



Technical Bulletin  
***VersaLine*** VL4513 Series  
***Submersible Level Transmitter***

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*This Technical Bulletin is designed to provide some in-depth background to the design features and applications for the PMC VersaLine VL4513 Series Submersible Level Transmitter*

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# VL4513 Technical Bulletin

*The VL4513 Series is a "State-of-the-Art" Submersible Level Transmitter that combines innovative sensing technology with proven manufacturing techniques. The current design is based on more than 30 years experience in providing reliable submersible pressure transmitters for water related applications. On the following pages we feature some of the product highlights that should make these transmitters the product of choice.*

*The product has an anticipated reliability (MTBF) of more than 12 years and an all titanium welded construction is supported by a 5-year Corrosion Warranty.*

**Breather** connected directly to sensor reference to ensure ideal performance

**Fully-Potted** to provide secondary level of protection against water ingress

**Solid State Electronics** providing 4-20 mA, 2-wire

**Laser-Welded Titanium** housing with 5-year Corrosion Warranty

**Anti-Shock Nose Cone** to avoid damage from water hammer



**Custom Vented Cable** with Kevlar® strain retention

**Injection-Molded Cable Seal** eliminates water ingress

**0.725 inch (18.5 mm) diameter** for installation into small diameter bore holes

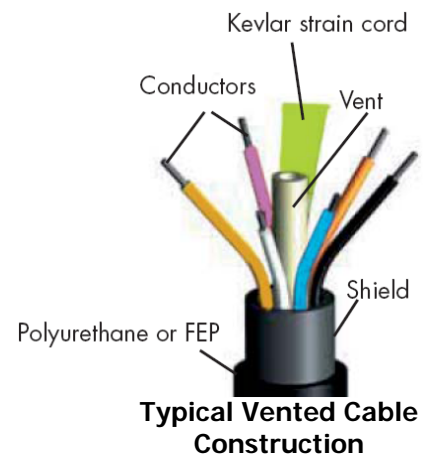
**Piezoresistive Technology** provides High Accuracy and good Long Term Stability

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## Custom Vented Cable with Kevlar® strain retention

The rugged polyurethane sheathed cable supplied as standard with the PMC VL4500 Series is custom designed to provide maximum longevity and reliability for the wide variety of installations anticipated. A thick outer sheathing of either polyurethane or FEP encloses four electrical conductors, a shield which is connected to the case of the transmitter to avoid ground loops, and a nylon vent which is positioned in the center of the cable to avoid crimping. The cable can be coiled around a minimum of 2 inch diameter in places where space is limited. PMC can supply up to 5000 feet in a single length and the embedded Kevlar strain relief is capable of supporting up to 200 lbs without elongation. On shipment the termination end of the cable is protected to avoid ingress of moisture in the shipping and storage process.



## Breather (vent) connected directly to sensor reference to ensure ideal performance

The breather or vent tube is designed to compensate for barometric pressure changes. This tube is connected directly to the reference side of the sensing diaphragm thus avoiding any chambers or air pockets in which moisture can collect. As part of the manufacturing process the vent tube is purged with clean nitrogen thus insuring at the time of shipment no moisture exists in the tube. The open end is protected for shipment and recommendations are provided to insure the appropriate installations are adhered to for long term reliability and zero maintenance.

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## **Injection-Molded Cable Seal** eliminates water ingress

PMC adopts a well-proven mining technique of molding the polyurethane cable to the transmitter body with an injection process. The design effectively creates a polyurethane to polyurethane “weld” to the cable and a compressive seal to the transmitter body. This process incorporates just the one material thus avoiding a wide range of different materials often associated with other sealing methods. With the Kevlar strain component attached to the transmitter, there is no strain on the cable connection to introduce movement and possible failures over time. This is a proven and extremely reliable cable attachment process and is successfully installed in hundreds of thousands of assemblies worldwide.



## **Fully-Potted** to provide secondary level of protection against water ingress

The entire internal assembly of the VL4500 Series is potted with a carefully selected material to remove all voids and air pockets which might have the possibility of harboring moisture which could eventually cause the transmitter to fail. This is a particularly demanding requirement for submersible transmitters and is by far the most common cause of failure. With this design and the isolation of the breather tube, the PMC transmitter will continue to work even if the cable sheath is damaged to the point of allowing moisture ingress. This design is a highly developed process based on more than 30 years experience with these products

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## **Laser-Welded Titanium housing with 5-year Corrosion Warranty**

For the ultimate in long term reliability and the avoidance of corrosion, PMC prefers to provide a Titanium housing. Titanium is entirely impervious to corrosion from brackish or sea water which is often found in inland waterways or aquifers which are close to the ocean. The PMC construction involves all metal parts constructed from titanium and welded using the latest laser techniques. To support this PMC offers a 5-year corrosion warranty. On Page 10 of this bulletin we have provided a compatibility/comparison chart for the materials generally used in the transmitter construction.



## **0.725 inch (18.5 mm) diameter for installation into small diameter bore holes**

The VL4513 is designed to pass through a 0.75 inch/19 mm diameter hole at the wellhead. This design is ultimately intended to be installed in wells of 1.0 inch/25 mm diameter or other applications where space is of a premium. PMC manufactures other submersible transmitters of a similar design but in diameters of 1.0 inch/25 mm, 0.69 inch/17.5 mm, and 0.39 inch/10 mm.

## **Anti-Shock Nose Cone to avoid damage from water hammer**

It is a little known fact that submersible transmitters are susceptible to damage from water hammer when installed close to pumps and valves, etc. The VL4500 series incorporates a specially designed nose cone to absorb pressure spikes from water hammer thus avoiding such damage.



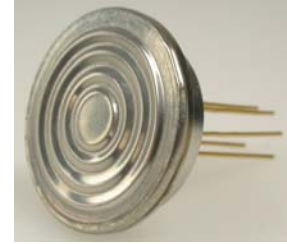
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## **Piezoresistive Technology**

provides High Accuracy  
and good Long Term Stability

The pressure sensing technology incorporated is a highly developed version of a strain gauge silicon sensor commonly known as piezoresistive. The sensor is totally isolated from the surrounding metal components and housed within an oil fill which is used to transfer the pressure/level from the titanium isolating diaphragm. The resultant pressure sensor



(pictured right) provides extremely high accuracy (0.1% standard, 0.05% achievable) and very good long term stability. This is sometimes referred to as drift and quoted at 0.1% per year in a water related application. In reality, because the drift will reduce with age, the PMC product is unlikely to drift more than 0.5% from the original calibration, even in the long term. Because most applications are seeking reliability over accuracy, the long term performance of a PMC transmitter can generally be considered to require no recalibration over its life. The PMC piezoresistive technology provides a 400% proof pressure (the pressure up to which no damage or calibration shift will occur) for ranges up to 150 psi. Transmitters are supplied for a fixed range which can be from 0-30 inches WC to 0-300 psi.

## **Solid State Electronics**

providing 4-20 mA, 2-wire

The VL4500 Series incorporates a conventional 4-20 mA, 2-wire electrical protocol. However, in recognition of many installations being remote requiring battery or solar power, the custom design circuitry is capable of being pulse-powered preferably for a period of 1ms. Thus the power consumption becomes very small and supportive of long term use.



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## **Cable termination practices for submersible pressure/level transmitters -**

### **Background:**

A properly constructed submersible transmitter is a highly reliable product, which will last many years in service, perhaps even a decade or more. Correct installation is key to long term survival, however, and the number one cause of premature failure is improper installation.

### **Vented Cable:**

Most submersible transmitters rely on a vented cable to properly “reference” the sensor to atmospheric pressure. The vent ensures that the transmitter measures only the pressure caused by the head of fluid, and not changes in atmospheric pressures caused by weather or by installations at differing elevations.

While a vented transmitter offers considerably better accuracy than sealed types of sensors, care must be taken to properly terminate the vented cable. Moisture entering the cable through the vent tube, and in some cases moisture wicking into the cable between the conductors, can severely affect reliability and service life.

### **Terminating the cable:**

Whenever possible, the process of trimming and terminating the cable should be done under dry conditions. When cable termination must be done under rainy or wet conditions, care should be taken to keep the end of the cable sealed and dry until it is placed in a protective enclosure such as a **TE-10** Dri-Box.

(Continued)

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## **Cable termination practices for submersible pressure/level transmitters - contd.**

### **Moisture damage protection:**

Moisture (including humidity) is prevented from entering the vent tube by one of two methods. The most common method involves the use of a desiccant, either in the form of an in-line cartridge (**MP-10**) or a desiccant pack built into an enclosure (TE-10). The second method uses a sealed reference volume (**MP-11**) which comes pre-filled with dry nitrogen. The sealed volume approach means that no outside air enters the vent system, making this approach maintenance free.

The TE-10 enclosure has the added advantage of protecting both the vent tube and the exposed end of the cable. This means that, provided the desiccant packs are replaced periodically, no appreciable moisture will ever enter through the vent tube or around the conductors.

### **Sealing the cable:**

If the MP-10 or MP-11 approaches are used, the exposed end of the cable must be sealed with silicone RTV or a similar sealant, and protected from weather to the greatest extent practical.

The most reliable installation results when the MP-11 is used in conjunction with TE-10 or similar enclosure. In this configuration the MP-11 provides a dry, maintenance-free termination for the vent tube, and the TE-10 provides a moisture proof enclosure that protects the stripped end of the cable.

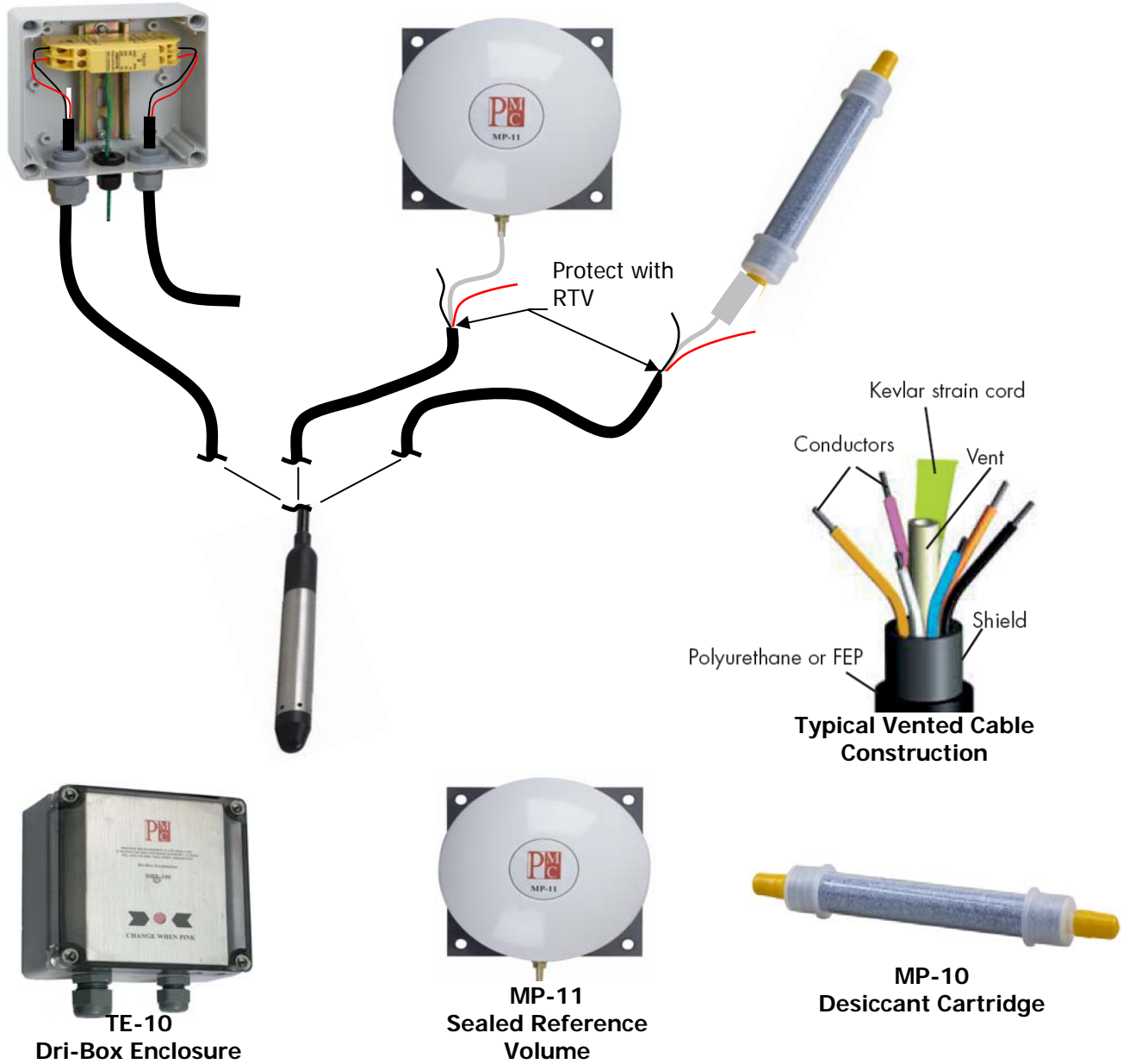
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## Cable termination practices for submersible pressure/level transmitters - contd.

The diagrams below illustrate the recommended sealing methods:





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## TECHNICAL BULLETIN

### Technical Note for PMC VersaLine Submersible Transmitters

#### Material Compatibility Guidelines

#### COMMON CORROSIVE COMPOUNDS

	CARBON STEEL	316 SS	TITANIUM	NEOPRENE	POLY URETHANE	TEFLON
ACETIC ACID, AIR FREE	C	A	A	C	C	A
ALUMINUM SULFATE	A	C	A	A	?	A
AMMONIUM NITRATE	A	A	A	A	A	A
AMMONIUM PHOSPHATE	D	A	A	A	A	A
AMMONIUM SULFATE	C	B	A	A	A	A
BENZOIC ACID	C	A	A	D	?	A
CALCIUM CHLORIDE (ALKALINE)	?	D	A	A	A	A
CALCIUM HYPOCHLORITE	?	C	A	D	?	A
CARBON DIOXIDE, WET	C	A	A			A
CARBON TETRACHLORIDE	D	B	A	D	D	A
CARBONIC ACID	C	B	A	A	?	A
CHLORINE GAS, WET	D	D	A	D	D	A
CHROMIC ACID	D	B	A	D		A
COPPER SULFATE	C	B	A	A	A	A
FERRIC CHLORIDE	D	D	A	B	B	A
HYDROGEN SULFIDE, LIQUID	C	A	A	B	D	A
NITRIC ACID	C	A	A	B	D	A
SODIUM CHLORIDE	D	C	A	A	A	A
SODIUM HYPOCHLORIDE	D	D	A	A	A	A
SODIUM THIOSULFATE	B	A	A	A	A	A
SULFURIC ACID	D	D	B	B	B	A
SULFUROUS ACID	D	B	A	B	B	A
VINEGAR	C	A	A	B	B	A
SEAWATER	D	C	A	B	A	A
ZINC CHLORIDE	D	B	A	A	A	A
ZINC SULFATE	C	A	A	A	A	A

A – NO EFFECT    B – MINOR EFFECT    C – MODERATE EFFECT    D – SEVERE EFFECT



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## **ACCESSORIES**

PMC offers a selection of accessories and options to enhance the use of the VL4513 Submersible Level Transmitter. These options are designed to aid in the installation of the transmitter and ensure the best reliability is achieved. PMC has more than 20 years experience with the applications of submersible pressure transmitters in both waste water and ground water in deep wells and surface water. Accessories such as the Termination Enclosure, Surge Protection, Cable Hanger, Sink Weights and various moisture protection features have proved invaluable to the long term liability for these transmitters. For more details please refer to data sheet VLA 702.

## **SUMMARY**

The performance specification of the VL4513 is included in data sheet VL4500 008. This Technical Bulletin attempts to provide details of the highly developed features which combine to achieve one of the most reliable and high performance submersible level transmitters available.

In referencing the accuracy capabilities on Page 6 and the zero maintenance achieved by using appropriate vent protection installation methods (Page 8), the VL4513 is capable of providing in excess of 10 years maintenance free operation.

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