Process

Instrumentation

CALIBRATION

MURSHEED ALAM

2018

INSTRUMENTATION (CALIBRATION) NOTES

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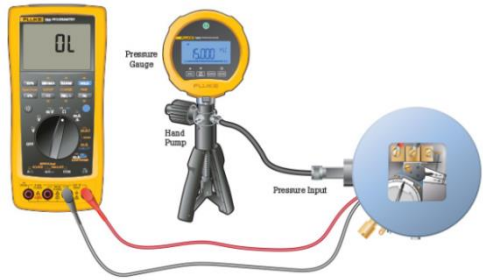
INSTRUMENTATION (CALIBRATION) NOTES

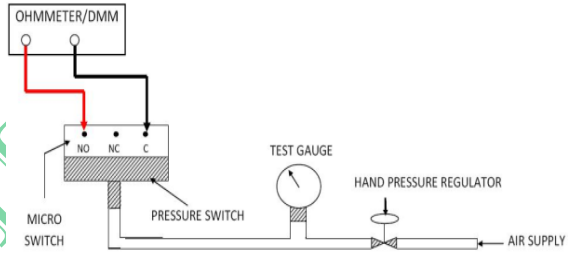
1. Calibration of pressure switch.

❖ Equipments required



- ➢ Pressure Source
- ➢ Accurate Gauge
- ➢ Micro switch contact monitoring device.
- For high pressure application Hand pump is more suitable.
- For low pressure shop air or simple regulated pressure can be used or electronic pressure source can be used.
- Pressure should have an accuracy of 0.25 %.

❖ Procedure of the Pressure Switch Bench Calibration



- ➢ Connect the pressure switch to a hand pressure regulator and test gauge, as shown in the diagram above.
- ➢ With a Multimeter, set to the continuity range to check and verify that the switch contacts are as indicated: NO (Normally open) and NC (Normally close).
- ➢ Connect the Ohmmeter or DMM between the normally open contacts (NO) and the common terminal (C) of the switch. The meter should read “open circuit”. Adjust the hand pressure regulator to increase the pressure to the set point of the pressure switch until the contacts change over. The meter should now read “short circuit”. Note the pressure reading and write it down. This pressure is the switch set point for a “rising” pressure.
- ➢ Increase the pressure to the switch to its maximum rating. Slowly reduce the pressure to the switch until the switch changes over from closed to normally open again. Note and write down this pressure reading. This pressure is the switch setting for a “falling” pressure.

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When error found, adjust set point by screw adjustment and repeat until desired value obtained.

- From the readings you have taken work out the pressure difference between the rising and falling pressure settings. This is called the "dead band" of the switch. The dead-band calculated should be equal to or less than the manufacturers' dead-band. The maximum dead-band is usually stated by the manufacturer.

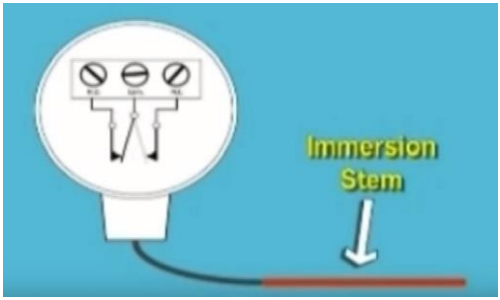
❖ **Following information must be present in Pressure Switch Calibration Certificate:**

- Unique instrument identifier .E.g.: P&ID Tag.
- Mfg., Model, Serial Number, Location.
- Set point with units of pressure
- Reset point (if necessary) or some way to indicate "trip on increasing input"
- NO or NC contacts
- Tolerance with units of measure
- Test equipment used with unique identifier and next due date
- As found and As left data
- Results
- Technician signature / Date

2. Calibration of Temperature Switch.

❖ **Equipments required**

a) Temperature Bath.
b) Switch Contact Monitoring Device



❖ **Procedure of Temperature Switch Calibration:**

- Remove temperature sensor from process.
- Connect test equipment
- For high Temperature Switch (TSH), place sensor in a calibrated bath/block test standard at a temperature below the specified trip point and allow to stabilize.

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- For low Temperature Switch (TSL), place sensor in a calibrated bath/block test standard at a temperature above the specified trip point and allow to stabilize.
- Slowly increase or decrease temperature to obtain trip point.
- Slowly decrease or increase temperature to obtain reset point.
- Repeat "X" times for repeatably.

3. Calibration of RTD type Temperature Transmitter

❖ **Equipments required**

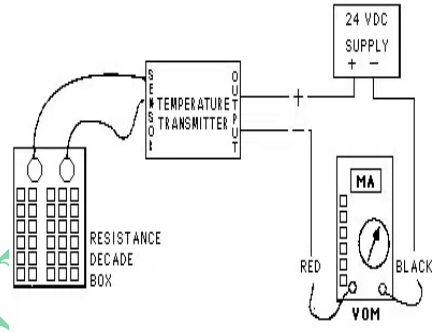
a) Temperature Transmitter,
b) 24 VDC power supply
c) Multimeter digital
d) Decade (Resistance) box.

❖ **Formula for calibration:**

Formula: - Rt = R0+αt

For a pt100 RTD:

α = 0.385
R0 = 100.



❖ **Procedure of RTD Temperature transmitter Calibration:**

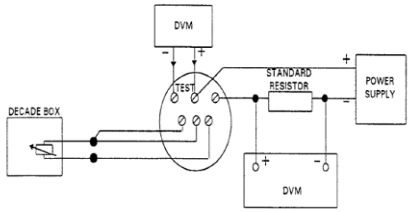
- Remove the temperature element (RTD) from transmitter.
- Connect the circuit as shown in figure above.
- Put multimeter in ma.
- By the equation we can find what will be the output resistance of RTD in specific temperature.

Example: Range: - 0° C ~ 200° C
Formula: - Rt = R0+αt

Let's take the temp= 50°C

So,

R50°C = 100+0.385*50
=100+19.25 =119.25Ω **Ans,**



Temperature	Resistance	O/P Current
0°C	100 Ω	4ma
50°C	119.25 Ω	8ma
100°C	138.5 Ω	12ma
150°C	157.75 Ω	16ma
200°C	177 Ω	20ma

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- So by the equation we can find resistance values for 5 point calibration (4ma,8ma,12ma,16ma,20ma)
- By setting these resistance values using decade box we can find the corresponding ma in multimeter.
- By changing the zero and span potentiometer in transmitter we can do the 5 point calibration.
- Repeat the process.

4. Calibration of Thermocouple type Temperature Transmitter

❖ **Equipments required**

a) Temperature Transmitter,
b) 24 VDC power supply
c) Multimeter digital
d) Milli volt source {(DPC-725/754 (documenting process calibrator)}

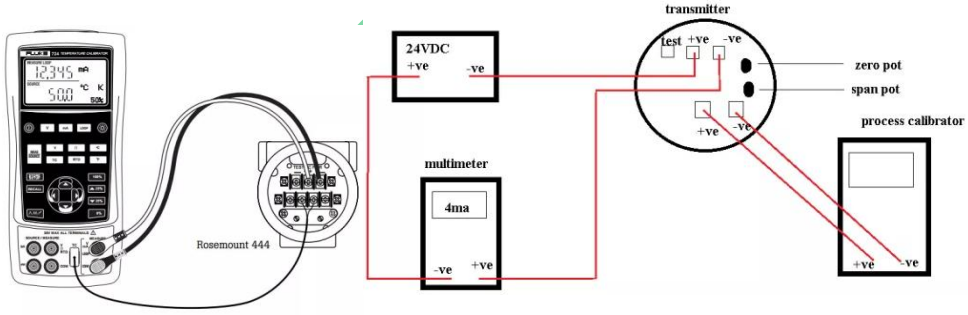
Formula for calibration:

Formula: - For a 'K' type thermocouple:

mV = °C × 0.0416

°C = mV ÷ 0.0416

❖ **Procedure of Thermocouple Temperature transmitter Online Calibration**



- Connect the circuit as shown in figure.
- Put multimeter into ma.

Example:

Range = 0 ~ 200°C

Formula: - mV = °C × 0.0416

Let's take the temp= 50°C

mV = 50 × 0.0416 = 2.08 mV **Ans.**

So 5 point calibration values are like this:-

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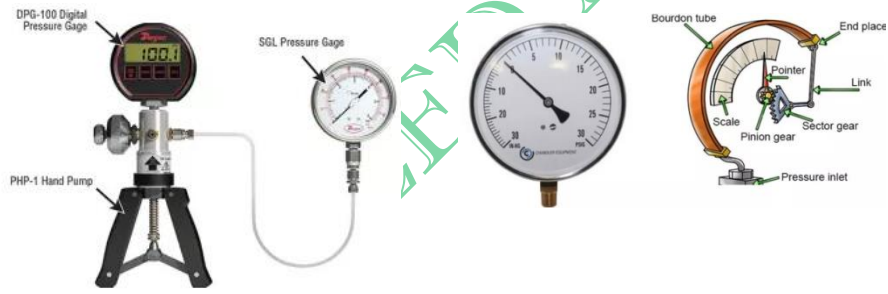
Temperature	mV	O/P Current
0°C	0 mV	4ma
50°C	2.08 mV	8ma
100°C	4.16 mV	12ma
150°C	6.24 mV	16ma
200°C	8.32 mV	20ma

So right now we know the corresponding values of temp to ma.

- Select thermocouple option in process calibrator.
- And give different values of temperature in process calibrator and check the mA in multimeter and by adjusting zero and span potentiometer in the transmitter correct the ma values.
- Repeat this procedure.

5. Calibration of pressure guage.



❖ **Procedure of pressure guage Calibration:**

- Connect the equipment's as shown in above **figure** to calibrate the pressure gauge.
- Apply pressure 0%(zero adjust)
- Adjust the zero screw or put the pointer on 0%
- Apply pressure 100%(span adjustment)
- To correct the indication increase or decrease the sector arm
- Apply pressure 50%(linear adjust)
- Adjust the length of link or pull the pointer using puller and place at correct spot
- Check points 0%,25%,50%,70% and 100%
- Repeat these steps to get correct values

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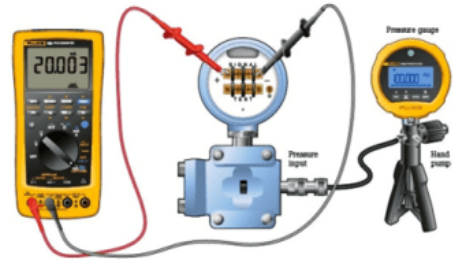
6. Calibration of Pressure Transmitter.

❖ **Equipments required**

- Pressure transmitter,
- Multimeter,
- HART communicator,
- Hand held test pump (pressure source).

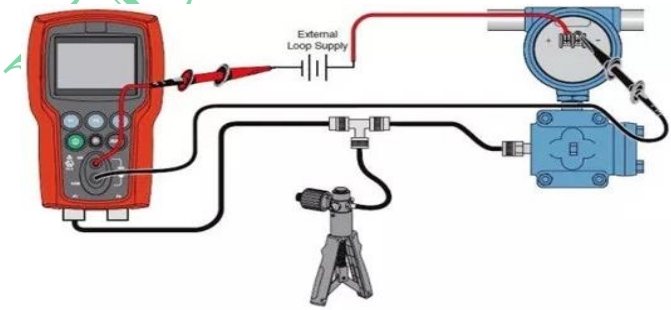


❖ **Procedure OF Pressure Transmitter online calibration**

- Isolate the Pressure Transmitter from the Process.
- Slowly open the vent plug and the vent valve to release the pressure.
- Connect the multimeter with the transmitter and ensure that output is 4ma when 0% pressure is applied.
- Connect the hand held test pump (pressure source) to the transmitter. Ensure there is no leak.
- Apply pressure range at 0%, 25%, 50%, 75%, and 100% and check there is any error.
- If there is any error calibration should be done.
  - **If transmitter is analog transmitter**
- Apply 0% pressure as per LRV with hand held test pump and check multimeter if it is not 4ma adjust the zero pot in the transmitter and correct transmitter output to 4ma
- Apply 100%pressure as per the URV and correct 20ma in multimeter by adjusting span pot in the transmitter

NOTE: Repeat these steps to rectify error.

- **In case of SMART Transmitter**



We have to use HART communicator. Connect the communicator with the transmitter select the HART Communicator Menu for lower

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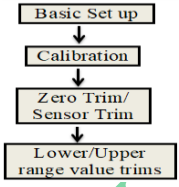
range value trim and upper range value trim using these steps:



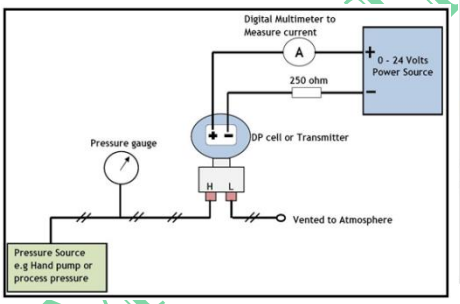
- HART communicator will automatically calibrate the transmitter.
- Restore the process connection
- Take the transmitter on line. Ensure there is no leak

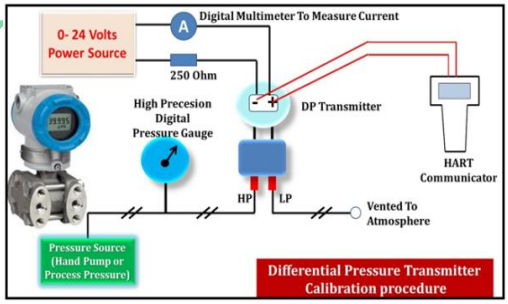
NOTE: Small example of five point calibration is given below:

Low range value = 0psi
Upper range value = 200psi

PERCENT OF RANGE (%)	INPUT PRESSURE	OUTPUT CURRENT (IDEAL)
0%	0 PSI	4.00 mA
25%	50 PSI	8.00 mA
50%	100 PSI	12.00 mA
75%	150 PSI	16.00 mA
100%	200 PSI	20.00 mA
75%	150 PSI	16.00 mA
50%	100 PSI	12.00 mA
25%	50 PSI	8.00 mA
0%	0 PSI	4.00 mA

7. Calibration of DP Transmitter.





❖ Equipments required

a) 24 VDC power supply
b) Multimeter digital
c) Pneumatic hand pump
d) Low pressure hand pump
e) High precision digital test gauge
f) HART communicator.

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❖ **Procedure of DPT transmitter bench Calibration**

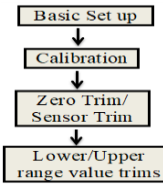
- Remove the differential pressure transmitter from the process
- Make sure the equalizing valve manifold is closed.
- connect the transmitter with the calibration equipments as shown in fig
- Apply the LRV pressure with the hand held test pump and check the multimeter reading
- If it is not 4ma then calibration is required.

◆ **If transmitter is analog transmitter**

- By applying 0% pressures by test pump adjust the zero pot in transmitter to get 4ma output in multimeter.
- Apply 100% pressure and adjust span pot to get 20ma in multimeter.
- Check for 25%, 50%, and 75%.
- Repeat the process to ensure that no error is occurred.

◆ **In case of SMART Transmitter**

We have to use HART communicator, connect the communicator with the transmitter select the HART Communicator Menu for lower range value trim and upper range value trim.



- Basic Set up – Calibration – Zero Trim/Sensor Trim —Lower/Upper range value trims.
- HART communicator will automatically calibrate the transmitter.
- Restore the process connection
- Take the transmitter on line. Ensure there is no leak

8. Calibration of DP Transmitter at field.

❖ **Example calculation:**

Transmitter range = 0-2 kg/cm^2
LRV = 0 kg/cm^2
URV = 2 kg/cm^2.

Note: Capillary flange at same elevation

❖ **Equipments required**

- Data sheet,
- Pressure calibrator,
- Multimeter,
- Hart communicator.

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❖ **Procedure of DP Transmitter Calibration:**

- Ask panel man to put the controller in manual mode for control loop and to put it on MOS for ESD loop.
- Hook up HART Communicator and verify some parameters by refer to data sheet. Typical parameters are, tag number, PV, LRV and URV.
- Isolate the instrument from the process.

WARNING: **If the process is hazardous, please unsure proper flushing is done to remove the entire hazard.**

- Open vent valve at drip ring and open plug at the top of the drip ring (if available) to release the process pressure.
- Clean the liquid inside the drip ring and put back the plug for high side only (if available) & Expose the low side to atmosphere.
- Hook up a multimeter in series with the signal to the DCS to measure current signal.
- In this condition both capillary flange will be atm pressure at difference high.
- Multimeter should show 4mA and PV at HART communicator should shows 0 (LRV).
- If not, do zero adjustment at transmitter using HART Communicator.
- Connect pressure calibrator to high side flange (drip ring).
- Apply pressure depend data sheet span (URV).
- Multimeter should show 20mA and PV at HART communicator should shows same with URV.
- If not, do span adjustment at transmitter using HART Communicator.
- Verify the linearity by increasing and decreasing the pressure (0%, 25%, 50%, 75%, 100%, 75%, 50%, 25% and 0% of range).
- After completion of the job ask panel operator to put loops back in normal mode or normalize the MOS.
- Fill the calibration form and file it for future reference.

9. Calibration of pH Electrode?

❖ **Procedure of pH electrode Calibration**

Select two buffers that bracket the expected sample pH.

More buffers can be used for greater accuracy over a wider pH range. For best accuracy, use buffers that are no more than 3 pH units apart.

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❖ **Procedure of pH meter calibration - Buffer solution**

- Refer PH meter manual for specific details on operating your meter.
- Remove the electrode and rinse it distilled water. Wipe the electrode with tissue paper to remove excess water and place electrode into the first buffer of pH 7.
- Calibrate the meter to read the temperature corrected value of the first buffer.
- Rinse the electrode as before and place in the second buffer. Wait for a stable reading. Calibrate the meter to read the temperature corrected value of the second buffer.
- Rinse the electrode as before. Place the electrode in the sample and wait for a stable reading. Record the pH and temperature of your sample.

❖ **Tips for pH meter/Electrode calibration**

- Always use fresh pH buffers.
- The electrode calibration slope should be 95-102%
- Remove the electrode filling solution cover when measuring, to ensure a uniform flow of filling solution.
- Between measurements, rinse the electrode with distilled water and then with the next sample to be measured.
- Stir all buffers and samples consistently.
- Place some insulating material between your stirrer and your sample to prevent heating of your sample.
- Avoid rubbing or wiping electrode bulb.
- Store your pH electrode properly.

10. Calibration of Magnetostrictive Level Transmitter.

❖ **Procedure of Magnetostrictive level transmitter Bench Calibration.**

Magnetostrictive Level Transmitter calibration can be changed with the unit push buttons

- **Setting the 4mA point:**
- Establish a tank level of 0% or move the float to the desired 0% point
- Enter the calibration mode by pressing the UP & DOWN buttons together for 1 second.

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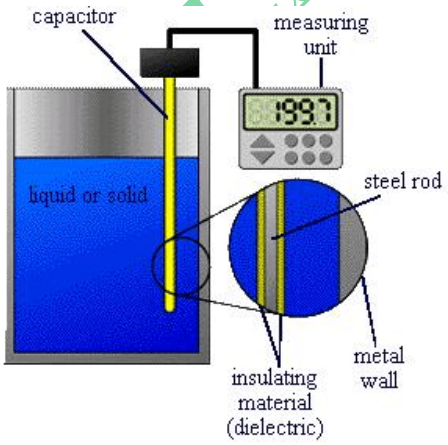
- Press the DOWN button for 1 second to set the output at 4.00mA.
- Setting the 20mA point:
- Establish a tank level of 100% or move the float to the desired 100% point
- Enter the calibration mode by pressing the UP & DOWN buttons together for 1 second.
- Press the UP button for 1 second to set the output at 20.00 ma

Note: The above steps can be repeated as many times as required.

11. Calibration of capacitance type level transmitter

❖ Procedure of capacitance type level Transmitter calibration:

- Remove the level transmitter from the system (tank).
- Check whether transmitter shows zero reading by connecting with multimeter otherwise release the pressure.



If the transmitter is smart

- Connect 475 hart communicator and multimeter to the level transmitter.
- Put Multimeter to ma.
- Fill the corresponding liquid in correct density and note down the readings. Fill liquid at 25%, 50%, 75% and 100% in both ascending and descending orders and note down the readings.
- Check for errors if there is zero and span adjusts should be done.
- **For zero calibration :** Drain the liquid and check the multimeter if it is not 0 then go to sensor trim option in the HART then go to zero trim and the HART communicator will automatically trim the sensor in to zero.
- **For span calibration:** Fill 100% and wait for some time then go to sensor trim and select span trim in HART communicator the 475 will automatically trim the sensor into 20ma.
- After doing zero and span trimming again check the reading at 0%, 25%, 50%, 75% and 100%.

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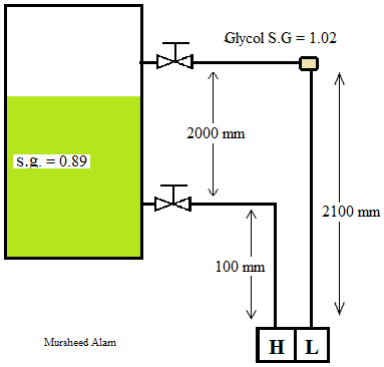
In case of non smart capacitance type transmitter.

- Connect a multimeter and rotate the zero pot and stop when multimeter shows 4ma.
- Fill the chamber to maximum liquid level and rotate the span screw to 20ma.
- Repeat these steps and check all readings.

12. Calibration of DP Level transmitter with actual pressure.



Example Calculation:

Product S.G=0.89
Glycol S.G = 1.02
Measurement length = 2000mm.
Off set = 100mm.
Full length =2000+100 = 2100mm.

DP = pressure at high side – pressure at low side

LRV = (Off set × Product S.G) – (Measurement length × Glycol S.G)
= (100mm x 0.89) – (2000 x 1.02) = 89 – 2040
= **-1951 mmH2O**

URV = (Full length × Product S.G) – (Measurement length × Glycol S.G)
= (2100mm x 0.89) – (2000 x 1.02) = 1869 – 2040
= **-171 mmH2O**

Note: LRV and URV calculation may have small variation as compare with HART communicator reading due to calibration with actual pressure.

❖ Procedure of DP LT Calibration with actual pressure:

- Hook up HART Communicator and verify some parameters by refer to data sheet. Typical parameters are, tag number, PV, LRV and URV.

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- Isolate the instrument from the process.
- Release both pressure and drain low side liquid only through manifold drain.
- **PRECAUTION 1:** During this process, please do not open the equalizing valve at the manifold.
- Open both plug at seal pot.
- Top up the seal liquid for low side until half of seal pot.
- Remove the tubing at high side of the flange (not at the manifold side) to drain remaining liquid in equalizing tube.
- **PRECAUTION 2**: Do not remove the process fluid in tubing of HP Side. Please ensure it is full with process liquid.
- Install back both plug and connect back tubing at high side of the flange
- Hook up a multimeter in series with the signal to the DCS to measure current signal.
- Open low side (top) isolation valve only and high side (bottom) isolation valve remain closed.
- Multimeter should show 4mA If not, do zero adjustment at transmitter using HART Communicator.
- Isolate back low side (top) isolation valve and released the pressure through high side vent valve seal pot.
- Close the vent at seal pot.
- Fill up the equalizing tube until full with product by removed the top fitting and slowly open the isolation valve (high side) until the equalizing tube is full (or up to 100% level) with product.
- Close the high side isolation valve.
- Install back any fitting that was remove for filling up the equalizing tube.
- Open low side (top) isolation valve only and high remain closed.
- Multimeter should show 20mA. If not, do span adjustment at transmitter using HART Communicator.

Note: **The reason to open the low side (top) isolation valve is to get the actual pressure vessel.**

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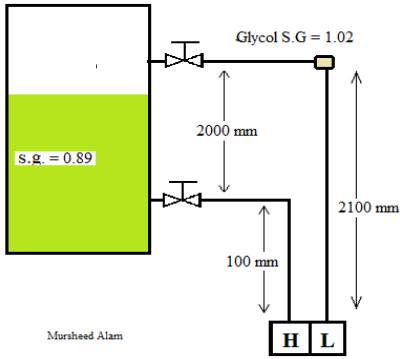
13. Calibration of DP Level Transmitter at field.



Example Calculation:

Product S.G=0.89
Glycol S.G = 1.02
Measurement length = 2000mm.
Off set = 100mm.
Full length =2000+100 = 2100mm.

DP = HP –LP

LRV = (Off set × Product S.G) – (Measurement length × Glycol S.G)
= (100mm × 0.89) – (2000 x 1.02) = 89 – 2040
= **-1951 mmH2O**

URV = (Full length × Product S.G) – (Measurement length × Glycol S.G)
= (2100mm × 0.89) – (2000 x 1.02) = 1869 – 2040
= **-171 mmH2O**

Note: Calculation for apply pressure at high side manifold transmitter.

0% = **(Off set × Product S.G)** = (100mm × 0.89) = 89 mmH2O
100% = **(Full length × Product S.G)** = (2100mm × 0.89) = 1869 mmH2O

Equipments required

- Data sheet,
- Pressure calibrator,
- Multimeter,
- Hart communicator.

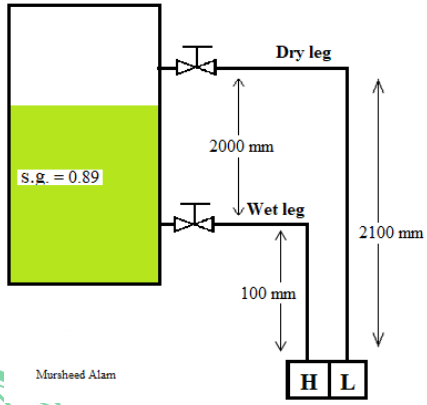
❖ **Procedure of DP Level Transmitter Calibration at field:**

- Ask panel man to put the controller in manual mode for control loop and to put it on MOS for ESD loop.
- Hook up HART Communicator and verify some parameters by refer to data sheet. Typical parameters are, tag number, PV, LRV and URV.
- Isolate the instrument from the process.
- Release both pressure and drain low and high side liquid throughout manifold drain.
- Open both plug at seal pot.
- Top up seal liquid for low side until half of seal pot.
- Remove tubing at high side of manifold.

- Hook up pressure calibrator at high side and isolate the vent valve.
- Hook up a multimeter in series with the signal to the DCS to measure current signal.
- Apply pressure as per calculation when level equivalent to zero, Multimeter should show 4mA.
- If not, do zero adjustment at transmitter using HART Communicator.
- Apply pressure as per calculation when level equivalent to 100%, Multimeter should show 20mA.
- If not, do span adjustment at transmitter using HART Communicator.
- After completion of the job ask panel operator to put loops back in normal mode or normalize the MOS.
- Fill the calibration form and file it for future reference.

Note: There is many way to perform calibration for DP level but the important thing is the DP reading at HART communicator should same with the LRV and URV.

14. Calibration of Differential Pressure Level transmitter for low side Dry Leg.



Example Calculation:

Product S.G	=0.89
Measurement length	= 2000mm.
Off set	= 100mm.
Full length =2000+100	= 2100mm.

DP = HP – LP

LRV = (Off set × Product S.G) – pressure at low side
= (100mm x 0.89) – 0 = 89 – 0 = **89 mmH2O**

URV = (Full length × Product S.G) – pressure at low side
= (2100mm x 0.89) – 0 = 1869 – 0 = **1869 mmH2O**

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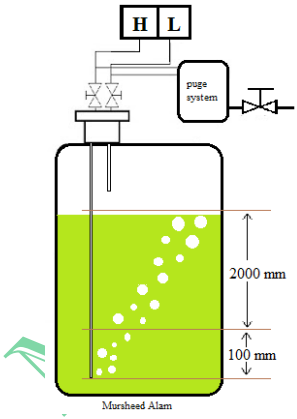
❖ **Procedure of DP LT Calibration with actual pressure:**

- Hook up HART Communicator and verify some parameters by refer to data sheet. Typical parameters are, tag number, PV, LRV and URV.
- Isolate the instrument from the process.
- Remove connection at manifold to the process after release the process pressure
- Connect pressure calibrator to high side of manifold.
- Expose the low side to atmosphere.
- Hook up a multimeter in series with the signal to the DCS to measure current signal.
- Apply pressure as per datasheet LRV. Multimeter should show 4Ma.
- If not, do zero adjustment at transmitter using HART Communicator.
- Apply pressure as per datasheet URV. Multimeter should show 20mA.
- If not, do span adjustment at transmitter using HART Communicator.
- Verify the linearity by increasing and decreasing the pressure (0%,25%,50%,75%,100%,75%,50%,25% and 0%of range)

Note: LRV and URV range from data sheet should include the pressure effect from bottom flange height to the transmitter and the SG of process liquid.

15. Calibration of Bubbler type DP LT.



Example Calculation:

Product S.G = 0.89
Measurement length = 2000mm.
Off set = 100mm.
Full length =2000+100 = 2100mm.

DP = HP – LP

LRV = (Off set × Product S.G) – LP.
= (100mm x 0.89) – 0 = 89 – 0 = **89 mmH2O**

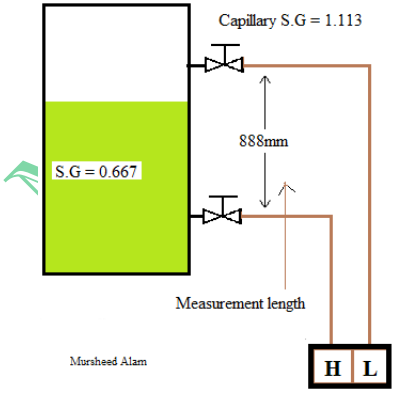
URV = (Full length × Product S.G) – pressure at low side
= (2100mm x 0.89) – 0 = 1869 – 0 = **1869 mmH2O**

INSTRUMENTATION (CALIBRATION) NOTES

❖ **Procedure of Displacer LT Calibration with two S.G.:**

- Ask panel man to put the controller in manual mode for control loop and to put it on MOS for ESD loop.
- Hook up HART Communicator and verify some parameters by refer to data sheet. Typical parameters are, tag number, PV, LRV and URV.
- Isolate the instrument from the process.
- **WARNING: If the process is hazardous, please unsure proper flushing is done to remove the entire hazard.**
- Remove the tubing connection at manifold to the process after released the process pressure.
- Connect pressure calibrator to high side of the manifold.
- Expose the low side to atmosphere.
- Hook up a multimeter in series with the signal to the DCS to measure current signal.
- Apply pressure as per data sheet LRV. Multimeter should show 4mA.
- If not, do zero adjustment at transmitter using HART Communicator.
- Apply pressure as per data sheet URV. Multimeter should show 20mA.
- If not, do span adjustment at transmitter using HART Communicator.
- Verify the linearity by increasing and decreasing the pressure (0%, 25%,50%, 75%, 100%, 75%, 50%, 25% and 0% of range)
- After completion of the job ask panel operator to put loops back in normal mode or normalize the MOS.

16. Calibration of DP LT for Capillary type.



Example Calculation:

Product S.G	=0.667
Capillary S.G	= 1.113
Measurement length	= 888mm.

DP = HP – LP

INSTRUMENTATION (CALIBRATION) NOTES

LRV = 0 – (Measurement length × Capillary S.G)
= 0 – (888 x 1.113) = – **988.34mmH2O**

URV = (Measurement length × Product S.G) – (Measurement length × Capillary S.G)
= (888 x 0.667) – (400 x 1.113) = 592.3 – 988.34
= – 396.04 mmH2O

The span is (Measurement length × Product S.G) = 592.3 mmH20

Note: This example is for onsite calibration without bringing down the flange.

❖ **Procedure of DP LT with capillary Calibration:**

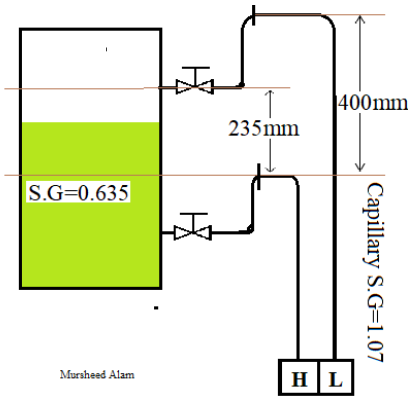
- Ask panel man to put the controller in manual mode for control loop and to put it on MOS for ESD loop.
- Hook up HART Communicator and verify some parameters by refer to data sheet. Typical parameters are, tag number, PV, LRV and URV.
- Isolate the instrument from the process.

WARNING: If the process is hazardous, please unsure proper flushing is done to remove the entire hazard.

- Open vent valve at drip ring and open plug at the top of the drip ring (if available) to release the process pressure
- Clean the liquid inside the drip ring and put back the plug for high side only (if available).
- Expose the low side to atmosphere
- Hook up a multimeter in series with the signal to the DCS to measure current signal.
- In this condition both capillary flange will be atm pressure at difference high
- Multimeter should show 4mA and PV at HART communicator should shows same with LRV
- If not, do zero adjustment at transmitter using HART Communicator
- Connect pressure calibrator to high side flange (drip ring)
- Apply pressure depend on calculation for span= (A x Product S.G)
- Multimeter should show 20mA and PV at HART communicator should shows same with URV
- If not, do span adjustment at transmitter using HART Communicator
- Verify the linearity by increasing and decreasing the pressure (0%,25%,50%,75%,100%,75%,50%,25% and 0%of range)
- After completion of the job ask panel operator to put loops back in normal mode or normalize the MOS.

INSTRUMENTATION (CALIBRATION) NOTES

17. Calibration of DP LT for Capillary type with offset.



Example Calculation:

Product S.G=0.635
Capillary S.G = 1.07
Measurement length = 235mm.
Off set = 400mm.

DP = HP – LP

LRV = 0 – (offset length × Capillary S.G)
= 0 – (400 x 1.07) = – **428mmH2O**

URV = (Measurement length × Product S.G) – (Full length × Capillary S.G)
= (235 x 0.635) – (400 x 1.07) = 149.225 – 428
= – 278.775 mmH2O

The span is (Measurement length × Product S.G) = 149.225 mmH20

Note: This example is for onsite calibration without bringing down the flange.

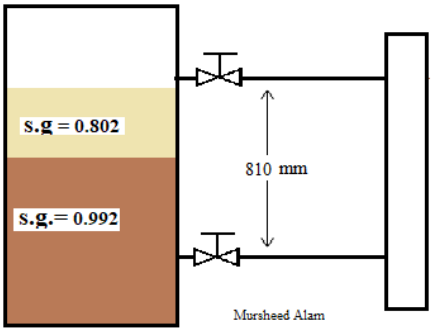
❖ Procedure of DP LT capillary type with offset Calibration:

- Ask panel man to put the controller in manual mode for control loop and to put it on MOS for ESD loop.
- Hook up HART Communicator and verify some parameters by refer to data sheet. Typical parameters are, tag number, PV, LRV and URV.
- Isolate the instrument from the process.
- **WARNING: If the process is hazardous, please unsure proper flushing is done to remove the entire hazard.**
- Open vent valve at drip ring and open plug at the top of the drip ring (if available) to release the process pressure.
- Clean the liquid inside the drip ring and put back the plug for high side only (if available).
- Expose the low side to atmosphere.

INSTRUMENTATION (CALIBRATION) NOTES

- Hook up a multimeter in series with the signal to the DCS to measure current signal.
- In this condition both capillary flange will be atm pressure at difference high.
- Multimeter should show 4mA and PV at HART communicator should shows same with LRV.
- If not, do zero adjustment at transmitter using HART Communicator
- Connect pressure calibrator to high side flange (drip ring).
- Apply pressure depend on calculation for span.
- Multimeter should show 20mA and PV at HART communicator should shows same with URV.
- If not, do span adjustment at transmitter using HART Communicator.
- Verify the linearity by increasing and decreasing the pressure (0%, 25%, 50%, 75%, 100%, 75%, 50%, 25% and 0% of range).
- After completion of the job ask panel operator to put loops back in normal mode or normalize the MOS.

18. Calibration of Displacer level transmitter.



Example Calculation:

Low S.G = 0.802
High S.G = 0.992
Measurement length = 810mm.

0% = (Measurement length × Low S.G)
= (810 x 0.802) = **649.42 mm**
100% = (Measurement length × High S.G)
= (810 x 0.992) = **803.52 mm**

❖ **Procedure of Displacer LT Calibration with two S.G.:**

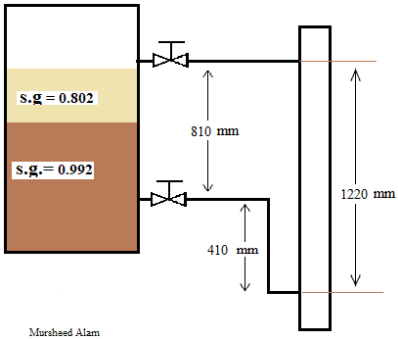
- Ask panel man to put the controller in manual mode for control loop and to put it on MOS for ESD loop.
- Hook up HART Communicator and verify some parameters by refer to data sheet. Typical parameters are, tag number, PV, LRV and URV.
- Isolate the instrument from the process.

INSTRUMENTATION (CALIBRATION) NOTES

WARNING: **If the process is hazardous, please unsure proper flushing is done to remove the entire hazard.**

- Remove isolation drain valve and open the vent flange.
- Connect water pump to drain line and line up the reference tube.
- Calculate the new measurement to get equivalent up trust force with S.G and length.
- Mark on the chamber for reference calibration (0%, 25%, 50%, 75%, 100 %,).
- Hook up a multimeter in series with the signal to the DCS to measure current signal.
- Apply water level until 0% marking on chamber. Multimeter should show 4mA.
- If not, do zero adjustment at transmitter using HART Communicator.
- Apply water level until 100% marking on chamber. Multimeter should show 20mA.
- If not, do span adjustment at transmitter using HART Communicator.
- Verify the linearity by increasing and decreasing the pressure. (0%, 25%, 50%, 75%, 100%, 75%, 50%, 25% and 0% of range)
- After completion of the job ask panel operator to put loops back in normal mode or normalize the MOS

19. Calibration of Displacer level transmitter with offset.



Example Calculation:

Low S.G = 0.802
High S.G = 0.992
Measurement length = 810mm.
Off set = 410mm.
Displacer length =810+410 = 1220mm.

0% **= (High S.G x off set length) + (low S.G x Measurement length)**
= (0.992 x 410) + (0.802 x 810)
= 406.72 + 649.62 **= 1056.34mm**

100% **= (High S.G x Displacer length)**
= (0.992 x 1220) = **1210.24mm**

INSTRUMENTATION (CALIBRATION) NOTES

❖ **Procedure of offset Displacer LT Calibration with two S.G.:**

- Hook up HART Communicator and verify some parameters by refer to data sheet. Typical parameters are, tag number, PV, LRV and URV.
- Isolate the instrument from the process.

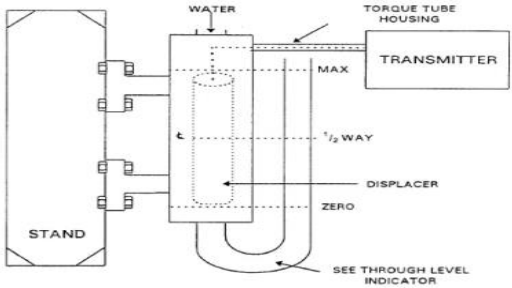
WARNING: **If the process is hazardous, please unsure proper flushing is done to remove the entire hazard.**

- Remove isolation drain valve and open the vent flange.
- Connect water pump to drain line and line up the reference tube
- Calculate the new measurement to get equivalent up trust force with S.G and length.
- Mark on the chamber for reference calibration (0%, 25%, 50%, 75%, 100 %,).
- Hook up a multimeter in series with the signal to the DCS to measure current signal.
- Apply water level until 0% marking on chamber. Multimeter should show 4mA.
- If not, do zero adjustment at transmitter using HART Communicator.
- Apply water level until 100% marking on chamber. Multimeter should show 20mA.
- If not, do span adjustment at transmitter using HART Communicator.
- Verify the linearity by increasing and decreasing the pressure. (0%,25%,50%,75%,100%,75%,50%,25% and 0%of range)

20. Calibration of level troll or Displacer type level transmitter.

❖ **Equipments required**

a) Leveltroll,
b) Multimeter digital
c) Transparent tube



❖ **Procedure of Leveltroll/displacer level transmitter Calibration:**

- Close the both primary isolation valves.
- Drain the liquid in the displacer chamber through the drain valves

- Now there is no liquid in the chamber so it means 0%, so adjust the zero pot in the transmitter and check the value in multimeter and correct to 4ma.
- Now open 1st primary isolation valve and fill the liquid to the center of the top flange(if the liquid is water, otherwise calculate the length of full level of the liquid by taking product of specific gravity of liquid and height of the displacer)
- Adjust the span pot in the transmitter and adjust 20ma in multimeter.
- Repeat the process.

21. Calibration of level troll or Displacer type level transmitter with weight.

❖ **Wet Calibration with Water for Liquid level**

Zero:

- Hang displacer on torque tube arm rod.
- Adjust Zero to 3 psi.

Span:

- Fill up water into the chamber.
- Adjust Span to 15 psi.
- 0%, 25%, 50%, 75% & 100%. Mark on chamber.
- Fill up & Drain water to check 0%, 25%, 50% , 75% & 100%.Check output.
- Check function two three times.

Note: Compensate specific gravity difference of water & process liquid.
Process liquid specific gravity is 0.7
Water specific gravity is 1.0
To calibrate level transmitter 100% level.
Water level to be fill up in chamber = 0.7/1.0 x 100 % = 70 %.

❖ **Dry Calibration with Weights**

Find out Displacer
W= Displacer weight in 2400Gram (2.4 kg)
Specific gravity of process liquid. (WATER)= 1.0

INSTRUMENTATION (CALIBRATION) NOTES

V = Volume of displacer. 1620.84
Displacer diameter 7.620 Centimetre (3 inches)
Length of Displacer 35.56 centimetre (14 inch)
Volume= $3.14 \times r^2 \times h$ $= 3.14 \times 3.81 \times 3.81 \times 35.56$ $= 1620.84$

Zero:

- For 0% hang displacer or 2400 gram weight on torque tube arm rod.
- Adjust Zero to 3 psi.

Span:

- For 100% Hang weigh
  t= Displacer weight – Volume X Specific gravity
  = 2400 – 1620 X 1= 780.
- Adjust Span to 15 psi.
- Check function two three times for calibration.

Level (%)	Hang weight (gram)	Transmitter o/p (psi)
0	2400	3
25	1995	6
50	1590	9
75	1180	12
100	780	15

For each 25% step subtract 405 Gram weight from hang weight.1620/4=405.
Note: Compensate specific gravity difference of water & process liquid.

❖ Wet Calibration with Water For Interface level

Zero:

Displacer in lighter liquid:

Process liquid specific gravity is 0.7
Water specific gravity is 1.0

- Mark chamber at 70%
- Fill up water in chamber
- To calibrate level transmitter 0% level.
- Water level to be fill up in chamber = 0.7/1.0 x 100 %= 70 %
- Adjust Zero to 3 psi.

Span :

Displacer in heavier liquid:

- Process liquid specific gravity is 1Fill up 100% water into the chamber.
- Adjust Span to 15 psi.

INSTRUMENTATION (CALIBRATION) NOTES

❖ Dry Calibration with Weights

Find out Displacer

W = Displacer weight in 2400Gram (2.4 kg)
Specific gravity of process liquid Oil = 0.7
V = Volume of displacer. 1620.84
Displacer diameter: - 7.620 Centimetre (3 inches).
Length of Displacer: - 35.56 centimetre (14 inch)
Volume= 3.14 X r^2 X h= 3.14 X 3.81 X 3.81 X 35.56= 1620.84

Zero :

Displacer in lighter liquid

- For 0% hang weight on torque tube arm rod.
- Hang weight= Displacer weight – Volume X Specific gravity
  = 2400 – 1620 X 0.7= 2400 - 1134
  = 1266
- Adjust Zero to 3 psi.

Span:

Displacer in heavier liquid.

- For 100% Hang weight= Displacer weight – Volume × S.g.
  = 2400 – 1620 X 1 = 780
- Adjust Span to 15 psi.
- Check function two three times for calibration.

Level (%)	Hang weight (gram)	Transmitter o/p (psi)
0	2400	3
25	1145.5	6
50	1023	9
75	901.5	12
100	780	15

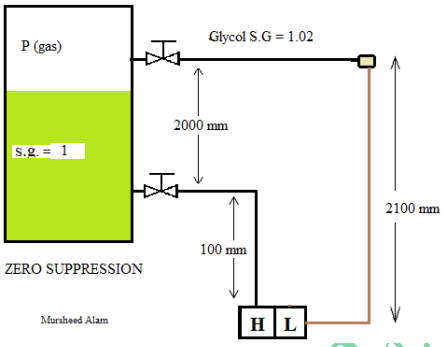
For each 25% step subtract 121.5 Gram weight from hang weight.
(1620-1134=486)
(486÷4=121.5).

INSTRUMENTATION (CALIBRATION) NOTES

22. Level Transmitter Calibration – (Zero Suppression and Zero elevation).

❖ Level Measurement – Zero Suppression (WET LEG)

If an instrument is mounted below a vessel it sense a total head but the head due to the distance from the instrument location to the bottom of the vessel does not represent level in the vessel. This head must be must be cancelled by a range suppression calibration, using the zero adjustment provided in the instrument.



Example Calculation:

Product S.G	= 1
Glycol S.G	= 1.02
Measurement length	= 2000mm.
Off set	= 100mm.
Full length	= 2100mm.

Span = (H × D)
= 2000 × 1 = **2000 mmH$_2$O.**

DP = HP – LP

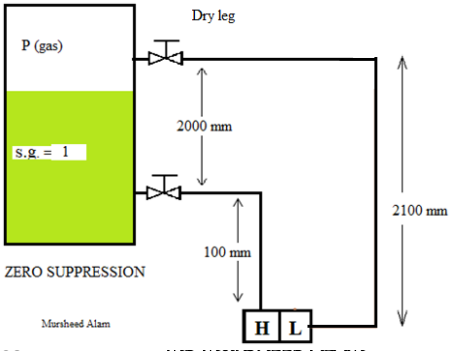
LRV = (offset length × product S.G) – (Full length × glycol S.G)
= (100 × 1) – (2100 × 1.02) = 100 – 2142 = **– 2042 mmH$_2$O.**

URV = (Measurement length × Product S.G) – (Full length × glycol S.G)
= (2100 × 1) – (2100 × 1.02) = 2100 – 2142 = **– 42 mmH$_2$O.**

Span = URV – LRV = -42 - (2042) = -42 + 2042 = **2000mmH$_2$O**

SO,
The Range will be: **– 2042 to -42 mmH$_2$O.**

❖ Level Measurement – Zero Suppression (DRY LEG)



Example Calculation:

Product S.G	= 1
Measurement length	= 2000mm.
Off set	= 100mm.
Full length	= 2100mm.

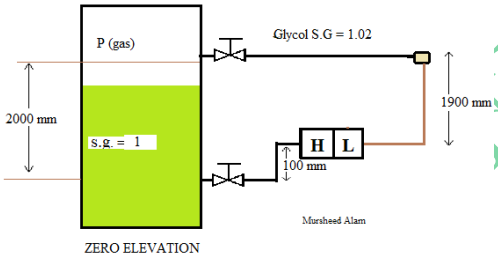
Span = (H × D)
= 2000 × 1 = **2000 mmH$_2$O.**

INSTRUMENTATION (CALIBRATION) NOTES

DP = HP – LP
LRV = (offset length × product S.G) – (Full length × product S.G)
= (100 × 1) – (2100 × 1) = 100 – 2100 = **– 2000 mmH_2O.**
URV = (Measurement length × Product S.G) – (Full length × product S.G)
= (2100 × 1) – (2100 × 1) = 2100 – 2100 = **0 mmH_2O.**
Span = URV – LRV = 0 – (-2000) = 0 + 2000 = **2000mmH_2O**
SO,
The Range will be: **– 2000 to 0 mmH_2O.**

❖ Level Measurement – Zero Elevation (WET LEG)

If an instrument is mounted above a vessel, the distance from the instrument location to the zero level of the level must be added by a range elevation calibration again using the zero adjustment provided in the instrument.



Example Calculation:

Product S.G	= 1
Glycol S.G	= 1.02
Measurement length	= 2000mm.
Off set	= 100mm.
Full length (LP Side)	= 1900mm.

Span = (H × D)
= 2000 × 1 = **2000 mmH_2O.**

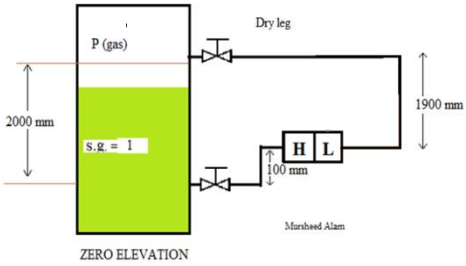
DP = HP – LP
LRV = {0 - (offset length × product S.G)} – (Full length × glycol S.G)
= {0 - (100 × 1)} – (1900 × 1.02) = (0 – 100) – 1938
= -100 - 1938 = **– 2038 mmH_2O.**

URV = (Measurement length × Product S.G) – (Full length × glycol S.G)
= (1900 × 1) – (1900 × 1.02) = 1900 – 1938 = **– 38 mmH_2O.**

Span = URV – LRV = -38 - (-2038) = -38 + 2038= 2000mmH_2O
SO,
The Range will be: **– 2038 to -38 mmH_2O.**

INSTRUMENTATION (CALIBRATION) NOTES

❖ Level Measurement – Zero Elevation (DRY LEG)



Example Calculation:

Product S.G = 1
Measurement length = 2000mm.
Off set = 100mm.
Full length (LP Side) = 1900mm.

Span = (H × D)
= 2000 × 1 = **2000 mmH$_2$O.**

DP = HP – LP

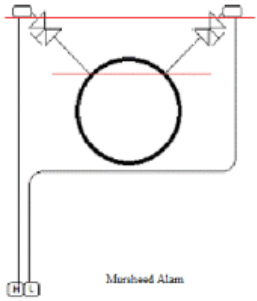
LRV = {0 - (offset length × product S.G)} – (Full length × product S.G)
= {0 - (100 × 1)} – (1900 × 1) = (0 – 100) – 1900
= -100 - 1900 = **– 2000 mmH$_2$O.**

URV = (Measurement length × Product S.G) – (Full length × product S.G)
= (1900 × 1) – (1900 × 1) = 1900 – 1900 = **0 mmH$_2$O.**

Span = URV – LRV = 0 - (-2000) = 0 + 2000 = 2000mmH$_2$O
SO,
The Range will be: **– 2000 to 0 mmH$_2$O.**

Once zero calibration is complete for either zero suppression or elevation, the span adjustment provided in the instrument is used to calibrate the actual range of level change measured in the vessel.

23. Calibration of steam flow DP Transmitter.



Example Calculation:

Instrument calibrated range: 0 – 2500 mmH2O
Process calibrated range: 0 – 7000 kg/h
Q = K×P
0% (0 mmH2O) = (0/2500) × 7000 = 0 × 7000
= 0 kg/h
50% (1250 mmH2O) = (1250/2500) × 7000
= 0.5 × 7000 = 3500 kg/h
100% (2500 mmH2O) = (2500/2500) × 7000
= 1 × 7000 = 7000 kg/h

INSTRUMENTATION (CALIBRATION) NOTES

❖ Equipments required

- Data sheet,
- Pressure calibrator,
- Multimeter,
- Hart communicator.

❖ Procedure of steam flow DP Transmitter Calibration:

- Ask panel man to put the controller in manual mode for control loop and to put it on MOS for ESD loop.
- Hook up HART Communicator and verify some parameters by refer to data sheet. Typical parameters are, tag number, PV, LRV and URV.
- Isolate the instrument from the process.
- Release both pressure and drain low and high side liquid throughout manifold drain.
- Connect pressure calibrator to high side of manifold.
- Expose the low side to atmosphere.
- Hook up a multimeter in series with the signal to the DCS to measure current signal.
- Apply pressure as per data sheet LRV (normally 0mmH2O), Multimeter should show 4mA.
- If not, do zero adjustment at transmitter using HART Communicator.
- Apply pressure as per data sheet URV, Multimeter should show 20mA.
- If not, do span adjustment at transmitter using HART Communicator.
- Verify the linearity by increasing and decreasing the pressure (0%, 25%, 50%, 75%, 100%, 75%, 50%, 25% and 0% of range).
- Fill up back water until half of seal pot.
- After completion of the job ask panel operator to put loops back in normal mode or normalize the MOS.

INSTRUMENTATION (CALIBRATION) NOTES

24. Calibration of flow (Pitot tube) DP Transmitter.

Example Calculation:

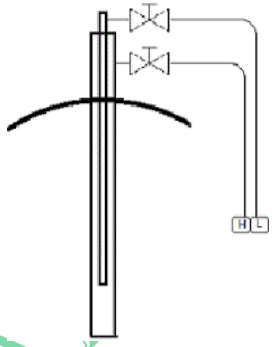
Instrument calibrated range: 0 – 5000 mmH_2O.
Process calibrated range: 0 – 22900 kg/h

Q = K×P

0% (0 mmH_2O) = (0/5000) **×** 22900
= 0**×** 22900 = 0 kg/h.

50% (2500 mmH_2O) = (2500/5000) **×** 22900
= 0.5**×** 22900 = 11450 kg/h

100 % (5000 mmH_2O) = (5000/5000) **×** 22900
= 1**×** 22900 = 22900 kg/h



Procedure of flow (Pitot Tube) DP Transmitter Calibration:

- Ask panel man to put the controller in manual mode for control loop and to put it on MOS for ESD loop.
- Hook up HART Communicator and verify some parameters by refer to data sheet. Typical parameters are, tag number, PV, LRV and URV.
- Isolate the instrument from the process.
- Remove connection at manifold to the process after release the process pressure and Connect pressure calibrator to high side of manifold.
- Expose the low side to atmosphere.
- Hook up a multimeter in series with the signal to the DCS to measure current signal.
- Apply pressure as per data sheet LRV, Multimeter should show 4mA.
- If not, do zero adjustment at transmitter using HART Communicator.
- Apply pressure as per data sheet URV, Multimeter should show 20mA.
- If not, do span adjustment at transmitter using HART Communicator.
- Verify the linearity by increasing and decreasing the pressure (0%, 25%, 50%, 75%, 100%, 75%, 50%, 25% and 0% of range).
- After completion of the job ask panel operator to put loops back in normal mode or normalize the MOS.
- Fill the calibration form and file it for future reference.

INSTRUMENTATION (CALIBRATION) NOTES

25. Calibration of Capillary type flow Transmitter.

Example Calculation:

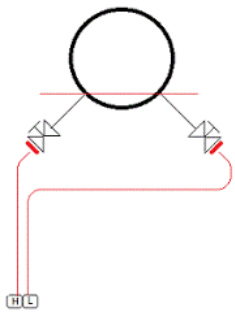
Instrument calibrated range: 0 – 2500 mmH2O
Process calibrated range: 0 – 130 m^3/h.

Q = K×P

0% (0 mmH2O) = (0/2500) × 130 = 0 × 130 = 0 m3/h.
50% (1250 mmH2O) = (1250/2500) × 130 = 0.5 × 130 = 65 m3/h
100% (2500 mmH2O) = (2500/2500) × 130 =1× 130 = 130 m3/h

Equipments required

- Data sheet,
- Pressure calibrator,
- Multimeter,
- Hart communicator.



❖ **Procedure of capillary type FT Calibration:**

- Ask panel man to put the controller in manual mode for control loop and to put it on MOS for ESD loop.
- Hook up HART Communicator and verify some parameters by refer to data sheet. Typical parameters are, tag number, PV, LRV and URV.
- Isolate the instrument from the process.
- Open vent valve at drip ring and open plug at the top of the drip ring (if available) to release the process pressure.
- Clean the liquid inside the drip ring and put back the plug for high side only (if available).
- Connect pressure calibrator to high side of manifold & Expose the low side to atmosphere.
- Hook up a multimeter in series with the signal to DCS to measure current signal.
- Apply pressure as per data sheet LRV, Multimeter should show 4mA.
- If not, do zero adjustment at transmitter using HART Communicator.
- Apply pressure as per data sheet URV,Multimeter should show 20mA.
- If not, do span adjustment at transmitter using HART Communicator.
- Verify the linearity by increasing and decreasing the pressure.
- After completion of the job ask panel operator to put loops back in normal mode or normalize the MOS.
- Fill the calibration form and file it for future reference.

INSTRUMENTATION (CALIBRATION) NOTES

26. I/P converter calibration.

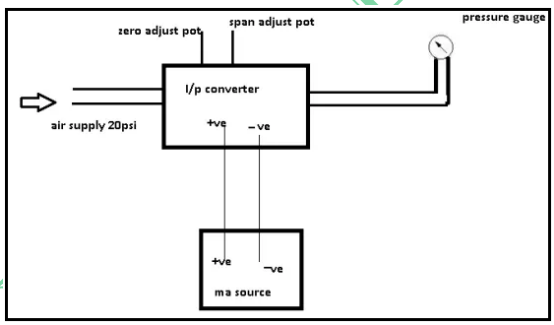
❖ **Equipments required**

- I/P converter,
- Milliamp source,
- Pressure source(20 psi),
- Master gauge.

Note: No need of external power supply (24vdc) for working (neither for calibration)

❖ **Procedure of I/P converter online Calibration:**

- Remove the I/P from the process.
- If there is any top cover in I/P remove it.
- Connect 20-psi supply pressure and connect a milliamp source to the I/P.



- Set the input signal to 4 mA and check the output pressure on gauge as 3 psi.
- If the pressure is showing more or less than 3 psi then adjust zero.
- Turn zero adjustment screw slowly by very small turn to obtain 3-psi pressure. More turning of zero adjustment may damage the I/P converter. Counterclockwise rotation increases the pressure, and clockwise rotation decreases the pressure.
- Set the input current signal to 20 mA and check the output pressure on gauge as 15 psi.
- Turn the span adjustment potentiometer very slowly by small turn to obtain 15-psi pressure. More turning of span adjustment may damage the I/P converter.
- Repeat step 4 to check that the desired low value (4 ma ~ 3 psi) has not changed after adjusting the span. If necessary repeat from steps 3
- Reconnect the I/P in the process.

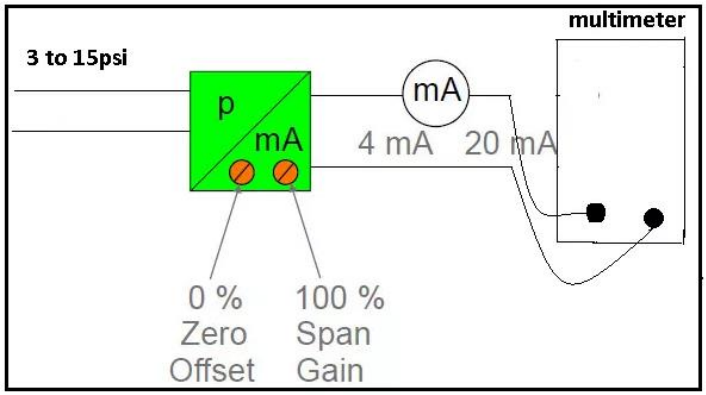
INSTRUMENTATION (CALIBRATION) NOTES

27. P/I converter calibration.

❖ Equipments required

- Supply voltage 24vdc,
- Pressure source(handheld test pump),
- Multimeter.

❖ Procedure of P/I converter Bench Calibration.

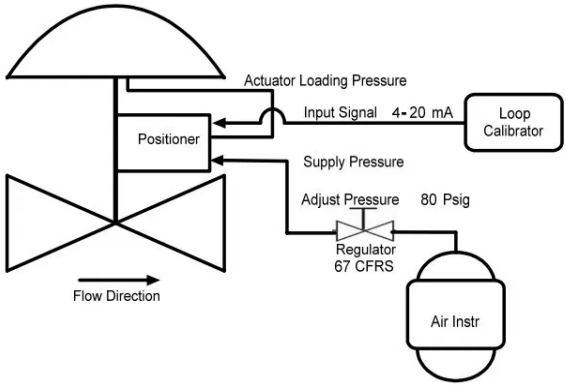


- Set digital calibrator on measure mode.
- Connect input signal i.e. 3-15 psig.
- Set the input signal to 3 psig and check the output current as 4 mA.
- If the current is showing more or less than 4 mA then adjust zero pot to make output 4ma.
- Set the input pressure signal to 15 psig and check the output current 20 mA.
- Turn the span adjustment potentiometer on Converter and adjust 100%.
- Repeat step 3 to check that the desired low value (3 psig ~ 4mA) has not changed after adjusting the span.

NOTE: If necessary repeat steps 3 through 4 to fine-tune the unit.

INSTRUMENTATION (CALIBRATION) NOTES

28. Stroke checking of Control Valve.



❖ **Equipment and Materials Required:**

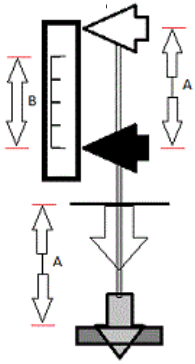
a) Air Instrument**.**
b) Loop Calibrator **(4 – 20 mA).**
c) Connector**.**
d) Tubing and ferrule sets.

❖ **Procedure of Control Valve Stroke checking:**

- Connect control valve and its accessories as per connection diagram (consider control valve is an 'air to close' valve).
- Apply Air Instrument for Supply pressure to Regulator.
- Adjust Regulator until pressure as per datasheet for Supply Pressure to POSITIONER.
- Set Loop Calibrator to provide current Input Signal (4-20mA) to POSITIONER.
- Apply 4 mA to positioner using loop Calibrator.
- Check the stem movement it must be at minimum position, if there is any error adjust the zero calibrating screw in positioner.
- Apply 20 mA to positioner using loop Calibrator.
- Check the stem position it must be at 100% position ,if there is any error adjust the span screw in the positioner
- Apply 0%, 25%, 50%, 75%, and 100% of the signal & observe the corresponding stroke of the valve & stem position.

INSTRUMENTATION (CALIBRATION) NOTES

29. Calibration of Control Valve.



Example calculation:

A: Max travel from stem = 70mm
B: Scale plate = 50mm
New open adjustment should be (50/70) × 100 = 71.48%

❖ **Equipments required**

- Data sheet,
- Hart communicator.

❖ **Procedure of Control Valve Calibration:**

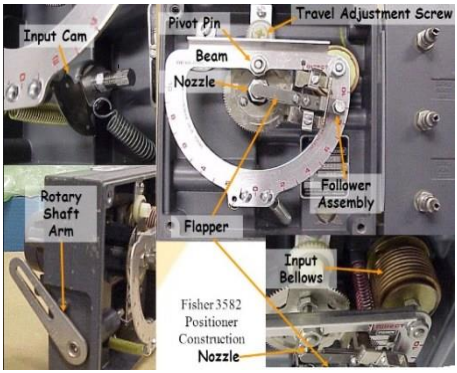
- Ask panel man to put the controller in manual mode for control loop.
- Isolate the Valve from the process.

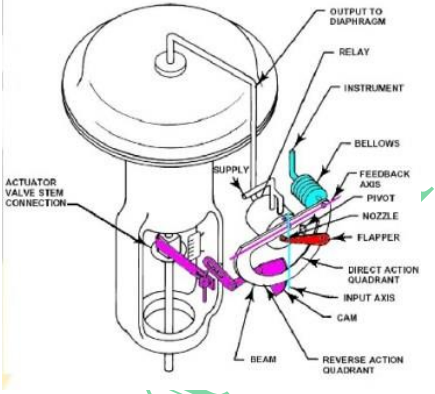
WARNING: **The Isolation of control valve from the process shall be done by field operator. Careful step shall be done to ensure no upset to the operation.**

- Hook up HART Communicator and verify some parameters by refer to data sheet such as Tag Number, OP and etc.
- Change from normal mode to setup mode.
- Select auto find stop (wait some minute).
- If full open is more than 100% select open adjustment and put new number as per calculation.
- Make an auto calibration (wait some minute).
- Verify the linearity by increasing and decreasing the travel (0%, 25%, 50%, 75%, 100%, 75%, 50%, 25% and 0% of range).
- After completion of the job ask panel operator to put loops back in normal mode.
- Fill the calibration form and file it for future reference.

INSTRUMENTATION (CALIBRATION) NOTES

30. Calibration of Control Valve Positioner.





❖ **Equipments required:**

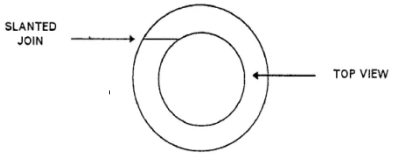
- positioner,
- Control valve.
- Pressure source.

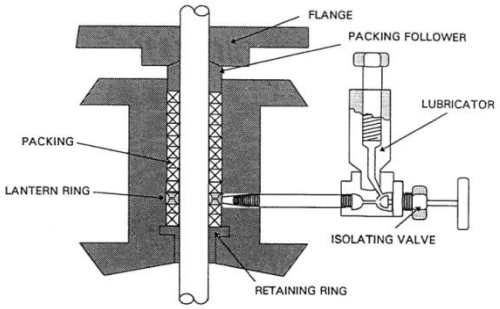
❖ **Procedure of Control Valve positioner Calibration:**

- Zero adjustments are done at the nozzle
- Span adjustment is done by moving flapper assembly (follower assembly) along the summing beam
- Air supply to the positioner is 20 psi.
- To calibrate move the flapper assembly to midrange of direct side or about no.6
- Increase the input signal to 3 psi.
- Adjust the nozzle in or out slowly to make the output gauge output 0 psi.
- Increase the input pressure to 15 psi.
- If the output saturates too soon (at the output gauge) before giving 15psi move the flapper assembly to smaller number in the summing beam.
- If the output saturates too late or above 15 psi move flapper assembly to larger number at the summing beam.
- Every time when you move the flapper assembly reset the nozzle to zero also.

INSTRUMENTATION (CALIBRATION) NOTES

31. Replacements of Valve stem packing.





Valve stem packing is the process of tightening the valve gland follower with packing material to reduce or eliminate process leaks. The rings are metal with a hole at the centre. Which allows lubrication to forced into the space between the ring and the stem. The lubrication usually used is silicon grease.

- **Procedure for Removing the Valve packing:**
- Open the gland follower dog bolts & open the gland follower.
- Remove the packing rings using packing tools, without scratching the shaft.
- If there is a lantern ring, remove this with a piece of wire bent into a hook.
- Make sure all packing scraps have been removed.
- **Procedure for Installing New Valve Packing**
- Clean the shaft well using a non-flammable, non-toxic solvent.
- Brush down and then wipe the area with a clean rag.
- Calculate how many rings will be required by measuring the gap between the shaft and the stuffing box, the depth of the stuffing box and the thickness of the lantern ring.
- Wind the packing material round the mandrel as many times as the number of rings required.
- Cut the rings with a sharp knife.
- Check how many rings you need to put below the lantern ring. Only correct number of rings can place below the lantern ring. Otherwise, it will not be in line with the lubricator.
- Lubricate the rings with an anti-seize compound, so they will go in more easily.
- Insert the packing rings and lantern ring one by one, pushing them into the stuffing box as far as they can go.
- Ring joints should stagger and cut on a slant, as shown:

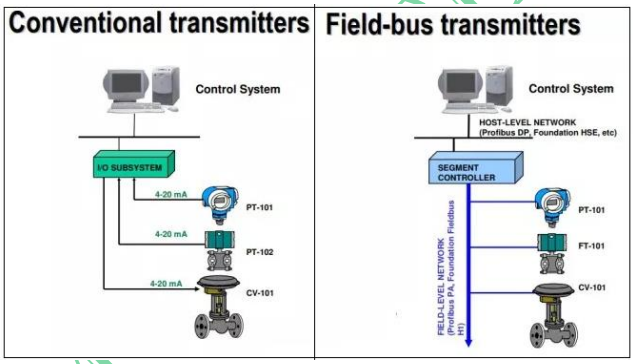
INSTRUMENTATION (CALIBRATION) NOTES

32. Calibration of Fieldbus Transmitters.

❖ Calibration in Fieldbus terminology

The terminology differs between the calibration of the conventional instrument and the digital one. Traditionally in metrology, the word calibration means that the instrument under test is compared to a more precise instrument and may include trimming or adjusting the instrument to show the correct readings again. In fieldbus terminology, the word calibration means that the instrument is being configured or verified. The main reason to calibrate is that even the best instruments drift and lose their ability to give precise measurements. Drift makes calibration necessary. Environment conditions, elapsed time and type of application can affect the stability of a instrument. Even instruments from the same manufacturer, type and range can show varying performance. You can find that a unit has good stability, while another performs differently.

❖ Difference between conventional & fieldbus transmitters:



❖ Conventional transmitters

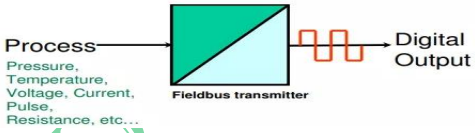
- Analogue one-way signal
- Only one variable.
- A pair of cable to each instrument.
- Conversion of mA signal to digital for I/O subsystem.

INSTRUMENTATION (CALIBRATION) NOTES

❖ Field-bus transmitters

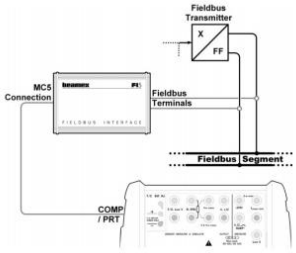
- Digital two-way signal.
- Huge amount of information is transferred.
- Several instruments in one bus cable (multi-drop).
- No conventional I/O systems needed.
- Open standard – Instruments from any manufacturer can be in the same Field-bus.

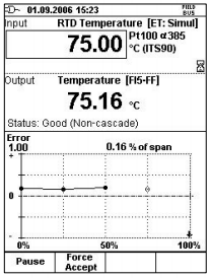
The main difference between a Fieldbus transmitter and conventional transmitters is that the output signal is a fully digital Fieldbus signal. Change the output signal does not change the need for periodic calibration.



❖ Procedure for calibrating Fieldbus transmitters

Beamex MC5 Fieldbus Calibrator is a combination of a multifunction process calibrator and a Field-bus configurator, which can be used with both industrial standards **Foundation Field-bus** H1 and Profi-bus PA. It also houses **HART** configuration and calibration facility.





❖ STEPS for calibrating Fieldbus transmitters

- 2 persons needed for calibration.
- Make connections.
- Calibrate and document automatically – Simulate or generate the input and read the digital output of the Field-bus instrument.
- Trim (adjust) if required and perform As Left calibration automatically or manually.
- Upload calibration results to calibration software and print the calibration certificate.

INSTRUMENTATION (CALIBRATION) NOTES

33. If a control valve in a stuck how will you start checking?

a) Obtain the permit.

b) First of all get the control valve is passed from operation.

c) Check the lingual to the diaphragm of the control valve.

d) Disconnect it possible the actuator stem from the control valve stem.

e) Stroke the actuator and see whether the actuator operates or not. If not then the diaphragm may be punctured.

f) If the actuator operates connect it back to the plug stem stroke the control valve. If it does not operate loosen the gland nuts a bit and see if it operates. If it does not then the control valve has to be removed from the line to w/shop.