PRINT DATE: 08/03/97

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL HARDWARE
NUMBER: 02-1E-071 -X

SUBSYSTEM NAME: LANDING DECELERATION - WHEEL, BRAKE & TIRE
REVISION: 2 06/10/91

PART DATA

	PART NAME / VENDOR NAME	PART NUMBER / VENDOR NUMBER
LRU	: NLG WHEEL ASSEMBLY	MC621-0050

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
NOSE LANDING GEAR WHEEL

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 2
TWO

FUNCTION:
CIRCULAR FRAME, SPLIT WHEEL TYPE, ON WHICH THE AIRCRAFT TIRE IS MOUNTED.

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SUBSYSTEM: LANDING DECELERATION - WHEEL, BRAKE & TIRE
LRU :NLG WHEEL ASSEMBLY
ITEM NAME: NLG WHEEL ASSEMBLY

CRITICALITY OF THIS FAILURE MODE:1/1

FAILURE MODE:
LEAKAGE - RESULTING IN LANDING WITH A FLAT TIRE.

MISSION PHASE:
OO DE-ORBIT

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

■ CAUSE:
IMPROPER SEALING/SEATING OF (1)TIRE TO RIM (2)WHEEL HALVES (3)THERMAL RELIEF PLUGS (4) OVER-INFLATION PLUG/TRANSDUCER TO WHEEL O-RING (5)INFLATION VALVE (6) INFLATION VALVE INTERNAL SEAT.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN A) N/A
B) N/A
C) N/A

- FAILURE EFFECTS -

■ (A) SUBSYSTEM:
LOSS OF ROLLING AND LOAD CARRYING CAPABILITY ON THE AFFECTED WHEEL/TIRE ASSEMBLY. IF FAILURE OCCURS AT OR SHORTLY AFTER NOSE WHEEL TOUCHDOWN, REMAINING WHEEL/TIRE ASSEMBLY WILL FAIL. PROBABLE FAILURE OF NLG STRUT OR IT'S ATTACHMENTS.

■ (B) INTERFACING SUBSYSTEM(S):
SAME AS A.

■ (C) MISSION:
PROBABLE LOSS OF MISSION/CREW/VEHICLE DUE TO NLG COLLAPSE (IF BOTH

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WHEEL/TIRE ASSEMBLIES FAIL).

■ (D) CREW, VEHICLE, AND ELEMENT(S):
SAME AS C.

- DISPOSITION RATIONALE -

■ (A) DESIGN:
WHEEL ASSEMBLY IS DESIGNED FOR "ZERO" LEAKAGE, SEALS USED ARE DESIGNED TO ALLOW MINIMAL LEAKAGE (STATE-OF-THE-ART). WHEEL IS DESIGNED WITH A 15 DEGREE BEAD SEAT ANGLE (BSA) WHICH RESULTS IN AN IMPROVED WHEEL/TIRE SEAL INTERFACE (COMMERCIAL BSA IS 5 DEGREES).
O-RING SEAL/INSTALLATION BETWEEN WHEEL HALVES PER SAE AS666A. OVER-INFLATION PLUG/TIRE PRESSURE TRANSDUCER, THERMAL RELIEF PLUG AND INFLATION VALVE INSTALLATION PORTS ARE SEALED PER MS33649. INFLATION VALVE ASSEMBLY IS STANDARD MS27436. VALVE CAP DESIGN INCLUDES A REDUNDANT SEAL. DESIGN MINIMUM FACTOR OF SAFETY IS 1.5.

(B) TEST:
QUALIFICATION TESTS: THE WHEEL/TIRE ASSEMBLY WAS PRESSURIZED WITH NITROGEN GAS AND THERMALLY CYCLED FROM AMBIENT TO 100 DEG F TO MINUS 60 DEG F AND BACK TO AMBIENT. EACH CYCLE IS 18 HOURS LONG, AND 10 CYCLES ARE PERFORMED. THERE IS A ONE HOUR MINIMUM DWELL AT EACH TEMPERATURE EXTREME.

THE WHEEL ALSO PASSED STATIC TESTS,DIFFUSION TESTS AND YIELD COMBINED LOAD TESTS - THE WHEEL/TIRE ASSEMBLY WAS SUBJECTED TO THE FOLLOWING ULTIMATE COMBINED LOAD APPLICATION;
ACTING INBD - 27,750 LBS RADIAL LOAD AND 13,900 LBS SIDE LOAD.
ACTING OUTBD - 23,100 LBS RADIAL LOAD AND 11,550 LBS SIDE LOAD.
ALL THE REQUIREMENTS OF LEAKAGE, INTERFERENCE AND PERMANENT SET WERE MET.

ACCEPTANCE/TURNAROUND (FOR ALL WHEEL/TIRE ASSEMBLIES) CONSISTS OF;
(1) INFLATION PRESSURE VERIFICATION.

(2) STORAGE AT ROOM TEMPERATURE FOR 2 DAYS (TO ALLOW FOR TIRE STRETCH)

(3) REINFLATE AND PERFORM 5 DAY COLD TEMP FOLLOWED BY 7 DAY AMBIENT TEMP LEAK TESTS.

(4) STORAGE AT ROOM TEMP FOR 2 WEEKS

(5) INFLATION PRESSURE VERIFICATION (USING SAME GAUGE USED IN (1).

OMRSD: FLIGHT TIRE DECAY RATE;

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THIS TEST DETERMINES THE DECAY RATE FOR EACH FLIGHT TIRE/WHEEL ASSEMBLY PER THE REQUIREMENTS OF THE ML0308-0143 SPECIFICATION.

FLIGHT TIRE PRESSURE CHECKS:
THIS CHECK VERIFIES THE TIRE PRESSURE FOR EACH FLIGHT TIRE/WHEEL ASSEMBLY, PER THE REQUIREMENTS OF THE ML0308-0143 SPECIFICATION, IF MORE THAN 30 DAYS HAVE ELAPSED SINCE THE LAST FLIGHT TIRE PRESSURE.

TIRE PRESSURES FOR FLIGHT:
TIRE PRESSURES ARE VERIFIED FIVE DAYS BEFORE FINAL RETRACTION FOR FLIGHT. MLG TIRES FLIGHT PRESSURE REQUIREMENT IS 365 PSIG TO 370 PSIG.
NLG WHEEL/TIRE CERT:
VERIFIES NLG WHEEL/TIRE ASSEMBLY HAS BEEN BUILT UP AND TESTED PER THE V070-510502 DRAWING, ML0308-0028 NOSE LANDING GEAR RIGGING SPECIFICATION AND ML0308-0143 NLG WHEEL/TIRE INSTALLATION AND INSPECTION SPECIFICATION.
THIS INCLUDES TORQUING THE INFLATION VALVE CAP TO A VALUE OF 8 TO 10 IN-LBS.

FREQUENCY - ALL VEHICLES AT GROUND TURNAROUND.

(C) INSPECTION:
RECEIVING INSPECTION
RECORDS AND TEST REPORTS ARE MAINTAINED CERTIFYING MATERIAL AND PHYSICAL PROPERTIES (RAW MATERIAL, FORGING).

CONTAMINATION CONTROL
CLEANLINESS AND CORROSION CONTROL REQUIREMENTS ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
MACHINED WHEEL INSPECTED VISUALLY AND DIMENSIONALLY DURING FABRICATION, PRIOR TO SHOT PEENING. FINAL INSPECTION IS VISUAL AND DIMENSIONAL.
INSTALLATION OF O-RINGS, PLUGS AND VALVES ARE VERIFIED BY INSPECTION.

CRITICAL PROCESSES
FORGING, HEAT TREATING AND SHOT PEENING ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
FORGINGS ARE ULTRASONICALLY INSPECTED.

TESTING
ONE FORGING PER LOT IS DESTRUCTIVELY TESTED AND ANALYZED CHEMICALLY AND FOR GRAIN FLOW. TEST BARS ARE TENSILE TESTED.

PACKAGING/HANDLING

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HANDLING AND PACKAGING REQUIREMENTS ARE VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:
NONE.

(E) OPERATIONAL USE:
FAILURE DETECTED ON ORBIT, AN ABORT DECISION IS REQUIRED TO ATTEMPT A LANDING BEFORE LOAD CARRYING CAPABILITY OF THE TIRE IS LOST.
TIRE/WHEEL FAILURE AT (OR SHORTLY AFTER) NLG TOUCHDOWN - CREW WILL USE AERO RUDDER AND DIFFERENTIAL BRAKING IN AN ATTEMPT TO MAINTAIN DIRECTIONAL CONTROL.

- APPROVALS -

RELIABILITY ENGINEERING	G. TATE	
DESIGN ENGINEERING	M. T. PORTER	for M.T. Porter
QUALITY ENGINEERING	D. DESAI	6/10/91
NASA RELIABILITY		7/26/91
NASA SUBSYSTEM MANAGER		7/26/91
NASA QUALITY ASSURANCE		6-28-91