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Single master and dual master air gauging systems:

The principles of air gauging are simple: When you blow compressed air through opposing jets of air across the diameter of a bore, the up-stream back-pressure of that air drops as the size of the bore increases. In a tightly con-figured system, this generates a pressure distance curve.

Air gauging is one of the first forms of precision measurement, with systems employed in industry since the 1930s. Air gauging was the earliest form of extreme close tolerance measurement available, and many of the air plug con-figurations developed during the early days have not changed much since then.

However, the readouts have changed dramatically. The digital readouts of today offer greater range and higher resolutions. Also, today's amplifiers provide additional functions such as one button calibration; displaying actual part size; auto-zero function; calculating camber; changing the display from ID to OD with simple programming; USB -PC interfaces for SPC data logging making inspection faster and easier and more consistent and accurate for the user.

The two air gauging options are single and dual master systems. Both have their advantages (and disadvantages), and both are available for worldwide use. Understanding these differences in performance, and practicality will help users make the best choice for their application.

Single master systems:

This approach is not unique to air gauging. The same concept is used in certain amplifier and LVDT systems. Both are manufactured to known electrical characteristics resulting in a predictable voltage displacement curve. Manufacturing to a standard allows for interchangeability while still maintaining overall system performance. Knowing this, users only need a single master to set zero for comparative measurements. Only on a regular calibration cycle does the span need to be verified.

With air gauging, single master systems offer various advantages:

1. Calibration is accomplished using a single master.

2. Tooling and displays of the same fixed magnification are interchangeable, with

no adjustment necessary.

3. Accuracy and linearity is preset throughout the entire range.

4. Measurements are stable, repeatable and not susceptible to pressure changes.

5. Medium/high air pressure (32 psi) helps to clean parts.

6. Greater jet clearance adds provides longer tooling life.

Certifiable tools and restrictor kits are available to verify the performance

The other method of air gauging is to use two masters to set the span of the readout. The user sets the tooling and air gage display so that the span displayed on the readout matches the span between the High and Low limit setting masters.

Dual master air gage displays are typically built around an adjustable or programmable back pressure system in which a mechanical or electronic display monitors the change in back pressure that results when the air jets in the tooling are restricted as they approach the surface to be measured. Older systems will usually have "span", "spread" or "magnification" and "zero" knobs for the desired span adjustments. Newer systems use a sampling system to obtain these values and digital programming for read-out adjustment.

Just as there were good and bad characteristics with the single master system, the same applies to the dual master process:

• The air flow restrictors and adjusters are easily accessible and can be cleaned if they get contaminated.

• The system has excellent linearity.

• The magnification of the air displays are adjustable, so they can be used with many different ranges of air tooling.

• The gages will accept almost any brand of air tooling, and the set points of the masters can be adjusted.

• The units use two masters, which are easily traceable but add to initial cost.

• The response time is excellent.

• Medium/high air pressure (32 psi) helps to clean parts.

• The dual master systems can be used with smaller jets for very short lands and large jets, allowing for either short-range, high-tolerance applications or longer-range, loose-tolerance applications.

• The customer is not tied down to any one manufacturer because many make tooling for dual master, back pressure air-circuit-type gages.

The biggest weakness of older dual master systems was that while the end points of the gage span are set with the two masters, what is happening in between was not known. With modern digital units, linearity is verified as better than current single master systems. If data collection is critical and used for real process control, linearity around the target specification is critical. This is where dual mastering has a slight advantage compared to a single master system. Whichever system you are considering, consult your supplier for technical advice and support.

Walden Gage
Distribution & Calibration Services Inc.

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UNIVERSAL DIGITAL AIR/ELECTRONIC COMPARATOR MODELS DR1 & SR-1 FEATURES :

1) PRESET ELECTRONICS – IN STANDARD OPERATING MODE, NO ADJUSTMENT IS NECESSARY

2) FULLY PROGRAMMABLE SPREAD, ZERO AND "ACTUAL SIZE" SETTINGS TO ACCOMMODATE ALL TYPES OF AIR GAGE TOOLING

3) ONE KNOB OR PUSHBUTTON CALIBRATION FOR EASY ERROR FREE CALIBRATION

4) RANGE IS ONLY LIMITED BY THE QUALITY AND DESIGN OF THE TOOLING USED AND FAR EXCEEDS THE RANGES OF ALL TYPES OF FEDERAL, EDMUNDS, SHEFFIELD AND ALL OTHER ONE OR TWO MAS-TER SYSTEMS

5) RANGES AND RESOLUTIONS ARE CONSISTENT FOR ALL TYPES OF TOOLING.

6) LARGE 4 1/2″ ANALOG REFERENCE METER IS USER PROGRAMMABLE TO COVER VIRTUALLY ANY RANGE FROM +- .000020 TO +- .010″ OR BETTER.

7) 0-10 VDC ANALOG OUTPUT

8) ACCURACY / LINEARITY: 0.25% FULL SCALE WITH .000010″ OR .000001″ RESOLUTION.

9) REPEATABILITY: +- 1/4 DIGIT. F/S

10) RESPONSE TIME: 16 MILLISECONDS

11) PROGRAMMABLE FOR I.D. OR O.D. MEASUREMENT.

12) PROGRAMMABLE UNDER & OVERLIMIT LIGHTS AND ADJUSTABLE LIMIT POINTERS OPTIONAL

13) BRIGHT DIGITAL DISPLAY AVAILABLE IN RED OR GREEN, WITH OR WITHOUT SPLASH COVER.

14) RUGGED 16 GAUGE STEEL ENCLOSURE AND CUSTOM DESIGNED COMPONENTS ENSURE RELIABLE PERFORMANCE IN HARSH PRODUCTION ENVIRONMENTS.

15) USER PROGRAMMABLE RESOLUTIONS OF .0001, .00001, OR .000001″, .001, OR .0001mm.

16) DIGITAL METER USER PROGRAMMABLE TO READ DEVIATION FROM ZERO, OR ACTUAL SIZE – INCH OR MILLIMETER

17) "AUTO ZERO" FUNCTION FOR QUICK CALIBRATION OR "DEVIATION FROM ZERO" REFERENCES.

18) OPTIONAL USB RS232 OR RS485 OUTPUT FOR SPC/SQC APPLICA TIONS – NO CONVERTER NEEDED.

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Frequently Asked Questions:

Q: How can I tell if my probes or air rings are still good?

A: A simple balance test will show if your gaging is operating properly. With your probe attached to your amplifier, the jets positioned horizontally at 9:00 & 3:00, and your spread set, place the zero ring (or high limit ring if it is a 2 ring mastered gage) on the probe. Press the ring against the left jet and note any change in the reading. Then press the ring against the right jet and note any change. Any movement exceeding .000020 per side indicates an imbalance that will affect accuracy and repeatability.

Q: What is the difference between a standard blind and super blind air probe?

A: The difference between blind and super blind is the distance the jets are placed from the end of the probe. Since this is a D2500 probe, standard blind has the centerline of the jets .156 back from the end and would basically get a read-ing in the middle of a .300 land. Super blind has the centerline placed .090 back and will read 2/3 of the .300 land.

Q: Can you give me a brief written explanation of how we would master the 5-6 probes that are manifolded to an SR1? I believe you said we could master one probe and would not need to re-master the other probes, when we switch from one probe to another. And:What level of precision are the probes matched to each other? Can that be put in writing on the quote?

A: All SR1 tooling is calibrated on the SR1 system to a known "master zero". Each probe in a matched set is calibrated to read +/- .000025″ of that master zero, when mastered with its respective ring gage. Therefore, when one tool is mastered, or "zeroed", switching to another in the matched set though the mani-fold, will maintain that zero within the specified +/-.000025″ tolerance. i.e., if you apply the second probe's master, the reading will fall within the zero tolerance.

WALDEN GAGE

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Phone: 631-729-6216

FX: 631-615-4661

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