

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : LANDING/DECELERATION-LGC FMEA NO 02-1A -111-1

REV: 09/19/8

ASSEMBLY : NOSE LANDING GEAR (NLG)					
P/N RI : MC621-0012					
P/N VENDOR : 1170600 MENASCO					
QUANTITY : 1	VEHICLE	102	103	104	
: ONE	EFFECTIVITY:	X	X	X	
:	PHASE(S):	PL LO	OO DO	LS	

PREPARED BY:		REDUNDANCY SCREEN:	A-	B-	C-
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ITEM:  
NOSE LANDING GEAR TORQUE TUBE ASSEMBLY

FUNCTION:  
PROVIDES SUPPORT AND DRIVE TO LOCK BRACE ASSEMBLY FROM THE HYDRAULIC ACTUATOR IN RELEASE OF THE NLG STRUT, 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.

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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 NLG/ MECHANISM INSTALLATION (LANDING GEAR OPERATION) - 32 CYCLES OF THE LANDING GEAR DURING ALT, 15 DEVELOPMENT CYCLES AND 353 QUALIFICATION L: 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 NLG SHOCK STRUT ASSEMBLY DURING DROP TESTS - TEN DROP TESTS WERE PERFORMED TO SATISFY THE DESIGN REQUIREMENTS FOR THE SHOCK STRUT ASSEMBLY.

MAXIMUM VERTICAL LOAD WAS 109,400 LBS.

MAXIMUM SINK SPEED WAS 13.6 FPS.

FATIGUE LOAD SPECTRUM TESTS WERE CONDUCTED FOR LANDING, LANDING ROLLOU 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:** NLG 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. CORROSION PROTECTION REQUIREMENTS ARE VERIFIED BY INSPECTION.

**ASSEMBLY/INSTALLATION**

ALL MATERIAL PROCESSES VERIFIED BY MIPS PRIOR TO NEXT MANUFACTURING OPERATIONS. DIMENSIONS AND SURFACE ROUGHNESS ARE VERIFIED BY INSPECTION.

**NONDESTRUCTIVE EVALUATION**

MATERIAL SURFACE DEFECTS ARE DETECTED BY MAGNETIC PARTICLE, NITAL ETCH, AND FLOURESCENT PENETRANT INSPECTION.

**CRITICAL PROCESSES**

HEAT TREATING, SHOT PEENING, CHROME AND CD-TI PLATING ARE VERIFIED BY INSPECTION.

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**TESTING**

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

**HANDLING/PACKAGING**

HANDLING AND PACKAGING REQUIREMENTS ARE VERIFIED BY INSPECTION.

**(D) FAILURE HISTORY**

A FAILURE OCCURRED DUE TO LACK OF MATERIAL PLATING PROCESS CONTROLS WHICH RESULTED IN STRUCTURAL FAILURE DUE TO BRITTLINESS. PRIME MANUFACTURER INITIATED NEW CONTROLS. PARTS WERE REPROCESSED BY STRIPPING, INSPECTING, REPLATING AND CERTIFICATION - THIS WAS "NON-FLIGHT" FAILURE, PRIOR TO STS-1.

**(E) OPERATIONAL USE**

NONE.