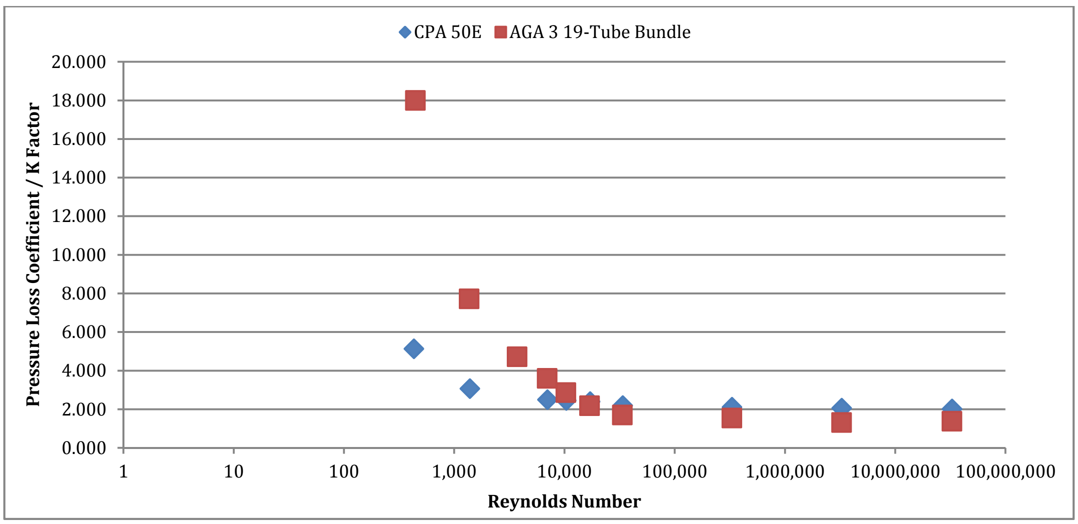
CPA Flow Conditioners for Liquid Applications

The CPA 50E and 65E flow conditioner are extremely effective solutions for liquid measurement applications. This applies to all volumetric flow meter scenarios; ultrasonic, turbine, orifice or venturi.

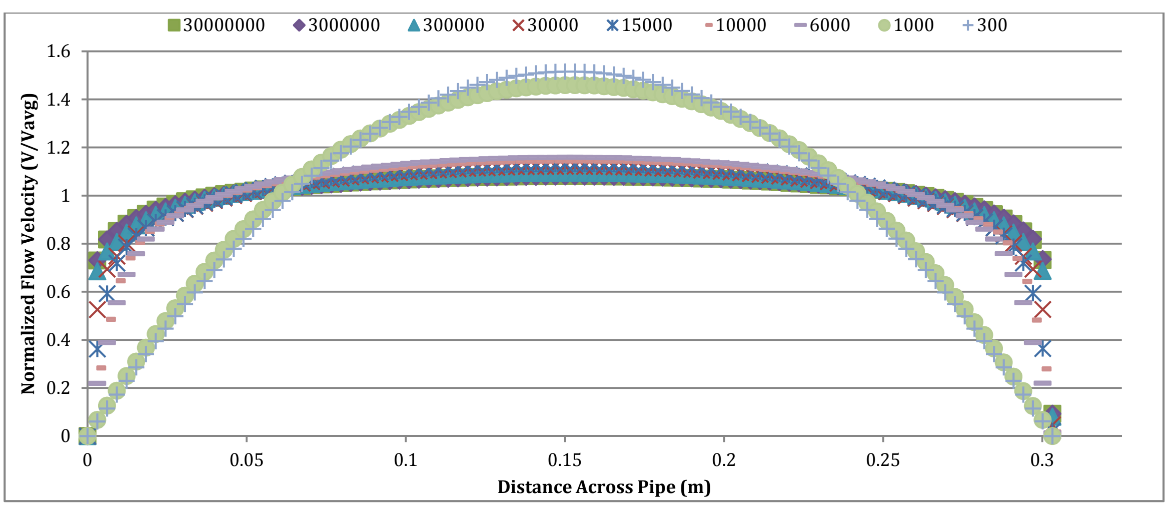
CPA 50E/65E vs AGA 3 19-Tube Bundles

In liquid applications, the CPA 50E and 65E can actually have a lower pressure drop than typical tube bundles or straightening vanes. The design of tube bundle is detrimental in applications with high viscosity fluids due to the significant increase in pipe wall friction in the flow conditioner passages.



Pressure loss coefficient of CPA 50E vs AGA 3 19-Tube Bundle across a range of fluid measurement scenarios.

Perforated plate flow conditioners such as the CPA 50E & 65E will outperform typical straightening vanes and AGA 3 tube bundles in certain liquid measurement applications. The CPA 50E and 65E can restore fully developed, swirl free flow in fluids with Reynolds numbers ranging from 300 to 30000000.



Flow profiles generated by the CPA 50E across a Reynolds number range of 300 – 30000000.

Liquids vs Gas

In the engineering world, thermodynamics has trained us to be sensitive of fluid phase; liquids and gases behave differently and must be treated different as a result. This is critical in thermodynamics as fluid phase can have a significant effect on the thermodynamic behavior and resultant calculations.

Flow measurement is concerned with fluid dynamics, not thermodynamics. Fluid dynamics simply deals with how a fluid behaves as it is flowing in a controlled volume such as a pipe. Fluid dynamics does not care about fluid phase; gases and liquids behave very much the same. Fluid dynamics is primarily concerned with fluid viscosity.

Reynolds Number

Reynolds number (Re) is a non-dimensional term that is used to compare one fluid application to another. It allows us to instantly compare the behavior of any gas or liquid. Natural gas, air, water, fuel oil, LNG, crude oil, etc can instantly be benchmarked against each other to describe how the fluid is acting in any flowing scenario.

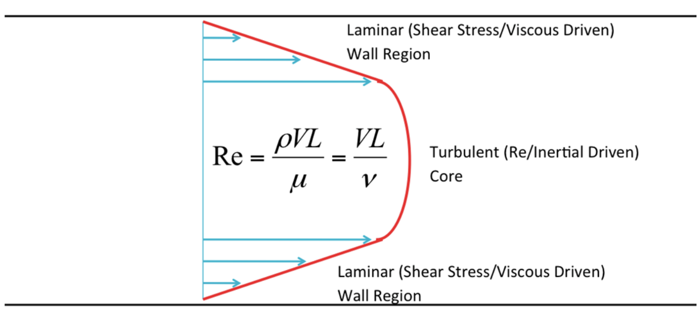
$$\mathrm{Re} = \frac{\rho V L}{\mu}$$

ρ = Bulk fluid density, *kg/m³*.
V = Bulk fluid velocity, *m/s*.
L = Cross sectional diameter of fluid flow, *m*.
μ = Bulk fluid dynamic viscosity, *Pa * s*.

Laminar vs Turbulent Flow

Reynolds number helps us distinguish between laminar and turbulent fluids. Laminar flows are applications where the flow viscosity and pipe wall friction overwhelms other flow behaviors. It is typically found in very slow, thick fluids such as crude oil applications. Turbulent flow is when the random turbulent movement of the flow overwhelms the viscosity and wall friction. It is found in fast flowing situations with fluids such as water, light petroleum liquids, air or natural gas. Laminar flow is typically for a Reynolds number range of 100 – 2500 while turbulent fluids have Reynolds numbers above 5000.

From a flow measurement standpoint, Reynolds number changes the shape of the velocity flow profile that is being measured. Turbulent flows have a flat flow profile due to higher inertial mixing forces and lower wall friction while laminar flows have more peaky flow profiles due to a lack of inertial mixing and high wall friction. The CPA 50E is able to restore flow profiles in either scenario.



Showing the development of a velocity flow profile due to laminar and turbulence fluid forces.