

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-3A-6402-X

SUBSYSTEM NAME: ORBITAL MANEUVER

REVISION : 2 89/08/08

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
■ LRU :	ACTUATOR, ENGINE GIMBAL, PITCH	MC621-0009-2161
■	AEROJET/AIRESEARCH	1186897
■ LRU :	ACTUATOR, ENGINE GIMBAL, YAW	MC621-0009-2163
■	AEROJET/AIRESEARCH	1186898

■ EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
GIMBAL OUTPUT DRIVE ASSEMBLY INCLUDING ACME SCREW, NUT TUBE ASSEMBLY,
END BEARINGS AND ATTACHMENT FITTINGS.

■ QUANTITY OF LIKE ITEMS: 4
1 FOR EACH OF 4 ACTUATORS

■ FUNCTION:
THE ACME SCREW CONVERTS THE MOTOR ROTARY MOTION TO LINEAR MOTION. THE
END BEARINGS PROVIDE ACTUATOR ATTACH POINTS BETWEEN THE ENGINE INJECTOR
FLANGE AND VEHICLE TO ALLOW MOVEMENT OF THE ENGINE AND SWIVELING
BETWEEN PITCH AND YAW ATTACH POINTS. ACME SCREW CAUSES THE NUT TUBE TO
TRANSLATE AND CAUSE MOVEMENT OF THE GIMBAL RING FOR ENGINE THRUST
VECTOR CONTROL. THE REDUNDANT ACME NUT TUBE APPLIES THE MOTOR TORQUE
THROUGH SPLINE TEETH EXTENDING ALONG THE NUT TUBE TO CAUSE THE NUT TUBE
TO ROTATE AROUND THE SCREW AND TRANSLATE FOR ENGINE GIMBALLING. IN ONE
CASE THE ACME SCREW ROTATES WITHIN THE NUT TUBE AND IN THE OTHER IT IS
STATIONARY AND THE NUT TUBE ROTATES ABOUT IT.

SHUTTLE CRITICAL ITEMS LIST - ORBITER

NUMBER: 03-3A-6402-02

REVISION: 2 01/01/87

SUBSYSTEM: ORBITAL MANEUVER
LRU :ACTUATOR, ENGINE GIMBAL, PITCH
ITEM NAME: ACTUATOR, ENGINE GIMBAL, YAW

CRITICALITY OF THIS
FAILURE MODE:IR2

- FAILURE MODE:
PHYSICAL BINDING/JAMMING, FAILS OUT OF TOLERANCE, EXCESS POWER/FORCE
REQUIRED.

MISSION PHASE:
LO LIFT-OFF
OO DE-ORBIT

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

- CAUSE:
CONTAMINATION, CORROSION, INADEQUATE LUBE, EXCESS WEAR OR FORCE,
IMPROPER OR DEFECTIVE MATERIAL, TOLERANCE OR CLEARANCE, TUBE/SHAFT BENT,
SHOCK, VIBRATION, TEMPERATURE, VACUUM.

- CRITICALITY 1/1 DURING INTACT ABORT ONLY? N

- REDUNDANCY SCREEN A) PASS
- B) PASS
- C) PASS

PASS/FAIL RATIONALE:

- A)
- B)
- C)

- FAILURE EFFECTS -

- (A) SUBSYSTEM:
LOSS OF FUNCTION - REQUIRES ENGINE SHUT-DOWN (LOSS OF TVC - INABILITY
TO GIMBAL ONE AXIS OF ONE ENGINE).
- (B) INTERFACING SUBSYSTEM(S):
DEGRADATION OF INTERFACE SUBSYSTEM - EXCESS POWER DRAIN.
- (C) MISSION:
POSSIBLE EARLY MISSION TERMINATION. REDLINE ADDITIONAL PROPELLANT FOR
RCS DEORBIT BURN. NEXT PLS DEORBIT IF SUFFICIENT PROPELLANT NOT
AVAILABLE.

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- (D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT. ENGINE CAN BE ISOLATED AND PROPELLANT UTILIZED BY OTHER ENGINE.
- (E) FUNCTIONAL CRITICALITY EFFECTS
POSSIBLE CREW/VEHICLE LOSS - IR EFFECT ASSUMES LOSS OF USE OF BOTH OMS ENGINES AND INADEQUATE PROPELLANT FOR RCS DEORBIT.

- DISPOSITION RATIONALE -

- (A) DESIGN:
ACTUATOR IS DESIGNED TO PREVENT BINDING AND JAMMING. TIGHT TOLERANCES ARE UTILIZED THROUGHOUT ACTUATOR. BEARINGS ARE USED TO FACILITATE MOVEMENT, AND BOTH DRY LUBE AND WET LUBE ARE USED TO MINIMIZE FRICTION AND WEAR. TIGHT FIT BETWEEN RACE AND UNIBALL PREVENTS ENTRANCE OF CONTAMINATION AND ACTS AS WIPER TO INSURE CLEAN SURFACES. MOTOR HAS SUFFICIENT POWER TO DRIVE AND HOLD ENGINE UNDER ALL OPERATING ENVIRONMENTS. REDUNDANT ENGINE SYSTEMS ARE PROVIDED.

- (B) TEST:
QUALIFICATION TESTS
ACTUATOR COMPONENT QUAL TESTS INCLUDED VIBRATION, THERMAL VACUUM, HOLDING CHARACTERISTICS, LIFE CYCLE, BENCH/DESIGN SHOCK AND ULTIMATE LOAD. GIMBAL ACTUATOR WAS ALSO VERIFIED DURING SYSTEM EVALUATION AND QUAL TESTS ON ENGINE SUBSYSTEM.

ACCEPTANCE TESTS
IRREVERSIBILITY, END PLAY, TRANSIENT RESPONSE, BRAKING, ELECTRICAL POWER, SLEW RATE AND FORCE OUTPUT.

GROUND TURNAROUND

V79AZ0.010 PERFORMS LEFT OMS TVC INTERFACE VERIFICATION FOR FIRST FLIGHT AND EVERY 5 FLIGHTS.

V79AZ0.020 PERFORMS RIGHT OMS TVC INTERFACE VERIFICATION FOR FIRST FLIGHT AND EVERY 5 FLIGHTS.

V79AZ0.030 PERFORMS LEFT OMS TVC VERIFICATION ON UNINSTALLED POD FOR FIRST FLIGHT AND CONTINGENCY.

V79AZ0.040 PERFORMS RIGHT OMS TVC VERIFICATION ON UNINSTALLED POD FOR FIRST FLIGHT AND CONTINGENCY.

FILE II OF SOOFA0.700 PERFORMS OMS GIMBAL PROFILE EVERY FLIGHT.

V43CE0.030 REQUIRES INSPECTION OF POD INTERIOR AND ENGINE COMPARTMENT EVERY 5 FLIGHTS.

- (C) INSPECTION:
RECEIVING INSPECTION
RECEIVING INSPECTION VERIFIES MATERIAL AND PROCESS CERTIFICATIONS.

CONTAMINATION CONTROL

INSPECTION VERIFIES CLEANLINESS AND CORROSION PROTECTION REQUIREMENTS.

ASSEMBLY/INSTALLATION

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-3A-6402-02

MANUFACTURING, ASSEMBLY, AND INSTALLATION PROCEDURES ARE VERIFIED BY INSPECTION. CRITICAL DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. MANDATORY INSPECTION POINTS ARE VERIFIED BY INSPECTION.

CRITICAL PROCESSES

INSPECTION VERIFIES HEAT TREATING, NITRIDING, ANODIZATION, GLASS BEAD PEENING, CHROME PLATING AND DRY FILM LUBE.

NONDESTRUCTIVE EVALUATION

INSPECTION VERIFIES FLORESCENT PENETRANT INSPECTION AND MAGNETIC PARTICLE INSPECTION OF DETAILED PARTS.

TESTING

INSPECTION VERIFIES TAKING OF TENSILE TEST SPECIMENS, VERIFIES TENSILE TESTING, AND VERIFIES ULTIMATE TENSILE STRENGTH, YIELD STRENGTH, AND % ELONGATION. TEST EQUIPMENT AND TOOL CALIBRATION IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

HANDLING, PACKAGING STORAGE AND SHIPPING REQUIREMENTS ARE VERIFIED BY INSPECTION. PARTS PROTECTION IS VERIFIED BY INSPECTION.

■ (D) FAILURE HISTORY:

NO FLIGHT FAILURES OF THIS TYPE HAVE OCCURRED. A PREPRODUCTION ACTUATOR USED AT WSTF DID JAM DUE TO HIGH FRICTION (REF. CAR NO. AC1898). THE ROLLER BEARINGS AT THE ROD END OF THE ACTUATOR WERE FOUND TO BE BADLY CORRODED. THE CORROSION WAS CAUSED BY LONG EXPOSURE TO THE SEVERE MOISTURE/PROPELLANT VAPOR ENVIRONMENT. CORRECTIVE ACTION, CONSISTING OF APPLICATION OF ELECTROLESS NICKEL PLATING TO THE ROLLER BEARINGS, HAS BEEN IMPLEMENTED ON ALL FLIGHT ACTUATORS.

■ (E) OPERATIONAL USE:

ISOLATE FAILED ENGINE & COMPLETE MISSION REQUIREMENTS USING CROSSFEED FOR PROPELLANT UTILIZATION. REDLINE ADDITIONAL PROPELLANT FOR RCS BACKUP DEORBIT. POSSIBLE MISSION IMPACT (DECREASED PROPELLANT AVAILABLE FROM OMS TO RCS THROUGH INTERCONNECT FOR ON-ORBIT OPERATIONS). NEXT PLS DEORBIT IF PROPELLANT FOR RCS NOT AVAILABLE.

- APPROVALS -

RELIABILITY ENGINEERING: J. N. HART
 DESIGN ENGINEERING : V. F. ROZDOS
 QUALITY ENGINEERING : W. J. SMITH
 NASA RELIABILITY :
 NASA SUBSYSTEM MANAGER :
 NASA QUALITY ASSURANCE :

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