DIMENSIONAIR I AIR GAGING INSTRUMENTS

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Mahr FEDERAL

EXACTLY

Experience with Gaging Technology

Technical innovation and quality-oriented thinking are the core competencies of successful businesses. Both competencies are not possible without metrology. Measurement instruments verify research and development results and document product quality. Without continuous advancement of metrology, there would be no technical progress.

Mahr Federal has been an innovator of precision hole gaging since the first air gaging was introduced in the 1940's. Mahr Federal has perfected the Single Master Air Gage system that out performs other systems with its accuracy and linearity. The quality is built into the tooling and display units.

Over this period of time, Mahr Federal has designed 100,000's of air gages - from the most basic air plug to complex automated air gaging systems. All are capable of measuring the most demanding manufactured pieces - critical for today's automotive, medical and aerospace requirements.

Recently, Mahr Federal has further advanced its leadership with a new line of the most universal Dimensionair systems that allow for unmatched performance from adjustable magnification air gaging systems. Our breakthrough products bring ease of use and high performance to any air gaging system.

There are precision hole applications where mechanical fixed plugs may best fit the application. In the 1970's, Mahr Federal again was an innovator in fixed plug gaging with the introduction of the Dimentron Plug in the 1970's. Again, through the subsequent years, thousands of successful Dimentron Plug solutions have been employed in the manufacturing environment.

Engineering solutions to these tough measuring application demands is done all within Mahr Federal. From the initial concept, through engineering, design, precision manufacturing and finally assembly and test are all performed in house. We take full responsibility and accountability for the gages produced - right until they are delivered and performing on your shop floor.

To be a Metrology Supplier - one has to know and understand metrology. Mahr Federal has built one of the best Precision Measurement facilities in the country. Mahr Federal's calibration system is certified to ISO-9001:2008 by NQA, USA and accredited to ISO 17025 NVLAP Lab Code 200605-0.

We are committed to metrology and to bringing the best metrology solutions to you.

Dimensionair® Air Gages

Why Mahr Federal Air Gaging?

Mahr Federal has been an innovator in air gaging since its introduction in the 1940's. With the Dimensionair system, the accuracy is built into the readout and the tooling. With the new Universal Systems - precision magnification adjustments allow for the most linear two master systems available.

Experience

Over this period of time, Mahr Federal has designed 100,000's of air gages - from the most basic air plug to complex automated air gaging systems. All are capable of measuring the most demanding manufactured pieces - critical for today's automotive, medical and aerospace requirements.

Innovation

Mahr Federal offers a wide range of display and tooling options. Offering basic and proven performance along with some of the most progressive portable gaging systems brings precision to the shop floor. New materials for air tooling such a Stainless Steel, Chrome products, 10V, D2 and Tungsten Carbide are some of the options for manufacturing tooling that meets the requirements of your specific application.

Delivery Performance

Ordering tooling and not having it when you need it just does not work. Mahr Federal has put in place manufacturing principles that can get you the tools you want when you need them. We deliver on time, to customer's expectations and demonstrate it time after time.

Value and Service

Mahr Federal offers one of the largest trained sales teams to offer expertise to solve your measurement problems. A team of Direct Field Sales personnel, Providence-based Application Engineers and Factory Trained Distribution is available to support you both before and after the sale. Combining this with new processes that actually allow for more cost effective tooling helps to provide the best value for your measurements solution.

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Dimensionair® Air Gages

The Need for Air Gaging

Air Gaging is the inspection tool that allows you to measure many jobs faster, more conveniently, and more accurately than other gaging methods. In the measurement of all hole conditions, air gaging is unsurpassed for speed and accuracy and while in checking any dimensional characteristic, air offers sufficient magnification and reliability to measure tolerances well beyond the scope of mechanical gages.

Easy to Use

Production workers do not require special training to use air gages. To check a hole, for instance, it is not necessary to develop skill in rocking the gage to find the true diameter, merely insert the air plug in the hole and read the meter. It is as simple as that.

Economical

Once the basic gage is purchased, additional tooling for a wide variety of jobs can be used with it. It is not necessary to buy a complete gage for each new dimension that requires checking. Because of its adaptability, air gaging often becomes the primary measuring system in a complete quality control program.

Versatile

Air gages effectively measure all common types of dimensions and are particularly suited to checking dimensional relationships. Some of these are taper, parallelism, squareness, straightness, and center distance. Match gaging, which permits the selection of mating parts for a specific amount of clearance or interference, is easily accomplished with just one reading on one dial.

The non-contact characteristic of air gaging makes them particularly useful for checking soft, highly polished, thin-walled or otherwise delicate material.

Small gage heads and remote reading meters give air gages a distinct advantage in measuring multiple dimensions. Fixtures are smaller and remote meters permit placing contacts in positions that are inaccessible for other types of gages. Air gaging is often combined with electronic signaling to provide instant indication of part size.

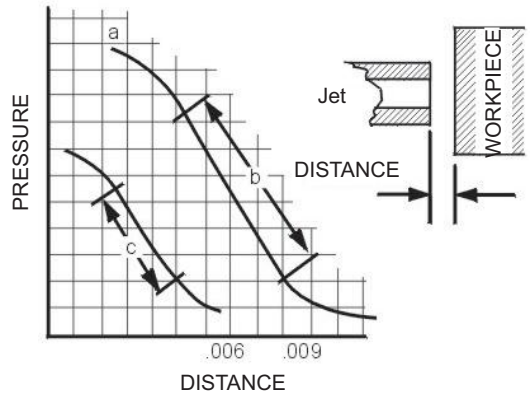
Air gages are readily adaptable to measuring parts in the machine. Their small gage heads make most dimensions accessible with new displays that can bring the measurement results right to the point of manufacture, thus speeding the process and making it easier for the operator to make his critical measurements. A unique advantage is that the stream of air tends to clean the measuring area from coolant or oil, providing accurate measurement without first cleaning the part.

What is Air Gaging and Why Does It Work

Air gaging is a measuring system that uses airflow and/or air pressure to determine the size of a measured part. With the laws of physics to make the measurement, the system relies on the fact that flow and pressure are directly proportionate to clearance and react inversely to each other.

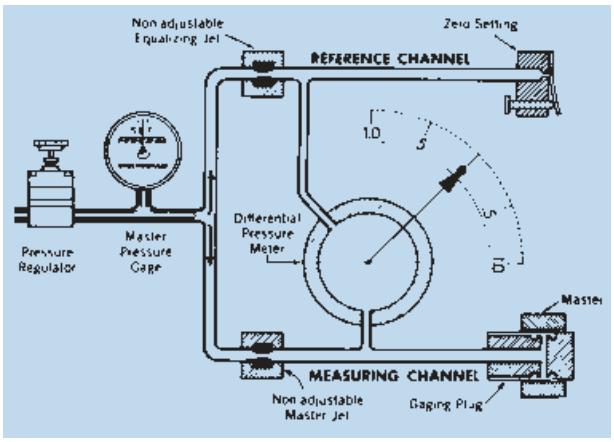
The relationship between air pressure and distance of a restriction (workpiece) to the air escape (jets) can be plotted on a graph - (line a). As the distance between jets and work surface increases, the pressure decreases and the ratio becomes linear, as represented by the straight section "b".

This straight portion of the curve can be accurately calibrated, and represents the scale of the Dimensionair. Compare its length with "c" on the other curve, which is the usable portion of other air gage scales. This longer linear scale gives the Dimensionair its longer usable measuring range. Note also that the Dimensionair scale is displaced further to the right, providing more initial clearance between the air plug and workpiece surface for easier gaging.



Dimensionair Air Gages
Mahr Federal's Dimensionair Air Gages are unique among dimensional air gages. Basically a differential air pressure type, they are the only instruments that give you the advantages of fixed magnification and a balanced air system. A linear, precisely calibrated scale provides graduations of definite, known values. Greater tooling clearance for increased wear life, setting to "Zero" with only a single master with no other masters required, and immunity to normal air pressure fluctuations are additional advantages of the exclusive Dimensionair system. With the Mahr Federal differential system, the accuracy is built into the tooling and the display.

How the Balanced Air System Works
With the balanced air system, air from the supply line first passes through a regulator, then is divided into two channels. Air in one leg (the reference channel) escapes into the atmosphere through the adjustable zero restrictor, while air in the opposite leg (the measuring channel) escapes through the gage head jets. The two channels are bridged by an extremely precise indicating meter which responds immediately to any differential in air pressure between the two channels.



Zero Setting Simple and Stable
With the Dimensionair's balanced system, setting zero is entirely independent of the measuring and magnifying functions of the gage. Magnification is fixed and cannot be affected by the setup process.

To set up the gage, a master is placed on the measuring head (producing a back pressure). The zeroing knob is then adjusted to equalize the air pressure in the two channels. When this condition exists, the dial reads zero. No further adjustment is necessary. Any deviation in the size of the workpiece from the master size will change the pressure in the measuring leg and produce a change in meter reading.

Advances in Adjustable (2 Master) Air Systems
Mahr Federal has taken the adjustable magnification back pressure system and adapted it for use with its precision differential meter and air/electronic transducers. The Universal Dimensionair's magnification is controlled, matching the pressure to the precise balance between the tool and the reference channel. The second adjustable restriction releases excess air to the atmosphere to adjust the zero position. This system is capable of the broad magnification adjustment of any air gage system. It accommodates almost any size nozzle, as large as 0.050 in. or as small as 0.020 in.

Two setting masters - minimum and maximum - are used to calibrate the system, defining and displaying both ends of the particular tolerance range. With modern electronic systems, this process can be automated so that the gage leads the operator through the mastering routine. The zeroing and magnification adjustments are done automatically - without operator intervention.

Dimensionair® Air Gages

Additional Advantages of Mahr Federal Long Gaging Range – Single Master

The long measuring range of the Dimensionair system permits a smaller bodied air plug, which provides greater plug clearance. Even with greater clearance, there is no centralizing error. The total clearance between plug body and setting ring is detailed in the table below. Direct Benefits of Greater Clearance:

Tolerance Clearance from Nominal Size

Plug I.D.	Nominal Size above mm/*in*	To & include mm/*in*	Clearance from Nominal Size mm/*in*
DP100, DP60	0.63 / ***.248"***	76.3/ ***3.004"***	0.081/ ***0.0032"***
DP50	3 / ***0.123"***	3.5 / ***0.140"***	0.015 / ***0.0006"***
	3.5 / ***0.140"***	4.7 / ***0.185"***	0.027 / ***0.0011"***
	4.7 / ***0.185"***	6.3 / ***0.248"***	0.030 / ***0.0012"***
	6.3 / ***0.248"***	76.3 / ***3.004"***	0.045 / ***0.0018"***
	76.3 / ***3.004"***	127 / ***5"***	0.071 / ***0.0028"***
	Above 127 / ***5"***		0.081 / ***0.0032"***
DP20	3 / ***0.123"***	3.5 / ***0.140"***	0.009 / ***0.00035"***
	3.5 / ***0.140"***	4.7 / ***0.185"***	0.013 / ***0.0005"***
	4.7 / ***0.185"***	6.3 / ***0.248"***	0.015 / ***0.0006"***
	6.3 / ***0.248"***	76.3 / ***3.004"***	0.023 / ***0.0009"***
	76.3 / ***3.004"***	12 7 / ***5"***	0.071 / ***0.0028"***
	Above 127 / ***5"***		0.081 / ***0.0032"***
DP10	All sizes to 1.750		0.014 / ***0.00055"***
DP5	All sizes to 1"		0.005 / ***0.0002"***

More versatile gaging - Dimensionair plugs easily enter irregular holes to check conditions such as taper, out-of-round, barrel shape, etc. that are inaccessible to plugs with less clearance.

Increased gaging speed - Quicker entrance into the hole and no jet positioning problem makes gaging faster with Dimensionair plugs than with plugs which require less clearance.

Less plug wear - Greater clearance eliminates much of the wear caused by the plug body rubbing on the edge and walls of the hole. If, after long hard use, a Dimensionair plug should wear, there is no effect on magnification, as frequently occurs with air gages that do not use fixed magnification.

Large, deep-set Air Jets - Longer range permits the measuring jets to be set deep into the plug body, providing good protection. Dimensionair jets are larger and less likely to become clogged.

Measuring range/magnification

Type	Measuring range	Magnification
DP 50	76µm/ ***.003"***	2500:1
DP 20	38µm /***.0015"***	5000:1
DP 10	15µm/ ***.0006"***	10,000:1

For applications greater than 1000 feet, special calibration is required.

The Dimensionair System is known as the One Master Air Gage because only one zero master is required for each size to be measured. This economical feature is the result of fixed magnification - the accuracy is built in! Because its magnification cannot be adjusted or changed accidentally, or drift because of airline surges, the Dimensionair has a linear, calibrated scale with meaningful graduations.
It's easy to set zero
Step one - place the Master on air tooling.
Step two - Adjust zero setting screw until meter hand is on zero or - press Auto Zero on Electronic Systems

That's all. Set-up is completed in just a few seconds.

Stability - Once Set, Stays Set
An outstanding feature of the Dimensionair is its stability. Once set, zero does not drift. Because the air pressure in the balanced system is split between two channels, any normal changes in pressure from the regulator or larger surges in the factory air system affect each channel equally and thus cancel out. Therefore, the gage setting is not affected. The only change in measuring pressure is through the variation of workpiece size.

Dependability
Fixed magnification, which is never disturbed by searching for zero or by changes in source pressure, and the stability of its zero setting are why the Dimensionair is so dependable. Tolerance limits never shift during the working day, remaining the same for the last piece as for the first.

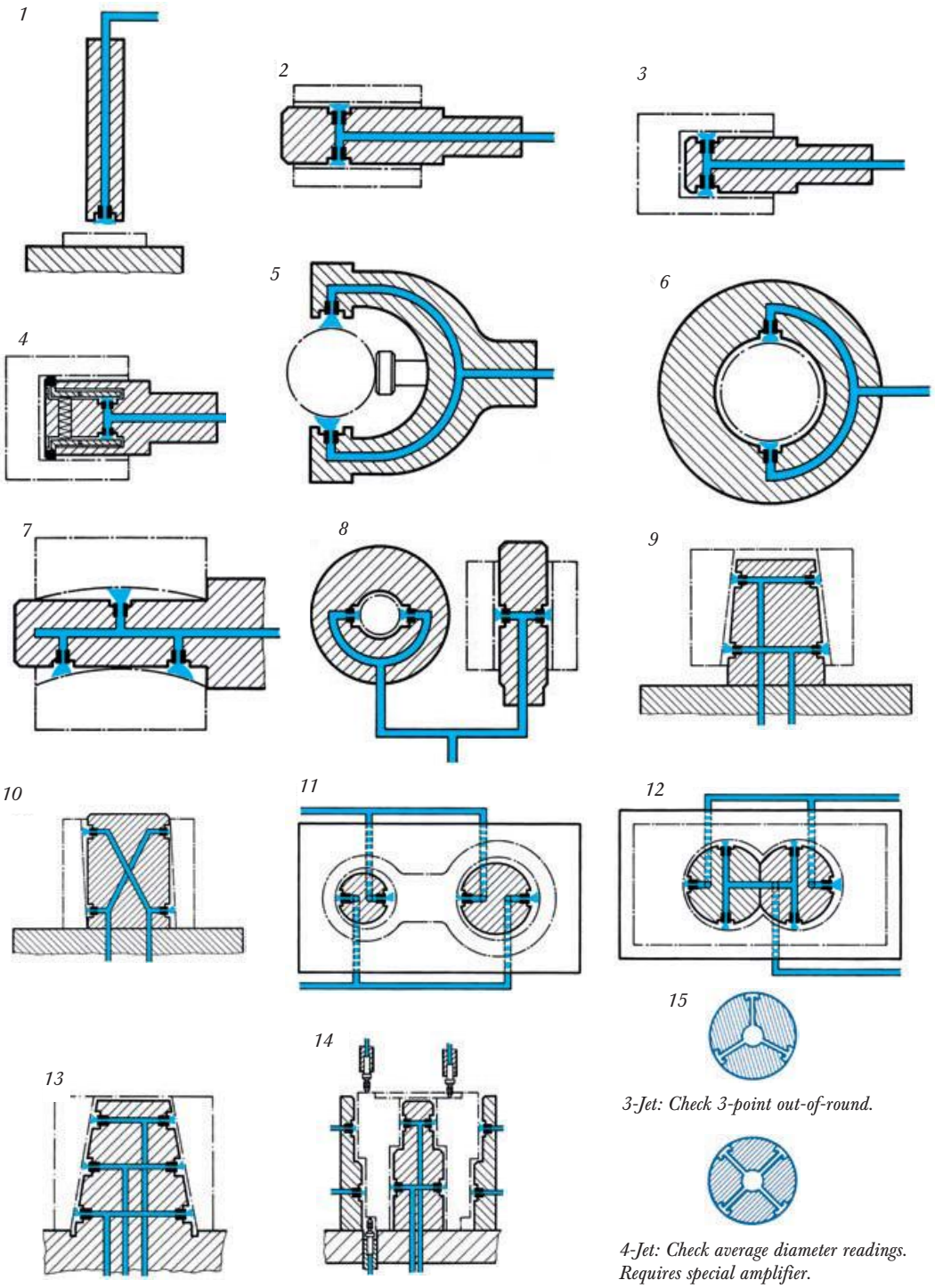
Dimensionair is the gaging of choice in automatic machine control where a lack of reliability in the gaging process can upset an entire production schedule.

Advances for Two Master Systems
Mahr Federal has taken the adjustable magnification system to new limits. For those applications where min-max mastering systems have been incorporated, the flexibility of the Universal Dimensionair and two mastering electronic amplifiers provide new read out capabilities. The Universal Dimensionair can act as a single master set-up with all its advantages - or can be adapted to virtually any existing dual master air tooling. Therefore, it is not necessary to switch air gaging systems - just choose the adaptability of a Mahr Federal display and put your system to use.

Dimensionair® Air Gages

Dimensionair® Air Gaging Applications

Though most frequently used for diameter measurement, many other types of dimensional conditions can be checked more conveniently, more accurately, and more economically with the Dimensionair than with other types of gages. Though it would be impossible to show every type of measurement successfully accomplished by air, here are a few representative examples:



3-Jet: Check 3-point out-of-round.

4-Jet: Check average diameter readings. Requires special amplifier.

1 Thickness or wall thickness measurement with jet air probe.

2 Diameter measurement of cylindrical through bores with air plug gage.

3 Diameter measurement of cylindrical blind bores with air plug gage.

4 Diameter measurement at a given distance from the face of a part. Most plugs can be supplied with a Stop Collar.

5 Diameter or thickness measurement with air snap gage.

6 Diameter measurement of cylindrical shafts with air ring gage.

7 Straightness measurement of a cylindrical bore with special air plug gage.

8 Match measurement between bore and shaft with air plug gage and air ring gage.

9 Taper measurement of an inner cone with taper air plug gage. Measurement based on differential measurement method.

10 Perpendicularity measurement of a cylindrical bore to the end face with special air plug gage. Measurement based on differential measurement method.

11 Measurement of spacing between separate cylindrical bores with air plug gages. Measurement based on differential measurement method.

12 Measurement of spacing between incomplete cylindrical bores with air plug gages. Measurement based on differential measurement method.

13 Taper measurement, form measurement and diameter measurement of inner cone with taper air plug gage.

14 Multiple internal and external measurements with measuring jets and contact gages in conjunction with a seven-column gage.

15 Multi-Jet Air Plugs can be provided. Jet placement determines the information read by the amplifier.

Dimensionair® Air Gages

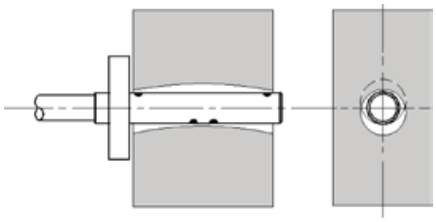
Dimensionair® Air Gaging Applications

Though most frequently used for diameter measurement, many other types of dimensional conditions can be checked more conveniently, more accurately, and more economically with the Dimensionair than with other types of gages. There are thousands of gaging applications successfully accomplished by air, here are a few representative examples of the more frequently encountered applications.

The balanced system of the Dimensionair offers unique advantages in gaging certain dimensional conditions such as concentricity, squareness, or straightness. Not only can one Dimensionair do the job for which two gages are usually required but, for these applications, it requires no master.

Straightness

Dimensionair gages can be used to check straightness of either inside or outside surfaces as well as diameter. For internal measurement, an air plug is furnished with a pair of opposed jets to check diameter and a set of four jets arranged as shown in the diagram for inspecting straightness. The diameter air jets and the straightness jets are each connected to separate Dimensionair meters. As the plug is passed through the part, both diameter and any lack of straightness are clearly displayed on their respective meters. An air ring can be similarly equipped to check both diameter and straightness of external surfaces.



Clearance and Interface (Match Gaging)

The balanced calibrated system of Dimensionair permits reading clearance or interference of mating parts, as well as the actual diameter of each part, on one dial without any adjustment or resetting.

Air plug and ring are connected through "T" fitting to measuring side of special air meter. One part (serving as reference) is placed in gaging position and various mating pieces checked in turn until proper clearance reading (left of zero) is obtained. Readings to right of dial indicate interference. Diameter of either part can be sized directly by comparing against master of mating part.

Center Distance

Center distance between bores is checked without influence from piece to piece variation in size on a differential Dimensionair. Two dual jet air plugs are used as a pair, with the two "near" jets channeled together as are the two "far" jets. These combinations are then introduced to opposite sides of a differential meter. Spacing of air plugs in the fixture is set to show the ideal condition, so the meter hand reads zero with a master or nominal workpiece in place. With this arrangement, any change in diameter will affect each pair of jets equally so that center distance checks will be independent of hole diameter. The same type of arrangement using air rings serves center distance of O.D.'s. In each case, only one Dimensionair is required at considerable cost saving over competitive makes.

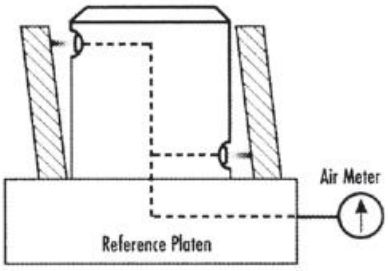
Dimensionair® Air Gages

Squareness

Bore-to-face: Method A

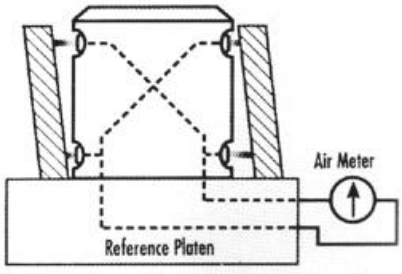
An air plug having offset jets is mounted on platen. Part is rotated 180 degrees. Comparison of total indicator readings shows relative squareness as compared to that of master or a nominal condition workpiece.

A 2-jet air plug mounted on a precision platen is connected to a regular Dimensionair meter. Inset shows location of offset air jets on opposite sides of air plug.



Bore-to-face: Method B

Top and bottom jets on each side of air plug are channeled to opposite sides of a special air meter to provide differential type measurement. Lack of squareness is indicated by movement of meter hand as part is rotated on reference platen. This method is used primarily when squareness reading should not be influenced by any taper condition.



Flatness

When small parts are involved, either contact or non-contact measurement can be made using an airprobe or jet probe set in a small surface plate . Proper probe depth is accomplished by an adjusting bracket. The inspection of the part is made by simply moving it over the probe and reading flatness variations directly on the Dimensionair readout.

Flatness gage specifications: Surface plate of black Granite, typical 12" x 12" x 4" (inspection grade A). Three point support provides accuracy to 50µ". Other plate sizes and accuracies are available.

For large parts that are too large to move over a surface plate, the probe can be mounted into a serrated plate that has been lapped flat. This assembly is moved over the part and read out on the air gage readout.

Automatic Gaging Applications

Special tooling can be designed and manufactured for use in automatic gaging systems. Plugs with multiple jets and circuits can be configured for virtually any size and geometric condition.

Diameter, taper, straightness, concentricity and center location can be checked quickly and accurately with an engineered air plug. Because air jets can be machined into locations where electronic probes would not fit, they provide unmatched gaging capabilities. When the parts are rotated, dynamic checks such as out of roundness and max or min diameters can be found.

Also, special wear strips and floating tooling adaptors can be designed into the automatic gaging station to provide long life of the plug for thousands of dimensional checks.

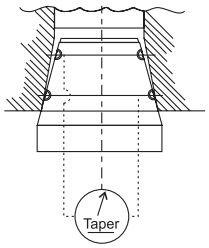
Dimensionair® Air Gages

Taper Gages

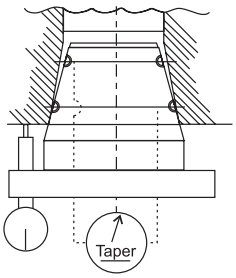
The use of tapers has never been more important than it is today. In the manufacture of tool holders and spindles, the control of taper and size determines how well the machine can perform during its cutting cycle. In orthopedic parts, the matching of tapers is critical to how well the knee or shoulder replacement will perform. Air gaging is ideal for these applications. Multiple circuit air jets can be placed in very small tapers where another method can be used to match air gaging speed and performance.

Two conditions most important in controlling taper are taper size and angle. Size is controlled by tolerance and is, therefore, identical to a cylindrical I.D. or O.D. Taper angle, on the other hand, can be controlled by at least three different methods:

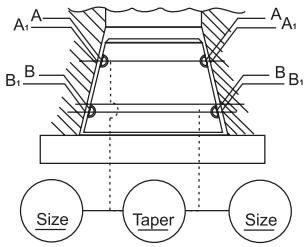
1. Included angle or angle per side.
2. Taper per inch or per foot.
3. Controlling two diameters at specified datum locations.



Simple "Jam Fit" design provides measurement of taper angle



Addition of indicator provides indication of taper diameter



Shoulder style allows for independent circuits allow for taper and diameter measurement. Addition third circuit can help determine straightness of taper side.

Regardless of the method used, the effect on tapered air gaging is the same, since it produces a differential change between two diameters at a fixed distance apart.

The two styles of tooling are *Shoulder* and j*am* Fit. The function of the tapered part to be measured determines the style.

Jam Fit tooling measures taper angle as a differential change between two diameters, ignoring change in taper size. For example, if the tapered size increased by .254mm/.010", but the angle had not changed, the differential meter would indicate no change in reading. These parts have no shoulder or a controlling face and become joined at the point of taper. If a tapered hole is not controlled for size, for example, the mating taper is allowed to drop deeper or ride higher in the hole as the size changes. A typical example is (NMTB) machine tool tapered spindles and collets.

Shoulder style tooling is capable of checking both taper size and angle simultaneously. Typically, one or both of the parts to be measured will have a shoulder or a face from which the size of the taper is dimensioned. The function of these parts demand that both the size and angle be controlled. Manufacturers of some types of orthopedic joints require that size and angle, and often times runout of the tapered diameter, be measured.

Mahr Federal can provide taper tooling for a wide variety of standard machine tool tapers including ISO7388 and 297 along with tools for checking HSK holders. Contact your Mahr Federal representative for ordering details.

When specifying a taper requirement, always consider:

What is to be measured?

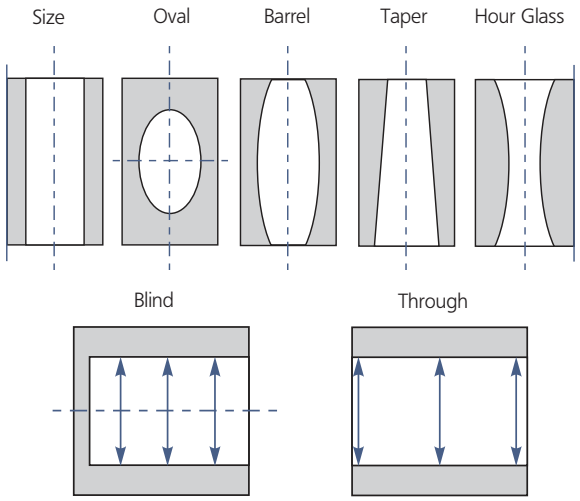
- Taper angle
- Diameters at certain locations
- Taper and diameter
- Length of taper and possible location for sensing points
- Should the gage be portable or bench mounted?
- What does the operator need for readout?

The Millimar S 1841 V-measuring instrument with LED display is most suitable for use on the shop floor.

Dimensionair® Air Gages

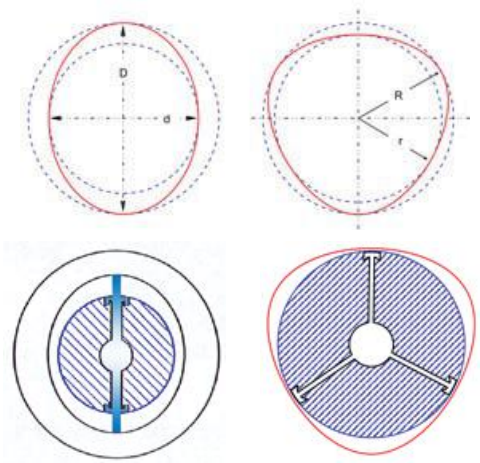
Versatility of Air gages Checking for Bore Size and Form

Two Point Gaging



The most common air plug is designed for two-jets offering differential bore measurement for size. Since the jets act differentially, they provide accurate bore measurement for size without regard to position in the bore. With the accuracy built into the plugs, Mahr Federal ensure that the jets are balanced and they read the same. Because the jets respond differentially any radial play in line with the jets is cancelled out and accurate bore sizes are read. Thus a two jet system can be used to explore the part axially for not only size but by monitoring the change of size barrel, taper or hourglass conditions can be inspected for.

Two vs. Three Point Gaging



Even Number Lobbing

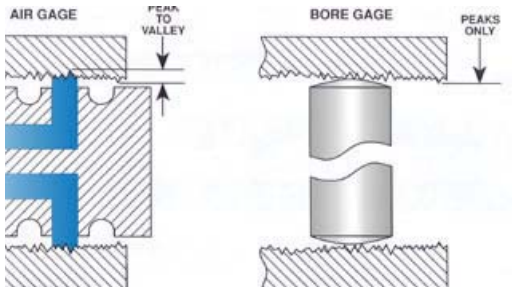
Odd Number Lobbing

Often the manufacturing process used to create the bore leave minor form errors in the bore. As tolerances get tighter, form and surface finish errors become a greater percentage of the tolerance. Therefore, for parts with tight tolerances, it is important to know something about the form of the part prior to selecting two or three jet tooling.

When the part has an even number of lobes, as in the case of an oval shaped part, two jet tooling is ideal for rotational exploration of the part. This rotation will take the plug through the highs and lows of the oval for an indication of size variation.

However if the part has an odd number of lobes, as is typical with centerless ground parts where an tri-lobed shape is common, a two jet plug will not be able to measure this diameter change during a gage rotation. Only with a three jet air plug or ring will these lobes be able to be picked up and measured for diameter variation.

The Importance of Surface Finish



Surface finish is a part characteristic to be considered with air gaging. With tight tolerance parts, surface finish and air gaging go hand in hand for producing reliable results. Since an air gage jet sends out a curtain of air, it covers an area of the part. If the surface finish is large compared to the part tolerance, the air curtain must fill in the deep valleys when building up the air back pressure for measurement. This is unlike a contacting mechanical plug which rides only on the peaks of the surface. To improve correlation between measuring systems, review the maximum surface finish conditions when selecting your air gage system.

Millimar. Air Evaluation Units

OVERVIEW

	Analog DA	Universal DA	µDimensionAir	832 DDA
				
Catalog page	14	15	16	18
Display	Large analog scale with 2 tolerance markers	Large analog scale with 2 tolerance markers	Analog display with 1 digital line display	LCD with an analog display
Measuring channels	Single Channel	Single Channel	Single Channel	Single or Dual Channel
Compatible air tooling	Mahr Federal	Mahr Federal Universal	Mahr Federal Universal	Mahr Federal
Max. Resolution	0.2 µm / ***.00001"***	0.1 µm / ***.000005"***	0.01 µm / ***.00002"***	0.2 µm / 0.01 µm* ***.00001"/.00001"***
Input Combinations	-	-	-	+A, - A, +B , -B , A + B , A - B , A +B , -A - B
Features / Programs	1	1	1	1
Test steps	1	1	1	1
Dynamic measurements	–	–	MAX, MIN, MAX-MIN	MAX, MIN, MAX-MIN, (MAX+MIN)/2, mean
Mastering Mode:	Nominal Master	Max/Min Master/ Nominal	Nominal or Max/Min	Nominal or Max/Min
Classification	–	–	3 classes	5 class LED and I/O
Control inputs and outputs / SPS connections	–	–	–	5 Opto-coupler outputs
Analog output	–	–	–	1
Data interfaces / ports	–	–	USB, ASCII/Digimatic	RS232, 9 pin, plug
Configuration	Turn value	Turn value	Keypad	Keypad
Battery operated	–	–	Yes	No, AC powered
Dimensions in mm (H x W x D)	137 x 157 x 80	165 x 190 x 148	254 x 168 x 143	205 x 160 x 165

C1208 PE	C 1245	1840 PE	S 1841 PE
			
20	21	22	24
Analog scale with a two line background lit digital display	Analog scale with a two line digital display	Column analog scale, 2 line digital display	Illuminated column with analog scale and 2 line digital display
Single Channel	Single or Dual Channel	Single Channel	1, 2, 3 or 4 Channel
Mahr / Mahr Federal	Mahr / Mahr Federal	Mahr / Mahr Federal	Mahr / Mahr Federal
0.1 µm / ***.000005"***	0.1 µm / ***.000005"***	0.1 µm / ***.000005"***	0.1 µm / ***.000005"***
+A, - A, +B , -B , A + B , A - B , B - A , -A - B	Formula editor for 80 characters Functions: + / - / * / ÷/ () / Factor	+A, - A, +B , -B , A + B , A - B , B - A , -A - B	Formula editor for 80 characters Functions: + / - / * / ÷/ () / Factor
2 / 2	16 / 6	2 / 2	16 / 6
1	6	1	6
MAX, MIN, MAX-MIN, (MAX+MIN)/2, mean	MAX, MIN, MAX-MIN, (MAX+MIN)/2, mean	MAX, MIN, MAX-MIN, (MAX+MIN)/2, mean	MAX, MIN, MAX-MIN, (MAX+MIN)/2, mean
Nominal or Max/Min	Nominal or Max/Min	Nominal or Max/Min	Nominal or Max/Min
LED - 5 class Display - 3 class	max. 998, max. 62 on I/O	5 class	max. 998, max. 62 on I/O, 5 LED's
3 Opto-coupler inputs, 3 Opto-coupler outputs	3 Opto-coupler inputs, 6 Opto-coupler outputs	3 Opto-coupler inputs, 3Opto-coupler outputs	6 Opto-coupler inputs, 12 Opto-coupler outputs
–	1	1	2
RS232, 9 pin, plug	RS232, 9 pin, plug	RS232, 9 pin, plug	RS232, 9 pin, plug
Keypad / D1000S prog.	Keypad / D1000X prog.	Keypad / D1000S prog.	Keypad / D1000X prog.
No, AC powered	No, AC powered	No, AC powered	No, AC powered
210 x 160 x 155	137 x 157 x 80	165 x 190 x 148	245 x 225 x 487

Dimensionair® Air Gages (Single Master System)

Features

- Uses regular shop air (40 - 150 psig).
- Internal pressure regulator keeps measuring pressures within calibrated range.
- Adjust meter to zero using a single setting master and the zero setting screw.
- High visibility meter has fine line graduations and a needle-thin hand for clear, precise readings. An air filter is included to remove dust and dirt contaminants from airline.
- Tooling mounts to the front of the unit. Connections are tight with finger pressure.
- No recalibration necessary when changing tooling. Just set zero and measure!
- Models available in 5 magnifications, 2 dial styles, and either Metric or Inch.

Technical Data

Magnification	Tooling ID no.	Range	Minimum Graduation	Dial Style	Surface Finish (recommended) µin Ra	/	µm Ra	Maximum Part Tolerance (recommended)	Order no.
1250:1	100	***.006"***	***.0001"***	Regular 82.6 mm / ***3.25"*** diameter	***100***	/	2.54	***±.002"***	**2095183**
2500:1	50	***.003"***	***.00005"***		***50***	/	1.27	***±.001"***	**2095184***
5000:1	20	***.0015"***	***.00002"***		***20***	/	0.50	***±.0005"***	**2095185***
10000:1	10	***.0006"***	***.00001"***		***10***	/	0.25	***±.0002"***	**2095186**
20000:1	5	***.0003"***	***.000005"***		***5***	/	0.12	***±.0001"***	**2095189**
1250:1M	100	152 µm	2 µm		***100***	/	2.54	± 50 µm	**2095190**
2500:1M	50	76 µm	1 µm		***50***	/	1.27	± 25 µm	**2095191***
5000:1M	20	38 µm	0.5 µm		***20***	/	0.50	± 13.5 µm	**2095192***
10000:1M	10	15.2 µm	0.2 µm		***10***	/	0.25	± 5 µm	**2095193**
20000:1M	5	7.6 µm	0.1 µm		***5***	/	0.12	± 2.5 µm	**2095194**
4000:1	50	***.003"***	***.000025"***	Large 152.4 mm / ***6"*** diameter	***50***	/	1.27	***±.001"***	**2095195***
8000:1	20	***.0015"***	***.000010"***		***20***	/	0.50	***±.0005"***	**2095196***
16000:1	10	***.0006"***	***.000010"***		***10***	/	0.25	***±.0002"***	**2095197**
32000:1	5	***.0003"***	***.000005"***		***5***	/	0.12	***±.0001"***	**2095198**
4000:1M	50	76 µm	0.5 µm		***50***	/	1.27	± 25 µm	**2095199***
8000:1M	20	38 µm	0.2 µm		***20***	/	0.50	± 13.5 µm	**2095200***
16000:1M	10	15.2 µm	0.2 µm		***10***	/	0.25	± 5 µm	**2095201**
32000:1M	5	7.6 µm	0.1 µm		***5***	/	0.12	± 2.5 µm	**2095202**

Dimensionair® Universal Air Gages (Single or Dual Master System)

Interchangeable Dials

Each Universal Dimensionair is furnished with an adaptor (for connecting standard Mahr Federal air tooling). Optional adaptors are available for virtually any air tooling application.

Features

- Uses regular shop air (40 -150 psig).
- Internal pressure regulators and differential meter assure ultimate stability over full operating range.
- Adjust span and zero setting to tune the gaging range to the interchangeable dial ranges.
- Interchangeable dials provide an easy, inexpensive means to accommodate various ranges
- High visibility meter has fine line graduations and a needle-thin hand for clear, precise readings.
- An air filter is included to remove dust and dirt contaminants from airline.
- Tooling mounts to the front of the unit. Adaptors are available for virtually any tooling configuration.

Technical Data

Dial Size diameter mm / inch	82.6 / 3.25"
Housing Dimensions mm	127 x 187 x 197 (high)
	inch 5" x 7.125" x 7.75"
Weight (including filter) approx.	6.7 kg / 14.25 lbs.
Operating Pressure	414-1034 kPa / 60-150 psig

A plastic protective cover for Universal Dimensionair is available **Order no. ACV-1**

Ordering Information

Universal Dimensionair, complete with air filter and standard tooling adaptor for Mahr Federal air tooling. Supplied with one **2242662** Dial. **Order no. 2098125**

Optional Dials

	Total Range	Range	Dial Graduations	Magnification	Order no.
(inch)	***.006"***	***±.003"***	***.0001"***	1260:1	**2242760**
	.004"	***±.002"***	***.0001"***	1875:1	**2242761**
	.003"	***±.0015"***	***.00005"***	2500:1	**2242662**
	.002"	***±.001"***	***.00005"***	3750:1	**2242763**
	.0015"	***±.00076"***	***.00002"***	5000:1	**2242764**
	.001"	***±.0005"***	***.00002"***	7500:1	**2242765**
	.0006"	***±.0003***	***.00001"***	10000:1	**2242766***
(metric)	152 µm	± 76 µm	2 µm	1260:1	**2242770**
	100 µm	± 50 µm	2 µm	1875:1	**2242771**
	76 µm	± 38 µm	1 µm	2500:1	**2242772**
	50 µm	± 25 µm	1 µm	3750:1	**2242773**
	38 µm	± 19 µm	0.5 µm	5000:1	**2242774**
	15.2 µm	± 7.6 µm	0.2 µm	10000:1	**2242776***

Tooling Adaptors

Adaptors are available for many standard tooling configurations:

Thread/Adaptor style	Plug Type / Measured size	Order no.	
10-32	2.7686 mm / ***.109"*** to 12.547 mm /***.494"***	**AAD-194****	**AAD-313**
1/4-28	12.547 mm / ***.494"*** to 23.876 mm / ***.940"***	**AAD-193****	**AAD-312**
1/2-20	23.876 mm / ***.940"*** to 139.7 mm / ***5.500"***	**AAD-195****	**AAD-314**
1/8 Barb	3/8-32 Female	**2242767**	
Setlock	Moore	**2242777**	
8mm	Mahr Row	**2240621**	
12mm	Mahr Row	**2240623**	
9/32-40	Mahr Federal High Mag	**AAD-165**	

**Requires AAD-165 adaptor, ** Includes bleed to simulate MFI jetting.*

µDimensionair® II Air Gages (Single or Dual Master System)

The µDimensionair is the ultimate of portability and versatility – in your hand or at the workbench or machine tool. Shown with optional 2239307 Bench Kit

All parts of the µDimensionair are completely interchangeable and included with the gaging system – versatility is built in.

All *µDimensionair* gages are supplied with output capability.

Features

- Affordable
- Versatile
- Innovative
- Rugged
- No other air gaging system offers so much – in the palm of your hand – mounted to the workbench or even right to the machine tool. µDimensionair is rated IP54, so it can be used on the shop floor – and the air tooling cleans dirt from the part for high performance measurements – fast and easy!
- Air gage readout is right in front of you – simple and clear.
- Fixed resolution and balanced air system makes the gage stable and reliable for your manufacturing environment.

µDimensionair II offers:

- Single and Min/Max mastering selectable
- All other features of the µMaxµm II Digital Indicator:
  - Dynamic Mode operation: Min, Max, TIR
  - Multiplier factor and hold function
  - Data output with selectable serial number
  - MarConnect data output:
    -- USB
    -- OPTO RS232C
    -- Digimatic

Versatility

The ultimate in configuration – interchangeable handle allows for pistol grip or normal end-mount for easy application of the plug to the part. For large, heavy plugs, mount the handle between the tooling and the display – assures a well-balanced, ergonomic measuring system. Can also be mounted to a bench stand when parts are brought to the gage.

Accessories

Bench stand provides safe and secure µDimensionair storage between measurements.

Order no. 2241109

Slide valve controls air to tooling – saves cost of wasted air, reduces air noise.

Order no. 2240993

Swivel coupling allows for rotating tooling to fully explore bore.

Order no. 2240594

For applications where the local elevation is greater than 305m / 1000 feet, special calibration is required.

µDimensionair® II Air Gages (Single or Dual Master System)

Technical Data

		µDimensionair II 	
		Resolution	**Tooling I.D. Numbers**
Measuring range	± 0.080mm ***± .003”***	0.002mm, 0.001mm ***.0001", .00005”***	60
	± 0.040mm ***± .0015”***	0.001mm, 0.0005mm ***.00005”, .00002“***	50
	± 0.020mm ***± .00075”***	0.001mm, 0.0005mm ***.00005”, .00002“***	20
Data Output		USB / ASCII / Digimatic	
Battery Life		6,000 hours	
Operating Temperature	5 - 35° C / ***41 - 95° F***		
Storage Temperature	0 - 60° C / ***32 - 140° F***		
Repeatability	± 1 Last Significant Digit (LSD)		
Calibration Accuracy	± 1 Last Significant Digit (LSD)		
Linear Error	± 1% full scale (LSD)		
Response Time	Approximately 1 second		
Thermal Stability	0.1% of full scale/F		
Tolerance Indicators	Two — over / under (3 Class)		
Weight	25 kg / ***5.5 lbs***		
Dimensions - Main body	approx. 100 x 60 x 70 mm / ***approx. (4” x 2.5” x 3”)***		
Auto Power Off	15 minutes of non-use		
Power Requirements	3 volt lithium battery coin cell, 2 per unit — CR-2450		
Air Supply	2.10 ± .01 bar / 30.4 ± .15 psi		
Display	Rotates through 270 degrees		
Order no.		**2103200***	

** Complete with handle, adaptor and hose*

Accessories

	µDimensionair II Order no.
Pressure Regulator with filter	**2238020***
Pressure Meter	**2095924**
Bench Kit with adaptor	**2239307**
Battery 3V type CR-2450	**EBY-1018**
Insulated Handle	**2237666**
Shut off slide valve	**2240993**
Rest Stand	**2241109**
Swivel coupling adaptor	**2240594**
Air Regulator Trap	**AFL-24**
20' Long Hose	**2237713**
Supply Hose to Regulator/Filter	**AHO-2**
Data interface:	
USB Cable (MarCom or PC, 2m)	**4346023**
RS232 Cable (OPTO- 2m)	**4346020**
Digimatic Cable (10 pin plug 2m)	**4346021**

** For applications where the local elevation is greater than 305m / 1000 feet, special calibration is required.*

Optional Factory Configured Features for *µDimensionair II*:

- Locked multiplier factor
- Disabled sleep mode
- Locked inch/mm button
- Locked setup mode with password
- Power up in inch/mm unit on battery change
- Calibration lockout with password

832 Dimensionair® Air Gaging (Single Master System)

Features

- Digital and analog displays in a single unit. Large, high contrast digital readout shows exact deviation from zero; analog display shows measurement conditions at a glance
- Fixed resolution and balanced air system makes the Digital Dimensionair a stable and reliable system for manufacturing environments.
- Only a single master required to set zero; system is precalibrated for correct magnification
- Ranges and resolutions for virtually any air gage application, including 2, 3, 4 and 6 jet tooling plus AirProbes and JetProbes.
- Dynamics measurement capability
- RS-232 Output – for communicating with a data collector, computer or printer, permitting statistical process control
- Master Deviation – enhances measurement by making Auto Zero even more accurate.

Technical Data

Model	Measuring Range	Digital Resolution	Analog Resolution	Tooling I.D. Number
Low Magnification Single or Dual Input	±0.080 mm /**±.003"**	0.0002 mm /**10µ"**	0.004 mm /**150µ"**	60
	±0.040 mm /**±.0015"**		0.002 mm /**75µ"**	50
	±0.020 mm /**±.00075"**		0.001 mm /**38µ"**	20
High Magnification Single or Dual Input	±0.008 mm /**±.0003"**	0.0001 mm /**5µ"**	0.0004 mm /**15µ"**	10
	±0.004 mm /**±.00015"**		0.0002 mm /**8µ"**	5

Operating Temperature	5~35° C / ***41~95° F***
Storage Temperature	0~60° C / ***32~140° F***
Repeatability	±1 digit or ±1% of range, whichever is greater
Calibration Accuracy	±1 digit*
Linear Error	±1 digit
Response Time (Electronics)	43 msec.
Response Time (Air)	Approx. 1 sec. (dependent on hose length of air tooling)
Thermal Stability	0.1% of full scale/°F
Digital I/O	Five TTL opto-isolated outputs
Data Output	RS-232, transmits Channels A, B, (or both – dual input models only)
Analog Output	±5 VDC full scale for displayed value signal ±A, ±B
Measuring Modes	Actual, Minimum, Maximum, T.I.R., Nominal
Tolerance Indicators	Five LEDs
Weight (approx.)	5 kg / ***11 lbs.***
Dimensions H x W x D	254 x 197 x 216 mm / ***10" x 7.75" x 10.25"***
Display Modes	A or B or both (dual input models only)
Auto Power Off	After 30 minutes of non-use (selectable)
Power Requirements	100 Vac to 240 Vac, 50-60Hz with power module (Furnished)

Note: All models listed may be ordered for: 1-Jet, 2-Jet, 3-Jet, 4-Jet, or 6-Jet applications. At time of ordering, PLEASE designate the number of jets to be used on the system.

** For applications where the local elevation is greater than 305m/1000 feet, special calibration is required.*

832 Dimensionair® Air Gaging (Single Master System)

Technical Data

Number of Jets	Voltage/Adaptor	Low Magnification Single Input Order no.	High Magnification Single Input Order no.	Low Magnification Dual Input Order no.	High Magnification Dual Input Order no.
1, 2, 3	110/U.S.	**2004100**	**2004103**	**2004106**	**2004109**
4	110/U.S.	**2004101**	**2004104**	**2004107**	**2004110**
6	110/U.S.	**2004102**	**2004105**	**2004108**	**2004111**
1, 2, 3	240/International	**2004112**	**2004115**	**2004118**	**2004121**
4	240/International	**2004113**	**2004116**	**2004119**	**2004122**
6	240/International	**2004114**	**2004117**	**2004120**	**2004123**

Accessories

Order no.	Description
7024634	RS-232 Cable, Amplifier to MSP-2 Printer or computer, 2m / 6ft cable
ECV-1276	Oil/Splash Cover (opaque)–provides protection for the 832 Digital Dimensionair® when used in harsh environments
ECV-1285	Oil/Splash Cover (clear)–provides protection for the 832 Digital Dimensionair when used in harsh environments
ECB-1857	Footswitch for HOLD/RESUME, 3m / 10ft cable
ECB-1858	Footswitch for DYNAMIC RESET, 3 m / 10ft cable
ECB-1859	Footswitch for SEND DATA, 3m / 10ft cable
ECB-1855	Pushbutton for DYNAMIC RESET, 1.5m / 5ft cable
ECB-1860	Pushbutton for SEND DATA, 1.5m / 5ft cable
ECB-1868	Pushbutton for HOLD/RESUME and SEND DATA, 3m / 10ft cable
EKT-1236-W3	Relay Box – five relays each with Normally Open/Normally Closed contacts: Contact Rating – 30 Vdc/120 Vac, 3 amps Power Supply – 120 Vac Dimensions – 39 mm x 129 mm x 134.6 mm d/ 1.53“ x 5.08“ x 5.32“ with ECB-1886-W2*, 6.1 mm / 24“ interconnect cable amplifier/relay box
EKT-1236-W4	Same as W3, except with 220 Vac Power Supply
EKT-1236-W5	Same as W3, except with 240 Vac Power Supply
2010000	Power Supply, U.S. Adaptors (120V)
2010001	Power Supply, International Adaptor (120/240V)
Mating Connectors	
ECN-1695-W2	Digital I/O (15 pin male)
ECN-1693	Reset Data (3/32 microphone plug)
ECN-1695-W1	RS-232 Digital Output (9 pin female)

** Order ECB-1886-W1 for 305 mm / 12" interconnect cable, or, ECB-1886-W3 for 914 mm / 36" cable.*

Splash cover

Millimar C 1208 PE Compact, User-friendly Length Measuring Unit

Model Types and Accessories

			Order no.
C1208 PE	10000 F	Mahr Federal compatible	**5312093**
C1208 PE	2500 F/ 5000 F	Mahr Federal compatible	**5312095**

Accessories

Connection cable (9 pin D-Sub jack to D-Sub jack), length 3 m	**7024634**
Control unit with 3 pushbuttons	**5318430**
Footswitch for Millimar for	
Input 1	**5330955**
Input 2	**5330956**
Input 3	**5330957**
Air Supply Adaptor Kit	**2121236**

Features

Functions
- Favorites, using the SELECT button, frequently required settings can be directly called up
- Static measurements ± A, ± B and all combinations
- Dynamic measurements: Max, Min, Max-Min, Max+Min, mean value
- Auto-detect mode. Two measuring devices can be connected (probe, plug gage. . .) - the measuring device used is automatically shown on the display
- 1 point or 2 point master measurements
- Programmable via built-in keypad or RS232 interface via MS-Windows configuration software D1000S

Display
- Backlit LCD display with scale display and two-line digital display
- 5 three-colored status lamps for warning and tolerance limits
- Up to 2 features can be displayed at the same time

Connections
- One input for pneumatic measuring devices (optionally compatible to PE systems from Mahr or Mahr Federal)
- RS232 interface
- Three digital inputs for measuring start, master measurements, sending measuring value
- Three digital outputs for GO, NO-GO, rework, measuring time

Technical Data

Display	Backlit LCD display 115 mm x 70 mm
Analog scale	Indicator, 61 graduation
Range and text display	Characters LCD, 5 x 7, Dot matrix, alpha-numerical
Measured value display	7 digit LCD, 7 segments
Tolerance display	5 LEDs, 3 colors
Display ranges	± 3, 10, 30, 100, 300, 1000, 3000, 10000 µm ***± 0.0001. 0.0003; 0.001; 0.003; 0.01; 0.03; 0.1; 0.3 inch*** or tolerance related

Measuring range / resolution (tooling dependent)

2500:1	100 (±50) µm / 0.1µm
5000:1	50 (±25) µm / 0.1µm
10000:1	25 (±12.5) µm / 0.1µm

Error limits

10 x analog display	2 % (51 pixel)
Digital display	0.05 %
Temperature coefficient	± 0.005 %/°C
Operating temp. range	0 °C to 45 °C

Interfaces

Computer, printer	RS232, 9 pin, male (PC compatible configuration)
Control inputs	3 opto-coupler outputs, 24 V, 10 mA 24 V, 100 mA
Control outputs	3 opto-coupler inputs, 24 V, 100 mA 24V, 10 mA
Current supply Mains unit	100 V to 240 V, 47 Hz to 63 Hz
Power consumption	10 VA
Protection class	IP53 with conductive dust IP43
Housing dimensions (H x W x D)	ca. 205 x 160 x 165 mm
Weight	ca. 2.1 kg

Millimar C 1245 PE Flexible Length Measuring Unit for versatile tasks (single or dual master system)

Model types

			Order no.
C1245 PE/F	2500	with regulator	**5331271**
C1245 PE/F	5000	with regulator	**5331271**
C1245 PE/F	10000	with regulator	**5331273**
For 2 pneumatic probes			
C1245 PE/F 2	2500	without regulator	**5331275***
C1245 PE/F 2	5000	without regulator	**5331275***
C1245 PE/F 2	10000	without regulator	**5331277***
Accessories			
Air Supply Adaptor Kit			**2121236**
Baseplate* with 2 regulators (req'd for PE/F 2 Units			**5330909**

Features

Display
- Analog indicator instrument for measuring value display
- Two-line LCD display to display the measuring value and help texts
- 5-color status lamps for warning and tolerance limits
- Up to 3 features can be shown simultaneously

Functions
- 16 characters can be defined
- With an equation editor (80 characters) input channels C1 to C8 are mathematically linked with factors and brackets using the 4 basic mathematical functions
- Static measurements: current value, square root, arc tangent
- Dynamic measurements: Max, Min, Max-Min, Max+Min, mean values
- Statistical functions: n, x-bar S, Xmax, Xmin, R
- Measuring value memory for 5000 measuring values
- Measuring Start / Stop via keyboard, digital input, RS232

Connections
- 2 input modules can be used in the basis unit
- RS232 interface
- 1 analog output
- 3 digital inputs for measuring start, master measurement / zeroing, sending data
- 6 digital outputs for GO, NO-GO, rework, collective goods, measuring time, 4 classes, BCD interface

Technical Data

Display	Analog indicator instrument, LCD 53 mm x 40 mm
Analog scale	145 mm x 80 mm
Range and text display	7 characters LCD, 5x7 dot matrix, alpha-numerical
Measured value display	7 characters LCD, 7 segment
Tolerance display	5 LEDs, 3-colored
Display ranges	± 10, 30, 100, 300, 1000, 3000, 10000 µm ***± 0.0003; 0.001; 0.003; 0.01; 0.03; 0.1; 0.3 inch***

Measuring range / resolution (tooling dependent)

2500:1	100 (±50) µm / 0.1µm
5000:1	50 (±25) µm / 0.1µm
10000:1	25 (±12.5) µm / 0.1µm

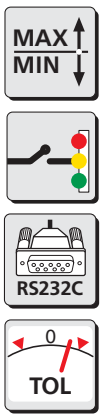
Error limits

10 x analog display	2 % (51 pixel)
Digital display	0.05 %
Temperature coefficient	± 0.005 %/°C
Operating temp. range	0 °C to 45 °C

Interfaces

Computer, printer	RS232, 9 pin, male (PC compatible configuration)
Control inputs	6 opto-coupler outputs, 24 V, 10 mA, 10 mA 24 V, 100 mA
Control outputs	3 opto-coupler inputs, 24 V, 100 mA
Current supply	90 V to 264 V,
Mains unit	47 Hz to 63 Hz
Power consumption	11 VA
Protection class	IP53 with conductive dust IP43
Housing dimensions (H x W x D)	ca. 205 x 160 x 165 mm
Weight	ca. 2.2 kg

Millimar S 1840 PE Length Measuring Instrument with three-color illuminated bar graph (single or dual master system)



Features

Assess and judge measuring results at a glance – nothing is easier than that with the Millimar S 1840 Column Amplifier. For measurements with air measuring devices

The Millimar S 1840 C Column Amplifier offers a broad range of functions for combining the signals from both static and dynamic measurements.

Measuring results are indicated by way of 101 three-color LEDs. When the programmable warning and tolerance limits are exceeded, the LEDs change their color from green to yellow or red, accordingly – high visibility from any distance.

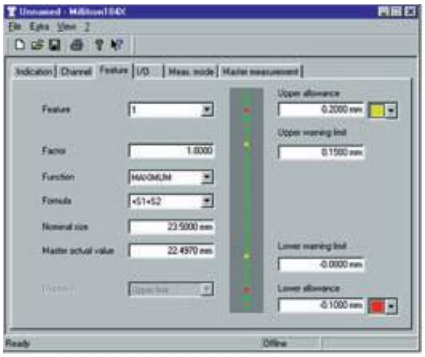
Display
- Easy-to-read 3-color illuminated bar graph with analog warning and tolerance limit display
- Backlit, two-line LCD for the display of measuring values, help tests and units of measurement
- Up to two characteristics can be displayed simultaneously

Connections
- Single input.
- RS 232 interface
- Analog output
- Three digital inputs for measuring start, master measurement, etc.
- Three digital outputs for Accept – Reject – Rework classification, measuring time, etc.

Functions
- Dynamic measurements: Max, Min, Max-Min, Max+Min, mean
- Windows® software for configuring the LED display The Millimar S 1840 column amplifier can be programmed either menu-guided via the integrated membrane keypad or with the provided Microsoft Windows® configuration software
- Single Master or Dual Master setup
- Password lockout in Setup Mode

- Supplied with:
  Mains power supply plug

Configuration Software



The Millimar S 1840 Aolumn Amplifier can be programmed either menu-guided via the integrated membrane keypad or with the provided Microsoft Windows® configuration software.

Shown with 2239307 stand

Millimar S 1840 PE Length Measuring Instrument with three-color illuminated bar graph (single or dual master system)

Technical Data

Analog display	101 LED elements, 3-color	Computer, printer	RS232, 9 pin, male (PC compatible configuration)
Range and text display	7 character LCD, 14 segment, alphanumerical	Control inputs	3 opto-coupler outputs, 24 V, 10 mA
Measured value display	7-stellig LCD, 7 Segment	Control outputs	3 opto-coupler inputs, 24 V, 100 mA
Tolerance display	via color range of the anlog display	Analog output voltage	1 V/mm
Display ranges	± 1, 10, 30, 100, 300, 1000, 3000, 10000 µm ***± .0001; .0003; .001; .003; .01; .03; .1; .3 inch*** or tolerance related	Power supply	90 V bis 264 V, 47 Hz to 63 Hz
		Power consumption	20 VA
Error limits		Protection class	IP53 with conductive dust IP43
10 x analog display	1 % (101 LEDs)	Housing dimensions (H x W x D)	ca. 487 x 47 x 144 mm ***ca. 19.17" x 1.85" x 5.67"***
Digital display	± 1 digit	Weight	ca. 1.6 kg
Temperature coefficient	± 0.005 %/°C		
Operating temp. range	0 °C to 45 °C		
Interfaces			

Air/electronic converter for Millimar S 1840 PE

Measuring principle	differential pressure		
Measuring value acquisition	piezo		
Magnification	2500:1	5000:1	10000:1
Air measuring range in µm ***(inch)***	± 50 ***(±.00196")***	± 25 ***(±.00098")***	± 12.5 ***(±.00049")***
Resolution	0.1 µm / ***.000005"***		
Measuring error in µm ***(inch)***	< 1 % of measuring range, better 0.5 %		
Signal noise in µm ***(µinch)***	<= 0.4 ***(15.748)***	<= 0.2 ***(7.874)***	<= 0.1 ***(3.937)***
Setting time in sec. (1 m / 3.3 ft hose)	<= 0.3	<= 0.3	<= 0.5
Setting time in sec. (2 m / 6.6 ft hose)	<= 0.5	<= 0.5	<= 0.7
Operating temperature	0 . . . 40 °C (32 . . . 104 °F)		
Supply pressure (> 4 bar before regulator)	2 bar ± 5 %		
Air supply connection	PU hose, dia 8 x 1 ***(.315 x .0394")***		
Measuring air connection	PU hose, dia. 6 x 1 ***(.236 x .0394")***		
Zero setter (OFFSET)	electrical		
Amplification (GAIN)	electrical		
Air consumption	approx. 1-2 m^3 ***(1.308-2.616 cu.yd.)***		

Splash Cover

Order no.

Millimar S 1840 PE to connect air measuring devices

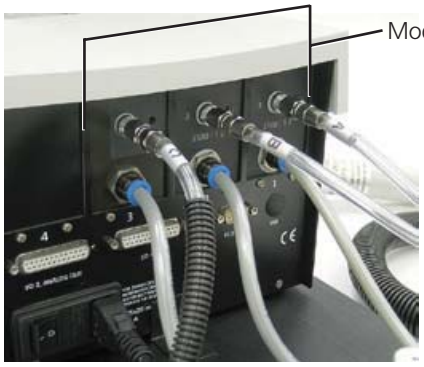
		Tooling I.D.	Order no.
S 1840 PE/F	Low magnification for 1 air gage 2500:1 / 5000:1 without regulator	50/20	**5318455***
S 1840 PE/F	High magnification for 1 air gage10000:1 without regulator	10,5	**5318457***

** Base with Regulator required and sold separately, Air Supply Kit recommended*

Accessories

	Order no.
Base Foot With 1 Regulator for 1 1840 PE Column Unit	**5330914**
Base Foot With 2 Regulators for 2 1840 PE Column Units	**5330915**
Base Foot With 3 Regulators for 3 1840 PE Column Units	**5330916**
Connection Cable (9 pin D-Sub jack to D-Sub jack), length 3 m	**7024634**
Control Unit with 3 pushbuttons	**5318430**
Footswitch for Millimar	**5330955**
Configuration Software D1000 S	**7090375**
Air Supply Adaptor Kit Includes AFL-24 Filter and AHO-2 Hose	**2121236**
Splash Cover	**2247956**
Hand Switch Handle with send data button	**2252413**

Dimensionair® Air Gages



Features

Assess and judge measuring results at a glance – nothing is easier than that with the Millimar S 1840 Column Amplifier. For measurements with air measuring devices.

The Millimar S 1841 Column Amplifier offers a broad range of functions for combining the signals from both static and dynamic measurements. Up to 4 display units may be used.

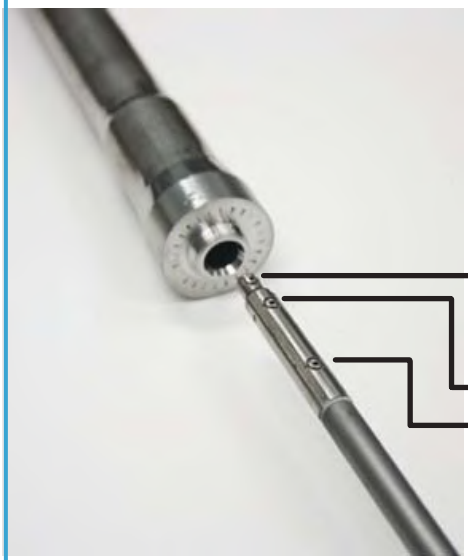
Measuring results are indicated by way of 101 three-color LEDs. When the programmable warning and tolerance limits are exceeded, the LEDs change their color from green to yellow or red, accordingly – high visibility from any distance.

Display unit
- Easy-to-read 3-color illuminated bar graph with analog warning and tolerance limit display
- Backlit, two-line LCD for the display of measuring values, help tests and units of measurement
- Up to two characteristics can be displayed simultaneously

Connections
- Single input
- RS 232 interface
- Analog output
- 6 digital inputs for measuring start, master measurement, etc.
- 12 digital outputs for Accept – Reject – Rework classification, measuring time, etc.

Functions
- Dynamic measurements: Max, Min, Max-Min, Max+Min, mean.
- Microsoft Windows® software for configuring the LED display
  The Millimar S 1841 Column Amplifier can be programmed using a menu guide via the integrated membrane keypad or with the provided Microsoft Windows® configuration software
- Single Master or Dual Master setup
- Password lockout in Setup Mode
- Supplied with:
  Mains power supply plug

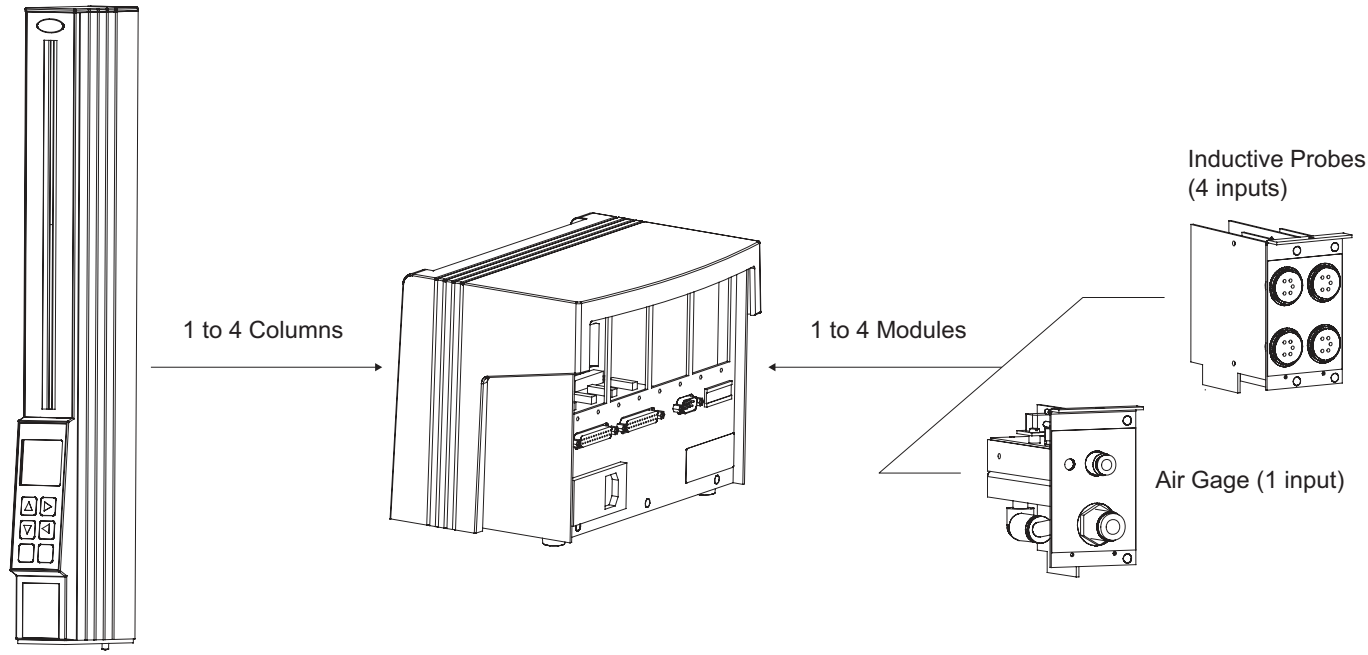
Application Examples



Small Diameter | Center Diameter | Large Diameter | Taper Center-Large

Millimar S 1841 Multi-Gaging Column Amplifier with 3 colored LED's

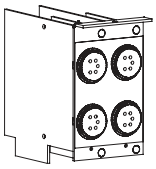
Technical Data



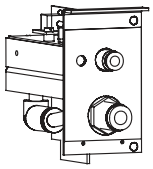
Indicating and operating column

Base unit

Base unit - input modules



Input module for inductive probes
4 input channels for inductive probes



Input module for air gages
1 input channel for air gages air/electronic converter piezo
Supply pressure 2.1/30.4psi bar +/- 5 %
(> 4 bar before pressure reducer)
Each module requires 1 pressure reducer

Millimar Intelligent Measurement Interface system

X1715

X1741

Features

Millimar X 1715 is a smart and universal measurement interface system for complex measuring tasks on the production floor. It is ideal as a signal transformer between sensors and the electronic measured data processsing.

Functions
- Static and dynamic measurements
- Equation editor
- Definition of 16 features are possible
- One or two point master measurement

Connections
- 1 to 8 measuring device inputs
- RS-232 interface
- Analog output
- 3 digital inputs and 6 digital outputs

- Supplied with:

  Operating instructions, connection cable and a mains power supply plug

Technical Data

Measuring range inductive probe	4000 (± 2000) µm, ***± .08"*** Resolution 0.1 µm, ***.000005"***
Response time	
- Meas. value memory	0.005s
- Outputs	0.020s
Error limits	
- 0.3% (min. 0.2 µm)	
Temperature coefficient	± 0.005%/°C
Oper. temperature range	0°. . . 50°C / 32° F . . . 122° F
Interfaces	
Computer, printer	RS232, 9 pin interface (PC-compatible layout)
- Control outputs	6 Optocoupler-outputs, 24V, 100mA
- Control inputs	3 Optocoupler-inputs, 24V, 10mA
Analog output voltage	programmable

Power supply	90 V . . . 264 V, 47Hz . . . 63Hz
Power consumption	11 VA
Protection class	IP53 IP43 with conductive dust
Dimensions (H x B x T)	ca. 160 x 205 x 165 mm ***ca. 6.30" x 8.07" x 6.49"***
Weight	ca. 2 kg / 4.40 lbs

Millimar 1940. Air/Electronic Converter

To "Mahr" Inductive Probe type

Air-controlled probes are becoming more and more widespread in dimensional metrology. Air/electronic converters convert the measuring signal (air pressure) into an electronic signal. **Millimar 1940** is particularly well-suited to measurements with narrow tolerances. Its cutting-edge carrier frequency measuring system means it can be connected to the evaluation instruments in the same way as an inductive probe.

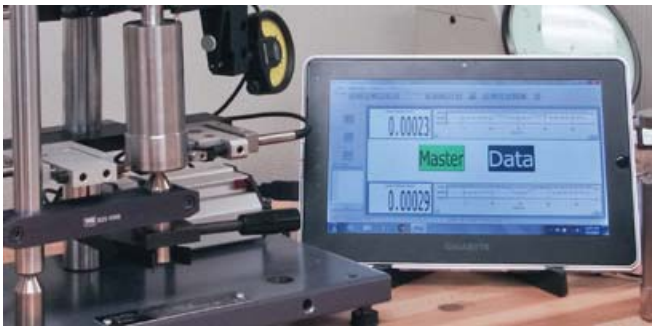
Millimar X 1941. Air/Electronic Converter

To Analog Output

Air/electronic converters convert the signals from pneumatic measuring equipment (air pressure) into electrical signals. The piezo-electrical measuring system means that the **X 1941** Air/Electronic converter can be finely aligned with most of the pneumatic systems on the market. The **Millimar X 1941** has an analog signal output. It can therefore be very easily connected to the measuring computer and control system.

Dimensionair® Air Gages - PC based Air Gage Systems

Small sized modular based PC systems



For gaging applications more complex than a bench amplifier requiring basic part classification and trend information, Mahr Federal can provide the ideal custom solution with its series of modular components.

Starting with a small PC based touchscreen computer and modular interfaces, a tailor made solution will provide the ideal combination of power and value.

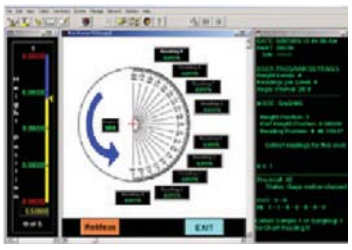
Modules include Air/Electronic convertors, LVDT's, I/O and much more. The Windows based software allows for easy screen customization, part gaging programs and basic data analysis, all custom integrated into your air gage solution.

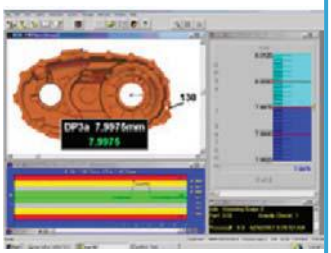
Full size benchtop PC systems

Our benchtop PC air gage system utilizes an integral touchscreen PC and user configurable SPC software. The basic configured system starts with two air-electric USB based modules and manual shutoff valves. More advanced systems may include up to 8 air-electric modules with automatic solenoid operation controlled by the user software. Other accessories, like footswitch triggers, may be used for hands free data collection. Larger non-benchtop configurations may also be provided based on application requirements.

Applications suitable for this type of system are multiple bore measurement on housing and castings, taper, straightness, squareness, match gaging, centerline, small orifice flow, in-process automation, and more. It has a complete data collection capability with full flexible statistical analysis and reporting. Operator screens customized for clear identification of measurement location with step-by-step instruction.

- Windows-based software
- Password protected menus and access authorization
- Easy programming of the inspection
- Freely programmable calculation format
- Fast selection to display the measurements conducted
- Aid monitor for easy adjustment of sensors
- Multiple display formats available
- Measurement is saved (manually or automatically)
- Statistical evaluation of a measuring result
- Depiction as a histogram and SPC control card.
- Measurement systems analysis (GR&R) integrated
- Data export in numerous data formats
- I/O interface for automatic control





Dimensionair® Air Gages

Multiple jet plugs for average diameters, multiple diameters, taper and straightness.

Air snaps combined with column gages for multiple diameters read easily at the point of manufacture.

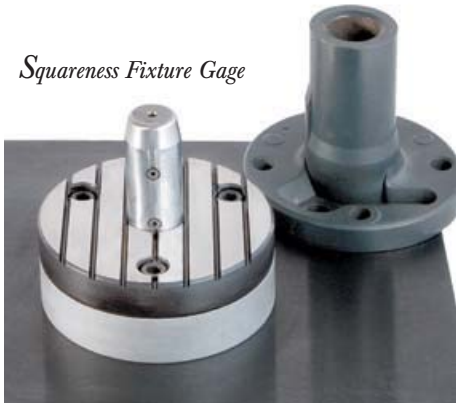
Partial diameter air tooling for half bearing measurement

Air gaging for width and depth

Tapered Snap

Air tooling for I.D. and O.D. tapers – angle, size and side straightness

Squareness Fixture Gage



Dimensionair® Air Gages – Air Plugs

Features

- **Calibrated I.D. tooling for the Dimensionair® Air Gaging Systems**
- Tooling is interchangeable without adjusting system magnification.
- Federal Air Plugs have large clearance (see table below), allowing easy entrance into the hole being measured and greater measuring range.
- Long life - wide clearance and hard chrome (optional) body extends useful life of the Air Plug.
- Deep, recessed jets - Air jets are recessed into the plug body which protects them from damage.
- Large jet size eliminates clogging from dirt and oils..

Plug identification

Air Plugs are marked with an identification number which identifies its size, number of jets, plug style, and the Dimensionair® Model the plug should be used with.

For example: **DP50-T2-1.000** is the identification number of an Air Plug for a **2095184** or a standard magnification 832 Dimensionair (DP50), through-hole style with two jets (-T2), and 25mm/1.000" nominal size (-1.000).

The number (50) which identifies the Dimensionair intended is marked on the plug and also appears on the dial of the Dimensionair to help in matching the tooling to its corresponding Dimensionair model.

Identification	Nominal Size from		To & include		Clearance from Nominal Size	
	mm	*inch*	mm	*inch*	mm	*inch*
DP100*, DP60	3	***.123"***	3.5	***.140"***	0.030	***.0012"***
	3.5	***.140"***	4.7	***.185"***	0.045	***.0018"***
	4.7	***.185"***	6.3	***.248"***	0.061	***.0024"***
	6.3	***.248"***	76.3	***3.004"***	0.081	***.0032"***
	76.3	***3.004"***	127	***5.000"***	0.089	***.0035"***
	above 127	***5.000"***			0.107	***.0042"***
DP50	3	***.123"***	3.5	***.140"***	0.015	***.0006"***
	3.5	***.140"***	4.7	***.185"***	0.027	***.0011"***
	4.7	***.185"***	6.3	***.248"***	0.030	***.0012"***
	6.3	***.248"***	76.3	***3.004"***	0.045	***.0018"***
	76.3	***3.004"***	127	***5.000"***	0.071	***.0028"***
	Above 127	***5.000"***			0.081	***.0032"***
DP20	3	***.123"***	3.5	***.140"***	0.009	***.00035"***
	3.5	***.140"***	4.7	***.185"***	0.013	***.0005"***
	4.7	***.185"***	6.3	***.248"***	0.015	***.0006"***
	6.3	***.248"***	76.3	***3.004"***	0.023	***.0009"***
	76.3	***3.004"***	127	***5.000"***	0.071	***.0028"***
	Above 127	***5.000"***			0.081	***.0032"***
DP10	1.57	***.062"***	44.5	***1.750"***	0.009	***.00035"***
	44.5	***1.750" up***			0.014	***.00055"***
DP5	1.57	***.062"***	25.40	***1.000"***	0.004	***.000175"***
	25.40	***1.000"***	44.45	***1.750"***	0.005	***.0002"***
	44.45	***1.750" up***			0.007	***.0003"***

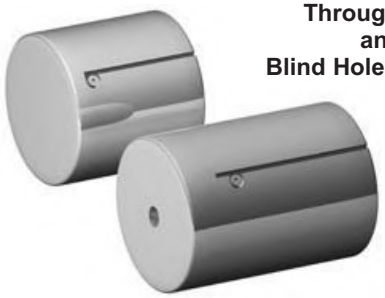
** DP-100 not available below 9.525 mm / .375"*

Ordering Information

When ordering Air Plugs please specify:

1. Nominal I.D. Size and Tolerance.
2. Dimensionair model to be used.
3. Air Plug style (Through Hole, Blind Hole, or Counterbore).
4. Air Plug finish (Chrome-plated or Hardened Steel).
5. Order Master Setting Ring at same time.

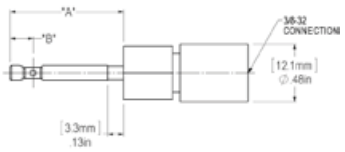
Unless otherwise specified, Mahr Federal will furnish a 2-jet, Through Hole, High Chrome Air Plug for a 2500:1 Dimensionair.



Through Hole and Blind Hole Air Plugs

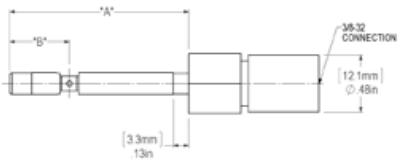
Through Hole Plugs (DP50 - DP20 & 60)

3.12-4.70 mm/ .123-.185"



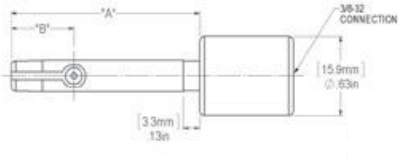
Minimum recommended hole length: 4.75 mm / ***.187***"

4.70-6.30 mm/ .185-.248"



Minimum recommended hole length: 4.75 mm / ***.187***"

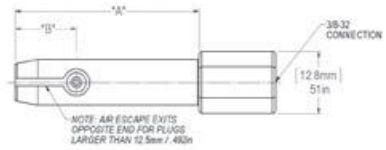
6.30-9.49 mm/ .248-.3735"



Minimum recommended hole length: 6.35 mm / ***.250***"

With guide sleeve or stop collar: 1.8 mm / ***.070***"

9.49-14.94 mm/ .3735-.588"

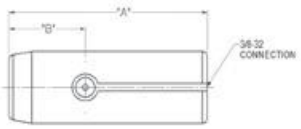


Minimum recommended hole length: 6.35 mm / ***.250***"

With guide sleeve or stop collar: 1.8 mm / ***.070***"

May be used with AEX-1 or -2 Extensions for deep holes.

14.94-19.05 mm/ .588-.750"

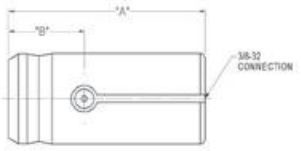


Minimum recommended hole length: 6.35 mm / ***.250***"

With guide sleeve or stop collar: 1.8 mm / ***.070***"

May be used with AHA-4 or -5 Extensions for deep holes.

19.05-37.69 mm/ .750-1.484"

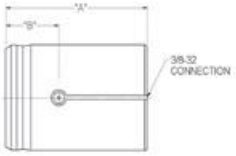


Minimum recommended hole length: 6.35 mm / ***.250***"

With guide sleeve or stop collar: 1.8 mm / ***.070***"

May be used with AHA-4 or -5 Extensions for deep holes.

37.69-76.30 mm/ 1.484-3.004"

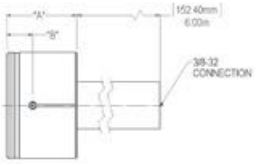


Minimum recommended hole length: 6.35 mm / ***.250***"

With guide sleeve or stop collar: 1.8 mm / ***.070***"

May be used with AHA-4 or -5 Extensions for deep holes.

76.30-114.30 mm/ 3.004-4.500"



Minimum recommended hole length: 6.35 mm / ***.250***"

With guide sleeve or stop collar: 1.8 mm / ***.070***"

Technical Data - Through Hole Plugs

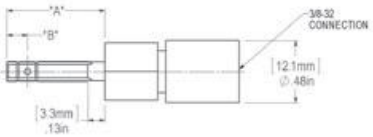
Measured Size mm ***inch***

Above	To & include	"A"	"B"	Minimum Hole Length*	Measuring Range		
					DP50	DP20	DP60
3.12 / ***0.123"***	3.56 / ***0.140"***	23.81 / ***0.938"***	4.76 / ***0.188"***	4.75 / ***0.187"***	0.025 / ***0.0010"***	0.013 / ***0.0005"***	0.051 / ***0.0020"***
3.56 / ***0.140"***	4.70 / ***0.185"***	23.81 / ***0.938"***	4.76 / ***0.188"***	4.75 / ***0.187"***	0.038 / ***0.0015"***	0.0200 / ***0.00075"***	0.076 / ***0.0030"***
4.70 / ***0.185"***	6.30 / ***0.248"***	38.10 / ***1.500"***	12.70 / ***0.500"***	4.75 / ***0.187"***	0.051 / ***0.0020"***	0.025 / ***0.001"***	0.102 / ***0.0040"***
6.30 / ***0.248"***	9.49 / ***0.3735"***	38.10 / ***1.500"***	12.70 / ***0.500"***	6.35 / ***0.250"***	0.076 / ***0.0030"***	0.038 / ***0.0015"***	0.152 / ***0.0060"***
9.49 / ***0.3735"***	14.94 / ***0.588"***	38.10 / ***1.500"***	12.70 / ***0.500"***	6.35 / ***0.250"***	0.076 / ***0.0030"***	0.038 / ***0.0015"***	0.152 / ***0.0060"***
14.94 / ***0.588"***	19.05 / ***0.750"***	41.28 / ***1.625"***	15.88 / ***0.625"***	6.35 / ***0.250"***	0.076 / ***0.0030"***	0.038 / ***0.0015"***	0.152 / ***0.0060"***
19.05 / ***0.750"***	37.69 / ***1.484"***	41.28 / ***1.625"***	15.88 / ***0.625"***	6.35 / ***0.250"***	0.076 / ***0.0030"***	0.038 / ***0.0015"***	0.152 / ***0.0060"***
37.69 / ***1.484"***	76.30 / ***3.004"***	50.80 / ***2.000"***	19.10 / ***0.750"***	6.35 / ***0.250"***	0.076 / ***0.0030"***	0.038 / ***0.0015"***	0.152 / ***0.0060"***
76.30 / ***3.004"***	114.30 / ***4.5"***	50.80 / ***2.000"****	19.10 / ***0.750"***	6.35 / ***0.250"***	0.076 / ***0.0030"***	0.038 / ***0.0015"***	0.152 / ***0.0060"***

** If a guide sleeve or stop collar is used, minimum hole length can be as small as 1.78 mm /. 070" for holes larger than 6.30 mm / .248".*
*** A handle 152 mm / 6" long and 33.3 mm / 1.31" diameter is supplied with plugs over 76.5 mm / 3.004".*

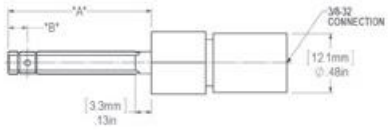
Blind Hole/Counterbore Plugs (DP50 - DP20 & 60)

3.94-4.7 mm / .155-.185“



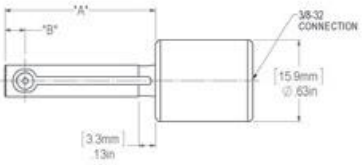
Minimum recommended hole length: 6.35 mm / ***.250“***.
Note: Masters must simulate workpiece for holes of this size.

4.7-6.30 mm / .185-.248“



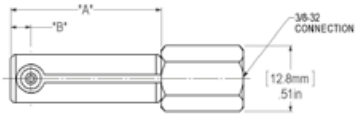
Minimum recommended hole length: 6.35 mm / ***.250“***

6.30-9.49 mm / .248-.3735“



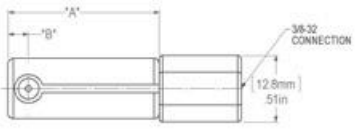
Minimum recommended hole length: 6.35 mm / ***.250“*** Shorter bores can be checked. Consult Mahr Federal Customer Resource Center.

9.49-11.86 mm / .3735-.467“



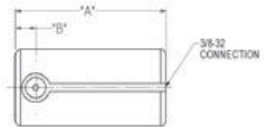
Minimum recommended hole length: 6.35 mm / ***.250“***. Shorter bores can be checked. Consult Mahr Federal Customer Resource Center. May be used with Extension AHA-28 for deep holes.

11.86-14.94 mm / .467-.588“



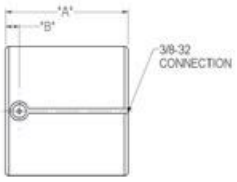
Minimum recommended hole length: 6.35 mm / ***.250“*** Shorter bores can be checked. Consult Mahr Federal Customer Resource Center. May be used with Extensions AEX-1 or -2 for deep holes.

14.94-37.69 mm / .588-1.484“



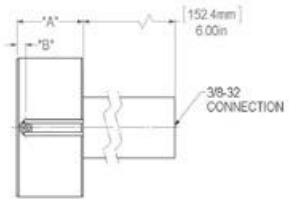
Minimum recommended hole length: 6.35 mm / ***.250“***. Shorter bores can be checked. Consult Mahr Federal Customer Resource Center. May be used with AHA-4 or -5 Extensions for deep holes.

37.69-76.30 mm / 1.484-3.004“



Minimum recommended hole length: 6.35 mm / ***.250“***. Shorter bores can be checked. Consult Mahr Federal Customer Resource Center. May be used with AHA-4 or -5 Extensions for deep holes.

76.30-114.30 mm / 3.004-4.50“



Minimum recommended hole length: 6.35 mm / ***.250“***.

Super Blind Plugs

Blind Hole Air Plugs can be furnished to check shorter holes than listed above, and can be furnished to check closer to the bottom of a hole. Holes must be at least 1.91 mm/**.075“** long, and the distance from the end of the plug to the center-line of the jets can be as short as 1.40mm/**.055“** for plugs below 6.34mm/**.250“** or 1.14mm/**.045“** for plugs above 6.34mm/**.250“**.

Technical Data - Blind Hole/Counterbore Plugs

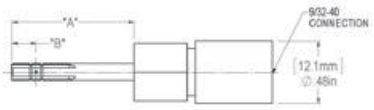
Measured Size mm / ***inch***

Above	To & Include	“A”	“B”	Minimum Hole Length*	Measuring Range DP50	DP20	DP60
3.94 / ***0.155“***	4.70 / ***0.185“***	19.10 / ***0.750”***	3.96 / ***0.156“***	6.35 / ***0.250“***	0.038 / ***0.0015“***	0.200 / ***0.00075“***	0.076 / ***0.0030“***
4.70 / ***0.185“***	6.30 / ***0.248“***	29.36 / ***1.156”***	3.96 / ***0.156“***	6.35 / ***0.250“***	0.051 / ***0.0020“***	0.025 / ***0.0010“***	0.102 / ***0.0040“***
6.30 / ***0.248“***	9.49 / ***0.3735“***	29.36 / ***1.156”***	3.96 / ***0.156“***	6.35 / ***0.250“***	0.076 / ***0.0030“***	0.038 / ***0.0015“***	0.152 / ***0.0060“***
9.49 / ***0.3735“***	11.86 / ***0.467“***	29.36 / ***1.156”***	3.96 / ***0.156“***	6.35 / ***0.250“***	0.076 / ***0.0030“***	0.038 / ***0.0015“***	0.152 / ***0.0060“***
11.86 / ***0.467“***	14.94 / ***0.588“***	29.36 / ***1.156”***	3.96 / ***0.156“***	6.35 / ***0.250“***	0.076 / ***0.0030“***	0.038 / ***0.0015“***	0.152 / ***0.0060“***
14.94 / ***0.588“***	37.69 / ***1.484“***	29.36 / ***1.156”***	3.96 / ***0.156“***	6.35 / ***0.250“***	0.076 / ***0.0030“***	0.038 / ***0.0015“***	0.152 / ***0.0060“***
37.69 / ***1.484“***	76.30 / ***3.004“***	35.71 / ***1.406”***	3.96 / ***0.156“***	6.35 / ***0.250“***	0.076 / ***0.0030“***	0.038 / ***0.0015“***	0.152 / ***0.0060“***
76.30 / ***3.004“***	114.3 / ***4.5“***	38.10 / ***1.5”*/****	3.96 / ***0.156“***	6.35 / ***0.250“***	0.076 / ***0.0030“***	0.038 / ***0.0015“***	0.152 / ***0.0060“***

** If a guide sleeve or stop collar is used, minimum hole length can be as small as 1.78 mm / .070" for holes larger than 6.30 mm / .248".*
*** A handle 152 mm/6" long and 33.3 mm/1.31" diameter is supplied with plugs over 76.30 mm / 3.004".*

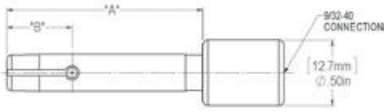
Through Hole Plug (DP10 — DP5)

1.57-6.35 mm/ .062-.250"



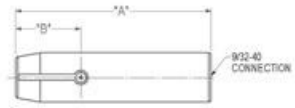
Minimum recommended hole length: 3.18 mm / ***.125"***.

6.35-9.49 mm/ .250-.3735"



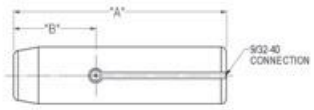
Minimum recommended hole length: 3.18 mm / ***.125"***.
With guide sleeve or stop collar: 1.14 mm/ .045".

9.49-11.10 mm/ .3735-.437"



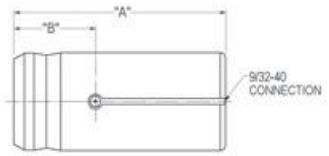
Minimum recommended hole length: 3.18 mm / ***.125"***.
With guide sleeve or stop collar: 1.14 mm / ***.045"***. May be used with AHA-23 or -24 Extensions for deep holes.

11.10-19.05 mm/ .437-750"



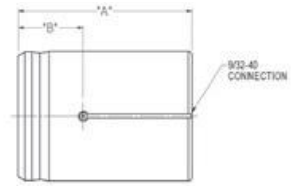
Minimum recommended hole length: 3.18 mm / ***.125"*** with proper support min. is 1.14 mm/ ***.045"***. May be used with AHA-23 or -24 Extensions for deep holes.

19.05-44.45 mm/ .750-1.750"



Minimum recommended hole length: 3.18 mm / ***.125"***.
With guide sleeve or stop collar: 1.14 mm / ***.04"***. May be used with AHA-23 or -24 Extensions for deep holes.

44.45-76.45 mm/1.750-3.010"



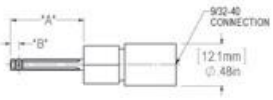
Minimum recommended hole length: 3.18 mm / ***.125"***.
With guide sleeve or stop collar: 1.14 mm / ***.04"***. May be used with AHA-23 or -24 Extensions for deep holes.

Through Hole Plugs *mm / inch*

Above		To & include		"A"		"B"		Minimum Hole Length*		Measuring Range DP10		Measuring Range DP5	
1.57	***.062"***	6.35	***.250"***	23.81	***.938"***	4.76	***.188"***	3.18	***.125"***	0.015	***.0006"***	0.008	***.0003"***
6.35	***.250"***	9.49	***.3735"***	38.10	***1.500"***	12.70	***.500"***	3.18	***.125"***	0.015	***.0006"***	0.008	***.0003"***
9.49	***.3735"***	11.10	***.437"***	41.28	***1.625"***	15.88	***.625"***	3.18	***.125"***	0.015	***.0006"***	0.008	***.0003"***
11.10	***.437"***	19.05	***.750"***	41.28	***1.625"***	15.88	***.625"***	3.18	***.125"***	0.015	***.0006"***	0.008	***.0003"***
19.05	***.750"***	44.45	***1.750"***	41.28	***1.625"***	15.88	***.625"***	3.18	***.125"***	0.015	***.0006"***	0.008	***.0003"***
44.45	***1.750"***	76.45	***3.010"***	50.80	***2.000"***	2.000	***.625"***	3.18	***.125"***	0.015	***.0006"***	0.008	***.0003"***

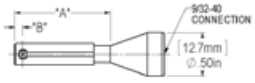
Blind Hole Plug (DP10 — DP5)

3.18-6.35 mm/ .125-.250"



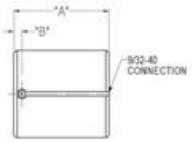
Minimum recommended hole length: 3.96 mm / ***.156"***.

6.35-11.10 mm/ .250-.437"



Minimum recommended hole length: 3.18 mm / ***.125"***.

11.10-76.45 mm/ .437-3.010"



Minimum recommended hole length: 3.18 mm / ***.125"***.
Use AHA-23 or -24 Extensions for deep hole applications.

Blind Hole/Counterbore Plugs

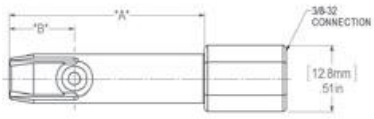
Above		To & include		"A"		"B"		Minimum Hole Length*		Measuring Range DP10		Measuring Range DP5	
mm	***inch***	mm	***inch***	mm	***inch***	mm	***inch***	mm	***inch***	mm	***inch***	mm	***inch***
3.18	***.125"***	6.35	***.250"***	21.44	***.844"***	2.39	***.094"***	3.96	***.156"***	.015	***.0006"***	.008	***.0003"***
6.35	***.250"***	11.10	***.437"***	27.79	***1.094"***	2.39	***.094"***	3.05	***.120"***	.015	***.0006"***	.008	***.0003"***
11.10	***.437"***	76.45	***3.010"***	27.79	***1.094"***	2.39	***.094"***	3.05	***.120"***	.015	***.0006"***	.008	***.0003"***

** If a guide sleeve or stop collar is used, minimum hole length can be as small as 1.1 mm/ .045" for holes larger than 6.4 mm/.250".*

Super Blind Plugs
Blind Hole Air Plugs can be furnished to check shorter holes than listed above, and can be furnished to check closer to the bottom of a hole. Holes must be at least 1.9 mm/.075" long, and the distance from the end of the plug to the center-line of the jets can be as short as 1.4mm/.055" for plugs below 6.4 mm/.250" or 1.1 mm/.045" for plugs above 6.4 mm/.250".

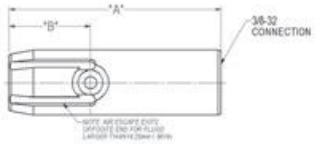
Through Hole Plug (DP100)

9.53-12.70 mm/ .375-.500"



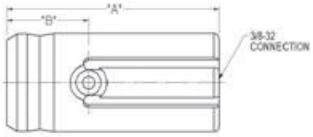
Minimum recommended hole length: 6.35 mm / ***.250"***, with proper support min. is 3.18 mm / ***.125"***. May be used with AEX-1 or -2 Extensions for deep holes.

12.70-19.05 mm/ .500-.750"



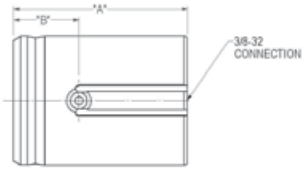
Minimum recommended hole length: 6.35 mm / ***.250"***, with proper support min. is 1.14 mm/ ***.125"***. May be used with AHA-4 or -5 Extensions for deep holes.

19.05-37.85 mm/ .750-1.490"



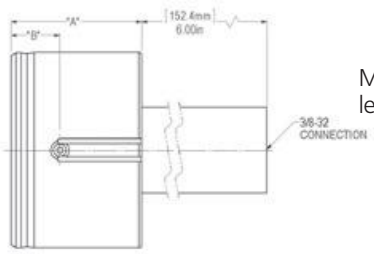
Minimum recommended hole length: 6.35 mm / ***.250"***, with proper support min. is 1.14 mm/ ***.125"***. May be used with AHA-4 or -5 Extensions for deep holes.

37.85-76.30 mm/ 1.490-3.004"



Minimum recommended hole length: 6.35 mm / ***.250"***. May be used with AHA-4 or -5 Extensions for deep holes.

76.30-114.30 mm/ 3.004-4.500"



Minimum recommended hole length: 6.35 mm / ***.250"***.

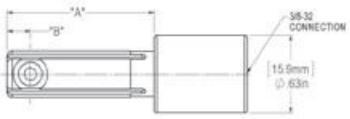
Through Hole Plugs

Measured Size mm/*inch*

Above		To & include		"A"		"B"		Minimum Hole Length*		Measuring Range	
9.53	***.375"***	12.70	***.500"***	38.10	***1.500"***	12.70	***.500"***	6.35	***.250"***	.152	***.006"***
12.70	***.500"***	19.05	***.750"***	41.28	***1.625"***	15.88	***.625"***	6.35	***.250"***	.152	***.006"***
12.70	***.500"***	37.85	***1.490"***	41.28	***1.625"***	15.88	***.625"***	6.35	***.250"***	.152	***.006"***
37.85	***1.490"***	76.30	***3.004"***	50.80	***2.000"***	19.05	***.750"***	6.35	***.250"***	.152	***.006"***
76.30	***3.004"***	114.30	***4.500"***	50.80	***2.000"***	19.05	***.750"***	6.35	***.250"***	.152	***.006"***

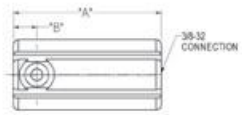
Blind Hole/Counterbore Plugs

9.53-14.25 mm/ .375-.561"



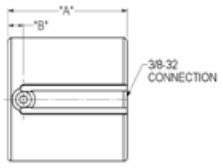
Minimum recommended hole length: 7.92 mm / ***.312"***.

14.25-37.85 mm/ .561-1.490"



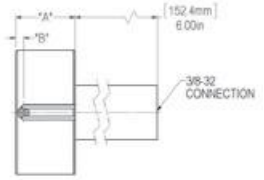
Minimum recommended hole length: 7.92 mm / ***.312"***. Use with AHA-4 or -5 handles for deep hole applications.

37.85-76.30 mm/ 1.490-3.004"



Minimum recommended hole length: 7.92 mm / ***.312"***. Use with AHA-4 or -5 handles for deep hole applications.

76.30-114.30 mm/ 3.004-4.500"



Minimum recommended hole length: 7.92 mm / ***.312"***.

Super Blind Plugs

Blind Hole Air Plugs can be furnished to check shorter holes than listed above, and can be furnished to check closer to the bottom of a hole. Holes must be at least 4.45 mm / ***.175"*** long, and the distance from the end of the plug to the centerline of the jets can be as short as 2.5 mm / ***.100".***

Measured Size mm/*inch*

Above		To & include		"A"		"B"		Minimum Hole Length*		Measuring Range	
9.53	***0.375"***	14.25	***0.561"***	30.15	***1.187"***	4.75	***0.187"***	7.92	***0.312"***	0.152	***0.0060"***
14.25	***0.561"***	37.85	***1.490"***	30.15	***1.187"***	4.75	***0.187"***	7.92	***0.312"***	0.152	***0.0060"***
37.85	***1.490"***	76.30	***3.004"***	36.53	***1.438"***	4.75	***0.187"***	7.92	***0.312"***	0.152	***0.0060"***
76.30	***3.004"***	114.30	***4.500"****	36.53	***1.438"***	4.75	***0.187"***	7.92	***0.312"***	0.152	***0.0060"***

Notes:

* *If a guide sleeve or stop collar is used, minimum hole length can be as small as 3.18 mm/.125"*

** *A handle 152 mm/6" long and 33.3 mm/1.31" diameter is supplied with plugs over 76.3 mm /3.004". For smaller or larger plugs than those shown above, or for any modification to the specifications shown, contact Mahr Federal Customer Resource Center.*

Measuring Deep Holes with Air Plugs

Non-Relieved Air Plugs

When precise plug alignment must be maintained through the entire length of a deep hole, Non-Relieved Air Plugs can be provided. The entire length of these plugs is held to the clearances of Air Plugs described on page 4. Extra lengths of up to 101.85mm/4.010in can be provided for plugs from 6.3mm/.248in to 63.75mm/2.510in diameter. Contact Mahr Federal Customer Resource Center to specify Non-Relieved Air Plugs.

Relieved Air Plugs

When only the "A" length dimensions (see pages 29 through 33) need to be held to Air Plug clearances, several options exist, depending on the size of the hole being measured:

Small: 4.75mm/.187in to 9.4mm/.370in (Through Hole Plugs) and. 4.75mm/.187in to 11.86mm/.467in (Blind Hole Plugs). Plugs are provided as a solid piece, with the "A" dimensions held to Air Plug clearances, and the remainder machined to a slightly smaller diameter.

Contact Mahr Federal Customer Resource Center to specify Air Plugs in these sizes.

Larger Bores: Both Through Hole and Blind Hole Plugs larger than 9.53mm/.375in have no shoulder to prevent deep hole gaging, and require using either handles or extensions to facilitate gaging.

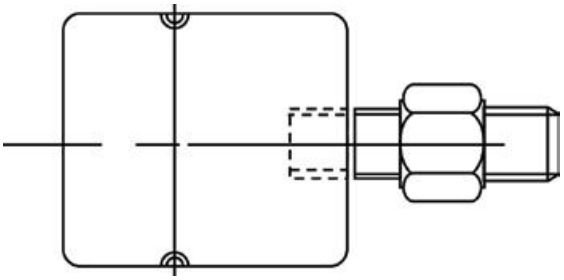
A releived multi-circuit airplug for deep holes

Extended Range Air Plugs – Oil Industry

Air tooling is available for measuring long bores, such as pump barrels used in the oil field industry. The tooling is modified to have up to a 0.254mm/.010in total range. It carries a DPS model number and is basically 2500:1 tooling with extra clearance, a 1/4in polished, trailing and leading edge radius, as well as a full .006in thickness on diameter of hard chrome plate for increased wear life.

The tooling is designed for use on model DA-SPEC-190 Dimensionair® with a choice of three available ranges:

5-0-5:	±0.127mm/±.005in,
8-0-2:	+0.200/-0.050mm +.008/-.002in
9-0-1:	+0.225/-0.025mm +.009/-.001in.



The plugs are typically used with a 30ft long hose. AHO-SPEC-102 is a rubber hose and AHO-SPEC-175 is a heavy duty hydraulic hose. The system is ideal for accurately measuring size within ±.005in of zero, but also when extended range is needed for approach and over or to monitoring bore wear typical for pump barrels.

Contact Style Air Plugs

Mahr Federal's Dimentron® Plugs can be used with 2500:1 Dimensionair systems as a 2-point contact type Air Plug.

AirProbe® and Handle Assemblies for these Plugs are available in three ranges:

Model	AirProbe (included)	Range mm/in	Matching Dial for Dimensionair Amplifier	
			Metric	Inch
AAT-192	**AA-2-3**	0.076/***.003"***	**ADL-28**	**ADL-95**
AAT-194	**AA-2-6**	0.152/***.006"***	**ADL-16**	**ADL-96**
AAT-193	**AA-2-15**	0.381/***.015"***	**ADL-20**	**ADL-97**

Assembly includes AirProbe, AD-140 Adaptor, HA-88 Handle, AL-1737 Flat Contact Point, and AHO-1 Hose. Order dial separately.

Dimensionair® Air Gages

Options for Air tooling

Materials

Standard Air plugs are normally furnished in High Chrome Content Stainless Steel. Mahr Federal has extensively tested this material and it has demonstrated extremely long life and strong resistance to rusting. In fact wear characteristics are so good that in many cases optional chroming is not required. However, depending on the application and experience from our technical support team we can recommend other process or material options such as flash chroming for extra protection or manufacturing air plugs in other materials for extreme use applications such as CMP-10V, or adding carbide wear strips.

Non-relieved Air Plugs

Normally when using an air plug in a deep hole, extensions are combined with the plug to reach the bottom of the bore. In some cases, lands and interruptions can interfere with plug movement. In these cases a non-relieved plug can be specified. Here the plug is made to a specific length (in 1 inch increments) so that the land will help guide the plug through the part.

Special Jet Locations/Multiple Bore Diameter

For certain blind hole applications the location of the jets are critical to measuring the diameter at precisely the location as called out on the part print. Special jet locations can be called out as part of the plug requirements, or, requirements may call for multiple diameters (the same or different) to be measured simultaneously. Special plugs have multiple jets at different diameter positions that can speed up the gaging process.

Sometimes when multiple diameters are measured with the same plug, the bore concentricity may be greater than the measuring range of the plug. In cases such as these, "floating" plug bodies, can be used to allow for alignment into the bores.

Multiple Diameters

Round Plug

Square Plug

Dual Circuit Plug

Multiple Diameter Thin Wall

Width

Floating Multiple Diameter Plugs

Dimensionair® Air Gages

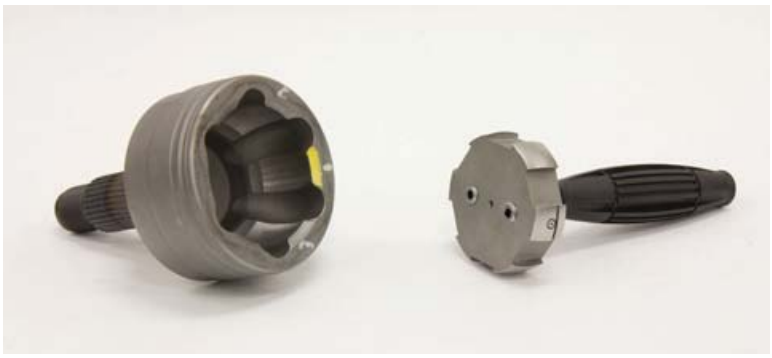
Options for Air Tooling

Special Shapes

Air tooling for precision bores is by far the most common air gaging application. However, air tooling can be configured to meet virtually any gaging requirement. These may include square plugs, plugs for measuring partial chords in a ball socket, spherical shaped plug gages, plugs measuring multiple diameters in pump housing or "mouse gages" designed to measure and explore slot widths in parts. Let us take a look at your application.

Oblong Taper Plug

Center Distance



Spherical Air Plugs

Automated Gaging

Air gaging can be successfully used as part of an automated process. Designs can be made to account for these applications. To help in part alignment the leading edge of the air plug is critical for either making entry into the part easy or aligning the part to the bore thus an easy entry lead in can be incorporated. Also, Mahr Federal has an extensive library of compliance fixtures to help guide the plug into the part when staging is not properly aligned to the part.

We also can provide gaging stations that can be implemented into robot loaded work stations that allow for easy part loading and direct feedback to the station controller.

Integrated Air Gage OD Station

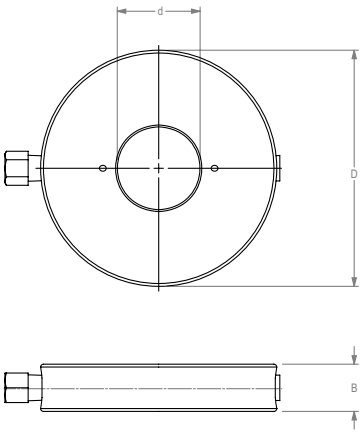
Stop Collars / Slit Jets

For precisely positioning the plug at specified depths, a stop collar is the effective solution. These inexpensive options are a must for short bores. They position the measuring jets at the proper location while assuring the plug is square to the bore.

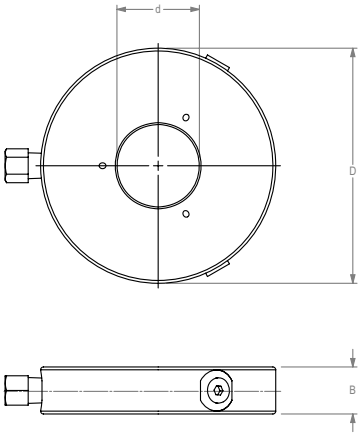
For short lands, standard jetting may be replaced with alternate jet configurations. When combined with a stop collar, these short lands can be inspected.

Dimensionair® Air Rings

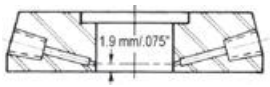
Air Rings are supplied in several styles for external measuring. Two and three jet rings are most common, used for checking outside diameters for sizes out of round conditions from 6.3 mm / ***.248"*** to 63.5 mm / ***2.500".*** Four and six jet rings are also available for special applications. All Air Rings have chrome-plated wear surfaces unless otherwise specified.



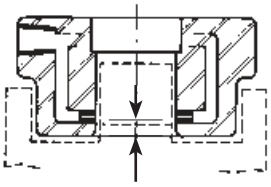
Jet air ring gage with
2 measuring jets



Jet air ring gage with
3 measuring jets



Shoulder Type
(for 2500:1 & 4000:1
5000:1 & 8000:1 only)

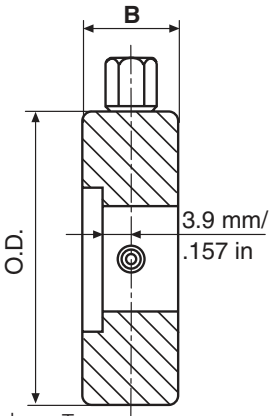


Snout Types

For applications where O.D.'s need to be checked near a shoulder, or where part length is restricted, contact Mahr Federal for technical assistance about shoulder and Snout Type Air Rings.

When ordering ring gages, please specify the following:

- Nominal workpiece dimensions
- Tolerance
- Desired magnification
- Instrument used
- Setting plug to be supplied?



Counterbore Type

Diameter d mm / *inch*	Diameter D mm / *inch*	Width B mm / *inch*
6.3-7.6 / ***.248-.299"***	76.2 / ***3.00"***	25.4 / ***1.00"***
7.6-9.3 / ***.299-.366"***	76.2 / ***3.00"***	25.4 / ***1.00"***
9.3-13.0 / ***.366-.512"***	76.2 / ***3.00"***	25.4 / ***1.00"***
13.0-21.0 / ***.512-.827"***	76.2 / ***3.00"***	25.4 / ***1.00"***
21.0-25.4 / ***.827-1.00"***	76.2 / ***3.00"***	25.4 / ***1.00"***
25.4-38.4 / ***1.00-1.51"***	101.6 / ***4.00"***	25.4 / ***1.00"***
38.4-44.5 / ***1.41-1.75"***	101.6 / ***4.00"***	25.4 / ***1.00"***
44.5-50.8 / ***1.75-2.00"***	127.0 / ***5.00"***	25.4 / ***1.00"***
50.8-63.5 / ***2.00-2.50"***	127.0 / ***5.00"***	25.4 / ***1.00"***
63.5-76.2 / ***2.50-3.00"***	139.7 / ***5.50"***	25.4 / ***1.00"***

See pages 30-33 for size ranges

Air Rings may be attached directly to a Dimensionair or used on a base and connected to the gage with a plastic hose. Vee type Guide Chutes can be furnished on one or both sides if Air Rings are from 6.3mm/0.248" through 44.5mm/1.750". Tube type guide can be furnished on sizes from 6.3mm/.248" through 63.5mm/2.500".

Technical Data

Air rings used with air plugs for thin walled parts

Large air rings

Dimensionair® Air Rings

Options for Air Rings

Bases for Air Rings

Depending on the application there are many ways to hold an air ring. They may be hand held and placed over the part if the part is still on the machine. They may be front mounted, horizontally or vertically on the Dimensionair or for larger parts, they can be mounted to a base and held vertically or horizontally.

Special bases are available to mount the ring horizontally and incorporate a part lifting mechanism to aid in part removal.

Guide Chutes

Guide chutes and vees are available in a host of options to improve the inspection process. Vee type guide chutes can be furnished on one or both sides of an air ring from 6.3mm/***0.248***" through 44.5mm/***1.75***". Other options include tube type guide chutes for sizes 6.3mm/***0.248***" through 63.5mm/**2.5**".

Standard length of the guide chutes are 63.5mm/**2.5**" and affix to the side of the Air Ring. Normal length of the chute is 63.5mm/**2.5**". Other options including heavy duty out riggers and universal vee stands can be provided.

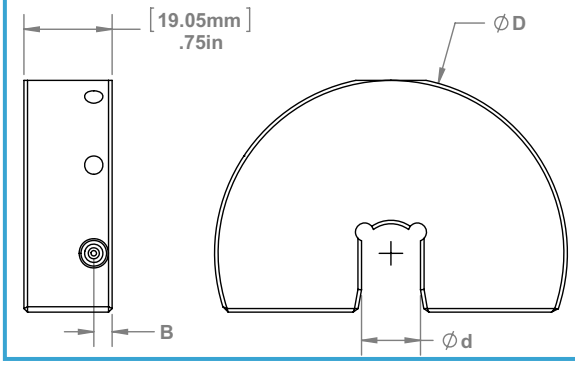
Options for Air Snaps

Since side clearances can present gaging problems with crankshaft diameters or similar applications, Mahr Federal designed a new line of Air Snaps that make the tough measurements easier and affordable.

We based our new Air Snap design on our own proven air tooling techniques, known for providing long life and high-resolution in tough shop environments. Now you can measure fixed sizes from 12.5mm/***0.49***" through 184mm/***7.25***" using D-2500 and D-5000 systems. Widths are typically 19mm/***0.75***" but can be customized to reach diameters having tight clearances.

Jet locations can be located central in the snap or positioned close to either side for exploring close to a shoulder.

Multiple circuit Air Snaps are available for speeding the process while checking the journal for size variation, taper, barrel or hourglass shape.



Measured size mm/*inch*		D	B	
Above	To and Include		Blind	Through
12.70/***0.50***"	25.40/***1.00***"	76.2/**3**"	3.963/***0.156***"	9.525/***0.375***"
25.40/***1.00***"	44.45/***1.75***"	101.6/**4**"	3.963/***0.156***"	9.525/***0.375***"
44.45/***1.75***"	69.85/***2.75***"	127.0/**5**"	3.963/***0.156***"	9.525/***0.375***"
69.85/***2.75***"	95.25/***3.75***"	152.4/**6**"	3.963/***0.156***"	9.525/***0.375***"
95.25/***3.75***"	120.65/***4.75***"	177.8/**7**"	3.963/***0.156***"	9.525/***0.375***"

Dimensionair® Air Gages

AirProbes and JetProbes

- AirProbes and JetProbes provide modular, convenient gage heads for use in hand-held gages and for designing into fixture gages.
- 9.5mm/***.375"*** bodies provide standardized mounting configurations.
- Compact size allows easy access to hard-to-reach dimensions.
- AirProbes and JetProbes are calibrated for instant use with Dimensionair® systems - just set zero and measure!
- Available in single-probe and matched-probe configurations.

AA-1-3 AirProbe and AAT-19 JetProbe Assembly

AirProbes

For use where contact-type measurement is required with 2500:1 Dimensionair Systems. AirProbes are available in Regular Action (counter-clockwise meter movement when spindle is depressed) or Reverse Action (clockwise meter movement when spindle is depressed) and in various ranges. When used with Model 2500:1 Dimensionair, the Meter Dial must be specified to match the AirProbe range (see table below). AirProbe and Dial are color coded - just match the color band on the AirProbe to the colored dot on the Dial to be sure that the AirProbe range matches the readout on the Dimensionair. AirProbes are provided with AAD-55 Straight Adaptor for attaching to Air Hoses.

Order no.	Range		Style / Color Code***	Matching Dial Model		Graduations	
	mm	***inch***		inch	metric	µm	***inch***
AA-1-3*	0.076	***.003"***	Regular / Red	**ADL-28****	**ADL-95****	1	***.00005"***
AA-2-3*	0.076	***.003"***	Reverse / Red	**ADL-28****	**ADL-95****	1	***.00005"***
AA-1-6	0.152	***.006"***	Regular / Green	**ADL-16**	**ADL-96**	2	***.0001"***
AA-2-6	0.152	***.006"***	Reverse / Green	**ADL-16**	**ADL-96**	2	***.0001"***
AA-1-30	0.762	***.030"***	Regular / Blue	**ADL-24**	**ADL-98**	10	***.0005"***
AA-2-30	0.762	***.030"***	Reverse / Blue	**ADL-24**	**ADL-98**	10	***.0005"***

* *.003" Range AirProbes can also be used with 5000:1 Dimensionairs, but the working range is reduced to .0015".*
** *These dials are the same as normally supplied on 2500:1 Dimensionairs, except for the color code.*
*** *Regular AirProbes have single color band; reverse AirProbes have double color band.*

AirProbes can be supplied in matched pairs, either two Regular Action AirProbes or one Regular and one Reverse Action AirProbe. Contact Mahr Federal Customer Resource Center to specify.

AirProbes JetProbes

JetProbes are similar to AirProbes, except they have an open jet at the end, instead of a contacting spindle. JetProbes are ideal for measuring flatness of surfaces which cannot be touched, or for building into fixture designs where air gaging is called for. JetProbes can be used with 2500:1, 5000:1 Dimensionairs, and are supplied singly or in matched pairs. **Order no. AAT-19** for single JetProbe or **AAT-20** for a matched pair. JetProbes are supplied with AHO-1 Air Hose, a zero setting valve, and hardware for mounting to the Dimensionair.

Dimensionair® Air Gages

Accessories

Handles

When an Air Plug is used with a hose, it should be equipped with a Handle to avoid excessive strain on the air connection and corrosion on the polished plug body. Handles may be combined for gaging deep holes.

Selection of a handle or extension is determined by the bore itself and whether or not it is preceded by a larger C-bored diameter. Corresponding thread sizes of the handle or extension must also be considered.

If no portion of the handle or extension enters the part, only thread sizes must be considered. If the plug does enter the part, then both O.D. and thread size must be considered.

AHA-23 and AHA-24 Handles – Used with 10000:1 thru 32000:1 plugs.

AHA-6 Handle – accepts AHO-1 Hose on one end and the following plug sizes on the opposite end: all 1250:1 thru 8000:1 plugs up to 76.45mm/3.010in. Has Bakelite insulating cover. Recommended for 37.85mm/1.490in up to 76.45mm/3.010in diameters.

AHA-15 Handle – Used and furnished with 1250:1 thru 8000:1 through or blind hole plugs. For plugs over 76.3mm/3.004in.

2237666 – High impact and coolant resistant, light weight composite handle – normally furnished with uDimensionair and air snaps.

AHA-66 and 2236070 – light weight aluminum handles without or with air shutoff valve.

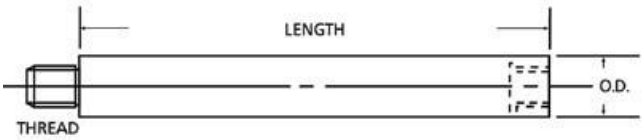
AHA-28 Handle – Used with 2500:1 thru 8000:1 Blind hole plugs in the 9.47mm/0.373in to 11.86mm/0.467in range, using an AAD-315 Adaptor.

Extensions

AEX-1 and AEX-2 Extensions – Used with 2500:1 thru 8000:1 Through hole air plugs in the 9.5mm/0.3735in to 14.9mm/0.588in range. Blind hole air plugs in the 11.86mm/0.467in to 14.9mm/0.588in range, using an AAD-55 Adaptor.

2201975 – extension used with BA-100 adjustable base. Provides easily configured base for bench-mounted air tooling fixturing.

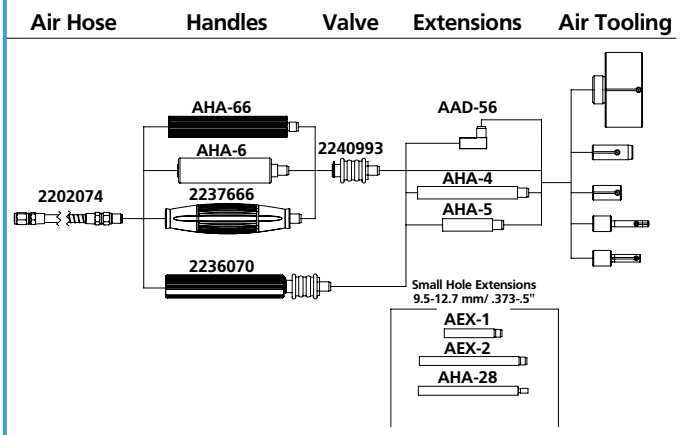
AHA-4 and AHA-5 Extensions – accept AHO-1 Hose on one end and the following plug sizes on the opposite end: all 1250:1 thru 8000:1 plugs up to 76.30mm/3.004in.



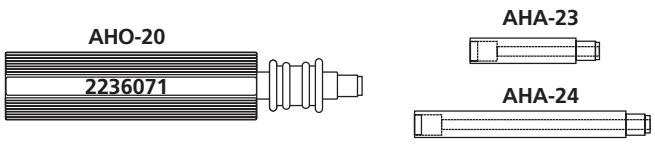
Order no.	Thread	O.D. mm/in	Length mm/in
AHA-4	3/8-32	12.07/***.475"***	102/***4"***
AHA-5	3/8-32	12.07/***.475"***	51/***2"***
AHA-6	3/8-32	25/***1.0"***	102/***4"***
AHA-15	1-1/8-18	33.4/***1.315"***	152/***6"***
AHA-20	3/8-32	12.7/***.500"***	144.8/***5.70"***
AHA-23	9/32-40	9.14/***.360"***	51/***2"***
AHA-24	9/32-40	9.14/***.360"***	102/***4"***
AHA-28	10-32	9.14/***.3603"***	102/***4"***
AEX-1	5/16-32	9.02/***.355"***	51/***2"***
AEX-2	5/16-32	9.02/***.355"***	102/***4"***
2201975*	3/8-32	9.5/***.374"***	61.7/***2.43"***

** Use on BA-100*

Accessory Configuration for DP60/DP50/DP20 Systems – Low Magnification



Accessories for High Magnification Systems – DP10/DP5



Air Gaging Accessories

Air Gage Calibration Kits

Magnification Kits

Magnification Kits provide a means for checking Amplifier accuracy, traceable to the National Institute of Standards and Technology (NIST). Each Kit contains restrictors that provide pressure characteristics at zero and at both ends of the scale, a calibrated dial diagram and a Certificate of Calibration.

Order no.	For use with:	Tooling
AMR-SPEC-136	1250:1	DP/DR100
2094182	1260:1	DP/DR60
AMR-12	2500:1/4000:1	DP/DR50
AMR-13	5000:1/8000:1	DP/DR20
AMR-14	10000:1/16000:1	DP/DR10
AMR-15	20000:1/32000:1	DP/DR5

AMR-12

Air Tooling Accessories

Manifolds

Manifolds allow connecting multiple pieces of air tooling to one Dimensionair. Toggle valves allow activation of the selected tool. Manifolds are compatible with Dimensionairs 1250:1 through 8000:1M Manifolds for use with other Dimensionairs, contact Mahr Federal Customer Resource Center — **1-800-343-2050.**

Order no.	Description
2248282	2-way Manifold
2248283	3-way Manifold
2248284	4-way Manifold
2248285	5-way Manifold

Manifold 2248283

Hoses

Supply hoses and hoses between Dimensionair and air tooling.

Order no.	Description	Thread
AHO-1	0.9 m / 3 ft Air hose for tooling for Models 1250:1 – 8000:1. (Tygon)	3/8-32
AHO-8	1.5 m / 5 ft Air hose for tooling on Models 1250:1 – 8000:1. (Tygon)	3/8-32
AHO-10	1.8 m / 6 ft Air hose for tooling on Models 1250:1 – 8000:1. (Tygon)	3/8-32
AHO-20	0.9 m / 3 ft Air hose for tooling on Models 10000:1 – 32000:1. (Tygon)	9/32-40
ARG-1	Replacement O-ring for AHO-1, -8, -10 Hoses and AHA-4, -5, -6, -20 Handles.	
ARG-6	Replacement O-ring for AHO-20 Hose, AHA-23 and -24 Handles.	
ARG-10	For AEX-1, AEX-2 and AHA-28	

Air Supply Accessories

Traps and Filters

Good gaging practice requires clean, dry air for gage performance. Dimensionair Models are furnished with a particle filter. Shop air contains water and oil, which should be removed, using Model **AFL-24** Oil and Water Separator Trap.

Order no.	Description
AHO-2	1.5 m / 5 ft Air Supply Hose. Fits all Dimensionair models. (rubber), thread is 7/16-20
AFL-10	Particle Filter (normally furnished on all Dimensionair Models). Filter size: 5 microns; Maximum pressure: 250 p.s.i.; maximum working temperature: 175°F.
AFL-24	Oil and Water Separator Trap, includes mounting hardware. Filtering capacity: 99.7% removal of oil and water; filter size: 3-6 microns; maximum pressure: 150 p.s.i.; flow rate: 20 cubic feet of air/minute @ 80 p.s.i.
AFL-23	Replacement cartridge for AFL-24.
AFL-21	Replacement cartridge for AFL-10.

AFL-24 Trap

Standards

AGD Master Setting Rings, Discs, and Plugs

Master Rings

- Traceable certification and calibration available on request.
- Lapped to size and polished.
- Non-gaging areas black oxidized – ring faces ground.
- Meet all requirements of ANSI Specification B47.1-1988.
- Manufactured in accordance with ANSI Specification B89.1.6-1984.

Master Plugs

- Traceable certification and calibration available on request.
- Stabilized and hardened.
- 100% usable grinding surface.
- Ends ground square.
- Lapped finish.

Master Discs AGD Style 3

- Traceable certification and calibration available on request.
- Lapped to size and polished.
- Non-gaging areas black oxidized – ring faces ground.
- Meet all requirements of ANSI Specification B47.1-1988.
- Manufactured in accordance with ANSI Specification B89.1.5.
- Furnished with clear insulators.
- All dimensions are AGD style 3.

Classes and Tolerances

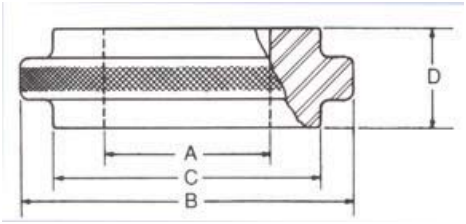
Size Range of Work (mm/inch)		Tolerance of Master		
To and Above	Including	Class XXX	Class XX	Class X
2.67/ ***.105"***	20.96/ ***.825"***	.00025/ ***.00001"***	.00051/ ***.00002"***	.00102/ ***.00004"***
20.96/ ***.825"***	38.35/ ***1.510"***	.00038/ ***.000015"***	.00076/ ***.00003"***	.00152/ ***.00006"***
38.45/ ***1.510"***	63.75/ ***2.510"***		.00102/ ***.00004"***	.00203/ ***.00008"***
63.75/ ***2.510"***	114.55/ ***4.510"***		.00127/ ***.00005"***	.00254/ ***.00010"***
114.55/ ***4.510"***	165.35/ ***6.510"***		.00165/ ***.000065"***	.00330/ ***.00013"***
165.35/ ***6.510"***	216.15/ ***8.510"***		.00203/ ***.00008"***	.00406/ ***.00016"***

Master plugs and discs are furnished in hardened steel, either plain or chrome plated. They are made in Class XX and X for Air Gage applications. Discs are also available in Class Y.

Tolerances are divoded equaly plus and minus from the required size unless otherwise specified. Plug and disc certification supplied on request.

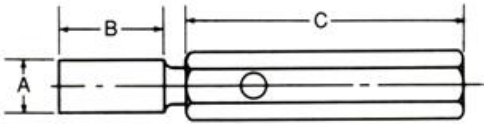
If Air Rings 1.5" and smaller are equipped with guide chutes, A.G.D. style 3 Discs are required.

Master Setting Rings AGD



(mm/*inch*)			
"A"	**"B"**	**"C"**	**"D"**
1.52 - 3.8/ *.060 - .150"*	23.83/ *.938"*		6.35/ *.250"*
3.8 - 5.84/ *.150 - .230"*	23.83/ *.938"*		9.53/ *.375"*
5.84 - 9.27/ *.230 - .365"*	23.83/ *.938"*		14.3/ *.563"*
9.27 - 12.95/ *.365 - .510"*	34.93/ *1.375"*		19.05/ *.750"*
12.95 - 20.95/ *.510 - .825"*	44.45/ *1.750"*		23.83/ *.938"*
20/95 - 28.83/ *.825 - 1.135"*	53.98/ *2.125"*		28.58/ *1.125"*
28.83 - 38.35/ *1.135 - 1.510"*	63.5/ *2.500"*		33.35/ *1.313"*
38.35 - 51.05/ *1.510 - 2.010"*	102/ *4"*	73.0/ *2.875"*	38.1/ *1.5"*
51.05 - 63.75/ *2.010 - 2.510"*	114.3/ *4.500"*	85.7/ *3.375"*	38.1/ *1.5"*
63.75 - 76.45/ *2.510 - 3.010"*	127/ *5"*	101.6/ *4.000"*	38.1/ *1.5"*
76.45 - 89.15/ *3.010 - 3.510"*	139.7/ *5.500"*	114.3/ *4.500"*	38.1/ *1.5"*
89.15 - 101.85/ *3.510 - 4.010"*	161.93/ *6.375"*	130.2/ *5.125"*	38.1/ *1.5"*
101.85 - 120.9/ *4.010 - 4.760"*	181.15/ *7.250"*	149.2/ *5.875"*	38.1/ *1.5"*
120.9 - 139.95/ *4.760 - 5.510"*	209.5/ *8.250"*	168.3/ *6.625"*	38.1/ *1.5"*
139.95 - 159/ *5.510 - 6.260"*	234/ *9.250"*	187.3/ *7.375"*	38.1/ *1.5"*
159 - 178.05/ *6.260 - 7.010"*	260.35/ *10.250"*	206.4/ *8.125"*	38.1/ *1.5"*
178.05 - 197.1/ *7.010 - 7.760"*	285.75/ *11.250"*	225.4/ *8.875"*	38.1/ *1.5"*
197.1 - 216.15/ *7.760 - 8.510"*	311.15/ *12.250"*	244.5/ *9.625"*	38.1/ *1.5"*

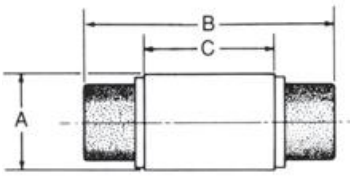
Master Setting Plugs AGD



"A"	**"B"**	**"C"**
6.3 - 9.3/ *.248 - .365"*	19.05/ *.750"*	69.85/ *2.750"*
9.3 - 13.0/ *.365 - .510"*	25.4/ *1.0"*	76.2/ *3.0"*
13.0 - 21.0/ *510 - .825"*	31.75/ *1.25"*	82.55/ *3.25"*
21.0 - 28.8/ *.825 - 1.135"*	34.93/ *1.375"*	92.08/ *3.625"*
28.8 - 38.4/ *1.135 - 1.510"*	38.1/ *1.500"*	102/ *4"*
38.4 - 51.1/ *1.510 - 2.010"*	47.63/ *1.875"*	127/ *5"*
51.1 - 63.8/ *2.010 - 2.510"*	50.8/ *2.0"*	127/ *5"*
63.8 - 76.5/ *2.510 - 3.010"*	53.98/ *2.125"*	152.4/ *6"*

Standards

Master Setting Discs AGD



(mm/inch)		
"A"	**"B"**	**"C"**
3.8 - 6.1/ ***.150 - .240"***	41.28/ ***1.625"***	11.25/ ***.438"***
6.1 - 9.3/ ***.240 - .365"***	42.88/ ***1.688"***	12.70/ ***.500"***
9.3 - 13.0/ ***.365 - .510"***	47.63/ ***1.875"***	14.30/ ***.563"***
13.0 - 21.0/ ***.510 - .825"***	49.23/ ***1.938"***	15.88/ ***.625"***
21.0 - 28.8/ ***.825 - 1.135"***	57.15/ ***2.250"***	17.48/ ***.688"***
28.8 - 38.4/ ***1.135 - 1.510"***	60.33/ ***2.375"***	22.17/ ***.813"***
38.4 - 51.1/ ***1.150 - 2.010"***	60.33/ ***2.375"***	22.23/ ***.875"***
51.1 - 63.8/ ***2.010 - 2.510"***	60.33/ ***2.375"***	22.23/ ***.875"***
63.8 - 76.5/ ***2.510 - 3.010"***	85.73/ ***3.375"***	25.40/ ***1"***
76.5 - 89.2/ ***3.010 - 3.510"***	85.73/ ***3.375"***	25.40/ ***1"***
89.2 - 101.9/ ***3.510 - 4.010"***	85.73/ ***3.375"***	25.40/ ***1"***
101.9 - 114.3/ ***4.010 - 4.510"***	85.73/ ***3.375"***	25.40/ ***1"***
114.3 - 120.9/ ***4.510 - 4.760"***	85.73/ ***3.375"***	25.40/ ***1"***
120.9 - 127.3/ ***4.760 - 5.510"***	85.73/ ***3.375"***	25.40/ ***1"***
127.3 - 133.6/ ***5.510 - 5.260"***	85.73/ ***3.375"***	25.40/ ***1"***
133.6 - 140.0/ ***5.260 - 5.510"***	85.73/ ***3.375"***	25.40/ ***1"***
140.0 - 146.3/ ***5.510 - 5.760"***	85.73/ ***3.375"***	25.40/ ***1"***
146.3 - 152.7/ ***5.760 -6.010"***	85.73/ ***3.375"***	25.40/ ***1"***
152.7 - 159.0/ ***6.010 - 6.260"***	85.73/ ***3.375"***	25.40/ ***1"***
159.0 - 165.4/ ***6.260 - 6.510"***	85.73/ ***3.375"***	25.40/ ***1"***
165.4 - 171.7/ ***6.510 - 6.760"***	85.73/ ***3.375"***	25.40/ ***1"***
171.7 - 178.1/ ***6.760 - 7.010"***	85.73/ ***3.375"***	25.40/ ***1"***
178.1 - 184.4/ ***7.010 - 7.260"***	85.73/ ***3.375"***	25.40/ ***1"***
184.4 - 190.8/ ***7.260 - 7.510"***	85.73/ ***3.375"***	25.40/ ***1"***
190.8 - 197.1/ ***7.510 - 7.760"***	85.73/ ***3.375"***	25.40/ ***1"***
197.1 - 203.5/ ***7.760 - 8.010"***	85.73/ ***3.375"***	25.40/ ***1"***

Custom Part Masters

Custom Part Masters are used as a standard for many Engineered Gage Solutions. Almost every dedicated variable gage in use has at least one custom master associated with it. Typically these masters are used on shop floor inspection equipment as artifacts that reference the equipment. Some common examples include rotors, connecting rods, pistons, special tapers, cylinder liners, hydraulic and pump housings.

All masters are made of tool steel, hardened and double stabilized. Chrome plate is also available. In cases where the gage might be used in a corrosive environment, 440-C Stainless Steel may be used. Certain tight manufacturing tolerance applications may need min., mean and max. condition masters for greater accuracy when setting the gage fixture.

Our Technical Support department will be pleased to review your custom master needs.

Standards - Setting Rings 6105 N / 6107 S, DIN Type B

Millimar 6105 Setting Rings for jet air gage plugs and contact gage plugs.
Millimar setting rings have been carefully hardened, aged, ground and lapped.

Quality	N
Manufacturing tolerance	JS3
Cylinder form tolerance	0.4 x numerical value of IT4

Millimar 6107 Setting Rings for jet air gage plugs.
Millimar setting rings have been carefully hardened, aged, ground and lapped.

Quality	S
Manufacturing tolerance	JS3
Cylinder form tolerance	0.1 x numerical value of IT4
Measuring uncertainty of the labeled nominal value	0.5 x numerical value of IT1

Setting Rings 6105 N

From mm	to & including mm	Order no.	from mm	to & including mm	Order no.	from mm	to & including mm	Order no.
2	3	**2105300**	60	65	**2105316**	105	110	**2105332**
3	4	**2105301**	65	68	**2105317**	110	115	**2105333**
4	6	**2105302**	68	70	**2105318**	115	120	**2105334**
6	7	**2105303**	70	72	**2105319**	120	125	**2105335**
7	10	**2105304**	72	75	**2105320**	125	130	**2105336**
10	11	**2105305**	75	78	**2105321**	130	135	**2105337**
11	18	**2105306**	78	80	**2105322**	135	140	**2105338**
18	21	**2105307**	80	82	**2105323**	140	145	**2105339**
21	28	**2105308**	82	85	**2105324**	145	150	**2105340**
28	32	**2105309**	85	88	**2105325**	150	155	**2105341**
32	40	**2105310**	88	90	**2105326**	155	160	**2105342**
40	47	**2105311**	90	92	**2105327**	160	165	**2105343**
47	50	**2105312**	92	95	**2105328**	165	170	**2105344**
50	55	**2105313**	95	98	**2105329**	170	175	**2105345**
55	58	**2105314**	98	100	**2105330**	175	180	**2105346**
58	60	**2105315**	100	105	**2105331**	180	185	**2105347**

Setting Rings 6107 S

From mm	to & including mm	Order no.	from mm	to & including mm	Order no.	from mm	to & including mm	Order no.
3	4	**2105400**	34	37	**2105414**	68	70	**2105428**
4	6	**2105401**	37	42	**2105415**	70	72	**2105429**
6	8	**2105402**	42	44	**2105416**	72	75	**2105430**
8	10	**2105403**	44	45	**2105417**	75	78	**2105431**
10	18	**2105404**	45	46	**2105418**	78	80	**2105432**
18	23	**2105405**	46	48	**2105419**	80	82	**2105433**
23	24	**2105406**	48	50	**2105420**	82	85	**2105434**
24	25	**2105407**	50	52	**2105421**	85	88	**2105435**
25	26	**2105408**	52	55	**2105422**	88	90	**2105436**
26	27	**2105409**	58	55	**2105423**	90	92	**2105437**
27	28	**2105410**	60	58	**2105424**	92	95	**2105438**
28	30	**2105411**	62	60	**2105425**	95	98	**2105439**
30	32	**2105412**	65	62	**2105426**	98	100	**2105440**
32	34	**2105413**	68	65	**2105427**	100	102	**2105441**

Dimensionair® Air Gaging Applications

Differential Air Gaging

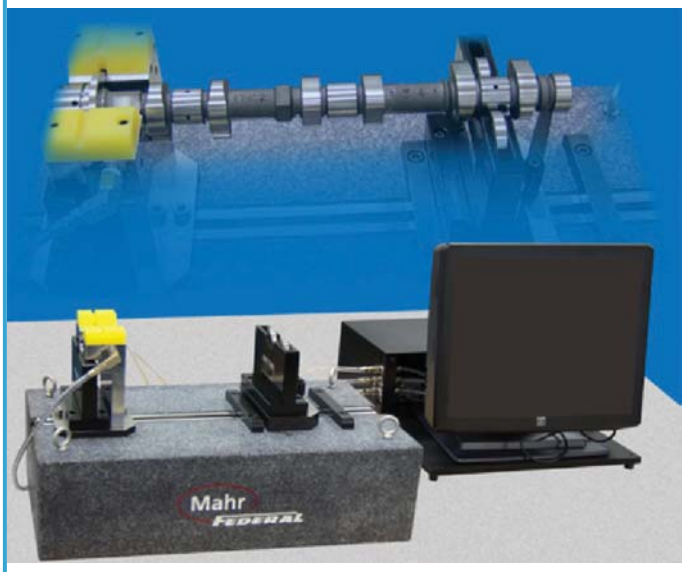
Clearances on hydraulic valves and pumps today are measured in microns and it is critical to ensure the match is correct for proper valve operation.

When an air ring and plug are combined with a differential amplifier the operator can quickly measure both the ID and OD of the parts and read directly the clearance between the two.

This combination allows for matching the two components together as a pair or creates a method for fast sorting of parts for later use.

Options exist for computerized solutions where part programs are created for the tooling which allows for fast switchover for different parts and data tracking of the matched pairs for documentation of the match.

Air Gaging for Camshaft Ends face Run-out

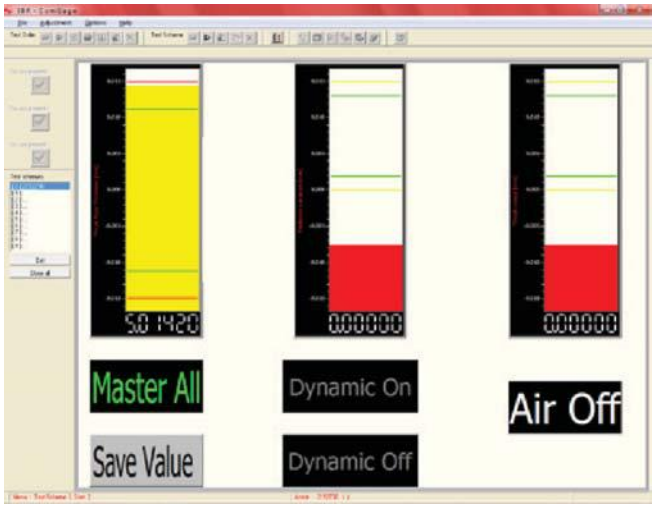


Air gaging built into dedicated shop floor gages provides high performance and trouble free solutions. Camshafts have critical relationships between the axis of rotation and the end faces in order to create noise-free operation and extend the life of the camshaft.

This custom solution consists of a gaging computer that measured three critical features: the thrust face thickness, thickness variations of the thrust face and the run-out of the thrust face to the bearing journals of the camshaft.

Tolerances were in the order of 0.015mm/***0.0006***" and gage GR&R performance was to automotive requirements.

The gaging computer provided three A/E transducers to read each feature and combine them for the desired results. the gaging computer provided for means to shut off air automatically when not in use, provide easy mastering and data collection to document the results and use for process control



Dimensionair® Air Gaging Applications

Air Gaging to measure small diameter through holes

When the gage requirement is to measure hole diameters smaller than 1.5mm/***0.060"*** air gaging offers unique options. For applications such as this the small orifice itself becomes the restrictor and back pressure or flow can be used to check hole size. Flow based on a controlled system makes it possible to monitor the maximum diametrical size of a hole or orifice. Flow rate is typically classified by two points in a fixed range and allows air gage systems to use a min and max master to verify pass or fail part status very simply. Systems can range from a single column gage for a dedicated orifice size or full PC system that cover a range of sizes. Diameters from 0.1mm/***0.004"*** to 1.5mm/***0.060"*** are achieved with flow rates from 0.2 to 20 lpm (liters per minute). Repeat better than 1µm/***40µ"***and linearity better than 2.5µm/***100µ"*** are possible.

Applications suitable for this type of system are small nozzles, valve components, needles, restrictors of most any type of material, plastic, metal, or other. These systems are commonly used for high volume product or where mechanical and optical solutions are unable to meet the requirement. Air gages are fast, reliable, and easy to use and a suitable choice for flow measurement.

Air Gaging for Electric Motors

When the electric motor shaft is being turned or ground in the machine an air snap is the fastest and easiest-to-use precision gage to measure the diameters. Data can be collected and even fed back to the machine for automatic size control.

A wide range of display options provide clear feedback to the operator.

Many measuring tasks are carried out with measuring hand tools such as calipers and micrometers. However for the critical diameters such as those found on the bearing diameters in the end housing or the critical motor shaft diameters, air gaging is the choice at the point of manufacture.

Often odd number lobing is found with the bearing diameter bores on the motor housing because of the manufacturing process used to create the holes. For this a 3-jet blind hole air plug is ideal since it provides high resolution results of this precision bore, based on the bores form.

Shown with 2252413 data send handle

Dimensionair® Air Gaging Applications

Air Gaging Stations for Engine Blocks

An air gage station provided to measure all the critical bores in a small engine block. The station includes a gaging computer, the various air tooling, and masters in an enclosed work station. The crank and cam bores are measured with 2-jet air plugs having long handles that allow orientation of the air jets and an indication of the journal locations. The balance shaft bore, due to its broad tolerance and high surface finish, is checked with a special mechanical plug assembly. Finally the cylinder bores are measured with a multiple jet plug having four planes. Each plane has four jets for two diameters set at 90° apart.

The gaging computer displays the measured results for each feature. The operator is guided through a prescribes gaging sequence. The gaging computer has an integrated SPC package , data storage and user programmable output for interfacing to machine tool feedback

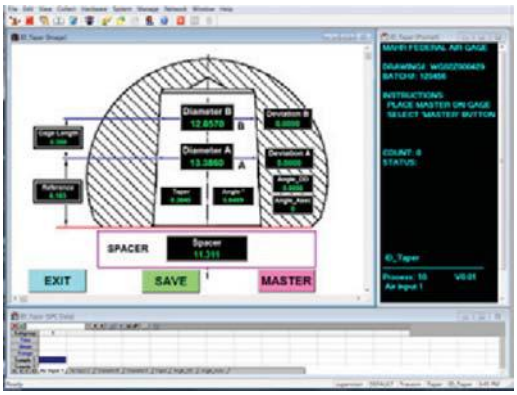
Air Gaging for Orthopedic applications

Air gaging is the ideal solution for measuring precision orthopedic taper parts. Since the air jet sets are so small and can be placed into close proximity in small tooling, measuring the tapers for diameter and taper is fast and easy.

Whether it be for stems, cups or balls the tooling can be used at the point of manufacture to ensure the process is manufacturing the tapers to the critical dimensions.

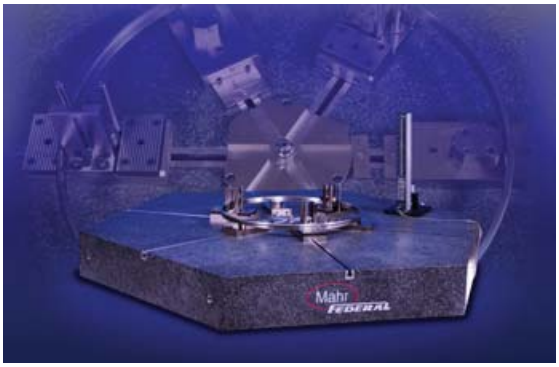
In one case a manufacturer of orthopedic implants needed to improve measurement and documentation proficiency of parts with literally hundreds of configurations. Air gaging was desired because it can quickly and accurately measure precision tapers. But because air gaging is custom made for the application, there can be just as many air tools as there are part variations -- a logistics nightmare when there are thousands of component combinations.

To reduce the number of tools, Mahr Federal designed a unique master air tool with multiple jetting and a series of spacers that allowed one tool to be used on all the various tapers, regardless of length. The gage could be zeroed on a single master spacer and the operator could measure parts by selecting the appropriate spacer.



Dimensionair® Air Gaging Applications

Masterless ID/OD gage for large Diameters



Today's precision thin section bearings offer high running accuracy in a low profile design to meet specific application requirements.

Basic components of a large diameter gage for thin walled parts start with a ridged plate which varies in size based on the part sizes to be measured up to 80 inches. On the plate are 6 radial grooves in which the sensing heads run along. A precision ball and gage blocks make this a masterless gaging system.

Because of the 6 measuring points a multi-function display can be used to display numerous diameters including:

- Three two point diameter
- Two three point diameters
- The average of the two and three point diameters
- 2, 3 or 6 point out of round
- The part can even be rotated 60 degrees to have another complete set of diameters for the part

Air gaging for machine tool spindles and taper tool holders

With a taper jet air plug or air jet ring with three indicating columns and 2 Air /Electric convertors inputs the following parameters can be evaluated:

- Large diameter
- Small diameter
- Taper D1-D2
- Taper ratio L/(D2-D1)
- Nominal diameters at a defined height D1+((D2-D1)*L1/L)

Or with the use of a gaging computer multiple diameters can be combined for complete tool holder and spindle analysis

As the demands for precision machining and high speeds increase, manufacturing tolerances on spindle and tool holder tapers have gotten tighter.

Air taper gages are designed to match the parts taper and measure multiple diameters along the length of the taper. Then by comparing the diameters the taper and its shape can be measured.

Mastering is simply a matter of inserting the taper master and adjusting the zero. Measuring is even easier: just insert the part and take the reading.

Dimensionair® Air Gaging Applications

Multiple Diameters

Stators and Rotors found in motors have tolerances both on the large and small diameter. Because the air jet is so small and can be built into complex shaped tooling, air gaging provides the capability of having multiple jets placed in very close proximity to each other. There are very few sensors that have this characteristic.

In this application special part-like tooling was created that is capable of measuring two diameters simultaneously on the odd numbered (5) interrupted surfaces. And the part diameters are measured at three levels which requires 30 air jets per tool.

The system is completed with two sets of three air columns displays so that all size diameters are displayed separately and can easily be scanned for both size and form errors such as taper or barrel shape.

Air Gages for Thickness

Air gaging is an ideal solution where a non-contact sensor is required that can provide a scratch free measurement and still provide high accuracy results.

Mahr jet probes provide such a solution. Open jet AirProbes are ideal for measuring flatness of a surface which cannot be touched or for building into special fixture gage designs.

When used in a matched probe configuration they can provide thickness measurement without regard to position. In this application special disc thickness gage allows for exploring the part surface for thickness variation in a non-contact manner. Adjustability of the probes and interchangeable fixturing allows for a family of discs to be measured.

Precision Measurement Center

Precision Measurement Center – Mahr Federal's Metrology Laboratory in Providence, RI.

The environment, by far, is the biggest contributor to measurement errors.

Mahr Federal's Precision Measurement Center in Providence was built to minimize environment related errors.

Structurally, the Center is different. All measurement equipment rests on a five-foot thick concrete slab located just below the floor. Weighing nearly 375 tons, the slab is independent of the surrounding building and is supported by three 30-foot tubular steel columns which rest on a vibrationally stable layer of rock.

This elaborate construction eliminates the influence of external vibrations which could cause measurement inaccuracies ... even eliminating the influence of laboratory personnel moving about the room. Because the slab is so well isolated from its local environment, other disturbances such as highway traffic and heavy equipment in the adjoining factory do not adversely affect the high accuracy gaging equipment.

Model 130B Gage Block Comparator

High Accuracy Measurements

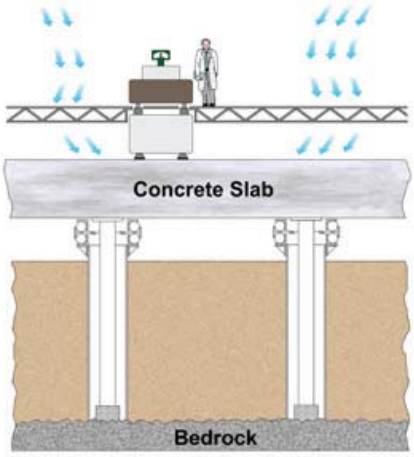
High accuracy is realized with uncertainty measurements of 0.06 micron/2.3 microinch on gage blocks (up to 50 mm/2.3 inch long).

The Mahr 828 CiM in the Precision Measurement Center has a gaging uncertainty of as little as .000004". Its measuring precision, high measuring speed, innovative measuring processes, and ease of operation all combine to ensure fast, reliable measurements.

Additionally, the Mahr Federal Model 130B-24 and Model 130B-16 Gage Block Comparators, widely used and recognized as the finest of their kind, are employed in the Precision Measurement Center together with the Model 136B-3 Master Ring and Disc Comparators.

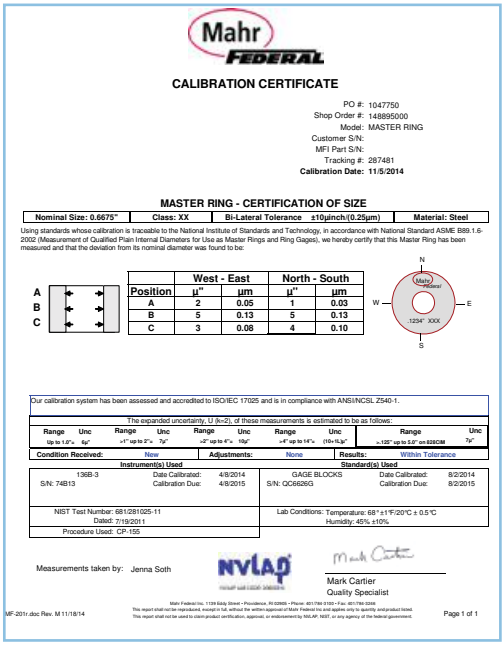
Air and Atmosphere ... tightly controlled

A complex air conditioning, circulation and filtration system controls our Measurement Center's temperature and atmospheric conditions. Air cascades through the room from ceiling to floor, changing itself every half-minute. This important vertical down flow eliminates air stratification, helps control dust and provides a barrier of clean air between the gages and technicians. Since air temperature and humidity can adversely affect measurements, air temperature is maintained at 68°F/20°C, within 2/10 of 1°C and relative humidity is a constant 40%, ±10%.



NIST Traceability Grand Master Sets

Working masters are remeasured annually against the Grand Master sets, which are calibrated at NIST on a regular schedule. This procedure provides Mahr Federal and its customers with a link directly traceable to NIST, assuring not only that our standards are accurate, but the lab itself, the equipment and measuring techniques used are rigidly maintained. Thereby, our commitment to a constant quest for the highest reliability in industrial metrology is also constantly maintained. Mahr Federal's Calibration system is certified to ISO-9001:2008 by NQA, USA and accredited to ISO 17025 NVLAP Lab Code 200605-0.



Mahr FEDERAL

CALIBRATION CERTIFICATE

PO #: 1047750
Shop Order #: 148895000
Model: MASTER RING
Customer S/N:
MFI Part S/N:
Tracking #: 287481
Calibration Date: 11/5/2014

MASTER RING - CERTIFICATION OF SIZE

Nominal Size: 0.6675"	Class: XX	Bi-Lateral Tolerance ±10μinch(0.25μm)	Material: Steel

Using standards whose calibration is traceable to the National Institute of Standards and Technology, in accordance with National Standard ASME B89.1.6-2002 (Measurement of Qualified Plain Internal Diameters for Use as Master Rings and Ring Gages), we hereby certify that this Master Ring has been measured and that the deviation from its nominal diameter was found to be:

	West - East		North - South	
Position	μ"	μm	μ"	μm
A	2	0.05	1	0.03
B	5	0.13	5	0.13
C	3	0.08	4	0.10

Our calibration system has been assessed and accredited to ISO/IEC 17025 and is in compliance with ANSI/NCSL Z540-1.

The expanded uncertainty, U (k=2), of these measurements is estimated to be as follows:

Range	Unc	Range	Unc	Range	Unc	Range	Unc	Range	Unc
Up to 1.0"	6μ"	>1" up to 2"	7μ"	>2" up to 4"	10μ"	>4" up to 14"	(10+1L)μ"	>.125" up to 3.0" on 828CiM	7μ"

Condition Received:	New	Adjustments:	None	Results:	Within Tolerance

Instrument(s) Used

136B-3	Date Calibrated: 4/8/2014	GAGE BLOCKS	Date Calibrated: 8/2/2014
S/N: 74B13	Calibration Due: 4/8/2015	S/N: QC6626G	Calibration Due: 8/2/2015
NIST Test Number: 681/281025-11 Dated: 7/19/2011		Lab Conditions: Temperature: 68° ±1°F/20°C ± 0.5°C Humidity: 45% ±10%	
Procedure Used: CP-155			

Standard(s) Used

Measurements taken by: Jenna Soth

NVLAP

Mark Cartier
Quality Specialist

Mahr Federal Inc., 1144 Eddy Street • Providence, RI 02905 • Phone: 401-784-3100 • Fax: 401-784-3246
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This report shall not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

MF-201r.doc Rev. M 11/18/14

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Calibration Services

International Standards require complete documentation and calibration of all gaging instruments. Mahr Federal Inc., as well as being a manufacturer of quality dimensional measuring instruments, is an established primary source for high accuracy dimensional measurement services.

Mahr Federal offers an inspection and recalibration program for dimensional standards including:

- gage blocks • master rings • master discs and plugs • master balls (roundness)
- cylindrical form and precision reference specimens surface roughness standards.

For these services, we have created an ideal environment - a metrology laboratory in Providence, Rhode Island that is ranked as one of the world's finest.:

- High quality measurements - 0.06 micron/2.3 micro inch uncertainty of measurement on gage blocks (up to 50 mm/2 in long).
- All measurements traceable to the Standards of the United States.
- Grand Masters/Primary standards used in our Measurement Center have been certified by NIST.
- Calibration system is certified to ISO-9001:2008 by NQA, USA and accredited to ISO 17025 NVLAP Lab Code 200605-0.
- We offer Fast turnaround and competitive prices.

Mahr Federal also specializes in the calibration and certification of the following gages including:

Dial, Digital & Test Indicators • Mikrokators® • Micrometers • Dial & Vernier Calipers • Pin & Radius Gages • Snaps, I.D. / O.D. & Bore Gages • Dimentron® Plugs • Plug & Ring Gages • Groove, Caliper, Thickness, Thread, Height & Depth Gages • Air Gages & Magnification Kits • Electronic Amplifiers & Gage Heads • Surface Finish Gages • Level Systems

nqa global assurance

Certificate of Registration

This is to certify that the Quality Management System of:

Mahr Federal Inc. (HQ)
1139 Eddy Street
Providence, RI 02905
(See appendix for additional locations)

applicable to:

Sales, design, manufacture and servicing of dimensional gages and gaging systems and dimensional calibration services including field service for masters, standards and gages

has been assessed and approved by
National Quality Assurance, U.S.A., against the provisions of:

ISO 9001: 2008

Certificate Number: 10057
EAC Code: 35, 19
First Issued: October 6, 1995
Valid Until: August 29, 2016
Reissued: August 29, 2013

For and on behalf of
NQA, USA, 4 Post Office Square,
Acton, MA 01720

ANAB ACCREDITED

Page 1 of 2

This approval is subject to the company maintaining its system to the required standard, which will be monitored by NQA, USA, an accredited organization under the ANSI-ASQ National Accreditation Board.

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 200605-0

Mahr Federal Inc.
Providence, RI

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

CALIBRATION LABORATORIES

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2014-04-01 through 2015-03-31
Effective dates

For the National Institute of Standards and Technology

Dimensionair® Air Gages

Worksheet for Ordering Master Rings

Requirement: (1) Nominal sized master or,
(optionally) (1) Minimum and (1) Maximum Deviation Master

Single (zeroing) Master Information:

Measurement Units: ☐Inch ☐metric Quantity required: 1 / 2 / 3 / _____
Nominal Master Size: _____ Class: ☐Y ☐X ☐XX ☐ XXX
Material: ☐Steel ☐Chrome Special Marking: _____
Certification to Class: ☐ Yes ☐ No Certification to Size: (extra cost) ☐ Yes ☐ No
Tolerance Applied: Bi-Lateral (Per rules for nominal masters) Uni-Lateral (Per rules for Go / NoGo masters)

Deviation Master Information:

Measurement Units: ☐Inch ☐metric Quantity required: 1 / 2 / 3 / _____
Minimum Master Size: _____
Maximum Master Size: _____ Class: ☐ Y ☐X ☐XX ☐ XXX
Material: ☐Steel ☐Chrome Special Marking: _____
Certification to Class: ☐ Yes ☐ No Certification to Size: (extra cost) ☐ Yes ☐ No
Tolerance Applied: Bi-Lateral (Per rules for nominal masters) Uni-Lateral (Per rules for Go / NoGo masters)

Worksheet for Ordering Master Plugs and Discs

Requirement: (1) Nominal sized master or,
(optionally) (1) Minimum and (1) Maximum Deviation Master

Single (zeroing) Master Information:

Measurement Units: ☐Inch ☐metric Style: ☐Disc ☐Plug
Quantity required: 1 / 2 / 3 / _____
Nominal Master Size: _____ Class: ☐Y ☐X ☐XX
Material: ☐Steel ☐Chrome Special Marking: _____
Certification to Class: ☐ Yes ☐ No Certification to Size: (extra cost) ☐ Yes ☐ No
Tolerance Applied: Bi-Lateral (Per rules for nominal masters) Uni-Lateral (Per rules for Go / NoGo masters)

Deviation Master Information:

Measurement Units: ☐Inch ☐metric Style: ☐Disc ☐Plug
Quantity required: 1 / 2 / 3 / _____
Minimum Master Size: _____ Class: ☐Y ☐X ☐XX
Maximum Master Size: _____ Class: ☐Y ☐X ☐XX
Material: ☐Steel ☐Chrome Special Marking: _____
Certification to Class: ☐ Yes ☐ No Certification to Size: (extra cost) ☐ Yes ☐ No
Tolerance Applied: Bi-Lateral (Per rules for nominal masters) Uni-Lateral (Per rules for Go / NoGo masters)

Note: Mahr Federal recommends XX masters certified to size instead of XXX certified to class.

Dimensionair® Air Gages

Worksheet for Ordering Air Rings

Special care MUST be taken when preparing proposals for Air Rings. There are five basic styles of Air Rings. Centered jets, offset jets, shoulder type, counter bored type, and snout type. Air rings may be attached directly to the Dimensionair, or used with base and guide chutes that can only be provided at time of manufacture. Mahr Federal strongly recommends a drawing (CAD preferred) accompany this inquiry.

Company _____ Contact: _____ Part Number: _____

Phone: _____ Fax: _____ E-mail: _____

Required Information:

Feature Size mm/inch):

Size Tolerance:

Number of Jets*:

Air Ring Style:

- Center jets
- Offset jets
- Shoulder style
- Counter bored
- Snout

Overall length of diameter:

Quantity:

Dimensionair/Display to be used:

Part prints for other then non-standard plugs are required.

Options for Air Rings:

OD Restrictions:

Special Plug Markings:

Base required:

Guide chutes required:

- Vee Style
- Tube Style
- Length of chute: 63mm/2.5" or 152mm/6"

ISO Long Form Certification of Air Ring required?

Tooling Hose Required:

Shut-off

Master required?

Nominal?

AMR Calibration kit required?

Technical Assistance at Mahr Federal:
Phone: 401-784-3100
Fax: 401-784-3246 E-mail: information@mahr.com

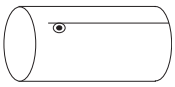
Dimensionair® Air Gages

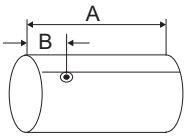
Worksheet for Ordering Air Plugs

There are two basic styles of Air Plugs, Thru Hole and Blind Hole Styles. Dimension "B" refers to the dimension of the Jet Centerline to the Nose of the Air Plug. The overall dimension is indicated by Dimension "A". There is an option for Super Blind Plugs that further reduces Dimension "B", permitting checking closer to the bottom of the part.

If extra length is necessary and an extension or handle will not work, you can specify extra plug length in 1" /25mm increments. NON-Relieved should only be specified for valve bores where obstructions like lands could make it difficult to remove the tool.

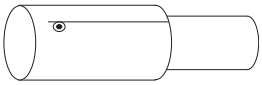
When possible specify the Dimensionair model number you are ordering the tooling for.

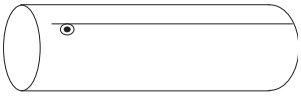

Through Hole



Blind Hole

Non-Relieved body diameter means the same for entire length


Relieved


Non-Relieved

Company _____ Contact: _____ Part Number: _____

Phone: _____ Fax: _____ E-mail: _____

Required Information:

Feature Size (bore dia):

Size Tolerance:

Number of Jets*:

Plug Style: Thru, Blind

Location Jets:

Extra Body length Req'd?

Extra length* =

Quantity:

Overall Bore Length*:

Dimensionair/Display to be used:

Part prints for other then non-standard plugs are required.

Surface Finish

Options for Air Plugs:

Stop Collar:

OD Restrictions:

Special Plug Markings:

Extensions Required / length:

ISO Long Form Certification of Air Plug required?

Tooling Hose Required:

Handle Required:

Shut-off

Master required?

Nominal?

AMR Calibration kit required?

AFL-24 Oil/Water trap required?

** 2 jet check size, ovality, taper, bellmouth; 3 jet check 3 point out of round; 4 jet Average Diameter, requires special Dimensionair; 6 jet Average 2 point and 3 point out of round, requires special Dimensionair.*

Technical Assistance at Mahr Federal:
Phone: 401-784-3100
Fax: 401-784-3246 E-mail: information@mahr.com

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Mahr Federal Inc. • 1144 Eddy Street • Providence, RI 02905 • Phone: 1-800-343-2050 • Fax: 1-401-784-3246 • Internet: www.mahr.com

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