SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :FLIGHT CONTROL MECH FMEA NO 02-2B -A01-ES-13 REV:12/04/87

ASSEMBLY :TVC ACTUATOR
P/N RI :MC621-0015
P/N VENDOR:MOOG
QUANTITY :6
:6 ACT, 187 SEALS PER
:ACTUATOR, TOTAL 1122

CRIT. FUNC: 1R
CRIT. HDW: 2

VEHICLE EFFECTIVITY:	102	103	104
	X	X	X

PHASE(S): PL LO X GO DO LS

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

PREPARED BY:		APPROVED BY:	APPROVED BY (NASA):
DES	N LEVERT	DES	SSM
REL	C NELSON	REL	REL
QE	M SAVALA	QE	QE

ITEM:
SEAL, HYDRAULIC, TO ATMOSPHERE

FUNCTION:
PROVIDES A SEAL BETWEEN TWO MATING PARTS TO HOLD HYDRAULIC FLUID PRESSURE, AND TO PREVENT HYDRAULIC FLUID FROM LEAKING OVERBOARD.

FAILURE MODE:
LEAKAGE, EXTERNAL

CAUSE(S):
CONTAMINATION, SEAL DETERIORATION, IMPROPER ASSEMBLY, IMPROPER SURFACE FINISH

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

(A) NONE

(B) LIMITED LOSS OF HYDRAULIC FLUID FROM ONE HYDRAULIC SYSTEM; HOWEVER, BARRIER SEALS LIMIT LEAKAGE.

(C,D) NONE

(E) FUNCTIONAL CRITICALITY EFFECTS-POSSIBLE LOSS OF MISSION, CREW/VEHICLE AFTER TWO FAILURES: FAILURE OF SEAL AND BARRIER SEAL, RESULTING IN LOSS OF TWO HYDRAULIC SYSTEMS. "B" SCREEN IS FAILED SINCE THE BARRIER SEALS LIMIT LEAKAGE SUCH THAT A FAILURE MAY BE UNDETECTABLE.

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

(A) DESIGN
DYNAMIC ROD SEALS, DUAL ELASTOMERIC TYPE, WITH BACKUP RINGS. ALSO, BARRIOR SEAL (PISTON RING TYPE) LIMITS LEAKAGE TO 3 GALLONS/HOUR AT 3,000 PSI IN THE EVENT THE DYNAMIC SEALS FAIL. SINGLE STATIC SEALS HAVE BACKUP RINGS PLUS BARRIER TYPE SEAL. BARRIER SEALS LIMIT LEAKAGE TO 6 GALLONS/HOUR IN THE EVENT A STATIC SEAL FAILS.

(B) TEST
QUALIFICATION-ENDURANCE CYCLING-400 MISSION DUTY CYCLES UNDER LOAD AT

MAXIMUM TEMPERATURE OF 275 DEGREES F. ACTUATOR WAS VIBRATED AT FLIGHT LEVELS AND TESTED AT -65 AND 250 DEGREES F. 100,000 PRESSURE IMPULSE CYCLES AT EACH SUPPLY AND RETURN PORT, AT 230 DEG F. SUPPLY PORTS CYCLED FROM 3,000 PSIG TO 4,500 PSIG TO 1,500 PSIG, BACK TO 3,000 PSIG EACH CYCLE; RETURN PORTS, FROM 750 PSIG TO 1,500 PSIG TO 0 PSIG, BACK TO 750 PSIG. PERFORMANCE RECORD TESTS CONDUCTED AT 35 AND 225 DEGREES F FOLLOWING ENDURANCE TESTING. BURST PRESSURE OF 9,000 PSIG APPLIED AT SUPPLY PORTS; 4,500 PSIG, TO RETURN. VERIFIED THAT ALL PARTS WERE WITHIN ACCEPTABLE LIMITS DURING DISASSEMBLY AND INSPECTION AT COMPLETION OF QUALIFICATION.

ACCEPTANCE-PROOF PRESSURE OF 4,500 PSIG APPLIED AT SUPPLY PORTS. BURN-IN PRESSURE IMPULSE CYCLE TESTS AT 240 DEGREES F: (1) 1,500 IMPULSE CYCLES, 2,400-3,800 PSIG APPLIED AT SUPPLY PORTS, (2) SIMULTANEOUSLY, 1,500 IMPULSE CYCLES, 0-1,500 PSIG AT RETURN PORTS. STATIC LEAK CHECK AT NULL WITH NORMAL OPERATING PRESSURES AND NO EXTERNAL LOAD. ACTUATOR PERFORMANCE TESTS VERIFY ALL HYDRAULIC SEALS ARE OPERATIONAL. FLUID FROM ACTUATOR IS VERIFIED TO MEET CLEANLINESS LEVEL 190 PER MA0110-301.

OMRSD-HYDRAULIC SYSTEM INSPECTION, PERFORMED PRIOR TO EACH MISSION. VISUAL INSPECTION FOR EVIDENCE OF LEAKAGE OR DAMAGE. HYDRAULIC FLUID SAMPLES ARE TAKEN AFTER EVERY FLIGHT AND VERIFIED TO BE WITHIN SPECIFIED CLEANLINESS LEVELS.

(C) INSPECTION

RECEIVING INSPECTION
EACH SEAL AND BACKUP RING IS 100 PERCENT INSPECTED FOR SIZE (ID, OD AND CROSS SECTION), FINISH (UNDER MAGNIFICATION) AND SELECTED MATERIAL PROPERTIES. VENDOR MATERIAL CERTIFICATIONS ARE VERIFIED.

SPECIAL PROCESSES
ALL SEALING SURFACES ARE 100 PERCENT INSPECTED FOR SIZE AND FINISH PER SPECIAL PROCEDURE. SELECTED CRITICAL SEALING SURFACES ARE VERIFIED BY ROCKWELL AND DCAS MANDATORY INSPECTION.

CONTAMINATION CONTROL
PARTS AND ASSEMBLY TOOLS/AIDS ARE CLEANED PRIOR TO ASSEMBLY. ASSEMBLY LUBRICANTS ARE WITHIN CLEANLINESS LEVELS AS PRESCRIBED BY DOCUMENTATION. TEST MEDIA VERIFIED BY MCOG CONTAMINATION CONTROL PLAN. END ITEM FLUID SAMPLE ANALYSIS VERIFIED PRIOR TO SHIPMENT.

ASSEMBLY/INSTALLATION
ALL SEALS AND MATING SURFACE FINISHES ARE INSPECTED PER SPECIAL PROCEDURE. O-RING AND BACKUP RING INSTALLATIONS ARE VERIFIED BY MANDATORY INSPECTION. TORQUES ARE VERIFIED BY MANDATORY INSPECTION. SHIM THICKNESSES ARE VERIFIED BY ASSEMBLER AND IN-PROCESS INSPECTOR. PHOTOGRAPHS OF SINGLE BACKUP RING SEAL INSTALLATIONS ARE TAKEN. CORRECT SEAL PART NUMBER VERIFIED, INSPECTION OF SEAL MATING PART SURFACE FINISHES AND COMPONENT INTEGRITY VERIFIED, SEALS AND MATING SURFACES ARE LUBRICATED PRIOR TO ASSEMBLY. SEAL INSTALLATIONS ARE PERFORMED IN CLEAN ROOM ENVIRONMENT. CERTIFIED PERSONNEL ARE UTILIZED, AND SPECIALLY DESIGNATED ASSEMBLY AIDS ARE REQUIRED.

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TESTING
EXTERNAL LEAKAGE IS VERIFIED BY ATP TO BE WITHIN ACCEPTABLE LIMITS. ROCKWELL DESIGN AND QUALITY PERSONNEL, WITH NASA PARTICIPATION, CONDUCT A DETAILED ACCEPTANCE REVIEW OF THE HARDWARE AT THE VENDOR'S FACILITY, PRIOR TO THE SHIPMENT OF EACH END ITEM COVERED BY CONTROL PLAN. ATP VERIFICATION IS MIP FOR RI QA REPRESENTATIVE.

(D) FAILURE HISTORY
THERE IS NO HISTORY OF FAILURE FOR THIS FAILURE MODE.

(E) OPERATIONAL USE
NONE