The McCrometer static gravimetric flow calibration stand can test **l/2"** to **4"** V-Cone flowmeters. Attached drawing STAND1 is a schematic diagram of the testing apparatus. Attached drawing ELBOW2 is a diagram of the piping before, through, and after the test section. The closed system recirculates water constantly from a 500 gallon storage tank.

The flow is drawn from the tank by an electric pump via 4" PVC pipe. From the pump, the water enters an upstream header. The 10 inch by 6 foot chamber incorporates straightening vanes and a dampening screen to dampen pulsations from the pump. A recirculating by-pass line of 2" PVC pipe also helps to reduce pulsations. The water leaves the header horizontally through a 2" PVC ball valve. This is used to ease start-up vibrations in the diverter section.

The water passes through 100 inches of straight 2" PVC pipe before entering the double elbows out of plane. Flow then passes through the thirty-four foot horizontal test section. After passing the V-Cone and the downstream pipe run, the water turns vertical, passing a 2" PVC ball valve. This valve is used for flow regulation purposes. The diverter section follows.

A pneumatic system diverts the water to either a receiving tank open directly to the storage tank or to a collection tank. The collection tank is used during testing for weighing the collected water over a measured time. A timer is triggered by an optical sensor on the diverter to measure the precise time of the collection period. A mercury thermometer is used to measure fluid temperature as the collected water drains back into the storage tank.

In the test section, the meter was leveled prior to testing. Differential pressure taps on the meter were positioned horizontally facing the "inside" of the elbows. A "smart" differential pressure transmitter measured the differential pressure (DP) created by the meter. The 4 to 20 mA signal from the transmitter was measured with a Keithley **196** multimeter. Test data was taken down manually from the Keithley. Approximately fifty readings were taken for each point.

Prior to testing, the transmitter was calibrated using a pneumatic dead weight tester. The "smart" capability of the transmitter allowed the full scale DP of the transmitter to be scaled to the full scale DP created by each meter at the desired high flowrate. Full scale DP was set at 125 "H_2O, 50 "H_2O, and 25 "H_2O for beta ratios of 0.367, 0.650, and 0.750 respectively. This allowed for the greatest resolution from the transmitter.

The McCrometer static weight 4" to 16" V-Cone meter flow calibration lab is shown, in schematic representation, in the diagram STAND2. The facility constantly circulates water through the testing area. Fluid passes through the pump(s) into an upstream header. The header serves to dampen pump hammer. A ten inch by-pass recirculating line between the header and the pump also dampens hammer at low flow rates and can be used to regulate upstream pressure as well as maximize pump efficiency. Flow passes through the test section of the facility where the meter is located. Differential pressure taps on the meter are connected to a differential pressure transmitter which, in turn, sends a 4-20 milliamp signal to an analog to digital converter. The signal from the A/D converter is processed by an IBM-PC compatible computer. Flow is regulated downstream of the testing section by concentric orifice flow regulating discs and an electronically controlled butterfly valve, which are set to a constant flow position before a test is begun, through out the test, until after the test is completed. The flow then passes over a piston driven diverter that channels the water into: 1) an exhaust tank when the test is inactive, or 2) a collection tank when the test is active. The test is activated by optical switch mounted on the diverter. The switch makes contact when the "test active" trigger is pressed. It is deactivated by the same optical switch making contact again when the "test inactive" trigger is pressed. The fluid gathered in the collection tank is then weighed on a precision scale to determine the weight of water involved in the test. A timer is triggered active and inactive simultaneouslyto the optical switch. This is the time reference for the test. Fluid temperature is measured during the test via a mercury thermometer.

Key components of the system are:

The Pump - Two 60 hp electric centrifugal pump.

The Header - 24" diameter x 6' stainless steel chamber.
Flow Regulation - electronically controlled positionable 8" butterfly valve.

Weight - A precision certified NIST traceable scale, capable of collection over 30,000 pound of water to a resolution of 2 pounds.

Time - A precision digital timer, traceable to NIST, capable of 999 second tests to a resolution of 0.001 second.

Temperature - Two precision electronic liquid temperature sensors, traceable to NIST, with a range of -20 to 120 degrees fahrenheit and a resolution of 1 degree fahrenheit.

DP Transmitters - A variety of precision DP transmitters from 4 inches of water column full scale to 750 inches of water column full scale, each calibrated against a certified NIST traceable pneumatic dead weight tester and incline manometers. All transmitters are set to generate outputs linear to differential pressure.

Analog to Digital Converter - 12 bit resolution, samples the signal from the transmitter at different rates from 5OkHz to 5OOHz to avoid harmonic biases.

IBM-PC Compatible 32 bit resolution on computations. Utilizes characteristic curve fits for DP transmitter performance (determined from dead weight testing). Variably selectible test lengths and inter-test delays between sampling groups are used. The program is capable of sampling up to 12 discreet groups of differential pressure signals across a test period and gathers 50 samples per sample group (the 50 samples are averaged for the sample group value, and then the sample groups are averaged to yield the test differential pressure). Weight, time and temperature are entered separately.