# eralytics' new TVS TM - Temperature Verification Sensor for ASTM D5191 testing


## Introduction

Picture 1: TVS™ - D5191

Several standard methods (ASTM D5191 [1], D5188 [2] and equivalents, etc.) require the sample to be air saturated and cooled down to 0°C – 1°C. Because the solubility of air in solvents follows Henry's law and highly depends on the solvent's temperature, proper cooling is essential. If not performed accordingly, the measured vapor pressure will be lower than expected, in extreme cases the result can be outside the stated tolerance limits. This fact poses several different problems:

- Unnecessary recalibrations, if low QC vapor pressure readings are misinterpreted as instrument drift.
- For gasoline blending applications the bias can reach up to **3 kPa (0.44 psi)**, leaving a dangerous uncertainty whether the allowed upper pressure limit is exceeded.
- Generally, the reproducibility will be worse, making it difficult to compare the results obtained throughout the entire process chain.

These issues will eventually be responsible for an **increased expense of time and money.**

eralytics' new **TVS™ – ASTM D5191 Temperature Verification Sensor** (patent pending) allows monitoring the sample temperature directly in the sample container, thus featuring an immediate check of the sample preparation even before the actual measurement, offering a neat solution for these challenges.

## Experimental

n-pentane serves as a reference material for many methods, measured according to ASTM D5191 a total vapor pressure of **112.8 ± 1.2 kPa (16.36 ± 0.17 psi)** is expected, assuming that the sample preparation has been properly performed.

To reflect this importance, the total vapor pressure (Ptot) of n-pentane and a gasoline sample was determined with the sample preparation done at different temperature levels. The respective sample was cooled to the target temperature in a cooling bath and air saturated according to ASTM D5191. Upon setting the parameters on ERAVAP, the sample was taken out of the bath, the temperature verification sensor **TVS™** was introduced into the sample container and the measurement was immediately started.

n-pentane and Gasoline were measured 3x at each temperature level, beginning at 0°C (32°F) and increasing the sample temperature in 5°C steps up to 25°C (77°F). The total vapor pressure and the sample temperature was then recorded.

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## Results

The obtained values of Ptot are displayed in Figure 1 & Figure 2:

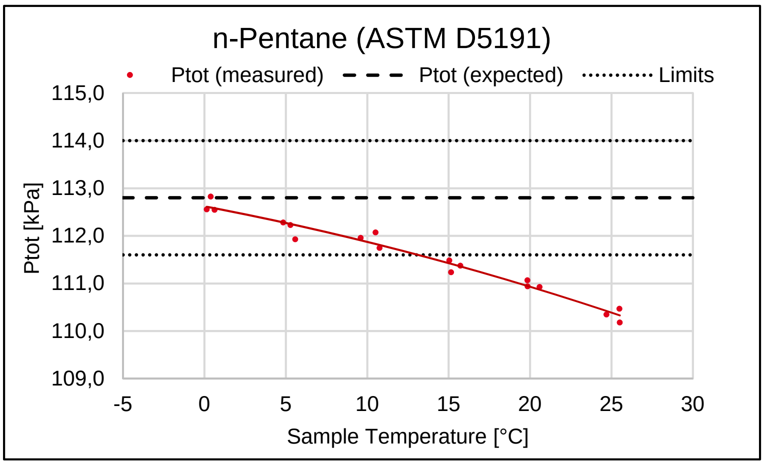

Figure 1: Ptot of n-pentane, measured according to ASTM D5191

Clearly visible in Figure 1, the resulting total vapor pressure decreases at elevated sample temperature values. If measured with a sample preparation thoroughly conducted at 0°C the expected value of **112.8 kPa (16.36 psi)** is perfectly reached. Whereas at a critical limit of the sample temperature at approximately 12°C the measured vapor pressure drops below the lower tolerance limit of **111.6 kPa (16.19 psi)** for n-pentane.

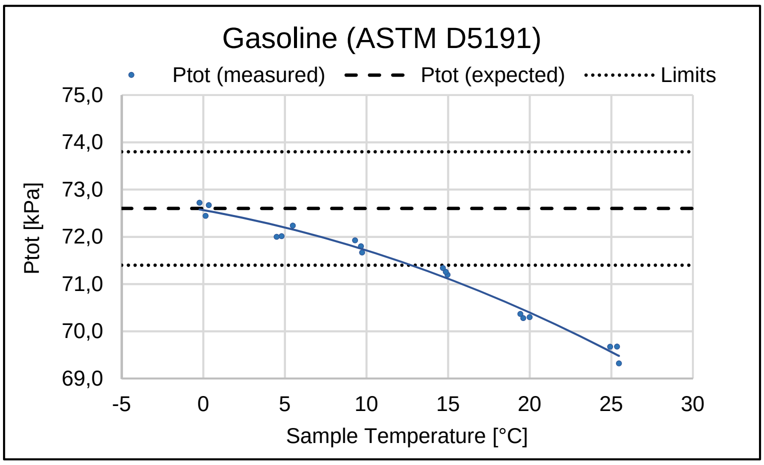

Figure 2: Ptot of gasoline, measured according to ASTM D5191

As for gasoline, the sample temperature dependent drop of the measured total vapor pressure is even bigger (Figure 2). When reaching ambient temperature, representing no cooling at all during sample preparation, the difference compared to the sample preparation done at 0°C causes a **3 kPa (0.44 psi) decrease** of the measured Ptot. This deviation is approximately 10 times the repeatability of the measurements.

## Conclusion

eralytics' new **TVS$^{TM}$** for ERAVAP allows monitoring the temperature directly in the sample container. The measured sample temperature is stored in the result files for later review. By specifying upper (and lower) temperature limits an automatic warning can be triggered if the sample temperature does not match the requirements, making the **TVS$^{TM}$** a perfect tool to improve quality control in your testing lab.

## References

1. Standard Test Method for Vapor Pressure of Petroleum Products (Mini Method)
   **ASTM D5191 – 15**
2. Standard Test Method for Vapor-Liquid Ratio Temperature Determination of Fuels (Evacuated Chamber and Piston Based Method)
   **ASTM D5188 – 16**