

Supporting Information for “A Magnetorheological Elastomer Based Proportional Valve for Soft Pneumatic Actuators”

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Abstract

This Supporting Information includes: the detailed dimensions of the MRE valves, the dimensions of the four different MRE geometries investigated, and the detailed setup and parameters of the PID controllers used.

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Dimensions of the MRE valves

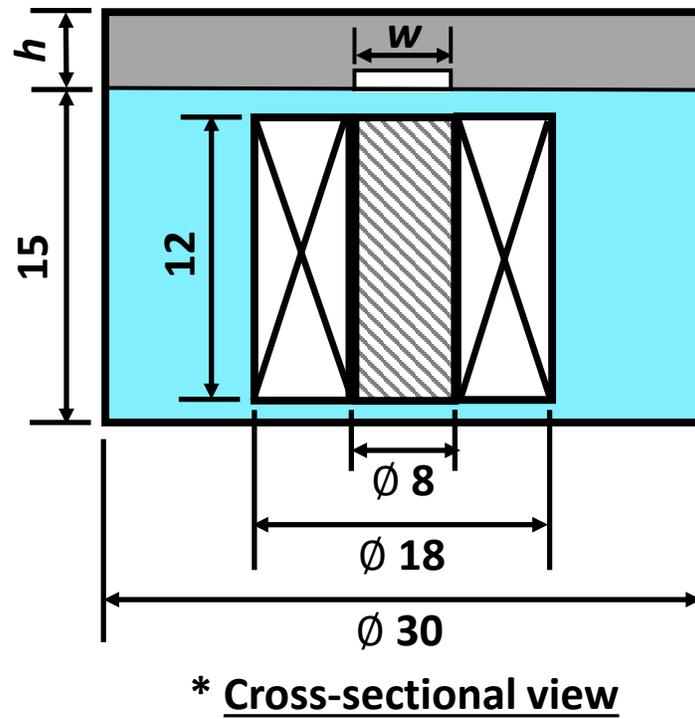


Figure 1: The detailed dimensions of the MRE valves presented, h and w are the adjustable parameters investigated in this work.

Dimensions of the four different MRE geometries investigated

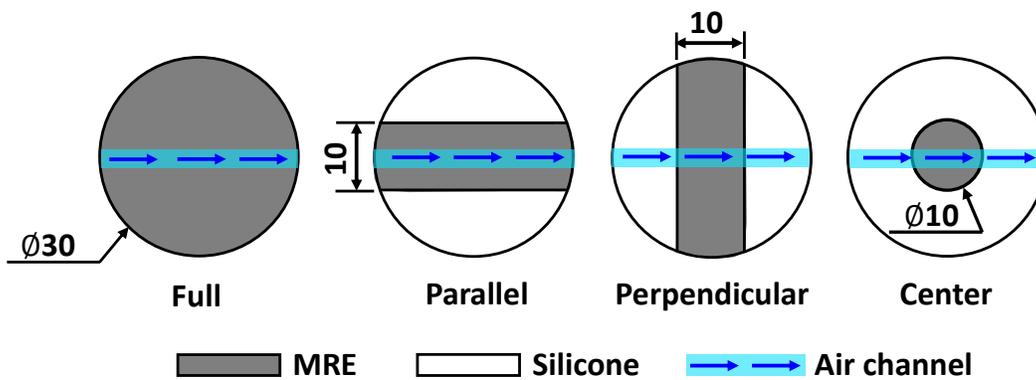


Figure 2: The detailed dimensions of the four different MRE geometries investigated.

Setup details of the PID controller

For controlling the flowrate and pressure, a microcontroller (Teensy 4.1) is used to implement the closed-loop PID controller. The detailed setup and parameters of the PID controllers used are attached below.

Parameter	Value (<i>Units</i>)
Controller Input	Flowrate error (<i>mL/min</i>)
Controller Output	PWM duty factor
Output Range	0 (fully OFF) to 255 (fully ON)
Sampling Rate	50 Hz
Bias	128
P Gain	0.06
I Gain	0.04
D Gain	0.01
Wind-up Limit	From -100 to 100

Table 1: Setup of the PID controller for flowrate control with “Only PID” control scheme

Parameter	Value (<i>Units</i>)
Controller Input	Flowrate error (<i>mL/min</i>)
Controller Output	PWM duty factor
Output Range	0 (fully OFF) to 255 (fully ON)
Sampling Rate	50 Hz
Bias	Given by model
P Gain	0.02
I Gain	0.02
D Gain	0.01
Wind-up Limit	From -100 to 100

Table 2: Setup of the PID controller for flowrate control with “PID + Model” control scheme

Parameter	Value (<i>Units</i>)
Controller Input	Flowrate error (<i>mL/min</i>)
Controller Output	PWM duty factor
Output Range	0 (fully OFF) to 255 (fully ON)
Sampling Rate	50 Hz
Bias	128
P Gain	0.07
I Gain	0.0
D Gain	0.02
Wind-up Limit	From -100 to 100

Table 3: Setup of the PID controller used for pressure control