

SIMPLE, POWERFUL, RELIABLE WATER LEVEL MONITORING

# Level TROLL®

From the Water Level Experts



Systems for Every Application and Budget
Superior Accuracy and Performance
FREE 24/7 Technical Support

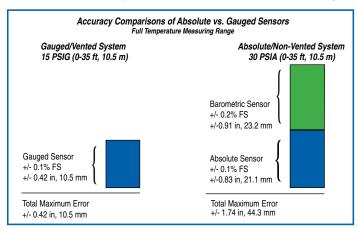
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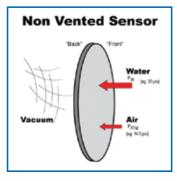
# Level TROLL® Instruments Water Level Monitoring for Every Application and Budget

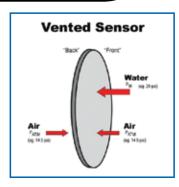
#### Accuracy of Absolute and Gauged Sensors

To demonstrate the impact of a sensor's accuracy specification on water level measurements, consider the following example. An absolute instrument and a gauged instrument have an accuracy specification of  $\pm 0.1\%$  FS (full scale) from 0 to 50° C. The specification of  $\pm 0.1\%$  FS represents a deviation from 100% accuracy.

Absolute (non-vented) sensors respond to atmospheric pressure and pressure head above the sensor, which impacts water level measurements. A barometric sensor must be used alongside an absolute sensor so that barometric pressure effects can be negated from water level data. In this example, the barometric sensor has an accuracy







specification of  $\pm 0.2\%$  FS from 0 to 50° C. Therefore, the post-corrected data for true water level has an accuracy of  $\pm 0.3\%$  FS, because the error of the absolute instrument and the barometric sensor is cumulative.

Gauged (vented) sensors allow atmospheric pressure to be applied to the back of the pressure sensor, canceling out the effect of external atmospheric pressure fluctuations. The gauged sensor measures true water level elevations within  $\pm 0.1\%$  FS because the gauged sensor and the vented cable eliminate the effects of atmospheric pressure. Gauged sensor data does not need to be post-corrected for barometric pressure effects as long as the vent tube of the cable is venting properly. Accuracy of the gauged sensor is, in fact,  $\pm 0.1\%$  FS, thus **qauged systems are the most accurate**.

All In-Situ Level **TROLL** instruments are factory calibrated over the full pressure and temperature range, ensuring their specified accuracies. Many other loggers on the market are calibrated at only one or two points and meet stated accuracy only at those points.

#### Recommended System by Application

Application	Level <b>TROLL®</b> 100 and 200 (ABS)	Level <b>TROLL®</b> 300 (316 SS)	Level TROLL® 500 (Titanium)	Level <b>TROLL®</b> 700 (Titanium)	Recommended cable type
Aquifer characterization			0	Χ	Vented
Multi-well testing			0	X	Vented
Long-term monitoring in fresh, brackish, or saltwater	0		X		Vented or non-vented
River, lake, and reservoir monitoring		0	X		Vented or non-vented
Stormwater monitoring			X	0	Vented
Tide/harbor monitoring			0	Χ	Vented
Wetlands/estuaries monitoring	0		Х		Vented or non-vented
Crest stage gaging	0	X			Non-vented
Flood and storm surge monitoring	0		Х		Non-vented
Dewatering: mining and construction		0	Х		Vented or non-vented
Landfill monitoring	0		Х		Vented or non-vented
Municipal and industrial monitoring (SCADA integration)		0	Х		Vented or non-vented
Real-time monitoring via telemetry			Х	0	Vented
TROLL® Net hub compatible			0	Х	Vented or non-vented

X = recommended by In-Situ Inc. O = can also be used

### Level TROLL® Instruments

#### Water Level Monitoring for Every Application and Budget



#### Level TROLL® 700 Instrument

#### The professional's choice for water level monitoring

- Vented (gauged) or non-vented (absolute) instrument
- Professional logging types include linear average, step linear, true logarithmic, and fast linear (4x/second)
- Titanium construction for all applications (0.72" OD)

#### Level **TROLL**® 500 Instrument Confidence in all applications, even saltwater

- Vented (gauged) or non-vented (absolute) instrument
- Titanium body ideal for harsh environments (0.72" OD)

#### Level **TROLL**® 300 Instrument Durable design for fresh water and industrial monitoring

- Non-vented (absolute) instrument
- Stainless steel construction suited for long-term monitoring (0.82" OD)

### Level **TROLL**® 100 and 200 Instruments **Economical, reliable operation**

- Non-vented (absolute) instruments
- ABS body offers corrosion- and chemical-resistance (1.03" OD)
- Simple data download via docking station or direct-read cable (Level TROLL 200 only)

#### Industry-Leading Performance in Water Level Monitoring

From advanced aquifer characterization, to long-term monitoring, to economical data collection, In-Situ® Level TROLL instruments yield accurate level/pressure and temperature measurements with powerful data logging and flexible communications. You'll find an instrument perfectly suited to your application and budget.

**Superior accuracy** – To guarantee accuracy under all operating conditions, instruments undergo an extensive full-scale calibration procedure for pressure and temperature. Each instrument includes a serialized calibration report.

**Intuitive user interface** – Simplify data collection and management with Win-Situ® 5 software. Win-Situ 5 operates across the entire Level TROLL platform and features setup wizards, fast data download rates, multiple water level reference options, and more.

**Low-power consumption** – Extend instrument deployments and get the **only** industry guarantee for battery life. Powered by a 3.6V lithium battery, Level TROLL instruments operate for **a minimum** of 5 years or 2 million readings ... or get a free instrument replacement. Instruments can also be run on external power and external battery packs (except Level TROLL 100).

**Expandable deployments** – Detach and extend cable lengths by using the RuggedCable® system with twist-lock, titanium connectors (Level TROLL 300, 500, and 700).

**Telemetry and SCADA readiness** – Access data when you need it. No adapters or confusing proprietary protocols required.

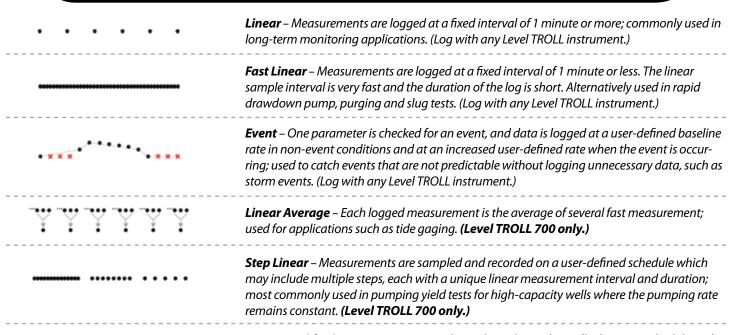
- Level TROLL 300, 500, and 700 instruments include fully compliant Modbus RS485, SDI-12, and 4-20 mA communication options.
- Level TROLL 200 instrument can connect via Modbus RS485 or SDI-12.

**24/7 technical support** – In-Situ technical support experts can assist with instrument setup, calibration, troubleshooting, and application-related questions. Fast, friendly, and always free, technical answers are just a phone call away – anytime you need it.



# Level TROLL® Instruments Water Level Monitoring for Every Application and Budget

#### Logging Types



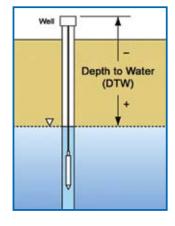
**True Logarithmic** – Measurements are logged on a logarithmically decaying schedule and gradually get further apart until they become linear; most commonly used in rapid drawdown pump, purging and slug tests. **(Level TROLL 700 only.)** 

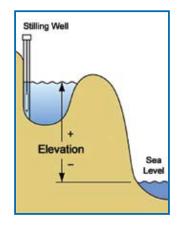
For the most accurate results, enable Fixed Density with Gravitational Compensation in Win-Situ 5 or Win-Situ Mobile software - available on all Level **TROLL** instruments. Visit **www.in-situ.com** to download technical notes.

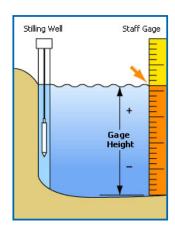
#### Setting Up a Water Level Reference

In addition to depth and pressure, water level measurements can be expressed in several ways. In-Situ offers multiple options for setting up water level references for ground and surface water.

- 1. **Depth to Water** Records the distance from the top of a well casing or other reference point down to the water surface. Logged readings increase as the water level decreases (i.e., as the water surface gets farther away from the reference point). This reference point measurement is commonly used to monitor drawdown in groundwater wells.
- 2. **Elevation** Relates the sensor measurements to mean sea level or any other datum you choose. Logged readings increase as the water level increases. Elevation references are commonly used in surface water monitoring.
- 3. Gage Height Reports water level readings relative to a staff gage. Useful for river and stream gaging.

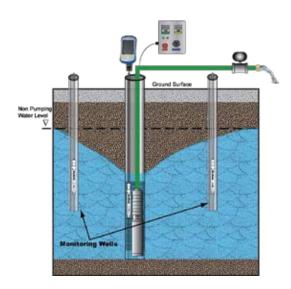






# Level TROLL® Instruments Water Level Monitoring for Every Application and Budget

#### Aquifer Characterization – Slug and Pumping Tests



**Slug Test** – Estimate hydraulic conductivity (K) in minutes – as opposed to hours for a pump test. This method requires the depression or elevation of static water in a well, and the measurement of time it takes to equilibrate. A slug is inserted into the well, which causes the water level to rise; then the slug is removed, which causes the water level to fall. Time is measured until the water level returns to its original static position. The most common log types used are logarithmic or fast linear.

**Pumping Test (step)** – A well is pumped at different rates for short periods of time, and the aquifer's response or drawdown is measured in a monitoring well to determine well efficiency or final pump rate for a constant rate pump test. The most common log types used are logarithmic in the pumping well and fast linear in the monitoring well.

**Pumping Test (constant rate)** – Also known as a yield test, a constant rate pump test is typically performed after a step test. Pump tests deliver a more accurate hydraulic conductivity value (K) compared to slug tests. The pumping well is pumped at a constant rate for 24+ hours, and level data is collected in monitoring wells to determine the storage coefficient (S), radius of influence, and other hydrologic parameters. The most common log types used are logarithmic or step linear.

#### Long-Term Monitoring and Resource Management

**Long-Term Groundwater Monitoring** – Develop historical data on groundwater aquifers to determine water influences and usages for residential planning, water rate billing, contamination plume direction, groundwater/surface water interaction, seasonal water demand, and other related issues. One or more monitoring wells are equipped with vented water level instruments. The most common log type used is linear, typically at 15-minute intervals or longer.

**Stormwater Monitoring** – Collect data on amount and rate of stormwater runoff to assess recharge rate into groundwater aquifers and to monitor the impact of groundwater/surface water interaction. Gauged instruments are mounted in outfall basins, storm sewers, or groundwater wells near recharge area. Linear and event logging are commonly used.

**Estuary Level and Tide Monitoring** – Gather and report tidal changes and water level elevations in coastal areas. Instruments are mounted on fixed structures in PVC pipe or stilling wells and vented to atmosphere. The most common log type used is linear average. For maximum accuracy, tide gage systems should compensate for water density. Dynamic density compensation is available on the Aqua TROLL® 200 instrument.

**River and Stream Gaging** – Determine and track water level over extended periods of time and assess the impacts of discharge, rainfall, and runoff. The level instrument is usually placed in a slotted PVC pipe or stilling well with a vented cable. Linear and event logging are commonly used.

**River Crest Stage Gaging** – Track high water levels or flood crest of streams and rivers. An absolute instrument is secured to a fixed structure, such as a bridge piling. Absolute sensor data must be post-corrected for barometric changes. Linear and event logging are commonly used.

**Flood and Storm Surge Monitoring** – Gather data on flood events by securing instruments in a stream or floodplain to prevent loss in a flood event. Absolute instruments are often used due to concerns of flooding. Absolute pressure sensor data must be post-corrected for barometric changes for accurate results. Linear and event logging are commonly used.

**Dewatering** – Monitor the removal of water when pumping a riverbed, construction site, mine/quarry, or water well. An absolute or gauged instrument continuously monitors water level. Linear logging is commonly used.

**Remediation** – Monitor groundwater levels in a sealed well during remediation of contaminated soil. Linear logging is commonly used.



Groundwater monitoring in a coastal zone using Level TROLL 700 and RuggedReader® PC



Stream gaging using Level TROLL® 500 and RuggedReader® handheld PC

#### Level TROLL® Instruments

Software and Telemetry

#### Win-Situ® Software – One Platform for Multiple Devices

Industry-leading Win-Situ\* software from In-Situ® Inc. is the communication platform used to configure and manage data from any Level TROLL or Aqua TROLL® instrument. To collect and manage data in the field, use the waterproof, shockproof RuggedReader® handheld PC. The RuggedReader handheld PC uses Microsoft® Windows® Mobile operating system and Win-Situ Mobile software.

With Win-Situ 5 and Win-Situ Mobile software, you can easily:

- **Manage site data** Configure equipment and enter site-specific details once, then use this information whenever you need it.
- **View instrument status and data in real-time** See indicators of instrument battery, memory, and alarms. Display data either numerically or graphically.
- **Customize logging and level references** Software offers a variety of options for groundwater and surface water applications.
- Troubleshoot problems Use built-in diagnostic tools to identify and resolve device, communication, and software issues.
- **Export data for reporting and analysis** Quickly download and export data to Microsoft Excel and other analysis programs.



<sup>\*</sup> Win-Situ 5 requires: Microsoft® Windows® 2000 Professional SP4 or higher; Windows® XP Professional SP2 or higher; or Windows Vista®; and Internet Explorer® 6.01 or higher.



#### **Software Utilities**

**Win-Situ Baro Merge™ software** – Simplifies post-correction of data from absolute instruments using data from a BaroTROLL instrument or from user-defined barometric readings.

**Win-Situ Software Manager** – Keeps your software and instrument firmware up-to-date by automatically checking for the latest versions on the In-Situ web site. This eliminates the need to manually track and download software and firmware updates. Free updates available at www.in-situ.com.

**Win-Situ Sync** – Moves data and site files automatically between Win-Situ PC software and the RuggedReader handheld PC. This allows the rapid transfer of data by field teams during monitoring projects.

#### TROLL® Link Telemetry Systems – Real-Time, Remote Access

Flexible, economical TROLL Link telemetry systems offer reliable, secure data retrieval from remote locations. TROLL Link systems offer full compatibility with Level TROLL 200, 300, 500, and 700 instruments.

- **Save time and money** Quickly access real-time data while reducing labor and travel costs.
- **Simplify set up** Configure instruments from remote locations.
- **Communicate with every site** Choose from satellite or cellular options to ensure communication with your site.
- **Stay informed** Real-time event notifications/alarms alert you to changing conditions, including early detection of sensor fouling or damage.
- Retrieve data online View and analyze data from anywhere in the world via the secure In-Situ® Data Center or Win-Situ® Plus software.
- **Reduce power consumption** Low-power systems eliminate the need for on-site power and preserve instrument battery by using renewable, solar power supply.
- **Get expert advice and service** Call for free technical support anytime. Systems warranted for one year.



#### Level TROLL® Instruments

Water Level Monitoring for Every Application and Budget

#### Accessories for Level TROLL 300, 500 and 700 Instruments



**RuggedCable®** Systems – RuggedCable systems with twist-lock titanium connectors offer reliability and ease-of-use – no special adapters required. Durable polyurethane or Tefzel® jacketed cables are available and include a two-year warranty.

- Titanium cable extenders quickly join multiple lengths of cable.
- Stripped and tinned cables connect directly to SCADA, DCP, or PLC systems via Modbus RS485, SDI-12, or 4-20 mA.



**TROLL® Com Device** – Establishes communication between a Level TROLL 300, 500, or 700 and a PC or RuggedReader handheld PC. Available in either cable or direct connect versions via USB or RS232.

**TROLL**® **Net Hub** – Networks up to 32 devices (connected by up to 8 hubs). Connects multiple devices to a single laptop, RuggedReader handheld PC, or TROLL Link telemetry system.



Baro**TROLL®** Instrument – Measures and logs barometric pressure data, which is used to compensate for changes in water level due to barometric fluctuations. Win-Situ Baro Merge $^{\mathsf{TM}}$  software automatically subtracts BaroTROLL readings from data collected by an absolute Level TROLL instrument. Titanium construction stands up to harsh conditions.

#### Accessories for Level TROLL 100 and 200 Instruments

Baro**TROLL**® 100 *Instrument* – Measures and logs barometric pressure data, which is used to compensate for changes in water level due to barometric fluctuations.



**TROLL® Com** 200 **Device** – Use a low-cost TROLL Com to download data from the cable-connect version of the Level TROLL 200 instrument.

**Docking Station** – Use a docking station to set up or download data from Level TROLL 100 and 200 instruments 47 (USB or RS232 connectors available).

**Low-Cost Cable and Suspension Wire** – Deploy the Level TROLL 200 instrument using a direct-read cable with a top-of-well connector or using a stripped and tinned version for connection to SCADA, DCP, or TROLL Link telemetry systems via Modbus RS485 or SDI-12 communication options. Use suspension wire to deploy any absolute sensor (Level TROLL 100). Three standard lengths of suspension wire are available.

#### Level Monitoring Accessories



*Visit www.in-situ.com for a full range of accessories, including:* 

- TROLL® Shield antifouling nose cone Slows biofouling of sensor in adverse conditions.
- Well caps Choose from a selection of locking well caps, vented well caps, and well docks.
- NPT adaptor Install Level TROLL instrument into threaded process piping.
- **Desiccants** Vented cables require desiccants.
- In-Situ Level TAPES Choose from the economical Level TAPE 100 or the rugged Level TAPE 200 for accurate distance to water measurements in wells, boreholes, and surface water applications. Scaled in feet or meters; multiple lengths available.

#### Calibration, Maintenance, & Warranty Services: Keep Instruments in Top Condition

After prolonged use, a factory recalibration can return your instrument to original specifications. Calibration of Level TROLL instruments includes operational checks, firmware upgrades, and calibration of the pressure sensor. In-Situ Inc. offers maintenance programs for all Level TROLL instruments. Two-, three-, four-, and five-year warranties are available. Call for details.

### Level TROLL® 100, 200, 300, 500, 700

#### Specifications

VERSIONS	100	200	300	500	700
Operational temp. range	-20°C to 50°C	-20°C to 50°C	-20°C to 80°C	-20°C to 80°C	-20°C to 80°C
Outer diameter (OD)	1.03" (2.62 cm)	1.03" (2.62 cm)	0.82" (2.08 cm)	0.72" (1.83 cm)	0.72" (1.83 cm)
Length	5.5" (14 cm)	5.5" (14 cm)	9.0" (22.9 cm)	8.5" (21.6 cm)	8.5" (21.6 cm)
Weight	0.33 lb (0.15 kg)	0.33 lb (0.15 kg)	0.54 lb (0.24 kg)	0.43 lb (0.197 kg)	0.43 lb (0.197 kg)
Output options	USB or RS232 via docking station	USB or RS232 via docking station; Modbus RS485 or SDI-12	Modbus RS485, SDI-12, 4-20mA	Modbus RS485, SDI-12, 4-20mA	Modbus RS485, SDI-12, 4-20mA
Housing material	ABS	ABS	Stainless Steel	Titanium	Titanium
Nose cone material	ABS	ABS	Black Delrin®	Black Delrin	Black Delrin
Internal battery	3.6 V lithium	3.6 V lithium	3.6 V lithium	3.6 V lithium	3.6 V lithium
Battery life	5 years or 2M readings, minimum	5 years or 2M readings, minimum	5 years or 2M readings, minimum	5 years or 2M readings, minimum	5 years or 2M readings, minimur
External power	No	8-36 VDC	8-36 VDC	8-36 VDC	8-36 VDC
Memory	0.5 MB	1 MB	1 MB	2 MB	4 MB
Data records	32,000	50,000	50,000	100,000	350,000
Fastest logging rate	1 per second	1 per second	1 per second	2 per second	4 per second
Fastest output rate					
Modbus	NA	2 per second	2 per second	2 per second	2 per second
SDI-12	NA	2 per second	2 per second	2 per second	2 per second
4-20 mA update rate	NA	NA	2 per second	2 per second	2 per second
Measurement types	Linear, fast linear, event	Linear, fast linear, event	Linear, fast linear, event	Linear, fast linear, event	Linear, fast linear, linear
					average, step linear, event, and true logarithmic
Pressure Sensor	Piezoresistive	Piezoresistive	Silicon strain gauge	Silicon strain gauge	Silicon strain gauge
Sensor material	Ceramic	Ceramic	Stainless Steel	Titanium	Titanium
Sensor accuracy @ 15°C	± 0.1% FS typical	± 0.1% FS typical	± 0.1% FS	± 0.05% FS	± 0.05% FS
Sensor accuracy 0-50°C (FS)	Typical ± 0.3% FS max.	Typical ± 0.3% FS max.	± 0.2% FS	± 0.1% FS	± 0.1% FS
Sensor resolution	± 0.01% FS or better	± 0.01% FS or better	± 0.01% FS or better	± 0.005% FS or better	± 0.005% FS or better
Sensor range	Non-vented*	Non-vented*	Non-vented	Non-vented	Non-vented
	0-30 ft (0-9.0 m)	0-30 ft (0-9.0 m)	(30 psia) 0-35 ft (10.5m)	(30 psia) 0-35.76 ft (10.90 m)	(30 psia) 0-35.76 ft (10.90 m)
	0-100 ft (0-30 m)	0-100 ft (0-30 m)	(100 psia) 0-200 ft (60m)	(100 psia) 0-197.2 ft (60.11 m)	(100 psia) 0-197.2 ft (60.11 m)
	0-250 ft (0-76 m)	0-250 ft (0-76 m)	(300 psia) 0-650 ft (200m)	(300 psia) 0-658.6 ft (200.7 m)	(300 psia) 0-658.6 ft (200.7 m)
				(500 psia) 0-1120.0 ft (341.3 m)	(500 psia) 0-1120.0 ft (341.3 m)
					(1000 psia) 0-2274 ft (693.1 m)
				Vented	Vented
				(5 psig) 0-11.54 ft (3.517 m)	(5 psig) 0-11.54 ft (3.517 m)
				(15 psig) 0-34.61 ft (10.55 m)	(15 psig) 0-34.61 ft (10.55 m)
				(30 psig) 0-69.21 ft (21.10 m)	(30 psig) 0-69.21 ft (21.10 m)
				(100 psig) 0-230.7 ft (70.32 m)	(100 psig) 0-230.7 ft (70.32 m)
				(300 psig) 0-692.1 ft (211.0 m)	(300 psig) 0-692.1 ft (211.0 m)
				(500 psig) 0-1154 ft (351.7 m)	(500 psig) 0-1154 ft (351.7 m)
Burst pressure		0-30 ft (60 ft, 18 m); 0-100 ft (134 ft, 40.8 m); 0-250 ft (368 ft, 112 m)	Maximum 2x range; burst 3x range	Maximum 2x range; burst 3x range	Maximum 2x range; burst 3x rang
Units of measure (pressure)	psi, kPa, bar, mbar, mmHg	psi, kPa, bar, mbar, mmHg	psi, kPa, bar, mbar, mmHg, inHg, cm ${\rm H_2O}$ , and in ${\rm H_2O}$	psi, kPa, bar, mbar, mmHg, inHg, cm ${\rm H_2O}$ , and in ${\rm H_2O}$	psi, kPa, bar, mbar, mmHg, inHg cmH $_{\rm 2}$ O, and inH $_{\rm 2}$ O
Units of measure (level)	m, mm, cm, in, and ft	m, mm, cm, in, and ft	m, mm, cm, in, and ft	m, mm, cm, in, and ft	m, mm, cm, in, and ft
Temperature Sensor	Silicon	Silicon	Silicon	Silicon	Silicon
Temperature accuracy	± 0.3° C	± 0.3° C	± 0.1° C	± 0.1° C	± 0.1° C
Temperature resolution	0.01° C or better	0.01° C or better	0.01° C or better	0.01° C or better	0.01° C or better
	Fahrenheit, Celsius	Fahrenheit, Celsius	Fahrenheit, Celsius	Fahrenheit, Celsius	Fahrenheit, Celsius

Minimum computer system requirements: 400MHZ Pentium® II, 128MB RAM, 100MB free disk space, Internet Explorer® 6.01 or higher. Windows® 2000 Professional SP4 or better, or Windows XP Professional SP2 or better, or Windows Vista®, CD ROM Drive, Serial or USB port.

#### Warranty

Level TROLL and BaroTROLL instruments come with a 1-year warranty. Up to 5-year extended warranties available. RuggedCable® systems include a 2-year warranty.





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#### **CALL TO PURCHASE OR RENT**



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<sup>\*</sup>BaroTROLL® 100/200 recommended for post-correcting Level TROLL 100 and Level TROLL 200 instruments.