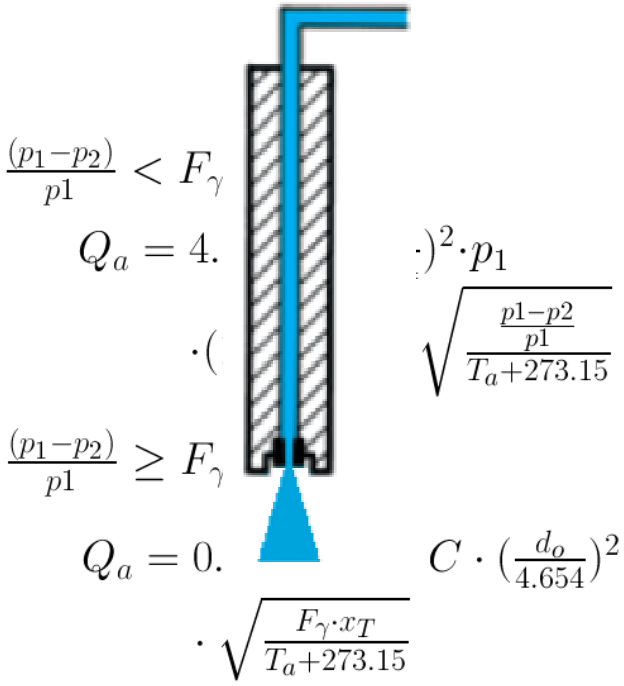
Willrich Precision
Ph 866-945-5742
sales@willrich.com



Mahr Federal MarSolutions

Product Application Introduction

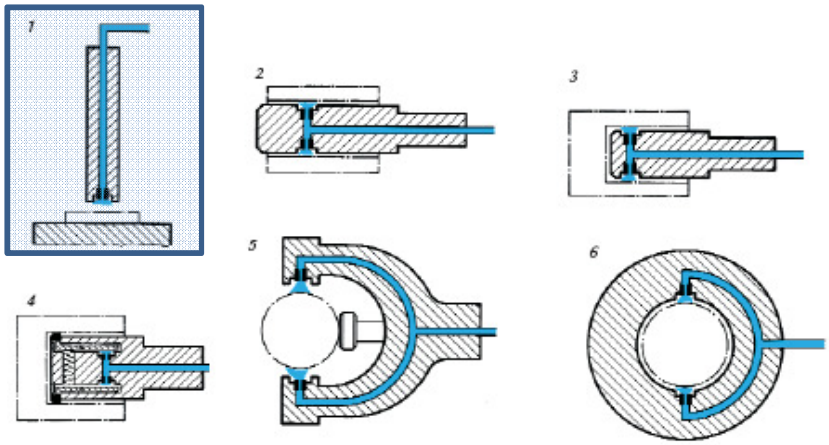
AIR FLOW GAGING

Mahr

Why Talk About Air Flow Gaging?

- Manufacturer's of small holes need a way to measure them
- Mahr Federal is a known leader in air gaging, including exotic applications
- Flow is a natural element of back-pressure systems
- No air tooling required

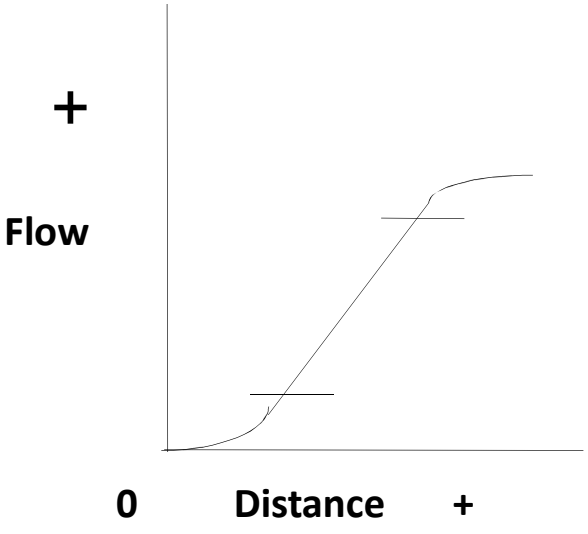
Dimensional Air Gage Applications



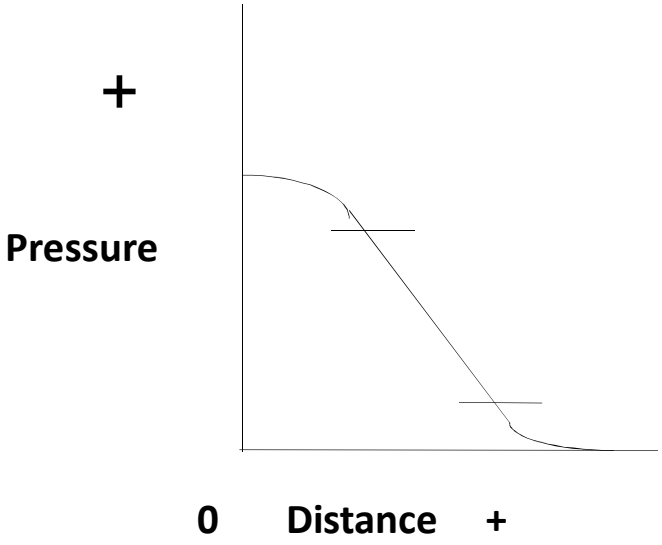
- Requires two components
  - Air Tooling
  - Reflective Surface (Restriction)
    - Master
    - Part

Dimensional Air Gage Applications

What's Happening with Flow and Pressure



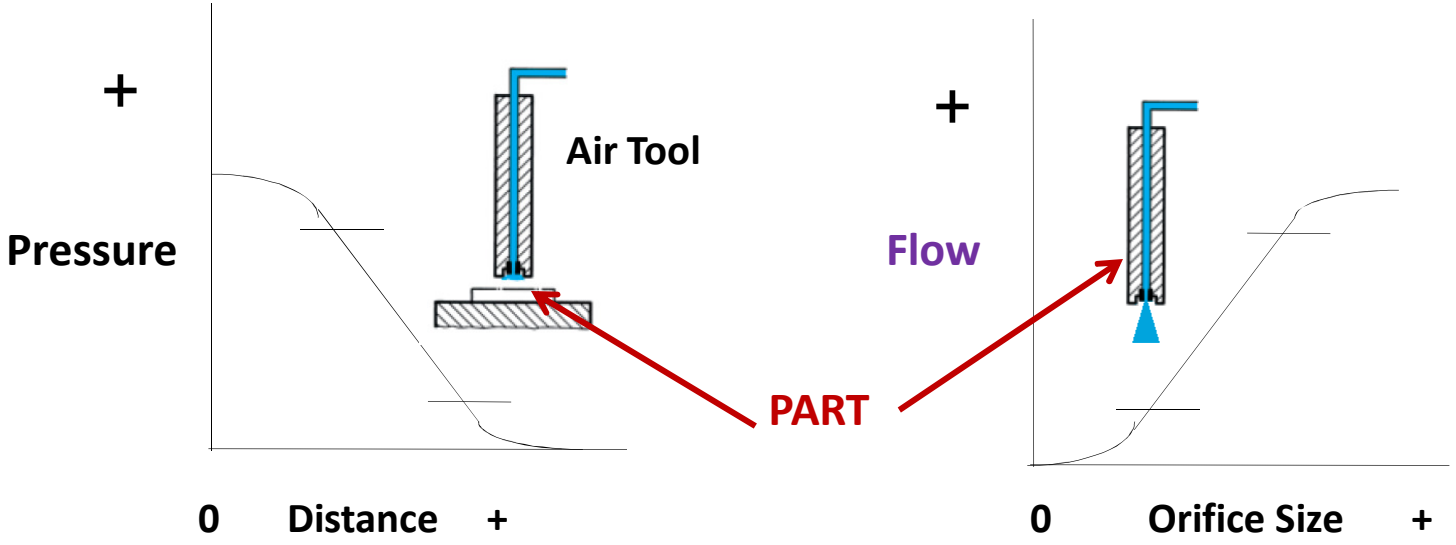
Flow increases as the distance between the nozzle and restriction/gap increases



Pressure increases as the distance between the nozzle and restriction

/gap decreases

Basic Difference in Flow Gaging



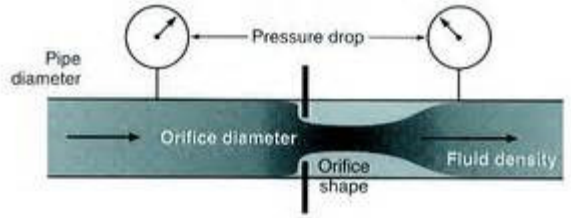
Pressure is created and increases as the distance between the nozzle/orifice and **restriction** decreases

Flow increases as the opening of the nozzle/orifice increases to atmosphere (**no restriction**)

Flow Gaging

What is flow gaging?

In basic terms, flow or flow rate is a measure of the amount of air/gas or liquid that flows through a particular device per some unit of time.



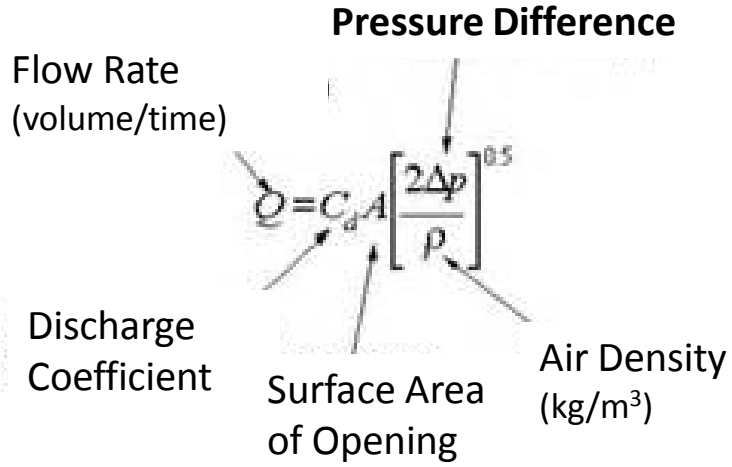
Units of measure are;

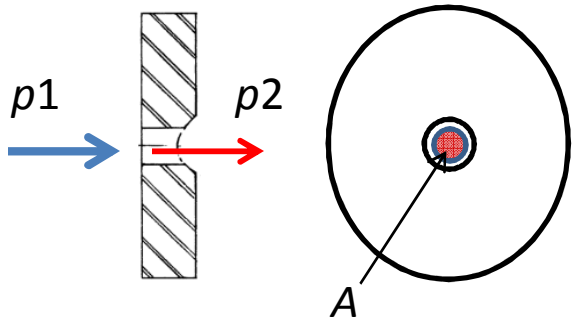
liters/minute

cm^3/minute

milliliters/second (for very low flow rates)

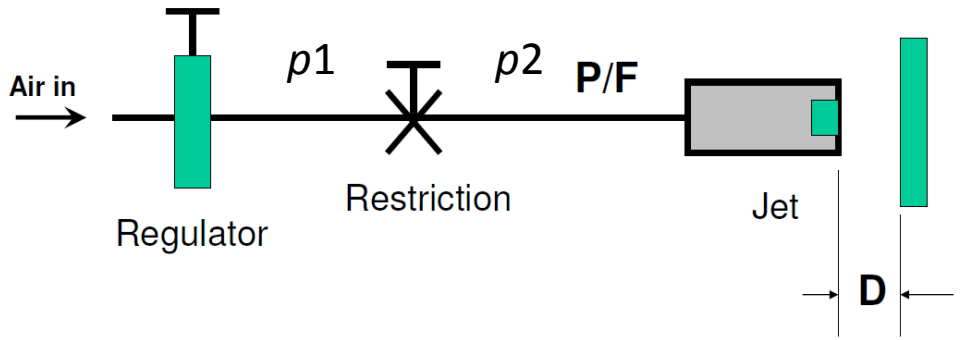
Air Flow Gaging - Basic Math





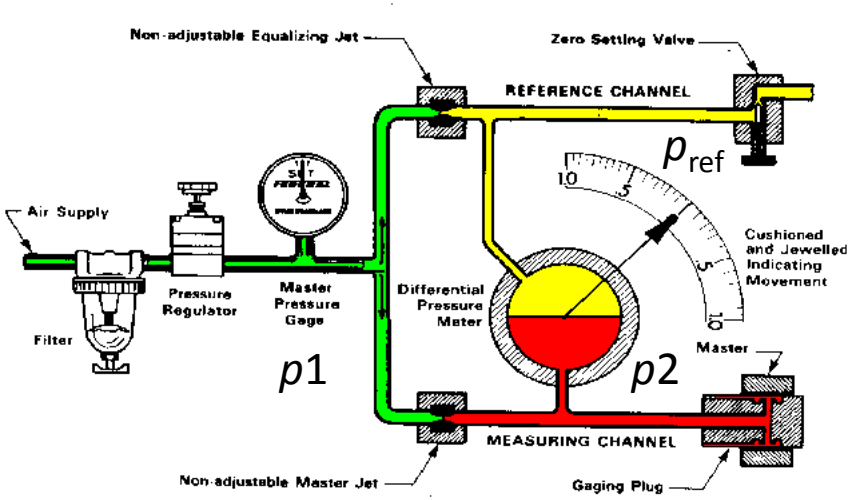
- Air Density Factors :
  - Temperature
  - Humidity
  - Altitude
  - Specific Gas Constant(dry air)
- Discharge Coefficient : Based on shape of orifice (~0.61 for a flat plate orifice)

Basic Flow/Back Pressure System



- Most flow gages typical for large air volume flow systems, like HVAC systems
- Less concern for dimension, more concern about controlling volume displacement and air handling
- The lower the flow rate the more unstable it is
- For measurement use, normally low input pressure used (~10psi)

Balanced Air System



- Balanced air system allows more stability for low flow rates and increase in input pressure used (~30 psi)
- Flow measures a dimensional maximum value only. It cannot explore the surface or geometry.
- Flow requires some form of un-interrupted hole(s)
- For Flow, part replaces the air tool
- Higher operating pressure allows for increased flow resulting in faster response

Air Flow Gaging – Application Elements

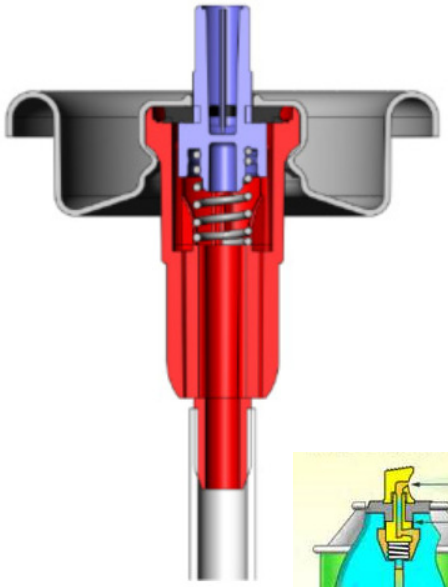
- Commonly qualified using 2 points, Pass/Fail only (min/max master)
- Fixed input pressure/flow rate allows ability to convert to dimensional value
- The lower the flow rate the slower the reading response
- Finding defects/clogs in multiport components is possible (surface area *A*)
- Magnification/Gain set to masters used
- The larger the range of hole sizes to measure the more masters needed

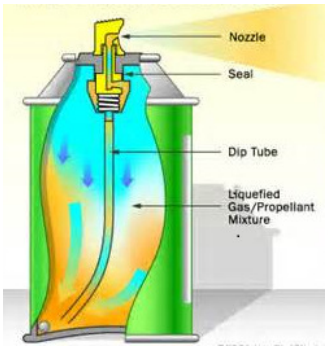
Types of Components Measurable by use of Flow

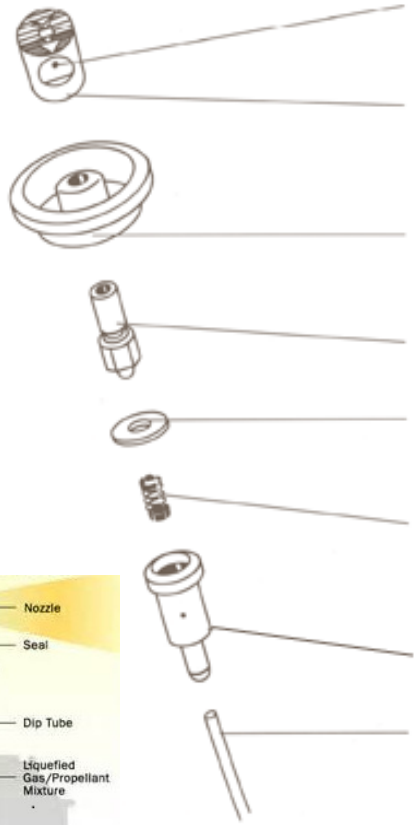
- → **Valves**
- → **Needles**
- → **Nozzles (Injection Molding, Compressor, etc.)**
- → **Multiport Miniature Parts**
- → **Simple Fixed Restrictors**
- → **Custom Small Hole Parts**

Types of Flow Components

→ **Valves**







Valve
The opening where the product comes out. A wide variety of valves control how much of the product comes out, how fast, and in what direction.

Actuator
The spray button which enables a user to activate the aerosol delivery system. Actuators are designed to be easy to use and to control the application of the product.

Valve Cup
Metal cup at top of the container with sealing materials attached that holds all the valve components together.

Stem
The connection between the actuator and the spring.

Stem Gasket
The key to an aerosol can. The gasket seals the opening around the valve stem, keeping the can airtight.

Spring
Maintains pressure on the gasket which seals the can. Pressing down on the actuator releases that pressure, opening the seal.

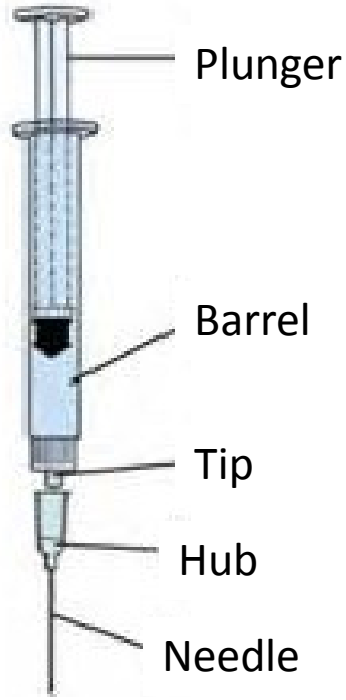
Housing
The cylinder which holds the spring and connects the dip tube to the valve assembly.

Dip Tube
A hollow tube which extends from the valve to the bottom of the can, allowing the product under pressure to be pushed out through the va l ve .

Types of Flow Components

→ Valves

→ **Needles**



Types of Flow Components

→ Valves

→ Needles

→ **Nozzles (Injection Molding, Compressor, etc.)**

Types of Flow Components

→ Valves

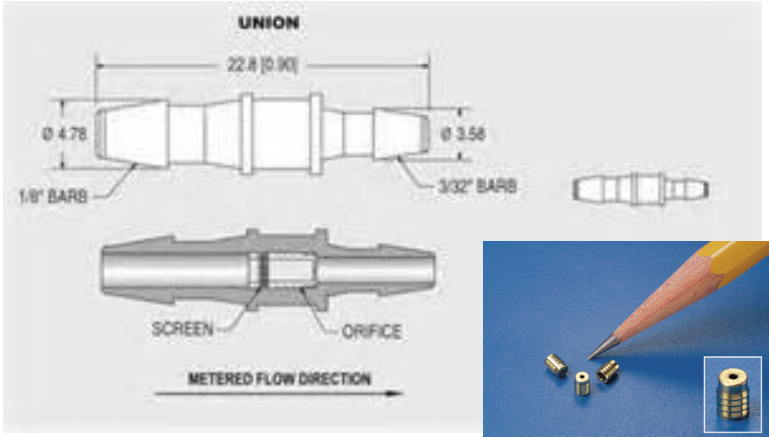
→ Needles

→ Nozzles (Injection Molding, Compressor, etc.)

→ **Multiport and Miniature Parts**

Types of Flow Components

- → Valves
- → Needles
- → Nozzles (Injection Molding, Compressor, etc.)
- → Multiport Miniature Parts
- → **Simple Fixed Restrictors**



Types of Flow Components

- → Valves
- → Needles
- → Nozzles (Injection Molding, Compressor, etc.)
- → Multiport Miniature Parts
- → Simple Fixed Restrictors
- → **Custom Small Hole Parts**

Air Flow Measuring Systems

- **STANDARD CATALOG AIR GAGE**
  - Column or bench amp with min/max mastering
  - Some orifice sizes fit into standard product measuring range
  - Other orifices require minor gage modification

- **PC BASED AIR GAGE**
  - Uses air electronic modules direct to pc
  - Configurable with multiple modules
  - Ability to correct linearity over long ranges

Air Flow Gaging – Case Study I

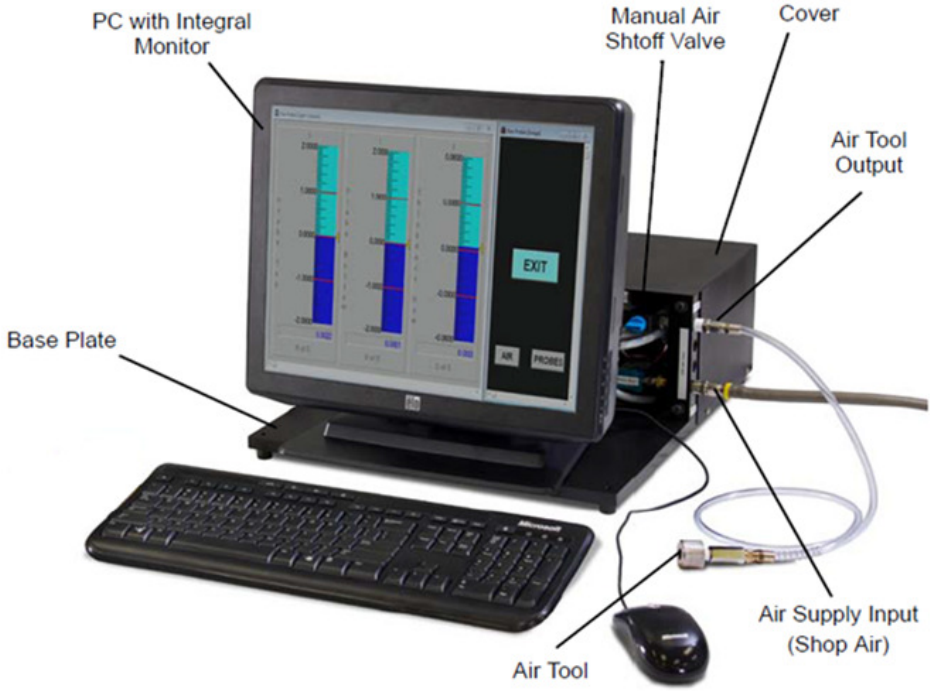
- Column/Bench Air Gage
  - Must match flow to the back-pressure type system
  - Custom master restrictor and bleed combination may be needed
  - Requires min and max masters
  - The smaller the orifice size measured the shorter the span of the masters is needed
  - Minimize air hose lengths as much as possible
  - Limited to measurement of one orifice size*

Air Flow Gaging – Case Study II

- Air PC Gage System
  - Able to measure multiple orifice sizes
  - Ability to correct linearity and maintain accurate readings throughout range
  - Requires 3 master set minimum for each air module used (calibration)
  - Each module uses its own regulated circuit

Air Flow Gage System

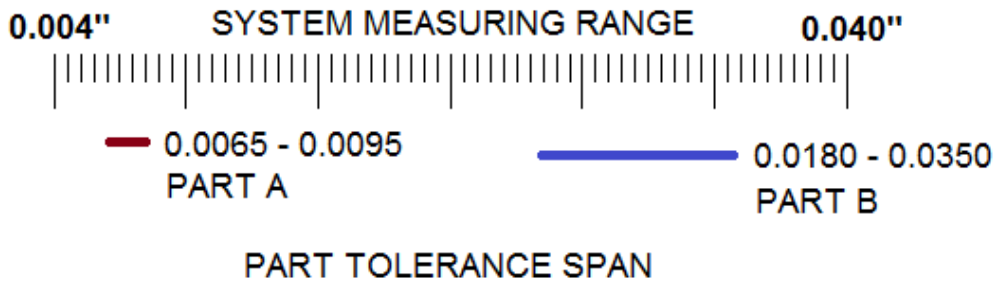
- Full PC Benchtop Gage System
  - Integral Windows based touchscreen computer
  - Air-to-electronic modules with usb connection
  - Control solenoids interfaced via IO module and power supply
  - External fixture designed specific to part



Air Flow Gaging Application

System Specification:

- Part orifice sizes can range from 0.004in./0.1mm to 0.040in./1.0mm diameter



- Part tolerance spans from 0.003in./0.08mm to 0.027in./0.69mm
- The system is designed to measure maximum diameter of a small thru-hole orifice.
- The flow rate (lpm) is calculated based on the fixed balance system and measured diameter size.

Flow Gage Technical Setup

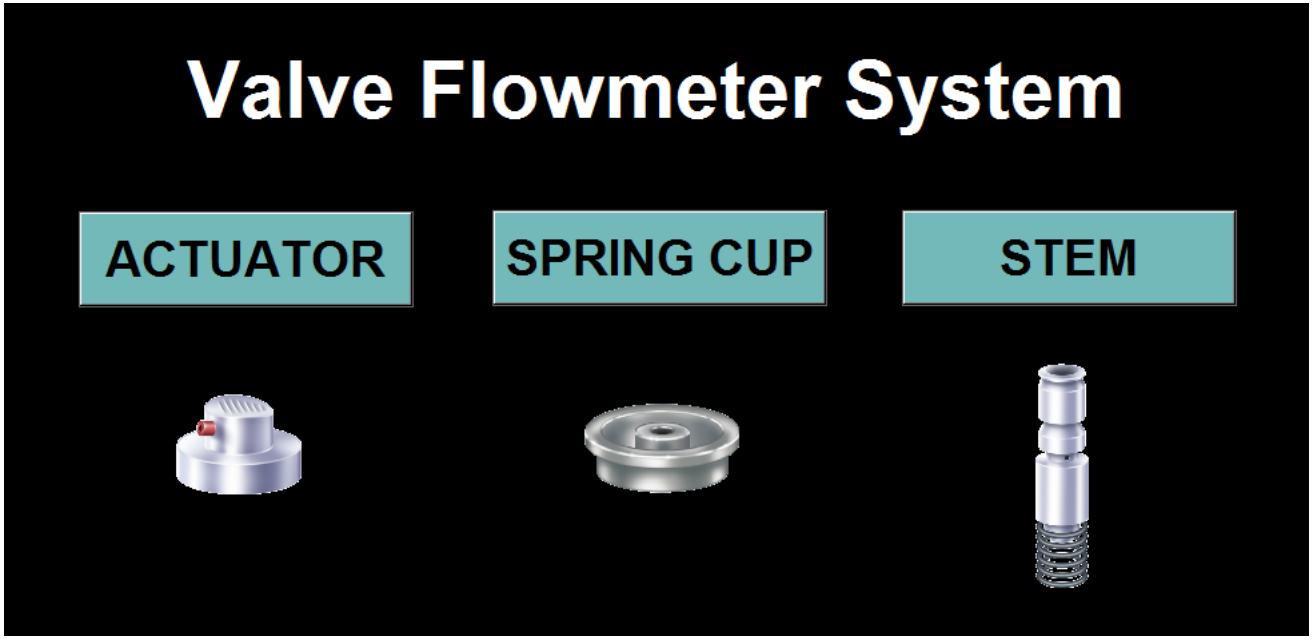
- QA/Engineering maintenance of remote part file

PART#	NOM.	-TOL	+TOL	ORIFICES	SIZE	B/P Rev
2803F	0.0285	0.0260	0.0310	1	0.0285	
55999	0.0252	0.0220	0.0283	1	0.0252	
56000	0.0250	0.0230	0.0270	1	0.0250	
A0012	0.0320	0.0300	0.0340	1	0.0320	
B501D	0.0165	0.0150	0.0180	1	0.0165	
CC047	0.0228	0.0215	0.0240	1	0.0228	

- Periodic calibration check with masters (master gage when needed)
- Technician setup of machine#, mold#, and part# to be run in production (operator need only enter machine#)

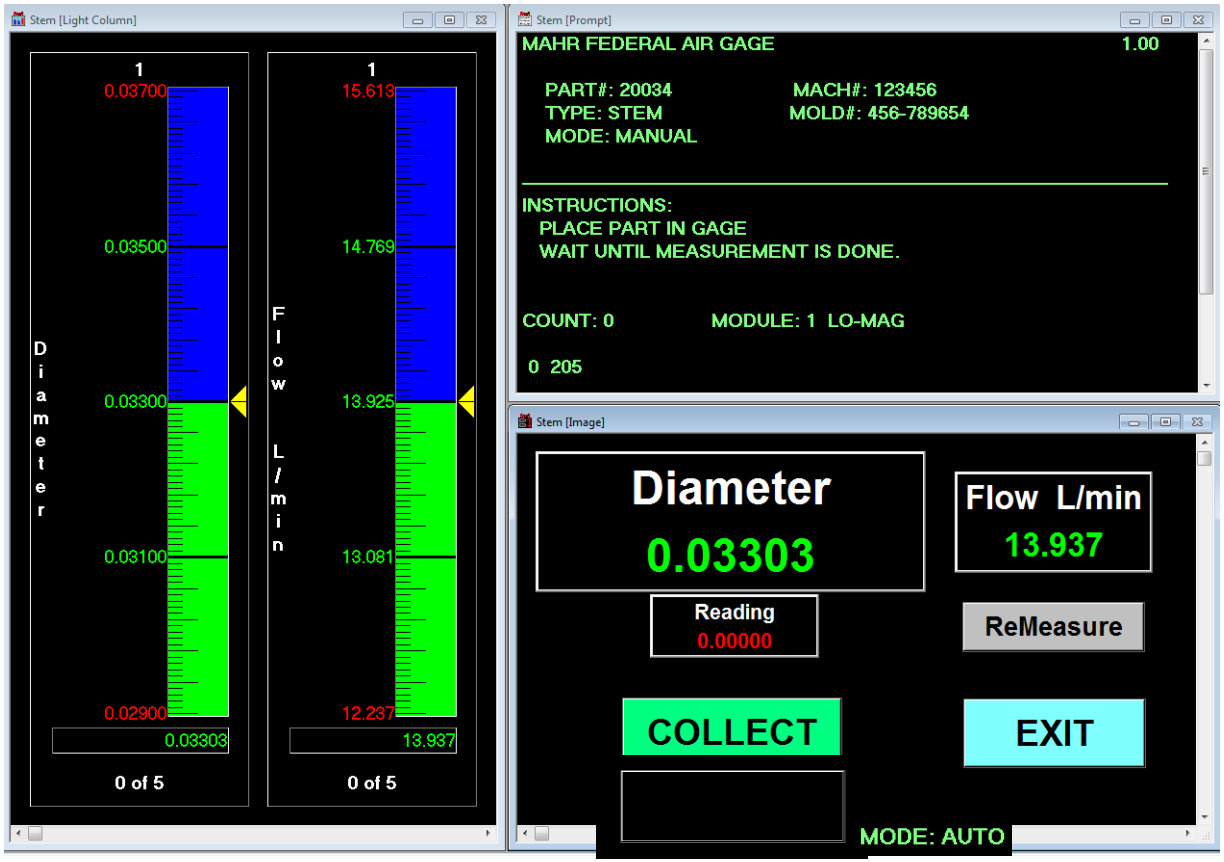
Gage Operation

- Operator Selects a part to measure and is prompted to enter a machine number or any needed user information



Gage Operation

- Gage retrieves all part information from remote file and enters data collection mode



Gage Operation

- No Mastering required by the operator
- Part placed firmly in gage fixture and data is collected (manual or automatic)
- Timers control gage idle time and allowed lot measurement time
- No external sensor needed
- At lot completion, exit back to main screen

Air Flow Gage Principle

- Orifice diameter sizes from 0.004 to 0.039 inch in 0.001±0.0001 inch increments (36 masters)
- Targeted accuracy 0.0001 inch and Repeat 0.00004 inch
- Only 3 Masters needed for gage operation / checks
- Each valve component has hundreds of part numbers
- Automatic data collection without a part present sensor
- Built-in auto-scaling between multiple modules

Air Flow Gaging

- “The” system to measure small hole sizes

Air Flow Gaging

What is important to remember about Air Flow Gaging?

- Simple 2-point measurement (pass/fail)
- Flow is non-dimensional – meaning it can measure max size only, not geometry or shape
- Air Gaging offers an easy solution – don't over think it