Product Bulletin
34.2:L3
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L3 Pneumatic Level Controller

The *L3* pneumatic level controller (see figure 1) is designed to sense liquid level or interface level in a vessel, and produce a standard pneumatic output signal proportional to the process variable.

The controller comes complete with a wafer-style sensor which can be flange-mounted to the top of a vessel or installed in a customer-supplied cage or chamber as shown in figure 5.

Figure 1. L3 Pneumatic Level Controller shown Installed in a Typical Customer-Supplied Cage

Features

- **Installation Versatility**—With the integration of a wafer-style liquid level sensor and transmitter into one product, the *L3* enables users to install pneumatic level controllers to a variety of industry standard or custom process vessel connections. Installing the *L3* in a customer-supplied external cage gives process equipment designers freedom to select the best process vessel connection location and configuration to meet specific application requirements.

- **Easy Adjustment**—Set point and proportional valve opening are made with simple dial-knob controls.

- **Simple, Durable Construction**—Few moving parts are used. Knife-edged driver bearing in sensor and plated brass instrument case ball bearing for torque tube rotary shaft help provide low-friction operation.

- **Easy Reversibility**—Action is field reversible from direct to reverse or vice versa without additional parts.

- **Reduced Maintenance Costs**—Spring-out wire provides for in-service cleaning of relay orifice (figure 3).

- **Reduced Operating Costs**—Supply pressure conservation is enhanced because relay exhaust opens only when output pressure is being reduced.

- **NACE Compliant**— The materials used in the *L3* wafer-style sensor (see table 1) meet the metallurgical requirements of NACE MR0175-2002. Environmental limits may apply.

Principle of Operation

The sensor consists of a wafer body, torque tube assembly and displacer (see figure 2) and is available in CL150, 300, and 600. The wafer body mounts between NPS 3 or 4 raised face flanges.

The torque tube assembly consists of a hollow torque tube with a shaft welded inside it at one end and protruding from it at the other end.

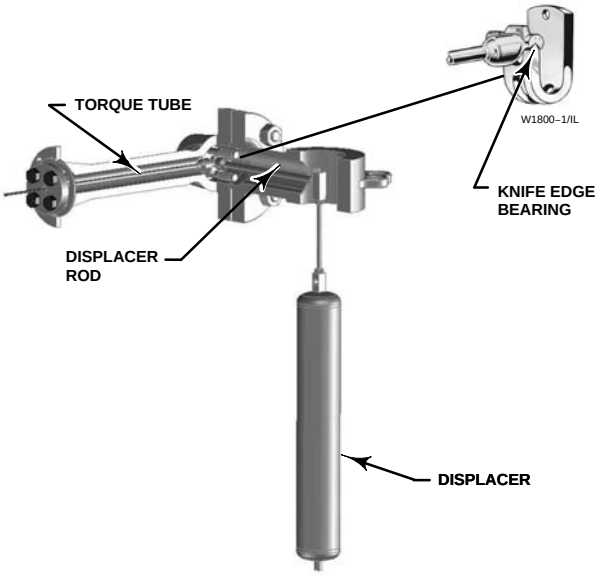


Figure 2. L3 Wafer-Style Sensor

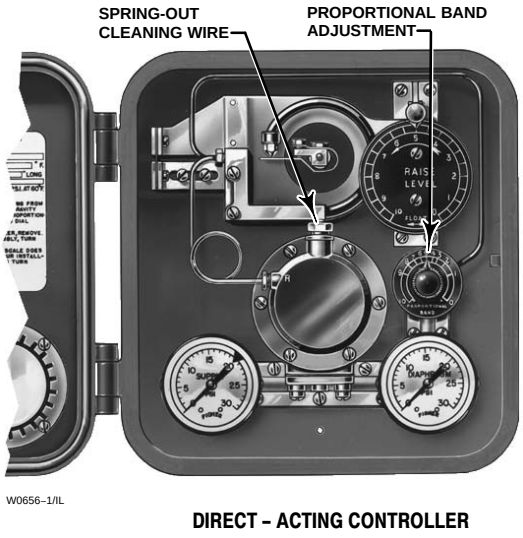


Figure 3. L3 Controller

The unconnected end of the tube is sealed by a gasket and clamped rigidly to the torque tube arm, permitting the protruding end of the shaft to twist and therefore transmit rotary motion. This allows the interior of the torque tube to remain at atmospheric pressure, thus eliminating packing and the disadvantages of packing friction. This is a proven and reliable seal.

A change in liquid level, interface level, or density/specific gravity buoys up the displacer by a force equal to the weight of the liquid displaced. Corresponding vertical movement of the displacer results in angular movement of the displacer rod around the knife-edge. Since the torque tube assembly is a torsional spring which supports the displacer and determines the amount of movement of the displacer rod for a given displacement change, it will twist a specific amount for each increment of buoyancy change.

The controller uses the pressure-balanced relay with a yoked double-diaphragm assembly. Supply pressure either passes through the fixed orifice or bleeds out the nozzle. Nozzle pressure registers on the large relay diaphragm, and output pressure on the small relay diaphragm. Refer to figure 4.

As long as the process remains constant, the displacer will hold the torque tube shaft and attached flapper steady in relation to the nozzle. The nozzle-flapper opening will permit pressure to bleed from the nozzle as fast as it enters through the fixed orifice of the relay, keeping the pressure loading on the large relay diaphragm at the amount necessary to balance the output pressure loading on the small relay diaphragm.

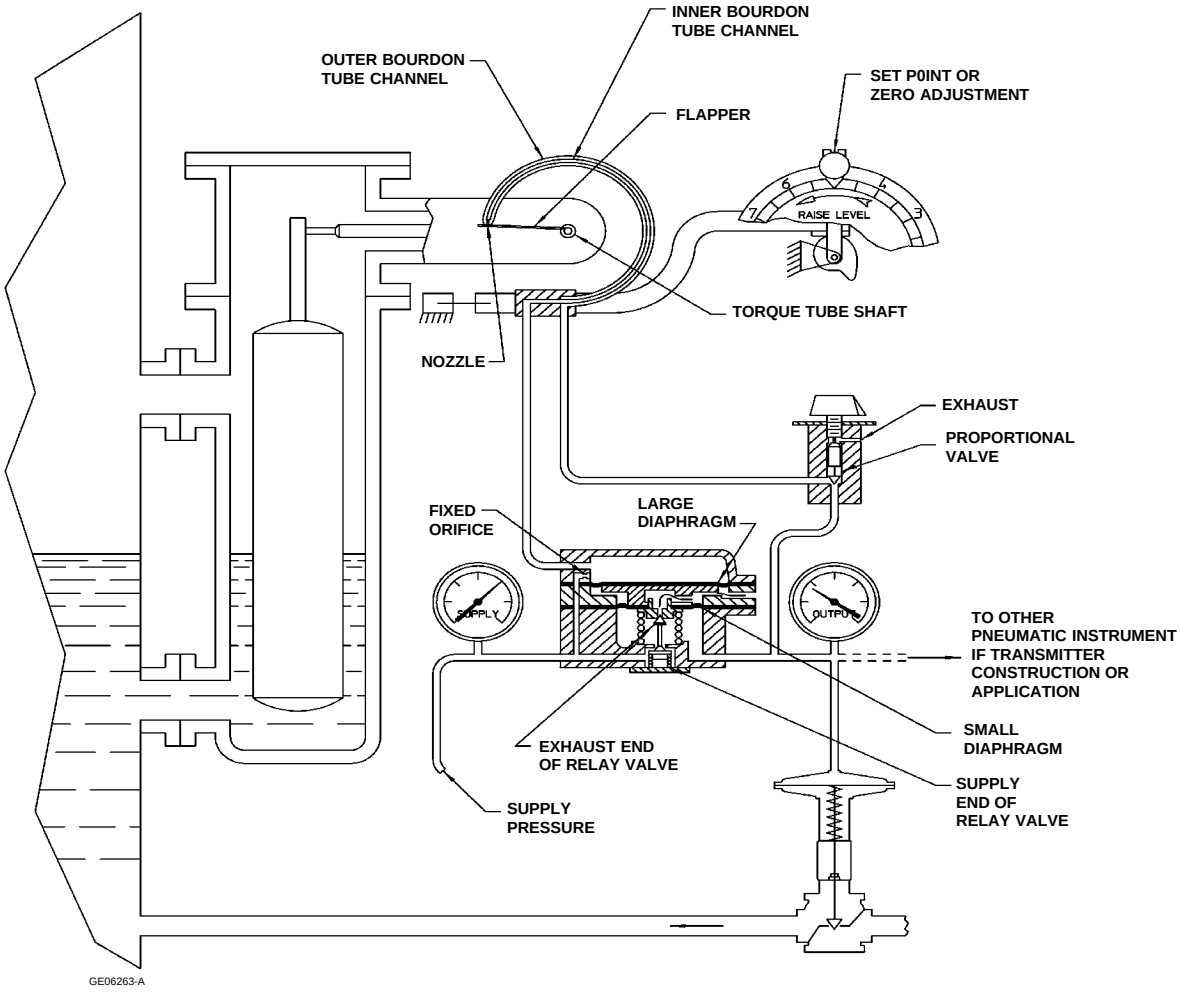


Figure 4. L3 Schematic

A process variable change (such as a variation in downstream demand that affects liquid outflow and thus the level of the tank shown in figure 4) changes the buoyant force acting on the displacer and moves the flapper with respect to the nozzle. An increasing buoyant force with direct action, or decreasing buoyant force with reverse action, produces a nozzle-flapper restriction that increases nozzle pressure on the large relay diaphragm. This opens the supply end of the relay valve and increases relay output pressure. But a decreasing buoyant force with direct action, or increasing buoyant force with reverse action, produces a nozzle-flapper opening that bleeds off nozzle pressure on the large relay diaphragm and opens the exhaust end of the relay valve to let output pressure (and thus actuator loading pressure) bleed away. The relay diaphragm pressure differential equalizes and a new output pressure is maintained according to the change in displacer position.

Ordering Information

When ordering, specify:

Wafer-Style Sensor Construction

- **Size**—NPS 3 or 4 raised-face flange wafer-style sensor suitable for CL150 through 600 flange rating
- **Material**—Steel or stainless steel
- **Application**—Level or interface

Notes

Right-hand mounting is standard, and can be field configured to left-hand mounting as required by installation.

During shipment, displacers are detached from the sensors.

Equalizing piping, stillwells, or other equipment may be required for installation. Emerson Process Management does not provide this equipment.

Instruction manuals used with the *L3* pneumatic displacer level controller are 2500 and 2503 Series Controllers and Transmitters (part number D200124X012) and 249W Cageless Wafer Style Level Sensor (part number D102803X012).

Cage Construction

Note

A cage is not supplied with the *L3*.

For a factory built cage-style construction, contact your Emerson Process Management sales office.

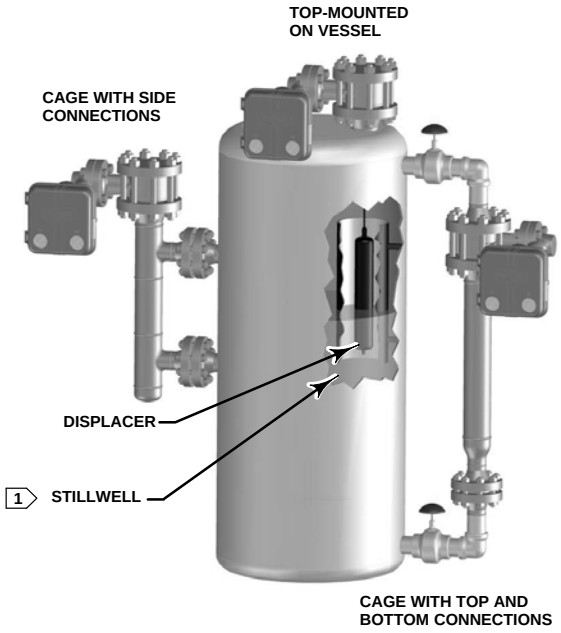
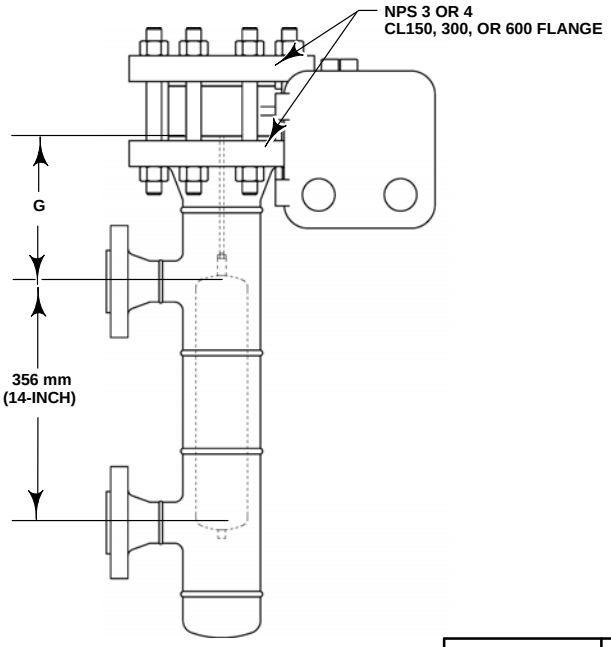


Figure 5. L3 Mounted on Vessel

Figure 6 provides guidelines for fabricating a cage.

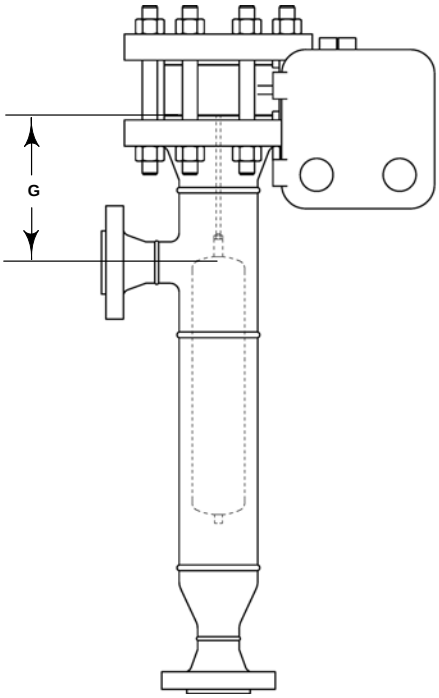
When fabricating a cage or chamber, maintain at least a minimum clearance of 10 mm (3/8-inch) between the diameter of the displacer and the inside diameter of the cage or displacer. Dirty or viscous fluids may require a larger clearance. Provide sufficient cage length below the displacer to ensure that the displacer does not hit the bottom of the cage. When installing the cage, it must be vertically plumb so that the displacer does not strike the side of the cage.

See figure 7 for overall envelope dimensions for mounting an *L3.*

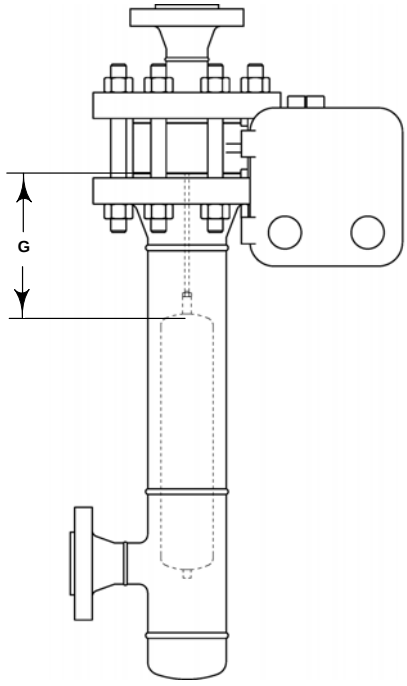


CAGE WITH UPPER AND LOWER SIDE VESSEL CONNECTIONS
GE06541

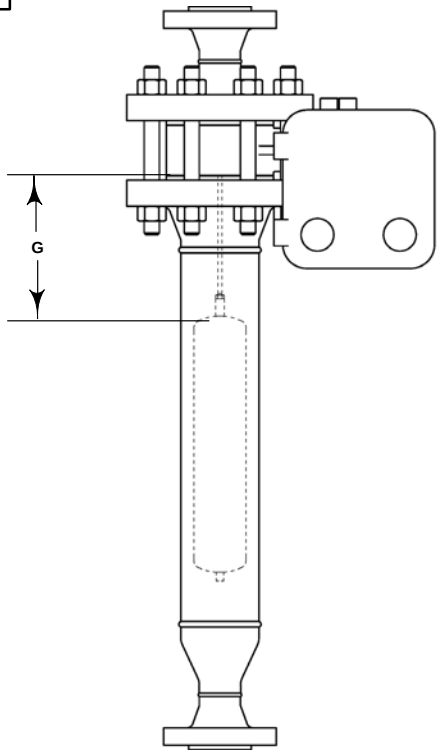
WAFER-STYLE SENSOR SIZE	G	
	mm	INCH
NPS 3	178	7.00
NPS 4	216	8.50



CAGE WITH UPPER SIDE AND BOTTOM VESSEL CONNECTIONS
GE06542



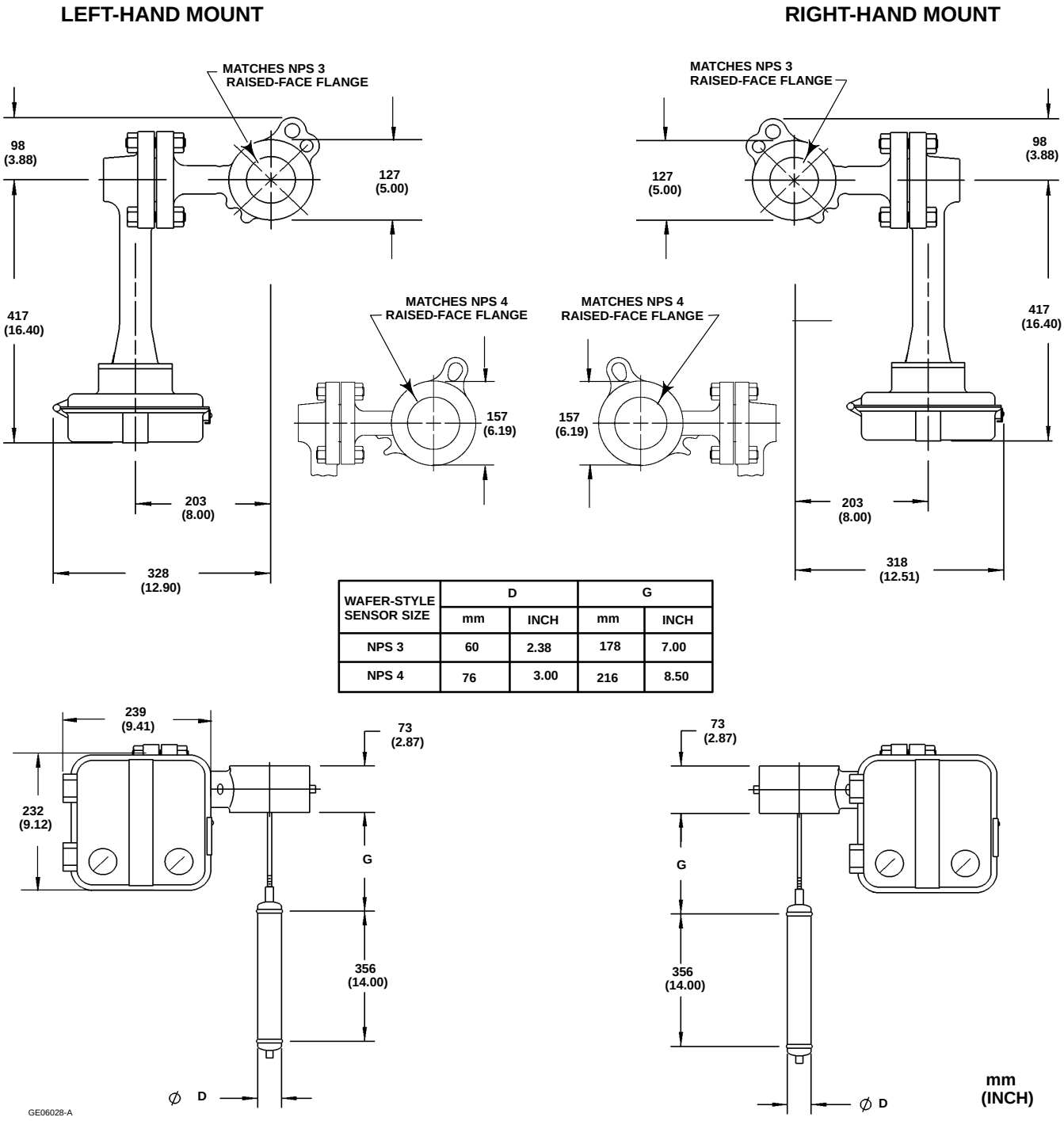
CAGE WITH TOP AND LOWER SIDE VESSEL CONNECTIONS
GE06540



CAGE WITH TOP AND BOTTOM VESSEL CONNECTIONS
GE06545

NOTES:
1. VESSEL CONNECTIONS ARE EITHER NPS 1-1/2 OR 2 CL150, 300 OR 600 FLANGES. (VESSEL ENDS CAN BE ALSO SCREWED OR SOCKET WELDED CONNECTIONS).
2. DISPLACER LENGTH IS 14-INCHES.

Figure 6. Typical Cage Constructions



WAFER-STYLE SENSOR SIZE	D		G	
	mm	INCH	mm	INCH
NPS 3	60	2.38	178	7.00
NPS 4	76	3.00	216	8.50

Figure 7. Overall Envelope Dimensions for the L3

Specifications

Available Configurations

Controller: 2500, proportional only
Wafer-Style Sensor: 249W

Matches NPS 3 or 4 raised face flange, suitable for CL150 through 600 flange rating

Displacer length: 356 mm (14-inches)

Input Signal

Level or Interface Level: From 0 to 100 percent of displacer length

Allowable Specific Gravity

Liquid Level: 0.4 to 1.2
Interface Level:
NPS 3 wafer: 0.17 differential
NPS 4 wafer: 0.11 differential

Output Signal

0.2 to 1.0 bar (3 to 15 psig) or
0.4 to 2.0 bar (6 to 30 psig)

Output Action

■ Direct (increasing fluid or interface level or specific gravity increases output pressure) or
■ Reverse (increasing fluid or interface level or specific gravity decreases output pressure)

Supply Pressure(1)

Normal Operation:

0.2 to 1.0 bar (3 to 15 psig): 1.4 bar (20 psig)
0.4 to 2.0 bar (6 to 30 psig): 2.4 bar (35 psig)

Maximum Recommended:
3 bar (45 psig)

Steady-State Air Consumption(2)

0.2 to 1.0 bar (3 to 15 psig):
Minimum(3): 0.11 normal m^3/hr (4.2 scfh)
Maximum(4): 0.72 normal m^3/hr (27 scfh)

0.4 to 20. bar (6 to 30 psig):
Minimum(3): 0.19 normal m^3/hr (7 scfh)
Maximum(4): 1.1 normal m^3/hr (42 scfh)

Proportional Band

Proportional band of 0 to 100 percent of displacer length or displacement force change (10 to 100 percent recommended).

Set Point

Continuously adjustable to position control point or differential gap of less than 100 percent anywhere within displacer length (fluid or interface level)

Performance

Hysteresis and Deadband: <1% of output span at 100% proportional band
Repeatability:
NPS 3 sensor: 0.3% of displacer length or displacement force change
NPS 4 sensor: 0.2% or displacer length or displacement force change
Typical Frequency Response: 4 Hz and 90-degree phase shift at 100 percent of proportional band, differential gap, or span with output piped to typical instrument bellows using 6.1 meters (20 feet) of 6.4 mm (1/4-inch) tubing
Ambient Temperature Error: ±1.5 percent of output pressure change per 28°C (50°F) of temperature change at 100 percent of proportional band, differential gap, or span when using sensor with standard wall N05500 torque tube

Standard Tubing Connections

1/4 NPT internal

Sensor Working Pressures(1)

CL600 maximum

Standard Supply and Output Pressure Gauge Indications

0.2 to 1.0 bar (3 to 15 psig): 0 to 30 psig
0.4 to 2.0. bar (6 to 30 psig): 0 to 60 psig

Construction Materials

Controller: Die cast aluminum case

Wafer-Style Sensor: See table 1

Mounting Positions

Mounts on top of vessel or on customer supplied cage (see figure 5)

–continued–

Specifications (continued)

Operating Limits

Allowable Process Temperatures(2)
Maximum: 232°C (450°F). See figure 8.

Operative Ambient Temperatures(2)
–40 to 71°C (–40 to 160°F)

Hazardous Area Classification

2500 Series controllers comply with the requirements of ATEX Group II Category 2 Gas and Dust

CE ⟨Ex⟩ II 2 G D

NOTE: Specialized instrument terms are defined in ANSI/ISA Standard 51.1 – Process Instrument Terminology.
1. The pressure/temperature limits in this bulletin and any applicable standard or code limitation should not be exceeded.
2. Normal m^3/hr=normal cubic meters per hour at 0°C and 1.01325 bar. Scfh=standard cubic foot per hour at 60°F and 14.7 psia.
3. At zero or maximum proportional band or span setting.
4. At setting in middle of proportional band or span range.

Table 1. Wafer-Style Sensor Construction Materials

PART	MATERIAL(2)
Wafer body and torque tube arm	NPS 3, WCC or CF8M (316 stainless steel, cast)
	NPS 4, LCC or CF8M
Torque tube	N05500 nickel alloy
Displacer	NPS 3, S31600 (316 stainless steel)
	NPS 4, S30400 (304 stainless steel)
Trim(1)	S31600
Bolting	NCF coated steel grade B7 studs or cap screws and grade 2H nuts
Torque tube arm gasket and torque tube end gasket	Graphite/stainless steel

1. Trim parts include displacer rod, driver bearing, displacer stem parts, and stem connection parts
2. NACE MR0175-2002 compliant. Meets the metallurgical requirements of NACE MR0175-2002. Environmental limits may apply.

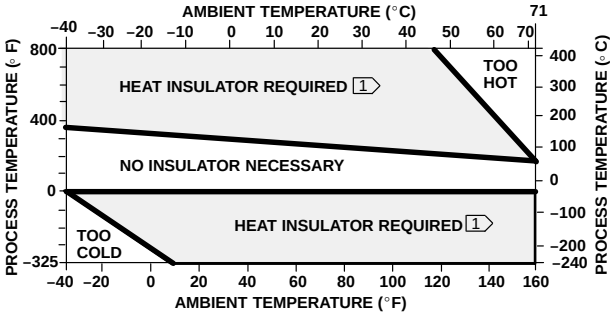


Figure 8. Guidelines for Heat Insulator Usage

Note

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