Fermilab

Particle Physics Division
Mechanical Department Calibration
Standards/Procedures

Number: MD-CALPROC-013 **Date:** 6/26/2009

Manufacturer: Barton

Model: Barton Model 6005 Gage Pressure Electronic Transmitter

Reviewer(s): James E. Tweed

This Procedure is used for:

Calibration of Barton electro-mechanical gauges.

SECTION 4

CALIBRATION AND ADJUSTMENTS

4-1. GENERAL

A. Normal Operation

A gage pressure unit furnished by the factory is normally calibrated to a customer specified range. If no range is specified, the unit is factory set to its upper range limit. In the mode of operation most commonly used, the output from the transmitter varies between 4 and 20 mA or 10 and 50 mA. This output is linear with the measured variable as shown on graph A, Figure 4-1.

B. Span

By using the span adjustment, the span of the transmitter output may be varied in a linear manner, from 100 percent of full scale down to 10 percent. Graph B of Figure 4-1 illustrates the relation between the output and the measured variable when the span is set at 80 percent, 50 percent and 10 percent of the nominal range. For example, a transmitter having an upper range limit of 0-300 psi, when set to 10 percent span, will provide a 4-20 mA (or 10-50 mA) signal which is linear with a change of only 0-30 psi in the measured variable. This adjustment may be used where a change in the measurement range is required from time to time.

C. Suppression/Elevation

The electronics signal need not be tied to the "zero" of the measured variable. Zero gage pressure can be suppressed or elevated with respect to the minimum output signal, either 4 mA or 10 mA. Zero control is adjustable between 1 inch Hg Abs to +100 percent of upper range limit, with the condition that the total calibrated span and zero adjustment does not exceed the upper range limit. For example, in Figure 4-1, Graph C, the electronic output is linear between -50 to -10 percent, -20 to 0 percent, 50 to 60 percent, and 50 to 100 percent.

D. Damping

Damping is used in applications where the measured pressure pulsates due to mechanical vibration, pumps, etc. Damping is accomplished by increasing the RC time constant of the electronics, which effectively "smooths" the output oscillations.

E. Jumper-Plug Adjustments

The coarse zero, coarse span, and damping adjustments are accomplished by simply relocating the jumper-plug with a screwdriver.

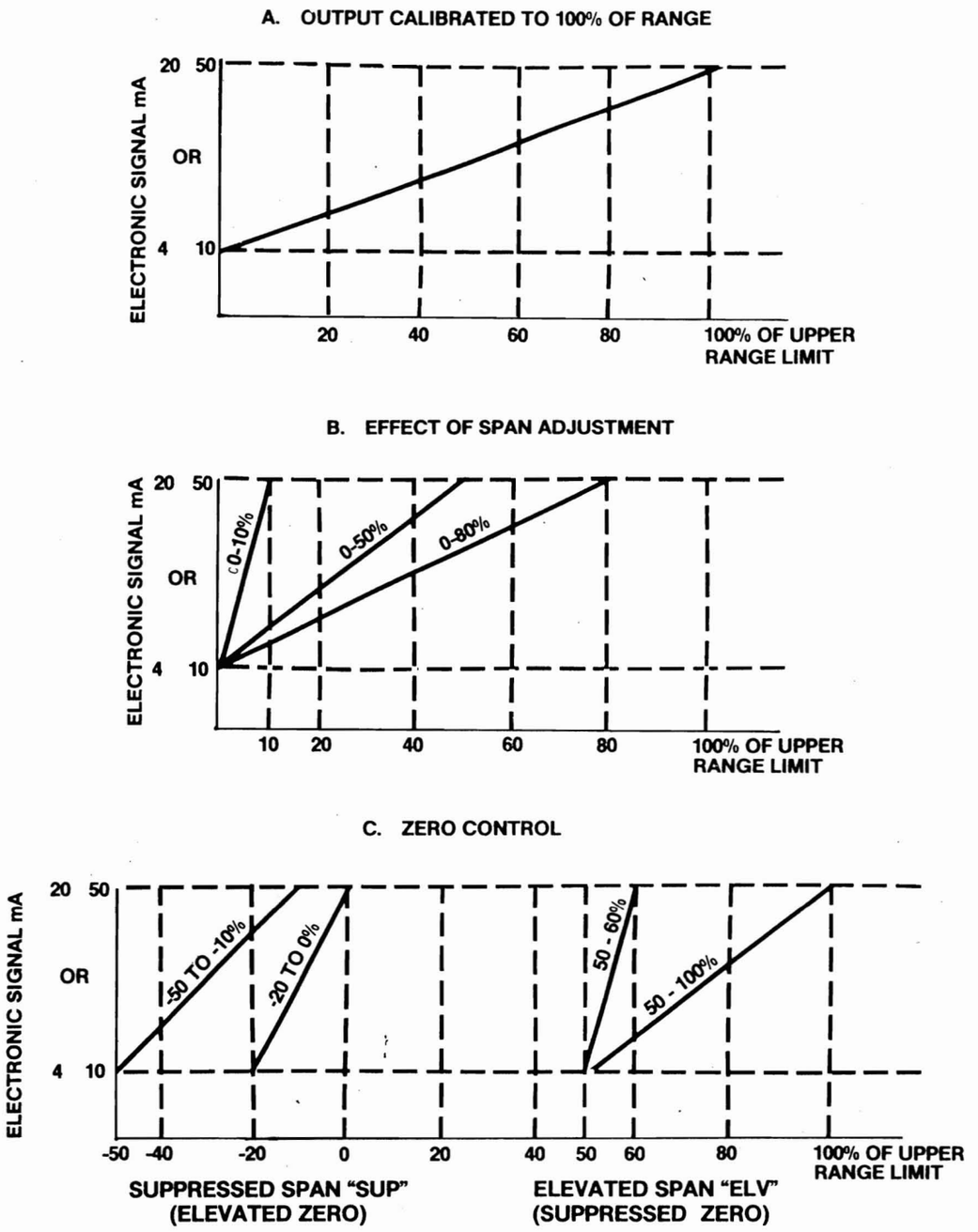

Figure 4-1. Span and Zero Adjustment

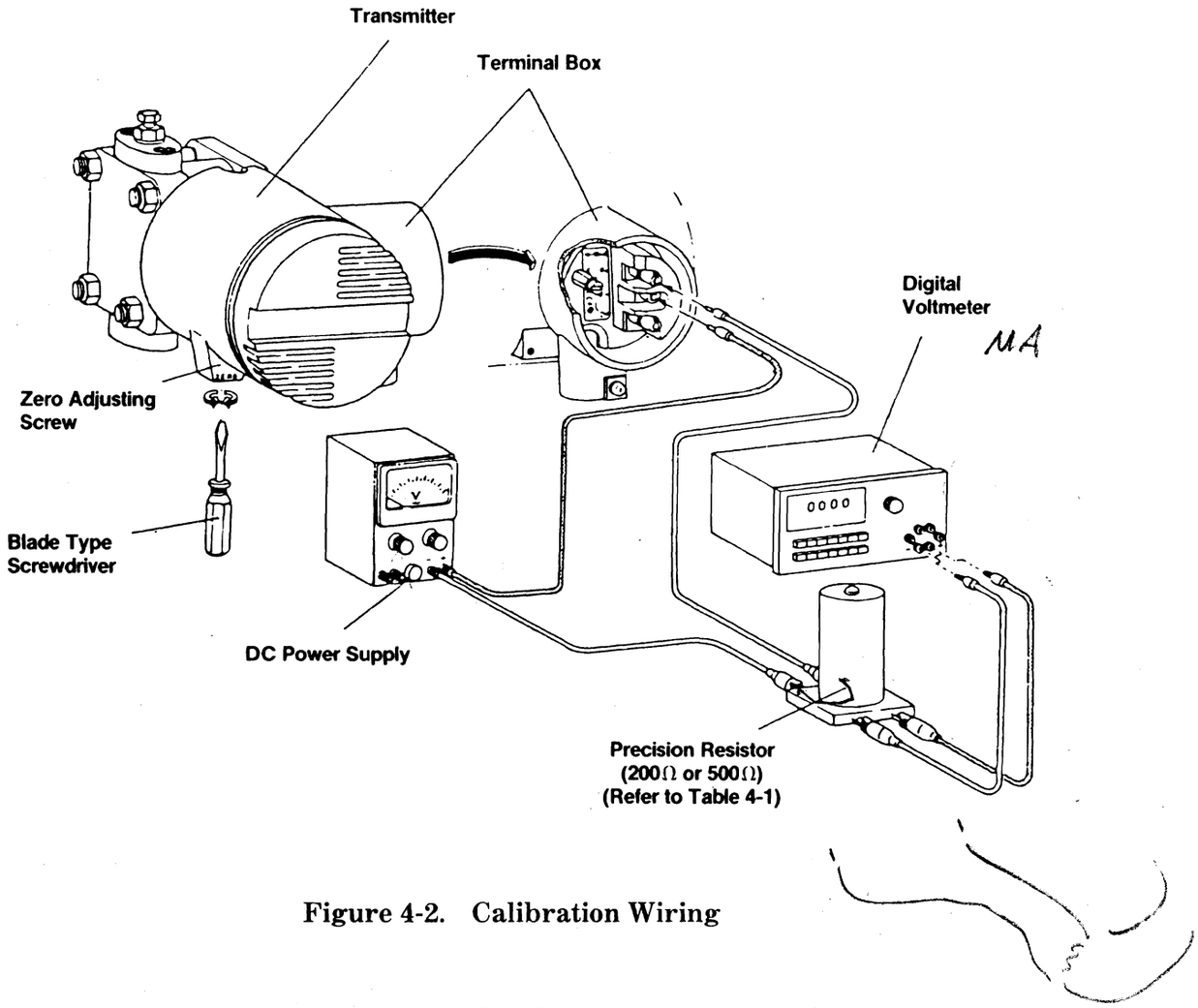

Figure 4-2. Calibration Wiring

NOTICE

USE OF METAL TOOLS TO REMOVE ELECTRONICS HOUSING COVERS MAY DAMAGE HOUSING FINISH.

4-2. DAMPING ADJUSTMENT PROCEDURE

1. Position 0 of the **Damping** adjustment provides no damping (see Figure 4-3). If no damping is required, the jumper-plug can be left in this position.

2. If damping is required, with a screwdriver relocate the jumper-plug. Position 1 provides minimum damping and position 3 provides maximum damping. Refer to the Specifications (Section 1-3) for the time constant corresponding to each position.

4-3. CALIBRATION

A. Calibration Check Points

Normally the points at which the calibration of the instrument is checked are zero, mid-scale, and full scale of the range. These points correspond to an output of 4, 12, and 20 mA (or 10, 30, and 50 mA, as applicable). For a more accurate check, linearity may be verified at three points between the two end points.

B. Calibration Procedure

Perform the calibration procedure as follows:

1. Place the **Coarse Zero** jumper-plug in the proper location (see Figure 4-3).
2. Place the **Coarse Span** jumper-plug in the proper location to obtain the coarse span desired (see Figure 4-4).
3. Connect the transmitter and test equipment as shown in Figure 4-2. Turn power on.

CAUTION

POWER SUPPLY VOLTAGE MUST NOT EXCEED 27 VDC ON UNITS WITH ARRESTERS.

4. With zero calibration pressure applied, adjust the fine zero control to obtain 2.000 volts output, +0.004 volt.
5. With full scale calibration pressure applied, adjust the fine span control on the amplifier to obtain 10.000 volts +0.004 volt output. Turn clockwise to increase the span, counterclockwise to decrease the span.
6. Repeat steps 4 and 5 until no adjustment is required.
7. Apply ½ full scale calibration pressure. The output reading should be 6.000 volts plus or minus the tolerance specified in Table 4-2.*
8. Measure the output voltage at 0, 25, 50, 75 and 100 percent of the calibrated range, increasing and decreasing pressures. The measured value at each input shall be within the tolerance specified in Table 4-2.*
9. Return the cover to the electronics housing. Tighten by hand or to a torque of 14.5 ft-lbs.

* If output is not within the tolerance specified, refer to Appendix C for linearity adjustment instructions.

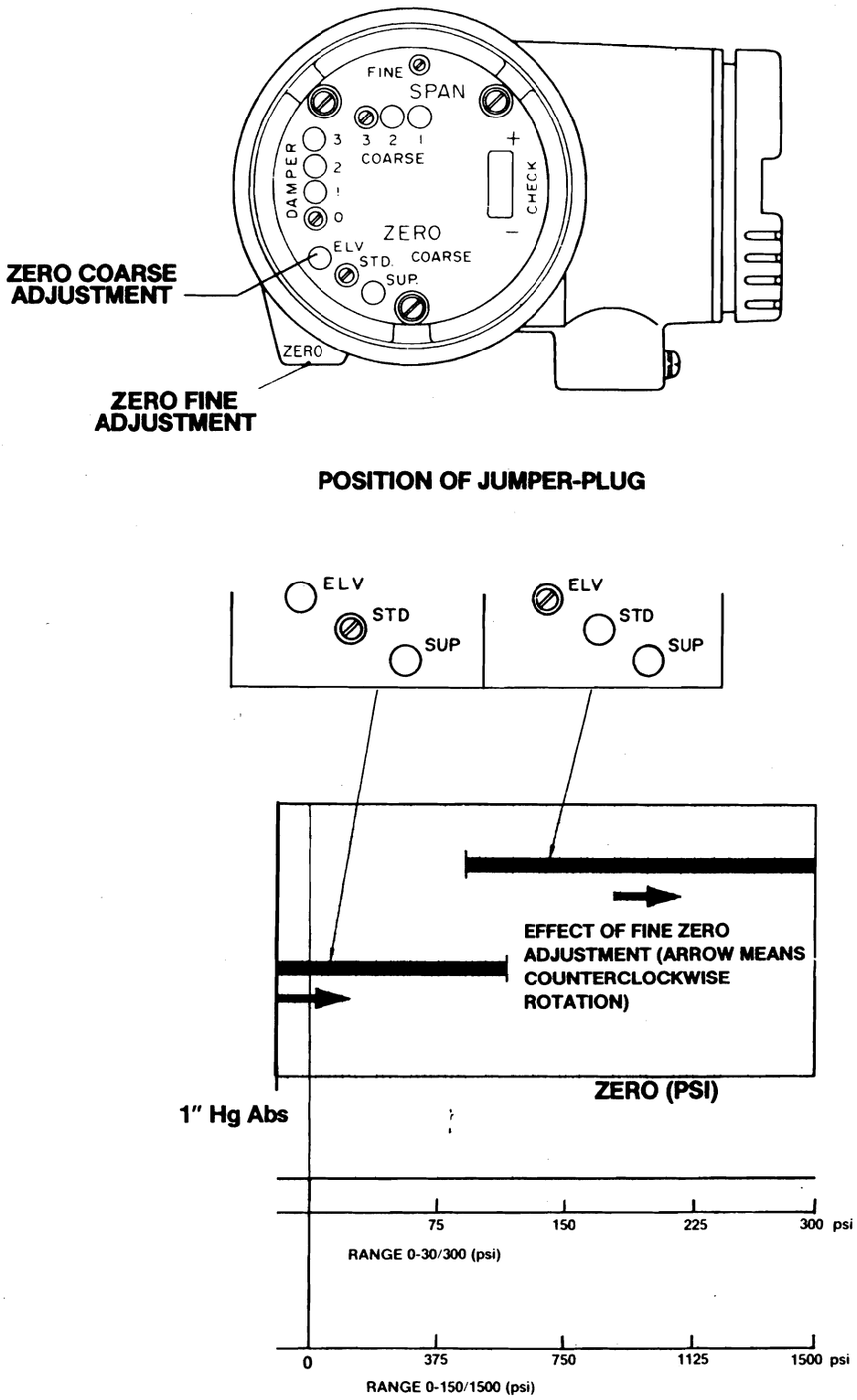

Figure 4-3. Adjustable Zero

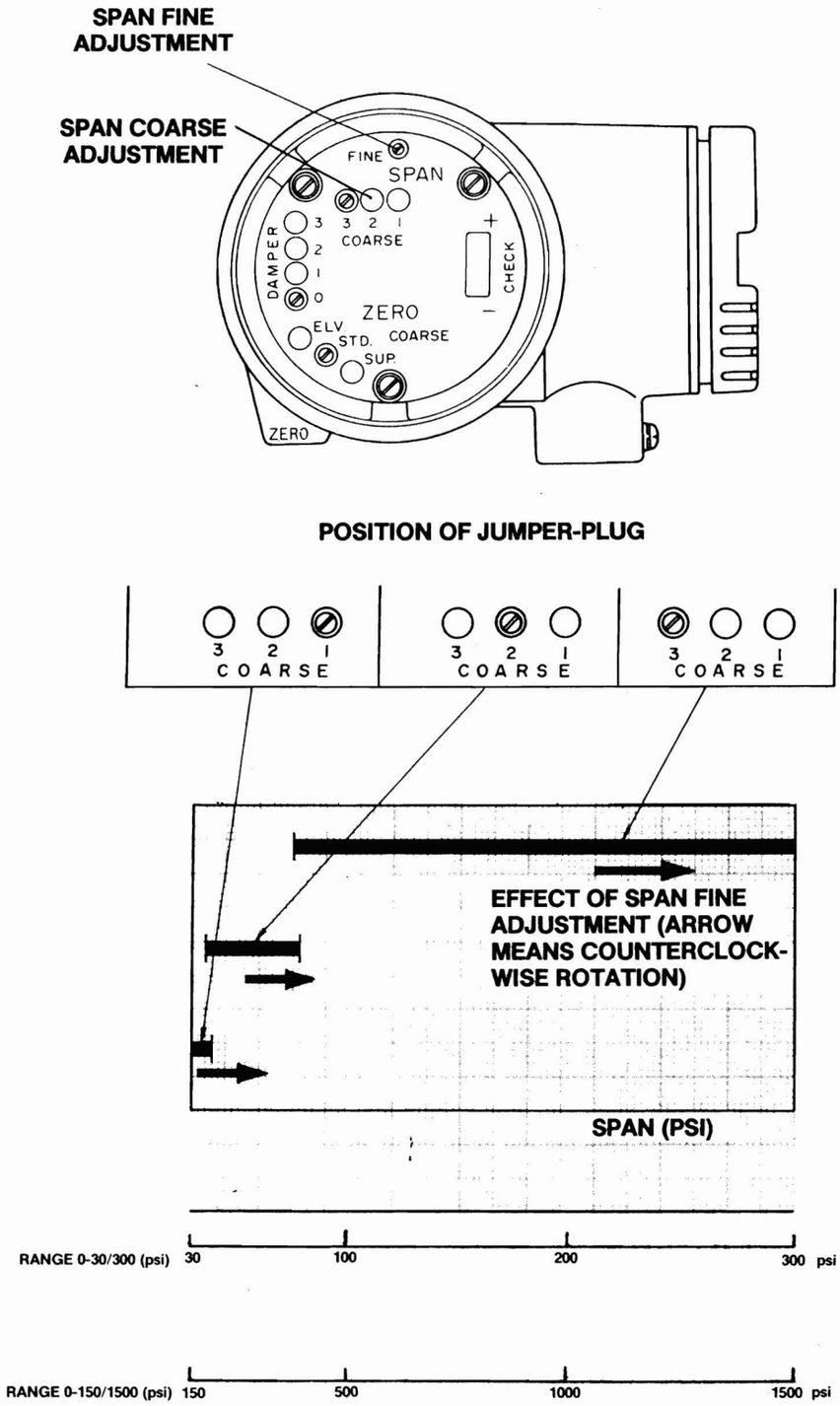

Figure 4-4. Adjustable Span

Table 4-1. Calibration Equipment

Equipment	Requirements
Digital Voltmeter	±0.05% accuracy (4-½ digit)
Power Supply	
4-20 mA Output	24 VDC current limited at 30 mA
10-50 mA Output	45 VDC current limited at 65 mA regulation 3%, ripple 1%
Precision Load Resistor	
4-20 mA Output	500 ohms ±0.01%, 1 W*
10-50 mA Output	200 ohms ±0.01%, 1 W*
Pressure Source (to provide zero to full scale pressure)	
Accuracy	0.05%
Stability	0.05%

Table 4-2. Linearity

Input (% FS)	Output (Volts)	Tolerance
0.000	2.000	±0.25% for all ranges
25.000	4.000	
50.000	6.000	
75.000	8.000	
100.000	10.000	

*Resistance value for 2-10 volts output. For 1-5 volts output, reduce resistance values by one-half, to 250 ohms for 4-20 mA and 100 ohms for 10-50 mA.