QuantityWare

BCP 1.0A

Standard Implementation GPA TP-25

Temperature Correction for the Volume of light Hydrocarbons Tables 23E and 24E

19.03.2007

Notes:

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Introduction

This solution is an implementation of Standard GPA TP-25 (GPA Technical Publication TP-25 Temperature Correction for Volume of light Hydrocarbons Tables 23E and 24E)
with the QuantityWare product Bulk Calculations Petroleum Version 1.0A (BCP 10A).

GPA TP-25 supports the calculation of LPG based on a temperature of 60 degree Fahrenheit and relative density.

An additional procedure has been installed to support base temperatures of 15 and 20 degree Celsius. Absolute density and API Gravity are also now supported.
The original GPA TP-25 standard procedure has not been changed by the “15 / 20 degree Celsius” enhancement.

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

This solution can be accessed by the SAP Quantity Conversion Interface (QCI) and is controlled by the Conversion Groups provided.

1. Installation

The technical implementation is provided as a part of a CSP package.

Please follow the standard SAP instructions for importing service packages into your system via transaction SPAM.

SAP Oil and Gas must be installed

QuantityWare's BCP 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/BCP_10A must be activated in the relevant clients.

Please refer to the QuantityWare BCP 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. Components of the Installation

The main part of the installation is

Function: **/QTYW/GPA_TP25**
Determine Base Density and VCF of LPG

Which is a part of the

Function Group: **/QTYW/STANDARDS_COM**
Standard Procedures of Oil and Gas

The function can be called via the Export/Import interface or from the application via the QCI using the provided Conversion and Reading Groups:

Conversion Groups: To use tables 23E and 24 E directly as described in GPA TP-25, without any additional processing.
GP25 - GPA TP-25: LPG @ 60 FAHRENHEIT & RELATIVE DENSITY

To use tables 23E and 24 E directly as described in GPA TP-25, with input and output density conversion.
GP23 - GPA TP-25: LPG @ 60 FAHRENHEIT & API GRAVITY
G25D - GPA TP-25: LPG @ 60 FAHRENHEIT& DENSITY

> ⚠ ***QuantityWare Enhancement*** *using tables 23E and 24 E for calculations at a Base temperature of 15 and 20 degree Celsius*
> ***GP21 - GPA TP-25: LPG @ 15 CELSIUS & ABSOLUTE DENSITY***
> ***GP22 - GPA TP-25: LPG @ 20 CELSIUS & ABSOLUTE DENSITY***

Reading Groups: **G25A - GPA TP 25 , FOR LPG, API GRAVITY, FAH**
G25C - GPA TP 25 , FOR LPG, ABSOLUTE DENSITY, CEL
G25D - GPA TP 25 , FOR LPG, ABSOLUTE DENSITY
GP25 - GPA TP 25 , FOR LPG (SAP standard, not shipped by QW)

Test program: **/QTYW/GPATP25_TEST**

3. Formula and requirements

3.1. Implemented formula

This is an implementation of the standard GPA TP-25 formula.

The formula provides a correction factor for the:

- Density:

API Gravity	Relative Density	Absolute Density Kg/m3
542,3 – 59,7	0.21 – 0.74	209,8 - 739,3

- Temperature:

Celsius	Fahrenheit
-45.5 – 93.3	-50 – 200

3.2. Implementation to be used by the QCI and requirements

The QCI also offers the possibility to calculate volumes at any defined temperature; to do so, it needs a volume correction factor. This can be derived from the relation of the densities.

Density Measurement:
Test Density
Test Temperature

Volume Measurement:
Transaction Quantity
Material Temperature

4. Enhancements to support 15 and 20 degree Celsius

4.1. Tables 23E and 24E

Similar to the procedures of the ASTM D 1250-80 tables, the GPA provided a set of two tables in the TP-25 standard - table23E and table24E.
The numbers 23 and 24 are usually used for tables that have been designed for a base of 60 degree Fahrenheit in relative density; consequently, 23E and 24E follow this definition.
The letter E stands for the product type “LPG”.

4.2. The meaning of “Base Conditions”

It is possible to use a different type/unit of density and convert it - before the calculation - to the density type/unit that is needed by a standard procedure. The type/unit of density can then also be converted back after the calculation.

> ⚠ *The Base Temperature of a table/procedure cannot be changed.*

Here, a short explanation:
We will use three types of conditions:

OBSERVED (OBS)	The temperature, pressure, etc. and volume we measured in the real world at the current conditions.
BASE (BAS)	The conditions we will convert the density to, in order to have a fixed condition with which we can handle the quantities. There are three commonly used base temperatures: 60 degree Fahrenheit, 15 and 20 degree Celsius.
ALTERNATE (ALT)	This is any other temperature to which the OBS or BAS density/volume can be corrected.

4.3. Calculation Procedures

There are two possible methods by which to calculate quantities between the conditions mentioned in 4.2, above.
The simplest is BAS to ALT:

BAS -> ALT	We have the density at the base temperature. Now we can calculate straight to any alternate condition. This is why the base condition is very important. We know exactly what we have and can start to calculate.
OBS -> BAS	This is a much more complicated calculation. It requires a number of calculations (e.g. BAS -> ASLT) and iterations to reach the base conditions.

Standard GPA TP-25 offers:

Table23E
- Calculation OBS -> BAS
- Input: OBS temperature, density
- Output: Base density

Table24E
- Calculation BAS -> ALT
- Input: Base density, Alternate temperature
- Output: Volume Correction Factor (VCF) Bas -> ALT

4.4. Procedure to work with another Base

Unfortunately, the thermal expansion of differing petroleum products is not linear over temperature and pressure changes.
The tables/procedures used to calculate thermal expansion are based on many measurements starting from base conditions, thus we cannot simply convert the temperature. In ASTM D 1250-80 an attempt to cover these conditions was made by the provision of different tables; It can be proven that the results of this approach are inaccurate. (See document “ASTM D 1250 - Historical and technical overview”, available from QuantityWare upon request.)
ASTM D 1250-04 chose a different method, resulting in the approach that ALL calculations are executed on the same base conditions as 60 degree Fahrenheit.
The consequence of this concept is that all calculations must be considered as being OBS -> BAS or BAS -> ALT.
This is how ASTM D 1250-04 defines calculations on a basis of 15 or 20 CEL; it is mathematically and physically absolutely correct and according to our observations and tests, it works very well!

We used the tables 23E and 24E and coupled them with logic similar to ASTM D 1250-04, procedure 11.1.7.3.

4.5. Calculation test at different base temperatures

To determine results that can be compared, it is necessary to find combinations of input parameters that are not too heavily affected by unit conversion (owing to the temperature and the density scale). Density and API have a different accuracy, the same situation is present between Fahrenheit and Celsius.
We determined a set of parameters where the input parameter conversion will have less impact. Here is one example:

Conv. Grp. **Base temp.** **Base density**	**GP25** **60 FAH** **Rel.Density**	**GP23** **60 FAH** **API Gravity**	**G25D** **60 FAH** **Abs. Density**	**GP21** **15 CEL** **Abs. Density**	**GP22** **20CEL** **Abs. Density**
Input:					
Density	0.5640	119.4 API	563,4 Kg/m3	563,4 Kg/m3	563,4 Kg/m3
Temperature	14 FAH	14 FAH	14 FAH	-10 CEL	-10 CEL
Input volume	10000 L	10000 L	10000 L	10000 L	10000 L
Result:					
L15	10592.177	10592.177	10592,177	10592,177	10592,177
UG6	2802.047	2802.047	2802,047	2802,047	2802,047
Kg	5637.296	5636.818	5637,292	5637,294	5637,294

The calculated volumes are absolutely identical.

Small differences appear in the results of mass calculatons; these are caused by the definition of significant digits for density, especially at API Gravity.
The largest difference observed is between Relative Density and API Gravity at the same Base Temperature of 60 degree Fahrenheit; this calculation is performed by using the unmodified standard GPA TP-25 with a conversion of the API to Rel. Density before the calculation.
The difference is:
GP25, base 60 FAH, Rel Density: 5637.296 Kg
GP23, base 60 FAH, API Gravity: 5636.818 Kg
This is a difference of 0.478 Kg, which is 0.08%.

5. Installation Test

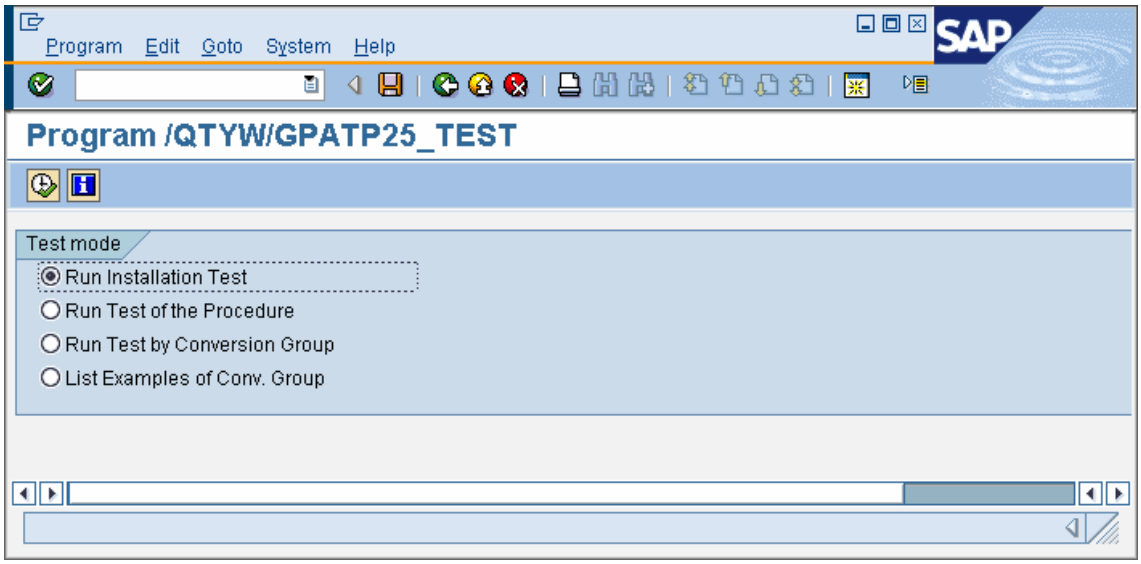
Along with the package QuantityWare provides a test program that can be used to test the installation and perform calculations with the standard:

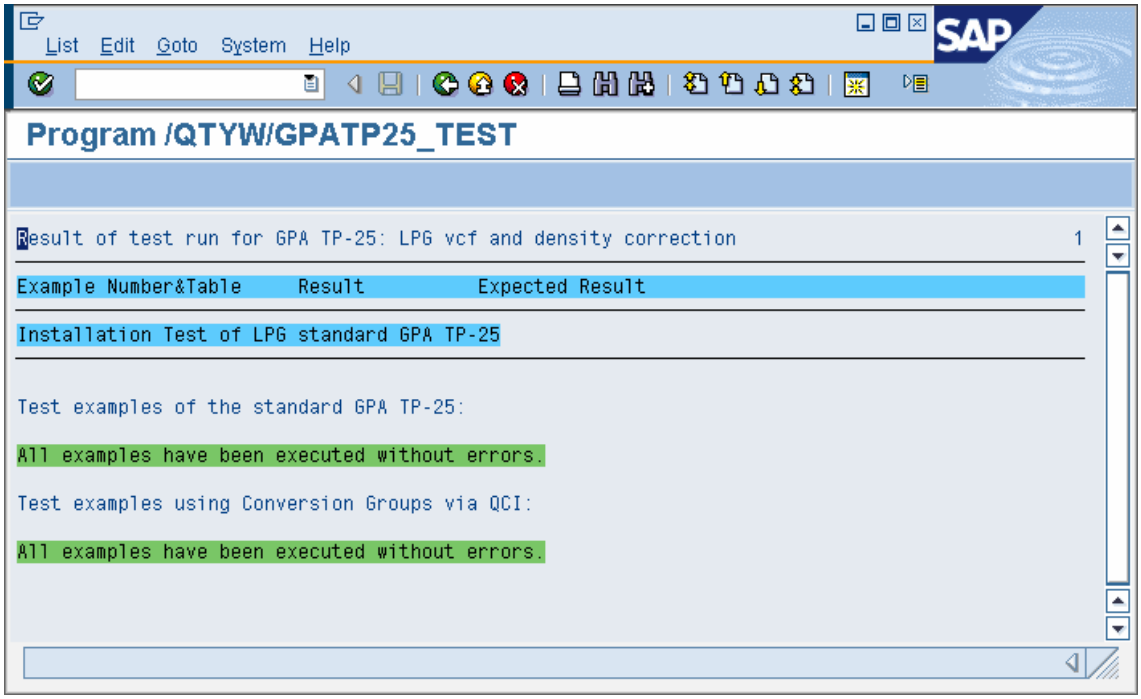
/QTYW/GPATP25_TEST

There two ways to call and use the function:

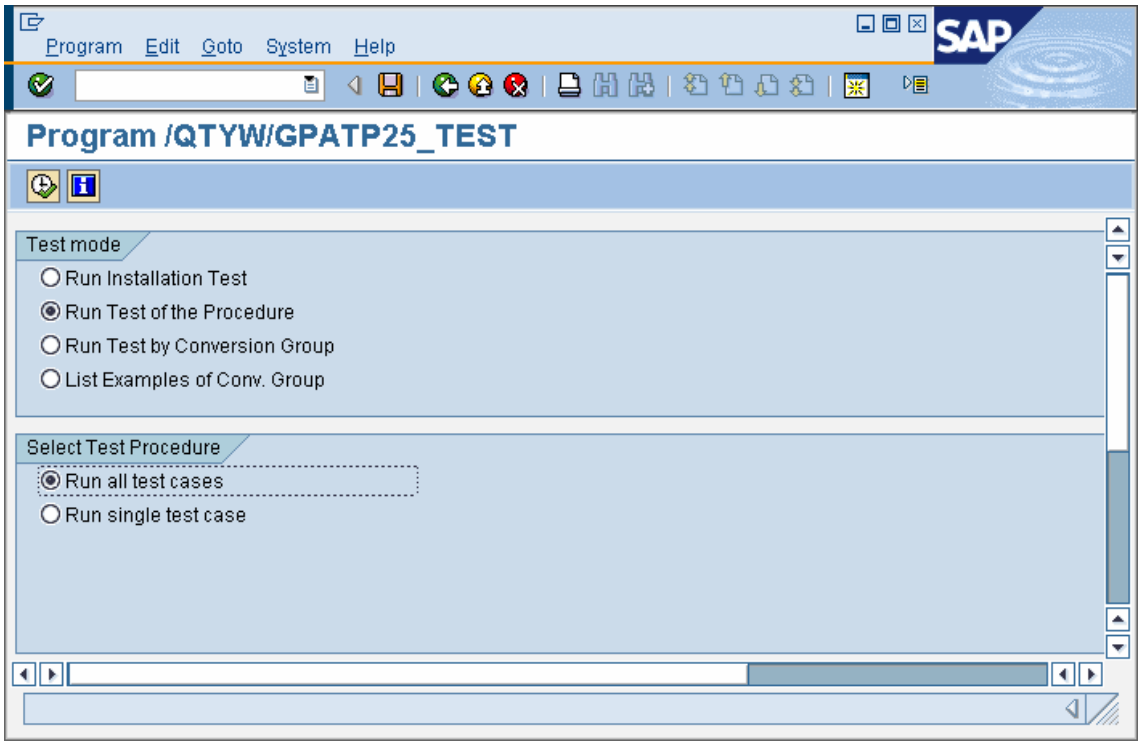
- Direct call of the function via the export/import interface
- Call the function via the QCI controlled by the conversion group.

The option “Installation Test” is the default and runs all implemented examples.

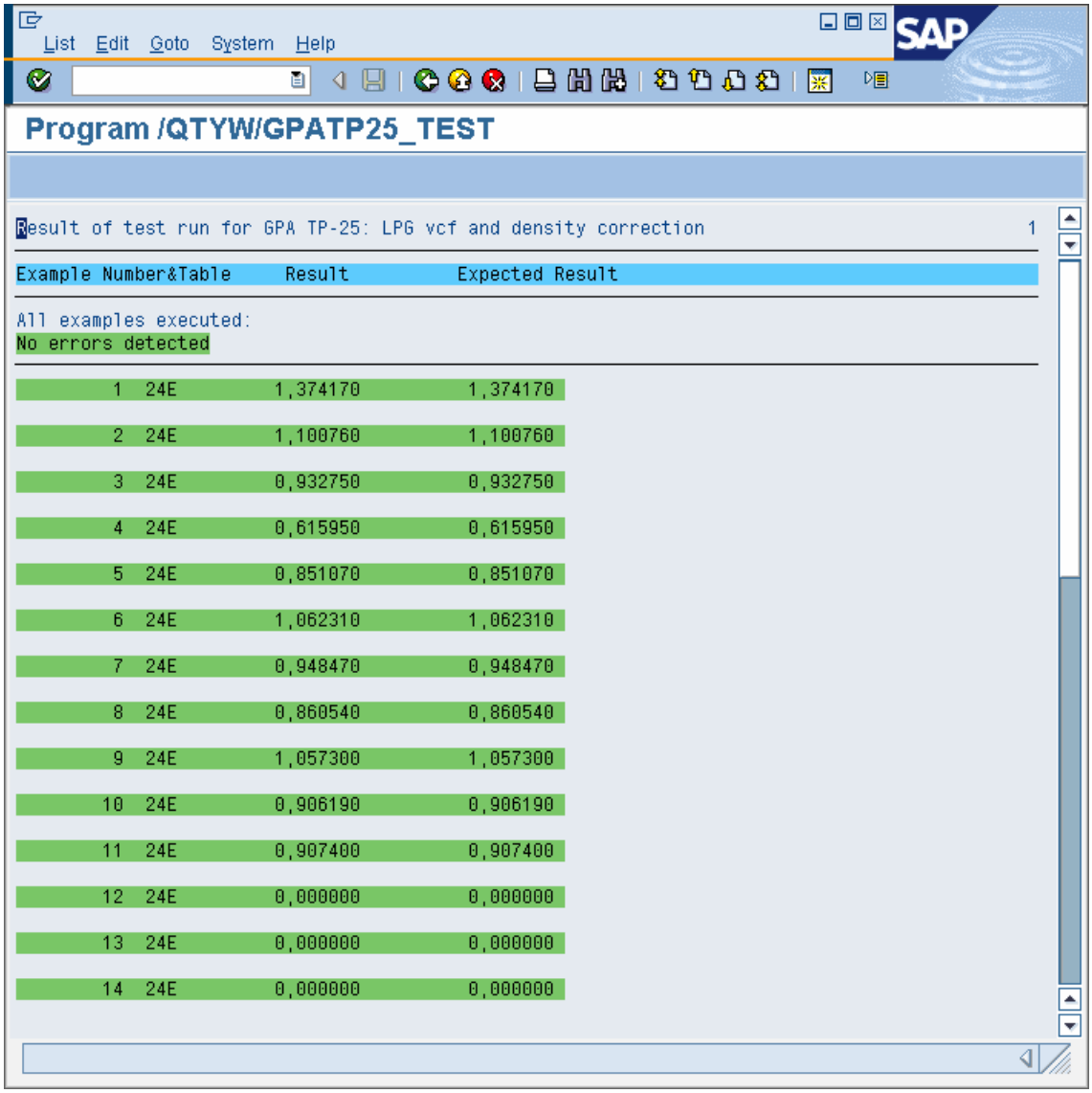




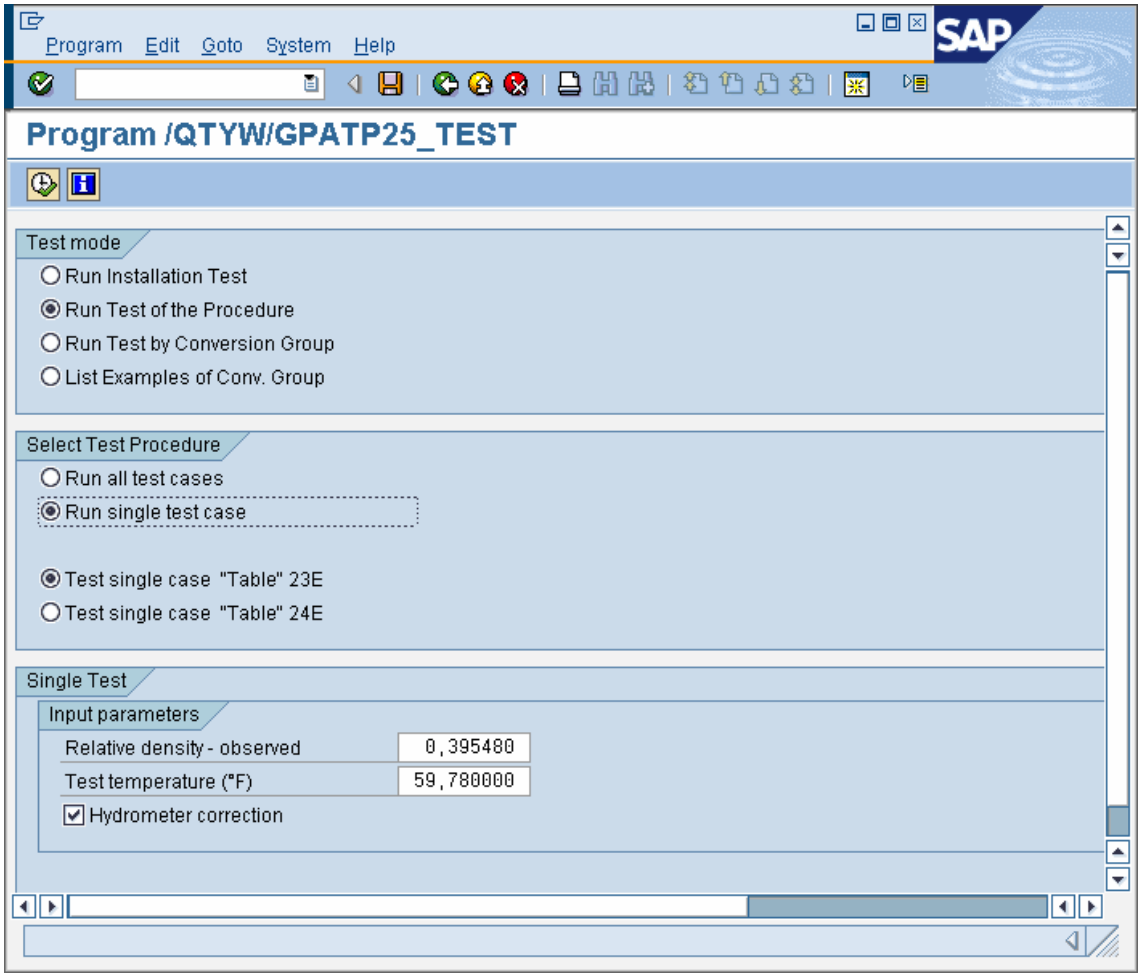
You can run all implemented examples of the standard by a direct call, or one specifically chosen case as shown below:



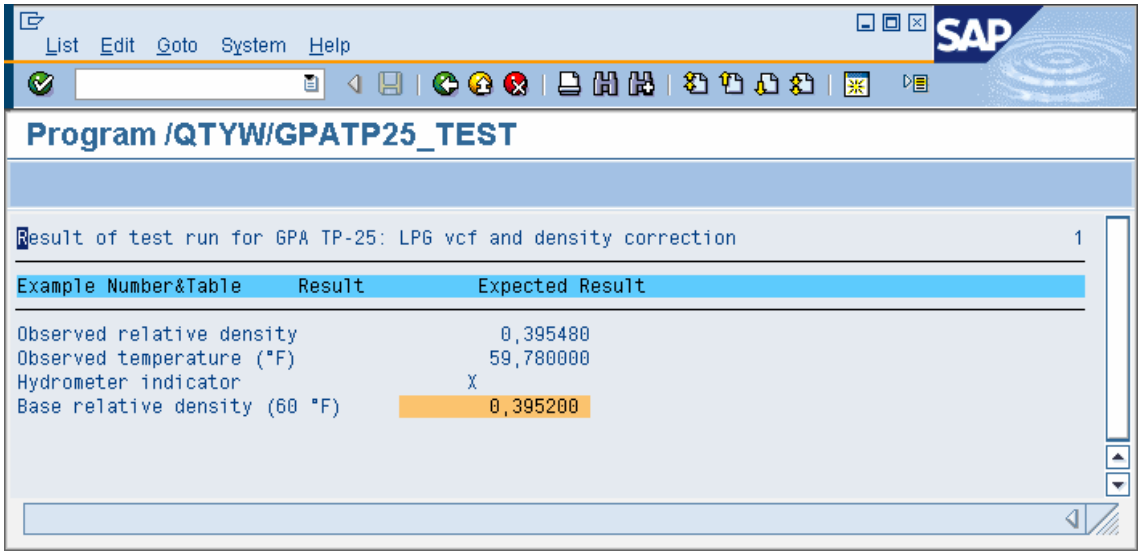
Result:



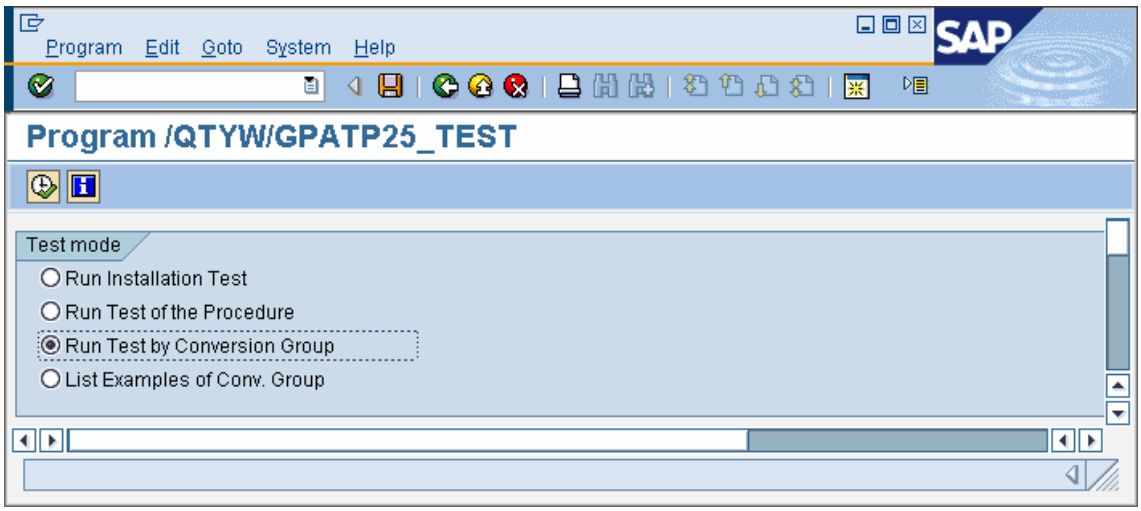
Or select one single case to test the procedure with:



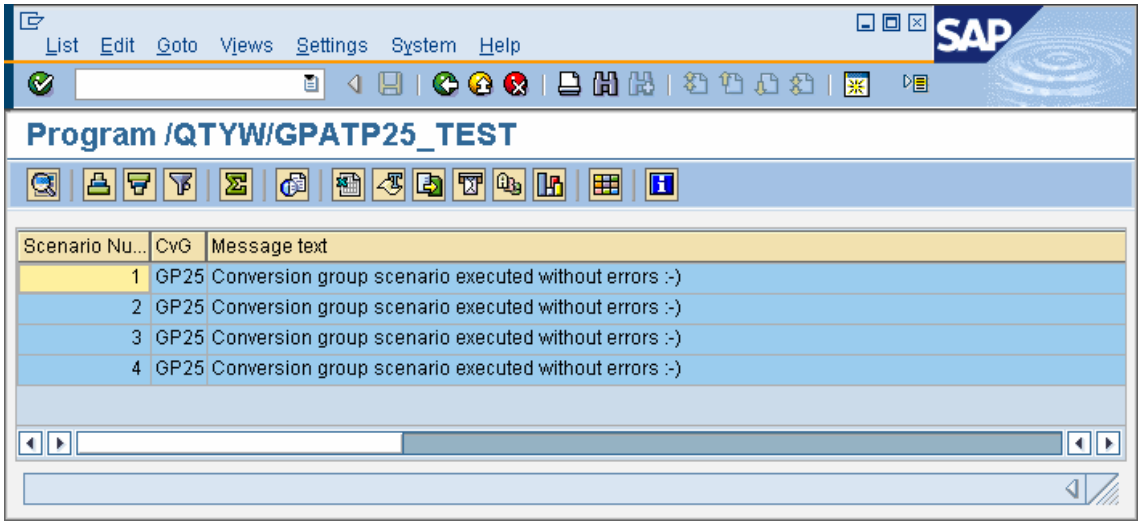
The program will run the calculation and show the result:



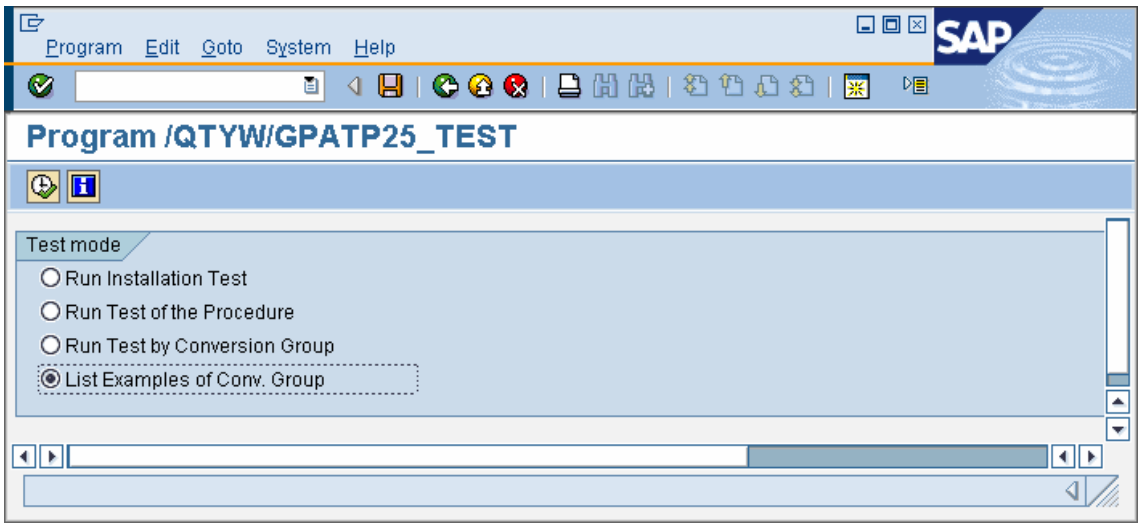
By running via Conversion Groups:

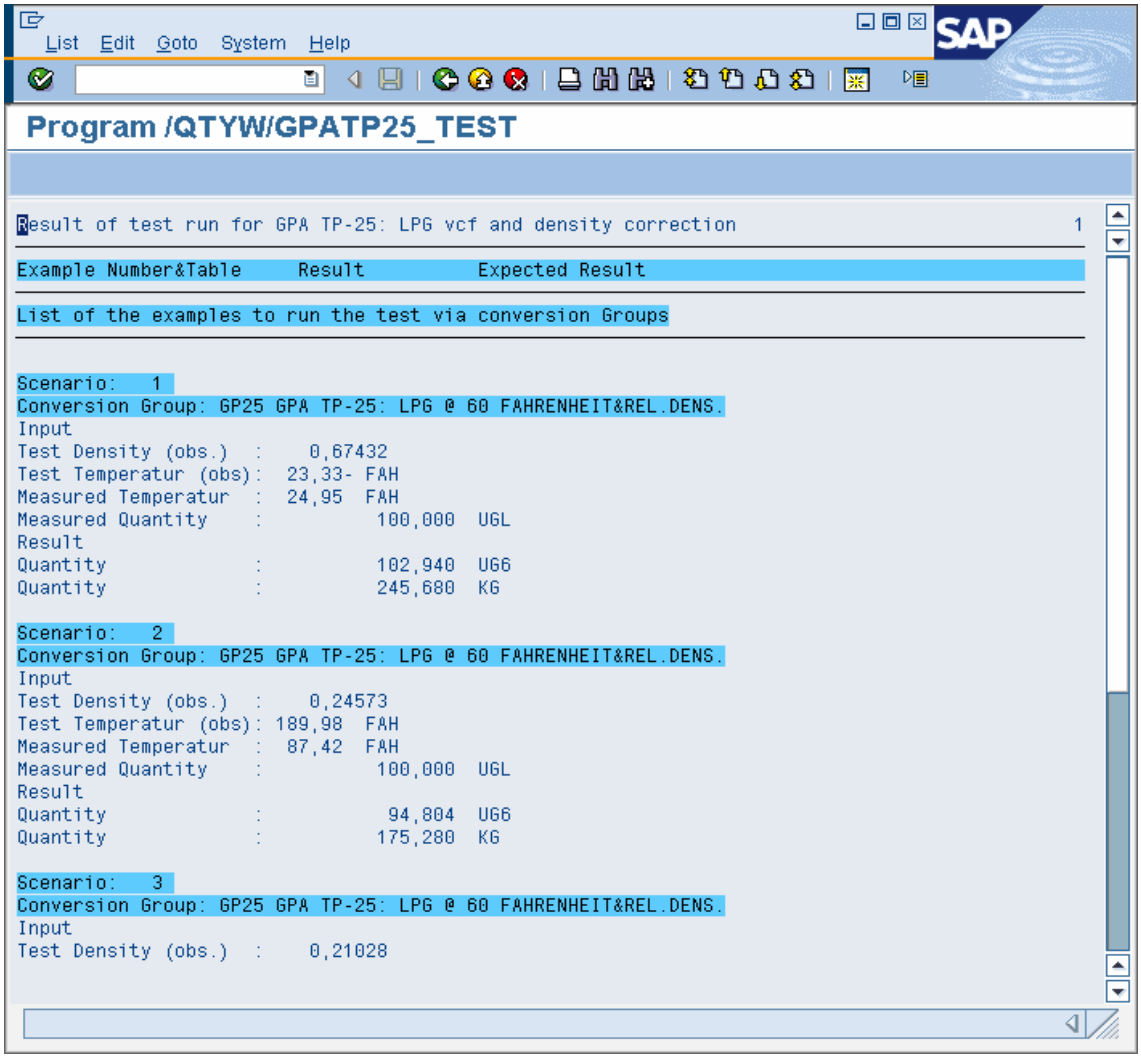


The Program shows the list of the successfully executed Conversion Groups (as below), or errors which occurred:



A list of Conversion Group examples can be shown:





6. Disclaimer

The QuantityWare implementation of GPA TP-25 contains both an implementation of the 'pure' GPA TP-25 standard, and 'extensions' which are provided by QuantityWare based upon current methods of standards' calculation and physical laws.
Even if all tests return the expected Volume Correction Factors, we cannot guarantee for absolute correctness – in the same way as the standards organisations themselves do not guarantee for absolute correctness with in-house implementations (e.g. the API ASTM D1250-04 'C' implementation.)
A standard Disclaimer is detailed at the beginning of every ABAP source:

```
* This implementation uses VCF formulas used by functions related to the
* standards. See description in the function modules.
*
* This Software is provided on an "AS IS" basis with no warranties.
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* QantityWare GmbH can not guarantee the correctness of the formulas
* used in this code nor of the correctness of the results.
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