

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.

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

CRITICALITY OF THIS  
FAILURE MODE:1/1

- FAILURE MODE:  
STRUCTURAL FAILURE

MISSION PHASE:

PL PRELAUNCH  
 LO LIFT-OFF  
 OO ON-ORBIT  
 DO DE-ORBIT  
 LS LANDING SAFING

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

- CAUSE:  
EXCESS WEAR OR FORCE, GALLING, IMPROPER OR DEFECTIVE MATERIAL,  
TOLERANCES OR CLEARANCES, TUBE OR GEAR SHAFT BENT, SHOCK, VIBRATION.

- CRITICALITY 1/1 DURING INTACT ABORT ONLY? N

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

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):  
LOSS OF INTERFACE FUNCTION.

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- (C) MISSION:  
POSSIBLE EARLY MISSION TERMINATION. REDLINE ADDITIONAL PROPELLANT FOR RCS DEORBIT BURN. NEXT PLS DEORBIT IF SUFFICIENT PROPELLANT NOT AVAILABLE.
- (D) CREW, VEHICLE, AND ELEMENT(S):  
POSSIBLE CREW/VEHICLE LOSS - FAILURE OF ONE OF THESE LISTED ITEMS COULD RESULT IN A JAGGED/SHARP EDGE WHICH IN TURN COULD PUNCTURE A PROPELLANT LINE RESULTING IN PROPELLANT LEAK, FIRE, OR EXPLOSION.
- (E) FUNCTIONAL CRITICALITY EFFECTS:  
NONE.

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- DISPOSITION RATIONALE -  
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- (A) DESIGN:  
STRUCTURAL DESIGN FACTOR OF SAFETY IS 1.4. THE ACTUATOR HARDWARE IS REDUNDANT EXCEPT FOR THE INTERFACE SURFACE BETWEEN THE ACME SCREW AND NUT TUBE, THE END BEARINGS AND END ATTACHMENT FITTINGS. THE LIFE OF THE BEARINGS HAS BEEN DEMONSTRATED FOR 2X THE ANTICIPATED 100 MISSION USAGE CYCLES. REDUNDANT ENGINE SYSTEMS ARE PROVIDED.
- (B) TEST:  
QUALIFICATION TEST  
INCLUDES VIBRATION UNDER SIMULATED MISSION USAGE CONDITIONS, ENDURANCE CYCLING, RANDOM VIBRATION, HOLDING CHARACTERISTICS, AND ULTIMATE LOADS. ITEM IS ALSO QUALIFIED AS PART OF ENGINE SUBASSEMBLY. ITEM IS VERIFIED DURING SYSTEM EVALUATION AND QUAL TESTS ON ENGINE SUBSYSTEM AT WSTF AND SUPPLIER. ITEM CHECKED DURING ATP AND PRE-FLIGHT TESTS.

## ACCEPTANCE TEST

EXAMINATION OF PRODUCT, ACCEPTANCE VIBRATION, IRREVERSIBILITY, END PLAY, TRANSIENT RESPONSE, BRAKING, ELECTRICAL POWER, SLEW RATE AND FORCE OUTPUT.

## GROUND TURNAROUND

V79AZD.010 PERFORMS LEFT OMS TVC INTERFACE VERIFICATION FOR FIRST FLIGHT AND EVERY 5 FLIGHTS.  
V79AZD.020 PERFORMS RIGHT OMS TVC INTERFACE VERIFICATION FOR FIRST FLIGHT AND EVERY 5 FLIGHTS.  
V79AZD.030 PERFORMS LEFT OMS TVC VERIFICATION ON UNINSTALLED POD FOR FIRST FLIGHT AND CONTINGENCY.  
V79AZD.040 PERFORMS RIGHT OMS TVC VERIFICATION ON UNINSTALLED POD FOR FIRST FLIGHT AND CONTINGENCY.  
FILE II OF SOOFAO.700 PERFORMS OMS GIMBAL PROFILE EVERY FLIGHT.  
V43CED.030 REQUIRES INSPECTION OF POD INTERIOR AND ENGINE COMPARTMENT

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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

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 ON PRODUCTION UNITS.

■ (E) OPERATIONAL USE:

ISOLATE FAILED ENGINE AND 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 BACKUP NOT AVAILABLE. IF FAILURE ALSO CAUSES PROPELLANT LEAK, USE PERIGEE ADJUST BURN TO DEplete PROPELLANT FROM LEAKING POD (OUT OF PLANE IF NECESSARY) AND REDUCE DELTA V REQUIREMENT FOR DEORBIT. AFTER LEAKED PROPELLANT HAS DISPERSED, PERFORM DEORBIT BURN WITH GOOD POD. (LEAKAGE IS ISOLATABLE BY USE OF PROPELLANT TANK ISOLATION VALVES.)

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- APPROVALS -

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

*[Handwritten signatures and dates]*  
 : *[Signature]* 5-10-89  
 : *[Signature]* 9-10-89  
 : *[Signature]*  
 : *[Signature]* 9/1/89  
 : *[Signature]* 9/1/89  
 : *[Signature]* 10/21/89