“Vapor Pressure Measurement Of Gasoline, Crude Oil & LPG With New ASTM D5191 & D5188 Speed Test”

Philipp Jordan
Welcome to a new era of petroleum testing

PERFORMANCE YOU CAN RELY ON

eralytics™ GmbH

www.eralytics.com
Profile

- Development
- Production
- Sales
- After-Sales Service

of innovative, reliable and easy to operate petroleum testing equipment.
Experience you can rely on

- Eralytics founded in May 2007 by 4 industry insiders
- Several hundred installations in > 50 countries
- World-wide sales & service network – North America: COMPASS INSTRUMENTS
Mission

Add value for our customers by enhancing their ability to perform reliable measurements with

- highest precision
- maximum speed
- easiest operation
Quality you can rely on

- eralytics is ISO 9001:2008 certified since Jan 2008
- ISO 9001:2008 certificate from DET NORSKE VERITAS
Product range

- **ERAVAP** - vapor pressure tester of gasoline, crude oil & LPG
- **ERASPEC** - mid-FTIR fuel analyzer for gasoline, diesel, FAME & jet fuel
- **ERACHECK** - hydrocarbons in water tester
ERAVAP

Vapor pressure measurement at its best

• Vapor pressure measurement of
  Gasoline
  LPG
  Crude oil
  Jet fuel
  Chemicals

• V/L ratio measurement of
  Gasoline
Old Methods & Equipments – REID Bomb

ASTM D 323, EN 12 (wet REID)
ASTM D 4953 (dry REID)

Problems of these manual methods:

- poor precision
- slow measurement (> 25 minutes)
- 100 ml sample volume
ERAVAP
New and Modern Technique

Piston based system

1. temperature sensor
2. insulation
3. outlet valve
4. waste container
5. manifold
6. sample
7. inlet valve
8. measuring cell
9. piston with pressure sensor
Dry Vapor Pressure Equivalent: DVPE  
(still often called RVP)

**ERAVAP**  
Mini Method

ASTM D5191  
EN13016-1  
IP394

…correlation to ASTM D4953  
-> sample preparation necessary  
(cooling and air saturation)
ERAVAP
Mini Method

ASTM D5191
EN13016-1
IP394

4mL vapor -> Ptot

1mL sample -> <- sample must be cooled and air saturated prior to injection

DVPE = 0.965xPtot – 3.78kPa
(Correlation formula to DVP (ASTM D4953))
ERAVAP
Triple Expansion Method

Measurement of **absolute vapor pressure** by determination of dissolved gas (air) in the liquid.

**ASTM D6378**

- no sample preparation (cooling and air saturation)

…correlation to ASTM D5191
ERA VAP
Triple Expansion Method

ASTM D6378:

1. expansion

filling 1mL

2. expansion

v1

v2

v3

p2

p3

dissolved air

sample

sample

sample
ERAVAP
Current & Future Method – Triple Expansion

ASTM D6378:

\[
\begin{align*}
    p_1 &= p_{\text{liquid}} + p_{\text{gas1}} \\
    p_2 &= p_{\text{liquid}} + p_{\text{gas2}} \\
    p_3 &= p_{\text{liquid}} + p_{\text{gas3}} \\
\end{align*}
\]

Gas law: \( p \times v = \text{constant} \)

\[
\begin{align*}
    p_{\text{gas1}} \times (v_1 + v_{\text{gas}}) &= p_{\text{gas2}} \times (v_2 + v_{\text{gas}}) = p_{\text{gas3}} \times (v_3 + v_{\text{gas}}) \\
\end{align*}
\]

-> solve the formula to determine \( P_{\text{gas3}} \)

-> \( P_{\text{abs}} = P_3 - P_{\text{gas3}} \)  \( P_{\text{abs}} = \) absolute vapor pressure of the liquid

-> no sample preparation necessary (cooling and air saturation)

…correlation to ASTM D5191: \( DVPE = P_{\text{abs}} - 1.005\text{kPa} \)
ERAVAP
Measures according to all important standard methods

- ASTM  North America Standardization
- EN    Europe Standardization
- EI     British Energy Institute
- GOST  Russian Standardization
- JIS    Japanese Standardization
- SHT   Chinese Standardization
ERAVAP

Excellent precision for all important VP methods

- ASTM D 5191 / DVPE of gasoline
- ASTM D 6378 / DVPE of gasoline
  (correlation to D 323 & D 4953)
- ASTM D 5188 / V/L ratio of gasoline
- ASTM D 6377 / VP of crude oil
- ASTM D 6897 / VP of LPG (ERAVAP\textsuperscript{LPG})
  (correlation to D1267)

=> mostly used by Refiners, Pipeline Operators, Independent labs, Crude and LPG production, Automotive industry, R&D labs etc.
ERAVAP
High Speed Testing with max. Precision

D5191 & D5188 Speed Test

VP of gasoline
+ T(V/L=20) of gasoline
at the push-of-a-button

→ Both results are displayed and stored under the same sample ID!
ERAVAP
Excellent precision for all important VP methods

• ASTM D 6378 Curve / Pabs of fuel
tendency of a substance to evaporate over a certain temperature range

• ASTM D 5188 Curve
Temperature tendency of an air saturated substance to stay at atmospheric pressure with varying V/L ratio.

=> mostly used in automotive industry and R&D labs
ERAVAP

Easiest Operation

1. Select the standard method

Select by the touch screen the standard method
2. Connect the sample
   Put the tube into the sample bottle
ERAVAP
Easiest Operation

3. Press Run
   The measurement is automatically performed and the result is displayed within 5 minutes
ERAVAP
Easiest Operation

4. Result

Results can be transferred to
LIMS
Network drive,
RCS software,
Printer,
Memory stick

Save to memstick: /results/eravap/EV0138720/
ERA VAP
performance you can rely on

Easy and safe operation:
→ no skills necessary
→ everybody can be trained in 1 minute

Fully automated instrument:
→ no operator bias
→ results in 5 minutes
ERAVAP

- **Password security**
  - For advanced and untrained users
  - 6 user levels for individual instrument access
  - Password protection
ERAVAP
performance you can rely on

- Temperature range
  (stability: 0.02 °C):
  User programmable
  0-120°C (32-250°F)
  No external cooling!
- Pressure range
  (resolution: 0.1 kPa):
  0-1000 kPa (0-145 psi)
ERAVAP LPG
Vapor pressure measurement at its best

- Vapor pressure of LPG
- **Extended pressure range:** 0 - 2000 kPa (0 - 290 psi) (resolution: 0.1 kPa)
- ASTM D 6897 / VP of LPG (excellent correlation to ASTM D 1267)
ERAVAP
performance you can rely on

- Measuring time: 5 min
- Precision:
  Repeatability: $r = 0.3 \text{ kPa}$
  Reproducibility: $R = 0.7 \text{ kPa}$
  (2,2-DMB @ VP = 70 kPa)
- Cleaning: automatic flushing, cleaning by next sample
ERAVAP Features

- Maintenance free
  - Automated oiling system for the piston
  - High precision piston drive with self lubricating slide
  - Rugged solenoid valves
  - Only inlet filters to be changed when very dirty samples are measured
ERAVAP
performance you can rely on

Latest technology for reliable operation:

- Industrial PC
- Linux system
- Universal input power supply (85-264V)
  => No influence of voltage fluctuations
ERAVAP

- Multiple connections for easy data management

USB, Ethernet and RS232 connection for printer, computer, barcode reader, mouse, keyboard, LAN, and LIMS
ERAVAP
Maintenance and Service Features

• Fast and easy calibration
  no disassembling to calibrate
temperature and pressure sensors
ERAVAP
Maintenance and Service Features

• Substance calibration at site
  fast and easy calibration for emergency with pure substances

• Calibration History tracking
  regain factory calibration or previous calibration

• Remote Service via internet
  Instrument access via internet by eralytics or your local dealer for fastest service
ERAVAP
Features

• QC Mode: ASTM D6299
  Statistical Quality Assurance and Graphical Control Charting

- For each standard method up to 8 QC samples or fuels

- ASTM D6299 used by Exxon Mobile, Shell, Chevron, Marathon etc.
ERAVAP
Features

- **QC Mode: ASTM D6299**
  - Result List
  - Individual results can be excluded from the statistics
ERAVAP
Features

• QC Mode: ASTM D6299
  - Mean Value
  - Sigma
  - Moving Range
  - Mean Moving Range
  - Site Precision
  - Detailed point information
  - Graph
ERAVAP
Features

• QC Mode: ASTM D6299
  - Warning Levels from 1 to 3 Sigma
  - Automatic warning by the instrument when test is out of range
ERAVAP

- ERASOFT RCS PC software
  - Remote control (several analyzers)
  - Data transfer
  - Result view, print, storage
ERAVAP

- Free Software upgrade: simply with USB stick or Erasoft RCS
ERAVAP
Performance you can rely on

Auto Sampler
10 Positions (option)

• Full automation
• Freely programmable
• Directly attached to the instrument – portable!
• Automatic sample introduction via 10 inlet tubes or via gas-tight syringes
ERAVAP

Portable & Rugged

- Small footprint
- Light weight (7 kg)
- Metal Housing

→ The perfect solution for mobile testing!
ERAVAP
Proven performance

International users include:

as well as:

US Army, Shell, Chevron, Total, Suncor, Buckeye Pipeline, Magellan Pipeline, Statoil, Sinopec, etc.
ERAVAP
Proven performance

US Army / TACOM
After intensive lab and field tests we decided that ERAVAP is the new standard instrument for measuring vapor pressure in all US Army field labs.

Mr. James Doherty
Jim.Doherty@us.army.mil
ERAVAP
Proven performance

Esso Refinery Rotterdam:

During more than 6 weeks we tested Eralytics ERAVAP against Herzogs HVP972 and Grabners MINIVAP VPSH. Many samples were measured every day by different operators.

After this intensive comparison program we were convinced about the superior performance and ease of operation of ERAVAP and purchased this instrument.
ERAVAP
Proven performance

Marathon Petroleum Research Lab:

‘We ran duplicates on ERAVAP from Eralytics vs. MINIVAP VPS from AMETEK/Grabner Instruments and are very satisfied that the ERAVAP gives equivalent results. From now on ERAVAP is the new standard instrument for measuring vapor pressure in all Marathon Petroleum laboratories.’

David P. Wesley
dpwesley@marathonpetroleum.com
(Comparison tests made in September 2007)
Welcome to a new era of petroleum testing

THANK YOU!

eralytics™ GmbH
Performance you can rely on.

www.eralytics.com