



Phosphate

Phosphate Measurements

Phosphorus compounds – in particular ortho-phosphate PO_4^{3-} – are considered to be the limiting nutrients in most stagnant and flowing waters. An increase in their concentration caused by higher input (wastewater, avulsion etc.) results directly in increasing eutrophication of the water with known effects such as increased growth of algae, oxygen depletion as far as anoxia in the deeper regions, etc.

Measuring Methods

Molybdenum blue method

In an acidic medium, ortho-phosphates bond with ammonium molybdate to form molybdenic phosphoric acid. With the aid of a reducing agent this forms phosphorus molybdenum blue compound. Photometrical measurement of dye intensity can be performed at 880 nm.

Vanadate/molybdate method (yellow method)

In acids, ortho-phosphate ions react with ammonium molybdate and ammonium vanadate to form yellow ammonium phosphoric vanadomolybdate. This can be photometrically analyzed at 380 nm.

Phosphorus Compounds in Water

Phosphorus occurs in 3 compounds in natural waters:

- inorganic, dissolved ortho-phosphate
- dissolved organic phosphorus compounds
- particulate phosphorus (bound in biomass or attached to particles),

which add up to the total of phosphorus content P_{Total} , an important parameter in monitoring wastewater treatment plant effluents.

Measuring Methods and Digestion

There are two methods available for determining phosphate or phosphorus concentrations:

- Molybdenum blue method
- Vanadate/molybdate method (yellow method)

Both techniques are based on the measurement of ortho-phosphate. Digestion of both dissolved organic as well as particulate phosphorus compounds is therefore mandatory for determining the total P content. In addition, an unfiltered sample must be acquired in order to include all solid matters in the digestion process. Digestion is usually performed by heating the sample with peroxodisulfate and sulfuric acid.

Elimination of Phosphates in Wastewater

To meet the required limits of P concentration in the effluent, the modern wastewater treatment facility has two methods available:

- Biological elimination of phosphates “Bio-P”: incorporation of phosphate in microbial biomass (usually in combination with a preliminary anaerobic stage to stimulate luxury consumption of phosphate and intracellular storage as polyphosphate)
- Chemical-physical elimination of phosphates: Chemical precipitation of ortho-phosphates using metallic salts (usually Fe³⁺ or Al³⁺). The use of ortho-phosphate analyzers for effective control and regulation of precipitations results in considerable savings.

Regulation according to P Concentration

With a continuous monitor PO₄ analyzer, the operator of water treatment plants can realize significant cost savings.

(cf. Application Report PO4 1609 2003 01e)



NEW

On-site analyzer P 700 IQ

In order to also compete in the field of phosphate measurements with cutting-edge technology, WTW has expanded its range of measuring equipment and now offers an ortho-phosphate measurement of the IQ SENSOR NET.

P 700 IQ

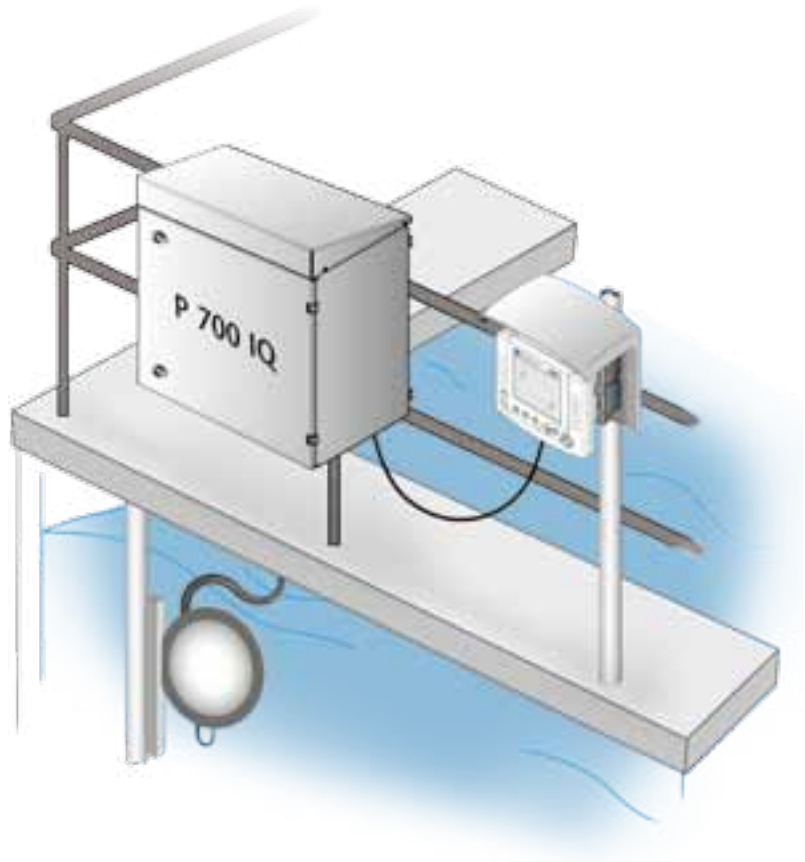
- Low reagent consumption
- Wide measuring range
- Automatic calibration
- On-site installation
- Direct connection to the IQ SENSOR NET

IQ
SENSOR NET^{XT}

PO₄



- The benefits at a glance:**
- **On-site installation**
Analyzer can be used outdoor in any weather conditions (option)
 - **Compact design**
Pump for permeate supply is integrated in the analyzer housing (option)
 - **Low Reagent Consumption**
Reduction of cost of ownership
 - **Wide measuring range**
Suitable for universal applications
 - **Automatic calibration**
Reliable results due to automatic calibration function (adjustable)
 - **Direct connection to the IQ SENSOR NET**
Take advantage of the IQ SENSOR NET world: flexibility, modularity, reliability and cost efficient system extension



Features of the P 700 IQ

The P 700 IQ can directly be operated at the process tank in an external installation (on-site). Short transporting routes and timely measurement values are therefore guaranteed. The device is well protected against weather effects due to passive insulation and an active temperature control.

Fully automatic calibration function with selectable calibration intervals provides special operating safety (can be deactivated).

The measuring principle is based on the photometric yellow method (molybdate-vanadate), which has been used for years to measure orthophosphate. In addition, the P 700 IQ has been distinguished by its extremely low reagent consumption – a benefit that reduces operating costs significantly.

Based on the large measuring range, the P 700 IQ can be used universally. Switching between the measuring ranges can be accomplished at any time at no additional cost.

As easy to use as an IQ sensor

The P 700 IQ is directly connected to the IQ SENSOR NET via the SNCIQ cable (System 2020 XT). The power is supplied to the analyzer itself.

All settings are made via the terminal/controller, as all other IQ sensors.

The user has all the advantages of the IQ SENSOR NET world available with the P 700 IQ – an unbeatable advantage in terms of flexibility, modularity and security.

The integration of the analyzer into existing IQ systems and their expansion to include additional measured variables are simple and designed to be user-friendly.

Parameter section

Dissolved Oxygen

pH/ORP

Conductivity

Turbidity/Suspended Solids

Nitrogen

Carbon: COD/TOC/DOC/BOD/SAC

Phosphate

Sludge level

IQ SENSOR NET

Information for the
IQ SENSOR NET, see
page 74



Technical Data P 700 IQ

Measuring method	Molybdate-vanadate
Measuring range	Measuring range A: 0.05 ... 15.00 mg/l PO ₄ -P Measuring range B: 1 ... 50 mg/l PO ₄ -P
Resolution	Measuring range A: 0.05 mg/l PO ₄ -P Measuring range B: 1 mg/l PO ₄ -P
Accuracy	Measuring range A: ±2%, ±0.05 mg/l Measuring range B: ±2%, ±1 mg/l
Response time t ₉₀	<5 min
Detection limit	Measuring range A: 0.05 mg/l PO ₄ -P Measuring range B: 1 mg/l PO ₄ -P
pH range	5 ... 9
Sample temperature	4 ... 45 °C (39.2 ... 113 °F)
Measuring interval	<5 min (adjustable)
Operating temperature	-4 ... 104 °F (-20 ... 40 °C)
Storage temperature	-4 ... 122 °F (-20 ... 50 °C)
Reagent consumption	2500 ml container for 8 months at a measuring range (A) at a 10 min measurement interval 2500 ml container for 4 months at a measuring range (B) at a 10 min measurement interval
Cleaning Solution	1000 ml for 4 months with daily cleaning
Conformity	CE
Equipment safety	EN 61010-1; UL 3111-1, CAN/CSA C22.2 No. 1010.1)
Climate control	Heater and fan
Power supply	115/230 VAC
Weight	~66 lb (~30 kg; without reagents)
Dimensions	~26.69 x 30.71 x 15.55 in. (~678 x 780 x 395 mm)
Outputs	Relays, analog outputs, interfaces via System 2020 XT
Calibration	Manual or automatic (adjustable)

Ordering Information

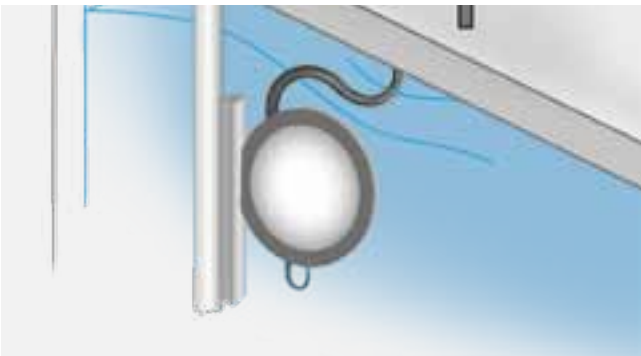
P 700 IQ		Order. No.
P 700 IQ-PO230	Orthophosphate analyzer P 700 IQ for the IQ SENSOR NET with integrated pump unit for filtration, Outdoor, 230V	8P-111
P 700 IQ-PI230	Orthophosphate analyzer P 700 IQ for the IQ SENSOR NET with integrated pump unit for filtration, Indoor, 230V	8P-110
P 700 IQ-O230	Orthophosphate analyzer P 700 IQ for the IQ SENSOR NET, Outdoor, 230V	8P-101
P 700 IQ-I230	Orthophosphate analyzer P 700 IQ for the IQ SENSOR NET, Indoor, 230V	8P-100



115V versions on request

Filtration P 700 IQ

- Compact design (permeate pump can be integrated in P 700 IQ housing)
- Easy and quick to clean
- Long operating periods between two cleanings
- High operational safety



The sample preparation is specifically designed for the operation of the analyzers that work with very small sample amounts. In order to keep the dead times as low as possible at the relatively low level of permeate, which are needed for the analysis, the permeate is continuously withdrawn by using a vacuum and delivered to the analyzer.

The filter module is immersed into the tank via a bracket mounted on the tank's edge and supplies the analyzer with permeate via a suction line. Maintenance takes place directly at the tank's edge: The technically sophisticated rail system allows the user to lift the filter without any effort from the tank and clean it, which saves time and is easy to maintain.

A special feature of the sample filtration: The pump unit is already installed in the housing of the P 700 IQ (option). This combination is easy to install and cost effective.

Technical Data of the P 700 IQ Filtration

Membrane area	155.00 in ² (1.000 cm ²)
Maximum operating temperature:	113 °F (45 °C)
Maximum operating overpressure (Raw water to permeate side):	2.0 bar at 68 °F (20 °C)
Operating under pressure (permeate side):	approx. 0.5 bar at 68 °F (20 °C)
Materials:	Housing: PVC Seals: NBR Screws: Stainless steel

Ordering Information

Model	Description	Order. No.
FM	Filter membrane module including mounted diaphragm	821 987
M 1.5	Tank bracket (rail) 1.5 m, chain, bracket	821 986
M-EXT 1.5	Extension tank bracket 1.5 m, chain, bracket	821 985
FM-Adapter	Adapter for the horizontal assembly of the filter membrane module	821 983
SL 230-5	Suction incl skid/ heater 230 VAC, 5 m	821 982
SL 230-10	Suction incl skid/ heater 230 VAC, 10.94 yd (10 m)	821 980
SL 5	Suction line including skids, unheated, 5m	821 978
SL 10	Suction line including skids, unheated, 10.94 yd (10 m)	821 977
RL 230-2	Heated Permeate return line, 230 VAC, 2 m	821 976
RL 2	Permeate return line unheated, 2 m	821 974
Filter	Membrane insert PMM (1 set=2 pieces)	821 972



115V versions on request

Parameter section
Dissolved Oxygen
pH/ORP
Conductivity
Turbidity/Suspended Solids
Nitrogen
Carbon: COD/TOC/DOC/BOD/SAC
Phosphate
Sludge level

TresCon® OP 210

- Yellow method
- Continuous background compensation
- Continuous/Discontinuous operation selectable

Online orthophosphate measurement

- Control or feedback control of chemical phosphate precipitation, e.g. precipitating agent addition with simultaneous precipitation
- Monitoring biological phosphate elimination
- Measuring the phosphate pollution in natural waters
- Monitoring the phosphate concentration in the drinking water



Measuring Principle

The PO₄ module uses the vanadate/molybdate method (yellow method) for determining the orthophosphate content. A reagent reacts with phosphate in the sample to color the sample solution yellow. The intensity of this color is recorded photometrically and evaluated as a measure of the phosphate content.

Technical Data OP 210

Measuring Ranges	PO ₄ -P	PO ₄
	Measuring range 1: 0.05 - 3.00 mg/l; 1.5 - 100 µmol/l	0.15 - 9.00 mg/l; 1.5 - 100 µmol/l
	Measuring range 2: 0.1 - 10.0 mg/l; 3 - 320 µmol/l	0.3 - 30.0 mg/l; 3 - 320 µmol/l
	Measuring range 3: 0.1 - 25.0 mg/l; 3 - 800 µmol/l	0.3 - 80.0 mg/l; 3 - 800 µmol/l
Resolution (Display)	Measuring range 1: 0.01 mg/l or µmol/l	
	Measuring range 2: 0.1 mg/l or µmol/l	
	Measuring range 3: 0.1 mg/l or µmol/l	
Accuracy	±2% of the measured value ±0.01 mg/l PO ₄ -P (Measuring range 1) ±2% of the measured value ±0.1 mg/l PO ₄ -P (Measuring range 2 and 3)	
Coefficient of Variation for Method	2% (for all measuring ranges)	
Response Time	<4 min to measured value (after alteration in concentration at module input)	
Measuring Interval	Quasi-continuous measurement, 5, 10, 15, 20, 25 or 30 min settings	
Calibration	Automatic 2-point calibration (time and interval selectable)	
Background Correction	Continuous background compensation based on new WTW algorithm	
Sample Input	Approx. 0.06 l/h, solid content <50 mg/l (e.g. sewage treatment plant effluent)	
Consumption	Reagent, 10 l: 60/155/310/465 days with cont./10/20/30 min measuring intervals	
	Standard B 1.5 l: 90 days with 24 h calibration interval	
	Cleaning solution, 1.5 l: 45 days with 24 h cleaning interval	
Maintenance Interval	Every 6 months	
Guaranty	2 years for defects of quality	

Ordering Information

Separate TresCon® analyzer module for Orthophosphate for extension of an existing TresCon® system (requires 1 measuring place)		Order. No.
OP 210/ MB 1	Module for Orthophosphate: Measuring range 1	820 004
OP 210/ MB 2	Module for Orthophosphate: Measuring range 2	820 005
OP 210/ MB 3	Module for Orthophosphate: Measuring range 3	820 006
TresCon®-basic instrument with analysis module OP 210 for ortho-phosphate (wall mounting, space for 2 further modules)		Order. No.
TresCon® P 211/MB1	Orthophosphate, Measuring range 1	8A-40030
TresCon® P 211/MB2	Orthophosphate, Measuring range 2	8A-50030
TresCon® P 211/MB3	Orthophosphate, Measuring range 3	8A-60030
TresCon® Uno single parameter system ortho-phosphate with analysis module OP 210		Order. No.
TCU/P211-MB1	TresCon® Uno for Orthophosphate: Measuring range 1	820 104
TCU/P211-MB2	TresCon® Uno for Orthophosphate: Measuring range 2	820 105
TCU/P211-MB3	TresCon® Uno for Orthophosphate: Measuring range 3	820 106



Accessories and Consumables see brochure "Product Details"

TresCon® OP 510

- 2-point calibration – high degree of accuracy
- Automatic Monitoring
- “Blue” method



Online P_{Total} measurement

- Monitoring the effluent from wastewater treatment plant for P_{Total}
- Monitoring phosphorus pollution in natural waters

Measuring Principle

The P_{Total} module consists of two units: in the first unit (digestion unit) the sample undergoes a chemical-thermal digestion; in the second unit the total phosphorus content is determined.

During the digestion all the phosphorus compounds contained in the sample are converted to orthophosphate; this can be determined photometrically. The phosphorus compounds are oxidized by peroxodisulfate under acidic conditions.

This process is accelerated by overpressure and an increased temperature so that very short digestion times are achieved.

The subsequent analysis is by the molybdenum blue method. The sample is mixed with a molybdate reagent which reacts with phosphate via an intermediate chemical step to form a blue coloration. The intensity of this coloration is a measure of the original concentration of the phosphate ions. It is measured photometrically and evaluated.

Technical Data OP 510	
Measuring Ranges	P _{Total} : 0.01 ... 3.00/6.00*; 0.3 ... 100/200*
Resolution (Display)	Range: 0.01 ... 3.00 mg/l : 0.01 mg/l 0.30 ... 100 µmol/l : 0.1 µmol/l
Accuracy	± 3 % of the measured value ± 0.05 mg/l P _{Total}
Measuring Principle	Photometric reference beam method after digestion
Measuring Method	Molybdenum blue methode
Coefficient of Variation for Method	1.5 %
Measuring Interval	10, 15, 20, 25, 30 or 60 min can be set (DIN EN measurement with 30 min digestion at approx. 248 °F/120 °C)
Calibration	Fully automatic 2-point calibration
Consumption	Reagents A, B, C, D: 10/15/20/30/60 days with 10/15/20/30/60 min measuring intervals Standard, 1.5 l: 70 days with 24 h calibration interval Cleaning solution, 1.5 l: 60 days with 24 h cleaning interval
Maintenance Interval	Every 3 months
Guaranty	2 years for defects of quality

Ordering Information		Order. No.
OP 510	Separate TresCon® analyzer module for total phosphorus for extension of an existing TresCon® system (requires 2 TresCon® measuring locations)	820 011
TresCon® P 511	TresCon®-basic instrument with analysis module OP 510 for total phosphorus (wall mounting, space for 1 further module)	8A-8X030

Accessories and Consumables see brochure “Product Details”
 Homogenizer available on demand (see brochure “Product Details”)
 * by continuous sample dilution in a 1:1 ratio

Parameter section

Dissolved Oxygen

pH/ORP

Conductivity

Turbidity/Suspended Solids

Nitrogen

Carbon: COD/TOC/DOC/BOD/SAC

Phosphate

Sludge level