

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : FLIGHT CONTROL MECH FMEA NO 02-2B -A01-ST-6 REV: 12/04/87

ASSEMBLY : TVC ACTUATOR
P/N RI : MC621-0015
P/N VENDOR: MOOG
QUANTITY : 6
: TWO FOR EACH ENGINE

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

CRIT. FUNC: 1
CRIT. HDW: 1

PREPARED BY: DES N LEVERT
REL C NELSON
QE M SAVALA

REDUNDANCY SCREEN: A-N/A B-N/A C-N/A
APPROVED BY: *[Signature]*
DEST. *[Signature]*
REL. *[Signature]*
QE *[Signature]*

SSM *[Signature]*
REL. *[Signature]*
QE *[Signature]*

ITEM:
ACTUATOR, SSME TVC, STRUCTURE

FUNCTION:
PROVIDES THE FORCE AND CONTROL TO GIMBAL THE SSME AND MAINTAIN COMMANDED ENGINE BELL POSITIONS.

FAILURE MODE:
FRACTURE OF ACTUATOR TAILSTOCK, ROD END, PISTON HEAD, PISTON ROD

CAUSE(S):
MATERIAL DEFECT, FATIGUE

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

(A) LOSS OF ONE ACTUATOR FUNCTION.

(B) POSSIBLE LOSS OF ONE ENGINE POSITION CONTROL WHICH MAY CAUSE CAUSE ENGINE COLLISION. DURING ENTRY, POSSIBLE ENGINE INTERFERENCE WITH BODY FLAP FUNCTION.

(C,D) POSSIBLE LOSS OF MISSION, CREW/VEHICLE. LOSS OF FUNCTION CAN RESULT IN LOSS OF VEHICLE CONTROL.

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

(A) DESIGN
PISTON HEAD MARGIN OF SAFETY (MS) OF 0.21 MINIMUM (MIN); BOTTOM PITCH AND YAW MS IS 0.41 MIN, ROD END MS IS 0.25 MIN, PISTON ROD MS IS 0.13 MIN AND TAIL STOCK TOP PITCH MS IS 1.17 MIN, AND BOTTOM PITCH AND YAW MS IS 0.73 MIN, WITH FRACTURE MECHANICS APPLIED.

(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 WAS TESTED AT -65 AND 275 DEGREES F. 100,000 PRESSURE IMPULSE CYCLES AT EACH SUPPLY AND RETURN PORT, AT 230 DEGREES F.

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SUPPLY PORTS WERE 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. BURST PRESSURE OF 9,000 PSIG APPLIED AT SUPPLY PORTS; 4,500 PSIG AT RETURN. VERIFIED THAT ALL PARTS WERE WITHIN ACCEPTABLE LIMITS DURING DISASSEMBLY AND INSPECTION AT COMPLETION OF QUALIFICATION. COLUMN LOAD APPLIED AT 4,500 PSIG IN BOTH EXTEND AND RETRACT POSITIONS. 20g SHOCK PULSE APPLIED IN EACH OF THREE AXES.

ACCEPTANCE-PROOF PRESSURE OF 4,500 PSI APPLIED AT SUPPLY PORTS. BURN-IN PRESSURE IMPULSE CYCLE TESTS AT 240 DEGREES F: (1) 1,500 IMPULSE CYCLES; 2,400-3,800 PSI APPLIED AT SUPPLY PORTS, (2) SIMULTANEOUSLY, 1,500 IMPULSE CYCLES; 0-1,500 PSI AT RETURN PORTS. PERFORMANCE TESTS VERIFY THAT ALL ACTUATOR COMPONENTS MEET OPERATIONAL REQUIREMENTS.

OMRSD-HYDRAULIC SYSTEM INSPECTION AND TVC CYCLING, PERFORMED PRIOR TO EACH MISSION.

(C) INSPECTION

RECEIVING INSPECTION

COMPONENT RAW MATERIAL CERTIFICATIONS ARE VERIFIED BY INSPECTION AND ANALYSIS.

CRITICAL PROCESSES

SWAGING OF ROD END AND TAILSTOCK BEARINGS IS VERIFIED BY INSPECTION.

NDE

PIECE PARTS EVALUATED BY SELECTED PENETRANT, MAGNETIC PARTICLE, ULTRASONIC, AND RADIOGRAPHIC INSPECTIONS.

SPECIAL PROCESSES

CRITICAL/CLOSE TOLERANCE DIMENSIONS AND FINISHES ARE 100 PERCENT INSPECTED FOLLOWING MACHINING.

ASSEMBLY/INSTALLATION

CLOSE TOLERANCE FITS AND ASSEMBLY TORQUES ARE VERIFIED BY INSPECTION. PERSONNEL ARE TRAINED/CERTIFIED IN THE USE OF SPECIALLY DESIGNATED TOOLS/FIXTURES WHICH ARE REQUIRED IN ASSEMBLY DOCUMENTATION.

TESTING

ATP IS VERIFIED BY INSPECTION. 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 THE CONTROL PLAN.

HANDLING/PACKAGING

HANDLING/PACKAGING PROCESSES UTILIZE SPECIALLY DESIGNED CONTAINERS AND INSERTS PROTECTING FROM STRUCTURAL/ENVIRONMENTAL DAMAGE.

(D) FAILURE HISTORY

THERE IS NO HISTORY OF FAILURE FOR THIS FAILURE MODE.

(E) OPERATIONAL USE

NONE.