Document Number 221=183=098

POLYMETRON Model 8398 Inductive probe

USER MANUAL

April 2010, Version D

HACH LANGE

UNITED FOR WATER QUALITY

Restriction of hazardous substances (RoHS)

The European Union RoHS Directive and subsequent regulations introduced in member states and other countries limits the use of six hazardous substances used in the manufacturing of electrical and electronic equipment.

Currently, monitoring and control instruments do not fall within the scope of the RoHS Directive, however Hach Lange has taken the decision to adopt the recommendations in the Directive as the target for all future product design and component purchasing.

Note: *The following only applies to exports of this product into the People's Republic of China.*

含有有毒或者危险物质及成分的产品。

环保使用期限标记（年）

	有毒或者危险物质和成分					
部件名称	铅	汞	镉	六价铬	多溴联苯	多溴联苯醚
Conductivity plastic sensor (8310, 8311, 8312)	O					
Conductivity stainless steel sensor (8314, 8394)	O				O	
Digital sensor PCB	O				O	
Glass electrode	O				O	

O: 表示所有此类部件的材料中所含有毒或危险物质低于限制要求

X: 表示至少有一种此类部件材料中所含有毒或危险物质高于限制要求

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1. INTRODUCTION

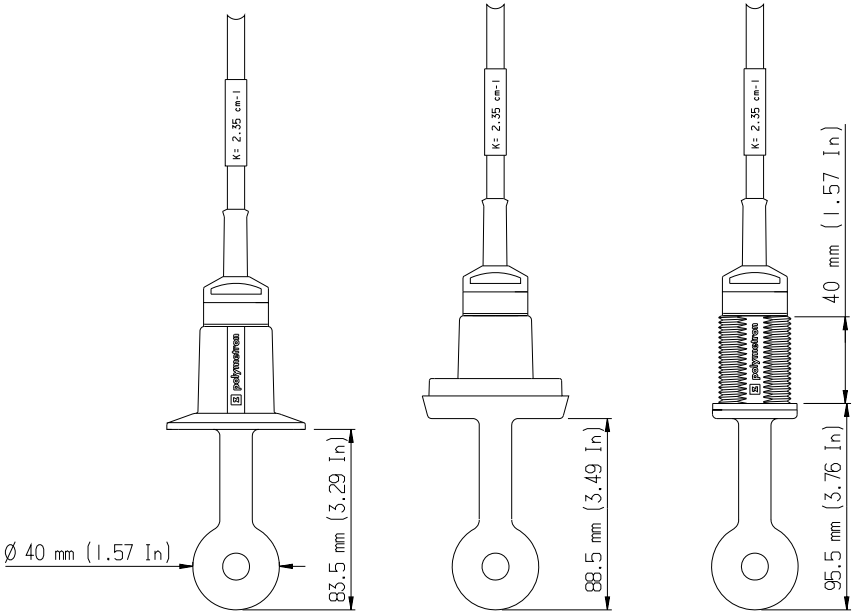
1.1 General

The 8398 range of probes makes use of inductive technology, which is particularly recommended for corrosive and soiling uses, making use of conductivity or concentration measurements. The main uses are as follows:

- Determination of solution concentrations: in-place cleaning, regeneration of resin in water processing plants, surface treatment.
- Accurate interface control in conduits: in-place cleaning in the food and pharmaceutical industries.
- Waste water testing: industrial and town sewerage plants.

1.2 Probes

WARNING: Non-removable cable!



8398.2
2"clamp

8398.3
DN50 dairy connection

8398.5
1" Gas

2. OPERATING PRINCIPLE

2.1 Conductivity reminder

Electrolytic conductivity refers to the ability of a liquid to conduct an electrical current (conductivity is the opposite of resistivity). In metals, the electrical current flows by electron displacement, in liquids it flows by ion transport. The conductivity of a solution is dependent both upon the solution's ionic concentration and temperature.
To obtain a solution's actual conductivity (in $S.cm^{-1}$), it is necessary to multiply the measured conductance 1/R (in S) by a coefficient dependent solely upon the geometry of the probe and termed "cell or K constant", expressed in cm^{-1}.

$$C = \frac{K}{R} \ (S.cm^{-1})$$

In order to allow the comparison between measurements made at different temperatures, this measurement needs to be brought back to a **reference temperature** (generally 25 °C). This temperature dependency can be easily expressed in the form of relative variation in degrees Celsius. It is referred to as the temperature coefficient (α).

$$C_{Tref} = C_T \ [1 + \alpha \ (T - T_{ref})]^{-1}$$

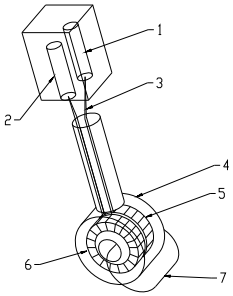
C_{Tref} : Conductivity compensated to the reference temperature
C_T : Conductivity measured at T
T_{ref} : Reference temperature (generally 25 °C)
α : Temperature coefficient of the solution (% / °C)

Examples:

Product	**Soda (NaOH) 5 %**	**Nitric acid (HNO_3) 10 %**
α :	2.01	1.45

REMARK:
1 S = 1000 mS (R = 1 Ω)
1 mS = 1000 µS (R = 1 kΩ)

2.2 Principle of inductive technology



1 : Receiver
2 : Oscillator
3 : Cables
4 : Thermoplastic insulator
5 : Receiver
6 : Transmitter
7 : Induced current

The 8398 probes are made up of two coils that are completely insulated from the process:

- The primary (or transmitter) coil, supplied with alternating voltage, produces an alternating electromagnetic field that generates an electrical current in the solution.

- The secondary (or receiver) coil detects the size of the weak current induced by the movement of ions in the solution.

The absence of contact between the electrical part and the solution (magnetic coupling) provides a large number of advantages compared to the traditional technique using metallic electrodes:

- No polarisation and hence a broad measurement range.
- High chemical and mechanical resistance.
- Possibility of performing measurements in soiling products.
- Perfectly hygienic design.

3. TECHNICAL SPECIFICATIONS

3.1 Specifications

Measurement range	0 to 2000 mS/cm
Precision	± 2 % of the displayed value or ± 0.004 mS/cm
Conductivity response	< 1 s
Temperature response	T 50 % = 20 s T 90 % = 2 mn
Cell constant	K = 2.35 cm^{-1}
Roughness	Ra < 0.5 µm (roughness certificate on request, Ref.: 08398=T=1111)
Chemical resistance	Our mono-block probe is made from PEEC (poly ether ether Ketone), whose chemical resistance is summarised in the table §9. ***WARNING:*** PEEC is not resistant to high concentrations of oxidative acids (nitric and sulphuric acid > 70 %, etc.) In the case of probe 8398.5, one must consider the other materials in contact with the process (EPDM or VITON gaskets, PP or 316 stainless steel extension, etc.).
Mechanical resistance	PEEC possesses a flexion temperature (pressure: 18 bars) of approximately 300 °C. *In the case of probe 8398.5, take account of extensions, if any.*
Heat resistance	PEEC is a polymer that is particularly well-suited to sterilisation, it can therefore withstand temperatures of 140 °C.

3.2 Compliance

- Probes are factory tested and are delivered with a certificate of compliance with specifications.
  Models 8398.2 and 8398.3 are particularly well-suited to applications where sanitary requirements are extremely stringent (compliance with the European food directive 90/128/CE modified by directive 93/9/CE). Indeed, these probes do not possess any retention zones that could allow the development of bacteria (interstices, slits, joints, etc.) and have a roughness inferior to 0.5 µm (optional certificate, ref. 08398=T=1111).

- The measurement chain, made up of an 8398 probe and of our conductivity transmitters, complies with European directives 89/336/CEE and 73/23/CEE modified by directive 93/68/CEE.

4. PROBE START-UP

4.1 Cable connection

WARNING: Fit the DN50 clamping nut or the immersion rod onto the probe before wiring!

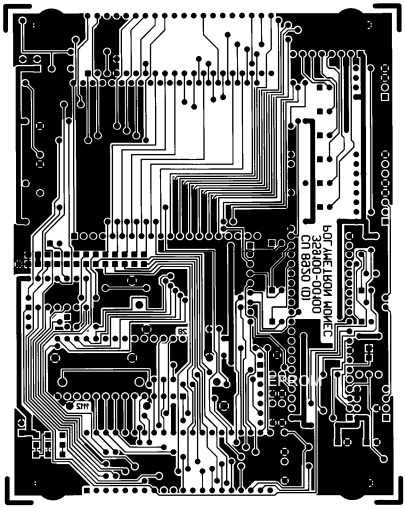
Make the following connections

	COND 9125	**COND 8921 (channels 1 and 2)**
1 : GREEN or yellow (Pt100)	TEMP +	14 and 19
2 : YELLOW or green (Pt100)	TEMP -	15 and 20
3 : BLACK (secondary coil shielding)	GND	30 and 32
4 : WHITE (secondary coil)	IN	31 and 33
5 : BLACK (primary coil shielding)	GND	16 and 21
6 : BROWN (primary coil)	OUT	17 and 22
7 : WHITE (external shielding)	EXTERNAL SHIELDING	EXTERNAL SHIELDING

REMARK: The probe is fitted as standard with 5 metres of cable. We recommend not cutting this cable in order to avoid any connection errors. If the length is insufficient, please order the following accessories:

- Junction box, ref.: 08335=A=6000
- Cable (per metre, maximum 50 m), ref.: 150727,10000

4.2 Use with a 8921 conductimeter



The use of a type 8398 inductive probe connected to a type 8921 2-channel conductimeter requires that this latter be fitted with a software version greater than or equal to the following versions:

Software	Minimum version no.	Memory reference
Standard	3.76	08921=A=6200
Concentration	1.04	08921=A=6400
Special	4.07	08921=A=6305

To install your new software version, proceed as follows:

- Remove the transmitter's front panel (4 screws).
- On the rear of the front panel, there are two circuit boards. Remove the first of these two circuit boards (4 screws).
- At the rear of this printed circuit board, carefully change the integrated circuit (EPROM) represented on the figure opposite.
- Check that the memory has been inserted in the correct position, otherwise it would be irreversibly damaged.
- Re-fit the front panel and initialise the instrument's default parameters using command 900.
- Reprogram the instrument to your configuration and configure command **C101 (102)** with **Argument 2**, which corresponds to the 8398 probe's cell constant, equal to 2.35.

4.3 Use with a 9125 conductimeter

Set the two switches (I/K) inside the instrument to position I.
Check that the measurement type is set to inductive.

5. PROBE CALIBRATION

REMARK: For more detailed information, see the user instructions of out 9125 and 8921 transmitters. We recommend proceeding in the following order:

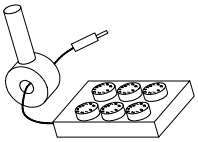
❑ **Set the cell constant value on your transmitter to 2.35 cm^{-1}.**

❑ **Calibrate your temperature sensor:**
Submerge the probe in a solution for approximately 10 min., raise the temperature of this solution using a thermometer (accurate to ± 0.1°C if possible). Set the transmitter to process calibration mode, then adjust the temperature value.

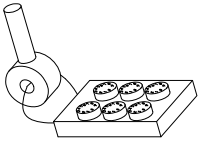
❑ **Calibrate conductivity (two solutions)**

Electrical calibration:

Perform the "electrical" calibration of the probe with a decade box, using a wire no longer than 50 cm and with a minimum cross-section of 0.38 mm².
The resistance values to use are: ∞ for zero adjustment (decade box disconnected):



then 200 Ohms (default instrument value) for slope adjustment:



***REMARK*: After returning to measurement mode, the value displayed by the transmitter takes account of the cell constant and also of temperature compensation.**

Example: 200 Ohms on decade box, T = 20 °C, transmitter set for 25 °C compensation with a coefficient of 2 %, unit mS/cm:

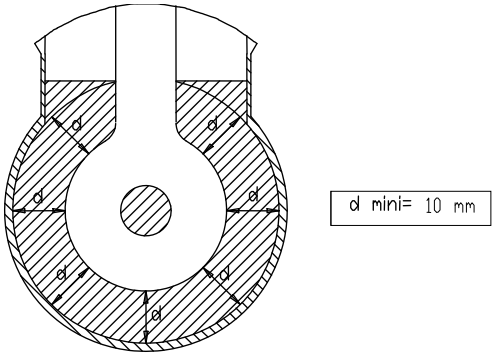
DISPLAY: [2.35/200]. $[1 + 0.02 \times (20 - 25)]^{-1}$ = **13.06 mS/cm (c.f. Ch. 2-1)**

Process calibration (9125 only):

During the first calibration of the chain, process calibration must be performed at two distinct points (probe in air, then in the control solution).
After this, calibration can be performed on a single point (control solution only).

***WARNING:* If you are using a 9125 with software version < 1.12, the cell constant value must be set prior to calibration.**
Any alteration of the cell constant value after calibration would cancel the calibration for this probe (slope reset to 100 %).

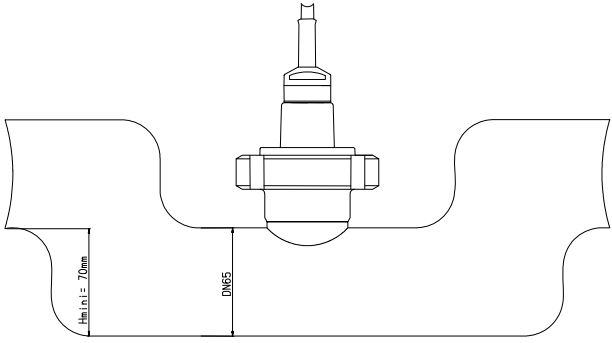
6. INSTALLATION PRECAUTION



Minimum distance between probe and conduit

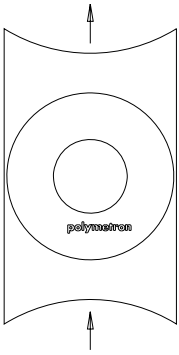
When the electrical field lines are partially obstructed by a wall, the measured conductivity is altered (increased if the wall is a conductor, decreased if it is an insulator). With our "high performance" shielding system, 100 % of the field lines of our probe are channelled to within less than 10 mm, thus allowing **measurements to be made without disturbance in DN65 conduits**.
It is also possible to perform measurements in DN50 conduits, using our DN65 / DN50 converging / diverging T-pieces (reference 08398=A=6000 for 8398.3 probes and 08398=A=7000 for 8398.2 probes). These T-pieces therefore allow users to connect to DN50 conduits, while performing their measurements in a DN65 diameter.

WARNING: In order to work optimally, the probe must be completely submerged in the liquid. We therefore recommend the use of a U-bend tube.

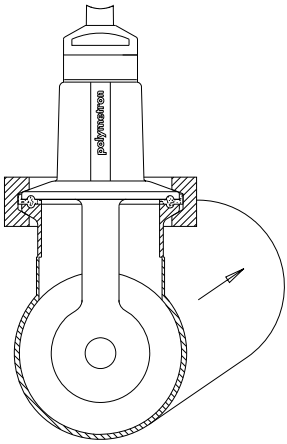


Installation direction

The opening of the probe must face the conduit's flow direction, thus avoiding the influence of flow rate and to perform the self-cleaning of this opening. For optimal operation, the "POLYMETRON" marking should be positioned in the conduit's flow direction, as shown in the following figure:



8398.3



8398.2

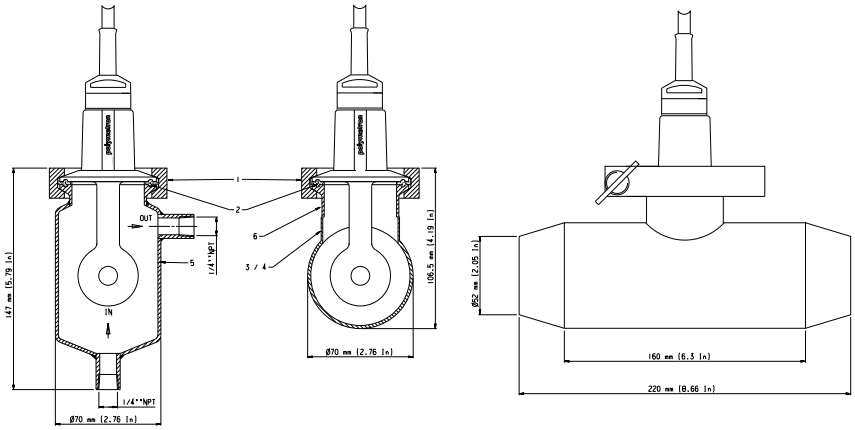
→ : flow direction in the conduit

7. ACCESSORIES

There are three probe versions, that are distinguished by the type of connector used.

7.1 Probe 8398.2, 2" clamp model (08398=A=2000)

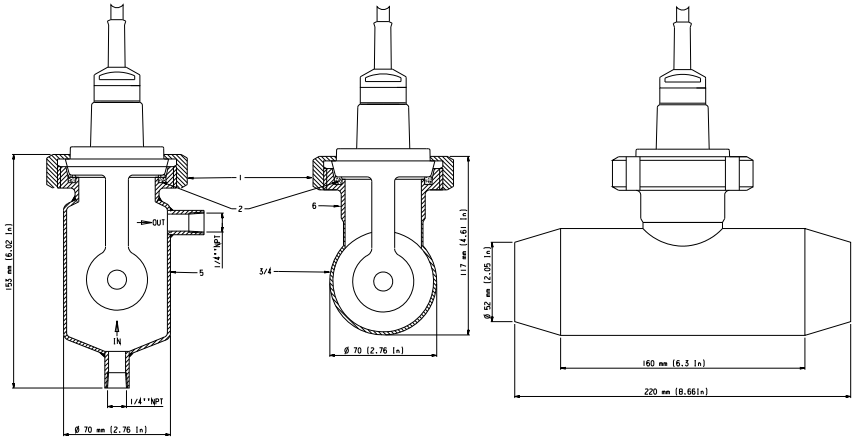
APPLICATION: FREE FLOW

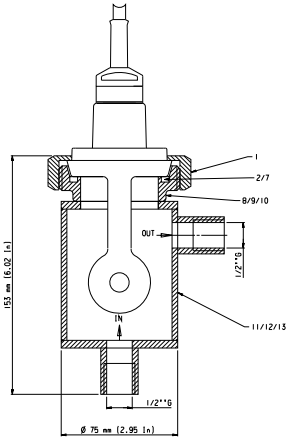


Number:	Reference:	Designation	Installation
1	581=000=510	2" stainless steel clamp collar	-
2	429=500=510	EPDM joint for 2" clamp	-
6	581=100=510	2" stainless steel ferrule to weld	Min. DN65
1+2+6	08398=A=0510	Kit with 2" stainless collar + 2" EPDM joint + 2" stainless ferrule	Min. DN65
1+2+3	08398=A=7500	Kit with 2" stainless collar + 2" EPDM joint + DN65 stainless T-piece	DN65
1+2+4	08398=A=7000	Kit with 2" stainless collar + 2" EPDM joint + DN65/50 stainless T-piece	DN50
1+2+5	08398=A=8200	Kit with 2" stainless collar + 2" EPDM joint + Stainless flow chamber (inlet / outlet 1/4" NPT)	Derivation

7.2 Probe 8398.3, DIN 11851 / DN50 dairy connection model (08398=A=3000)

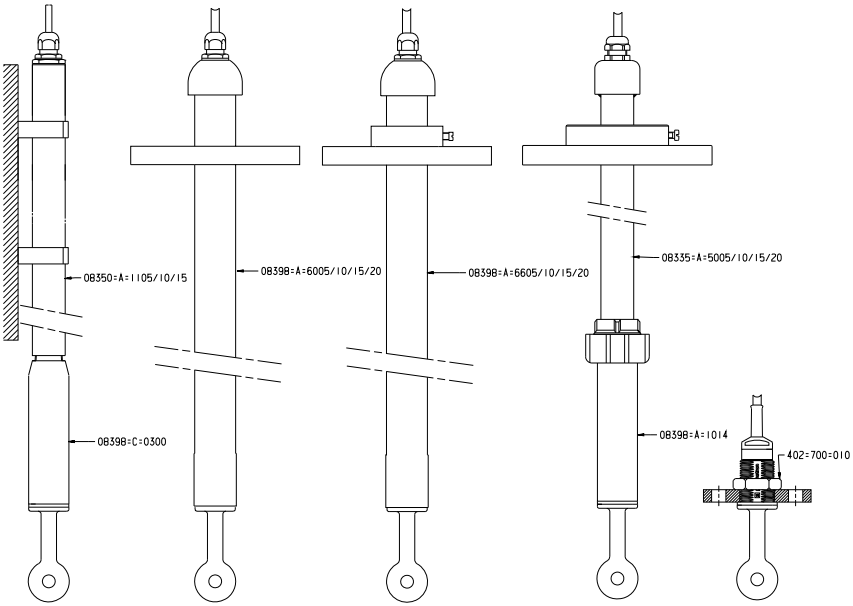
APPLICATION: FREE FLOW





Number:	Reference:	Designation	Installation
1	402=400=500	Stainless steel DN50 DIN screw	
2	429=600=500	EPDM DIN DN50 joint	
7	429=600=501	VITON DIN DN50 joint	
6	581=200=500	DIN DN50 stainless steel ferrule to weld (H = 35 mm)	
1+2+6	08398=A=0500	Kit with DN50 stainless screw + EPDM DN50 joint + DN50 stainless ferrule to weld (H = 35 mm)	Min. DN65
1+7+8	08398=A=5310	Kit with DN50 stainless screw + VITON DN50 joint + PVC ferrule to glue (H = 23 mm)	Min. DN65
1+2+9	08398=A=5320	Kit with DN50 stainless screw + EPDM DN50 joint + PP ferrule to weld (H = 23 mm)	Min. DN65
1+7+10	08398=A=5330	Kit with DN50 stainless screw + VITON DN50 joint + PVDF ferrule to weld (H = 23 mm)	Min. DN65
1+2+4	08398=A=6000	Kit with DN50 stainless screw + EPDM DN50 joint + DN65/50 T-piece	DN50
1+2+3	08398=A=6500	Kit with DN50 stainless screw + EPDM DN50 joint + DN65 stainless T-piece	DN65
1+2+5	08398=A=8300	Kit with DN50 stainless screw + EPDM DN50 joint + Stainless flow chamber (inlet / outlet 1/4" NPT)	Derivation
1+7+11	08398=A=8310	Kit with DN50 stainless screw + VITON DN50 joint + PVC flow chamber (inlet / outlet 1/2" gas)	Derivation
1+2+12	08398=A=8320	Kit with DN50 stainless screw + EPDM DN50 joint + PP flow chamber (inlet / outlet 1/2" gas)	Derivation
1+7+13	08398=A=8330	Kit with DN50 stainless screw + VITON DN50 joint + PVDF flow chamber (inlet / outlet 1/2" gas)	Derivation

7.3 Probe 8398.5, 1" threaded model gas



Remark: Flanges are not supplied individually.

This model is a universal model, specially adapted to immersion measurements. it is supplied as standard with an EPDM sheet gasket, an optional Viton joint (ref. 08398=C=3438) is also available, along with the stainless steel 1"G screw (402=700=010).
We propose as standard several PP and 316 L stainless steel accessories for immersion at various depths (0.5/1/1.5/2 m):

Reference	Material	Immersion (m)	Flange	Immersion setting	Adapter required
08335=A=5005	PP	0.5	DN65 PVC	Adjustable	08398=A=1014 (H = 150 mm)
08335=A=5010	PP	1	DN65 PVC	Adjustable	08398=A=1014
08335=A=5015	PP	1.5	DN65 PVC	Adjustable	08398=A=1014
08335=A=5020	PP	2	DN65 PVC	Adjustable	08398=A=1014
08398=A=6005	PP	0.5	DN50 PP	Fixed	-
08398=A=6010	PP	1	DN50 PP	Fixed	-
08398=A=6015	PP	1.5	DN50 PP	Fixed	-
08398=A=6020	PP	2	DN50 PP	Fixed	-
08398=A=6605	PP	0.5	DN50 PVC	Adjustable	-
08398=A=6610	PP	1	DN50 PVC	Adjustable	-
08398=A=6615	PP	1.5	DN50 PVC	Adjustable	-
08398=A=6620	PP	2	DN50 PVC	Adjustable	-
08350=A=1105	PP	0.5	-	Clip	08398=C=0300 (H = 130 mm)
08350=A=1110	PP	1	-	Clip	08398=C=0300
08350=A=1115	PP	1.5	-	Clip	08398=C=0300
08350=A=1120	PP	2	-	Clip	08398=C=0300
08878=A=1500	STAINLESS	1.5	(*)	Adjustable	08398=C=0500

(*): No flange, to be used with 08878=C=1600 support

8. MAINTENANCE

WARNING: Read the "installation precaution" and "cable connection" chapters carefully.

→ If there is a doubt concerning the operation of a probe, disconnect it from the transmitter, leaving it in place on your process and ensure that you obtain the following resistance values (see 4.1 Cable connection):

R (1-2) ≈ 110 Ω (at 25 °C) (Temperature sensor Pt100)
R (3-4) ≈ [1…2] Ω (Secondary coil)
R (5-6) ≈ [1…2] Ω (Primary coil)
R (3-5) ∞ Ω (Coil electrical insulation)

→ If the checks performed do not generate any erroneous resistance values, the probe can be considered to be working properly.

→ If the measurement is still not satisfactory, remove the probe from the process and calibrate it (see "probe calibration" chapter), set the transmitter to "no temperature compensation", then check the following points:

Displayed conductivity (K = 2.35)	Simulated resistance
470 µS/cm	5 kΩ
4.7 mS/cm	500 Ω
47 mS/cm	50 Ω
470 mS/cm	5 Ω

9. PRECAUTIONARY LABELS

Read all labels and tags attached to the instrument. Personal injury or damage to this instrument could occur if not observed.

This symbol, if noted on the instrument, references the instruction manual for operation and / or safety information.

Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/96/EC), European electrical equipment users must now return old or end-of life equipment to the Producer for disposal at no charge to the user.

Note: *For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment for proper disposal.*

Important document. Retain with product records.

10. CHEMICAL RESISTANCE TABLE

0: yes, -: no, x: momentarily	(°C)	PEEK			PVDF			PP		
	%	20	60	100	20	60	100	20	60	100
Sulphuric acid	10	0	0	0	0	0	0	0	0	0
	50	0	0	x	0	0	0	0	0	x
	95	-	-	-	0	x	-	x	-	-
Hydrochloric acid	10	0	0	x	0	0	0	0	0	x
	Sat	0	0	x	0	0	0	0	0	x
Nitric acid	< 25	0	0	0	0	0	x	0	0	-
	50	x	x	x	0	0	x	x	-	-
	95	-	-	-	0	x	-	-	-	-
Phosphoric acid	< 25	0	0	0	0	0	0	0	0	0
	50	0	0	0	0	0	0	0	0	-
	95	0	0	0	0	0	0	0	0	-
Hydrofluoric acid	40	-	-	-	0	0	0	0	0	-
	75	-	-	-	0	0	0	0	0	-
Acetic acid	10	0	0	0	0	0	0	0	0	0
	glacial	0	0	x	0	x	-	0	x	-
Formic acid	80	x	x	x	0	0	0	0	0	-
Citric acid	50	0	0	0	0	0	0	0	0	0
Calcium hydroxide	Sat	0	0	0	0	0	0	0	0	-
Potassium hydroxide	50	0	0	0	0	0	x	0	0	-
Sodium hydroxide	10	0	0	0	0	x	-	0	0	0
	40	0	0	0	0	0	x	0	0	-
Ammonia	10	0	0	0	0	0	0	0	0	-
	30	0	0	0	0	0	0	0	0	-
Ammonium chloride	Sat	0	0	0	0	0	0	0	0	0
Zinc chloride	50	0	0	0	0	0	0	0	0	-
Iron chloride	50	0	0	0	0	0	0	0	0	0
Sodium sulphite	Sat	0	0	0	0	0	0	0	0	-
Sodium carbonate	Sat	0	0	0	0	0	0	0	0	-
Potassium chloride	Sat	0	0	0	0	0	0	0	0	0
Sodium sulphate	Sat	0	0	0	0	0	0	0	0	0
Calcium chloride	Sat	0	0	0	0	0	0	0	0	0
Sodium chloride	Sat	0	0	0	0	0	0	0	0	0
Sodium nitrate	50	0	0	0	0	0	0	0	0	-
Aluminium chloride	Sat	0	0	0	0	0	0	0	0	0
Hydrogen peroxide	30	0	0	0	0	0	0	0	0	-
Sodium hypochlorite	50	0	0	0	0	0	0	x	x	-
Potassium dichromate	Sat	0	0	0	0	0	0	0	0	0
Chlorinated salt water		0	0	0	0	x	-	-	-	-
Ethanol	80	0	0	0	0	0	x	0	0	0
Cyclohexane		0	0	0	0	0	x	-	-	-
Toluene		0	0	0	0	0	0	x	-	-
Trichloroethane		0	0	0	x	x	x	-	-	-
Water		0	0	0	0	0	0	0	0	0

0: yes, -: no, x: momentarily		EPDM			VITON			316 L		
		20	60	100	20	60	100	20	60	100
Sulphuric acid	10	0	0	0	0	0	0	0	x	x
	50	0	x	-	0	0	x	x	x	x
	95	**x**	-	-	0	x	-	x	x	x
Hydrochloric acid	10	0	0	0	0	0	0	-	-	-
	sat	-	-	-	0	0	0	-	-	-
Nitric acid	< 25	0	x	-	0	0	0	0	0	0
	50	-	-	-	0	0	0	0	x	x
	95	-	-	-	0	0	x	0	x	x
Phosphoric acid	< 25	0	0	0	0	0	0	-	-	-
	50	0	0	x	0	0	0	-	-	-
	95	x	x	-	x	x	-	-	-	-
Hydrofluoric acid	40	-	-	-	0	0	0	-	-	-
	75	-	-	-	0	0	0	-	-	-
Acetic acid	10	0	0	0	x	x	-	0	0	x
	glacial	0	x	-	-	-	-	0	0	x
Formic acid	80	0	0	x	-	-	-	0	x	x
Citric acid	50	0	0	0	0	0	0	0	0	0
Calcium hydroxide	Sat	0	0	0	0	0	0	0	0	0
Potassium hydroxide	50	0	0	x	x	x	-	0	0	0
Sodium hydroxide	10	0	0	x	0	x	-	0	0	0
	40	0	0	x	0	x	-	0	0	0
Ammonia	10	0	0	0	-	-	-	0	0	0
	30	0	0	0	-	-	-	0	0	-
Ammonium chloride	Sat	0	0	0	0	0	0	x	x	x
Zinc chloride	50	0	0	0	0	0	0	x	x	x
Iron chloride	50	0	0	0	0	0	0	-	-	-
Sodium sulphite	Sat	0	0	0	0	0	-	0	0	0
Sodium carbonate	Sat	0	0	-	0	0	0	0	0	0
Potassium chloride	Sat	0	x	-	0	0	0	0	x	x
Sodium sulphate	Sat	0	0	0	0	0	0	0	0	0
Calcium chloride	Sat	0	0	0	0	0	0	0	0	x
Sodium chloride	Sat	0	0	0	0	0	0	x	x	x
Sodium nitrate	50	0	0	0	0	0	0	x	x	x
Aluminium chloride	Sat	0	0	0	0	0	0	-	-	-
Hydrogen peroxide	30	0	0	-	0	0	0	0	0	0
Sodium hypochlorite	50	x	x	-	0	0	x	x	x	x
Potassium dichromate	Sat	0	x	x	0	0	0	0	0	x
Chlorinated salt water		-	-	-	0	x	-	-	-	-
Ethanol	80	0	0	0	0	x	x	0	0	0
Cyclohexane		-	-	-	0	0	0	0	0	0
Toluene		-	-	-	-	-	-	0	0	0
Trichloroethane		-	-	-	x	x	x	0	0	-
Water		0	0	0	0	0	0	0	0	0

UNITED FOR WATER QUALITY