Pneumatic Measurement

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Pneumatic Measurement

Sections:

1. Principles of Pneumatic Instruments
2. Application of Pneumatic Metrology
3. Metrological Advantages of Pneumatic Comparators
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Principles of Pneumatic Instruments

Back-Pressure Instruments

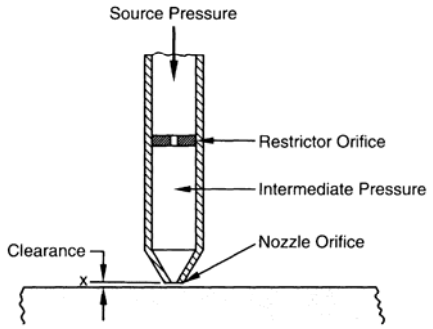


FIGURE 11–2 This is the double orifice system upon which back-pressure pneumatic comparators are based.

Principles of Pneumatic Instruments

Back-Pressure Instruments

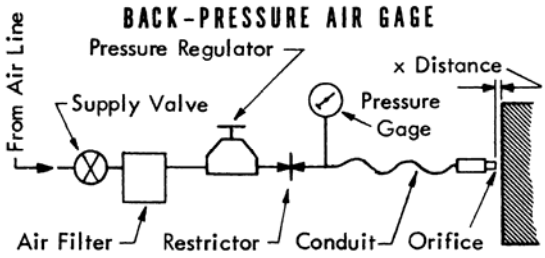


FIGURE 11–3 In the basic back-pressure air gage, a change in x alters the conduit pressure and is read on the pressure gage.

Principles of Pneumatic Instruments

Balanced Systems

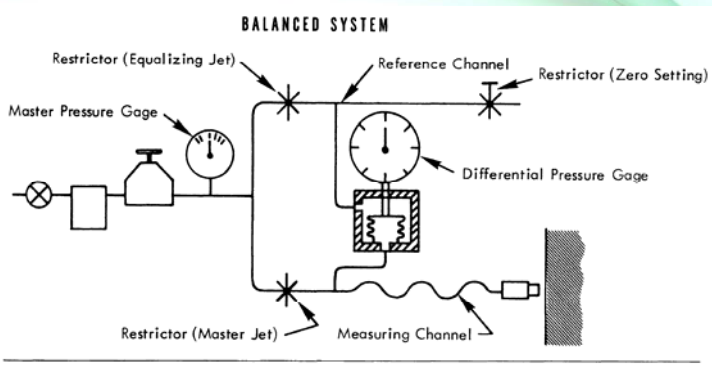


FIGURE 11–5 The balanced system has fixed amplification. The only adjustment is zero setting.

Principles of Pneumatic Instruments

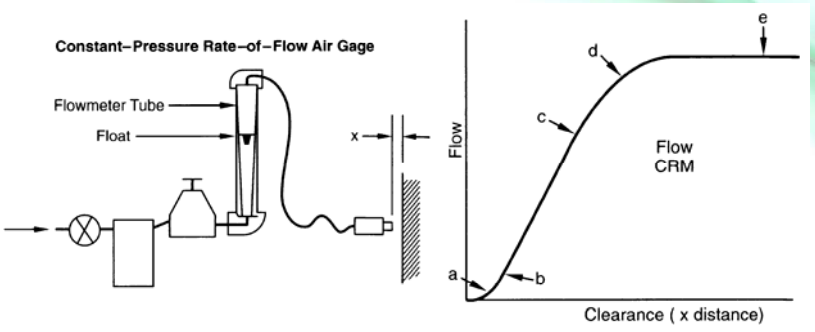
BALANCED SYSTEM DATA

Amplification	Discrimination	Measuring Range
1250:1	0.0025 mm 0.0001 in.	0.150 mm 0.006 in.
2500:1	0.00125 mm 0.00005 in.	0.075 mm 0.003 in.
5000:1	0.00050 mm 0.00002 in.	0.035 mm 0.0015 in.
10000:1	0.000125 mm 0.000005 in.	0.015 mm 0.0006 in.
20000:1	0.000125 mm 0.000005 in.	0.0075 mm 0.0003 in.

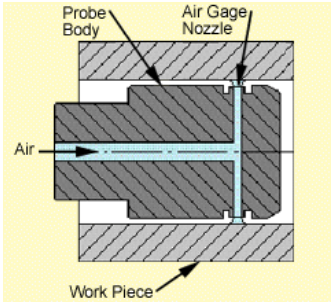
FIGURE 11–7 The balanced systems are available in a wide selection of amplifications and with relatively wide measuring ranges.

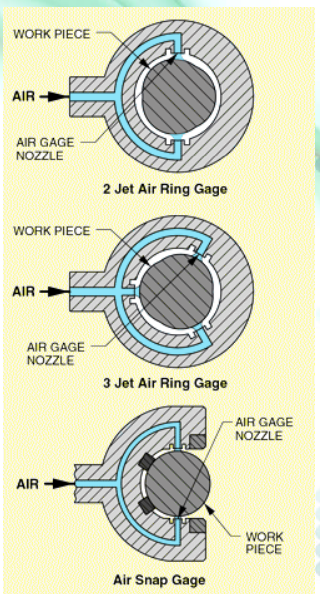
Principles of Pneumatic Instruments

Rate of Flow Systems



Application of Pneumatic Metrology





Application of Pneumatic Metrology

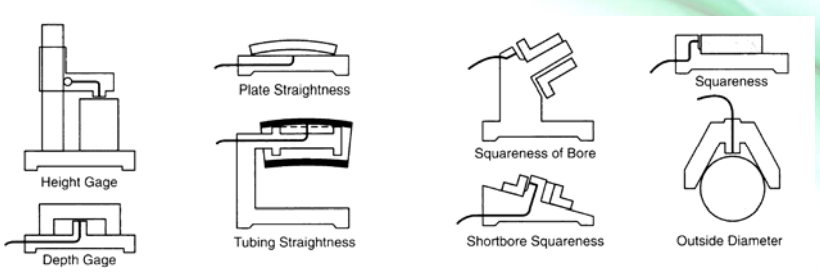


FIGURE 11–13 Single jet nozzles form the basic gaging element as in these examples.

Application of Pneumatic Metrology

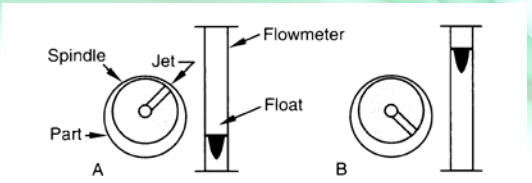


FIGURE 11–14 Rotation of the single jet spindle changes the height of the float.

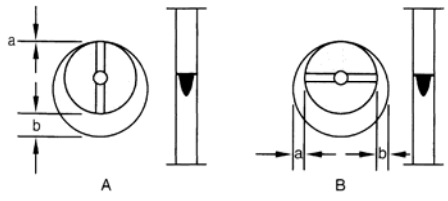


FIGURE 11–15 With opposite jets, rotation of the spindle does not change the float height because (a + b = x) for any position.

Application of Pneumatic Metrology

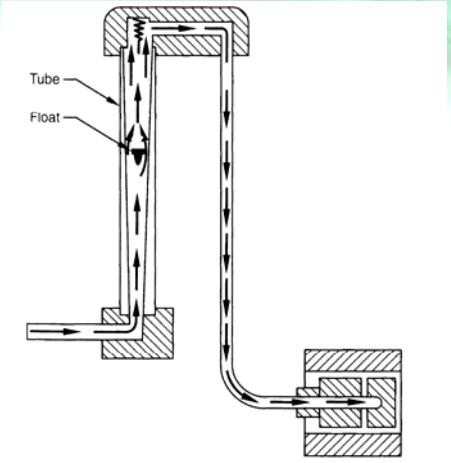


FIGURE 11–16 Cross section of typical spindle for the measurement of inside diameters.

Application of Pneumatic Metrology

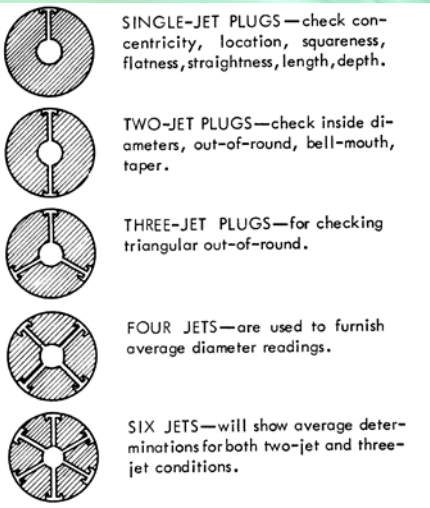


FIGURE 11–17 With a simple change of the spindle, a variety of characteristics may be checked.

Application of Pneumatic Metrology

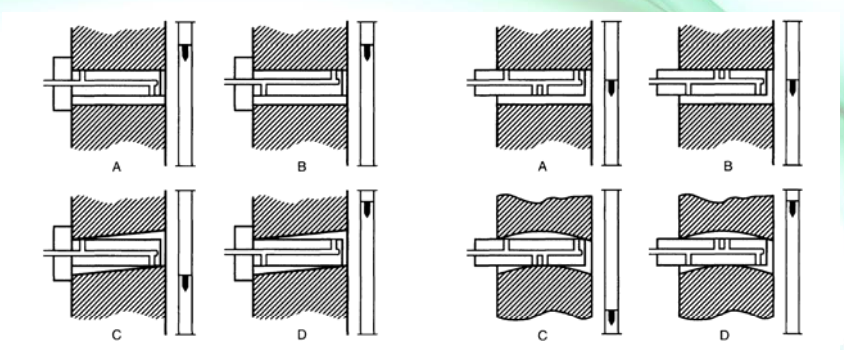


FIGURE 11–19 If the axis of the hole is square to the shoulder, rotating the spindle does not alter the height of the float as in A and B. Lack of squareness is shown by a fluctuating float height as in C and D.

FIGURE 11–20 This spindle checks straightness. Rotating the spindle from A to B does not change the combined clearances if the hole is straight. If it is not, a maximum and minimum reading results.

Application of Pneumatic Metrology

Principles of Pneumatic Instruments

FEATURES OF PNEUMATIC METROLOGY

Functional Features:

1. No wearing parts
2. Rapid response
3. Remote positioning of gage heads
4. Self-cleansing of heads and parts
5. No hysteresis
6. Adaptability to diverse part features
7. Small size of gage head

Metrological Features:

1. No direct contact
2. Minimum gaging force
3. Inspection of attribute (go and no-go gaging) or variable (size) measurement
4. Range of amplification
5. Adaptability to several modes of measurement (length, position, surface topography)

FIGURE 11–11 These features recommend air gaging for small holes, highly polished parts, fragile or easily determined parts, remote measurements, and the inspection of multiple part features. This is based primarily on the rate-of-flow type of air gage with flowmeter columns, but many of the features apply to other air gages as well.

Metrological Advantages of Pneumatic Comparators

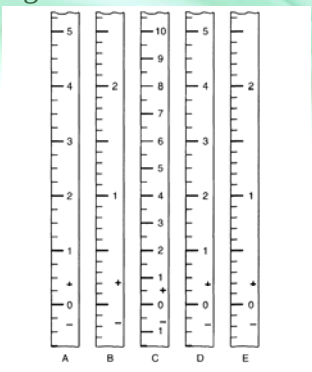


FIGURE 11–30 With pneumatic comparators, tolerances can be spread over great scale lengths, thus minimizing observational error.

POWER AND DISCRIMINATION—PNEUMATIC COMPARATORS

	Amplification	Scale Range	Scale Length	Part Tolerance	Tolerance Spread	Discrimination
A	1,000 to 1	0.0075	7 1/2"	0.005	5"	0.0002
B	2,000 to 1	0.0045	9"	0.003	6"	0.0001
C	5,000 to 1	0.0018	9"	0.0012	6"	0.00005
D	10,000 to 1	0.0009	9"	0.0006	6"	0.000020
E	20,000 to 1	0.00045	9"	0.0003	6"	0.000010

Metrological Advantages of Pneumatic Comparators

Reasons for Pneumatic Inspection of Small Holes:

1. Pneumatic gaging elements can be very small. This permits precision measurement of smaller inside diameters than is possible by other means of measurement.
2. Deeper holes can be inspected because depth has little effect on ease of measurement.
3. Greater accuracy is obtained because rocking and centralizing are unimportant.
4. Nominal gaging force permits thin-walled and yielding materials to be measured.
5. Absence of metal-to-metal contact protects finely finished surfaces.

Reading the Pneumatic Comparator

<u>Advantages of Pneumatic Comparators:</u>

i) The gauging member does not come into contact with the part to be measured and hence practically no wear takes place on the gauging member.
ii) It has usually very small number of moving parts and in some cases none.
iii) Measuring pressure is very small and the jet of air helps in cleaning the dust, if any, from the part to be measured.
iv) It is possible to have very high magnification.
v) The indicating instrument can be remote from the measuring unit.
vi) It is very suitable device for measuring diameter of holes where the diameter is small compared with the length.
vii) It is probably the best method for determining the ovality and taperness of circular bores.

Reading the Pneumatic Comparator

Disadvantages of Pneumatic Comparators:

i) They require elaborate auxiliary equipment such as accurate pressure regulation.
ii) The scale is generally not uniform.
iii) When indicating device is the glass tube, then high magnification is necessary in order to avoid the meniscus errors.
iv) The apparatus is not easily portable and is rather elaborate for many industrial applications.
v) Different gauging heads are required for different dimensions.

http://www.youtube.com/watch?v=sPS29gFUo8Y

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