Technical Specifications

Principle of operation

The most known and established methods within the laboratory and online process world as of today are the ASTM D5191, D6377 and D6897 (expansion methods).

The fundamentals of thermodynamics and physics are the basis of these relevant ASTM methods, which are used to determine the total vapor pressure (Ptot) of a given sample. The most important terminology defined within the ASTM methods are i) absolute vapor pressure (Pabs), ii) total vapor pressure (Ptot), iii) partial pressures of gas (Pgas).

(Eq. 1) $$Ptot = Pabs + Pgas$$

The ASTM D5191 is the most reliable and widely accepted master ASTM method worldwide and the reasons as to why that is, are to be evaluated within this article. The predecessor of the ASTM D5191 was the so-called dry method but the procedure and apparatus defined by the corresponding ASTM D4953 were not suitable for implementation into the online process world. In fact it was concluded by interlaboratory studies (1988, 1991, 2003 and 2008) that the ASTM D5191 method is more precise and beyond that perfectly suitable for process implementations with a cycle time of approximately 7 minutes.

The so-called single expansion method ASTM D5191 (mini method) is used to determine the total vapor pressure of volatile liquids such as gasoline and gasoline-oxygenate blends which are regulated by various government agencies. After introducing a known volume of chilled sample into the evacuated test chamber a piston expands the volume establishing a vapor to liquid ratio of 4:1 at a constant temperature of 37.8°C (100°F). The test method procedure leads to the detection of the Ptot, which is by definition the sum of the partial pressure of the sample and the sum of the partial pressures of the gas (Pgas). The Dry Vapor Pressure Equivalent (DVPE) according to ASTM D4953 can be calculated once Ptot has been determined by a correlation equation (refer to section 14.2 of ASTM D5191 method).

Another established master method is the above-mentioned ASTM D6377 which also defines the single piston expansion method to determine the vapor pressure exerted in vacuum specifically for crude oils. The key differentiation between the ASTM D6377 and D5191 lies within the variety settings for the temperature (from 0°C to 100°C) and ratio (from 4:1 to 0.02:1). However, the ASTM D6377 and ASTM D5191 are very closely related regarding apparatus and procedure and in fact the determined Ptot in the test method ASTM D5191 is equivalent to the vapor pressure of crude oil at 4:1 vapor liquid ratio (VPCR4) at measurement temperature of 37.8°C used in the ASTM D6377.

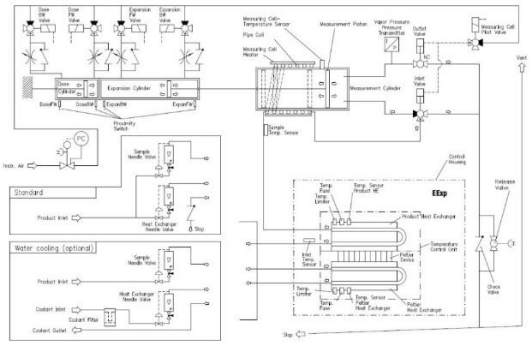

Figure 1: Flow schematic and principle of operation RVP-4

Model:	RVP-4.1 Reid Vapour Pressure Analyser shown with Closed Loop Chiller 
Tag No:	CPT-AIT-27002
Operation:	Process Stream 1 Crude Oil Validation Stream 2: Hexane or Pentane (option)
Manufacture:	Bartec-Benke GmbH
Area Classification:	ATEX approved for Zone 1 Hazardous Area (II 2 G Ex h IIC T4 Gb X) (Certification Concept Exp / I.S / Exe)
Measuring Principle:	Expansion Piston. Typical Cycle Time 5 to 7min
Measurement Standard:	ASTM D323, D5191, D4953, D6377, D5482, D5190, D1267, D6897 D6377
Analyser Features:	19" TFT colour Display with Touch Screen Functionality. Industrial PC with windows 10 embedded operating system. Integrated failure diagnostic and self-monitoring. Wide range of inlet temperatures. Low Sample consumption Low maintenance. Automatic or Manual Validation available. No Piston Lubrication required. No flames arrester required on sample inlet & outlet lines to analyser.
Accuracy:	Repeatability & Reproducibility According to or better than DIN EN/ASTM standards. (Typically, 0.1% FS).
Measuring Temperature:	37.8°C (100°F) Adjustable
Measuring Range:	RVP: 0 to 1.6 bara
Expected Value:	RVP: Typically, 0.7 bar(a) psia
Analyser Output:	1 x 4-20mA non-isolated active output. (RVP) Other Options Modbus/RTU via RS485 or Ethernet TCP/IP on request
Alarm Outputs:	Volt free contacts
Electrical Supply:	Analyser Nominal Voltage 230 Vac ±10% 50/60Hz 500 watts Closed Loop Chiller Nominal Voltage 400 Vac 3ph +N+E 50/60Hz
Ambient:	+5°C to +40°C
Protection Class:	IP54 (NEMA 13) indoor installation
Sample Requirements:	
Inlet Temperature:	5 to 45°C
Inlet Pressure:	2 to 8 bars (29 to 72.5psi) Min 2 bar above expected VP
Sample Flow Rate:	5 to 10 Ltrs/hr @ sample inlet & water content ≤ 500ppm
Sample Filtered	10µ
Sample Temperature Changes	Max 0.2°C/min
Sample Drain/Vent:	Atmospheric.
Instrument Air:	5 to 7 bars (75 to 102psi)
Coolant:	5 to 50°C +/- 1°C per min (Optional Bartec-Benke closed loop chiller)
Inlet Pressure	200-700 kPa
Flow Rate	5 to 40 Ltrs/hr
Filtered	50µ
Other Utilities Requirements:	Please refer to Analyser Data Sheet for further information

Deviations and General Comments

1. All quoted analyzers and systems are IP 54 and suitable for installation and operation in ATEX Zone 1 areas. . **(Please note that it's the Purge Vent Exit which downgrades the analyser to IP54)**

2. All goods will be subject to our normal in-house testing and quality assurance procedures during design and manufacture. These procedures include the following:

   Visual inspection for compliance with approved drawings
   Pressure and leak testing of all tubing (sample and auxiliary systems)

3. All physical property analyzers will undergo a "wet FAT" with sample and corresponding test runs. Please note samples can be provided by customer or BARTEC BENKE will select suitable sample

4. For number of mA inputs / outputs and digital inputs / outputs for the physical property analyzers please see the individual data sheets and / or the statements given in the individual positions of the proposal.

5. Please note that the offered closed loop chiller requires a power feeder with three (3) phases. One (1) phase power supply is sufficient for analyzer but not for chiller. This needs to be considered in conjunction with the existing power distribution at the analyzer shelter and required utilities onsite.

6. The samples for the physical property analyzers must be in a certain temperature range to meet the specifications. Therefore, Closed Loop Chillers are foreseen where they are necessary.

7. It would not be possible to use the sample as the cooling media, because sample pressure is too high, and if you were to reduce the same pressure it would be very close to the Vapour Pressure Result, and you could have a mixture of vapour and liquid which is not acceptable.

8. The process analyzers must be installed inside of analyzer shelters. Ambient temperature of equipment shall not exceed +5°C to 40 °C, maximum allowed humidity is 80 % (non-condensing). The analyzers are suitable for installation in Zone 1 and certified according to ATEX regulations (2014/14/EU).

9. The Analyser is ATEX approved, but only (II 2 G Ex h IIC T4 Gb X)y

10. Sample system is offered as option.

11. Maximum Sample inlet temperature to analyser 45 °C

12. Compliance to NACE MR-0175 is not applicable for the analyzer

13. Positive Alloy material identification is not applicable for the analyzer

14. Due to the nature of the electronic components used within the analyser Computer, various modules etc., it not possible to topicalization of these components.

15. Bartec-Benke Standard Paint specification will be used