

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-1CA-0503-X

SUBSYSTEM NAME: MAIN PROPULSION

REVISION : 0 02/23/89 W

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
SRU :	DISCONNECT, ET PRESS	MC284-0391-0001
SRU :	DISCONNECT, ORB PRESS	MC284-0391-0022

QUANTITY OF LIKE ITEMS: 1  
ONE GH2

## DESCRIPTION/FUNCTION:

PROVIDES THE FLOW PATH BETWEEN THE ET AND THE ORBITER FOR THE GH2 FROM THE MAIN ENGINES TO PRESSURIZE THE ET. ALSO USED FOR He ANTI-ICING FLOW (PRELAUNCH) AND He 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 GH2 PRESSURIZATION LINE VENT VALVE (LV52) TO VENT THE GH2 SYSTEM DURING VACUUM INERTING.

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SUBSYSTEM: MAIN PROPULSION

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ITEM NAME: DISCONNECT, ORB PRESS

CRITICALITY OF THIS  
FAILURE MODE: 1/1

## FAILURE MODE:

EXTERNAL LEAKAGE OF THE ET/ORB INTERFACE

## MISSION PHASE:

PL PRELAUNCH  
LO LIFT-OFF

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

## CAUSE:

DAMAGED INTERFACE SEAL, INSUFFICIENT PRELOAD, CONTAMINATION.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? *N/A*

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

## PASS/FAIL RATIONALE:

A)

B)

C)

## - FAILURE EFFECTS -

## (A) SUBSYSTEM:

DURING ENGINE OPERATION, RESULTS IN GH2 LEAKAGE INTO THE ORB/ET UMBILICAL CAVITY. HYDROGEN ENTERS THE AFT FUSELAGE AND ESCAPES INTO THE ATMOSPHERE. POSSIBLE FIRE/EXPLOSIVE HAZARD BOTH INTERNAL AND EXTERNAL TO THE VEHICLE. POSSIBLE AFT COMPARTMENT OVERPRESSURIZATION.

DURING ANTI-ICING OPS AND ET HELIUM PREPERESS, LEAKAGE INTO THE AFT COMPARTMENT MAY BE DETECTABLE USING HGDS (UP TO T-9 MINUTES).

ON THE GROUND, NO HAZARDOUS GAS DETECTION CAPABILITY CURRENTLY EXISTS AT THE ET/ORBITER INTERFACE. INFRARED CAMERAS, COLOR TV MONITORS, AND PAPER STRIPS MAY DETECT THE PRESENCE OF FIRE.

LOSS OF ET LH2 ULLAGE PRESSURE WILL RESULT IN VIOLATION OF TANK

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MINIMUM STRUCTURAL CAPABILITY REQUIREMENTS AND UNCONTAINED SSME SHUTDOWN DUE TO LOW NPSP. THE FLOW CONTROL VALVES WILL OPEN IN AN ATTEMPT TO MAINTAIN ET ULLAGE PRESSURE.

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

**(C) MISSION:**  
POSSIBLE LAUNCH SCRUB IF DETECTED.

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

**(E) FUNCTIONAL CRITICALITY EFFECTS**  
FUNCTIONAL CRITICALITY EFFECTS:

1R/2, 2 SUCCESS PATHS. TIME FRAME - ET HIGH PRESSURE LOADING PHASE.  
1) EXTERNAL LEAKAGE PAST ET/ORB INTERFACE SEAL.  
2) LOSS OF HELIUM ANTI-ICING PURGE.

ALLOWS GH2 FROM THE ET TO LEAK INTO THE ORB/ET UMBILICAL CAVITY CAUSING HYDROGEN TO ENTER BOTH THE AFT FUSELAGE AND ESCAPE INTO THE ATMOSPHERE. POSSIBLE AFT COMPARTMENT OVERPRESSURIZATION. POSSIBLE FIRE/EXPLOSIVE HAZARD BOTH INTERNAL AND EXTERNAL TO THE VEHICLE.

ON THE GROUND, NO HAZARDOUS GAS DETECTION AT ET/ORBITER INTERFACE, BUT MAY BE DETECTED WITHIN THE AFT COMPARTMENT TO T-38 SECONDS. INFRARED CAMERAS AND COLOR TV MONITORS MAY DETECT THE PRESENCE OF FIRE.

POSSIBLE LAUNCH SCRUB IF DETECTED.

POSSIBLE LOSS OF CREW/VEHICLE.

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- DISPOSITION RATIONALE -  
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**(A) 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.

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,

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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° 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 HALVES.

THE ORBITER HALF CONTAINS THE INTERFACE MATING SEAL MADE OF 301 CRES FULL HARD SHEET STOCK WHICH IS TREATED WITH DRY LUBRICANT AND LAPPED TO OBTAIN FLATNESS (8 MICRO-INCH SURFACE FINISH). THE INTERFACE SEAL IS HELD AGAINST THE ET SEAT (FEP TEFLON COATED CRES) BY THE PRELOAD EXERTED BY THE ORBITER HALF AND ITS INSTALLATION IN THE UMBILICAL PLATE. THE MATING PROCEDURE CAUSES THE COMPRESSION OF ORBITER HALF BELLEVILLE SPRINGS WHICH CREATE THE REQUIRED PRELOAD ON THE INTERFACE MATING SEAL.

LOSS OF PRELOAD IS POSSIBLE DUE TO STRUCTURAL FAILURE OF THE BELLEVILLE SPRINGS (INCONEL 718) USED IN THE ORBITER DISCONNECT INSTALLATION. 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 SOOGEN.720

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

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AFTER MATING OF THE ORBITER/EXTERNAL TANK UMBILICALS, THE PRESSURIZATION SYSTEMS ARE LEAK CHECKED. ANY BELLEVILLE SPRING FAILURE OR DAMAGE TO THE INTERFACE SEAL WILL BE DETECTED AT THIS POINT.

EXTERNAL LEAKAGE DUE TO CONTAMINATION IS AVOIDED BY THE FILTRATION OF THE FACILITY SUPPLIED GASSES TO 25 MICRONS ABSOLUTE IN THE GROUND SYSTEM. THAT SAME SYSTEM IS MAINTAINED TO THE 300A CLEANLINESS LEVEL OF KSC SPEC -123. THE CONTAMINATION WOULD HAVE TO BE PRESENT AT THE TIME OF MATING AND WOULD BE DETECTED IN THE LEAK CHECK.

DURING MATING OF THE ET/ORBITER UMBILICALS A VISUAL INSPECTION (USING A BOROSCOPE) OF THE INTERFACE IS PERFORMED TO INSURE PROPER POPPET STEM MATING. IMPROPER ALIGNMENT WILL CAUSE BENDING OF THE POPPET STEMS AND PREVENT POPPETS FROM FULLY OPENING, FULLY CLOSING ON SEPARATION, AND MAY CAUSE INTERFACE LEAKAGE.

(B) TEST:  
ATP

EXAMINATION OF PRODUCT

PROOF PRESSURE  
920 PSIG MATED  
500 PSIG ORBITER HALF  
56 PSIG ET HALF

INTERNAL LEAKAGE (ACROSS CLOSURE, DEMATED), BOTH HALVES  
20 PSIG GHe (18 SCIM MAX)  
40 PSIG GHe (100 SCIM MAX)

EXTERNAL LEAKAGE, MATED  
600 PSIG GHe (100 SCIM MAX)

OPERATIONAL TEST (3 CYCLES)  
PRESSURIZE BOTH HALVES TO 5 PSIG  
MATE  
RAISE PRESSURE TO 37 PSIG  
DEMATE  
RECORD ENGAGE (120 LB MAX) AND DISENGAGE (50 LB MAX) FORCES

ROSAN INSERT TORQUE VERIFICATION

CERTIFICATION

COMPONENT

HIGH TEMPERATURE LEAKAGE (500°F)  
MATED WITH 600 PSIG GHe (183 SCIM MAX AT INTERFACE)

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DEMATED, ACROSS CLOSURE (EACH HALF)  
 20 PSIG GHe (18 SCIM MAX)  
 40 PSIG GHe (201 SCIM MAX)

## VIBRATION

RANDOM: 48 MINUTES IN EACH OF TWO AXES AT 600 PSIG, 500½F  
 FOLLOWED BY ATP OPERATIONAL AND LEAKAGE TESTS AT BOTH  
 500½F AND AMBIENT

## THERMAL CYCLE (100 CYCLES)

## MATE -

REDUCE BODY TEMPERATURE TO -100½F  
 FLOW 8 LB/SEC GO2 AT 600 PSIG AND 500½F (26 PSID MAX PRESSURE DROP)  
 THROUGH UNIT UNTIL BODY TEMPERATURE IS STABILIZED (700 SECONDS MAX)  
 REDUCE PRESSURE TO 37 PSIG

## DEMATE

AFTER EACH 25 CYCLES PERFORM HIGH TEMPERATURE LEAKAGE TEST AND  
 OPERATIONAL, INTERNAL LEAKAGE, AND EXTERNAL LEAKAGE TESTS

## LIFE CYCLE

380 OPERATIONAL TESTS AT AMBIENT

100 OPERATIONAL TESTS AT 500½F

AFTER EACH 25 CYCLES PERFORM INTERNAL AND EXTERNAL LEAKAGE TESTS

BURST (MATED): 1,200 PSIG

## SYSTEM

## 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). THE DISCONNECT WAS ALSO  
 SUBJECTED TO UMBILICAL RETRACT TESTS AT BOTH NOMINAL CONDITIONS AND  
 SIMULATED HYDRAULIC RETRACT ACTUATOR FAILURES.

## OMRSD

V41BUO.330 MPS DISCONNECT (PD4,5) CAVITY INSPECTION (EVERY FLIGHT)  
 V41BVO.020 PD4,5 GO2/GH2 PRESS DISCONNECT CLEANING (EVERY FLIGHT)  
 V41BVO.030 ORB/ET UMBILICAL DISCONNECT AND SEAL INSPECTION (EVERY FLT)  
 T41QAL.100 GO2/GH2 PREPRESS 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 DISC (PD5) INTERFACE SEAL LEAK TESTS (EVERY  
 FLT)

(C) INSPECTION:  
 COMPONENT

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## RECEIVING INSPECTION

INCOMING COMPONENTS ARE VERIFIED BY INSPECTION FOR MATERIALS AND PROCESSES CERTIFICATION.

## CONTAMINATION CONTROL

THE DISCONNECT INTERNAL SURFACES ARE MAINTAINED TO LEVEL 400A PER REQUIREMENT. CORROSION PROTECTION IS IMPLEMENTED AND VERIFIED. PROTECTIVE CAPS ARE PROVIDED TO PREVENT CONTAMINATION AND PROTECT SEALING SURFACES.

## ASSEMBLY/INSTALLATION

CRITICAL DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. MANUFACTURING PROCESSES AND INSTALLATION AND ASSEMBLY OPERATIONS, INCLUDING PARTS PROTECTION, ARE VERIFIED BY INSPECTION. TORQUE FORCES APPLIED TO PARTS ARE VERIFIED BY INSPECTION.

## CRITICAL PROCESSES

HEAT TREATMENT AND PART PASSIVATION ARE VERIFIED BY INSPECTION. APPLICATION OF DRY FILM LUBRICANT IS VERIFIED BY INSPECTION.

## NONDESTRUCTIVE EVALUATION

THE BODY CASTING IS X-RAYED AND PRESSURE TESTED. THE BODY CASTING IS PENETRANT INSPECTED AFTER PRELIMINARY MACHINING.

## TESTING

ATP IS VERIFIED BY INSPECTION.

## HANDLING/PACKAGING

PACKAGING FOR SHIPMENT IS VERIFIED BY INSPECTION.

## 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 2 INCH DISCONNECT MATING SURFACE ABOVE THE 17 INCH DISCONNECT MATING SURFACE AS EXTERNAL FORCE IS APPLIED TO THE 2 INCH DISCONNECT, ARE DIMENSIONALLY INSPECTED. THE SHIMS, WHICH ARE REQUIRED TO SET THE PRELOAD IN THE UNMATED CONDITION, ARE DIMENSIONALLY INSPECTED.

## (D) FAILURE HISTORY:

THREE CASES DURING ATP WHERE THE MATED DISCONNECT WAS PRESSURIZED TO 600 PSIG AND HAD AN EXTERNAL LEAKAGE OF 200 SCIM (REFERENCE CAR'S A4715, A4716). A BUILDUP OF THE EVERLUBE LUBRICANT BETWEEN THE SEAT AND SEAL INTERFACE CAUSED THE FAILURE. DRAWING IS CHANGED TO REQUIRE THE LAPPING OF ONE SIDE OF THE INTERFACE SEAL AFTER EVERLUBE IS APPLIED.

AT THE SUPPLIER, EXTERNAL LEAKAGE WAS 180 SCIM DUE TO A ROUGH COATING

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OF TEFLON ON THE CAP SEALING SURFACE (REFERENCE CAR AC8544). THE SURFACE WAS RECOATED; FAILURE IS ATP SCREENABLE.

DURING QUALIFICATION TESTING AFTER THE SAND AND DUST EXPOSURE TEST, THE MATED DISCONNECT EXHIBITED EXTERNAL LEAKAGE OF 270 SCIM (REFERENCE CAR A5202). FAILURE RESULTED FROM A REDUCTION IN COMPRESSIVE FORCE ON THE COPPER GASKET STATIC SEAL AT THE CAP TO BODY INTERFACE. DRAWINGS AND ASSEMBLY PROCEDURES HAVE BEEN CHANGED TO REQUIRE A DIFFERENT MATERIAL FOR THE CAP-TO-BODY INTERFACE SCREWS, A HIGHER SCREW INSTALLATION TORQUE, AND A TORQUE WRENCH THAT ALLOWS PROPER ALIGNMENT.

SIX CASES DURING QUALIFICATION TESTING WHERE THE EXTERNAL LEAKAGE OCCURRED AT THE INTERFACE OR DYNAMIC SEAL BETWEEN THE ORBITER AND TANK SECTIONS (REFERENCE CAR A5378, A6138). A SIMILAR FAILURE OCCURRED DURING THE THERMAL CYCLING (REFERENCE CAR AB6946). BOTH SEALING SURFACES SHOW SIGNS OF WEAR. THE LEAKAGE WAS ATTRIBUTED TO THE TANK DISCONNECT HALF WHICH IS A LIMITED LIFE ITEM. TANK SECTION MATING SEAL WAS REWORKED AND QUALIFICATION TESTING WAS COMPLETED. ADDITIONALLY, THE CLAMPING FORCE ON THE DISCONNECTS WAS INCREASED FOR TESTING PURPOSES. THE COPPER GASKET SEAL DRAWING WAS REVISED TO LAP BOTH SURFACES TO ENSURE PROPER FLATNESS.

DURING QUALIFICATION THERMAL CYCLING TESTING, THE LEAKAGE RATE WAS 280 SCIM AT THE INTERFACE SEAL (REFERENCE CAR AB9144). THE DRY LUBRICANT COATING HAD WORN THROUGH DUE TO REPEATED MATING AND DEMATING OF THE DISCONNECT. A DESIGN CHANGE HAS BEEN INITIATED TO APPLY A TEFLON COATING TO THE SEALING SURFACE OF THE TANK HALF.

TWO CASES AT KSC OCCURRED WHERE THE COMBINED EXTERNAL LEAKAGE OF THE GH2 2 INCH AND THE GH2 VENT WAS 50 SCIM (REFERENCE CAR'S AB5395, AB5471). OMRSD WAS REVISED TO ALLOW 100 SCIM LEAKAGE.

AT KSC, LEAKAGE BETWEEN THE LO2 2 INCH LINE AND THE LO2 2 INCH DISCONNECT LEAKED 7.5 SCCM (REFERENCE CAR AB6442). THE SEALING SURFACE OF THE FLANGE WAS SCRATCHED DUE TO HANDLING. THE LEAKAGE WAS DETECTED DURING OMI MAIN PROPULSION SYSTEM LEAK AND FUNCTIONAL CHECK.

AT KSC, THE MATED DISCONNECT LEAKED 32 SCIM AT 6 PSIG (REFERENCE CAR AC9328). MAXIMUM ALLOWED IS 30 SCIM. 300 CRES CONTAMINATION WAS FOUND ON THE MATING SEALING SURFACES. CONTAMINATION WAS REMOVED AND THE LEAKAGE RATE WAS 11.8 SCIM.

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)



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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.

## (E) OPERATIONAL USE:

WHEN THE ULLAGE PRESSURE DROPS BELOW 31.6 PSI, THE CREW WILL OPEN THE LH2 FLOW CONTROL VALVES WITH THE COCKPIT SWITCH. WHEN THIS IS NOT EFFECTIVE AND THE NPSP DROPS BELOW A PREFLIGHT ACCEPTED VALUE, THE CREW WILL ABORT TO TAL OR ACLS.

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- APPROVALS -  
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RELIABILITY ENGINEERING: L. H. FINEBERG  
 DESIGN ENGINEERING : J. E. OSLUND  
 QUALITY ENGINEERING : R. WILLIAMS  
 NASA RELIABILITY :  
 NASA SUBSYSTEM MANAGER :  
 NASA QUALITY ENGINEER:

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