

xylem

USER GUIDE

WUG-10015-03

iPERL+

WATER MANAGEMENT SYSTEM


SENSUS
a xylem brand

Revision history

Revision Number	Date	Description
01	20-MAY-24	Initial version
02	03-JUN-24	Update low flow range.
03	16-AUG-24	Added Normal Test Flow Limits per UL 327b

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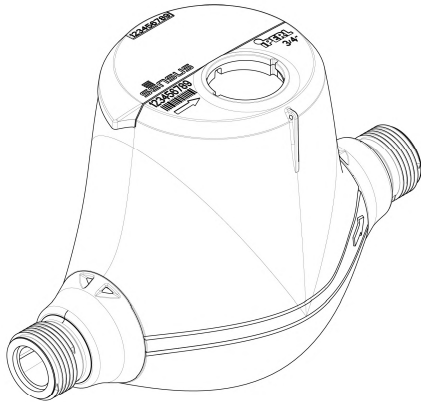
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1 Introducing iPERL+

iPERL® is an innovative residential water management system with unparalleled low flow accuracy, high flow durability, and minimal wear and maintenance needs.

Sensus iPERL+ smart water meters are designed to capture both lost water and lost revenue. The innovative magnetic technology delivers unmatched low flow registration and minimal pressure loss. With no moving parts, iPERL+ maintains its accuracy over a 20-year lifetime and is equipped with smart water alarms to deliver the intelligence you need to quickly resolve issues in the field.



Industry Leading Performance

The patented measurement technology of the iPERL+ water meter provides continuous and enhanced accuracy ranges at both low and high flows and perpetual accuracy over the life of the product. The iPERL+ meter has a 20-year accuracy warranty and a 20-year battery life guarantee. Over this 20-year lifespan, your iPERL+ will measure just as accurately as the day it was installed.

Solid State Electromagnetic Technology

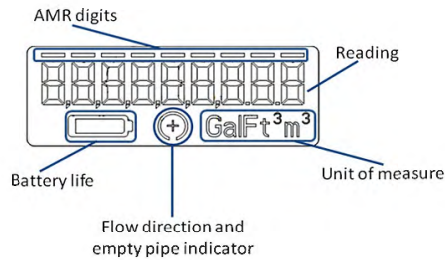
By avoiding the use of a mechanical measuring element inside the flow tube, metering performance is linear over the entire flow range and ensures no reduction in accuracy at any flow rate over the life of the meter. The iPERL meter uses our patented remanent magnetic field technology and requires far less energy to deliver superior accuracy.

Construction

The iPERL+ meter body is available in two versions. The first version has a flow tube that is comprised entirely of composite polymer. The second version is comprised of lead-free bronze alloy with a composite polymer core. Both versions use the same thermal polymer shell with the same electronic register inside.

Electronic Register

The 9-digit hermetically-sealed electronic register with LCD display was designed to eliminate dirt, water, and moisture contamination in pit settings. The large, easy-to-read display includes AMI/AMR digits, direction of flow, units of measure, and empty pipe detection. The AMI/AMR digits and units of measure are fully programmable. The register also provides user configurable data logging.



Tamperproof

The integrated construction of the iPERL+ water meter prevents removal of the register to obtain free water. The magnetic tamper and low field alarms will both indicate any attempt to tamper with the magnetic field of the iPERL+ meter. The meter communication alarm indicates a possible cut cable.

Features

iPERL+ contains the following features and functionality.

Security method

The security system ensures that only authorized people are allowed to modify system settings.

Data logging

Data logging is defined as volume used and maximum flow rate per unit of time. Unit of time is programmable with a default of one hour intervals. Usage data can be extracted from the system using field software and hardware.

Resettable reading

The system reading may be reset through the bi-directional TouchRead® connection.

Reading recovery

The system reading is stored on an hourly basis for recovery purposes.

Reboot

If the system reboots for any reason, iPERL+ saves all parameters to their latest settings.

Reprogram

iPERL+ logs up to five programming sessions.

Dead Battery

If the system loses power for any reason, the system may be powered through the TouchCoupler to retrieve the last reading.

Memory and self monitoring alarms

iPERL+ self-monitoring alarms detect and report any memory failures.

Continuous Flow

Detect continual consumption of water over a period of time to indicate downstream leaks. This protects your utility, infrastructure and customers through alarm notifications that can reduce water loss and leak adjustment costs.

Empty Pipe

Detects the absence of water in the flow tube and sends an alert. Allows you to identify main breaks downstream and water shortages for quicker resolution to

ensure water availability. This alarm can also indicate the water meter has been removed from service, or notify you of potential tamper.

High Flow

Detect broken pipes and reduce property damage through an alert triggered by the detection of excessive flow rates.

Low Battery

Replace your meters before they stop recording consumption through alerts indicating battery capacity to the meter or valve is running low.

Reverse Flow

Keep untreated water from re-entering your distribution system and deter tampering attempts through an alarm triggered when reverse flow is detected at the meter.

Tampering Detect magnetic interference to reduce apparent water losses and protect against unauthorized activities.

Alarm persistence

Alarm persistence is the number of additional days an alarm notification will continue being reported after the condition is no longer active.

This is most important if you have an AMR system. If you only get data from your meters periodically, such as on a 30, 60, or 90 day reading cycle, then you may miss some alarms that happen between your reading days. If your persistence period is set for 35 days, then the meter will inform you about the alarm condition for another 35 days after the alarm goes away. This enables you to get the most data out of your meter so you can catch all of the alarms.

The persistence period sets how long the alarm will continue to display after the alarm is no longer active. The recommended setting for your persistence period is for 5 days past your reading schedule. For example, if you read on a 60-day cycle, a good persistence period is 65 days. That will make sure that you see all alarms that have happened since you last read a route.

For AMI systems, the persistence period acts as extra backup to make sure you always get your alarm data. The recommended AMI setting for the persistence period is 8 days.

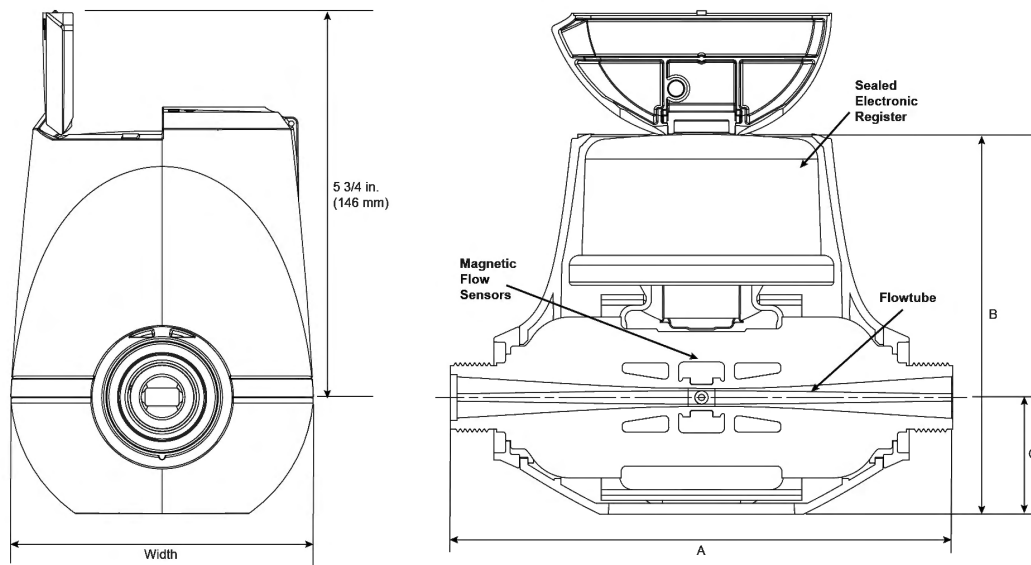
Security

The security system ensures that only qualified personnel may modify SmartPoint module settings.

You may use field software and hardware to communicate with SmartPoint module if the Fixed Base system cannot communicate with the base station. In this case, you must go into the field to troubleshoot an encrypted SmartPoint module.

Specifications

iPERL+ is precisely engineered to meet the following physical specifications.



iPERL side views

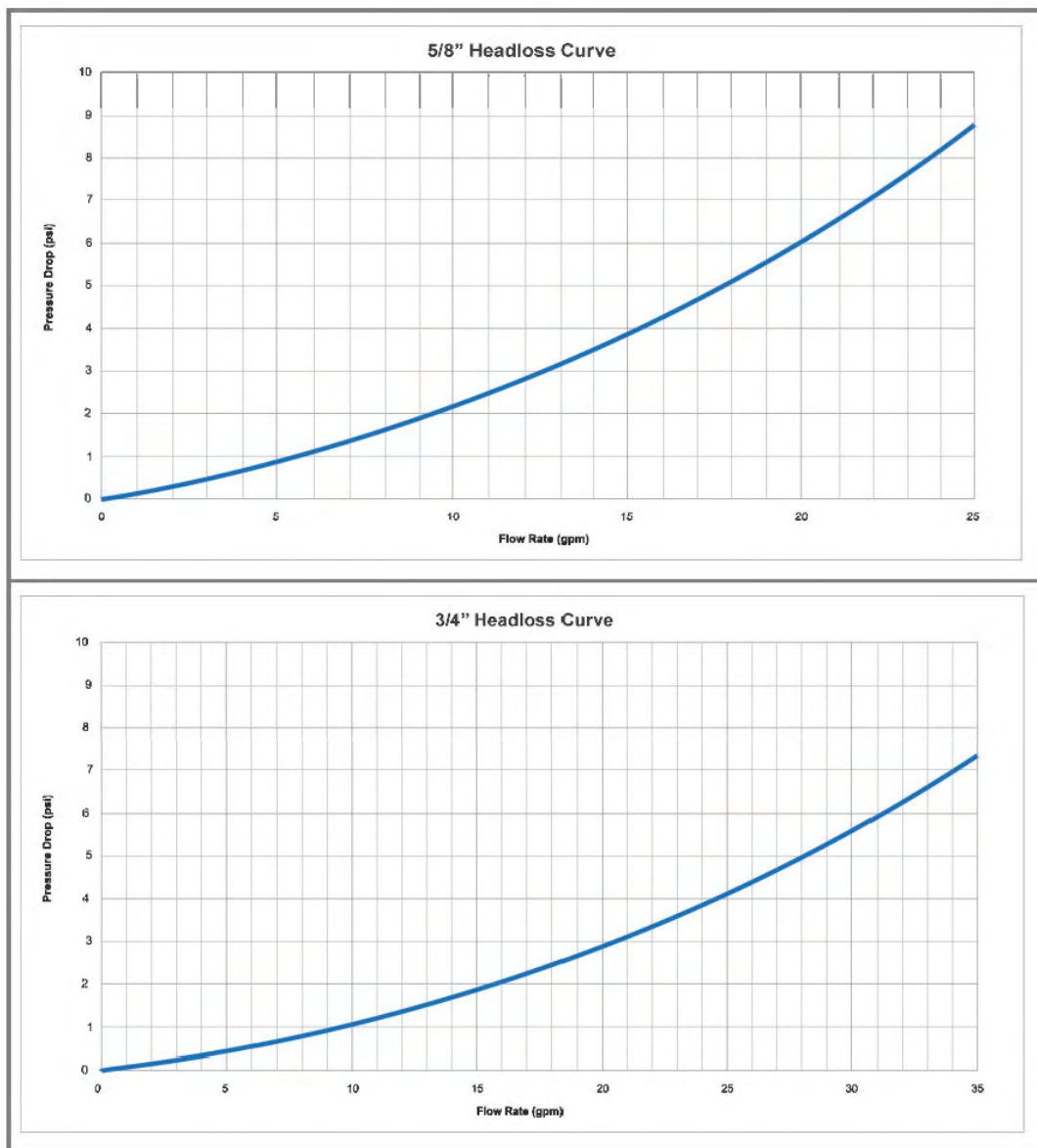
Dimensions and net weights

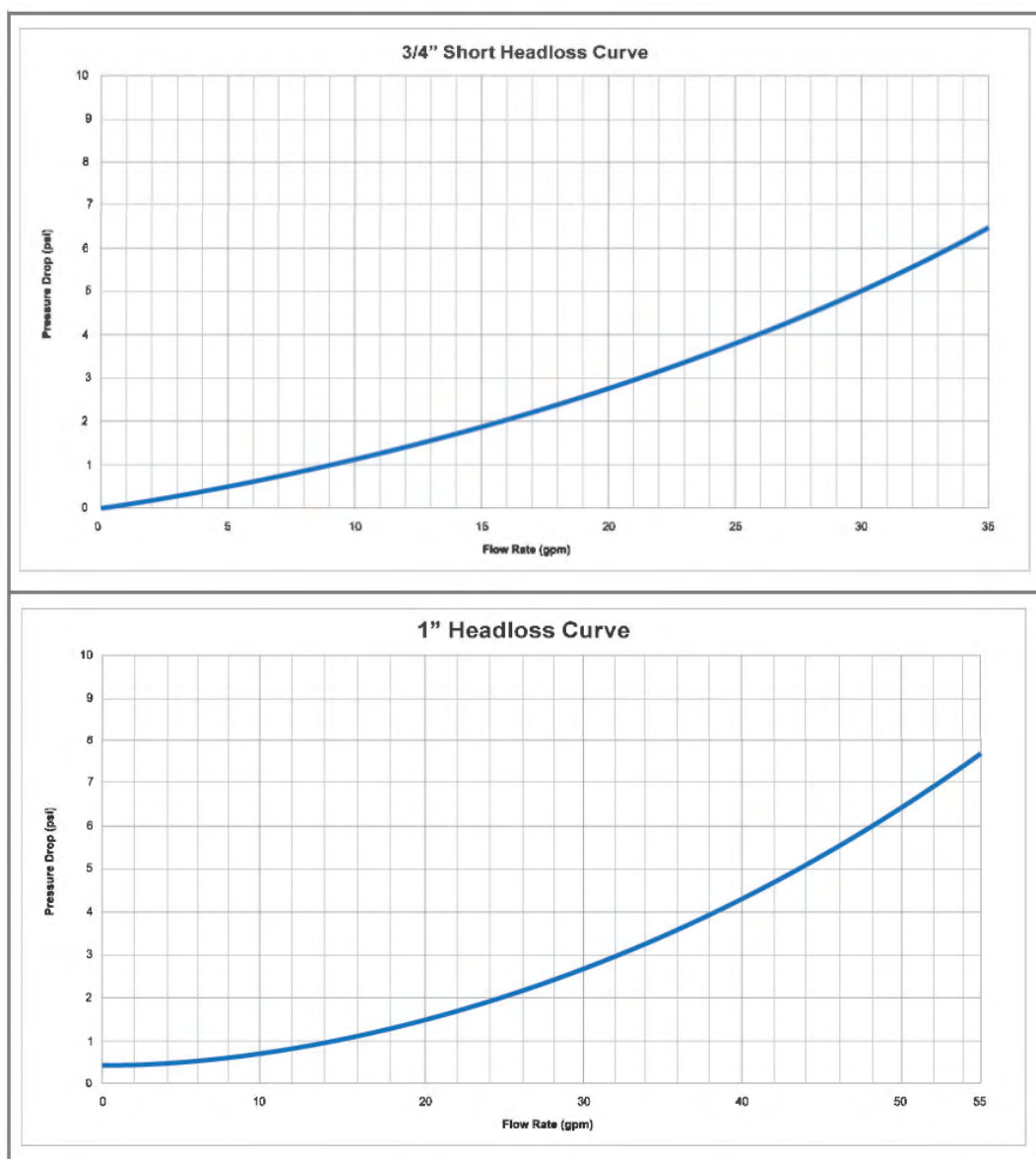
Size	A (lay length)	B (height)	C	Spud Ends	NPSM Thread Size	Width	Polymer Net Weight	Metal Net Weight
5/8" (DN 15 mm)	7-1/2" (190 mm)	6-1/10" (155 mm)	1-3/4" (44 mm)	5/8" (15 mm)	3/4" (19 mm)	4-1/2" (114 mm)	3.1 lb (1.4 kg)	4.9 lb (2.2 kg)
5/8" x 3/4" (DN 15mm x 20mm)	7-1/2" (190 mm)	6-1/10" (155 mm)	1-3/4" (44 mm)	3/4" (20 mm)	1" (25 mm)	4-1/2" (114 mm)	3.1 lb (1.4 kg)	4.9 lb (2.2 kg)
3/4" Short (DN 20 mm)	7-1/2" (190 mm)	6-1/10" (155 mm)	1-3/4" (44 mm)	3/4" (20 mm)	1" (25 mm)	4-1/2" (114 mm)	3.1 lb (1.4 kg)	5.1 lb (2.3 kg)
3/4" (DN 20 mm)	9" (229 mm)	6-1/10" (155 mm)	1-3/4" (44 mm)	3/4" (20 mm)	1" (25 mm)	4-1/2" (114 mm)	3.2 lb (1.5 kg)	5.2 lb (2.4 kg)
1" (DN 25 mm)	10" (273 mm)	6-1/10" (155 mm)	1-3/4" (44 mm)	1" (25 mm)	1-1/4" (32 mm)	4-1/2" (114 mm)	3.3 lb (1.6 kg)	5.7 lb (2.6 kg)

Operational specifications

Service	Measurement of potable and reclaim water. 0-100% humidity. Fully submersible. IP68 rated.
Temperature	Water operating temperature range of 33 °F (0.55 °C) to 80 °F (26.7 °C) . Ambient air operating temperature -22 °F (-30 °C) to -140 °F (60 °C). Storage air temperature -30 °F (-34.4 °C) to 158 °F (70 °C).
Starting Flow	5/8" (DN 15 mm) size: 0.03 gpm (0.007 m³/h) 5/8" x 3/4" (DN 20 mm) size: 0.03 gpm (0.007 m³/h) 3/4"S (DN 20 mm) size: 0.03 gpm (0.007 m³/h) 3/4" (DN 20 mm) size: 0.03 gpm (0.007 m³/h) 1" (DN 25 mm) size: 0.11 gpm (0.025 m³/h)
Low Flow Range (+-3%)	5/8" (DN 15 mm) size: Between 0.05 gpm (0.011 m³/hr) and 0.18 gpm (0.041 m³/hr) 5/8" x 3/4" (DN 20 mm) size: Between 0.05 gpm (0.011 m³/hr) and 0.18 gpm (0.041 m³/hr) 3/4"S (DN 20 mm) size: Between 0.05 gpm (0.011 m³/hr) and 0.18 gpm (0.041 m³/hr) 3/4" (DN 20 mm) size: Between 0.05 gpm (0.011 m³/hr) and 0.18 gpm (0.041 m³/hr) 1" (DN 25 mm) size: Between 0.3 gpm (0.068 m³/hr) and 0.4 gpm (0.09 m³/hr)
Normal Water Operating Flow Range (+-1.5%)	5/8" (DN 15 mm) size: 0.18 to 25 gpm (0.04 to 5.7 m³/hr) 5/8" x 3/4" (DN 20 mm) size: 0.18 to 35 gpm (0.04 to 8.0 m³/hr) 3/4"S (DN 20 mm) size: 0.18 to 35 gpm (0.04 to 8.0 m³/hr) 3/4" (DN 20 mm) size: 0.18 to 35 gpm (0.04 to 8.0 m³/hr) 1" (DN 25 mm) size: 0.4 to 55 gpm (0.09 to 12.5 m³/hr)
Normal Test Flow Limits (per UL 327b Listing, at ±1.5% accuracy)	3/4" (DN 20 mm) size: 2 to 30 gpm (0.5 to 6.8 m³/hr) 1" (DN 25 mm) size: 2 to 50 gpm (0.5 to 11.4 m³/hr)
Maximum Operating Pressure	5/8", 5/8" x 3/4", 3/4"S and 3/4" size: 200 psi (13.8 bar) 1" size: 175 psi (12.1 bar)
Maximum Operating Pressure (per UL 327b Listing, at ±1.5% accuracy)	3/4" and 1" size: 175 psi (12.1 bar)
Measurement Technology	Solid state electromagnetic flow
Register	Hermetically sealed, 9-digit programmable electronic register, AMR/AMI compatible
Materials	External housing – Thermal polymer Flowtube – Composite polymer or a bronze alloy flowtube with a composite polymer internal core Electrode – Silver/silver chloride Register cover – Hermetically sealed glass
Alarm Defaults	Alarm Duration - 90 days; Leak Duration - 24 hours; Datalog Interval - 1 hour; Alarm Mask - All alarms reported; History Mask - All event types reported

Headloss curves





Physical specifications

		5/8" (DN15)	5/8" x 3/4" (DN20)	3/4" Short (DN20)	3/4" (DN20)	1" (DN25)
AWWA Normal Flow	GPM (m3/h)	0.11 - 25 (0.02 - 5.7)	0.11 - 35 (0.02 - 8)	0.11 - 35 (0.02 - 8)	0.11 - 35 (0.02 - 8)	0.4 - 55 (0.09 - 12.5)
AWWA Minimum Flow	GPM (m3/h)	0.03 (0.007)	0.03 (0.007)	0.03 (0.007)	0.03 (0.007)	0.11 (0.025)
AWWA Continuous Flow	GPM (m3/h)	25 (5.7)	35 (8)	35 (8)	35 (8)	55 (12.5)
Laying Length	Inches (mm)	7-1/2 (190)	9 (229)	7-1/2 (190)	9 (229)	10-3/4 (273)
Height - Base to Lid	Inches (mm)	6-1/10 (155)	6-1/10 (155)	6-1/10 (155)	6-1/10 (155)	6-1/10 (155)

		5/8" (DN15)	5/8" x 3/4" (DN20)	3/4"Short (DN20)	3/4" (DN20)	1" (DN25)
Height - Base to Center Line	Inches (mm)	1-3/4 (44)	1-3/4 (44)	1-3/4 (44)	1-3/4 (44)	1-3/4 (44)
Width	Inches (mm)	4-1/2 (114)	4-1/2 (114)	4-1/2 (114)	4-1/2 (114)	4-1/2 (114)
Pipe Threads	Inches (mm)	3/4 (19)	1 (25)	1 (25)	1 (25)	1-1/4 (32)
Polymer Net Weight	Pounds (Kilograms)	3.1 (1.4)	3.2 (1.5)	3.1 (1.4)	3.2 (1.5)	3.3 (1.6)
Metal Net Weight	Pounds (Kilograms)	4.9 (2.2)	4.9 (2.2)	5.1 (2.3)	5.2 (2.4)	5.7 (2.6)
Pressure Loss - Maximum Flow	psi at GPM (bar at m3/h)	4.0 at 15 (0.3 at 3.4)	2.0 at 15 (0.1 at 3.4)	2.0 at 15 (0.1 at 3.4)	2.0 at 15 (0.1 at 3.4)	2.0 at 25 (0.1 at 5.7)

2 Installation

When installing an iPERL+ water meter, you must install, activate, and configure the water meter to achieve full functionality.

Preparing the iPERL+ site

Before you install your iPERL+ meter, you need to prepare the site.

The iPERL+ meter is designed to be installed in either an outdoor pit or in an indoor basement.

1. Unpack the meter from the packaging and remove the spud thread protectors. Inspect the meter for any parts that may have been damaged during shipping.
2. If a new install, thoroughly flush the new water service plumbing before installing the meter.
3. Turn off the water supply valves.



CAUTION: Make sure that metallic water service plumbing is properly grounded as per local electrical codes. A ground strap or similar must be used if you believe or suspect electrical current is passing through the service pipe or if you believe or suspect that the service pipe may be used as an electrical ground.

4. If an existing install, remove the current meter out of the pit or basement.

Installing iPERL+

After the site has been prepared, you can install the iPERL+ meter.

Considerations

- The water meter should be installed on the discharge side of a pump with the flow directional arrow pointed downstream.
 - If a pump is installed on the outlet side of the water meter, a minimum of ten (10) diameters of straight pipe should be immediately downstream of the water meter to obtain valid system registration.
 - Suitable shutoff valves should be installed adjacent to the inlet and outlet of the water meter so that the service may be shutoff if it is necessary to remove the meter.
 - Clean and flush the service line thoroughly on the inlet side before installing.
 - The water lines must be coaxially aligned within three (3) degrees (0.4 inches) to ensure a proper seal.
 - It is recommended that old gaskets be completely removed and discarded and new 3/32" thick rubber gaskets be used with every installation.
1. Orient the iPERL+ meter so that the direction of the flow arrow on the meter body is aligned with the direction of the plumbing system water flow.
 2. Install the new meter connection gaskets in both meter couplings.



Important: Never use thin meter gaskets.

3. Align threads and hand-tighten the coupling nuts.



Note: Ensure water service connections are aligned and the meter has stress-free line connections to avoid damaging the meter.

4. Using a wrench, tighten an extra 1/4 to 1/2 turn on each coupling unit.



Note: Do not over tighten. You may tighten after turning on the water (if leaks are present). Additionally, do not use the opposite coupling nut for support when tightening a coupling nut. This could overstress the meter body and cause it to crack.

5. After the new meter is installed, shut off the outlet shut-off valve.
6. Open the inlet shut-off valve slowly until the meter is full of water and ensure that there are no leaks.
7. Open the outlet valve slowly until air is out of the meter and service line.
8. Open a valve downstream of the meter to ensure that no foreign debris in the water obstructs the operation of the meter.
9. It will take about 60 seconds for the iPERL+ to register flow after exiting an empty pipe condition. Check the consumption on the meter to make sure it is registering in the positive direction and not displaying an empty pipe alarm or registering negative flow. If registering negative flow, check that the meter is installed in the correct direction.
10. Connect a coupler cable or a 3-wire cable and attach to a SmartPoint module (if applicable).
11. Record meter and read information as required by the utility.

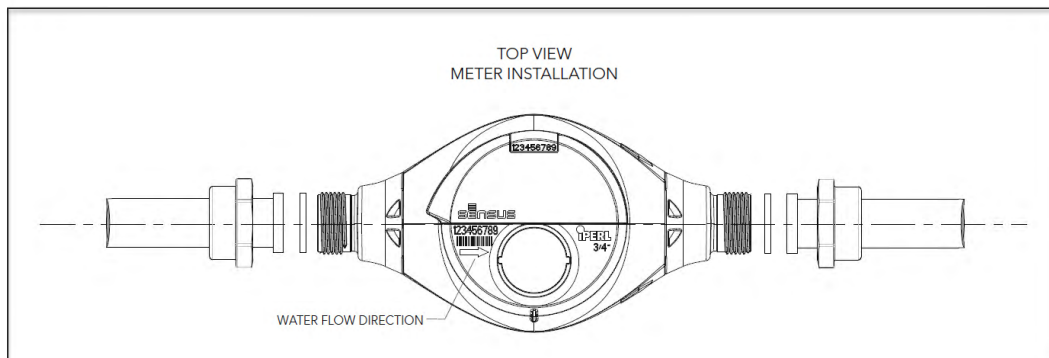


Figure 2-1: iPERL+ installation top view

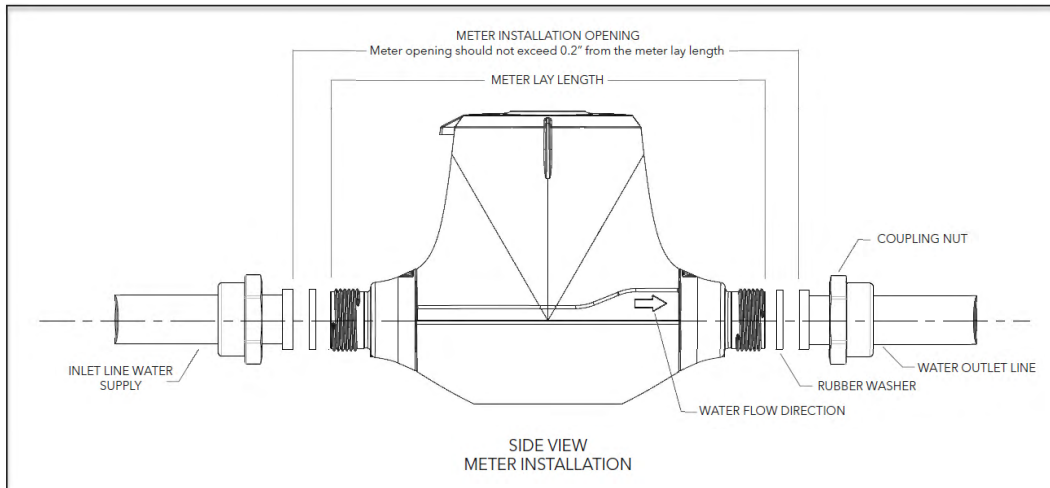


Figure 2-2: iPERL+ installation side view

Cable Assembly

Sensus Part Number	Description
SM50546439001	TR EXTENDER 6FT, PASSIVE - Y1
SM50546439002	TR EXTENDER 25 FT, PASSIVE - Y2
SM50546439003	DRY SET CONNECTOR, ACTIVE - Y3
SM50546439004	3-WIRE, 6FT, NO TRPL, ACTIVE - Y4
SM50546439005	3-WIRE, 25FT, NO TRPL, ACTIVE - Y5
SM50546439006	3-WIRE, 5FT, ITRON, ACTIVE - Y6
SM50546439007	3-WIRE, 25FT, ITRON, ACTIVE - Y7
SM50546439008	3-WIRE, 6FT, TRPL, ACTIVE - Y8
SM50546439009	3-WIRE, 25FT, TRPL, ACTIVE - Y9
SM50546439010	3-WIRE, 5FT, NICOR, ACTIVE - YA
SM50546439011	3-WIRE, 20FT, NICOR, ACTIVE - YB
SM50546439012	3-WIRE, 50FT, NICOR, ACTIVE - YC

Connect directly to an iPERL+ meter

Connect directly to the iPERL+ meter instead of through the SmartPoint module.

You will need a field device with FieldLogic Tools, a FieldLogic Communicator, and a touchcoupler cable.

1. Power on the field device.
2. Power on the FieldLogic Communicator.
3. Connect the FieldLogic Communicator to the field device.
4. Connect one end of the coupler cable to the FieldLogic Communicator.
5. Start the FieldLogic Tools application on your field device.

Configure the iPERL+ meter register directly

The iPERL+ meter register can be configured directly.

Before configuring the register, make sure that you have the appropriate up-to-date product configuration loaded on your field device and that you have successfully connected your field device and communication device to the register.

1. From the FieldLogic Tools Device Summary page, select **Configure**.
2. The register configuration process begins.

After successful configuration, a confirmation screen displays.

3. Select **OK** to return to the Device Summary screen.

Connect to an iPERL+ meter

Before working with an iPERL+ meter, connect to it with an Android, iOS, or Windows 10/11 App field device and a CommandLink.

1. Power on the field device.
2. Power on the CommandLink.
3. Start the FieldLogic Tools application on your field device.
4. From the Connect screen, enter the FlexNet ID of the SmartPoint module using the keypad or bar code scanner and select the green Connect icon.
5. Check the CommandLink's LEDs to ensure that the blue LNK LED is illuminated, indicating a Bluetooth connection between the field device and the CL.
6. FieldLogic Tools attempts to communicate with the SmartPoint module through the CL.

Activate and configure the SmartPoint module

After physically installing the meter, you can activate it by connecting it to a SmartPoint module and then activating the SmartPoint module.

To activate the iPERL+ meter, you will need an Android, iOS, or Windows 10/11 App field device and a FieldLogic Communicator or an AutoGun.

Before activating a SmartPoint module, make sure that you have successfully connected your field device and communication device to the SmartPoint module.

1. From the FieldLogic Tools Device Summary page, select **Activate**.
2. If the GPS source is set to **Required for all SmartPoints** in the device configuration, and FieldLogic does not have a valid GPS fix, an activation error displays. Select **OK** to return to the SmartPoint module main menu.
3. If activating a dual port SmartPoint module, the Choose Port(s) screen displays. Select the desired port, or select **All Ports** to activate both ports.
4. Select **OK**.
5. If prompted, select the applicable device configuration.
6. The activation process begins.

After successful activation, the Activate Success confirmation message displays.

7. Select **OK** to return to the Device Summary screen.

8. From the activated SmartPoint module screen, select **Disconnect** to disconnect from the SmartPoint module.



Note: Be sure to disconnect from the SmartPoint module when finished to prevent multi-transmissions with LAT. This ends the meter to CommandLink communications in preparation for network operations.

Deactivate an iPERL+ meter

An activated iPERL+ meter must be deactivated prior to maintenance, exchange, or removal.

1. From the FieldLogic Tools Device Summary screen, select **Deactivate**.
2. When the deactivation confirmation message displays, select **Yes**.
The deactivation process begins.
3. Select **OK** on the Deactivate Success screen to return to the Device Summary screen.
4. Select **Disconnect** to disconnect from the SmartPoint module.

Replace an existing iPERL+

To replace an existing meter with the iPERL+:

1. If connecting with a SmartPoint module, deactivate the SmartPoint module using steps from [Deactivate an iPERL+ meter](#) on page 16.
2. Turn off the water supply valve.
3. Pull the current meter out of the pit or disassemble the current meter.
4. Follow the installation steps as detailed in [Installing iPERL+](#) on page 12.
5. Attach the existing SmartPoint module, if one was attached to the meter you are replacing, to the new meter.
6. Activate the SmartPoint module using FieldLogic Tools as described in [Activate and configure the SmartPoint module](#) on page 15.

3 iPERL+ operations

When operating iPERL+, details can be viewed through direct connection, SmartPoint, and Device Manager.

Data logs are accessed through direct connection.

View iPERL+ meter details

View or audit the status, configuration parameters, and network settings of an iPERL+ meter in a read-only state.



Note: The parameter setting fields are read-only, and display settings that are stored in the SmartPoint module. To modify these settings, you must use a product configuration containing the applicable values.

1. From the FieldLogic Tools Device Summary page, select **View Details**.

The Port 1 and Port 2 sections, if applicable, report identical information that is divided into three subsections: Status, Register Settings, Alarm Settings. Scroll on your device to view these different sections.

The Alarm Settings section displays backflow, high flow, and leak detection threshold settings.

2. Scroll to the **Network** section to view network-specific information such as FlexNet IDs, utility code, and encryption status.
3. Select **Close** to return to the Device Summary screen.

View iPERL+ details (Device Manager)

To take advantage of the iPERL+'s advanced functionality, the Device Manager operator must enable these functions in the AMI fixed-base network. If you are in an AMI fixed-base network, you can view details through Device Manager.

From the **Devices** menu > **Meters** tab, select the applicable device.

From the **About this Device** page, you can see the status of the , view the reads, the transmit rate, and so on.

Connect directly to an iPERL+ meter

Connect directly to the iPERL+ meter instead of through the SmartPoint module.

You will need a field device with FieldLogic Tools, a FieldLogic Communicator, and a touchcoupler cable.

1. Power on the field device.
2. Power on the FieldLogic Communicator.
3. Connect the FieldLogic Communicator to the field device.
4. Connect one end of the coupler cable to the FieldLogic Communicator.
5. Start the FieldLogic Tools application on your field device.

View iPERL+ meter register details

View iPERL+ meter details through the register.

You can access information about the iPERL+ meter using FieldLogic Tools through the direct connection method instead of through connecting to a SmartPoint module if you are not in a fixed base network.



Note: If you are using FieldLogic Tools to view device details through a SmartPoint module in a fixed base network, then the **View Details** function presents different information. For example, viewing details directly through the register will not display any port information, because only SmartPoint modules have ports.

1. From the FieldLogic Tools Device Summary page, select **View Details**.
FieldLogic displays the details available for the iPERL+. Scroll to view all details.
2. Select **Close** to return to the Device Summary screen.

View sensor readings

View sensor readings through the details screen on an activated SmartPoint.

The sensors need to be enabled in Device Manager before the readings display in FieldLogic.

1. From the activated SmartPoint screen, select **View Details**.
The Status screen of the Port 1 tab displays the Pressure and Temperature readings.
2. Select the right arrow to view the Register Settings. The "Type" now displays Smart Meter in addition to TouchCoupler.

4 iPERL+ alarms

iPERL+ alarms provide information about the meter's functions.

The length of time that the alarms remain is customizable to ensure that operators catch all alarms that have been triggered since the last visit to the meter.

iPERL+ alerts

The following information describes the alarms, errors, and warnings for the iPERL+ meter.

iPERL+ user configurable alerts

Meter event name	Event description	Event trigger	Event threshold
Continuous Flow	This alarm indicates the meter has detected continuous flow for an extended time period. For example, a leak on the downstream of the meter.	Option: Enabled / Disabled Default: Enabled in Smart Mode Trigger duration: 24 Hours (default) 48 Hours, 72 Hours	Gallons per minute: 0.11 GPM, 0.25 GPM, 0.50 GPM, 0.75 GPM, 1.00 GPM, 1.25 GPM, 1.50 GPM. Defaults: 5/8" & 5/8"x3/4" .0.11 GPM; 3/4", 0.11 GPM; 1", 0.25 GPM. Cubic feet per hour: 0.88 CF/HR, 2.00 CF/HR, 4.00 CF/HR, 6.00 CF/HR, 8.00 CF/HR, 10.00 CF/HR, 12.00 CF/HR. Defaults: 5/8" & 5/8"x3/4", 0.88 CF/HR; 3/4", 0.88 CF/HR; 1", 2.00 CF/HR. Cubic meters per hour: 0.025 M3/HR, 0.050 M3/HR, 0.110 M3/HR, 0.170 M3/HR, 0.220 M3/HR, 0.280 M3/HR, 0.340 M3/HR Imperial Gallons Per minute: <i>Currently not supported in iPERL+</i>

Meter event name	Event description	Event trigger	Event threshold
High Flow	The high flow alarm indicates the meter has detected an excessive flow rate, possibly caused by a broken pipe.	Option: Enabled/Disabled. Default: Enabled in Smart Mode Trigger Duration: 1 hour (Default), 2 hours, 3 hours, 4 hours, 8 hours, 12 hours, 16 hours, 20 hours, 24 hours.	Gallons per minute: 20.00GPM, 25.00 GPM, 30.00 GPM, 35.00 GPM, 40.00 GPM, 45.00 GPM, 50.00 GPM, 55.00 GPM. Defaults: 5/8", 25.00 GPM; 5/8"x3/4" & 3/4", 35.00 GPM; 1", 55.00 GPM. Cubic feet per hour: 160.00 CF/HR, 200.00 CF/HR, 240.00 CF/HR, 280.00 CF/HR, 320.00 CF/HR, 360.00 CF/HR, 400.00 CF/HR, 440.00 CF/HR. Defaults: 5/8", 200.00 CF/HR; 5/8"x3/4" & 3/4", 280.00 CF/HR; 1", 440.00 CF/HR. Cubic meters per hour: 4.50 M3/HR, 5.70 M3/HR, 6.80 M3/HR, 7.90 M3/HR, 9.00 M3/HR, 10.20 M3/HR, 11.40 M3/HR, 12.40 M3/HR. Defaults: 5/8", 5.70 M3/HR; 5/8"x3/4" & 3/4", 7.90 M3/HR; 1", 12.40 M3/HR. Imperial Gallons Per minute: <i>Currently not supported in iPERL+</i>

Meter event name	Event description	Event trigger	Event threshold
Reverse Flow	A reverse flow alarm indicates the endpoint has detected reverse flow (decreasing reading values) for a specified period of time.	Option: Enabled / Disabled Default: Enabled in Smart Mode Trigger duration: 1 min (default), 2 min, 4 min, 6 min, 8 min, 10 min, 15 min, 30 min, 60 min.	Gallons per minute: -1.00 GPM, -2.00 GPM, -4.00 GPM, -6.00 GPM, -8.00 GPM, -10.00 GPM. Default: -1.00 GPM for all sizes. Cubic feet per hour: -8.00 CF/HR, -16.00 CF/HR, -32.00 CF/HR, -48.00 CF/HR, -64.00 CF/HR, -80.00 CF/HR. Default: -8.00 CF/HR for all sizes. Cubic meters per hour: -0.22 M3/HR, -0.45 M3/HR, -0.90 M3/HR, -1.36 M3/HR, -1.82 M3/HR, -2.27 M3/HR. Default: -0.22 M3/HR for all sizes. Imperial Gallons Per minute: <i>Currently not supported in iPERL+</i>

iPERL+ pre-defined alarms

Meter event name	Event description	Event trigger
Hardware Failure	Set if a catastrophic hardware problem occurred. Failure conditions cover processor failure and meter calibration corruption.	Trigger Condition: <i>User Experience:</i> Meter experienced a processor hardware glitch or meter factory calibration has been defaulted. Recommend further inspection of alarm data to verify valid meter calibration. <i>Technical Details:</i> -USC failure (oscillator fault, system clock failure). or -The calibration structure, which is stored in non-volatile INFOMEM, is corrupt and set to defaults. Clear Condition: After triggered this alarm is permanently set to active. The alarm can only be cleared via command.

Meter event name	Event description	Event trigger
Non-Volatile Memory Error	Indicates a failure when attempting to read the newest version of a file stored in internal flash during normal operations (excluding Datalog reads), or a failure to initialize the calibration structure in non-volatile INFOMEM.	Update: When flash files are read on bootup or accessed in response to a command. Trigger Condition: <i>User Experience:</i> Possible loss of the most recent metrology/alarm history, or meter calibration has been loaded with defaults. Only possible with meter reboot. Recommend further inspection of alarm data to verify valid meter calibration. <i>Technical Details:</i> -Calibration structure could not get loaded with the Master Calibration file or Backup Calibration file. or -Loaded a file data entry which is not the newest in the given Flash file. or -Error opening a Flash file. Clear Condition: This is a one-shot type alarm. It is automatically set to inactive after triggered.
Empty Pipe	Alarm indicates the absence of water in the flow tube.	Update: Alarm condition is evaluated every ASIC field sample period. Trigger Condition: <i>User Experience:</i> Absence of water in the meter's flow tube for 5 minutes continuously. <i>Technical Details:</i> Metrology measured impedance exceeds threshold for 5 minutes continuously. Clear Condition: Alarm is set to inactive when conditions return to normal.

Meter event name	Event description	Event trigger
Magnetic Tamper	Detected an attempt to tamper with the meter by application of a magnet.	Update: Alarm condition is evaluated every ASIC field sample period. Trigger Condition: <i>User Experience:</i> An external magnetic field applied to the flow tube disrupts normal flow measurement. Typically indicates an attempt at tampering to stop proper metering. <i>Technical Details:</i> If the change in magnetic field per microsecond of field drive is out of range, the alarm will be triggered. Condition must present for 15 minutes continuously. Clear Condition: Alarm is set to inactive when conditions return to normal.
Near End-of-Life	The meter is approaching the end of the expected product life.	Update: Alarm condition is evaluated hourly. Trigger Condition: <i>User Experience:</i> The meter has been operating for 20.5 years, and the battery is nearing exhaustion. <i>Technical Details:</i> After 20.5 years have elapsed since meter's stored time of manufacture. Clear Condition: Alarm is set to inactive when the "End-of-Life" alarm becomes active.
End-of-Life	The meter has reached the end of expected product life.	Update: Alarm condition is evaluated hourly. Trigger Condition: <i>User Experience:</i> The meter has been operating for 21 years, the battery exhaustion is imminent. <i>Technical Details:</i> After 21 years have elapsed since meter's stored time of manufacture. Clear Condition: Once conditions are met this alarm is permanently set to active.

Meter event name	Event description	Event trigger
Internal Communication Error	Indicates a hardware communications error occurred between the metrology processor and the ASIC.	Trigger Condition: <i>User Experience:</i> The meter's processor experienced a hardware related communication glitch with the metrology ASIC. <i>Technical Details:</i> Hardware or communication failure during ASIC initialization or run-time sampling. Note: A communication hard lockup of the ASIC chip or SPI bus typically results in a processor reboot in an attempt to recover. Clear Condition: Alarm is set to inactive when conditions return to normal.
Reboot	Occurs if the meter has been rebooted due to hardware issue or firmware upgrade.	Trigger Condition: <i>User Experience:</i> The meter rebooted. Typically seen after a firmware upgrade. <i>Technical Details:</i> Processor reboot due to hardware/firmware issue or firmware upgrade completed. Clear Condition: This is a one-shot type alarm. It is automatically set to inactive after triggered.

Meter event name	Event description	Event trigger
EMF Range	Voltage between the two electrodes is too large to measure water flow.	Update: Alarm condition is evaluated every ASIC field sample period. Trigger Condition: <i>User Experience:</i> Electrode voltage readings are too high for flow sensor to accurately calculate the flow measurements. <i>Technical Details:</i> Conditions are evaluated when meter has been out of Empty Pipe state for 2.5 days (default), and the condition is present for 15 min. continuously. -Absolute value of the electrode delta (differential voltage between the electrodes) > 180mV. or -The absolute value of the high-resolution ASIC ADC > 220000 counts Clear Condition: Alarm is set to inactive when conditions return to normal.
Low Field	The alarm detects when the magnetic field is lower than acceptable to accurately accumulate volume.	Update: Alarm condition is evaluated every ASIC field sample period. Trigger Condition: <i>User Experience:</i> Flow sensor cannot regulate the magnetic field to the minimum strength required to accurately calculate flow measurements. <i>Technical Details:</i> Alarm is set when the measured magnetic field is lower than a third of its normal value (the target value at 'Normal Field' setting) for 2 minutes continuously. Note: The field drive time will increase during a Low Field condition which may trigger Magnetic Tamper alarm. Clear Condition: Alarm is set to inactive when conditions return to normal.

Meter event name	Event description	Event trigger
High Current	Early detection of high power consumption. Indication that the meter has been operating more frequently than expected which will affect battery life and potentially the warranty on the meter. The most likely cause is an increase in communications with the meter (for example, repeated meter readings, overactive alarms, or firmware download).	Update: Alarm condition is evaluated every 15 min. Trigger Condition: <i>User Experience:</i> Unusually high meter power consumption detected which could lead to reduced battery life. Commonly caused by meter radio communication such as meter readings or firmware download. <i>Technical Details:</i> Estimated power consumption over the past 15 minutes is more than 4 times higher than the target average power consumption. Clear Condition: Alarm is set to inactive when conditions return to normal.
Low Primary Battery (Voltage)	Battery voltage is low indicating meter battery power is almost exhausted.	Update: Alarm condition is evaluated every 15 min. Trigger Condition: <i>User Experience:</i> Battery power is almost exhausted as determined by the low battery supply voltage. <i>Technical Details:</i> After battery voltage drops below 2.5V for 60 minutes. Clear Condition: Alarm is set to inactive when conditions return to normal. Note: When the alarm occurs, the meter will be put into "End-of-Life" operating mode. In this mode the meter will reduce power consumption and may not accurately measure water flow. Even if the alarm returns to inactive the meter will remain configured in the End-of-Life operating mode.

Meter event name	Event description	Event trigger
Glide Slope	Excessive deviation in Glide Slope.	Update: Alarm condition is evaluated hourly. Trigger Condition: <i>User Experience:</i> Power consumption has been high for an extended period. Power to the flow sensor will be reduced to compensate until power usage returns to normal. Flow measurement accuracy may be affected while in the reduced power mode. <i>Technical Details:</i> When the "Seconds Used" is 8 weeks greater than "Seconds Active". Clear Condition: Alarm is set to inactive when conditions return to normal.
High Temperature (ASIC Temp)	High temperature detected.	Update: Alarm condition is evaluated every 15 min. Trigger Condition: <i>User Experience:</i> Meter is operating above maximum temperature of +85DegC. <i>Technical Details:</i> ASIC temperature > +85 Deg C for 60 min continuously. Clear Condition: Alarm is set to inactive when conditions return to normal.
Configuration Error	Indicates one or more calibration factors were not set, or that the calibration file has reverted to defaults. This alarm is typically only set during the meter manufacturing process.	Trigger Condition: <i>User Experience:</i> Indicates meter calibration has default values. Recommend further inspection of alarm data to verify valid meter calibration. <i>Technical Details:</i> -After a processor reset if one or more of the meter calibration factors has not been set. or -If calibration factors are reset via command. Clear Condition: The required calibration factors have been appropriately set via command.

Meter event name	Event description	Event trigger
Misc Metrology	Indicates an issue with the functioning of the iPERL+ metrology. -High Electrode Voltage Noise. -Excessive Flow Rate measured.	Update: Alarm condition is evaluated every ASIC field sample period. Trigger Condition: <i>User Experience:</i> External voltage noise introduced to the meter flow tube is interfering with normal flow sensor measurements. <i>Technical Details:</i> - High Electrode Voltage Noise for 30 minutes continuously, and not in empty pipe state. or -Excessive Flow Rate detected in metrology where 8 consecutive samples > maximum physically possible flow for the meter. Clear Condition: Alarm is set to inactive when conditions return to normal.
Low Temperature (ASIC Temp)	Low temperature detected.	Update: Alarm condition is evaluated every 15 min. Trigger Condition: <i>User Experience:</i> Meter is operating below minimum temperature of 0DegC. <i>Technical Details:</i> ASIC temperature < 0 Deg C for 60 min continuously. Clear Condition: Alarm is set to inactive when conditions return to normal.

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- 1) The tissue in plants that brings water upward from the roots;
- 2) a leading global water technology company.

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