

Pneumatic Indicating Controllers



Description

Model 40 Pneumatic Controllers automatically position a valve or other final control element to maintain process pressure at the desired set point. As receiving controllers, they can control any process variable transmitted as a pneumatic signal.

Standard models have proportional band adjustments for controlling processes where load changes are infrequent and can be corrected by the manual reset feature, standard in every controller. By a simple screwdriver adjustment, the standard proportional controller can be changed to two-position control action with adjustable differential gap.

Model 40 Controllers are available with control modes of 100% proportional, 200% proportional plus reset and 300% proportional plus reset plus rate (PID) (for processes with frequent load changes). They not only satisfy ordinary control requirements, but are equally proficient in controlling processes with unfavorable characteristics.

The basic instrument is also available as an indicating pneumatic transmitter. Mounted close to the point of measurement, it transmits an air pressure signal proportional to the measured variable to another indicator, recorder or controller.

Features

- Quality, flexibility, accuracy and dependability
- Indication of measured variable
- A non-bleed, high capacity relay with excellent stability and fast response
- Easy field calibration
- Broad selection of control modes; proportional plus reset, proportional plus reset plus rate, differential gap and two position bypass
- Wide selection of process measuring elements for pressure, differential pressure, flow and level
- Large, easy-to-read black on white dial for maximum resolution
- Case and door with epoxy powdered finish for environmental protection

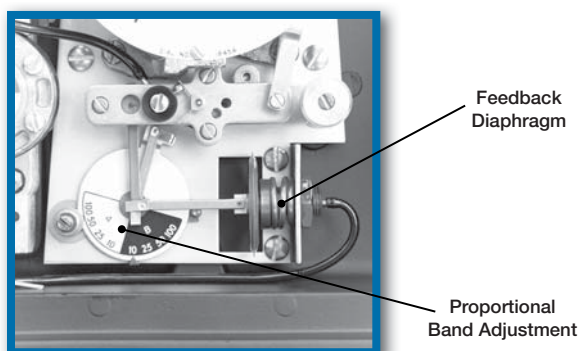
Pneumatic Indicating Controllers

Guide to Controller Selection

Type Of Process Dynamics	Description	Examples	Control Required
Capacity Lag Large Tank	Found when there is an appreciable inventory or storage of the controlled medium.	Level control in process retention tanks. Batch heating.	On-Off differential gap.
Transfer Lag	Found when it is necessary to force corrective action through a resistive element before it affects the process.	—	Proportional plus rate plus reset.
Instantaneous Response	Found when the manipulated variable is the same as the controlled variable or if they are dynamically equal	Flow control, pressure control or liquids in pipelines or other vessels completely filled with the liquid.	Proportional plus reset.
Velocity-Distance Lag	Found when the measuring device is downstream of the point of corrective action. Equals the separating distance ÷ the stream velocity.	Any process control requiring reaction time before measurement. Any analytical variable control loop where the sampling system produces dead time.	Proportional plus slow reset (do not use rate). Eliminate dead time if possible.

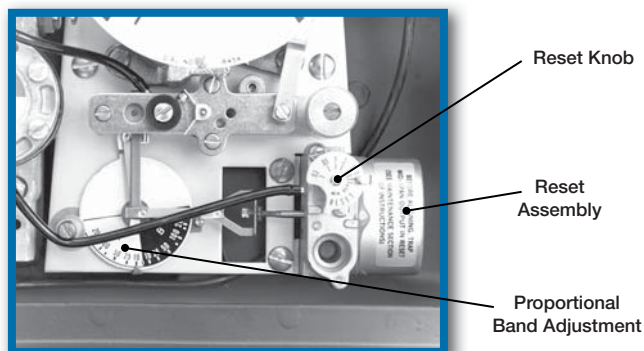
Control Actions

Proportional Control: This action provides an output signal proportional to the measured variable. Standard output pressure for controllers is 3-15 psi with proportional band adjustment of 1 to 100%. Band widths to 200% are also available. Outputs of 6-30 psi and 3-27 psi are optional. An index on the chassis plate of a controllers permits precise setting of band widths. Proportional control alone is ideal for process pressure regulation service (upstream) or relief service (downstream). Standard proportional controllers are recommended for most batch processes and a great many continuous processes where load changes are small or infrequent.



Proportional Plus Reset Action: When load changes are large or frequent and the process will not tolerate quick or drastic changes in control action, automatic reset is desirable to avoid excessive offset from the desired value under wideband proportional control. The feedback diaphragm on the standard proportional controllers is replaced with a reset assembly. A standard

reset needle valve offers a wide range of settings from 0.03 to 5.0 minutes per repeat (optional .03 to .5 minutes repeat available).



Differential Gap Action: This is a two-position control mode standard in all Model 40 Proportional Controllers. The output pressure of the controller remains at maximum (20 psi standard) or minimum (0 psi) until the controlled measurement crosses a band or gap, causing the output pressure to reverse. The measured variable must then span the gap in the opposite direction before the output signal is restored to the original condition. Differential gap action is useful in controlling pumps and compressors to prevent excessive on-off cycling. Several controllers set in sequence with overlapping bands may be used for cutting in several stages of a process successively and cutting them out in reverse order. Gap may be adjusted over the full range of the proportional band.

Features

Adjusting Wrench: 1/4" x 1/8" stored on door can be used for all necessary adjustments on movement, pointers and nozzle.

Shroud: Anodized aluminum shroud brightens dial area for greater visibility under adverse lighting conditions.

Case: Cast aluminum with dust ledge and deep weatherproof gaskets, captive stainless hinge pins and latch shaft, rectangular glass. Optional gas-tight construction with case tapped for 1/2" pipe vent. For high-pressure applications, shatter-proof glass and blowout grommets are available. Anodize is available for maximizing corrosion resistance.

Orifice: Sapphire 0.008" bore with integral push-button cleaner.

Dial: Large, easy-to-read black on white dial face with full 7" scale for maximum resolution.

Process Indications: Black adjustable pointer on 3-1/2" precision gauge dial (7" scale length). Readily adjusted to compensate for hydrostatic heads in piping.

Movement: Micrometer range adjustment plus adjustable sector and link for scale-shape calibration of both indicating and set point mechanisms provide easy field calibration.

Finish: Die-cast aluminum with semi-flat black powdered epoxy finish.

Set-Point Adjust: Internal or external available.

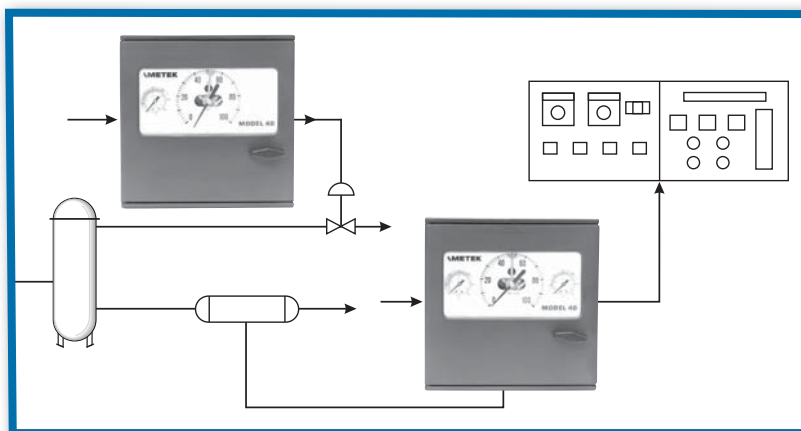
Relays: Non-bleed, high capacity relay is standard on all controllers. Bleed rate of less than 0.1 SCFM at 9 psi output and the capacity to deliver over 3.0 SCFM result in exceptionally stable, fast responding controller. May be easily dismantled for cleaning without disturbing factory-set adjustments. Anodize is available for maximizing corrosion resistance.

Proportional Band Adjustment: Adjustable by screwdriver within 90 degree quadrant indicated on dial. For available band widths and control options, consult factory.

Nozzle: Specifically designed for increased stability of pneumatic circuit, nickel silver nozzle can be turned on turret to reverse control action. 0.018" bore.

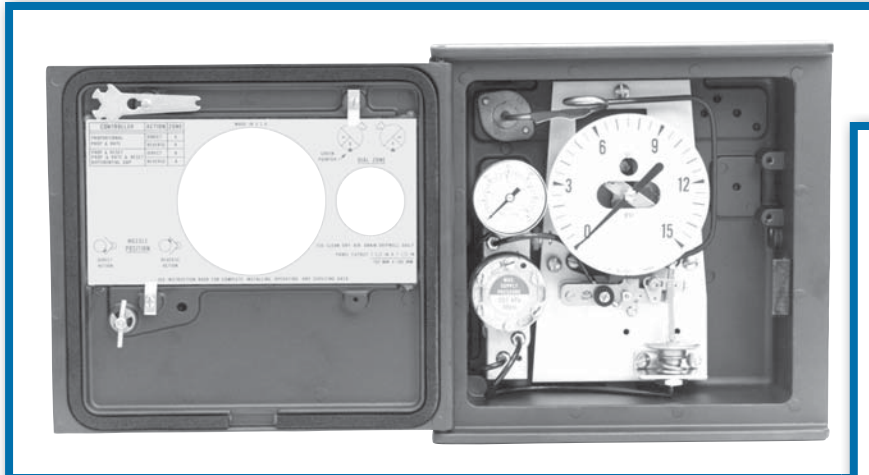
Specifications

- **Indication Accuracy:** 1% middle half of scale, 1-1/2% remainder. Most ranges may be calibrated to 1/2% accuracy at nominal extra charge.
- **Sensitivity:** Less than 0.1% of full scale at 100% Proportional band.
- **Frequency Response:** Flat to 400 CPM with 200 ft. of 1/4" tubing and 1.2 cubic inch capacity. Flat to 120 CPM with 18' 3/8" tubing and 200 cubic in. capacity.
- **Construction:** Moving parts are designed as light as possible to keep friction and inertia forces low. This design also results in higher resistance to vibration and shock.
- **Mounting:** Surface, flush panel, pipe-supported or valve-mounted. For dimensions, see page 7.
- **Air Supply:** 20 psi for 3-15 psi range; 35 psi for 3-27 & 6-30 psi range; 65 psi for 12-60 psi range. A filter and dripwell are recommended ahead of each controller to ensure clean, dry air supply. May be operated on natural gas or bottled CO₂.
- **Connections:** Standard back connections are 1/4" female NPT.



- **Measuring Elements:** A wide range of precalibration measuring elements for pressure are detailed on page 5.
- **Modular Construction:** Each of the following components may be removed without disturbing the other components: control chassis complete, precalibrated elements, feedback assemblies, complete relay units, or supply gauge only, or nozzle feed orifice and cleaner assembly only, or relay diaphragm housing and valve stem only-output gauge and tubing.

Model 40 Pneumatic Transmitters



Description

The Model 40 Pneumatic Transmitter is designed to sense pressure and transmit an air signal which is precisely proportional to the measured variable. This output signal from the transmitter may be fed to any remotely located monitoring, recording or control instrument.

Model 40 Pneumatic Transmitters insure increased safety by eliminating the need for piping high-pressure, toxic, corrosive, inflammable or other dangerous fluids or gases through the plant.

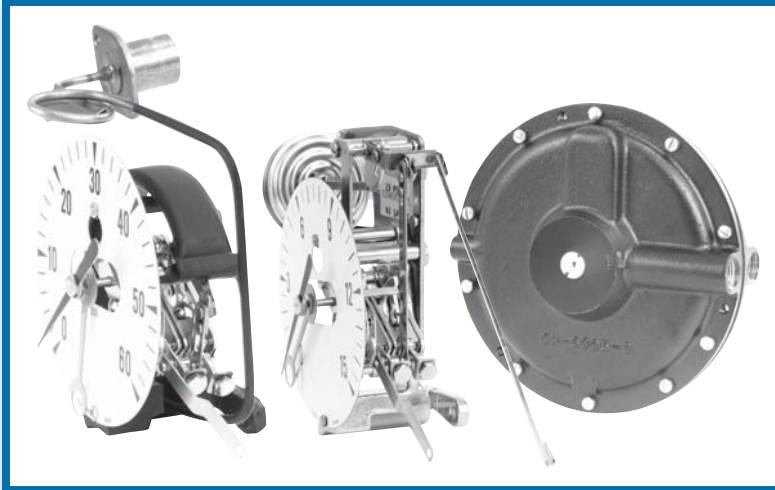
Model 40 Transmitters provide an added convenience, in that operation of a single transmitter with its high capacity relay can be used to actuate a number of receivers for indication, recording or control at a number of points throughout a plant. Also, transmitters measuring many different variables provide standard 3-15 psi output signals, thereby reducing all variables to common readout devices and simplifying centralized panelboards and control stations.

Model 40 Transmitters are designed, in physical appearance, to match the Indicating Pneumatic Controllers.

Features

- Reliability—highly essential, since a transmitter must operate for extended periods in inaccessible places without attention.
- Sensitivity and freedom from deadband—an absolute requirement, since the transmitter constitutes the first instrument in the control loop.
- High accuracy and repeatability—mandatory for consistency and control stability.
- Measuring elements—ranges and materials are same as those for indicating controllers, however, the element assemblies are not interchangeable between controllers and transmitters.
- Stabilized pneumatic circuit—output signal is stabilized with all combinations of output capacity or load and transmission line resistance. Changes in air supply pressure to the transmitter have a negligible effect on the output.
- Accuracy—measurement to output—within 1% of full scale on indicating transmitters; 0.5% on most ranges of indicating transmitters available at extra charge.
- Feedback assembly—a diaphragm capsule of Ni-Span C provides precise follow-up to maintain exact transmitter calibration.
- Air supply and output pressure—20 psi supply pressure and an output pressure range of 3-15 psi are standard. Other special ranges, as an example, 6-30 psi with a 35 psi supply pressure, are available. A filter and drip-well are recommended ahead of each transmitter, to ensure a clean, dry air supply.

Precalibrated Measuring Elements



Pressure

"C" Type Bourdon Tubes: Model 40 Pneumatic Controllers and Transmitters are furnished with precalibrated "C" type bourdon tube measuring elements. The wide, powerful Bourdon tube is carefully drawn, coiled and heat-treated to ensure a precise measuring element, permanent in calibration, and having exceptional overrange capacity. Phosphor bronze tubes are soft-soldered into cast brass sockets. Stainless steel elements are inert gas welded to provide maximum corrosion resistance. Standard ranges are listed in Table 1.

Differential Pressure Capsule: The differential pressure element used in the Model 40 controller is available in ranges from 10" W.C. to 400 psi with static working pressure to 3,000 psi (Table 2). The

Table 1. Bourdon Tube Ranges/Materials

ELEMENT RANGE	PHOS BRONZE	316 SS
0-30" Hg VAC	✓	✓
0-13 to 0-17 PSI	✓	✓
0-25 to 0-35	✓	✓
0-50 to 0-70	✓	✓
0-85 to 0-110	✓	✓
0-150 to 0-180	—	✓
0-190 to 0-230	✓	✓
0-250 to 0-350	✓	✓
0-350 to 0-450	—	✓
0-450 to 0-550	—	✓
0-550 to 0-700	—	✓
0-700 to 0-900	—	✓
0-900 to 0-1200	—	✓
0-1200 to 0-1700	—	✓
0-1700 to 0-2300	—	✓
0-2300 to 0-3000	—	✓

Compound range available. Consult your representative.
✓ = Available elements

Table 3. Diaphragm Ranges/Materials

ELEMENT RANGE	NI-SPAN C	316 SS
0-50 to 0-60"	—	✓
0-66 to 0-105"	✓	—
0-90 to 0-110"	—	✓
0-110 to 0-160"	✓	—
0-120 to 0-160"	—	✓
0-6 to 0-8 PSI	—	✓
0-8 to 0-11 PSI	—	✓
0-9 to 0-12 PSI	✓	—
0-11 to 0-13.5 PSI	—	✓
0-15, 0-30" Hg VAC	✓	—
3-15 PSI	✓	✓

✓ = Available elements

Table 2. Differential Pressure Element Ranges/Materials

METER BODY		RANGES AVAILABLE	
SWP (PSI)	MATERIAL	316 S.S. BELLOWS	BE CU BELLOWS
500	Brass	0-100 psi to 0-400 psi	0-30" W.C. to 0-400 psi
500	316 S.S.	0-30" W.C. to 0-400 psi	0-30" W.C. to 0-400 psi
1,000	Brass	—	0-60" W.C. to 0-400 psi
1,000	316 S.S.	0-60" W.C. to 0-400 psi	0-60" W.C. to 0-400 psi
1,500	Steel or 316 S.S.	0-60" W.C. to 0-400 psi	0-60" W.C. to 0-400 psi
3,000	Steel or 316 S.S.	0-60" W.C. to 0-400 psi	0-60" W.C. to 0-400 psi
6,000	Steel or 316 S.S.	0-70" W.C. to 0-400 psi	0-70" W.C. to 0-400 psi
10,000	Alloy steel (4140)	0-100" W.C. to 0-400 psi	0-100" W.C. to 0-400 psi

*Absolute pressure ranges available from 100" W.C. to 400 psi.
NOTE: Consult factory for additional ranges.

basic unit incorporates a high and low pressure bellows connected to a center plate. When two different pressures are applied to the high and low side the high pressure bellows contracts, forcing the fill fluid through the center plate into the low pressure bellows which expands. The motion of the low pressure bellows is transmitted via a temperature compensated linkage to the instrument output shaft.

Diaphragm: Low pressure controllers and transmitters are offered with a standard diaphragm measuring element comprised of stacked capsules of Ni-Span C or stainless steel. Diaphragm capsules are made of two contoured plates with nested corrugations and silver-brazed, or welded edges. They have a long working stroke, yet occupy minimum space. A sturdy element with large effective area, this design provides friction-free operation and precise indication. The constant thermal elastic characteristic of Ni-Span C practically eliminates thermal shift with wide variation in ambient temperatures. Welded type 316 stainless steel diaphragms are also offered for the ranges indicated in Table 3. Diaphragm elements are interchangeable with bourdon elements.

Slack Diaphragms: Extremely low gauge pressures are measured and controlled by molded Buna N slack diaphragm elements (Table 4).

Low differential pressures such as encountered in air flow and draft applications are measured by molded Buna N slack diaphragm elements. Elements are also used in extremely low compound pressure ranges and vacuum range transmitters and controllers. Differential measurements at static pressures as high as 15 psi can be made.

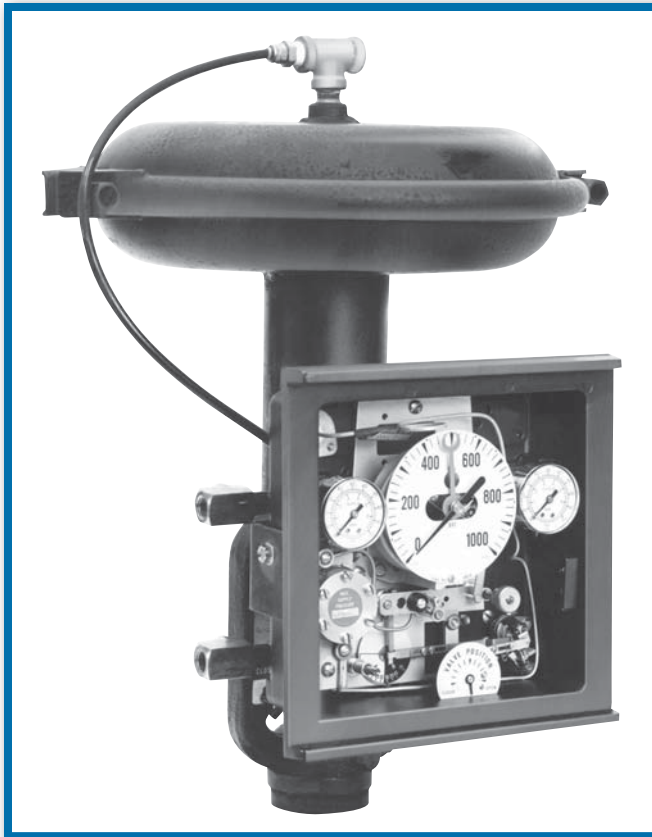
Table 4. Low Pressure Diaphragm Ranges

RANGE INCHES H ₂ O	PRESSURE	PRESSURE DIFFERENTIAL
0-4.5 to 0-8.4	✓	✓
0-8.5 to 14.5	✓	✓
0-14.6 to 0-24.9	✓	✓
0-25 to 0-43.9	✓	✓
0-44 to 0-80	✓	✓

✓ = Available elements

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Model 40 Pilot Positioner



Description

The Model 40 Controller-Positioner combines in one compact unit the functions of (a)—an indicating pneumatic controller for pressure, temperature or any pneumatically transmitted variable, and (b)—a valve positioner which amplifies air power to position a pneumatically operated control valve accurately and rapidly.

This instrument accurately positions the valve in response to changes in measured variable as small as 0.1% full scale. It ensures rapid valve response even through full travel and

results in economies through use of smaller topworks. Instead of pneumatic feedback from valve stem position, the instrument employs mechanical feedback to the controller through a lever system. Thus the valve is forced to assume a precise position proportional to the controlled variable.

The unit includes a high-capacity, non-bleed relay providing more rapid and accurate positioning. By means of a unique valve stem take-off, the Controller-Positioner will actuate any diaphragm motor valve with stem travels from 3/8" to 4" in any combination of stem direction and air-to-open or air-to-close topworks. A rear mounting pad provides for the vertical location of the instrument on virtually all makes and sizes of diaphragm motor operators.

The standard Controller-Positioner operates on any air supply pressure from 20 to as high as 65 psi and is available with 1-75% Proportional Control or 1-75% Differential Gap Action—with easy field reversibility.

It may be actuated by any of the measuring elements described on pages 5 and 6 (except slack diaphragms or DP capsules), or it may be used as a pneumatic received in conjunction with a distantly located Indicating Pneumatic Transmitter.

Features

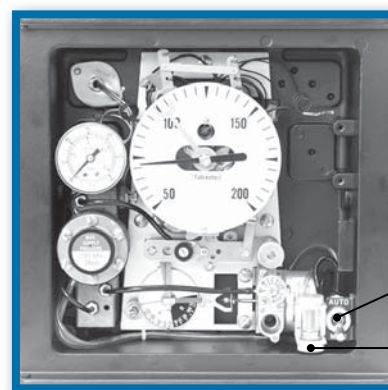
There are several advantages to the Controller-Positioner over two separate units—

- It is located close to the process and directly on the valve for fast, accurate response
- It needs only one air supply and thus reduces installation and maintenance costs
- It mounts readily on all standard diaphragm valves and other pneumatic actuators
- It saves space required for a second instrument
- It is low in initial cost as well as maintenance and operating costs

Optional Indicating Controller Features

Automatic/Manual Function: This option allows the process to be controlled automatically or manually with provision for bumpless transfer.

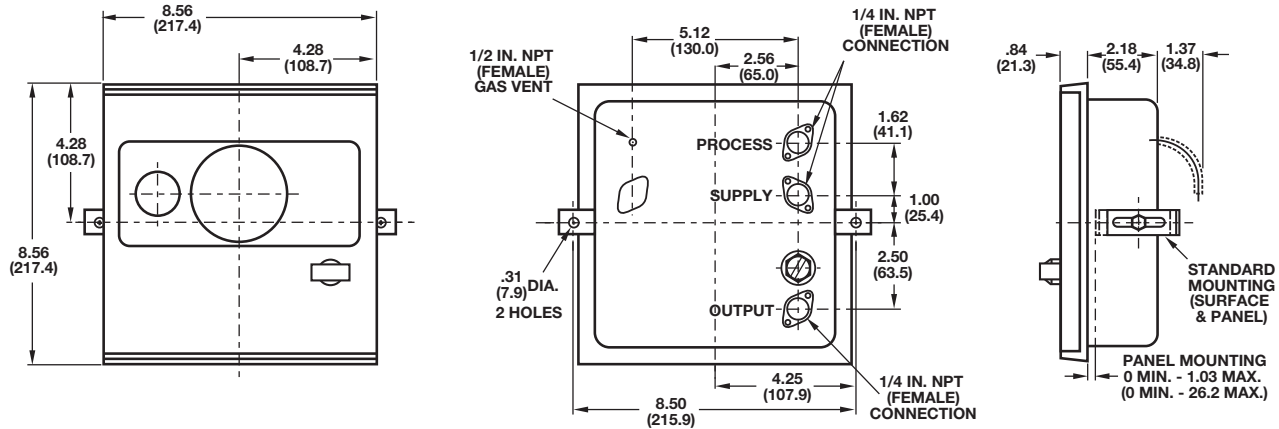
A 3-way valve in the nozzle line permits automatic or manual control of instrument output using a pressure regulator mounted on top of the relay. Bumpless transfer is facilitated by a differential pressure indicator which responds to very low pressure differentials. This makes it possible to closely match regulator pressure to nozzle pressure. With this system, controller output air is used for manual control. Air delivery and control response are the same for manual and automatic modes.



Transfer
Toggle
Switch

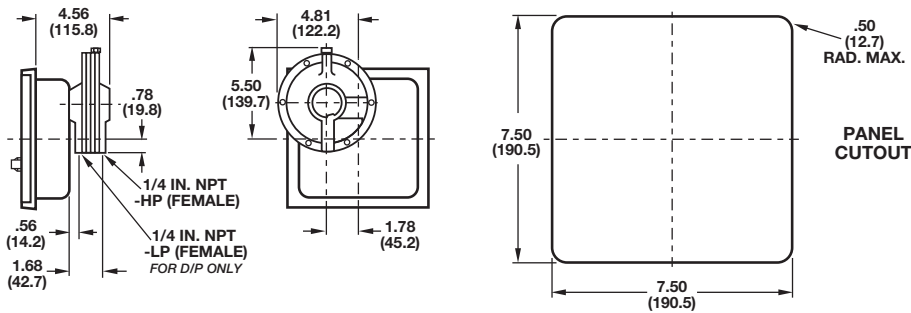
Differential
Pressure
Indicator

INDICATING CONTROLLER



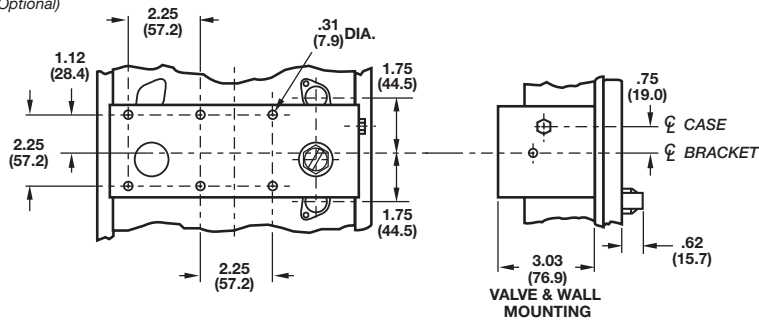
SLACK DIAPHRAGM CONTROLLER

(Not available valve mounted)



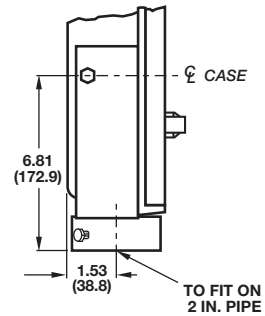
VALVE MOUNTING

(Optional)

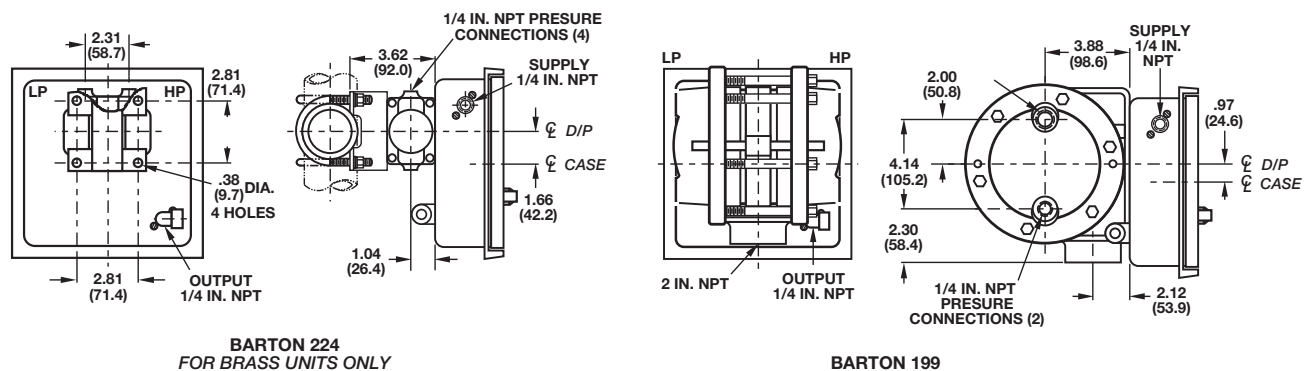


PIPE MOUNTING

(Optional)



DIFFERENTIAL PRESSURE CONTROLLER



BARTON 224
FOR BRASS UNITS ONLY

BARTON 199

Pneumatic Indicating Controllers

Model Numbering:

Model 40 Pressure Instruments									
Control Mode									
1	200% Prop. & Reset	5	75% Prop. (Positioner only)						
2	100% Prop.	7	300% PID (3/15 psi only)						
3	200% Prop.								
Output									
1	3/15 psi								
2	3/27 psi								
3	6/30 psi								
5	12/60 psi (Prop. only)								
Instrument Type									
B	Contr. W/2 Pos. By-Pass (not with PID)								
K	Controller								
P	Pilot Positioner (75% Prop. 12/60 Out Only)								
T	Transmitter (100% Prop. Only) 3/15 or 3/27 psi only								
Element Type									
B	Bourdon Tube	F	Slack Diaph. (D/P or Center 0)						
C	Barton #199 (Consult Factory)	I	Barton #224 (Consult Factory)						
D	Metal Diaphragm (Press.)	J	Metal Diaph. (Suppressed Zero)						
E	Metal Diaphragm (0-30 in. Hg Vac, Ni Span C only)	R	Indicating Level						
		S	Slack Diaph. (Pressure)						
Element Material									
0	No Element	7	Buna N						
1	Bronze	S	Special						
3	St. Stl. (316)	8	Buna N (Center 0)						
5	Ni Span C	9	C or I Element Type						
Element Range									
Enter first 2 digits of desired span so that it gives the desired span when multiplied by the multiplier and the unit of measure.									
Examples: 0 to 100 psi span is 101 (10 x 10 psi); 3 to 15 psi span is 120 (12 x 1 psi)									
Multiplier & Units									
0	x 1 psi	3	x 1000 psi						
1	x 10 psi	5	x 1 in. Water						
2	x 100 psi	6	x 10 in. Water						
Eng. Units or Dial No.									
Options									
AB	External Set Point Knob								
AC	Overrange Stop (Element Type B, D, J only)								
AD	Air Filter, Regulator & Drip Well								
AG	Shatterproof Glass								
AH	Blowout Grommet								
AI	External Reset Connection								
AM	Metal Tags								
AP	Vented Case (1/2" NPT)								
AR	Special Calibration								
AW	Fast Reset Valve								
BH	Pipe Mounting Bracket								
BI	Valve & Wall Mounting Bracket								
BK	Wall Mounting Bracket								
BL	Supply Gauge								
BR	Blank Shroud								
OX	Cleaned for Oxygen Service								
—	Custom Scale								
DQ	Anodized Case, Door, Relay								
Model 40	1	1	B	B	3	30	1	?	BL