FAILURE MODES EFFECTS ANALYSIS (FMEA) – NON-CIL HARDWARE
NUMBER: 07-1A-725204 -X

SUBSYSTEM NAME: CREW STATION AND EQUIPMENT
REVISION: 3 09/17/98

PART DATA

	PART NAME **VENDOR NAME**	**PART NUMBER** **VENDOR NUMBER**
LRU	: SEAT, SPECIALIST/PASSENGER	MC621-0069-2002
LRU	: SEAT, SPECIALIST/PASSENGER	MC621-0069-2003
LRU	: SEAT SUPPORT, MISSION SPEC.	V610-333010

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
SEAT, SPECIALIST/PASSENGER
SEAT SUPPORT, MISSION SPECIALIST NO. 1 (SEAT RELOCATION RAIL)

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS:
5 MAX VARIED SPECIALIST SEATS AND 1 SEAT SUPPORT RAIL ASSEMBLY

FUNCTION:
SEAT PROVIDES LAUNCH AND LANDING SUPPORT AND PROPER BODY POSITIONING. THE PASSENGER SEAT (MAX OF 5) IS ATTACHED TO THE FLOOR BY QUICK DISCONNECTS, HAS TWO SEAT BACK ANGLE POSITIONS (2 DEGREES FORWARD AND 10 DEGREES AFT OF VERTICAL), FOLDABLE LEGS, HEADREST AND BACK FOR IN-FLIGHT STOWAGE, AND EXTENDABLE HEADREST (7 INCHES IN 1 INCH INCREMENTS). THE PASSENGER SEAT HAS A PERSONNEL RESTRAINT ASSEMBLY CONSISTING OF ADJUSTABLE LAP, SHOULDER AND ZERO "G" RESTRAINT BELTS MATING TO A CENTER BUCKLE. THE SHOULDER HARNESSES ARE RETRACTED (WITH LOCKS) BY THE INERTIA REELS. FUNCTION OF SEAT RELOCATION RAIL IS TO RELOCATE SEAT 3 (MS-1) 5.5 INCHES AFT OF THE EXISTING ORBITER FLOOR SEAT ATTACH STUDS. THE RELOCATION RAIL ATTACHES TO THE FLOOR WITH IDENTICAL QUICK DISCONNECTS TO THE ONES WHICH ARE ON THE SEATS. THE SEAT ATTACHES TO STUDS ON THE RELOCATION RAIL WHICH ARE IDENTICAL TO THE STUDS ON THE ORBITER FLOOR.

FAILURE MODES EFFECTS ANALYSIS FMEA – NON-CIL FAILURE MODE
NUMBER: 07-1A-725204-01

REVISION#: 3 09/17/98

SUBSYSTEM NAME: CREW STATION AND EQUIPMENT
LRU: SEAT, SPECIALIST/PASSENGER **CRITICALITY OF THIS**
ITEM NAME: SEAT SUPPORT, MISSION SPEC. **FAILURE MODE:** 1R3

FAILURE MODE:
SEAT LEG TO RAIL QUICK DISCONNECT (QD) FAILS TO SECURE PASSENGER SEAT, UNLOCKS PREMATURELY; RAIL QUICK DISCONNECT FAILS TO SECURE RAIL ASSEMBLY, UNLOCKS PREMATURELY; SEAT LEG TO FLOOR QUICK DISCONNECT FAILS TO SECURE PASSENGER SEAT, UNLOCKS PREMATURELY.

MISSION PHASE:
LO LIFT-OFF
DO DE-ORBIT

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

CAUSE:
UNCOUPLING OF DISCONNECT BY FAILURE OF RETENTION BUTTON SPRING

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN
A) PASS
B) PASS
C) PASS

PASS/FAIL RATIONALE:
A)
OMRSD CHECKOUT CAN DETECT FAILURE

B)
DETECTABLE DURING SEAT RE-INSTALLATION

C)
NO SINGLE FAILURE COULD CAUSE LOSS OF MULTIPLE FITTINGS OR LOSS OF ONE FITTING AND A CRASH

- FAILURE EFFECTS -

(A) SUBSYSTEM:

FAILURE MODES EFFECTS ANALYSIS (FMEA) – NON-CIL FAILURE MODE
NUMBER: 07-1A-725204-01

TWO FAILURES REQUIRED FOR LOSS OF ONE QD ATTACHMENT, (COLLAR AND SLIDE BUTTON DEPRESSED). ALSO, FAILURE OF MORE THAN ONE QD OR FAILURE OF ONE QD AND A CRASH SCENARIO PRQUIRED FOR LOSS OF SEAT STRUCTURAL INTEGRITY, WHICH WILL CAUSE PASSENGER SEAT OR RAIL AND PASSENGER SEAT DETACHMENT AND PERMIT CREWMEMBER TO BE TOSSED, RESULTING IN POSSIBLE CREW MEMBER INJURY OR LOSS OF LIFE.

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

(C) MISSION:
POTENTIAL LOSS OF MISSION DUE TO CREWMEMBER INJURY IF FAILURE OCCURS DURING LAUNCH.

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

(E) FUNCTIONAL CRITICALITY EFFECTS:
SAME AS (A).

-DISPOSITION RATIONALE-

(A) DESIGN:
THE PASSENGER SEAT (MAX OF 5) IS ATTACHED TO DECK OR RAIL ASSEMBLY BY QUICK DISCONNECTS AT EACH OF FOUR LEGS. THE QUICK DETACH METHOD AND FOLDING OF THE LEG SUPPORTS ALLOWS INFLIGHT REMOVAL AND STOWAGE. DISCONNECT HALVES ARE MATED AND LOCKED BY THE ACTION OF A SECURING COLLAR AND SECONDARY BALL PLUNGER LOCK WHICH PREVENTS DISENGAGEMENT OF THE COLLAR. THE QUICK DISCONNECT IS COMPRISED OF A BODY MADE OF 2024-T351 ALUMINUM ALLOY BAR PER QQ-A-225/6, A STUD MADE OF INCONEL 718 PER AMS 5662B, DOGS MADE OF INCONEL 718 PER AMS 5662B, A COLLAR MADE OF INCONEL 718 PER AMS 5662B, A RETAINER RING MADE OF 302 CRES WIRE PER AMS 5688 COLD DRAWN, A PLUNGER MADE OF 304 CRES BAR PER AMS 5639 AND A SPRING MADE OF 302 CRES WIRE PER QQ-W-423.

THE SEAT SUPPORT RAIL ASSEMBLY IS ATTACHED TO FLIGHT FLOOR DECK BY QUICK DISCONNECTS AT EACH OF FOUR ATTACHMENTS. THE QUICK DISCONNECTS ARE IDENTICAL TO THOSE ON THE SEAT.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- NON-CIL FAILURE MODE
NUMBER: 07-1A-725204- 01

(B) TEST:
ACCEPTANCE TESTS
EACH QUICK DISCONNECT INCLUDES ENGAGE AND DISENGAGE CYCLING UP TO A TOTAL OF 10 CYCLES TO INSURE PROPER FUNCTION OF LOCKING MECHANISM AND DOGS, AND FIT CHECK WITH MATING STUD (DECK MOUNTING STUDS ARE MADE OF 17-4 PH STAINLESS STEEL PER AMS 5643).

EACH PASSENGER SEAT IS FIT CHECKED WITH SEAT INTERFACE FIXTURE TO VERIFY SEAT INSTALLATION.

EACH RAIL ASSEMBLY IS FIT CHECKED WITH SEAT AND ORBITER TO VERIFY A PROPER INSTALLATION DURING CEIT (CREW EQUIPMENT INTERFACE TEST).

QUALIFICATION TESTS/ANALYSES
SEAT ASSY, STRUCTURALLY ATTACHED BY THE QUICK DISCONNECTS, IS LOADED USING A 230 LBS (ONE-G) BODY BLOCK TO EACH OF THE FOLLOWING CONDITIONS: (1) 10 G DOWN (-Z), (2) 20 G FORWARD (-X), AND (3) 18.79 G FORWARD (-X) AND 6.84 G RIGHT (+Y) (IN COMBINATION), VIBRATION CYCLES IN EACH OF THE THREE ORTHOGONAL AXES WITH A SPECTRAL DENSITY 20 HZ TO 150 HZ INCREASING AT THE RATE OF 6 DB/OCTAVE, 150 HZ TO 1000 HZ CONSTANT AT 0.03 G-G/HZ, 1000 HZ TO 2000 HZ DECREASING AT THE RATE OF 6 DB/OCTAVE FOR A DURATION OF 3, 7, 14, AND 24 MINUTE INTERVALS. THE DISCONNECT AND FOLDABLE LEGS WERE CYCLED 500 TIMES DURING CERTIFICATION TESTS. ANALYSIS IDENTIFIES REAR LEG LOAD OF 8789 LBS ALONG LEG AXIS AT COMBINATION OF CRASH LOADING OF 18.79 G FWD/6.84 G RIGHT.

THE SEAT SUPPORT RAIL ASSEMBLY IS STRESS ANALYZED FOR MAXIMUM LOADING CONDITIONS WITH 313 POUND CREWMEMBER SITTING IN THE SEAT, WHICH IS MOUNTED ON THE RAIL ASSEMBLY AND UNDER G-LOADINGS AS LISTED IN (1), (2) AND (3) ABOVE. EVERY COMPONENT OF RAIL ASSEMBLY SHOWS POSITIVE SAFETY MARGIN. THE RAIL FLANGES AT 2 PLACES IN THE VICINITY OF THE QUICK DISCONNECTS HAVE THE LOWEST SAFETY MARGIN OF .02.

GROUND TURNAROUND TEST
ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:
RECEIVING INSPECTION
CHEMICAL ANALYSIS AND PHYSICAL TEST REPORTS AND/OR CERTIFICATIONS ARE MAINTAINED FOR FORGINGS, BAR PLATE, SHEET AND FABRIC. PURCHASED MACHINED PARTS ARE CHECKED DIMENSIONALLY.

CONTAMINATION CONTROL
INSPECTION VERIFIES SEATS ARE GENERALLY AND VISIBLY CLEAN PER MA0110-301

ASSEMBLY/INSTALLATION
MANUFACTURING PROCESSES, ASSEMBLY, AND INSTALLATION OPERATIONS ARE VERIFIED BY INSPECTION. DIMENSIONS OF MACHINED PARTS ARE INSPECTED.

TESTING

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- NON-CIL FAILURE MODE
NUMBER: 07-1A-725204-01

ACCEPTANCE TEST PROCEDURE (ATP) FUNCTIONAL TEST OF THE SEAT LATCH MECHANISMS IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING
PARTS PROTECTION IS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:
CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATA BASE. THE FAILURE HISTORY DATA PROVIDED BELOW IS NO LONGER BEING KEPT UP-TO-DATE.

CAR AD5491-010 JSC, TRAINING. A TRAINER PASSENGER SEAT LEG TIEDOWN FITTING WAS DIFFICULT TO ATTACH TO FLOOR STUD BECAUSE OF BROKEN TEETH. THREE DOGS WERE SENT TO THE LABORATORY FOR INSPECTION OF FATIGUE OR STRESS FRACTURE. THE LABORATORY EXAMINATION REVEALED NO FATIGUE OR STRESS FRACTURE INDICATIONS. THE DOGS WERE CUT WRONG. THE PUNCH PRESS DID NOT ADVANCE THE SHEET STOCK FAR ENOUGH TO CLEAR THE PREVIOUS PUNCH MARK. DISASSEMBLY AND INSPECTION OF THE DELIVERED FLIGHT TIE DOWN FITTINGS WAS COMPLETED. CORRECTIVE ACTION: THE PROCUREMENT SPECIFICATION (ME161-0020) WAS REVISED TO REQUIRE INSPECTION OF THE TIE DOWN FITTING DETAIL PARTS BEFORE ASSEMBLY, IN ADDITION TO THE EXAMINATION OF THE COMPLETED FITTING ASSEMBLIES.

(E) OPERATIONAL USE:
OPERATIONAL EFFECT OF FAILURE FAILURE OF QUICK-DISCONNECT RETENTION DEVICE(S) DURING THE ASCENT OR ENTRY PHASE MAY CAUSE SEAT OR RAIL AND SEAT RELEASE, RESULTING IN CREW INJURY WITH POSSIBLE LOSS OF CREWMEMBER AND/OR VEHICLE DAMAGE.

CREW ACTION
IF FAILURE OCCURRED DURING THE ASCENT PHASE, ON-ORBIT REPAIR OF THE RETENTION DEVICES WILL BE ATTEMPTED, USING THE IN-FLIGHT MAINTENANCE (IFM) TOOLS.

CREW TRAINING
CREWMEMBERS ARE TRAINED IN OPERATION OF ATTACH FITTING. GENERIC TRAINING IS PROVIDED IN WHICH THE CREW IS INSTRUCTED IN WHAT TOOLS ARE AVAILABLE, AND THE GENERAL TECHNIQUES OF REPAIRING MECHANISMS.

MISSION CONSTRAINTS
NONE.

INFLIGHT CHECKOUT
VERIFY INTEGRITY OF QUICK DISCONNECTS.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- NON-CIL FAILURE MODE
NUMBER: 07-1A-725204- 01

- APPROVALS -

EDITORIALLY APPROVED	: BNA	: J. Kimura 9-18-98
TECHNICAL APPROVAL	: VIA APPROVAL FORM	: 96-CIL-032_07-1A