Application News

Turbine Meter Measures Fuel Flow Over Wide Operating Range

Industry: Aerospace ***Service: Ground Test Flow Rate*** ***Fluid: Jet A***

Overview

In the aerospace industry, ground testing of fuel systems and components is critical to ensure flight worthiness. Engineers evaluating this equipment require valid flow data to order to understand the operation of the fuel system or individual component under changing environmental conditions.

Turbine flow meters are the most common choice for ground testing applications, where demanding accuracy, range, dynamic response and environmental conditions are encountered.

Situation

A leading manufacturer of jet turbine engines was seeking a flow meter to accurately measure fuel flow over a wide range of 0.6 to 60 GPM. Fuel flow data had to be collected with the fuel at various temperatures - and accuracy was critical.

Turbine flow meters are one of the most precise flow sensors on the market if used and calibrated properly. However, like other meters, they are only as good as their last calibration. The kinematic viscosity of the fluid being measured affects turbine meter accuracy. For this reason, a calibration in fluid of the same kinematic viscosity is required to achieve the best accuracy. Because fluid kinematic viscosity changes due to temperature, multiple calibrations at different kinematic viscosities are often mandatory.

Solution

Modern turbine flow meters can use a technique known as a "Universal Viscosity Curve" to operate over varying kinematic viscosity values. This process involves calibrating the flow meter over the viscosity range, and then using electronics to determine the correct flow rate based on the input temperature of the fluid and the frequency from the meter. Limitations of this technique include calibrating the flow meter at kinematic viscosities that do not vary by more than a 10:1 ratio from one another over the range of kinematic viscosities, and restricting the meter range to a 10:1 turndown. Operation at extended ranges is possible, however, output accuracy will degrade due to a drop off in meter linearity in situations beyond the 10:1 normal flow range.

To address the wide temperature range, the customer determined that five discrete fluid temperatures were needed for their data requirements. The solution was to calibrate the flow meter in fluids that match the kinematic viscosities of the process fluid at the five different temperatures.

In order to handle the wide flow range (100:1 turndown), linearization would have to be performed by the flow meter's electronics. Flow Technology's LinearLink™ provides this capability, ensuring the linearity of the flow meter meets a +/- 0.1% reading specification over the 100:1 turndown. The LinearLink is provided with VisualLink software enabling the user to program the electronics with calibration data. For this application, data would be acquired with the fluid at a given temperature corresponding to one of the calibrations performed on the flow meter. The fluid temperature would then be changed to the next value and additional data acquired. This technique requires that calibration data for the next kinematic viscosity be loaded into the LinearLink for the best possible accuracy. This is easily accomplished using the VisualLink software and programming cable for the electronics.

System Description

Flow Technology provided the customer with a flow measurement system providing the best possible accuracy over wide temperature and flow ranges. The system consisted of a standard, one-inch FT-16 Series turbine flow meter and a pick-off style LinearLink flow meter linearizer. The LinearLink provides a signal compensating for turbine non-linearity inherent at the lowest flow rates. Using this technology, turbine meters can achieve 100:1 turndown with increased speed of response.

Technical Information

Flow Meters (Model Number):	FT-16 AEU5-LEA-0
Electronics (Model Number):	LN-5-C-MA-1 with programming cable
Flow Rate:	0.6 to 60 GPM
Fluid:	Jet A

FTI FLOW TECHNOLOGY™

8930 S. Beck Ave., Suite 107 • Tempe, AZ, 85284 USA
Tel: 480.240.3400 • Fax: 480.240.3401 • Toll-free: 800.528.4225
E-mail: ftimarket@ftimeters.com • Web: www.ftimeters.com