

ASTM D1250-04 DLL

Windows32 Dynamic Link Library

Temperature and pressure volume correction factors for generalized crude oils, refined products, and lubricating oils.

Version 1.0

```
int ASTM1250_base_to_alternate(int commodity, double alpha60, int alpha60_unit,  
double T, int T_unit, double P, int P_unit, double rho60,  
int rho60_unit, double *rho, int rho_unit, double *alpha60out,  
int alpha60out_unit, double *FP, int FP_unit, double *CTL,  
double *CPL, double *CTPL)
```

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Revision 1.0

Overview

ASTM1250_base_to_alternate

This function calculates the Volume Correction Factor (VCF) for correcting from the density at the base conditions (60°F and 0 psig) to alternate temperature and pressure conditions.

ASTM1250_observed_to_base

This function calculates the density at the base conditions (60°F and 0 psig) that is consistent with an observed density at its temperature and pressure condition.

ASTM1250_cond1_to_cond2

This function calculates the density at given conditions (condition 2) that is consistent with an observed density at its temperature and pressure condition (condition 1). Typically applications are:

- Calculating the density at base conditions different from 60°F / 0 psig (e.g. 15°C / 0 kPa) that is consistent with an observed density at its temperature and pressure condition. Condition 1 is the observed condition, condition 2 is the base condition and *basecond* is 2.
- Calculating the density from base conditions different from 60°F / 0 psig (e.g. 15°C / 0 kPa) to alternate temperature and pressure conditions. Condition 1 is the base condition, condition 2 is the alternate condition and *basecond* is 1.
- Calculating the density at alternate conditions that is consistent with an observed density at its temperature and pressure condition. In this case condition1 is the observed condition, condition 2 is the alternate condition and *basecond* may be 1 or 2.

ATTENTION: In this case FP, CTL, CPL, CTPL are calculated with respect to condition 1 or condition 2 and are NOT in compliance with ASTM D 1250-04!

ASTM1250_regression

This function accepts measured density values and derives values of the density at 60°F and the thermal expansion factor at 60°F.

ASTM1250_round

This function rounds density, temperature, pressure, thermal expansion coefficient, and volume correction factor values. These rounding rules are needed to generate the final volume correction factor due to temperature and pressure and to generate the tables in printed tabular (historical) format. All input values must be rounded when generating the tables in historical format.

ASTM1250_ITS90_to_IPTS68

This function converts temperature from ITS-90 to IPTS-68 basis.

ASTM1250_base_to_alternate

This function calculates the Volume Correction Factor (VCF) for correcting from the density at the base conditions (60°F and 0 psig) to alternate temperature and pressure conditions.

*int ASTM1250_base_to_alternate(int commodity, double alpha60, int alpha60_unit, double T, int T_unit, double P, int P_unit, double rho60, int rho60_unit, double *rho, int rho_unit, double *alpha60out, int alpha60out_unit, double *FP, int FP_unit, double *CTL, double *CPL, double *CTPL)*

Arguments:

commodity	[in]	Commodity group describing liquid (0=not given, 1=Crude Oil, 2=Refined Products, 3=Lubricating Oil)
alpha60	[in]	Pre-calculated 60°F thermal expansion factor (if commodity group not given)
alpha60_unit	[in]	alpha60 unit (0=1/°F, 1=1/°C)
T	[in]	Alternate temperature
T_unit	[in]	Alternate temperature unit (0=°F, 1=°C)
P	[in]	Alternate pressure
P_unit	[in]	Alternate pressure unit (0=psi, 1=kPa, 2=bar)
rho60	[in]	Density at base conditions (60°F and 0 psig)
rho60_unit	[in]	Density at base conditions unit (0=kg/m ³ , 1=rel. dens., 2=deg. API)
rho	[out]	Density at alternate conditions
rho_unit	[in]	Density at alternate conditions unit (0=kg/m ³ , 1=rel. dens., 2=deg. API)
alpha60out	[out]	Thermal expansion factor at 60°F (if not input)
alpha60out_unit	[in]	Thermal expansion factor at 60°F unit (0=1/°F, 1=1/°C)
FP	[out]	Scaled compressibility factor
FP_unit	[in]	Scaled compressibility factor unit (0=1/psi, 1=1/kPa, 2=1/bar)
CTL	[out]	Volume correction factor due to temperature
CPL	[out]	Volume correction factor due to pressure
CTPL	[out]	Combined volume correction factor due to temperature and pressure

Return value:

0	OK
1	Temperature out of range
2	Pressure out of range
3	rho60 out of range
4	alpha60 out of range

ASTM1250_observed_to_base

This function calculates the density at the base conditions (60°F and 0 psig) that is consistent with an observed density at its temperature and pressure condition.

*int ASTM1250_observed_to_base(int commodity, double alpha60, int alpha_unit, double T, int T_unit, double P, int P_unit, double rho, int rho_unit, double *rho60, int rho60_unit, double *FP, int FP_unit, double *CTL, double *CPL, double *CTPL)*

Arguments:

commodity	[in]	Commodity group describing liquid (0=not given, 1=Crude Oil, 2=Refined Products, 3=Lubricating Oil)
alpha60	[in]	Pre-calculated 60°F thermal expansion factor (if commodity group not given)
alpha60_unit	[in]	alpha60 unit (0=1/°F, 1=1/°C)
T	[in]	Temperature at which the observed density was measured
T_unit	[in]	Temperature at which the observed density was measured unit (0=°F, 1=°C)
P	[in]	Pressure at which the observed density was measured
P_unit	[in]	Pressure at which the observed density was measured unit (0=psi, 1=kPa, 2=bar)
rho	[in]	Observed density
rho_unit	[in]	Observed density unit (0=kg/m ³ , 1=rel. dens., 2=deg. API)
rho60	[out]	Density at base conditions (60°F and 0 psig)
rho60_unit	[in]	Density at base conditions unit (0=kg/m ³ , 1=rel. dens., 2=deg. API)
FP	[out]	Scaled compressibility factor
FP_unit	[in]	Scaled compressibility factor unit (0=1/psi, 1=1/kPa, 2=1/bar)
CTL	[out]	Volume correction factor due to temperature
CPL	[out]	Volume correction factor due to pressure
CTPL	[out]	Combined volume correction factor due to temperature and pressure

Return value:

0	OK
1	Temperature out of range
2	Pressure out of range
3	rho60 out of range
4	alpha60 out of range
5	no convergence
6	density out of range

ASTM1250_cond1_to_cond2

This function calculates the density at given conditions (condition 2) that is consistent with an observed density at its temperature and pressure condition (condition 1). Typically applications are:

- Calculating the density at base conditions different from 60°F / 0 psig (e.g. 15°C / 0 kPa) that is consistent with an observed density at its temperature and pressure condition. Condition 1 is the observed condition, condition 2 is the base condition and *basecond* is 2.
- Calculating the density from base conditions different from 60°F / 0 psig (e.g. 15°C / 0 kPa) to alternate temperature and pressure conditions. Condition 1 is the base condition, condition 2 is the alternate condition and *basecond* is 1.
- Calculating the density at alternate conditions that is consistent with an observed density at its temperature and pressure condition. In this case condition1 is the observed condition, condition 2 is the alternate condition and *basecond* may be 1 or 2.

ATTENTION: In this case FP, CTL, CPL, CTPL are calculated with respect to condition 1 or condition 2 and are NOT in compliance with ASTM D 1250-04!

```
int ASTM1250_cond1_to_cond2(int commodity, double alpha60, int alpha_unit, double T1, int T1_unit,
double P1, int P1_unit, double rho1, int rho1_unit, double T2, int T2_unit, double P2, int P2_unit,
double *rho2, int rho2_unit, double *FP, int FP_unit, double *CTL, double *CPL, double *CTPL,
int basecond)
```

Arguments:

commodity	[in]	Commodity group describing liquid (0=not given, 1=Crude Oil, 2=Refined Products, 3=Lubricating Oil)
alpha60	[in]	Pre-calculated 60°F thermal expansion factor (if commodity group not given)
alpha60_unit	[in]	alpha60 unit (0=1/°F, 1=1/°C)
T1	[in]	Temperature of condition 1
T1_unit	[in]	Temperature of condition 1 unit (0=°F, 1=°C)
P1	[in]	Pressure of condition 1
P1_unit	[in]	Pressure of condition 1 unit (0=psi, 1=kPa, 2=bar)
rho1	[in]	Density at condition 1
rho1_unit	[in]	Density at condition 1 unit (0=kg/m ³ , 1=rel. dens., 2=deg. API)
T2	[in]	Temperature of condition 2
T2_unit	[in]	Temperature of condition 2 unit (0=°F, 1=°C)
P2	[in]	Pressure of condition 2
P2_unit	[in]	Pressure of condition 2 unit (0=psi, 1=kPa, 2=bar)
rho2	[out]	Density at condition 2
rho2_unit	[in]	Density at condition 2 unit (0=kg/m ³ , 1=rel. dens., 2=deg. API)
FP	[out]	Scaled compressibility factor (with respect to basecond)
FP_unit	[in]	Scaled compressibility factor unit (0=1/psi, 1=1/kPa, 2=1/bar)
CTL	[out]	Volume correction factor due to temperature (with respect to basecond)
CPL	[out]	Volume correction factor due to pressure (with respect to basecond)
CTPL	[out]	Combined volume correction factor due to temperature and pressure (with respect to basecond)
basecond	[out]	Condition that is used as base condition to calculate FP, CTL, CPL, CTPL (1 or 2)

Return value:

0	OK
1	Temperature out of range
2	Pressure out of range
3	rho60 out of range
4	alpha60 out of range
5	no convergence
6	density out of range

ASTM1250_regression

This function accepts measured density values and derives values of the density at 60°F and the thermal expansion factor at 60°F.

```
int ASTM1250_regression(double T[], int T_unit, double rho[], int rho_unit, int n, double *alpha60,
    int alpha60_unit, double *rho60, int rho60_unit)
```

Arguments:

T[]	[in]	Individual temperature values for which there is a density measurement
T_unit	[in]	Temperature unit of T[] (0=°F, 1=°C)
rho[]	[in]	Individual density measurement
rho_unit	[in]	Density unit of rho[] (0=kg/m ³ , 1=rel. den., 2=deg. API)
n	[in]	Number of measured density values
alpha60	[out]	Thermal expansion factor at 60°F
alpha60_unit	[in]	Unit of alpha60 (0=1/°F, 1=1/°C)
rho60	[out]	Density at 60°F
rho60_unit	[in]	Unit of rho60 (0=kg/m ³ , 1=rel. den., 2=deg. API)

Return value:

0	OK
1	Less than 10 measurements
2	Temperature range does not span 60°F

ASTM1250_round

This function rounds density, temperature, pressure, thermal expansion coefficient, and volume correction factor values. These rounding rules are needed to generate the final volume correction factor due to temperature and pressure and to generate the tables in printed tabular (historical) format. All input values must be rounded when generating the tables in historical format.

double ASTM1250_round(double x, double increment)

Arguments:

x	[in]	Density, temperature, pressure, thermal expansion coefficient or volume correction factor value.
increment	[in]	Rounding increment (see chapter 11.1.5.4 of ASTM D 1250-04 and IP 200/04)

Return value:

Rounded density, temperature, pressure, thermal expansion coefficient or volume correction factor value.

ASTM1250_ITS90_to_IPTS68

This function converts temperature from ITS-90 to IPTS-68 basis.

double ASTM1250_ITS90_to_IPTS68(double T, int unit)

Arguments:

T	[in]	ITS-90 temperature
unit	[in]	temperature unit (0=°F, 1=°C)

Return value:

IPTS-68 temperature