Bulk Calculations – Petroleum BCP 3.0

Supported Standards Manual

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

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, & Energy 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"

Version History

Version	Date	Description
00	2017-03-31	Initial Release
01	2017-05-25	IMPORTANT: Nomenclature changed to support additional SAP basis releases for BCS 3.0 (see page ii/v)
02	2017-05-26	Updated ISO 91:2017 support/clarified ISO 91-1:1992 support
03	2017-10-11	S/4HANA 1709 validity confirmed - support of ASTM D1555(M)-2016 and ISO 6578:2017 (LPG) added
04	2019-02-17	S/4HANA 1809 validity confirmed - support of ASTM D1550-18 added & ASTM D2962-10(2019) confirmation - clarified DIN 51757 usage for products not covered by ASTM D1250
05	2019-06-04	Extended description and typographic error corrected in "Ethylene & Propylene"
06	2020-05-05	Support of ASTM D1250 -19 – API MPMS Chapter 11.1 Addendum 1 & 2 added – Support of API MPMS Chapter 11.2.4 – second edition - GPA 8217 added
06.1	2020-07-17	Editorial update

07	2021-02-5	Support of MS-19 Fourth Edition – Basic Asphalt Manual – Emulsified Asphalt
08	2021-09-20	S/4HANA 2020 / 2020_EX validity confirmed - modern QW document style applied - 30A CSP02 / 30B CSP01 changes
09	2022-02-01	Support of ASTM D1555-21, ASTM D4311(M)-21, Anhydrous Ammonia (Meas. Canada), GPA Standard 8117 / API MPMS 11.2.5 Second Edition. GPA 8217 nomenclature update
10	2022-04-13	Support of ABNT NBR 5992 (2016)
11	2022-09-15	Support of ASTM D1298-12b (2017), ASTM D1555M-22
12	2022-12-22	Clarification of C.N.P. 6 – 70 support
13	2023-06-21	Support of RESOLUÇÃO ANP Nº 894 - 22 / C.N.P. Nº 6
14	2023-11-01	30A CSP03 / 30B CSP02 changes & editorial update; ASTM D633 withdrawal, Support of ASTM D2962-23, Errata 1 API MPMS Chapter 11.2.5 support
15	2024-03-19	Support of API MPMS Chapter 11.3.3 Third Edition
16	2024-04-15	Adjust products support of API MPMS 11.1.2.5 - ASTM D1250-19 Addendum 2 changes

Contents

1.   Bulk Calculations Petroleum – Supported Standards

Bulk product quantity conversions in SAP Oil, Gas, & Energy systems are defined by four different types of measurement standards. All four types of standards are equally relevant and need to be considered for your quantity conversion configuration:

- Standards defining the calculation model

- Standards defining Correction factors due to effects of Temperature and Pressure on Liquid product volumes – CTPL standards

- Standards defining conversions between mass and weight

- Standards defining conversion factors between units of measure (UoM) of the same quantity (SAP dimension)

BCP provides implementation procedures and preconfigured conversion groups that are based on these four standard types. The exact designation of these standards is listed in the following sections.

1.1.   Standards - Calculation Model

1. API MPMS Chapter 12

2. EN ISO 4267 - Part 2

3. DIN 51650-06

4. Business practice models – linear DCF (Density Correction Factor) model

5. SAP QCI legacy model with BAdI implementations

Added complexity must be considered (e.g., for LPG vapor space calculations, sediment & water calculations, alcohol % calculations, different base conversion unit sets etc.) such that at the time of document publication, QuantityWare BCP supports 20 calculation models for liquid bulk products. Note that not all calculation model correction factors of API MPMS Chapter 12 and EN ISO 4267 - 2 are relevant for ERP processes and are thus not supported in the respective models.

1.2. Standards - Temperature and Pressure Corrections – CTPL Standards

1. ISO 91:2017 (reviewed and confirmed 2022)

2. API MPMS Chapter 9.1 – ASTM D1298-12b (2017)

3. API MPMS Chapter 9.1 – ASTM D1298-99

4. API MPMS Chapter 11.1 – 2019 – ASTM D1250-19 (including Addendum 2)

5. API MPMS Chapter 11.1 – 2004 – ASTM D1250-04 (including Addendum 1)

6. API MPMS Chapter 11.1 – 1980 – ASTM D1250-80 (including 1984 and 1988 revisions)

7. Petroleum Measurement Tables 1952 – Historical Edition – ASTM D1250-52: Table 6

8. API MPMS Chapter 11.2.1(M)

9. API MPMS Chapter 11.2.2(M)

10. API MPMS Chapter 11.2.4 – second edition - GPA 8217 – 2019

11. API MPMS Chapter 11.2.4 – first edition - GPA TP-27

12. API MPMS Chapter 11.2.5 – GPA 8117 – second edition

13. API MPMS Chapter 11.2.5 – GPA TP-15 – second edition, including errata 1 (October 2023)

14. API MPMS Chapter 11.2.5 – GPA TP-15 – first edition

15. API MPMS Chapter 11.3.3 – 2019 – third edition[1]

16. API MPMS Chapter 11.3.3 – 2015 – second edition

17. API MPMS Chapter 11.3.3 – 2011 – first edition

18. QuantityWare extension of GPA TP-27 for 23 °C (and other base temperatures)

19. GPA TP-25

20. QuantityWare extension of GPA TP-25 for 15 °C and 60 °F

21. ASTM D1555M-22

22. ASTM D1555-21

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[1] API MPMS 11.3.3 2019 Annex E specifies ethanol compressibility calculations for CPL calculations. CPL calculations are not yet supported with BCP 3.0 – see B.7 for details

23. ASTM D1555-16

24. ASTM D1555M-16

25. ASTM D1555M-08

26. ASTM D1555-09

27. ASTM D1555-04a

28. ASTM D1555M-04a

29. ASTM D1550-18

30. ASTM D1550-94(15)

31. ASTM D4311(M)-21

32. QuantityWare extension for 20 °C base temperature of ASTM D4311-21

33. ASTM D4311-15

34. QuantityWare extension for 20 °C base temperature of ASTM D4311-15

35. ASTM D4311-09

36. QuantityWare extension for 20 °C base temperature of ASTM D4311-09

37. ASTM D4311-04

38. ASTM D633-11(16) – withdrawn by ASTM in July 2023

39. ASTM D633-97(05) – withdrawn by ASTM in July 2023

40. ASTM D2962-23

41. ASTM D2962-10(19)

42. ASTM D2962-97(07)

43. ABNT NBR 5992-16

44. ABNT NBR 5992-08

45. ABNT NBR 5992-80

46. Bol. téc. PETROBRAS, Rio de Janeiro, 43 (1): 11-18, jan./mar. 2000

47. BS EN 14214:2012

48. Linear density correction factor (DCF) calculation

49. Linear volume correction factor (VCF) calculation

50. DIN 51757-11

51. DIN 51757-94

52. ISO 6578:2017 – LPG

53. ISO 6578:1991 – LPG

54. Brazilian Standard RESOLUÇÃO C.N.P. No. 6 – 70, Tabela II[2]

55. Brazilian Standard RESOLUÇÃO ANP No 894 -2022, Tabela I & II[3]

56. ISO 91-1:1992[4]

57. ISO 91-2:1991

58. ISO 3675:1998 (reviewed and confirmed 2021)

59. MS-19 Emulsified Asphalt – fourth edition, Basic Asphalt Manual

60. Anhydrous Ammonia – Measurement Canada Standard

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[2] This implementation is **not based on the printed tables**, but on a mathematical formula provided by South American customer industry experts - see ABAP function /QTYW/CNP_6_70_TII and note 000113 for details.

[3] This standard is identical with the RESOLUÇÃO C.N.P. No. 6 – 70 standard and provides a table-value based implementation – see note 000114 for details

[4] Support of historical 1953 metric edition - Tables 53 and 54 for LPG - not included

1.3. Standards - Conversions between Mass and Weight

1. ISO 91:2017 (reviewed and confirmed 2022)

2. API MPMS Chapter 11.5, Part 1, 2 and 3 – ASTM D1250-08(13)e1: incl. errata September 2013, reapproved 2015

3. ISO 91-1:1992 – Tables 8, 26, 56

4. Petroleum Measurement Tables Volume XI/XII – ASTM D1250-80: Tables 8, 26, 56

5. Petroleum Measurement Tables 1952 - Historical Edition – ASTM D1250-52: Table 11

6. DIN 51757-11

7. DIN 51757-94

1.4. Standards - UoM Conversion Factors

1. ISO 91:2017 (reviewed and confirmed 2022)

2. API MPMS Chapter 15 – Guidelines for the Use of the International System of Units (SI) in the Petroleum and Allied Industries

3. API MPMS Chapter 11.5 – Appendix D - ASTM D1250-08(13)e1

4. Petroleum Measurement Tables Volume XI/XII - ASTM D1250-80: Table 1

5. IEEE/ASTM SI 10TM – American National Standard for the Use of the International System of Units (SI): The Modern Metric System (2002)

6. NIST – Guide for the Use of the International System of Units (SI) - Special Publication 811 – 2008

7. BIPM – Le Système international d'unités (SI) – 2006

Appendix A.   Products - ASTM D1250

BCP covers all procedures of the:

API Manual of Petroleum Measurement Standards

   Chapter 11- Physical Properties Data

      Section 1   Temperature and Pressure Volume

            Correction Factors for Generalized

            Crude Oils, Refined Products, and Lubricating Oils

   Adjunct to: ASTM D1250-04 and IP 200/04

Herein referred to as ASTM D1250-04

BCP covers all procedures of the:

API Manual of Petroleum Measurement Standards

   Chapter 11- Physical Properties Data

      Section 1   Temperature Volume

            Correction Factors for Generalized

            Crude Oils, Refined Products, and Lubricating Oils

   Adjunct to: ASTM D1250-80 and IP 200/80, ISO 91-1

Herein referred to as ASTM D1250-80

Both ASTM D1250-04 and ASTM D1250-80 support the same products and coexist next to each other (See Appendix A.1 (Mandatory Information) in ASTM D1250-08(13)). Read the QuantityWare working paper WP_QuantityWare_Comparison_ASTM_D1250_2004_1980 available in the Knowledge Base at www.quantityware.com if you are interested in the differences between these two versions.

A.1.   Crude Oil

Generalized crude oils in the range of –10 °API to 100 °API gravity are supported

A.2.   Refined Products

A.2.1. Gasoline

Motor gasoline and unfinished gasoline blending stock with a base density range between approximately 50 °API and 85 °API. Examples:

- premium gasoline
- gasoline
- unleaded gasoline
- motor spirit
- clear gasoline
- low lead gas
- motor gasoline
- catalyst gas
- alkylate
- catalytic cracked gasoline
- naphtha
- reformulated gasoline
- aviation gasoline

A.2.2. Jet Fuels

Jet fuels, kerosene, and Stoddard solvents with a base density range between approximately 37 °API and 50 °API. Examples:

- jet fuel A
- jet kerosene
- aviation jet A
- kerosene
- aviation turbine fuel
- Stoddard solvent
- white kerosene
- JP-2
- JP-8

A.2.3. Fuel Oils

Diesel oils, heating oils and fuel oils with a base density range between approximately –10 °API and 37 °API. Examples:

- No. 6 fuel oil
- fuel oil PA
- low sulfur fuel
- LT (low temperature) fuel oil
- fuel oil
- fuel oil LLS (light low sulfur)
- No. 2 furnace oil
- furnace oil
- auto diesel
- gas oil
- No. 2 burner fuel

- diesel fuel

- heating fuel

- premium diesel

A.3.   Lubricating Oils

Generalized lubricating oils with an initial boiling point greater than 700 °F (370 °C) and in the density range between approximately –10 °API to 45 °API are supported.

A.4.   Special Applications

Products derived from petroleum or petroleum-based with minor proportions of other constituents and have been tested to establish a specific thermal expansion factor.

A.5.   Waxy Crudes

Certain ranges can be calculated using ASTM D1250.

A.6.   Natural and Drip Gasolines

Certain ranges can be calculated using ASTM D1250.

Natural gasolines are a part of the Generalized Crude Oil commodity group. Drip gasoline is a mixture of natural gas liquids, primarily butanes, pentanes, hexanes, and heptanes. Drip gasoline is also a part of the Generalized Crude Oil commodity group. Aromatic natural gasoline is a part of the Generalized Refined Products commodity group.

A.7.   Reformulated Fuels

The Special Application procedure can be used for all gasoline, oxygenates, and mixtures. See API MPMS Chapter 11.1.

A.8.   MTBE

Methyl tertiary butyl ether can be calculated as special application at 60 °F with a thermal expansion factor of 789.0e-06 / °F.

A.9.   JP-4

JP-4 is best represented as Generalized Crude Oil or Special Application. See API MPMS Chapter 11.1 for details.

A.10.   Pure Compounds

- Pure paraffinic compounds (C5+) are well represented as Generalized Crude Oil.

- Non-paraffinic pure compounds (C5+) can be treated as a Special Application.

A.11.   Blends of Gasoline and Ethanol

A rigorous treatment is given in API MPMS 11.3.4 – which utilizes the fundamental methods given in API Chapter MPMS 11.1.

Read the QuantityWare working paper "Biofuel Measurement Standards Selection" for detailed guidance, which is available in the Knowledge Base at www.quantityware.com.

Read the Ethanol FAQ for additional details.

A.12.   Vacuum Gas Oil

Vacuum gas oil is a distillation product of crude oil generally with a boiling range between 310 °C to 600 °C. This group of materials was included in the data base for Fuel Oils group of the products tables and was best represented by the products tables.

A.13.   Naphtha

Naphtha is a general term for flammable hydrocarbon mixtures. In the refining industry, petroleum naphtha typically has a boiling range between 35 °C and 205 °C and consists of hydrocarbons containing between 4 and 11 carbon atoms. Virgin naphtha was included in the data base for the Gasolines group of the product tables and was best represented by the products tables. Heavy naphtha was significantly better represented by the products tables for this group.

The product list in this Appendix is cited from:

"THE USE OF THE PETROLEUM MEASUREMENT TABLES – Manual of Petroleum Measurement Standards, Chapter 11.1, American Petroleum Institute, Revised October 1995", API MPMS Chapter 11.1 – 2004 and API MPMS Chapter 11.1. – 2019 Addendum 2

Appendix B.   Products – Other Standards

B.1.   LPG and NGL

1. Should be calculated using API MPMS 11.2.4 – GPA 8217 (former GPA TP-27). This standard is implemented in BCP 3.0.

2. If an LPG 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 BCP 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.

4. In Brazil, national standard RESOLUÇÃO ANP Nº 894 - 22 / C.N.P. Nº 6 – 7 Table I & II is relevant - This standard is implemented in BCP 3.0.

B.2.   LNG

Standards concerning these products are not implemented in BCP 3.0. **LNG calculations are fully supported with QuantityWare BCG 3.0 (Bulk Calculations – Gas).**

B.3.   Cyclohexane and Industrial Aromatic Hydrocarbons

Use ASTM D1555 or 1555M. This standard is implemented in BCP 3.0.

If the sale of product or the calculation of densities and quantity conversion takes place in Germany, use the Y method defined in DIN 51757 and calculation procedures defined in DIN51650. This standard is implemented in BCP 3.0.

B.4. Asphalt

1. Asphalt can be calculated using ASTM D4311. This standard is implemented in BCP 3.0. QuantityWare has implemented the formula-based calculation as defined in ASTM D4311-04, ASTM D4311-09 and ASTM D4311-15/21.

2. Emulsified asphalt can be calculated using MS-19, fourth edition – Basic Asphalt Manual. This standard is implemented in BCP.

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.

> Note that when calculating a volume correction factor using the formula and constants defined in ASTM D4311-04/09/15/21, the results do not always match with the printed table values in ASTM D4311-04/09/15/21.

B.5. Road Tars

Road Tars can be calculated using ASTM D633. This standard is implemented in BCP. This standard has been withdrawn in July 2023 by ASTM without replacement – see related news Item for details.

B.6. Bio Diesel

Automotive fuels – Fatty acid methyl esters (FAME) for diesel engines according to the European standard: BS EN 14214:2012 Bio Diesel. This standard is implemented in BCP.

This European Standard specifies requirements and test methods for marketed and delivered FAME to be used either as automotive fuel for diesel engines at 100% concentration, or as an extender for automotive fuel for diesel engines in accordance with the requirements of EN 590. For bio fuel mixtures, read the QuantityWare working paper "Biofuel Measurement Standards Selection" for detailed guidance, which is available in the Knowledge Base at www.quantityware.com.

B.7.   Ethanol

1. Ethanol conversions are supported with Brazilian standard ABNT NBR 5992-80, ABNT NBR 5992-08 and ABNT NBR 5992-16. This standard is implemented for all versions in BCP 3.0. This standard calculates volumes (at the base temperature of 20 °C and various alternate temperature bases) and masses and weights (total product and alcohol portion) based on the input values (mass ratio and observed volume or test density) for a temperature range of 10 °C to 40 °C.

2. Alternatively, for the U.S., API MPMS Chapter 11.3.3 "Miscellaneous Hydrocarbon Product Properties – Ethanol Density and Volume Correction Factors" may be used. This standard is implemented in BCP 3.0. Note that the CPL calculations define in the third edition of API MPMS 11.3.3 - 2019 are not yet supported, as pipeline transportation of ethanol is still minimal – see DOE Data Center Report.

3. Linear DCF calculations are also relevant for ethanol quantity conversions globally. Such calculations are available with BCP 3.0.

4. If the sale of ethanol or the calculation of densities and quantity conversion takes place in Germany, use the Y method defined in DIN 51757 and calculation procedures defined in DIN51650. This standard is implemented in BCP 3.0.

Read the Ethanol FAQ for additional details.

B.8.   Ethylene and Propylene

1. ISO 6578 supports temperature correction calculations for propane/propylene mixtures. This standard is implemented in BCP 3.0.

2. Ethylene is NOT supported with BCS 3.0. QuantityWare has analyzed API MPMS 11.3.2.1 - Ethylene Density and the referenced IUPAC-88 Ethylene EOS Paper (Thermodynamic Properties of Ethylene from Freezing Line to 450 K at Pressures to 20 MPA - M. Jahangiri et al.) and could not identify an implementation guideline for software developments therein.

B.9. Butadiene

1. The temperature corrections should be calculated using ASTM D1550. An implementation is included in BCP 3.0.

2. If the sale of Butadiene or the calculation of densities and quantity conversion takes place in Germany, use the Y method defined in DIN 51757 and calculation procedures defined in DIN51650. This standard is implemented in BCP 3.0.

B.10. Bulk Chemicals

Bulk chemicals can be calculated utilizing a linear density correction factor (DCF) best practice standard, which is globally used by terminal operating companies. This standard is implemented in BCP 3.0.

If the sale of your bulk chemical products or the calculation of densities and quantity conversion takes place in Germany, check if usage of the Y method defined in DIN 51757 and calculation procedures defined in DIN51650 is required. This standard is implemented in BCP 3.0.

Appendix C. CPL Standard Integration

The following three standards define CPL calculations:

- API MPMS Chapter 11.2.1(M): Crude oil & products

- API MPMS Chapter 11.2.2(M): LPG

- API MPMS Chapter 11.1 - 2004: Crude oil & products

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 MQCI CTL standards the CPL calculation is supported:

- API MPMS Chapter 11.1 – 2004 adjunct to ASTM D1250-04

- API MPMS Chapter 11.1 – 1980 adjunct to ASTM D1250-80

- ASTM D1250-52 – Table 6

- RESOLUÇÃO ANP No 894 – 2022 / C.N.P. No. 6 1970 Table I & II

- API MPMS Chapter 11.2.4 – GPA 8217 (former GPA TP-27)

- ISO 6578-1991/2017 – LPG

Appendix D.   Standard Range Limits & Extensions

CTPL and mass/weight conversion standard implementations are typically valid for defined range limits of input data (density, temperature, pressure values). The most complex limit definitions are those defined for ASTM D1250-04 and ASTM D1250-80, which are briefly discussed in this Appendix.

D.1.   Temperature, Pressure, and Density Limits of ASTM D1250-04

ASTM D1250-04 defines the following range limits (for additional details, read API MPMS Chapter 11.1 2004)

Density limits:

Density	Crude Oil	Refined Products	Lubricating Oils
Density kg/m³ @ 60 °F	610.6 to 1 163.5	610.6 to 1 163.5	800.9 to 1 163.5
Relative Density @ 60 °F	0.611 20 to 1.164 64	0.61120 to 1.164 64	0.801 68 to 1.16 46
°API Gravity @ 60 °F	100.0 to -10.0	100.0 to -10.0	45.0 to -10.0
Density kg/m³ @ 15 °C	611.16 to 1 163.79	611.16 to 1 163.86	801.25 to 1 163.85
Density kg/m³ @ 20 °C	606.12 to 1 161.15	606.12 to 1 160.62	798.11 to 1 160.71

Temperature, thermal expansion factor and pressure limits:

Unit	Crude Oil, Refined Products, Lubricating Oils
°C	-50.00 to 150.00
°F	-58.0 to 302.0
Psi(gauge)	0 to 1 500
kPa(gauge)	0 to 1.034e+04
Bar(gauge)	0 to 103.4
Alpha 60/°F	230.0e-06 to 930.0e-06
Alpha 60/°C	414.0e-06 to 1674.0e-06

D.2.   Temperature and Density Limits of ASTM D1250-80

The density and temperature limits of ASTM D1250-80 are given in:

Petroleum Measurement Tables – Volume Correction Factors – Volume X – Background, Development and Program Documentation.

Since no written documented limits are available for the D Tables, and also not for the 59 (20 °C) and 60 (20 °C) Tables, and some limits are given with graphical figures only, QuantityWare does not provide comprehensive documentation on the 1980 limits here. Read the API MPMS Chapter 11.1 2004 which contains the most complete documentation of ASTM D1250-80 range limits and extensions.

D.3. Range Limit Extensions

Although the range limits of ASTM D1250-04 have been extended in comparison to ASTM D1250-80, it may still be a business requirement to further extend these limits.

Whenever it is technically feasible (which is the case for ASTM D1250-80 and ASTM D1250-04 implementations), QuantityWare ABAP implementations of CTPL and mass-to-weight standards support range extensions via one single customizing setting, where you simply set the "Extend range of standard implementation" indicator for a conversion group.
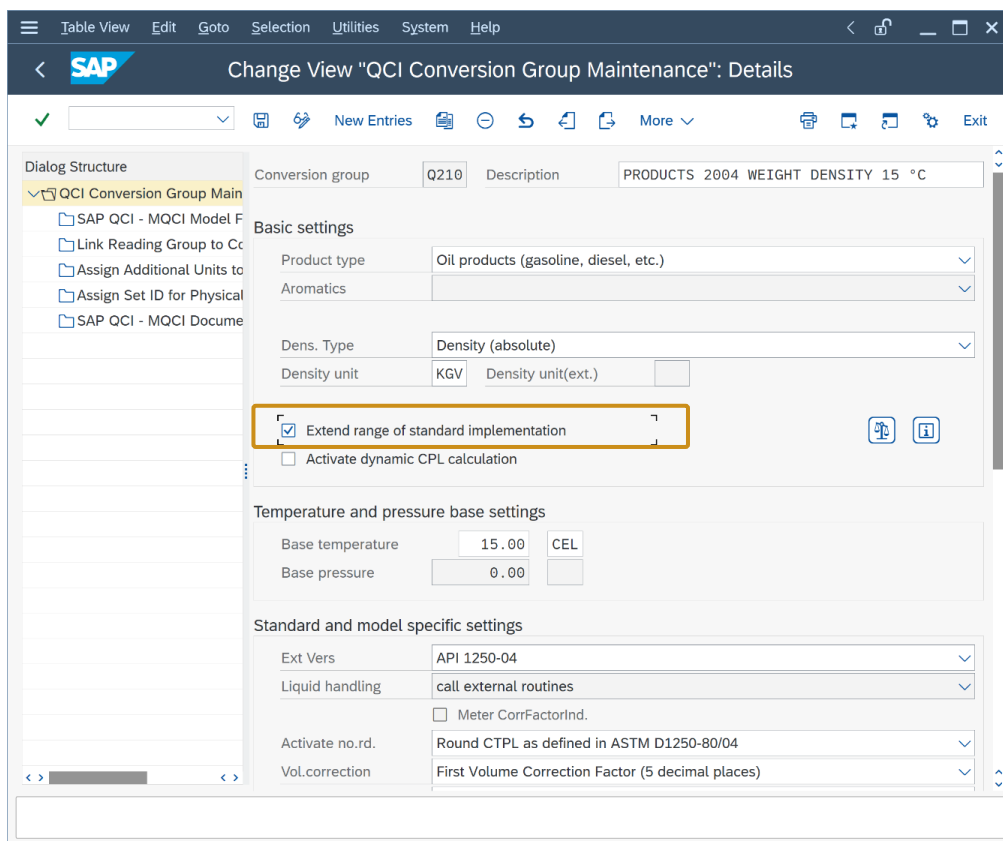
If you decide to extend the range limits for a certain conversion group, it is strongly recommended to define customer specific range limit checks for that conversion group, to prevent fraudulent usage or input of corrupted data.

Appendix E. Supported Standards – Installation Test

For all standard implementations, QuantityWare delivers an individual installation test, which is accessible via the PMC. Each test is implemented as an SAP test report, which typically executes two test cases. The BCP Installation Test is then the sum of:
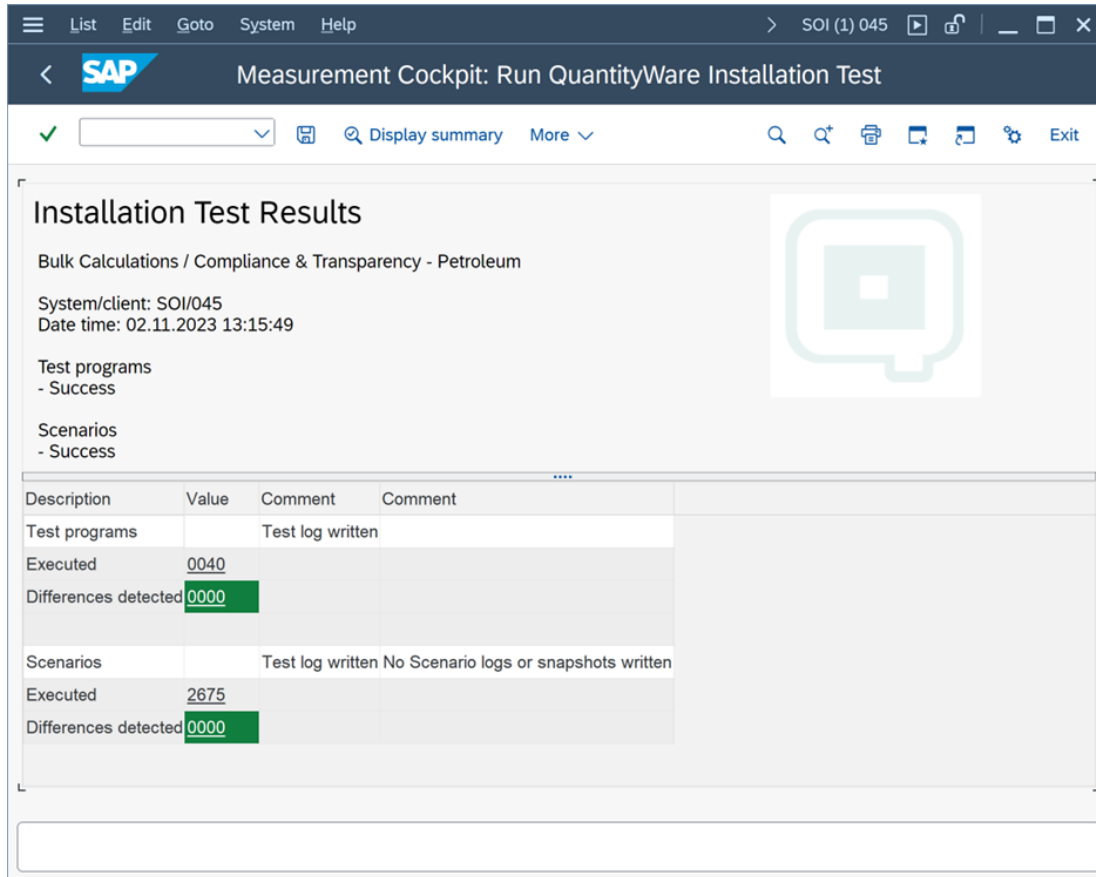
- All individual standard installation tests

- Additional integration test reports

- 2 675 Test Scenarios

The BCP Installation Test is executed with **one click** from the PMC 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 BCP template client (045), where you simply click on "Run Installation Test" in tab strip "Test Tools" of the PMC:
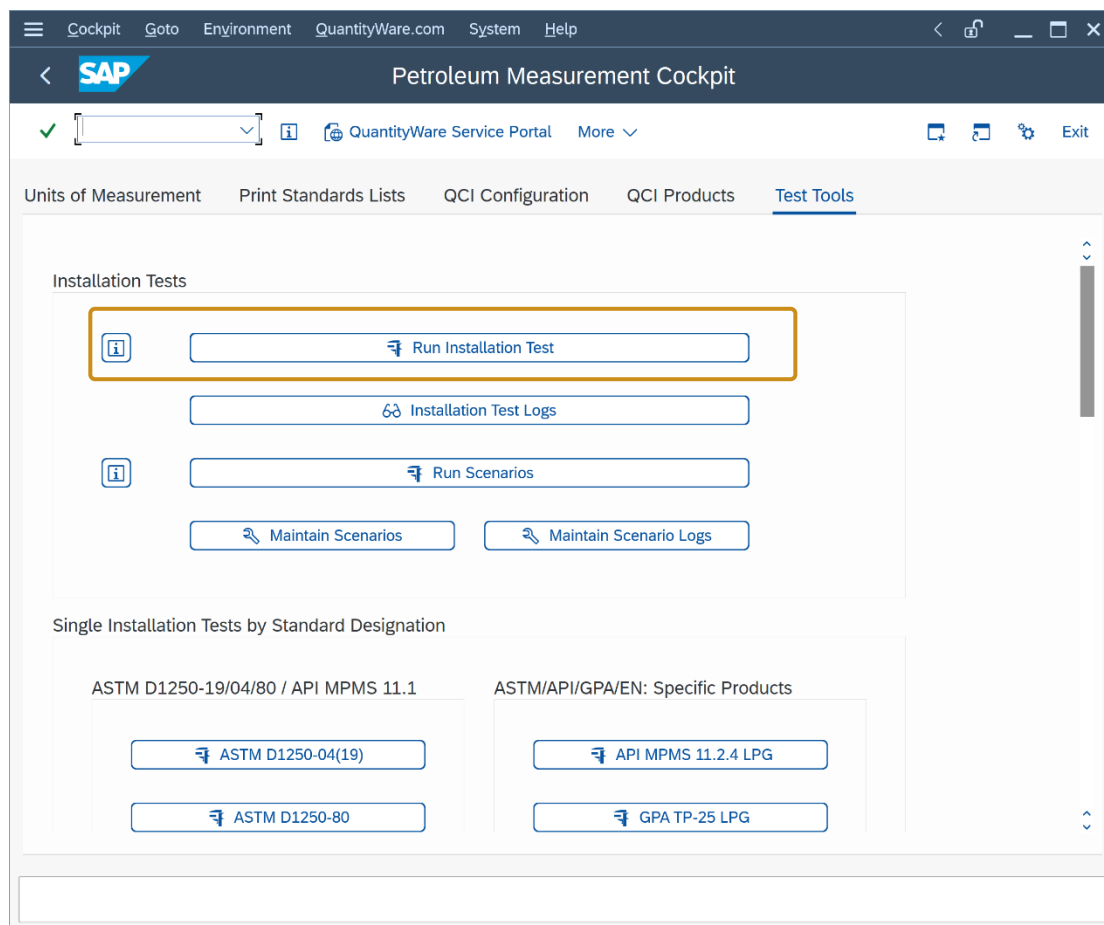
If the test is executed successfully, you see the following list:
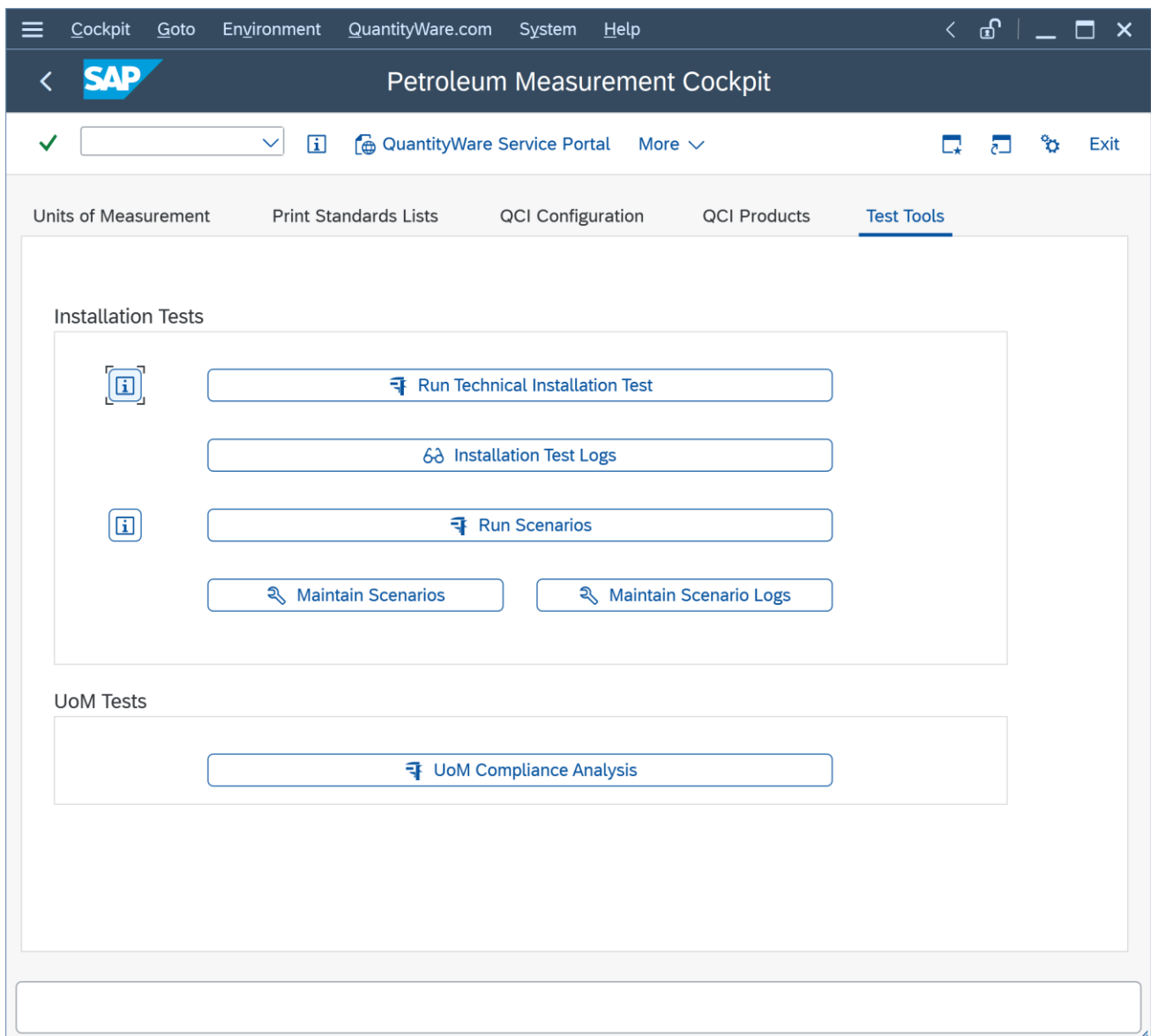
If you want to execute a single test for a specific standard, you access all single tests from this list directly.

> If you log on to a client, where the QuantityWare BC set has not been activated, you have access to the BCP Technical Installation Test via the Petroleum Measurement Cockpit. Without the configuration template data delivered with the BC set, the complete Installation Test would partially run with errors due to missing configuration data.

More details can be found in the BCP Documentation Reference Manual.

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