pH

pH and ORP Systems
Reliable in Pure Water Treatment Applications

With many decades of experience in designing pH/ORP electrodes METTLER TOLEDO offers a state-of the-art solution for practically any type of process analytical application.

Functional definition

pH can be described as a measurement of the relative acidity of a solution. Oxidation reduction potential (ORP) as measured with an ORP electrode, provides an indication of the oxidative state of the solution. It is important to measure, and often to control the pH and/or ORP of a solution for several reasons:

- To produce products with consistent well defined properties
- To efficiently produce products at optimal cost
- To avoid health risks
- To protect the environment
- To prevent physical/chemical damage to materials
- To meet regulatory requirements
- To expand scientific knowledge

The accurate measurement of pH/ORP is critical in most industries. Each application has unique physical requirements of chemical, temperature, and pressure resistance and possibly hygienic design. Another factor is what is to be done with the measurement: monitoring only, data logging or process control.

pH electrode selection

It is important to understand the details of the application before selecting a pH electrode. The table gives an initial glance at the various electrodes available and typical applications. Selection of a pH electrode requires a thorough knowledge of the process. Once the requirements are known, comparison of the electrode specifications detailed in this catalog will identify the appropriate sensor.

Thornton pH electrode selection guide by industries and applications

	ORP* 10 505 3339	ORP* 10 505 3288	pH 52 000 512	pH 52 002 559 / 52 005 373 (ISM)	pH 52 002 987 / 52 005 381 (ISM)	pH 41 453 3102	pH 52 002 989 / 52 005 382 (ISM)	pH pHure Sensor
Industrial processes								
Pharmaceutical Industry								
Makeup Water	•	•		•				•
Wastewater				•	•	•	•	
Power Industry								
Makeup water	•	•		•				•
Cycle chemistry	•			•				•
Stator cooling				•				•
Scrubber					•	•	•	
Wastewater			•	•	•	•		
Semiconductor Industry								
Makeup water	•	•		•				•
Pure water								
Recycle, reclaim, waste			•	•	•	•	•	
Water Treatment								
Air scrubbers		•			•	•	•	
Cooling water		•		•	•	•	•	
Neutralization	•	•			•	•	•	
Potable water				•				
Wastewater Treatment								
Flue gas neutralization		•		•	•	•	•	
Galvanic wastewater	•	•		•	•	•	•	
Industrial wastewater		•			•	•	•	
Precipitation of heavy metals		•		•	•	•	•	
Sludge dewatering		•			•	•	•	

* New pH/ORP Sensors with ISM allow measurement of pH and ORP with the same sensor!

pH/ORP Sensors with ISM

Convenient Maintenance and Calibration

4260i/SG-225
For Retractable Housing

4260i/SG-120 3250i/SG-120

METTLER TOLEDO Thornton offers detachable pH and ORP sensors for M300 and 770MAX with VP connector directly on the electrode body to allow convenient maintenance and calibration. ISM versions are also available for use with the M800 and M300 ISM. A variety of housings match installation requirements. Preamplifiers are used with 770MAX and allow signal transmission up to 91 m (300 ft). Measuring circuits can operate with or without solution ground for maximum flexibility and stability.

Specifications

General	
Measuring electrode	Glass pH, platinum ORP
Reference electrode	Silver-silver chloride with double junction or equivalent
Temperature compensator	Pt 1000 included in all pH sensors; not in ORP sensors
pH range	0 – 14 pH, except InPro 4010 which is 2 – 12 pH
Maximum flow	3 m/s (10 ft/s)
Max. cable lengths	20 m (65 ft)

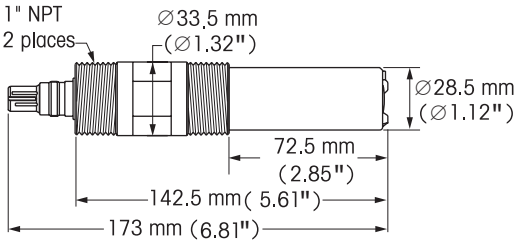
For electrode ratings see table "Ordering Information" on the next page.
For housings see pages 34-35.

Features Overview

- Convenient electrical and process connections for easy maintenance and calibration
- Advanced METTLER TOLEDO sensor technology for high performance and long life
- Integral temperature sensing for accurate measurement and compensation
- On-line pH sensor diagnostics in M300 for assurance of process surveillance

Typical Applications

- Wastewater neutralization
- Pharmaceutical water treatment
- Power and steam generation cycle chemistry and scrubbers
- Semiconductor ultrapure water treatment



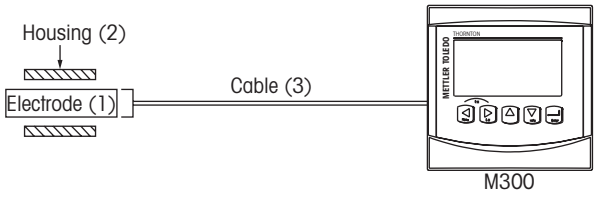
Dimensions of 4501

www.mt.com/Thornton-pH

Ordering Information

Electrodes	Rating	Sensor Type	Electrode Conn.	Housing Conn.	Length	Order Number
– For pH, General Purpose, Low Cost Applications for M300/770MAX						
4010–120–Pt 1000	0 to 60 °C (32 to 140 °F) 2 bar(g)/60 °C (30 psig/140 °F) 5 bar(g)/45 °C (75 psig/113 °F)	Polysulfone and glass	VP	Pg 13.5	120 mm	52 000 512
– For pH, General Purpose, High Pressure Applications for M300/770MAX						
4260–120–Pt 1000	See housing limits	Glass	VP	Pg 13.5	120 mm	52 002 987
– for pH & ORP, general purpose, high pressure applications ISM						
4260 i–SG–120	See housing limits	Glass and Pt	K8S	Pg 13.5	120 mm	52 005 381
– for pH & ORP, retractable ISM						
4260 i–SG–225	See housing limits	Glass and Pt	K8S	Pg 13.5	225 mm	52 005 382
– For pH, General Purpose & Moderately Pure Water Applications* for M300/770MAX						
3250 SG–120–Pt 1000	0 to 100 °C (32 to 212 °F) 4 bar(g) (60 psig)	Glass	VP	Pg 13.5	120 mm	52 002 559
– for pH & ORP, general purpose & moderately pure water ISM						
3250 i–SG–120	0 to 100 °C (32 to 212 °F)	Glass and Pt	K8S	Pg 13.5	120 mm	52 005 373
– For pH, HF–Resistant Applications for M300/770MAX						
4262–120–Pt 1000–VP	See housing limits	Glass	VP	Pg 13.5	120 mm	52 003 550
– For ORP, General Purpose & Moderately Pure Water Applications for M300/770MAX						
Pt 4805–DPA–S8–120	0 to 100 °C (32 to 212 °F) 2.5 bar(g) (36 psig)	Glass and Pt	S8	Pg 13.5	120 mm	10 505 3339
– For ORP, General Purpose, High Pressure Applications for M300/770MAX						
Pt 4805–DXK–S8–120	See housing limits	Glass and Pt	S8	Pg 13.5	120 mm	10 505 3288
– For pH, General Purpose, High Chemical Resistance for M300/770MAX						
4501–VP–Pt1000–SG	0 to 100 °C (32 to 212 °F) 7 bar(g)/65 °C (100 psig/149 °F) 3.5 bar(g)/100 °C (50 psig/212 °F)	PVDF and glass	VP	1" NPT insertion or 1" NPT submersion	–	41 453 3102
– For pH, Retractable Applications for M300/770MAX						
4260–225–Pt1000	See housing limits	Glass	VP	Pg 13.5 retractable	225 mm	52 002 989
– For ORP, Retractable Applications for M300/770MAX						
Pt 4805–DXK–S8–225	See housing limits	Glass and Pt	S8	Pg 13.5 retractable	225 mm	10 505 3255

*For use with moderately pure waters (conductivity 5 to 50 µS/cm) use 53 300 021 housing in ¾" NPT earth–grounded metal pipe tee with flow < 100 ml/min and discharge to open drain. For higher purity and/or higher accuracy in pure water see pHure Sensor™, page 30-31.



With M300, a complete pH or ORP installation requires an electrode (1), a housing (2) and a VP or AS9 cable (3). For suitable housings consult the table on page 32. For suitable cables see table page 72-73. No preamplifier is required. Each installation requires a Thornton M300 transmitter.

Did You Know

Some ISM pH probes allow you to perform both a pH and ORP measurement using the same sensor? Now there is no need to stock both pH and ORP sensors.

pHure Sensor™ with ISM

Reliable pH Measurement in Pure Waters

ISM

The METTLER TOLEDO Thornton pHure Sensor™ for M800 and M300 ISM uses a special internally-pressurized gel electrolyte reference electrode to produce results similar to a flowing junction but with much more convenient installation and maintenance. The electrode also includes a low resistance pH glass membrane, an integral, fast-responding RTD, and AK9 connection. All components of the pHure Sensor™ have been optimized for performance and value and conform to ASTM Standard D5128. Various lengths of cable can be selected to provide flexibility in locating the sensor.

Specifications

Wetted materials	Glass pH, platinum ORP
Process connections	¼" NPTF in/out
Flow housing volume	5 ml with electrode in place
Maximum pressure	Atmospheric pressure for optimum stability; operational 0 to 2.5 bar(g) (0 to 35 psig); can safely withstand 7 bar(g) (100 psig)
Sample temperature	0 to 80 °C (32 to 176 °F); short term to 100 °C (212 °F)
Sample pH	1 – 11 pH
Sample flowrate	50 to 150 ml/ min
Sample conductivity	> 0.8 µS/cm for highest accuracy
Connection	VP cable from sensor to instrument or preamp
Components included	Combination pH electrode, Flow housing (58 084 010), and cable

Features Overview

– Pressurized gel electrolyte
– Accurate, fast responding temperature compensator
– Low resistance glass membrane
– Solution ground connection
– Low volume 316 stainless steel flow housing

Typical Applications

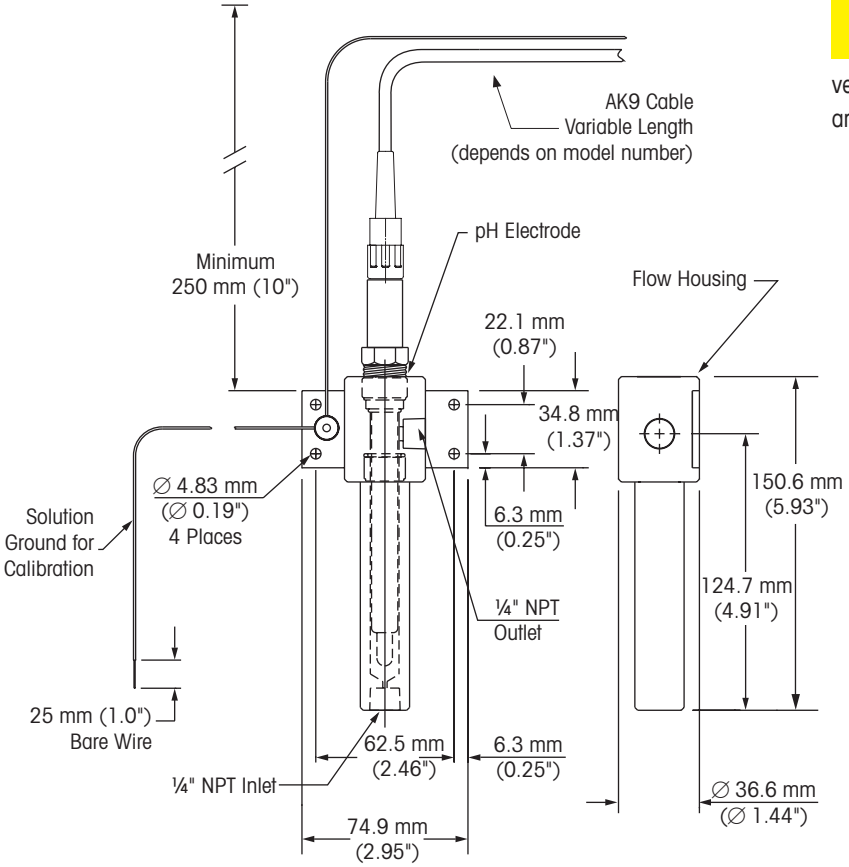
– Reverse osmosis – pH adjustment of clean recycle water or between membranes in two pass systems to optimize rejection rates
– Power plant cycle chemistry
– Monitoring and controlling pH levels to comply with guidelines and minimize corrosion and scaling

www.mt.com/Thornton-pH

Ordering Information

pHure Sensor™ ISM	Order Number
pHure Sensor™ with 1 m (3 ft) AK9 cable	58 032 406
pHure Sensor™ with 3 m (10 ft) AK9 cable	58 032 407
pHure Sensor™ with 5 m (16 ft) AK9 cable	58 032 408
pHure Sensor™ with 10 m (33 ft) AK9 cable	58 032 409
Replacement ISM combination electrode with temperature compensator	52 003 821
pHure Sensor™ used with M300	
pHure Sensor™ with 1 m (3 ft) VP cable	58 032 236
pHure Sensor™ with 3 m (10 ft) VP cable	58 032 237
pHure Sensor™ with 5 m (16 ft) VP cable	58 032 238
pHure Sensor™ with 10 m (33 ft) VP cable	58 032 239
Spare Parts for non-ISM Sensors	
Replacement combination electrode with RTD	52 002 447

pHure Sensor™ dimensions



Did You Know

The small volume and high sample velocity of the pHure Sensor™ assures fast response by preventing power plant corrosion products from accumulating around the electrode membrane.

NEW! pHure Sensor™ LE with ISM
Reliable pH Measurement in Pure Waters

ISM

The METTLER TOLEDO Thornton pHure Sensor™ 2003 for M300 and 2003i for 770MAX, M800 and M300 ISM uses a free-flowing junction to provide the most accurate pH measurement available in low conductivity water. The electrode includes a special pH glass membrane, an integral, fast-responding temperature sensor, and VP or AK9 connection. All components of the pHure Sensor™ have been optimized for performance and value and conform to ASTM Standard D5128. Various lengths of cable can be selected to provide flexibility in locating the sensor.

Specifications

Wetted materials	Glass pH, platinum solution ground/ORP
Process connections	¼" NPTF in/out
Flow housing volume	5 ml with electrode in place
Maximum pressure	Atmospheric pressure for optimum stability; can safely withstand 7 bar(g) (100 psig)
Sample temperature	0 to 100 °C (32 to 212 °F)
Sample pH	1 – 12 pH
Sample flowrate	50 to 125 ml/min
Sample conductivity	> 0.3 µS/cm for highest accuracy
Connection	AK9 or VP cable from sensor to instrument
Reference electrode	3M KCl
Components included	Combination pH electrode, 3 motor KCl electrolyte, Flow housing, and cable

Features Overview

– Free-flowing junction/diaphragm
– Simultaneous pH & ORP measurments
– Accurate, fast responding temperature compensator
– Low resistance glass membrane
– Low volume 316 stainless steel flow housing
– Easily refillable electrolyte chamber

Typical Applications

– Power plant cycle chemistry where pH measurement in low conductivity water is critical
– Reverse osmosis – pH adjustment of clean recycle water or between membranes in two pass systems to optimize rejection rates
– Monitoring and controlling pH levels to comply with guidelines and minimize corrosion and scaling

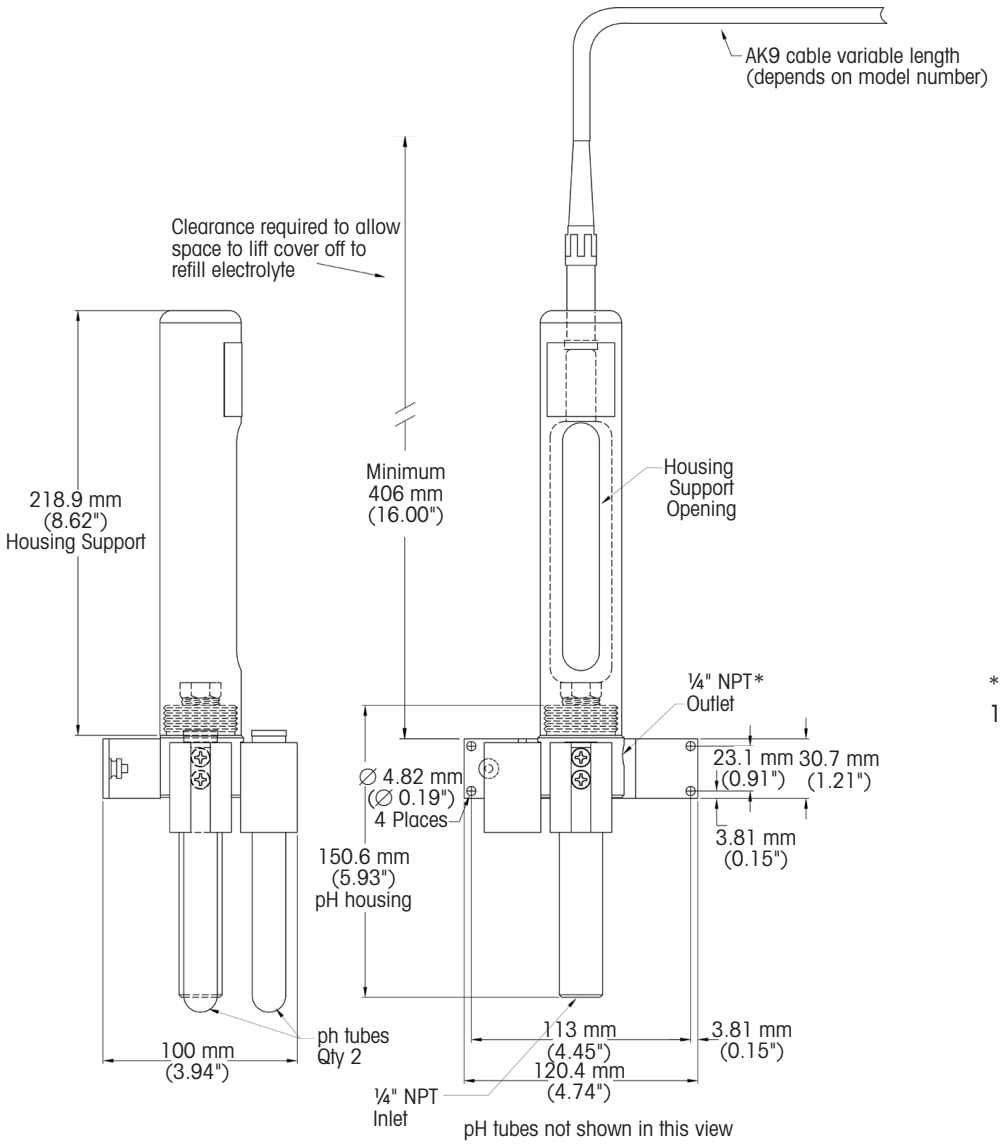
www.mt.com/Thornton-pH

Ordering Information

pHure Sensor™ ISM	Order Number
pHure Sensor™ LE with ISM, 1 m (3 ft) AK9 cable	58 032 420
pHure Sensor™ LE with ISM, 3 m (10 ft) AK9 cable	58 032 421
pHure Sensor™ LE with ISM, 5 m (16 ft) AK9 cable	58 032 422
pHure Sensor™ LE with ISM, 10 m (33 ft) AK9 cable	58 032 423
pHure Sensor™ used with M300 & 770MAX	
pHure Sensor™ LE for M300, 1 m (3 ft) VP cable	58 032 250
pHure Sensor™ LE for M300, 3 m (10 ft) VP cable	58 032 251
pHure Sensor™ LE for M300, 5 m (16 ft) VP cable	58 032 252
pHure Sensor™ LE for M300, 10 m (33 ft) VP cable	58 032 253
Replacement Sensors	
pHure Sensor™ for M300 replacement electrode	30 039 085
pHure Sensor™ ISM replacement electrode	30 039 086

For pH and ORP buffers, refer to page 35.

pHure Sensor™ dimensions



* Note: Drain tubing should be 10 mm O.D. (3/8″) or larger.

pH/ORP Housings
Flexibility in Meeting Process Requirements

58 084 00X

53 300 021

58 084 014

METTLER TOLEDO Thornton housings provide a fixed NPT or solvent weld process connection. For easy access to the electrode for cleaning, calibration or replacement, they have internal O-ring seals with hand-tightened mounting nut. The compact METTLER TOLEDO electrode design includes measuring, reference and fast-responding temperature compensator functions so only a single process connection is ever needed.
Housings should be mounted to orient the tip of the electrode at least 15° below horizontal to assure reliable contact of internal electrolyte with the measuring membrane. They should not be mounted horizontally or upside-down.

Specifications

pH Housings	Order Number		
	53 300 021	52 401 520	41 722 3001
Wetted parts	CPVC	PVDF	PVC
Sensor fitting	¾" NPT insertion or submersion [a]	¾" NPT insertion or submersion [a]	1" weld tee
Pressure rating	7 bar(g) at 20 °C 100 psig at 68 °F 2 bar(g) at 80 °C 30 psig at 176 °F	6 bar(g) at 20 °C 87 psig at 68 °F 1 bar(g) at 100 °C 15 psig at 212 °F	3.5 bar(g) at 60 °C 50 psig at 140 °F
Suitable pH sensors (by Order Number) [b]:			
– 52 000 512	•	•	•
– 52 002 987	•	•	•
– 52 002 559	•	•	•
– 52 005 373	•	•	•
– 10 505 3288	•	•	•
– 10 505 3339	•	•	•

pH Housings	Order Number		
	1000-40	1000-41	1000-42
Wetted parts	CPVC	PVDF	316 SS
Sensor fitting	Retractable 1 ½" NPT	Retractable 1 ½" NPT	Retractable 1" NPT
Pressure rating	5 bar(g) at 80 °C 75 psig at 176 °F	5 bar(g) at 100 °C 75 psig at 212 °F	7 bar(g) at 100 °C 100 psig at 212 °F
Suitable pH sensors (by Order Number) [b]:			
– 41 453 3102	–	–	–
– 52 002 989	•	•	•
– 10 505 3255	•	•	•

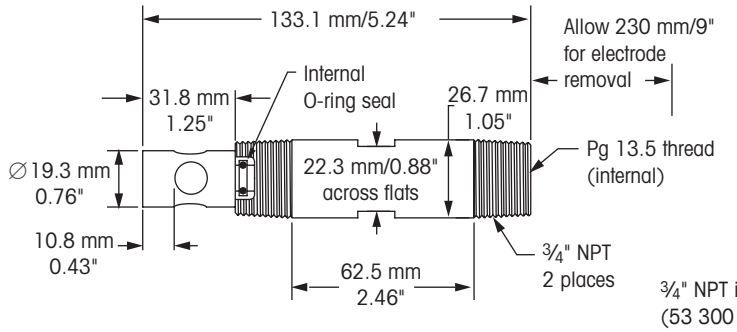
a For insertion in plastic pipe, use ¾ × 1" reducing bushing and 1" pipe tee.
For submersion with plastic pipe, use ¾ × 1" reducing coupling and 1" pipe.

b For information about the corresponding pH sensors consult page 29.

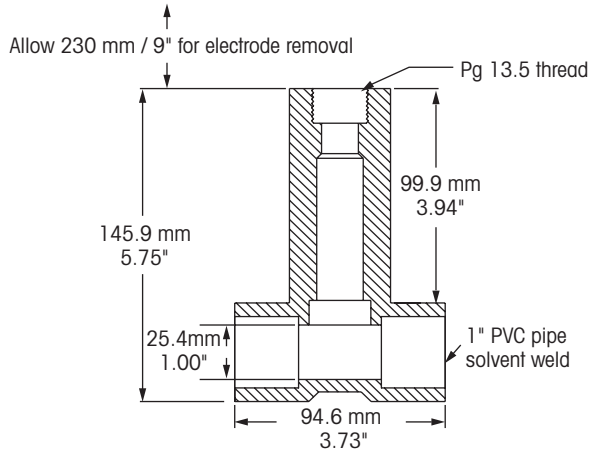
Did You Know
The 41 453 3102 pH electrode described on page 29 provides 1" NPT connections without a separate housing. It can be inserted into a 1¼" or larger NPT pipe tee with reducing bushing or can be immersed using a 1" NPT coupling and support pipe.

www.mt.com/Thornton-pH

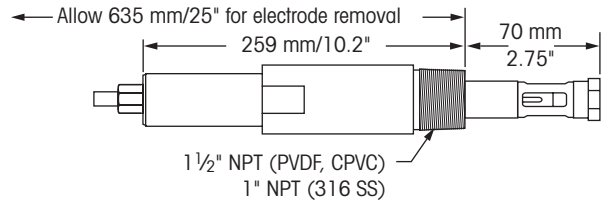
Drawings of pH housings



¾" NPT insertion or submersion
(53 300 021 & 52 401 520)



1" weld tee (58 084 014)



Retractable 1 ½" NPT (58 084 00X)

pH and ORP (Redox) Standard Buffer Solutions

Ordering Information

pH and Redox Buffers	Volume	Order Number
pH Buffers		
pH 4.01 buffer	250 ml	51 340 057
pH 7.00 buffer	250 ml	51 340 059
pH 9.21 buffer	250 ml	51 300 193
pH 10.00 buffer	250 ml	51 340 056
Redox Buffers		
Redox buffer 220 mV	6 X 250 ml	51 340 081