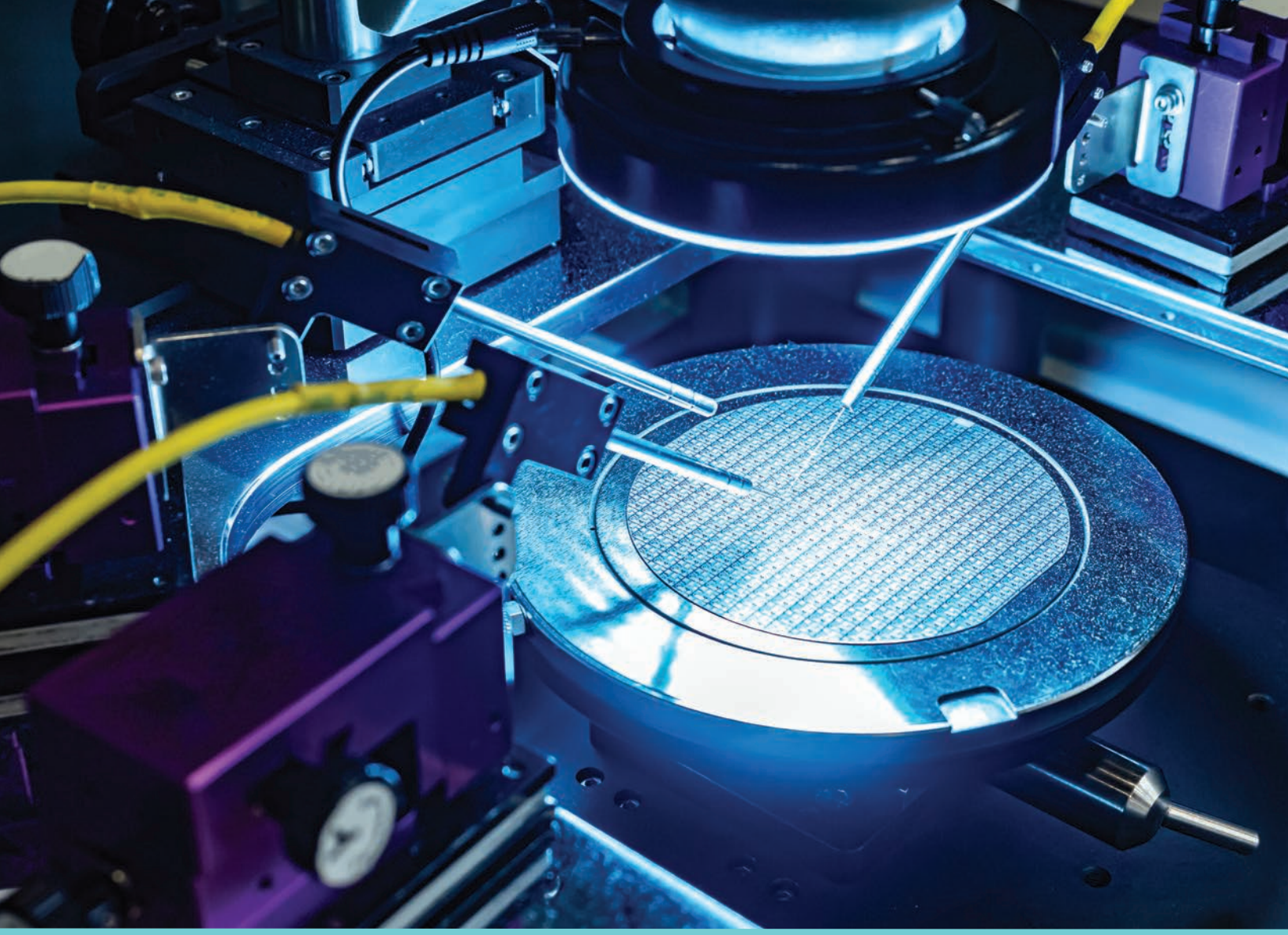
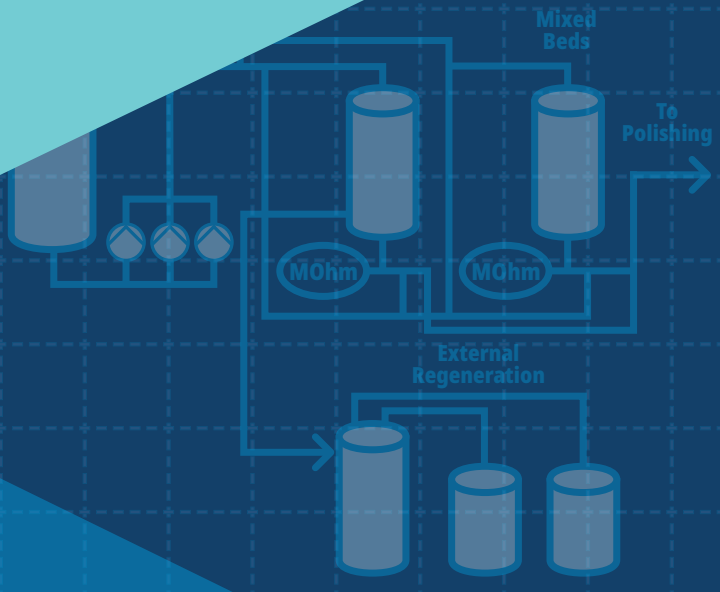


Solutions for Electronics & Semiconductor Water Applications

ULTRAPURE WATER (UPW)



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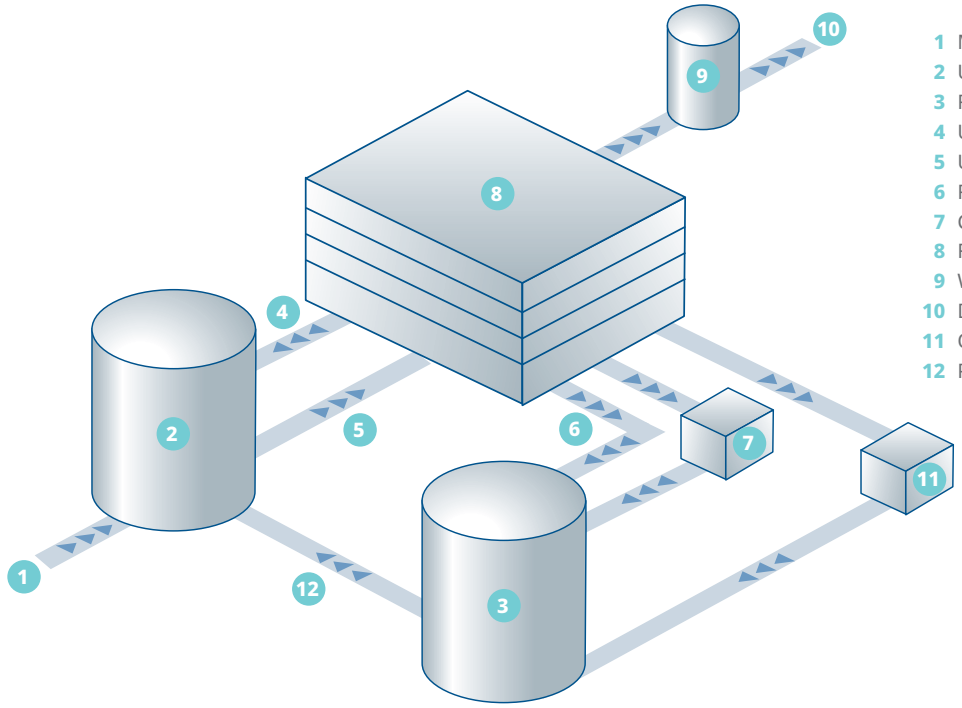
Semiconductor Manufacturing Process



1 Mains Water
2 Ultrapure Water Production
3 Recycling System
4 Ultrapure Water Loop
5 Ultrapure Water Loop
6 Rinsing Water
7 CMP
8 FAB
9 Wastewater Treatment
10 Discharge
11 Organic Industrial Wastewater
12 Pre-treated Recycled Water

Figure 1: *Electronic component manufacturing unit: main components in UPW and IWW recycling systems*

General Statement

Semiconductor industries are in the need of ultrapure water (UPW) as the essential cleaning fluid and this water requires the most extreme qualities. Most of this water is used for rinsing "silicon wafers" after each elementary component and circuit installation operation.

The more modern is the plant, the smaller are the electronic elements produced and therefore the lowest are the detection limits required for any instruments used to control the quality of the water. Table 1 illustrates changes to rinsing water specifications quoted in DRAM documentation; the increasingly fine nature of the etching carried out is such that no particulate deposit, bacteria (even dead) or salts capable of creating a significant fault, must be left by this water.

The race towards miniaturization results in extreme requirements that must be achieved, and in addition, a high degree of reliability is demanded. Any quality defect will appear as an increased in the manufactured product rejected and even shutting down production and causing considerable financial losses.

Semiconductor industries are often requesting analyzer performance far above what is available on the market and our Hach portfolio will be challenged. However, we can provide the largest portfolio of solutions, covering both process and laboratory customer requests and with best in class performance.

Etching fineness		0.9 µm	0.7 µm	0.5 µm	0.35 µm	0.25 µm	0.13 µm
DRAM	octets	1 M	4 M	16 M	64 M	256 M	1 G
Resistivity (25 °C)	M Ohm · cm	17.8	18.1	18.2	18.2	18.2	18.2
Bacteria	CFU · L^{-1}	100	50	50	30	20	10
TOC	ppb	50	10	5	3	2	1
SIO_2	ppb	10	5	5	3	3	1
Cations	ppt	1,000	500	50	5	2	
Anions	ppt	100	100	75	50	20	20
Oxygen	ppb	25	25	25	10	10	3
Particles > 0.5 µm	nb · L^{-1}	200	200	200	50	50	5
Particles > 0.2 µm	nb · L^{-1}	500	500	500	100	100	10
Particles > 0.1 µm	nb · L^{-1}	1,000	1,000	1,000	350	350	100
Particles > 0.05 µm	nb · L^{-1}			1,000	1,000	200	

Table 1: *Ultrapure water for the electronics industry—example of changing specifications*

Within Hach, we do not have all the products requested by semiconductor industries, but we have very good connection possibilities with sister companies like Pall or Beckman Coulter.

The aim of that document is to highlight all the solutions we can propose to this specific industry.

Water Classification According ASTM D5127 norm

Type E-1—This water is classified as microelectronic water to be used in the production of devices having line widths between 0.5 and 1.0 µm.

Type E-1.1—This water is classified as microelectronic water to be used in the production of devices having line widths between 0.25 and 0.35 µm.

Type E-1.2—This water is classified as microelectronic water to be used in the production of devices having line widths between 0.09 and 0.18 µm.

Type E-1.3—This water is classified as microelectronic water to be used in production of devices having line widths between 0.065 and 0.032 µm. This type is the water of ultimate practical purity produced in large volumes and is intended for the most critical microelectronic uses. ASTM Type E-1.3 is also identical to the SEMI (Semiconductor Equipment and Materials International) Guide for Ultrapure Water Used in Semiconductor Processing (F063), 2010 version.

Type E-2—This water is classified as microelectronic water to be used in the production of devices that have dimensions between 1 and 5 µm.

Type E-3—This grade of water is classified as macroelectronic water to be used in the production of devices having dimensions larger than 5 µm. This grade may be used to produce larger components and some small components not affected by trace amounts of impurities.

Type E-4—This grade may be classified as water used in preparation of plating solutions and for other applications where the water being used can be of lesser quality.

For more information, refer to ASTM D5127 norm.

Process Step-By-Step Description

Pretreatment

Water is filtered through a twin-layer filter and then through activated carbon before being finally softened with cationic resin, the latter step in order to limit the danger of fouling and scaling affecting reverse osmosis 1. Clearly, this stage depends on the quality of the available raw water (in this case, surface water).

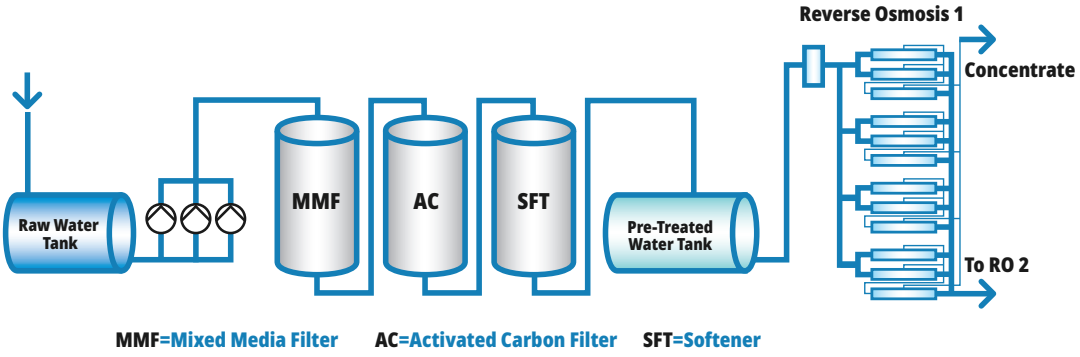


Figure 2: Ultrapure Water Line, Pretreatment

Possible Pretreatment Hach Equipment Concerned

- Conductivity (MMF, AC)
- Cationic conductivity (Softener)
- Turbidity (AC)

Make-Up Water Treatment

This treatment involves a second osmosis working in «2nd pass mode» which, at this stage, will have eliminated between 99% and 99.99% of virtually all ions, organic matter, and particles.

The permeate is stored in a tank where it is subjected to ozonation (sterilizing and oxidizing the organic matters (OM)) before being pumped to the 150 nm UV where residual ozone is destroyed, and TOC oxidation completed (see oxidation and reduction).

A vacuum de-aerator removes most of the CO_2 and oxygen (residual content < 10 ppb). The remaining ions that have passed through the two osmosis units or that have been created by ozone UV oxidation are removed by externally regenerated mixed beds, providing thorough resin regeneration and avoiding any danger of water becoming polluted anew by the regeneration reagents.

Downstream from the mixed beds, we should obtain a conductivity that is very close to the theoretical figure of 0.055 µs/cm (18.2 MΩ·cm at 20 °C).

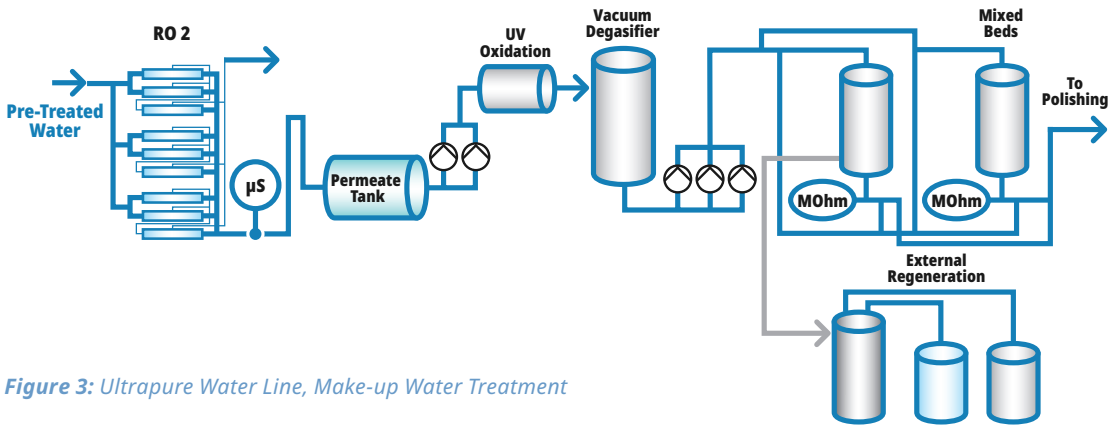


Figure 3: Ultrapure Water Line, Make-up Water Treatment

Possible Make-Up Water Hach Equipment Concerned

- UPW Conductivity
- Purecal
- Turbidity
- Dissolved Oxygen
- Dissolved Ozone
- Dissolved Carbone Dioxide
- ATP
- TOC*

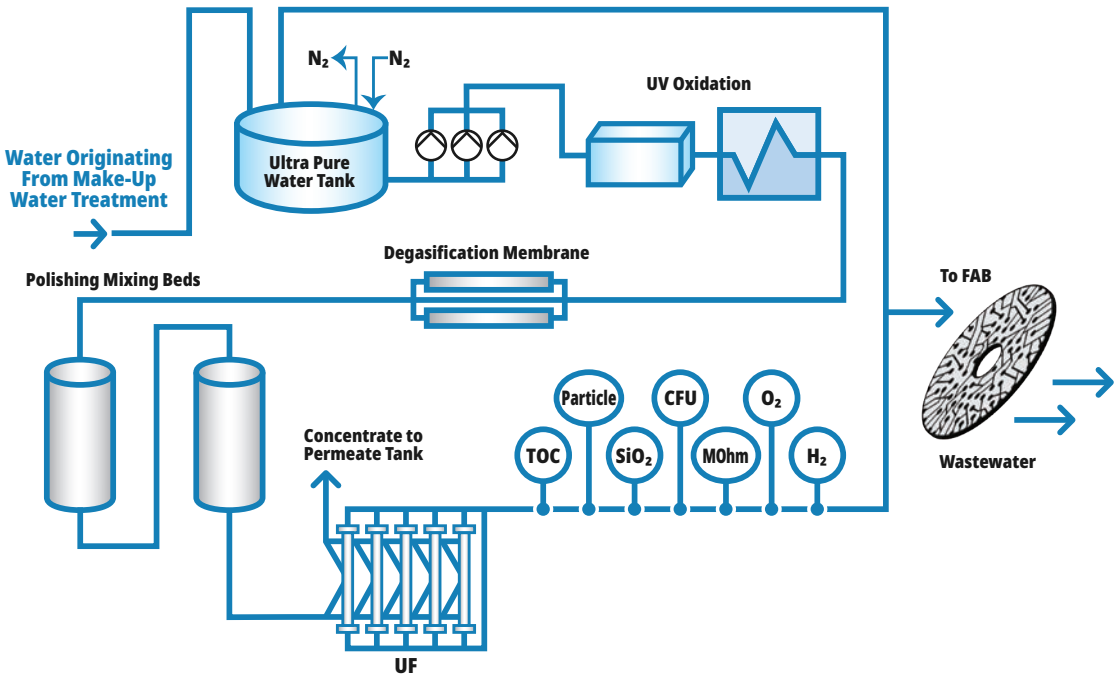
**Not provided by Hach.*

Polishing and Distribution Loop

This closed loop on the EUP tank (in nitrogen) is used to maintain:

- Distribution where water is constantly flowing round, thus avoiding any stagnant points (sites for bacterial recolonization ...);
- The quality of this water through a further UV oxidation, de-aeration of the final O_2 and CO_2 ppb through a de-aeration membrane, and then non-regenerating mixed beds installed on this loop.

Filtration through ultrafilters just upstream from extraction points guarantees final particle removal down to less than 1 particle > 0.05 µm per mL. After the ultrafilters, water quality is constantly monitored: at least its TOC, its particles, its conductivity and its silica content.



Possible Polishing and Distribution Loop Hach Equipment Concerned

- UPW Conductivity
- Purecal
- Ultra-low turbidity
- Silica
- Dissolved Oxygen
- Dissolved Hydrogen
- Dissolved Carbon Dioxide
- ATP
- TOC*
- Liquid Particle Counters*

**Not provided by Hach.*

Figure 4: *Ultrapure Water Line, Polishing and Distribution Treatment*

Effluent Treatment Line for the Semiconductor Industry

General Statement

Originally the poor cousin of EUP, effluent treatment has become increasingly important as the result of more and more demanding discharge standards and because of the emergence of new types of discharge produced by new production processes which, consequently, make effluent treatment more complicated.

A modern manufacturing unit has effluent that is processed through five systems:

- acid and base effluents;
- effluent containing hydrofluoric acid (HF);
- chemical and mechanical polishing effluent (CMP) containing suspended solids, colloids, etc.;
- CMP effluent that also contains copper;
- effluent containing ammonia and OM.

Depending on environmental restrictions, these effluents must undergo specific pretreatment and they are then usually neutralized together.

3 Examples of Installation

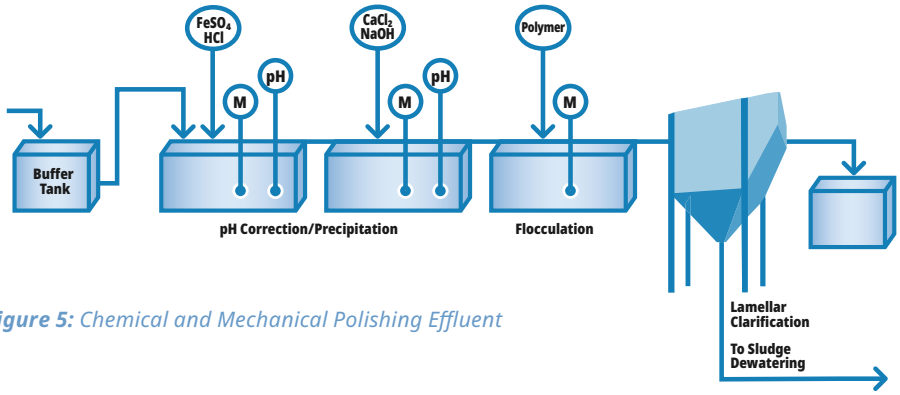


Figure 5: Chemical and Mechanical Polishing Effluent

Possible Effluent Water Hach Equipment Concerned

- Turbidity
- Suspended Solids
- pH
- Fluoride
- Aluminum
- Copper
- Iron
- TOC

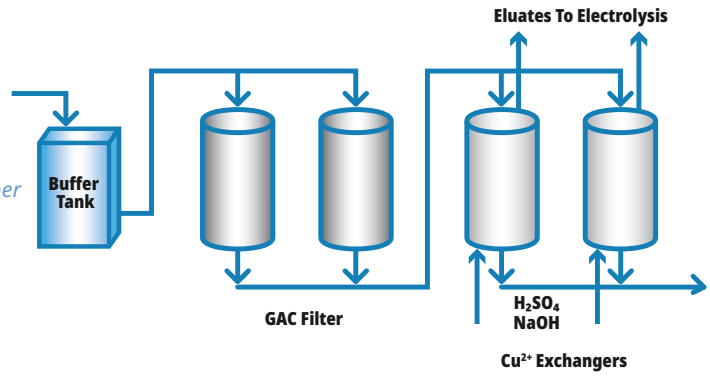


Figure 6: Chemical and Mechanical Polishing Effluent Containing Copper

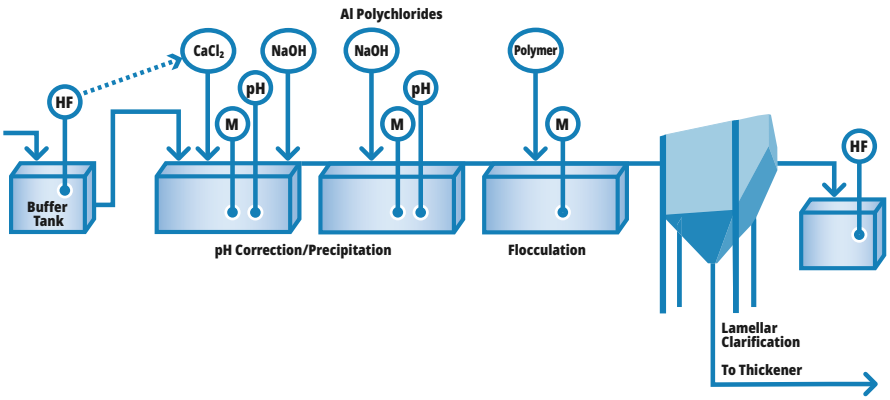


Figure 7: Wastewater Containing Hydrofluoric Acid

Recycling of Process Water

This is a dilemma for the high-quality water user that are the electronic and semiconductor manufacturer.

On one side, the amount of water required increase year over year and we can in overall consider that the rinsing and reusable waters have contamination levels that are far lower than those of the available raw water (potable or source water) and that segregating and retreating this rinsing water can prove extremely cost-effective.

On the other side, the fear of the presence of any kind of pollutants in the recycled water and the very high level of resource and energy developed to produce an under control ultrapure water, meeting all the requested criteria, generates production risk not always accepted.

Therefore, to mitigate the risks associated to such recycling process, several elements must be taken into consideration:

1. Recycling processes must be reliable and redundant, copying as closely as possible the raw water purification processes
2. All undesired elements present in the recycled water and not able to be securely treated by the main water purification processes should be eliminated before any adding in the general water preparation process.
3. Additionally, because of drought conditions, the authorities in some countries have recently imposed up to 85% recycling in order to restrict extractions from the natural environment with levels in residual discharges obviously higher.
4. Any change to the manufacturing process will have an impact on the effluent treatment. This requires permanent dialogue between producer and suppliers.

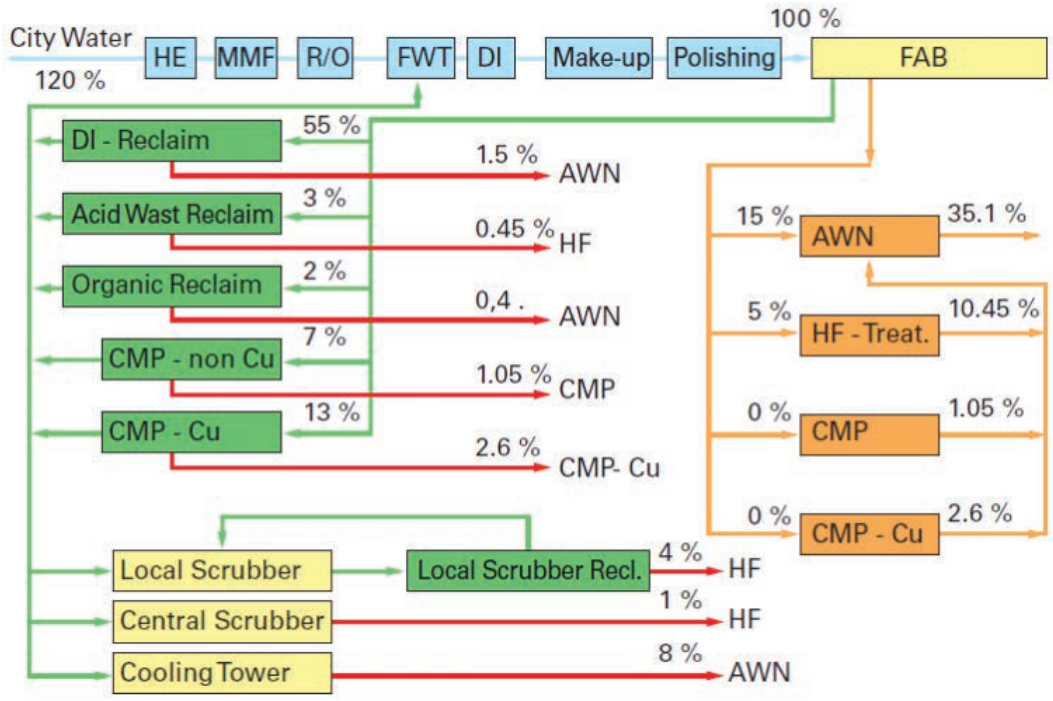


Figure 8: *Recycling Water Matrix*

Rinsing water treatment lines, after checking that they have limited contamination, are treated as follows:

- Suspended solids and colloids from CMPs are removed through UF membranes;
- Ions are passed through ion exchangers (Af – CaF – AF line);
- Isopropylic alcohol, the main organic matter present, is removed through a biofilter, usually followed by multimedia, activated carbon and reverse osmosis filtration (Figure 9).

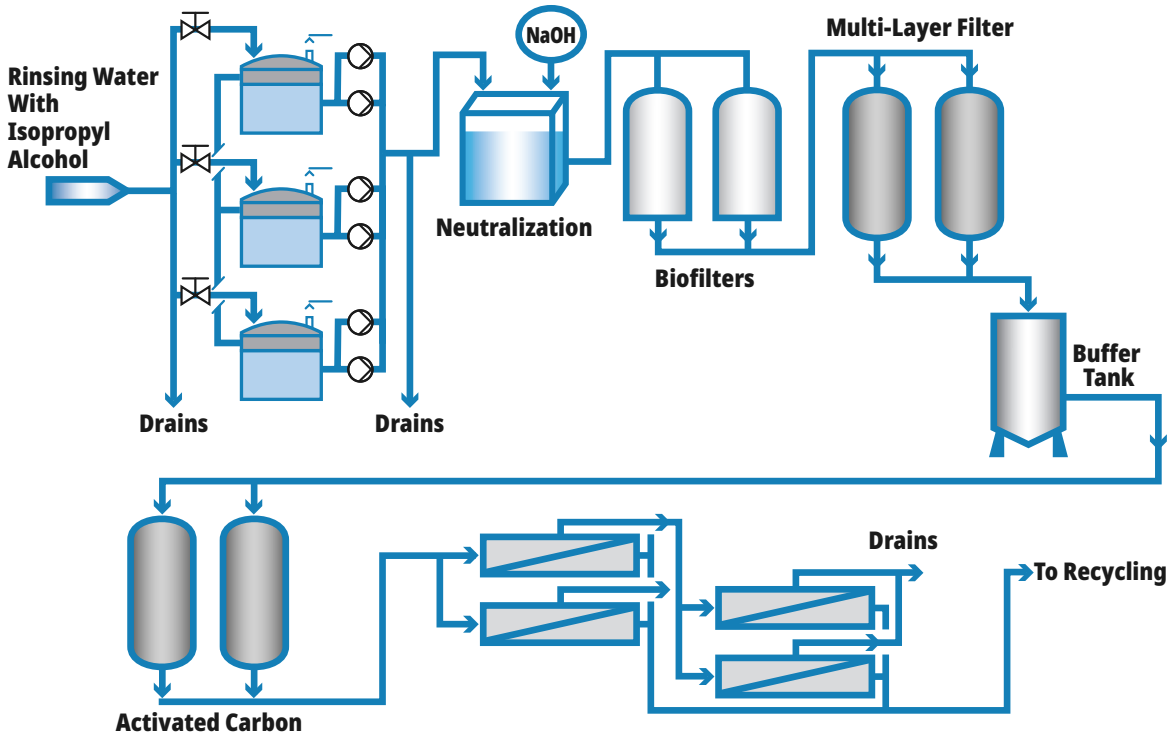


Figure 9: *Rinsing Water with Isopropyl Alcohol Recycling Cycle*

Path Between Laboratory & Online Systems

Hach Process and laboratory solutions are interlinked. However, this connection is not sufficiently highlighted with customers. This guide offers a way to set the link and alert the customer about the total solution we are representing.

If the customer uses Hach laboratory products, it may be worth presenting them the process solutions we can offer to support their daily work and therefore lighten their daily duties with online 24/7 measurement. The process solution will also help them to have a continuous survey of the process values independently from the laboratory measurement cadence.

If the customer is looking for or is already equipped with a process solution, the Hach laboratory portfolio provides an obvious continuum in the customer process control journey.

See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Alkalinity, Alkalinity & Hardness

	Free/Total Alkalinity	Free Alkalinity & Total Hardness	Total Alkalinity & Total Hardness		Free/Total Alkalinity & Total Hardness	Free/Total Alkalinity & Calcium/Total Hardness
Reference	EZ5001	EZ5003	EZ5011	EZ5004	EZ5005	EZ5006
Range	100-5000 mg/L	Alk 100-5000 mg/L TH 25-1000 mg/L	Alk 40-1000 mg/L TH 25-1000 mg/L	Alk 100-5000 mg/L TH 25-1000 mg/L	Alk 100-5000 mg/L TH 25-1000 mg/L	Alk 100-5000 mg/L TH/TH Ca 25-1000 mg/L
Method	Acid-base titration	Calmagite EDTA titration with LED dipping probe				
Interferences	Soaps, oily matter, suspended solids or precipitates may coat the glass electrode and cause a sluggish response.	Hardness: Some metal ions interfere by causing fading or indistinct end points or by stoichiometric consumption of EDTA. Suspended or colloidal organic matter also may interfere with the end point. Large amounts of color and turbidity interferes. Fats, oil, proteins, surfactants and tar. Alkalinity: Soaps, oily matter, suspended solids or precipitates may coat the glass electrode and cause a sluggish response.				
Sample Quality	Maximum particle size 100 µm, < 0.1 g/L; Turbidity < 50 NTU					
Filters	Microfiltration with PES membranes with Bypass					EZ9250
	Microfiltration with PES membranes immersion in situ					EZ9200
Dilution*	External Dilution Unit 1/50, 1/100, 1/150, 1/200, 1/250					EZ9700
	Internal Dilution Option 1/2, 1/4, 1/10					

Note: APA 6000 system is replaced by EZ analyzers.
See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Aluminum

	Aluminum		
	Dissolved Al(III)	**Total Al**	**Disolved Al(III) + Total Al**
Type of Water	Effluent, Final Industry Wastewater	Effluent, Final Industry Wastewater	Effluent, Final Industry Wastewater
Reference	EZ1001	EZ2000	EZ2300
Range	10 - 150 µg/L	10 - 150 µg/L	10 - 150 µg/L
Method	Colorimetric measurement using pyrocatechol violet method at 578 nm	Colorimetric measurement after digester using pyrocatechol violet method at 578 nm	
Interferences	Large amounts of color and turbidity interfere. Fats, oil, proteins, surfactants and tar.		
Sample Quality	Maximum particle size 100 µm, < 0.1 g/L; Turbidity < 50 NTU		
Filters	Microfiltration with PES membranes with Bypass		EZ9250
	Microfiltration with PES membranes immersion in situ		EZ9200
Dilution	External Dilution Unit 1/50, 1/100, 1/150, 1/200, 1/250		EZ9700
	Internal Dilution Option 1/2, 1/4, 1/10		See configurator

See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Ammonium

	Ammonium				
Type of Water	E-1, E-1.1, E-1.2, E-1.3	Final Industry Wastewater	Industry Wastewater	Industry Wastewater	Industry Wastewater
Reference	EZ1002	EZ1003	EZ4005	EZ3000/EZ3001	EZ3500/EZ3501/EZ3502
Range	0.005 - 0.1 mg/L NH_4-N	0.25 - 2 mg/L NH_4-N	100 - 5000 mg/L NH_4-N	1 - 10 mg/L NH_4-N / 10 - 100 mg/L NH_4-N	1 - 10 mg/L NH_4-N / 5 - 100 mg/L NH_4-N / 50 - 1000 mg/L NH_4-N
Method	Colorimetric measurement at 630 nm based on standard method APHA 3500-NH_3 (Berthelot)	Colorimetric measurement at 450 nm conform with standard method EPA 350.1 (Nessler)	Acid-base titration with sulphuric acid, conform with standard method APHA 4500-NH_3 (C)	Discontinuous, direct measurement by combined ion-selective electrode, conform with standard method APHA 4500-NH_3 (D)	Discontinuous measurement by combined ion-selective electrode with standard addition, conform with standard method APHA 4500-NH_3 (E)
Interferences	Amino acids, hydrazine and urea. Large amounts of color and turbidity interfere. Fats, oil, proteins, surfactants and tar.	Acetone, alcohols, aldehydes, aliphatic and aromatic amines, chlorine, glycine, organic chloramines and sulphide. Large amounts of color and turbidity interfere. Fats, oil, proteins, surfactants and tar.	Soaps, oily matter, suspended solids or precipitates may coat the glass electrode and cause a sluggish response. Allow additional time between titrant additions to let the electrode come to equilibrium or clean the electrodes occasionally. Alkaline compounds may interfere with the titration.	Volatile amines interfere. Fats, oil, proteins, surfactants and tar.	
Sample Quality	Maximum particle size 100 µm, < 0.1 g/L; Turbidity < 50 NTU				
Filters	Microfiltration with PES membranes with Bypass				EZ9250
	Microfiltration with PES membranes immersion in situ				EZ9200
Dilution	External Dilution Unit 1/50, 1/100, 1/150, 1/200, 1/250				EZ9700
	Internal Dilution Option 1/2, 1/4, 1/10				

See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Boron

	Boron	
	Dissolved B(III)	
Type of Water	Effluent, Final Industry Wastewater	
Reference	EZ1004	
Range	0 - 500 µg/L	
Method	Colorimetric measurement at 405 nm using Azomethine-H	
Interferences	Aluminium, Iron, Copper, Titanium and Zinc ions in high concentrations may interfere. Large amounts of color and turbidity interfere. Fats, oil, proteins, surfactants and tar.	
Sample Quality	Maximum particle size 100 µm, < 0.1 g/L; Turbidity < 50 NTU	
Filters	Microfiltration with PES membranes with Bypass	EZ9250
	Microfiltration with PES membranes immersion in situ	EZ9200
Dilution	External Dilution Unit 1/50, 1/100, 1/150, 1/200, 1/250	EZ9700
	Internal Dilution Option 1/2, 1/4, 1/10	See configurator

See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Chloride

	Chloride			
Type of Water	Effluent / Final Industry Wastewater	Industry Wastewater	Industry Wastewater	Industry Wastewater
Reference	EZ1005	EZ3003/3004/3005	EZ3503/3504/3505	EZ4006
Range	1 - 10 mg/L Cl	1 - 10 mg/L Cl 10 - 100 mg/L Cl 100 - 1000 mg/L Cl	1 - 10 mg/L Cl 5 - 100 mg/L Cl 50 - 1000 mg/L Cl	1 - 10 mg/L Cl 5 - 100 mg/L Cl 25 - 500 mg/L Cl
Method	Colorimetric measurement of turbidity at 480 nm after silver chloride (AgCl) precipitation, based on standard method APHA 4500-Cl (B)	Discontinuous, direct measurement by combined ion-selective electrode, conform with standard methods EPA 9212 and ASTM D512-12	Discontinuous measurement by combined ion-selective electrode with standard addition	Potentiometric titration with silver nitrate ($AgNO_3$), conform with standard method APHA 4500-Cl (D)
Interferences	Substances in amounts normally found in potable waters will likely not interfere. Bromide, iodide and cyanide register as equivalent chloride concentrations. Sulfide, thiosulphate and sulphite interfere but can be removed by treatment with hydrogen peroxide. Orthophosphate > 25 mg/L interferes by precipitating as silver phosphate. Iron > 10 mg/L interferes. Large amounts of color and turbidity interfere. Fats, oil, proteins, surfactants and tar	Bromide, sulfide, iodide, cyanide ions may interfere. Mercury must be absent. Ammonia and thiosulphate may interfere. Fats, oil, proteins, surfactants and tar.		Bromide, sulfide, iodide ions may interfere. Ferricyanide causes high results and must be removed. Chromate and dichromate interfere and should be reduced to chromic state or removed. Ferric iron interferes if present in an amount substantially higher than the amount of chloride. Chromic ion, ferrous ion and phosphate do not interfere. Fats, oil, proteins, surfactants and tar.
Sample Quality	Maximum particle size 100 µm, < 0.1 g/L; Turbidity < 50 NTU			
Filters	Microfiltration with PES membranes with Bypass			EZ9250
	Microfiltration with PES membranes immersion in situ			EZ9200
Dilution	External Dilution Unit 1/50, 1/100, 1/150, 1/200, 1/250			EZ9700
	Internal Dilution Option 1/2, 1/4, 1/10			

See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Chlorine

	Chlorine Analyzers				
Reference	Ultra Low Range Cl17	Cl17sc Free Chlorine	Cl17sc Total Chlorine	ClF10sc Free Chlorine	ClT10sc Total Chlorine
Range	0.008 - 5 mg/L Cl_2	0.03 - 10 mg/L		0.03 - 20 mg/L	
Method	Colorimetric DPD Standard Method 4500-Cl G	Colorimetric measurement at 510 nm		Reagent less, electrochemical, 3 electrodes amperometric system	
Accuracy	± 5% or ± 0.01 mg/L (whichever is greater) from 0 - 4 mg/L; ± 10% from 4 - 5 mg/L	± 5% or ± 0.04 mg/L (whichever is greater) from 0 - 5 mg/L Cl_2 ± 10% from 5 - 10 mg/L Cl_2		±3% of the reference test (DPD) at constant pH less than 7.2 (±0.2 pH unit) ±10% of the reference test (DPD) at stable pH less than 8.5 (±0.5 pH unit from the pH at calibration)	±10% of the reference test** (DPD) at stable pH less than 8.5 (±0.5 pH unit from the pH at calibration) ±20% of the reference test (DPD) at stable pH greater than 8.5
Interferences	Other oxidizing agents such as bromide, chlorine dioxide, permanganate, and ozone will cause a positive interference.	Other oxidizing agents such as bromide, chlorine dioxide, permanganate, and ozone will cause a positive interference. Hardness must not exceed 1,000 mg/L $CaCO_3$.		Monochloramine, chlorine dioxide, ozone, and c halk deposits	Chlorine dioxide, ozone, and chalk deposits
Sample Quality	Y-strainer filtration with 40-mesh screen or higher			NA	

See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Chromium

	Chromium			
	Dissolved Cr(VI)	**Total Cr**	**Dissolved Cr(VI) + Total Cr**	**Total Cr + Dissolved (Cr(III)+Cr(VI))**
Type of Water	Effluent, Final Industry Wastewater	Effluent, Final Industry Wastewater	Effluent, Final Industry Wastewater	Effluent, Final Industry Wastewater
Reference	EZ1009	EZ2001	EZ2301	EZ2400
Range	0 - 500 µg/L	0 - 500 µg/L	0 - 500 µg/L	0 - 500 µg/L
Method	Colorimetric measurement at 546 nm using diphenylcarbazide method, conform with standard method APHA 3500-Cr (B)		Colorimetric measurement after digester at 546 nm using diphenylcarbazide method, conform with standard method APHA 3500-Cr (B)	
Interferences	Fe (III), Hg > 200 mg/L, Mo > 200 mg/L, V > 5 mg/L. Large amounts of color and turbidity interfere. Fats, oil, proteins, surfactants and tar.		Fe (III), Hg > 200 mg/L, Mo > 200 mg/L, V > 5 mg/L. Large amounts of color and turbidity interfere. Fats, oil, proteins, surfactants and tar.	
Sample Quality	Maximum particle size 100 µm, < 0.1 g/L; Turbidity < 50 NTU			
Filters	Microfiltration with PES membranes with Bypass			EZ9250
	Microfiltration with PES membranes immersion in situ			EZ9200
Dilution	External Dilution Unit 1/50, 1/100, 1/150, 1/200, 1/250			EZ9700
	Internal Dilution Option 1/2, 1/4, 1/10			See configurator

Note: Chromium analyzer model EZ6003 is not suitable for industrial applications.
See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Conductivity / Resistivity

	Ultrapure Water*	Pure Water	Ultrapure Water Conductivity Certification System
Type of Water	E-1, E-1.1, E-1.2, E-1.3, E-2, E-3	E-4	E-1, E-1.1, E-1.2, E-1.3, E-2, E-3
Reference**	08310=A=0000	08311=A=0000	09526=A=0000
Cell Constant	K = 0.01	K = 0.1	K = 0.01
Range	0.01 - 200 µS/cm 5KΩ – 100 MΩ.CM	0.1 – 2 mS/cm 0.5kΩ – 10 MΩ.cm	0.01 - 200 µS/cm 5kΩ – 100 MΩ.cm
Method	Analog Contacting Conductivity Sensor with a cell constant determined according to ISO 7888 and ASTM D 1125 standards		Analogical Contacting Conductivity Sensor with a cell constant determined according to ISO 7888 and ASTM D 1125 standards. 9526 System certified according ASTM D5391
Interferences	Soaps, oily matter, suspended solids or precipitates may coat the glass electrode and cause a sluggish response. Air bubbles may generate measurement instability.		

** For ultrapure water application it is recommended to use Polymetron Conductivity Module for SC200 Ultrapure Controller (Product #: 9525800)*
*** Reference 8310 and 8311 can work up to 10 bars and 125°C. If higher pressure and/or temperature resistance are required, please select 8315 (k=0.01), 8394 (k=0.01, CIP) or 8316 (k=0.1) able to resist up to 25 bars and 150°C.*

	Drinking/Surface Water	Polluted Water
Type of Water	Incoming Water	Industry Wastewater
Reference	3798	3700*
Cell Constant	K = 2.35	K = 4.7
Range	250 µS/cm ... 2.5 S/cm	200 µS/cm ... 2.0 S/cm
Method	Inductive Conductivity Sensor	
Interferences	None	

** Sensor material must be selected in function of the application to be measured.*
See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Copper

	Copper			
	Dissolved Cu(II)		Total Cu	Total Cu + Dissolved Cu(II)
Type of Water	Effluent, Final Industry Wastewater		Effluent, Final Industry Wastewater	Effluent, Final Industry Wastewater
Reference	EZ1010	EZ1011	EZ2002	EZ2302
Range	0 - 3 mg/L	0 - 5 mg/L	0 - 3 mg/L	0 - 3 mg/L
Method	Colorimetric measurement at 546 nm using bicinchoninate method conform with Hach Method 8506	Colorimetric measurement at 480 nm using bathocuproine method conform with standard method APHA 3500-Cu (C)	Colorimetric measurement after Digester at 546 nm using bicinchoninate method, conform with Hach Method 8506	
Interferences	Acidity, metal ions like Aluminium (III) > 10 mg/L, Cyanide, Hardness, Iron (III) > 10 mg/L, Nickel (II) and Silver (II). Large amounts of color and turbidity interfere. Fats, oil, proteins, surfactants and tar.			
Sample Quality	Maximum particle size 100 µm, < 0.1 g/L; Turbidity < 50 NTU			
Filters	Microfiltration with PES membranes with Bypass			EZ9250
	Microfiltration with PES membranes immersion in situ			EZ9200
Dilution	External Dilution Unit 1/50, 1/100, 1/150, 1/200, 1/250			EZ9700
	Internal Dilution Option 1/2, 1/4, 1/10			See configurator

See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Dissolved Hydrogen

	Dissolved Hydrogen	
Reference	3121x*	31290TC*
Range	0 ppb to 75 ppb or 0 ppb to 300 ppb or 0 ppb to 3200 ppb or 0 ppb to 32 ppm 0 Pa to 5 kPa or 0 Pa to 20 kPa or 0 Pa to 200 kPa or 0 Pa to 2000 kPa	0 to 2 ppm or 0 to 25 cc/kg or 0 to 1.5 bar 0 to 10 ppm or 0 to 120 cc/kg or 0 to 6 bar 0 to 20 ppm or 0 to 220 cc/kg or 0 to 12 bar
Method	Electrochemistry	Thermal Conductivity
Accuracy	The greater of ±1% of reading or ± 0.03 ppb, or ± 1 Pa	±1% of reading, or ±2 ppb, or ±0.03 cc/kg, or ±1.5 bar
Channels	1 - 3	1 - 3

** Must be combined with 410/510 controllers, 3 m cable (32510.03) and, flow chamber (32001.01X).*
See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Dissolved Nitrogen

	Dissolved Nitrogen
Reference	3159xTC*
Range	0-350 ppm, or 0-300 ml/L, or 0-20 bar
Method	Thermal Conductivity
Accuracy	The greater of ±2% of reading or ± 0.3 ppm, or ± 0.25ml/L, or ± 15 mbar
Purge Gas	CO_2 or H_2 or Argon or He
Channels	1 - 3

** Must be combined with 410/510 controllers, 3 m cable (32510.03) and, flow chamber (32001.01X).*
See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Dissolved Oxygen

	Dissolved Oxygen		
Type of Water	E-1, E-1.1, E-1.2, E-1.3	E-1, E-1.1, E-1.3	
Reference	GA2400*	K1100*	3100
Range	0.1 ppb - 20 ppm or 0.25 Pa - 50 kPa	0.6 - 2000 ppb	0.6 - 2000 ppb
Method	Electrochemistry	Luminescent Dissolved Oxygen (process)	Luminescent Dissolved Oxygen (portable)
Accuracy	±1% of reading, or ± lower measurement range, whichever is greater	± 0.8 ppb or 2 % whichever is greater	± 0.8 ppb or 2 % whichever is greater
Channels	1 - 3	1 - 3	1

** Must be combined with 410/510 controllers, 3 m cable (32510.03) and, flow chamber (32001.01X).*
See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Dissolved Ozone

	Dissolved Ozone
Reference	C1100*
Range	0 ppb - 50 ppm O_3
Method	Electrochemistry
Accuracy	± 0.4 ppb or ±5%, whichever is the greater
Channels	1 - 3

** Must be combined with 410/510 controllers, 3 m cable (32510.03) and, flow chamber (32001.01X)*
See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Fluoride

	Fluoride		
Type of Water	Effluent / Final Industry Wastewater	Effluent / Final Industry Wastewater	Industry Wastewater
Reference	EZ3007	EZ3507	EZ3508
Range	0.1 – 10 mg/L F^-	0.1 – 10 mg/L F^-	1 – 100 mg/L F^-
Method	Discontinuous, direct measurement by combined ion-selective electrode, conform with standard methods EPA 9214 and ASTM D1179	Discontinuous measurement by combined ion-selective electrode with standard addition	
Interferences	Metal ions like aluminium > 72 mg/L, calcium > 108 mg/L and iron > 150 mg/L. Fats, oil, proteins, surfactants and tar.		
Sample Quality	Maximum particle size 100 µm, < 0.1 g/L; Turbidity < 50 NTU		
Filters	Microfiltration with PES membranes with Bypass		EZ9250
	Microfiltration with PES membranes immersion in situ		EZ9200
Dilution	External Dilution Unit 1/50, 1/100, 1/150, 1/200, 1/250		EZ9700
	Internal Dilution Option 1/2, 1/4, 1/10		
Channels	1 – 8		

See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Hardness (Calcium and/or Total)

	Hardness						
	Total Hardness	**Calcium Hardness**	**Total & Calcium Hardness**	**Total & Calcium & Magnesium Hardness**	**Total Hardness**	**Total Hardness**	**Calcium Hardness**
Reference	EZ1016	EZ1017	EZ1304	EZ1036	EZ4043	EZ4041	EZ4044
Range	0.025 - 1 mg/L $CaCO_3$	0.025 - 1 mg/L $CaCO_3$	0.025 - 1 mg/L $CaCO_3$	TH/TH ca: 0.025 - 1 mg/L $CaCO_3$ TH Mg: 0.1– 1 mg/L, expressed as $CaCO_3$	0.25 - 10 mg/L $CaCO_3$	100 - 1000 mg/L $CaCO_3$	100 - 1000 mg/L $CaCO_3$
Method	Colorimetric measurement at 610 nm using calmagite/ EDTA	Colorimetric measurement at 610 nm using hydroxynaph-thol blue / EDTA	TH: Colorimetric measurement at 610 nm using calmagite / EDTA TH Ca: Colorimetric measurement at 610 nm using hydroxynaphthol blue/EDTA		Colorimetric titration by EDTA using color indicator calmagite at 610 nm		Colorimetric titration by EDTA using color indicator hydroxynaph-thol blue at 620 nm
Interferences	Some metal ions interfere by causing fading or indistinct end points or by stoichiometric consumption of EDTA. Fats, oil, proteins, surfactants and tar.	Dissolved Copper Cu(II) > 2 mg/L, Iron Fe(II) > 20 mg/L, Manganese > 10 mg/L, Zinc > 5 mg/L, Lead > 5 mg/L, Aluminium > 5 mg/L and Tin Sn(IV) interfere. Orthophosphate precipitates Calcium at the pH of the test. Strontium and Barium give a positive interference and alkalinity in excess of 300 mg/L may cause an indistinct end point in hard waters. Large amounts of color and turbidity interfere. Fats, oil, proteins, surfactants and tar.			Some metal ions interfere by causing fading or indistinct end points or by stoichiometric consumption of EDTA. Suspended or colloidal organic matter also may interfere with the end point. Large amounts of color and turbidity interfere. Fats, oil, proteins, surfactants and tar.		
Sample Quality	Maximum particle size 100 µm, < 0.1 g/L; Turbidity < 50 NTU						
Filters	Microfiltration with PES membranes with Bypass						EZ9250
	Microfiltration with PES membranes immersion in situ						EZ9200
Dilution*	External Dilution Unit 1/50, 1/100, 1/150, 1/200, 1/250						EZ9700
	Internal Dilution Option 1/2, 1/4, 1/10						

See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Iron

	Iron								
	Dissolved Fe(II)	**Total Dissolved (Fe(II) + Fe(III))**	**Dissolved Fe(II) + Total Dissolved (Fe(II) + Fe(III))**	**Dissolved Fe(II) + Total Dissolved (Fe(II)+F Fe(III)) + Dissolved Fe(III)**	**Total Fe**	**Total Fe + Dissolved Fe(II)**	**Total Fe + Total Dissolved (Fe(II) + Fe(III))**	**Total Fe + Total Dissolved (Fe(II) + Fe(III)) + Dissolved Fe(II)**	**Total Fe + Total Dissolved (Fe(II) + Fe(III)) + Dissolved Fe(II) + Dissolved Fe(III)**
Tupe of Water	Effluent, Final Industry Wastewater								
Reference	EZ1023	EZ1024	EZ1302	EZ1303	EZ2005	EZ2305	EZ2306	EZ2307	EZ2308
Range	0.01 - 1 mg/L	0.01 - 1 mg/L	0.01 - 1 mg/L	0.01 - 1 mg/L, 0.04 - 1 mg/L FeIII	0.01-1 mg/L	0.01-1 mg/L	0.01-1 mg/L	0.01-1 mg/L	0.01 - 1 mg/L, 0.04 - 1 mg/L FeIII
Method	Colorimetric measurement using TPTZ color solution (578nm)				Colorimetric measurement after digester using TPTZ color solution (578nm)				
Interferences	Metal ions like Pb > 10 mg/L, Zn > 2 mg/L, Ni > 2 mg/L, Cu > 5 mg/L. Strong oxidising agents (o3, Kmno3, clo2), Cyanide, Nitrite, Phosphate (polyphosphate more than orthophosphate), Chromium, Zinc in concentrations exceeding 10 times that of Iron. Bismuth, Cadmium, Mercury, Molybdate, and Silver precipitate Phenanthroline. Polyphosphate must be absent. Large amounts of color and turbidity interfere. Fats, oil, proteins, surfactants and tar.								
Sample Quality	Maximum particle size 100 µm, < 0.1 g/L; Turbidity < 50 NTU								
Filters	Microfiltration with PES membranes with Bypass							EZ9250	
	Microfiltration with PES membranes immersion in situ							EZ9200	
Dilution	External Dilution Unit 1/50, 1/100, 1/150, 1/200, 1/250							EZ9700	
	Internal Dilution Option 1/2, 1/4, 1/10							See configurator	

See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Manganese

	Manganese		
	Dissolved Mn(II)	**Total Mn**	**Total Mn + Dissolved Mn(II)**
Type of Water	Effluent, Final Industry Wastewater		
Reference	EZ1025	EZ2003	EZ2303
Range	0.01-1 mg/L	0.02 - 1 mg/L	0.02-1 mg/L
Method	Colorimetric measurement using formaldoxime method at 450 nm	Colorimetric measurement after digestor using formaldoxime method at 450 nm	
Interferences	Large amounts of color and turbidity interfere. Fats, oil, proteins, surfactants and tar.		
Sample Quality	Maximum particle size 100 µm, < 0.1 g/L; Turbidity < 50 NTU		
Filters	Microfiltration with PES membranes with Bypass		EZ9250
	Microfiltration with PES membranes immersion in situ		EZ9200
Dilution	External Dilution Unit 1/50, 1/100, 1/150, 1/200, 1/250		EZ9700
	Internal Dilution Option 1/2, 1/4, 1/10		

Note: Manganese analyzers model EZ6006 and EZ6204 are not suitable for industrial applications.
See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Nickel

	Nickel	
	Dissolved Ni(II)	**Total Ni**
Type of Water	Effluent, E-4, Final Industry Wastewater	
Reference	EZ1027	EZ2004
Range	5 – 500 µg/L	10 – 500 µg/L
Method	Colorimetric measurement using Di Methyl Glyoxime (DMG)	Colorimetric measurement using Di Methyl Glyoxime (DMG), after hot-acid digestion
Interferences	Metal ions like Aluminium (III) [(Al)3+)], Bismuth (II) [(Bi)2+], Cadmium (II) [(Cd)2+)], Chromium (III) [(Cr)3+)], Cobalt (II) [(Co)2+)], Copper (II) [(Cu)2+)], Iron (II) [(Fe)2+)], Iron (III) [(Fe)3+)], Lead (II) [(Pb)2+)], Manganese (II) [(Mn)2+)], Magnesium (II) [(Mg)2+)], Mercury (II) [(Hg)2+)], Palladium (II) [(Pd)2+)], Platinum (II) [(Pt)2+)], Silver (II) [(Ag)+)], Tin (II) [(Sn)2+)] & Zinc (II) [(Zn)2+)] Large amounts of color and turbidity interferes. Fats, Oil, Proteins, Surfactants and Tar.	Metal ions like Aluminium (III) [(Al)3+)], Bismuth (II) [(Bi)2+], Cadmium (II) [(Cd)2+)], Chromium (III) [(Cr)3+)], Cobalt (II) [(Co)2+)], Copper (II) [(Cu)2+)], Iron (II) [(Fe)2+)], Iron (III) [(Fe)3+)], Lead (II) [(Pb)2+)], Manganese (II) [(Mn)2+)], Magnesium (II) [(Mg)2+)], Mercury (II) [(Hg)2+)], Palladium (II) [(Pd)2+)], Platinum (II) [(Pt)2+)], Silver (II) [(Ag)+)], Tin (II) [(Sn)2+)] & Zinc (II) [(Zn)2+)]. Sample solutions containing complexing agents like EDTA or Cyanide must be digested with Potassium peroxodisulphate [K2S2O8]. When the COD concentration is >300 mg/L to 500 mg/L double the quantity of Potassium peroxodisulphate. Large amounts of color and turbidity interferes. Fats, Oil, Proteins, Surfactants and Tar.
Sample Quality	Maximum particle size 100 µm, < 0.1 g/L; Turbidity < 50 NTU	
Filters	Microfiltration with PES membranes with Bypass	EZ9250
	Microfiltration with PES membranes immersion in situ	EZ9200
Dilution	External Dilution Unit 1/50, 1/100, 1/150, 1/200, 1/250	EZ9700
	Internal Dilution Option 1/2, 1/4, 1/10	See configurator

Note: Nickel analyzers model EZ6007 dissolved Nickel Ni(II) and EZ6205 total Nickel are not suitable for industrial applications.
See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Nitrate/Nitrite

	Nitrate	Nitrite	Nitrate & Nitrite
Type of Water	Effluent, E3, E4, Final Industry Wastewater	Effluent, E3, E4, Final Industry Wastewater	Effluent, E3, E4, Final Industry Wastewater
Reference	EZ1028	EZ1029	EZ1301
Range	2 - 100 µg/L NO_3-N	1 - 100 µg/L NO_2-N	2 - 200 µg/L NO_3-N & 1 - 200 µg/L NO_2-N
Method	Colorimetric measurement at 546 nm using NEDD, conform with standard method ASTM 4500-NO3-A	Colorimetric measurement at 546 nm using NEDD, conform with standard method ASTM 4500-NO2-A	Colorimetric measurement at 546 nm using NEDD, conform with standard method ASTM 4500-NO3-A Colorimetric measurement at 546 nm using NEDD, conform with standard method ASTM 4500-NO2-A
Interferences	Ions like Antimony Sb(III), Bismuth, Chloroplatinate, Gold, Iron Fe(III), Lead, Mercury, Metavanadate, Silver can precipitate with Nitrate. Presence of Copper Cu(II) may decompose the diazonium salt which results in a low result. Strong oxidizing agents. Tricloramine results in a false red color. Large amounts of color and turbidity interfere. Fats, oil, proteins, surfactants and tar.		
Sample Quality	Maximum particle size 100 µm, < 0.1 g/L; Turbidity < 50 NTU		
Filters	Microfiltration with PES membranes with Bypass		EZ9250
	Microfiltration with PES membranes immersion in situ		EZ9200
Dilution	External Dilution Unit 1/50, 1/100, 1/150, 1/200, 1/250		EZ9700
	Internal Dilution Option 1/2, 1/4, 1/10		
Channels	1 – 8		

See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

pH/ORP

	pH/ORP	
Type of Water	E-4, inlet, outlet	E-1, E-1.1, E-1.2, E-1.3, E-2, E-3
Reference	Differential Sensor/Combination Sensor	08362=A=0000(pH); 08362=A=1111 (ORP)
Range	-2 to 14 pH (pHD); 0 to 14 pH (3/4 inch); -1500 to +1500 mV (pHD) -2000 to +2000 mV (3/4 inch)	2 to 12 pH; - 1500 to 1500 mV
Method	**pH-** Two electrodes compare the process value to a stable internal reference standard buffer solution. The internal electrode is non-flowing, foul-resistant characteristics. **ORP-** Oxidation Reduction Potential. Cell potential is measure from a cell compising a nobel metal electrode that does not take part in the reaction. A reference electrode provides an electrical reference point of measurement.	**pH-** two-electrode system whereby a combined glass and reference electrode compares the potential of the electrical energy of the sample to the internal reference solution and produces a voltage value per the Nernst equation. This value is converted to pH. **ORP-** determination of the electron activity of a solution by using an inert indicator electrode and a reference electrode. The potential difference between the indicator electrode and the reference electrode equals the redox potential of the system.
Interferences	Stray current in Sample	
Sample Quality	N/A	

See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Phosphates

	Phosphates			
Type of Water	Effluent, E3, E4, Final Industry Wastewater	Effluent, E4, Final Industry Wastewater	Effluent, E4, Final Industry Wastewater	Effluent, E3, E4, Final Industry Wastewater
Reference	5500		EZ1031	EZ1032
Range	4-3000 µg/L as PO_4	0.2-50 mg/L as PO_4	0.1 - 10 mg/L PO_4-P	0.005 - 1 mg/L PO_4-P
Method	Colorimetric		Colorimetric measurement using vanadate yellow method (450 nm)	Molybdate blue method (630 nm), conform with APHA 4500-P (C) and (E)
Interferences	No interferences		Positive interference is caused by Silica Arsenate if the sample is heated. Negative interferences are caused by Arsenate, Fluoride, Thorium, Bismuth, Sulphide, Thiosulphate, Thiocyanate or excess of Molybdate. Blue color is caused by Ferrous Iron, but this does not affect results for Ferrous Iron concentrations < 100 mg/L. If Nitric Acid is used, Chloride interferes from 75 mg/L. Large amounts of color and turbidity interfere. Fats, oil, proteins, surfactants and tar.	Arsenic (V), Chromium (VI), Copper (II) > 10 mg/L, Iron (III) > 10 mg/L, Sulphide > 2 mg/L, Vanadium, Silica > 60 mg/L. Large amounts of color and turbidity interfere. Fats, oil, proteins, surfactants and tar.
Sample Quality	< 2 NTU, no oil, no grease, Maximum particle size 100 µm		Maximum particle size 100 µm, < 0.1 g/L; Turbidity < 50 NTU	
Filters	Microfiltration with PES membranes with Bypass			EZ9250
	Microfiltration with PES membranes immersion in situ			EZ9200
Dilution*	External Dilution Unit 1/50, 1/100, 1/150, 1/200, 1/250			EZ9700
	Internal Dilution Option 1/2, 1/4, 1/10			
Channels	1 – 6			

** Not applicable on model 5500.*

See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Silica

	Silica		
Type of Water	E-1, E-1.1, E-2, E-3, E-4	E-1, E-1.1, E-2, E-3, E-4	E-3, E-4
Reference	5500	EZ1034	EZ1035
Range	0.5 ppb - 5000 µg/L SiO_2	1 – 100 µg/L SiO_2	10 – 1000 µg/L SiO_2, up to 100 mg/L
Method	Colorimetric	Colorimetric measurement at 800 nm	Colorimetric measurement at 630 nm
Interferences	No interferences	Tannin, large amounts of Iron, Sulfide and Phosphate interfere. Large amounts of color and turbidity interfere. Fats, oil, proteins, surfactants and tar.	
Sample Quality	< 2 NTU, no oil, no grease, Maximum particle size 100 µm	Maximum particle size 100 µm, < 0.1 g/L; Turbidity < 50 NTU	
Filters	Microfiltration with PES membranes with Bypass		EZ9250
	Microfiltration with PES membranes immersion in situ		EZ9200
Dilution*	External Dilution Unit 1/50, 1/100, 1/150, 1/200, 1/250		EZ9700
	Internal Dilution Option 1/2, 1/4, 1/10		
Channels	1 – 6		

** Not applicable on model 5500.*
See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Sodium

	Sodium		
Type of Water	E-1, E-1.1,E-2, E-3,E-4	Effluent, Final Industry Wastewater	
Reference	5600	EZ3015	EZ3016
Range	0.01 ppb - 10,000 µg/L Na^+	10 - 100 mg/L Na^+	100 - 1000 mg/L Na^+
Method	Continuous, direct measurement by ion-selective electrode	Discontinuous, direct measurement by combined ion-selective electrode	
Interferences	No interferences if pH after conditioning is greater than 10.5	Silver ions (Ag^+) must be absent. The sodium electrode is sensitive to the following ions. The ratio of these ions to sodium ($X+/Na^+$) should thus not be larger than the value in brackets: H^+ (< 0.001), Li^+ (<1), K^+ (< 5), NH_4^+ (< 50), Mg_2^+ (< 2000). Fats, oil, proteins, surfactants and tar.	
Sample Quality	< 2 NTU, no oil, no grease, Maximum particle size 100 µm	Maximum particle size 100 µm, < 0.1 g/L; Turbidity < 50 NTU	
Filters	Microfiltration with PES membranes with Bypass		EZ9250
	Microfiltration with PES membranes immersion in situ		EZ9200
Dilution*	External Dilution Unit 1/50, 1/100, 1/150, 1/200, 1/250		EZ9700
	Internal Dilution Option 1/2, 1/4, 1/10		

** Not applicable on model 5600.*
See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Sulfate

	Sulfate	
Type of Water	Effluent, Industry Wastewater	Industry Wastewater
Reference	EZ1036	EZ4039
Range	10 - 40 mg/L SO_4	20 - 200 mg/L SO_4
Method	Colorimetric measurement of turbidity at 450 nm after barium precipitation, conform with standard methods EPA 375.4 and APHA 4500-SO4	Colorimetric titration by EDTA using color indicator calmagite at 610 nm after barium sulphate precipitation
Interferences	No Other metals that form complexes with EDTA. Silica > 500 mg/L, organic matter in water. Suspended or colloidal organic matter also may interfere with the endpoint. Large amounts of color and turbidity interfere. Fats, oil, proteins, surfactants and tar.	Some metal ions interfere by causing fading or indistinct end points or by stoichiometric consumption of EDTA. Silica > 500 mg/L interferes. Suspended or colloidal organic matter also may interfere with the end point. Large amounts of color and turbidity interfere. Fats, oil, proteins, surfactants and tar.
Sample Quality	Maximum particle size 100 µm, < 0.1 g/L; Turbidity < 50 NTU	
Filters	Microfiltration with PES membranes with Bypass	EZ9250
	Microfiltration with PES membranes immersion in situ	EZ9200
Dilution	External Dilution Unit 1/50, 1/100, 1/150, 1/200, 1/250	EZ9700
	Internal Dilution Option 1/2, 1/4, 1/10	
Channels	1 – 8	

See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Total Organic Compounds (TOC)

	TOC	
Type of Water	E-3, E-4	E-2, E-3, E-4
Reference	B3500C	B3500ul
Range	0 - 25 mg/L C, 0 - 100 mg/L C	0 - 5000 µg/L C
Method	Infrared measurement of CO_2 after patented Two-Stage Advanced Oxidation Process (TSAO) (DIN EN 1484:1997-08, ISO 8245:1999-03, EPA 415.1)	Infrared measurement of CO_2 after patented Two-Stage Advanced Oxidation Process (TSAO) using Hydroxyl Radicals
Interferences	None	
Sample Qulaity	Maximum particle size 100 µm	

Note: TOC measurement for water purer than E-2, please contact your local Beckman Coulter representative for Anatel TOC solution.
See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Turbidity

	Turbidity		
Reference	TU5300 Online Laser Turbidimeters	TU5400 Online Laser Turbidimeters	TU5200 Benchtop Laser Turbidimeters
Range	EPA: 0-700 NTU/FNU/TE/F/FTU 0 - 100 mg/L 0 - 175 EBC ISO: 0 - 1000 NTU/FNU/TE/F/FTU 0 - 100 mg/L 0 - 250 EBC		
Method	Class 2 laser product, with embedded 650 nm (EPA 0.43 mW) or Class 1 laser product, with embedded 850 nm (ISO), max. 0.55 mW (complies with IEC/EN 60825-1 and to 21 CFR 1040.10 in accordance with Laser Notice No. 50)		
Accuracy	±2% or 0.01 NTU from 0 - 40 NTU ±10% of reading from 40 - 1000 NTU based on Formazin primary standard		
Repeatability	Better than 1% of reading or ±0.002 NTU.	±0.0006 NTU (TU5400) on Formazin at 25°C (77 °F), whichever is greater.	<40 NTU: Better than 1% of reading or ±0.002 NTU on Formazin at 25 °C, whichever is greater. >40 NTU: Better than 3.5% of reading on Formazin at 25 °C.

See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Zinc

	Zinc	
	Dissolved Zn(II)	
Type of Water	Effluent, Final Industry Wastewater	
Reference	EZ1040	
Range	0 - 1 mg/L	
Method	Colorimetric measurement at 630 nm using Zincon, conform with standard method APHA 3500-Zn (B)	
Interferences	Al(III) > 5 mg/L, Cd(II) > 1 mg/L, Chromate > 50 mg/L, Cr(III) > 10 mg/L, Co(II) > 30 mg/L, Cu(II) > 30 mg/L, Fe(II) > 9 mg/L, Fe(III) > 7 mg/L, Mn(II) > 5 mg/L, Ni(II) > 5 mg/L, organic matter and extreme sample pH fluctuation. Large amounts of color and turbidity interfere. Fats, oil, proteins, surfactants and tar.	
Sample Quality	Maximum particle size 100 µm, < 0.1 g/L; Turbidity < 50 NTU	
Filters	Microfiltration with PES membranes with Bypass	EZ9250
	Microfiltration with PES membranes immersion in situ	EZ9200
Dilution	External Dilution Unit 1/50, 1/100, 1/150, 1/200, 1/250	EZ9700
	Internal Dilution Option 1/2, 1/4, 1/10	See configurator

Note: Zinc analyzers model EZ6010, EZ6104, EZ6106, EZ6109, EZ6208, EZ6303, EZ6305 and EZ6308 are not suitable for industrial applications.
See the Lab Applications Quick Reference Guide, starting on page 26, for Hach laboratory solutions.

Lab Applications Quick Reference Guide

Application				Instrument												Vertical Market											
																Drinking Water						Industrial					
Parameter	EPA	Chemistry	Range (mg/l unless noted)	AT1000	HQd Meter	DR6000 Spectrophotometer	DR3900 Spectrophotometer	DR1900 Spectrophotometer	DR900 Colorimeter	DR300	SL1000	Kits	Digital Titrator	Other Instrument	Raw Water	Clarifier Effluent	Filter/Membrane Effluent	Final Effluent	Distribution System	Waste Water	Power/Steam	Chemical/Petrochemical	Pulp & Paper	Food	Beverage	Metals/Mining
Acidity		Sodium Hydroxide/Methyl Orange/Phenolphthalein	10-4000										•		•						•	•	•	•	•	•
Advanced Drinking Water Lab												•														
Advanced Portable Lab												•														
Advanced Wastewater Lab												•														
Alkalinity		pH-metric titration	0.4-20 mmol/L	•											•	•		•	•	•	•	•	•	•	•	•
Alkalinity		TNT870	25-400			•	•	•							•	•		•	•	•	•	•	•	•	•	•
Alkalinity		ChemKey	20-200								•				•	•		•	•	•	•	•	•	•	•	•
Alkalinity		ChemKey	200-700								•				•	•		•	•	•	•	•	•	•	•	•
Alkalinity		Sulfuric Acid/ Phenolphthalein/Bromcresol Green-Methyl Red	10-4000										•		•	•		•	•	•	•	•	•	•	•	•
All colorimetric		All colorimetric	variable										Lachat		•	•	•	•	•	•	•	•	•	•	•	•
Aluminum		Alumion	0.008-0.800			•	•	•	•	•					•	•		•		•	•	•	•	•	•	•
Aluminum		Eriochrome Cyanide R	0.006-0.250			•	•	•							•	•		•		•	•	•	•	•	•	•
Aluminum		TNT848	0.02-0.50			•	•	•							•	•		•		•	•	•	•	•	•	•
Arsenic	•	Silver Diethyldithiocarbamate	0-0.200			•	•	•							•			•		•	•	•	•	•	•	•
Ballast Water Validation												•														
Barium		Turbidimetric	2-100			•	•	•	•											•	•	•	•	•	•	•
Barium		Turbidimetric	2-10000			•	•	•	•											•	•	•	•	•	•	•
Basic Drinking Water Laboratory												•														
Basic Wastewater Lab												•														
Benzotriazole/ Tolyltriazole		UV Photolysis	1.0-20.0			•	•	•	•												•	•	•	•	•	•
Biochemical Oxygen Demand	•	Luminescent	0.05-20.00		•										•					•	•	•	•	•	•	•
Boiler Feed and Scale												•														
Boiler Treatment Control												•														
Boron		Carmine	0.2-14			•	•	•	•											•	•	•	•	•	•	•
Boron		Carmine	2-50			•	•	•	•											•	•	•	•	•	•	•
Boron		TNT877	0.02-2.50			•	•	•												•	•	•	•	•	•	•
Bromine		Electrometric titration	0.500-200/100 g g Br2	•														•		•	•	•	•	•	•	•
Bromine		DPD powder pillow	0.05-4.50			•	•	•	•						•			•		•	•	•	•	•	•	•
Bromine		DPD AccuVac	0.05-4.50			•	•	•	•						•			•		•	•	•	•	•	•	•
Cadmium		TNT852	0.02-0.30			•	•	•							•			•		•	•	•	•	•	•	•
Cadmium		Dithizone	0.0007-0.0800			•	•	•							•			•		•	•	•	•	•	•	•
Carbon Dioxide		Sodium Hydroxide/ Phenolphthalein	10-1000										•		•						•	•	•	•	•	•
Chelants, Free		Magnesium Chloride/Calmagite	0-20.0										•		•			•			•	•	•	•	•	•
Chelants, Total		Bismuth Nitrate/Methylthymol Blue	0-40.0										•		•			•			•	•	•	•	•	•
Chemical Oxygen Demand (COD)		Manganese III TNT	30-1000			•	•	•	•						•					•	•	•	•	•	•	•
		Mercury-free TNT825	25-1000			•	•	•							•					•	•	•	•	•	•	•
		Dichromate TNT	0.7-40			•	•	•	•						•					•	•	•	•	•	•	•
	•	Dichromate TNT	3-150			•	•	•	•						•					•	•	•	•	•	•	•
	•	Dichromate TNT	20-1500			•	•	•	•						•					•	•	•	•	•	•	•
		Dichromate TNT	200-15000			•	•	•	•						•					•	•	•	•	•	•	•
		TNT820	1-60			•	•	•							•					•	•	•	•	•	•	•
	•	TNT821	3-150			•	•	•							•					•	•	•	•	•	•	•
	•	TNT822	20-1500			•	•	•							•					•	•	•	•	•	•	•
		TNT823	250-15000			•	•	•							•					•	•	•	•	•	•	•
		TNT824	5000-60000			•	•	•							•					•	•	•	•	•	•	•
Chloramine (Mono)		Indophenol TNT	0.1-10.0			•	•	•	•	•						•	•	•	•							
Chloramine (Mono)		Indophenol	0.04-4.50			•	•	•	•	•						•	•	•	•							
Chloramine (Mono)		ChemKey	0.04-4.60								•					•	•	•	•							
Chloramine (Mono) and Nitrogen, Free Ammonia		Indophenol	0.04-4.60			•	•	•	•	•						•	•	•	•							
Chloride		Silver nitrate titration	5-400	•											•			•		•	•	•	•	•	•	•
Chloride		Mercuric Thiocyanate	0.1-25.0			•	•	•							•			•		•	•	•	•	•	•	•
Chloride		TNT879	1.0-1000			•	•	•							•			•		•	•	•	•	•	•	•
Chloride		QuanTab test strip	30-600												•			•		•	•	•	•	•	•	•
Chloride		QuanTab test strip	300-6000												•			•		•	•	•	•	•	•	•
Chloride		Mercuric Nitrate/ Diphenylcarbazone	10-8000										•		•			•		•	•	•	•	•	•	•
Chloride		Silver Nitrate/Potassium Chromate	10-10000										•		•			•		•	•	•	•	•	•	•
Chloride		Ion selective elctrode	0.1-35500		•						•				•			•		•	•	•	•	•	•	•
Chlorine Demand	•	DPD powder pillow	variable			•	•	•	•	•									•							
Chlorine Dioxide		Thiosulfate titration	100-4500	•											•	•	•	•	•		•	•	•	•	•	•
Chlorine Dioxide		Phenyl arsine oxide titration	0.100-5.00	•											•	•	•	•	•		•	•	•	•	•	•
Chlorine Dioxide		Chlorophenol Red	0.01-1.00			•	•	•							•	•	•	•	•		•	•	•	•	•	•
Chlorine Dioxide	•	DPD powder pillow	0.04-5.00			•	•	•	•	•					•	•	•	•	•		•	•	•	•	•	•
Chlorine Dioxide	•	DPD AccuVac	0.04-5.00			•	•	•	•	•					•	•	•	•	•		•	•	•	•	•	•

Application				Instrument											Vertical Market											
															Drinking Water						Industrial					
Parameter	EPA	Chemistry	Range (mg/l unless noted)	AT1000	HQd Meter	DR6000 Spectrophotometer	DR3900 Spectrophotometer	DR1900 Spectrophotometer	DR900 Colorimeter	DR300	SL1000	Kits	Digital Titrator	Other Instrument	Raw Water	Clarifier Effluent	Filter/Membrane Effluent	Final Effluent	Distribution System	Waste Water	Power/Steam	Chemical/Petrochemical	Pulp & Paper	Food	Beverage	Metals/Mining
Chlorine Dioxide		Direct read	1-50			•	•	•	•						•	•	•	•	•		•	•	•	•	•	•
Chlorine Dioxide		Direct read	5-1000			•	•	•	•						•	•	•	•	•		•	•	•	•	•	•
Chlorine, Free		Phenyl arsine oxide titration	0.003-5.0	•											•	•	•	•	•	•	•	•	•	•	•	•
Chlorine, Free	•	DPD powder pillow	0.02-2.00			•	•	•	•	•						•	•	•	•	•	•	•	•	•	•	•
Chlorine, Free	•	DPD AccuVac	0.02-2.00			•	•	•	•	•						•	•	•	•	•	•	•	•	•	•	•
Chlorine, Free		DPD Rapid Liquid	0.02-2.00			•	•	•	•	•						•	•	•	•	•	•	•	•	•	•	•
Chlorine, Free	•	DPD powder pillow	0.05-4.00			•	•	•	•	•						•	•	•	•	•	•	•	•	•	•	•
Chlorine, Free	•	Indophenol	0.04-4.50			•	•	•	•	•						•	•	•	•	•	•	•	•	•	•	•
Chlorine, Free		DPD TNT	0.09-5.00			•	•	•	•	•						•	•	•	•	•	•	•	•	•	•	•
Chlorine, Free	•	DPD powder pillow	0.1-10.0			•	•	•	•	•						•	•	•	•	•	•	•	•	•	•	•
Chlorine, Free	•	TNT866	0.05-2.00			•	•	•								•	•	•	•	•	•	•	•	•	•	•
Chlorine, Free	•	ChemKey	0.04-4.60								•					•	•	•	•	•	•	•	•	•	•	•
Chlorine, Free and Total		DPD-FEAS	0-3.00										•		•	•	•	•	•	•	•	•	•	•	•	•
Chlorine, Hypochlorite		Iodometric	50000-150000										•		•					•	•	•	•	•	•	•
Chlorine, Total		Phenyl arsine oxide titration	0.100-5.000	•											•	•	•	•	•	•	•	•	•	•	•	•
Chlorine, Total	•	TNT867	0.05-2.00			•	•	•								•	•	•	•	•	•	•	•	•	•	•
Chlorine, Total		DPD TNT	0.09-5.00			•	•	•	•							•	•	•	•	•	•	•	•	•	•	•
Chlorine, Total		DPD rapid liquid	0.02-2.00			•	•	•								•	•	•	•	•	•	•	•	•	•	•
Chlorine, Total	•	ULR rapid liquid	0.002-0.500			•	•	•								•	•	•	•	•	•	•	•	•	•	•
Chlorine, Total	•	ULR rapid liquid OriFlo	0.002-0.500			•	•	•								•	•	•	•	•	•	•	•	•	•	•
Chlorine, Total		ChemKey	0.04-10.0								•					•	•	•	•	•	•	•	•	•	•	•
Chlorine, Total	•	DPD powder pillow	0.02-2.00			•	•	•	•	•						•	•	•	•	•	•	•	•	•	•	•
Chlorine, Total	•	DPD AccuVac	0.02-2.00			•	•	•	•	•						•	•	•	•	•	•	•	•	•	•	•
Chlorine, Total	•	DPD powder pillow	0.05-4.00			•	•	•	•	•						•	•	•	•	•	•	•	•	•	•	•
Chlorine, Total		DPD TNT	0.09-5.00			•	•	•	•	•						•	•	•	•	•	•	•	•	•	•	•
Chlorine, Total	•	DPD powder pillow	0.1-10.0			•	•	•	•	•						•	•	•	•	•	•	•	•	•	•	•
Chlorine, Total		Iodometric	1-70000										•		•	•	•	•	•	•	•	•	•	•	•	•
Chlorite		Phenyl arsine oxide titration	0.100-5.00	•											•	•	•	•			•	•	•	•	•	•
Chromate		Iodometric	20-400										•							•	•	•	•	•	•	•
Chromium, Hexavalent	•	Diphenylcarbohydrazide powder pillow	0.010-0.700			•	•	•	•						•			•		•	•	•	•	•	•	•
Chromium, Hexavalent	•	Diphenylcarbohydrazide AccuVac	0.010-0.700			•	•	•	•						•			•		•	•	•	•	•	•	•
Chromium, Hexavalent	•	TNT854	0.03-1.00			•	•	•							•			•		•	•	•	•	•	•	•
Chromium, Total	•	TNT854	0.03-1.00			•	•	•							•			•		•	•	•	•	•	•	•
Chromium, Total		Alkaline Hypobromite Oxidation	0.01-0.70			•	•	•	•						•			•		•	•	•	•	•	•	•
Cobalt		PAN	0.01-2.00			•	•	•												•	•	•	•	•	•	•
Color		Platinum-Cobalt	3-500 units			•	•	•	•						•			•		•	•	•	•	•	•	•
Color		ADMI Weighted Ordinate	5-250 units			•														•	•	•	•	•	•	•
Color		Spectral colorimetry	variable											Lico							•	•	•	•	•	•
Combined Ecology												•														
Complete Aquaculture Lab												•														
Complete Boiler and Cooling Water												•														
Complete Water Quality Lab												•														
Complete Water Quality Lab with Meter												•														
Conductivity/Salinity/ TDS		Potentiometric	0.01-200000 µs/cm	•											•	•	•	•	•	•	•	•	•	•	•	•
Conductivity/Salinity/ TDS	•	Potentiometric	0.01-200000 µs/cm		•						•				•	•	•	•	•	•	•	•	•	•	•	•
Construction Effluent Monitoring												•														
Copper		Porphyrin	0.001-0.210			•	•	•	•						•			•	•	•	•	•	•	•	•	•
Copper	•	Bicinchoninate CuVer 1	0.04-5.00			•	•	•	•	•					•			•	•	•	•	•	•	•	•	•
Copper	•	Bicinchoninate CuVer 2	0.04-5.00			•	•	•	•	•					•			•	•	•	•	•	•	•	•	•
Copper		TNT860	0.1-8.0			•	•	•							•			•	•	•	•	•	•	•	•	•
Copper	•	ChemKey	0.06-5.75								•				•			•	•	•	•	•	•	•	•	•
Corrosivity (Langelier Index)		Langelier index	10-1000	•															•							
Corrosivity (Langelier Index)		Langelier Index	10-1000										•						•							
Craft Brewing												•														
Cyanide		Pyridine-Pyrazalone	0.002-0.240			•	•	•	•						•			•		•	•	•	•	•	•	•
Cyanide		TNT862	0.01-0.6			•	•	•							•			•		•	•	•	•	•	•	•
Cyanuric Acid		Turbidimetric	5-55				•	•	•									•			•	•	•	•	•	•
Deposit and Surface Analysis												•														
Dissolved Oxygen		Luminescent	0.1-20		•						•				•	•		•	•	•	•	•	•	•	•	•
Dissolved Oxygen		HRDO	0.3-15.0			•	•	•	•						•	•	•	•	•	•	•	•	•	•	•	•
Dissolved Oxygen		UHRDO	1.0-40.0			•	•	•	•						•	•	•	•	•	•	•	•	•	•	•	•
Dissolved Oxygen		Indigo Carmine	0.006-0.800			•	•	•	•						•	•	•	•	•	•	•	•	•	•	•	•
Dissolved Oxygen		Azide Winkler	1-2400										•		•	•	•	•	•	•	•	•	•	•	•	•
Drinking Water Starter with Backpack												•														

Application				Instrument											Vertical Market											
															Drinking Water						Industrial					
Parameter	EPA	Chemistry	Range (mg/l unless noted)	AT1000	HQd Meter	DR6000 Spectrophotometer	DR3900 Spectrophotometer	DR1900 Spectrophotometer	DR900 Colorimeter	DR300	SL1000	Kits	Digital Titrator	Other Instrument	Raw Water	Clarifier Effluent	Filter/Membrane Effluent	Final Effluent	Distribution System	Waste Water	Power/Steam	Chemical/Petrochemical	Pulp & Paper	Food	Beverage	Metals/Mining
Eclox Rapid Response												•														
Environmental Water Quality Lab												•														
Fish Farming												•														
Fluoride	•	SPADNS solution	0.02-2.00			•	•	•	•						•			•			•	•	•	•	•	•
Fluoride	•	SPADNS AccuVac	0.02-2.00			•	•	•	•						•			•			•	•	•	•	•	•
Fluoride	•	SPADNS II solution	0.02-2.00			•	•	•	•									•			•	•	•	•	•	•
Fluoride	•	SPADNS II AccuVac	0.02-2.00			•	•	•	•									•			•	•	•	•	•	•
Fluoride	•	TNT878	0.1-2.5			•	•	•										•			•	•	•	•	•	•
Fluoride	•	Ion selective elctrode	0.02-19000		•						•							•								
Formaldehyde		MBTH	0.003-0.500			•	•	•													•	•	•	•	•	•
Formaldehyde		TNT871	0.5-10			•	•	•													•	•	•	•	•	•
FOS/TAC		Nordmann method	400-25000	•																	•	•	•	•	•	•
Full PPA												•														
General Boiler Water												•														
Hardness		Ion selective elctrode titration	20-720	•											•			•	•	•	•	•	•	•	•	•
Hardness		Chlorophosphonazo solution pillows	0.008-1.000			•	•	•							•			•	•	•	•	•	•	•	•	•
Hardness		Chlorophosphonazo bulk solution	0.008-1.000			•	•	•							•			•	•	•	•	•	•	•	•	•
Hardness		Chlorophosphonazo rapid liquid	0.004-1.000			•	•	•							•			•	•	•	•	•	•	•	•	•
Hardness		Calmagite	0.05-4.00			•	•	•	•						•			•	•	•	•	•	•	•	•	•
Hardness		TNT869	20-350			•	•	•							•			•	•	•	•	•	•	•	•	•
Hardness		ChemKey	3-100								•				•			•	•	•	•	•	•	•	•	•
Hardness		ChemKey	90-750								•				•			•	•	•	•	•	•	•	•	•
Hardness, Calcium		EDTA/CalVer	10-4000										•		•			•	•	•	•	•	•	•	•	•
Hardness, Total		EDTA/Calmagite	10-4000										•		•			•	•	•	•	•	•	•	•	•
Hardness, Total, Sequential		EDTA/CalVer/Calmagite	10-4000										•		•			•	•	•	•	•	•	•	•	•
HQ40d Portable Env. Monitoring												•														
HQd Laboratory												•														
Hydraulic Fracturing Water												•														
Hydraulic Fracturing Water Analysis Lab												•														
Hydrazine		p-Dimethylamino-benzaldehyde solution	0.004-0.600			•	•	•	•												•	•	•	•	•	•
Hydrazine		p-Dimethylamino-benzaldehyde AccuVac	0.004-0.600			•	•	•	•												•	•	•	•	•	•
Ind. Starter w/ Backpack												•														
Ind. Water Quality Lab												•														
International Bitter Units		TNT817	>2 IBU			•	•	•													•	•	•	•	•	•
Iodine		DPD powder pillow	0.07-7.00			•	•	•							•			•		•	•	•	•	•	•	•	•
Iodine		DPD AccuVac	0.07-7.00			•	•	•							•			•		•	•	•	•	•	•	•	•
Iron		1,10-Phenanthroline powder pillows	0.02-3.00			•	•	•	•						•	•		•		•	•	•	•	•	•	•
Iron		1,10-Phenanthroline AccuVac	0.02-3.00			•	•	•	•						•	•		•		•	•	•	•	•	•	•
Iron		FerroZine	0.001-0.100			•	•	•	•						•	•		•		•	•	•	•	•	•	•
Iron		FerroZine rapid liquid	0.009-1.400			•	•	•	•						•	•		•		•	•	•	•	•	•	•
Iron		FerroZine solution pillows	0.009-1.400			•	•	•	•						•	•		•		•	•	•	•	•	•	•
Iron		TPTZ powder pillows	0.012-1.800			•	•	•	•						•	•		•		•	•	•	•	•	•	•
Iron		TPTZ AccuVac	0.012-1.800			•	•	•	•						•	•		•		•	•	•	•	•	•	•
Iron		FerroMo	0.01-1.80			•	•	•	•						•	•		•		•	•	•	•	•	•	•
Iron	•	FerroVer powder pillow	0.02-3.00			•	•	•	•						•	•		•		•	•	•	•	•	•	•
Iron	•	FerroVer AccuVac	0.02-3.00			•	•	•	•						•	•		•		•	•	•	•	•	•	•
Iron		FerroVer powder pillow	0.1-300.0			•	•	•	•						•	•		•		•	•	•	•	•	•	•
Iron		ChemKey	0.05-3.00								•				•	•		•		•	•	•	•	•	•	•
Iron	•	TNT858	0.2-6.0			•	•	•							•	•		•		•	•	•	•	•	•	•
Iron		EDTA/Sulfosalicylic acid	10-1000										•		•	•		•		•	•	•	•	•	•	•
Lead		LeadTrak	0.005-0.150			•	•	•							•			•	•	•	•	•	•	•	•	•
Lead	•	Dithizone	0.003-0.300			•	•	•							•			•	•	•	•	•	•	•	•	•
Lead		TNT850	0.1-2.0			•	•	•							•			•	•	•	•	•	•	•	•	•
Magnesium		TNT849	0.5-0.50			•	•	•							•			•	•	•	•	•	•	•	•	•
Manganese		PAN	0.006-0.700			•	•	•	•						•	•		•		•	•	•	•	•	•	•
Manganese	•	Periodate Oxidation	0.1-20.0			•	•	•	•						•	•		•		•	•	•	•	•	•	•
MEL Potable Water Lab												•														
MEL/MF Total Coliform Lab												•														
MEL/MPN Total Coliform and E. coli Lab												•														
MEL/P-A Safe Drinking Water Lab												•														
Mercury		Cold vapor concentration	0.0001-0.0025			•	•	•							•			•		•	•	•	•	•	•	•
Moisture		Karl Fischer titration	1-100 mg	•																	•	•	•	•	•	•

Application				Instrument												Vertical Market											
																Drinking Water						Industrial					
Parameter	EPA	Chemistry	Range (mg/l unless noted)	AT1000	HQd Meter	DR6000 Spectrophotometer	DR3900 Spectrophotometer	DR1900 Spectrophotometer	DR900 Colorimeter	DR300	SL1000	Kits	Digital Titrator	Other Instrument	Raw Water	Clarifier Effluent	Filter/Membrane Effluent	Final Effluent	Distribution System	Waste Water	Power/Steam	Chemical/Petrochemical	Pulp & Paper	Food	Beverage	Metals/Mining
Molybdenum		Ternary complex	0.02-3.00			•	•	•	•												•	•	•	•	•	•
Molybdenum		Mercaptoacetic acid powder pillows	0.2-40.0			•	•	•	•												•	•	•	•	•	•
Molybdenum		Mercaptoacetic acid AccuVac	0.2-40.0			•	•	•	•												•	•	•	•	•	•
Nickel		PAN	0.006-1.000			•	•	•	•						•			•		•	•	•	•	•	•	•
Nickel	•	Heptoxime	0.02-1.80			•	•	•							•			•		•	•	•	•	•	•	•
Nickel		TNT856	0.1-6.0			•	•	•							•			•		•	•	•	•	•	•	•
Nitrification Control												•														
Nitrogen, Ammonia	•	Ion selective elctrode	0.1-14000		•										•	•	•	•	•	•	•	•	•	•	•	•
Nitrogen, Ammonia	•	TNT830	0.015-2.00			•	•	•							•	•	•	•	•	•	•	•	•	•	•	•
Nitrogen, Ammonia	•	TNT831	1-12			•	•	•							•	•	•	•	•	•	•	•	•	•	•	•
Nitrogen, Ammonia	•	TNT832	2-47			•	•	•							•	•	•	•	•	•	•	•	•	•	•	•
Nitrogen, Ammonia		TNT833	0.015-130			•	•	•							•	•	•	•	•	•	•	•	•	•	•	•
Nitrogen, Ammonia		Salicylate	0.01-0.50			•	•	•	•						•	•	•	•	•	•	•	•	•	•	•	•
Nitrogen, Ammonia		Salicylate TNT	0.02-2.50			•	•	•	•						•	•	•	•	•	•	•	•	•	•	•	•
Nitrogen, Ammonia		Salicylate TNT	0.4-50.0			•	•	•	•						•	•	•	•	•	•	•	•	•	•	•	•
Nitrogen, Ammonia	•	Nessler	0.02-2.50			•	•	•							•	•	•	•	•	•	•	•	•	•	•	•
Nitrogen, Ammonia, Free		Indophenol	0.01-0.50			•	•	•							•	•	•	•	•	•	•	•	•	•	•	•
Nitrogen, Ammonia, Free		ChemKey	0.05-0.50								•				•	•	•	•	•	•	•	•	•	•	•	•
Nitrogen, Ammonia, Total		ChemKey	0.05-1.50								•				•	•	•	•	•	•	•	•	•	•	•	•
Nitrogen, Nitrate	•	TNT835	0.23-13.5			•	•	•							•			•	•	•	•	•	•	•	•	•
Nitrogen, Nitrate	•	TNT836	5-35			•	•	•							•			•	•	•	•	•	•	•	•	•
Nitrogen, Nitrate		Cadmium reduction	0.01-0.50			•	•	•	•						•			•	•	•	•	•	•	•	•	•
Nitrogen, Nitrate		Cadmium reduction powder pillows	0.1-10.0			•	•	•	•						•			•	•	•	•	•	•	•	•	•
Nitrogen, Nitrate		Cadmium reduction AccuVac	0.1-10.0			•	•	•	•						•			•	•	•	•	•	•	•	•	•
Nitrogen, Nitrate		Cadmium reduction powder pillows	0.3-30.0			•	•	•	•						•			•	•	•	•	•	•	•	•	•
Nitrogen, Nitrate		Cadmium reduction AccuVac	0.3-30.0			•	•	•	•						•			•	•	•	•	•	•	•	•	•
Nitrogen, Nitrate		Direct read	0.1-10.0			•									•			•	•	•	•	•	•	•	•	•
Nitrogen, Nitrate		Chromotropic acid TNT	0.2-30.0			•	•	•	•						•			•	•	•	•	•	•	•	•	•
Nitrogen, Nitrate		Ion selective elctrode	0.1-14000		•						•				•			•	•	•	•	•	•	•	•	•
Nitrogen, Nitrite	•	Diazotization powder pillows	0.002-0.300			•	•	•	•						•			•		•	•	•	•	•	•	•
Nitrogen, Nitrite	•	Diazotization AccuVac	0.002-0.300			•	•	•	•						•			•		•	•	•	•	•	•	•
Nitrogen, Nitrite		Diazotization TNT	0.003-0.500			•	•	•	•						•			•		•	•	•	•	•	•	•
Nitrogen, Nitrite		Ferrous sulfate	2-150			•	•	•	•						•			•		•	•	•	•	•	•	•
Nitrogen, Nitrite	•	TNT839	0.015-0.600			•	•	•							•			•		•	•	•	•	•	•	•
Nitrogen, Nitrite	•	TNT840	0.6-6.0			•	•	•							•			•		•	•	•	•	•	•	•
Nitrogen, Nitrite		ChemKey	0.005-0.600								•				•			•		•	•	•	•	•	•	•
Nitrogen, Nitrite		Cerium Ion/Ferroin	100-2500										•		•			•		•	•	•	•	•	•	•
Nitrogen, Total		Titanium trichloride reduction TNT	0.2-25.0			•	•	•	•						•			•		•	•	•	•	•	•	•
Nitrogen, Total Digestion		Persulfate TNT	0.5-25.0			•	•	•	•						•			•		•	•	•	•	•	•	•
Nitrogen, Total Digestion		Persulfate TNT	2-150			•	•	•	•						•			•		•	•	•	•	•	•	•
Nitrogen, Total Digestion		TNT826	1-16			•	•	•							•			•		•	•	•	•	•	•	•
Nitrogen, Total Digestion		TNT827	5-40			•	•	•							•			•		•	•	•	•	•	•	•
Nitrogen, Total Digestion		TNT828	20-100			•	•	•							•			•		•	•	•	•	•	•	•
Nitrogen, Total Kjeldahl	•	TNT880	0-16			•	•	•							•			•		•	•	•	•	•	•	•
Nitrogen, Total Kjeldahl		Nessler	1-150			•	•	•	•						•			•		•	•	•	•	•	•	•
Oxidation-Reduction Potential (ORP)		Potentiometric	-2000-2000 mV		•						•				•	•	•	•	•	•	•	•	•	•	•	•
Oxygen Scavengers		Iron reduction	0.003-0.1500			•	•	•	•												•	•	•	•	•	•
Ozone		Indigo	0.1-1.50			•	•	•	•						•	•	•	•		•	•	•	•	•	•	•
PCB		Immunoassay	1-50			•	•	•												•	•	•	•	•	•	•
Peracetic Acid		DPD	0.10-10.00			•	•	•							•	•	•	•	•	•	•	•	•	•	•	•
Peracetic Acid		ChemKey	0.04-50.0								•				•	•	•	•	•	•	•	•	•	•	•	•
Peracetic Acid		DPD	0.01-35 %										•		•	•	•	•	•	•	•	•	•	•	•	•
pH	•	Potentiometric	0-14 units	•											•	•	•	•	•	•	•	•	•	•	•	•
pH		Phenol red	6.5-8.5 units						•	•					•	•	•	•	•	•	•	•	•	•	•	•
pH	•	Potentiometric	0-14 units		•						•				•	•	•	•	•	•	•	•	•	•	•	•
Phenols	•	4-Aminoantipyrine	0.002-0.200			•	•	•													•	•	•	•	•	•
Phenols		TNT868	5-150			•	•	•													•	•	•	•	•	•
Phosphonates		Persulfate UV oxidation	0.02-125			•	•	•	•						•			•		•	•	•	•	•	•	•
Phosphorus, Acid Hydrolyzable		PhosVer TNT	0.06-3.50			•	•	•	•						•			•	•	•	•	•	•	•	•	•
Phosphorus, Reactive		Chemkey	0.2-4.00								•				•			•	•	•	•	•	•	•	•	•
Phosphorus, Reactive		Chemkey	1.0-30.0								•				•			•	•	•	•	•	•	•	•	•
Phosphorus, Reactive	•	PhosVer powder pillows	0.02-2.50			•	•	•	•						•			•	•	•	•	•	•	•	•	•

Application				Instrument											Vertical Market											
															Drinking Water						Industrial					
Parameter	EPA	Chemistry	Range (mg/l unless noted)	AT1000	HQd Meter	DR6000 Spectrophotometer	DR3900 Spectrophotometer	DR1900 Spectrophotometer	DR900 Colorimeter	DR300	SL1000	Kits	Digital Titrator	Other Instrument	Raw Water	Clarifier Effluent	Filter/Membrane Effluent	Final Effluent	Distribution System	Waste Water	Power/Steam	Chemical/Petrochemical	Pulp & Paper	Food	Beverage	Metals/Mining
Phosphorus, Reactive	•	PhosVer AccuVac	0.02-2.50			•	•	•	•						•			•	•	•	•	•	•	•	•	•
Phosphorus, Reactive	•	Ascorbic acid rapid liquid	0.019-3.000			•	•	•							•			•	•	•	•	•	•	•	•	•
Phosphorus, Reactive	•	PhosVer TNT	0.06-5.00			•	•	•	•						•			•	•	•	•	•	•	•	•	•
Phosphorus, Reactive		Amino acid	0.23-30.00			•	•	•	•						•			•	•	•	•	•	•	•	•	•
Phosphorus, Reactive		Molybdovanadate reagent solution	0.3-45.0			•	•	•	•						•			•	•	•	•	•	•	•	•	•
Phosphorus, Reactive		Molybdovanadate AccuVac	0.3-45.0			•	•	•	•						•			•	•	•	•	•	•	•	•	•
Phosphorus, Reactive		Molybdovanadate rapid liquid	0.3-45.0			•	•	•	•						•			•	•	•	•	•	•	•	•	•
Phosphorus, Reactive		Molybdovanadate TNT	1.0-100.0			•	•	•	•						•			•	•	•	•	•	•	•	•	•
Phosphorus, Reactive		TNT846	1.6-30			•	•	•							•			•	•	•	•	•	•	•	•	•
Phosphorus, Reactive	•	TNT843	0.15-4.50			•	•	•							•			•	•	•	•	•	•	•	•	•
Phosphorus, Reactive	•	TNT844	1.5-15.0			•	•	•							•			•	•	•	•	•	•	•	•	•
Phosphorus, Reactive	•	TNT845	6-60			•	•	•							•			•	•	•	•	•	•	•	•	•
Phosphorus, Total	•	TNT843	0.15-4.50			•	•	•							•			•	•	•	•	•	•	•	•	•
Phosphorus, Total	•	TNT844	1.5-15.0			•	•	•							•			•	•	•	•	•	•	•	•	•
Phosphorus, Total	•	TNT845	6-60			•	•	•							•			•	•	•	•	•	•	•	•	•
Phosphorus, Total	•	PhosVer TNT	0.06-3.50			•	•	•	•						•			•	•	•	•	•	•	•	•	•
Phosphorus, Total		Molybdovanadate TNT	1.0-100.0			•	•	•	•						•			•	•	•	•	•	•	•	•	•
Pool Master												•														
Potassium		Tetraphenylborate	0.1-700			•	•	•							•			•			•	•	•	•	•	•
Professional Boiler Treatment/Boiler Feed												•														
Professional Boiler Treatment/Boiler Feed and Cooling Water												•														
Professional Water Treatment Lab												•														
QbD1200	•	UV-persulfate digestion	0.0004-100										QbD1200		•		•	•	•		•	•	•	•	•	•
Quaternary Ammonium Compounds		Direct binary complex	0.2-5.0			•	•	•													•	•	•	•	•	•
Salinity		Mercuric Nitrate/Diphenylcarbazone	0-100000										•		•					•	•	•	•	•	•	•
Saltwater Aquaculture												•														
Sampling		NA	NA										AS950							•	•	•	•	•	•	•
Selenium		Diaminobenzidine	0.01-1.00			•	•	•							•			•			•	•	•	•	•	•
Silica		Heteropoly blue reagent solution	0.003-1.000			•	•	•	•						•			•			•	•	•	•	•	•
Silica		Heteropoly blue powder pillows	0.010-1.600			•	•	•	•						•			•			•	•	•	•	•	•
Silica		Silicomolybdate	1-100			•	•	•	•						•			•			•	•	•	•	•	•
Silver		Cadion	0.02-0.70			•	•	•							•			•		•	•	•	•	•	•	•
Sodium		Potentiometric titration	0.1-5 %	•																•	•	•	•	•	•	•
Sodium		Ion selective elctrode	0.023-23000		•										•			•		•	•	•	•	•	•	•
Soil and Irrigation Water												•														
Soil Extraction												•														
Soil Fertility												•														
Storm Water												•														
Stream Survey												•														
Sulfate	•	SulfaVer powder pillows	2-70			•	•	•	•						•			•			•	•	•	•	•	•
Sulfate	•	SulfaVer AccuVac	2-70			•	•	•	•						•			•			•	•	•	•	•	•
Sulfate		SulfaVer	2-7000			•	•	•	•						•			•			•	•	•	•	•	•
Sulfate		TNT864	40-150			•	•	•							•			•			•	•	•	•	•	•
Sulfate		TNT865	150-900			•	•	•							•			•			•	•	•	•	•	•
Sulfide	•	Methylene blue	0.005-800			•	•	•	•						•			•		•	•	•	•	•	•	•
Sulfide		Methylene blue	0.01-70			•	•	•	•						•			•		•	•	•	•	•	•	•
Sulfide		TNT861	0.1-2.0			•	•	•							•			•		•	•	•	•	•	•	•
Sulfite		Phenyl arsine oxide titration	0-20.0	•											•	•				•	•	•	•	•	•	•
Sulfur Dioxide (Free and Total)		Potentiometric titration	4.5-430	•																	•	•	•	•	•	•
Surface Water												•														
Surfactants (Anionic)		Crystal violet	0.002-0.275			•	•	•	•											•	•	•	•	•	•	•
Surfactants (Anionic)		TNT874	0.1-4.0			•	•	•												•	•	•	•	•	•	•
Surfactants (Nonionic)		TNT875	0.2-6.0			•	•	•												•	•	•	•	•	•	•
Surfactants (Nonionic)		TNT876	6.0-200			•	•	•												•	•	•	•	•	•	•
Tannins and Lignins		Tyrosine	0.1-9.0			•	•	•	•						•			•			•	•	•	•	•	•
Ten-Parameter Aquaculture												•														
Thiols		Potentiometric titration	1.5-100 mg/kg	•																	•	•	•	•	•	•
THM		THM Plus	0.010-0.600			•	•	•							•	•	•	•	•							
THM Formation Potential		THM Plus	0.010-0.600			•	•	•							•	•	•	•	•							
Total Acid Number		Potentiometric titration	0.05-260	•																	•	•	•	•	•	•
Total Acidity		Potentiometric titration	2-243000	•																	•	•	•	•	•	•

Application				Instrument											Vertical Market											
															Drinking Water						Industrial					
Parameter	EPA	Chemistry	Range (mg/l unless noted)	AT1000	HQd Meter	DR6000 Spectrophotometer	DR3900 Spectrophotometer	DR1900 Spectrophotometer	DR900 Colorimeter	DR300	SL1000	Kits	Digital Titrator	Other Instrument	Raw Water	Clarifier Effluent	Filter/Membrane Effluent	Final Effluent	Distribution System	Waste Water	Power/Steam	Chemical/Petrochemical	Pulp & Paper	Food	Beverage	Metals/Mining
Total Base Number		Potentiometric titration	1-100	•																	•	•	•	•	•	•
Total Micro		LuminUltra adenosine triphosphate	variable									PhotonMaster			•					•	•	•	•	•	•	•
Total Organic Carbon	•	TNT810	1.5-30			•	•	•							•		•	•	•	•	•	•	•	•	•	•
Total Organic Carbon	•	TNT811	30-300			•	•	•							•		•	•	•	•	•	•	•	•	•	•
Total Organic Carbon		Direct TNT	0.3-20.0			•	•	•	•						•		•	•	•	•	•	•	•	•	•	•
Total Organic Carbon		Direct TNT	15-150			•	•	•	•						•		•	•	•	•	•	•	•	•	•	•
Total Organic Carbon		Direct TNT	100-700			•	•	•	•						•		•	•	•	•	•	•	•	•	•	•
Total Petroleum Hydrocarbons (TPH)		Immunoassay	semi-quant			•	•	•							•			•			•	•	•	•	•	•
Toxicity (ToxTrak)		ToxTrak	0-100 %			•	•	•	•						•					•	•	•	•	•	•	•
Turbidity	•	Nephelometric	0-700 NTU										TU5200		•	•	•	•	•	•	•	•	•	•	•	•
Turbidity	•	Nephelometric	0-10000 NTU										TL23		•	•	•	•	•	•	•	•	•	•	•	•
Turbidity		Nephelometric	0-1000 NTU										2100Q		•	•	•	•	•	•	•	•	•	•	•	•
UV254		Direct read	semi-quant			•									•		•	•		•	•	•	•	•	•	•
Vicinal Diketones		TNT819	0.015-0.5 mg/kg			•	•	•													•	•	•	•	•	•
Volatile Acids		TNT872	50-2500			•	•	•							•			•		•	•	•	•	•	•	•
Volatile Acids		Esterification	27-2800			•	•	•	•						•			•		•	•	•	•	•	•	•
Volatile Acids		Sodium Hydroxide/Phenolphthalein	100-2400										•		•	•	•	•	•	•	•	•	•	•	•	•
Wastewater Treatement Plant Lab												•														
Water Conditioning Lab												•														
Zinc	•	Zincon	0.01-3.00			•	•	•	•						•			•		•	•	•	•	•	•	•

Titrator

AT1000

Spectrophotometers

DR6000

DR3900

DR1900

Colorimeters

DR900

DR300

E-Chemistry

HQD Meters and Probes

Portable Parallel Analyzer

SL1000

Turbidimeters

TU5200

TL2300

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DOC060.93.10241.Mar26