SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :LANDING/DECELERATION-LGC FMEA NO 02-1A -075 -3 REV:03/03/88

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 X LS
:

REDUNDANCY SCREEN: A- B- C-

PREPARED BY:		APPROVED BY:		APPROVED BY (NASA):
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ITEM:
NOSE LANDING GEAR (NLG) SHOCK STRUT NOSE GEAR SHOCK STRUT INNER AND OUTER CYLINDER AND LOAD CARRYING MEMBERS

FUNCTION:
NOSE GEAR LOAD CARRYING STRUT/DAMPER - A PASSAGE OF HYDRAULIC FLUID THROUGH AN ORIFICE ABSORBS THE ENERGY OF IMPACT AND IN WHICH DRY NITROGEN IS USED AS THE ELASTIC MEDIUM TO RESTORE THE UNSPRUNG PARTS TO THEIR EXTENDED POSITION.

FAILURE MODE:
FLAT STRUT DUE TO LOSS OF HYDRAULIC FLUID

CAUSE(S):
EXCESSIVE SEAL LEAKAGE

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

(A) LOSS OF ALL HYDRAULIC FLUID IN THE STRUT WILL CAUSE LOSS OF DAMPING/ SHOCK ABSORBING CAPABILITY RESULTING IN COLLAPSE OF STRUT.

(B) DAMAGE TO VEHICLE STRUCTURE.

(C,D) PROBABLE LOSS OF MISSION/CREW/VEHICLE IF NOSE GEAR COLLAPSES ON LANDING OR DURING ROLLOUT.

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

(A) DESIGN
THE SHOCK STRUT DYNAMIC SEALS WERE SELECTED FOR RESISTANCE TO SPIRAL FAILURE AND ARE DESIGNED TO ACCOMMODATE THE EXPECTED STRUT WORKING PRESSURES WITHOUT LEAKING. A PISTON ROD SCRAPER PROTECTS THE LOWER (PISTON) SEAL FROM CONTAMINATION.
THE STATIC SEALS ARE PREFORMED HYDRAULIC PACKINGS WITH BACKUP RINGS ON EACH SIDE OF THE SEAL. THE SHOCK STRUT DESIGN PROVIDES FOR CARRYING A SPARE STATIC AND DYNAMIC SEAL IN THE LOWER PISTON BEARING.

A HYDRAULIC LEAK ANALYSIS WAS CONDUCTED TO ASCERTAIN THE POSSIBILITY OF LOSING ALL HYDRAULIC FLUID DUE TO LEAKING WHILE ON ORBIT - RESULTS SHOW THAT WITH THE WORSE CASE CONDITIONS OF MANUFACTURING TOLERANCE BUILDUPS, TEMPERATURE, FLUID VAPOR PRESSURE AND WITH NO PISTON SEAL INSTALLED, IT WOULD TAKE MORE THAN THE STANDARD SEVEN DAY ORBITAL STAY TIME TO DEGRADE THE DAMPING PERFORMANCE OF THE STRUT (DUE TO HYDRAULIC FLUID LEAKAGE). THEREFORE FAILURE OF THE SHOCK STRUT DUE TO LOSS OF HYDRAULIC FLUID IS NOT CONSIDERED CREDIBLE.

(B) TEST

QUALIFICATION TESTS INCLUDE; A DYNAMIC LEAKAGE TEST, PROOF PRESSURE AND LEAKAGE TEST AND LOW TEMPERATURE TEST.

DYNAMIC LEAKAGE TEST: THE SHOCK STRUT WAS SERVICED WITH HYDRAULIC FLUID AND PRESSURIZED WITH NITROGEN GAS TO 10 PERCENT OF NORMAL INFLATION PRESSURE. WITH THE SHOCK STRUT IN A VERTICAL POSITION, THE PISTON WAS CYCLED 3 TIMES OVER THE FULL STROKE. EXTERNAL OIL LEAKAGE DID NOT EXCEED ONE DROP AND INTERNAL LEAKAGE DID NOT EXCEED THE 1.0 STANDARD CUBIC INCH OF GAS LEAKAGE (REQUIREMENT) INTO THE HYDRAULIC CHAMBER.

STATIC LEAK TEST: THE SHOCK STRUT WAS SERVICED AND RESTRAINED AT THE NORMAL STATIC POSITION IN A VERTICAL ATTITUTE FOR AN 8 HOUR PERIOD. THE EXTERNAL AND INTERNAL LEAKAGE DID NOT EXCEED ONE DROP PER SEAL FOR THAT PERIOD.

PROOF PRESSURE AND LEAKAGE TEST: THE SHOCK STRUT WAS RESTRAINED AND LOADED TO THE MAXIMUM WORKING AND SERVICE PRESSURE CONDITIONS TO DEMONSTRATE STRUCTURAL INTEGRITY OF THE PRESSURIZED ELEMENTS. EACH TEST CONDITION WAS APPLIED FOR 15 MINUTES.
THERE WAS NO PERMANENT DEFORMATION AT THE CONCLUSION OF THE TEST.

TEMPERATURE: SHOCK STRUT ASSEMBLY WAS EXPOSED TO MINUS 40 DEGREES F FOR 48 HOURS, THEN RETURNED TO AMBIENT TEMP AND HELD THERE FOR 24 HOURS. TOTAL PRESSURE LOSS WAS ZERO PSIG (6 PSIG ALLOWED). FREE GAS LEAKAGE FROM THE BLEED PORT WAS ZERO MILLILITRES (8,193 MILLILITRES IS ALLOWED) AND THERE WAS NO EVIDENCE OF FLUID LEAKAGE FROM THE GAS PORT.

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.

ACCEPTANCE TESTS INCLUDES; VERIFICATION THAT CERTIFIED MATERIALS AND PROCESSES WERE USED, DYNAMIC LEAKAGE TEST AND STATIC LEAKAGE TEST.

OMRSD: NOSE LANDING GEAR ZONAL DETAIL INSPECTIONS; THE SHOCK STRUT IS VISUALLY INSPECTED FOR LEAKAGE AT THE GLAND NUT AREA, THE BLEED SCREW AREA AND FLUID REPLENISHING VALVE ON THE OUTER CYLINDER.
IF LEAKAGE IS NOTED THE V51 FILE OF THE OMRSD PERFORMS A CHECK FOR EXCESSIVE HYDRAULIC FLUID LEAKAGE (1 DROP PER HOUR MAX.)
A STRUT FLUID LEVEL CHECK IS ALSO PERFORMED AND THE STRUT IS SERVICED IF REQUIRED.

FREQUENCY - ALL VEHICLES AT 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 SHOP TRAVELER MIPS.

CRITICAL PROCESSES
HEAT TREATMENT, CHROME AND CD-TI PLATING ARE VERIFIED BY INSPECTION. SHOT PEENING IS ALSO 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.