An Overview of Industry Standards Related to Natural Gas Measurement

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INTRODUCTION

What is a standard? Why are standards important? Merriam-Webster dictionary defines *standard* as:

1) "a conspicuous object (as a banner) formerly carried at the top of a pole and used to mark a rallying point especially in battle or to serve as an emblem"
2) "something established by authority, custom, or general consent as a model or example"
3) "something set up and established by authority as a rule for the measure of quantity, weight, extent, value, or quality"
4) "the fineness and legally fixed weight of the metal used in coins"
5) "the basis of value in a monetary system"
6) "a structure built for or serving as a base or support"

From these definitions, it appears that one could conclude that a standard should have value; be established by general consent or by an organization; be a "yardstick" to measure quantity, quality, and value; and be a "base or support" upon which one can built procedures and policies.

Standards have been developed and are continually being developed to help provide uniform and consistent actions or results, improve safety, minimize legal action, and to improve efficiencies.

Standards are a vital part of our every day lives. Many of the benefits that we have gained as a result of standards often go unnoticed. We are usually unaware of the role of standards in raising quality levels, reliability, safety, interchangeability and efficiency. We often take for granted that a pipe fitting we purchased at one store will thread onto a pipe we purchased from a different store. We expect that a USB memory stick we "mail ordered" will plug into the new computer that we purchased at a local discount store. When things go well – when systems, machinery and devices work well and safely – it is because they conform to standards.

The gas industry has adopted standards for these same reasons. Without standards that set guidelines for meter tube dimensions, orifice plate thickness, BTU calculations, etc. each company may be tempted to use whatever methods might benefit their company the greatest. A different method might even be used for selling than might be used for buying. Standards help insure that all participants participate on the same level, use the same guidelines, and without unfair advantages.

STANDARD ORGANIZATIONS

What are the organizations that have developed or currently are developing standards for the gas measurement industry? The majority of the adopted standards that cover gas measurement have been developed by AGA (American Gas Association), API (American Petroleum Institute), ISO (International Organization for Standardization), and GPA (Gas Processors Association). Other organizations such as ANSI (American National Standards Institute) and NIST (National Institute of Standards and Technology) are also involved. Many times these organizations jointly sponsor or indorse a common standard. One example of this is a booklet named "Orifice Metering of Natural Gas". This booklet is referred to as ANSI/API 2530: Second Edition, AGA Report No. 3, and GPA 8185-85.

AMERICAN GAS ASSOCIATION (AGA)

The AGA was founded in 1918 and represents 197 local energy utility companies throughout the United States. AGA's members account for approximately 83 percent of all natural gas delivered by the nation's local natural gas distribution companies.

Mission Statement
"The American Gas Association advocates the interests of its members and their customers, and provides information and services promoting efficient demand and supply growth and operational excellence in the safe, reliable and efficient delivery of natural gas".

AMERICAN PETROLEUM INSTITUTE (API)

API represents more than 400 members involved in the oil and natural gas industry and is the primary trade association of that industry. Companies both large and small are offered the opportunity to be involved in shaping API programs and policy priorities. API has been vital in establishing, maintaining and publishing standards for the oil and natural gas industry since the early 1900's. API was established in 1919 and the first standard was published in 1924. API's involvement in standards has

helped to insure consistency and ensure fairness in the marketplace and promote acceptance of products and practices globally. API distributes approximately 550 standards and recommended practices covering all segments of the oil and natural gas industry to promote the use of safe, interchangeable equipment and proven and sound engineering practices. API also provides the opportunity for standards development, technical cooperation and other activities to improve the industry's competitiveness.

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO's principal activity is the development of standards and is the world's largest developer of standards. ISO is a network of the national standards institutes of 156 countries, on the basis of one member per country. ISO officially began operation in February of 1947.

The widespread adoption of International Standards means that businesses using International Standards are increasingly free to compete on many more markets around the world.

ISO standards are developed by technical committees that are made up of experts from the industrial, technical and business sectors which have requested the standards and eventually put them into practice.

GAS PROCESSORS ASSOCIATION (GPA)

The GPA had its beginning in 1921. At that time, the industry was disorganized and lacked standards of any kind. As an example, there were over 100 different specifications for natural gasoline and no meaningful tests for determining product quality. During this confusing time, a small group of plant operators formed the Association of Natural Gasoline Manufacturers. This group adopted the first standard specifications for natural gasoline. They also developed simple, reproducible test methods for determining specific gravity, vapor pressure, and other tests to better define the industry's products.

The organization went through several more name changes, and in 1974 changed their name to Gas Processors Association (GPA). GPA, as the name implies, is an organization of operating and producing companies that are engaged in the processing of natural gas. GPSA is an organization of companies that supply and service the needs of the industry. Throughout its history, the GPA has become the focal point of progress and the "problem solver" of the gas processing industry. One of GPA's main contributions to the processing industry has been the development of standard specifications for natural gas liquid products. Nearly all natural gasoline sold since 1922 and all LP gas sold since 1930 have been traded on the basis of GPA specifications.

GPA Publication 2145 refers to the physical properties of the various gas components. This data is essential for accurate custody transfer quality data. However, the proper application of these physical properties is also essential for accurate measurement. GPA technical sections have addressed this problem by developing a number of standardized calculation procedures for applying this basic data to custody transfer measurements of natural gas and natural gas liquids.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI was founded in 1918 and adopted its present name in 1969. ANSI's primary goal has been to enhance the global competitiveness of the United States business and American quality of life by promoting voluntary consensus standards and conformity assessment systems and promoting their integrity. ANSI is the sole accreditor of U.S. voluntary consensus standards developing organizations. ANSI serves and protects the public interest since standard's developers accredited by ANSI must meet the Institute's requirements for openness, balance, consensus and other due process safeguards.

ANSI is the dues paying member and sole U.S. representative to the ISO organization.

NATIONAL INSTITUE OF STANDARDS AND TECHNOLOGY (NIST)

NIST was founded in 1901. NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life. NIST helps government and industry develop standards for weights and measures. NIST laboratories maintain more than 1200 different Standard Reference Materials that are the equivalent of certified "rulers" that government and industries use to check the accuracy of the most exacting measurements.

APPLICATION OF STANDARDS

How are these standards applicable to our industry and particularly to natural gas measurement? There are specific standards that apply to tolerances, dimensions, length requirements, pipe roughness, etc. in the manufacture of meter tubes. There are standards that apply to orifice plate thickness, flatness, centering of the orifice plate, etc. There are standards for calculating the heating value of a gas mixture and the relative density. There are standards for calculating the compressibility of a gas. There are standards that define how the gas volume will be calculated. It is critical that each of these standards be followed to ensure that an accurate and consistent volume or mass is calculated each and every time. Consistent, repeatable results can only be obtained if each party adheres to the same industry established standards at

all measurement locations. This insures fair, equitable and consistent expectations and minimizes possible litigation between parties that are involved in the buying and selling of natural gas. The contracts between these parties include sections that are specific to measurement.

Some examples of wording within gas contracts that contain reference to industry standards are:

" the gas delivered to ……. shall be measured with meters constructed and installed, and whose computations of quantity are made in accordance with the provisions of API 14.3/AGA Report #3, AGA Report #9 or the latest revision thereof."

"for all measurement of gas…..the BTU content per cubic foot shall be determined for a cubic foot of gas at a temperature of sixty (60) degrees Fahrenheit and at an absolute pressure of 14.73 pounds per square inch on a dry basis."

"when and where electronic measurement and flow computers are used, the gas shall have its volume, mass, gravity, composition or energy content, determined and calculated in accordance with applicable AGA standards including, but not limited to, ANSI/API 14.3.1&2/AGA Report No. 3, latest edition, AGA Report No. 5, latest edition, AGA 8 for supercompressibility, AGA Report No. 7, latest edition and API Chapter 21.1 latest edition for measurement by electronic flow computers"

"Gas samples shall be obtained in accordance with the procedures set forth in GPA Standard 2166 (latest edition) "Obtaining Natural Gas Samples for Analysis by Gas Chromatography" and API 14.1 Section 1 (latest edition). Gas samples shall be analyzed in accordance with procedures set forth in GPA Standard 2261 (latest edition) "Analysis for Natural Gas and Similar Gaseous Mixtures by Gas Chromatography."

"the gas shall not contain more than two percent (2%) of carbon dioxide"

"the gas shall have a total or gross heating value of not less than 950 BTU per cubic foot at a pressure base of 14.73 dry."

Several of the examples listed refer directly to specific industry standards. The examples that do not specify a specific standard, do list specific requirements that must be met. To meet these requirements, some action, procedure or standard must be followed to get the correct answers. In the last example; for a party to know that their gas has a BTU content of 950 or greater, they would need to sample the gas correctly, and then analyze the gas with a chromatograph. The physical constants from GPA 2145 would be used, procedures from GPA 2261 would be followed and calculations from GPA 2172 utilized correctly to obtain the correct dry BTU at 14.73 pressure base. If the gas was sampled correctly, per API 14.1 and GPA 2166, the correct answer should be obtained. Thus, at least five specific standards would be utilized.

STANDARDS THAT APPLY TO VARIOUS METER TYPES

Meter Type	AGA	API	GPA	ANSI	Comments
Orifice	AGA # 3 Part 1	API 14.3 Part 1	GPA 8185-90 Part 1		Same document. "Natural Gas Fluids Measurement - Concentric, Square-Edged Orifice Meters - General Equations and Uncertainty Guidelines"
Orifice	AGA # 3 Part 2	API 14.3 Part 2	GPA 8185-00 Part 2		Same document. "Natural Gas Fluids Measurement - Concentric, Square-Edged Orifice Meters - Specification and Installation Requirements"
Orifice	AGA # 3 Part 3	API 14.3 Part 3	GPA 8185-91 Part 3	ANSI/API 2530-1991, Part 3	Same document. "Natural Gas Fluids Measurement - Concentric, Square-Edged Orifice Meters - Natural Gas Applications"
Orifice	AGA # 3 Part 4	API 14.3 Part 4	GPA 8185-92 Part 4		Same document. "Natural Gas Fluids Measurement - Concentric, Square-Edged Orifice Meters – Background, Development, Implementation Procedures and Subroutine Documentation"
Turbine, PD, Coriolis & Ultrasonic	AGA # 7				"Measurement of Gas by Turbine Meter"- (applies to ultrasonic and coriolis meters if frequency output is used)

Meter Type	AGA	API	GPA	ANSI	Comments
Ultrasonic	AGA # 9				"Measurement of Gas by Multipath Ultrasonic Meters"
Ultrasonic	AGA # 10				“Speed of Sound in Natural Gas and Other Related Hydrocarbon Gases”. This may be used to compare the SOS shown by the meter compared to calculated SOS, as a diagnostics tool.
Coriolis	AGA # 11	API 14.9			"Measurement of Natural Gas by Coriolis Meter"
Applies to All Types	AGA #5				"Fuel Gas Energy Metering" (1996) provides for units of gas volume or mass-to-energy equivalents
Applies to All Types	AGA # 8				“Compressibility Factor of Natural Gas and Related Hydrocarbon Gases”
Applies to All Types		API 14.1			“Collecting and Handling of Natural Gas Samples for Custody Transfer”
Applies to All Types			GPA 2145-03		“Table of Physical Constants for Hydrocarbons & Other Compounds of Interest to the Natural Gas Industry”
Applies to All Types			GPA 2166-05		“Obtaining Natural Gas Samples for Analysis by Gas Chromatography”
Applies to All Types			GPA 2198-03		“Selection, Preparation, Validation, Care and Storage of Natural Gas and Natural Gas Liquids Reference Standard Blends”
Applies to All Types		API 14.4	Developed jointly with GPA Section H		“Converting Mass of Natural Gas Liquids & Vapors to Equivalent Liquid Volumes
Applies to All Types			GPA 2261-00		“Analysis for Natural Gas & Similar Gaseous Mixtures by Gas Chromatography”
Applies to All Types		API 14.5	GPA 2172-96		“Calculation of Gross Heating Value, Specific Gravity, & Compressibility of Natural Gas Mixtures from Compositional Analysis”
Applies to All Types	(endorsed by AGA)	API 21.1			Flow Measurement Using Electronic Metering Systems - Electronic Gas Measurement"

REFERENCES

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4. ansi.org
5. iso.org
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