

4.16 Fluid Flow Metering and Mixing Technologies

Statement: A widely applicable suite of technologies with optimized capabilities for fluid metering, mixing, and conditioning.

Problem: There are many conduit-constrained fluid flow applications that require fluid mixing and, possibly, measurement of fluid attributes. Such applications include chemical processing, a wide variety of manufacturing processes, and mechanical processes (e.g., hydraulic systems) that utilize fluid flow. With respect to fluid mixing, mixers without moving parts or power requirements are preferred. With respect to measurement of fluid attributes, it is preferred that the measurement system not disturb the fluid flow. Satisfaction of both preferences has proven elusive when both fluid mixing and measurement of fluid attributes are required.

Solution: To solve the problem, an innovative suite of prototype fluid plug technologies with an array of capabilities for fluid flow metering, mixing, and conditioning. Each innovation within this suite is based upon a core technology that has no moving parts, is simple to manufacture, and provides high reliability and efficiency. Also, the base fluid plug technology can be modified with very few or no hardware changes to achieve the desired effect or combination of mixing, metering, and conditioning capabilities depending on the application.

Technology description: The innovations included in this technology suite are variations of the same base innovation, which typically consists of a fluid plate or plug of varying thickness. The device is simple to install and can be mounted between two flanges in a fluid-flow conduit, or it can be threaded or welded into the conduit. In some curved-pipe applications, the device can be integrated into a pipe fitting, bend, elbow, or tee. The face of the plug features several ports through which fluid flows. The orientation and position of these ports vary, depending on the needs of a specific application. The design balances fluid flow and kinetic energy across the plug face to create the desired flow effect. The device can smooth the fluid flow for superior conditioning, decrease turbulence for highly accurate metering, or increase turbulence to enhance fluid mixing. For example, discrete openings parallel to the fluid flow will decrease turbulence for accurate metering and conditioning. Other shapes of fluid openings can be introduced to change flow velocity or energy. The openings can also contain tapers and/or be directed along an unparallel path to the flow conduit to induce fluid mixing. In addition, the open flow area of the plug can be more heavily weighted on one side to amplify or offset the fluid effects around bends.

Benefits of the product: This technology has great potential where flow mixing and measurements are required:

- Improved efficiency.
- More economical.
- Superior accuracy.
- Improved mixing.
- Mixing and metering in a single device.