

## Crude oil measurement with MINIVAP according to D6377-10

---

The inter laboratory study (Round Robin) in 2003 was made to assess accuracy of crude oil measurements for VP measurements at 37.8°C at V/L = 4:1 and V/L = 0.02:1. In the following section only the V/L = 4:1 measurements are considered. The precision statement shows almost no difference in precision, when crude oil is measured without the use of a pressurized floating piston cylinder (FPC) for sample introduction.

But there is an important difference in the readings which indicates that not using a FPC severely affects results, as crude oils have lost light ends when introduced from bottles. Crude oil that contains little to no volatiles does not show this big difference.

In the following section repeatability and reproducibility are highlighted and some measurements on the same sample, with and without using an FPC will clarify this relation between light ends and crude oil. It is also important to know that D6377 is more accurate than D323, independent of the fact, whether an FPC was used or not.

The results of the Round Robin for ASTM D6377 show the following precision:

### 1) D6377 measurements with using a floating piston cylinder

VP measurement at 37.8 °C at V/L = 4:1

$$r = 2.48 \text{ kPa}$$

$$R = 4.26 \text{ kPa}$$

### 2) D6377 measurements filled via tube from the bottle

VP measurement at 37.8 °C at V/L = 4:1

$$r = 2.29 \text{ kPa}$$

$$R = 5.26 \text{ kPa}$$

### 3) D323 measurements

VP measurement at 37.8 °C at V/L = 4:1

$$R = 9.0 \text{ kPa}$$

Although the repeatability between bottle and FPC measurements looks equal, measurements according to D6377 reveal drastic differences, when filling with FPC is compared to filling via Bottle. With bottle filling the light ends are lost prior to measurement. The following example shows the drastically lower values, that result from bottle filling:

FPC filling; D6377 measurement at V/L = 4:1 and 37,8°C; RVPE = 0,834*VPCR4 (pressurized crude)												
FPC	Crude #1		Crude #2		Crude #3		Crude #4		Crude #5		Crude #6	
V/L	VPCR [kPa]	RVPE [kPa]	VPCR [kPa]	RVPE [kPa]	VPCR [kPa]	RVPE [kPa]	VPCR [kPa]	RVPE [kPa]	VPCR [kPa]	RVPE [kPa]	VPCR [kPa]	RVPE [kPa]
4:1	116,9	97,5	41,9	34,9	59,5	49,6	49,2	41,0	72,0	60,0	72,9	60,8
4:1	116,3	97,0	41,4	34,5	59,5	49,6	50,0	41,7	74,3	62,0	73,4	61,2

Bottle filling; D6377 measurement at V/L = 4:1 and 37,8°C; RVPE = 0,915*VPCR4 (non-pressurized crude)												
Bottles	Crude #1		Crude #2		Crude #3		Crude #4		Crude #5		Crude #6	
V/L	VPCR [kPa]	RVPE [kPa]	VPCR [kPa]	RVPE [kPa]	VPCR [kPa]	RVPE [kPa]	VPCR [kPa]	RVPE [kPa]	VPCR [kPa]	RVPE [kPa]	VPCR [kPa]	RVPE [kPa]
4:1	104,9	96,0	34,8	31,8	48,5	44,4	39,4	36,1	71,6	65,5	70,6	64,6
4:1	104,7	95,8	34,9	31,9	48,6	44,5	42,1	38,5	74,2	67,9	70,2	64,2

Includes volatile components

No volatile components

	Crude #1		Crude #2		Crude #3		Crude #4		Crude #5		Crude #6	
V/L 4:1	VPCR [kPa]	RVPE [kPa]	VPCR [kPa]	RVPE [kPa]	VPCR [kPa]	RVPE [kPa]	VPCR [kPa]	RVPE [kPa]	VPCR [kPa]	RVPE [kPa]	VPCR [kPa]	RVPE [kPa]
∅ FPC	116,6	97,2	41,7	34,7	59,5	49,6	49,6	41,4	73,2	61,0	73,2	61,0
∅ Bottle	104,8	95,5	34,9	31,9	48,6	44,4	40,8	37,3	72,9	66,7	70,4	64,4
Delta	-11,8 kPa		-6,8 kPa		-11,0 kPa		-8,9 kPa		-0,3 kPa		-2,8 kPa	
Diff.	11,3 %		19,5 %		22,6 %		21,7 %		0,3 %		3,9 %	

Includes volatile components

No volatile components

For crude oil containing volatiles, the difference in vapour pressure readings between measurements with the FPC and measurements with a simple bottle is around 10 kPa (or up to 20%).

For crude oil containing little to no volatiles the difference is by far smaller.

It is therefore highly recommended to use a floating piston cylinder for crude oil measurements. Otherwise the results might be repeatable, but not accurate enough.