

ViscoAnalytic

DC-52

Kinematic Viscosity

Dynamic Viscosity

Observed Density

Base Density

Specific Gravity

Alternative Density

Advantages

- No pressure effect
- Insensitive to plant vibration
- Continuous real time measurement
- No remote electronics
- Self-cleaning
- Low/no maintenance
- Fast response
- Hazardous area installation

Applications

- Fuel oil/crude oil blending
- Pipeline interface detection
- Quench oil control
- Fuel oil heater control
- Oil and petrochemical
- Marine industry & Military
- General industries

**Correlation to
ASTM D445,
ISO 3104,
IP71**

**Calculated:
ASTM D341**

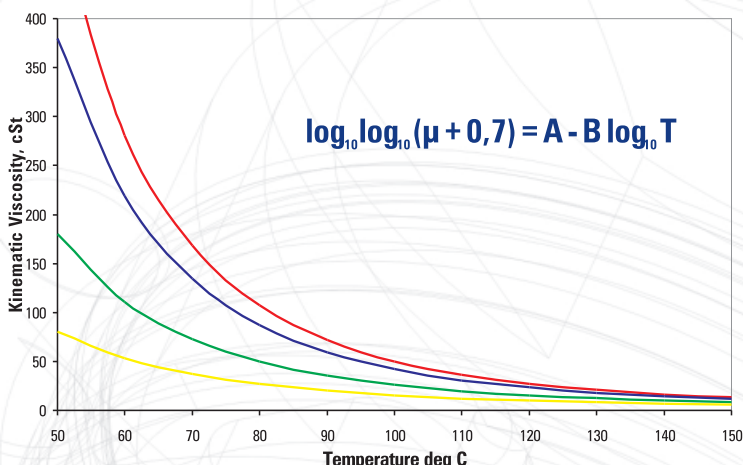
**Multi-Curve
Method**

**According to
ASTM D1250
Tables**

IN PROCESS TO EXCELLENCE

Viscosity temperature referral methods based on the ASTM D341 equation

Dual Viscometer Method



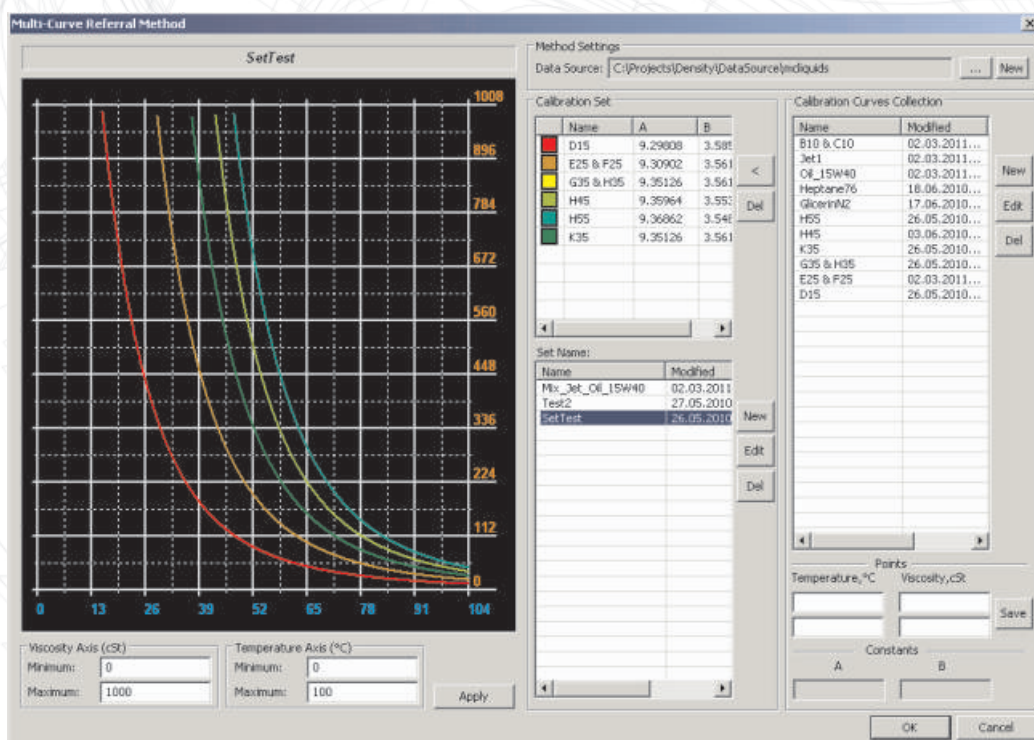
T: Temperature in °K

μ: Kinematic Viscosity in cSt

A & B: Coefficients specific to the fluid

Two viscometers are arranged in a series, separated by a heat exchanger in such way that they measure Viscosity at different temperatures compared to each other. These two measurements are used to calculate the values of A and B in the ASTM D341 equation. Using these values the Viscosity at any other temperature can be calculated.

Multi-Curve Method



Typical applications include:

- blending of heavy fuel oils in terminals,
- blending of heavy fuel oils on barges,
- fuel oil quality checking on barges and on board receiving ships,
- product interface detection e.g. in multi-product pipelines or in packaging plant.

Multi-Curve Method is the simplest indirect method for Viscosity calculation at base/reference temperature.

This method uses a single viscometer.

The sensor is programmed with a number of representative curves of Temperature vs Viscosity.

A ratio method is used to compare the measured Viscosity to the reference curve data at the observed temperature and from this ratio, to determine the Viscosity at the reference temperature.

Terminal Box

DM-Interface in the Terminal Box allows the sensors to act as standalone transmitters.

Built-in ASTM Tables converse observed values to base/relative density, etc.

Alternative Density

LEMIS process software allows ViscoAnalytic to find density at any user defined temperature. This is an alternative density.

Alternative density values are correlated according to the standard ASTM D1250 for petroleum products.

Principle of operation

A precision calibrated vibrating element process density and viscosity transmitter with an integral temperature sensor. The sensor is a tubular element fully immersed in the flow stream. It vibrates in hoop mode at the resonant frequency.

The sensor electronics employ sophisticated signal processing and computational algorithms to deliver high accuracy measurements. The sensor has a rugged design and is fully suited to the process environment with little or no need for service, maintenance or cleaning. The measurement is robust: the calibration is very stable over a long period of time and does not require re-calibration, under normal circumstances. Taken together these features result in a sensor with a long service life, a high on-stream factor and very low cost of ownership.

$$f = 1 / T$$

f - frequency

T - oscillation period

$$\rho = A + B \cdot T_R^2$$

ρ - density

A, B - calibration coefficients

T_R - resonator oscillation period

$$\mu = \eta / \rho$$

μ - kinematic viscosity

η - dynamic viscosity

ρ - density

$$\Delta T = T_2 - T_1$$

$1/\Delta T$ - bandwidth

T_1 - oscillation period at a point A

T_2 - oscillation period at a point B

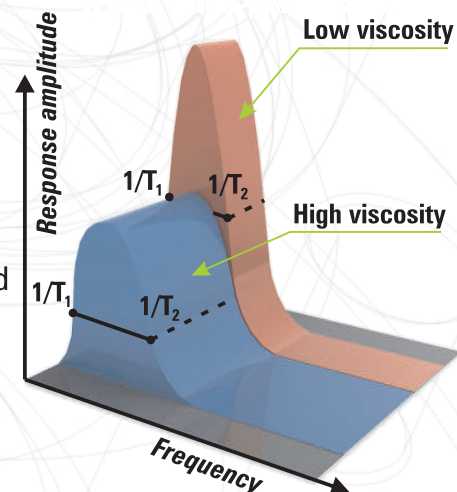
$$\eta = C + D(\Delta T/T_R)^2 + E(\Delta T/T_R)^4$$

η - dynamic viscosity

C, D, E - calibration coefficients

$1/\Delta T$ - bandwidth

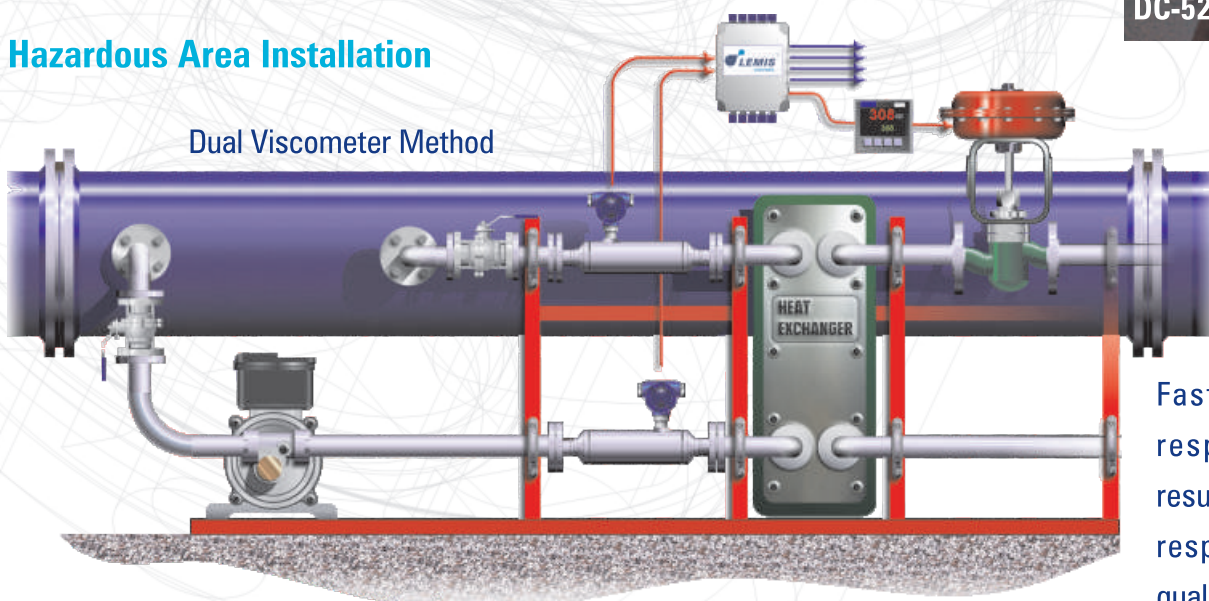
T_R - resonator oscillation period



DC-52 G-type Installation

Hazardous Area Installation

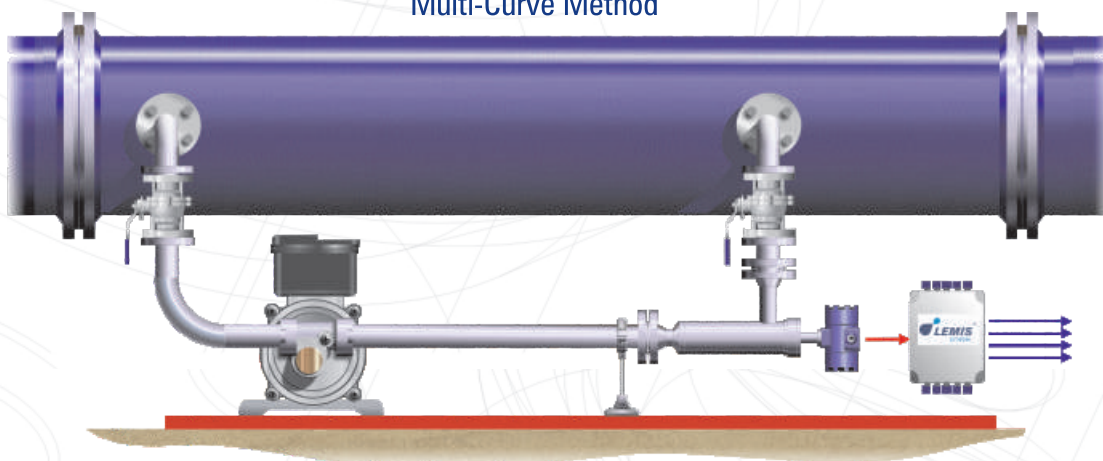
Dual Viscometer Method



Measure at the point of optimum process control

Fast loop flow & fast response measurement results in a fast control response allowing tight quality control

Multi-Curve Method



Low installation costs - no long heated sample loops to analyser houses

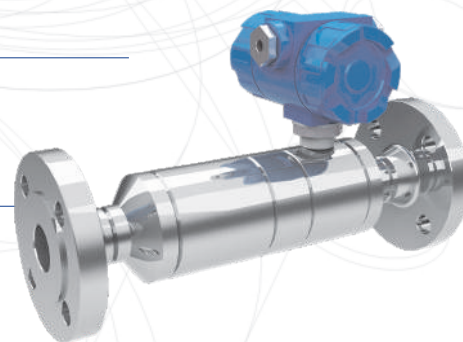
Flexible and multi-functional - multiple reference temperature calculations of density and kinematic viscosity

Specifications

Measuring range:

Density	0... 3 g/cm ³ (0... 3000 kg/m ³)
Density Standard	0.6... 1.2 g/cm ³ (600... 1200 kg/m ³)
Dynamic Viscosity	Up to 2000 mPa·s (up to 2000 cP)
Temperature	-200... +200°C (-328... +392°F)

DC-50 S-type



Accuracy:

Density	Up to ±0.00025 g/cm ³ (up to ±0.25 kg/m ³)
Dynamic Viscosity	±1% of span
Temperature	±0.2°C (±0.4°F)

Repeatability:

Density	Up to ±0.000125 g/cm ³ (up to ±0.125 kg/m ³)
Dynamic Viscosity	±0.5% of span
Temperature	±0.1°C (±0.2°F)

Resolution:

Density	0.0001 g/cm ³ (0.1 kg/m ³)
Dynamic Viscosity	0.1 mPa·s (0.1 cP)
Temperature	0.01°C (0.02°F)

DC-50 G-type



Process Connection

NPT 3/8", 1/2", 3/4", 1"
ANSI 1/2", 1", 2", 3", 4"
DN 10, 15, 25, 50, 80, 100

Operating Pressure

Up to 100 Bar (up to 1450 psi)

Supported Measuring Units

Real Density: g/cm³, kg/m³, lb/gal, lb/ft³; API; SG
Dynamic Viscosity: mPa·s, cP
Kinematic Viscosity: mm²/s, cSt
Referred Density: at 15°C, 20°C, 60°F; API60; SG60
Tables ASTM D1250
Alcohol Tables
Temperature in °C or °F

Ambient Temperature

-40... +85°C (-40... +185°F)

Weather Rating

IP68 for sensor and IP65 for other parts

Power voltage:

Device	110-230V AC (50-60 Hz) or 24V DC (16-28V DC)
Sensor	6-14V DC (30 mA)

Implosion Protection Marking

ATEX II 1/2G Ex ia IIB T4; **IECEX** Ex ia IIB T4 Ga /Gb; CCE

Digital Output

Standard: RS485, Modbus; user choice of signals and protocols

Analog Output

4-20 mA, up to 3 channels

Pressure Effect

No pressure effect

Temperature Compensation

Automatic

Viscosity Compensation

Automatic

Factory Calibration

Calibration certificates supplied as standard

For more information please visit www.lemis-process.com



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