Product Bulletin
62.1:546
D200061X012
December 2008

Fisher® 546, 546S, and 546NS Electro-Pneumatic Transducers

Fisher® 546, 546S, and 546NS transducers (figure 1) receive a direct-current input signal and use a torque motor, nozzle-flapper, and pneumatic relay to convert the signal to a proportional pneumatic output signal. Nozzle pressure, which operates the relay, is also piped to the torque motor feedback bellows. This provides a comparison between input signal and nozzle pressure and reduces errors in nozzle pressure.

The transducer can be mounted on a pneumatic diaphragm control valve actuator to provide accurate operation of the valve. The integrated high-capacity pneumatic relay eliminates the need for additional boosters or relays for operation of control valves.

The transducer also can be used to provide stable operation when its output signal is transmitted to small terminal volume chambers such as control bellows in pneumatic valve positioners.

Figure 1. Fisher® 546 Transducer Mounted on 657 Pneumatic Diaphragm Actuator

Features

- **Vibration Resistance**—High natural frequency of torque motor moving parts results in negligible vibration influence. Also meets typical seismic requirements for nuclear service.

- **Easy Adjustment**—Screwdriver adjustments for span and zero are conveniently located and have arrows indicating rotation to increase settings (see figure 2).

- **Field-Reversible Action**—No additional parts required to reverse action of 546 or 546NS; 546S versions cannot be reversed in the field but can be purchased either direct or reverse acting.

- **Simple Relay Removal**—Integrated pneumatic relay is mounted outside case and can be removed without disturbing electrical or pressure connections or impairing explosion safety.

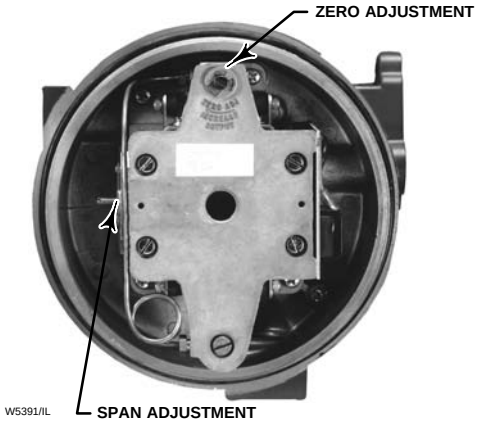


Figure 2. Zero and Span Adjustments (Cover Removed)

Specifications

Available Configurations

546: Electro-pneumatic signal transducer with explosion-proof case and cover
546S: Similar to the 546 except designed for intrinsically safe, non-incendive, or dust-ignition applications
546NS: Similar to the 546 except provided with EPDM elastomers for use in elevated temperature and radiation environments
All transducer types may be ordered ■ with or ■ without a Fisher 67CFR filter regulator. The 51 mm (2 inch) supply pressure gauge mounted on the regulator may be ■ 0 to 30 psig or ■ 0 to 60 psig range

Input Signals

546 and 546NS: ■ 4 to 20 mA DC, ■ 10 to 50 mA DC, ■ 1 to 9 V DC, or ■ Two-way split range using either half of one of the standard input signal spans
546S: ■ 4 to 20 mA DC or ■ For Factory Mutual only, a two-way split range using either half of the 16 mA DC span. Signal must not exceed 30 VDC, 20 mA DC.

Internal Resistance of Torque Motor

4 to 20 mA DC Input Signal: 176 ±10 ohms
10 to 50 mA DC Input Signal: 90 ±10 ohms
1 to 9 VDC Input Signal: 1300 ±50 ohms (temperature compensated circuit)

Output Signals

Ranges:
For 546 and 546NS: ■ 0.2 to 1.0 bar (3 to 15 psig), ■ 0.4 to 2.0 bar (6 to 30 psig), ■ 0 to 1.2 bar (0 to 18 psig) or ■ 0 to 2.3 bar (0 to 33 psig)
For 546S: ■ 0.2 to 1.0 bar (3 to 15 psig), ■ 0.4 to 2.0 bar (6 to 30 psig), or ■ 0 to 2.3 bar (0 to 33 psig)
Action: 546 and 546NS are field reversible between ■ direct and ■ reverse (546S is available with either direct or reverse action, but cannot be reversed in the field.)

Supply Pressure(1)

Recommended: 0.3 bar (5 psi) higher than upper range limit of output signal
Maximum: 3.5 bar (50 psig)

Maximum Steady-State Air Consumption(2)

At 1.4 bar (20 psig) Supply Pressure: 0.6 normal m^3/hr (21 scfh)
At 2.4 bar (35 psig) Supply Pressure: 0.8 normal m^3/hr (30 scfh)

Maximum Output Air Capacity(2)

At 1.4 bar (20 psig) Supply Pressure: 12.9 normal m^3/hr (480 scfh)
At 2.4 bar (35 psig) Supply Pressure: 18.5 normal m^3/hr (690 scfh)

Performance(3)

Reference Accuracy: ±0.75% of output signal span
Independent Linearity: ±0.50% of output signal span
Open Loop Gain: 26
Frequency Response: Gain is attenuated 3 dB at 20 Hz with 546 output signal piped to a typical instrument bellows with 305 mm (12 inch) of 1/4 inch tubing
Electromagnetic Interference (EMI): Tested per IEC 61326-1 (Edition 1.1). Meets emission levels for Class A equipment (industrial locations) and Class B equipment (domestic locations). Meets immunity requirements for industrial locations (Table A.1 in the IEC specification document). Immunity performance shown in table 1.

Operative Ambient Temperature Limits(1)

−40 to 66°C (−40 to 150°F)

Construction Materials

Case and Cover: Aluminum
O-Rings:
546 and 546S: Nitrile
546NS: EPDM
Flame Arrestors: Stainless steel
Supporting Bracket/Torsion Member: Stainless Steel
Magnets: Alloy steel
Nozzle: Stainless steel

– Continued –

Specifications (Continued)

Construction Materials (continued)

Feedback Bellows: Brass
Relay Body: Aluminum
Relay Restriction: Aluminum/Stainless Steel
Relay Diaphragm:
546 and 546S: Nitrile
546NS: EPDM/Nomex®
Relay Valve Plug and Seat Ring: Brass

Connections

Supply Pressure: 1/4 NPT internal located on side of case (located on filter-regulator if a 67CFR is mounted to transducer)
Output Pressure: 1/4 NPT internal located on side of case
Vent: 1/4 NPT internal with screen located on relay
Electrical: 1/2 NPT internal located on bottom of case

Electrical Classification

Hazardous Area:

Intrinsic Safety, Explosion proof, Dust-Ignition proof,

Intrinsic Safety Explosion proof, Non-incendive, Dust-Ignition proof,

Refer to table 2 for specific approval information.

NEMA 3R, CSA Enclosure 3

Adjustments

Zero and Span Adjustments: Screwdriver adjustments located inside case (see figure 2)

Mounting

Mounting parts are available for ■ control valve actuator mounting, ■ pipestand (2 inch nominal) mounting, or ■ surface mounting

Approximate Weight

4.1 kg (9 lb)

NOTE: Specialized instrument terms are defined in ANSI/ISA Standard 51.1 – Process Instrument Terminology.
1. The pressure/temperature limits in this document and any applicable standard or code limitation should not be exceeded.
2. Normal m^3/hr--Normal cubic meters per hour (0°C and 1.01325 bar, absolute). Scfh--Standard cubic feet per hour (60°F and 14.7 psia).
3. Performance values are obtained using a 546 or a 546S transducer with a 4 to 20 mA DC input signal and a 0.2 to 1.0 bar (3 to 15 psig) or a 0.4 to 2.0 bar (6 to 30 psig) output signal. Ambient temperature is 24°C (75°F). A transducer with other input or output signals may exceed these values.

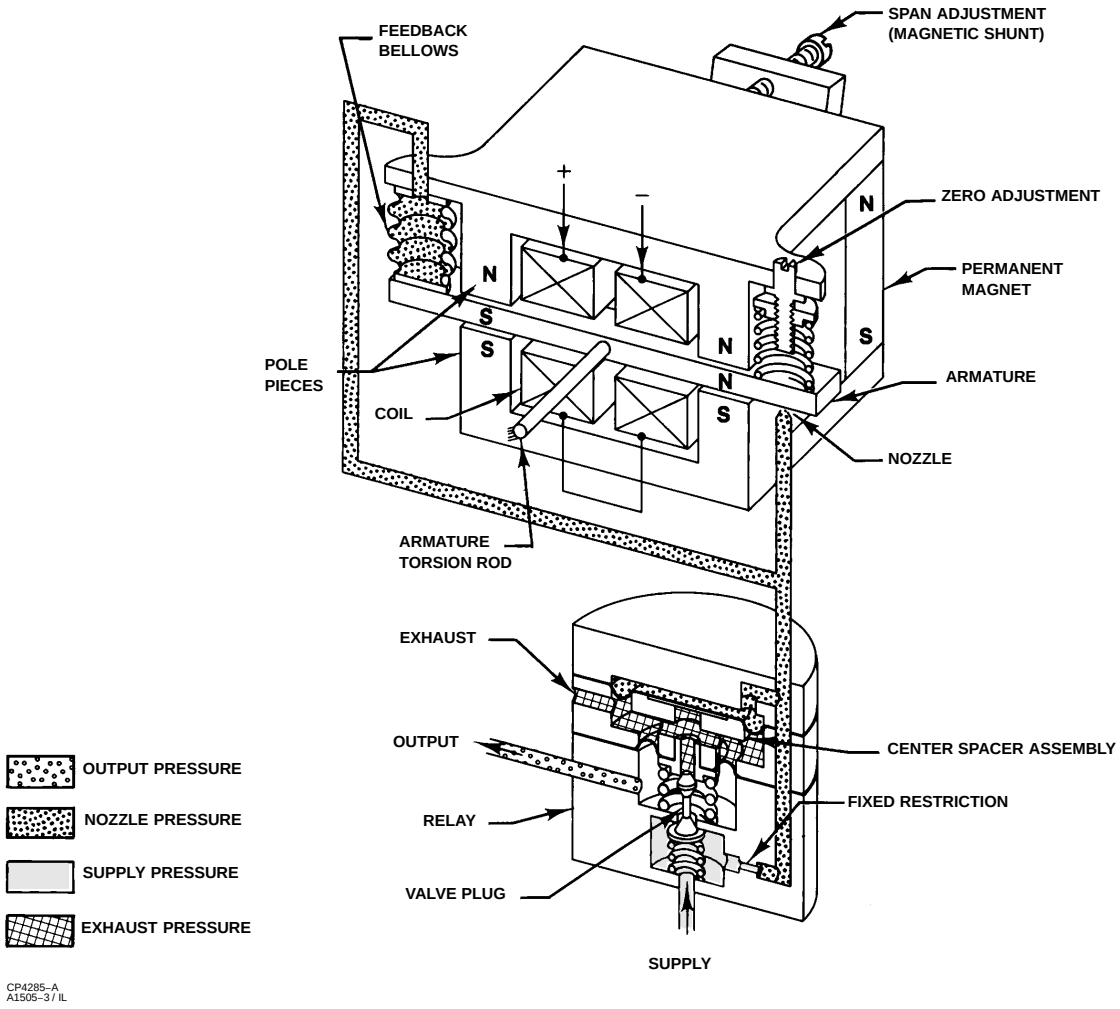


Figure 3. Fisher® 546 Transducer Schematic

Principle of Operation

Refer to figure 3, and assume that the transducer is direct acting. As the DC milliamp signal increases, so does the magnetic field around the coils. This results in an increased magnetic attraction between the armature and the pole pieces. The armature rotates slightly clockwise to cover the nozzle, increasing pressure in the nozzle, the upper chamber of the relay, and the feedback bellows. Increased nozzle pressure and increased pressure in the upper chamber of the relay cause the relay supply port to open, increasing the output pressure to the actuator and the control valve. At the same time, the increased pressure in the feedback bellows acts to move the armature back to the equilibrium position. In this way, the new nozzle pressure is compared to the DC input signal by the force balance principle.

As the DC input signal decreases, magnetic attraction is reduced and the armature rotates slightly in the counterclockwise direction to uncover the nozzle. Decreased nozzle pressure and decreased pressure in the upper chamber of the relay cause the relay exhaust port to open and allow output pressure to bleed to atmosphere. Pressure to the control valve is reduced until equilibrium is attained.

Reverse-acting transducers operate in a similar manner except that when the DC input signal increases, pressure to the actuator and control valve decreases.

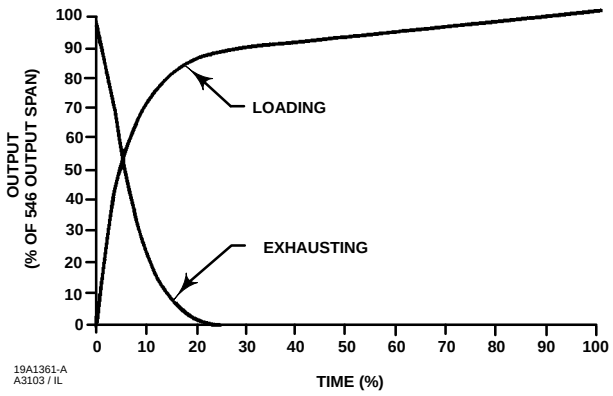


Figure 4. Output-Time Relationships for Fisher® 546, 546S, and 546NS Transducers

Valve Stroking Time

Figure 4 shows relative times for loading and exhausting an actuator. Exhausting times are nominally 25 percent of the loading times. Stroking time depends upon the size of the actuator, travel, relay characteristics and the magnitude and rate of change of the input signal. If stroking time is critical, contact your Emerson Process Management sales office.

546NS for Nuclear-Service Applications

The 546NS transducer is designed for nuclear power applications. The 546NS construction includes materials that provide superior performance in elevated temperature and radiation environments.

The O-rings are EPDM (ethylene propylene) and the diaphragms are EPDM/Nomex. EPDM demonstrates superior temperature capability and shelf life over nitrile. (Use a clean, dry, oil-free air supply with instruments containing EPDM components. EPDM is subject to degradation when exposed to petroleum-based lubricants.) The Nomex diaphragm fabric demonstrates improved strength retention at elevated temperature and radiation conditions.

Under the 10CFR50, Appendix B, quality assurance program, the 546NS transducer is qualified "commercial grade dedicated". These can be supplied as 10CFR, Part 21 items.

Installation

Standard positions for actuator mounting and pipestand mounting are shown in figures 1 and 5, respectively. Dimensions are shown in figure 5.

Ordering Information

To determine what ordering information is required, refer to the Specifications table. Carefully review the information under each specification and in the referenced table. Specify the desired choice wherever there is a selection to be made. Always specify the type number as identified in the Available Configurations specification.

For transducers that are to be used in intrinsically safe installations, specify the rating required and the system with which the unit will be used.

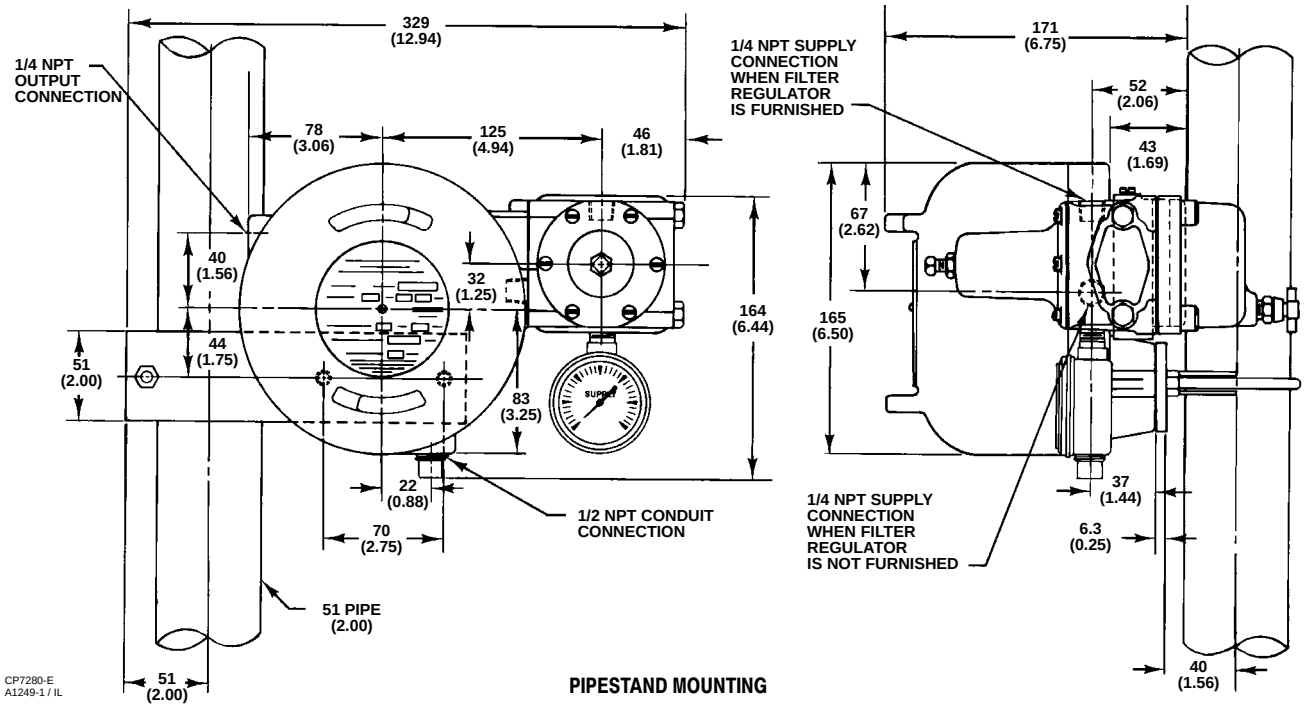
When ordering actuator mounting parts, specify the actuator type, size, travel, and diaphragm pressure range. For all Fisher 657 and 667 actuators except size 80, specify whether actuator yoke or actuator casing mounting is desired (yoke mounting is only available on size 80 actuators).

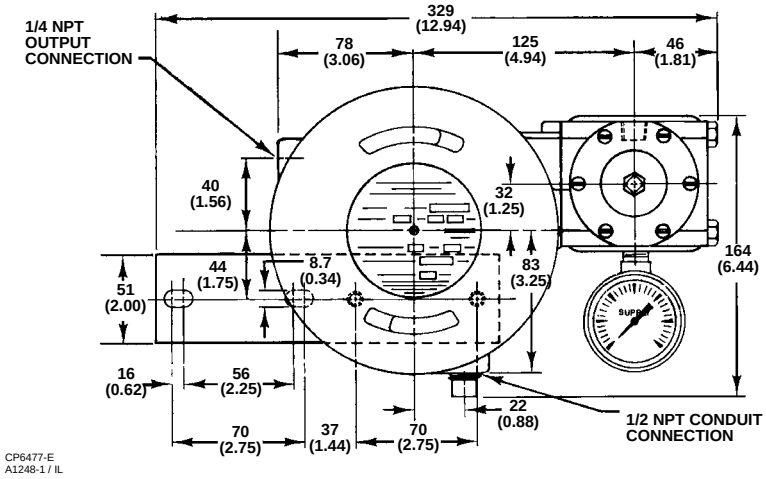
For split-range operation, specify the portion of input signal to be used; e.g., 4 to 12 milliamps of a standard 4 to 20 milliamp signal.

For nuclear service applications, consult your Emerson Process Management sales office for additional information and order assistance.

Note

Neither Emerson Emerson Process Management, nor any of their affiliated entities assumes responsibility for the selection, use, or maintenance of any product. Responsibility for the selection, use, and maintenance of any product remains with the purchaser and end-user.





mm
(INCH)

Figure 5. Dimensions

Table 1. Electromagnetic Immunity Performance

PORT	PHENOMENON	BASIC STANDARD	TEST LEVEL	PERFORMANCE CRITERIA(1)
Enclosure	Electrostatic discharge (ESD)	IEC 61000-4-2	4 kV contact 8 kV air	A
	Radiated EM field	IEC 61000-4-3	80 to 1000 MHz @ 10V/m with 1 kHz AM at 80%	A
	Rated power frequency magnetic field	IEC 61000-4-8	60 A/m at 50 Hz	A
I/O signal/control	Burst (fast transients)	IEC 61000-4-4	1 kV	A
	Surge	IEC 61000-4-5	1 kV (line to ground only, each)	B
	Conducted RF	IEC 61000-4-6	150 kHz to 80 MHz at 3 Vrms with 1kHz AM at 80%	A

Specification limit = ±1% of span
1. A=No degradation during testing. B = Temporary degradation during testing, but is self-recovering.

Table 2. Hazardous Area Classifications—CSA (Canada)

CERTIFICATION BODY	TYPE	CERTIFICATION OBTAINED	ENTITY RATING	TEMPERATURE CODE	ENCLOSURE RATING
CSA	546S	(Intrinsic Safety) Class/Division Class I Division 1 GP A,B,C,D per drawing 29A1594	– – –	T5 (T_{amb} = 66°C)	CSA ENC 3
	546, 546NS	(Explosion Proof) Class/Division Class I, Division 1, Group C,D Class II, Division 1, Groups E,F,G	– – –	T5 (T_{amb} = 66°C)	CSA ENC 3
	546, 546NS	Class I, Division 2, Groups A,B,C,D Class II, Division 2, Groups E,F,G	– – –	T5	CSA ENC 3

Table 3. Hazardous Area Classifications—FM (United States)

CERTIFICATION BODY	TYPE	CERTIFICATION OBTAINED	ENTITY RATING	TEMPERATURE CODE	ENCLOSURE RATING
FM	546S	(Intrinsic Safety) Class/Division Class I, II, III Division 1 Groups A,B,C,D,E,F,G per drawing 26A5936	V_{max} = 33.3 VDC I_{max} = 175 mA C_i = 0 L_i = 0	T4A (T_{amb} = 66°C)	NEMA 3R
	546, 546NS	(Explosion Proof) Class/Division Class I, Division 1, Groups C,D Class II, Division 1, Groups E,F,G	– – –	T5 (T_{amb} = 60°C)	NEMA 3R
	546, 546S, 546NS	Class I, Division 2, Groups A,B,C,D Class II, Division 2, Groups F,G	– – –	T5	NEMA 3R

546 Series Transducers

Product Bulletin
62.1:546
December 2008

Emerson Process Management
Marshalltown, Iowa 50158 USA
Sorocaba, 18087 Brazil
Chatham, Kent ME4 4QZ UK
Dubai, United Arab Emirates
Singapore 128461 Singapore

www.Fisher.com

EMERSON
Process Management