

Appendix E

Rig Air Supply Manual

The rig air supply system is used for all experiments discussed in this thesis, and therefore its operation is explained once here and can be applied to each experiment. The air supply system has three major components: the supply lines, pressure and flow control devices, and flow measurement. Each component and its operation is discussed in detail in the following paragraphs.

The rig can consume compressed air from two separate compressors. The RFL has a Kaeser Sigma Profile SM-11 compressor located in a dedicated room just inside the front door of the lab. Air can also be delivered from a large four cylinder, high pressure compressor located in the basement of the Aerospace Engineering side of Randolph Hall. Refer to Appendix D for information regarding the operating procedures for this compressor. For any operation or maintenance information about the Kaeser compressor, consult its manual in the RFL equipment files. The manual provides information on routine maintenance, as well as adjustments that can be made to the performance of the compressor.

Figure E-1 shows a picture of the air supply lines along with the flow and pressure control devices for the air supply system. Line 1 is a ½ inch line from the Kaeser compressor and line 2 is a 2 inch line from the Aerospace compressor. The orange and yellow handled ball valves control these lines. Be sure to only open one line at a time, as opening both simultaneously could damage the RFL air system and possibly lead to operator injury. Line 1 is regulated at 60 psi and connects straight into the rig electronic pressure regulator. The regulator for Line 1 is located in the hall above the circuit breaker panels, and its manual can be found in the RFL equipment files. Line 2 can deliver air at any pressure up to 300 psi so the Kaye & MacDonald ZG 093 regulator is required to reduce the pressure to within the maximum limits of the electronic regulator. Both Line 1 and the regulated Line 2 join in a tee before the electronic pressure regulator. Economical pressure gauges are installed to indicate the pressure both

upstream and downstream of the Kaye & MacDonald and electronic regulators. The manuals for both pressure regulators can be found in the RFL equipment files.

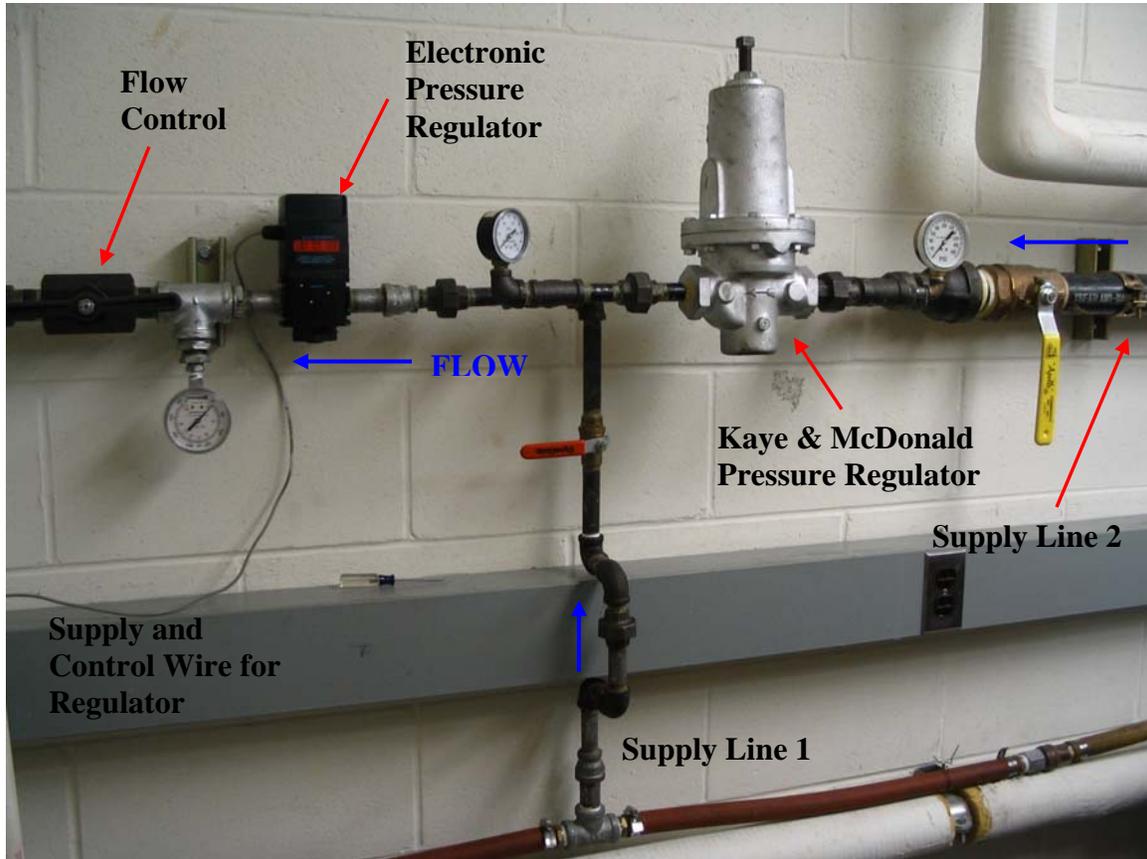


Figure E-1. Rig air supply system; supply lines, pressure and flow control devices.

After passing through the flow control valve, the flow turns 90 degrees and enters the Eldridge Products Inc. thermal mass flow meter shown in Figure E-2. The manual for this flow meter is located in the RFL equipment files, and contains the flow meter specifications should it need to be recalibrated at some point in the future. The air flow rate measured by the flow meter is converted into a voltage which is sampled by a National Instruments DAQ card in the 'LDV computer.' A LabVIEW VI running on the 'LDV computer' samples the flow meter voltage, takes an average over ten samples, applies the meter calibration equation, and displays the air flow rate in both SCFM and kg/s. The rig flowmeter was calibrated against a Hastings 301-D thermal mass flow meter before any experiments were run. The results of the calibration are applied to the

measured flow rate in LabVIEW. After passing through the flow meter, air enters a ½ inch diameter tube in which it travels to the test section inlet plenum.

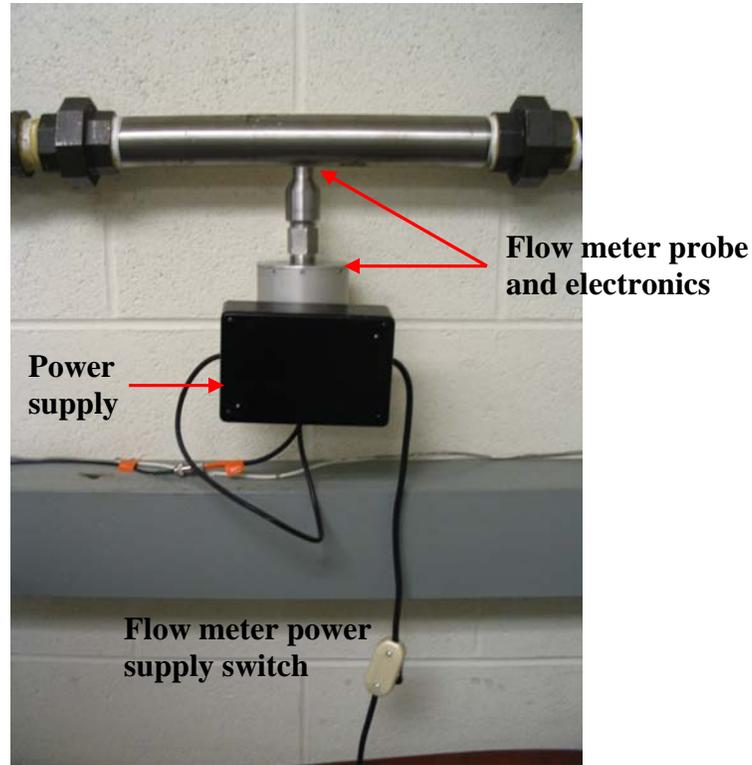


Figure E-2. Eldridge Products Inc. thermal mass flow meter.

The electronic pressure regulator is powered by a pair of power supplies located in the top of the ‘LDV Electronics Rack.’ These power supplies are shown in Figure E-3. The top supply provides a constant +12 Volt supply power for the regulator, while the lower supply provides the control voltage for the regulator from 0 to +10 Volts. The regulator can also be current-controlled, but in this application, voltage control was simpler to implement and the line length was short enough to avoid any noise problems.



Figure E-3. Electronic pressure regulator power supply and control voltage source.

To achieve a desired air flow rate from the rig air supply system, it is best to set the electronic pressure regulator control voltage with the flow control valve half-open. Once the desired flow rate has been approximately achieved with the regulator control voltage, adjustments to the flow control valve permit a fine tuning of the flow rate.