

CIL  
EHM CRITICAL ITEMS LIST

12/24/91 SUPERSEDES 01/02/90

ANALYST:

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NAME P/N REV	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
PRESSURE GAGE, ITEM 213G ----- 09799042-3 (1)	1/1	213G1M04: Rupture of the bourdon tube assembly.  CAUSE: Material heat treatment, weld defect or thin wall condition.	END ITEM: Rapid release of high pressure oxygen and resulting shock wave into the sensor reference cavity. Possible ignition of particles in the reference cavity, for a small leak, a vent hole is provided for pressure relief.  O/E INTERFACE: Loss of SOP oxygen supply.  MISSION: Abort EVA.  CREW/VEHICLE: Possible loss of crewman.	A. Design - The maximum expected number of operating pressure cycles during the life of this item is 1000, and proof pressure cycles is 25. A fracture mechanics analysis predicts that the bourdon tube will leak before burst. The fracture mechanics analysis also predicts that a defect 93.4% or more through the bourdon tube wall is required to cause a leak during the 15 year life of the item. The bourdon tube is made of Inconel N-750 and is silver soldered into a 304 CRES tube on one end. That tube is in turn copper brazed into a 309 CRES socket. The other end of the tube is closed off and soldered to the pointer. Each bourdon tube assembly is stress tested to 35,000 psi which is higher than the SOP burst requirement of 14,800 psi. The bourdon tube sensing element has been designed with a factor of safety of 1.5 at operating conditions. The reference chamber vent hole prevents case overpressurization if the bourdon tube leaks. A ruptured bourdon tube however would flow in excess of the chamber vent hole capacity.  B. Test - Component Acceptance Test - The vendor, Krauss, performs five (5) stress proof pressure cycles to 15,000 psi and five (5) proof pressure cycles to 11,200 psi prior to gage calibration. If hysteresis remains, then five (5) more proof pressure cycles to 11,200 psi are performed prior to a re-calibration. The gage is scrapped if hysteresis still remains. This procedure ensures that the bourdon tube is properly strain hardened.  CIL PDA Test - The rupture of the bourdon tube at max operating pressure (7,480 psia) due to material heat treatment or braze defects would be detected by proof, leakage, and instrument accuracy testing. The item is proof pressure tested at 11,100 - 11,500 psig O2 for 5 minutes minimum, and then visually inspected for evidence of distortion, cracks, or other defects. Sequentially, the item is externally leak tested with a 2% He and 98% N2 gas mixture at a pressure of 5800-6200 psig in a chamber vacuum. Leakage must not exceed $5.55 \times 10^{-5}$ scc/sec He ( $5.55 \times 10^{-5}$ scc/sec He now represents total end item (SOP) leakage). The accuracy of the item is checked by pressurizing it to 200 and 6000 psig

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	1/1	213GFR041		<p>with tolerances of +300/-200 and +/-600 respectively.</p> <p><b>Certification Tests -</b>                      During 5/89 the 8V799045 SOP completed 5000 on/off cycles and 400 proof cycles which is four times the 15 year expected use cycles. During the flow testing phase, the SOP completed 325 total hours of regulation at 5 ppm or 0.16 ppb. The SOP assembly also completed the 15 year random vibration, sinusoidal vibration, design shock and bench shock testing.</p> <p>During 8/82 the 8V767710 SOP completed 112 blowdown cycles which is 3 times the cycle certification requirement of 35 to satisfy the 8V799045 certification requirements.</p> <p><b>C. Inspection -</b>                      There is 100% inspection, including proof pressure and leakage test of all the elements exposed to the high pressure medium during vendor acceptance testing. Particulates are minimized by cleaning those elements exposed to the oxygen to NIS15B QMSAA.</p> <p><b>B. Failure History -</b>                      None.</p> <p><b>E. Ground Turnaround -</b>                      Tested for rupture of the Scudron Tube Assembly per FEMR-R-601, SOP Servicing for Flight.</p> <p><b>F. Operational Use -</b>                      Crew Response -                      Pre/PastERR: No response possible.                      EVA: No response possible.                      Training - No training specifically covers this failure mode.                      Operational Considerations - N/A.</p>