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McMillan Model U801 Flow Controller
Guide To Selecting Flow Ranges and Pressure Configurations.

Pressure Configurations Available

There are five different pressure configurations for the Model U801. Availability for each depends on the flow rate required. The configurations are specified as follows:

Valve	Min P psi	ΔP psid
P5	5	2-10
P10	10	4-20
P20	20	5-40
P25	25	7-50
P40	40	10-60

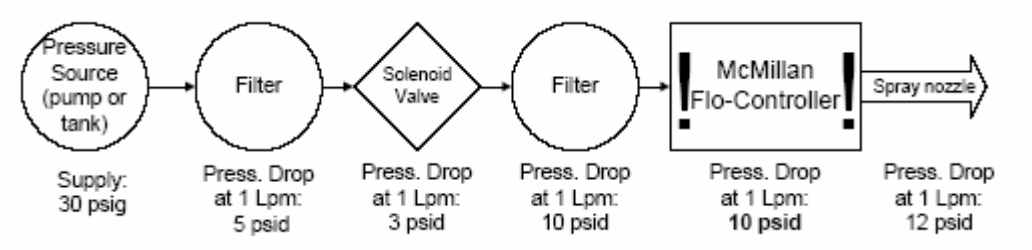
Each valve configuration is denoted by the minimum pressure required for 100% of the rated flow eg. A P20 unit requires 20psi or more to flow 100% of the rated flow. This does NOT mean that the unit cannot operate at lower pressures.

The pressure range detailed in the third column above indicates the recommended differential pressure range for each configuration unit. The first (lower) number is the minimum pressure required for 50% of the rated flow and the second number is the maximum pressure for stable control.

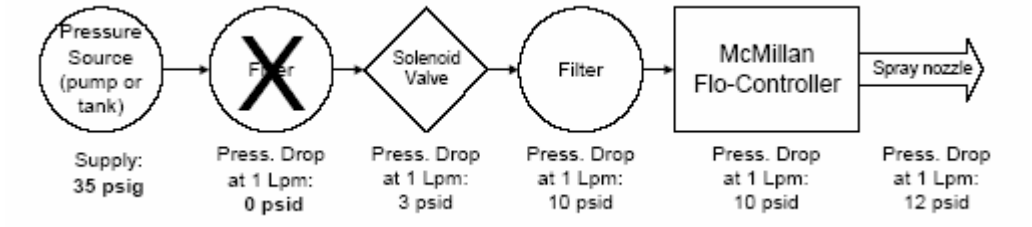
For a P20 valve 5psi (or more) is required for 50% of flow and 20psi (or more) is required for 100% of flow. The maximum pressure for stable control is 40psi. Above this the unit would still function but there would be a decrease in resolution and accuracy.

Selecting the Correct Pressure Configuration and Flow Range

It is important to determine the actual pressure available to operate the unit. This can be done by taking into account the pressure requirements of all the equipment in the system. Differential pressure, or pressure drop, in a system is cumulative. For example, consider this system:



This system starts with 30 psig of supply pressure but other components (minus the flow controller) total 30 psid. This leaves no pressure for the flow controller. Either the supply pressure would have to be increased, and/or a source of pressure drop (such as the post-pump filter) would need to be eliminated:



The system now has 10psi available to operate the flow controller. If the supply pressure was 40psi then there would be 15psi available to operate the controller.

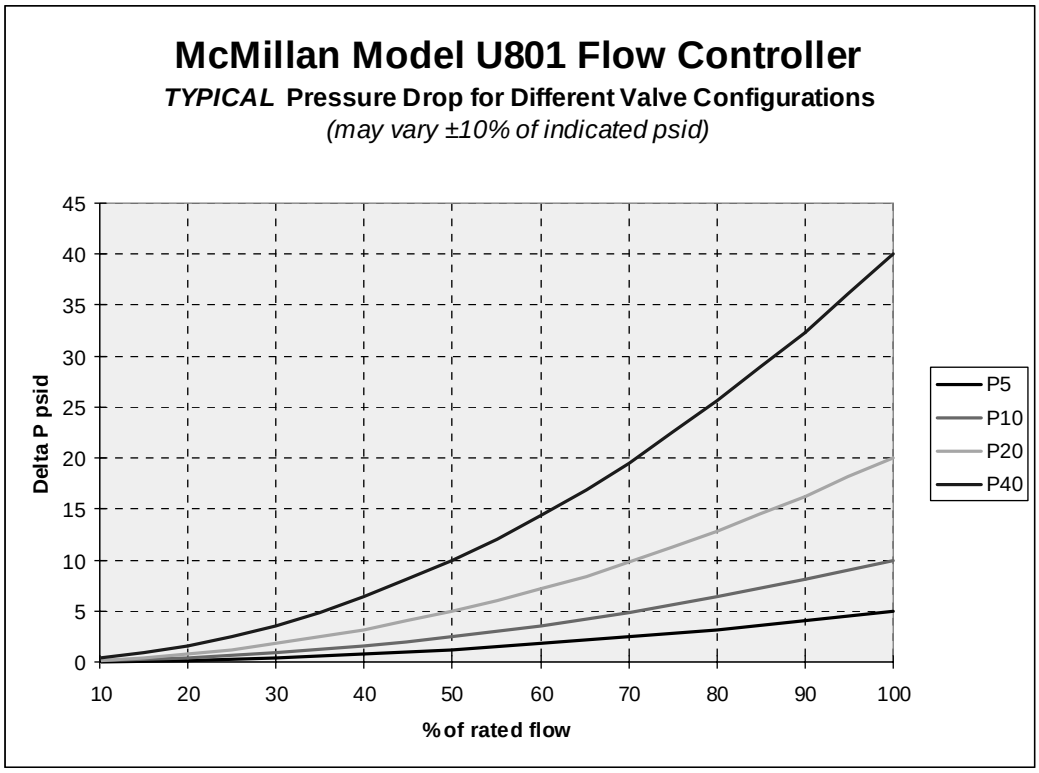
The different pressure configurations available for each flow range are detailed in the following table:

Flow Range	Range	P5	P10	P20	P25	P40
15-100mlpm	3	X	X	YES	X	YES
20-200mlpm	4	YES	YES	YES	X	YES
50-500mlpm	5	YES	YES	YES	X	YES
0.1-1.0lpm	6	YES	YES	YES	X	YES
0.2-2.0lpm	7	YES	YES	YES	X	YES
0.5-5.0lpm	8	X	X	YES	X	YES
1.0-10.0lpm	9	X	X	X	YES	YES

For simple systems where the available pressure is stable, selection of the correct flow range and pressure configuration is relatively easy. For example, if the pressure available to the unit is 25 psi and flow needs to be controlled at 300mlpm then a range 5, 6 or 7 unit with P20 valve would be the obvious choices.

For systems where the available pressure varies and several control points are required, selection of the correct configuration can be complex. In this case it is important to consider the differential pressure requirement at each flow rate control point.

The required differential pressure for the controller decreases exponentially with decrease in flow rate.



Note: the P5 and P10 control from 20-100% of the maximum rated flow. All other configurations control from 10-100% of the maximum rated flow.

To calculate the minimum required differential pressure at a certain flow rate the following formula may be used:

$DP = (YourFlow \div MaxFlow)^2 \times MinDP$

- DP = minimum required differential pressure at YourFlow
- YourFlow = flow rate (in mLpm or Lpm) where you wish to calculate DP
- MaxFlow = 100% rated flow rate for your flow controller (in same units as YourFlow)
- MinDP = Minimum differential pressure required at 100% rated flow (see table above) in psid

By referring to the graph above, suitable configurations for any given pressure and flow may be deduced.

For example consider the following systems:

1. Pressure varies between 7 and 13psi, flow needs to be controlled at 250mlpm. The options are:

50-500mlpm unit. Here 250mlpm is 50% of flow. By consulting the graph above it can be seen that at this flow a P5 valve requires approx 1psi, a P10 approx 2.5psi, a P20 approx 5psi and a P40 approx 10psi.

The P5 valve can be excluded as the maximum allowable pressure for stable control is 10psi. The P40 is also unusable as the available pressure is sometimes below 10psi. That leaves the P10 or P20 as options

It should be noted that as the P20 requires 20psi for 100% of the flow range ie. 500mlpm, then the maximum that could be flowed through the unit at 7psi is approx 300mlpm and at 13psi is 400mlpm. Even though the total capability of the unit is restricted, there is no problem in controlling at the required 250mlpm. Similarly the P10 configuration would be restricted to approx 425mlpm at 7psi.

0.1-1.0lpm unit. Here 250mlpm is 25% of rated flow. In this case the P5, P10, P20 and P40 would all work. The best choices however would be the P20 or P40 as their slightly higher pressure requirement at 25% of flow make stable, accurate control more predictable.

0.2-2.0lpm unit. Here 250mlpm is 12.5% of the flow. A P20 or P40 would work but control would be at the limits of the unit's capability. A 50-500mlpm unit would provide a better solution.

2. Pressure varies between 7 and 13psi, process flow needs to be controlled at 200mlpm AND 50mlpm. The are two possible flow ranges that can be selected and three potential valve configurations (the P5 has a maximum pressure of 10psi for stable control). By consulting the graph or using the formula above the required differential pressure at each flow control rate can be deduced as follows:

	20-200mlpm unit		**50-500mlpm unit**	
Valve	Approx ΔP at 50mlpm	Approx ΔP at 200mlpm	Approx ΔP at 50mlpm	Approx ΔP at 200mlpm
P10	0.6	10	N/A	1.6
P20	1.2	20	0.2	3.2
P40	2.5	40	0.4	6.4

For the **20-200mlpm unit,** the P10 option would work.

For the **50-500mlpm unit,** the P20 or P40 option would work.

3. The same as example (2) above but with a second liquid (eg deionised water) being occasionally flushed at 400mlpm with a pressure or 45psi:

The 20-200mlpm unit would no longer be suitable as both the 400mlpm and 45psi is outside it's capabilities. Similarly the 50-500mlpm unit with a P20 valve would not be suitable as 45psi is above the maximum recommended pressure for stable control.

The only option would be a 50-500mlpm unit with a P40 valve. This would successfully control both liquids within the stated parameters.