Electrodes for pH measurements

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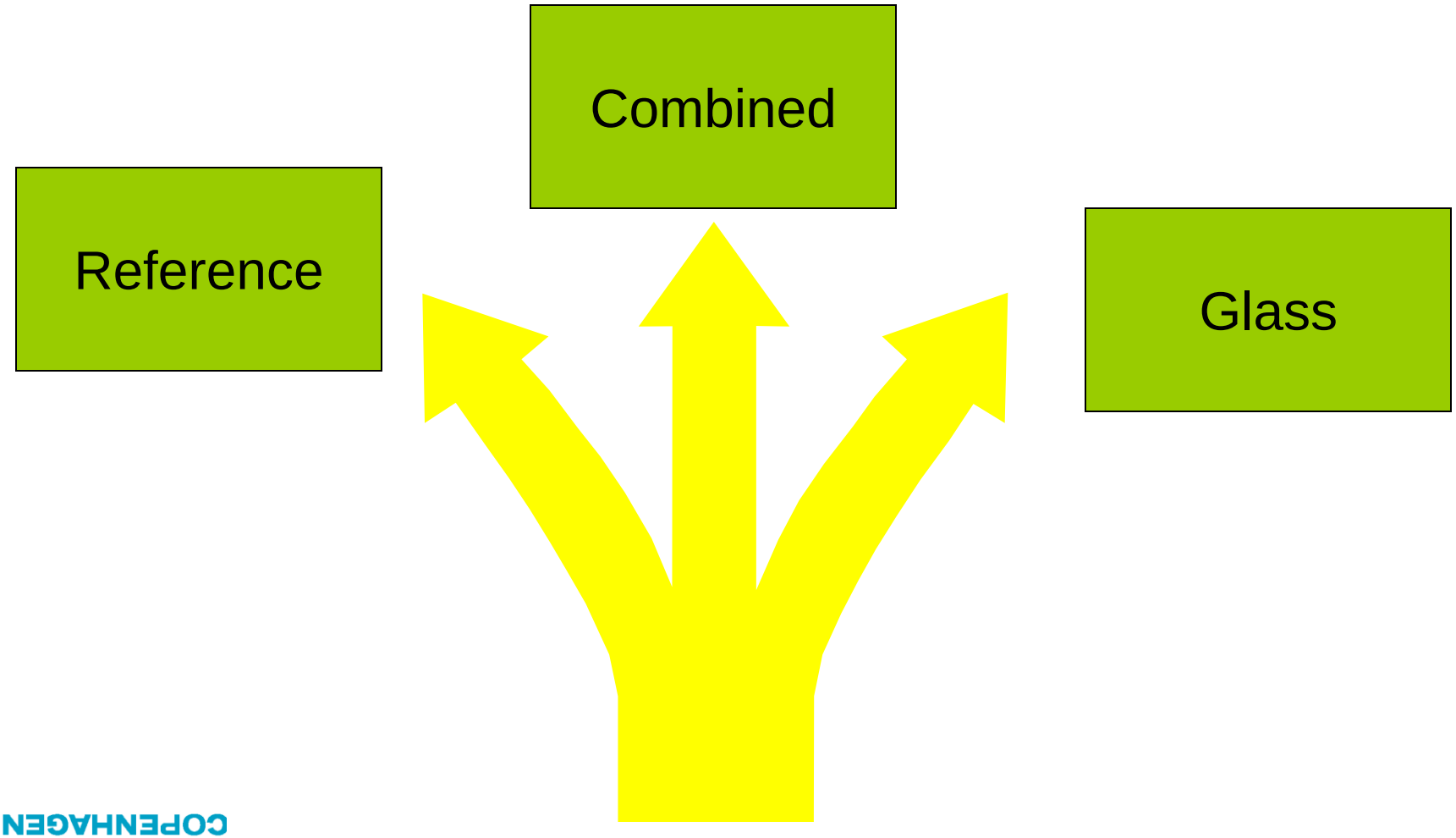
- when you need to be sure...

Different types



Electrode working principle

Glass electrode

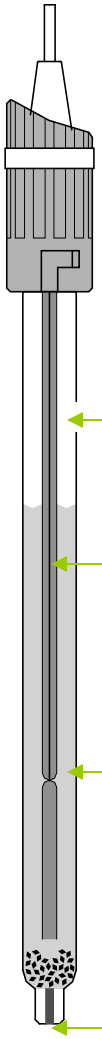
Electrode body

Internal reference element

Internal solution

Glass membrane

Reference electrode



Filling hole

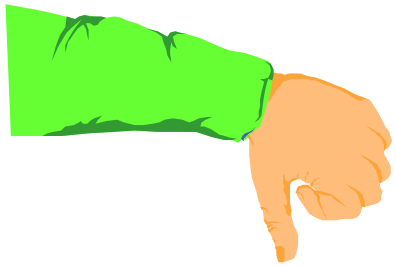
Reference element

Reference electrolyte

Liquid junction

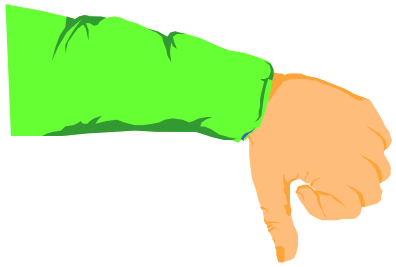
Sensitive parts

Reference electrode



Liquid junction

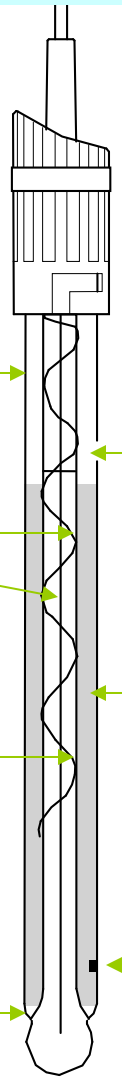
Glass electrode



Glass membrane

Principle of a combined electrode

Combined pH electrode



Electrode body

Internal and external reference elements

Internal solution

Glass membrane

Filling hole

Reference electrolyte

Liquid junction (porous)

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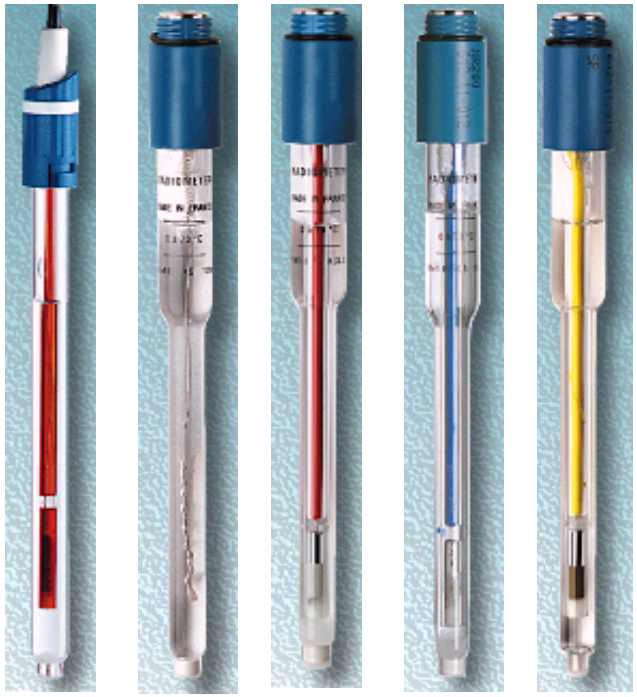
Various reference elements



- Red Rod from Radiometer Analytical
- Silver-silver/chloride (Ag/AgCl)
- Calomel (Hg/Hg_2Cl_2)
- Mercurous sulphate (Hg/Hg_2SO_4)
- Mercuric oxide (Hg/HgO)

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The liquid junctions

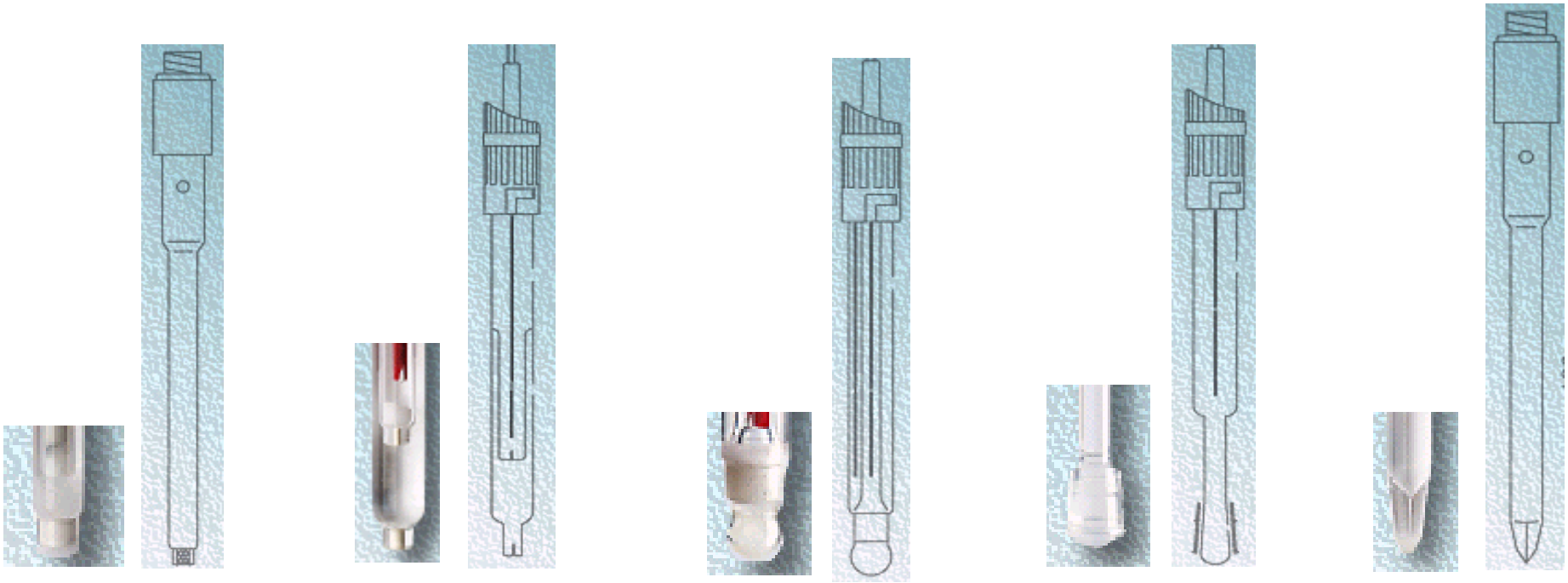
Porous pin

Annular

Fibre

Double junction

Reversed sleeve



10 µl/h

10 µl/h

100 µl/h

1 ml/h

<10µl/h

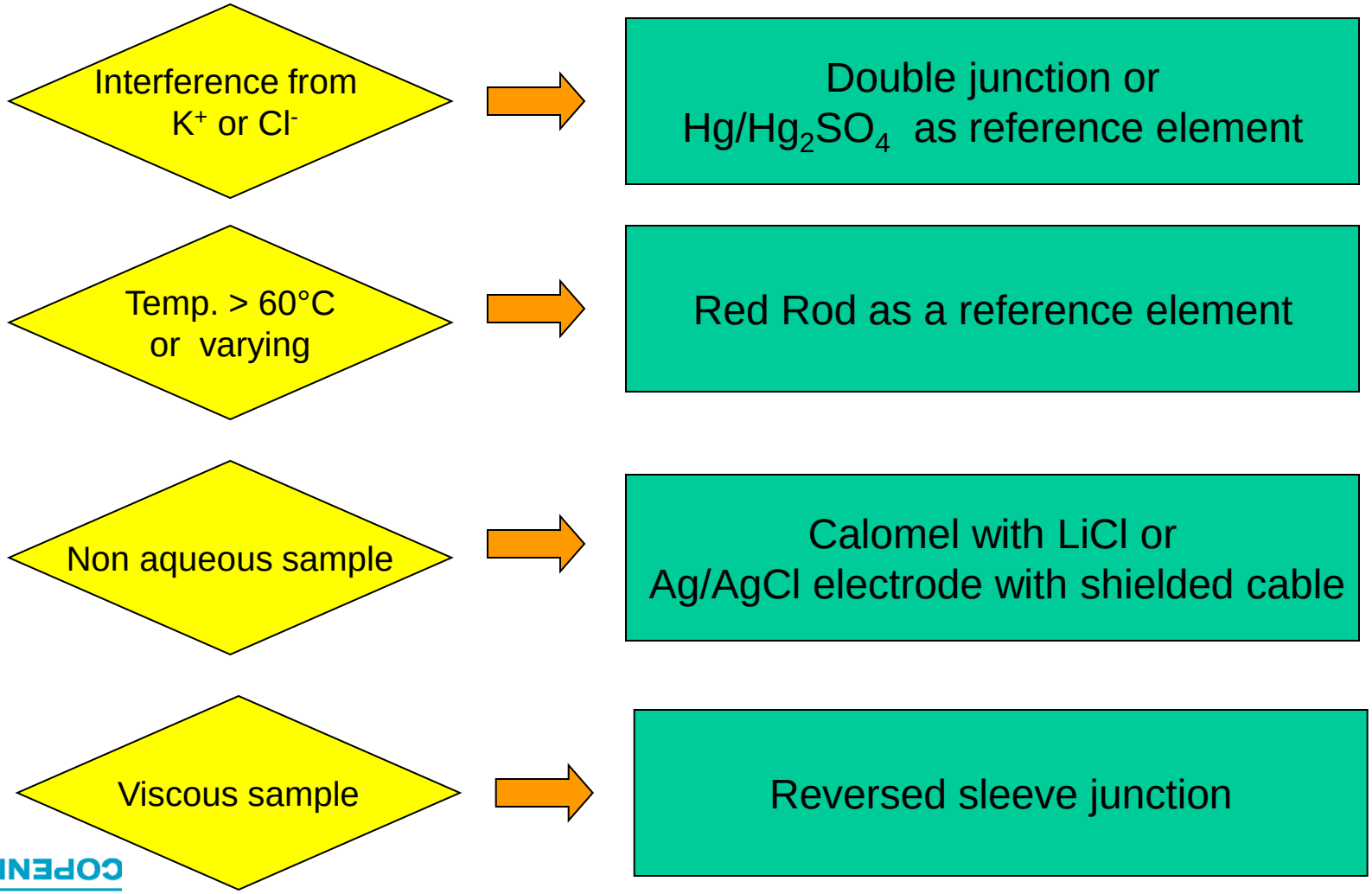
How to select electrodes

Combined electrodes → Easy to use

Separate reference electrode →

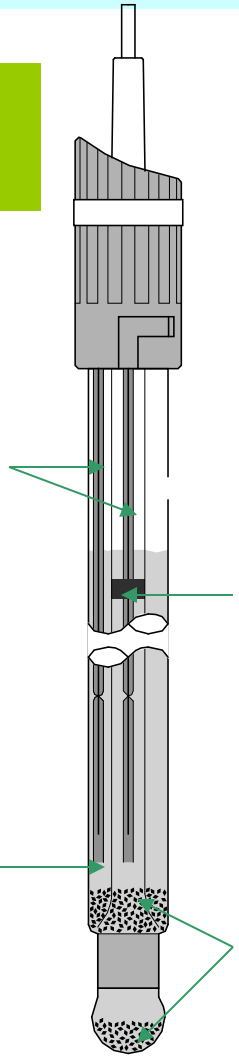
- when liquid junction gets easily clogged
- Non-aqueous solutions or with low ionic strength.
- Electrolyte includes incompatible ions

How to select a reference electrode



Red Rod: an innovation

Red Rod combined pH electrode



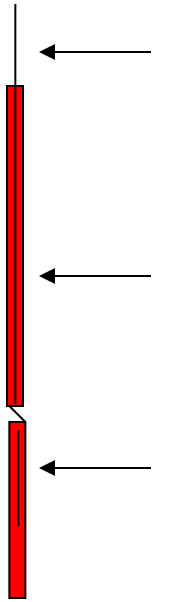
Internal and external Red Rod elements

Internal solution (pH0 = 6.65)

External solution (saturated KCl)

KCl crystals

Sketch of a Red Rod



Ag wire

Red cartridge

Active part

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Benefits of Red Rod technology

Longer lifetime

Less risk of porous pin clogging,
no **Ag^+ ions** in the filling solution

Better measurement accuracy

The reference elements are protected from light by the **red cartridge** which means a more stable potential

Faster response

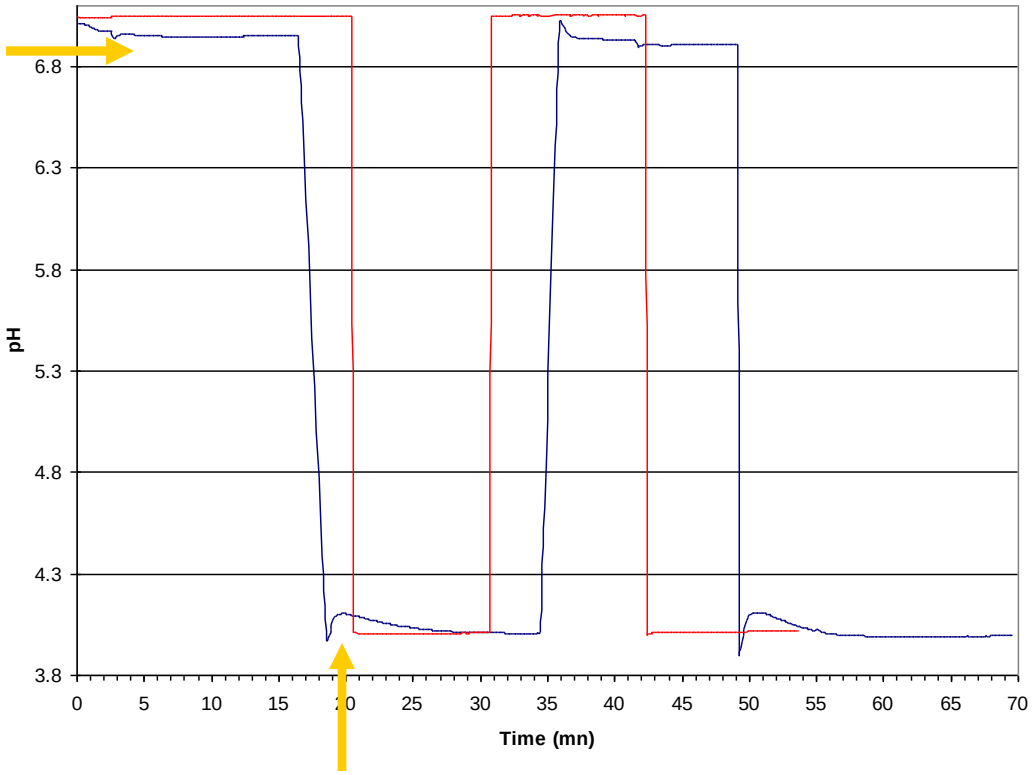
The internal and external reference elements are perfectly symmetrical**.**

Therefore the behaviour remains the same even when there are large pH or temperature variations.

Measurements from 0 to 100°C

Reproducible results

Comparison between a Red Rod and a «conventional» electrode



pH 7.000 at 50°C
pH 4.005 at 25°C

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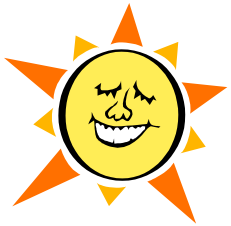
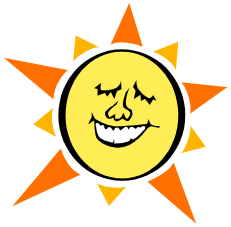
Electrode maintenance

Electrode maintenance

Correct and regular maintenance means:



Fast response



Reproducible and reliable measurements

A longer lifetime

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Electrode maintenance

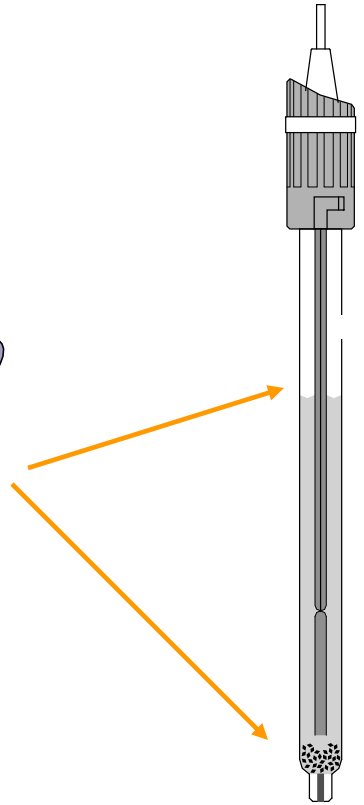
Filling solutions

Type	Description
KS100	saturated KCl, 500 ml
KCl.L	saturated KCl, 100 ml
KCl.C	KCl crystals, 15 g
KCl.Ag	KCl 3M saturated with AgCl, 100 ml
KS110	KCl 3M, 500 ml
KS120	saturated KCl saturated with AgCl, 500 ml
KS160	saturated K_2SO_4 , 500 ml

Cleaning solutions

Type	Description
RENOVO.N	Normal cleaning solution, 250 ml
RENOVO.X	Strong cleaning solution, 250 ml
KS400	Pepsine solution in HCl, 250 ml
KS410	Thiourea solution, 250 ml

Check the state of the electrode



Reference electrode

- Level of solution (0.5 to 1 cm)
- Crystals:
  - Present
  - Move freely
  - No air bubble

Every day

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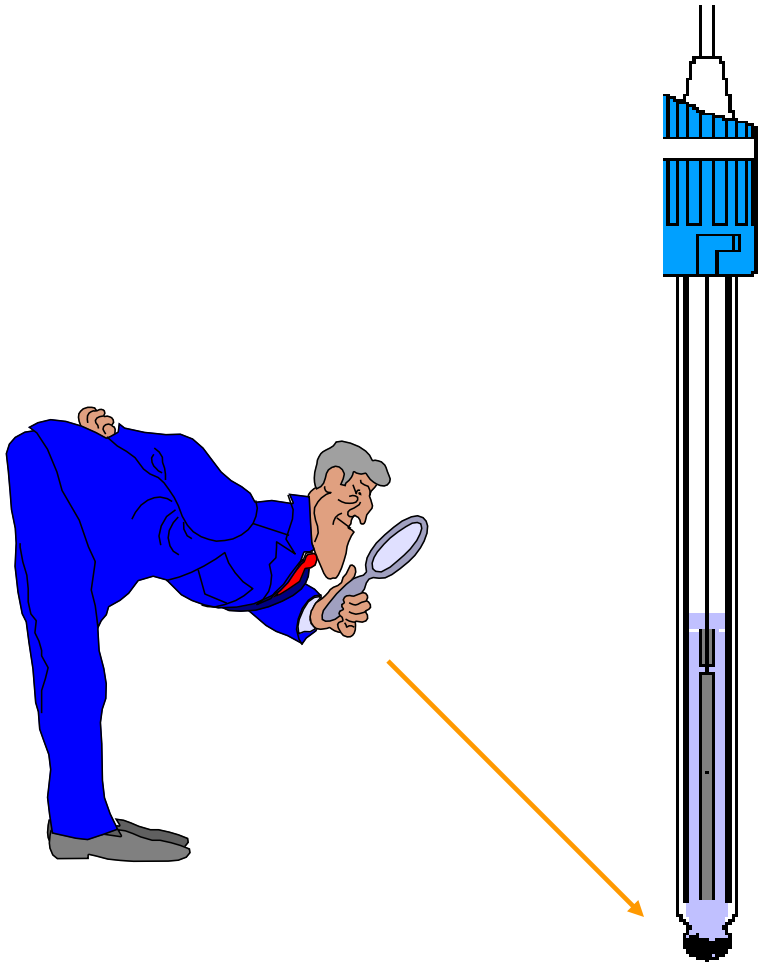
Check the state of the electrode



Glass electrode

- Glass membrane:
  - Clean
  - No cracks or scratches

Every day

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How to clean

Protein contamination	Immerse electrode in RENOVO.X solution for approx. 3 min. Rinse with deionised water.
	Immerse electrode in KS400 solution (pepsin in HCl 0.1 M) for several hours and rinse with deionised water.
Grease or oil deposit	Rinse with a solvent miscible with water (i.e. acetone), then rinse with deionised water.
	Close filling hole and immerse in RENOVO.N for 12 to 16 hours.
Silver or sulphide contamination	Close the filling hole and immerse electrode in a KS410 (Thiourea) solution for several hours. Renew the filling solution.

GK ANNEX

A complete **kit** for Red Rod electrodes:

- cleaning solutions
- filling solutions
- accessories
- logbook
- instructions

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Troubleshooting

Low sensitivity and/or slow response

Drifting potential

Unstable readings

Low sensitivity/slow response

Air bubbles

Remove bubbles:
- Tap the electrode with fingers
- Dip the tip in water at 60°C

pH sensitive glass bulb contaminated or not hydrated

Identify the contamination
- Use suitable cleaning solution

Hydration:
- At least 1 hour in pH 4

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Low sensitivity/slow response

Calibration error

Buffers:
- Check date of validity
- Use fresh, quality buffers

Electrode too old

Replace the electrode

Drifting potential

Air bubbles

Remove bubbles:
- Tap the electrode with finger
- Dip the tip in water at 60°C

Level of salt-bridge solution too low

Refill with new solution up to 0.5 cm under the filling hole
(check there are crystals)

Drifting potential

Inadequate flow of salt-bridge solution

- Check filling hole is uncovered
- If liquid junction contaminated, clean it

No stirring

Reproducible stirring during calibration and measurements

Unstable readings

Air bubbles

Remove bubbles:
- Tap the electrode with finger
- Dip the tip in water at 60°C

Liquid junction clogged with crystals from salt-bridge

Replace the filling solution (heat the electrode in a 60°C water bath for 10 min. to dissolve crystals)

Unstable readings

Contamination with proteins

Lower the electrode tip into:
- RENOVO.X (3 min)
- KS400, pepsin solution (2 hours)

Contamination with oil or grease

Lower the electrode tip into:
- RENOVO.N (12 hours)
- Solvent miscible with water (e.g. acetone)

Unstable readings

Contamination of liquid junction with silver or sulphides

Lower the electrode tip into: KS410, thiourea solution (for a few hours)

Poor connection

Check that the electrode is properly connected and that the meter used is grounded

The end