Designation: ~~D4888 – 06 (Reapproved 2015)~~ D4888 – 20

Standard Test Method for Water Vapor in Natural Gas Using Length-of-Stain Detector Tubes[1]

This standard is issued under the fixed designation D4888; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers a procedure for rapid and simple field determination of water vapor in natural gas pipelines. Available detector tubes provide a total measuring range of 0.1 to 40 mg/L, although the majority of applications will be on the lower end of this range (that is, under 0.5 mg/L). At least one manufacturer provides tubes that read directly in pounds of water per million cubic feet of gas. See Note 1.

1.2 Detector tubes are usually subject to interferences from gases and vapors other than the target substance. Such interferences may vary among brands because of the use of different detection methods. Consult manufacturer's instructions for specific interference information. Alcohols and glycols will cause interferences on some water vapor tubes because of the presence of the hydroxyl group on those molecules.

1.3 *Units*—The values stated in SI units are to be regarded as the standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate ~~safety~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D4150 Terminology Relating to Gaseous Fuels

3. Terminology

3.1 *Definitions*—For definitions of general terms used in D03 Gaseous Fuels standards, refer to Terminology D4150.

4. Summary of Test Method

4.1 The sample is passed through a detector tube filled with a specially prepared chemical. Any water vapor present in the sample

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[1] This test method is under the jurisdiction of ASTM Committee D03 on Gaseous Fuels and is the direct responsibility of Subcommittee D03.07 on Analysis of Chemical Composition of Gaseous Fuels.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

reacts with the chemical to produce a color change or stain. The length of the stain produced in the detector tube, when exposed to a measured volume of sample, is directly proportional to the amount of water vapor present in the sample. A hand-operated piston or bellows-type pump is used to draw a measured volume of sample through the tube at a controlled rate of flow. The length of stain produced is converted to milligrams per ~~litre~~liter of H_2O by comparison to a calibration scale supplied by the manufacturer for each box of detection tubes. The system is direct reading, easily portable, and completely suited to making rapid spot checks for water vapor under field conditions.

NOTE 1—Detector tubes are available with calibration scales printed in pounds of water per million cubic feet of gas (lb/MMCF). The conversion factor is 1 mg/L = 62.3 lb/MMCF (7 lb/MMCF = 0.11 mg/L).

5. Significance and Use

5.1 The measurement of water vapor in natural gas is important because of the gas quality specifications, the corrosive nature of water vapor on pipeline materials, and the effects of water vapor on utilization equipment.

5.2 This test method provides inexpensive field screening of water vapor. The system design is such that it may be used by nontechnical personnel with a minimum of proper training.

6. Apparatus

6.1 *Length-of-Stain Detector Tubes*—A sealed glass tube with the breakoff tips sized to fit the tube holder of the pump. The reagent layer inside the tube, typically a silica gel substrate coated with the active chemical, must be specific for water vapor and produce a distinct color change when exposed to a sample of gas containing water vapor. Any substances known to interfere must be listed in the instructions accompanying the tubes. A calibration scale should be marked directly on the tube; however, other markings that provide for ready interpretation of water vapor content from a separate calibration scale supplied with the tubes shall be acceptable. The calibration scale shall correlate water vapor concentration to the length of the color stain. Shelf life of the detector tubes must be a minimum of two years from date of manufacture when stored according to manufacturers' recommendations.

6.2 *Detector Tube Pump*—A hand-operated pump of a piston or bellows type. It must be capable of drawing 100 mL per stroke of sample through the detector tube with a volume tolerance of ±5 mL.[3] It must be specifically designed for use with detector tubes.

NOTE 2—A detector tube and pump together form a unit and must be used as such. Each manufacturer calibrates detector tubes to match the flow characteristics of its specific pump. Crossing brands of pumps and tubes is not permitted, as considerable loss of system accuracy is likely to occur.[3]

6.3 *Gas Sampling Chamber*—Any container that provides for access of the detector tube into a uniform flow of sample gas at atmospheric pressure and isolates the sample from the surrounding atmosphere. A stainless steel needle valve (or pressure regulator) is placed between the source valve and the sampling chamber for the purpose of throttling the sample flow. Flow rate should approximate one to two volume changes per minute or, at minimum, provide exit gas flow throughout the detector tube sampling period.

NOTE 3—A suitable chamber may be devised from a polyethylene wash bottle of nominal ~~500-mL (16-oz) or 1-L (32-oz)~~500 mL (16 oz) or 1 L (32 oz) size. The wash bottle's internal delivery tube provides for delivery of sample gas to the bottom of the bottle. A ½~~-in.~~ in. hole cut in the bottle's cap provides access for the detector tube and vent for the purge gas (Fig. 1).

7. Procedure

7.1 Select a sampling point that will provide access to a representative sample of the gas to be tested (source valve on the main line). The sample point should be on top of the pipeline and equipped with a stainless steel sample probe extending to the middle third of the pipeline. Open the source valve momentarily to clear the valve and connecting nipple of foreign materials.

7.2 Install needle valve (or pressure regulator) at the source valve outlet. Connect sampling chamber using the shortest length of tubing possible (Fig. 1). Many flexible tubing materials will be suitable for water vapor sampling; however, if the sampler is also used for other constituents such as hydrogen sulfide, then tubing materials should be chosen carefully. Avoid using tubing that

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[3] *Direct Reading Colorimetric Indicator Tubes Manual*, ~~, First ed.,~~ Second Edition, American Industrial Hygiene Association, ~~Akron, OH 44311, 1976.~~Publication No. 172-SI-93, 1993.

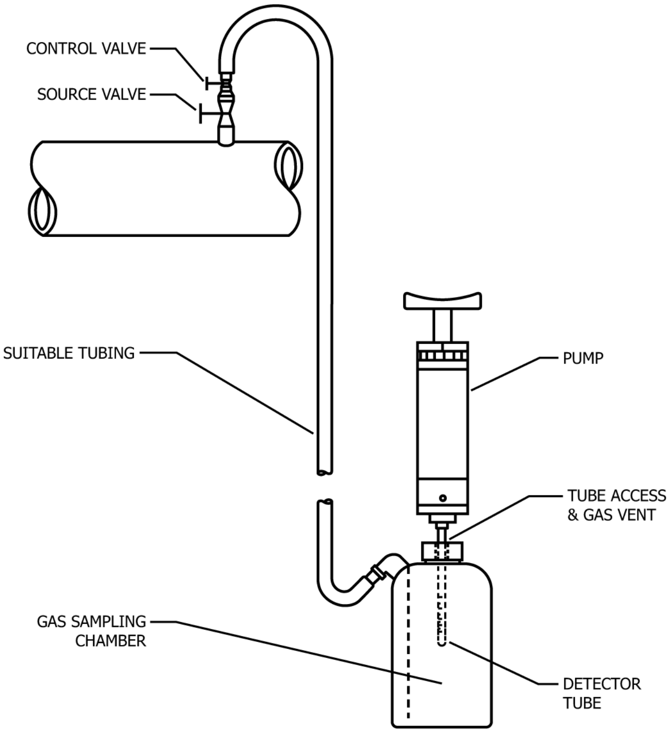

FIG. 1 Pump and Tube Apparatus

reacts with or absorbs hydrogen sulfide, such as copper or natural rubber. Use materials such as TFE-fluorocarbon, polyethylene, or stainless steel. Stainless steel tubing is preferred. (**Warning**— Exiting gases are highly flammable and may contain toxic levels of hydrogen sulfide. Consider venting the exit gases away from the user when possible.)

7.3 Open source valve. Open needle valve enough to obtain positive flow of gas chamber, in accordance with ~~4.3~~6.3. Purge the container for at least 3 min (Fig. 1). Purge for at least 10 min if a polyethylene bottle is used.

7.4 Before each series of measurements, test the pump for leaks by operating it with an unbroken tube in place. Consult manufacturers' instructions for leak check procedure details and for maintenance instruction if leaks are detected. The leak check typically takes 1 min.

7.5 Select the tube range that best encompasses water vapor concentration. Reading accuracy is improved when the stain length extends into the upper half of the calibration scale. Consult manufacturer guidelines for using multiple strokes to achieve a lower range on a given tube.

7.6 Break off the tube tips and insert the tube into the pump, observing the flow direction indication on the tube. Place the detector tube into the sampling chamber through the access hole, such that the tube inlet is near the chamber center (Fig. 1).

NOTE 4—Detector tubes have temperature limits of 0 to ~~40°C~~40 °C (32 to ~~104°F),~~104 °F), and sample gases must remain in that range throughout the test. Cooling probes are available for sample temperatures exceeding ~~40°C.~~40 °C.

7.7 Operate the pump to draw the measured sample volume through the detector tube. Observe tube instructions when applying multiple strokes. Ensure that a positive flow is maintained throughout the sample duration at the sampling chamber gas exit vent. Observe tube instructions for proper sampling time per pump stroke. The tube inlet must remain in position inside the sampling chamber until the sample is completed. Many detector tube pumps will have stroke finish indicators that eliminate the need to time the sample.

NOTE 5—It is very important to ensure that ambient air is not being drawn into the sample. Ambient humidity is often much higher than the water vapor level in the gas sample, and intrusion could bias the ~~reading's~~readings high (for example, at ~~60°F~~60 °F and 10 % relative humidity air contains about ~~83-lb~~83 lb H_2O/MMCF or about 1.33 mg/L).