APPLICATION GUIDE

PIPELINE DEWPOINT TUBES

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Background

Detector tubes have been used for years to detect the presence of contaminants in natural gas, including hydrogen sulfide, carbon dioxide and water vapor. Detector tubes can also confirm the levels of odorant additives like mercaptans. However, there are special considerations when detector tubes are used to detect water vapor dew point levels.

Water vapor levels in natural gas pipelines are controlled to a minimum to prevent corrosion of transport equipment and utilization equipment (e.g., household appliances). Water vapor occurs naturally in gas wells and is removed via contact dryers utilizing triethylene glycol. Water vapor levels are monitored at the dryer outlet to assure that the water vapor is below some minimum acceptable level (usually 6 pounds of water per million cubic feet [Lb/MMCF] of gas). As gas is bought and sold downstream water dew point levels are often checked again.

Taking a Sample

Preventing ambient air from entering the sample poses the single most important issue for monitoring water vapor levels in natural gas. Because water vapor levels in ambient air can readily be 100 times higher than vapor levels in the gas, even the slightest air intrusion can dramatically affect sample results. A proper sampling device should be used to prevent such air intrusion. Several types are discussed below, each with its own set of advantages and disadvantages.

Types of Samplers

Accumulator bulbs are quite popular and work very well (refer to Figure 1). These devices are usually stainless steel spheres with a pipe fitting on the inlet side and a series of small exit holes on the opposite end. A single hole on the equator of the sphere allows a detector tube sample to be drawn from the center point inside the bulb. This type of sampler has the advantage of a quick set up and short purge time (1-2 minutes). The disadvantage lies in hot weather use where moisture from the air can condense on the outside of the sampler. Contact between the tube inlet and this condensate must be avoided for accurate sampling. A simple fix is to wipe the sampler dry with a towel just before inserting the detector tube.

Flow-through samplers also work well (refer to Figures 2 & 3). In this type of sampler gas is forced to change direction prior to venting, causing the container to remain full of gas. Flow-through samplers can be made from glass, various metals, polyethylene, or other plastics. They can be set up quickly, but the various materials require different purge times. Polyethylene and other plastics tend to absorb moisture and require longer purge times (typically 5-10 minutes). Glass requires a shorter purge time, but is breakable. This can be a problem at a remote sampling site.

Regardless of which sampler you use, the gas flow rate through the sampler should be 1-2 LPM (at minimum) to stay ahead of the maximum flow rate of the gas detection hand pump. The pump's peak flow rate occurs at the beginning of the sample, when the pump vacuum is at its maximum level.

Though other sampler types are no doubt in use, accumulator bulbs and flow-through samplers are the most common. With any sampling device the most important factor is to keep ambient air out of the sample. If a detector tube measurement is suspected of being too high, air intrusion is the first thing to look for.

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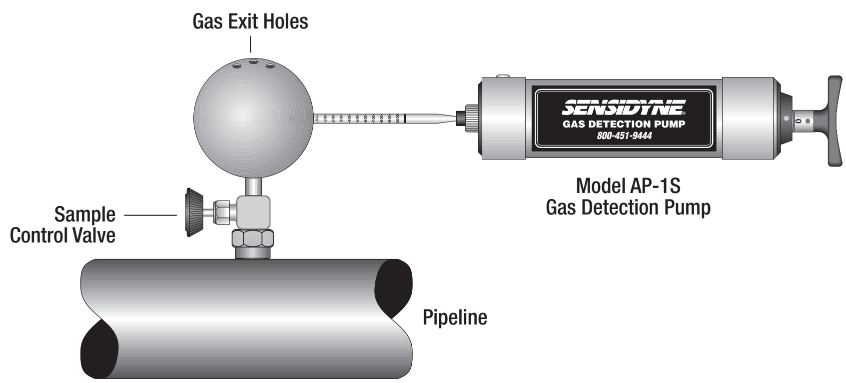

Figure 1
Accumulator Style Sampler

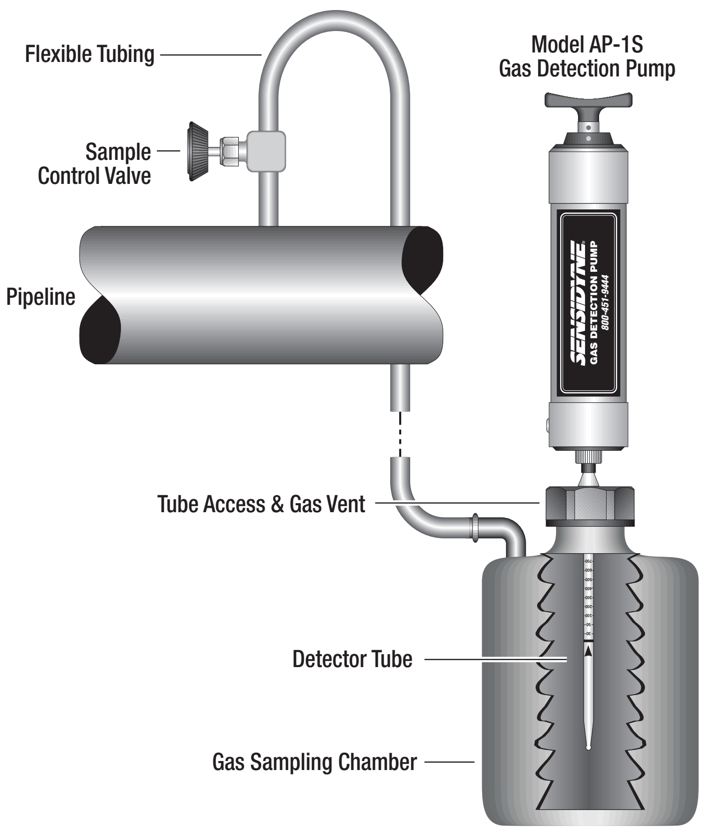

Figure 2
Standard Flow-Through Sampler

Temperature Correction

Most water vapor detector tubes contain a temperature correction chart in the instructions. **Do not ignore this chart**. You must understand two important points regarding temperature correction in order to ensure accurate and expedient results. The points are outlined below.

- The sampler temperature (NOT the pipeline temperature) is the key temperature measurement in natural gas sampling. Pipeline gas is under high pressure, and it cools considerably as it expands while exiting the pipe. **Note**: The pipeline temperature can easily be 50–60°F (10-16°C) warmer than the sampler temperature (the temperature the tube "sees").

- A **simple trick** can virtually eliminate the need for temperature charts. Detector tubes are factory-calibrated at 68°F (20°C). Sampling at this temperature requires no correction at all. The trick is to adjust the flow rate of the gas flowing through the sampler until the temperature is close to 68°F (20°C). Place a small thermometer inside the sampler to verify the temperature. A temperature window of 65–75°F (18-24°C) will keep all temperature corrections within ± 10%, which is generally insignificant in these measurements (e.g., 6.0 ± 0.6 Lb/MMCF).

Color Change

Sensidyne water vapor dew point detector tubes utilize a chemistry that produces a color change in stages. The reagent turns light green and then darker green and finally purple-blue as the reagent becomes wetter. For this reason multi-colored stains are usually observed. When this happens, darker colors will be nearer the zero mark, while lighter colors will be toward the maximum end of the stain. All of these colors are caused by reaction to moisture. The maximum point of the stain indicates the water vapor level.

Interferences

Natural gas pipelines can contain methanol and triethylene glycol from various processes. Methanol is injected into pipelines to prevent hydrocarbon freezing in cold weather and in deep water offshore sites. Triethylene glycol is used in the contact dehydrators and can entrain into the pipeline. Both of these substances can affect the tube reading.

Methanol is a positive interferent that causes the tube to read high (once the methanol level exceeds some minimum level). Triethylene glycol (TEG) interference is more complex. It is theorized that the tubes do not respond to TEG directly, due to its high boiling point and low vapor pressure. However, the TEG entering the system from the dehydrator has water physically attached to it, and that water can cause problems. Field testing has indicated that the low range water vapor tube 177UR is not affected by the presence of TEG, however the high range tube 177UL can read high if the TEG levels are also high. Sensidyne/Kitagawa ethylene glycol tubes 232SA and 232SB may be used to detect the presence of TEG.

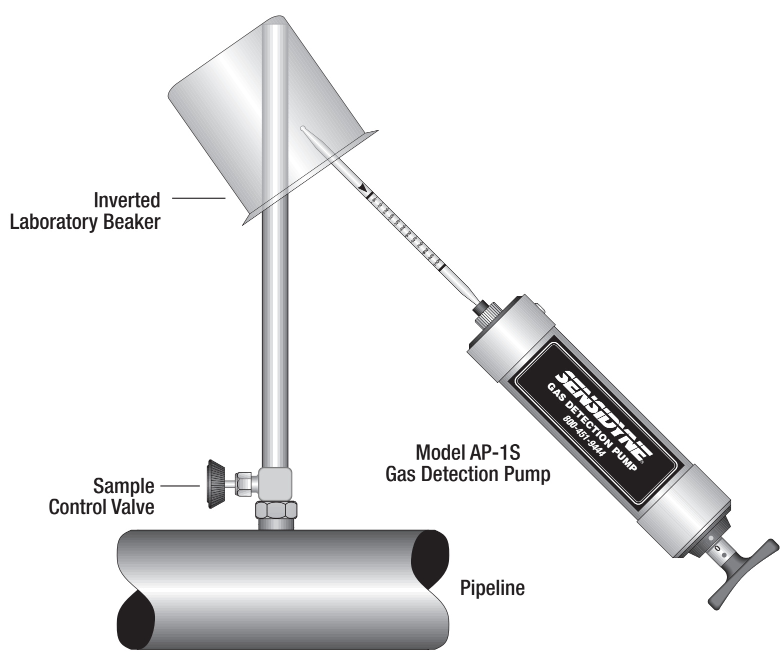

Figure 3
Simple Flow-Through Sampler

Channeling and Feathering

Today's detector tubes have over 50 years of commercial development behind them, and users should expect very few problems. Years ago it was not uncommon for detector tubes to display abnormal stain end points caused by conditions known as channeling and feathering. With today's quality control these problems are not very common, but they still can occur with an occasional production lot, even with the best of brands. While these problems are not commonplace today, it is still wise to know how to interpret them if encountered.

Channeling occurs when the particle size is not consistent, and open channels form within the tube that allow the sample to travel easier through one side of the tube than through the other. The stain's end point will be angled instead of straight across. To read a tube in which channeling has occurred, simply read the stain's highest point and lowest point and take an average of the two readings. (See Figure 4).

Similarly feathering can occur when the sample flow rate is slightly too fast. With feathering, the end of the stain is diffused, because the available chemical was not completely reacted at the maximum end. To read a tube in which feathering has occurred, read the end of the dark stain and the end of the total stain and take the average. (See Figure 4). In the case of Sensidyne/Kitagawa water vapor tubes, this would be a darker and lighter shade of green.

Note: All examples in Figure 4 are for a reading of 5 Lb/MMCF

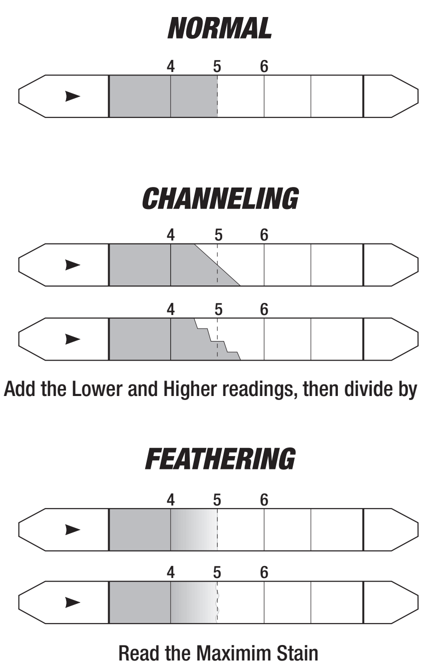

Figure 4
Channeling & Feathering

Sampling Technique

Detector tubes provide a marvelous screening tool for speed and ease of use in dew point measurements in natural gas pipelines. Some simple rules will assure optimum accuracy.

1) Always use a sampler of a design that will prevent ambient air intrusion. Ambient air normally contains much higher levels of moisture than does the gas. Intrusion of even small amounts of ambient air into the sample will cause the tubes to read high.

2) Moisture can condense on the outside of stainless steel accumulator type samplers in hot and humid weather. Wipe off the moisture on the sampler with a towel prior to sampling. This ensures that the condensate is not contacting the open inlet of the detector tube.

3) Use a small thermometer to monitor the temperature inside the sampler. This is the temperature that is used when applying temperature corrections per the tables in the detector tube instruction sheets.

4) By adjusting the gas flow rate, the sampler temperature can be set to fall within 65–75°F (18-24°C), thus minimizing or even eliminating temperature corrections.

5) Samples should be taken from the center of the sampling chamber with the gas flowing at a minimum of 1-2 LPM. Slower flow rates may allow air to intrude, causing high readings. When using accumulator type samplers, the tube inlet should not be close to the exit vent holes.

6) Water vapor detector tubes should be read immediately after the sample is taken. The sample finish indicator on the pump will tell the operator when the sample is completed. At that point it is best to read the tube before it is completely removed from the sampler. Water vapor from the ambient air will diffuse into an open tube and will darken and lengthen the stain very quickly in humid air. Sensidyne/Kitagawa tubes 177UL and 177UR have protective layers that will prolong the reading compared to other brands, but the humidity intrusion is only delayed. For optimum results, read the tube immediately following the completion of the sample.

