PRINT DATE: 10/08/90

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE
NUMBER: 02-4A-593202-X

SUBSYSTEM NAME: ACTUATION MECHANISM - HATCHES

REVISION : 2 10/08/90

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU :	ACTUATOR, LATCH DR, I/E HATCH ELLANEF	MC287-0036-0007 A1039A10-7

PART DATA

- EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
  ACTUATOR, LATCH DRIVE, INGRESS/EGRESS HATCH

- QUANTITY OF LIKE ITEMS: 1
  ONE

- FUNCTION:
  THIS COMPONENT IS A SEALED AND MANUALLY OPERATED REDUCTION GEARBOX THAT PROVIDES A MEANS FOR DRIVING THE HATCH LATCHES TO EITHER THE OPEN OR THE CLOSED POSITION. THE ACTUATOR CAN BE OPERATED FROM EITHER SIDE OF THE HATCH BY THE FLIGHT CREW OR GROUND PERSONNEL. A MECHANICAL LOCK AND A "NO-BACK" IS PROVIDED FOR RESTRAINT BETWEEN USES. THE DESIGN UTILIZES DUAL (REDUNDANT) O-RING SEALS TO PREVENT LEAKAGE OF CABIN ATMOSPHERE THROUGH OR PAST THE ACTUATOR.

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :ACTUATION MECH-HATCHES FMEA NO 02-4A -593202 -3 REV:10/27/87

ASSEMBLY :HATCH, INGRESS/EGRESS
P/N RI :MC287-0036-0007
P/N VENDOR:A1039A10-7 ELLANEF
QUANTITY :1

CRIT. FUNC: 2R
CRIT. HDW: 3

VEHICLE EFFECTIVITY:	102	103	104
PHASE(S): PL	LO X	OO X	DO X LS

REDUNDANCY SCREEN: A-FAIL B-FAIL C-PASS

PREPARED BY:
DES R. H. YEE
REL M. B. MOSKOWITZ
QE J. BARKER

APPROVED BY:
DES R. H. Yee for A.C. Ordonez
REL
QE

APPROVED BY (NASA):
SSM
REL
QE

ITEM:
ACTUATOR, LATCH DRIVE, SEALS, INGRESS/EGRESS HATCH

FUNCTION:
THIS COMPONENT IS A SEALED AND MANUALLY OPERATED REDUCTION GEARBOX THAT PROVIDES A CONTROLLED OUTPUT FOR DRIVING THE HATCH LATCHES TO EITHER THE OPEN OR CLOSED POSITION. THE ACTUATOR CAN BE OPERATED FROM EITHER SIDE OF THE HATCH BY THE CREW OR GROUND PERSONNEL. THE DESIGN UTILIZES DUAL O-RING SEALS TO PREVENT LEAKAGE OF CABIN ATMOSPHERE THROUGH OR PAST THE ACTUATOR.

FAILURE MODE:
LEAKAGE

CAUSE(S):
AGING/OXIDATION/SUBLIMATION, CONTAMINATION/FOREIGN OBJECT/DEBRIS, DEFECTIVE PART MATERIAL OR MANUFACTURING DEFECT

EFFECTS ON:
(A)SUBSYSTEM (B)INTERFACES (C)MISSION (D)CREW/VEHICLE

(A,B,C,D) NO EFFECT IF SINGLE SEAL FAILS. TWO SUCCESSIVE SEAL FAILURES ARE NECESSARY BEFORE LOSS OF CABIN ATMOSPHERE TO THE OUTSIDE CAN RESULT. EARLY MISSION TERMINATION WOULD RESULT ONLY IF LEAKAGE WAS EXCESSIVE.

FAILS REDUNDANCY SCREENS "A" AND "B" BECAUSE SEALS CANNOT BE VERIFIED INDIVIDUALLY.

DISPOSITION & RATIONALE:
(A)DESIGN (B)TEST (C)INSPECTION (D)FAILURE HISTORY (E)OPERATIONAL USE

(A) DESIGN
SEALS ARE STANDARD TYPE DUAL O-RING SEALS HELD IN SEPARATE GROOVES AGAINST A ROTATING INPUT SHAFT (LIMITED TO 450 DEG) OR AGAINST A SLIDING LOCKING STEM (LIMITED TO LESS THAN 3/8 INCH STROKE). DESIGNED FOR REPEATED USE - 2,000 CYCLES; EACH ROTATIONAL CYCLE OF THE INPUT SHAFT INCLUDES ONE FULL CLOCKWISE AND ONE FULL COUNTERCLOCKWISE ROTATION WITH A NORMAL 30 LB LOAD AT THE HANDLE (EQUIVALENT TO 10 YEAR, 100 MISSION LIFE) - WITHOUT SCHEDULED SERVICING OR MAINTENANCE. EACH SLIDING CYCLE OF THE LOCKING STEM INCLUDES ONE FULL UN-LOCKING AND ONE FULL LOCKING ACTION OF THE FLIP-OVER LOCKING LEVER.

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(B) TEST

QUALIFICATION TESTS: SEALS QUALIFIED AS PART OF COMPONENT QUALIFICATION TESTING OF LATCH ACTUATOR MC287-0036-0004 AND -0006 (PER CR-287-0036-0006C). QUALIFICATION TESTS INCLUDE: LIMIT LOAD TEST (10 CYCLES; WITH 3,750-4,941 LB AT OUTPUT ARM AND 150 LB AT HANDLE), CABIN ATMOSPHERE TEST (INCLUDES SALT FOG FOR 1 HOUR, 60 DEG P AND 120 DEG F AT 80% RELATIVE HUMIDITY FOR 120 HOURS), RANDOM VIBRATION TESTING 48 MINUTES IN EACH OF THREE ORTHOGONAL AXES, SHOCK TEST (+/- 20 G'S, 11 MILLISECONDS EACH SHOCK, 110 TOTAL; PER MIL-STD-810), NORMAL OUTPUT TEST (2,000 CYCLES AT 30 LB LOAD AT HANDLE; NOMINAL 8 CYCLES PER MISSION AND GROUND TURNAROUND; 800 CYCLES PER 100-MISSION LIFE), THERMAL CYCLE TEST BETWEEN -65 DEG F AND +275 DEG F (5 COMPLETE CYCLES AT EACH EXTREME TEMPERATURE - WITH A MINIMUM TEMPERATURE SOAK OF 60 MIN) AND ACCELERATION TEST (+/- 5 G'S IN EACH OF THREE ORTHOGONAL AXES, 5 MINUTES IN EACH AXIS).

ACCEPTANCE TESTING INCLUDES: 100% EXAMINATION, 100% X-RAY, 100% LEAKAGE TESTING (NOT TO EXCEED 0.00001 STD CC/SEC/INCH OF SEAL AT 16 PSI LIMIT DELTA P) AND 100% NORMAL LOAD TEST (10 CYCLES, WITH 30 LB AT HANDLE AND 775-988 LB ON OUTPUT ARM).

OMRSD: VISUALLY AND FUNCTIONALLY INSPECT FOR EVIDENCE OF DAMAGE PER CREW HATCH DETAIL INSPECTION FOR EACH FLIGHT. NO OMRSD TEST CAPABLE OF DETECTING FIRST FAILURE OF SEAL. MAINTENANCE SAMPLING ON ACTUATOR AND SEALS AFTER FIRST 36 FLIGHTS/8 YEARS AND THEN AFTER NEXT 12 FLIGHTS/2 YEARS.

(C) INSPECTION

RECEIVING INSPECTION
RAW MATERIAL VERIFIED, VISUAL INSPECTION/IDENTIFICATION PERFORMED, PARTS PROTECTION VERIFIED. O-RINGS ARE MAGNIFICATION INSPECTED FOR DAMAGE.

CONTAMINATION CONTROL
CONTAMINATION CONTROL PROCESSES AND CORROSION PROTECTION PROVISIONS VERIFIED. ALL PARTS ARE CLEANED TO LEVEL 300 PRIOR TO ASSEMBLY AND VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
MANUFACTURING, INSTALLATION AND ASSEMBLY OPERATIONS ARE VERIFIED BY SHOP TRAVELER MANDATORY INSPECTION POINTS (MIPS). DETAIL PARTS CONFIGURATIONS ARE VERIFIED BY INSPECTION. O-RINGS ARE MAGNIFICATION INSPECTED PRIOR TO INSTALLATION.

NONDESTRUCTIVE EVALUATION
STRUCTURAL INTEGRITY VERIFIED BY NONDESTRUCTIVE EVALUATION (NDE) (X-RAY) AND TECHNICIANS CERTIFICATIONS ARE VERIFIED BY INSPECTION.

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

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(D) FAILURE HISTORY

THERE HAVE BEEN NO ACCEPTANCE TEST, QUALIFICATION TEST, FIELD OR FLIGHT FAILURES ASSOCIATED WITH THIS FAILURE MODE.

(E) OPERATIONAL USE

THE RATE OF LEAKAGE AND FEASIBILITY OF COMPLETING THE MISSION CAN BE DETERMINED.