Measurement

Thursday, May 2nd, 2024, 11:00 a.m. – 11:50 a.m.

Natural Gas Measurement Standards Update

By
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Over 38 years of progressive experience in management, marketing, measurement, automation and remote monitoring/control. At present, I am a Sr. Director of Business Development with Eagle Research Corporation. I have been an active participant in industry standards developing groups for data communication and measurement. I belong to national IEEE, ISA, AWWA organizations, ISA112 SCADA Standard working Group, AGA Transmission Measurement Committee, AGA Customer Field Service & Measurement (Distribution Measurement) Committee, and AGA Operating Equipment & Services Associates Managing Committee, API Committee on Liquid Measurement (COLM), API Committee on Gas Fluid Measurement (COGFM), Western Gas Measurement Short Course (WGMSC) past Board, Appalachian Gas Measurement Shor Course (AGMSC) Committee and Gild of Ancient Supplers. I have an Executive M.B.A from Marshall University, West Virginia and have M.S. in Electrical Engineering from West Virginia Institute of Technology. I am married to Darshana and have two daughters, Preeya & Anika.

What will be covered today?

- Natural Gas Measurement Standards/Documents Update from:
  - American National Standards Institute
  - American Gas Association
  - American Petroleum Institute
  - GPA Midstream Association

Why do we need “Standards”?

- Provides accumulated knowledge base for best practices.
- Allow improved measurement.
- Provide means for measurement consistency.
- Provide guidelines for proper installation and application of technology.
- Referenced in contracts.
- Developed by industry consensus

Standards

- A document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines, or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context. Standards typically include elements of specifications and recommended practices.

Other related document - definitions

- **Technical Reports** (White Paper, Engineering/Technical Notes, Bulletins) Documents that convey technical information on a specific subject or topic and are generally issued on a one-time basis, are not standards

- **Code**

A document intended for adoption by regulatory agencies or authorities having jurisdiction.

- **Recommended Practice**

A document that communicates recognized industry practices.

- **Specification**

Documents that are written in such a way as to facilitate communications between purchasers, manufacturers, and/or service suppliers. Specifications may include datasheets that may be used in industrial transactions.

For Standards – It is important to understand …….

- **shall**—is used to indicate that a provision is mandatory;
- **should**—is used to indicate that a provision is not mandatory, but recommended as good practice;
- **may**—is used to indicate that a provision is optional;
- **can**—is used for statements of possibility or capability.

National vs International

While there are efforts to “harmonize” US and international standards, differences remain.

Natural Gas Related Standards Organizations

- American Gas Association (AGA)
- American National Standards Institute (ANSI)
- American Petroleum Institute (API)
- Gas Processors Association (GPA Midstream Association) (GPA)
- American Society of Mechanical Engineers (ASME)
- American Society of Testing and Materials (ASTM)
- American National Standard Institute (ANSI)
- International Organization for Standardization (ISO)
- International Legal Metrology (IOML)
- Additional organizations that are country-specific.
- There is interaction between most of these organizations – coordination & information exchange.

This presentation…

- This presentation is limited to US gas measurement standards that have been updated (or created) in the past few years

- In Particular – we will focus on natural gas related measurement documents from
  - American National Standard Institute (ANSI)
  - American Gas Association (AGA)
  - American Petroleum Institute (API)
  - Gas Processors Association (GPA Midstream Association) (GPA)

American National Standards Institute

ANSI B109 Family of Standards
For Gas Displacement Meters and Service Regulators

Number	Standard	Edition	Remarks
B109.1	Gas Displacement meters (500 cubic feet per hour capacity and under)	2019	Reaffirmation with out any changes. Public comment closed April 1, 2024
B109.2	Diaphragm Type Gas Displacement Meters (over 500 cubic feet per hour capacity)	2020	
B109.3	Rotary type Gas Displacement Meters	2019	Reaffirmation with out any changes. Public comment closed April 1, 2024
B109.4	Gas Regulators - Non-Pilot Loaded - Nominal Pipe Size (NPS) 1-1/4 inch and smaller.	2021	
B109.5	Self-Operated Diaphragm-Type Natural Gas Service Regulators (For Nominal Pipe Size up to and including 2 inches and inlet pressures up to 125 psig with outlet pressure of 20 psig or less not covered in ANSI B109.4)	New	2nd Public Review Closed
B109.6	Single Path Ultrasonic Gas Meters (Under 1400 Cubic Feet Per Hour Capacity)	2024	

Source: ANSI Committees - American Gas Association (aga.org)

Updated by Tushar K. Shah

AGA - Related Committees

- TMC (Transmission Measurement Committee)

Measurements related activities of this committee cover large volume natural gas flow measurement including calculation of physical and thermodynamic properties, primarily for custody transfer purposes. Ancillary and auxiliary devices along with electronic flow measurement systems are also covered. They are also involved in issues related to gas quality management and odorization.

- CFSM (Customer Field Service and Measurement)
  - Old – DMRC – Distribution Measurement and Regulation Committee.

Measurements related activities of this committee covers metering practice for low volume natural gas measurement, AMR/AMI, meter testing & maintenance to ensure accurate calculation of volumetric quantities

Publications

The majority of AGA's publications by the TMC. These fall into three major categories:

- Normative Guides
- Introduction and Training
- Related Issues

Courtesy of Ken Buys, AGA

Normative Publication

Reports contain detailed information, often contain prescriptive requirements.

Title	Catalog	Year	Comments
AGA Report No. 3,Part 1: General Equations & Uncertainty Guidelines	XQ1201	2012	API 14.3.1
AGA Report No. 3,Part 2: Specifications and Installation Requirements	XQ1601	2016	API 14.3.2
AGA Report No. 3,Part 3: Natural Gas Applications	XQ1304	2013	API 14.3.3
AGA Report No. 3,Part 4: Background, Development, Implementation Procedure	XQ9211	1992	API 14.3.4
AGA Report No. 4A: Natural Gas Contract, Measurement and Quality Clauses	XQ2102	2021	Under review
AGA Report No. 5, Natural Gas Energy Metering	XQ0901	2009	API 14.5 - Currently Open
AGA Report No. 6, Field Proving of Gas Meters Using Transfer methods	XQ1302	2013	Currently Open
AGA Report No. 7, Measurement of Natural Gas by Turbine Meters	XQ0601	2006	
AGA Report No. 8, Part 1, Thermodynamic Properties of Natural Gas and Related Gases, DETAIL and GROSS Equations of State	XQ1704-1	2017	
AGA Report No. 8, Part 2, Thermodynamic Properties of Natural Gas and Related Gases: GERG - 2008 Equation of State	XQ1704-2	2017	Scheduled for review
AGA Report No. 9, Measurement of Gas by Multipath Ultrasonic Meters	XQ2105	2022	Currently open Low flow applications
AGA Report No. 11, Measurement of Natural Gas by Coriolis Meter	XQ1301	2013	API 14.9

Courtesy of Ken Buys, AGA

Introduction and Training Publications

Gas Measurement Manuals introduce a subject, and train new measurement personnel.

Title	Catalog	Year	Comments
GMM Part 1: General	XQ1081	2022	Completed
GMM Part 2: Displacement Metering	XQ2103	2021	
GMM Part 3: Orifice Meters	XQ9011	1990	Publishing soon
GMM Part 4: Gas Turbine Metering	XQ1701	2017	
GMM Part 5: Other Measurement Methods	XQ0483	2004	
GMM Part 6: Auxiliary Devices	XQ0779	2007	
GMM Part 7: Measurement Calculations and Data Gathering	XQ0379	2003	
GMM Part 8: Electronic Flow Computers and Transducers	XQ8805	1988	Sunset publication
GMM Part 9: Design of Meter and Regulator Stations	XQ8803	1988	
GMM Part 10: Pressure and Volume Control	XQ0584	2005	
GMM Part 11: Measurement of Gas Properties	XQ8804	1988	
GMM Part 12: Meter Proving; and Part 13: Distribution Metering Data	XQ0278	2002	
GMM Part 14: Meter Repair and Selection (Revised)	XQ0381	2003	
GMM Part 15: Electronic Corrector	XQ9901	1999	Currently Open
GMM Part 16: Ultrasonic Metering, First Edition		New	Currently Open
GMM Part 17: Coriolis Metering, First Edition	XQ2002	2020	

Courtesy of Ken Buys, AGA

Measurement Related Publications

Title	Catalog	Year	Comments
Odorization Manual, 2017	XQ1702	2017	Currently Open
Interchangeability of Other Fuel Gases with Natural Gases -Research Bulletin 36	XH0203	2002	
Natural Gas Quality Management Manual	XQ1303	2013	
Fluidic Oscillation Measurement for Natural Gas Applications	XQ0503	2005	
The Theory and Operations of Meter Shop Sonic Nozzle Proving Systems for the Natural Gas Industry	XQ0308	2003	

Courtesy of Ken Buys, AGA

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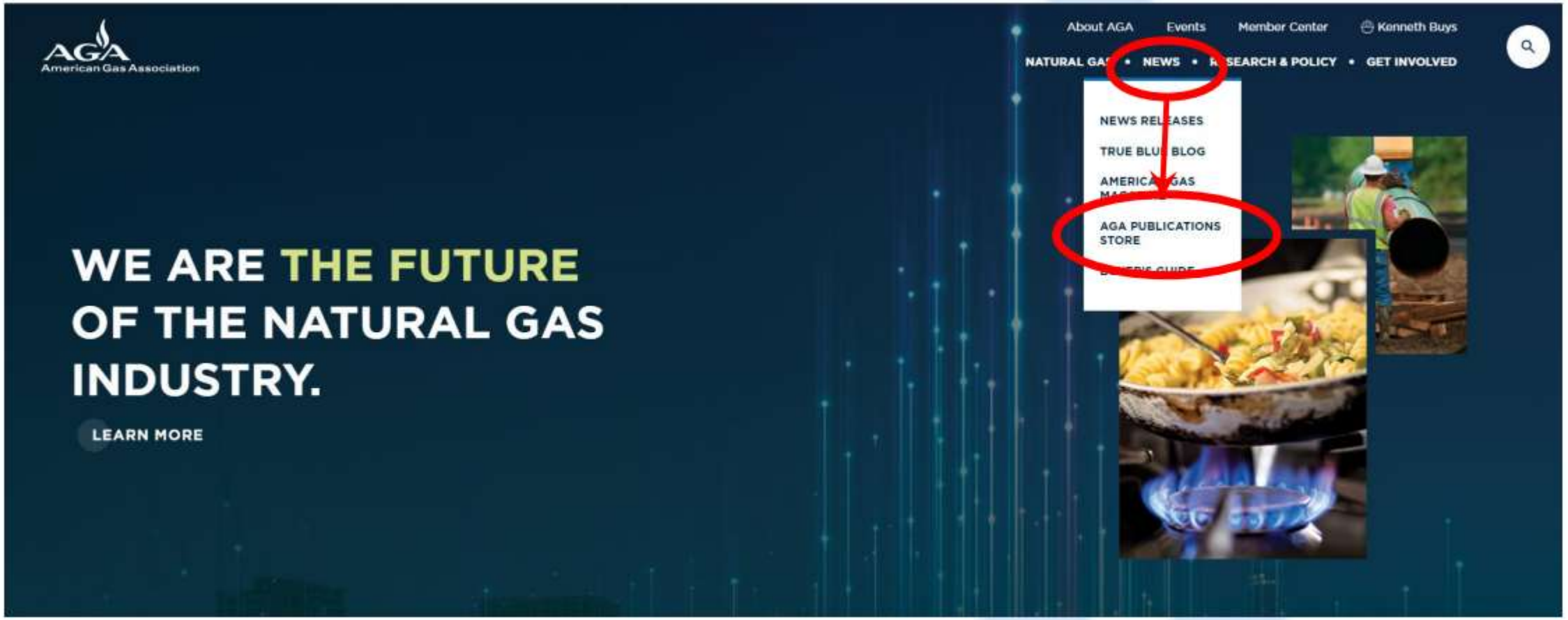
  - American Petroleum Institute (API)
  - Gas Processors Association (GPA Midstream Association) (GPA)

Publications Store on AGA Website



On the AGA Home Page go to "NEWS", then "AGA PUBLICATIONS STORE"

Courtesy of Ken Buys, AGA

API STANDARDS COMMITTEES

- API Committee on Standardization of Oilfield Equipment and Materials (CSOEM)
- API Committee on Refinery Equipment (CRE)
- API Committees on Pipeline Standards (COPS)
- API Safety and Fire Protection Committee (SFPS)
- API Rail Standards Committee (RSC)
- API Truck Standards Committee (TSC)
- API Committee on Petroleum Measurement (COPM)

API COPM SUBCOMMITTEES

- Committee on Evaporation Loss Estimation – (CELE)
- Committee on Gas Fluids Measurement – (COGFM)
- Committee on Liquid Measurement – (COLM)
- Committee on Measurement Accountability – (COMA)
- Committee on Measurement Education and Training – (COMET)
- Committee on Measurement Quality (Joint ASTM D02.02) – (COMQ)
- Committee on Production Measurement and Allocation – (CPMA)

API COPM Structure

Committee of Petroleum Measurement (Kristen Nelson– Chair)	Subcommittees	Manual of Petroleum Measurement Standards (MPMS)									
	COMET Measurement Education & Training (TJ Tajani – Chair)	Ch 1 Terms and Definitions	Spanish Translation	New Member Orientation	Chairmen's Orientation	General Session Speaker Workgroup					
	COLM Liquid Measurement (Jason Sharbonno - Chair)	Ch 2 Tank Calibration	Ch 3 Tank Gauging	Ch 4 Proving Systems	Ch 5 Metering	Ch 6 Meter Assembly	Ch 12 Calculations	Ch 13 Stats	Ch 16 Mass Measurement	Ch 18 Custody Transfer	Ch 21.2 Electronic Liquid Measurement
	CPMA Production Measurement (Pamela Chacon– Chair)	Ch 20 Allocation									
	CELE Evaporation Loss (Noelle Strid – Chair)	Ch 19 Evaporation Loss									
	COMA Measurement Accountability (Brian Bourgeois – Chair)	Ch 17 Marine Measurement	Ch 23 Reconciliation Of Quantities								
	COMQ / ASTM D02.02 Measurement Quality (Paul Furman– Chair)	Ch 7 Temperature	Ch 8 Sampling	Ch 9 Density	Ch 10 S &W	Ch 11 Physical Properties	Ch 15 SI Units			Ch 18 Custody Transfer	
	COGFM Gas Fluid Measurement (Don Sextro – Chair)	Ch 14 Gas Fluids	Ch 21.1 Electronic Gas Measurement	Ch 22 Test Protocol							

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API COPM SUBCOMMITTEES
Subcommittee on Gas Fluids Measurement (COGFM)

API's Measurement Standards Program

- Natural Gas Fluids Measurement, MPMS Chapter 14
- Electronic Gas Measurement, MPMS Chapter 21.1
- Testing Protocols, MPMS Chapter 22

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API COPM SUBCOMMITTEES

Subcommittee on Measurement Education and Training (COMET)

API's Measurement Standards Program

- Vocabulary:
  - MPMS Chapter 1 Online Terms & Definitions Database
- Spanish Translation
- Education & Training

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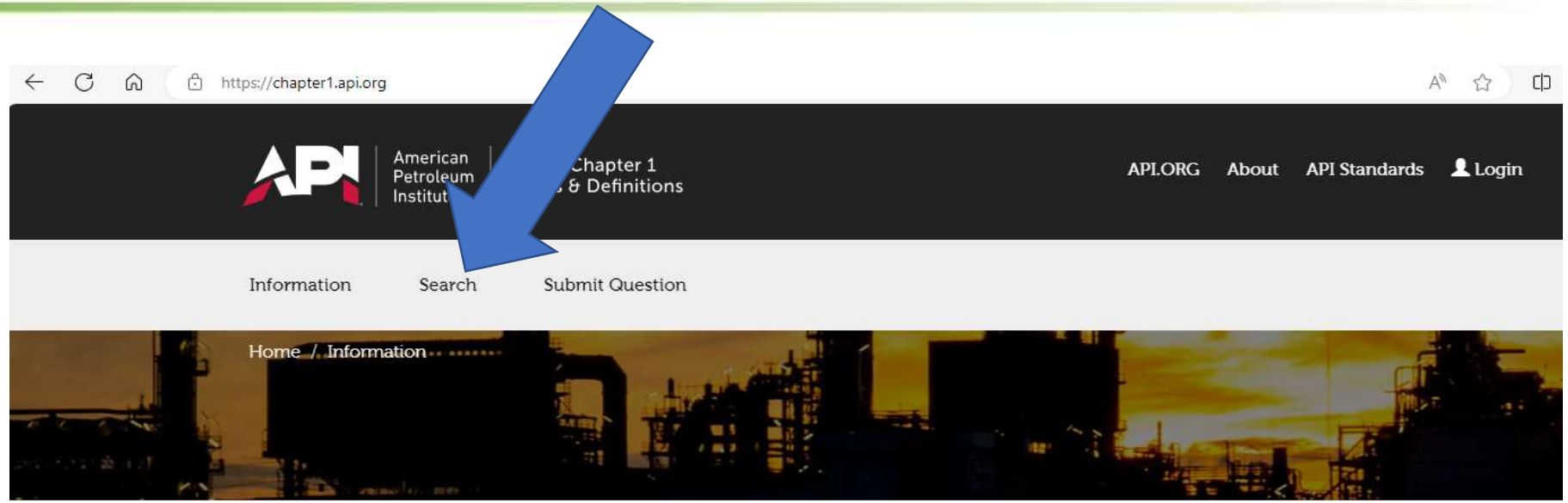
API COPM- MPMS Chapter 1 Online Terms & Definitions Database



https://chapter1.api.org

MPMS CHAPTER 1: GENERAL INFORMATION

The Chapter 1 Terms and Definitions online database provides definitions and terms used throughout the API Manual of Petroleum Measurement Standards (MPMS). The database is searchable by term, definition, chapter, subcommittee, and other filters. It is used by general users for searching terms and definitions within the Chapters of the MPMS. It is also used by Committee on Petroleum Measurement Subcommittee and Work Group members for maintenance of terms and standard development.

General users may print the results of their search and COPM members may print certain requested reports.

Chapter 1 Terms and Definitions is an evergreen document with the permanent goal to strive for one definition for each term and that is technically correct, concise, universal, logical, and stands on its own.

Chapter 1 is updated when there are applicable changes to the MPMS Standards. Questions on the Database contents may be submitted using the 'Submit Question' page.

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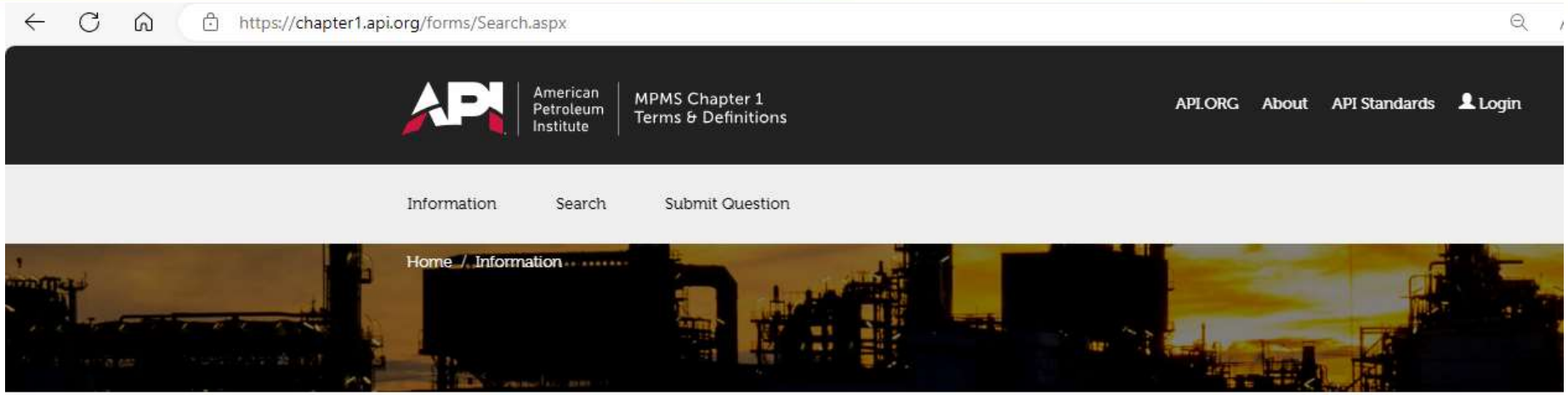
API COPM- MPMS Chapter 1 Online Terms & Definitions Database



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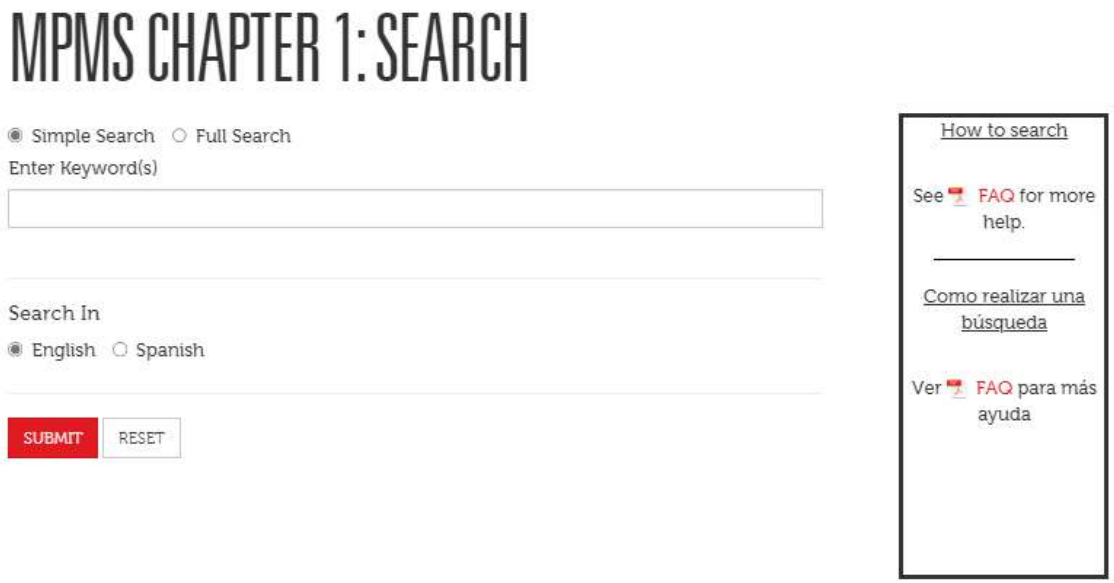

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COGFM Standards

C/SC	Chairman or [contact]	Ch./Std	Chapter/Standard/Title	Edition/Yr.	Due for Action	Ballot Status
COGFM	P. Chacon	13.X	Methods of Evaluating Gas Metering System Uncertainty	New Std	N/A	N/A
COGFM	M. Firmin	14.1	Collecting and Handling of Natural Gas Samples for Custody Transfer	8th Ed 9/22	2027	N/A
COGFM	C.Cutler	14.3.1	Concentric, Square-Edged Orifice Meters – General Equations and Uncertainty Guidelines	4th Ed 9/12 Errata 7/13	2027	N/A
			(AGA Report No. 3 Part 1)	Rfmd 7/22		
COGFM	S. Philips	14.3.2	Concentric, Square-Edged Orifice Meters – Specification and Installation Requirements (AGA Report No. 3 Part 2)	5th Ed 3/16 Errata 1 3/17 Errata 2 1/19 Rfmd 12/23	2023	N/A
COGFM	[K. Fry]	14.3.3	Concentric, Square-Edged Orifice Meters – Natural Gas Applications (AGA Report No. 3 Part 3)	4th Ed 11/13 Rfmd 6/21	2026	N/A

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COGFM Standards

C/SC	Chairman or [contact]	Ch./Std	Chapter/Standard/Title	Edition/Yr.	Due for Action	Ballot Status
COGFM	[M. Abens]	14.3.4	Concentric, Square-Edged Orifice Meters – Background Development, Implementation Procedures and Subroutine Documentation (AGA Report No. 3 Part 4)	4th Ed 10/19	2024	N/A
COGFM	Keith Fry	14.4	Converting Mass of Natural Gas Liquids and Vapors to Equivalent Liquid Volumes (GPA 8173)	2nd Ed 6/17 Rfmd 5/22	2027	N/A
COGFM	[J. Merkins]	14.5	Calculation of Gross Heating Value, Specific Gravity and Compressibility of Natural Gas Mixture from Compositional Analysis (GPA 2172)	3rd Ed 1/09 Rfmd 11/20	2025	N/A
COGFM	[E. Estrada]	14.7	Mass Measurement of Natural Gas Liquids and Other Hydrocarbons (GPA 8182)	5th Ed 2/18 Rfmd 7/23	2028	N/A
COGFM	[A. Floyd]	14.9	Measurement of Natural Gas by Coriolis Meter (AGA Report No. 11)	2nd Ed 2/13 Rfmd 9/18 Available from AGA	2023	Closed Ballot

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COGFM Standards

C/SC	Chairman or [contact]	Ch./Std	Chapter/Standard/Title	Edition/Yr.	Due for Action	Ballot Status
COGFM	[E. Estrada]	14.1	Measurement of Flow to Flares	2nd Ed 12/21	2026	N/A
COGFM	[J. Merkins]	14.12	Measurement of Gas by Vortex Meters	1st Ed 3/17 Rfmd 2/22	2027	N/A
COGFM	S. Phillips S. Anson	14.13	Recommended Practice for Fuel Gas Measurement and Meter Selection in Non-Custody Applications	1st Ed 12/22	2027	N/A
COGFM	A. Hubbell	14.14	Venturi Metering of Natural Gas and Other Related Hydrocarbon Fluids	1st Ed 3/23	2028	N/A
COGFM	A. Hubbell	14.XX	Pressure Determination	New 1st Ed	N/A	N/A

Courtesy of Patty Fusaro, API

COGFM Standards

C/SC	Chairman or [contact]	Ch./Std	Chapter/Standard/Title	Edition/Yr.	Due for Action	Ballot Status
COGFM	M. Webb K. Fry	21.1	Electronic Gas Measurement	2nd Ed 2/13 Rfmd 6/21	2026	N/A
COGFM	[J. Merkins]	22.1	Testing Protocols — General Guidelines for Developing Testing Protocols for Devices Used in the Measurement of Hydrocarbon Fluids (AGA Report 13)	2nd Ed 8/15 Add 1 11/18 Add 2 2/22	2027	N/A
COGFM	[J. Merkins]	22.2	Testing Protocols — Differential Pressure Flow Measuring Devices	2nd Ed 4/17 Rfmd 2/22	2027	N/A
COGFM	[E. Estrada]	22.3	Testing Protocols — Flare Gas Meters	1st Ed 8/15 Rfmd 10/21	2026	N/A

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COGFM Standards

C/SC	Chairman or [contact]	Ch./Std	Chapter/Standard/Title	Edition/Yr.	Due for Action	Ballot Status
COGFM	C. Hodges J. Merkins	22.5	Testing Protocol for Flow Computer Calculations	New Std	2024	Published in March 2024
COGFM	[G. Clark]	22.6	Testing Protocol for Gas Chromatographs	1st Ed 8/15 Rfmd 10/20	2025	N/A
COGFM	C. Hodges K. Fry	22.X	Testing Protocol for Flow Conditioners for Orifice Meters	New Std	N/A	N/A
COGFM	S. Phillips	TR 2571	Fuel Gas Measurement	1st Ed 3/11	N/A	N/A
COGFM	[N. Englade]	TR 2575	Thermally Cracked Gas	1st Ed 9/14	N/A	N/A
COGFM	[T. Glazebrook]	White Paper	Electronic Flow Measurement Using Wireless Communication Technology		N/A	N/A

Courtesy of Patty Fusaro, API

GPA Midstream - Analysis, Test Methods and Product Specifications Standards

Designation	Title	Last Publication	Champion
GPA 2145	Table of Physical Properties for Hydrocarbons and Other Compounds of Interest to Natural Gas and Natural Gas Liquids Industries	Revised 2016 *No Update Until NIST Prescribes	
GPA 2172	Calculation of Gross Heating Value, Relative Density, Compressibility and Theoretical Hydrocarbon Liquid Content for Natural Gas Mixtures for Custody Transfer	Reaffirmed 2019	WG14
GPA 8117	A Simplified Vapor Pressure Correlation for Commercial NGLs	Revised 2020	
GPA 8173	Method for Converting Mass Natural Gas Liquids and Vapors to Equivalent Liquid Volumes	**Revised 2017**	WG69
GPA 8182	Standard for Mass Measurement of Natural Gas Liquids and Other Hydrocarbons	Revised 2023	
GPA 8186	Measurement of Liquid Hydrocarbon by Truck Scales	**Revised 2017**	Eric Estrada, Targa Resources
GPA 8195	Tentative Standard for Converting Net Vapor Space Volumes to Equivalent Liquid Volumes	**Published 1995**	WG17
GPA 8217	Temperature Correction for the Volume of NGL and LPG Tables 23E, 24E, 53E, 54E, 59E, and 60E	**Revised 2019**	

Courtesy Martin Erne, GPA Midstream Association

GPA Midstream – Measurement and Quantity Determination Standards

Designation	Title	Last Publication	Status
GPA 2145	Table of Physical Properties for Hydrocarbons and Other Compounds of Interest to Natural Gas and Natural Gas Liquids	Revised 2016	GPA 2145 does not follow 5-year review cycle. Updates made per NIST prescription.
GPA 2172 / API MPMS 14.5	Calculation of Gross Heating Value, Relative Density, Compressibility and Theoretical Hydrocarbon Liquid Content for Natural Gas Mixtures for Custody Transfer	Reaffirmed 2019	Update being led by Don Sextro, Targa Resources
GPA 8117 / API MPMS 1.2.5	A Simplified Vapor Pressure Correlation for Commercial NGLs	Revised 2021	Current
GPA 8173 / API MPMS 14.4	Method for Converting Mass Natural Gas Liquids and Vapors to Equivalent Liquid Volumes	Revised 2017	Update being led by Keith Fry, Howard Measurement
GPA 8182 / API MPMS 14.7	Standard for Mass Measurement of Natural Gas Liquids	Revised 2018	Current
GPA 8186	Measurement of Liquid Hydrocarbon by Truck Scales	Revised 2017	Reaffirmation ballot underway
GPA 8195	Tentative Standard for Converting Net Vapor Space Volumes to Equivalent Liquid Volumes	Published 1995	Update being led by Don Sextro, Targa Resources
GPA 8217 / API MPMS 11.2.4	Temperature Correction for the Volume of NGL and LPG - Tables 23E, 24E, 53E, 54E, 59E and 60E	Revised 2017	Current

GPA Midstream – Measurement and Quantity Determination Standards

Workgroup & Initiatives Reports	Lead
WG14: GPA 2172 Update	Don Sextro, Targa Resources
WG17: GPA 8195 Update	Jennifer Hagerman, MPLX
WG43: GPA Midstream Glossary Update	Jessica Swan, SPL, Inc.
WG69: GPA 8173 Revision	Mr. Fry
WG70: Reference Guide for Determining Emissions	Zeeshan Shaikh, Hilcorp
WG77: Multi-Path Ultrasonic Metering at or Near Hydrocarbon Dew Point of Natural Gas	Duane Harris, Sick
WG80: Material Balance	Mr. Fry
GPA 8173 Spreadsheet Development	Matt Holmes, Quorum Software

Courtesy Martin Erne, GPA Midstream Association

THANK YOU

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