

## FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 06-1C-0165 -X

SUBSYSTEM NAME: ARS - ARPCS

REVISION: 4

10/27/98

## PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: N2/AUX O2 SUPPLY PANEL CARLETON TECHNOLOGIES	MC250-0002-2020 2721-0001
SRU	: VALVE, LATCHING	2886-0001-23

## EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

N2 TANK SUPPLY VALVE (ITEM 1.29)

REFERENCE DESIGNATORS: 40V61A16LV3  
40V61A16LV4

QUANTITY OF LIKE ITEMS: 2

## FUNCTION:

PROVIDES CAPABILITY TO ISOLATE A SET OF TWO NITROGEN SUPPLY TANKS FROM  
THE 3300 PSI MANIFOLD OF THE N2/AUX O2 SUPPLY PANEL.

## - APPROVALS -

EDITORIALLY APPROVED	: BNA	: <u>J. Kenna 10-25-98</u>
TECHNICAL APPROVAL	: VIA APPROVAL FORM	: <u>96-CIL-029_06-1C</u>

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL FAILURE MODE  
NUMBER: 06-1C-0165-02**

REVISION# 3 08/26/93 R

SUBSYSTEM NAME: ARS - ARPCS  
LRU: N2/AUX O2 SUPPLY PANEL  
ITEM NAME: VALVE, LATCHING

CRITICALITY OF THIS  
FAILURE MODE: 1R2

**FAILURE MODE:  
EXTERNAL LEAKAGE**

**MISSION PHASE:**

PL PRELAUNCH  
LO LIFT-OFF  
OO ON-ORBIT  
DO DE-ORBIT  
LS LANDING SAFING

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

**CAUSE:  
MECHANICAL SHOCK, VIBRATION, CORROSION**

**CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO**

**REDUNDANCY SCREEN** A) PASS  
B) PASS  
C) PASS

**PASS/FAIL RATIONALE:**

A)  
B)  
C)

**- FAILURE EFFECTS -**

**(A) SUBSYSTEM:**

ISOLATION OF A LEAK ON THE DOWNSTREAM SIDE OF THE POPPET RESULTS IN LOSS OF NORMAL USE OF BOTH NITROGEN SUPPLY SYSTEMS.

**(B) INTERFACING SUBSYSTEM(S):**

CORRECTING ACTION DEACTIVATES BOTH NITROGEN SYSTEMS, REMOVING NITROGEN PRESSURE FROM THE WATER TANKS, PAYLOAD AND CABIN MAKEUP SYSTEM.

**(C) MISSION:**

POSSIBLE EARLY MISSION TERMINATION DEPENDING ON LEAK RATE.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL FAILURE MODE  
NUMBER: 06-1C-0165-02**

**(D) CREW, VEHICLE, AND ELEMENT(S):**  
NO EFFECT.

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

LOSS OF N2 MAKEUP CAPABILITY RESULTS IN LOSS OF ABILITY TO SUPPORT AN 8.0 PSIA CONTINGENCY AND LOSS OF ABILITY TO PURGE CABIN IN CASE OF A CONTAMINATED CABIN.

---

**-DISPOSITION RATIONALE-**

---

**(A) DESIGN:**

THE VALVE IS AN INTERMITTENT DUTY, 28 VOLT DC MOTOR OPERATED, LATCHING VALVE WHICH COMPRISES A VALVE PLUNGER, LATCHING MECHANISM, MOTOR ASSEMBLY AND VALVE POSITION INDICATION. VALVE HOUSING MATERIAL IS 6061-T651 ALUMINUM ALLOY, WHICH IS ANODIZED FOR CORROSION RESISTANCE. VALVE BODY AND FITTINGS ARE PH 13-8 CONDITION A CRES, WHICH IS PRECIPITATION HARDENED CORROSION RESISTANT STEEL AND HAS A HIGH STRENGTH TO WEIGHT RATIO. A NICKEL BELLOWS IS UTILIZED AS A DYNAMIC SEAL WHICH CONSIDERABLY REDUCES FRICTION, STICKING AND WEAR. BAL-SEALS ACT AS BACKUP TO BELLOWS LEAKAGE. STATIC SEALS ARE SILASTIC 675 SILICONE RUBBER, WHICH HAS GOOD RESISTANCE TO ENVIRONMENTAL EXPOSURE, FLEXING AND FATIGUE. IT ALSO HAS LOW FLAMMABILITY AND OUTGASSING. THE OZONE RESISTANCE OF SILICONE RUBBER IS EXCELLENT. PLUNGER MOVEMENT IS INITIATED BY A SCREW-DRIVEN ACTUATOR WHICH IS DRIVEN BY THE GEAR MOTOR OUTPUT SHAFT. BELLEVILLE SPRING LATCHING PROVIDES POSITIVE DETENTING. THE VALVE STEM IS HIGHLY POLISHED FOR EASE OF OPERATION (REDUCED FRICTION PROTECTS SEALS). THE VALVE STEM HAS REDUNDANT SEALS WHICH GIVE ADDED PROTECTION AGAINST EXTERNAL LEAKAGE. VALVE INLET/OUTLET PORTS ARE FILTER PROTECTED TO 25 MICRONS.

**(B) TEST:**

ACCEPTANCE TEST - PER ATP 2666-37. PROOF PRESSURE TEST AT 4975 +/- 25 PSIG. EXTERNAL LEAKAGE TEST AT 3325 +/- 25 PSIG FOR 15 MINUTES MINIMUM, 0.4 SCCM MAX LEAKAGE. INTERNAL LEAKAGE TESTS (FORWARD AND REVERSE) AT 75 +/- 5 PSIG AND 3325 +/- 25 PSIG, 2.5 SCCM MAX LEAKAGE.

QUALIFICATION TESTING - PER QTP 2721-3. RANDOM VIBRATION SPECTRUM 20 TO 80 HZ INCREASING AT 6 DB/OCTAVE TO 0.03 G\*\*2/HZ, CONSTANT AT 0.03 G\*\*2/HZ FROM 80 TO 300 HZ, DECREASING AT 6 DB/OCTAVE FROM 300 TO 2000 HZ FOR 48 MINUTES IN EACH OF THREE ORTHOGONAL AXES. SINUSOIDAL VIBRATION SWEEP - FROM 5 TO 35 HZ AT ONE OCTAVE PER MINUTE SWEEP RATE. LIFE CYCLE TEST - PRESSURIZED BETWEEN 1500 AND 3300 PSIG; MINIMUM 50 CYCLES. DESIGN SHOCK - 20 G TERMINAL SAWTOOTH PULSE OF 11 MS DURATION IN EACH DIRECTION OF THREE ORTHOGONAL AXES. ATP TO VERIFY NO LEAKAGE IS PERFORMED AFTER SHOCK AND VIBRATION TESTING.

IN-VEHICLE TESTING - LINES ARE OVERPRESSURE TESTED WITH COMPONENTS INSTALLED AT 4125-4325 PSIG. JOINTS ARE LEAK TESTED AT 2900-3000 PSIG, 1 X 10 EXP -7 SCCS GHE MAX LEAKAGE.

1 OMRSD - GN2 SYSTEM FILL/SAMPLE LONG TERM N2 SYSTEM LEAK CHECK VERIFIES PRESSURE DECAY IS LESS THAN 5.0 PS/DAY AT FLIGHT LOADS.

**(C) INSPECTION:**

**FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL FAILURE MODE  
NUMBER: 06-1C-0165-02**

RECEIVING INSPECTION  
RAW MATERIAL CERTIFICATIONS VERIFIED BY INSPECTION.

CONTAMINATION  
CLEANLINESS TO LEVEL 300 OF MAO110-301 VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION  
DIMENSIONAL CHECKS PERFORMED BY INSPECTION. MIPS FOR CONCENTRICITY AND PERPENDICULARITY. DIAMETER AND THREADS ON LOWER BELLOWS VERIFIED BY INSPECTION. VISUAL DIMENSIONAL, BELLOWS RATES AND CHECK FOR BELLOWS DAMAGE PERFORMED BY INSPECTION. 10X INSPECTION ON SEAL RING IS VERIFIED. NICKEL FINISH ON BELLOWS IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES  
PASSIVATED PARTS AND ANODIZING VERIFIED BY INSPECTION. HEAT TREATMENT VERIFIED BY INSPECTION. SOLDER CONNECTIONS VERIFIED BY INSPECTION IN ACCORDANCE WITH NHB5300.4(3A). APPLICATION OF LUBRICANT ON SEAL RING VERIFIED BY INSPECTION. TIG WELD SCHEDULE VERIFIED BY INSPECTION.

NONDESTRUCTIVE ANALYSIS  
RADIOGRAPHIC AND PENETRANT INSPECTION OF WELD VERIFIED BY INSPECTION. LEAK TEST IS VERIFIED BY INSPECTION.

TESTING  
ATP VERIFIED BY INSPECTION.

HANDLING/PACKAGING HANDLING, PACKAGING, STORAGE AND SHIPPING PROCEDURES ARE VERIFIED.

**(D) FAILURE HISTORY:**

ONE RELATED FAILURE HAS OCCURRED:

AC3739-010, 8/20/82. DURING TEMPERATURE CYCLE TESTING OF AN N2/AUX O2 SUPPLY PANEL AT THE SUPPLIER TO DETERMINE THE CAUSE OF ANOTHER FAILURE, THE POPPETS OF TWO N2 LATCHING VALVES FAILED TO CLOSE UPON COMMAND DURING A LOW TEMPERATURE EXCURSION (-65F). CAUSE WAS WATER IN THE BELLOW/POPPET ASSEMBLIES. CORRECTIVE ACTION - ASSEMBLY INSTRUCTION WAS AMENDED TO INCLUDE A VACUUM BAKE AT 180 F FOR ONE HOUR PRIOR TO INSTALLING TEFLON SECONDARY SEALS AND TESTING AT -65 F. SPECIAL WARNING INSTRUCTIONS WERE ISSUED TO CLEANING PERSONNEL TO EXCLUDE WATER FROM THE BELLOWS ASSEMBLY CLEANING PROCEDURE.

**(E) OPERATIONAL USE:**

CONSUMABLES MONITORING WILL ALLOW THE DETERMINATION FOR EITHER 1) NORMAL MISSION OPERATIONS, 2) MINIMUM DURATION MISSION, 3) MISSION ABORT AND/OR, 4) CLOSING OF THE N2 ISOLATION VALVE TO ISOLATE THE LEAK AND REOPENING THE VALVE ONLY AS REQUIRED TO REPRESSURIZE THE CABIN.

**- APPROVALS -**

EDITORIALLY APPROVED : RI  
EDITORIALLY APPROVED : JSC  
TECHNICAL APPROVAL : VIA CR

*[Handwritten Signature]*  
:SS02500  
7/31/93