

QuantityWare Validation Report

Comparison of two
ASTM D1250-80
implementations: SAP
ABAP & C

Documentation of comparison
results: BCP 10A ASTM
D1250-80 implementation.

Notes

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Introduction

Increasingly, QuantityWare BCP (Bulk Calculations – Petroleum) customers are replacing their legacy API c-code (1980) implementations with the corresponding BCP implementation of ASTM D1250-80. This is typically a first step (driven by national legal requirements to stay for with the 1980 version, while allowing the customer to leverage the various massive benefits delivered with BCP) before moving to the most current ASTM D1250-04 version at some later point in time.

In this validation report we publicly provide the detailed results of all comparison measurements which QuantityWare performed in 2007 during the implementation and quality assurance phase of our ASTM D1250-80 standard development.

Before publication of this report (September 2009), all calculations were repeated to ensure that only the most current data was used.

Comparison methodology

QuantityWare purchased a license for the API C-code implementations from the American Petroleum Institute (API) in 2007.

To our knowledge, the API C-code 1980 version is no longer available for purchase.

For this comparison, we compiled and linked the 1980 version to the SAP Quantity Conversion Interface (QCI). We then performed more the 60 million single calculations for both the API c-code implementation and our QuantityWare BCP 10A implementation.

The comparison was automated via a QuantityWare internal SAP ABAP report which:

- calculates volume correction factors or base densities
(depending on the ASTM D1250-80 table that requires comparison)
- via the QuantityWare BCP implementation
- via the API C-code implementation
- for a wide range of density and temperature values
- with user defined increments.

If differences are detected, they are marked and can be printed out and analyzed after the report has completed a comparison run.

A comparison run was made for each ASTM D1250-80 table (5, 6, 23, 24, 53, 54, 59 and 60) for all product types.

Comparison results

Table 1 contains the summarized results of all comparison runs. The table lists the specific ASTM D1250-80 table, the density and temperature range and increments, and shows the number of calculations performed for each run.

▲ For all 62.326.690 single calculations, the results of the BCP ABAP based implementation and the API c-code implementation are identical.

Table	Density			Temperature			Calculations
	From	To	Increment	From	To	Increment	
5A	0	100	0,1	0	300	0,1	3.004.001
5B	0	85	0,1	0	300	0,1	2.553.851
5D	-10	45	0,1	0	300	0,1	1.653.551
6A	0	100	0,1	0	300	0,1	3.004.001
6B	0	85	0,1	0	300	0,1	2.553.851
6D	-10	45	0,1	0	300	0,1	1.653.551
23A	0,611	1,076	0,0005	0	300	0,1	2.793.931
23B	0,6535	1,076	0,0005	0	300	0,1	2.538.846
23D	0,8	1,164	0,0005	0	300	0,1	2.187.729
24A	0,611	1,076	0,0005	0	300	0,1	2.793.931
24B	0,6535	1,076	0,0005	0	300	0,1	2.538.846
24D	0,8	1,164	0,0005	0	300	0,1	2.187.729
53A	610,5	1075	0,5	18.00-	150	0,1	1.563.330
53B	653	1075	0,5	18.00-	150	0,1	1.420.445
53D	800	1164	0,5	20.00-	150	0,1	1.240.029
54A	610,5	1075	0,5	18.00-	150	0,1	1.563.330
54B	653	1075	0,5	18.00-	150	0,1	1.420.445
54D	800	1164	0,5	20.00-	150	0,1	1.240.029
59A	610,5	1075	0,5	18.00-	150	0,1	1.563.330

Table	Density			Temperature			Calculations
	From	To	Increment	From	To	Increment	
59B	653	1075	0,5	18.00-	150	0,1	1.420.445
59D	800	1164	0,5	20.00-	150	0,1	1.240.029
60A	610,5	1075	0,5	18.00-	150	0,1	1.563.330
60B	653	1075	0,5	18.00-	150	0,1	1.420.445
60D	800	1164	0,5	20.00-	150	0,1	1.240.029
Number of all calls:							62.326.690

Table	Thermal Expansion Coefficient			Temperature			Calculations
	From	To	Increment	From	To	Increment	
6C	0,00027	0,00093	0,0000005	0	300	0,1	3.964.321
24C	0,00027	0,00093	0,0000005	0	300	0,1	3.964.321
54C	0,000486	0,001674	0,0000005	18.00-	150	0,1	3.995.737
60C	0,000486	0,001674	0,0000005	20.00-	150	0,1	4.043.277

Table 1:

Summarized comparison data for all ASTM D1250-80 petroleum measurement tables. The temperature units of measure are °C and °F, the density units are °API, rel. density and absolute density (kg/m³) for the corresponding tables.

Table 2 gives an overview of the total runtime for these comparison runs.

Table	Runtime in seconds		Runtime ratio
	QW ABAP:	API C-code:	API C-code/ABAP
5A	2.139	42.050	19,7
5B	2.010	36.991	18,4
5D	982	24.817	25,3
6A	777	42.170	54,3
6B	669	37.101	55,5
6C	762	60.224	79,0
6D	413	25.073	60,7
23A	1.987	41.090	20,7
23B	1.992	38.223	19,2
23D	1.340	33.134	24,7
24A	744	40.821	54,9
24B	682	37.966	55,7
24C	727	60.346	83,0
24D	563	33.261	59,1
53A	1.068	23.209	21,7
53B	1.074	21.554	20,1
53D	722	18.846	26,1
54A	387	22.899	59,2
54B	357	21.269	59,6
54C	783	60.729	77,6
54D	296	18.822	63,6
59A	1.992	23.001	11,5
59B	1.821	21.406	11,8
59D	1.246	18.642	15,0
60A	1.232	22.796	18,5
60B	1.104	21.211	19,2
60C	918	46.110	50,2
60D	882	18.761	21,3
Summary	29.669	912.522	30,8

Table 2: Runtime for comparison calculations in seconds.

The total runtime for the ABAP calculations in seconds converts to approx. 8 ½ hours, for the API c-codes the total runtime converts to approx. 253 ½ hours. Three runs were executed in parallel in background mode, so that the total elapsed time for this comparison study took about 3 days.

BCP customers can print the detailed results using the Petroleum Measurement Cockpit.

However, a list for a single table run typically contains more than 2500 pages.

QuantityWare can provide such lists to BCP customers as PDF documents, if, e.g. legal experts and authorities require detailed data. One list is typically around 120 MB in size.

Summary

In this paper we focused on a detailed analysis of a comparison between the QuantityWare ASTM D1250-80 API MPMS Chapter 11.1 volume correction factor calculation routines, SAP ABAP implementation, and the legacy API c-code implementation.

For more than 60 million single calculations we obtained identical results.

This impressive, but not surprising result is based upon our detailed technical analysis of the ASTM D1250-80 implementation instructions, which are described in another working paper.

The ASTM D1250-04 has now been available for 5 years. The oil industry is now in a transformation process towards this recommended, new and improved standard, which eliminates fixed point arithmetic issues. The industry-wide transformation process will probably take another 5 to 15 years (depending on various factors such as legal requirements and national measurement standard adjustments, as well as the various cost issues for each business). Thus the findings documented in this paper will still be relevant and helpful during the transition time.

QuantityWare offers implementations of all available ASTM D1250 versions to ensure a smooth and individual transition process for our customers, which can be made to fit their specific requirements. QuantityWare BCP customers can readily replace their legacy API c-code installations with our BCP implementation of the ASTM D1250-80 version, since all possible calculation results are identical when simply replacing that volume correction factor and base density calculation sections of the quantity conversion implementation.