# FINGERPRINT ANALYSIS BY CAPILLARY GAS CHROMATOGRAPHY
## On Stock Tank Oil from atmospheric flash of sample in cylinder # L - 375

| Component | | Mol % |
|---|---|---|
| Hexanes minus | C6- | 0.00 |
| Hexanes | C6 | 1.32 |
| Heptanes | C7 | 10.05 |
| Octanes | C8 | 9.26 |
| Nonanes | C9 | 29.72 |
| Decanes | C10 | 15.15 |
| Undecanes | C11 | 22.31 |
| Dodecanes | C12 | 8.58 |
| Tridecanes | C13 | 2.54 |
| Tetradecanes | C14 | 0.50 |
| Pentadecanes | C15 | 0.15 |
| Hexadecanes | C16 | 0.11 |
| Heptadecanes | C17 | 0.06 |
| Octadecanes | C18 | 0.09 |
| Nonadecanes | C19 | 0.07 |
| Eicosanes | C20 | 0.05 |
| Heneicosanes | C21 | 0.04 |
| Docosanes | C22 | 0.00 |
| Tricosanes | C23 | 0.00 |
| Tetracosanes | C24 | 0.00 |
| Pentacosanes | C25 | 0.00 |
| Hexacosanes | C26 | 0.00 |
| Heptacosanes | C27 | 0.00 |
| Octacosanes | C28 | 0.00 |
| Nonacosanes | C29 | 0.00 |
| Triacontanes | C30 | 0.00 |
| Hentriacontanes | C31 | 0.00 |
| Dotriacontanes | C32 | 0.00 |
| Tritriacontanes | C33 | 0.00 |
| Tetratriacontanes | C34 | 0.00 |
| Pentatriacontanes Plus | C35+ | 0.00 |
| TOTAL | | 100.00 |

| | |
|---|---|
| Molecular Weight Calculated * : | 131.0 |
| Density @ 60 °F Calculated * : | 0.7730 |

*Calculation based on generalized properties as published by Katz and Firoozabadi

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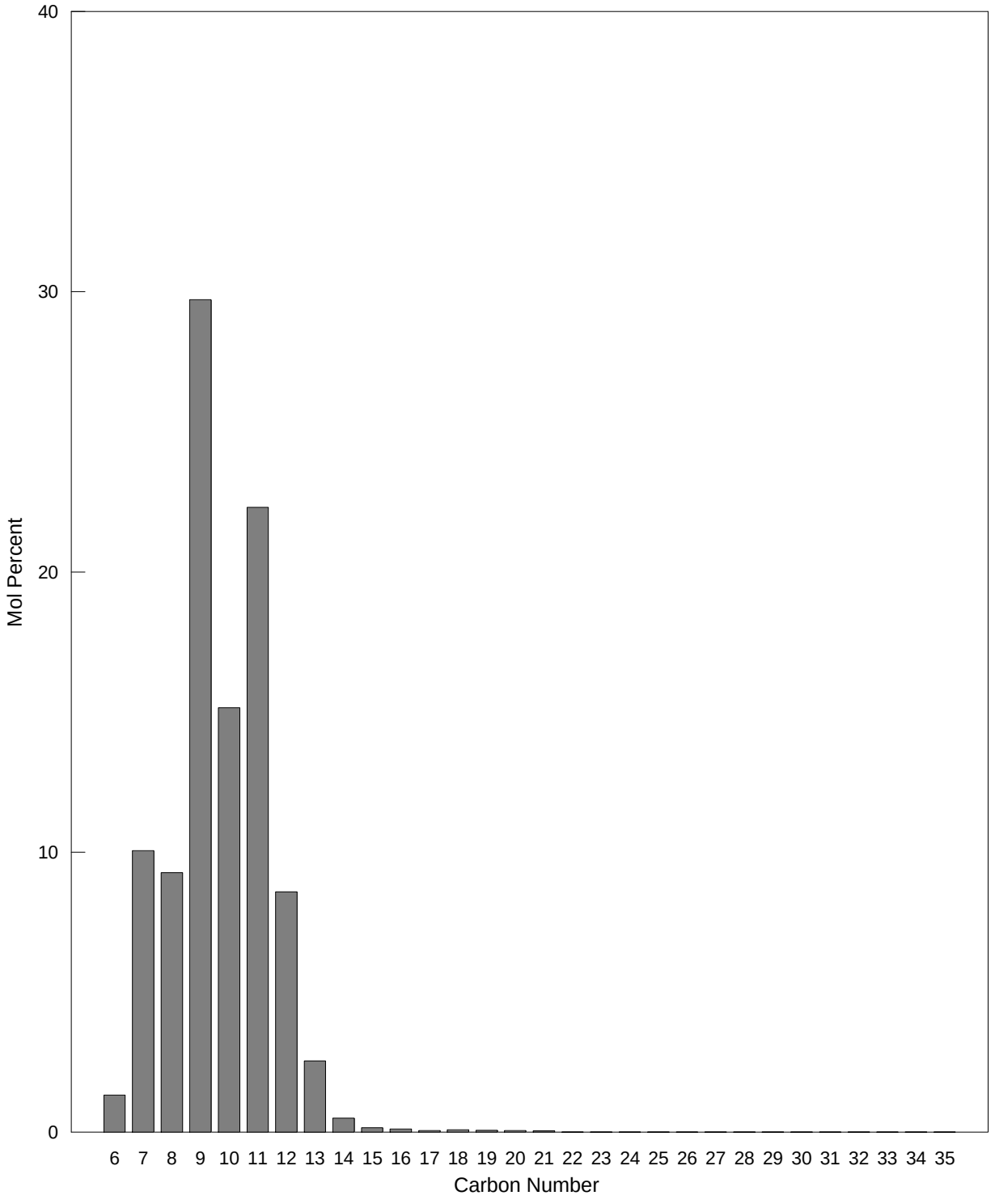
On Stock Tank Oil from atmospheric flash of sample in cylinder # L - 375



## Compositional Analysis of MDT (position # 4) Bottom Hole Gas Reservoir Fluid in Cylinder # L-375

| Component | | Stock Tank Liquid Mol % | Stock Tank Gas Mol % | Reservoir Fluid Mol % |
|---|---|---|---|---|
| Hydrogen Sulphide | H2S | 0.00 | 0.00 | 0.00 |
| Carbon Dioxide | CO2 | 0.01 | 0.66 | 0.66 |
| Nitrogen | N2 | 0.00 | 3.15 | 3.15 |
| Methane | C1 | 0.57 | 93.75 | 93.67 |
| Ethane | C2 | 0.06 | 1.50 | 1.50 |
| Propane | C3 | 0.06 | 0.43 | 0.43 |
| Iso-Butane | iC4 | 0.05 | 0.13 | 0.13 |
| N-Butane | nC4 | 0.07 | 0.13 | 0.13 |
| Iso-Pentane | iC5 | 0.06 | 0.04 | 0.04 |
| N-Pentane | nC5 | 0.06 | 0.03 | 0.03 |
| Hexanes | C6 | 1.31 | 0.05 | 0.05 |
| Heptanes | C7 | 9.96 | 0.08 | 0.09 |
| Octanes | C8 | 9.17 | 0.02 | 0.03 |
| Nonanes | C9 | 29.44 | 0.01 | 0.03 |
| Decanes | C10 | 15.01 | 0.01 | 0.02 |
| Undecanes | C11 | 22.10 | 0.01 | 0.03 |
| Dodecanes | C12 | 8.50 | 0.00 | 0.01 |
| Tridecanes | C13 | 2.52 | 0.00 | 0.00 |
| Tetradecanes | C14 | 0.50 | 0.00 | 0.00 |
| Pentadecanes | C15 | 0.15 | 0.00 | 0.00 |
| Hexadecanes | C16 | 0.11 | 0.00 | 0.00 |
| Heptadecanes | C17 | 0.06 | 0.00 | 0.00 |
| Octadecanes | C18 | 0.09 | 0.00 | 0.00 |
| Nonadecanes | C19 | 0.07 | 0.00 | 0.00 |
| Eicosanes Plus | C20+ | 0.09 | 0.00 | 0.00 |
| TOTAL | | 100.00 | 100.00 | 100.00 |

| | | | | |
|---|---|---|---|---|
| **Ratios** | | | | |
| Molar Ratio | : | 0.0008 | 0.9992 | 1.0000 |
| Mass Ratio | : | 0.0059 | 0.9941 | 1.0000 |
| Liquid Ratio (bbl/bbl) | : | 1.0000 @ SC | -- | -- @ PT* |
| Gas Liquid Ratio | : | 1.0000 bbl @ SC | > 1000000 SCF | -- |
| **Stream Properties** | | | | |
| Molecular Weight | : | 129.4 | 17.24 | 17.33 |
| Density obs. (gm/cc) | : | 0.7718 @ 60 °F | -- | -- @ PT* |
| Gravity (AIR = 1.000) | : | 51.7 °API @ 60 °F | 0.596 | -- °API |
| GHV (BTU/scf) | : | -- | 1011 | -- |
| **Hexanes Plus Properties** | | | | |
| Mol % | : | 99.07 | 0.18 | 0.26 |
| Molecular Weight | : | 130.29 | 100.22 | 108.69 |
| Density (gm/cc @ 60 °F) | : | 0.7732 | 0.6894 | 0.7175 |
| Gravity (°API @ 60 °F) | : | 51.34 | 73.56 | 65.51 |
| **Heptanes Plus Properties** | | | | |
| Mol % | : | 97.76 | 0.13 | 0.21 |
| Molecular Weight | : | 130.91 | 106.46 | 115.60 |
| Density (gm/cc @ 60 °F) | : | 0.7740 | 0.6974 | 0.7279 |
| Gravity (°API @ 60 °F) | : | 51.14 | 71.21 | 62.71 |
| **Dodecanes Plus Properties** | | | | |
| Mol % | : | 12.08 | 0.00 | 0.01 |
| Molecular Weight | : | 168.74 | -- | 168.74 |
| Density (gm/cc @ 60 °F) | : | 0.8063 | -- | 0.8063 |
| Gravity (°API @ 60 °F) | : | 43.81 | -- | 43.81 |
| **Eicosanes Plus Properties** | | | | |
| Mol % | : | 0.09 | 0.00 | 0.00 |
| Molecular Weight | : | 282.11 | -- | 282.11 |
| Density (gm/cc @ 60 °F) | : | 0.8643 | -- | 0.8643 |
| Gravity (°API @ 60 °F) | : | 32.06 | -- | 32.06 |

* (P)ressure : 2798 psig * (T)emperature : 189 °F

**NO DEW POINT ENCOUNTERED AT 189 °F - RESERVOIR FLUID IS DRY GAS**

## Compositional Analysis of MDT (position # 5) Bottom Hole Gas Reservoir Fluid in Cylinder # L-207

| Component | | Stock Tank Liquid Mol % | Stock Tank Gas Mol % | Reservoir Fluid Mol % |
|---|---|---|---|---|
| Hydrogen Sulphide | H2S | 0.00 | 0.00 | 0.00 |
| Carbon Dioxide | CO2 | 0.01 | 0.67 | 0.67 |
| Nitrogen | N2 | 0.00 | 3.22 | 3.22 |
| Methane | C1 | 0.57 | 93.61 | 93.53 |
| Ethane | C2 | 0.06 | 1.51 | 1.51 |
| Propane | C3 | 0.07 | 0.46 | 0.46 |
| Iso-Butane | iC4 | 0.05 | 0.14 | 0.14 |
| N-Butane | nC4 | 0.07 | 0.13 | 0.13 |
| Iso-Pentane | iC5 | 0.07 | 0.05 | 0.05 |
| N-Pentane | nC5 | 0.08 | 0.04 | 0.04 |
| Hexanes | C6 | 1.31 | 0.05 | 0.05 |
| Heptanes | C7 | 9.95 | 0.07 | 0.08 |
| Octanes | C8 | 9.17 | 0.03 | 0.04 |
| Nonanes | C9 | 29.43 | 0.02 | 0.04 |
| Decanes | C10 | 15.00 | 0.00 | 0.01 |
| Undecanes | C11 | 22.09 | 0.00 | 0.02 |
| Dodecanes | C12 | 8.50 | 0.00 | 0.01 |
| Tridecanes | C13 | 2.52 | 0.00 | 0.00 |
| Tetradecanes | C14 | 0.50 | 0.00 | 0.00 |
| Pentadecanes | C15 | 0.15 | 0.00 | 0.00 |
| Hexadecanes | C16 | 0.11 | 0.00 | 0.00 |
| Heptadecanes | C17 | 0.06 | 0.00 | 0.00 |
| Octadecanes | C18 | 0.09 | 0.00 | 0.00 |
| Nonadecanes | C19 | 0.07 | 0.00 | 0.00 |
| Eicosanes Plus | C20+ | 0.09 | 0.00 | 0.00 |
| TOTAL | | 100.00 | 100.00 | 100.00 |

| | | | | |
|---|---|---|---|---|
| **Ratios** | | | | |
| Molar Ratio | : | 0.0008 | 0.9992 | 1.0000 |
| Mass Ratio | : | 0.0059 | 0.9941 | 1.0000 |
| Liquid Ratio (bbl/bbl) | : | 1.0000 @ SC | -- | -- @ PT* |
| Gas Liquid Ratio | : | 1.0000 bbl @ SC | > 1000000 SCF | -- |
| **Stream Properties** | | | | |
| Molecular Weight | : | 129.3 | 17.26 | 17.4 |
| Density obs. (gm/cc) | : | 0.7718 @ 60 °F | -- | -- @ PT* |
| Gravity (AIR = 1.000) | : | 51.7 °API @ 60 °F | 0.597 | -- °API |
| GHV (BTU/scf) | : | -- | 1010 | -- |
| **Hexanes Plus Properties** | | | | |
| Mol % | : | 99.03 | 0.17 | 0.25 |
| Molecular Weight | : | 130.29 | 97.35 | 107.08 |
| Density (gm/cc @ 60 °F) | : | 0.7732 | 0.6856 | 0.7166 |
| Gravity (°API @ 60 °F) | : | 51.34 | 74.70 | 65.77 |
| **Heptanes Plus Properties** | | | | |
| Mol % | : | 97.72 | 0.12 | 0.20 |
| Molecular Weight | : | 130.91 | 102.92 | 113.91 |
| Density (gm/cc @ 60 °F) | : | 0.7740 | 0.6929 | 0.7273 |
| Gravity (°API @ 60 °F) | : | 51.14 | 72.52 | 62.87 |
| **Dodecanes Plus Properties** | | | | |
| Mol % | : | 12.07 | 0.00 | 0.01 |
| Molecular Weight | : | 168.74 | -- | 168.74 |
| Density (gm/cc @ 60 °F) | : | 0.8063 | -- | 0.8063 |
| Gravity (°API @ 60 °F) | : | 43.81 | -- | 43.81 |
| **Eicosanes Plus Properties** | | | | |
| Mol % | : | 0.09 | 0.00 | 0.00 |
| Molecular Weight | : | 282.11 | -- | 282.11 |
| Density (gm/cc @ 60 °F) | : | 0.8643 | -- | 0.8643 |
| Gravity (°API @ 60 °F) | : | 32.06 | -- | 32.06 |

* (P)ressure : 2798 psig * (T)emperature : 189 °F

**NO DEW POINT ENCOUNTERED AT 189 °F - RESERVOIR FLUID IS DRY GAS**

# CONSTANT MASS STUDY
## @ 189 °F
On Bottom Hole Sample from Cylinder # L-375

| Pressure (psig) | | Relative Volume (V/Vsat) (1) | Formation Volume Factor (Bg) (2) | Gas Expansion Factor (E) (3) | Deviation Factor (Z) | Specific Volume (CFT/LB) | Gas Viscosity (Centipoise) (4) |
|---|---|---|---|---|---|---|---|
| 5000 | | 0.6227 | 0.00361 | 276.72 | 0.988 | 0.07917 | 0.0255 |
| 4000 | | 0.7344 | 0.00426 | 234.60 | 0.933 | 0.09338 | 0.0225 |
| 3500 | | 0.8191 | 0.00475 | 210.34 | 0.911 | 0.10415 | 0.0210 |
| 3000 | | 0.9361 | 0.00543 | 184.06 | 0.893 | 0.11903 | 0.0195 |
| 2798 | * | 1.0000 | 0.00580 | 172.30 | 0.890 | 0.12715 | 0.0189 |
| 2500 | | 1.1122 | 0.00646 | 154.92 | 0.885 | 0.14142 | 0.0181 |
| 2000 | | 1.3835 | 0.00803 | 124.54 | 0.882 | 0.17592 | 0.0168 |
| 1500 | | 1.8486 | 0.01073 | 93.21 | 0.886 | 0.23505 | 0.0156 |
| 1000 | | 2.8187 | 0.01636 | 61.13 | 0.905 | 0.35839 | 0.0146 |
| 500 | | 5.7963 | 0.03364 | 29.73 | 0.944 | 0.73700 | 0.0139 |

* Reservoir Pressure

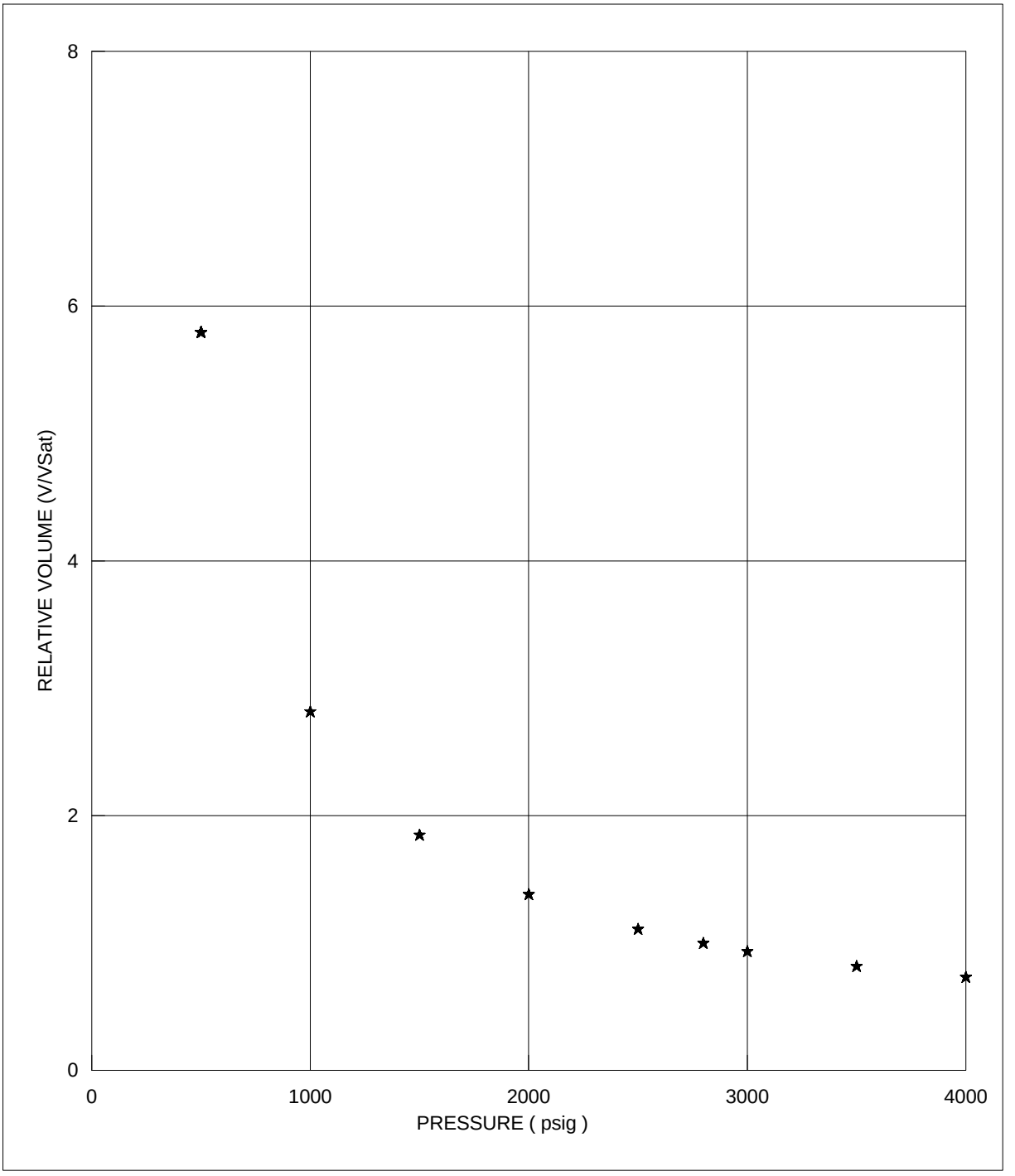
**NO DEW POINT ENCOUNTERED AT 189 °F - RESERVOIR FLUID IS DRY GAS**

(1) Cubic feet of gas at indicated pressure and temperature per cubic foot at reservoir pressure
(2) Cubic feet of gas at indicated pressure and temperature per cubic foot at 14.696 psia and 60 °F
(3) Cubic feet of gas at 14.696 psia and 60 °F per cubic foot at indicated pressure and temperature
(4) Calculated from correlation of Lee, Gonzales and Eakin

# RELATIVE VOLUME

Equation of best fit

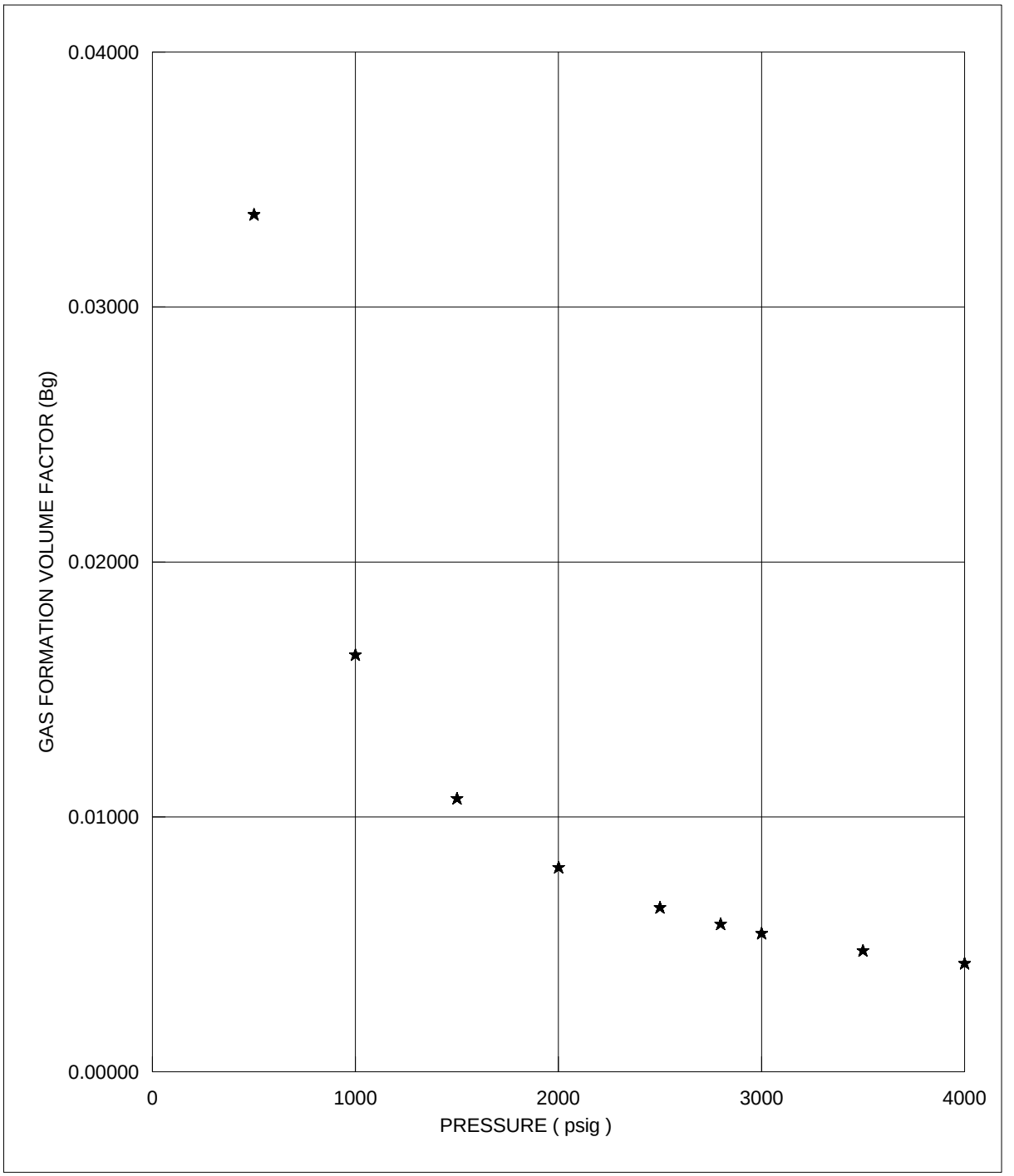
V/VSat = +1.07E+01 -1.26E-02 * P +6.14E-06 * P^2 -1.31E-09 * P^3 +1.01E-13 * P^4



# GAS FORMATION VOLUME FACTOR

Equation of best fit

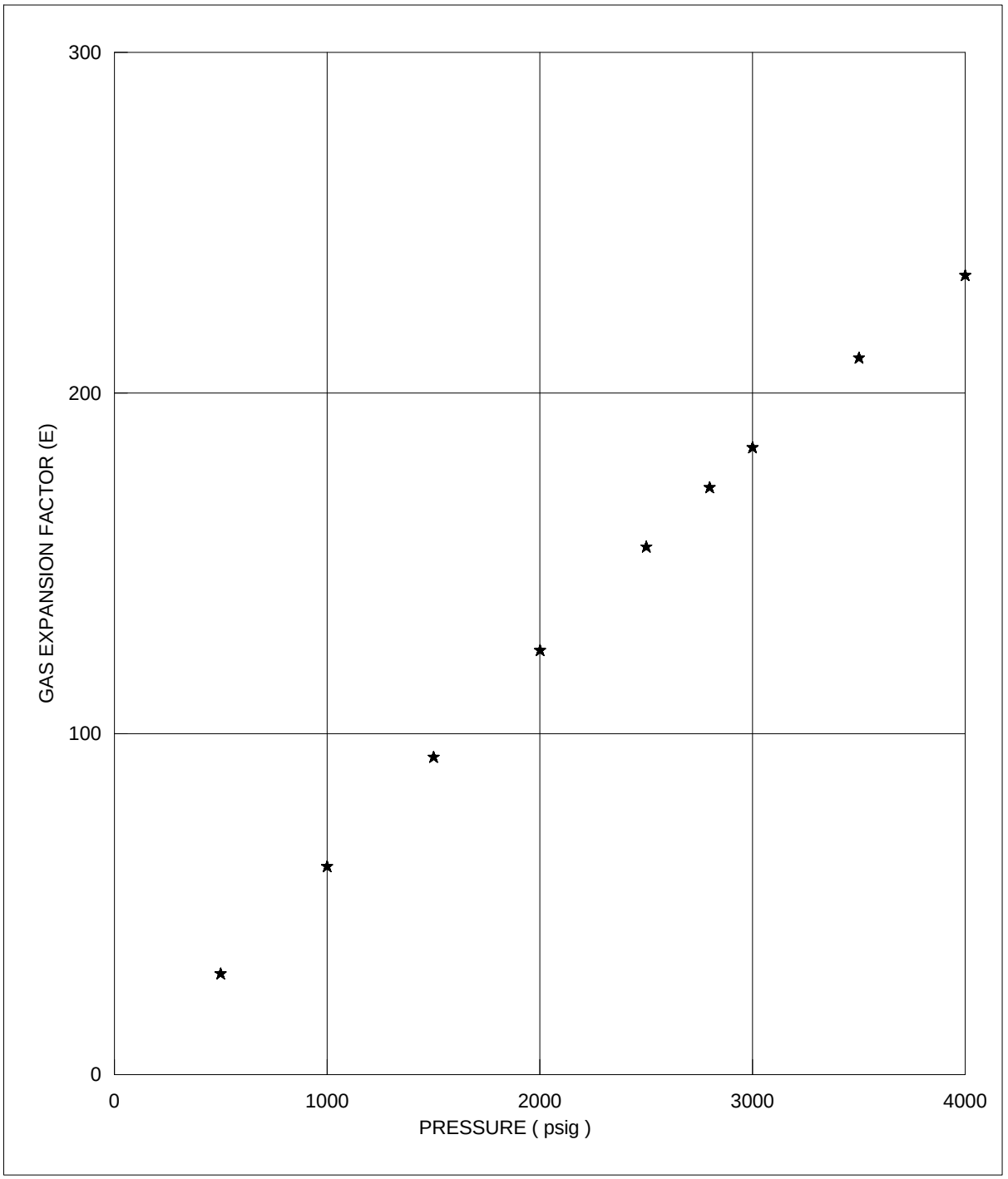
Bg = +4.93E-02 -4.10E-05 * P +1.23E-08 * P^2 -1.20E-12 * P^3 +0.00E+00 * P^4



# GAS EXPANSION FACTOR

Equation of best fit

E = -2.58E+00 +6.36E-02 * P +1.02E-06 * P^2 -5.16E-10 * P^3 +0.00E+00 * P^4

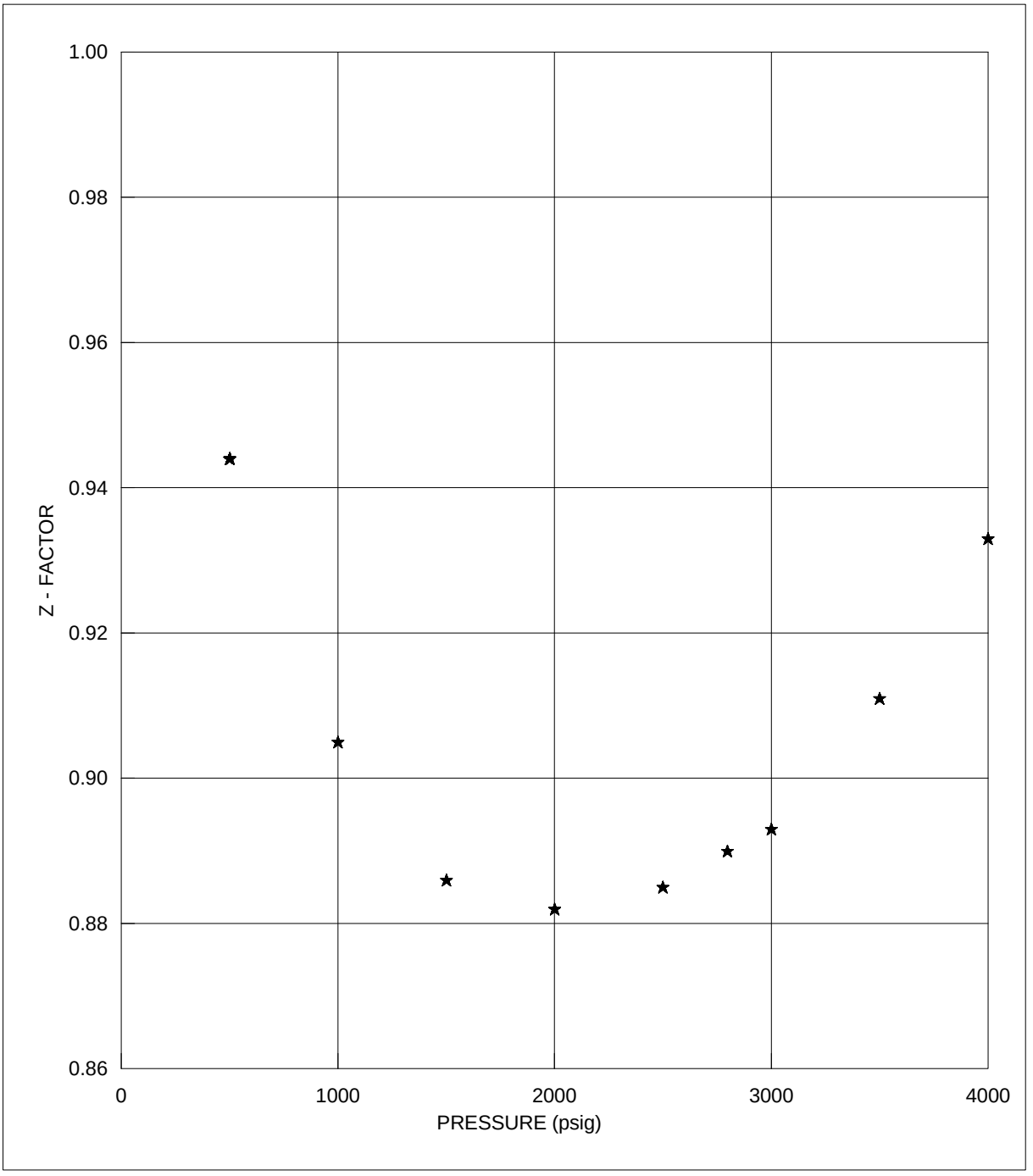


# GAS DEVIATION FACTOR

Equation of best fit

Z

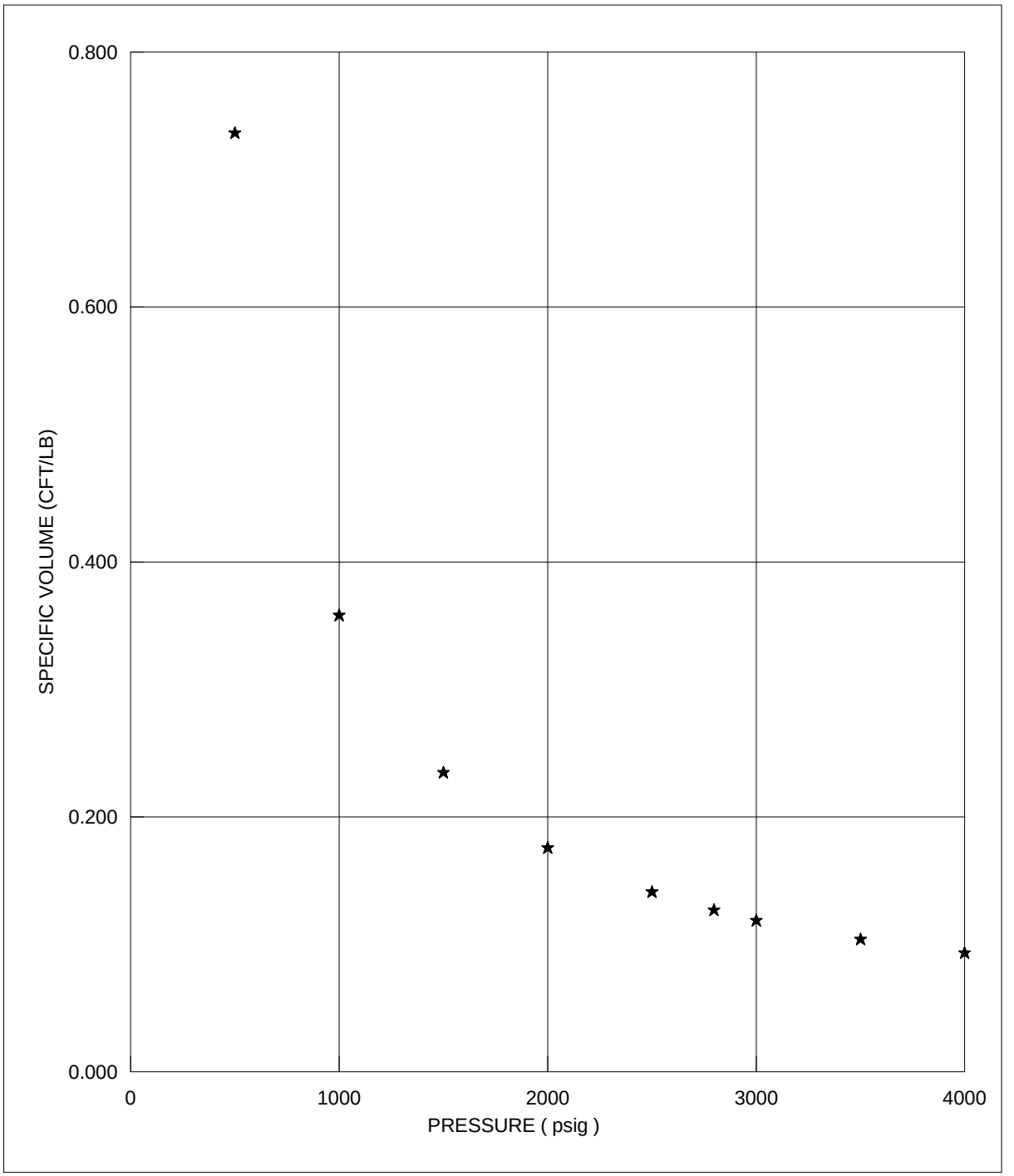
Z = +1.01E+00 -1.52E-04 * P +6.09E-08 * P^2 -9.47E-12 * P^3 +6.43E-16 * P^4



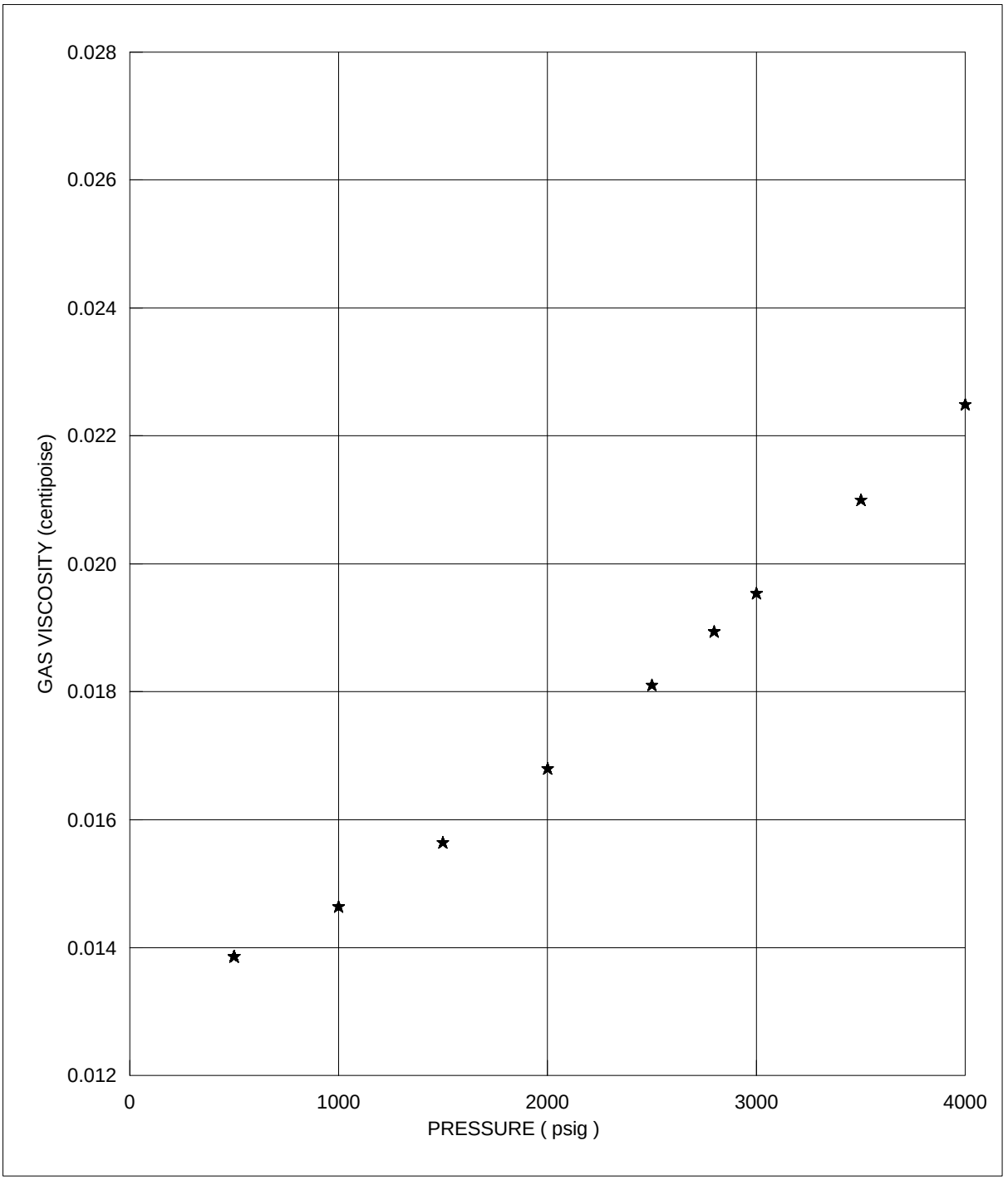
# RESERVOIR FLUID SPECIFIC VOLUME

Equation of best fit

SV = +1.08E+00 -8.99E-04 * P +2.70E-07 * P^2 -2.62E-11 * P^3 +0.00E+00 * P^4



# VISCOSITY OF RESERVOIR FLUID

Equation of best fit

$$\mu = +1.33E-02 + 7.49E-07 * P + 6.09E-10 * P^2 - 6.12E-14 * P^3 + 1.31E-18 * P^4$$