Grumman Corporation

CRITICAL ITEMS LIST

GRUMMAN

ABBY NOMENCLATURE: MANIPULATOR FOOT RESTRAINT

ASSEMBLY PART NO: SCD 33140100

PREPARED BY: L. HAHN & F. PERAZZO

REPORT NO: MAN 87-R-4

REVISION: A

DATE: 13 MAY 1988

FMEA REF	REV	NAME, QTY & DRAWING REF DESIGNATION	CRIT	FAILURE MODE AND CAUSE	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
C1		Astronaut-to-MFR Tether QTY (one each lower & upper) Dwg C95-126 (lower) Dwg C95-127	1/1	C1 - (a) Structural failure of cable or hook due to defective material or, (b) Hook fails open due to contamination, galling or broken latch spring	END ITEM Loss of safety restraint for EVA Crew-member GFE INTERFACE N/A MISSION N/A CREW / VEHICLE Possible loss of crewmember due to separation from orbiter	A. Design In addition to considering the launch loads discussed under cases A1 and B1, the MFR has been designed to accomodate the following conditions in the deployed configurations: - Astronaut handling loads of one hundred pounds in any direction. Inertial response loads of MFR to RMS runaway accelerations (2.6 ft/sec/sec linear accelx,y, or z axes and 0.5 rad/sec/sec Roll acel about x axes) - RMS constrained motion load of 300 pounds ultimate, any point, any direction. - 140 pound couple by each foot to footplate assembly - 343 pound load applied to any tether/reel assembly. - The design minimizes orbital EVA thermal stresses by utilizing aluminum as the one basic structural material, coated with a low absorption thermal control coating per Grumman spec CSS-MFR-PS-001 Using the above load spectrum design safety margins of 1.14 for deformation and 1.40 for failure have been achieved. All springs are corrosion resistant and will be cycled a small fraction of nominal cyclic life in the 20 mission life of the MFR. Fatigue life based upon random response loads with appropriate stress concentration factors has been established using a scatter factor of 4.0 (e.g., 80 mission fatigue life based upon S-N curves.) All materials are per table 1 and 2 of MSFC-SPEC-522A to reduce stress corrosion, and are certified for traceability/quality.

C1

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CRITICAL ITEMS LIST

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ASSY NOMENCLATURE: MANIPULATOR FOOT RESTRAINT

ASSEMBLY PART NO: 660-33405-109

PREPARED BY: L. HAHN & F. PERAZZO

REPORT NO. 660-81-8-8

REVISION A &

DATE: 6 JULY 1988

FMEA REF	REV	NAME, QTY & DRAWING REF DESIGNATION	CRIT	FAILURE MODE AND CAUSE	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
C1		Astronaut-to-MFR Tether QTY (one each lower & upper) Dwg C95-126 (lower) Dwg C95-127	1/1	C1 - (a) Structural failure of cable or hook due to defective material or, (b) Hook fails open due to contamination, galling or broken latch spring	END ITEM Loss of safety restraint for EVA Crew-member GFE INTERFACE N/A MISSION N/A CREW / VEHICLE Possible loss of crewmember due to separation from orbiter	B. TEST HISTORY 1. Acceptance test per procedure 360-94 B1 at Grumman (7/7/83) before and after all tests. ATP includes functional tests of all operating functions and a general visual inspection. 2. Stiffness test per procedure 360-104 B1 at Grumman (7/7/83). Demonstrated stanchion end play less than .5 inch for five pound load in any direction and deflection less than 3 inches Lateral and 2 inches longitudinal for 1 hundred pound loads. 3. Vibration and shock test per procedure 360-98 B1 at Grumman (7/7/83). Demonstrated ability to withstand design levels without structural failure within significant resonance. Several sources required the application of ballast. 4. APC/MFR ultimate load tests per STS83-0044 at Rockwell (5/83). Loads applied in 10 steps, each comprising 10% of limit load no yield was observed at the ultimate load of 1.4 x limit 5. Thermal vacuum test at JSC (7/29/84). MFR was operated at ambient temperature, plus 224 f and -137 f (average lowest achievable chamber temp) at an average vacuum of .00006 torr 6. Center of gravity test at JSC (12/2/84) 7. Moment of inertia swing test at JSC (9/4/85) C. INSPECTION 1. NAVPRO inspects all production end items at completion of final assembly 2. Anodic hard coated aluminum parts inspected for compliance to MIL-A-8625 C by DCAS. Certificate of compliance on file at Grumman Bethpage 3. Thermal Control Coating process is controlled by inspections, (post prime, cure, post coating and cure), and sample testing for coating thickness, coating adhesion, and emittance/solar absorption D. FAILURE HISTORY None (per PRACA database). The MFR has been successfully utilized on five missions, STS 16, 13, 51A, 51I, and 61C. E. TURNAROUND Inspection per 521/PIA 05004 N/C III DEC 1987 includes a functional test of all MFR operating functions and a general visual inspection. F. OPERATIONAL USE 1. Operational Effect of Failure - Crewman may separate from orbiter (worst case). Task delayed, increasing overall EVA time 2. Crew Action - Orbiter crew required to maneuver orbiter to floating crewmember, who may tether back to MFR via waist tether 3. Crew Training - standard training - to remain in foot platform during MFR operations which minimizes chance of separation 4. Mission Constraints - none 5. In Flight Checkout - Tether will be inspected prior to its use this will minimize the chance of loose during EVA