MSA XCell® Pulse Technology Detectors; **Stand-Alone Bump Testing**

Technical Brief

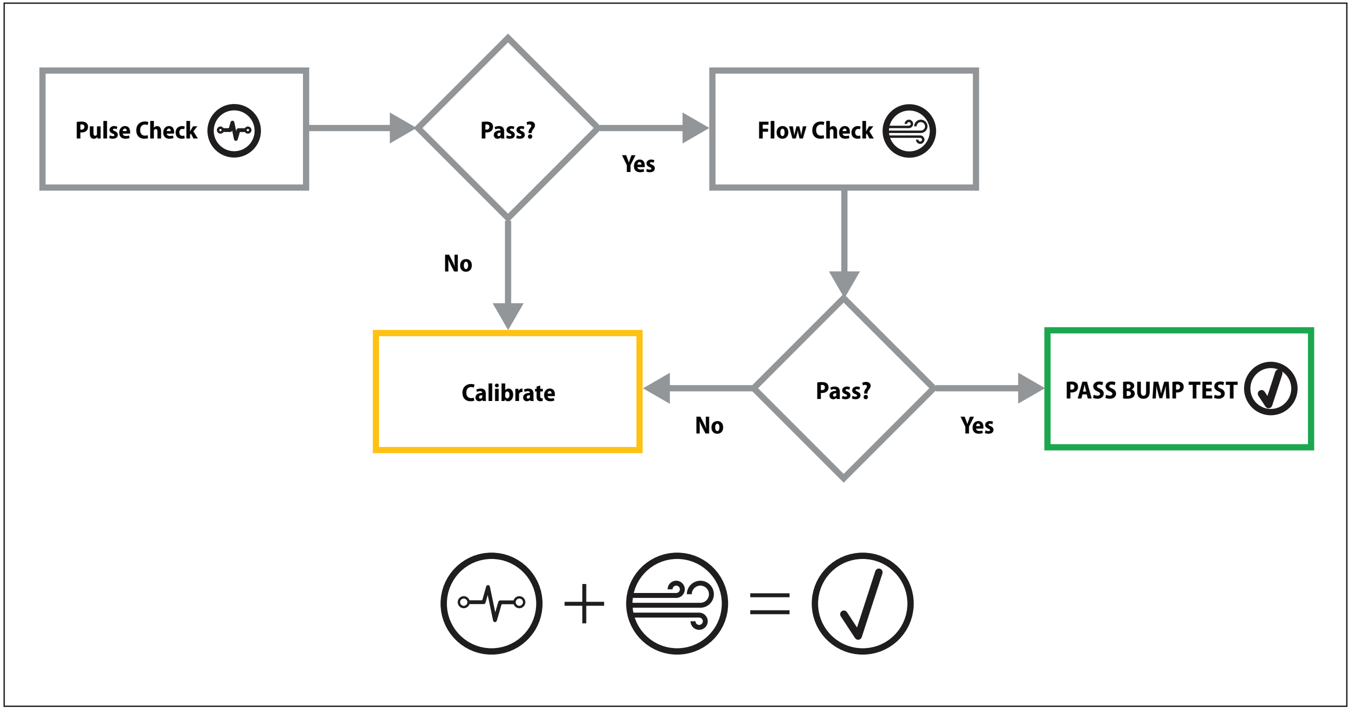
Bump testing helps to ensure gas detector functionality and that gas can reach the sensor. A bump test of gas detectors prior to each day's use is an industry best practice to maintain worker safety. Additionally, bump testing and calibration record traceability is also key to ensure compliance and record-keeping.

According to the International Safety Equipment Association (ISEA), the purpose of a bump test is two-fold:

- Test confirms that challenge gas can reach sensor(s).
- Test confirms that sensor readings can trigger an alarm if exposed to gas.

Many employers are reluctant to include daily bump testing as part of their standard procedures, as testing can be time consuming and difficult to track, especially at facilities that employ large gas detector fleets or those that disperse workers over wide geographical areas. Furthermore, bump testing also requires use of calibration equipment and gases that can be costly.

MSA's patented*, proprietary XCell Pulse Technology is now offered in a single-gas H2S portable ALTAIR 2X Gas Detector version. This new technology provides an active electronic pulse check to interrogate and adjust sensors. This electronic pulse check, combined with a check of sensor flow path by exhaling near the sensor opening, allows a stand-alone bump test to be performed without the need for calibration accessories or bottled calibration gas.



ELECTRONIC CHECK

MSA XCell Pulse Technology includes an electronic check, or sensor interrogation, to determine if the sensor is present and operating properly by applying an electronic pulse to the sensor. The pulse generates a similar electronic reaction to that which occurs when a sensor electrode is exposed to target gas.

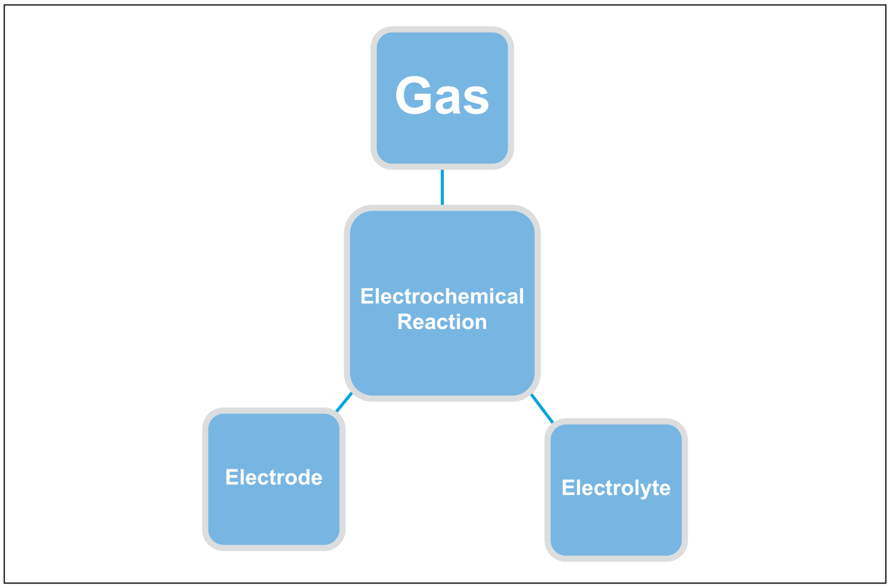
WHAT IS MEASURED?

All electrochemical sensors operate on the following basic principle: gas enters the sensor and diffuses through the working sensor electrode and to the electrolyte/catalyst interface. This electrode's coating includes catalytic elements that react with target gas. An electrical response is generated with the convergence of the electrode, electrolyte and target gas; this convergence is known as *triple point*. At molecular level, each working sensor electrode has thousands of potential triple points. A particular sensor's sensitivity has a high correlation to the number of triple points able to be generated. All sensors can lose

* *US patents # 7,413,645: #7,959,777*

sensitivity over time due to age, environmental conditions or other exposures. By pulsing the sensor, measurements are based upon the total number of triple points that can react to test gas.

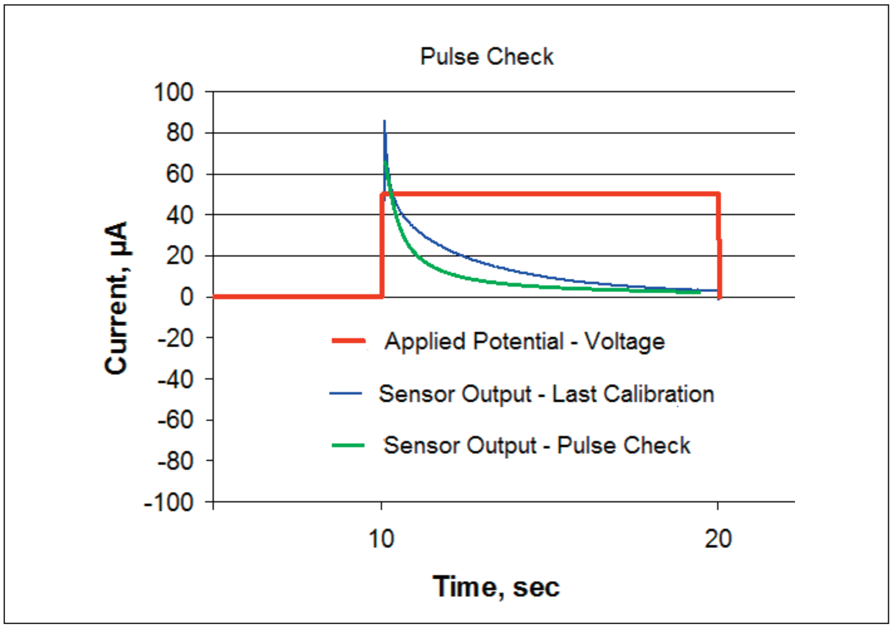
The pulse check calculates changes sensor output response electronically. A voltage pulse is applied to the sensor that activates and measures the electrode and electrolyte interaction. The response is analyzed and used to indicate sensor output sensitivity to verify that internal sensor components are functioning properly and that an electrochemical reaction can take place if exposed to gas.



HOW THE ELECTRONIC PULSE CHECK WORKS

The electronic pulse response is analyzed and used to predict sensor output sensitivity and verify that sensor internal components function properly.

Predicted sensitivity is compared to stored sensitivity from the most recent gas calibration in order to determine sensor accuracy since the last calibration. Predicted sensitivity is based upon a regression model using initial sensitivity levels and change in sensor response function to electronic checks. Regression output is used to determine whether sensors should be recalibrated or if they are sufficiently close to sensitivity level from previous calibration.



If a difference is measured in sensor response within acceptable range, correction can be applied to measured output to adjust the sensor for accuracy. Adjustment is possible due to ASICs used in MSA's XCell Sensors. If the output signal has drifted outside acceptable range, the instrument will notify the user that calibration is necessary.

Other devices are available in the marketplace that determine sensor functionality, but MSA holds the only patented process to analyze for sensor accuracy and adjust the signal as needed.

Figure 1 shows actual sensor performance during trials within ambient, 85% relative humidity and 15% relative humidity conditions. Actual measurement is the result of the detector observing exactly 20 ppm H_2S. Calculated performance is predicted sensor performance calculated using a regression model.

Due to the ability to measure and correct sensor sensitivity, the device correctly maintains and adjusts for variation. In addition to this extreme testing, several sensors were tested in use conditions typical of Houston, Texas climate. Figure 2 represents sensor performance in a simulated environment cycling from 20° C (68° F) 90% relative humidity (RH) to 34° C (93° F) 55% RH over a 60-day period. Multiple sensors were subjected to this evaluation with a high level of accuracy within this time period.

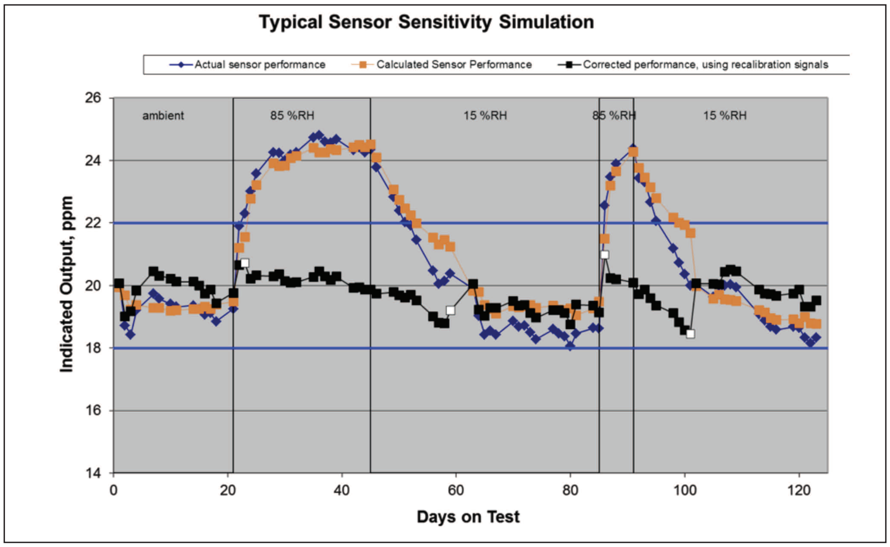


Figure 1

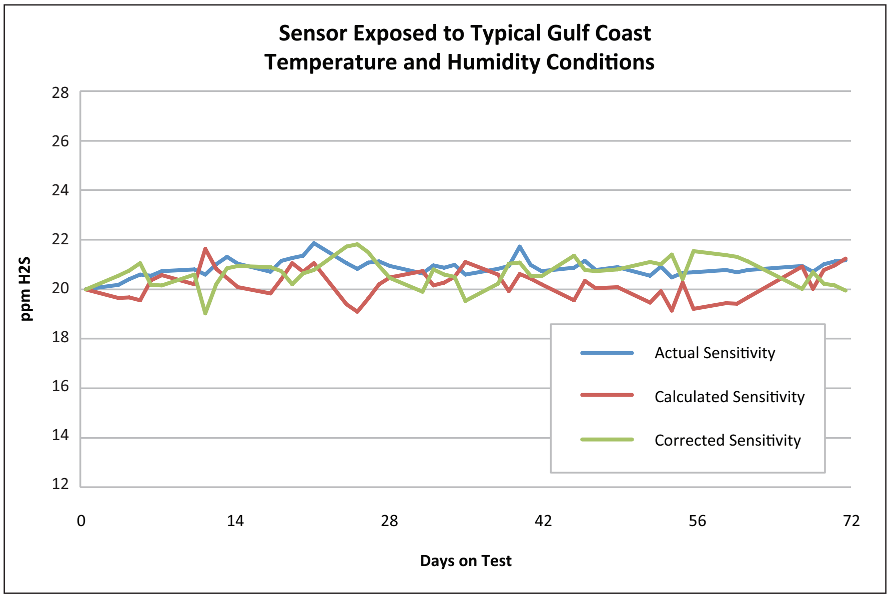
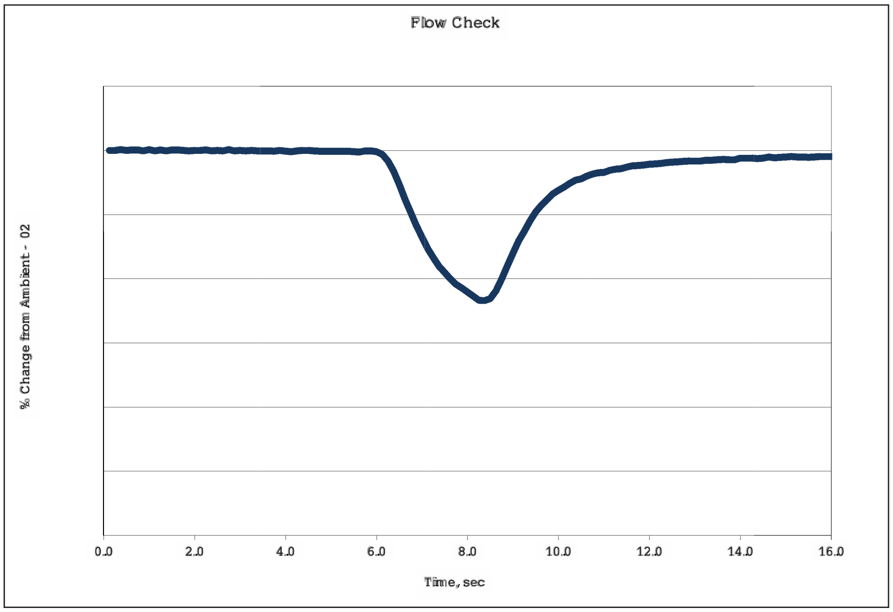


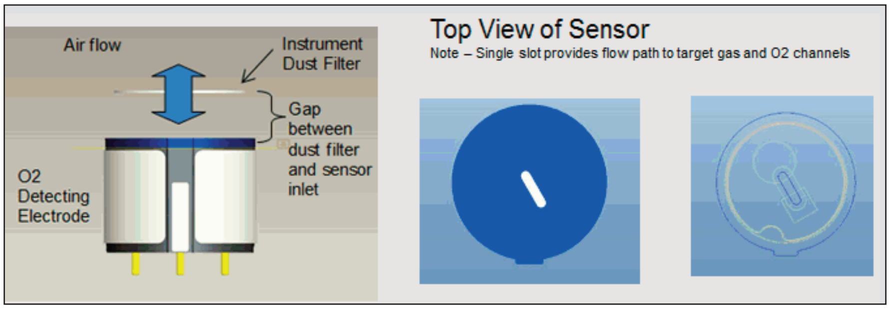
Figure 2

FLOW CHECK- HOW IT WORKS

To complete a stand-alone bump test, confirmation that gas can reach the sensor is necessary. Once the pulse check is complete, the user exhales into the device; an O_2 channel embedded within the sensor measures for a drop in oxygen as the user exhales. The drop in O_2 content rate at which gas diffuses across the barrier is measured and is used to determine sensor functionality.



The figure at right shows an example of flow rate in and out of the sensor face. Although individuals exhale at different rates, the rate at which gas leaks back out of the sensor following the test changes if the sensor becomes blocked. If the sensor is blocked, the rate at which breath enters and leaves the sensor face is measurably slower than that of an unobstructed sensor.



The sensor is **not** a combined H_2S/O2 sensor; rather, the sensor is a single H_2S sensor that uses an O_2 electrode only for testing for filter blockage during a flow check. Although two channels are operating, the sensor includes a single flow path for gas. The oblong opening shown at right allows gas to enter both channels, thereby ensuring that flow path to the H_2S channel is intact.

By using an electronic pulse check and exhale test, users perform a stand-alone bump test that prepares the detector for each day's use. MSA interrogation sensor electronic check capability provides users with significant cost saving benefits resulting from reduction in required calibration gas and accessories and easier coordination of bump testing for your MSA portable instrument fleet.

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