REFEX pH Sensors

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Introduction:

Refex is a solid State Ag/AgCl reference electrode.

Refex is unique being the only non-porous/non-leaking reference electrode

Refex has replaced the need to have a liquid-junction and acts as both an immobilized electrolyte and also a non-porous protective interface separating the medium under test from the internal Ag/AgCl half-cell. The entire outside surface of the Refex electrode is electrochemically active – it does not foul – even when completely coated (oily waste water being a good example) Being non-porous Refex continues to perform up to 20BAR pressure and full vacuum. Refex withstands varying temperature between 0.90 C without degrading (no sucking / blowing of electrolyte). Refex being non porous has a higher impedance than leaking/porous reference electrodes – typically Refex has an impedance< 50Kohm – this is not a problem with modern pH transmitters with duel high impedance galvanic ally separated sensor inputs. Refex is a non-glass reference electrode compatible with all electrochemical-measuring electrodes. Refex can be used for anodic corrosion potential measurements.

fig. 1
Conventional pH electrode
Porous Junction

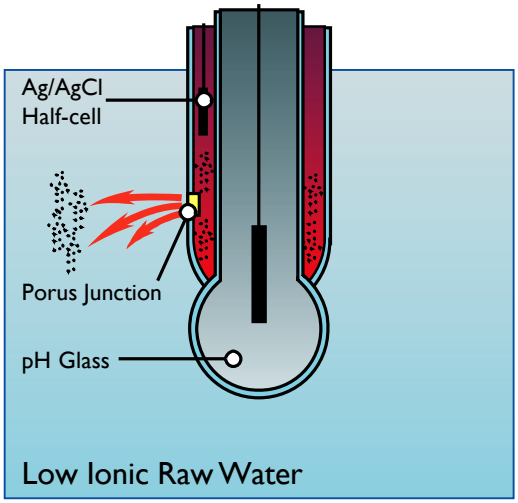
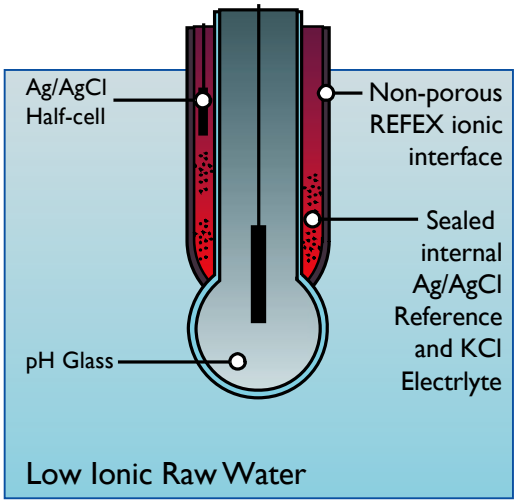


fig. 2
REFEX pH electrode
Non-Porous Junction



Application/Retrofit Index:

> Food and Beverage – Dairy – non-glass – protein resisting
> Sulphides – Sour Waters with H2S – Desulphurization of Flue gases – Stack Gas Scrubber waters.
> Ultra Pure Waters – Boiler Feed – Power Generation – Refex being non-porous there's no diffusion potention error (all other leaking reference electrode in UPW produce a pH 0.3 diffusion potential error across the liquid-junction)
> Silicates/Chromates/Cyanide/HF – Refex is resistant to chemical and abrasion attack – only the measuring electrode needs to be replaced.
> NaOH and KOH and most acids – Refex is resistant to pH extremes
> Pigments and Fine particles (Ti02 and Indigo Blue being typical)
> Potable Water Treatment (all stages including cold low ionic raw waters with magnesium and iron traces)
> Sewage and Effluent Neutralization – being non-porous – Refex does not foul.
> Withstands varying pressures up to 20BAR and vacuum.
> Withstands varying temperatures 0.90C
> Withstands all Oil/LNG and most petrochemical applications.

Retrofits and Cable/connectors:

Refex Cable and Cap Connector Systems

> IP65 Fixed cable – standard lengths 1,3,5,10m
> Euro Cap Connector System with PG13, 5 (S.7 type)
> Yokogawa Head Cap System
> ABB/Emerson 1" NPT process mounting
> ¾" BSP Flow Cell process mounting

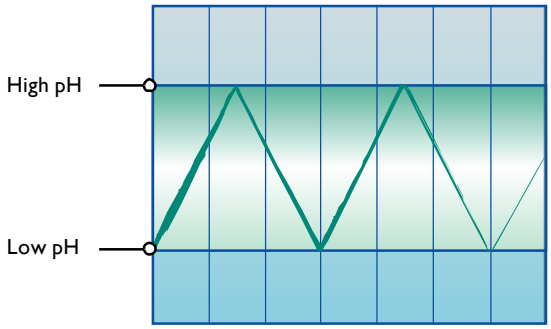
Refex Retrofit electrodes for existing pH installations:

> ABB/TBI
> Emerson
> Yokogawa
> Endress and Hauser

Instant response to pH change.

The Refex solid state reference system against the Refex pH glass electrode responds instantaneously to pH change. This is a very important quality when titration and chemical dosing is required. The entire wetted outside surface of the Refex reference electrode is electrochemically active – non-porous - without diffusion potential / flow errors – and also resistant to fouling – the instant response and accuracy of the Refex electrodes prevents pH over-shoot and unnecessary wastage of expensive dosing chemicals resulting in significant savings. (see Fig 1.)

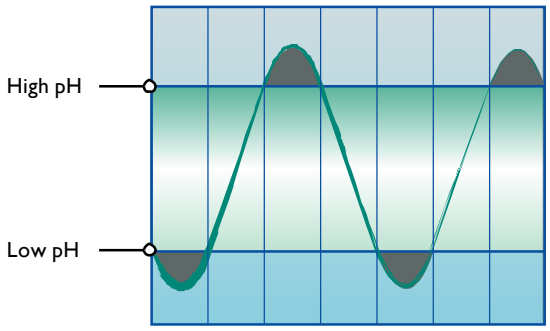
fig. 1
REFEX Non Porous pH Sensor - Solid State
pH Response = Alpine Peaks = No Wastage of Dosing Chemicals



No Wasted Dosing Chemicals

Slow responding conventional electrodes over-shoot and exceed the high and low pH alarm settings –this roller coaster effect results in unnecessary wastage of dosing chemicals (See Fig 2.)

fig. 2
Normal pH Sensor with Porous Junction
pH Response = 'Rollercoaster' Overshoot



Shaded Areas = pH Overshoot
and Wasted Dosing Chemicals

Evaluation of a New Solid-State Reference Electrode Junction Material for Ion-Selective Electrodes.

By Dermot Diarmond, Eamon McEnroe and Mary McCarrick. School of Chemical Sciences, Glasnevin, Dublin 9, Ireland
Andrzej Lewenstam. Laboratory for Analytical Chemistry, Ado Akademi, SF-20500 Turku, Finland

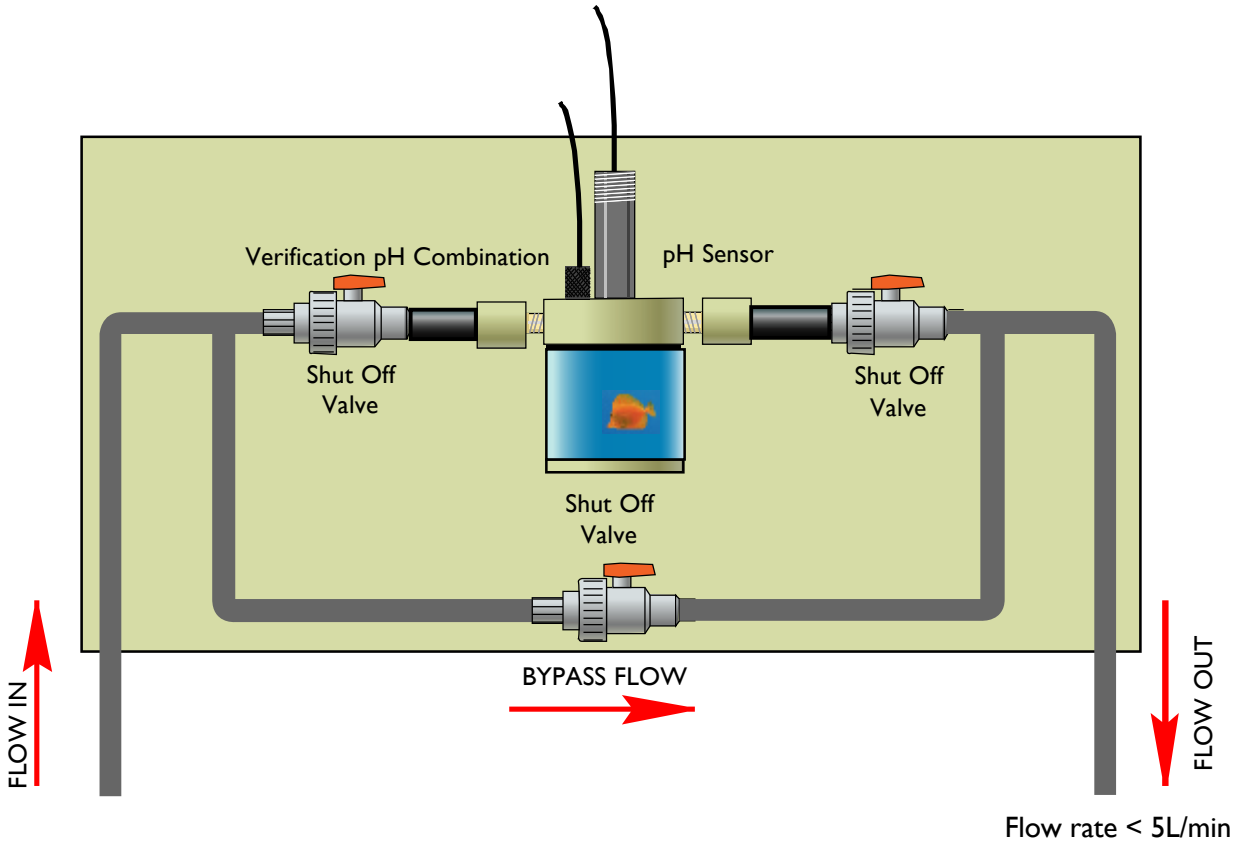
Received September 12, 1993

The performance and properties of a new low-resistance material, Refex, suitable for use in reference electrode junctionsis described. The material is a solid polyvinyl acetate that contains a very large loading KCl (1:1 w/w KCl/PVA). Despite relatively large active surface areas in the designs studied (stand-alone reference and combination Ph), leakage rates of KCl are remarkably low.

pH measurements in ultrapure water and comparative measurements in common buffer solutions against standard refernce electrodes confirm the stability of the potential developed across the junction to be very stable. Impedance studies verify the importance of the KCl doping for realisation of the low resistance and attractive electrochemical properties of the material.

REFEX pH Bypass System for all stages of Potable Water Treatment

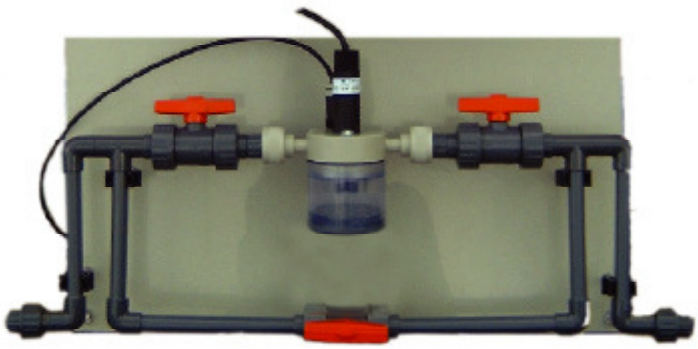
Compatible with all models of pH Transmitters



Flow rate < 5L/min

Equipment:

Process pH/REFEX Combination Probe
Type: EC-3/4"BSP-2001-TC-1m
TC Options: Pt100
Pt1000
3 KOhm Balco
(Please specify required TC when ordering.)
Verification Electrode
Type: EC-FT-PG 13,5-2001-25mm-Pt1000-BNC
1 x PP. Flow Cell
1 x PVC Bypass System
1 x Back Panel



Refex pH System for Potable Water Treatment - Electrode Option 1.

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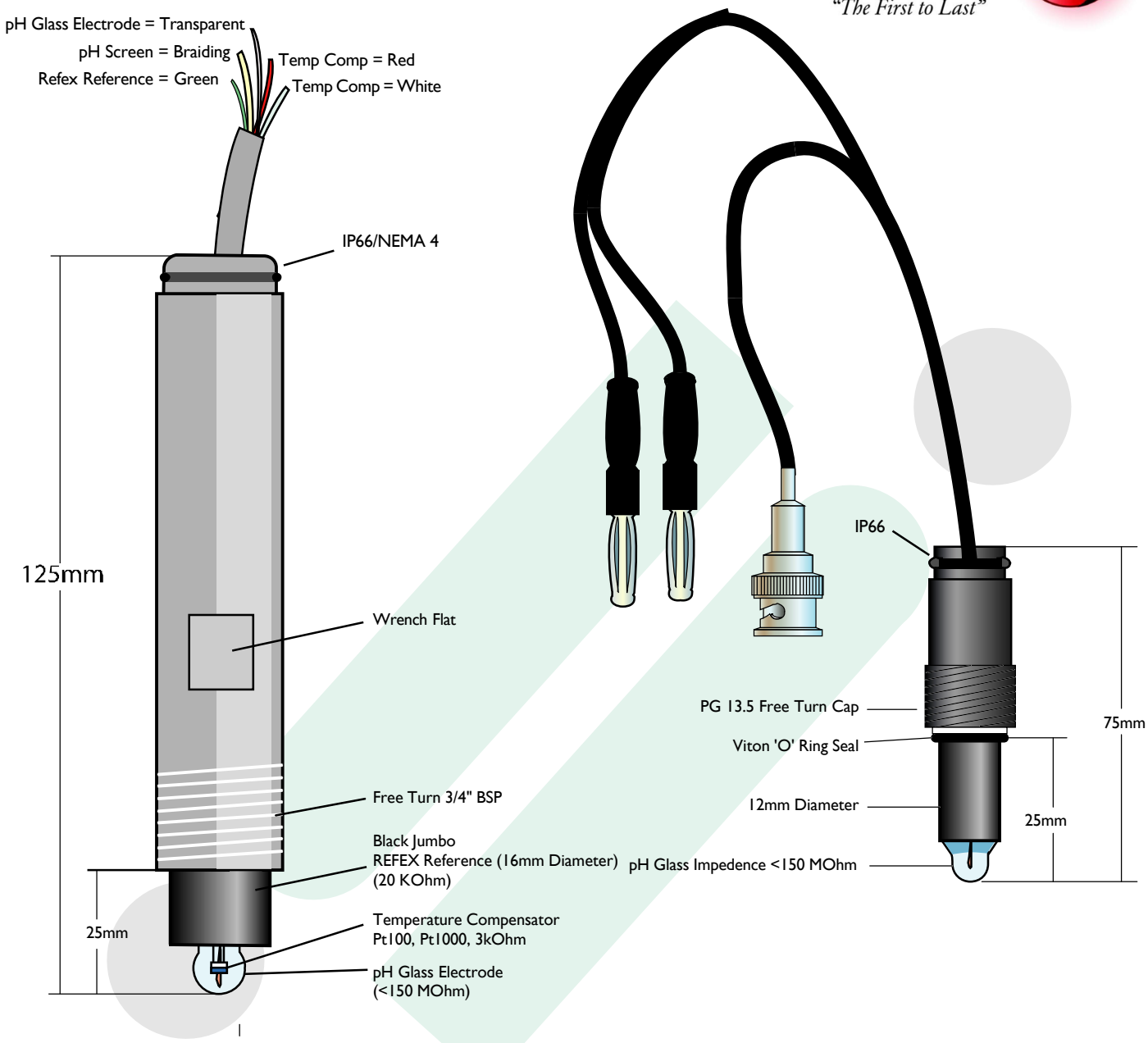
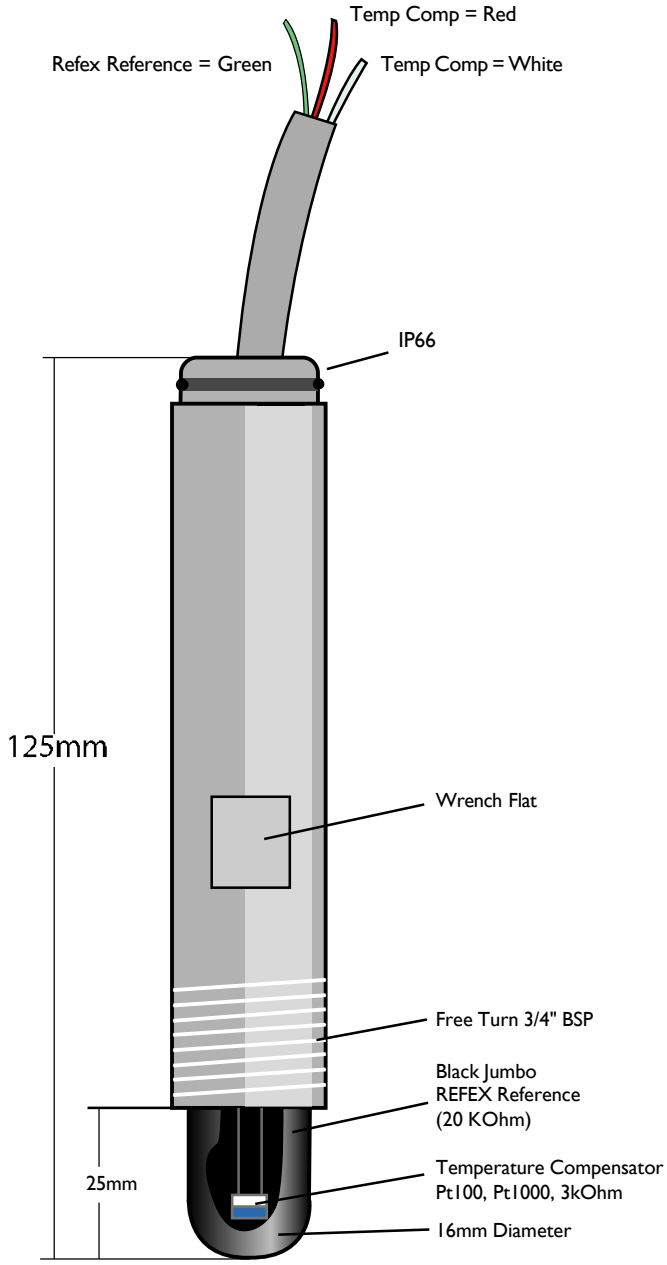
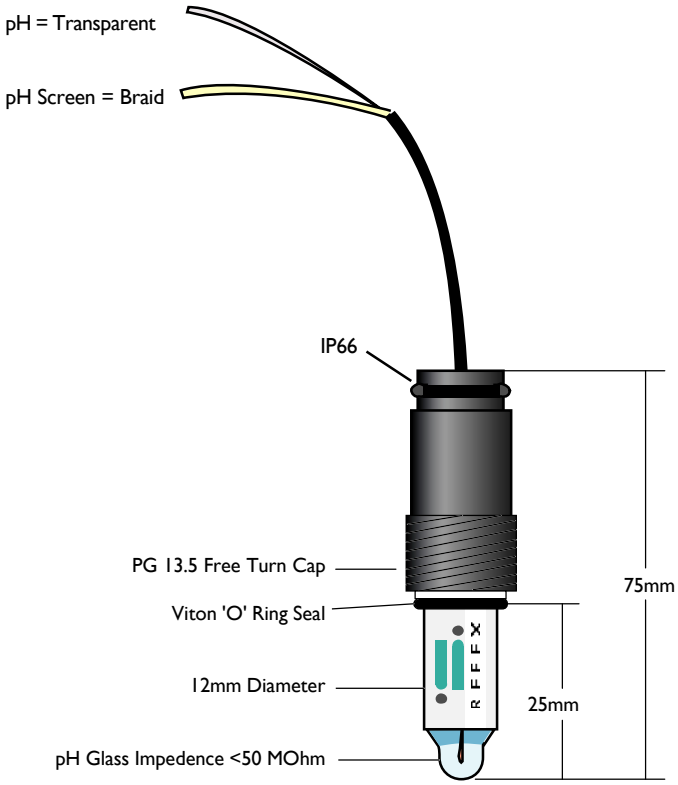


REFEX/pH Combination Electrode (Process):	
pH Range	: 0 - 13.5 (100mOhm)
Temp Range	: 0-60 DegC
Reference	: REFEX Solid State <20kOhm
Process Fitting	: 3/4" BSP Free Turning
Cable Options	: 1m/3m/5m/10m (Please Specify)
T.C. Options	: Pt100, Pt1000, 3kOhm (Please Specify)
Wetted Surfaces	: Refex Reference,
	: Ryton Body, Viton 'O' Ring
Part No.	: EC-FT-3/4"BSP-2001-TC-Cable

REFEX/pH Combi Electrode (Verification):	
pH Range	: 0-13.5
Temp Range	: 0-60 DegC
Process Fitting	: PG 13.5
Cable Options	:1m/3m/5m/10m
	: (Please Specify)
Temp Comp	: Pt1000
Part No.	: EC-FT-PG13.5-2001-25mm-Pt1000-11-BNC
pH Meter	: Knick Portamess 911

Refex pH System for Potable Water Treatment - Electrode Option 2.





REFEX Reference Electrode:	
Temp Range	: 0-90 DegC
Impedence	: 20 kOhms
Process Fitting	: 3/4" BSP
Cable Options	: 1m/3m/5m/10m (Please Specify)
T.C. Options	: Pt100, Pt1000, 3kOhm (Please Specify)
Wetted Surfaces	: Refex Reference,
	: Ryton Body, Viton 'O' Ring
Part No.	: EC-FT-3/4"BSP-5710-25mm

pH Glass Electrode:	
pH Range	: 0-13.5
Temp Range	: 0-90 DegC
Process Fitting	: PG 13.5
Cable Options	:1m/3m/5m/10m
	: (Please Specify)
Part No.	:EC-FT-PG13.5-5610-25mm

REFEX IMMERSION/WASHER SYSTEM

For Sewage Treatment Applications

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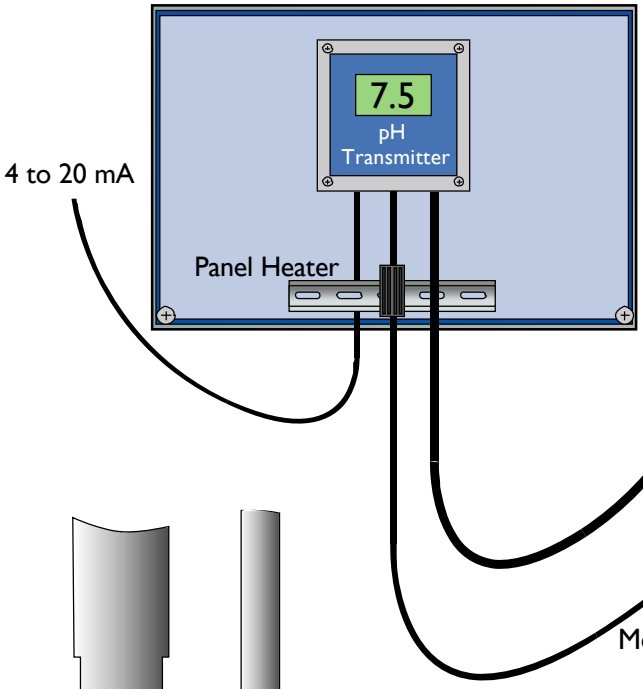
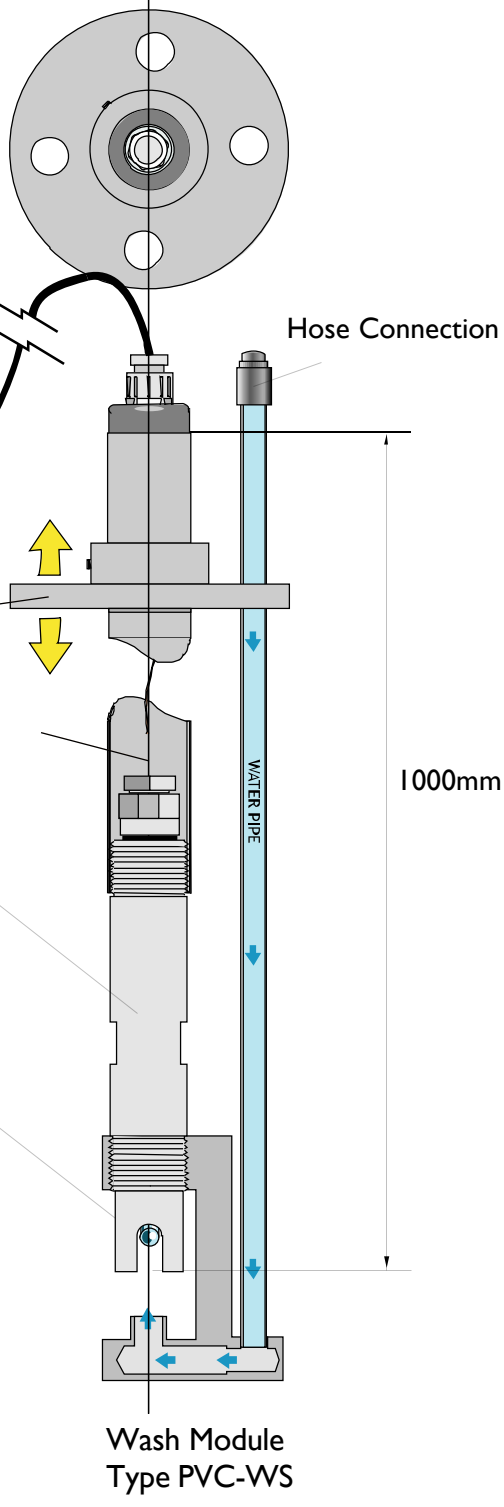
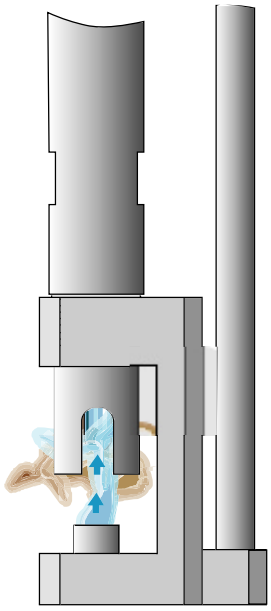
Dip System/ Immersion System

PANEL MOUNTED pH METER



PLAN VIEW





Temp Comp:
PT100 PT1000 3K Balco Please Specify

Cable Options:
3m 5m 10m Please Specify

pH Verification between the various stages of Potable Water and Lab.

Problem:
To obtain pH verification it is necessary to follow certain protocols. Taking grab samples back to a remote laboratory for pH measurement always results in confusion and pH differences compared to the process pH values. The reasons for this is that the grab sample is exposed and contaminated by air - the sample is static as opposed to flowing with different measuring conditions, pH sensors, pH meters, pH buffers and temperatures.

In order to obtain reliable and accurate pH verification - The verification measurement should be made at the process point in a flowing condition (an overflowing beaker or directly in the pH sensor flow cell beside the process pH sensor) A level playing field must be established - the process and hand held pH instruments should be calibrated at the process point at the same time using the same buffers and also the same electrode type and at the same temperature. PH buffers 4.01 and pH 6.88 should be used - a two-point calibration is sufficient. Working to this protocol pH verification and agreement is assured. Taking grab samples back to a remote laboratory only produces pH anomalies and is never advised.

fig. 1
pH Verification on-site using REFEX Solid-state pH combination electrode -same as process.

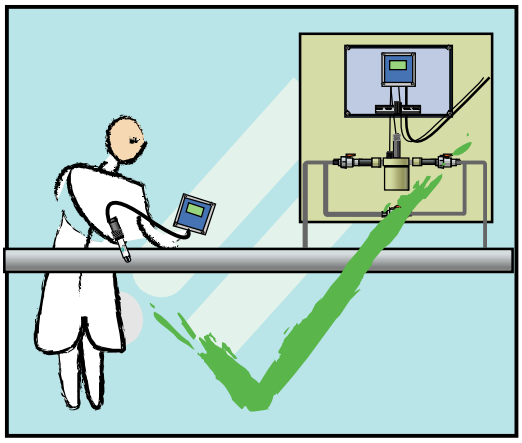
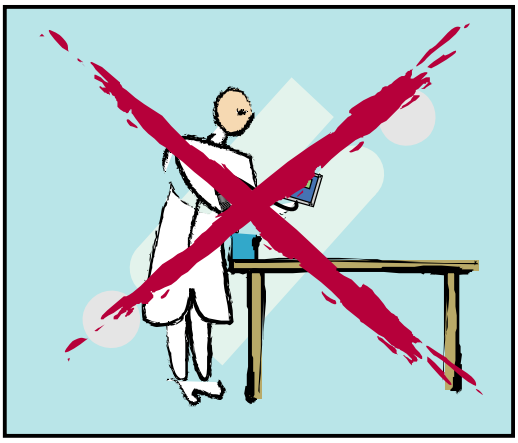


fig. 2
pH Verification in the Lab.



Solution:
When new Refex pH sensors are installed into the flow cell - it is advisable to allow the sensors to become conditioned for 2 hours in the flow - before the final pH calibration is made. The electrodes are stored in 3.0mol/l KCl and it will take 2 hours for the sensors to become conditioned to the flowing raw and treated water. The Refex electrode is guaranteed for 12 months in operation - and should be replaced annually as a preventive maintenance protocol.

Conclusion:
The Refex pH system provides a technically unrivalled and consistent pH performance - guaranteed for 12 months with the minimum amount of maintenance - no wasted dosing chemicals. High-resolution automatic measurement and dosing control. The most important stages being Raw and treated water waters - the flocculation/coagulations optimized ensuring trouble free treatment at every stage downstream and optimized high yields of top quality compliant final water.

Effects of fouling and deposit coating of pH and Reference electrodes

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Problem:
Electrode fouling has to date been one of the major problems requiring frequent electrode cleaning and recalibration. The problems relate to the need for a porous liquid-junction for the reference electrode. The porous junction can be porous ceramic, Teflon, even wood. The liquid junction becomes clogged by the medium this increases the impedance. Typical coating problems are lime scaling, manganese, precipitation between hydrogen sulphides with AgCl, Proteins/fat build up in sewage and industrial effluents. Fine particle clogging –pigments and dye stuffs etc. Reference electrodes are low impedance sensors (typically 5 kOhm) the pH glass electrode is a high impedance sensor (typically 100 MOhm) clogging/coating deposit on sensors increases the impedance by 1Mohm – this is not a major problem for the pH glass electrode – the impedance increases to 101 MOhm (1% increase) however the impedance across the porous liquid junction increases from 5 kOhm to 1005 kOhm – this is exactly where the problem lies. One solution has been the pressurization of the electrolyte to force a positive KCl out-flows across the junction to prevent clogging of the liquid junction – this method is expensive and still did not over-come precipitation clogging. (See Fig 1 and Fig 2.)

fig. 1
CLEAN POROUS JUNCTION

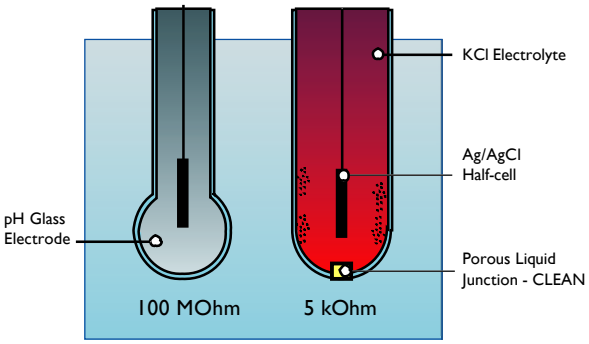
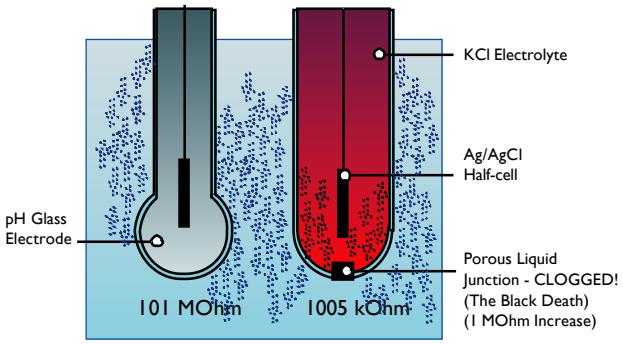


fig. 2
CONTAMINATED POROUS JUNCTION

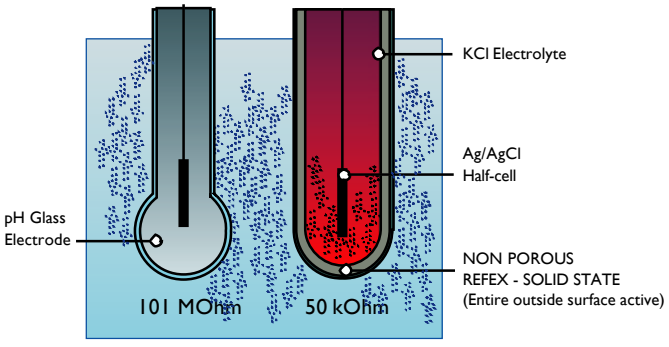


Solution:
Should the pH response start to become sluggish due to pH glass electrode coating, the pH Glass electrode is easily cleaned using detergent, mild HCl acid or caustic wash. Sometimes during the cleaning of the pH electrode (wet wad of cotton wool) the electrode can become statically charged - after cleaning the pH glass membrane the electrode should be given 15 minutes to become discharged and reconditioned to the environment of the medium under pH test before recalibration of the electrodes (2 point calibration is sufficient).

The REFEX reference electrode is a non-porous solid-state reference electrode unaffected by coating build up and being non-porous cannot clog. When the coating build up on the outside surface of the REFEX electrode remains wet and conductive the mV output from the REFEX electrode remains the stable. The outside surfaces can be cleaned off using the same cleaning method as the pH glass electrode. The electrodes pH and REFEX must be kept hydrated at all times - dehydrations of the electrodes increases the impedance of the REFEX (out of range).

Conclusion:
The REFEX solid-state electrode has overcome the main problems relating to reference electrode coating and contamination. The non-porous quality has overcome the precipitations problems (sulphides and proteins etc.). The performance is almost maintenance free and the life of the electrodes extended by many times the normal. REFEX continues to perform even in the most highly contaminated sewage, process and industrial effluent waters.
(See Fig 3.)

fig. 3
CONTAMINATED REFEX NON-POROUS JUNCTION



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