

## Introduction

Flow measurement technologies are affected by changes in fluid specific gravity and viscosity. NT® Electronic Flowmeters and Integrated Flow Controllers are frequently used to measure and control fluids with specific gravity and viscosity characteristics significantly different than water.

Entegris differential pressure flowmeters and flow controllers are factory calibrated in DI water. They are also used to accurately measure fluids with different viscosity and specific gravity characteristics. Entegris provides correction factors for these fluids to assure accurate flow measurement.

When applying the correction factors:

- Any 4400 or 5400 Series flowmeter or 6500 flow controller may be used
- No flowmeter re-calibration is required
- The correction is a linear function

## Differential Pressure Measurement

Entegris' patented technology for differential pressure flow measurement incorporates two pressure sensors separated by a venturi style orifice (Figure 2). The orifice causes a differential pressure drop which is proportional to fluid flow rate. If there is no flow the differential pressure is zero. As the flow rate increases, the differential pressure increases.

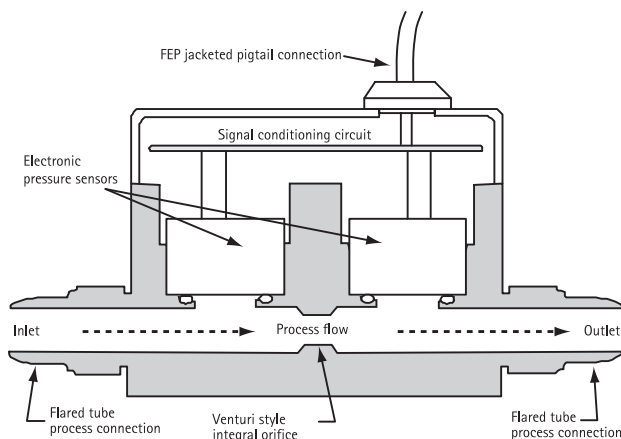


Figure 2: NT® Electronic Flowmeter, cutaway view

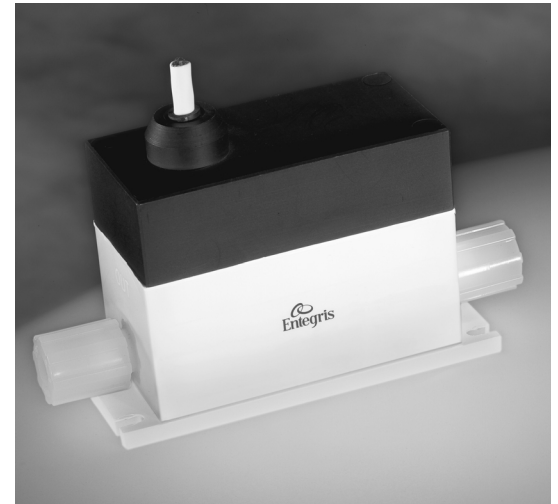


Figure 1: NT® Electronic Flowmeters simultaneously measure fluid flow and pressure

Entegris' flowmeter electronics provide a linear signal (4-20mA output signal) that corresponds to the calibrated flow rate of deionized water.

## Viscosity and Specific Gravity

The pressure differential of a fluid traveling through an orifice is affected by viscosity and specific gravity. While traveling through an orifice, a fluid with viscosity or specific gravity greater than water creates a greater pressure differential. This increased pressure differential is a predictable phenomenon.

Entegris' differential pressure flowmeter that has been factory calibrated for water flow measurement can be accurately used to measure fluids with different viscosity and specific gravity characteristics. Applying a linear correction specific to that fluid will result in an accurate flow measurement. In order to determine the proper corrections for a particular fluid, the following information is necessary:

1. Flow range and fitting size of flowmeter,
2. Specific gravity and viscosity of fluid at the operating temperature.

Based on this information, Entegris can supply the corrections to determine the 4 mA and 20 mA output values for use with your flowmeter in your fluid. These new 4 mA and 20 mA values may then be entered into the digital display or system controller.

## Example

As an example, an NT<sup>®</sup> Electronic Flowmeter 4400-03-F04-B06-A is specified for use with 98 percent sulfuric acid at ambient temperature.

- This flowmeter has a 1/2" fitting size and 2-10 l/min. flow range in deionized water.
- At ambient temperature the specific gravity of 98 percent sulfuric acid is 1.83 and the viscosity is 25.5 cP.

Based on this information, the corrections for the 4 and 20 mA points are 1.3 and 6.9 l/min., respectively. This information is then entered into the digital display or system controller to maintain accurate readings. Note that fluctuations in fluid composition, temperature, specific gravity or viscosity can affect the corrections.

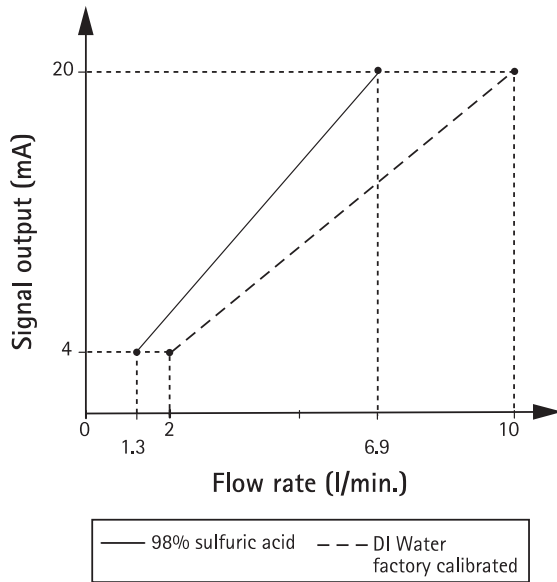


Figure 3: Flow rates for DI water and 98 percent sulfuric acid at ambient temperature with an NT<sup>®</sup> Electronic Flowmeter, Model 4400-04-F03-B06-A

In summary, the flowmeter was factory calibrated using DI water for a flow rate of 2-10 l/min. By applying the fluid properties, the flow rate of 98 percent sulfuric acid is mathematically determined to 1.3-6.9 l/min. Figure 3 illustrates this correction.

This example may be repeated for any fluid if the specific gravity and viscosity are known. Therefore, the same flowmeter can be used to monitor several fluids without the need for calibration or disassembly of the unit. Contact Entegris to obtain corrections for your fluid.

Entegris designs and manufactures measurement instruments for the high purity and corrosive chemical environments of the semiconductor industry. Our products measure flow, pressure and level for the various acids, caustics, solvents and slurries used in the industry.

## For More Information

For more information on electronic flowmeter systems or our complete line of fluoropolymer fluid handling solutions, contact your local Entegris distributor or Entegris, Inc.

To review our complete line of sensing and control product solutions visit Entegris' Web site at [www.entegrisfluidhandling.com](http://www.entegrisfluidhandling.com) or contact Entegris Customer Service.

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