

# IndSen®

## In-line pH/ORP/ISE Electrodes Handbook



Founded in 1991, Apera Instruments specializes in the development and manufacture of electrochemical sensors and instruments. More than 400,000 sensors every year are produced in our ISO 9001 certified factory, serving our customers across more than 50 countries by our companies in U.S.A, Germany, Japan, and China.

Adopting state-of-the-art pH sensor manufacturing technologies and premium key materials from Switzerland, Apera developed LabSen series laboratory pH/ORP/ISE electrodes and IndSen series in-line pH/ORP/ISE electrodes, aiming to provide extraordinary products and services to ensure the success of our clients for their measurement and monitoring purposes.

Monitoring the pH and ORP of in-line process can be widely applied in the fields such as chemical industry, food and beverage, biotechnology, pharmaceutical industry, etc, which require high-quality continuous monitoring in harsh chemical processes, high hygiene standard, in-situ sterilization, etc. Undoubtedly, advanced sensor technologies plays an indispensable role in these areas. Compared to laboratory tests, in-line process monitoring has higher demands on the stability, reliability, and longevity of the electrodes.

This handbook illustrates our sensor technologies and structures, offering solutions based on applications. And it recommends the appropriate electrode selection. With our knowledge, experience, and quality control, we strive to provide you with the most professional and timely support for your success.

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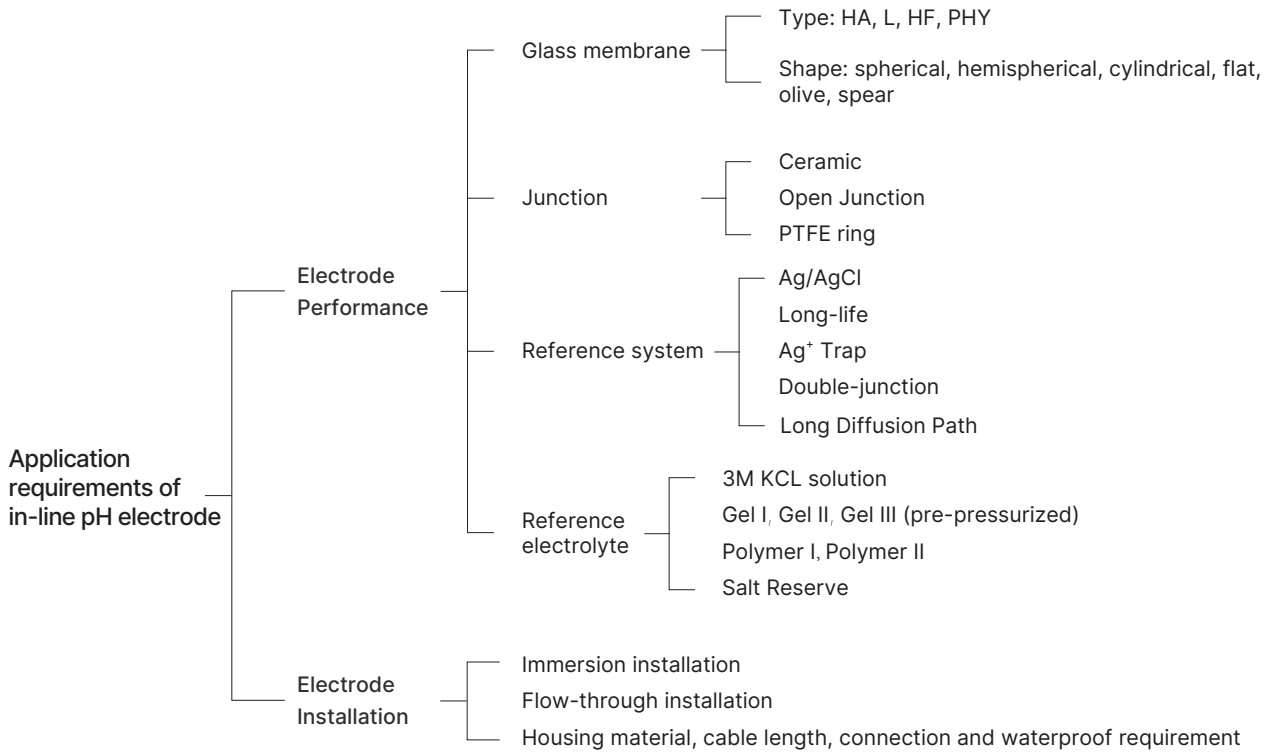
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# IndSen pH Electrode Technology

In addition to the requirements for electrode installation, pH electrodes used for industrial process control also have more requirements for electrode performance, which is reflected on the design of structure and parameter of each electrode.

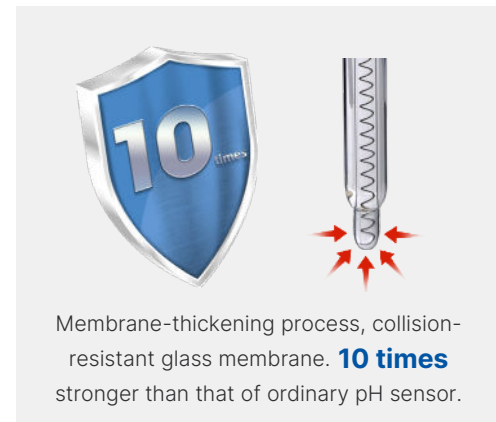


## [ Type of Glass Membrane ]

pH sensitive glass membrane senses the H<sup>+</sup> activity in solutions. The quality of glass membrane depends on the formula type and membrane shape, which is the core technologies of pH electrode.

The following four glass membranes are commonly used in industrial pH electrodes

|              |                                                                                                               |
|--------------|---------------------------------------------------------------------------------------------------------------|
| HA membrane  | Designed for high pH value and high temperature monitoring with minimal alkali error                          |
| L membrane   | With the lowest possible impedance, this membrane is for solutions with low ionic strength or low temperature |
| HF membrane  | Hydrofluoric acid resistant glass membrane for solutions containing hydrofluoric acid                         |
| PHY membrane | Strongest membrane, resistant to high temperature, chemical corrosion, ideal for sterilization & autoclaving  |



## [ Shape of Glass Membrane ]

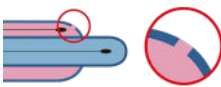
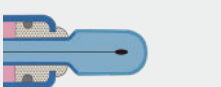


IndSen industrial pH glass membrane is produced using a membrane-thickening process with a glass lathe, which can form various shapes of glass membranes, including cylindrical and olive shapes that increase surface area and reduce membrane impedance, as well as flat and spear shapes that meet functional requirements.

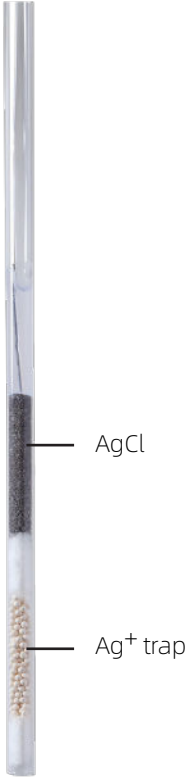
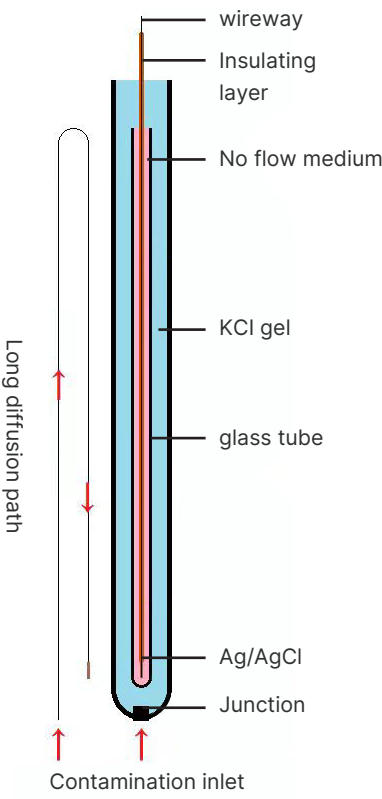
# IndSen pH Electrode Technology

## [ Junction ]

The junction is the interface between reference system and sample solution. IndSen electrodes has the following junction types.

| Type             | Diagram                                                                           | Remark                                                                                                                                                                                                             |
|------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ceramic Junction |  | Made with porous ceramic material, slow electrolyte outflow, vulnerable to contamination and clogging. It is suitable for water treatment or sewage works, industrial processes, etc.                              |
| Open Junction    |  | Solid polymer electrolyte and open junction allow direct full contact with solutions, no clogging and maintenance free. Suitable for heavily contaminated media, including varnishes, oils, suspensions, and more. |
| PTFE Junction    |  | Porous PTFE ring, water repellent, resistant to chemical corrosions and high temperature, low risk of contamination or clogging. Only for very contaminated and adherent media or oily media.                      |

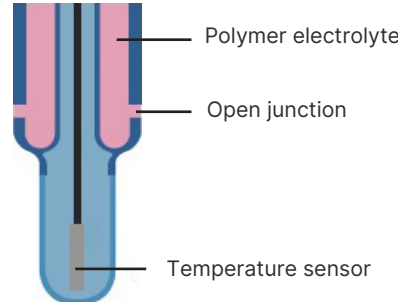
## [ Reference system ]

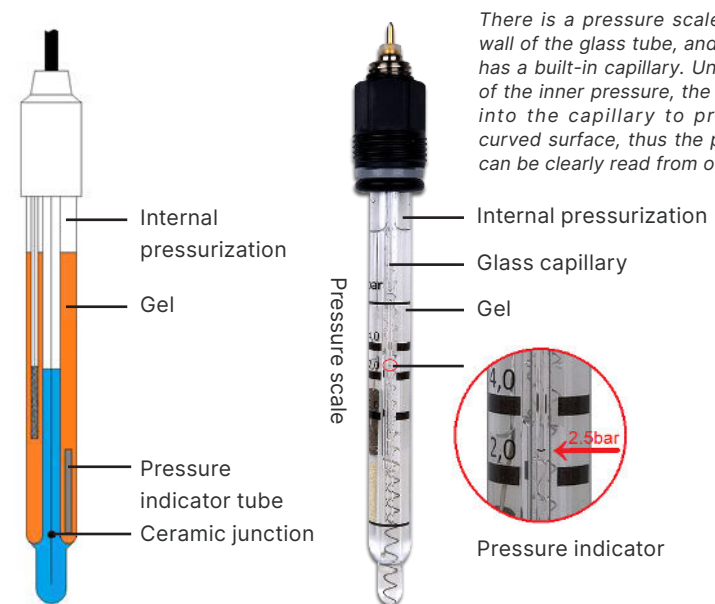
| Long-life Reference System                                                                                                                                                                                                     | Ag <sup>+</sup> Trap Reference System                                                                                                                                                                                             | Long Diffusion Path Reference System                                                                                                                                                                                                                               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                              |                                                                                                                                                 |                                                                                                                                                                                |
| <p>To ensure the long-term stability of the reference electrode, the reference electrolyte does not contain silver ions, which prevents the reaction with sulfides or proteins in sample solutions that clog the junction.</p> | <p>The Ag<sup>+</sup> trap absorbs the exuded silver ions, ensuring that the reference electrolyte is free of Ag<sup>+</sup>, and preventing samples containing sulfides and amino acids from poisoning the reference system.</p> | <p>There are two reference electrolyte systems — an anti-poisoning long diffusion path and a non-flow medium inside the second reference system, which greatly delay the contaminants diffusion and effectively keep the stability of the reference potential.</p> |

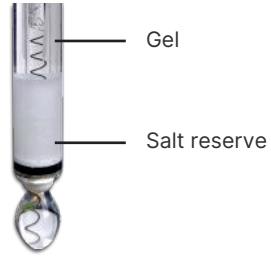
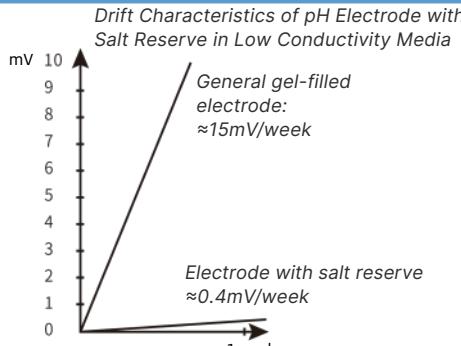
# IndSen pH Electrode Technology

## [ Reference Electrolyte ]

The reference electrolyte, mainly 3M KCl solution, was originally simple, but as in-line pH and ORP sensors have high requirement for long-term stability, resistance to high temperature, high pressure and contamination in complex chemical applications as well as withstanding the sterilization and disinfection processes in pharmaceutical and biological applications, many new reference electrolyte technologies have emerged. IndSen pH and ORP electrodes adopt the following special reference electrolytes.

| Polymer Electrolyte                                                                                                                                                                                                                          |                                                                                                                                                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Open junction, polymer electrolyte in direct contact with sample, pressure resistant to 6 bar, suitable for almost all measurement areas, including oily samples, low ionic strength samples, protein samples and suspension samples.</p> |  <p>Polymer electrolyte</p> <p>Open junction</p> <p>Temperature sensor</p> |

| Pre-pressurized Electrolyte                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The pre-pressurized gel electrolyte ensures the junction is continuously subject to cleaning by the constant outflow of small amounts of electrolyte.</p> <p>Figure A shows the conventional process.</p> <p>Figure B shows a patented new process with direct pressure reading.</p> |  <p>Internal pressurization</p> <p>Gel</p> <p>Pressure indicator tube</p> <p>Ceramic junction</p> <p>Internal pressurization</p> <p>Glass capillary</p> <p>Gel</p> <p>Pressure scale</p> <p>Pressure indicator</p> <p>There is a pressure scale on the inner wall of the glass tube, and the electrode has a built-in capillary. Under the action of the inner pressure, the gel is pressed into the capillary to produce a tiny curved surface, thus the pressure value can be clearly read from outside.</p> |
| Figure A Conventional Process                                                                                                                                                                                                                                                           | Figure B Readable Pre-Pressurization Process (Swiss Patent)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

| Salt storage electrolyte                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>With salt reserve, the stability of pH electrode in low conductivity solution is greatly improved.</p> |  <p>Gel</p> <p>Salt reserve</p>  <p>Drift Characteristics of pH Electrode with Salt Reserve in Low Conductivity Media</p> <p>mV</p> <p>General gel-filled electrode: <math>\approx 15\text{mV/week}</math></p> <p>Electrode with salt reserve <math>\approx 0.4\text{mV/week}</math></p> <p>1week</p> |

# pH Measurement and Electrode Selection

## [ IndSen 912/931 Series ]

In-line pH electrodes suitable for surface water, wastewater, and strong alkali solutions



IndSen 912-S8



IndSen 931-S8

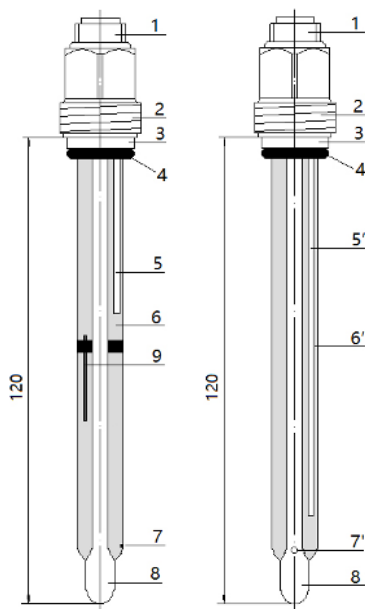
|                       | IndSen 912                                                                             | IndSen 931           |
|-----------------------|----------------------------------------------------------------------------------------|----------------------|
| pH Range              | 0~14 pH                                                                                |                      |
| Temperature Range     | 0~100 °C                                                                               | 0~80 °C              |
| Pressure              | 6 bar                                                                                  |                      |
| Cable Connection      | Cab, S3, S8, P8 and VP<br>(see P22 "Electrode Interfaces and Cable Wires" for details) |                      |
| Process Connection    | Silicone cap: none; Remaining connections: PG13.5                                      |                      |
| Reference System      | Long life reference                                                                    | Ag <sup>+</sup> trap |
| Junction Type         | Ceramics×1                                                                             | Open×2               |
| Reference Electrolyte | Gel II+second junction                                                                 | Polymer I            |
| Shaft Length          | 120 mm                                                                                 |                      |
| Shaft Diameter        | 12 mm                                                                                  |                      |
| Shaft Material        | Lead-free glass                                                                        |                      |
| Temperature Sensor    | Options: None, Pt1000, Pt100, NTC                                                      |                      |
| Glass Membrane        | HA                                                                                     |                      |

### Electrode Features

- IndSen 912: The double-junction reference structure prevents electrode contamination and provides better long-term stability.
- IndSen 931: Open junction and polymer electrolyte for direct contact with samples without contamination.
- HA alkali-resistant glass membrane, which greatly reduces alkali errors in pH electrodes and is suitable for a wide variety of applications.
- IndSen 931: The Ag<sup>+</sup> trap reference system effectively prevents solutions containing sulfides or amino acids from poisoning the junction.
- Different types of temperature sensors can be selected as needed to achieve automatic temperature compensation.

#### \*Note

pH monitoring of in-line process involves many special requirements and uncertainties. Feel free to contact us directly if you find it challenging to get reliable testing results. We will be able to customize the most appropriate electrode for you.



|                                   |                         |
|-----------------------------------|-------------------------|
| 1-S8 connection                   | 6-Gel                   |
| 2-PG13.5 thread                   | 6'-Polymer              |
| 3-Washer                          | 7-Ceramics×1            |
| 4-Seal ring                       | 7'-Open Junction×2      |
| 5-Long life reference             | 8-pH sensitive membrane |
| 5'-Ag <sup>+</sup> trap reference | 9- Second junction      |

### Ordering information (give an example)

| Model                   | Length | Temp.  | Connector | Cable       |
|-------------------------|--------|--------|-----------|-------------|
| IndSen 912-Cab/3        | 120 mm | N/A    | Cab/3m    | N/A         |
| IndSen 912-Cab/3-Pt1000 | 120 mm | Pt1000 | Cab/3m    | N/A         |
| IndSen 912-S8           | 120 mm | N/A    | S8        | AS9/1 – 15m |
| IndSen 912-MP4-Pt1000   | 120 mm | Pt1000 | MP4       | MP5/1 – 15m |
| IndSen 931-Cab/3        | 120 mm | N/A    | Cab/3m    | N/A         |
| IndSen 931-Cab/3-Pt1000 | 120 mm | Pt1000 | Cab/3m    | N/A         |
| IndSen 931-S8           | 120 mm | N/A    | S8        | AS9/1 – 15m |
| IndSen 931-MP4-Pt1000   | 120 mm | Pt1000 | MP4       | MP5/1 – 15m |



# pH Measurement and Electrode Selection

## [ IndSen 915/925/917/919 Series ]

In-line pH electrodes suitable for low temperature, low ionic strength solutions and pure water

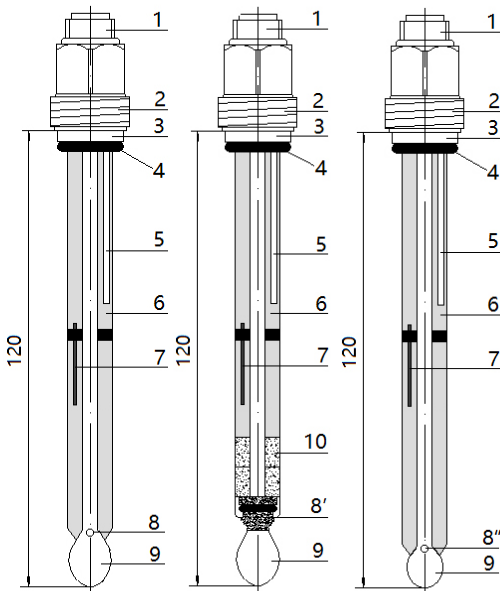


IndSen 915-S8

IndSen 925-S8

IndSen 917-S8

|                       | IndSen 915                                                                             | IndSen 925                            | IndSen 917                | IndSen 919              |
|-----------------------|----------------------------------------------------------------------------------------|---------------------------------------|---------------------------|-------------------------|
| pH range              | 0~11 pH                                                                                |                                       |                           |                         |
| Temperature           | -5~80 °C                                                                               |                                       | -30~80 °C                 | -5~80 °C                |
| Pressure              | 6 bar                                                                                  |                                       |                           | 10 bar                  |
| Cable Connection      | Cab, S3, S8, P8 and VP<br>(see P22 "Electrode Interfaces and Cable Wires" for details) |                                       |                           |                         |
| Process Connection    | Silicone cap: none; Remaining connections: PG13.5                                      |                                       |                           |                         |
| Reference System      | Long-life reference                                                                    |                                       |                           | Ag <sup>+</sup> trap    |
| Junction Type         | Ceramics ×3                                                                            | PTFE ring                             | Ceramics ×1               | Ceramics ×1             |
| Reference Electrolyte | Gel I / Gel II + Second junction                                                       | Gel II+ Second junction+ Salt reserve | Gel III + Second junction | Pre-pressurized gel III |
| Shaft Length          | 120 mm                                                                                 |                                       |                           |                         |
| Shaft diameter        | 12 mm                                                                                  |                                       |                           |                         |
| Shaft materials       | Lead-free glass                                                                        |                                       |                           |                         |
| Temperature sensor    | Options: None, Pt1000, Pt100, NTC                                                      |                                       |                           |                         |
| Membrane/ Impedance   | L / 50 MΩ                                                                              |                                       |                           |                         |



|                       |                   |
|-----------------------|-------------------|
| 1-S8 connection       | 7-Second junction |
| 2-PG13.5 thread       | 8-Ceramics×3      |
| 3-Washer              | 8'-PTFE ring      |
| 4-Seal ring           | 8"-Ceramics×1     |
| 5-Long life reference | 9- pH membrane    |
| 6-Gel                 | 10-Salt reserve   |

### Electrode Features

- IndSen 915: Three ceramic junctions increase the ion concentration around the bulb to improve measurement stability.
- IndSen 917: -30°C will not freeze using Gel III reference electrolyte.
- IndSen 919: Using pre-pressurized gel and a ceramic junctions ensures stable electrolyte outflow during measurement.
- The L glass membrane featured with the lowest possible impedance is suited for low ionic strength, low temperature and pure water use.
- The double-junction structure effectively obstructs the reference poisoning and prolongs the electrode's service life.

#### \*Note

pH monitoring of in-line process involves many special requirements and uncertainties. Feel free to contact us directly if you find it challenging to get reliable testing results. We will be able to customize the most appropriate electrode for you.

### Ordering information (give an example)

| Model                | Length | Temp.  | Connector | Cable      |
|----------------------|--------|--------|-----------|------------|
| IndSen 915-Cab/3     | 120 mm | N/A    | Cab/3m    | N/A        |
| IndSen 915-P8-Pt1000 | 120 mm | Pt1000 | P8        | AP9/1 ~15m |
| IndSen 925-Cab/3     | 120 mm | N/A    | Cab/3m    | N/A        |
| IndSen 925-P8-Pt1000 | 120 mm | Pt1000 | P8        | AP9/1 ~15m |
| IndSen 917-Cab/3     | 120 mm | N/A    | Cab/3m    | N/A        |
| IndSen 917-P8-Pt1000 | 120 mm | Pt1000 | P8        | AP9/1 ~15m |
| IndSen 919-Cab/3     | 120 mm | N/A    | Cab/3m    | N/A        |
| IndSen 919-P8-Pt1000 | 120 mm | Pt1000 | P8        | AP9/1 ~15m |

# pH Measurement and Electrode Selection

## [ IndSen 933/934/941 Series ]

In-line pH electrodes for strong acid, high temperature, corrosive, high pressure and viscous solutions



IndSen 933-S8    IndSen 934-S8    IndSen 941-S8

|                              | IndSen 933                                                                             | IndSen 934 | IndSen 941              |
|------------------------------|----------------------------------------------------------------------------------------|------------|-------------------------|
| pH Range                     | 0~11 pH                                                                                | 0~13 pH    | 0~14 pH                 |
| Temperature Range            | 0~80 °C                                                                                | 0~130 °C   | 0~100 °C                |
| Pressure                     | 6 bar                                                                                  | 10 bar     | 6 bar                   |
| Cable Connection             | Cab, S3, S8, P8 and VP<br>(see P22 "Electrode Interfaces and Cable Wires" for details) |            |                         |
| Process Connection           | Silicone cap: none; Remaining connections: PG13.5                                      |            |                         |
| Reference Systems            | Ag <sup>+</sup> trap                                                                   |            |                         |
| Junction Type                | Open ×2                                                                                | Open ×2    | Ceramics×1              |
| Reference Electrolyte        | Polymer I                                                                              | Polymer II | Pre pressurized gel III |
| Shaft Length                 | 120 mm                                                                                 |            |                         |
| Shaft Diameter               | 12 mm                                                                                  |            |                         |
| Shaft Material               | Lead-free glass                                                                        |            |                         |
| Temperature Sensor           | Options: None, Pt1000, Pt100 and NTC                                                   |            |                         |
| Glass Membrane               | HF                                                                                     | HA or PHY  | HA                      |
| Solution grounding electrode | Optional                                                                               |            |                         |

### Electrode Features

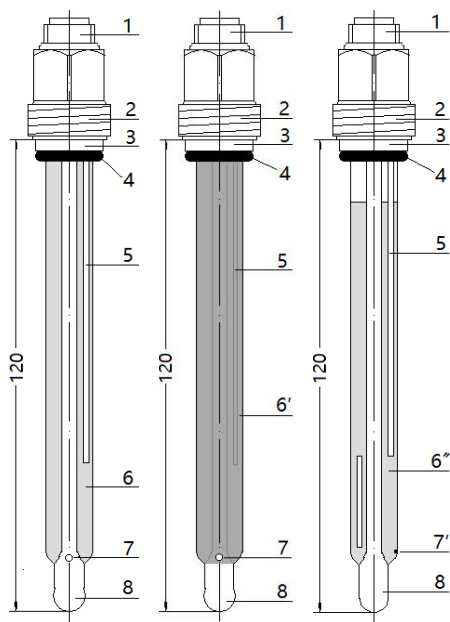
- IndSen 933: HF glass membrane is suitable for hydrofluoric acid solutions and strong acid solutions
- IndSen 934: HA membrane, which greatly reduces alkali errors in pH electrodes, is suitable for a wide range of applications; PHY glass membrane is suitable for high temperature, corrosive and complex liquids (e.g. electroplating solution).
- IndSen 941: Pre-pressurized gel is suitable for high pressure and viscous liquids.
- The Ag<sup>+</sup> trap reference system effectively prevents solutions containing sulfides or amino acids from poisoning the junction.
- Different types of temperature sensors can be selected as needed to achieve automatic temperature compensation.

#### \*Note

pH monitoring of in-line process involves many special requirements and uncertainties. Feel free to contact us directly if you find it challenging to get reliable testing results. We will be able to customize the most appropriate electrode for you.

### Ordering information (give an example)

| Model                   | Length | Temp.  | Connector | Cable     |
|-------------------------|--------|--------|-----------|-----------|
| IndSen 933-Cab/3        | 120 mm | N/A    | Cab/3m    | N/A       |
| IndSen 933-Cab/3-Pt1000 | 120 mm | Pt1000 | Cab/3m    | N/A       |
| IndSen 933-S8           | 120 mm | N/A    | S8        | AS9/1~15m |
| IndSen 933-P8-Pt1000    | 120 mm | Pt1000 | P8        | AP9/1~15m |
| IndSen 934-Cab/3        | 120 mm | N/A    | Cab/3m    | N/A       |
| IndSen 934-Cab/3-Pt1000 | 120 mm | Pt1000 | Cab/3m    | N/A       |
| IndSen 934-S8           | 120 mm | N/A    | S8        | AS9/1~15m |
| IndSen 934-P8-Pt1000    | 120 mm | Pt1000 | P8        | AP9/1~15m |



|                                  |                             |
|----------------------------------|-----------------------------|
| 1-S8 connection                  | 6'-High temperature polymer |
| 2-PG13.5 thread                  | 6''-Pre pressurized gel     |
| 3-Washer                         | 7-Open ×2                   |
| 4-Seal ring                      | 7'-Ceramics×1               |
| 5-Ag <sup>+</sup> trap reference | 8- pH membrane              |
| 6-Polymer                        |                             |



# pH Measurement and Electrode Selection

## [ IndSen 405 Series ]

In-line pH electrodes for biotech, life science, and pharmaceutical applications



IndSen 405-P-120-K8S

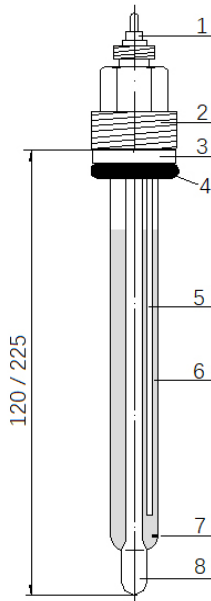
|                       | IndSen 405-P-120                                                            |
|-----------------------|-----------------------------------------------------------------------------|
| Measurement Range     | 0~12 pH                                                                     |
| Temperature Range     | Operating temperature: 0 – 100 °C;<br>sterilization temperature: 0 – 130 °C |
| Operating Pressure    | 2.5 bar                                                                     |
| Cable Connection      | K8S or S8                                                                   |
| Process Connection    | PG13.5                                                                      |
| Reference System      | Ag <sup>+</sup> trap                                                        |
| Junction Type         | Ceramics × 1                                                                |
| Reference Electrolyte | Pre-pressurized gel III<br>(P - Swiss patented tech, G - general tech)      |
| Shaft Length          | 120 mm/225 mm                                                               |
| Shaft Diameter        | 12 mm                                                                       |
| Shaft Materials       | Lead-free glass                                                             |
| Temperature Sensor    | /                                                                           |
| Sterilizable          | Yes                                                                         |
| Autoclavable          | Yes                                                                         |
| Glass Membrane        | HA                                                                          |

### Electrode Features

- IndSen 405: Any ingress of process medium into the reference system is avoided by the pre-pressurized electrolyte. The electrode can withstand repeated sterilization and autoclaving at 130 °C.
- The Ag<sup>+</sup> trap reference system effectively prevents solutions containing sulfides or amino acids from poisoning the junction.
- Different lengths of cables and connectors are available as needed.

#### \*Note

pH monitoring of in-line process involves many special requirements and uncertainties. Feel free to contact us directly if you find it challenging to get reliable testing results. We will be able to customize the most appropriate electrode for you.



|                 |                                  |
|-----------------|----------------------------------|
| 1-K8S Connector | 5-Ag <sup>+</sup> trap reference |
| 2-PG13.5 Thread | 6-Pre-pressurized gel            |
| 3-Washer        | 7-Ceramics                       |
| 4-Seal ring     | 8-pH membrane                    |

### Ordering information (give an example)

| Model                | Length | Temp. | Connector | Cable     |
|----------------------|--------|-------|-----------|-----------|
| IndSen 405-P-120-K8S | 120 mm | N/A   | K8S       | AK9/1~15m |
| IndSen 405-P-225-K8S | 225 mm | N/A   | K8S       | AK9/1~15m |
| IndSen 405-P-120-S8  | 120 mm | N/A   | S8        | AS9/1~15m |
| IndSen 405-P-225-S8  | 120 mm | N/A   | S8        | AK9/1~15m |

*Note: IndSen 405-P are pre-pressurized gels using the Swiss patented technology.*

*IndSen 405-G are pre-pressurized gels using the general process. See P3 for details.*

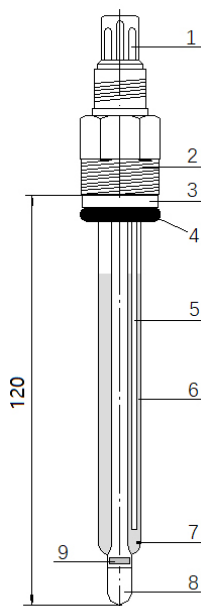
# pH Measurement and Electrode Selection

## [ IndSen 3253/3253S Series ]

In-line pH electrodes for life science and pharmaceutical industries (with built-in temp. sensor & solution ground)



IndSen 3253S-P-120-VP



|                                  |                       |
|----------------------------------|-----------------------|
| 1-VP Connector                   | 6-Pre-pressurized gel |
| 2-PG13.5 thread                  | 7-Ceramics            |
| 3-Washer                         | 8- pH membrane        |
| 4-Seal ring                      | 9-Platinum sensor     |
| 5-Ag <sup>+</sup> trap reference |                       |

|                       | IndSen 3253-P-120-VP                                                        | IndSen 3253S-P-120-VP                            |
|-----------------------|-----------------------------------------------------------------------------|--------------------------------------------------|
| Measurement Range     | 0~12 pH                                                                     |                                                  |
| Temperature Range     | Operating temperature: 0 – 100 °C;<br>sterilization temperature: 0 – 140 °C |                                                  |
| Operating Pressure    | 4 bar                                                                       |                                                  |
| Cable Connection      | VP or P8                                                                    |                                                  |
| Process Connection    | PG13.5                                                                      |                                                  |
| Reference System      | Ag <sup>+</sup> trap                                                        |                                                  |
| Junction Type         | Ceramic × 1                                                                 |                                                  |
| Reference Electrolyte | Pre-pressurized gel III<br>(P - patented technology, G - general process)   |                                                  |
| Shaft Length          | 120 mm                                                                      |                                                  |
| Shaft Diameter        | 12 mm                                                                       |                                                  |
| Shaft Material        | Lead-free glass                                                             |                                                  |
| Temperature Sensor    | Options: Pt1000 or Pt100                                                    |                                                  |
| Sterilizable          | Yes                                                                         |                                                  |
| Autoclavable          | Yes                                                                         |                                                  |
| Glass Membrane        | PHY                                                                         |                                                  |
| Solution Ground       | /                                                                           | Auxiliary platinum sensor<br>(good for ORP test) |

### Electrode Features

- The PHY membrane and pre-pressurized gel electrolyte make the electrode optimized for autoclaving and in-situ sterilization, withstanding repeated sterilization at up to 140 °C without loss of performance and minimal zero-point offset.
- IndSen 3253S: Equipped with an auxiliary platinum sensor, serving as the solution ground for preventing measurement errors due to ground potentials as well as redox (ORP) measurement electrode.
- The Ag<sup>+</sup> trap reference system effectively prevents solutions containing sulfides or amino acids from poisoning the junction.

#### \*Note

pH monitoring of in-line process involves many special requirements and uncertainties. Feel free to contact us directly if you find it challenging to get reliable testing results. We will be able to customize the most appropriate electrode for you.

### Ordering information (give an example)

| Model                        | Length | Temp.  | Grounding | Cable | Connector |
|------------------------------|--------|--------|-----------|-------|-----------|
| IndSen 3253-P-120-VP-Pt1000  | 120 mm | Pt1000 | N/A       | VP    | VP6/1~15m |
| IndSen 3253-G-120-VP-Pt1000  | 120 mm | Pt1000 | N/A       | VP    | VP6/1~15m |
| IndSen 3253-P-120-P8-Pt1000  | 120 mm | Pt1000 | N/A       | P8    | AP9/1~15m |
| IndSen 3253-G-120-P8-Pt1000  | 120 mm | Pt1000 | N/A       | P8    | AP9/1~15m |
| IndSen 3253S-P-120-VP-Pt1000 | 120 mm | Pt1000 | Yes       | VP    | VP6/1~15m |
| IndSen 3253S-G-120-VP-Pt1000 | 120 mm | Pt1000 | Yes       | VP    | VP6/1~15m |

Note: IndSen 3253-P and IndSen 3253S-P are pre-pressurized gels using the Swiss patented technology.  
IndSen 3253-G and IndSen 3253S-G are pre-pressurized gels using the general process. See P3 for details.

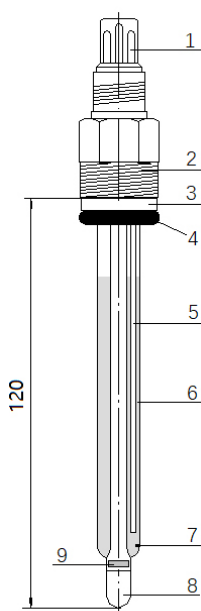
# pH Measurement and Electrode Selection

## [ IndSen 3250/3250S Series ]

In-line pH electrodes for biotech and pharmaceutical industries (with built-in temp. sensor& solution ground)



IndSen 3250S-P-120-VP



|                                    |                       |
|------------------------------------|-----------------------|
| 1-VP Connector                     | 6-Pre-pressurized gel |
| 2-PG13.5 thread                    | 7-Ceramics            |
| 3-Washer                           | 8- pH membrane        |
| 4-Seal ring                        | 9-Platinum sensor     |
| 5 - Ag <sup>+</sup> trap reference |                       |

|                       | IndSen 3250-P-120                                                          | IndSen 3250S-P-120-VP                            |
|-----------------------|----------------------------------------------------------------------------|--------------------------------------------------|
| Measurement Range     | 0~14 pH                                                                    |                                                  |
| Temperature Range     | Operating temperature: 0~100 °C;<br>Sterilization temperature: 0~130 °C    |                                                  |
| Operating Pressure    | 4 bar                                                                      |                                                  |
| Cable Connection      | VP or P8                                                                   | VP                                               |
| Process Connection    | PG13.5                                                                     |                                                  |
| Reference System      | Ag <sup>+</sup> trap                                                       |                                                  |
| Junction Type         | Ceramic × 1                                                                |                                                  |
| Reference Electrolyte | Pre-pressurized gel III<br>(P - patented technology , G - general process) |                                                  |
| Shaft Length          | 120 mm                                                                     |                                                  |
| Shaft Diameter        | 12 mm                                                                      |                                                  |
| Shaft Material        | Lead-free glass                                                            |                                                  |
| Temperature Sensor    | Optional: Pt1000 or Pt100                                                  |                                                  |
| Sterilizable          | Yes                                                                        |                                                  |
| Autoclavable          | Yes                                                                        |                                                  |
| Glass Membrane        | HA                                                                         |                                                  |
| Solution Grounding    | /                                                                          | Auxiliary platinum sensor<br>(good for ORP test) |

### Electrode Features

- The combination of HA membrane and the pre-pressurized electrolyte is suited to a wide variety of applications in the biotechnology, pharmaceutical and chemical process industries, and is resistant to high temperature and strong alkali solutions.
- IndSen 3250S: Equipped with an auxiliary platinum sensor, serving as the solution ground for effectively eliminating the risk of electrostatic interference as well as redox (ORP) measurement electrode.
- The Ag<sup>+</sup> trap reference system effectively prevents solutions containing sulfides or amino acids from poisoning the junction.

### \*Notes

pH monitoring of in-line process involves many special requirements and uncertainties. Feel free to contact us directly if you find it challenging to get reliable testing results. We will be able to customize the most appropriate electrode for you.

### Ordering information (give an example)

| Model                        | Length | Temp.  | Grounding | Cable | Connector |
|------------------------------|--------|--------|-----------|-------|-----------|
| IndSen 3250-P-120-VP-Pt1000  | 120 mm | Pt1000 | N/A       | VP    | VP6/1~15m |
| IndSen 3250-G-120-VP-Pt1000  | 120 mm | Pt1000 | N/A       | VP    | VP6/1~15m |
| IndSen 3250-P-120-P8-Pt1000  | 120 mm | Pt1000 | N/A       | P8    | AP9/1~15m |
| IndSen 3250-G-120-P8-Pt1000  | 120 mm | Pt1000 | N/A       | P8    | AP9/1~15m |
| IndSen 3250S-P-120-VP-Pt1000 | 120 mm | Pt1000 | Yes       | VP    | VP6/1~15m |
| IndSen 3250S-G-120-VP-Pt1000 | 120 mm | Pt1000 | Yes       | VP    | VP6/1~15m |

*Note: IndSen 3250-P and IndSen 3250S-P are pre-pressurized gels using the Swiss patented technology.*

*IndSen 3250-G and IndSen 3250S-G are pre-pressurized gels using the general process. See P3 for details.*

# pH Measurement and Electrode Selection

## [ IndSen 4800/4800F/4802 Series ]

In-line pH electrodes for harsh environment and aggressive chemical process (with built-in temp. sensor)



IndSen 4800-120

IndSen 4800F

IndSen 4802

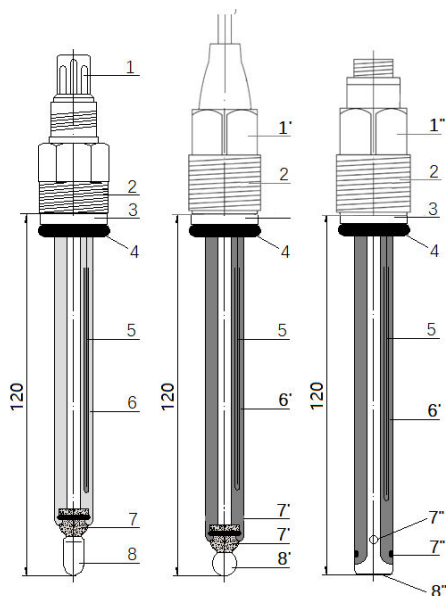
|                       | IndSen 4800-120               | IndSen 4800F   | IndSen 4802          |
|-----------------------|-------------------------------|----------------|----------------------|
| Measurement Range     | 0~14 pH                       |                |                      |
| Temperature Range     | 0~130 °C                      |                |                      |
| Operating Pressure    | 10 bar                        | 13 bar         | 13 bar               |
| Cable Connection      | VP, P8 or S3                  |                |                      |
| Process Connection    | PG13.5                        |                |                      |
| Reference System      | Long diffusion path           |                |                      |
| Junction Type         | PTFE Ring                     | PTFE + Open x2 | Ceramic x2 + Open x2 |
| Reference Electrolyte | Gel II                        | Polymer II     | Polymer II           |
| Shaft Length          | 120 mm                        |                |                      |
| Shaft Diameter        | 12 mm                         |                |                      |
| Shaft Material        | Lead-free glass               |                |                      |
| Temperature Sensor    | Options: Pt1000, Pt100 or NTC |                |                      |
| Sterilizable          | N/A                           |                |                      |
| Autoclavable          | N/A                           |                |                      |
| Glass Membrane        | HA / Cylindrical              | HA / Spherical | HA / Φ10 Flat        |
| Solution Grounding    | Optional                      |                |                      |

### Electrode Features

- IndSen 4800 offers prolonged service life and reliable measurements in aggressive chemicals e.g. oxidizing media, strong acid or alkali solutions, sulfide-bearing media, or at high operational pressures.
- The combination of the long diffusion path reference system and the gel electrolyte delays the diffusion of contamination and effectively resists the poisoning of the reference electrode, significantly reducing electrode maintenance and frequency of replacement.
- Φ10 flat film, impact resistant and anti-abrasion, effectively improves the impact of water flow containing solid particles and improves the life of the glass film.
- The HA high alkali resistant glass membrane greatly reduces the pH electrode alkali error and can be used at up to 130 °C.

### \*Notes

pH monitoring of in-line process involves many special requirements and uncertainties. Feel free to contact us directly if you find it challenging to get reliable testing results. We will be able to customize the most appropriate electrode for you.



|                                 |                       |
|---------------------------------|-----------------------|
| 1-VP Connector                  | 6'-Polymer            |
| 1'-S3 Connector                 | 7-PTFE ring           |
| 1''-P8 Connector                | 7''-PTFE+ Open        |
| 2-PG13.5 Thread                 | 7''-Ceramic + Open    |
| 3-Washer                        | 8-HA Cylindrical Film |
| 4-Seal ring                     | 8'-HA Spherical film  |
| 5-Long diffusion path reference | 8''-Φ10 HA Flat film  |
| 6-Gel                           |                       |

### Ordering information (give an example)

| Model                        | Length | Temp.  | Grounding | Cable | Connector |
|------------------------------|--------|--------|-----------|-------|-----------|
| IndSen 4800-120-VP-Pt1000    | 120 mm | Pt1000 | N/A       | VP    | VP6/1~15m |
| IndSen 4800-120-P8-Pt1000    | 120 mm | Pt1000 | N/A       | P8    | AP9/1~15m |
| IndSen 4800F-120-VP-Pt1000   | 120 mm | Pt1000 | N/A       | VP    | VP6/1~15m |
| IndSen 4800F-120-P8-Pt1000   | 120 mm | Pt1000 | N/A       | P8    | AP9/1~15m |
| IndSen 4802-HA-120-VP-Pt1000 | 120 mm | Pt1000 | N/A       | VP    | VP6/1~15m |
| IndSen 4802-HA-120-P8-Pt1000 | 120 mm | Pt1000 | N/A       | P8    | AP9/1~15m |

# pH Measurement and Electrode Selection

## [ IndSen 4260/4260F Series ]

In-line pH electrodes for highly demanding chemical processes

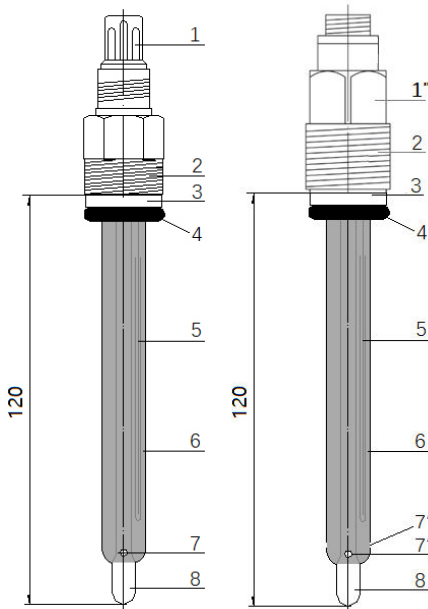


IndSen 4260-120-VP



IndSen 4260F-120-P8

|                       | IndSen 4260-120                     | IndSen 4260F-120 |
|-----------------------|-------------------------------------|------------------|
| Measurement Range     | 0~14 pH                             |                  |
| Temperature Range     | 0~130 °C                            |                  |
| Operating Pressure    | 10 bar                              | 13 bar           |
| Cable Connection      | VP, P8 or S3                        |                  |
| Process Connection    | PG13.5                              |                  |
| Reference System      | Long diffusion path                 |                  |
| Junction Type         | Open ×2                             | Ceramic + Open   |
| Reference Electrolyte | Polymer II                          |                  |
| Shaft Length          | 120 mm                              |                  |
| Shaft Diameter        | 12 mm                               |                  |
| Shaft Material        | Lead-free glass                     |                  |
| Temperature Sensor    | Options: None, Pt1000, Pt100 or NTC |                  |
| Sterilizable          | N/A                                 |                  |
| Autoclavable          | N/A                                 |                  |
| Glass Membrane        | HA                                  |                  |
| Solution Grounding    | Optional                            |                  |



### Electrode Features

- Designed for highly demanding chemical processes including high temperature and pressure, low ionic strength solutions, organic solvents, suspensions, emulsions and protein-containing solutions, and especially insensitive to anionic salt content such as nitrates, sulfates and carbonates.
- The combination of high-temp. polymer electrolyte and the open junction are equipped to resist toxic substances and eliminate reference contamination and junction clogging.
- The long diffusion path reference system delays the diffusion of contamination and effectively resists the poisoning of the reference electrode, significantly reducing electrode maintenance and frequency of replacement.
- The HA high alkali resistant glass membrane greatly reduces the pH electrode alkali error and can be used at up to 130 °C.

### \*Notes

pH monitoring of in-line process involves many special requirements and uncertainties. Feel free to contact us directly if you find it challenging to get reliable testing results. We will be able to customize the most appropriate electrode for you.

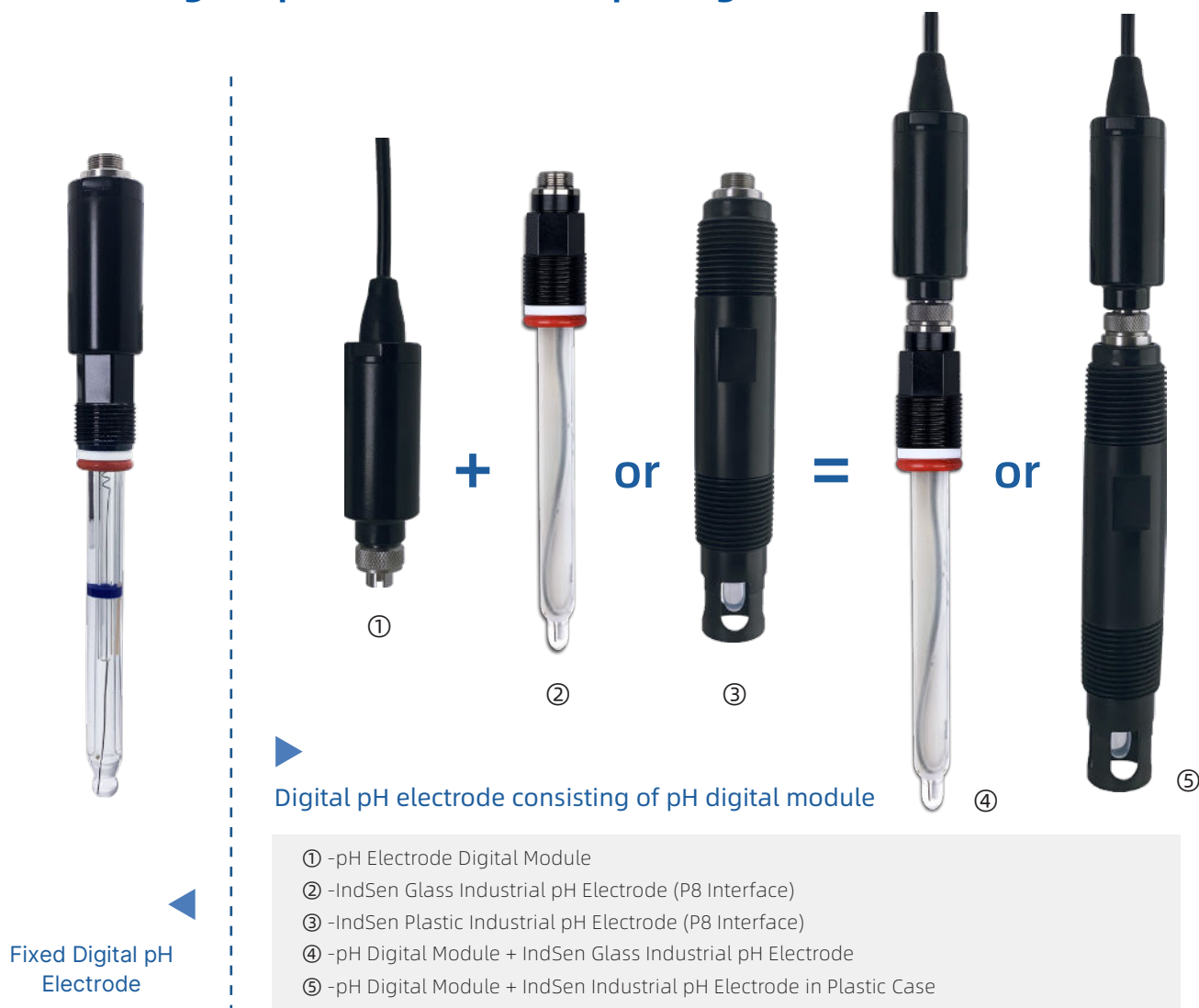
### Ordering information (give an example)

|                 |                                 |
|-----------------|---------------------------------|
| 1-VP Connector  | 5-Long diffusion path reference |
| 1'-P8 Connector | 6-Polymer II                    |
| 2-PG13.5 Thread | 7-Open×2                        |
| 3-Washer        | 7'-Ceramic + Open               |
| 4-Seal Ring     | 8- pH membrane                  |

| Model                      | Length | Temp.  | Connector | Cable     |
|----------------------------|--------|--------|-----------|-----------|
| IndSen 4260-120-VP-Pt1000  | 120 mm | Pt1000 | VP        | VP6/1~15m |
| IndSen 4260-120-P8-Pt1000  | 120 mm | Pt1000 | P8        | AP9/1~15m |
| IndSen 4260F-120-VP-Pt1000 | 120 mm | Pt1000 | VP        | VP6/1~15m |
| IndSen 4260F-120-P8-Pt1000 | 120 mm | Pt1000 | P8        | AP9/1~15m |

## pH Measurement and Electrode Selection

### [ IndSen Digital pH Electrode and pH Digital Module Series ]



## Parameter characteristics of Apera digital pH electrodes and digital modules

### ■ Features of digital electrode and digital module

- Signal stability: long-distance transmission, power supply isolation, preventing all kinds of interference
- Bus control: multi-point measurement and centralized signal display are possible.
- Calibration data is stored in the data module, which can be calibrated in the laboratory, plug and play on site; it can also be calibrated in the field using the instrument or software program.
- Replacement of different pH electrodes at will, the digital module is permanently valid.
- Waterproof grade: IP67

### ■ Selection and configuration of pH digital modules

- Transmission signals (by digital module model): RS485, 4-20mA and 0-5V
- Configurable electrodes for pH digital modules: All IndSen glass industrial pH electrodes with P8 interface  
All IndSen molded industrial pH electrodes with P8 interface



# pH Measurement and Electrode Selection

## [ IndSen 812/822 Series ]

pH electrodes for environmental industry applications for surface water and wastewater pH measurement

### Note

pH monitoring of in-line process involves many special requirements and uncertainties. Feel free to contact us directly if you find it challenging to get reliable testing results. We will be able to customize the most appropriate electrode for you.



IndSen812-S8



IndSen822-P8

|               |                       | IndSen 812                                                                          | IndSen 822                           |
|---------------|-----------------------|-------------------------------------------------------------------------------------|--------------------------------------|
| Parameters    | pH Range              | 0-14pH                                                                              |                                      |
|               | Temperature Range     | 0-80°C                                                                              |                                      |
|               | Pressure              | 6bar                                                                                |                                      |
| Structure     | Junction Type         | Ceramics ×1                                                                         | PTFE ring                            |
|               | Reference System      | Ag <sup>+</sup> trap                                                                | Double junction/ Long-life reference |
|               | Reference Electrolyte | Gel                                                                                 | Gel                                  |
|               | Membrane              | 6#                                                                                  | 6#                                   |
|               | Temperature Sensor    | Options: None, Pt1000, Pt100, NTC30kΩ                                               |                                      |
| Specification | Cable Connection      | Cab, S3, S8, P8 and VP (see P22 "Electrode Interfaces and Cable Wires" for details) |                                      |
|               | Process Connection    | PG13.5                                                                              |                                      |
|               | Shaft Material        | Lead-free glass                                                                     |                                      |
|               | Size                  | φ12×120mm                                                                           |                                      |

# pH Measurement and Electrode Selection

## [ IndSen 600 Series ]

pH electrodes for surface water, wastewater and industrial effluents.



IndSen632



IndSen632P



IndSen638

### Electrode Characteristics

- All kinds of series, to meet a variety of working conditions, the best price-performance ratio
  - pH electrode
  - pH + temperature electrode
  - pH + temperature + grounding electrode
- The shell is made of PPS (polyphenylene sulfide), high temperature resistance, high insulation, corrosion resistance close to PTFE.
- Adopting two types of structure: connection type and split type, split type (P8 interface) + AP9 connecting cable, more convenient for installation and use.
- The upper and lower ends adopt 3/4 NPT threads, which can be used for immersed or flow-through installation.
- Reference system: Adopting double liquid complex and long life reference system, the reference electrolyte does not contain silver ions, which can effectively prevent electrolyte scaling and poisoning of the reference electrode.
- Liquid complex: PTFE+open+solid polymer structure for better resistance to contamination and clogging of the liquid complex.

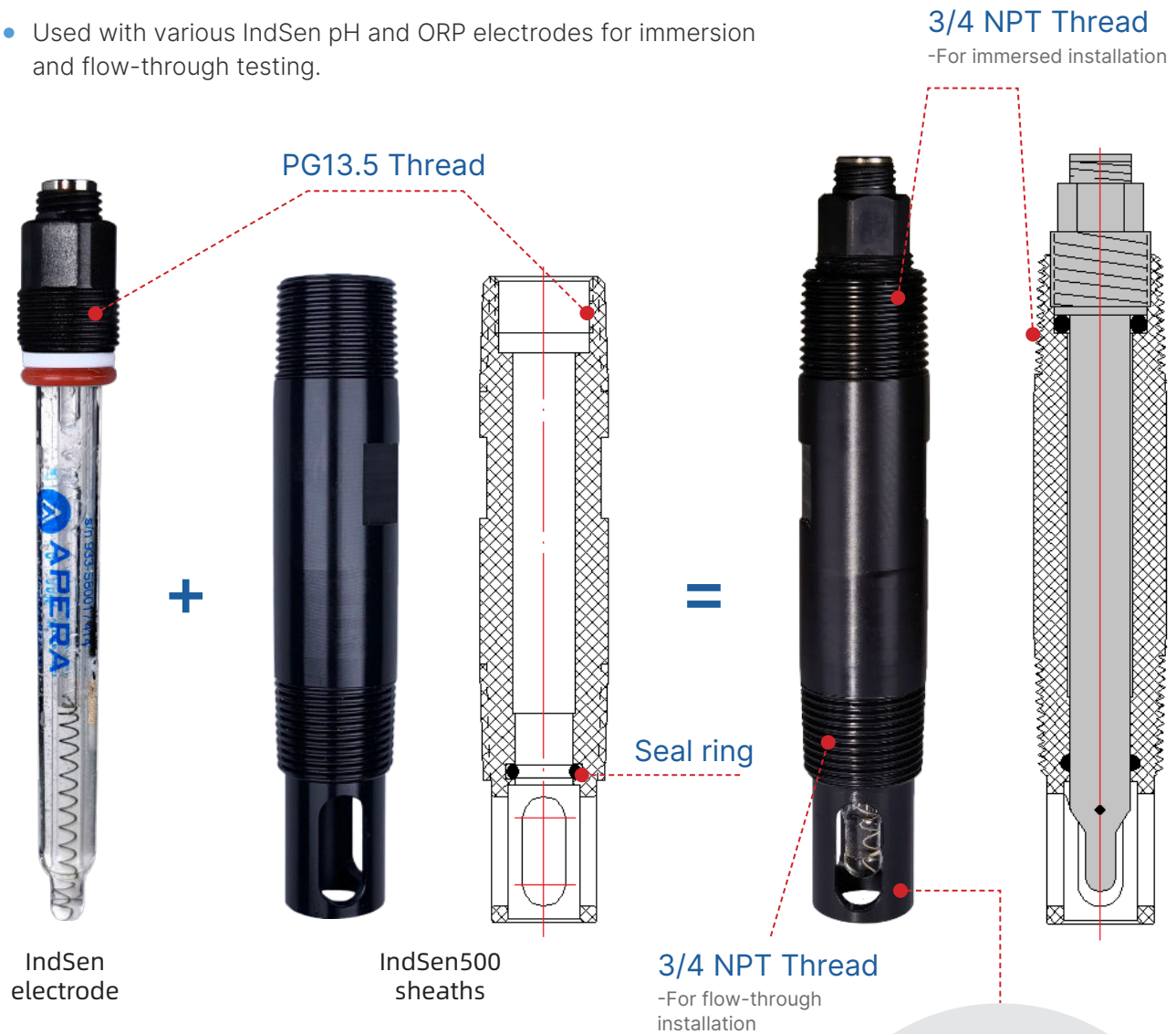
|                  |                           | IndSen632                                                        | IndSen638                                                                                                         | IndSen632P                                                                     | IndSen638P                                                                                                      | IndSen622                                                 | IndSen628                                                                                             |
|------------------|---------------------------|------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| Parameters       | pH Range                  | 0~14pH                                                           |                                                                                                                   | 0~14pH                                                                         |                                                                                                                 | 0~14pH                                                    |                                                                                                       |
|                  | Temperature Range         | 0-100°C                                                          |                                                                                                                   | 0-100°C                                                                        |                                                                                                                 | 0-80°C                                                    |                                                                                                       |
|                  | Pressure                  | 7bar                                                             |                                                                                                                   | 7bar                                                                           |                                                                                                                 | 7bar                                                      |                                                                                                       |
| Structure        | Reference Systems         | Long-life reference + Second junction                            |                                                                                                                   |                                                                                |                                                                                                                 |                                                           |                                                                                                       |
|                  | External Junction         | PTFE ring + Open x2                                              |                                                                                                                   | PTFE ring + Open x2                                                            |                                                                                                                 | PTFE ring + Open x2                                       |                                                                                                       |
|                  | Internal Junction         | Ceramics                                                         |                                                                                                                   | Ceramics                                                                       |                                                                                                                 | Ceramics                                                  |                                                                                                       |
|                  | External Electrolyte      | Polymer                                                          |                                                                                                                   | Polymer                                                                        |                                                                                                                 | Polymer                                                   |                                                                                                       |
|                  | Internal Electrolyte      | Gel                                                              |                                                                                                                   | Gel                                                                            |                                                                                                                 | Gel                                                       |                                                                                                       |
|                  | Membrane                  | HA / Cylindrical                                                 |                                                                                                                   | HA /φ8 Flat                                                                    |                                                                                                                 | 6#/ Spherical                                             |                                                                                                       |
|                  | Temperature Sensor        | Options: None, Pt1000, Pt100, NTC                                |                                                                                                                   |                                                                                |                                                                                                                 |                                                           |                                                                                                       |
|                  | Solution Ground           | Options: Platinum needle                                         |                                                                                                                   |                                                                                |                                                                                                                 |                                                           |                                                                                                       |
| Specification    | Shaft Materials           | PPS (Polyphenyl sulfone)                                         |                                                                                                                   |                                                                                |                                                                                                                 |                                                           |                                                                                                       |
|                  | Size                      | φ27×142mm                                                        |                                                                                                                   | φ27×142mm                                                                      |                                                                                                                 | φ27×142mm                                                 |                                                                                                       |
|                  | Thread                    | 3/4-14 NPT                                                       |                                                                                                                   | 3/4-14 NPT                                                                     |                                                                                                                 | 3/4-14 NPT                                                |                                                                                                       |
|                  | Connector                 | /                                                                | P8                                                                                                                | /                                                                              | P8                                                                                                              | /                                                         | P8                                                                                                    |
|                  | Cable length              | 1~15m                                                            | /                                                                                                                 | 1~15m                                                                          | /                                                                                                               | 1~15m                                                     | /                                                                                                     |
|                  | Connection cable          | /                                                                | AP9/1~15m                                                                                                         | /                                                                              | AP9/1~15m                                                                                                       | /                                                         | AP9/1~15m                                                                                             |
|                  | Electrode Characteristics |                                                                  | High Temperature and High Alkali HA Cylindrical Membrane<br>Reference system pressure and contamination resistant |                                                                                | High temperature and alkali resistant HA flat membrane<br>Reference system pressure and contamination resistant |                                                           | Conventional window film, the reference system is resistant to pressure and pollution, cost-effective |
| Recommended Uses |                           | For harsh chemical processes<br>For induced flow desulfurization |                                                                                                                   | For harsh chemical processes<br>For high pressure, high solids desulfurization |                                                                                                                 | For environmental protection and water treatment projects |                                                                                                       |

# pH Measurement and Electrode Selection

## [ IndSen 500 Industrial Electrode Sleeves ]

Industrial PPS electrode sleeve – heat and chemical resistant, extends electrode life.

- Used with various IndSen pH and ORP electrodes for immersion and flow-through testing.



| IndSen500 Series |                    |                                 |
|------------------|--------------------|---------------------------------|
| Specification    | Shell Material     | PPS<br>(Poly Phenylene Sulfide) |
|                  | Size               | φ27×142mm                       |
|                  | Process Connection | 3/4-14 NPT                      |



Provides housing protection for glass electrodes  
Effective protection of electrodes

# IndSen ORP Electrode Technology

## [ ORP Sensitive Membrane Types ]

| Type     | Shape             | ORP Range | Temperature Range | Applications                                                                         |
|----------|-------------------|-----------|-------------------|--------------------------------------------------------------------------------------|
| Platinum | Pin/Membrane/Ring | ±2000mV   | -10~135°C         | Chromate reduction, nitrite oxidation, swimming pool and drinking water disinfection |
| Gold     | Pin/Membrane/Ring | ±2000mV   | -10~135°C         | Cyanide oxidation, water disinfection                                                |
| Silver   | Cup               | ±2000mV   | 0~80°C            | Titration of any ion that forms a precipitate with silver                            |

## [ ORP Sensitive Membrane Shapes ]



## [ ORP Measurement Pain Points and Solutions ]

| Difficulties in ORP measurement                                                                                                                                                                                                                                                                                                                                                       | Solution                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>◆ Platinum/gold electrodes can develop a very thin oxide layer or become contaminated during storage and use, altering the electrode's measurement interface; in reducing solutions, platinum/gold electrodes adsorb hydrogen, which slows down the electrode's response time, with readings equilibrating over hours or even days.</li> </ul> | <p>By refining the platinum, gold or silver surface with a macromolecule coating, the electrode surface is isolated from the environment and always kept in perfect condition, which makes the electrode response speed up significantly, and the readings are basically balanced in about 2 minutes; and the consistency of the measurement values of different ORP electrodes is greatly improved.</p> |
| <ul style="list-style-type: none"> <li>◆ Each platinum/gold electrode has different oxidation and contamination conditions, causing it to behave differently in low ionic strength samples and high ionic strength standard solutions. Measurements are usually accurate in calibration solutions, while differ by tens or even a hundred millivolts in water samples.</li> </ul>     |                                                                                                                                                                                                                                                                                                                                                                                                          |
| <ul style="list-style-type: none"> <li>◆ Silver electrodes oxidize very easily in air, causing large measurement errors</li> </ul>                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                          |
| <ul style="list-style-type: none"> <li>◆ Platinum/gold electrodes have large errors when measuring at high temperatures.</li> </ul>                                                                                                                                                                                                                                                   | <p>Adopting a high-temperature-resistant reference system.</p>                                                                                                                                                                                                                                                                                                                                           |

# ORP Measurement and Electrode Selection

## [Industrial ORP Composite Electrode]



IndSen 316-S8   IndSen 317-S8   IndSen 334-S8

|                       | IndSen 316               | IndSen 317            | IndSen 334           |
|-----------------------|--------------------------|-----------------------|----------------------|
| Measurement Range     | ±2000 mV                 | ±2000 mV              | ±2000 mV             |
| Temperature Range     | 0~100 °C                 | 0~100 °C              | 0~130 °C             |
| Pressure              | 6 bar                    | 6 bar                 | 10 bar               |
| Electrode Connector   | S3, S8, P8 or VP         |                       |                      |
| Process Connection    | PG13.5                   |                       |                      |
| Reference System      | Long-life reference      | Long-life reference   | Long diffusion path  |
| Junction Type         | Ceramics                 | Ceramics              | Open x2              |
| Reference Electrolyte | Gel + Second junction    | Gel + Second junction | Polymer II           |
| Shaft Length          | 120 mm                   | 120 mm                | 120 mm               |
| Shaft Diameter        | 12 mm                    | 12 mm                 | 12 mm                |
| Shaft Materials       | Lead-free glass          | Lead-free glass       | Lead-free glass      |
| Temperature Sensor    | /                        |                       |                      |
| Membrane              | Φ6×3 mm<br>Platinum ring | Φ6×3 mm<br>Gold ring  | Φ6×3 mm<br>Gold ring |

## [Silver Electrodes]



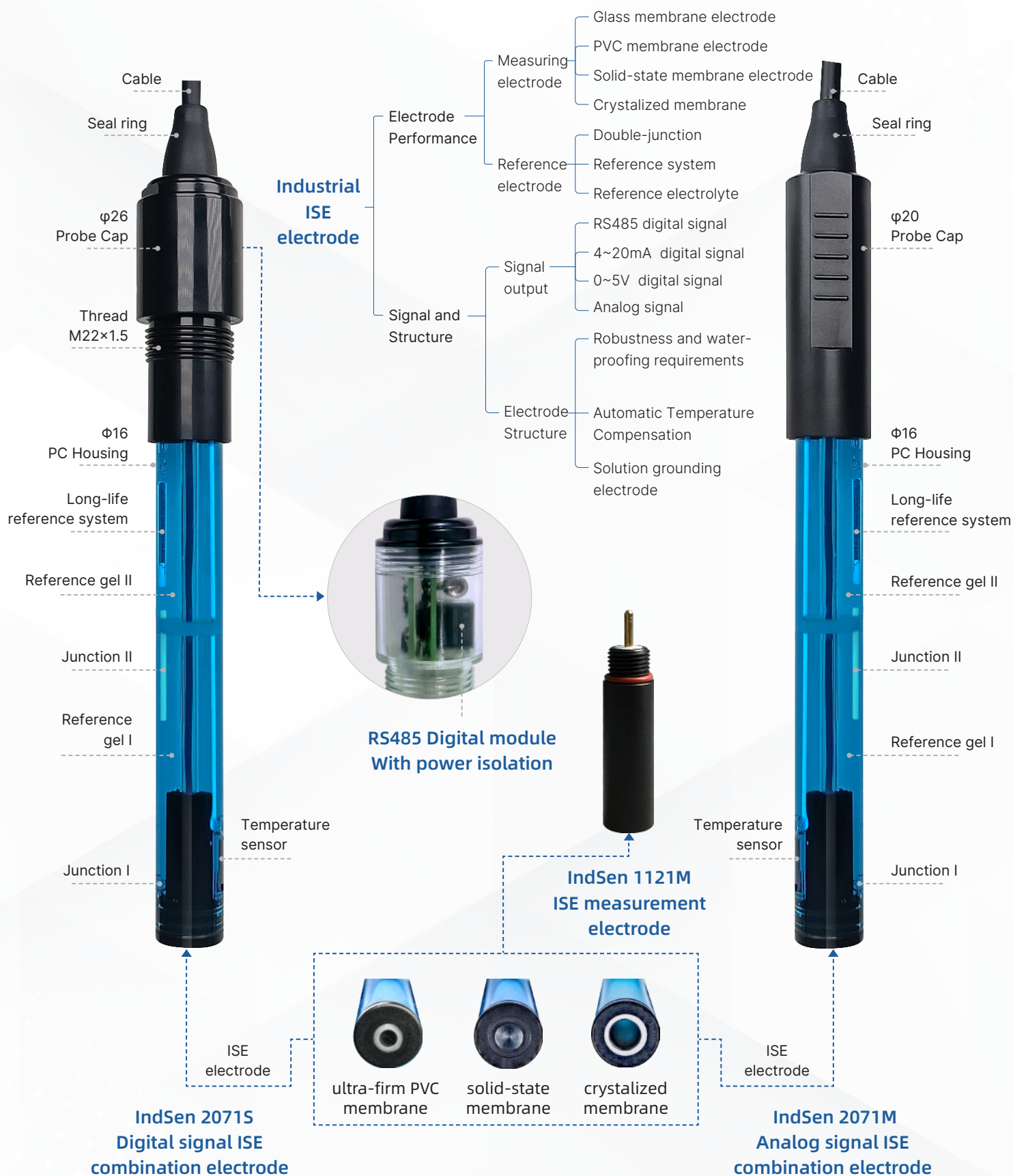
IndSen 206-S7

IndSen 207-S3

|                       | IndSen 206                        | IndSen 207                            |
|-----------------------|-----------------------------------|---------------------------------------|
| Measurement Range     | ±2000 mV                          | ±2000 mV                              |
| Temperature Range     | 0~100 °C                          | 0~100 °C                              |
| Pressure              | /                                 | 6 bar                                 |
| Electrode Connector   | S7                                | S3, S8, P8 or VP                      |
| Process Connection    | PG13.5                            |                                       |
| Junction Type         | Ceramics x2                       | Ceramics x2                           |
| Reference System      | Ag <sup>+</sup> trap              | Long-life reference + Second junction |
| Reference Electrolyte | 1M KNO <sub>3</sub> Solution      | 1M KNO <sub>3</sub> Gel + 3M KCl Gel  |
| Shaft Length          | 120 mm                            | 120 mm                                |
| Shaft Diameter        | 12 mm                             | 12 mm                                 |
| Shaft Materials       | Lead-free glass                   | Lead-free glass                       |
| Temperature Sensor    | Options: None, Pt1000, Pt100, NTC |                                       |
| Membrane              | Φ6.6*6mm Silver Cup               | Φ6.6*6mm Silver Cup                   |

※ For more information about electrode ordering, please call us.

# IndSen ISE Electrode Technology





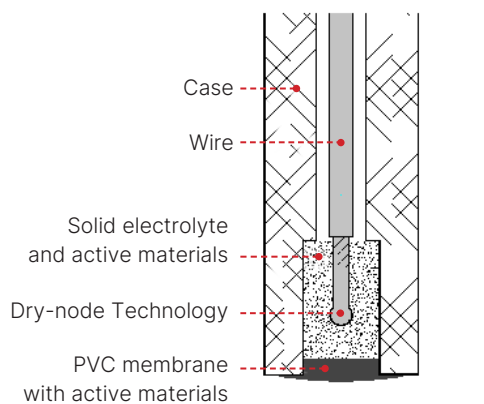
# IndSen ISE Electrode Technology

## [ Classification of Ion Electrodes ]

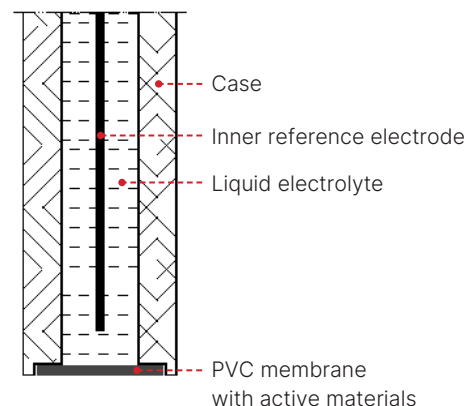
| Firm PVC membrane                                                                                                                                                                                                                                   | Solid-state membrane                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Crystallized membrane                                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| Calcium ion combination electrode and measuring electrode<br>Potassium ion combination electrode and measuring electrode<br>Nitrate ion combination electrode and measuring electrode<br>Ammonium ion combination electrode and measuring electrode | Chloride ion combination electrode and measurement electrode<br>Bromide ion combination electrode and measurement electrode<br>Iodide ion combination electrode and measurement electrode<br>Copper ion combination electrode and measurement electrode<br>Lead ion combination electrode and measurement electrode<br>Cadmium ion combination electrode and measurement electrode<br>Mercury ion combination electrode and measurement electrode<br>Silver/sulfide ion combination electrode and measurement electrode | Fluoride ion combination electrode and measurement electrode |

## [ IndSen Ultra-firm PVC Membrane ISE Electrode Structure and Features ]

The strength and durability of the ordinary PVC membrane are poor, and the service life of the electrode is only 3 to 6 months. IndSen Ultra-firm PVC membrane electrode adopts innovative technologies, including the solid electrolyte, active material repository, and a rugged structure. The service life of the Ultra-firm PVC membrane electrode now is 2-3 times longer than that of the ordinary PVC membrane electrode. Not only is the upgraded electrode easy to use and stable in performance, but also it guarantees Apera users a 12-month shelf life.



Ultra-firm PVC membrane electrode diagram



Ordinary PVC membrane electrode diagram

## [ Performance Comparison ]

|                                | Ultra-firm PVC membrane                                                                 | Ordinary PVC membrane                                                         |
|--------------------------------|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| PVC membrane                   | ★ About 1.2mm in thickness, with no dent                                                | 0.3 – 0.8mm in thickness, the surface of the membrane can be bulged or dented |
| Ionic active materials         | ★ A repository of active materials, greatly extending the service life of the electrode | Exists only in PVC membrane, active materials are easy to disappear           |
| Reference electrode            | ★ Solid electrolyte, no fluidity or volatilization, strengthening the membrane          | Liquid electrolyte, easily volatile, does not support membrane strength       |
| Preparation before measurement | ★ No need to soak or soak for a few minutes                                             | Need to soak for hours                                                        |
| Service life of electrode      | ★ The shelf life is 12 months, and the warranty period is 6 months                      | The shelf life is less than 6 months                                          |

# ISE Measurement and Electrode Selection

## [ Technical Specifications ]

| Model                                                         | Ion                          | Electrode Membrane      | Range     |                                      |              | Temperature Range °C | pH Range pH |
|---------------------------------------------------------------|------------------------------|-------------------------|-----------|--------------------------------------|--------------|----------------------|-------------|
|                                                               |                              |                         | pX        | mol/L                                | mg/L         |                      |             |
| Calcium ion combination electrode and measurement electrode   | Ca <sup>2+</sup>             | Ultra-Firm PVC membrane | 5.3~1 pCa | 5×10 <sup>-6</sup> ~10 <sup>-1</sup> | 0.20~4008    | 5~50                 | 4~11        |
| Potassium ion combination electrode and measurement electrode | K <sup>+</sup>               |                         | 6~0 pK    | 10 <sup>-6</sup> ~1                  | 0.039~3910   | 5~50                 | 1~9         |
| Nitrate combination electrode and measurement electrode       | NO <sub>3</sub> <sup>-</sup> |                         | 5~0 pNO   | 10 <sup>-5</sup> ~1                  | 0.62~62000   | 5~50                 | 4.6~8       |
| Ammonium ion combination electrode and measurement electrode  | NH <sub>4</sub> <sup>+</sup> |                         | 5~0.3 pNH | 10 <sup>-5</sup> ~0.5                | 0.18~9000    | 5~50                 | 2~8.5       |
| Fluoride ion combination electrode and measurement electrode  | F <sup>-</sup>               | Crystalized membrane    | 6~1 pF    | 10 <sup>-6</sup> ~10 <sup>-1</sup>   | 0.019~1900   | 5~45                 | 5~6         |
| Chloride ion combination electrode and measurement electrode  | Cl <sup>-</sup>              | Solid-state membrane    | 4.3~1 pCl | 5×10 <sup>-5</sup> ~10 <sup>-1</sup> | 1.775~3550   | 5~60                 | 2~11        |
| Bromide ion combination electrode and measurement electrode   | Br <sup>-</sup>              |                         | 5.3~1 pBr | 5×10 <sup>-6</sup> ~10 <sup>-1</sup> | 0.40~7990    | 5~60                 | 2~11        |
| Iodide ion combination electrode and measurement electrode    | I <sup>-</sup>               |                         | 6.3~1 pI  | 5×10 <sup>-7</sup> ~10 <sup>-1</sup> | 0.0635~12690 | 5~60                 | 2~11        |
| Copper ion combination electrode and measurement electrode    | Cu <sup>2+</sup>             |                         | 6.3~1 pCu | 5×10 <sup>-7</sup> ~10 <sup>-1</sup> | 0.032~6355   | 5~60                 | 3~7         |
| Silver/sulfur combination electrode and measurement electrode | Ag <sup>+</sup>              |                         | 6~0 pAg   | 10 <sup>-6</sup> ~1                  | 0.11~108000  | 5~80                 | 1~9         |
|                                                               | S <sup>2-</sup>              |                         | 6~0 pS    | 10 <sup>-6</sup> ~1                  | 0.03~32000   | 5~50                 | 13~14       |
| Lead ion combination electrode and measurement electrode      | Pb <sup>2+</sup>             |                         | 5~1 pPb   | 10 <sup>-5</sup> ~10 <sup>-1</sup>   | 2.1~21000    | 5~80                 | 3~7         |
| Cadmium ion combination electrode and measurement electrode   | Cd <sup>2+</sup>             |                         | 6~1 pCd   | 10 <sup>-6</sup> ~10 <sup>-1</sup>   | 1.1~11000    | 5~80                 | 3~7         |
| Mercury ion combination electrode and measurement electrode   | Hg <sup>2+</sup>             |                         | 6~0 pHg   | 10 <sup>-6</sup> ~1                  | 2~200000     | 5~80                 | 0~2         |

## [ Factors Affecting Measurement Stability ]

The accuracy and stability of industrial ISE measurement depend not only on the performance and reliability of ISE electrodes and reference electrodes, but also on how to eliminate the influence of interfering substances, that is, the correct test method.

| Affecting Factors                                        | Solutions                                                                                                                                                      |
|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Impurities in the solution                               | <ul style="list-style-type: none"> <li>• Use a filter to remove impurities</li> <li>• Use a light soft brush to regularly clean up the probe tip</li> </ul>    |
| Temperature                                              | Divert the solution to the measuring tank where the solution temperature can be adjusted.                                                                      |
| Ionic strength and interfering ions in the solution      | Use an ion-strength modifier and mix it with a proportional pump.                                                                                              |
| pH of the solution                                       | Adjust the pH value of the solution in the sample cell, or use a proportional pump to mix                                                                      |
| Electrode potential drifting after long-term measurement | <ul style="list-style-type: none"> <li>• Periodic manual calibration and maintenance of electrodes</li> <li>• Periodic automatic calibration device</li> </ul> |

# ISE Measurement and Electrode Selection

## [ Technical Specifications by Electrode Models ]

| Classification                    | Model                     | Name/model symbol/ion symbol                                                                                                                                                                                                                                                                                         | Membrane Type                                                                                                                                                                                       | Output Signal        | Function                                                                                          |
|-----------------------------------|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|---------------------------------------------------------------------------------------------------|
| Digital ISE Combination Electrode | IndSen2071S- <b>X</b>     | <b>X</b> represents: Calcium/CA/Ca <sup>2+</sup> , Potassium/K/K <sup>+</sup> , Ammonium/NH/NH <sub>4</sub> <sup>+</sup> , Nitrate/NO/NO <sub>3</sub> <sup>-</sup><br>e.g. IndSen2071S- <b>CA</b>                                                                                                                    | Rugged PVC membrane                                                                                                                                                                                 | RS485 Digital Signal | Power supply isolation<br>Automatic temperature compensation<br>With solution grounding electrode |
|                                   | IndSen2071S- <b>Y</b>     | <b>Y</b> represents: Chloride/CL/Cl <sup>-</sup> , Bromide/BR/Br <sup>-</sup> , Iodine/I/I <sup>-</sup> , Copper/CU/Cu <sup>2+</sup> , Silver/AG/Ag <sup>+</sup> , Sulfur/S/S <sup>2-</sup> , Lead/PB/Pb <sup>2+</sup> , Cadmium/CD/Cd <sup>2+</sup> , Mercury/HG/Hg <sup>2+</sup><br>e.g., IndSen2071S- <b>CL</b>   | Solid membrane                                                                                                                                                                                      |                      |                                                                                                   |
|                                   | IndSen2071S-F             | Fluorine/F/F <sup>-</sup>                                                                                                                                                                                                                                                                                            | Single crystal membrane                                                                                                                                                                             |                      |                                                                                                   |
| Analog ISE Combination Electrode  | IndSen2071M- <b>X-T</b>   | <b>X</b> represents: Calcium/CA/Ca <sup>2+</sup> , Potassium/K/K <sup>+</sup> , Ammonium/NH/NH <sub>4</sub> <sup>+</sup> , Nitrate/NO/NO <sub>3</sub> <sup>-</sup><br>e.g., IndSen2071M- <b>CA-T</b>                                                                                                                 | Rugged PVC membrane                                                                                                                                                                                 | Analog Signal        | With automatic temperature compensation<br>Solution grounding electrode optional                  |
|                                   | IndSen2071M- <b>X</b>     |                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                     |                      | Without automatic temperature compensation<br>Solution Grounding Electrode Optional               |
|                                   | IndSen2071M- <b>Y-T</b>   | <b>Y</b> represents: Chloride/CL/Cl <sup>-</sup> , Bromine/BR/Br <sup>-</sup> , Iodine/I/I <sup>-</sup> , Copper/CU/Cu <sup>2+</sup> , Silver/AG/Ag <sup>+</sup> , Sulfur/S/S <sup>2-</sup> , Lead/PB/Pb <sup>2+</sup> , Cadmium/CD/Cd <sup>2+</sup> , Mercury/HG/Hg <sup>2+</sup><br>e.g., IndSen2071M- <b>CL-T</b> | Solid membrane                                                                                                                                                                                      |                      | With Automatic Temperature Compensation<br>Solution Grounding Electrode Optional                  |
|                                   | IndSen2071M- <b>Y</b>     |                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                     |                      | Without Automatic Temperature Compensation<br>Solution Grounding Electrode Optional               |
|                                   | IndSen2071M-F-T           | Fluoride/F/F <sup>-</sup>                                                                                                                                                                                                                                                                                            | Single crystal membrane                                                                                                                                                                             |                      | With automatic temperature compensation<br>Solution Grounding Electrode Optional                  |
|                                   | IndSen2071M-F             |                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                     |                      | Without Automatic Temperature Compensation<br>Solution grounding electrode optional               |
|                                   | ISE measurement electrode | IndSen1121M- <b>X</b>                                                                                                                                                                                                                                                                                                | <b>X</b> represents: Calcium/CA/Ca <sup>2+</sup> , Potassium/K/K <sup>+</sup> , Ammonium/NH/NH <sub>4</sub> <sup>+</sup> , Nitrate /NO/NO <sub>3</sub> <sup>-</sup><br>e.g., IndSen2071M- <b>CA</b> |                      | Rugged PVC membrane                                                                               |
| IndSen1121M- <b>Y</b>             |                           | <b>Y</b> represents: Chloride/CL/Cl <sup>-</sup> , Chlorine/BR/Br <sup>-</sup> , Iodine /I/I <sup>-</sup> , Copper/CU/Cu <sup>2+</sup> , Silver/AG/Ag <sup>+</sup> , Sulfur/S/S <sup>2-</sup> , Lead/PB/Pb <sup>2+</sup> , Cadmium/CD/Cd <sup>2+</sup> , Mercury/HG/Hg <sup>2+</sup><br>e.g., IndSen2071S- <b>CL</b> | Solid membrane                                                                                                                                                                                      | /                    |                                                                                                   |
| IndSen1121M-F                     |                           | Fluoride/F/F <sup>-</sup>                                                                                                                                                                                                                                                                                            | Single crystal membrane                                                                                                                                                                             | /                    |                                                                                                   |

## Other

### [ Connector and Cable ]

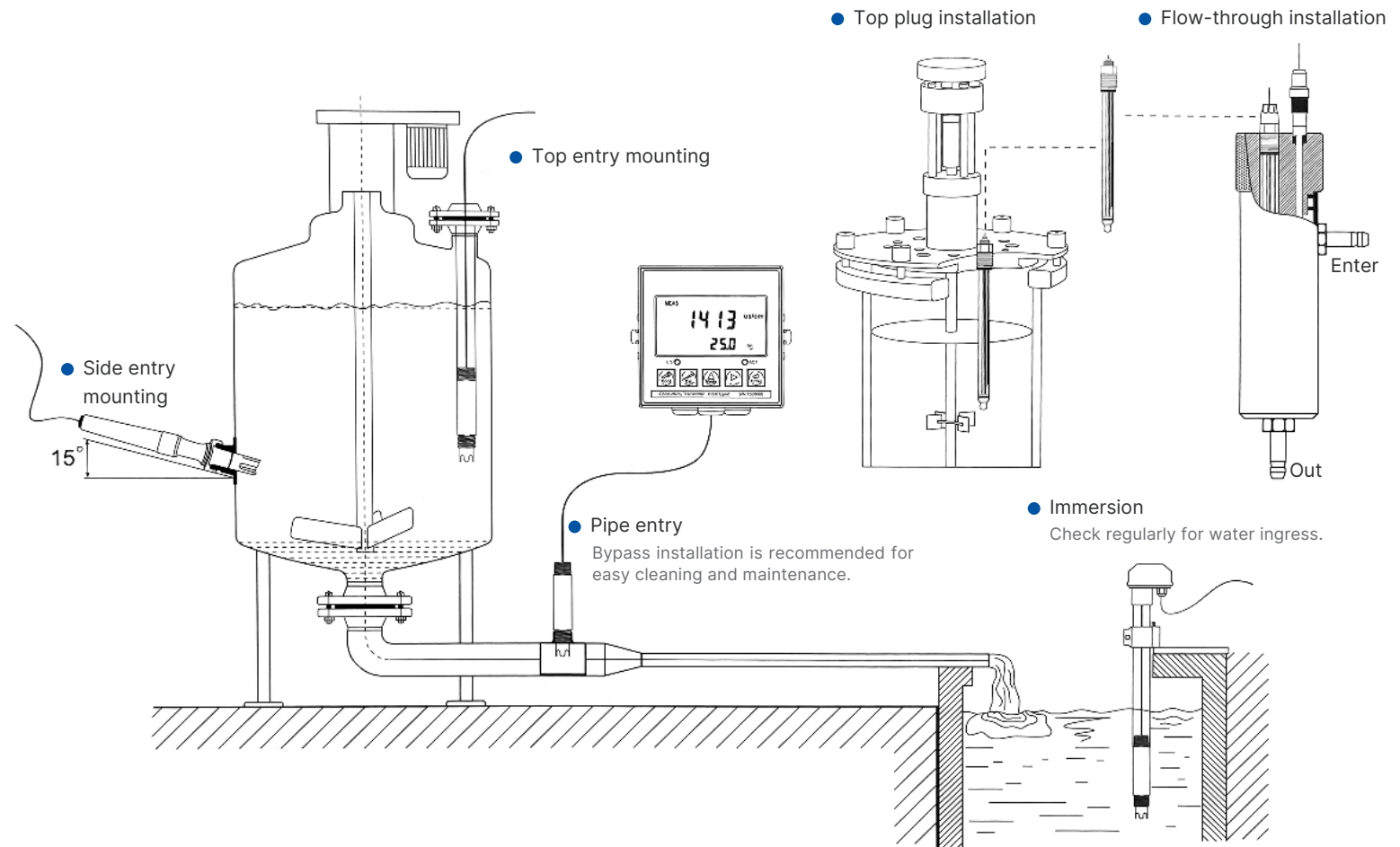
| Connector |                                                                                     |        | Connecting Cable |                                                                                                |                                 |
|-----------|-------------------------------------------------------------------------------------|--------|------------------|------------------------------------------------------------------------------------------------|---------------------------------|
| Model     | Picture                                                                             | Thread | Model            | Picture                                                                                        | Cable length                    |
| Cab/      |    | N/A    | N/A              | N/A                                                                                            | Electrodes with cable<br>1~15 m |
| S3/       |    | PG13.5 | N/A              | N/A                                                                                            | Electrodes with cable<br>1~15 m |
| S8        |    | PG13.5 | AS9/             | 2-pin       | 1~15 m                          |
| P8        |    | PG13.5 | AP9/             | 8-pin       | 1~15 m                          |
| VP        |  | PG13.5 | VP6              | 2~6 pins  | 1~15 m                          |

Notes: 1. The suffix of the electrode connector models indicates the cable length, e.g. Cab/3, means 3-meter cable.

2. The suffix of the connection cable models indicates the cable length, e.g. AS9/3, for 3-meter cable.

# Other

## [ Industrial pH/ORP electrode installation diagram ]





# In-line pH Electrode Selection Guide

|                        | Page                       | P13      |          |            | P15 |     | P4  |     | P5  |     |     |
|------------------------|----------------------------|----------|----------|------------|-----|-----|-----|-----|-----|-----|-----|
|                        | IndSen®                    | 622 /628 | 632 /638 | 632P /638P | 812 | 822 | 912 | 931 | 915 | 917 | 919 |
| Water Treatment        | Surface water              | ●        | ●        |            | ●   | ●   | ●   | ●   |     |     |     |
|                        | Cooling water              |          |          |            |     |     | ●   | ●   |     |     |     |
|                        | Neutralization             |          |          |            |     |     |     |     |     |     |     |
|                        | Pure water                 |          |          |            |     |     |     |     | ●   |     | ●   |
|                        | Low temperature            |          |          |            |     |     |     |     |     | ●   |     |
|                        | Drinking water             | ●        |          |            |     |     | ●   |     | ●   |     | ●   |
| Wastewater Treatment   | Flue gas neutralization    |          |          |            |     |     |     |     |     |     |     |
|                        | Desulphurization           |          | ●        | ●          |     |     |     |     |     |     |     |
|                        | Electroplating             |          | ●        |            |     |     |     |     |     |     |     |
|                        | Industrial wastewater      |          | ●        |            |     |     |     | ●   |     |     |     |
|                        | Contains hydrofluoric acid |          |          |            |     |     |     |     |     |     |     |
|                        | Heavy metal precipitation  |          |          |            |     |     |     |     |     |     |     |
|                        | Sludge Dewatering          |          |          |            |     |     |     |     |     |     |     |
| Industry Process       | Chemical production        |          |          |            |     |     | ●   | ●   |     |     |     |
|                        | Chlor-alkali industry      |          |          |            |     |     |     |     |     |     |     |
|                        | Dyes                       |          |          |            |     |     |     |     |     |     |     |
|                        | Oil refining               |          |          |            |     |     |     | ●   |     |     |     |
|                        | Pulp and Paper             |          |          |            |     |     |     | ●   |     |     |     |
| Pharma industry        | Biopharmaceuticals         |          |          |            |     |     |     |     |     |     |     |
|                        | Upstream, downstream       |          |          |            |     |     |     |     |     |     |     |
|                        | Chemical Pharmaceutical    |          |          |            |     |     |     |     |     |     |     |
| Food Products Industry | Beverage and alcohol       |          |          |            |     |     | ●   | ●   |     |     |     |
|                        | Dairy products             |          |          |            |     |     |     | ●   |     |     |     |
|                        | Yogurt, cheese             |          |          |            |     |     |     | ●   |     |     |     |
|                        | Sugar and starch           |          |          |            |     |     |     | ●   |     |     |     |
|                        | Cleaning in Place (CIP)    |          |          |            |     |     |     |     |     |     |     |
|                        | Yeast                      |          |          |            |     |     |     |     |     |     |     |



|     | P6  |     |     | P7  | P8   | P9   | P10  |       |      | P11  |       |
|-----|-----|-----|-----|-----|------|------|------|-------|------|------|-------|
| 925 | 933 | 934 | 941 | 405 | 3253 | 3250 | 4800 | 4800F | 4802 | 4260 | 4260F |
|     |     |     |     |     |      |      |      |       |      |      |       |
|     |     |     | ●   |     |      | ●    |      |       |      | ●    |       |
|     |     |     | ●   |     |      | ●    | ●    |       |      | ●    |       |
| ●   |     |     |     |     |      |      |      |       |      |      |       |
|     |     |     |     |     |      |      |      |       |      |      |       |
| ●   |     |     | ●   |     |      | ●    |      |       |      |      |       |
|     |     | ●   | ●   |     |      | ●    | ●    |       |      | ●    |       |
|     |     |     |     |     |      |      |      | ●     | ●    |      | ●     |
|     |     | ●   | ●   |     | ●    |      | ●    |       |      | ●    |       |
|     |     | ●   | ●   |     |      |      | ●    |       |      | ●    |       |
|     | ●   |     |     |     |      |      |      |       |      |      |       |
|     |     |     | ●   |     | ●    | ●    | ●    | ●     |      | ●    | ●     |
|     |     | ●   | ●   |     |      |      |      |       |      | ●    |       |
|     |     | ●   | ●   |     |      | ●    | ●    |       |      | ●    |       |
|     |     | ●   | ●   |     |      |      | ●    | ●     |      | ●    |       |
|     |     |     |     |     |      |      | ●    | ●     |      |      |       |
|     |     | ●   |     |     |      |      | ●    |       |      | ●    |       |
|     |     | ●   | ●   |     |      | ●    | ●    |       |      | ●    |       |
|     |     | ●   |     |     |      |      | ●    |       |      | ●    |       |
|     |     |     | ●   | ●   | ●    | ●    |      |       |      |      |       |
|     |     |     | ●   | ●   | ●    | ●    |      |       |      |      |       |
|     |     |     | ●   | ●   | ●    | ●    |      |       |      |      |       |
|     |     |     | ●   |     |      | ●    |      |       |      |      |       |
|     |     |     | ●   |     |      | ●    |      |       |      |      |       |
|     |     |     | ●   |     |      | ●    |      |       |      |      |       |
|     |     | ●   | ●   |     |      | ●    | ●    |       |      | ●    |       |
|     |     |     |     | ●   | ●    | ●    |      |       |      |      |       |
|     |     |     | ●   |     |      | ●    |      |       |      |      |       |



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