

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 02-1A-076-X

SUBSYSTEM NAME: LANDING/DECELERATION/LANDING GEAR CONTROL  
REVISION : 0 11/18/88 W

CLASSIFICATION	NAME	PART NUMBER
LRU	NLG SHOCK STRUT ASSEMBLY	MC621-0012
SRU	NLG TORQUE ARMS (MENASCO)	1170605
SRU	NLG TORQUE ARMS (MENASCO)	1170629

QUANTITY OF LIKE ITEMS: 2  
ONE UPPER  
ONE LOWER

DESCRIPTION/FUNCTION:

NLG TORQUE ARMS - MAINTAINS ALIGNMENT BETWEEN AXLE/PISTON ASSEMBLY AND NLG STRUT CYLINDER AND TRANSMITS STEERING ACTUATOR MOVEMENTS TO THE WHEELS.

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SUMMARY

SUBSYSTEM NAME: LANDING/DECELERATION/LANDING GEAR CONTROL  
LRU :NLG SHOCK STRUT ASSEMBLY  
LRU PART #: MC621-0012  
ITEM NAME: NLG TORQUE ARMS (MENASCO)

FMEA NUMBER	ABBREVIATED FAILURE MODE DESCRIPTION	CIL PLG	CRIT	H2D PLG
02-1A-076-01	STRUCTURAL FAILURE	X	1R2	

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 02-1A-076-01

REVISION: 0 11/22/88 W

SUBSYSTEM: LANDING/DECELERATION/LANDING GEAR CONTROL  
LRU :NLG SHOCK STRUT ASSEMBLY  
ITEM NAME: NLG TORQUE ARMS (MENASCO) | CRITICALITY OF THIS FAILURE MODE:1R2

FAILURE MODE:  
STRUCTURAL FAILURE

MISSION PHASE:  
DO DE-ORBIT

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

CAUSE:  
OVERLOAD, DEFECTIVE PART/MATERIAL

CRITICALITY 1/1 DURING ANY MISSION PHASE OR ABORT?, N

REDUNDANCY SCREEN A) PASS  
B) FAIL  
C) PASS

PASS/FAIL RATIONALE:  
A)

B)  
FAILS SCREEN "B" BECAUSE THERE IS NO INDICATION OF THIS FAILURE PRIOR TO LANDING.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:  
LOSS OF NWS ACTUATOR STEERING AND DAMPING FUNCTION.

(B) INTERFACING SUBSYSTEM(S):  
NO EFFECT, THE NLG CO-ROTATING WHEELS PROVIDE SUFFICIENT DAMPING AFTER LOSS OF ACTUATOR DAMPING FUNCTION.

(C) MISSION:  
POSSIBLE LOSS OF MISSION/CREW/VEHICLE WITH TWO FAILURES - LOSS OF NOSE WHEEL STEERING AND LOSS OF DIFFERENTIAL BRAKING. THESE FAILURES WILL CAUSE LOSS OF DIRECTIONAL CONTROL.

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SAME AS C.

## RATIONALE FOR CRITICALITY:

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- DISPOSITION RATIONALE -  
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## (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 FOR 32K AND 65K PAYLOAD CONFIGURATION. MATERIAL PROCESSES-BARE PARTS ARE NOT EXPOSED TO CORROSIVE ACID ENVIRONMENT IN PLATING SHOP MORE THAN 30 DAYS AND PARTS ARE SHOT PEENED AFTER MACHINE OPERATIONS TO PREVENT STRESS CORROSION ON 300 M MATERIALS.

## (B) TEST:

## QUALIFICATION TESTS:

CERTIFICATION INCLUDES ULTIMATE STRENGTH TEST, SHOCK STRUT DROP TESTS, STATIC LOADS TEST, DYNAMIC TESTS AND 400 DEPLOYMENT CYCLES. THE TORQUE ARM ASSEMBLY WAS CERTIFIED AS AN INTEGRAL PART OF THE NLG/MLG MECHANISM INSTALLATION (LANDING GEAR OPERATION) - 32 CYCLES OF THE LANDING GEAR DURING ALT, 15 DEVELOPMENT CYCLES AND 353 QUALIFICATION LIFE 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 ARM ASSEMBLY 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 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: NLG ZONAL DETAIL VISUAL INSPECTION; THE UPPER AND LOWER TORQUE ARMS ARE INSPECTED FOR CONDITION AND SECURITY.

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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 VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

ALL MATERIAL PROCESSES VERIFIED BY MIP'S PRIOR TO NEXT MANUFACTURING OPERATIONS. INSTALLATION OF COTTER PIN AND LOCK WIRE VERIFIED AT ASSEMBLY LEVEL. BUSHINGS AND BUSHING INSTALLATION VERIFIED BY INSPECTION. DIMENSIONS AND SURFACE ROUGHNESS REQUIREMENTS VERIFIED BY INSPECTION.

CRITICAL PROCESSES

INSPECTION VERIFIES HEAT TREATMENT AND SHOT PEENING PER MIL-S-13165.

NONDESTRUCTIVE EVALUATION

MATERIAL SURFACE DEFECTS ARE DETECTED BY FLUORESCENT PENETRANT INSPECTION.

TESTING

ATP IS VERIFIED BY INSPECTION. TENSILE TESTING AFTER HEAT TREATING IS VERIFIED BY INSPECTION. STRESS CORROSION TESTING AFTER HEAT TREATING IS ALSO VERIFIED BY INSPECTION.

PACKAGING/HANDLING

HANDLING AND PACKAGING REQUIREMENTS ARE VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:

NONE.

(E) OPERATIONAL USE:

NONE.

- APPROVALS -

RELIABILITY ENGINEERING: G. T. TATE  
DESIGN ENGINEERING : R. A. GORDON  
QUALITY ENGINEERING : W. J. SMITH  
NASA RELIABILITY : G. L. JACKSON  
NASA SUBSYSTEM MANAGER :  
NASA QUALITY ASSURANCE :

*[Handwritten signatures and dates]*  
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