



Level



Pressure



Flow



Temperature



Liquid
Analysis



Registration



Systems
Components



Services



Solutions

pH measurement in industrial processes

Selection and engineering guide for your
industry and application



Look for our link emblem inside to access
more information about Endress+Hauser and our products

Endress+Hauser 

People for Process Automation

Step by step

pH determination is an essential measurement in all industries. Monitoring of product quality or of chemical reactions is often done by means of pH measurement. The pH value is related to the hydrogen ion (H⁺) concentration in an aqueous solution and therefore to the solutions acidity. The pH can (in theory) vary in water between 0 – 14, with 0 being the acidic and 14 the caustic end of the scale.

Application conditions for pH measurement can be very different ranging, e.g., from

wastewater and chemical mixtures to ultra pure water in power stations or life science industry. The lifetime of a pH electrode depends on these conditions, but as well on cleaning, calibration, regeneration intervals and on the right choice of sensor type. A complete pH measuring point consists of the sensing element (pH electrode), an assembly, cable and transmitter. This guide helps you with the selection of the right sensor and assembly for your applications including the transmitter.

Overview of pH

measurement equipment

This section is comprised of a short description of different types of necessary components:

- pH electrodes
- Assemblies
- Transmitters

Each part contains technical descriptions followed by tables summarizing technical data including advantages and application limits.

Checklist/Spec-Sheet

For a complete specification a checklist is provided with the option to add a sketch of the installation conditions. Please use this format for professional inquiries.

A

Selection of pH electrode according to application

Starting with a flow chart (3.1) this section enables you to do a proper pre-selection based on chemical and physical behaviors of the process medium. From there you are directed to the individual chapters (3.2 – 3.8) with the indication of the recommended pH electrode including key advantages as well as applications limits and alternatives.

B

Selection of assembly for a given application

Followed by the pH electrode selection the assemblies section starts as well with a flow chart (4.1) guiding you to the individual chapters (4.2 – 4.5) based on installation and application conditions. Similar to Section B you will be given a first choice including alternatives.

Depending on pH electrode “liquid- or gel-filled” you need to specify respectively order corresponding options of a retractable assembly. Additionally, make sure to select a pneumatically driven retractable assembly in case you want to use Topcal or Topclean for automatic cleaning and/or calibration.

Based on the selected pH electrode in Section B please check mechanical compatibility (table in 4.6) to verify corresponding pH electrode length and max. required free space for mounting assemblies, e.g., in pipes, bypasses or small tanks..

C

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A

B

C

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1. Overview of pH electrodes and installation types

1.1 Sensor types



Glass type sensor

The sensing element of the standard pH-glass electrode is a gel layer on the glass bulb with a sub-micrometer thickness. This layer is able to incorporate H^+ and this results in a change of the electrostatic potential across the glass bulb. This potential change is measured relative to a reference element which is in contact to the medium by the diaphragm to create a closed electrical loop.

Orbisint, Ceraliquid, Ceragel, Orbipore

Different types of glass sensors are available, e.g., hygienic and non-hygienic versions. These differ in the type of diaphragm used (ceramic, Teflon® or none) and in the kind of gel or liquid used for the reference system. Resistance of the sensor against blocking of the diaphragm and poisoning of the reference depends strongly on the selection of reference and diaphragm type.



ISFET sensor

The sensing element of an ISFET sensor is a semiconductor chip forming an ion selective field effect transistor. The ISFET chip is especially sensitive to H^+ ions. Non-glass sensors are non-breakable and the ISFET sensors can tolerate higher amounts of organic solvents than glass type sensors. Glass and ISFET type sensors use the same reference and diaphragm types.

Tophit

Main application areas of the ISFET type is whenever glass is not allowed or wished, e.g., in food processes or when there are high amounts (> 20%) of organic solvents. ISFET sensors are made from PEEK™ and have a lower alkaline and acid error compared to glass type sensors. One restriction of the ISFET chip is that it can not withstand hot caustics (CIP!).



Enamel sensor

The main advantage of enamel sensors is their robustness. The sensors have especially long calibration cycles and the measurement requires accordingly less maintenance.

Ceramax

Liquid KCl filled reference with hygienic ceramic diaphragm. The linear range is from pH 0 to 10, hygienic design, CIP- and SIP-able, no retractable assembly necessary. Different process connections are available.



Revolutionary Memosens technology

pH measurement got easier and more reliable since Endress+Hauser invented Memosens. Inductive signal and energy transmission without any metallic contacts between sensor head and cable connection ensures trouble-free operation even in humid environments. With the galvanically decoupled system and the storage of calibration data in the sensor head it is possible

to calibrate the sensor on its own instead of the whole loop. Decoupling of measurement and calibration is possible. The “D” in the name of an Endress+Hauser sensor indicates that it is available with Memosens (e.g., CPxxxD; D = digital).

See also section 5.1 on page 50 or www.us.endress.com/memosens

1. Overview of pH electrodes and installation types

1.2 pH electrodes



	Glass sensor Orbisint CPS11/CPS11D	Glass sensor Ceragel CPS71/CPS71D	Glass sensor Orbipore CPS91/CPS91D	
	 	 	 	
pH range	0 to 14	0 to 14	0 to 14	
Temperature range	32 to 275°F / 0 to 135°C	32 to 275°F / 0 to 135°C	32 to 230°F / 0 to 110°C	
Max. pressure	Up to 232 psi / 16 bar (with B-glass)	Up to 188.5 psi / 13 bar	Up to 188.5 psi / 13 bar	
Min. conductivity	50 µS/cm	10 µS/cm	500 µS/cm	
Organic content	< 20 vol%	< 20 vol%	< 20 vol%	
Shaft material	Glass	Glass	Glass	
Diaphragm	PTFE	Ceramic	Open junction	
Reference system	Gel filled	Gel filled, double chamber	Stabilized gel reference	
Special options	For higher HF content, for poisoning media, BT version with ion trap for poisoning media and version with salt ring	Pressurized reference, upside-down mounting, Certificate of Compliance available	For soiling media	
Application	Water, wastewater, process	Pharma, fermenter, process	Emulsions, suspensions, precipitation reactions	

Glass sensor Ceraliquid CPS41/CPS41D		Glass sensor Orbipac CPF81/CPF81D		Glass sensor Purisys CPF201	
 		 		 	
0 to 14		0 to 14		0 to 14	
32 to 275°F / 0 to 135°C		32 to 176°F / 0 to 80°C		35.6 to 167°F / 2 to 75°C	
145 psi / 10 bar with counter pressure		Up to 145 psi / 10 bar		50 psi / 3.45 bar	
0.04 µS/cm		50 µS/cm		0.1 µS/cm	
Higher level possible depending on application		< 20 vol%		Not specified	
Glass		Glass		Stainless steel	
Ceramic		PTFE		PTFE	
Liquid filled		Gel filled, double chamber		Gel	
		Flat membrane			
Ultrapure water, fat, dye, food, process		Wastewater, mining		Pure water	

1. Overview of pH electrodes and installation types

1.2 pH electrodes



	ISFET sensor Tophit CPS471/CPS471D	ISFET sensor Tophit CPS491/CPS491D	ISFET sensor Tophit CPS441/CPS441D	
				
				
Max. pressure	Up to 145 psi / 10 bar	Up to 145 psi / 10 bar	Up to 145 psi / 10 bar	
pH range	0 to 14	0 to 14	0 to 14	
Temperature range	5 to 275°F / -15 to 135°C	5 to 230°F / -15 to 110°C	5 to 266°F / -15 to 130°C	
Min. conductivity	10 µS/cm	500 µS/cm	0.1 µS/cm	
Organic content	High level possible depending on application	High level possible depending on application	High level possible depending on application	
Shaft material	PEEK™, chip sealing	PEEK™	PEEK™	
Diaphragm	Ceramic	Open junction	Ceramic	
Reference system	Gel filled, double chamber	Stabilized gel reference	Liquid filled	
Special options	3-A certificate, Certificate of Compliance available		3-A certificate	
Application	Non aqueous media, galvanic, pharma, fermenter, process	Non aqueous media, emulsions, suspensions, precipitation reactions	Non aqueous media, ultra-pure water, fat, dye, food, process	

Enamel sensor**Ceramax
CPS341D**

87 psi / 6 bar

0 to 10

32 to 284°F / 0 to 140°C

50 μ S/cm

< 20 vol%

Enamel on stainless steel

Ceramic

Liquid filled

EHEDG

Food and pharma

1. Overview of pH electrodes and installation types

1.3 Assembly types



Immersion holders

These types of assemblies are mainly used for installations in open vessels and channels. Such assemblies are usually found in wastewater treatment plants or the chemical industry. When installation from top of the container or vessels is the only possibility – immersion holders are a good choice.

Dipfit

The standard CPA111 made from polypropylene (PP) is mainly used in the wastewater market. We also offer the CPA140 made from PVDF or stainless steel for harsher applications (e.g., chemical industry). Different immersion lengths are available and both assemblies can hold up to three sensors for redundant measurement. Spray cleaning options are available for both assemblies.



Modular immersion holders

These new types of assemblies have advantages in immersion applications such as in wastewater industries. They are available for sensors with a wide variety of connection threads. Not only 12 mm pH glass sensor for pH or O₂ but also sensors for turbidity or nitrate. The system can be mounted in nearly all locations (pipes, rails, etc.) by using different pipes, holders and accessories.

The modular system allows an optimum configuration for every measuring application

- Using 120 mm Memosens sensors
- Versions in stainless steel or PVC
- Assembly length from 600 mm (23.6") to 3600 mm (11.8') in steps of 600 mm (23.6")

A float assembly is available for varying water levels.

- Quick fastener for:
 - fast installation and exchange of Memosens sensors with contactless plug-in head
 - twist-free installation of fixed-cable sensors
 - alignment of sensors

Flexdip

Flexdip CYA112 is used for installations in open vessels and channels. Such assemblies are usually found in wastewater treatment plants.



Insertion assemblies

In batch processes where you have access to sensors, you use fixed installations using insertion assemblies. Such assemblies are often used in pharmaceutical and food production.

Unifit

The CPA442 is an assembly made from stainless steel for Food & Pharma.

There are several options for the process connection especially hygienic clamp connections. For special hygienic demands a certified hygienic design and certificates according to EHEDG are available with corresponding surface roughness.



Flow-through assemblies

Installation in process pipes or bypasses can be done by using flow-through type assemblies. Such setups are often found in water works, beverages industry, chemical industry or on analytical panels in power plants.

Flowfit

For the water works segment the CPA250 made from PP is a good choice. The robust CPA240 is available in chemically resistant PVDF or stainless steel for the measurement of ultra pure water (prevention of static charges). Both assemblies have 3 sensor slots and the option to upgrade for chemical spray cleaning.



Retractable assemblies

Main advantage of retractables is sensor exchange or cleaning can easily be done without process interruption. The insertion or retraction process can be done manually or automatically (pneumatic retraction). The pneumatically driven assemblies can be combined with automatic cleaning and calibration.

Cleanfit

In addition to manual and automatic retraction, we offer a wide variety of materials and seals to fit your applications. Pneumatically driven retractables can have a ball valve for additional safety. The pneumatic version can be automated for cleaning by using Topclean CPC30. To have cleaning and calibration the Topcal CPC310 can be used. See below.

Topclean CPC30 – Automatic cleaning

See also section 5.2 on page 51 or www.us.endress.com/cpc30



Topcal CPC310 – Automatic cleaning and calibration

See also section 5.2 on page 51 or www.us.endress.com/cpc310



1. Overview of pH electrodes and installation types

1.4 pH assemblies



(Type of electrode see table on page 48)

	Flowfit CPA240 	Flowfit CPA250 	Unifit CPA442 	
Max. operating pressure/temp. dependent on material	145 psi/10 bar at 284°F/140°C, metal 116 psi/8 bar at 140°F/60°C, PVDF	87 psi/6 bar at 68°F/20°C 0 psi/bar at 176°F/80°C	145 psi/10 bar at 32°F/0°C to 284°F/140°C	
Materials in contact with medium	PVDF, 1.4404/316L	PP	1.4435	
Sealings	EPDM/Viton®, Chemraz®/Fluoraz®	EPDM	EPDM-FDA, FMP-FDA, silicone-FDA	
Process connections	Welding adapter for DN 25 pipe Flange DN 25 PN 16 Flange ANSI 1" 150 lbs Flange JIS 10K 25 A Thread FNPT ½"	Thread G 1" NPT 1"	DN 25 standard, DN 25 also for B.Braun port, Tri-Clamp® 1.5"; Tri-Clamp® 2" Dairy fitting DN 50 DIN11851/2.5" Varivent® DN 40-125/0.4" APV DN 40-100/0.4" Neumo BioControl D 50	
Cleaning	Spray cleaning connection G ½"	Spray cleaning CPR31	3-A	
Remarks	■ PMC (potential matching) in Alloy C4; Tantal ■ Number/connection: 3 x PG13.5	■ PWIS (Paint wetting impairment substances) free available ■ Number/connection: 3 x PG13.5	EHEDG approval with surface finish $R_a = 0.8 \mu\text{m}$ or $0.4 \mu\text{m}$	
Application	Water, boiler feedwater, ultra pure water, cooling water, fertilizer, sugar production, gas scrubbers, petrochemical	Water, wastewater treatment or beverages	Food, pharmaceutical, chemical, water	

Ecofit CPA640 	Dipfit CPA111 	Dipfit CPA140 	Flexdip CYA112 
145 psi/10 bar at 194°F/90°C, metal 87 psi/6 bar at 176°F/80°C, PVDF	58 psi/4 bar at 68°F/20°C, 176°F/80°C at 0 psi/bar	145 psi/10 bar at 212°F/100°C, metal 87 psi/6 bar at 68°F/20°C, PVDF	58 psi/4 bar at 68°F/20°C, 176°F/80°C at 0 psi/bar
PVDF, 1.4571/316Ti, Monel	PP	PVDF, 1.4404/316L	PVC, 1.4404/316L
Viton®	EPDM	EPDM/Viton®/ Chemraz®/Fluoraz®	EPDM
M-NPT ½", M-NPT ¾", thread M 25 x 1.5	Flange DN 100 Adjustable flange DN 100 Suspension bracket Pendulum frame mounting	Flange DN 80 PN16 Flange ANSI 3" 150 lbs Flange JIS 10K 80A	For sensor adapter, G1, NPT ¾", G ¾", PG13.5
	External spray cleaning CPR30, internal spray cleaning CPR31	External spray cleaning CPR30, internal spray cleaning CPR31	
Replacement of CPF81 by glass electrodes	- Wet bucket - Number/connection: 3 x PG13.5	- Mounting of KCl reservoir onto the assembly - Number/connection: 3 x PG13.5	Modular system, many accessories
Water, wastewater, floculent dosage, surface water, industrial water monitoring, wastewater neutralization	Water/wastewater	Chemical industry, pesticides and fertilizers, petrochemical, power plants metal industry	Water/wastewater treatment, plant design, open channels, basins, open tanks and process vats, fluctuating water levels

1. Overview of pH electrodes and installation types

1.4 pH assemblies



(Type of electrode see table on page 48)

	Cleanfit CPA450 	Cleanfit CPA451 	Cleanfit CPA471 	Cleanfit CPA472 
Max. operating pressure/temperature	58 psi/4 bar at 248°F/120°C, 174 psi/12 bar static max.	29 psi/2 bar at 176°F/80°C	145 psi/10 bar at 212°F/100°C (with stainless steel housing)	87 psi/6 bar at 68°F/20°C
Material in contact with medium	1.4404/316L (no PVDF-PTFE) Alloy C4, Titanium	1.4404	1.4404/316L	PP, PVDF
Sealings	EPDM/Viton®/Kalrez®	Viton®	EPDM/Viton®/Kalrez®	EPDM/Viton®/Kalrez®
Operation	Manual	Manual	Manual/pneumatic	Manual/pneumatic
Process connections	Thread G1¼", G1½" external, thread NPT 1¼", G1½" external, flange DN 32, DN 40, DN 50 flange ANSI 1¼", 1½", 2" 150 lbs,	G2" internal thread G2" internal thread with welded fitting h = 50 mm/1.97" Flange DN 50/PN 16 Flange ANSI 2"/ 150 lbs	Size 25, 1¼" internal thread NPT 1" external thread Tri-Clamp® 2" Dairy fitting DN 50 (acc to. DIN 11 851) Flange DN 50, 2" ANSI 150 lbs	G1¼" external thread NPT 1" external thread Dairy fitting DN 50 (acc to. DIN 11 851) Flange DN 50, 2" ANSI 150 lbs
Convertible to pneumatic	No	No	Yes	Yes
Sealing to process	Ball valve	Ball valve	O-rings	Self sealing piston
Special options	Manual or with worm gear handle	Cleaning: rinse connection G1/8"	Flow chamber available, PWIS free version	Flow chamber available
Application	Water, wastewater, process	Wastewater	Water, food, process	Water treatment, washers

Cleanfit CPA472D	Cleanfit CPA473	Cleanfit CPA474	Cleanfit CPA475	Cleanfit CPA477
				
145 psi/10 bar at 212°F/100°C, 284°F/140°C max.	145 psi/10 bar at 212°F/100°C, 266°F/130°C max.	87 psi/6 bar at 176°F/80°C, 248°F/120°C -14.5 psi/1 bar	145 psi/10 bar at 212°F/100°C, 284°F/140°C for sterilization	87 psi/6 bar at 194°F/90°C
PEEK™, PVDF, conductive PVDF, Hastelloy C4, Titanium, SS 1.4571	1.4404/316L	PP/PEEK™/PVDF	1.4404/316L	316Ti
EPDM/Viton®/ Kalrez®	EPDM/Viton®/ perfluoroelastomer	EPDM/Viton®/ perfluoroelastomer	EPDM-FDA/FPM- FDA/Viton®	EPDM/Viton®
Manual/pneumatic	Manual/pneumatic	Manual/pneumatic	Manual/pneumatic	Manual/pneumatic
Size 25, 1½ internal thread Flange DN 50, DN 80, 2" ANSI 150 lbs Flange JIS 10K 25 A	Size 25, 1½ internal thread Tri-Clamp® 2" Dairy fitting DN 65 (DIN 11 851) Flange DN 50, 2" ANSI 150 lbs	Dairy fitting DN 50 (DIN 11 851) Flange DN 50, 2" ANSI 150 lbs	Size 25, 1½ internal thread Tri-Clamp® 2" Dairy fitting DN 50 (acc to. DIN 11 851) Varivent® N 68 mm APV DN50-100 Flange DN 50, 2" ANSI 150 lbs	Flange DN 40, DN 50, flange 11/2", 2" ANSI 150 lbs
Yes	Yes	Yes	Yes	Yes
O-rings	Ball valve	Ball valve	Form ring	Ball valve, special options
Various flow assemblies PFA-lined, 3.1 certificates	Flow chamber, optionally with wiping seal	Flow chamber, optionally with wiping seal	Hygienic design, flow chamber, certificates: 3.1, 3-A, EHEDG	Extra long immersion, special chamber for dirty medium
Heavy duty and process application	Chemical industry, paper industry, sticky medium	Paper industry, industrial water treatment	Food and pharma processes	Paper industry, chemical industry, fibrous media

1. Overview of pH electrodes and installation types

1.5 Transmitters for pH measurement



Liquiline M CM42

Easy, intuitive operation with clear text menus is one of the benefits with this two-wire transmitter for hazardous and general purpose applications. When used with Memosens sensors predictive maintenance is possible to indicate events such as calibration cycle.

Parameter change from pH to conductivity or dissolved oxygen

is easy due to the modular design. Use Liquiline CM42 for calibration of Memosens sensors in the laboratory. Your benefit: No calibration on site means less interruption of pH measurement in the process. Available outputs include 0/4 to 20 mA, HART® FOUNDATION™ Fieldbus and PROFIBUS® PA.



Liquiline M CM44

Four-wire transmitter with 2-channels, simple and intuitive operation with clear text menu. Mix and match of all sensors with Memosens technology in any combination. Predictive

maintenance functionalities can be used (e.g., process check system, delta slope, delta zero point or a calibration timer). Up to 4 current outputs 0/4 to 20 mA. Up to 4 relays, advanced diagnostics functions.



Liquisys CPM223/CPM253

The Liquisys transmitter is available as a panel mounted version CPM223 or with field housing CPM253. Relay functions are available as an option (e.g., neutralization processes and spray cleaning function). Available outputs are 0/4 to 20 mA,

HART® or PROFIBUS® PA/DP. Have the same look and feel for all analytical parameters: this transmitter platform is available for pH, conductivity, dissolved oxygen, turbidity and chlorine. Advanced diagnostics functions such as sensor check system are optional.



Mycom CPM153

The 4-wire device Mycom with backlit display can be used for pH measurement in hazardous areas with sensors in zone 0 and transmitter in Ex zone 1. It can be used as a dual channel pH transmitter and obtains relay function for cleaning/controlling purposes. The Mycom transmitter

is used for measurement and control in our automatic cleaning or cleaning/calibration system, Topclean or Topcal, respectively. Choose your preferred output signal either 0/4 to 20 mA, HART® or PROFIBUS® PA. Advanced diagnosis functions such as sensor check system are optional.

1. Overview of pH electrodes and installation types

1.6 pH transmitters



	Liquiline CM42 	Liquiline CM44 	
Measured parameters	pH glass, pH non-glass, conductivity, oxygen, ORP	pH glass, pH non-glass, conductivity, oxygen, turbidity, nitrate, ORP	
Input	Analog, Memosens	Memosens	
Power supply	2-wire transmitter 12 to 30 V DC (HART®, w/o HART®) 9 to 32 V DC (PROFIBUS, FOUNDATION™ Fieldbus)	4-wire transmitter 18 to 36 V DC / 20 to 28 V AC 85 to 265 V AC	
N°/Types of output	Up to 2 current outputs, 0/4 to 20 mA, 1 x HART®	Up to 4 linear current outputs 0/4 to 20 mA	
Approvals	ATEX II(1) 2G, FM, CSA, SIL2	CE, cCSAus	
Communication	0/4 to 20 mA, HART®, PROFIBUS® PA, FOUNDATION™ Fieldbus	0/4 to 20 mA	
Dual channel	No	Yes	
Housing	Plastic, SS	Plastic	
Display	Graphic display and plain text guidance	Graphic display and plain text guidance	
Mounting	Mounting plate: IP67 (Similar to NEMA 4X)	Field: IP66 and IP67	
Specials	Quick setup function, navigator sensor module replaceable, predictive maintenance system	Quick setup, graphic user interface, modular expandable	

Liquisys
CPM223/CPM253



Mycom
CPM153



pH glass, pH non-glass, conductivity, oxygen, turbidity, chlorine, ORP	pH glass, pH non-glass, conductivity, oxygen, ORP
Analog, Memosens	Analog, Memosens
4-wire transmitter 100/115/230 V AC 24 V AC/DC	4-wire transmitter 100 to 230 V AC 24 V AC/DC
2 linear current outputs, 1 alarm contact, up to 4 additional relays	2 linear current outputs, 1 alarm contact, up to 5 relays
ATEX II 3G	ATEX II(1) 2G, FM, CSA
0/4 to 20 mA, HART®, PROFIBUS® PA, DP	0/4 to 20 mA, HART®, PROFIBUS® PA
No	Yes
Plastic	Aluminum
2 line LCD	Backlit LCD with dot matrix
Panel: IP54/Similar to NEMA 3S (front), IP30/Similar to NEMA 1 (housing) Field: IP65/Similar to NEMA 4X	Field: IP65 (Similar to NEMA 4)
Cleaning with a timer, Chemoclean, PID controller...	Logbook, data logger, DAT module, Chemoclean, controller, NAMUR output contacts, different user levels ...

2. Checklist

Customer contact data:			
Name:		Company:	
Email:		Telephone:	
		Please fill in	Notes
Medium	pH range		
	Conductivity [$\mu\text{S}/\text{cm}$]		
	Sulfides (S^{2-}), Cyanides (CN^-), Ammonia (NH_3) [mg/l]		
	Hydrofluoric acid (HF) [mg/l]		
	Organic solvent content [%]		
	Fat, grease, sticky medium		
	Suspended solids		
	Abrasives		
Process data	Process temperature		
	Process pressure		
	Flow velocity		
Process connection	Kind of connection/size		
Installation	Ambient temperature		
	Installation in pipe		
	Installation in vessel	From top: From side:	
	Bypass installation		
	Sample preparation		
Transmitter	2-/4-wire		
	Ingress protection		
	Digital communication (HART®, PROFIBUS®, FOUNDATION™ Fieldbus)		
	Dosing to be controlled by transmitter?		
	Automatic cleaning?		
	Cleaning medium allowed to contaminate medium?		
	Multichannel device		
Approvals/Certificates	Ex (Ex ia, Ex d)		
	EHEDG		
	3-A		
	FDA listed material		
	SIL		
	3.1 certificate		

Customer contact data:	
Name:	Company:
Email:	Telephone:

Special demands / short application description / drawing:

3. Selection of pH electrodes according to applications

3.1 Flow chart for pH electrode selection

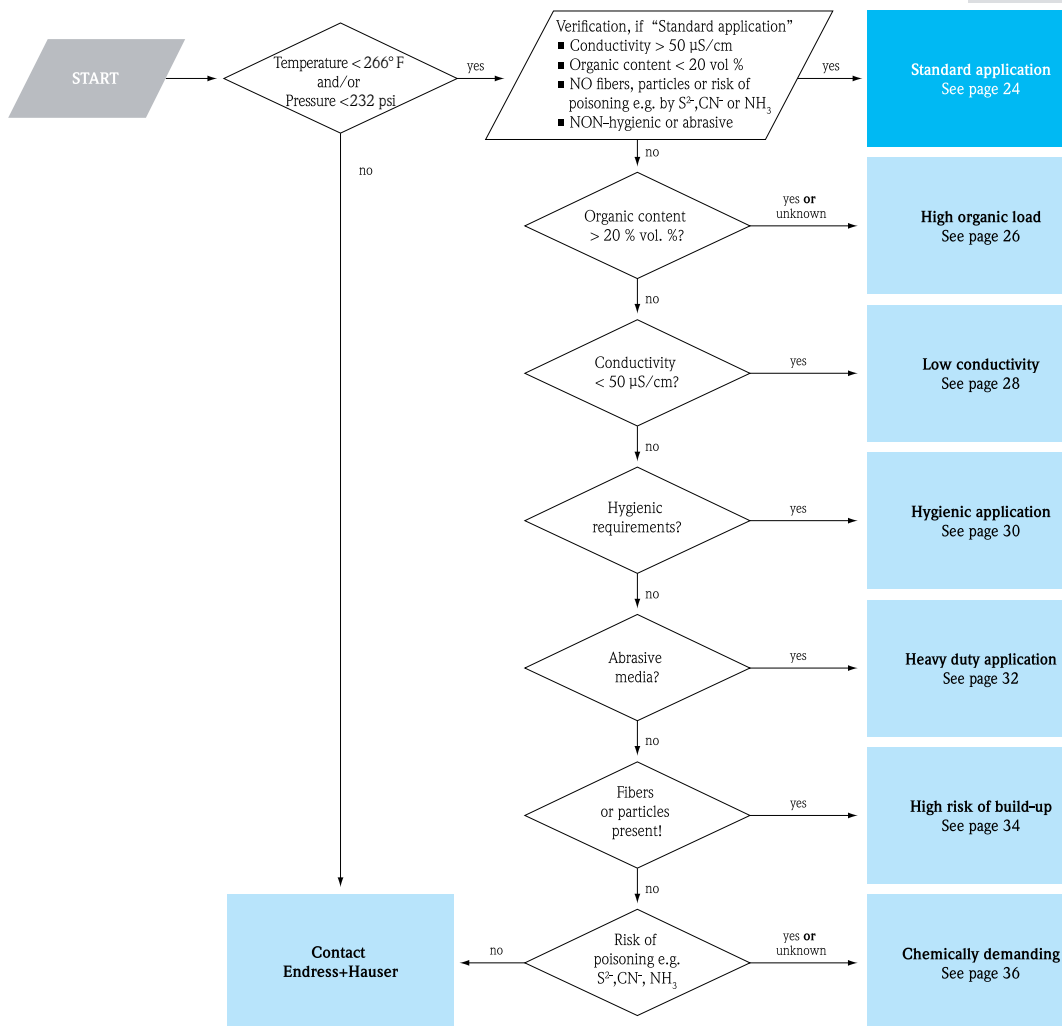
B

The selection of a pH electrode is primarily based on chemical and physical behaviors of the process medium. Combinations with process or industry specific requirements such as “hygienic” will reduce the choice of pH electrodes suitable for certain applications. However, the key criteria are based on maximum expected lifetime and maintenance efforts such as calibration or refilling of KCl.

As some of the conditions might be difficult to predict there is also the choice in the flow chart “unknown” From there you are directed to the individual chapters (3.2 – 3.8) with the indication of the recommended pH electrode including key advantages as well as application limits and alternatives. Simplified to reduce complexity, you may find combinations that require contact with specialists.

Two basic approaches for selecting pH electrodes:

- 1) For a known application, there are “First Choice” recommendations provided in Chapters 3.2 through 3.8.
- 2) To verify a known pH electrode or new unknown application, refer to flow chart on page 23.



3. Selection of pH electrodes according to applications

3.2 Application: Standard



B

Standard
application

First Choice

Orbisint CPS11/CPS11D pH electrode



Orbipac CPF81/CPF81D pH electrode



Advantages

- Dirt-repellent Teflon® diaphragm
- Most universal with broad application spectrum

- Dirt-repellent Teflon® diaphragm
- Sensor integrated in plastic holder with thread connection

Technical data

- Process temperature
5°F to 176°F/-15°C to 80°C (A-glass),
32°F to 275°F/0°C to 135°C (B-glass)
- Process pressure
Up to 232 psi/16 bar with B-glass
- pH range
2 to 12 (A-glass), 0 to 14 (B-glass)
- Sensor lengths
120, 225, 360 and 425 mm
- Transmission
Memosens and TOP68

- 32°F to 176°F/0°C to 80°C
- Up to 145 psi/10 bar (176°F/80°C)
- 0 to 14
- Memosens, TOP68 and fixed cable

Application limits

- Heavily soiling media need spray cleaning – see assembly page 12 ff.
- Slower response of sensor with Teflon diaphragm

→ Liquid-filled CPS41/CPS41D with ceramic diaphragm

- Heavily soiling media needed spray cleaning – see assembly page 12 ff.
- Slower response of sensor with Teflon diaphragm

→ liquid-filled CPS41/CPS41D with ceramic diaphragm

Application: Standard		
Conditions	Process	Typ. Liquids
■ Conductivity > 50 µS/cm ■ Organic content < 20 vol % ■ NO fibers, particles or risk of poisoning, e.g., by S²⁻, CN⁻ or NH₃ ■ NON-hygienic or abrasive	■ Neutralization ■ Water treatment	■ Wastewater

B

Standard
application

Ceraliquid
CPS41/CPS41D pH electrode



- Fast response time due to ceramic diaphragm and liquid filling
- More soiling-resistant due to continuous flushing of diaphragm

5°F to 176°F/-15°C to 80°C (A-glass),
32°F to 275°F/0°C to 135°C (B-glass)
Up to 145 psi/10 bar, KCl vessel CPY7 with
counter pressure necessary
2 to 12 (A-glass), 0 to 14 (B-glass)
120, 225, 360 and 425 mm
Memosens and TOP68

- Manual refilling of electrolyte vessel necessary
- Heavily soiling media needed spray cleaning – see assembly page 12 ff.

→ Gel-filled
CPS11/CPS11D
or
CPF81/CPF81D

3. Selection of pH electrodes according to applications

3.3 Application: High organic load



B

High organic
load

First Choice			
Tophit CPS441/CPS441D pH electrode		Tophit CPS471/CPS471D pH electrode	
			
Advantages			
■ No aging effect of ISFET chip caused by organics ■ Up to 95% organic content possible ■ Stable and fast measurement due to liquid reference		■ No aging effect of ISFET chip caused by organics ■ Stable and fast measurement due to liquid reference	
Technical data			
■ Process temperature ■ Process pressure ■ pH range ■ Sensor lengths ■ Transmission			
5°F to 275°F/-15°C to 135°C up to 145 psi/10 bar, KCl vessel CPY7 with counter pressure necessary 0 to 14 120, 225, 360 and 425 mm Memosens and TOP68		5°F to 275°F/-15°C to 135°C up to 145 psi/10 bar 0 to 14 120, 225, 360 and 425 mm Memosens and TOP68	
Application limits			
■ Presence of hot caustics, e.g., during "CIP" ■ Soiling media			
		→ Glass type CPS41/CPS41D → CPS41/CPS41D and/or automatic cleaning with Topclean (see page 51)	
		■ Organic content > 50 % ■ Remark: Generally automatic cleaning with Topclean (see page 51) recommended due to glass electrode technology in organics	
		→ ISFET sensor CPS441/CPS441D	

Application: High organic load		
Conditions	Process/Industry	Typ. Liquids
■ Organic content > 20 vol % ■ NO fibers, particles or risk of poisoning, e.g., by S²⁻,CN⁻ or NH₃ ■ NON-hygienic or abrasive	■ Dye and pigment production	■ Impregnating resin

B

High organic
load

3. Selection of pH electrodes according to applications

3.4 Application: Low conductivity



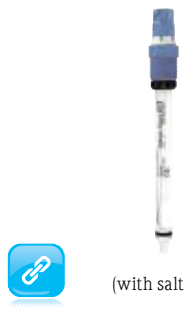
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First Choice			
Ceraliquid CPS41/CPS41D pH electrode  		Purisys CPF201 pH electrode  	
Advantages	■ Fast response time due to ceramic diaphragm and liquid filling ■ Extended life time because of continuous reference refilling		■ No electrolyte refilling necessary ■ Electrode with flow chamber ensures repeatable measurement and avoids static charges [spare electrode w/o chamber available]
Technical data	■ Process temperature 5°F to 176°F/-15°C to +80°C (A-glass), 32°F to 275°F/0°C to 135°C (B-glass) ■ Process pressure Up to 145 psi/10 bar, KCl vessel CPY7 with counter pressure necessary ■ pH range 2 to 12 (A-glass), 0 to 14 (B-glass) ■ Sensor lengths 120, 225, 360 and 425 mm ■ Transmission Memosens and TOP68		32°F to 167°F/0°C to 75°C - Up to 50 psi/3.45 bar 0 to 14 - TOP68
Application limits	■ Manual refilling of electrolyte vessel necessary ■ Chance of continuous outflow of KCl traces	→ Gel-filled CPS11/CPS11D with salt ring or CPF201 → CPS11/CPS11D or CPF201	■ For “Memosens-based” instrumentation use ■ Limited life time of approx. 6 months until electrolyte reservoir is used up → CPS11/CPS11D → CPS41/CPS41D

Application: Low conductivity		
Conditions	Process/Industry	Typ. Liquids
■ Conductivity < 50 µS/cm ■ NO fibers, particles or risk of poisoning, e.g., by S²⁻, CN⁻ or NH₃ ■ NON-abrasive	■ Power [Pharma]	■ Boiler water ■ Pure/ultra pure water "WFI"

B

Orbisint
CPS11/CPS11D pH electrode



(with salt ring)

- No electrolyte refilling necessary

5°F to 176°F/-15°C to +80°C (A-glass)

2 to 12 (A-glass)
120, 225, 360 and 425 mm
Memosens and TOP68

- Limited life time of approx. 6 months until electrolyte reservoir is used up

→ CPS41/CPS41D

Low conductivity

3. Selection of pH electrodes according to applications

3.5 Application: Hygienic



B

First Choice		
Ceragel CPS71/CPS71D pH electrode  		Tophit CPS471/CPS471D pH electrode  
Advantages	■ “Certificate of Compliance” for bio-compatibility available - CIP/SIP resistant ■ Pressurized reference version available for better resistance against blocking ■ Upside down version for small fermenters	■ Non-glass sensor ■ “Certificate of compliance” for bio-compatibility available
Technical data		
■ Process temperature	32°F to 275°F/0°C to 135°C	5°F to 275°F/-15°C to 135°C
■ Process pressure	Up to 188.5 psi/13 bar, up to 145 psi/10 bar for upside down version, up to 87 psi/6 bar for pressurized reference	Up to 145 psi/10 bar
■ pH range	0 to 14	0 to 14
■ Sensor lengths	120, 225, 360 and 425 mm	120, 225, 360 and 425 mm
■ Transmission	Memosens and TOP68	Memosens and TOP68
Application limits	■ Risk of glass breakage ■ Low conductivity, < 10 µS/cm (e.g., WFI)	■ Reduced resistance against hot caustic (CIP) ■ Soiling media
	→ Non-glass ISFET- sensor CPS471/CPS471D → CPS41/CPS41D	→ Retract sensor during cleaning cycle or use CPS41/CPS41D, CPS71/CPS71D → CPS41/CPS41D, CPS71/CPS71D and/or automatic cleaning [see page 51]

Application: Hygienic

Conditions	Process/Industry	Typ. Liquids
- Conductivity > 50 µS/cm - Organic content < 20 vol % - NO fibers, particles or risk of poisoning, e.g., by S^{2-}, CN^{-} or NH_3 - NON-abrasive	- Food - Pharma	- Fermentation - WFI (water for injection)

Ceraliquid
CPS41/CPS41D pH electrode



- CIP/SIP resistant
- Liquid-filled reference to prevent blocking

Tophit
CPS441/CPS441D pH electrode



- Non-glass sensor
- Liquid-filled reference to prevent blocking

Ceramax
CPS341D



- Long term stability
- Less calibration
- Life time up to approx. 5 years
- Less risk of breakage
- Direct mounting in process with hygienic process connection
- Fast response

5°F to 176°F/-15°C to 80°C (A-glass),
32°F to 275°F/0°C to 135°C (B-glass)
Up to 145 psi/10 bar, KCl vessel
CPY7 with counter pressure
necessary
2 to 12 (A-glass), 0 to 14 (B-glass)
120, 225, 360 and 425 mm
Memosens and TOP68

5°F to 275°F/-15°C to 135°C

Up to 145 psi/10 bar, KCl vessel
CPY7 with counter pressure
necessary
0 to 14
120, 225, 360 and 425 mm
Memosens and TOP68

32°F to 284°F/0°C to 140°C

Up to 87 psi/6 bar

0 to 10

Memosens

- Risk of glass breakage
→ Non-glass ISFET sensor
CPS441/
CPS441D
→ CPS71/CPS71D
- Chance of continuous outflow of KCl traces
→ Gel-filled CPS71/CPS71D
or CPS471/
CPS471D
- Manual refilling of electrolyte vessel necessary

- Reduced resistance against hot caustic (CIP)
→ Retract sensor during cleaning cycle or use CPS41/CPS41D, CPS71/CPS71D
- Soiling media
→ CPS41/CPS41D, CPS71/CPS71D and/or automatic cleaning [see page 51]

- Manual refilling of electrolyte vessel necessary
- Significantly higher investment costs than standard electrode.

- Gel-filled CPS71/
CPS71D or
CPS471/
CPS471D

3. Selection of pH electrodes according to applications

3.6 Application: Heavy duty – abrasive



B

Heavy duty application

	First Choice	
	Orbipac CPF81/CPF81D pH electrode 	Tophit CPS491/CPS491D pH electrode 
Advantages	■ Flat membrane prevents glass abrasion ■ Double chamber reference offers protection against poisoning	■ Sensor design allows mounting of sensing element in “flow shadow”
Technical data	■ Process temperature 32°F to 176°F/0°C to 80°C ■ Process pressure Up to 145 psi/10 bar (176°F/80°C) ■ pH range 0 to 14 ■ Sensor lengths Memosens, TOP68 and fixed cable ■ Transmission	■ 5°F to 230°F/ -15°C to 110°C ■ Up to 145 psi/10 bar ■ 0 to 14 ■ 120, 225, 360 and 425 mm ■ Memosens and TOP68
Application limits	■ Strongly abrasive particles will reduce life time → ISFET CPS491/ CPS491D	■ Open junction means less protection against poisoning → CPF81/CPF81D

Application: Heavy duty – abrasive		
Conditions	Process/Industry	Typ. Liquids
■ Conductivity > 50 µS/cm ■ Organic content < 20 vol % ■ NO fibers, particles or risk of poisoning, e.g., by S²⁻,CN⁻ or NH₃ ■ NON-hygienic	■ Mining	■ Slurries

B

Heavy duty
application

3. Selection of pH electrodes according to applications

3.7 Application: High risk of buildup



B

First Choice

Orbipore CPS91/CPS91D pH electrode



Orbisint CPS11/CPS11D pH electrode



Advantages	■ Open junction is less prone to plugging ■ Good resistance to poisoning due to the ion trap available with "BT version"		■ Dirt-repellent Teflon® diaphragm ■ Most universal with broad application spectrum ■ Good resistance to poisoning due to ion trap available with "BT version"
Technical data	■ Process temperature 32°F to 230°F/0°C to 110°C ■ Process pressure Up to 188.5 psi/13 bar ■ pH range 0 to 14 ■ Sensor lengths 120, 225, 360 and 425 mm ■ Transmission Memosens and TOP68		■ 5°F to 176°F/-15°C to +80°C (A-glass), 32°F to 275°F/0°C to 135°C (B-glass) ■ Up to 232 psi/16 bar with B-glass ■ 2 to 12 (A-glass), 0 to 14 (B-glass) ■ 120, 225, 360 and 425 mm ■ Memosens and TOP68
Application limits	■ Extreme risk of poisoning ■ Heavily soiling media	→ CPS11/CPS11D with option "BT" → Automatic cleaning [see page 51]	■ With small particle sizes chance of blocking
			→ CPS91/CPS91D

Application: High risk of buildup		
Conditions	Process/Industry	Typ. Liquids
■ Conductivity > 50 µS/cm ■ Organic content < 20 vol % ■ NON-hygienic or abrasive	■ Pulp and paper ■ Power and energy	■ Paper bleaching ■ Emulsions ■ Flue gas desulfurization

B

High risk
of buildup

3. Selection of pH electrodes according to applications

3.8 Application: Chemically demanding



B

First Choice			
Ceraliquid CPS41/CPS41D pH electrode		Orbisint - BT version CPS11/CPS11D pH electrode	
			
		 (BT version)	
Advantages	■ Fast response time due to ceramic diaphragm and liquid filling ■ Extended lifetime with outstanding poison resistance because of continuous reference refilling		■ Dirt-repellent Teflon® diaphragm ■ Good resistance to poisoning due to ion trap ■ Most universal with broad application spectrum
Technical data	■ Process temperature 5°F to 176°F/-15°C to 80°C (A-glass), 32°F to 275°F/0°C to 135°C (B-glass) ■ Process pressure Up to 145 psi/10 bar, KCl vessel CPY7 with counter pressure necessary ■ pH range 2 to 12 (A-glass), 0 to 14 (B-glass) ■ Sensor lengths 120, 225, 360 and 425 mm ■ Transmission Memosens and TOP68		■ Process temperature 5°F to 176°F/-15°C to +80°C (A-glass), 32°F to 275°F/0°C to 135°C (B-glass) ■ Process pressure Up to 232 psi/16 bar with B-glass ■ pH range 2 to 12 (A-glass), 0 to 14 (B-glass) ■ Sensor lengths 120, 225, 360 and 425 mm ■ Transmission Memosens and TOP68
Application limits	■ Manual refilling of electrolyte vessel necessary	→ Gel-filled CPS11/CPS11D “BT version” or CPS71/CPS71D “BP option”	■ For faster response time and better poison resistance → CPS41/CPS41D or CPS71/CPS71D “BP option”

Application: Chemically demanding		
Conditions	Process/Industry	Typ. Liquids
■ Risk of poisoning, e.g., by S^{2-},CN^{-} or NH_3 ■ Conductivity > 50 $\mu S/cm$ ■ Organic content < 20 vol % ■ NON-hygienic or abrasive	■ All	■ HCN production ■ Chemical process solutions

Ceragel
CPS71/CPS71D pH electrode



- Fast response time without refilling of electrolyte
- Pressurized reference version for better resistance against poisoning

32°F to 275°F/0°C to 135°C

Up to 188.5 psi/13 bar, up to 145 psi/10 bar for upside down version, up to 87 psi/6 bar for pressurized reference

0 to 14

120, 225, 360 and 425 mm

Memosens and TOP68

- For fastest response time and best poison resistance
- CPS41/CPS41D

4. Selection of assembly

4.1 Flow chart for assembly selection

General considerations

Correct assembly selection requires consideration of the installation and application conditions as well as pH electrode selection.

Please be aware that several retractable assemblies are available in different versions suitable for either gel or liquid-filled electrodes. Retrofitting from one version to another is either impossible or requires considerable effort. Make sure that you select an assembly that matches the length of the pH electrode. See table 4.6 on page 48 for details.

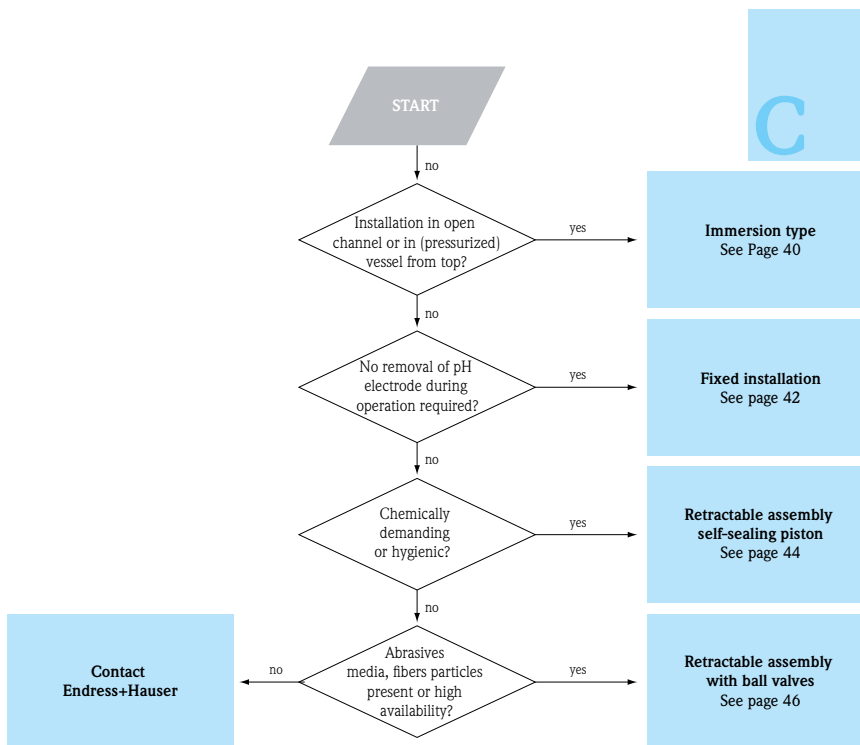
For chemically demanding and safety relevant applications, ball valve sealed assemblies should be used due to complete mechanical isolation during the exchange process.

Manual retraction assemblies are only possible with up to 29 psi/2 bar process pressure although the assembly is suitable for higher pressures during normal operation. For retraction at a higher pressure you need a pneumatic version.

For automatic cleaning and calibration using Topclean and Topcal, you must select pneumatically driven retractable assemblies.

For applications using Memosens technology to operate with 2 pH electrodes (one in the application and the 2nd in the calibration/recovering cycle) retractable assemblies are recommended unless sensor is installed in bypass. This ensures the exchange of pH electrodes under process conditions.

For hygienic applications (e.g., FDA conformity or EHEDG certificates) you will find the selection in the technical data).



4. Selection of assembly

4.2 Immersion type



First Choice

Flexdip
CYA112



Dipfit
CPA111



	First Choice			
	Flexdip CYA112  		Dipfit CPA111  	
Advantages	■ Modular system for a wide variety of sensor mounting, e.g., pH, turbidity, nitrate		■ 3 electrode slots for redundant measurement ■ Flexible immersion depth by chemically resistant pipes ■ Spray cleaning head as option	
Technical data	■ Process temperature 32°F to 140°F/0 to 60°C, PVC; 32°F to 194°F/0 to 90°C, 316L ■ Process pressure 0 to 58 psi/4 bar_{rel} ■ Wetted materials PVC; 316L, EPDM, Viton® - Process connection Different holder systems, float ball, chain from Nylon hanging, pendulum frame mounting ■ Immersion depth 23.6 in. to 11.8 ft./600 to 3600 mm		14°F to 176°F/-10 to 80°C 0 to 58 psi/4 bar _{rel} PP, EPDM Flange DN 100, adjustable flange DN 100, hanging bracket, pendulum frame mounting 19.7 in. to 9.8 ft./500 to 3000 mm	
Application limits	■ Spray cleaning available on request ■ Long immersion depth or high lateral load like agitation on request	→ CPA111 [for CPF81/CPF81D] → CPA140	■ Long immersion depth or high lateral load like agitation	→ CYA112 with float installation from side of the vessel if possible

Installation in open channels, basins and in closed vessels from top

- Immersion assemblies are usually used for installation in open channels and basins fixed by chains or on a rail. Version with flanges can as well be used for installation of the sensor from the top of a vessel. Typical applications are, e.g., municipal and industrial wastewater.



Dipfit
CPA140



- 3 electrode slots for redundant measurement
- Robust process sealing due to the bayonet mounting method

14°F to 302°F/-10 to 150°C

0 to 145 psi/10 bar_{rel}
PVDF, SS 316L, EPDM, Viton®, Chemraz®
Flange DN 80, ANSI 3" and JIS

19.7 in. to 8.2 ft./500 to 2500 mm

- Service-friendly change of sensor

→ Retractable
CPA450 or
CPA473

C

Immersion
type

4. Selection of assembly

4.3 Fixed installation



First Choice – Standard

**Flowfit
CPA250**



**Flowfit
CPA240**



Advantages

- 3 electrode slots for redundant measurement
- Low cost PP, flow through style
- Easy calibration using the detachable calibration vessel

- 3 electrode slots for redundant measurement
- Certificate according to NACE available
- Different design (axis) of inlet and outlet of the fluid available

Technical data

- Process temperature 32°F to 176°F/0 to 80°C
- Process pressure 0 to 87 psi/6 bar_{rel}
- Wetted materials PP, EPDM

- 14°F to 284°F/-10 to 140°C
- 0 to 87 psi/6 bar_{rel}
- PVDF, 316L, EPDM, FPM, Chemraz®

- Process connection Thread G1, NPT 1", flange DN 25; 90° or 180° between in- and outflow

- Thread or flanges DN 25; 90° or 180° between in- and outflow

- Immersion depth

Application limits

- Installation in tank or vessel → CPA640 or CPA442
- Temperature > 176°F/80°C → CPA240 in 316L or PVDF

- Large dimension, e.g., panels in power stations → 71042404 [on request]
- Change of sensor under pressure → Retractable CPA471 or CPA472

Installation in pipes/bypass with flow through or insertion type assembly

- Suitable for processes which do not need frequent replacement or calibration of pH electrode. For applications with pressure in pipe medium, flow has to be interrupted in the pipe or bypass to get access to the sensor by an external valve.



First Choice - Hygienic

Unifit
CPA442



Ecofit
CPA640



- Variety of process connections
- Economical solution for batch processes

- Best value version

14°F to 284°F/-10 to 140°C
0 to 87 psi/6 bar_{rel}
1.4435/316L, EPDM-FDA, FPM-FDA,
silicone-FDA
Thread G 1¼", NPT, Tri-Clamp®, Varivent®,
Bioconnect, AVP, DN 25 and DN 50 dairy
fitting

14°F to 284°F/-10 to 140°C
0 to 87 psi/6 bar_{rel}
PVDF, 1.4571/316L
Thread G 1¼" or M25x1.5, NPT ½", ¾"

0.98", 1.96", 3.34"/25 mm, 50 mm or 85
mm

- Change of sensor
under pressure in
hygienic design

→ Retractable
CPA475

- Only thread
process
connections

→ CPA442

C

Fixed
installation

4. Selection of assembly

4.4 Retractable assembly (self-sealing piston)



	First Choice - Standard		First Choice - High chemical compatibility	
	Cleanfit CPA471		Cleanfit CPA472	
	 		 	
Advantages	■ Most economical retractable assembly ■ Available in 316L for wide range of applications		■ Non-metallic material offers good chemical compatibility against most acids and caustics ■ Fully retractable in PP + PVDF with plastic housing, e.g., for water treatment	
Technical data				
■ Process temperature	32°F to 284°F/0 to 140°C		32°F to 176°F/0 to 80°C, PVDF	
■ Process pressure	0 to 58 psi/4 bar _{rel} (housing of metal)		0 to 87 psi/6 bar _{rel}	
■ Wetted materials	SS 316L, EPDM, FPM, Kalrez®		PP, PVDF, EPDM, FPM	
■ Process connection	G 1¼", NPT 1", Tri-Clamp® 2", dairy DN 50, flanges		G 1¼", NPT 1", dairy DN 50, flanges DN 50/ANSI	
■ Immersion depth	Up to 8.19"/208 mm		Up to 8.46"/215 mm	
Application limits	■ Chemical resistance of 316L → CPA472/CPA472D ■ Dirty media (fibers) → CPA473		■ Temperatures > 176°F/80°C or pressure > 87 psi/6 bar or PP/PVDF chemically not compatible → CPA472/CPA472D	

Installation in pipe and vessels with self-sealing piston

- Manual and pneumatic



First Choice - Heavy duty

Cleanfit CPA472/CPA472D



- Wide variety of materials available for best chemical compatibility
- Heavy duty version available with flow chamber and optional sight glass
- Immersion depth up to 11"/280 mm

-4°F to 284°F/-20 to 140°C, short time
max. to 320°F/160°C
0 to 145 psi/10 bar_{rel}
SS 316L, Alloy C4, Titanium, PVDF,
PVDF-LF, PEEK™
G 1¼", flanges DN 50/80, ANSI 2" JIS

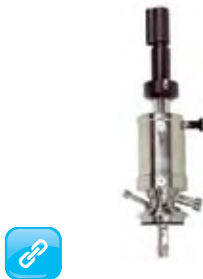
Up to 11"/280 mm

- High investment costs

→ CPA472,
CPA471

First Choice - Hygienic

Cleanfit CPA475



- Hygienic design for a wide range of hygienic applications (3-A, FDA-listed materials, EHEDG certificate)
- Pneumatic version for automatic cleaning/calibration with Topclean or Topcal

14°F to 284°F/-10 to 140°C

0 to 145 psi/10 bar_{rel}
1.4435/316L

G 1¼", Tri-Clamp® 2", Varivent® N 68,
dairy DN 50, flanges 50/ANSI
Up to 3.98"/101 mm

- Relatively high investment costs
- Longer immersion length

→ CPA442

→ on request

C

Retractable assem.
self-sealing piston

4. Selection of assembly

4.5 Retractable assembly (with ball valves)



First Choice – Manual

**Cleanfit
CPA450**



**Cleanfit
CPA451**



Advantages	■ Variable immersion depth up to 27.5"/700 mm ■ Open sensor protection guard prevents fiber buildup around the sensor ■ Increased safety due to high pressure protection		■ Only retractable assembly for use with Orbipac CPF81/CPF81D
Technical data ■ Process temperature ■ Process pressure ■ Wetted materials ■ Process connection ■ Immersion depth ■ Operation	32°F to 266°F/0 to 130°C 0 to 58 psi/4 bar retraction; 0 to 232 psi/16 bar static SS 316L and Alloy C4, Titanium, EPDM, FPM, Kalrez® G 1¼", G 1½" NPT ½", flanges DN 32, ANSI 1½" and 2" 3 types: from 3.94" to 27.5"/100 up to 700 mm Manual		32°F to 176°F/0 to 80°C 29 psi/2 bar at 176°F/80°C SS 1.4404, nicked brass G 2" internal thread, G 2" internal thread with welded fitting, flange DN50 PN16, flange ANSI 2" 2 types: 6.69" and 10.6"/170 and 270 mm Manual
Application limits	■ Not for KCl electrodes ■ Not compatible with CPF81/CPF81D ■ Insertion on higher pressure 58 psi to 145 psi/4 to 10 bar	→ CPA473 → CPA451 → Pneumatic retractable CPA472D	■ No sensor protection by protection guard ■ Remark: Some assembly options not compatible with all pH electrodes → CPA477

Installation in pipe and vessels with ball valve



- Ball valve offers safety process sealing
- Manual and/or pneumatic

First Choice – Pneumatic

Cleanfit
CPA473



- Open sensor protection guard and tape wiper prevents fiber buildup around the sensor, e.g., media in pulp & paper, mining

Cleanfit
CPA474



- Suitable for aggressive medium
- Open sensor protection guard and tape wiper prevents fiber buildup around the sensor, e.g., media in pulp & paper, mining

Cleanfit
CPA477



- Easy replacement of the sensor due to exchangeable sensor holder
- Easy removal of the retractable assembly from the ball valve

32°F to 266°F/0 to 130°C
0 to 145 psi/10 bar_{rel}

SS 316L, FPM, Kalrez®

G 1¼", dairy DN 50, flanges DN 50/ANSI

Up to 9.05"/230 mm
Manual/pneumatic

- Not compatible with CPF81/CPF81D
- Remark: For sticky and abrasive medium choose "tape wiper option"

→ CPA451

32°F to 266°F/0 to 130°C
0 to 87 psi/6 bar_{rel}

PP, PVDF, PEEK™, Kalrez®

G 1¼", dairy DN 50, flanges DN 50/ANSI

Up to 8.15"/207 mm
Manual/pneumatic

- PP/PVDF/PEEK™ chemically not compatible
- Not compatible with CPF81/CPF81D
- Higher immersion length

→ CPA473

→ CPA451

→ On request

32°F to 194°F/0 to 90°C
0 to 87 psi/6 bar

1.4571, EPDM, FPM

Flange DN 40, others on request

Up to 3.94"/100 mm
Manual/pneumatic

- Relatively high investment costs
- Longer immersion length

→ CPA473

→ Available on request

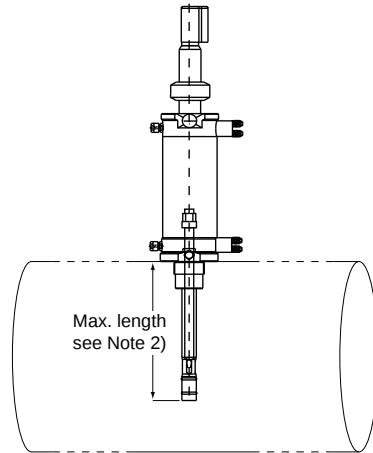
Retractable assem.
with ball valves

C

4. Selection of assembly

4.6 Required pH electrode length and total mounting length for different assemblies

		Total length ²⁾ [add 3.94"/100 mm for liquid-filled sensors]	Glass type				
			CPS11/ CPS11D	CPS41/ CPS41D ¹⁾	CPS71/ CPS71D	CPS91/ CPS91D	
CPA111		see Note 3)	4.72"/120mm	4.72"/120mm	4.72"/120mm	4.72"/120mm	
CYA112		see Note 3)	4.72"/120mm	4.72"/120mm	4.72"/120mm	4.72"/120mm	
CPA140		see Note 3)	4.72"/120mm	4.72"/120mm	4.72"/120mm	4.72"/120mm	
CPA240		13.8"/350mm	4.72"/120mm	4.72"/120mm	4.72"/120mm	4.72"/120mm	
CPA250		13.8"/350mm	4.72"/120mm	4.72"/120mm	4.72"/120mm	4.72"/120mm	
CPA442		9.84"/250mm	4.72"/120mm	4.72"/120mm	4.72"/120mm	4.72"/120mm	
CPA640		7.87"/200mm	4.72"/120mm	4.72"/120mm	4.72"/120mm	4.72"/120mm	
CPA450		see Note 3)	4.72"/120mm	n/a	4.72"/120mm	4.72"/120mm	
CPA471	short	15.7"/400mm	4.72"/120mm	8.86"/225mm	4.72"/120mm	4.72"/120mm	
	long	23.6"/600mm	8.86"/225mm	n/a	8.86"/225mm	8.86"/225mm	
CPA472	short	15.7"/400mm	4.72"/120mm	8.86"/225mm	4.72"/120mm	4.72"/120mm	
	long	23.6"/600mm	8.86"/225mm	n/a	8.86"/225mm	8.86"/225mm	
CPA472/ CPA472D	short	25.6"/650mm	8.86"/225mm	14.2"/360mm	8.86"/225mm	8.86"/225mm	
	long	35.4"/900mm	14.2"/360mm	n/a	14.2"/360mm	14.2"/360mm	
CPA473	short	23.6"/600mm	8.86"/225mm	16.7"/425mm	8.86"/225mm	8.86"/225mm	
	long	39.4"/1000mm	14.2"/360mm	n/a	14.2"/360mm	14.2"/360mm	
CPA474	short	23.6"/600mm	8.86"/225mm	16.7"/425mm	8.86"/225mm	8.86"/225mm	
	long	39.4"/1000mm	14.2"/360mm	n/a	14.2"/360mm	14.2"/360mm	
CPA475		15.7"/400mm	4.72"/120mm	8.86"/225mm	4.72"/120mm	4.72"/120mm	
CPA477		47.2"/1200mm	4.72"/120mm	n/a	4.72"/120mm	4.72"/120mm	



	ISFET		
	CPS441/ CPS441D ¹⁾	CPS471/ CPS471D	CPS491/ CPS491D
	4.72"/120mm	4.72"/120mm	4.72"/120mm
	4.72"/120mm	4.72"/120mm	4.72"/120mm
	4.72"/120mm	4.72"/120mm	4.72"/120mm
	4.72"/120mm	4.72"/120mm	4.72"/120mm
	4.72"/120mm	4.72"/120mm	4.72"/120mm
	4.72"/120mm	4.72"/120mm	4.72"/120mm
	4.72"/120mm	4.72"/120mm	4.72"/120mm
	n/a	4.72"/120mm	4.72"/120mm
	8.86"/225mm	4.72"/120mm	4.72"/120mm
	n/a	8.86"/225mm	8.86"/225mm
	8.86"/225mm	4.72"/120mm	4.72"/120mm
	n/a	8.86"/225mm	8.86"/225mm
	14.2"/360mm	8.86"/225mm	8.86"/225mm
	n/a	14.2"/360mm	14.2"/360mm
	16.7"/425mm	8.86"/225mm	8.86"/225mm
	n/a	14.2"/360mm	14.2"/360mm
	16.7"/425mm	8.86"/225mm	8.86"/225mm
	n/a	14.2"/360mm	14.2"/360mm
	8.86"/225mm	4.72"/120mm	4.72"/120mm
	n/a	4.72"/120mm	4.72"/120mm

Notes:

- ¹⁾ Liquid-filled [KCl]
- ²⁾ The indicated length is the "worst" case length which must be considered, e.g., installed in pipes to ensure mechanical space; depending on process connection may be shorter for individual assembly (see drawing)
- ³⁾ Depending on length of "dipping assembly"

C

5. Life cycle management of pH loops

5.1 Calibration concept for the laboratory using Memosens and Memobase



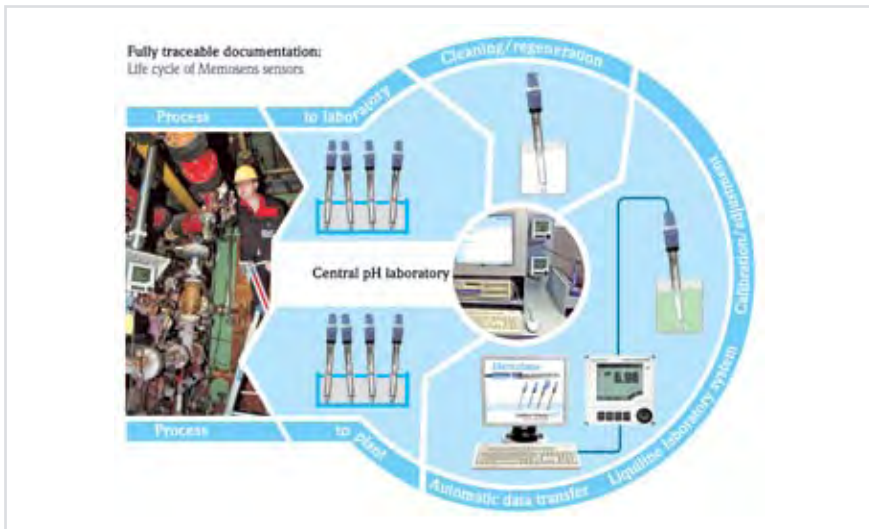
Memosens technology converts analog signals to digital. Because of this the sensor is the only component which must be inspected and calibrated regularly. The cable and transmitter have much less impact on the measurement process than in the case of an analog system, which is sensitive to moisture and electromagnetic interference, among other things.

Memosens sensors not only store process data which can be used for predictive maintenance, but most importantly store current calibration data such as the slope and zero point of the pH electrodes. This has enabled the development of the laboratory calibration concept using the Liquiline CM42 transmitter, Memosens sensors and Memobase software.

Calibration at the application's site takes time and during this process you have no monitoring of the process pH value. With Memosens you can simply replace the sensor in the process with a pre-calibrated one and the measurement

is available immediately. The most important maintenance task is then carried out in the environment of the laboratory. There the sensors are cleaned, conditioned and calibrated under optimum conditions.

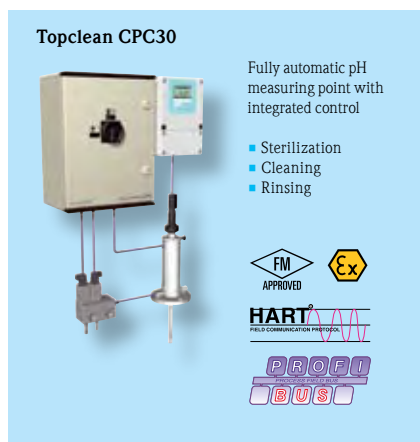
The laboratory calibration concept is supported by the Memobase sensor and data management software. Memobase stores all sensor and calibration information in a database which can be used as a server. This offers visualization, reporting and data export functionality. The software supports not only pH glass electrodes and pH ISFET electrodes, but also sensors for ORP, conductivity and dissolved oxygen. Memobase is available in 12 languages and is linked to the W@M portal from Endress+Hauser. As a result, professional life cycle management of all sensors used in the process is possible.



5.2 Fully automatic measuring, calibration, sterilization and cleaning with Topclean and Topcal

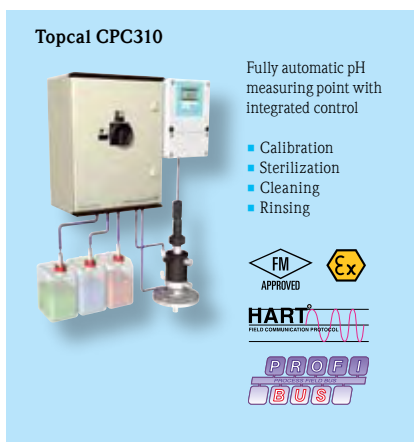
Topclean CPC30

Topclean offers the ability to automatically rinse and clean the electrodes outside the process. With the addition of an optional valve, sterilization can also be performed.



Topcal CPC310

The fully automated Topcal system for greater demands provides reliable measurement results with a minimum amount of maintenance particularly in aggressive and highly contaminated media as often occur in chemical processes. With Topcal, you can clean and calibrate fully automatically outside the process. Maintenance work is reduced to changing the electrodes and buffer as well as the cleaning solution.



5.3 Lifetime of pH electrodes

You might be wondering why there are so many different pH electrodes and options available. The answer lies in the measuring principle. On the one hand the sensing element, glass or ISFET (ion selective field effect transistor) is directly in contact with the medium. Any deposits, abrasive particles, mechanical stress and aggressive chemicals will have an impact on the measurement accuracy and/or life time of the sensor. Additionally, the diaphragm of the pH electrode brings the reference system in direct contact with the medium. Ions which react with the silver reference wire such as sulfides and cyanides can destroy the reference system. Plugging of the diaphragm interrupts

the measurement while dilution of the reference solution changes the potential of the reference system. The latter effect is the reason why a pH electrode has to be calibrated regularly. Problems associated with water egress of connectors or ground leaks are no longer an issue due to Memosens technology.

What is the lifetime of the sensor? It depends, sensor lifetime is based on sensor choice, cleaning intervals and of course the application. Because of this pH electrodes have a life cycle and are therefore considered consumable items.

5. Life cycle management of pH loops

5.4 Accreditation for permanent buffer laboratory

Correct measurement of the pH value not only serves to ensure that limit values are adhered to, but that the pH value is also often used as a reference variable for product quality or used directly for control purposes. The requirements for pH measurement are extremely difficult, as this applies across the measuring range of 14 orders of magnitude. Measurement accuracy and reproducibility begin and end with correct calibration of the pH measuring point.

For calibration, pH buffer solutions are used worldwide across all sectors. The zero point and slope of a pH electrode are important reference variables for the quality of a pH measurement. These are calculated using two different pH buffer solutions.



The accuracy of the later pH measurement in the process is directly dependent on the quality and accuracy of the specified pH value of the pH buffer solutions. For many years Endress+Hauser has been manufacturing quality buffers for the following pH values: 2.00, 4.00, 7.00, 9.00, 9.22, 10.00 and 12.00. These buffers meet even the toughest requirements of the pharmaceutical industry and contain only FDA-listed preservatives.



Endress+Hauser underwent the DKD's demanding accreditation process in accordance with DIN EN ISO/IEC 17025:2005. On May 5, 2009, the accreditation body granted the authority to issue calibration certificates for pH buffer solutions. These are issued in the calibration laboratory with the DAR registration number DKD-K-52701 at the production facility in Waldheim Germany.

This accreditation confirms that the actual values and maximum deviations of the manufactured pH buffer solutions are determined in a manner that is correct and traceable. In the measuring range of pH 2 – 10, the smallest specifiable measuring uncertainty of 0.02 applies. In the measuring range of pH > 10 – 12.5, the smallest specifiable measuring uncertainty of 0.05 applies. This means that customers can rely completely on Endress+Hauser's pH quality buffers. Users from all industrial sectors benefit from the reliability of these calibration solutions.



5.5 Steam/water analysis systems



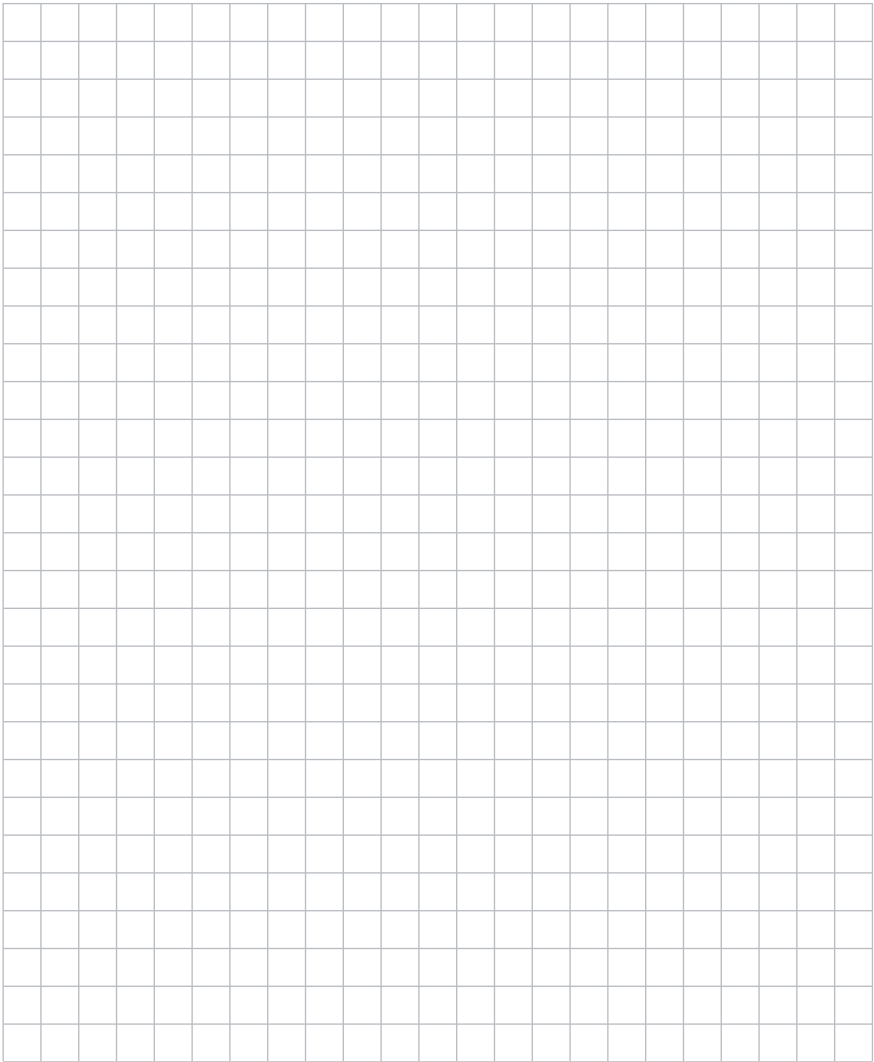
Steam production consumes a high amount of energy within industrial processes. The usage of high quality water in boiler applications of power plants and utility departments prevents corrosion processes and buildup. This ensures keeping the boiler efficiency high and therefore contributes to energy saving.

Endress+Hauser offers the full scope of equipment for the analysis of pure water for such boiler applications. As pressure and temperature are in most cases too high to measure directly in the process a sample conditioner is needed in front of the analytical panels. This is as well in the Endress+Hauser offering.





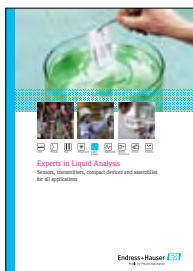
Notes



Notes

Supplementary documentation

- Parameter overview
FA 007C/24/en



Links

- Application Selection Software
www.us.endress.com/applicator
- Overview of all components
www.us.endress.com/pH
- Memosens technology
www.us.endress.com/memosens
- Topclean
www.us.endress.com/cpc30
- Topcal
www.us.endress.com/cpc310

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