

Model 444 Alphaline[®] Temperature Transmitters



Product Discontinued

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Model 444 Alphaline® Temperature Transmitters

NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.

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SNF-0004

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Introduction

OVERVIEW

This manual is designed to assist in installing, operating, and maintaining Rosemount® Model 444 Alphaline® Temperature Transmitters.

Section 2 Installation

provides mechanical, electrical, and environmental considerations to guide you through a safe and effective transmitter installation.

Section 3 Calibration

provides different Model 444 calibration procedures.

Section 4 Maintenance and Troubleshooting

provides hardware diagnostics, maintenance tasks, basic hardware troubleshooting techniques, and considerations for returning materials.

Section 5 Specifications and Reference Data

provides functional, performance, and physical transmitter specifications; also includes transmitter dimensional drawings, ordering information, and spare parts.

Section 6 Options

provides a listing of transmitter options and a description of each.

Appendix A Approval Drawings

contains approval drawings for Canadian Standards Association (CSA) and Factory Mutual (FM) intrinsic safety installation.

Appendix B Temperature Sensor Reference Information

provides reference information regarding the application of various Rosemount temperature sensors.

Installation

OVERVIEW

This section includes the following transmitter installation information:

- General Considerations
- Mechanical Considerations
 - Mounting Stability
 - Access Requirements
- Electrical Considerations
 - Power Supply
 - Field Wiring
 - Sensor Connections
 - Grounding
 - Multi-Channel Installations
 - Surges/Transients
- Environmental Considerations
 - Temperature Environment
 - Moist or Corrosive Environments
 - Hazardous Location Installation
 - Intrinsically Safe Installation
- Installation Procedure
 - Mechanical
 - Electrical

GENERAL CONSIDERATIONS

⚠ WARNING

Failure to follow these installation guidelines may result in death or serious injury. Make sure only qualified personnel perform the installation.

⚠ WARNING

Explosions can cause death or serious injury. Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

Use the Rosemount Model 444 Alphaline Temperature Transmitter when the temperature measurement point is remote from the control, readout, or recording point, or where the measurement point is exposed to environmental conditions that would be harmful to unprotected signal conditioning equipment.

Electrical temperature sensors such as RTDs and thermocouples

produce low-level signals proportional to their sensed temperature. Model 444 temperature transmitters convert the low-level sensor signal to a standard 4–20 mA dc signal that is relatively insensitive to lead length and electrical noise. This current signal is then transmitted to the control room via two wires.

Figures 2-1, and 2-2 show recommended mounting configurations for transmitter and sensor assemblies. See **Section 6 Options** for information regarding Model 444 transmitter accessories.

MECHANICAL CONSIDERATIONS

You can attach the transmitter directly to the sensor assembly as shown in Figures 2-1 and 2-2. An optional mounting bracket permits the transmitter to be mounted remotely from the sensor(s), either on a flat surface or attached to a two-inch pipe (See Figure 2-11 on page 2-13). The choice of mounting method must take into account a number of factors:

Mounting Stability

Mounting stability is an important consideration. The transmitter, though rugged, may require supplementary support under high-vibration conditions, particularly if extensive thermowell lagging or long extension fittings are used. In such instances, the pipestand mounting technique shown in Figure 2-11 on page 2-13 is preferable.

Access Requirements

When choosing an installation location and position, take into account the need for access to the transmitter.

Housing Rotation

You may rotate the transmitter in 90-degree increments to improve field access to both compartments.

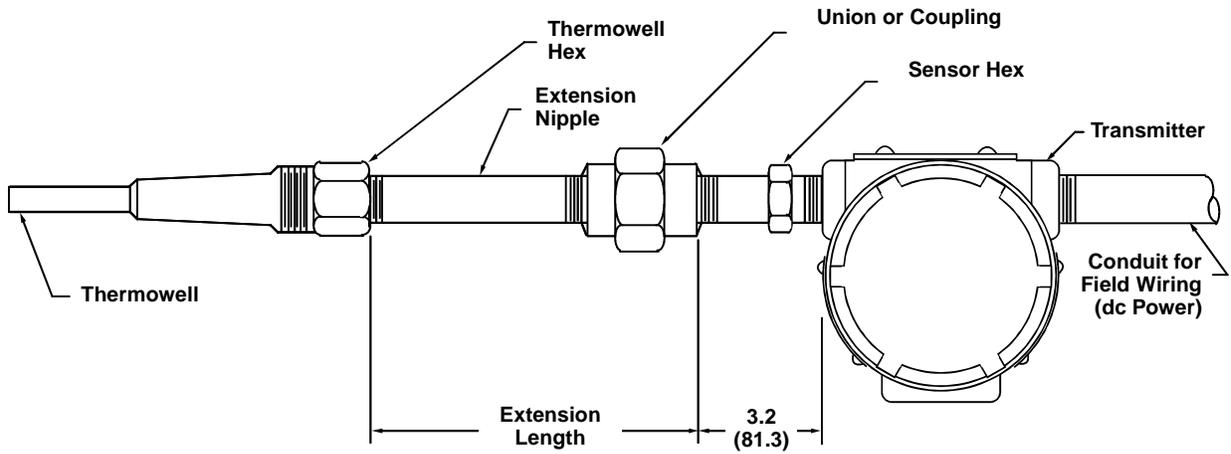
Terminal Side of Electronics Housing

Make wiring connections through the conduit openings on the terminal side of the electronics housing. Mount the transmitter so the terminal side is accessible, and be sure to provide adequate clearance for cover removal.

Circuit Side of Electronics Housing

The transmitter electronics are installed in the circuit side of the transmitter housing. In case of electronic malfunction, provide adequate clearance for circuit-side cover removal. Also, be sure to account for additional clearance if a meter is to be installed. For more information regarding the meter option, refer to **Section 6 Options**.

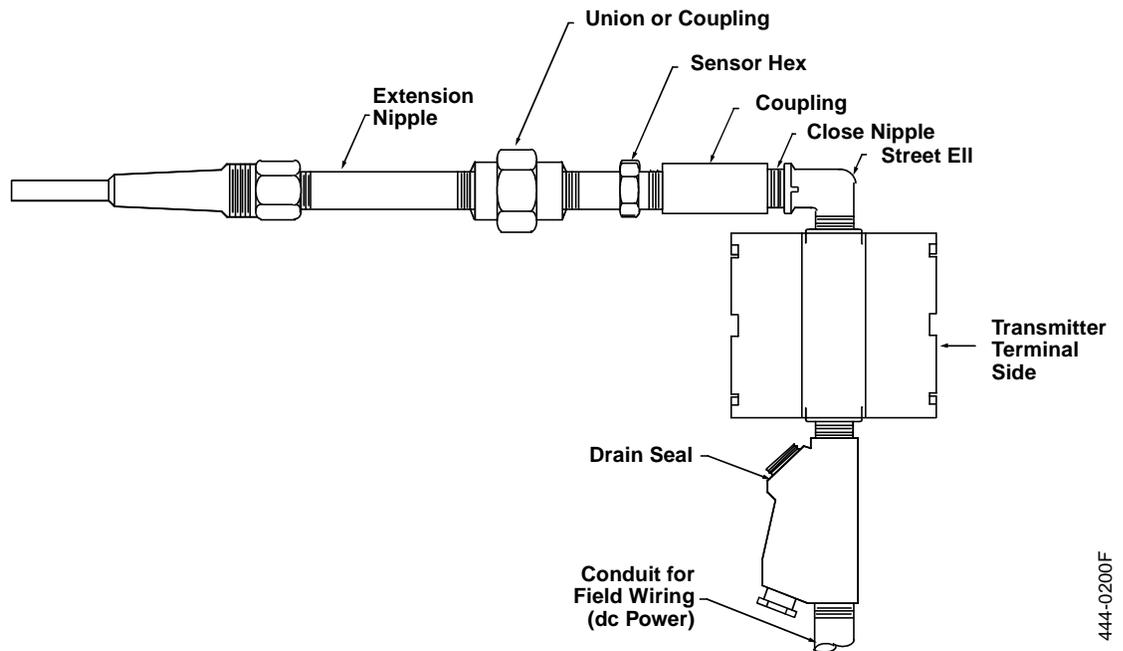
FIGURE 2-1. Recommended Process Mounting.



NOTE
Dimensions are in inches (millimeters).

444-0200C

FIGURE 2-2. Recommended Process Mounting with Drain Seal.



444-0200F

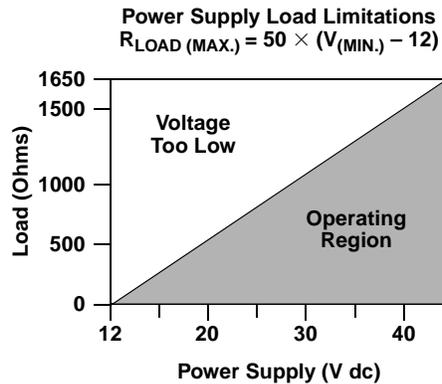
ELECTRICAL CONSIDERATIONS

This section contains information that you should consider when preparing to install Model 444 transmitters. Read this section carefully before going on to the installation procedures. Metal conduit should be used to enclose cabling for best results in electrically noisy environments.

Power Supply

The dc power supply should provide power with less than 2% ripple. The input voltage versus load limitation relationship for 4–20 mA transmitters is shown in Figure 2-3. Figure 2-4 shows field wiring for a standard Model 444 transmitter. Figure 2-5 shows field wiring for Models 444LL and 444LM low-power voltage output units, which require 100K ohms minimum load. The total R-load is the sum of the resistance of the signal leads and the load resistance of the controller, indicators, and related devices. Note that the resistance of intrinsic safety barriers, if used, must be included in the total load.

FIGURE 2-3. Model 444 Load Limits.



Field Wiring

⚠ WARNING

Explosions may result in death or serious injury. Do not remove the instrument cover in explosive atmospheres when the circuit is alive.

⚠ WARNING

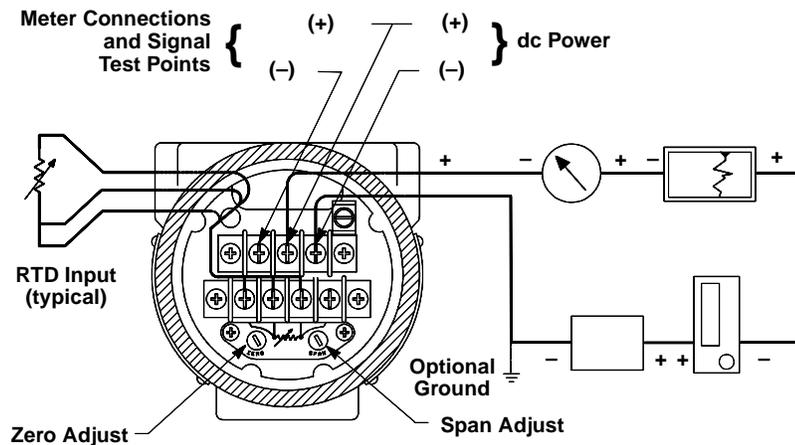
High voltage that may be present on leads can cause electrical shock. Avoid contact with leads and terminals.

⚠ CAUTION

Do not apply high voltage (e.g. ac line voltage) to the transmitter terminals. Abnormally high voltage can damage the unit.

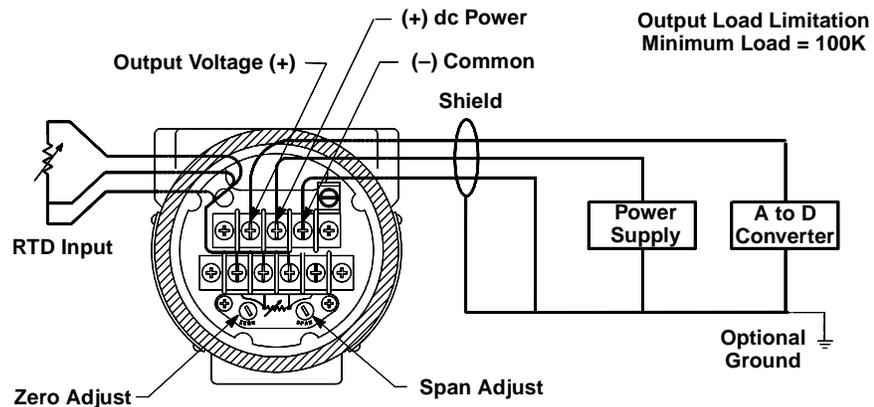
All power to the transmitter is supplied over the signal wiring. Signal wiring need not be shielded, but use twisted pairs for best results. Do not run unshielded signal wiring in conduit or open trays with power wiring, or near heavy electrical equipment. To power the transmitter, connect the positive power lead to the terminal marked “+” and the negative power lead to the terminal marked “-” (see Figures 2-4 and 2-5). Tighten the terminal screws to ensure adequate contact. No additional power wiring is required.

FIGURE 2-4. Field Wiring for the Standard Model 444 Transmitters.



444-0000C02A

FIGURE 2-5. Field Wiring for Low-Power Model 444 Transmitters (444LL and LM).



444-0000A02A

Sensor Connections

⚠ WARNING

Explosion may result in death or serious injury. Do not remove the instrument cover in explosive atmospheres when the circuit is alive.

⚠ WARNING

High voltage that may be present on leads can cause electrical shock. Avoid contact with the leads and the terminals.

RTD Inputs

Various RTD configurations are used in industry; each configuration offers a specific solution for compensating the effects of lead wire resistance. They include 3- and 4-wire designs. The correct installation for each of these RTDs is shown in Figures 2-6a and b on page 2-6.

If the transmitter is mounted remotely from the RTD, operation will be satisfactory, without recalibration, for lead wire resistances of up to 2 ohms per lead (equivalent to 200 feet of 20 AWG wire). In this case, the leads between the RTD and transmitter should be shielded.

The correct connections for a compensation loop RTD and a 2-wire RTD are shown in Figure 2-6c and Figure 2-6d, respectively. In a 2-wire RTD, however, both leads are in series with the sensor element, so significant errors (0.1 °C) could occur if the lead lengths are greater than one foot. For longer runs when using a 2-wire RTD, attach a third lead and connect as shown in Figure 2-6a.

FIGURE 2-6. Sensor Wiring Diagrams.

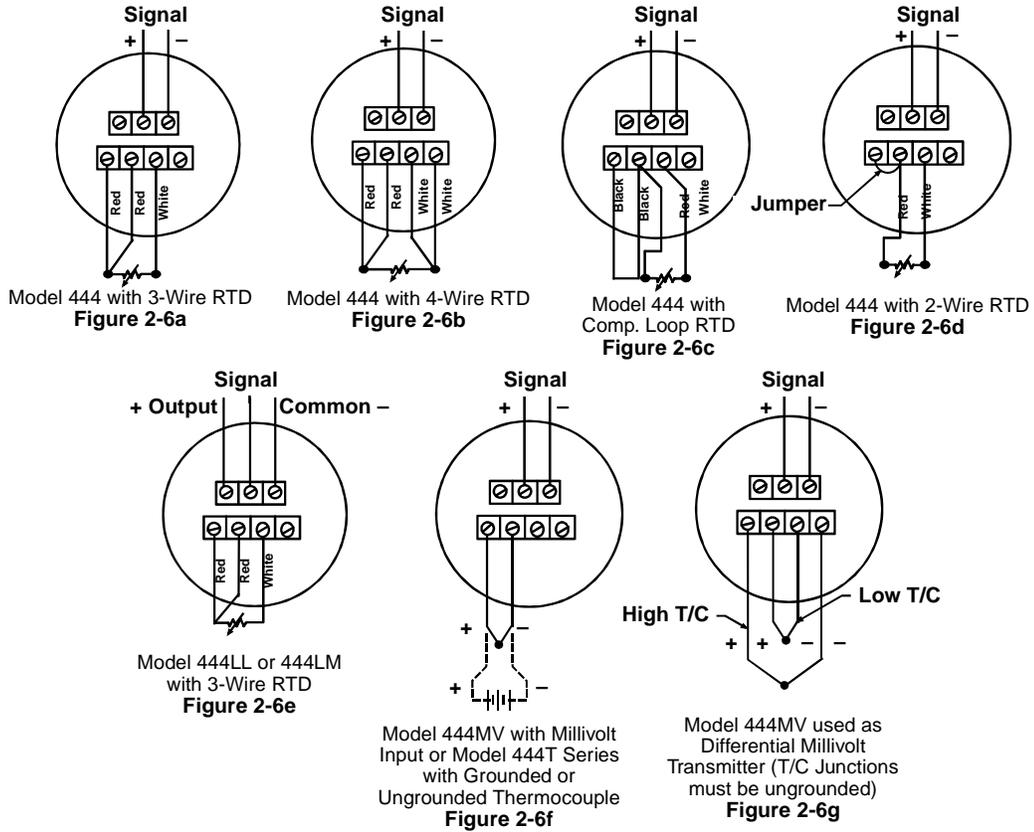
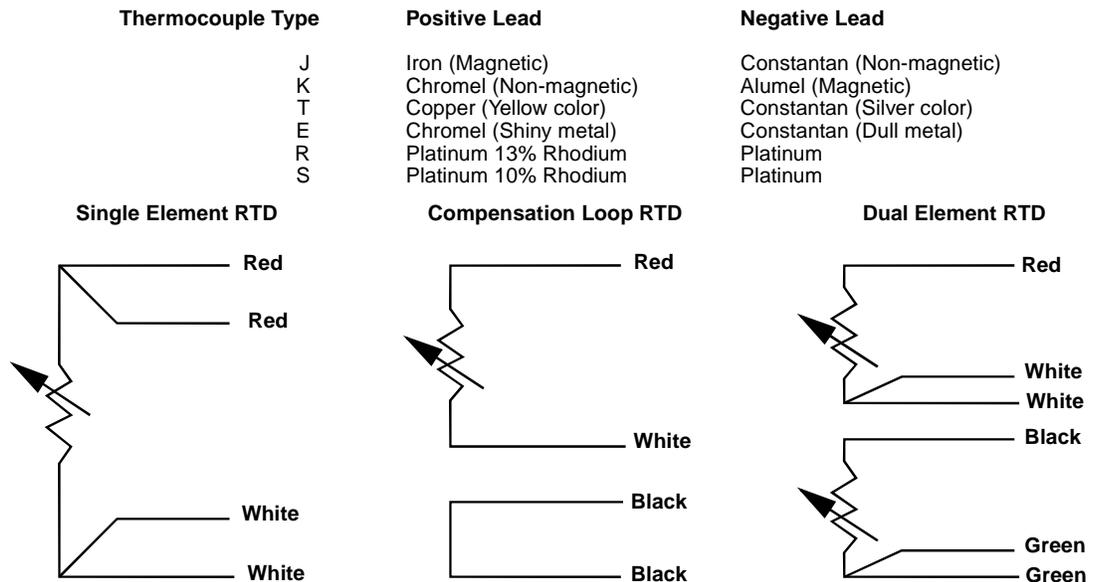


FIGURE 2-7. Characteristics of Thermocouple and RTD Input Wires.



444-0203A\B\C\D

444-0207A

Thermocouple or Millivolt Inputs

In the case of thermocouples, make connections between the sensor and the transmitter with thermocouple wire. For process mounting applications, connect the thermocouple directly to the transmitter. For installations where the transmitter is mounted remotely from the sensor, use appropriate thermocouple extension wire. As with all low-level signal wiring, shielding is recommended for long runs. Make input connections for the Model 444MV Millivolt Transmitter using copper wires. The correct connections for thermocouple and millivolt inputs are shown in Figures 2-6f and g.

Grounding

The transmitter will operate with the current signal loop either floating or grounded. However, many types of readout devices are affected by the extra noise in floating systems. If operation appears noisy or erratic, grounding the current signal loop at a single point may solve the problem. The negative terminal of the power supply is the best place to ground the loop. Alternately, either side of the readout device could be grounded. Do not ground the current signal loop at more than one point.

Thermocouple and millivolt transmitters are isolated, so the input circuit also may be grounded at any single point (when a grounded thermocouple is used, this point is the grounded junction), and the signal loop may be grounded at any point.

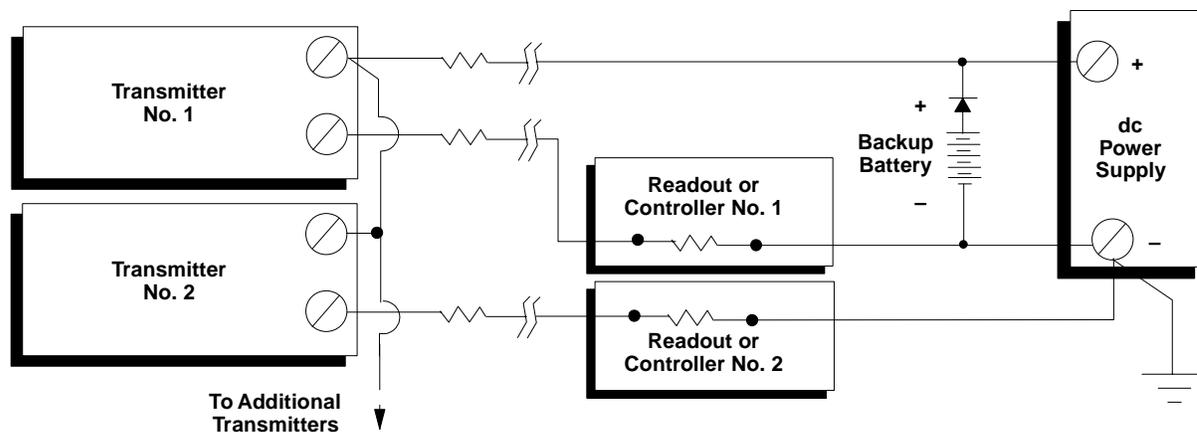
The 444RL transmitter is not isolated, so there can be no grounds in the RTD circuit. Since RTDs must be well-insulated from ground in order to give correct temperature readings, this is not normally an installation limitation. The positive side of the power supply should not be grounded for use with RTD input transmitters. The 444RI9 should be used with grounded RTDs.

If using shielded wire, connect the shield of the sensor-to-transmitter cable to the shield of the transmitters-to-receiver cable. Ground the shielding only at the signal loop ground.

Multi-Channel Installations

Figure 2-8 illustrates how several transmitters can be connected to a single master power supply. In this instance, the system can be grounded only at the negative power supply terminal. Since several channels are dependent on one supply, an uninterruptible power supply or backup battery should be considered if loss of all channels would pose operational problems. The diodes shown in Figure 2-8 prevent unwanted charging or discharging of the battery.

FIGURE 2-8. Multi-Channel Installation.



Surges/Transients

The transmitter will withstand electrical transients of the energy level usually encountered in static discharges or induced switching transients. However, high-energy transients, such as those induced in wiring from nearby lightning strikes, can damage both the transmitter and the sensor.

To protect against high-energy transients, install Model 444 transmitters in conjunction with the Rosemount Model 470 Transient Protector. The Model 470 prevents damage from transients induced by lightning, welding, heavy electrical equipment, or switch gears. Refer to the Model 470 Transient Protector product data sheet, pub. no. 00813-0100-4191 for more information.

ENVIRONMENTAL CONSIDERATIONS

Temperature Environment

The transmitter will operate within specifications for ambient temperatures between -25 and 85 °C. It will function, but not necessarily within specifications, in ambient temperatures between -40 and 100 °C.

Aside from ambient temperature variations, heat from the process is transferred from the thermowell to the transmitter housing. If the process temperature is near or beyond specification limits, use excess thermowell lagging or an extension nipple to protect the transmitter from the high temperature condition. See Figure 2-10.

EXAMPLE:

Suppose the maximum ambient temperature is 40 °C and the temperature to be measured is 540 °C. The maximum allowable housing temperature rise is the rated temperature specification limit minus the existing ambient temperature ($85 - 40$), or 45 °C. As shown in Figure 2-9, an “E” dimension of 3.6 inches will result in a housing temperature rise of 22 °C. An “E” dimension of 4 inches would therefore be the minimum recommended length, and would provide a safety factor of about 25 °C. A longer “E” dimension, such as 6 inches, would be desirable in order to reduce errors caused by transmitter temperature effect, although in that case the transmitter would probably require extra support. If a thermowell with lagging is used, the “E” dimension may be reduced by the length of the lagging.

FIGURE 2-9. Model 444 Transmitter Housing Temperature Rise.

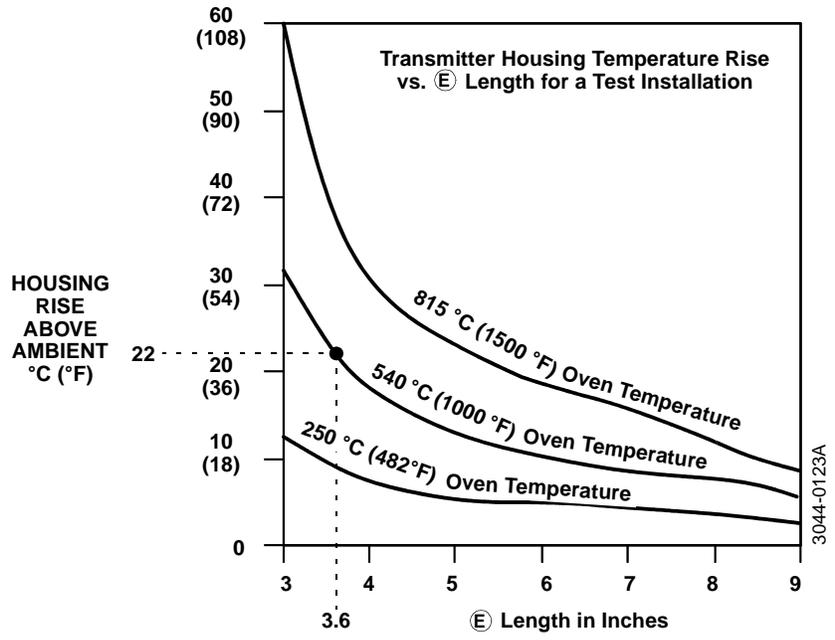
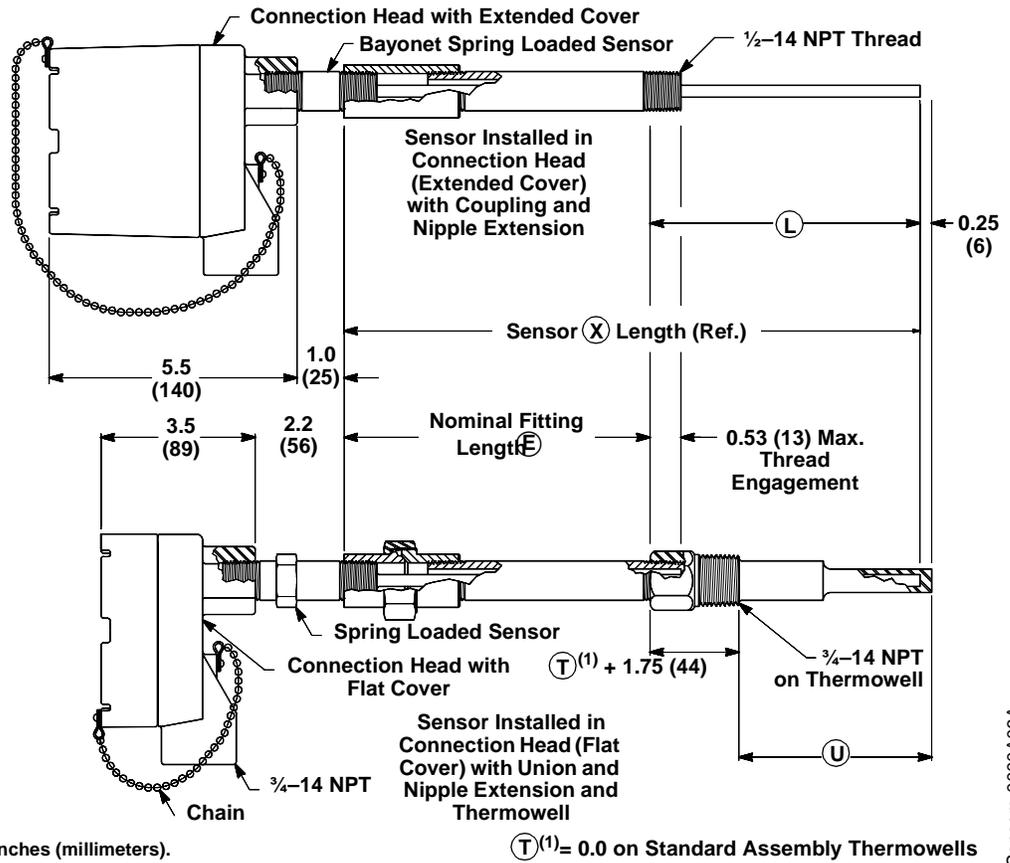


FIGURE 2-10. Sensor Assembly Dimensional Drawings.



Sensors-0000A06A

Moist or Corrosive Environments

The transmitter is designed to resist attack by moisture and other corrosives. The coated circuit boards are mounted in a compartment completely sealed from the conduit entrances. O-ring seals protect the interior when the covers are installed. In humid environments, however, it is still possible for moisture “breathing” to occur in conduit lines. If the transmitter is mounted at a low point in the conduit run, the terminal compartment could fill with water, causing electrical shorting. The transmitter should be mounted so moisture from the conduit will not drain into the housing. In some instances a drain seal, installed as shown in Figure 2-2 on page 2-3, is advisable.

Hazardous Location Installation

⚠ WARNING

Explosions may result in death or serious injury. Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

⚠ WARNING

Explosions may result in death or serious injury. Both transmitter covers must be fully engaged to meet explosion-proof requirements.

The Model 444 is designed with an explosion-proof housing and circuitry suitable for intrinsically safe and non-incendive operation. Individual transmitters are clearly marked with a tag indicating the approvals they carry. The various approvals are available as options. Refer to **Section 5 Specifications and Reference Data** for a complete listing of available approvals.

To maintain certified ratings for installed transmitters, install in accordance with applicable installation codes and approval drawings. Refer to **Appendix A Approval Drawings** for Model 444 installation drawings. For future orders, refer to the current product price list for the most up-to-date information on these approvals.

Intrinsically Safe Installation

⚠ WARNING

For explosion-proof installations, installation location must be made in accordance with Rosemount drawing 00444-0261, Rev. E.

For intrinsically safe installations, installation location must be made in accordance with Rosemount drawing 00444-0034, Rev. C (CSA) or 00444-0264, Rev. B (SAA).

You can use Intrinsically safe installations instead of explosion-proof installations in hazardous areas. In such configurations, the transmitter and sensor are located in a hazardous area, and the current signal leads are connected to equipment in a non-hazardous area through intrinsic safety barriers that limit the voltage and current fed into the hazardous area. Install in accordance with the barrier manufacturer’s instructions for the specific barrier used. For approval information, refer to Table 5-1 on page 5-4, and Table 5-2 on page 5-5. For installation information, refer to the intrinsically safe barrier systems reference drawings in **Appendix A Approval Drawings**.

INSTALLATION PROCEDURE

Installation consists of mounting the transmitter and sensor assembly and making electrical connections. If mounting the transmitter directly to the sensor assembly, use the process mounting technique shown in Figure 2-1 or Figure 2-2, on page 2-3. For transmitter locations remote from the sensor, use conduit between the sensor and transmitter. Transmitter hubs will accept male conduit fittings with ½–14 NPT; ½–14 NPSM; or ½–14 taper thread per ANSIC 80.4.

⚠ WARNING

Explosion may result in death or serious injury. Do not remove the instrument cover in explosive atmospheres when the circuit is alive.

⚠ WARNING

High voltage that may be present on leads may cause electrical shock. Avoid contact with the leads and the terminals.

⚠ WARNING

Process leaks may result in death or serious injury. Install and tighten thermowells or sensors before applying pressure, or process leakage may result. Removing the thermowell or sensor while in operation may cause process fluid leaks.

Mechanical

1. Mount the thermowell to the pipe or process container wall.
2. Attach any necessary extension nipples and adapters. Seal the nipple and adapter threads with silicone or tape.
3. Screw the sensor into the thermowell.
4. Install drain seals if required for severe environments or to satisfy code requirements (See Figure 2-2 on page 2-3).
5. Attach the transmitter to the thermowell assembly. Seal the adapter threads with silicone or tape.
6. Install conduit for field wiring to the remaining conduit entry of the transmitter. Seal conduit threads with silicone or tape.
7. Pull field wiring leads through the conduit into the terminal side of the transmitter housing.

Electrical

⚠ WARNING

For explosion-proof installations, wiring connections must be made in accordance with Rosemount drawing 00444-0261, Rev. E.

For intrinsically safe installations, wiring connections must be made in accordance with ANSI/ISA-RP12.6, and Rosemount drawing 00444-0034, Rev. C (CSA) or 00444-0264, Rev. B (SAA).

For all installations, wiring connections must follow the National Electric Code.

Preliminary Checkout

1. For any Model 444 unit, first verify that the transmitter is calibrated to the required range. Calibration is usually performed by substituting an input in place of the sensor, and this is most conveniently accomplished prior to sensor connection. Refer to the calibration procedures in **Section 4 Maintenance and Troubleshooting**.

Input Connections

2. **Model 444RL:** Connect the RTD leads as shown in Figure 2-6a, b, c, d, or e depending upon the lead compensation method used.

Model 444T series: Connect the thermocouple leads as shown in Figure 2-6f. Polarity is important; be sure to identify the leads accurately. The negative lead is usually red; if there is no color coding, the characteristics provided in Figure 2-7 may be helpful.

Model 444MV: If using the transmitter as a millivolt-to-milliamperre converter, use ordinary copper leads for input connections as shown in Figure 2-6f. If using the transmitter with two thermocouples to measure differential millivolt, connect the thermocouples as shown in Figure 2-6g. The “high” thermocouple causes the transmitter output to increase when its temperature increases relative to the “low” thermocouple. Grounded thermocouples cannot be used for differential measurements.

Models 444LL and LM: In these low-power option packages, the RTD leads are connected the same as in the conventional RTD arrangements shown in Figure 2-6a, b, c, and d.

Output Connections

3. For all 4–20 mA models, use ordinary copper wire of sufficient size to assure that the voltage across the transmitter power terminals does not go below 12 V dc (See Figure 2-3). For multi-channel or intrinsically safe installations, see applicable paragraphs in this section.

Model 444RL: Connect current signal leads as shown in Figure 2-6a, b, c, or d.

Model 444T series: Connect current signal leads as shown in Figure 2-6f.

Model 444MV: Connect current signal leads as shown in Figure 2-6f or g.

Models 444LL and LM: Connect current signal leads as shown in Figure 2-6e.

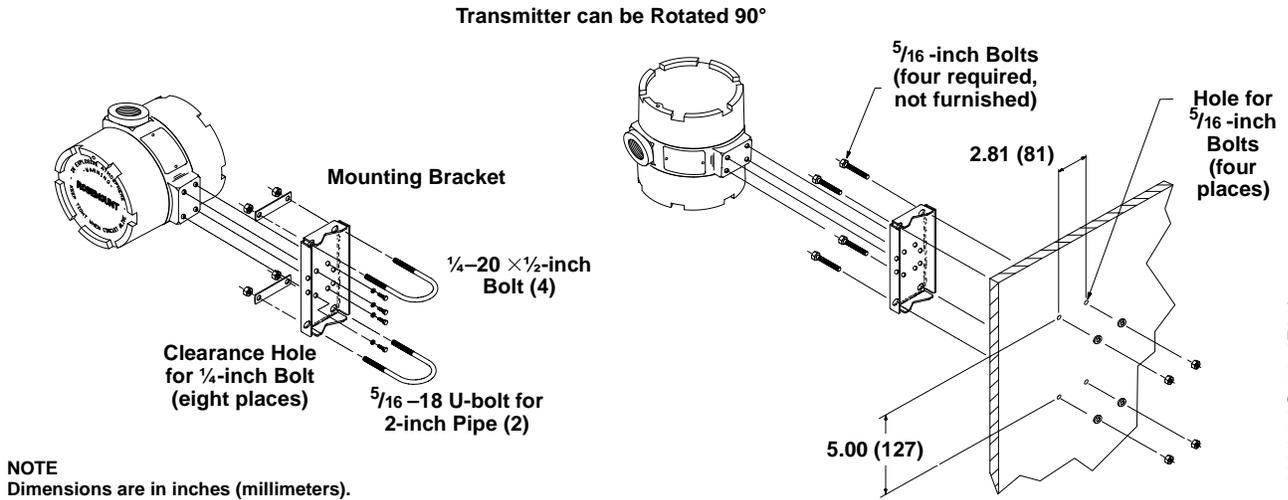
Final Checkout

4. For all models, recheck the polarity and correctness of connections; then turn the power on.

FIGURE 2-11. Model 444
with
Optional Mounting Bracket.

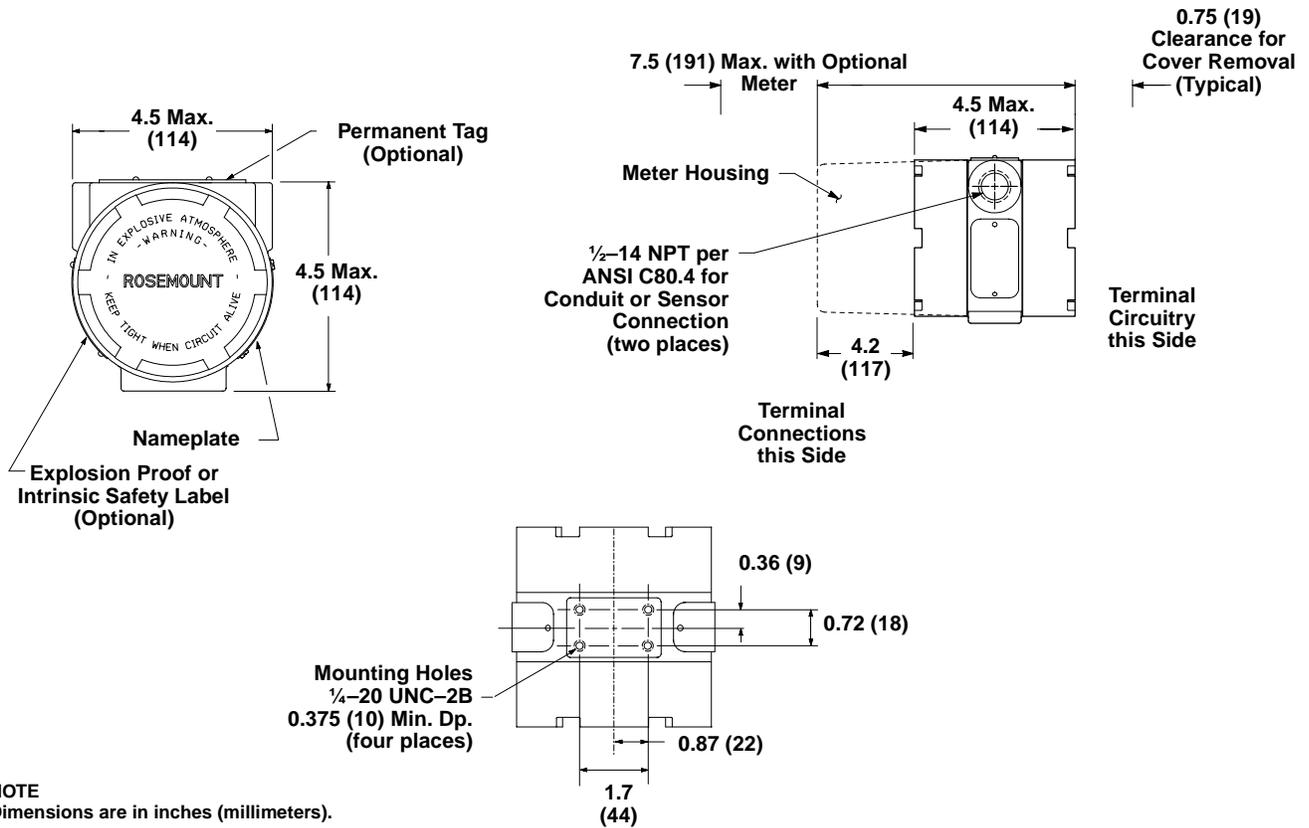
PIPESTAND MOUNTING

PANEL OR SURFACE MOUNTING



444-1151G, 1151F04A

FIGURE 2-12. Model 444
Dimensional Drawings



444-51LTE 05A, 51LTG 05A, 51LTF 05A

Calibration

OVERVIEW

Each transmitter is factory calibrated to the temperature range shown on the nameplate. If calibration to a specific range is not specified on the purchase order, the transmitter is calibrated to maximum span with a base temperature of 0 °C, and the “Calibration” entry on the transmitter nameplate is left blank. For more specific calibration information and a complete breakdown of transmitter parts, refer to **Section 5 Specifications and Reference Data**.

Only a few calibration laboratories have the kind of precision temperature baths necessary for accurate direct calibration of a temperature sensor or sensor/transmitter system. As a result, the transmitter is normally calibrated by substituting a resistance decade box for an RTD or a compensated thermocouple simulator for a thermocouple.

This section contains the following transmitter calibration information:

- Calibrating a RTD Transmitter
- Calibrating a Thermocouple Transmitter
- Calibrating a Low-Power Transmitter
- Calibrating a Millivolt Transmitter

SAFETY MESSAGES

This section contains procedures that require removing the transmitter covers and making electrical connections. The following safety messages apply to all such procedures.

WARNING

Explosion may result in death or serious injury. Do not remove the instrument cover in explosive atmospheres when the circuit is alive.

WARNING

High voltage that may be present on leads can cause electrical shock. Avoid contact with the leads and the terminals.

CALIBRATING A RTD TRANSMITTER

Calibration Equipment Required:

Readout Resistor. The transmitter test terminals give a 40–200 mV signal. The Models 444RL and 444RL ___B0912 have a jumper-selectable 4–20 mA test output option (2-board sets). If this is not suitable for the test equipment available, a $\pm 0.1\%$ tolerance, 0.5 W precision wirewound resistor is needed. Suggested values include a 100-ohm resistor to give a 0.4 to 2 volt output; or 500 ohms for 2 to 10 volts.

Voltmeter (such as a 5-digit DVM). Voltage rating is dependent upon the test signal. Accuracy is $\pm 0.01\%$; resolution is 1 mV.

dc Power Supply. Power capability is 24 V dc at 35 mA.

Resistance Decade Box. Precision type, 5-dial, with largest dial providing 100-ohm steps. Accuracy is ± 0.02 ohm. The decade box should be periodically calibrated against a 5-dial Wheatstone bridge.

Lead Simulation Resistors. If the transmitter is to be mounted remote from the RTD, and the lead resistance between the transmitter and the RTD is greater than 2 ohms per lead (equivalent to 200 ft of 20 AWG wire), the transmitter should be trimmed with simulated lead resistances for best accuracy. This requires wirewound resistors with resistance values equal to the nominal lead resistance of the RTD.

Calibration Procedure

To calibrate a model 444RL or 444RL___B0912, perform the following procedure:

1. The Models 444RL and 444RL ___B0912 have a jumper-selectable 4–20 mA test output option. If a 4–20 mA test output is required, reposition the test terminal output jumper on the range board (the default setting is 40–200 mV). Refer to steps 2 through 4 of the disassembly procedure, on page 4-4, for information on removing the circuit board assembly.

Place the jumper in the position labelled “A” for a 4–20 mA test output. See Figure 3-1. Refer to steps 5 through 12 of the reassembly procedure, on page 4-5, for information on reinstalling the circuit board assembly.

2. Remove the cover from the terminal side of the transmitter housing.
3. If an RTD is already connected, remove all RTD lead connections.
4. Attach the calibration test equipment as shown in Figure 3-2. Use miniature banana plugs to make terminal connections. Use simulated lead resistors only if necessitated by long lead wire lengths, as discussed above.

NOTE

If using RTD configurations other than the 3-wire design shown in Figure 3-2, refer to Figure 2-6 on page 2-6 for the correct wiring.

5. If trimming the transmitter to a new range, you may have to reposition the Coarse Zero Jumper on the Range Board. If so, see the disassembly procedure on page 4-4. Position the jumper in the location shown in Table 3-1. (A transmitter with a Base Temperature outside the regions shown in Table 3-1 is a special design, and does not contain a Coarse Zero Jumper.) Reassemble the circuit boards.

6. Determine the RTD resistance at the desired base and full scale temperatures. For Calibration Code 1 (see Table 5-3, on page 5-9), these resistances are listed in Table B-1.
7. Turn the power on.
8. Set the decade box to the resistance corresponding to the desired base temperature. Adjust the zero potentiometer until the output is 4 mA. Remember that recovery time of the unit from an underscale condition is longer than from an over-scale condition. Therefore, set the box to a higher resistance than that desired, then bring it down to the correct value.
9. Set the decade box to the resistance corresponding to the desired full scale temperature. Adjust the span potentiometer until the output is 20 mA.
10. Repeat steps 8 and 9 until you obtain the 4 and 20 mA readings without readjusting the span and zero potentiometers. Complete this process more quickly by noting the full scale reading before readjusting the span pot, using the span pot to overshoot the desired reading by 20%, and then using the zero pot to readjust the full scale reading to 20 mA.

EXAMPLE:

To calibrate the Model 444RL1U1 for a range of 100 to 150 °F (38 to 66 °C), first consult Table 3-1, and plug the jumper into pins Z2. From Table B-1, trim points are 114.68 and 125.37 ohms corresponding to 100 °F and 150 °F respectively. After adjusting the base to 4 mA, and setting the decade to full scale resistance, output equals 22.5 mA, or 2.5 mA greater than desired. Set the span pot to an output lower than 20 mA by the amount equal to 20% of 2.5 equals 0.5 mA, or 19.5 mA. Reset the zero pot so the output equals 20 mA. Repeat steps 8 and 9 and this procedure until readjustments are no longer necessary.

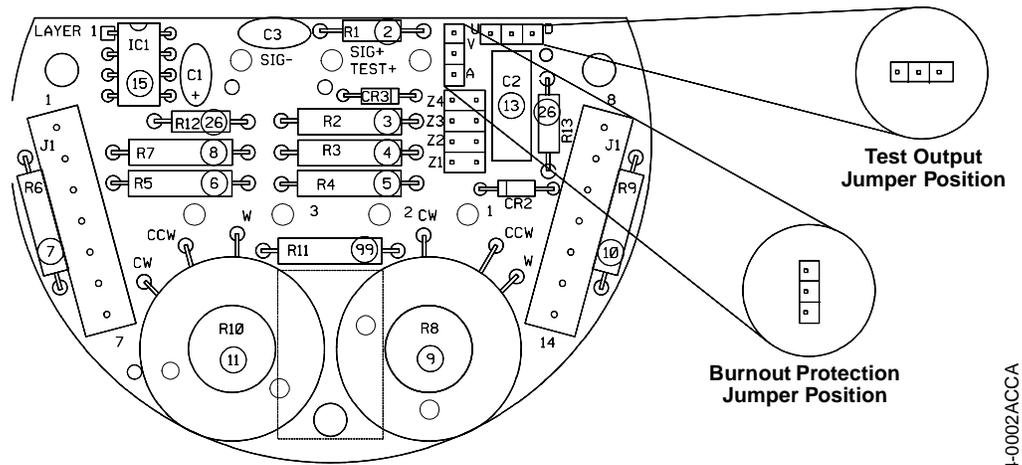
11. Disconnect the decade box and the readout resistor. Reconnect the RTD and power leads. Replace the terminal cover.
12. Mark the correct range in the “Calibration” space on the nameplate

TABLE 3-1. Coarse Jumper Location, Model 444R.

| Base Temperature Region | | Jumper Location | | |
|---|------------|-----------------|--------|-------------------------------------|
| ° C | ° F | 444RL1 | 444RL2 | 444RL3 |
| -50 to 0 | -58 to 32 | Z1 | Z1 | Continuously adjustable (no jumper) |
| 0 to 50 | 32 to 122 | Z2 | Z1 | |
| 50 to 100 | 122 to 212 | Z3 | Z2 | |
| 100 to 150 | 212 to 302 | Z4 | Z2 | |
| NOTE | | | | |
| If the base temperature is at a dividing point between regions, use the lower jumper position optimum performance; i.e., use location Z1 rather than Z2 for Model 444RL1 with a base temperature of 0 °C. | | | | |

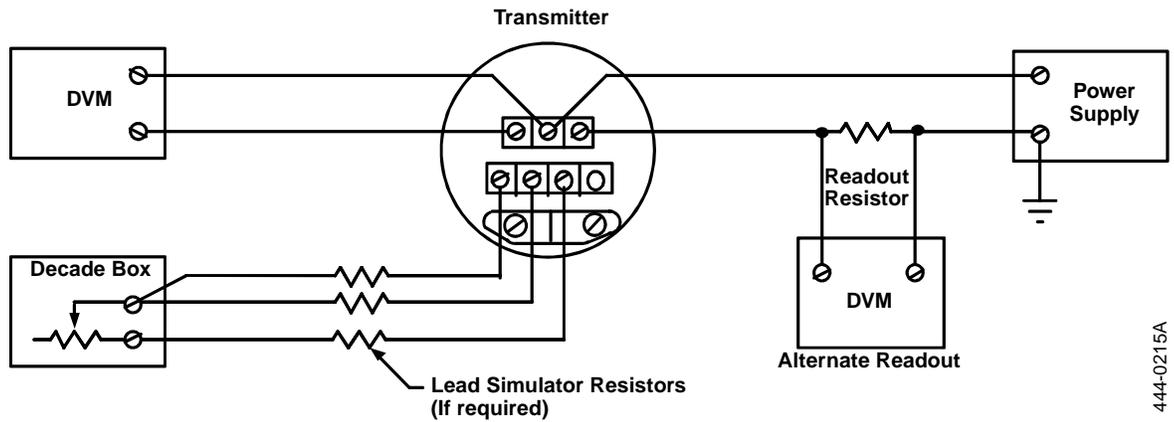
Rosemount Model 444 Alphaline Temperature Transmitters

FIGURE 3-1. Location of Test Input and Burnout Protection Jumper on Model 444RL Range Board.



444-0002ACCA

FIGURE 3-2. RTD Transmitter Calibration Diagram.



444-0215A

CALIBRATING A THERMOCOUPLE TRANSMITTER

Using a Compensated Thermocouple Simulator

Calibration Equipment Required

Compensated Thermocouple Simulator. Precision voltage source providing conformity to NIST Monograph 125 thermocouple curves. Reflect accuracy of simulator to desired calibration span. A simulator accuracy four times better than the transmitter is recommended (0.05% of calibrated span or 0.005mV whichever is greater). Simulator inaccuracies greater than this will degrade system accuracy and factory calibration is recommended.

Voltmeter. Such as a 5-digit DVM. Accuracy is $\pm 0.01\%$; resolution is 1 mV.

dc Power Supply. Power capability is 24 Vdc at 35 mA.

Thermocouple Wire. Use the same type as that used in the construction of the thermocouple.

Readout Resistor. The transmitter test terminals give a 40–200 mV signal. If this is not suitable for the test equipment available, a $\pm 0.1\%$ tolerance, 0.5 W precision wirewound resistor is needed. Suggested values include a 100-ohm resistor to give a 0.4 to 2 volt output; 250 ohms for 1 to 5 volts; or 500 ohms for 2 to 10 volts.

Calibration Procedure

1. Remove the cover from the terminal side of the transmitter housing.
2. If a thermocouple is already connected, remove all thermocouple lead connections.
3. Connect the equipment as shown in Figure 3-4. Be sure to maintain polarity from the transmitter to the thermocouple simulator. Make terminal connections using miniature banana plugs.
4. If trimming the transmitter to a new range, you may have to reposition the Coarse Zero Jumper on the Range Board. If so, see the Disassembly Procedure on page 4-4. Position the jumper in the location shown in Table . (A transmitter with a base temperature outside the regions shown in Table is a special design and does not contain a Coarse Zero Jumper. Also, Model 444 TR and TS transmitters do not have Coarse Zero Jumpers.) Reassemble the circuit boards.
5. Determine the base and full scale temperatures.
6. Turn the power on.
7. Refer to the thermocouple simulator instructions for setting the thermocouple type and engineering units. Set the simulator to the base (zero) temperature and adjust the zero pot until the output is 4 mA (or 40 mV at the test terminals).
8. Set the simulator to the full scale temperature and adjust the span pot until the output is 20 mA (or 200 mV at the test terminals).
9. Repeat steps 7 and 8 until you obtain the 4 and 20 mA readings without readjusting the pots. Use the “overshoot” technique described in step 9 of the RTD calibration procedure, if desired.
10. Disconnect the simulator leads. Reconnect the thermocouple and power leads, if required. Replace the terminal side housing cover.
11. Mark the new range in the “Calibration” space on the nameplate.

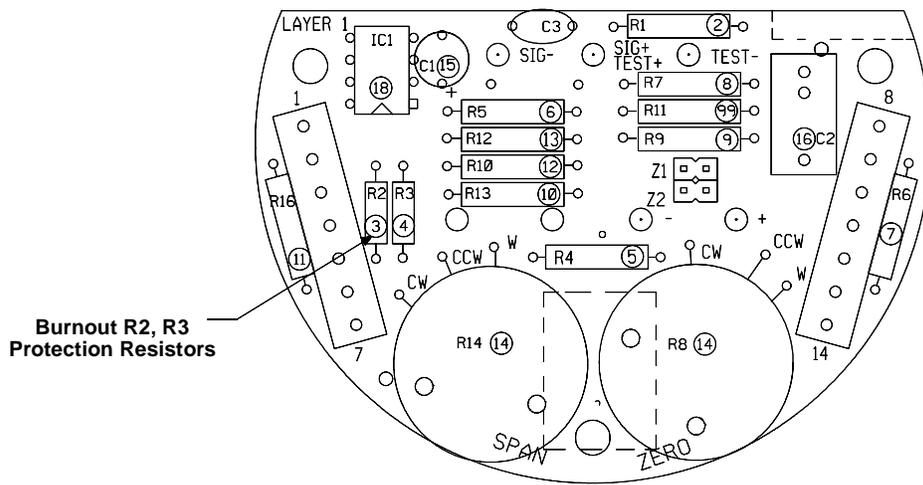
Rosemount Model 444 Alphaline Temperature Transmitters

TABLE 3-2. Coarse Zero Jumper Location, Model 444TJ, TK, TF, TT, and MV Range Code 1.

| Transmitter Base Region | | | Coarse Zero Jumper Location |
|-------------------------|------------|---------|-----------------------------|
| °C | °F | mV | |
| -50 to 50 | -58 to 122 | -2 to 3 | Z1 |
| 50 to 100 | 122 to 302 | 3 to 8 | Z2 |

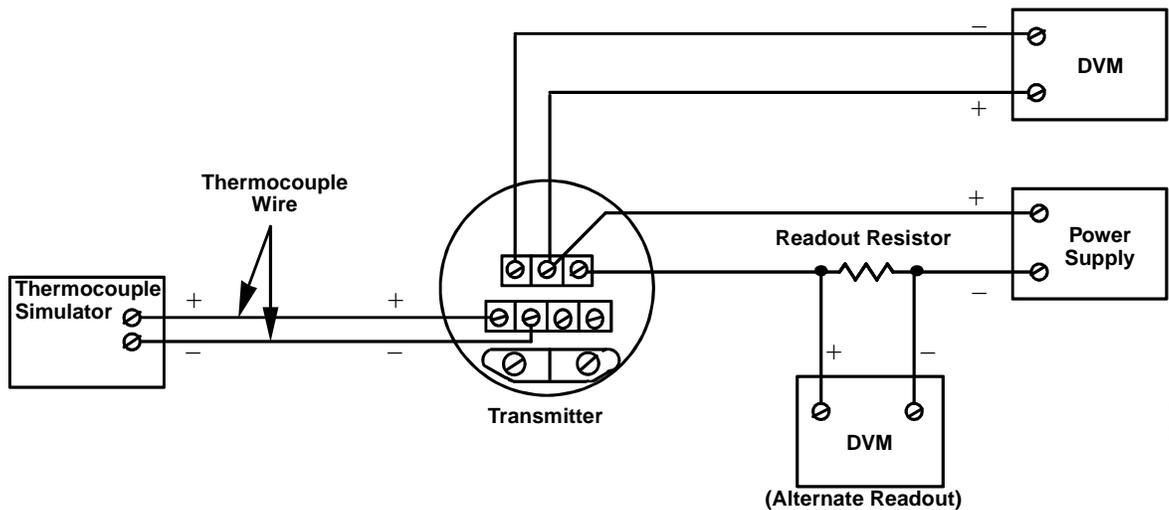
NOTE
Range Codes 2 and 3 are continuously adjustable over the range shown in Table 1. (No Coarse Zero Jumper)

FIGURE 3-3. Location of Burnout Protection Jumper on Model 444T Range Board.



444-0010ACCA

FIGURE 3-4. Compensated Thermocouple Simulator Calibration Diagram.



444-0216A

Using an Ice Bath

Calibration Equipment Required

Millivolt Source. Precision voltage source providing outputs from -10 to 100 mV. Reflect accuracy of four times better than the 444 transmitter is recommended (0.05% of calibrated span or 0.005 mV whichever is greater).

Voltmeter. Such as a 5-digit DVM. Accuracy is $\pm 0.01\%$; resolution is 1 mV.

dc Power Supply. Power capability is 24 V dc at 35 mA.

Thermocouple Wire. Use the same type as that used in the construction of the thermocouple.

Readout Resistor. The transmitter test terminals give a 40 – 200 mV signal. If this is not suitable for the test equipment available, a $\pm 0.1\%$ tolerance, 0.5 W precision wirewound resistor is needed. Suggested values include a 100 -ohm resistor to give a 0.4 to 2 volt output; 250 ohms for 1 to 5 volts; or 500 ohms for 2 to 10 volts.

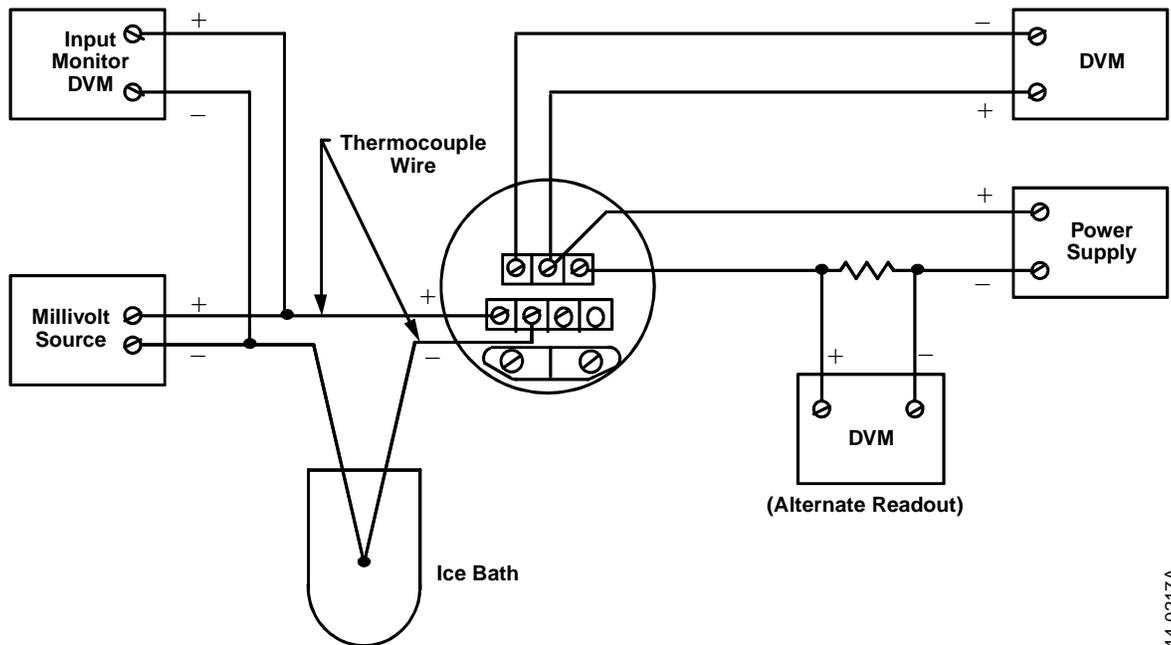
Ice Bath. For highest accuracy, a stirred ice bath (such as a Rosemount 911A) should be used, as well as ice made from deionized or distilled water.

Input Monitor Voltmeter. Use to monitor source when required. Resolution of ± 0.001 mV for ranges up to 100 mV. This can be the same as voltmeter used to measure transmitter output if rangeability and resolution are sufficient for both levels.

Calibration Procedure

1. Remove the cover from the terminal side of the transmitter housing.
2. Install the equipment as shown in Figure 3-5 and allow the thermocouple junctions to stabilize at the ice point. Make terminal connections with miniature banana plugs.
3. If trimming the transmitter to a new range, you may have to reposition the Coarse Zero Jumper on the Range Board. If so, see the disassembly procedure on page 4-4. Position the jumper in the location shown in Table . (A transmitter with a base temperature outside the regions shown in Table is a special design and does not contain a Coarse Zero Jumper. Also, Model 444 TR and TS transmitters do not have Coarse Zero Jumpers.)
4. Determine the thermocouple millivolt levels at the desired base and full scale temperatures. See NIST Monograph 125 or Table B-1.
5. Turn the power on.
6. Set the millivolt source until the monitoring voltmeter reads the emf corresponding to the desired base temperature. Adjust the zero pot until the output is 4 mA.
7. Set the millivolt source until the monitoring voltmeter reads the emf corresponding to the desired full scale temperature. Adjust the span pot until the output is 20 mA.
8. Repeat steps 6 and 7 until you obtain the 4 and 20 mA readings without readjusting the pots. Use the “overshoot” technique described in step 9 of the RTD calibration procedure, if desired.
9. Mark the correct range in the “calibration” space on the nameplate.

FIGURE 3-5. Ice Bath Calibration Diagram.



444-0217A

CALIBRATING A LOW-POWER TRANSMITTER

Calibration Equipment Required

Voltmeter. Such as a 5-digit DVM. Accuracy is $\pm 0.01\%$; resolution is 1 mV.

dc Power Supply. Power capability is 5 V dc at 1.5 mA for Model 444LL and 8 V dc at 2 mA for Model 444LM.

Resistance Decade Box. Precision type, 5-dial, with largest dial providing 100-ohm steps. Accuracy is ± 0.02 ohm. The decade box should be periodically calibrated against a 5-dial Wheatstone bridge.

Lead Simulation Resistors. If the transmitter is to be mounted remote from the RTD, and the lead resistance between the transmitter and the RTD is greater than 2 ohms per lead (equivalent to 200 ft of 20 AWG wire), the transmitter should be trimmed with simulated lead resistances for best accuracy. This requires wirewound resistors with resistance values equal to the nominal lead resistance of the RTD.

Load Resistor. If the transmitter is to be operated with a load that is significantly different from the DVM used for calibration, a load resistor can be used for best calibration accuracy. A metal film, carbon comp, or wirewound resistor, as well as a decade box can be used to simulate the actual load.

Calibration Procedure

The following steps describe the procedure for calibrating a low-power transmitter, as shown in Figure 3-6:

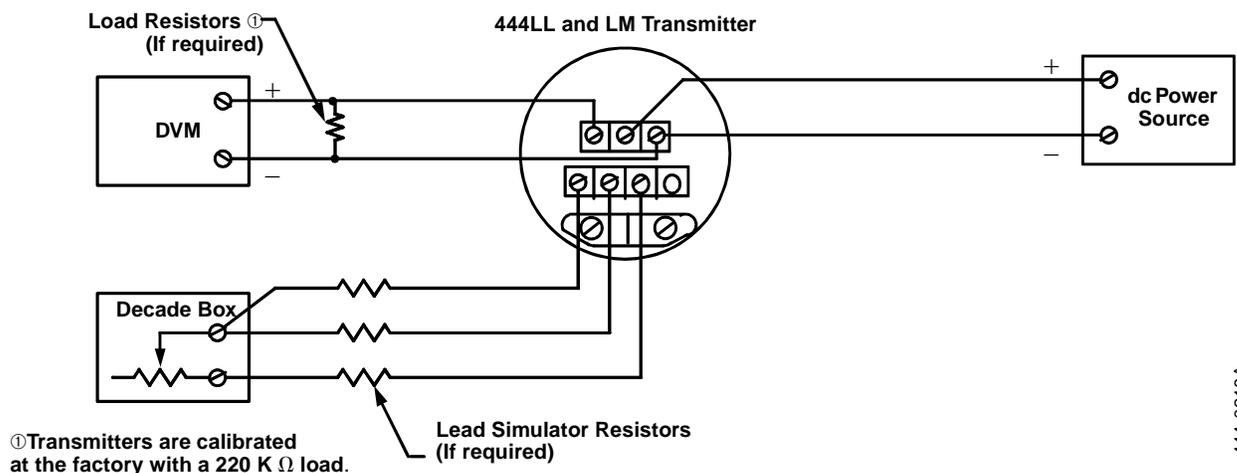
1. Remove the cover from the terminal side of the transmitter housing.
2. If an RTD is already connected, remove all RTD lead connections.
3. Attach the calibration test equipment as shown in Figure 3-6. Make terminal connections using miniature banana plugs. Use simulated lead resistors only if necessitated by long lead wire lengths, as discussed above.

NOTE

If using RTD configurations other than the 3-wire design shown in Figure 3-2, refer to Figure 2-6 on page 2-6 for the correct wiring.

4. Determine the RTD resistance at the desired base- and full-scale temperatures. For Calibration Code 1 (see Table 5-5), obtain these resistances from Table B-1.
5. Turn the power on.
6. Set the decade box to the resistance corresponding to the desired base temperature. Adjust the zero potentiometer until the output is 0.8 V for Model 444LL or 1.0 V for Model 444LM.
7. Set the decade box to the resistance corresponding to the desired full-scale temperature. Adjust the span potentiometer until the output is 3.2 V for Model 444LL or 5.0 V for Model 444LM.
8. Repeat steps 6 and 7 until you obtain both the zero- and full-scale readings without adjusting the span and zero potentiometers. Complete this process more quickly by noting the full-scale reading before readjusting the span pot, using the span pot to overshoot the desired reading by 20%, and then using the zero pot to readjust the full scale reading.
9. Disconnect the decade box and the readout. Reconnect the RTD and power leads. Replace the terminal cover.
10. Mark the correct range in the “Calibration” space on the nameplate.

FIGURE 3-6. Low-Power Transmitter Calibration Diagram.



**CALIBRATING A
MILLIVOLT
TRANSMITTER**

Calibration is identical to the thermocouple type (see Figure 3-5 on page 3-8), except that a reference junction and ice bath are not used. The millivolt source is connected directly to the transmitter input terminals with copper wire, and the desired millivolt levels are entered directly. See Table 3-2 for Coarse Zero Jumper locations.

Maintenance and Troubleshooting

OVERVIEW

This section contains the following transmitter maintenance and troubleshooting information:

Hardware Diagnostics

- Troubleshooting
- Repair
 - Disassembly Procedure
 - Reassembly Procedure
 - Interchangeability of Parts
 - Burnout Protection Adjustments
- Repair and Warranty Service
- Return of Materials

⚠ WARNING

Use only the procedures and new parts specifically referenced in this manual. Unauthorized procedures or parts can affect product performance and the output signal used to control a process, and may render the instrument dangerous. Direct any questions concerning these procedures or parts to Rosemount Inc.

HARDWARE DIAGNOSTICS

If you suspect a malfunction, refer to Table 4-1 to verify that transmitter hardware and process connections are in good working order. Under each of the seven major symptoms, you will find specific suggestions for solving the problem. Always deal with the most likely and easiest-to-check conditions first.

TROUBLESHOOTING

This section offers tips for troubleshooting several kinds of potential malfunctions. To determine a malfunction, use pin-like probes to break through the protective coating to make measurements on a circuit board.

Rosemount Model 444 Alphaline Temperature Transmitters

TABLE 4-1. Transmitter Troubleshooting Symptoms and Corrective Actions.

| Symptom | Potential Source | Corrective Action |
|--|----------------------|---|
| High Output | Sensor | Check for a sensor or thermocouple open circuit. (RL, MV, T-Series with upscale burnout protection only) |
| | Loop Wiring | Check for dirty or defective terminals, interconnecting pins, or receptacles. |
| | Electronics Assembly | Check for dirty or defective interconnecting pins. |
| Erratic Output | Loop Wiring | Check for adequate voltage to the transmitter. Check for intermittent shorts, open circuits, and multiple grounds. Check for dirty or defective terminals or interconnection pins. |
| | Electronics Assembly | Check for dirty or defective interconnecting pins. |
| Low Output or No Output | Sensor | Check RTD leads to ensure that they are not shorting together or to ground. (RL only) Check for correct RTD lead connection. (RL only) Check for open RTD lead on double-lead side. (RL only) |
| | Loop Wiring | Check for adequate voltage to the transmitter. (RL only) Check for intermittent shorts, open circuits, and multiple grounds. (MV, T series only) Check for proper polarity at the signal terminal. (MV, T series only) Check for dirty or defective terminals or interconnection pins. |
| Excessive Current (over 30 mA) | Loop Wiring | Check for short between current signal leads. Check to ensure that current signal leads ARE NOT connected to sensor terminals. Check that sensor leads ARE NOT grounded when positive side of power supply is grounded (RL, RL___B0912, LL, and LM) |
| | Electronics Assembly | Check for defective components in amplifier or current control section. |
| Excessive Output Shift with Ambient Temperature | Sensor | Check for incorrect thermocouple type or Incorrect thermocouple polarity connection (T series only) |
| | Electronics Assembly | Check to ensure that the burnout -protection jumpers positioned correctly (MV, T series only). Check for defective components in voltage regulator or dc-to-ac converter section (MV, T series only). Check for defective components in amplifier or current control section (all models). May require replacement electronics assembly. |
| Unit Cannot be Trimmed to Desired Base Temperature | Transmitter | Check to ensure that unit is capable of desired range. |
| | Electronics Assembly | Check to ensure that the range board jumper is in the correct position. Check to ensure that the burnout -protection jumpers positioned correctly. (MV, T series only). Check for defective zero pot. |
| Unit Cannot be Trimmed to Desired Span. | Transmitter | Check to ensure that unit is capable of desired range. |
| | Loop Wiring | Check for adequate voltage to the transmitter. |
| | Electronics Assembly | Check for defective components in amplifier or current control section. Check for defective components in voltage regulator section. Check for defective span pot. |

REPAIR**⚠ WARNING**

Exposure to hazardous substances can cause death or serious injury. If a hazardous substance is identified, a Material Safety Data Sheet (MSDS), required by law to be available to people exposed to specific hazardous substances, must be included with the returned materials.

In case of a failure, particularly one in which the transmitter's output goes to one extreme and stays there, the first step is to determine whether the fault lies with the sensor(s) or the transmitter. Although only a careful calibration can determine sensor shifts, catastrophic failures (such as an open or shorted sensor element) can be checked with an ohmmeter at the time the transmitter is disconnected from the sensor(s).

NOTE

The Resistance vs. Temperature and Millivolt vs. Temperature tables for the standard Model 444 sensor input types are presented in Table B-1 in **Appendix B Temperature Sensor Reference Information**.

RTD Test: A platinum RTD with an ice-point (°C) resistance of 100 ohms should read approximately as shown in Table B-1 at other temperatures. The resistance between the two leads on the same side of the sensing element should be low, a few ohms at most. Resistance between any of the RTD leads and the sensor sheath should be high (1 megohm or greater).

Thermocouple Test: Thermocouple resistance should be low (10 ohms or less for short runs of heavy wire). For longer runs of extension wire, resistance will be roughly ten times the resistance of copper wire of the same diameter. If the sensor and receiving equipment are functioning properly, the transmitter will probably require repair.

The transmitter is designed for easy replacement of its plug-in, modular circuit boards. A malfunction can be most easily isolated by substituting boards one at a time until the unit functions properly.

It is recommended that customers return defective circuit boards to Rosemount Inc. for repair (see "RETURN OF MATERIALS" on page 4-6). This ensures that replacement parts meet the design criteria for the board and that the malfunctioning board is completely checked and repaired.

Rosemount Inc. offers a circuit board repair/replacement program through its many service centers. Please contact your Rosemount field sales office for price and delivery information.

Disassembly Procedure

⚠ WARNING

Explosion can cause death or serious injury. Do not remove the instrument cover in explosive atmospheres when the circuit is alive.

⚠ WARNING

High voltage that may be present on leads can cause electrical shock. Make sure all power to the transmitter is off before wiring.

NOTE

The numbers in parentheses refer to parts shown in the Illustrated Parts List, Table 5-7, in **Section 5 Specifications and Reference Data**.

1. Terminal blocks for making all field wiring electrical connections are located in a compartment identified as “Terminal Side” on the nameplate. The sensor terminals, power supply and signal-test terminals, as well as the zero and span adjustments are accessible by removing the Electronics Housing Cover (2) from the terminal side. The terminals are permanently attached to the housing and must not be removed.
2. The transmitter electronics Circuit Board Assembly (5, 6, 7) is located in a separate compartment, identified as “Circuit Side” on the nameplate. Make sure power is off. Then remove Circuit Side Cover (2).

NOTE

On the standard RTD input (Model 444RL), fast turn-on (Model 444RL __B0912), and low-power (Models 444LL and LM) units, boards 5 and 6 are integrated into one board.

3. Remove the three Circuit Board Assembly Screws (4).
4. Push equally on the zero and span adjustment pot shafts from the terminal side. This will allow you to grasp and remove the Circuit Board Assembly.
5. If troubleshooting is required, it is best to keep the Circuit Board Assembly together for initial evaluation. Otherwise, the board assembly may be disassembled by grasping the Output Board (5) around its circumference and pulling it gently and evenly away from the other two boards. Remove the Amplifier Board (6) in the same manner. Take care not to bend the interconnection pins.
6. The adjustment pot shafts are sealed by two small O-rings (1D). Remove, if necessary, by taking off the O-ring Retainer Plate (1B), which is held in place by two small screws (1C).
7. The Nameplate (1E), Hazardous Service Certification Label (9), and Instrument Tag (8) are held in place with Drive Screws (1F). Remove any of these by gripping the head of the Drive Screw with pliers and carefully turning counter-clockwise.

Reassembly Procedure

WARNING

Explosions can cause death or serious injury. Both transmitter covers must be fully engaged to meet explosion-proof requirements.

1. Inspect all O-rings (1D,3) and replace if necessary. Lightly grease new O-rings with silicone grease to guarantee an adequate seal.
2. If the O-ring Retainer Plate (1B) has been removed, be sure the correct side is facing outward. The resistor symbol should be visible on RTD Transmitters, while a thermocouple symbol should be visible on Thermocouple or Millivolt transmitters.
3. Inspect threaded connections on the housing and covers to make sure a minimum of five undamaged threads will be fully engaged. If the threads are shiny, apply a thin layer of molybdenum disulphide thread coating (such as Moly-Kote) to prevent galling of the aluminum threads.
4. If the Range Board (7A) requires a Coarse Zero Jumper (7B) check to make sure it is in the correct location for the desired temperature range. See Table 3-1, on page 3-3 or Table 3-2, on page 3-6.
5. Orient the Range Board (7A) and Amplifier Board (6) as shown in the Illustrated Parts List. Taking care not to bend the pins, plug the Amplifier Board into the Range Board. Press together until all three standoffs on the Amplifier Board rest against the Range Board.
6. Orient the Output Board (5) so its standoffs line up with the standoffs of the Amplifier/Range Board combination. Carefully and evenly, plug the output board into the Amplifier/Range Board. Take care not to bend the pins. Press together until all three standoffs on the Output Board rest against the Amplifier Board.
7. The circuit board assembly may be bench-tested, or calibrated outside the housing through the use of Test Terminal Strips (11 and 12). See the discussion of Calibration and Troubleshooting in this section.
8. If the circuit board assembly has been calibrated outside the housing, be very careful to ensure the zero and span adjustment pots are not moved while inserting the circuit board assembly into the housing.
9. Orient the circuit board assembly so the pot shafts line up with the pot holes in the housing.
10. Insert the circuit board assembly firmly into the housing.
11. Replace the three Circuit Board Assembly Screws (4).
12. Replace the transmitter covers (2). Tighten the covers hand-tight.

Interchangeability of Parts

WARNING

Use only the procedures and new parts specifically referenced in this manual. Unauthorized procedures or parts can affect product performance and the output signal used to control a process, and may render the instrument dangerous. Direct any questions concerning these procedures or parts to Rosemount Inc.

Mechanical Parts

- All mechanical hardware is interchangeable among units without regard to model numbers.
- Nameplates are interchangeable only among units that share the same input types (i.e. RTD, Thermocouple, or Millivolt).

Electrical Parts

- Amplifier Board: Interchangeable among Models 444T and 444M.
- Output Board: 444T series (TE, TJ, TK, TT, TR, TS) and 444MV share a common output board.
- Range Board: Interchangeable among units of the same input code (e.g., 444RL1).

Burnout Protection Adjustments

The Model 444T series (TE, TJ, TK, TT, TR, TS) and Model 444MV have a resistor network that drives the output either upscale or downscale if an open occurs in the input circuit. This option is identified in the model number. To convert from upscale to downscale, disassemble the circuit board assembly and remove R3 (22 meg, ¼WCC resistor) from the range board. To convert from downscale to upscale, replace R3. If no burnout protection is desired (as in some instances where the source has a high input impedance), remove both R2 and R3. See Figure 3-3, on page 3-6.

Model 444RL has a jumper on the range board to select burnout protection. Placing the jumper in the “U” position will cause the output to be driven upscale if the RTD opens. If the jumper is in the “D” position the output will be driven downscale. See Figure 3-1, on page 3-3. Models 444LL and 444LM have inherent upscale burnout protection that cannot be changed. Model 444RL also has a jumper on the range board to specify mA output at the transmitter test terminals. Setting the jumper at the “V” position produces a 40–200 mV output at the test terminals. Setting the jumper at the “A” position produces a 4–20 mA output at the test terminals. See Figure 3-1, on page 3-4.

REPAIR AND WARRANTY SERVICE

Repair and warranty service is available through the Rosemount Regional Service Centers. Submit damage claims directly to the carrier.

RETURN OF MATERIALS

CAUTION

Exposure to hazardous substances can cause death or serious injury. If a hazardous substance is identified, a Material Safety Data Sheet (MSDS), required by law to be available to people exposed to specific hazardous substances, must be included with the returned materials.

To expedite the return process, call the Rosemount North American Response Center toll-free at 800-654-RSMT (7768). This center, available 24 hours a day, will assist you with any needed information or materials.

The center will ask for product model and serial numbers, and will provide a Return Material Authorization (RMA) number. The center will also ask for the name of the process material the product was last exposed to.

The Rosemount North American Response Center will detail the additional information and procedures necessary to return goods exposed to hazardous substances.

Specifications and Reference Data

FUNCTIONAL SPECIFICATIONS

Inputs

Models 444RL, LL, and LM

100 Ω R_0 platinum RTD per IEC 751.

Model 444T

Thermocouple types E, J, K, T, R, and S per NIST (grounded or ungrounded).

Model 444MV

Millivolt input (grounded or ungrounded) source impedance less than 100 Ω .

R-numbers, specials

Special inputs other than standards, consult factory.

Spans

RTD

| | |
|----------|---|
| Platinum | 45 to 135 °F (25 to 75 °C). 125 to 380 °F (70 to 210 °C). 360 to 1080 °F (200 to 600 °C). |
| Copper | 180 to 540 °F (100 to 300 °C). |
| Nickel | 45 to 360 °F (25 to 200 °C). |

Thermocouples

| | |
|-----------------|-----------------------------------|
| Type J, K, E, T | 180 to 540 °F (100 to 300 °C). |
| Type J | 504 to 1458 °F (280 to 810 °C). |
| Type K, E | 504 to 1510 °F (280 to 840 °C). |
| Type K | 845 to 2540 °F (470 to 1410 °C). |
| Type R, S | 1467 to 3000 °F (815 to 1670 °C). |

Millivolt

5 to 15 mV.
15 to 45 mV.

Outputs

Linear with temperature for RTD inputs.

Linear with millivolt input signal for thermocouple or millivolt inputs; thermocouple and millivolt models input/output isolated to 500 V dc.

Models 444RL, T, MV

4–20 mA.

Model 444LL

0.8–3.2 V dc.

Model 444LM

1.0–5.0 V dc.

Output Limits (approximate)

Models 444RL, T, MV

Low: 3.9 mA dc.
High: 30.0 mA dc.

Model 444LL

Low: 0.1 V dc.
High: 4.2 V dc.

Model 444LM

Low: 0.125 V dc.
High: 6.2 V dc.

Power Supply

Models 444RL, T, and MV

12 to 45 V dc at terminals of transmitter.

Model 444LL

5 to 12 V dc (overvoltage protected to 24 V dc)
max current = 1.5 mA.

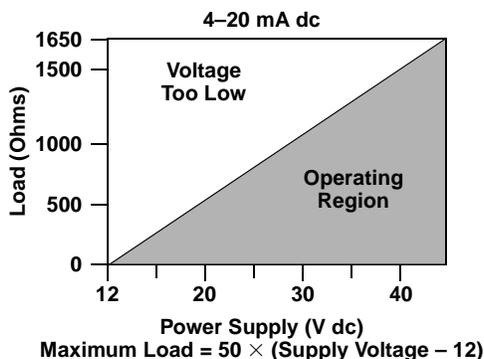
Model 444LM

8 to 12 V dc (overvoltage protected to 24 V dc)
max current = 2.0 mA.

Load Limits

Models 444RL, T, and MV

4–20 mA dc.



Span and Zero

Continuously adjustable, as defined in the ordering table. Adjustments are accessible from the terminal side of the transmitter housing.

Transmitter Temperature Limits

–13 to 185 °F (–25 °C to 85 °C), transmitter operates within specifications.

–40 to 212 °F (–40 °C to 100 °C), transmitter operates without damage.

–58 to 248 °F (–50 °C to 120 °C), storage.

–13 to 149 °F (–25 °C to 65 °C), transmitter operates within specifications for meter option.

Loss of Input

Upscale burnout indication standard for RTD inputs, downscale burnout indication optional. Upscale burnout indication standard for thermocouple and millivolt inputs; downscale burnout indication or no indication optional.

Turn-on Time

2 seconds. No warm-up required.

**PERFORMANCE
SPECIFICATIONS****Accuracy**

$\pm 0.2\%$ of calibrated span (or, for thermocouple and millivolt inputs, ± 0.02 millivolts, whichever is greater). $\pm 0.5\%$ for copper, nickel, and isolated RTD inputs, 0.1% for differential RTD inputs. Includes combined effects of transmitter repeatability, hysteresis, linearity (conformity instead of linearity for thermocouple input), and adjustment resolution. Does not include sensor error.

Stability

$\pm 0.2\%$ of calibrated span for six months.

Ambient Temperature Effect

Errors for $50\text{ }^{\circ}\text{F}$ ($28\text{ }^{\circ}\text{C}$) change in ambient temperature.

RTD Inputs

Zero: $\pm 0.17\text{ }^{\circ}\text{C}$,

plus

Span: $\pm 0.22\%$,

plus

Elevation/Suppression: $\pm 0.083\%$ of base temperature in $^{\circ}\text{C}$.

T/C Inputs (Includes Effect of Cold Junction)

Zero: $\pm 1.38\text{ }^{\circ}\text{C}$,

plus

Span: $\pm 0.28\%$ of span,

plus

Elevation/Suppression: $\pm 0.11\%$ of base temperature in $^{\circ}\text{C}$.

Millivolt Inputs

Zero: $\pm 0.038\text{ mV}$,

plus

Span: $\pm 0.28\%$ of span,

plus

Elevation/Suppression: $\pm 0.11\%$ of base input in mV.

Input Impedance (Thermocouple and mV Inputs)

More than 1 megohm—burnout resistors disconnected.

Power Supply Effect

$\pm 0.005\%$ per volt.

Load Effect

No load effect other than the change in voltage supplied to the transmitter.

Vibration Effect

$\pm 0.05\%$ of span per g to 200 Hz in any axis for 3 g's up to 33 Hz, 2 g's from 33 to 70 Hz and 1 g from 70 to 200 Hz.

Mounting Position Effect

None.

PHYSICAL SPECIFICATIONS

Materials of Construction

Electronics Housing

Low-copper aluminum. (NEMA 4X). IP 54, IP 65, IP 66.

Housing Paint

Polyurethane.

Housing O-rings

Buna-N.

Sensor and Conduit Connections

1/2-inch conduit on electronics housing. Screw terminals and integral test jacks compatible with miniature banana plugs (Pomona 2944, 3690 or equal).

Weight

Transmitter: 3 lb (1.4 kg).

Transmitter with mounting bracket: 4 lb (1.8 kg).

Hazardous Location Certifications

Factory Mutual (FM) Approvals

E5 Explosion Proof: Class I, Division 1, Groups B, C, and D. Dust Ignition Proof: Class II, Division 1, Groups E, F, and G; Class III, Division 1 hazardous locations. Indoor and outdoor use. NEMA Enclosure Type 4X.

Refer to Factory Mutual Explosion Proof Drawing 00444-0261.

I5 Intrinsic Safety: Class I, Division 1, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III, Division 1 hazardous locations; Intrinsically safe system only when applying Table 5-1 entity parameters. Nonincendive: Class I, Division 2, Groups A, B, C, and D; Indoor and outdoor use. NEMA Enclosure Type 4X.

Refer to Factory Mutual Intrinsic Safety Drawing 01151-0214.

K5 Combination of E5 and I5.

TABLE 5-1. FM Entity Parameters.

| Model 444 Parameters | Associated Equipment Parameters | FM Approved for Class I, II, III, Division 1, Groups | | |
|---|---|--|----|----------|
| | | A | B | C thru G |
| $V_{MAX} = 40\text{ V}$ $I_{MAX} = 165\text{ mA}$ $C_i = 0.044\mu\text{F}$ $L_i = 0$ | V_{OC} or $V_T \leq 40\text{ V}$ I_{SC} or $I_T \leq 165\text{ mA}$ $C_A > 0.044\mu\text{F}$ $L_A > 0$ | • | • | • |
| $V_{MAX} = 40\text{ V}$ $I_{MAX} = 225\text{ mA}$ $C_i = 0.044\mu\text{F}$ $L_i = 0$ | V_{OC} or $V_T \leq 40\text{ V}$ I_{SC} or $I_T \leq 225\text{ mA}$ $C_A > 0.044\mu\text{F}$ $L_A > 0$ | NA | NA | • |

Canadian Standards Association (CSA) Approvals

E6 Explosion Proof: Class I, Division 1, Groups C and D; Dust-ignitionproof Class II, Division 1, Groups E, F, and G; Class III, Division 1 hazardous locations; Suitable for Class I, Division 2, Groups A, B, C, and D; CSA Enclosure Type 4X.

I6 Intrinsic Safety: Class I, Division 1, Groups A, B, C, and D. Intrinsically safe system only when applying Table 5-2 parametric parameters. Temperature code T2D. CSA Enclosure Type 4X.

Refer to CSA Intrinsic Safety Drawing 00444-0034.

C6 Combination of E6 and I6.

TABLE 5-2. CSA Parametric Parameters.

| Barrier Manufacturer/Model | CSA Approved for Class I, Division 1 Groups | | | |
|---|---|----|---|---|
| | A | B | C | D |
| Any CSA approved zener barrier ≤30 V, ≥330 Ω or ≤28 V, ≥300 Ω or ≤22 V, ≥180 Ω | • | • | • | • |
| Foxboro Converters 2AI-I2V-CGB 2AI-I3V-CGB 2AS-I2I-CGB 2AS-I3I-CGB 3AD-I3IA CS-E/CGB-A 3A2-I2D CS-E/CGB-A, 3A2-I3D CS-E/CGB-A 3A4-I2DA CS-E/CGB-A 3F4-I2DA1 CS-E/CGB-A | NA | • | • | • |
| Any CSA approved zener barrier ≤30 V, ≥150Ω | NA | NA | • | • |

Standards Association of Australia (SAA) Certifications

- E7** Flameproof:
Ex d IIB+H2 T6
Class I, Zone 1.
DIP T6
Class II.

Special Conditions for Safe Use (“X”):
For transmitters having NPT or PG cable entry thread, an appropriate flameproof thread adaptor shall be used to facilitate application of certified flameproof cable glands. Only SAA-certified flameproof temperature sensors shall be used with the Model 444 Temperature Transmitter if fitted directly into the tapped entry of the enclosure.

- I7** Intrinsic Safety:
Ex ia IIC T6 (T_{amb} = 40 °C)
Ex ia IIC T5 (T_{amb} = 70 °C)
Class I, Zone 0

Entity Parameters:
U_i = 30 V
I_i = 200 mA
P_i = 1.0 W
C_i = 0.024 μF
L_i = 0

Refer to SAA Intrinsic Safety Drawing 00444-0264.

Special Conditions for Safe Use (“X”):
The equipment has been assessed to the “Entity” concept and upon installation the barrier/entity parameters must be taken into account.

- N7** Type “n”:
Ex n IIC T6 (T_{amb} = 40 °C)
Ex n IIC T5 (T_{amb} = 70 °C)
Class I, Zone 2

Special Conditions for Safe Use (“X”):
The equipment must be connected to a supply voltage which does not exceed the rated voltage. The enclosure end caps must be correctly fitted while the equipment is powered.

Centro Elettrotecnico Sperimentale Italiano (CESI/CENELEC) Certifications

E8 Flameproof:

EEx d IIC T6

I8 Intrinsic Safety:

Model 444RL

EEx ia IIC T6 ($T_{amb} = 40\text{ }^{\circ}\text{C}$) [$P_i = 0.75\text{ W}$]

EEx ia IIC T5 ($T_{amb} = 55\text{ }^{\circ}\text{C}$) [$P_i = 1.0\text{ W}$]

EEx ia IIC T4 ($T_{amb} = 80\text{ }^{\circ}\text{C}$) [$P_i = 1.0\text{ W}$]

Model 444T_ & MV

EEx ib IIB T6 ($T_{amb} = 40\text{ }^{\circ}\text{C}$) [$P_i = 0.75\text{ W}$]

EEx ib IIB T5 ($T_{amb} = 55\text{ }^{\circ}\text{C}$) [$P_i = 1.0\text{ W}$]

EEx ib IIB T4 ($T_{amb} = 80\text{ }^{\circ}\text{C}$) [$P_i = 1.0\text{ W}$]

Entity Parameters:

$V_i = 30\text{ V dc}$

$I_i = 200\text{ mA}$

$P_i = 0.75\text{ W (T6)}$

$P_i = 1.0\text{ W (T5)}$

$P_i = 1.0\text{ W (T4)}$

$C_i = 0.024\text{ }\mu\text{F (Model 444RL)}$

$C_i = 0.006\text{ }\mu\text{F (Model 444T_ \& MV)}$

$L_i = 0.$

Special Conditions for Safe Use (“X”):

If the temperature sensor connected to the input circuit does not tolerate an alternating tension of 500V for 60 seconds, the certified transducers must be powered by galvanically-insulated equipment. Model 444RL temperature transducers must be connected to associated electronic equipment certified to EN 50.014/EN 50.020 standards.

British Approvals Service for Electrical Equipment Flammable Atmospheres (BASEEFA) Type N Certification

N1 Ex N II T5

Maximum Voltage: 35 V dc

Maximum Current: 30 mA dc

An appropriate stainless steel tag will be supplied according to the certification option selected.

**LCD METER
SPECIFICATIONS
(OPTIONS D AND E)****Functional
Specifications****Configuration**

4 mA point limits: -999 to 1000.

Span limits: 0200 to 9999.

The sum of the 4 mA point and span must not exceed 9999. Adjustments are made using non-interactive zero and span buttons.

Temperature Limits

Storage: -40 to 85 °C (-40 to 185 °F).

Operating: -20 to 70 °C (-4 to 158 °F).

Between -40 to -20 °C (-40 to -4 °F) loop is intact and the meter is not damaged.

Humidity Limitation

0 to 95% non-condensing relative humidity.

Update Period

750 ms.

Response Time

Responds to changes in input within a maximum of two update periods. If the filter is activated, then the display responds to the change within nine update periods.

**Performance
Specifications****Digital Display Resolution**

0.05% of calibrated range ± 1 digit.

Analog Bar Graph Resolution

0.05% of calibrated range.

Indication Accuracy

0.25% of calibrated range ± 1 digit.

Stability

Over Time: 0.1% of calibrated range ± 1 digit per six months.

Temperature Effect

0.01% of calibrated range per °C on zero.

0.02% of calibrated range per °C on span over the operating temperature range.

Power Interrupt

All calibration constants are stored in EEPROM memory and are not affected by power loss.

Failure Mode

LCD meter failure will not affect transmitter operation.

Under/Over Range Indication

Input current < 3.5 mA: Display blank.

Input current > 22.0 mA: Display flashes 112.5% of full scale value or 9999, whichever is less.

**Physical
Specification****Meter Size**

2¼-inch diameter face with four, ½-inch high characters.

**ANALOG METER
SPECIFICATIONS
(OPTIONS B AND C)**

**Functional
Specifications**

Meter Indication

0 to 100% linear scale.
Special optional ranges.

Temperature Limits

-40 to 65 °C (-40 to 150 °F).

Humidity Limits

0 to 100% relative humidity.

Zero Adjustment

Adjustment screw on face of meter.

**Performance
Specifications**

Indication Accuracy

±2% of calibrated span.

Temperature Effect

Less than 2% of full scale at any point within the temperature limits.

**Physical
Specification**

Meter Size

2¼-inch diameter face with 2-inch long scale.

TABLE 5-3. 444 Model Structure.

| Model | Product Description | | | | | |
|---|--|------------------|-------------------|------------------|------------------|-------------------|
| 444 | Alphaline Temperature Transmitter | | | | | |
| Code | Input Type ⁽¹⁾ | Temperature Span | | Base Temperature | | Upper Range Limit |
| | | Minimum | Maximum | Minimum | Maximum | |
| RL1 | Platinum RTD | 45 °F (25 °C) | 135 °F (75 °C) | -58 °F (-50 °C) | 300 °F (150 °C) | 435 °F (225 °C) |
| RL2 | 100 Ω R ₀ | 125 °F (70 °C) | 380 °F (210 °C) | -58 °F (-50 °C) | 300 °F (150 °C) | 680 °F (360 °C) |
| RL3 | linearized output | 360 °F (200 °C) | 1080 °F (600 °C) | -58 °F (-50 °C) | 300 °F (150 °C) | 1380 °F (750 °C) |
| RL9 | Special Input, Range or Accuracy (minimum span 3 Ω) | | | | | |
| | Thermocouple | | | | | |
| TJ1 | Type J | 180 °F (100 °C) | 540 °F (300 °C) | -58 °F (-50 °C) | 300 °F (150 °C) | 840 °F (450 °C) |
| TJ2 | Type J | 504 °F (280 °C) | 1458 °F (810 °C) | -58 °F (-50 °C) | 930 °F (500 °C) | 1400 °F (760 °C) |
| TK1 | Type K | 180 °F (100 °C) | 540 °F (300 °C) | -58 °F (-50 °C) | 300 °F (150 °C) | 840 °F (450 °C) |
| TK2 | Type K | 504 °F (280 °C) | 1510 °F (840 °C) | -58 °F (-50 °C) | 930 °F (500 °C) | 2440 °F (1340 °C) |
| TK3 | Type K | 845 °F (470 °C) | 2540 °F (1410 °C) | -58 °F (-50 °C) | 930 °F (500 °C) | 2500 °F (1370 °C) |
| TE1 | Type E | 180 °F (100 °C) | 540 °F (300 °C) | -58 °F (-50 °C) | 300 °F (150 °C) | 840 °F (450 °C) |
| TE2 | Type E | 504 °F (280 °C) | 1510 °F (840 °C) | -58 °F (-50 °C) | 930 °F (500 °C) | 1830 °F (1000 °C) |
| TT1 | Type T | 180 °F (100 °C) | 540 °F (300 °C) | -58 °F (-50 °C) | 300 °F (150 °C) | 750 °F (400 °C) |
| TR1 | Type R | 1467 °F (815 °C) | 3000 °F (1670 °C) | 0 °F (-18 °C) | 1500 °F (815 °C) | 3200 °F (1760 °C) |
| TS1 | Type S | 1467 °F (815 °C) | 3000 °F (1670 °C) | 0 °F (-18 °C) | 1500 °F (815 °C) | 3200 °F (1760 °C) |
| T_9 | Special Range or Accuracy (minimum span 3 mV, maximum span 100 mV) | | | | | |
| MV1 | Millivolt | 5 mV | 15 mV | -2mV | 8 mV | 23 mV |
| MV2 | Millivolt | 15 mV | 45 mV | -2mV | 20mV | 65 mV |
| MV9 | Special Range or Accuracy (minimum span 3 mV, maximum span 100 mV) | | | | | |
| Code | Loss of Input Indication | | | | | |
| U | Upscale (standard for all input types) | | | | | |
| D | Downscale | | | | | |
| N | None (not available for platinum RTD inputs) | | | | | |
| Code | Calibration | | | | | |
| 1 | Trim to IEC 751 Class B (RTD) or NIST Curve (thermocouple) | | | | | |
| 2 | Trim to Specific Model 68/78/88 Calibration Schedule | | | | | |
| 3 | Trim to Other Nominal Curve (customer must specify separately) (Note: Millivolt input must use Code 3.) | | | | | |
| Code | Meter Options | | | | | |
| A | None | | | | | |
| B | Integral Analog Meter, Special Scale (same as calibrated range) | | | | | |
| C | Integral Analog Meter, 0–100% Scale | | | | | |
| D | Integral LCD Meter, 0–100% Scale ⁽²⁾ | | | | | |
| E | Integral LCD Meter, Special Scale (specify range, mode, and engineering units) ⁽¹⁾ | | | | | |
| Code | Mounting Bracket | | | | | |
| 1 | None | | | | | |
| 2 | Mounting Bracket for 2-inch Pipe or Surface Mounting | | | | | |
| Code | Hazardous Area Certifications | | | | | |
| NA | No Certification Required | | | | | |
| E5 | FM Explosion-Proof Approval | | | | | |
| I5 | FM Intrinsic Safety and Non-incendive Approval | | | | | |
| E6 | CSA Explosion-Proof Approval | | | | | |
| I6 | CSA Intrinsic Safety Approval (444RL and 444T only) | | | | | |
| E7 | SAA Explosion-Proof Certification | | | | | |
| I7 | SAA Intrinsic Safety Certification | | | | | |
| N7 | SAA Non-incendive Certification | | | | | |
| E8 | CESI Explosion-Proof Certification (When ordering a transmitter with this option, place a W before the model number: W444.) | | | | | |
| I8 | CESI Intrinsic Safety Certification (When ordering a transmitter with this option, place a W before the model number: W444.) | | | | | |
| N1 | BASEEFA Non-incendive Certification (When ordering a transmitter with this option, place a T before the model number: T444.) | | | | | |
| Code | Options | | | | | |
| Q4 | 2-Point Calibration Certificate | | | | | |
| A1 | One (1) ½ NPT to M20 (CM 20) SST Thread Adapter | | | | | |
| A2 | One (1) ½ NPT to M20 (CM 20) SST Thread Adapter | | | | | |
| Code | Special | | | | | |
| RXXXX | Unique Range (use with RL9, T_9, and MV9 inputs) | | | | | |
| Typical Model Number: 0444 RL3 U 1 A 2 E5 Q4 | | | | | | |

(1) Refer to Temperature Sensors, Assemblies, and Accessories Product Data Sheet, Rosemount pub. no. 00813-0100-2654 for information about Rosemount sensor assemblies.

(2) LCD Meters are only available with RL1, RL2, or RL3. (may be reconfigured in the field.)

Rosemount Model 444 Alhaline Temperature Transmitters

TABLE 5-4. 444RL Fast Turn-on Model Structure.

| Model | Product Description | | | | | |
|--|--|------------------|------------------|------------------------------|-----------------|-------------------|
| 444 | Alhaline Fast Turn-On Temperature Transmitter | | | | | |
| Code | Input Type ⁽¹⁾ | Temperature Span | | Base Temperature (4mA Point) | | Upper Range Limit |
| | | Minimum | Maximum | Minimum | Maximum | |
| RL1 | Platinum RTD 100 Ω R ₀ | 45 °F (25 °C) | 135 °F (75 °C) | -58 °F (-50 °C) | 300 °F (150 °C) | 435 °F (225 °C) |
| RL2 | linearized output | 125 °F (70 °C) | 380 °F (210 °C) | -58 °F (-50 °C) | 300 °F (150 °C) | 680 °F (360 °C) |
| RL3 | linearized output | 360 °F (200 °C) | 1080 °F (600 °C) | -58 °F (-50 °C) | 300 °F (150 °C) | 1380 °F (750 °C) |
| Code | Loss of Input Indication | | | | | |
| U | Upscale (standard for all input types) | | | | | |
| Code | Calibration | | | | | |
| 1 | Trim to IEC 751 Curve (RTD) | | | | | |
| 2 | Trim to Specific Model 68/78/88 Calibration Schedule | | | | | |
| 3 | Trim to Other Nominal Curve (customer must specify separately) | | | | | |
| Code | Meter Options | | | | | |
| A | None | | | | | |
| B | Integral Analog Meter, Special Scale (must specify range, mode, and engineering units) | | | | | |
| C | Integral Analog Meter, 0–100% Scale | | | | | |
| Code | Mounting Bracket | | | | | |
| 1 | None | | | | | |
| 2 | Mounting Bracket for 2-inch Pipe or Surface Mounting | | | | | |
| Code | Hazardous Area Certifications | | | | | |
| NA | No Certification Required | | | | | |
| E5 | FM Explosion-Proof Approval | | | | | |
| E6 | CSA Explosion-Proof Approval | | | | | |
| I6 | CSA Intrinsic Safety Approval | | | | | |
| Code | Options | | | | | |
| Q4 | 2-Point Calibration Certificate | | | | | |
| A1 | One (1) ½ NPT to M20 (CM 20) SST Thread Adapter | | | | | |
| A2 | One (1) ½ NPT to M20 (CM 20) SST Thread Adapter | | | | | |
| Code | Special | | | | | |
| B0912 | Fast Turn-on Electronics | | | | | |
| Typical Model Number: 0444 RL3 U 1 A 2 NA B0912 | | | | | | |

(1) Refer to *Temperature Sensors, Assemblies, and Accessories Product Data Sheet*, Rosemount pub. no. 00813-0100-2654 for information about Rosemount sensor assemblies.

TABLE 5-5. 444LL, LM Model Structure.

| Model | Product Description | | | | |
|--|--|------------------|----------------|------------------------------|---------------|
| 444 | Alkaline Low-Power Temperature Transmitter | | | | |
| Code | Input Type ⁽¹⁾ | Temperature Span | | Base Temperature (4mA Point) | |
| | | Minimum | Maximum | Minimum | Maximum |
| LL1 | Platinum RTD | 75 °F (42 °C) | 150 °F (83 °C) | -25 °F (-32 °C) | 50 °F (10 °C) |
| LM1 | 100 Ω R ₀ Linearized Output | 75 °F (42 °C) | 150 °F (83 °C) | -25 °F (-32 °C) | 50 °F (10 °C) |
| Code | Loss of Input Indication | | | | |
| U | Upscale | | | | |
| Code | Calibration | | | | |
| 1 | Trim to IEC 751 Curve (RTD) | | | | |
| 2 | Trim to Specific Model 68/78/88 Calibration Schedule | | | | |
| Code | Meter Options | | | | |
| A | None | | | | |
| Code | Mounting Bracket | | | | |
| 1 | None | | | | |
| 2 | Mounting Bracket for 2-inch Pipe or Surface Mounting | | | | |
| Code | Options | | | | |
| NA | No Certification Required | | | | |
| E5 | FM Explosion-Proof Approval | | | | |
| E6 | CSA Explosion-Proof Approval | | | | |
| I6 | CSA Intrinsic Safety Approval (444RL and 444T only) | | | | |
| Typical Model Number: 0444 LM1 U 1 A 2 E5 | | | | | |

(1) Refer to *Temperature Sensors, Assemblies, and Accessories Product Data Sheet*, Rosemount pub. no. 00813-0100-2654 for information about Rosemount sensor assemblies.

TABLE 5-6. Meter Kits.

| Part Description | Part Number | Spares Category ⁽¹⁾ |
|---|-----------------|--------------------------------|
| 40–200 mV Analog Meter Kit ⁽²⁾ | 00444-0194-0001 | C |
| 40–200 mV Analog Meter Kit (CENELEC and I.S. approved) ⁽²⁾ | 00444-0194-0005 | C |
| 40–200 mV Analog Meter | 01151-0687-0003 | C |
| 40–200 mV Analog Meter (CENELEC approved) | 01151-0744-0003 | C |
| 4–20 mA LCD Meter Kit ^{(2) (3)} | 00444-0194-0004 | C |
| 4–20 mA LCD Meter | 01151-1300-1000 | C |
| Mounting Hardware and Cover Kit | 00444-0194-0002 | C |
| Mounting Hardware Kit | 00444-0194-0003 | C |
| Cover Assembly | 01151-2610-0001 | C |
| Meter with Special Scale ⁽⁴⁾ | scale: XX to XX | C |

(1) Normally, no spare parts required for C classification.

(2) Meter kit includes meter, mounting hardware, and cover assembly.

(3) LCD Meters are only available with RL1, RL2, and RL3 (may be reconfigured in the field).

(4) For Special Scale Meters, order appropriate meter and indicate special scale desired. Mounting hardware and cover assembly must be ordered separately

Rosemount Model 444 Alphaline Temperature Transmitters

TABLE 5-7. Standard Parts List.

| Item Number | Model | Part Description | Part Number | Spares Category ⁽¹⁾ |
|-----------------|-------|--|---|---|
| 1 | 444R | Housing Kit—RTD Input | 00444-0028-0001 | C |
| | 444T | Housing Kit—Thermocouple Input | 00444-0028-0002 | C |
| | 444M | Housing kit—Millivolt Input | 00444-0028-0003 | C |
| | | Electronics housing kit consists of: 1 each electronics housing (item ^(A)) 1 each O-ring retainer plate (item ^(B)) 2 each 6–32 × 3/16 retainer plate screws (item ^(C)) 2 each pot O-rings (item ^(D)) 1 each nameplate (item ^(E)) 2 each #4–40 × 3/16 screws (item ^(F)) | | |
| ⁽²⁾ | ALL | Housing Cover—Quantity One | 90032-0240-0003 | C |
| ⁽³⁾ | ALL | Housing Cover O-ring | 01151-0033-0003 | C |
| ^(D) | ALL | Adjustment Potentiometer O-ring (pkg. of 12) | 00444-0030-0001 | B |
| ⁽⁴⁾ | ALL | Electronics Assembly Screws, 6–32 × 17/8 (pkg. of 12) | 00444-0031-0001 | C |
| ⁽³⁾ | ALL | Cover O-rings. (pkg. of 12) | 00444-0030-0001 | B |
| ⁽⁵⁾ | ALL | A/O Board—RTD Input (2 board set, Figure 5-1) Output Board—T/C, mV Input (3 board set, Figure 5-2) | 00444-0228-0001 00444-0015-0001 | A A |
| ⁽⁶⁾ | ALL | Amplifier Board—All Inputs (3 board set, Figure 5-2) | 00444-0007-0003 | A |
| ^(7A) | 444R | Range Board—RTD Inputs 25 to 75 °C Span (Input Code RL1) 70 to 210 °C Span (Input Code RL2) 200 to 600 °C Span (Input Code RL3) Special Range RL9 (requires 3 board set – consult factory) | 00444-0221-0001 00444-0221-0002 00444-0221-0003 00444-0003-XXXX | A A A A |
| ^(7A) | 444T | Range Board—Thermocouple Inputs Type J, 100 to 300 °C Span (Input Code TJ1) Type J, 280 to 840 °C Span (Input Code TJ2) Type K, 100 to 300 °C Span (Input Code TK1) Type K, 280 to 840 °C Span (Input Code TK2) Type K, 470 to 1410 °C Span (Input Code TK3) Type E, 100 to 300 °C Span (Input Code TE1) ⁽²⁾ Type E, 280 to 840 °C Span (Input Code TE2) Type T, 100 to 300 °C Span (Input Code TT1) Type R, 815 to 1670 °C Span (Input Code TR1) Type S, 815 to 1670 °C Span (Input Code TS1) Special Range T-9 Kit (consult factory) | 00444-0262-0002 00444-0262-0006 00444-0262-0003 00444-0262-0007 00444-0262-0008 00444-0262-0001 00444-0262-0005 00444-0262-0004 00444-0262-0009 00444-0262-0010 00444-0013-XXXX | A A A A A A A A A A A |
| ^(7A) | 444M | Range Board—Millivolt Inputs 5 to 15 mV (Input Code MV1) 15 to 45 °C Span (Input Code MV2) Special Range MV9 (consult factory) | 00444-0023-0001 00444-0023-0002 00444-0023-XXXX | A A A |
| ^(7B) | 444R | Range Board Zero Jumpers (pkg. of 12) | 00444-0036-0001 | A |
| ⁽⁸⁾ | ALL | Instrument Tag (optional) | 01151-0148 | C |
| ⁽⁹⁾ | ALL | Certification Label | – | C |
| 10 | ALL | Mounting Bracket Kit 1 each mounting bracket (item ^(10A)) 4 each 1/4–20 × 1/2 bolts (item ^(10B)) 2 each U-bolts (item ^(10C)) 4 each 1/4 washers (item ^(10D)) 4 each 5/16–18 nuts (item ^(10E)) 2 each washer plates (item ^(10F)) | 00444-0022-0001 | C |
| ⁽¹¹⁾ | ALL | Terminal Block, Three-position | C10448-0106 | D |
| ⁽¹²⁾ | ALL | Terminal Block, Four-position | C10448-0109 | D |

(1) Spares Categories (2) Thermocouple Range Board Kit Consists of:
 Code A – Recommended 1 spare part per 25 transmitters. 1 each T/C Range Board.
 Code B – Recommended 1 spare part per 50 transmitters. 1 each External CJC Block.
 Code C – None normally required.
 Code D – Not used on transmitters, but recommended for repair activities.

TABLE 5-8. Parts List for Model W444 Transmitter (CESI/CENELEC Approval).

| Item Number | Part Description | Part No. | Spares Category ⁽¹⁾ |
|-------------|---|-----------------|--------------------------------|
| 1 | Housing Kit ⁽²⁾ — RTD Input | 00444-0028-0001 | C |
| | Housing Kit ⁽²⁾ — Thermocouple Input | 00444-0028-0002 | C |
| | Housing kit ⁽²⁾ — Millivolt Input | 00444-0028-0003 | C |
| ② | Housing Cover—Quantity One | 90032-0240-0003 | C |
| ③ | Housing Cover O-rings | 01151-0033-0003 | B |
| ⑩ | Adjustment Potentiometer O-rings | 00444-0030-0001 | B |
| ④ | Electronics Assembly Screws | 00444-0031-0001 | C |
| ⑤ | A/O Board—RTD Input | 00444-0228-0001 | A |
| | Output Board—T/C, mV Input | 00444-0015-0002 | A |
| | Output Board—RD Input | 00444-0111-0001 | A |
| ⑥ | Amplifier Board | 00444-0007-0003 | A |
| ⑦A | Range Board | | |
| | W444 RL1 | 00444-0221-0001 | A |
| | W444 RL2 | 00444-0221-0002 | A |
| | W444 RL3 | 00444-0221-0003 | A |
| | W444 RL9 (consult factory) | 00444-0003-XXXX | A |
| | W444 TJ1 | 00444-0262-0002 | A |
| | W444 TJ2 | 00444-0262-0006 | A |
| | W444 TK1 | 00444-0262-0003 | A |
| | W444 TK2 | 00444-0262-0007 | A |
| | W444 TK3 | 00444-0262-0008 | A |
| | W444 TE1 | 00444-0262-0001 | A |
| | W444 TE2 | 00444-0262-0005 | A |
| | W444 TT1 | 00444-0262-0004 | A |
| | W444 TR1 | 00444-0262-0009 | A |
| | W444 TS1 | 00444-0262-0010 | A |
| | W444 T_9 (consult factory) | 00444-0013-XXXX | A |
| | W444 MV1 | 00444-0023-0001 | A |
| | W444 MV2 | 00444-0023-0002 | A |
| | W444 MV9 (consult factory) | 00444-0023-XXXX | A |
| ⑦B | Range Board Zero Jumpers | 00444-0036-0001 | A |
| 10 | Mounting Bracket Kit | 00444-0022-0001 | C |
| ⑪ | Terminal Block, Three-position | C10448-0106 | D |
| ⑫ | Terminal Block, Four-position | C10448-0109 | D |

(1) Spares Categories

Code A – Recommended one spare part per 25 transmitters.

Code B – Recommended one spare part per 50 transmitters.

Code C – None normally required. Code D – Not used on transmitters, but recommended for repair activities (see Instruction Manual).

(2) Housing kit includes housing, adjustment potentiometer O-rings, O-ring retainer plate and nameplate.

Rosemount Model 444 Alphaline Temperature Transmitters

TABLE 5-9. Parts List for Model T444 Transmitter (BASEEFA Approval).

| Item Number | Part Description | Part No. | Spares Category ⁽¹⁾ |
|----------------------------|--|-----------------|--------------------------------|
| 1 | Housing Kit ⁽²⁾ —RTD Input | 00444-0028-0001 | C |
| | Housing Kit ⁽²⁾ —Thermocouple Input | 00444-0028-0002 | C |
| | Housing kit ⁽²⁾ —Millivolt Input | 00444-0028-0003 | C |
| ② | Housing Cover—Quantity One | 90032-0240-0003 | C |
| ③ | Housing Cover O-rings | 01151-0033-0003 | B |
| ⑩ | Adjustment Potentiometer O-rings | 00444-0030-0001 | B |
| ④ | Electronics Assembly Screws | 00444-0031-0001 | C |
| ⑤ | A/O Board—RTD Input | 00444-0228-0001 | A |
| | Output Board—T/C, mV Input | 00444-0015-0001 | A |
| ⑥ | Amplifier Board | 00444-0007-0003 | A |
| ⑦A | Range Boards | | |
| | T444 RL1 | 00444-0136-0001 | A |
| | T444 RL2 | 00444-0136-0002 | A |
| | T444 RL3 | 00444-0136-0003 | A |
| | T444 RL9 (consult factory) | 00444-0136-XXXX | A |
| | T444 TE1 | 00444-0273-0001 | A |
| | T444 TJ1 | 00444-0273-0002 | A |
| | T444 TK1 | 00444-0273-0003 | A |
| | T444 TT1 | 00444-0273-0004 | A |
| | T444 TE2 | 00444-0273-0005 | A |
| | T444 TJ2 | 00444-0273-0006 | A |
| | T444 TK2 | 00444-0273-0007 | A |
| | T444 TK3 | 00444-0273-0008 | A |
| | T444 TR1 | 00444-0273-0009 | A |
| | T444 TS1 | 00444-0273-0010 | A |
| | T444 T_9 (consult factory) | 00444-0138-XXXX | A |
| | T444 MV1 | 00444-0139-0001 | A |
| T444 MV2 | 00444-0139-0002 | A | |
| T444 MV9 (consult factory) | 00444-0139-XXXX | A | |
| ⑦B | Range Board Zero Jumpers | 00444-0036-0001 | A |
| 10 | Mounting Bracket Kit | 00444-0022-0001 | C |
| ⑪ | Terminal Block, Three-position | C10448-0106 | D |
| ⑫ | Terminal Block, Four-position | C10448-0109 | D |

For meter information, see page 7.

(1) *Spares Categories*

Code A – Recommended one spare part per 25 transmitters.

Code B – Recommended one spare part per 50 transmitters.

Code C – None normally required.

Code D – Not used on transmitters, but recommended for repair activities (see Instruction Manual).

(2) *Housing kit includes housing, adjustment potentiometer O-rings, O-ring retainer plate and nameplate.*

TABLE 5-10. Parts List for Model 444 RL Fast Turn On Transmitter (RTD Input).

| Item Number | Part Description | Part No. | Spares Category ⁽¹⁾ |
|-------------|---|---|--------------------------------|
| 1 | Housing Kit ⁽²⁾ | 00444-0028-0001 | C |
| ② | Housing Cover—Quantity One | 90032-0240-0003 | C |
| ③ | Housing Cover O-rings | 01151-0033-0003 | B |
| ①D | Adjustment Potentiometer O-rings | 00444-0030-0001 | B |
| ④ | Electronics Assembly Screws | 00444-0031-0001 | C |
| ⑤ | Output Board 444 RL B0912 | 00444-0126-0001 | A |
| ⑦A | Range Boards RL1 B0912 RL2 B0912 RL3 B0912 | 00444-0221-0011 00444-0221-0012 00444-0221-0013 | A A A |
| ⑦B | Range Board Zero Jumpers | 00444-0036-0001 | A |
| 10 | Mounting Bracket Kit | 00444-0022-0001 | C |
| ⑪ | Terminal Block, Three-position | C104480106 | D |
| ⑫ | Terminal Block, Four-position | C104480109 | D |

For meter information, see page 7.

(1) *Spares Categories*

Code A – Recommended one spare part per 25 transmitters.

Code B – Recommended one spare part per 50 transmitters.

Code C – None normally required.

Code D – Not used on transmitters, but recommended for repair activities (see Instruction Manual).

(2) *Housing kit includes housing, adjustment potentiometer O-rings, O-ring retainer plate and nameplate.*

TABLE 5-11. Parts List for Model 444 LL, 444 LM Low Power Transmitter (RTD Input).

| Item Number | Part Description | Part No. | Spares Category ⁽¹⁾ |
|-------------|--|------------------------------------|--------------------------------|
| 1 | Housing Kit ⁽²⁾ | 00444-0028-0005 | C |
| ② | Housing Cover—Quantity One | 90032-0240-0003 | C |
| ③ | Housing Cover O-rings | 01151-0033-0003 | B |
| ①D | Adjustment Potentiometer O-rings | 00444-0030-0001 | B |
| ④ | Electronics Assembly Screws | 00444-0031-0001 | C |
| ⑤ | Output Board 444 LL Output Board 444 LM | 00444-0159-0001 00444-0159-0002 | A A |
| ⑦A | Range Boards 444 LL 444 LM | 00444-0157-0001 00444-0157-0002 | A A |
| ⑦B | Range Board Zero Jumpers | 00444-0036-0001 | C |
| 10 | Mounting Bracket Kit | 00444-0022-0001 | C |
| ⑪ | Terminal Block, Three-position | C104480106 | D |
| ⑫ | Terminal Block, Four-position | C104480109 | D |

No meter available.

(1) *Spares Categories*

Code A – Recommended one spare part per 25 transmitters.

Code B – Recommended one spare part per 50 transmitters.

Code C – None normally required.

Code D – Not used on transmitters, but recommended for repair activities (see Instruction Manual).

(2) *Housing kit includes housing, adjustment potentiometer O-rings, O-ring retainer plate and nameplate.*

Rosemount Model 444 Alphaline Temperature Transmitters

TABLE 5-12. Parts List for Model 444 Increased Accuracy or Special Range Transmitters.

| Item Number | Part Description | Part No. | Spares Category ⁽¹⁾ |
|-------------|--|-----------------|--------------------------------|
| 1 | Housing Kit ⁽²⁾ —RTD Input | 00444-0028-0001 | C |
| | Housing Kit ⁽²⁾ —Thermocouple Input | 00444-0028-0002 | C |
| | Housing kit ⁽²⁾ —Millivolt Input | 00444-0028-0003 | C |
| ② | Housing Cover—Quantity One | 90032-0240-0003 | C |
| ③ | Housing Cover O-rings | 01151-0033-0003 | B |
| ⑩ | Adjustment Potentiometer O-rings | 00444-0030-0001 | B |
| ④ | Electronics Assembly Screws | 00444-0031-0001 | C |
| ⑤ | Output Board RL9 | 00444-0005-0001 | A |
| | Output Board T_9 | 00444-0015-0001 | A |
| | Output Board MV9 | 00444-0015-0001 | A |
| ⑥ | Amplifier Board | 00444-0007-0003 | A |
| ⑦A | Range Boards | | |
| | RL9 (consult factory) | 00444-0003-XXXX | A |
| | T_9 (consult factory) | 00444-0013-XXXX | A |
| | MV9 (consult factory) | 00444-0023-XXXX | A |
| ⑦B | Range Board Zero Jumpers | 00444-0036-0001 | C |
| 10 | Mounting Bracket Kit | 00444-0022-0001 | C |
| ⑪ | Terminal Block, Three-position | C10448-0106 | D |
| ⑫ | Terminal Block, Four-position | C10448-0109 | D |

For meter information, see below.

(1) *Spares Categories*

Code A – Recommended one spare part per 25 transmitters.

Code B – Recommended one spare part per 50 transmitters.

Code C – None normally required.

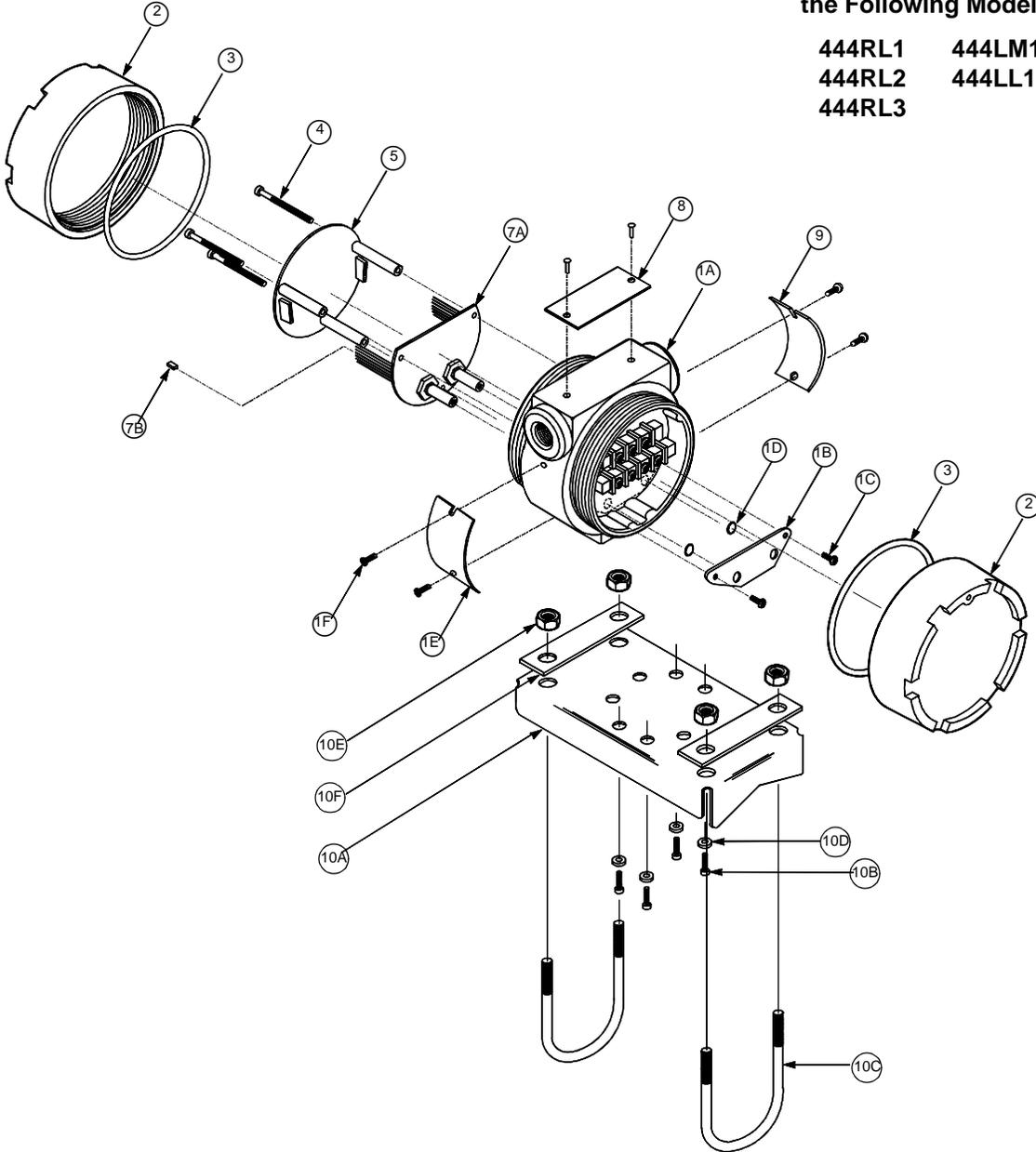
Code D – Not used on transmitters, but recommended for repair activities.

(2) *Housing kit includes housing, adjustment potentiometer O-rings, O-ring retainer plate and nameplate.*

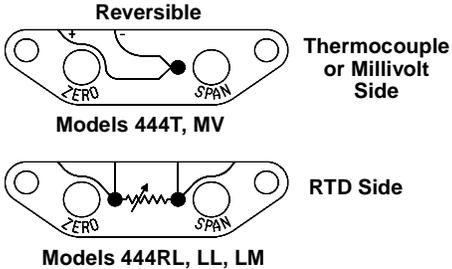
FIGURE 5-1. Transmitter Exploded View 1.

View Corresponds to the Following Models:

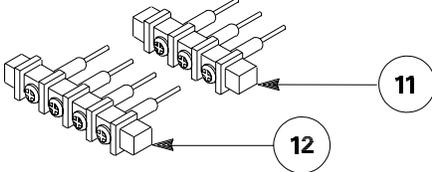
- 444RL1 444LM1
- 444RL2 444LL1
- 444RL3



Detail of Item 1B. O-Ring Retainer Plate Wiring Diagrams



Accessory Terminal Blocks For Bench Testing

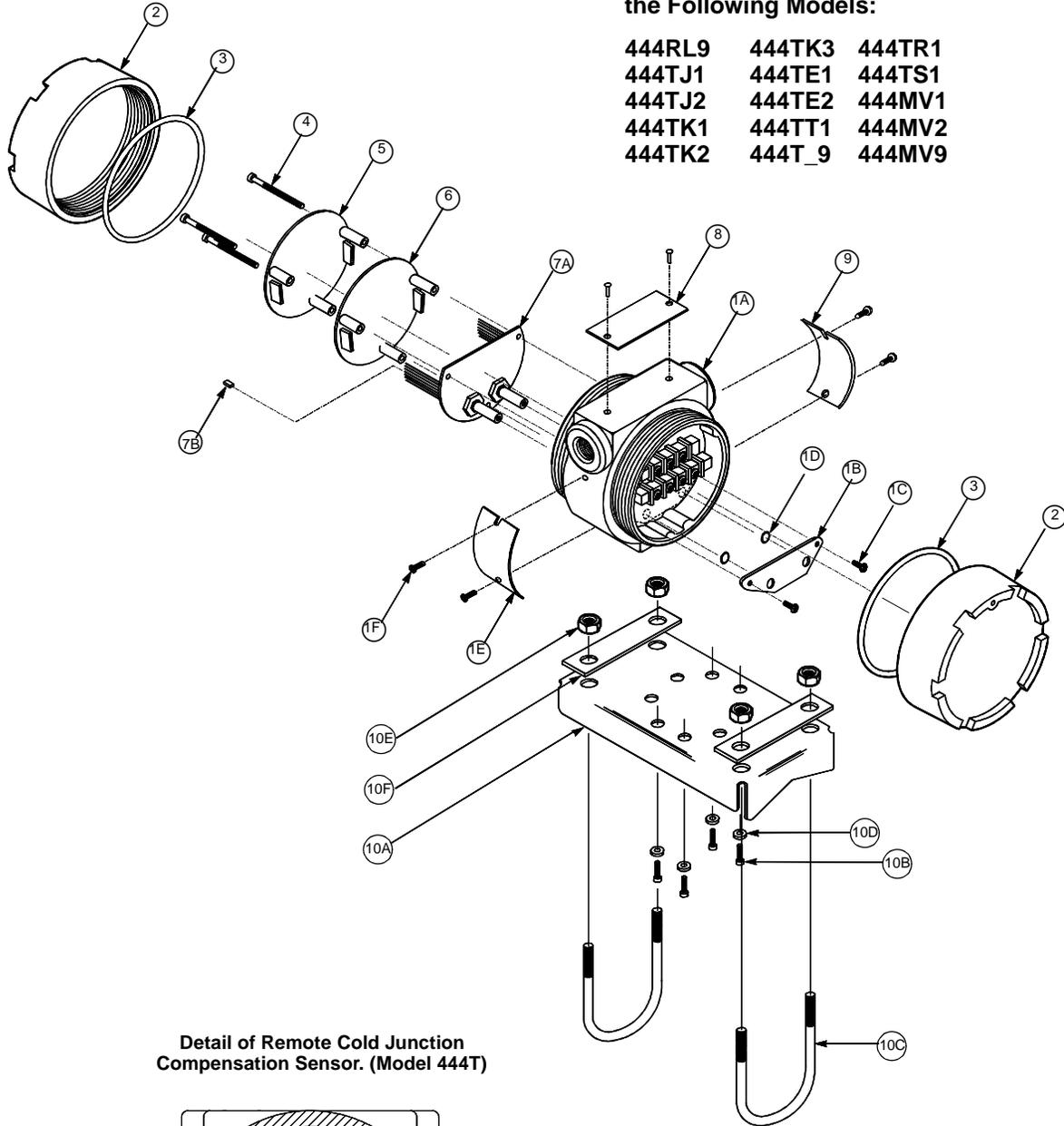


444-1151C02A, 0071A01A, 0071B01A, 1151H02A

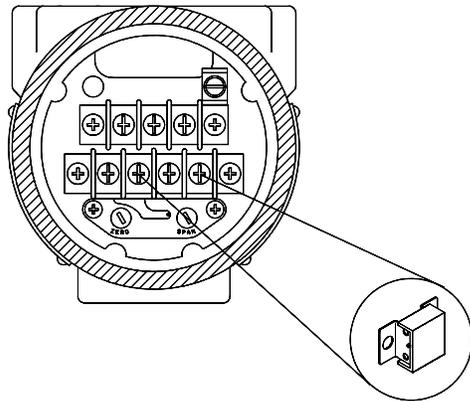
FIGURE 5-2. Transmitter Exploded View 2.

View Corresponds to the Following Models:

| | | |
|--------|--------|--------|
| 444RL9 | 444TK3 | 444TR1 |
| 444TJ1 | 444TE1 | 444TS1 |
| 444TJ2 | 444TE2 | 444MV1 |
| 444TK1 | 444TT1 | 444MV2 |
| 444TK2 | 444T_9 | 444MV9 |



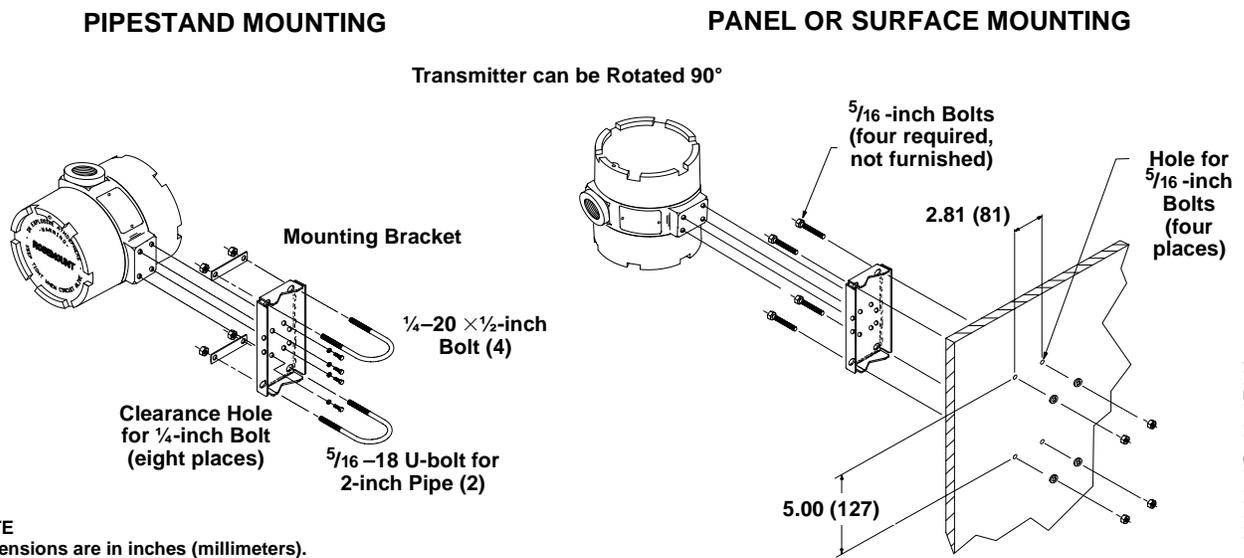
Detail of Remote Cold Junction Compensation Sensor. (Model 444T)



MOUNTING BRACKET

The mounting bracket option provides auxiliary configurations for mounting the Model 444 transmitter. With this option you can either mount the transmitter to a 2-inch pipe or a suitable flat panel. The bracket is constructed of carbon steel with carbon steel U-bolts. See Figure 6-1 for an exploded view of the Model 444 with a mounting bracket in both configurations.

FIGURE 6-1. Model 444 with Optional Mounting Bracket.



**LCD / ANALOG
METER**

The LCD and analog meters provide local indication of the transmitter output. Both meters attach easily to the terminal side of the transmitter.

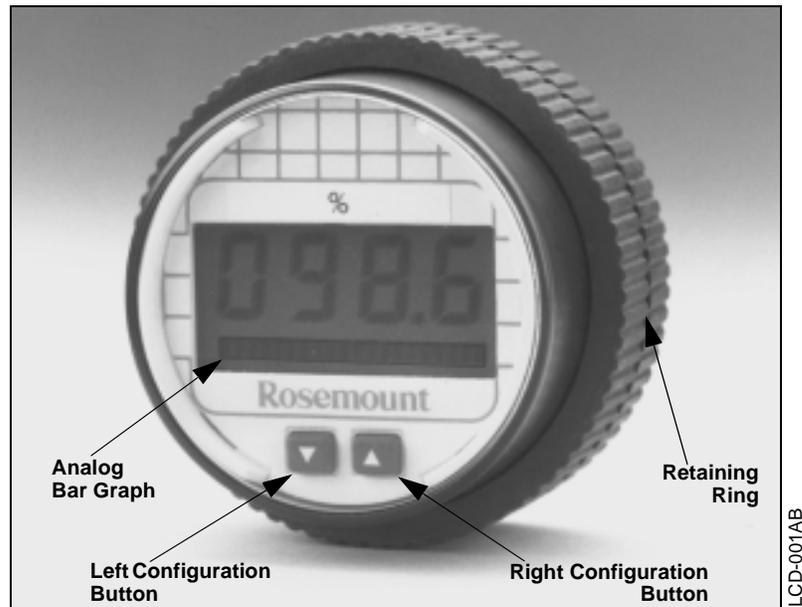
LCD METER

The Rosemount® LCD meter plugs directly into the Model 444 to provide a highly accurate digital display of the process variable. The meter adds no voltage drop in the 4–20 mA current loop when connected directly across the transmitter test terminals.

Configuration

Configure the LCD meter to meet specific requirements by using the left and right calibration buttons located on the meter face as shown in Figure 6-2. The analog bar graph is also shown in Figure 6-2. The 20-segment bar graph is factory calibrated and represents 4–20 mA directly.

FIGURE 6-2. LCD Meter.



No calibration equipment is required to configure the LCD meter, but between 4 and 20 mA must exist in the loop in order for the meter to operate. The actual value of the current is not significant. In addition, meter configuration does not affect the transmitter/loop current. Use the following meter configuration procedure to properly configure the LCD meter.

Remove the Cover

1. Unscrew the retaining ring shown in Figure 6-2 and lift the transparent cover off of the housing.

NOTE

The LCD meter time-out is approximately 16 seconds. If keys are not pressed within this period, the indicator reverts to reading the current signal.

Position the Decimal Point and Select the Meter Function

2. Press the left and right configuration buttons simultaneously and release them immediately.
3. To move the decimal point to the desired location, press the left configuration button. Note that the decimal point wraps around.
4. To scroll through the mode options, press the right configuration button repeatedly until the desired mode is displayed. See Table 6-1.

TABLE 6-1. LCD Meter Modes.

| Options | Relationship between Input Signal and Digital Display |
|--|---|
| L in | Linear |
| L inF | Linear with five-second filter |
| Srt | Square root |
| SrtF | Square root with five-second filter |
| <p>Square root function only relates to the digital display. The bar graph output remains linear with the current signal.</p> <p>Square root response The digital display will be proportional to the square root of the input current where 4 mA=0 and 20 mA=1.0, scaled per the calibration procedure. The transition point from linear to square root is at 25% of full scale flow.</p> <p>Filter response operates upon "present input" and "input received in the previous five second interval" in the following manner: $\text{Display} = (0.75 \times \text{previous input}) + (0.25 \times \text{present input})$ This relationship is maintained provided that the previous reading minus the present reading is less than 25% of full scale.</p> | |

Store the Information

5. Press both configuration buttons simultaneously for two seconds. Note that the meter displays "----" for approximately 7.5 seconds while the information is being stored.

Set the Display Equivalent to a 4 mA Signal

6. Press the left button for two seconds.
7. To decrement the display numbers, press the left configuration button and to increment the numbers, press the right configuration button. Set the numbers between -999 and 1000.
8. To store the information, press both configuration buttons simultaneously for two seconds.

Set the Display Equivalent to a 20 mA Signal

9. Press the right button for two seconds.
10. To decrement the display numbers, press the left configuration button on the display and to increment the numbers, press the right configuration button. Set the numbers between -999 and 9999. The sum of the 4 mA point and the span must not exceed 9999.
11. To store the information, press both configuration buttons simultaneously for two seconds. The LCD meter is now configured.

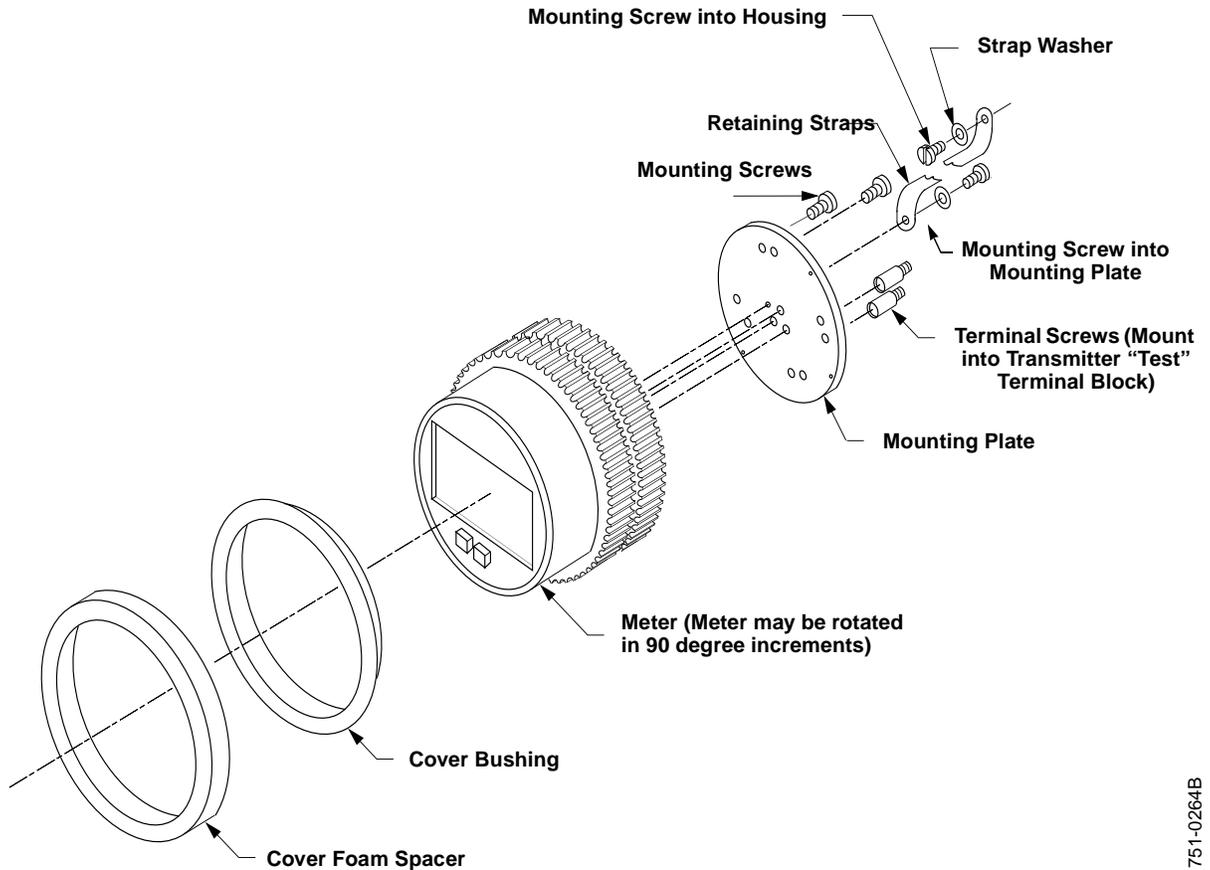
Replace the Cover

12. Make sure the rubber gasket is seated properly, replace the transparent cover, and replace the retaining ring.

LCD Meter Assembly

Figure 6-3 shows the mounting hardware required to properly install the LCD meter on a Model 444 transmitter. This mounting hardware may also be used with the Rosemount universal (analog) meter.

FIGURE 6-3. LCD Meter Exploded View



751-0264B

LCD Meter Specifications

Functional Specifications

Input Signal

4–20 mA dc.

Meter Indication

4-digit LCD showing –999 to 9999. A 20-segment bar graph directly represents the 4–20 mA current.

Scaling/Calibration

4 mA Point Limits: –999 to 1000.

Span limits: 0200 to 9999.

The sum of the 4 mA point and span must not exceed 9999.

Adjustments are made using non-interactive zero and span buttons.

Hazardous Locations Certifications

Approved for use with Rosemount Models 444, 751, 1135, 1144, and 1151.

Performance Specifications**Overload Limitation**

666 mA.

Temperature Limits

Storage: -40 to 85 °C (-40 to 185 °F).

Operating: -20 to 70 °C (-4 to 158 °F).

Between temperatures -40 to -20 °C (-40 to -4 °F), the loop is intact and the meter is not damaged.

Humidity Limitation

0 to 95% non-condensing relative humidity.

Update Period

750 ms.

Response Time

Responds to changes in input within a maximum of two update periods. If the filter is activated, then the display responds to the change within nine update periods.

Digital Display Resolution

0.05% of calibrated range ± 1 digit.

Analog Bar Graph Resolution

0.05% of calibrated range.

Indication Accuracy

0.25% of calibrated range ± 1 digit.

Stability

Over Time: 0.1% of calibrated range ± 1 digit per six months.

Temperature Effect

0.01% of calibrated range per °C on zero.

0.02% of calibrated range per °C on span over the operating temperature range.

Power Interrupt

All calibration constants are stored in EEPROM memory and are not affected by power loss.

Failure Mode

LCD meter failure will not affect transmitter operation.

Under/Over Range Indication

Input current < 3.5 mA: Display blank.

Input current > 22.0 mA: Display flashes 112.5% of full scale value or 9999, whichever is less.

Physical Specification**Meter Size**

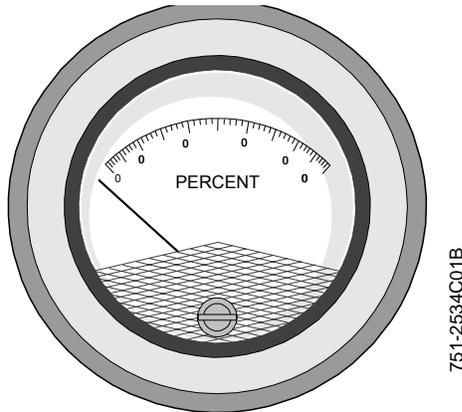
2¼-inch diameter face with ½-inch high characters.

ANALOG METER

The analog meter plugs directly into the Model 444 to provide an accurate local indication of user-specified units. It requires an analog 4–20 mA dc, 10–50 mA dc, or 40–200 mV dc transmitter output from a two-wire transmitter, and adds no voltage drop in the 4–20 mA current loop when connected directly across the transmitter test terminals.

The large 2¼-inch diameter meter face has a two-inch long scale for easy readability, as shown in Figure 6-4. A meter-zero adjustment is located on the meter faceplate. You can rotate the meter in 90-degree increments within the transmitter housing for convenient viewing.

FIGURE 6-4. Analog Meter Face.



Analog Meter Specifications

Functional Specifications

Input Signal
 4–20 mA dc
 10–50 mA dc } Maximum series resistance is
 40–200 mV } 10 ohms for milliameters.

Meter Indication
 0 to 100% linear scale.
 Special optional ranges.

Overload Limit
 150% of rated end scale value for two minutes.

Temperature Limits
 –40 to 65 °C (–40 to 150 °F).

Humidity Limit
 0 to 100% relative humidity.

Zero Adjustment
 Adjustment screw on face of meter.

Performance Specifications

Indication Accuracy
 ±2% of calibrated span.

Temperature Effect
 Less than 2% of full scale at any point within the temperature limits.

Physical Specification

Meter Size
 2¼-inch diameter face with 2-inch long scale.

Hazardous Locations Certifications Drawings

Rosemount Drawing 00444-0261, 2 Sheets:
Model 444 Explosion-proof Installation Drawing, Factory Mutual.

Rosemount Drawing 01151-0214, 6 Sheets:
Index of Intrinsically Safe Barrier Systems and Entity parameters for
444, 1135, 1144, 1151, and 2051 Transmitters and 751 Field Indicators.

Rosemount Drawing 00444-0034, 2 Sheets:
CSA Intrinsic Safety Approvals for Model 444.

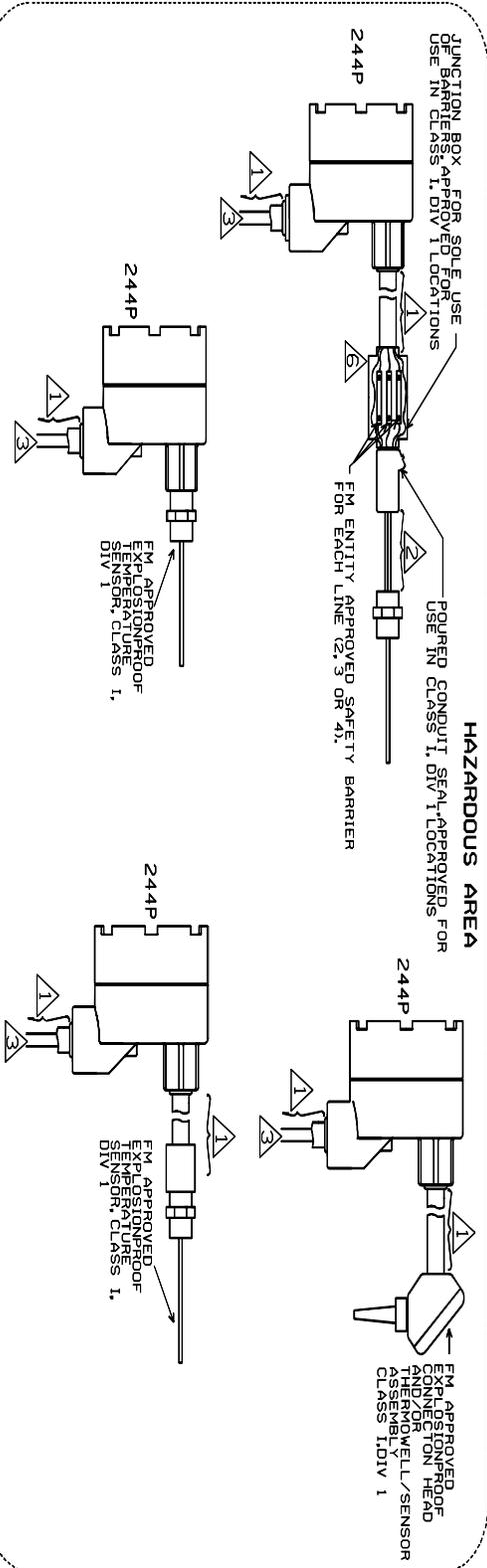
Rosemount Drawing 00444-0264, 1 Sheet:
Model 444 SAA Intrinsic Safety Configuration

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| REV | DESCRIPTION | CHG. NO. | APP'D | DATE |
|-----|----------------------|----------|-------|------|
| C | ADD NOTE 8, REDRAWN. | 647224 | DRR. | 8/6, |

REVISIONS

HAZARDOUS AREA



CLASS II INSTALLATIONS MUST USE AN FM APPROVED DUST-IGNITIONPROOF SENSOR.

8. 244P CONFIGURATION MUST BE COMPLETED OUTSIDE OF HAZARDOUS LOCATION.
7. IN AMBIENTS GREATER THAN 40°C, SPRING LOADED TEMPERATURE SENSORS USED WITHOUT AN EXPLOSIONPROOF THERMOWEL MUST BE RATED FOR AT LEAST 85°C.
6. TERMINALS FOR INTRINSICALLY SAFE (I/S) CIRCUITS SHALL BE ADEQUATELY SEPARATED FROM TERMINALS FOR NON-I/S CIRCUITS BY ONE OF THE FOLLOWING METHODS:
 - a. SEPARATION MAY BE ACCOMPLISHED BY DISTANCE. THE DISTANCE BETWEEN I/S AND NON-I/S TERMINALS SHALL BE AT LEAST 50mm (2 in). CARE SHALL BE EMPLOYED IN THE EVENT THAT A WIRE BECOMES DISLODGED.
 - b. SEPARATION MAY BE ACCOMPLISHED BY USE OF EITHER AN INSULATING PARTITION OR A GROUNDED METAL PARTITION BETWEEN I/S AND NON-I/S TERMINALS. NONMETALLIC PARTITIONS SHALL POSSESS SUFFICIENT THICKNESS AND SHALL BE SUPPORTED SUCH THAT THEY CAN NOT BE READILY DEFORMED. METAL PARTITIONS SHALL BE GROUNDED AND SHALL POSSESS SUFFICIENT STRENGTH AND RIGIDITY SUCH THAT DAMAGE DURING WIRING IS UNLIKELY.
5. COMPONENTS REQUIRED TO BE APPROVED MUST BE APPROVED FOR GAS GROUP APPROPRIATE TO AREA CLASSIFICATION.
4. ALL CONDUIT THREADS TO BE ASSEMBLED FIVE FULL THREADS MINIMUM.
3. TRANSMITTER MUST NOT BE CONNECTED TO EQUIPMENT GENERATING MORE THAN 250VAC.
2. INTRINSIC SAFETY WIRING METHODS.
1. WIRING METHOD SUITABLE FOR CLASS I, DIV 1, ANY LENGTH

NOTES:

LESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES. REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125 - TOLERANCES -

| | |
|----------|------------|
| DECIMALS | FRACTIONS |
| XX+1 | +1/32 |
| XXX+010 | ANGLES 42° |

DO NOT SCALE PRINT

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Eden Prairie, MN 55344 US

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| APP'D. C. GOETZINGER | 12/17/91 | |
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| TITLE | MODEL 244P | |
| EXPLSIONPROOF INSTALLATION DRAWING, FACTORY MUTUAL | | |
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| SCALE | NONE | WT. |
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| | REV | DESCRIPTION | CHG. NO. | APP'D | DATE |
| | E | ADD RAIL MOUNT STYLE. | 660358 | R.M. | 09/21/95 |

Rosemount 244P & 244PR transmitters are F.M. approved as intrinsically safe when used in circuit with approved barriers which meet the entity parameters listed in the Class I, II, III; Division 1 and 2; and gas groups indicated below.

To assure an intrinsically safe system, the transmitter and barrier must be wired in accordance with the barrier manufacturer's field wiring instructions and the applicable circuit diagram indicated on sheets 2 & 3.

The entity concept allows interconnection of intrinsically safe apparatus to associated apparatus not specifically examined in combination as a system. The approved entity concept parameters are the following:

CLASS I, II, & III; DIV. 1 & 2, GROUPS A, B, C, D, E, F, AND G

| 244P & 244PR PARAMETERS | BARRIER PARAMETERS |
|------------------------------|---|
| $V_{MAX} = 40V$ | V_{OC} MUST BE LESS THAN OR EQUAL TO 40V |
| $I_{MAX} = 180mA$ | I_{SC} MUST BE LESS THAN OR EQUAL TO 180mA |
| $P_{MAX} = 1.0 \text{ WATT}$ | $(\frac{V_{oc} \times I_{sc}}{4})$ MUST BE LESS THAN OR EQUAL TO 1.0 WATT |
| $C_I = 0.014 \mu F$ | C_A MUST BE GREATER THAN 0.014 μF |
| $L_I = 0$ | L_A MUST BE GREATER THAN 0 |

CLASS I, II, & III; DIV. 1 & 2, GROUPS C, D, E, F, AND G

| 244P & 244PR PARAMETERS | BARRIER PARAMETERS |
|------------------------------|---|
| $V_{MAX} = 40V$ | V_{OC} MUST BE LESS THAN OR EQUAL TO 40V |
| $I_{MAX} = 250mA$ | I_{SC} MUST BE LESS THAN OR EQUAL TO 250mA |
| $P_{MAX} = 1.0 \text{ WATT}$ | $(\frac{V_{oc} \times I_{sc}}{4})$ MUST BE LESS THAN OR EQUAL TO 1.0 WATT |
| $C_I = 0.014 \mu F$ | C_A MUST BE GREATER THAN 0.014 μF |
| $L_I = 0$ | L_A MUST BE GREATER THAN 0 |

NOTE: Entity parameters listed apply only to associated apparatus with linear output.

244P & 244PR must be installed in an F.M. approved enclosure, such as a NEMA rated enclosure (i.e. Connection Head, Junction Box, Rail Mount Enclosure). Examples:

Connection Head (Part # 00244-5004-0013): NEMA 4X with I.S. approval label.

Connection Head (K5 Option): Explosion proof for Class I, Div. 1, Groups B,C,& D
 Dust-ignition proof for Class II & III, Div. 1, Groups E,F,&G
 Hazardous Locations
 NEMA 4X

Rail Mount Enclosure Options: 244PR0 or 244PR9

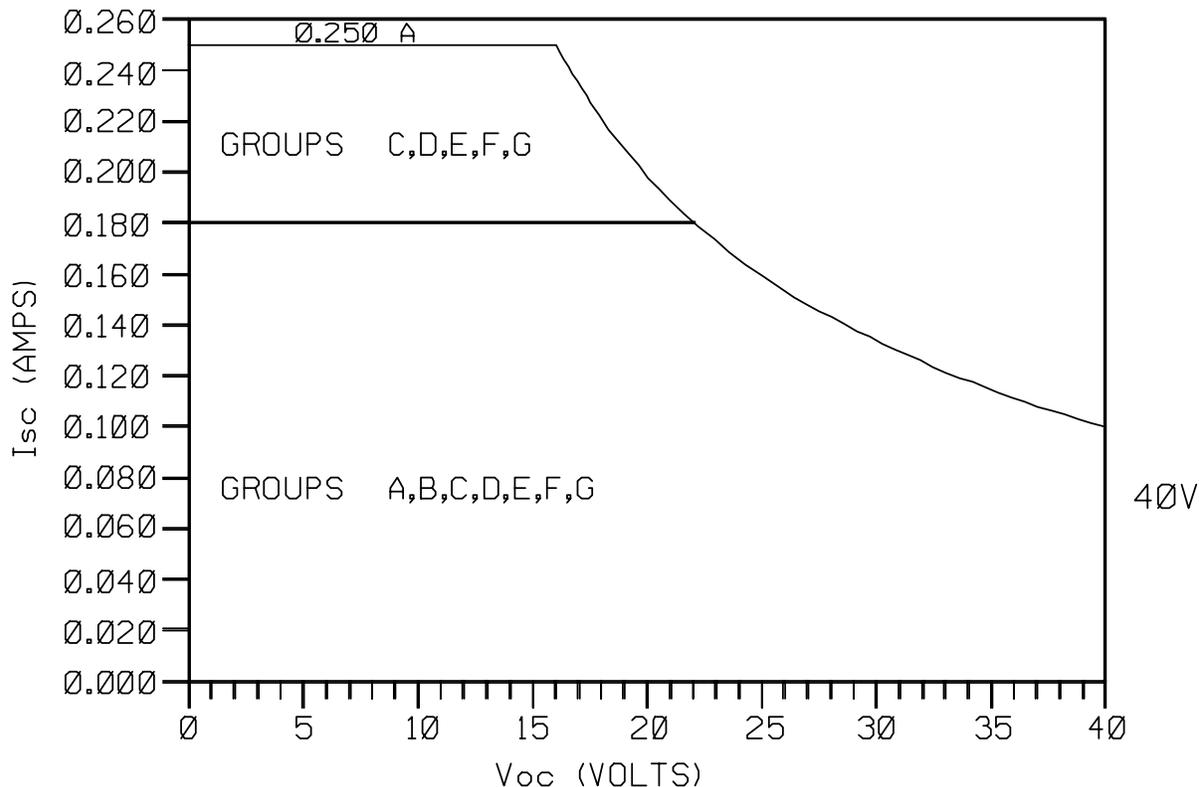
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| | | | | |
|---|---------------------|--------------|---|--------------|
| UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES. REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125 - TOLERANCES - DECIMALS FRACTIONS .X±.1 ±1/32 .XX±.02 ANGLES .XXX±.010 ±2° DO NOT SCALE PRINT | CONTRACT NO. | | ROSEMOUNT [®] Measurement Control Analytical Valves Rosemount Inc. 12001 Technology Drive Eden Prairie, MN 55344 USA | |
| | DR. CHRIS SCRIBNER | 10/21/91 | | |
| | CHK'D | | INSTALLATION DRAWING: | |
| | APP'D-C. GOETZINGER | 12/20/91 | 244P FM I/S CONFIGURATION | |
| | APP'D. GOVT. | | SIZE A | FSCM NO |
| | | SCALE N/A | WT. | SHEET 1 OF 3 |

| REVISIONS | | | | |
|-----------|-------------|----------|-------|------|
| REV | DESCRIPTION | CHG. NO. | APP'D | DATE |
| E | | 660358 | | |

244P & 244PR BARRIER PARAMETERS

$P_{max} = 1.0 \text{ WATT}$

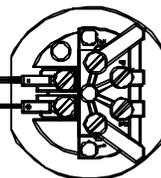


NON-HAZARDOUS AREA

HAZARDOUS AREA

ASSOCIATED APPARATUS

(SEE SHEET 3 FOR DETAILS)



SENSOR TERMINALS
SEE NOTE 1

MODEL 244P OR 244PR

ENCLOSURE-
SEE NOTE 2

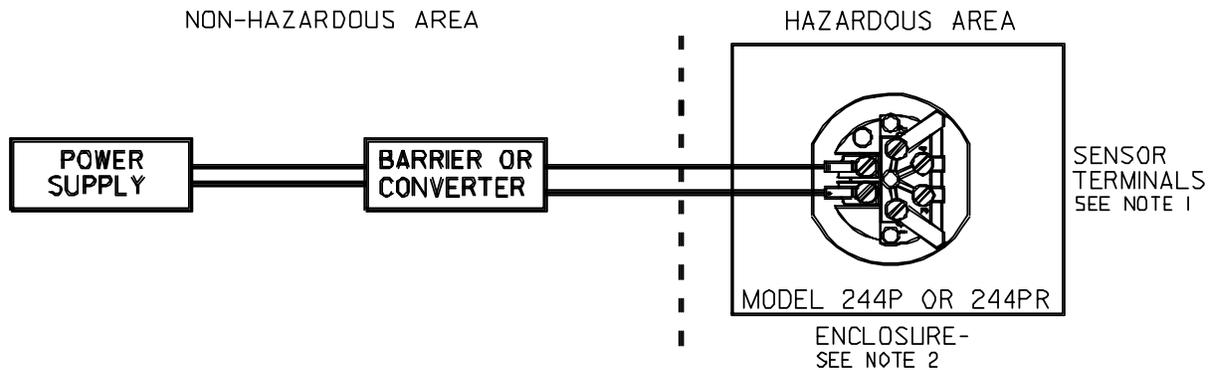
| | |
|---|--------------------|
| Rosemount Inc. 1200 Technology Drive Eden Prairie, MN 55344 USA | |
| DR. | C. SCRIBNER |
| ISSUED | |

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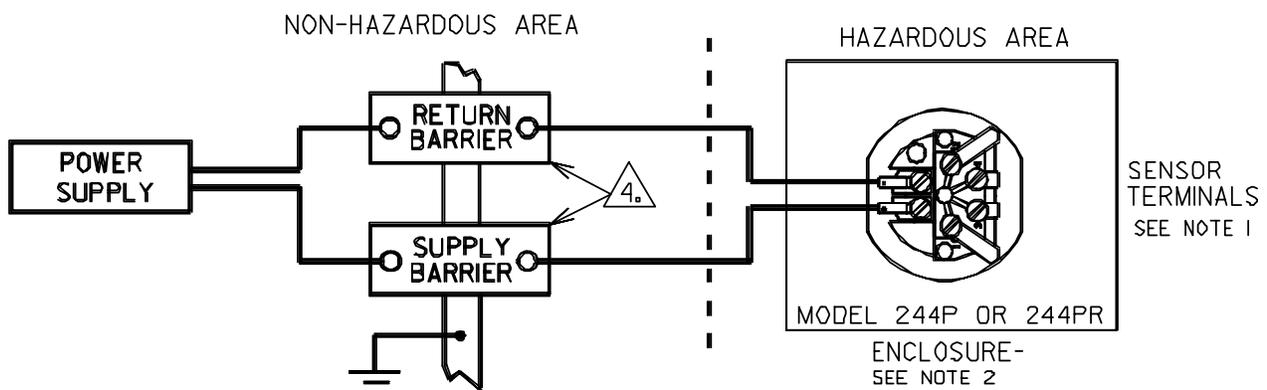
| | | | |
|----------|---------|---------|-------------------|
| SIZE | FSCM NO | DWG NO. | 00244-5103 |
| A | | | |
| SCALE | N/A | WT. | |
| | | SHEET | 2 OF 3 |

| REVISIONS | | | | |
|-----------|-------------|----------|-------|------|
| REV | DESCRIPTION | CHG. NO. | APP'D | DATE |
| E | | 660358 | | |

Circuit Diagram 1:
One Single or Dual Channel Barrier/Converter



Circuit Diagram 2:
Supply and Return Barriers



4. This Configuration can only be used for barriers approved in this combination.
3. Up to four model 761 indicators may be wired in series with the transmitter configurations shown and may be located in either the Hazardous or Non-Hazardous area.
 2. Adequate Enclosure is required to meet installation codes stipulated in ISA 12.8 and the National Electrical Code (NEC). Use approved enclosure appropriate for Environmental Protection and/or Hazardous Locations. For example, an enclosure suitable for Class II and III, Division 1 and 2 Hazardous Locations.
 1. Only equipment classified as simple apparatus, such as Thermocouples and RTD's, may be connected to sensor terminals. Cable length between the sensor terminals (1-4) and the sensor must be less than 16,000 feet.

NOTES:

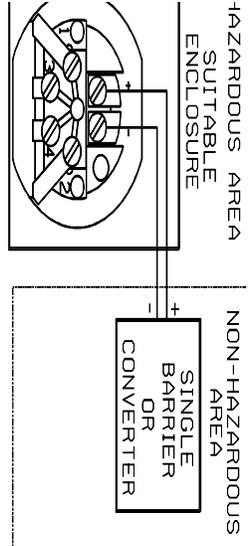
| | | | | |
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| Rosemount Inc. 12001 Technology Drive Eden Prairie, MN 55344 USA | | THIS DRAWING WAS CREATED ON CAD. DRAWING IS ARCHIVED ON MAGNETIC TAPE FOR ECO CHANGES. | | |
| DR. CHRIS SCRIBNER | SIZE A | FSCM NO | DWG NO. 00244-5103 | |
| ISSUED | SCALE N/A | WT. _____ | SHEET 3 OF 3 | |

FORM NO. 80651A-1REV. C

PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY DATE _____

| REVISIONS | | CHG. NO. | APP'D | DA |
|-----------|---|----------|-------|------|
| REV | DESCRIPTION | | | |
| D | DELETE Exp 1 T3C & GROUP B FROM CLASS 1, DIV. 1 FOR EXPLOSIONPROOF; ADD 244PR TO TITLE AND GENERAL APPROVAL INFORMATION | 662601 | C.G. | 09/2 |

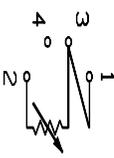
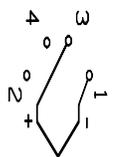
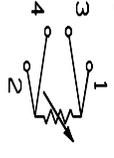
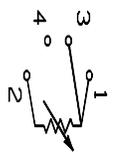
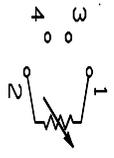
ASSURE AN INTRINSICALLY SAFE SYSTEM, THE TRANSMITTER AND BARRIER MUST BE WIRED IN ACCORDANCE WITH THE BARRIER MANUFACTURER'S FIELD WIRING INSTRUCTIONS AND THE APPLICABLE CIRCUIT DIAGRAM SHOWN BELOW. THE MODEL 244P AND 244PR MUST BE INSTALLED IN A SUITABLE ENCLOSURE.



TE: ONLY EQUIPMENT CLASSIFIED SIMPLE APPARATUS, SUCH AS ERMIDCOUPLES AND RTD'S, MAY BE CONNECTED TO SENSOR TERMINALS.

| INTRINSICALLY SAFE/SECURITE | INTRINSEQUE |
|---|--|
| DEVICE CSA APPROVED ZENER BARRIER PARAMETERS 30 V OR LESS 330 OHMS OR MORE 28 V OR LESS 300 OHMS OR MORE 25 V OR LESS 200 OHMS OR MORE 22V OR LESS 180 OHMS OR MORE | APPROVED FOR CLASS 1, DIV. 1 GROUPS A, B, C, & D GROUPS B, C, & D |
| FOXBORO CONVERTERS 2AS-131-CGB, 2A1-13V-CGB 2A1-12V-CGB, 2AS-121-CGB 3A2-12D CS-E/CGB-A 3A4-12D41 CS-E/CGB-A 3A2-131R CS-E/CGB-A 3A4-12DA CS-E/CGB-A CSA APPROVED ZENER BARRIER 30 V OR LESS 150 OHMS OR MORE | GROUPS C, & D |

CSA CLASS 1, DIV. 2 GROUPS A, B, C, D HAZARDOUS LOCATION:



2 WIRE **3 WIRE** **4 WIRE** **TC** **RTD W/COMP LOOP**
ARNING-EXPLOSION HAZARD- Do not disconnect equipment unless power has been switched off or the drea is known to be non-hazardous.
/ERTISSEMENT-RISQUE D'EXPLOSION- Avant de déconnecter l'équipement, couper le courant ou s'assurer que l'emplacement est désigné non-dangereux.

THE 244P AND 244PR MUST BE INSTALLED IN A CSA APPROVED ENCLOSURE (i.e., APPROVED RAIL MOUNT ENCLOSURE OR CONNECTION HEAD). EXAMPLE: 244P CONNECTION HEAD (PART # 00244-5007-0005); CSA ENCLOSURE TYPE 4X WITH 1/S APPROVAL LABEL. 244P CONNECTION HEAD (C6 OPTION): EXPLOSIONPROOF FOR CLASS 1, DIV. 1, GROUPS C, D CLASS 1, DIV. 2, GROUPS A, B, C, D CLASS 1, DIV. 1, HAZARDOUS LOCATIONS CSA ENCLOSURE TYPE 4X

ESS, OTHERWISE SPECIFIED DIMENSIONS IN INCHES. REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125 - TOLERANCES -

| | | |
|----------|-----------|--------|
| DECIMALS | FRACTIONS | ANGLES |
| +1 | 1/32 | #20 |
| X+.002 | | |
| XX+.010 | | |

DO NOT SCALE PRINT

| | | |
|--------------|-----------------|----------|
| CONTRACT NO. | DR. C. SCRIBNER | 9/14/92 |
| APP'D. GOVT. | A. KIAN | 11/11/92 |
| APP'D. | A. KIAN | 11/11/92 |

TITLE INSTALLATION DRAWING:
 244P AND 244PR CSA
 INTRINSIC SAFETY

SIZE FSCM NO. DWG NO. 00244-5106
 SCALE N/A WT. SHEET 1 OF 1

Rosemount Inc.
 12001 Technology Drive
 Eden Prairie, MN 55344 U

Temperature Sensor Reference Information

TABLE B-1. Resistance Versus Temperature Curve $R_0=100.00 \Omega$, $\alpha=0.00385$ Reference Standard IEC 751.

| °C | 0 | -10 | -20 | -30 | °C | -40 | -50 | -60 | -70 | -80 | -90 |
|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----|
| -200 | 18.49 | | | | | | | | | | |
| -100 | 60.25 | 56.19 | 52.11 | 48.00 | 43.87 | 39.71 | 35.53 | 31.32 | 27.08 | 22.80 | |
| 0 | 100 | 96.09 | 92.16 | 88.22 | 84.27 | 80.31 | 76.33 | 72.33 | 68.33 | 64.30 | |

| °C | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | 100 | 103.90 | 107.79 | 111.67 | 115.54 | 119.40 | 123.24 | 127.07 | 130.89 | 134.70 |
| 100 | 138.50 | 142.29 | 146.06 | 149.82 | 153.58 | 157.31 | 161.04 | 164.76 | 168.46 | 172.16 |
| 200 | 175.84 | 179.51 | 183.17 | 186.82 | 190.45 | 194.07 | 197.69 | 201.29 | 204.88 | 208.45 |
| 300 | 212.02 | 215.57 | 219.12 | 222.65 | 226.17 | 229.67 | 233.17 | 236.65 | 240.13 | 243.59 |
| 400 | 247.04 | 250.48 | 253.90 | 257.32 | 260.72 | 264.11 | 267.49 | 270.86 | 274.22 | 277.56 |
| 500 | 280.90 | 284.22 | 287.53 | 290.83 | 294.11 | 297.39 | 300.65 | 303.91 | 307.15 | 310.38 |
| 600 | 313.59 | 316.80 | 319.99 | 323.18 | 326.35 | 329.51 | 332.66 | 335.79 | 338.92 | 342.03 |
| 700 | 345.13 | 348.22 | 351.30 | 354.37 | 357.42 | 360.47 | 363.50 | 366.52 | 369.53 | 372.52 |
| 800 | 375.51 | 378.48 | 381.45 | 384.40 | 387.33 | | | | | |

| °F | 0 | -10 | -20 | -30 | °F | -40 | -50 | -60 | -70 | -80 | -90 |
|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----|
| -300 | 25.18 | 22.80 | 20.41 | 18.01 | | | | | | | |
| -200 | 48.46 | 46.17 | 43.87 | 41.56 | 39.25 | 36.93 | 34.60 | 32.26 | 29.91 | 27.55 | |
| -100 | 71.00 | 68.77 | 66.54 | 64.30 | 62.05 | 59.80 | 57.55 | 55.28 | 53.02 | 50.74 | |
| 0 | 93.03 | 90.85 | 88.66 | 86.47 | 84.27 | 82.07 | 79.87 | 77.66 | 75.44 | 73.22 | |

| °F | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | 93.03 | 95.21 | 97.39 | 99.57 | 101.74 | 103.90 | 106.07 | 108.22 | 110.38 | 112.53 |
| 100 | 114.68 | 116.83 | 118.97 | 121.11 | 123.24 | 125.37 | 127.50 | 129.62 | 131.74 | 133.86 |
| 200 | 135.97 | 138.08 | 140.18 | 142.29 | 144.38 | 146.48 | 148.57 | 150.66 | 152.74 | 154.82 |
| 300 | 156.90 | 158.97 | 161.04 | 163.11 | 165.17 | 167.23 | 169.29 | 171.34 | 173.39 | 175.43 |
| 400 | 177.47 | 179.51 | 181.54 | 183.57 | 185.60 | 187.62 | 189.64 | 191.66 | 193.67 | 195.68 |
| 500 | 197.69 | 199.69 | 201.69 | 203.68 | 205.67 | 207.66 | 209.64 | 211.62 | 213.60 | 215.57 |
| 600 | 217.54 | 219.51 | 221.47 | 223.43 | 225.38 | 227.34 | 229.28 | 231.23 | 233.17 | 235.11 |
| 700 | 237.04 | 238.97 | 240.90 | 242.82 | 244.74 | 246.65 | 248.57 | 250.48 | 252.38 | 254.28 |
| 800 | 256.18 | 258.07 | 259.96 | 261.85 | 263.74 | 265.62 | 267.49 | 269.36 | 271.23 | 273.10 |
| 900 | 274.96 | 276.82 | 278.67 | 280.53 | 282.37 | 284.22 | 286.06 | 287.90 | 289.73 | 291.56 |
| 1000 | 293.38 | 295.21 | 297.03 | 298.84 | 300.65 | 302.46 | 304.27 | 306.07 | 307.87 | 309.66 |
| 1100 | 311.45 | 313.24 | 315.02 | 316.80 | 318.58 | 320.35 | 322.12 | 323.88 | 325.64 | 327.40 |
| 1200 | 329.16 | 330.91 | 332.66 | 334.40 | 336.14 | 337.88 | 339.61 | 341.34 | 343.07 | 344.79 |
| 1300 | 346.51 | 348.22 | 349.93 | 351.64 | 353.35 | 355.05 | 356.74 | 358.44 | 360.13 | 361.81 |
| 1400 | 363.50 | 365.18 | 366.85 | 368.52 | 370.19 | 371.86 | 373.52 | 375.18 | 376.84 | 378.48 |
| 1500 | 380.13 | 381.77 | 383.41 | 385.05 | 386.68 | 388.31 | 389.94 | | | |

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