QuantityWare

BCG 1.0A

Standard Implementation - ISO 13443 & ISO 6976

Implementation & configuration for natural gas conversions including property calculations

Notes:

Contents

Introduction

This solution is a configuration implementation based on the Standards:

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

and

Standard 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)

The solution is part of the product Bulk Calculations Gas Version 1.0A (BCG 10A).

The solution runs only in an SAP ABAP environment in which IS-Oil has been implemented.

The solution can be accessed by the SAP Quantity Conversion Interface (QCI) and is controlled by the Conversion Groups provided within this configuration implementation.

1. Installation

The technical implementation is provided as a part of a CSP package for BCG 10A.
Please follow the standard SAP instructions for importing service packages into your system via transaction SPAM, or the implementation on installation packages via transaction SAINT.

SAP Oil and Gas must be installed

QuantityWare BCG 10A must be installed.

Customizing settings, which are needed in every client in which this standard will be used, are included in the delivery package.
On releases based upon SAP 4.72 and below, the related customizing transport must be imported into all necessary clients, or distributed to them from client 000.
On releases based upon SAP ERP 2005 (ECC 6.00) or newer, BC Set /QTYW/BCG_10A must be activated in the relevant clients.

Please refer to the QuantityWare BCG 10A Installation Guide for more information.

> ⚠ *WARNING: If you import the customizing template into a pre-existing client, any pre-existing entries listed within the template (transport or BC-Set) will be OVERWRITTEN!*

2. Basic definitions of natural gas quantities and behaviour

Besides serving as basic feedstock for the chemical industry, natural gas is predominantly used for heat production as a fuel in large industry sites and millions of households worldwide.
In order to define a trading value for natural gas and to ensure natural gas interchangeability, certain quantities that characterize natural gas must be defined and recorded in business transactions for various processes e.g. inventory management, quality assurance, pricing and excise duty payments. For a comprehensive list of such quantities we recommend ISO standard ISO 6976 as a reference.
With BCG 1.0A QuantityWare delivers conversion groups that are designed for all globally known standard reference conditions for natural gas in the gas phase (high and low pressure regime (CNG), as well as conversion groups for NGL (Natural Gas Liquids). With the release of BCG 1.0A, LNG (Liquefied Natural Gas) support is also in scope.
In order to aid the comprehension of this documentation, we cite the most important definitions from standard ISO 6976 & ISO 6578.

Common definitions:

Superior calorific value:

The amount of heat which would be released by the complete combustion in air of a specified quantity of gas, in such a way that the pressure p_1 at which the reaction takes place remains constant, and all the products of combustion are returned to the same specified temperature t_1 as that of the reactants, all of these products being in the gaseous state except for water formed by combustion, which is condensed to the liquid state at t_1.

> ⚠ *A synonym for calorific value is the term **heating value**. Calorific values can be specified on a molar or mass basis. Then the calorific value depends on the combustion reference conditions t_1 and p_1. More commonly, calorific values are determined based upon a volumetric basis ;in this instance, the calorific value needs to be specified with the combustion reference conditions t_1 and p_1 as well as the volumetric reference conditions t_2 and p_2.*

Inferior calorific value:

The amount of heat which would be released by the complete combustion in air of a specified quantity of gas, in such a way that the pressure p_1 at which the reaction takes place remains constant, and all the products of combustion are returned to the same specified temperature t_1 as that of the reactants, all of these products being in the gaseous state.

Density:

The density is the mass of a gas sample divided by its volume at specified conditions of pressure and temperature.

Relative density:

The density of a gas divided by the density of dry air of standard composition (see Annex B ISO 6976:1995 for a definition of dry air) at the same specified conditions of pressure and temperature.

Wobbe index:

The superior calorific value on a volumetric basis at specified reference conditions, divided by the square root of the relative density at the same specified metering reference conditions.

> ⚠ *The Wobbe index is an important quality designation for natural gas, which is commonly used to determine trade prices and the interchangeability of natural gas.*
>
> ⚠ *The SAP QCI does not calculate the Wobbe index for natural gas. BCG contains functions to perform these calculations within the delivered global templates.*

Gas interchangeability:

An important business requirement when trading natural gas is that natural gas combustion is kept at a defined quality levels that are e.g. required by burners. The Wobbe index (sometimes also referred to as Wobbe number) can serve as one important quality number to ensure interchangeability of natural gas batches with e.g. an apparent different composition.

Ideal gas and real gas:

An ideal gas is one that obeys the ideal gas law:

$p \cdot V_m = R \cdot T$ …(1)

where

p is the absolute pressure

T is the thermodynamic temperature

V_m is the volume per mole of gas

R is the molar gas constant, in coherent units.

No real gas obeys this law. For real gases, equation (1) must be rewritten as

$p \cdot V_m = Z(T,p) \cdot R \cdot T$ …(2)

where Z(T,p) is a variable often close to unity, and is known as the compression factor.

Compression factor:

The actual (real) volume of a given mass of a gas at specified pressure and temperature divided by its volume, under the same conditions, as calculated by the ideal gas law.

Combustion reference conditions:

The specified temperature t_1 and pressure p_1. These are the conditions at which the fuel (natural gas) is notionally burned.

Metering reference conditions:

The specified temperature t_2 and pressure p_2. These are the conditions at which the amount of the fuel to be burned is notionally determined; there is no a priori reason for these to be the same as the combustion reference conditions.

> ⚠ *A range of reference conditions is in use throughout the world. In order to ensure ease of trade, exact conversions of natural gas quantities between different sets of reference conditions is required, based on international standards. This range of different reference conditions is also one of the main reasons why natural gas quantity conversions are complex, even in the low pressure regime.*

Standard reference conditions of selected countries:

Country	t_1	p_1	t_2	p_2
Argentina	-	101,325 kPa	15 °C	101,325 kPa
Australia	15 °C	101,325 kPa	0 °C	101,325 kPa
Austria	25 °C	101,325 kPa	0 °C	101,325 kPa
Belgium	25 °C	101,325 kPa	0 °C	101,325 kPa
Brazil	-	101,325 kPa	0 °C	101,325 kPa
Canada	15 °C	101,325 kPa	15 °C	101,325 kPa
China	20 °C	101,325 kPa	20 °C	101,325 kPa
Czechoslovakia	25 °C	101,325 kPa	20 °C and 0 °C	101,325 kPa
Denmark	25 °C	101,325 kPa	0 °C	101,325 kPa
Egypt	-	101,325 kPa	15 °C	101,325 kPa
Finland	-	101,325 kPa	15 °C	101,325 kPa
France	0 °C	101,325 kPa	0 °C	101,325 kPa
Germany	25 °C	101,325 kPa	0 °C	101,325 kPa
Hong Kong	-	101,325 kPa	15 °C	101,325 kPa
Hungary	-	101,325 kPa	0 °C	101,325 kPa
India	-	101,325 kPa	0 °C	101,325 kPa
Indonesia	-	101,325 kPa	0 °C	101,325 kPa
Iran	-	101,325 kPa	15 °C	101,325 kPa
Ireland	15 °C	101,325 kPa	15 °C	101,325 kPa
Italy	25 °C	101,325 kPa	0 °C	101,325 kPa
Japan	0 °C	101,325 kPa	0 °C	101,325 kPa
Netherlands	25 °C	101,325 kPa	0 °C	101,325 kPa
New Zealand	-	101,325 kPa	15 °C	101,325 kPa
Norway	-	101,325 kPa	15 °C	101,325 kPa
Pakistan	-	101,325 kPa	15 °C	101,325 kPa
Romania	25 °C	101,325 kPa	15 °C and 0 °C	101,325 kPa
Russia	25 °C	101,325 kPa	20 °C and 0 °C	101,325 kPa
Spain	0 °C	101,325 kPa	0 °C	101,325 kPa
Sweden	-	101,325 kPa	0 °C	101,325 kPa
United Kingdom	15 °C	101,325 kPa	15 °C	101,325 kPa
USA*	15 °C	101,325 kPa	15 °C	101,325 kPa
Yugoslavia	0 °C	101,325 kPa	0 °C	101,325 kPa

* The USA typically operate at 60°F and different reference pressure conditions

Source: ISO 13443 and ISO 12213.
On the other hand, ISO 6976 specifies six sets of reference conditions for heating values on a volumetric basis (Table 5 therein), which can be extracted from the above table, and one additional set (25/15) is apparently in usage in some countries. QuantityWare thus defines a global template for the SI system based on seven sets of combustion and metering reference conditions, plus an additional three sets of U.S. customary conditions.

3. Components of the Installation

Within this implementation, we provide conversion groups and reading groups together with formula implementations that calculate the base density, base heating value and the Wobbe Index as well as quantity values (energies, masses, volumes at any desired reference condition set) for natural gas (LOW PRESSURE) at IDEAL GAS CONDITIONS (SAP QCI & QuantityWare MQCI) and REAL GAS CONDITIONS (QuantityWare MQCI only).

Customizing data:

The conversion groups QVF0 to QVFN are provided for the MQCI implementations, conversion groups QVB0 to QVC5 are provided for SAP QCI implementations.

> ⚠ *Conversion groups defined with U.S. customary and SI units and all known reference conditions are available.*

Programs & Test Tools:

The following programs are provided:

- Test report: /QTYW/ISO13443_TEST (SAP QCI) and /QTYW/VALIDATE_MQCI_NATGAS_LNG (MQCI)
- Function Group: /QTYW/ISONG with relevant functions

BAdI Implementations:

In order to pass the Wobbe Index (calculated within QuantityWare Function /QTYW/WOBBE_CONNECTOR) to the calling application, you have to implement SAP QCI BAdI OIB_QCI_CUST_PARAM for SAP QCI conversion groups ONLY.

/QTYW/NATGAS Active
Move additional natural gas parameters to appl
OIB_QCI_CUST_PARAM
This BAdI provides exactly one method which has to be implemented as defined in this example:

```
METHOD if_ex_oib_qci_cust_param~move_cust_par_to_result .
```

```
*/ QW Implementation to pass additional natural gas results to
*/ calling application
  DATA: ls_naturalgas_export TYPE /qtyw/naturalgas_export.

  CALL FUNCTION 'OIB_QCI_MOVE_ITAB_TO_STRUC'
    EXPORTING
      i_ddic_reference         = '/QTYW/NATURALGAS_EXPORT'
    IMPORTING
      e_structure              = ls_naturalgas_export
    TABLES
      t_oib_a10                = it_param
    EXCEPTIONS
      structure_not_exists     = 1
      field_type_not_valid     = 2
      inconsistent_customizing = 3
      OTHERS                   = 4.
  IF sy-subrc <> 0.
    MESSAGE ID sy-msgid TYPE sy-msgty NUMBER sy-msgno
            WITH sy-msgv1 sy-msgv2 sy-msgv3 sy-msgv4
            RAISING calculation_failure.
  ENDIF.

  MOVE-CORRESPONDING ls_naturalgas_export TO cs_customer.

ENDMETHOD.
```

4. Formula and requirements

Implemented formula

This is an implementation of natural gas conversion groups based on ISO 13443: *"Natural gas – Standard reference conditions" 1996-12-15 and ISO 6976 "Natural gas – Calculation of calorific values, density, relative density and Wobbe index from composition", Second edition 1995-2-01. Corrected and reprinted 1996-02-01.*

The formulas utilized by the conversion groups described in this document are implemented within the SAP QCI and QuantityWare BCG 10A functions. Together they allow conversions between different sets of standard (base) 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, calculation formulas based on ISO 6976:1995 (E) are utilized by the SAP QCI.

> ⚠ *All MQCI conversion groups are configured (ABAP call to QuantityWare function) to calculate the Wobbe Index for the natural gas sample. This template is designed for low pressure / ideal gas behaviour and real gas if you utilize the MQCI conversion groups. For high pressure regimes, you can utilize either the AGA8 or SGERG88 implementations delivered within BCG 10A.*

Implementation requirements

In order to use the SAP QCI conversion groups delivered with this package, you have to activate the SAP basic natural gas conversion routines in customizing: If not already activated, go to:

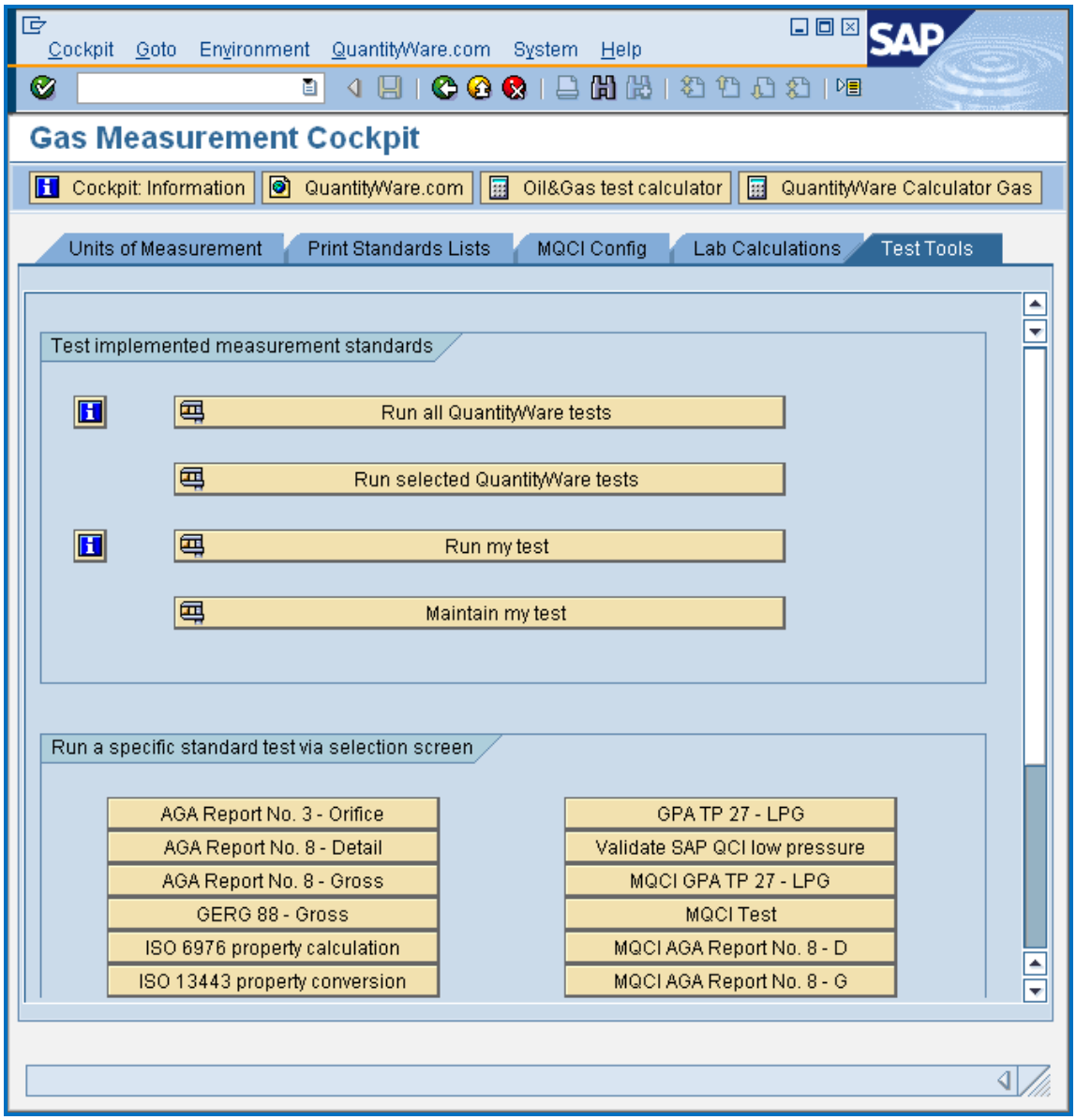
> ⚠ *Industry Solution Oil & Gas (Downstream) → HPM (Hydrocarbon Product Management) → Petroleum Measurement Standards → Quantity Conversion Interface (QCI) Configuration → Activate SAP conversion routines for natural gas*

Here, you can activate the SAP natural gas routines. Afterwards, run the validation and test report. If no errors are reported, productive usage of the SAP QCI with BCG 10A for natural gas is possible.

> ⚠ *The QuantityWare MQCI conversion groups do not require such an activation*

5. Installation Test

Included in the BCG 1.0A package are test & validation programs that can be used to test and also validate the installation of this conversion group set. You can easily access the tests via the Gas Measurement Cockpit:



6. Integration into SAP - QCI desktop calculator

This configuration implementation (global template) is fully integrated into the QCI and thus into all logistics processes such as the SAP Trader's & Schedulers Workbench (TSW). The desktop calculator (transaction O3QCITEST) can be accessed from the Gas Measurement Cockpit and used to calculate natural gas quantities for all of the above defined conversion groups: