Minisystem Computes Gas Flow

An Alcoa extrusions plant in Spanish Point, Utah had been monitoring natural gas usage with turbine flowmeters (volumetric) but wished to convert to mass flow for improved accuracy. The turbine manufacturer could have provided a compensated measurement, but only if the flowmeters were replaced. As these were 3 and 4 inch meters replacement costs would have been high, and piping changes would have been needed. Alcoa needed a less-expensive solution.

Background

Gas volume expands directly with pressure and inversely with temperature. Mass, not volume, needs to be measured when monitoring inventory, billing for usage or controlling applications from heating to anesthesia. Some flowmeters such as positive displacement and coriolis technologies measure mass flow directly but most respond to volumetric flow.

Mass is related to volume by the perfect gas law:

Mass = (Constant) x Volume x Absolute Pressure / Absolute Temperature

When measuring gas the term “Mass” is commonly replaced by “Standard Volume”; for example, Standard Cubic Feet. One Standard Cubic Foot is the amount of gas that would fill one cubic foot at a specified pressure and temperature. In the US gas industry the commonly-used reference conditions are:

Pressure = Standard sea level atmospheric pressure = 14.73 psi or 101.65kPa.

Temperature = 60 degrees Fahrenheit, equivalent to 15.6 degrees Celsius or 288.7 Kelvin (absolute)

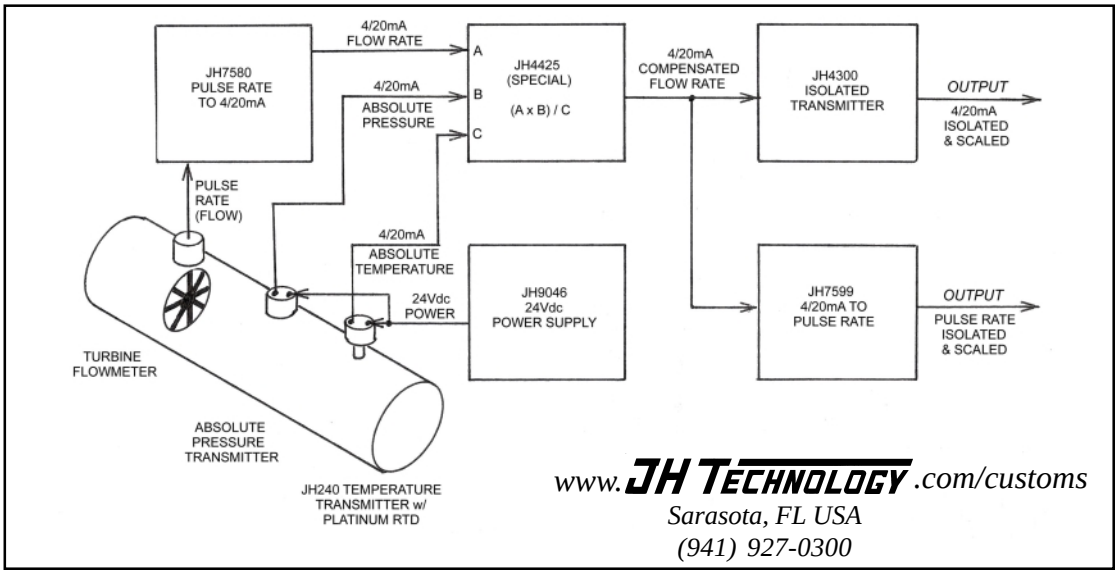
The gas law equation becomes:

Standard Cu. Ft. = Actual Cu. Ft. x (Abs. Pressure/14.73 psi) x (288.7K/Abs. Temperature)

Our Solution

By adding temperature and pressure sensors to the gas lines, JH Technology was able to create a mass flow Minisystem using signal conditioners. Five modules convert the turbine pulses to DC, perform multiplication and division, produce both 4-20mAdc and pulse rate outputs proportional to mass flow in SCFH (Standard Cubic Feet per Hour) and provide 24Vdc power to the pressure and temperature sensors. The modules were premounted and wired on a panel and placed inside a NEMA-4 field enclosure.

Alcoa’s Keith Tanner reports that the system provided significant savings compared to the costs of new flowmeters, and even more by eliminating the need for piping changes.



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