

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE

NUMBER: MO-AA4-505-X

SUBSYSTEM NAME: STABILIZED PAYLOAD DEPLOYMENT SYSTEM

REVISION : 2 07/31/90

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
■ SRU :	PAYLOAD DISCONNECT ASSEMBLY	V790-544004

PART DATA

■ EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
DISCONNECT ASSEMBLY, PAYLOAD SEPARATION

■ QUANTITY OF LIKE ITEMS: 2
ONE PER PEDESTAL

■ FUNCTION:

THE PAYLOAD DISCONNECT ASSY (PDA) IS ATTACHED TO THE PAYLOAD AND PERFORMS ONE HALF THE ACT OF SEPARATING THAT PAYLOAD FROM THE ORBITER. THE ORBITER DISCONNECT ASSEMBLY, (MO-AA4-510, 515, & 520), PERFORMS THE OTHER HALF. THE TWO PDA'S, ONE ON EACH PEDESTAL, ACT SIMULTANEOUSLY BUT INDEPENDENTLY TO ACCOMPLISH THE PAYLOAD RELEASE PROCESS; THIS IS NOT CONSIDERED TO BE FUNCTIONAL REDUNDANCY. THIS MECHANISM CONSISTS OF A STRUCTURE THAT SUPPORTS A SWIVEL ASSEMBLY (V790-544036). WHEN ASSEMBLED FOR USE, THIS UNIT IS ATTACHED TO THE ORBITER DISCONNECT ASSEMBLY (ODA) WHERE THE SWIVEL IS RETAINED BY THREE RETRACTOR PINS AND A TENSILE PRE-LOAD. WHEN THE PAYLOAD RELEASE FUNCTION IS SELECTED AND THE RETRACTORS ARE FIRED, THE PINS RELEASE THE SWIVEL AND A SPRING LOADED PISTON PUSHES THE PDA (AND THE PAYLOAD) AWAY FROM THE ODA AND THE ORBITER.

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SUBSYSTEM: STABILIZED PAYLOAD DEPLOYMENT SYSTEM REVISION# 2 07/31/90

ITEM NAME: PAYLOAD DISCONNECT ASSEMBLY CRITICALITY OF THIS FAILURE MODE: 1/1

■ FAILURE MODE:
PREMATURE OPERATION

MISSION PHASE:
OO ON-ORBIT

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

■ CAUSE:
STRUCTURAL FAILURE

■ 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:
A PREMATURE FAILURE OF THE SWIVEL WILL CAUSE SEPARATION OF THE PDA AND THE ODA. AN INDICATION OF RELEASE IS MADE ONLY WHEN THE PISTON AND EJECTOR SPRING ARE FULLY EXTENDED.

■ (B) INTERFACING SUBSYSTEM(S):
POSSIBLE CONTACT BETWEEN THE PAYLOAD AND ORBITER STRUCTURE.

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- (C) MISSION:
LOSS OF MISSION
- (D) CREW, VEHICLE, AND ELEMENT(S):
POSSIBLE LOSS OF CREW/VEHICLE DUE TO POSSIBLE CONTACT BETWEEN PAYLOAD AND ORBITER.
- (E) FUNCTIONAL CRITICALITY EFFECTS:
POTENTIAL CONTACT BETWEEN THE PAYLOAD AND ORBITER STRUCTURE.

- DISPOSITION RATIONALE -

- (A) DESIGN:
THE PAYLOAD DISCONNECT ASSEMBLY IS MADE OF HIGH STRENGTH CORROSION RESISTANT MATERIAL FOR SPACE ENVIRONMENT USE. THE DESIGN SHOWS POSITIVE STRUCTURAL MARGIN BY ANALYSIS AND MEETS 1.4 MINIMUM FACTOR OF SAFETY.
- (B) TEST:
QUALIFICATION TESTS HAVE BEEN SUCCESSFULLY COMPLETED FOR THE POA V790-544004 AND THE ODA V790-544003 IN ACCORDANCE WITH DETAIL TEST PROCEDURE (DTP) S142-801 TO THE TEST REQUIREMENTS OF TR S144028. DETAILS OF THESE TESTS ARE DOCUMENTED IN STS89-0436 ORBITER DISCONNECT ASSEMBLY QUALIFICATION TEST DATED MARCH 1989.

OMRSD: GROUND TURNAROUND
FREQUENCY OF CHECKOUT IS MISSIONS DEPENDENT. X-RAY INSPECTION TO VERIFY CORRECT ASSEMBLY.
- (C) INSPECTION:
ALL DIMENSIONAL CHARACTERISTICS ARE VERIFIED BY INSPECTION. PROCESSES ARE VERIFIED BY INSPECTION EITHER AT ROCKWELL OR AT SUPPLIER FACILITIES. MATERIAL CERTIFICATION IS VERIFIED BY INSPECTION - X-RAY AFTER ASSEMBLY FOR PROPER ALIGNMENT AND DYE PENETRANT OF PIECE PART IS VERIFIED BY INSPECTION.
- (D) FAILURE HISTORY:
** AD8079.- IN PREPARATION FOR CONDUCTING ACCEPTANCE TESTS (MLO 108-0019) AND DEVELOPMENT OPERATIONAL TESTS (TR S144025C), THE PAYLOAD DISCONNECT ASSEMBLY (V790-544004) AND THE ORBITER DISCONNECT ASSEMBLY (V790-544003) WERE ASSEMBLED IN ACCORDANCE WITH L&T STD 80378. THE PROCESS REQUIRES THAT THESE DISCONNECTS BE ASSEMBLED USING THE MC325-0048-0001 RETRACTORS. L&T STD 80378 REQUIRES A ONE-HOUR "HOLD", FOLLOWING ASSEMBLY AND PRIOR TO FURTHER OPERATIONS, FOR PRELOAD STABILIZATION. WHEN THE ONE-HOUR HOLD HAD BEEN COMPLETED AND THE RESTRAINING FIXTURE REMOVED, THE TWO DISCONNECT ASSEMBLIES SEPARATED.

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INSPECTION DISCLOSED THAT THE PISTONS IN ALL THREE RETRACTORS HAD BEEN DISPLACED AND THEIR SHEAR PINS HAD BEEN SHEARED. THESE THREE RETRACTORS WERE THE SAME COMPONENTS USED IN ALL EARLIER TESTING OF THE SECONDARY SPOS PEDESTAL. THE UNITS HAD BEEN ASSEMBLED AND PRELOADED (1800 POUNDS) TWELVE TIMES THEN EXPOSED TO RANDOM VIBRATION AND LOAD CYCLING. THE EVENTS AND EVIDENCE INDICATE THAT THE ASSEMBLY AND RIGGING PROCEDURES WERE IMPROPERLY PERFORMED. SCRATCH MARKS ON THE HARDWARE, TOGGLE, AND RETRACTOR PISTONS INDICATE THAT PRELOADING HAD BEEN APPLIED TO THE CORNERS OF THE PISTONS. A PRELOAD APPLIED AT THIS POINT WOULD RESTRICT THE RETRACTOR ASSEMBLIES FROM ROTATING ON THEIR MOUNTING SURFACE TO A POSITION THAT WOULD BE A NATURAL ALIGNMENT OF THE PISTON AND THE TOGGLE. AN ORAL REVIEW OF THE PROCESS DISCLOSED THAT ASSEMBLY HAD OCCURRED WITH THE SEPARATION BETWEEN THE PAYLOAD AND ORBITER DISCONNECTS IN A VERTICAL PLANE. THIS ACTION IS IN CONTRADICTION WITH STEP 1.2 OF L&T STD 8037B APPENDIX A. WHEN PROPERLY ASSEMBLED, THE PISTON OF THE RETRACTOR RESTRAINS THE SWIVEL OF THE PAYLOAD DISCONNECT. WHEN PAYLOAD RELEASE IS INITIATED THE RETRACTORS ARE FIRED, THE RETRACTOR PINS RELEASE THE SWIVEL AND, THE EXPULSION PIN ACTING WITH ITS PRELOADED SPRING FORCE PUSHES THE TWO DISCONNECT ASSEMBLIES APART.

RIGGING SPECIFICATION M10308-0199, THE DOCUMENT ON WHICH THE L&T STD 8037B IS BASED, HAS BEEN REVISED TO CLARIFY AND IMPROVE THE INSTALLATION PROCEDURE AND ENGINEERING ORDER A 03 APPLIES. THERE WERE NO FAULTS FOUND WITH THE PROCEDURE AS RELEASED, THIS CHANGE PROVIDES ONLY AN ENHANCEMENT OF THE PROCESS. AN ADDITIONAL PROCEDURE HAS BEEN ADDED TO THE SPECIFICATION FOR X-RAY INSPECTION FOLLOWING ASSEMBLY AND PRIOR TO FLIGHT. ENGINEERING ORDER B 01 APPLIES. AN EMPHASIS HAS BEEN MADE TO ASSURE THAT PERSONNEL PERFORMING THIS ASSEMBLY PROCESS ARE FULLY INSTRUCTED AND CORRECTLY FOLLOW THE PRESCRIBED PROCEDURES. IN THIS VEIN, FURTHER EMPHASIS IS MADE THAT THE ASSEMBLY ACTIONS BE TAKEN ONLY WHEN THE SEPARATION PLANE IS HORIZONTAL.

- (E) OPERATIONAL USE:
NONE.

- APPROVALS -

RELIABILITY ENGINEERING:	W. R. MARLOWE	<i>W. R. Marlowe 8/6/90</i>
DESIGN ENGINEERING	: G. CAMPBELL	<i>G. Campbell</i>
QUALITY ENGINEERING	: M. F. HERGEN	<i>M. F. Hergen 8/3/90</i>
NASA RELIABILITY	: G. E	<i>G. E 9/7/90</i>
NASA SUBSYSTEM MANAGER	:	<i>[Signature] 9/25/90</i>
NASA QUALITY ASSURANCE	:	<i>[Signature] 9/6/90</i>