H_2S Measurement: Brass vs. Stainless Steel Regulators

Users of pressure reducing gas regulators are faced with a choice in the materials of construction when they select a regulator to be used in conjunction with a cylinder of calibration gas, in calibration, bump testing or sensor challenge for portable gas detection instruments.

There are several models of regulators available; fixed flow, variable/selectable flow and demand flow. The selection depends on the type of instrument to be calibrated. Instruments or docking stations with pumps should not be directly attached to any fixed flow regulators, because the delivery pressure of fixed flow regulators is generally around 50 psig, and the diaphragms in the pumps can endure only about 5-7 psig before the diaphragm can potentially suffer damage. In certain instances, depending on the instrument manufacturer, some non-pump equipped instruments may use fixed flow regulators with docking stations, so the testing of fixed flow regulators is relevant.

In order to use a fixed flow regulator, pump-equipped instruments or docking stations should use a pressure relieving "T" in the line, which in many cases can be regulated with a flowmeter, in the so-called "wasted flow" method. This method balances the flows between outlets on the T, between one outlet open to atmosphere and the other outlet connected to the instrument pump with the inlet connected to the regulator.

The preferred apparatus is the demand flow regulator which is actually a vacuum activated valve, sensing when the pump calls for gas and opening and closing the valve so that it satisfies the pump's demand, hence the name "demand flow." The demand flow regulator essentially mimics atmospheric pressure, and is similar in delivery pressure to tedlar bags but is more convenient and durable. Typically, use of demand flow regulators eliminates wasted flow by delivering only the exact amount of gas needed by the instrument, yielding gas savings that are quite impressive.

Regardless of the type of regulator chosen to calibrate the instrument, the materials of construction need to be considered to ensure the best results. After observing some clients using regulators with brass components with H_2S, Pangaea Gases, LLC and Pine Environmental Services, LLC collaborated in an experiment to demonstrate and quantify the differences in measured concentrations of H_2S when regulators with brass components were used rather than aluminum and stainless steel.

The tubing used is also important, as H_2S is a quite reative gas that will react with any susceptible materials in the flow stream. Teflon is the preferred material. In the experiment Tygon was used since all the data would be considered relative and not an absolute rigorous analysis per se.

Pangaea provided two brand new aluminum slide valve piston style regulators with flow rates of 0.5 lpm and C10 connections. Slide valves are a relatively new style of regulator that eliminates rotary and push button valves, dramatically reducing the cost of the regulator. One had a brass piston and gauge socket, while the other had a stainless steel piston and gauge socket. Both regulators had aluminum bodies. The regulators are operated by pulling up the collar, which is located just below the hose barb outlet, to permit flow and pushing it back down to halt flow.

Pangaea also provided a new patent-pending demand flow regulator to demonstrate its accuracy, ease of use and cost effectiveness, achieved by calibration gas savings versus the wasted flow method.

Pine provided a very old brass fixed flow regulator that was used in venting down expired or near-empty cylinders of H_2S calibration gas. Pine also provided the instrument and calibration gas for the experiment, ensuring that the instrument had been freshly calibrated with gas that was well within its certification period and had pressure over 100 psig during the experiment.

Ergonomics in the Warehouse: Lightening the Load on Workers

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By bringing work to the employees, working along production or packing lines, these lift tables not only increase productivity, they reduce worker fatigue and drastically decrease the risk of serious back injuries.

Lean on safety when moving materials. Tilter tables function very similar to scissor lift tables in that they raise materials to workers, preventing unnecessary bending and lifting. However, tilter tables take these scissor lifts a step further and tilt the work into the employee's work area further reducing the movement and leaning required to access materials.

Generally used with small parts and components that are typically stored in bins and baskets, tilters position these parts and hard to reach objects within simple reach of workers to minimize the need to reach and bend to access materials when assembling products or picking orders, creating a more ergonomic and efficient work process.

Don't turn your back on warehouse safety. Turntables allow workers to rotate their work to them, rather than walking around it. When used with the scissor lift tables, they reduce reaching, bending, twisting and walking associated with palletizing operations, easily enhancing both ergonomic and laborsaving benefits.

Ideally, automation in a plant facility or warehouse would completely eliminate the risk of back injuries, slips and falls. But since there will likely always be some human element working to manually move materials and products, companies must seek alternative, ergonomic solutions to prevent the injuries sustained by warehouse workers. In-plant lift products provide just that, a safe lifting solution for virtually any material handling application to help reduce worker fatigue and injuries.

Author: Doug McLeod, Director of Lift Products
Kelley Company www.kelleycompany.com 800-558-6960

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H_2S Measurement: Brass vs. Stainless Steel Regulators

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The instrument was turned on and warmed up according to the manufacturer's procedures. The pump mode was utilized for the measurements and the wasted flow method was utilized for delivery of the cal gas to the instrument sensor. The fixed flow regulators were connected to the instrument one at a time, using the same tubing and cal gas cylinder. Gas was flowed until stable readings were obtained, i.e., 10 seconds or more without a change in the displayed concentration of H_2S. These were not per se calibrations but rather simply measurements of the concentration of H_2S in the gas reaching the sensor after travelling through the regulator and tubing. After each observation, the regulators were changed. Data was recorded and analyzed. To provide contrast, readings were also taken using the demand flow regulator and the very old brass regulator. The data is shown in the chart.

Hydrogen Sulfide concentrations vs gas regulator material of construction

	H_2S measured concentration (ppm molar volume)											
Measurement Number	1	2	3	4	5	6	7	8	9	10	Average	Range
Brass piston/gauge	24.8	25.8	26.3	26.5	26.8	27.0	26.9	27.2	27.2	27.2	26.6	2.4
Stainless Steel piston/gauge	26.3	26.8	27.0	27.0	27.5	27.5	27.8	27.7	27.7	27.7	27.3	1.4
SS gauge Demand Flow	27.7	27.7	27.7	27.7							27.7	0
Old brass body/piston/gauge	27.2	27.2	27.2	27.2							27.2	0
Gas Mixture: 25 ppm H_2S, 100 ppm CO, 2.5% CH_4, 19% O_2, Balance N_2												

Discussion

Both brass and stainless steel regulators produced increasing concentration measurements as the test progressed until the concentrations stabilized. On average, the brass regulator showed a 0.7 ppm/2.6% consistently lower concentration than did the stainless steel regulator, with the difference reaching 6% early in the life of the brass regulator. The stainless steel regulator was more consistent over the range of the individual measurements and reached its peak concentrations more rapidly than did the brass model. The demand flow regulator matched the stabilized concentration of the stainless steel slide valve regulator immediately, while the very old brass regulator that had been exposed to much H_2S over its years, immediately reached the stabilized concentration of the brass regulator.

Brass regulators, whether new or old, once stabilized, still produced concentrations of H_2S at the sensors that were consistently lower than stainless steel regulators. Care should be exercised, especially if the brass regulator is new, due to the propensity to produce significantly lower concentrations of H_2S at the sensors. Brass would not be a recommended material of construction when considering H_2S.

Though not experimentally studied, we presume that similar results would be obtained by directing the gas from the regulators into a tedlar bag for subsequent withdrawal by the instrument or docking station pumps. Many other factors can also be at work at the same time. Consideration that analytical errors are additive would seem to indicate that when errors are discovered due effort to reduce them would be prudent.

Authors:
J Hill, Pine Environmental Services, LLC, Office Manager, Hudson, Ohio
Tim Phaneuf, Pine Environmental Services, LLC, Technical Director, Scarborough, Maine
James R. MacNeal, Pangaea Gases, LLC, Managing Partner, Burton, Ohio

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