SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-1B2-0405-X

SUBSYSTEM NAME: MAIN PROPULSION SYSTEM

REVISION : 0 02/21/89 W

		PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	:	DISCONNECT, RECIRC RTN (ET)	MC284-0390-0014
LRU	:	DISCONNECT, RECIRC RTN (ORB)	MC284-0390-0046

ITEM:
DISCONNECT, LH2 RECIRCULATION RETURN, 4 INCH DIAMETER, ORBITER & ET MAT

REFERENCE DESIGNATORS: PD3

QUANTITY OF LIKE ITEMS: 1
ONE

DESCRIPTION/FUNCTION:
ET/ORBITER RECIRCULATION RETURN DISCONNECT PROVIDES THE PATH FOR LH2 RECIRCULATION. 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 RECIRCULATION LH2. 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.

PRINT DATE: 02/21/8

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-1B2-0405-03

REVISION: 0 02/21/89 W

SUBSYSTEM: MAIN PROPULSION SYSTEM
LRU DISCONNECT, RECIRC RTN (ET)
ITEM NAME: DISCONNECT, RECIRC RTN (ORB)

CRITICALITY OF THIS FAILURE MODE:1/1

FAILURE MODE:
EXTERNAL LEAKAGE AT THE ORBITER/ET UMBILICAL INTERFACE, DURING LOADING/ DRAIN AND ENGINE OPERATION.

MISSION PHASE:
PL PRELAUNCH
LO LIFT-OFF

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

CAUSE:
IMPROPER ENGAGEMENT, DAMAGED MATING SEALS, UMBILICAL PRELOAD SPRING FAILURE (CARRIER PLATE), CONTAMINATION.

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:
RESULTS IN LH2 LEAKAGE INTO THE UMBILICAL CAVITY. MAJOR PORTION OF LH2/GH2 WILL ENTER THE AFT COMPARTMENT CAUSING POSSIBLE AFT COMPARTMENT OVERPRESSURIZATION AND FIRE/EXPLOSION HAZARD. LH2/GH2 LEAKAGE EXTERNAL TO THE UMBILICAL MAY CAUSE DAMAGE TO THE VEHICLE AND A FIRE/EXPLOSION HAZARD. POSSIBLE LOSS OF CRITICAL ADJACENT COMPONENTS DUE TO CRYO EXPOSURE. LEAKAGE IS DETECTABLE DURING PROPELLANT LOADING BY HAZARDOUS GAS DETECTION SYSTEM (HGDS).

SECONDARY SEAL IS NOT CONSIDERED REDUNDANT SINCE IT WAS NOT DESIGNED TO SERVE AS A BACKUP TO THE PRIMARY SEAL. SECONDARY SEAL WILL PREVENT EXCESSIVE LEAKAGE.

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

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

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

(E) FUNCTIONAL CRITICALITY EFFECTS

- DISPOSITION RATIONALE -

(A) DESIGN:
COMPONENT

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 GH2 AT 0 TO 47 PSIG. A RETAINING BAND AROUND THE PRIMARY SEAL (TEFLON) PREVENTS SEAL BLOW-OUT DURING SEPARATION.

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.

SYSTEM

IN THE INSTALLED POSITION (ET/ORBITER UMBILICAL MATED), THREE BELLEVILLE SPRINGS PROVIDE AN INTERFACE SEALING PRELOAD OF 2200 POUNDS MINIMUM.

EXPOSURE OF THE CRES MATERIAL BELLEVILLE SPRINGS TO THE SALT AIR ENVIRONMENT AT KSC LIMITS THEIR MATERIAL LIFE. THE ESTABLISHED BELLEVILLE TIME LIMIT CRITERIA FOR MAXIMUM EXPOSURE IS:

I MATED (WITHOUT PURGE).....4 MONTHS
II MATED (WITH PURGE).....VARIES, REF OMRSD 500GEN.720

ALL VEHICLES FLYING WITH THE CRES MATERIAL SPRINGS (BEGINNING WITH OV103, STS-26) IN THE DISCONNECT ASSEMBLIES HAVE BEEN REWORKED WITH NE

BELLEVILLE SPRINGS USING THE CRES MATERIAL. IN ADDITION, A CONTINUOUS, CONDITIONED, DRY AIR PURGE WILL BE PROVIDED AT THE DISCONNECT TO REDUCE THE BELLEVILLE STRESS CORROSION (BEGINNING WITH OV103, STS-26). SINCE THE ORBITER MATED TIME (AND CORRESPONDING BELLEVILLE EXPOSURE DURATION) FOR STS-27 & 30 (OV104) IS MUCH SHORTER THAN THE RECOMMENDED LIMITS, NO DRY AIR PURGE WAS REQUIRED.

THE BELLEVILLE SPRING MATERIAL HAS BEEN CHANGED TO CORROSION RESISTANT MP35N (NICKEL-COBALT-CHROMIUM ALLOY) MUTLIPHASE MATERIAL. THESE NEW SPRINGS WILL BE INSTALLED ON THE VEHICLE DISCONNECTS AS SOON AS PRODUCTION UNITS ARE MADE AVAILABLE. THE CONTINUOUS POST MATING PURGE IS NOT REQUIRED FOR THIS MATERIAL.

(B) TEST:
ATP

EXAMINATION OF PRODUCT

PROOF PRESSURE:

ACTUATOR: 1720 PSIG
ORBITER HOUSING: 156 PSIG, FLAPPERS OPEN AND CLOSED
ET HOUSING: 48 PSIG, FLAPPERS OPEN AND CLOSED

LEAKAGE - AMBIENT AND CRYO (-300 DEG F):

ACTUATOR (OPEN AND CLOSED POSITION) - 740 PSIG

BUMPER SEAL LEAKAGE; 740 PSIG

SHAFT SEAL LEAKAGE; 740 PSIG

CAP SEAL LEAKAGE; 740 PSIG (AMBIENT ONLY)

VALVE BODY

SHAFT SEAL LEAKAGE
ORBITER SECTION: 5, 20, 37, AND 120 PSIG
ET SECTION: 5, 20, AND 37 PSIG

CLOSURE SEAL (INTERNAL) LEAKAGE
ORBITER SECTION: 5, 20, 37, AND 120 PSIG
ET SECTION: 5, 20, AND 37 PSIG

MATING SEAL LEAKAGE (47 PSIG)

EXTERNAL LEAKAGE (37 PSIG)

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-1B2-0405-03

RELIEF FUNCTION:

CRYO (-300 DEG F) CRACK AND RESEAT (.75 TO 10 PSID)

POSITION INDICATOR (AMBIENT):

VERIFICATION OF OPERATION

ELECTRICAL CHARACTERISTICS:

CONTACT RESISTANCE
INSULATION RESISTANCE
DIELECTRIC STRENGTH

RESPONSE TIME:

AMBIENT AND CRYO (-300 DEG F)
400 AND 740 PSIG ACTUATION PRESSURE

CERTIFICATION

COMPONENT QUALIFICATION

INTERFACE CLAMPING FORCE APPLIED DURING ALL AMBIENT AND CRYO TESTING.

OPERATING LIFE:

AMBIENT
800 FLAPPER CLOSURE CYCLES AT 740 PSIG
200 FLAPPER CLOSURE CYCLES AT 400 PSIG

CRYO
300 CLOSURE CYCLES AT 750 PSIG (-400 DEG F)
100 CLOSURE CYCLES AT 400 PSIG (-400 DEG F)

VIBRATION - 3 AXES:
RANDOM VIBRATION (48 MINUTES IN EACH OF THREE AXES WITH CLOSURE IN OPEN POSITION WHILE PRESSURIZED TO 37 PSIG AND AT -300 DEG F (OPEN PRESSURE REMOVED IN LAST 10 MINUTES OF EACH AXIS).

ELECTRICAL CHARACTERISTICS:

CONTACT RESISTANCE
INSULATION RESISTANCE
DIELECTRIC STRENGTH

BONDING:

ELECTRICAL CONDUCTIVITY SHALL NOT EXCEED 100 MILLIOHMS.

CRYOGENIC RELIEF OPERATION:

CRACK AND RESEAT PRESSURE SHALL BE BETWEEN 0.75 AND 10 PSIG

ENGAGE/DISENGAGE CYCLING:

AMBIENT
100 DISENGAGEMENT CYCLES:
15 CYCLES WITH FLAPPERS OPEN USING ACTUATOR PRESSURE
15 CYCLES WITH FLAPPERS MECHANICALLY LATCHED OPEN
70 CYCLES WITH FLAPPERS CLOSED USING ACTUATOR PRESSURE

CRYO
300 DISENGAGEMENT CYCLES, CRYO (-320 DEG F):
12 CYCLES WITH FLAPPERS OPEN USING ACTUATOR PRESSURE
12 CYCLES WITH FLAPPERS MECHANICALLY LATCHED OPEN
276 CYCLES WITH FLAPPERS CLOSED USING ACTUATOR PRESSURE

10 DISENGAGEMENT CYCLES, CRYO (-400 DEG F):
3 CYCLES WITH FLAPPERS OPEN USING ACTUATOR PRESSURE
[illegible] CYCLES WITH FLAPPERS MECHANICALLY LATCHED OPEN
[illegible] CYCLES WITH FLAPPERS CLOSED USING ACTUATOR PRESSURE

LEAKAGE - AMBIENT AND CRYO (-300 DEG F):

ACTUATOR (OPEN AND CLOSED POSITION)

BUMPER SEAL LEAKAGE; 740 PSIG

SHAFT SEAL LEAKAGE; 740 PSIG

VALVE BODY

SHAFT SEAL LEAKAGE
ORBITER SECTION: 5, 20, 37, AND 120 PSIG
ET SECTION: 5, 20, AND 37 PSIG

CLOSURE SEAL (INTERNAL) LEAKAGE
ORBITER SECTION: 5, 20, 37, AND 120 PSIG
ET SECTION: 5, 20, AND 37 PSIG

MATING SEAL LEAKAGE (47 PSIG)

EXTERNAL LEAKAGE (37 PSIG)

VALVE RESPONSE TIMES:

CRYO (-300 DEG F) AND AMBIENT
VALVE PRESSURIZED TO 5 PSIG AND AMBIENT PRESSURE
ACTUATOR PRESSURIZED TO 740 PSIG AND 400 PSIG

BURST TEST:

ORBITER SECTION 180 PSIG; FLAPPER IN CLOSED POSITION
ET SECTION 56 PSIG; FLAPPER IN CLOSED POSITION
ACTUATOR 3400 PSIG; SIMULTANEOUSLY APPLIED TO OPEN AND CLOSED PORTS.

THE CONSOLIDATED CONTROL VALVES WERE QUALIFIED BY SIMILARITY TO THE FOLLOWING TESTS THAT WERE PERFORMED ON AMETEK/CALMEC VALVES:

VIBRATION - 3 AXES:

TRANSIENT VIBRATION (SINUSOIDAL SWEEP): 5 TO 35 Hz AT AMBIENT CONDITIONS

RANDOM VIBRATION (48 MINUTES IN EACH OF THREE AXES WITH CLOSURE IN OPEN POSITION WHILE PRESSURIZED TO 37 PSIG AND AT -300 DEG F (OPEN PRESSURE REMOVED IN LAST 10 MINUTES OF EACH AXIS).

SALT FOG: 48 HOURS, INTERNALLY PRESSURIZED TO 5 PSIG

SHOCK, BENCH HANDLING (DEMATED)

THERMAL CYCLE (3 CYCLES): +70 TO -400 TO -20 TO +70 DEG F

OPERATING LIFE:

AMBIENT
1500 FLAPPER CLOSURE CYCLES AT 740 PSIG
1000 FLAPPER CLOSURE CYCLES AT 400 PSIG

300 DISENGAGEMENT CYCLES:
50 CYCLES WITH FLAPPERS OPEN USING ACTUATOR PRESSURE
50 CYCLES WITH FLAPPERS MECHANICALLY LATCHED OPEN
150 CYCLES WITH FLAPPERS CLOSED USING ACTUATOR PRESSURE
50 CYCLES WITH ACTUATOR OPENING AND CLOSING PORTS PRESSURIZED SIMULTANEOUSLY AND CLOSURE DEVICES OPEN

CRYO
700 CLOSURE CYCLES AT 740 PSIG (-400 DEG F)
300 CLOSURE CYCLES AT 400 PSIG (-400 DEG F)

10 DISENGAGEMENT CYCLES (-400 DEG F):
2 CYCLES WITH FLAPPERS OPEN USING ACTUATOR PRESSURE
2 CYCLES WITH FLAPPERS MECHANICALLY LATCHED OPEN
4 CYCLES WITH FLAPPERS CLOSED USING ACTUATOR PRESSURE
2 CYCLES WITH ACTUATOR OPENING AND CLOSING PORTS PRESSURIZED SIMULTANEOUSLY AND CLOSURE DEVICES OPEN

290 DISENGAGEMENT CYCLES (-300 DEG F):
50 CYCLES WITH FLAPPERS OPEN USING ACTUATOR PRESSURE
50 CYCLES WITH FLAPPERS MECHANICALLY LATCHED OPEN
140 CYCLES WITH FLAPPERS CLOSED USING ACTUATOR PRESSURE

50 CYCLES WITH ACTUATOR OPENING AND CLOSING PORTS PRESSURIZED SIMULTANEOUSLY AND CLOSURE DEVICES OPEN

ELECTRICAL CHARACTERISTICS:

CONTACT RESISTANCE
INSULATION RESISTANCE
DIELECTRIC STRENGTH

BONDING:

ELECTRICAL CONDUCTIVITY SHALL NOT EXCEED 100 MILLIOHMS.

BURST TEST:

ORBITER SECTION 180 PSIG; FLAPPER IN CLOSED POSITION
ET SECTION 56 PSIG; FLAPPER IN CLOSED POSITION
ACTUATOR 3400 PSIG: SIMULTANEOUSLY APPLIED TO OPEN AND CLOSED PORTS.

UMBILICAL SEPARATION TEST
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 LH2. THE DISCONNECT WAS ALSO SUBJECTED TO UMBILICAL RETRACT TESTS AT BOTH NOMINAL CONDITIONS AND SIMULATED HYDRAULIC RETRACT ACTUATOR FAILURE CONDITIONS. THE DISCONNECT WAS ALSO SUBJECTED TO 5 BACKUP MODE CLOSURE TESTS.

OMRSD
V41BUO.161 LH2 FEEDLINE SCREEN INSPECTION (I5)
V41BUO.163 LH2 FEEDLINE SCREEN INSPECTION - VERTICAL (I25)
V41BVO.020 PD3 LH2 RECIRC DISCONNECT CLEANING (EVERY FLIGHT)
V41BVO.030 ORB/ET UMBILICAL DISCONNECT AND SEAL INSPECTION (EVERY FLT)
T41FLO.060 PD3 LH2 RECIRC DISC LEAK DETECTOR FLOW THROUGH (EVERY FLT)
T41QAL.100 LH2 4 INCH DISCONNECT CLEANING (EVERY FLIGHT)
T41QAL.060 INSPECT ET/ORB SEALING SURFACES (EVERY FLIGHT)
SOOGEN.720 MPS 2"/4" DISCONNECT TRICKLE PURGE (EVERY FLIGHT - ONLY APPLICABLE TO THE CRES MATERIAL BELLEVILLE SPRINGS)
SOOHCO.400 VERIFY ET/ORB DISCONNECT MATING AND ALIGNMENT (EVERY FLIGHT)
SOOOOO.080 VERIFY ORB/ET LH2 DISC INTERFACE SEAL LEAK TESTS (EVERY FLT)

(C) INSPECTION:
RECEIVING INSPECTION
RAW MATERIALS ARE VERIFIED BY INSPECTION FOR MATERIAL AND PROCESS CERTIFICATION.

CONTAMINATION CONTROL
CONTAMINATION CONTROL PROCESSES AND CORROSION PROTECTION PROVISIONS ARE VERIFIED. INTERNAL SURFACES CLEANING TO LEVEL 400 IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

COMPONENT
ALL DETAIL PARTS ARE INSPECTED UNDER 40X MAGNIFICATION FOR BURRS, DAMAGE, AND CONTAMINATION. CRITICAL DIMENSIONS, CLEARANCE, AND SURFACE FINISHES ARE VERIFIED. SEALS ARE VISUALLY EXAMINED PRIOR TO INSTALLATION FOR DAMAGE AND CLEANLINESS. FLAPPER SPRINGS ARE INSTALLED AND VERIFIED BY INSPECTION AFTER LOAD TEST. MANDATORY INSPECTION POINTS ARE INCLUDED IN THE ASSEMBLY PROCEDURE.

UMBILICAL ASSEMBLY
HEAT TREATED AND DRY FILM LUBE COATED BELLEVILLE SPRINGS ARE VISUALLY INSPECTED AND LOAD TESTED PRIOR TO ASSEMBLY. CORRECT INSTALLATION OF THE BELLEVILLE WASHERS IS A MANDATORY INSPECTION POINT. THE SHIMS, WHICH ARE REQUIRED TO SET THE HEIGHT OF THE 4 INCH DISCONNECT MATING SURFACE ABOVE THE 17 INCH DISCONNECT MATING SURFACE AS EXTERNAL FORCE IS APPLIED TO THE 4 INCH DISCONNECT, ARE DIMENSIONALLY INSPECTED. THE SHIMS, WHICH ARE REQUIRED TO SET THE PRELOAD IN THE UNMATED CONDITION, ARE DIMENSIONALLY INSPECTED.

CRITICAL PROCESS
PARTS PASSIVATION, HEAT TREATMENT, AND ANODIZING ARE VERIFIED. ETCHING OF AL ALLOY, CLEANING AL SAND CASTINGS, BRUSH CLEANING, AND SOLDERING ARE VERIFIED BY INSPECTION. DRY FILM LUBRICANT APPLICATION IS VERIFIED.

NONDESTRUCTIVE EVALUATION
CASTING AND ROUGH MACHINING OF THE BODY ARE INSPECTED BY X-RAY AND DYE PENETRANT.

TESTING
ATP IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING
IN-PROCESS OPERATIONS ARE VERIFIED BY INSPECTION TO PROTECT PARTS AND PRECLUDE MISHANDLING. PARTS PACKAGING IS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:
THERE HAVE BEEN NO ACCEPTANCE TEST, QUALIFICATION TEST, FIELD OR FLIGHT FAILURES ASSOCIATED WITH EXTERNAL LEAKAGE AT THE ET/ORB INTERFACE.

BROKEN BELLEVILLE WASHERS WERE FOUND ON THE GO2 2" PRESSURIZATION DISCONNECT (PD4) UMBILICAL ASSEMBLY ON MPTA AND OV102 (REFERENCE CAR AD3602 AND AD3464). INVESTIGATION HAS DETERMINED THAT THE FAILURES WERE DUE TO STRESS CORROSION OF THE WASHERS. CORRECTIVE ACTION IS TO CHANGE THE BELLEVILLE WASHER MATERIAL TO CORROSION RESISTANT MP35N

(NICKEL-COBALT-CHROMIUM ALLOY) MULTIPHASE MATERIAL. THESE NEW WASHERS WILL BE INSTALLED ON THE VEHICLE DISCONNECTS AS SOON AS PRODUCTION UNITS ARE MADE AVAILABLE. OV103 (STS-26 & 29) AND OV104 (STS-27) UMBILICAL ASSEMBLIES HAVE ALREADY BEEN REWORKED WITH NEW BELLEVILLE WASHERS USING THE CURRENT MATERIAL (CRES). THIS PROCEDURE WILL CONTINUE UNTIL THE MP35N WASHERS ARE AVAILABLE. IN ADDITION, A CONTINUOUS, CONDITIONED, DRY AIR PURGE WILL BE PROVIDED AT THE DISCONNECT TO REDUCE THE BELLEVILLE STRESS CORROSION ON ALL VEHICLES THAT ARE TO FLY WITH THE CRES MATERIAL. APPROVED EXPOSURE DURATION OF THE MATED UNPURGED CRES BELLEVILLE WASHERS IS DETERMINED TO BE 4 MONTHS. SINCE THE ORBITER MATED TIME (AND CORRESPONDING BELLEVILLE EXPOSURE DURATION) FOR STS-27 (OV104) IS MUCH SHORTER THAN THE RECOMMENDED LIMITS, NO DRY AIR PURGE WAS REQUIRED.

GENERAL SYSTEM CONTAMINATION

THIS FAILURE MODE HAS NOT OCCURRED ON THIS COMPONENT DUE TO CONTAMINATION. HOWEVER, GENERAL MPS SYSTEM CONTAMINATION HAS OCCURRED WHICH MAY LODGE ANYWHERE IN THE SYSTEM CAUSING THIS FAILURE MODE (REFERENCE THE FOLLOWING PARAGRAPHS).

CONTAMINATION FAILURES HAVE OCCURRED AT ALL PHASES OF MANUFACTURING AND PARTS REPLACEMENT. IN ALL CASES, STRICT ADHERENCE TO CLEANLINESS CONTROL PROCEDURES IS THE PRIMARY METHOD OF CONTAMINATION PREVENTION.

NUMEROUS LARGE PARTICLES OF BLACK RUBBER MATERIAL WERE FOUND DURING A POST FLIGHT EXAMINATION OF THE LH2 17 INCH DISCONNECT OF OV099 (FLIGHT 7, REFERENCE CAR AC9800). THE LO2 AND LH2 SYSTEMS OF ALL VEHICLES WERE EXAMINED. NO RUBBER WAS FOUND IN ANY OTHER VEHICLES. AFTER EXTENSIVE INVESTIGATION THE ORIGIN WAS NOT DETERMINED.

METAL SHAVINGS HAVE BEEN DISCOVERED IN LINES AND COMPONENTS, WHICH WAS MOST LIKELY GENERATED WHEN THEY WERE CUT OUT AND/OR REPLACED (REFERENCE CARs AC9868, A9654, AC2210, AB1706; DR AD2226). METHODS ARE BEING REVISED TO MINIMIZE PARTICLE GENERATION WHEN INSTALLING/REPLACING COMPONENTS, LINES, AND FITTINGS REQUIRING WELDED OR BRAZED JOINTS (PRODUCT QUALITY IMPROVEMENT COUNCIL). PERSONNEL HAVE BEEN CAUTIONED. ROCKWELL PROBLEM ACTION CENTER WILL CONTINUE TO MONITOR BRAZING/WELDING REWORK CONTAMINATION. PROCEDURES ARE BEING REVISED TO IMPROVE CLEANLINESS MAINTENANCE DURING COMPONENT BUILD UP AND REWORK (REFERENCE MCR 12512). SUPPLIER DOCUMENTS/PROCEDURES HAVE BEEN REVIEWED AND CLEANLINESS MAINTENANCE PROCEDURES HAVE BEEN IMPROVED.

A PIECE OF A BRAZING PREFORM LODGED IN A 2-WAY SOLENOID VALVE ON OV-099 AT PALMDALE CAUSING A LEAKAGE FAILURE (REFERENCE CARs AC2111, AB2538). STEEL AND ALUMINUM PARTICLES CAUSED EXCESSIVE LEAKAGE ON THE 850 PSIG HELIUM RELIEF VALVE (REF CAR AC2229). FOR BOTH FAILURES CORRECTIVE ACTION WAS TO ADD SPECIAL PURGE PORTS TO THE MPS HELIUM PANEL ASSEMBLIES TO IMPROVE THE QUALITY OF FINAL CLOSEOUT BRAZES.

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-1B2-0405-03

SEVERAL FOREIGN MATERIALS WERE INTRODUCED INTO THE MPS SYSTEM DURING MANUFACTURE AND PARTS REPLACEMENT. EXAMPLES ARE: GLASS CLOTH IN LINE TO PREVENT TRAVEL OF CHIPS DOWN LINE: POLYSTYRENE OBJECT TO HOLD VALVE POPPET OPEN WHILE PURGING; COTTON SWAB MATERIAL AND GLASS BEADS FROM CLEANING OPERATION; MISCELLANEOUS PLASTIC; FOAM; AND TAPE (REFERENCE CARS AB4751, AC2217, AC6768, AC9868, MPS3A0005, AC7912, AB0530). MATERIALS WERE REMOVED AND PERSONNEL WERE CAUTIONED. A HIGH FLOW DELTA P TEST AT PALMDALE WAS ADDED TO VERIFY THAT LINES WERE NOT PLUGGED. GRIT BLASTING (GLASS BEADS AND SAND USED TO CLEAN A LINE) IS NO LONGER PERFORMED. PROCEDURES ARE BEING REVISED TO IMPROVE CLEANLINESS MAINTENANCE DURING COMPONENT BUILD UP AND REWORK (REFERENCE MCR 12512). SUPPLIER DOCUMENTS/PROCEDURES HAVE BEEN REVIEWED AND CLEANLINESS MAINTENANCE PROCEDURES HAVE BEEN IMPROVED.

ONE PIECE OF WIRE WAS FOUND IN THE INTERNAL RELIEF VALVE OF THE LO2 PREVALVE ON OV103 (REFERENCE CAR AC9101). THE SOURCE OF THE CONTAMINATION WAS NEVER FOUND, BUT IT WAS BELIEVED TO BE FROM THE ET. OTHER CONTAMINATION HAS BEEN FOUND ON THE FEEDLINE SCREENS, SUCH AS AN UNIDENTIFIED ROUND OBJECT AND VARIOUS METALLIC PARTICLES (REFERENCE CARS AB0529 AND AB0530). SOURCE OF CONTAMINATION WAS UNDETERMINED. BORESCOPE EXAMINATIONS ARE CONDUCTED ON ALL FEEDLINE SCREENS EVERY FIFTH FLIGHT TO VERIFY CLEANLINESS. CONTAMINATION WAS REMOVED WHEN POSSIBLE.

(E) OPERATIONAL USE:
FLIGHT: NO CREW ACTION CAN BE TAKEN.

GROUND: OMI S1004 (LH2 SYSTEM) TITLED "EMERGENCY PROCEDURE FOR MAJOR LEAK OR FIRE ..." CONTAINS SAFING SEQUENCE OF EVENTS FOR MAJOR LEAKS IN PROPELLANT SYSTEMS.

- APPROVALS -

RELIABILITY ENGINEERING	L. H. FINEBERG	
DESIGN ENGINEERING	J. E. OSLUND	3-1-89
QUALITY ENGINEERING	E. GUTIERREZ	3-3-89
NASA RELIABILITY		
NASA SUBSYSTEM MANAGER		3-22-89
NASA QUALITY ASSURANCE		3-22-89