

PRINT DATE: 03/02/89

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-1A3-0408-1

SUBSYSTEM NAME: MAIN PROPULSION SYSTEM

REVISION : 0 03/02/89 W

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU :	VALVE LATCH ASSY (LO2)	MC284-0389-0551
LRU :	17" DISC VALVE ASSY, ET LO2	MC284-0389-0552

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
DISCONNECT, LO2 FEED (WITH LATCH) 17 INCH, ORBITER & ET HALF.

REFERENCE DESIGNATORS: FD1

QUANTITY OF LIKE ITEMS: 1
ONE

FUNCTION:

ET/ORBITER FEED LINE DISCONNECT PROVIDES LO2 PROPELLANT TO THE MPS AND A MEANS OF LOADING AND DETANKING THE ET. EACH DISCONNECT HALF CONTAINS A PNEUMATICALLY ACTUATED FLAPPER CLOSURE DEVICE WHICH REMAINS IN ITS LAST ACTUATED POSITION (BISTABLE). THE VALVES ARE CLOSED AFTER MECO TO PREVENT PROPULSIVE VENTING LEADING TO ET/ORBITER RECONTACT, TILE/DOOR DAMAGE DUE TO EXPOSURE TO PROPELLANTS, LOSS OF HELIUM SUPPLY DURING MANIFOLD REPRESSURIZATION (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 PNEUMATICALLY (POST MECO). REDUNDANT OPEN AND CLOSE (TWO EACH) VALVE POSITION SWITCHES ARE LOCATED ON THE ORBITER HALF OF THE DISCONNECT. THE FLAPPER DRIVE MECHANISM IS DESIGNED TO ALLOW RELIEF OF PROPELLANTS TRAPPED BETWEEN THE FLAPPERS AFTER DISCONNECT CLOSURE.

A PNEUMATICALLY ACTUATED LATCH MECHANISM IS PROVIDED TO PREVENT THE VALVE FLAPPERS FROM CLOSING DURING FLOW CONDITIONS. THE LATCH IS BISTABLE AND IS CONTROLLED BY A SEPARATE PNEUMATIC ACTUATOR ASSEMBLY WITH REDUNDANT LOCK AND UNLOCK (TWO EACH) POSITION SWITCHES. LATCH MECHANISM INCORPORATES TOGGLE PIVOT WHICH ALLOWS FLAPPER CLOSURE DURING BACK UP MECHANICAL SEPARATION WITH LATCH IN LOCKED POSITION. SEE LATCH FMEA/CIL 0454 FOR ADDITIONAL INFORMATION.

SHUTTLE CRITICAL ITEMS LIST - ORBITER

NUMBER: 03-1A3-0408-06

REVISION: 0 03/02/89 W

SUBSYSTEM: MAIN PROPULSION SYSTEM

LRU VALVE LATCH ASSY (LO2)

CRITICALITY OF THIS

ITEM NAME: 17" DISC VALVE ASSY, ET LO2

FAILURE MODE:1/1

FAILURE MODE:

ORBITER FLAPPER FAILS TO CLOSE (POST MECO THROUGH ET SEPARATION)

MISSION PHASE:

LO LIFT-OFF

VEHICLE/PAYLOAD/KIT EFFECTIVITY:	102	COLUMBIA
	: 103	DISCOVERY
	: 104	ATLANTIS

CAUSE:

CONTAMINATION, PIECE PART STRUCTURAL FAILURE, BINDING

CRITICALITY 1/1 DURING INTACT ABORT ONLY? N

REDUNDANCY SCREEN A) N/A
 B) N/A
 C) N/A

PASS/FAIL RATIONALE:

A)

B)

C)
------ FAILURE EFFECTS -

(A) SUBSYSTEM:

CASE I - ORBITER FLAPPER:

CONTAMINATION OR STRUCTURAL FAILURE OF THE MECHANICAL LINKAGE TO THE ORBITER FLAPPER WOULD NOT ALLOW THE FLAPPER TO CLOSE EITHER BY PNEUMATIC ACTUATION OR BY MECHANICAL SEPARATION CLOSURE (UMBILICAL RETRACT). VEHICLE SOFTWARE WILL INHIBIT ET STRUCTURAL SEPARATION SINCE BOTH DISCONNECT CLOSED SWITCHES WILL PROPERLY INDICATE ORBITER FLAPPER FAILURE TO CLOSE.

CASE II - ET FLAPPER:

CONTAMINATION WILL NOT ALLOW ET FLAPPER TO FULLY CLOSE.

CASE III - ET AND ORBITER FLAPPERS:

BINDING IN THE DRIVE MECHANISM LINKAGE AT THE INPUT END OF THE ET FLAPPER TORSION BAR OR INPUT END OF THE ORBITER FLAPPER DRIVE SHAFT

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WILL RESULT IN POSSIBLE FAILURE TO CLOSE BOTH FLAPPERS EITHER BY PNEUMATIC ACTUATION OR BY MECHANICAL SEPARATION CLOSURE (UMBILICAL RETRACT). THIS IS DUE TO MECHANICAL INTERFERENCE BETWEEN FLAPPER FORK AND ROLLER ARM ASSEMBLY.

(B) INTERFACING SUBSYSTEM(S):
SAME AS A.

(C) MISSION:

CASE I:

FOR NOMINAL, ATO, AND AOA MISSIONS ET SEPARATION IS DELAYED FOR SIX MINUTES TO VENT RESIDUAL PROPELLANT THROUGH FAILED DISCONNECT. THIS IS TO PREVENT ORB/ET RECONTACT DUE TO PROPULSIVE VENTING AT SEPARATION. POSSIBLE TILE AND DOOR DAMAGE AT THE ORB/ET UMBILICAL AREA DUE TO CRYO EXPOSURE. FOR RTLS, TAL, AND MISSIONS WHERE OMS BURN CANNOT BE DELAYED ET STRUCTURAL SEPARATION IS NOT DELAYED AND ET/ORB RECONTACT IS LIKELY. ALSO RESULTS IN LOSS OF HELIUM SUPPLY DURING MANIFOLD REPRESS CAUSING POSSIBLE LOSS OF AFT COMPARTMENT PURGE (RTLS AND TAL ABORT CRITICAL).

CASE II:

RESULTS IN ET FLAPPER FAILING TO FULLY CLOSE WHICH MAY CAUSE POSSIBLE TILE AND DOOR DAMAGE AT THE ORB/ET UMBILICAL AREA DUE TO CRYO EXPOSURE.

CASE III:

MAY RESULT IN FAILURE TO SEPARATE ET FROM ORBITER

(D) CREW, VEHICLE, AND ELEMENT(S):
POSSIBLE LOSS OF CREW/VEHICLE.

(E) FUNCTIONAL CRITICALITY EFFECTS

- DISPOSITION RATIONALE -

(A) DESIGN:

A PNEUMATIC ACTUATOR MOUNTED ON THE ORBITER HALF OF THE DISCONNECT DRIVES THE ET FLAPPER THROUGH A ROLLER/CLEVIS LINKAGE. THIS ACTION IN TURN DRIVES A SECOND ROLLER/CLEVIS LINKAGE WHICH OPERATES THE ORBITER FLAPPER AND THE POSITION INDICATOR ASSEMBLY.

DESIGN FACTORS OF SAFETY FOR INTERNAL PRESSURE ARE 1.3 PROOF, 1.5 BURST FOR THE DISCONNECT. THE ORBITER FLAPPERS HAVE A MINIMUM USEFUL LIFE OF 3500 CYCLES WHICH IS EQUIVALENT TO 100 ORBITER MISSIONS. THE ET FLAPPERS HAVE A MINIMUM LIFE OF 150 CYCLES WHICH IS EQUIVALENT TO ONE ORBITER MISSION. STRUCTURAL ANALYSIS INDICATES 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 (ET - ONE MISSION, ORBITER - 100 MISSIONS).

THE DISCONNECT VALVE CONSISTS OF COMPONENTS MANUFACTURED FROM 2024-T65.

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AL ALLOY (FLAPPER ASSEMBLY), INCONEL 718 (ARM FOLLOWER) AND A286 CRES (ARM DRIVE ASSEMBLY). THE VALVE HOUSING IS MANUFACTURED FROM 2219 AL ALLOY. THE ROLLER, FORK, TORSION BAR AND DRIVE SHAFT ASSEMBLIES ARE MANUFACTURED FROM INCONEL 718 AND CRES MATERIALS. BINDING IS PRECLUDED BY USE OF VESPEL BUSHING/BEARINGS.

THE PNEUMATIC ACTUATOR (PRIMARY MODE) OPERATES THE DISCONNECT FLAPPERS OPEN-TO-CLOSE AND CLOSE-TO-OPEN WITH AN EXTERNAL HELIUM SOURCE GAS PRESSURE OF 740 PSIG. THE PNEUMATIC ACTUATOR PISTON SEALS ARE REDUNDANT TO MINIMIZE LEAKAGE. DYNAMIC SEAL IS OF RULON "A", SPRING IS OF 310 OR 302 CRES. STATIC SEAL IS OF TFE TEFLON, SPRING IS OF 301 CRES. DESIGN FACTORS OF SAFETY FOR INTERNAL PRESSURE ARE 1.5 (PROOF), AND 2.0 (BURST) FOR THE ACTUATOR. PROOF PRESSURE TESTED TO 1275 PSIG. ACTUATOR PISTON (6061-T651 AL) SLIDES IN CYLINDER ASSEMBLY (SURFACE FINISH IS 8 MICROINCH) ON NONMETALLIC PISTON GUIDES (SURFACE FINISH IS 32 MICROINCH). ROD (304 CRES, SURFACE FINISH 8 MICROINCH) SLIDES ON NONMETALLIC BEARINGS (SURFACE FINISH 32 MICROINCH).

THE DISCONNECT IS ALSO DESIGNED TO ALLOW MECHANICAL CLOSURE OF FLAPPERS AS A BACKUP MODE UPON DISENGAGEMENT OF THE ORBITER AND EXTERNAL TANK UMBILICAL ASSEMBLIES. THE MATING SURFACES OF THE EXTERNAL DRIVE MECHANISMS ARE COATED WITH MICROSEAL TO MINIMIZE BINDING.

(B) TEST:
ATP (ACTUATOR)

PROOF: AMBIENT, 1275 PSIG

OPERATIONAL (TWO CYCLES): AMBIENT: 400, 740, 780 PSIG

RESPONSE TIME (OPENING/CLOSING):
ROOM AMBIENT/-300 DEG F
RESPONSE TIME AT 400, 700 AND 780 PSIG

LEAKAGE: EXTERNAL AND INTERNAL, AMBIENT AND CRYO

ATP - ET/ORBITER MATED DISCONNECT ASSEMBLY

FLAPPER ANGLE: ET 4.5 +/- 0.25 DEG, ORB 3.0 +/- 0.25 DEG

TIP LOAD: ET 55 LB MINIMUM, ORB 40 LB MINIMUM

POSITION SWITCH VERIFICATION: LATCH IN LOCKED POSITION. ROTATION FROM FLAPPER POSITION OF REST ON DOWNSTRIKE SURFACE TO FLAPPER POSITION WHERE OPEN INDICATOR LIGHT TURNS ON MUST BE 4 DEG, MINIMUM.

PROOF:
AMBIENT, 1275 PSIG, ACTUATOR
286 PSIG FOR ORBITER CLOSURE DEVICE
58 PSIG FOR ET CLOSURE DEVICE

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OPERATIONAL CYCLE:

CRYO, -300 DEG F, ACTUATOR PRESSURE 740 PSIG FOR 8 CYCLES AND 450 PSIG FOR 5 CYCLES
 AMBIENT, He AT 400 PSIG (1 CYCLE) AND 740 PSIG (5 CYCLES)

CLEANLINESS VERIFICATION: MOISTURE FREE AND CLEANED TO LEVEL 400A OF MA 0110-301

LEAKAGE:

EXTERNAL

VALVE: LN2/AMBIENT TEMPS: 50 SCIMS OF GHE AT 10 PSIG, 50 SCIMS OF GHE AT 50 PSIG; LATCH SHAFT SEAL, 80 SCIMS OF GHE; 150 SCIMS OF GN2 AT 185 PSIG; LATCH SHAFT SEAL, 80 SCIMS OF GN2

VALVE ACTUATOR:

CRYO (BODY TEMP AT -300 DEG F, ACTUATOR AT -200 TO 0 DEG F)/AMBIENT TEMPS: 100 SCIMS OF GHE AT 740 PSIG

INTERNAL

VALVE: AMBIENT TEMPS: 1000 TO 2000 SCIMS OF GHE AT 1 TO 15 PSIG; 2500 SCIMS OF GN2 AT 200 PSIG

LN2 TEMPS: 2500 SCIMS OF GHE AT 60 PSIG; 2500 SCIMS OF GN2 AT 200 PSIG

VALVE ACTUATOR:

CRYO (BODY TEMP AT -300 DEG F, ACTUATOR AT -200 TO 0 DEG F)/AMBIENT TEMPS: 100 SCIMS OF GHE AT 740 PSIG

RELIEF OPERATION: -300 DEG F, CRACKING/RESEAT PRESSURE, 0.1-5 PSID (ET ONLY)

ELECTRICAL CHARACTERISTICS (INSULATION RESISTANCE AND VOLTAGE DROP), AND DIELECTRIC STRENGTH

FLOW LINER - ROUNDNESS VERIFICATION (FREE END EIGHT POINTS MEASUREMENT)

CERTIFICATION

COMPONENT QUALIFICATION (INCLUDES TESTING FROM PREVIOUS CONFIGURATION: WITHOUT LATCH)

SALT FOG

VIBRATION - THREE AXES:

SINUSOIDAL: 5 TO 35 HZ AT 0.25 G, ZERO TO PEAK

RANDOM: 20 TO 2,000 HZ 5.7 G RMS FOR X-AXIS, 5.2 G RMS FOR Y AND Z-AXIS, NO FLOW (LN2), FLAPPERS OPEN, LATCH

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ENGAGED

THE DISCONNECT IS CHILLED WITH LN2 AND STABILIZED AT -300 DEG F. 10 PSIG DISCONNECT, 740 PSIG ACTUATOR. THESE CONDITIONS ARE MAINTAINED THROUGHOUT SINUSOIDAL AND RANDOM VIBRATION. ACTUATOR VENTED DURING LAST TWO MINUTES OF VIBRATION.

THERMAL CYCLE: -400 TO 150 DEG F, 3 CYCLES

OPERATING LIFE:

AMBIENT, 740 PSIG HE FOR A TOTAL OF 2,400 CYCLES FOR ORBITER AND 100 CYCLES FOR ET.

THE RELIEF MECHANISM WAS CYCLED DURING ET VALVE CYCLING.

CRYO, 740 PSIG HE, -400 DEG F FOR A TOTAL OF 1000 CYCLES FOR ORBITER AND 50 CYCLES FOR THE ET.

THE RELIEF MECHANISM WAS CYCLED DURING ET VALVE CYCLING.

ELECTRICAL CHARACTERISTICS (INSULATION RESISTANCE AND VOLTAGE DROP)

LEAKAGE: EXTERNAL AND INTERNAL, AMBIENT AND CRYO

ENGAGE - DISENGAGE: ENGAGE FORCE = 1000 LBS MAX, DISENGAGE FORCE = 6000 LBS MAX

BURST TEST: PNEUMATIC ACTUATOR, 1700 PSIG HYDROSTATIC PRESSURE FOR 2 MINUTES

TYPE I AND TYPE II MATED (OPEN POSITION) 450 PSIG HYDROSTATIC PRESSURE FOR 2 MINUTES

TYPE I AND TYPE II DEMATED (CLOSED POSITION) 330 PSID TO TYPE I, 68 PSID TO TYPE II FOR 2 MINUTES

UMBILICAL SEPARATION TEST: (WITHOUT LATCH)

THE DISCONNECT WAS INSTALLED IN THE UMBILICAL ASSEMBLY DURING THE SEPARATION TEST PROGRAM. THE UMBILICAL ASSEMBLY WAS SUBJECTED TO RANDOM VIBRATION TESTS (4.4 HOURS PER AXIS) WHILE FILLED WITH LN2. THE DISCONNECT WAS ALSO SUBJECTED TO UMBILICAL RETRACT TESTS AT BOTH NOMINAL CONDITIONS AND SIMULATED HYDRAULIC RETRACT ACTUATOR FAILURES.

UMBILICAL SEPARATION TEST: (WITH LATCH)

FLAPPER PNEUMATICS/LATCH PNEUMATICS/PYROS/RETRACTOR HYDRAULICS

(1) PNEUMATIC CLOSURE (NORMAL) - 4 CYCLES

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(2) MECHANICAL CLOSURE (BACKUP) - 5 CYCLES

BOTH PERFORMED AT AMBIENT, LN2 AND LH2 CONDITIONS.

FLOW LINER WATER FLOW TESTS:
-----DESIGN FLOW TO 19,600 GPM
ALLOWABLE DELTA P IS 10 PSID AT THE LINER

TO DETERMINE THE STABILITY OF THE FLOW LINER. THE FLOW TUBE HAD NO PERMANENT DAMAGE AFTER BEING SUBJECTED TO WATER FLOWS UP TO 20,000 GPM (TEST TIME OF 2 MINUTES / 6 RUNS MINIMUM). AFTER VERIFYING PERFORMANCE AT 20,000 GPM, THE UNIT WAS SUBJECTED TO 22,700 GPM TO VERIFY DESIGN MARGIN (NO PERMANENT DAMAGE).

FLAPPER ANGLE STABILITY MARGIN WATER FLOW TESTS:
-----FOURTEEN (14) EXPLORATORY TEST SERIES (FLOW 4,000 TO 20,800 GPM)
E.T. FLAPPER SETTING VARYING FROM 1.6 TO 5.8 DEG.
ORB. FLAPPER SETTING VARYING FROM 0.9 TO 5.4 DEG.

CERTIFICATION TEST RUN AT WORST CASE PRODUCTION SETTING (FLOW RANGE TO 109% POWER LEVEL).

PROOF TEST SERIES - MAXIMUM FLOW 22,700 GPM, AT ANGLES BELOW MINIMUM FLIGHT SETTINGS

PRODUCTION ANGLE SETTINGS

E.T. 4.5 +/- 0.25 DEG

ORB. 3.0 +/- 0.25 DEG

FLAPPER TIP LOAD MARGIN WATER FLOW TEST:

EIGHT (8) EXPLORATORY TEST SERIES (FLOW RANGE TO 109% POWER LEVEL)

FLOW 4,000 TO 20,600 GPM

ORBITER: 3.0 +/- 0.1 DEG FOR SEVEN SERIES, 4.1 +/- 0.1 FOR ONE SERIES
TIP LOAD RANGE: 20 TO 62 LBS

ET: 3.95 +/- 0.1 DEG

TIP LOAD RANGE: 23 TO 61 LBS

RECOMMENDED TIP LOAD:

ORBITER: 40 LBS MINIMUM

ET: 55 LBS MINIMUM

LATCH WATER FLOW TESTS:

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 TWENTY-FOUR (24) EXPLORATORY TEST SERIES (FLOW 4,000 TO 22,100 GPM)

CERTIFICATION TEST RUN AT MINIMUM PRODUCTION SETTING (FLOW RANGE TO 109% POWER LEVEL).

TWO TEST SERIES IN FILL DIRECTION (FLOW 4,000 TO 6,400 GPM), LATCH PNEUMATIC PRESSURE VENTED (BISTABILITY)

PROOF TEST - 23,200 GPM

LATCH CRYO FLOW TESTS:

SIXTEEN (16) TESTS WITH LN2/LO2 (FLOWS VARY FROM ONE ENGINE AT 65% TO THREE AT 109%):

DISCONNECT FLAPPER STABILITY/LOADS

CAVITATION

FRICTION PRESSURE LOSS

ENGINE CUTOFF SENSOR RESPONSE

STEADY STATE TEST: LN2 (65% AND 109% OF RATED POWER LEVEL), LATCH ENGAGED. LO2 (100%, 104% AND 109% OF RATE POWER LEVEL), LATCH ENGAGED AND NOT ENGAGED.

TERMINAL DRAIN: (SATURATED LO2) (65% AND 109%) LATCH ENGAGED AND NOT ENGAGED.

OMRSD

V41AYO.010 LO2 EXTERNAL LEAK TEST (15)
 V41AYO.130 LO2 DECAY TEST (EVERY FLT)
 V41AYO.221 HELIUM SIGNATURE TEST (EVERY FLT)
 V41AYO.260 LO2 SHAFT SEAL LEAK CHECK (15)
 V4-AZ0.130 ACTUATOR INTERNAL LEAK TEST (15)
 V4.5B0.080 LO2 SEAT LEAKAGE TEST (EVERY FLT)
 V41B10.240 ORB/ET DISC RESPONSE TIME (POST FLT DATA ANALYSIS)
 V41BUC.280 DISCONNECT FLAPPER ANGLE VERIFICATION (EVERY FLT)
 V41BUC.320 DISCONNECT INSPECTION AND TIP LOAD VERIF (EVERY FLT)
 V41BUC.330 MPS COMPONENT CAVITY INSPECTION (EVERY FLT)
 V41BUC.370 LO2/LH2 17" DISC ACTUATOR OPERATIONAL VERIF (EVERY FLT)
 T41QAL.090 LO2/LH2 17" DISCONNECT INSPECTION (EVERY FLT)
 T41FUN.040 OPENING TORQUE BEFORE MATING (EVERY FLT)
 T41FUN.061 ET 17" TIP LOAD/FLAPPER ANGLE INSPECTION (EVERY FLT)
 T41FUN.070 ROLLER ARM INSPECTION (EVERY FLT)
 SOOOOO.090 PD1 RESPONSE TIME (MATED) (EVERY FLT)
 SOOHCO.400 VERIFY ET/ORB DISC POSITIONS (PRIOR TO MATING) (EVERY FLT)

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(C) INSPECTION:**RECEIVING INSPECTION**

RAW MATERIALS ARE VERIFIED BY INSPECTION FOR MATERIAL AND PROCESS CERTIFICATION. ALL MACHINED ITEMS ARE DIMENSIONALLY INSPECTED AND VERIFIED (MIL-STD-105). CHEMICAL/MECHANICAL PROPERTIES AND RECORDS OF RECEIVED MATERIALS ARE RETAINED FOR VERIFICATION. BODY FORGING IS ULTRASONICALLY AND DYE PENETRANT INSPECTED.

CONTAMINATION CONTROL

CLEANLINESS LEVEL TO 400A VIA FREON FLUSH AND SAMPLE VERIFIED. ALL SEAL GROOVES ARE INSPECTED FOR CLEANLINESS AND EVIDENCE OF DAMAGE.

ASSEMBLY/INSTALLATION

THREADED INSERTS AND CRITICAL DIMENSIONS VERIFIED BY INSPECTION. SEALING SURFACES ARE VISUALLY INSPECTED FOR DEFECTS. REPAIRED AND REWORKED ITEMS ARE DIMENSIONALLY CHECKED. LOG OF CLEAN ROOM VERIFIED. ALL ENGINEERING-DEFINED FEATURES AND SURFACE FINISHES AND TORQUE REQUIREMENTS ARE COMPLETELY INSPECTED AND VERIFIED.

THE PRIMARY INTERFACE SEAL IS CHECKED FOR ID, OD AND ROUNDNESS. ALL DIMENSIONS DEFINED IN DRAWING ARE VERIFIED BY INSPECTION.

CRITICAL PROCESSES

HEAT TREATMENT AND PART PASSIVATION ARE VERIFIED BY INSPECTION.

NON-DESTRUCTIVE EVALUATION

PARTS ARE RADIOGRAPHICALLY AND DYE PENETRANT INSPECTED AS IMPOSED BY ENGINEERING IN THE DRAWING REQUIREMENTS.

TESTING

ATP AND TEST MEASUREMENT EQUIPMENT CALIBRATION VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PACKAGING FOR SHIPMENT VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:**ATP**

A FAILURE TO CLOSE WAS EXPERIENCED DURING ATP (REFERENCE CAR A7682). THE ACTUATOR PISTON ROD WAS BENT. REVISION "D" WAS MADE TO THE DRAWING AND THIS INCREASED THE REQUIREMENT OF MINIMUM YIELD STRENGTH FROM 36,000 TO 67,000 PSI.

HIGH CLOSING TORQUE ON THREE OCCASIONS DURING ATP HAS DETERMINED THAT A REDESIGN WAS NECESSARY ON DRIVE SHAFT BEARINGS (REFERENCE CAR'S AB8568, AB8514, AB8726). TOLERANCES ON THE BEARING WERE REVISED AND THE ALLOWABLE TORQUE AT CRYOGENIC TEMPERATURE WAS INCREASED FROM 100 FT-LBS TO 140 FT-LBS.

THE VALVE FAILED TO CLOSE DURING ATP ON 8/25/78 (REFERENCE CAR AB1173)

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THE FAILURE WAS DUE TO EXCESSIVE CONTRACTION OF THE ACTUATOR'S PISTON SEALS (AT LH2 TEMPERATURES) SQUEEZING DOWN ON THE PISTON WITH SUFFICIENT FORCE TO RESTRAIN PISTON MOVEMENT. CORRECTIVE ACTION WAS TO SELECT LARGER PISTON SEAL DIAMETERS FOR ALL ACTUATORS AND REMOVE FOAM INSULATION FROM THE ACTUATOR END CAP (RAISES ACTUATOR OPERATING TEMPERATURE).

QUALIFICATION

THE 17 INCH DISCONNECT FAILED TO FULLY CLOSE DURING UMBILICAL QUALIFICATION SEPARATION TESTING (REFERENCE CAR AB6240). A REDESIGN OF THE CLEVIS WAS INCORPORATED TO INCREASE THE DRIVESHAFT ROTATION FOR CLOSING THE FLAPPERS. NO FURTHER INCIDENTS HAVE OCCURRED.

AN LO2 DISCONNECT FAILED TO CLOSE DURING QUALIFICATION TESTING AT CYROGENIC TEMPERATURES (REFERENCE CAR AB4717). FAILURE TO CLOSE WAS CAUSED BY SOME INSULATING FOAM ON THE ROLLER BLOCK BEARINGS AND INADEQUATE SIDE CLEARANCES IN THE BEARING ASSEMBLY. TEFLON TAPE WILL BE PROVIDED DURING FOAMING OPERATIONS TO EXCLUDE FOAM FROM BEARING AREAS. ALL VEHICLES WERE RETROFITED WITH REDESIGNED ACTUATORS WHICH PROVIDE ADEQUATE CLEARANCES.

THE LO2 UNIT ALSO FAILED TO CLOSE DURING QUALIFICATION TESTING (REFERENCE CAR AB4077). BEARING MATERIALS WERE CHANGED TO VESPEL SP-1 FROM VESPEL SP-21 WHICH REDUCES THE COEFFICIENT OF FRICTION AND IMPROVES THE BEARING STRENGTH AT CRYOGENIC TEMPERATURES.

A ONE-TIME OCCURRENCE DURING LO2 SEPARATION TESTING INDICATED THAT MANUALLY MOVING THE VALVE ACTUATOR ROLLER BLOCK ASSEMBLY COULD CAUSE THE LINKAGE TO TRAVEL OVERCENTER AND LOCK UP. TRIMMING/MACHINING OF THE ACTUATOR PISTON BUMPER SEALS PER NEW DESIGN 5791009-101 PREVENTS THAT PROBLEM FROM RECURRING (REFERENCE CAR AC4101).

ACTUATOR BEARINGS FAILED DURING THE AMBIENT LIFE CYCLES OF THE QUALIFICATION TEST (REFERENCE CAR AB3744). A REDESIGN WAS IMPLEMENTED WITH VESPEL SP-1 FOR IMPROVED STRENGTH AND REDUCTION OF COEFFICIENT OF FRICTION.

FIELD

THE FLOW LINER WAS FOUND DISTORTED UPON REMOVAL FROM THE MPTA ON 3/9/81 (REFERENCE CAR AB8941). THE CAUSE OF THE FAILURE WAS INCORRECT INSTALLATION OF THE FLOW LINER FOLLOWING STATIC FIRING #5. SUBSEQUENT PROPELLANT FLOWS SEVERELY DISTORTED THE LINER UNTIL IT CAME IN CONTACT WITH THE ORBITER FLAPPER. IT WAS FOUND THAT THE INSTALLATION PROCEDURES USED ON THE MPTA AS A RESULT OF DISCONNECT REMOVAL/REWORK ARE NOT REPRESENTATIVE OF THE PROCEDURES USED ON FLIGHT HARDWARE. CORRECTIVE ACTION WAS TO CHANGE THE INSTALLATION PROCEDURES TO THAT OF KSC OMI S0004.

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THE LO2 FLOW LINER ON OV102 (FLT STS-4) WAS FOUND TO BE DISTORTED DURING POST-FLIGHT CHECKOUT (REFERENCE CAR 04F001). DAMAGE WAS ATTRIBUTED TO AN INCORRECT MATING PROCEDURE OR INTERFERENCE WITH FERRY PLATES. CORRECTIVE ACTION WAS TO FABRICATE AN INSPECTION TOOL (SAR K-2312) TO MEASURE THE FLOW LINER ROUNDNESS IN THE VAB BEFORE MATING. THIS WILL INSURE THAT NO OUT OF ROUNDNESS CONDITION HAS OCCURRED FROM THE FERRY CLOSEOUT PLATE. THIS TOOL IS NOT CURRENTLY IN USE.


AN INCIDENT OCCURRED AT KSC WHEN TIP LOAD/ANGLE MEASUREMENT/SETTING TESTS WERE BEING CONDUCTED. ONE OF FOUR FLAPPER OPEN STOP ASSEMBLY SCREWS WAS FOUND TO BE LOOSE. THE PROPER METHOD OF RELATING RUNNING TORQUE TO LOCKING TORQUE WAS NOT PERFORMED. PARKER HANNIFIN DOCUMENT 2EPS5790015 HAS BEEN REVISED TO CORRECT THIS SITUATION (REFERENCE CAR AC7672).

(E) OPERATIONAL USE:

FOR NOMINAL, ATO AND AOA MISSIONS, ET SEPARATION WILL BE MANUALLY PERFORMED 6 MINUTES AFTER MECO. THE MPS DUMP IS PERFORMED DURING THIS WAIT PERIOD. DUE TO THE TIME CRITICAL NATURE OF RTLS AND TAL, SEPARATION IS PERFORMED IMMEDIATELY.

- APPROVALS -

RELIABILITY ENGINEERING: L. H. FINEBERG
DESIGN ENGINEERING : J. E. OSLUND
QUALITY ENGINEERING : E. GUTIERREZ
NASA RELIABILITY :
NASA SUBSYSTEM MANAGER :
NASA QUALITY ASSURANCE :


: PPB 3-2-89
: A. Gutierrez 3-3-89
: Y. H. Kuo 3-12-87
: John Perry for DSIC 3-25-89