



White Paper

Title: Ambient Air Calibration Method for Model 9000/1 Series Analyzers

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The Model 9000/1 series analyzers make use of a chemical sensor to measure oxygen. This chemical sensor has the intrinsic characteristics of producing less than 0.10 equivalent oxygen when no oxygen is present (Zero Stable), and produces a linear voltage output within 2% relative to gas concentration with respect to the molecular concentration of oxygen from 0.0% to 100.0% at sea level.

The chemical sensor is, however, span unstable - in that the oxygen sensitivity transform to voltage output varies with time and temperature, and may vary from sensor to sensor in a range of 9.0 mV to 13.0 mV when exposed to 20.9% Oxygen at standard temperature and pressure. In addition, the chemical sensor gradually reduces in output over time, with 50% of nominal output being reached in 12 to 18 months when exposed to room air on a continuous basis.

The Model 9000/1 is designed to make the best use of these intrinsic characteristics of the chemical sensor by three means:

1. Electronic offsets in the product which may cause zero offset indications are reduced by using low offset and low temperature coefficient analog circuitry. In addition, during final test any residual zero offsets are removed from the oxygen measurement channel by the use of a software offset constant determined during factory calibration on a unit-by-unit basis.
2. Both the long term (aging) and short term (temperature) effects which effect span stability are accommodated by periodically resetting the Oxygen reading to conform with known gas, in this case room air. This is accomplished by room air calibration (Zero) the analyzer on a periodic basis, which for the Model 9000/9001 is upon power up (the unit will not operate without this initial Zero), 5 minutes after power up, and every 30 minutes thereafter. This is adequate to correct both the short and long term span drift characteristics of the oxygen sensor.
3. The oxygen sensor output when measuring ambient air is also monitored during the Zero function. If the sensor voltage output is less than 50% of the nominal new output value, a 'Lo' prompt appears on the oxygen display, advising the operator that the oxygen sensor, while still functional, is approaching its end of life. (This test function also provides a general confirmation that the operator is sampling room air during the

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zero process.) In general, the operator will have 30 days of functional use after the appearance of the 'Lo' prompt in which to order, receive, and change the O2 sensor – which is an operator-accessible part. (The analyzer does NOT need to be returned to the factory if the 'Lo' prompt appears – as the analyzer will automatically accommodate sensor to sensor variations when a new sensor is installed.)

These provisions effectively eliminate the requirement that the analyzer oxygen measurement channel be periodically calibrated using calibration gas. Ambient air oxygen levels are very stable, ranging from 20.4% to 20.8% depending on the temperature and relative humidity. As the analyzer is specified to measure oxygen with a relative accuracy of $\pm 5\%$, the span and offset errors that result using the processes above are less than 1/5 of the published specification, and so periodic analyzer gas calibration is not necessary to assure analyzer oxygen accuracy within the equipment specifications.

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