

P55 Pressure Transducer Handbook



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P55 Handbook

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Model P55

Differential Pressure Transmitter



Features:

- **Small, Rugged DP Transmitter for Liquid Service**
- **+/-5 Vdc or 4-20 mA Two-Wire Output**
- **Full Scale Range from 2.22" H₂O to 3200 psi**
- **Excellent Temperature Characteristics**
- **0.25% Accuracy – 0.1% Accuracy Optional**

The Validyne Model P55 is a compact differential pressure transmitter designed for industrial measurement applications. The variable reluctance sensing technology allows the P55 to be used in a wide variety of low pressure measurements where fast dynamic response, high resistance to vibration and superior signal stability through ambient temperature change is required. The P55 will accept both gases and liquids directly at the sensing diaphragm; there are no internal isolation fluids to slow the sensor response or cause excessive temperature shift errors.

The P55 is available in three output configurations: 4-20 mA current sink output, DC output and isolated DC output. The 4-20 mA output version is a true two-wire system which will operate over a supply voltage of 9 to 55 Vdc.

The DC version is a direct replacement for the Vdc signal. The isolated DC output version provides the same +/-5 Vdc signal, isolated from the power supply by 100 MOhms

The P55 is also available in an absolute pressure version with a welded variable reluctance sensor. Zero and span controls are available for external adjustment, and the wiring may be via connector or pigtail options.

The P55 is Ideal for:

- **Level Measurements**
- **Hydraulic Systems**
- **Vehicle Testing**

P55 Specifications

General Specifications –

Ranges:

P55D: +/-0.08 psid to +/-3200 psid
P55A: 0 - 0.08 psia to 0 - 3200 psia

Accuracy:

P55D: +/-0.25% FS, includes non-linearity, hysteresis and non-repeatability
P55E: +/-0.1% FS, as above
P55A: +/-0.5% FS, as above

Overpressure:

P55D: 200% FS up to 4000 psi maximum with less than 0.5% FS output shift
P55A: 20 psia or 200% FS, whichever is greater, up to 4000 psia maximum, for less than 0.5% zero shift

Line Pressure:

P55D: 3200 psig maximum, with zero shift less than 1%/Kpsi

Pressure Ports:

P55D: 1/8" female NPT with 8-32 Bleed Screw & Gasket, STD
P55A: 5/16-24 UNF-2B with 1/8" male NPT adapter included

Environmental Specifications -

Operating Temp: -65 F to +250 F

Compensated Temp: 0 to +160 F
-65F to +250 F (Optional)

Temperature Errors: +/-0.5% FS
For Operating Temperature Range of 0 F to +160 F

+/-0.9% FS
For Operating Temperature Range of -65 F to +250 F

Includes non-linearity and hysteresis errors

Sensor Physical Specifications -

Pressure Media: Liquids & gases compatible with 410 SST and Inconel

O-Rings: Buna-N Standard, other compounds available

Pressure Cavity Volume: 4 e-3 cu in, each port

Volumetric Displacement: 3 e-4 cu in at FS

Weight: 16 Oz.

Power Requirements -

Power Supply: 9 to 55 Vdc, unregulated

Current Draw:

4-20 mA Output: 25 mA max
+/-5 Vdc Versions: 3 mA, typ

Signal Output -

4-20 mA Output: 4 to 20 mA
DC Voltage Output: +/-5 Vdc @ 0.5 mA

Zero Balance: By external adjustment
Span: By external adjustment

Frequency Response: Low Pass Filter at 250 Hz, -3 db

Line Regulation: 0.02%

Output Noise: 2 mVrms

Insulation Resistance: 100 MOhms, any terminal to case

Ordering Information

P55D-1-N-1-40-S-4-A

Measurement

- A = Absolute
- D = Differential
- E = Extended Accuracy, 0.1% FS

Electrical Connection

- 1 = PT02A Amphenol Connector
- 2 = PT02E Environmental Connector
- 4 = 1/2" NPT Conduit w/24" Leads

O-Rings

- L = Fluorosilicone
- N = Buna-N (Std)
- E = Ethylene Propylene
- V = Viton-A
- S = Silicone
- K = Kalrez
- T = Teflon (2 psid & above)

Output Type

- 1 = 0 to +5 Vdc
- 2 = 0 to +5 Vdc
- 3 = 0 to 2.5 to +5 Vdc
- 4 = 4-20 mA
- 5 = 4 -12 -20 mA
- 6 = 0 to +5 Vdc, Isolated
- 7 = 0 to +/-5 Vdc, Isolated
- 8 = 0 to +2.5 Vdc to +5 Vdc, Isolated

Pressure Connection

- A = 1/8" Female NPT w/8-32 Bleed Port
- B = 1/8" Female NPT & 1/8" Female NPT Bleed Port
- E = 5/6" Female per AND 10050-2, No Bleed Port, P55A Only
- F = 1/4" OD Tube X 1" Long, No Bleed Port

Sensor Material

- 4 = 410 SST
- 5 = 410 SST Nickel Plated*
- 6 = 410 SST Gold Plated*

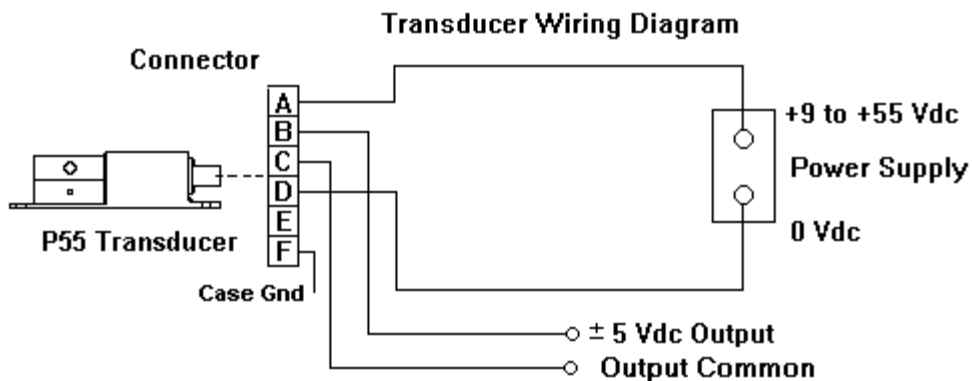
Operating Temp. Range

- S = 0 to 160 F
- W = -65 F to +250 F

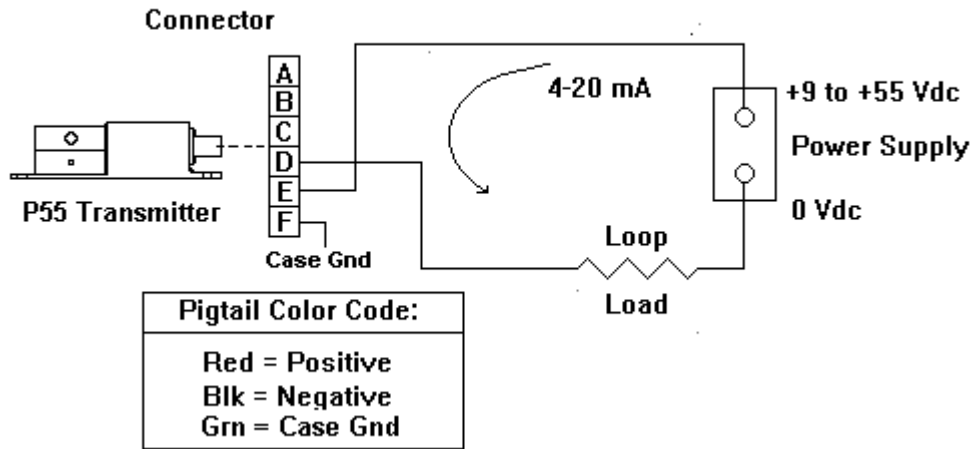
Pressure Range

XX = Two Digit Range Code (see chart)

Wiring Diagram



Non-Isolated Pigtail Color Code:	Isolated Pigtail Color Code:
Red = + Power Yel = - Power	Red = + Power Blk = - Power
Orn = + Signal Gry = Output Common	Orn = + Signal Grv = - Signal
Grn = Case Gnd	Grn = Case Gnd



PRESSURE RANGE CHART						
Range Dash No.	PSI	IN HG.	IN H₂O	KPA	TORR	CM H₂O
20	.125	.25	3.5	.86	6.5	8.80
22	.20	.41	5.5	1.40	10.3	14.0
24	.32	.65	8.9	2.2	16.5	22.5
26	.50	1.02	14.0	3.5	25.8	35.0
28	.80	1.6	22.2	5.5	41.4	56.0
30	1.25	2.5	35.0	8.6	65.0	88.0
32	2.0	4.1	55.0	14.0	103	140
34	3.2	6.5	90	22.0	165	225
36	5.0	10.2	140	35.0	258	350
38	8.0	16.0	222	55.0	414	560
40	12.5	25.0	350	86.0	650	880
42	20	41.0	550	140	1030	1400
44	32	65.0	890	220	1650	2250
46	50	102	1400	350	2580	3500
48	80	160	2220	550	4140	5600
50	125	250	3500	860	6500	8800
52	200	410	5500	1400	10300	14000
54	320	650	8900	2200	16500	22500
56	500	1020	14000	3500	25800	35000
58	800	1600	22200	5500	41400	56000
60	1250	2500	35000	8600	65000	88000
62	2000	4100	55000	14000	103000	140000
64	3200	6500	89000	22000	165000	225000

I. INTRODUCTION

DC Output Pressure Transducers combine a rugged and reliable variable reluctance pressure sensor with a solid state carrier demodulator, yielding a DC-DC transducer capable of operating from an unregulated power supply and providing a proportional analog output signal.

Differential and gage versions feature symmetrical pressure cavities with only corrosion resistant materials and Oring cavity seals in contact with the pressure media. Absolute versions feature all-welded stainless steel construction and are not field serviceable. Both versions provide internal adjustments for Zero and output Span.

II. UNPACKING

Transducers are shipped with plastic caps, plugs or adhesive stickers over the pressure ports. These prevent dirt from entering the pressure cavities. It is recommended that the covers be left on the ports until making pressure connections.

On very low range units, the port covers may have a small hole in them. This is done to eliminate internal pressures caused by installing the cover. Be sure to check the shipping carton thoroughly for any accessory items – pressure fitting adapters, mating connectors, etc. – that may have been ordered. A pressure fitting adapter with Oring seal is also provided with absolute versions.

III. INSTALLATION

Proper installation of a transducer is important but not difficult. This section covers a few guidelines regarding mounting, pressure connections, plumbing, liquid-filling (or “bleeding”) and electrical connections which, when observed, will go a long way toward assuring the success of the measurement.

Mounting. An integral plate with four holes is provided for mounting on a flat surface (See Figure 1 for details). To prevent strains on the tubing connections, the absolute version, or the differential version with fitting adapters for use with tubing systems, should be mounted using the integral plate. The differential version with two 1/8-27 NPT female pipe ports may be mounted by rigid pipe connections.

To prevent strain on the transducer body, the integral plate should be mounted on a flat surface. Such strain can cause small zero shifts that can be accentuated by temperature changes.

Mounting the transducer above the point of measurement will minimize accumulation of dirt or condensate, enhancing the internal cleanliness of the transducer. Finally, be sure to provide access to the electrical connector and bleed ports.

Plumbing. Plumbing should allow transducer removal and re-installation without shutdown of the pressure system. If the transducer is used for gage pressure measurement where one port is left open to the atmosphere, a simple shutoff valve can be installed in the line to the transducer. The open (reference) port should be covered by a porous filter to prevent access of dirt and dust (use a plastic cap with a small hole). Non-porous plugs are not recommended; the relatively small volume of air in the reference cavity will severely damp transducer response and substantially increase temperature error.

A differential pressure transducer used to measure the pressure drop across an orifice or filter requires more extensive valving not only to place it into operation but also to remove it without overpressure damage. In this case a valve arrangement as shown in Figure 2 should be used.

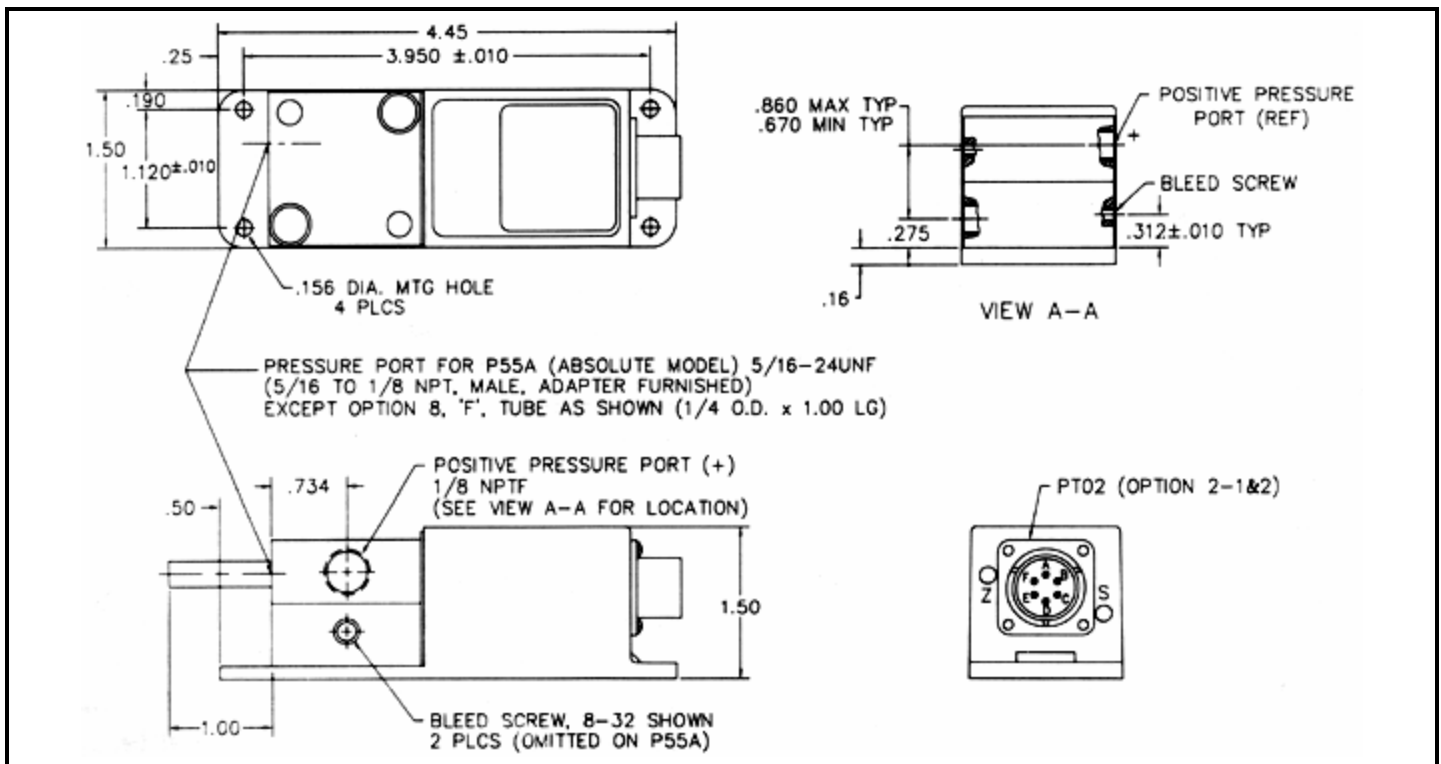


FIGURE 1. Outline/Installation Drawing

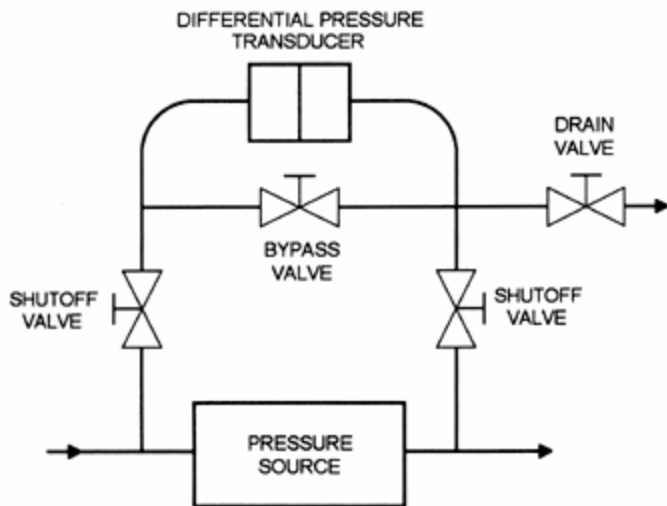


FIGURE 2. Typical Valve Arrangement for DP Use

To pressurize the transducer, close the drain valve and open the bypass valve. Then both shutoff valves are opened to apply line pressure equally to both sides of the transducer. Finally, close the bypass valve. To remove the transducer, open the bypass valve, close the shutoff valves and open the drain valve. Valve manifolds for this purpose are commercially available from valve and fitting suppliers.

Pressure Connections. Pressure connections are made via ports in each cavity. Before making connections to the transducer, be sure the connecting pipe or fitting is free of loose internal scale and check the threads for cleanliness or damage. If torn or nicked, clean up the thread with a die or chaser. Then wrap the tapered thread with two layers of 0.5" wide Teflon pipe thread tape (available at most plumbing supply stores), stretching it lightly as it's wrapped so that it conforms to the threads. Wrap in the direction of the thread, as if screwing on a fitting. The Teflon acts as both a thread lubricant and sealant, minimizes thread galling and makes disassembly easier.

When attaching the pipe or fitting, screw it in with a small wrench until it is snug, then, give it another one-half turn. If the threads are not properly prepared and/or excessive torque is applied to the tapered thread, the case material around the pressure port can crack from the high tensile stress created.

The 5/16-24 port requires a mating fitting adapter with an O-ring to make a leak-free connection. A 5/16-24 to 1/8-27 NPT male fitting adapter, with O-ring, is standard.

Liquid-Filling ("Bleeding"). A bleed port for each pressure cavity facilitates cleaning or liquid filling of the cavities. The bleed port is sealed with a set screw machined to carry a glass-filled Teflon gasket at its inner end. The gasket provides the sealing action. For static pressure measurements it is generally unnecessary to fill the pressure cavity with the liquid media as any trapped air or gas will transmit the pressure to the sensing diaphragm. However, when good response to dynamic pressure changes or oscillations in liquid-filled systems is important, the pressure cavities and transducer connections should be free of gas.

Otherwise the trapped gas acts as a pneumatic damper and can seriously decrease the frequency response of the measuring system. To remove entrapped gases, loosen the bleed screw one or two turns with a 5/64" hex wrench, with system pressure ON (It is recommended that the bleed screw not be fully removed as the bleed screw gasket could be lost, making an effective seal impossible). After the trapped gas has been expelled and bubble-free liquid begins to flow out the vent hole, tighten the bleed screw to seal the cavity. Note that the bleed port vent hole for the negative pressure cavity is covered by the integral (mounting) plate with the transducer normally mounted. If it is necessary to liquid-fill this cavity, it is suggested that the two screws used to secure the transducer to the base plate be removed to provide sufficient clearance for the expelled media to exit the vent during the bleed operation.

Electrical Connections. The standard electrical connector is a 6-pin PT02A-10-6P (Bendix, or equivalent). Input and output connections are as shown on Figure 1. The internal circuitry is electrically isolated from the transducer case. If desired, the cable shield can be connected to the transducer case through the connector shell. However, if the transducer is grounded through its mounting or through the pressure connections, the cable shield should be left floating at the transducer end to eliminate noise from ground currents circulating through the cable shield.

IV. CALIBRATION

As supplied from the factory, DC transducers have been calibrated for the full scale pressure and output voltage levels specified on the purchase order. If desired, the transducer can be adjusted for other pressure/voltage relationships, using internal Zero and Span adjustments provided in the electronics module. To determine the range of full scale pressures a given transducer may be calibrated to without diaphragm replacement, see the Pressure Range Chart.

EQUIPMENT REQUIRED:

- DC Power Supply
- Digital Voltmeter, 0 to 10.00Vdc
- scale Calibrated Pressure Source

PROCEDURE:

- A.** Connect the transducer to a calibrated pressure source commensurate with the transducer range. For absolute versions, use a vacuum pump for zero psia input and full scale ranges less than atmospheric pressure.
- B.** Connect the DC power supply to terminals A (+) and D (-) of the connector. Set the supply voltage to the voltage to be used at the installation. See the data sheet specification for the particular unit for power supply voltages.
- C.** Connect the DVM to terminals B (+) and C (-) of the connector.
- D.** Apply zero pressure to the transducer, and adjust zero potentiometer Z for a DVM reading of ± 0.01 Vdc. (This can be set at any value between ± 1 Vdc). CW rotation causes (+) increases in output.
- E.** Apply full scale pressure to the transducer and adjust potentiometer S for a DVM reading of 5.00 ± 0.01 Vdc. This can be set at any voltage between 3 and 5.5 Vdc.
- F.** Repeat steps E and F until interaction between adjustments is eliminated.



Date: 11/24/2010

Time: 2:16:36 PM

CALIBRATION CERTIFICATE

Sales Order:

Work Order: T1572

Model Number: P55D - 1 - E - 2 - 32 - S - 4 - A

Range: 2 PSI

Serial Number: 590263

Employee Number: 2110

Initial: _____

Pressure Equipment Asset Number: 1375

Pressure Equipment Mfg and Model Number: MENSOR PCS-400

Pressure Equipment Calibration Due Date: 3/9/2011

Interface Equipment Asset Number: 1281

Interface Equipment Mfg and Model Number: VEC 601

Interface Equipment Calibration Due Date: 9/28/2011

Ambient Temperature: 68.8 F

Calibration Type: 9 Point Cal

Calibration Data:

<u>Pressure</u>	<u>Unit Output</u>
<u>PSI</u>	<u>VDC</u>
0.000	0.000
1.000	2.501
2.000	5.001
1.000	2.504
0.000	0.001
-1.000	-2.496
-2.000	-5.003
-1.000	-2.503
0.000	-0.011




Date: 11/24/2010

Time: 3:12:20 PM

CALIBRATION CERTIFICATE

Sales Order:
Work Order: T1572
Model Number: P55D - 1 - E - 2 - 32 - S - 4 - A
Range: 2 PSI
Serial Number: 590259

Employee Number: 2110

Initial: 

Pressure Equipment Asset Number: 1375
Pressure Equipment Mfg and Model Number: MENSOR PCS-400
Pressure Equipment Calibration Due Date: 3/9/2011

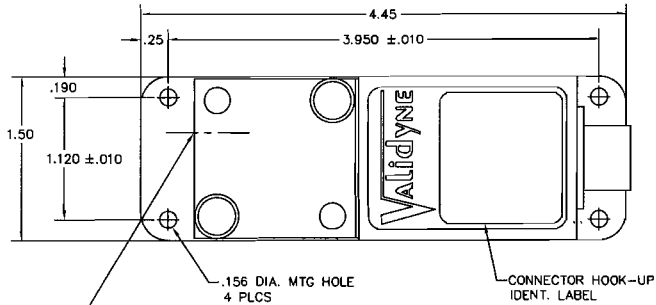
Interface Equipment Asset Number: 1281
Interface Equipment Mfg and Model Number: VEC 601
Interface Equipment Calibration Due Date: 9/28/2011

Ambient Temperature: 69 F

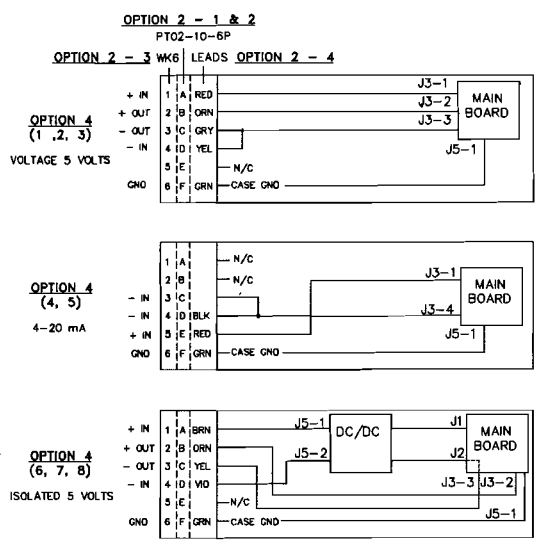
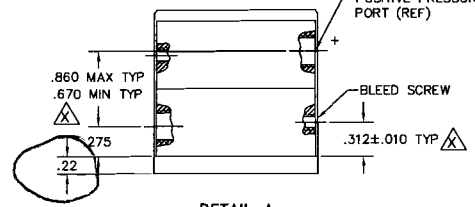
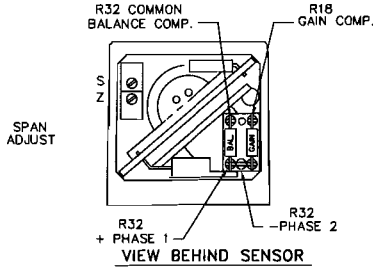
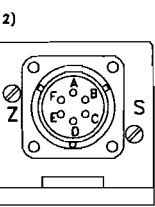
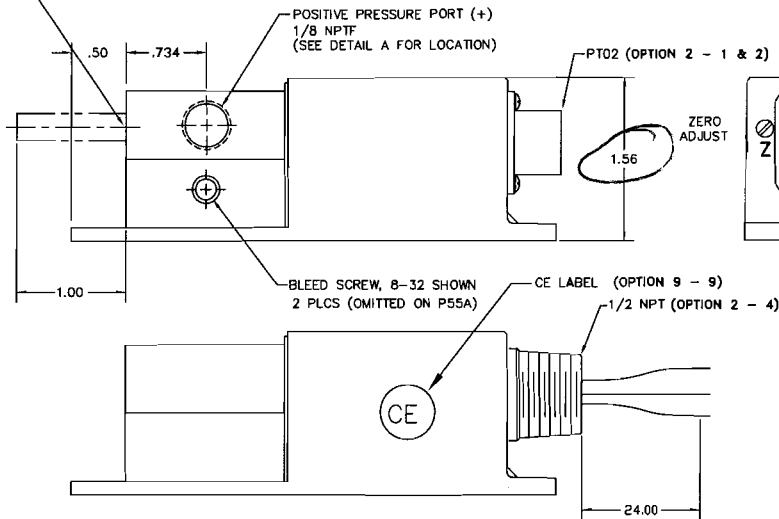
Calibration Type: 9 Point Cal

Calibration Data:

<u>Pressure</u>	<u>Unit Output</u>
<u>PSI</u>	<u>VDC</u>
0.000	0.000
1.000	2.501
2.000	5.000
1.000	2.503
0.000	0.001
-1.000	-2.498
-2.000	-5.002
-1.000	-2.506
0.000	-0.011



PRESSURE PORT FOR P55A (ABSOLUTE MODEL) 5/16-24UNF (5/16 TO 1/8 NPT, MALE, ADAPTER FURNISHED) EXCEPT OPTION 8, 'F', TUBE AS SHOWN (1/4 O.D. x 1.00 LG)



REVISIONS		SIZE B	P55	REV. B
SYM	DESCRIPTION	DATE	APPROVED	
A1	ADDED OPTION 9 - SEE DCN	5/11/98	DAS	
B	ADDED BAL. & GAIN DETAIL- SEE DCN	4/99		

MODEL NUMBER BREAKDOWN
MODEL NUMBER P55D-2-N-1-40-S-4-A-1

OPTION	DESCRIPTION
OPTION 1	TYPE OF MEASUREMENT D DIFFERENTIAL OR GAGE A ABSOLUTE (NOT NEMA 4)
OPTION 2	ELECTRICAL CONNECTOR 1 PTO2A-10-6P 2 PTO2E-10-6P (STD)(NEMA 4) 3 WK-6-32S (CANNON) 4 1/2 NPT, 24 GA. LEADS(NEMA 4)
OPTION 3	O'RINGS MATERIAL FROM O'RING SELECTION CHART
OPTION 4	CALIBRATED OUTPUT ISOL -FS ZERO +FS 1 - - 0 +5VDC 2 - -5VDC 0 +5VDC 3 0 +2.5VDC +5VDC 4 4mA 4mA 20mA 5 4mA 12mA 20mA 6 X - 0 +5VDC 7 X -5VDC 0 +5VDC 8 X 0 +2.5VDC +5VDC
OPTION 5	PRESSURE RANGE DASH No. FROM RANGE & DIAPHRAGM SELECTION CHART
OPTION 6	COMPENSATED TEMP RANGE S 0° TO +160°F W -65° TO +250°F
OPTION 7	SENSOR MATERIAL 4 410 STAINLESS STL 5 410 NICKEL PLATED 6 410 GOLD PLATED 7 17-7 PH SST (10PSI & ABOVE)
OPTION 8	PORT TYPES A 1/8-27NPTF (PORT) & 8-32 BLEED B PRESSURE PORT & BLEED SCREW PORT BOTH 1/8-27 NPTF (410 ONLY) E 5/16-24 FEMALE PER AND1005G-2 (FOR ABSOLUTE ONLY) F PRESSURE PORT: 1/4" O.D. x 1" LG TUBE
OPTION 9	SPECIALS 1 EXTERNAL ACCESS TO Z & S COMPENSATION 9 CE APPROVED

8-32 BLEED PORT DIM IS .312±.010
1/8-27 NPTF BLEED PORT DIM. IS .275±.010
DIMENSION VARIES WITH PRESSURE RANGE.
NOTES: UNLESS OTHERWISE SPECIFIED.

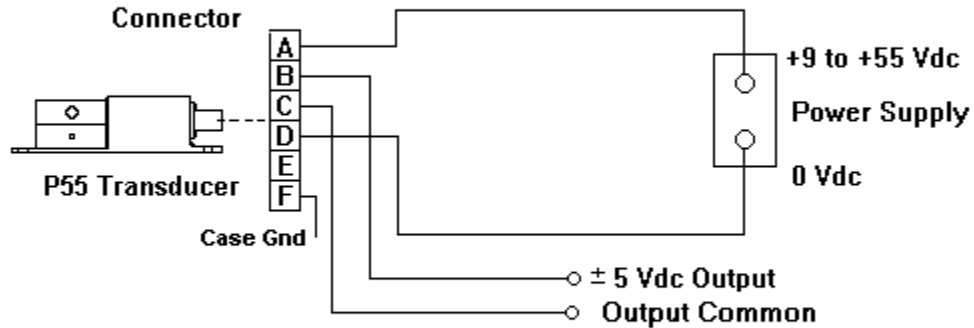
TOL. UNLESS NOTED:
DEC. XXX ±0.010
FRAC. & DEC. X.XX ±0.2
ANGLES ±1/2°
DIAMETERS WITH SAME CL. SHALL BE CONCENTRIC WITHIN 0.005 TIR.
SURFACES MUST BE FLAT WITHIN 0.002 PER IN MAX FILLET 0.015 UNLESS NOTED
DEBURR EDGES 0.005 MAX. UNLESS NOTED
SURFACE FINISH $\sqrt{}$ UNLESS NOTED
DRILLED HOLE TOL. PER AND10387.

CODE IDENT No.
33107

SCALE	1/1	Validyne ENGINEERING CORPORATION	NORTHBRIDGE, CALIFORNIA 91324
DWN	TD	7/93	MODEL P55
CK'D	DAS	1/94	MAT'L PER BOM
APP'VD	DAS	1/94	FINISH PER BOM
TITLE			
P55			
OUTLINE DRAWING			

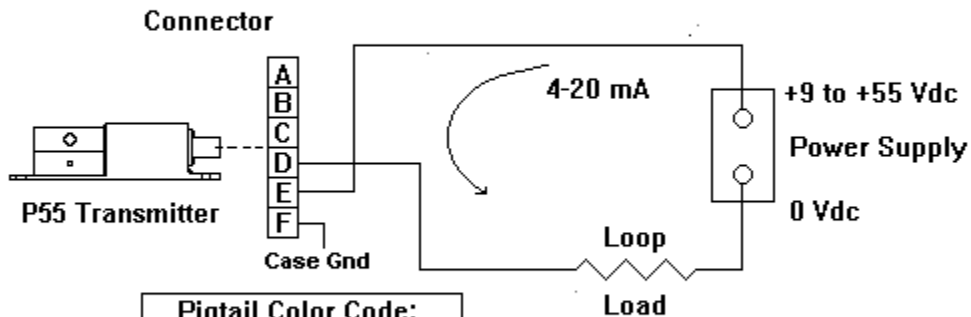
Transducer Wiring Diagram

Voltage Output



Non-Isolated Pigtail Color Code:	Isolated Pigtail Color Code:
Red = + Power Yel = - Power Orn = + Signal Gry = Output Common Grn = Case Gnd	Red = + Power Blk = - Power Orn = + Signal Grv = - Signal Grn = Case Gnd

4-20 mA Output



Pigtail Color Code:
Red = Positive Blk = Negative Grn = Case Gnd

P55 Calibration Procedure

Power and Signal Connections

The P55 will come calibrated by the factory for the pressure range specified on your purchase order. A calibration sheet will be included showing five pressure/signal points for unidirectional calibrations and 9 pressure/signal points for bidirectional calibrations.

The P55 calibration is normally checked and updated at six month intervals. To do this you will need the following:

- DC Power Source +9 to +55 Vdc, capable of sourcing 50 mA
- Multi-meter capable of measuring 0 to +/- 5 Vdc and 0 to 25 mA
- Pressure Source capable of providing full scale pressure to within 0.05%

Verify the output version from the model number on the nameplate and the data sheet:

Voltage output versions will have 1, 2, 3, 6, 7 or 8 in the Calibrated Output specifier
Current output versions will have 4 or 5 in the Calibrated Output specifier

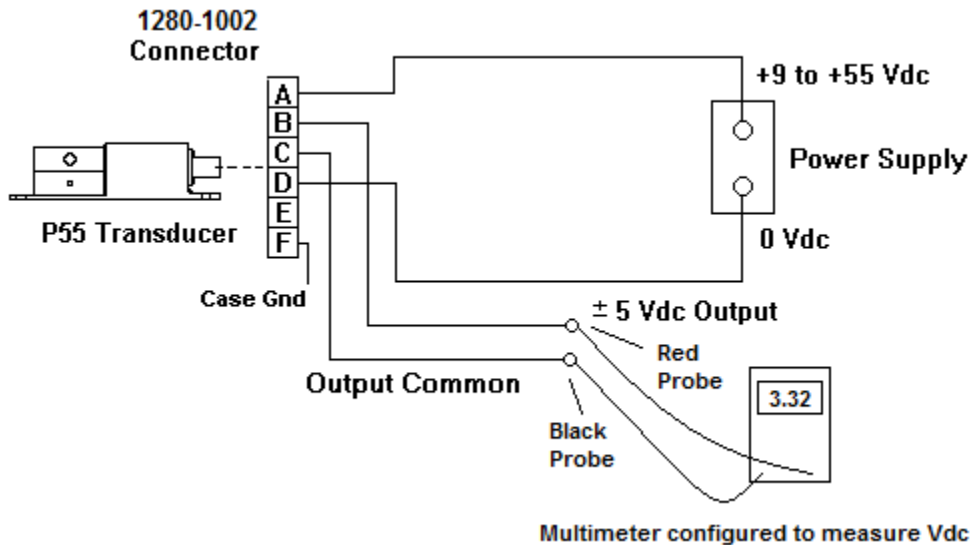
MODEL NUMBER

P55D- 4 - N - 4 - 44- S - 4 - A

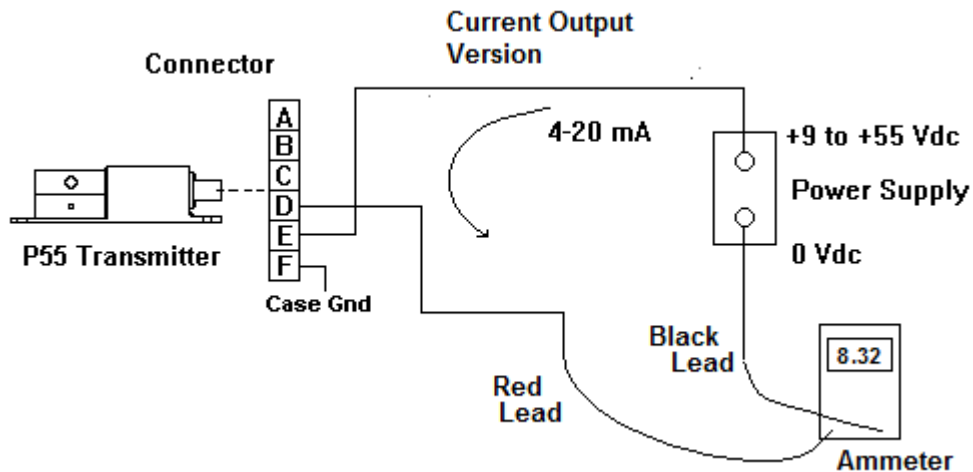
Calibrated Output	Isolation	-FS	ZERO	+FS
1			0	+5 Vdc
2		-5 Vdc	0	+5 Vdc
3		0	+2.5 Vdc	+5 Vdc
4			4 mA	20 mA
5		4 mA	12 mA	20 mA
6	Yes		0	+5 Vdc
7	Yes	-5 Vdc	0	+5 Vdc
8	Yes	0	+2.5 Vdc	+5 Vdc

Wire for Power and Signal

First, wire the P55 for power and signal as shown below (voltage output version):



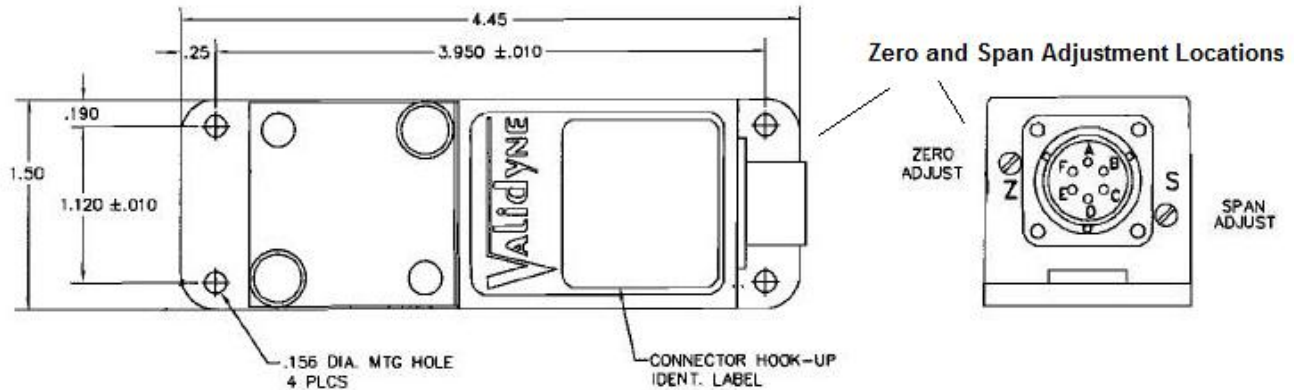
If you have a 4-20 mA current output P55, wire as shown:



With the power applied, but no pressure connected to the sensor, note the output reading. It should be very close to **0.000 +/-0.005 Vdc** for the voltage output versions (-1, -2, -7 or -8), and **4.000, +/-0.005 mA** for the current output versions (-4). For offset voltage output versions (-3, -7) the output should be **2.500, +/- 0.005 Vdc**. For offset current output versions (-5), the signal should be **12.000, +/-0.005 mA** at zero pressure on the transducer.

Zero and Span Adjustment Locations

Notice on the rear of the P55, by the electrical connector, there are two screw-driver adjustments. One is marked **Z** for zero adjustment and one marked **S** for Span adjustments.



Zero Adjustment

With zero differential pressure applied to the transducer (both ports open to atmosphere), turn the **Zero** adjustment until the correct zero pressure signal is attained. The correct signal will depend on the output version you have (see model number information above).

For output versions **-1, -2, -6** and **-7**, the correct zero signal is **0.000 Vdc, +/-0.005 Vdc**

For output versions **-3** and **-8**, the correct zero signal is **2.500 Vdc, +/-0.005 Vdc**

For output version **-4**, the correct zero signal is **4.000 mA, +/-0.005 mA**

For output version **-5**, the correct zero signal is **12.000 mA, +/-0.005 mA**

Span Adjustment

With full scale pressure applied to the + pressure port, turn the **S** adjustment for the correct full scale output signal.

For output versions **-1, -2, -3, -6, -7** and **-8**, the correct FS signal is **5.000 Vdc, +/-0.005 Vdc**

For output version **-4** and **-5**, the correct FS signal is **20.00 mA, +/-0.005 mA**

If you have a unidirectional P55 (**-1, -6** or **-4**) proceed to **Checking for Accuracy**.

For bidirectional transducers (-2, -3, -5, -7 and -8), apply the full scale pressure to the – pressure port and observe the output signal.

For output versions -2 and -7, the correct -FS signal is **-5.000 Vdc, +/-0.005 Vdc**

For output versions -3 and -8, the correct -FS signal is **0.000 Vdc, +/-0.005 Vdc**

For output version -5, the correct -FS signal is **4.000 mA, +/-0.005 mA**

The Span adjustment may need to be tweaked slightly to achieve a balanced output at both + and – full scale.

The outputs should be re-checked at zero pressure and the Zero adjustment tweaked accordingly.

Checking for Accuracy

The P55 should calibrate such that the maximum error is 0.25% of full scale from a best-fit line to zero, mid-scale, full scale, mid-scale and zero pressure readings (unidirectional). For bi-directional versions the pressure readings are additionally taken at – mid-scale, -full scale, -mid-scale and zero (a total of 9 points).

Spreadsheets for both unidirectional and bidirectional output versions are available so that all the calculations for accuracy are included.

See the Validyne website for details.

Temperature Isolation of Pressure Sensors

Frequently it is necessary to measure the pressure of fluids which at temperatures above or below the rated operating range of the available pressure transducers. The expense of a special transducer can often be avoided if the pressure sensor is isolated from the pressure source by a short length of pipe or tubing.

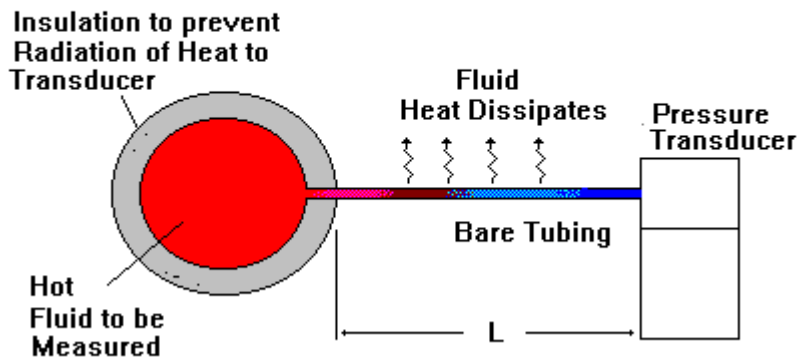
The curves below show the lengths of tubing needed to limit the temperature at the transducer to a range of 0 deg F to 200 deg F for fluid temperatures between -400 deg F and +1700 deg F.

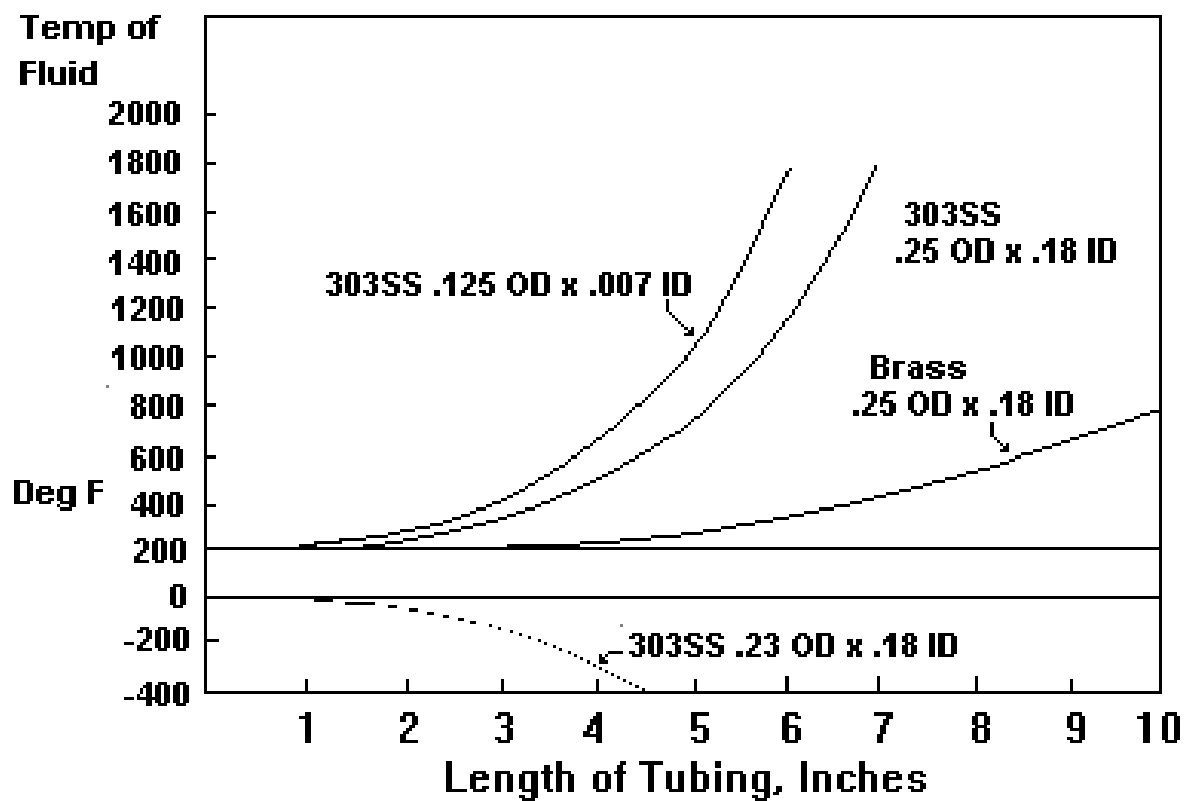
The curves are based on the following assumptions:

- The piping is insulated to limit radiant heat transfer to the transducer. The major source of thermal input to the sensor is by conduction through the connecting tubing.
- The pressure media has a coefficient of thermal conductivity less than 0.4 BTU/hr/ft/deg F. This includes a wide range of liquids and gases.
- The ambient air temperature around the transducer is not greater than 100 deg F.
- The heat transfer rate from the bare tubing to still air is 1.44 BTU/sq ft/hr/deg F

There is no flow of fluid through the tubing to the transducer, therefore the only path for heat transfer is conduction. Because the tubing is not insulated and the ambient air temperature is less than 100 deg F, the heat dissipation of the tubing protects the transducer, even to extremes in temperature of the fluid to be measured.

Temperature Isolation of Pressure Transducers





Bench Testing the P55 Pressure Transducer

Introduction:

The Validyne P55 pressure transducer is a DC Power/DC Signal pressure transducer that is calibrated for a 0 to +/-5 Vdc or 4-20 mA signal. This discussion will describe how to power and test a P55 with a 0 to +/-5 Vdc output signal to determine if it is behaving normally.

Equipment Needed:

DC Power Supply – Any DC power source +9 to +55 Vdc capable of supplying 20 mA or more. Almost any kind of DC supply will work.

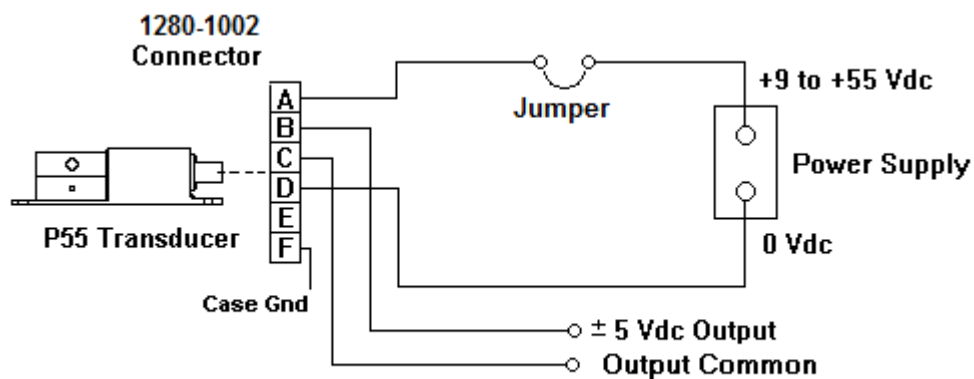
Multi-Meter – Capable of measuring voltages up to 50 Vdc, current to 500 mA, resistances from short to open circuit.

1280-1002 – The standard 6-pin mating connector for the P55.

Wire – to connect to P55 to the power source and signal output terminals of the 1280-1002.

Connections:

Make up a test wiring harness as shown in the diagram below.

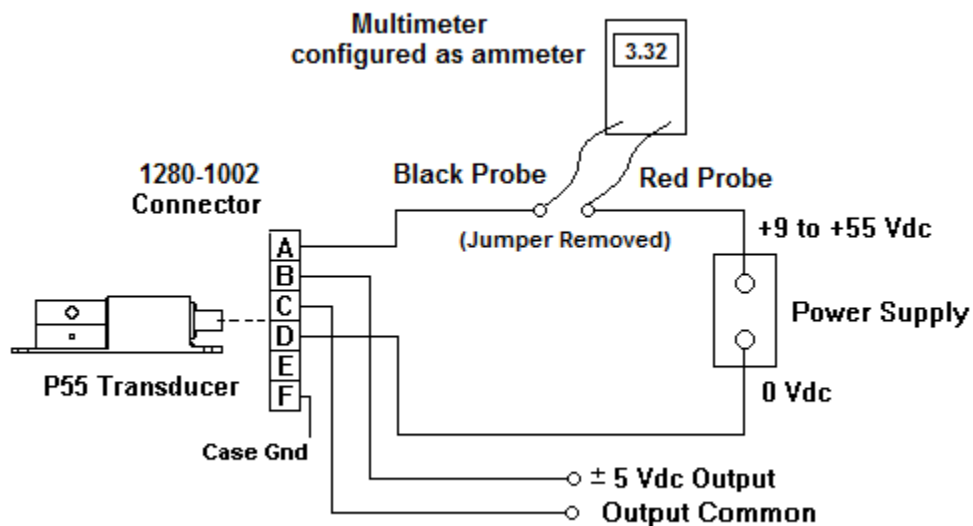


Current Draw Test:

The first test of the P55 is to determine if it is drawing the correct amount of current. This is done by measuring the current flow with the multimeter configured as an ammeter and inserted in series with the +Power connection, as shown below.

The current will flow from the power supply through the multimeter and to the transducer.

The correct current draw for the voltage output P55 is between 3 and 10 mA.



Note: Caution! Be sure to briefly touch the ammeter probe to the power terminal and observe the current reading to be sure there is not a short circuit. A dead short could damage the meter or the power supply.

Results:

Normal current draw is between 3 and 10 mA.

If a P55 is drawing 0 ma (no current) then re-check the wiring and make sure the power supply has been turned on. If the transducer does not draw any current it cannot produce a usable signal and should be returned for repair.

Transducers showing a dead short – very high current draw - cannot be repaired in the field and should also be returned.

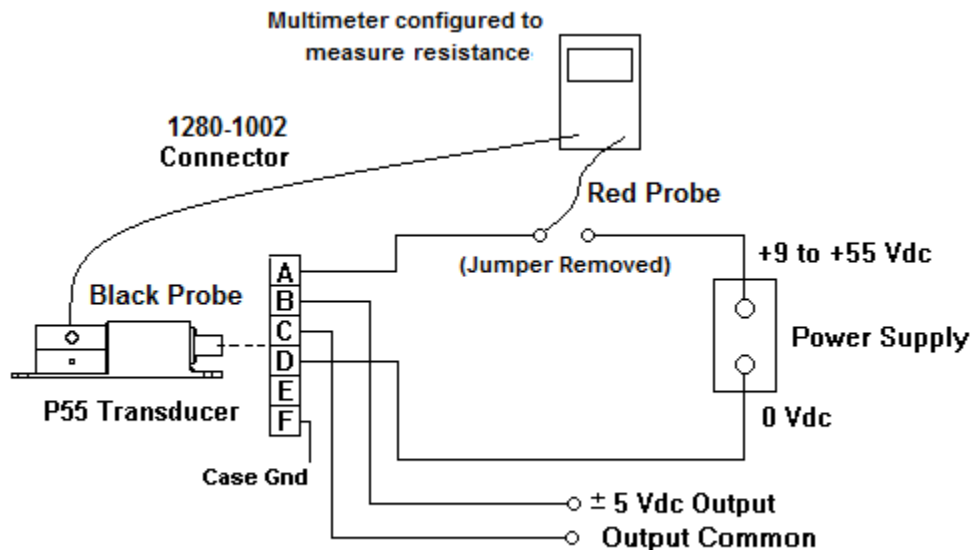
Electronics Isolation Test:

If a P55 transducer is drawing the correct amount of current, the next test is to verify the electrical isolation of the sensor body.

Note: The Power Supply must be OFF – unplug from AC mains.

The isolation is measured with the multimeter in the DC Resistance mode, as shown below.

Note that the Black Probe of the multimeter is touching the metal sensor body. The Red Probe is connected to pin A of the connector.



Results:

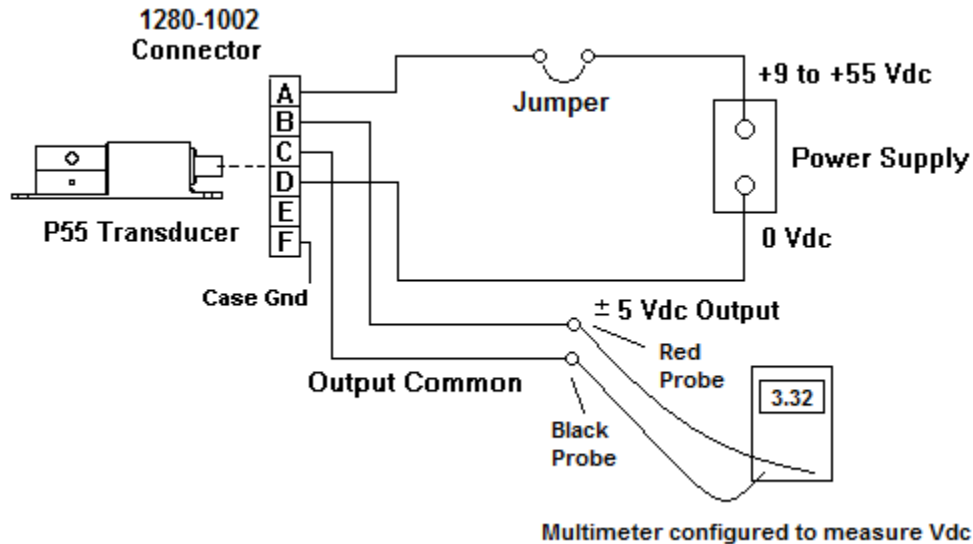
The correct isolation resistance is 100 MegOhm or higher. The actual reading may depend on the quality of your multimeter but any value above 10 MegOhms will provide usable performance. The multimeter may read Open Circuit – and this is an acceptable reading.

Isolation readings below 100 K Ohms can mean that the sensor will exhibit drift or an unstable output signal. This may be caused by corrosion inside the sensor cavity.

If corrosion inside the sensor is advanced it may attack the sensor's internal coil wires and cause the output signal to go off-scale, as determined by the next test.

Output Signal Check:

Connect the transducer to the DC power supply and check the output signal as shown below:



With zero pressure applied to the transducer – both ports open to atmosphere – the output signal should be near 0.000 Vdc.

Turn the **Zero Adjustment** (located near the electrical connector, marked **Z**) and the output signal should swing a few tenths of a volt.

If you have a fairly low range transducer (full scale less than 5 psi) try squeezing to + port with your finger to compress the air slightly inside the positive sensor cavity. If you have a higher range sensor and can obtain a pressure source, apply a mid-scale pressure to the + port of the sensor. The output signal voltage should increase in the positive direction.

Do the same with the - port and the signal should increase in the negative direction.

Results:

A P55 working normally will respond to the Zero Adjustment and to pressures applied to the sensor.

A transducer whose signal moves, but then stops as pressure increases may need cleaning.

An off-scale signal reading, greater than +6 or -6 Vdc, combined with a low isolation reading (see above) could indicate a corroded sensor – disassemble and inspect for corrosion, especially around the coil lids in the center of the sensor body.

A transducer with a steady signal of 0 Vdc cannot be repaired in the field.

P55 Specification Definitions

Here are explanations and definitions for the P55 specifications published in the data sheet.

Pressure Range:

All P55 transducers are zero-based transducers - that means they are always calibrated from zero pressure to some greater full scale pressure. P55D models are differential pressure transducers and the output always starts at 0 differential – that is, the pressure on both the + and – ports is equal (normally ambient atmosphere or zero gage pressure).

P55A models measure absolute pressure and are based at 0 psia.

The full scale measurement range of the P55s depends on the Range Code ordered. Listed below is the location of the range code in the model number and the range chart showing the corresponding full scale pressures:

MODEL NUMBER				
P55D- 4 - N - 4 - 44- S - 4 - A				
CALIBRATED OUPUT				
	Isolation	-FS	ZERO	+FS
1			0	+5 Vdc
2		-5 Vdc	0	+5 Vdc
3		0	+2.5 Vdc	+5 Vdc
4			4 mA	20 mA
5		4 mA	12 mA	20 mA
6	Yes		0	+5 Vdc
7	Yes	-5 Vdc	0	+5 Vdc
8	Yes	0	+2.5 Vdc	+5 Vdc
PRESSURE RANGE				
Range Number from Range & Diaphragm Selection Chart				

PRESSURE RANGE CHART						
Range Dash No.	PSI	IN HG.	IN H₂O	KPA	TORR	CM H₂O
20	.125	.25	3.5	.86	6.5	8.80
22	.20	.41	5.5	1.40	10.3	14.0
24	.32	.65	8.9	2.2	16.5	22.5
26	.50	1.02	14.0	3.5	25.8	35.0
28	.80	1.6	22.2	5.5	41.4	56.0
30	1.25	2.5	35.0	8.6	65.0	88.0
32	2.0	4.1	55.0	14.0	103	140
34	3.2	6.5	90	22.0	165	225
36	5.0	10.2	140	35.0	258	350
38	8.0	16.0	222	55.0	414	560
40	12.5	25.0	350	86.0	650	880
42	20	41.0	550	140	1030	1400
44	32	65.0	890	220	1650	2250
46	50	102	1400	350	2580	3500
48	80	160	2220	550	4140	5600
50	125	250	3500	860	6500	8800
52	200	410	5500	1400	10300	14000
54	320	650	8900	2200	16500	22500
56	500	1020	14000	3500	25800	35000
58	800	1600	22200	5500	41400	56000
60	1250	2500	35000	8600	65000	88000
62	2000	4100	55000	14000	103000	140000
64	3200	6500	89000	22000	165000	225000

A P55D with a unidirectional voltage output and range code 42 will be calibrated as follows:

0 Vdc = 0 psid to +5 Vdc = 20.00 psid

The output will be linear in between: 2.500 Vdc = 10 psid, etc

For unidirectional current output versions, the output signal is 4 to 20 mA and the -42 would be calibrated:

4 mA = 0 psid to 20 mA = 20.00 psid.

Note: Full Scale Calibrations in Between Range Codes May Be Specified on the PO

The same P55D with a voltage output and range code 42 could be calibrated as follows:

0 Vdc = 0 psid, +5 Vdc = 15.00 psid

The range code in the model number must be greater or equal to the full scale calibrations.

Note: Calibrations May be Specified by the Purchaser in any Engineering Units

So the -42 range could be calibrated 0 to 550 In H₂O, for example or 0 to 500 In H₂O.

Accuracy:

The error of the P55 is defined as the sum of non-linearity and hysteresis.

Non-Linearity is defined as the maximum deviation of any point on a 5 point calibration curve (for unidirectional calibration) or from a 9 point calibration curve (bidirectional calibrations) from the best-fit line to those points, expressed as a percent of full scale.

Hysteresis is defined as the greatest difference between two calibration points at the same calibration pressure, expressed as a percent of full scale.

Differential P55D models have a maximum error of +/-0.25% FS and absolute pressure P55A models have a maximum error of +/-0.5%, as calculated above.

Spreadsheets are available for both unidirectional and bidirectional calibrations that automatically determine the non-linearity and hysteresis, as shown below.

	A	B	C	D	E	F	G	
1	Calibration Data Worksheet							
2	Model:	P55D-1-N-2-32-S-4-A						
3	S/N:	119204						
4	Date:	1/20/2004				Slope	2.5005	
5	Cal Temp =	72 F				Intercept	0.001111	
6					Sensitivity	10.006		
7		Pressure, Psid	Signal, Vdc	BFSL	Error, % FS			
8								
9		0.00	0.001	0.001	0.00			
10		1.00	2.496	2.502	0.06			
11		2.00	5.008	5.002	0.06			
12		1.00	2.501	2.502	0.01			
13		0.00	0.002	0.001	0.01			
14		-1.00	-2.502	-2.499	0.03			
15		-2.00	-4.998	-5.000	0.02			
16		-1.00	-2.495	-2.499	0.04			
17		0.00	-0.003	0.001	0.04			
18				Non-Linearity, %FS	0.06			
19		Hysteresis, Vdc	0.007	Hysteresis, %FS	0.07			
20								
21								

OverPressure:

For P55D, overpressure is defined as the maximum differential pressure the transducer can withstand without compromising subsequent measurements.

This is determined by the range code of the transducer (see model number info above).

For example, the -36 range will measure 0 to +/-5 psi differential pressure. If the sensor is exposed to up to 10 psi differential, no damage will result and the transducer can make subsequent measurements of 5 psi and below accurately.

Some further examples:

-42 will tolerate a maximum differential pressure of 40 psi

-20 will tolerate a maximum differential pressure of 7 In H₂O

-56 will tolerate a maximum differential pressure of 1000 psi

Note: The maximum pressure that the sensor can contain is 4000 psig!

So the -64 range, with a full scale of 3200 psi differential will likely leak once the overpressure reaches 4000 psig – somewhat less than twice the full scale range of the transducer.

Absolute sensors whose full scale is less than atmospheric pressure will in all cases tolerate up to 20 psia pressure. So even the P55A with range code -20 (full scale of 0.125 psia) will accept up to 20 psia pressure (atmospheric pressure plus a little) without damage.

Line Pressure:

The line pressure specification applies only to differential models (P55D). The maximum line pressure for the P55D is 3200 psig and this is the maximum pressure that can be applied to both ports simultaneously. It is often necessary to measure small differential pressures at high line pressures – as in measuring the pressure drop across a high-pressure filter. The filter may operate at 1000 psig, but have less than a 5 psi differential pressure drop across it. A P55D range code -36 could be used to measure the actual pressure drop across the filter because the + port (upstream side of the filter) might have 1005 psig and the – port (downstream side) 1000 psig. There is a difference of 5 psid but the common-mode line pressure is 1000 psig.

There is a slight error that occurs as a function of line pressure – the zero output will shift as much as 1% per 1000 psig of line pressure. This can be corrected using a 3-valve manifold so that the differential pressure can be equalized across the P55 while the full line pressure is applied to both ports. Turning the Zero adjustment will re-zero the output signal at the operating line pressure.

For any P55D operating at high line pressures care must be taken not to expose one side of the transducer to full line pressure while the other side is at atmospheric pressure – this will result in severe overpressure and require repair.

Pressure Ports:

MODEL NUMBER P55D- 4 - N - 4 - 44- S - 4 - A

PORT TYPES

A	1/8"-27 NPTF (port) & 8-32 Bleed Screw (Differential Transducer) 5/16"-24 Female w/1/8" male NPT adapter (Absolute Transducer)
B	Pressure Port & Bleed Screw Port Both 1/8"-27 NPTF (410 only) (Differential Transducer)
E	5/16"-24 Female Per AND10050-2 with 1/8" male NPT adapter (Absolute Only)
F	Pressure Port: 1/4" O.D. x 1" Long Tube (Differential or Absolute Transducer)

The pressure ports are the piping connections on the transducer body that are used to connect the transducer to a pressure source. The standard connection for the P55D is 1/8" female NPT pipe threads. These are standard plumbing connections and adapters may be purchased from a variety of sources to connect to plastic or steel tubing. Swagelok adapter fittings are often used with the P55.

There are two 1/8" NPT ports for the standard P55 – one port for each side of the differential pressure transducer. These are marked + and -. The + port is normally connected to the higher pressure and the – port to the lower pressure in the system to be measured. The transducer so configured will measure the difference between the two pressures.

When the – port of a P55D is left open to atmosphere, the + port will measure gage pressure.

The standard P55D also has bleed ports opposite the 1/8" NPT pressure ports. The bleed ports are 8-32 set screws with a small gasket that is used to allow the air inside the sensor cavity to be displaced with liquid. This is useful for making fast dynamic measurements in fluid-filled systems.

An alternate pressure port configuration provides for two 1/8" NPT female threaded ports on each half of the sensor. In this configuration there is no bleed port but rather a second 1/8" NPT port. This can be used to connect additional plumbing to the transducer or to flush the sensor cavity, etc. A pipe plug can also be used to plug off one of the open NPT ports.

P55A absolute sensors have a single 5/16" female straight thread port. An adapter is supplied so that a 1/8" male NPT pipe thread interface is provided.

Both the differential and absolute versions can be ordered with a 1" long 1/4" OD tube stub that can be used to connect directly to a Swagelok fitting. This is useful if threaded connections are not appropriate.

Operating Temperature Range:

P55s can withstand temperatures from -65 F to +250 F without damage. The temperature error, however, depends on the compensated temperature range (see below)

	MODEL NUMBER
	P55D- 4 - N - 4 - 44- S - 4 - A
COMPENSATED TEMP RANGE	
S	0 to +160 °F
W	-65 to +250 °F

Compensated Temperature Range:

The standard P55 is corrected for temperature errors from 0 F to +160 F. The maximum temperature error will be +/-0.5% FS over this range.

A wide range version can be ordered compensated over -65 F to +250 F. The maximum error over this range will be +/-0.9% FS

It is usually possible to isolate the P55 so that even hot fluids such as steam lines can be measured using the 0 to 160 F version – see technical note on installation.

Pressure Media:

	MODEL NUMBER
	P55D- 4 - N - 4 - 44- S - 4 - A
SENSOR MATERIAL	
4	410 Stainless Steel
5	410 Nickel Plated
6	410 Gold Plated
7	17-7 PH SST (10 psi & above)

The P55 can accept liquids and gases compatible with the materials of construction. The sensor body and sensing diaphragm are made of 410 steel and there is an inconel foil piece also exposed to the pressure media. The sensor body and diaphragm can be plated with nickel or gold to increase resistance to oxidation.

O-Rings:

	MODEL NUMBER
	P55D- 4 - N - 4 - 44- S - 4 - A
O-RINGS	
N	Buna-N (STD)
E	Ethylene Propylene
K	Kalrez
L	Fluorosilicone
S	Silicone
T	Teflon (2 psi & above)
V	Viton-A

There are also O-rings exposed to the pressure media as part of the sensor assembly. These O-Rings are available in a variety of compounds for compatibility with the fluids to be measured. Check the Parker O-Ring Handbook for a compatibility chart.

Pressure Cavity Volume:

This is the amount of fluid required to fill the sensor cavity – 1.2×10^{-2} Cu In each side.

Volumetric Displacement:

This is the amount of fluid required to move the sensing diaphragm from zero to full scale, a very small amount: 6×10^{-4} Cu In.

Power Supply:

The P55 will operate on any DC power supply capable of delivering +9, or up to +55 Vdc. A +12 Vdc supply will work. A +15 Vdc supply will work and a +24 Vdc supply will work – any DC power between +9 and +55 V. Almost any power supply that has a clean, noise-free output will work – all the P55s draw very little current (see below).

Current Requirements:

The current requirements will vary based on model and output type, but all are very small.

The standard voltage output transducers (model options -1, -2, -3) require 3 mA.

The isolated voltage output versions (model options -6, -7, -8) require 7 mA.

The 4-20 mA current output versions (model options -4, -5) require 4 to 20 mA. These units will draw at least 2.5 mA (offscale negative) to as much as 25 mA (offscale positive).

Signal Output:

P55s with 4-20 mA outputs (model options -4, -5) will draw 4-20 mA (maximum 25 mA in overpressure) as long as the power supply voltage is sufficient to power the transducer and any voltage drops through the current loop.

$$V_{\min} = (0.025 \times R) + 9$$

Where: V_{\min} = minimum power supply voltage, Vdc
R = loop resistance, Ohms

If, for example, there is a 250 Ohm resistor in the current loop to produce a voltage signal, the P55 minimum supply should be:

$$V_{\min} = (.025 \times 250) + 9 = 15.25 \text{ Vdc}$$

For P55s with voltage outputs (model options -1, -2, -3, -6, -7, -8) the output is 0 to +/-5 Vdc and will source 0.5 mA. The input impedance for these signal, therefore, must be at least 10K Ohms. Most receiving devices – multimeters, chart recorders, PLCs or computer interfaces – provide several hundred M Ohms of input impedance.

Note that the -1 and -6 Vdc output options will produce a negative voltage signal (if the pressure goes negative) but the calibration at the factory is unidirectional only. These units can generally be calibrated bidirectionally in the field if needed.

Zero Balance:

The output signal at zero pressure is adjustable in the field by turning the Z adjustment on the rear panel of the transducer (near the electrical connector). This can be used to fine-tune the calibration or to correct for zero offsets with line pressure.

The maximum change in signal possible by adjustment of the Z control is +/-5% FS (250 mV).

Span:

The full scale output of the P55 can be adjusted by turning the S control on the rear panel of the P55 (near the electrical connector). This is used to tweak full scale calibration and has approximately 10% FS adjustment range.

Frequency Response:

P55 transducers can provide a flat response to pressure oscillations as high as 80 Hz in gas and 250 Hz in liquids when close-plumbed to the varying pressure source. A low-pass filter on the analog output is set to -3 dB at 250 Hz.

Line Regulation:

Line regulation is the amount of measurement error that is the result of changing the power voltage. The maximum P55 error that results from any change in power supply voltage (between 9 and 55 Vdc) is 0.03%

Output Noise:

This is noise riding on the output signal. The P55 can exhibit as much as 2 mVrms of noise, typically at 5 Khz. The noise level is the limiting factor in P55 pressure measurement resolution.

Insulation Resistance:

The P55 electronics are completely isolated from the sensor body and plumbing. A P55 will exhibit 100 M Ohms of isolation resistance from any power or signal connection to its case.

The breakdown of isolation is often a sign of corrosion inside the sensor cavity and can cause drift in the output signal.

Isolation:

P55s with the isolation option (model options -6, -7, -8) will have power-to-signal isolation of 100 M Ohms @500 Vdc.

Connections:

MODEL NUMBER P55D- 4 - N - 4 - 44- S - 4 - A

ELECTRICAL CONNECTOR

1	PT02A-10-6P (STD)
2	PT02E-10-6P
3	WK6-32S (Cannon)
4	1/2" Male NPT with 6" Leads 24-Gage

The standard P55 (model option -1) has a six-pin Amphenol connector. The mating electrical connector is Amphenol p/n PT06A-10-6S, Validyne p/n 1280-1002. An environmental version of the standard 6-pin connector that is resistant to water spray is model option -2. The mate for this is Amphenol p/n PT06E-10-6S, Validyne p/n 1281-1002. A Cannon WK6 connector is available for legacy systems, model option 3. The mating electrical connector for this is Cannon p/n WK6-21C-1/4, Validyne p/n 1310-0632

The P55s supplied with pigtail leads will have a 1/2" male NPT thread for mounting a conduit junction box.

How to Return a P55 for Repair

The P55 can be bench-checked for functionality and calibrated in the field. If the P55 is not operating correctly it can be returned to Validyne for repair or rework. Here is the warranty statement:

P55 Warranty

Validyne warrants equipment of its own manufacture to be free from defects in material and workmanship under normal conditions of use and service.

Validyne will rework or replace any P55 found to be defective on its return to Validyne within three (3) years of ship date of original shipment.

Buyer is requested to contact Validyne for an RMA number and a customer return form prior to return of equipment under warranty. Shipment to Validyne shall be at Buyer's expense, with return at Validyne's expense. Investigation of NON-VERIFIED problems or malfunctions, whether warranty or not, are subject to a \$100.00 evaluation charge.

The warranty carries no liability, either expressed or implied, beyond our obligation to the original purchaser to rework or replace, at Validyne's option, the unit under the warranty. Prices, specifications, and designs are subject to change without notice.

This warranty is void if the product is subjected to misuse, accident, neglect, or improper application or operation. Misuse includes:

- Application of power supply voltage in excess of 55 Vdc
- Corrosion of the wetted sensor surfaces
- Severe mechanical damage

Warranty on repair work is 90 days or through the remainder of the original warranty period, whichever is longer. Warranty rework will not be performed for any account past due.

Out of Warranty Rework

Units returned to Validyne for rework which are out of warranty will be subject to the following conditions:

Buyer is requested to contact Validyne for an RMA number & a customer return form. The return form must be completed & a not-to-exceed purchase order included or a minimum evaluation and/or calibration charge of \$100.00 will apply.

Any requirement for a quotation before rework should be communicated to Validyne when the RMA number is requested. A \$100.00 evaluation charge will be invoiced and full repair charges will be provided.

If it is determined that unit is uneconomical to repair, Buyer has the option to purchase a new unit. In such an event, the \$100 evaluation charge will be waived.

Shipping charges in both directions are the responsibility of the Buyer for all out of warranty returns. Warranty on repair work is 90 days or through the remainder of the original warranty

Return instructions will be included upon request of an RMA form and RMA number.

The RMA number and RMA form can be requested via email to: **sales@validyne.com**