CONFAB INSTRUMENTATION

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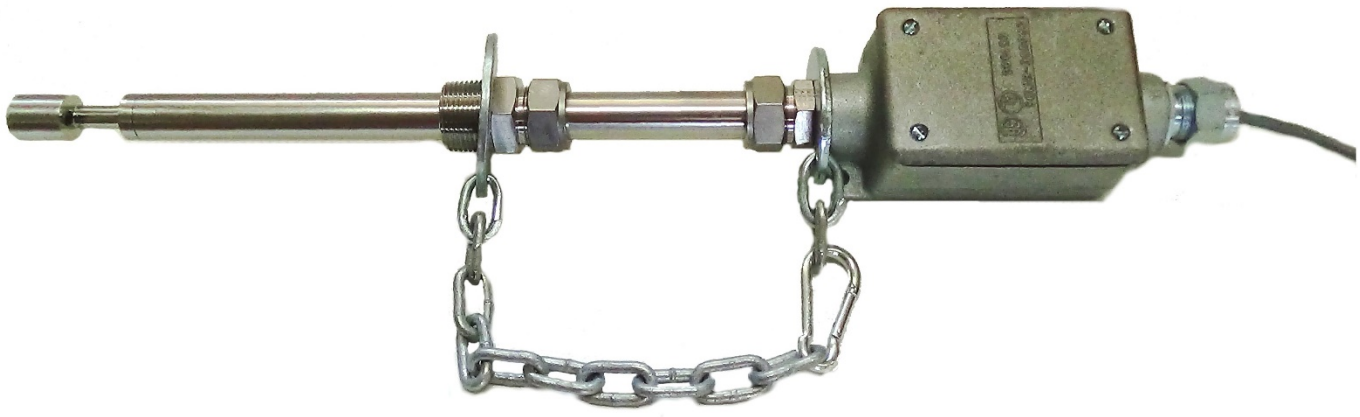
MODEL 951
Suspended Solids Sensor
Installation & Instruction Manual



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1. PRINCIPLE OF OPERATION

A prefocused incandescent lamp directs an intense beam of light through the process fluid. The particulate in the fluid absorbs the light in proportion to its concentration. The remaining light is detected by a silicon detector that generates a current signal proportional to the particulate concentration. The signal is converted, amplified and scaled to provide a linear 4-20mA isolated output signal for connection to control/monitoring systems.

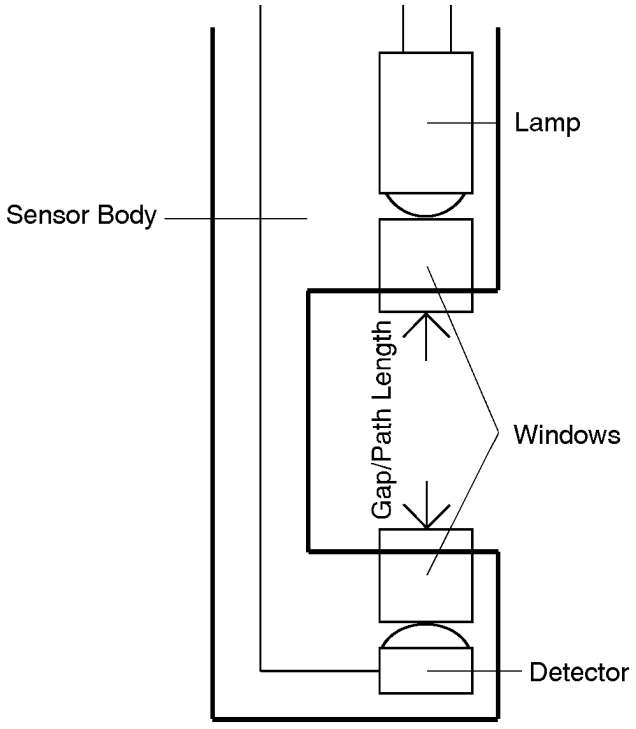
The instrument is "peaked" to operate in the near-infrared radiant (NIR) energy spectrum to eliminate errors due to visible colors in the particulate and the process liquid.

Key components of the sensing head are shown in Figure A below. The sensing head has been hydrodynamically designed to eliminate problems such as plugging, solids separation and dewatering of pulp stock.

The sensor's unique design reduces the effects of stray light and moderate window obscuration. It utilizes an optimum optical path length so that a linear response is provided over a wide dynamic range of suspended solids concentrations.

Figure A

Key Components of Sensor Head



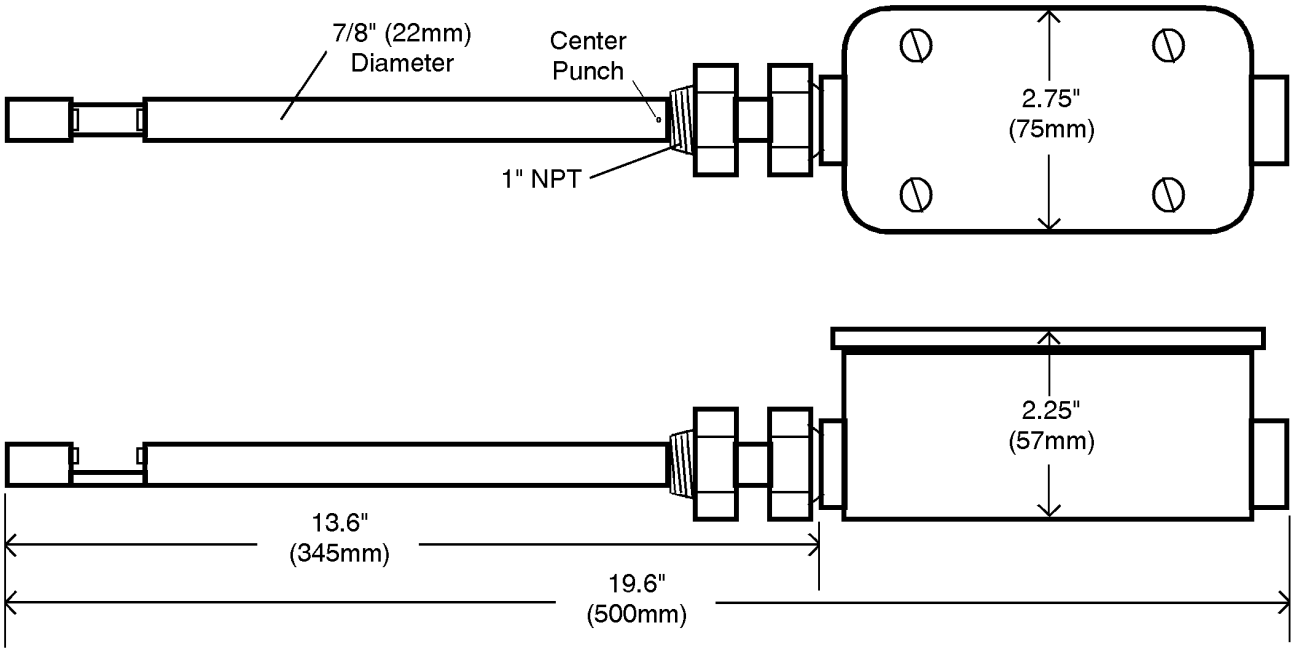
2. INSTALLATION

A. Dimensions

Figure B below shows the dimensions of the insertion-type sensor.

Figure B

Insertion-Type Sensor Dimensions



B. Installation

Line Size: There are no restrictions on the maximum pipe diameter into which the sensor can be installed. However, if a 2-inch or smaller line is to be monitored, install a 2-inch or larger "T" to prevent the sensor from blocking the line. Figure C below shows some typical insertion-type sensor installations.

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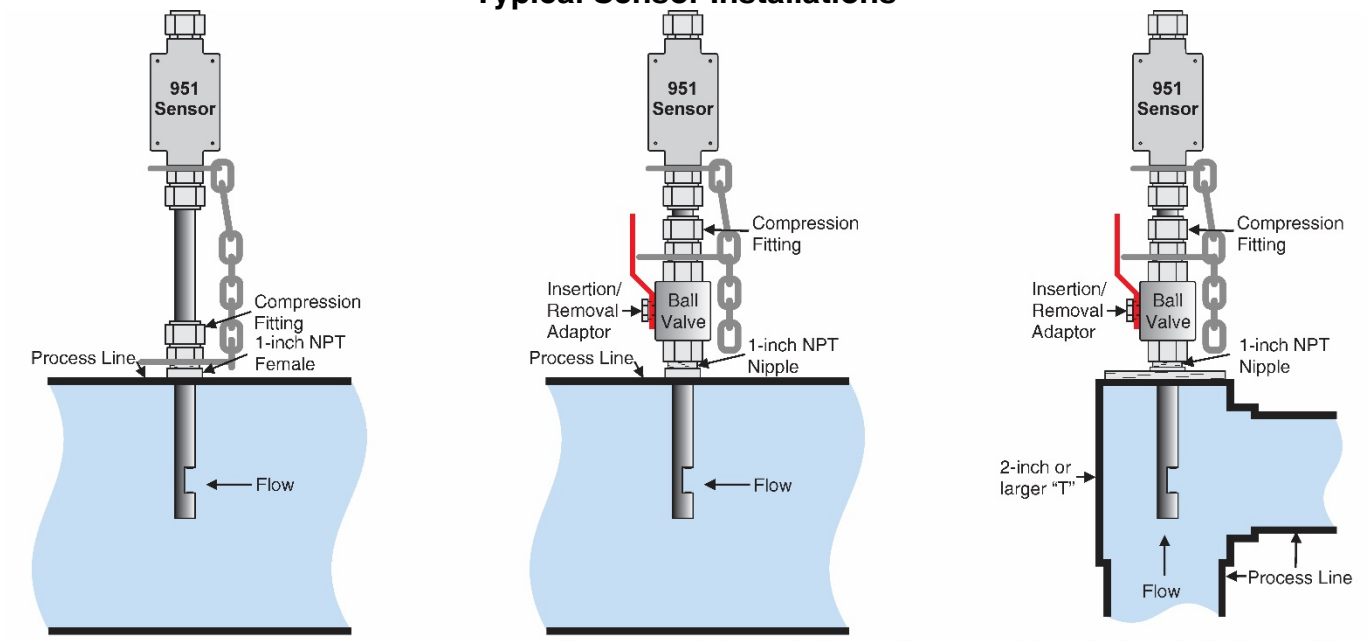
Figure C

Typical Sensor Installations



Large Pipe or Tank Installation

Large Pipe or Tank Installation with Insertion/Removal Assembly

Pipe "T" Installation with Insertion/Removal Assembly

Transparent Lines: If the sensor is to be used in a transparent (e.g., glass, PVC, acrylic, etc.) process or sample line, the pipe must be wrapped with tape to prevent ambient light from entering the pipe and affecting the readings. Wrap the pipe for a distance of at least five pipe diameters from the sensor. **Black PVC electrical tape will not block light sufficiently.** Use an aluminum tape or wrap any tape over a metallic foil.

Temperature: The sensor should not be exposed to a process temperature that is below -10^{0}C or greater than 110^{0}C.

Pressure: The sensor should not be used where the process pressure is greater than 150 psig (10 BAR). **A safety chain is provided and MUST be used (see Section C on page 4).**

Entrained Gas: Gas bubbles in suspension can cause errors, so care should be taken to locate the sensor upstream of anything that could create a pressure drop (e.g., orifice plates, valves, pumps, etc.) and cause dissolved gases to come out of solution.

Mounting (without optional insertion/removal adaptor ball valve assembly): While any position on the periphery of the process pipe may be used to install the sensor, a position above the horizontal plane is recommended, particularly if the sensor is to be removed frequently. The sensor may either be installed through a "T" or a weldment that has been installed on the process pipe. The "T" or weldment must provide a 1" NPT female thread. After mounting the "T" or weldment, thread the male compression fitting supplied with the instrument into the "T" or weldment. Be sure that the large washer with one end of the safety chain fastened to it is captured between the compression fitting and the process pipe.

Mounting (with optional insertion/removal adaptor ball valve assembly): While any position on the periphery of the process pipe may be used to install the sensor, a position above the horizontal plane is recommended, particularly if the sensor is to be removed frequently. The sensor may either be installed through a "T" or a weldment that has been installed on the process pipe. The "T" or weldment must provide a 1" NPT male thread. After mounting the "T" or weldment, thread the supplied ball valve assembly into the "T" or weldment.

C. Insertion

CAUTION: IT IS HIGHLY RECOMMENDED THAT THE PROCESS LINE BE DEPRESSURIZED AND DRAINED BEFORE INSERTING OR REINSERTING THE SENSOR. DO NOT ATTEMPT TO INSERT THE SENSOR WHEN THE PROCESS FLUID IS HIGHLY ACIDIC OR CORROSIVE, OR AT ELEVATED TEMPERATURES OR PRESSURES.

An insertion depth between 1" and 4" is suggested. If the process pipe is empty or filled with a clean fluid, position the sensor at a depth where a minimum reading is obtained on the meter. This is to assure that any internally-reflected light from the process piping can be zeroed out. To further reduce internally reflected light, rotate the sensor so that the small center punch located below the junction box is facing upstream. In other words, if the process pipe is horizontal and the sensor is inserted into the top of the pipe, the center punch should be facing in line with the flow towards the upstream side. This permits a "scrubbing" action on the windows, and helps eliminate any buildup on the sensor while keeping reflected light at a minimum. Figure C on page 3 shows how to position the sensor. Follow the appropriate instructions below to complete the insertion of the sensor.

Insertion (without optional insertion/removal adaptor ball valve assembly): When the sensor has been positioned satisfactorily, firmly tighten the compression fitting so that the sensor cannot be pulled out or rotate. **The large washer that holds one end of the safety chain must be captured between the compression fitting and the process pipe.**

AFTER PROPERLY INSTALLING THE SENSOR AND BEFORE THE LINE IS PRESSURIZED, TAKE ALL THE SLACK OUT OF THE SAFETY CHAIN BY MOVING THE "CLIP" TYPE LINK UNTIL THE SAFETY CHAIN IS TAUT.

Insertion (with optional insertion/removal adaptor ball valve assembly): With the ball valve in the "closed" position and the compression fitting slightly loosened, insert the sensor into the compression fitting until it stops against the closed portion of the ball. Reconnect the safety chain and remove all slack using the "clip" connector on the chain. **The large washers on the safety chain must be "captured" between the compression fittings -- one on the valve**

and the other on the sensor. Tighten the compression fitting to a "snug" position, then insert the sensor further while containing most of the liquid. While standing to the side of the sensor, **SLOWLY** open the ball valve to permit the liquid to reach the outer compression fitting. When the valve is completely open, insert the sensor to its proper position and retighten the compression fitting until it stops leaking.

AFTER PROPERLY INSTALLING THE SENSOR AND BEFORE THE LINE IS PRESSURIZED, TAKE ALL THE SLACK OUT OF THE SAFETY CHAIN BY MOVING THE "CLIP" TYPE LINK UNTIL THE SAFETY CHAIN IS TAUT.

Junction Box: Route the power and output cable through the cable seal as described on page 6. Tighten the seal to ensure a moisture-tight seal. Make the wire connections as shown in Figure D on page 7 and reinstall the cover and gasket to assure a weather-tight seal. It is important that the inside of the junction box be kept dry at all times. If the junction box is positioned so that it is difficult to make the wire connections, the box may be rotated by loosening the compression fitting immediately under the box.

NOTE: DO NOT ROTATE THE BOX MORE THAN 180 DEGREES IN EITHER DIRECTION OR THE INTERNAL WIRING MAY BE DAMAGED. BE SURE TO RETIGHTEN THE COMPRESSION FITTING.

This completes the installation of the sensor.

D. Removal

CAUTION: DO NOT ATTEMPT TO REMOVE THE SENSOR WHEN THE LINE IS FILLED OR UNDER PRESSURE IF THE PROCESS FLUID IS ACIDIC, CORROSIVE, OR AT ELEVATED PRESSURES OR TEMPERATURES. NEVER STAND IN FRONT OF THE SENSOR WHILE ATTEMPTING TO REMOVE IT FROM A PIPE THAT IS UNDER PRESSURE.

To remove the sensor from the process line, please follow the appropriate steps below.

Removal (without optional insertion/removal adaptor ball valve assembly): The process line will have to be depressurized and probably drained. The sensor may then be safely removed by disconnecting the safety chain and loosening the compression fitting.

Removal (with optional insertion/removal adaptor ball valve assembly): If it is not possible or practical to de-pressurize the line, **extreme care** must be taken to ensure that the sensor is not "blown out" by the process pressure when the compression fitting is loosened. Please follow these steps:

1. Loosen the safety chain one or two links by moving the "clip" towards the process pipe.
2. Loosen the compression fitting sufficiently to permit pulling the sensor out to the new limit of the safety chain.
3. Retighten the compression fitting and repeat steps 1 through 3 until the sensor is clear of the ball valve.
4. Close the valve and withdraw the sensor completely.

3. WIRING

A. General

1. All wires should be routed away from potential RF (radio frequency) sources and large inductive loads.

2. All wiring connections at the sensor must go through the cable seal, and the seal must be tightened sufficiently to keep moisture out. Be sure that the cover on the sensor is tightly screwed down to avoid leakage into the sensor.

3. Assure that the interconnecting cable to the sensor is correctly installed (see Figure D on page 7) and all terminals are tightened. Strip about 3 to 4 inches of the cable cover back to expose the 5 wires. Make sure the cable seal on the sensor seals against the unstripped cable. The cable seal will not seal around the 5 exposed wires. **Use only the cable supplied with the instrument or equivalent.** Standard cable length is 25 feet. Optional lengths up to 1000 feet are available.

4. Before connecting the power, be sure that the supplied voltage matches the voltage indicated on the service label. Figure D on page 7 shows how the power wires should be connected.

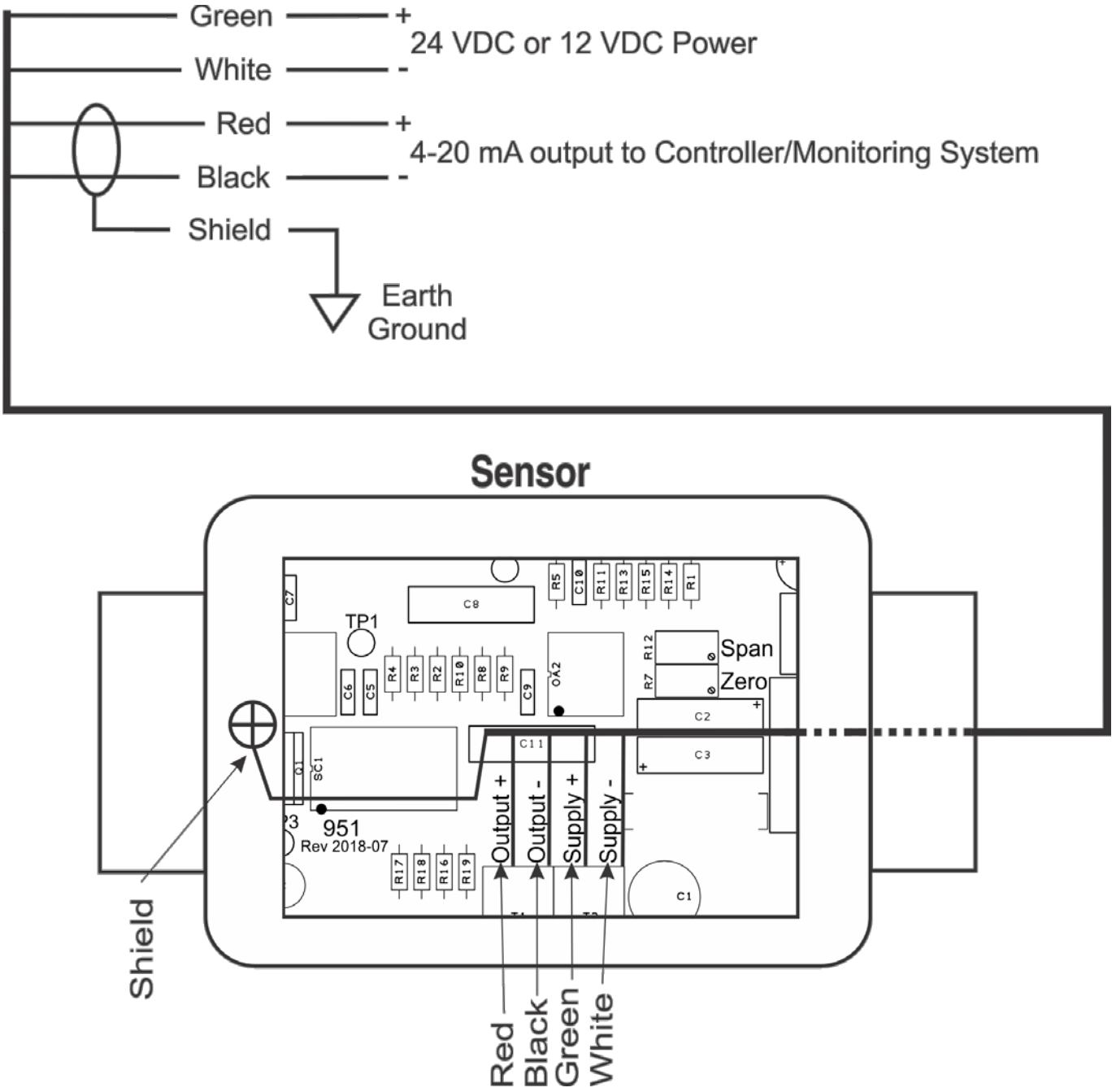
5. Wire the sensor output with the shielded twisted pair (red and black wires) as shown in Figure D on page 7. Ground the shield as shown in Figure D on page 7**.**

NOTE: RFI (Radio Frequency Interference) and large inductive loads such as motors, solenoid valves and large switches can affect the operation of the instrument. Therefore, both the sensor should be properly grounded to eliminate the effects of RFI. If the instrument is mounted in the vicinity of any large inductive loads, all interconnecting cable should be installed in conduit that does not contain power cables.

B. Wiring Diagram

Figure D

Wiring Diagram



4. CALIBRATION

A. General

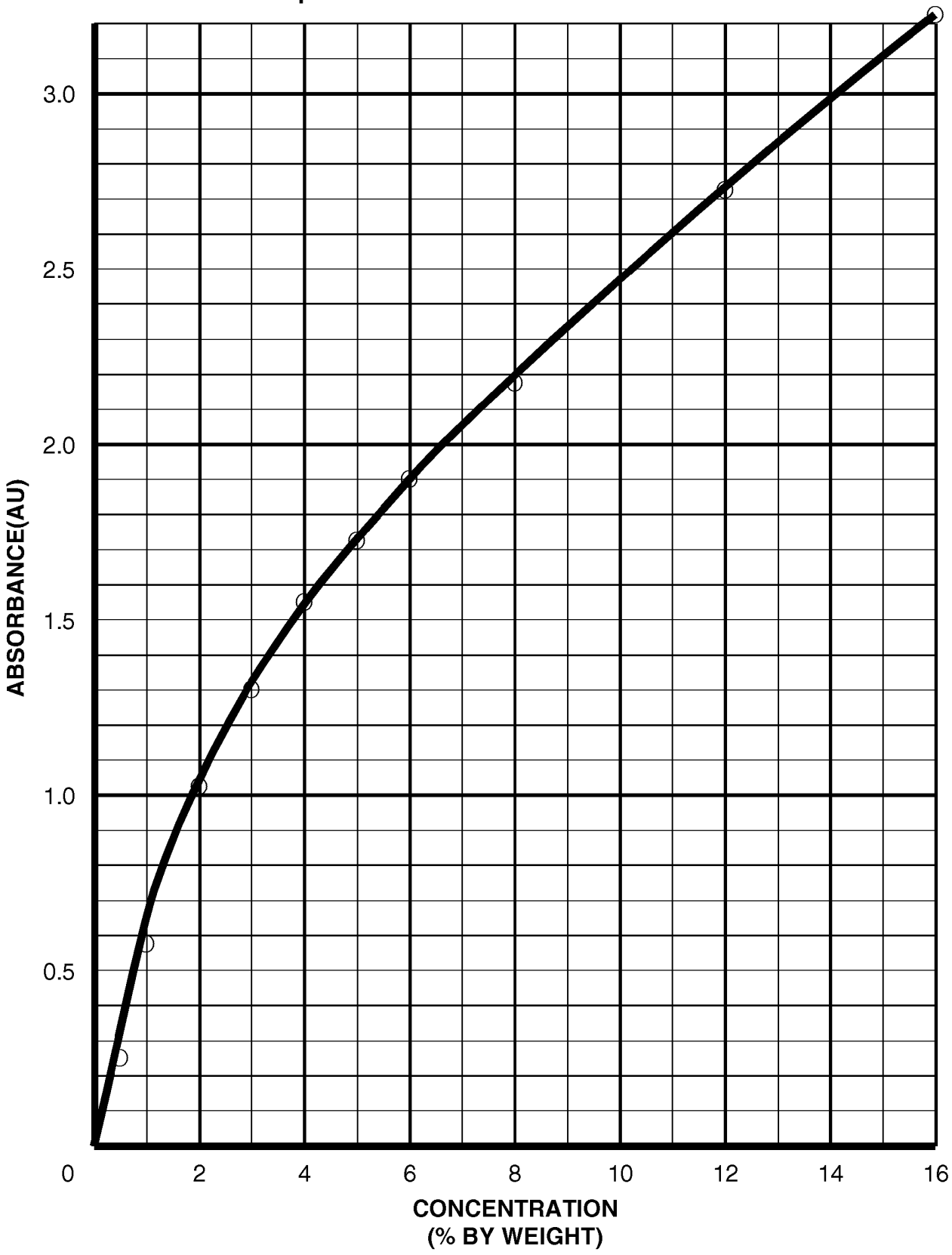
The Model 951 has been factory calibrated using distilled water and an electronic current source. The instrument may easily be recalibrated by mixing solids with distilled water. First, the zero point (4 mA) is established using distilled water. If it is desired to elevate the zero to say 5% (solids), then a 5% (solids) sample is used for the zero point. The span is set by adjusting the instrument to correspond to a known gravimetric sample. A known gravimetric sample can be made by mixing 1 gram of dry solids from the process with 1 liter of distilled water. This will yield a 1000 ppm (parts per million) mixture (using 2 grams will yield 2000 ppm, and so on). Only the zero and one other point need be established. Prior to checking or changing calibration, the sensor must be powered on and warmed up for at least 5 minutes.

The “Zero” and “Span” adjustments for calibrating the sensor are located on the circuit board behind the cover of the sensor box. Depending on the darkness of the solids, the response can be somewhat non-linear. Dark solids tend to give a more linear response than light solids. Figure E on page 9 shows the Model 951 response curve for Brewer’s Yeast. The Brewer’s Yeast graph covers a measurement span of 0 to 16% (0 to 160,000 ppm); however, on most applications the area of interest is much less, and the curve is usually "flat" (linear) for smaller segments. Calibrating the instrument over a smaller concentration range will result in more accurate readings in that range.

RESPONSE CURVE

Figure E

951 Response Characteristics to Brewer's Yeast

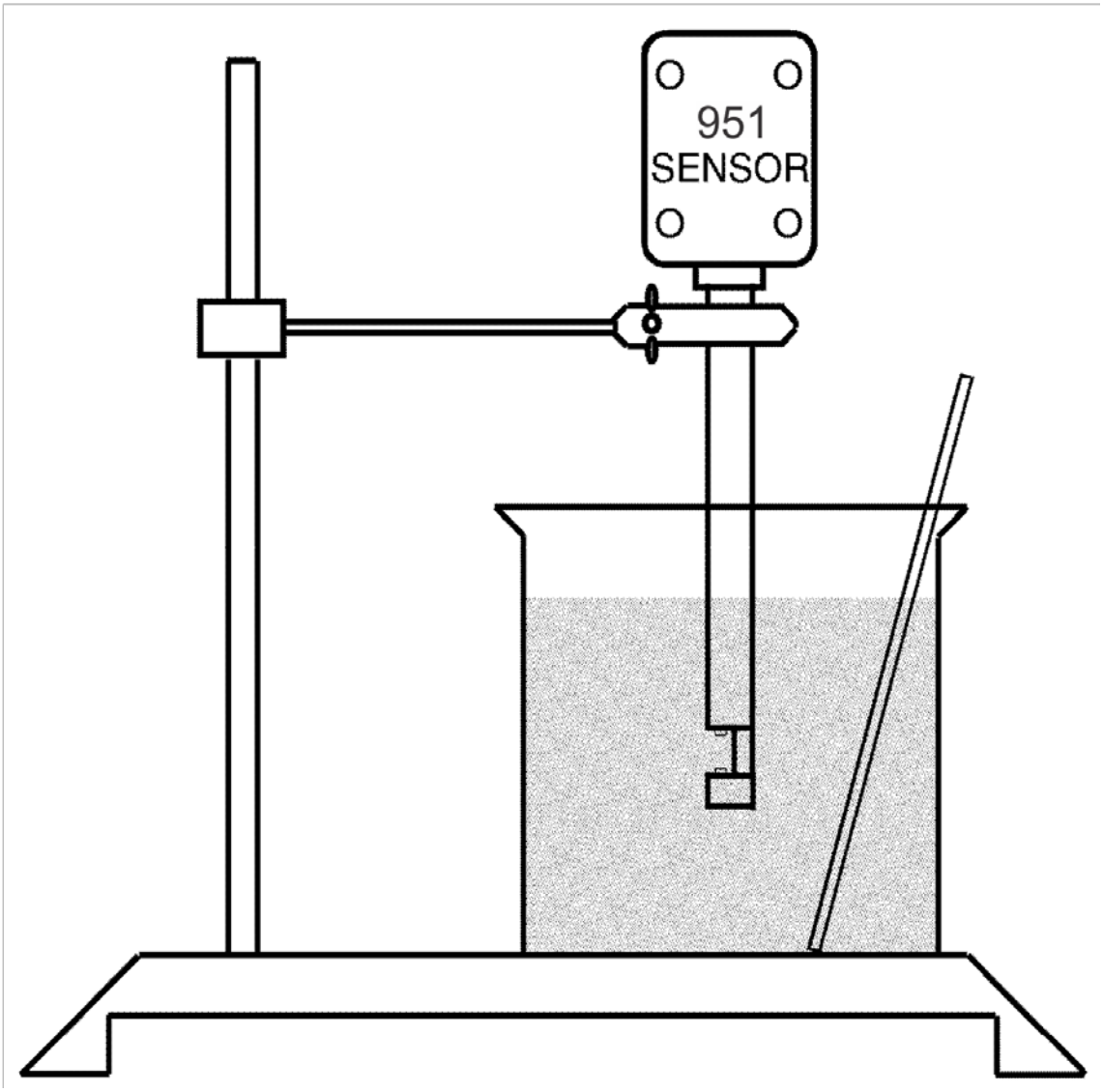


B. Laboratory

This method is normally used on new sensors prior to their installation or on sensors that have been completely removed from the process. Laboratory calibration will require the apparatus as shown in Figure F below. The sensor must be wired according to the wiring instructions. During calibration, care must be taken to eliminate bright natural light from the sample and sensor tip. Care should also be taken to place the sensor in the middle of the sample chamber to avoid internally reflected light.

Figure F

Laboratory Apparatus



The calibration is a two-step procedure. Samples at each end of the desired range should be available.

In most instances, the zero point is established using clean water. For the upscale value, a sample of the product near the normal operating concentration will be required. If a sample of the normal concentration is not available, any sample of known value will suffice. For example, if 16% pulp is not available for a 16% operating range, use an 11% sample and set the sensor span so that the meter reads 11/16 of the 4-20 mA span (15 mA).

The calibration procedure is as follows:

a. Place the sensor in the clean water sample and set the Zero to give a 4mA output.*

b. Next, place the sensor in a sample that is near the operating concentration of the process and set the Span to give an output that corresponds to the sample concentration.

c. Repeat steps **a.** and **b.** above to check the calibration. If the calibration is off, make the necessary adjustments.

* **NOTE:** For certain applications, an offset zero may be used to provide better accuracy over a narrower concentration range. If calibrating with an offset zero, choose two samples of known concentration that are in the operating range where best accuracy is needed. One sample should be at the low end of the range and the other sample should be at the high end of the range. Calibrate the instrument using the procedure below:

    a. Place the sensor in the low concentration sample and set the Zero to give an output that corresponds to the low sample concentration.

    b. Next, place the sensor in the high concentration sample and set the Span to give an output that corresponds to the high sample concentration.

    c. Repeat steps **a.** and **b.** above to check the calibration. If the calibration is off, make the necessary adjustments. If the offset zero is large, you may have to repeat steps **a.** & **b**. several times.

C. In-Line

Small calibration adjustments can be made without removing the sensor from the line, provided that accurate laboratory equipment is available and a representative sample of the process liquid can be taken.

1. If the output is reading off-scale (below 4 mA or above 20 mA), adjust the Zero until the reading is between 4 and 20 mA.

2. Take a grab sample and simultaneously note the output current.

3. Determine the value of the sample's solids concentration in ppm or % solids.

4. Convert the concentration to a corresponding output current.

Output current = 4mA + 16mA x (sample concentration/full span concentration)

5. After the output current has been determined, note the present instrument reading and adjust the Zero to correct.

EXAMPLE

Output when sample taken (from step 2.)	=	12.00mA
Lab test value (from step 3.)	=	1500ppm
Calculated current for 1500ppm sample (2000ppm scale)	=	16.00mA
Difference (reads too low)	=	4.00mA
Present current reading (from step 5.)	=	11.00mA
Add difference (4.00mA) to present current reading	=	15.00mA
Set output (by adjusting Zero) to read	=	15.00mA

5. TROUBLESHOOTING

Problem	Possible Causes	Check/Remedy
No output	No power Blown fuse	Check supply voltage. Check fuse.
Output cannot be set to 4mA	Too much absorbed light Poor sensor connections or incorrect wiring Sensor leads not insulated from body of sensor or conduit Wet connection in converter or sensor housings No power to sensor Faulty sensor lamp or defective sensor/transmitter	Place sensor in clean water to set Zero. Check connections and wiring. Check sensor wires. Look for water or condensate on connections. Voltage should be between 11 & 26 VDC on power terminals. If the proper voltage (11-26 VDC) is on power terminals and the lamp in the sensor is not on, then the lamp, lamp wiring or sensor circuit board has failed.
Output does not change and indication is high	Faulty sensor lamp	Check to see if sensor lamp is on. If lamp is off, check voltage across power terminals in sensor. If the proper voltage (11-26 VDC) is on the terminals and the lamp in the sensor is not on, then the lamp, lamp wiring or sensor circuit board has failed.
Unstable reading	Air bubbles or very large particles in process line RFI pickup Heavy Inductive loads	Take sample and check for bubbles or large particles. If present, relocate sensor. Earth ground sensor properly. Mount sensor away from power cables. Put sensor wires in conduit.
Reading does not agree with lab results	Improper calibration Lab procedure error Lab instrument error Defective sensor/transmitter	Recalibrate instrument. Check procedure. Check instrument. Refer to supplier.
Readings drift with time	Converter not warmed up Sensor/converter connections wet Deposit build-up on sensor	Warm up converter for 5 minutes. Look for water or condensate on connections. Dry connections. Remove sensor and clean.
Output below 4mA	Line is partially or completely empty Improper calibration	Make sure that water in the line is covering the tip of the sensor. Recalibrate instrument.

6. TECHNICAL SUPPORT

If technical support is required, please contact us at the phone number on the front cover, and be prepared to supply the following information:

_____**Model Number** (951)

_____**Serial Number** (label inside and stamped on back)

_____**Light Gap/Path Length** (1/2.5cm/special)

_____**Sensor Type** (Insertion)

_____**Date Purchased**

_____**Output** (Current/Voltage)

_____**Power** (12VDC/24VDC)

_____**Process Temperature**

_____**Process Pressure**

_____**Process Turbidity Range** (0-2NTU, 0-20NTU etc.)

_____**Process Solid** (Sand/Pulp/Yeast)

_____**Process Liquid** (Water/Oil/Alcohol)

_____**Process Solid Concentration**

_____**Process Piping Material** (ABS/Stainless)

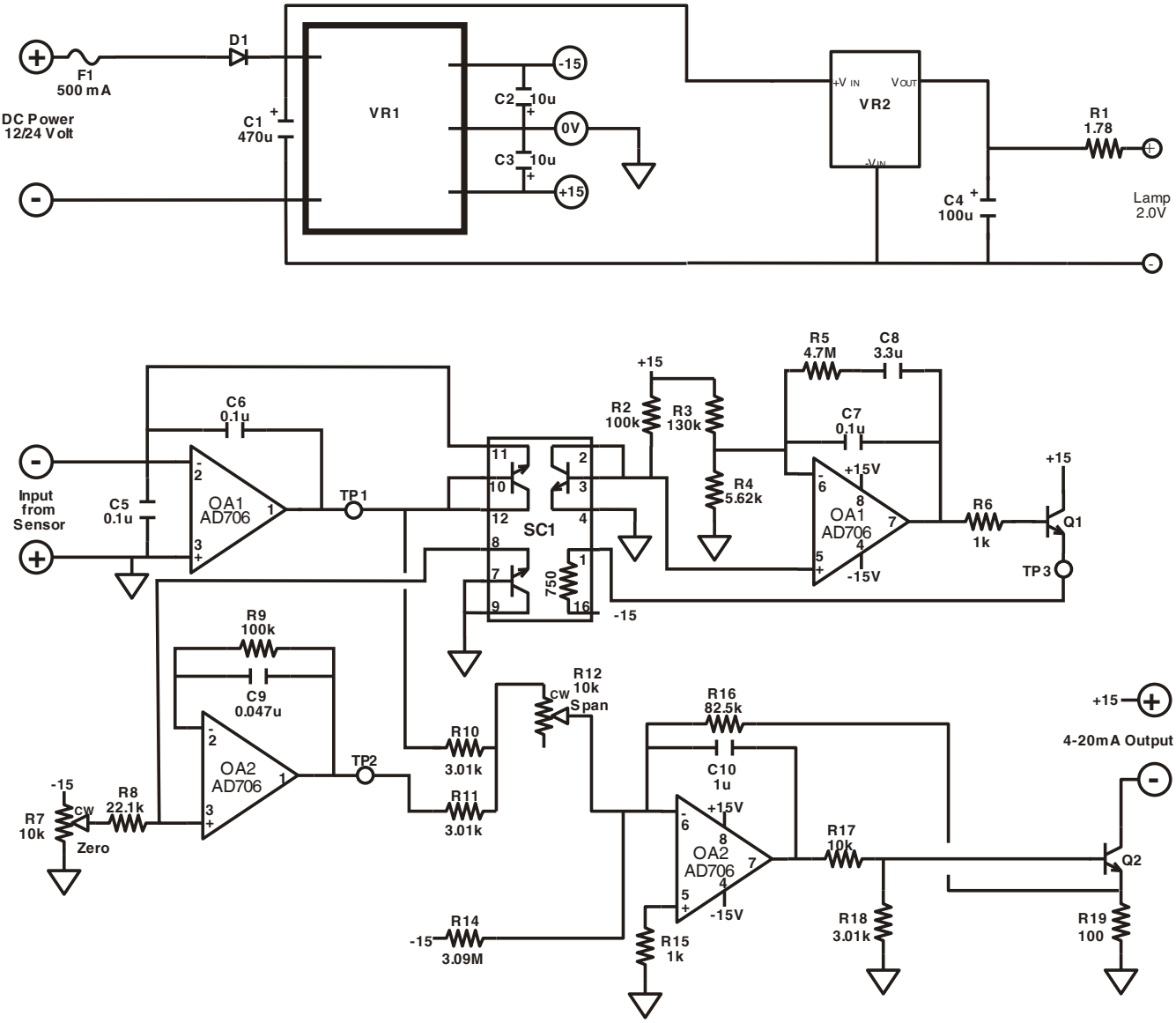
_____**Process Piping Size**

_____**Anything else you feel is important**

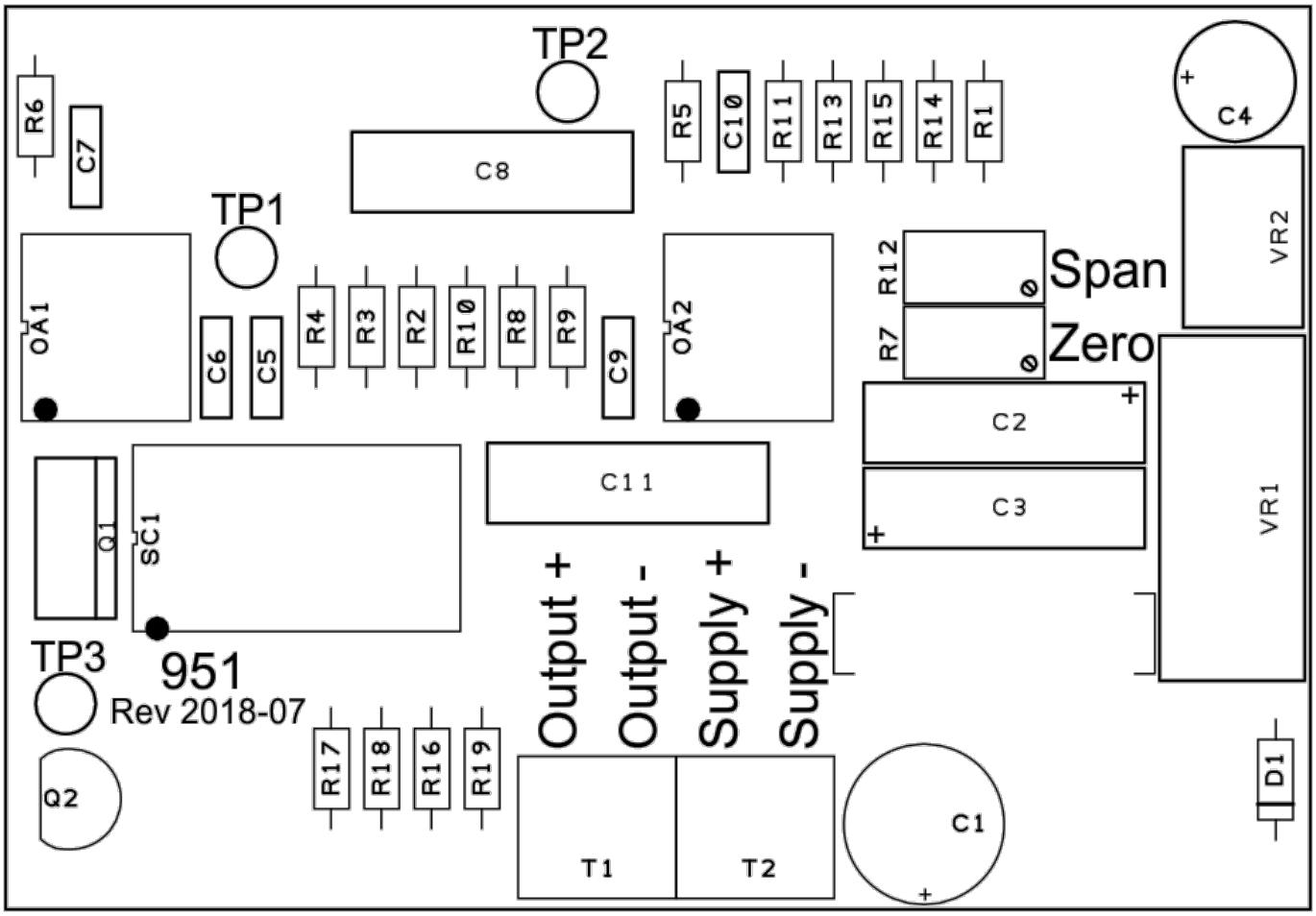
7. TECHNICAL DIAGRAMS

A. Model 951 Suspended Solids Sensor

Model 951 Circuit Diagram

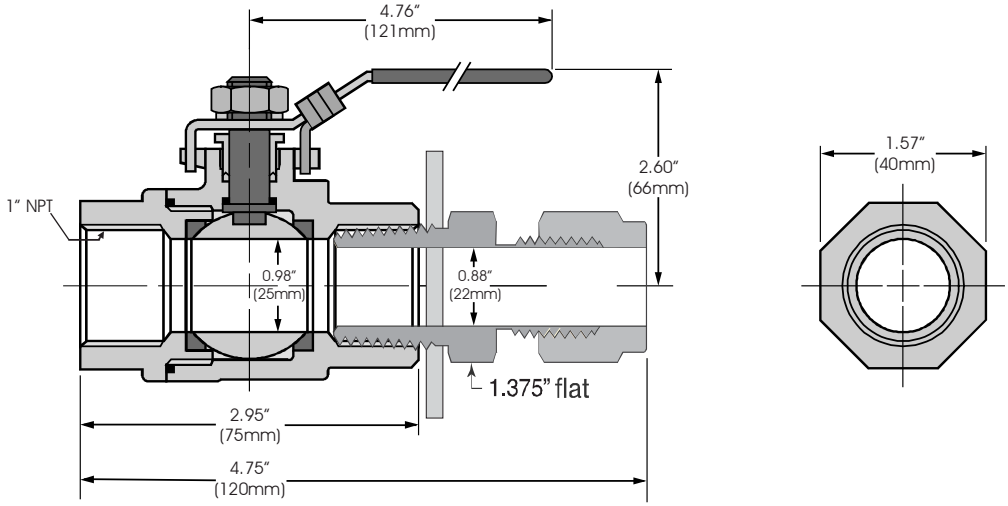


Model 951 Circuit Board Component Layout

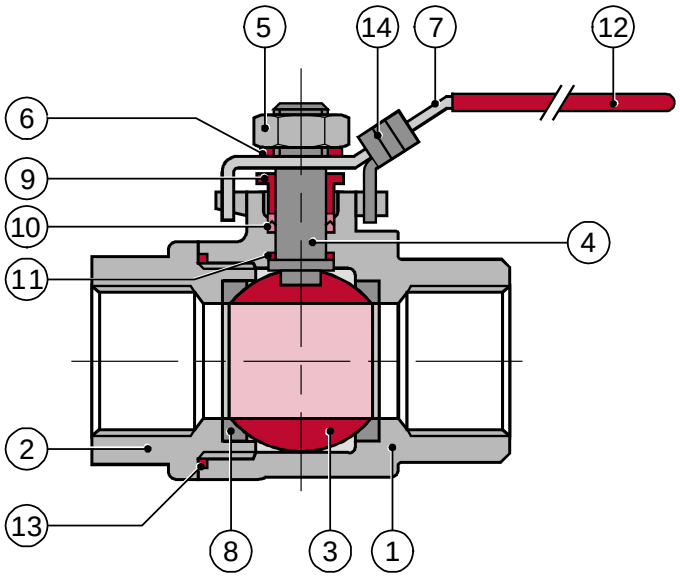


B. Pipe Insertion Assembly Dimensions and Materials

Dimensions:



Materials:



No.	Part	Material	Qty.
1	Body	ASTM A351 Gr. CF8M	1
2	End Cap	ASTM A351 Gr. CF8M	1
3	Ball	AISI 316	1
4	Stem	AISI 316	1
5	Stem Nut	AISI 304	1
6	Stem Washer	AISI 304	1
7	Handle	AISI 304	1
8	Seat	PTFE	2
9	Gland Nut	AISI 304	1
10	Stem Packing	PTFE	1
11	Thrust Washer	PTFE	1
12	Handle Sleeve	Vinyl	1
13	Joint Gasket	PTFE	1
14	Locking Device	AISI 304	1

8. WARRANTY

Confab Instrumentation's products are warranted to be free from defects in material and workmanship for a period of one (1) year from the date of shipment. The final determination as to whether the product has failed due to defects in materials or workmanship rests solely with Confab Instrumentation. Products that have been proven to be defective in workmanship or materials will be repaired or replaced at Confab Instrumentation's facility at no charge to the buyer. Defective instruments must be returned to Confab Instrumentation freight prepaid. **THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE GIVEN IN CONNECTION WITH THE SALE OF ANY CONFAB INSTRUMENTATION PRODUCT(S).** In no event shall Confab Instrumentation be liable for consequential, incidental or special damages. The buyer's sole and exclusive remedy and the limit of Confab Instrumentation's liability for any loss whatsoever, shall not exceed the purchase price paid by the purchaser for the product or equipment to which a claim is made.