Type 546, 546S, & 546NS Electro- Pneumatic Transducers

Type 546, 546S, and 546NS transducers 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 corrects errors in nozzle pressure.

The transducer can be mounted on a pneumatic diaphragm control valve actuator to provide accurate operation of the valve. The high-capacity transducer 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. *Type 546 Mounted on Type 657 Pneumatic Diaphragm Actuator*

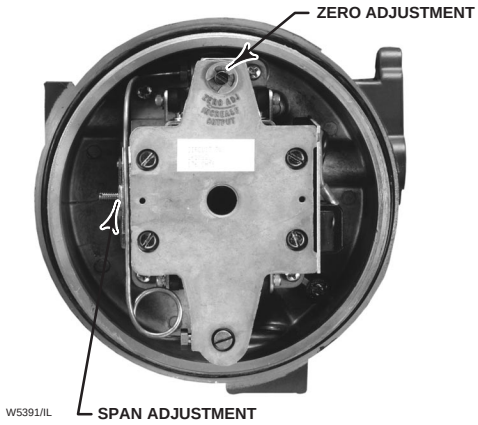

Figure 2. *Zero and Span Adjustments (Cover Removed)*

Features

- **Vibration Resistance**—High natural frequency of torque motor moving parts results in negligible vibration influence. Also meets seismic typical 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 Type 546 or 546NS; Type 546S versions cannot be reversed in the field but can be purchased either direct or reverse acting.

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

Specifications

Available Configurations

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

Input Signals(1)

Type 546 and 546NS: ■ 1 to 5 mA dc, ■ 4 to 20 mA dc, ■ 10 to 50 mA dc, ■ 1 to 9 Vdc, or ■ Two-way split range using either half of one of the standard input signal spans
Type 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 mAdc.

Internal Resistance of Torque Motor

1 to 5 mA dc Input Signal: ■ 2500 ±120 ohms (standard) or ■ 12,000 ±50 ohms (temperature compensated circuit)
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(1)

Ranges:(1)
For 546 and 546NS: ■ 3 to 15 psig (0.2 to 1.0 bar), ■ 6 to 30 psig (0.4 to 2.0 bar), ■ 3 to 27 psig (0.2 to 1.9 bar), or ■ 0 to 33 psig (0 to 2.3 bar)
For 546S: ■ 3 to 15 psig (0.2 to 1.0 bar), ■ 6 to 30 psig (0.4 to 2.0 bar), ■ 3 to 27 psig (0.2 to 1.9 bar), ■ 0 to 18 psig (0 to 1.2 bar), or ■ 0 to 33 psig (0 to 2.3 bar)
Action: Type 546 and 546NS are field reversible between ■ direct and ■ reverse (Type 546S is available with either direct or reverse action, but cannot be reversed in the field.)

Supply Pressure(1)

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

Maximum Steady-State Air Consumption(1)(2)

At 20 psig (1.4 bar) Supply Pressure: 0.35 scfm (0.6 normal m^3/hr)
At 35 psig (2.4 bar) Supply Pressure: 0.50 scfm (0.8 normal m^3/hr)

Maximum Output Air Capacity(2)

At 20 psig (1.4 bar) Supply Pressure: 8.0 scfm (13.4 m^3/hr)
At 35 psig (2.4 bar) Supply Pressure: 11.5 scfm (19.3 m^3/hr)

Performance(3)

Reference Accuracy: ±0.75% of output signal span
Independent Linearity:(1) ±0.50% of output signal span
Open Loop Gain:(1) 26
Frequency Response:(1) Gain is attenuated 3 dB at 20 Hz with Type 546 output signal piped to a typical instrument bellows with 12 inch (305 mm) of 1/4 inch tubing

Operative Ambient Temperature Limits(1)

–40 to +150°F (–40 to 66°C)

Construction Materials

Case and Cover: Aluminum
O-Rings:
Type 546 and 546S: Nitrile
Type 546NS: EPDM
Flame Arrestors: Stainless steel
Torsion Rod: Stainless steel
Magnets: Alloy steel
Nozzle: Stainless steel
Feedback Bellows: Brass
Relay Body: Aluminum
Relay Restriction: Brass and synthetic sapphire
Relay Diaphragm:
Type 546 and 546S: Nitrile
Type 546NS: EPDM/Nomex
Relay Valve Plug and Seat Ring: Brass

Connections

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

–Continued–.

Specifications (Continued)

Electrical Classification

Refer to Hazardous Area Classification bulletins

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 (Transducer Only)

9 lb (4.1 kg)

1. Defined in ISA Standard S51.1-1979.
2. Scfm—Standard cubic feet per minute (60°F and 14.7 psia). Normal m^3/hr—Normal cubic meters per hour (0°C and 1.01325 bar, absolute).
3. Performance values are obtained using a Type 546 or a Type 546S transducer with a 4 to 20 mAdc input signal and a 3 to 15 psig (0.2 to 1.0 bar) or a 6 to 30 psig (0.4 to 2.0 bar) output signal. Ambient temperature is 75°F (24°C). A transducer with other input or output signals may exceed these values.

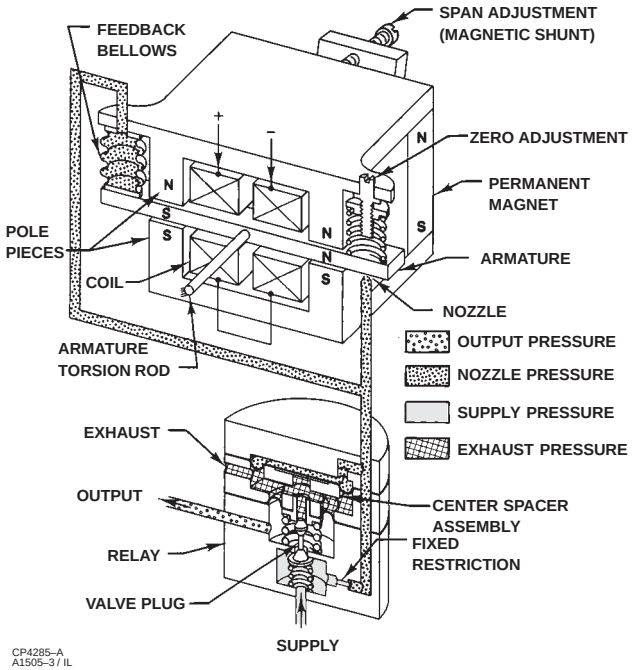

Figure 3. *Type 546 Transducer Schematic*

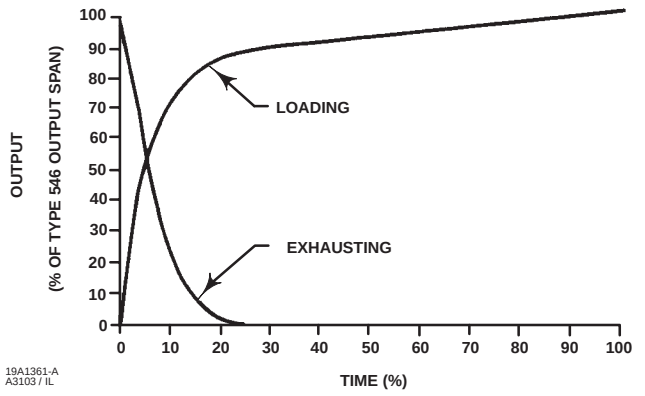

Figure 4. *Output-Time Relationships for Type 546, 546NS, and 546S Transducers*

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.

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 Fisher Controls sales office or representative.

Type 546NS for Nuclear-Service Applications

The Type 546NS transducer meets typical requirements of the nuclear power industry. The Type 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(1) demonstrates superior temperature capability and shelf life over nitrile. The Nomex diaphragm fabric demonstrates improved strength retention at elevated temperature and radiation conditions.

In addition, the Type 546NS transducer is qualified “commercial grade dedicated” under Fisher’s 10CFR50, Appendix B, quality assurance program. 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 on page 2. 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 Type 657 and 667 actuators except size 80, specify whether actuator yoke or actuator casing mounting is desired (yoke mounting only is 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 the factory for ordering assistance.

1. Use a clean, dry, oil-free air supply with instruments containing EPDM components. EPDM is subject to degradation when exposed to petroleum-based lubricants.

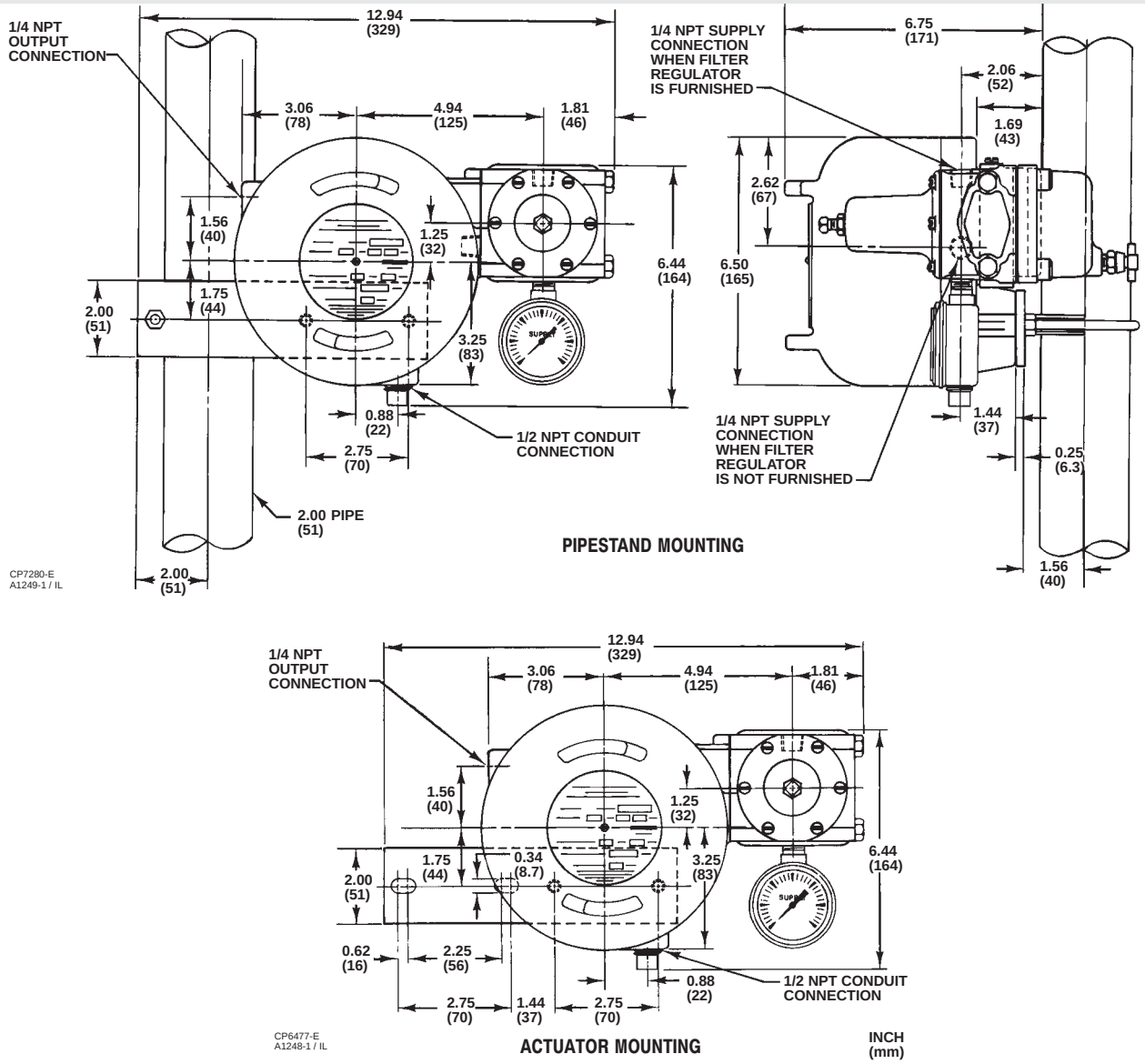

Figure 5. *Dimensions*

For information, contact Fisher Controls:
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