QuantityWare

Bulk Calculations - Gas
BCG 3.0

Supported Standards Manual

Lists the standards supported by BCG 3.0 at the time of document publication

06.05.2020

Notes

The latest version of this documentation can be found in the QuantityWare Knowledge Base. All documentation is kept current for the combinations of latest BCS release with the latest supported SAP Oil & Gas release. For all currently supported combinations see Note #000086 “Support and Release (Lifecycle) details” page 2, “Release Lifecycle”.

Your release level can be determined via:
“/o/QTYW/COCKPIT” -> “Cockpit” -> “Support Package Level”

Contents

Version History

BCS 3.0 CSP01 v00	31.03.2017	Initial Release
BCS 3.0	26.05.2017	IMPORTANT: Nomenclature changed to support additional SAP basis releases for BCS 3.0 (see page ii/v)
BCS 3.0	03.08.2017	Updated GPA 2172 support
BCS 3.0	10.11.2017	S/4HANA 1709 validity added; ISO 6578:2017 support added; AGA Report No. 8 - 2017 support added
BCS 3.0	17.02.2019	S/4HANA 1809 validity added
BCS 3.0	06.05.2020	API MPMS 11.2.4 second edition support added – clarification when to use ISO 6578 for LPG / NGL added
BCS 3.0	20.11.2019	S/4HANA 1909 validity added
BCS 3.0	17.07.2020	Editorial update

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Bulk Calculations Gas – List of Supported Standards

Natural gas bulk product quantity value calculations in a SAP Oil & Gas system are defined by seven different types of standards that are all equally relevant and need to be considered for your quantity conversion configuration:

- Standards defining the calculation model
- Standards defining correction factors due to pressure and temperature on product volumes and energies
- Standards defining calculations of densities and heating values from composition including physical property data
- Standards defining the conversion factors between mass and weight (NGL/LPG)
- Standards defining the conversion factors between UoM of one dimension
- Standards defining metering technologies
- Standards defining terminology

BCG 3.0 provides implementation procedures and preconfigured conversion groups that are based on the standards listed in the following chapters.

Standards - Calculation Model

1. AGA Report No. 7
2. API MPMS Chapter 12
3. EN ISO 4267-2
4. DIN 51650-06
5. Business practice models for LNG & natural gas

Technically, the number of implemented calculation models is determined by the possible combinations of required standards from all three different types of standards described below.

In addition, added complexity must be considered (e.g. for NGL and LNG vapor space calculations).
At time of document publication, QuantityWare BCG 3.0 supports six main calculation models for NGL/LPG and two calculation models for natural gas and LNG.

Standards - Temperature & Pressure Corrections – CTPL - NGL/LPG

1. API MPMS Chapter 11.2.2(M)
2. API MPMS Chapter 11.2.4 – second edition - GPA 8217 - 2019
3. API MPMS Chapter 11.2.4 – first edition - GPA TP-27
4. API MPMS Chapter 11.2.5 - GPA TP-15
5. ISO 6578 Second edition 2017-10
6. ISO 6578 First edition 1991-12-01
7. QuantityWare extension of GPA TP-27 for 20 °C (and other base temperatures)
8. GPA TP-25
9. QuantityWare extension of GPA TP-25 for 15 °C and 60 °F

Standards - Temperature & Pressure Corrections – Natural Gas

1. ISO 12213 (Part 1 to 3) Second edition 2006-11-15
2. AGA Report No. 8: “Thermodynamic Properties of Natural Gas and Related Gases – DETAIL and GROSS Equations of State” third Edition April 2017
3. Compressibility Factors of Natural Gas and other related Hydrocarbon Gases” AGA Transmission Measurement Committee Report No. 8, Second Edition, November 1992, 2nd Printing July 1994, API MPMS Chapter 14.2, Second Edition, Revised August 1994, Reaffirmed, February 2006.
4. ISO 13443 First edition 1996-12-15
5. GOST 30319.0/1/2/3 – 96: Natural Gas. Methods of Calculation of Physical Properties

Standards - Calculation of Densities and Heating Values from Composition

1. ISO 6976 Second edition 1995-12-01, including Corrigendum 1 to 3
2. GOST 22667-82 (incl. revision 1,1993)
3. ISO 6578 Second edition 2017-10
4. ISO 6578 First edition 1991-12-01
5. GPA 8173-94
6. ASTM D4784 – revised Klosek and McKinley Model

7. GPA 2172-96 / API MPMS Chapter 14.5 - dry natural gas
8. GPA 2172-09 / API MPMS Chapter 14.5 - dry natural gas
9. GPA 2172-14 / API MPMS Chapter 14.5 - dry natural gas
10. GPA Standard 2145-03 Rev.2
11. GPA Standard 2145-09
12. GPA Standard 2145-16

Standards - Conversion Factors Between Mass and Weight – NGL/LPG

1. ASTM D1250-08 – API MPMS Chapter 11.5
2. ASTM D1250-80 - Tables 8, 26, 56
3. DIN 51757-94(11)

Standards - UoM Conversion Factors

1. API MPMS Chapter 15 – Guidelines for the Use of the International System of Units (SI) in the Petroleum and Allied Industries
2. API MPMS Chapter 11.5 – Annex D - ASTM D1250-08(13)^{e1}
3. Petroleum Measurement Tables Volume XI/XII - ASTM D1250-80: Table 1
4. IEEE/ASTM SI 10™ – American National Standard for the Use of the International System of Units (SI): The Modern Metric System (2002)
5. NIST – Guide for the Use of the International System of Units (SI) - Special Publication 811 – 2008
6. BIPM – Le Système international d'unités (SI) – 2006

Standards - Metering Technologies

1. "Orifice Metering of Natural Gas and other related Hydrocarbon Gases", AGA Report No. 3, Third Edition, October 1990, API MPMS Chapter 14.3, GPA 8185-90.
2. AGA Report No. 7 – Measurement of Natural Gas by Turbine Meters
3. ISO 6974 First edition – 1984-10-15: Normalization calculations

Standards - Terminology

1. GPA 1167-83
2. ISO/DIS 14532
3. Terminology defined in standards listed above

For all standard implementations of all types defined above and the complete software integration layer, QuantityWare has defined an automated installation test – see Annex D for details.

> ⚠ *BCG conversion groups that are based on the standards listed above are designed for dry natural gas, LNG and NGL. Read QuantityWare note 000059 for additional details concerning wet gas conversions.*

Annex A: Physical Property Range Limits

Natural Gas – Low and High Pressure

Temperature & pressure limits ISO 13443:

The pressure range for reference condition conversions defined in this standard is:

95 kPa < p < 105 kPa (13.78 Psi < p < 15.23 Psi)

The temperature range for reference condition conversions defined in this standard is:

270 K < T < 300 K (26°F < T < 80 °F)

Parameter limit - guidelines ISO 6976:

N_2 should not be present in amounts exceeding 0.3 mole fraction.

CO_2 and C_2H_6 should each not exceed 0.15 mole fraction.

No other component (other than methane) should exceed 0.05 mole fraction.

Ranges of application ISO 12213-3:

Pipeline quality gas:

- absolute pressure: 0 MPa to 12 MPa
- temperature: 263 K to 338 K
- mole fraction of carbon dioxide: 0 to 0.20
- mole fraction of hydrogen : 0 to 0.10
- superior calorific value: 30 MJ/m³ to 45 MJ/m³
- relative density: 0.55 to 0.80

The mole fraction of other components is not required as input, but shall lie within the ranges defined as well in ISO 12213. A set of wider ranges is also given in ISO 12213-3.

Ranges of application ISO 12213-2:

Pipeline quality gas:

- absolute pressure: 0 MPA to 12 MPa (up to 65 MPa for wider range)
- temperature: 263 K to 338 K
- superior calorific value: 30 MJ/m³ to 45 MJ/m³
- relative density: 0.55 to 0.80
- mole fraction of methane: 0.7 to 1.00
- mole fraction of nitrogen: 0 to 0.20
- mole fraction of carbon dioxide: 0 to 0.20

- mole fraction of ethane: 0 to 0.10
- mole fraction of propane: 0 to 0.035
- mole fraction of butanes: 0 to 0.015
- mole fraction of hexanes: 0 to 0.001
- mole fraction of hexanes: 0 to 0.001
- mole fraction of heptanes: 0 to 0.0005
- mole fraction of octanes plus higher hydrocarbons: 0 to 0.0005
- mole fraction of hydrogen : 0 to 0.10
- mole fraction of carbon monoxide: 0 to 0.03
- mole fraction of helium: 0 to 0.005
- mole fraction of water: 0 to 0.00015

A set of wider ranges is also given in ISO 12213-2.

LPG and NGL

1. Should be calculated using API MPMS 11.2.4. This standard is implemented in BCG 3.0. The preceding standard, GPA TP-25, has been superseded by API MPMS 11.2.4.
2. If an LPG/LNG product contains 20% or more of unsaturated hydrocarbons, the density shall be calculated given one of the methods in ISO 6578. ISO 6578 is implemented in BCG 3.0.
3. If the sale of product or the calculation of densities and quantity conversion takes place in Germany, use the X method defined in DIN 51757 and calculation procedures defined in DIN51650. This standard is implemented in BCP 3.0.

LNG

ISO 6578:1991(E)

Temperature range: -180 °C to -140 °C

Molecular mass: 16 to 30 kg/mol

Allowed components:

- Methane
- Ethane
- Propane
- n-Butane
- i-Butane
- n-Pentane
- i-Pentane
- n-Hexane
- Nitrogen

- Oxygen

QuantityWare also supports data entry and checks of trace components (e.g. mercaptane and sulfur).

ISO 6578:2017(E)

Temperature range: 106 K to 118 K (approx. -167 °C to -155 °C)

Molecular mass: 16 to 20 kg/mol

Allowed components:

- Methane
- Ethane
- Propane
- n-Butane
- i-Butane
- n-Pentane
- i-Pentane
- Nitrogen

QuantityWare also supports data entry and checks of trace components (e.g. mercaptane and sulfur).

Annex B: Implementation Details - Selected Standards

AGA Report No. 3

The full title of this standard is:

"Orifice Metering of natural gas and other related hydrocarbon fluids", AGA report no. 3, adjunct to API MPMS 14.3 & GPA 8185-90".

> ⚠ *For natural gas flow rate measurements, the following definition (from AGA report no. 3) has to be considered.*

Orifice Meter:

An orifice meter is a fluid flow measuring device that produces a differential pressure to infer flow rate. The meter consists of the following elements:

- A thin, concentric, square-edged orifice plate
- An orifice plate holder consisting of a set of orifice flanges (or orifice fitting) equipped with the appropriate differential pressure sensing taps
- A meter tube consisting of the adjacent piping sections (with or without flow conditioners)

> ⚠ *A detailed list of all orifice engineering and technical terms and their definitions can be found in AGA report no. 3, part 1: "General equations and uncertainty guidelines".*

With QuantityWare BCG 3.0 a complete set of calculation functions that implement AGA Report No. 3 orifice functions is delivered with function group /QTYW/AGA83 – function /QTYW/AGA3_ORIFICE. Within your customer project, you may integrate this function into your metering developments (e.g. SAP TSW ticketing process).

ISO 6578

The full title of this standard is:

ISO 6578, first edition 1991-12-01: "Refrigerated hydrocarbon liquids – static measurement – Calculation procedure" – LNG part.

ISO 6578, second edition 2017-10: "Refrigerated hydrocarbon liquids – static measurement – Calculation procedure" – LNG part.

The revised Klosek and McKinley model defined in ISO 6578 is also described in:

ASTM D 4784-93 (Reapproved 2003): "Standard Specification for LNG Density Calculation Models"

The revised Klosek and McKinley Model is one of four available models, and is widely used within the LNG processing industry. ISO 6578 is also relevant for refrigerated NGL/LPG density calculations as well as vapor corrections for NGL and LNG. All ISO 6578 calculations are supported with BCG 3.0 for both NGL/LPG and LNG.

ISO 13443

The full title of this standard is:

ISO 13443 First edition 1996-12-15 "Natural gas - Standard reference conditions"

Although ISO 13443 defines a temperature value of 15 °C (288.15 K) and a pressure value of 101.325 kPa as standard reference conditions for measurements and calculations for real dry gas (natural gases, natural-gas substitutes, similar fluids in the gaseous state), it is recognized that in certain circumstances it may be impracticable or even forbidden to use these ISO standard reference conditions (e.g. forced by national legislation or contractual obligations). Thus, conversion formulas are provided in ISO 13443 which enable values of properties (relating to any known other reference conditions) to be converted to values for the ISO standard reference conditions.
In addition to the formulas provided within ISO 13443, table values are provided as well. With BCG 3.0, you can define for a conversion group whether the formula from ISO 13443 are utilized or the table values. Via the Gas Measurement Cockpit, you have access to list prints,

test calculators and all configuration options. You may also define table values to convert between U.S. customary (°F, PSI) and metric (°C, kPa) condition sets.

ISO 6976

The full title of this standard is:

ISO 6976 Second edition 1995-12-01, corrected and reprinted 1996-02-01 "Natural gas – Calculation of calorific values, density, relative density and Wobbe index from composition" .

> ⚠ *In August 2016, the new 2016 version of this standard has been issued by ISO. With BCS 3.0 CSP02, required adjustments and enhancements from ISO 6976(2016) are scheduled to be delivered (Q1 2019)*

GPA 2172

The full title of this standard is:

"Calculation of Gross Heating Value, Relative Density, Compressibility and Theoretical Hydrocarbon Liquid Content for Natural Gas Mixtures For Custody Transfer" – GPA Standard 2172, API MPMS Chapter 14.5

> ⚠ *Both ISO 6976 and GPA 2172 provide calculation definitions describing how to calculate physical properties based on a known molar composition. QuantityWare supports property calculations of dry natural gas for both standards via the conversion group concept.*

ISO 12213

The full title of this standard is:

ISO 12213, Second edition 2006-11-15, "Calculation of compression factor"

This ISO standard covers AGA Report No. 8 and SGERG88 compression factor calculations, which are all supported by BCG 3.0.

GOST 30319

In GOST 30319.2-96,*"Natural Gas, Methods of Calculation of Physical Properties – Determination of Compressibility Coefficient"* four methods are defined how to calculate the compressibility coefficient. These four methods are the AGA Report No. 8 – 92DC method, the GERG91 method (identical with the AGA Report No. 8 gross method 2), the NX 19modified method, and the VNIC SMV method. QuantityWare provides implementations and configuration data for all four methods.

Annex C: CPL Standard Integration - NGL

With QuantityWare BCG 3.0, support of CPL correction factor calculations for NGL/LPG is delivered. The following two standards define NGL CPL calculations:

1. API MPMS Chapter 11.2.2(M) – NGL/LPG
2. API MPMS Chapter 11.2.5 – GPA TP-15 – NGL/LPG

Due to technical restrictions within the SAP QCI calculation logic, support of CPL calculations is only possible and thus provided for MQCI conversion groups, in conjunction with the appropriate CTL standard.

1. If static tank vapor space calculations are applied, no CPL correction is applied.
2. The CPL calculation introduces the material/observed pressure and allows calculation of a CTPL to correct observed volumes (or transaction - observed and standard - volumes only).
3. Test density values are not corrected and are assumed to be either available at base conditions or to require temperature corrections only.

For the following NGL/LPG MQCI CTL standards the CPL calculation is supported:

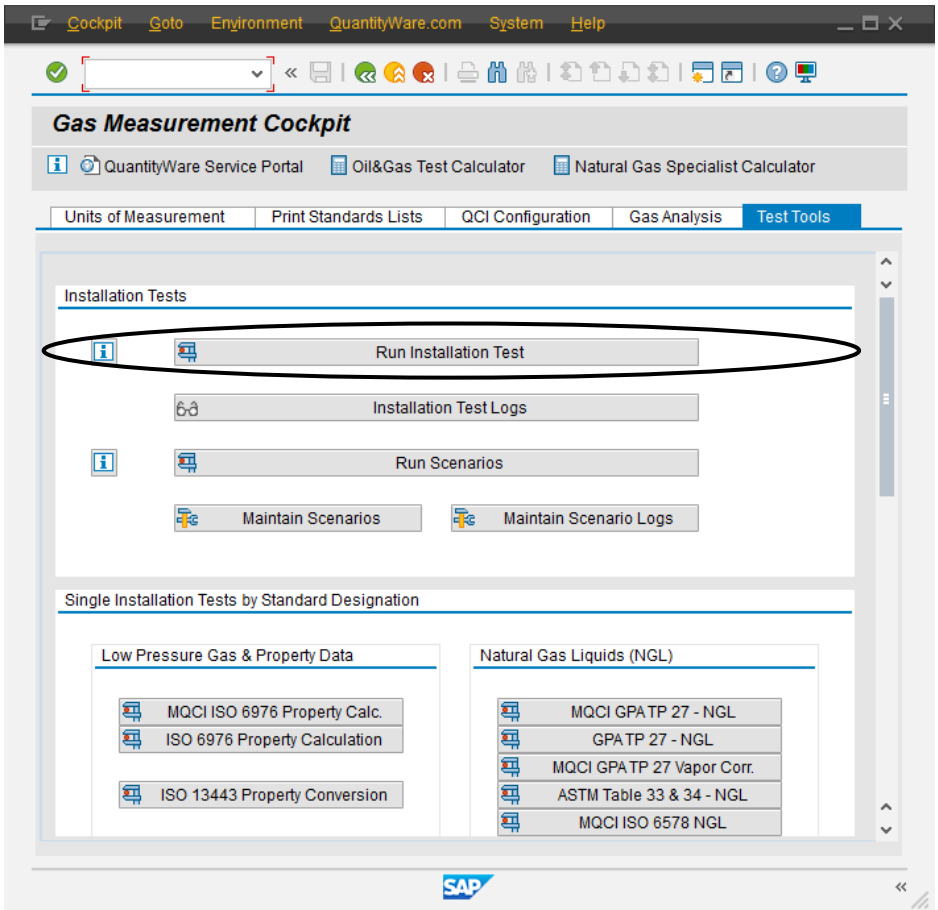
- API MPMS Chapter 11.2.4
- ISO 6578

Annex D: Supported Standards – Installation Tests

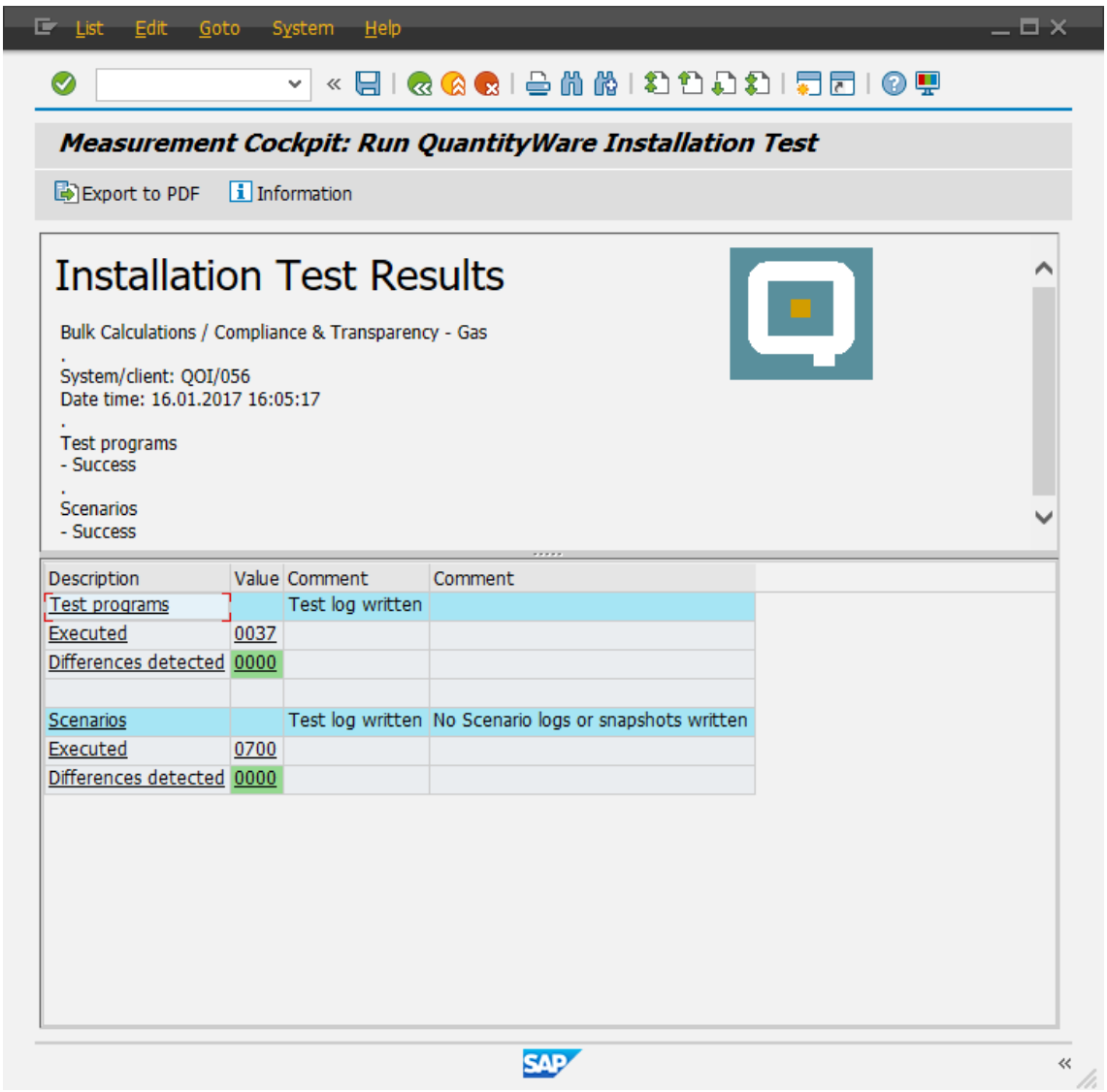
The Gas Measurement Cockpit (GMC) allows easy identification of QuantityWare BCG 3.0 template conversion groups according to the assigned measurement standards. For all standard implementations, QuantityWare delivers an individual installation test. Each test is implemented as a SAP test report, which typically executes two test cases. The BCG 3.0 installation test is the sum of:

- All individual installation tests
- Additional integration test reports
- 700 Test scenarios

The BCG 3.0 installation test is executed with one click from the GMC and is to be performed only in the QuantityWare template client 045, in one dedicated system in your system landscape. Execution of the installation test is started while logged on to the BCG 3.0 template client (045), where you simply click on “Run Installation Test” in tab strip “Test Tools” of the GMC:

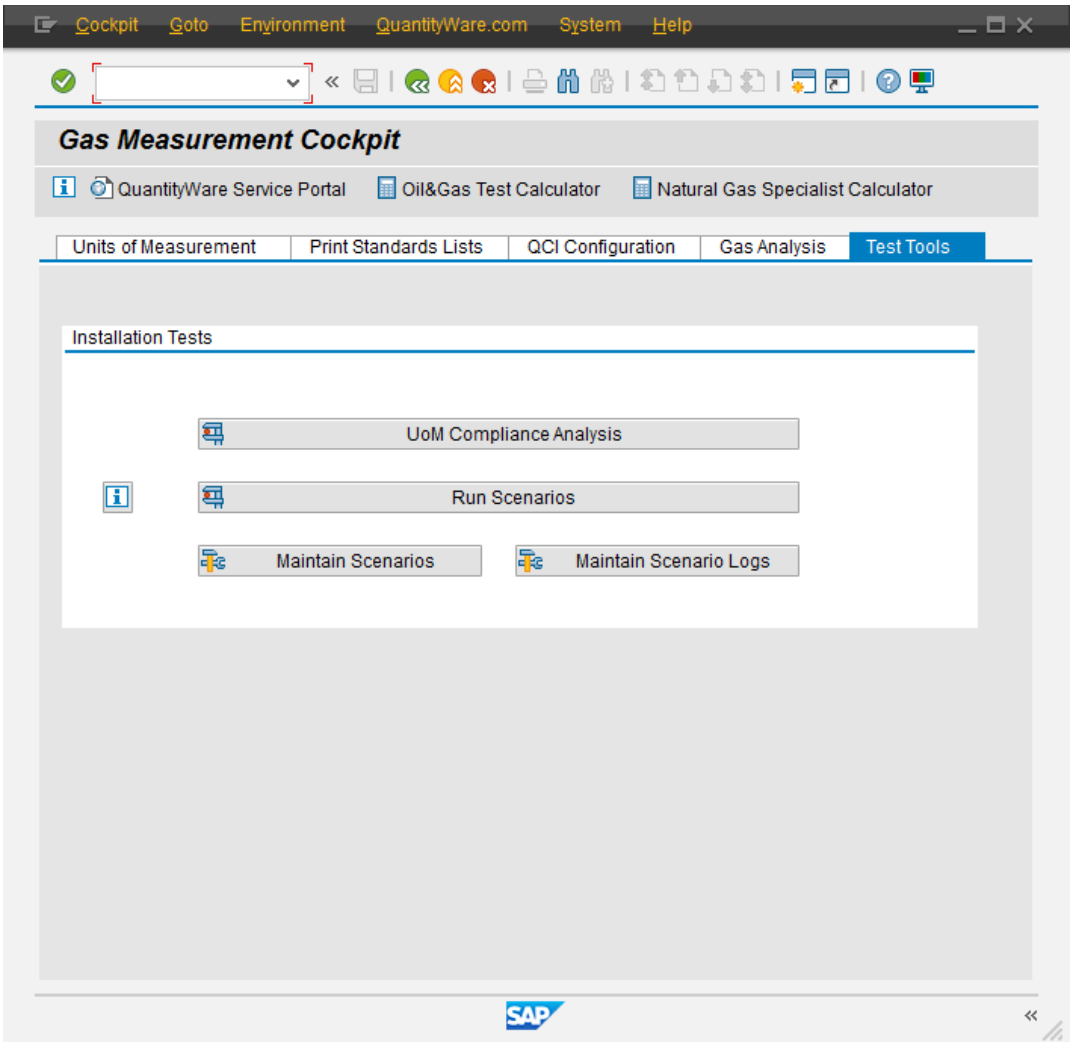


If the test is executed successfully, you see the following list:



If you want to execute a single test for a specific standard, you can access all tests from this list. All tests are designed in the same way to ensure seamless control of the tests by measurement experts.

> ⚠ *If you log on to a client where the QuantityWare BC set has not been activated, you will not have access to the installation tests via the Gas Measurement Cockpit - without the configuration template delivered with the BC set, the installation test will run with errors due to missing configuration.*



More details can be found in the BCG 3.0 Documentation Reference Manual.