

Model 0491 Viscometer

ATAC viscometers provide a complete solution for automatic analysis of petroleum process streams. The systems offer a choice of transmitters and capillary sizes and can analyse both Newtonian and non-Newtonian fluids. ATAC viscometers meet the requirements both in Processing Units for control of cut points or quality of blending components, and in Finished Products to meet quality specifications.

Model 491 wide bore Viscometer measures Dynamic Viscosity (cP) of petroleum products in correlation with ASTM D445/2170. The wide bore capillary enables the accurate viscosity measurement of non-Newtonian samples, for example residual fuels.

As well as Dynamic Viscosity, both analysers can provide the Kinematic Viscosity (cSt) if the sample density is also being measured or is known to be stable or assumed (as in ASTM D2170).

TYPICAL APPLICATIONS

- Lube oil blending
- Fuel oil blending
- Lube oil de-waxing
- Distillate fuel product specification
- Visbreaker feed stock
- Residual fuels (Model 491)

The Hagen-Poiseuille equation

$$\mu = 1.45 \times 10^5 \times d^4 P / QL$$

Where:

μ = absolute viscosity in centiPoise (cP)

d = capillary bore (mm)

P = differential pressure across capillary (bar)

Q = sample flow (ml/min)

L = capillary length (mm)

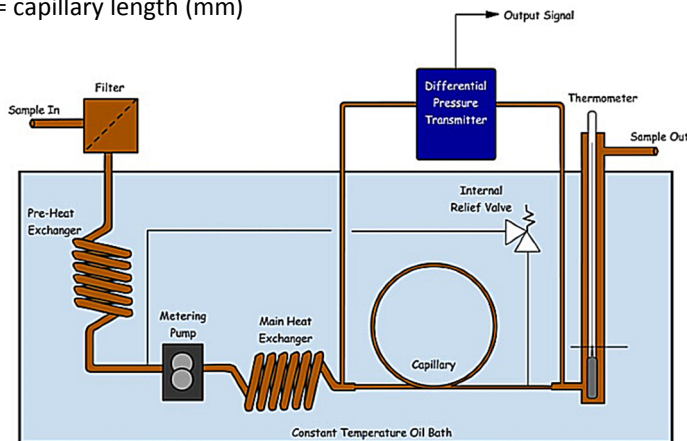


Figure 1: Model 0491 schematic



PRINCIPLE OF OPERATION

A schematic of the analyser is shown in figure 1.

Viscometers measure differential pressure across a capillary through which the sample fluid is passed.

The differential pressure is proportional to the absolute viscosity of the fluid as described by the Hagen-Poiseuille equation.

As d, Q and L are constants, the absolute viscosity (μ) is directly proportional to the differential pressure measured across capillary (P).



A precision pump meters sample flow and two heat exchangers, fitted either side of the metering pump, ensure the sample metered by the pump is at approximately the same temperature as sample entering the capillary.

Input pressure is set so that the metering pump suction pressure is always positive.

The sample flows at a constant rate through the capillary across which a differential pressure transmitter is connected.

The output of this pressure transmitter is directly proportional to the absolute viscosity of the sample. All critical components are maintained at a fixed temperature by immersion in an oil bath controlled by a precision temperature controller, heater and (when necessary) water cooling. The temperature is monitored by the relevant ASTM (IP) thermometer. The Model 1077 has the added convenience that the capillary is housed in an easily removable holder to enable cleaning or range changing without needing to lower the oil bath.

Specifications

Configuration	Single wide bore capillary	
Ranges	Minimum : 0-10cP - Maximum : 0-3500cP	
Repeatability	± 0.5% FS	
Precision	± 1% FS	
Response time	30 seconds to 3 minutes, depending on sample temperature	
Measurement temp.	Normally 40-150°C (100 -300°F) but 170°C is available (see options)	
Output signal	Range (depending on transmitter selected – see options) : 4-20 mA fully isolated, loop powered or digital output. Out-of-service alarm contact signalling mains failure (or off) or bath temperature fuse blown.	
Local display	0 - 100% linear scale on the transmitter	
Temperature bath capacity	22 litres of oil Use Shell Thermia B or equivalent oil. Normal maximum working temperature of bath is 170°C (protected by thermal fuse). Sample temperature at capillary outlet is measured by spirit-in-glass thermometer.	
Cooling water	When sample is at high temperature relative to measuring temperature or when measurement temperature is low with respect to ambient temperature, a supply of cool, potable water (9 - 45 l/h) should be provided to carry away excess heat. The necessary coil is fitted as standard. If potable water is not available, alternative cooling coil materials can be provided.	
Dimensions	Width 490 mm Depth 1075 mm Height 1270 mm Weight 230 kg	
Sample conditions required at inlet	Pressure: within range 0.7 - 21 bar g (10 - 305 psig) depending on viscosity of sample Temperature: must be within ±100°C (212°F) of the required measuring temperature Flow: 60.7 ml/min (0.8 gal/h) when power supply frequency is 50 Hz and 72.8 ml/min (0.9 gal/h) at 60 Hz	
Power supply	Voltage: 115V or 230V ±10% Frequency 50 or 60 Hz Consumption: single phase 1.5 kVA or 2.0 kVA depending on specified measurement temperature	
Connections	Sample:	1/4" NPT (female) inlet, 3/8" NPT (female) outlet
	Cooling water	1/4" NPT (female) inlet, 1/4" NPT (female) outlet
	Electrical	M25 (power), M20 (alarm)
	Signal out	M20
	Steam tracing	Model 1077 - steam at low pressure (1 bar max) required for samples having pour point above lowest ambient temperature. Connection is 1/4" o.d. compression. (see options)
Explosion Protection	ATEX certified for use in Zone 1 areas  II 2G EEx d e ia IIB T3-T4* (*Dependant on model) Certificate no. ITS09ATEX1654X  II 2G EEx d e ia IIB+H ₂ T3-T4* (*Dependant on model) Certificate no. ITS09ATEX1655X	
Options	Local digital display / transmission of controlled bath temperature Bath temperature (standard up to 110°C) up to 170°C Environmental protection to IP65 ATEX IIB + H ₂ certification Choice of pressure transmitter manufacturer; Emerson Rosemount / Honeywell / Foxboro / Yokogawa Metric adaptors for end user connection if required Steam tracing for Model 1077 (if required – see connections) Provision for secondary fast loop (for improved response times)	