Calculation of Gross Heating Value, Relative Density, Compressibility and Theoretical Hydrocarbon Liquid Content for Natural Gas Mixtures for Custody Transfer

GPA Standard 2172–09

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Introduction

This standard supersedes previous editions of GPA Standard 2172/API *MPMS* Chapter 14.5, *Calculation of Gross Heating Value, Specific Gravity and Compressibility Factor for Natural Gas Mixtures from Compositional Analysis* and it incorporates and supersedes GPA Reference Bulletin 181, *Tentative Reference Bulletin Heating Value as a Basis for Custody Transfer of Natural Gas*. This standard also supersedes the GPM calculations in GPA Standard 2261, *Analysis for Natural Gas and Similar Gaseous Mixtures by Gas Chromatography* and GPA Standard 2286, *Tentative Method of Extended Analysis for Natural Gas and Similar Gaseous Mixtures by Temperature Programmed Gas Chromatography* as well as Table IV of GPA Standard 2261.

This standard is for the use of those involved in custody transfer of natural gas. Unless fixed by statute, it is the responsibility of the parties to contracts to agree on procedures for determining volumes, heating values and standard conditions for custody transfer.

This standard is similar to ISO 6976, *Natural gas—Calculation of calorific values, density, relative density and Wobbe index from composition*, and to AGA Report No. 5, *Natural Gas Energy Measurement*.

Calculation of Gross Heating Value, Relative Density, Compressibility and Theoretical Hydrocarbon Liquid Content for Natural Gas Mixtures for Custody Transfer

1 Scope

This standard presents procedures for calculating, at base conditions from composition, the following properties of natural gas mixtures: gross heating value, relative density (real and ideal), compressibility factor and theoretical hydrocarbon liquid content which in the U.S. is typically expressed as GPM, the abbreviation for gallons of liquid per thousand cubic feet of gas.

Rigorous calculation of the effect of water upon these calculations is complicated. Because this document relates primarily to custody transfer, the water effect included is an acceptable contractual calculation. Annex A of this standard contains a detailed investigation of the effect of water and detailed derivations of the equations presented in the standard.

2 Normative References

The following documents contain provisions, which through reference in this text constitute provisions of this standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the normative document referred to applies.

API *Manual of Petroleum Measurement Standards* (*MPMS*) Chapter 14.1, *Collecting and Handling of Natural Gas Samples for Custody Transfer*

AGA Report No. 5 [1], *Fuel Gas Energy Metering*

AGA Report No. 8, *Compressibility Factor of Natural Gas and Related Hydrocarbon Gases*

GPA Standard 2145 [2], *Table of Physical Properties for Hydrocarbons and Other Compounds of Interest to the Natural Gas Industry*

GPA Standard 2166, *Obtaining Natural Gas Samples for Analysis by Gas Chromatography*

GPA Standard 2261, *Analysis for Natural Gas and Similar Gaseous Mixtures by Gas Chromatography*

GPA Standard 2286, *Tentative Method of Extended Analysis for Natural Gas and Similar Gaseous Mixtures by Temperature Programmed Gas Chromatography*

GPA Standard 2377, *Test for Hydrogen Sulfide and Carbon Dioxide in Natural Gas Using Length of Stain Tubes*

GPA Standard 8173, *Method for Converting Mass of Natural Gas Liquids and Vapors to Equivalent Liquid Volumes*

GPA TP-17, *Table of Physical Properties of Hydrocarbons for Extended Analysis of Natural Gases*

IGT Research Bulletin No. 8 [3], *Equilibrium Moisture Content of Natural Gases*

3 Terms and Definitions

For purposes of this standard, the following terms and definitions apply.

3.1
adjusted heating value
The quantity Hv^{id} / Z (adjusted heating value) is energy transferred as heat per real gas volume. When multiplied by the

[1] American Gas Association, 400 N. Capitol St., N.W., Suite 450, Washington, D.C. 20001, www.aga.org.
[2] Gas Processors Association, 6060 American Plaza, Tulsa, Oklahoma 74135, www.gpamidstream.com.
[3] Institute of Gas Technology, 1700 S. Mount Prospect Road Des Plaines, Illinois 60018, www.gastechnology.org.