

PAGE: 1

PRINT DATE: 02/15/90

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-1-0436-X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION : 1 02/15/90

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
■ LRU :	VALVE, RELIEF	MC284-0501-0002
■	PARKER-HANNIFIN	5760074-101

PART DATA

- EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
VALVE, RELIEF, 1 INCH, LH2 FEEDLINE MANIFOLD RELIEF.
- REFERENCE DESIGNATORS: RV6
- QUANTITY OF LIKE ITEMS: 1
ONE LH2
- FUNCTION:
RELIEVES PRESSURE BUILDUP FROM LH2 MANIFOLD. THE VALVE INLET IS ISOLATED FROM THE FEED SYSTEM UNTIL MECO BY THE UPSTREAM FEEDLINE RELIEF SHUTOFF VALVE (PV8). THE RELIEF VALVE INCORPORATES A SENSE PORT WHICH SENSES THE LH2 MANIFOLD PRESSURE VIA A SENSE LINE. THE CRACKING AND RESEAT PRESSURES ARE BETWEEN 40 & 55 PSIG.

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :MAIN PROPULSION FMEA NO 03-1 -0436 -5 REV:04/08/88F

ASSEMBLY :PARKER-HANNIFIN	CRIT. FUNC:	1
P/N RI :MC284-0501-0002	CRIT. HDW:	1
P/N VENDOR:	VEHICLE	102 103 104
QUANTITY :1	EFFECTIVITY:	X X X
:ONE LH2	PHASE(S):	- PL X LO X OO DO LS

PREPARED BY:	REDUNDANCY SCREEN:	A-	B-	C-
DES J E OSLUND	APPROVED BY:	APPROVED BY (NASA):		
REL L H FINEBERG	DES <u>N. B. Bedford</u>	SSW <u>William F. Fineberg</u>		
QE E M GUTIERREZ	REL <u>L. A. Scott</u>	REL <u>William F. Fineberg</u>		
	QE <u>B. Williams</u>	QE <u>Scott Williams</u>		

ITEM:

VALVE, RELIEF, 1 INCH, LH2 FEEDLINE MANIFOLD RELIEF. (RV6)

FUNCTION:

RELIEVES PRESSURE BUILDUP FROM LH2 MANIFOLD. REQUIRED TO OPERATE FOR OI-SB ORBITER SOFTWARE - FOR NOMINAL, ATO, AOA, AND TAL MISSIONS LH2 MANIFOLD PRESSURE INCREASES TO RELIEF PRESSURE SETTING PRIOR TO INITIATION OF PROPELLANT DUMP.

FOR OI-8C MISSIONS, 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.

THE VALVE INLET IS ISOLATED FROM THE FEED SYSTEM UNTIL MECO BY THE UPSTREAM FEEDLINE RELIEF SHUTOFF VALVE (PV8). THE RELIEF VALVE INCORPORATES A SENSE PORT WHICH SENSES THE LH2 MANIFOLD PRESSURE VIA A SENSE LINE. THE CRACKING AND RESEAT PRESSURES ARE BETWEEN 40 & 55 PSIG.

FAILURE MODE:

RUPTURE/LEAKAGE OF THE VALVE BODY DURING LOADING, ASCENT, AND DUMP/INERT.

CAUSE(S):

FATIGUE, MATERIAL DEFECTS, DAMAGED/DEFECTIVE BODY JOINT SEALS.

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :MAIN PROPULSION

FMEA NO 03-1 -0436 -5

REV:04/08/88

EFFECT(S) ON:

(A)SUBSYSTEM (B)INTERFACES (C)MISSION (D)CREW/VEHICLE

(A,B) LH2 LEAKAGE INTO THE AFT COMPARTMENT FROM MANIFOLD SENSE LINE (VALVE INLET IS NOT EXPOSED TO LH2 UNTIL RELIEF SHUTOFF VALVE (PVB) IS OPENED AT MECO). POSSIBLE LOSS OF ADJACENT CRITICAL FUNCTIONS DUE TO CRYO EXPOSURE. POSSIBLE AFT COMPARTMENT OVERPRESSURIZATION AND FIRE/EXPLOSION HAZARD. LEAKAGE INTO AFT COMPARTMENT DETECTABLE DURING PROPELLANT LOADING USING HAZARDOUS GAS DETECTION SYSTEM (HGDS).

ALSO RESULTS IN POSSIBLE LOSS OF HELIUM SUPPLY DURING MANIFOLD REPRESSURIZATION CAUSING LOSS OF AFT COMPARTMENT PURGE (RTLS AND TAL ABORT CRITICAL).

(C) ON GROUND, VIOLATION OF HGDS LCC REQUIREMENT WILL RESULT IN LAUNCH SCRUB.

(D) POSSIBLE LOSS OF CREW/VEHICLE.

DISPOSITION & RATIONALE

(A)DESIGN (B)TEST (C)INSPECTION (D)FAILURE HISTORY (E)OPERATIONAL USE:

(A) DESIGN

THE RELIEF VALVE CONSISTS OF TWO SECTIONS: A PRESSURE ACTUATED MAIN POPPET SECTION AND A PILOT SECTION WHICH SENSES MANIFOLD 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 END CAP, THE PILOT HOUSING, AND THE MAIN BODY ARE CONSTRUCTED OF 6061-T651 ALUMINUM ALLOY. THE INTERMEDIATE HOUSING IS CONSTRUCTED OF 304L CRES. THE THERMAL ISOLATOR IS CONSTRUCTED OF VESPEL SP21. THE MAIN SEAT VALVE HOUSING IS CONSTRUCTED OF PH13-8MO CRES.

THE VALVE IS DESIGNED FOR A STRUCTURAL FACTOR OF SAFETY OF 2.0 PROOF, 4.0 BURST. IT IS DESIGNED FOR 10,000 CYCLES (100 MISSION EQUIVALENT) AND TESTED THROUGH A TOTAL OF 5000 CYCLES UNDER CRYOGENIC AND AMBIENT TEMPERATURES.

THERE ARE SIX EXTERNAL LEAK PATHS. THEY ARE SEALED USING SPRING LOADED FACE SEALS (SPRING IS INCONEL, JACKET IS TEFLON). THE VALVE BODY SEALING SURFACES HAVE 8 MICROINCH SURFACE FINISH.

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :MAIN PROPULSION

FMEA NO 03-1 -0436 -5

REV:04/08/88

(B) TEST

ATP

VISUAL INSPECTION

STROKE VERIFICATION OF MAIN POPPET (0.225 +/- 0.002 INCH)

AMBIENT TEST

PROOF PRESS: VALVE BODY, 110 PSIG INLET & SENSE PORT, 300 PSIG OUTLET

INTERNAL LEAKAGE:

1 TO 35 PSIG GHe AT INLET AND SENSE PORT
10 SCIM MAX AT OUTLET PORT

EXTERNAL LEAKAGE: 55 PSIG GHe; 5 SCIM MAX

CRACK/RESEAT: 40 TO 55 PSIG

REVERSE FLOW LEAKAGE:

10 PSID GHe OUTLET TO INLET
MAIN SEAT LEAKAGE 50 SCIM MAX
PILOT REVERSE LEAKAGE 1700 SCIM MAX.

CRYOGENIC TEST (GHe AT -300 DEG F):

CRACK/RESEAT: 40 TO 55 PSIG, VALVE BODY AMBIENT

EXTERNAL LEAKAGE: 55 PSIG, 10 SCIM MAX, VALVE BODY -100 DEG F

INTERNAL LEAKAGE: 35 PSIG, 10 SCIM MAX, VALVE BODY -100 DEG F

CERTIFICATION

LIFE TEST

CRYO - 4500 CYCLES OPEN AND CLOSED USING LN2, VALVE CHECKED FOR
INTERNAL LEAKAGE AFTER EACH 500 CYCLES, VALVE CHECKED FOR CRYO
INTERNAL LEAKAGE AFTER EACH 1500 CYCLES.

AMBIENT - 500 CYCLES, VALVE INTERNAL LEAK CHECK EACH 50 CYCLES.

CRYO STEADY STATE FLOW TEST

SENSES PORT PRESS AT 65 PSIG GHe AT -412 DEG F
FLOW RATE OF 272 GPM LH2 AT 23 PSID

CRYO RESPONSE TEST

1.5 SEC TO INDICATE STEADY FLOW AFTER CRACKING WITH LH2

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :MAIN PROPULSION

FMEA NO 03-1 -0436 -5

REV:04/08/88

CRYO FUNCTIONAL TEST USING LH2

CRACKED AT 51 PSIG; RESEAT AT 44 PSIG

RANDOM VIBRATION 13.3 HOURS IN EACH OF THE THREE AXES

FIRST 4 HOUR AND 26 MINUTE PERIOD

ENVIRONMENT: AMBIENT

SENSE PORT: 35 PSIG GHe AT -425 DEG F

MAIN INLET: AMBIENT

SECOND 4 HOUR AND 26 MINUTE PERIOD

ENVIRONMENT: AMBIENT TO +100 TO -100 TO AMBIENT

SENSE PORT: 35 PSIG GHe AT -425 DEG F

MAIN INLET: 35 PSIG GHe AT -425 DEG F

THIRD 4 HOUR AND 26 MINUTE PERIOD

ENVIRONMENT: AMBIENT

SENSE PORT: 35 PSIG GHe AT -425 DEG F

MAIN INLET: 35 PSIG LN2

CRACK/RESEAT AND INTERNAL LEAKAGE PERFORMED AT COMPLETION OF EACH AXIS OF VIBRATION.

BENCH HANDLING AND DESIGN SHOCK PER MIL-STD-810

FOLLOWED BY AMBIENT CRACK/RESEAT AND INTERNAL LEAKAGE TESTS.

THERMAL CYCLE TEST (3 CYCLES)

VALVE AT 70 DEG F; SHOCKED WITH -300 DEG F FLUID FOR 20 MINUTES MIN;
VALVE ALLOWED TO WARM UP TO 70 DEG F; VALVE HEATED TO 275 DEG F FOR 15
MINUTES. DURING THE 15 MINUTES THE VALVE WAS TESTED FOR AMBIENT
CRACK/RESEAT PRESSURE.

ELECTRICAL BONDING

BURST TEST

220 PSIG ON SENSE AND INLET PORTS, 600 PSIG ON OUTLET PORT

OMRSD

V41AYO.020 ORBITER LH2 PROP SYS EXTERNAL LEAK TEST (15)

V41AYO.140 LH2 PROP SYS DECAY CHECK (EVERY FLIGHT)

V41AYO.221 SIGNATURE LEAK CHECK (EVERY FLIGHT)

V41AYO.280 RV5,6 FEEDLINE RELIEF PILOT BELLOWS LEAK CHECK (EVERY FLIGHT)

V41BHO.120 RV6 LH2 MANIFOLD RELIEF VALVE FUNCTIONAL (PRIOR TO FIRST
REFLIGHT OF EACH VEHICLE)

V41BUO.010 ORBITER MPS COMPONENT INSPECTION (EVERY FLIGHT)

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : MAIN PROPULSION

FMEA NO 03-1 -0436 -5

REV:04/08/88

(C) INSPECTION

RECEIVING INSPECTION

RAW MATERIALS ARE VERIFIED BY INSPECTION FOR MATERIAL AND PROCESS CERTIFICATION. PART PROTECTION COATING AND PLATING REQUIREMENTS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CONTAMINATION CONTROL PROCESS AND CORROSION PROTECTION PROVISIONS ARE VERIFIED. CLEANLINESS TO LEVEL 400A (PROCUREMENT SPECIFICATION REQUIREMENT IS 400) VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

ALL CRITICAL DIMENSIONS ARE VERIFIED BY INSPECTION. LOG OF CLEAN ROOM AND TOOL CALIBRATION IS VERIFIED BY INSPECTION. TORQUE PER DRAWING REQUIREMENTS AND SURFACE FINISH ARE VERIFIED BY INSPECTION. SURFACES REQUIRING CORROSION PROTECTION ARE VERIFIED BY INSPECTION. ALL SEALING SURFACES AND SEALS ARE VISUALLY EXAMINED BEFORE INSTALLATION USING 10X MAGNIFICATION. MANDATORY INSPECTION POINTS ARE INCLUDED IN THE MANUFACTURING PROCEDURE.

CRITICAL PROCESSES

HEAT TREATMENT, WELDING, PARTS PASSIVATION, AND ANODIZING ARE VERIFIED. DRY FILM LUBRICANT APPLICATIONS ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

ALL WELDS ARE VISUALLY EXAMINED AND VERIFIED BY DYE PENETRANT. IN ADDITION, BELLWS WELDS (EXCLUDING END FITTING WELDS) ARE X-RAYED.

TESTING

ATP VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PACKAGING FOR SHIPPING IS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

THERE HAVE BEEN NO ACCEPTANCE TEST, QUALIFICATION TEST, FIELD OR FLIGHT FAILURES ASSOCIATED WITH THIS FAILURE MODE.

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :MAIN PROPULSION

FMEA NO 03-1 -0436 -5

REV:04/08/88

(E) OPERATIONAL USE

FLIGHT: NO CREW ACTION IS REQUIRED.

GROUND: OMI S1004 SEQUENCE TITLED "EMERGENCY PROCEDURE FOR MAJOR LEAK OR FIRE IN THE ORBITER AFT FUSELAGE" CONTAINS SAFING SEQUENCE OF EVENTS FOR MAJOR LEAKS IN THE HYDROGEN SYSTEM.