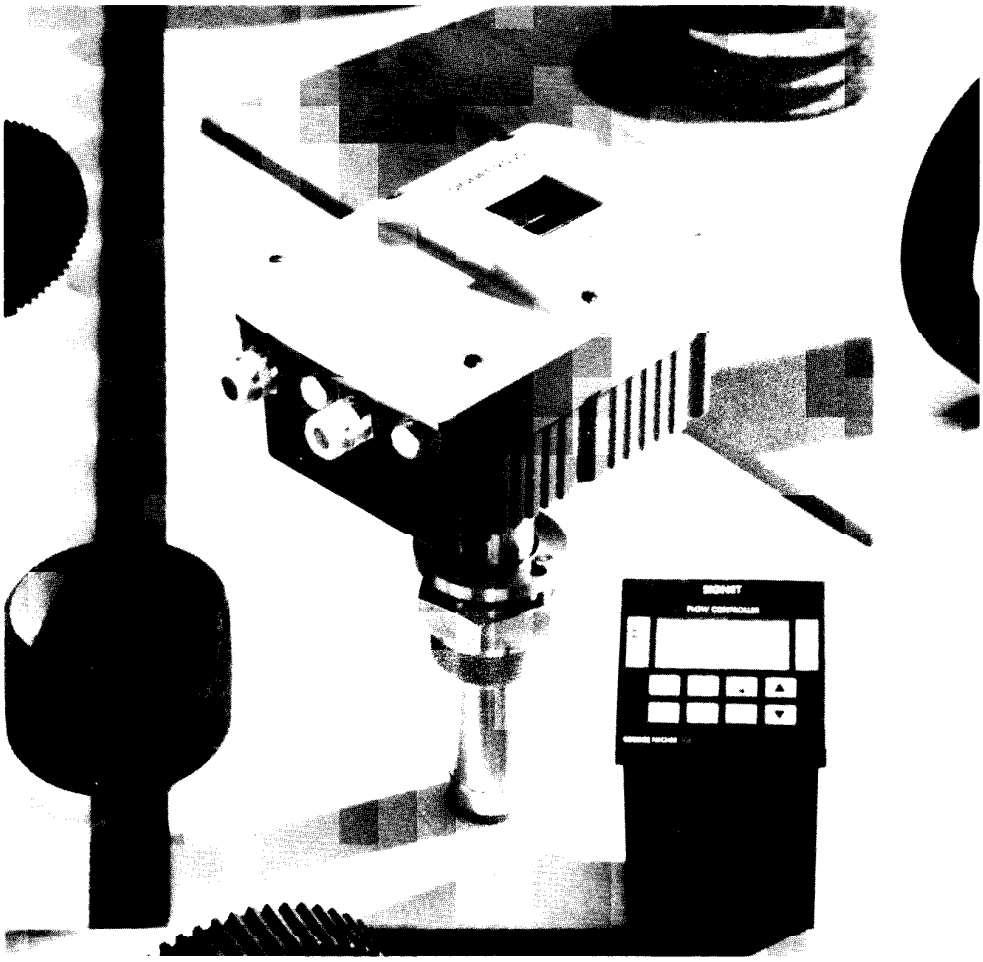
SIGNET 2550 Insertion Magmeter



Installation and Application Tips

GEORGE FISCHER +GF+

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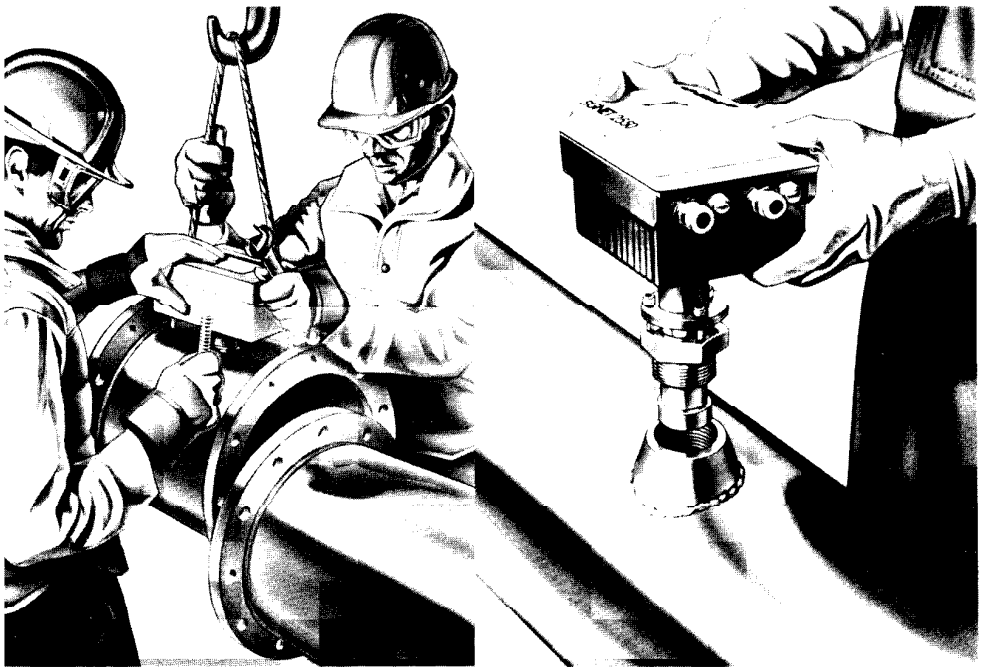
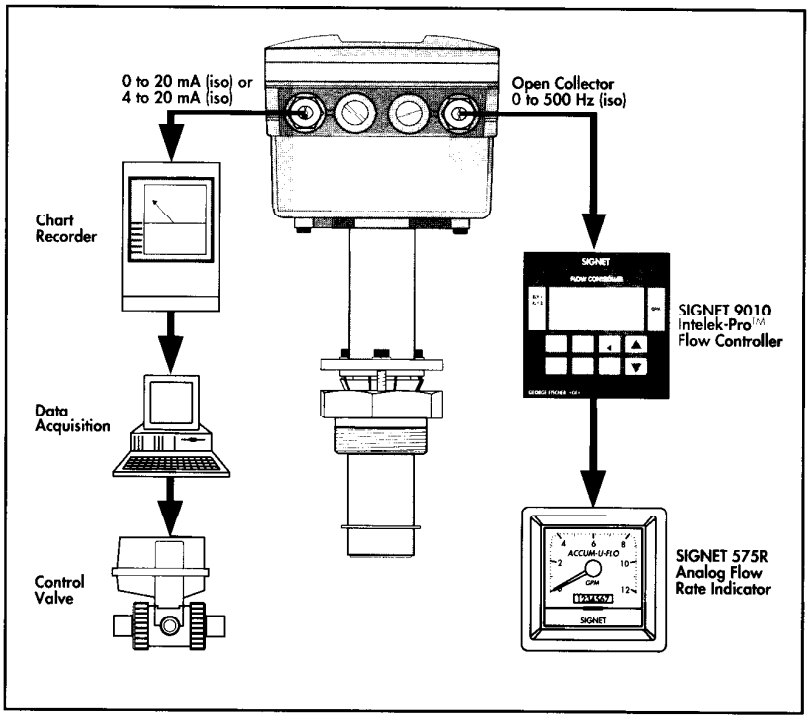


Overview

The U.S. magmeter market represents approximately 100 million dollars in annual sales. Zero headloss, and generally non fouling nature have allowed magmeters to encroach on the market shares of more traditional technologies (e.g., orifice and turbine). Recent technological innovations have helped expand the magmeter market by simultaneously enhancing its capabilities such as: increased application of bi-polar dc pulsed designs, reduced weight and power consumption, a standard design that handles most applications, a one size fits all concept, and reducing its cost. The first magnetic flowmeters, introduced in the 1950's, were cumbersome, expensive, high power consumption devices.

Despite all of these improvements, the full line magmeters for larger pipe sizes are still expensive and highly cumbersome to install and maintain. This is where the SIGNET 2550 Insertion Magmeter comes in handy: more economical, easy to calibrate, install and maintain.



Using the latest in magmeter technology, bi-polar dc pulsed, exclusive temperature compensation techniques, N.I.S.T. traceability, and state-of-the-art microprocessor based circuitry, the 2550 provides the most features for the dollar

The major advantages of the SIGNET 2550 Insertion Magmeter are:

- Insertion design (simple installation, easy maintenance)
- Rugged, NEMA 4 metal design
- Local digital display
- Leading manufacturer warranty
- Microprocessor based (no potentiometers, more features)
- Automatic calibration (based on pipe dimensions or volumetric calibration for special applications)
- Multiple isolated outputs
- >10,000 meg ohm input impedance (resilient to coatings)
- No moving parts to foul
- Virtually zero headloss
- Lower cost per sensing point (approximately 1/2 the price of 6" full bore mags)
- Reduced inventory costs (one P/N for many pipe sizes)
- Wet Calibration and N.I.S.T. traceability (2" – 12")

2550 Magmeter Principle of Operation Simplified

Michael Faraday, English chemist and Physicist (1791 - 1867), made discoveries that led to what is now commonly known as Faraday's Law of Electromagnetic Induction. This law states, in magmeter terms, that the magnitude of the voltage induced in a conductive medium moving through a magnetic field that is perpendicular both to the flow and to a line between the electrodes, is in fact directly proportional to the product of the strength of the magnetic flux density (B), the velocity of the medium (v), and the path length (L) between the probes:

$$E = \text{constant} \times B \times L \times v$$

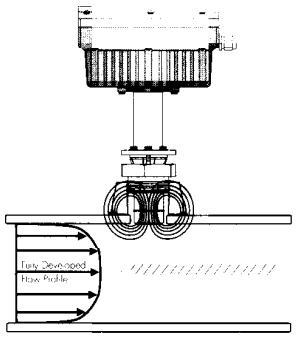
This result is proportional to the voltage induced in the conductive fluid caused by its movement at right angles to the applied magnetic field. The faster the conductive fluid moves through the magnetic field, the more voltage will be induced. The voltage that is produced, between the two magmeter electrodes, as a cross product of the magnetic field and the velocity field is then measured, divided by the magnetic field strength, and the result is displayed as fluid velocity, ($V \approx E/B$).

The SIGNET 2550 Insertion Magmeter provides the magnetic field while the strength of this magnetic field is being monitored several times per second. Any changes in the field strength as a result of temperature, etc., will be compensated for by the microprocessor. The two stainless steel sensing electrodes are precision machined and installed to exacting measurements, and the insertion depth of the electrodes into the pipe is predetermined ensuring uniform performance. As a result of the magnetic field being known, the distance between the sensing electrodes and insertion depth also being a constant, the induced voltage will then be directly proportional to the fluid velocity.

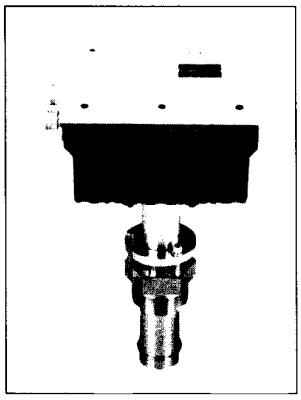
The electromagnetic field produced by the SIGNET 2550 Insertion Magmeter is a bi-polar dc pulse. The 2550 excites the electromagnet with a pulsed dc current in one polarity, then pulsed with a reverse polarity. Of the many advantages of this pulsed method is a reduced likelihood of magnetic attraction to end of the mag probe. Additionally, this method eliminates electrolytic polarization of the electrodes. Signet's method for zero compensation eliminates the need for user adjustments regardless of zero shifts that may occur as a result of minimal fluid noise or sensing electrode coating. It is important to be aware that sensor coating will have little or no effects providing the effective conductivity remains high enough (>5μS/cm) for the magmeter to properly operate.

In the case of the SIGNET 2550 Insertion Magmeter the metal body of the probe acts as the solution ground, providing for a more accurate measurement, whether in a plastic or metal pipe. The input impedance of the 2550 is >10,000 Meg ohms. This high input impedance allows flow measurements to be made in relatively low conductive fluids (>5μS/cm), or in fluids that could cause low resistive coatings to occur on the sensing electrodes.

In addition the SIGNET 2550 Insertion Magmeter utilizes state-of-the-art filtering and the on board microprocessor provides the user with such fluid diagnostics as quantifying turbulence in the flow profile and the amount of noise present in the fluid. The two output signals are isolated as standard practice. The microprocessor also eliminates the use of potentiometers and allows for automatic calibration by simply entering the pipe i.d. The liquid crystal display has a security access code and also serves as the local flow rate display.



Faraday's principle: Movement of a conductive fluid through a magnetic field generates a perpendicular eletromotive force proportional to its velocity



Insertion principle, simple installation, microprocessor based design, and many standard features make the SIGNET 2550 Insertion Magmeter a premier in insertion flow sensing technology.

Power Requirements and Wiring

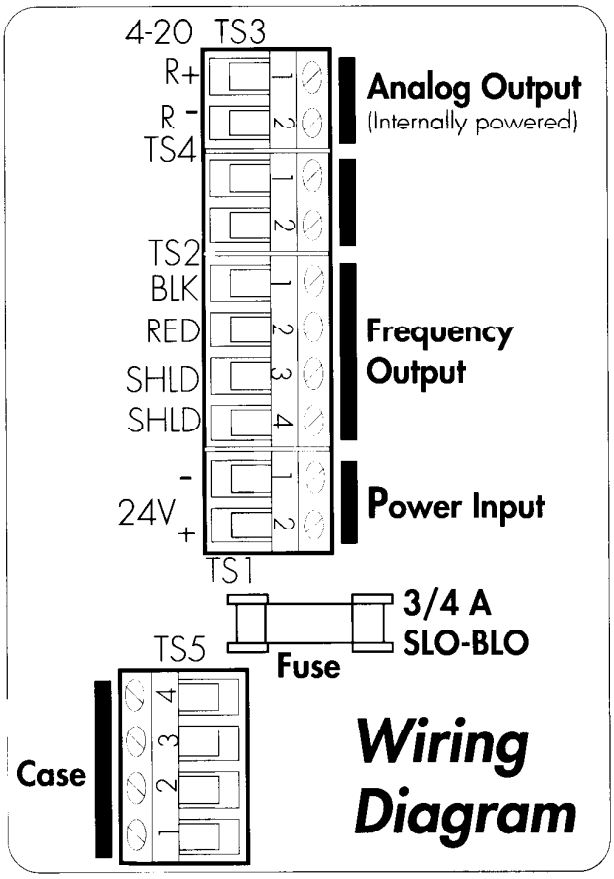
Power Supply Recommendation:
Use a 24 vdc ±10%, 600 mA, linear type power supply
The recommended power supply (or equivalent) is Model No. HB24-1.2A (24vdc @ 1.2 amps). This can be purchased from: Power-One, Inc. Camarillo, CA, phone, (805) 987-8741, or (800) 678-9445, Fax, (805) 388-0476

Wiring: The analog output of the 2550 is field selectable 0-20 mA or 4-20 mA isolated, with a maximum load capability of 600 ohms. Use Beldon Cable #8451 (or equivalent), 22 AWG two conductor, twisted pair with shield. Connect the shield or drain wire to the shield terminal of TS2 inside the 2550 (see Figure 1).

The frequency output of the 2550 is an isolated open collector, 0-500 Hz pulse with a 50% duty cycle, (5-12 vdc). Maximum recommended distance to run signal is 500 feet. Use Beldon Cable #8451 (or equivalent), 22 AWG two conductor, twisted pair with shield. Connect the shield or drain wire to the shield terminal of TS2 inside the 2550 (see Figure 1).

Power and Ground Wiring
For the 24 vdc, run 18 AWG wire less than 100 feet. The earth ground wire (TS5) should be 18 AWG **solid** copper less than 100 feet total distance from the main earth ground

Figure 1



Grounding Considerations

First, you'll need to determine the necessity for earth grounding as well as learning a means for quantifying the effects of the grounding technique. Make sure the "Filt" is set to 60cy for 60 Hz power systems. Connect a local earth ground (EG1) to the TS5 terminal strip of the 2550. If the power cable is less than 100 feet, EG2 is an acceptable alternative. However, using both the EG1 and EG2 is the preferred method (see Figure 2).

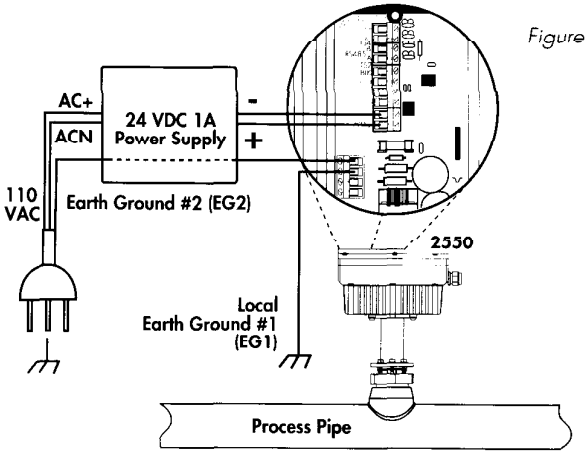


Figure 2

After completing the installation and wiring of the 2550, monitor the "STDE" value. In a full pipe with and without flow, "STDE" value represents the electrical noise in the liquid and is displayed in volts, i.e. 0.05 or 50 millivolts.

If "STDE" is less than 0.05, then typically no additional grounding is needed. However, a lower standard "STDE" reading is most desirable. If "STDE" is greater than 0.05, follow the steps below:

a) in plastic piping systems, identify places where the fluid is in electrical contact with any external structures/grounds. Connect such points to TS5 where practical.

b) in metal pipe, "STDE" values should always be low unless the interior is thoroughly coated with non-conductive material. In such a case, if EG1 and EG2 are not adequate, some of the coating material should be removed.

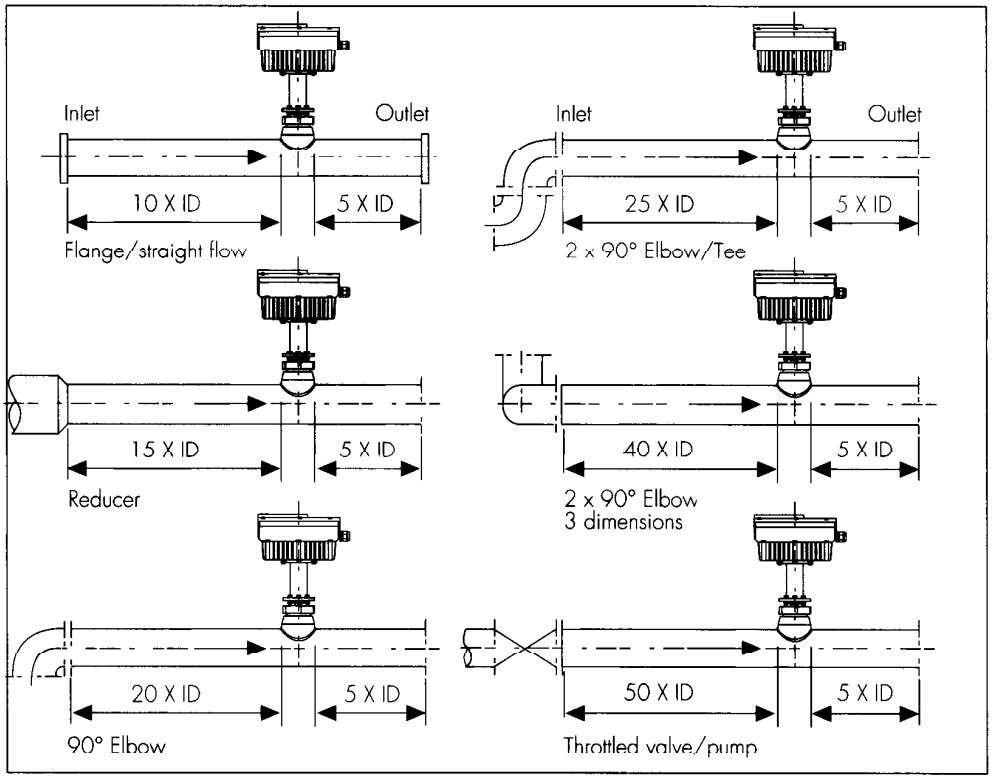
Latest cellular manufacturing technology in ISO 9001 registered facility ensures the high quality of the SIGNET 2550 Insertion Magmeter

Piping Considerations

Flow sensors, including the SIGNET 2550 Insertion Magmeter depend upon a "fully developed turbulent flow profile" for maximum linearity and accuracy. To achieve this requirement the fluid must have a Reynolds number greater than 4500, and the sensor must be located in a straight run of pipe. At least 10 pipe diameters of uninterrupted straight pipe upstream of the sensor and at least 5 pipe diameters of uninterrupted straight pipe downstream is required. Major obstructions such as pumps, throttled valves, elbows, etc will require considerably longer straight runs. Take this into consideration when selecting a fitting/sensor location (see Figure 3).

In horizontal pipe runs, install the fitting/sensor at an angle away from the top or bottom of the pipe, this will minimize the effect of air bubbles and sediment (see Figure 4). Any fitting/sensor angle is acceptable in vertical pipe runs. Vertical pipe runs with downward flow must be pressurized and have back pressure to insure a full pipe, upward flows are preferred.

Figure 3



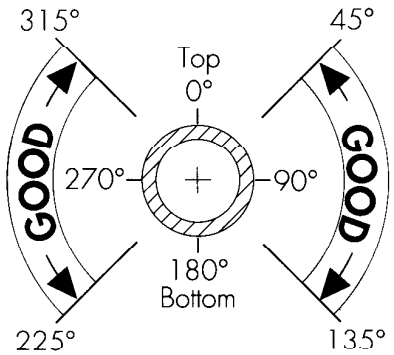
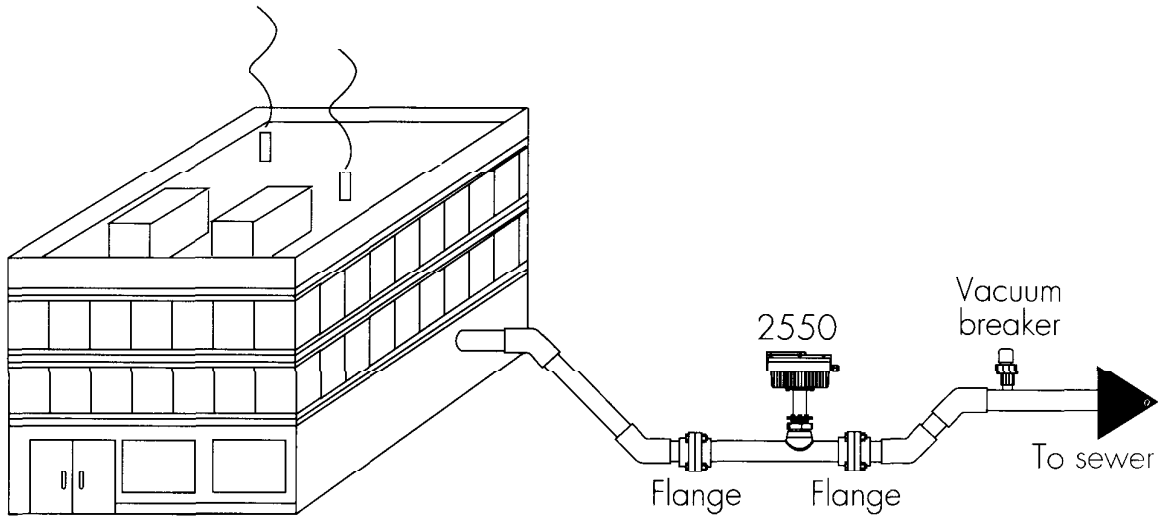


Figure 4

Gravity Flows/Partially Filled Pipes



The 2550 Insertion Magmeter is ideal for monitoring industrial effluent. However, there are several concerns that need to be addressed prior to the sale and installation of the 2550

Gravity flows and partially filled pipes are commonly found in applications dealing with industrial effluent. One problem is that pipes are often oversized, which greatly reduces the fluid velocity. Frequently these pipes are not full during flow and completely empty during no flow conditions. Another possible problem found is that open ended lines often do not provide sufficient back pressure to provide a stable flow profile.

Often these problems can be overcome with the installation methods shown above. At the sensing point, plumbing a low spot or trap ensures a full pipe during flow conditions. By utilizing 45° elbows instead of 90° elbows, there will be less pressure drop and less distortion in the flow profile. Make sure the vertical rise out of the trap is tall enough to provide some back pressure, but not taller than the highest point in the system. The more elevation difference between the inlet and the final outlet, the better for a gravity flow application. In addition, a reducer at the end of the pipe may be required to create adequate back pressure. After the trap, a vacuum breaker may be needed to ensure the trap stays full during no flow conditions. The use of flanges in the trap allows pipe removal for periodic cleaning. Occasionally, the best way to monitor final effluent flows would be to pump from a holding tank.

2550 Magmeter in Large Pipes

You will find the larger the pipe size the more attractive the price for the 2550 Magmeter becomes. An 18' full bore mag sells for around $20,000.00 compared to a Signet under $3,000.00. That presents an irresistible opportunity. How do you go about successfully selling and installing a 2550 Magmeter into large pipe applications?

First of all the 2550 Magmeter is specified for 2" through 12" pipes. However, the 2550 has calibration lookup tables built into the software from 1.80" through 39.00". The calibration data for the 2" through 12" pipes will meet the advertised accuracy specifications of ±2% of reading or ±0.05 ft/s whichever is greater.

In pipes larger than 12" the 2550 Magmeter will still be linear and repeatable. However, due to various reasons including the calibration tables and inconsistencies in the pipe walls of larger pipes you may experience a less than desired shift in the overall accuracy. If a high degree of accuracy is required in pipe sizes larger than 12" it is recommended that an alternate method of determining the actual flow rate be used during the initial installation and calibration of the magmeter. To determine this information, volumetric measurement, portable flowmeters, or pump curves are frequently used. While there is flow in the pipe determine the actual flow rate and match the 2550 to this value while in the "CALB" mode (see example on page 11).

In addition to using the Magmeter Application Assistance Form (see page 19) when pursuing large pipe applications the following areas will need your close attention.

• The amount of straight run available: Typically you will find one of two conditions when dealing with large pipe applications. One, there are miles of straight run. Two, there is only 2 or 3 pipe diameters of straight run. Forget selling in the latter, you want straight runs and good flow profiles.

• Partially filled pipes: Watch out, it seems the larger the pipe the less likely it is full. You want a full pipe at least when there is flow. And it is best to have a full pipe even when there is no flow otherwise you will need a flow switch to interrupt the 2550 output during no flow conditions.

• Low flows: Often in large pipe applications the flow rate is specified in millions of gallons per day. This is okay, just remember when you are calculating the fps or gpm, find out if the flows are continuos or intermittent. Also, be careful of change in flow velocities. The velocity may be 6 fps 80% of the time and 0.2 fps 20 % of the time. For example in an 18" line 0.2 fps equals 140 gm, that is below the 0.3 fps spec (210 gpm) for the 2550

• High velocities: The LCD readout on the 2550 is four digit. If you are in a large pipe and will see flow greater than 9999 gpm then the mag display needs to be calibrated to read fps. However, the remote display, computer, recorder, or signet indicator could still be spanned for gpm.

• Insertion Depth: The 2550 Magmeter has a probe that is 8.1025" long. The sensor must be installed at least 0.2 inches into the fluid being measured Keeping in mind that the probe must pass through the Signet adjustment nut, the installation fitting, the pipe wall, and still have enough length to get 0.2 inches into the fluid. Low profile installation fittings will greatly increase your chances in larger pipes. Remember to calculate all the dimensions prior to selling the magmeter (see Figure 5).

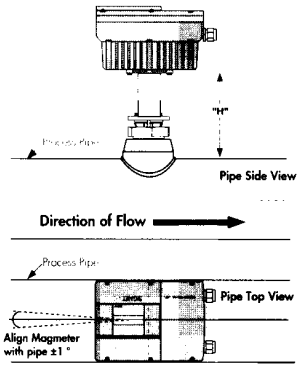


Figure 5

Large Pipe and Custom Calibrations

Calibration Example: First perform the standard calibration including engineering units, pipe, i.d., etc. Then perform the CALb (custom calibration) as illustrated on page 17 of the 2550 instruction manual.

The CALb function allows you to compare the 2550 calibration to your own volumetric or alternate flow measurement system. The 2550 stores this flow rate under the display function RatU.

The calibration based on the pipe data is still stored in the memory, and can be recalled by selecting the display function RatE.

To use CalB, first enter the access code then use the arrow keys until the display shows: "CALb"

Calculate the flow rate by measuring the volume output for a fixed time period.
volume ÷ time = flow rate

Step:	Press:	To display:	
1.	ENTER	50.00	*This is current display selection RatE*
2.	RUN/EDIT	CALb	
3.	ENTER	50.00	*Now the display has a flashing digit.*
4.	ENTER	50.00	
5.	▲	51.00	
6.	▲	52.00	*Use the enter, up and down arrow keys to set the new flow rate.*
7.	ENTER	52.00	
8.	ENTER	52.00	*When completed, the new calibration is stored as RatU.*
9.	ENTER	52.00	
10.	ENTER	52.00	*Press the enter key to return to normal operation.*

The CalB function returns the display to normal operation when completed.

Industry/Applications

The SIGNET 2550 Insertion Magmeter finds applications in a variety of industries. Some of the more common applications are described below with additional applications listed.

Ground Water Remediation

In Ground Water Remediation applications, SIGNET paddlewheels are used to monitor flow rates at the injection points. Here, the 2550 can be used to monitor and record the flow of the recovery wells (OEM'S, consultants, and superfund sites).

For this process, decontaminated water is applied or injected into the contaminated soil. As the water percolates through the contaminated soil down to a boundary layer, the percolation leaches out the contaminates. The 2550 Magmeter monitors and records the nearby recovery well flows which are to be decontaminated and re-used for injection. Other SIGNET applications include pH, ORP, and conductivity.

River/Lake Water Inlet for Power Plants

In river/lake water inlets for power plant applications, the 2550 is used to monitor flow/volume of cooling water taken from rivers or lakes. Typically, the sensing point is prior to the sand filters. Also, the 2550 is used for discharge monitoring back into the river or lake. Additional SIGNET applications include flow, pH, and conductivity on the R.O. systems, as well as specific process applications for flow and conductivity (OEM's, end-users, engineering firms).

Paper Mills

In paper mills, the 2550 is used for various chemical and water lines, i.e., flows to Top Sheet and Base Sheet, Final Effluent, White Water and Reject lines. All these applications should be less than 5% stock. Additional SIGNET applications would be R.O. system, waste treatment, cooling towers, and boiler make up (OEM's, end-users, and engineering firms).

Applications at a Glance

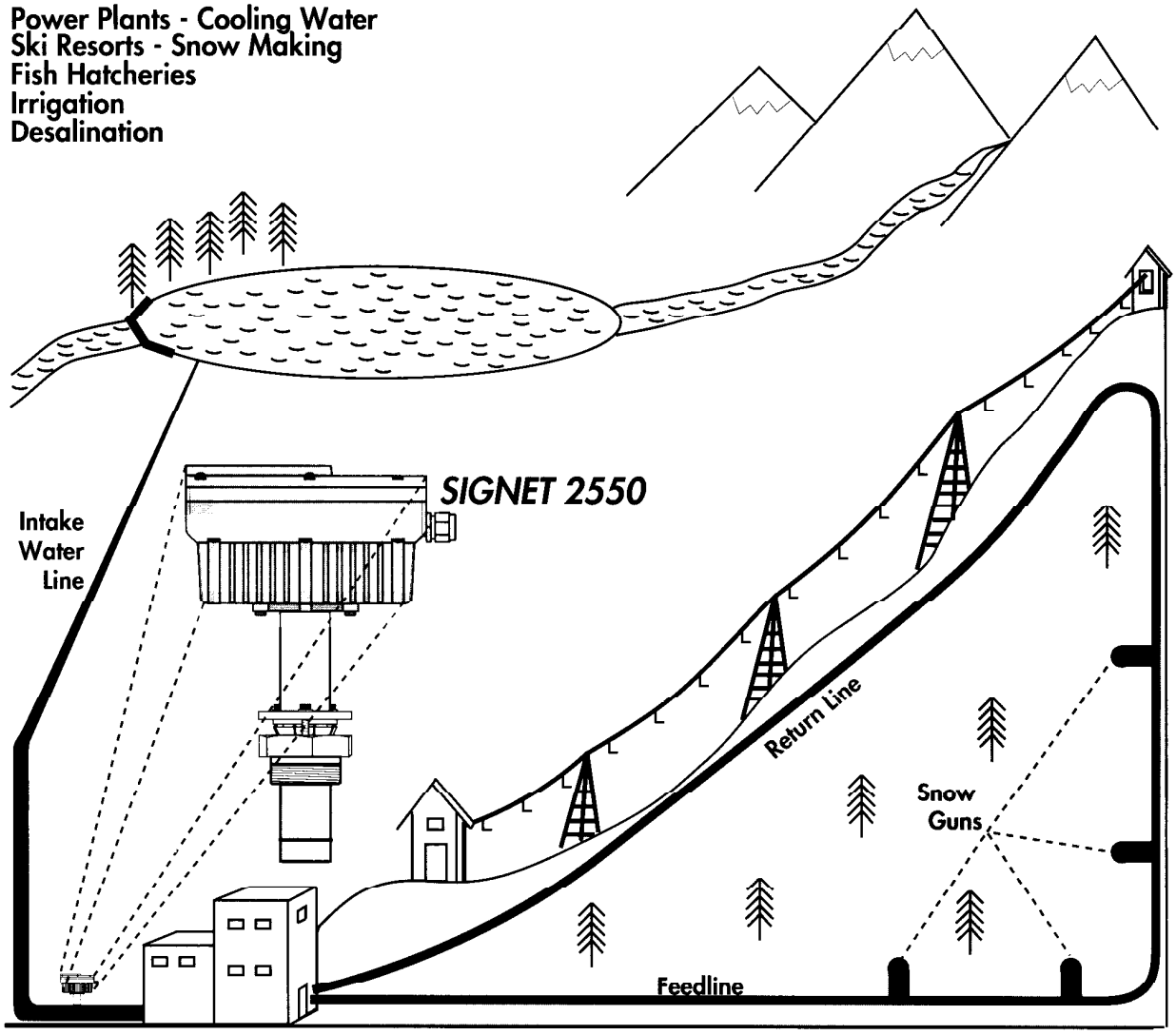
1) Ground water remediation
2) Inlet water power plants
3) Discharge monitoring power plants
4) Reject lines pulp and paper
5) Top sheet pulp and paper
6) Base sheet pulp and paper
7) White water pulp and paper
8) Chemical/water lines pulp and paper
9) Waste treatment pulp and paper
10) Inlet water snow making
11) Inlet water fish hatcheries
12) Irrigation pond water
13) Irrigation ground water
14) Landfill leachate
15) Gold mining leachate
16) Iron mining leachate
17) Copper mining leachate
18) Uranium mining leachate
19) Silver mining leachate
20) Resin regeneration
21) Separators flow municipal waste treatment
22) Cooling Tower flow
23) Pulp lines winery
24) Pulp lines fruit juices
25) ** Industrial effluent**

SIGNET 2550 Magmeter Application:

Intake Water

River Water
Lake Water

Power Plants - Cooling Water
Ski Resorts - Snow Making
Fish Hatcheries
Irrigation
Desalination

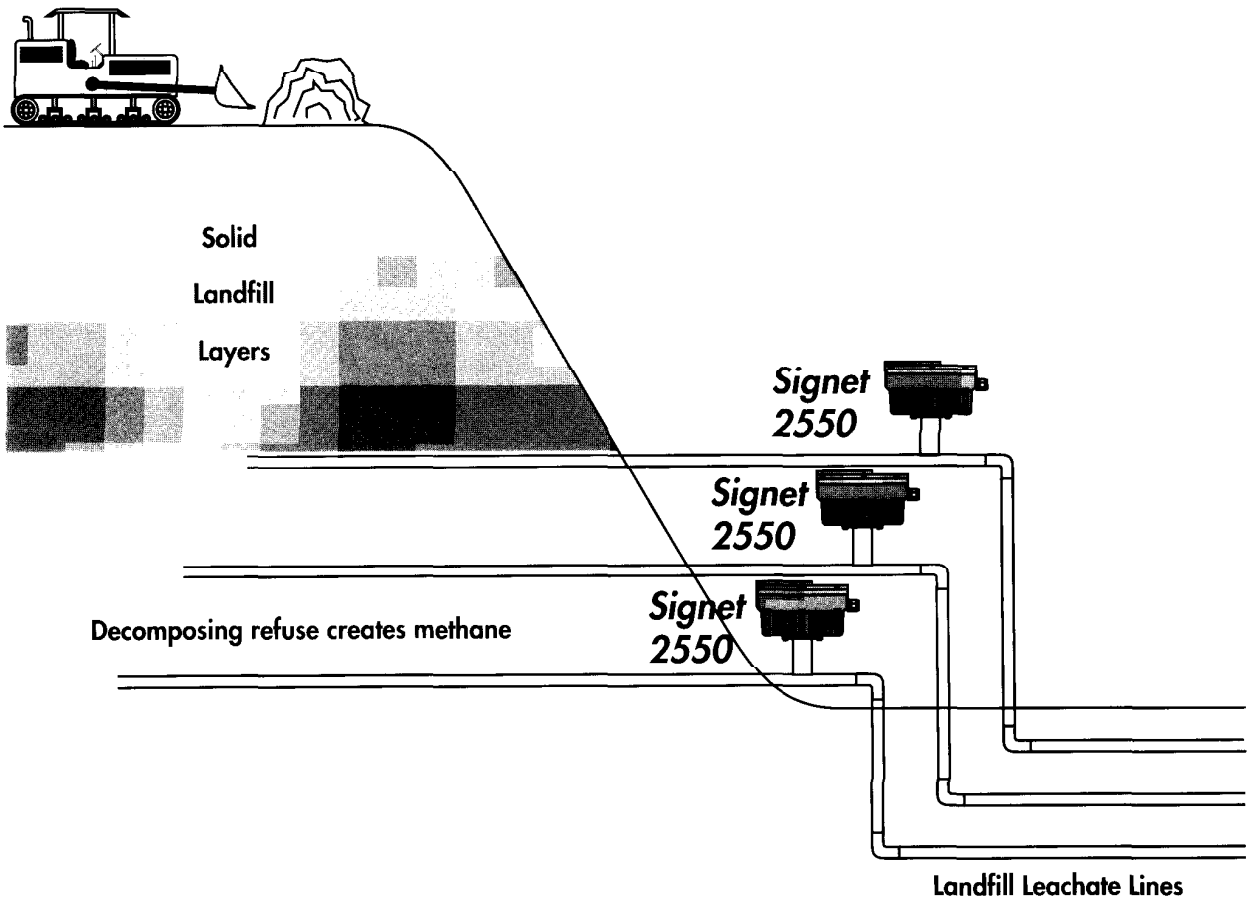


INTAKE WATER:

Often in industrial applications there is the requirement to pump water from rivers or lakes. Usually power plants whether they are steam or nuclear are located near a body of water so that they may draw in water and process it for heating and cooling. The flow rate measurement of this water is best made with a SIGNET 2550 Magmeter. In addition ski resorts that manufacture their own snow pump raw water, in which flow velocities are critical for the process of atomizing the water into snow. Desalination plants also require Magmeters for flow measurement.

SIGNET 2550 Magmeter Application:

Waste to Energy

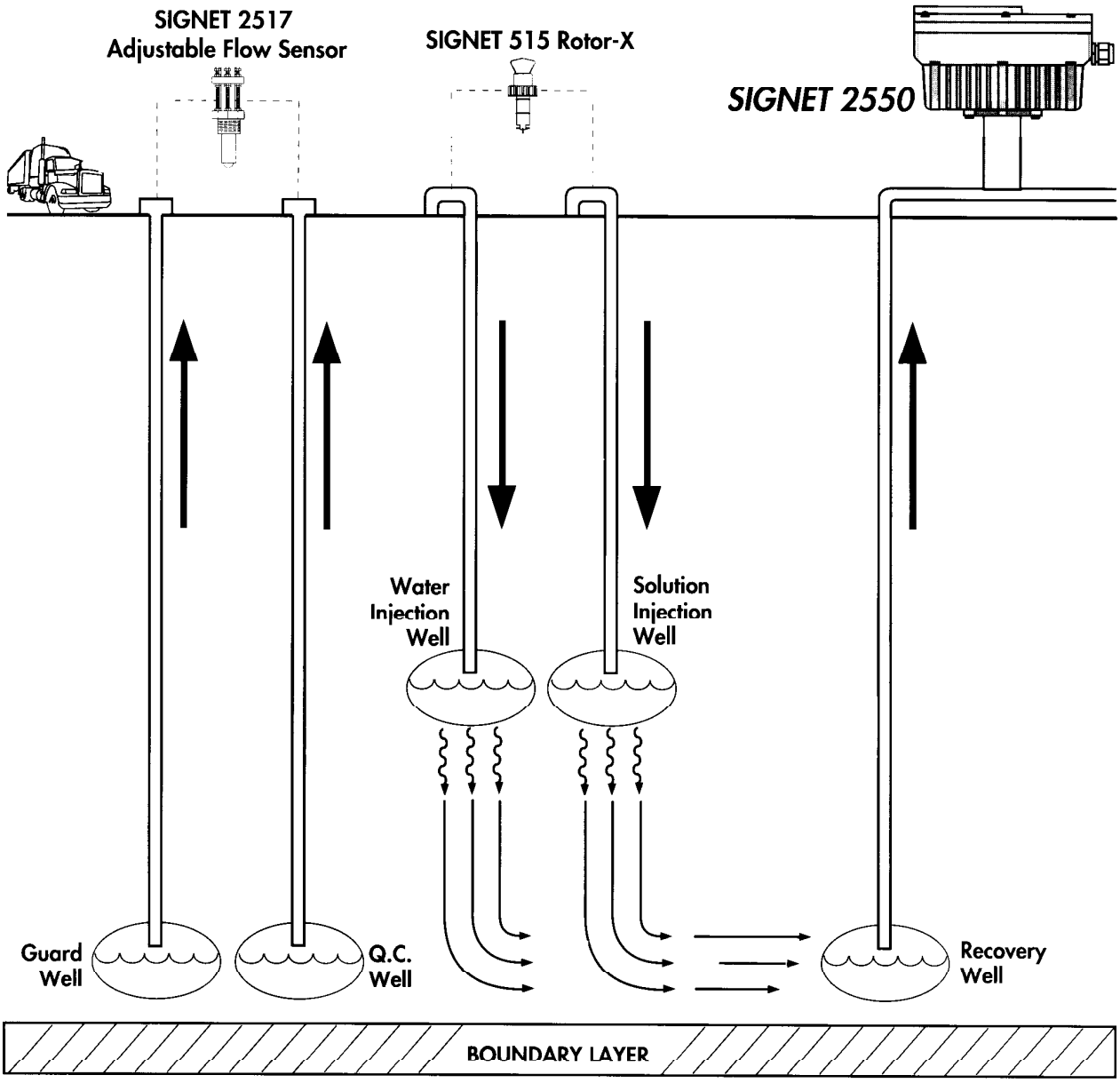


WASTE TO ENERGY:

Waste to Energy is becoming a popular way to process/dispose the Methane that is naturally produced in landfills as garbage decomposes. Landfill methane leachate is captured and pumped into a processing facility where it is used to fire steam generators, thus producing electricity. The SIGNET 2550 Magmeter is well suited for the leachate line. Several opportunities for Signet exist within the power plant.

SIGNET 2550 Magmeter Application:

"Tight Formation" Uranium, Copper, Silver Mining

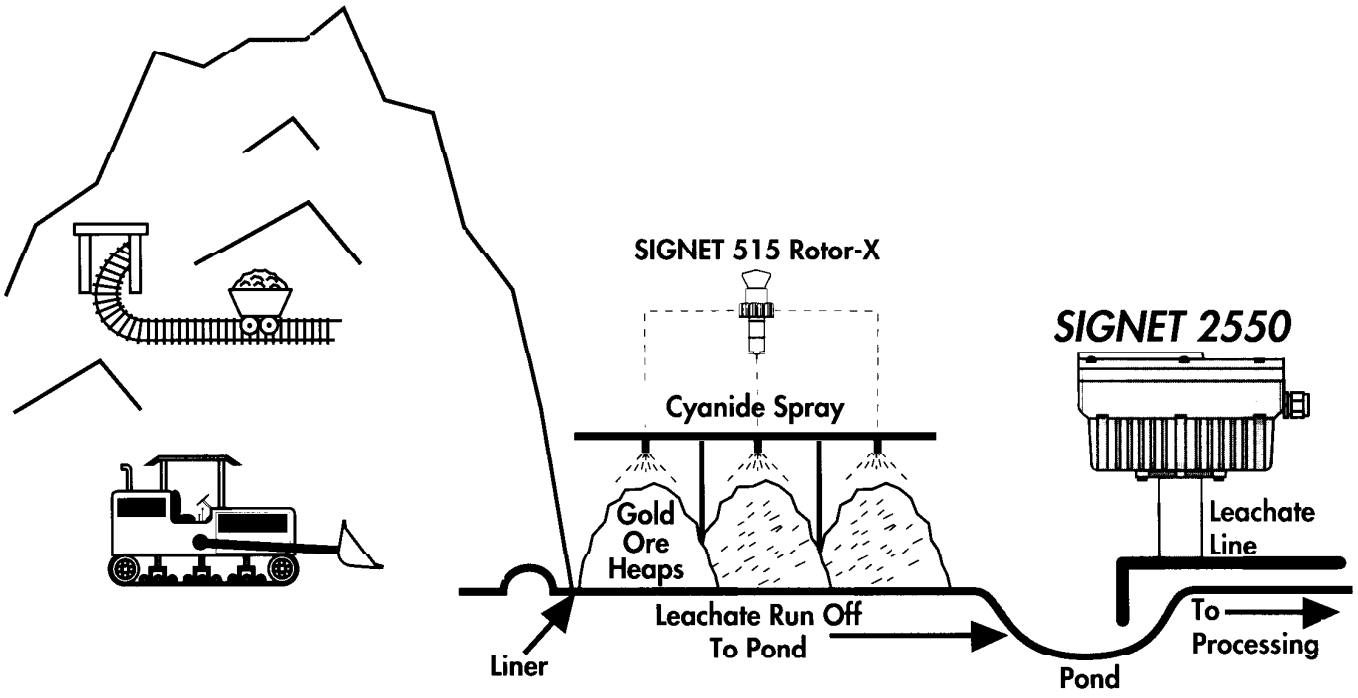


TIGHT FORMATION MINING:

In Uranium, Copper, and Silver mining process the environmental impact is minimized. Instead of digging many tunnels or large quarries, a number of wells are drilled. Water and chemicals are injected into the ground and the precious metals are leached out. A recovery well is situated down stream where the leachate is captured and pumped up to the surface for processing. The recovery line is an ideal location for the SIGNET 2550 Magmeter.

SIGNET 2550 Magmeter Application:

Gold Mining "Heap Leach"

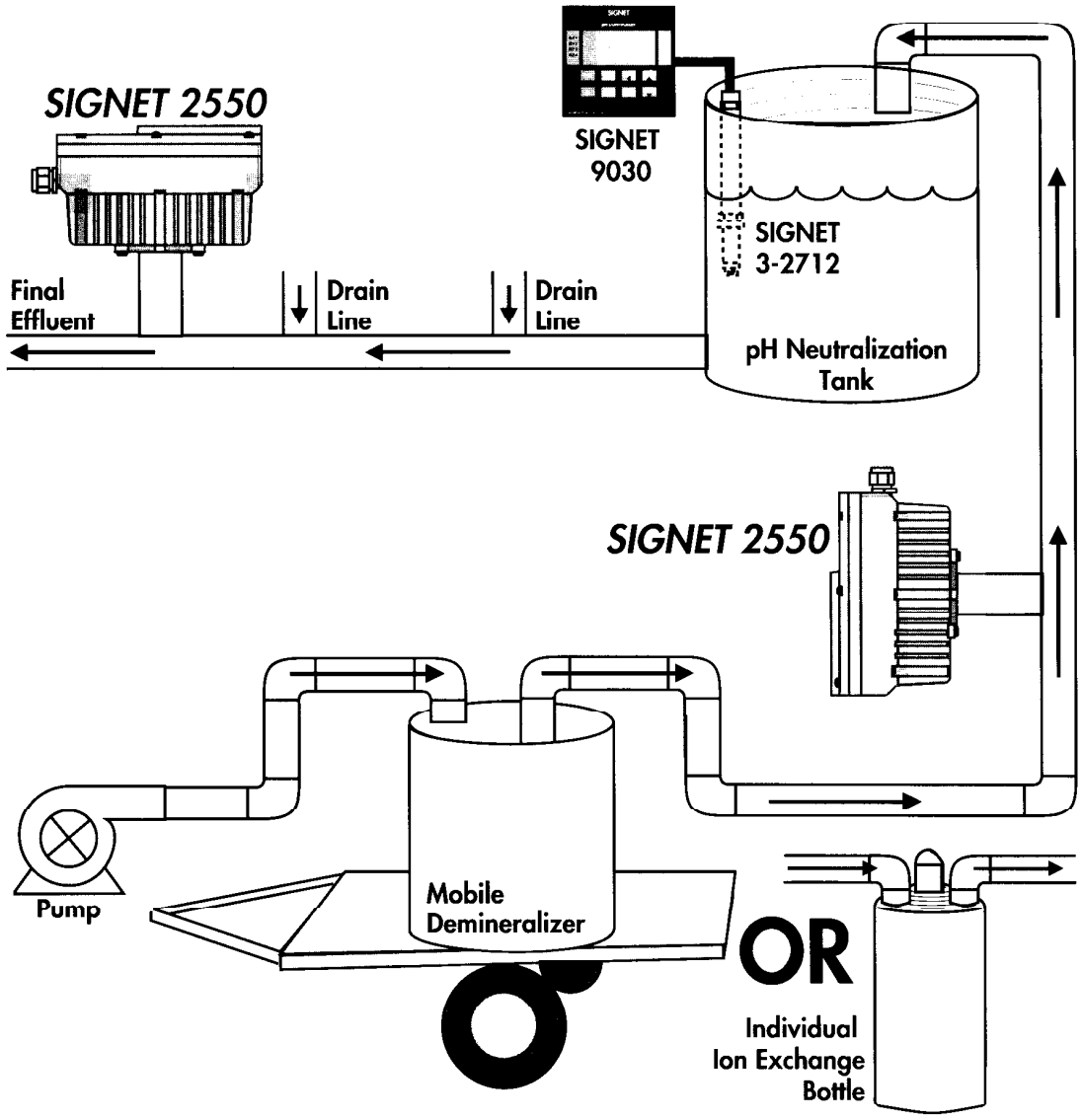


HEAP LEACH GOLD MINING:

Production mining and processing of gold usually involves "Heap Leaching". Basically gold ore is piled in "Heaps" and a cyanide solution is applied to the "Heap". As the gold leaches out it is gathered on a liner that runs off to a catch pond where the leachate is then pumped away for processing. The leachate line is an ideal location for the SIGNET 2550 Magmeter.

SIGNET 2550 Magmeter Application:

Resin Regeneration



RESIN REGENERATION:

Many OEM's in the Ultrapure industry have mobile demineralizers and/or ion exchange bottles. Demineralizers and ion exchange bottles are periodically backwashed for regeneration purposes. The water from the backwash cycle contains broken resin beads and sometimes whole resin beads. These beads are abrasive and can clog moving parts. There are two points of flow measurement required that are well suited for the SIGNET 2550 Magmeter. The backwash flow rate, this is used to monitor the performance of the backwash cycle. The second is the final effluent to the sewer after the pH Neutralization System.

SIGNET 2550 Insertion Magmeter Specification

1.0 SIGNET 2550 Insertion Magmeter: A mag flow sensor provided in compliance with this specification shall measure the volumetric liquid flow rate in a full pipe and produce a temperature compensated electric signal proportional to the flow. The magnetic field generated shall be bipolar DC. The flow sensor shall be of the insertion type. The sensing element shall be an electromagnetic device with an input signal impedance >10,000 meg ohms.

The flow sensor shall respond to flow velocities between 0.3 and 20 feet per second. Integral to the sensor shall be a NEMA 4 enclosure containing the microprocessor based electronics and digital display requiring 24 Vdc. The electronics shall be fully menu driven (no potentiometers) and output two isolated signals, a field spanned 0 or 4-20 mA, and an open collector pulse.

Every SIGNET 2550 Insertion Magmeter is wet tested and certified on an N.I.S.T. traceable flow loop.

Automatic field calibration based on pipe dimensions or volumetric calibration for special applications.

The flow sensor shall be constructed of materials in contact with the liquid consisting of 316, 303, 302 stainless steel, and PFA Teflon ®. Where elastomeric seals are used, Fluorocarbon (Viton) shall be used.

The flow sensor shall be of an adjustable type, requiring a 2" NPT female pipe fitting (threadolet, saddle, etc), allowing installation in pipes sizes 2" and up. The flow sensor shall have a maximum pressure rating of 250 PSIG and a maximum temperature of 212°F. The integral electronics shall have a temperature range of -4 to 176°F.

Each 3-2550 flow sensor supplied in compliance with this specification shall be tested and a N.I.S.T. traceable certificate shall be provided with each sensor. The test certificate shall verify the linearity and functional operation of the sensor for flow velocities between 0.3 and 20 feet per second.

2550 MAGMETER APPLICATION ASSISTANCE FORM

NAME: _____ TITLE: _____ DATE: _____

COMPANY: _____

ADDRESS: _____

CITY: _____ STATE: _____ ZIP: _____

TELEPHONE:( ) - _____ EXT. _____ FAX:( ) - _____

NAME OF PROJECT: _____

PRIORITY: IMMEDIATE: _____ FUTURE: _____ ROUTINE: _____

DESCRIPTION OF APPLICATION (including piping description 50 diameters upstream/ 5 dia down stream of sensor): _____

PIPING MATERIAL: _____ SIZE: _____ SCHEDULE: _____

FLUID TEMP. RANGE: MIN: _____ MAX: _____ NOMINAL: _____

LINE PRESS. RANGE: MIN: _____ MAX: _____ NOMINAL: _____

FLUID TO BE MEASURED: _____ CONCENTRATION: _____ %

FLUID VISCOSITY: _____ SPECIFIC GRAVITY: _____

PERCENT SOLIDS: _____ SIZE OF SOLIDS: _____

DESCRIPTION OF SOLIDS: _____

FLOW RATE: MIN: _____ MAX: _____ NOMINAL: _____

REQUIRED ACCURACY: _____ UNIT OF MEASUREMENT: _____

DISTANCE FROM SENSOR TO INSTRUMENT: _____

AVAILABLE PWR: 110 VAC: _____ 220 VAC: _____ 24 VDC: _____ NONE: _____

SPECIFIC FLOW INSTRUMENTATION NEEDS: (Check appropriate spaces)

FLOW RATE: _____ ANALOG: _____ DIGITAL: _____

ACCUMULATOR: _____ ONE ALARM: _____ TWO ALARM: _____

ISO 4-20 mA: _____ NON-ISO 4-20 mA: _____ 0-5 VDC: _____

TTL PULSE: _____ BATCH CONTROL: _____ PUMP PULSER: _____

OTHER FEATURES: _____

ADDITIONAL NOTES: _____