUT VALVES:

THREE VALVES ARE LINE MOUNTED (WELDED IN PLACE) IN THE V070-415770 PANEL AND CONTROLS THE HELIUM INTO A PARTICULAR ENGINE PURGE SUPPLY FROM THE VALVE ACTUATION SYSTEM OR ANOTHER ENGINE PURGE SUPPLY. VALVE IS OPENED AT MECO +20 SECONDS TO ALLOW ALL THREE ENGINE HELIUM SUPPLIES TO SUPPLEMENT THE PNEUMATIC HELIUM SUPPLY DURING THE MPS DUMP SEQUENCES. THE VALVE IS ALSO OPENED DURING ENTRY TO SUPPLEMENT THE PNEUMATIC HELIUM SUPPLY FOR MPS ENTRY REPRESSURIZATION AND AFT COMPARTMENT/OMS POD PURGE.

HELIUM SUPPLY BLOWDOWN VALVE:

TWO VALVES ARE LINE MOUNTED USING DYNATUBE FITTING IN THE V070-415752 PANEL. SERIES REDUNDANT VALVES PROVIDE HELIUM PURGE CAPABILITY INTO THE OMS PODS AND ET LH_2 UMBILICAL/AFT COMPARTMENT DURING ENTRY TO PRECLUDE FLAMMABLE CONCENTRATIONS OF HAZARDOUS GASES FROM THE WAKE BEING INJECTED. ALSO USED FOR MAINTENANCE AND SAFETY PURPOSES TO BLOW DOWN THE HELIUM SYSTEM BELOW 2,000 PSI; FOR PERSONNEL SAFETY.

LH_2 PRESSURE LINE VENT VALVE:

PROVIDES A MEANS OF VENTING PRESSURE IN THE LH_2 TANK PRESSURIZATION LINE FOR VACUUM INERTING.

LH_2 FEED MANIFOLD RTLS PRESS VALVE:

TWO VALVES ARE LINE MOUNTED IN SERIES USING DYNATUBE FITTINGS ISOLATE PNEUMATIC SYSTEM HELIUM PRESSURE (750 PSIA) FROM THE LH_2 FEED MANIFOLD. DURING AN RTLS MISSION, AFTER THE FEEDLINE RELIEF SHUT-OFF VALVE (PV-8) IS OPENED, THE TWO VALVES ARE OPENED TO PROVIDE A FLOW PATH FOR HELIUM TO PRESSURIZE THE LH_2 MANIFOLD AS AN AID IN DUMPING PROPELLANTS.

COMPONENT: VALVE, SOLENOID, 2-WAY, HELIUM

(MC284-0403)

LO_2 MANIFOLD REPRESS VALVE:

TWO VALVES ARE LINE MOUNTED IN SERIES USING DYNATUBE FITTINGS ISOLATE PNEUMATIC SYSTEM HELIUM PRESSURE (750 PSIA) FROM THE 20 PSIG REGULATOR (PR-5). THE TWO VALVES ARE OPENED TO PROVIDE A FLOW PATH TO THE REGULATOR FOR PRESSURIZING THE LO_2 MANIFOLD AS AN AID IN DUMPING PROPELLANTS AND IN REPRESSURIZING THE LO_2/GO_2 SYSTEMS FOR ENTRY.

LH_2 MANIFOLD REPRESS VALVE:

TWO VALVES ARE LINE MOUNTED IN SERIES USING DYNATUBE FITTINGS ISOLATE PNEUMATIC SYSTEM HELIUM PRESSURE (750 PSIA) FROM THE 20 PSIA REGULATOR (PR-6). THE TWO VALVES ARE OPENED TO PROVIDE A FLOW PATH TO THE REGULATOR FOR PRESSURIZING THE LH_2 MANIFOLD AS AN AID IN DUMPING PROPELLANTS AND IN REPRESSURIZING THE LH_2/GH_2 SYSTEM FOR ENTRY.

ENGINE 2 PNEUMATIC HELIUM CROSSOVER VALVE:

ISOLATES THE HELIUM SUPPLY DEDICATED TO ENGINE 2 FROM THE PNEUMATIC VALVE ACTUATION HELIUM SUPPLY. CROSSOVER VALVE IS NORMALLY OPENED AT MECO TO COMBINE RESIDUAL HELIUM FROM THE ENGINE 2 SUPPLY WITH THE PNEUMATIC VALVE ACTUATION HELIUM SUPPLY FOR MECO VALVE ACTUATION AND MPS PROPELLANT DUMP. IT IS ALSO OPEN DURING ENTRY (AT MAJOR MODE 304) TO SUPPORT AFT COMPARTMENT PURGE AND MPS SYSTEM REPRESSURIZATION.

ENGINE 1, 2 AND 3 HELIUM SUPPLY ISOLATION VALVE:

SIX VALVES ARE LINE MOUNTED (WELDED TO TUBE) IN PARALLEL TO ISOLATE THE ENGINE HELIUM SUPPLY FROM REMAINDER OF SYSTEM WHEN IN THE CLOSED POSITION. ALL VALVES ARE OPEN DURING PRELAUNCH AND LIFT-OFF; LV-3 IS OPEN FOR DEORBIT AND POSTLANDING. THE VALVES ARE LOCATED ON PARALLEL REDUNDANT PANELS (V070-415771 AND V070-415772 PANELS) TO ASSURE HELIUM FROM EACH MAIN ENGINE SUPPLY TO ITS PARTICULAR ENGINE INTERFACE.

ENGINE 1, 2 AND 3 HELIUM SUPPLY INTERCONNECT PANEL IN VALVES:

THREE VALVES ARE LINE MOUNTED (WELDED IN PLACE) IN THE V070-415772 PANEL (1 PANEL FOR EACH ENGINE) AND PROVIDES CONTROL OF HELIUM INTO A PARTICULAR ENGINE PURGE SUPPLY FROM THE VALVE ACTUATION SYSTEM OR ANOTHER ENGINE PURGE SUPPLY. THE VALVES OPENED AT MECO (BEFORE THE ENGINES SHUTDOWN) TO ALLOW THE VALVE ACTUATION HELIUM SUPPLY TO SUPPLEMENT THE ENGINE HELIUM PURGE SUPPLY DURING THE POST SHUTDOWN PURGE.

COMPONENT: VALVE, SOLENOID, 2-WAY, HELIUM

(MC284-0403)

DESIGN: TYPES I AND V (-0011 AND -0017)

THE VALVE IS A PILOT OPERATED SOLENOID VALVE CONTROLLING THE APPLICATION OF VALVE INLET PRESSURE TO THE POPPET. THE POPPET IS PART OF A RING ASSEMBLY (PISTON) THAT IS SPRING LOADED TO THE CLOSED POSITION. THE RING ASSEMBLY CONTAINS THE MAIN POPPET SEAL (VESPEL SP-21) AND THE SECONDARY SEAL (VESPEL SP-21) WHICH PREVENT LEAKAGE PAST THE POPPET IN THE OPEN/CLOSED POSITION. THE VALVE INLET PRESSURE IS ALWAYS EXERTING AN OPENING FORCE ON THE PISTON. WHEN THE SOLENOID IS DEENERGIZED, THE PILOT VALVE DIRECTS THE INLET PRESSURE TO THE CLOSING SIDE OF THE POPPET, UNBALANCING THE FORCE FROM THE INLET SIDE. THIS ALLOWS THE SPRING FORCE PLUS THE PRESSURE-AREA DIFFERENTIAL FORCE TO HOLD THE VALVE CLOSED. WHEN THE SOLENOID IS ENERGIZED, THE PILOT VALVE VENTS THE PRESSURE AT THE CLOSING SIDE OF THE PISTON TO AMBIENT. THIS ALLOWS THE INLET PRESSURE TO OVERCOME THE VALVE SPRING FORCE AND OPEN THE VALVE.

THE PILOT VALVE UTILIZES CRES BALL AS A CLOSURE DEVICE SEALING AGAINST EITHER OF TWO SEATS. IN THE DEENERGIZED STATE, THE BALL IS HELD AGAINST THE CLOSING SEAT BY A SPRING ACTIVATED PUSHROD. WHEN ENERGIZED, THE SOLENOID FORCE OVERCOMES THE SPRING FORCE AND TRANSLATES THE PUSHROD AND BALL AND HOLDS THE BALL AGAINST THE OPENING SEAT. TOTAL BALL MOVEMENT (STROKE) IS LESS THAN 0.05 INCH.

FAILURE OF THE VALVE TO OPEN CAN BE CAUSED BY (1) BINDING OF THE VALVE PISTON OR INSUFFICIENT VENTED PRESSURE. INSUFFICIENT VENTING CAN BE CAUSED BY (2) SOLENOID FAILURE, (3) STRUCTURAL FAILURE OF THE PILOT BALL OR FORCE TRAIN CARRYING THE SOLENOID FORCE TO THE PILOT BALL, (4) BINDING OF THE SOLENOID PLUNGER, OR (6) FAILURE OF THE PILOT VENT CHECK VALVE TO OPEN.

FAILURE OF THE VALVE TO REMAIN OPEN REQUIRES APPLICATION OF SUFFICIENT PRESSURE TO THE CLOSING SIDE OF THE PISTON TO BALANCE THE OPENING PRESSURE ALLOWING THE MAIN SPRING TO CLOSE THE VALVE. THIS CAN BE CAUSED BY (1) SOLENOID FAILURE, (2) STRUCTURAL FAILURE OF THE PILOT BALL OR FORCE TRAIN CARRYING THE SOLENOID FORCE TO THE PILOT BALL, OR (3) FAILURE OF INTERNAL SEALS.

(1) BINDING BETWEEN THE PISTON ASSEMBLY AND THE VALVE BODY IS PRECLUDED BY MANUFACTURING THEM AS A "MATCHED SET." THE RING ASSEMBLY OD IS FINAL MACHINED TO BE 0.0001-0.0003 INCH LESS THAN THE BODY ID. THE BODY BORE IS POLISHED TO A 16 MICROINCH FINISH.

(2) THE SOLENOID COIL IS HOUSED IN AN EB WELDED AND LEAK-TESTED CRES ASSEMBLY. THE COIL UTILIZES HIGH TEMPERATURE WIRE WOULD ON A CORE. AN ELECTRICAL CONNECTOR IS WELDED ON THE HOUSING. HIGH TEMPERATURE WIRES BETWEEN THE CONNECTOR AND THE COIL ARE SILVER SOLDERED AT THEIR CONNECTIONS. THE COMPLETE ASSEMBLY IS IMPREGNATED WITH EPOXY UNDER VACUUM CONDITIONS. THIS TYPE OF SOLENOID CONSTRUCTION HAS BEEN SUCCESSFULLY USED ON MANY PROGRAMS AND HAS BEEN SUBJECTED TO OVER 10,000 LIFE AND THERMAL QUALIFICATION CYCLES.

(3) THE FORCE TRAIN CONSISTS OF THE SOLENOID PLUNGER, THE SOLENOID STOP, AND TWO PUSHRODS. THE PLUNGER AND STOP ARE MASSIVE BY COMPARISON TO THE PUSHRODS, AND ARE BOTH OF 430 CRES. THE 17-4PH CRES PUSHRODS ARE ALIGNED IN SERIES WITHIN THE STOP, AND CARRY ONLY AXIAL LOADS. IF THE ROD NEAREST THE SOLENOID WERE TO FAIL STRUCTURALLY, IT WOULD CONTINUE TO PERFORM ITS FUNCTION BECAUSE IT IS TOTALLY CONTAINED IN THE STOP (THE ROD OD IS 0.125 INCH AND THE STOP ID IS 0.126 INCH). THE ROD IN CONTACT WITH THE PILOT BALL IS HEAT TREATED AND ALSO CONTAINED WITHIN AND GUIDED BY THE SOLENOID STOP FOR NEARLY 60 PERCENT OF ITS LENGTH. WITHIN THE REMAINING 40 PERCENT, THE ROD TAPERS TO A DIAMETER OF 0.030 INCH. THIS PORTION OF THE ROD PASSES THROUGH THE CLOSING SEAT (WHICH GUIDES IT) TO MAKE CONTACT WITH THE BALL.

(4) BINDING OF THE 430 CRES SOLENOID PLUNGER WITHIN THE 304L SOLENOID SPOOL ASSEMBLY IS PRECLUDED BY A DRY FILM LUBRICANT APPLIED TO THE PLUNGER AND INSURING ALL BURRS ARE REMOVED FROM THE ID OF THE SPOOL ASSEMBLY.

(5) THE HIGH PRESSURE AND VENTED PORTIONS OF THE VALVE ARE SEALED FROM ONE ANOTHER BY USE OF SOFT SILVER PLATED, INCONEL "V" SEALS.

(6) THE VENT CHECK VALVE, WHICH SCREWS INTO THE SOLENOID VALVE VENT PORT, IS OF A SIMPLE DESIGN, CONTAINING ONLY 5 PARTS, CRACK AND RESEAT PRESSURES ARE 0.5 PSID AND THE UNIT IS DESIGNED FOR 10,000 CYCLES. HIGH INLET PRESSURE (710 PSIA NOMINAL) ACTING ON A LARGE POPPET (0.603 INCH DIAMETER) PRODUCES A FORCE IN EXCESS OF 400 POUNDS TO ASSURE CHECK VALVE OPENING. THE CHECK VALVE BODY AND POPPET ARE OF 2024-T6 ALUMINUM, AND TO PREVENT GALLING OR BINDING, HAVE BEEN HARD ANODIZED.

COMPONENT: VALVE, SOLENOID, 2-WAY, HELIUM

(MC284-0403)

TYPES II AND III (-0002 AND -0003)

THE SOLENOID VALVE IS A NORMALLY CLOSED, DIRECT-ACTING VALVE. WHEN DEENERGIZED, THE VALVE POPPET IS HELD AGAINST THE VALVE SEAT BY A SPRING AND A BELLOWS, EITHER OF WHICH CAN MAINTAIN THE CLOSED POSITION. THE BELLOWS ASSEMBLY INTERIOR IS EXPOSED TO OUTLET PRESSURE BY VENT HOLES THROUGH THE POPPET, PROVIDING A FORCE BALANCE WHICH ALLOWS THE SOLENOID, WHEN DEENERGIZED TO REMAIN CLOSED BY SPRING FORCE ONLY EVEN IF THE OUTLET PRESSURE INCREASES. WHEN ENERGIZED THE SOLENOID NEED ONLY DEVELOP SUFFICIENT FORCE TO OVERCOME THE BELLOWS AND SPRING FORCES TO OPEN THE VALVE BECAUSE THE FORCE BALANCE ACROSS THE POPPET ASSIST IN OPENING.

VALVE FAILURE TO OPEN/REMAIN OPEN WOULD REQUIRE STRUCTURAL FAILURE OF THE PLUNGER ASSEMBLY, OR SOLENOID ASSEMBLY FAILURE. BINDING WILL ALSO CAUSE VALVE FAILURE TO OPEN.

BINDING OF THE PLUNGER TO THE SOLENOID CORE ASSEMBLY CAN CAUSE VALVE FAILURE TO OPEN. TO PREVENT BINDING, BOTH THE PLUNGER AND THE SOLENOID CORE ASSEMBLY (THROUGH WHICH IT SLIDES) ARE MADE FROM 430 AND 304L CRES AND MANUFACTURED TO CLOSE TOLERANCES (THE CORE ASSEMBLY INTERNAL DIAMETER IS 0.674/0.675, AND THE PLUNGER OUTER DIAMETER IS 0.67325/0.67220). THE PLUNGER IS TREATED WITH A DRY LUBRICANT AND HAS A FAVORABLE LENGTH TO DIAMETER RATIO (L/D).

STRUCTURAL FAILURE OF THE PLUNGER, THE POPPET, THE BELLOWS ASSEMBLY, OR THE POPPET-TO-PLUNGER PIN CAN CAUSE VALVE FAILURE TO OPEN/REMAIN OPEN. THE 430 CRES PLUNGER, 304 CRES RETAINER AND POPPET, AND 17-4 PH HEAT TREATED CRES PIN TRANSFER ONLY THE LOAD OVERCOMING THE BELLOWS RESISTANCE. THE ELECTRO DEPOSITED Ni-Co-Cu BELLOWS IS DESIGNED FOR 20,000 CYCLES AND HAS A SPRING RATE OF 110 LB/INCH OVER A STROKE OF 0.060 INCH. THE WEAK LINK IN THIS POWER TRAIN WOULD BE THE PIN (0.093 OUTER DIAMETER), IF IT WERE NOT FOR THE NEAR NEGLIGIBLE LOAD.

THE SOLENOID COIL IS HOUSED IN AN EB WELDED AND LEAK-TESTED CRES ASSEMBLY. THE COIL UTILIZES HIGH TEMPERATURE WIRE WOULD ON A CORE. AN ELECTRICAL CONNECTOR IS WELDED ON THE HOUSING. HIGH TEMPERATURE WIRES BETWEEN THE CONNECTOR AND THE COIL ARE SILVER SOLDERED AT THEIR CONNECTIONS. THE COMPLETE ASSEMBLY IS IMPREGNATED WITH EPOXY UNDER VACUUM CONDITIONS. THIS TYPE OF SOLENOID CONSTRUCTION HAS BEEN SUCCESSFULLY USED ON MANY PROGRAMS AND HAS BEEN SUBJECTED TO OVER 10,000 LIFE AND THERMAL QUALIFICATION CYCLES.

COMPONENT: VALVE, SOLENOID, 2-WAY, HELIUM

(MC284-0403)

DESIGN PARAMETERS:

	TYPE			
	I	II	III	V
OPERATING PRESSURE (PSIG)	0-4500	0-850	0-850	0-4500
PROOF PRESSURE (PSIG)	9000	1560-1580	1560-1580	6750
BURST PRESSURE (PSIG)	18000	3400	3400	18000
OPERATING TEMPERATURE (°F)				
FLUID	-100 to +250	-100 to +250	-100 to +250	-100 to +250
ENVIRONMENT	-160 TO +175	-160 TO +175	-160 TO +175	-160 TO +175
WEIGHT (LB)	2.0	2.37	3.0	3.0
INLET/OUTLET PORTING SIZES	3/8 IN.	3/8 IN.	1/2 IN.	1/2 IN.
PULL IN VOLTAGE (VDC)	18	18	18	18
DROP OUT VOLTAGE (VDC)	2	2	2	2
OPENING RESPONSE TIME	100 MS	100 MS	100 MS	100 MS
CLOSING RESPONSE TIME	100 MS	100 MS	100 MS	100 MS
LEAKAGE:				
EXTERNAL	1×10^{-3} SCCM (4015-4085 PSIG)	1×10^{-3} SCCM (718-782 PSIG)	1×10^{-3} SCCM (718-782 PSIG)	1×10^{-3} (4015-4085 PSIG)
INTERNAL: INLET TO OUTLET AND INLET TO VENT (DEENERGIZED)	2 SCCS (101-110 PSIG) 2 SCCS (4500 PSIG)	2 SCCS (150-163 PSIG) 2 SCCS (803-847 PSIG)	2 SCCS (150-103 PSIG) 2 SCCS (803-847 PSIG)	2 SCCS (101-110 PSIG) 2 SCCS (4500 PSIG)

COMPONENT: VALVE, SOLENOID, 2-WAY, HELIUM

(MC284-0403)

	TYPE			
	I	II	III	V
INTERNAL: ENERGIZED VENT	2 SCCS (4500 PSIG)			2 SCCS (4500 PSIG) 2 SCCS (250-500 PSIG)
VENT CHECK VALVE LEAKAGE	2 SCCS (15 PSIG)			2 SCCS (15 PSIG)
INTERNAL: OUTLET TO INLET		2 SCCS (150-163 PSIG) (803-847 PSIG)	2 SCCS (150-163 PSIG) (803-847 PSIG)	
ELECTRICAL POWER:	1.5 AMPS MAXIMUM STEADY STA 2.0 AMPS PEAK TRANSIENT CURRENT			
OPERATING VOLTAGE:	30 ± 2 VOLTS DC			
MATERIALS:				
BODY	304L CRES	6061-T651	6061-T651	304L CRES
POPPET	304 CRES	304 CRES	304 CRES	304 CRES
POPPET SEAL	VESPEL	VESPEL	VESPEL	VESPEL
RETURN SPRING		ELGILOY	ELGILOY	
MAIN SPRING	17-7 PH CRES			17-7 PH CRES

COMPONENT: VALVE, SOLENOID, 2-WAY, HELIUM

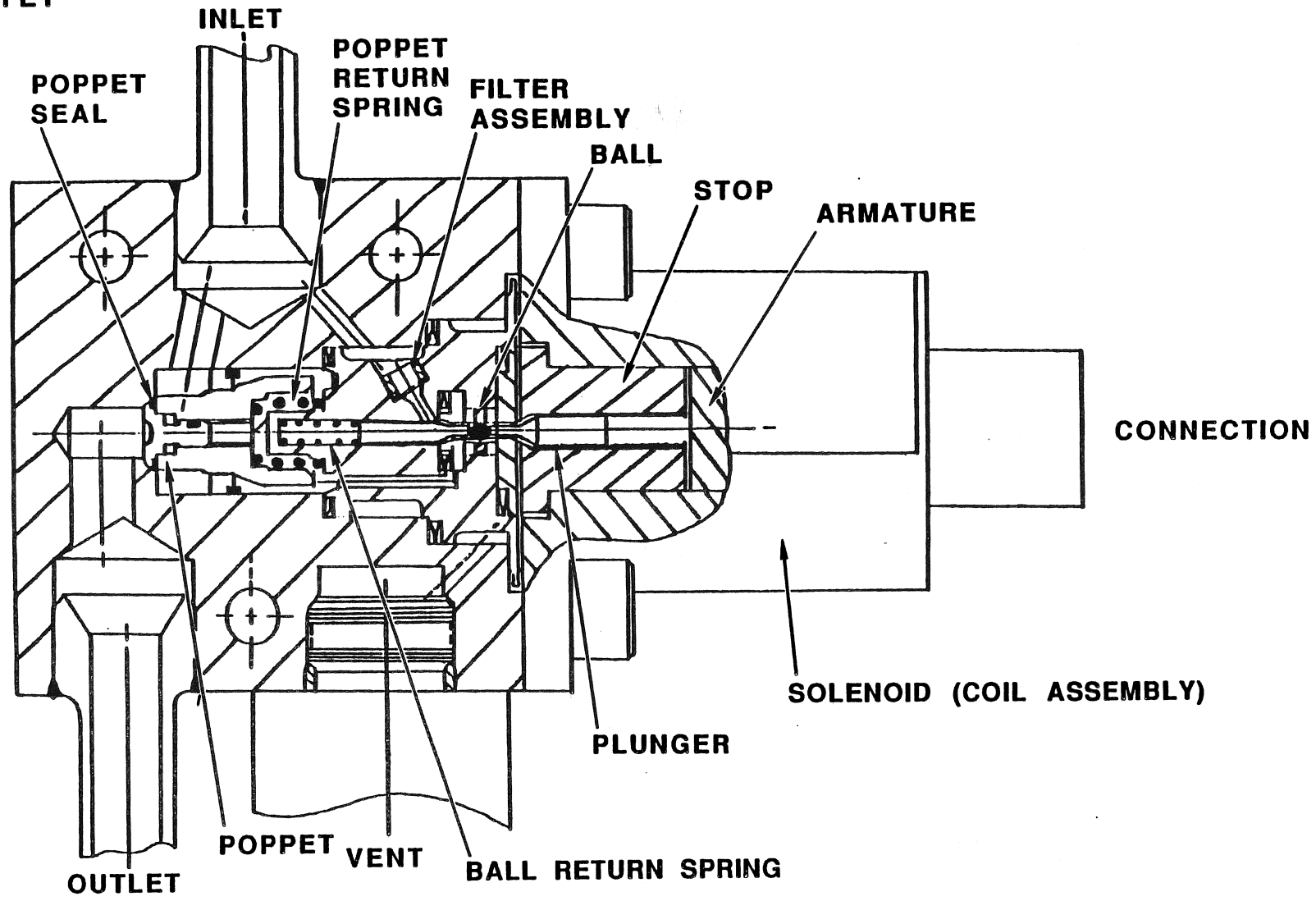
(MC284-0403)

	TYPE			
	I	II	III	V
BALL	430 CRES			430 CRES
BELLOWS		304 CRES, NICKEL, COBALT 17-4PH CRES	304 CRES, NICKEL, COBALT 17-4PH CRES	
PLUNGER		430 CRES	430 CRES	
RETAINER		304 CRES	304 CRES	
INSERT LOCKING		NYLON	NYLON	
SEAT, SPRING		17-4 CRES	17-4 CRES	
V-SEAL	SILVER PLATED INCONEL (5)	SILVER PLATED INCONEL (2)	SILVER PLATED INCONEL (2)	SILVER PLATED INCONEL (5)
SOLENOID ASSY	304L AND 430 CRES	304L AND 430 CRES	304L AND 430 CRES	304L AND 430 CRES
SLEEVE	304 CRES			304 CRES
SEATS	17-4 PH			17-4 PH
SPACER	304 CRES			304 CRES
PUSHROD	17-4 PH			17-4 PH
PILOT SPRING	17-7 PH			17-7 PH
11107-5 CHECK VALVE	USED ON			USED ON

COMPONENT: VALVE, SOLENOID, 2-WAY, HELIUM

(MC284-0403)

TYPE I



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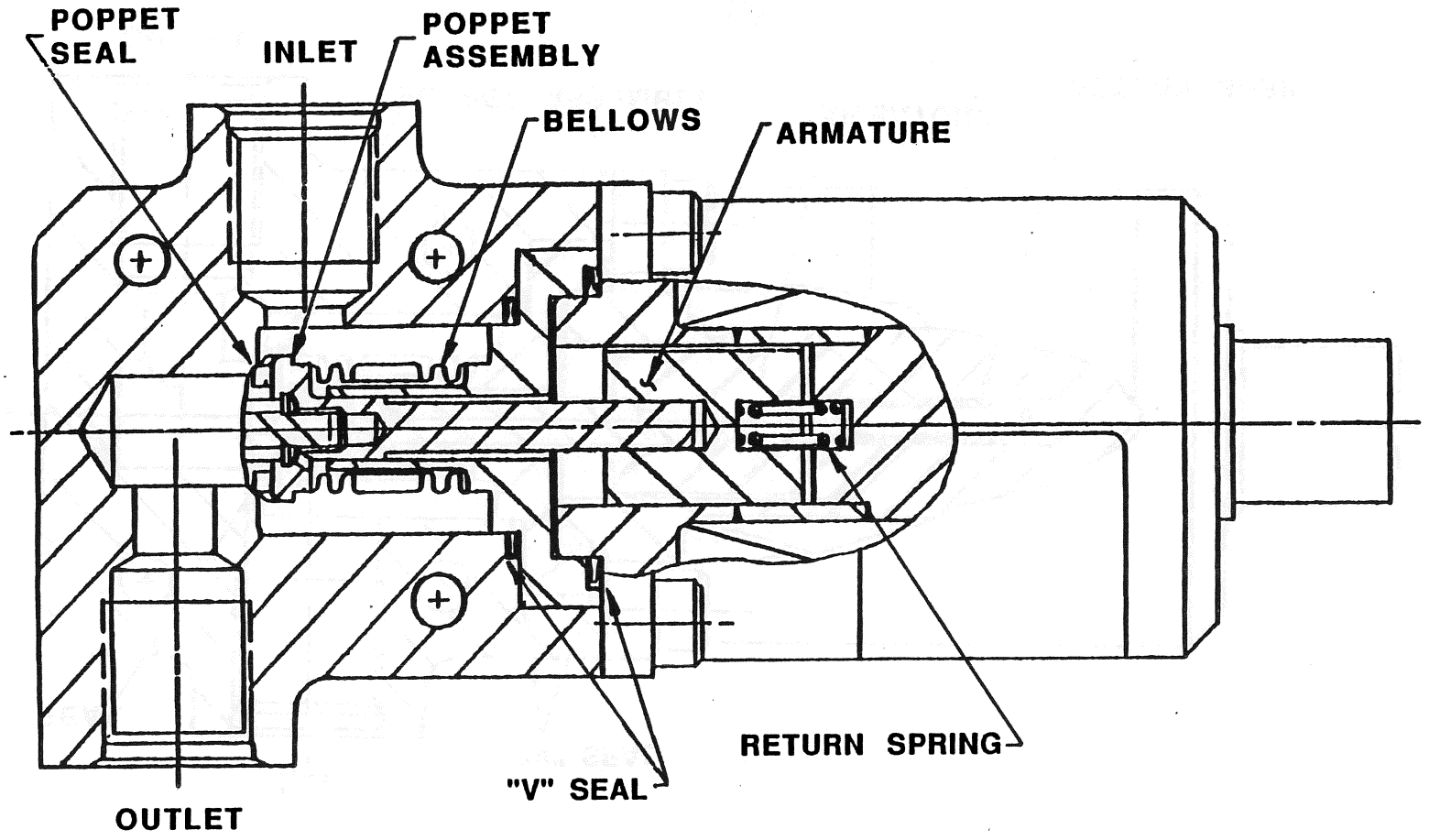
COMPONENT: VALVE, SOLENOID, 2-WAY, HELIUM

(MC284-0403)

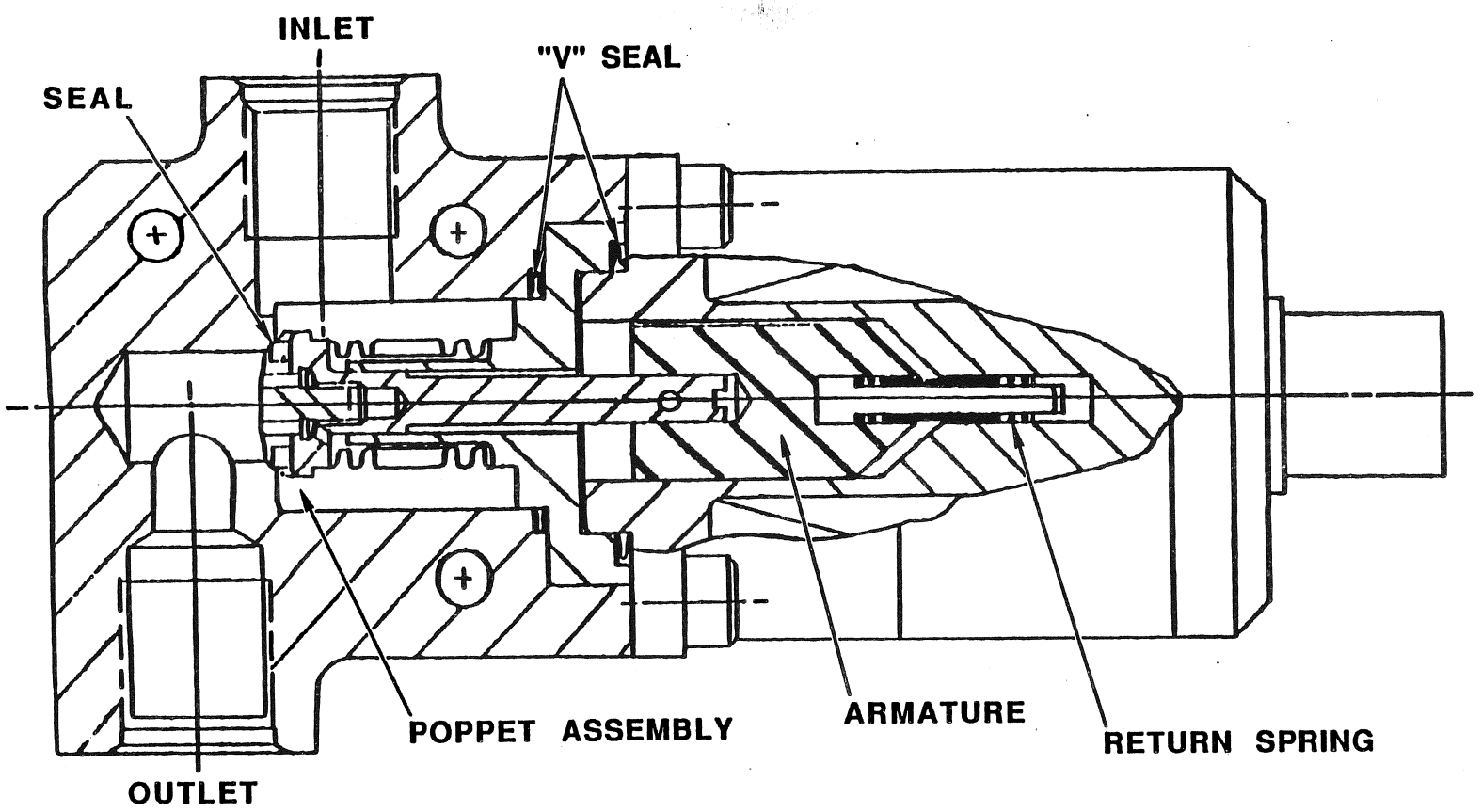
TYPE II



COMPONENT: VALVE, SOLENOID, 2-WAY, HELIUM

(MC284-0403)

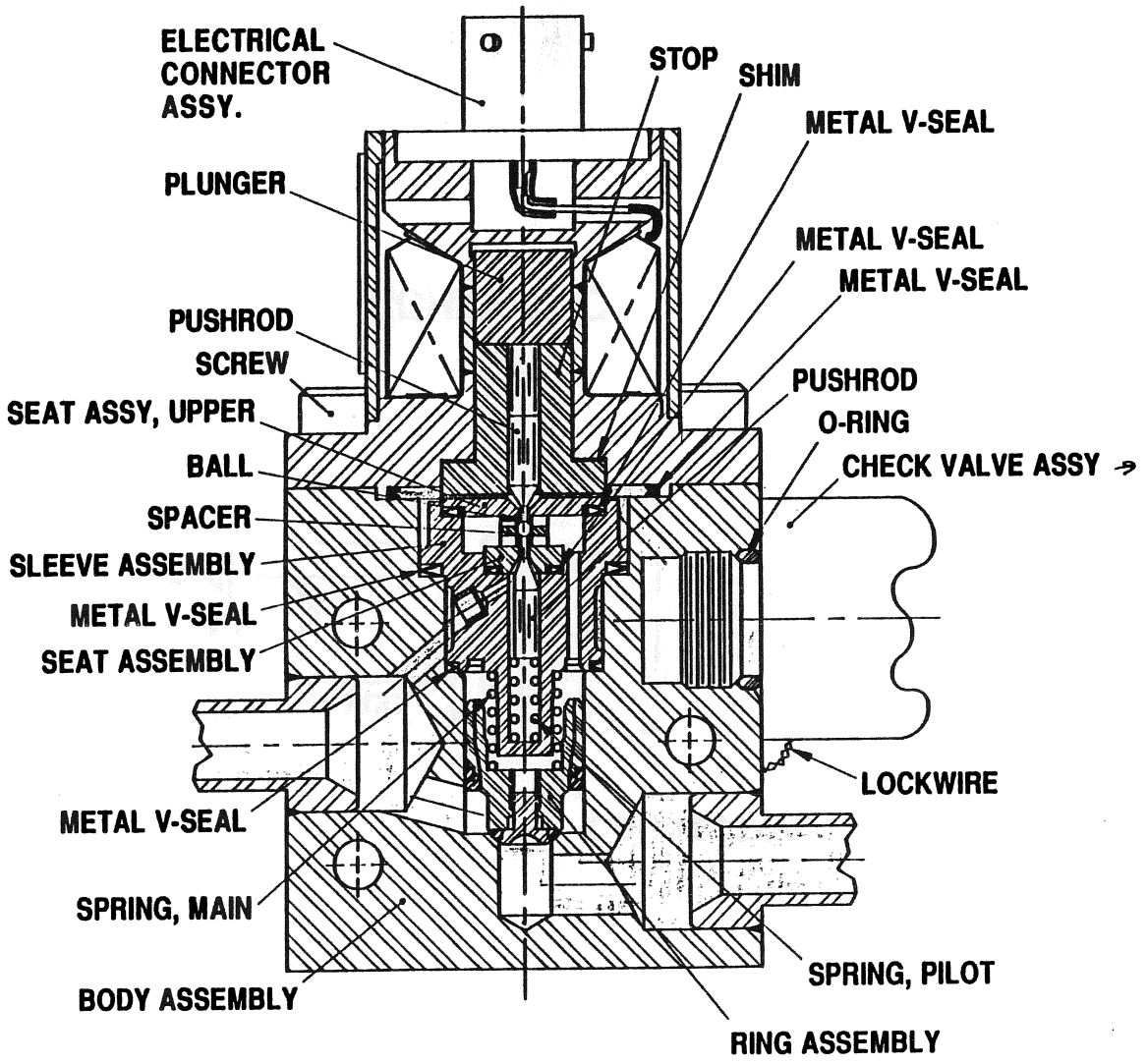
TYPE III



COMPONENT: VALVE, SOLENOID, 2-WAY, HELIUM

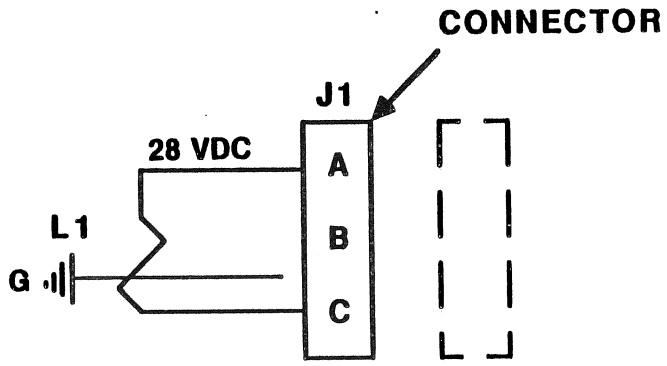
(MC284-0403)

TYPE V



COMPONENT: VALVE, SOLENOID, 2-WAY, HELIUM

(MC284-0403)



SCHEMATIC

COMPONENT: VALVE, SOLENOID THREE WAY

(MC284-0404)

FMEA/CIL NO: 03-1-0219
THROUGH 03-1-0232
03-1-0215
03-1-0216
03-1-0243
THROUGH 03-1-0245

VENDOR : EG AND G WRIGHT COMPONENTS
P/N RI : MC284-0404-0021 AND -0012
P/N VENDOR: 13110-4; 1311-3
QUANTITY : 46 PER END ITEM
(22) -0021 HIGH FLOW, VALVE ACTUATION SOLENOID VALVE
(24) - 0012 LOW FLOW, VALVE ACTUATION SOLENOID VALVE

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM: -0021

VALVES, SOLENOID, NORMALLY CLOSED 3-WAY, 3/8 INCH FOR LO_2 AND LH_2 17-INCH DISCONNECTS AND PREVALVE CONTROL

OPENING VALVES: LV-12, LV-14, LV-16, LV-18, LV-20, LV-22, LV-46, LV-48, LV-83, LV-84 AND LV-85

CLOSING VALVES: LV-13, LV-15, LV-17, LV-19, LV-21, LV-23, LV-47, LV-49, LV-80, LV-81 AND LV-82

ITEM: -0012

VALVE, SOLENOID, NORMALLY CLOSED 3-WAY, 1/4 INCH FOR LO_2 AND LH_2 1 INCH, 1-1/2 INCH, AND 2 INCH SHUTOFF VALVES, LO_2 AND LH_2 FILL AND DRAIN VALVES, 17 INCH DISCONNECT LATCH CONTROL VALVES, LH_2 4 INCH DISCONNECT

OPENING VALVES: LV-28, LV-30, LV-32, LV-34, LV-36, LV-39, LV-50, LV-66, LV-67, LV-72, LV-73, LV-79

CLOSING VALVES: LV-24, LV-25, LV-29, LV-31, LV-33, LV-35, LV-51, LV-65, LV-68, LV-76, LV-77, LV-78

COMPONENT: VALVE, SOLENOID THREE WAY

(MC284-0404)

FUNCTION:

THE SOLENOID VALVES CONTROL PNEUMATIC PRESSURE TO CLOSE OR OPEN VARIOUS PNEUMATICALLY OPERATED VALVES LOCATED IN THE MAIN PROPULSION SYSTEM. THE HIGH FLOW SOLENOID VALVES OPERATE THE LO_2 AND LH_2 PREVALVES AND 17 INCH DISCONNECTS. IN THE CRITICALITY I APPLICATION, "ENGINE SHUTDOWN MODE," REDUNDANT SOLENOID VALVES ARE USED TO INSURE VALVE CLOSING. THE LOW FLOW SOLENOID VALVES ARE UTILIZED TO OPERATE VALVES WITH SMALL VOLUME ACTUATORS AND VALVES REQUIRING LOW ACTUATION FORCES.

DESIGN:

THE VALVE IS A THREE-WAY NORMALLY CLOSED, TWO POSITION, CONTINUOUS DUTY TYPE, WITH HERMETICALLY SEALED ELECTRICAL COMPONENTS. THE VALVE IS SPRING-LOADED SO THAT IN THE DE-ENERGIZED POSITION THE PRESSURE PORT IS CLOSED AND THE ACTUATION PORT IS OPEN TO THE VENT PORT. WITH THE VALVE ENERGIZED, THE VENT PORT IS CLOSED AND THE PRESSURE PORT IS OPEN TO THE ACTUATION PORT. THE VALVE SHALL BE SO CONSTRUCTED THAT ALL INTERNAL LEAKAGE IS DIRECTED TO THE VENT PORT. A VENT PORT PROTECTIVE DEVICE IS REQUIRED AS A REMOVABLE ASSEMBLY TO PROVIDE VENT PORT, MOISTURE, AND CONTAMINATION PROTECTION. FILTERS ARE PROVIDED ON THE INLET AND OUTLET PORTS TO PREVENT CONTAMINATION.

VALVE IS DESIGNED TO A PRESSURE FACTOR OF SAFETY OF 2.0 PROOF, 4.0 BURST. THE CLOSURE DEVICE IS A 430 CRES BALL ACTING UPON EITHER OF TWO VESPEL SEATS. THE VALVE FEATURES A BALANCED LOAD ON THE BALL BY APPLYING INLET PRESSURE (750 PSIG NOMINAL) DIRECTLY TO THE BALL AT THE INLET SEAT AND INDIRECTLY (VIA A BELLOWS) THROUGH THE VENT SEAT. THE BELLOWS IS ASSISTED BY A SPRING, THE FORCE OF WHICH INSURES THE BALL IS HELD SECURELY AGAINST THE INLET SEAT WHEN THE SOLENOID IS DEENERGIZED. UPON BEING ENERGIZED THE SOLENOID DEVELOPS THE FORCE TO OVERCOME THE SPRING LOAD AND SEATS THE BALL ONTO THE VENT SEAT TO ALLOW HELIUM FLOW. TOTAL POPPET MOVEMENT (STROKE) IS LESS THAN 0.040 INCH.

COMPONENT: VALVE, SOLENOID THREE WAY

(MC284-0404)

FOR THE VALVE TO FAIL TO DEACTUATE MEANS THE FORCE TO RETURN THE BALL TO THE INLET SEAT IS NOT PRESENT, THE FORCE HOLDING IT ON THE VENT SEAT IS NOT REMOVED, OR FLOW OUT THE VENT PORT IS PREVENTED. WHEN THE SOLENOID IS DEENERGIZED. THE FORCE TO RETURN THE BALL TO THE INLET SEAT IS PROVIDED BY THE BELLOWS ASSEMBLY AND SPRING THROUGH THE VALVE POPPET. IF THE BELLOWS FAILS, OR LEAKS TO THE POINT OF REDUCING THE BELLOWS INTERNAL PRESSURE TO LESS THAN THE VALVE INLET PRESSURE, THE LOAD BALANCING FEATURE IS ELIMINATED. INLET FLOW AGAINST THE BALL WOULD CONTINUE TO HOLD IT AGAINST THE VENT SEAT (AFTER DEENERGIZING THE SOLENOID) CAUSING THE VALVE TO FAIL TO DEACTUATE. THE BELLOWS ARE MADE OF NICKEL-COBALT-COPPER AND ARE ASSEMBLED INTO A SUBASSEMBLY. THIS SUBASSEMBLY IS PROOF PRESSURE TESTED AT 1,550 PSIG PRIOR TO VALVE FINAL ASSEMBLY. IF THE SPRING BREAKS THE PRESSURIZED BELLOWS WOULD EXERT SUFFICIENT FORCE TO RETURN THE BALL TO THE INLET SEAT; HOWEVER, SEAT LEAKAGE MAY RESULT. THE SPRING IS MADE FROM 17-7PH CRES (ELGILOY) WIRE AND IS HEAT TREATED FOLLOWING FORMING. IT HAS A SPRING RATE OF 13.5 LB/INCH AND EXERTS A FORCE OF 7.54 LB. IN ITS INSTALLED CONDITION.

FAILURE TO REMOVE THE FORCE HOLDING THE BALL ON THE VENT SEAT, WHEN THE SOLENOID IS DEENERGIZED, COULD BE CAUSED BY BINDING IN THE SOLENOID. FORCE TO DRIVE THE BALL TO THE VENT SEAT IS DELIVERED FROM THE SOLENOID BY A PLUNGER AND BY TWO PUSHRODS (ALIGNED IN SERIES WITHIN, AND GUIDED BY, THE SOLENOID STOP). THE AREAS OF POTENTIAL BINDING ARE BETWEEN THE PLUNGER AND SOLENOID OR BETWEEN THE PUSHRODS AND THE SOLENOID STOP. TO PRECLUDE BURRS THE SOLENOID BORE IS HONED, AND TO PREVENT BINDING, THE PLUNGER IS COATED WITH A DRY-FILM LUBRICANT. THE SOLENOID STOP IS MADE OF A MUCH HARDER MATERIAL (430 CRES) THAN EITHER OF THE PUSHRODS (17-4PH AND 304 CRES) TO PREVENT GALLING.

THE VENT CHECK VALVE, WHICH SCREWS INTO THE SOLENOID VALVE VENT PORT, IS OF SIMPLE DESIGN, CONTAINING ONLY FIVE PARTS. CRACK AND RESEAT PRESSURES ARE 0.5 PSID AND THE UNIT IS DESIGNED FOR 10,000 CYCLES. HIGH INLET PRESSURE (710 PSIA NOMINAL) ACTING ON A LARGE POPPET (0.603 INCH DIAMETER) PRODUCES A FORCE IN EXCESS OF 400 POUNDS TO ASSURE CHECK VALVE OPENING. THE CHECK VALVE BODY AND POPPET ARE OF 2024-T6 ALUMINUM, AND TO PREVENT GALLING OR BINDING, HAVE BEEN HARD ANODIZED. TO PRECLUDE COCKING, THE POPPET STEM IS CLOSELY GUIDED OVER 50 PERCENT OF ITS LENGTH BY THE BODY BORE (STEM, 0.139 INCH DIAMETER; BORE, 0.141 INCH DIAMETER).

CLOGGING OF THE 20 MICRON NOMINAL, 40 MICRON ABSOLUTE, RATED ACTUATION PORT FILTER WOULD PREVENT THE SOLENOID FROM VENTING THE ACTUATOR, CREATING THE EFFECT OF FAILURE TO DEACTUATE. THE FILTER IS PLEATED IN ORDER TO INCREASE SURFACE AREA.

COMPONENT: VALVE, SOLENOID THREE WAY

(MC284-0404)

DESIGN PARAMETERS AND FEATURES:

OPERATING TEMPERATURE: MINUS 160°F TO PLUS 175°F

FLUID TEMPERATURE: MINUS 160°F TO PLUS 250°F

OPERATING PRESSURES: ZERO TO 850 PSIG

PROOF PRESSURE: 1,700 PSIG MINIMUM

BURST PRESSURE: 3,400 PSIG MINIMUM

WEIGHT: TYPE I: 2.25 LB
TYPE II: 1.86 LB

VALVE PORT SIZE: TYPE I (-0021) - 3/8 INCH
TYPE II (-0012) - 1/4 INCH

VALVE OPERATING TIME:

OPENING AND CLOSING RESPONSE: 100 MILLISECONDS (MAX)

PULL IN VOLTAGE: 18 VOLTS DC

DROP OUT VOLTAGE: 1.5 VOLTS DC

FLOW RATE:

TYPE I: 0.02 LB/SEC; 10 PSID INLET PRESSURE 710 PSIG

TYPE II: 0.01 LB/SEC; 10 PSID, INLET PRESSURE 710 PSID

LEAKAGE: 850 PSIG

EXTERNAL - 5 SCCH HELIUM
INTERNAL - 2 SCCS DEENERGIZED
- 7 SCCS ENERGIZED

VENT PORT - 10 SCCM MAX AT 5 TO 15 PSIG

CONTINUOUS CURRENT 100 HR MINIMUM EXPOSED TO STILL AIR AT 175°F MINIMUM AND 32 VOLT DC

CURRENT LOAD:

1.5 AMPERES MAXIMUM STEADY STATE
2.0 AMPERES MAXIMUM TRANSIENT

COMPONENT: VALVE, SOLENOID THREE WAY

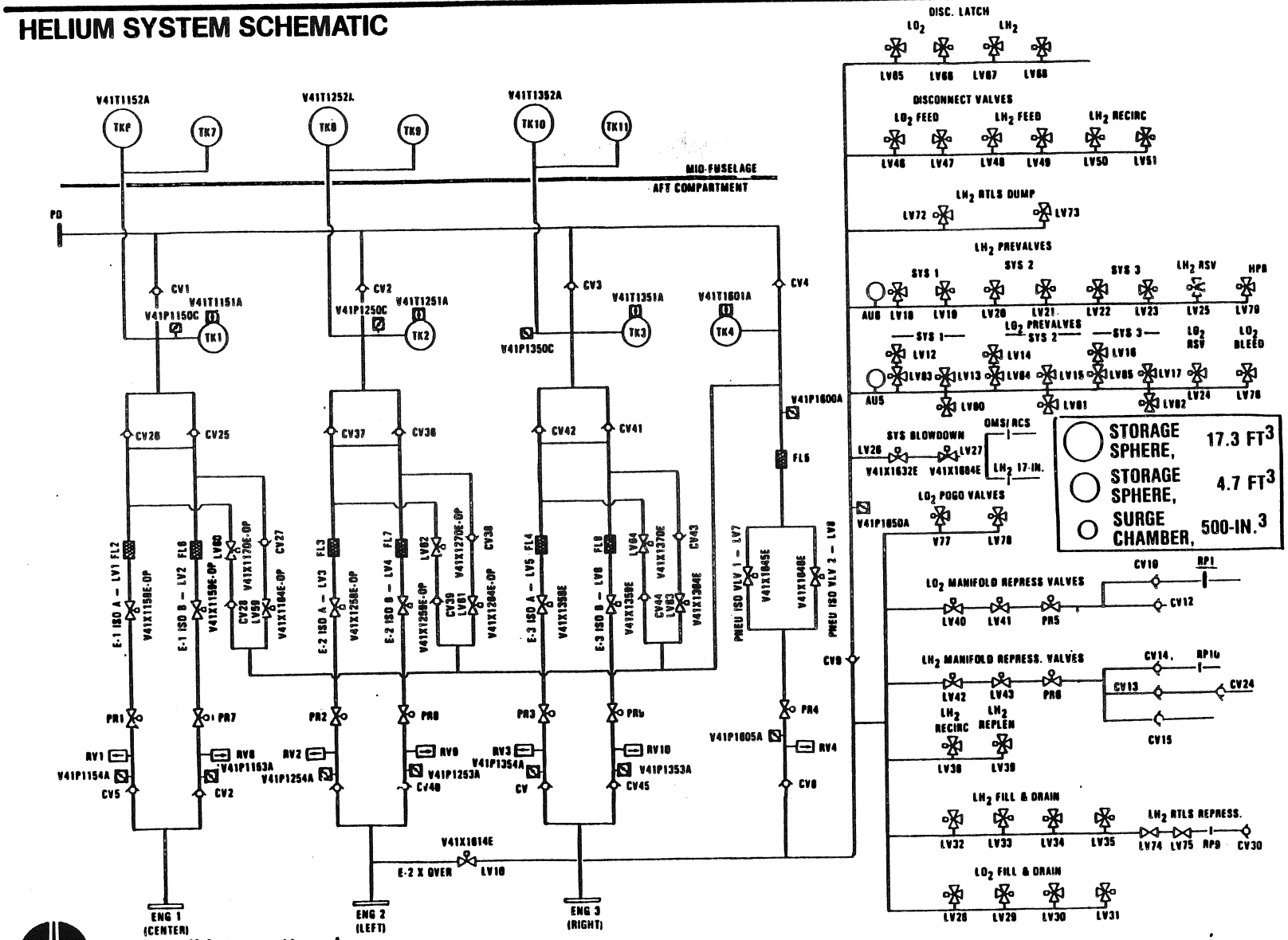
(MC284-0404)

MATERIAL
VALVE BODY: 6061-T651 ALUMINUM FILTER AND RETAINER: 304 CRES POPPET: 304 CRES STOP ROD: 304 CRES SPACER: 304 CRES V-SEALS: INCO 750 BELLOWS: 304 CRES AND NICKEL SPRING: 17-7 PH CRES LOWER SEAT: 17-4 CRES AND VESPEL BALL: 430 SPACER: 347 CRES SPACER: 304 CRES UPPERSEAT: 304 CRES AND VESPEL SOLENOID ASSY: 430 AND 304L CRES "O" RING: SILICONE

COMPONENT: VALVE, SOLENOID THREE WAY

(MC284-0404)

HELIUM SYSTEM SCHEMATIC



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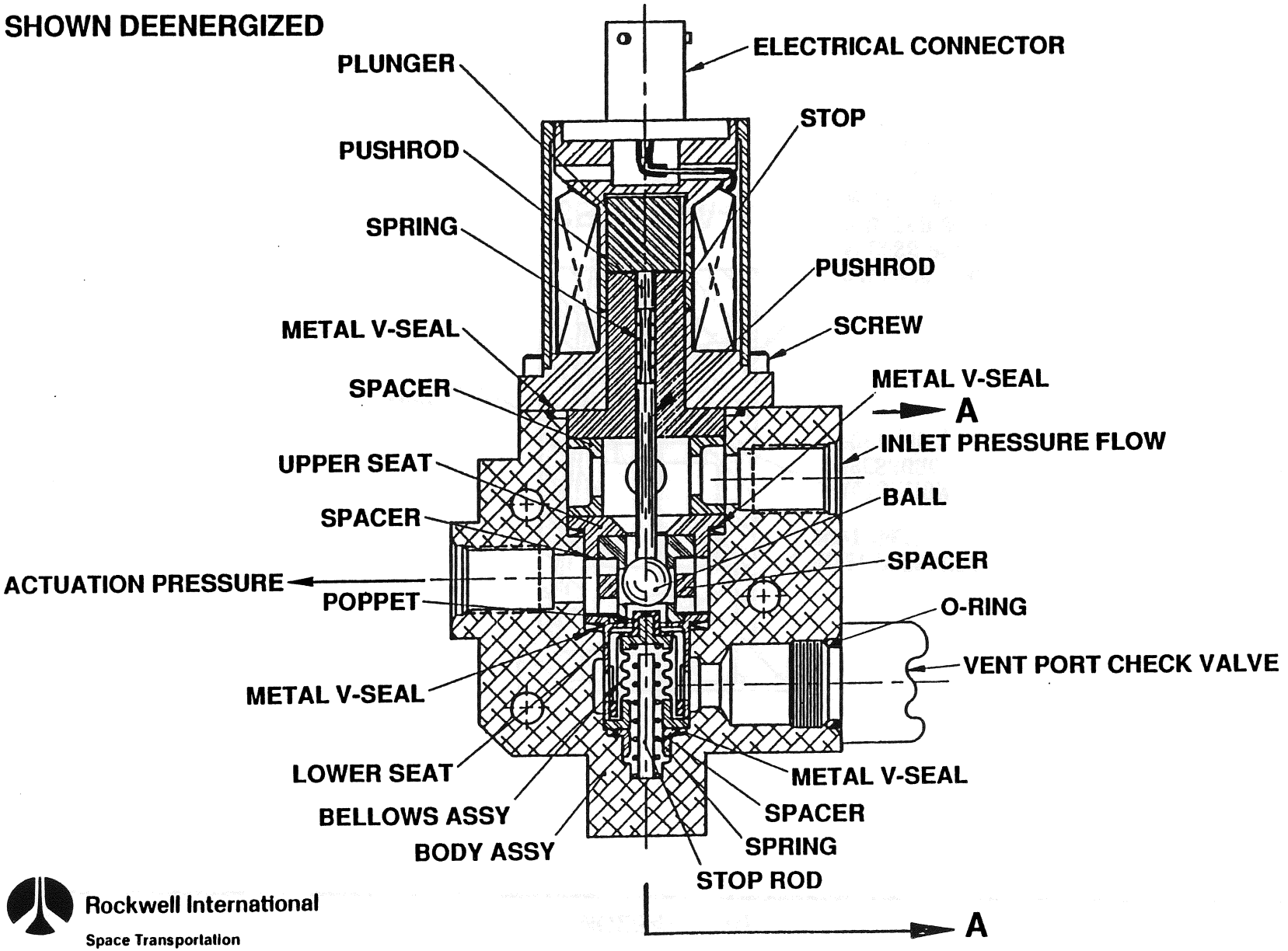
COMPONENT: VALVE, SOLENOID THREE WAY

(MC284-0404)

SHOWN DEENERGIZED



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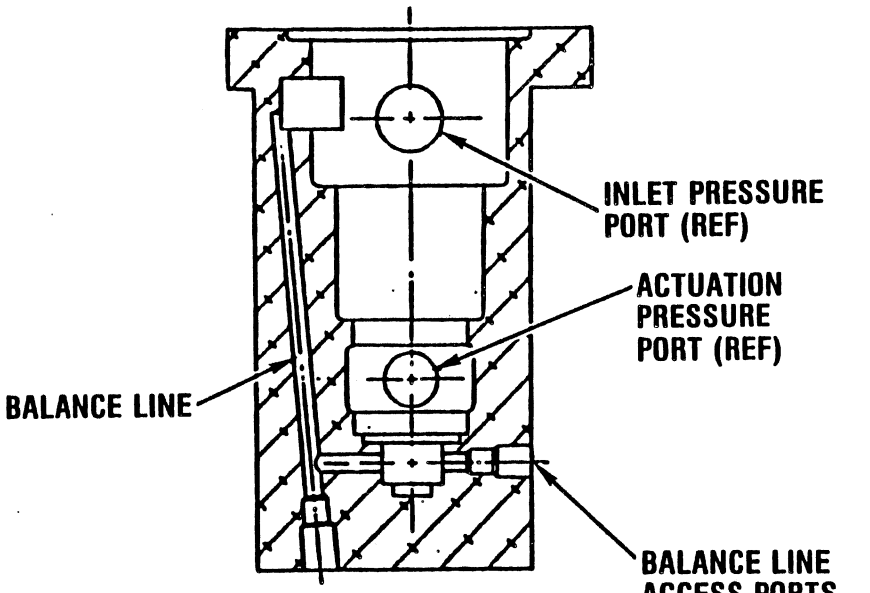
COMPONENT: VALVE, SOLENOID THREE WAY

(MC284-0404)

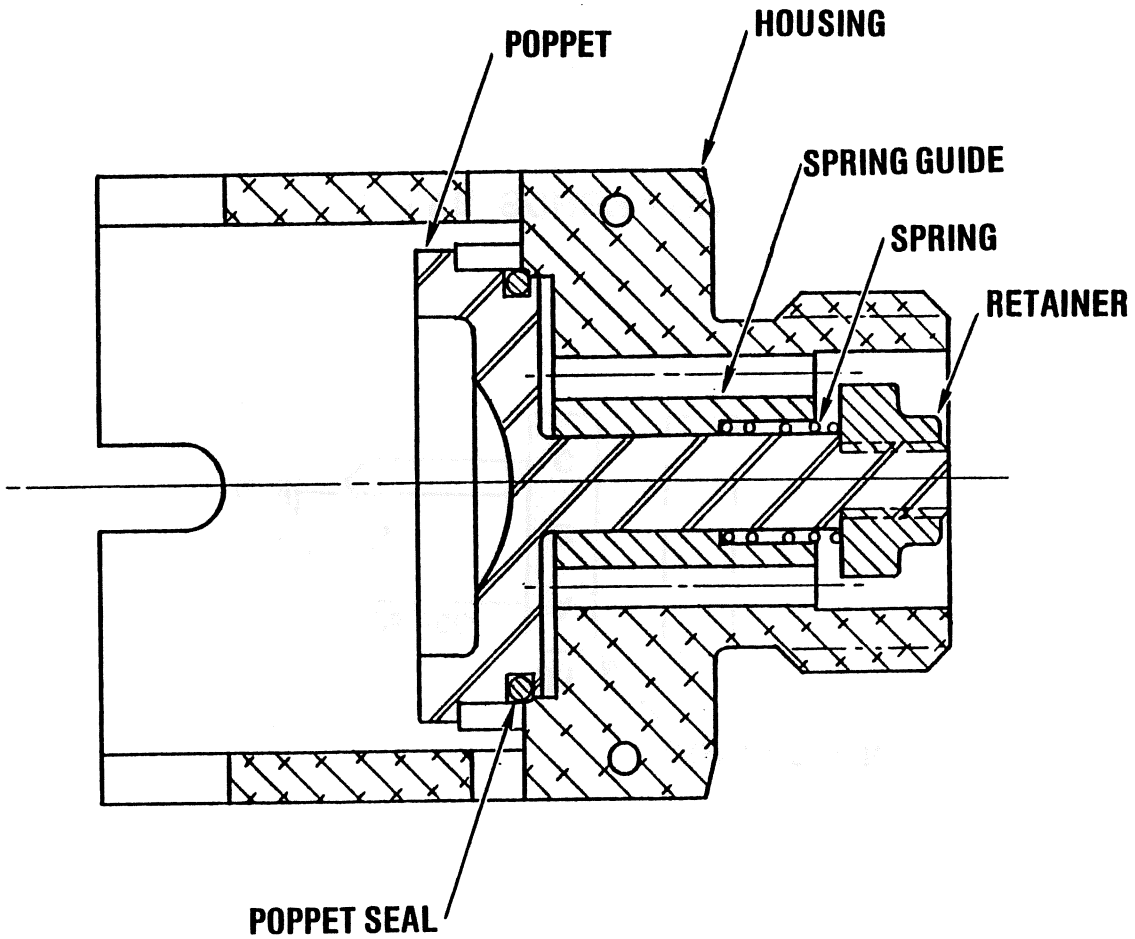


SECTION A-A

COMPONENT: VALVE, SOLENOID THREE WAY

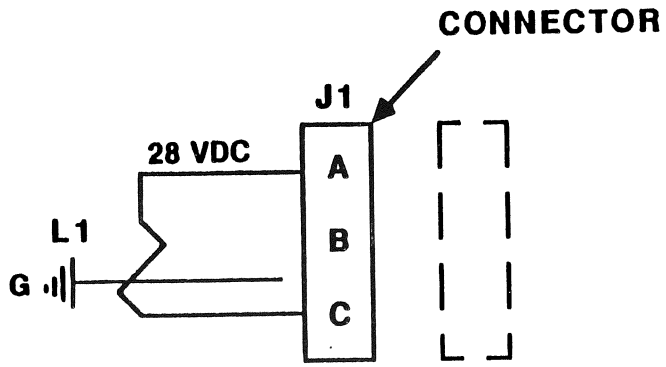
(MC284-0404)

VENT CHECK VALVE
VENDOR P/N 11107-5



COMPONENT: VALVE, SOLENOID THREE WAY

(MC284-0404)



VALVE SCHEMATIC

COMPONENT: VALVE, SHUTOFF, LO_2 AND LH_2 RELIEF

(MC284-0406)

FMEA/CIL NO. 03-1-0437

VENDOR : FAIRCHILD CONTROL
P/N RI : MC284-0406-0002 FOR OV-103 AND SUBS
: MC284-0406-0001 FOR OV-102
P/N VENDOR: 74329000-101 AND -103
QUANTITY : 2 PER END ITEM
: ONE LH_2 AND ONE LO_2

ITEM:

VALVE, ONE INCH LH_2 AND LO_2 FEEDLINE RELIEF SHUTOFF, PNEUMATICALLY ACTUATED CLOSED, NORMALLY OPEN (PV7, PV8)

FUNCTION:

ISOLATES THE LH_2 AND LO_2 PROPELLANT FEED SYSTEMS FROM THE FEEDLINE RELIEF SYSTEM. MAINTAINED CLOSED FROM START OF PROPELLANT LOADING UNTIL MECO. VALVE IS MOUNTED ON THE INBOARD FILL AND DRAIN VALVE BODY.

DESIGN:

THE VALVE IS A NORMALLY OPEN, FLAPPER-TYPE SHUTOFF VALVE, WITH A PNEUMATIC ACTUATOR. IT IS SPRING LOADED TO THE OPEN POSITION BY A BELLOWS WITHIN THE ACTUATOR. IN THE ACTUATOR-VENTED CONDITION THE BELLOWS SPRING FORCE IS TRANSMITTED TO THE VALVE FLAPPER VIA A BELLOWS GUIDE (SHAFT) AND MECHANICAL LINKAGE TO ROTATE THE FLAPPER AWAY FROM THE VALVE SEAT. WHEN ACTUATION PRESSURE IS APPLIED TO THE ACTUATOR THE BELLOWS IS COMPRESSED, CAUSING THE BELLOWS GUIDE AND MECHANICAL LINKAGE TO ROTATE THE FLAPPER TO THE VALVE CLOSED POSITION. VALVE INLET PRESSURE ASSISTS IN HOLDING THE FLAPPER TO THE VALVE SEAT. AT MECO THE SOLENOID IS CLOSED AND THE ACTUATOR IS VENTED THROUGH THE VENT PORT OF THE SOLENOID VALVE. SPRING FORCE OF THE BELLOWS THEN OPENS THE FLAPPER.

THE FLAPPER VALVE IS OPERATED BY THE BELLOWS THROUGH A PINNED LINKAGE CONSISTING OF A FLAPPER ARM, A LINK, AND A BELLOWS GUIDE WELDED TO THE BELLOWS. THE FLAPPER ARM IS MADE FROM COPPER-BERYLLIUM #172 AND HEAT TREATED TO CONDITION HT. THE FLAPPER LINK IS OF 2219-T87 AL AND IS .278 INCH THICK. THE PINS ARE A286 CRES AND HAVE A 0.2475 INCH DIAMETER. THE BELLOWS GUIDE IS MACHINED FROM 304L CRES, WHICH IS SUBSEQUENTLY ANNEALED. THE BELLOWS IS FORMED FROM TWO PLYS OF 0.01 INCH INCONEL 718 AND IS HEAT TREATED AFTER FORMING.

COMPONENT: VALVE, SHUTOFF, LO_2 AND LH_2 RELIEF

(MC284-0406)

IT IS DESIGNED FOR 10,000 CYCLES; 5 TIMES GREATER THAN THE VALVE SPECIFICATION REQUIREMENT. THE BELLOWS ASSEMBLY ACCEPTANCE TESTING INCLUDES PROOF PRESSURE, LEAKAGE, AND CYCLING.

THE ACTUATOR INLET PORT IS EQUIPPED WITH A FILTER TO PREVENT ACTUATOR CONTAMINATION. POSITION INDICATION MICROSWITCHES FOR VALVE OPEN AND CLOSED POSITION ARE ACTUATED BY A SHAFT CONNECTED TO THE BELLOWS GUIDE. THE MICROSWITCHES USED ARE IDENTICAL TO THOSE USED ON OTHER MPS COMPONENTS, HOWEVER, THIS USAGE DOES NOT MAINTAIN A PRELOAD ON THE SWITCH ARMS.

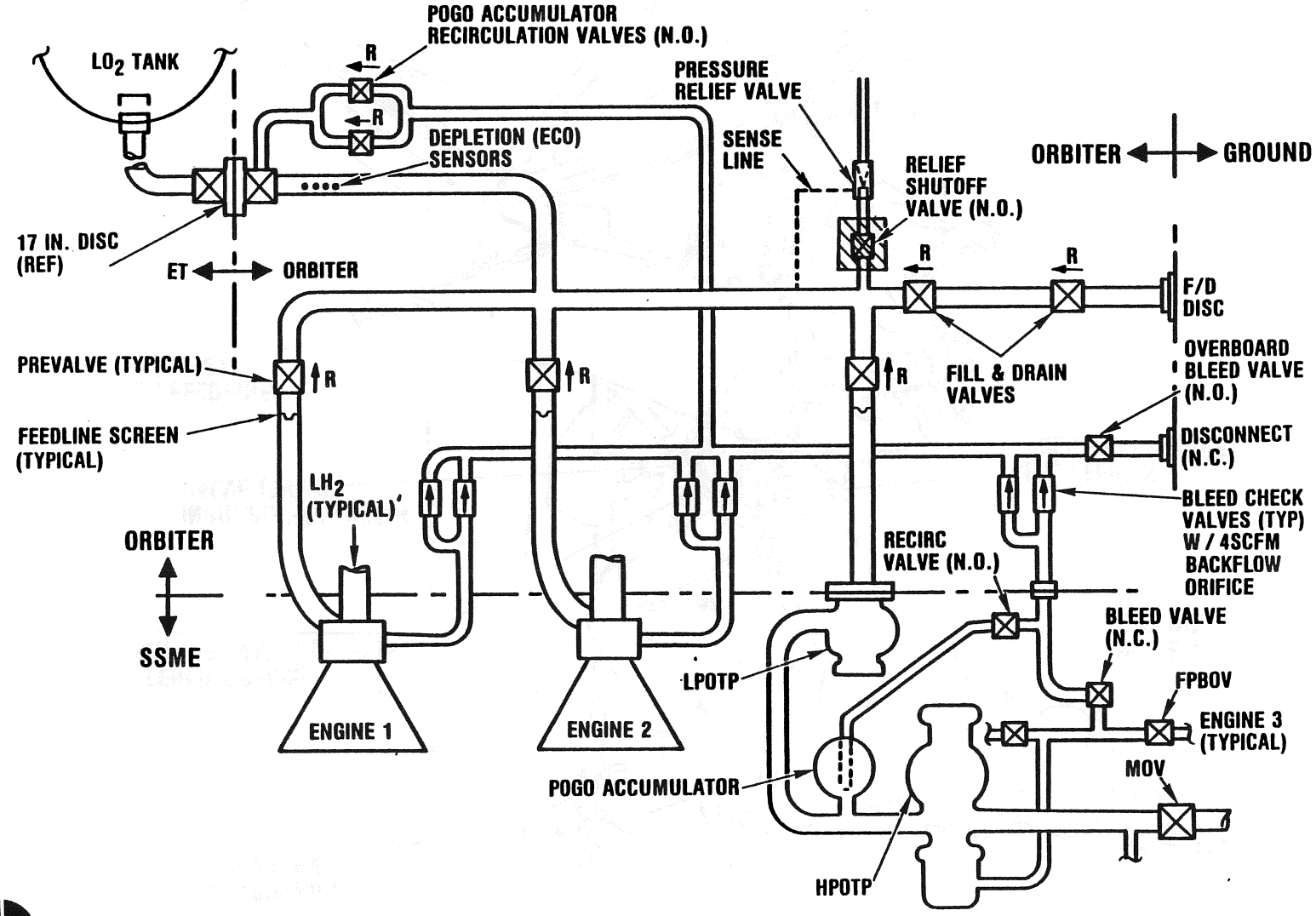
DESIGN PARAMETERS AND FEATURES:

OPERATING PRESSURE:	OPEN 0-220 PSIG LO_2, 0-60 PSIG LH_2 CLOSED 0-200 PSIA LO_2, 0-50 PSIA LH_2
MAX. FLOW AND ΔP:	2.4 LB/S LH_2 AT 50 PSIG, ΔP 2.8 PSID 24.0 LB/S LO_2 AT 200 PSIG, ΔP 16.6 PSID
TEMPERATURE RANGE:	-423°F TO 170°F OPERATING, 200°F MAX. NON-OPERATING
ENVELOPE DIMENSION:	4.8 X 8.7 INCHES
WEIGHT:	4.0 LB MAX.
ACTUATION PRESSURE:	700-780 PSIG NOM., 850 PSIG MAX., 400 PSIG MIN.
LO_2 SURGE PRESSURE LIMIT:	275 PSIA
VALVE RESPONSE:	
CLOSING TIME	3.0 SECONDS MAXIMUM
OPENING TIME	1.5 SECONDS MAXIMUM
EXTERNAL LEAKAGE	.25 SCIM AT -423°F TO +170°F
INTERNAL LEAKAGE:	75 SCIM AT -320°F TO +170°F (LO_2) 150 SCIM AT -423°F TO +170°F (LH_2)
PROOF PRESSURE:	413 PSIG VALVE BODY 1275 PSIG ACTUATOR
BURST PRESSURE:	550 PSIG VALVE BODY 3400 PSIG ACTUATOR

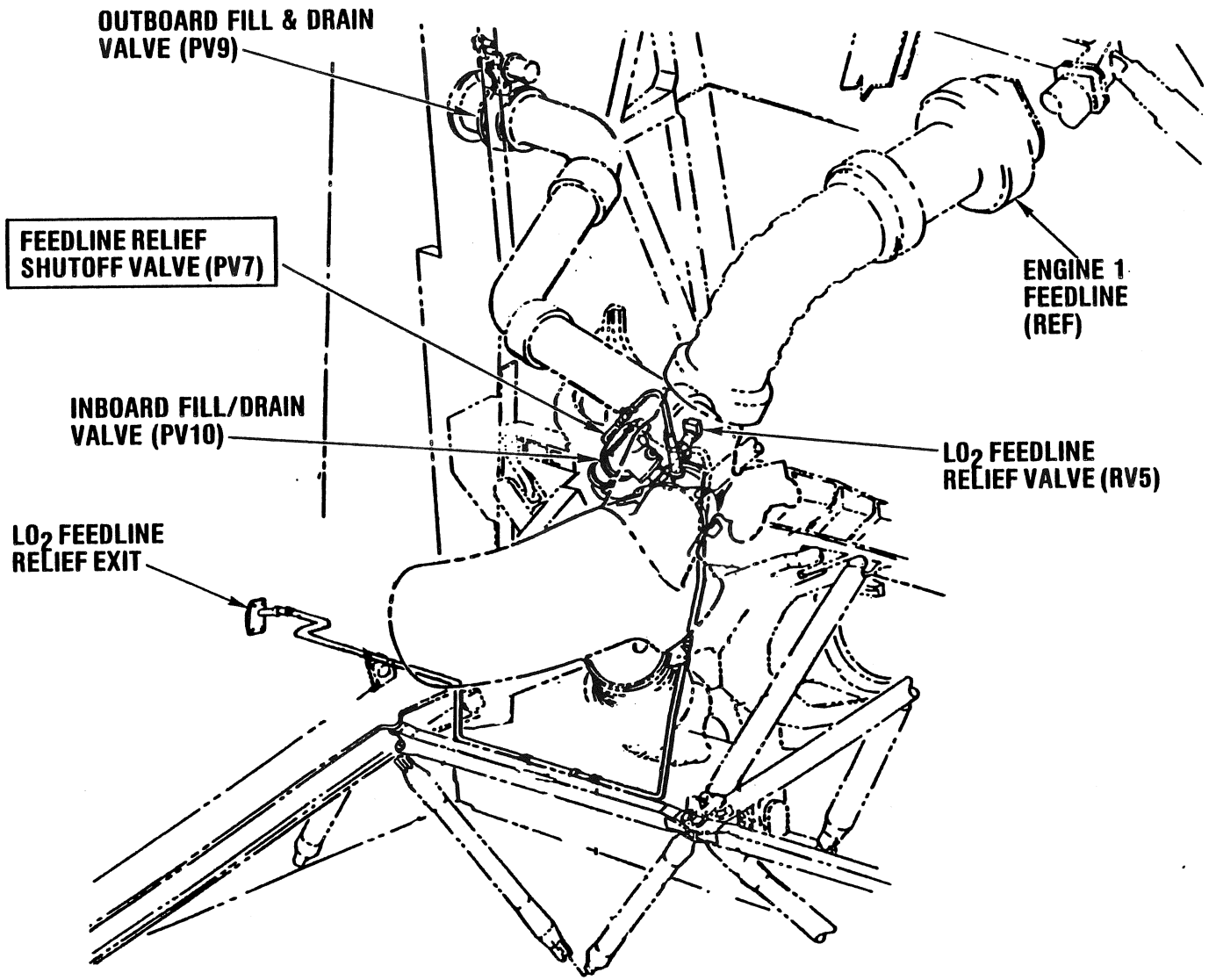
MATERIALS
VALVE BODY: 2219-T852
ACTUATOR BODY: A356-T6
BELLOWS: INCONEL 718
GUIDE BELLOWS: 304L CRES
CYLINDER CLEVIS: 6061-T651
FLAPPER SEAL: KEL F
RETAINER: A286
GUIDE: A286

COMPONENT: VALVE, SHUTOFF, LO_2 AND LH_2 RELIEF
(MC284-0406)

LO_2 SYSTEM

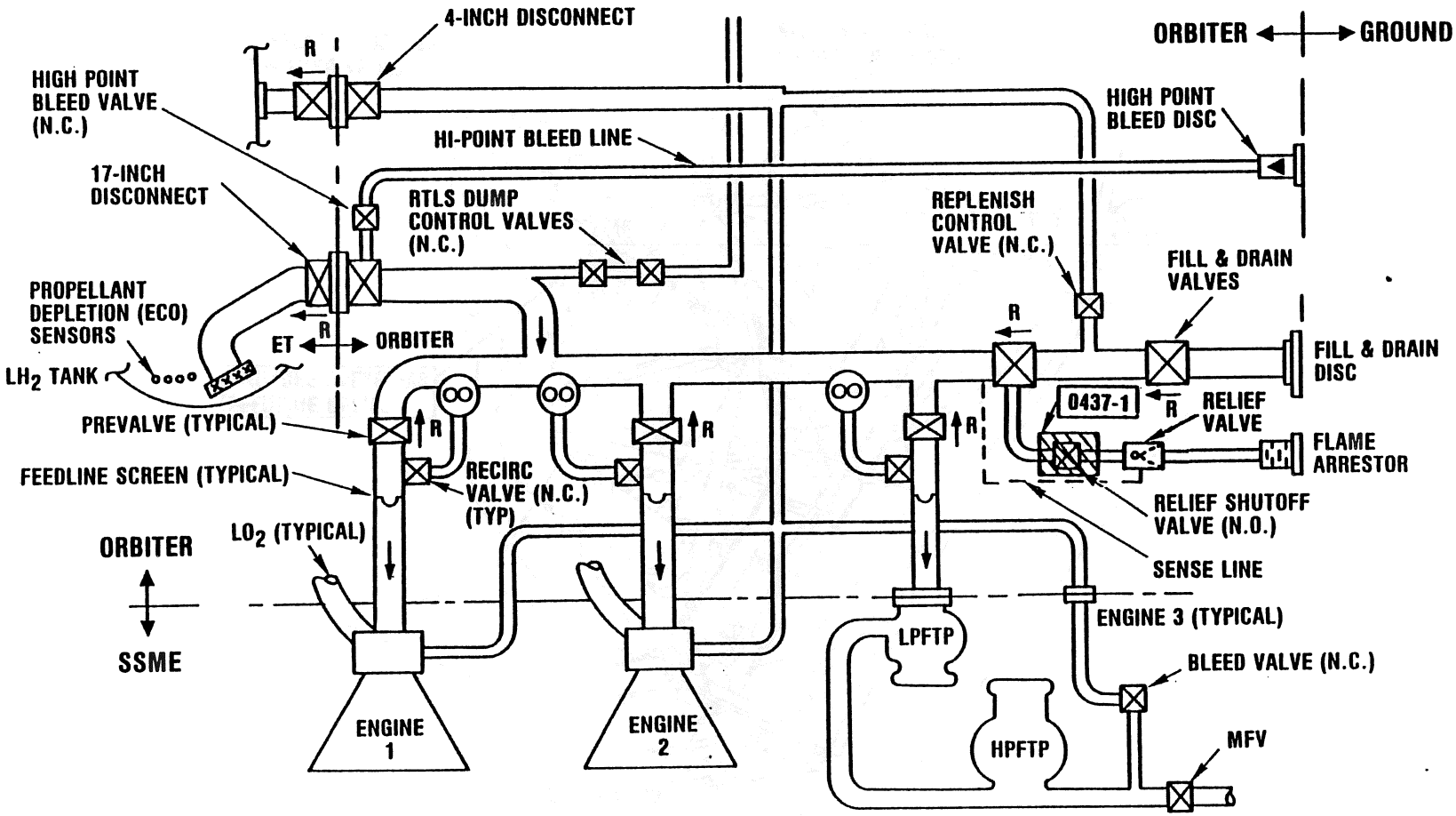


COMPONENT: VALVE, SHUTOFF, LO_2 AND LH_2 RELIEF
(MC284-0406)

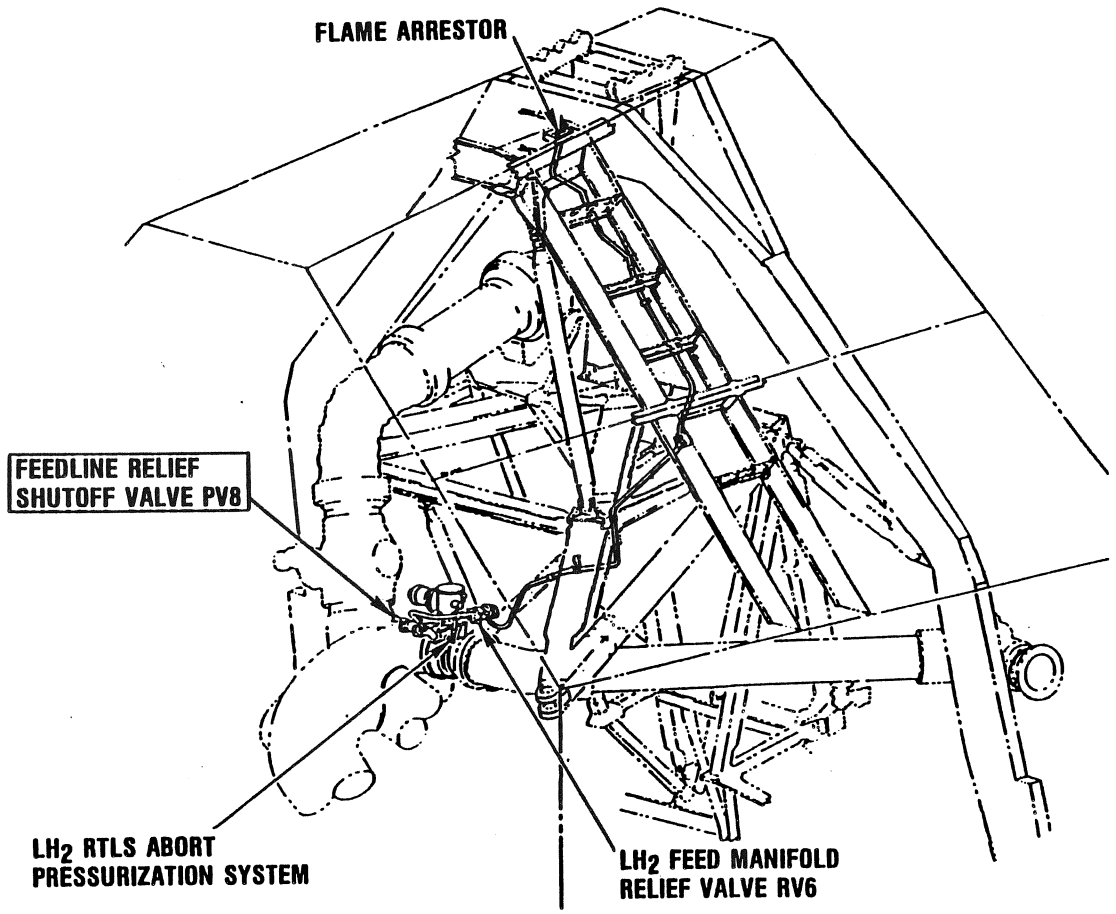


COMPONENT: VALVE, SHUTOFF, LO_2 AND LH_2 RELIEF
(MC284-0406)

LH_2 SYSTEM

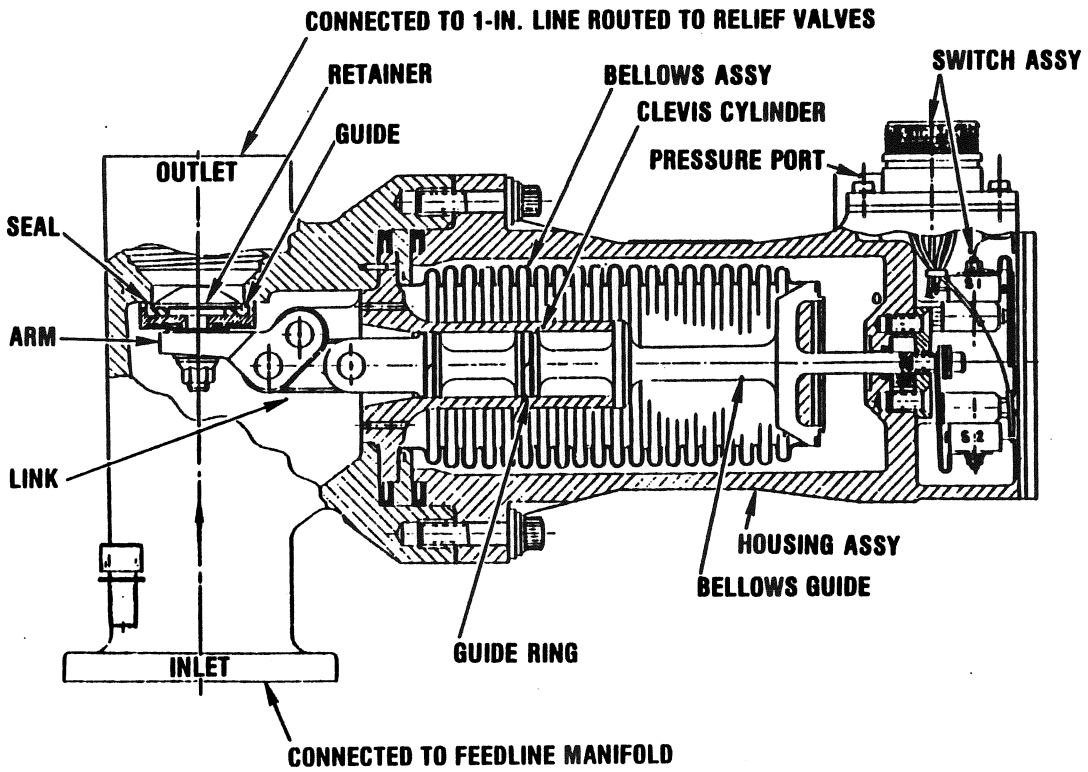


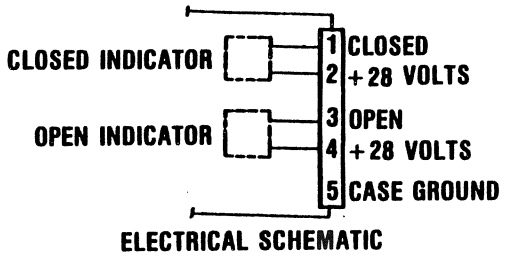
COMPONENT: VALVE, SHUTOFF, LO_2 AND LH_2 RELIEF
(MC284-0406)



COMPONENT: VALVE, SHUTOFF, LO_2 AND LH_2 RELIEF
(MC284-0406)

MC284-0406-0002





ELECTRICAL SCHEMATIC

COMPONENT: VALVE, RELIEF, IN LINE (LH_2 AND LO_2)

(MC284-00501)

FMEA/CIL NO: 03-1-0436
03-1-0412

ASSEMBLY : PARKER-HANNIFIN
P/N RI : MC284-0501-0001, -0002
P/N VENDOR: 5760073-101 (LO_2), 5760074-101 (LH_2)
QUANTITY : 2 PER END ITEM
: ONE LO_2 (-0001)
: ONE LH_2 (-0002)

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X		

ITEM: VALVE, RELIEF, 1 INCH, LH_2 (RV6) AND LO_2 (RV5) FEEDLINE MANIFOLD RELIEF.

FUNCTION:

RELIEVES PRESSURE BUILDUP FROM MANIFOLD. THE VALVE INLET IS ISOLATED FROM THE FEED SYSTEM UNTIL MECO BY THE UPSTREAM FEEDLINE RELIEF SHUTOFF VALVES (PV8, PV9). THE RELIEF VALVE INCORPORATES A SENSE PORT WHICH SENSES THE MANIFOLD PRESSURE VIA A SENSE LINE. THE CRACKING AND RESEAT PRESSURES ARE BETWEEN 190-220 PSIG FOR THE TYPE I VALVES AND 40 AND 55 PSIG FOR THE TYPE II VALVES.

THIS VALVE IS REQUIRED TO OPERATE FOR OI-8B ORBITER SOFTWARE - FOR NOMINAL, ATO, AOA, AND TAL MISSIONS LH_2 MANIFOLD PRESSURE INCREASES TO RELIEF PRESSURE SETTING PRIOR TO INITIATION OF PROPELLANT DUMP.

FOR OI-8C MISSIONS (STS-34 AND SUBS), APPROVED ORBITER SOFTWARE CHANGE CR89399 EXTENDS RTLS DUMP VALVE OPEN TIME TO MECO + 90 SECONDS FOR ALL MISSIONS EXCEPT RTLS. AS A RESULT OF THIS CHANGE, A MANIFOLD PRESSURE INCREASE TO RELIEF PRESSURE SETTING PRIOR TO INITIATION (MECO + 120 SECONDS FOR NOMINAL, ATO, AND AOA MISSIONS; APPROXIMATELY MECO + 2 TO 3 MINUTES FOR TAL MISSIONS) OF DUMP IS NOT EXPECTED.

COMPONENT: VALVE, RELIEF, IN LINE (LH_2 AND LO_2)

(MC284-00501)

DESCRIPTION:

VALVE

THE RELIEF VALVE CONSISTS OF TWO SECTIONS: A PRESSURE ACTUATED MAIN POPPET SECTION AND A PILOT SECTION WHICH SENSES/COMPARES MANIFOLD PRESSURE TO AMBIENT PRESSURE BY MEANS OF A SENSING LINE.

THE PILOT SECTION CONTROLS THE OPENING AND CLOSING OF THE MAIN POPPET BY ALLOWING THE MANIFOLD PRESSURE TO ENTER OR EXIT A CONTROL CHAMBER. WHEN THE MANIFOLD PRESSURE REACHES A PREDETERMINED PILOT SETTING, THE PILOT VENTS THE CHAMBER PRESSURE OVERBOARD ALLOWING THE PRESSURE DIFFERENTIAL ACROSS THE MAIN POPPET TO PUSH THE MAIN POPPET OPEN. ONCE THE MANIFOLD PRESSURE DROPS BELOW THE PILOT CONTROL SETTING, THE PILOT POPPET CLOSES, THE MANIFOLD PRESSURE ENTERS THE CONTROL CHAMBER, AND THE MAIN POPPET CLOSES.

THE PILOT BELLOWS ASSEMBLY CONSISTS OF A TWO-PLY BELLOWS, A FLANGE, AND A CAP; ALL OF INCONEL 625 AND PASSIVATED. THE SEAMS OF THE BELLOWS ARE FUSION WELDED (FULL PENETRATION). THE FLANGE AND CAP ARE FUSION WELDED TO THE BELLOWS. ALL WELDS ARE DYE PENETRANT INSPECTED. EACH BELLOWS ASSEMBLY IS PROOF TESTED AND LEAK CHECKED BEFORE BEING ELECTRON BEAM WELDED TO THE MIDDLE HOUSING ASSEMBLY. THE WELD IS DYE PENETRANT INSPECTED, PROOF PRESSURE TESTED, AND LEAK TESTED. THE PROOF PRESSURE FACTOR OF SAFETY AT AMBIENT TEMPERATURE IS 1.5 FOR THE VALVE OUTLET AND 2.0 FOR THE INLET FOR TYPE I UNITS. FOR THE TYPE II UNITS THE PROOF PRESSURE FACTOR IS 2.0 FOR THE INLET AND OUTLET. THE BURST PRESSURE FACTOR OF SAFETY IS 4.0 FOR THE VALVE BODY. THE YIELD FACTOR OF SAFETY IS 1.0. THE ULTIMATE FACTOR OF SAFETY IS 1.5.

THE OPERATING LIFE OF THE VALVE IS A MINIMUM OR 5,000 CYCLES. THE VALVE SHALL HAVE A MINIMUM USEFUL LIFE OF 10,000 CYCLES, WHICH IS EQUIVALENT TO 100 ORBITAL MISSIONS IN A 10 YEAR PERIOD FROM THE DATE OF DELIVERY. THE SHELF LIFE OF THE VALVE IS 12 YEARS AFTER THE DATE OF DELIVERY.

THE PILOT SPRING-SEAT COMPRESSION SPRING IS 0.041 INCH DIAMETER ELGILOY WIRE AND HEAT TREATED.

COMPONENT: VALVE, RELIEF, IN LINE (LH_2 AND LO_2)

(MC284-00501)

DESIGN PARAMETERS:

	Type I (LO_2)	Type II (LH_2)
CURRENT CONFIGURATION:	(-0001)	(-0002)
CRACKING AND RESEAT PRESSURE:	190 - 220 PSIG	40 - 55 PSIG
SURGE PRESSURE:	275 PSIG	50 PSIG
FLOW CAPACITY:	24 LB/SEC AT -260°F	2.4 LBS/SEC AT -419°F
INTERNAL LEAKAGE:	10 SCIM OF GO_2 AT 0-180 PSIG AND -300 TO +275°F	10 SCIM OF GH_2 0 - 35 PSIG AND -423 TO +275°F
EXTERNAL LEAKAGE:	5 SCIM GO_2 AT 0 TO 220 PSIG OVER -300°F TO +275°F	10 SCIM GH_2 AT 0 TO 55 PSIG OVER -423°F TO +275°F
OPERATING TEMPERATURE RANGE:	PLUS 275 TO MINUS 300F	PLUS 275 TO MINUS 432
NOMINAL LINE SIZE:	ONE INCH	ONE INCH
ENVELOPE DIMENSIONS:	4-1/8 IN. X 4-1/8 IN. X 7-1/2 IN.	4-1/8 IN. X 4-1/8 IN. 7-1/2 IN.
WEIGHT:	7.5 LB	7.5 LB

COMPONENT: VALVE, RELIEF, IN LINE (LH_2 AND LO_2)

(MC284-00501)

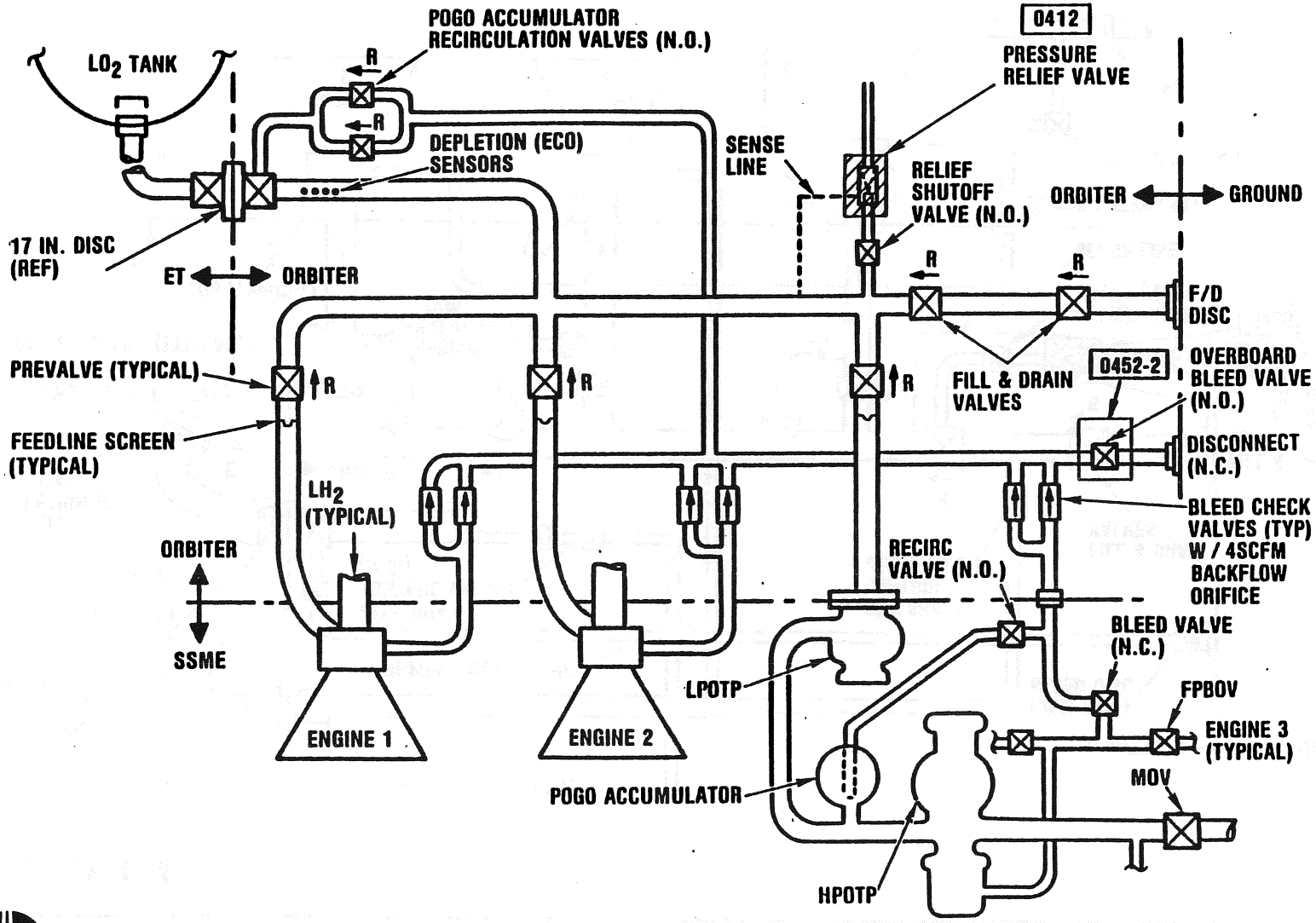
	TYPE I (LO_2)	Type II (LH_2)
PROOF PRESSURE: INLET OUTLET SENSE PORT	 440 PSIG 450 PSIG 440 PSIG	 110 PSIG 300 PSIG 110 PSIG
BURST PRESSURE: INLET OUTLET SENSE PORT	 880 1200 880	 220 600 220
DIFFERENTIAL PRESSURE DROP:	105 PSID	20 PSID

MATERIALS
BODY: 304L CRES/6061-T651 BELLOWS ASSY: INCONEL 625 SEAL: TEFLON SPRING, BELLVILLE: 302 CRES SPRING, COMPRESSION: ELGILOY

COMPONENT: VALVE, RELIEF, IN LINE (LH_2 AND LO_2)

(MC284-00501)

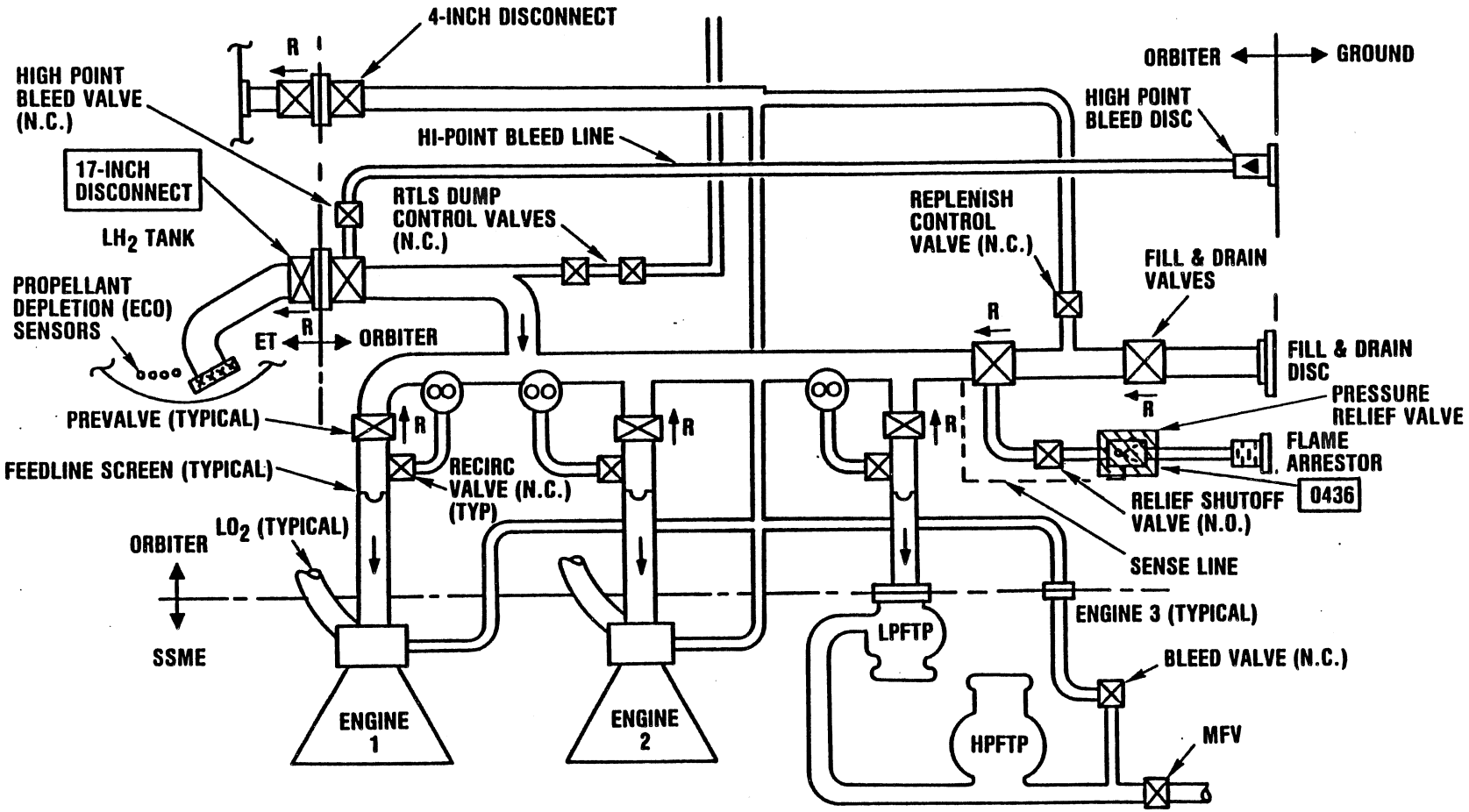
LO_2 SYSTEM



COMPONENT: VALVE, RELIEF, IN LINE (LH_2 AND LO_2)

(MC284-00501)

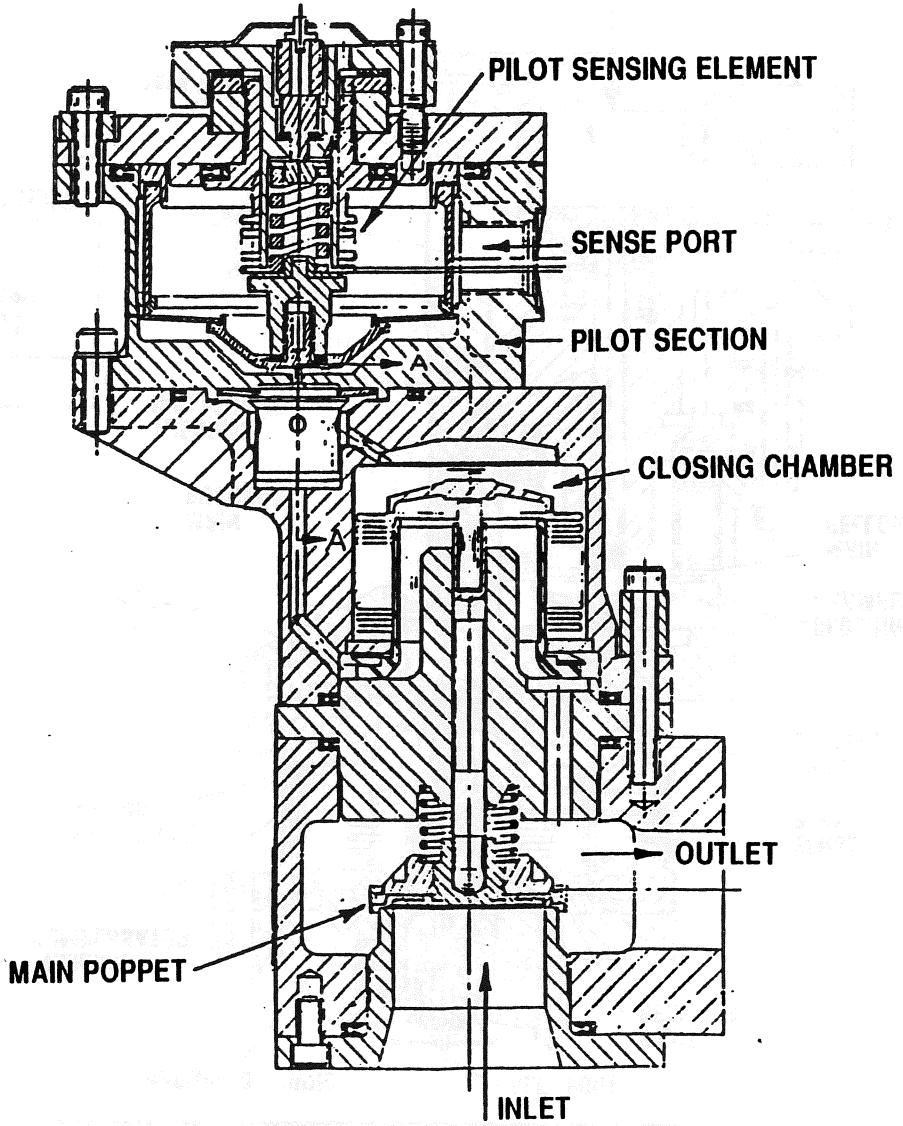
LH_2 SYSTEM



COMPONENT: VALVE, RELIEF, IN LINE

(MC284-0501)

LO_2, TYPE I



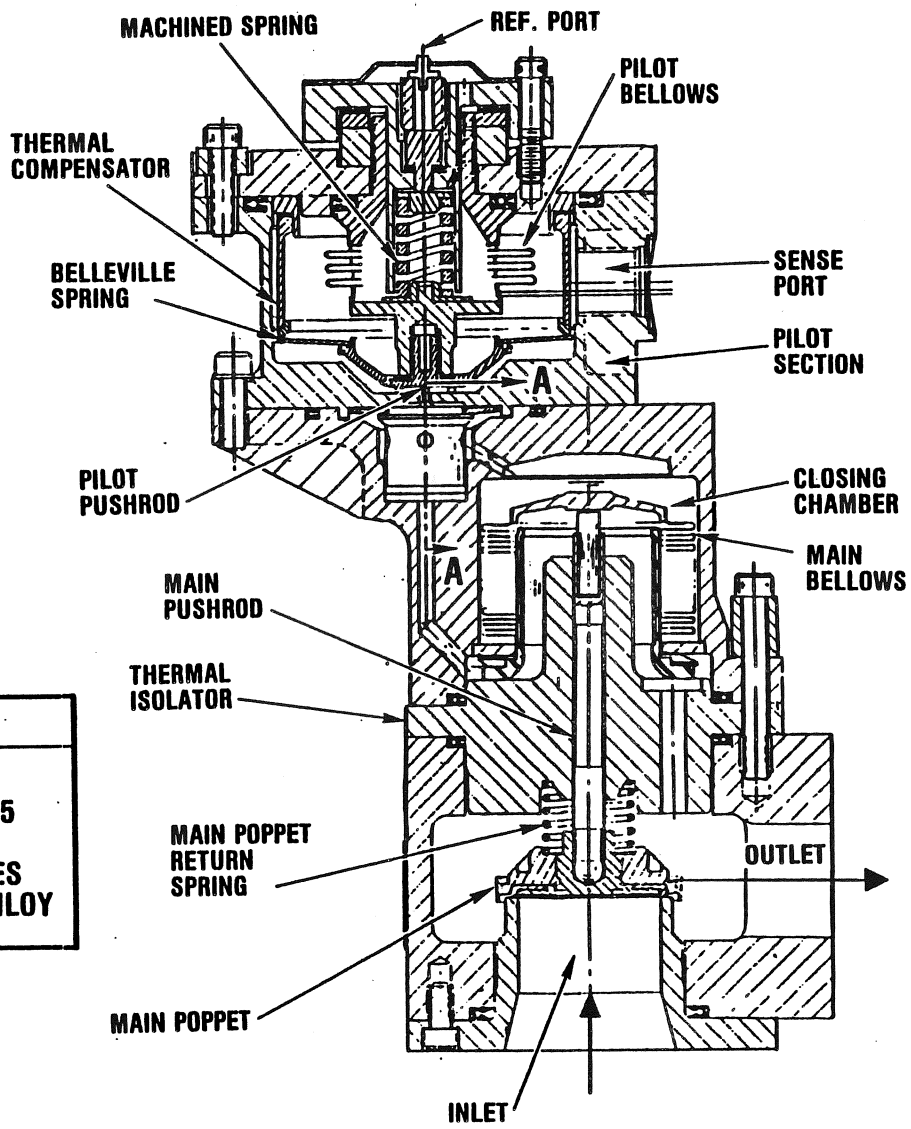
Rockwell International

Space Transportation
Systems Division

COMPONENT: VALVE, RELIEF, IN LINE

(MC284-0501)

LH_2, TYPE II

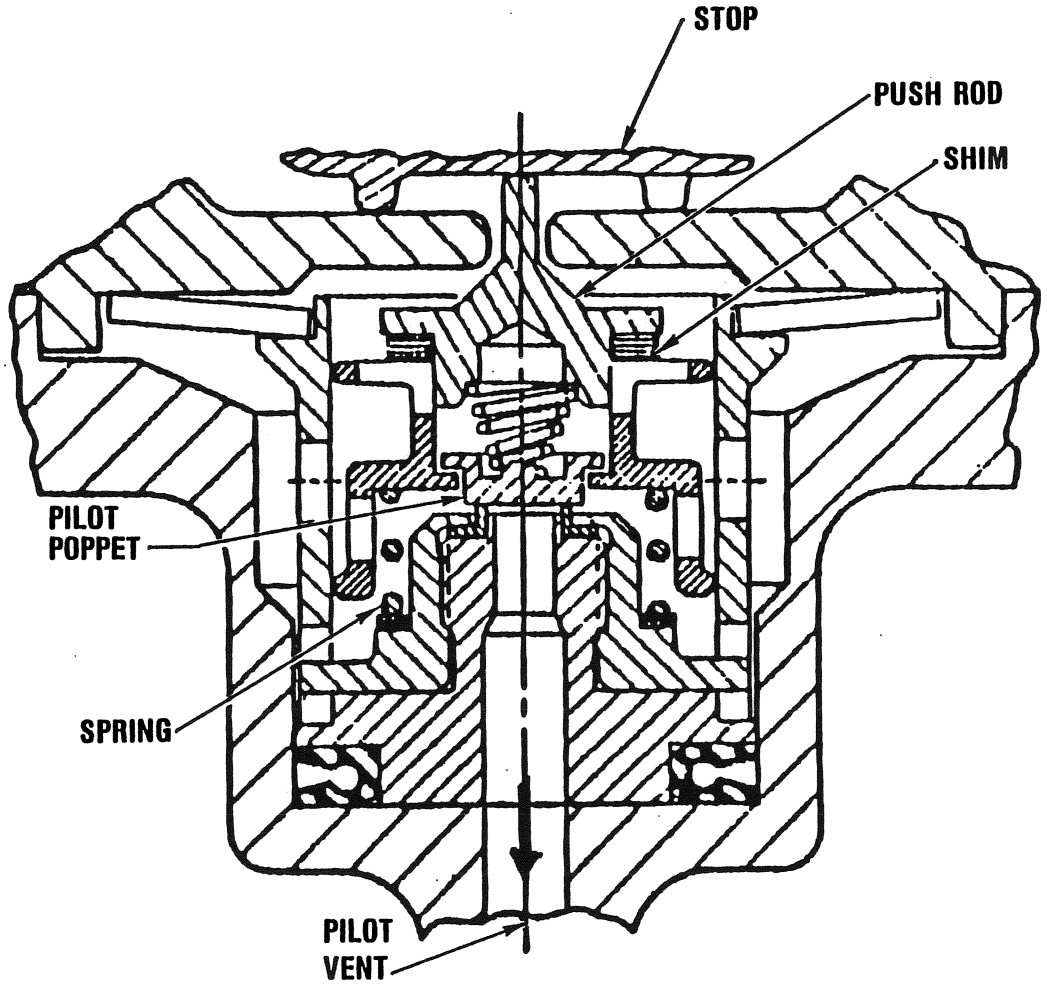


MATERIALS
BODY: 304L CRES/6061-T651
BELLOWS ASSY: INCONEL 625
SEAL: TEFLON
SPRING, BELLVILLE: 302 CRES
SPRING, COMPRESSION: ELGILOY

COMPONENT: VALVE, RELIEF, IN LINE

(MC284-0501)

PILOT POPPET ASSY



SECTION A-A

COMPONENT: VALVE, CHECK, DUAL

(MC284-0515)

FMEA/CIL NO: 03-1-0451

VENDOR : PARKER HANNIFIN
P/N RI : MC284-0515-0003
P/N VENDOR: 5760024-103
QUANTITY : 3 PER END ITEM
(1 PER ENGINE)

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

VALVE, DUAL CHECK, LO_2 BLEED, 1 INCH INLET & OUTLET DIAMETER (CV31, CV33, CV35).

FUNCTION:

THE VALVE CONSISTS OF TWO CHECK VALVES IN PARALLEL IN ONE ASSEMBLY. THE PURPOSE OF THE TWO CHECK VALVES IN PARALLEL IS TO PROVIDE REDUNDANCY FOR NORMAL OPERATION. A 4 SCFM BLEED ORIFICE IS PROVIDED FOR PURGING THE ENGINES DURING RE-ENTRY.

PARALLEL FLAPPERS CONTAINED IN ONE CHECK VALVE ASSEMBLY PROVIDE A PATH FOR LO_2 RECIRCULATION/BLEED AND POGO SUPPRESSION FLOW. PREVENTS REVERSE FLOW OF LO_2 INTO THE SSME DURING START SEQUENCE AND IN THE EVENT OF AN ENGINE MALFUNCTION (PREMATURE SHUTDOWN). ONE CHECK VALVE ASSEMBLY IS PROVIDED FOR EACH ENGINE SYSTEM.

EACH CHECK VALVE ASSEMBLY HAS ONE 0.052 INCH ORIFICE TO PROVIDE A CONTROLLED (4 SCFM) GHE REPRESSURIZATION PURGE TO THE RESPECTIVE SSME DURING ENTRY (DUE TO THE EXCESSIVE LEAK RATE THROUGH THE ENGINE HPOT SEALS THE LO_2 PREVALVES ARE MAINTAINED CLOSED TO PREVENT LOSS OF HELIUM SUPPLY).

POGO RECIRCULATION VALVES (PV20, 21) ARE OPENED AT T-12.5 SECONDS TO CHILL DOWN POGO RETURN LINE UNTIL OVERBOARD BLEED VALVE (PV19) IS CLOSED AT T-9.4 SECONDS. THIS CHECKS (VALVE FLAPPERS CLOSE) BLEED FLOW FROM ENGINES UNTIL ENGINE START. ENGINE START SEQUENCE BEGINS AT T-6.6 SECONDS.

COMPONENT: VALVE, CHECK, DUAL

(MC284-0515)

DESIGN:

THE LO_2 CHECK VALVE HOUSING IS MADE FROM 321/304L CRES. SPRING-LOADED (ELGILOY) PARALLEL FLAPPERS (TEFLON-COATED 304 CRES) ARE USED TO PROVIDE THE REVERSE FLOW CHECK CAPABILITY. THE HINGE BOXES ARE TEFLON COATED TO PREVENT BINDING. THE FLAPPER CRACKING PRESSURE IS 0.5 PSID, WHICH IS LESS THAN THE SYSTEM PRESSURE ACTING TO OPEN THE FLAPPERS. THE ASSEMBLY INCLUDES A 0.052 INCH ORIFICE FOR REPRESSURIZATION/PURGING OPERATIONS.

THE DESIGN FACTORS OF SAFETY FOR PROOF IS 2 TIMES OPERATING PRESSURE (800 PSIG), AND 4 TIMES OPERATING PRESSURE (1,600 PSIG) FOR BURST. STRUCTURAL ANALYSIS INDICATES POSITIVE MARGINS OF SAFETY FOR ALL CONDITIONS OF VALVE OPERATIONS; FRACTURE/FATIGUE ANALYSES SHOW THAT ALL CRITICAL PARTS ARE SATISFACTORY FOR FOUR TIMES EXPECTED LIFE.

SYSTEM CONTAMINATION IS MINIMIZED DUE TO THE PRESENCE OF AN ET SCREEN, PREVALVE SCREENS, A GSE DEBRIS PLATE, A GSE FILTER, AND MAINTAINING A CLEANLINESS LEVEL OF 800A.

CURRENT CONFIGURATION: (-0003)

DESIGN PARAMETERS:

USEFUL LIFE: THE VALVE HAS A MINIMUM USEFUL LIFE OF 5,000 CYCLES OR A 100-ORBITAL MISSIONS IN A 10 YEAR PERIOD FROM DATE OF DELIVERY

PROOF PRESSURE: 800 PSIG

BURST PRESSURE: 1,600 PSIG (VALVE BODY), 550 PSIG (CLOSURE DEVICE)

OPERATING PRESSURES: 400 PSIG (MAX)

CHECK PRESSURE RANGE: 0 - 275 PSID

COMPONENT: VALVE, CHECK, DUAL

(MC284-0515)

CRACKING PRESSURE: 0.5 PSID AT -290°F TO +140°F

OPERATING TEMPERATURES: -100°F TO +130°F

FLUID TEMPERATURE RANGE: -297°F TO +140°F

LINE SIZE: 1.0 INCH

EXTERNAL LEAKAGE: 1.0×10^{-5} SCCS He AT 0-400 PSIG

WEIGHT: 1.16 POUNDS

ENVELOPE SIZE: 8.12 INCH X 3.00 INCH DIA.

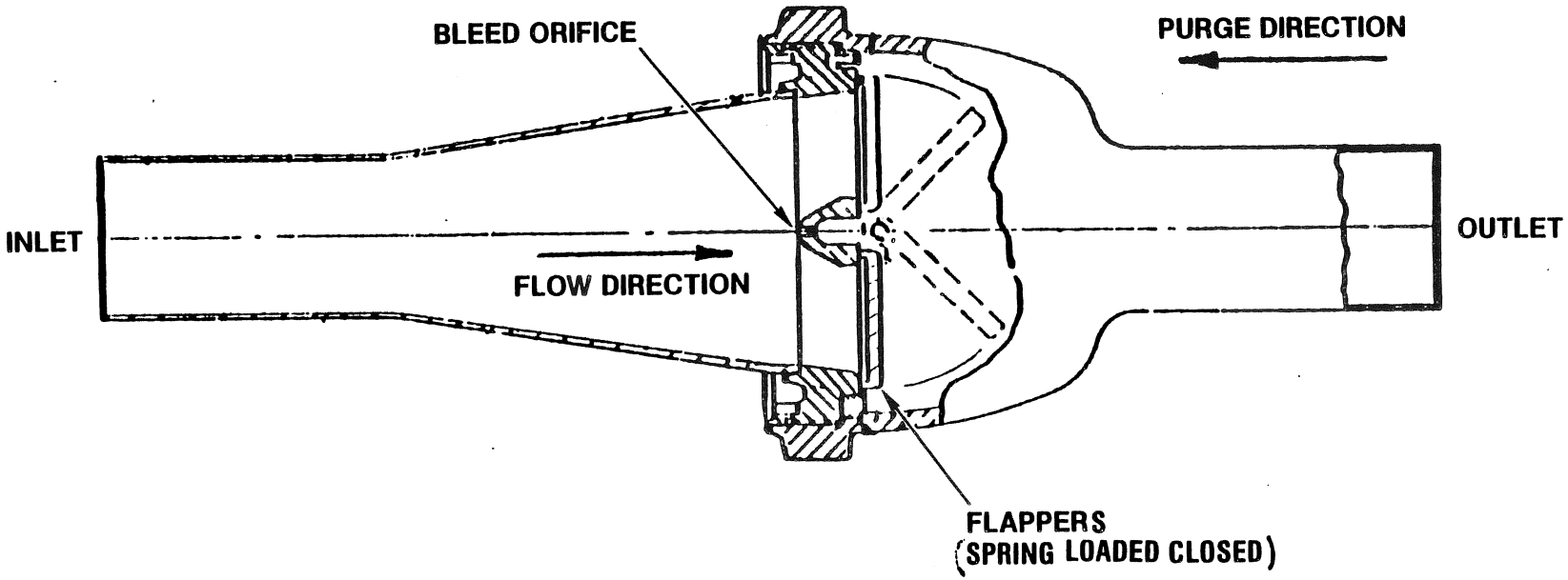
FLOW RATE AND PRESSURE DROP: (FOR EACH FLOW PASSAGE)

FLUID	FLUID TEMPERATURE	INLET PRESSURE	FLOW RATE	MAX. PRESSURE DROP
LO_2	SUB-COOLED LIQUID	--	4 LB/SEC	3.2 PSID
GO_2	PLUS 70 TO 90°F	20 PSIA MAX.	0.057 LB/SEC	0.8 PSID
LO_2	SUB-COOLED LIQUID	--	21 LB/SEC	INFORMATION ONLY
(SIMULTANEOUS FLOW THROUGH BOTH PASSAGES)				
LO_2	SUB-COOLED LIQUID	--	4 LB/SEC	1.2 PSID
GO_2	PLUS 70 TO 90°F	20 PSIA MAX.	0.057 LB/SEC	0.6 PSID
(REVERSE FLOW DIRECTION)				

4.25 + .25 SCFM OF HELIUM WHEN CORRECTED TO AN INLET PRESSURE OF 25 PSIG; OUTLET PRESSURE AT AMBIENT, AND A GAS TEMPERATURE OF 70 DEGREES F.

COMPONENT: VALVE, CHECK, DUAL

(MC284-0515)



COMPONENT: REGULATOR, HELIUM PRESSURE, 750 PSIG

(MC284-0533)

FMEA/CIL NO. 03-1-0205

VENDOR : EATON CONSOLIDATED CONTROLS
P/N RI : MC284-0533-0005/-0004*
P/N VENDOR: 73664-0005/-0004
QUANTITY : 7 PER END ITEM =
: 6 (2 PER ENGINE He SUPPLY) PR1, 2, 3, 7, 8, 9
: 1 (FOR PNEUMATIC LEG) PR4

VEHICLE EFFECTIVITY:	102	*103	104	105
	X	X	X	X

ITEM:

REGULATOR, 750 PSIG, ENGINE HELIUM SUPPLY (0.375 INCH DIAMETER INLET, 0.5 INCH DIAMETER OUTLET)
ETER OUTLET).

FUNCTION:

REGULATES THE ENGINE HELIUM SUPPLY PRESSURE FROM 4,500 TO 900 PSIG DOWN TO 750 PSIA, WHICH IS THE NOMINAL OPERATING PRESSURE AT THE ORBITER/ENGINE INTERFACE. THE DOWNSTREAM SYSTEM INCORPORATES A RELIEF VALVE TO PREVENT DOWNSTREAM OVERPRESSURIZATION IN EVENT THE REGULATOR FAILS HIGH. A REDUNDANT REGULATOR IS IN A PARALLEL LEG TO ASSURE GHe FROM EACH ENGINE SUPPLY TO ITS PARTICULAR ORBITER/ENGINE INTERFACE.

ONE REGULATOR IS USED IN THE ORBITER PNEUMATIC SYSTEM TO REGULATE THE HIGH PRESSURE-HELIUM SUPPLY TO A LOWER SYSTEM OPERATING PRESSURE FOR USE IN COMPONENT OPERATION, PROPELLANT FEED AND FILL SYSTEMS REPRESSURIZATION, PRESSURIZATION TO EXPEL PROPELLANTS FROM THE FEED SYSTEMS AND TO PROVIDE ENGINE PURGE GAS. THE REGULATOR IS USED PRIOR TO, DURING, AND AFTER COMPLETION OF FLIGHT.

COMPONENT: REGULATOR, HELIUM PRESSURE, 750 PSIG

(MC284-0533)

DESIGN:

THE REGULATOR IS A PILOT-OPERATED, FAST-RESPONSE, HIGH FLOW HELIUM REGULATOR WITH AN INTERNAL ABSOLUTE PRESSURE REFERENCE. THE OUTLET PRESSURE IS REGULATED BETWEEN 715 PSIA AND 770 PSIA WITH AN INLET PRESSURE BETWEEN 900 PSIG AND 4,500 PSIG AT FLOW RATES UP TO 1.0 POUND PER SECOND (PPS) MAXIMUM. THE REGULATOR IS AN ALL-WELDED UNIT WITHOUT ANY EXTERNAL ADJUSTMENT OR SENSING LINES.

WHEN THE OUTLET PRESSURE FALLS BELOW 715 PSIA, THE BELLOWS/SPRING ASSEMBLY EXPANDS AND FORCES THE PILOT POPPET TO OPEN VIA THE PILOT SHAFT. THIS ALLOWS A PRESSURE DECREASE BEHIND THE MAIN POPPET CAUSING IT TO SLIDE TO THE OPEN POSITION. THE BELLOWS/DAMPER ASSEMBLY SENSES THE OUTLET PRESSURE AND CLOSES WHEN THE OUTLET PRESSURF EXCEEDS 770 PSIA.

UNDER NORMAL REGULATOR OPERATION, WHEN THE OUTLET PRESSURE IS LOWERED, THE EXTERNAL PRESSURE ON THE BELLOWS ASSEMBLY DECREASES AND ALLOWS THE BELLOWS TO EXPAND. THIS RAPIDLY MOVES THE PILOT SHAFT AGAINST THE PILOT POPPET AND FORCES IT TO OPEN. THIS ALSO DECREASES THE BACKSIDE PRESSURE ON THE MAIN POPPET AND ALLOWS IT TO OPEN A FLOW PATH FROM THE INLET TO THE OUTLET. SEVERAL CONDITIONS COULD ALLOW THE REGULATOR TO FAIL HIGH:

BELLOWS LEAKAGE:

THE INCONEL 718 BELLOWS ASSEMBLY IS HERMETICALLY PRESSURE SEALED (WITH FREON 14) TO 78.5 PSIA. LEAKAGE OF THE BELLOWS ASSEMBLY CAUSES A PRESSURE BIAS WHICH RESULTS IN REGULATOR FAILING OPEN. TO PRECLUDE THIS, THE BELLOWS ASSEMBLY IS TESTED FOR LEAKAGE (1×10^{-7} SCCS) AND PRESSURIZED EXTERNALLY WITH He AT 700 TO 750 PSIG (8 HOURS MINIMUM) FOR DESIGNED BELLOWS LOAD PRIOR TO ASSEMBLY IN THE REGULATOR HOUSING.

RING GUIDE CONTAINMENT:

THE MAIN POPPET-RING GUIDES THE POPPET FROM THE OPEN TO CLOSED POSITION. THE RING IS MADE FROM VESPEL SP-21 TO MINIMIZE BINDING. THE MAIN POPPET ASSEMBLY PROVIDES 100 PERCENT CONTAINMENT OF THE RING.

COMPONENT: REGULATOR, HELIUM PRESSURE, 750 PSIG

(MC284-0533)

POPPET SEAT LEAKAGE:

THE MAIN AND PILOT POPPETS ARE PROTECTED FROM CONTAMINATION BY AN UPSTREAM 25 MICRON ABSOLUTE RATED FILTER ASSEMBLY. THE REGULATOR IS ASSEMBLED CLEAN TO LEVEL 100A AND THE HELIUM SUPPLIED TO THE ORBITER IS FILTERED BY GROUND SYSTEMS. A 125 MICRON FILTER IS PROVIDED TO PROTECT THE PILOT POPPET FROM CONTAMINATION.

POPPET PISTON BINDING:

THE POPPETS AND THE DAMPER PISTON ARE PROTECTED FROM BINDING BY THE USE OF MOLY-KOTE DRY LUBRICANT FOR THE ALUMINUM PARTS AND BY THE USE OF VESPEL SP-21 RINGS ON THE MAIN POPPET AND DAMPER ASSEMBLIES.

CLOGGED FILTER:

THE PILOT FILTER (APPROXIMATELY 125 MICRONS) PREVENTS CONTAMINATION FROM ENTERING THE PILOT CONTROL SECTION OF THE REGULATOR. IF THE FILTER BECOMES CLOGGED, THE FLOW TO THE PILOT SECTION DECREASES. THIS PREVENTS THE MAIN POPPET FROM CLOSING COMPLETELY OR THE PILOT POPPET FROM TRANSLATING. EITHER OF THESE CONDITIONS INCREASES THE OUTLET PRESSURE. THE HELIUM IS FILTERED BY THE GROUND SYSTEM AND BY AN UPSTREAM SYSTEM FILTER (25 MICRONS ABSOLUTE) BEFORE IT ENTERS THE REGULATOR INLET.

MAIN POPPET SPRING FAILURE:

FAILURE OF THE MAIN POPPET SPRING WOULD PREVENT THE REGULATOR FROM FULLY CLOSING. THE MAIN POPPET SPRING IS DESIGNED AGAINST FAILURE BY THE USE OF 302 CRES MATERIAL WHICH EXHIBITS GOOD FATIGUE ENDURANCE PROPERTIES.

PILOT POPPET SPRING FAILURE:

RESULTS IN FAILURE OF THE PILOT POPPET TO RETURN TO THE CLOSED POSITION. THIS WOULD PREVENT PRESSURIZATION OF THE BACKSIDE OF THE MAIN POPPET PISTON WHICH IS REQUIRED TO RETURN THE MAIN POPPET PISTON TO THE CLOSED POSITION (REDUCES REGULATOR OUTLET PRESSURE). THE SPRING IS CONSTRUCTED OF 302 CRES.

COMPONENT: REGULATOR, HELIUM PRESSURE, 750 PSIG

(MC284-0533)

DESIGN: (CONT.)

PILOT POPPET BINDING:

BINDING WOULD RESULT IN FAILURE OF THE PILOT POPPET TO RETURN TO THE CLOSED POSITION. THIS WOULD PREVENT PRESSURIZATION OF THE BACKSIDE OF THE MAIN POPPET PISTON WHICH IS REQUIRED TO RETURN THE MAIN POPPET PISTON TO THE CLOSED POSITION (REDUCES REGULATOR OUTLET PRESSURE). THE PILOT POPPET IS CONSTRUCTED OF POLYIMIDE SP-21 (DUPONT) TO MINIMIZE BINDING.

DESIGN PARAMETERS:

CURRENT CONFIGURATION:	(-0004 AND -0005)
PROOF PRESSURE:	INLET - 9,250 ± 250 OUTLET - 1,550 ± 50
BURST PRESSURE:	INLET - 18,000 OUTLET - 3,400
LINE SIZE:	INLET - 3/8 IN. BOSS OUTLET - 1/2 IN. BOSS
WEIGHT:	3.3 LB
OPERATING BAND:	700 TO 755 PSIG
OPERATING TEMPERATURE:	900 TO 2,000 PSIG, -80 F TO +220 F
	2,000 TO 4,500 PSIG, -60 F TO +220 F
EXTERNAL LEAKAGE:	1 SCIM MAX AT OPERATING PRESSURE
ENVELOPE DIMENSIONS (MAX):	3.54 INCHES X 3.10 INCHES X 2.91 INCHES

COMPONENT: REGULATOR, HELIUM PRESSURE, 750 PSIG

(MC284-0533)

OPERATION

DORMANT OPERATION

GAS ENTERS THE REGULATOR THROUGH THE SUPPLY INLET PRESSURE PORT, BUT IS PREVENTED FROM BEING PASSED THROUGH TO THE OUTLET BY THE CLOSED MAIN POPPET (6). SOME OF THE SUPPLY GAS GOES TO THE MAIN POPPET CONTROL CHAMBER THROUGH ORIFICE 91). THIS GAS FINDS ITS WAY TO THE BACK SIDE OF THE MAIN POPPET (3) WHERE IT APPLIES PRESSURE TO THE POPPET (6) KEEPING THE REGULATOR CLOSED. THE REST OF THE SUPPLY GAS FILLS THE OUTER CHAMBER (15) AND EQUALIZES THE PRESSURE ON THE PRESSURE ON THE POPPET. DURING THIS TIME, THE BELLOWS ASSEMBLY (12) AND THE BELLEVILLE SPRING ASSEMBLY (13) APPLIES A CONSTANT FORCE UPWARDS ON THE PILOT POPPET (7) BY THE PILOT SHAFT (8). THIS CONSTANT FORCE IS A DIRECT FUNCTION OF THE SPRING RATE OF THE BELLEVILLE SPRINGS AND BELLOWS ASSEMBLY AND THE OUTLET PRESSURE ACTING ON THE BELLOWS EFFECTIVE AREA. AS LONG AS THE OUTLET PRESSURE STAYS WITHIN THE 715 - 770 PSIA RANGE, THE REGULATOR WILL STAY CLOSED OR LOCKED-UP.

OUTLET FLOW DEMAND

UNTIL THIS MOMENT, THE CONTROL PRESSURE HAS BEEN EQUAL TO THE SUPPLY OR INLET PRESSURE (900 TO 4500 PSIG), AND THE NET PRESSURE FORCE HAS BEEN HOLDING THE MAIN POPPET CLOSED. HOWEVER, WHEN THE OUTLET PRESSURE FALLS BELOW 715 PSIA, THE REGULATOR WILL OPEN FLOWING HELIUM INCREASING THE OUTLET PRESSURE. THE BELLOWS ASSEMBLY SENSES THE OUTLET PRESSURE DECREASE, AND EXPANDS FORCING THE SHAFT (8) AGAINST THE PILOT POPPET (7). THIS ACTION OPEN THE PILOT ALLOWING FLOW THROUGH THE PILOT ORIFICE. THE PILOT ORIFICE IS SIZED LARGER THAN THE INLET ORIFICE (1) SO THAT THE PRESSURE IN THE MAIN POPPET CONTROL CHAMBER DECREASES ENOUGH TO CAUSE A PRESSURE IMBALANCE ACROSS THE MAIN POPPET (6) THUS OPENING THE REGULATOR.

WITH THE PILOT POPPET (7) NOW OPEN, THE CONTROL PRESSURE BEGINS TO DROP AS GAS FLOWS FROM THE CONTROL CHAMBER INTO THE OUTLET PORT SECTION. FLOW OF SUPPLY PRESSURE GAS INTO THE CONTROL CHAMBER IS RESTRICTED BY ORIFICE (1) AND THE CONTROL PRESSURE CONTINUES TO DROP UNTIL THE FORCE IT EXERTS (TENDING TO HOLD THE MAIN POPPET CLOSED) IS EQUAL TO THE SUPPLY PRESSURE FORCE TENDING TO OPEN THE POPPET. A FURTHER DECREASE IN THE CONTROL CHAMBER PRESSURE CAUSES THE MAIN POPPET (6) TO OPEN, PERMITTING GAS TO FLOW THROUGH THE OUTLET PORT. AS THE OUTLET PRESSURE BEGINS TO BUILD UP, IT IS FED BACK TO THE CONTROLLER SECTION THROUGH THE OUTLET PRESSURE SENSING PORT (9), WHERE IT IS APPLIED TO THE TOPSIDE OF THE DAMPER PISTON (11) AND THE

OUTSIDE OF THE BELLOWS (12). THE OUTLET PRESSURE CONTINUES TO INCREASE UNTIL THE FORCE IT EXERTS ON THE BELLOWS BEGINS TO OVERCOME THE FORCE EXERTED BY THE BELLOWS AND THE BELLEVILLE SPRINGS ON THE PILOT POPPET. FURTHER INCREASE IN OUTLET PRESSURE CAUSES THE PILOT VALVE TO CLOSE, ALLOWING GAS TO FLOW INTO THE CONTROL CHAMBER WITH A RESULTANT INCREASE IN CONTROL PRESSURE. AS CONTROL PRESSURE BEGINS TO BUILD, THE MAIN POPPET GRADUALLY CLOSES, BUILDING UP THE BALANCE PRESSURE AND CAUSING THE MAIN POPPET TO MOVE TO THE CLOSED POSITION. WHEN THE MAIN POPPET FINALLY CLOSES, GAS FLOW TO THE OUTLET PORT CEASES AND THE OUTLET PRESSURE STABILIZES.

REGULATOR STABILITY

A PNEUMATIC DASHPOT IS USED TO OBTAIN DAMPING OF THE MAIN POPPET MOTION. AS THE VALVE IS OPENED OR CLOSED, GAS FLOWS INTO THE SENSING SECTION BY ORIFICE (9). THE DAMPER (11) SENSES THE PRESSURE CHANGE AND INITIALLY MOVES QUICKLY TO ITS NEXT POSITION BECAUSE OF THE LARGE SURFACE AREA. HOWEVER, THE DAMPER ASSEMBLY (11) ALSO CONTAINS ORIFICE (10) WHICH ACTS AS A PNEUMATIC DASHPOT TO PREVENT EXCESSIVE OSCILLATION DURING THE TRANSIENT OPERATION OF THE DAMPER AND BELLOWS ASSEMBLIES. THIS ORIFICE SIZE IS CRITICAL TO THE STABILITY OF THE REGULATOR AND SHOULD BE SIZED BASED ON THE GEOMETRY OF THE ACTUAL PARTS INSTALLED IN EACH PARTICULAR REGULATOR. (THIS ORIFICE RESPONDS SIMILARLY TO A SHOCK ABSORBER IN AN AUTOMOBILE - A DASHPOT FOR THE COIL SPRINGS.)

PRESSURE BALANCE

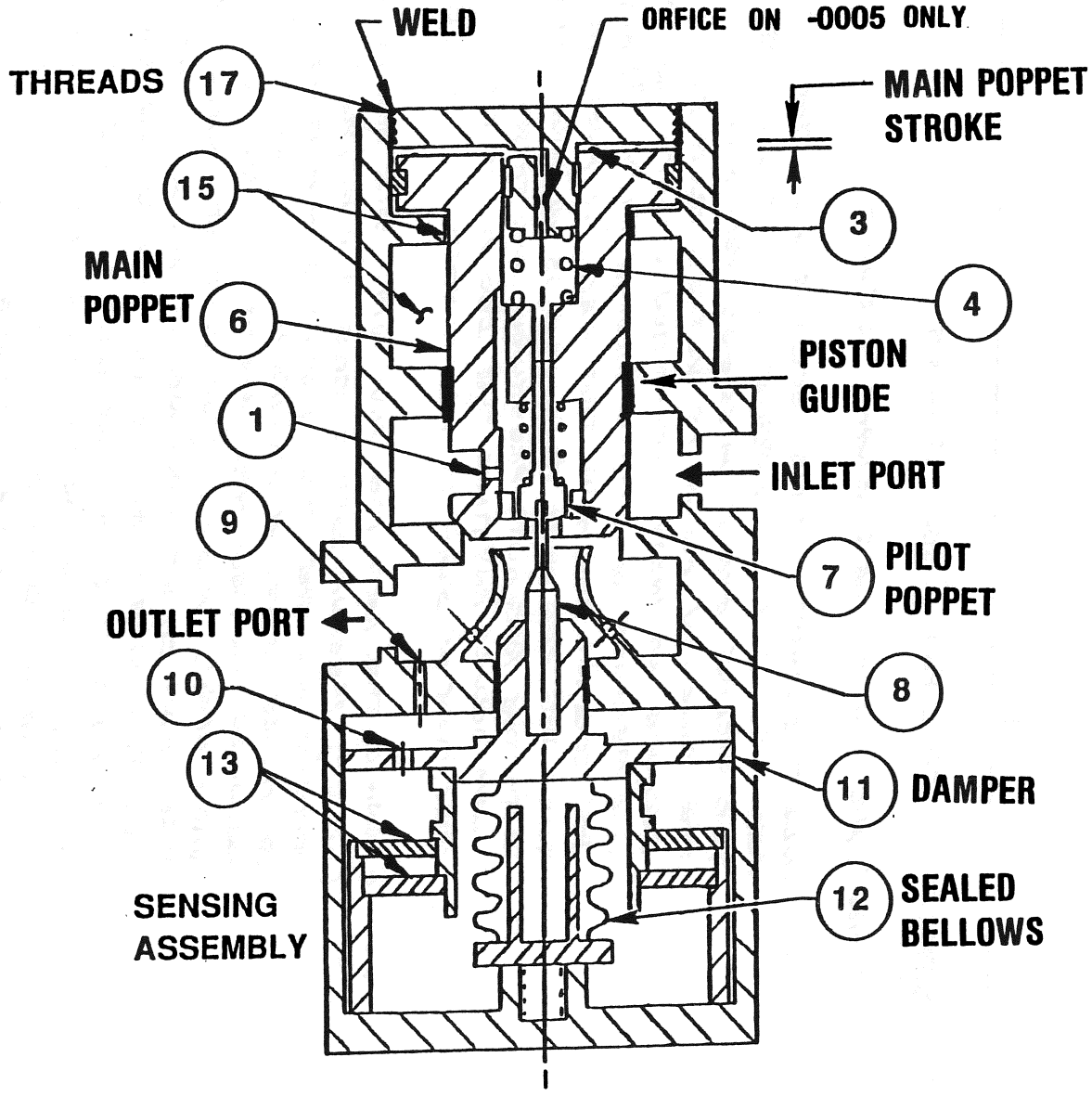
THE MAIN POPPET IS HELD CLOSED BY THE CONTROL PRESSURE ACTING ON THE EFFECTIVE AREA (3), AND BY THE MAIN POPPET SPRINGS (4). THE MAIN POPPET IS HELD OPEN BY THE SUPPLY PRESSURE ACTING ON EFFECTIVE AREA (15). WHEN THE SUPPLY PRESSURE IS EQUAL TO THE CONTROL PRESSURE, THE NET FORCE EXERTED BY THE CONTROL PRESSURE/AREA (3) AND THE MAIN POPPET SPRING (4) IS SUFFICIENT TO APPLY PRESSURE TO THE POPPET SEALING SURFACES.

SETTING THE SET-POINT

ERRORS IN REGULATED PRESSURE ARE INTRODUCED BY SPRING FORCES, DIMENSIONAL TOLERANCES OF PARTS, PRESSURE FORCES, FRICTION, VIBRATION, AND THERMAL EFFECTS. TO SET EACH REGULATOR TO THE DESIRED SET-POINT VALUE (715 - 770 PSIA), THE REGULATOR MUST BE CAPABLE OF ADJUSTMENT. THIS IS ACCOMPLISHED BY TIGHTENING OR LOOSENING THE SLEEVE ASSEMBLY AND TESTING FOR REGULATION PRIOR TO FINAL WELDING. THIS IS DONE BY THE SLEEVE ASSEMBLY THREADS (17).

COMPONENT: REGULATOR, HELIUM PRESSURE, 750 PSIG
(MC284-0533)

MATERIALS
HOUSING: 21-6-9 CRES MAIN POPPET: 21-6-9 PILOT POPPET: VESPEL SP-21 PISTON: 6061-T651 AL ALLOY BELLOWS: INCONEL 718 BELLEVILLE: ELGILOY



Rockwell International
Space Transportation
Systems Division

7-22-91

SUBJECT 750 PSI REG. SLAMS

THERE ARE TWO REG SLAM ISSUES

A. INLET SLAMS - THIS OCCURS ANYTIME THE REG ISO VLV IS OPENED AND IS LIMITED TO 700 CYCLES AND 12 MISSIONS PER FILE II VOL III THE CONCERN HERE IS VESPEL SLEEVES IN THE REG. BECAUSE NO INSTRUMENTATION EXISTS ON REG INLET AND BECAUSE OF SMALL VOLUME ($1.76 IN^3$) BETWEEN THE REG ISO VLV AND THE REG, IT MUST BE PRESUMED THAT THE REG INLET PRESSURE IS ALWAYS EQUALIZED WITH THE REG OUT PRESSURE AND THEREFORE A SLAM OCCURS ANYTIME THE ISO VLV IS OPENED. THIS TYPE OF SLAM IS AGGRAVATED BY ITEM B.

B. OPENING THE REG ISO VLV WITH THE DOWNSTREAM (OUTLET) PRESSURIZED CAUSES A OVERPRESSURE SITUATION. THE REG OPERATES IN A TIGHT BAND SO THERE IS NOT A SIGNIFICANT PRESSURE DIFFERENCE BETWEEN THE REG MAIN POPPET BEING CLOSED AND WIDE OPEN. A SMALL (BUT UNDEFINED) OUTLET PRESSURE DROP CAN CAUSE OPENING OF THE REG WITH ISO VLV CLOSED. WHEN THE ISO VLV IS OPENED THE OPEN REG MUST REACT TO THE OUTLET PRESSURE AND CLOSE. AS IS KNOWN THE REG INITIALLY OVERSHOOTS AS EVIDENCED BY THE 800 PSI R/V CRACKING. IF THE DOWNSTREAM PRESSURE IS ALREADY UP, THE OVERSHOOT IS MAGNIFIED TO THE POINT WHERE IT MAY BE ABOVE 55MC OR ORBITER CERT PRESSURES. THIS SPIKE IS TOO QUICK FOR ORBITER INSTRUMENTATION TO DETECT. REPEATED OPERATION IN THIS MODE IS DETRIMENTAL TO THE REG, THE R/V AND THE SYSTEM. THIS IS THE REASON FOR THE PROCEDURAL RESTRICTIONS ON PRESSURIZING AGAINST OUTLET PRESSURE.

Steve Coester

SYSTEM: LIQUID LEVEL, POINT LEVEL MONITOR SYSTEM

(MC432-0205)

FMEA/CIL NO. 03-1-0427

VENDOR : HERCULES AIRCRAFT SYSTEMS DIV.
P/N RI : MC432-0205-0013, -0019, -0021, -0027

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

QUANTITY:
: ELECTRONICS-0021: 1 PER ORB
: ORB SENSOR -0027: 2 PER ORB
: ET LO_2 SNSR-0019: 10 PER ET] PROCURED AND INSTALLED
: ET LH_2 SNSR-0013: 14 PER ET] BY MARTIN MARIETTA CO.

ITEM:

SENSORS AND ELECTRONICS, LO_2/LH_2 POINT LEVEL, ECO.

FUNCTION:

THIS SYSTEM PROVIDES A MEANS OF MONITORING THE PROPELLANT LEVEL IN THE LO_2/LH_2 EXTERNAL TANKS DURING LOADING AND ASCENT. POINT SENSOR TRANSDUCERS ARE LOCATED IN THE ET AND ON THE ORBITER (LO_2 17-INCH FEEDLINE) WITH SIGNAL CONDITIONING ELECTRONICS ON THE ORBITER TO MONITOR AND CONTROL LOADING AND DRAINING OF PROPELLANTS. SENSORS ARE REDUNDANT AT ALL CRITICAL LEVELS.

FOUR SENSORS IN THE ORBITER LO_2 FEEDLINE AND FOUR IN THE BOTTOM OF THE ET LH_2 TANK PROVIDE A SAFE BACKUP SSME CUTOFF SIGNAL TO PRECLUDE ENGINE PROPELLANT STARVATION, IN CASE A GUIDED (VELOCITY) MECO IS NOT ATTAINED. THE ECO LOGIC IS ARMED WHEN THE CALCULATED TOTAL PROPELLANT MASS REMAINING REACHES 32,000 LB OR UPON SECOND ENGINE FAILURE FOLLOWING SRB SEPARATION. ANY TWO OF FOUR LH_2 OR LO_2 DRY SENSORS WILL GENERATE A MECO COMMAND AFTER THE SYSTEM IS ARMED.

DESIGN:

THE TRANSDUCERS UTILIZE A THERMOSENSOR PRINCIPLE TO DETECT LIQUID/GAS. A CONSTANT CURRENT IS FED TO THE TRANSDUCERS AND THE RESULTANT VOLTAGE IS MONITORED TO DETECT THE FLUID CONDITION. VOLTAGE IS LOW WHEN THE TRANSDUCER IS IMMERSED IN A LIQUID SINCE HEAT TRANSFER IS HIGH AND THE PLATINUM SENSING ELEMENT TEMPERATURE STAYS LOW KEEPING THE ELEMENT RESISTANCE LOW. THE OPPOSITE EFFECT OCCURS WHEN THE TRANSDUCER IS IN A GAS. THE ELECTRONICS BOX POWERS AND MONITORS THE SENSORS AND ISSUES WET (ZERO VOLTS) AND DRY (28 VOLTS) SIGNALS.

SYSTEM: LIQUID LEVEL, POINT LEVEL MONITOR SYSTEM

(MC432-0205)

THE POINT SENSOR TRANSDUCERS UTILIZE 0.0005 INCH DIAMETER PLATINUM WIRE SENSING ELEMENTS MOUNTED ON A CERAMIC FRAME. THE ORBITER TRANSDUCER (LO_2 ECO) HAS TWO SENSING ELEMENT ASSEMBLIES CONTAINED WITHIN A FLANGE-MOUNTED HOUSING (304 CRES) AND CONTAINS ONE ELECTRONIC CONNECTOR. THE ET TRANSDUCERS HAVE ONE SENSING ELEMENT ASSEMBLY IN A HOUSING WHICH IS MOUNTED ON MASTS AND ON THE LH_2 SIPHON ASSEMBLY (BAFFLE) WITHIN THE LH_2/LO_2 TANKS. THE ET SENSOR USES A 356-T6 ALUMINUM INVESTMENT CASTING HOUSING WHICH IS TEFLON COATED ON THE INTERIOR TO ASSIST SYSTEM PERFORMANCE.

A SINGLE POINT SENSOR ELECTRONICS BOX IS HOUSED IN THE AFT AVIONICS BAY #5 ON A COLD PLATE. THE BOX HOUSING IS MADE OF DIP BRAZED 6061-T6 ALUMINUM. THE BOX CONTAINS A SERIES OF PRINTED CIRCUIT BOARDS WHICH ARE PLUGGED INTO A MOTHER BOARD. FLEX CIRCUITS INTERCONNECT THE PRINTED CIRCUIT BOARDS WITH THE INTERFACE ELECTRICAL CONNECTORS. THE BOX CONTAINS 14 SIGNAL CONDITIONING BOARDS, 2 POWER SUPPLY BOARDS, AND 1 CHECKOUT COMMAND ISOLATION BOARD. EACH SIGNAL CONDITIONING BOARD HAS ONE HYDROGEN AND ONE OXYGEN SIGNAL CONDITIONING CIRCUIT. PHYSICAL AND ELECTRICAL ISOLATION FOR EACH SIGNAL CONDITIONING CIRCUIT IS MAINTAINED.

EACH POWER SUPPLY BOARD HAS 2 SECTIONS. EACH SECTION CONVERTS VEHICLE 28 VDC POWER TO 14.5 VDC AND 12 VDC. VEHICLE POWER FROM THE THREE MAIN BUSES IS DISTRIBUTED TO THE POINT SENSOR ELECTRONICS POWER SUPPLIES. LOSS OF ANY ONE BUS WILL RESULT IN THE LOSS OF NO MORE THAN ONE POWER SUPPLY (1/2 OF A POWER SUPPLY BOARD). EACH POWER SUPPLY POWERS A GROUP OF SIGNAL CONDITIONING BOARDS. POWER IS DISTRIBUTED WITHIN THE BOX SO THAT ADJACENT SENSORS UTILIZE DIFFERENT POWER SUPPLIES.

SIGNALS FOR GROUND CHECKOUT ARE DISTRIBUTED THROUGH OPTICAL ISOLATION CIRCUITS ON THE CHECKOUT COMMAND ISOLATION BOARD. GROUND CHECKOUTS ARE PERFORMED PRIOR TO AND DURING PROPELLANT LOADING OPERATIONS. SENSOR CABLE AND CONNECTOR RESISTANCES ARE VERIFIED DURING OPF CHECKS.

VEHICLE CABLING/CONNECTORS ROUTING MAINTAINS CIRCUIT ISOLATION. SIX INTERFACE ELECTRICAL CONNECTORS ARE INSTALLED ON THE HOUSING. TWO ARE USED FOR ATP CHECKOUT AND THE REMAINING FOUR ARE USED FOR OPERATIONAL FUNCTIONS. THE SYSTEM IS DESIGNED TO PROVIDE A WET SIGNAL FOR THE PREDOMINANT FAILURE MODES (PREVENT OVERFILLING OF ET TANKS AND PREMATURE MECO). EACH CRITICAL SENSING LOCATION HAS TRANSDUCERS LOCATED TO PROVIDE EITHER VERTICAL OR HORIZONTAL REDUNDANCY (BY LOCATION).

THE POINT SENSOR ELECTRONICS BOX IS BUILT USING EEE COMPONENTS SCREENED TO MIL-STD-883 LEVEL B REQUIREMENTS. ALL EEE COMPONENTS WERE SELECTED SO THAT THEIR USAGE MEETS THE SHUTTLE DERATING REQUIREMENTS.

SYSTEM: LIQUID LEVEL, POINT LEVEL MONITOR SYSTEM

(MC432-0205)

THE ELECTRONICS BOXES ARE ENERGIZED USING 28 VDC POWER DURING CHECKOUT, PROPELLANT LOADING, AND THE ASCENT PORTION OF FLIGHT. THE SYSTEM IS DEENERGIZED WITHIN 5 MINUTES AFTER MAIN ENGINE SHUTDOWN.

DESIGN PARAMETERS:

USEFUL LIFE:

THE ASSEMBLIES HAVE A MINIMUM USEFUL LIFE EQUIVALENT TO 100 ORBITAL MISSIONS FOR THE ORBITER COMPONENTS AND ONE MISSION FOR THE ET COMPONENTS. THERE NO AGE, WEAR, CYCLE SENSITIVE COMPONENTS ON THESE ASSEMBLIES.

PROOF PRESSURE: 390 PSIG, 440 PSIG } LOX ECO POINT SENSOR ONLY

LIQUID SURFACE VELOCITIES:

		OPERATIONAL REQUIREMENTS		DESIGN
TRANSDUCER	FLUID	DRY TO WET CHANGE	WET TO DRY CHANGE	MAXIMUM
IN-TANK	LH_2	0.1 TO .33 FT/SEC	0.1 TO 1.0 FT/SEC	3.0 FT/SEC
	LO_2	0.1 TO .33 FT/SEC	0.1 TO 2.0 FT/SEC	3.0 FT/SEC
FEEDLINE	LO_2	NOT APPLICABLE	0.5 TO 16 FT/SEC	27 FT/SEC

IN-TANK TRANSDUCER LEVEL ACCURACY:

DRY OUTPUT SIGNAL OCCURS WHEN TRANSDUCER IS TOTALLY WITHDRAWN FROM THE FLUID AND WET OUTPUT SIGNAL IS GENERATED WHEN TRANSDUCER IS IMMERSED IN LIQUID WITHIN PLUS OR MINUS .02 INCH AT THE MINIMUM RATE OF FLUID LEVEL CHANGE.

RESPONSE TIMES:

	DRY TO WET CHANGE	WET TO DRY CHANGE
IN-TANK TRANSDUCER (LO_2)	130 ms	160 ms
(LO_2)	130 ms	130 ms
FEEDLINE TRANSDUCER (LO_2)	NOT APPLICABLE	350 ms

MAX. WEIGHT: IN-TANK TRANSDUCERS: .15 LB

FEEDLINE TRANSDUCER: .75 LB

ELECTRONICS PACKAGE FOR ORBITER: 18.50 LB

ELECT. BOX: MAX. POWER = 150 WATTS

SYSTEM: LIQUID LEVEL, POINT LEVEL MONITOR SYSTEM

(MC432-0205)

COMPONENT: ET POINT SENSOR (TRANSDUCER)
MC432-0205-0013 (LH_2)
MC432-0205-0019 (LO_2)

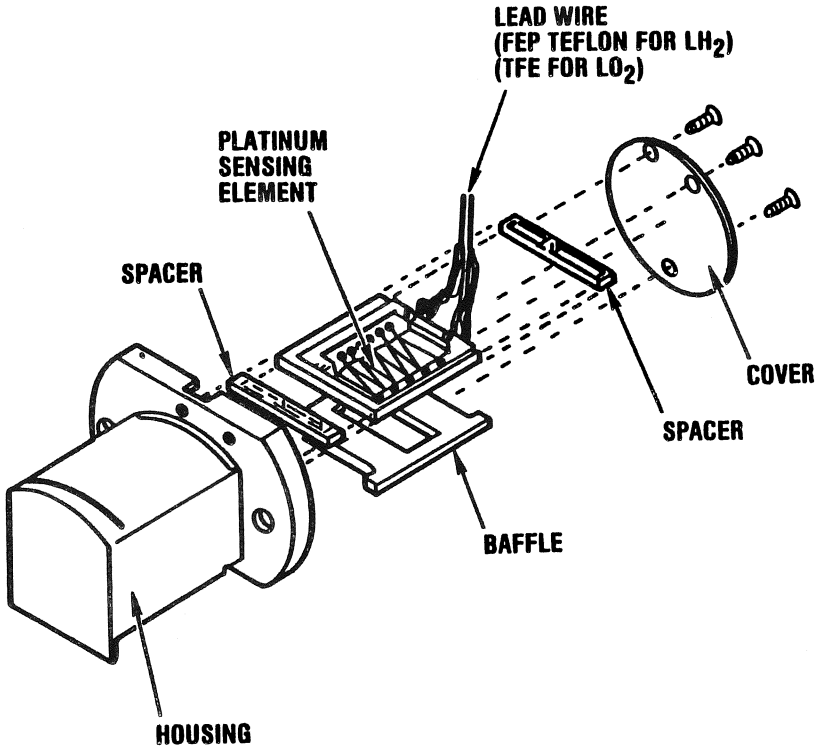
MATERIALS
HOUSING: 356T5 AL SENSING ELEMENT: PLATINUM

FUNCTION: DETECT THE PRESENCE OF LIQUID OR GAS

SUPPLIER: SIMMONDS PRECISION

FEATURES:

- LOCATED ON THE ET LH_2 SIPHON ASSEMBLY
- BACKUP TO GUIDED VELOCITY MECO
- PROVIDES MECO COMMAND UPON LH_2PROPELLANT DEPLETION
- CONTROL SENSORS FOR PROPELLANT LOADING



ET TRANSDUCER CONFIGURATION
(INTERIOR OF UNIT IS TEFLON COATED)

SYSTEM: LIQUID LEVEL, POINT LEVEL MONITOR SYSTEM

(MC432-0205)

COMPONENT: LO_2 LOW LEVEL SENSOR: MC432-0205-0027

OPERATING PRESSURE: 260 PSIA

PROOF PRESSURE: 390 PSIG

BURST PRESSURE: 440 PSIG

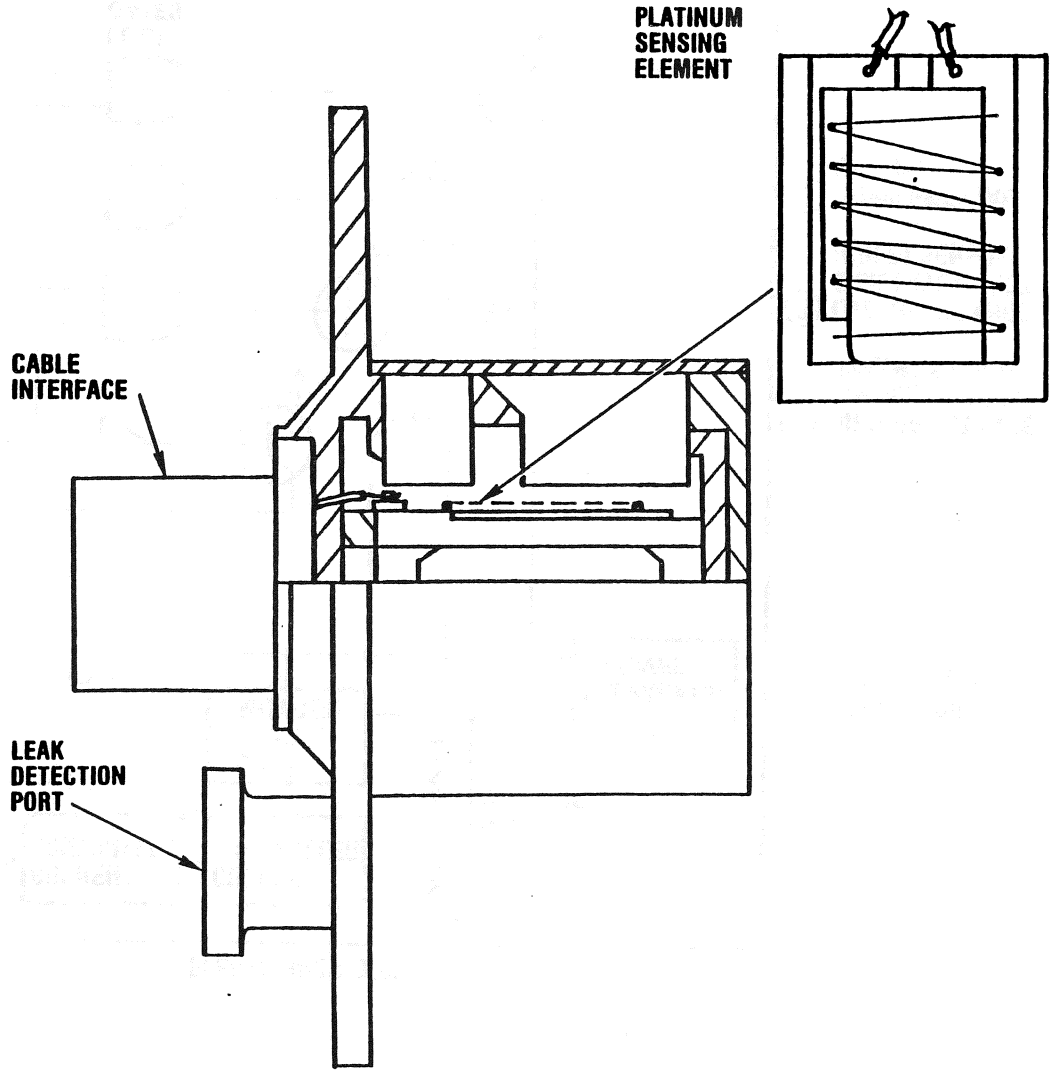
MATERIALS
HOUSING: 304 L SENSING ELEMENT: PLATINUM SENSOR MTG SEAL: NAFLEX

FUNCTION: DETECT THE PRESENCE OF LIQUID OR GAS

SUPPLIER: SIMMONDS PRECISION

FEATURES:

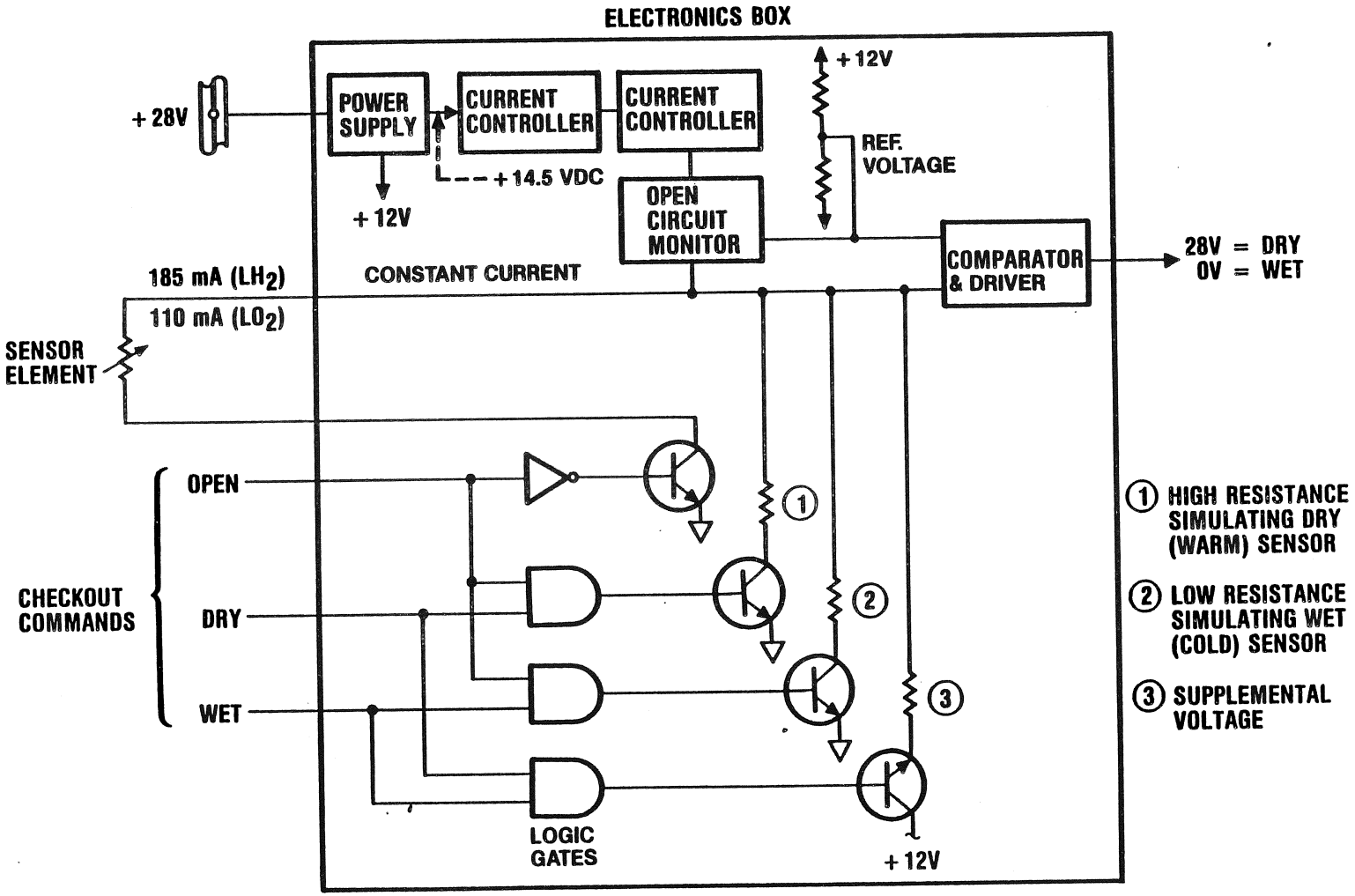
- REDUNDANT SENSING ELEMENTS ELECTRICALLY INDEPENDENT
- LOCATED IN THE ORBITER FEEDLINE
- FLANGE LEAK DETECTION PORT



SYSTEM: LIQUID LEVEL, POINT LEVEL MONITOR SYSTEM

(MC432-0205)

ECO/LEVEL SENSOR SIGNAL CONDITIONING CIRCUIT



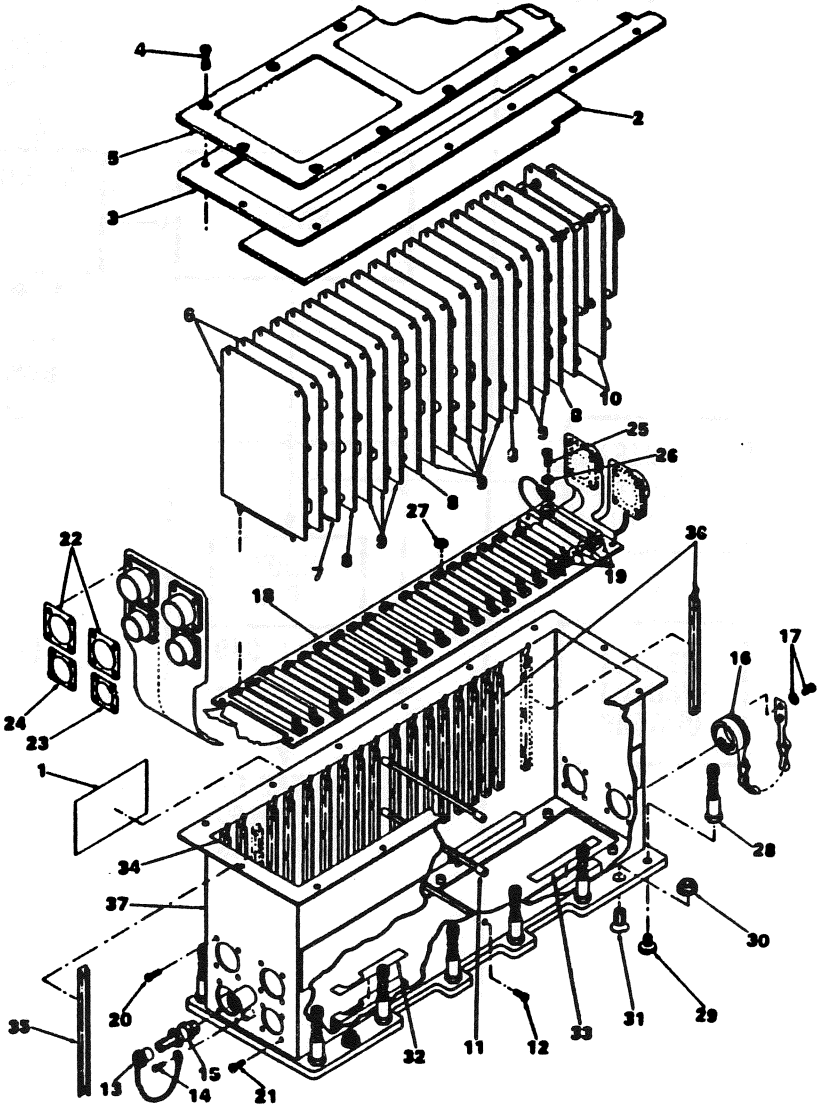
SYSTEM: LIQUID LEVEL, POINT LEVEL MONITOR SYSTEM

(MC432-0205)

MC432-0205-0021

PARTS LIST

ITEM NO.	SUPPLIER PART NUMBER	DESCRIPTION	UNITS PER ASSY
	472698-005	POINT SENSOR ELECT. BOX	REF
1	1500078-005	PLATE, IDENT.	1
	1500142	COVER SUBASSEMBLY	1
2	1500143	CUSHION, COVER	1
3	1500139	GASKET, COVER	1
4	DNRE7900L6AA3	SCREW ASSEMBLY, CAPTIVE	14
5	1500138	COVER, HOUSING	1
6	1500052-003	ECT SPACER BOARD	2
7	1500048	OPTO ISOLATOR	1
8	1500050-002-5	SIGNAL CONDITIONER, DEPLETION	4
9	1500050-001-2	SIGNAL CONDITIONER, POINT SENSOR	10
10	1500080	POWER SUPPLY	2
11	1500004	SPACER, HOUSING	3
12	048658	SCREW, PHD	2
13	1500151	CAP ASSEMBLY	1
14	048658	SCREW, PHD	1
15	MS27436T1	AIR VALVE	1
16	1500161	CAP, CONNECTOR	2
17	048658	SCREW, PHD	1
	MS15795-804	WASHER	1
18	1500141	FLEX CABLE SUBASSEMBLY	1
19	M39006701-3078	CAPACITOR	4
20	MS24693C5	SCREW (AP)	8
21	MS24693C4	SCREW (AP)	16
22	048668-1	GASKET, CONNECTOR	2
23	048668-3	GASKET, CONNECTOR	3
24	048668-2	GASKET, CONNECTOR	1
25	NAS1635-06LNG	SCREW	8
26	MS15795-805	WASHER	1
27	NAS549PL6	WASHER	1
28	ME112-0010-0014	SCREW ASSEMBLY, CAPTIVE	12
29	ME114-0025-0002	NUT, RETAINER	12
30	MD114-1001-0007	NUT, SELF-LOCKING	4
31	ME114-0026-0002	NUT, RETAINER	4
	1500140-001	HOUSING ASSEMBLY	1
32	1500153-1	INSULATOR, PWB	2
33	1500153-2	INSULATOR, PWB	4
34	048687-2	CARD GUIDE	18
35	048663-2	CARD GUIDE	2
36	048687-1	CARD GUIDE	18
37	1500137-001	HOUSING, ORBITER	1



POINT SENSOR ELECTRONICS BOX

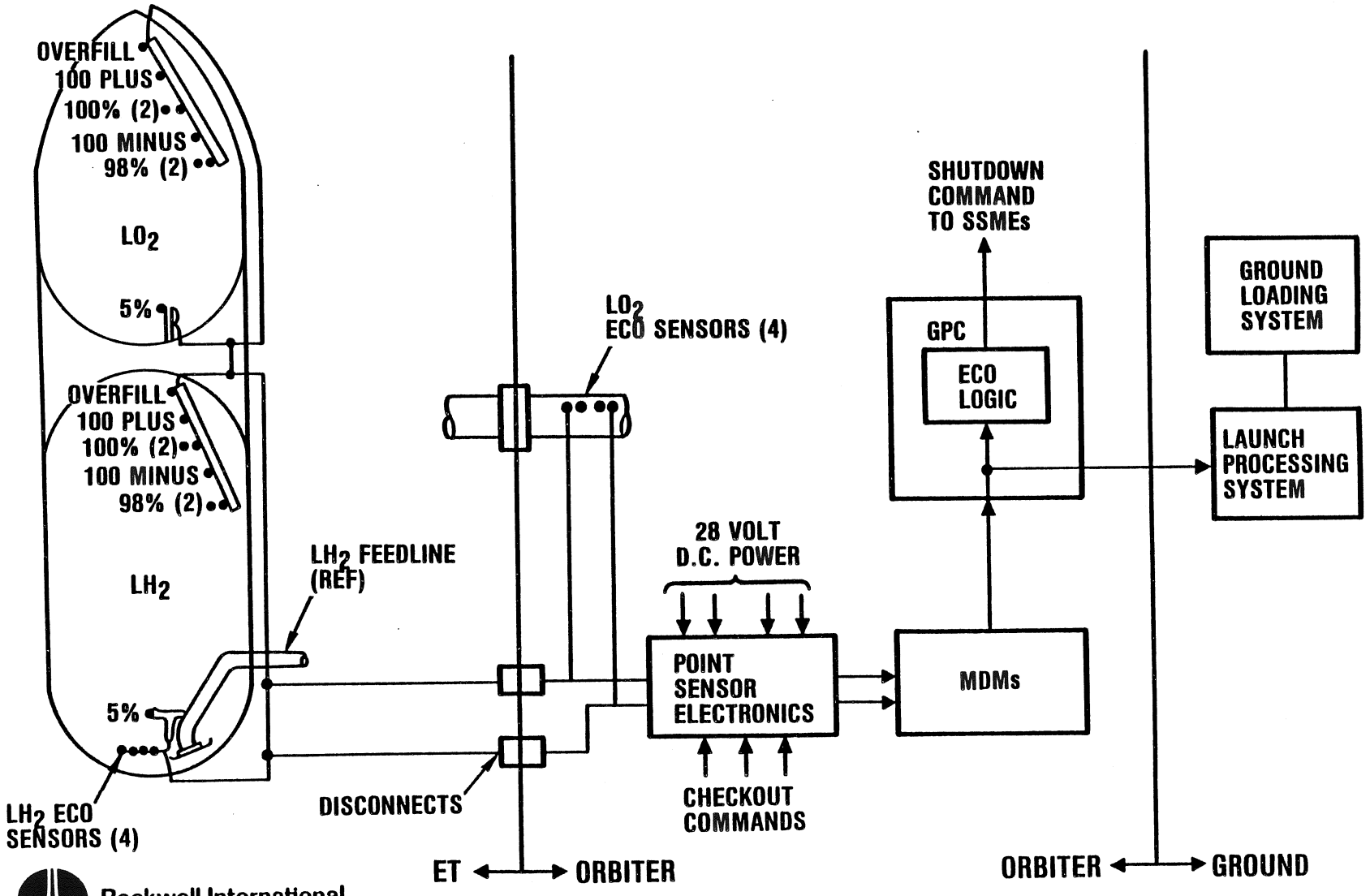
Rockwell International

Space Transportation Systems Division

SYSTEM: LIQUID LEVEL, POINT LEVEL MONITOR SYSTEM

(MC432-0205)

PROPELLANT GAUGING & DEPLETION CUTOFF SYSTEM:



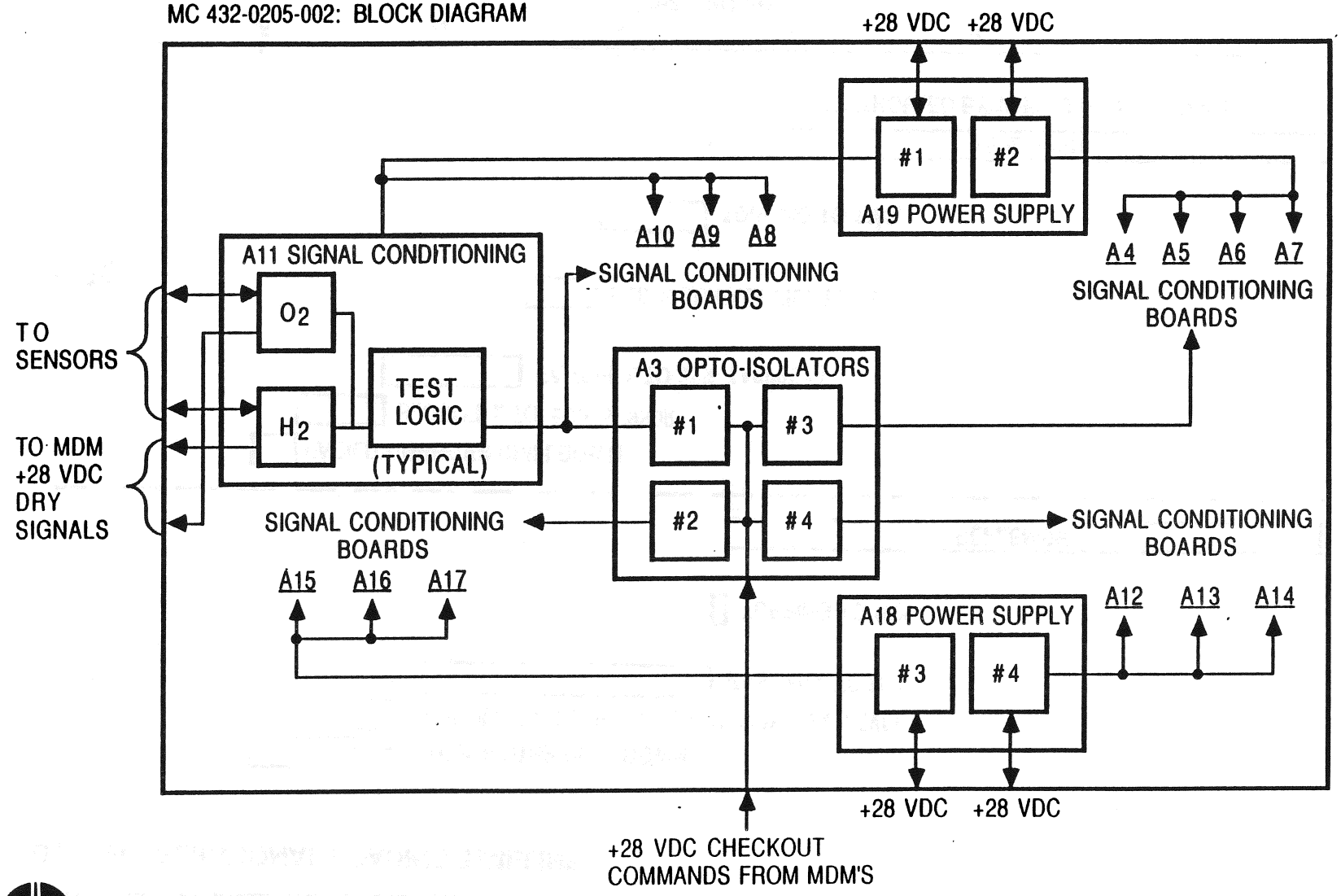
Rockwell International

Space Transportation Systems Division

SYSTEM: LIQUID LEVEL, POINT LEVEL MONITOR SYSTEM

(MC432-0205)

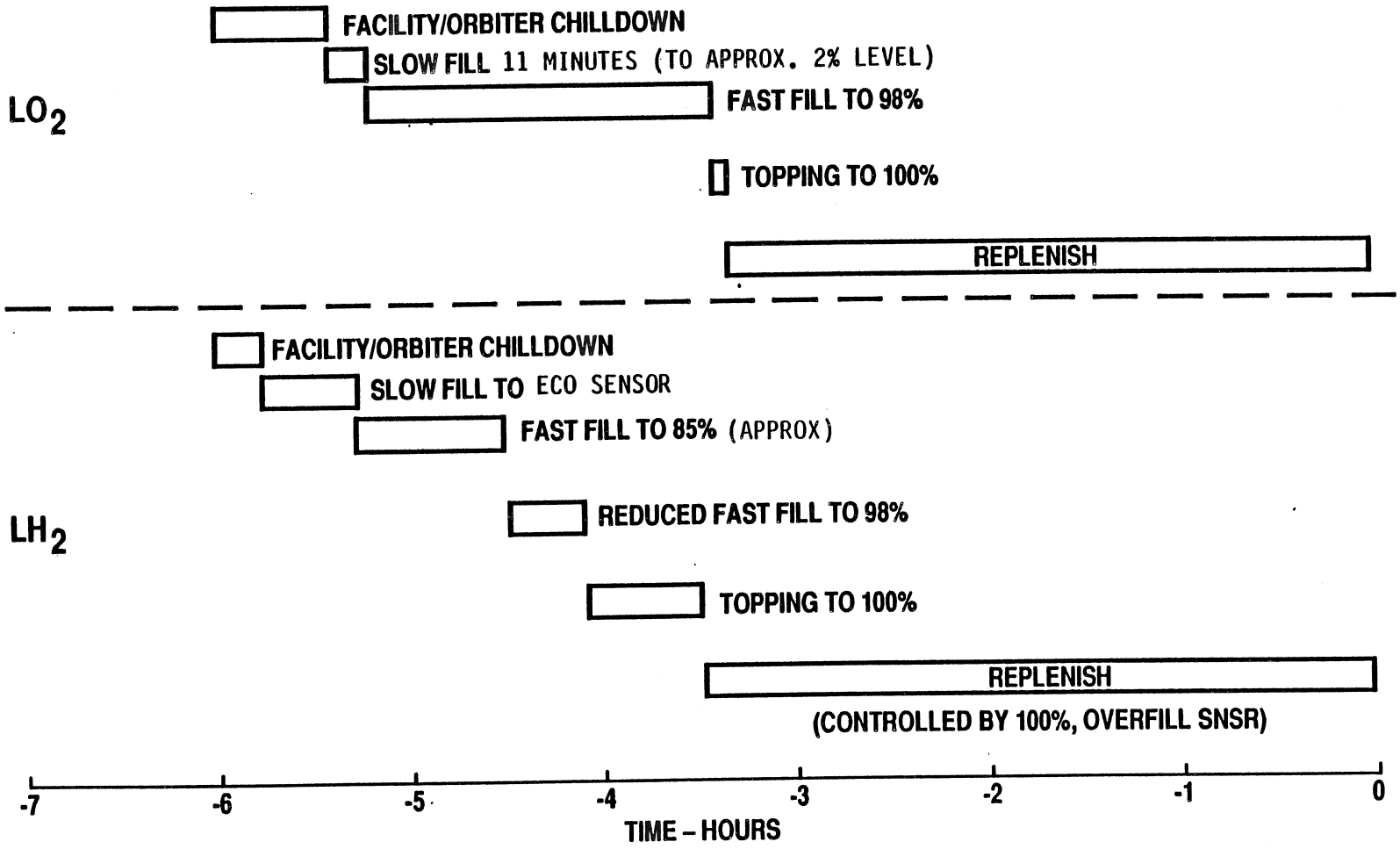
COMPONENT POINT SENSOR ELECTRONICS BOX
MC 432-0205-002: BLOCK DIAGRAM



SYSTEM: LIQUID LEVEL, POINT LEVEL MONITOR SYSTEM

(MC432-0205)

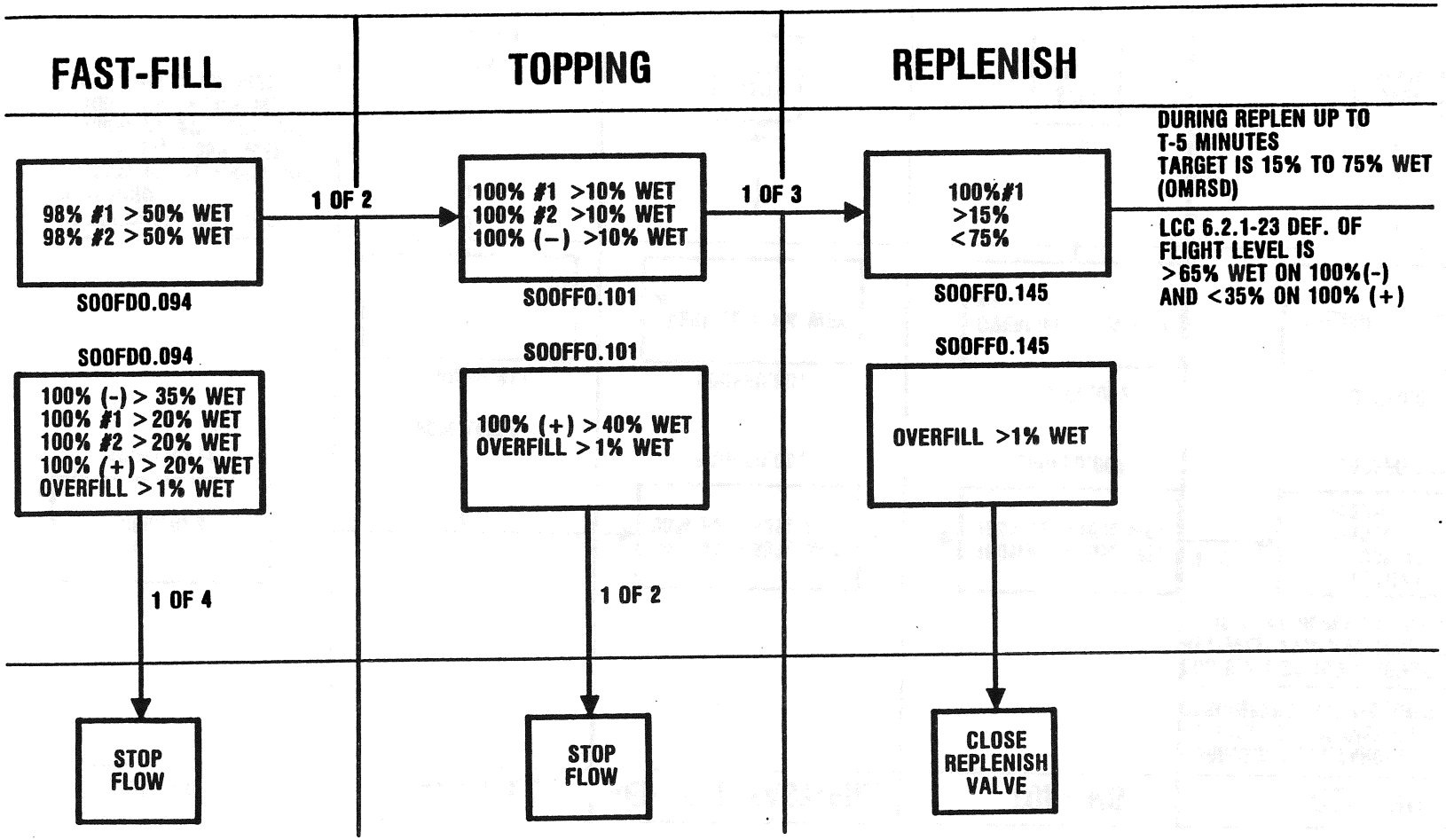
LO_2/LH_2 OPERATIONAL LOADING TIMELINE:



SYSTEM: LIQUID LEVEL, POINT LEVEL MONITOR SYSTEM

(MC432-0205)

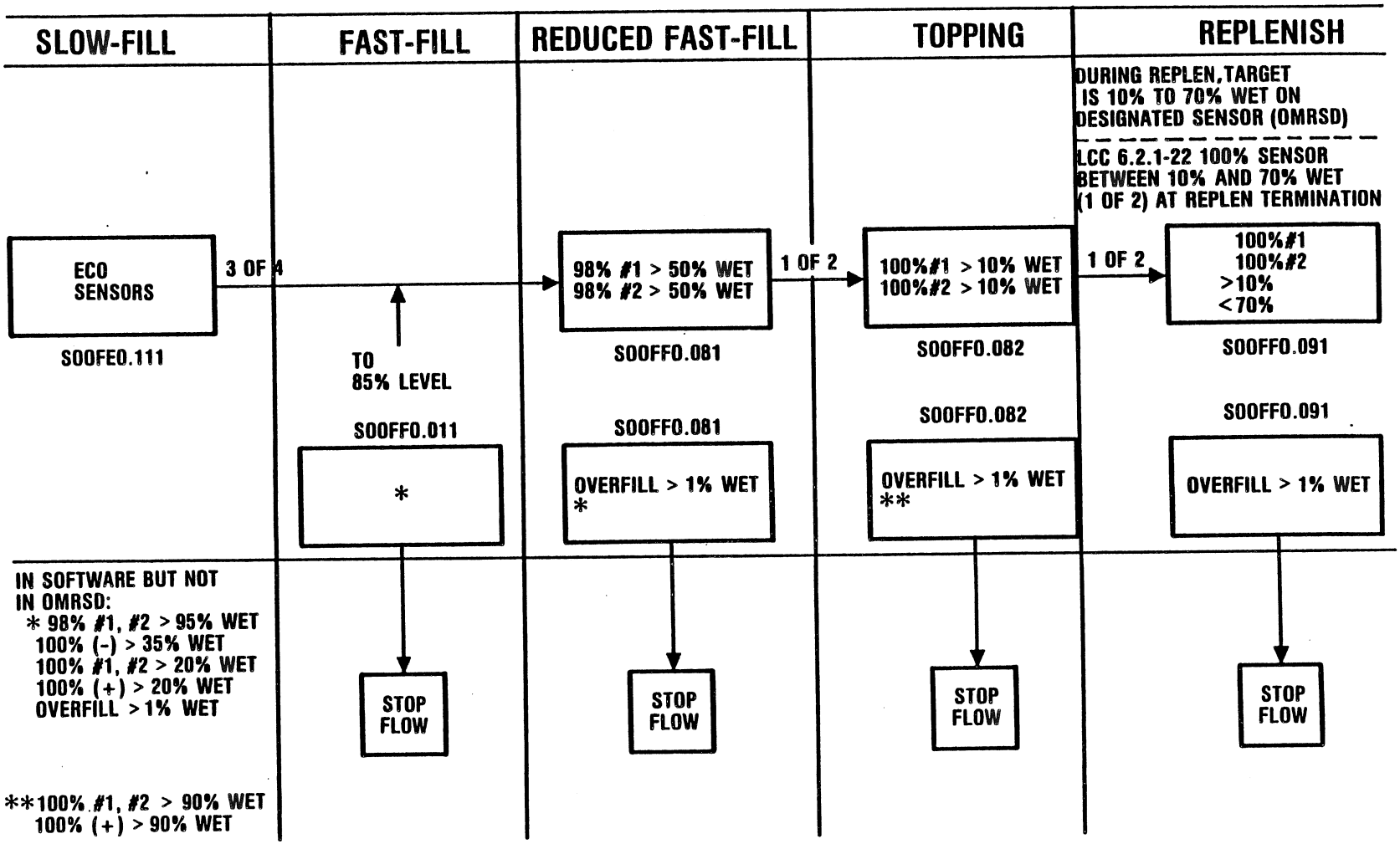
LO_2 LOADING CRITERIA:



SYSTEM: LIQUID LEVEL, POINT LEVEL MONITOR SYSTEM

(MC432-0205)

LH_2 LOADING CRITERIA:



COMPONENT: DIFFERENTIAL PRESSURE, TRANSDUCER, AND ELECTRONICS

(MC449-0164)

FMEA/CIL NO. 03-1-0410

VENDOR : HTL K-WEST
P/N RI : MC449-0164-0001 (LO_2 TRANSDUCER)
: -0002 (LH_2 TRANSDUCER)
: -0006 (ELECTRONICS)
:
QUANTITY : 1 EA PER END ITEM

VEHICLE EFFECTIVITY:	102	103	104
	X	X	X

ITEM:

TRANSDUCER, DIFFERENTIAL PRESSURE, LH_2 (MT50) AND LO_2 (MT44). ELECTRONICS, DIFFERENTIAL PRESSURE

FUNCTION:

THE TRANSDUCERS WITH THEIR SIGNAL CONDITIONERS PROVIDE A MEANS OF SENSING THE PROPELLANT LEVEL IN THE ET LH_2 AND LO_2 TANKS BETWEEN THE POINT SENSORS IN THE BOTTOM AND THE TOP OF THE TANKS. THE SYSTEM SENSES DIFFERENTIAL PRESSURE BETWEEN THE ORBITER 17-INCH FEEDLINES AND THE GH_2/GO_2 ORBITER 2-INCH PRESSURIZATION LINES. THIS DIFFERENTIAL PRESSURE REPRESENTS THE HEAD PRESSURE OF THE LIQUID IN THE LO_2 AND LH_2 TANKS. IT IS USED TO PROVIDE A GROSS INDICATION OF PROPELLANT LEVEL IN THE TANKS DURING PROPELLANT LOADING. THEY HAVE NO INFLIGHT FUNCTION. THIS SYSTEM IS ELECTRICALLY POWERED BUT PRESENTLY IT IS NOT ACTIVELY USED, AND WILL NOT BE INSTALLED ON OV-105.

DESIGN: TRANSDUCER

THE TRANSDUCER UTILIZES THE VARIABLE RELUCTANCE PRINCIPLE FOR SENSING PRESSURE. IT CONTAINS A DIAPHRAGM WHICH IS EB WELDED IN AN ASSEMBLY WITH TWO BACKUP PLATES. INCORPORATED WITHIN EACH BACKUP PLATE ARE INDUCTANCE COILS AND TEMPERATURE COMPENSATING CIRCUITS. PRESSURE TRANSMITTING CAPILLARY TUBES ARE FURNACE BRAZED TO THE BACKUP PLATES AND TERMINATE IN DYNATUBE FITTINGS FOR SYSTEM HOOKUP. THE CAPILLARY TUBE IS MADE FROM 321 CRES, 0.094 INCH OD; .028 INCH WALL THICKNESS. INCORPORATED INTO EACH BACKUP PLATE IS AN 0.015 INCH DIAMETER ORIFICE TO RESTRICT GAS FLOW THROUGH A FAILED DIAPHRAGM. THE DIAPHRAGM ASSEMBLY IS MOUNTED IN A HOUSING WHICH CONTAINS TWO COVER PLATES AND AN ELECTRICAL CONNECTOR WITH TEMPERATURE COMPENSATING RESISTORS AND THERMISTERS. THE TRANSDUCER IS INSULATED AND WRAPPED WITH REFLECTIVE TAPE UPON INSTALLATION.

COMPONENT: DIFFERENTIAL PRESSURE, TRANSDUCER, AND ELECTRONICS

(MC449-0164)

THE DIAPHRAGM IS MADE FROM 0.012 INCH THICK 17-7 STEEL, SANDWICHED BETWEEN TWO BACKUP PLATES OF 304 STEEL. TO PREVENT DAMAGE FROM THE EXTREME NON-OPERATING PRESSURES, THE DIAPHRAGM IS TOTALLY CONTAINED BETWEEN THE TWO BACKUP PLATES WHICH RESTRICT THE AMOUNT OF DIAPHRAGM DEFORMATION IN BOTH DIRECTIONS (0.0090 INCH MAXIMUM IN THE PRESSURIZATION LINE DIRECTION AND 0.0030 INCH MAXIMUM IN THE FEEDLINE DIRECTION). IN AN ANALYSIS PERFORMED BY THE MANUFACTURE, THE DIAPHRAGM WAS FOUND TO HAVE A SAFETY FACTOR OF 22.

THE DIAPHRAGM IS WELDED TO THE BACKUP PLATES. AN ANALYSIS PERFORMED BY THE MANUFACTURER INDICATED THE WELD SAFETY FACTOR AT 745 PSID MAXIMUM OPERATING PRESSURE (EQUIVALENT TO 109 PERCENT POWER LEVEL) TO BE 2.11 YIELD AND 5.27 ULTIMATE. STRUCTURAL ANALYSIS INDICATES POSITIVE MARGINS OF SAFETY FOR ALL CONDITIONS OF TRANSDUCER OPERATIONS.

DESIGN: ELECTRONICS

THE DIFFERENTIAL PRESSURE SIGNAL CONDITIONER (ELECTRONICS) HAS A GROUP OF MODULES CONTAINED WITHIN A SINGLE HOUSING WITH AN ELECTRICAL CONNECTOR. POWER SUPPLY, PRE-AMPLIFICATION, INVERTER DRIVER, AND COUNTER MODULES ARE USED. IN ADDITION, TWO SMALL PRINTED CIRCUIT BOARDS WITH BUFFER CIRCUITS AND CONNECTORS FOR PLUG-IN PROM (PROGRAMMABLE READ ONLY MEMORY) INTEGRATED CIRCUITS ARE PROVIDED. THE MODULES UTILIZE CORDWOOD (STACKED) CONSTRUCTION WHERE THE COMPONENTS ARE CONNECTED WITH WELDED NICKEL RIBBON. AFTER INSERTION OF THE MODULES INTO THE HOUSING, THEY ARE ENCAPSULATED WITH GLASS RESIN EPOXY. THE HOUSING IS SUBSEQUENTLY SEALED WITH EPOXY. THE PROM MODULES CONTAIN THE CALIBRATION CORRECTION FOR THE LO_2 AND LH_2 TRANSDUCERS.

DESIGN PARAMETERS:

USEFUL LIFE: THE ASSEMBLIES HAVE A MINIMUM USEFUL LIFE OF 100 ORBITAL MISSIONS.

SYSTEM ACCURACY: 4 PERCENT OF FULL SCALE

PRESSURES (TRANSDUCERS):	GO_2	GH_2
PROOF AND NON-OPERATING	220 PSID TO -600 PSID	55 PSID TO -600 PSID
BURST	440 TO -1200 PSID	110 TO -1200 PSID
OPERATING	40 TO 70 PSID	0 TO 3.0 PSID

COMPONENT: DIFFERENTIAL PRESSURE, TRANSDUCER, AND ELECTRONICS

(MC449-0164)

OUTPUT SIGNALS:

	GO_2 TRANSDUCER AND SIGNAL CONDITIONER		GH_2 TRANSDUCER AND SIGNAL CONDITIONER	
SIGNAL CONDITIONER OUTPUT SIGNAL	0.00 VDC	5.00 VDC	0.00 VDC	5.00 VDC
ΔP BETWEEN HIGH PRESSURE FILL LINE AND LOW PRESSURE PRESSURIZATION LINE AT TRANSDUCER	40.0 PSID	70.0 PSID	0.00 PSID	3.00 PSID

RESPONSE: 250 MILLISECONDS TO A SENSED PRESSURE CHANGE OF 90 PERCENT OF FULL SCALE.

WEIGHT: TRANSDUCER, 2.0 LB; ELECTRONICS PACKAGE, 3.7 LB

OPERATIONAL DESCRIPTION:

THE SIGNAL CONDITIONER POWER SUPPLY GENERATES AN AC SIGNAL WHICH IS FED TO THE TRANSDUCER. AS THE DIAPHRAGM MOVES IN THE TRANSDUCER IT CHANGES THE FORCE FIELD WHICH IS MONITORED BY PICKUP COILS. THE SIGNALS ARE THEN FED THROUGH A TEMPERATURE CORRECTION CIRCUIT BEFORE TRANSMITTAL BACK TO THE SIGNAL CONDITIONER. AT THIS POINT THEY ARE FED THROUGH A DEMODULATOR, CALIBRATION CORRECTION OUTPUT CIRCUITS. THE OUTPUT SIGNAL IS LINEAR THROUGH THE RANGE OF 0 TO 5 VDC.

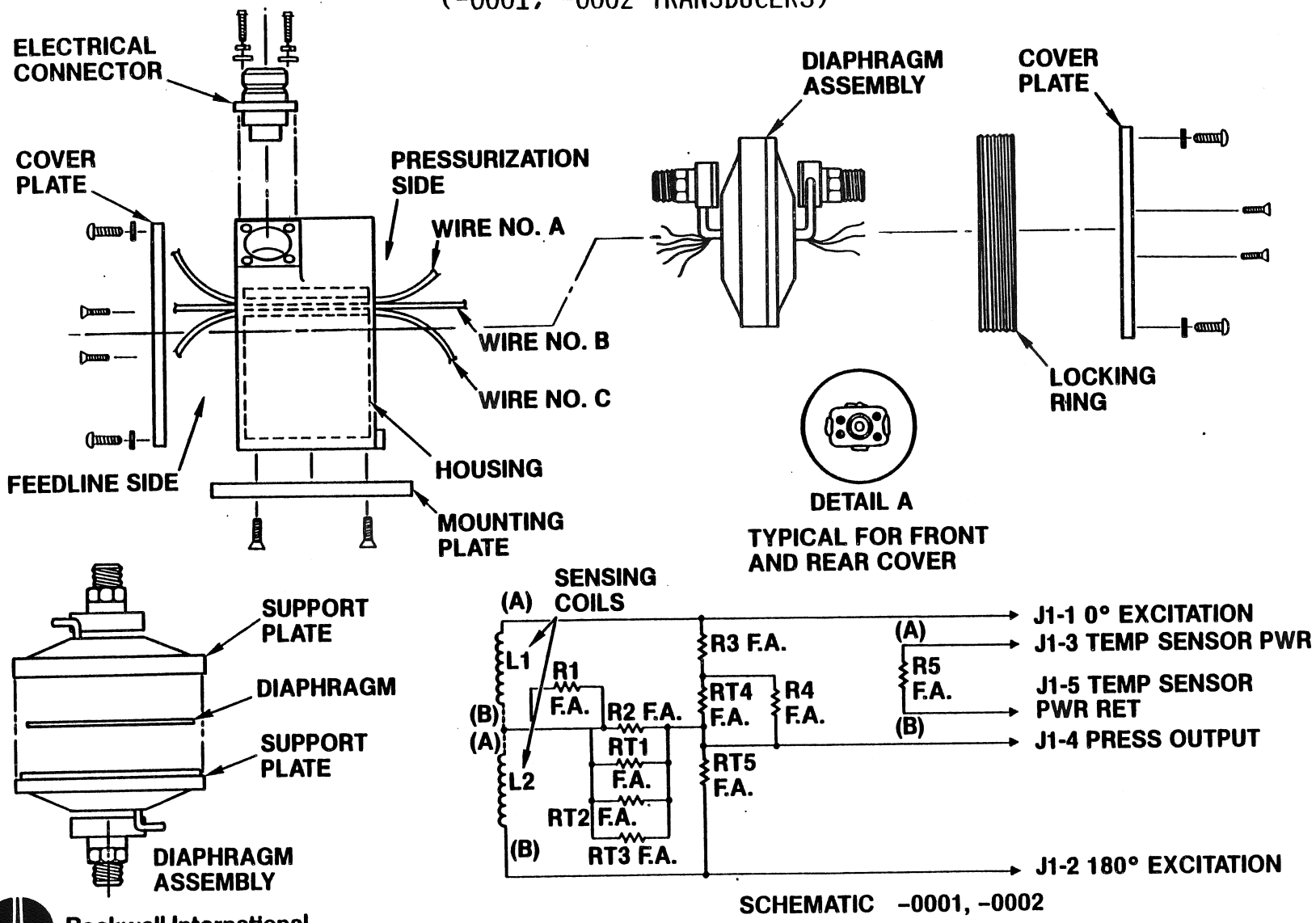
OPERATING GAS TEMPERATURES AND PRESSURES:

TRANSDUCER GAS INPUT	GO_2 TRANSDUCER	GH_2 TRANSDUCER
FILL/FEEDLINE		
PRESSURE	40 TO 75 PSIG	0 TO 8 PSIG
TEMPERATURE	MINUS 100 TO PLUS 85 F	MINUS 100 TO PLUS 85 F
PRESSURIZATION LINE		
PRESSURE	0 TO 5 PSIG	0 TO 5 PSIG
TEMPERATURE	MINUS 65 TO PLUS 130 F	MINUS 65 TO PLUS 130 F

COMPONENT: DIFFERENTIAL PRESSURE, TRANSDUCER, AND ELECTRONICS

(MC449-0164)

(-0001, -0002 TRANSDUCERS)



SCHEMATIC -0001, -0002

Rockwell International

Space Transportation Systems Division

COMPONENT: DIFFERENTIAL PRESSURE, TRANSDUCER, AND ELECTRONICS

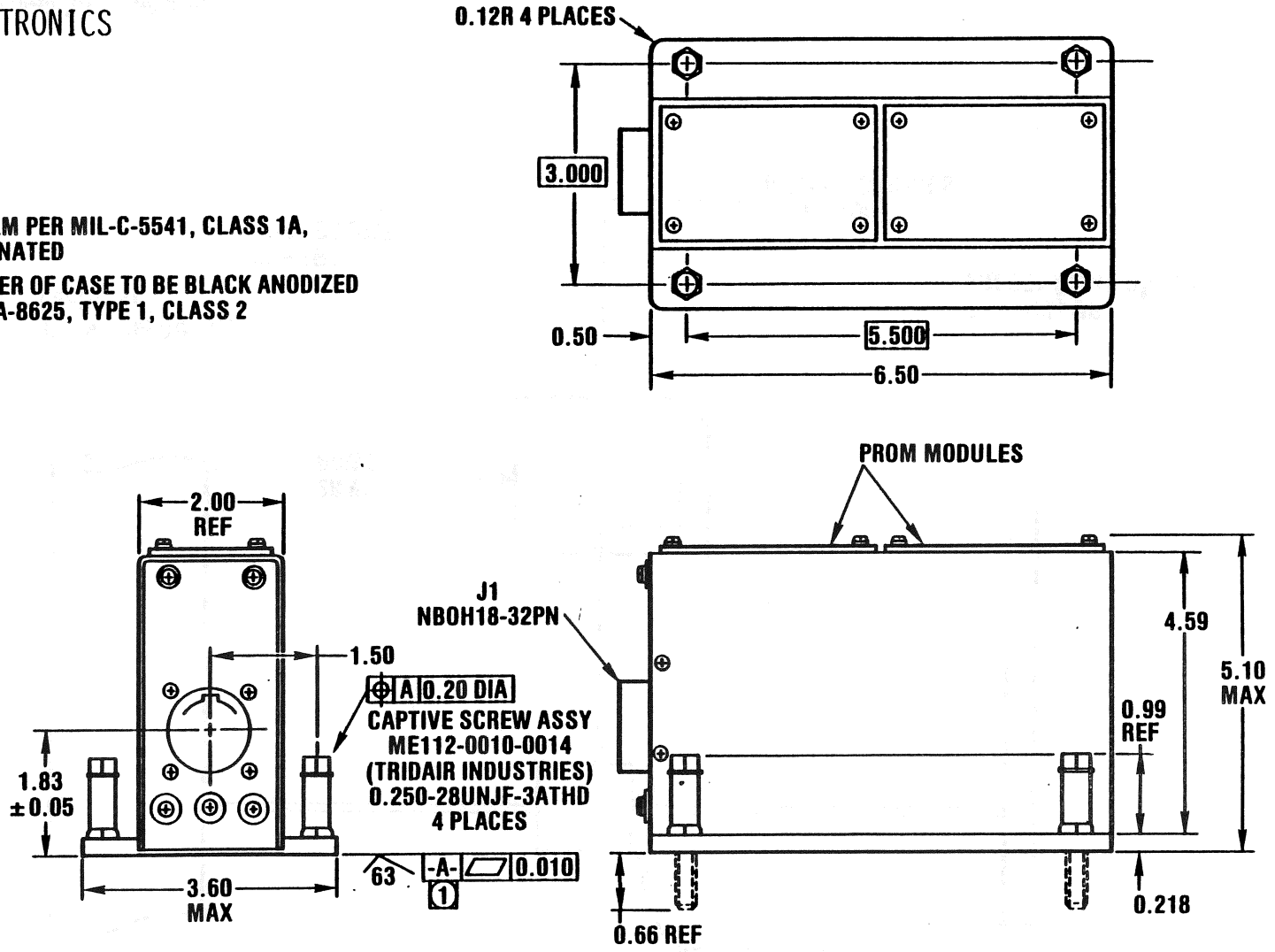
(MC449-0164)

-0006 ELECTRONICS

FINISH

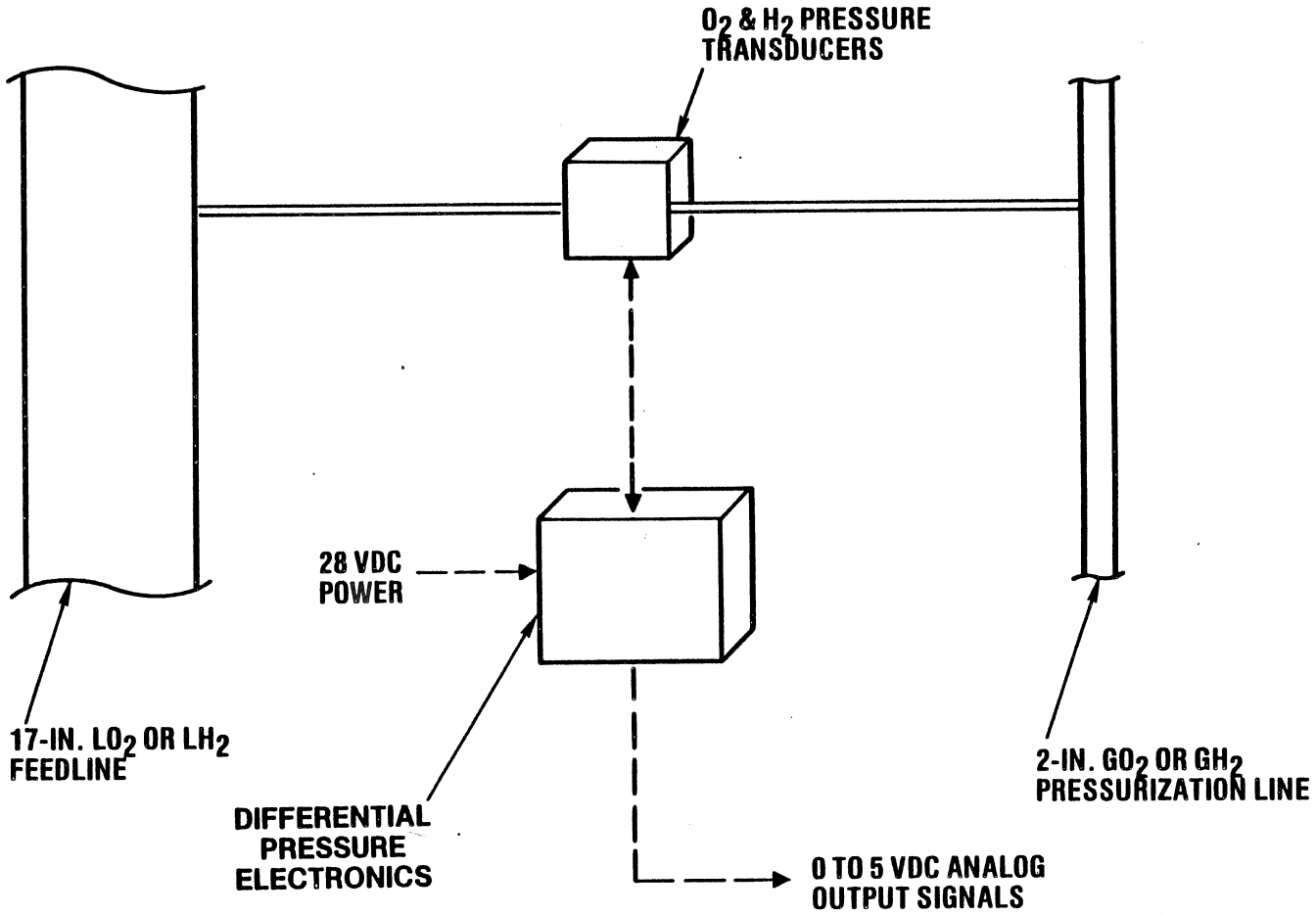
[1] CHEM FILM PER MIL-C-5541, CLASS 1A, AS DESIGNATED

2 REMAINDER OF CASE TO BE BLACK ANODIZED PER MIL-A-8625, TYPE 1, CLASS 2

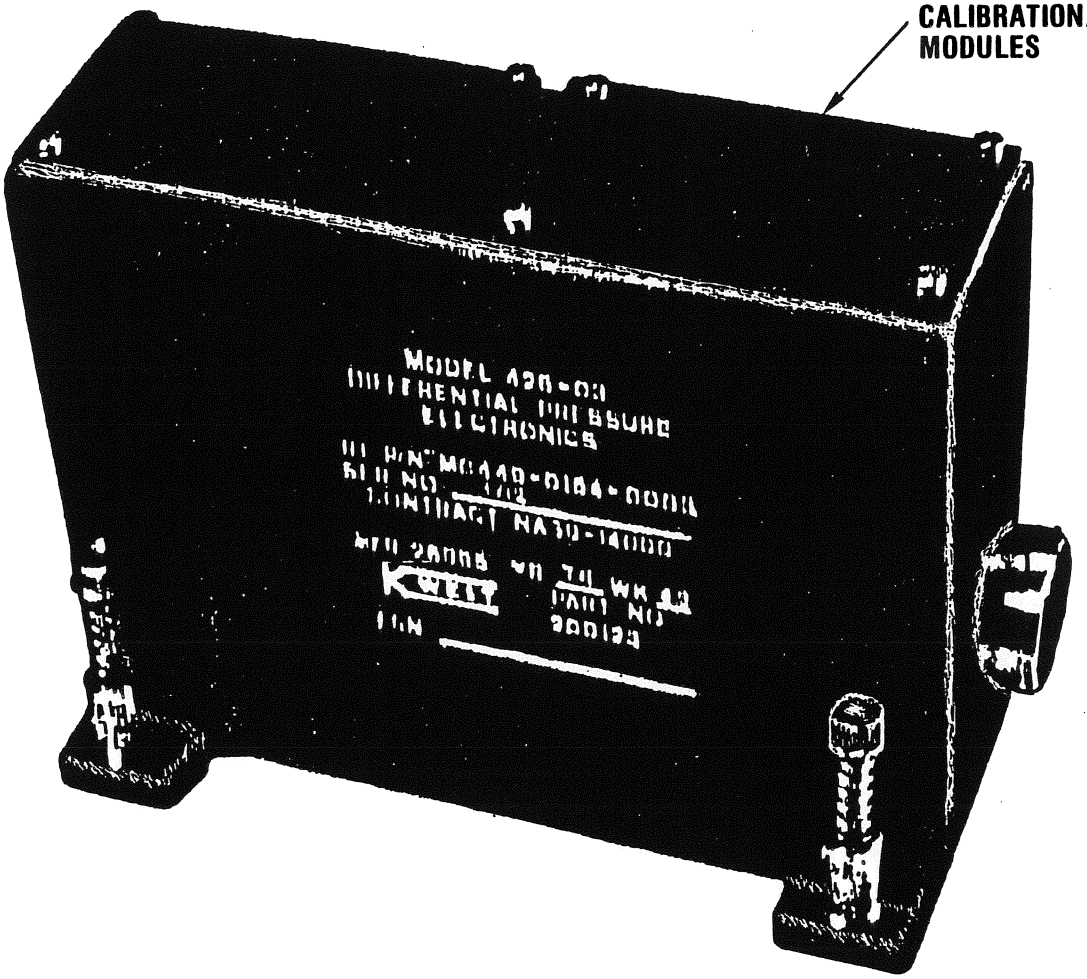


COMPONENT: DIFFERENTIAL PRESSURE, TRANSDUCER, AND ELECTRONICS
(MC449-0164)

BLOCK DIAGRAM — ΔP SYSTEM



COMPONENT: DIFFERENTIAL PRESSURE, TRANSDUCER, AND ELECTRONICS
(MC449-0164)



COMPONENT: SIGNAL CONDITIONER, ULLAGE PRESSURE

(MC476-0148)

FMEA/CIL NO. 03-1-0515

ASSEMBLY : PACIFIC SCIENTIFIC HTL K-WEST DIV.
P/N RI : MC476-0148-0005
P/N VENDOR:
QUANTITY : 3
: ONE PER SSME
:

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

SIGNAL CONDITIONER, ULLAGE PRESSURE, LO_2/LH_2.

FUNCTION:

EACH ULLAGE PRESSURE SIGNAL CONDITIONER (LOCATED IN AFT AVIONICS BAY 4, 5, OR 6) POWERS/MONITORS ONE PAIR OF GO_2 AND GH_2 ET ULLAGE PRESSURE TRANSDUCERS AND CONTROLS ONE PAIR OF GO_2 AND GH_2 FLOW CONTROL VALVES (FCVs). THE SIGNAL CONDITIONER GENERATES FCV CLOSE COMMANDS TO MAINTAIN ET ULLAGE PRESSURE WITHIN A REQUIRED RANGE. ADDITIONALLY, THE SIGNAL CONDITIONERS PROVIDE 0 TO 5 VDC ANALOG SIGNALS FOR GROUND CONTROL OF ET ULLAGE PRESSURE DURING PROPELLANT LOADING, TELEMETRY, AND COCKPIT ULLAGE PRESSURE DISPLAY/CAUTION AND WARNING. A COCKPIT SWITCH ALLOWS THE CREW TO OVERRIDE GH_2 FCV CLOSE COMMANDS FROM THE SIGNAL CONDITIONERS, CAUSING ALL GH_2 FCVs TO OPERATE AT HIGH FLOW.

TRANSDUCER PRESSURE SIGNALS ARE FED BACK TO THE SIGNAL CONDITIONER WHICH ISSUES THE APPROPRIATE VALVE OPEN AND CLOSE DISCRETE COMMAND SIGNALS TO MAINTAIN THE SENSED PRESSURE LEVEL WITHIN A 20 TO 22 PSIA BAND FOR OXYGEN TRANSDUCERS AND 32 TO 34 PSIA FOR HYDROGEN TRANSDUCERS.

COMPONENT: SIGNAL CONDITIONER, ULLAGE PRESSURE

(MC476-0148)

DESIGN:

THE SIGNAL CONDITIONER POWERS THE ET MOUNTED ULLAGE PRESSURE TRANSDUCERS (SUPPLIED BY THE ET MANUFACTURER), MONITORS THESE TRANSDUCERS, GENERATES ANALOG DATA AND CONTROL SIGNALS, AND PROVIDES DISCRETE VALVE HIGH AND LOW COMMAND SIGNALS FOR THE ORBITER-MOUNTED ULLAGE PRESSURE CONTROL VALVES (SUPPLIED BY THE ORBITER MANUFACTURER). ONE OXYGEN AND ONE HYDROGEN PRESSURE TRANSDUCER WILL BE USED WITH CORRESPONDING OXYGEN AND HYDROGEN SIGNAL CONDITIONERS WHICH ARE LOCATED IN A SINGLE ELECTRONIC PACKAGE (CONDITIONER). ONE OXYGEN AND ONE HYDROGEN PRESSURE CONTROL VALVE IS FED COMMAND SIGNALS FROM THE CONDITIONER. EACH TRANSDUCER SHALL BE TIED TO ONE ISOLATED SIGNAL CONDITIONER WHICH GENERATED COMMAND SIGNALS FOR ONE VALVE. A PRESSURE LEVEL BELOW THE MINIMUM PRESSURE CONTROL LEVEL WILL ALLOW THE NORMALLY OPEN ET PRESSURIZATION FLOW CONTROL VALVE TO GO TO HIGH FLOW POSITION. PRESSURE LEVELS ABOVE THE MAXIMUM PRESSURE CONTROL LEVEL SHALL PROVIDE A COMMAND SIGNAL WHICH WILL CAUSE THE ET PRESSURIZATION FLOW CONTROL VALVE TO GO TO LOW FLOW POSITION. THREE CONDITIONERS OF THIS DESIGN ARE ON EACH ORBITER FOR THREE PARALLEL INDEPENDENT SYSTEMS. ANY ONE OF THE THREE GO_2 AND GH_2 ULLAGE PRESSURE CONTROL SYSTEMS CAN FAIL IN-FLT AND THE VEHICLE WILL REMAIN WITHIN OPERATIONAL SAFETY REQUIREMENTS.

COMPONENT

THE ULLAGE PRESSURE SIGNAL CONDITIONER HAS TWO PHYSICALLY AND ELECTRICALLY ISOLATED MODULES MOUNTED ON A 6061-T6 ALUMINUM FRAME; ONE FOR GO_2 AND ONE FOR GH_2. EACH MODULE CONTAINS POWER SUPPLY, SIGNAL CONDITIONER, CHECKOUT CIRCUIT, AND FCV COMMAND CIRCUIT IN A 6061-T6 BLACK ANODIZED ALUMINUM HOUSING. DYNAMIC DAMPENING OF THE INTERNALLY MOUNTED COMPONENTS IS ACHIEVED BY ENCAPSULATION IN GLASS RESIN EPOXY. THE COMPONENTS ARE MOUNTED ON SEMI-RIGID NICKEL RIBBONS AND ARE HELD IN PLACE BY THE ENCAPSULANT. THE NICKEL RIBBONS ARE CONNECTED TO AN ELECTRICAL INTERFACE CONNECTOR. EACH MODULE IS THEN EXTERNALLY SEALED AFTER CHECKOUT WITH EPOXY SEALANT TO PROVIDE AN ENVIRONMENTAL SEAL.

EACH MODULE CONTAINS AN ELECTRICAL INTERFACE CONNECTOR, WHICH IS HERMETICALLY SEALED AND SOLDERED. THE CONNECTOR IS BUILT TO THE MSFC 40M SPECIFICATIONS FOR SPACE VEHICLES. ALL ELECTRONIC COMPONENTS WERE SELECTED SO THAT THEIR USAGE MEETS THE SHUTTLE DERATING REQUIREMENTS.

FCV CLOSE COMMANDS ARE CONTROLLED ON THE BASIS OF EXCITATION TO TRANSDUCER FEEDBACK VOLTAGE RATIO, REDUCING THE EFFECTS OF EXCITATION VOLTAGE SHIFTS. CHECKOUT COMMANDS FROM THE GROUND MDM ARE DISTRIBUTED THROUGH OPTICAL ISOLATION CIRCUITS IN EACH MODULE.

COMPONENT: SIGNAL CONDITIONER, ULLAGE PRESSURE

(MC476-0148)

EXCITATION POWER TO THE ET ULLAGE PRESSURE TRANSDUCER IS LIMITED TO 10 mA BY CURRENT LIMITING CIRCUITRY TO MAINTAIN A SAFE CONFIGURATION IN CASE OF AN EXTERNAL SHORT CIRCUIT.

SYSTEM

SEPARATE CABLE HARNESSES ARE USED ON THE ORBITER FOR EACH SIGNAL CONDITIONER (EACH POWERED BY A SEPARATE ORBITER MAIN BUS). THE OUTPUTS ARE FED TO SEPARATE MDMs AND VALVE LOAD DRIVERS TO MAINTAIN SIGNAL ISOLATION. TWO CABLE HARNESSES ARE USED ON THE EXTERNAL TANK (ET) FOR CONNECTION TO THE ET TRANSDUCERS. ET AND ORBITER CABLES TO THE TRANSDUCERS ARE SHIELDED WITH A SINGLE GROUND CONNECTION AT THE SIGNAL CONDITIONER TO MINIMIZE RF NOISE PROBLEMS. THE ET MAINTAINS AN EXTRA OUTER SHIELD FOR LIGHTNING PROTECTION WITH MULTIPLE POINT GROUNDS. ET TRANSDUCER FAILURE MODES ARE DOCUMENTED BY THE ET PROJECT.

DESIGN PARAMETERS: (EACH MODULE)

USEFUL LIFE: THE CONDITIONER HAS A MINIMUM USEFUL LIFE OF 2,000 HOURS OR A 100-ORBITAL MISSION EQUIVALENT.

DISCRETE SIGNAL OUTPUTS: ONE ON-OFF 28 VDC SIGNAL WHICH IS ROUTED TO A LOAD DRIVER FOR CONTROL OF ONE FLOW CONTROL VALVE.

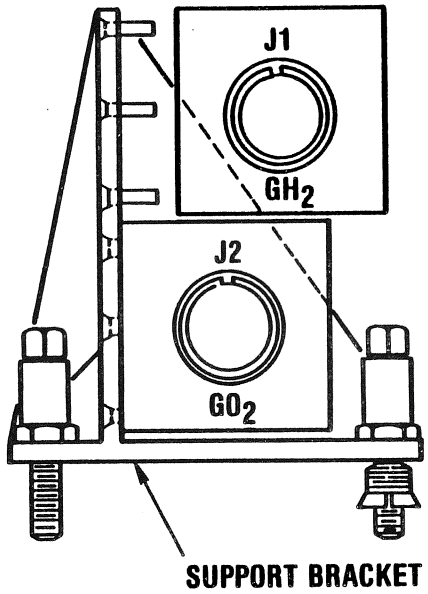
ANALOG SIGNAL OUTPUTS: ONE 0 TO 5 VDC UNIPOLAR ANALOG OUTPUT SIGNAL AND ONE DEDICATED SIGNAL GROUND RETURN.

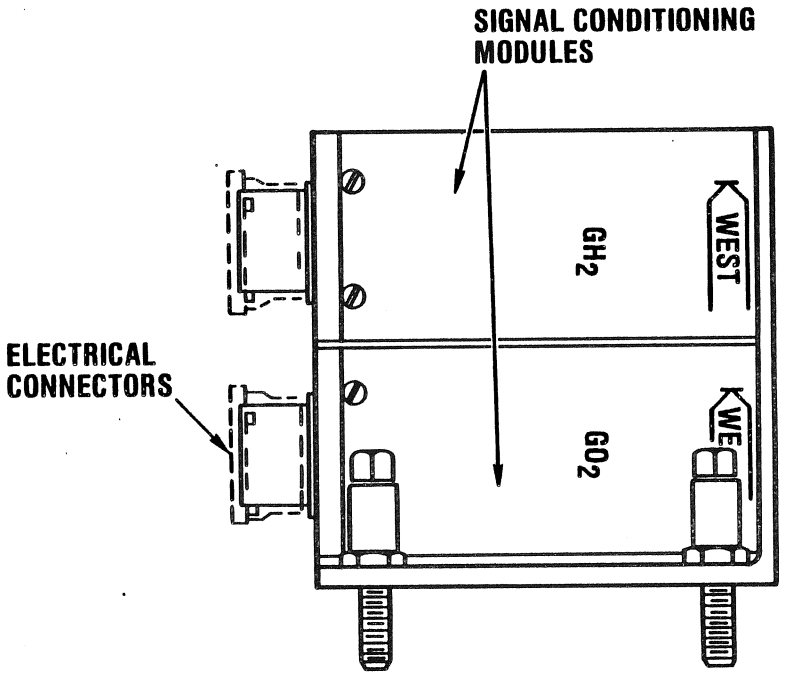
FREQUENCY RESPONSE: PASSBAND - FREQUENCY RESPONSE FLAT WITHIN 5 PERCENT FOR A SIGNAL INPUT OF DC TO 10 HZ; ROLLOFF - ATTENUATION 3 dB OR GREATER AT 35 HZ AND 30 dB OR GREATER AT 400 HZ INPUT FREQUENCY AND ROLLOFF AT A RATE OF 12 dB PER OCTAVE OR GREATER FOR FREQUENCIES ABOVE 400 HZ.

CIRCUIT PROTECTION: THE TRANSDUCER IS LIMITED TO 10 MILLIAMPERES D.C. MAXIMUM CURRENT UNDER ALL CONDITIONS (7 mA D.C. MAX STEADY STATE).

COMPONENT: SIGNAL CONDITIONER, ULLAGE PRESSURE

(MC476-0148)

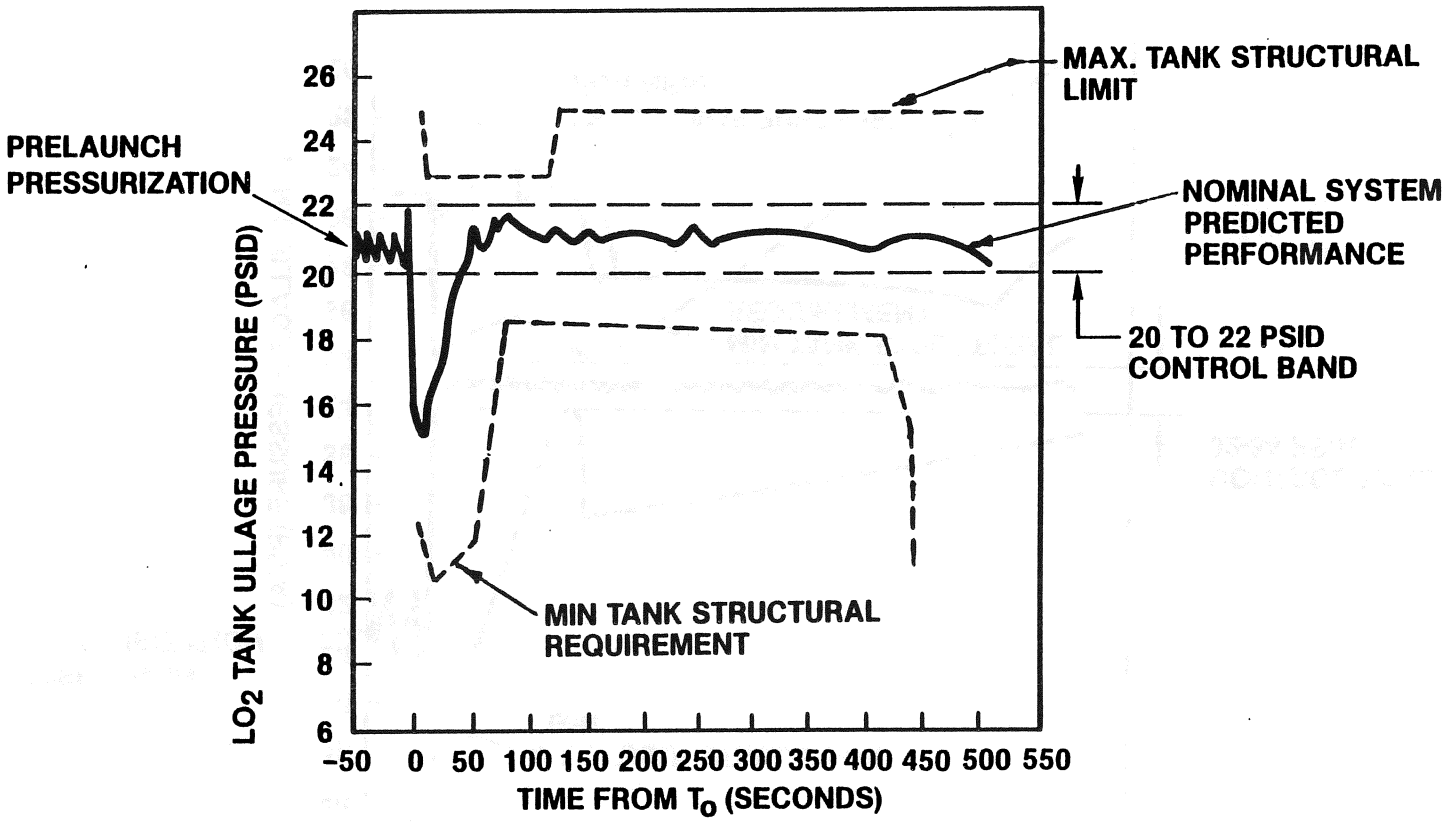




COMPONENT: SIGNAL CONDITIONER, ULLAGE PRESSURE

(MC476-0148)

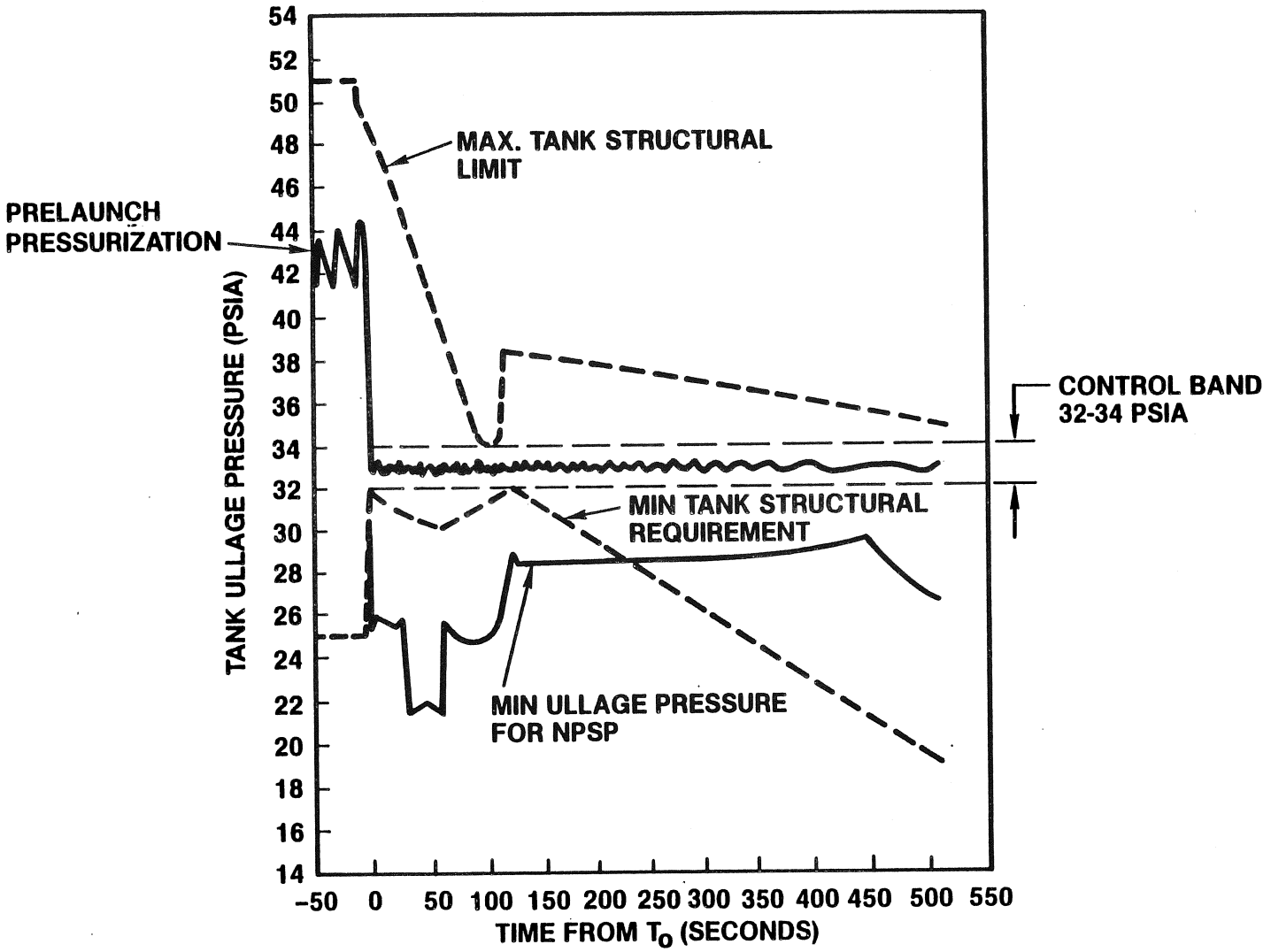
LO_2 PRESSURIZATION SYSTEM PERFORMANCE (NOMINAL CASE)



COMPONENT: SIGNAL CONDITIONER, ULLAGE PRESSURE

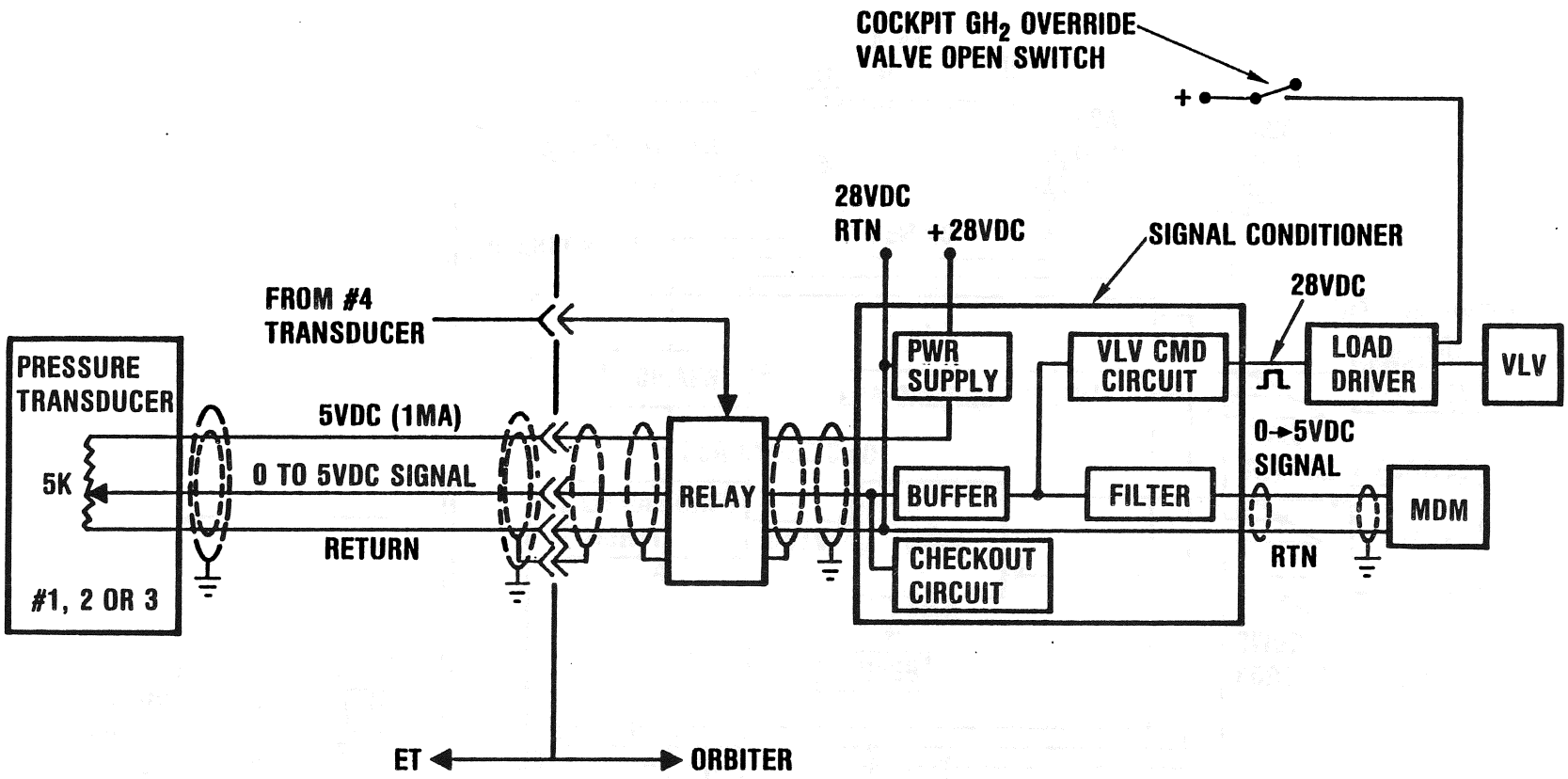
(MC476-0148)

LH_2 PRESSURIZATION SYSTEM PERFORMANCE (NOMINAL CASE)



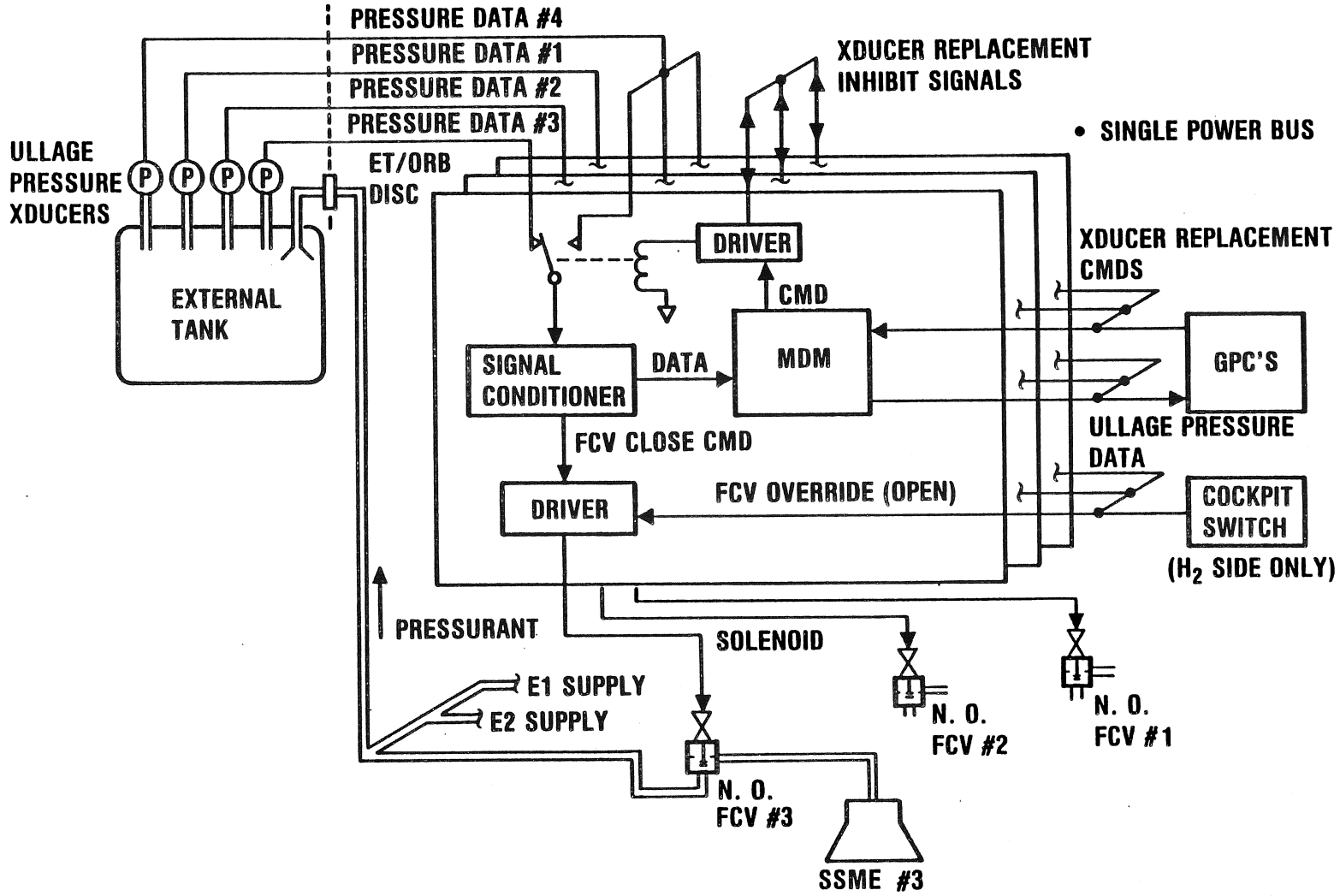
COMPONENT: SIGNAL CONDITIONER, ULLAGE PRESSURE

(MC476-0148)



COMPONENT: SIGNAL CONDITIONER, ULLAGE PRESSURE

(MC476-0148)



COMPONENT: MPS METALLIC BOSS K-SEAL

(ME261-0033)

FMEA/CIL NO. 03-1-0701

VENDOR : SIERRACIN/HARRISON
P/N RI : ME261-0033-XXXX
P/N VENDOR: (RI STANDARD PART)
QUANTITY : >100 PER END ITEM
: LOCATED IN
: MPS SYSTEMS

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

K-SEAL

FUNCTION:

PROVIDES A SEAL AT ALL THREADED PORTS.

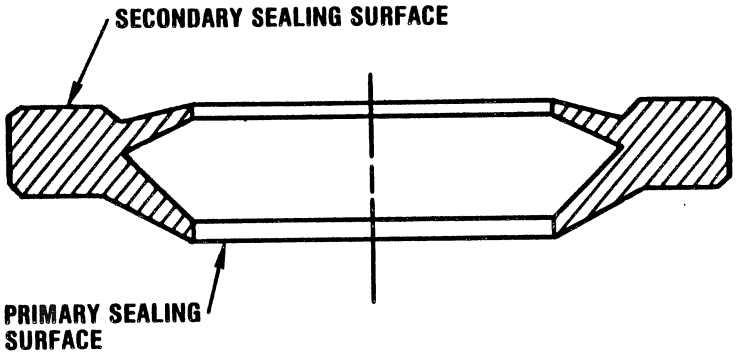
DESCRIPTION: ME261-0033 SEAL

TWO TYPES ARE USED IN THE MPS SUBSYSTEMS: TYPE II, GOLD PLATED AND PRIMARILY USED IN GASEOUS AND LIQUID OXYGEN APPLICATIONS; TYPE III, PLATED WITH A HARRISON MANUFACTURING COMPANY K-6 ALLOY AND PRIMARILY USED IN HYDROGEN AND HELIUM APPLICATIONS. BOSS SEALING IS ACCOMPLISHED BY DEFLECTION OF TWO THIN "K" LEGS INTERFACING WITH MATING CONICAL SURFACE.

COMPONENT: MPS METALLIC BOSS K-SEAL

(ME261-0033)

METALLIC BOSS (K-SEAL)



PROOF TEST (INSTALLED):

- LO_2: 286 PSIG (LEAK CHECKED AT 100 PSIG)
- LH_2: 66 PSIG (LEAK CHECKED AT 100 PSIG)

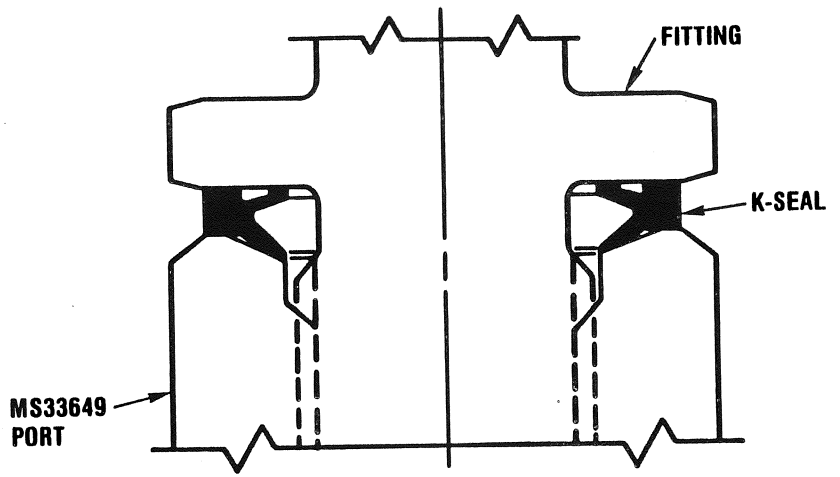
SEAL MATERIAL: A286 CRES BAR WITH K-6 NICKEL-LEAD COATING (TYPE III)

FUNCTION: PREVENT EXTERNAL LEAKAGE AT THE MS33649 BOSS PORTS

SUPPLIER: SIERRACIN/HARRISON

FEATURES:

- SUCCESSFULLY USED ON SATURN II IN SIMILAR APPLICATION
- SEAL IS HIGHLY VISIBLE AFTER INSTALLATION (0.060) THICK



COMPONENT: MPS FLANGE SEALS

(ME261-0045)

FMEA/CIL NO. 03-1-0701

VENDOR : VARIOUS VENDORS (SEE SCD)
P/N RI : ME261-0045-XXXX (SEE SCD)
P/N VENDOR:
QUANTITY : 78 PER END ITEM
: LOCATED IN MPS SYSTEMS
: VARIOUS P/N DASH NUMBERS

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM: SEALS, "NAFLEX" FLANGE FACE.

FUNCTION:

PROVIDES A SEAL BETWEEN BOLTED FLANGE FACES FOR LH_2 AND LO_2 PROPELLANT SYSTEM LINES AND COMPONENTS AND HELIUM/PRESSURIZATION SYSTEM LINE AND COMPONENTS WITH BOLTED FLANGES.

DESIGN:

THE SEALS USED WITH THE MPS LOW PROFILE FLANGE ARE SATURN II DESIGN/DEVELOPED STATIC FACE PRESSURE ASSISTED COMPRESSION SEALS. THE SEAL IS MANUFACTURED FROM INCONEL 718 ALLOY AND THE SEALING SURFACE IS TEFLON COATED OR SILVER PLATED. THE DESIGN TEMPERATURE RANGE IS -423 DEG F TO +600 DEG F. THE MAXIMUM DESIGN LEAKAGE ALLOWABLE FOR THE LOW PROFILE FLANGE COMPRESSION SEAL ASSEMBLY IS 1×10^{-2} STANDARD CUBIC CENTIMETERS/SECOND (SCCS) PER CIRCUMFERENTIAL INCH AT THE PRIMARY SEAL. THE DESIGN INCLUDES A SECONDARY BARRIER THAT RESTRICTS THE LEAKAGE IF THE PRIMARY SEAL FAILS. THE FLANGE DESIGN INCORPORATES A LEAK CHECK PORT TO MEASURE FLANGE/SEAL JOINT LEAKAGE.

DESCRIPTION: ME261-0045 SEAL

THE COMPONENT IS A STATIC FACE SEAL WITH THE PRIMARY SEALING FUNCTION BEING THE COMPRESSION OF TWO CANTILEVERED LIP RINGS WHICH ARE EITHER TEFLON COATED OR SILVER PLATED. SECONDARY SEALING IS PROVIDED BY THE SEAL COAT EXTENDING OUTWARD FROM THE PRIMARY SEAL. LEAK DETECTION CAPABILITY IS PROVIDED WITH AN INTERCONNECTED ANGULAR RECESS ON BOTH SIDES OF THE SEAL AND A LEAK DETECTION PORT IN ONE OF THE MATING FLANGES.

TWO TYPES ARE USED IN MPS SUBSYSTEMS: TYPE I, TEFLON COATED AND USED IN CRYOGENIC AND HELIUM SYSTEM APPLICATIONS; TYPE II, SILVER PLATED AND USED IN HIGH TEMPERATURE APPLICATIONS.

COMPONENT: MPS FLANGE SEALS

(ME261-0045)

FLANGE FACE SEAL

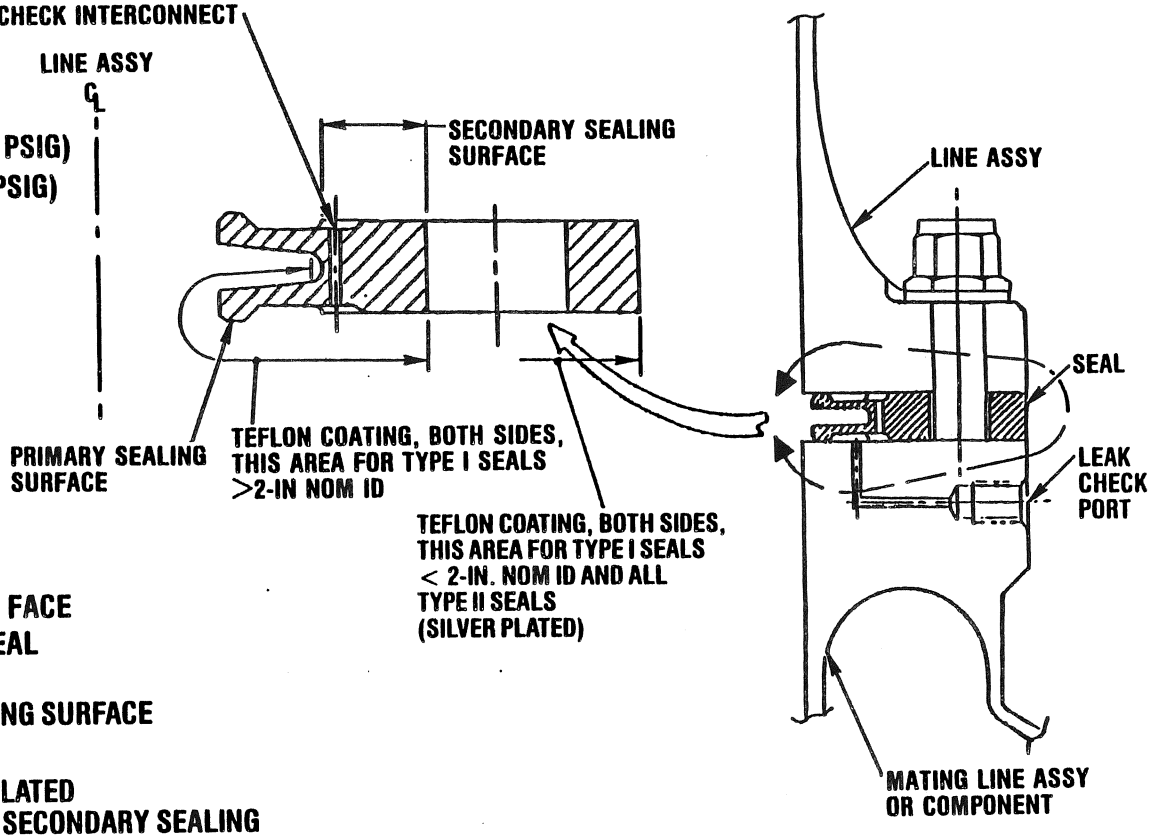
PROOF TEST (INSTALLED):

LO_2 SEAL: 286 PSIG (LEAK CHECKED AT 100 PSIG)
LH_2 SEAL: 66 PSIG (LEAK CHECKED AT 30 PSIG)

SEAL MATERIAL: INCO 718

FUNCTION: PREVENT EXTERNAL LEAKAGE AT MPS LOW PROFILE FLANGE JOINTS

SUPPLIER: VARIOUS (SEE SCD)



FEATURES:

- SATURN II DESIGN/DEVELOPED STATIC FACE PRESSURE ASSISTED COMPRESSION SEAL
- TEFLON COATED OR SILVER PLATED SEALING SURFACE
- INCLUDES A TEFLON COATED OR SILVER PLATED STRUCTURAL BARRIER WHICH PROVIDES SECONDARY SEALING
- INCORPORATES A LEAK CHECK PORT TO MEASURE FLANGE/SEAL JOINT LEAKAGE

COMPONENT: GIMBAL JOINT, PROPULSION SYSTEMS

(ME271-0092)

VENDOR : AMETEK/STRAZA
P/N RI : ME271-0092-0001, -0002, -0004 & -0005
P/N VENDOR: I/II 8-031251; IV/V 8-031318
QUANTITY : 3 GIMBALS PER LINE ASSEMBLY
:
LINE ASSY : TYPE I AND II (MPS)
TYPE IV AND V (OMS, 099 AND SUBS)

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM: GIMBAL JOINT - 1.5, 2.0 IN.

FUNCTION: THE COMPONENT ACCOMMODATES STRUCTURAL DEFLECTION, THERMAL, VIBRATION AND PRESSURE LOADS INDUCED TO THE SYSTEM LINE ASSEMBLIES. THREE GIMBALS ARE USED IN EACH LINE ASSEMBLY FOR THIS PURPOSE.

DESIGN: THE COMPONENT IS A UNIVERSAL ANGULAR MOTION FLEX JOINT THAT IS WELDED INTO AND BECOMES AN INTEGRAL PART OF THE FOLLOWING PROPULSION SYSTEM LINE ASSEMBLIES:

TYPE I	MPS GH_2 PRESSURIZATION SYSTEM (V070-415425 LINE ASSEMBLY)
	MPS GO_2 PRESSURIZATION SYSTEM (V070-415462 LINE ASSEMBLY)
	MPS POGO RETURN SYSTEM (V070-415350 LINE ASSEMBLY)
TYPE II	MPS LH_2 DUMP SYSTEM (V070-415287 LINE ASSEMBLY)
	MPS LO_2 BLEED SYSTEM (V070-415362 LINE ASSEMBLY)
TYPE IV	OMS OXIDIZER CROSSFEED LINES (OV-099 AND SUBS)
TYPE V	OMS FUEL CROSSFEED LINES (OV-099 AND SUBS)

THE COMPONENT CONSISTS OF TWO OPPOSITE FORMED FORKS LOCATED 90-DEGREES TO EACH OTHER AND LINKED TOGETHER WITH ENTRAPPED PINS THROUGH A GIMBAL RING. THE PRESSURE CARRIER IS SEALED WITH A MULTI-PLY CORRUGATED BELLOWS WHICH IS LINED TO PREVENT FLOW INDUCED VIBRATION.

THE COMPONENTS' FORK/RING ASSEMBLY PROVIDES TENSILE AND TORQUE LOAD CAPABILITY WHILE ACCEPTING ANGULAR DEFLECTIONS IN ALL PLANES OF MOTION.

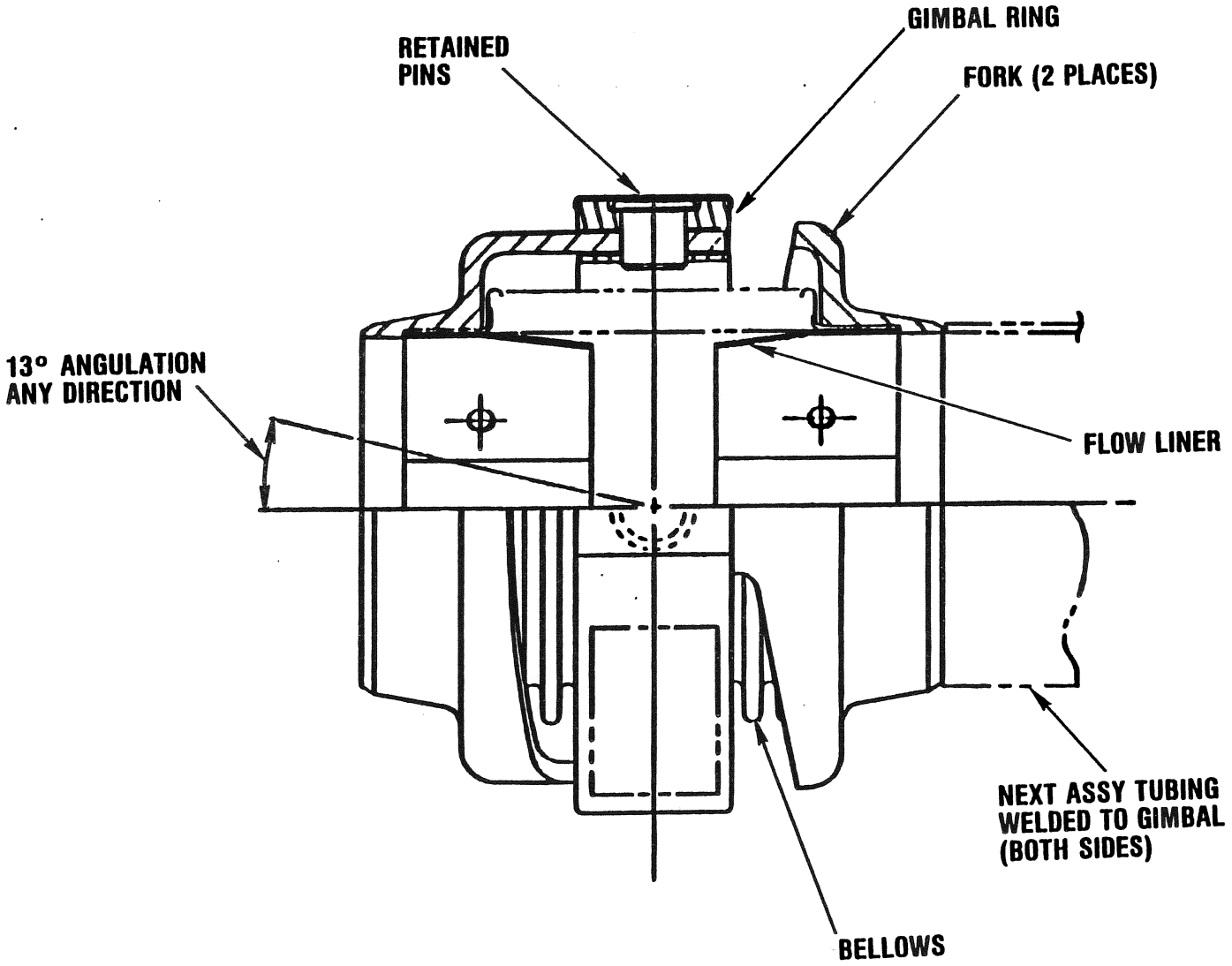
COMPONENT: GIMBAL JOINT, PROPULSION SYSTEMS

(ME271-0092)

TYPE I AND II (MPS)
TYPE IV AND V (OMS, 099 AND SUBS)

DESIGN PARAMETERS AND FEATURES:	TYPE			
	I	II	IV	V
CURRENT CONFIGURATION:	(-0001)	(-0002)	(-0004)	(-0005)
MEDIA:	GH_2, GO_2, LO_2	LH_2, LO_2	N_2O_4	NMH
TEMPERATURES, °F:	-297 TO +600	-423 TO +297	+150	+150
OPERATING PRESSURE MAXIMUM, PSIG:	650	400	900	900
PROOF PRESSURE (AMBIENT) PSIG:	1404	832	1840	1840
BURST PRESSURE (AMBIENT), PSIG:	2808	1664	3680	3680
SIZE, NOMINAL, INCHES:	2.0	1.50	1.50	1.50
PRESSURE DROP (MAX):	5.0 PSI (GO_2: 325 PSIA, 575 F, 8 LB/SEC)	2.5 PSI (LH_2: 55 PSIA, -423 F, 7 LB/SEC)	0.8 PSI (N_2O_4: 250 PSIA, 70 F, 18.22 LB/SEC)	0.5 PSI (MMH: 250 PSIA, 70 F, 11.39 LB/SEC)
WEIGHT, MAXIMUM, LB:	2.0	1.1	1.5	1.5
LEAKAGE:	1×10^{-5} SCCS GHe AT 200 PSIG (TYPE I AND II)		5×10^{-6} SCCS GHe AT 900 PSIG (TYPE IV AND V)	
FLOW CAPACITY (MAX):	21.0 LB/SEC	19.5 LB/SEC	18.2 LB/SEC	11.4 LB/SEC

COMPONENT: GIMBAL JOINT, PROPULSION SYSTEMS
(ME271-0092)



COMPONENT: COUPLING, TEST POINT

(ME276-0032)

FMEA/CIL: 03-1-0516

VENDOR : LEAR SIEGLER/ROMEC DIV.
P/N RI : ME276-0032-0017, -0018
P/N VENDOR:
QUANTITY : 2 PER END ITEM

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

COUPLING, TEST POINT

FUNCTION:

TWO AIRBORNE COUPLINGS ARE PROVIDED IN THE PRESSURIZATION SYSTEM. ONE FOR THE LO_2 TANK AND ONE FOR THE LH_2 TANK HELIUM PREPRESSURIZATION. THE COUPLINGS ARE PROVIDED FOR PRESSURIZING OR MEASURING THE TANK PRESSURE DURING THE SYSTEM CHECKOUT.

DESIGN:

THE COUPLING ASSEMBLY CONSISTS OF AN AIRBORNE HALF COUPLING (AHC), AN AIRBORNE HALF COUPLING CAP, A GROUND HALF COUPLING (GHC), AND A GROUND HALF COUPLING CAP. THE AIRBORNE AND GROUND HALF ARE SPRING LOADED CLOSED AND MECHANICALLY ACTUATED OPEN WHEN HALVES ARE ENGAGED.

COMPONENT: COUPLING, TEST POINT

(ME276-0032)

DESIGN PARAMETERS:

CURRENT CONFIGURATION: AHC (-0017), GHC (-0018)

WEIGHT:
0.25 LB (MAX) – AHC
1.00 LB (MAX) – GHC

ENVELOPE DIMENSIONS:
.71 MAX ACROSS FLATS X 2.75 – AHC
.90 MAX ACROSS FLATS X 3.43 – GHC

FLOW CAPACITY: 0.094 STANDARD ORIFICE DIAMETER

NOMINAL LINE SIZE: 3/8 DIAMETER MALE THREAD INLET CONNECTION (AHC)

USEFUL LIFE: THE COUPLING ASSEMBLY WILL OPERATE A MINIMUM OF 400 OPERATING CYCLES.

PRESSURES:

COUPLING TYPE	OPERATING PRESSURE (PSIG)	MAXIMUM SYSTEM PRESSURE (PSIG)	PROOF PRESSURE (PSIG)	BURST PRESSURE (PSIG)
(AHC AND GHC)	950	950	1,900	3,800

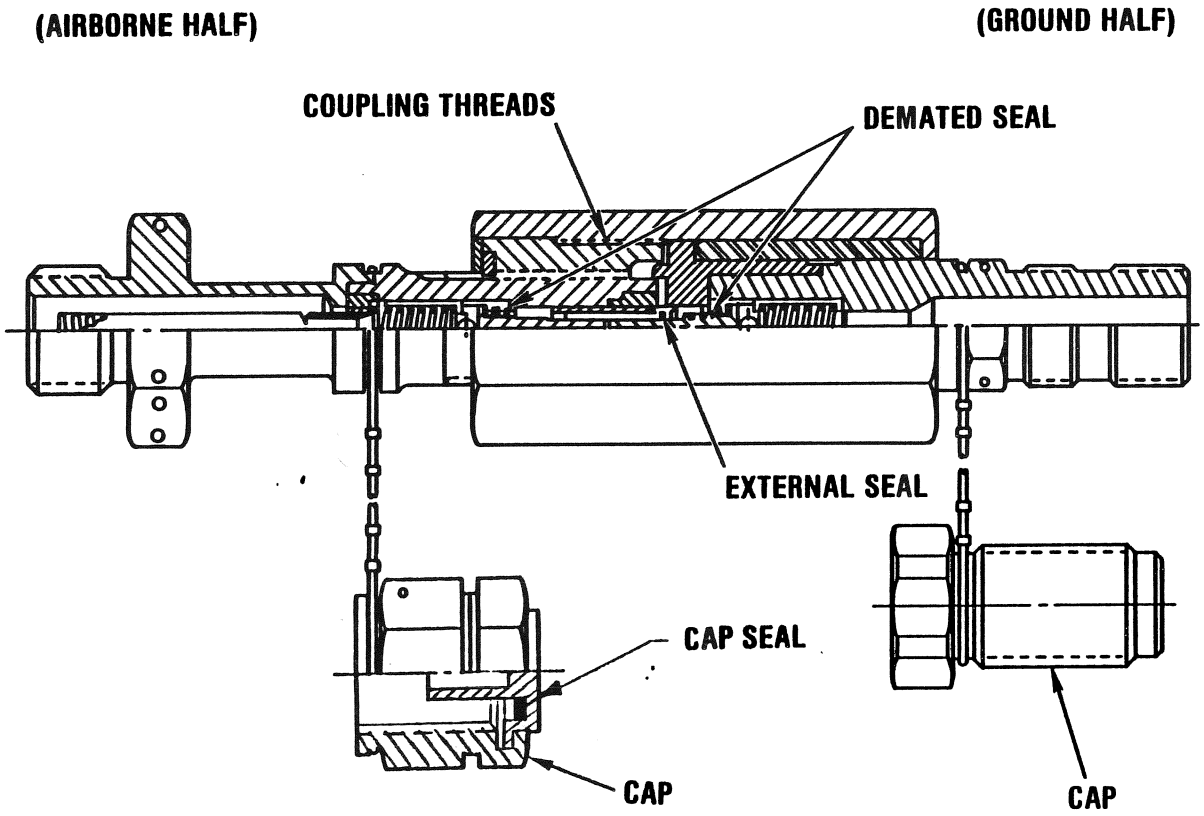
TEMPERATURES:

	COUPLING TYPE	TEMPERATURE
WITH FLUID IN SYSTEM	(AHC ONLY)	MINUS 100°F TO PLUS 350°F
	(GHC ONLY)	PLUS 20°F TO PLUS 150°F
	(AHC AND GHC ENGAGED)	PLUS 20°F TO PLUS 150°F
WITHOUT FLUID IN SYSTEM	(AHC ONLY)	MINUS 65°F TO PLUS 150°F
	(GHC ONLY)	MINUS 65°F TO PLUS 150°F
	(AHC AND GHC ENGAGED)	MINUS 23°F TO PLUS 150°F

COMPONENT: COUPLING, TEST POINT

(ME276-0032)

TYPE VII



COMPONENT: VALVE, CHECK, HELIUM

(ME284-0472)

VENDOR : CIRCLE SEAL
P/N RI : ME284-0472 (SEE BELOW)
P/N VENDOR:
QUANTITY : 33 PER END ITEM

FMEA/CIL NO. 03-1-0209

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM: VALVE, CHECK, HELIUM

FUNCTION: TYPE I: 1/4 IN. DIAMETER -0001, -0011 (LOCKWIRE ADDED)

THE TYPE I CHECK VALVE IS USED IN THE LO_2 AND LH_2 REPRESSURIZATION SYSTEM WHICH INTERCONNECTS THE PREPRESSURIZATION LINES TO THE FEEDLINE MANIFOLDS. AFTER LH_2 LOADING AND THE START OF THE LH_2 RECIRCULATION, THE CHECK VALVE PREVENTS THE ENTRANCE OF LIQUID HYDROGEN INTO THE LH_2 REPRESSURIZATION REGULATOR. DURING MAIN ENGINE START, THE CHECK VALVE PREVENTS PRESSURIZING OF THE FEEDLINE MANIFOLDS THROUGH THE REPRESS SYSTEM.

TYPE II: 3/8 IN. DIAMETER -0002

THE TYPE II CHECK VALVE IS USED IN THE HELIUM STORAGE FILL, THE SSME ENGINE PNEUMATIC PANELS AND THE VALVE ACTUATION PNEUMATIC PANELS. A TOTAL OF 16 VALVES ARE USED. IN THE HELIUM STORAGE FILL SYSTEM, THE CHECK VALVES PREVENT THE LOSS OF HELIUM IN THE STORAGE TANKS IN THE EVENT OF A LEAK UPSTREAM OF THE CHECK VALVES. IN THE SSME PNEUMATIC AND VALVE ACTUATION PANELS, THE CHECK VALVES ALLOW THE PANELS TO BE INTERCONNECTED SO THE HELIUM SUPPLY IN ALL THE STORAGE TANKS CAN BE USED INDEPENDENTLY OR INTERCONNECTED AS REQUIRED.

TYPE III: 1/2 IN. DIAMETER -0003, -0013 (LOCKWIRE ADDED)

THE TYPE III CHECK VALVE IS USED IN THE LO_2 MANIFOLD AND FEEDLINE REPRESSURIZATION SYSTEM AND IN THE VALVE ACTUATION PANEL. IN THE REPRESSURIZATION SYSTEM, THE CHECK VALVE PREVENTS THE ENTRANCE OF LIQUID OXYGEN FROM THE LO_2 FEEDLINE MANIFOLD TO THE REPRESS REGULATOR.

IN THE VALVE ACTUATION SUPPLY SYSTEM, THE CHECK VALVE IS USED TO ISOLATE THE SUPPLY LINE SURGE CHAMBERS FROM THE MAIN STORAGE SUPPLY. THE SURGE CHAMBER SUPPLY IS PROVIDED FOR OPERATION OF THE 17 IN. DISCONNECTS AND THE PREVALVES IN THE EVENT THAT THE MAIN SUPPLY PRESSURE IS NOT AVAILABLE DURING MECO.

TYPE IV: 3/4 IN. DIAMETER -0004, -0024 (LOCKWIRE ADDED)

THE TYPE IV CHECK VALVE IS USED IN THE VALVE ACTUATION PNEUMATIC SUPPLY PANEL, THE LH_2 MANIFOLD AND FEEDLINE REPRESSURIZATION SYSTEM, AND THE RTLS SYSTEM. IN THE VALVE ACTUATION PNEUMATIC SUPPLY PANEL, THE CHECK VALVE ISOLATES THE VALVE ACTUATION REGULATOR FROM VALVE ACTUATION LINE FEED SYSTEM.

IN THE LH_2 MANIFOLD REPRESSURIZATION SYSTEM, THE CHECK VALVE ISOLATES THE REPRESSURIZATION REGULATOR FROM LIQUID HYDROGEN IN THE LH_2 MANIFOLD. IN THE RTLS, THE CHECK VALVE ISOLATES THE RTLS HELIUM SUPPLY SYSTEM FROM LIQUID HYDROGEN DURING A VENT CYCLE OF THE LH_2 MANIFOLD RELIEF VALVE.

TYPE IV: (MODIFIED) 3/4 IN. DIAMETER -0014, -0034 (LOCKWIRE ADDED)

THE TYPE IV (MODIFIED) CHECK VALVE IS USED IN THE SSME PNEUMATIC SUPPLY PANELS AND ISOLATES THE PNEUMATIC PANEL REGULATOR FROM THE ENGINE HELIUM SUPPLY LINES. IN THE EVENT OF A LEAK UPSTREAM OF A CHECK VALVE, THE LOSS OF ENGINE PURGE HELIUM IS PREVENTED.

TYPE V: 1.0 IN. DIAMETER -0005

THE TYPE V CHECK VALVE IS USED IN THE GO_2 AND GH_2 HELIUM PREPRESSURIZATION SYSTEM TO PROVIDE REDUNDANCY TO THE CHECK VALVE IN THE T-0 UMBILICAL DISCONNECT. AFTER ENGINE START, THE CHECK VALVES PREVENT THE LOSS OF GO_2/GH_2 PRESSURANT IN THE EVENT OF A LEAK IN THE LINES OR DISCONNECT UPSTREAM OF THE CHECK VALVES.

DESIGN

THE CHECK VALVE IS A POPPET TYPE, SPRING LOADED AND PRESSURE ASSISTED TO THE CLOSED POSITION. THE POPPET AND SPRING ARE CONTAINED IN A THREADED HOUSING AND END CAP. THE POPPET SEAL IS A SELF-CENTERING TEFLON O-RING. THE VALVE BODY PROVIDES A GUIDE FOR THE POPPET TRAVEL. THE POPPET RESTS AGAINST THE SPRING GUIDE UNDER FLOW CONDITIONS.

COMPONENT: VALVE, CHECK, HELIUM

(ME284-0472)

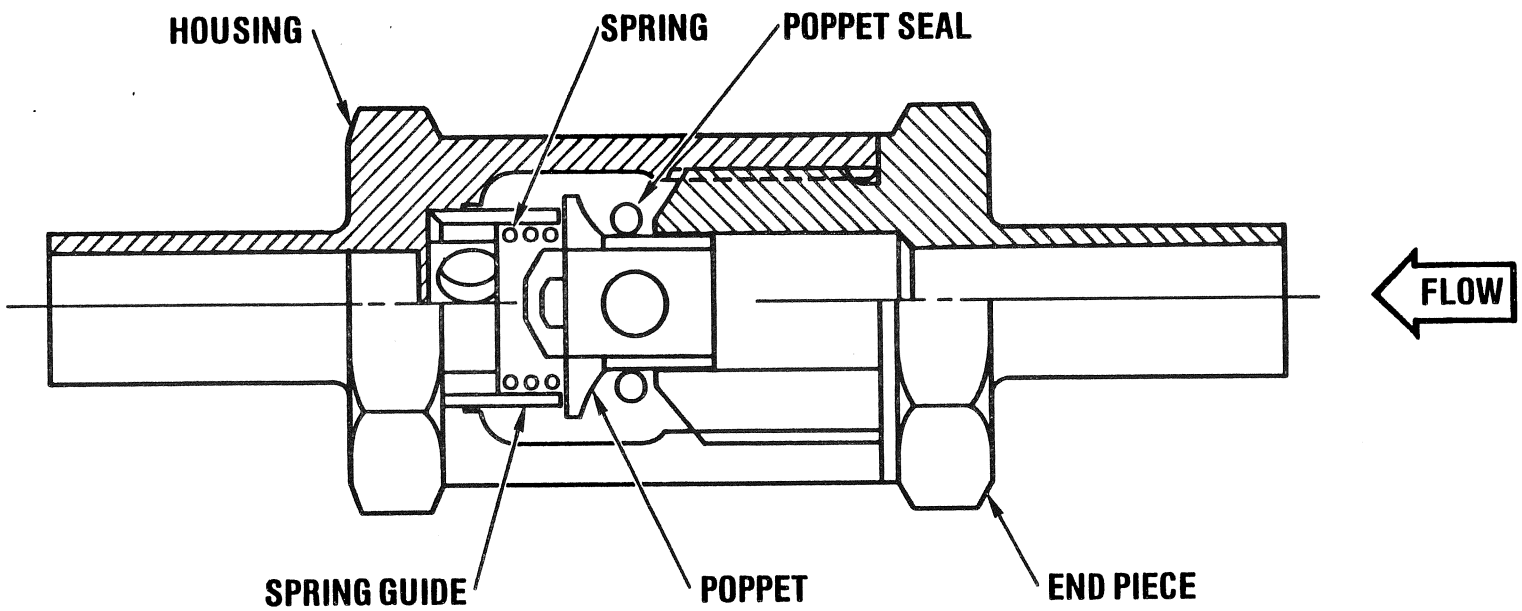
DESIGN PARAMETERS:

TYPE:	I	II	III	IV	IV (MODIFIED)	V
CURRENT CONFIGURATION	(-0011)	(-0002)	(-0013)	(-0024)	(-0034)	(-0005)
CRACKING PRESSURE	5 PSID MAX.	5 PSID MAX.	5 PSID MAX.	5 PSID MAX.	.06 PSID MAX.	5 PSID MAX.
RESEAT PRESSURE	2 PSID MIN.	2 PSID MIN.	2 PSID MIN.	2 PSID MIN.	.01 PSID MIN.	2 PSID MIN.
OPERATING PRESSURE (PSIG)	650	4500	850	850	850	750
OPERATING TEMPERATURE (°F)	-423 TO +250	-160 TO +250	-320 TO +250	-423 TO +250	-160 TO +250	-100 TO +350
FLUID TEMPERATURE (°F)	-160 TO +130	-160 TO +130	-160 TO +140	-160 TO +140	-160 TO +140	+20 TO +120
MIN. FLOW RATE (HELIUM, LB/S)	.005	.05	.08	0.202	.202	1.5
MAX PRESSURE DROP (PSID) AT MAX. INLET PRESS. OF ( ) PSIA	11 (100)	10 (4200)	10 (715)	44 (130)	15 (130)	167 (425)

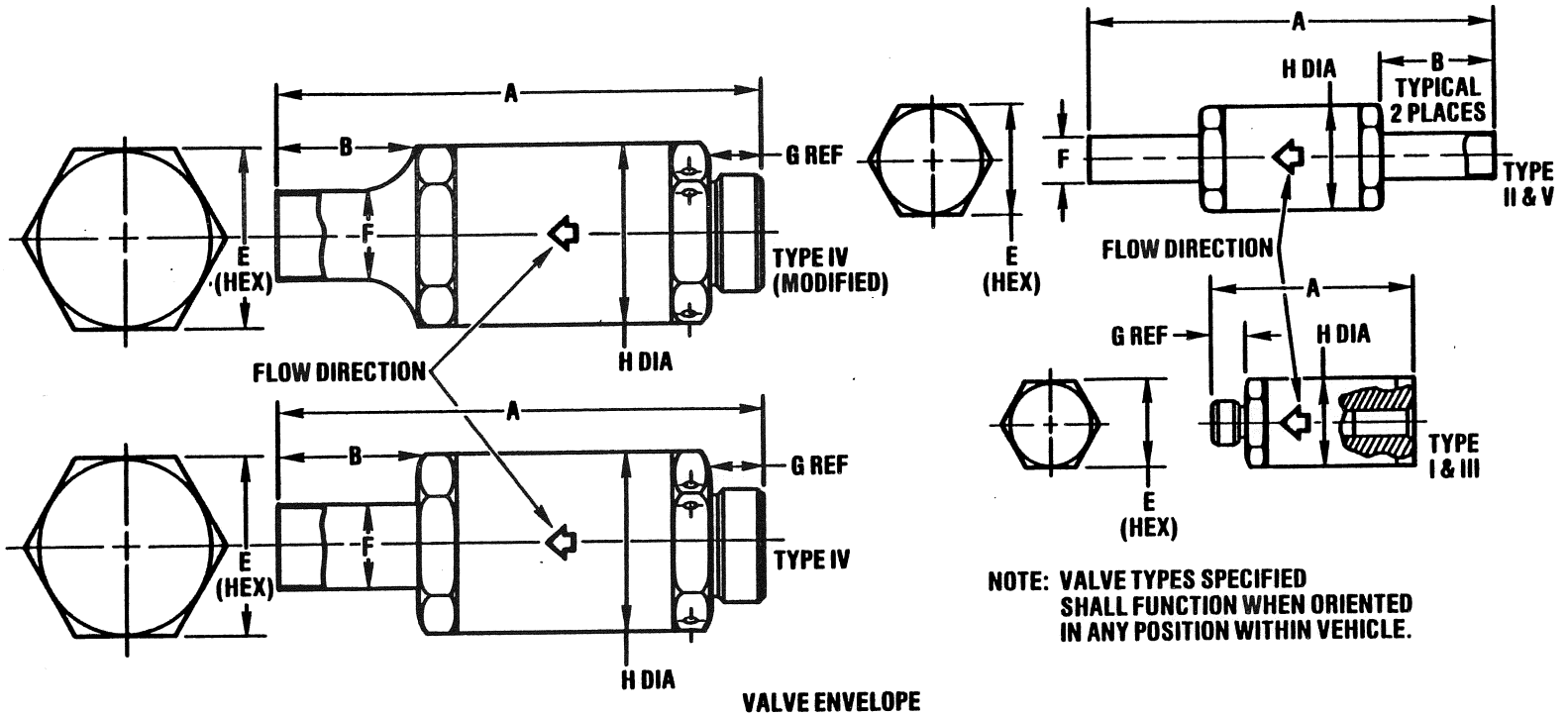
MATERIALS
BODY: INCONEL 718 (TYPES I AND III), 21-6-9 CRES (II AND V), 316 L (IV AND IV MOD) POPPET: 316 CRES (I, II, III, IV, V), A-286 (IV MOD) END PIECE: INCONEL 718 (I, II, IV, IV MOD), 21-6-9 CRES (II, V) POPPET SEAL: TEFLON SPRING: 302 CRES SPRING GUIDE: 316 CRES

COMPONENT: VALVE, CHECK, HELIUM

(ME284-0472)



COMPONENT: VALVE, CHECK, HELIUM
(ME284-0472)



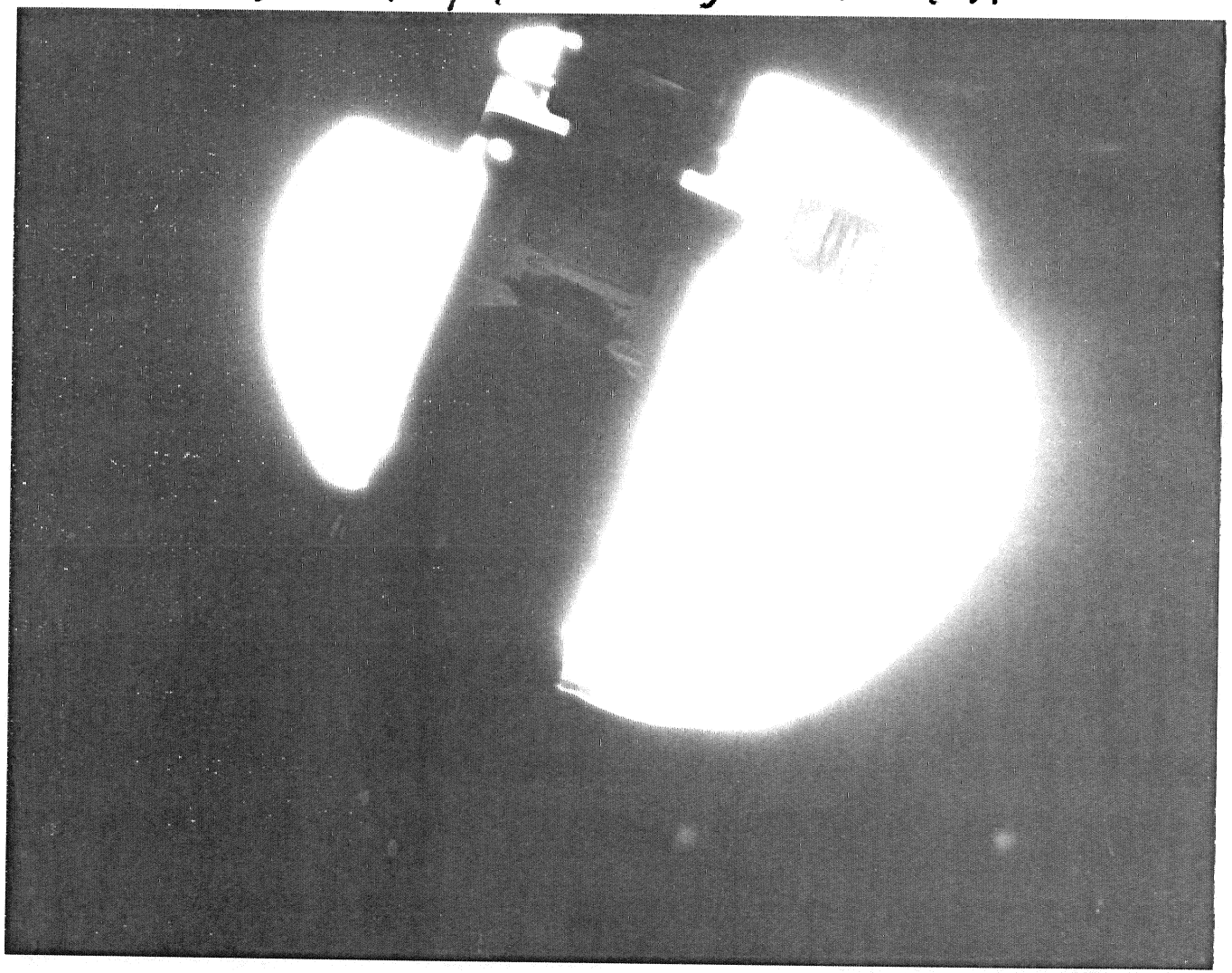
NOTE: VALVE TYPES SPECIFIED SHALL FUNCTION WHEN ORIENTED IN ANY POSITION WITHIN VEHICLE.

VALVE ENVELOPE

TYPE	CONTROL NO.	I&T	A	B	OUTLET	INLET	E MAX.	F DIA	G REF	H DIA	T THICKNESS
I	ME284-0472	T_S	1.850 MAX. 1.760 MIN	—	MP273-0002-1004	MS33649-04	.77	—	.290 MAX. .260 MIN	.755 MAX. .735 MIN	—
II	ME284-0472	T_S	3.715 MAX. 3.615 MIN	1.030 MAX. 1.010 MIN	BRAZE STUB	BRAZE STUB	.89	.378 MAX. .375 MIN	—	.880 MAX. .860 MIN	.042
III	ME284-0472	T_S	2.859 MAX. 2.769 MIN	—	MP273-0002-1008	MS33649-08	1.02	—	.323 MAX. .293 MIN	1.005 MAX. .985 MIN	—
IV	ME284-0472	T_S	4.372 MAX. 4.282 MIN	1.340 MAX. 1.280 MIN	BRAZE STUB	MP273-0002-1012	1.52	.754 MAX. .750 MIN	.427 MAX. .397 MIN	1.505 MAX. 1.485 MIN	.028 ▷
V	ME274-0472	T_S	5.680 MAX. 5.580 MIN	1.620 —	WELD STUB	WELD STUB	2.00	1.004 MAX. 1.000 MIN	—	2.000 MAX.	0.28
IV (MOD)	ME284-0472	T_S	4.347 MAX. 4.307 MIN	1.393 MAX. 1.333 MIN	BRAZE STUB	MP273-0002-1012	1.875	.754 MAX. .750 MIN	.427 MAX. .397 MIN	1.890 MAX.	.028

▷ VERIFIED BY RILSS TO BE 0.028 FOR WALL THICKNESS OF STUB 7-14-89

CV 13 X-Ray, OV-103, 10/18/91



CV Not Checked, Body Positioned Correctly.

COMPONENT: LH_2 RELIEF VALVE

(ME284-0474)

FMEA/CIL NO. 03-1-0411

VENDOR : CIRCLE SEAL
P/N RI : ME284-0474-0003
P/N VENDOR:
QUANTITY : 1 PER END ITEM

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

THE COMPONENT IS A SPRING LOADED CLOSED, PRESSURE ACTUATED OPEN, POPPET TYPE RELIEF VALVE. A HELICAL SPRING PROVIDES THE LOAD TO ESTABLISH THE RELIEVING PRESSURE.

FUNCTION:

PROVIDES MEANS OF RELIEVING EXCESS PRESSURE FROM THE PORTION OF LH_2 RECIRCULATION SYSTEM BETWEEN THE ENGINE BLEED VALVES, TOPPING VALVE, AND RECIRCULATION RETURN DISCONNECT. THE RECIRCULATION RETURN DISCONNECT IS CLOSED FOLLOWING SSME SHUTDOWN. THE VALVE RELIEVES LH_2 FROM THE RECIRC SYSTEM INTO THE LH_2 FEED MANIFOLD.

DESIGN:

THIS RELIEF VALVE IS AN OFF THE SHELF ITEM SIMILAR IN CONSTRUCTION TO AN IN-LINE CHECK VALVE. THE DESIGN CONSISTS OF A POPPET, A SPRING SEAT, AND A NUT, ALL OF 316 CRES; A ONE PIECE BODY OF INCONEL 718; A SPRING OF 302 CRES; AND A RESILIENT SEAL RING OF TEFLON. THE POPPET IS SPRING LOADED IN THE CLOSED POSITION. THE

COMPONENT: LH_2 RELIEF VALVE (CONT)

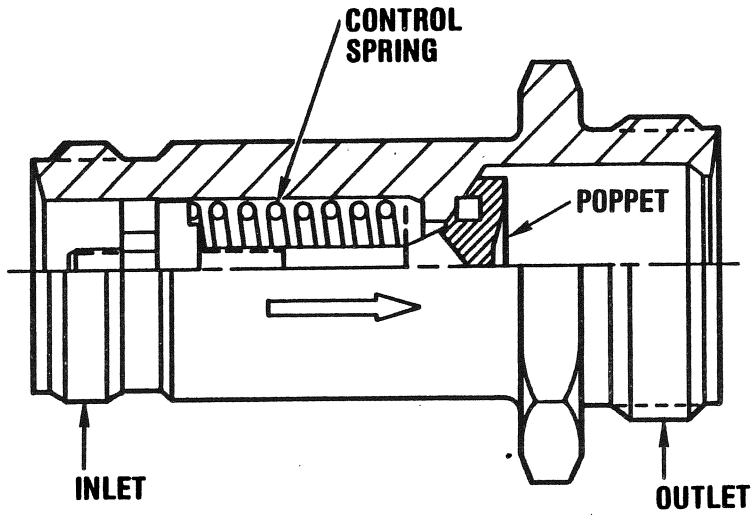
ME284-0474)

RESILIENT TEFLON SEALING RING, RETAINED IN A GROOVE IN THE POPPET, SEALS AGAINST A SPHERICAL SURFACE MACHINED IN THE BODY (32 MICROINCH SURFACE FINISH). UPSTREAM PRESSURE OVERCOMES THE SPRING FORCE TO UNSEAT THE POPPET. IF THE DOWNSTREAM PRESSURE IS GREATER THAN THE UPSTREAM PRESSURE THE DIFFERENTIAL WILL AID IN SEALING.

DESIGN PARAMETERS:

CURRENT CONFIGURATION:	(-0003)
OPERATING PRESSURE:	ZERO TO 130 PSIG
CRACKING PRESSURE:	5 TO 40 PSID
RESEAT PRESSURE:	5 TO 40 PSID
FLOW CAPACITY:	0.135 LB/S LIQUID HYDROGEN
PRESSURE DROP:	40 PSI AT 0.135 LB/S FLOW
EXTERNAL LEAKAGE:	2.0 SCCH GH_2 OR GHe AT OPERATING CONDITIONS
OPERATING LIFE:	400 CYCLES AMBIENT (73 PLUS OR MINUS 18 F)
	1000 CYCLES CRYOGENIC (MINUS 413 PLUS OR MINUS 10 F)
TEMPERATURE RANGE:	PLUS 160 TO MINUS 413 F
NOMINAL LINE SIZE:	3/8-INCH DIAMETER
ENVELOPE DIMENSIONS:	1.5-INCH DIAMETER X 1.9-INCH LONG
WEIGHT:	.25 LB

COMPONENT: LH_2 RELIEF VALVE
(ME284-0474)



COMPONENT: VALVE, CHECK, ENGINE ISOLATION

(ME284-0479)

FMEA/CIL NO: 03-1-0505

VENDOR : CIRCLE SEAL
ME284-0479-0012
: ME284-0479-0023
:
:
P/N VENDOR:
QUANTITY : 6 PER END ITEM
: 1 EA PER ENGINE
:

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM: HYDROGEN AND OXYGEN ENGINE ISOLATION CHECK VALVES
GO_2 CV 18, 19, 20 GH_2 CV 21, 22, 23

FUNCTION:

ONE VALVE IS USED PER ENGINE IN THE GO_2 AND GH_2 PRESSURIZATION SYSTEM. THE OUTLET OF EACH VALVE IS CONNECTED TO A COMMON LINE AND, IN THE EVENT OF AN ENGINE FAILURE, THE CHECK VALVES PREVENT REVERSE FLOW (LOSS OF PRESSURANT) THROUGH THE FAILED ENGINE.

DESIGN:

THE LO_2 COMPONENT IS A SINGLE POPPET, AND THE LH_2 IS A DUAL POPPET IN SERIES CONSTRUCTION-CHECK VALVE. BOTH DESIGNS ARE SPRING LOADED CLOSED AND PRESSURE ACTUATED OPEN. THE POPPETS AND SEAT ARE METALLIC FOR HIGH TEMPERATURE APPLICATION.

CLASSIFICATION:

TYPE IV	-0012	GH_2 VALVE, CHECK
TYPE III	-0023	GO_2 VALVE, CHECK

COMPONENT: VALVE, CHECK, ENGINE ISOLATION

(ME284-0479)

DESIGN PARAMETERS AND FEATURES:

	GO_2 TYPE III	GH_2 TYPE IV
OPERATING PRESSURE	4600 PSIG	4100 PSIG
PROOF PRESSURE	9200 PSIA	8200 PSIA
BURST PRESSURE	18,400 PSIG	16,400 PSIG
CRACKING PRESSURE	1.0 PSID MAX	2.0 PSID MAX
RESEAT PRESSURE	0.2 PSID MIN	0.2 PSID MIN
FLOW CAPACITY	2.75 LB/S	1.2 LB/S
EXTERNAL LEAKAGE	1.0 SCCH	1.0 SCCH
TEMPERATURE RANGE	MINUS 160 F TO PLUS 530 F	MINUS 160 TO PLUS 200 F
NOMINAL LINE SIZE	0.625 INCH	0.625 INCH
ENVELOPE DIMENSIONS	4.20 INCHES X 5.15 INCHES LONG	3.68 INCHES X 6.83 INCHES LONG
WEIGHT	2.6 LBS	4.0 LBS

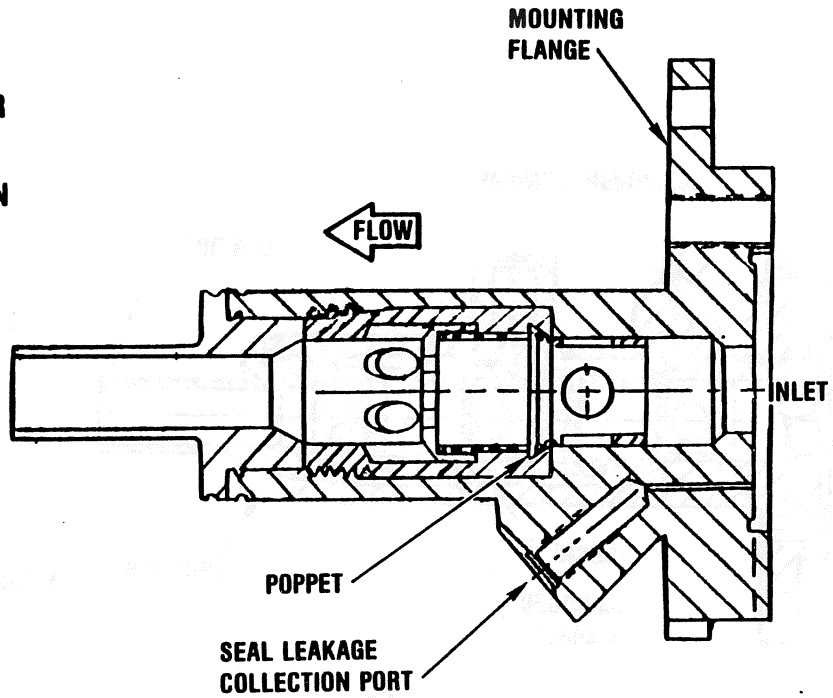
COMPONENT: VALVE, CHECK, ENGINE ISOLATION
(ME284-0479)

ME284-0479-0023
GO_2 TYPE III

FEATURES:

- SINGLE POPPET DESIGN
- INCORPORATES A LEAK DETECTION & A TRANSDUCER PORT
- SPRING LOADED CLOSED, PRESSURE ACTUATED OPEN
- CRACKING PRESSURE: 1.0 PSID MAX. TYPE III
- RESEAT PRESSURE: 0.2 PSID MIN TYPE III

MATERIALS
BODY: INCONEL 718
POPPET: BERYLLIUM COPPER ALLOY 172
SPRING: INCONEL X
TUBE END: INCONEL 718
SPRING GUIDE: INCONEL 718



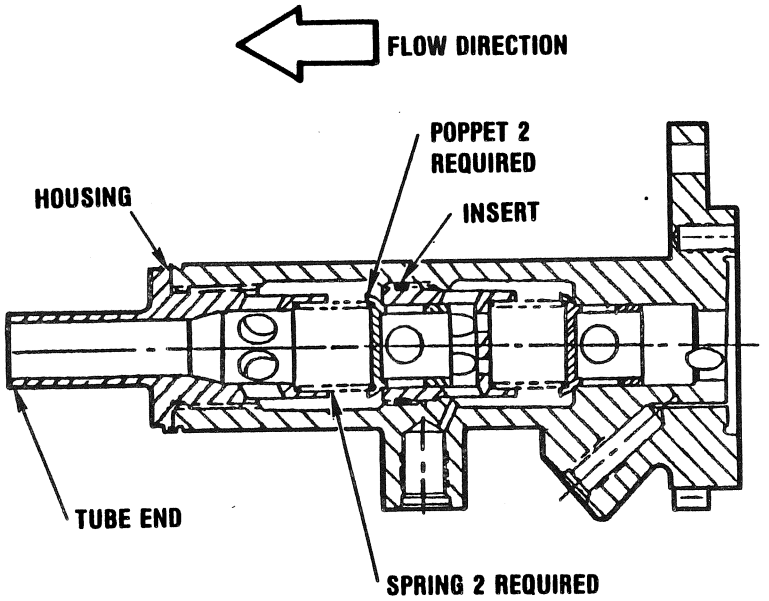
COMPONENT: VALVE, CHECK, ENGINE ISOLATION
(ME284-0479)

ME284-0479-0012
GH_2 TYPE IV

FEATURES:

- DUAL POPPET IN SERIES DESIGN
- TEST PORT BETWEEN POPPETS
- SPRING LOADED CLOSED, PRESSURE ACTUATED OPEN
- CRACKING PRESSURE: 2.0 PSID MAX.
- RESEAT PRESSURE: 0.2 PSID MIN

MATERIALS
BODY: 21-6-9 CRES
POPPET: BERYLLIUM COPPER ALLOY 172
SPRING: INCONEL X
TUBE END: A286 CRES
SPRING GUIDE: INCONEL 718



COMPONENT: FILTER, HELIUM

(ME286-0056)

FMEA/CIL NO. 03-1-0145

VENDOR : WINTEC
P/N RI : MC286-0056-0001, -0002
P/N VENDOR:
QUANTITY : 7 PER END ITEM

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

FILTER - HELIUM SUPPLY AT STORAGE BOTTLE EXIT

FUNCTION:

FILTER THE MAIN PROPULSION SYSTEM GASEOUS HELIUM SUPPLY AT THE EXIT OF THE STORAGE BOTTLES UPSTREAM OF THE 750 PSIG REGULATORS. (FL2) THRU (FL8) ARE LOCATED ON THE 6 ENGINE HELIUM PURGE PANELS AND ON THE ONE MPS PNEUMATIC VALVE PANEL.

DESIGN:

THE FILTER IS DESIGNED FOR PANEL MOUNTING WITH 3/8 DIAMETER BRAZE TUBE STUBS FOR BOTH THE INLET AND OUTLET SYSTEM CONNECTIONS. THE FILTER ELEMENT IS REPLACEABLE WITHOUT REMOVAL OF THE FILTER FROM THE SYSTEM.

CURRENT CONFIGURATION: FILTER ASSEMBLY (-0001), FILTER ELEMENT ASSEMBLY (-0002).

DESIGN PARAMETERS:

FILTRATION RATING: 25 MICRON ABSOLUTE

OPERATING PRESSURE: 0 - 4,500 PSIG

PROOF PRESSURE: 9,000 PSIG

COMPONENT: FILTER, HELIUM

(ME286-0056)

BURST PRESSURE: 18,000 PSIG

OPERATING TEMPERATURE: -160F TO +250F (MEDIA)

WEIGHT: 3.2 LB MAX

FLOW CAPACITY: .08 LB/SEC (GHe) AT 70 DEGREES F WITH A 20 PSID PRESSURE DROP

LEAKAGE: 1 X 10^{-4} SCCS (GHe) MAX AT 4,500 PSIG

LIFE CYCLE: THE FILTER SHALL HAVE A MINIMUM USEFUL LIFE OF 10 YEARS DURING WHICH IT SHALL BE PRESSURIZED A MINIMUM OF 17,000 HOURS. THE FILTER SHALL BE PRESSURIZED TO MAXIMUM PRESSURE FOR 10.5 HOURS A MINIMUM OF 100 TIMES. THE FILTER SHALL PASS A MINIMUM OF 350,000 STANDARD CUBIC FEET OF HELIUM DURING ITS USEFUL LIFE.

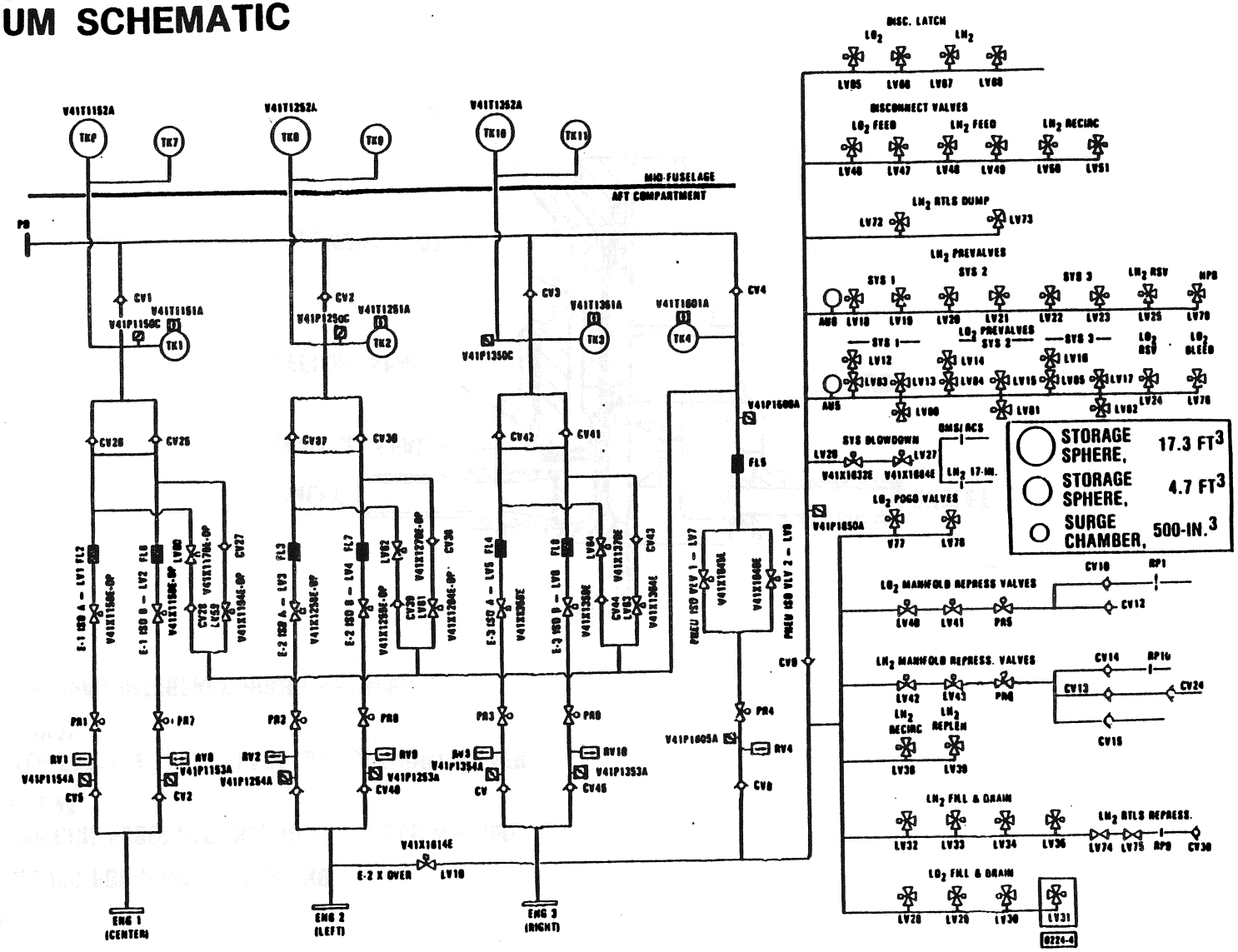
MATERIALS:

HEAD - 304L CRES
SUMP - 21-6-9 CRES
ELEMENT - STAINLESS STEEL
TUBES - 21-6-9 CRES
K-SEAL - LEAD COATED A286 CRES
SECONDARY SEAL - TEFLON

COMPONENT: FILTER, HELIUM

(ME286-0056)

HELIUM SCHEMATIC



Rockwell International

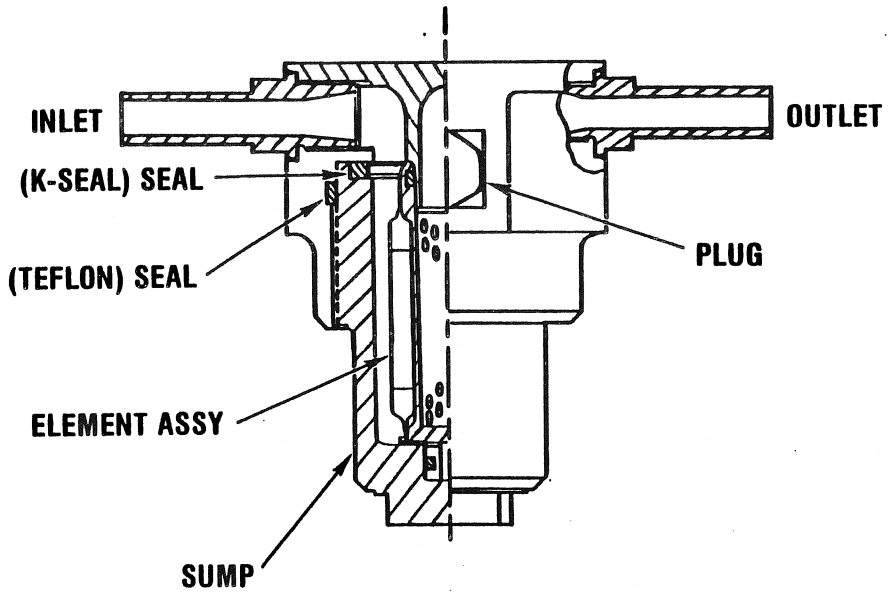
Space Transportation
Systems Division

COMPONENT: FILTER, HELIUM

(ME286-0056)

FEATURES:

- **DESIGNED FOR PANEL MOUNTING**
- **25 MICRON ABSOLUTE, STAINLESS STEEL WELDED ELEMENT**
- **FILTER ELEMENT IS REPLACEABLE WITHOUT FILTER REMOVAL**
- **SUMP/HEAD INTERFACE DOUBLE SEALED**



COMPONENT: SCREEN, MPS FEEDLINE, LO_2 AND LH_2

(ME286-0083)

FMEA/CIL NO. 03-1-0434

VENDOR : VACCO INDUSTRIES
P/N RI : ME286-0083-0001
P/N VENDOR: FIE10101-01
QUANTITY : 6 PER END ITEM
: 3 LO_2, 3 LH_2

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

SCREEN, PROPELLANT FEEDLINE (LO_2 AND LH_2).

FUNCTION:

A SCREEN IS INSTALLED AT EACH ENGINE INLET FEEDLINE TO PROTECT THE ENGINE AGAINST CONTAMINANT INGESTION. THE SCREEN IS LOCATED AT THE PREVALVE OUTLET FLANGE.

DESIGN:

THE DESIGN PERFORMANCE REQUIREMENTS ARE OPERATING PRESSURE 275 PSIG, PROOF PRESSURE 358 PSIG, BURST PRESSURE 413 PSIG, PROOF PRESSURE ACROSS SCREEN 4 PSID, BURST PRESSURE ACROSS SCREEN 7.0 PSID, AND THE FLUID OPERATING TEMPERATURE RANGE OF -423 F TO 200 F.

THE SCREEN WAS DESIGNED TO BE CAPABLE OF FLOWING A MINIMUM 982 POUNDS PER SECOND OF LIQUID OXYGEN AT AN INLET PRESSURE OF 45 PSIG WITH A MAXIMUM PRESSURE DROP OF 1.5 PSI. IN ADDITION, THE SCREEN IS CAPABLE OF FLOWING 165 POUNDS PER SECOND OF LIQUID HYDROGEN AT AN INLET PRESSURE OF 15 PSIG MINIMUM WITH A MAXIMUM PRESSURE DROP OF 0.8 PSI. THE HOLES IN THE FLOW AREA OF THE SCREEN ARE SIZED TO PREVENT A SPHERICAL PARTICLE WITH A DIAMETER OF 1,000 MICRONS OR GREATER FROM PASSING THROUGH THE SCREEN. THE SCREEN IS ONE-PIECE 316L STAINLESS STEEL, CHEM MILLED PRIOR TO FORMING.

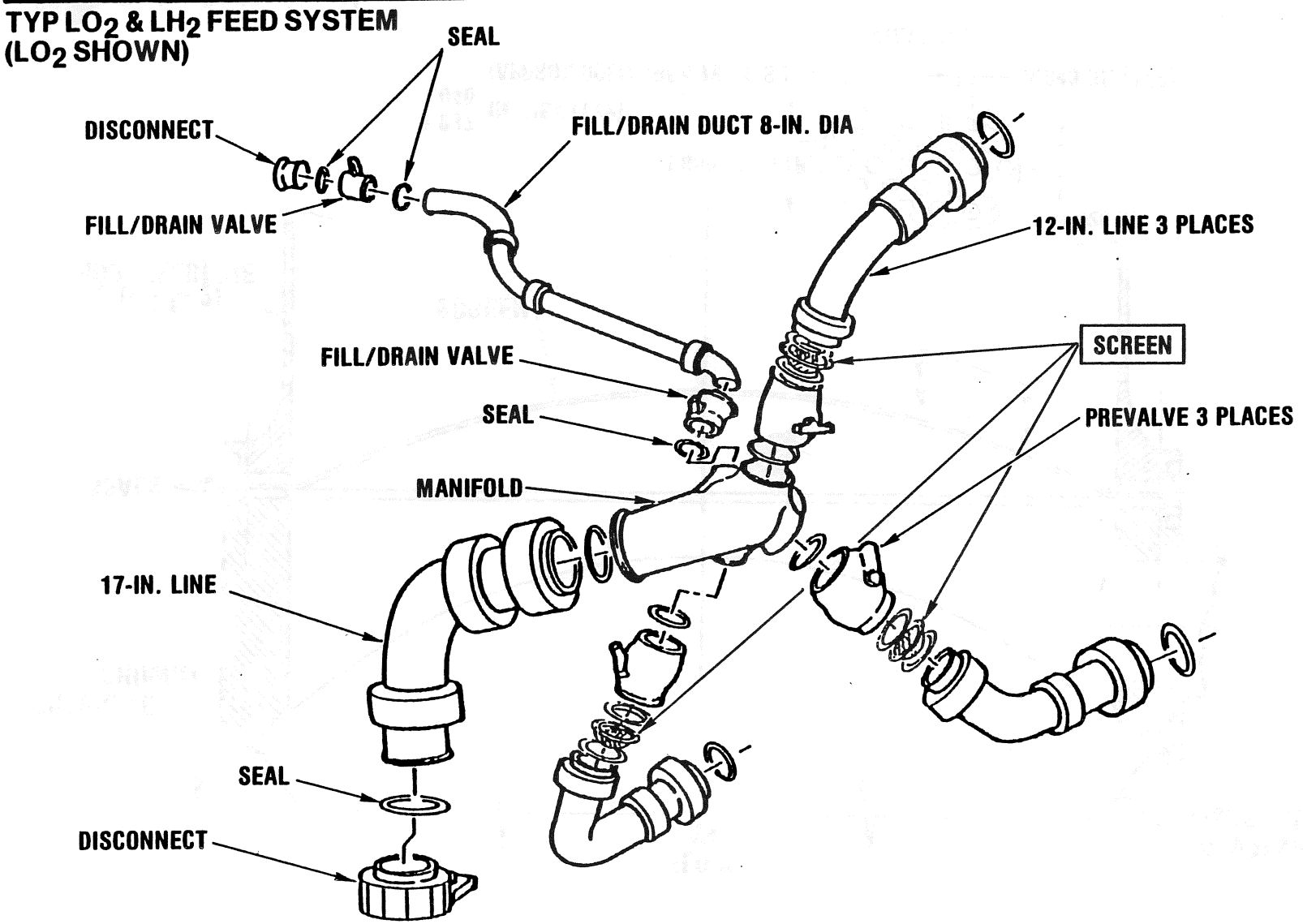
COMPONENT: SCREEN, MPS FEEDLINE, LO_2 AND LH_2

(ME286-0083)

DESIGN PARAMETERS AND FEATURES:

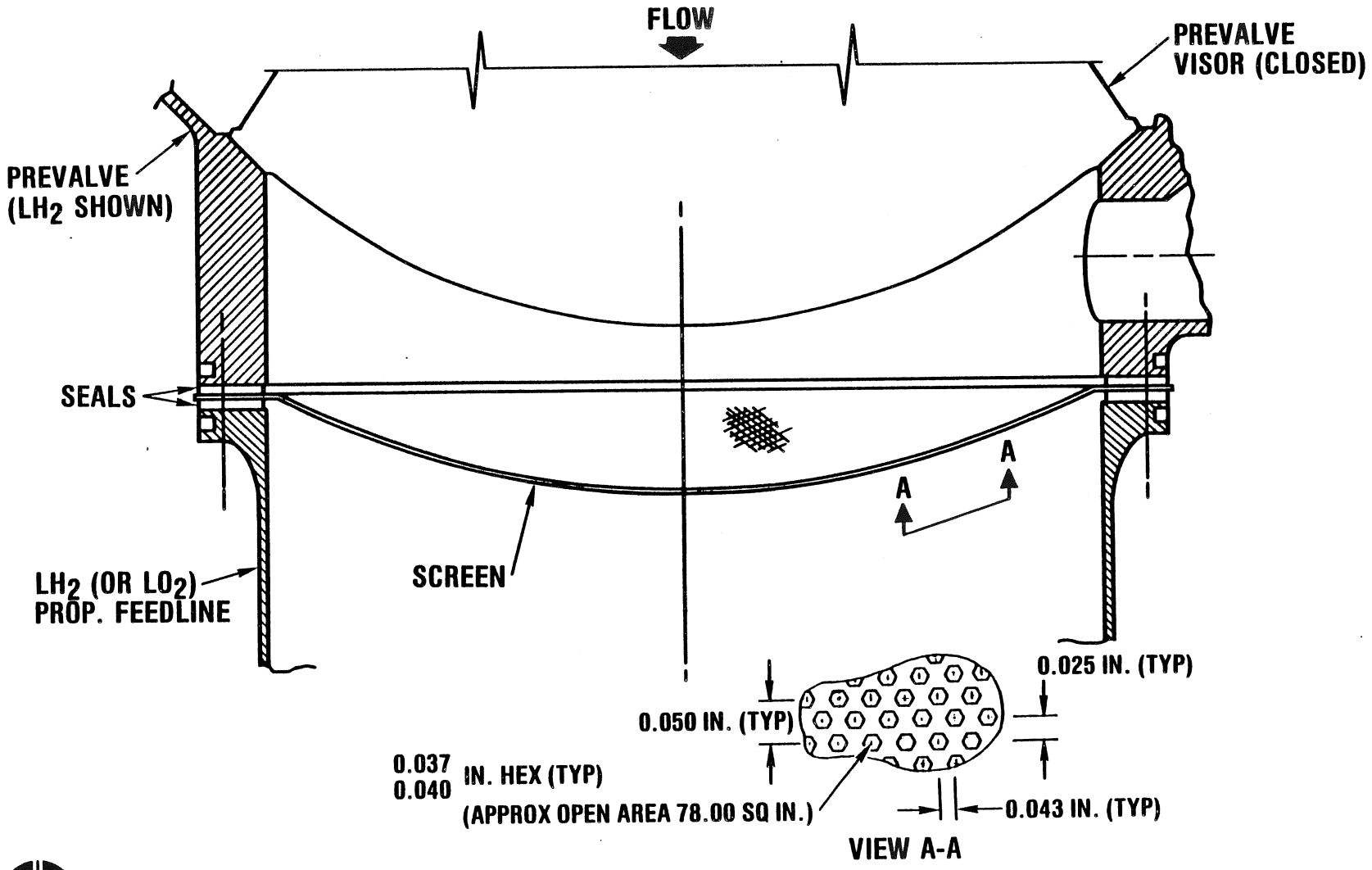
CURRENT CONFIGURATION:	(-0001)
OPERATING PRESSURE:	0 TO 275 PSIG
PRESSURE DROP:	2.6 PSID AT 45 PSIG; 1.4 PSID AT 15 PSIG
FLOW:	982 LB/S OF LO_2; 165 LB/S OF LH_2
TEMPERATURE RANGE FLUID:	-423 F TO +200 F
ENVELOPE DIMENSION:	14.098 DIAMETER X 1.56 HEIGHT
WEIGHT:	0.55 LB MAXIMUM

COMPONENT: SCREEN, MPS FEEDLINE, LO_2 AND LH_2
(ME286-0083)



COMPONENT: SCREEN, MPS FEEDLINE, LO_2 AND LH_2

(ME286-0083)



COMPONENT: GH_2 OUTLET PRESSURE TRANSDUCER

(ME449-0177)

FMEA/CIL NO. 30-1-0740

VENDOR : EATON CONSOLIDATED CONTROLS
P/N RI : ME449-0177-2580
P/N VENDOR:
QUANTITY : 3 PER END ITEM
: 1 PER ENGINE

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

TRANSDUCER, GH_2 PRESSURIZATION OUTLET PRESSURE (V41P1160A, V41P1260A, V41P1360A), 0 TO 5,000 PSIA

FUNCTION:

PROVIDES PRESSURE MEASUREMENT OF THE GH_2 BEING SUPPLIED BY THE ENGINE TO THE FLOW CONTROL VALVES FOR PRESSURIZATION OF THE EXTERNAL TANK. TRANSDUCER IS ON THE ORBITER SIDE OF THE ORBITER/SSME INTERFACE.

DESIGN:

THE TRANSDUCER UTILIZES A STRAIN GAGE PRESSURE MONITORING CONCEPT. THERE ARE FOUR STRAIN GAUGES ATTACHED TO A BEAM WHICH IS AN INTEGRAL PART OF THE DIAPHRAGM. THE TWO STRAIN GAUGES LOCATED NEAR THE CENTER OF THE BEAM ARE IN TENSION. THE TWO OUTER STRAIN GAUGES ARE IN COMPRESSION. THE DIAPHRAGM DEFLECTION DUE TO PRESSURE CHANGES IS TRANSMITTED TO THE BEAM CAUSING BEAM DEFLECTION. THE FOUR STRAIN GAUGES WILL MEASURE THIS DEFLECTION. THE STRAIN GAUGES ARE ALL CONNECTED TO A WHEATSTONE BRIDGE WHICH USES THE FOUR STRAIN GAUGE MEASUREMENTS TO PRODUCE AN OUTPUT SIGNAL PROPORTIONAL TO THE PRESSURE BEING SENSED.

COMPONENT: GH_2 OUTLET PRESSURE TRANSDUCER (CONT)

(ME449-0177)

THE STRAIN GAUGE LEADS ARE SOLDERED TO THE FEEDTHROUGH CONNECTOR AND SUPPORTED BY A HARNESS BOARD. MATERIALS AND PROCESSES USED ARE COMPATIBLE WITH THE ENVIRONMENTAL CONDITIONS. THE TRANSDUCER IS CAPABLE OF WITHSTANDING 1.5 TIMES MAXIMUM OPERATING PRESSURE WITHOUT CHANGING THE CALIBRATION.

RUPTURE/LEAKAGE OF THE TRANSDUCER IS PRECLUDED BY USE OF A PRIMARY AND SECONDARY BARRIER DESIGN CONCEPT. THE PRIMARY BARRIER UTILIZES WELDED 304L CRES COMPONENTS (THREADED FITTING AND DIAPHRAGM) AND IS DESIGNED FOR A PROOF PRESSURE OF 1.5 TIMES MAXIMUM OPERATING PRESSURE. A 304L CASE ASSEMBLY, INCLUDING FEEDTHROUGH TERMINALS, IS WELDED TO THE THREADED FITTING TO PROVIDE A SECONDARY BARRIER. THE SECONDARY BARRIER IS DESIGNED FOR A MINIMUM BURST PRESSURE OF 3 TIMES MAXIMUM OPERATING PRESSURE. STRUCTURAL ANALYSIS INDICATES A POSITIVE MARGIN OF SAFETY FOR ALL OPERATING CONDITIONS.

DESIGN PARAMETERS:

OPERATING PRESSURE: 0-5000 PSIA

PROOF PRESSURE: 7,500 PSIA

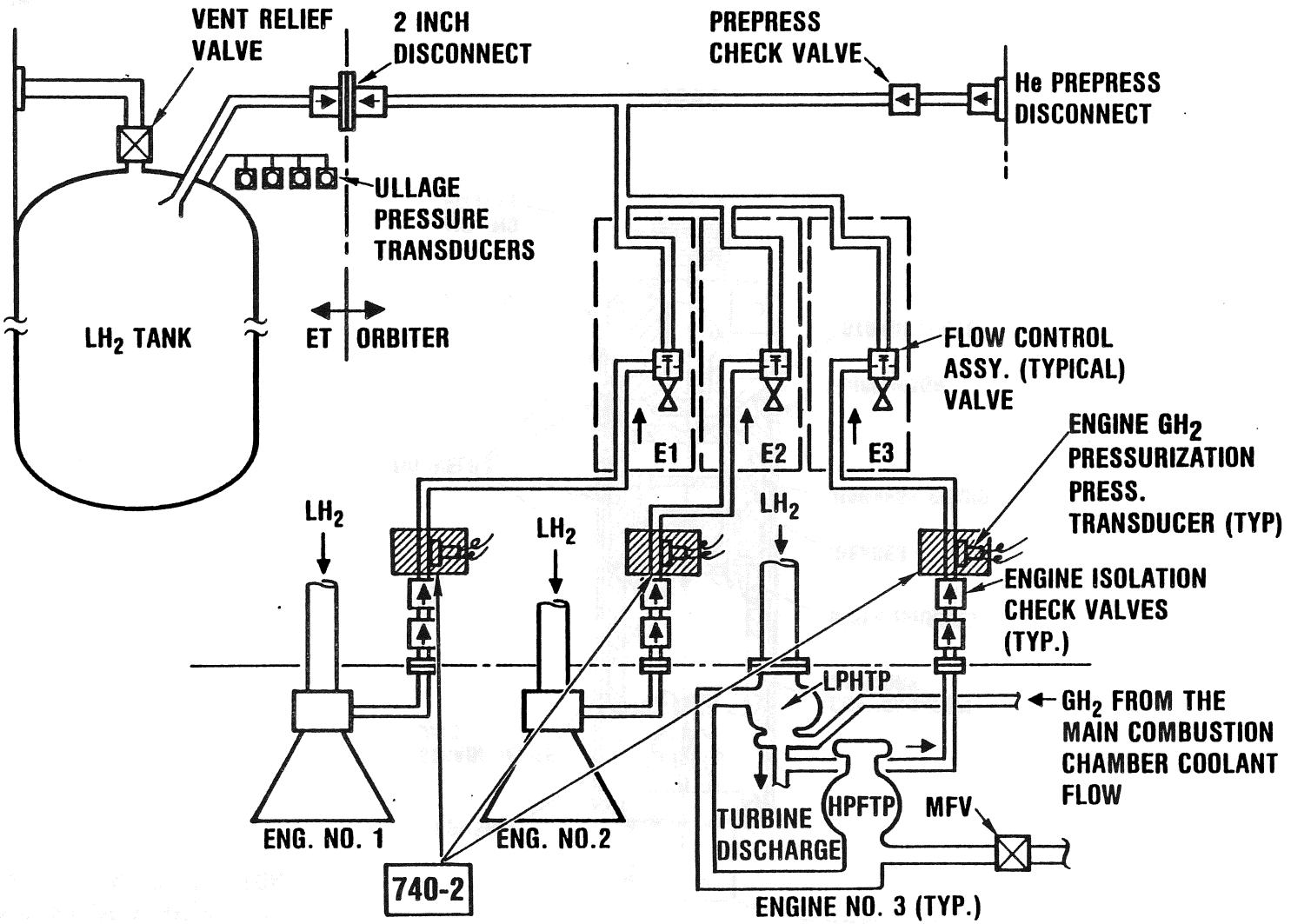
BURST PRESSURE: 15,000 PSIA

FEATURES: GRID LADDER COMPENSATION NETWORK

MATERIALS
HOUSING: 304L DIAPHRAGM: A286 FITTING: A286 HARNESS BOARD: PLASTIC SHEET LAM COPPER HEADER: 304L/ALLOY 52 TUBING DISC, STRAIN RELIEF: GLASSFABRIC (EPOXY)

COMPONENT: GH_2 OUTLET PRESSURE TRANSDUCER

(ME449-0177)



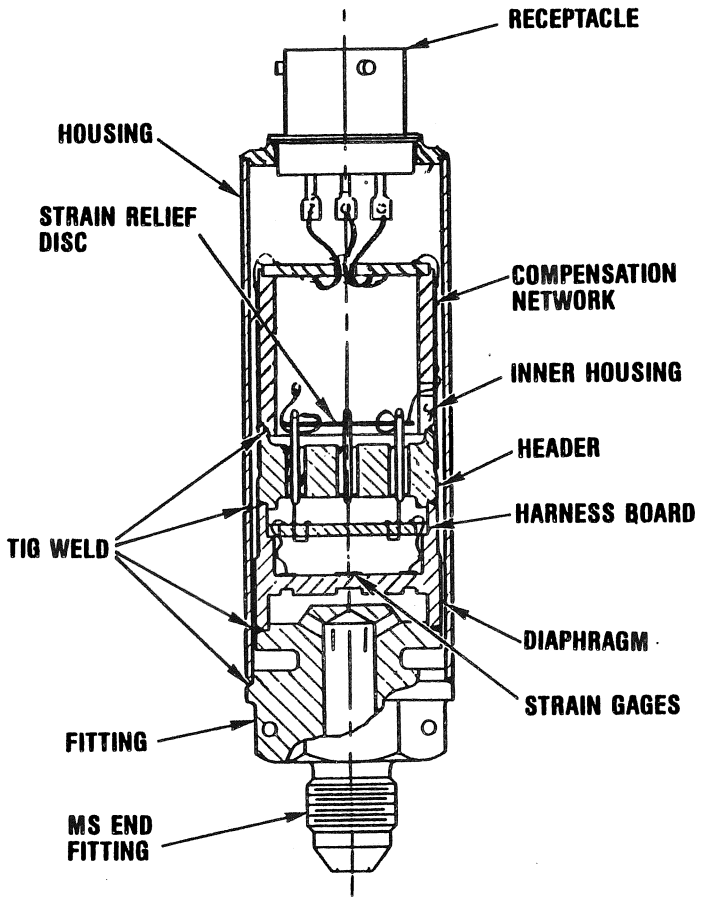
Rockwell International

Space Transportation Systems Division

COMPONENT: GH_2 OUTLET PRESSURE TRANSDUCER

(ME449-0177)

USED FOR:
GH_2 PRESS. SYSTEM AT
OUTLET OF SSME'S
#V41P1160A, 1260A, 1360A

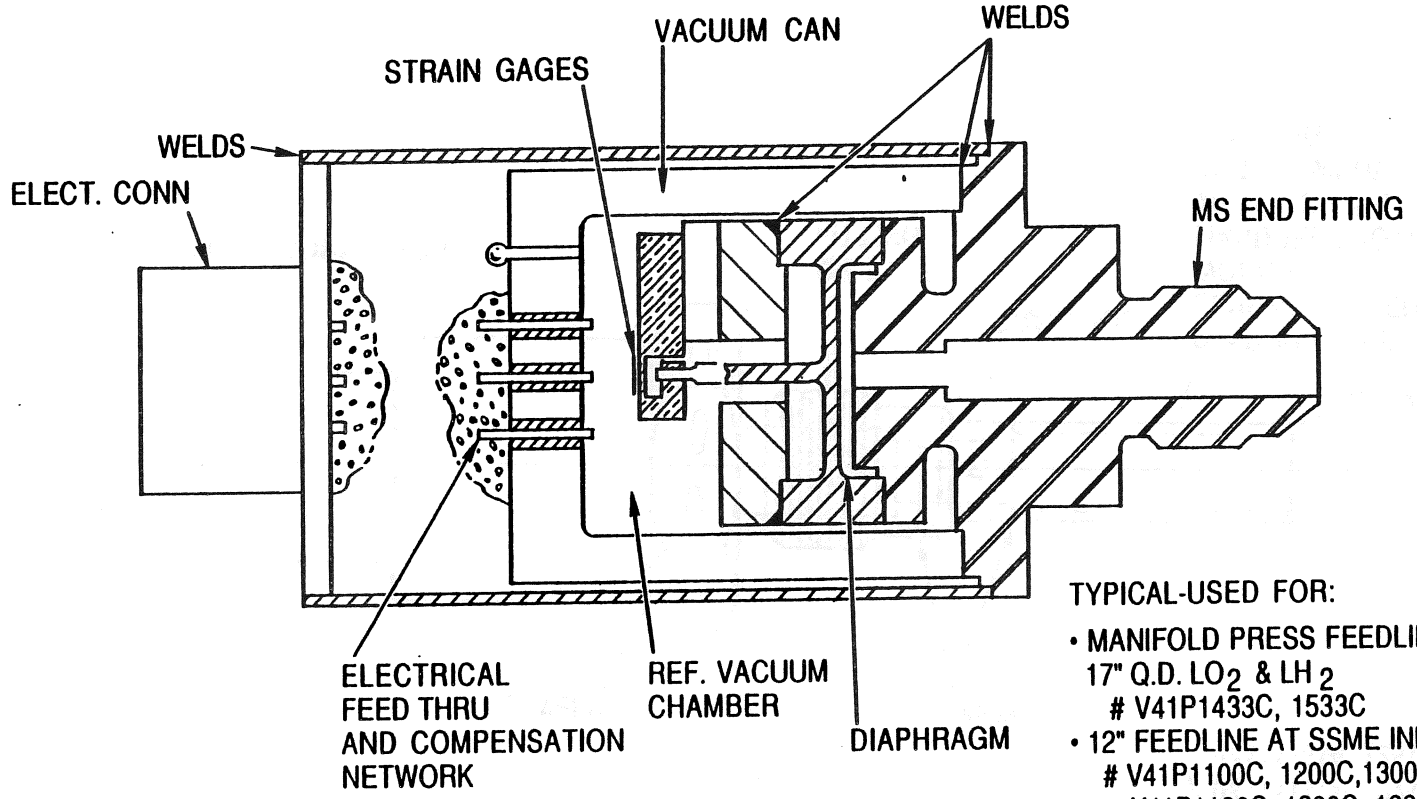


-2580

COMPONENT: PRESSURE TRANSDUCER

(ME449-0177)

ME449-0177-2573 (900 PSI)
ME449-0177-2574 (2200 PSI; OV/101 ALT. ONLY)



TYPICAL-USED FOR:

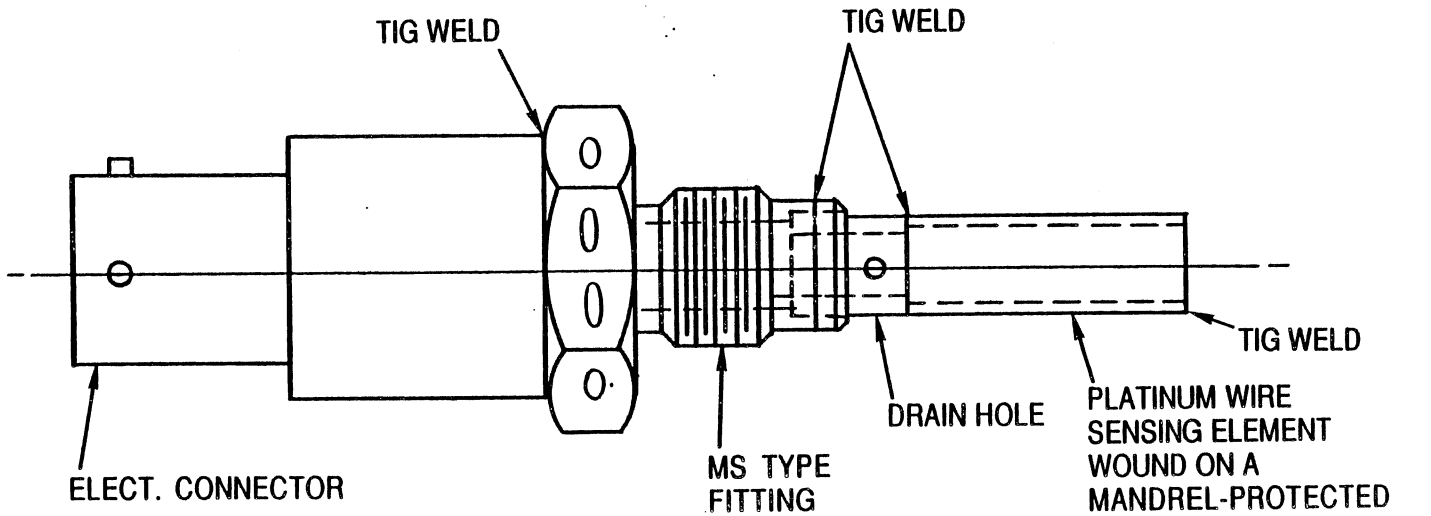
- MANIFOLD PRESS FEEDLINE AT 17" Q.D. LO_2 & LH_2
  # V41P1433C, 1533C
- 12" FEEDLINE AT SSME INLET LO_2 & LH_2
  # V41P1100C, 1200C,1300C
  V41P1130C, 1230C, 1330C
- PRESS LINE AT 17" Q.D. GO_2 & GH_2
  # V41P1490A, 1590A
- GHe BOTTLES & ACCUMULATOR
  # V41P1600A, 1150C, 1200C, 1350C, 1650A
- GH_2 REG OUT PRESSURES
  # V41P1153A, 1154A, 1253A, 1254A, 1353A, 1354A, 1605A

COMPONENT: TEMPERATURE PROBE

(ME449-0010)

ME449-0010-0010

TYPICAL USED FOR:
- GH_2 & GO_2 PRESS SYSTEM AT SSME OUTLETS
  # V41T1171A, 1271A, 1371A
    V41T1161A, 1261A, 1361A

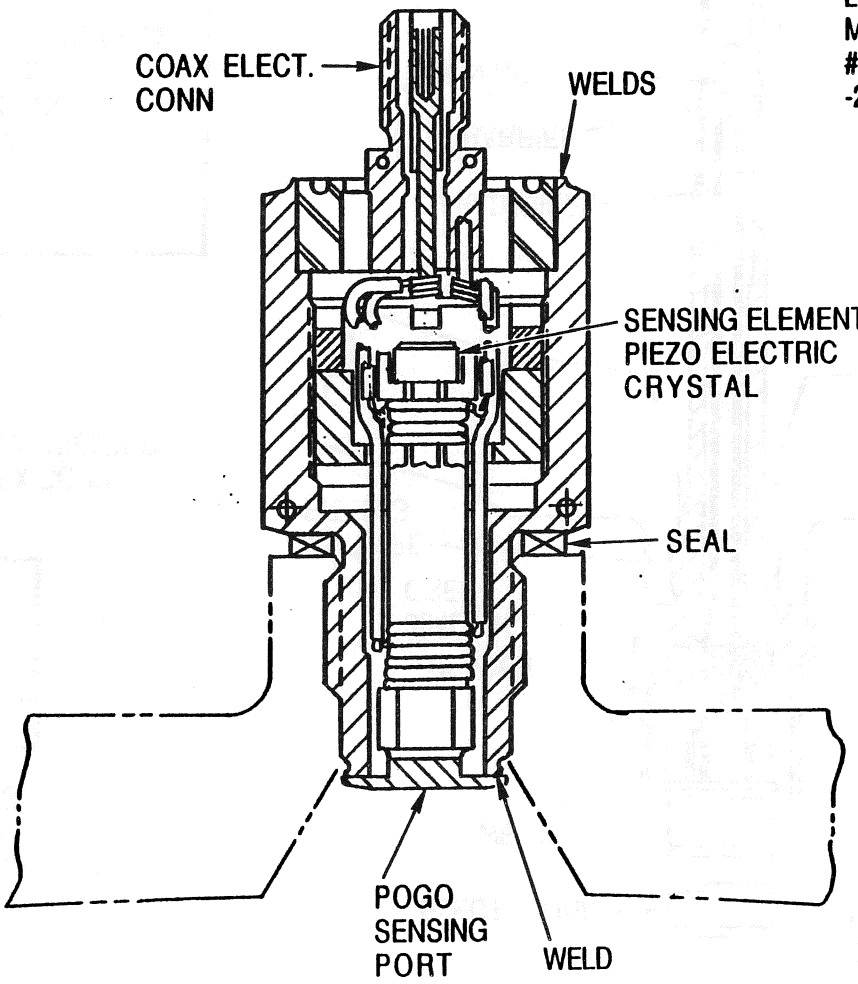


COMPONENT: PRESSURE TRANSDUCER

(MC449-0190)

MC449-0190-0190

USED FOR:
LOX FEEDLINE POGO
MEASUREMENT
#V41P9195A, 9295A, 9395A
-20 TO +20 PSI



COMPONENT: CRYOGENIC TEMPERATURE PROBE

(ME449-0013)

ME449-0013-0020

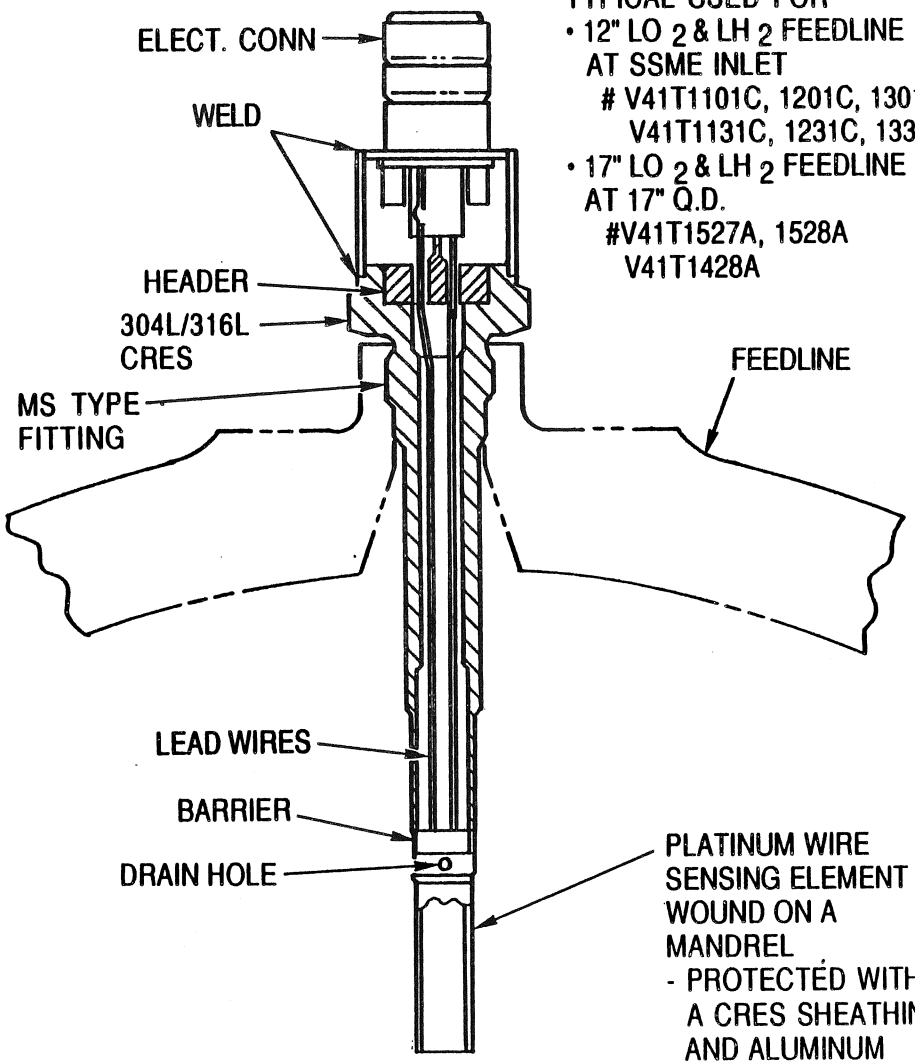
OPERATING PRESSURE: 1000 PSIA
PROOF PRESSURE: 1500 PSIA
BURST PRESSURE: 3000 PSIA

MATERIALS
PROBE: 304/316S.S. SENSING ELEMENT: PLATINUM

FEATURES:
- ONE PIECE MACHINED HEX BODY
- CONNECTOR AND TOP TIG WELDED
- RANGE
  - LO $_2$: -305°F TO -255°F
  - LH $_2$: -430°F TO -405°F

ME449-0156-0002

USED FOR: PNEUMATIC & ENGINE HELIUM STORAGE BOTTLES, V41T1601A, 1151C, 1251C, 1351C (SAME AS -0010 & -0013 EXCEPT TEMP RANGE AT 32°



COMPONENT: EVACUATION VALVE (VACUUM JACKETED LINES)

(7046-7)

VENDOR : CRYOLAB
P/N RI : N/A
P/N VENDOR: 7046-7 PLUG AND DISC ASSEMBLY
QUANTITY : 1 PER EACH VJ LINE

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

ONE EVACUATION VALVE IS PART OF EACH VJ LINE MC271-0073, -0074, -0075, AND -0076 AS APPLICABLE.

FUNCTION:

PERMITS REEVACUATION OF THE VACUUM ANNULUS WHEN REQUIRED.

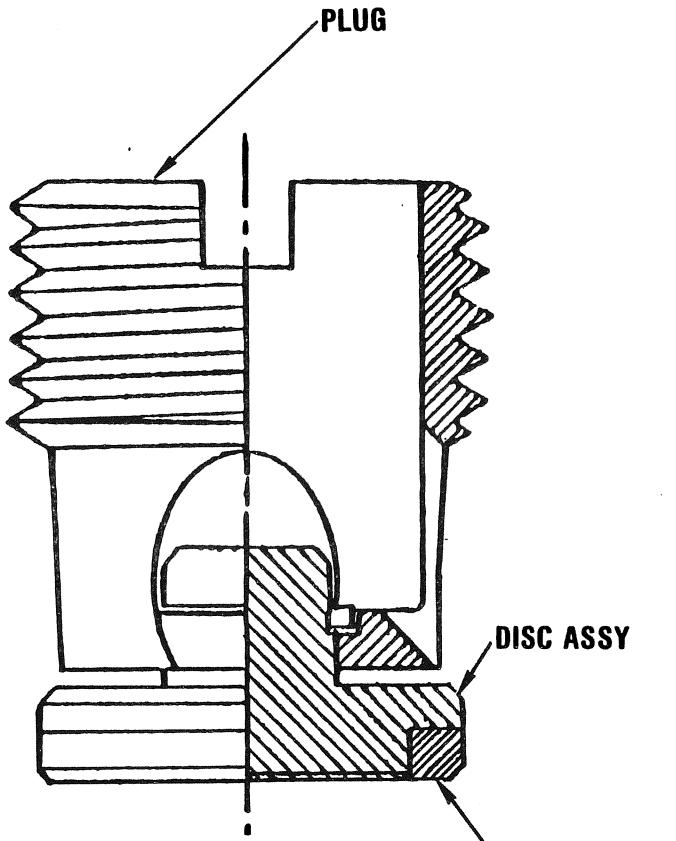
DESIGN:

THE EVACUATION VALVE CONSISTS OF A HOUSING WELDED TO THE VACUUM JACKET AND OPEN TO THE VACUUM ANNULUS. A THREADED REMOVABLE PLUG AND DISC ASSEMBLY CONTAINS A PRIMARY SEAL WHILE A THREADED-ON PROTECTIVE COVER CONTAINS A SECONDARY VACUUM SEAL. THE HOUSING HAS AN INTEGRAL SEALING SURFACE THAT THE PLUG AND DISC ASSEMBLY SEAL SEATS AGAINST TO AFFECT THE VACUUM SEAL. IN OPERATION, A G.S.E. PROVIDED VALVE OPERATOR IS ATTACHED TO THE HOUSING AND ENGAGES THE PLUG AND DISC ASSEMBLY. THE VALVE OPERATOR THEN OPENS THE VALVE BY RAISING THE PLUG AND DISC ASSEMBLY SUFFICIENTLY TO FORM A FREE-PATH INTO THE VACUUM ANNULUS OF THE LINE ASSEMBLY.

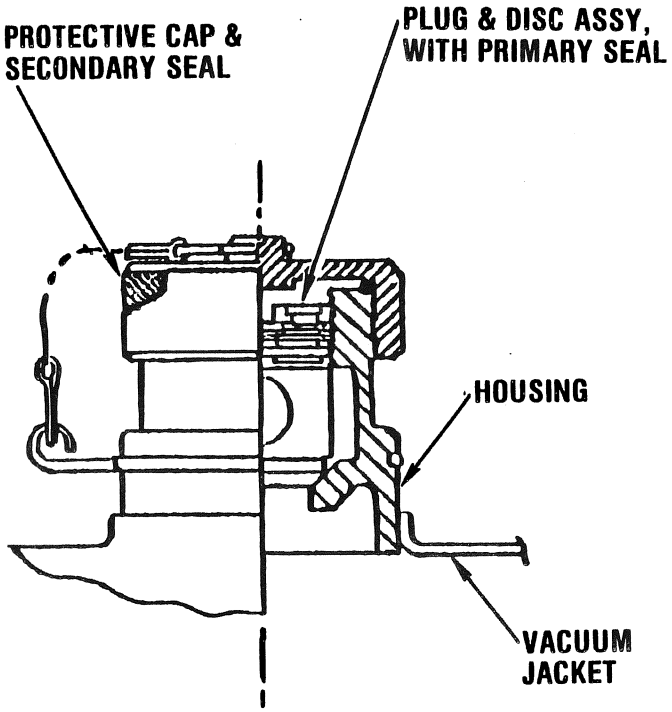
COMPONENT: EVACUATION VALVE (VACUUM JACKETED LINES)

(7046-7)

UTILIZED ON ALL VACUUM JACKETED LINES



DETAIL—PLUG & DISC ASSEMBLY
(REPLACEABLE PART)
P/N 7046-7



COMPONENT: THERMOCOUPLE VACUUM SENSING GAUGE TUBE (VACUUM JACKETED LINES)

(7780-1)

VENDOR : CRYOLAB
P/N RI : N/A
P/N VENDOR: 7780-1
QUANTITY : 1 PER EACH VJ LINE

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

TC GAUGE (THERMOCOUPLE VACUUM SENSING GAUGE TUBE).

ONE TC GAUGE IS PART OF EACH VJ LINE MC271-0073, -0074, -0075, AND -0076 AS APPLICABLE PER THE NOTED EFFECTIVITY. REFER TO APPLICABLE SECTION FOR TC GAUGE LOCATION ON THE LINE ASSEMBLY.

FUNCTION:

PERMITS ROUTINE PERIODIC PRE- AND POSTFLIGHT MONITORING OF THE VACUUM PRESSURE OF THE ANNULUS.

DESIGN:

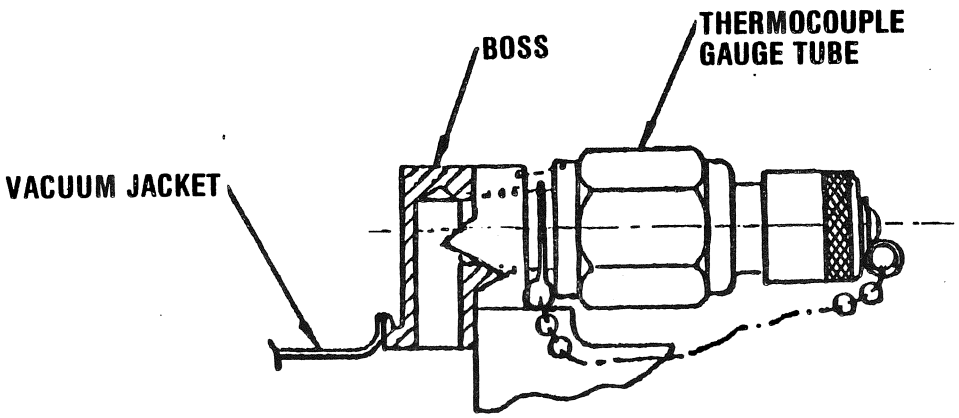
THE THERMOCOUPLE VACUUM SENSING GAUGE TUBE CONSISTS OF A HOLLOW HOUSING THREADED INTO A BOSS ON THE VACUUM JACKETED LINE WHICH IS OPEN TO THE VACUUM ANNULUS. THERE IS A HEADER ASSEMBLY WHICH IS HERMETICALLY SEALED TO THE HOUSING, AND A REMOVABLE CAP CHAINED TO THE HOUSING WHICH PROTECTS THE PINS IN THE HEADER ASSEMBLY. THE HEADER CONTAINS TWO SEPARATE SELF-HEATING THERMOCOUPLE ELEMENTS (CHANNEL A AND B) PROVIDING A REDUNDANT MEANS OF DIRECTLY MEASURING THE ELEMENT TEMPERATURE IN TERMS OF MILLIVOLTAGE OUTPUT ON A READOUT METER WITH A SCALE CALIBRATED FOR AIR PRESSURE IN MICRONS OF MERCURY.

THE OPERATING PRINCIPLE OF THE THERMOCOUPLE VACUUM GAUGE IS BASED UPON THE EFFECT OF CHANGE IN THERMAL CONDUCTIVITY OF AIR (OR OTHER GASES) IN THE LINE VACUUM ANNULUS AS THE PRESSURE CHANGES: THE THERMOCOUPLE ELEMENT IS HEATED WITH CONSTANT HIGH FREQUENCY ENERGY AND ADJUSTS ITSELF TO A VALUE PROPORTIONAL TO THE THERMAL CONDUCTIVITY OF THE SURROUNDING AIR. THE THERMOCOUPLE ELEMENT'S d.c. MILLIVOLTAGE OUTPUT IS THEREFORE A FUNCTION OF THE PREVAILING PRESSURE IN THE VACUUM ANNULUS OF THE LINE.

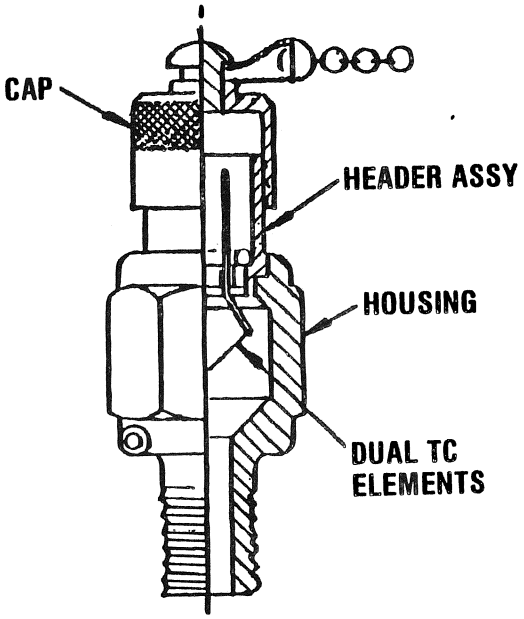
COMPONENT: THERMOCOUPLE VACUUM SENSING GAUGE TUBE (VACUUM JACKETED LINES)

(7780-1)

UTILIZED ON ALL VACUUM JACKETED LINES



TYPICAL INSTALLATION



DETAIL—THERMOCOUPLE GAUGE TUBE (REPLACEABLE)

COMPONENT: GETTER CONTAINER
(LH_2 RECIRC LINES AND LH_2 FILL AND DRAIN LINE)
(7808-2)

VENDOR : CRYOLAB
P/N RI : N/A
P/N VENDOR: 7808-2 HOLDER ASSEMBLY
QUANTITY : 1 PER EACH NOTED VJ LINE

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

ONE GETTER CONTAINER IS PART OF EACH MC277-0075 LH_2 RECIRC LINE AND THE MC271-0076 LH_2 FILL AND DRAIN LINE.

FUNCTION:

THE PURPOSE OF A "GETTER" MATERIAL IN A VACUUM SYSTEM IS TO REDUCE THE AMOUNT OF RESIDUAL NON-CONDENSABLE GAS IN THE VACUUM ANNULUS AT OPERATING (CRYOGENIC) TEMPERATURES. GETTERS WILL EMIT THESE SAME GASES AT AMBIENT OR ELEVATED TEMPERATURES. FOR THE MPS LINES THE GETTER MATERIAL IS PALLADIUM OXIDE (PdO). PdO ADSORBES HYDROGEN GAS AT CRYOGENIC TEMPERATURE. PdO CONTAINERS ARE VIRTUALLY A PERMANENT PART OF THE LINE AND NORMALLY WILL NOT REQUIRE MAINTENANCE.

DESIGN:

THE LH_2 RECIRCULATION AND REPLENISHMENT LINES AND LH_2 FILL AND DRAIN LINE

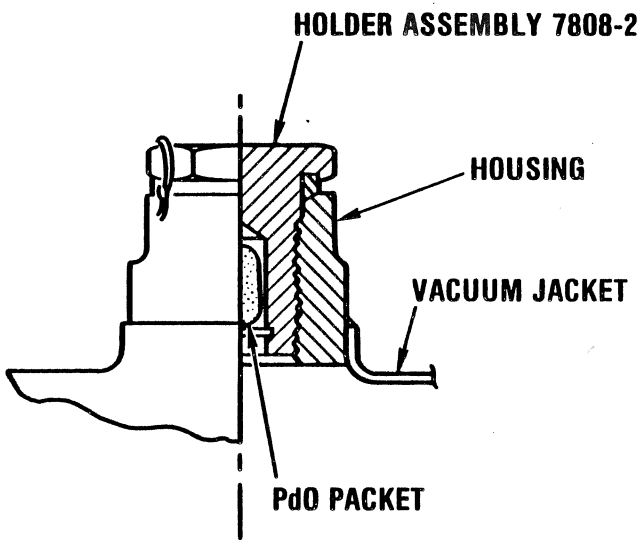
THE GETTER CONTAINER CONSISTS OF A HOUSING WELDED TO THE VACUUM JACKET AND OPEN TO THE VACUUM ANNULUS. A THREADED HEX HOLDER ASSEMBLY, LOCKWIRED TO THE HOUSING, CONTAINS A PACKET OF PdO CRYSTALS WHICH IS RETAINED BY A SCREEN AND SNAP RING.

MPS FEEDLINES (REFERENCE)

ON THE VACUUM JACKETED FEEDLINES, THE PdO CONTAINER IS PART OF THE BURST DISC ASSEMBLY (SEE 7841A & 7842A).

COMPONENT: GETTER CONTAINER
(LH_2 RECIRC LINES AND LH_2 FILL AND DRAIN LINE)
(7808-2)

UTILIZED ON ALL VACUUM JACKETED LINES



COMPONENT: BURST DISC ASSEMBLY (REPLACEABLE DISC ASSEMBLY)

(7841A AND 7842A)

VENDOR : CRYOLAB
P/N RI : N/A
P/N VENDOR: 7841A AND 7842A
QUANTITY : SEE BELOW
:

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

THE 7841A REPLACEABLE DISC AND CUTTER ASSEMBLY (1-INCH) IS APPLICABLE TO MC271-0075 VACUUM JACKETED LINES. THE 7842A REPLACEABLE DISC AND CUTTER ASSEMBLY (1-1/2-INCH) IS APPLICABLE TO THE MC271-0073, -0074 AND -0076 VACUUM JACKETED LINES. A HOUSING CONTAINING THE DISC ASSEMBLY IS PART OF EACH LINE ASSEMBLY.

FUNCTION:

THE PURPOSE OF A BURST DISC IN THE VACUUM JACKETED LINES IS TO PREVENT IMPLOSION OF THE PRESSURE CARRIER OR EXPLOSION OF THE VACUUM JACKET SHOULD AN OVERPRESSURIZATION OCCUR IN THE VACUUM ANNULUS.

DESIGN:

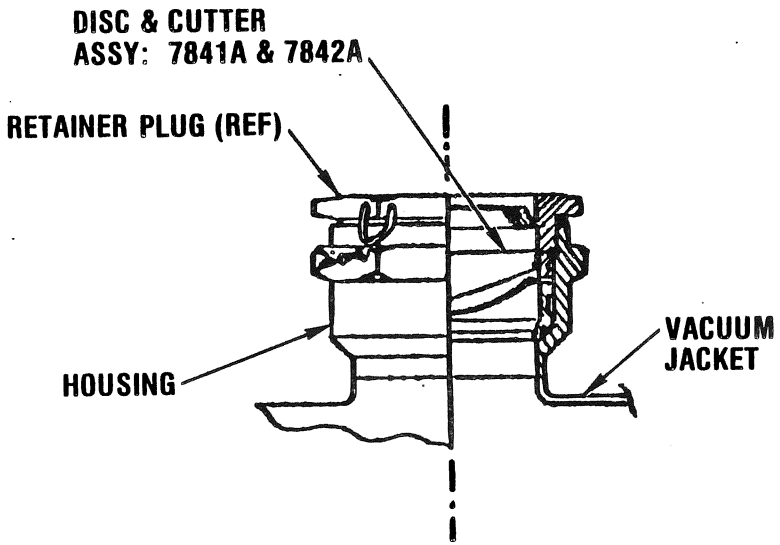
THE BURST DISC ASSEMBLY CONSISTS OF A HOUSING WELDED TO THE VACUUM JACKET AND OPEN TO THE VACUUM ANNULUS. A REMOVABLE DISC AND CUTTER ASSEMBLY IS RETAINED IN THE HOUSING BY A THREADED HEX PLUG WHICH HAS A WIRE MESH SCREEN TO PREVENT DAMAGE TO THE DISC. THE ASSEMBLY IS NOMINALLY 1.00-INCH IN DIAMETER ON THE LH_2 RECIRCULATION SYSTEM LINES AND 1.50-INCH IN DIAMETER ON ALL OTHERS. THE BURST DISC ASSEMBLY ON THE MPS FEEDLINES ALSO CONTAINS A PdO GETTER CONTAINER.

SHOULD AN OVERPRESSURIZATION OCCUR, THE CONCAVE DISC WILL REVERSE AND CUT ITSELF OPEN ON THE BLADES, THEREBY RELIEVING THE PRESSURE WITHOUT OTHERWISE DAMAGING THE LINE. THE DISC/CUTTER ASSEMBLY CAN THEN BE REPLACED.

COMPONENT: BURST DISC ASSEMBLY (REPLACEABLE DISC ASSEMBLY)

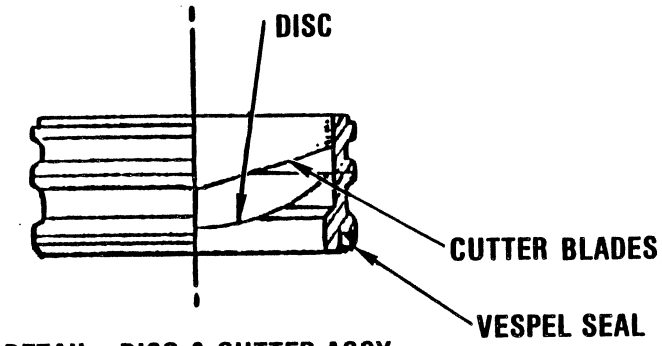
(7841A AND 7842A)

UTILIZED ON ALL VACUUM JACKETED LINES



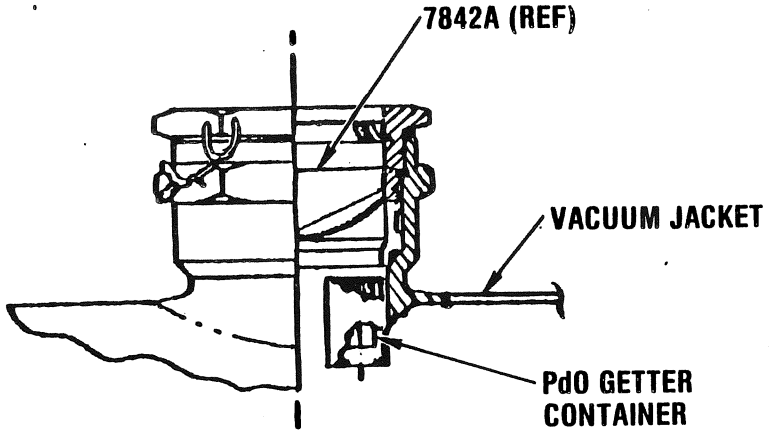
BASIC CONFIGURATION

UTILIZED ON ALL VACUUM JACKETED LINES, EXCEPT AS NOTED



DETAIL—DISC & CUTTER ASSY (REPLACEABLE)

(P/N 7841A)
(P/N 7842A)



MPS FEEDLINE (REF)

COMPONENT: SSME INTERFACE SEALS

(RS0088XX)

FMEA/CIL NO: N/A

VENDOR : VARIOUS VENDORS (SEE SCD)
P/N RI : ROCKETDYNE RS008846, 47 AND 50
P/N VENDOR:
QUANTITY : SEE TABULATIONS
: LOCATED AT MPS/SSME FLUID INTERFACES
: VARIOUS P/N DASH NUMBERS

VEHICLE EFFECTIVITY:	102	103	104	105
	X	X	X	X

ITEM:

SEALS, SSME INTERFACE

FUNCTION:

PROVIDES A SEAL AT THE BOLTED FLANGE FACES BETWEEN MPS AND SSME FLUID PANEL AND LOW PRESSURE PUMP INTERFACES IN ACCORDANCE WITH ICD 13M15000. THE SEALS ARE PART OF V070-410100 SSME INSTALLATION DRAWING.

DESIGN:

THE DESIGN, DEVELOPMENT, AND VERIFICATION OF THE FLUID INTERFACE SEALS IS THE RESPONSIBILITY OF THE SSME CONTRACTOR IN ACCORDANCE WITH ICD 13M15000. THE FOLLOWING TECHNICAL INFORMATION IS PROVIDED BY ROCKETDYNE. THE CRYOGENIC OR HIGH PRESSURE INTERFACE SEALS (RS008846 AND 47) ARE STATIC FACE PRESSURE ASSISTED COMPRESSION SEALS MANUFACTURED FROM INCONEL 718 ALLOY WITH THE SEALING SURFACE EITHER TEFLON COATED OR SILVER PLATED. THE DESIGN TEMPERATURE RANGE AND PRESSURE FOR THE TEFLON COATED SEALS IS -423 DEGREES FAHRENHEIT TO PLUS 165 DEGREES FAHRENHEIT AND 500 PSIG; -423 DEGREES FAHRENHEIT TO +900 DEGREES FAHRENHEIT FOR THE SILVER PLATED RS008846-027 AND -033; -423 DEGREES FAHRENHEIT TO +165 DEGREES FAHRENHEIT FOR THE SILVER PLATED RS008846-029. MAXIMUM DESIGN PRESSURE FOR ALL SILVER PLATED SEALS IS 5,000 PSIG. THE DESIGN INCLUDES A SECONDARY BARRIER THAT RESTRICTS THE LEAKAGE IF THE PRIMARY SEAL FAILS. THE FLANGE DESIGN OF THE SEAL INCORPORATES A LEAK CHECK PORT TO MEASURE FLANGE SEAL LEAKAGE.

COMPONENT: SSME INTERFACE SEALS

(RS0088XX)

THE AMBIENT SEAL (RS008850) IS A SPACER SEAL WITH AN ELASTOMER RING PROVIDING THE SEALING FUNCTIONS. THE DESIGN TEMPERATURE RANGE AND PRESSURE IS -30 DEGREES FAHRENHEIT TO +275 DEGREES FAHRENHEIT AND 800 PSIG. THE FLANGE DESIGN INCORPORATES A LEAK CHECK PORT TO MEASURE FLANGE/SEAL LEAKAGE.

DESCRIPTION:

THE COMPONENT AS USED IN CRYOGENIC APPLICATIONS IS A STATIC FACE SEAL WITH THE PRIMARY SEALING FUNCTIONS BEING THE COMPRESSION OF TWO CANTILEVERED LIP RINGS WHICH ARE EITHER TEFLON COATED OR SILVER PLATED. SECONDARY SEALING IS PROVIDED BY THE SEAL COAT EXTENDING OUTWARD FROM THE PRIMARY SEAL. THERE IS AN INTERCONNECTING ANNULAR RECESS ON BOTH SIDES OF THE SEAL PROVIDES ACCESS FOR LEAK DETECTION THROUGH A PORT IN ONE OF THE MATING FLANGES FOR THE SILVER PLATED SEAL. A STUB TUBE PROJECTING OUT FROM THE SEAL OD IS USED FOR LEAK DETECTION ON THE TEFLON COATED SEALS. FOR THE NON-CRYOGENIC SEAL, THE COMPONENT IS A SPACER SEAL WITH A MOLDED-IN-PLACE ELASTOMER RING ON EACH SIDE OF THE SEAL. AN INTERCONNECTED ANNULAR RECESS ON BOTH SIDES OF THE SEAL PROVIDES ACCESS FOR LEAK DETECTION THROUGH A PORT ON ONE OF THE MATING FLANGES.

LEAKAGE ALLOWABLE IS 7×10^{-2} SCCS PER FLANGE JOINT FOR ALL INTERFACE SEALS.

SSME INTERFACE SEAL TABULATION

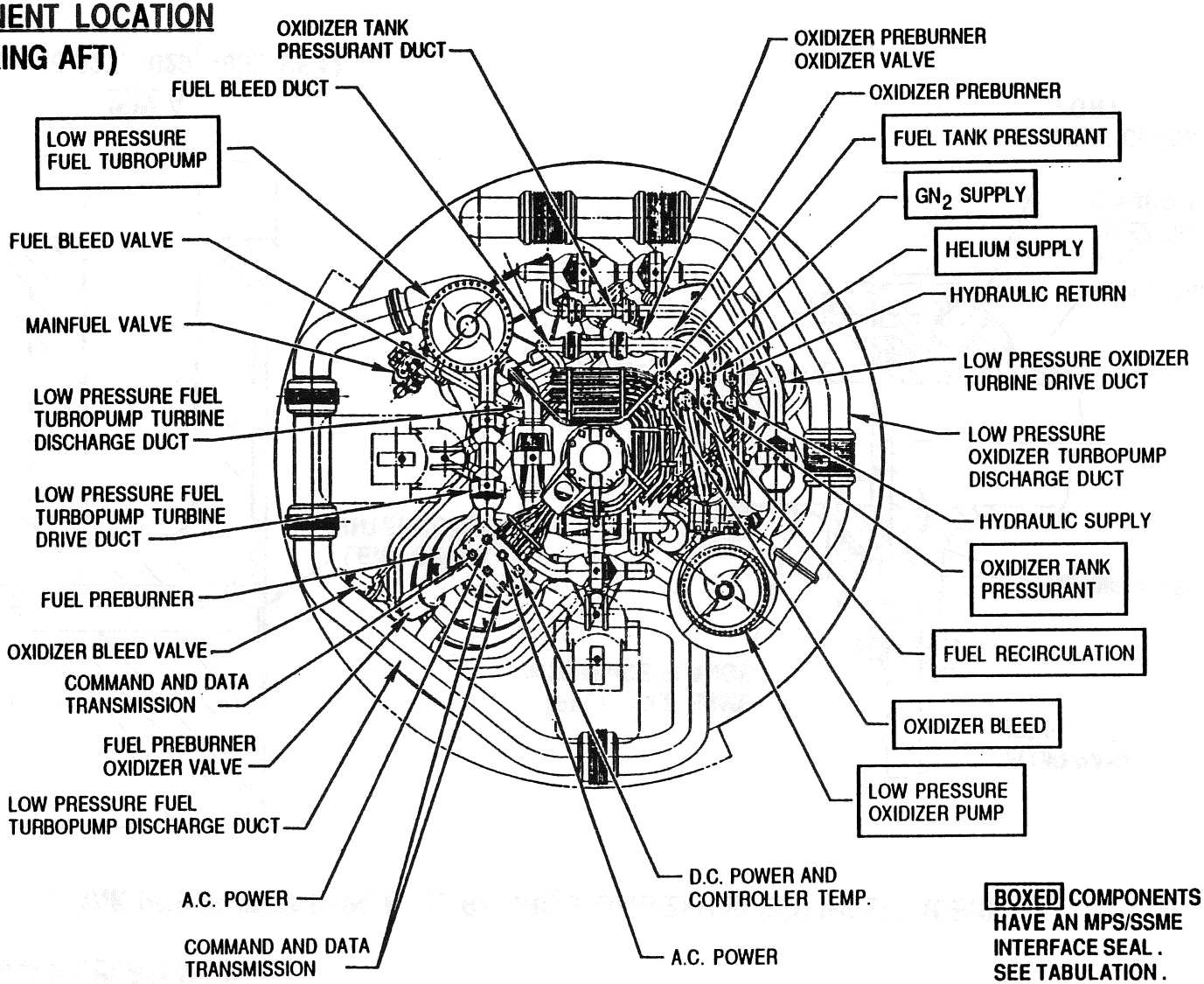
INTERFACE	PART NO.	SEALING SURFACE
LOW PRESSURE FUEL TURBOPUMP	RS008847-031	TEFLON COAT
LOW PRESSURE OXIDIZER PUMP	RS008847-021	TEFLON COAT
FUEL TANK PRESSURANT	RS008846-027	SILVER PLATE
OXIDIZER TANK PRESSURANT	RS008846-033	SILVER PLATE
GN_2 SUPPLY	RS008850-021	ELASTOMERIC RING
HELIUM SUPPLY	RS008850-021	ELASTOMERIC RING
FUEL RECIRCULATION	RS008846-029	SILVER PLATE
OXIDIZER BLEED	RS008846-029	SILVER PLATE

COMPONENT: SSME INTERFACE SEALS

(RS0088XX)

SAME COMPONENT LOCATION

(LOOKING AFT)



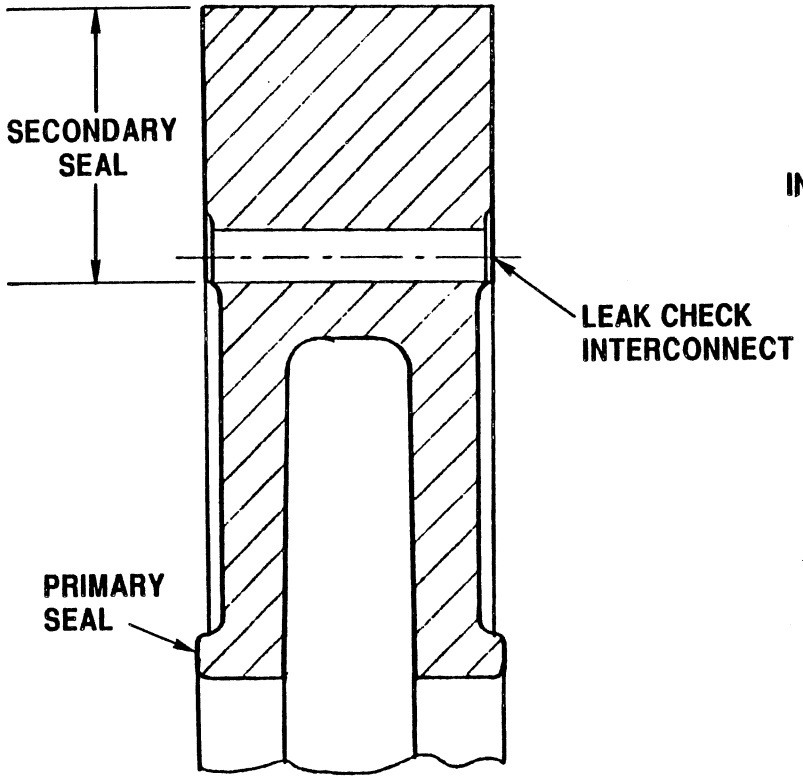
BOXED COMPONENTS HAVE AN MPS/SSME INTERFACE SEAL. SEE TABULATION.

COMPONENT: SSME INTERFACE SEALS

(RS0088XX)

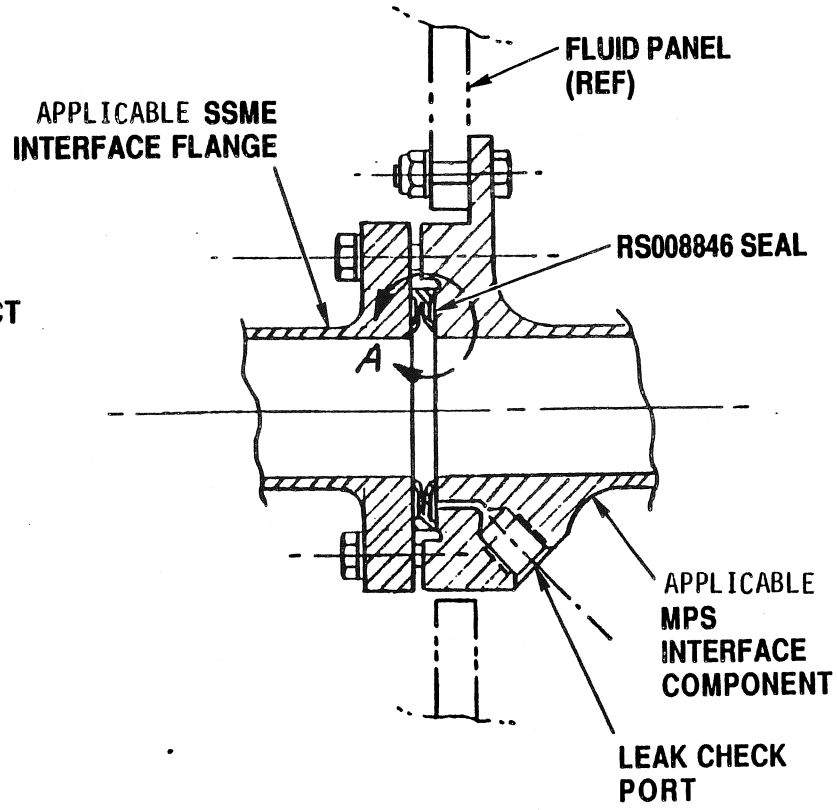
RS008846 SILVER PLATED SEAL

(TANK PRESSURIZATION, FUEL RECIRC & OXIDIZER BLEED INTERFACES)



VIEW A

RS008846-027, -029, -033 SEAL

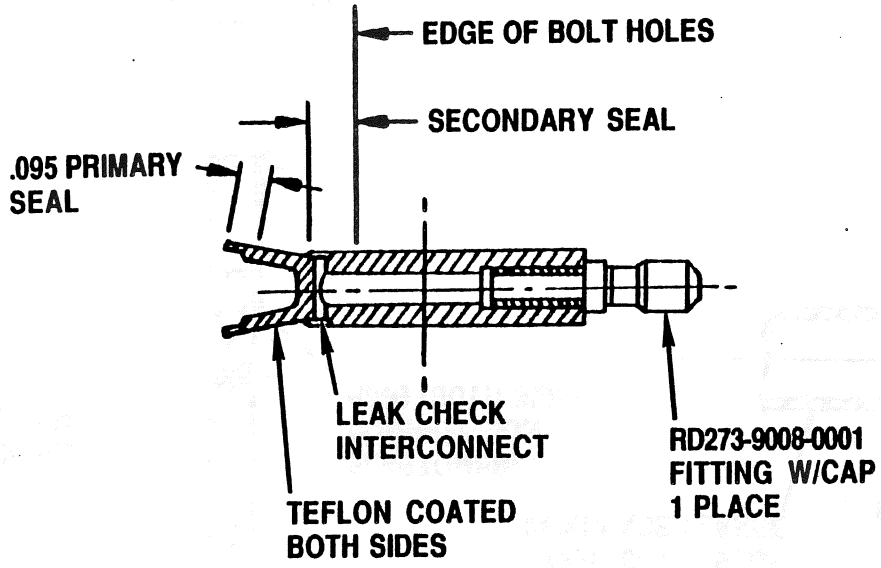


COMPONENT: SSME INTERFACE SEALS

(RS0088XX)

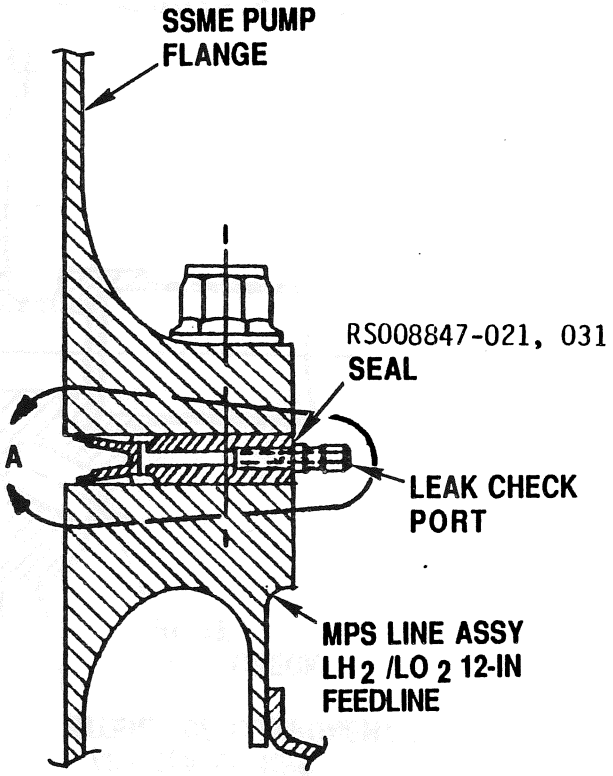
RS008847 TEFLON COATED SEAL

(PROPELLENT FEED SYSTEM INTERFACES)



VIEW A

RS008847-021, -031 SEAL

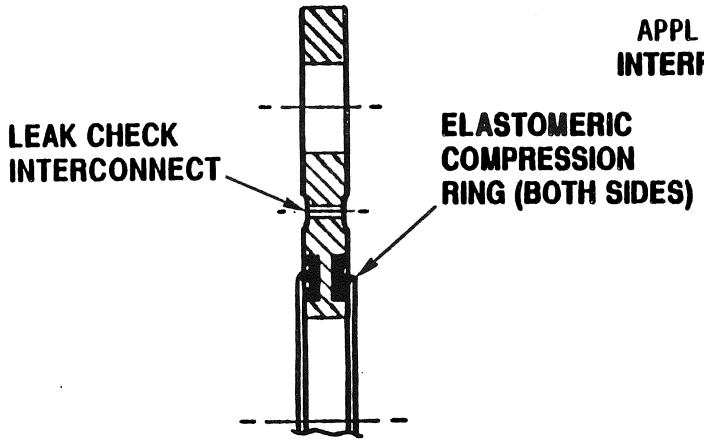


COMPONENT: SSME INTERFACE SEALS

(RS0088XX)

RS008850 LOW PRESSURE SEAL

(GN_2 AND HELIUM SUPPLY INTERFACES)



VIEW A
RS008850-021 SEAL