

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : LANDING/DECELERATION-LGC FMEA NO 02-1A -075 -1 REV:09/19/8

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

PREPARED BY:		REDUNDANCY SCREEN:	A-	B-	C-
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ITEM:
NOSE LANDING GEAR SHOCK STRUT INNER AND OUTER CYLINDER AND LOAD CARRYING MEMBERS

FUNCTION:
NLG STRUT/DAMPER - A PASSAGE OF HYDRAULIC FLUID THROUGH AN ORIFICE ABSORBS THE ENERGY OF IMPACT AND WHERE DRY NITROGEN IS USED AS THE ELASTIC MEDIUM TO RESTORE THE UNSPRUNG PARTS TO THEIR EXTENDED POSITION

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) LOSS OF MISSION/CREW/VEHICLE IF NOSE GEAR COLLAPSES.

DISPOSITION & RATIONALE:

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

(A) DESIGN

UNDER WORST CASE LOADING (FLAT STRUT DUE TO GN₂ LEAKAGE) THE STRUT IS CAPABLE OF WITHSTANDING ONE LANDING AT A DESIGN WEIGHT OF 207,000 POUNDS AND SINK SPEED OF 9.6 FEET PER SECOND WITH CORRESPONDING LANDING ROLLOUT AND BRAKING CONDITIONS, WITH NO YIELDING OF THE STRUCTURAL MEMBERS. DESIGNED TO FATIGUE LOAD SPECTRUM FOR LANDING, TAXI AND GROUND HANDLING CONDITIONS. DESIGNED TO LANDING IMPACT LOADS (SPIN UP AND SPRING BACK

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INCLUDING CROSSWIND 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 ACID ENVIRONMENT IN PLATING SHOP MORE THAN 30 DAYS AND PARTS ARE SHOT PEENED AFTER MACHINE OPERATIONS TO PREVENT STRESS CORROSION ON 300M MATERIALS.

(B) TEST

SHOCK STRUT QUALIFICATION TESTS INCLUDES; STATIC LOAD TESTS DYNAMIC TESTS, DROP TESTS AND FATIGUE LOAD TESTS. THE STATIC TEST PROGRAM APPLIED DESIGN AND ULTIMATE LOADS LANDING, TAXI AND GROUND HANDLING CONDITIONS TWO COMBINATIONS OF VERTICAL LOADS (71 KIPS AND 87 KIPS) AND FWD/AFT LOADS (44.5 KIPS AND 57.7 KIPS) WERE APPLIED TO THE STRUT DURING THE LANDING CONDITIONS TEST. EIGHT DIFFERENT TAXI LOADS TESTS AND FOUR GROUND HANDLING LOADS TEST CONDITIONS WERE ALSO PERFORMED.

TAXI CONDITION - THE STRUT WAS LOADED TO SIMULATE 3 POINT BRAKING, UNSYMMETRICAL BRAKING, TAXI BUMP AND LEFT/RIGHT TURN CONDITIONS WITH 32K/65K PAYLOADS AND 187 KIPS/227 KIPS VEHICLE WEIGHTS. VERTICAL LOADS RANGED FROM 30.3 KIPS TO 65.0 KIPS AND SIDE LOADS RANGED FROM ZERO TO 12.4 KIPS. DESIGN MINIMUM FACTOR OF SAFETY WAS 1.35 TO ULTIMATE STRENGTH.

GROUND HANDLING: THE STRUT WAS LOADED TO SIMULATE JACKING LOADS FOR 65 PAYLOAD AND 227 KIPS VEHICLE WEIGHT. APPLIED VERTICAL LOADS RANGED FROM 30.3 KIPS TO 40.8 KIPS. FORE/AFT LOADS AND SIDE LOADS RANGED FROM ZERO TO 34.1 KIPS AND ZERO TO 17.1 KIPS RESPECTIVELY. DESIGN MINIMUM FACTOR OF SAFETY WAS 1.5 TO ULTIMATE STRENGTH.

SHOCK STRUT ASSEMBLY 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.

FATIGUE STRESS ANALYSIS DETERMINED THE FATIGUE LIFE OF THE SHOCK STRUT ASSEMBLY A SCATTER FACTOR OF 4.0 WAS APPLIED TO THE LIFE CYCLE. THE PRESENT CONFIGURATION OF THE STRUT HAS A MARGIN OF SAFETY OF 5 PERCENT (ABOVE ALLOWABLE YIELD LOADS) FOR TUBULAR SECTIONS AND 16 PERCENT (ABOVE ALLOWABLE YIELD LOADS) FOR LUG SECTIONS.

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; CHECKS THE EXTERNAL SURFACES OF THE SHOCK STRUT FOR DAMAGED PAINT OR CORROSION. INSPECTS MAIN PISTON (EXPOSED AREA) CHROME PLATE SURFACE WITH PISTON EXTENDED (ORBITER ON JACKS) FOR DAMAGE AND INSPECTS THE SHOCK STRUT ASSEMBLY AT THE UPPER

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TRUNNION PIN AND UPPER TRUNNION LUG ATTACH POINTS FOR CONDITION AND SECURITY.
AN EXTERNAL VISUAL SURVEILLANCE INSPECTION OF THE LANDING GEARS FOR OBVIOUS EVIDENCE OF STRUCTURAL FAILURE OR DEFORMATION IS ALSO PERFORMED
FREQUENCY - ALL VEHICLES AT EACH GROUND TURNAROUND.

(C) INSPECTION

RECEIVING INSPECTION

MATERIALS AND PROCESS CERTIFICATIONS ARE VERIFIED BY INSPECTION. VISUAL INSPECTION AND IDENTIFICATION ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS AND CORROSION PROTECTION REQUIREMENTS ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

MANUFACTURING, INSTALLATION AND ASSEMBLY OPERATIONS ARE VERIFIED BY SHUTTLE TRAVELER MIPS.

CRITICAL PROCESSES

HEAT TREATMENT, CHROME AND CD-TI PLATING ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

INTERNAL MATERIAL DEFECTS ARE DETECTED BY ULTRASONIC INSPECTION. MATERIAL SURFACE DEFECTS ARE DETECTED BY MAGNETIC PARTICLE, NITAL ETCH AND FLUORESCENT PENETRANT INSPECTION.

TESTING

ATP IS VERIFIED BY INSPECTION.

PACKAGING/HANDLING

HANDLING AND PACKAGING REQUIREMENTS ARE VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

NONE.

(E) OPERATIONAL USE

NONE.