pH measurement in industrial processes

Selection and engineering guide for your industry and application

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 solution's 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, i.e. from wastewater and chemical mixtures to ultra pure water in power stations or the 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 application 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, i.e. in pipes, bypasses or small tanks.

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 with the medium by the diaphragm to create a closed electrical loop.

Orbisint®, Ceraliquid, Ceragel, Orbipore
Different types of glass sensors are available, i.e. 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 wanted, i.e. 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!).

Combined pH/ORP sensors

Combined sensors feature a platinum element in addition to the pH glass. This enables simultaneous measurement of pH value and ORP potential for a better process overview. Alternatively, the platinum element can be used for measurement of the reference impedance to anticipate decreases in sensor quality. Combined sensors directly deliver rH values that give information about a medium being oxidizing, neutral or reducing.

Memosens®

Different types of glass sensors are available, i.e. hygienic and non-hygienic versions. These differ in the type of diaphragm used (ceramic, Teflon or none). Resistance of the sensor against blocking of the diaphragm depends strongly on the selection of diaphragm type.

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, suitable for CIP and SIP, no retractable assembly necessary. Different process connections are available.

Revolutionary Memosens technology

pH measurement has become 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 (i.e. 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, ion trap, double chamber	Stabilized gel reference
Special options	For higher HF content, ion trap for poisoning media, BT version with ion trap for poisoning media, salt ring for low conductivity	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**	**Enamel sensor** **Ceramax** **CPS341D**	**Glass sensor** **Purisys** **CPF201**
				
	0 to 14	0 to 14	0 to 10	0 to 14
	32 to 275°F / 0 to 135°C	32 to 176°F / 0 to 80°C	32 to 284°F / 0 to 140°C	35.6 to 167°F / 2 to 75°C
	Up to 145 psi / 10 bar_{rel} with counter pressure	Up to 145 psi / 10 bar_{rel}	Up to 87 psi / 6 bar_{rel}	Up to 50 psi / 3.45 bar_{rel}
	0.04 µS/cm	50 µS/cm	50 µS/cm	0.1 µS/cm
	Higher level possible depending on application	< 20 vol%	< 20 vol%	Not specified
	Glass	Glass	Enamel on stainless steel	Stainless steel
	Ceramic	PTFE	Ceramic	PTFE
	Liquid filled	Gel filled, double chamber	Liquid filled	Gel
		Flat membrane	EHEDG	
	Ultrapure water, fat, dye, food, process	Wastewater, mining	Food and pharma	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_{rel}	Up to 145 psi / 10 bar_{rel}	Up to 145 psi / 10 bar_{rel}
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: EPDM	PEEK, chip sealing: perfluorelastomer	PEEK, chip sealing: EPDM or perfluorelastomer
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, food, fermenter, process	Non aqueous media, emulsions, suspensions, precipitation reactions	Non aqueous media, ultra-pure water, fat, dye, food, process

	Combined pH/ORP sensor Memosens CPS16D	Combined pH/ORP sensor Memosens CPS76D	Combined pH/ORP sensor Memosens CPS96D
			
	Up to 232 psi / 16 bar_{rel} (with B glass)	Up to 188.5 psi / 13 bar_{rel}	Up to 188.5 psi / 13 bar_{rel}
	pH: 0 to 14 ORP: -1500 to 1500 mV rH: 0 to 42	pH: 0 to 14 ORP: -1500 to 1500 mV rH: 0 to 42	pH: 0 to 14 ORP: -1500 to 1500 mV rH: 0 to 42
	32 to 275°F / 0 to 135°C	32 to 284°F / 0 to 140°C	32 to 230°F / 0 to 110°C
	50 µS/cm	10 µS/cm	500 µS/cm
	< 20 vol%	< 20 vol%	< 20 vol%
	Glass	Glass	Glass
	PTFE	Ceramic	Open junction
	Gel filled, ion trap	Gel filled, ion trap	Stabilized gel reference
		Pressurized reference system, upside-down mounting. CoC available	
	Water, wastewater, process	Pharma, fermenter, process	Emulsions, suspensions, precipitation reactions

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 (i.e. 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 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 O_2 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.

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

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
The 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, because the sensor resides in a cleaning chamber after retraction.

Cleanfit®
In addition to manual and automatic retraction, we offer a wide variety of materials and seals to fit your applications, including safety functions. 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$_{rel}$ at 284°F/140°C, metal 116 psi/8 bar$_{rel}$ at 140°F/60°C, PVDF	87 psi/6 bar$_{rel}$ at 68°F/20°C 0 psi/bar$_{rel}$ at 176°F/80°C	145 psi/10 bar$_{rel}$ 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 µm or 0.4 µm
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_{rel} at 194°F/90°C, metal 87 psi/6 bar_{rel} at 176°F/80°C, PVDF	58 psi/4 bar_{rel} at 68°F/20°C, 0 psi/bar_{rel} at 176°F/80°C	145 psi/10 bar_{rel} at 212°F/100°C, metal 87 psi/6 bar_{rel} at 68°F/20°C, PVDF	58 psi/4 bar_{rel} at 68°F/20°C, 0 psi/bar_{rel} at 176°F/80°C
	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	
	Application of glass electrodes with ¾" process connections	▪ 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, flocculent 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 CPA871	**Cleanfit CPA875**	**Cleanfit CPA450**
			
Max. operating pressure/temperature	232 psi/16 bar_{rel} at 284°F/140°C (metal and PEEK version)	232 psi/16 bar_{rel} at 284°F/140°C	58 psi/4 bar_{rel} at 248°F/120°C, 174 psi/12 bar_{rel} static
Material in contact with medium	1.4404/316L Alloy C22 PEEK, PVDF, PVDF conductive	1.4435/316L Alloy C22	1.4404/316L (no PVDF-PTFE) Alloy C4, Titanium
Sealings	EPDM/FKM/FFKM	EPDM-FDA/FKM-FDA/ FFKM-FDA	EPDM/Viton/Kalrez®
Operation	Manual/ pneumatic	Manual/ pneumatic	Manual
Process connections	Clamp 2", 2½" flange DN 40, DN 50, DN 80 Flange 2", 3" Flange 10K50, 10K80 Thread NPT 1½" Thread G 1¼ Dairy fitting DN 50, DN 65	Clamp 1½", 2", 2½" Aseptic DN 25, DN 50 Neumo Biocontrol D 65 Neumo Bioconnect D 50, D 65 Dairy fitting DN 50, DN 65 Thread G 1¼ Varivent flange	Thread G1¼ , G1½" external, thread NPT 1¼", G1½" external, flange DN 32, DN 40, DN 50 flange ANSI 1¼", 1½", 2" 150 lbs
Convertible to pneumatic	Yes	Yes	No
Sealing to process	O-rings	Gaskets	Ball valve
Special options	Immersion chamber version available	Double chamber version with dynamic sealing available, certificates: EHEDG, USP Class VI, ASME BPE, CoC, FDA	Manual or with worm gear handle
Application	Water, wastewater, process	Food and pharma processes	Water, wastewater, process

	Cleanfit CPA472D	Cleanfit CPA473	Cleanfit CPA474
			
	145 psi/10 bar_{rel} at 212°F/100°C, 284°F/140°C max.	145 psi/10 bar_{rel} at 212°F/100°C, 266°F/130°C max.	87 psi/6 bar_{rel} at 176°F/80°C, 0 psi/0 bar_{rel} at 248°F/120°C
	PEEK, PVDF, conductive PVDF, Hastelloy C4, Titanium, SS 1.4571	1.4404/316L	PP/PEEK/PVDF
	EPDM/Viton/Kalrez	EPDM/Viton/ perfluoroelastomer	EPDM/Viton/ perfluorelastomer
	Manual/pneumatic	Manual/pneumatic	Manual/pneumatic
	Size 25, 1¼ internal thread Flange DN 50, DN 80, 2" ANSI 150 lbs Flange JIS 10K 25 A	Size 25, 1¼ 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
	Yes	Yes	Yes
	O-rings	Ball valve	Ball valve
	Various flow assemblies PFA-lined, 3.1 certificates	Flow chamber, optionally with wiping seal	Flow chamber, optionally with wiping seal
	Heavy duty and process application	Chemical industry, paper industry, sticky medium	Paper industry, industrial water treatment

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 M 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 and CM44R
The four-wire transmitter offers up to 8 channels and simple and self-intuitive operation with clear text menu. It is able to measure 12 different parameters allowing to mix and match all sensors with Memosens technology in any combination. Predictive maintenance functionalities can be used (i.e. process check system, delta slope, delta zero point or a calibration timer) to optimize your maintenance strategy. Up to 4 current outputs 0/4 to 20 mA, up to 4 relays and advanced diagnostic functions complete the package. Liquiline multiparameter transmitter is available as field device and as DIN-rail version for mounting in cabinets and on DIN-rails.

Liquiline CM14
Liquiline CM14 is a basic transmitter that offers all you need to run a standard measuring point. It fits into the common cabinet cut-outs and is easy to commission thanks to digital Memosens technology. The Memosens hot plug & play concept allows to quickly install and configure your digital sensors.

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 (i.e. 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, 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/CM44R
		
Measured parameters	pH glass, pH ISFET, conductivity, oxygen, ORP	pH glass, pH ISFET, conductivity, free chlorine, oxygen, turbidity, nitrate, ORP, SAC, ammonium, sludge level, potassium, chloride
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
No/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, HART, PROFIBUS DP, Modbus RS485, Modbus TCP, Ethernet TCP, EtherNet/IP™, Webserver
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	Multi-parameter, quick setup, graphic user interface, modular expandable

	Liquiline CM14	**Liquisys** CPM223/CPM253	**Mycom** CPM153
			
	pH glass, ORP, conductivity, oxygen	pH glass, pH ISFET, conductivity, oxygen, chlorine, ORP	pH glass, pH ISFET, conductivity, ORP
	Memosens	Analog, Memosens	Analog, Memosens
	Four-wire transmitter 24 V to 230 V AC/DC wide range power supply	4-wire transmitter 100/115/230 V AC 24 V AC/DC	4-wire transmitter 100 to 230 V AC 24 V AC/DC
	Up to 2 linear current outputs 0/4 to 20 mA	2 linear current outputs, 1 alarm contact, up to 4 additional relays	2 linear current outputs, 1 alarm contact, up to 5 relays
	CE, cCSAus	ATEX II 3G	ATEX II(1) 2G, FM, CSA
	4 to 20 mA	0/4 to 20 mA, HART, PROFIBUS PA, DP	0/4 to 20 mA, HART, PROFIBUS PA
	No	No	Yes
	Plastic	Plastic	Aluminum
	2 line, LCD with dot matrix	2 line LCD	Backlit LCD with dot matrix
	IP65 / NEMA 4X	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)
	Compact device for panel and cabinet mounting	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 [µS/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

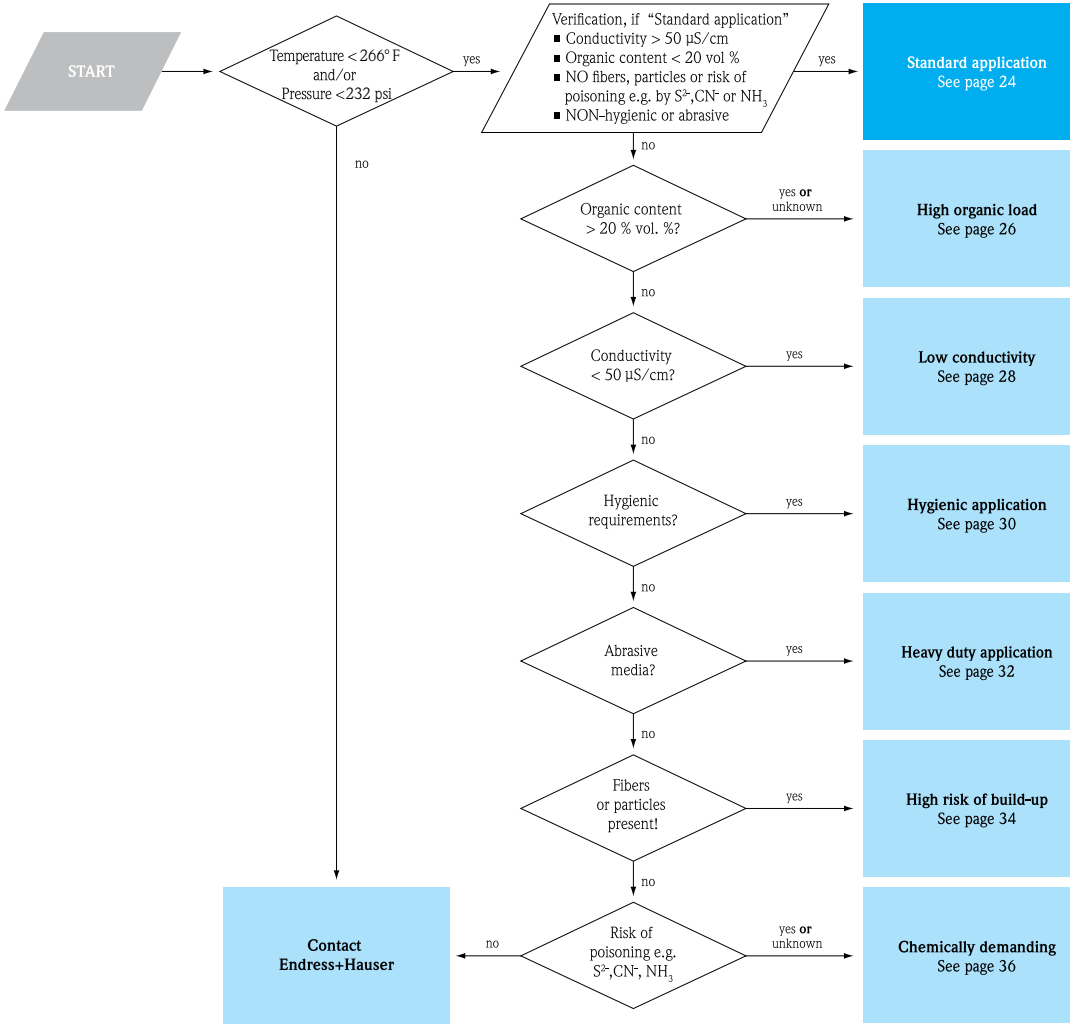
B

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.

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.

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.


START
Temperature < 266° F
and/or
Pressure <232 psi
yes
no
Verification, if "Standard application"
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
yes
Standard application
See page 24
no
Organic content
> 20 % vol. %?
yes or unknown
High organic load
See page 26
no
Conductivity
< 50 µS/cm?
yes
Low conductivity
See page 28
no
Hygienic
requirements?
yes
Hygienic application
See page 30
no
Abrasive
media?
yes
Heavy duty application
See page 32
no
Fibers
or particles
present!
yes
High risk of build-up
See page 34
no
Risk of
poisoning e.g.
S2-,CN-, NH3
yes or unknown
Chemically demanding
See page 36
no
Contact
Endress+Hauser

3. Selection of pH electrodes according to applications

3.2 Application: Standard

	First Choice			
	Orbisint CPS11/CPS11D pH electrode	**Memosens** CPS16D pH/ORP electrode	**Orbipac** CPF81/CPF81D pH electrode	
				
Advantages	▪ Dirt-repellent Teflon diaphragm ▪ Most universal with broad application spectrum ▪ CPS16D: simultaneous measurement of pH, ORP and rH values for a better process overview		▪ Dirt-repellent Teflon diaphragm ▪ Sensor integrated in plastic holder with thread connection	
Technical data ▪ Process temperature ▪ Process pressure ▪ pH range ▪ Sensor lengths ▪ Transmission	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_{rel} with B-glass 2 to 12 (A-glass), 0 to 14 (B-glass) 120, 225, 360 and 425 mm Memosens and TOP68®		32°F to 176°F/0°C to 80°C Up to 145 psi/10 bar_{rel} (176°F/80°C) 0 to 14 Memosens, TOP68 and fixed cable	
Application limits ▸ = alternative product	▪ Heavily soiling media need spray cleaning – see assembly page 12 forward ▪ Slower response of sensor with Teflon diaphragm	▸ Liquid-filled CPS41/CPS41D with ceramic diaphragm	▪ Heavily soiling media needed spray cleaning – see assembly page 12 forward ▪ 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 % ▪ NON-hygienic or abrasive	▪ Neutralization ▪ Water treatment	▪ Wastewater

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_{rel}, 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 forward

▸ Gel-filled CPS11/CPS11D or CPF81/CPF81D

3. Selection of pH electrodes according to applications

3.3 Application: 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 ▪ Stable and fast measurement due to liquid reference		▪ No aging effect of ISFET chip caused by organics ▪ Up to 95% organic content possible	
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_{rel}, 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_{rel} 0 to 14 120, 225, 360 and 425 mm Memosens and TOP68	
Application limits ▸ = alternative product	▪ Presence of hot caustics, i.e. during "CIP" ▪ Soiling media	▸ Glass type CPS41/CPS41D ▸ CPS41/CPS41D and/or automatic cleaning with Topclean (see page 51)	▪ Remark: Generally automatic cleaning with Topclean (see page 51) recommended	

Application: High organic load		
Conditions	Process/Industry	Typ. Liquids
▪ Organic content > 20 vol % ▪ NO fibers, particles or risk of poisoning, i.e. by S^{2-},CN^{-} or NH_3 ▪ NON-hygienic or abrasive	▪ Dye and pigment production	▪ Impregnating resin

3. Selection of pH electrodes according to applications

3.4 Application: Low conductivity

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 ▪ Process pressure ▪ pH range ▪ Sensor lengths ▪ Transmission	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_{rel}, 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		32°F to 167°F/0°C to 75°C Up to 50 psi/3.45 bar_{rel} 0 to 14 TOP68	
Application limits ▸ = alternative product	▪ 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, i.e. by S^{2-},CN^- or NH_3 ▪ NON-abrasive	▪ Power [Pharma]	▪ Boiler water ▪ Pure/ultra pure water "WFI"

Orbisint
CPS11/CPS11D pH electrode

(with salt ring)

▪ No electrolyte refilling necessary

5°F to 176°F/-15°C to +80°C (A-glass)

Up to 87 psi (6 bar_{rel})

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

3. Selection of pH electrodes according to applications

3.5 Application: Hygienic

First Choice

	Ceragel CPS71/CPS71D pH electrode	Memosens CPS76D pH/ORP 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_{rel}, up to 145 psi/10 bar for upside down version, up to 87 psi/6 bar_{rel} for pressurized reference		Up to 145 psi/10 bar_{rel}	
▪ 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	▸ Non-glass ISFET- sensor CPS471/ CPS471D	▪ Reduced resistance against hot caustic (CIP)	▸ Retract sensor during cleaning cycle or use CPS41/CPS41D, CPS71/CPS71D/ CPS76D
			▪ Soiling media	▸ CPS41/CPS41D, CPS71/CPS71D, CPS76D and/or automatic cleaning [see page 51]
▸ = alternative product				

Application: Hygienic		
Conditions	Process/Industry	Typ. Liquids
▪ Organic content < 20 vol % ▪ NON-abrasive	▪ Food ▪ Pharma	▪ Fermentation ▪ WFI (water for injection)

	Ceraliquid CPS41/CPS41D pH electrode	**Tophit** CPS441/CPS441D pH electrode	**Ceramax** CPS341D pH electrode
			
	▪ CIP/SIP resistant ▪ Liquid-filled reference to prevent blocking	▪ Non-glass sensor ▪ Liquid-filled reference to prevent blocking	▪ 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 ▪ Highly viscous media
	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_{rel}, 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_{rel}, 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_{rel} 0 to 10 Memosens
	▪ Risk of glass breakage ▪ Chance of continuous outflow of KCl traces ▪ Manual refilling of electrolyte vessel necessary	▸ Non-glass ISFET sensor CPS441/ CPS441D ▸ Gel-filled CPS71/ CPS71D, CPS76D or CPS471/ CPS471D	▪ Reduced resistance against hot caustic (CIP) ▪ Soiling media	▸ Retract sensor during cleaning cycle or use CPS41/CPS41D, CPS71/CPS71D, CPS76D ▸ CPS41/CPS41D, CPS71/CPS71D, CPS76D and/ or automatic cleaning [see page 51]	▪ Manual refilling of electrolyte vessel necessary ▪ Significantly higher investment costs than standard electrode	▸ Gel-filled CPS71/ CPS71D, CPS76D, or CPS471/ CPS471D

3. Selection of pH electrodes according to applications

3.6 Application: Heavy duty – abrasive

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 ▪ Process pressure ▪ pH range ▪ Sensor lengths ▪ Transmission	32°F to 176°F/0°C to 80°C Up to 145 psi/10 bar_{rel} (176°F/80°C) 0 to 14 Memosens, TOP68 and fixed cable		5°F to 230°F/ -15°C to 110°C Up to 145 psi/10 bar_{rel} 0 to 14 120, 225, 360 and 425 mm Memosens and TOP68	
Application limits ▸ = alternative product	▪ 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 % ▪ NON-hygienic	▪ Mining	▪ Slurries

3. Selection of pH electrodes according to applications

3.7 Application: High risk of buildup

	First Choice			
	Orbipore CPS91/CPS91D pH electrode	**Memosens** CPS96D pH/ORP electrode	**Orbisint** CPS11/CPS11D pH electrode	**Memosens** CPS16D pH/ORP electrode
				
Advantages	▪ Open junction is less prone to plugging ▪ Good resistance to poisoning due to the ion trap of CPS96D or CPS91D "BT version" ▪ CPS96D: Simultaneous measurement of pH, ORP and rH values for better process overview		▪ Dirt-repellent Teflon diaphragm ▪ Most universal with broad application spectrum ▪ Good resistance to poisoning due to ion trap of CPS16D and CPS11D "BT version" ▪ CPS16D: Simultaneous measurement of pH, ORP and rH values for better process overview	
Technical data ▪ Process temperature ▪ Process pressure ▪ pH range ▪ Sensor lengths ▪ Transmission	32°F to 230°F/0°C to 110°C Up to 188.5 psi/13 bar_{rel} 0 to 14 120, 225, 360 and 425 mm 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_{rel} with B-glass 2 to 12 (A-glass), 0 to 14 (B-glass) 120, 225, 360 and 425 mm Memosens and TOP68	
Application limits ▸ = alternative product	▪ Extreme risk of poisoning ▪ Heavily soiling media	▸ CPS11/CPS11D with option "BT", CPS16D ▸ Automatic cleaning [see page 51]	▪ With small particle sizes chance of blocking	▸ CPS91/CPS91D, CPS96D

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

3. Selection of pH electrodes according to applications

3.8 Application: Chemically demanding

	First Choice			
	Ceraliquid CPS41/CPS41D pH electrode 		**Orbisint** CPS11/CPS11D pH electrode  (BT version)	**Memosens** CPS16D pH/ORP electrode 
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 ▪ CPS16D: Simultaneous measurement of pH, ORP and rH values for better process overview	
Technical data ▪ Process temperature ▪ Process pressure ▪ pH range ▪ Sensor lengths ▪ Transmission	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_{rel}, 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 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_{rel} with B-glass 2 to 12 (A-glass), 0 to 14 (B-glass) 120, 225, 360 and 425 mm Memosens and TOP68	
Application limits ▸ = alternative product	▪ Manual refilling of electrolyte vessel necessary	▸ Gel-filled CPS11/CPS11D "BT version", CPS16D or CPS71/CPS71D "TP version", CPS76D "BP version"	▪ For faster response time and better poison resistance	▸ CPS41/CPS41D or CPS71/ CPS71D "TP version", CPS76D "BP version"

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

	Ceragel **CPS71/CPS71D** **pH electrode**	**Memosens** **CPS76D** **pH/ORP electrode**
	 (TP version)	 (BP version)
	▪ Fast response time without refilling of electrolyte ▪ Pressurized reference version for better resistance against poisoning ▪ CPS76D: Simultaneous measurement of pH, ORP and rH values for better process overview	
	32°F to 212°F/0°C to 100°C Up to 87 psi/6 bar_{rel} 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

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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.

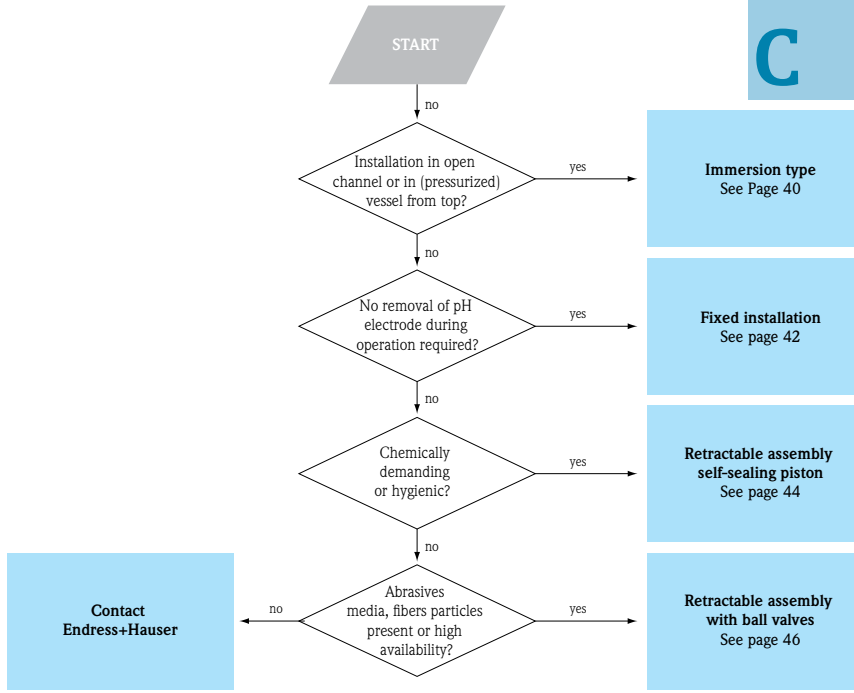
Manual retraction assemblies are only possible with up to 29 psi/2 bar process pressure although the assembly is suitable for higher pressures during normal operation. For retraction at a higher pressure you need a pneumatic version.

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 (i.e. FDA conformity or EHEDG certificates) you will find the selection in the technical data).

C


START
no
Installation in open channel or in (pressurized) vessel from top?
yes
Immersion type
See Page 40
no
No removal of pH electrode during operation required?
yes
Fixed installation
See page 42
no
Chemically demanding or hygienic?
yes
Retractable assembly self-sealing piston
See page 44
no
Abrasives media, fibers particles present or high availability?
yes
Retractable assembly with ball valves
See page 46
no
Contact Endress+Hauser

4. Selection of assembly

4.2 Immersion type

First Choice

	Flexdip CYA112		**Dipfit** CPA111	
				
Advantages	▪ Modular system for a wide variety of sensor mounting, i.e. pH, turbidity		▪ 3 electrode slots for redundant measurement ▪ Flexible immersion depth by chemically resistant pipes ▪ Spray cleaning head as option	
Technical data ▪ Process temperature ▪ Process pressure ▪ Wetted materials Process connection ▪ Immersion depth	32°F to 140°F/0 to 60°C, PVC; 32°F to 194°F/0 to 90°C, 316L 0 to 58 psi/4 bar_{rel} PVC; 316L, EPDM, Viton Different holder systems, float ball, chain from Nylon hanging, pendulum frame mounting 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 ▸ = alternative product	▪ 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 oper 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, i.e. 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

4. Selection of assembly

4.3 Fixed installation

	First Choice			
	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 ▪ Process pressure ▪ Wetted materials ▪ Process connection ▪ Immersion depth	32°F to 176°F/0 to 80°C 0 to 87 psi/6 bar_{rel} PP, EPDM Thread G1, NPT 1", flange DN 25; 90° or 180° between in- and outflow		14°F to 284°F/-10 to 140°C 0 to 87 psi/6 bar_{rel} PVDF, 316L, EPDM, FPM, Chemraz Thread or flanges DN 25; 90° or 180° between in- and outflow	
Application limits ▸ = alternative product	▪ Installation in tank or vessel ▪ Temperature > 176°F/80°C	▸ CPA640 or CPA442 ▸ CPA240 in 316L or PVDF	▪ Large dimension, i.e. panels in power stations ▪ Change of sensor under pressure	▸ 71042404 [on request] ▸ Retractable CPA871

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 1¾" 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 CPA875	▪ Only thread process connections ▸ CPA442

4. Selection of assembly

4.4 Retractable assembly (self-sealing piston)

	First Choice - Standard		First Choice - High chemical compatability	
	Cleanfit CPA871 		**Cleanfit** CPA871  PEEK or PVDF version	
Advantages	▪ Flexible retractable assembly for a broad range of applications ▪ Intelligent functions for highest process and personnel safety		▪ Non-metal material offers good chemical compatibility against most acids and caustics ▪ Fully retractable in PP + PVDF i.e. for water treatment	
Technical data ▪ Process temperature ▪ Process pressure ▪ Wetted materials ▪ Process connection ▪ Immersion depth	14 to 284°F / -10 to 140°C (PVDF: 14 to 212°F / -10 to 100°C) Manual: 0 to 116 psi / 8 bar_{rel}, Pneu.: 0 to 232 psi / 16 bar_{rel} SS 316L, PEEK, titanium, Alloy C22, PVDF Seals: EPDM, FKM, FFKM G 1¼", NPT 1½", Tri-Clamp, dairy fitting, flanges Up to 5.3 inches / 135 mm		14 to 284°F / -10 to 140°C (PVDF: 14 to 212°F / -10 to 100°C) Manual: 0 to 116 psi / 8 bar_{rel}, Pneu.: 0 to 232 psi / 16 bar_{rel} PEEK, PVDF, Seals: FPDM, FKM, FFKM G 1¼", NPT 1½", Tri-Clamp, dairy fitting, flanges Up to 5.3 inches / 135 mm	
Application limits ▸ = alternative product	▪ Chemical resistance of 316L ▪ Soiling media (fibers)	▸ CPA871 PEEK, PVDF versions, CPA472D ▸ CPA473	▪ Mechanical stability of sensor guide (strong cross flow)	▸ CPA472D

Installation in pipe and vessels with self-sealing piston

Manual and pneumatic

C

Retractable assem. self-sealing piston

First Choice - Hygienic	First Choice - Heavy duty
Cleanfit CPA875	**Cleanfit** CPA472D
	
▪ Hygienic design 3-A, FDA-listed materials and EHEDG certificate for a broad range of hygienic applications ▪ Double chamber with patented sealing principle for 100% sterile processes	▪ Various materials available for best chemical compatibility ▪ Heavy duty version available with flow chamber and sight glass as option ▪ High immersion depth up to 11 inches / 280 mm
14 to 284°F / -10 to 140°C Manual: 0 to 116 psi / 8 bar_{rel}, Pneu.: 0 to 232 psi / 16 bar_{rel} 1.4435/316L, Alloy C22 G 1¼", Tri-Clamp, aseptic, Neumo Biocontrol, Neumo Bioconnect, dairy fitting, Varivent flange Up to 3.1 inches / 80 mm	-4 to +284°F / -20 to 140°C, short time up to 320°F / 160°C 0 to 145 psi / 10 bar_{rel} SS 316L, alloy C4, titanium, PVDF, PVDF conductive, PEEK G 1¼", flanges DN 50/80, ANSI 2" JIS Up to 11 inches / 280 mm
▪ Double chamber version: relatively high investment costs ▸ CPA442	▪ Relatively high investment costs ▸ CPA871

4. Selection of assembly

4.5 Retractable assembly (with ball valves)

	First Choice - Manual		First Choice - Pneumatic	
	Cleanfit CPA450 		**Cleanfit** CPA473 	
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		▪ Open sensor protection guard and tape wiper prevents fiber buildup around the sensor, i.e. media in pulp & paper, mining	
Technical data				
▪ Process temperature	32°F to 266°F/0 to 130°C		32°F to 266°F/0 to 130°C	
▪ Process pressure	0 to 58 psi/4 bar_{rel} retraction; 0 to 232 psi/16 bar_{rel} static		0 to 145 psi/10 bar_{rel}	
▪ Wetted materials	SS 316L and Alloy C4, Titanium, EPDM, FPM, Kalrez		SS 316L , FPM, Kalrez	
▪ Process connection	G 1¼", G 1½" NPT ½", flanges DN 32, ANSI 1½" and 2"		G 1¼", dairy DN 50, flanges DN 50/ANSI	
▪ Immersion depth	3 types: from 3.94" to 27.5"/100 up to 700 mm		Up to 9.05"/230 mm	
▪ Operation	Manual		Manual/pneumatic	
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 ▸ Use CPA640 as adapter ▸ Pneumatic retractable CPA472D	▪ Not compatible with CPF81/CPF81D ▪ Remark: For sticky and abrasive medium choose "tape wiper option"	▸ Use CPA640 as adapter
▸ = alternative product				

Installation in pipe and vessels with ball valve

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

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Cleanfit
CPA474

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

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	▸ CPA473
▪ Not compatible with CPF81/ CPF81D	▸ Use CPA640 as adapter
▪ Higher immersion length	▸ On request

Retractable assem. self-sealing piston

4. Selection of assembly

4.6 Required pH electrode length and total immersion depth for different assemblies

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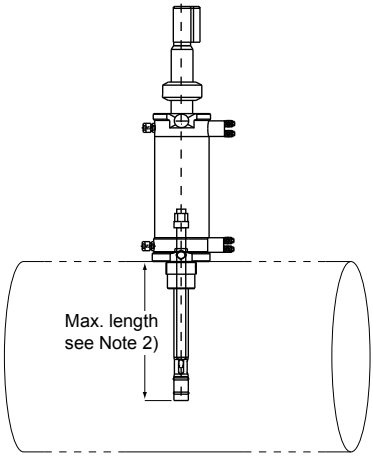
		Maximum immersion depth[2]	Glass sensors				
			CPS11/ CPS11D / CPS16D	CPS41/ CPS41D [1]	CPS71/ CPS71D / CPS76D	CPS91/ CPS91D / CPS96D	
CPA111		see note 3)	120 mm	120 mm	120 mm	120 mm	
CYA112		see note 3)	120 mm	120 mm	120 mm	120 mm	
CPA140		see note 3)	120 mm	120 mm	120 mm	120 mm	
CPA240		not applicable	120 mm	120 mm	120 mm	120 mm	
CPA250		not applicable	120 mm	120 mm	120 mm	120 mm	
CPA442		73 mm	120 mm	120 mm	120 mm	120 mm	
CPA640		85 mm	120 mm	120 mm	120 mm	120 mm	
CPA450		see note 3)	120 mm	n/a	120 mm	120 mm	
CPA472D	short	146 mm	225 mm	360 mm	225 mm	225 mm	
	long	280 mm	360 mm	n/a	360 mm	360 mm	
CPA473	short	100 mm	225 mm	425 mm	225 mm	225 mm	
	long	230 mm	360 mm	n/a	360 mm	360 mm	
CPA474	short	76 mm	225 mm	425 mm	225 mm	225 mm	
	long	207 mm	360 mm	n/a	360 mm	360 mm	
CPA871	basic short	36 mm	120 mm 225 mm	n/a 225 mm	120 mm 225 mm	120 mm 225 mm	
	basic long	78 mm	225 mm	n/a	225 mm	225 mm	
	immer-sion chamber	135 mm	225 mm 360 mm	n/a 360 mm	225 mm 360 mm	225 mm 360 mm	
CPA875	single chamber short	36 mm	225 mm	225 mm	225 mm	225 mm	
	single chamber long	78 mm	225 mm 360 mm	n/a 360 mm	225 mm 360 mm	225 mm 360 mm	
	double chamber	78 mm	225 mm 360 mm 360 mm	n/a 360 mm n/a	225 mm 360 mm 360 mm	225 mm 360 mm 360 mm	

	ISFET		
	CPS441/ CPS441D [1]	CPS471/ CPS471D	CPS491/ CPS491D
	120 mm	120 mm	120 mm
	120 mm	120 mm	120 mm
	120 mm	120 mm	120 mm
	120 mm	120 mm	120 mm
	120 mm	120 mm	120 mm
	120 mm	120 mm	120 mm
	120 mm	120 mm	120 mm
	n/a	120 mm	120 mm
	360 mm	225 mm	225 mm
	n/a	360 mm	360 mm
	425 mm	225 mm	225 mm
	n/a	360 mm	360 mm
	425 mm	225 mm	225 mm
	n/a	360 mm	360 mm
	n/a 225 mm	120 mm 225 mm	120 mm 225 mm
	n/a	225 mm	225 mm
	n/a 360 mm	225 mm 360 mm	225 mm 360 mm
	225 mm	225 mm	225 mm
	n/a 360 mm	225 mm 360 mm	225 mm 360 mm
	n/a 360 mm n/a	225 mm 360 mm 360 mm	225 mm 360 mm 360 mm



Notes:
1) Liquid-filled [KCl]
2) The indicated length is the maximum length which must be considered i.e. for installation in pipes to ensure mechanical space; depending on process connection it may be shorter for the individual assembly (see drawing)
3) Depending on length of immersion assembly

5. Life cycle management of pH loops

5.1 Calibration concept for the laboratory using Memosens and Memobase Plus

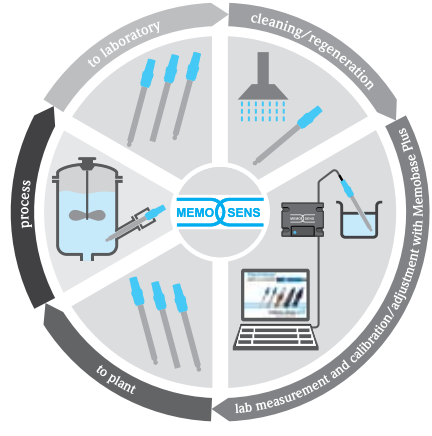
In the case of Memosens technology, the conversion from analog to digital signals takes place inside the sensor. That is why the sensor is the only component which must be inspected and calibrated regularly. The cable and the transmitter have much less impact on the measurement process than in the case 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 lab calibration concept using the Memobase Plus software.

Calibration on the applications site takes time. During the calibration 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 again immediately. The most important maintenance task is then carried out in the comfortable environment of the lab pertaining to the plant, where all the essentials are directly available. There the sensors are cleaned, conditioned and calibrated under optimum conditions.

The lab calibration concept is supported by the Memobase Plus sensor and data management software. Memobase Plus stores all sensor and calibration data 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, dissolved oxygen and free chlorine. Memobase Plus 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.

Fully traceable documentation:
Life cycle of Memosens sensors



5.2 Fully automatic measuring, calibration, sterilization and cleaning

Topclean CPC30
Topclean, the alternative, when automatic cleaning and manual calibration outside the process suffice. With Topclean, you have the option of automatically rinsing and cleaning the electrodes outside the process. With an additional valve, sterilization can also take place. The programming, safety functions and the data handling are the same as for Topcal.

Liquiline with Chemoclean Plus
The Liquiline multiparameter transmitter with Chemoclean Plus is the variable solution for automatic sensor cleaning. Liquiline features four independent relays to control a retractable assembly and cleaner supply. The system is supplemented by a compact valve block thus offering the flexibility of a multichannel device together with the option of automatically cleaning the electrodes outside the process.

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 that 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.

Topclean CPC30

Fully automatic pH measuring point with integrated control
- Sterilization
- Cleaning
- Rinsing

FM APPROVED
Ex
HART COMMUNICATION FOUNDATION
PROFIBUS®

Topcal CPC310

Fully automatic pH measuring point with integrated control
- Calibration
- Sterilization
- Cleaning
- Rinsing

FM APPROVED
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5. Life cycle management of pH loops

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.

5.4 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.

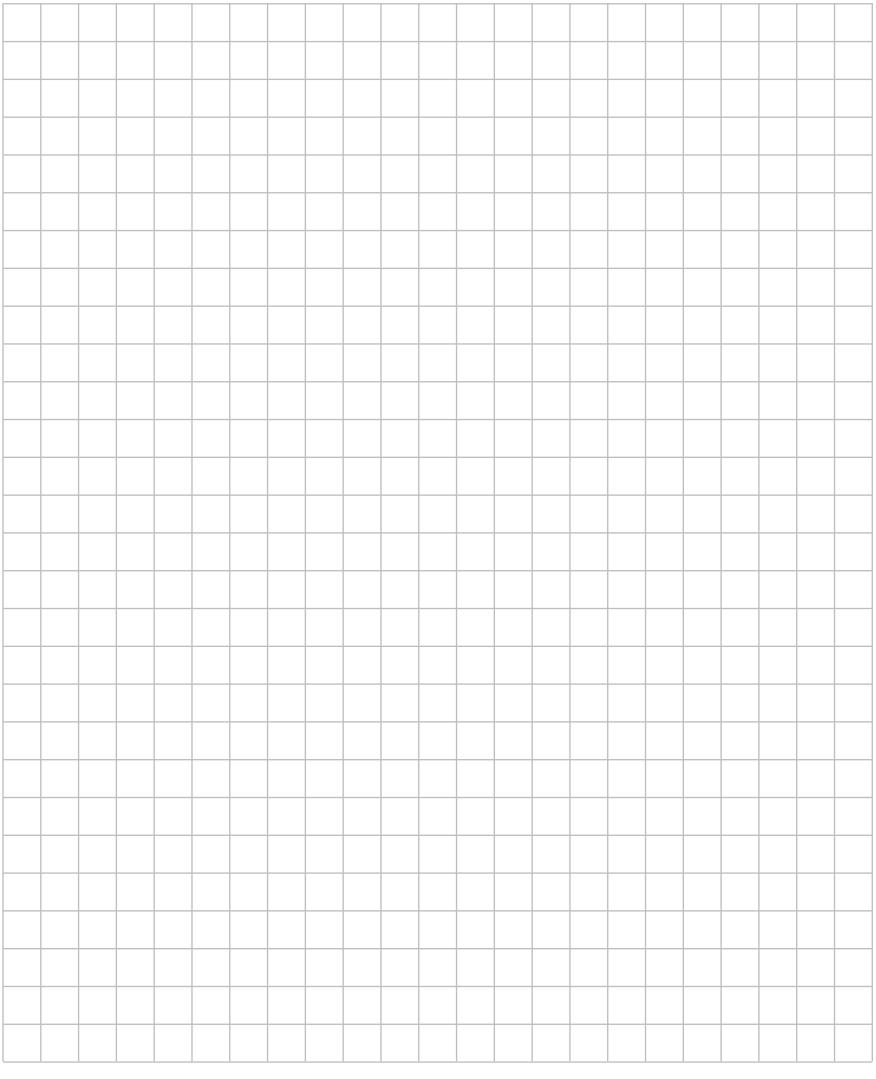
This accreditation confirms that the actual values and maximum deviations of the manufactured pH buffer solutions are determined in a manner that is correct and traceable. In the measuring range of pH 2 – 10, the smallest specifiable measuring uncertainty of 0.02 applies. In the measuring range of pH > 10 – 12.5, the smallest specifiable measuring uncertainly 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



Supplementary documentation

- Parameter overview
  FA00007C/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

USA	Canada	Mexico	International
Endress+Hauser, Inc. 2350 Endress Place Greenwood, IN 46143 Tel: 317-535-7138 888-ENDRESS Fax: 317-535-8498 info@us.endress.com www.us.endress.com	Endress+Hauser Canada 1075 Sutton Drive Burlington, ON L7L 5Z8 Tel: 905-681-9292 800-668-3199 Fax: 905-681-9444 info@ca.endress.com www.ca.endress.com	Endress+Hauser México S.A. de C.V. Fernando Montes de Oca 21 Edificio A Piso 3 Fracc. Industrial San Nicolás 54030 Tlalnepantla de Baz Estado de México México Tel: +52 55 5321 2080 Fax: +52 55 5321 2099 eh.mexico@mx.endress.com www.mx.endress.com	For international locations visit: www.endress.com/worldwide

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