TYLER
Advanced Corrosion Technologies

Industrial TACT Tool UHP-BD24-SS

Side Stream Installation

The UHP-BD24-SS inlet and outlet ports terminate through ball valves to ½"-NPT female fittings. These should be connected to the side stream plumbing using Teflon tape to seal the threads. The ball valves effectively isolate the device so that operation of the main line is not disrupted by biostud installation and removal procedures (Fig. 1). Once side stream installation is complete, the valves can be opened to allow flow. When the user is ready to begin the tactical monitoring schedule, the two ball valves may be closed and biostuds safely installed and extracted from the manifold before opening them again to permit normal flow.

Most industrial pipelines and tubes are designed to support the highest possible flow rates at which laminar flow can be maintained. Laminar flow is defined as streamlined, in which fluids flow in parallel layers with no disruption between them. The velocity of fluids moving in pipelines is typically optimized for laminar flow according to the equations of fluid dynamics in which the Reynolds number (a measure of the ratio of inertial forces to viscous forces) is defined as:

$$\mathrm{Re} = \frac{\rho \mathrm{v} D_H}{\mu} = \frac{\mathrm{v} D_H}{\nu} = \frac{\mathrm{Q} D_H}{\nu A}$$

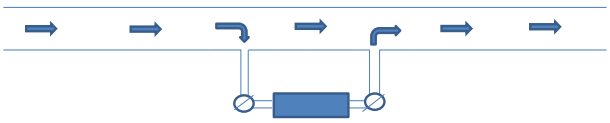
Where

- D_H is the hydraulic diameter of the pipe (m)
- Q is the volumetric flow rate (m^3/s)
- A is the cross sectional area of the pipe (m^2)
- v is the mean relative particle velocity (m/s)
- μ is the dynamic viscosity of the fluid (kg/m·s)
- ν is the kinematic velocity ($v=\mu/\rho$) (m^2/s)
- ρ is the density of the fluid (kg/m^3)

In general, a Reynolds number of less than 2000 will result in laminar flow in pipes of circular cross section, values between 2000 and 4000 will lead to transitional flow, and values above 4000 will result in turbulent flow (Fig. 2). This is a critical consideration for any device attempting to simulate conditions found in the field. Tyler biofilm devices are designed specifically to mimic field conditions so that a direct correlation can be made between biofilm growth observed in the test system and that of the system being monitored.

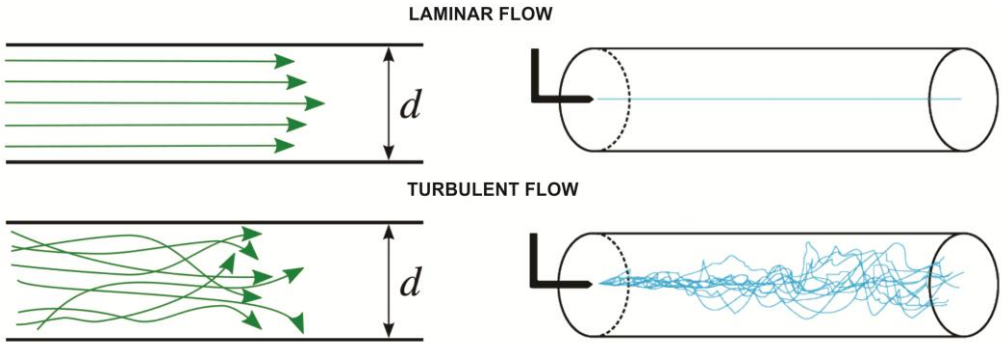
The ball valves permit adjustment of fluid flow so that conditions in the side stream device are equivalent to those in the main system being mirrored. Typically, the upstream valve is fully open, and the downstream valve is throttled back as required to create back pressure and limit the velocity of the fluid moving through the manifold.

Figure 1 – Side Stream Installation



Another critical test factor is composition: if the system being probed is made of cast iron, for example, the ideal biostud material is also cast iron; if carbon steel or copper or PVC, then carbon steel or copper or PVC biostuds, respectively, should be used in the TACT Tool.

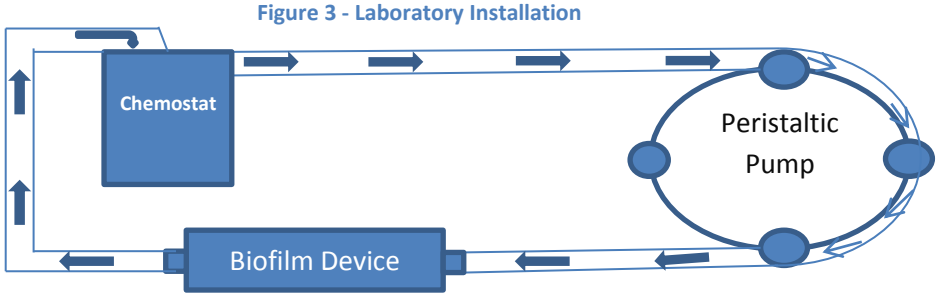
Figure 2 – Flow Characteristics



In-Line Installation

A second approach is to install the TACT Tool in-line with the process under examination (Fig. 3). This option is often used in narrow-bore cooling lines where the volumetric flow rate is appropriate for the unregulated manifold. Off-shore drilling rigs, for example, frequently install a TACT Tool as the last element in a water injection line, with the effluent simply discharged into the sea. This has the advantage that the TACT Tool is absolutely exposed to the same conditions as the system being monitored, but a drawback is that flow to the entire line must be stopped before biostuds can be changed out (a process requiring anywhere from 30 seconds to several minutes, depending on the number of samples).

Figure 3 - Laboratory Installation



Laboratory Installation

The UHP-BD24-SS may be used in a laboratory for the controlled growth and maintenance of biofilms. Typically, planktonic bacteria are cultured in a chemostat and perfused through the biofilm device using a peristaltic pump or gravity-siphon flow (Fig. 3). Tyler biofilm devices are designed to support laminar flow over a wide range of volumetric flow conditions. For low pressure devices, this represents flow rates of 1ml/min to more than 100ml/min. Correspondingly higher rates are supported by the larger bore of medium and high pressure devices.

Because laboratory installations are run at low pressures, the Biofilm Device can be installed using silicone or vinyl tubing in place of rigid piping. The system (both in the laboratory and in the field) should be cleaned thoroughly and sterilized prior to installation. Please refer to the articles below for a more in-depth description of typical testing procedures.

1. Adams, J.L., and R.J. McLean. 1999. Impact of *rpoS* deletion on *Escherichia coli* biofilms. Appl. Environ. Microbiol. 65:4285-4287.
2. Curtin, J., Cormican, M., Fleming, G., Keelehan, J., and Colleran E. 2003. Linezolid Compared with Eperezolid, Vancomycin, and Gentamicin in an *In Vitro* Model of Antimicrobial Lock Therapy for *Staphylococcus epidermidis* Central Venous Catheter-Related Biofilm Infections. Antimicrobial Agents and Chemotherapy. 47:3145-3148.