

## FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE

NUMBER: 03-3-4507-X

SUBSYSTEM NAME: ORBITAL MANEUVERING SYSTEM (OMS)

REVISION : 2 03/16/90

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU :	COUPLING, PROPELLANT FAIRCHILD STRATOS	MC276-0018 76301000 & 76306000

## PART DATA

## EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

COUPLING, OME FILL, BLEED AND DRAIN PORTS. (MD 467, 468, 473, 474, 475, 476, 477, 478, 567, 568, 573, 574, 575, 576, 577, 578)

QUANTITY OF LIKE ITEMS: 16

## FUNCTION:

PROVIDES CONNECTION TO PURGE ENGINE SUBASSEMBLY FOR GROUND SERVICING AND POST LANDING SAFING OPERATIONS IN ORDER TO REMOVE PROPELLANT IN CLOSED LINE SECTIONS, COMBUSTION CHAMBER REGENERATIVE COOLING CHANNELS, INJECTOR CAVITIES AND BIPROPELLANT VALVE ELEMENTS. COUPLING IS ALSO USED FOR ENGINE HIGH POINT BLEED. ITEM IS ACCESSIBLE AT ENGINE SERVICE PANEL. THE AIRBORNE HALF COUPLING (AHC) CONSISTS OF A SPRING LOADED POPPET, REDUNDANT SEALS AND FILTER. THE AHC CAP PROVIDES REDUNDANT SEALS AND PROTECTS THE AHC WHEN NOT IN USE.

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SUBSYSTEM: ORBITAL MANEUVERING SYSTEM (OMS) REVISION# 2 03/16/90  
LRU :COUPLING, PROPELLANT CRITICALITY OF THIS  
ITEM NAME: COUPLING, PROPELLANT FAILURE MODE:IR2

FAILURE MODE:  
EXTERNAL LEAKAGE (SEAL LEAKAGE)

MISSION PHASE:  
PL PRELAUNCH  
LO LIFT-OFF  
OO ON-ORBIT  
DO DE-ORBIT  
LS LANDING SAFING

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

CAUSE:  
CONTAMINATION, EXCESS OR IMPROPER USE (EXCESS TORQUE, SEAL DAMAGE),  
INADEQUATE MAINTENANCE (OF GSE HALF), NO LINE SUPPORT - SHAFT OR BORE  
BENT. PROPELLANT RESIDUE PRODUCTS, RETAINING NUT LOOSENS NEGATING CAP  
SEAL REDUNDANCY.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN A) FAIL  
B) FAIL  
C) PASS

PASS/FAIL RATIONALE:

- A)
- B)
- C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:  
LOSS OF REDUNDANCY FOR OVERBOARD LEAKAGE - NO EFFECT UNLESS REDUNDANT  
SEALS FAIL.

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(B) INTERFACING SUBSYSTEM(S):  
NO EFFECT.

(C) MISSION:  
SAME AS (B)

(D) CREW, VEHICLE, AND ELEMENT(S):  
SAME AS (B)

(E) FUNCTIONAL CRITICALITY EFFECTS:  
POSSIBLE LOSS OF CREW/VEHICLE IF LEAK RESULTS IN EXCESSIVE LOSS OF PROPELLANT OR STRUCTURAL/TPS DAMAGE. 1R EFFECT ASSUMES FAILURE OF COUPLING CAP. CAP SEAL CANNOT BE VERIFIED AFTER INSTALLATION. NO INSTRUMENTATION AVAILABLE FOR DETECTION OF FAILURE OF CAP OR COUPLING SEAL IN FLIGHT.

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- DISPOSITION RATIONALE -  
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(A) DESIGN:

DESIGN FACTORS - PROOF, 2 X MAX OP PRESSURE (1.1 X MAX SURGE PRESS); BURST - 3 X MAX OP PRESSURE (1.6 X MAX SURGE PRESS). CERTIFIED BY ANALYSIS (1/4"), CERTIFIED BY TEST TWO SIZES (1/2", 1"). COMPLETE STRESS ANALYSIS. GROUND HALF COUPLINGS/LINES SUPPORTED TO LIMIT STRESS ON COUPLINGS AND PREVENT DAMAGE TO SEALS AND WELD JOINTS. CAP PROVIDES A REDUNDANT SEAL, MINIMIZES LEAKAGE POTENTIAL AND PROTECTS COUPLING FROM EXTERNAL CONTAMINATION. FLUID ENTERING THE COUPLING IS FILTERED THROUGH A 25-MICRON FILTER AND THE FLIGHT HALF COUPLING ALSO INCORPORATES AN INTERNAL 200 MICRON FILTER.

■ (B) TEST:

QUALIFICATION TEST

(4 UNITS - 2 EACH 1/2", 1") - RANDOM VIBRATION (PUPPET OPEN AND CAP ON), SHOCK - BENCH AND DESIGN, THERMAL CYCLE (-30 TO +200 DEG F.), ENDURANCE - 600 CYCLES; BENDING AND AXIAL LOADS - 100 FT-LB, 100 LB. SURGE PRESSURE- 190,000 CYCLES TO 1300 PSI. BURST PRESSURE - 2130 PSI. PROPELLANT COMPATIBILITY. ALSO QUALIFIED AS PART OF POD ASSEMBLY. VIBRO ACOUSTIC TESTING AT JSC-131 EQUIVALENT MISSIONS. HOT-FIRE TEST PROGRAM AT WSTF - 517 TESTS (24 EQUIVALENT MISSION DUTY CYCLES). APPROXIMATELY SEVEN 7 YEARS PROPELLANT EXPOSURE.

ACCEPTANCE TEST

(EACH UNIT) - PROOF, FUNCTIONAL, LEAKAGE.

GROUND TURNAROUND

V43C80.202 REQUIRES LEAK CHECK OF COUPLING FOR FIRST FLIGHT AND EVERY

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5TH FLIGHT.

- V43CBO.206 REQUIRES LEAK CHECK FOR EACH CAP USED DURING TURNAROUND OPERATIONS FOR FIRST FLIGHT AND ON A CONTINGENCY BASIS.
- V43CBO.210 PERFORMS EXTERNAL LEAKAGE CHECKS.
- V43CBO.240 TOXIC VAPOR LEAK CHECK OF PROP FEED SYSTEM 1ST FLIGHT AND CONTINGENCY.
- V43CBO.275 PERFORMS PERIODIC LEAK CHECK OF ENGINE FEED SYSTEM DOWNSTREAM OF BI-PROPELLANT VALVE.
- V43CED.350 PERFORMS BI-PROP VALVE DRAIN AND PURGE EVERY FLIGHT.
- V43CFD.010 PERFORMS PRESSURE CHECK ON EACH COUPLING USED IN SERVICING BEFORE GSE IS DISCONNECTED. VERIFICATION OF THE PURITY OF PROPELLANTS ENTERING THE SYSTEM IS MAINTAINED PER SE-S-0073.

**(C) INSPECTION:**

RECEIVING INSPECTION  
MATERIALS AND PROCESSES CERTIFICATIONS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL  
CLEANLINESS TO LEVEL 100A AND CORROSION PROTECTION PROVISIONS ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION  
MANUFACTURING, ASSEMBLY AND INSTALLATION PROCEDURES ARE VERIFIED BY INSPECTION. CRITICAL DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. SEAL EXAMINATION UNDER 3X TO 7X MAGNIFICATION PRIOR TO INSTALLATION IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION  
PENETRANT AND RADIOGRAPHIC INSPECTION OF WELDS ARE VERIFIED BY INSPECTION.

CRITICAL PROCESSES  
THE WELDING PROCESS AND VERIFICATION THAT WELDS MEET SPECIFICATION REQUIREMENTS ARE VERIFIED BY INSPECTION.

TESTING  
TEST EQUIPMENT AND TOOL CALIBRATION ARE VERIFIED BY INSPECTION.  
ACCEPTANCE TEST IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING  
HANDLING, PACKAGING, STORAGE AND SHIPPING REQUIREMENTS ARE VERIFIED BY INSPECTION.

**(D) FAILURE HISTORY:**

CAR AB5074 RECORDS AN INSTANCE OF EXCESSIVE LEAKAGE ON THIS COUPLING IN THE MD476 APPLICATION DURING CHECKOUT AT KSC. THE POPPET SEAL WAS

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MISSING. ER 75380-33 WAS EXPANDED TO INCLUDE VERIFICATION OF INSTALLATION SIGN-OFF. SEE FMEA 03-3-2001-1 FOR THE TOTAL FAILURE HISTORY OF THIS COUPLING FOR ALL USE APPLICATIONS.

(E) OPERATIONAL USE:

NO ACTION FOR FIRST FAILURE, NOT DETECTABLE. IF REDUNDANT SEALS FAIL - FOR COUPLINGS UPSTREAM OF ENGINE BI-PROP VALVE - USE PERIGEE ADJUST BURN TO DEplete PROPELLANT FROM LEAKING POD (OUT OF PLANE COMPONENT IF NECESSARY) AND REDUCE DELTA-V REQUIREMENTS FOR DEORBIT. AFTER LEAKED PROPELLANT DISPERSED, PERFORM DEORBIT BURN WITH GOOD POD. FOR COUPLINGS DOWNSTREAM OF ENGINE BI-PROP VALVE - ISOLATE FAILED ENGINE AND COMPLETE MISSION REQUIREMENTS USING CROSSFEED FOR PROPELLANT UTILIZATION. REDLINE ADDITIONAL PROPELLANT FOR RCS BACKUP DEORBIT. NEXT PLS DEORBIT IF PROPELLANT FOR RCS BACKUP NOT AVAILABLE. POSSIBLE MISSION IMPACT. DECREASED PROPELLANT AVAILABLE FROM OMS TO RCS THROUGH INTERCONNECT FOR ON-ORBIT OPERATION.

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- APPROVALS -  
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RELIABILITY ENGINEERING: J. N. HART  
DESIGN ENGINEERING : D. W. CARLSON  
QUALITY ENGINEERING : O. J. BUTTNER  
NASA RELIABILITY :  
NASA SUBSYSTEM MANAGER :  
NASA QUALITY ASSURANCE :

: JAH  
: D. W. Carlson  
: O. J. Buttner  
: O. J. Buttner 4/2/90  
: Samuel M. Jordan 5-29-90  
: Chick M. J.