Technical Note
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Rosemount 3051S MultiVariable™ Gas Flow Principles

ACTUAL VERSUS STANDARD FLOW UNITS

Typically asked questions

How is standard volumetric flow different than actual volumetric flow? Is standard “volumetric” flow a mass flow or volumetric flow measurement? What are normal flow units?

Actual Flow Units

Actual volumetric flow rate indicates the actual volume of fluid that passes a given point in a pipe per unit time.

Standard Units

Standard Volumetric units define the mass of gas contained in one cubic foot or cubic meter at specific pressure and temperature reference points. These reference points are commonly referred to as standard, normal, or base conditions.

TABLE 1. Standard Normal Reference Conditions

	Base Pressure	Base Temperature
Standard US	14.696 psia (101.325 kPa)	60 °F (15.55 °C)
Standard ISO	101.325 KPa (14.696 psia)	15 °C (59 °F)
Standard AGA	14.73 psia (101.560 kPa)	60 °F (15.55 °C)
Normal	101.325 KPa (14.696 psia)	0 °C (32 °F)

Normal Units

Normal flow units are also used to express gas flow based on standardized (base) conditions. The difference between normal and standard flow units is the base reference conditions used and SI or US units of measure.

- Typical US Units: StdCuft/h, day, min.
- Typical SI Units: NmlCum/h , day, min.

NOTE:
Standard and Normal units are based on different reference conditions. Do not confuse Normal flow units with “normal flow rate” which is typically assumed to be about 80% of max flow rate if not defined.

Actual vs. Standard

Converting between actual and standard rates:

- The ratio of densities is the conversion factor
- Standard or Normal flow rate = ρact / ρstd x actual flow rate

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Reference Condition Errors

What is the % error in flow if the wrong reference value is used for measuring Normal or Standard Flow? What If 32 °F is used for reference temperature rather than the conventional 60 °F for standard units?

The error can be calculated using the Ideal Gas Law:

$$PV = nRT$$

$$P_1\frac{V_1}{T_1} = P_2\frac{V_2}{T_2}$$

$$\%Error = \frac{V_2}{V_1} = \frac{T_2}{T_1} \times \frac{P_1}{P_2}$$

$$\%Error = \frac{V_2}{V_1} = \frac{(32 + 459.67°R)}{(60 + 459.67°R)} \bullet \frac{(14.696psia)}{(14.696psia)}$$

$$\%Error = 5.4\%$$

Gas Flow Measurement

- Standard and Normal units are measures of mass flow
- The Actual Volume of gas depends on the pressure and temperature
- It is important to use the correct reference values when referring to standard or normal units

Emerson Process Management
Rosemount Measurement
8200 Market Boulevard
Chanhassen MN 55317 USA
Tel (USA) 1 800 999 9307
Tel (International) +1 952 906 8888
Fax +1 952 949 7001

Emerson Process Management
Blegistrasse 23
P.O. Box 1046
CH 6341 Baar
Switzerland
Tel +41 (0) 41 768 6111
Fax +41 (0) 41 768 6300

Emerson FZE
P.O. Box 17033
Jebel Ali Free Zone
Dubai UAE
Tel +971 4 811 8100
Fax +971 4 886 5465

Emerson Process Management Asia Pacific Pte Ltd
1 Pandan Crescent
Singapore 128461
Tel +65 6777 8211
Fax +65 6777 0947
Service Support Hotline : +65 6770 8711
Email : Enquiries@AP.EmersonProcess.com

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Process Management