Electronic Gas Flow Computer

Smith Meter ®
microFlow.net™ Gas

Calculations

Issue/Rev. 0.1 (3/11)

Bulletin TPFG001

Caution

The default or operating values used in this manual and in the program of the Smith Meter® microFlow.net™ Gas are for factory testing only and should not be construed as default or operating values for your metering system. Each metering system is unique and each program parameter must be reviewed and programmed for that specific metering system application.

Disclaimer

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Section I – Volume Calculations

The microFlow.net Gas can be configured to receive volume increment information from the meter in the form of a pulse stream or via a modbus communications link. The increment may be in the forward and/or the reverse direction. For each volume increment the calculations performed by the microFlow.net Gas to totalize and compensate the gas quantities from line conditions to base conditions are described in this document.

Volume at Flow Conditions Calculation

Pulse Input

$$\Delta \text{ Volume @ Line conditions} = \left(\frac{\text{Input Pulses}}{\text{K Factor}}\right) \textit{ x Meter Factor}$$

microFlow Terminology:

GV = IV x Meter Factor

Where:

IV = Indicated Volume = (Input Pulses/K Factor)

GV = Gross Volume = IV x Meter Factor

Meter Factor calculation is described in section V

K Factor is a fixed value configured by the operator

Communications Input

Δ Volume @ Line conditions = Current Total Volume – Previous Total Volume

Volume at Base Conditions Calculations

microFlow Terminology: GSV (Gross at Standard Volume)

Volume Pulse Input or Communications Input

$\Delta\ Q_{base} = \Delta$ Volume @ Line conditions x BMV

BMV = Density_{line} / Density_{base}

Where:

Flow Volume at Base Conditions (Q_{base})

Base Multiplier Value (BMV) – factor to change volume at line conditions to volume at base conditions

Densities (line and base) are calculated using AGA8 detailed method.

Section II – Heating Value Calculations

Δ Heating Value = $\Delta\ Q_{base}$ x Energy_{volume}

Energy_{volume} is calculated using AGA5 or ISO6976 based on user selection

Section III – Mass Flow Calculations

Δ Mass Flow = $\Delta\ Q_{base}$ x Density_{base}

Section IV – Totalizing

Totalizing of batch volumes, mass, and energy is performed by summing all of the increments during the batch.

Total = $\sum \Delta$ Measured Value (for the time the batch runs)

Where “Measured Value” is one of the following:

Volume @ Line conditions

Volume @ Base conditions

Energy

Mass

Section V – Meter Factor Linearization Calculations

The non-linearity of the meter calibration curve for each product can be approximated through use of a linearization method by entering meter factors at up to four different flow rates.

The meter factors used will be determined from a straight line interpolation of the meter factor and its associated flow rate.

Graphically, the linearization method used can be represented as a point slope function between points:

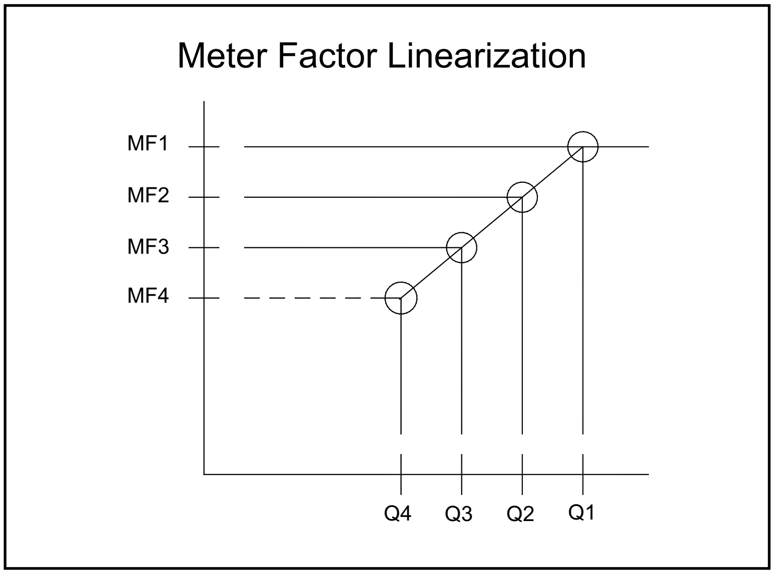

Figure 1. Four Point Meter Factor vs. Flow Rate Curve

where: MF1, MF2, … MF9, MF10 = meter factors 1 through 10
Q1, Q2, … Q9, Q10 = associated flow rates 1 through 10

The number of factors used is determined by the programming. Up to ten factors are available at corresponding flow rates. (See the meter factors and flow rate program codes.)

A. Calculations for meter factors between the flow points:

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

where:

m = slope (to be calculated)
y_2 = Meter factor at the lower flow rate
y_1 = Meter factor at the higher flow rate
x_1 = Flow rate for the meter factor of y_1
x_2 = Flow rate for the meter factor of y_2

B. After calculating *m*, calculate the straight line equation:

$$y - y_1 = m(x - x_1)$$

so

$$y = m(x - x_1) + y_1$$

where:

x = the present flow rate
y = the unknown meter factor

Section VI – RTD Temperature Input Conversion

The resistance temperature detector (RTD) supplies resistance from which temperature may be calculated. The Callendar-Van Dusen equation is used to approximate the RTD curve.

$$T = \frac{-A + \sqrt{A^2 - 4B\left(1 - \frac{R}{R(0)}\right)}}{2B}$$

Where:

T = temperature in °Celsius

R = resistance at temperature T

R(0) = resistance at 0°C

A = 3.9083 e-3

B = -5.775 e-7

Section VII – Load Average Values

The load average temperature, pressure, densities, etc will be accumulated in a volume-weighted method (see below). At the start of any batch, the current value will be used as the average. Thereafter, subsequent samples will be taken along with the accumulated volume to determine the load average value. The following formula will be used to calculate the load average value.

Load Average Value (LAV) Formula:

$$LAV = \frac{\sum (\Delta \text{ Volume} \times \text{Current parameter reading})}{\text{Total Volume}}$$

Load average temperature, pressure, density, etc values will only be calculated when correct entries have been made in the configuration to allow them to be calculated. If a probe or transducer alarm occurs, the corresponding current reading will stop being used in the calculation of the load average value. The current load average value for the failed transducer will be used for the remainder of the batch or until the transducer input returns to the working state.

Section VIII – Related Publications

The following literature can be obtained from FMC Technologies Measurement Solutions Literature Fulfillment at johno@gohrs.com or online at www.fmctechnologies.com/measurementsolutions. When requesting literature from Literature Fulfillment, please reference the appropriate bulletin number and title.

microFlow.net Gas

Specification .... Bulletin SS06049
Installation Manual .... Bulletin MNFG001
Operator Reference Manual .... Bulletin MNFG002
Operations Manual .... Bulletin MNFG003
Calculations .... Bulletin TPFG001

Revisions included in TPFG001 Issue/Rev. 0.1 (3/11):
Page 1. Data updated from "Volume at Flow Conditions Calculation" through "Volume at Base Conditions Calculations".

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