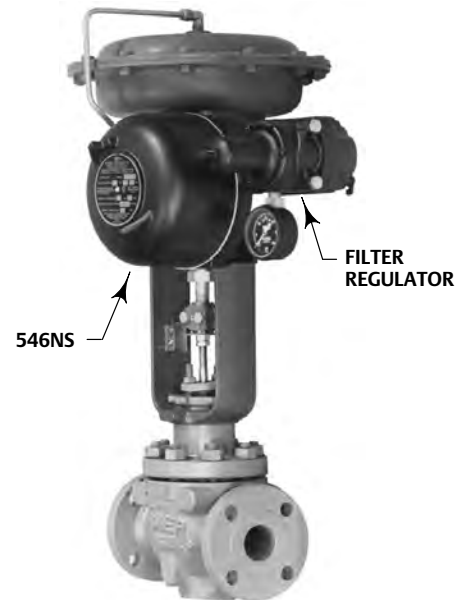


# Fisher™ 546NS Electro-Pneumatic Transducer

## Contents

Introduction .....	1
Scope of Manual .....	1
Description .....	2
Specifications .....	3
546NS Qualification .....	3
Educational Services .....	3
Installation .....	5
Hazardous Area Classifications .....	6
Mounting .....	7
Pressure Connections .....	7
Diagnostic Connections .....	7
Electrical Connections .....	8
Operating Information .....	9
Adjustments .....	9
Calibration .....	10
Equipment Required .....	10
Calibration Procedure .....	10
Recalibration .....	12
Changing Output Pressure Range .....	12
Reversing the Action .....	12
Split Range Operation .....	13
Principle of Operation .....	14
Maintenance .....	15
Relay Removal and Replacement .....	16
Replacing the Feedback Bellows Assembly .....	17
Troubleshooting .....	17
Electrical .....	17
Pneumatic .....	17
Alignment .....	18
Span Adjustment .....	18
Torque Motor Frame .....	19
Armature Travel Stop .....	19
Coil .....	19

Figure 1. Fisher 546NS Electro-Pneumatic Transducer Mounted on a 657 Pneumatic Diaphragm Actuator



Parts Ordering .....	20
Repair Kits .....	20
Parts List .....	20
Transducer .....	20
Torque Motor .....	21
Relay .....	23
Mounting Parts .....	24
Diagnostic Connections .....	24

## Introduction

### Scope of Manual

This instruction manual provides installation, operation, maintenance, and parts ordering information for the Fisher 546NS transducer and the 82 relay. Refer to separate manuals for instructions covering equipment used with the transducer.



Do not install, operate or maintain a 546NS transducer without being fully trained and qualified in valve, actuator and accessory installation, operation and maintenance. To avoid personal injury or property damage it is important to carefully read, understand, and follow all of the contents of this manual, including all safety cautions and warnings. If you have any questions about these instructions, contact your [Emerson sales office](#) before proceeding.

## Description

The 546NS transducer (figure 1) receives either a voltage (VDC) or a current (mA DC) input signal and transmits a proportional pneumatic output pressure to a final control element. A typical application is in electronic control loops where the final control element, generally a control valve, is pneumatically operated. The input signal, output pressure range, and electrical classification, if approved, of each transducer is indicated on the nameplate attached to the cover.

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. The NOMEX diaphragm fabric demonstrates improved strength retention at elevated temperature and radiation conditions.

### CAUTION

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

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.

## Specifications

Specifications are listed in table 1.

### 546NS Qualification

The 546NS is qualified to meet stringent environmental conditions encountered in nuclear power plant containment areas. Samples were subjected to the tests summarized below:

- Thermal Aging: accelerated service temperature of 54°C (130°F) over 10 years.
- Radiation Aging: 6 MRads Total Integrated Dose (TID)
- Seismic Event Simulation (DBE): no natural frequencies found between 5-100 Hz and seismic dwells of 8g uniaxial from 3-40 Hz when mounted using Fisher specified seismic mounting brackets.
- LOCA/MSLB Event Simulation: saturated steam for 14 hours at 160°C (320°F) followed by a gradual reduction to 83°C (182°F) over a 10 hour period.

Upon conclusion of the above tests, no loss of function or visible degradation was found.

## Educational Services

For information on available courses for the 546NS transducer, as well as a variety of other products, contact:

Emerson Automation Solutions  
Educational Services - Registration  
Phone: 1-641-754-3771 or 1-800-338-8158  
E-mail: [education@emerson.com](mailto:education@emerson.com)  
[emerson.com/fishervalvetraining](http://emerson.com/fishervalvetraining)

Table 1. Specifications

<p><b>Available Configuration</b></p> <p>Electro-pneumatic signal transducer with explosion-proof case and cover, with EPDM elastomers for use in elevated temperature and radiation environments</p> <p>The 546NS can be ordered with or without a Fisher 67 series filter regulator. A 51 mm (2 inch) circular supply pressure gauge may be mounted on the regulator.</p> <p><b>Input Signals</b></p> <p>■ 4 to 20 mA DC, ■ 10 to 50 mA DC, ■ 1 to 9 VDC, or ■ two-way split range using any half of one of the standard input signal spans</p> <p><b>Internal Resistance of Torque Motor</b></p> <p>4 to 20 mA DC Input Signal: <math>176 \pm 10</math> ohms  10 to 50 mA DC Input Signal: <math>90 \pm 10</math> ohms  1 to 9 VDC Input Signal: <math>1300 \pm 50</math> ohms  (temperature-compensated circuit)</p> <p><b>Output Signals</b></p> <p>Ranges:  0.2 to 1.0 bar (3 to 15 psig), 0.4 to 2.0 bar (6 to 30 psig)  Action: 546NS is field-reversible between direct and reverse action.</p> <p><b>Supply Pressure<sup>(1)</sup></b></p> <p>Recommended: 0.3 bar (5 psig) higher than upper range limit of output signal  Maximum: 3.5 bar (50 psig)</p> <p><b>Maximum Steady-State Air Consumption<sup>(2)</sup></b></p> <p>At 1.4 bar (20 psig) Supply Pressure:  0.6 normal m<sup>3</sup>/hr (21 scfh)  At 2.4 bar (35 psig) Supply Pressure:  0.8 normal m<sup>3</sup>/hr (30 scfh)</p> <p><b>Maximum Output Air Capacity<sup>(2)</sup></b></p> <p>At 1.4 bar (20 psig) Supply Pressure:  12.9 normal m<sup>3</sup>/hr (480 scfh)  At 2.4 bar (35 psig) Supply Pressure:  18.5 normal m<sup>3</sup>/hr (690 scfh)</p>	<p><b>Performance<sup>(3)</sup></b></p> <p>Actuator Loading Time: See figure 6</p> <p>Reference Accuracy<sup>(4)</sup>: <math>\pm 0.75\%</math> of the output span</p> <p>Independent Linearity: <math>\pm 0.50\%</math> of the output span</p> <p>Open Loop Gain: 26</p> <p>Frequency Response: Gain is attenuated 3 dB at 20 Hz with transducer output signal piped to a typical instrument bellows with 305 mm (12 inches) of 1/4 inch tubing</p> <p>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 2.</p> <p><b>Operative Ambient Temperature Limits<sup>(1)</sup></b></p> <p>-40 to 66°C (-40 to +150°F)</p> <p><b>Humidity Rating</b></p> <p>80% for temperatures up to 31°C (88°F), decreasing linearly to 50% RH at 40°C (104°F)</p> <p><b>Altitude Rating</b></p> <p>Up to 2000 meters (6562 feet)</p> <p><b>Application for Use</b></p> <p>This product is intended for indoor use only</p> <p><b>Electrical Classification</b></p> <p>Hazardous Area:</p> <p>CSA— Explosion-proof, Dust Ignition-proof, Div 2  FM— Explosion-proof, Dust Ignition-proof, Non-incendive</p> <p>Refer to table 3 and 4 for specific approval information.</p> <p>NEMA 3R, CSA enclosure 3</p> <p>NEMA 3R mounting orientation requires vent location to be below horizontal. Vent is shown in figure 9, key 69.</p> <p>Pollution Degree: 2</p> <p>Overvoltage Category: II</p>
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-continued-

Table 1. Specifications (continued)

<p><b>Adjustments</b></p> <p>Zero and Span Adjustments: Screwdriver adjustments located inside case (see figure 4)</p> <p><b>Connections</b></p> <p>Supply Pressure: 1/4 NPT internal located on side of case, (or located on the 67CFR filter-regulator if mounted)</p> <p>Output Pressure: 1/4 NPT internal located on side of case</p> <p>Vent: 1/4 NPT internal with screen located on relay</p> <p>Electrical: 1/2 NPT internal located on bottom of case</p>	<p><b>Approximate Weight</b></p> <p>4.1 kg (9 pounds)</p> <p><b>Declaration of SEP</b></p> <p>Fisher Controls International LLC declares this product to be in compliance with Article 4 paragraph 3 of the Pressure Equipment Directive (PED) 2014/68/EU. It was designed and manufactured in accordance with Sound Engineering Practice (SEP) and cannot bear the CE marking related to PED compliance.</p> <p>However, the product <i>may</i> bear the CE marking to indicate compliance with <i>other</i> applicable European Community Directives.</p>
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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<sup>3</sup>/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 transducer with a 4 to 20 mA DC input signal and a 0.2 to 1 bar (3 to 15 psig) or a 0.4 to 2 bar (6 to 30 psig) output signal. Ambient temperature is 24° C (73° F). A transducer with other input or output signals might exceed these values. Reference accuracies of ±3.5% can be expected with output ranges starting near zero psig.

4. Reference accuracy includes the effects of non-linearity, hysteresis, and deadband per SAMA Standard PMC 20.1-1973.

Table 2. Electromagnetic Immunity Performance

Port	Phenomenon	Basic Standard	Test Level	Performance Criteria <sup>(1)</sup>
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)	A
	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.

For Declaration of Conformity available in multiple languages:



## Installation

### ⚠ WARNING

**Warning - Explosion Hazard**

**Do not connect or disconnect this equipment unless power has been removed or the area is known to be nonhazardous.**

### ⚠ AVERTISSEMENT

**Avertissement- Risque d'explosion**

**Ne pas debrancher tant que le circuit est sous tension, a moins qu'il ne s'agisse d'un emplacement non dangereux.**

**⚠ WARNING**

Avoid personal injury from sudden release of process pressure. Before mounting the controller:

- Always wear protective clothing, gloves, and eyewear when performing any installation operations to avoid personal injury.
- Check with your process or safety engineer for any additional measures that must be taken to protect against process media.
- If installing into an existing application, also refer to the **WARNING** at the beginning of the Maintenance section in this instruction manual.

## Hazardous Area Classifications

Certain nameplates may carry more than one approval, and each approval may have unique installation/wiring requirements and/or conditions of “safe use”. These special instructions for “safe use” are in addition to, and may override, the standard installation procedures. Special instructions are listed by approval.

### Note

This information supplements the nameplate markings affixed to the product.

Always refer to the nameplate itself to identify the appropriate certification. Contact your [Emerson sales office](#) for approval/certification information not listed here.

## CSA and FM

No special conditions of safe use.

Refer to table 3 and 4 for approval information.

Table 3. Hazardous Area Classifications—CSA (Canada)

Certification Body	Certification Obtained	Temperature Code
CSA	Explosion-proof Class I, Division 1, Group C,D	T5 (Tamb = 66°C)
	Class II, Division 1, Groups E,F,G Class I, Division 2, Groups A,B,C,D Class II, Division 2, Groups F,G	T5

Table 4. Hazardous Area Classifications— FM (United States)

Certification Body	Certification Obtained	Temperature Code
FM	Explosion-proof Class I, Division 1, Groups C,D	T5 (Tamb = 60°C)
	Class II, Division 1, Groups E,F,G Class I, Division 2, Groups A,B,C,D Class II, Division 2, Groups F,G	T5

## Mounting

When a 546NS transducer is ordered as part of a control valve assembly, the factory mounts the transducer on the actuator and connects the necessary tubing, then adjusts the transducer as specified on the order.

Transducers also can be ordered separately for mounting on a control valve assembly already in service. The transducer may be ordered with or without mounting parts. Mounting parts include the appropriate bracket and bolts for attaching the unit to an actuator boss (with tapped holes) or for attaching it to the diaphragm casing. If preferred, mounting parts are available for mounting the transducer on a 51 mm (2 inch) diameter pipestand, a flat surface, or a bulkhead. Brackets for seismic mounting capability available upon request.

Tubing is not included if the transducer is not factory mounted. Use 9.5 mm (3/8-inch) outside diameter tubing for all supply and output connections. Tubing length between the transducer output and the final control element should be as short as possible to minimize its effect on control loop stability.

## Pressure Connections

### **⚠ WARNING**

**Severe personal injury or property damage may occur if the instrument air supply is not clean, dry and oil-free. While use and regular maintenance of a filter that removes particles larger than 40 micrometers in diameter will suffice in most applications, check with an Emerson Automation Solutions field office and industry instrument air quality standards for use with corrosive air or if you are unsure about the proper amount or method of air filtration or filter maintenance.**

### **Note**

The supply source must be clean, dry, oil-free, non-corrosive air at an unfailing pressure at least 0.3 bar (5 psig) higher than the upper limit of the transducer output pressure range. This means that for an output pressure range of 0.2 to 1.0 bar (3 to 15 psig) the supply pressure should be at least 1.4 bar (20 psig); for a 0.4 to 2.0 bar (6 to 30 psig) range, the supply pressure should be at least 2.4 bar (35 psig). The supply pressure to the filter regulator should not be more than 17.3 bar (250 psig) at a maximum temperature of 66°C (150°F).

If specified, the filter regulator is mounted on the transducer case. A pressure gauge on the regulator shows the supply pressure to the transducer.

1. Connect a supply pressure source to the 1/4 NPT IN connection on the filter regulator (if furnished) or to the 1/4 NPT SUPPLY connection on the transducer case (if a regulator is not furnished).
2. Run 9.5 mm (3/8-inch) outside diameter tubing from the 1/4 NPT OUTPUT connection on the transducer case to the input connection on the pneumatic actuator or valve positioner. This connection is made at the factory if the unit is shipped mounted on an actuator as shown in figure 1.

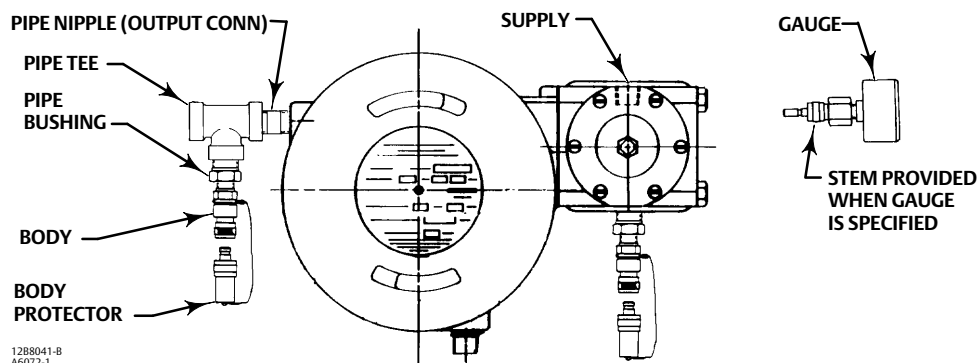
## Diagnostic Connections

To support diagnostic testing of valve/actuator/positioner packages, special connectors and hardware are available. Typical connector installations are shown in figure 2. The hardware used includes a 1/4 NPT pipe nipple and pipe tee with a 1/8 NPT pipe bushing for the connector. The connector consists of 1/8 NPT body and body protector.

### **Note**

If the transducer is used in a valve assembly with a positioner, no connections for diagnostic testing are required for the transducer. Install the connections for diagnostic testing at the positioner.

Figure 2. Diagnostic Connections



Install the connectors and hardware between the transducer and the actuator.

1. Before assembling the pipe nipple, pipe tee, pipe bushings, actuator piping, and connector body, apply sealant to all threads.
2. Turn the pipe tee to position the connector body and body protector for easy access when doing diagnostic testing.

## Electrical Connections

### ⚠ WARNING

For explosion-proof applications, disconnect power before removing the transducer cover. Personal injury or property damage may result from fire or explosion if power is applied to the transducer with the cover removed in a hazardous area. Also refer to the Warning at the beginning of the Operating Information section.

For explosion-proof applications, install rigid metal conduit and a conduit seal no more than 457 mm (18 inches) from the transducer. Personal injury or property damage may result from explosion if the seal is not installed.

Select wiring and/or cable glands that are rated for the environment of use (such as hazardous area, ingress protection, and temperature). Failure to use properly rated wiring and/or cable glands can result in personal injury or property damage from fire or explosion.

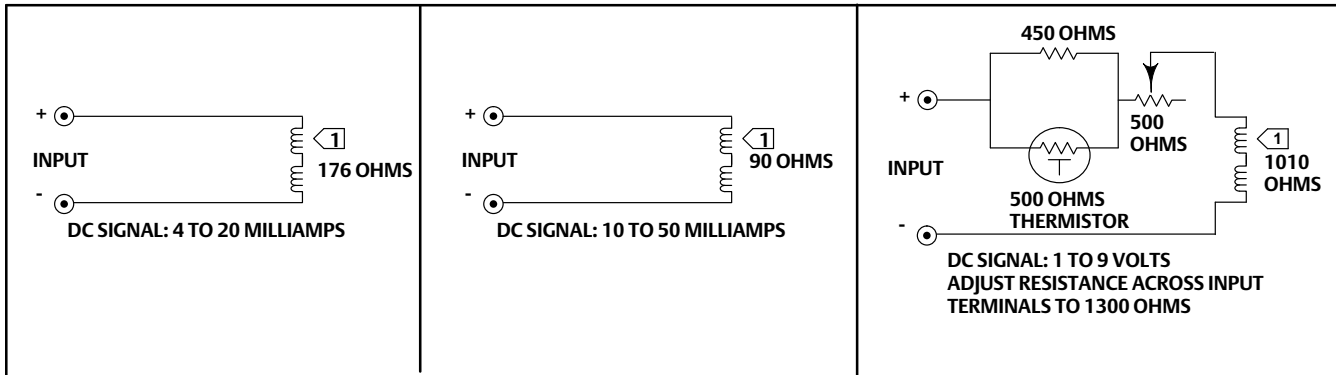
Wiring connections must be in accordance with local, regional, and national codes for any given hazardous area approval. Failure to follow the local, regional, and national codes could result in personal injury or property damage from fire or explosion.

The electrical connections are made in the transducer case. A 1/2 NPT conduit connection is provided in the bottom of the case. Use a suitable conduit seal for hazardous locations. The wires that carry the input signal from the control device are connected to the terminal mounting bracket assembly (key 53, figure 8).

For a direct-acting unit (i.e., increasing current produces an increasing output pressure), connect the positive wire from the control device to the positive terminal of the transducer and the negative wire to the negative terminal. For a reverse-acting unit (i.e., increasing current produces a decreasing output pressure), connect the positive wire from the control device to the negative terminal and the negative wire to the positive terminal. Typical circuits are shown in figure 3.



Figure 3. Typical Circuit Drawings



NOTE:  
 1 DC RESISTANCE OF COILS  
 CP8401-C  
 B1766-2/JL

**CAUTION**

Use a lubricant (key 95, figure 7) on the case-cover threads to prevent thread damage.

## Operating Information

**⚠ WARNING**

Personal injury or property damage may result from fire or explosion if power is applied to the transducer with the cover removed in a hazardous area.

If the transducer is installed in an application where explosion-proof classification is required, perform the following steps (prior to removal of the transducer cover) when any procedure in this section requires removal of the cover:

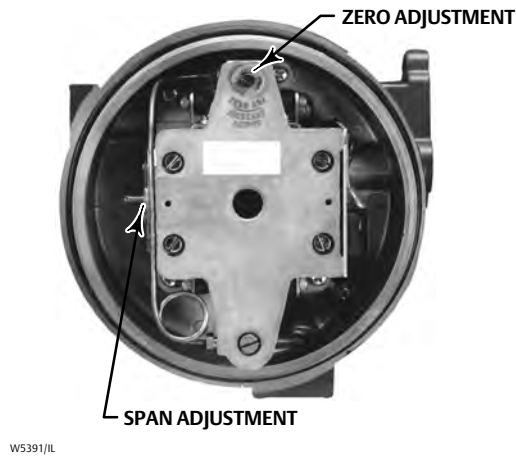
- Disconnect the electrical signal from the transducer.
- Remove the transducer to a non-hazardous area.
- Perform procedures as described in this section.
- Reinstall the transducer, and ensure the cover is secured before turning on the electrical signal.

## Adjustments

Adjust the filter regulator to provide the proper supply pressure to the transducer, then adjust the transducer span and zero (see figures 4 and 5) to match the application requirements and be within specifications.

---

Figure 4. Zero and Span Adjustments (Cover Removed)



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The zero adjustment is used to set the output pressure so that it corresponds to the proper value of the input signal. For example, if the output range is 0.2 to 1.0 bar (3 to 15 psig) and the input range is 4 to 20 mA DC and the unit is direct-acting, use the zero adjustment to set the output pressure at 0.2 bar (3 psig) when the input signal is 4 mA DC. Use the span adjustment to set the output pressure span so that full output pressure change results for a full change in the input signal. In this example, the output pressure change would be 0.8 bar (12 psi). Thus, the output pressure should start at 3 psig and increase to 1.0 bar (15 psig) as the input signal is changed from 4 to 20 mA DC.

A span adjustment will affect the zero. Therefore, follow any span adjustment with a zero adjustment. Provide a suitable gauge to measure the pressure.

## CAUTION

If the transducer is not used as specified in this instruction manual, the protection provided by the equipment may be impaired.

## Calibration

### Equipment Required

Choose a current or voltage source that is capable, without switching ranges, of driving the transducer through its entire input range. Switching ranges on a current source will produce spikes or mid-scale reverses in the input signal presented to the transducer, causing errors.

### Calibration Procedure

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#### Note

The following calibration procedure is for a 546NS transducer with a 4 to 20 mA DC input signal range and a 0.2 to 1.0 bar (3 to 15 psig) output range. Calibrate transducers with other inputs and outputs in a similar manner.

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1. Check the supply pressure to ensure it agrees with the minimum pressure on the transducer nameplate.
2. Adjust the input current to 4.00 mA DC.
3. Turn the zero screw until the output pressure is  $0.2 \pm 0.006$  bar ( $3.00 \pm 0.09$  psig).
4. Adjust the input to 20.00 mA DC.
5. If the output pressure is less than 1.028 bar (14.91 psig), turn the span screw clockwise to increase the span. If the output pressure is greater than 1.040 bar (15.09 psig), turn the span screw counterclockwise to decrease the span.

---

**Note**

Do not watch the output gauge while turning the span screw because the change in output is not a good indication of the change in span. While turning the span adjustment screw, the output pressure may move in the opposite direction than expected. For example, while turning the span screw in the INCREASING SPAN direction, the output pressure might decrease.

This should be disregarded since even though the output pressure decreases, the output span is increasing.

---

6. Repeat steps 2 through 5 until the output pressure is within one-third of the accuracy limits at 4 and 20 mA DC. One-third of the accuracy limits for a 0.2 to 1.0 bar (3 to 15 psig) output range is  $1/3 \times (\pm 0.0075) \times (15.00 - 3.00) = \pm 2$  mbar ( $\pm 0.03$  psig). Calibrate for maximum accuracy at the target end points [0.20 and 1.00 bar (3.00 and 15.00 psig)]. This allows for error at other calibration points in between.
7. Run the transducer through three calibration cycles before recording data. The cycles should be run from exactly 4.00 to 20.00 mA DC in a slow ramping fashion (no large step inputs).

---

**Note**

Large step inputs during calibration can result in an inaccurate reflection of the actual state of calibration. Use care to always change input in a slow, ramping fashion.

---

8. After returning from 20.00 mA DC during the last exercise cycle, move back upscale to the midpoint (12.00 mA DC) and record the first data point. Table 5 is an example of recorded data.
9. Record at the other calibration points desired by moving upscale to 20.00 mA DC then down scale to 4.00 mA DC, then back upscale to 12.00 mA DC. Refer to table 5 for common calibration points.

**CAUTION**

Reversing the DC input during the calibration cycle may result in product damage.

---

**Note**

During the calibration cycle, use care to avoid overshoot. In other words, if data is to be recorded at an 8.00 mA DC input while moving upscale and you accidentally pass 8.00 to some higher value, run the test again starting at step 7. with the three exercise cycles. *Do not* reverse direction and move down scale to 8.00 mA DC.

---

10. After completing the calibration cycle and recording data, verify that all data is within  $\pm 0.75\%$  accuracy limits. If not, the transducer may need to be recalibrated to move the end points slightly to bring the entire calibration curve within the accuracy limits.

## Recalibration

Table 5 shows typical recorded data where recalibration is necessary.

Table 5. Typical Calibration Data

TRANSDUCER INPUT mA DC	ACTUAL OUTPUT PRESSURE		TARGET OUTPUT PRESSURE	
	Bar	Psig	Bar	Psig
12.00	0.612	8.89	0.620	9.00
16.00	0.823	11.95	0.826	12.00
20.00	1.035	15.02	1.033	15.00
16.00	0.828	12.02	0.826	12.00
12.00	0.617	8.96	0.620	9.00
8.00	0.413	6.00	0.413	6.00
4.00	0.207	3.01	0.206	3.00
8.00	0.409	5.95	0.413	6.00
12.00	0.618	8.97	0.620	9.00

The 0.612 bar (8.89 psig) value at 12.00 mA DC is outside the accuracy limit of  $\pm 0.09$  from the target value. This data point can be raised by recalibrating the transducer and raising the end points enough to bring this low value within  $-0.6$  mbar ( $-0.09$  psig) of 0.62 bar (9.00 psig). A reasonable recalibration would be 0.21 and 1.04 bar (3.05 and 15.05 psig) at 4.00 mA DC and 20.00 mA DC, respectively. Recalibrate the instrument and recheck the calibration data as described in steps 7 through 10.

If the transducer remains outside of accuracy specifications after altering the calibration end points as much as possible consult your [Emerson sales office](#).

For transducers inaccurate to less than 5 percent of output span, relay repair or replacement may correct the problem. Refer to the alignment procedures in the Troubleshooting section to correct the operation of a faulty transducer. Also check for air leaks at the tubing, nozzle, relay, and bellows.

If the accuracy error is greater than 5 percent of output span, check the clearance between the armature and the coils. These parts are referenced as key 40 and key 42, respectively, in the Parts List section. The armature and the white plastic coil bobbin should be approximately 0.4 mm (1/64 inch) apart. If the parts are in contact, loosen the machine screws that hold the bobbin and reposition the bobbin.

## Changing Output Pressure Range

Changing the output pressure range from 0.2 to 1.0 bar (3 to 15 psig) to 0.4 to 2.0 bar (6 to 30 psig) or vice versa requires changing the feedback bellows (key 57, figure 8). To do this, refer to the replacing the feedback bellows assembly procedures in the Maintenance section.

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### Note

Re-magnetization of the torque motor is required when changing the output pressure range. Contact your [Emerson sales office](#) or service center.

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## Reversing the Action

Reversing the action of a 546NS transducer requires no special parts. The direction of armature rotation is dependent upon the direction of the current flow. Therefore, simply reverse the input current leads to the transducer to obtain the opposite action. Whenever the action is changed, readjust the zero of the transducer as outlined in the adjustments procedures.

## Split Range Operation

The 546NS transducer is suitable for two-way split range operation. In a two-way split the milliampere (mA) or voltage output signal of a single control device is split between two transducers electrically connected in series. Although each transducer receives the full signal, it is calibrated to provide a full output pressure range of 0.2 to 1.0 bar (3 to 15 psig) or 0.4 to 2.0 bar (6 to 30 psig) to the control valve with one-half the input signal. Because the transducer operates on only one-half of the normal input span, the feedback bellows must be changed to compensate for the shorter span.

Change the bellows as described in the replacing feedback bellows assembly procedure in the Maintenance section. Table 6 indicates which bellows is required for your conditions. Reset the span and zero adjustments to the split range values. Note that these transducers cannot provide a three-way split range.

Table 6. Feedback Bellows Output Pressure Range

OPERATION	INPUT SIGNAL, DC	BELLOWS SIZE			
		Full		Half	
		Bar	Psig	Bar	Psig
Full Range	1 to 9 V <sup>(1)</sup> 4 to 20 mA 10 to 50 mA	0.2 to 1.0	3 to 15	0.4 to 2.0	6 to 30
Split Range	4 to 12 mA or 12 to 20 mA 10 to 30 mA or 30 to 50 mA 1 to 5 VDC or 5 to 9 VDC	---	---	0.2 to 1.0	3 to 15

1. Temperature compensated circuit.

## Principle of Operation

Refer to the schematic drawing in figure 5. Assume that the transducer is direct-acting. An increase in the DC signal to the coils increases the magnetic field around the coils. This field increases the magnetic strength in the armature and the magnetic attraction across the air gap between the armature and the pole pieces.

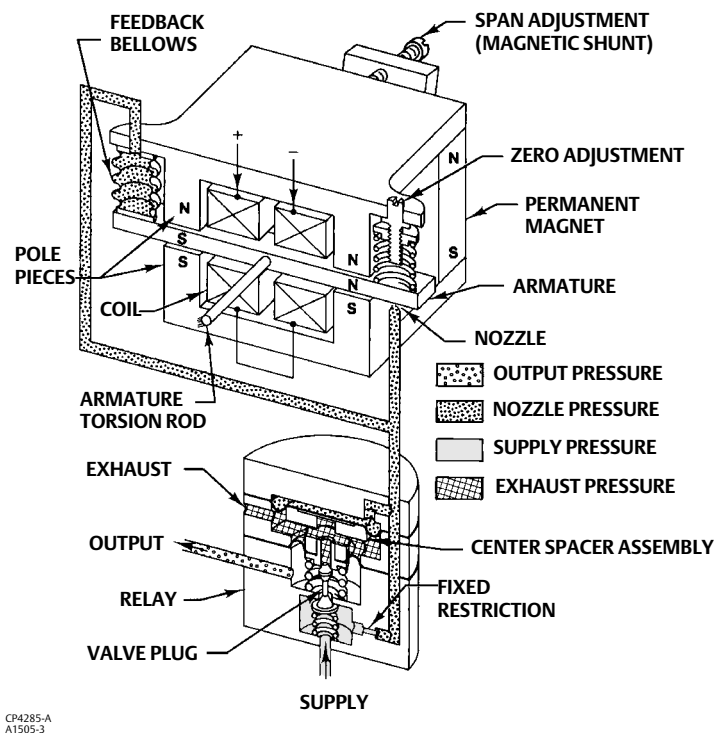
The pole pieces are already polarized by the permanent magnet. The armature polarity is as shown in the schematic. The magnetic attraction will therefore be downward at the nozzle end and upward at the feedback bellows end, resulting in a torque that rotates the armature about the fixed torsion rod to cover the nozzle.

The resulting restriction produces an increased pressure in the nozzle, in the upper chamber of the relay, and in the feedback bellows. The relay responds to the increase in nozzle pressure by increasing the output pressure to the actuator and control valve. The increased pressure in the feedback bellows creates a force that acts on the armature to move it back to an equilibrium position. In this way, the new nozzle pressure is compared to the input current by the force-balance principle.

The relay operates in the following manner. The nozzle pressure acts on the large top diaphragm to force the center spacer assembly (mounted between the two diaphragms) downward against the valve plug, closing the exhaust port and opening the supply port. Supply air then flows through the open port to the output pressure. The output pressure continues to increase until the relay diaphragm assembly is pushed back to its original position by the force of the pressure acting on the small diaphragm. When this occurs, the valve plug is closed again.

When a decreasing DC signal is received, the magnetic attraction across the air gap is reduced. The armature rotates to uncover the nozzle and decrease the pressure in the nozzle, relay, and feedback bellows. The relay diaphragm assembly moves upward, and the exhaust port opens to bleed the output pressure to atmosphere.

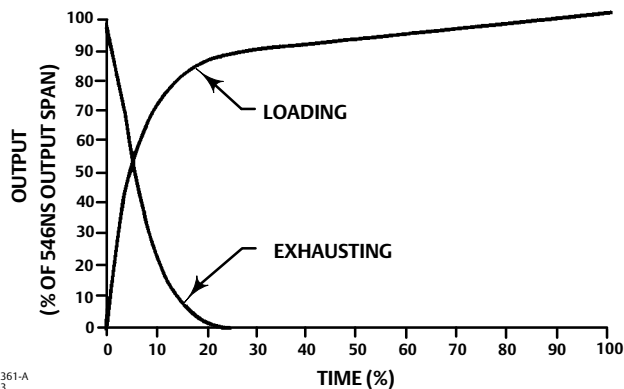
Figure 5. Transducer Schematic



The output decreases until the diaphragm assembly is forced back to its original position and the exhaust port is closed again. The reduced pressure in the feedback bellows diminishes the force to return the armature to the equilibrium position.

Figure 6 shows output-time relationship curves for loading and exhausting an actuator. Exhausting times are nominally 25 percent of the loading times.

Figure 6. Output-Time Relationship



Reverse-acting transducers operate in a similar manner except that when the DC input signal increases, the output pressure from the relay decreases. Conversely, a decreasing input signal increases the output pressure.

## Maintenance

Maintenance of the transducer consists of relay and feedback bellows replacement.

### ⚠ WARNING

The following maintenance procedures require that the transducer be taken out of service. This requires that certain precautions be taken to avoid personal injury or equipment damage caused by sudden release of pressure. Prior to maintenance:

- Always wear protective clothing, gloves, and eyewear when performing any maintenance procedures to avoid personal injury.
- Disconnect electrical power before removing the transducer cover.
- Shut off or disconnect pressure lines to the transducer.
- Disconnect any operating lines providing air pressure, electrical power, or a control signal to the actuator. Be sure the actuator cannot suddenly open or close the valve.
- Use bypass valves or completely shut off the process to isolate the valve from process pressure.
- Do not remove the actuator from the valve while the valve is still pressurized.
- Relieve process pressure on both sides of the valve.
- Vent the power actuator loading pressure and relieve any actuator spring precompression.
- Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.
- Check with your process or safety engineer for any additional measures that must be taken to protect against process media.

**⚠ WARNING**

For explosion proof applications, disconnect power before opening the transducer cover. Personal injury or property damage may result from fire or explosion if power is not disconnected.

**CAUTION**

The presence of Emerson Automation Solutions personnel and also approval agency personnel may be required if you service (other than normal, routine maintenance, such as calibration) or replace components on a transducer that carries a third-party approval. When you replace components, use only components specified by the factory. Substitution with other components may void the third-party approval. Also, always use proper component replacement techniques, as presented in this manual. Improper techniques can cause poor quality repairs and impair the safety features of the device.

Figure 8 shows the torque motor and associated parts. Shaded key numbers indicate parts that should not be disassembled from the torque motor because the magnetism in the torque motor magnets will decrease permanently.

Certain troubleshooting and alignment procedures are described at the end of this section. These may serve as a guide to correct some problems. Improper supply pressure and mechanical defects in pneumatic and electrical connections should be apparent upon inspection and repaired as appropriate.

**CAUTION**

Never disassemble the torque motor assembly because the magnetism in the torque motor magnets will decrease permanently. Shaded key numbers indicate parts that should not be disassembled from the torque motor (see figure 8). If troubleshooting or alignment attempts indicate either a faulty torque motor or the necessity of disassembling the torque motor consult your [Emerson sales office](#).

## Relay Removal and Replacement

Use the following procedure when removing and replacing a relay assembly. Refer to figure 9 for key number locations, unless otherwise directed.

1. Loosen the two mounting screws (key 68), and remove the relay assembly from the transducer case (key 1, figure 7).
2. To install the replacement relay assembly, install the two relay mounting screws (key 68) into the relay assembly. Apply lubricant (key 96) to the O-rings, and make sure the O-rings (keys 72, 73, and 74) are in place on the relay assembly.
3. Install the relay assembly on the transducer case. Tighten the mounting screws.
4. With the torque motor installed, apply supply pressure to the transducer case, and check the relay assembly for leaks with a soap solution.

**CAUTION**

Never disassemble the relay as this could result in permanent drift issues.



## Replacing the Feedback Bellows Assembly

Refer to figure 8 for key number locations.

1. Loosen the hex nut (key 31).
2. Remove the bellows screw (key 56) and O-ring (key 36) under the head of the bellows screw.
3. Pull the bellows assembly (key 57) out. The armature is slotted to allow removal of the bellows assembly.
4. Inspect and, if necessary, replace the two O-rings (key 36). Make sure the O-rings under the bellows assembly are in place.
5. Choose the correct bellows assembly as outlined in table 6. Install the new bellows assembly. Make sure that the O-ring (key 36) is in place.
6. Install the bellows screw and O-ring, and tighten the screw. Be sure the bellows assembly is not distorted in any direction. Tighten the hex nut (key 31).
7. Refer to the adjusting zero and span procedures in the Adjustments section.

## Troubleshooting

This section contains some checks for operational difficulties that may be encountered. If correcting the difficulties is not possible, contact your [Emerson sales office](#) or service center.

### Electrical

1. Check the output of the control device. Make sure that it is reaching the transducer.
2. Check the DC input signal. It should be the same as the range stamped on the transducer nameplate.
3. Check the resistance of the transducer circuit to see that it coincides with the value listed on the circuit identification tag located on the torque motor.
4. Check the terminal lugs for proper connections. If reverse action of the transducer is observed, simply reverse the input leads as indicated in the Reversing the Action procedures in the Operating Information section.

### Pneumatic

#### CAUTION

**Do not attempt to remove the nozzle (key 19, figure 8) for any reason. Nozzle removal requires disassembling the torque motor. Disassembling the torque motor will permanently reduce the strength of the magnets, causing improper operation. Also, do not adjust the baffle (key 18, figure 8). The spacing between the baffle and nozzle is preset and locked at the factory to obtain optimum performance of the transducer.**

1. Connect supply pressure and a pressure gauge to monitor the output. Check the operation of the transducer as follows:
  - a. Force the baffle (key 18, figure 8) against the nozzle. The output pressure should build up to approximately the supply pressure. If it does not, check for a leak in the pneumatic system or a burr on the nozzle.
  - b. Force the baffle away from the nozzle. The output pressure should drop to less than 0.07 bar (1 psig). If it does not, check the flame arrestors in the transducer case (see figure 7). If the flame arrestors require cleaning, first remove the torque motor assembly from the case by removing four machine screws (key 9, figure 7). Then, clean the flame arrestors by blowing them out with air pressure.

2. Check zero and span adjustment for proper setting. Refer to the adjustments procedure.
3. Check the supply pressure. It should be at least 0.3 bar (5 psig) above the upper limit of the output pressure range.
4. Check the filter regulator for moisture in the dripwell. Drain off any moisture, and clean the filter element if necessary.
5. If the transducer cycles, be sure there are no sharp bends in the copper capillary feedback tubing (key 56, figure 8) and that the tubing is not plugged.
6. Check the nozzle. If it is clogged, remove the entire torque motor assembly from the case by removing four machine screws (key 9, figure 7). Run a wire through the nozzle from the underside of the assembly.
7. Erratic operation may be caused by metal chips in the air gap between the armature and the pole pieces. Blow any chips out of the torque motor assembly with low pressure air.
8. A short in the coils may cause the device to give zero output. Return the device to a Fisher service center for repair.

## **⚠ WARNING**

**Severe personal injury or property damage may occur if the instrument air supply is not clean, dry and oil-free. While use and regular maintenance of a filter that removes particles larger than 40 micrometers in diameter will suffice in most applications, check with an Emerson Automation Solutions field office and industry instrument air quality standards for use with corrosive air or if you are unsure about the proper amount or method of air filtration or filter maintenance.**

9. Check the nozzle for residue. Air supply must be clean and dry. Use air filter to remove dirt and oil.
10. Check the pneumatic connection of the transducer to prevent leakage.

## Alignment

The following alignment procedures can be used in conjunction with troubleshooting procedures to correct the operation of a faulty transducer.

### Span Adjustment

Refer to figure 8 for key number locations, unless otherwise directed.

If setting the required span is not possible, additional span adjustment can be obtained by shifting the entire span adjustment assembly (key 55) at the flexure pivot end. The alignment procedure is as follows:

1. Shut off the DC input signal and supply pressure to the transducer.
2. Disconnect the external lead wires from the terminal mounting bracket assembly (key 53).
3. Loosen the four machine screws (key 9, figure 7) that hold the torque motor assembly to the case. Remove the entire torque motor assembly from the case.
4. Loosen the two flexure pivot screws (key 25) that hold the flexure pivot to the torque motor assembly base.
5. Slide the span adjustment assembly in or out as required. Sliding it in toward the base decreases the span; sliding it out away from the base increases the span.
6. Tighten the flexure pivot screws. Replace the torque motor assembly, and tighten the screws (key 9, figure 7). Make sure that the O-ring (key 37) is in place. Connect the external lead wires, and turn on the air supply.
7. Make final adjustment of the span with the span adjustment screw.

## Torque Motor Frame

The top pole piece plate (key 50, figure 8) of the torque motor can become twisted with respect to the bottom pole piece plate (key 51, figure 8). If this happens contact your [Emerson sales office](#).

## Armature Travel Stop

The armature travel stop (key 52, figure 8) must be in place to prevent overstressing the armature and coil support (key 41, figure 8) due to over-travel. The clearance between the armature and travel stop should be 0.13 mm (0.005 inches).

The two screws at the base of the travel stop can be loosened if an alignment is necessary.

## Coil

The coil assembly (key 42, figure 8) consists of a nylon bobbin wound with wire. The coils are not attached to the armature itself, and therefore, they must not touch the armature, or armature movements will be restricted. If this problem exists, loosen the two screws that attach each coil assembly to the armature and coil support. Sight down the armature and realign the coil assemblies for clearance with the armature. Tighten the screws.

## Parts Ordering

Whenever corresponding with your sales office about this equipment, mention the serial number of the unit. This serial number can be found on the nameplate.

### Note

In the torque motor assembly drawing (figure 8), there are many shaded key numbers. The shading indicates that these parts should not be disassembled and that they are not available as individual items.

### **⚠ WARNING**

**Use only genuine Fisher replacement parts. Components that are not supplied by Emerson should not, under any circumstances, be used in any Fisher instrument. The use of components not manufactured by Emerson Automation Solutions may void your warranty, might adversely affect the performance of the instrument, and could result in personal injury or property damage.**

## Repair Kits

Description	Part Number
Transducer Repair Kit Kit includes keys 6, 12, 36, 37, and 58	R546X000032
82 Relay Replacement Assembly Assembly includes two mounting screws (key 68)	10A8593X132

## Parts List (see figure 7)

### Note

Contact your [Emerson sales office](#) for Part Ordering information.

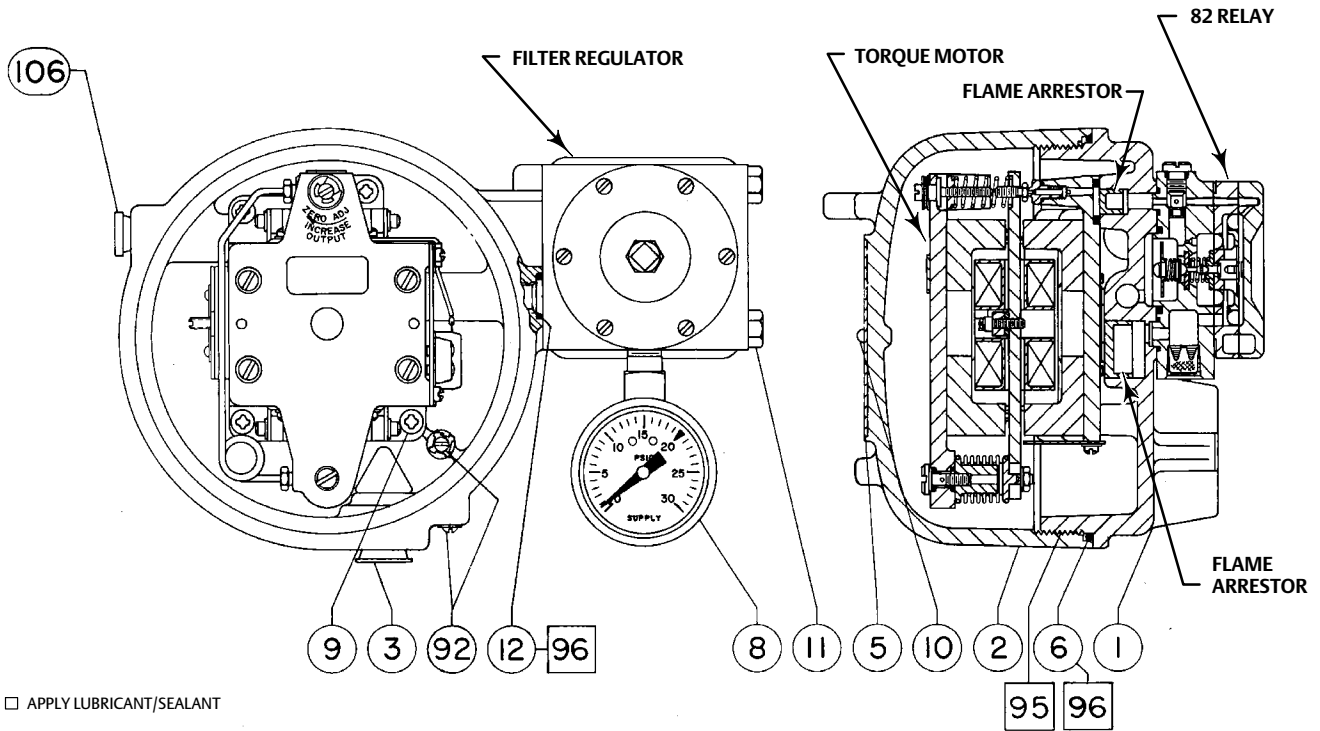
Key Description

### Transducer

- 1 Transducer Case Ass'y
- 2 Case Cover

Key	Description
3	Protective Plug
4	Tagging Plate (optional)
5	Nameplate, standard
6	O-Ring
8*	Pressure Gauge Triple scale 0-30 psig/0-.2 MPa/0-2 bar 0-60 psig/0-.4 MPa/0-4 bar Dual scale 0-30 psig/0-2 Kg/cm <sup>2</sup> 0-60 psig/0-4 Kg/cm <sup>2</sup>
9	Machine Screw (4 req'd)
10	Screw
11	Cap Screw (2 req'd) use with integrally mounted filter regulator only
12	O-Ring, EPDM, use with integrally mounted filter regulator only
13	Pipe Nipple For filter regulator only (not shown)
92	Wire Retainer (2 req'd)
96	Silicone-based lubricant, medium grade (not furnished with unit)
107	Street Elbow, use with integrally mounted filter regulator w/0-60 dual scale gauge
108	Pipe Plug For regulator w/o gauge

Figure 7. Transducer Assembly



□ APPLY LUBRICANT/SEALANT

NOTE: KEY 4 NOT SHOWN

30A8595-L  
B1768-3

Key Description

### Torque Motor (figure 8)

- 15(1) Adjusting Screw
- 16(1) Spring Seat
- 17(1) Spring-Zero Adjustment (SST)
- 18(1) Baffle
- 19(1) Nozzle
- 20(1) Hook-Up Wire Ass'y
- 21(1) Hook-Up Wire Ass'y
- 22(1) Hook-Up Wire (not shown)
- 25(1) Machine Screw
- 26(1) Screw
- 27(1) Cap Screw

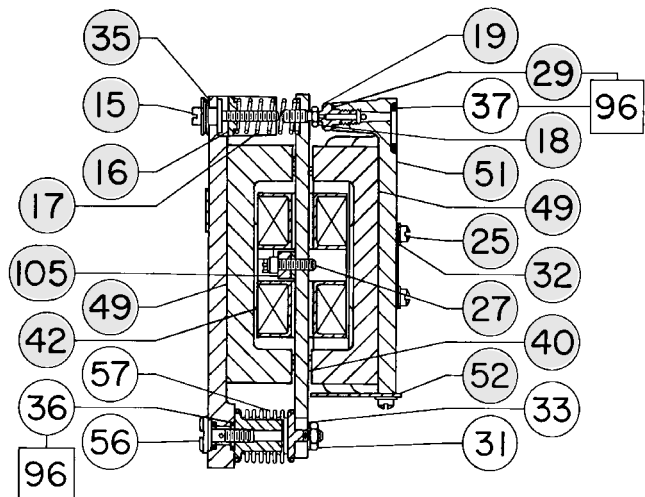
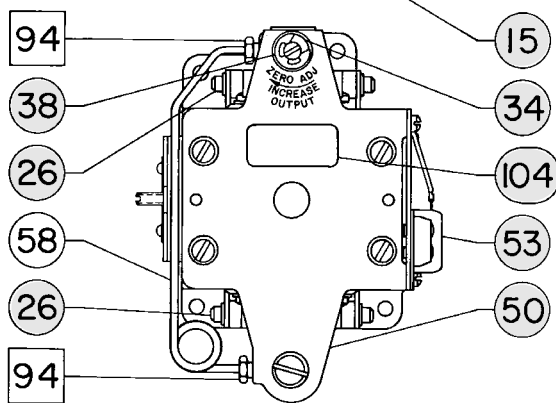
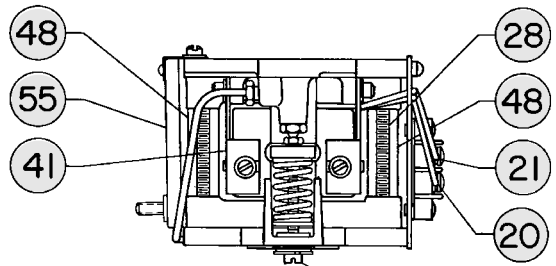
Key Description

- 28(1) Machine Screw
- 29(1) O-Ring
- 31 Hex Nut
- 32(1) Washer
- 33 Washer
- 34(1) Washer
- 35(1) Washer
- 36\* O-Ring (2 req'd)
- 37\* O-Ring
- 38(1) E-Ring
- 40(1) Armature
- 41(1) Coil Support
- 42(1) Coil Ass'y
- 48(1) Magnet
- 49(1) Pole Piece
- 50(1) Top Pole Piece Plate

\*Recommended spare parts

1. Parts are not field repairable. The torque motor assembly should never be disassembled because the magnetism in the torque motor will decrease permanently. Shaded key numbers shown in figure 8 indicate parts that should not be disassembled.

Figure 8. Torque Motor Assembly



□ APPLY LUBRICANT/SEALANT

NOTES:  
 1. SHADED KEY NUMBERS INDICATE PARTS THAT SHOULD NOT BE DISASSEMBLED FROM TORQUE MOTOR.  
 2. KEY NUMBERS 22 AND 103 ARE NOT SHOWN.

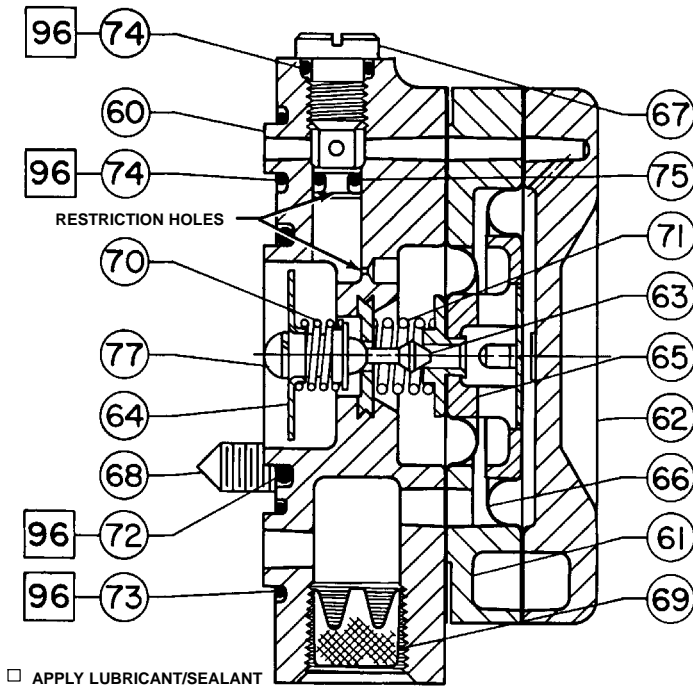
30A8594-K  
 81767-3

Key	Description
51 <sup>(1)</sup>	Bottom Pole Piece Plate
52 <sup>(1)</sup>	Travel Stop
53 <sup>(1)</sup>	Terminal Mounting Bracket Ass'y
55 <sup>(1)</sup>	Span Adjustment Ass'y <sup>(2)</sup>
56	Bellows Screw
57*	Bellows Ass'y Full Size, 21 mm (27/32 inch) O.D. Half Size, 13 mm (1/2 inch) O.D. Quarter Size, 9.5 mm (3/8 inch) O.D.

Key	Description
58	Tubing Ass'y
94	Anti-seize sealant (not furnished with unit)
96	Silicone-based lubricant, medium grade (not furnished with unit)
103	Set Screw (not shown)
105 <sup>(1)</sup>	Spacer

\*Recommended spare parts  
 1. Parts are not field repairable. The torque motor assembly should never be disassembled because the magnetism in the torque motor will decrease permanently. Shaded key numbers shown in figure 8 indicate parts that should not be disassembled.  
 2. The span adjustment assembly uses a bronze passive lock, rather than nylon, and a locking hex nut.

Figure 9. Fisher 82 Relay Assembly



□ APPLY LUBRICANT/SEALANT

NOTE:  
KEY 76 IS NOT SHOWN

A1504-1

## Relay (figure 9)

**Note**

The 546NS relay is not repairable. If the relay is defective, order the 82 Relay Replacement Assembly (refer to Parts Kits).

## Mounting Parts

### Note

Contact your [Emerson sales office](#) for mounting parts ordering information.

Key	Description
81	Mounting Plate Yoke Mounting 657, 657NS, 667, 667NS, all sizes for seismic mounting of 546NS Pipestand mounting Surface mounting Bulkhead mounting
82	Cap Screw Yoke mounting (2 req'd) 657NS & 667NS, sizes 70 & 80 Pipestand mounting (2 req'd) Surface mounting (2 req'd) Bulkhead mounting (2 req'd)
85	Washer Yoke mounting (4 req'd) All types, all sizes, Pipestand mounting (4 req'd)
86	Cap Screw (2 req'd) Yoke mounting 657NS & 667NS, Sizes 70, 80
87	Spacer (2 req'd) Yoke mounting 657NS & 667NS, Sizes 70, 80
90	Pipe Clamp Pipestand mounting

## Diagnostic Connections

FlowScanner™ diagnostic system hook-up  
Includes pipe tee, pipe nipple, pipe bushings,  
connector body, and body protector. See figure 2  
for part identification.

### Note

Contact your Emerson sales office for diagnostic connections ordering information.

If the transducer is used in a valve assembly with a positioner, no hook-up for diagnostic testing is required for the transducer. The hook-up for diagnostic testing should be installed at the positioner.

### Description

For units with gauges  
SST fittings  
Brass fittings

For units without gauges  
SST fittings  
Brass fittings

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