

12/24/94 SUPERSEDES 12/24/93

ANALYST:

NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
CO2 TRANSDUCER, ITEM 122 ----- SV767798-3 (1)	Z/1RB	122FM02: Erroneous output voltage, drifts low or loss of output.	END ITEM: P/Ns SV767798-3 and SV809145-1: CO2 partial pressure reading remains low or zero for an actual elevated CO2 environment.	A. Design P/Ns SV767798/SV809145: The electronic components are operating within the power derating requirements of SVNS7804 (derated to at least 75%). Microcircuits are qualified to the requirements of MIL-M-38510 and receive the burn in of Class B parts per method 5004 of MIL-STD-883. Transistors, diodes are qualified to the requirements of MIL-S-19500 and receive the burn in of JANIVK level parts per the applicable methods, 1038, 1039, 1040 of MIL-STD-750.
OR ----- Y SV809145-1 (1)		CAUSE: P/Ns SV767798-3 and SV809145-1: Voltage shift of the sensor element, electronics, or output from signal conditioner.	P/N SV809286-4: Transducer electrical signal generated (0-5 VDC) is below voltage required or zero for the actual vent loop CO2 gas partial pressure.	The electronic components are operating within power derating requirements of SVNS7804 (derated to at least 75%). Electronics and electrical assemblies designed and assembled per NASA Solder Spec. NHB 5300.4 (3A-1).
OR IN CO2 TRANSDUCER, ----- Z SV809286-4 (1)		Blockage of path to sensor from vent loop. Contamination of sensing element. P/N SV809286-4: Electronics failure in the microcontroller detector thermopiles/amplifier, thermocouple, or power supply. CO2 window degradation.	GFE INTERFACE: P/Ns SV767798-3 and SV809145-1: None for single failure. The CO2 sensor will be unable to detect a subsequent increase in EMU CO2 level. No warning if CO2 partial pressure rises. P/N SV809286-4: Decreased CO2 reading (lower than actual) at CO2 Removal Container outlet. No warning Indication given if CO2 partial pressure rises above tolerable	P/N SV809145: Sensing element and electronics interface incorporates a gold plated spring/gold plated button (electrical) connector and a KEL-F-800 coating over electrolyte sealing surfaces to minimize corrosion. P/Ns SV767798/SV809145: In the PLSS, blockage of the gas flow path and contamination of the sensing element is reduced by placement of the item 126 filter/orifice in the line to trap any debris that enters the line. The gas entering the sensor is also picked up from the vent loop at a location where its dew point is low to prevent moisture from condensing out on the sensor and reducing its effectiveness. P/N SV809286: The electronic components are operating within the power derating requirements of MIL-STD-875. Established reliability capacitors (Level P minimum) are qualified to MIL-C-123, MIL-C-39014, MIL-C-55365 or MIL-C-55691. Established reliability resistors (Level P minimum) are qualified to MIL-R-55342 or MIL-R-55182. Microcircuits are surface mounted DESC controlled components which are MIL-STD-883 compliant and PIND tested (cavity devices). Transistors and diodes are qualified to the requirements of MIL-S-19500, Level JANIVK as a minimum and PIND tested (cavity devices). Electronics and electrical assemblies are designed and assembled per NASA solder Spec. NHB 5300.4

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	Z/188	122FM02:	limit.	(3A-1).
			MISSION: None.	B. Test - P/N's 5V767798/5V809145: Component Acceptance Test (Vendor) - The CO2 sensor is subjected to acceptance testing per Sensornetics spec 551866 prior to shipment by the assembly vendor. This testing includes the following tests which insures the sensor output voltage stability: a. The sensing element is subjected to a vacuum (1-2 inches of Mercury) for 16 hours to check for electrolyte leakage, moisture or salt residue. b. Insulation resistance is measured across all functional connector pins and case at 100VDC. This insures there are no low resistance paths which would affect output voltage stability. c. Calibration is checked to see that the unit is within specified limits. This insures the unit has not shifted after being subjected to random vibration testing (6.1 gms). (flow tube not part of vendor test).
			CREW/VEHICLE: None for single failure. Possible loss of crewman with loss of CO2 (CO2 Removal Console).	FDA Test - A CO2 sensor ramp test is run per SEMU-60-010 which subjects powered sensor to a gas stream with a CO2 partial pressure ramp from 0.5 to 15 mm CO2 over a 30 minute period. This insures the sensor will respond to a high CO2 condition properly, and that the flow passage is clear.
				Certification Test - The item completed the 15 year structural vibration and shock certification requirement during 10/83. The item completed 10,084 flow cycles during 7/85 to fulfill the cycle certification requirement of 10,084. Class I engineering changes 42806-128 (Revised partial pressure requirement), 42806-168 (New sensor cover), 42806-192 (New filter), 42806-264-1 (Revised output graph), and 42806-292 (Calibration test change) have been incorporated and certified by analysis/similarity since this configuration was certified.
				P/N 5V809286: Component Acceptance Test - The CO2 transducer is subjected to the following acceptance tests per 5VNS13466 to ensure CO2 measurement accuracy: a) The transducer is subjected to CO2 concentration in

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	2/1R8	122F402:		<p>Oxygen of 2.5, 12, 24 and 30 mmHg at 0.0 +/- .2 psia, the transducer output accuracy must be +/-1, +/-1.2, +/-2 and +/-2 mmHg respectively.</p> <p>b) Sensor response time is measured for a step change in CO2 concentration from 2.5 to 24 mmHg. The sensor output must reach 90% of the 24 mmHg within 15 seconds.</p> <p>PDA Test - A CO2 transducer ramp test is run per SEMU-60-010. This test subjects a powered transducer to six 2.5 mmHg CO2 increases from 0 to 15 mmHg CO2. The six IR CO2 sensor readings are verified two minutes after each step change. This insures the transducer will respond to a high CO2 condition properly.</p> <p>Certification Test - The item completed the 15 year structural vibration and shock certification requirement during 11/94.</p> <p>C. Inspection - P/N's SV767798/SV809145: The assembly vendor calibrates the sensor and then lets it sit for at least 30 days before rechecking. If the sensor output voltage shifts an amount deemed unacceptable by the vendor, it is reprocessed through temperature cycling and readjusted until it becomes stable.</p> <p>P/N SV809286: The sensor head vendor calibrates the sensor head and provides a unique calibration table which is incorporated into the sensor microcontroller. All solder joints are inspected per NRB 5300.4 (3A-1).</p> <p>0. Failure History - P/N SV767798: B-ENU-122-A002 (10-17-91) - During CO2 response testing the CO2 pressure displayed on the DCN display remained a constant + 0.1 mmHg regardless of the actual CO2 concentration. The cause was theorized to be the element along the center electrode lead wire. This caused a corrosion buildup on the sensing element center electrode solder ball and on the electronics module spring where it contacts the solder ball and eventually caused an open circuit. The corrective action is to incorporate EC 163402-676 that requires the installation of a gold plated</p>

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	2/1RB	122FHD2:		<p>copper disk that is soldered over the center electrode solder ball and a layer of K&L-F-800 barrier coating on the possible electrolyte leakage path intersections.</p> <p>H-EMU-122-0005 (6/19/92) - The sensor elements exhibited electrolyte leakage at the RTV bond joint between the sense port end cap and Penton sensor housing. The bond joint is too weak to withstand additional HS handling required during final assembly after sensor rework to incorporate the corrosion prevention measures per EC 163402-676. Final assembly will now be done at the vendor, Sensormedics, to minimize bond joint stress, and the Penton housing surface will be abraded prior to RTV application to improve bond joint strength.</p> <p>H-EMU-122-0006 (8/19/92) - Electrochemical CO2 sensor exhibited a slow CO2 response time due to contamination buildup on the sensing bulb. Investigation revealed bulb had exceeded its one year refurbishment life. Therefore, no corrective action is required.</p> <p>P/N SV889145: None.</p> <p>P/N SV809286: H-EMU-122-0003, H-EMU-122-0004 (7/9/92) - IR sensor head subassemblies exceeded the allowable +/- 0.3 mmHg error band and the 4.0 volt minimum output range requirement. These outages were caused by the detectors shifting out of optimum alignment during electronics potting and not adjusting the offset and gain resistors correctly during manufacturing. The gain and offset resistor adjustment procedures have been modified (tighter limits during resistor adjustment and repeating the adjustment if requirements are not met) to ensure spec. voltage output range and error band are met.</p> <p>E. Ground Turnaround - P/Ns SV767798/SV809145/SV809286: Tested pre-flight per FEMU-R-001, para. 7.3.3.3.2.1, CO2 Response Time Check.</p> <p>F. Operational Use - P/Ns SV767798/SV809145/SV809286: Operational Use - Crew Response - PreEVA: Trouble shoot problem, if no success consider EMU 3 if available, otherwise continue.</p>

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	2/100	122FMO2:		EVA: When periodic status check reveals failure, assess CO2 level. If no symptoms noted, continue EVA. Periodically check for CO2 symptoms. Training - Crewman are trained to recognize the symptoms of high CO2. Operational Considerations - Flight rules defining go/no-go criteria related to EMU ventilation flow and CO2 control. EVA Check list procedures verify hardware integrity and systems operational status prior to EVA. Real Time Data System allows ground monitoring of EMU systems.