# General Catalog

## pH, ORP, Ion Selective, Conductivity, Dissolved Gases, Solutions and Accessories

Analytical Sensors & Instruments, Ltd.

*Measuring Your Success*[sm]

# ASI IS COMMITTED TO PROVIDING QUALITY PRODUCTS AND EXPERT TECHNICAL SERVICE

Welcome to the Analytical Sensors & Instruments Ltd. Electrochemical Products Catalog. Bound within the pages of this catalog, you will find the multitude of products and services that ASI has to offer. We are committed to providing our customers with the best engineered products, customized to your specifications and backed by our technical experts and product engineers.

***ASI is an OEM manufacturer specializing in e-chem sensors & products. We offer more than you realize, if you don't find what you need in these pages, contact us so that we may assist you in your search:***

**WORLDWIDE MANUFACTURING**

With a manufacturing, tooling, molding and assembly facilities in the U.S.A. and China, ASI is dedicated to finding what solution best fits your company's needs for outsourcing high quality products at an attractive price.

**ENGINEERING**

ASI has grown into a comprehensive OEM manufacturer for the electrochemical market place. Our engineering staff is dedicated to solving your problems.

**EXPERTISE**

ASI spends countless hours every year training our personnel to provide the best products at the highest quality. Our products have that world class feeling every customer deserves.

**SUPPORT**

Our technical support team and customer service personnel are standing by right now waiting for your phone call.

## Customer Contact Department

For orders, returns, repairs and quotes, contact us by phone, fax, mail or E-mail. All customer service associates have access to pricing and shipping information.


When placing an order, call between 8:30am and 5:00pm CST (Central Standard Time), Monday thru Friday. If you don't have an account with ASI, we would be happy to establish one after a short qualification process or through our dealer network.

We offer (upon request):

- ► Same day shipping (for orders received by 9 a.m. Central Time)
- ► Next-day delivery
- ► Drop shipments
- ► Carrier of choice (UPS, TNT, FedEx, ETC)
- ► Custom packaging
- ► Custom logo and graphics printing

***(800) 545-6132***

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# TECHNICAL INFORMATION



One of the most important benefits that ASI customers receive when they purchase one of our products is our unmatched customer service and technical support. With a team of customer service agents and on-staff electrochemists, our commitment to customer satisfaction is first and foremost. We are dedicated to helping you solve your analytical problems.

For technical support, contact our Customer Service Department at the phone or fax numbers below.


**Toll Free:** **800.545.6132**
**Phone:** **281.565.8818**
**Fax:** **281.565.8811**


Be sure to visit Analytical Sensor & Instruments Ltd. and Aurora Scientific Instruments (Shanghai) Ltd. on the World Wide Web.

**ASI's Home Page address is:**
***http://www.asi-sensors.com***

**Aurora Scientific's Home Page address is:**
***http://www.aurora-sensors.com***

# Terms and Conditions

## Restocking Charge

Permission to return new, excess inventory must be obtained prior to return.

Phone: 800.545.6132 or 281.565.8818
Fax: 281.565.8811

If any item is authorized to be returned for credit as a result of an incorrect purchase without a reorder, a 25% restocking charge of the price paid for the product will be assessed. Restocking arrangements must be made prior to the order being placed.

## Shipments

Unless specified on the purchase order, ASI will determine the most expedient and efficient means of shipment. Appropriate charges (such as freight, insurance and handling fees) will be added to the invoice.

## Short Shipments

ASI must be notified within 30 days of receipt of invoice of any item or billing discrepancies. All substantiated claims or short shipments will be remedied by a credit memo and a new order placed for short shipment. Any shipment discrepancy claimed after 30 days of the invoice date will not be honored and credit will not be issued by ASI.

## Return Merchandise Authorization (RMA)

Permission to return merchandise purchased from ASI must be obtained prior to return. See Product Warranty Information to determine if your product will fall within warrantable periods.

ATTN: RA##-###
Analytical Sensors & Instruments, Ltd.
12800 Park One Drive
Sugar Land, TX 77478

## Payment Terms

Net 30 days with established credit.


We accept Visa®, MasterCard®, American Express®, checks and money orders for payment. New accounts are required to provide three trade references and one bank reference with the initial order (submit 2 weeks prior to shipment to ensure on time delivery).

## Force Majeure

ASI will not be liable for failure to perform or for delay in performance due to fire, flood, strike or other labor difficulty, act of God, act of any government authority or of the purchaser, riot, embargo, fuel or energy shortage, wrecks or delays in transportation, inability to obtain necessary labor, materials, or manufacturing facilities from usual sources, or due to any cause beyond its reasonable control. In the event of a delay in performance due to such cause, the date of delivery or time of completion of performance will be extended by a period of time reasonable to overcome the effect of such delay.

## Product Warranties

The ASI warranty covers failures due to manufacturer's workmanship or material defects from the date of purchase by the customer. The customer should maintain proof of purchase. Warranty is void if the product has been abused, misused or repairs attempted by unauthorized persons.

Warranties herein are for product sold by ASI or its authorized dealers.

Any product sold by an ASI dealer must be returned to ASI for all warranty work. A Return Merchandise Authorization (RMA) number must be obtained from ASI Customer Service Department before returning any product for in-warranty repair or replacement.

In the event of failure within the warranty period, ASI will at ASI's option, repair or replace product not conforming to this warranty. There may be additional charges, including freight, for some products.

Most electrodes, sensors, machined or molded parts and solutions are warranted to be free of defects in material and workmanship for a period of twelve (12) months after date of purchase, provided use is in accordance with the operating limitations and maintenance procedures in the instruction manual and when not having been subject to accident, alteration, misuse or abuse. Speak with your Customer Service Agent to determine the exact length of warrant period prior to purchase.

*THE WARRANTIES DESCRIBED ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER STATUTORY, EXPRESSED OR IMPLIED, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OR MERCHANTABILITY OF FITNESS FOR A PARTICULAR PURPOSE AND ALL WARRANTIES ARISING FROM THE COURSE OF DEALING OR USAGE OF TRADE. THE BUYER'S SOLE AND EXCLUSIVE REMEDY IS FOR REPAIR OR REPLACEMENT OF THE NON-CONFORMING PRODUCT OR PART THEREOF, OR REFUND OF THE PURCHASE PRICE, BUT IN NO EVENT SHALL ASI (ITS CONTRACTORS AND SUPPLIERS OF ANY TIER) BE LIABLE TO THE BUYER OF ANY PERSON FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES WHETHER THE CLAIMS ARE BASED IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE), OR OTHERWISE WITH RESPECT TO OR ARISING OUT OF THE PRODUCT FURNISHED HEREUNDER. REPRESENTATION AND WARRANTIES MADE BY ANY PERSON, INCLUDING ASI AUTHORIZED DEALERS, REPRESENTATIVES AND EMPLOYEES OF ASI WHICH ALTER IN ADDITION TO THE TERMS OF THIS WARRANTY SHALL NOT BE BINDING UPON ASI UNLESS IN WRITING AND SIGNED BY ONE OF ASI's OFFICERS.*

# History of ASI

ASI owes its humble beginnings to its founders, Peter & Yuxian Cai. In 1989 Peter and Yuxian started ASI in the garage of their home. Peter & Yuxian have spent the last 30 years working for electrode manufacturing companies, learning and contributing to the progression of this industry. Yuxian was trained as a glass blower for pH stems in China and has trained all glass blowers at ASI and Aurora.

Starting with a hand full of electrode designs, Peter & Yuxian set out to develop different glass formulas to differentiate ASI from the competition. Today, ASI has 5 glass formulas for pH and one for sodium, in addition to 24 ion selective electrode formulas, 4 ORP (Redox) formats, 5 conductivity designs and many other techniques that Peter and Yuxian have developed at ASI for OEM customers.

In 1989, ASI had two employees in a garage and today ASI employs over 120 employees world-wide with offices in Texas, Colorado, and Shanghai (China). We own two buildings with a total manufacturing space of 31,000 square feet. In addition to manufacturing employees, ASI has two engineering groups to service our customers in the US and abroad. In 2000, ASI added tooling and injection molding to an ever expanding portfolio of products and services.

We would like to thank our customers for their years of loyalty and we look forward to many more years of providing our customers with great customer service, quality and affordable products as well as world-class engineering services.

# pH Info

### *Basic Theory*

When measuring pH, a user is not determining direct concentration of the hydrogen ion ($H^+$), but the negative log of hydrogen activity. This gives us the effective concentration of the hydrogen ions in a solution.

$$pH = -\log [H^+_{activity}]$$
$$[H^+_{activity}] = 10^{-pH}$$

Thus, a pH of 7 is equivalent to a hydrogen ion activity of $10^{-7}$ M (molar). Since water dissociates into hydrogen ions ($H^+$) and hydroxide ions ($OH^-$) in an aqueous solution, the following equilibrium reaction would be used to describe pH:

$$H_2O = H^+ + OH^-$$

Most pH readings range from 0 to 14. Solutions with a higher hydrogen ion activity than water (pH less than 7) are acidic; solutions with a lower hydrogen ion activity than water (pH greater than 7) are basic or alkaline.

pH is measured potentiometrically when using an electrode. In other words, your measurement is based on an electrical signal. A potential develops across the glass membrane of a pH electrode when it comes in contact with a solution. This potential varies as the pH varies, but requires a constant second potential to compare the changes against. This is the function of the reference electrode, to provide a constant potential, irregardless of pH.

In acidic or alkaline solutions, the voltage on the outer membrane surface changes proportionally to changes in hydrogen ion activity by the Nernst equation:

$$E = E_0 + (2.3RT/nF) \log [H^+]$$

Where:

| | | |
|---|---|---|
| E | = | total potential difference (measured in mV) |
| $E_0$ | = | standard potential |
| R | = | gas constant |
| T | = | temperature in Kelvin |
| n | = | number of electrons |
| F | = | Faraday's constant |
| $[H^+]$ | = | hydrogen ion activity |

The pH of any solution is a function of temperature. Voltage output from the electrode changes linearly in relationship to changes in pH. The temperature of the solution determines the slope of the response. One pH unit corresponds to 59.16 mV at 25 °C, the standard voltage and temperature to which all calibrations are referenced.

| TEMP | Buffer / pH Values versus Temperature | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0° C | 1.67 | 3.86 | 4.00 | 6.98 | 7.12 | 7.53 | 9.46 | 10.32 | 13.42 |
| 5° C | 1.67 | 3.84 | 4.00 | 6.95 | 7.09 | 7.50 | 9.40 | 10.25 | 13.21 |
| 10° C | 1.67 | 3.82 | 4.00 | 6.92 | 7.06 | 7.47 | 9.33 | 10.18 | 13.00 |
| 20° C | 1.67 | 3.79 | 4.00 | 6.88 | 7.02 | 7.43 | 9.23 | 10.06 | 12.63 |
| ***25° C** | **1.68** | **3.78** | **4.01** | **6.86** | **7.00** | **7.41** | **9.18** | **10.01** | **12.45** |
| 30° C | 1.68 | 3.77 | 4.01 | 6.85 | 6.99 | 7.40 | 9.14 | 9.97 | 12.29 |
| 40° C | 1.69 | 3.75 | 4.03 | 6.84 | 6.97 | 7.38 | 9.07 | 9.89 | 11.98 |
| 50° C | 1.71 | 3.75 | 4.05 | 6.83 | 6.96 | 7.37 | 9.01 | 9.83 | 11.71 |
| 60° C | 1.72 | -- | 4.08 | 6.84 | -- | -- | 8.96 | -- | -- |
| 70° C | 1.74 | -- | 4.12 | 6.85 | -- | -- | 8.92 | -- | -- |
| 80° C | 1.77 | -- | 4.16 | 6.86 | -- | -- | 8.88 | -- | -- |
| 90° C | 1.79 | -- | 4.21 | 6.88 | -- | -- | 8.85 | -- | -- |

**** This row indicates the pH buffer used in this comparision***

A pH electrode consists of two half-cells; an indicating electrode half-cell and a reference electrode half-cell. Most applications today use a combination electrode with both half cells in one body.

### *Standardization*

Buffers are solutions of known pH value that allow standardization of the electrode and meter. For best accuracy:

- Standardization should be performed with fresh buffer solutions
- Buffers used should frame the range of pH for the samples being tested
- Buffers should be at the same temperature as the samples

Since electrodes are the most sensitive pH instrument in your system, calibration, handling and maintenance are very important. Correct calibration procedures combined with proper maintenance will provide years of reliable readings.

Since glass pH electrodes measure $H^+$ activity relative to their reference half-cells, they must be calibrated periodically to ensure accurate, repeatable measurements. Although calibration against one pH buffer (one-point calibration) typically ensures accurate pH measurements, frequent two-point or three-point calibrations ensure the most reliable results. Make sure that your pH system includes calibration buffers for a range of pH values.

### *Handling, Using and Storage*

When handling pH electrodes, rinse the electrodes with distilled water before and after measuring a sample. Blot the end of the electrode with lint-free cloth to remove excess water. Never wipe the electrode to remove excess water – wiping can create static charges that interfere with correct pH measurement.

When storing your electrode, always keep your pH electrode moist. We recommend that you store your electrode in either commercially prepared storage solution, or a 1:1 solution of pH 4 buffer and 4M KCl. ***Do not store*** the electrode in distilled or deionized water – this will cause ions to leach out of the glass bulb and render your electrode useless. After storage, you may notice white KCl crystals deposited on your electrode. Such salt formation will not interfere with measurements, simply rinse the electrode with distilled water to remove the crystals and blot dry before use.

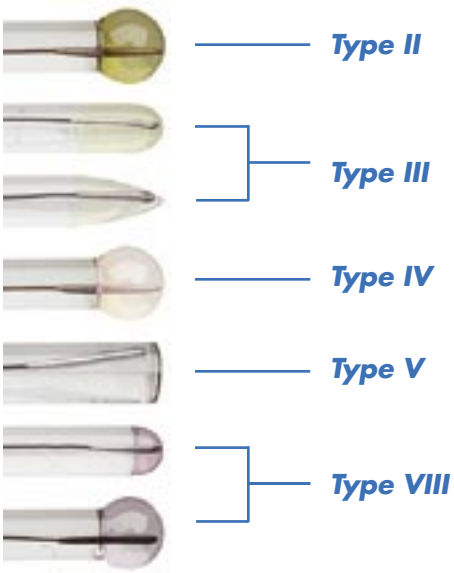
When using a refillable pH electrode, the solution should be filled up to, but not past, the refill hole. The refill hole must be open when measuring to ensure the fill solution flows properly through the reference junction.

pH electrodes are shipped with the pH bulb moist. Prior to using your electrode for the first time, follow these three steps to condition your electrode:

1. Remove the protective cap or boot from the bottom of the electrode and rinse the electrode with distilled or deionized water. (NOTE: Keep the protective cap or boot for use later during storage).
2. Place the electrode in a beaker containing one of the liquids listed below (in order of ionic ability to condition the electrode). Soak for 20 minutes.
   - 4.0 M KCl
   - 4.0 pH buffer
   - 7.0 pH buffer
3. After conditioning the electrode for 20 minutes, rinse the electrode with distilled or deionized water. The electrode is now ready for calibration and to measure pH.

### *pH Glass*

Sensing half-cells are the measuring portion of the electrode system and contain the pH-sensitive membrane. Proper selection is important, please use the following guide to aid you in your decision or contact an ASI representative for more details:




Type II: pH Range: 0 to 12 pH
Impedance Range: 45 to 360 MΩ
Temperature Range: -10 to 135 °C
Response Time: 15s
LIS Response Time: < 30s
Stability: ± 1mV (in 24 hours)

Type III: pH Range: 0 to 12 pH
Impedance Range: 200 to 600 MΩ
Temperature Range: -10 to 135 °C
Response Time: 30s
LIS Response Time: 45s
Stability: ± 1mV (in 24 hours)

Type IV: pH Range: 0 to 13 pH
Impedance Range: 25 to 360 MΩ
Temperature Range: -10 to 135 °C
Response Time: 10s
LIS Response Time: < 30s
Stability: ± 1mV (in 24 hours)

Type V: pH Range: 0 to 13 pH
Impedance Range: 20 to 315 MΩ
Temperature Range: -10 to 105 °C
Response Time: 10s
LIS Response Time: < 30s
Stability: ± 1mV (in 24 hours)
Low Sodium Error

Type VIII: pH Range: 0 to 14 pH
Impedance Range: 120 to 675 MΩ
Temperature Range: -10 to 135 °C
Response Time: 10s
LIS Response Time: < 30s
Stability: ± 1mV (in 24 hours)

*Note:*

- The impedance of a glass is given as a range of values @ 25°C. This is due to the different bulb shapes and the different glass stem sizes used in our products. Please ask your ASI account manager to determine the impedance of your glass.
- Temperature range is based on the abilities of the glass stem, not the overall combination electrode.
- Response time is the time to 95% of scale
- LIS: Low Ionic Strength Solution (< 100 µS)
- Response time is calculated on the pH stem level, not as a completed combination electrode.
- Response time in a combination electrode varies from design to design due to the various electrolytes and reference half-cells used in ASI sensors.

### *Reference*

Reference half-cells provide the reference potential needed for pH measurement. Many options are available to you, please use the following guide to aide you in your decision or contact an ASI representative for more details:

- Single Junction – ideal for general purpose applications
- Double Junction – ideal for solutions that contain sulfides, heavy metals or tris buffers to prevent contamination of the reference cell
- Silver/Silver Chloride (Ag/AgCl) – the most common internal element, suitable for almost all applications (temperature limit of 80°C)
- Calomel ($Hg/Hg_2Cl_2$) – is recommended for use in solutions containing proteins, organics or heavy metals which could react with silver and clog the reference junction (temperature limit of 70°C)
- Refillable – economical and long-lasting style that allows the user to refill the reference chamber with reference solution as needed
- Sealed – rugged and requires virtually no maintenance; however, they must be replaced when the reference fill-solution level is low.
- Dynagen – a self pressurizing electrolyte used in many industrial/process applications that involve high pressure.

### *Extend the Life of Your Electrode*

When an electrode ages, it may exhibit sluggish or noisy readings. You can attempt to improve performance with the following procedures:

*Reference Problems:*

A blocked reference junction is the most common problem of pH measurements. Symptoms include a slow response, off-scale and noisy readings. The procedure is specific to the type of electrode reference.

- GEL FILLED (non-refillable)– Soak the electrode in a beaker of warm water (60°C) for 15 minutes to remove dried gel or salts from the junction. Then place in a beaker of warm 4M KCl solution. Set aside until it returns to room temperature. The gel should be moist and the junction flow should be restored.
- LIQUID FILLED (refillable) – Drain the electrolyte from the electrode; rinse the cavity with distilled water; and refill with fresh electrolyte. Then soak the electrode in warm water (60°C) for 15 minutes to restore flow.

*Glass Bulb Problems:*

A glass membrane will get dirty over time, we suggest the following solutions for cleaning:

- PROTEIN – Use ASI Protein Cleaning Solution or wash in a solution of liquid soap, (about ½ teaspoon per 200mL warm water), using a soft cloth to gently wipe the pH glass - remember that pH glass is extremely delicate and breaks very easily.
- INORGANIC SALTS – Wash in 0.1M HCl or EDTA **(DO NOT SOAK)**; rinse with distilled water.
- GREASY FILMS – Wash in acetone or methanol **(DO NOT SOAK)**; wash with liquid soap then rinse with distilled water.

After cleaning, place the electrode in a storage solution for 15 minutes prior to use. The best storage solution for a combination electrode is available from ASI in several convenient sizes, however, a pH 4 buffer is also acceptable.

# pH/ORP Stems

While many customers are just looking for a reliable electrode, many customers ask us if we are able to supply stem work or sub-assembly product - our answer is absolutely!

ASI offers work on electrochemical sensors up to the point you desire - whether you want to just add your own cable or you just want the pH stem, ASI can deliver what you need.

Take a look here in our pH and ORP stem section and if you don't see what you want, call us today to quote your needs.

ASI offers 5 pH glass styles and 4 ORP elements routinely to our customers based on their design requirements. In addition, ASI has 5 glass stem sizes that are also offered. See below for more information:

Glass Stem Sizes:
- 0.115″ (2.92mm)
- 0.135″ (3.43mm)
- 0.195″ (4.95mm)
- 0.235″ (5.97mm)
- 0.310″ (7.87mm)
- 0.325″ (8.26mm)

Each stem size has different features and benefits that would be too difficult to communicate in this catalog, so please contact ASI for help in determining which glass type or ORP element would work best with each stem size.

The major difference in each stem in relation to pH bulbs is the differences in impedances for each stem size. It is also important to note that ASI can use each pH bulb in a variety of sizes and shapes. The most common are:

- Flat (self-cleaning)
- Convex (semi-flat - not shown)
- Hemi (Full bulb)
- Spear Tip (used in piercing applications)
- Dome (typical of process sensors)
- Hard Dome (reworkable glass used for extreme applications)

These are shown (left) in the same order from right to left.

ORP elements are available in:

- Platinum Band
- Gold Disk
- Platinum Disk
- Platinum Pin/Rod

These are shown to the right in the same order from top to bottom. Contact us today to determine which is the best for you.

# Reference Electrodes

ASI reference electrodes feature reliable, stable, drift free performance in a variety of sample types. The silver/silver chloride references offer high stability and should be used for most sample types. The calomel reference is ideal for use in Tris buffers or in the presence of organics, sulfides and samples which will complex silver. The double junction varieties offer high stability, eliminating $Ag^+$ / $Hg^+$ interference, and can be used with any ion selective electrode. All models here are available with any of these options. Glass versions tolerate cleaning with solvents after measuring foods, lubricants or oily, greasy samples. Epoxy models are rugged and are used in most routine pH applications.

## F001 Series

- Designed for rough handling
- Suitable for routine measurements

## F002 Series

- General purpose
- Suitable for applications requiring chemical resistance

## F012 Series

- Double junction protection
- Suitable for ISE applications and pH in the presence of $Ag^+$

## F022/23 Series

- Fast reference flow rate and easy to clean
- Model 22 is a 6mm OD and model 23 is 12mm OD
- Ground glass reference junction

## F025 Series

- Excellent ISE reference
- Tapered epoxy joint offers a fast flow rate
- Press the cap to flush the reference quickly and get back to your analysis

## F032 Series

- Unique reference with a replaceable reference junction
- Suitable for all applications

## F050 Series

- Industrial style reference
- Suitable for severe applications

| MODEL | F001 | F002 | F012 | F022/23 | F025 | F032 | F050 |
|---|---|---|---|---|---|---|---|
| **Body Material** | Epoxy | Glass | Glass | Glass | Epoxy | Epoxy | Glass |
| **Junction Type** | Single/Double | Single | Double | Single/Double | Single/Double | Single/Double | Single/Double |
| **Junction Material** | Ceramic Pin | Ceramic Pin | Ceramic Pin | Ground Glass | Sleeve | Ceramic Pin | Ceramic Pin |
| **Reference Style** | Sealed | Sealed | Refillable | Refillable | Refillable | Refillable | Sealed |
| **Max Temp (C)** | 80 °C | 80 °C | 80 °C | 80 °C | 80 °C | 80 °C | 80 °C |
| **Dia. x L (mm)** | 12mm x 120mm | 12mm x 120mm | 12mm x 120mm | 12mm x 120mm | 12mm x 120mm | 12mm x 150mm | 12mm x 80mm |

# Glass pH/ORP Electrodes

ASI manufactures a wide variety of glass pH and ORP electrodes that meet the demands of most applications. In addition to our standard models that work in general applications, we also offer models that utilize ground glass joints for dirty applications that might clog the electrode, semi-micro designs intended for applications where the sample is in small vessels like test tubes, and others that are able to be completely disassembled for easy cleaning like our pHastrode design. If you don't find the glass pH or ORP electrode that you are looking for in this catalog, give us a call and convey your needs, as our engineers are ready for any application.

## 02 Series

- Mono pH or ORP
- Suitable for research applications

## 11 Series

- General purpose pH or ORP
- Suitable for all applications
- Stable ceramic reference ensures reproducible measurements

## 12 Series

- Spear tipped model
- Suitable for applications that require piercing
- Annular reference provides stable readings

## 14 Series

- Refillable model with annular reference
- Suitable for all applications
- Longer service life than sealed models

## 16 Series

- Spear tipped model
- Suitable for piercing applications
- 8mm OD

## 23 Series

- Excellent for ASTM titrations
- High reference flow ground glass joint provides reliable endpoint determinations

## 59 Series

- ASI pHastrode design
- Rapid, drift free pH or ORP measurements in most samples
- Easily disassembled for a complete cleaning

| MODEL | 02 | 11 | 12 | 14 | 16 | 23 | 59 |
|---|---|---|---|---|---|---|---|
| **Body Material** | Glass | Glass | Glass | Glass | Glass | Glass | Glass |
| **Junction Type** | N/A | Sealed | Sealed | Refillable | Refillable | Refillable | Refillable |
| **Junction Material** | N/A | Annular | Annular | Annular | Annular | Sleeve | Sleeve |
| **Reference Style** | N/A | SJ/DJ | SJ/DJ | SJ/DJ | SJ | SJ | DJ |
| **Max Temp (C)** | 80 °C | 80 °C | 80 °C | 80 °C | 80 °C | 80 °C | 80 °C |
| **Dia. x L (mm)** | 12mm x 120mm | 12mm x 120mm | 12mm x 120mm | 12mm x 120mm | 12mm x 120mm | 12mm x 120mm | 12mm x 120mm |

**SJ references single junctions and DJ references double junctions*

## DG Series

- Refillable model
- Integral temperature element of choice
- Suitable for all applications

## 4C Series

- Semi-micro design
- Excellent for determinations in small, narrow neck vessels

## 4D Series

- Semi-micro design
- Refillable for a longer service life than sealed models

## 4E Series

- Semi-micro design
- Suitable for applications in test tubes or other small openings

## 4N Series

- Semi-micro design
- Smallest OD available standard (4mm)

## 5E Series

- Short semi-micro design
- Suitable for all applications

## 5B Series

- Semi-micro design
- Longest standard length available
- Refillable design for a long service life

## 5D Series

- Semi-micro design
- Suitable for all applications

| DG | 4C | 4D | 4E | 4N | 5B | 5D | 5E |
|---|---|---|---|---|---|---|---|
| Glass | Glass | Glass | Glass | Glass | Glass | Glass | Glass |
| Refillable | Refillable | Refillable | Refillable | Refillable | Refillable | Refillable | Refillable |
| Annular | Annular | Annular | Annular | Annular | Ceramic Pin | Ceramic Pin | Ceramic Pin |
| SJ/DJ | SJ/DJ | SJ/DJ | SJ/DJ | SJ | SJ/DJ | SJ | SJ |
| 80 °C | 80 °C | 80 °C | 80 °C | 80 °C | 80 °C | 80 °C | 80 °C |
| 12mm x 120mm | 6mm x 180mm | 6mm x 120mm | 6mm x 65mm | 4mm x 180mm | 8mm x 240mm | 8mm x 120mm | 8mm x 65mm |

# Plastic pH/ORP Electrodes

ASI offers many models with plastic bodies. Our standard models are constructed of chemically resistant epoxy and polycarbonate for general applications. In addition to our standard models, you will find models that have replaceable junctions, multi-color designs that give the ability to have your unique electrode, and electrodes that can be completely disassembled for easy cleaning like our plastic pHastrode design. Each model that ASI carries can be modified to have single or double junction references, a wide variety of sensing elements for pH and ORP and made refillable if you have the need. Call us today if you need customization.

## 01 Series

- Mono pH or ORP
- Research grade model
- Epoxy body chemically resistant

## 27 Series

- Flat tip model
- Refillable for a longer service life
- Ideal for small sample sizes

## 28 Series

- Flat tip model
- Sealed version
- Ideal for flat surface measurements
- Easy cleaning and stronger glass than round bulbs

## 31 Series

- Sealed standard model
- Available in polycarbonate or epoxy
- Suitable for general applications

## 35 Series

- Sealed standard model
- Available in blue or red polycarbonate
- Suitable for all applications

## 58 Series

- ASI pHastrode design
- Rapid, drift free pH or ORP measurements in most samples
- Easily disassembled for a complete cleaning

## DA Series

- Refillable model
- Integral temperature element of choice
- Suitable for all applications

| MODEL | 01 | 27 | 28 | 31 | 35 | 58 | DA |
|---|---|---|---|---|---|---|---|
| **Body Material** | Epoxy | Epoxy | Epoxy | PC or Epoxy | Polycarbonate | Epoxy | Epoxy |
| **Junction Type** | N/A | Refillable | Sealed | Sealed | Sealed | Refillable | Refillable |
| **Junction Material** | N/A | Fiber | Fiber | Fiber | Fiber | Sleeve | Ceramic Pin |
| **Reference Style** | Mono | SJ/DJ | SJ/DJ | SJ/DJ | SJ/DJ | SJ/DJ | SJ/DJ |
| **Max Temp (C)** | 60 °C | 80 °C | 80 °C | 60 °C | 60 °C | 80 °C | 80 °C |
| **Dia. x L (mm)** | 12mm x 120mm | 15mm x 120mm | 12mm x 120mm | 12mm x 120mm | 12mm x 120mm | 12mm 120mm | 12mm x 120mm |

## 6C Series

- Semi-mirco design
- Pellon reference provides stable readings
- Ideal for small vessel applications

## 7B Series

- Semi-mirco design
- Pellon reference provides stable readings
- Smallest plastic standard model available

## 7C Series

- Semi-mirco design
- Pellon reference provides stable readings
- Ideal for small vessel applications

| MODEL | 6C | 7B | 7C |
|---|---|---|---|
| **Body Material** | Epoxy | Epoxy | Epoxy |
| **Junction Type** | Sealed | Sealed | Sealed |
| **Junction Material** | Pellon Film | Pellon Film | Pellon Film |
| **Reference Style** | SJ | SJ | SJ |
| **Max Temp (C)** | 80 °C | 80 °C | 80 °C |
| **Dia. x L (mm)** | 9.5mm x 120mm | 6mm x 230mm | 6mm x 150mm |

# pH & ORP Cleaning Techniques

Cleaning and care of pH/ORP electrodes has been written about for decades. There are some points that need to be reviewed.

After use even in benign samples, the pH electrode performance may deteriorate, become slow and impede performance. At the outset of placing a new pH electrode into service, the user should make note of the response time, $E_o$ and slope of the new pH electrode. These values should be used as benchmarks to determine the condition of your pH electrode.

When your pH or ORP electrode gets slow, fouled and coated with contaminants, there are several things that you can do to restore performance. After some period of use, the pH electrode may show signs of slow response, difficulty in calibrating, inaccurate readings or differences in $E_o$ and slope from new performance.

The reason for this is that the sensing glass membrane becomes coated. These coatings range from organics such as oil, grease, proteins to metal ions or other contaminants. Removing them usually requires soaking or washing in a solution which will remove the coating; similar to cleaning your eyeglasses.

Metal ions, some proteins and organics can be removed by soaking the electrode in 0.01 N. HCl for 10-20 minutes. Follow this by soaking in pH electrode storage solution for 1-2 hours. Rinse the electrode in DI water, as usual, and recalibrate.

Next, the reference may become contaminated with various foulants. A single junction style pH electrode may become fouled with silver sulfide. This contamination is difficult to remove. The HCl treatment may help, but often, the best practice is to replace the electrode. If samples contain sulfides or similar silver-complexing agents, a double junction style electrode is recommended.

Proteins can be removed with HCl containing pepsin. Pepsin digests the protein and restores the glass surface. Soak the pepsin-cleaned pH electrode in pH electrode storage solution and recalibrate.

Finally, grease and oils can be removed from the measuring elements by washing with acetone or methanol and then warm tap water and dishwashing liquid. Use care if cleaning mechanically as the pH or ORP glass is fragile. Electrodes washed in this manner also need to be conditioned by storing in pH/ORP electrode storage solution and recalibrated.

When not in use, pH electrodes should be stored in pH electrode storage solution. This insures that the electrode glass remains hydrated, ready to measure accurately and quickly. The storage solution also helps keep the reference junction fully charged with KCl. Storing pH electrodes in distilled or deionized water is not recommended.

As a last resort, you can etch your pH glass with a 0.01M HF solution. It is suggested that you only allow the glass to be in contact with HF for 30 seconds or less. Once you have dipped your electrode in HF, clean it immediately with deionized water and place it in a heated (40 °C) KCl saturated pH 4 buffer and allow the electrode to remain in the solution over night as the solution cools (once you place the electrode in the solution, remove it from the heat). Once you have completed this last step, recalibrate your electrode. It should be noted that if you are attempting this extreme measure, it is very possible that your electrode is at the end of its service life and should be replaced.

# Conductivity Info

## Basic Theory

Conductivity is the ability of a solution to conduct electric current. The principle by which instruments measures conductivity is simple - two plates (cells) are placed in the sample, a potential is applied across the plates and the current is measured. Generally, the potential is in the form of a sine wave. Conductivity (C) is determined from the voltage and current values according to Ohm's Law:

$$C\ (\text{siemens}) = {}^{1}/_{R} = {}^{I\ (\text{amps})}/_{E\ (\text{volts})}$$

Since the charge on the ions in solution facilitates the conductance of electrical current, the conductivity of a solution is proportional to its ion concentration.

Note: Some solutions may not show a direct correlation to concentration; ionic interactions can alter the linear relationship between conductivity and concentration, especially in some highly concentrated solutions like sulfuric acid.

The basic unit of measurement for conductivity is Siemens (S). Since cell geometry affects conductivity values, standardized measurements are expressed in specific conductivity units (S/cm) to compensate for variations in electrode dimensions. For most solutions this measurement unit is much too large and either µS/cm or mS/cm are used instead. The corresponding terms for specific resistivity (R = 1/C) are ohm-cm, Kohm-cm and Mohm-cm. Generally users of ultra pure water prefer to use resistivity units of Mohm-cm or Kohm-cm, because measurement in this unit tends to spread the scale out into the range of interest. In these applications, the use of conductivity has the advantage of an almost direct relationship with impurities, especially at low concentrations. Hence, a rising conductivity reading shows increasing impurities in the given solution. The draw back to conductivity is that it is a non-specific measurement; it cannot distinguish between various types of ions and the reading is proportional to the combined effect of all ions present.

Most conductivity electrodes only have two plates, usually made of platinum or carbon (graphite). The four plate or 'Bull's Eye' design results in higher accuracy for measuring pure water.

The following shows optimum conductivity ranges for cells of three different constants:

| CELL CONSTANT | OPTIMUM CONDUCTIVITY RANGE (µS/cm) |
|---|---|
| 0.1 | 0.5 to 400 |
| 1.0 | 10 to 2,000 |
| 10.0 | 1000 to 200,000 |

## Applications

Since conductivity is proportional to the concentration of ions in solution (in most cases), conductivity measurement is a convenient way to determine the concentration of total dissolved solids (TDS) and the salinity of solutions. Common areas that conductivity sensors are used are:

*Boiler blowdown*
*Desalination*
*Reverse osmosis*
*Salinity testing*
*Water / Wastewater treatment*

## Conductivity Cells

ASI offers conductivity sensors with a two-electrode cell configuration (see figure 1) using platinum, titanium, or graphite. Our four-electrode cell or "Bulls Eye" (see figure 2) design uses a reference voltage to compensate for any polarization or fouling of the electrode plates. The reference voltage ensures that measurements indicate actual conductivity independent of electrode condition, resulting in higher accuracy for measuring pure water.

Figure 1

The conductivity cells for each electrode have specific cell constants (K) that are used in the determination of conductivity (C).

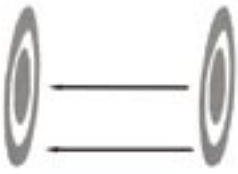


Figure 2

C = Cell Conductance x Cell Constant (K)

The cell constant (K) is the electrode separation distance (d) divided by the electrode area (a), so for a 1 cm cube of liquid: $K = {}^{d}/_{a} = 1\ cm^{-1}$

## Temperature Compensation

All conductivity measurements are temperature dependent. The degree to which temperature affects conductivity varies from solution to solution and can be compensated for using a temperature compensation meter with a thermistor in the conductivity electrode.

## Conductivity Meter Calibration And Cell Maintenance

Conductivity meters and cells should be calibrated to a standard conductivity solution. Selecting standards is very important, you should always choose one that has the approximate conductivity of the solution to be measured. In order to verify proper operation of your electrode, you should select another standard either above or below your first standard.

The conductivity of some common solutions is shown in the table below:

| | |
|---|---|
| Bottled water | 50 µS/cm |
| HCl (10%) | 709 mS/cm |
| HCl (30%) | 732 mS/cm |
| $HNO_3$ (31.0%) | 865 mS/cm |
| NaOH (5%) | 223 mS/cm |
| NaOH (50%) | 150 mS/cm |
| Ocean water | 53 mS/cm |
| Power plant boiler water | 1.0 µS/cm |
| Ultra pure water | 0.055 µS/cm |

A polarized or fouled electrode must be cleaned to renew the active surface of the cell. In most situations, hot water with a mild liquid detergent is an effective cleanser. Acetone easily cleans most organic matter, and hypochlorous solutions will remove algae, bacteria, or molds. To prevent cell damage, abrasives or sharp objects should not be used to clean an electrode. A cotton swab also works well for cleaning.

## Conductivity Values in µS/cm at 25°C

| % Weight | mg/L | NaCl | NaOH | HCl | Acetic Acid |
|---|---|---|---|---|---|
| 0.0001 | 1 | 2.2 | 6.2 | 11.7 | 4.2 |
| 0.001 | 10 | 21.4 | 61.1 | 116 | 15.5 |
| 0.01 | 100 | 210 | 603 | 1,140 | 63 |
| 0.1 | 1,000 | 1,990 | 5,820 | 11,100 | 209 |
| 1.0 | 10,000 | 17,600 | 53,200 | 103,000 | 640 |

# Conductivity Electrodes

ASI conductivity sensors are available in several standard models to fit a variety of needs. We offer glass, epoxy, plastic (polycarbonate), Kynar®, CPVC and ABS body construction types for platinum, titanium and graphite cells. We offer platinum cells in plate, pin and band styles for two-cell and four-cell measurements. Our titanium is available in two-cell configuration, while our graphite cells are available in two-cell and four-cell ("Bulls Eye") designs. We can offer your conductivity electrodes with or without integral temperature elements depending on your needs. Outside of what you will find on this page, ASI has been designing conductivity cells for OEMs for 15 years and would like the opportunity to bid your specific design - call us today!

## 01 Series

- Glass body, platinum cell
- High performance model
- Utilizes open loop design to prevent air trapping
- Excellent for chemically aggressive samples

## 02 Series

- Epoxy body, platinum cell
- Provide accuracy and precision in a rugged body
- Excellent for cooling towers, wastewater and environmental applications

## 03 Series

- Epoxy body, graphite cell
- No integral temperature element

## 04 Series

- PVC body, 2 cell platinum
- ¾ NPT Body for inline and submersible applicaitons

## 13 Series

- Epoxy body, graphite cell
- Integral temperature element in conductivity cell

## 25 Series

- ABS body, graphite cell
- Highest durability while providing reliable measurements
- Integral temperature element in 316 SS housing exposed

## 40 Series

- ASI "bulls-eye" design four-cell graphite
- Rugged and dependable in every application
- Smallest OD available is 16mm
- Can be customized for your application

| MODEL | 01 | 02 | 03 | 04 | 13 | 25 | 40 |
|---|---|---|---|---|---|---|---|
| **Body Material** | Glass | Epoxy | Epoxy | PVC | Epoxy | ABS | Epoxy |
| **Element** | 2-cell platinum | 2-cell platinum | 2-cell graphite | 2-cell platinum | 2-cell graphite | 2-cell graphite | 4-cell graphite |
| **Max Temp (C)** | 100 °C | 80 °C | 80 °C | 80 °C | 80 °C | 80 °C | 80 °C |
| **Dia. x L (mm)** | 12mm x 120mm | 12mm x 120mm | 12mm x 120mm | 12mm & ¾ NPT | 12mm s 120mm | 12mm x 120mm | 16mm x custom |
| **K Cell Values** | 0.1, 1, 10 | 0.1, 1, 10 | 0.1, 1, 10 | 0.1, 1, 10 | 0.1, 1, 10 | 0.1, 1, 10 | Custom |

# Dissolved Oxygen Info

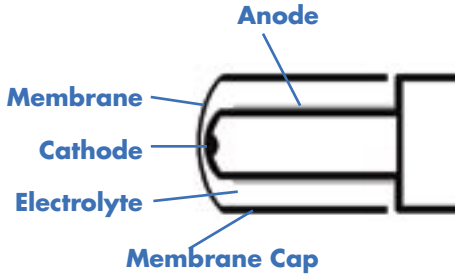
## Basic Theory

Dissolved oxygen analysis measures the amount of gaseous oxygen ($O_2$) dissolved in an aqueous solution. Oxygen gets into water by diffusion from the surrounding air, by aeration (rapid movement), and as a waste product of photosynthesis.

Dissolved oxygen is consumed in the water by respiration and decomposition. It is replenished mainly by the atmosphere and photosynthesis. Water temperature is a key factor in the regulation of water's oxygen level. Warm water contains a lower oxygen concentration than cold water. If DO concentrations get too high, though, the dissolved oxygen can become toxic to plant and animal life.

The Dissolved Oxygen Probe can be used to measure the concentration of dissolved oxygen in water samples tested in the field or in the laboratory. Since dissolved oxygen is one of the primary indicators of the quality of an aquatic environment, you can use this sensor to perform a wide variety of tests to determine changes in dissolved oxygen levels, especially in aquariums, photosynthesis and respiration, and on-site testing. In a stream or lake the evaluation of the capability of the water to support different types of life, the Biochemical Oxygen Demand (BOD) tests water samples containing organic matter that consumes oxygen as it decays and to determine the relationship between dissolved oxygen concentration and temperature of a water sample.

DO sensors use a thin membrane to cover a layer of electrolyte over a platinum cathode and silver anode, generally the cathode is almost in direct contact with the membrane. Oxygen will diffuse across the membrane at a rate proportional to its partial pressure—the greater the oxygen partial pressure, the more oxygen diffuses through the membrane. Then DO meters measure the current as oxygen is reduced at the cathode while more oxygen diffuses through the membrane. Since the diffusion current is directly proportional to the concentration of dissolved oxygen, the calibrated meter simply converts measured current into concentration units.




The concentration of dissolved oxygen is usually expressed in milligrams of oxygen per liter of water (mg/L) or parts per million (ppm). Some meters compare calculated oxygen content with observed concentration and report percent saturation ($O_2$% sat.).

There are two types of methods for determining dissolved oxygen, polarographically and galvanically. Polarographic probes require a voltage input from the meter to polarize the electrodes. Since the voltage from an external source may take up to 15 minutes to stabilize, polarographic probes usually need to warm up before use to ensure proper polarization of the electrodes. Galvanic probes have electrodes made from two different metals that spontaneously polarize to generate the voltage. Since the voltage is spontaneous rather than supplied by an external source, galvanic probes are always operable and do not require the "warm up" time that polarographic probes need for polarization.

## Environmental Impact

Adequate dissolved oxygen is necessary for good water quality. Oxygen is a necessary element to all forms of life. Natural stream purification processes require adequate oxygen levels in order to provide for aerobic life forms. As dissolved oxygen levels in water drop below 5.0 mg/L, aquatic life is put under stress. The lower the concentration, the greater the stress. Oxygen levels that remain below 1-2 mg/L for a few hours can result in large loss of aquatic life.

## Applications

Dissolved oxygen measurements are used to monitor processes where oxygen content affects reaction rates, process efficiency, or environmental conditions:

Aquariums
Bio-reactions
Environmental testing (lakes, streams, oceans)
Water / Wastewater treatment
Wine production

## Temperature Compensation

Temperature compensation is necessary for standardized DO measurements, as temperature affects both the solubility and diffusion rate of oxygen.

## Salinity Correction

The presence of dissolved salts limits the amount of oxygen that can dissolve in water. The relationship between the concentration of oxygen and partial pressure varies with the salinity of each sample, so most meter manufacturers supply the ability to manually correct for salinity to compensate for variations in ionic concentration.

## Biochemical Oxygen Demand (BOD)

The BOD test is typically perfomed in wastewater treatment plants, where it is important to understand the amount of oxygen that microorganisms consume from the water when they break down organic matter. This test allows the plant to determine the effectiveness of their water treatment, or the amount of pollution that still exists. By measuring the amount of oxygen dissolved in samples at the beginning and end of a specified incubation period, the relative oxygen requirements of wastewaters, effluents, and polluted waters can be determined. You can calculate BOD by measuring DO at time 1 ($T_1$) and subtracting the DO at time 2 ($T_2$); multiple that number by the final volume ($V_F$) and dividing that number by the initial sample volume (V):

$$BOD\ (mg/L) = (T_1 - T_2)V_F/V$$

## Troubleshooting Tips

When using a polarographic style probe, allow the probe at least 15 to 30 minutes before calibrating or measuring.

To ensure that the membrane has no air bubbles in the electrolyte solution, the ASI membrane caps are designed to release all air while the module is being installed.

Do not allow any air bubbles to be trapped on the membrane surface, as it will read an air bubble as an oxygen-saturated sample.

Calibrate your electrode at temperatures close to the sample temperature, even when using a meter with automatic temperature compensation (ATC).

Always calibrate your DO electrode dry using air as the 100% test point

It is important during measurement to stir the solution as oxygen consumption by the probe can momentarily reduce the oxygen concentration at the probe surface.

Membranes wear out, you should replace the membrane as needed.

# Dissolved Oxygen Electrodes

ASI offers polarographic and galvanic designs of dissolved oxygen sensors. Displayed here is our standard design polarographic DO electrode. In addition, we can design a DO electrode around any application that you have, since we do not display OEM exclusive products, the DO12 is our representative model for this type of electrode. For our dissolved oxygen electrode, we employ membrane caps as often as possible. Replaceable membrane caps remove the hassle of having to deal with membrane material and placing it correctly over the cathode assembly. Call today to get us started on your next DO project.

## 12 Series

DO12 series dissolved oxygen electrodes are designed for use in the laboratory and out in the field. They employ the popular polarographic (Clark) design. The DO12 is constructed of Delrin® for durability and long life. The DO12 utilizes a 10 Kohm thermistor as the standard temperature compensator.

The thermistor is housed in stainless steel and sealed on the electrode outer wall providing high speed temperature response and fast, accurate readings. The DO12 can be furnished with a different temperature element. Contact ASI for details.

The installation and replacement of the membrane is quick and easy. Simply fill the membrane cap assembly with DO electrolyte and screw it into place. Two membrane cap assemblies are included with each DO12 electrode.

Calibration of the Analytical Sensors, DO12 electrode is simple. A special calibration bottle is furnished with the DO12 to ensure fast, accurate calibration every time.

### Specifications:

| | |
|---|---|
| Construction: | ABS |
| Dimensions | |
| Body diameter: | 12mm |
| Overall length: | 150mm |
| Membrane cap: | 16mm OD x 30mm L |
| Output: | 0 to 40nA or 0 to 400nA |
| Response time: | 98% full response in 60 seconds at 25 °C |

# Temperature Probes

ASI offers a wide assortment of temperature probes for OEM applications. In addition to temperature probes, remember that ASI can outfit any other electrode manufactured with a temperature compensating element.

## 25 Series

The ASI model T025 stainless steel temperature probe provides accuracy over a broad range of temperatures. The Santoprene® handle resists damage from chemical contact while the molded strain relief protects the cable. Additionally, the T025 is completely submersible.

### Specifications:

| | |
|---|---|
| Construction: | Santoprene®, PVC, 316 stainless steel |
| Connectors: | Customer specified |
| Cable Length: | Customer Specified |
| Temperature Range: | -25 °C to 125 °C |
| Response Time: | 30 seconds, 0-100°C |
| Temperature Element: | Thermistor |

# ISE Info

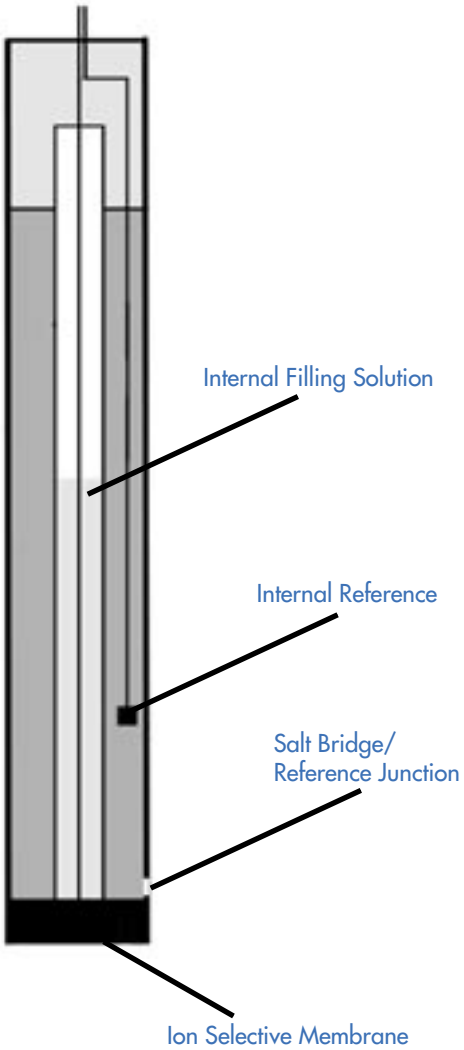
## Basic Theory

Ion-selective electrodes (ISEs) are membrane-based electrochemical sensors. The membrane is the component that makes the electrode selective for a particular ion.

Four different types of ISEs can be described, depending on the material of the membrane:

- Glass membrane (such as $Na^+$ or pH)
- Solid state membrane (such as $Pb^{2+}$)
- Polymeric membrane (such as $K^+$)
- Gas permeable membrane (such as $CO_2$)

A potential difference develops across the membrane when the electrode is placed in a solution. To measure the potential difference when the concentration of the ion of interest changes in the sample, an ISE is used in combination with an internal or external reference electrode. Schematically, the complete set up can be described as:

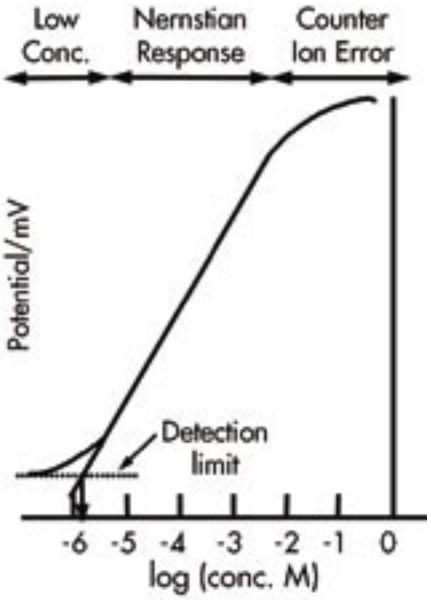



The relationship between the measured potential, E, and the ion activity in the sample, $a_i$, is mathematically described by the Nernst equation:

$$E = E_o + \text{slope} \cdot \log a_i$$

The slope term is equal to $2.3 \cdot RT/z_iF$, where

R is the gas constant, 8.314 $JK^{-1}mol^{-1}$
T is the absolute temperature, K
F is the Faraday equivalent, $9.6487 \cdot 10^4$ $Cmol^{-1}$
$z_i$ is the charge of the measured ion




The slope is equal to 59.16 mV/$z_i$ at 25 °C. If the measured ion is a monovalent ion such as potassium ($z_i$ = +1), a potential change of 59.16 mV would be observed at 25 °C for a ten-fold change in the concentration. Similarly, the potential change for a divalent ion such as calcium ($z_i$ = +2) would be 59.16/2 = 29.58 mV, also at 25 °C.

$E_o$ is a constant potential difference, which is typical of every ISE/reference electrode combination. The term $a_i$ is the activity of the ion, which is equal to the concentration only in diluted samples. The activity of the ion depends on the ionic strength of the sample, which is determined by its ionic content.

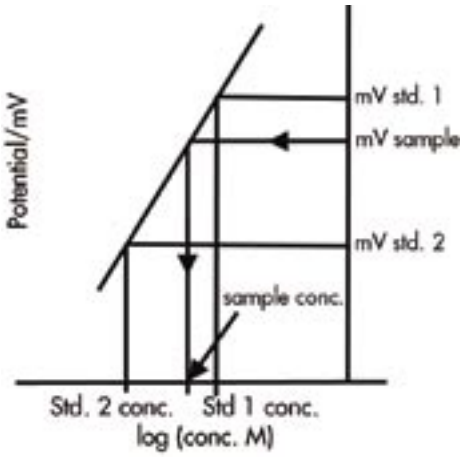
Deviation from linearity occurs both at low and high concentrations of the measured ion, and determines the lower and higher limits of detection. Accurate determinations can be done for samples with concentrations as low as $10^{-6}$ M. At high concentrations (usually higher than 0.1 M) the deviation from linearity is due to the effect of the counter-ion.

## Calibration and ISA/Buffers

In order to ensure the same ionic strength in standards and samples, it is strongly recommended to use an Ionic Strength Adjustor (ISA), usually in a 50:1 sample to ISA ratio.

Moreover, some ISEs can be used only in a limited pH range. The addition of a buffer to the ISA will adjust standards and samples to the desired pH value. More complex ISA formulations can include additives that complex possible interferences. The ISA can also contain preservatives such as antioxidant agents.

In order to make accurate determinations, it is strongly recommended to use at least two solutions of known concentration (standards) to calibrate the electrode. The standards are usually prepared by dilution with deionized water a 1000 ppm stock solution of the ion to be measured. The concentration of the sample should be included in the range of concentrations covered by the standards. Ideally, the electrode should be calibrated as often as possible, or at least once a week.




A response curve of the ISE can be defined by plotting the potential readings from the two standards (mV std 1 and mV std 2), versus the logarithm of the standard concentrations (Std 1 conc and Std 2 conc). Graphically, the concentration of the ion in the sample (sample conc) can be determined by measuring the sample potential (mV sample) and interpolating that value in the response curve defined by the two standards. Mathematically, from the Nersnt equation:

$$\text{mV sample} = E_o + \text{slope Log (sample conc)}$$
or
$$\text{sample conc} = 10^{[(\text{mV sample})-E_o]/\text{slope}}$$

where the $E_o$ and the slope terms can be calculated from the standard concentrations and mV readings.

The response of an ISE can be affected by the presence of other ions in the sample. The effect of these interfering ions can be quantified for every particular ISE and if the concentration of the interference is known, it can be corrected for. In other cases it is possible to analyze the sample by other methods, such as the Standard Addition method. This method in particular is very accurate when the sample matrix is complex or contains a high level of interfering ions.

### Cleaning

A good working ISE response stabilizes within one or two minutes. However the ISE can become sluggish if the membrane becomes dirty from grease or particles in the sample. The tip of a glass electrode can be cleaned with alcohol or a mild detergent, such as the one used to clean lab glassware. Polishing strips with very fine particles (e.g. 3 micron aluminum oxide) can be used to restore the surface of solid state ISEs. A PVC ISE should just be rinsed with water. After thoroughly rinsing with deionized water, the electrodes should be reconditioned by soaking for 2-4 hours in the lowest standard used for calibration. If the slope or the response time of the electrode is out of specification, longer soaking times (e.g. overnight) may be required before a new calibration is attempted with solid state styles.

### Storage

Regarding storage, glass ISEs can be stored in a low concentration standard. Solid state, PVC and gas ISEs can be kept in a low concentrated standard between samples, otherwise, these electrodes should be stored dry if not in use for several hours for solid state and several days for PVC and gas ISEs." Please refer to the Instruction Manual for particular recommendations for each ISE.

# ISE Quick Reference Information

**How do they work or what is an Ion-Selective Electrode?** An Ion Selective Electrode measures the potential of a specific ion in solution. This potential is measured against a stable reference electrode of constant potential. The potential difference between the two electrodes will depend upon the activity of the specific ion in solution. This activity is related to the concentration of that specific ion, therefore allowing the end-user to make an analytical measurement of that specific ion.

**How Does the mV Reading Correspond to the Concentration?** Standard solutions of known concentrations must be accurately prepared. These solutions are then measured with the pH/mV meter. The mV reading of each solution is noted and a graph of concentration vs. mV reading must be plotted. Now the unknown solution can be measured. The mV value of the unknown solution is then located on the graph and the corresponding solution concentration is determined.

**Several types of sensing electrodes are commercially available.** They are classified by the nature of the membrane material used to construct the electrode. It is this difference in membrane construction that makes an electrode selective for a particular ion.

**1. Polymer Membrane Electrodes (Organic Ion Exchangers and Chelating Agents)** -- Polymer membrane electrodes consist of various ion-exchange materials incorporated into an inert matrix such as PVC, polyethylene, polyurethane or silicone rubber. After the membrane is formed, it is sealed onto the end of a PVC tube. The potential developed at the membrane surface is related to the concentration of the species of interest. Electrodes of this type include potassium, calcium, fluoroborate, nitrate, perchlorate, and water hardness.

**2. Solid State Electrodes** -- Solid state electrodes utilize relatively insoluble inorganic salts within a membrane. Solid state electrodes exist in homogeneous or heterogeneous forms. In both types, potentials are developed at the membrane surface due to the ion-exchange process. Examples include silver/sulfide, lead, cupric, cyanide, thiocyanate, chloride and fluoride.

**3. Gas Sensing Electrodes --** Gas sensing electrodes are available for the measurement of dissolved gas such as ammonia, carbon dioxide, dissolved oxygen, nitrogen oxide, sulfur dioxide and Free Chlorine. These electrodes have a gas permeable membrane and an internal buffer solution. Due to their construction, gas sensing electrodes do not require an external reference electrode.

**4. Glass Membrane Electrodes --** Glass membrane electrodes are formed by doping the silicon dioxide glass matrix with various chemicals. The most common of the glass membrane electrodes is the pH electrode. Glass membrane electrodes are also available for the measurement of sodium ions.

# Ion Selective Electrodes

Ion Selective Electrodes (ISEs) are membrane electrodes that respond selectively to ions in the presence of other ions. These include probes that measure specific ions and gasses in solution. The use of Ion Selective Electrodes offers several advantages over other methods of analysis. First, the cost of initial setup to make analysis is relatively low. ISE determinations are not subject to most interferences such as color or turbidity in the sample.

There are few matrix modifications needed to conduct these analyses. These advantages make them ideal for use in the laboratory, out in the field or in the plant where they are most popular.

Analytical Sensors & Instruments has been manufacturing OEM Ion Selective Electrodes for 15 years. Our success has been accomplished through constant research and communication with our customers. Call ASI today to find out what ISE would best meet your OEM requirements.

## 11 Series


**Specifications:**

| | |
|---|---|
| Style: | Mono |
| Element: | Replaceable |
| Construction: | PVC/Epoxy |
| Dimensions | |
| Immersion: | 12 x 120mm |
| Cap: | 16 x 33mm |
| Module: | 12 x 50 |

## 01 Series

**Specifications:**

| | |
|---|---|
| Style: | Mono |
| Element: | Fixed |
| Reference: | N/A |
| Construction: | Epoxy |
| Dimensions | |
| Immersion: | 12 x 120mm |
| Cap: | 16 x 33mm |
| Cable: | Coax |

| Ion Name | ION Species | Series 01/11 Mono Part Number | Series 43 PermaFil Part Number | Series 03 FreshFil Part Number | Series 12 FreshTip Part Number | Series 35 Gas Sensing Part Number | Sensing Element |
|---|---|---|---|---|---|---|---|
| Ammonia | $NH_3$ | - - - | - - - | - - - | - - - | NH35 | Gas Sensing |
| Ammonium | $NH_4^+$ | NH11 | NH43 | - - - | NH12 | - - - | PVC Membrane |
| Bromide | $Br^-$ | BR01 | BR43 | BR03 | BR12 | - - - | Solid State |
| Cadmium | $Cd^{++}$ | CD01 | CD43 | CD03 | CD12 | - - - | Solid State |
| Calcium | $Ca^{++}$ | CA11 | CA43 | - - - | CA12 | - - - | PVC Membrane |
| Carbon Dioxide (carbonate) | $CO_2$ | - - - | - - - | - - - | - - - | CO35 | Gas Sensing |
| Chloride | $Cl^-$ | CL01 | CL43 | CL03 | CL12 | - - - | Solid State |
| Chlorine (Total Residual) | $Cl_2$ | RC01 | - - - | - - - | - - - | - - - | Solid State |
| Cupric | $Cu^{++}$ | CU01 | CU43 | CU03 | CU12 | - - - | Solid State |
| Cyanide | $CN^-$ | CN01 | CN43 | CN03 | CN12 | - - - | Solid State |
| Fluoride | $F^-$ | FL01 | FL43 | FL03 | FL12 | - - - | Solid State |
| Fluoroborate | $BF_4^-$ | BF11 | BF43 | - - - | BF12 | - - - | PVC Membrane |
| Iodide | $I^-$ | ID01 | ID43 | ID03 | ID12 | - - - | Solid State |
| Lead | $Pb^{++}$ | PB01 | PB43 | PB03 | PB12 | - - - | Solid State |
| Nitrogen Oxide | $NO_x$ | - - - | - - - | - - - | - - - | NO35 | Gas Sensing |
| Nitrate | $NO_3^-$ | NO11 | NO43 | - - - | NO12 | - - - | PVC Membrane |
| Nitrite | $NO_2^-$ | N211 | N243 | - - - | N212 | - - - | PVC Membrane |
| Potassium | $K^+$ | KT11 | KT43 | - - - | KT12 | - - - | PVC Membrane |
| Silver | $Ag^+$ | SS01 | SS43 | SS03 | SS12 | - - - | Solid State |
| Sulfide | $S^{2-}$ | SS01 | SS43 | SS03 | SS12 | - - - | Solid State |
| Surfactant | $X^+$ / $Y^-$ | XT11 | XT43 | - - - | XT12 | - - - | PVC Membrane |
| Sodium | $Na^+$ | NA01/02 | NA31 | NA44 | - - - | - - - | Glass Membrane |
| Thiocyanate | $SCN^-$ | SC11 | SC43 | SC03 | SC12 | - - - | Solid State |

## 12 Series


### Specifications:

| | |
|---|---|
| Style: | Combination |
| Element: | Replaceable |
| Reference: | Refillable |
| Construction: | PVC/ABS |
| Dimensions | |
| Immersion: | 12 x 120mm |
| Cap: | 16 x 60mm |
| Module: | 12 x 33 |

## 03 Series

### Specifications:

| | |
|---|---|
| Style: | Combination |
| Element: | Replaceable |
| Reference: | Refillable |
| Construction: | Epoxy |
| Dimensions | |
| Immersion: | 12 x 120mm |
| Cap: | 16 x 33mm |
| Cable: | Coax |

## 43 Series

### Specifications:

| | |
|---|---|
| Style: | Combination |
| Element: | Fixed |
| Reference: | Sealed |
| Construction: | PVC/Epoxy |
| Dimensions | |
| Immersion: | 12 x 120mm |
| Cap: | 16 x 33mm |
| Cable: | Coax |

## 35 Series

### Specifications:

| | |
|---|---|
| Style: | Combination |
| Membrane: | Replaceable |
| Reference: | Refillable |
| Construction: | ABS |
| Dimensions | |
| Immersion: | 12 x 120mm |
| Cap: | 16 x 33mm |
| Module: | 12 x 126mm |

| Range @ 25°C | pH Range | Temperature Range (°C) | Known Interferences |
|---|---|---|---|
| 1 x $10^{-6}$ to 1 M / (0.02 to 17,000 ppm) | Above 11 | 0 to 50 | Volatile Amines |
| 1 x $10^{-6}$ to 0.1 M / (0.02 to 1,800 ppm) | 4 to 10 | 0 to 50 | $K^+$, $Na^+$ |
| 5 x $10^{-6}$ to 1 M / (0.4 to 79,900 ppm) | 1 to 12 | 0 to 80 | $I^-$, $Cl^-$, $S^{2-}$, $CN^-$ and $NH_3$ |
| 1 x $10^{-6}$ to 0.1 M / (0.1 to 11,200 ppm) | 2 to 8 | 0 to 80 | $Hg^{2+}$, $Ag^+$ & $Cu^{2+}$ must be absent, high levels of $Pb^{2+}$ & $Fe^{2+}$ |
| 5 x $10^{-7}$ to 1 M / (0.02 to 40,000 ppm) | 2.5 to 11 | 0 to 50 | $Pb^{2+}$, $Hg^{2+}$, $Si^{2+}$, $Fe^{2+}$, $Cu^{2+}$, $Ni^{2+}$, $NH_3$, $Na^+$, $Li^+$, $Tris^+$, $K^+$, $Ba^{2+}$, $Zn^{2+}$, $Mg^{2+}$ |
| 1 x $10^{-4}$ to 0.01 M / (4.4 to 440 ppm) | 4.8 to 5.2 | 0 to 50 | Volatile Weak Acids |
| 5 x $10^{-5}$ to 1 M / (1.8 to 35,500 ppm) | 2 to 12 | 0 to 80 | $CN^-$, $Br^-$, $I^-$, $OH^-$ & $S^{2-}$ must be absent and $NH_3$ |
| 1 x $10^{-7}$ to 3 x $10^{-4}$ M / (0.01 to 20 ppm) | 3 to 10 | 0 to 50 | - - - |
| 1 x $10^{-6}$ to 0.1 M / (0.064 to 6,400 ppm) | 2 to 6 | 0 to 80 | $Hg^{2+}$ & $Ag^+$ must be absent; high levels $Fe^{2+}$, $Br^-$ and $Cl^-$ |
| 8 x $10^{-6}$ to 0.01 M / (0.2 to 260 ppm) | 10 to 14 | 0 to 80 | $I^-$, $Br^-$, $Cl^-$, $S^{2-}$ must be absent |
| 1 x $10^{-6}$ M to saturation / (0.02 ppm to saturation) | 5 to 7 @ $10^{-6}$M<br>11 @ 0.1M | 0 to 80 | $OH^-$ |
| 7 x $10^{-6}$ to 1 M / (0.6 to 87,000 ppm) | 2 to 12 | 0 to 50 | $I^-$, $BF^-$, $Br^-$, $Cl^-$, $ClO_3^-$, $ClO_4^-$, $F^-$, $HCO_3^-$, $HPO_4^{-2}$, $PO_4^{-3}$, $NO_2^-$, $NO_3^-$, $SO_4^{-2}$ |
| 5 x $10^{-8}$ to 1 M / (0.0064 to 127,000 ppm) | 0 to 14 | 0 to 80 | $CN^-$, $S_2O_3^{2-}$, $Cl^-$, $S^{2-}$, $NH_3$ |
| 1 x $10^{-6}$ to 0.1 M / (0.2 to 20,700 ppm) | 4 to 7 | 0 to 80 | $Hg^{2+}$, $Ag^+$, $Cu^{2+}$ must be absent; $Fe^{2+}$ & $Cd^{2+}$ |
| 4 x $10^{-6}$ to 0.005 M / (0.2 to 220 ppm) | - - - | - - - | - - - |
| 7 x $10^{-6}$ to 1 M / (0.4 to 62,000 ppm) | 2.5 to 11 | 0 to 50 | $ClO_4^-$, $I^-$, $ClO_3^-$, $F^-$ |
| 3.6 x $10^{-5}$ to 0.14 M / (1.6 to 6,400 ppm) | 2 to 12 | 0 to 40 | - - - |
| 1 x $10^{-5}$ to 1 M / (0.04 to 39,000 ppm) | 2 to 12 | 0 to 50 | $Cs^+$, $NH_4^+$, $Tl^+$, $H^+$, $Ag^+$, $Tris^+$, $Li^+$, $Na^+$ |
| 1 x $10^{-7}$ to 1 M / (0.01 to 107,900 ppm) | 2 to 12 | 0 to 80 | $Hg^{2+}$ |
| 1 x $10^{-7}$ to 1 M / (0.003 to 32,100 ppm) | 2 to 12 | 0 to 80 | $Hg^{2+}$ |
| End Point Indicator | - - - | 0 to 40 | - - - |
| 4 x $10^{-6}$ to 1 M / (0.1 to 23,000 ppm) | Above 9 | 0 to 80 | $H^+$, $K^+$ |
| 5 x $10^{-6}$ to 1 M / (0.29 to 58,100 ppm) | 2 to 10 | 0 to 80 | $I^-$, $Br^-$, $CN^-$, $NH_3$, $S_2O_3^{2-}$, $Cl^-$, $OH^-$, $S^{2-}$ |

# ISE Applications

## Species used by Industry

| | |
|---|---|
| Agriculture: | Nitrate, calcium, sodium, potassium, bromide, chloride, ammonia & fluoride |
| Plant Tissue: | Nitrate, chloride, fluoride, iodide, cyanide, calcium, sodium and potassium |
| Fertilizer: | Nitrate using the ammonia electrode, potassium and fluoride |
| Aquaculture: | Ammonia and calcium |
| Biomedical Research: | Calcium, carbon dioxide and ammonia |
| Education: | Various ISEs electrodes are used in most colleges and universities |
| Food Processing: | Chlorides, nitrate, sodium and fluoride |
| Milk and Dairy Products: | Chloride, calcium, fluoride, sodium and iodide |
| Soft Drinks: | Chloride, fluoride, carbon dioxide and residual chlorine |
| Alcohol: | Potassium, sodium, $CO_2$, fluoride, bromide, calcium, and residual chlorine |
| Vegetables: | Nitrate, chloride |
| Geology and Mining: | Fluoride, calcium, cyanide |
| Metallurgy and Metal Plating: | Fluoride, cupric, cyanide, fluoroborate, nitrate |
| Plating Baths: | Chloride, residual chlorine and ammonia |
| Pulp and Paper: | Sodium, chloride, calcium and sulfate |
| Petroleum Refining: | Ammonia, chloride |
| Pharmaceuticals: | Fluoride |
| Sewage Treatment: | Nitrate, ammonia, residual chlorine |
| Steam and Power Generation: | Chloride, sodium, residual chlorine, fluoroborate |
| Drinking Water: | Total residual chlorine, nitrate, calcium, chloride, and fluoride |
| Natural Water: | Bromide, calcium, chloride, fluoride, nitrate, potassium, silver, sodium, cupric |
| Sea Water: | Sodium, chloride, fluoride, nitrate and ammonia |

## Standard Methods & Applications

| SPECIES | ASTM | EPA | APHA | AOAC | USGS |
|---|---|---|---|---|---|
| **ALKALINITY** | D1067-88 | 310.1 | 2320B | 973.43 | I-1030 |
| **AMMONIA** | D1426-89 | 350.3 | 4500-NH3 (F), (G) | - - - | I-1524 |
| **BROMIDE** | D1246-88 | 60 FR 37974 (6) | - - - | - - - | - - - |
| **CARBON DIOXIDE** | D513-88A | - - - | - - - | - - - | - - - |
| **CHLORIDE** | D512-89 | 60FR 37974 (6) | 4500-CL (D) | 971.27, 980.25 | - - - |
| **CHLORIDE BY TITRATION** | - - - | - - - | - - - | 962.05, 962.07, 963.05, 966.10, 969.10 | - - - |
| **CHLORINE RESIDUAL** | - - - | 59 FR 62456 | 4500-CL (I) | - - - | - - - |
| **CYANATE** | - - - | | 4500-CN (L) | - - - | - - - |
| **CYANIDE** | D2036-89A | 60 FR 37974 (6) | 4500-CN (E) (F) | - - - | - - - |
| **FLUORIDE** | D3868-79, D1179-88B, D1179-88A | 59 FR 62456, 60 FR 37974 (6) | 4500-F (C) | 984.37, 975.08, 973.10 | I-1327, I-2327 |
| **IODIDE** | D3869 | - - - | - - - | - - - | |
| **KJELDAHL NITROGEN** | D3590-89A | .351.4 | 4500-NORG (A) (B) | - - - | - - - |
| **NITRATE** | - - - | 59 FR 62456 60 FR 37974 (6) | 4500-NO3 (D) (G) | - - - | - - - |
| **POTASSIUM** | - - - | - - - | 3500-K (E) | - - - | - - - |
| **SODIUM** | D2791 | - - - | - - - | 976.25 | - - - |
| **SULFIDE** | D4658 | 60 FR 37974 (6) | - - - | - - - | - - - |

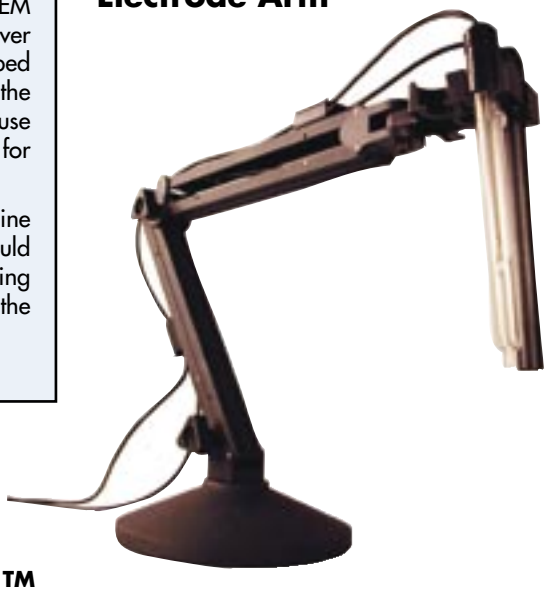
# Lab Electrode Accessories

ASI offers an assortment of OEM electrode accessories. Over the years, ASI has developed several accessories that make the functionality, maintenance and use of electrodes more convenient for users.

While only our standard line accessories are listed, ASI would be pleased to offer our engineering services to assist your company in the development of your accessories.

Why wait - contact ASI today.

## Electrode Arm



The ASI Electrode Arm is custom manufactured with the end user in mind. With a coiled metal spring and integrated wire looms, this electrode arm will hold any position to free your hands for more important tasks.

**Specifications:**

| | |
|---|---|
| Construction: | Metal & Plastic |
| Dimensions | |
| Base: | 24″ |
| Arm: | 6.5″ |
| Electrode Spaces: | 5 |

## Universal MicroStirrer™

The Universal MicroStirrer, exclusively available from ASI, snaps on the end of any 12mm electrode and provides a stirring mechanism when used with a magnetic stir plate.

**Specifications:**

| | |
|---|---|
| Construction: | ABS, magnet |
| Dimensions | |
| Body: | 17 x 24mm |
| Magnet: | 6mm disk |
| Available for: | 12mm & 0.5 in. |

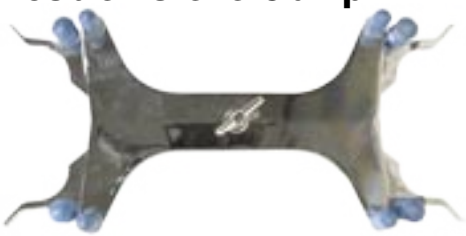
## Electrode Storage Bottle

The ASI Storage Bottle comes in two sizes, 20 mL and 60 mL. This item can be purchased in bulk, or as a replacement for the one you are missing!

## ASI Stir Stations

With molding capabilities in China, ASI is now offering custom stir stations to OEM customers only. The minimum order is 500 units, tooling charges will be quoted up front. Below is an example of ASI's stir station capabilities.

## Double Burette Clamp

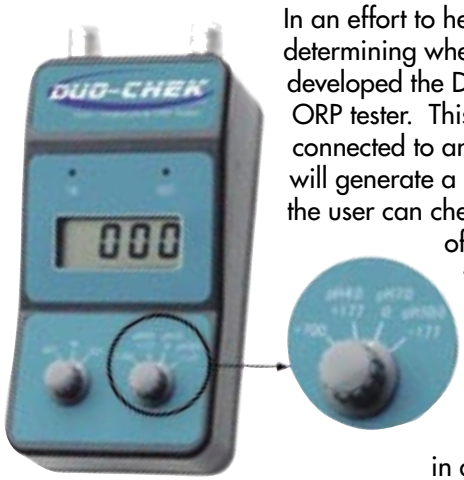


ASI offers OEM burette clamps that hold two burettes from micro to 100 mL. Simply compress mechanism, insert burette, and release. Constructed of light-weight aluminum. Unit attaches to standard support rods up to 5/8″.

**Specifications:**

| | |
|---|---|
| Construction: | Aluminum |
| Burette Size: | Micro to 100mL |
| Support Rod | up to 5/8″ |

## ASI DUO-CHEK pH & ORP Tester




In an effort to help consumers in determining where their failure is, ASI developed the DUO-CHEK pH and ORP tester. This simple device can be connected to any pH or ORP meter and will generate a set mV reading so that the user can check the performance of their meter. Likewise, the DUO-CHEK can be connected to a pH or ORP electrode and used to display mV readings so the electrode can be checked in an in-expensive manner without purchasing the wrong item.

# Process Sensor Info

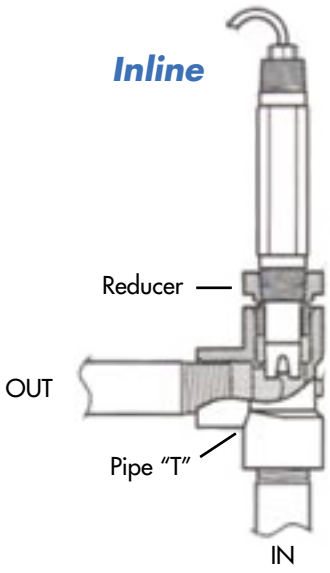
### *ASI Industrial Sensors*

ASI industrial sensors cover a wide range of applications, while we may not show the exact sensor you are thinking of in these pages, we would enjoy for you to provide us with your sketch and let our engineering department design the ultimate electrode for your company.

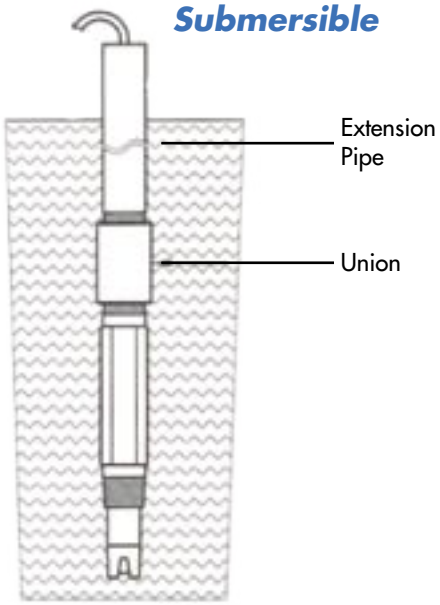
### *Installation Information*

ASI carries several types of industrial electrodes made for specific connection types. The most common type of sensor are the *Inline/Submersible* designs. We carry ½", ¾", 1" & 1½" NPT models. We recommend the following types of uses for these sensors:

### *Inline*

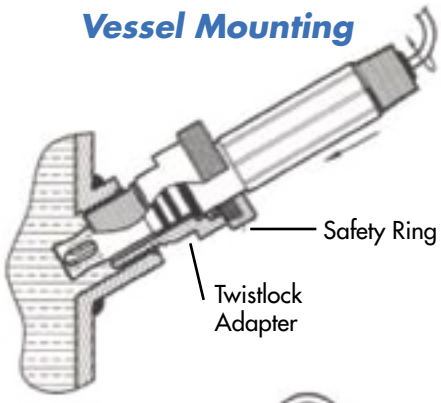



### *Submersible*

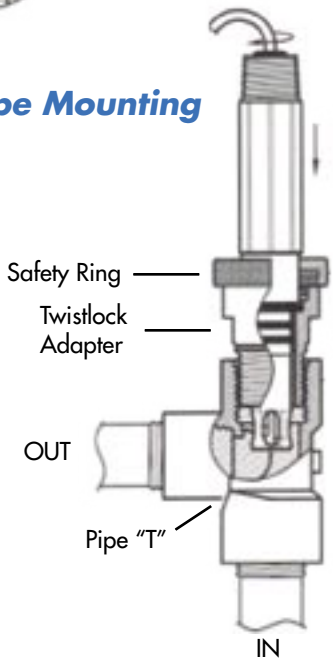



Another common type of sensor is the *Twistlock* design. We carry ¾"NPT and 1" NPT models that can also be used in submersible applications as already shown. The Twistlock design is simple to install and remove for easy cleaning. One simple ¼ turn will either lock or free the sensor from the mounting adapter. In addition, we can supply a safety ring that mounts on top of the adapter in case the user does not complete the full ¼ turn to lock the sensor. We recommend the following types of uses for this sensor:

### *Vessel Mounting*



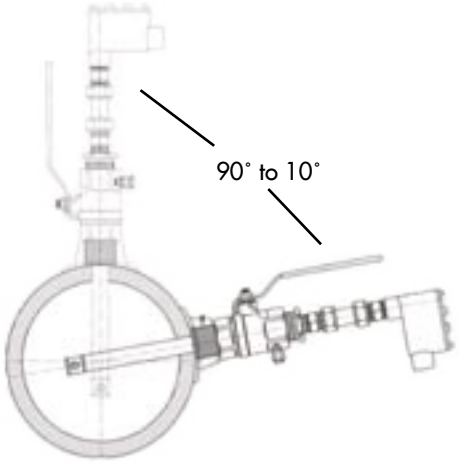

### *Pipe Mounting*



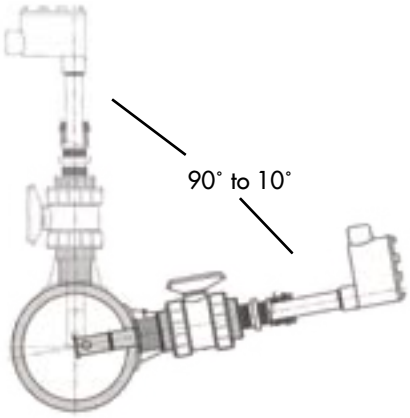

The *Field Rebuildable* sensor is similar to the twistlock design for installation, with the exception of not having the twistlock feature. Our Field Rebuildable design uses a mounting adapter and a locking adapter cap that fits over the electrode securing the electrode in place. This electrode is available for 2" Pipe "T"s and for 1" NPT Submersible applications. The key feature of this electrode is the ability to remove just the sensing element and replace it with a fresh sensor.

*Hot Tap Assemblies* and sensors are also available from ASI. We carry Kynar and 316 Stainless Steel versions of this assembly that can be seen on the next page. Both designs come with an integral ball valve assembly, relief valves and a junction box on the back. Typically we manufacture the total pipe lengths at 17", but we can customize the pipe size easily. The standard connection size for our Hot Tap assemblies is 1½" NPT. Below are our mounting suggestions for both designs:

### *316 Stainless Steel Model*




### *Kynar Model*




*NOTE:* ASI does not provide water proof cable unless it is requested. It is suggested that submersible applications use PVC pipe to protect the cable from water intrusion. It is also suggested that all industrial sensors are used at a minimum 10° angle to ensure proper reference function.

# Industrial/Process Sensors

## 52S Series Hot Tap

The ASI model 52S Hot Tap assembly allows electrode maintenance or replacement without interrupting process flow. The 52S model is specific to our 316 stainless steel version. This assembly comes equipped with a ball valve and relief valve. Custom insertion depths are available.

**Specifications:**

| | |
|---|---|
| Wetted Materials: | |
| Body: | 316 SS |
| O-ring: | EPR/Viton |
| Connection: | ½ inch NPT |
| Temperature Range: | 0 - 100 °C |
| Maximum Pressure: | 100 PSI |
| Electrodes Available: | pH, ORP, DO, Conductivity, Temperature |

## 52 Series Electrodes

The ASI Hot Tap sensor is constructed of Kynar® to ensure that it will withstand the worst process conditions. For pH and ORP applications, we use a self-pressurizing electrolye to prevent process contamination of the reference.

**Specifications:**

| | |
|---|---|
| Wetted Materials: | |
| Body: | Kynar® |
| Electrodes Available: | pH, ORP, DO, Conductivity, Temperature |

## 52K Series Hot Tap

The ASI model 52K Hot Tap assembly allows electrode maintenance or replacement without interrupting process flow. The 52K model is specific to our Kynar® plastic version. This assembly comes equipped with a ball valve and relief valve. Custom insertion depths are available.

**Specifications:**

| | |
|---|---|
| Wetted Materials: | |
| Body: | Kynar® |
| O-ring: | EPR/Viton |
| Connection: | ½ inch NPT |
| Temperature Range: | 0 - 100 °C |
| Maximum Pressure: | 100 PSI |
| Electrodes Available: | pH, ORP, DO, Conductivity, Temperature |

## 09 Series Glass Sensor

In addition to our plastic industrial products, ASI also offers glass industrial sensors. This model is a simple glass electrode with an industrial Kynar® cap. This sensor can withstand most chemical attacks.

**Specifications:**

| | |
|---|---|
| Body Material: | Glass and Kynar |
| Sensors: | pH and ORP |
| Temperature Range: | 0 - 100 °C |
| Body Dimensions: | 12 x 80mm |

## 82 Series Insertion

The 82 series insertion probe is a standard 1" OD tube with a double o-ring seal. We can outfit this sensor with any electrode sensing element required in CPVC, PVC and Kynar®. For pH and ORP applications, ASI provides the electrode with a double junction reference using our self-pressurizing electrolyte.

**Specifications:**

| | |
|---|---|
| Wetted Materials: | |
| Body: | CPVC, PVC, Kynar |
| O-ring: | EPR/Viton |
| Connection Size: | ¾" NPT Rear threads |
| Body Diameter: | 1" OD |
| Maximum Pressure: | 100 PSI |
| Electrodes Available: | pH, ORP, Conductivity, Dissolved Oxygen, ISE, Temperature |

# Industrial/Process Sensors

## PT Series Twistlock

The ASI PT Twistlock design is a very popular design with its ability to be inserted and removed from the process with a simple ¼ turn of the electrode. This electrode can be purchased as a kit (including the adapter and safety ring) or as a stand alone electrode. If the application changes to a submersible installation, we provide ¾" NPT threads on the back of the electrode. Triple O-rings provide redundant process seals and the locking pins are 316 stainless steel.

**Specifications:**

| | |
|---|---|
| Wetted Materials: | |
| Body: | Kynar®, 316SS |
| O-ring: | EPR/Viton |
| Connection: | ¾" or 1" inch NPT |
| Temperature Range: | 0 - 100 °C |
| Maximum Pressure: | 100 PSI |
| Electrodes Available: | pH, ORP, DO, Conductivity, Temperature |

## 85 Series Twistlock

The 85 series twistlock sensor incorporates a triple o-ring seal on the back of the module and two locking pins from 316 SS for 100 PSI applications, or the same material as the body for 60 PSI applications.

**Specifications:**

| | |
|---|---|
| Wetted Materials: | |
| Body: | CPVC, PVC, Kynar, 316 SS |
| O-ring: | EPR/Viton |
| Body Diameter: | 1" OD |
| Maximum Pressure: | 100 PSI |
| Electrodes Available: | pH, ORP, Conductivity, Dissolved Oxygen, ISE, Temperature |

## 83 Series Twistlock

The model 83 Twislock sensor uses a glass electrode in a Kynar®, PVC or CPVC body using 316 Stainless Steel pins as the locking mechanism. This sensor has ¾" NPT threads on the back of the body for use in submerisble applications. The body is 1" in outside diameter and has two flats to provide easy gripping. This sensor can be used with our ¾" NPT, 1" NPT or flange twistlock adapters.

**Specifications:**

| | |
|---|---|
| Wetted Materials: | |
| Body: | CPVC, PVC, Kynar, 316 SS |
| O-ring: | EPR/Viton |
| Connection Size: | ¾" NPT Rear threads |
| Body Diameter: | 1" OD |
| Maximum Pressure: | 100 PSI |
| Electrodes Available: | pH, ORP, Conductivity, Dissolved Oxygen, ISE, Temperature |

## Twistlock Adapters

ASI offers many twistlock adapters. We feature the ¾", 1" NPT adapters, as well as ANSI twistlock flanges. Our twistlock adapters are available in Kynar®, 315 Stainless Steel, Ultium, CPVC, Teflon® and PVC.

## BT Series Twistlock

The ASI BT Twistlock design is also a very popular design with its ability to be inserted and removed from the process with a simple ¼ turn of the electrode. This sensor is very similar to the PT Series on the previous page, other than it has a larger body design that makes insertion easier on the user. The larger body also gives more room for reference electrolyte to help increase sensor life. This sensor also comes standard with triple O-rings and 316 SS pins.

### Specifications:

| | |
|---|---|
| Wetted Materials: | |
| Body: | Kynar®, 316SS |
| O-ring: | EPR/Viton |
| Connection: | ¾" or 1" inch NPT |
| Temperature Range: | 0 - 100 °C |
| Maximum Pressure: | 100 PSI |
| Electrodes Available: | pH, ORP, DO, Conductivity, Temperature |

## B1 Series Field Rebuildable

The ASI model B1 Field Rebuildable sensor allows users to field repair the sensor by simply unscrewing the failed electrode and inserting a new cartridge. Since the main body is reusable, there is a lower cost for replacement parts. This sensor is available in ABS or CPVC depending on your application. With an integral temperature element of ORP element, you are sure to save money with this design.

### Specifications:

| | |
|---|---|
| Wetted Materials: | |
| Body: | ABS or CPVC |
| O-ring: | EPR/Viton |
| Connection: | 2" inch NPT |
| Temperature Range: | 0 - 80 °C |
| Maximum Pressure: | 100 PSI |
| Electrodes Available: | pH, ORP, DO, Conductivity, Temperature |

## 68 Series VersaProbe

The ASI model 68 sensor features 1" NPT threads on both ends of the sensor for in-line or submersible installations described on the previous page. This series of sensor is constructed from Kynar® to resist harsh process conditions. This sensor is designed to be rugged and allows for installations in high temperature and pressure applications. The optional 1½" NPT mounting adapter reduces cable twisting and can be used for in-line or submersible installations.

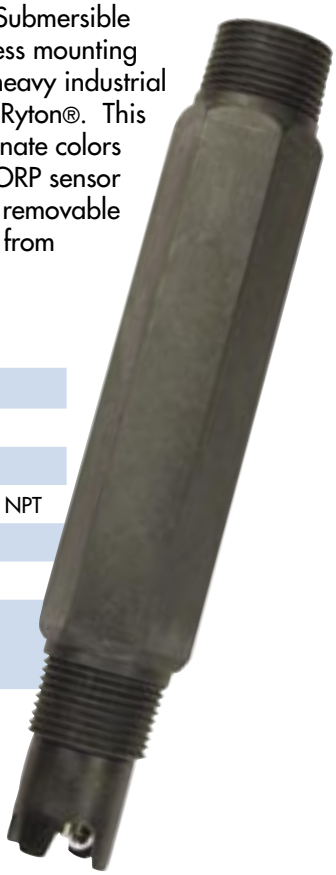
### Specifications:

| | |
|---|---|
| Wetted Materials: | |
| Body: | Kynar® |
| O-ring: | EPR/Viton |
| Connection: | 1" or 1½" NPT |
| Temperature Range: | 0 - 120 °C |
| Maximum Pressure: | 100 PSI |
| Electrodes Available: | pH, ORP, DO, Conductivity, Temperature |

# Industrial/Process Sensors

## 61 Series In-line/Submersible

Our standard ¾" NPT In-line/Submersible sensor is great for simple process mounting applications. This sensor is a heavy industrial sensor, as the body material is Ryton®. This sensor is also available in alternate colors with quantity orders. pH and ORP sensor versions come standard with a removable bulb guard to protect the glass from process abrasives.



**Specifications:**

| Wetted Materials: | |
|---|---|
| Body: | Ryton® |
| O-ring: | N/A |
| Connection: | ¾" or 1" inch NPT |
| Temperature Range: | 0 - 80 °C |
| Maximum Pressure: | 100 PSI |
| Electrodes Available: | pH, ORP, DO, Conductivity, Temperature |

## 62 Series In-line/Submersible

Our newest ¾" NPT In-line/Submersible electrode is much easier on the user when inserting the sensor into the process application. With the large body and grip, screwing the sensor into place is a snap. This model is also featured in our chemically resistant Kynar® material and ABS. If color is important, ABS models can be color coded to your need in quantity purchases.

**Specifications:**

| Wetted Materials: | |
|---|---|
| Body: | Kynar® or ABS |
| O-ring: | N/A |
| Connection: | ¾" inch NPT |
| Temperature Range: | 0 - 100 °C |
| Maximum Pressure: | 100 PSI |
| Electrodes Available: | pH, ORP, DO, Conductivity, Temperature |

## ASI Industrial Sensor Adpaters

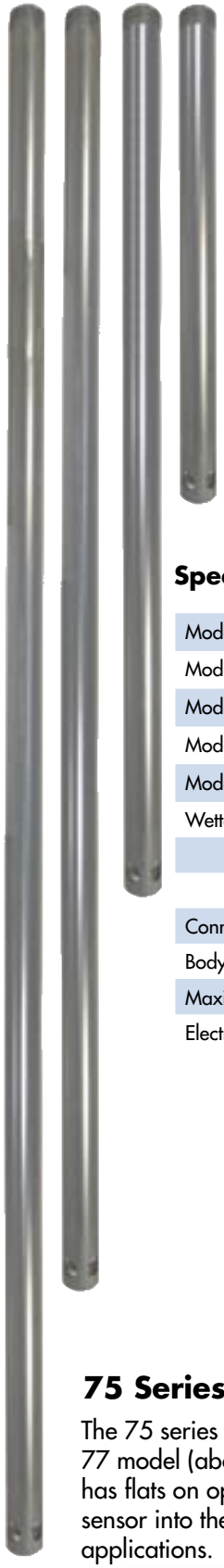
ASI custom machines several housings to fit standard industrial sensors with the integral PG 13.5 connector cap. Each housing is made for a specific combination of inline and submersible applications. We offer ¾" and 1" NPT connector sizes on the front (process) and back (submersible) sides. If you have another connection size that you need for your specific applicaiton, please do not hesitate to contact an ASI representative to get a quote.



## ASI Industrial Cable

ASI fits all industrial sensors with high-grade industrial cable. Our standard lengths on industrial products is 20 feet, but we can offer custom lengths of any size from 3 inches to 3000 feet depending on your application. Just remember that when using a pH electrode in an industrial setting, any length over 20 feet needs to have a preamp to assist the signal in reaching the end of the cable.

## 70/74/73/72/76 Series Submersible



ASI offers 5 submersible models. These submersible designs are available in PVC or CPVC and are designed for use in neutralization tanks, canals, cooling towers and other locations needing a submersible style sensor. These units are sealed from process moisture by Viton and EPR O-rings in both sealed and rebuildable models. Rebuildable models utilize the ASI B1 style cartridge.

### Specifications:

| | |
|---|---|
| Model 70 Length: | 48″ |
| Model 74 Length: | 36″ |
| Model 73 Length: | 24″ |
| Model 72 Length: | 12″ |
| Model 76 Length: | 6″ |
| Wetted Materials: | |
| Body: | CPVC, PVC, Kynar, 316 SS |
| O-ring: | EPR/Viton |
| Connection Size: | ¾″ NPT |
| Body Diameter: | 1 $^{5}/_{16}$″ OD |
| Maximum Pressure: | 100 PSI |
| Electrodes Available: | pH, ORP, Conductivity, Dissolved Oxygen, ISE, Temperature |

## 77 Series Inline/Submersible Model

The 77 series sensors are available with a guarded sensing element or self-cleaning with flat sensing elements. Standard models are constructed from CPVC, but are also available in PVC, Kynar® and 316 Stainless Steel. Each sensor has flats on opposite sides for easy placement of a tool to tighten the sensor into the "T" for inline use or onto another pipe for submersible applications.

### Specifications:

| | |
|---|---|
| Wetted Materials: | |
| Body: | CPVC, PVC, Kynar, 316 SS |
| O-ring: | EPR/Viton |
| Connection Size: | ¾″ NPT threads |
| Body Diameter: | 1.05″ OD |
| Maximum Pressure: | 100 PSI |
| Electrodes Available: | pH, ORP, Conductivity, Dissolved Oxygen, ISE, Temperature |

## 75 Series Inline/Submersible Model

The 75 series sensor from ASI uses the same plastic bodies as the 77 model (above), but with a glass sensing element. Each sensor has flats on opposite sides for easy placement of a tool to tighten the sensor into the "T" for inline use or onto another pipe for submersible applications.

### Specifications

| | |
|---|---|
| Wetted Materials: | |
| Body: | CPVC, PVC, Kynar®, 316 SS |
| O-ring: | EPR/Viton |
| Connection Size: | ¾″ NPT threads |
| Body Diameter: | 1.05″ OD |
| Maximum Pressure: | 100 PSI |
| Electrodes Available: | pH, ORP |

# Industrial/Process Sensors

## 54 Series Light Industrial

The ASI 54 series in-line sensor is designed for mounting in a standard ½" NPT connection for continuous flow-thru monitoring. This sensor is classified as a light industrial sensor as it is constructed of ABS plastic. We offer this electrode with color-coded caps to allow differentiation of different sensor types (e.g. blue for pH, red for ORP, etc). Removable guards are standard (not pictured) for pH and ORP sensors.

### Specifications:

| | |
|---|---|
| Wetted Materials: | |
| Body: | ABS |
| O-ring: | EPR |
| Connection: | ½" NPT |
| Temperature Range: | 0 - 80°C |
| Maximum Pressure: | 80 PSI |
| Electrodes Available: | pH, ORP, DO, Conductivity, Temperature |

## CT54 ½" NPT In-line/Submersible Conductivity

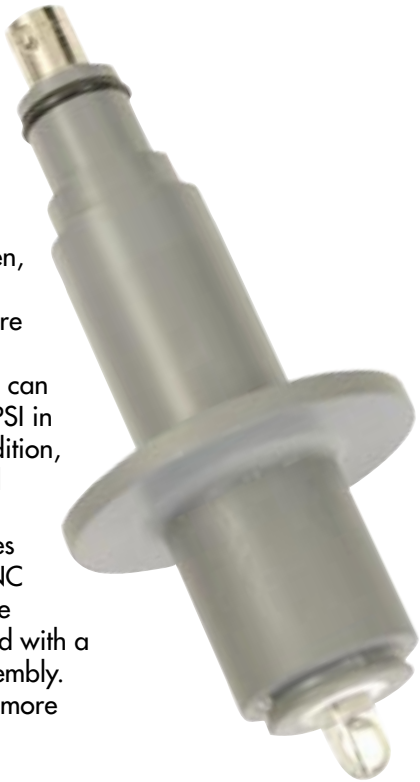
The ASI CT54 is a standard ½" NPT In-line and Submersible sensor. Based off the ASI 54 series light industrial sensor, the CT54 utlizes 2-cell and 4-cell (bulls-eye) conductivity technology to bring a light industrial sensor that is priced right for the commercial cooling tower market. Made of high impact ABS, this sensor can withstand medium chemcial attack and has good temperature properties. In addition to the pictured cell design (left), this sensor can be used with titanium pins exposed for easy cleaning. Integral temperature compensation is standard on most designs.

### Specifications:

| | |
|---|---|
| Wetted Materials: | |
| Body: | ABS |
| O-ring: | EPR/Viton |
| Connection: | ½" NPT |
| Temperature Range: | 0 - 80 °C |
| Maximum Pressure: | 80 PSI |
| Conductivity Elements: | Carbon, Platinum or Titanium (2 cell or 4 cell) |

## 65 Model

The model 65 sensor is designed with a flange mount. This sensor can be outfitted with any sensor that ASI manufactures, including: pH, ORP, Dissolved Oxygen, Conductivity, Ion Specific, and an Integral Temperature element. This sensor is made of CPVC plastic and can withstand 100 °C at 100 PSI in process conditions. In addition, this sensor can be outfitted with a battery powered preamp. This sensor comes standard with a female BNC mounted on the back of the sensor, but can be modified with a strain relief and cable assembly. Contact ASI sales to learn more about this product.



### Specifications:

| | |
|---|---|
| Wetted Materials: | |
| Body: | CPVC |
| O-ring: | EPR/Viton |
| Connection: | Female BNC |
| Temperature Range: | 0 - 100 °C |
| Maximum Pressure: | 100 PSI |
| Electrodes Available: | pH, ORP, ISE, DO, Conductivity & Temperature |

## CT55 Conductivity Cell

The ASI CT55 was developed for a specific application, paint. It works with any liquid, but the original intent was for it to be used in applications where the user can drain the cell using a removable bottom. This cell can be furnished with two cell or four cell designs with platinum, titanium or carbon elements. To clean this conductivity cell, you simply remove the bottom cap, flush it with a cleaning agent and use a toothbrush to scrub the inside. Users in the paint industry have found this design to be far better than standard dip type conductivity sensors.

### Specifications:

| | |
|---|---|
| Wetted Materials: | |
| Body: | PVC, Epoxy |
| O-ring: | EPR/Viton |
| Connection: | Screw Pin |
| Temperature Range: | 0 - 100 °C |
| Maximum Pressure: | N/A |
| Conductivity Elements: | Carbon, Platinum or Titanium (2 cell or 4 cell) |

## ASI Smart Sensor

Customers have asked us if we have the ability to integrate multiple sensors into a single package with space for electronics, in essence creating an assembly that can have interchangeable sensors in one housing. Our answer was the ASI SMART Sensor package. The model pictured is a prototype that we now use as a platform for these applications. The SMART Sensor package is available in several connector sizes, or without a connection thread for those wishing to install the unit in some other fashion. It uses replaceable pH/Reference/ISE sensors. The main users for this product are universities, environmental organizations and other research firms that need a platform that is interchangeable for research purposes. Contact an ASI sales representative so that we can begin working on a design for your application.

### Specifications:

| | |
|---|---|
| Body material: | ABS/CPVC/Epoxy |
| Replaceable sensors: | pH, Reference, ISE |
| Fixed sensors: | ORP, Temperature, Conductivity (2-cell or 4-cell) |
| Connection sizes: | 1", 1½", 2", 2½" NPT |
| O-rings: | EPR/Viton |

# Solutions

ASI offers buffers, reagents, standards, filling solutions, ionic strength adjusters and many more high quality solutions. For over 14 years we have developed our solutions capability to support our growth in the ISE and other sensor markets.

Our dedication to quality has ensured that thousands of electrodes have been tested using the highest quality solutions available. With over 150 different solutions in our inventory, ASI is ready to handle your solution needs.

We offer standard sizes that fit almost any application or request: 5 liter, 1 liter, 500 milliliter, 250 milliliter, 125 milliliter, 60 milliliter. Our 60mL and 125mL bottles are used primarily for ISA and filling solutions and come standard with our convenient flip top cap that enables ease of use.

In addition, all bottles are sealed with our leak proof seal that ensures that all solutions are fresh when they arrive at your location. The cap seal also provides a long term storage solution for your lab.


## pH Buffer Solutions

| Solution | Color | Size | Part number |
|---|---|---|---|
| pH 3.86 | Clear | 500mL | SDH386-500 |
| | Clear | 1L | SDH386-1L |
| pH 4.01 | Clear | 60mL | SDH401-60 |
| | Red | 250mL | SDH401-250 |
| | Red | 500mL | SDH401-500 |
| | Red | 1L | SDH401-1L |
| | Red | 5L | SDH401-5L |
| pH 6.86 | Clear | 500mL | SDH686-500 |
| | Clear | 1L | SDH686-1L |
| pH 7.01 | Clear | 60mL | SDH701-60 |
| | Green | 250mL | SDH701-250 |
| | Green | 500mL | SDH701-500 |
| | Green | 1L | SDH701-1L |
| | Green | 5L | SDH701-5L |
| pH 7.41 | Clear | 500mL | SDH741-500 |
| | Clear | 1L | SDH741-1L |
| pH 9.18 | Clear | 500mL | SDH918-500 |
| | Clear | 1L | SDH918-1L |
| pH 10.01 | Clear | 60mL | SDH100-60 |
| | Blue | 250mL | SDH100-250 |
| | Blue | 500mL | SDH100-500 |
| | Blue | 1L | SDH100-1L |
| | Blue | 5L | SDH100-5L |

## pH Reference Solutions

| Solution | Size | Part number |
|---|---|---|
| 4M KCl* | 125mL | RFOZNO-125 |
| (no Ag/AgCl) | 250mL | RFOZNO-250 |
| | 500mL | RFOZNO-500 |
| 4M KCl w/Ag/AgCl* | 125mL | RFOZAG-125 |
| | 250mL | RFOZAG-250 |
| | 500mL | RFOZAG-500 |
| 1M or 10% $KNO_3$ | 125mL | RFOZZ1-125 |
| | 250mL | RFOZZ1-250 |
| | 500mL | RFOZZ1-500 |
| 1M LiCl* | 125mL | RFOZL1-125 |
| | 250mL | RFOZL1-250 |
| | 500mL | RFOZL1-500 |
| 0.1M NaCl* | 125mL | RFOZX1-125 |
| | 250mL | RFOZX1-250 |
| | 500mL | RFOZX1-500 |
| 2M $NH_4Cl$ | 125mL | RFOZW1-125 |
| | 250mL | RFOZW1-250 |
| | 500mL | RFOZW1-500 |
| 4M LiCl* | 125mL | RFOZL4-125 |
| | 250mL | RFOZL4-250 |
| | 500mL | RFOZL4-500 |

**For these solutions gelled, call ASI sales.*

# Ion Selective Electrode Solutions*

| Ion Name | Fill Solution | ISA | 0.1 M Standard | 1000ppm Standard |
|---|---|---|---|---|
| **Ammonia** | RFNH31 | AJNH31 | SDNH31 | SDNH32 |
| **Ammonium** | RFNH41 | AJNH41 | SDNH41 | SDNH42 |
| **Bromide** | RF0BR1 | AJ0BR1 | SD0BR1 | SD0BR2 |
| **Cadmium** | RF0CD1 | AJ0CD1 | SD0CD1 | SD0CD1 |
| **Calcium** | RF0CA1 | AJ0CA1 | SD0CA1 | SD0CA1 |
| **Carbon Dioxide (Carbonate)** | RF0CB1 | AJ0CB1 | SD0CB1 | SD0CB1 |
| **Chloride** | RF0CL1 | AJ0CL1 | SD0CL1 | SD0CL2 |
| **Chlorine (Total Residual)** | RF0CR1 | AJ0CR1 | SD0CR1 | CD0CR2 |
| **Cupric** | RF0CU1 | AJ0CU1 | SD0CU1 | SD0CU2 |
| **Cyanide** | RF0CN1 | AJ0CN1 | - - - | - - - |
| **Fluoride** | RF0FL1 | AJ0FL1 | SD0FL1 | SD0FL2 |
| **Fluoroborate** | RF0FB1 | AJ0FB1 | SD0FB1 | SD0FB2 |
| **Iodide** | RF0ID1 | AJ0ID1 | SD0ID1 | SD0ID2 |
| **Lead** | RF0PB1 | AJ0PB1 | SD0PB1 | SD0PB2 |
| **Nitrogen Oxide** | RF0NO1 | AJ0NO1 | SD0NO1 | SD0NO2 |
| **Nitrate** | RF0N31 | AJ0N31 | SD0N31 | SD0N32 |
| **Nitrite** | RF0N21 | AJ0N21 | SD0N21 | SD0N22 |
| **Potassium** | RF0KT1 | AJ0KT1 | SD0KT1 | SD0KT2 |
| **Silver** | RF0SS1 | AJ0AG1 | SD0AG1 | SD0AG2 |
| **Sulfide** | RF0SS1 | AJ0SF1 | SD0SF1 | SD0SF2 |
| **Surfactant** | RF0XT1 | AJ0XT1 | SD0XT1 | SD0XT2 |
| **Sodium** | RF0NA1 | AJ0NA1 | SD0NA1 | SD0NA2 |
| **Thiocyanate** | RF0TC1 | AJ0TC1 | SD0TC1 | SD0TC2 |

** Please add a '-' and then the desired size of solution, our ISE solutions are available in 60mL, 125mL, 250mL, 500mL and 1L sizes.*

# Conductivity Standards & Solutions

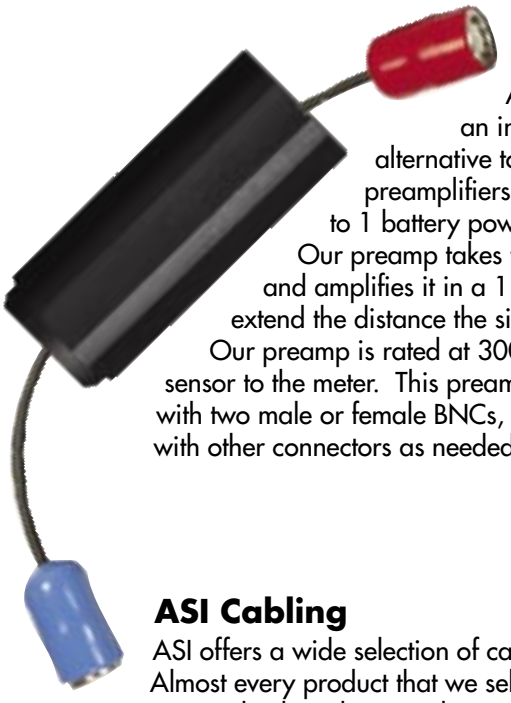
| Solution | Size | Part number |
|---|---|---|
| 1,000 µS (microsiemens) | 250mL | SDC010-250 |
| | 500mL | SDC010-500 |
| | 1L | SDC010-1L |
| 1,413 µS (microsiemens) | 250mL | SDC014-250 |
| | 500mL | SDC014-500 |
| | 1L | SDC014-1L |
| 12,880 µS (microsiemens) | 250mL | SDC128-250 |
| | 500mL | SDC128-500 |
| | 1L | SDC128-1L |
| 15,000 µS (microsiemens) | 250mL | SDC150-250 |
| | 500mL | SDC150-500 |
| | 1L | SDC150-1L |

# pH/ORP Cleaning & Storage Solutions

| Solution | Size | Part number |
|---|---|---|
| pH/ORP Storage Solution | 60mL | CSHOST-60 |
| | 250mL | CSHOST-250 |
| | 500mL | CSHOST-500 |
| | 1L | CSHOST-1L |
| pH/ORP Cleaning Solution | 60mL | CSHOCL-60 |
| | 250mL | CSHOCL-250 |
| | 500mL | CSHOCL-500 |
| | 1L | CSHOCL-1L |
| pH/ORP Protein Cleaning Solution | 60mL | CSHOPC-60 |
| | 250mL | CSHOPC-250 |
| | 500mL | CSHOPC-500 |
| | 1L | CSHOPC-1L |

# Preamps, Cables and Extensions

## A099 Battery Powered pH Preamp



ASI offers an inexpensive alternative to large preamplifiers with our 1 to 1 battery powered preamp. Our preamp takes the pH signal and amplifies it in a 1 to 1 ratio to extend the distance the signal can travel. Our preamp is rated at 300 feet from the sensor to the meter. This preamp comes standard with two male or female BNCs, or can be adapted with other connectors as needed.

## ASI Cabling

ASI offers a wide selection of cabling for its products. Almost every product that we sell has some type of wiring involved, and ASI prides itself in only using the best quality cabling for its customers. ASI offers the following types of cabling standard:

- **RG-174 Coax (low noise)**
- **Coax +2 conductors**
- **Coax +3 conductors**
- **Coax +4 conductors**
- **CE Approved Coax +4 conductors**
- **Single Conductor Teflon Coated Stranded 12, 18, 26 guages**
- **Single Conductor PVC Jacket 18, 22, 26, 28 guages**
- **Single Conductor Kynar Jacket 26 guage**

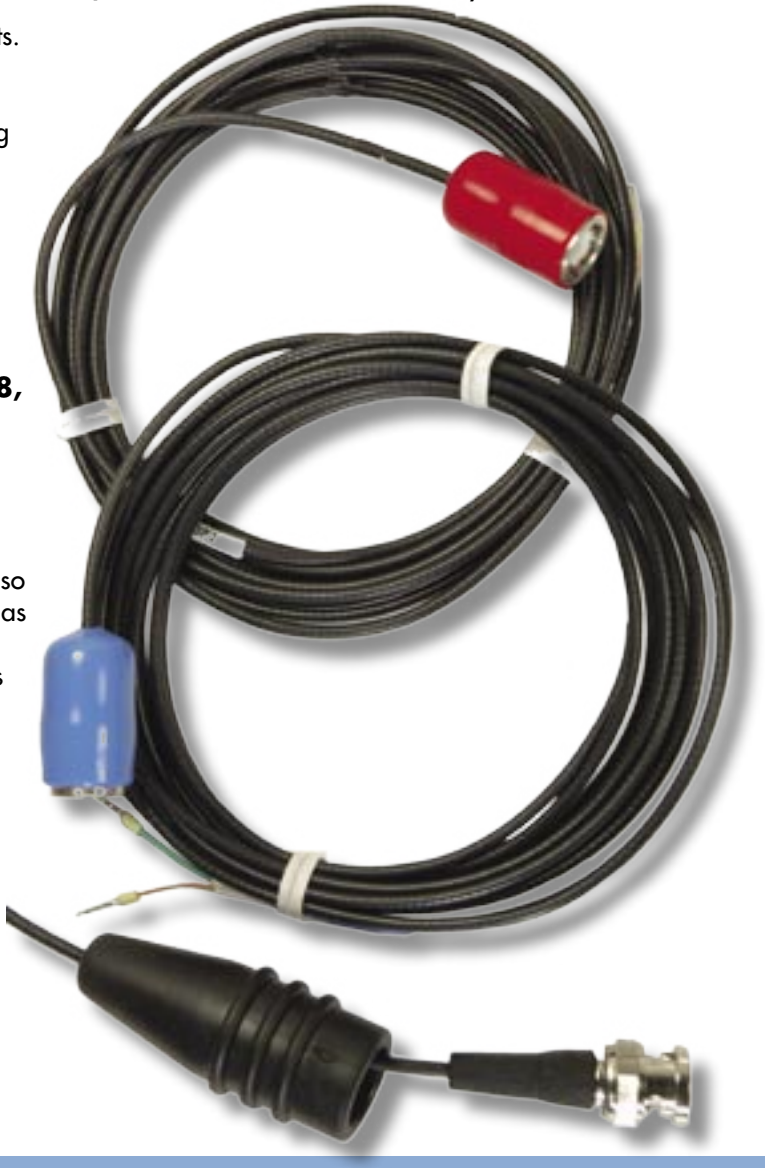
In addition to the different types of cable that ASI uses, we also custom order any cabling needed to complete your products as required, including waterproof cabling. ASI cabling is color coded to the customer need, but we offer the following colors standard on single conductor cables:

- **Blue**
- **Red**
- **Grey**
- **White**
- **Black**
- **Green**
- **Orange**
- **Violet**
- **Yellow**
- **Brown**
- **White/Violet**
- **White/Grey**

## ASI Extension Cables

In addition to our wide range of connectors (next page) and cabling options, we understand that sometimes it is better to have an extension cable instead of a hard wired cable directly into your sensor. It is easier on the user as they do not have to rerun long lengths of cable that generally does not go 'bad' as quickly as an electrode could. Keeping this in mind, ASI offers cable entensions in a multitude of lengths and types to fit every need. Here is a list of a few standard cable extensions that we offer:

- **B/B-S010 10 foot extension, BNC to BNC**
- **B/B-S020 20 foot extension, BNC to BNC**
- **B/B-S050 50 foot extension, BNC to BNC**
- **B/B-S100 100 foot extension, BNC to BNC**
- **B/T-S010 10 foot extension, BNC to Tinned Leads**
- **B/T-S020 20 foot extension, BNC to Tinned Leads**
- **B/T-S050 50 foot extension, BNC to Tinned Leads**
- **FB/T-S010 10 foot extension, Female BNC to Tinned**
- **FB/T-S020 20 foot extension, Female BNC to Tinned**
- **T/T-S010 10 foot extension, Tinned to Tinned**
- **T/T-S020 10 foot extension, Tinned to Tinned**



# Connectors

ASI has a wide assortment of cable and electrode connectors to meet any customers needs. In addition to the connectors listed on this page, ASI also has the ability to use customer specified connectors.

### DIN

### Phono/RCA

### 1/4 Mono/Stero Plug

### LEMO Multipin

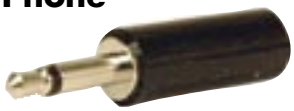
### Screw Cap

### 2.5mm Phone

### Mini DIN

### TNC

### 3.5mm Phone



### Modular/Molex

### Small Shielded 2 Conductor

### Banana Plug

### PG13.5 Screw Cap

### US Standard

### BNC

### Pin

# Conversions & Formulas

### Metric Prefixes

| PREFIX | SYMBOL | | MEANING |
|---|---|---|---|
| kilo- | (k) | = | $1 \times 10^{3}$ |
| deci- | (d) | = | $1 \times 10^{-1}$ |
| centi- | (c) | = | $1 \times 10^{-2}$ |
| milli- | (m) | = | $1 \times 10^{-3}$ |
| micro- | (μ) | = | $1 \times 10^{-6}$ |
| nano- | (n) | = | $1 \times 10^{-9}$ |
| pico- | (p) | = | $1 \times 10^{-12}$ |

### Length Conversions

Meter = m
Centimeter = cm
Decimeter = dm
Millimeter = mm
Micrometer = μm
1m = 10 dm = 100 cm = 1000 mm
1 m = 3.281 feet
1m = 1.094 yards
1 cm = 0.3937 inches
1mm = 0.03937 inches

### Concentration Formulas

Molar (M) = Moles of solute/Liters of solution
Parts-per-million (ppm) = mg of solute/Liters of water

### Density Conversions

Grams = g
Specific Gravity x 1 = g/mL
g/L x 8.345404 = lb/gal

### Pressure Conversions

1 bar = 14.50 psi = 750.06 mm of Hg
1 psi = 51.715 mm of Hg

### Flow Rate Conversions

GPM = 3.785 L/min
GPH = 0.125 GPM = 63.1 mL/min

### Temperature Conversions

Celsius = (˚F - 32) x 5/9 = ˚C
Fahrenheit = (˚C x 1.8) + 32 = ˚F
Kelvin = ˚C + 273.2

### Volume Conversions

Liter = L
Milliliter = mL
1 gallon = 3.785 L
1 quart = 0.25 gallons = 0.9464L
1L = 1.057 quarts = 0.2642 gallons
1 cc = 1 mL

# Plastic Properties

## Plastic Acroynms

| | | | | | |
|---|---|---|---|---|---|
| ABS | Acrylonitrile Butadiene Styrene | PA | Polyamide | PSU | Polysulfone |
| E-CTFE | Ethylene chlorotrifluoroethylene (Halar® ) | PC | Polycarbonate | PTFE | Polytetrafluoroethylene (Teflon®) |
| FEP | Fluorinated ethylenepropylene (Teflon® FEP) | PFA | Perfluoroalkoxy (Teflon® PFA) | PVC | Polyvinyl chloride |
| FKM | Fluoroelastomer (Viton®) | PMP | Polymethylpentene (TPX® ) | PVDF | Polyvinylidene fluoride (Kynar®) |
| HDPE | Polyethylene (high density) | PP | Polypropylene | SAN | Styrene-acrylnitrile |
| LDPE | Polyethylene (low density) | PS | Polystyrene | SIR | Silicone rubber |

## Chemical Resistances

| Substance class at 20° C | *PS* | *PC* | *PA* | *SAN* | *ABS* | *PVC* | *LDPE* | *HDPE* | *PP* | *PMP* | *ECTFE* | *PTFE/ FEP/ PFA* | *SIR* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Aldehydes** | - | 0 | 0 | - | - | - | + | + | + | 0 | + | + | 0 |
| **Alcohols, aliphatic** | + | + | 0 | + | + | + | + | + | + | + | + | + | + |
| **Esters** | - | - | + | - | - | - | 0 | 0 | 0 | 0 | + | + | 0 |
| **Ethers** | - | - | + | - | - | - | - | 0 | - | - | + | + | - |
| **Ketones** | - | - | + | - | - | - | 0 | 0 | 0 | 0 | 0 | + | |
| **Hydrocarbons** | | | | | | | | | | | | | |
| **aliphatic** | - | 0 | + | - | - | + | 0 | + | + | 0 | + | + | - |
| **aromatic** | - | - | + | - | - | - | 0 | + | 0 | - | + | + | - |
| **halogenated** | - | - | 0 | - | - | - | - | 0 | 0 | - | + | + | - |
| **Acids, weak/ diluted** | 0 | 0 | 0 | 0 | 0 | + | + | + | + | + | + | + | 0 |
| **Acids, strong/ concentrated** | 0 | - | - | - | - | + | + | + | + | + | + | + | - |
| **Acids, oxidizing** | - | - | - | - | - | - | 0 | 0 | 0 | 0 | 0 | + | - |
| **Bases** | | - | 0 | + | 0 | + | + | + | + | + | + | + | + |

*+ = excellent chemical resistance*
*Plastic not damaged after 30 days continuous contact with the substance. The plastic may remain resistant for years.*
*0 = good/limited chemical resistance*
*Continous contact for approx. 7 to 30 days causes slight damage which may be partially reversible (softening, swelling, reduction of mechanical strength, discoloration).*
*- = low chemical resistance*
*Continuous contact causes immediate damage to the plastic (reduction of mechanical strength, deformation, discoloration, cracks, dissolution, risk of breakage).*

# Plastic Properties

## Material Characteristics

| Plastic | Temperature | | Sterilization[5] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | max.[1] °C | min[2] °C | steam[4] 121 °C | Gas, ethylene oxide | Irradiation, 2.5 kGy | Ethanol | Transparency | Flexibility | Specific Weight, g/cm3 | Water absorption% |
| ***ABS*** | 90 | -40 | no | no | no | no | opaque | good | 1.05 | 0.27 |
| ***E-CTFE*** | 150° | - 100° | yes | yes | no | yes | transparent | moderate | 1.7 | < 0.10 |
| ***FEP*** | 205° | - 255° | yes | yes | no | yes | transparent | excellent | 2.15 | < 0.01 |
| ***FKM*** | 200° | - 20° | | | | | black | good | 1.9 | |
| ***HDPE*** | 110° | - 50° | no | yes | yes | yes | transparent | rigid | 0.95 | 0.01 |
| ***LDPE*** | 95° | - 50° | no | yes | yes | yes | transparent | excellent | 0.92 | 0.01 |
| ***PA*** | 90° | - 0° | no | yes | yes | yes | transparent | rigid | 1.13 | 1.3 |
| ***PC*** | 135° | - 135° | yes | yes | yes | yes | clear | stiff | 1.2 | 0.35 |
| ***PFA*** | 250° | - 270° | yes | yes | no | yes | transparent | excellent | 2.15 | 0.03 |
| ***PMP*** | 175° | - 150° | yes | yes | yes | yes | glass-clear | stiff | 0.83 | 0.01 |
| ***PP*** | 135° | 0° | yes | yes | no | yes | transparent | stiff | 0.9 | 0.02 |
| ***PS*** | 70° | - 20° | no | yes | yes | yes | glass-clear | stiff | 1.05 | 0.05 |
| ***PSU*** | 165° | -100° | yes | yes | | yes | clear | stiff | 1.24 | 0.3 |
| ***PTFE*** | 270° | -270° | yes | yes | no | yes | opaque | excellent | 2.25 | <0.01 |
| ***PVC*** | 70° | -30° | no[3] | yes | no | yes | clear | stiff | 1.35 | 0.06 |
| ***PVDF*** | 160° | -4° | yes | yes | yes | yes | transparent | stiff | 1.78 | 0.04 |
| ***SAN*** | 95° | -40° | no | yes | no | yes | glass-clear | stiff | 1.03 | 0.05 |
| ***SIR*** | 180° | -60° | yes | yes | no | yes | transparent | excellent | 1.1 | |

*[1] even higher for short periods*
*[2] embrittlement temperature*
*[3] except for PVC tubing which can be sterilized with steam up to 121°.*
*[4] Frequent steam sterilization reduces mechanical stability!*
*[5] First rinse apparatus with distilled water (prevents stress cracks). Remove or slightly unscrew the caps of sealed vessels, retighten when cooled down.*

# ASI Research & Engineering

## ASI Engineering

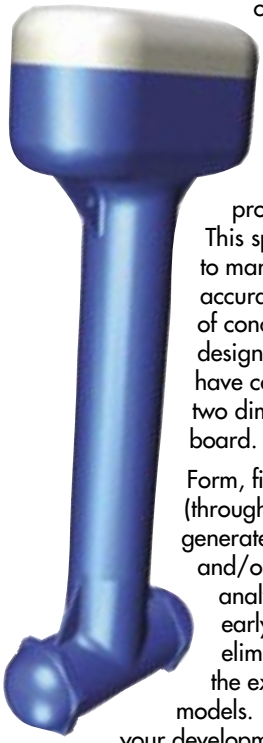
The Engineering Department at ASI works with other ASI departments and ASI customers to provide innovative sensor solutions and related product needs in a wide variety of applications. In keeping with our vision for the future, we offer cost effective services that are difficult to find or are cost prohibitive to most companies.

The primary goal of the department is to help ASI become a leading manufacturer of electrochemical sensors and related products. At ASI, we have the know how, the experience, and the tools to make your analysis product an unqualified commercial success, whether it is a derivative of an existing product or a new design.

Because of our decades of combined experience, ASI is quickly becoming known as a world leader in:

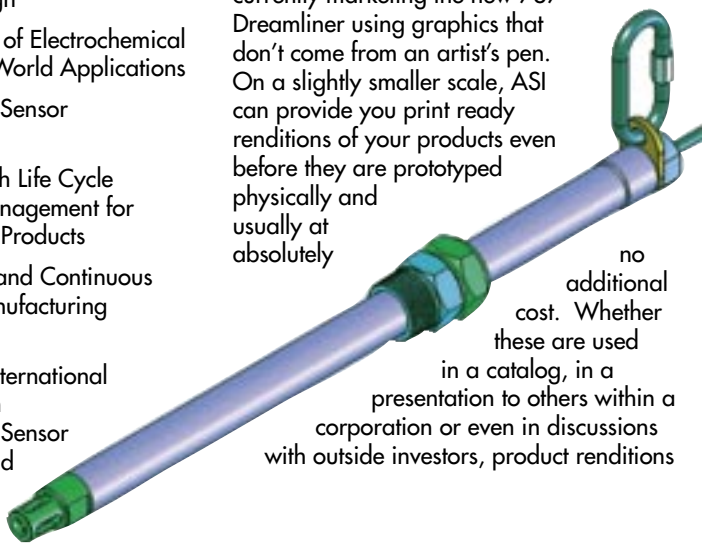
- Electrochemical Sensor and Sensor Accessory Design
- The Application of Electrochemical Theory to Real World Applications
- The Tailoring of Sensor Formulations
- Concept Through Life Cycle Engineering Management for Electrochemical Products
- Cost Reduction and Continuous Design and Manufacturing Improvement
- Domestic and International Collaboration in Electrochemical Sensor Development and Manufacture
- The Use of Engineering Tools Such as Solid Modeling and Various CAD/CAM Packages for Sensor Design

Computer generated graphics can do more than provide great, high resolution video games. At ASI we use this powerful tool to better visualize and communicate with you on your product concepts and providing realistic, accurate models - cutting product development time and prototyping costs. This speeds your time to market and the accurate visualization of concepts can lead to designs that may never have come to light on a two dimensional drawing board.



Form, fit and function (through computer generated animation and/or finite element analysis) can be tested early on in a project, eliminating much of the expense of physical models. This can lower your development costs and opens the door to the consideration of alternative designs quite easily.

ASI's ability to model a product in three dimensions without even cutting a piece of material can provide benefits that may be unanticipated. As an example, Boeing is currently marketing the new 787 Dreamliner using graphics that don't come from an artist's pen. On a slightly smaller scale, ASI can provide you print ready renditions of your products even before they are prototyped physically and usually at absolutely no additional cost. Whether these are used in a catalog, in a presentation to others within a corporation or even in discussions with outside investors, product renditions give you a step up on the competition. In today's world, that's always a plus. (See an example under the product spot light.)



Please contact your account representative or a member of the ASI Engineering staff for assistance with any of your electrochemical sensor or accessory design needs.

## ASI Research and Development

Our business model over the last decade has been to provide the highest level of engineering and research support to our customers as possible. The ASI R&D group spends hours each day running tests for customers. Please do not hesitate to contact us for assistance with your application or request.

In addition to testing, ASI R&D has the responsibility for building prototypes for new products and testing them against customer specifications. We pride ourselves in having the shortest time-to-market on a new product and our R&D team is dedicated to keeping that reputation.

Our R&D group documents all prototype products through their development stage, this enables our production engineers to look at the development of the product and determine if any past changes would benefit the product. This also gives ASI the ability to communicate with our customers on changes as they are happening and work through any changing needs. When a product is completed and ready for production, you can be assured that ASI will have a full set of drawings, models and production procedures in place to build your products in the most efficient manner possible.

Contact ASI today to get your project going, we are ready to measure your success!

# ASI Sales & Manufacturing

## *ASI Sales & Technical Support*

The ASI Sales team are technical experts in electrochemical sensors and related products. Our team is dedicated to bringing our customers the highest quality products designed and tested to their specifications.

Whether you have an obscure question about a process problem, or just need a quote on a common electrode, ASI Sales are ready for your calls daily from 8:30am till 5:30pm Monday thru Friday. Call us today for help, we are ready for your call.

## *ASI Manufacturing*

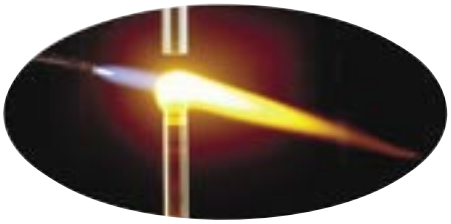
Our manufacturing facilities are in Sugar Land, Texas, located just outside of Houston and in Shanghai, China. Manufacturing at ASI consists of several 'shops' that work independently of one another to come together in assembly for finished products. Our 'shops' consist of:

*Assembly*

Our assembly lines are designed in groups of similar tasks, and thru cross-level training we are able to use individuals on multiple lines of products to ensure production is never interupted. Our assembly group is responsible for the assembly of materials from other shops into a final product ready for final testing and packaging.

*Glass Shop*

The ASI glass shop completes all glass work required to fill an order. This includes pH bulb blowing, glass references, ORP stems and DO stems. Each glass shop employee is trained for several years as an apprentice to a master glass blower before ever blowing a production pH bulb.



*Laboratory*

The lab at ASI is responsible for manufacturing assembly required reference gels, as well as all solution related products sold by ASI. ASI maintains MSDS's on all solution products manufactured at ASI for customer requests.

*Machine Shop*

Our machine shop consists of multiple lathes and mills that manufacture assorted plastic and metal parts used in our production lines. In addition to our manual machines, we also have two CNC vertical mills and two CNC lathes that ensure that all tolerances are met.

*Molding*

ASI molding is located in China at our Aurora branch. This division is responsible for molding all plastic parts that ASI deems high enough volume to support the need.

*Tooling*

ASI tooling is located with our molding operations in China. This is where our steel tools are made for use in our molding operations.

*QC & Packaging*

The last station that every product goes at ASI is our QC and packaging area. ASI is dedicated to customer satisfaction, and to ensure that we test all products (100%) using standard testing methods for each product. By customer request, ASI can complete alternative testing.

*Wire & Connector Assembly*

The wire and connector assembly area at ASI is responsible for completing all cable and connector assemblies required by assembly for products. Our team is very experienced in a multitude of connectors, and all assemblies are tested prior to reaching assembly.

# Aurora Scientific Instruments

471 Guiping Road, Bldg# 7,F-5, Shanghai, China
Phone: 011-86-21-64853728 Fax: 011-86-21-64851290

Aurora Scientific Instruments (Shanghai) Co., Ltd. (ASI-Shanghai), a bright addition to Analytical Sensors & Instruments Ltd. (ASI)

In late 1993, the founders of ASI, Peter and Yuxian Cai, went back to Shanghai, their birthplace to visit their families. During this first trip back to their birthplace, since they moved to the United States, Peter and Yuxian saw that China had just started the open door policy for foreign investment and the legalization of free enterprises. At that time Shanghai did not even have any highways or bridges across the Bund (Huang Pu River in the center of the city), but Peter and Yuxian sensed the vigorous changes on the horizon and predicted that China would be a vital part of the world economy quickly.

Peter and Yuxian officially established Aurora in Shanghai in late 1994 after investigating the details of opening a location in Mainland China and formally opened for business in early 1995.

The missions for Aurora were as follows:

- *Manufacture quality E-Chem sensors, such as pH, ORP, Conductivity, DO and temperature probes with ASI's technology at reduced costs*
- *Manufacture and assemble small instruments and electronic devices for ASI OEM customer's designs*
- *Out-source quality materials and parts at attractive prices for ASI and other customers*
- *Sell ASI high-end sensors, such as ISEs and process electrodes into China markets*
- *Assist our customers to sell their products into China markets*

After ten years' of effort, Aurora, with ASI's support and supervision, has achieved great success in all above areas. Now, Aurora has grown into an organization which currently occupies a space of 15,000 square feet, and has 60 employees in 12 functional departments:

- *Company Management*

- *Company Office*

- *Sales*


- *Purchasing*

- *Engineering*

- *Lab*

- *Glass Shop*

- *Machine Shop*

- *Molding Shop*

- *Assembly Shop*

- *Quality Control*

- *Warehouse & Material Management*

This joint effort that couples the low labor costs of Asia with the solid foundation of U.S. based personnel, services and technology has quickly given Aurora the reputation in both countries as a supplier of products of outstanding quality at extremely beneficial prices.

So the question you might be asking yourself is why am I interested in Aurora - the answer is that their capabilities are not matched in the area of overseas manufacturing. Whether the projects are for tooling of a preamp holder, a new electrode cap or a completely new electrode species to spice up your product line - Aurora is ready and willing to complete your project.

Your next question may be: just what type of project is Aurora capable of handling? Aurora has broadened their capabilities into electronics assembly, machining, injection molding, pH (and other sensing elements) glass blowing, solutions laboratory and much more. These capabilities, added to the extremely efficient ASI engineering team always spells success.

As you may expect, because of the close working relationship between the two companies, Aurora must maintain capabilities that are not always found in companies of its size. In the west, reliable high speed internet access is no longer considered anything special. That is not always the case in China, however. Aurora has both intranet and DSL internet capabilities. Communication is also aided by members of the Aurora staff with special skills. Several of our Aurora employees double as English-Shanghainese-Mandarin Chinese translators as does office staff member Liao. Their abilities to translate English based


documentation including drawings, work instructions, and all the other typical business communications are extremely important to the success of the relationship.

When hiring people, to work even in the most simple areas of assembly, Aurora's management is always very careful to choose only those that are very detail oriented, receptive to new ideas and processes and loyal to the company.

As you can tell, Aurora has the infrastructure, and most importantly, the people to continue to grow and prosper and to help make sure that those of us in the west working with them do the same.

We invite you to visit the Aurora website at www.aurora-sensors.com to learn more about our Mainland China facility. If you have questions about how they would be of value to your company, please contact the ASI sales office in Sugar Land, Texas, USA or contact Aurora directly.