

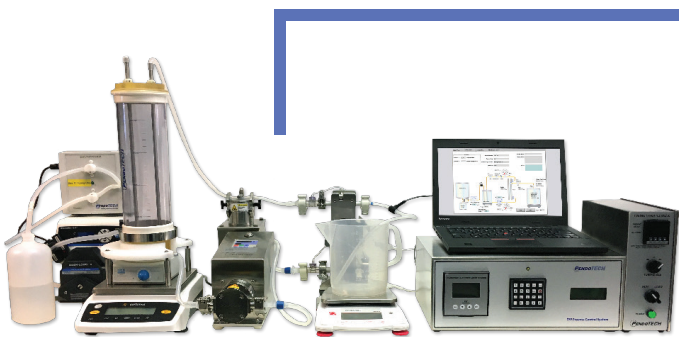
**PendoTECH® Throttle Valve™:
 For Pressure or Flow Control**

Product Overview

In bioprocess operations, flexible tubing is frequently used for process development and production. As liquid flows through the tubing, it is desirable to minimize contact with other components that may contribute to hold-up volume and may be contaminated by process fluids. The PendoTECH Tubing Throttle Valve enables pressure or flow control by varying flow path area by only contacting the outside of the tubing without the valve contacting the fluid. It is ideal for trans-membrane pressure (TMP) control in a tangential flow filtration (TFF) process where TMP is a major process control parameter.

Main Features

- Controls pressure or flow without contacting fluid
- Can be used with different types of tubing (included braided)
- Setpoint easily adjusted real-time with up/down arrows or via external signal
- The tubing size selector switch optimizes performance with different tubing diameters
- Remote control option available



*PendoTECH TFF Process Control System
 [Benchtop setup shown - can be used in all
 configurations]*



PendoTECH PressureMAT Throttle Valve Setup



*Rod Position Control by PLC/DeltaP
 with Remote Throttle Valve Version*

Details

The valve consists of the main items in the following picture:

Rod moves up/down to vary the flow path area like a traditional control valve

Tubing Guide can be quickly changed for different tubing sizes

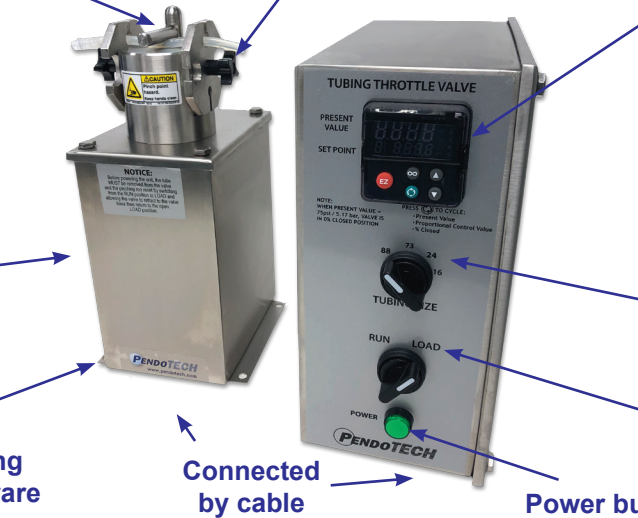
Set Point and Present Values are displayed and the Set Point can be entered externally by an analog signal or set locally via the keypad on this high-speed PID controller. This PID controller compares the present value and setpoint and adjusts the rod so they equal each other. [This component is not present with the remote version because in the remote version the position of the rod is set directly]

Precision stepper motor inside that can move in fine increments

Tubing size selector enables one valve to be used with a wide range of tube sizes with different wall thicknesses

Holes for optional mounting to system hardware

Install selector switch that lifts the rod for tubing installation (not present with remote control version)

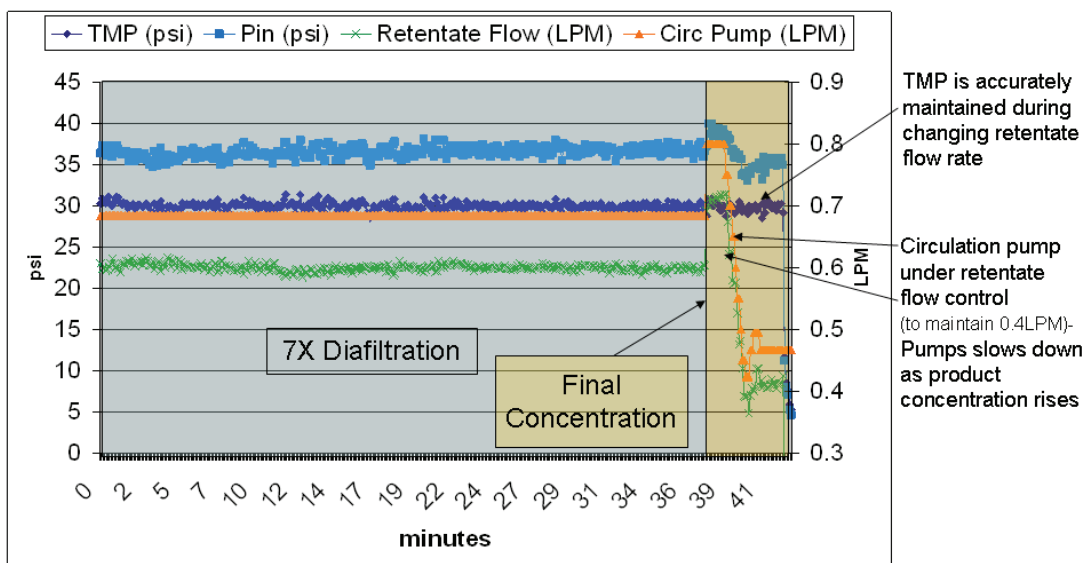


Connected by cable

Power button

As shown in the graph below there is data of trans-membrane pressure control in a cross-flow filtration process (Size 24 tubing, data every 3 secs). At the time point on the x-axis of 39 minutes as the pump is slowing down which would result in a change of the inlet pressure, the Throttle Valve responds quickly to maintain control of the TMP.

Diafiltration/Concentration Process with TMP Control



Features

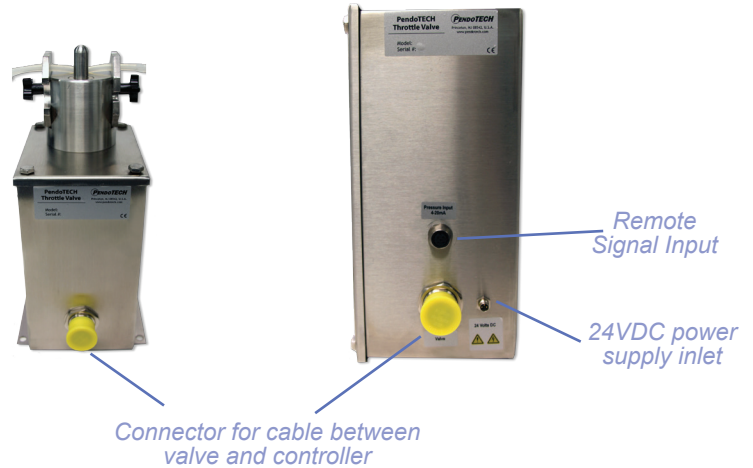
- Controls pressure or flow without contacting fluid
- Can be used with different types of tubing (included braided)
- Setpoint easily adjusted locally by keypad or externally
- One-touch display of valve % closed to monitor performance
- If default settings are not optimal; real-time adjustment of PID control settings

For use with different tubing sizes with each selectable on the front panel.

Can be used for FLOW CONTROL or PRESSURE CONTROL

- Flow Control:
 - Signal from flow meter plugs into valve
 - Flow set point is entered into the valve controller
 - The flow is maintained
 - Has been successfully used with pressurized liquid sources such as purified water systems and pressurized tanks
- Pressure Control:
 - Pressure signal plugs into valve
 - Pressure set point is entered into the valve controller
 - The back pressure is maintained
 - Can be used with constant flow systems to maintain a specific back pressure

Back Panel




Features of High Speed PID Controller

Present (Process) Value

Setpoint Value

Function Buttons:

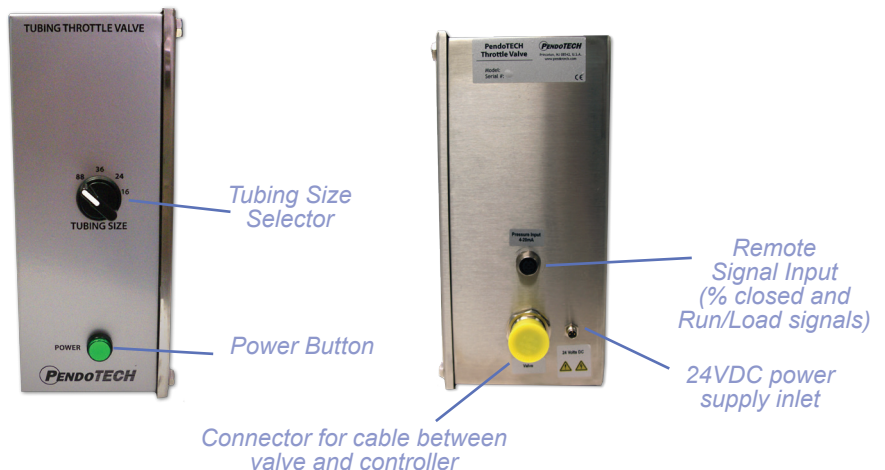
- Advance Key  - scroll display option for the 1st line - Present value, proportional control value or valve % closed

- UP/DOWN arrows - used to change values on display such as used to change P value (proportional control value) or if not in remote setpoint control then used for the setpoint



Remote Version Features

- Remote control of valve position with 4mA open and 20mA closed
- Remote dry contact performs Run/Load function

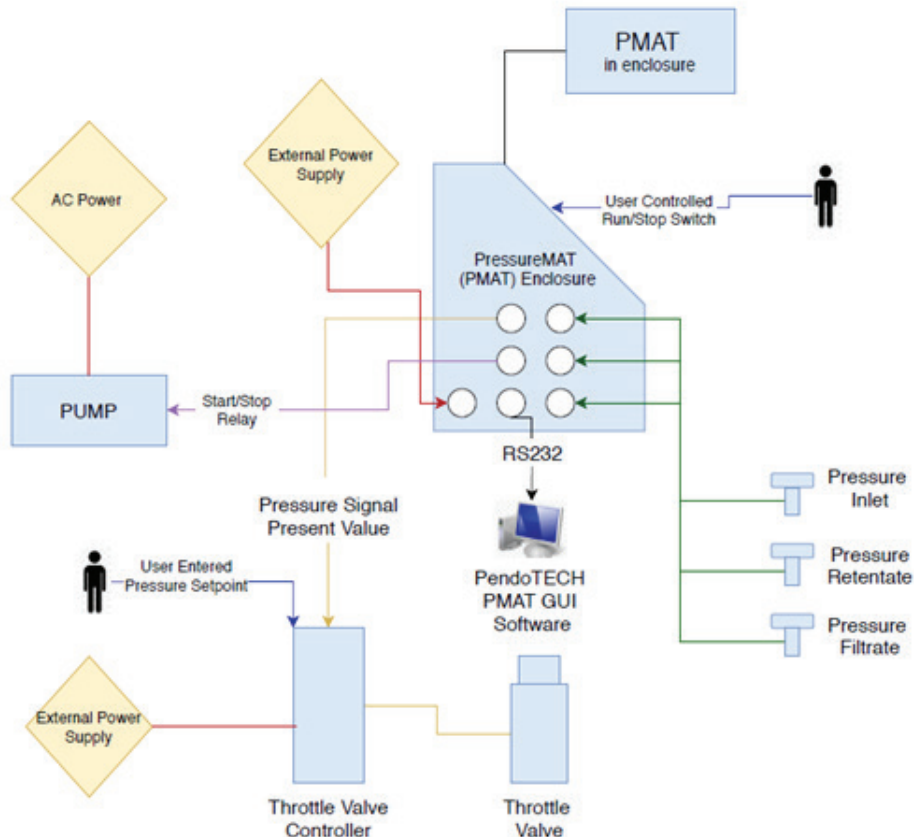


PendoTECH PressureMAT® TMP Control Station

The PressureMAT TMP Control Station is a special PressureMAT configuration of the model PMAT3 that can interface directly to the PendoTECH Tubing Throttle Valve for pressure control. One of the key applications of this product is automated control of trans-membrane pressure (TMP) in a TFF/Cross Flow Filtration Process. The setpoint is entered directly on the Tubing Throttle Valve and the present value of the TMP calculation is transmitted to the Tubing Throttle Valve. The high-speed PID controller regulates the position of the throttle valve rod so the present value will equal setpoint. The pump speed is controlled manually from the pump keypad; however, to coordinate the control interface between the PressureMAT and the pump start/stop, the pump is remotely controlled for start/stop by the TMP Control Station via a switch on the front panel. Additionally, if there is a PressureMAT alarm condition such as high pressure the pump will be stopped. Units of psi or bar can be selected.

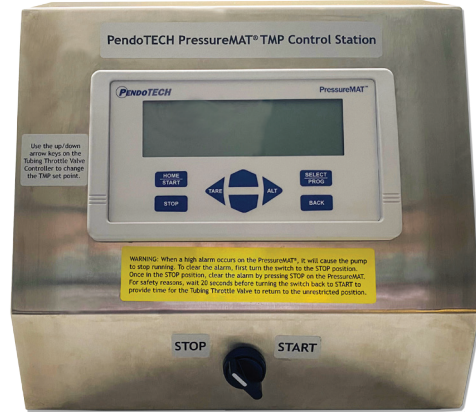


Below is shown a block diagram of the entire equipment schematic. The data from the PressureMAT and one scale can be logged directly to the PendoTECH PMAT-GUI Software (PC not shown in picture above)





The TMP Control Station contains a specially configured PressureMAT model PMAT3 that interfaces with the pump for remote start/stop and with the Tubing Throttle Valve to transmit the TMP present value.



START/STOP Switch

When the switch is in the STOP position, the pump will not be running, and the Tubing Throttle Valve will be in the unrestricted position (100% open). When the switch is in the START position, the pump will run, and the Tubing Throttle Valve will receive the TMP present value from the PMAT and begin to close to maintain the TMP set point



Left Side Panel

On the left side panel is where all connections are made to complete the setup. The connections are for:

- Throttle Valve (sends TMP signal)
- Pump (for remote start/stop of pump)
- Pressure Sensor Inputs (via 12ft reusable cables)
- RS232 (connection to PC software)
- Power Supply

There are pump interface cables available for a variety of different pump models. Any PendoTECH pressure sensor size can be used from the wide selection available.

Throttle Valve Specifications

Enclosure	Material: 304 stainless steel NEMA 4X sealed water-tight design
Dimensions (1) Valve (2) Controller	Valve Controller: L x D x H - 4 3/4 x 10 1/4 x 10 1/4 inches (12.065x26.0x26.0cm) Valve: 4 3/8 (5 1/4 at mounting base) x 5 7/8 x 11 (approx. to top of rod) inches 11.1 (13.3 at mounting base) x 14.9 x 27.9cm
Power requirement	24 Volts DC (1.5amp maximum 100-250VAC to 24VDC supply included)
Valve input signal	Present Value: 2-10V (default setting) in range of 75-0psi with 2V = 75psi [or 5.17bar] and 10v = 0 psi [or 0bar]. This is set to send a high present value if the signal is lost which will cause the value to open Remote Setpoint: 4-20mA value with 4mA = 0psi [or 0bar] and 20mA = 75psi [or 5.17bar]. 5 pin female M12 style connector : Pin 1: Present Value input – PLUS Pin 2: Analog ground - MINUS, Pin 3: Setpoint Value input-mA PLUS 18-28°C accuracy is 0.1% of reading + 0.03mA; 0-50°C accuracy is 0.3% of reading + 0.04mA 10Ω impedance, 100mA max overload, 10μamp resolution
Valve input signal - REMOTE VERSION Settings	4-20mA with 4mA open to position based on tubing size and 20mA to closed with position based on tubing size. Pin 1 is plus, Pin 2 is minus
Default tubing sizes	Masterflex Size (ID) : 16 (1/8inch), 24 (1/4inch), 73 (3/8inch) , 88 (1/2inch) NOTE: Other tube sizes with the same wall thickness as those listed can be used
Position Control	Linear actuator with precision stepper motor; Panel mount process controller with adjustable PID settings and setpoint and present value display based on analog input; fail to open
RUN/LOAD Position Control - STANDARD	Via panel mount switch
RUN/LOAD Position Control - REMOTE VERSION	Remote DRY CONTACT to Pin 3 and Pin 4 Pin 3 is plus, Pin 4 is minus Fully open to LOAD position with contact CLOSED and in RUN position with contact OPEN

Throttle Valve Ordering Information

PDKT-PVT	Throttle valve for flow or pressure control, tubing size selectable for size 16, 24, 73, 88
PDKT-PVT-P	Throttle valve for flow or pressure control, tubing size selectable for size 16, 24, 73, 88 without PID controller

PressureMAT TMP Control Station Ordering Information

PMAT-BNCH-PVTP	PressureMAT water-tight benchtop stainless steel box with PMAT3 installed, for use with PendoTECH Tubing Throttle Valve, TMP Control
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PressureMAT TMP Control Station Includes*:

- PressureMAT model PMAT3 installed into the stainless steel enclosure
- Three cables for connection of pressure sensors - 12ft / 4meters
- Power Supply with blades for country
- PressureMAT® (PMAT) TMP Control Station Setup and Usage Instructions

* Pump interface cable not included - the cable for specific pump model must be ordered separately