

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ORBITAL MANEUVER FMEA NO 03-3 -6408 -1 REV:12/14/87

ASSEMBLY : ENGINE SUBSYSTEM CRIT. FUNC: 1
P/N RI : MC621-0009 CRIT. HDW: 1
P/N VENDOR: 1186500-29 VEHICLE 102 103 104
QUANTITY : 2 EFFECTIVITY: X X X
: 1 FOR EACH ENGINE PHASE(S): PL X LO X OO X DO X LS

PREPARED BY: DES V F ROZKOS APPROVED BY: DES *[Signature]* REDUNDANCY SCREEN: A- B- C-
REL C M AKERS REL *[Signature]* APPROVED BY (NASA): SSM *[Signature]*
QE W J SMITH QE *[Signature]* REL *[Signature]* 12-9-87
QE *[Signature]* 12-87

ITEM:
GIMBAL RING

FUNCTION:
A BOX SECTIONED RING FABRICATED FROM 6AL-4V TITANIUM ALLOY FORGING IS USED TO ATTACH THE THROAT GIMBALLED ENGINE IN THE CENTER OF THE RING & INTERSECTION OF IMAGINARY LINES CONNECTING PITCH AND YAW BEARINGS. RING IS ATTACHED TO THE VEHICLE & TRANSMITS THRUST LOADS THROUGH 2 MOUNTING PADS & 2 SHORT STRUTS 90 DEG APART.

FAILURE MODE:
STRUCTURAL FAILURE

CAUSE(S):
EXCESS WEAR OR FORCE, IMPROPER ASSEMBLY OR MATERIAL DEFECT, CORROSION, SHOCK, VIBRATION.

EFFECT(S) ON:
(A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE
(A) LOSS OF REDUNDANCY - MAY REQUIRE SHUT-DOWN OF ONE ENGINE (INABILITY TO GIMBAL ENGINE).
(B) DEGRADATION OR LOSS OF INTERFACE FUNCTION. POSSIBLE ENGINE SUBSYSTEM AND VEHICLE STRUCTURE DAMAGE.
(C) POSSIBLE EARLY MISSION TERMINATION. REDLINE ADDITIONAL PROPELLANT FOR RCS BACKUP DEORBIT. NEXT PLS DEORBIT IF SUFFICIENT PROPELLANT NOT AVAILABLE.
(D) POSSIBLE CREW/VEHICLE LOSS-RESULTANT POD AND STRUCTURE DAMAGE COULD RESULT IN LACK OF ENGINE RESTRAINT CAUSING POSSIBLE BREAKING OF

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OMS PROPELLANT LINES AND CONNECTORS.

DISPOSITION & RATIONALE:

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

(A) DESIGN

THE DESIGN FACTOR OF SAFETY IS 1.4. GIMBAL RING UTILIZES BOX CONFIGURATION FOR TORSIONAL RIGIDITY. COMPLETE STRESS ANALYSIS PERFORMED. CORROSION RESISTANT MATERIALS SELECTED. REDUNDANT ENGINE SUBSYSTEM PROVIDES REDUNDANCY.

(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, VIBRATION TEST AT ENGINE LEVEL. ALSO SUBJECTED TO GIMBAL SPRING RATE AND ULTIMATE LOAD TEST.

ACCEPTANCE TEST

EXAMINATION OF PRODUCT, WELD INSPECTIONS, INSTALLATION VERIFIED BY VISUAL INSPECTION DURING ASSEMBLY.

GROUND TURNAROUND

V43CE0.030 PERFORMS DETAILED VISUAL INSPECTION EVERY 5 FLIGHTS OR WHENEVER POD IS REMOVED.

SOOFAC.700 PERFORMS OMS GIMBAL PROFILE EVERY FLIGHT.

V79AZ0.010 AND V79AZ0.020 PERFORMS LEFT & RIGHT OMS TVC VERIFICATION FOR FIRST FLIGHT AND EVERY 5 FLIGHTS.

V79AZ0.030 & V79AZ0.040 PERFORMS LEFT & RIGHT TVC VERIFICATION (POD ONLY) FOR FIRST FLIGHT & CONTINGENCY.

GIMBAL CHECK PERFORMED IN FLIGHT AFTER OMS-1,2, & PRIOR TO DEORBIT.

(C) INSPECTION

RECEIVING INSPECTION

MATERIALS AND PROCESSES CERTIFICATIONS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS TO LEVEL 200 FOR MMH AND 200A FOR NTO AND CORROSION PROTECTION PROVISIONS ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

MANUFACTURING, ASSEMBLY AND INSTALLATION PROCEDURES ARE VERIFIED BY INSPECTION. CRITICAL DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. PHYSICAL AND DIMENSIONAL INSPECTION OF ALL COMPONENTS DURING FABRICATION IS VERIFIED BY INSPECTION. DIMENSIONAL INSPECTION OF RING AFTER ASSEMBLY IS VERIFIED BY INSPECTION.

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NONDESTRUCTIVE EVALUATION

PENETRANT AND RADIOGRAPHIC INSPECTION OF WELDS ARE 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
NONE.

(E) OPERATIONAL USE

PERFORM REMAINING MISSION REQUIREMENTS USING CROSSFEED FOR UTILIZATION OF PROPELLANT FROM POD WITH FAILED ENGINE. POSSIBLE EARLY MISSION TERMINATION BECAUSE STATUS OF OTHER COMPONENTS NEAR THE GIMBAL RING AND ONE MAY BE UNKNOWN. REDLINE ADDITIONAL PROPELLANT FOR RCS BACKUP DEORBIT. NEXT PLS DEORBIT IF PROPELLANT FOR RCS BACKUP NOT AVAILABLE. POSSIBLE MISSION IMPACT. DECREASED PROPELLANT AVAILABLE FROM OMS TO RCS THROUGH INTERCONNECT FOR ON-ORBIT OPERATION.