

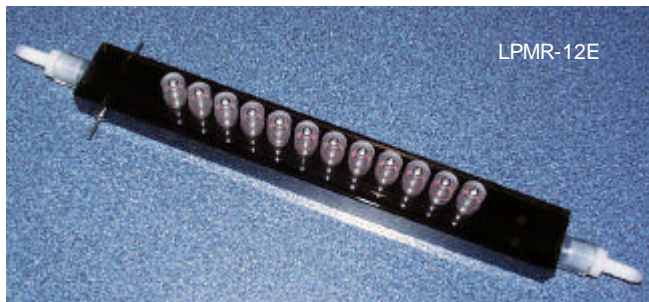
Tyler Research Corporation

Low- and Mid-Pressure Biofilm Devices

The Tyler Research Low- and Mid-Pressure Biofilm Devices (LPMR-series and MPMR-series) are available in a variety of materials including metals (stainless steels, aluminum alloys, bronze and brass alloys, specialized ferrous and non-ferrous alloys, etc.) engineered plastics (polyimide, polyetheretherketone, Kevlar, Teflon, etc.) and plastics (transparent and opaque acrylics, polyvinylchloride, Corian, etc.). Seals are available from buna, viton, nitrile and silicone. The systems are designed to contain *n* sampling coupons of virtually any composition, each with a surface area of 50mm² (LPMR- and MPMR-series) or 100mm² (MPMR-series). The coupons are held in a linear array along a channel of rectangular cross section, forming part of the channel wall. LPMR- and MPMR-series devices may be spliced into open or closed-loop systems, connected via standard barbed fittings. Pressure ratings of the manifolds vary with composition and seal configuration, typically ranging from 100 to 800 kPa and with flow rates of from 0.02 milliliters/minute to 4000 milliliters/minute.

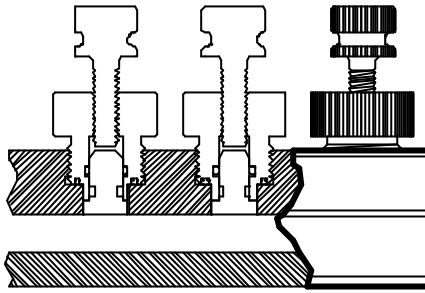


Standard low-pressure manifolds are available in a clear transparent acrylic or a dark bronze-tinted transparent acrylic, or in totally opaque PVC. The LPMR-12 and the LPMR-25 contain, respectively, 12 or 25 individual



ports in a linear array along a channel of rectangular cross-section (typically 10mm x 3mm). Each port accepts a press-fit plug holding a sample coupon with a surface area of 50 mm² (typically stainless steel, although coupons may be made from almost any material). The design of the plug is such that the surface of the coupon essentially becomes part of the channel wall. Bacteria introduced into the fluid stream adhere to the coupon and ultimately establish a biofilm, which may then

be removed for analysis. These devices are intended for low-flow applications with a maximum pressure rating of 100 kPa. Low-pressure biofilm devices are also available in an electrical format. Depending on the conductivity of the sample coupon, one or two platinum electrodes traverse the primary bore, and each coupon holder is designed for electrical contact, so that a weak alternating electric field may be established to influence biofilm growth.



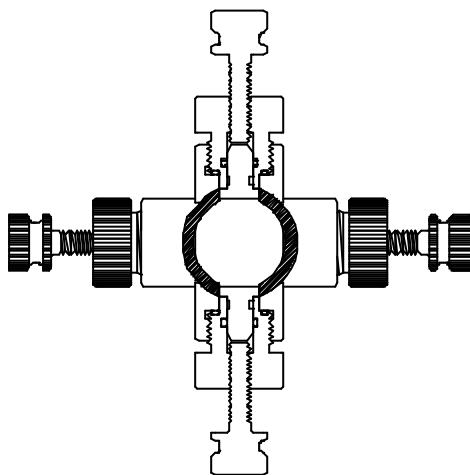
The LPMR series is a modification of the original Robbins device, with press-fit plugs sealed by a radial O-ring (see schematic diagram at right).

The mid-pressure systems (of which there are many different types) are of Tyler design, with screw-in plugs sealed by an axial O-ring (see schematic diagram at left). This type is capable not only of higher pressures and flow rates, but provides a superior positioning of the coupon in the laminar flow region of the manifold.



Within the mid-pressure series there are two basic manifold designs. The first is a heavy-walled tube of circular cross-section with ports positioned radially and inlet and outlet ports at either end. The standard bore for this configuration is 2.5cm with lengths ranging from 30cm (6 sampling ports positioned at 0° and 180°, each capable of holding a single removable coupon with a surface area of 100 mm²) to 150cm (32 sampling ports positioned at 0°, 90°, 180° and 240°. Typically machined from PVC, the system is intended for high-flow applications at pressures below 400 kPa.

The second design class in the mid-pressure series offers the same coupon size and material considerations, but is a monolithic block with linear or serpentine sampling port arrays in a uniform rectangular channel cross section (see the MPMR-15N figure above). These are often designed specifically for industrial applications where space constraints are a consideration.



Radial Port Configuration

In most instances coupons of large surface area (greater than 100mm²) are best accommodated by a cassette-type manifold, although special designs can be made to permit their use in multiple port-type systems such as the standard tubular and monolithic MPMR-series devices. Cassettes are locked in place in the manifold with thumbscrews against full contact O-rings. The standard channel configuration is of rectangular cross section in either linear or serpentine arrays. Typically machined from acrylic or PVC, the MPCR-25, for example, contains 5 flat cassettes, each of which holds 5 coupons. The surface area of each coupon is 285mm² and the maximum rated pressure of this device is 275 kPa.

Sterilization Procedures for Biofilm Devices

All metal biofilm devices are capable of being autoclaved, as are those machined from certain high performance engineered plastics. There are many alternatives to autoclaving for those materials (such as polyvinyl chloride and acrylic), which will not survive exposure to sterilizing temperatures. These include thorough washing in mild detergents and warm water followed by one or more of the following procedures:

- 1) exposure to ethylene oxide gas (available in many hospitals)
- 2) exposure to ionizing radiation (Cobalt 60 gamma or X-rays)
- 3) treatment with agents containing 2% glutaraldehyde (*e.g.* Cidex)
- 4) soaking overnight in sodium hypochlorite solution (5%)
- 5) prolonged exposure to sodium metabisulfite solution (15 g/liter)

Ionizing radiation may cause surface crazing of some materials (such as acrylic) and may lead to color changes over time. In the event that procedures 3, 4, or 5 are used, it is important to soak and rinse the devices in sterile deionized water thoroughly before placing them back in service.