SUBSYSTEM :LANDING/DECELERATION-LGC   FMEA NO 02-1A -010 -1    REV:09/19/88

| | | | | | |
|---|---|---|---|---|---|
| ASSEMBLY | :MAIN LANDING GEAR (MLG) | | | CRIT. FUNC: | 1 |
| P/N RI | :MC621-0011 | | | CRIT. HDW: | 1 |
| P/N VENDOR | :1170353 MENASCO | VEHICLE | 102 103 104 | | |
| QUANTITY | :2 | EFFECTIVITY: | X X X | | |
| | :ONE LEFT MAIN GEAR | PHASE(S): | PL LO OO DO LS X | | |
| | :ONE RIGHT MAIN GEAR | | | | |

REDUNDANCY SCREEN:  A-    B-    C-

| PREPARED BY: | | APPROVED BY: | | APPROVED BY (NASA): | |
|---|---|---|---|---|---|
| DES | R. A. GORDON | DES | | SSM | |
| REL | J. S. MULLEN | REL | | REL | 9/27 |
| QE | W. J. SMITH | QE | | QE | |

ITEM:
   MAIN LANDING GEAR TORQUE TUBE ASSEMBLY

FUNCTION:
   PROVIDES SUPPORT AND DRIVE TO LOCK BRACE ASSEMBLY FROM THE HYDRAULIC
   ACTUATOR IN RELEASE OF MLG STRUTS, ALSO PROVIDES SUPPORT BETWEEN
   TRUNNION ASSEMBLIES.

FAILURE MODE:
   STRUCTURAL FAILURE

CAUSE(S):
   OVERLOAD, DEFECTIVE PART/MATERIAL.

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

   (A) LOSS OF LOAD CARRYING CAPABILITY.

   (B) DAMAGE TO VEHICLE STRUCTURE.

   (C,D) PROBABLE LOSS OF MISSION/CREW/VEHICLE DUE TO GEAR COLLAPSE.

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

(A) DESIGN
   DESIGNED TO FATIGUE LOAD SPECTRUM FOR LANDING, TAXI, AND GROUND HANDLING
   CONDITIONS.  DESIGNED TO LANDING IMPACT LOADS (SPIN-UP AND SPRING BACK
   INCLUDING  CROSSWIND DRIFT CONDITIONS) USING A MINIMUM FACTOR OF SAFETY
   OF 1.0 TO YIELD STRENGTH OF MATERIAL IN ACCORDANCE WITH ESTABLISHED
   CRITERIA FOR COMMERCIAL AND MILITARY AIRCRAFT.  DESIGNED TO A MINIMUM
   FACTOR OF SAFETY OF 1.4 FOR TAXI AND GROUND HANDLING LOADS MATERIAL
   PROCESSES - BARE PARTS ARE NOT EXPOSED TO CORROSIVE ENVIRONMENT IN
   PLATING SHOP MORE THAN 30 DAYS AND PARTS ARE SHOT PEENED AFTER MACHINE
   OPERATIONS TO PREVENT STRESS CORROSION ON 300 M MATERIALS.

## SHUTTLE CRITICAL ITEMS LIST - ORBITER

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**(B) TEST**

QUALIFICATION TESTS:  CERTIFICATION INCLUDES ULTIMATE STRENGTH TEST,
SHOCK STRUT DROP TESTS, STATIC LOADS TEST, DYNAMIC TESTS AND 400
DEPLOYMENT CYCLES.
THE TORQUE TUBE ASSEMBLY WAS CERTIFIED AS AN INTEGRAL PART OF THE MLG
MECHANISM INSTALLATION (LANDING GEAR OPERATION) - 32 CYCLES OF THE
LANDING GEAR DURING ALT, 15 DEVELOPMENT CYCLES AND 353 QUALIFICATION LI
CYCLES FOR A TOTAL OF 400 CYCLES.  (THE LANDING GEAR WAS CYCLED FROM UP
AND LOCKED TO DOWN AND LOCKED EACH TIME).
ENVIRONMENT:
HIGH TEMP TESTS; 3 CYCLES AT 140 DEG F
COLD TEMP TESTS; 3 CYCLES AT -35 DEG F TO -40 DEG F

THE TORQUE TUBE WAS ALSO TESTED AS AN INTEGRAL PART OF THE MLG SHOCK
STRUT ASSEMBLY DURING DROP TESTS - ELEVEN DROP TESTS WERE PERFORMED TO
SATISFY THE DESIGN REQUIREMENTS FOR THE SHOCK STRUT ASSEMBLY.
MAXIMUM VERTICAL LOAD WAS 179,817 LBS.
MAXIMUM SINK SPEED WAS 11.69 FPS.

FATIGUE LOAD SPECTRUM TESTS WERE CONDUCTED FOR LANDING, LANDING ROLLOUT
BRAKING AND TURNING LOAD CONDITIONS - THE STRUT WAS SUBJECTED TO CYCLIC
APPLICATION OF VERTICAL, FORE/AFT AND SIDE LOADS IN EACH CONDITION.

ACCEPTANCE TESTS:  ACCEPTANCE INCLUDES VERIFICATION THAT CERTIFIED
MATERIALS AND PROCESSES WERE USED.  ACCEPTANCE TESTS ALSO VERIFY
DIMENSIONS, WEIGHTS AND FINISHES.

OMRSD: MLG ZONAL DETAIL VISUAL INSPECTION; THE TORQUE TUBE AND IT'S
ATTACHMENTS ARE INSPECTED FOR CONDITION AND SECURITY.

FREQUENCY - ALL VEHICLES AT GROUND TURNAROUND.

**(C) INSPECTION**

**RECEIVING INSPECTION**
INSPECTION VERIFIES ALL RAW MATERIALS TO COMPLY WITH MATERIAL
REQUIREMENTS THROUGH PERIODIC COUPON ANALYSIS.

**CONTAMINATION CONTROL**
ALL CLEANLINESS LEVELS VERIFIED BY INSPECTION.

**ASSEMBLY/INSTALLATION**
ALL MATERIAL PROCESSES VERIFIED BY MIPS PRIOR TO NEXT MANUFACTURING
OPERATIONS.

**NONDESTRUCTIVE EVALUATION**
MATERIAL SURFACE DEFECTS ARE VERIFIED BY MAGNETIC PARTICLE, NITAL ETCH,
AND ULTRASONIC INSPECTION.

**CRITICAL PROCESSES**
HEAT TREATING, SHOT PEENING, CHROME AND CD-TI PLATING VERIFIED BY
INSPECTION.

# SHUTTLE CRITICAL ITEMS LIST - ORBITER

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**TESTING**
TORSIONAL OVERLOADS ARE VERIFIED BY DYNAMIC AND STATIC TESTS PERFORMED
DURING QUALIFICATION TESTING.

**HANDLING/PACKAGING**
HANDLING AND PACKAGING REQUIREMENTS VERIFIED BY INSPECTION.

(D) **FAILURE HISTORY**
NONE

(E) **OPERATIONAL USE**
NONE

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