

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE

NUMBER: 07-1A-725203-X

SUBSYSTEM NAME: CREW STATION AND EQUIPMENT

REVISION : 2 03/12/90

| | PART NAME VENDOR NAME | PART NUMBER VENDOR NUMBER |
|---------|----------------------------|------------------------------|
| ■ LRU : | SEAT, COMMANDER OR PILOT | MC621-0069-1003 |
| ■ LRU : | SEAT, COMMANDER OR PILOT | MC621-0069-1006 |
| ■ LRU : | SEAT, COMMANDER OR PILOT | MC621-0069-1007 |
| ■ LRU : | SEAT, SPECIALIST/PASSENGER | MC621-0069-2002 |
| ■ LRU : | SEAT, SPECIALIST/PASSENGER | MC621-0069-2003 |

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

QUANTITY OF LIKE ITEMS: 7
2 CREW AND 5 PASSENGER MAX

FUNCTION:

SEATS PROVIDE LAUNCH AND LANDING SUPPORT AND PROPER BODY POSITIONING. THE CREW SEATS (COMMANDER AND PILOT POSITIONS) ARE BOLTED TO THE FLIGHT DECK FLOOR, HAVE MOTORIZED AND HAND DRIVEN (MANUAL BACKUP) MOVEMENT IN THE Z-Z (10 INCHES) AND X-X (5 INCHES), TWO SEAT BACK ANGLE POSITIONS (2 DEGREES FORWARD AND 10 DEGREES AFT OF VERTICAL), FOLDABLE BACK AND HEADREST FOR IN FLIGHT STOWAGE, AND HEADREST HEIGHT ADJUSTMENT (7 INCHES IN 1 INCH INCREMENTS). THE PASSENGER SEATS (MAX OF 5 EACH) ARE ATTACHED TO THE FLOOR BY QUICK DISCONNECTS, HAVE 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 CREW AND PASSENGER SEATS HAVE A 5-POINT PERSONNEL RESTRAINT ASSEMBLY CONSISTING OF ADJUSTABLE LAP BELT, SHOULDER HARNESS AND NEGATIVE G-STRAP MATING TO A CENTER BUCKLE. THE SHOULDER HARNESSES ARE RETRACTED (WITH LOCKS) BY THE INERTIA REELS.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
NUMBER: 07-1A-725203-02

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SUBSYSTEM: CREW STATION AND EQUIPMENT
LRU :SEAT, COMMANDER OR PILOT
ITEM NAME: SEAT, SPECIALIST/PASSENGER

CRITICALITY OF THIS
FAILURE MODE:1/1

FAILURE MODE:

RESTRAINT HARNESS SYSTEM FAILS TO RESTRAIN, RELEASES PREMATURELY. BROKEN CENTER BUCKLE SPRING ALLOWS DEPRESS OF ENGAGING CATCH THUS RELEASING STRAP TANG. "C" CLIP RETAINS PRESSURE BAR OF ADJUSTER; IF LOST, STRAP WOULD RELEASE.

MISSION PHASE:

LO LIFT-OFF
OO ON-ORBIT
DO DE-ORBIT

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

CAUSE:

BROKEN CENTER BUCKLE LATCH SPRING(S) OR ADJUSTER PRESSURE BAR "C" CLIP BREAKS.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

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

PASS/FAIL RATIONALE:

A)
B)
C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF RESTRAINT SYSTEM WILL PERMIT CREWMEMBER TO BE TOSSED, RESULTING IN POSSIBLE BODILY INJURY OR LOSS OF LIFE. POTENTIAL LOSS OF

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VEHICLE DURING LAUNCH DUE TO INABILITY OF UNRESTRAINED CREWMEMBER TO PERFORM CRITICAL FUNCTIONS.

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

(C) MISSION:
SAME AS (A)

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

- (E) FUNCTIONAL CRITICALITY EFFECTS:
NONE.

- DISPOSITION RATIONALE -

(A) DESIGN:

THE RESTRAINT HARNESS, AS A COMPONENT OF THE SEAT, IS DESIGNED TO RESTRAIN THE CREWMEMBER BY SHOULDER/TORSO AND LAP/LEG STRAPS. THE HARNESS HAS A SECURE BUT QUICK RELEASE BUCKLE AS A ONE ATTACHMENT POINT FOR THE STRAPS. ALL STRAPS ARE ADJUSTABLE AND SECURE THE CREWMEMBER TO THE SEAT BY PREADJUSTED LAP STRAPS. INERTIA REELS FOR THE SHOULDER STRAP HAVE MANUAL AND AUTOMATIC LOCK. THE LAP STRAPS ARE SECURED TO EACH SEAT SIDE BY BOLTED ANCHOR FITTINGS. SHOULDER/LAP RESTRAINT ASSEMBLY IS COMPRISED OF POLYESTER WEBBING MURDOCK # X854. LAP BELT 2.25 X .060, SHOULDER STRAPS 1.75 X .060. MARGIN OF SAFETY OF HARNESS IS 1.53 CONSIDERING: HARNESS LOAD DISTRIBUTION OF 55 PERCENT AT SHOULDER STRAPS AND 45 PERCENT AT LAP BELT/BUCKLE.

- (B) TEST:

ACCEPTANCE TESTS

FINAL ACCEPTANCE INCLUDES CHECKING THE INERTIA REEL TENSION, INERTIA REEL MANUAL LOCK, INERTIA REEL AUTOMATIC LOCK, CENTER BUCKLE FOR RELEASE AND RELOCK OPERATIONS.

QUALIFICATION TEST/ANALYSES

INERTIA REELS DESIGNED/TESTED TO REQUIREMENTS IN MIL-STD-8236. CERTIFIED BY TEST TO 5250 LBS. THE LAP BELT/ANCHOR FITTING CERTIFIED BY TEST TO 6775 LBS. RESTRAINT HARNESSES ARE 6000 LBS BREAKING STRENGTH, 8500-8800 LBS BY TEST. RESTRAINT HARNESSES HAVE BEEN FULLY QUALIFIED PER MIL-STD-810. HARNESS ASSY IS CYCLED 500 TIMES. COMPONENTS TESTED AS PART OF SEAT/HARNESS ASSY 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, AND VIBRATION CYCLES IN EACH OF THE 3 ORTHOGONAL (IN COMBINATION) AXES USING A ONE-G BODY

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BLOCK 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 ABOVE TESTS WERE PERFORMED PRIOR TO THE ADDITION OF THE NEGATIVE G-STRAP. THE NEGATIVE G-STRAP WAS CERTIFIED BY ANALYSIS.

TURNAROUND INSPECTION

SEAT HARNESSSES ARE PHYSICALLY INSPECTED FOR PARTS AND OPERATION. INERTIA REELS ARE CHECKED FOR EXTRACTION, RETRACTION AND LOCK/RELEASE. THE BUCKLE IS OPERATED FOR INSERTION, LOCK AND RELEASE OF SHOULDER STRAP/LAP BELT TANGS. THE ADJUSTERS ARE OPERATED FOR STRAP CLAMP ACTION AND RELEASE. PARTS INSPECTION INCLUDES STRAP FOR DAMAGE AND "C" CLIP INSTALLATION IN ADJUSTER. REFERENCES: OMRSD V66, FILE III, OMI V6034, OMI V5096, OMI 50007.

(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.

NONDESTRUCTIVE EVALUATION

WELDS ARE VERIFIED BY RADIOGRAPHIC INSPECTION AND MAGNETIC PARTICLE INSPECTION.

CRITICAL PROCESSES

WELDING PROCESS VERIFIED BY INSPECTION. VACUUM HEAT TREAT VERIFIED BY INSPECTION. ELECTROLESS NICKEL PLATE VERIFIED BY INSPECTION.

TESTING

FINAL ACCEPTANCE TESTS ARE VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PARTS PROTECTION IS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:

ONE OV-102 HARNESS ADJUSTER REPAIRED. SNAP RING

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"C" CLIP WAS FOUND MISSING DURING PRE-FLIGHT COMMANDER SEAT INSPECTION/CHECKOUT. IT HAD BEEN INTENTIONALLY REMOVED.

C-CLIP FAILED (FOUND MISSING) IN A TRAINER SEAT CAUSING LAP BELT ADJUSTER TO MALFUNCTION.

STS-30 (OV-104) FAILURE IN WHICH THE SHOULDER HARNESS C-CLIP FAILED, CAUSING THE ADJUSTER TO MALFUNCTION DURING LAUNCH SCRUB. (REFERENCE FAILURE REPORT K80821).

(E) OPERATIONAL USE:

OPERATIONAL EFFECT OF FAILURE
RELEASE AT ANY PART OF HARNESS ASSY COULD CAUSE CREWMEMBER LOSS OF RESTRAINT, PERMITTING CREWMEMBER TO BE TOSSED, AND RESULTING IN POSSIBLE BODILY INJURY OR LOSS OF LIFE.

CREW ACTION
IF DETECTED, NONE.

CREW TRAINING
TRAINER AND SIMULATORS USED TO DEMONSTRATE AND TRAIN CREWS IN THE OPERATION/USE OF THE SEAT/RESTRAINT SYSTEM.

MISSION CONSTRAINTS
NONE.

INFLIGHT CHECKOUT
SEE CREW TRAINING ABOVE.

- APPROVALS -

RELIABILITY ENGINEERING: J. BANAKAR
DESIGN ENGINEERING : F. P. MAH
QUALITY ENGINEERING : D. DESAI
NASA RELIABILITY :
NASA SUBSYSTEM MANAGER :
NASA QUALITY ASSURANCE :

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