

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ORBITAL MANEUVER FMEA NO 03-3 -6409 -1 REV:11/14/87

ASSEMBLY : ENGINE GIMBAL ACTUATOR CRIT. FUNC: 1R
 P/N RI : MC621-0009 CRIT. HDW: 2
 P/N VENDCR: 1186510 VEHICLE 102 103 104
 QUANTITY : 8 EFFECTIVITY: X X X
 : 4 FOR EA ENG SUBSYSTEM PHASE(S): PL LO OO DO X LS

PREPARED BY: APPROVED BY (NASA):
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ITEM:
 BEARING, GIMBAL RING.

FUNCTION:
 FOUR BEARINGS FACILITATE SWIVEL OF THE GIMBAL RING AND 2-AXIS ENGINE GIMBALLING.

FAILURE MODE:
 STRUCTURAL FAILURE, BINDING

CAUSE(S):
 EXCESS WEAR OR FORCE, CORROSION; IMPROPER INSTALLATION OR DEFECTIVE MATERIAL, TOLERANCES OR CLEARANCES; SHOCK, VIBRATION, LOSS OF LUBRICANT.

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

(A) LOSS OF FUNCTION - MAY REQUIRE ENGINE SHUT-DOWN (LOSS OF TVC - INABILITY TO GIMBAL ENGINE).

(B) LOSS OF INTERFACE FUNCTION.

(C) POSSIBLE EARLY MISSION TERMINATION. REDLINE ADDITIONAL PROPELLANT FOR RCS DEORBIT BURN. DEORBIT NEXT PRIMARY LANDING SITE IF SUFFICIENT PROPELLANT NOT AVAILABLE.

(D) NO EFFECT. ENGINE CAN BE ISOLATED AND PROPELLANT UTILIZED BY OTHER ENGINE.

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(E) FUNCTIONAL CRITICALITY EFFECT - POSSIBLE CREW/VEHICLE LOSS - LOSS OF THRUST VECTOR CONTROL. 1R EFFECT ASSUMES FAILURE OF OTHER OMS ENGINE AND INADEQUATE PROPELLANT FOR RCS DEORBIT. BEARING FAILURE IS NOT ANTICIPATED TO RESULT IN LOSS OF ENGINE RESTRAINT.

DISPOSITION & RATIONALE:

(A) DESIGN (B) TEST (C) INSPECTION (D) FAILURE HISTORY (E) OPERATIONAL USE

(A) DESIGN

THE DESIGN FACTOR OF SAFETY IS 1.4. HIGH STRENGTH CORROSION RESISTANT STEEL (STAR J CRES 440) IS UTILIZED. DRY FILM LUBRICANT IS USED. THE REDUNDANT ENGINE SUBSYSTEM PROVIDES REDUNDANCY. ADEQUATE CLEARANCES ARE USED TO PREVENT BINDING OR INTERFERENCE.

(B) TEST

QUALIFICATION TESTS

USED ON STRUCTURAL TEST ARTICLE FOR POD STRUCTURAL QUAL. QUALIFIED AS PART OF ENGINE ASSY, 138 HOT-FIRE TESTS DURING ENGINE QUAL. 498 TESTS AT SYSTEM LEVEL AT WSTF. TESTS SHOW MARGIN OF 2X ANTICIPATED MISSION USAGE CYCLES. IN EXCESS OF 90,000 GIMBAL CYCLES WERE COMPLETED. VIBRATION TEST AT ENGINE LEVEL.

ACCEPTANCE TESTS

EXAMINATION OF PRODUCT. INSTALLATION VERIFIED BY VISUAL INSPECTION DURING ASSEMBLY.

GROUND TURNAROUND

V43CE0.030 PERFORMS DETAILED VISUAL INSPECTION EVERY FIVE FLIGHTS OR WHENEVER POD IS REMOVED.

V79AZ0.010 PERFORMS LEFT POD TVC INTERFACE VERIFICATION.

V79AZ0.020 PERFORMS RIGHT POD TVC INTERFACE VERIFICATION.

V79AZ0.030 PERFORMS LEFT POD ONLY TVC VERIFICATION.

V79AZ0.040 PERFORMS RIGHT POD ONLY TVC VERIFICATION.

SOOFA0.700 PERFORMS OMS GIMBAL PROFILE EACH FLIGHT.

TVC TESTS INCLUDE POSITION ACCURACY, TRAVEL AND RESPONSE, HEAT SHIELD CLEARANCE AND MOTOR POWER.

(C) INSPECTION

RECEIVING INSPECTION

MATERIALS AND PROCESSES CERTIFICATIONS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS TO LEVEL 100A AND CORROSION PROTECTION PROVISIONS ARE VERIFIED BY INSPECTION.

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ASSEMBLY/INSTALLATION

MANUFACTURING, ASSEMBLY AND INSTALLATION PROCEDURES ARE VERIFIED BY INSPECTION. CRITICAL DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. COMPONENTS ARE DIMENSIONALLY VERIFIED BY INSPECTION DURING FABRICATION. THE RING IS DIMENSIONALLY VERIFIED BY INSPECTION AFTER ASSEMBLY.

NONDESTRUCTIVE EVALUATION

PENETRANT AND RADIOGRAPHIC INSPECTION OF WELDS ARE VERIFIED BY INSPECTION. PENETRANT INSPECTION OF THE STELLITE BALL AFTER SINTERING, MACHINING AND PRIOR TO LUBRICANT APPLICATION IS VERIFIED BY INSPECTION.

TESTING

TEST EQUIPMENT AND TOOL CALIBRATION ARE VERIFIED BY INSPECTION. ACCEPTANCE TEST IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

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

(D) FAILURE HISTORY

CAR AC6673 RECORDS THE INITIAL INSTANCE OF CRACKING OF THRUST MOUNT GIMBAL BEARINGS DUE TO HIGH INSTALLATION LOADS TRANSMITTED BY THE HYDRAULIC PRESS. INVESTIGATION REVEALED A NUMBER OF SIMILAR CONDITIONS. ASSEMBLY CHANGES INCLUDING IMPROVED TOOLING AND INSTALLATION METHODS FOR ALIGNMENT WERE IMPLEMENTED TO LIMIT ANY EXCESS INSTALLATION FORCE. ALL ENGINES ASSEMBLED PRIOR TO CORRECTIVE ACTION IMPLEMENTATION HAVE BEEN RETURNED TO THE SUPPLIER FOR BEARING REPLACEMENT.

(E) OPERATIONAL USE

IF FAILED ENGINE POSITION VECTOR IS NEAR REQUIRED CENTER OF GRAVITY LOCATION, THE ENGINE MAY BE USED FOR THE DEORBIT BURN. IF ENGINE IS UNAVAILABLE, REDLINE ADDITIONAL PROPELLANT FOR RCS BACKUP DEORBIT. NEXT PLS DEORBIT IF PROPELLANT NOT AVAILABLE. POSSIBLE MISSION IMPACT. DECREASE IN PROPELLANT AVAILABLE FROM OMS TO RCS FOR INTERCONNECT FOR ON-ORBIT OPERATION.