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R22ATEC Oxygen Sensors

Tested in 16% CO2/N2 gas

By Michael Gonzalez

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INTRODUCTION:

The objective of this report is to determine if exposure to short and long durations affects the offset requirement of the R22ATEC O2 sensor. The offset specification requirement is ≤0.1% O2 in ≤30 seconds for a step change from air to 0% O2.

TESTS:

Five (5) R22ATEC O2 sensors (TAI PN C44611-R22ATEC) were taken out of stock for the 2 tests as described below. First, all sensors were connected in series using nylon flow adaptors with compressed air flowing at 1 scfh flow rate, with a dwell time of 2 hours . After sensors had stabilized at room temperature, approx 24 deg C, the 5 channels on the chart recorders were calibrated. Here, 100% Full Scale (FS) on the recorder was calibrated to equal 20.9% oxygen and the speed on the recorder set at 1 cm/hour.

In test #1, the long exposure time, sensors were exposed to 16% CO2/Nitrogen at 1 scfh flow for approx. 5-8 hours during the day. First, the speed on the recorder was changed to a faster speed at 2 cm/minute where each "cm" division equaled 30 seconds. At the same time the range on the recorder was changed from 20.9% to 2.09% oxygen where 5% full scale = 0.1% oxygen. By adjusting these 2 parameters, the offset readings at 30 seconds could then be easily measured. After the first 4 minutes, the speed was changed to 1 cm/hour. For over-night run, sensors were returned to air. This process was repeated each day between the periods of 9/22/04 to 10/4/04. Air readings and offset readings at 30 seconds were taken and documented in Lab Notebook # 237. Offset data can be seen in table #1 and air output data can be seen in table #3.

In test #2, the short exposure time, sensors were allowed to stabilize in air and then were exposed to 16% CO2/Nitrogen at 1 scfh flow for approx. 4-9 minutes. Again, the speed on the recorder was changed to a faster speed at 2 cm/minute where each division equaled 30 seconds. At the same time the range on the recorder was changed from 20.9% to 2.09% oxygen where 5% full scale = 0.1% oxygen. Adjusting these 2 parameters, the offset readings at 30 seconds could then be easily measured. After the exposure to CO2 gas, the sample gas was switched back to air. This process was repeated 12 times during the test day 10/4/04. Again, air readings and offset readings at 30 seconds were taken and documented in Lab Notebook # 237. Offset data can be seen in table #2 and air output data in table #3.

EQUIPMENT:

- Air, 20.9% O2
- 16% CO2 balance N2, Certified Mixture No. 48-91939600-001
- 100% Nitrogen
- Nylon flow adaptors (5)
- Chart recorder (2), Linseis Models L6514B
- Digital multimeter, Fluke Model 189, Cal No. 287901-1

RESULTS:

Table 1: Test #1 (long-term exposure to 16% CO2 Exposure after being in air)

Date	Time (**Hrs**) exposed to Air (20.9%)	% O2 Offset after 30 sec exposure to 16% CO2					**Hrs** left in 16% CO2
		367138	367139	367140	367141	367142	
9/22/04	2 test started	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	7
9/23/04	15	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	8-3/4
9/24/04	17	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	7
9/27/04	17	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	7
9/28/04	16-1/2	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	7-1/2
9/29/04	16-1/2	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	7-1/2
9/30/04*	17	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	7
10/1/04*	18-1/2	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	5-1/2
10/4/04	64-1/2 week-end run	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	2

* Note: These 2 runs for Sn 367138, -139, -140 can be seen in sample Chart #1.

Table 2: Test #2 (short-term exposure to 16% CO2 Exposure after being in air)

Cycle No.	Time (**mins**) exposed to Air (20.9%)	% O2 Offset after 30 sec exposure to 16% CO2					**Mins** left in 16% CO2
		367138	367139	367140	367141	367142	
1	4	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	4-1/2
2	7	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	4-1/2
3	7	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	4
4	7	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	4
5	9	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	4
6	7	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	9
7	8	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	4-1/2
8	7-1/2	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	4
9	7	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	4
10	10	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	5-1/2
11 *	8	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	7-1/2
12 *	14 longer final cycle	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	10

* Note: These 2 cycles for Sn 367138, -139, -140 can be seen in sample Chart #2.

Table 3: Daily Air Output Readings, in mV

Note: Output Specification is 7.0 – 13.0 mV.

Date	Sn 367138	Sn 367139	Sn 367140	Sn 367141	Sn 367142
9/22/04	10.149	10.828	10.965	10.709	11.136
9/23/04	10.085	10.787	10.902	10.662	11.082
9/24/04	10.067	10.748	10.861	10.606	11.053
9/27/04	10.158	10.869	11.003	10.747	11.188
9/28/04	10.154	10.853	10.987	10.705	11.160
9/29/04	10.112	10.809	10.934	10.640	11.119
9/30/04	10.032	10.748	10.868	10.572	11.069
10/1/04	10.042	10.762	10.880	10.579	11.089
10/4/04	10.042	10.754	10.880	10.556	11.102

CONCLUSION:

The results from both tests performed on the 5 R22ATEC oxygen sensors show that short-term and long-term exposure to 16% CO2/N2 gas did not affect the offset readings of the R22ATEC sensors. The required specification of a 0.1% O2 reading after 30 seconds from air to zero gas (in this case, 16% CO2/N2 gas) was achieved each time. Chart #1 and 2 of the last 2 pages show representative short and long-term exposure traces of 3 sensors, Sn 367138, 367139 and 367140. Also, as can be seen from the data in table #3, the output readings in air (taken just before exposure to CO2 gas) were very stable with very low output drift. Outputs in air were well within the required range of 7.0-13.0 mV.

Chart 1: Sample run of long-term CO2 exposure of Sn 367138, -139 & -140.

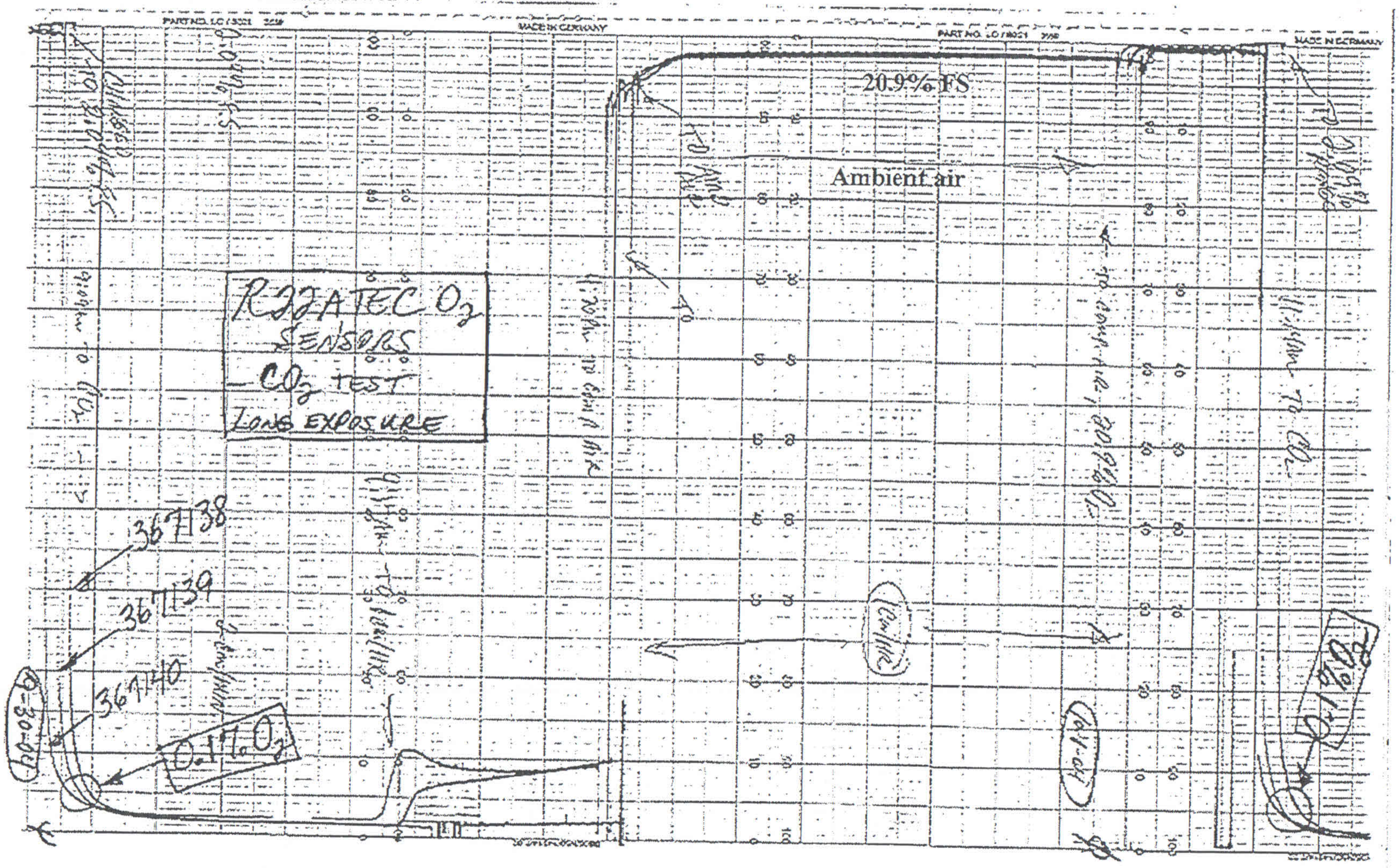

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Chart 2: Sample cycle #11 & 12 of short-term CO2 exposure - Sn 367138, -139 & -140.