API MPMS
Chapters 5 and 6

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API MPMS – History

• API’s Manual of Petroleum Measurements Standards (MPMS) has been the Best Measurement Practice (BMP) for the measurement of petroleum products since the 1920’s
API MPMS – Standards Development

The standards are developed in working groups consisting of experts from the industry's principal suppliers, consultants, and principal operating companies.

The process allows for review and approval by the Committee on Petroleum Measurement so that all concerns are properly addressed.
Chapter 5 – Metering

Defines the internationally recognized metering technologies for petroleum measurement and the accessories needed to provide secure, accurate, and reliable measurement.
Chapter 5 – Standards

Chapter 5.1
General Considerations for Measurement by Meters
4th Edition / October 2005
Chapter 5 – Standards

Chapter 5.2
Measurement of Liquid Hydrocarbons by Displacement Meters
3rd Edition / October 2005
Chapter 5 – Standards

Chapter 5.3
Measurement of Liquid Hydrocarbons by Turbine Meters
5th Edition / September 2005
Chapter 5 – Standards

Chapter 5.4
Accessory Equipment for Liquid Meters
4th Edition / September 2005
Chapter 5 – Standards

Chapter 5.5
Fidelity and Security of Flow Measurement Pulsed-Data Transmission Systems
2nd Edition / July 2005
Chapter 5 – Standards

Chapter 5.6
Measurement of Liquid Hydrocarbons by Coriolis Meters
1st Edition / October 2002
Chapter 5 – Standards

Chapter 5.8
Measurement of Liquid Hydrocarbons by Ultrasonic Flowmeters Using Transit Time Technology
2nd Edition / February 2005
Chapter 5.1 – General Considerations

Provides guidelines common to all metering technologies including:

• Advantages of metering
• Guidelines for meter selection
• Meter performance criteria
• Considerations for installation and operation
Meters – PD, TM, Coriolis, and LUFM

Standard section in each of the respective meter standards:

• Introduction
• Scope
• Field of application
• Reference publications
Meters – PD, TM, Coriolis, and LUFM (Cont.)

- Design considerations
- Selection of meter and accessories
- Installation
- Meter performance
Meters – PD, TM, Coriolis, and LUFM

Additional sections may also be included where needed. For example the ultrasonic meter standard also includes:

• Auditing and reporting requirements
• Diagnostics and security and access
• Security and access
Meters – PD, TM, Coriolis, and LUFM

In addition annexes are normally included to explain a specific aspect of the technology. For example the 2011 Ultrasonic standard includes:

• Principle of operation
• Verification and validation of meter performance
Meters – PD, TM, Coriolis, and LUFM (Cont.)

• Reynolds number performance
• Manufactured flow pulses and their Impact on the proving process
Chapter 5.8 – Example
Appendix A – Principal of Operation

The average velocity is therefore determined by the following:

\[ \bar{V} = \frac{L}{2 \cos \theta} \times \frac{t_B > A - t_A > B}{t_A > B \times t_B > A} \]
5.4 Accessory Equipment – Meters

The proper operation of a meter also includes the proper meter accessories. This standard includes:

5.4. 6 Mechanical Accessories
5.4. 7 Electronic Accessories
5.4 Accessory Equipment – Meters (Cont.)

5.4. 8 Interface Connections
5.4. 9 Installing Pulse-Driven Accessories
5.4.12 Security
5.5 Fidelity and Security of Pulse – Data Transmission

The details to install and operate today's sophisticated electronic meters and accessories are addressed by these standards.

• 5.5.6 Levels of Security
• 5.4.7 System Design Considerations
5.5 Fidelity and Security of Pulse – Data Transmission (Cont.)

• 5.5.8 Installation

• 5.5.9 Inspection and Maintenance
5.0 Summary

API Chapter 5 provides the latest and best information on all metering technologies for custody transfer and other high accuracy petroleum measurement applications.
Chapter 6 – Metering Assemblies

Provides specific information on some common systems used for measuring liquid hydrocarbons
Chapter 6 – Standards

Chapter 6.1
Lease Automatic Custody Transfer (LACT) Systems
Chapter 6 – Standards (Cont.)

Chapter 6.2
Loading Rack Metering Systems
3rd Edition / February 2004
Chapter 6 – Standards (Cont.)

Chapter 6.4
Metering Systems for Aviation Fueling Facilities
Chapter 6 – Standards (Cont.)

Chapter 6.5
Metering Systems for Loading and Unloading Marine Bulk Carriers
Chapter 6 – Standards (Cont.)

Chapter 6.6
Pipeline Metering Systems
2nd Edition / May 1991 /
Reaffirmed, March 2002
Chapter 6 – Standards (Cont.)

Chapter 6.7
Metering Viscous Hydrocarbons 2
Chapter 6.1 – LACT

• **Scope of Application** – The design and operation of unattended Custody Transfer (CT) system for the transfer of crude oil from the production field to a pipeline carrier

• **Requirements** – A LACT shall provide the net volume and quality of the crude in a fail-safe tamperproof system
Chapter 6.1 – LACT (Cont.)

- **CT Meter** – Traditionally positive displacement and turbine meters were used but Coriolis mass meters are also in use today.
- **Proving** – LACT systems must have a means for proving the CT meter; normally they have connections for a portable prover.
- **Delivery** – Details on the connecting to the pipeline are included in this standard.
Chapter 6.2 – Load Rack

- **Field of Application** – Design, selection of equipment and operation of loading rack metering system for loading hydrocarbons into tank trucks
- **Requirements** – The system must provide gross volume to safely load the truck and net volume for the invoice. It must meet all local weights and measures requirements because it is a wholesale transaction
Chapter 6.2 – Load Rack (Cont.)

- **CT Meter** – Normally positive displacement meters are used for viscous products and turbine meters for light products. Coriolis mass meters are also in use today, practically for LPG applications.

- **Proving** – The CT meter are proven with portable provers either bi-annually or quarterly depending on seasonal conditions.
• **Blending and Additives** – Many large loading terminals have sophisticated blending and additive injection systems. The proper design and use of the different available systems are addressed in the standard.
Chapter 6.2 – Example
Ratio Blending System
Chapter 6.4 – Aviation

• **Field of Application** – General requirements for the metering of aviation fuel dispensed to an aircraft either by a “refueler” or a "Hydrant Cart“

• **Refuelers** – Are tank trucks with meters, filters, pumps, and controls to refuel aircraft. Normally they are built to also defuel planes
Chapter 6.4 – Aviation (Cont.)

• **Hydrant Carts** – Have only a meter and controls. They are connected to a hydrant system that has filters and pumps

• **Requirements** – The fuel may be loaded at gross observed volume (uncompensated for temperature) but standard volume is used for weight calculation and stock reconciliation
Chapter 6.4 – Aviation (Cont.)

- **Meters** – Non-ferrous mechanical positive displacement meters are predominately used for aviation meters but electronic meters are permitted

- **Proving** – The standard has details on how and when to prove aviation meters
Chapter 6.4 – Example

Hydrant Cart with Mechanical Meter
Chapter 6.5 – Marine

- **Scope of Application** – The operation and special arrangement of meters, provers, accessories, and instrumentation for loading and unloading of bulk marine carriers

- **Requirements** – Marine metering systems are normally dedicated for loading or unloading. Loading systems are typically the custody transfer point. Unloading systems check the delivery
Chapter 6.5 – Marine (Cont.)

- **CT Meter** – Marine volume transfers are large, typically 80,000 to 800,000 m³, so high volume PD Meters and traditional and helical turbine meters are used. Ultrasonic meters can also be used but require larger provers.
Chapter 6.5 – Marine (Cont.)

- **Proving** – The volume and value of these transfers require the highest level of accuracy possible. In most cases the meters are proven at least once on each loading or unloading of a ship.

- **Delivery** – The systems includes samplers for qualitative measurement and the delivered volume is in standard units corrected for temperature and pressure.
Chapter 6.6 – Pipeline

• **Scope of Application** – The selection of the type of meters, accessories, and instruments; optimum proving methods and best operation of the metering system

• **Field of Application** – Gathering systems, crude, and refined products and LPG pipelines
Chapter 6.6 – Pipeline (Cont.)

• **Requirements** – Pipeline systems are the custody transfer point and deliveries are typically based on a contract where measurement standards such as API are specified.

• **CT Meter** – Traditionally positive displacement and turbine meters were used but Coriolis mass meters, helical turbine meters, and ultrasonic meters may be used.
Chapter 6.6 – Pipeline (Cont.)

- **Proving** – The type of meter, products to be transported, and volume of the transfer determine the best proving method, which is well addressed in this standard.

- **Delivery** – As with marine systems, pipeline systems include samplers for qualitative measurement and the delivered volume is in standard units corrected for temperature and pressure.
Chapter 6.7 – Viscous Hydrocarbons

- **Scope of Application** – The selection and operation of meters on high viscosity (HV) hydrocarbons, especially when heated to facility flow.

- **Requirements** – The meter and accessories must be chosen to meet the operating requirements. In many cases the special meter construction is needed so details of the application must be provided the manufacturer.
Chapter 6.7 – Viscous Hydrocarbons (Cont.)

- **CT Meter** – Traditionally positive displacement meters are used for HV applications but helical turbine meters, Coriolis mass meters, and ultrasonic meters are also used in selective applications

- **Proving** – The type of meter and characteristics of the product determine the best proving method as discussed in the standard
Chapter 6.7 – Viscous Hydrocarbons (Cont.)

**Delivery** – Systems include samplers for qualitative measurement and the delivered volume is in standard units corrected for temperature and pressure. In general the uncertainty in the measurement of HV hydrocarbons is greater than lower viscosity products.
Conclusion

API’s MPMS Chapters 5 and 6 offer:

• Over 80 years of experience in the accurate measurement of petroleum

• The Best Measurement Practice in using new measurement technologies such as Coriolis and ultrasonic meters