

Transmitter Calibration with the Fluke 750 Series Documenting Process Calibrator

The precision sourcing and measurement capabilities of the rugged Fluke Documenting Process Calibrator (DPC) make it an ideal choice for the calibration of process instrumentation. The following examples show how to address transmitter calibrations quickly and effectively using the Fluke 753 or 754 Documenting Process Calibrators.

Calibrating a 2 Wire Thermocouple Transmitter with the Fluke 750 Series Documenting Process Calibrators

The transmitter in this example is a 2 wire transmitter (needs loop power). The input stimulus for this device is from a type K thermocouple with an input range of 100 °C to 300 °C at 0 % and 100 %. The output drawn against loop power is 4-20 mA at 0 % and 100 % with a tolerance of 0.25 %. The steps below show how to: 1) perform a three point ascending (3↑) As Found (pre-adjustment) test at 0-50-100 %, and Tag the results, 2) adjust the zero and span (span = 100 %) of the transmitter, then 3) perform a three point ascending As Left (post-adjustment) test at 0-50-100 %, Tag those results and review them in memory.

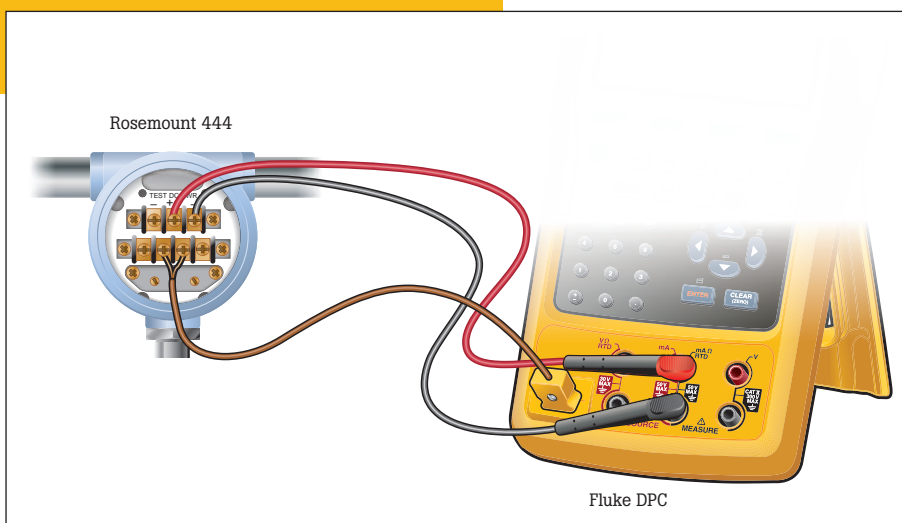


Figure 1.

1. Connect a type K mini-connector into the "TC" input of the DPC and connect to the thermocouple input of the transmitter (Figure 1). It is necessary that you use the correct type of mini-connector for this connection to the DPC.
2. Connect the center two terminals of the DPC to the connections on the transmitter where loop power is applied (Figure 1).

Note: If you prefer to use house loop power rather than supplying loop power from the DPC, connect these two leads in series with the loop supply to the transmitter.

Application Note

3. Once your connections are made, starting from the DPC power up state (or measure screen), select the "mA" button to measure milliamps (Figure 2).

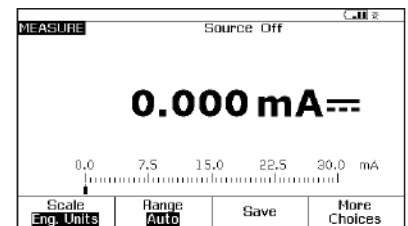
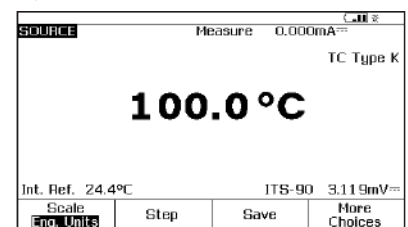


Figure 2.

4. Next depress the "MEAS/SOURCE" button; now you are in the source screen. Since you want to source a thermocouple, press "TC/RTD" once. Press ENTER to select TC. Use the down arrow to move the cursor to "K" and then press "ENTER." Select "Linear T" and press ENTER. The DPC will respond with "?????" asking for a temperature to source. Depress "100" and "ENTER" (Figure 3).

Figure 3.



- Next press the "MEAS/SOURCE" button once and you will be in the split screen mode (Figure 4).

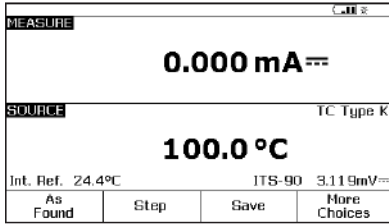


Figure 4.

Note: Skip to step 7 if you are measuring current in series using the house loop power source mentioned in step (2).

- Next, depress the "SETUP" button on the DPC. The cursor should begin on loop power. Depress "ENTER," down arrow until the DPC cursor is on Enabled and depress "ENTER." Next depress the "Done" softkey (Figure 5).

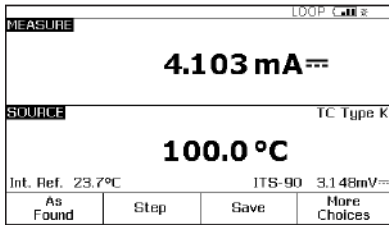


Figure 5.

- At this point depress "As Found" and select "Instrument" and press "ENTER," then fill in the template, use the default "Delay=0 seconds.")

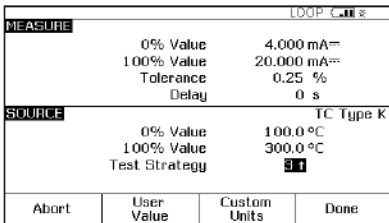


Figure 6.

Depress "DONE." You should now see the split screen and are presented with soft key choices of "Abort," "Auto Test," and "Manual Test" (Figure 7).

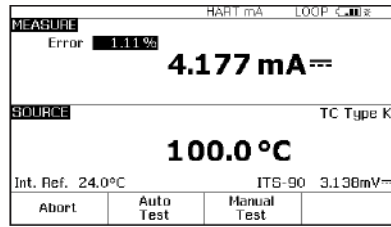


Figure 7.

- Select "Auto Test," and watch the DPC take 0 %, 50 % and 100 % measurements of current (4, 12 and 20 mA nominal) while sourcing 100 °C, 200 °C and 300 °C.
- Once the DPC has completed this evaluation, it will display the post test summary screen with the SOURCE, MEASURE and ERROR columns. Failures in the error column will be in reverse video (Figure 8). Depress "Done."

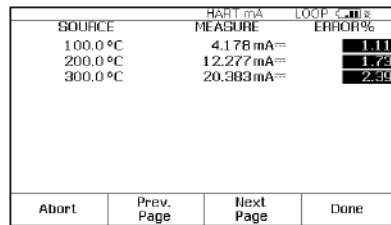


Figure 8.

- Now you are presented with the Tag entry screen (Figure 9).

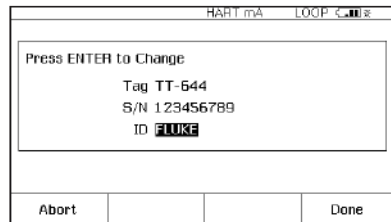


Figure 9.

Press the "ENTER" key to edit the entries. Depress "Done" when complete until the split screen reappears with the soft key options of "As Left," "Adjust," "Save" and "More Choices" on the display of the DPC.

- At this point, select "Adjust" and the DPC will source 0 % and measure for 4 mA to

0.25 %. As long as the error exceeds .25 % the error window in the measure half of the screen will be in reverse video. Adjust the zero on the transmitter until the error is less than 0.25 %. Next, select "Go to 100 %" and adjust the transmitter span in the same way. You may also "Go to 50 %" to check linearity at mid-span.

- After adjustment is complete, select "As Left," "Done" and "Autotest." Watch the 0-50-100 % evaluations. If the adjustment was successful, all the errors in the post run summary should be in normal video (or less than .25 %) (Figure 10).

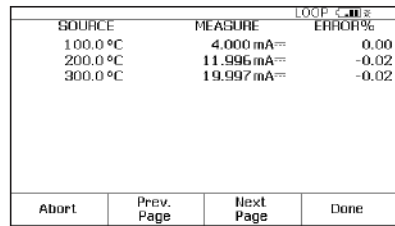


Figure 10.

- Select "Done," "Done," and "Done" again and you are done!

To review your results in memory, select the "More Choices" soft key, the "Review Memory" soft key and move your cursor to the applicable result and press enter. Select "As Found" or "As Left," then "ENTER" and review the setup for the test, select "Next Page" for the results, and press "Tag" for its associated label. Select "Done" and "Done". Move your cursor to the applicable "As Left" result and press "ENTER" and review the test setup, select "Next Page" for the results, and press "Tag" for its associated label. When you are finished reviewing results, press "Done" until right-most soft key label changes to "More Choices."

3 and 4 Wire RTD Sourcing for the Fluke 750 Series Documenting Process Calibrators

One of the most frequently asked application questions pertaining to the 750 Series Documenting Process Calibrators is, "How do I hook up the test leads to the DPC to source 3 and 4 wire RTDs?" For 3 and 4 wire RTD **measurement**, the DPC has embedded hookup diagrams that easily show you how to connect the DPC. However, for 3 and 4 wire RTD **source**, the DPC does not offer that assistance.

The example shown below (Figure 11) depicts the hookup for a 3 and 4 wire Rosemount 444 RTD Transmitter. You will need an additional pair of TL22 test leads and AC20 industrial test clips to complete all the connections necessary for this application. In order to double the available connections to the source terminals on the DPC, you also will need to utilize the short black jumpers supplied with the Documenting Process Calibrator.

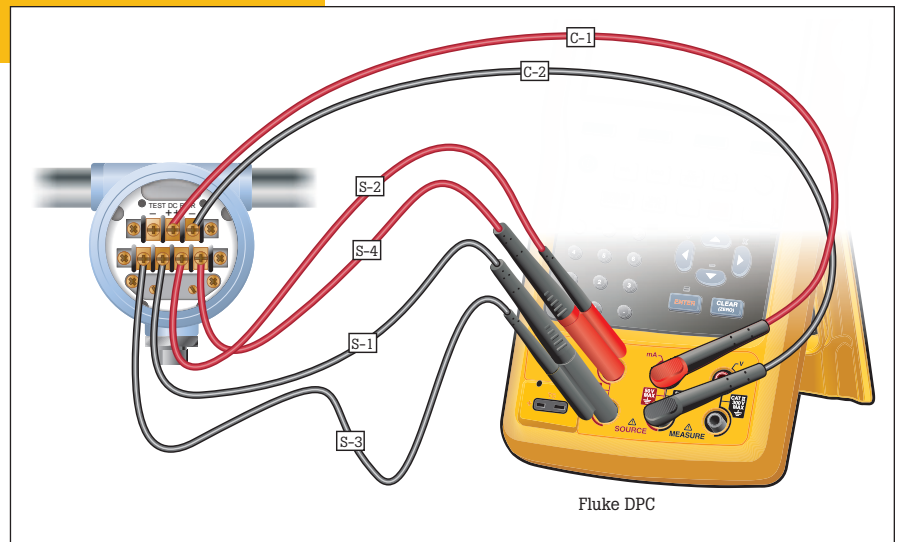


Figure 11.

1. Make the RTD source connections, S1, S2, S3 and S4 (omit S3 and S4 for 2 wire RTDs and S4 for 3 wire RTDs; S4 is only needed for 4 wire RTD sourcing).
2. Next, connect the loop power and current measurement connections, C1 and C2.
3. Once the connections are made as per the diagram in Figure 11, enable the loop 24 volt power from the setup screen, source the pertinent RTD for the specific transmitter being evaluated, and set the measure mode to mA.
4. At this point, enter the split screen mode of the DPC and perform the As Found, Adjust and As Left tests as you did in the previous thermocouple transmitter example.

Calibration of an I to P (Current to Pressure) with the Fluke 750 Series Documenting Process Calibrators

A common device in the Fluke DPC workload is the I to P. The I to P device is used to convert electrical loop analog control of 4-20 mA to pneumatic analog loop control of 3-15 PSI. The device in this example is an I to P with current input values of 4-20 mA for 0 % and 100 % with output range of 3-15 PSI for 0 % and 100 %, +/- 2 %. This step-by-step example describes how to: 1) perform a three point ascending (3↑) As Found (pre-adjustment) test at 0-50-100 %, Tag the results, 2) Adjust the zero and span (span = 100 %) of the I to P, then 3) perform a three point ascending As Left (post-adjustment) test at 0-50-100 %, Tag those results and review them in memory.

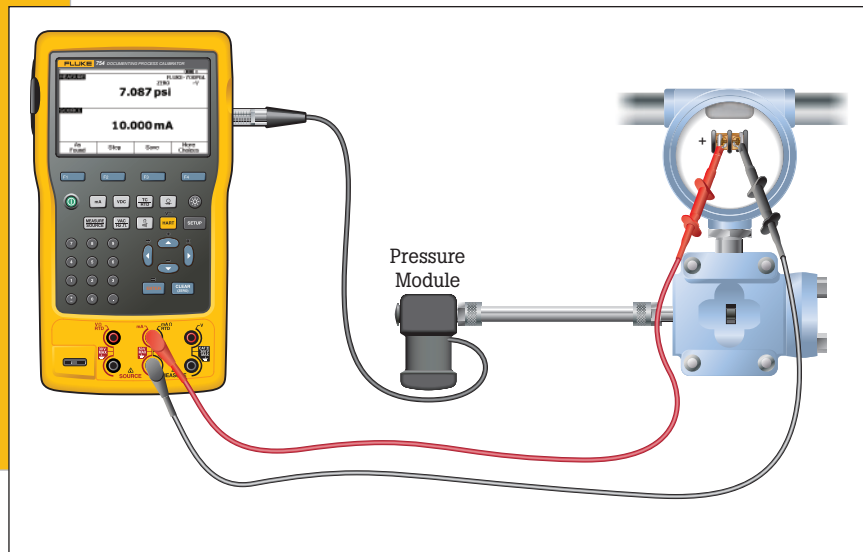


Figure 12.

1. Connect the pressure module to the DPC. Connect the output of the I to P to the input of the pressure module. If you are using a differential pressure module, make sure (for this example) that it is a 15 PSI module and connect to the input labeled "H" (Figure 12).
2. Connect from the center two banana type connections of the DPC to the input of the I to P where control current is supplied (Figure 12).
3. Once your connections are made, assuming you are in the power up state (or measure screen), select the "Pressure" button (directly above the "Range" button) (Figure 13).
4. Next depress the "MEAS/SOURCE" button; now you are in the source screen (Figure 14).



Figure 13.

Since you want to source a current, depress "mA." Depress "ENTER" which chooses "Source mA" when given the choice of "Source mA" or "Simulate Transmitter." When the DPC responds with ????? asking for a current to source, depress "4" and "ENTER."

5. Next depress the "MEAS/SOURCE" button once and you should be in the split screen mode (Figure 15).

MEASURE		FLUKE-700PD5	
3.008 psi			
SOURCE			
4.000 mA			
As Found	Step	Save	More Choices

Figure 15.

SOURCE			
Measure 0.025psi			
Select Function			
Off			
Scale	Step	Save	More Choices
Eng. Units			

Figure 14.

- At this point depress “As Found”, select “Instrument” and press “ENTER,” then fill in the template as shown in figure 16.

MEASURE		FLUKE-700PDS	
0% Value	3.000 psi		
100% Value	15.000 psi		
Tolerance	2.00 %		
Delay	0 s		
SOURCE			
0% Value	4.000 mA		
100% Value	20.000 mA		
Test Strategy	3P		
Abort	User Value	Custom Units	Done

Figure 16.

Press “DONE.” You should now see the split screen, with soft key choices of “Abort,” “Auto Test” and “Manual Test.”

- Select “Manual Test,” and watch the DPC start at 0 %. Once the reading has settled, depress “accept point.” Perform the 50 % and 100 % measurements the same way.
- Once the 753/754 has completed this evaluation, it will display the post test summary screen with the SOURCE, MEASURE and ERROR columns. Failures appear in reverse video in the Error column (Figure 17). Depress “Done.”

SOURCE	MEASURE	ERROR%	
4.000 mA	3.261 psi	2.18	
12.000 mA	9.477 psi	3.48	
20.000 mA	15.490 psi	4.08	
Abort	Prev. Page	Next Page	Done

Figure 17.

- Now you see the Tag entry screen (Figure 18).

Press ENTER to Change	
Tag PT100	
S/N 123456789	
ID 15	
Abort	Done

Figure 18.

Press the “ENTER” key to edit the entries. Depress “Done” when complete until the split screen reappears with the soft key options of: “As Left,” “Adjust,” “Save,” and “More Choices.”

- At this point, select “Adjust” and the DPC will source 0 % (4 mA) and measure for 3 PSI to 2 %. As long as the error exceeds 2 % the Error window in the measure half of the screen will be in reverse video. Adjust the zero on the I to P until the error is less than 2 %. Next select “Go to 100 %” and adjust span in the same way. Select “Go to 50 %” and evaluate linearity.
- After adjustments are complete, select “As Left,” “Done” and “Manual Test” and repeat step (8). If the adjustment was successful, all the errors in the post run summary should be in normal video (Figure 19).

SOURCE	MEASURE	ERROR%	
4.000 mA	3.001 psi	0.01	
12.000 mA	9.001 psi	0.01	
20.000 mA	15.000 psi	0.00	
Abort	Prev. Page	Next Page	Done

Figure 19.

- Select “Done,” “Done,” and “Done” again and you are done!

To review your results in memory, select the “More Choices” soft key, then the “Review Memory” soft key. Move your cursor to the applicable result and press ENTER. Select “As Found” or “As Left,” then “ENTER. Press “Next Page” for the results, and press “Tag” for its associated label. Select “Done” and “Done” and move your cursor to the applicable “As Left” result and press “enter.” Review the setup for the test, select “Next Page” for the results, and press “Tag” for its associated label. When you are finished reviewing results, press “Done” until right-most soft key label changes to “More Choices.”

Calibration of a Pressure Transmitter (Pressure to Current or P to I) with the Fluke 750 Series Documenting Process Calibrators

A common device in the Fluke DPC workload is the pressure transmitter or P to I device. The P to I device is used to convert pneumatic analog loop control signals of 3-15 PSI or other measured pressures to electrical loop analog control signals of 4-20 mA. The device in this example is a P to I with pressure input values of 3-15 PSI for 0 % and 100 % with output range (drawn from loop power) of 4-20 mA for 0 % and 100 %, +/- 2 %.

In this step-by-step example we will:

- 1) perform a three point ascending (3↑) As Found (pre-adjustment) test at 0-50-100 %, and Tag the results,
- 2) adjust the zero and span (100 %) of the P to I, then
- 3) perform a three point ascending As Left (post-adjustment) test at 0-50-100 %, tag those results and review them in memory.

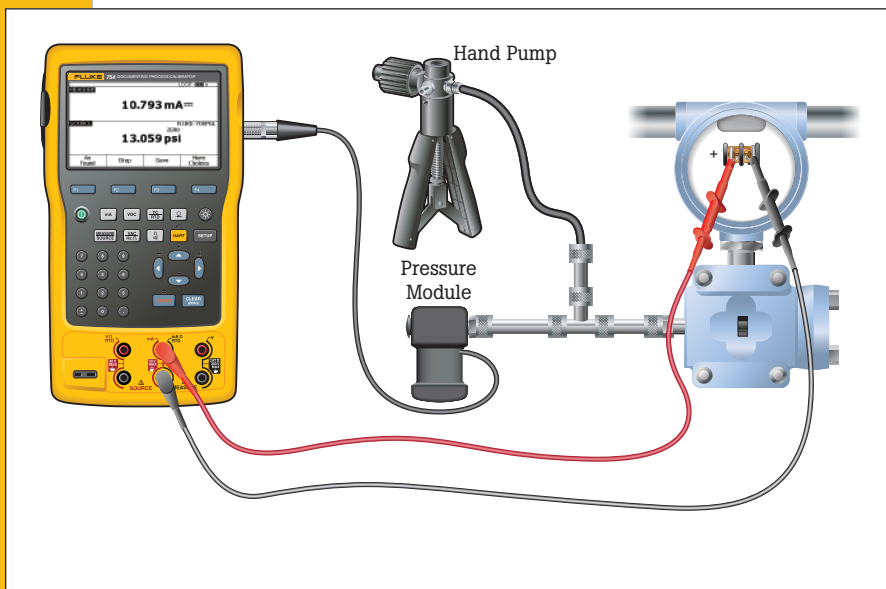


Figure 20.

1. Connect the pressure module to the DPC. Connect the input of the P to I and the output of a pressure hand pump to the input of the pressure module using a "T" connector (Figure 20). If you are using a differential pressure module, ensure (for this example) it is a 15 PSI module and connect to input labeled "H."
2. Connect from the center 2 banana type connections of the DPC to the input of the P to I where loop power is supplied (Figure 20).
3. Next, depress the "SETUP" button on the DPC. The cursor should begin on loop power. Depress "ENTER," down arrow to Enabled and depress "ENTER." Next depress the "Done" softkey.
4. Once your connections are made, assuming you are in the power up state (or measure screen), select the mA button.

5. Next depress the "MEAS/SOURCE" button; now you are in the source screen (Figure 21).

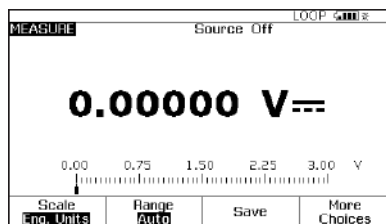


Figure 21.

7. Next depress the "MEAS/SOURCE" button once and you should be in the split screen mode (Figure 23).

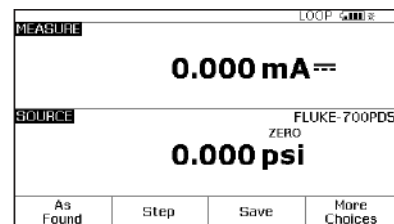


Figure 23.

6. Since we wish to source a pressure (using a hand pump) depress the pressure button, (directly above the HART or range button) (Figure 22).



Figure 22.

- At this point depress “As Found”, select “Instrument” and press “ENTER,” then fill in the template per Figure 24.

MEASURE		LOOP C 0.0%	
0% Value	4.000 mA ⁻⁻⁻		
100% Value	20.000 mA ⁻⁻⁻		
Tolerance	2.00 %		
Delay	0 s		
SOURCE		FLUKE-700PDS	
0% Value	3.000 psi		
100% Value	5.000 psi		
Test Strategy	3.1		
Abort	User Value	Custom Units	Done

Figure 24.

Depress “DONE.” You should now see the split screen and are presented with soft key choices of “Abort,” “Auto Test,” and “Manual Test.”

- Select Manual Test, and watch the DPC for the prompt: “Go to 3 PSI” (Figure 25).

MEASURE		LOOP C 0.0%	
Error	0.12%		
4.015 mA⁻⁻⁻			
SOURCE		FLUKE-700PDS	
Go To	3.000psi		
2.997 psi			
Abort		Accept Point	

Figure 25.

At that point using the hand pump, pump until the DPC display is reasonably close to 3 PSI and depress “Accept Point.” Now the DPC should display “Go to 9 PSI.” Again, using the hand pump, pump up reasonably close to 9 PSI and depress “Accept Point.” When the DPC responds with “Go to 15 PSI” pump to that value and “Accept Point.” It is important to understand a key feature of the DPC at this point. When the error is being calculated on the measured mA by the DPC, it will make the calculation based on the deviation of the amount of pressure being sourced. What this means is,

if you are sourcing 3.120 PSI (1% of span above nominal), the DPC will look for a mA reading of 4.160 mA (also 1% of span above nominal). In order to make a proper evaluation of the device you need only to get reasonably close to the nominal pressure values with the hand pump. The remaining source pressure error is compensated for by the DPC during mA measure calculations.

- Once the DPC has completed this evaluation, it will display the post test summary screen with the SOURCE, MEASURE and ERROR columns (Figure 26). Depress “Done.”

SOURCE	MEASURE	LOOP C 0.0%	ERROR%
3.000 psi	4.015 mA ⁻⁻⁻		0.10
8.999 psi	12.433 mA ⁻⁻⁻		2.71
15.028 psi	20.801 mA ⁻⁻⁻		4.77
Abort	Prev. Page	Next Page	Done

Figure 26.

- Now you are presented with the Tag entry screen (Figure 27).

MEASURE		LOOP C 0.0%	
Press ENTER to Change			
Tag	PT101		
S/N	123456789		
ID	TORV		
Abort			Done

Figure 27.

Press the “ENTER” key to edit the entries, press “Done” when complete until the split screen reappears with the soft key options of: “As Left,” “Adjust,” “Save,” and “More Choices.”

- At this point, select “Adjust” and the DPC will source 0%, instruct you to “Go to 3 PSI” and measure for 4 mA to 2%. As long as the error exceeds 2% the Error window in the measure half of the screen will be in reverse video. Adjust the zero on the P to I until the error is less than 2 %. Next select “Go to 100 %” and adjust span in the same way.
- After adjustment is complete, select “As Left,” “Done” and “Manual Test” and repeat step (9). If the adjustment was successful, all the errors in the post run summary should be in normal video (Figure 28).

SOURCE	MEASURE	LOOP C 0.0%	ERROR%
3.003 psi	4.017 mA ⁻⁻⁻		0.08
9.007 psi	12.008 mA ⁻⁻⁻		-0.01
15.004 psi	20.000 mA ⁻⁻⁻		-0.03
Abort	Prev. Page	Next Page	Done

Figure 28.

- Select “Done,” “Done,” and “Done” again and you are done!

To review your results in memory, select “More Choices” soft key, “Review Memory” soft key, move your cursor to the applicable and press “ENTER” and review the setup for the test, select “Next Page” for the results, depress “Tag” for its associated label. Select “Done” and “Done” next move your cursor to the applicable “As Left” result and depress “ENTER” and review the setup for the test, select “Next Page” for the results, depress “Tag” for its associated label. When you are finished reviewing results, press “Done” until right-most soft key label changes to “More Choices.”

Note on Uploading Results to Your PC

If you are using a 743/744 or 753/754, you may choose an instrumentation management software package from this list:

Fluke DPC/TRACK2™



AMS from Emerson Process Management, (formerly Fisher-Rosemount).



PRM (Plant Resource Manager) from Yokogawa Electric Corporation.

Prime Technologies



On Time Support Process/Track

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Additional information is available for download from www.fluke.com on these products

- Pressure Calibration Application Note
- Custom Units Application Note
- Switch Test Application Note
- HART Calibration Application Note
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